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Appendix 26

Inspection and Tests

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1. GENERAL

The quality control, inspection and testing for the equipment and materials shall be performed during manufacturing in accordance with CONTRACT and CONTRACTOR shall submit the inspection and Test Program and Quality plan to EMPLOYER in his own proposal for EMPLOYER's approval.

2. INSPECTION PROCEDURE

CONTRACTOR shall prepare a detailed inspection and testing plan for all EPC Phases such as vendor selection, procurement, Release note, Transportation, construction, Erection, pre-commissioning& commissioning, Operation, guarantee period which will be subject to approval by EMPLOYER.

The CONTRACTOR shall be responsible for arranging and coordinating the use of a Third-Party Inspection and Independent Inspection Agency (IIA) for third party inspection, verification and certification of materials and equipment required for the WORK. The IIA shall be subject to EMPLOYER approval.

The Inspection procedure covers inspection in CONTRACTOR'S / Vendor's works. Field inspection shall be additionally required.

- Full inspection shall be required for every item, with the sole exception that for proven vendors Approved by EMPLOYER, CONTRACTOR may reduce the percentage of inspection of equipment and materials as given in part II of this procedure. This issue must be confirmed by EMPLOYER.
- Regardless of this procedure all purchase orders shall include a statement that the equipment and materials are subject to inspection by CONTRACTOR and/or by EMPLOYER. Vendors shall not be advised of waiving of inspection until the materials are ready. However, for waiver of complete or part of the inspection, shall be taken by CONTRACTOR case by case for each applicable purchase order or equipment.

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- Inspection percentages herein are related to the quantity (number off) of the item of equipment concerned and are not intended to indicate the equipment.
- Where 100% inspection is called for against particular series, it means that all equipment and materials in the series shall be inspected. Where 10% is called for (e.g.) small electrical motors, thermo wells) it means that 10% of the quantity ordered on each vendor shall be fully inspected.
- The CONTRACTOR shall establish document and maintain an effective Quality Assurance System as outlined in recognized codes such as ISO 9000 series, B.S. 5750, ASME Volume VIII Div. I, API, TEMA, Canadian Standard Z-299 and Quality Assurance Plans included in Standard Specifications etc. To ensure that the work is performed in a planned, systematic manner to the best quality standards and properly documented to provide confidence that equipment supplied and/or work executed and services performed by him conform to the applicable specifications and all the requirements of CONTRACT and work executed by him shall perform satisfactorily over the entire period of its life.

Quality Assurance

Quality Assurance Systems-plans/procedures of the CONTRACTOR shall generally cover the following aspects/details, which shall be furnished by CONTRACTOR before start of WORK.

- A quality Assurance Organization with curriculum vitae of key personnel responsible for the quality assurance.
- Complete details pertaining to the responsibility authority and accountability of the quality assurance personnel.
- Design, engineering, procurement, supply, supervision of erection/ installation, testing and commissioning, control plans for quality including selection procedures for

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suppliers/sub-CONTRACTORS, procedures for shop testing/inspection at manufacturer's works for inspection and control at forwarding, handling, loading, unloading, shopping, transporting of all materials/equipment/plants etc. including packing etc. and inspection of materials on receipt at ports, godowns, works etc. procedures and controls regarding segregation of rejected material and disposal thereof and storage, preservation and safe custody of accepted good materials and further processing thereof.

- Quality control of process such as welding, heat treatment, nondestructive tests etc.
- Control procedures/plans for calibration and safe upkeep of instruments, gauges and similar testing equipment etc. f) Quality audit & maintenance records/procedure etc.
- Other relevant details.

Quality Assurance System-plans/procedures of CONTRACTOR shall be furnished in the form of a QA manual. CONTRACTOR shall be required to provide explanation pertaining to the details furnished by him in accordance with provisions contained in this clause any further details.

3. In addition, all the quality Assurance programs/plans as per specifications of the CONTRACT, shall be fully complied with by the CONTRACTOR.

4. In respect of any special inspection, testing and/or witnessing required by the CONTRACT, laws, ordinances, or any public authority for any equipment to be inspected, tested, witnessed or approved prior to delivery.

2.1. EXTENT OF INSPECTION FOR VESSELS AND STORAGE TANKS

2.1.1. Drums and Pressure Vessels

100 % inspection.

2.1.2. Storage Tanks including silos, hoppers, bines

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100 % inspection.

2.1.3. Process Driers

100 % inspection.

2.1.4. Cyclones

100% inspection

2.2. EXTENT OF INSPECTION FOR MECHANICAL EQUIPMENT

2.2.1. Pumps and Drivers

- Witnessing of hydraulic tests on pump casings.
- Witness running and strip inspection tests for all pumps and NPSH test when difference between NPSH available and NPSH required is less than or equal to one meter.
- Final inspection for all pumps.
- 100 % inspection and witnessing of tests on electric motor drivers of 175 kW and larger.
- 10 % final inspection, and witnessing of tests on electric motor drivers of below 175 kW.
- 100 % inspection and witnessing of running tests on steam turbine drivers of 175 kW and larger.
- Final inspection and dimensional check only on steam turbine drivers of below 175 kW.
- 100% inspection and witnessing of performance and sound level test.

2.2.2. Compressors and Drivers

- 100% inspection of all types of compressors and gears.

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- Extent of inspection of drivers shall be same as for pump drivers in 4.1 above.
- 100% inspection and witnessing of performance and sound level test.

2.2.3. Filters

100% inspection

2.2.4. Product Finishing and Packaging Equipment

100% inspection

2.2.5. Mixers and Agitators

100% inspection

2.2.6. Injector

100% Inspection

2.2.7. Other Mechanical EQUIPMENT

Extent of inspection shall be agreed with EMPLOYER

2.3. EXTENT OF INSPECTION FOR CIVIL & STRUCTURAL STEEL

2.3.1. Structural steel

10% inspection of steel for structures, tower platform, other platforms and steel yard supports.

2.3.2. Buildings Anchor bolts, grating, checkered plate (if any)

10% inspection of steel frames,

2.3.3. Other Civil Requisitions

Extent of inspection shall be as per project specifications.

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2.4. EXTENT OF INSPECTION FOR PIPING

2.4.1. Valves (excluding control valves) / Slide Valve

- 10% inspection of cast or forged carbon steel valves for cold services and all valves of 900 series and above. Hydraulic and air tests on body and seat shall not be witnessed.
- 10% inspection of cast or forged carbon steel valves for other services.
- 10% inspection of alloy steel valves. Hydraulic and 2 air tests on body and seat shall not be witnessed.
- 100% inspection of alloy valves 12 and above.
- 10% inspection of other cast iron, brass, aluminum, other non-ferrous or non-metallic valves in this section.
- 10% inspection of chain wheels, guides, extension stems, floor stand etc.

2.4.2. Carbon Steel shop Fabricated Piping inspection

100 % inspection

2.4.3. Shop Fabricated other than Carbon Steel Piping inspection.

100 % inspection

2.4.4. Random Pipes

- 100 % inspection of stainless steel, alloy steel or other alloy pipe.
- 100 % inspection of carbon steel pipe for cold service.
- 10 % inspection of other carbon steel, cast iron, brass, copper, aluminium, other non-ferrous or non-metallic pipes and tubing.
- 100 % inspection of glass lined, rubber lined and lead lined pipes.

2.4.5. Fitting

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- 100% inspection of stainless steel, or other alloy fittings.
- 100% Inspection of carbon steel fittings for cold services
- 10% inspection of other carbon steel, cast iron. Brass, copper, aluminum, other non-ferrous or non-metallic fittings.
- 100% inspection of glass lined, rubber lined and lead lined fittings.

2.4.6. Flanges

- 100% Inspection of stainless steel, alloy steel or other alloy flanges.
- 100% Inspection of carbon steel flanges for cold service.

2.4.7. Bolts, Studs and Gaskets

10% inspection.

2.4.8. Underground pipes

- 100% inspection 10" and above.
- 10% inspection for smaller sizes.

2.4.9. Piping specialties

- 100% inspection of steam traps.
- 10% inspection of strainers, filters or separators except in the case of special large.

2.4.10. Pipeline filters, or where bodies are fabricated or are of alloy steel.

- 10% inspection of drip rings blinds.
- Inspection of variable and constant spring type pipe hangers/supports.

2.4.11. Expansion Joints

100% Inspection

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2.5. EXTENT OF INSPECTION FOR INSTRUMENTS

2.5.1. Instruments

- 10% inspection of temperature, flow, level or pressure indicators.
- 100% Inspection of temperature, flow, level and pressure controllers and recorders
- 100% Inspection of analyzers.
- 10% inspection of thermo wells and orifice flanges.
- 10% inspection of howlers or air-sets.

2.5.2. Control Valves

- Inspection of temperature, flow, level, and pressure control valves.
- Inspection of hand control valves.
- Inspection of motor operated valves, slide valves and solenoid operated valves.

2.5.3. Safety Relief Valves

100% inspection.

2.5.4. Panel boards

100% inspection.

2.5.5. Instrument piping

- Inspection of alloy steel pipes, valves and fittings, except compression type fittings which shall not be inspected.
- Inspection of carbon steel pipes and fittings, bolts or gaskets, or valves.

2.5.6. Electrical Distribution for Instruments (cables, Junction boxes, fuses etc.)

10% inspection.

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2.5.7. Weather protection Materials

10% inspection.

2.5.8. Supports and Racks

10% inspection.

2.5.9. Instrument Air Dryers Inspection of instrument air dryers

100% inspection.

2.5.10. Other Instrument Requisitions

Extent of inspection of other materials to be agreed with EMPLOYER

2.5.11. Control System (DCS, PLC, F&G, ...)

100% Inspection

2.6. EXTENT OF INSPECTION FOR ELECTRICAL EQUIPMENT/WORKS

2.6.1. Underground

10% inspection.

2.6.2. Power Equipment

- 100% Inspection of electrical generators
- 100% Inspection of switchgears
- 100% Inspection of all capacities of transformers
- 100% Inspection of motor control centers (MCCS)
- 100% Inspection of power control centers (PCCS)
- 100% Inspection of turn-around power centers
- 10% inspection of relays

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- 100 % inspection of DC / AC UPS.
- 100% inspection of VFD panels.

2.6.3. Power Distribution (above ground)

10% inspection.

2.6.4. Lighting

10% inspection.

2.6.5. Communication

10% inspection.

2.6.6. Supports and Racks

10% inspection.

2.6.7. Other Electrical Equipment

Extent of inspection for other electrical EQUIPMENT such as cathodic protection, Earthing, Battery charger, Arrester, cables, telecommunication system etc. to be agreed with EMPLOYER

2.7. EXTENT OF INSPECTION FOR PROTECTIVE COVER

(According to CONTRACTOR'S procedures.)

- Pipe Insulation Materials Inspection as agreed.
- Equipment Insulation Materials Inspection as agreed.
- Paint Inspection as agreed.
- Fireproofing Materials Inspection as agreed.
- Steam Tracing Materials Inspection as agreed.

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- Electrical Tracing Materials Inspection as agreed.
- Other protective Cover Materials Inspection as agreed.

2.8. EXTENT OF INSPECTION FOR MISCELLANEOUS EQUIPMENT

2.8.1. Package Process Units

100% Inspection

2.8.2. Catalysts and Chemicals

100% Inspection.

2.8.3. Maintenance Warehouse and Laboratory Equipment

Extent of inspection as agreed with EMPLOYER.

2.8.4. Fire Protection Equipment

Extent of inspection as agreed with EMPLOYER

2.8.5. Spare Parts

Extent of inspection as agreed with EMPLOYER.

3. MATERIAL CERTIFICATE

Material shall be verified by material manufacturers in accordance with the related standards.
Material certificates and / or mill sheet shall be reviewed.

4. INSPECTION AND TESTS

4.1. VISUAL AND DIMENSIONAL INSPECTION

Visual inspection shall be carried out to check the following items on normal condition.

- The compliance with the drawings and specifications.

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- The workmanship of surface finish, shape and others.

Dimensional Inspection shall be carried out on component of equipment in accordance with the drawings as follows:

- Major dimension such as overall length, width, height and others.
- The pitch of foundation bolt holes.
- Other dimensions and clearances as may be necessary.

4.2. PARTIAL ASSEMBLY OR ASSEMBLY INSPECTION

For the partially or completely assembled equipment in the shop, the assembly inspection shall be carried out on the appearance, dimension, etc.

4.3. NO LOAD TEST

For main machinery and equipment which have the sliding or rotating parts, the no-load running test shall be carried out by using temporary or job motor. During this test, the voltage, amperage, sound, vibration and temperature of bearings shall be checked.

4.4. FUNCTION TEST AT SHOP

The functional test shall be carried out on the rotating machines such as fan, pump, compressor, etc. to confirm that such items as capacity, speed, pressure, etc. meet the specified values and also to check the mechanical conditions such as vibration, bearing temperature, sound, etc.

4.5. NON-DESTRUCTIVE TEST (NDT)

The following test shall be carried out based on the related standards.

- Dye penetration Test (PT)
- Magna-flux Test (MT)
- Ultrasonic Test (UT)

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- Radiographic Test (RT)

4.6. PRESSURE TEST (HYDROSTATIC TEST/PNEUMATIC TEST)

Pressure test shall be carried out in accordance with the specification.

4.7. 10. PAINTING AND SANDBLAST INSPECTION

Painting and Sand blast inspection shall be carried out in regard to the following:

- Surface preparation
- Average Dry Film Thickness after each painting
- Painting colour
- Appearance

4.8. FINAL VISUAL INSPECTION BEFORE PACKING

- The following check shall be carried out.
- Visual check
- Check on rust prevention.
- Quantity check.

4.9. PACKING AND MARKING INSPECTION BEFORE SHIPPING

Packing inspection shall be performed in regard to the packing style, quantities and tag numbers in accordance with the packing list.

4.10. MECHANICAL TESTS, CHEMICAL ANALYSIS AND HEAT TREATMENT

Test pieces shall be branded in the presence of the CONTRACTOR and EMPLOYER or their inspectors and for important welding, forgings and castings the position of the pieces shall be to approval. Where heat treatment is necessary the test piece shall not be removed before the

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treatment is carried out.

4.11. INSPECTION AND TEST CLASSIFICATION AND ABBRIVATIONTABLE AT SHOP

The CONTRACTOR shall exactly study the attached sample inspection and test classification table (table 15-1, 16-1) and propose its own inspection and tests table appropriate to each equipment and/or material.

For Equipment which is provided or supplied by Vendors, The Vendor Inspection plan is acceptable to be verified by CONTRACTOR and Extent of inspection should be agreed with EMPLOYER.

4.12. EXPLANATION OF THE MARKS IN THE ATTACHED TABLE:

Mark in the column of SCOPE OF WITNESS means the following: Mark Meaning

M: Sub-CONTRACTOR's/ manufacturers own inspection and/or test.

K: Inspection and/or test carried out by the CONTRACTOR/Sub-CONTRACTOR under witness of the CONTRACTOR's inspectors.

O: Inspection and/or test carried out by the CONTRACTOR/Sub-CONTRACTOR under witness of EMPLOYER's inspectors.

Mark in the column of REPORT/CERTIFICATE TO BE SUBMITTED means the following:

Mark Meaning

R: The CONTRACTOR shall submit the report/certificate to EMPLOYER.

X: The CONTRACTOR shall not submit the report/certificate to EMPLOYER.

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5. TABLE FOR MECHANICAL EQUIPMENT

Mechanical Equipment

INSPECTION and TEST ITEM	OBJECT to be INSPECTION	SCOPE of WITNESS	REPORT to be SUBMITTED
Material Certificate for All Components		M	R
Visual Inspection for All Components		K	R
Dimensional Inspection for Major Components		O	R
Partial Assembly Inspection for All Components		O	R
No-Load Test		O	R
Function Test at Shop		O	R
Non-Destructive Test (NDT)		O	R
Pressure Test		O	R
Other Tests		Depends on Type of Equipment	R
Painting Inspection		O	R
Final Visual Inspection		O	R
Packing Inspection Before Shipping		O	R

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6. TABLE FOR ELECTRICAL, INSTRUMENT AND CONTROL EQUIPMENT

Electrical, Instrument and Control Equipment

INSPECTION and TEST ITEM	OBJECT to be INSPECTION	SCOPE of WITNESS	REPORT to be SUBMITTED
Visual Inspection		M	R
Dimensional Inspection		K	R
Insulation Resistance Test		O	R
Power Frequency Voltage Test		O	R
Resistance Measurement		O	R
Polarity Test		O	R
Induced Potential Test		O	R
Operation (Sequence) Test		O	R
Efficiency Test		O	R
No-Load Loss at Rated Voltage		O	R
Standard Function Test		O	R
Other Tests		Depends on Type of Equipment	

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