MINISTRY OF DEFENCE (DGQA)

STANDARD QUALITY ASSURANCE PLAN

MARINE RUBBER HOSES

The SQAP is applicable for various types of rubber hoses used in the Indian Navy

STANDARD QAP NO. DGQA/DQA(WP)/RUBBER HOSE/15/2019/REV 0 DT 30 JAN 2019

Total Nos. of Pages: 23

ISSUING AUTHORITY

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

RECORD OF AMENDMENTS

Sl. No.	Date of Amendment	Amendments	Authority	Remarks

MINISTRY OF DEFENCE (DGQA)

STANDARD QUALITY ASSURANCE PLAN FOR MARINE RUBBER HOSES

STANDARD QAP NO. DGQA/DQA(WP)/RUBBER HOSE/15/2019/REV 0 30 JAN 2019

(A GEORGE)
REAR ADMIRAL
ADGQA(WP)

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 QAP has been prepared for reference of the Indian Navy and its Contractors so as to leverage Quality Assurance during execution of the contracts. No alteration is to be made to this Standard QAP 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 Rubber Hoses for *IN* Ships.

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

4. The Standard QAP has been prepared with concurrence of Professional Directorate (IHQ MoD(N) / DME 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. DQA (WP) reserves the right to amend or modify the contents of this Standard QAP without consulting or informing any holder of this document.

6. When this Standard QAP is incorporated into contracts, users are responsible for their correct application while complying with contractual and other statutory requirements. Compliance with Standard QAP does not of itself confer immunity from legal obligations.

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

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

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

CONTENTS

STANDARDS INVOKED

SL.	SPECIFICATION	DESCRIPTION
1.	Def-Stan 02-345 (NES 345)	Flexible pipe assemblies & bellows.
	IS 5797- 2016	Rubber hoses and assemblies for aircraft ground fueling and de-fueling
2.	ASTM D380-2012	Standard test methods for rubber hoses.
3.	ISO 37; BS 903 Part A2	Method for determination of tensile stress strain properties and elongation at break.
4.	ISO 34; BS 903 Part A3	Method for determination of tear strength (trouser, angle and crescent test pieces.
5.	ISO 815-1; BS 903 Part A6	Method for determination of compression set at ambient, elevated or low temperatures.
7.	ISO 4649; BS 903 Part A9	Determination of abrasion resistance.
8.	ISO 36; BS EN 28033	Adhesion Strength.
9.	BS 903 Part A13	Method for determination of stiffness at low temperature (Gehman Test).
10.	ISO 1817; BS 903 Part A16	Determination of the effects of liquids.
11.	ISO 188; BS 903 Part A19	Heat resistance and accelerated ageing test.
12	ISO 7619; BS 903 Part A26	Method for determination of hardness (hardness between 10 IRHD and 100 IRHD).
13.	ISO 1431-1 (Procedure A); BS903:A43; BS EN 27326	Rubber & Plastic Hoses. Assessment of Ozone resistance under static conditions.
14.	ISO 5603, BS903: A56, ASTM D2229	Steel Cord Adhesion

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

SPECIFIC REQUIREMENTS

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

2. Imported items will be accepted against following import documents:-

(a) Bill of Lading or Shipping Bill or Airway Bill

(b) Invoice of OEM or Country of Origin.

(c) Bill of Entry.

(d) OEM CoC indicating governing specifications and values to which the items are tested along with OEM Test Certificates/ Test Reports/ Catalogue and Data Sheet.

(e) Guarantee/ Warranty Certificate of supplier/ OEM, as applicable as per PO.

ABBREVIATIONS

VI	Visual Inspection
DI	Dimensional Inspection
LTC	Lab Test Certificate
STC	Supplier Test Certificate
MTC	Material Test Certificate
CC	Conformance/Compliance Certificate
CHP	Customer Hold Point
IR	Inspection Report
NABL	National Accreditation Board For Testing And Calibration of Laboratories
P	Perform
R	Review
V	Verification
W	Witness
TC	Test Certificate
OEM	Original Equipment Manufacturer
TT	Type Test
DBOM	Detailed Bill of Material

SCOPE

Scope of Quality Assurance: The scope of Quality Assurance will cover witness and review of all manufacturing activities during all stages viz. raw material stage and final inspection. The following quality assurance activities will be carried out:-

(a) Drawing of test slab and test buttons.
(b) Visual Inspection.
(c) Dimensional Inspection.
(d) Review of Lab Test Certificates.
(e) Review of OEM Test Certificates.
(f) Witness of in-house Lab Testing, if applicable.
(g) Issue of CHP clearance.
(h) Issue of Dispatch Clearance or Issue of Form-IV, as applicable.

ITEM DESCRIPTION

A *hose* is a flexible, reinforced conduit used to move materials from one point to another. It is flexible to accommodate motion, alignment, vibration, thermal expansion and contraction, portability, ease of routing, and ease of installation.

The hoses are generally made up of three elements viz., *Tube, Reinforcement* and *Cover*. Each of these elements is usually attached to the adjacent element by bonding agents or thin layers of specially compounded rubber.

Cover is the outermost or visible area of the hose. It is designed to provide protection against wear, abrasion, cuts, weather and the general destructive action encountered in normal service. Covers are designed for specific applications and can be made to be resistant to oils, acids, abrasion, flexing, sunlight, ozone, etc.

Reinforcement is the supporting structure of the hose. Reinforcement can be textile, plastic, or metal, alone or in combination, built into the body of the hose to withstand internal pressures, external forces, or a combination of both. The type and amount of reinforcing material used depends on the method of manufacture and on the service requirements.

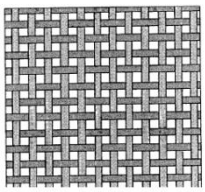
Tube is the innermost element of a hose and is compounded to provide resistance to the material being carried. With the wide range of rubber compounds available, a hose can be built to withstand abrasive materials, chemicals, oil and a wide variety of other materials.

The most common types of rubber used for manufacturing hoses are as follows:-

- ABR Acrylics
- AEM Ethylene acrylic
- AU Urethane
- BIIR Bromobutyl
- BR Polybutadiene
- CIIR Chlorobutyl
- CM Chlorinated Polythelene
- CO Epichlorohydrin Rubber
- CR Neoprene
- CSM Hypalon
- EAM Ethylene vinyl Acetate
- ECO Epichlorohydrin copolymer
- EPDM Ethylene Propylene Rubber
- EPM Ethylene Propylene Rubber
- EU Urethane
- FKM Fluoroelastomer

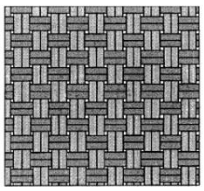
- HNBR Hydrogenated
- IIR Butyl
- IR Polyisoprene
- MQ Silicone
- NBR Nitrile
- NR Natural rubber
- SBR Styrene-butadiene
- T Thiokol
- XLPE Cross-linked Polyethylene
- XNBR Carboxylated Nitrile

Textile fabrics used as reinforcement in hose construction provide the strength to achieve the desired resistance to internal pressure or to provide resistance to collapse, or both. The properties of a fabric depend on the construction and the material from which the yarn is made and on the type of weave used. The various types of weaves used are *Plain Weave*, *Twill Weave, Basket Weave and Leno Weave.* To adhere to the tube and cover of the hose, the fabric must be rubberized. The fabric is either frictioned or coated with a thin layer of rubber.

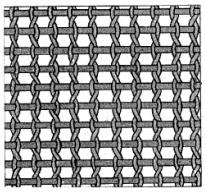


Plain Weave

Twill Weave



Basket Weave



Leno Weave

Reinforcing wire is used in a wide variety of hydraulic and industrial hose, primarily where textiles alone do not satisfy the special engineering requirements or the service conditions for which the hose is designed. Various types of wires used in the hoses are Steel wire, High tensile low carbon steel wire, Flat Wire Braid, Wire Cable, Round Wire, Rectangular Wire, Half-round Wires, Alloy and Non-ferrous Wires, Static Wires (to prevent build up of static electricity).

Hose is manufactured in the unvulcanised state by forming a cylindrical tube over which a reinforcement and cylindrical cover are applied. In its uncured form, a hose tube will often need support to maintain proper internal diameter (ID) and dimensional tolerances while being processed through the various stages of manufacture. There are three basic methods of making hose. They are *Non-mandrel, Flexible mandrel*, and *Rigid mandrel* method.

The *Non-mandrel* method of manufacture is generally used for lower working pressure (less than 500 psi), smaller diameter (less than 2"), textile reinforced hoses not requiring stringent dimensional tolerances. Non-mandrel hose is manufactured by passing long lengths of extruded tube material through a machine which adds the reinforcement in braided, spiraled or knitted layers. In this method, the hose is not built on a mandrel. Therefore lengths are not restricted to the length of the mandrels.

Flexible mandrel method is used for mid-range working pressures (up to 5000 psi) with ID's of 1/8" to 1-1/2". The flexible mandrel method combines the long length advantage of non-mandrel hose with the close inside diameter tolerances and high pressure ratings of rigid mandrel hose. This is achieved by building the hose on a long length mandrel made of flexible plastic or rubber.

Non-Mandrel Hose

Flexible Mandrel

Rigid mandrel method is used for any rubber hose larger than 2" ID and also for 1/8" to 2" ID hoses that have higher working pressures, especially wire spiral reinforced products. Hose produced by this method is supported on a rigid metal mandrel and is handled horizontally during production. While a rigid mandrel limits the hose length, it ensures good control of the inside diameter. It also offers sufficient support to the tube that either wire or textile reinforcement may be applied at high tensions, which is necessary in high pressure constructions. After the cover is applied, the hose may be wrapped tightly with nylon tape for curing, giving the familiar "wrapped" appearance to the cover.

Rigid Mandrel - Braided

The *tubes (inner most layer of the hoses)* are manufactured either by *Extrusion* or by *Hand Wrapping*. In tube *extrusion* process, an uncured rubber or thermoplastic compound ribbon or pellets are fed into the extruder, through the screw or auger with proper temperature controls and finally forced through a pair of metal dies, where the cylindrical tube is formed. In wrapping process, rubber compound is calendered to a specific thickness and width and then spirally wrapped on the rigid mandrel with sufficient overlap to form the tube.

The *cover (outermost layer of the hoses)* is manufactured using techniques synonymous with the tubing techniques described previously. In most instances the same equipment is used.

Various types of reinforcements used in hoses are *Braid, Spiral, Knit, Wrap* and *Woven*. Combinations, such as spiral / knit, are available. Selection of reinforcing equipment is dependent on pressure rating, size, fitting requirements, flexibility, and crush resistance levels.

Vulcanisation (curing) changes the rubber hoses from a plastic to elastic material that is significantly stronger and rebounds to its original shape after load deformation. Vulcanisation is achieved by heating the rubber products to temperature between 280° F to 400°F. Pressurised steam is very commonly used for vulcanization. The vulcanisation techniques using pressurized steam include *Lead Cure, Wrap Cure, Open Cure, Curved Cure* etc.

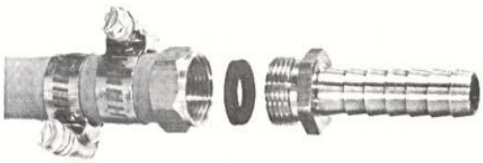
Couplings are attached to the end of hose in order to facilitate connection to a pressure source. In order to make this transition successful, the coupling termination must provide a leak proof seal and the hose / coupling interface must be properly matched. The three basic methods for making leak proof terminations are *Washer seal, Mechanical seal* and *Thread seal*.

The coupling types are broadly broken down into the following categories:-

(a) Reusable shanks with clamps
(b) Reusable couplings without clamps
(c) Non-reusable couplings
(d) Special Purpose fittings and clamps

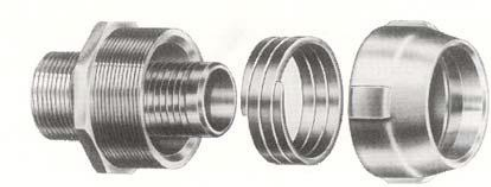
Reusable shanks with clamps consist of a shank, that can often be reused, and banding clamps. These types of couplings are further categorised into *short shank*, *long shank*, *interlocking type*, and *compression ring type* couplings.

Short Shank Couplings



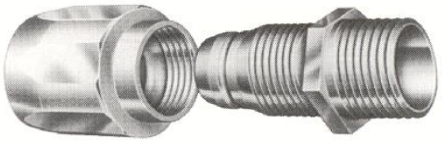
Long Shank Coupling

Interlocking Coupling

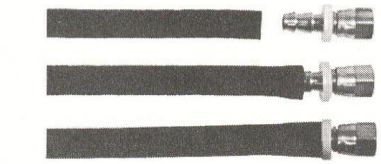


Compression Ring Type Coupling

Reusable couplings without clamps category can be clasified into two main types – '*Screw type'* and '*Push-on type'*. *Screw type* of reusable coupling consists of a threaded socket and shank. The socket is placed on the hose end and then the shank is screwed into the threaded portion of the socket until the shank is seated against the socket. The hose wall is compressed between the socket and shank to provide the coupling hold. *Push-on type* of coupling functions without the use of bands or sockets. They consist of a male serrated shank and require the use of specially designed hose.

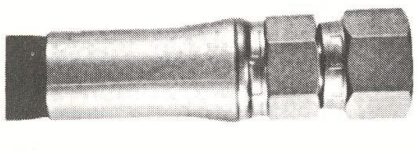


Screw type of Reusable Coupling

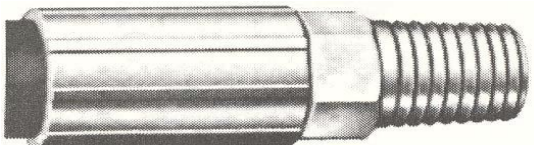


Push-on type of Coupling

There are four types of *Non-reusable couplings*: *swaged-on, crimped-on, internally expanded*, and *built-in fittings*. *Swaged-on Coupling* is applied by using special equipment to swage a ferrule on to the outside of the hose. *Swaging* is defined as squeezing the ferrule by passing it lengthwise into a split die. *Crimped-on Coupli*ng is applied by crimping or compressing it radially by a number of fingers moving toward the hose axis. This coupling attachment method is versatile since crimped assemblies can be used for low-pressure hose, as well as high-pressure hydraulic hose. *Internally Expanded Full Flow Coupling* is attached by passing an expander through the I.D. of the shank. This expands the shank, thus providing compression of the hose wall to aid in coupling retention while achieving full flow characteristics. Large bore hose is commonly manufactured with *Built-in fittings*. The primary reason is that the fittings need to be attached to the hose body in order to withstand the end thrust pressures. Common types are *Built-In Nipples* (BIN), *Built-in Nipple Flange* (BINF), *Built-in Rubber Covered Flange* (BIRF), and *Beaded Ends with Split Ring Flanges* (BE).

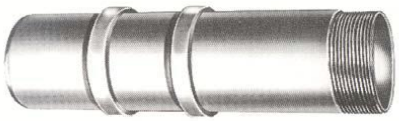


Swaged-on Coupling

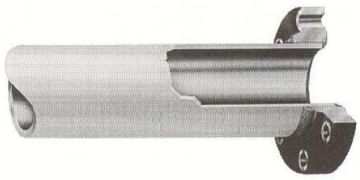


Crimped-on Coupling

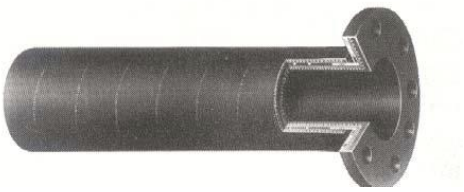
Internally Expanded Full



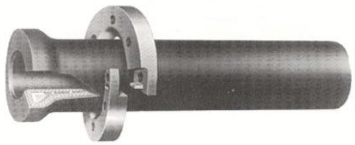
BIN



BINF



BIRF



BE

The *Special Couplings and Clamps* include following:-

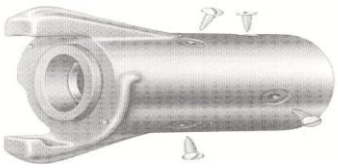
(a) *Sand Blast Sleeve Fittings* are designed so that the material carried through the hose does not contact the metal. It is used for sand blast and cement placement hose.

(b) *Radiator and Heater Clamps* are used for automotive coolant hose applications to attach the hose to the radiator, heater, or engine. These clamps can also be used for low-pressure water discharge applications.

(c) *Gasoline Pump Hose Coup*lings are similar to an internally expanded full flow coupling. They are primarily used for gasoline pump hose.

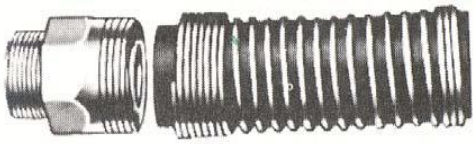
(d) *Welding Hose Couplings* have machined brass shanks with right and left-handed threads to prevent mixing up the acetylene and oxygen lines.

(e) *Fire Hose Couplings* are used with fire hoses. The bowl of the coupling fits over the hose end and the hose is forced against the inner surface of the bowl by an expansion ring.

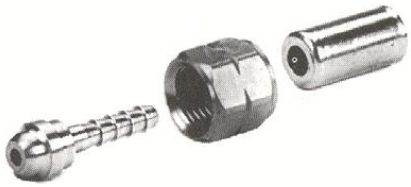


Sand Blast Sleeve Fitting

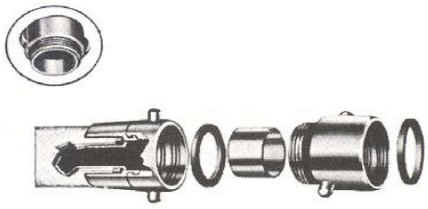
Radiator and Heater Clamp



Gasoline Pump Coupling



Welding Hose Coupling



Fire Hose Coupling

Important *Physical Characteristics* of hoses encompass following:-

(a) Flexibility and Bend Radius. *Flexibility* and *Minimum Bend Radius* are important factors in hose design and selection if it is known that the hose will be subjected to sharp curvatures in normal use. When bent at an angle too sharp, hose may kink or flatten in the cross-section. The reinforcement may also be unduly stressed or distorted and the hose life shortened. Adequate *Flexibility* means the hose should be able to conform to the smallest anticipated bend radius without overstress. The *minimum bend radius* is generally specified for each hose. This is the radius to which the hose can be bent in service without damage or appreciably shortening its life. The radius is measured to the inside of the curvature. Formula to determine minimum hose length given hose bend radius and degree of bend required:

$$\frac{A}{360} X\ 2\pi B = L$$

where:

A = Angle of bend
B = Given bend radius of hose
L = Minimum length of hose to make bend (Bend must be made equally along this portion of hose length).
π = (Pi) 3.14

(b) Suction and Vacuum. Some applications require the hose to resist collapse when exposed to suction and vacuum. Such hose get subjected to crushing forces because the atmospheric pressure outside the hose is greater than the internal pressure. The hose can collapse and restrict the flow, unless the hose is constructed to resist these pressure differentials. The most common method of preventing hose collapse is building helical wire reinforcement into the hose body. The size and spacing of the wire reinforcement will depend on the size of the hose and the expected pressure differential for the application.

The *effect of oil on rubber* depends on a number of factors that include the type of rubber compound, the composition of the oil, the temperature and time of exposure. Rubber compounds can be classified as to their degree of oil resistance based on their physical properties after exposure to a

standard test fluid. As per RMA classification, the rubber samples are immersed in IRM 903 oil at 100ºC for 70 hours. As a guide to user of hose in contact with oil, the oil resistance classes and a corresponding description are as follows:-

Class	Volume Change Maximum	Tensile Strength Retained
Class A (High Oil Resistance)	25%	80%
Class B (Medium / High Oil Resistance)	65%	50%
Class C (Medium Oil Resistance)	100%	40%

STANDARD QUALITY ASSURANCE PLAN

Part - I: **General Information**

1. The following generic information must generally be indicated on each QAP as its identity:-

(a) Item Name
(b) Item Technical Details (as applicable)
(c) Purchase Order Reference
(d) Name of Main Indenter/ Ordering Authority
(e) Name of end user
(f) Name of Firm / Manufacturer
(j) References of Relevant Drawings
(k) QAP No. & Date (as indicated by the firm)
(l) Contractual Delivery Date
(m) Inspection Authority
(p) Inspection Agency
(q) Quantity (as applicable)

Part - II:-

Standard QAP for Marine Rubber Hoses	Appendix "A"

APPENDIX-A

STANDARD QUALITY ASSURANCE PLAN FOR MARINE RUBBER HOSES DGQA/DQA(WP)/RUBBER HOSES/15/2019/REV 0 DATED 30 JAN 19

SL. NO.	MATERIALS / COMPONENTS AS PER SOTR/ QA ACTIVITY	QTY. AS PER P.O.	CHARACTERISTICS / TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE CRITERIA	FORMAT OF RECORD	ACTION BY QAE	REMARKS
1.0.0	**VERIFICATION OF DRAWINGS / DOCUMENTS / TYPE TEST**								
1.1.0	Drawings & Documents		Approved Drawings & Documents	100%	P.O / SOTR / TNC Minutes / PIL / Catalog	Conformity to specifications	List of approved drawings	R	
1.2.0	Type Test Reports		Availability & verification	100%	PO & SOTR / TNC Minutes / Catalog / Approved drgs.	Hoses should be tested in the past & relevant certificate is available	Type test reports	R	Type tests are to be conducted, if not undertaken earlier or test certificate not held or type tests are invalid in accordance with the latest specifications
2.0.0	**MATERIAL INSPECTION**								
2.1.0	Cover		Material identification & stamping	01 sample per lot per mix	P.O / SOTR / TNC Minutes / PIL / Catalog / Approved drgs. / NES 345 / ASTM D 380-2000 / IS 5797:2016	Conformity to specifications & approved drgs.	IR	CHP for W	Batch No. to be included in IR
			Polymer identification	01 sample per lot per mix		Conformity to specifications & approved drgs.	LTC	CHP for R	Testing to be done at NABL approved laboratory.
			Physical properties of rubber used:- (a)Tensile strength (b) Elongation at break (c) Hardness (d)Compression set (e)Volume change in distilled water (f) Modulus of Rigidity (g)Tear resistance (h)Abrasion resistance (j) Ozone resistance	01 sample per lot per mix		Conformity to specifications & approved drgs.	LTC	CHP for R	*Post satisfactory testing of material at NABL accredited laboratory proportion rubber mix will be identified and recorded.* *Subsequently during production process rubber raw material will be tested for identification of rubber properties &*

SL. NO.	MATERIALS / COMPONENTS AS PER SOTR/ QA ACTIVITY	QTY. AS PER P.O.	CHARACTERISTICS / TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE CRITERIA	FORMAT OF RECORD	ACTION BY QAE	REMARKS
			(k)Fluid resistance:- • Hardness change • Tensile strength change • Elongation at break change • Compression set • Volume swell (l) Flexibility at low temperature						*ash content. Values achieved in production testing must match the initial test results'.* Compression set test to be done on cylindrical buttons of known thickness
2.2.0	Tube / Lining		Material Identification & stamping	01 sample per lot per mix	P.O / SOTR / TNC Minutes / PIL / Catalog / Approved drgs. / NES 345 / ASTM D 380-2000 / IS 5797:2016	Conformity to specifications & approved drgs.	IR	CHP for W	Batch No. to be included in IR
			Polymer identification	01 sample per lot per mix		Conformity to specifications & approved drgs.	LTC	CHP for R	
			Physical properties of rubber used: (a)Tensile strength (b)Elongation at break (c) Hardness (d)Compression Set (e)Volume change in distilled water (f) Modulus of Rigidity (g)Tear resistance (h)Abrasion resistance (j)Fluid resistance:- • Hardness change • Tensile strength change • Elongation at break change • Compression set • Volume swell • ***Contact with Potable Water**	01 sample per lot per mix		Conformity to specifications & approved drgs.	LTC	CHP for R	Testing to be done at NABL approved laboratory *Post satisfactory testing of material at NABL accredited laboratory proportion rubber mix will be identified & recorded. Subsequently during production process rubber raw material will be tested for identification of rubber properties & ash content. Values achieved in production testing must match the initial test results'.*

SL. NO.	MATERIALS / COMPONENTS AS PER SOTR/ QA ACTIVITY	QTY. AS PER P.O.	CHARACTERISTICS / TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE CRITERIA	FORMAT OF RECORD	ACTION BY QAE	REMARKS
			(k) Flexibility at low temperature (l**) **Fuel soluble matter %age**						** Before a flexible fitting is accepted for use with potable water, evidence is to be supplied by manufacturer that the lining material has been satisfactorily tested in accordance with the 45th Report of the Director of Water Examination of the Metropolitan Water Board. Section XI, Materials in contact with Potable Water 1971-73.* ****Fuel soluble matter %age test is applicable only for fuel / AVCAT hoses**
2.3.0	Cover & Tube / Lining		(a)Resistance to accelerated ageing:- • Change in tensile strength • Change in elongation at break • Change in Hardness (b)Resistance to high & low temperature (c) Freedom from corrosive properties	01 sample per lot per size (dia)	P.O / SOTR / TNC Minutes / PIL / Catalog / Approved drgs. / NES 345 / ASTM D 380-2000 / IS 5797:2016	Conformity to specifications& approved drgs.	LTC	CHP for R	Testing to be done at NABL approved laboratory

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			(d)Adhesion checks: • Lining / Reinforcement • Cover / Reinforcement • Between Reinforcement Layers (e) Fuel contamination check						**For AVCAT hoses adhesion checks are to be performed dry as well as after contact with test liquid** **Applicable only for AVCAT hoses**
2.4.0	Reinforcement (Fabrics / Wires)		Material identification	01 sample per lot per size (dia)	P.O / SOTR / TNC Minutes / PIL / Catalog / Approved drgs.	Conformity to specifications& approved drgs.	IR	W	
			Physical & Chemical properties				LTC/ OEM TC	R	Testing to be done at NABL approved laboratory
2.5.0	End Fittings		Material Identification	01 sample per lot per size (dia)	P.O / SOTR / TNC Minutes / PIL / Catalog / Approved drgs.	Conformity to specifications & approved drgs.	IR	W	
			Physical & Chemical properties				LTC/ OEM TC	R	Testing to be done at NABL approved laboratory
3.0.0	**INPROCESS CHECKS**								
3.1.0	**TYPE TEST**								
3.1.1	Hose Assembly with couplings and fittings		Visual & Dimensional inspection – Length, OD, ID, Wall Thickness, Lining thickness, Wall concentricity	04 samples per lot per size (dia)	P.O / SOTR / TNC Minutes / PIL / Catalog / Approved drgs. / NES 345 / ASTM D 380-2000 / IS 5797:2016	Conformity to specifications & approved drgs.	IR	W	
			Bore Check				IR	W	
			Room temperature flexibility Test				LTC / OEM TC/ IR	R / W	In case of ***LTC***, test to be done at NABL approved Lab. Lab Test Report is to be ***Reviewed*** by QAE. In Case of ***IR***, tests are to be ***Witnessed***
			Low temp flexibility test				LTC / OEM TC/ IR	R / W	
			Pressure Test - Hydrostatic Stability (a) Hose elongation /				LTC / OEM TC/ IR	R / W	

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			contraction (b) OD expansion / change (c) Twist (d) Warp						by QAE.
			Pressure & Stiffness Test				LTC / OEM TC/ IR	R / W	
			Kink Test				LTC / OEM TC/ IR	R / W	
			Endurance Test				LTC / OEM TC/ IR	R / W	
			Vacuum Test				LTC / OEM TC/ IR	R / W	
			Proof Test				LTC / OEM TC/ IR	R / W	
			Burst Pressure Test				LTC / OEM TC/ IR	R / W	
			Cross-sectional Examination				LTC / OEM TC/ IR	R / W	
			Electrical bonding continuity & resistance				LTC / OEM TC/ IR	R / W	
			Flammability Test				LTC / OEM TC/ IR	R / W	
			Immersion Test (a) Change in volume Test (b)Strength Reduction Test Standard Test Fluid as per ASTM D471 / ISO 1817-2005 may be used until other liquids are specifically specified				LTC / OEM TC/ IR	R / W	***Applicable for fuel and lub oil hoses only*** In case of ***LTC***, test to be done at NABL approved Lab. Lab Test Report is to be ***Reviewed*** by QAE.

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									In Case of ***IR*** tests are to be ***Witnessed*** by QAE.
			Crush Recovery Test • After 1 min • After 10 mins				LTC / OEM TC/ IR	R / W	***Applicable for AVCAT hoses only***
			Measurement of mass per unit length				LTC / OEM TC/ IR	R / W	In case of ***LTC***, test to be done at NABL approved Lab. Lab Test Report is to be ***Reviewed*** by QAE.
			Change in length at max working pressure				LTC / OEM TC/ IR	R / W	In Case of ***IR***, tests are to be ***Witnessed*** by QAE.
3.2.0	**PRODUCTION TEST**								
3.2.1	Production Test		Visual & Dimensional inspection – Length, OD, ID, Wall Thickness, Lining thickness, Wall concentricity	100%	P.O / SOTR / TNC Minutes / PIL / Catalog / Approved drgs. / NES 345 / ASTM D 380-2000 / IS 5797:2016	Conformity to specifications & approved drgs.	IR	CHP for W	To be conducted for Hose & End fittings
			Bore check	100%			IR	CHP for W	To be done prior to fitment of end fittings
			Pressure test (1.5 X working of pressure)	100%			IR	CHP for W	
			Proof pressure test	01 sample per lot per size (dia)			IR	CHP for W	
			Burst pressure test	01 sample per lot per size (dia)			IR	CHP for W	
			Electrical bonding continuity & resistance	01 sample per lot per size (dia)			LTC / OEM TC/ IR	R / W	In case of ***LTC***, test to be done at NABL approved Lab. Lab Test Report is to be

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									Reviewed by QAE. In Case of ***IR***, tests are to be ***Witnessed*** by QAE
4.0.0	**FINAL INSPECTION**								
4.1.0	Final Inspection		Weight Recording	100%	P.O / SOTR / TNC Minutes / PIL / Catalog / Approved drgs. / NES 345 / ASTM D 380-2000 / IS 5797:2016	Conformity to specifications & approved drgs.	Weight Certificate	R	
			Marking on hose	100%			IR	W	
			Packing & Preservation	100%			IR	W	
			Tally & Identification	100%			IR	R	
4.2.0	Submission of Form-4 (I&T certificate)		Correctness	100%	SOTR, PO	SOTR,PO	Form-4 (I&T Certificate)	P	Submission of Form - 4 (I&T Certificate)

NOTE:-

1. Items to be supplied should conform to latest specifications.
2. Material Testing to be done at NABL accredited Laboratory.
3. The QAP does not apply to items not in the scope of supply of the firm.
4. Test of elastomer compound properties are to be undertaken with reference to the technical specification.
5. The objective of the tests is to ascertain compliance to the reference specifications. Tests which are not applicable as per the relevant reference specifications are not to be undertaken.
6. The column 'Quantity as per P.O' has been left blank which has to be filled by the firm as per P.O while submitting QAP for approval.
7. All test samples are to be offered to QAE for identification ensuring traceability.
8. Shelf Life of rubber should be as per the PO on the date of Final Inspection.
9. **Hoses are to be flushed, dried and blanked at both ends with end caps for preservation**.