

## WELDING INSPECTOR'S KNOWLEDGE & COMPETENCY REQUIREMENTS

SI No	SUBJECTS	BASIC LEVEL	STD. LEVEL	ADV. LEVEL
1	<b>Role &amp; responsibilities of a Welding Inspector</b>			
	<ul style="list-style-type: none"> <li>• Preparation and reviewing of controlling documents e.g. QAP, ITP</li> </ul>			X
	<ul style="list-style-type: none"> <li>• Review, comment and witnessing of welding procedure and performance qualification</li> </ul>		X	X
	<ul style="list-style-type: none"> <li>• Verification of calibration of equipments and instruments</li> </ul>	X	X	X
	<ul style="list-style-type: none"> <li>• Witnessing of NDT inspection activities</li> </ul>	X	X	X
	<ul style="list-style-type: none"> <li>• Verification of all stage inspection activities during fabrication</li> </ul>	X	X	X
	<ul style="list-style-type: none"> <li>• Review of NDT inspection reports and activities</li> </ul>		X	X
	<ul style="list-style-type: none"> <li>• Verification of NDE and welder's qualification &amp; certification records</li> </ul>		X	X
	<ul style="list-style-type: none"> <li>• Interacting with other departments to ensure fabricated components</li> </ul>			X
2	<b>Welding Inspectors Check List</b>			
	<ul style="list-style-type: none"> <li>• Inspection documents and reports to be prepared reviewed and approved by the Welding Inspector during various stage of fabrication, in line with approved QAP / ITP such as WIE, LPT report, Raw Material Inspection report, WPS, PQR, WPQ, Pneumatic Test report etc.</li> </ul>		X	X
3	<b>Quality Assurance of welds</b>			
	<ul style="list-style-type: none"> <li>• Elements of QMS and definition</li> </ul>	X	X	X
	<ul style="list-style-type: none"> <li>• ISO: 3834</li> </ul>		X	X
	<ul style="list-style-type: none"> <li>• Quality Assurance plan – Preparation &amp; Review</li> </ul>		X	X
4	<b>Raw materials control and traceability + Welding Consumables</b>			
	<ul style="list-style-type: none"> <li>• Relevant product forms e.g. plate, pipe, forgings and castings and their relevant ASTM standards for CS, SS, Al &amp; Ni alloys.</li> </ul>	X	X	X
	<ul style="list-style-type: none"> <li>• MSTP ( Material sampling and Test plan )</li> </ul>	X	X	X
	<ul style="list-style-type: none"> <li>• Welding Consumables selection and Testing</li> </ul>	X	X	X
	<ul style="list-style-type: none"> <li>• Material Traceability mechanisms</li> </ul>	X	X	X
	<ul style="list-style-type: none"> <li>• Material storage - PMI</li> </ul>	X	X	X
5	<b>Metallurgy and Weldability of Steels</b>			
	<ul style="list-style-type: none"> <li>• Phases in steel, Fe – C &amp; CCT diagrams</li> </ul>	X	X	X
	<ul style="list-style-type: none"> <li>• Hardenability and Weldability of steels</li> </ul>	X	X	X
	<ul style="list-style-type: none"> <li>• Carbon – Manganese steels and concept of C.E.</li> </ul>		X	X
	<ul style="list-style-type: none"> <li>• Low alloy steels for low temperature, high temperature and high tensile service and their weldability</li> </ul>			X
	<ul style="list-style-type: none"> <li>• Austenitic, Ferritic, Martensitic and Duplex Stainless Steels and their weldability</li> </ul>			X

6	<b>Metallurgy and Weldability of Non-ferrous metals and alloys</b>			
	• Aluminium and Al alloys			X
	• Nickel and Ni alloys			X
7	<b>Welding &amp; Cutting Processes</b>			
	• Oxy-fuel, Plasma and Laser cutting processes	X	X	X
	• Water – jet and abrasive cutting		X	X
	• SMAW, GMAW, FCAW, GTAW & SAW processes	X	X	X
	• Resistance welding processes	X	X	X
	• Arc welding power sources – Transformer, generator, thyristor & invertors	X	X	X
	• Selection of power sources, AC/ DC, importance of polarity	X	X	X
	• Advanced welding and Brazing processes		X	X
	• Introduction to welding automation		X	X
8	<b>Dissimilar Welding, Repair Welding and PWHT</b>			
	• Problems in dissimilar welding		X	X
	• Selection of consumables in dissimilar welding	X	X	X
	• PWHT – Temperature, soaking time, heating & cooling rate, uniformity of temperature		X	X
	• Calibration of furnace, thermo-couples and recorders		X	X
	• Stress relieving and solution annealing		X	X
	• Surfacing & Repair welding – preparation of work piece for repair, WPS for repair.		X	X
9	<b>Weld defects including distortion in welds</b>			
	• Classification of weld defects	X	X	X
	• Process related and metallurgy related defects	X	X	X
	• Causes and remedies		X	X
	• Distortion and residual stress control during design and during & after fabrication		X	X
10	<b>Quality levels for welds and Weld Quality Standards</b>			
	• ISO: 6520-1 – Classification and definition of weld defects	X	X	X
	• ISO: 5817 Quality levels for Arc welded joints in steel	X	X	X
	• Relevant API and AWS standards			
11	<b>Welding Joints, Symbols and Positions</b>			
	• Weld joints and welding symbols	X	X	X
	• Welding positions as per AWS & ISO	X	X	X
12	<b>Codes &amp; Standards</b>			
	• Need for codes and standards	X	X	X
	• Difference between code, standard, specification and procedure	X	X	X
	• Construction codes – ASME, ISO	X	X	X
	• Welding Codes – ASME Sec IX, ISO: 15609, ISO: 15614, ISO: 9606 – 1 etc	X	X	X

13	<b>Welding Qualification – Procedure and Performance</b>			
	• Consumables qualification		X	X
	• Welding Procedure Specification		X	X
	• Essential, non-essential & Special essential variables		X	X
	• Formats – WPS, PQR & WPQ		X	X
	• Qualification ranges		X	X
	• Destructive & non-destructive testing of samples.		X	X
14	<b>Metrology</b>			
	• Nomenclature of butt and fillet welds	X	X	X
	• Measurement of butt and fillet welds	X	X	X
	• Weld Inspection Tools – Weld inspection gauges, fillet gauges	X	X	X
	• Techniques for measurement of distortion	X	X	X
15	<b>Introduction to NDT of Welds</b>			
	• What is NDT and need for NDT	X	X	X
	• Classification of NDT techniques	X	X	X
	• Different NDT modalities and applications	X	X	X
16	<b>Visual Inspection Theory</b>			
	• Basic visual inspection	X	X	X
	• Visual inspection aids	X	X	X
	• VI report format	X	X	X
	• Codes and standards for Visual inspection	X	X	X
17	<b>LPT &amp; MPT Theory</b>			
	• Basic and principles of LPT and MT		X	X
	• Equipment and classification		X	X
	• Report formats		X	X
	• Limitations and advantages		X	X
	• Sensitivity		X	X
	• Codes and standards		X	X
18	<b>RT Theory</b>			
	• Basics and principles		X	X
	• Equipment & sources		X	X
	• Film		X	X
	• Radiographic techniques		X	X
	• Radiographic quality – IQI and density		X	X
	• Advances in radiography – DR, CR & M focal		X	X
	• Codes and standards		X	X
	• Advantages and limitations		X	X
19	<b>RT Film interpretation</b>			
	• Viewing radiographic films with different defects			X
	• Identification of different defects			X
	• Demonstration of density			X

	• Selection of IQI			X
	• Artefacts			X
20	<b>UT Theory</b>			
	• Basics and principles		X	X
	• Equipments, transducers and couplants		X	X
	• Normal and angle beam inspection		X	X
	• Factors affecting POD – Beam skewing		X	X
	• Sizing of discontinuities		X	X
	• Advantages and limitations		X	X
	• Codes and standards		X	X
	• UT report formats		X	X
21	<b>Destructive Testing of Welds</b>			
	• Tensile Testing – Longitudinal and Transverse		X	X
	• Bend Tests – Root, Face & Side		X	X
	• Impact Testing – Room Temp and Low Temp		X	X
	• Fillet Test – Macro & Fracture		X	X
	• Relevant standards – Location , orientation and acceptance criteria		X	X
22	<b>Hazards and Safety in Welding</b>			
	• Hazards in welding and cutting	X	X	X
	• Electrical and arc related hazards	X	X	X
	• Gas and gas cylinder and pipeline related hazards	X	X	X
	• PPEs	X	X	X
	• Shading of viewing glasses including auto-darkening helmets	X	X	X
	• Ventilation	X	X	X
	• Safety standards in welding eg. Z49.1	X	X	X
	<b>Recommended Training hours</b> (including practical demo of welding processes, RT and Destructive Testing and visit to Fabrication unit.)	96 hrs min	48 hrs min	48 hrs min

'X' means applicable for the corresponding level.