



## **MINISTRY OF DEFENCE (DGQA)**

### **STANDARD QUALITY ASSURANCE PLAN**

### **LUB OIL AND FUEL CENTRIFUGES**

**CENTRIFUGES ARE USED TO SEGREGATE CONTAMINANTS  
SUCH AS SOLID IMPURITIES AND WATER FROM FUEL AND  
LUBRICATING OILS**

**STANDARD QAP NO. DGQA/DQA(WP)/CFG/22/2020/REV 0  
DATED 29 JUL 20**

**Total Nos. of Pages: 19**

#### **ISSUING AUTHORITY**

**DIRECTORATE OF QUALITY ASSURANCE (WARSHIP PROJECT)  
MINISTRY OF DEFENCE (DGQA)  
'H' BLOCK, NIRMAN BHAWAN P.O.  
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	MINISTRY OF DEFENCE / DGQA	LUB OIL AND FUEL CENTRIFUGES	PAGE	02
	DIRECTORATE OF QUALITY ASSURANCE (WARSHIP PROJECTS) NEW DELHI - 110 011	STANDARD QAP NO. DGQA/ DQA(WP)/CFG/22/2020/REV0	REV. NO.	0
			DATE	29JUL 20

## RECORD OF AMENDMENTS

SI. No.	Date of Amendment	Amendments	Authority	Remarks

	MINISTRY OF DEFENCE / DGQA	LUB OIL AND FUEL CENTRIFUGES	PAGE	03
DIRECTORATE OF QUALITY ASSURANCE (WARSHIP PROJECTS) NEW DELHI - 110 011	STANDARD QAP NO. DGQA/ DQA(WP)/CFG/22/2020/REV0	REV. NO.	0	
		DATE	29 JUL 20	

## **MINISTRY OF DEFENCE (DGQA)**

### **STANDARD QUALITY ASSURANCE PLAN (SQAP)** **FOR LUB OIL AND FUEL CENTRIFUGES**



**SQAP NO.**  
**DGQA/DQA (WP)/CFG/22/2020/REV 0**  
**DATED 29 JUL 20**

  
 (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**

 <p>MINISTRY OF DEFENCE / DGQA DIRECTORATE OF QUALITY ASSURANCE (WARSHIP PROJECTS) NEW DELHI - 110 011</p>	<p>LUB OIL AND FUEL CENTRIFUGES STANDARD QAP NO. DGQA/ DQA(WP)/CFG/22/2020/REVO</p>	PAGE	04
		REV. NO.	0
		DATE	29 JUL 20

## 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 Lub Oil and Fuel Centrifuges for *I/N* Ships.
3. The website ***http://www.dgqadefense.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 M/s ALFA LAVAL and representatives of Professional Directorates and Production Directorates of the *I/N*. Any user of this Standard QAP within DGQA/ *I/N* 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**

 <p>MINISTRY OF DEFENCE / DGQA DIRECTORATE OF QUALITY ASSURANCE (WARSHIP PROJECTS) NEW DELHI - 110 011</p>	LUB OIL AND FUEL CENTRIFUGES	PAGE	05
	STANDARD QAP NO. DGQA/ DQA(WP)/CFG/22/2020/REV0	REV. NO.	0
		DATE	29 JUL 20

## CONTENTS

SL.NO.	DESCRIPTION	PAGE
1.	Standards Invoked	06
2.	Specific Requirements	07
3.	Abbreviations	09
4.	Scope	10
5.	System Description	11
6.	SQAP	12
APP 'A'	Standard QAP for Lub Oil and Fuel Centrifuges	13
APP 'B'	Standard QAP for Oil Heater	18

 <p>MINISTRY OF DEFENCE / DGQA</p> <p>DIRECTORATE OF QUALITY ASSURANCE (WARSHIP PROJECTS) NEW DELHI - 110 011</p>	<p>LUB OIL AND FUEL CENTRIFUGES</p> <p>STANDARD QAP NO. DGQA/ DQA(WP)/CFG/22/2020/REV0</p>	PAGE	06
		REV. NO.	0
		DATE	29 JUL 20

## STANDARDS INVOKED

(a)	DEFSTAN 02-323	Centrifuges
(b)	DEFSTAN 02-327	Pumps &Eductors
(c)	NSS I/ II	Requirements for High Impact Shock Tests, Shipboard Machinery Equipment and Systems
(d)	MIL-STD-167-1A	Mechanical Vibrations of Shipboard Equipment.
(e)	MIL-STD-740-2	Structure Borne Vibratory Acceleration Measurements and Acceptance Criteria for Shipboard Equipment
(f)	MIL-STD-1474-E	Noise Limits
(g)	DEF STAN 02-723	Requirements of Marker Plates
(h)	DME 452	Documentation Specifications
(j)	BR 3013(2)	Admiralty Pipe Work Standards
(k)	DGS 251	Painting
(l)	DGS 252	Electrical Systems-Design, Manufacturing and Testing
(m)	DME 463	Valves
(n)	MIL-STD-461E/F	EMI/EMC Requirement for Electronic Equipment
(p)	DEF STAN 61-5	Electrical Power Supply System
(q)	SES S/DEF 133	Standard Electrical and Environmental Tests
(r)	SES 18	Electronic Equipment
(s)	SES 19	Static Conversion Equipment

*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*

 <p>MINISTRY OF DEFENCE / DGQA DIRECTORATE OF QUALITY ASSURANCE (WARSHIP PROJECTS) NEW DELHI - 110 011</p>	<p>LUB OIL AND FUEL CENTRIFUGES STANDARD QAP NO. DGQA/ DQA(WP)/CFG/22/2020/REV0</p>	PAGE	07
		REV. NO.	0
		DATE	29 JUL 20

## **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. If casting is being poured without integral test bar, then only the pouring is to be witnessed by Inspector.
3. 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.
4. Make of the Items should be as per approved PIL / Detailed Bill of Material (DBOM) or *In* approved sources.
5. 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.
6. In case of bought out items, physical verification / function of item may be undertaken during assembly of the equipment to avoid repetition.
7. 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/ Warrante certificate from the supplier/ OEM as per supply order.
8. ESS test, wherever applicable (Thermal Cycling, Random Vibration and Burn in / Endurance) shall be conducted as per DQA(N) policy vide letters 66301/Policy-07/DQA(N)/QA-07 dated 09 Aug 16.
9. Ingress protection testing will be as per applicable IP rating.
10. 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.
11. Conformal coating of PCBs to be done as per DQA(N) policy letter 580930/DQA(N)/EL dated 17 Feb 14.

 <p>MINISTRY OF DEFENCE / DGQA DIRECTORATE OF QUALITY ASSURANCE (WARSHIP PROJECTS) NEW DELHI - 110 011</p>	MINISTRY OF DEFENCE / DGQA	LUB OIL AND FUEL CENTRIFUGES	PAGE	08
	DIRECTORATE OF QUALITY ASSURANCE (WARSHIP PROJECTS) NEW DELHI - 110 011	STANDARD QAP NO. DGQA/ DQA(WP)/CFG/22/2020/REV0	REV. NO.	0
			DATE	29 JUL 20

12. 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.

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

14. Since the Centrifuges are 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.

15. Post promulgation of this SQAP, separate QAP approval for 'LO and Fuel Centrifuges' is not required. The manufacturer shall be required to submit confirmation to concerned QA Agency regarding acceptance of SQAP either in totality or with some design specific inclusions and/or exclusions, if any, along with the following details.

- (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
- (i) 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)
- (r) Inclusions, if any
- (s) Exclusions, if any

16. The SQAP along with the 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
LO	Lubricating Oil
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

 <p>MINISTRY OF DEFENCE / DGQA DIRECTORATE OF QUALITY ASSURANCE (WARSHIP PROJECTS) NEW DELHI - 110 011</p>	LUB OIL AND FUEL CENTRIFUGES	PAGE	10
	STANDARD QAP NO. DGQA/ DQA(WP)/CFG/22/2020/REVO	REV. NO.	0
		DATE	29 JUL 20

## 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 LO & Fuel Centrifuge: -

- (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 or review of Eddy Current Test Report, if applicable.
- (g) Review of Heat Treatment Charts.
- (h) Witness of Endurance Trials & Tilt Test and Review of Shock Test and SBN & ABN reports for qualification of Type Test, as applicable.
- (i) Review of ET, EMI/EMC and ESS reports, in addition to Pr / Post ET inspection, as applicable.
- (j) Review of Draft documentation and witness/Stamping of final documentation, as applicable.
- (l) Issue of CHP clearance.
- (m) Issue of Dispatch Clearance or Issue of Form-IV, as applicable.

 <p>MINISTRY OF DEFENCE / DGQA DIRECTORATE OF QUALITY ASSURANCE (WARSHIP PROJECTS) NEW DELHI - 110 011</p>	LUB OIL AND FUEL CENTRIFUGES	PAGE	11
	STANDARD QAP NO. DGQA/ DQA(WP)/CFG/22/2020/REV0	REV. NO.	0
		DATE	29 JUL 20

## **SYSTEM DESCRIPTION**

1. Centrifuges are separators, used to remove contaminants like solid impurities and water from fuel and lubricating oils stored in the ship's service tanks. The solid impurities and water are removed by gravity and centrifugal action at high speed in a vertical separator. Self-cleaning Centrifuges are generally preferred for sludge waste removal.
2. Centrifuge installations typically include the following:-
  - (a) Oil Supply and Discharge Pumps with associated relief valves. The Supply Pump may be separately mounted and powered.
  - (b) Oil suction strainer.
  - (c) Oil heater, for centrifuges other than fuel centrifuges.
  - (d) Interconnecting pipe work connected to centrifuge (shipbuilder's supply).
  - (e) Operating water tank and other water supplies with valves and strainers.
  - (f) Anti-flood tank, for non-self-cleaning centrifuges.
  - (g) Sludge tank for self-cleaning centrifuges.

 <p>MINISTRY OF DEFENCE / DGQA DIRECTORATE OF QUALITY ASSURANCE (WARSHIP PROJECTS) NEW DELHI - 110 011</p>	LUB OIL AND FUEL CENTRIFUGES	PAGE	12
	STANDARD QAP NO. DGQA/ DQA(WP)/CFG/22/2020/REV0	REV. NO.	0
		DATE	29 JUL 20

## **STANDARD QUALITY ASSURANCE PLAN**

### **Part - I: General Information**

- (a) Standards Invoked
- (b) Specific Requirements
- (c) Abbreviations
- (d) Scope
- (e) System Description

### **Part - II: Technical Inspection/ Trials**

Standard QAP of Lub Oil and Fuel Centrifuges	Appendix- 'A'
QAP of Oil Heater for Lub Oil and Fuel Centrifuges	Appendix- 'B'

**STANDARD QUALITY ASSURANCE PLAN FOR LUB OIL & FUEL CENTRIFUGES**

Sl. No	Material /Components as per SOTR/ QA Activity	Characteristic/ Type of Check	Quantum of Check	Reference Documents	Acceptance Criteria	Format of Record	Action by QAE	Remarks
<b>1.0.0 SECTION I: DRAWINGS/DOCUMENTS/ TYPE TEST REQUIREMENTS</b>								
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	<p><b>For Shipyard Orders:</b> If equipment is not Type Tested OR reports are not held, Type Test shall be undertaken as per SQAP.</p> <p><b>For IHQ/ CPRO Orders:</b> Type Test shall be applicable, only if indicated in PO.</p>
<b>2.0.0 SECTION II: RAW MATERIAL INSPECTION</b>								
2.1.0	(a) Bowl Body (b) Bowl Hood (c) Lock Ring (d) Bowl Disc (e) Top Disc (f) Distributor	Type, Size, Material conformity and Rating as applicable	100%	PO, SOTR/ TSP, TNC Minutes, Approved drawings & DBOM	Compliance to specifications	OEM CoC	CHP for R	
2.2.0	Separator Frame Top & Bottom Part	Chemical composition of Ingot	01 Sample / Heat / Lot	PO, SOTR/ TSP, TNC Minutes, Approved drawings & DBOM	Compliance to specifications	Mil TC	R	
		Pouring with integral test bar	100%		Compliance to specifications	IR	R	Pouring shall be witnessed by QAE rep if performed without integral test bar
		Material Identification & Stamping	100%		--	--	P	
		Chemical composition & Mechanical properties	100%		Compliance to specifications	NABL TC	CHP for R	

Sl. No	Material /Components as per SOTR/ QA Activity	Characteristic/ Type of Check	Quantum of Check	Reference Documents	Acceptance Criteria	Format of Record	Action by QAE	Remarks	
2.3.0	<b>BOUGHT-OUT ITEMS</b>								
2.3.1	(a) Operating Water Tank (b) Anti Flood Tank (c) Sludge Tank	Chemical composition & Mechanical properties	100%	PO, SOTR/ TSP, TNC Minutes, Approved drawings & DBOM	Compliance to specifications	NABL TC	CHP for R		
		DPT of Weld Joints	100%		Nil defects	NDT Report	R		
		VI & DI	100%		Compliance to specifications	IR	R		
2.3.2	Base Frame	Chemical composition & Mechanical properties	100%	PO, SOTR/ TSP, TNC Minutes, Approved drawings & DBOM	Compliance to specifications	NABL TC	CHP for R		
		DPT of Weld Joints	100%		Nil defects	NDT Report	R		
		VI & DI	100%		Compliance to specifications	IR	R		
2.3.3	Lifting Gear	Type, Size, Material conformity and Rating as applicable	100%	PO, SOTR/ TSP, TNC Minutes, Approved drawings & DBOM	Compliance to specifications	STC	CHP for R		
2.3.4	S & V Mounts	Inspection as per SQAP for S&V Mounts				I-Note	CHP for R		
2.3.5	Motor	Inspection as per SQAP for Motors				I-Note	CHP for R		
2.3.6	Starter/ Control Panel	Inspection as per SQAP for Starter/ Control Panel				I-Note	CHP for R		
2.3.7	Oil Heater	Inspection as per separately approved QAP at Appendix-B				I-Note	CHP for R	Refer to Note 10	
2.4.0	<b>COTS ITEMS</b>								
2.4.1	(a) Suction Pump (b) Discharge Pump	Type, Size, Material conformity and Rating as applicable	100%	PO, SOTR/ TSP, TNC Minutes, Approved drawings & DBOM	Compliance to specifications	STC	R		
					Compliance to specifications	STC	R		
2.4.2	Valves	Type, Size, Material conformity and Rating as applicable	100%		Compliance to specifications	STC	R		
2.4.3	Flexible Hoses	Type, Size, Material conformity and Rating as applicable	100%		Compliance to specifications	STC	R		
2.4.4	Air filter	Type, Size, Material conformity and Rating as applicable	100%		Compliance to specifications	STC	R		

Sl. No	Material /Components as per SOTR/ QA Activity	Characteristic/ Type of Check	Quantum of Check	Reference Documents	Acceptance Criteria	Format of Record	Action by QAE	Remarks
2.4.5	Strainer	Type, Size, Material conformity and Rating as applicable	100%	PO, SOTR/ TSP, TNC Minutes, Approved drawings & DBOM	Compliance to specifications	STC/ CoC	R	
2.4.6	Pneumatic actuator	Type, Size, Material conformity and Rating as applicable	100%		Compliance to specifications	STC	R	
2.4.7	Thermometers, Pressure Gauges, Temperature Sensors, Level Switches, Solenoid Valves	Type, Size, Material conformity and Rating as applicable	100%		Compliance to specifications	STC& Calibration Certificates	R	
2.4.8	Pipes	Chemical composition & Mechanical properties	100%		Compliance to specifications	STC/ CoC	R	
		VI & DI	100%			IR	R	
		Pressure Testing	100%			IR	R	
3.0.0	<b>SECTION III: IN-PROCESS INSPECTION</b>							
3.1.0	Separator Frame Top & Bottom Part	VI & DI	100%	PO, SOTR/ TSP, TNC Minutes, Approved drawings & DBOM	Compliance to specifications	IR	R	
3.2.0	(a) Operating Water Tank (b) Anti Flood Tank (c) Sludge Tank	Water Fill Test for 24 Hrs	100%		Nil Leakages	IR	CHP for R	
3.3.0	Valves	Pressure Test	100%		Nil Leakages	IR	R	
4.0.0	<b>SECTION IV: TYPE TESTING</b>							
4.1.0	Centrifuge in assembled condition	VI & DI	01 unit	PO, SOTR/ TSP, TNC Minutes, Approved drawings, DBOM & Approved ATP	Compliance to specifications	IR	W	
		Weight	01 unit		Compliance to specifications	IR	W	
4.2.0	System interlocks and alarms	Cold/ Hot Checks	01 unit		Compliance to specifications	IR	W	Values as per approved ATP/ FATs Protocol
4.3.0	Endurance Run	All functions and parameter check	01 unit		Compliance to specifications	IR	W	Duration as per approved ATP/ FATs Protocol
		Flow Rate	01 unit			IR	W	
		Moisture Content in Oil before and after separation	01 unit			NABL TC	R	

Sl. No	Material /Components as per SOTR/ QA Activity	Characteristic/ Type of Check	Quantum of Check	Reference Documents	Acceptance Criteria	Format of Record	Action by QAE	Remarks
4.4.0	Noise	Air Borne Sound Power radiated	01 unit	PO, SOTR/ TSP, TNC Minutes, Approved drawings, DBOM & Approved ATP	Compliance specifications to	IR	R	Report to be submitted to IHQ for approval
		Structure Borne Noise	01 unit			IR	R	
4.5.0	Shock & Vibration	Shock & Vibration Test/ Analysis	01 unit	PO, SOTR/ TSP, TNC Minutes, Approved drawings, DBOM & Approved ATP	Conformity specifications to	NSTL / NABL Lab report	R	Scope of trials as per SOTR/ Approved ATP. Report to be submitted to IHQ for approval
4.6.0	Tilt Test (unit is to run for 01 hour with 20° tilt in each direction)	All functions and parameter check	01 unit			IR	W	Scope of trials as per SOTR/ Approved ATP. Report to be submitted to IHQ for approval
		Flow Rate	01 unit			IR	W	
		Moisture Content in Oil before and after separation	01 unit			NABL TC	R	
5.0.0	<b>SECTION V: FINAL INSPECTION/ FATs</b>							
5.1.0	Centrifuge in assembled condition	VI & DI	100%	PO, SOTR/ TSP, TNC Minutes, Approved drawings, DBOM & Approved ATP/ FATs Protocol	Compliance specifications to	IR	W	
5.2.0	System interlocks and alarms	Cold/ Hot Checks	100%			IR	W	
5.3.0	Performance Test	All functions and parameter check	100%			IR	W	Duration as per approved ATP/ FATs Protocol
		Flow Rate	100%			IR	W	
		Moisture Content in Oil before and after separation	100%			NABL TC	R	
5.4.0	Noise & Vibration Test	Air Borne Sound Power radiated	100%	PO, SOTR/ TSP, TNC Minutes, & FATs document	Compliance specifications to	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/ FATs Protocol.
		Structure Borne Noise	100%			IR	R	
		Vibration trials (Overall vibration and narrow band spectrum)	100%			IR	R	
6.0.0	<b>PRE-REQUISITE-ISSUE OF I &amp; T CERTIFICATE / FORM-IV</b>							
6.1.0	Liquidation of all observations during FATs	Liquidation of defects	100%	SOTR/ TSP, TNC Minutes, & FATs document	All defects liquidated	IR	W	

Sl. No	Material /Components as per SOTR/ QA Activity	Characteristic/ Type of Check	Quantum of Check	Reference Documents	Acceptance Criteria	Format of Record	Action by QAE	Remarks
6.2.0	Weight (Dry & Weight)	Weight recording	First piece of lot	PO, SOTR/ TSP, TNC Minutes, Approved drawings & DBOM	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	
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.	Tests for chemical composition and mechanical properties are to be done at NABL accredited labs only.
4.	Test bed set up, internal performance test reports and compliance SOTR/TNC to be submitted to QAE before FATs.
5.	The specifications mentioned in column 'Reference Documents' are only indicative.
6.	Packing material should not contain environmentally hazardous material prohibited by law/ regulation.
7.	In the SQAP- OEM means integrator of the LO & Fuel Centrifuge.
8.	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.
9.	This SQAP is applicable for loose supply items also where Integrated FATs is not required.
10.	In case the oil heater is of Imported in nature, then it is to be accepted against Import Documents. If it is COTS in nature, then it is to be accepted against STC.

**QUALITY ASSURANCE PLAN: OIL HEATER FOR LUB OIL & FUEL CENTRIFUGES**

SI No.	Material/ components as per SOTR/ QA activity	Characteristics/ Type of check	Quantum of Check	Reference documents	Acceptance criteria	Format of Record	Action by QAE	Remarks	
<b>1.0.0 RAW MATERIAL INSPECTION</b>									
1.1.0	Plate for Tank shell, Bottom plate, RF Pad	Chemical composition & Mechanical properties	01 Sample / Lot	PO, SOTR/ TSP, TNC Minutes, Approved drawings & DBOM	Conformity to specifications	NABL TC	CHP for R	Samples to be drawn by QAE rep.	
1.2.0	Nozzle pipe (Inlet/ outlet), Heater bush, RTD bush								
1.3.0	Tube, Tie rod, Baffle plate								
1.4.0	Base Plate, Blind Flange, Slip-on Flange								
1.5.0	Insulation cover					NABL TC			
1.6.0	Heating element (Ni-Cr wire)					STC			
1.7.0	Mineral Wool								
<b>2.0 IN PROCESS INSPECTION</b>									
2.1	Assembly of Heater element to tube sheets (Flange) with Baffles and Tie rod	VI & DI	100%	PO, SOTR/ TSP, TNC Minutes, Approved drawings & DBOM	Conformity to specifications	IR	W		
<b>3.0 FINAL INSPECTION</b>									
3.1	Heating element	Measurement of Ohmic resistance – (i) 1380 Ω @ 380V, (ii) 1720 Ω @ 415V (± 10% at each voltage)	100%	PO, SOTR/ TSP, TNC Minutes, Approved drawings & DBOM	Conformity to specifications	IR/ TC	W		
		IR & HV Test				IR/ TC			
		Leakage Current test				IR/ TC			
3.2	Overall Assembly	VI & DI	100%	Conformity to specifications	IR/	W			
		Hydro test for 30 Min. @ 7.5 Kg/Cm <sup>2</sup>			IR/ TC	CHP for W			
		Ohmic resistance of groups			IR/ TC	W			

		Shock test	100%	PO, SOTR/ TSP, TNC Minutes, Approved drawings & DBO	Compliance to Shock Grade NSS-II	Shock test report	R	FE Analysis Report or Test done at NABL Lab
		Painting	100%		Conformity to specifications	IR	W	
		Preservation & Packing	100%		Compliance to specifications	Packing list	W	