



## Preface to NSQF (Level-4) Compliant Edition



Directorate General of Training (DGT) under the Ministry of Skill Development & Entrepreneurship, being the apex organization for development and coordination of vocational training at the national level, undertakes steps from time to time to improve its various aspects in line with changing market and industry requirements. In 2015, DGT initiated the process of incorporating the concept of competency based curricula. In order to do so, the curriculum of each CTS trade has been reoriented with appropriate National Skill Qualification Framework (NSQF) level.

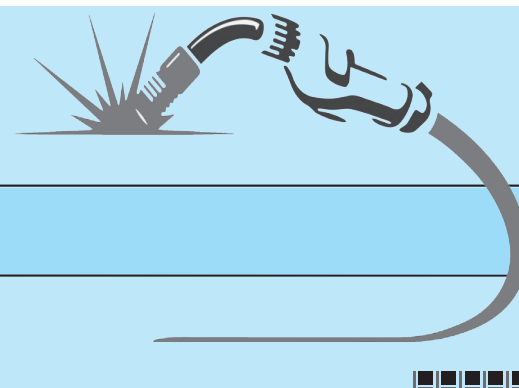
The curriculum for the trade Welder has been made Level 4 compliant. This trade is one among the top popular trades delivered nationwide through a large network of Industrial Training Institutes. The duration of training for this trade is one year and during this period, the trainees are trained broadly in three major areas viz. Professional Skill, Professional Knowledge and Employability Skills. The time devoted for Professional Skill training i.e. practical is more than 50% of the total training hours available.

This book has been written to fulfil the needs of the trainees to understand, learn and be professionally skilled in the Welder trade. The latest DGT prescribed curriculum has been strictly followed. To begin with description of general shop outfit and trainee's tool kit is given so as to familiarise trainees with tools and equipment that they will be required to work with. Necessary introduction to welding processes is also included.

Then follows the various exercises sequentially as per the curriculum arranged in eight modules, each exercise describing not only job sequence and other essential details to practically complete the exercise but also necessary skill information specific to the given exercise. Each module is followed by relevant short questions & answers in the form of Viva Voce, which trainees often have to face during trade practical test. In the end a comprehensive set of over 50 practical jobs for practice are given which largely include exercises as seen in AITT exam in the past. As such, we sincerely hope that the trainees will find this book of immense help during the entire training period.

Hoping this book helps the trainees prepare for practical trade test with confidence, we stand committed for continuous improvement and would, therefore, welcome suggestions from our esteemed readers.

— Author



# Contents

NSQF (Level-4) Compliant Competency based Curriculum for Welder Trade Practical (Under CTS)..... vii – viii

MODULE	PAGES
<b>1. INDUCTION TRAINING AND WELDING PROCESSES (OAW, SMAW) .....</b>	<b>1–58</b>
Exercise 1 : Demonstration of Machinery used in the Trade (OAW, SMAW).....	1
Exercise 2 : Identification of Safety Equipment and their use.....	15
Exercise 3 : Hack Sawing, Filing Square to Dimensions .....	17
Exercise 4 : Layout and Marking .....	19
Exercise 5 : Setting of Oxy-Acetylene Welding Equipment, Lighting and Setting of Flame.....	21
Exercise 6 : Perform Fusion Run without Filler Rod on MS Sheet 3 mm Thick in Flat Position (OAW) .....	27
Exercise 7 : Setting up of Arc Welding Machine and Accessories and Striking an Arc (SMAW) .....	28
Exercise 8 : Deposit Straight Line Bead on MS Plate 10 mm Thick in Flat Position (SMAW).....	32
Exercise 9 : Depositing Bead with Filler Rod On M.S. Sheet 2 mm Thick in Flat Position (OAW) .....	34
Exercise 10 : Edge Joint on MS Sheet 2 mm Thick in Flat Position without Filler Rod (OAW).....	36
Exercise 11 : Weaved Beads on M.S. Plate 10 mm Thick in Flat Position (SMAW).....	38
Exercise 12 : Setting Up of Oxy-Acetylene Gas Cutting Equipment and Straight Cutting by Free Hand (OAGC).....	42
Exercise 13 : Bevel Cutting by Gas Cutting Process (OAGC).....	46
Exercise 14 : Circular Gas Cutting on M.S. Plate 10 mm Thick by Profile Cutting Machine (OAGC).....	48
Exercise 15 : Marking and Perform Radial Cuts, Cutting Out Holes using Oxy-Acetylene Gas Cutting (OAGC).....	51
Exercise 16 : Identification of Gas Cutting Defects (OAGC).....	52
<b>2. WELDING TECHNIQUES .....</b>	<b>59–83</b>
Exercise 1 : Square Butt Joint on M.S. Sheet 2 mm Thick in Flat Position (OAW).....	59
Exercise 2 : Fillet “T” Joint on M.S. Plate 10 mm Thick in Flat Position (1F) (SMAW).....	61
Exercise 3 : Open Corner Joint on M.S. Sheet 2.0 mm in Flat Position (1F) (OAW).....	64
Exercise 4 : Fillet Lap Joint on M.S. Plate 10 mm Thick in Flat Position (1F) (SMAW) .....	67
Exercise 5 : Fillet ‘T’ Joint on M.S. Sheet 2.0 mm in Flat Position (OAW).....	70
Exercise 6 : Open Corner Joint on M.S. Plate 10 mm Thick in Flat Position (1F) (SMAW).....	73
Exercise 7 : Fillet Lap Joint on M.S. Sheet 2.0 mm in Flat Position (OAW).....	76
Exercise 8 : Single “V” Butt Joint on M.S. Plate 12 mm Thick in Flat Position (SMAW) .....	78
<b>3. WELDABILITY OF STEELS (OAW, SMAW) .....</b>	<b>84–182</b>
Exercise 1 : Testing of Weld by Visual Inspection (I & T).....	84
Exercise 2 : Inspection of Welds using Weld Gauges (I & T).....	87
Exercise 3 : Square Butt Joint on M.S. Sheet 2.0 mm in Horizontal Position (2G) (OAW).....	90
Exercise 4 : Straight Line Beads on M.S. Plate 10 mm Thick in Horizontal Position (SMAW) .....	92
Exercise 5 : Fillet – ‘T’ Joint on M.S. Plate 10 mm Thick in Horizontal Position (2F) (SMAW) .....	94
Exercise 6 : Fillet – Lap Joint on M.S. Sheet 2.0 mm in Horizontal Position (2F) (OAW).....	97
Exercise 7 : Fillet Weld in Lap Joint on M.S. Plates 10 mm in Horizontal Position (2F) (SMAW).....	99
Exercise 8 : Fusion Run with Filler Rod on M.S. Sheet 2.0 mm in Vertical Position (OAW) .....	101
Exercise 9 : Square Butt Joint on M.S. Sheet 2.0 mm in Vertical Position (3G) (OAW) .....	103
Exercise 10 : Single “Vee” Butt Joint on M.S. Plate 12 mm Thick in Horizontal Position (2G) (SMAW).....	105

Exercise 11	: Weaved Beads on M.S. Plate 10 mm Thick in Vertical Position (SMAW).....	107
Exercise 12	: Fillet 'T' Weld on M.S. Sheet 2.0 mm in Vertical Position (3F) (OAW).....	111
Exercise 13	: Fillet 'T' Weld on M.S. Plate 10 mm Thick in Vertical Position (3F) (SMAW).....	114
Exercise 14	: Structural Pipe Welding Butt Joint on M.S. Pipe $\phi$ 50 mm $\times$ 3 mm Thickness in IG (Rolling) Position (OAW).....	116
Exercise 15	: Fillet Lap Joint on M.S. Plate 10 mm Thick in Vertical Position (3G) (SMAW).....	120
Exercise 16	: Open Corner Joint on M.S. Plate 10 mm Thick in Vertical Position (3F) (SMAW).....	122
Exercise 17	: Structural Pipe Welding Elbow Joint on M.S. Pipe $\phi$ 50 mm $\times$ 3 mm Wall Thickness in Flat Position (1G) (OAW).....	124
Exercise 18	: Structural Welding 90° 'T' Joint on M.S. Pipe Diameter 50 mm $\times$ 3 mm Wall Thickness in Flat Position (1G) (Oaw).....	127
Exercise 19	: Single "V" Butt Joint on M.S. Plate 12 mm Thick in Vertical Position (3G) (SMAW).....	129
Exercise 20	: Pipe Welding 45° Angle Joint on M.S. Pipe $\phi$ 50 $\times$ 3 mm Wall Thickness (1G) (OAW).....	133
Exercise 21	: Straight Line Beads on M.S. Plate 10 mm Thick in Overhead Position (SMAW).....	136
Exercise 22	: Pipe Flange Joint on M.S. Pipe $\phi$ 50 mm $\times$ 3 mm Wall Thickness and M.S. Plate 3 mm Thick in Flat Position (SMAW).....	139
Exercise 23	: Fillet 'T' Joint on M.S. Plate 10 mm Thick in Overhead Position (4F) (SMAW).....	142
Exercise 24	: Pipe Welding Butt Joint on M.S. Pipe $\phi$ 50 $\times$ 5 mm Wall Thickness in 1G Position (SMAW).....	146
Exercise 25	: Fillet – Lap Joint on M.S. Plate 10 mm Thick in Overhead Position (4G) (SMAW).....	149
Exercise 26	: Single 'V' Butt Joint on M.S. Plate 10 mm Thick in Overhead Position (4G) (SMAW).....	151
Exercise 27	: Pipe Butt Joint on M.S. Pipe $\phi$ 50 mm $\times$ 6 mm Wall Thickness in 1G (Rolled) Position (SMAW).....	154
Exercise 28	: Square Butt Joint on Stainless Steel Sheet 2.0 mm Thick in Flat Position (OAW).....	157
Exercise 29	: Square Butt Joint on Stainless Steel Sheet 2 mm Thick in Flat Position (SMAW).....	159
Exercise 30	: Square Butt Joint on Brass Sheet 2 mm Thick in Flat Position (OAW).....	161
Exercise 31	: Square Butt Joint on M.S. Sheet 2 mm Thick by Brazing (OAW).....	164
Exercise 32	: Single 'V' Butt Joint on Cast Iron Plate 10 mm Thick in Flat Position (SMAW).....	165
Exercise 33	: ARC Gouging on M.S. Plate 10 mm Thick in Flat Position (AG).....	168
Exercise 34	: Square Butt Joint on Aluminium Sheet 3 mm Thick in Flat Position (OAW).....	170
Exercise 35	: Bronze Welding of Single 'V' Butt Joint in Flat Position on Cast Iron Plate 12 mm Thick (OAW).....	173
<b>4.</b>	<b>INSPECTION AND TESTING.....</b>	<b>183–197</b>
Exercise 1	: Dye Penetrant Test.....	183
Exercise 2	: Magnetic Particle Test.....	185
Exercise 3	: Nick-Break Test.....	189
Exercise 4	: Free Bend Test.....	191
Exercise 5	: Fillet Fracture Test.....	194
<b>5.</b>	<b>GAS METAL ARC WELDING.....</b>	<b>198–262</b>
Exercise 1	: Introduction to Gas Metal Arc Welding.....	198
Exercise 2	: Setting Up of GMAW Machine and Accessories and Striking an Arc.....	201
Exercise 3	: Depositing Straight Line Beads on M.S. Plate 10 mm Thick in Flat Position by GMAW.....	203
Exercise 4	: Fillet Weld Tee Joint on M.S. Plate 10 mm Thick in Flat Position by DIP Tranfser (1F).....	206
Exercise 5	: Fillet Weld – Lap Joint on M.S. Sheet 3 mm Thick in Flat Position by DIP Transfer for 1F.....	209
Exercise 6	: Fillet Weld 'T' Joint on M.S. Sheet 3 mm Thick in Flat Position by DIP Transfer (1F).....	212
Exercise 7	: Fillet Weld Corner Joint on M.S. Sheet 3 mm Thick in Flat Position by DIP Transfer (1F).....	214
Exercise 8	: Butt Weld – Square Butt Joint on M.S. Sheet 3 mm Thick in Flat Position (1G).....	217
Exercise 9	: Butt Weld Single V Butt Joint on M.S. Plate 10 mm Thick by DIP Transfer in Flat Position (1G).....	220
Exercise 10	: Fillet Weld Tee Joint on M.S. Plate 10 mm Thick in Horizontal Position by DIP Transfer (2F).....	224
Exercise 11	: Fillet Weld Corner Joint on M.S. Plate 10 mm Thick in Horizontal Position by DIP Transfer (2F).....	227
Exercise 12	: Fillet Weld 'T' Joint on M.S. Sheet 3 mm in Horizontal Position by DIP Transfer (2F).....	230
Exercise 13	: Fillet Weld – Corner Joint on M.S. Sheet 3 mm Thick in Horizontal Position by DIP Transfer (2F).....	234
Exercise 14	: Fillet Weld – Tee Joint on M.S. Plate 10 mm Thick in Vertical Position (Vertical Up) by DIP Transfer (3F).....	237
Exercise 15	: Fillet Weld Outside Corner Joint on M.S. Plate 10 mm Thick in Vertical Upward Position by DIP Transfer (3F).....	240

Exercise 16	: Fillet Weld Lap Joint on M.S. Sheet 3 mm Thick in Vertical Position by DIP Transfer (3F).....	243
Exercise 17	: Fillet Weld Outside Corner Joint on M.S. Sheet 3 mm Thick in Vertical Position by DIP Transfer (3F) ....	246
Exercise 18	: Fillet Weld Lap and 'T' Joint on M.S. Sheet 3 mm Thick in Overhead Position by DIP Transfer (4F).....	249
Exercise 19	: Tee Joint on M.S. Pipe $\phi$ 60 mm OD $\times$ 3 mm Wt 1G Position Rolling.....	253
Exercise 20	: Depositing Bead on S.S. Sheet in Flat Position.....	256
Exercise 21	: Butt Weld Stainless Steel 2 mm Thick Sheet in Flat Position by DIP Transfer .....	258
<b>6.</b>	<b>GAS TUNGSTEN ARC WELDING.....</b>	<b>263–286</b>
Exercise 1	: Depositing Bead on Aluminium Sheet 2 mm Thick – Flat Position .....	263
Exercise 2	: Butt Weld Square Butt Joint on Aluminium Sheet 2 mm Thick in Flat Position.....	266
Exercise 3	: Fillet Weld – Tee Joint on Aluminium Sheet 2 mm Thick in Flat Position (1F) .....	268
Exercise 4	: Fillet Weld Outside Corner Joint on Aluminium Sheet 2 mm Thick in Flat Position (1F).....	271
Exercise 5	: Butt Weld Square Butt Joint on Stainless Steel 1.6 mm Thick in Flat Position with Purging Gas (1G) ....	272
Exercise 6	: Fillet Weld Tee Joint on Stainless Steel Sheet 1.6 mm Thick in Flat Position (1F).....	275
Exercise 7	: Pipe Butt Joint on Aluminium Pipe $\phi$ 50 mm $\times$ 3 mm WT in Flat Position (1G).....	278
Exercise 8	: Tee Joint on M.S. Pipe $\phi$ 50 mm OD $\times$ 3 mm WT Flat Position (1F).....	281
<b>7.</b>	<b>PLASMA ARC CUTTING AND RESISTANCE WELDING.....</b>	<b>287–298</b>
Exercise 1	: Plasma Straight Cutting on Ferrous and Non-Ferrous Metals .....	287
Exercise 2	: Lap Joint on Stainless Steel by Resistance Spot Welding.....	291
Exercise 3	: Lap Joint on M.S. Resistance Spot Welding.....	295
<b>8.</b>	<b>REPAIR AND MAINTENANCE .....</b>	<b>299–321</b>
Exercise 1	: Square Butt Joint on Copper Sheet 2 mm Thick in Flat Position (1G).....	299
Exercise 2	: 'T' Joint on Copper to M.S. Sheet 2 mm Thick in Flat Position by Brazing (1F).....	301
Exercise 3	: Silver Brazing on S.S. Sheet with Copper Sheet 'T' Joint.....	303
Exercise 4	: Silver Brazing on Copper Tube to Tube .....	307
Exercise 5	: Bronze Welding of Cast Iron Single 'V' Butt Joint on Cast Iron Plate 6 mm Thick .....	310
Exercise 6	: SMAW Welding of Cast Iron Plate 6 mm Thick in Flat Position .....	312
Exercise 7	: Hard Facing Practice on MS Round $\phi$ 25 mm by Using Hard Facing Electrodes in Flat Position .....	314
Exercise 8	: Repairing a Broken Cast Iron Part .....	317
	<b>PRACTICAL JOBS FOR PRACTICE .....</b>	<b>322–352</b>
	<b>Compilation of Practical Jobs for Practice—1 to 61.....</b>	<b>322–347</b>
Exercise 1	: Write the working steps of fillet weld in lap joint on M.S. plates in overhead welding position by arc welding, as shown in Fig.....	347
Exercise 2	: Write the working steps for single 'V' butt joint by arc welding process for the job shown in Fig. ....	348
Exercise 3	: Write the working steps for a square butt joint in flat position by oxy-acetylene welding process for the job shown in Fig. ....	348
Exercise 4	: Write the working steps for tee joint as shown in Fig. in flat position by electric arc welding process. ....	349
Exercise 5	: Write the working steps for open corner joint as shown in Fig. in flat position by electric arc welding process. ....	350
Exercise 6	: Write the working steps for butt welding of aluminium sheets as shown in Fig. by gas welding process..	351
Exercise 7	: Write the working steps for butt welding of M.S. pipes as shown in Fig. in fixed position by gas welding process. ....	351
Exercise 8	: Write job sequence for arc welding for butt weld single 'V' butt joint MS plate 10 mm position overhead as per drawing.....	352