Steel Cord Conveyor Belts for Hoisting and Conveying

Dimensions , Requirements

DIN 22131 Part 1

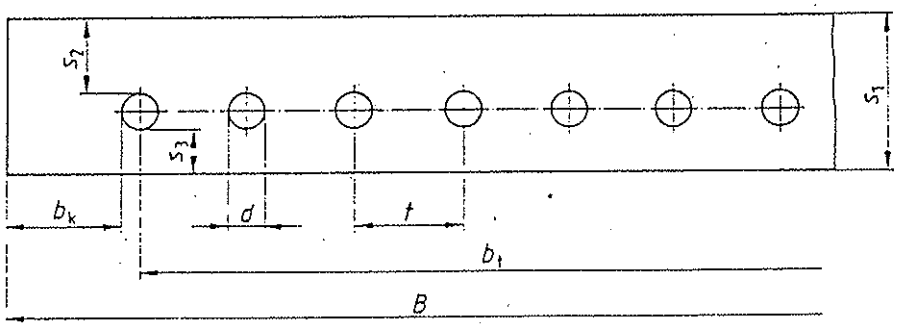
Dimensions in mm

1 Scope and Field of Application

This specification applies to conveyor belts with steel cords in the longitudinal direction as reinforcement for conveyors for general use. Steel cord reinforced conveyor belts for underground coal mining with special technical security requirements : see DIN 22129 Part 1 to Part 4.

2 Belt Construction

Steel cord reinforced belts according to this specification consist of an enrubbered core of steel cords surrounded by rubber covering plates. The thickness of these covers is determined according to the dynamic duty. The cords may be reinforced if desired by textile (T) or metallic (S) transverse reinforcements.



B : belt width
B_t : Supporting belt width
d : cord diameter
b_k : rubber edge width
t : cord division

S_1 : belt thickness
S_2 : cover thickness, carrying side
S_3 : cover thickness, running side

Picture 1 : Cross section of the belt

3 FORMULA SYMBOLS AND UNITS

Table 1 : Formula Symbols and Units

Symbol	Significance	Unit	Stated in DIN 22 13
A	Cover wear off	mm^3	Part 1,3
B	Belt width	mm	Part 1,3,4
F_a	Pull-out force of the cord	N/mm cord length	Part 1,3,4
F_{bs}	Breaking force of the in the belt cured steel cord	kN	Part 1,3,4
S_v	Safety factor for the number of joint steps	-	Part 4
T	Strip resistance	N/mm belt width	Part 1,3
b_k	Edge width	mm	Part 1
b_t	Supporting belt width	mm	Part 1
b_1	Distance between the outer side of the outer cords	mm	Part 3
d	Cord diameter	mm	Part 1,3,4
f	Deflection (throughability)	mm	Part 1,3
l_a	Bevel length	mm	Part 4
l_{Anb}	Cord binding length	mm	Part 4
l_p	Partial joint step length by cord displacement	mm	Part 4
l_q	Partial joint length of the cord deflection	mm	Part 4
l_s	Distance between the blunt opposite cord ends	mm	Part 4
$l_ü$	Overlapping length	mm	Part 4
l_v	Joint length	mm	Part 4
n_b	Number of bindings within a series of steps	-	Part 4
n_s	Number of cords	-	Part 1
n_{st}	Number of steps (for belt joints)	-	Part 4
S_G	Rubber thickness between the cords in the joint area	mm	Part 4
S_1	Belt thickness	mm	Part 1,3
S_2	Cover thickness, carrying side	mm	Part 1,3
S_3	Cover thickness, running side	mm	Part 1,3
t	Cord division	mm	Part 1,3,4
t_m	Center cord division	mm	Part 3
Δ_i	Difference from the individual values S_{2i} to the median value S_{2j}	mm	Part 3
ξ_R	Percentage elongation of the covers after tearing	%	Part 1
σ_R	Tear resistance of the covers	N/mm^2	Part 1
φ	Additional value to determine the real pull out force of the cord	-	Part 4

4 DIMENSIONS, SIGNIFICANCE

4.1. Belt Type

Table 2 shows the most current belt types. Belt types ranging from ST 500 to ST 8000 are technically possible. Particular details may be agreed upon request.

Table 2 : Dimensions

Belt Type		ST1000	ST1250	ST1600	ST2000	ST2500	ST3150	ST3500	ST4000	ST4500	ST5000	ST5400
Min. breaking load (N/mm) Supporting belt width		1000	1250	1600	2000	2500	3150	3500	4000	4500	5000	5400
Cord diameter d max		4.1	4.9	5.6	5.6	7.2	8.1	8.6	8.9	9.7	10.9	11.3
Cord division t ± 1.5		12	14	15	12	15	15	15	15	16	17	17
Min. thickness of the covers		4	4	4	4	5	5.5	6	6.5	7	7.5	8
Belt Width B	limit dimensions	n_s = Number of cords										
500	± 5	39	34	--	--	--	--	--	--	--	--	--
650	± 7	51	44	40	51	40	40	40	40	37	--	--
800	± 8	64	55	50	64	50	50	50	50	46	43	43
1000	± 10	81	69	64	81	64	64	64	64	59	55	55
1200	± 10	97	84	77	97	77	77	77	77	71	66	66
1400	± 12	114	98	90	114	90	90	90	90	84	78	78
1600	± 12	131	112	104	131	104	104	104	104	96	90	90
1800	± 14	147	127	117	147	117	117	117	117	108	102	102
2000	± 14	164	141	130	164	130	130	130	130	121	113	113
2200	± 15	181	155	144	181	144	144	144	144	134	125	125
2400	± 15	197	169	157	197	157	157	157	157	146	137	137
2600	± 15	214	184	170	214	170	170	170	170	159	149	149
2800	± 15	231	198	184	231	184	184	184	184	171	161	161
3000	± 15	247	212	197	247	197	197	197	197	184	172	172
3200	± 15	264	227	210	264	210	210	210	210	196	184	184

The constructions printed in the dark are to be preferred.

4.2. Covers

4.2.1. Thickness of the Covers

The thickness S_3 of the cover of the running side shall not be lower than the minimum thickness of table 2. For special duties thicker covers are possible. The thickness S_2 of the carrying cover consists of the minimum thickness value as per table 2 increased by an additional value that may be influenced by varying factors and which are to be determined in accordance with DIN 22101. When belt securing devices are incorporated in the covers increased cover thicknesses may be required.

4.2.2. Classification of Goods

The cover classification is determined in accordance with the required duty.

4.3. Belt Thickness

The belt thickness S_1 results from the addition of the cord diameter d and the cover thicknesses S_2 and S_3. The cord thickness tolerance of the dimension S_1 is + 10 %. The lower belt thickness tolerance for a belt width ≤ 20 mm is 1.0 mm and maximum 1.5 mm for a belt > 20 mm.

4.4. Belt Length

A + 2 % deviating delivery length is permitted. The number of individual lengths and delivery conditions are to be fixed by mutual agreement.

4.5. Belt Edges

The edge width b_K shall not be lower than 15 mm.

4.6. Ordering Data

1400 m steel cord reinforced conveyor belt (ST) of 2200 mm width, minimum breaking load of 3500 N/mm belt width, covers of 10 mm on the carrying side and 7 mm on the running side and of classification Y.

1400 m steel cord reinforced conveyor belt DIN 22131 - 2200 St 3500 10/7 Y

Conveyor belts with traverse reinforcement are to be fixed by agreement.

5. REQUIREMENTS

5.1. Breaking Load of the Steel Cords

The breaking load of the in a belt cured cord F_{bs} shall at least be equal to the product of the minimum breaking load of the belt and the cord division as per table 2, increased by about 10 %.

Table 3 : Breaking load of the steel cords

Belt Type	ST1000	ST1250	ST1600	ST2000	ST2500	ST3150	ST3500	ST4000	ST4500	ST5000	ST5400
Breaking load of the in the belt cured steel cord F_{bs} in kN (min.)	13.2	19.2	26.4	26.4	41.2	52.0	57.7	66.0	79.2	93.5	101.0

5.2. Position of the Steel Cord in the Conveyor Belt

The cords in the belt shall run rectilinearly. The tolerance of the cord division refers to the deviation of the individual steel cords in the conveyor belt. Only 5 % of the steel cords may exceed it.
The deviation of the carrying belt width from the arithmetic value $(n_s-1)/t$ shall not exceed 1 %.
The steel cords of the belt shall lie in one plane. The difference Δ_i (see DIN 22131 Part 3) shall not exceed ± 1.5 mm. Maximum 5 % of the differences may exceed ± 1 mm.

5.3. Number and Spacing of Cord Joints

Following conditions are to observed per individual length :
a) Only 2 % of the cords may be joined.
b) No cord shall have more than one joint.
c) Interspace between joints in longitudinal direction shall be more than 10 m.

5.4. Cord Pull-out Force

The adhesion between rubber and steel cord is determining for the quality of a steel cord reinforced conveyor belt and for the force transmission in the belt junction.
The adhesion is determined by the pull-out force F_a.

Table 4 : Steel cord pull out force - delivery condition versus thermic treatment condition

Belt Type		ST1000	ST1250	ST1600	ST2000	ST2500	ST3150	ST3500	ST4000	ST4500	ST5000	ST5400
Cord pull-out force F_a N/mm cord length min.	delivery condition	80	95	105	105	130	140	145	150	165	175	180
	after thermic treatment	75	90	95	95	120	130	140	145	160	170	175

5.5. Covers - Quality Classification

The values of table 5 shall be held on over a distance ranging from the cover surface to 25 % of the cord diameter d at both sides of the cords.

Table 5 : classification

Classification	Tear resistance σ_R N/mm² Min.	Elongation after ξ % Min.	Cover wear off A mm³ Max.
W	18	400	90
X	25	450	120
Y	20	400	150
K*)	20	400	200

* For hardly inflammable conveyor belts in accordance with DIN 22103 with antistatic covers as per DIN 22104

These values will help to determine the appropriate raw material for covers by some of their characteristics. Also other value such as tear resistance may stand for a further basis to evaluate.
Reliable conclusions originating from practical behavior of the covers, such as wear or cut resistance cannot be determined from these values only.

5.6. Strip Resistance

The strip resistance T between covers and rubber core shall be at least 12 N/mm samples width.

5.7. Ageing of the Covers

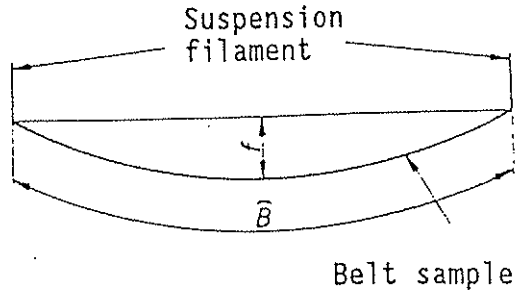
The average values for tear resistance σ_R and percentage elongation after tearing ξ_R as well as for strip resistance T after artificial ageing shall not be lower than 25 % of the average value obtained at non-aged conditions.

5.8. Throughability

The throughability is characterized by the relation of the deflection f to the belt width B :

Table 6 : Minimum values at 3 carrying rolls with the same size in accordance as per DIN 22107

Deflection angle of the carrying side rolls	$\frac{f}{B}$ Min
20°	0.08
25°	0.10
30°	0.12
35°	0.14
40°	0.16
45°	0.18
50°	0.20
55°	0.23
60°	0.26



Belt sample

Picture 2 : Suspension of the Sample

5.9. Straightness

Steel cord reinforced conveyors belts running freely on a perfectly straightened device and moderately charged shall not track sideways for more than ± 40 mm for a belt width up to 800 mm and for more than ± 5 % (± 75 mm max however) of the belt width for widths over 800 mm.

5.10. Hardly inflammable Belt Covers of Classification K

Requirements in accordance with DIN 22103.

5.11. Antistatic Property

Requirements in accordance with DIN 22104.

6. IDENTIFICATION

The conveyor belt shall be identified as per DIN 22131 Part 2.

7. TESTING

The testing of the conveyor belts shall be carried out in accordance with DIN 22131 Part 3.

Steel Cord Conveyor Belts for Hoisting and Conveying

Dimensions , Requirements

DIN 22131 Part 1

Stated Standards

DIN 22101	Continuous conveyors ; Conveyor belts for bulk goods ; Principles for calculation and explanation
DIN 22103	Hardly inflammable conveyor belts ; Requirements, testing
DIN 22104	Antistatic conveyor belts with textile reinforcement ; Requirements, testing
DIN 22107	Continuous conveyors ; Prescriptions for supporting rolls for bulk goods conveyor belts ; Main sizes
DIN 22129 Part 1	Steel cord reinforced conveyor belts for underground coal mining ; Dimensions, requirements
DIN 22129 Part 2	Steel cord reinforced conveyor belts for underground coal mining ; Identification
DIN 22129 Part 3	Steel cord reinforced conveyor belts for underground coal mining ; Testing
DIN 22129 Part 4	Steel cord reinforced conveyor belts for underground coal mining ; Belt junctions ; Dimensions ; Requirements
DIN 22131 Part 2	Steel cord reinforced conveyor belts for general use ; Identification
DIN 22131 Part 3	Steel cord reinforced conveyor belts for general use ; Testing
DIN 22131 Part 4	Steel cord reinforced conveyor belts for general use ; Belt junctions, dimensions, requirements

Previous Editions

DIN 22131 Part 1 : 02.65
DIN 22131 Part 2 : 02.65

Modifications

Against the in January 1986 withdrawn February 1965 edition and DIN 22131 T2/02.65 next changes have been introduced :

a) Release of the pre-Standard character
b) Changing of Standard title
c) Introduction of table 1
d) Extension of the number of belt types
e) Entering of pull-out force of the cord
f) Changing of the cover plate classification
h) Introduction of ordering data
g) Entering of the identification in DIN 22131 Part 2

Explanations

The ST 1250 belt type construction deviating from the withdrawn DIN 22131 T1/02.65 has been fixed to enable a 1-step junction. It has been adapted for that purpose to DIN 22129 Part 1.

The corrosion extension in the cords after belt damaging may be retarded by rubber penetration to the cords.

Internal Patent Classification

B 65 G 15/36

Steel Cord Conveyor Belts for Hoisting and Conveying

Identification

DIN 22131 Part 2

Dimensions in mm

1 Scope

This specification covers steel cord reinforced conveyor belts in accordance with DIN 22131 Part 1.

2 Identification

If no other agreement exists steel cord reinforced conveyor belts shall be clearly and durably marked on the carrying side.
Durable marking means for example stamping during hot processing. The stamping depth is adapted to the cover thickness.

Table 1 : Stamping Depth

Thickness of the cover (carrying side)	Stamping Depth ≈ Stamping Depth
< 6	1
≥ 6	2.5

2.1. Running Identification of Steel Cord Conveyor Belt

The identification consists of characters and figures in accordance with DIN 30640 Part 2.
The identification groups are separated by interspaces.

For conveyor belts with a belt width ≤ 800 mm :
- height of the characters 50 mm
- distance from the belt edge 50 mm

For conveyor belts with a belt width > 800 mm :
- height of the characters 80 mm
- distance from the belt edge 80 mm

Conveyor belts up to 1400 mm width are only marked at one belt side.
Wider conveyor belts shall be marked on both belt sides.

The identification starting at a 5 mm distance from the edge of the belt.
The distance between the marks for one-side identification shall be about 10 m, for two-side identification about 20 m.

STEEL CORD CONVEYOR BELTS FOR HOISTING AND CONVEYING

IDENTIFICATION

DIN 22131 PART 2

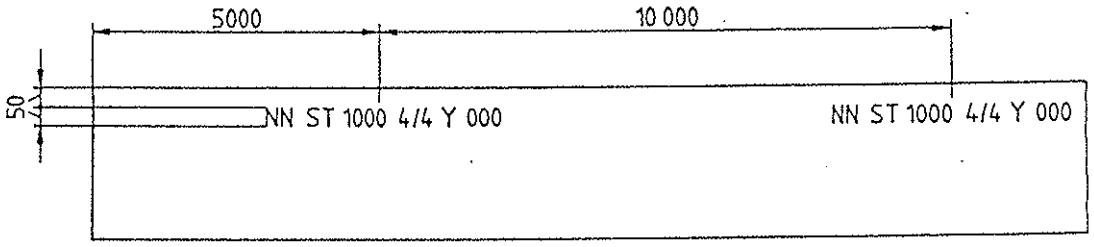
The marks shall be applied as per following order of succession :

NN ST 2000 10/6 Y 000

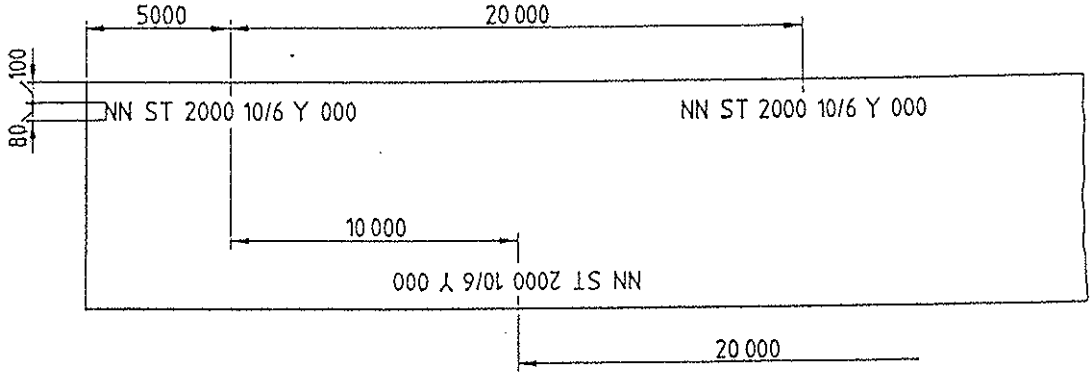
- Manufacturer's identification
- Belt type
- Cover thickness of carrying & running side
- Identification of cover's quality classification
- Mark number of the belt

2.1.1. Models of Identification

Model 1 :



Model 2 :



2.2. Identification of ready for Shipment wound Steel Cord reinforced Conveyor Belt

The wound conveyor belt shall have an oil paint or similar outside mark with following data :

- manufacturer's identification
- length of the belt in mm
- belt width in mm
- belt type in accordance with DIN 22131 Part 1
- thickness of the covers in mm
- belt designation

Steel Cord Conveyor Belts for Hoisting and Conveying

Identification

DIN 22131 Part 2

Stated Standards

DIN 22131 Part 1	Steel cord reinforced conveyor belts for general conveying technics ; Dimensions, requirements
DIN 30640 Part 2	Writing on technical products ; Perpendicular modern grotesque writing ; Representations and dimensions

Previous Editions

DIN 22131 Part 1 : 02.65

Modifications

Compared to the in January 1986 withdrawn Standard DIN 22131 T1/02.65 next changes have been applied :

a) Release of the pre-Standard character
b) Modification of Standard title and contents
c) Requirements deleted and transferred to DIN 22131 Part 1
d) Data accepted as identification

Internal Patent Classification

B 65 D 63/02
B 65 G 15/36

Table 2 : Sample Lengths

Belt Type	Sample Length min.
ST 1000	500
ST 1250	
ST 1600	700
ST 2000	
ST 2500	
ST 3150	850
ST 3500	900
ST 4000	1000
ST 4500	1150
ST 5000	1250
ST 5400	1350

2.10.3. Testing of Cord Height

Perpendicularly to the belt edge a 8 mm wide groove is made over the whole belt width of the carrying cover side.
The depth of the groove shall be treated by appropriate means (e.g. brushes) in such a way as to uncover the entire surface of the cords.
The distance - i.e. from the cord surface to the cover surface (carrying side) - shall be measured to 0.1 mm (S_{2i}) for each cord.
From those values the median is calculated (see DIN 53598 Part 1). The difference Δ_i of the measuring values before the median value is reported.

According to the 3 classes :

	Δ	$\leq$	1 mm
1 mm	$< \Delta$	$\leq$	1.5 mm
	LΔ	$>$	1.5 mm

Class population and sum frequency is determined.

2.10.4. Inflammability Resistance

Testing in accordance with DIN 22103.

2.10.5. Antistatic properties

Testing in accordance with DIN 22104.

3 TEST REPORTING

Agreed test reporting shall be carried out as per DIN 50049.

Steel Cord Conveyor Belts for Hoisting and Conveying

Testing

DIN 22131 Part 3

Dimensions in mm

1 Field of Application

This specification covers the testing of steel cord reinforced belt cords in accordance with DIN 22131 Part 1 (formula symbols and units : see DIN 22131 Part 1).

2 Testing

2.1. General, Number of Samples, Evaluation

Unless otherwise agreed the tests shall be carried out on 3 selected samples. For testing as per sections 2.4, 2.5, 2.6. 2.10.1 the mean value is calculated from the individual values. If one individual value deviates from the mean value for more than 10 % it shall be removed. Three other samples shall be taken very close to that area. The final mean value is to be calculated from these three values and the remaining ones.
In case of dispute a from both sides as neutral acknowledged testing place shall be appointed.
The tests shall not be carried out within the two days after the manufacture of the conveyor belts.

2.2. Sampling

To issue a test certificate a sample of two successive lengths shall be selected fully representing both lengths.
If additional sample tests are to be carried out a number of belt samples of at least 450 mm length shall be selected in belt width direction approximately equally divided in accordance with table 1.

Table 1 : Number of Samples

Length of the belts	Number of samples
Up to 500 m	1
Over 500 m to 1000 m	2
Over 1000 m to 2000 m	3
Over 2000 m to 3500 m	4
Over 3500 m to 5000 m	5
Over 5000 m to 7000 m	6
Over 7000 m to 10000 m	7

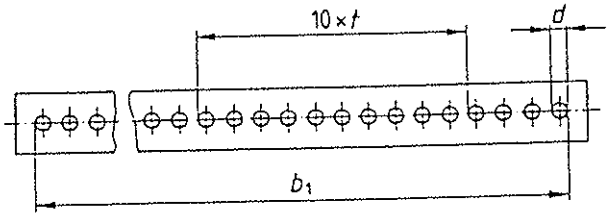
2.3. Dimensions

2.3.1. Belt Width
The belt width B shall be determined to within 1 mm.

2.3.2. Belt Thickness
The belt thickness S_1 shall be determined by means of a micrometer dial gauge in accordance with DIN 878 (measuring nut diameter 20 mm, measuring force 1 N) to 0.1 mm.
Measuring is carried out once in the middle of the belt and subsequently at 150 mm from the belt edge. The mean value shall be reported to 0.1 mm.

2.3.3. Thickness of the Cover
On the by paragraph 2.3.2. designated spots in the belt section the carrying cover is removed along the cords by incision and the rest thickness of the conveyor belt (S_3 + d) is determined to 0.1 mm by means of a dial gauge in accordance with paragraph 2.3.2.
From these values and from the measured belt thickness S_1 and the cord diameter d the cover thickness S_2 and S_3 of the carrying and running side are determined by difference building as mean value of three measurements (see DIN 22131 Part 1).

2.3.4. Cord Diameter, Number of Cords and Cord Division
The cord diameter is designated by the diameter d of the circumference as per DIN 3051 Part 2.
The cord diameter is determined in accordance with DIN 3051 Part 4 for cords with an even number of strands.
For strands with an odd number of strands appropriate means shall be used e.g. a profile projector.
For the sample sketched hereafter showing the total belt width B the distance b_1 is the full width distance between the outer sides of the edge cords determined by a measuring band.



Picture 1 : Belt Section

The number n_s of the cords in the belt section is counted. The mean cord division is to be calculated from

$$t_m = \frac{b_1 - d}{n_s - 1}$$

To check the cord division t, 10 cord divisions at an at random chosen spot of the belt section are counted. The distance between the left side of the first and the eleventh cord is determined (see picture 1) ; divided by ten it gives us the average cord division of the belt piece concerned. The value shall be designated in mm rounded to 0.1 mm.

2.4. Breaking Force of the steel Cords

To judge about the steel cord breaking force F_{bs} the manufacturer's work certificate is accepted. The data of the work certificate are used to determine the breaking force of the belt.

2.5. Pull-out Force of the Cord

The pull-out force F_a is calculated on an embedded steel cord that is removed in longitudinal direction in delivery condition and after thermic treatment. Test in accordance with ISO 7623 - 1984.

2.6. Thermic Post-treatment

During thermic post-treatment the samples are retreated for 150' at 145 ± 5° C cover temperature and at about 10 bar pressure (50 bar maximum however) by means of a vulcanizing press with distant pieces (thickness in accordance with samples thickness less 1 ± 0.5 mm).

2.7. Strip Resistance T between Cover Rubber and Core Rubber

Test in accordance with ISO 8094 - 1984.

2.8. Tear Resistance, % Elongation after Tearing, Cover Wear off

Tear Resistance	σ_R	Test in accordance with DIN 53504
% elongation after tearing	ξ_R	
Cover wear off	A	Test in accordance with DIN 53516

2.9. Ageing

Artificial ageing for 7 days in an at (70 ± 1)° C heated and naturally ventilated cabinet is carried out in accordance with DIN 53508.
Tear resistance and % elongation after tearing of the covers as well as strip resistance between covers and cords are compared before and after ageing.
The difference of the test results before and after ageing is to be indicated as a percentage of the values of the non-aged samples.

2.10. Other Tests

Next tests are not carried out regularly but on buyer's request.

2.10.1. Throughability
Test in accordance with ISO 703 - 1988.

2.10.2. Breaking Force F_{bs} of the in the Belt cured Steel Cords
Testing in accordance with ISO 76622/2 - 1984 with sample lengths as per table 2.

Steel Cord Conveyor Belts for Hoisting and Conveying

Belt joints, Dimensions, Requirements

DIN 22131 Part 4

Dimensions in mm

1 Field of Application

This specification covers belt joints with which steel cord reinforced conveyor belts can be undisconnectably joined in accordance with DIN 22131 Part 1.

2 Definitions

Formula symbols and units : see DIN 22131 Part 1.

2.1. Belt jointing

Belt joints according to this specifications are these areas in which two belt length are connected over intermediate rubber layers for tensile strength transmission in accordance with the in paragraph 3.1. shown schemes.

2.2. Joint Length

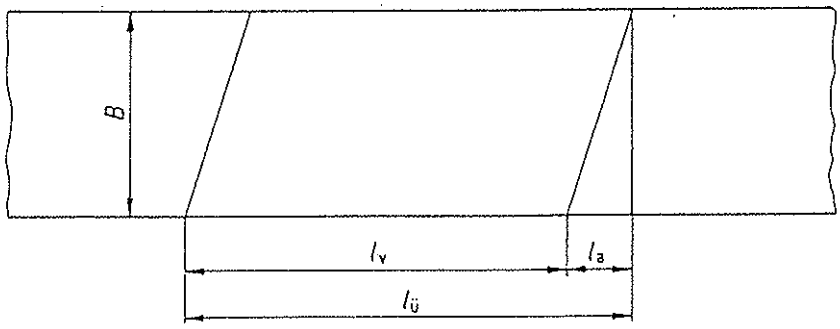
The joint length l_v (see picture 1) covers the belt length necessary for an appropriate functional joint.

2.3. Length of Overlap

The length of overlap $l_ü$ (required belt length) (see picture 1) for a belt joint is :

$$l_ü = l_v + l_a \quad (l_a = 0.3.B)$$

l_a is dropped for joints carried out at right angles.



Picture 1 : Joint length and length of overlap

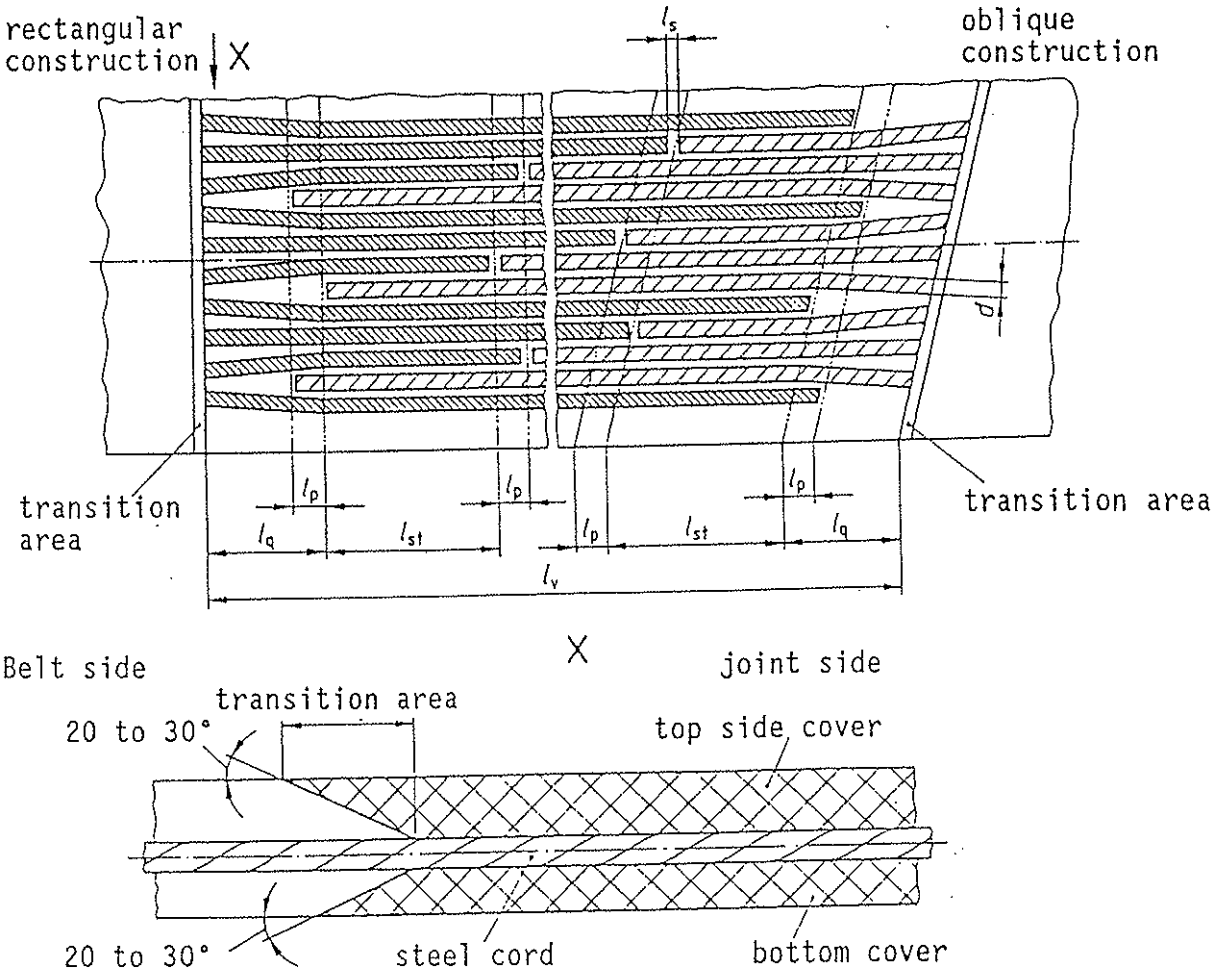
3 REQUIREMENTS

3.1. General Requirements

3.1.1. Construction

Joint length and geometric construction of the joint conform to cord diameter c and cord division t as well as to the minimum breaking load of a cord F_{bs} and the pullout force F_a in the joint area.
To discharge the joint when bending the belt at the barrels the cord ends are removed. The joint is carried out obliquely; a rectangular construction however is allowed.

The joint length l_v consists of :
- cord migration areas l_q
- moving of cord ends l_p
- minimum step lengths



Picture 2 : joint construction of a 3 stepped joint

Steel Cord Conveyor Belts for Hoisting and Conveying

Belt joints, Dimensions, Requirements

DIN 22131 Part 4

The conveyor belt construction in accordance with DIN 22131 Part 1 and the joint systems are selected so as to give arithmetically determined value of at least 1.9 mm as required rubber thickness (S_G) for tensile strength transmission between the cords in the joint area for belts up to type ST 3150 and values inferior to 2.3 mm for higher breaking load types.
S_G values : see table 1.

Table 1 : Minimum thickness of the rubber layer

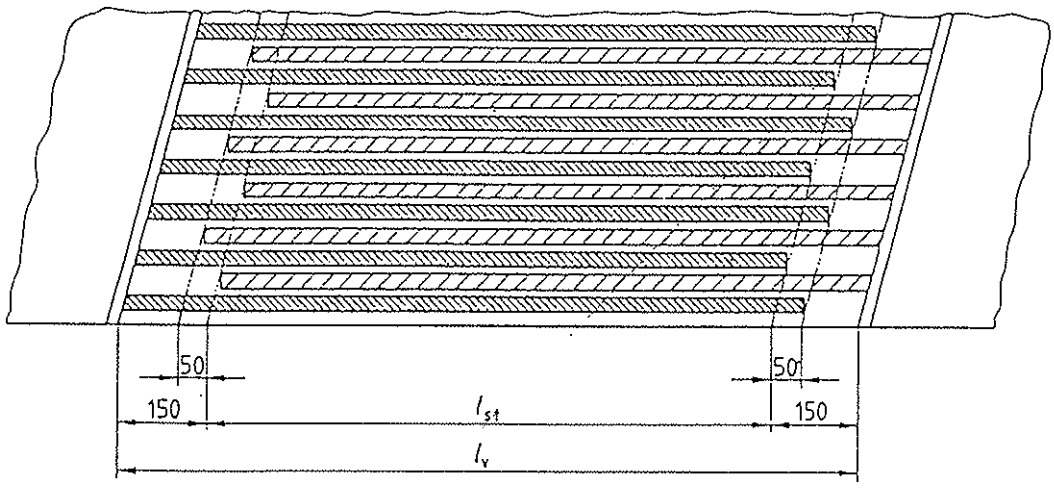
Belt Type	ST1000	ST1250	ST1600	ST2000	ST2500	ST3150	ST3500	ST4000	ST4500	ST5000	ST5400
Min. thickness of rubber layer S_G	1.9	2.1	1.9	2.4	2.5	1.9	2.6	2.3	2.3	2.7	2.3

Do consider following prescriptions for belt joining :
- Extensive adhesion areas by stepped transition
- Maintenance of adhesive rubber on the cord
- Application of high elastic rubbers
- High binding capability of the applied materials
- Head distance $l_s \geq 3 \times d$
- Uniform intermediate rubber thickness S_G
- Avoid in front of each positioned blunt cords at the edge
- Deviations from the scheme shall be corrected.

3.1.2. 1 Step Belt Joint

Table 2 : Step and joint lengths

Belt Type	ST 1000	ST 1250	ST 1600
Min step length l_{st}	300	350	450
Joint length l_v	600	650	750

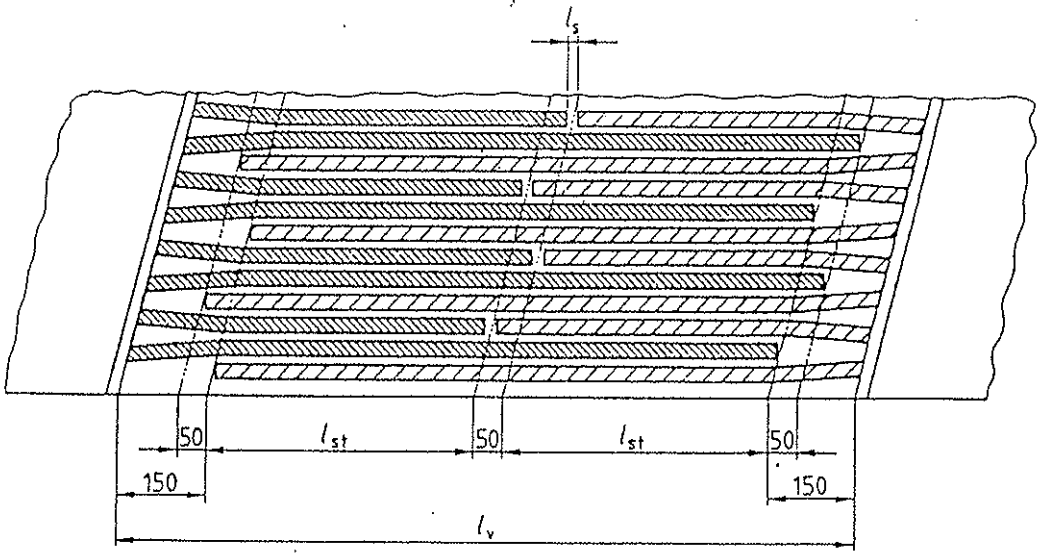


Picture 3 : 1 step joint (section)

3.1.3. 2 Stepped Belt Joint

Table 3 : Step and joint lengths

Belt Type	ST 2000	ST 2500	ST 3150
Min step length l_{st}	400	500	650
Joint length l_v	1150	1350	1650

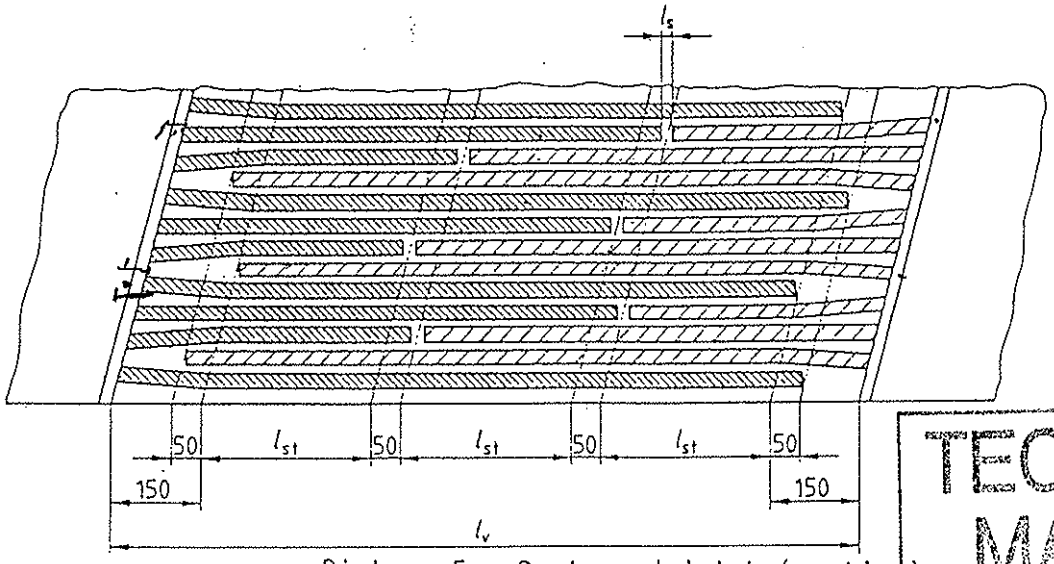


Picture 4 : 2 stepped joint (section)

3.1.4. 3 stepped Belt Joint

Table 4 : Step and joint lengths

Belt Type	ST 3500	ST 4000	ST 4500
Min step length l_{st}	650	750	800
Joint length l_v	2350	2650	2800

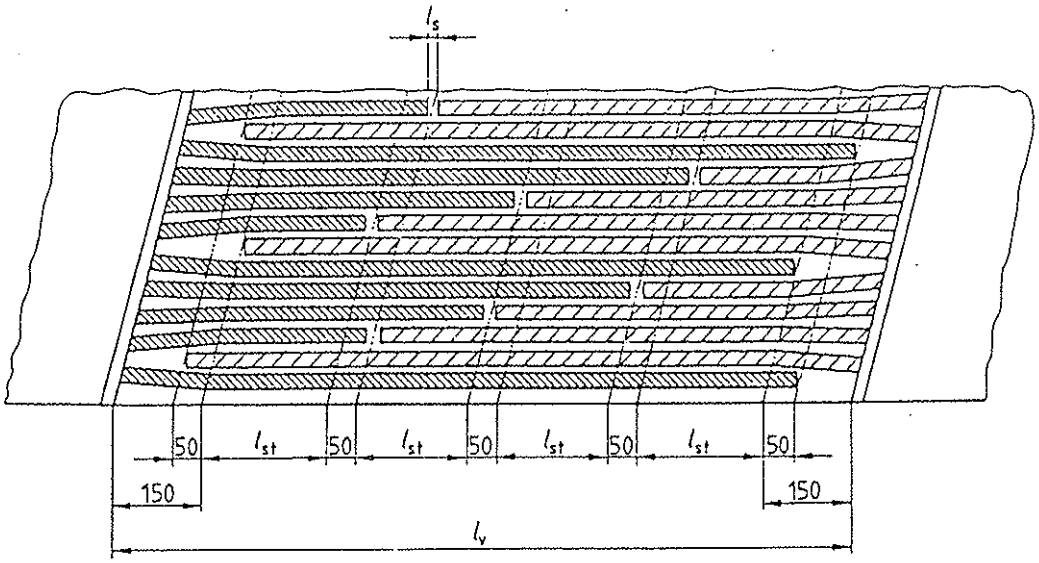


Picture 5 : 3 stepped joint (section)

3.1.5. 4 stepped Belt Joint

Table 5 : Step and joint lengths

Belt Type	ST 5000	ST 5400
Min step length l_{st}	900	1000
Joint length l_v	4050	4450



Picture 6 : 4 stepped joint (section)

3.1.6. Other Constructions

It is allowed to deviate from the inlay pattern for cords and step lengths if the inlay criteria for the belt joint are hold on as per following description. Such a deviation shall be agreed upon between the manufacturer of the joint and the user. In case of deviation from the stated schemes, it shall be proved to be convenient for use by calculating the binding length of the cords or by running an appropriate dynamic test procedure.

The by calculation proved evidence shall be carried out according to following procedure :

When calculation the binding length l_{Anb} of the cords pay attention to the following :

The pull-out force F_a is determined on a sample in which a cord is bound on both sides to cords of the opposite side. In the belt joint also one-side bindings are allowed. It is generally accepted that one-side bindings can only transmit the half of the force of a two-side binding. There may be considered that it is not the binding cord length to the opposite cord that is determining, but the sum of the binding lengths in the step constructions. The product of this sum and the real pull-out force shall not be lower than the sum of the individual breaking load in this step construction.

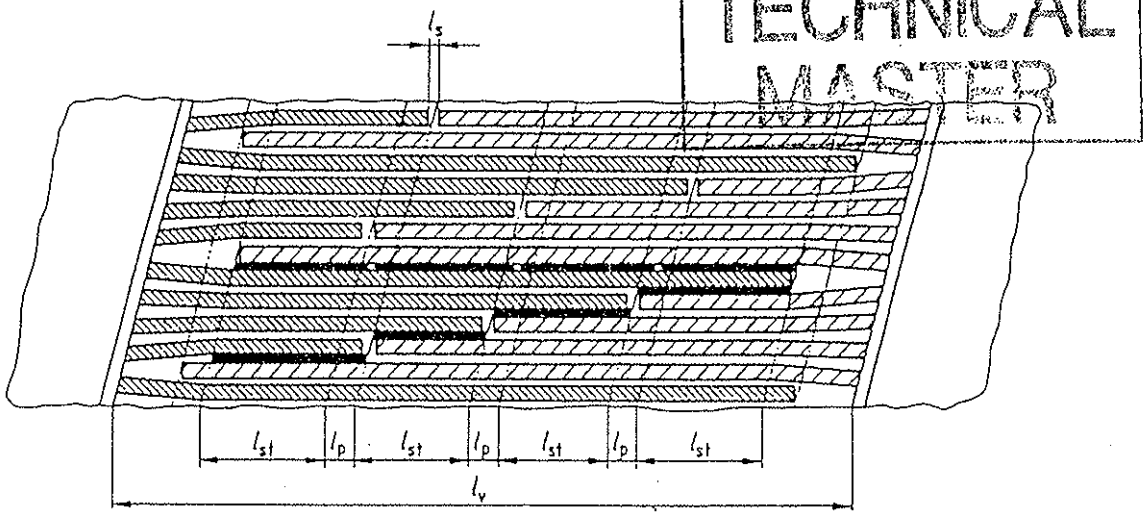
The step length l_{st} and the joint lengths l_v are to be calculated according to the relations :

$$l_{st} = \frac{\Sigma\, l_{Anb}}{n_b} \cdot s_v \qquad (1)$$

and

$$l_v = n_{st} \cdot l_{st} + (n_{st} - 1) l_p + 2\, l_q \qquad (2)$$

$$\Sigma\, l_{Anb} \text{ being } = \frac{2 \cdot F_{bs} \cdot n_{st} \cdot 10^3}{F_a \cdot \varphi} \qquad (3)$$



Picture 7 : 8 bindings within a step construction with a 4-stepped joint

The empirically determined additional value φ considers the dependence of the pull-out force F_a from the thickness of the rubber layer S_G between the cords in the joint area. It is only valid for S_G = up to max 5 mm. The intermediate rubber layer is determined by the formula :

$$S_G = \frac{t}{\frac{n_{st} + 1}{n_{st}}} - d \qquad (4)$$

It shall not be lower than 1.5 mm. The real pull-out force in the joint is the product of $F_a \cdot \varphi$.

$$\varphi = 0.4 + 0.2\, S_G - 0.018\, S^2_G \qquad (5)$$

The safety factor S_v is adapted to the different step joint numbers.

S_v = 1.1 for 1 and 2 stepped joints
S_v = 1.2 for 3 stepped joints
S_v = 1.3 for 4 stepped joints.

The step length l_{st} shall be rounded off to the next by 50 divisible number.

3.2. Requirements as to the Joint Material

The joint material shall be as per manufacturer's current prescriptions. Conveyor belts with covers of classification K shall be joined by antistatic cover material.

4 CONVEYOR JOINT MANUFACTURING

Detailed information about belt joint manufacturing and requirements for curing are provided by specialized companies.

The heated covers shall exceed the joint for at least 150 mm on both sides in longitudinal direction and the belt width for minimum 50 mm in each direction.

The heated covers shall be tested at a steady pressure of at least 10 bar. Mechanical pressure means are prohibited.

STATED STANDARDS

DIN 22131 Part 1 Steel cord reinforced conveyor belts for general conveying technics ; Dimensions, requirements

OTHER STANDARDS

DIN 22131 Part 2 Steel cord reinforced conveyor belts for general conveying technics ; Identification

DIN 22131 Part 3 Steel cord reinforced conveyor belts for general conveying technics ; Testing

PREVIOUS EDITIONS

DIN 22131 Part 4 : 02.65

MODIFICATIONS

Compared to the in January 1986 withdrawn February 1965 edition next changes have been applied :

a) Releasing of the pre-Standard character
b) Changing of the Standard title
c) Re-treatment of the Standard contents
d) Insertion of 4-step belt joint
e) Stating of calculation procedure

EXPLANATIONS

The in this standard fixed joint constructions and their inlay reinforcements are exclusively based on a statistic approach as the impulses to consider the only representative dynamic duties have not been sufficiently tested up to now.

Recent examinations a.o. on a 2 barrel-circumference test stand with increasing load to determine time resistance, aim at defining the involved materials' behavior in conveyor belt joints under dynamic duty.

Improvements to the inlay patterns for the cords as well as for joint sizing and even possibly for material choice seem to be possible.

INTERNATIONAL PATENT CLASSIFICATION

B 65 G 15/00