



Hevea Rubber Technologies (P) Ltd.

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Internal Document for Testing Procedure for Elastomeric Bearings

Document Details: Testing of Expansion Joints

Product: Strip Seal Expansion Joints

Testing Location: Hevea Rubber Technologies Pvt. Ltd

Reference Specification : IRC SP 69 : 2011



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1 Visual Inspection

All expansion Joints of the lot are visually inspected for absence of any defects in surface finish, shape or any other supervisual defects

2 Dimensional Analysis

All joints are inspected for overall plan dimensions, height breadth, thickness and C/S Area

Height of Edge Beam	Min 80 mm	Measured using vernier calliper
Thickness of Edge Beam	Min 10 mm	Measured using vernier calliper
Thickness of Lip Seal	Min 6 mm	Measured using vernier calliper
Min Cross Sectional Area	Min 1500 mm ²	Calculated using a weighing balance
Spacing of Anchor Bolts	1 in 100 mm	Measured using a tape

Length & Breadth



Thickness



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Expansion Joint - Steel Edge Beam and Chloroprene Seal

Serial No.	Location	Drawing No.	Length of the Joint
1		As mentioned in certification	

Dimension Analysis

SI No	Parameter	MoRTH Spec	Actual Dimension	Comments
1	Height of the Edge Beam	Min 80 mm	101 mm	Approved
2	Thickness of Edge Beam	Min 10 mm	12.10 mm	Approved
3	Thickness of lip seal	Min 6 mm	6.5 mm	Approved
4	Area of Edge Beam	Min 1500 mm ²	1624 mm ²	Approved
5	Spacing of Anchor Bolts	Max 125 mm	120 mm	Approved
7	Length of Anchor Bolts	-	160 mm	Approved

Prepared By
Kurian Kurien

Witnessed By

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Inspection of Strip Seal Expansion Joint System

Thickness of Paint

Serial No.	Location	Drawing No.	Length of the Joint
1	As mentioned in certification		

The sample was taken and the elchometer was used to gauge the thickness of the paint. This was found to be above 150 mm as prescribed by IRC SP 69: 2011

Process Time for Test: 10 minutes

Inference

Test Result : The paint thickness was checked at random points and was found to be above 150 mm

Elchometer



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Inspection of Strip Seal Expansion Joint System

Dye Penetration Test

Serial No.	Location	Drawing No.	Length of the Joint
1		As mentioned in certification	

D. P Material Used

- A) Cleaner Make Orion 115 D
- B) Penetrant Make Orion 115P
- c) Developer Make Orion 115 R

Process Time for Penetration: 10 minutes

Inference

Test Result : No Significant defects were observed

Post Cleaning : Yes. Cleaned and recoated with the paint



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Inspection of Strip Seal Expansion Joint System



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Inspection of Strip Seal Expansion Joint System

Pull out Test

A Sample piece of 1 mtr seal selected.

Design movement of elastomeric seal = 40 mm

Serial No.	Location	Drawing No.	Length of the Joint
1	As mentioned in certification		

Serial No.	Seal Opening	Expansion %	Observation	Remark
1	40	0	No Slip	OK
2	80	100%	No Slip	OK
3	120	200%	No Slip	OK
4	142	255%	Seal Slip off	OK

Pull out test is carried out once on 1 meter sample piece (RM) selected at random.

The test piece is fixed to the test frame using fastening bolts and subjected to lateral force.

The joint is stretched until the sealing element slips off. The minimum stretching of the joint before slip off shall be at least 150% of the rated movement capacity of the seal.

The maximum movement of the expansion joint - 40 mm

The minimum criteria for passing the pull out test - The seal should not pull out before 60 mm.

The joint was stretched till 120 mm and the seal was still in place.

Test Result

:As the seal slipped from the strip seal at 255% which is > 150% as per specification. Hence found satisfactory

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Inspection of Strip Seal Expansion Joint System

Cyclic Motion Test

Serial No.	Location	Drawing No.	Length of the Joint
1	As mentioned in certification		

Cyclic Motion Test is carried out once on one meter sample piece selected at random. The test sample is fixed to the test frame using fastening bolts and subjected to 9100 expansion and contraction cycles @ minimum 30 cycles per hour

At test site the frequency was adjusted to 6-7 cycles per minute or 380 cycles per hour to ensure that the test is completed within 25 hours. The test movement was set at 55 mm

The test was conducted for a total of 25 hours and the seal was taken out after the test.

Test Result : No Sign of distress on the strip seal or the edge beam was found after 9100 cycles

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Inspection of Strip Seal Expansion Joint System

Ponding Test

Serial No.	Location	Drawing No.	Length of the Joint
1	As mentioned in certification		

Water shall be continuously ponded along one meter length of the joint for a minimum period of 4 hours for a depth of 25 mm above the highest point of joint top.

The depth of water shall not be less than 25mm any time during the test. A close inspection of the underside of the joint shall not reveal any leakage.

Test Result : After 24 hours the seal was taken out and inspected for any leakage. None was found

Prepared By
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Witnessed By



1. Physical Properties	IS
a. Hardness	IS 3400 (2)
b. Tensile Strength	IS 3400 (1)
c. Elongation at Break	IS 3400 (1)
d. Compression set	IS 3400 (10)
e. Accelerated Ageing	IS 3400 (4)
f. Adhesion Strength Test	IS 3400 (14)

Test Name	Hardness testing
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Test Procedure

IRHD Tester is placed over the bearings or the test pieces and the measurement is read directly from the gauge of the tester. The test will be satisfactory if the hardness read is 53±5



Test Name	Tensile Strength
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Test Procedure

Dumbbells are prepared from the test compound as per specification given in IS 3400 This is fixed on to the tensile testing machin and stretched at a constant rate of transverse till the test piece breaks. The load (Breaking force in Newtons) at which the test piece breaks is noted and the following calculations are computed

$$\text{tensile strength} = \frac{\text{(load at break)}}{\text{(original width) (original thickness)}} \quad \begin{matrix} \text{Breaking Force in Newton} \\ \text{Area - Initial cross sectional area in mm} \end{matrix}$$

3 Readings are taken and average arrived at, Test will be deemed satisfactory if TS>13.8 Mpa

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Test Name	Elongation
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Test Process

Test is conducted in the same manner as for tensile strength. Length of the narrow portion at the breaking point is noted and the following calculations are made

$$\% \text{ Elongation} = \frac{L - L_0}{L_0} \times 100$$

Where L = Length in millimeters between bench marks at break
Lo= The intial length in millimeters between bench marks

Test will be deemed satisfactory if the elongation at break is 250% or more



Note the same machine is used for testing the aged piece (for Tensile and Elongation) and Adhesion piece



Test Name	Compression Set
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Test Process

Test buttons are prepared from test compound. 3 test buttons are compressed up to 75% of the initial thickness inside a metal fixture. This is placed inside an ageing oven at 100°C for 24 hours. After the ageing is over, the pieces are taken out and the thickness is measured

The following calculation is made

$$\text{Compression Set \%} = \frac{t_0 - t_i}{t_0 - t_s} \times 100$$

Where t_0 =	Initial Thickness in mm of test pieces
t_i =	thickness of test pieces in mm after recovery
t_s =	height of the spacer in mm

Test will be deemed satisfactory if the Compression set obtained is less than 28%

Ageing Oven



Compression Set Apparatus





Test Name	Accelerated Ageing
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Test Process

Dumbbells and buttons are placed inside an ageing oven and are subjected to a temperature of 100°C for 72 hours. After ageing is completed, hardness, tensile and elongation tests are done on the dumbbells

The Test will be deemed satisfactory if the following results are achieved.

Change in Hardness	+15	Note for DMRC +5
Change in Tensile Strength	-15%	
Change in Elongation	-30%	

Ageing Oven



Tensile Testing



Hardness Testing





Test Name	Adhesion Strength
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Test Process

A 6mm thick rubber test piece is moulded on to a metal piece. The width of the rubber piece will be 25mm and length 125mm which will adhere to an area of 25 mm² of the face of the metal. The metal piece dimensions are 1.5mm thick x 25 mm width x 60mm long
The test piece with metal attachment is fixed on the tensile testing machine and load is applied. The maximum force required to cause separation over the distance of 25 mm is recorded.

Calculation is as follows

The breaking force from the tensile testing machine is noted in kgF 'A'

The value is then converted to Newton by multiplying it with 9.81 and then multiply by 1000 to convert the value to KN

Hence $9.81 \times 1000 \times A$ is the breaking force for 25 mm of the material.

$$\begin{array}{rcl} 25 & = & 9.81 \times 1000 \times A \\ 1000 & = & ? \end{array}$$

Applying unitary method

$$\text{Adhesion in KN/meter} = \frac{9.81 \times 1000 \times A}{25}$$

The test will be deemed satisfactory if the separation takes place after a force of 7 KN/Meter

UTM Machine'





2. Chemical Properties	ASTM
a. Specific Gravity	ASTM D - 297
b. Ash Content	ASTM D 297
c. Polymer Identification	IS 3400 (10)
d. Polymer content	(Indirect)

Test Name	Specific Gravity
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Specific gravity of the test piece will be determined by Hydrostatic method
The weight of the specimen in air and then in water is taken and the density is calculated as follows

$$\text{Density, D} = \frac{0.9971 \times A}{A - (B - C)}$$

Where A – mass of specimen in gms
B – mass of specimen and wire in water in gms
C – mass of supporting wire in gms

Test Name	Ash Content
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Weigh 1 gm of specimen of sample and keep it in an ignited crucible. This is placed inside a muffle furnace and heated up to 550°C for one hour. The door of the furnace is opened 3 to 5 cm and heating is continued for 30 more minutes. The crucible is then removed from the furnace and cooled in a dessicator and then weighed.

$$\% \text{ Ash} = \frac{(A - B)}{C} \times 100$$

Where A – weight in gms of ash plus crucible
B – weight in gms of crucible
C – weight in gms of specimen



Test Name	Polymer Identification
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Test Process

Shake a 0.2 gm sample with 2 cm³ of Iodine Solution. If the violet colour fades noticeably in 2 to 3 minutes. CR is indicated. Burn the sample in contact with a clean copper wire. A persistent green flame indicates chlorine.

Test Name	Polymer Content
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Test Process

The rubber Content of the specimen is calculated by subtracting the sum of non-rubber constituents from 100%

% Polymer - 100% – (% of Acetone +% of Carbon + % of ash)

a) Acetone Content

1 gm of homogenous rubber compound is weighed and wrapped in a filter paper. This is placed in an extraction apparatus containing acetone and then extracted for 12 to 16 hours (6 to 8 extractions per hour). The extract is then dried and cooled and then weighed.

$$\text{Solvent extract \% by weight} = \frac{W1}{W2} \times 100$$

Where W1 = Weight in gms of the matter extracted

W2 = Weight in gms of the test portion

b) Carbon black Content

0.5 gm of acetone extracted specimen is placed in a beaker and 30 ml of concentrated nitric acid is added. This is heated on a water bath till the reaction subsides completely and carbon black has settled completely. Cool and filter through asbestos matted gooch crucible by gentle suction. When all carbon black has been transferred, wash it with concentrated nitric acid and hot water till the filtrate is acid free. The filtrate is then washed with acetone. Dry the crucible in an oven at 100 ± 5°C for about 1 hour. Cool in a desiccator and weigh (W2).

The Crucible is then placed in a muffle furnace at 900°C for about 1 hour to burn off carbon black. Cool to room temperature and weigh again (W3).

$$\% \text{ of Carbon Black} = \frac{W2 - W3}{W} \times 100$$



Where W weight in gms of specimen before acetone extraction
W2 weight in gms of specimen before ashing
W3 weight in gms of specimen after ashing

c. Ash Content
As given earlier

II Material Properties of Mild Steel

Test Name	Physical Properties
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The 3mm or 4 mm specimen is cut in to dumbbell shapes and loaded on to the Universal Testing Machine (UTM-STEEL). The load is applied to the specimen in a transverse manner. The reading on the computer will be noted when the specimen breaks.

The operator will take the Gauge length (initial and Final), width (Initial and Final) and thickness (initial and Final). These readings are then fed on to the computer system. The computer will generate the following readings using the above mentioned meqs

Ultimate Tensile Strength	IS 2062	Min 250 Mpa
Yield Stress	IS 2062	Min 410 Mpa
Elongation	IS 2062	Min 23%

