



Form No. 2038

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PRODUCT STANDARD

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**TITLE : FLEXIBLE SEPARATOR (AIR CELL)**

**1. CONSTRUCTION**

POLYIMIDE NYLON FABRIC COATED ON BOTH SIDES WITH SYNTHETIC RUBBER AND MEETING THE COMPLETE REQUIREMENT OF THIS SPECIFICATION SHALL BE USED FOR FABRICATION OF FLEXIBLE SEPARATORS. CONSTRUCTION OF THE SEPARATOR SHALL BE AS SHOWN IN FIGURE-1. ADHESIVES USED SHALL BE COMPATIBLE WITH AIR AND TRANSFORMER OIL AT 100 °C. JOINTS SHALL BE PROPERLY DESIGNED & SUITABLY VALCANIZED. FURTHER, SEPARATOR SHALL BE REINFORCED AT BOTTOM FACE AS SHOWN IN FIGURE 1. TO AVOID DAMAGE DUE TO CONTACT WITH MAGNETIC OIL GAUGE FLOAT. THERE SHALL NOT BE ANY PATCH WORK. ADAPTOR USED SHALL BE MADE FROM STRUCTURAL STEEL CONFORMING TO Fe-410-S TO IS:226. ADAPTOR AND BOLTS SHALL BE CADMIUM PLATED AND PASSIVATED (CD-8 OF IS:1572) OR ZINC PLATED AND PASSIVATED.(Fe/Zn 12.5 OF IS:1573).. THE WIDTH OF THE OVERLAP AT THE JOINTS TO BE SUCH THAT THERE IS NO POSSIBILITY OF JOINT OPENING AND LEAKAGE AND SHOULD BE MINIMUM 75 mm. THE WIDTH OF SIDE JOINTS SHALL BE AS IN FIGURE 1.

**2. FUNCTIONAL REQUIREMENT**

- (I) FLEXIBLE SEPARATOR SHALL BE SUITABLE FOR CONTINUOUS USE IN TRANSFORMER OIL AT -20°C TO 100°C
- (II) INSIDE COATING SHALL BE VERY GOOD WEATHER AND OZONE RESISTANT. OUTSIDE COATING SHALL BE TRANSFORMER OIL RESISTANT. COMPOUNDS USED FOR COATING SHALL NOT DETERIORATE IN SERVICE.

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**TITLE : FLEXIBLE SEPARATOR (AIR CELL)**

- (III) SEPARATOR SHALL BE SUITABLE FOR INFLATION AND DEFLATION  
DUE TO CHANGE IN OIL VOLUME IN THE CONSERVATOR. FURTHER,  
SEPARATOR SHALL BE DESIGNED TO COLLAPSE SLOWLY AS OIL LEVEL  
RISES IN THE CONSERVATOR.
- (IV) SEPARATOR SHALL NOT DEVELOP CRACKS AT -20°C.
- (V) FIXATION LUGS AND ADAPTER SHALL BE PROVIDED ON THE  
SEPARATOR AS SHOWN IN FIGURE-1.

3. MATERIALS

3.1 BASIC FABRIC  
BASIC FABRIC USED FOR MAKING COATED FABRIC FOR MANUFACTURING  
FLEXIBLE SEPARATORS SHALL MEET THE FOLLOWING REQUIREMENT  
MATERIAL - POLYAMIDE 6/NYLON 6, PLAIN WEAVE FABRIC OF SUITABLE  
CONSTRUCTION.

3.2 COATING COMPOUNDS  
THE RUBBER COMPOUNDS USED FOR INSIDE AND OUTSIDE COATING ON THE  
POLYAMIDE/NYLON FABRIC SHALL MEET THE REQUIREMENT AS GIVEN BELOW-

3.2.1. OIL SIDE COATING

MATERIAL ACRYLONITRILE BUTADINE RUBBER (NBR) COMPOUND BA - 70 OF BS  
BS: 2751.

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## TITLE : FLEXIBLE SEPARATOR (AIR CELL)

(ix)	AGEING IN TRANSFORMER OIL TO IS:335 AT 100°C FOR 168 HRS CHANGE IN PROPERTIES OF RUBBER COMPOUND AFTER AGEING.		T1	IS : 3400 (Pt-6)
	(a) MASS (b) VOLUME (c) HARDNESS (d) TENSILE STRENGTH (e) ELONGATION AT BREAK	+ 3 % MAX. + 10% MAX ± 3 IRHD MAX. -15% MAX. -35% MAX.		IS: 3400 (Pt-9) IS: 3400 (Pt-6) IS: 3400 (Pt-2) IS: 3400 (Pt-1) IS: 3400 (Pt-1)
(x)	AGEING OF OIL AS PER BS 5354 (a) INCREASE IN ACIDITY (b) INCREASE IN SLUDGE CONTENT	0.1 Mg KOH/gm MAX. 0.05% MAX.	T2	IS: 1448 (Pt-2) IS: 12177 TO BE TESTED AT BHEL USING ONE STD. TEST SLAB SUPPLIED BY MANUFACTURER . SIZE 3x12.5 x 75 mm
(xi)	AGEING IN TRANSFORMER OIL TO IS:335 AT 100 °C FOR 30 DAYS. (a) CHANGE IN HARDNESS (b) CHANGE IN VOLUME	±5 IRHD MAX... + 12% MAX.	T2	IS: 3400 (Pt-6) IS:3400 (Pt-2) IS:3400 (Pt-6)
(xii)	FLEXIBILITY AT LOW TEMPERATURE (-10°C)	SHALL NOT CRACK OR BECOME BRITTLE	T1	SAMPLE WILL BE KEPT IN COLD CHAMBER FOR 5 HRS AND THEN BENT BY 180°C ON A MANDREL OF 3mm DIA.
(xiii)	COLOUR	BLACK	T	VISUAL

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TITLE : FLEXIBLE SEPARATOR (AIR CELL)

## 3.2.2. AIR SIDE UNDER COATING

MATERIAL - CHLOROPRENE RUBBER COMPOUND C 60 OF BS 2752

SL. NO	PROPERTY	REQUIREMENT	TYPE OF TEST	TEST METHOD
(i)	HARDNESS	$+5$ $60$ $-4$ IRHD	T	IS:3400 (Pt-2)
(ii)	SPECIFIC GRAVITY	1.36 ± 0.04	T	IS:3400 (Pt-9) METHOD B
(iii)	TENSILE STRENGTH	13 Mpa MIN.	T	IS:3400 (Pt-1)
(iv)	ELONGATION AT BREAK	250 % MIN.	T	IS:3400 (Pt-1) LARGE TYPE TEST SPECIMEN
(v)	COMPRESSION SFT $+0$ $-2$ HRS. AT 70° C.	25 % MAX.	T1	IS:3400 (Pt-10)
(vi)	RESISTANCE TO HEAT AGEING, 168HRS AT 100°C IN AIR (a) CHANGE IN HARDNESS (b) CHANGE IN TENSILE STRENGTH (c) CHANGE IN ELONGATION AT BREAK	+ 10% MAX. - 25% MAX - 40 % MAX	T1	IS:3400 (Pt-4) IS:3400 (Pt-2) IS:3400 (Pt-1) IS:3400 (Pt-1)
(vii)	ADHESION TO AND CORROSION OF METALS 168HRS AT 70°C.	THERE SHALL BE NO CORROSION OR PITTING OF THE METAL AND COMPOUND SHALL NOT ADHERE OR SHOW ANY SIGN OF LIQUID EXTRACTION	T1	BS 903 Pt - A 37 METHOD A USING CARBON STEEL
(viii)	ADHESION TO POLYAMIDE 6 FABRIC	45N±2.5 cm WIDTH OF STRIP. MIN.	T1	TEST SPECIMEN TO IS: 3400 (Pt-5) TESTING BY MANUFACTURER'S GLUE METHOD
(ix)	FLEXIBILITY AT LOW TEMP. (AT - 10° C)	SHALL NOT CRACK OR BECOME BRITTLE	T1	SAMPLE SHALL BE KEPT IN COLD CHAMBER FOR 5hrs. AND THEN BENT BY 180° ON A MANDREL OF 3mm DIA
(x)	COLOUR	BLACK	T	VISUAL

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**TITLE : FLEXIBLE SEPARATOR (AIR CELL)**

3.2.3 AIR SIDE OUTER COATING: ~~COMPOUND~~ MATERIAL-----HYPALON 40

SL. NO.	PROPERTY	REQUIREMENT	TYPE OF TEST	TEST METHOD
(i)	HARDNESS	65±5 IRHD SHORE A	T1	IS : 3400(Pt-2)
(ii)	SPECIFIC GRAVITY	1.6 ± 0.05	T1	IS : 3400 (Pt-9) METHOD - B
(iii)	TENSILE STRENGTH	8 M pa MIN.	T1	IS : 3400 (Pt-1)
(iv)	ELONGATION AT BREAK	250% MIN.	T1	IS : 3400 (Pt-1)
(v)	FLEXIBILITY AT LOW TEMP. (AT -10°C)	SHALL NOT CRACK OR BECOME BRITTLE	T1	SAMPLE SHALL BE KEPT IN COLD CHAMB- FOR 5 HRS. & THEN BENT BY 180° ON MANDREL OF 3mm DIA.
(vi)	RESISTANCE TO HEAT AGEING IN AIR 168HRS AT 100 °C (a) CHANGE IN HARDNESS (b) CHANGE IN TENSILE (c) CHANGE IN ELONGATION AT BR EAK	+10% MAX  -25% MAX -40% MAX	T1	IS: 3400 (Pt-2)  IS:3400 (Pt-1) IS :3400 (Pt-1)
(vii)	RESISTANCE TO OZONE (O3) FOR 96 HRS. AT 40°C O3 CONCENTRATION 200 ± 20 PPHM	SHALL NOT DEVELOP CRACKS	T2	IS: 3400 (Pt 20)
(viii)	COLOUR	OLIVE GREEN	T	VISUAL

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**TITLE : FLEXIBLE SEPERATOR (AIR CELL)**

4.0 COATED FABRIC :-

Sl. NO	PROPERTY	REQUIREMENT	TYPE OF TEST	TEST METHOD
(i)	MATERIAL	NYLON6. PLAIN WEAVE. FABRIC OF SUITABLE CONSTRUCTION	T	IS : 667 - 1981
(ii)	THICKNESS	POLYIMIDE FABRIC 0.5±0.05mm COATED FABRIC 1.25±0.1 mm	T	IS 7702 IS : 7016 (Pt-1)
(iii)	MASS OF POLYIMIDE FABRIC	OIL SIDE COATING 455g/m <sup>2</sup> MIN COMBINED AIR SIDE UNDER & OUTER COATING 615g/m <sup>2</sup> MIN COATED FABRIC 1400 <sup>+200</sup> g/m <sup>2</sup> -80	T	IS : 7016 (Pt-1)
(iv)	WEIGHT OF BASIC FABRIC	200 g/m <sup>2</sup> MIN	T	IS : 7016 (Pt-1)
(v)	COLOUR OF	AIR SIDE OLIVE GREEN OIL SIDE BLACK	T	VISUAL
(vi)	TEAR STRENGTH ALONG THE WARP ALONG THE WEFT	300 N, MIN.	T	IS : 7016 (Pt-3)
(vii)	BREAKING STRENGTH ALONG THE WARP ALONG THE WEFT WIDTH MIN.	3 kN/50 mm	T	IS : 7016 (Pt-2)
(viii)	ELONGATION AT BREAK ALONG THE WARP ALONG THE WEFT	25% MIN 30% MIN	T	IS : 7016(Pt-2)
(ix)	AIR PERMEABILITY	5X10 <sup>-12</sup> cm <sup>3</sup> .cm ----- MAX cm <sup>2</sup> S.cm. Hg	T2	A STM - D 1334
(x)	LOW TEMP BEND TEST AT -20°C.	SHALL PASS	T1	IS : 7016 (Pt-10) SPECIMEN SHALL BE KEPT IN COLD CHAMBER FOR 5HRS AND THEN BENT BY 180° ON A MANDREL OF 3mm DIA
(xi)	BURSTING STRENGTH	7 MPa MIN.	T2	IS : 7016 (Pt - 6) METHOD -A : METHOD-B
(xii)	RESISTANCE TO PERFORATION	390 N MIN.	T1	MANUFACTURER'S METHOD
(xiii)	RESISTANCE TO DAMAGE BY FLEXING	SHALL WITH STAND 100000 CYCLES WITHOUT DAMAGE	T1	IS : 7016 (Pt-4) SPECIMEN SIZE WILL BE 25mm X 150 mm TESTING WITHOUT FOLDING
(xiv)	BLOCKING RESISTANCE	NO BLOCKING	T1	IS : 7016 (Pt-9)
(xv)	MEASUREMENT OF CUT GROWTH	SHALL PASS THE TEST	T1	MANUFACTURER'S METHOD

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**TITLE : FLEXIBLE SEPARATOR (AIR CELL)**

**VISUAL TESTING:**

1. LONGITUDINAL/VERTICAL FOLD ALONG THE LENGTH IS NOT ACCEPTABLE.
2. FABRIC FOLD UPTO 150 mm IS ALLOWED ACROSS THE WIDTH
3. PRESENCE OF FABRIC CONSECUTIVE KNOTS WITHIN DISTANCE OF 2 METERS IS NOT ACCEPTABLE.
4. MISSING CORDS, FABRIC HOLE MORE THAN 0.5 MM DIA IS NOT ACCEPTABLE
5. TIGHT EDGE, BAGGINESS ARE NOT ACCEPTABLE

**5. TESTING OF FLEXIBLE SEPARATOR :**

- (i) SURFACE FINISH (ROUTINE CHECK) :  
SHALL HAVE GOOD SURFACE FINISH . FREE FROM DEEP LINES,PITS UNCOATED AREA, PIN HOLES, CRACKS, PAINT MARK ETC.SURFACE SHOULD BE CLEAN AND FREE FROM DUST, SOIL AND OTHER EXTRANEIOUS MATTER. COATING SHALL BE UNIFORM WITHOUT ANY PATCH WORK..
- (ii) SEPARATOR SHALL BE INFLATED & DEFLATED TEN TIMES.THE PRESSURE SHALL BE 10 Kpa (0.105kg cm2 OR 1.5 PSI). THERE SHALL NOT BE ANY VISIBLE SIGN OF DAMAGE TO SEPARATOR (ROUTINE TEST).
- (iii) SEPARATOR SHALL BE INFLATED AT 10KPa (0.105Kg/cm2 OR 1.5 PSI) AND SHALL BE KEPT FOR 24HRS THERE SHALL NOT BE ANY LEAKAGE/SEEPAGE OF THE AIR (ROUTINE TEST).
- (iv) DIMENSIONS AS PER FIG.1 ON PAGE-9 OF TR 10150 A AND BHEL PURCHASE ORDER(ROUTINE CHECK)

**6. PACKING:**

FLEXIBLE SEPARATORS SHALL BE PROPERLY FOLDED AND WRAPPED IN POLYETHENE SHEET AND THEN PACKED IN PAPER BOARD BOXES TO AVOID DAMAGE IN TRANSIT BOXES TO BE PROPERLY STRAPPED.

7. GUARANTEE WARANTY CERTIFICATE, REPAIR INSTRUCTIONS STORAGE HANDLINE & INSTALLATION INSTRUCTIONS SHALL BE FURNISHED ALONG WITH EACH SEPARATOR.

8. THE MANUFACTURES LOGO SHALL BE SCREEN PRINTED ON AIR CELL.INK USED FOR PRINTING SHALL BE COMPITABLE WITH TRANSF. OIL.

9. CODES FOR TYPE OF TEST INDICATED IN PARA 3 & 4 ABOVE ARE AS UNDER:

- |    |                                |
|----|--------------------------------|
| T  | ROUTINE TEST                   |
| T1 | TYPE TEST (ONCE IN 3 YEARS)    |
| T2 | TYPE TEST (ONCE IN FIVE YEARS) |

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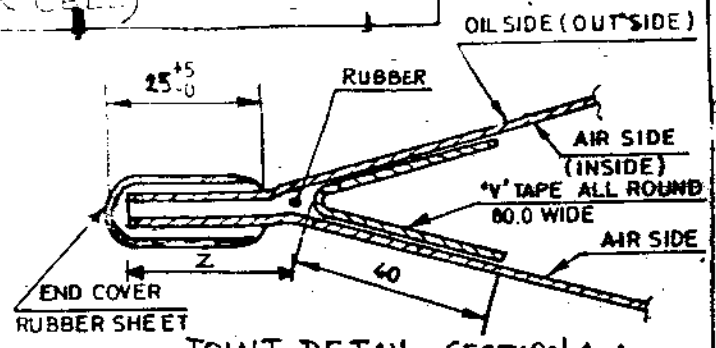
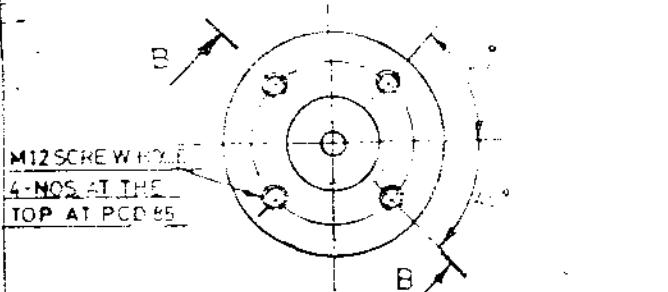
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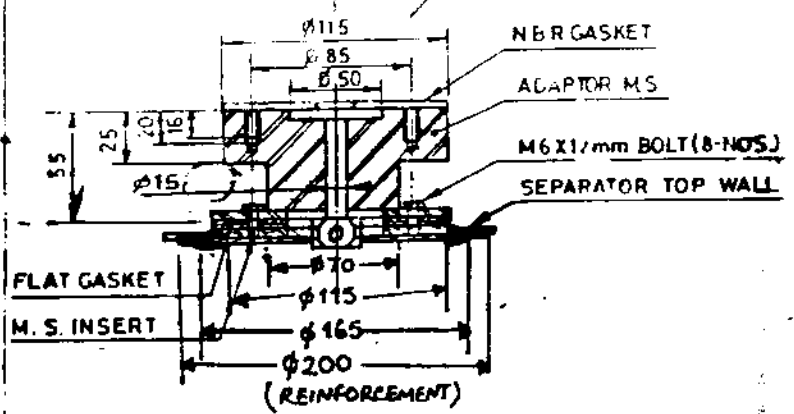
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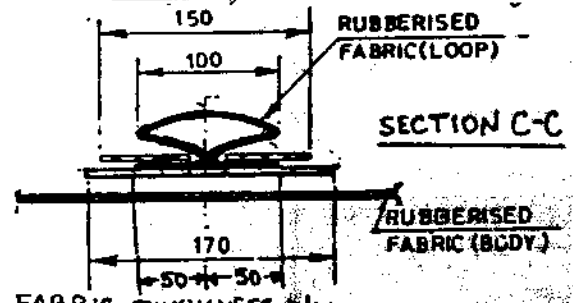


JOINT DETAIL SECTION A-A

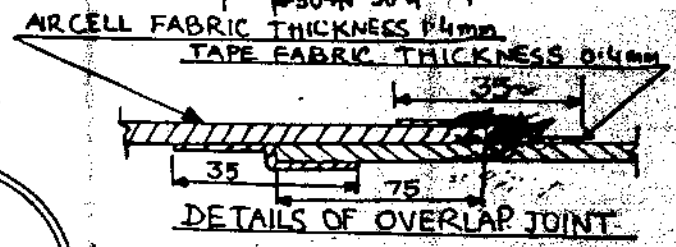
SIZE OF AIRCELL	Z
LARGE	35
MEDIUM	30
SMALL	25



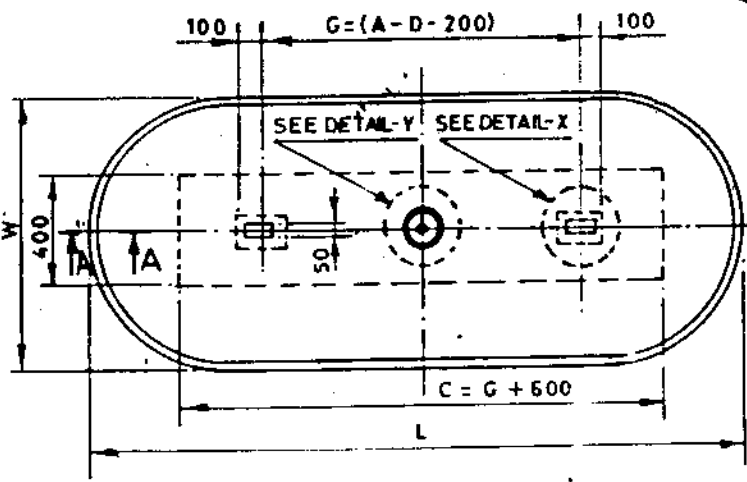
SECTION B-B (DETAIL-Y)



SECTION C-C

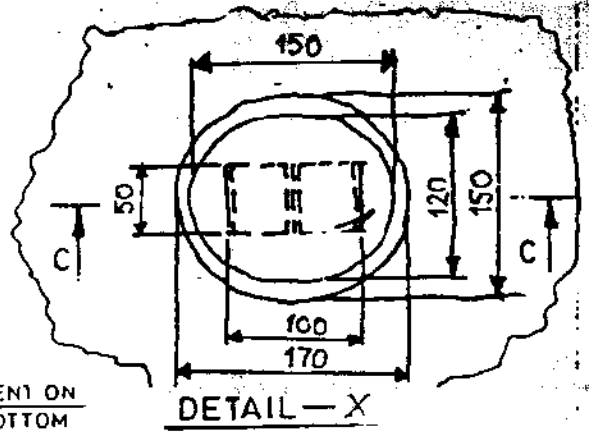


DETAILS OF OVERLAP JOINT



A & D ARE CONSERVATOR LENGTH AND DIA

REINFORCEMENT ON AIR CELL BOTTOM



DETAIL - X

FIG - 1

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TITLE : **FLEXIBLE SEPERATOR (AIR CELL)**

**DIMENSIONS AND TOLERANCES OF FLEXIBLE AIR CELL IN THE DEFLATED CONDITION**

S.No.	WIDTH W $\pm$ 1.5%	LENGTH L $\pm$ 1.5%	DISTANCE BETWEEN LOOPS G $\pm$ 10	
1	825	3035	2010	SMALL
2	980	2350	1170	
3	982	3230	2050	
4	1140	2620	1280	MEDIUM
5	1140	3270	1930	
6	1295	2755	1260	
7	1455	2435	780	LARGE
8	1295	3745	2250	
9	1455	3215	1560	
10	1455	3995	2340	
11	1610	3490	1680	
12	1610	4130	2320	
13	1770	3670	1700	
14	1770	4190	2220	
15	1925	3775	1650	
16	1925	4665	2540	
17	2080	4230	1950	
18	2080	4980	2700	
19	2240	4550	2110	
20	2240	5200	2750	
21	2395	4795	2200	
22	2240	5850	2200	

NOTE: ALL DIMENSIONS ARE IN mm.

REF: RRI 1 & RRI 2

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