IPSS	**SPECIFICATION FOR SYNTHETIC FABRIC REINFORCED RUBBER. CONVEYOR BELTING - GENERAL PURPOSE**	**IPSS:2-03-006-20** *(***Second *Revision****)*
	Based on IS 1891 (Part-1):1994	Formerly: IPSS: 2-03-006-95 (First Revision)

0. FOREWORD

0.1 This Inter Plant Standard prepared by the Standards Committee on Conveyors, IPSS 2:3, in consultation with reputed manufacturers of conveyor belts, was adopted in 1988, revised with first revision in February 1995 and subsequently revised with second revision in August, 2020.

0.2 The developments in the belt manufacturing technology incorporating the use of natural and/or synthetic rubber, nylon or any other man-made fibre have been adopted to the extent possible. Necessary guidelines for conversion of existing installation using cotton/ cotton-nylon reinforced belting to other man-made fibre reinforced belting have been provided in **Appendix-A.**

0.3 In the preparation of this standard assistance has been derived from IS 1891 (Part-1):1994 Conveyor and elevator textile belting specification: Part-1: General purpose belting (fourth revision).

0.4 This standard was originally published in 1988. In the light of the experience gained in the usage of this standard since then and after extensive discussions with the executives in the steel plants and captive mines, consultancy organizations and the experts from the conveyor belt manufacturing organizations, through a Workshop on Conveyors, held on 21 January 1995, this revision has been finalized. The major changes include:

a) Inclusion of belt widths of 1800 mm and 2000 mm.

b) Modification on the provisions of transverse joints in line with IS 1891 (Part-I):1994.

c) Deletion of the provision of longitudinal joints.

d) Modification of requirements on elongations for NN belting.

e) Fixation of manufacturer's responsibility on the quality of reels for packaging of rolls of belting.

f) Replacement of all test procedures by reference to appropriate Annexes of IS 1891 (Part-1):1994.

I. SCOPE

1.1 This Inter Plant Standard deals with conveyor belting in the range of 500 mm to 2000 mm wide and having woven synthetic fabric construction. It specifies the basic requirements of fabric reinforced rubber conveyor belting for

general purpose and sets out a range of belts according to their construction, width, rating and cover thickness.

1.2 This standard does not cover the requirements of heat, oil and fire resistant belting.

2.0 DEFINITIONS

2.1 For the purpose of this standard the definitions given in IS 4240:1984. Glossary of conveyor terms and definitions (first revision) shall apply, in addition to the following:

2.1.1 **NW (PP)** - The abbreviation used to identify the fibres used in the woven fabric forming part of the carcass of a conveyor belt. In this abbreviation NN (PP) indicates that both warp and weft are of Nylon (Polyamide).

2.1.2 **EP** - The abbreviation used to identify the fibres used in the woven fabric forming part of the carcass of a conveyor belt. In this abbreviation E indicates that polyester yarn is used for the warp and P indicates that Nylon is used for the weft of the fabric.

3.0 CONSTRUCTION

3.1 **General -** Conveyor belting shall be suitable for joining by vulcanizing and shall have full width fabric reinforcement in cut edge construction for all synthetic carcass belting.

3.2 **Carcass**

3.2.1 **Construction-** Conveyor belting will be of plied construction and shall have three or more plies of woven fabric.

3.2.2 **Transverse Joints** - Transverse joints in fabrics shall be at an angle of 45° to 70°C to the longitudinal axis. The minimum distance between the joints shall be as follows:

i) Outer plies - Joints in outer plies shall not be less than 75 m apart in the same ply. The adjoining edges shall be butt closely together but shall not overlap.

ii) Inner plies - The joints shall not be less than 15 m apart and there shall not be more than two joints in any one ply in 150 m of the belting.

iii) Adjacent plies - The joints shall not be less than 3 m apart.

iv) Non-adjacent plies - The joints shall be not less than 3 m apart.

3.2.3 **Longitudinal Joints** - These joints shall not be permitted anywhere.

3.2.4 The carcass shall have adequate thickness of interply rubber of suitable electometric compound for all synthetic carcass belting.

3.2.5 **Pull Belt Thickness**

3.2.5.1 Tolerance on belt thickness across the width when measured in accordance with Annexure C of IS 1891 (Part 1): 1994, the difference between any two measurements of the overall thickness shall not exceed 10% of the mean of thickness of the measurements made.

3.2.5.2 The full belt thickness when measured in accordance with Annexure C of IS 1891 (Part 1): 1994 shall be as specified and the difference between the mean and the specified values shall not vary by more than $\pm$ 7%

3.3 **Covers**

3.3.1 **Thickness -** The cover thickness on the load carrying side of the belting shall be one of the following:

3 mm, 4 mm, 5 mm, 6 mm, 8 mm, 10 mm or 12 mm. (should be $\geq$ 3mm)

Cover thickness on the non-load carrying side of the belting shall be one of the following:

1.5 mm, 2 mm, 3 mm or 4 mm. (should be $\geq$ 1.5 mm)

3.3.2 **Material** - The cover rubber, when removed from the belt shall not have values less than those specified below for tensile strength, elongation at break and abrasion resistance:

Cover Grade	Tensile Strength (Minimum) MPa	Elongation at Break (Minimum) %	Abrasion Loss (Maximum) Cubic mm
M 24	24	450	150
N 17	17	400	200

3.3.2.1 The method of test to be adopted shall be that described for dump-bell test pieces in IS 3400 (Part-1):2012. Method of test for vulcanized rubbers: Part-I Tensile stress - strain properties (second revision).

3.3.2.2 The abrasion loss of rubber cover shall be tested as per the method given in Annexure D of IS 1891 (Part 1): 1994.

3.3.3 **Resistance of Ageing** – After ageing for 72 hours at 70 $\pm$ 1 deg C in accordance with IS 3400 (Part 4) : 2012, methods of test for vulcanized rubbers : Part 4 accelerated ageing (second revision), the tensile strength and elongation at break of the rubber cover shall not vary from the original values by more than the limits specified below :

Parameter	Change (Maximum) %
Tensile Strength	+ 10, -20
Elongation at break	+ 10, -25

3.3.4 **Tolerance on Cover Thickness** – The average value of the cover thickness when measured as described in Annexure C of IS 1891 (Part 1): 1994 shall not fall below the specified thickness by more than the limits specified below :

Specified Cover Thickness	**Tolerance**
Upto and including 4 mm	- 0.2 mm
Over 4 mm	- 5.0 %

4 FULL THICKNESS TENSILE STRENGTH

4.1 The full thickness tensile strength of the finished belting when determined in accordance with the method described in Annex F of Is 1891 (Part 1):1994 shall not be less than the values specified below both in the warp and weft directions:

Full Thickness Tensile Strength (FITS)

Rating	**No. of Plies**	**Warp (Minimum) kN/m Width**	**Weft (Minimum) kN/m Width**
315	3	315	125
400	3	400	160
500	3	500	Not required to be specified
630	3 & 4	630	
800	4	800	
1000	4	1000	
1250	4 & 5	1250	
1400	5 & 6	1400	
1600	5 & 6	1600	
1800	6	1800	
2000	5 & 6	2000	

5. ELONGATION

5.1 **Elongation at Reference Load** - For this requirement reference force is taken as one-tenth of the specified full thickness tensile strength in the warp. This is based on the usually followed safety factor of 10. But it does not necessarily imply that the safety factor to be considered in design calculations is 10, as this depends on other governing conditions of the installation.

The elongation at the reference load in the warp direction of the finished belting, when tested by the method described in Annex F of IS 1891 (Part-1):1994 shall be:

1.5 & maximum in elastic elongation and 1.25 % Maximum in permanent elongation and a total of 2 % Maximum for EP Belting	For NN Belting

5.2 **Elongation at Break** - The elongation of the finished belting in the warp direction at the force corresponding to the maximum tensile strength (that is, at break), when tested by the method described in Annex F of IS 1891 (Part-1):1994 shall not be less than 12 percent at break for NN belting and 10 percent for EP belting.

6. ADHESION

6.1 The mean force required to strip one ply from the next and to strip the cover from the plies, when determined by the method described in Annexure G of IS : 1891 (Part 1) – 1994 shall not be less than the values specified below in both warp and waft direction :

Construction of Carcass	Ply to Ply kN/m	Cover to Ply when cover is	
		1.5 mm Thick kN/m	Over 1.5 mm Thick kN/m
NN	7.0	4.2	6.0
EP	5.4	3.8	4.2

NOTE : No individual value obtained at the time of measurement shall be below the value specified by more than 0.8 kN/m.

7. WIDTH OF BELTING

7.1 Unless otherwise agreed, conveyor belt widths shall be selected from the following subject to tolerance of $\pm$ 1%:

500 mm, 650 mm, 800 mm, 1000 mm, 1200 mm, 1400 mm, 1600 mm, 1800 mm and 2000 mm

8. LENGTH OF BELTING

8.1 The length of the belting shall be as specified by the purchaser subject to the following tolerances:

a	Belts delivered in the endless and mounted in that way	+ 0.5 %
b	For open belts, the maximum difference between delivered length and the ordered length	+ 2 %

8.2 The length of the endless belt shall be measured in accordance with the method described in Annexure E of IS : 1891 (Part 1) – 1994.

9. TROUGHABILITY

9.1 When tested in accordance with the methods described in Annexure H of IS: 1891 (Part 1) – 1994 the belting shall meet the troughability requirements given below for appropriate troughing angle specified by the customer:

Troughing Angle	Troughability (Minimum)
20 deg	0.05
25 deg	0.07
30 deg	0.09
35 deg	0.11
45 deg	0.17

10. FREEDOM FROM DEFECTS

10.1 The belting shall be straight when laid fiat and the workmanship and finish shall be in accordance with the best manufacturing practice. Rectification of surface defects and blemishes which do not interfere with the satisfactory life of belt is permitted.

11. SAMPLING AND TESTING

11.1 Test certificates required by this standard shall be furnished by the manufacturer. For testing and inspection of all parameters except abrasion resistance and troughability, the samples will be drawn in accordance with the plan given below, based on the ordered length of belting of the same characteristics (type, grade, width, etc.). The sample shall consist of the full width of the finished belting and shall not be less than 600 mm in length.

Length of Belting (m) ordered for each type	No. of Samples
Up to 500	1
From 501 to 1000	2
From 1001 to 2000	3
From 2001 to 3500	4
From 3501 to 5000	5
From 5001 to 7000	6
From 7001 to 10000	7
Each addition of 3000	1

11.1.1 For abrasion resistance test, one sample shall be drawn for conducting one set of tests for every 5000 m length of belting offered or part thereof having the same cover rubber grade.

11.1.2 For troughability test one sample shall be drawn for conducting one set of tests for each different width, rating and duty of belt ordered.

12. MARKING AND PACKING

12.1 The belting shall be marked on the carrying side using characters at least 20 mm high. Marking shall be repeated at a spacing of 5 to 15 m and shall indicate:

a. The rating and duty of the belt indicating the specific type of the fabric.

b. The cover grade used

c. The last two figures of the year of manufacture

d. The manufacturer’s trade mark and

e. The number of this interplant standard.

f. Marking shall be 100mm away from belt edge

g. Marking shall be provided at the interval of 10m

While all these seven items shall be branded on the belt to achieve a permanent marking, any other information required by the purchaser shall he marked by other means like transfer or stencil and will be limited to the first three metres of the beginning of the roll.

12.2 The belts shall be suitably packed and the following information shall be painted on the packing of every roll :

1. Purchaser’s order number
2. Width of the Belt in mm.
3. Type of fabric and number of plies.

4. The rating of the belt in kN/m width.
5. Total thickness of belt
6. The duty of the belt as per the manufacturer's catalogue.
7. Cover thickness.
8. Cover grade
9. length of the roll in m.
10. Customer item / catalogue number.
11. Direction of role.
12. Where to break the package.
13. The number of this Interplant Standard.

12.3 The manufacturer shall ensure the delivery of roll on metallic/ wooden reels which shall not collapse while handling / mounting at site.

APPENDIX - A

(Clause 0.2)

GUIDELINES FOR CONVERSION OF EXISTING INSTALLATION USING COTTON/ COTTON-NYLON REINFORCED BELTING TO SYNTHETIC FABRIC REINFORCED BELTING

A-1 ASSUMPTIONS

A-1.1 Fundamentally the exercise on conversion of existing installations using cotton and cotton/nylon reinforced constructions to all synthetic fabric reinforced belting is made on the basic assumption that the existing cotton or cotton/nylon belting on installation' is giving a satisfactory service life. In case the existing belting is not performing satisfactorily it is preferable to work the working tension details from the first principles and arrive at a suitable belt construction in consultation with the belt manufacturers.

A-2 PRECAUTIONS

A.2.1 Considering its low weight, excessive flexibility both in the longitudinal and transverse directions, while selecting the equivalent all-synthetic belt constructions care should be taken to check the radii of curvatures in the case of installations with concave/convex curve to avoid belt lift off and also the transition distances. Also it would be necessary to check the weights in the gravity take up, since the weight requirement for all synthetic belting will be less than those required for installations using cotton and cotton/nylon reinforced belting.

A-3 BASIS OF SELECTION

A-3.1 **Nomenclature of All-synthetic Reinforced Bolting** - All-synthetic reinforced beltings are designated to denote the minimum guaranteed full thickness tensile strength and the number of reinforcing plies of synthetic textile. For example, 500/3 denotes a belting having a minimum guaranteed full thickness tensile strength of 500 kN/m width, incorporating 3 plies of all-synthetic textile reinforcement.

Basically all synthetic conveyor belting is manufactured in 3 different Type or Duty ratings. While these represent. part of the nomenclature of the belting by any one manufacturer, these types also play a significant role in the performance of the belting itself. The difference between the 'three types is the difference in interply rubber thickness used, which ultimately, together with the carcass plies, constitute the body of the belt. These also contribute

to the varying degrees of flexibility, impact resistance, belt thickness and belt weight. The type of the duty selected for a particular installation depends on the belt width, percentage utilization of cross-sectional load conveying area, idler spacing, loading cycle, material hulk density and the belt tension itself . In fact, each type of duty has a minimum carcass thickness: which, together with the, plies, represents the body of the belt to support the load of specific material bulk density.

A-3.2 **Maximum Recommended Working Tension (MRWT)** - The first step in selection is the calculation of Maximum Recommended Working. Tension of the existing belt in use on the installation. The values of MRWT for the different types of cotton and cotton/nylon fabrics are listed below for ready reference. These are the MRWT considering vulcanized joints and .gravity take-up.

Cotton Dck Belting		**Cotton/ Nylon Belting**	
Fabric Type	**MRWT in kN/m per ply**	**Fabric Type**	**MRWT in kN/ m per ply**
28	5.3	CN 70	7.0
32	6.1	CN 80	8.0
36	7.0	CN 90	9.0
42	8.0	CN 105	10.5
48	10.5	CN 130	13.0
		CN 175	17.5

A-3.2.1 The full belt MRWT of the belt construction in use can thus be calculated by multiplying the number of plies of the existing fabric in use by the *respective* value of MRWT as specified above.

A-3.3 **Selection of All Synthetic Reinforced Belting**

A-3.3.1 The full belt MRWT thus arrived at should be matched with the MRWT values specified below:

Rating	No. of Plies	FTTS (minimum) kN/m per Width	Recommended Working Tension (Maximum) kN/m
315	3	315	31
400	3	400	40
500	3	500	50
630	3	630	63
630	4	630	70
800	4	800	90
1000	4	1000	110
1250	4 & 5	1250	140
1400	4 & 5	1400	155
1600	4 & 5	1600	180
1800	6	1800	190
2000	5 & 6	2000	220

NOTE: It may be noted that the full thickness tensile strength and corresponding maximum recommended working tension values for both N/N and EP belting are the same.

A-3.3.2 Having selected the belting meeting the requirements of MRWT one should now select the type of the belting (different nomenclature used by the different manufacturers for example, Type I, Type II, Type III or general duty, Extra Duty, Heavy Duty etc.). This is to determine the minimum number of plies and to support the load adequately without undue sagging between the idlers. This depends upon the body of the carcass and the bulk density of the material to be carried. This information would normally be available in any manufacturer's catalogue.

A-3.3.3 The construction thus selected should now .be checked for its adequacy for troughing *in* the specified bolt' width, the details of which, are available in the manufacturers catalogues.

A-3.3.4 The cover thicknesses and grade of cover rubber may either be retained or suitably modified depending upon the performance characteristics of the existing belt construction in use.

ANNEXURE TO APPENDIX - A

Example 1 :

1. Specification of belting in use : Conventional cotton duck belting of ¨tpecifications:

1000 mm wide x 6 ply x Fabric 42 x 5.0/1.5 mm rubber covers, skim coated plies, Grade M-24 for carrying iron ore (of bulk density 2.1 T/m3).

2. Maximum recommended working tension of Fabric 42 8.0 kN/m/ply. Therefore, full belt MRWT = 6 x 8.0 = 48.0 kN/m.

3. The all nylon belting equivalent with MRWT nearest to this is 50 kM/m i.e., belt type 500. This means that any belt of type 500 (i.e.' 500/3, 500/4, 500/5, etc) shall be suitable with respect to the MRWT equivalent.

4. Now the duty of the belting has to be arrived at from the Manufacturer's catalogue, so that the belt selected has the adequate body to support load like iron ore of bulk density 2.1 T/cubic metre. Generally a 500/3 construction in Heavy Duty with a maximum belt width of 900 mm has the adequate load support characteristic. Since the belt under study is of 1 000 mm width, we have to move to the next higher type (i.e. 630/3) which has an adequate body to support the load up to 1 000 mm width when carrying iron ore. 630/3 has a MRWT of 63 kNim and therefore, it takes care of the equivalent MRWT of 48.0 kN/m.

5. After having selected the type and duty, it has to be cross-checked with the Manufacturer's catalogue to ensure whether the belt selected has adequate transverse flexibility to trough on the idlers in use.

6. Having selected belt construction of 1 000 mm x 630/3 Heavy Duty, the top and bottom rubber cover thicknesses are to be selected. Generally the cover thickness which are in use are retained, provided no problem is reported on these. However, if any problem is encountered with the existing cover thicknesses, these are suitably changed. In the case under study the rubber cover thicknesses are 5.0/1.5 mm.

Thus the all-nylon belting equivalent is as follows:

1 000 mm wide *x* 630/3 Heavy Duty with 5.0 mm face and 1.5 mm back rubber covers, Grade M-24.

Please note that skim coating has not been provided in the all-nylon belting, since the inter-ply rubber thickness provided in this construction is more than the normal skim coating done in conventional cotton duck belting.

Example 2 :

1. Specification of belting in use: Cotton/nylon reinforced belting of specification:

800 mm wide x 4 ply x CN 130 x 3.0/1.5 mm rubber covers, skim coated plies, Grade N-17 for carrying coal (of bulk density 0.8 T/cubic metre).

2. Maximum recommended working tension of Fabric CN 130 = 13.0 kN/m/ply. Therefore, full belt MRWT = 4 x 13.0 = 52.0 kN/m.

3. The all-nylon belting equivalent with MRWT nearest to this is 63.0 kN/m i.e., belt type 630. This means that any belt of Type 630 (i.e. 630/3, 630/4, etc) shall be suitable with .respect to the MRWT equivalent.

4. Now, the duty of the belting has to be arrived at from the Manufacturer's catalogue, so that the belt selected has the adequate body to support load like coal of bulk density 0.8 T/cubic metre. A General Duty belting in 630/3 construction with 800 mm width shall have adequate body to support coal.

5. After having selected the type and duty, it has to be cross-checked with manufacturer's catalogue to ensure whether the selected belt has adequate transverse flexibility to trough on the idlers in use.

6. Having selected belt construction of 800 mm x 630/3 General Duty, the top and bottom rubber cover thicknesses are to be selected. Generally the cover thickness which are in use are retained, provided no problem is reported on these. However, if any problem is encountered wits: the existing rubber cover thicknesses, these are suitLbly changed. In the case under study, the rubber cover thicknesses are 3.0/1.5 mm. Thus the_ all-nylon belting equivalent is as follows:

800 mm wide x 630/3 General Duty with 3.0 mm face and 1.5 mm back rubber covers, Grade N-17.

Please note that skim coating has not been provided in all-nylon belting, since the inter-ply rubber thickness Provided in all-nylon belting is more than the normal skim coating done in conventional cotton/nylon belting.