Conveyor Manufacturers Association of South Africa Limited.

CMA MC01 Rev 01

CLAMPS FOR BELT CONVEYORS

INDEX

ITEM **Page**

1. SCOPE

This specification covers the general technical requirements for belt clamps for use on belt conveyors. Standard terminology for the specification of clamps is defined. The guide covers the minimum parameters for the design of both fixed and portable clamps. Note that specifications for the anchor points and attachments to the clamps are not covered in this guide and are to be referred to the relevant specifications

1.1. Definitions

1.1.1. Clamp

A device for restraining or pulling a conveyor belt. The conveyor belting may be under no operating tension, but may be subject to inherent tensions as a result of the slope of the conveyor.

1.1.2. Cover

This refers to the rubber or PVC covering on the conveyor belting. The cover is placed on the top (carrying) side of the belt and on the bottom (pulley side) of the belt. The cover thickness of the top cover is often greater than the bottom cover.

1.1.3. Beams

The beams are the main carrying members of the clamp and transmit the vertical force onto the belt surface, either directly, or as a part of a clamp.

1.1.4. Traverse

A traverse is a clamp assembly, when the system consists of more than one element, placed in series along the length of the clamping area.

1.1.5. Stroke

The stroke is the distance that the clamp surface moves perpendicular to the surface of the belt, when the clamp is activated.

1.1.6. Clamp Length

The clamp length is the dimension of the beams when measured along the length of the belt.

1.1.7. Clamp Width

The clamp width is the dimension of the beams when measured across the width of the belt.

2. Clamp Categories

Clamps are grouped into two categories

2.1. Fixed clamps – (Belt restraining Clamps)

2.2. Portable or Pulling clamps

3. Clamp Types

Clamps are further categorised by type, as either Dimension based or Pressure based clamps, within the categories listed in 2.1.1 and 2.1.2.

4. Clamp Requirements

4.1. Friction coefficient

The design of the clamp shall be based on a friction coefficient between the clamp and the belting of not greater than the following.

Type of Belting	Plied or Steelcord Rubber	Solid Woven PVC
Friction coefficient μ	0,6	0,5

4.2. Clamp Pressure

In all cases, the clamp pressure shall not exceed 2 MPa

4.3. Construction

4.3.1. Material.

The clamps may be manufactured from either steel plate or aluminium sections.

4.3.2. Exclusions

Chequer plate and “Vastrap” profiled plates are not recommended and should be disallowed. In the same manner, plates with an expanded metal covering are not recommended and should be disallowed.

4.3.3. Surface Texture

The surface texture of the clamps should be in the range R_a = 6,3 μm to R_a = 12,5 μm.

4.3.4. Surface Quality

The surfaces contacting the belt should be shot-blasted to Sa 2½ in order to remove any mill scale, weld spatter or accumulated rust and should preferably be left un-painted.

4.3.5. Surface Cleanliness

The surface of the clamps contacting the belt should further be wire brushed and cleaned just before application to remove any residual oxidation.

4.3.6. Edge Preparation

The clamp leading edges should be chamfered to 6 mm at approximately 30°, in order to minimise the danger of the clamp edges cutting into the belting.

5. Clamp Safety

5.1. Factor of safety

The Factor of Safety for the design of the clamp and the clamping force shall be not less than 3

5.2. Fail to Safe

The design of clamps shall be such that the units will fail to safety.

5.2.1. Portable Clamps

In the case of portable clamps, “Fail to Safety” implies that the units will automatically engage in the event of a component failure, such as a hydraulic hose rupture.

5.2.2. Fixed Clamps

In the case of fixed clamps, “Fail to Safety” implies that the units will not engage while the conveyor is running.

6. Portable Clamps

These clamps are used for pulling the belt into place for splicing or joining. In some cases, the clamps may be utilised to hold the belting during splicing. In such cases, the user shall verify that the clamp operating range is compatible with the conveyor tension at that point. The basic requirements for Portable Clamps for Belt Conveyors may be summarised as follows :

6.1. Operating Range

The operating range for portable clamps shall be

10 kN 15 kN 30 kN 60 kN

The range refers to the clamp maximum pulling force.

6.1.1. Pressure limit

It is to be noted that the clamp pressure is subject to the limit as given in 4.2. above and the clamp selection will therefore be subject to a knowledge of the conveyor tensions to be overcome.

6.1.2. Range development

Other ranges may be developed, in conjunction with the Operator and the Supplier.

6.1.3. Clamp Type

Portable clamps are usually dimension based.

7. Fixed Clamps

These clamps are installed at strategic locations on the conveyor installation and are, by definition, fixed. The clamps usually operate at much higher forces than portable or pulling clamps. The location of the clamp is also dictated by the recognition of local stored energy and the need to control that energy under maintenance or splicing operations. The basic requirements for Fixed Clamps for Belt Conveyors may be summarised as follows

7.1. Operating Range

The operating range for fixed clamps shall commence at 100 kN and may be categorised in 100 kN steps.

7.1.1. Pressure limit

It is to be noted that the clamp pressure is subject to the limit as given in 4.2. above and the clamp selection will therefore be subject to a knowledge of the conveyor tensions to be overcome.

7.1.2. Clamp Type

Fixed clamps are usually pressure based, or a combination of both pressure and dimension based.

8. Dimension-Based Clamps

8.1. Operation

Dimension-based clamps operate on the clamp stroke being adjusted with respect to the belt thickness.

8.2. Belt Thickness

It is to be noted that the thickness of a belt may (and most probably will) vary across the belt width end sections. The thickness shall be measured at the point of clamping.

8.3. Clamp Stroke

The stroke of the clamp with respect to the belt thickness shall be so determined that the pressure limitation as per 4.2 is not exceeded.

8.4. Toggles

The clamps may be equipped with adjustable toggles, in order to set the stroke in accordance with the belt thickness.

8.5. Operation by Eccentric

It must be noted that clamps that are operated by means of an eccentric are not normally suitable for high tension installations. In any event, eccentrically operated clamps will be subject to the same stroke and pressure limitations and should be equipped with stroke limiting devices.

9. Pressure-Based Clamps

9.1. Clamp Pressure

Pressure-based clamps shall be designed such that the clamp pressure limitation as per 4.2 is not exceeded.

9.2. Pressure Gauge

The clamp system shall be equipped with a pressure gauge that will clearly indicate the system pressure or force, referred to the belt surface.

9.3. Toggles

The clamps may be equipped with adjustable toggles, in order to set the initial stroke in accordance with the belt thickness.

9.4. Clamp Stroke

The clamp stroke shall be so adjusted to be not more than half the total belt cover thickness, within the clamp pressure limitation.

10. Clamp Beams

10.1. Beam Deflection

The design of clamp plates and beams shall be such that the beam deflection shall be limited to the lesser of 1:500, or 0,5·t, where t refers to the belt minor cover thickness.

10.2. Location of Pressure Points

The deflection of the clamp beam or plate will be dependent on the location of the applied pressure points. It follows that clamps that have the pressure points on the beam ends will be subject to a greater bending moment and may therefore be required to be heavier than clamps where the pressure points are applied more evenly across the belt width.

11. Clamp Sizing

The basic clamp pulling or restraining force may be determined by

$F \leq 2\mu \cdot n \cdot N \cdot \frac{1}{\eta}$, (equation 1)

where

F	=	Restraining or pulling force (Clamp category)	kN
μ	=	coefficient of Friction as determined by paragraph 4.2	
n	=	number of clamping beams or traverses	
N	=	Force on the clamp or traverse per element	kN
η	=	Factor of Safety. See paragraph 2.2.4	

Example

Determine the minimum plate clamp dimensions for a conveyor W = 1200 mm wide, with a belt class of T_b = 1600, when the belt tension at the clamp is determined at 80% of the belt rated tension. The belt factor of safety SF = 10

For a belt rated tension of $T_r = \frac{T_b \cdot W}{SF \times 10^3} = \frac{1600 \times 1200}{10 \times 10^3} = 192$kN, the applied clamp pull must be not less than $F = 0{,}8 \cdot T_r = 153{,}6$ kN.

Since the clamp is specified as a plate clamp, there will be one element or traverse, therefore n = 1. The coefficient of friction μ = 0,6 and the factor of safety η = 3. Thus, from equation (1), $N = \frac{F \cdot \eta}{2 \cdot \mu \cdot n}$ kN. Since the specification is for a plate clamp, n = 1. Thus $N = \frac{F \cdot \eta}{2 \cdot \mu \cdot n} = \frac{153{,}6 \times 3}{2 \times 0{,}6 \times 1} = 384$ kN.

The area of the clamp is given by $A_c = W_c \cdot L_c$ m², where W_c and L_c refer to the clamp width and length respectively.

The clamp pressure is then determined by $P_c = 2 \times 10^6 = \frac{N}{A_c} = \frac{N}{L_c \cdot W_c}$ Pa. (equation 2)

The effective clamp width is given by the belt width. Thus W_c = 1,2 m.

The clamp length may then be found from equation (2). $L_c = \frac{N}{P_c \cdot W_c} = \frac{384 \times 10^3}{2 \times 10^6 \times 1{,}2} = 0{,}160$ m and a clamp 1,2 m wide × 160 mm would be required.

12. ACKNOWLEDGEMENTS

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Nepean Conveyors
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13. RECORD OF AMENDMENTS

Revision 00	December 2004	Original document
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