MINISTRY OF DEFENCE (DGQA)

STANDARD QUALITY ASSURANCE PLAN

HP AIR COMPRESSORS

AIR COMPRESSOR SERVES TO COMPRESS AIR FROM LOW PRESSURE TO THE DESIRED HIGH PRESSURE. AIR COMPRESSORS DELIVERING COMPRESSED AIR ABOVE 30 BARS ARE CONSIDERED AS HIGH-PRESSURE AIR COMPRESSOR.

STANDARD QAP NO. DGQA/DQA (WP)/HPAC/21/2020/REV 0
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ISSUING AUTHORITY

DIRECTORATE OF QUALITY ASSURANCE (WARSHIP PROJECT)
MINISTRY OF DEFENCE (DGQA)
'H' BLOCK, NIRMAN BHAWAN P.O.
NEW DELHI - 110 011

RECORD OF AMENDMENTS

Sl. No.	Date of Amendment	Amendments	Authority	Remarks

MINISTRY OF DEFENCE (DGQA)

STANDARD QUALITY ASSURANCE PLAN (SQAP) FOR HP AIR COMPRESSORS

SQAP NO. DGQA/DQA (WP)/HPAC/21/2020/REV 0

(A GEORGE)
REAR ADMIRAL
ADGQA(WP)

Promulgated by

DIRECTORATE OF QUALITY ASSURANCE (WARSHIP PROJECT)
MINISTRY OF DEFENCE (DGQA)
'H' BLOCK, NIRMAN BHAWAN PO
NEW DELHI - 110 011

CONDITION OF RELEASE

1. This Standard Quality Assurance Plan (SQAP) has been formulated for reference of the Order Placement Agencies, Inspection Authority, Inspection Agencies and the Industry. No alteration is to be made to this SQAP except by the issue of authorised amendment by DQA (WP).

2. It is to be applied, as required, for Quality Assurance during various stages of manufacture of HP Air Compressors (HPAC) for *IN* Ships.

3. The website ***htpp://www.dgqadefence.gov.in*** may also be referred for other Quality Assurance related inputs.

4. The SQAP has been prepared on the basis of decisions made during the collegiate meeting held at DQA(WP) with leading manufacturers of HPAC and representatives of Professional Directorates and Production Directorates of the *IN*. Any user of this Standard QAP within DGQA/ *IN* or in industry may propose an amendment to it with valid justification. Proposals not applicable to particular contract can be sent directly to DQA (WP), New Delhi, and those directly applicable to a particular contract are to be dealt with using contract procedures.

5. The specifications and standards laid out in the SQAP are indicative only. The specifications/ parameters and standards given in the Statement of Technical Requirement (SOTR) / Technical Specifications (TSP) / MoM of TNC / Approved drawings will be final and binding.

6. DQA(WP) reserves the right to amend or modify the contents of this SQAP without consulting or informing any holder of this document.

7. In case the SQAP is incorporated into contracts, users are responsible for their correct application while complying with contractual and other statutory requirements. Compliance with SQAP does not of itself confer immunity from legal obligations.

8. Enquiries in connection to these requirements may be made from:

Directorate of Quality Assurance (Warship Projects)
Ministry of Defence
'H' Block, Nirman Bhawan P.O
New Delhi - 110 011

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STANDARDS INVOKED

SL. NO.	SPECIFICATION	DESCRIPTION
1	AISI SS 316	Specification for steel material.
2	ASME Sec II Part A	Ferrous material specifications
3	ASME Sec II Part B	Non-ferrous material specifications
4	ASME Sec V	Non-destructive examination
5	ASME Sec VIII	Rules for construction of pressure vessels
6	ASME Sec IX	Qualification Standard for welding, brazing & fusing procedures
7	ASTM A 148	Std specs for steel castings, high strength for structural purposes
8	ASTM A 216	Std specs for steel castings suitable for fusion welding
9	ASTM A 217	Std specs for steel castings Martensitic Stainless & Alloy for pressure containing parts
10	ASTM A 609	Std practice for performing pulse-echo ultrasonic examination
11	ASTM A 743	Standard specification for castings, Iron-Chromium, Iron-Chromium-Nickle, corrosion resistant for general application
12	ASTM E 125	Std reference photographs for MPI in ferrous castings
13	ASTM E 165	Standard practice for liquid penetrant examination
14	ASTM E 186	RT for heavy walled steel castings
15	ASTM E 272	RT for Copper based and Nickle Copper Alloy castings
16	ASTM E 446	RT for steel castings up to 2-inch thickness
17	ASTM E 1032	Std test method for radiographic examination of weldments
18	ASTM E 1320	Standard reference radiographs for Titanium casting
19	BS 1400	Copper alloy ingots and copper alloy and high conductivity copper castings
20	BS 2871: Part 2	Copper & Copper alloy tubes
21	BR 3013(2)	Pipes/ fittings
22	BR 3021	*IN* Shock Manual
23	BS 4670	Specification for alloy steel forging
24	Def Stan 02-477	Flexible hoses
25	Def Stan 02-797 Part-4	Carbon steel fittings / Pipe work engineering
26	Def Stan 604	Selection of electrical indication instruments
27	DGS 251	Painting

28	EN 10250-2	Open die steel forging
29	IS 2062	Hot medium & high tensile structural steel
30	IS: 5456-1985	Testing of Positive displacement type Air Compressors and Exhausters
31	ISO 2372	Specification for vibration test.
32	MEPC 107(49)	IMP MARPOL resolution
33	MIL-STD-1474D	Design criteria standard, noise limits
34	MIL-STD-167-1	Mechanical vibrations of shipboard equipment
35		
36	MIL-STD-740-2	SBN measurement & acceptance criteria of shipboard equipment
37	NSS I/ II	Requirements for high impact shock tests based on IN Shock Policy, Shipboard Machinery Equipment and systems.
38	NES 313	Diesel Engine for Marine Propulsion and auxiliary machinery.
39	NES 314	Compressed Air system
40	NES 315	HP Air Compressors
41	NES 316	Compressed Air Purification Equipment (Air drier)
42	NES 360	Valves
43	NES 362	Testing of Equipment & Assemblies after manufacture
44	NES 375	Valve design & manufacture
45	NES 507/737/1005	Painting
46	NES-723	Tally & Diagram plates
47	SA 105	Specification for Carbon Steel Forging

Note:- The Standards given are indicative only. The specifications / parameters given in the SOTR / Technical Specifications (TSP) / MoM of TNC / Approved drawings will be final and binding

SPECIFIC REQUIREMENTS

1. Testing of physical and chemical properties has to be done by NABL accredited laboratory only (including firm's NABL accredited laboratory).

2. All castings are to be subjected to RT and/ or UT, as applicable, to qualify the same in accordance with the approved *class* of casting, unless otherwise specified in P.O. & SOTR / TSP. The extent of RT will be as per the approved drawing. The *class* of casting is to be invariably mentioned in the drawing/ DBOM.

3. All forgings are to undergo UT for soundness and integrity checks.

4. Tubes/ pipes shall be subjected to Eddy Current test unless exempted in PO/ TEC.

5. Shooting sketch indicating critical test zones and test zones are to be submitted prior to testing.

6. NDT procedure to be approved by ASNT/ ISNT Level III qualified person based on standards and acceptance criteria specified in SOTR / TSP / applicable standards and performed by ASNT/ ISNT Level II / Level III qualified person.

7. Make of the Items should be as per approved PIL / Detailed Bill of Material (DBOM) or *IN* approved sources.

8. The outsourced components in the SQAP are indicative only. OEM is to categorize the outsourced components, specific to their product, in the QAP as per the approved DBOM / Drawings and in accordance with Chapter-5 of QAD-01 R01.

9. Imported items will be accepted against following import documents as per DQA(N) letter No. 66301/Policy/DQA(N)/SG dated 14 Nov 17: -

(a) Copy of one among Bill of Lading/ Shipping Bill/ Airway Bill.
(b) Invoice by OEM or Country of Origin certificate of equipment with packing list.
(c) Bill of Entry for Warehousing.
(d) The certificate of Conformity (CoC) indicating governing specifications and values to which the items are tested along with OEM Test Certificates/ Test Reports/ Catalogue/ Data Sheet.
(e) Guarantee/ Warrantee certificate from the supplier/ OEM as per supply order.

10. ESS test (Thermal Cyling, Random Vibration and Burn in / Endurance) as per DQA(N) policy vide letters 66301/Policy-07/DQA(N)/QA-07 dated 09 Aug 16.

11. Ingress protection testing will be as per applicable IP rating.

12. TT, EMI / EMC Test and ET will be done at Government/PSU test centers or NABL accredited labs. EMI/EMC Acceptance Test Plan is to be duly vetted by NEC Mumbai.

13. If TT, EMI/EMC and ET have already been done in earlier projects on identical units, it will not be done again & the reports of earlier tested units will have to be provided for review of Inspection Agency.

14. Conformal coating of PCBs to be done as per DQA(N) policy letter 580930/DQA(N)/EL dated 17 Feb 14.

15. Bought-out items will be subjected to normal QA inspections as per QAP.

16. Since the HPAC is to be subjected to FATs, the draft Operating Instructions, Technical Documentation and firm's in-house test report is to be made available prior to raising request for conduct of the same.

17. Items/ components classified as Bought-out/ COTS is indicative only. In this regard, the approved GA drawing and DBOM shall be final binding.

18. Post promulgation of this SQAP, separate QAP approval for HP Air Compressors is not required. The manufacturer shall be required to submit confirmation to concerned QA Agency and/ or OPA, towards acceptance of SQAP either in totality or with some design specific inclusions and/or exclusions w.r.t. SQAP, if any. The SQAP along with proposed inclusions/ exclusions approved by DQA(WP) shall be deemed as the approved QAP for the particular PO.

ABBREVIATIONS

ABN	Air Borne Noise
ASNT	American Society of Non-destructive Testing
CHP	Customer Hold Point
CoC	Certificate of Conformance
DBOM	Detailed Bill of Material
DI	Dimensional Inspection
DPT	Dye Penetrant Test
EMC	Electro Magnetic Conduction
EMI	Electro Magnetic Induction
ESS	Environment Stress Screening
ET	Environmental Testing
FATs	Factory Acceptance Trials
IFATs	Integrated Factory Acceptance Trials
IR	Inspection Report
ISNT	Indian Society of Non-destructive Testing
LTC	Lab Test Certificate
MPT	Magnetic Particle Test
MTC	Material Test Certificate
NABL	National Accreditation Board for Testing and Calibration Laboratories
NDT	Non-destructive Testing
OEM	Original Equipment Manufacturer
P	Perform
PQR	Procedure Qualification Record
QA	Quality Assurance
QAP	Quality Assurance PLAN
R	Review
SBN	Structure Borne Noise
SOTR	Statement of Technical Requirement
STC	Supplier Test Certificate
TC	Test Certificate
TNC	Technical Negotiation Committee
TSP	Technical Specifications
TT	Type Test
V	Verification
VI	Visual Inspection
VME	Versa Module Europa
W	Witness
WPQ	Welder Performance Qualification
WPS	Welding Procedure Specification

SCOPE

Scope of Quality Assurance. The scope of QA includes witness / review at all stages of manufacturing viz., raw material stage, in-process stage and final stage. The scope also covers witness / review of Type Testing, wherever applicable.

The SQAP contains comprehensive list of inspections and/or trials that are applicable for QA of the equipment. In addition, QA of the equipment will also be governed by specific conditions laid down in SOTRs and 'Approved Drawings'. The inspections/ tests / trials must be contemporary to latest technology/ techniques available in the industry at the time of placement of purchase order.

The following QA activities will be carried out for the HPAC: -

(a) Visual Inspection.

(b) Dimensional Inspection.

(c) Witness of pouring in absence of integral test bar.

(d) Review of Lab Test Certificates.

(e) Witness of in-house Lab Testing, if applicable.

(f) Witness of Non-destructive Testing viz. UT, DPT & MPT.

(g) Witness or review of Eddy Current Test Report, if applicable.

(h) Review of RT films and reports.

(j) Review of Heat Treatment Charts.

(k) Witness of Endurance Trials & Tilt Test and Review of Shock Test and SBN & ABN reports for qualification of TypeTest, as applicable.

(l) Review of ET, EMI/EMC and ESS reports, in addition to Pre / Post ET inspection, as applicable.

(m) Review of Draft documentation and witness/Stamping of final documentation, as applicable.

(n) Issue of CHP clearance.

(o) Issue of Dispatch Clearance or Issue of Form-IV,as applicable.

SYSTEM DESCRIPTION

1. Air Compressor serves to compress air from low pressure to the desired high pressure. There are several types of air compressors. Air pressure above 30 bars is considered as high pressure and air compressors delivering compressed air above 30 bars are considered as High-Pressure Air Compressors. Most widely used air compressors onboard naval ships are of reciprocating type. Normally multistage HP air compressors are used onboard *IN* Ships. The compressed high-pressure air is stored onboard in HP air storage bottles and post pressure reduction it is used for following shipboard applications: -

(a) Air Siren (pressure generally 7 bars).
(b) Instrument air (pressure generally 7 bars).
(c) Air circuit breakers (pressure 50-150 bar).
(d) For hydraulic accumulator (pressure 50-250 bars).
(e) Breathing air.
(f) Engine starting, Submarine diving/ surfacing (pressure up to 400 Bar).
(g) Missile applications.
(h) Deep sea diving.

2. HPAC installations onboard ships would broadly include: -

(a) HPAC complete with prime mover (motor/ diesel engine), associated piping, instrumentation, control system, base plate, mounting arrangements and necessary couplings for connecting the high-pressure air compressors to ship's system.

(b) Air Drier unit with portable Dew Point Meter including connection for Shore Air Supply facility.

(c) Intake air filters cum silencer.

(d) Fresh water expansion tank, if required, complete with low level switch/ sensor & level Indicator.

(e) Lube oil & fresh water cooler as applicable.

(f) Sea Water & Fresh water supply and return connections on the compressor.

STANDARD QUALITY ASSURANCE PLAN

Part - I. **General Information**

The following generic information must generally be provided on each QAP as its identity:-

(a) Equipment name
(b) Equipment technical details (as applicable)
(c) Purchase Order reference
(d) Sub/Sub-Sub Orders reference (as applicable)
(e) Name of Main Indenter/ Ordering Authority
(f) Name of end user
(g) Name of firm / manufacturer
(h) SOTRs reference
(j) Yard No./ Name of ship where to be fitted (if available)/End user
(k) References of relevant drawings
(l) QAP No. & Date (as indicated by the firm)
(m) Contractual delivery date
(n) Inspection Authority
(p) Inspection Agency
(q) Quantity (as applicable)

Part - II.

Standard QAP of HP Air Compressor	Appendix "A"

APPENDIX-A
(Refers to Part-II, Page 13)

STANDARD QUALITY ASSURANCE PLAN FOR HP AIR COMPRESSOR

Sl. No	Material /Components asper SOTR/ QA Activity	Characteristic/ Type of Check	Quantum of Check	Reference Documents	Acceptance Criteria	Format of Record	Action by QAE	Remarks
1.0.0	**SECTION I : DRAWINGS/DOCUMENTS/ TYPE TEST REQUIREMENTS**							
1.1.0	Drawings & Documents - GA drawings with DBOM - Manufacturing drawings	Verification of drawings / documents	100%	PO, SOTR/ TSP & TNC Minutes	PO, TSP/ SOTR & TNC Minutes	List of documents	R	Manufacturing drawings will be vetted with reference to approved GA drawings and DBOM in OEM premises
1.1.2	Type Test Report	Verification	One per Type	PO, TSP/ SOTR & TNC Minutes	Equipment is Type Tested and reports are held	Type Test reports	R	**For Shipyard Orders:** If equipment is not Type Tested OR reports are not held, Type Test shall be undertaken as per SQAP. **For DPRO/CPRO Orders:** Type Test shall be applicable, only if indicated in PO.
2.0.0	**SECTION II : RAW MATERIAL INSPECTION**							
2.1.0	**Castings:**							
2.1.1	Crank case, Cylinder Block, Cylinder, Liner, Cylinder head, End cover, Pistons etc	Pouring of casting material	100%	SOTR/ TSP, TNC Minutes, Approved drawings & mfg. drawings	Conformity to specifications	IR	R	Refer Note 9
		Heat treatment, if necessary	100%			HT Chart/ Report	R	
		Chemical composition & Mechanical property	1 sample per Heat			NABL TC	R	
2.1.2	Piston Rings	Chemical composition & Mechanical property	1 sample per Heat			STC/ CoC	R	

Sl. No	Material /Components asper SOTR/ QA Activity	Characteristic/ Type of Check	Quantum of Check	Reference Documents	Acceptance Criteria	Format of Record	Action by QAE	Remarks
2.2.0	**Forgings:**							
2.2.1	Crank shaft, Connecting rods etc	Material identification & stamping	100%	SOTR/ TSP, TNC Minutes, Approved drawings & mfg. drawings	Conformity to specifications	IR	W	Refer Note 10
		Heat treatment, if necessary	100%			HT Chart/ Report	R	
		Chemical composition, Mechanical property, Grain Size / Grain Flow Lines	1 sample per Heat per size			NABL TC	R	
2.2.2	Cylinder head (forged)	Material identification & stamping	100%		Conformity to specifications	IR	W	Refer Note 10
		Heat treatment, if necessary	100%			HT Chart/ Report	R	
		Chemical composition, Mechanical property, Grain Size / Grain Flow Lines	1 sample per Heat per size			NABL TC	R	
2.3.0	Pistons (Manufactured from Bars)	Material identification & stamping	100%		Conformity to specifications	IR	W	
		Chemical composition & Mechanical property	1 sample per Heat			NABL TC	R	Refer Note 11
		VI & DI	100%			IR	R	
2.4.0	**BOUGHT OUT ITEMS**							
2.4.1	Base frame	Material identification & stamping	100%	SOTR/ TSP, TNC Minutes, Approved drawings & mfg. drawings	Conformity to specifications	IR	W	
		Chemical composition & Mechanical property	1 sample per Lot		Conformity to specifications	NABL TC	R	Refer Note 12
		DPT of welded joints	100%		No weld defects	NDT Report	R	
		VI & DI	100%			IR	R	
2.4.2	Prime mover (Motor or Diesel Engine)	Motor - Complete QA inspection as per SQAP	100%		Clearance by QAE	I-Note (Form - IV)	R	
		Diesel Engine - Complete QA	100%					

Sl. No	Material /Components asper SOTR/ QA Activity	Characteristic/ Type of Check	Quantum of Check	Reference Documents	Acceptance Criteria	Format of Record	Action by QAE	Remarks
		inspection as per Approved QAP.						
2.4.3	Control panel and Starter	Complete QA inspection as per SQAP	100%	SOTR/ TSP, TNC Minutes, Approved drawings & mfg. drawings	Clearance by QAE	I-Note (Form - IV)	R	
2.4.4	Air dryer	Complete QA inspection as per separately approved QAP	100%		Clearance by QAE	I-Note (Form - IV)	R	
2.4.5	Inlet filter, Suction and Discharge valves	Type, Size, Make, Material conformity and Rating as applicable	100%		Conformity to specifications	STC / CoC	R	
2.4.6	S&V Mounts	Complete QA inspection as per SQAP/ separately approved QAP	100%		Clearance by QAE	I-Note (Form - IV)	R	
2.4.7	Pressure, Temperature gauges & other types of Instrumentation	Type, Size, Make, Material conformity	100%		Conformity to specifications	STC/ CoC	R	
		Calibration	100%		Calibration to be in-date; Validity of calibration to be specified	OEM/ NABL lab calibration certificate	R	
2.4.8	Oil Moisture Separator	Material conformity (shell and dish ends), type, size, flow and rating	100%		Conformity to specifications	STC/ CoC	R	
		Hydrostatic pressure test (1.5 times of working pressure)	100%			STC/ CoC	R	Duration as per approved ATP
2.4.9	Inter and After Cooler/ Plate Type Heat Exchangers	Material conformity for Tubes & Plates	100%		Conformity to specifications	STC/ CoC	R	
		DPT of joints	100%			NDT Report	R	Applicable only in case of manual welding/ brazing

Sl. No	Material /Components asper SOTR/ QA Activity	Characteristic/ Type of Check	Quantum of Check	Reference Documents	Acceptance Criteria	Format of Record	Action by QAE	Remarks
		Hydrostatic pressure test of both sides (1.5 times of working prs.)	100%			IR	R	Duration as per approved ATP
2.4.10	Cooling fan	Material Conformity	100%	SOTR/ TSP, TNC Minutes, Approved drawings & mfg. drawings	Conformity to specifications	STC/ CoC	R	
		VI & DI	100%			STC/ CoC	R	
		Balancing	100%			Balancing report	R	
2.4.11	Air system pipes	Material Conformity & Pressure Testing	100%		Conformity to specifications	STC	R	Refer to Note 13
		VI & DI	100%			IR	R	
2.4.12	All air system fittings, gaskets, 'O' rings, bearings, covers, oil/mech. seals, gears, deflectors, central rings, oil pan, dipstick, suction strainer, coupling, breather, shafts, keys, bracket etc.	Type, Size, Make, material conformity and Rating as applicable	100%		Conformity to specifications	STC/ CoC	R	Shelf life certificate be submitted for rubber items.
2.4.13	Gudgeon Pin	Chemical Composition	100%		Conformity to specifications	STC / CoC	R	
		Hardness						
2.4.14	Cooling Water Pump & Lub Oil Pump	Material Conformity of components	100%		Conformity to specifications	STC	R	
		Delivery Rating (Pressure, Flow Rate)	100%			STC	R	
2.4.15	Fresh Water Cooler & Lub Oil Cooler - Shell & Tube Type (if applicable)	Chemical composition & Mechanical property (for Tubes, Plates & End Covers)	100%		Conformity to specifications	STC	R	
		Eddy Current Test of tubes	100%			STC	R	
		DPT of Joints	100%			NDT Report	R	Applicable only in case of manual welding/ brazing

Sl. No	Material /Components asper SOTR/ QA Activity	Characteristic/ Type of Check	Quantum of Check	Reference Documents	Acceptance Criteria	Format of Record	Action by QAE	Remarks
		Hydrostatic pressure test of both sides (1.5 times of working prs.)	100%			IR	R	Duration as per approved ATP
2.5.0	**COTS Items**							
2.5.1	Cooling water pipes, Fasteners, other valves, V-Belt and flexible hose etc.	Type, Size, Make, material conformity and rating, as applicable	100%	SOTR/ TSP, TNC Minutes, Approved drawings & mfg. drawings	Conformity to specifications	STC/ CoC	R	
3.0.0	**SECTION III : IN-PROCESS INSPECTION**							
3.1.0	**Castings:** Crank case, Cylinder Block, Cylinder liners, Cylinder heads, Piston and End covers	VI & DI	100%	SOTR/ TSP, TNC Minutes, Approved drawings & mfg. drawings	Conformity to specifications	IR	R	
		Hydrostatic test (Only for Crank case and Cylinders)	100%			IR	R	
		RT/ UT (as applicable)	100%			NDT Report	R	Refer to Note 3
		DPT/ MPT on machined surface (as applicable)	100%			NDT Report	R	
		Honing inspection for cylinder liners	100%			IR	R	
3.2.0	**Forgings:** Crank shaft, Connecting rods & Gudgeon pin etc.	VI & DI	100%		Conformity to specifications	IR	R	
		RT/ UT (as applicable)	100%			NDT Report	R	Refer to Note 3
		Crankshaft - Dynamic balancing	100%			Balancing Report	R	Not applicable in case of dimension-controlled manufacturing. To be ratified in approved drawing
3.3.0	Piston	Diametrical clearance between cylinder and piston	100%		Conformity to specifications	IR	R	
3.4.0	Piston rings	Groove clearance & Closed gap	100%		Conformity to specifications	IR	R	

Sl. No	Material /Components asper SOTR/ QA Activity	Characteristic/ Type of Check	Quantum of Check	Reference Documents	Acceptance Criteria	Format of Record	Action by QAE	Remarks
3.5.0	Gudgeon pin	Diametrical clearance between piston pin and connecting rod bearing bore	100%	SOTR/ TSP, TNC Minutes, Approved drawings & mfg. drawings	Conformity to specifications	IR	R	
3.6.0	Cooling Water System	Pressure Testing (1.5 X Working Pressure)	100%		Conformity to specifications	IR	R	Not applicable in case the cooling water system has no joints
4.0.0	**SECTION IV: TYPE TESTING**							
4.1.0	Endurance Run	All functions and parameter check	01 unit	SOTR/ TSP, TNC Minutes, approved drg. & approved ATP	Conformity to specifications	IR	W	Duration as per approved ATP
4.2.0	Tilt Test (unit is to run for 01 hour with 20° tilt in each direction)	All functions and parameter check	01 unit		Conformity to specifications	IR	W	Duration as per approved ATP
4.3.0	Noise	Air Borne Sound Power radiated	01 unit		Conformity to specifications	IR	R	Report to be submitted to IHQ for approval
		Structure Borne Noise	01 unit			IR	R	
4.4.0	Shock& Vibration	Shock & Vibration Test/ Analysis	01 unit	SOTR/ TSP, TNC Minutes, BR 3021, approved drg.& approved ATP	Conformity to specifications	NSTL / NABL Lab report	R	Scope of trials as per SOTR/ Approved ATP Report to be submitted to IHQ for approval
5.0.0	**SECTION V: FINAL INSPECTION/ FATs**							
5.1.0	Compressor in assembled condition along with dryer (if applicable)	VI & DI (overall dimensions)	100%	SOTR/ TSP, TNC Minutes, Approved drawings & mfg. drawings	Conformity to specifications	IR	W	
		Pneumatic Leakage Test of air side at operating pressure	100%		Conformity to specifications	IR	W	
5.1.1	Functional testing (FATs): - Safety cut outs, Safety valve functioning Preliminary run, Proving run, Performance test	Safety Device Checks and Performance Trials	100%	SOTR/ TSP, TNC Minutes & approved FATs document	Conformity to specifications	FATs Report	W	

Sl. No	Material /Components asper SOTR/ QA Activity	Characteristic/ Type of Check	Quantum of Check	Reference Documents	Acceptance Criteria	Format of Record	Action by QAE	Remarks
5.1.2	Noise & Vibration Test	Air Borne Sound Power radiated	100%	SOTR/ TSP, TNC Minutes, approved drg. & approved FATs document	Conformity to specifications	IR	R	ABN, SBN and Vibration Trial report to be submitted to IHQ through QAE for approval Scope of trials as per SOTR/ Approved ATP
		Structure Borne Noise	100%			IR	R	
		Vibration trials (Overall vibration and narrow band spectrum)	100%			IR	R	
5.1.3	Air Quality Test (if applicable)	Quality of compressed air at air dryer outlet	100%		Conformity to specifications	NABL LTC	R	Sample to be drawn by QA rep
6.0.0	**PRE-REQUISITE-ISSUE OF I & T CERTIFICATE / FORM-IV**							
6.1.0	Liquidation of all observations during FATs	Liquidation of defects	100%	SOTR/ TSP, TNC Minutes, & FATs document	All defects liquidated	IR	W	
6.2.0	Weight (Dry & Weight)	Weight recording	First piece of lot	SOTR/ TSP, TNC Minutes & approved drawings	Conformity to specifications	IR	W	
			Balance			IR	R	
6.3.0	Submission of as-made drawing, if applicable	Verification and Stamping	100%		Conformity to specifications	IR	P	Refer Note-14
6.4.0	Painting & Preservation	Visual inspection	100%		Conformity to specifications	IR	R	Validity of preservation is to be specified
6.5.0	OBS items as per Purchase Order	Product identification and Visual Inspection	100%		OBS are supplied as per PO	MTC and CoC	W	
6.6.0	Packing & Marking	Check for packing list	100%	PO, SOTR/ TSP & TNC Minutes	SOTR/PO/ Approved drawing	Packing list	R	
6.7.0	Books / Manuals	Submission of documents/ manuals	100%	PO, SOTR/ TSP & TNC Minutes	All documents submitted	List	R	

Note:-	
1.	Imported components shall be accepted as per DQN policy letter 66301/Policy/DQA(N)/SG dated 14 Nov 17.
2.	STC is to be issued by the original manufacturer of the item. Certificate of Conformity (CoC) may be issued by the equipment manufacturer or integrator who has sourced the item for use in the equipment. CoC / STC must indicate governing specifications and values to which the item has been tested. The certificate must include copies of test reports.

3.	(a) **Radiographic Testing (RT)**. RT is to be conducted by ASNT / ISNT Level - II/ III technician as per procedure approved by ASNT / ISNT Level - III technician. On completion of testing, the RT report is to be endorsed by ASNT / ISNT Level - III technician. (b) **Other NDT Procedures**. Other tests like UT, MPT and DPT can be performed by ASNT / ISNT Level - II/ III qualified technician as per procedure approved by ASNT / ISNT Level - III qualified technician and the report can be endorsed by ASNT / ISNT Level - II/ III qualified technician.
4.	Tests for chemical composition and mechanical properties are to be done at NABL accredited labs only.
5.	Test bed set up, internal performance test reports and compliance SOTR/TNC to be submitted to QAE before FATs.
6.	The specifications mentioned in column 'Reference Documents' are only indicative.
7.	Packing material should not contain environmentally hazardous material prohibited by law/ regulation.
8.	In the SQAP- OEM means integrator of the HPAC.
9.	(a) **Pouring is Witnessed**. Test bars from the representative heat shall be identified and stamped by QAE rep during pouring. Post heat treatment (if required) along with castings, randomly drawn test bars shall be sealed by the QAE rep and forwarded to NABL lab for chemical analysis & mechanical property tests. (b) **Pouring is not Witnessed**. Adequate number of test bars shall be poured along with the castings in the same heat. Post heat treatment (if required) of test bars along with castings, randomly selected test bars shall be stamped and sealed by the QAE rep and sent to NABL Lab for chemical analysis and mechanical property tests. Further, to cross check with the chemistry of actual casting, an additional sample preferably as a solid piece of size adequate for spectrometric analysis OR metal scrapings (for wet analysis) shall also be drawn by the QAE Rep from one randomly selected casting per heat, stamped, sealed and forwarded to NABL lab for testing. Additionally, hardness shall also be checked on a randomly selected casting per heat in presence of the QAE rep to ascertain the mechanical property. The results of both samples must conform to the applicable standard.
10.	(a) **Closed Die Forgings**. A finished forging shall be randomly selected post heat treatment (if applicable) by the QAE rep, stamped, sealed and forwarded to NABL lab for chemical analysis, mechanical property tests, observation of grain size and forging flow lines. If certain components are small and the finished forging cannot be used for lab tests, such components should be specified in the approved drawings along with details of tests which cannot be undertaken. (b) **Open Die Forgings**. Test sample for chemical analysis, mechanical property tests, observation of grain size and forging flow lines shall be drawn by the QAE rep from extra metal (~ 300 mm) provisioned at the end of the forgings, stamped, sealed and forwarded to NABL lab. In case of more than one forging from same heat, extra material is to be provided on all forgings for random sampling.
11.	In case of components made from bars (like pistons), test sample for chemical analysis & mechanical property tests shall be drawn by the QAE rep from extra metal (~ 300 mm) provisioned at the end of the component, stamped and forwarded to NABL lab.
12.	Chemical analysis & mechanical property tests shall be undertaken only for load bearing members/ structural rolled sections (I-beams, C-Sections etc.) of the base frame. To facilitate collection of test sample, adequate metal shall be left attached to the fabricated frame. Test sample shall be drawn by the QA rep from such extra metal available, stamped, sealed and forwarded to NABL lab for testing.
13.	STC for Air System pipes/ tubes should adequately cover the chemical composition and mechanical properties of material used and the pressure to which they have been tested by the manufacturer.
14.	As-made drawings, duly incorporating changes implemented during the manufacturing stage, are to be submitted by the OEM for approval of IHQ through the concerned QAE. Submission of As-made drawings is mandatory for issue of I-Notes but approval of the same shall be delinked from the issue of I-notes.
15.	Where the standard does not specify any specific chemical composition, the foundry can adjust the components to meet the desired physical/ mechanical properties. In such cases the chemical composition specified by the foundry shall be used as the acceptance criteria for the chemical composition tests.