



TSD 6206 A

# PLANT PURCHASING SPECIFICATION BHOPAL

BP22962

Rev. No. 04

PAGE 1 OF 2

**SUPERSEDES**  
BP 22962 Rev. 03

## NYLON EXTRUSIONS AND MOULDING (TYPE 6)

### 1. GENERAL :

This specification governs the quality of nylon extrusions and mouldings made from Type 6 general purpose nylon. The material shall not be affected by alkaline, weak acids, alcohols and other common solvents. Superior electrical grade materials are covered by BP 22961 (Nylon Type 11).

### 2. APPLICATION :

Used as cable bush and oil injection plug in A.C. Machines, as rod form in switchgear and for manufacturing of sealing washers for use in Transformers.

### 3. COMPLIANCE WITH NATIONAL STANDARDS :

There is no Indian Standard covering this type of material.

### 4. DIMENSIONS AND TOLERANCES V

Shall be stated on order or the drawing accompanying the order.

### 5. FINISH:

The material shall be smooth and free from surface imperfections and blow holes.

### 6. TEST METHODS :

Unless otherwise specified, the test shall be conducted in accordance with the relevant methods of BS: 7663-1993. In case of components, density, water absorption and hardness shall done on the components itself.

### 7. SAMPLE FOR TEST :

Six no. of samples in size 3 tk x 150 x 150 mm moulded from the same batch and in the same manner as the consignment concerned, shall be supplied for testing and approval purpose.

### 8. PHYSICAL PROPERTIES :

8.1 Density at Room Temp. :  $1.13 \pm 0.05$  g/cc.

8.2 Water Absorption at Room Temp. : 1.5% Max.

Revision :  
Reviewed & brought upto date.

Issued by :  
STANDARDS AND MATERIALS GROUP  
TECHNICAL SERVICES DEPARTMENT

Rev No : 04

Date : 12.02.2022

Date of first issue : May-1969



TSD 6207 A

## PLANT PURCHASING SPECIFICATION BHOPAL

BP22962

Rev. No. 04

PAGE 2 OF 2

### 9. MECHANICAL PROPERTIES :

#### 9.1. Tensile Strength : 60 N/mm<sup>2</sup>, Min. (OPTIONAL TEST)

In case of rod, the test shall be done in as received condition

#### 9.2. Hardness (ASTM D 785) : 110 ± 10, Rockwell 'L'.

### 10. ELECTRICAL PROPERTIES :

#### 10.1. Electrical Strength (BDV) at Room Temp.

Unless otherwise specified on the drawing, BDV value shall be 10 kV/mm on a 3mm thick test specimen.

### 11. CHEMICAL PROPERTIES :

#### 11.1. Identification of material :

The material shall be nylon when identified by Infra-red spectrophotometer or by any conventional method.

### 12. TEST CERTIFICATE :

Three copies of test certificates shall be supplied with each consignment.

In addition, the supplier shall ensure to enclose one copy of test certificate along with their dispatch documents to facilitate quick clearance of the material.

The test certificate shall bear the following information.

BP 22962 (Rev. 04) : Nylon Extrusions and Mouldings (Type 6) :

Our Order No.

Batch/Lot No.

Test values obtained/certificate for compliance for clause 5 and 8 to 11.

### 13. PACKING AND MARKING :

The nylon extrusions and mouldings shall be suitable packed to avoid contamination and damage in transit. Packages shall be labelled with the following information.

BP 22962 : Nylon Extrusions and Mouldings (Type 6)

Our Order No.

Supplier's / Manufacture's Name & Grade.

Date of Manufacture.

Drawing and Item Nos.

Net and gross weight

64520/2024/HEP-SWM20900



# PRODUCT STANDARD

## SWITCHGEAR ENGINEERING DIVISION

SG 12719 REV.00

PAGE 1 OF 2

### GLASS FIBRE-REINFORCED POLYAMIDE MOULDINGS TYPE PA 66 GF 30

#### 1.0 INTRODUCTION

Glass fibre re-inforced polyamide mouldings are used as mechanical / electrical parts such as centering rings of vacuum interrupters in the assembly of vacuum circuit breakers.

#### 2.0 MATERIAL PROPERTIES

The basic type of this thermoplastic material is Polyamide PA 66 reinforced with a mean glass fibre content of 30 % by weight and is designated by : PA 66 GF 30 generally conforming to guideline VDI/VDE 2479 sheet 2. The reference values of the main properties of this material are :

PROPERTY	UNIT	TEST METHOD	VALUE
----------	------	-------------	-------

#### - PHYSICAL :

Density	g/cubic cm	DIN53479	1.35
Glass content	%	-	30
Water Absorption (23 deg C, saturation)	%	DIN53472	5.5

#### - MECHANICAL

Flexural strength	N/sq mm	DIN 53452	230
Yield stress	N/sq mm	DIN 53455	190
Breaking elongation	%	DIN 53455	5
Ball pressure hardness (30s)	N/sq mm	DIN 53456	265

#### - ELECTRICAL

Electrical breakdown strength	KV/mm	DIN 53481	60
----------------------------------	-------	-----------	----

#### - THERMAL

Melting point	Deg C	-	255
Upper temperature limits for application for a few years			
- For static loading	Deg C	-	170
- For impact loading	Deg C	-	120
- For short temperature peaks	Deg C	-	250

COPYRIGHT AND CONFIDENTIAL

The information on this document is the property of Bharat Heavy Electricals Limited  
It must not be used directly or indirectly in any way detrimental to interest of Co.

REV.

ALTD.

APPD.

DATE.

PRINTS TO :-

SWM(P)  
QCX  
MCD  
HVD

APPROVED –

R. K. Shukla

PREPARED


SMM

ISSUED

RKK

DATE

17.07.95

			<b>PRODUCT STANDARD</b> SWITCHGEAR ENGINEERING DIVISION		SG 12719 REV.00	
						PAGE 2 OF 2
		Process shrinkage (injection moulding) %				0.3 to 0.7
		<b>FLAMMABILITY</b> Group as per VDE 0304 Part 3/5.10				VDE0304 II C
<b>COPYRIGHT AND CONFIDENTIAL</b>  The information on this document is the property of Bharat Heavy Electricals Limited. It must not be used directly or indirectly in any way detrimental to interest of Co.		Trade names of equivalent materials (non-reinforced) of this category are				
		<b>Trade name</b>		<b>Manufacturer</b>		
		AKULON 'R600'		M/S AKZO, NETHERLANDS		
		DURETHAN 'A'		M/S BAYER, GERMANY		
		MARANYL 'A'		M/S ICI, UK		
		SNIAVITRID		M/S SNIA, ITALY		
		TECHNYL 'A'		M/S RHONE, FRANCE		
		ULTRAMID 'A'		M/S BASF, GERMANY		
		ZYTEL 'E'		M/S DU-PONT, USA		
		NAILONPLAST 'A'		M/S MONTEFIBRE, SNIA, ITALY		
		CELANESE NYLON		M/S		
		CATALIN		M/S CATALIN, USA		
		TORAY		M/S TOYO RAYON, JAPAN		
		<u>3.0 COLOUR OF MOULDINGS</u> Black unless otherwise specified on drawing				
		<u>4.0 DIMENSIONS AND FINISH</u> Dimensional and finish requirements of the mouldings shall be as per the item drg.				
		<u>5.0 SUPPLIER APPROVAL PROCEDURE :</u> Supplier shall send few samples of the mouldings ordered before bulk supply for dimension verification and assembly trials. Also Test certificate / Guarantee certificate / Proof of using equivalent grade material shall be submitted along-with samples for approval of materials used during mfg. After the sample approval only the bulk supplies shall be made.				
		<u>6.0 ACCEPTANCE CRITERION</u> <b>SUPPLIER'S TEST CERTIFICATE :</b> Supplier shall send a Test Certificate of material properties / Guarantee Certificate for use of approved material grade.  <b>CHECKS AT BHEL :</b> Tests for density, Glass content, water absorption and Hardness shall be conducted on the component and the values shall be as per para 2.				
		<u>7.0 IDENTIFICATION OF MARKINGS</u> Supplier's name/logo, mfg batch no. shall be etched / marked on the flat face of the moulding surface.				
		8.0 PACKING : The mouldings shall be packed suitably to protect against damages during transit and atmospheric effects.				





## CORPORATE PURCHASING SPECIFICATION

AA 222 05

Rev. No. 02

PAGE 1 OF 5

**PHENOLIC LAMINATED PAPER BASE SHEET GRADE- P 3****1.0 GENERAL:**

This specification governs the quality requirements of laminated sheet made from layers of cellulose paper using thermosetting phenolic resin as the bonding medium. The material has temperature index of at least 105.

**2.0 APPLICATION:**

For use in switch gear, transformers etc., where good electrical insulating properties and very good mechanical properties under humid conditions with very low water absorption and hot punching properties are required.

**3.0 COMPLIANCE WITH NATIONAL STANDARDS:**

The material shall comply, in general, with the following requirements of National standard and also meet the requirements of this specification.

IS: 2036 - 1995, Gr.: P 3 : "Phenolic Laminated Sheets"

**4.0 DIMENSIONS AND TOLERANCES:****4.1 Sizes:**

Material shall be supplied in the nominal width, length and thickness as stated on BHEL order.

**4.1.1 Preferred Thickness:**

0.5, 1.0, 1.5, 2, 3, 4, 5, 6, 8, 10, 12, 15, 20, 25, 30, 40 and 50 mm.

**4.2 Tolerances:****4.2.1 Tolerance on Width and Length:**

Width or length, mm	Tolerance, $\pm$ mm
Upto & including 1000	35
Above 1000	50


**Revisions :**

Cl: 33.4.3 of MOM of MRC-E

**APPROVED :**

INTERPLANT MATERIAL  
RATIONALISATION COMMITTEE-MRC ( E )

Rev. No. 02	Amd.No.	Reaffirmed	Prepared	Issued	Dt. of 1st Issue
Dt: 01.10.2003	Dt :	Year :	BHOPAL	Corp. R&D	OCTOBER, 1978

AA 222 05	CORPORATE PURCHASING SPECIFICATION	
Rev. No. 02		
PAGE 2 OF 5		

**4.2.2 Tolerance on Thickness:**

Thickness, mm			Thickness, mm		
Above	Upto & incld.	Tolerance (±) mm	Above	Upto & incld.	Tolerance (±) mm
-	0.4	0.07	10.0	12.00	0.50
0.4	0.6	0.09	12.0	16.0	0.60
0.6	1.0	0.11	16.0	20.0	0.70
1.0	1.6	0.14	20.0	25.0	0.85
1.6	2.0	0.17	25.0	32.0	1.09
2.0	2.5	0.20	32.0	40.0	1.25
2.5	3.0	0.21	40.0	50.0	1.50
3.0	4.0	0.23			
4.0	5.0	0.28			
5.0	6.0	0.34			
6.0	8.0	0.40			
8.0	10.0	0.45			

**4.3 Tolerance on Flatness - for sheets of Thickness 3.0mm and above:**

The flatness of sheets shall be such that when a sheet is placed without restraint on a flat surface, concave side, if present up, departure at any point of the surface from a light straight edge laid in any direction upon it shall not exceed the following:

- a) 0.50 mm under a 300 mm straight edge.
- b) 3.00 mm under a 600 mm straight edge.
- c) 6.00 mm under a 1000 mm straight edge.

**5.0 FINISH:**

The surface of the sheets shall be even, smooth, free from visible defects like blisters, loose fibres, resin concentration, delamination, wrinkles, local deformation and dents. The material shall be supplied with trimmed edges and the colour shall be preferably natural tan or natural brown, unless otherwise stated in BHEL order.

**6.0 TEST SAMPLES:**

Three sheets of ordered thickness and size 300 X 300 mm, prepared from the same batch shall be supplied for testing and approval purpose.



## CORPORATE PURCHASING SPECIFICATION

AA 222 05

Rev. No. 02

PAGE 3 OF 5

**7.0 PROPERTIES:**

When tested in accordance with the relevant test methods specified in BHEL standard AA 085 17 01, the material shall show the following properties:

**7.1 Physical Properties:****7.1.1 Water Absorption:**

Maximum permissible water absorption after immersion in water 20<sup>0</sup>C for 24 hours shall be as follows:

Nominal thickness, mm	mg., max	Nominal thickness, mm	mg., max
0.4	23	4.0	33
0.5	24	5.0	36
0.6	24	6.3	38
0.8	25	8.0	41
1.0	26	10.0	45
1.2	27	12.0	48
1.6	29	16.0	55
2.0	30	20.0	62
2.5	31	25.0	70
3.0	32	Above 25*	91

\* Thickness above 25mm shall be machined to 25mm, keeping one side intact.

**7.1.2 Resistance to Hot Oil:**


When a specimen is immersed in hot oil at 110<sup>0</sup> C for 24 hours, it shall not show any sign of splitting, blistering, disintegration or appreciable warping.

**7.1.3 Heat Ageing:**

When a test piece of 100 x 100mm of ordered thickness is kept at 125<sup>0</sup> C for 24 hours and then cooled, it shall not show any sign of crumbling, cracking or blistering.

**7.2 MECHANICAL PROPERTIES:****7.2.1 Cross Breaking Strength:**

For sheets 1.5mm thickness and above: 90 N/mm<sup>2</sup>, min.

AA 222 05	CORPORATE PURCHASING SPECIFICATION	
Rev. No. 02		
PAGE 4 OF 5		

**7.2.2 Shear Strength Flat wise:**  
For sheets 1.5mm thickness and above: 61 N/mm<sup>2</sup>, min.

**7.2.3 Tensile strength:**  
For sheets above 1.5mm and above : 70 N/mm<sup>2</sup>, min.

**7.2.4 Compressive Strength Proof:**  
For sheets 5mm and above : 82 N/mm<sup>2</sup>, min.

**7.2.5 Impact Strength - Charpy-Edgewise:**  
For sheets above 2.5mm and below 10mm thick: 0.8 Joules/cm<sup>2</sup>, min  
For sheets 10mm thick and above : 1 Joules/cm<sup>2</sup>, min

**7.2.6 Splitting Load Edgewise:**  
For sheets 10mm and above : 1.96 KN, min

**7.2.7 Punching ( For sheets of thickness below 2.5mm):**  
When the sheet under test is pierced in a single operation with a pattern given in IS:1998, there shall be no excessive lifting or cracking around the holes..

**7.2.8 Machinability (For sheets of thickness 3mm and above):**  
The sheet shall be capable of being sawn, milled, drilled and tapped with a M 3.5 tap and shall be capable of being shaped in a shaping machine without showing any signs of splitting, cracking or chipping.


**8.0 ELECTRICAL PROPERTIES:**

**8.1 Insulation Resistance :**  
Insulation resistance of the test sample after immersion in water at 20<sup>0</sup> C for 24 hours, shall be 1000 Megohms, minimum.

**8.2 Electric Strength Proof In oil at 90<sup>0</sup>C:**

**8.2.1 Flatwise:**

Thickness, mm ( upto 3mm)	Proof voltage, kV
0.4	6.6
0.5	7.5
0.6	8.7
0.8	10.3
1.0	11.8
1.2	13.0
1.6	15.0
2.0	16.6
2.5	18.5
3.0	20.5

	<b>CORPORATE PURCHASING SPECIFICATION</b>	<b>AA 222 05</b>
		<b>Rev. No. 02</b>
		<b>PAGE 5 OF 5</b>

**8.2.2 Edge wise:**

For sheets 3mm and above: 20 kV

**8.2.3 Dissipation Factor (Tan delta):**

0.2 max. at 50 Hz.

**9.0 TEST CERTIFICATES:**

Unless otherwise specified, three copies of test certificates shall be supplied alongwith each consignment .

In addition, the supplier shall ensure to enclose one copy of the test certificate along with their despatch documents to facilitate quick clearance of the material.

The test certificate shall bear the following information:

AA 22205 (Rev.No 02): Phenolic Laminated Paper Base Sheet Grade P 3  
 BHEL order No.  
 Manufacturer's / Supplier's Name  
 Grade/Trade mark, if any  
 Batch/Lot No.  
 Quantity supplied  
 Test Values obtained and certificate for compliance with clauses 7.0 and 8.0.

**10.0 PACKING AND MARKING:**

The boards shall be suitably packed in wooden cases lined with water proof paper from inside. Each sheet should be separated from other sheet by a thick paper or cord board..

Identification slips shall be pasted suitably on all corners of each board/sheet giving the size of the board and manufacturers code number/grade.

Each package shall be marked with the following information:

AA 22205 Phenolic Laminated Paper Base Sheet Grade P 3  
 BHEL order No.  
 Manufacturer's / Supplier's Name  
 Grade/Trade mark, if any  
 Batch/Lot No.  
 Thickness, Width & Length  
 No. of sheets  
 Net weight and Gross weight

**11.0 REFERRED STANDARDS (Latest Publications Including Amendments) :**

1) IS:1998                      2) IS:2036                      3) AA 085 17 01