



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

COMPETENCY BASED CURRICULUM

REFRACTORY TECHNICIAN

(Duration: Two Years)

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 5



SECTOR –CAPITAL GOODS AND MANUFACTURING



Directorate General of Training

REFRACTORY TECHNICIAN

(Engineering Trade)

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CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 5

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

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1. COURSE INFORMATION

During the two-year duration of Refractory Technician trade, a candidate is trained on Professional Skill, Professional Knowledge, Engineering Drawing, Workshop Calculation & Science and Employability Skill related to job role. In addition to this, a candidate is entrusted to undertake project work and extracurricular activities to build up confidence. The broad components covered under Professional Skill subject are as below:-

FIRST YEAR: In this year, the trainee learns about safety and environment, use of fire extinguishers, artificial respiratory resuscitation to begin with. He gets the idea of trade tools & its standardization, familiarize with basics of electricity, test the cable and measure the electrical parameter. Practice Arc welding gas cutting and welding process, fitting jobs of solid metal and pipes. Identify and test manufacturing process.

The candidate will be able to ensure quality control, handling of raw materials, checking consistency of mixed material, monitoring of moulding and pressing operation, drying bricks and dryer operation, loading / unloading of finished product and perform operation and maintenance of kiln and waste utilisation.

SECOND YEAR: In this year, the trainee will be able to perform brick cutting and joining, basic application of monolithic refractory, fitting of scaffold, operate gunning machine, ramming, patching. In addition, they can perform computer operation and packaging of refractory.

The candidate will be able to prepare heating chart and perform opening, repair, testing, checking of vibrator and identify physical defects, parts of furnaces, construct refractory lining, prepare technical report and documentation as per industrial need and operational function and maintenance of supporting tools and machines.

2.1 GENERAL

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

The Refractory Technician Trade under CTS is delivered nationwide through a network of ITIs. The course is of two-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) impart requisite core skill, knowledge and life skills. After passing out the training program, the trainee is awarded National Trade Certificate (NTC) by DGT which is recognized worldwide.

Trainee broadly needs to demonstrate that they are able to:

- Read & interpret technical parameters/documentation, plan and organize work processes, identify necessary materials and tools.
- Perform tasks with due consideration to safety rules, accident prevention regulations and environmental protection stipulations;
- Apply professional knowledge, core skills & employability skills while performing the job, and repair & maintenance work.
- Check the task/job for functioning, identify and rectify errors in task/job.
- Document the technical parameters in tabulation sheet 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 join Apprenticeship programs in different types of industries leading to a National Apprenticeship certificate (NAC).
- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming an 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 two year:

S No.	Course Element	Notional Training Hours	
		1 st Year	2 nd Year
1	Professional Skill (Trade Practical)	1000	1000
2	Professional Knowledge (Trade Theory)	280	360
3	Workshop Calculation & Science	80	80
4	Engineering Drawing	80	80
5	Employability Skills	160	80
	Total	1600	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 have 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	<ul style="list-style-type: none"> • 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 work which demonstrates attainment of a reasonable	<ul style="list-style-type: none"> • Good skill levels in the use of hand tools, machine tools and workshop equipment.

<p>standard of craftsmanship, with little guidance, and regard for safety procedures and practices</p>	<ul style="list-style-type: none"> • 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.
<p>(c) Weightage in the range of more than 90% to be allotted during assessment</p>	
<p>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.</p>	<ul style="list-style-type: none"> • 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

Refractory Technician; builds and repairs furnaces, ovens, kilns, fireboxes, fire places and other high temperature structures by laying and setting firebricks and refractory blocks, using chemical heat resistant cement, fireclay, mortar etc. with hand tools. Receives instructions from appropriate authority regarding nature and type of work to be done. Spreads minimum possible fireclay mortar evenly over furnace with trowel and lays and taps fire bricks or refractory blocks in position in correct alignment according to specification. Seals joints with fireclay mortar or chemically resistant cement to bind bricks together making provision for expansion of joints in furnace in linings. Prepares support to proper curvature to replace arched roofs of furnaces or to construct new ones as directed or specified. Patches portions of furnaces with fireclay, as necessary and removes excess of mortar. May specialize in building and repairing particular type of high temperature construction. May replace linings of ladles or tapping sports of furnaces. May build new smoke tunnels.

Reference NCO-2015:

- a) 7112.0300 - Bricklayer, Refractory

4. GENERAL INFORMATION

Name of the Trade	REFRACTORY TECHNICIAN
Trade Code	DGT/1117
NCO - 2015	7112.0300
NSQF Level	Level-5
Duration of Craftsmen Training	2 Years (3200 Hours)
Entry Qualification	Passed 10 th class examination with Science and Mathematics or its equivalent.
Minimum Age	14 years as on first day of academic session
Eligibility for PwD	LD, LC, DW, AA, DEAF
Unit Strength (No. Of Students)	24(There is no separate provision of supernumerary seats)
Space Norms	130 Sq. m.
Power Norms	3 KW
Instructors Qualification for:	
1. Refractory Technician Trade	<p>B.Voc/Degree in Mechanical/ Ceramic/ Metallurgy Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field.</p> <p style="text-align: center;">OR</p> <p>03 years Diploma in Mechanical /Ceramic/Metallurgy Engineering from AICTE recognized board of technical education or Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field.</p> <p style="text-align: center;">OR</p> <p>NTC/NAC passed in the Trade of "Refractory Technician" With three years' experience in the relevant field.</p> <p>Essential Qualification: Relevant National Craft Instructor Certificate (NCIC) in any of the variants under DGT.</p> <p>Note: 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.</p>
2. Workshop Calculation & Science	<p>B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field.</p> <p style="text-align: center;">OR</p> <p>03 years Diploma in Engineering from AICTE recognized board of technical education or Advanced Diploma (Vocational) from DGT</p>

	<p>with two years' experience in the relevant field.</p> <p style="text-align: center;">OR</p> <p>NTC/ NAC in any one of the engineering trades with three years' experience.</p> <p><u>Essential Qualification:</u> National Craft Instructor Certificate (NCIC) in relevant trade.</p> <p style="text-align: center;">OR</p> <p>NCIC in RoDA or any of its variants under DGT.</p>					
3. Engineering Drawing	<p>B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field.</p> <p style="text-align: center;">OR</p> <p>03 years Diploma in Engineering from AICTE recognized board of technical education or Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field.</p> <p style="text-align: center;">OR</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 three years experience.</p> <p><u>Essential Qualification:</u> National Craft Instructor Certificate (NCIC) in relevant trade.</p> <p style="text-align: center;">OR</p> <p>NCIC in RoDA / D'man (Mech /civil) or any of its variants under DGT.</p>					
4. Employability Skill	<p>MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years' experience with short term ToT Course in Employability Skills from DGT institutes.</p> <p>(Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above)</p> <p style="text-align: center;">OR</p> <p>Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills from DGT institutes.</p>					
5. Minimum Age for Instructor	21 Years					
List of Tools and Equipment	As per Annexure – I					
Distribution of training on hourly basis: (Indicative only)						
Year	Total Hrs /week	Trade Practical	Trade Theory	Workshop Cal. & Sc.	Engg. Drawing	Employ ability Skills
1 st	40 Hours	25 Hours	7 Hours	2 Hours	2 Hours	4 Hours

2 nd	40 Hours	25 Hours	9 Hours	2 Hours	2 Hours	2 Hours
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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)

FIRST YEAR:

1. Perform basic workshop operations using suitable tools for fitting, riveting, drilling etc. observing suitable care following safety precautions.
2. Perform forging, piercing, bending, riveting, punching and edge cutting operation.
3. Perform sheet metal work.
4. Perform checking and measuring components with precision instrument.
5. Make different fit of components for assembling observing principle of interchangeability and check for functionality.
6. Perform Arc welding process.
7. Perform gas cutting and welding process.
8. Use proper taps and dies for making internal and external threads on solid metal and pipes.
9. Perform basic electrical measurement.
10. Enumerate the various types of refractories.
11. Identify the major forms and sources of pollution and control techniques in refractory industry.
12. Practice operation and maintenance of various fuel handling plant.
13. Identify the different raw material and handling.
14. Perform the measures of quality control.
15. Demonstrate the manufacturing processes.
16. Identify the different grain size, mixing machine – operation and adjustment and checking consistency of mixed material.
17. Perform operation and monitoring of moulding and pressing (manual / hydraulic).
18. Practice on drying bricks and dryers.
19. Identify the different temperature measuring instrument and maintenance.
20. Ensure proper loading/ unloading, drying schedule, firing schedule and inspect the finished product.
21. Perform the operation and maintenance of kiln and waste utilisation.

SECOND YEAR:

22. Demonstrate the basic application of monolithic refractory.
23. Perform brick cutting and joining.
24. Perform fitting of scaffold.
25. Perform gunning, ramming and patching.
26. Demonstrate the energy conservation followed by industry.
27. Perform basic computer operation.
28. Perform the method of packaging in refractory industry.
29. Perform installation and repair of brick work.
30. Perform opening, repair, testing, checking of vibrator and identify the physical defect.
31. Identify the different parts of furnaces.
32. Perform with skill in the model workshop / fields.
33. Create report observing heating chart.
34. Construct refractory lining.
35. Prepare technical report and documentation as per industrial need.
36. Demonstrate operational function and maintenance of supporting tools and machines.

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
FIRST YEAR	
1. Perform basic workshop operations using suitable tools for fitting, riveting, drilling etc. observing suitable care following safety precautions.	Identify basic hand tools for fitting, riveting, drilling etc. with due care and safety.
	Use tool and job holding devices for metal sawing.
	Mark on the job with the help of marking tools.
	Cut metal piece by hacksaw, file the flat surfaces and check dimensions.
	Chip flat surface along the marked line.
	Drill holes on MS plate as per tap drill size and make thread by tapping.
	Check flatness, squareness and measure dimension of the job.
2. Perform forging, piercing, bending, riveting, punching and edge cutting operation.	Prepare a hearth for forging.
	Make a centre punch by forging.
	Make a flat chisel.
	Make a screw driver.
	Make a cube from a MS round bar by a jack hammer.
	Perform piercing, bending, riveting punching and edge cutting in press tool.
3. Perform sheet metal work.	Cut geometrical shapes from metal sheet.
	Make a funnel of metal sheet.
	Use of flat scraper to make the surface even of a dove tail fitting.
4. Perform checking and measuring components with precision instrument.	Check surface roughness of a surface plate.
	Perform Angular Measurement using Bevel protector and Sine bar.
	Measure distance / clearance using dial test indicator.
	Perform Gear and Screw Thread Measurement. (two wire method and screw pitch gauge).
	Perform checking work piece by limit gauges.

5. Make different fit of components for assembling observing principle of interchangeability and check for functionality.	Make Step fit, angular fit, angle, surfaces.
	Scrap on flat surfaces, curved surfaces and parallel surfaces and test.
	Scrap a cylindrical bore.
	Locate accurate holes & make accurate hole for stud fit.
6. Perform Arc welding process.	Practice Arc welding process.
	Striking straight beads left to right and right to left.
	Weld a square butt joint.
	Weld a Lap joint.
	Weld a Tee joint.
	Weld a Corner joint.
7. Perform gas cutting and welding process.	Practice of Gas cutting and Gas welding.
	Cutting of straight and curved metal pieces.
	Fusion runs on a M.S. Sheet Left to Right.
	Fusion runs on a M.S. Sheet Right to Left.
8. Use proper taps and dies for making internal and external threads on solid metal and pipes.	Use of dies and making of external threads.
	Use of tap and prepare tapped holes.
	Make threads on various dia. MS rods and fit the threaded rods on previous tapped holes.
	Use of Pipe fittings and prepare joints.
	Threading of pipes with the use of pipe die.
	Prepare a pipe line using different types of pipe joints.
9. Perform basic electrical measurement.	Measure AC, DC by using multimeter.
	Measure AC voltage using step up & step down transformer.
	Measure resistance, Voltage & current.
10. Enumerate the various types of refractories.	Ensure the different types of bricks and chemical composition.
	Practice various types of refractories and shapes.
11. Identify the major forms and sources of pollution and control techniques in refractory industry.	Operate water spray gun, vacuum sweepers, Dry fog nozzles, watersprinkler.
	Practice on prevention of various health hazards occurring from refractory materials.

	Identify sources of pollution & various control techniques .
12. Practice operation and maintenance of various fuel handling plant.	Practice on handling various fuels.
	Operation & maintenance of Producer gasplant.
13. Identify the different raw material and handling.	Identify the different raw materials used in manufacturing refractory.
	Identify the physical and chemical properties of refractory materials.
14. Perform the measures of quality control.	Identify the basic concept of 5S, Kaizen, TPM, TQM and ISO:9000.
	Ensure the quality control for refractory items.
15. Demonstrate the manufacturing processes.	Demonstrate & practice different manufacturing processes at plant/video demonstration.
16. Identify the different grain size, mixing machine – operation and adjustment and checking consistency of mixed material.	Demonstrate & practice on Sieve Analysis of different grain size.
	Identification of parts of mixing machine & operation of mixing machine.
	Practice on changing adjusting scrapper, adjustment of roller height.
	Checking consistency of mixed material and workability.
17. Perform operation and monitoring of moulding and pressing (manual / hydraulic).	Practice on weighing of material, filling the mould & operating the pressing (Mechanical & Hydraulic) and gauging of the bricks.
	Physical inspection of bricks for cracks, lamination & wrecks, warpage.
	Checking of bulk density of bricks.
	Practice on operation /monitoring parameters of press. (Manual/Hydraulic).
	Identify the Segregation, Sizes, Edges & corner and any other physical defects.
18. Practice on drying bricks and dryers.	practice on drying of bricks.
	Practice on operating dryers.

19. Identify the different temperature measuring instrument and maintenance.	Demonstrate / practice of different temperature measuring instrument.
	Measure temperature by pyrometer reading.
	Perform the steps of preventive maintenance.
20. Ensure proper loading/unloading, drying schedule, firing schedule and inspect the finished product.	Observe the loading and unloading.
	Monitor the drying schedule and firing schedule.
	Inspect physically the finished product.
	Practice on loading/unloading of bricks.
21. Perform the operation and maintenance of kiln and waste utilisation.	Practice on operation & maintenance of kiln.
	Practice on firing schedule.
	Practice on brick checking.
	Demonstration waste utilization.
SECOND YEAR	
22. Demonstrate the basic application of monolithic refractory.	Practice different application method of monolithic refractory at plant.
	Inspect defects follow the acceptance criteria.
23. Perform brick cutting and joining.	Perform brick laying of shaped refractory.
	Perform brick cutting and brick joining by hand or machine.
24. Perform fitting of scaffold.	Practice on fitting scaffolding.
	Identify the materials used in scaffolding.
	Maintain the safety aspect in scaffolding.
25. Perform gunning, ramming and patching.	Practice with gunning machine.
	Practice in ramming, patching, shot crating, coating and hot repair.
26. Demonstrate the energy conservation followed by industry.	Demonstration on energy conservation.
	Practice on 5S.
	Acquire practical knowledge on kiln maintenance.
27. Perform basic computer operation.	Familiarization & Identification of computer parts.
	Practice on computer for MS word, MS power point, MS Excel.

28. Perform the method of packaging in refractory industry.	Perform packaging of refractory.
	Arrange to load of different shapes in pallet.
29. Perform installation and repair of brick work.	Cut brick in machine.
	Check perpendicularity of lining using plumb.
	Prepare mortar.
	Monitor thickness of mortar during installation.
	Demolish existing / used lining.
	Use of levelling tool, Sprit level, water level.
	Use of wooden hammer for adjusting brick level.
	Measure, cutting & Installation of Key brick.
	Practice on hand grinding.
	Use of brick holder & brick.
Use of skew brick & Arch making, use of screw jack.	
30. Perform opening, repair, testing, checking of vibrator and identify the physical defect.	Opening & repair of vibrator needle, rammer, pneumatic breaker, replacement of chisel.
	Testing of water quality using litmus paper. Water temperature, quantity of mixing water, time of mixing, Lead time/ measurement, Mixer operation, adjustment of scrapper & Cleaning mixer after use & preventive maintenance.
	Preparation & Fixing of shuttering, Checking Vibrator for capability, vibration time, Height of Castable for vibration, Roding practice.
	Sprinkling water on casted segment for natural/wet curing.
	Identifying & reporting physical defects after Dry out.
31. Identify the different parts of furnaces.	Identify the parts of furnaces.
32. Perform with skill in the model workshop / fields.	Practical training in the model workshop / fields.
33. Create report observing heating chart.	Preparation of heating chart & reportmaking.
	Perform curing, preheating and dry out.
34. Construct refractory lining.	Practice on refractory lining.

	Construction of vertical wall, brick laying, gunning, anchor welding, fixing of shuttering & formers, vibro casting, Ramming, Patching/Troweling, fettling.
35. Prepare technical report and documentation as per industrial need.	Prepare different Types of documentation as per industrial need by different methods of recording information.
36. Demonstrate operational function and maintenance of supporting tools and machines.	Demonstration & practice Tools, Tackles and Operation.
	Perform operation of fixing devices and extraction devices.
	Maintenance of Refractory lining. : Different types of refractory practices like LD converter, Laddle, Tundishes, Slide gate refractory, rotary kiln, Mills, Reheating furnace.

SYLLABUS FOR REFRACTORY TECHNICIAN TRADE			
FIRST YEAR			
Duration	Reference Learning Outcome	Professional Skills (Trade Practical) With Indicative Hours	Professional Knowledge (Trade Theory)
Professional Skill 150 Hrs; Professional Knowledge 42 Hrs	Perform basic workshop operations using suitable tools for marking, drilling, chipping and fitting observing suitable care following safety precautions.	Trade and Orientation <ol style="list-style-type: none"> 1. Visit to various sections of the institute and identify location of various installations. (6 hrs) 2. Identify safety signs for danger, warning, caution & personal safety message. (4 hrs) 3. Use of personal protective equipment (PPE). (4 hrs) 4. Practice elementary first-aid. (4 hrs) 5. Preventive measures for electrical accidents & steps to be taken in such accidents. (4 hrs) 6. Use of Fire extinguishers. (3 hrs) 	Familiarization with the working of Industrial Training Institute system. Importance of safety and precautions to be taken in the industry/shop floor. Introduction to PPEs. Introduction to First-Aid. Response to emergencies e.g. power failure, fire, and system failure. Importance of housekeeping & good shop floor practices. Occupational Safety & Health: Health, Safety and Environment guidelines, legislations & regulations as applicable. (07 hrs)
		Hand tools and their uses <ol style="list-style-type: none"> 7. Identify the different hand tools. (2 hrs) 8. Use of vice, clamps, holding the job in the vice and practice of metal sawing. (8 hrs) 9. Marking practice using hermaphrodite caliper, surface gauge, engineers" try square, marking off table 	Identification, specifications, uses and maintenance of commonly used hand tools, such as:- Steel rule, Divides, Callipers, Centre punch, Dot punch, Prick punch and hammers, V-block, marking off table. State the correct shape of files for filing different profiles. Bench vice, types, use, care

		<p>etc. (6 hrs)</p> <p>10. Marking out lines, gripping suitably in the vice jaw, hacksawing to given dimensions. (8 hrs)</p> <p>11. Workshop practice on filing flat surfaces and hacksawing. (10 hrs)</p> <p>12. Practice of checking flatness and squareness. (6 hrs)</p> <p>13. Filing four edges, checking all dimensions with outside caliper and steel rule. (10 hrs)</p>	<p>and maintenance, vice clamp, hacksaw frame and blade, their types, uses. Method of sawing. (14 hrs)</p>
		<p>14. Marking of straight, arcs and parallel lines with odd leg callipers, scribing block and steel rule . (12 hrs)</p> <p>15. Marking practice with divider. (Circles, arcs and parallel lines). (9 hrs)</p> <p>16. Chipping flat surfaces along a marked line. (12 hrs)</p> <p>17. Finding and marking centre line of cylindrical system, with the help of "spirit level and plumb". (10 hrs)</p> <p>18. Drilling of various sizes of holes on a MS plate. (12 hrs)</p> <p>19. Tapping of different sizes tapped holes on drilled job. (10 hrs)</p> <p>20. Measurement of different dimensions using Vernier height gauge, verniercaliper and micrometer. (10 hrs)</p>	<p>Scribing block, Chisel - types, metal and use. Marking block and uses. Surface plates, parallel block, angle plate and Trammel. Surface plate, its use, care and maintenance. Use of Spirit level.</p> <p>Types of drill bits and parts. Method of drill grinding, cutting angle, defects in drilling and its remedy. Drill chuck and its use. Drilling Process: Types of drilling machines and their use.</p> <p>Taps and Tapping: Types, parts, formula for tapped hole, method of cutting thread with tap. Tap handle, method of extract a broken tap.</p> <p>Vernier height gauge, vernier caliper its leastcount, use, care and maintenance.</p> <p>Outside and inside micrometer. It's reading least count, use, care and</p>

			<p>maintenance.</p> <p>Gauge and indication classification. Types of gauges and their use. Use of slip gauge.</p> <p>Ring action. Working principle of dial gauge.</p> <p>(21 hrs)</p>
<p>Professional Skill 50 Hrs;</p> <p>Professional Knowledge 14 Hrs</p>	<p>Perform forging, piercing, bending, riveting, punching and edge cutting operation.</p>	<p>Forging:</p> <p>21. Preparation of hearth. (6 hrs)</p> <p>22. Making of centre punch. (5 hrs)</p> <p>23. Making of flat chisel. (8 hrs)</p> <p>24. Making of screwdriver. (6 hrs)</p> <p>Press Tool</p> <p>25. Practice on pneumatics tools like jack hammer, rammer & pressure gauge. (13 hrs)</p> <p>26. Piercing, bending, riveting punching and edge cutting in press tool machine. (12 hrs)</p>	<p>Blacksmith and Forging/Heat treatment: Forge types and uses. Forge tools.</p> <p>Forging operations such as: Marking, Cutting, Drawing out, Jumping, Bending, Punching, Setting down and Forge welding. (07 hrs)</p> <p>Mechanism of force transmission in presses. Details of hydraulic and pneumatic presses.(07 hrs)</p>
<p>Professional Skill 25 Hrs;</p> <p>Professional Knowledge 07 Hrs</p>	<p>Perform sheet metal work.</p>	<p>Sheet metal work</p> <p>27. Cutting various types of Geometrical shapes. (13 hrs)</p> <p>28. Use of flat scraper to make the surface even of a dove tail fitting. (12 hrs)</p>	<p>Sheet metal work: Introduction, sheet metal hand tools, shears, sheet metal bench tools such as vice and machine tools. Scrapers: Types, method of scraping, Precautions during scraping operation.</p> <p>(07 hrs)</p>
<p>Professional Skill 25 Hrs;</p> <p>Professional Knowledge</p>	<p>Perform checking and measuring components with precision instrument.</p>	<p>29. Check surface roughness of a surface plate. (4 hrs)</p> <p>30. Perform Angular Measurement using Bevel protector and Sine bar. (5</p>	<p>Definition of accuracy, precision and error.</p> <p>Principle of vernier scale and least count.</p> <p>Measuring methods with</p>

07 Hrs		<p>hrs)</p> <p>31. Measure distance/clearance using dial test indicator. (5 hrs)</p> <p>32. Perform Gear and Screw Thread Measurement.(two wire method and screw pitch gauge). (6 hrs)</p> <p>33. Perform checking work piece by limit gauges. (5 hrs)</p>	<p>Vernier calliper, Micrometers (inside & outside), Telescopic gauge, Height gauge, Depth gauge, Slip gauge.</p> <p>Major parts, functions and measuring methods of Bevel Protector, Sine bar, Angle gauges, Spirit level, Clinometers, Auto collimator.</p> <p>Application of Dial Test Indicator/gauge.</p> <p>Measuring methods of Straightness, Flatness, Squareness, Parallelism, Perpendicularity, Roundness, Concentricity, Cylindricity, run out, ovality. (07 hrs)</p>
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Make different fit of components for assembling observing principle of interchangeability and check for functionality.	<p>Fitting Joints</p> <p>34. File and make Step fit, angular fit, angle, surfaces (Bevel gauge accuracy 1 degree). (8 hrs)</p> <p>35. Scrap on flat surfaces, curved surfaces and parallel surfaces and test. (6 hrs)</p> <p>36. Scrap cylindrical bore. (5 hrs)</p> <p>37. Locate accurate holes & make accurate hole for stud fit. (6 hrs)</p>	<p>Fasteners: Kinds of fastening Bolts, their types and uses, Nuts, their types and uses, Washers, types and uses, Screws, Key and Key way, types and uses. Studs. Pins and cotters. (07 hrs)</p>
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Perform Arc welding process.	<p>Welding</p> <p>38. Practice Arc welding process. (10 hrs)</p> <p>39. Striking straight beads left to right and right to left. (3 hrs)</p> <p>40. Weld a square butt joint. (3 hrs)</p> <p>41. Weld a Lap joint. (3 hrs)</p> <p>42. Weld a Tee joint. (3 hrs)</p>	<p>Arc welding process: Welding method, welding machines, electrode, coding, polarity, edge preparation, types of welding joints and beads.(07 hrs)</p>

		43. Weld a Corner joint. (3 hrs)	
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Perform gas cutting and welding process.	Gas Cutting 44. Practice of Gas cutting and Gas welding. (8 hrs) 45. Cutting of straight and curved metal pieces. (5 hrs) 46. Fusion runs on a M.S. Sheet Left to Right.(6 hrs) 47. Fusion runs on a M.S. Sheet Right to Left. (6 hrs)	Gas welding methods: Oxy-acetylene welding, Flames, Gas and Arc welding tools, Oxygen and Acetylene cylinder, Gas regulator, Gas welding equipment, backward and rightward welding. Welding positions. (07 hrs)
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Use proper taps and dies for making internal and external threads on solid metal and pipes.	48. Use of dies and making of external threads. (8 hrs) 49. Use of tap and prepare tapped holes. (8 hrs) 50. Make threads on various dia. MS rods and fit the threaded rods on previous tapped holes.(8 hrs) 51. Use of Pipe fittings and prepare joints. (8 hrs) 52. Threading of pipes with the use of pipe die. (8 hrs) 53. Prepare a pipe line using different types of pipe joints. (10 hrs)	Dies and its use: Types of dies, die handle, method of using a die, Reamer parts, kinds of reamer, stud extraction. Pipe and pipe fittings: Different types of pipes, Pipe Accessories, G.I Pipe accessories, Tools and signs (symbols) of pipe fitting. (14 hrs)
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Perform basic electrical measurement.	54. Measure AC, DC by using multimeter. (5 hrs) 55. Measure AC voltage using step up & step down transformer. (10 hrs) 56. Measure resistance, Voltage & current. (10 hrs)	Fundamental of AC & DC, voltmeter, ammeter, ohm meter, transducer and sensors. Principle of magnetic induction (Self & mutual), Electric passive component – resistor, capacitor & inductor. (07 hrs)
Professional Skill 50 Hrs; Professional Knowledge	Enumerate the various types of refractories.	54. Demonstrate & practice of various types of refractories. (50 hrs)	Definition of refractory. Classification of refractory. Properties of refractories. Bricks classification, chemical composition and its application area wise,

14 Hrs			<p>insulation , Bricks expansion material (ceramic fibre, Hysil block etc.),</p> <p>Different Shapes:</p> <ul style="list-style-type: none"> • Regular Straight shapes. • Side Arch Shape. • End Arch Shape. • Key and Mini key Shape. • Semi Universal Shape. • Circular Bricks. Skewback Shape. • Checkers Bricks. <p>Other refractory product like castable, motaretc. (14 hrs)</p>
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Identify the major forms and sources of pollution and control techniques in refractory industry.	<p>55. Practice on operation of water spray gun,vacuum sweepers, Dry fog nozzles, watersprinkler etc. (30 hrs)</p> <p>56. Demonstrate & practice on prevention of various health hazards. (20 hrs)</p>	<p>Safety and environment measures. Major forms of pollution in refractory industry. Sources of pollution & various control techniques. Occupational health hazards and its control. Different hazards in refractory industry. Prevention of occupational diseases. (14 hrs)</p>
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Practice operation and maintenance of various fuel handling plant.	<p>57. Practice on handling various fuels. (20 hrs)</p> <p>58. Operation & maintenance of Producer gas plant. (30 hrs)</p>	<p>Types of fuel used in refractory industry:</p> <ul style="list-style-type: none"> • Coal • Coke • Producer Gas • Furnace oil • LPG <p>Safety & occupational hazard aspect in handling Producer gas plant. (14 hrs)</p>
Professional Skill 25 Hrs; Professional Knowledge 14 Hrs	Identify the different raw material and handling.	59. Demonstrate & practice of different raw material & handling of same. (25 hrs)	Different raw materials used in manufacturing refractory & their basic physical & chemical

Knowledge 07 Hrs			properties. (07 hrs)
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Perform the measures of quality control.	60. Demonstrate & practice on quality control. (25 hrs)	Quality assurance, Definition & importance of Quality control, quality circle. Basic Concept of 5S, Kaizen, TPM, TQM & ISO9000. (07 hrs)
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Demonstrate the manufacturing processes.	61. Demonstrate & practice different manufacturing processes at plant/video demonstration. (50 hrs)	Different processes involved in refractory. a) Crushing, Grinding and Sieving b) Batching & mixing c) Hand moulding d) Pressing e) Vibro casting f) Drying g) Firing h) Physical checking. (14 hrs)
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Identify the different grain size, mixing machine – operation and adjustment and checking consistency of mixed material.	Crushing & grinding 62. Demonstrate & practice on Sieve Analysis of different grain size. (15 hrs) 63. Identification of parts of mixing machine & operation of mixing machine. (15 hrs) 64. Practice on changing adjusting scrapper, adjustment of roller height. (10 hrs) 65. Checking consistency of mixed material and workability. (10 hrs)	Crushing & grinding: Knowledge of adjustment for fineness of the output. Various types/parts of Mixing machine. Maintenance of mixing machines. Mixing sequence of different quality mixtures. Physical check of mixture to ensure completion of mixing. Unloading of mixture to bucket and moisture content of mixture. (14 hrs)
Professional Skill 100 Hrs; Professional	Perform operation and monitoring of moulding and pressing	Moulding and pressing 66. Practice on weighing of material, filling the mould &	Moulding and pressing: Types of press & sequence of operation of press machine. Press capacity linked with bulk

Knowledge 28 Hrs	(manual / hydraulic).	<p>operating the pressing (Mechanical & Hydraulic) and gauging of the bricks. (15 hrs)</p> <p>67. Physical inspection of bricks for cracks, lamination & wrecks, warpage. (15 hrs)</p> <p>68. Checking of bulk density of bricks. (05 hrs)</p> <p>69. Practice on operation /monitoring parameters of press. (Manual/ Hydraulic). (15 hrs)</p> <p>70. Segregation, Sizes, Edges & corner and any other physical defects. (50 hrs)</p>	<p>density.</p> <p>Different defects, identification & reporting.</p> <p>Shaping/Moulding methods. The various processes of shaping/moulding and their limitation.</p> <p>The process of release from mould and handling of bricks to prevent damage.</p> <p>Pre weighing of mixture for consistent product. (28hrs)</p>
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Practice on drying bricks and dryers.	<p>71. Demonstrate/ practice on drying of bricks. (20 hrs)</p> <p>72. Practice on operating dryers. (30 hrs)</p>	<p>Drying of bricks.</p> <p>The objectives of drying.</p> <p>Classification of dryers. The various dryers used in refractory industries and the process involved in these. (14 hrs)</p>
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Identify the different temperature measuring instrument and maintenance.	<p>73. Demonstrate / practice of different temperature measuring instrument. (8 hrs)</p> <p>74. Reading of temperature. (5 hrs)</p> <p>75. Practice on preventive maintenance. (12 hrs)</p>	<p>Temperature, Measurement & instruments used in measuring temperature.</p> <p>Thermocouple & its application in measuring temperature (Pyrometer).</p> <p>Maintenance system. Types of maintenance.</p> <p>Importance of preventive maintenance.</p> <p>Preventive maintenance steps on various plant & machinery. (07 hrs)</p>
Professional Skill 75 Hrs;	Ensure proper loading/ unloading,	76. Observation and practice on loading/unloading. (20 hrs)	Types of kilns for calcinations of raw materials.

Professional Knowledge 21 Hrs	drying schedule, firing schedule and inspect the finished product.	77. Drying schedule, monitoring of firing schedule. (20 hrs) 78. Physical Inspection of finished product. (10 hrs) 79. Practice on loading/unloading of bricks. (25 hrs)	Different zones of kiln, Fuel used in the kiln. (21 hrs)
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Perform the operation and maintenance of kiln and waste utilisation.	80. Practice on operation & maintenance of kiln. (15 hrs) 81. Practice on firing schedule. (15 hrs) 82. Practice on brick checking. (10 hrs) 83. Demonstration waste utilization. (10 hrs)	Firing of bricks. Kilns for firing of refractory and loading pattern of bricks. Firing schedule & Maturing temperature. Different types of kilns used for firing of bricks. <ul style="list-style-type: none"> • Tunnel kiln. • Chamber kiln. • Shuttle kiln. • Down Draught (DD) kiln. Checking of bricks after firing: Sizes, lamination / Cracks, Spongy / Segregation and Edge and corner breakage and other physical defects. Waste Utilization: Recycling of refractory. Control of dust and gasses leakage during the process. Efficient utilization of resources. Optimization of kiln loading Mill house. Operational discipline & control, Firing criteria. (14 hrs)

SYLLABUS FOR REFRACTORY TECHNICIAN TRADE			
SECOND YEAR			
Duration	Reference Learning Outcome	Professional Skills (Trade Practical) With Indicative Hours	Professional Knowledge (Trade Theory)
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	Demonstrate the basic application of monolithic refractory.	84. Demonstrate & practice different application method at plant/ video demonstration. (50 hrs)	Basic Application of monolithic refractory 1. Storage 2. Worksite 3. Equipment 4. Installation 5. Steel surface 6. Anchoring 7. Formwork / shuttering 8. Water quality 9. Mixing 10. Sampling 11. Vibrating / Rodding 12. Application 13. Joints in monolithics 14. Curing 15. Dry out 16. Criteria for acceptance Cracks 17. Defects and acceptance criteria 18. Inspection. (18 hrs)
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	Perform brick cutting and joining.	85. Brick cutting (m/c & hand), Brick joining. (50 hrs)	Basic application of shaped refractory. Various Heat Treatment Processes 1. Hardening 2. Normalizing 3. Tempering 4. Annealing 5. Case Carburizing. (18 hrs)

Professional Skill 25 Hrs; Professional Knowledge 09 Hrs	Perform fitting of scaffold.	86. Practice on fitting scaffolding. (25 hrs)	Scaffolding. Purpose of scaffolding. Materials used in scaffolding & safety aspect in it. (09 hrs)
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	Perform gunning, ramming and patching.	87. Practice with gunning machine, ramming, patching. (50 hrs)	Gunning, Ramming, Shot crating, Patching, Coating, hot repair. (18 hrs)
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	Demonstrate the energy conservation followed by industry.	88. Demonstration on energy conservation. (10 hrs) 89. Practice on 5S. (15 hrs)	Energy conservation. Concerns for energy conservation. Energy conservation drive. Areas of improvement. Best practices to be adopted for energy conservation. (09 hrs)
		90. Industry visit to get practical knowledge of kiln maintenance. (25 hrs)	Maintenance of kilns. Preventive, Periodical & break down maintenance. Various parameters to be checked during maintenance. Melting practice of Pig Iron. Melting practice of Grey Cast Iron (09 hrs)
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	Perform basic computer operation.	Introduction to computer basics 91. Familiarization & Identification of computer parts. (10 hrs) 92. Practice on computer for MS word, MS power point, MS Excel. (40 hrs)	Introduction to computer basics: Basics of computer, MS word, MS power point, MS Excel. Report writing as per Proforma. (18 hrs)
Professional Skill 100 Hrs; Professional	Perform the method of packaging in refractory industry.	93. Practice on packaging. (100 hrs)	Packaging of refractory : Design of pallets. Pallet dimensions. Arrangement of loading of

<p>Knowledge 36 Hrs</p>			<p>different shapes inthe pallets. Outer packaging for containershipment. Stretch wrapping. Primary packing. Secondary packing. Final packing. (36 hrs)</p>
<p>Professional Skill 125 Hrs; Professional Knowledge 45 Hrs</p>	<p>Perform installation and repair of brick work.</p>	<p>94. Operation of brick cutting m/c.(15 hrs) 95. Checking perpendicularity of lining using plumb. (5 hrs) 96. Mortar preparation. (10 hrs) 97. Monitoring thickness of mortar during installation. (10 hrs) 98. Demolition of existing/ used lining. (15 hrs) 99. Use of levelling tool, Sprit level, water level. (10 hrs) 100. Use of wooden hammer for adjusting brick level. (5 hrs) 101. Measuring, cutting & Installation of Key brick. (25 hrs) 102. Practice on hand grinding. (10 hrs) 103. Use of brick holder & brick. (8 hrs) 104. Use of skew brick & Arch making, use of screw jack. (12 hrs)</p>	<p>Sorting tools</p> <ul style="list-style-type: none"> • Hand tools to remove packing materials <p>Survey tools</p> <ul style="list-style-type: none"> • Levelling tools • Length level 2 m1 • Marking paint red <p>Carpenter tools</p> <ul style="list-style-type: none"> • Hammer; nails; wood; electric/handsaw <p>Demolishing / wrecking</p> <ul style="list-style-type: none"> • Wrecking Machine, wrecking hammers <p>Brickwork tools</p> <ul style="list-style-type: none"> -- Marking Pen -- Hammer; (metallic / rubber/ wood) -- Buckets -- Rigging chisels -- Trowel for applying mortar -- Measuring tools (meter; stick; level;brick layer string -- Profiles; brick-layer string; -- Brick Cutting machine, (diamond saw) -- Level instrument; -- Paddle mixer for mixing mortar, -- Brick Laying Machine, /screw

			jack. (45 hrs)
Professional Skill 100 Hrs; Professional Knowledge 36 Hrs	Perform opening, repair, testing, checking of vibrator and identify the physical defect.	<p>105. Opening & repair of vibrator needle, rammer, pneumatic breaker, replacement of chisel. (15 hrs)</p> <p>106. Testing of water quality using litmus paper. Water temperature, quantity of mixing water, time of mixing, Lead time/measurement, Mixer operation, adjustment of scrapper & Cleaning mixer after use & preventive maintenance. (30 hrs)</p> <p>107. Preparation & Fixing of shuttering, Checking Vibrator for capability, vibration time, Height of Castable for vibration, Roding practice. (35 hrs)</p> <p>108. Sprinkling water on casted segment for natural/wet curing. (15 hrs)</p> <p>109. Identifying & reporting physical defects after Dry out. (5 hrs)</p>	<p>1. Storage</p> <p>2. Worksite</p> <p>3. Equipment</p> <p>4. Installation</p> <ul style="list-style-type: none"> • Steel surface • Anchoring • Formwork / shuttering • Water quality • Mixing • Sampling • Vibrating / Rodding • Application • Joints in monolithics <p>5. Curing</p> <p>6. Dry out</p> <p>7. Criteria for acceptance</p> <ul style="list-style-type: none"> • Cracks • Defects and acceptance criteria <p>8. Inspection. (36 hrs)</p>
Professional Skill 25 Hrs; Professional Knowledge 09 Hrs	Identify the different parts of furnaces.	110. Demonstration on different parts of the furnaces. (25 hrs)	<p>Application of refractory:</p> <p>Nomenclature of different parts of the furnaces. The industries of application of refractory:</p> <ul style="list-style-type: none"> • Iron & Steel • Aluminium & non-ferrous • Foundry • Cement • Thermal Power/Inclinators • Petrochemical/Refinery

			<ul style="list-style-type: none"> • Chemical/Fertilizer • Glass. (09 hrs)
Professional Skill 75 Hrs; Professional Knowledge 27 Hrs	Perform with skill in the model workshop / fields.	111. Practical training in the modelworkshop / fields. (75 hrs)	Iron & steel:- Hot metal transfer Ladle, Torpedo Ladles, Sponge iron kilns. Video/Visual display(audio visual display) Induction furnace, Electric Arc furnace, LD converter,Ladles, Tundish. (27 hrs)
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	Create report observing heating chart.	112. Preparation of heating chart & reportmaking. (50 hrs)	Curing, Preheating/Dry out, tempering schedule/cycle of furnaces after refractory installation.
Professional Skill 100 Hrs; Professional Knowledge 36 Hrs	Construct refractory lining.	113. Refractory lining practices. (50 hrs) 114. Construction of vertical wall, brick laying, gunning, anchor welding, fixing of shuttering & formers, vibro casting, Ramming, Patching/ Troweling, fettling (Construction/ expansion joints) (50 hrs)	Study of the refractory lining drawings. Shaped & Unshaped refractory lining. Anchor types, Construction joints, Expansion joints. Iron & steel: Slide gate fixing, Porous plug fixing, Fixing of CCrefractories. (36 hrs)
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	Prepare technical report and documentation as per industrial need.	115. Prepare different Types of documentation as per industrial need by different methods of recording information. (50 hrs)	Importance of Technical English terms used in industry –(in simple definition only)Technical forms, process charts, activity logs, in required formats of industry, estimation, cycle time, productivity reports, job cards.(18 hrs)
Professional Skill 100 Hrs;	Demonstrate operational function	116. Demonstration & practice Tools, Tackles and	Tools, Tackles and Operation: Trainings : (Understanding

<p>Professional Knowledge 36 Hrs</p>	<p>and maintenance of supporting tools and machines.</p>	<p>Operation. (100 hrs)</p>	<p>different parts, function and operation), Gunning machine, Spray machine, Fixing devices – PP, SGP, CC Extraction devices – PP, SGP, CC; Pneumatic Rammer, Pencil Vibrator, Vibrating & Casting machines. Maintenance of Refractory lining. : Different types of refractory practices like LD converter, Ladle, Tundishes, Slide gate refractory, rotary kiln, Mills, Reheating furnace. Occupational Health Hazards and its control. Types of hazards. Knowledge about hazardous materials in the process and how to handle them. Fundamental of fire and explosion and how to prevent fire. Identification of fire extinguisher. Metal safety data sheet (MSDS). (36 hrs)</p>
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SYLLABUS FOR CORE SKILLS

1. Workshop Calculation & Science (Common for two year course) (80Hrs + 80 Hrs)
2. Engineering Drawing (Common for Group-I (Mechanical Trade Group)) (80Hrs + 80 Hrs)
3. Employability Skills (Common for all CTS trades) (160Hrs + 80 Hrs)

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.

List of Tools & Equipment			
REFRACTORYTECHNICIAN (For Batch of 24 Candidates)			
S No.	Name of the Tools and Equipment	Specification	Quantity
A. TRAINEES TOOL KIT			
1.	Steel Rule	12"	25 Nos.
2.	Hammer Ball Pin	0.45 Kg	25 Nos.
3.	Hammer Flat (optional)		25 Nos.
4.	Chisel Cold Flat	2cmX22Cm	25 Nos.
5.	File Flat	300 mm Bastered	25 Nos.
6.	File Flat	300 mm Second Cut	25 Nos.
7.	File Half Round Bastard	200 mm	25 Nos.
8.	Safety goggles		25 Nos.
9.	Goggles Furness, Antigua Around Heat Proof		25 Nos.
10.	Head wear anticoncusion Furness		7 Nos.
11.	Pliers	20cm	25 Nos.
12.	Vice bench	12cm Jaw	25 Nos.
13.	Sledge Hammer	5 kg	5 Nos.
14.	Buckets	10 Ltr. Capacity	7 Nos.
15.	Sprit level	150 mm	7 Nos.
16.	Pocket steel Tape	1800mm long	25 Nos.
17.	Crow Bar	1500mm	2 Nos.
18.	Screw Driver	300mm	25 Nos.
19.	Bench Grinder		2 Nos.
20.	Hacksaw	30cm adjustable	25 Nos.
21.	Work Bench	2400mm x 1300mm x 800 mm	5 Nos.
22.	Shovel		5 Nos.
23.	Trammel		2 Nos.
24.	Scriber		25 Nos.
25.	Callipers Odd leg		25 Nos.
26.	Caliper inside	150 mm	25 Nos.
27.	Centre Punch	150 mm	25 Nos.

28.	Trowels	(Square & triangle, 4nos. each)	10 Nos.
29.	Measuring tape	2500mm	7 Nos.
30.	Hand gloves Leather		25 Nos.
31.	Pliers	150mm	25 Nos.
32.	Screw driver	100mm	25 Nos.
33.	Tester		25 Nos.
B. Tools & Equipments for Production:			
34.	Jaw crusher		1 No.
35.	Roller crusher		1 No.
36.	Ball Mill/ Vibro mill		1 No.
37.	Sieves		7 Nos.
38.	Mixer machine		1 No.
39.	Press Machine		1 No.
40.	Dryer (Oven hot air)		1 No.
41.	Kiln		1 No.
42.	Moulds(Different shapes)		2 each
43.	Drying furnace (Lab scale) Int. Vol.1m ³		1 No.
44.	Rammer		1 No.
45.	Air Compressor	5 bar	1 No.
C. Tools & Equipments for Application:			
46.	Brick cutting m/c with cutting wheel		7 Nos.
47.	Stirrer		2 Nos.
48.	Gunning machine		2 Nos.
49.	Models for electric arc furnace		1 No.
50.	Models for Basic Oxygen furnace		1 No.
51.	Models for Rotary kiln		1 No.
52.	Ladle		1 No.
53.	Tundish		1 No.
54.	Jack hammer with drill bits		1 No.
55.	Spirit level		5 Nos.
56.	Water level		5 Nos.
57.	Wooden/aluminium rafter (optional)		2 Nos.
58.	Plumb		7 Nos.
59.	Masonry hammer		7 Nos.
60.	Slide caliper		7 Nos.
61.	Wooden hammer		7 Nos.

62.	GI Pipe	2" with clamps for scaffolding	As required
63.	Filler Gauge	Min 0.5 mm - 5 mm	1 No.
64.	Laser thermometer (Optional)		1 No.
65.	Pyrometer		1 No.
66.	Joint filler		1 No.
67.	Chisel flat	20X200mm	7 Nos.
68.	Pressure gauge		1 No.
69.	Screw jack		1 No.
70.	Weighing m/c	Min: 10 Kg	1 No.
71.	Wheel barrow		2 Nos.
72.	MS pan		2 Nos.
73.	Measuring flask		2 Nos.
74.	Litmus paper		As required
75.	Thermometer		1 No.
76.	Stop watch		1 No.
77.	Glass biker		1 No.
78.	Star Delta starter		1 No.
79.	Multimeter		2 Nos.
80.	Voltmeter		2 Nos.
81.	Flowmeter		2 Nos.
82.	Vicat apparatus		1 No.
83.	Piano wire/ Wire gauge pad (Optional)		2 nos.
84.	Auto CAD software		1 No.
85.	Hand saw		12 Nos.
86.	Electric hand drill		1 No.
87.	Micrometer	(0-25, 25-50,50-75mm)	1 set each
88.	Vernier callipers	(0-200mm) (.02 discount)	1 No.
89.	Welding transformer (Not required if welder trade exist)		1 No.
90.	C-Clamp	20 cm Perforated Hood	7 Nos.
91.	C-Clamp	30cm Light Duty Steel	7 Nos.
92.	Surface plate	300x300mm	2 Nos.
93.	Drill twist (metric)	3 mm to 12mm	1 sets
94.	Tapes and dies complete set in box BSW,BSF, Metric		2 sets each
95.	Oil Can $\frac{1}{2}$ ft		3 Nos.
96.	Wire Brush		12 Nos.

97.	Double ended spanner	10mm to 25mm	7 Nos.
98.	Drill Chuck	0 to 12 morse taper	1 No.
99.	Drill machine to drill	upto 12mm dia	1 No.
100.	Digital multimeter		5 Nos.
101.	AC Motor	single Phase	1 No.
102.	AC Motor	three Phase	1 No.
E. List of additional tools for allied trade in welding			
103.	Transformer welding set	150 amps. - continuous welding current, with all accessories and electrode holder	1 Set
104.	Welder cable to carry 200 amps. With flexible rubber cover		24 Meter
105.	Lugs for cable		12 Nos.
106.	Earth clamps.		2 Nos.
107.	Arc welding table (all metal top) 122 cm X 12 cm X 60 cm with positioner.		1 No.
108.	Oxy - acetylene gas welding set equipment with hoses, regulator and other accessories.		1 Set.
109.	Gas welding table with positioner		1 No
110.	Welding torch tips of different sizes		1 Set
111.	Gas lighter.		2 Nos
112.	Trolley for gas cylinders.		1 No
113.	Chipping hammer.		2 Nos
114.	Gloves (Leather)		2 Pairs
115.	Leather apron.		2 Nos
116.	Spindle key for cylinder valve.		2 Nos.
117.	Welding torches	5 to 10 nozzles.	1 Set.
118.	Welding goggles		4 Pairs.
119.	Welding helmet with coloured glass		2 Nos.
120.	Tip cleaner		12 Sets.
F. Tools for Allied Trade- Sheet Metal Work			
121.	Trammel	30cm.	1 no.
122.	Prick punch		2 nos.
123.	Mallet.		2 nos.

124.	Snips straight	25 cm.	2 nos.
125.	Setting hammers with handle.		2 nos.
126.	Planishing hammer.		2 nos.
127.	Snip bent	25 cm.	2 nos.
128.	Stake hatchet.		2 nos.
129.	Stake grooving.		2 nos.
130.	Gauge imperial sheet.		1 no.
G. General Furniture:			
131.	Almirah	as per required size	2 Nos.
132.	Steel Rack	5'x4'x2'	2 Nos.
133.	Fire Extinguisher		2 Nos.
134.	First aid Box		1 No.
Note: -			
1. Internet facility is desired to be provided in the class room.			

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/ contributed for finalizing the course curriculum of Refractory Technician Trade.			
S No.	Name & Designation Sh./Mr./Ms.	Organization	Remarks
1.	A. D. Shahane, Vice-President, (Corporate Trg.)	Larsen & Turbo Ltd., Mumbai:400001	Chairman
2.	Dr. P.K.Jain, Professor	IIT, Roorkee, Roorkee-247667, Uttarakhand	Member
3.	N. Ramakrishnan, Professor	IIT Gandhinagar, Gujarat-382424	Member
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17.	K Venugopal Director & COO	NTTF, Peenya, Bengaluru	Member
18.	B.A.Damahe, Principal L&T Institute of Technology	L&T Institute of Technology, Mumbai	Member

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25.	Dasarathi.G.V.	CADEM Tech. Pvt. Ltd., Bengaluru	Member
26.	L.R.S.Mani	Ohm Shakti Industries, Bengaluru	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 Apprenticeship 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

