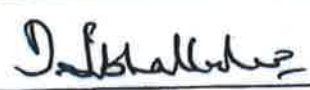



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**ACCEPTANCE TEST PLAN
FOR BULK SUPPLIES OF
BEML TATRA VEHICLE
BRAKE CYLINDERS**

Prepared by R&D Defence	Approved by COA (BEML)
	

पी मुनियांडी / P Muniyandi
प्र. वै. अ. / PScO
उप नियंत्रक / Dy Controller



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1.0 SCOPE

This document is applicable for the manufacture of parts, assembly and testing (both performance and Type) of the Brake Cylinders of 4 types. This document is to be followed by the manufacturer, QC and customer.

2.0 SYSTEM DESCRIPTION

Brake Cylinders requirement for BEML Tatra vehicles (variants) are given below and they are applicable to 'S' cam brake system.

- i) Front Axle-1 : 131612164012 (2/Eqpt.)
- ii) Front Axle-2 RH : 131612193017 (1/Eqpt.)
- iii) Front Axle-2 LH : 131612193019 (1/Eqpt.)
- iv) Rear Axle : 131612193004 (4/Eqpt.)

3.0 SPECIFICATION

Specification as per drawings for Cylinders Size, Stroke of Piston and applicable pressure.

4.0 GENERAL ARRANGEMENT

- a. The supplier shall check and ensure documents for all the raw materials as per relevant drawings and specification for the Mechanical, Chemical and metallographic properties from NABL approved labs prior to manufacturing. The raw materials that are meeting the drawing requirements are only to be used.
- b. The test reports for the raw materials shall be submitted to BEML-QA by the supplier and take approval before bulk production starts.
- c. Manufacturing method is Cold Deep Drawn process for cylinder housings and Pressure Die Casting (PDC) for Piston Head 1 & 2 of Rear cylinder and Top cover for FR1 & FR2.
- d. Detailed inspection of the components for dimensions as per drawing shall be carried out by the QC personnel of supplier and records are to be maintained and to be submitted for verification to BEML.
- e. The machined parts and inspection reports of parts and Assemblies shall be made available to the BEML-QA agency at works for verification.
- f. The following list of documents to be produced to BEML inspection rep. at the time of inspection of every batch.
 - i) Material test certificate for metal/rubber/plastic for that batch
 - ii) Dimensional reports of all assemblies and parts

- iii) Calibration records of test equipment
- iv) Type test of that batch

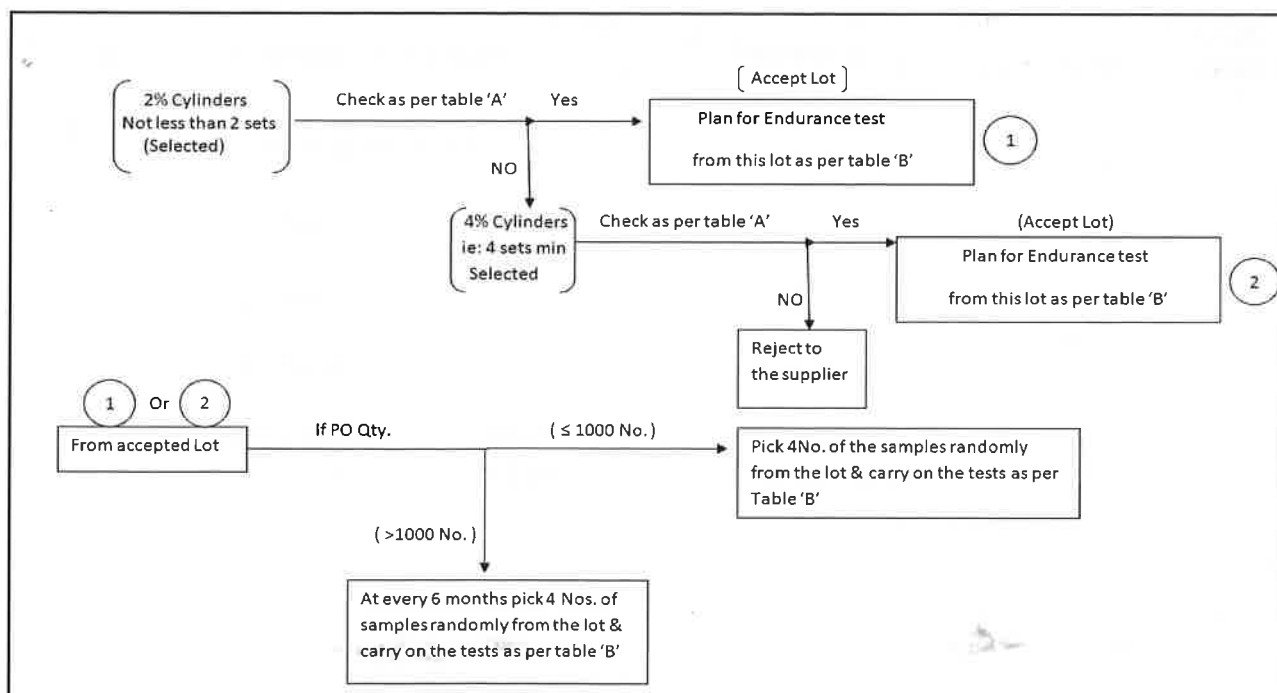
- g) Ordering, supply and acceptance follows as per BEML normal procedure. Each consignment shall be accompanied by packing list, Quality clearance document, Quality Inspection stamp certificate.
- h) Supply should have name plate consisting of BEML Part number, Part name, Month & Year of manufacturing.

5.0 VISUAL INSPECTION & OTHER TESTS

All the parts, sub-assemblies, assembly (100% of items) should be free from physical/mechanical defects like dents/damages due to transportation, blow holes, cracks, corrosion effect, burns, dust/dirt and peeling of colour etc. Supplier should ensure the same.

5.1 PERFORMANCE TESTS

Supplier shall offer the cylinders batch (Lot) for Quality check.



Flow chart: The below explained sample testing procedure has been given in the above Flow chart.

100% of sample checking to be carried out as per Table –A by Vendor (M/s. Nucon Aero space).

Select 2% of the each category (part number) of cylinders (not less than 2 cylinders) randomly/or specified by BEML from the Lot and carry out checking as per 'Table-A' below.

In case some of the brake cylinders do not confirm to the parameters as per Table-A, a second selection of 4% of the each category (part number) cylinders (not less than 4 cylinders) select randomly/ or specified by BEML from the Lot and carry out checking as per 'Table-A' below.

If some of the brake cylinders are found not confirming as per 'Table-A', then the entire consignment will be returned/rejected to the manufacturer. If the case is otherwise the consignment is considered to be satisfactory and refer below 6.1 Type Test procedure in Table-B).

Table-A #: As per above discussion, selected cylinders to be tested as per this table.

Sl.No.	Overview of the tests	Clause No.	Sampling (*)	Supplier	BEML	CQA (BEML) (**)
1	Inspection of dimensions	1	100%	P	W	-
2	Strength Test	2	100%	P	W	-
3	Sealing tests	3	100%	P	W	-
4	Test for proper operation	4	100%	P	W	-

'Table-A' (above) & 'Table-B' (below) follows for P - Perform, W - Witness, (*) - on sampling basis, (**) - Will be carried out Quality Audit.

Explanation of Clauses in above Table 'A':

Clause-1: Inspection of dimensions:

The dimensions are checked with applicable instruments of appropriate accuracy.

Clause-2 : Strength test:

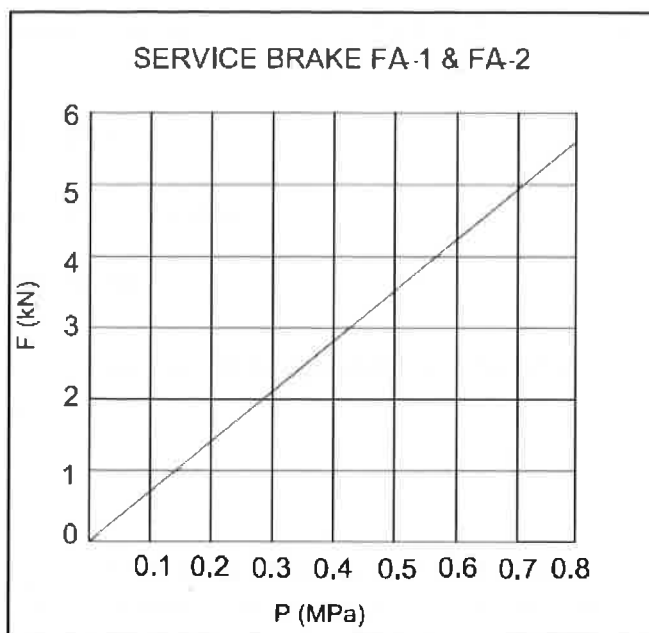
Each brake cylinder assembly is to be subjected to strength test by compressed air to 12 bar ie. 1.5 times the normal operating pressure, for 3 min. The hardware should retain its shape without any deformation or leak.

Clause-3: Sealing test: Sealing test procedure follows as below.

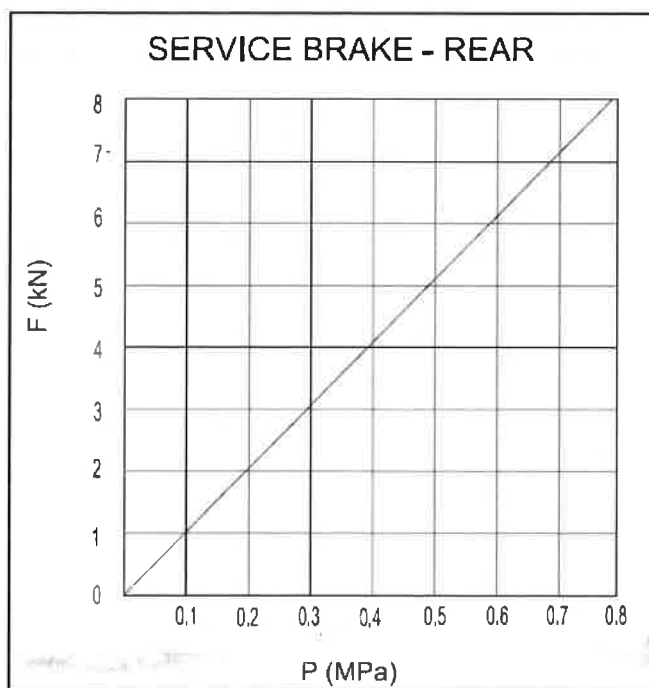
- The cylinder is connected to an air tank of volume 12 litres and at a pressure of 0.3 MPa, it should not exhibit a reduction in pressure of more than 0.01 MPa during a period of 20 minutes.
- The test is carried out at a stroke of 30 mm.
- The cylinder immersed in water to a depth of 1 metre, with the vent opening connected to atmosphere, no water should ingress into the cylinder during a period of 1 hour of immersion.
- With the cylinder immersed in water, with a pressure of 0.02 MPa, the air must not escape from the venting area / should be closed water tight.
- Water must not enter into the cylinder even during operation under water. The scheduled test for actual fording operation will be carried out on the test equipment which enables verification of the operation under water to a depth of 0.5 m for a period of 1 hour. After immersion of the cylinder, 10 cycles of operations shall be carried out during a period of 1 minute at a stroke of 80 mm, after 1 hour interval once again 10 cycles are carried out.
- Water should not enter into the cylinder even in case of failure of the dust proof seal.

Clause-4: Testing for proper operation:

All the brake cylinders are to be tested for the brake force produced at different cylinder pressure to confirm that the force requirements are met. The test to be conducted for 2, 4, 6 & 8 bar and the values should be as per the graphs below with tolerance -5% for 'Front axle-I, Brake cylinders' and 'Front axle-II, Brake cylinders'.



The test to be conducted for 2, 4, 6 & 8 bar and the values should be as per the graphs below with tolerance -7% for Rear axle-I & II, Brake cylinders.



- The movement of the piston in the working position must be in both the directions and must be smooth without sticking and other undesirable effects.

- During reduction in pressure below the piston to 0 MPa, the piston and piston rod must return to the starting position.

5.2 ACCEPTANCE CRITERIA

As per the relevant / applicable drawings.

6.0 TYPE TESTS PROCEDURE

If all the above tests completed on the cylinders successfully, then, refer PO copy and follow the below procedure.

6.1 TYPE TEST

If PO quantity less than 1000 nos. of each category in a year, select 1 no. from each of 4 types of cylinders randomly from the lot (covered in article 5 above) and carry out the Type tests as per 'Table-B'. If PO quantity more than 1000 nos. in each category in a year, select 1 no. from each of 4 types of cylinders randomly from the lot (covered in article 5 above) and carry out the Type tests as per 'Table-B', once in every manufacturing period of 6 (six) months. Since FR-2 (LH) & (RH) are same except for the mounting flange orientation, they are considered as single category and either LH or RH or combination of them can be used for Type/Endurance tests.

Table-B

Overview of portions of the tests	Clause No.	Order of tests from sample nos.			
		1	2	3	4
Test for water tightness	3c, 3e				x
Test for resistance to changes in temp.	5	x			
Test for proper operation	4	x			
Strength & Sealing tests	2, 3	x			
Inspection of parts of rubber and plastic material which should not fail during any test	-	x			
Strength test	2	x			
Test for resistance to vibration	6		x		

Test for proper operation	4		x		
Sealing test	3		x		
Inspection of dimensions	1		x		
Test for resistance to corrosion	7		x	x	
Durability test	8				x
Test for proper operation	4		x		x
Sealing test	3				x
Thorough inspection of all parts after dismantling the assembly	-				x

In sample number 2 occurrence of corrosion is evaluated on individual parts.

In sample number 3 occurrence of corrosion is evaluated on the outer surface.

Explanation of Clauses in above Table 'B':

Clauses: 1, 2, 3 and 4 are covered under Table- 'A'

Clause-5: Test for resistance to change in temperature:

This test is carried out on test equipment which can ensure the following:

- The cylinder is placed in the chamber and cooled to a temperature of $-40\pm 3^{\circ}\text{C}$, at which it is maintained for 2 hours. Then the temperature is increased to $-30\pm 3^{\circ}\text{C}$ and tested for proper operation and sealing, during which pressurized air at a temperature $-30\pm 3^{\circ}\text{C}$ is admitted into the cylinder. During the tests a leakage of maximum 0.05 MPa for a period of 10 minutes from air reservoir of 12 litres is permitted. Use of Anti freezer not required in the testing due to Silicon base seals & lubricants used due to their wide range of flowability.
- The cylinder is heated to a temperature of $60\pm 2^{\circ}\text{C}$ at which temperature it is maintained for 2 hours and tested for proper operation and sealing during which pressurized air at a temperature of $60\pm 2^{\circ}\text{C}$ is admitted into the cylinder. During the tests a leakage of maximum 0.05 MPa for a period of 10 minutes from air reservoir of 12 litres is permitted.



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Clause-6: Test for resistance to vibration:

Resistance to vibration is tested on suitable equipment, which is calibrated and must be able to withstand the characteristic vibration of 50Hz and five times the normal gravitational acceleration for a period of 4 hours. Cylinders must not be damaged during the test.

Clause-7: Test for resistance to corrosion ##:

Salt fog test are to be carried out on thoroughly degreased cylinder assembly, test to be carried out for a total duration of 96 hours. This test is to evaluate the adequacy of surface protection coatings to withstand the corrosive environment exposed to, satisfactorily. At the end of the test, clean the cylinder. Check and confirm that it is free from corrosion to the extent which would prevent its further use.

Clause-8: Durability:

Durability is verified by life tests (below given Life test/Endurance test) which is the ability of Brake cylinders to maintain capability under given test conditions.

Life Test/Endurance Test:

To determine the durability of Brake cylinders the below given tests to be performed.

- i). The Brake cylinders Service Brake to be tested for 2,00,000 strokes at the rate of 1000 cycles/hour at a constant pressure of 0.4 MPa and with 2/3 of the maximum stroke of the piston.
- ii) The Brake cylinders Emergency Brake to be tested for 50,000 strokes at the rate of 1000 cycles/hour at a constant pressure of 0.6 MPa and with 2/3 of the maximum stroke of the piston.

After this test there should not be reduction in pressure of more than 0.01 MPa during 10 minutes duration, at a pressure of 0.4 MPa (in Emergency brake testing 0.6 MPa) from an air reservoir of 12 litres.

7.0 WARRANTY

12 months from the date the material is put to actual use or 18 months from the date of receipt of supply whichever is earlier and if any defects are found within the above period for any reason stated, the supply has to be replaced by the supplier at free of cost within a reasonable time. Rubber items/seals condition to be checked thoroughly during fitment on vehicle.

8.0 PACKING, TRANSPORT AND STORAGE

8.1 Packing:

All openings in the unit are suitably plugged and the Brake Cylinders transport boxes, packed wrapped in waterproof paper to prevent any damage during transport.

8.2 Transport and Storage:

Brake cylinders must be transported in suitable covered condition so that during transport damage can be avoided. Transportation and Storage must not be in open area or unprotected from atmosphere/Temperature.

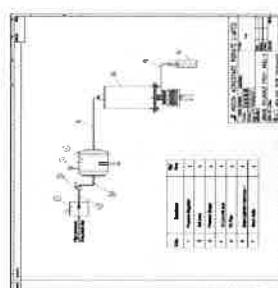
Storage area must be well ventilated and relative humidity must not be more than 80%. Transport/Storage temperature should not be in sudden change. The supply laid out freely at least 20cm above the floor but not stored on floor.

For the supply / storage period more than one month, it is necessary to protect against corrosion suitably and the method should be agreed in advance between manufacturer and BEML.

After a two year period of storage the manufacturer and BEML must agree on the measures to be taken on the supply before fitting on vehicles. Rubber items/seals condition to be checked thoroughly at this stage and to be changed if required. In the stores there must be a record of the period of storage and the type of protection given.



FA-1 Cylinder: Sealing test set up



FA-1: Schematic diagram



FA-2: Sealing test set up



RA: Sealing test set up

➤ The above photos/images are set up at vendor works

9. REFERENCE DOCUMENTS

a) Standard: CSN 30 3557 #

b) Standards: IS 9844-1981 ##

