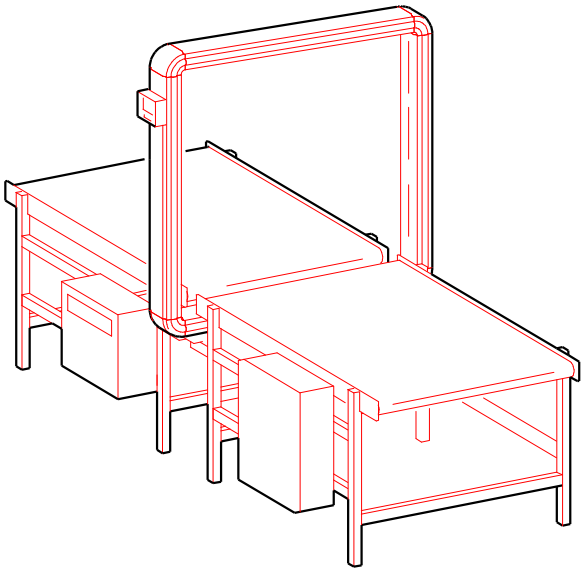
CS5000 FRAMES

Mechanical Designers Manual

Cargoscan A/S, October 1996



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Version 1.16 Part no. 790006

Table of Contents

1 Introduction

The purpose of this manual is to provide necessary information to those who want to design the CS5000 Frame into their own mechanical conveying system.

1.1 Brief CS5000 Frame Installation Requirements.

- The construction of the conveyor system must allow the CS5000 Frame to be removed from of the system, without disassembling the Frame.

- Tolerances in relative position between CS5000 Frame and conveyors are ± 1mm.

- An exact and stable relative position between the CS5000 Frame and the conveyor system is required.

- Objects must move undisturbed across the slots between the conveyors in order to make good measurement.

- **Accuracy (performance) of the CS5000 Frame is directly dependent to the installation tolerances given in chapter 4.**

2 Description of CS5000 Frame

2.1 CS5000 Frame

The CS5000 Frame is made out of four pieces of extruded Aluminium-profiles, with aluminium corners. These pieces are referred to as bars. See figure 1.

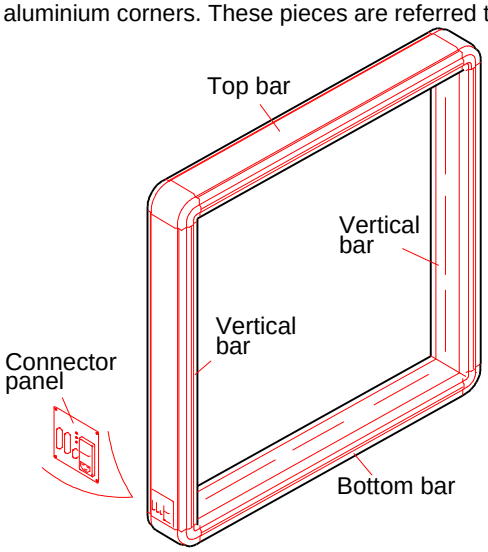


Figure 1. CS5000 Frame

Drawing 1 (see Appendix) describes the bars. Metal rods with threaded holes are inserted into notches in the bars as shown in figure 2. These rods slide freely within the notches. Frames are delivered with 4 long and 8 short rods as shown in figure 2.

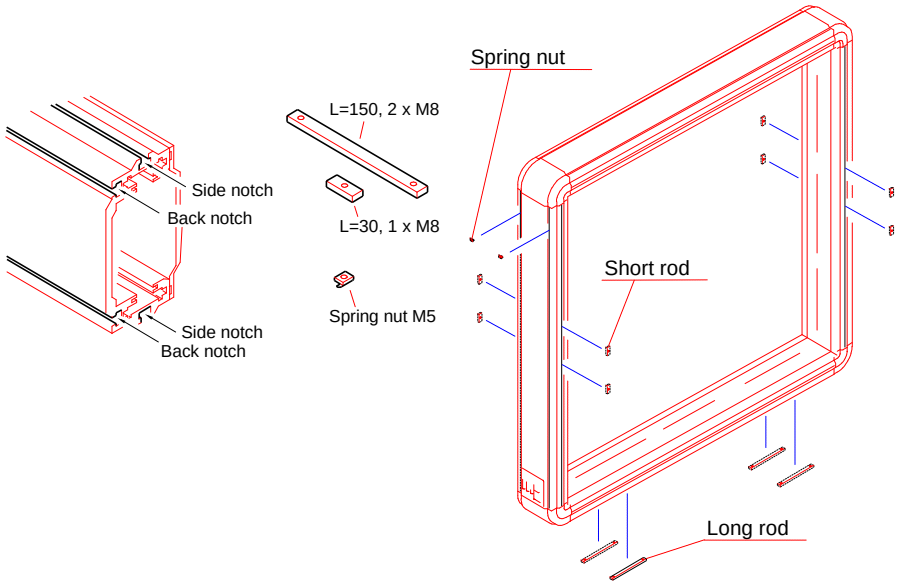


Figure 2. Metal rods inserted in the Al-profile

The display is mounted with two spring nuts (PN.260006) above the connector panel on the vertical bar (see figure 2).

There are two types of metal rods: short rods (PN.260074) and long rods (PN.260075), with one and two threaded holes respectively. See drawing 2 and 3.

During manufacturing, Cargoscan inserts metal rods in the bar notches:

Bottom bar: Two long metal rods in each of the back notches, allowing the pedestals to be fastened.

Vertical bar: One short metal rod in each of the side notches of the both bars, allowing the struts to be fastened on either side of the profile.

One spring nut in each of the back notches of the bar holding the connector plate, allowing the indicator unit to be fastened to the profile.

Additional Spring nuts and metal rods can be ordered from Cargoscan (drawings in Appendix A). Cargoscan also delivers a mounting kit for the Frame (PN.550516). This is described in Appendix B. “CS5000 Frame Mounting Kit. Also refer to figure 3 and 4 to see how these details are used.

The CS5000 Frame should be placed on two pedestals, and stabilized by two struts. See figure 3.

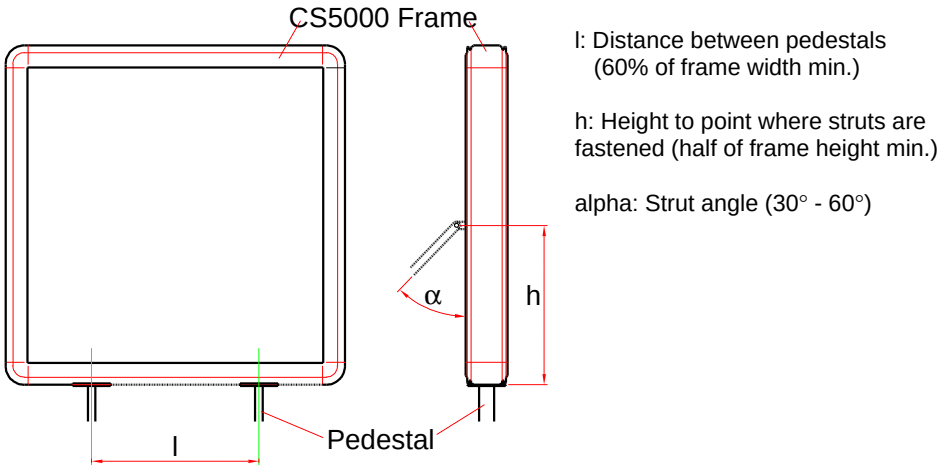


Figure 3. Mechanical mounting of CS5000 Frame

Mechanical details may be fastened to the bars by fixing them with bolts to the metal rods. See examples in figure 4.

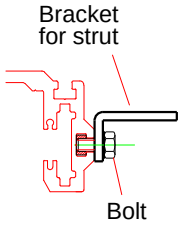


Figure 4. Bracket for strut fastened to the vertical bar.

2.2 How to mount plug protection box

The plug protection box (PN.220207) is designed to cover the connector panel and the cables. This protection box should be mounted after connecting the cables on the connector panel.

Part list:

Pos.	*Qty*	*Name*
1	4	Screw stop M6x25 DIN 916
2	1	Box
3	4	Nut M6 DIN 934
4	4	Washer ∅6.4 DIN 125 zn

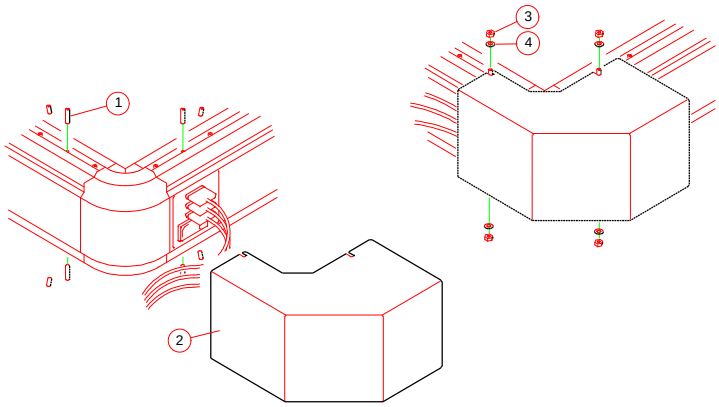


Figure 4b. Plug Protection Box

Remove any old stop screws in second hole from corner as shown.
Mount and tighten M6 x 25 stop screws (1) in vacant holes.
Slide box (2) on to corner entering the new screws.
Mount and tighten nuts (3) and washers (4).

2.3 Size and weight of CS5000 Frames

Figure 5 describes the overall mechanical dimensions, and dimensions of the measuring field of a CS5000 Frame.

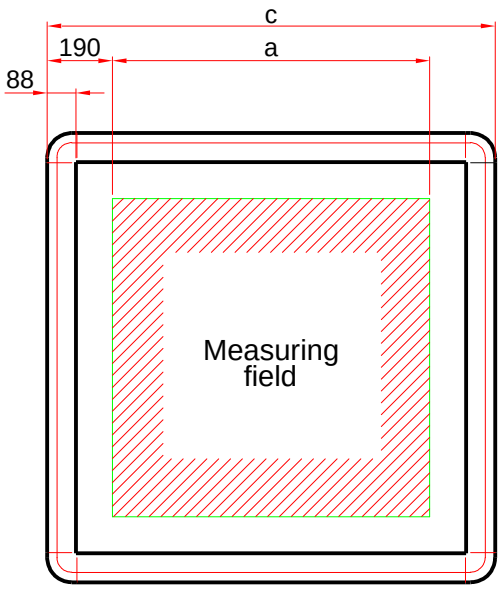


Figure 5. Mechanical dimensions and measuring field, CS5000 Frame
a: measuring field
c: outer dimensions

Horizontal and vertical dimensions are of equal size on ordinary frame versions.

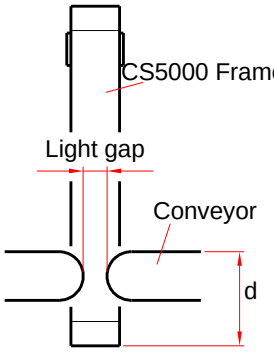
NB: The measuring frame will not be able to measure an object unless the outermost parts of the object moves a minimum of 10 mm inside the border of the measuring field. This allows measuring parcels with width and height up to 94 cm on a frame with 96 cm measuring field, assuming that the parcel is **exactly** centered in the measurement field, both in horizontal end vertical direction

Model no	Maximum parcel width and height (mm)	Measuring field (mm)	Outer dimension of frame (mm)	Weight of frame (kg)
CS5000 x0xx	940	960	1340	61
CS5000 x1xx	1260	1280	1660	77

3 Conveyors

The parcels are brought through the CS5000 Frame on two conveyors.
General advice concerning CS5000 Frame installation:

- Tolerances for relative position between CS5000 Frame and conveyors are ± 1 mm.
- The diameter of the conveyor rollers nearest the measuring gap must be so small that even the smallest parcels moves smoothly across the gap between the conveyor belts
- The construction of the conveyor system must allow the CS5000 Frame to be removed from the system, without disassembling the Frame.
- The CS5000 Frame should be mounted perpendicular to the approach and exit conveyors.
- An exact and stable relative positioning between the CS5000 Frame and the conveyors is required.
- Bottom bar must always be mounted on the bottom (please see figure 1).
- The Top level plane of the conveyors should be a minimum of 230 mm above the underside of the Frame bottom bar (please see figure 6). Note that as this dimension is increased, the measurement field height is reduced.
- The conveyor rollers should be positioned into the interior of the Frame, as shown on figure 6. Space below the conveyor belts is required for the lower bar and Frame support. Width and positioning of the conveyor, in combination with the actual parcels, should not allow any of the parcels to break the boarders of the measuring field, neither on top nor sides. Container guides should be installed to control box/parcel position within the measuring field
- Do not use a conveyor belt that is too shiny. It may reflect the infrared light used by the sensor in the gap under the package. This may affect the measurement result. This will typically only be a problem with new conveyers. (Sand belt if required).



d: Distance from conveyors down to bottom bar of Frame.

d= Min. 200 mm

Figure 6. Positioning of conveyors

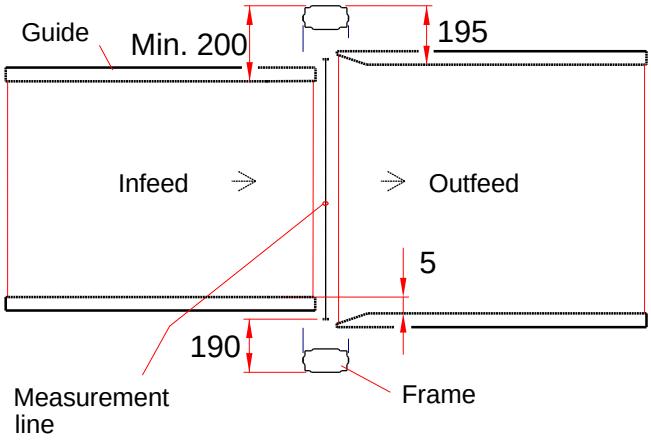


Figure 6b. Positioning of conveyors

It is important that the package is not disturbed by the side guides on the outfeed conveyor. Minimum clearances for side guides are described in figure 6b.

NB: The recommended dimensions for conveyors and guides in figures 6 and 6b assumes that no part of the object moves outside the guides on the infeed conveyor and that no part of the object moves down into the split between the conveyors. Objects to be measured in practical life are often cardboard boxes, often bulging boxes, often skew objects and often objects with ropes, labels e.t.c. standing out from the box. For transport industry the minimum dimensions of 200 mm from the outside of the frame to the zone where the parcel is moving are thus strongly recommended to be increased to 230 mm

(The height from underside of frame up to the conveyor, and the distance from the outside of the frame in to the guide on the conveyor on figure 6 and 6b).

These extra margins are of course not required when the objects to be measured are regular exactly right-angled objects.

3.1 Service accessibility

If the Frame should require service - it is necessary to access connector plate and its corners.

The CS5000 Frame consists of electronic circuit boards fastened to slide rails inside the Frame bars. These may be pulled out of the Frame through its detachable corners. Each bar of electronics may be pulled out through two corners.

To service the CS5000 Frame, free space equivalent to the length of the bar must exist on one end of each bar (please refer to figure 7 for details and example).

The service technician also needs to access each corner of the frame to reinstall cable connections.

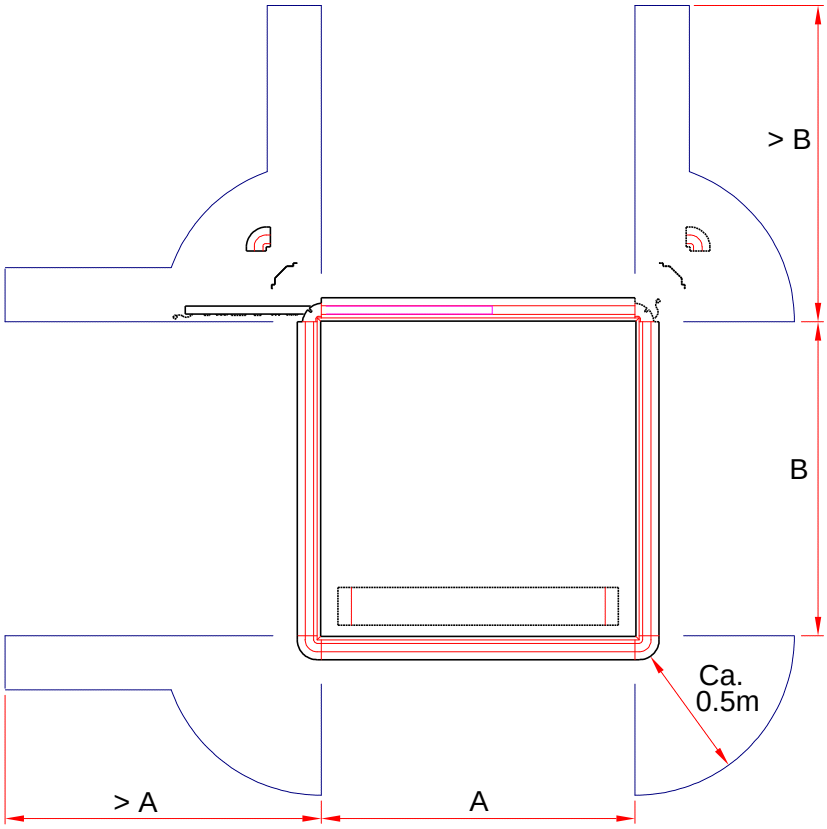


Figure 7. Example on how space may be allocated for service, refer to text for details.

4 Requirements for Conveyors

Chapter 4 describes the requirements to the conveying system to be sufficient to meet Cargoscan's accuracy specifications for CS5000 Frame.

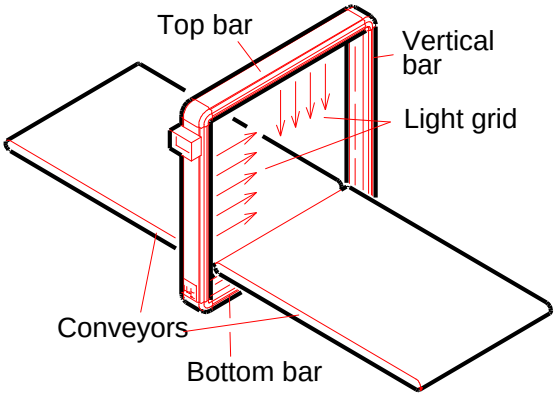
> ANY FAILURE TO COMPLY TO THESE SPECIFICATIONS WILL RESULT IN REDUCED MEASUREMENT ACCURACY AND CARGOSCAN CANNOT BE HELD TO GUARANTEE ACCURACY OF THE EQUIPMENT.

The CS5000 Frame as a dimension measurement instrument is a very accurate device that measures within 5mm accuracy. On randomly oriented objects the following accuracy can be achieved when the CS5000 Frames are installed in a "perfect" conveying system:

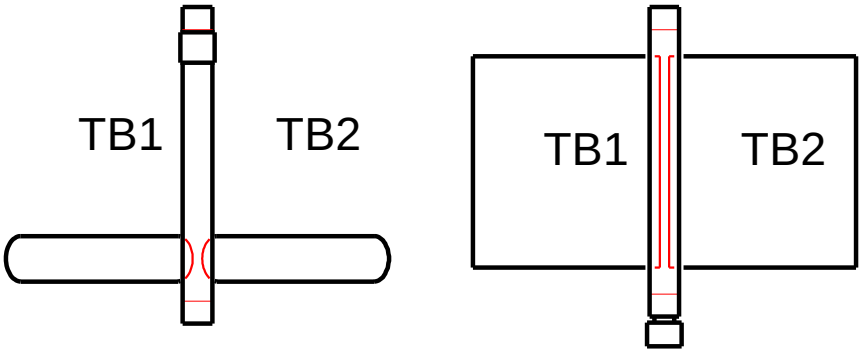
Mean deviation from correct value: < 2mm
Standard deviation: < 1.5mm

> THE CS5000 FRAME ALONE, IS JUST HALF THE DIMENSION MEASUREMENT INSTRUMENT. THE OTHER HALF CONSISTS OF THE CONVEYING SYSTEM ON EACH SIDE OF THE CS5000 FRAME. ONLY WHEN THESE ARE MADE SPECIFICALLY FOR THE TASK, CAN THE ABOVE CLAIMED ACCURACY BE GUARANTEED BY CARGOSCAN.

4.1 Important Geometrical considerations when mounting the CS5000



3 - D view



de view *Overhead view*

Figure 8. Correct mounting of Frame in relation to conveyors.

The CS5000 Frame is mounted in a gap between two conveyors (designated TB1 and TB2 in the diagrams). A grid of infrared light is generated across the transport direction in horizontal and vertical directions. Information from the shadow that the object generates in the light grid along with information about conveyor movement is used to measure the dimensions of the object.

It is important that the objects moves smoothly without vibration through the CS5000 Frame. The objects must not "bump" over the gap between the two conveyors.

4.2 Requirements for Minimum gap G between the conveyors

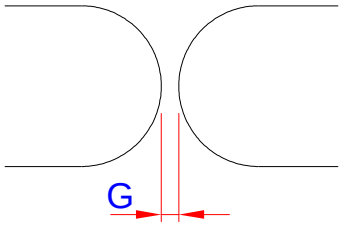


Figure 9. Minimum gap between the conveyors

The table below gives minimum G (gap) according to conveyor speed:

SPEED m/min.	Light gap G mm
< 150	12
150-200	15
200-250	18

Table 1. Minimum G (gap) dependent on Conveyor speed

- These requirements are absolute requirements for a free light gap between the conveyor belts: Manufacturing tolerances of the conveyors from the conveyor manufacturer. Deviation in belt thickness, seam thickness, roller movement as conveyor moves and other mechanical considerations must be taken into account so that this light gap, with the frame centered between the two belts, can be guaranteed.

- To achieve optimum accuracy belt seams should be no thicker than the belt material. Nor should the seam be a shiny metallic staple or lacing.

- Use of stapled belts is not recommended due to thickness and reflective properties that may cause erroneous measurements.

It must be possible to adjust the position and orientation of the frame in the light gap. Refer to chapter 4.8 where the skewing of the frame is defined.

4.3 Minimum object size due to roller diameter

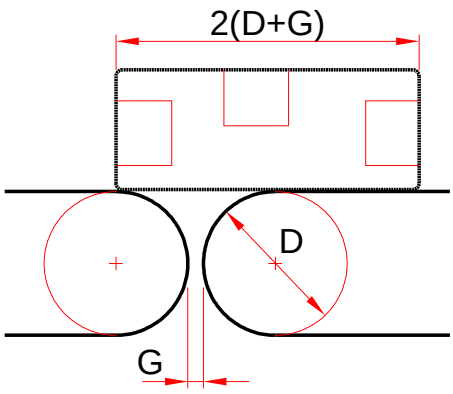


Figure 10. Design of conveyors

The gap between conveyors, and the diameter on the conveyor end rollers determine the smallest object that can be measured correctly. An object will not be measured correctly unless it has a stable surface with length along the conveyor belt that is long enough to move smoothly through the CS5000 Frame, without vertical motion or rocking motion caused by the gap between the conveyors.

The figure shows the theoretical smallest length of an object that can be measured, with given values of end roller diameter (D), and light gap between conveyors (G), assuming that the object has uniform density.

The table below shows the theoretical minimum length along the conveyor belt for different values of D.

D	G	Length of smallest package
50 mm	15 mm	130 mm
80 mm	15 mm	190 mm
100 mm	15 mm	230 mm

Table 2. Values for Figure 10

Cargoscan recommends:

D = 50 mm
G = 15 mm

During measurement the object floats over the light gap between the conveyors. The distance where the conveyors does not support the object limits the smallest object that can be reliably measured, as described on the previous page.

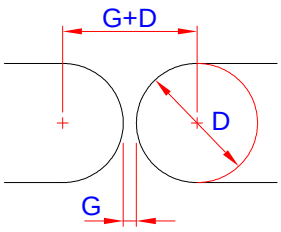


Figure 11.

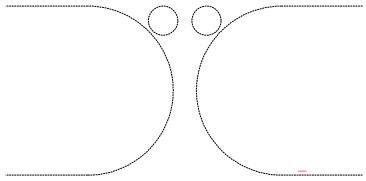


Figure 12.

This distance can be reduced by using extra support rollers. Refer to figure 12.

4.4 Height difference between conveyors

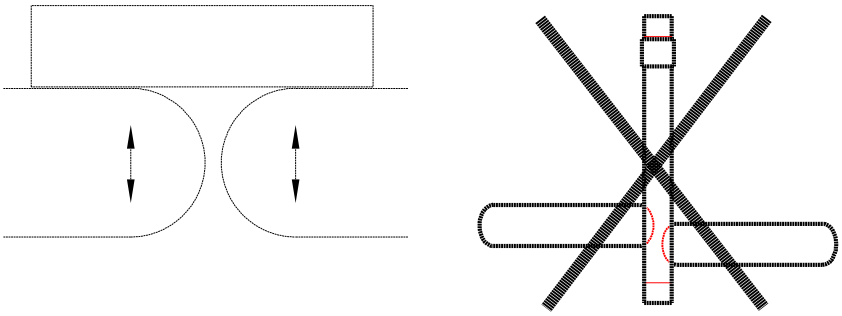


Figure 13.

To prevent the object from moving vertically as the object moves across the gap, the height difference between the conveyors must be minimal. **To achieve the specified accuracy it must be less than 1mm.**

The conveyor taking the object away from the gap must always be the lower conveyor belt of the two.

4.5 Difference in angles between conveyors.
Both conveyor top surfaces must be parallel. The angle between them must be smaller than 4 mRad.

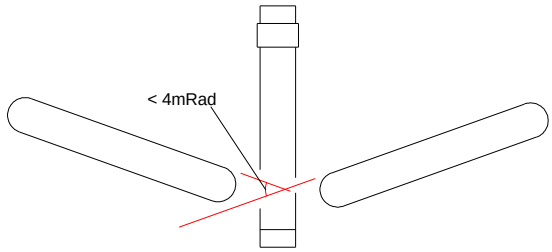


Figure 14.

4.6 Difference in conveyor direction of movement
The direction of movement of the two conveyors must be the same, within 5 mRad. This is to prevent the object from turning as it is measured.

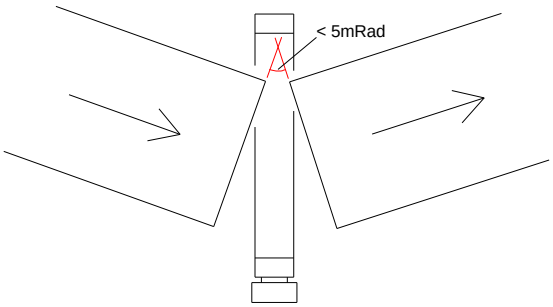


Figure 15.

4.7 Difference of speed between conveyors.
A speed controller on the conveyors is necessary to make sure the speed does not differ by more than 2% between the two conveyors. The CS5000 Frame pulse counter is measuring the movement of just one conveyor. Especially on heavy objects this speed may vary as the object crosses the slot between the conveyors. Cargoscan recommends the use of synchronous speed controllers for inbound and outbound conveyor speed control.

4.8 Angle of the CS5000 Frame relative to the conveyors.
The bottom bar of the CS5000 Frame must be parallel to the plane defined by the conveyors.
The vertical bar of the CS5000 Frame must be 90° to the plane defined by the conveyors.

To achieve this, the mounting of the Frame must be adjustable. Cargoscan recommends a water level (2 meters long) be used to adjust the angles to better than 1mRad.

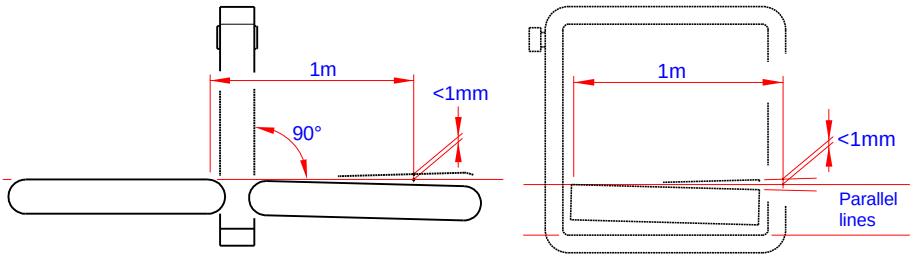


Figure 16.

The bottom bar of the Frame must be mounted normal to the transport direction. However it must be possible to adjust the angle between the bottom bar and the transport direction as described below.

The angle between the bottom bar and a line exactly perpendicular to the direction of movement of the conveyors defines the skewing of the Frame. The skewing must be adjustable. Adjustment should be made according to the CS5000 service manual. Errors dependent on the orientation of the objects will result if this angle is not adjusted correctly (The skewing is illustrated in figure 17 and 18). Skewing is in the order 1-5 mRad.

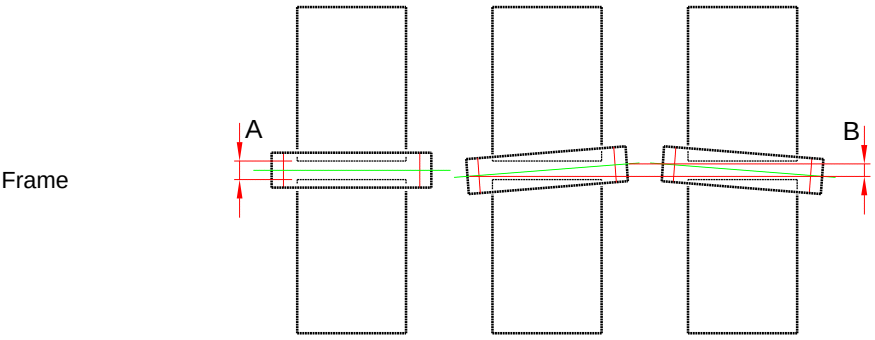


Figure 17. Mount CS5000 Frame so that it can be adjusted in the transport direction (Skewing)

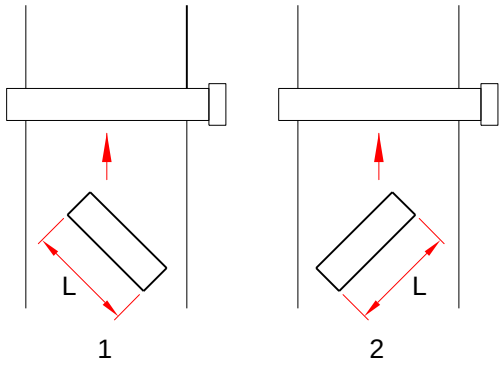


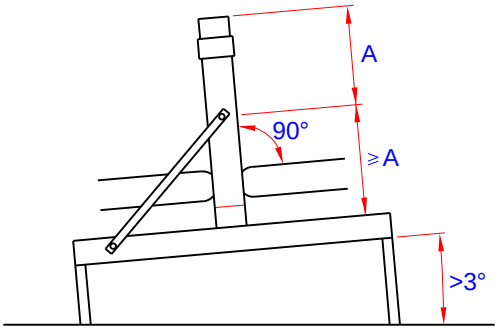
Figure 18. Control of skewing.

Object length measures same in both orientations (1 and 2) if skewing is correctly adjusted. It will measure different for the two orientations if skewing is not correctly adjusted.

4.9 Proper calibration for pulse-counter values.
The frame will not measure according to specification, unless the procedures for proper calibration of the pulse-counter are precisely followed. Please see the CS5000 Frames Service and Installation Manual.

4.10 Mechanical mounting

The CS5000 Frame should always be supported by one or two struts, fixing the position of the frame firmly.
In cases where the conveyor is tilted by more than 3° from the horizontal, particular attention to frame support will be required. Struts should be fixed to the Frame at a height not less than half the frame height.



If the conveyors tilt more than 10°, carefully observe if the packages to be measured are slipping on the conveyor. Package slipping will result in inaccurate measurements

Figure 19.
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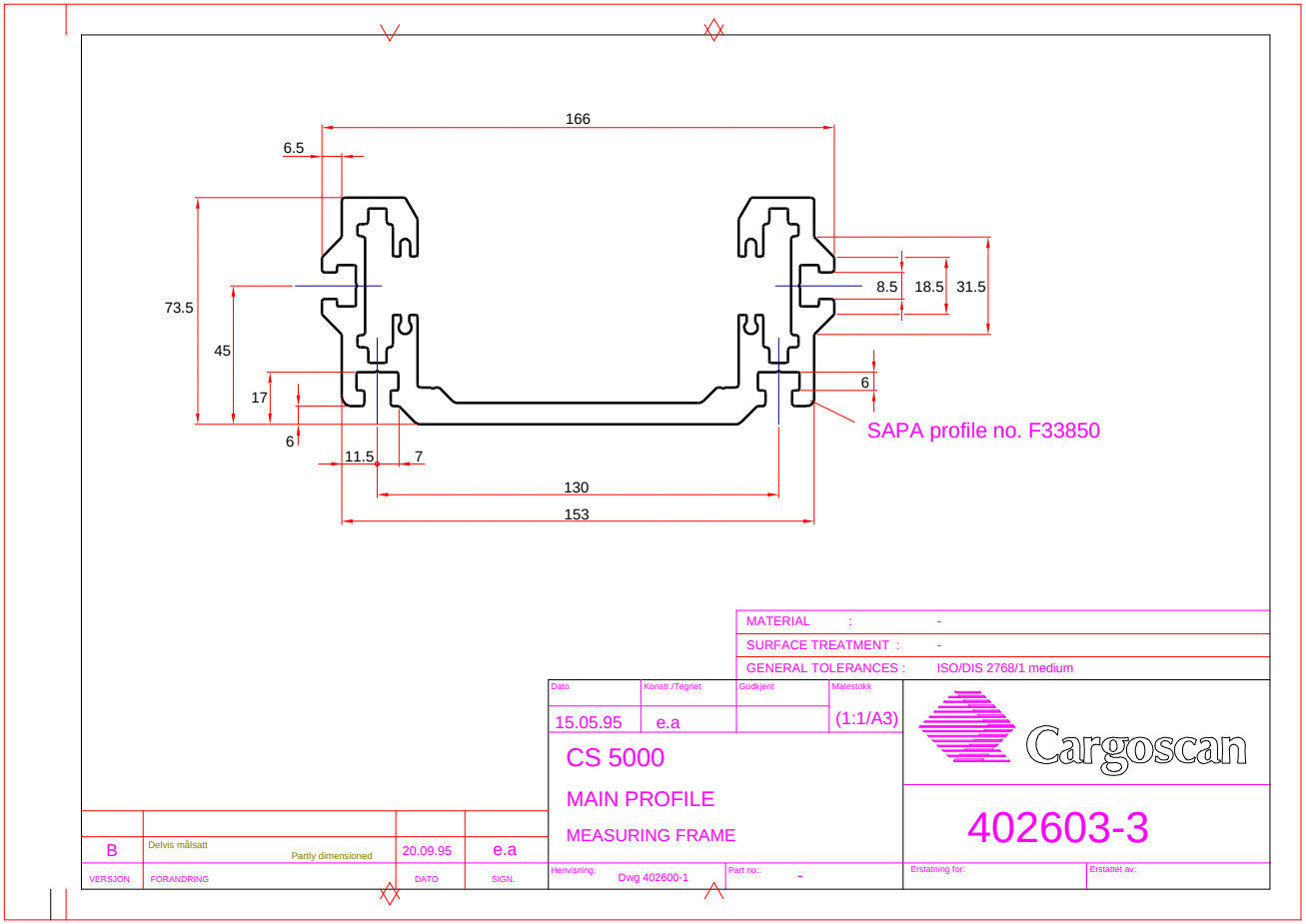
Appendix A: Drawings

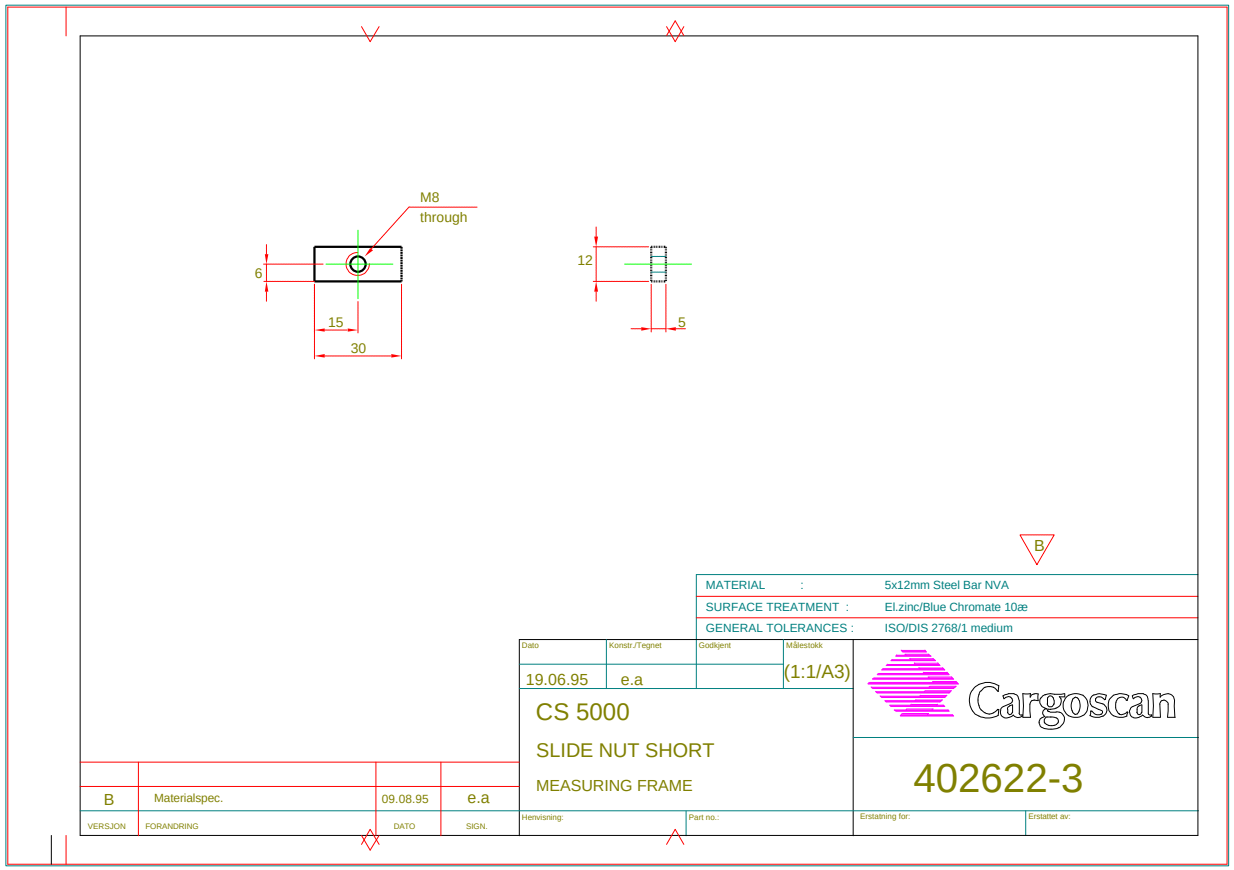
Drawing 1 Main profile (Al. profile).

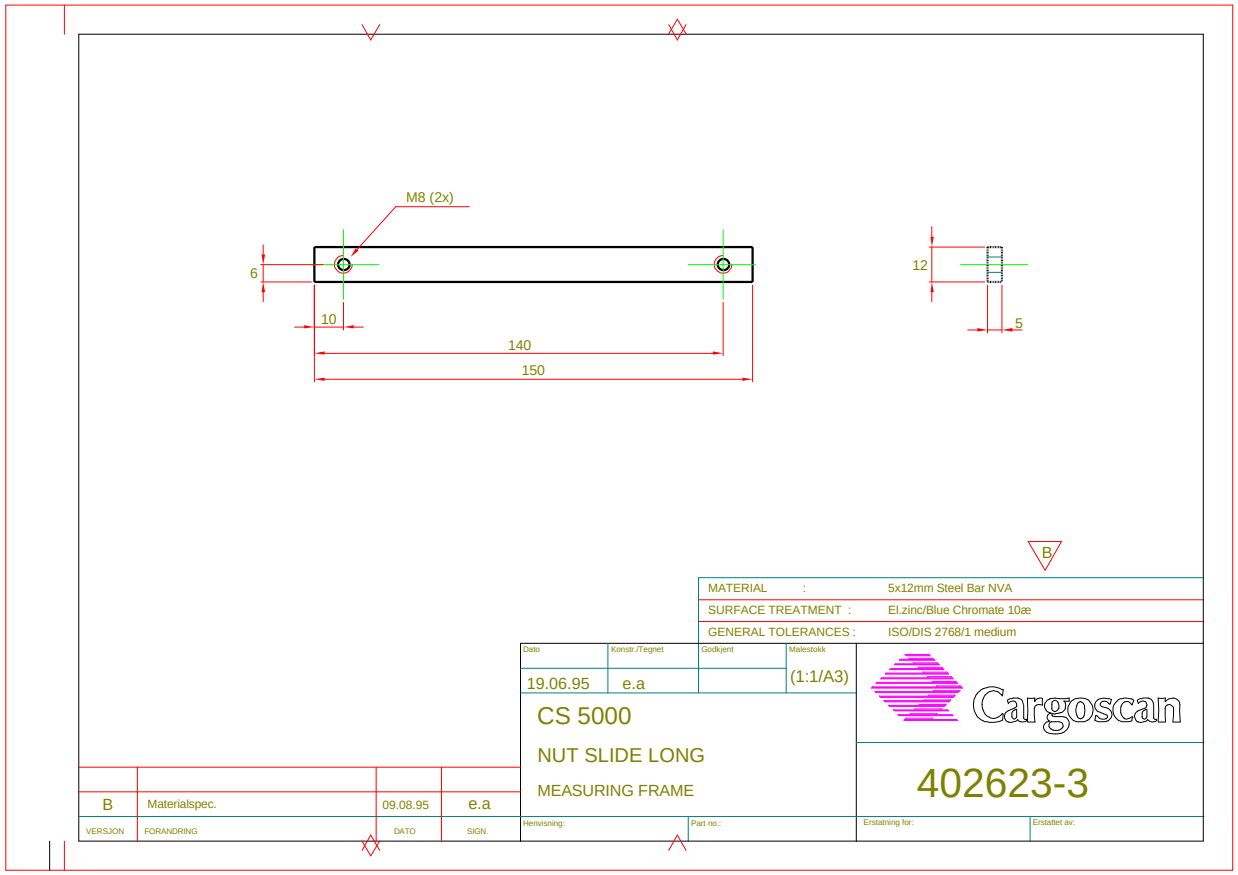
Drawing 2 Slide nut short (Short metal rod).

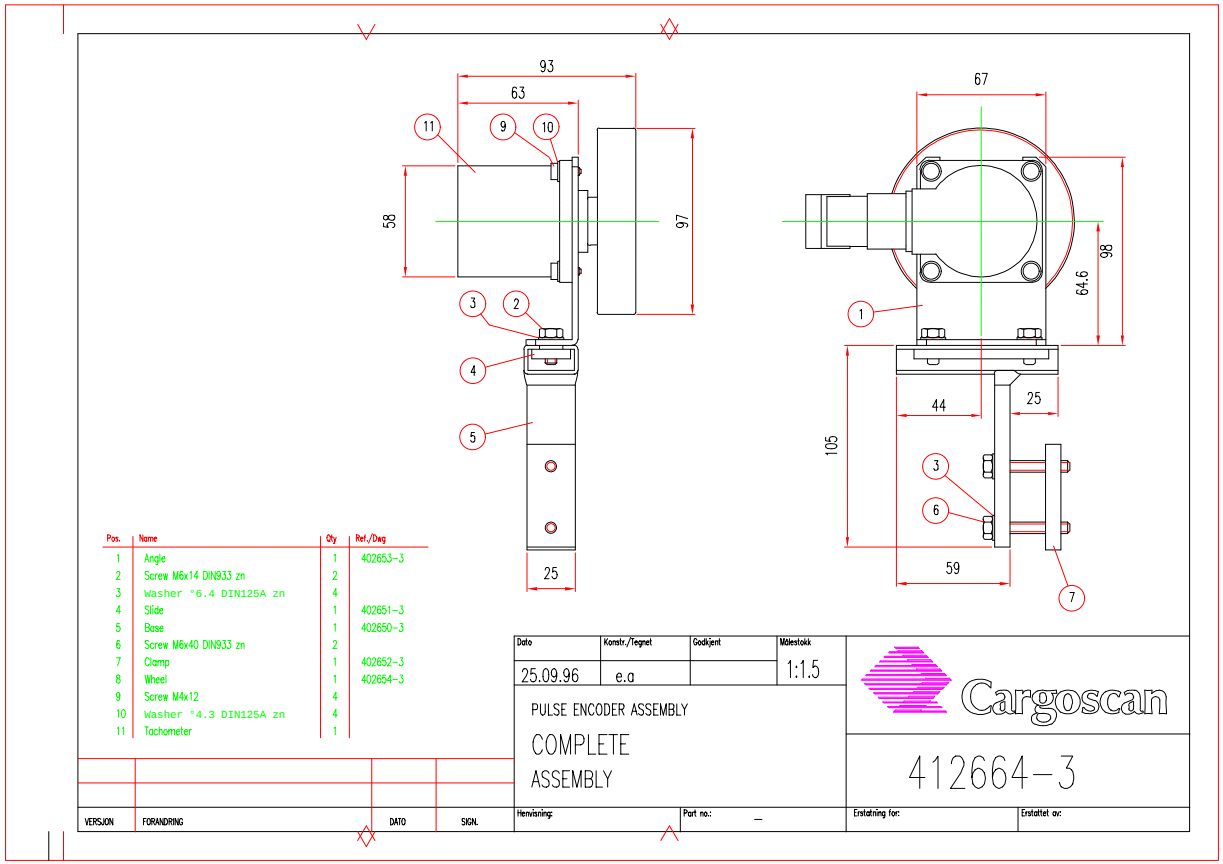
Drawing 3 Slide nut long (Long metal rod).

Drawing 4 Pulse encoder assembly









Pos.	Name	Qty	Ref./Dwg
1	Angle	1	402653-3
2	Screw M6x14 DIN933 zn	2	
3	Washer °6.4 DIN125A zn	4	
4	Slide	1	402651-3
5	Base	1	402650-3
6	Screw M6x40 DIN933 zn	2	
7	Clamp	1	402652-3
8	Wheel	1	402654-3
9	Screw M4x12	4	
10	Washer °4.3 DIN125A zn	4	
11	Tachometer	1	

Dato	Konstr./Tegnet	Godkjent	Målestokk
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PULSE ENCODER ASSEMBLY

COMPLETE ASSEMBLY

Cargoscan

412664-3

VERSJON	FORANDRING	DATO	SIGN.

Henvisning: | Part no.: – | Erstatning for: | Erstattet av:

APPENDIX B: MOUNTING DETAILS

CS5000 Frame Mounting Details (Mounting Kit)

- Bill Of Material
- Assembly Instructions
- Drawing

BILL OF MATERIAL

SYMBOL	REQ'D	DESCRIPTION
1	1	CS5000 Frame
2	1	Plate, Base Support
3	2	Bracket, Lower Slide
4	2	Foot, Articulated Mounting
5	2	Bracket, Frame Adaptor
6		
7	2	Clip, Strut Adjustment
8	2	Bar, Strut
9	2	Nut, 3/4-10NC HEX JAM
10	2	Screw, M10-1.5P x 160mm HHCS Full THD
11	4	Screw, M10-1.5P x 40mm FLHD
12	4	Screw, M10-1.5P x 25mm HHCS
13		
14		
15	10	Screw, M8-1.25P x 25mm HHCS
16	2	Screw, M8-1.25P x 20mm HHCS
17		
18	6	NUT, M10-1.5P Nylock
19		
20	2	NUT, M8-1.25P HEX
21		
22	4	Washer, M10 Lock
23	12	Washer, M10 Flat
24	12	Washer, M8 Lock

ASSEMBLY INSTRUCTIONS

1. Mount base support plate (#2) to a rigid Frame using the (4) 1/2” ø mounting holes.

2. Install flat washer (#23) on M10 x 160mm screw (#10), insert in hole as shown. Add FW(#23) and run nylock nut (#18) on screw until it is snug, loosen 1/4 turn to allow screw to turn free.

3. Hold slide bracket in place and run screw assembly on until bracket is centered over slot.

4. Install the M10 fasteners (#12, 22, 23) for slide bracket.

5. Install 3/4” nut (#9) on foot (#4) about midway up shaft and screw foot into slide bracket.

6. Install Frame adaptor (#5) to top of foot using (#11, 18, 23) fasteners.

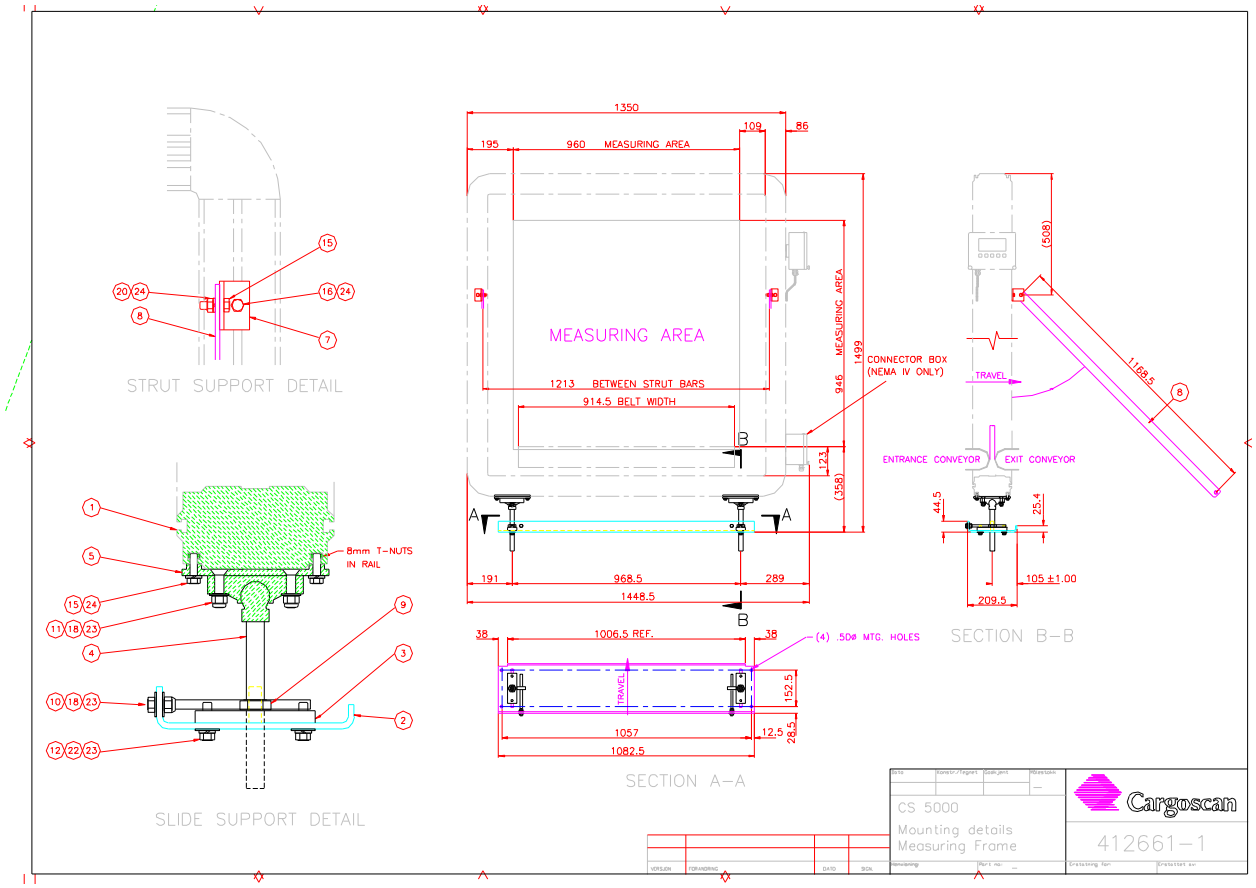
7. Mount strut clip (#7) to Frame using T-nuts in grooves and fasteners supplied as shown.

8. Mount strut bar (#8) to strut clip as shown.

9. Stand - up Frame and secure to adaptor plate and strut to rigid Frame.

10. Refer to Chapter 4 in CS5000 Frames Mechanical Designers Manual for final adjustments of Frame.

11. Refer to Chapter 4.2 of the manual for minimum light gap.


STRUT SUPPORT DETAIL
SLIDE SUPPORT DETAIL
8mm T-NUTS IN RAIL
1350
109
86
195
960 MEASURING AREA
MEASURING AREA
1213 BETWEEN STRUT BARS
914.5 BELT WIDTH
946 MEASURING AREA
1499
CONNECTOR BOX (NEMA IV ONLY)
123
(358)
191
968.5
289
1448.5
38
1006.5 REF.
38
(4) .5Dø MTG. HOLES
TRAVEL
152.5
12.5
28.5
1057
1082.5
SECTION A–A
(508)
TRAVEL
1168.5
ENTRANCE CONVEYOR
EXIT CONVEYOR
44.5
25.4
105 ±1.00
209.5
SECTION B–B
CS 5000
Mounting details
Measuring Frame
Cargoscan
412661–1