

Approval body for construction products
and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and
Laender Governments



European Technical Assessment

ETA-19/0430
of 9 January 2020

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the
European Technical Assessment:

Deutsches Institut für Bautechnik

Trade name of the construction product

Pallet Racking System NR

Product family
to which the construction product belongs

Steel static storage systems - Adjustable pallet racking
systems

Manufacturer

NEDCON B.V.
Nijverheidsweg 26
7005 BJ DOETINCHEM
THE NETHERLANDS

Manufacturing plant

Factories of NEDCON B.V

This European Technical Assessment
contains

58 pages including 6 annexes which form an integral part
of this assessment

This European Technical Assessment is
issued in accordance with Regulation (EU)
No 305/2011, on the basis of

EAD 200059-00-0302

European Technical Assessment

ETA-19/0430

English translation prepared by DIBt

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Specific part

1 Technical description of the product

The construction products are corrosion-protected steel components of the Nedcon Pallet Racking System NR for the storage and retrieval of goods. The goods to be stored are generally on pallets or in box-containers. Annex 1 provides an overview of the racking systems.

Two vertical upright profiles made of steel, which are bolted together via diagonals and, if necessary, horizontal bracing members make up the upright frames of the racking system. The uprights are thin-walled cold-formed Ω -shaped steel sections, which are produced by roll forming. They are continuously perforated over their length. The uprights are fastened by means of a bolted connection to the base plate construction made of steel. The upright frames take over the vertical loads and ensure the stiffening in the transverse (cross aisle) direction of the pallet racking system. For connecting the pallet beams to the uprights so-called beam end connectors (BEC) with hooks are welded at the end of the pallet beams. The BEC are hooked into the perforation provided for this purpose within the uprights.

The rotational stiffness of the floor connection to the upright and the BEC connection to the upright ensures the stiffening of the pallet racking system in the longitudinal (down aisle) direction.

The components and the system setup of the product are given in the Annexes to this European Technical Assessment. They shall correspond to the information given in the Annexes 1 to 5.

The material properties, dimensions and tolerances not indicated in Annexes 1 to 5 shall correspond to the information laid down in the technical information¹ to this European Technical Assessment.

2 Specification of the intended use in accordance with the applicable European Assessment Document

The construction products are intended to be used according to EAD 200059 00 0302, clause 1.2.

The performances given in Section 3 are only valid if the racking system components are used in compliance with the specifications and conditions given in the Annexes to this European Technical Assessment and if the assembly and setup is carried out according to the manufacturer's assembly instructions.

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the racking system components of at least 10 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

¹ The technical documentation is deposited with Deutsches Institut für Bautechnik and as far as relevant for the tasks of the approved bodies involved in the attestation of conformity procedure is handed over to the approved bodies.

3 Performance of the product and references to the methods used for its assessment

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Upright characteristics	See Annex 6.1
BEC characteristics	See Annex 6.2
Floor connection characteristics	See Annex 6.3
Upright frame characteristics	See Annex 6.4
Beam characteristics	See Annex 6.5
Upright splices characteristics	No Performance Assessed

4 Assessment and verification of constancy of performance (AVCP) system applied, with reference to its legal base

In accordance with EAD No. 200059 00 0302, clause 3.1, the applicable European legal act is: 1998/214/EC

The system to be applied is: 2+

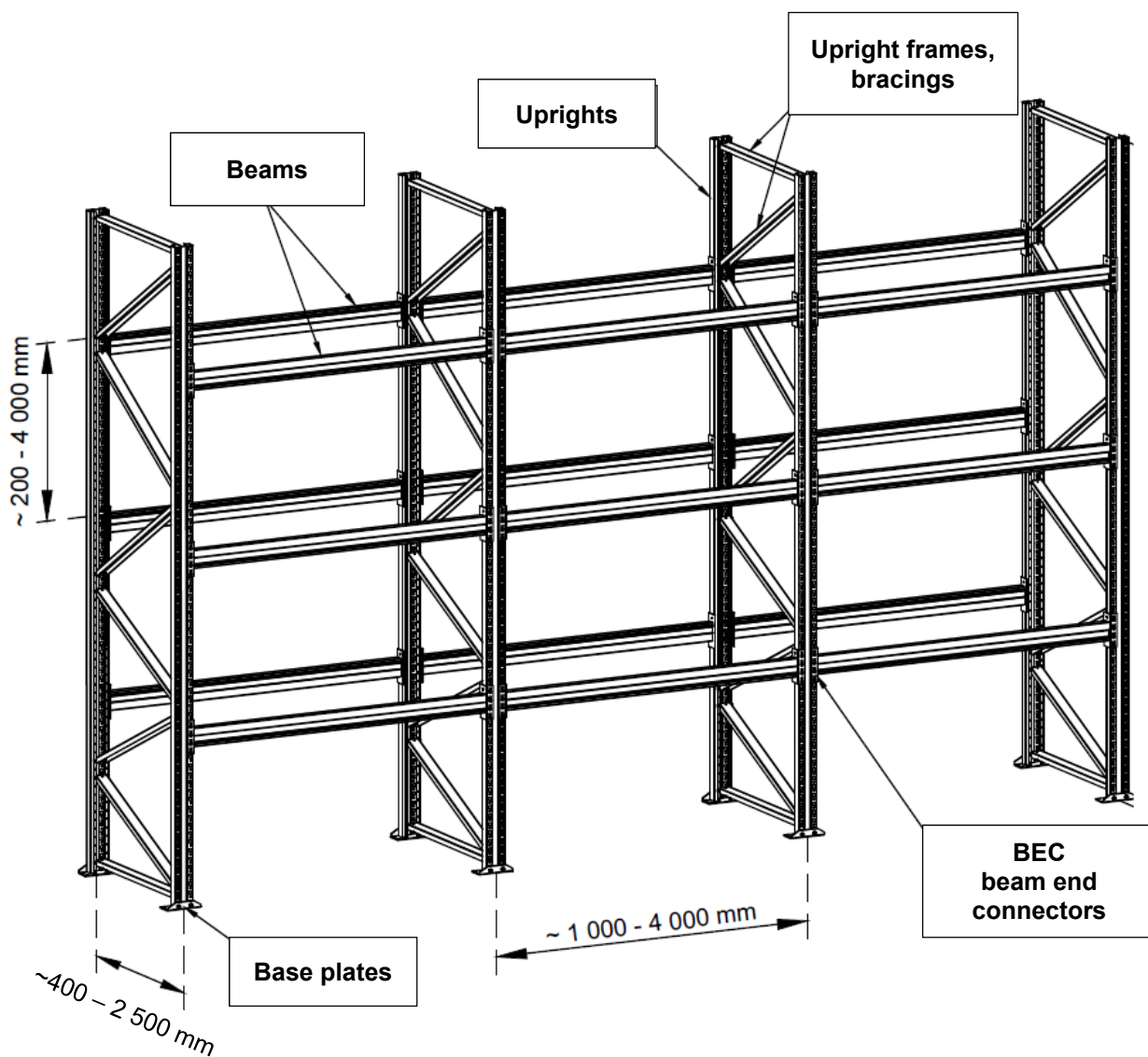
5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited with Deutsches Institut für Bautechnik.

Issued in Berlin on 9 January 2020 by Deutsches Institut für Bautechnik

BD Dipl.-Ing. Andreas Kummerow
Head of Department

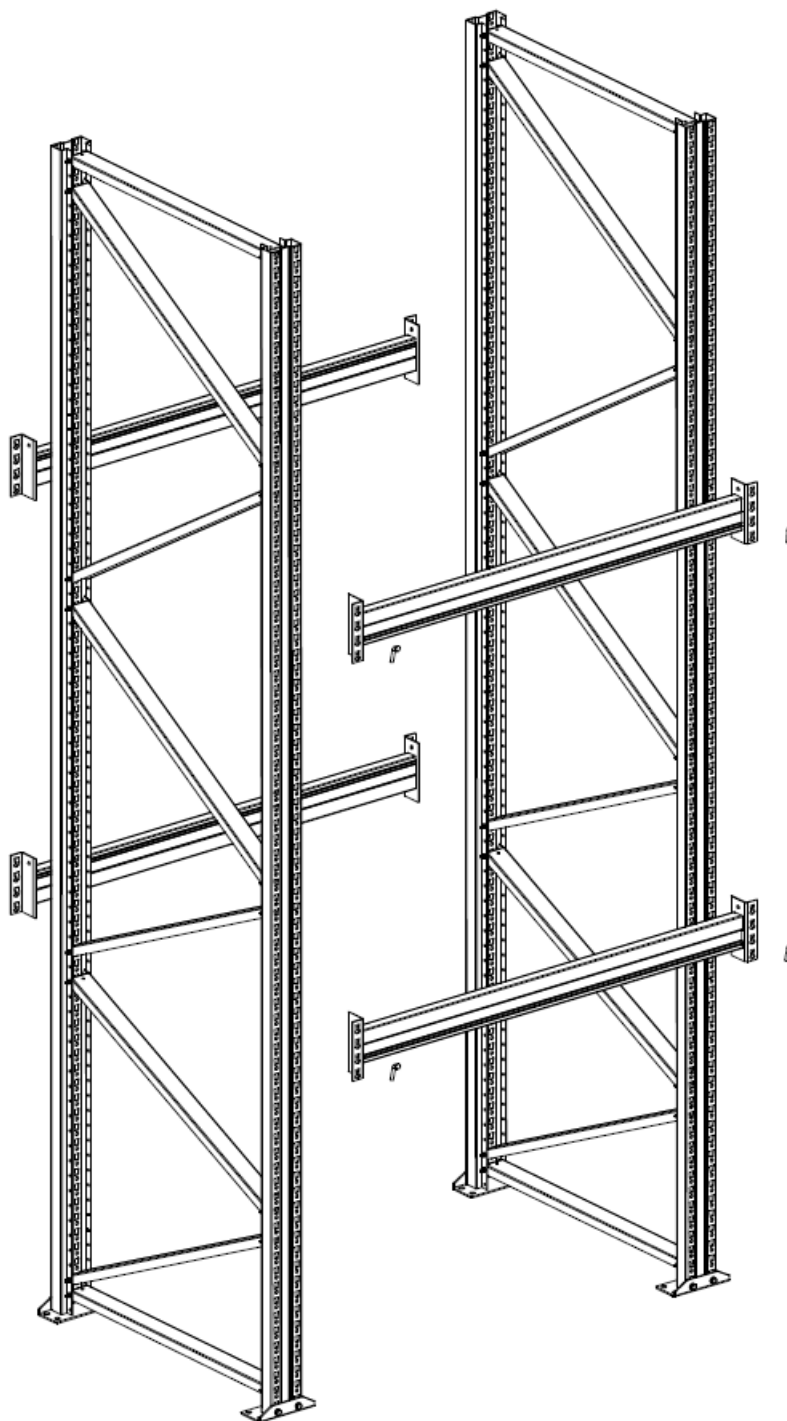
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Reimuth



Pallet Racking System NR

Overview of the racking system

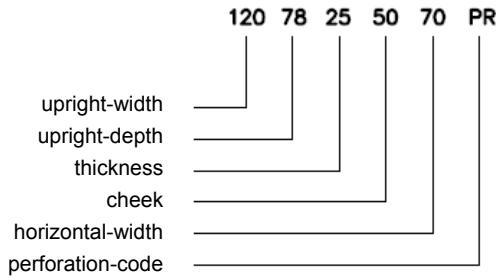
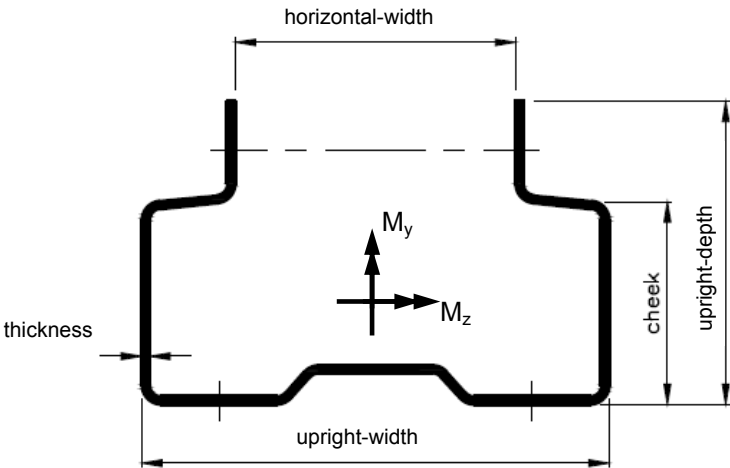
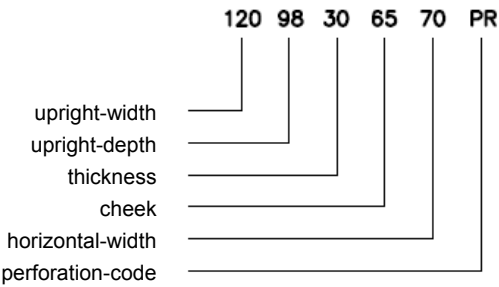
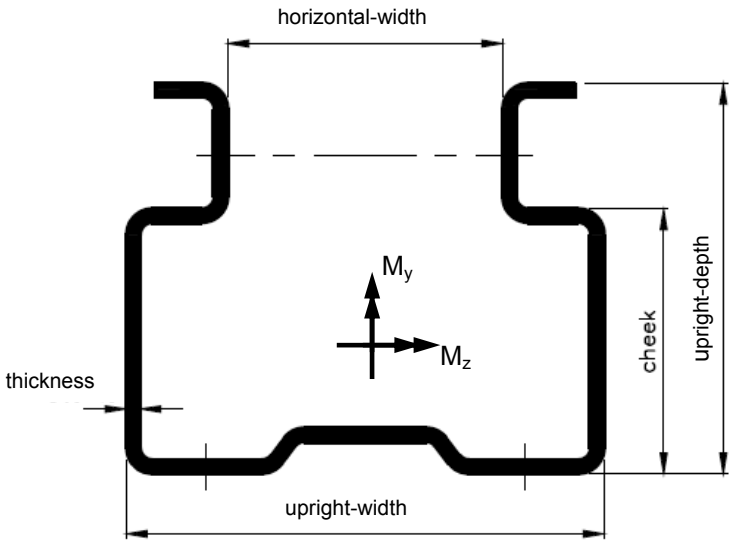
Annex 1



Pallet Racking System NR

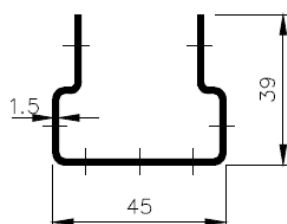
Overview of upright frames
with pallet beams

Annex 1.1



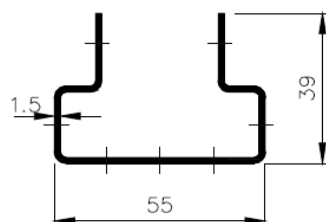
all dimensions in mm

Pallet Racking System NR	Annex 2.1
Uprights Descriptions	



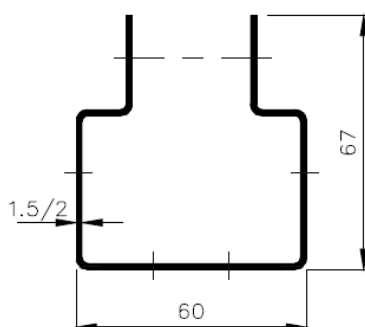
04539152032

Group 0
Uprights



05539152032

Group A
Uprights



06067154030
06067204030

Group B1
Uprights

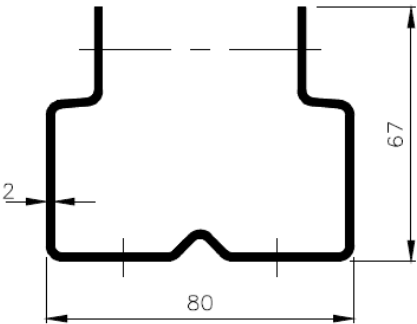
all dimensions in mm

detailed component information
deposited with DIBt

Pallet Racking System NR

Uprights (Group 0, A and B1)
Width 45, 55, and 60mm

Annex 2.2



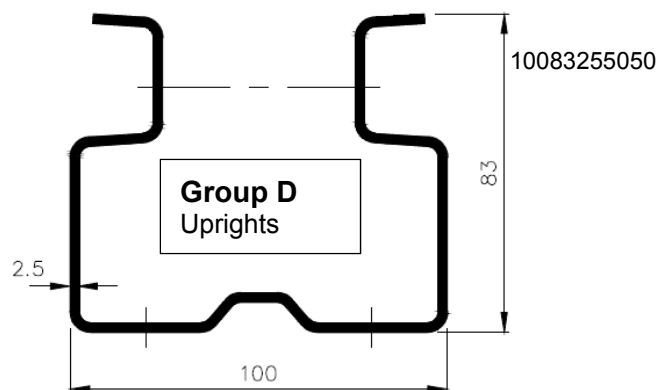
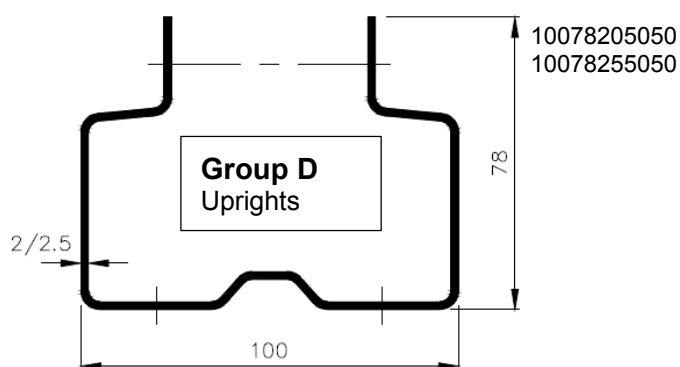
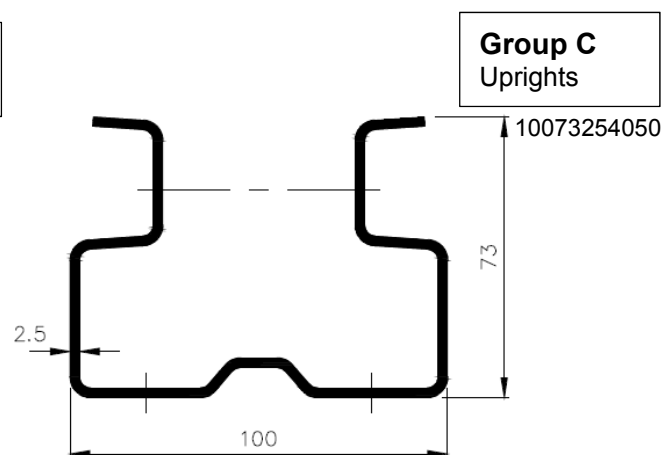
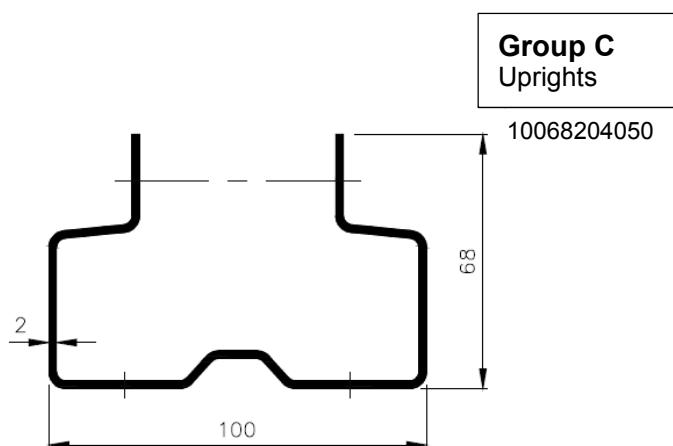
08067204050

Group B2
Uprights

all dimensions in mm

detailed component information
deposited with DIBt

Pallet Racking System NR	Annex 2.3
Uprights (Group B2) Width 80mm	



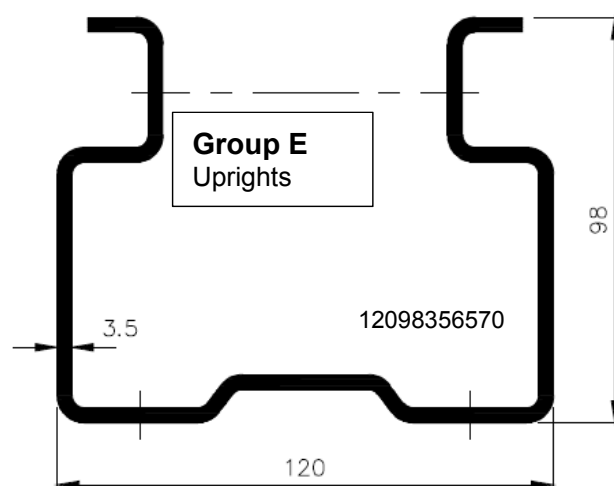
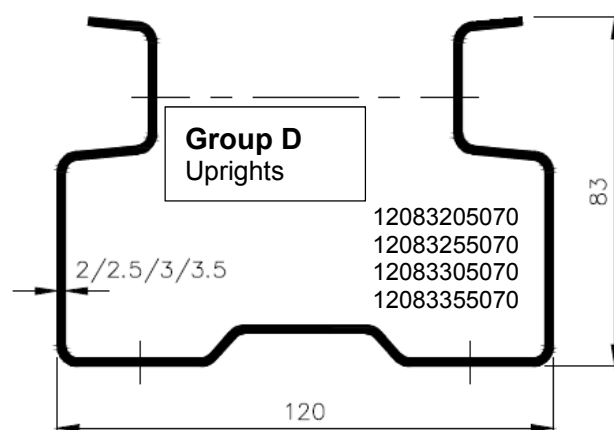
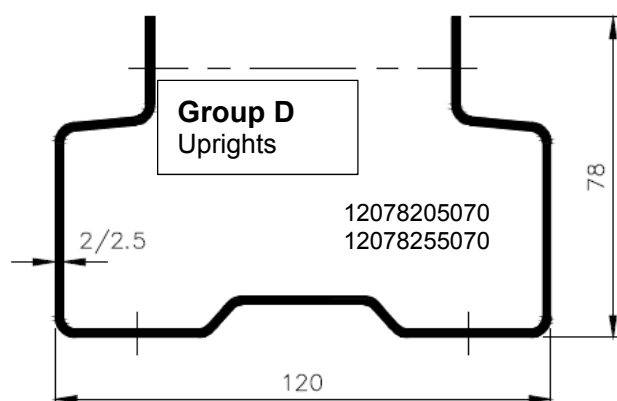
all dimensions in mm

detailed component information
deposited with DIBt

Pallet Racking System NR

Uprights (Group C and D)
Width 100mm

Annex 2.4



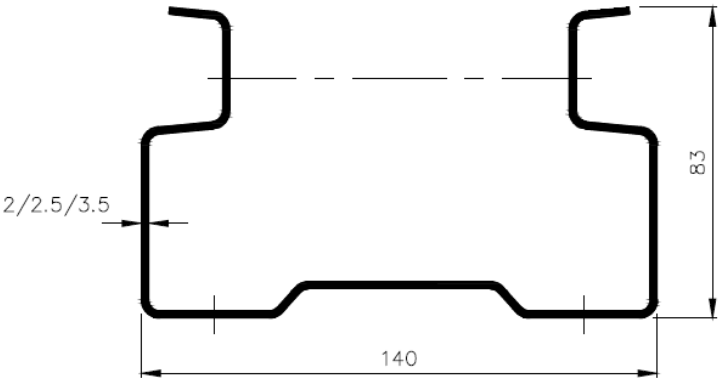
all dimensions in mm

detailed component information
deposited with DIBt

Pallet Racking System NR

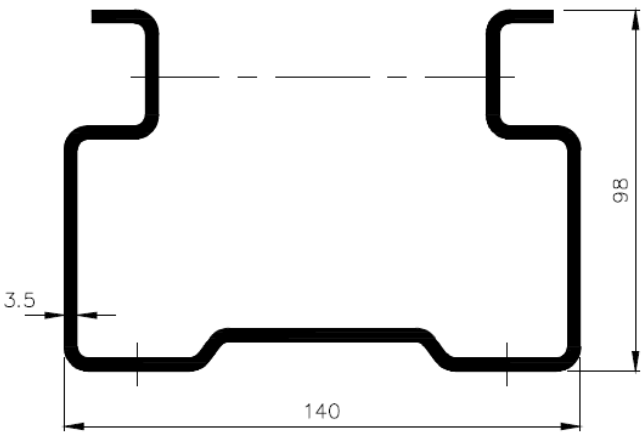
Uprights (Group D and E)
Width 120mm

Annex 2.5



14083205090
14083255090
14083355090

Group D
Uprights



14098356590

Group E
Uprights

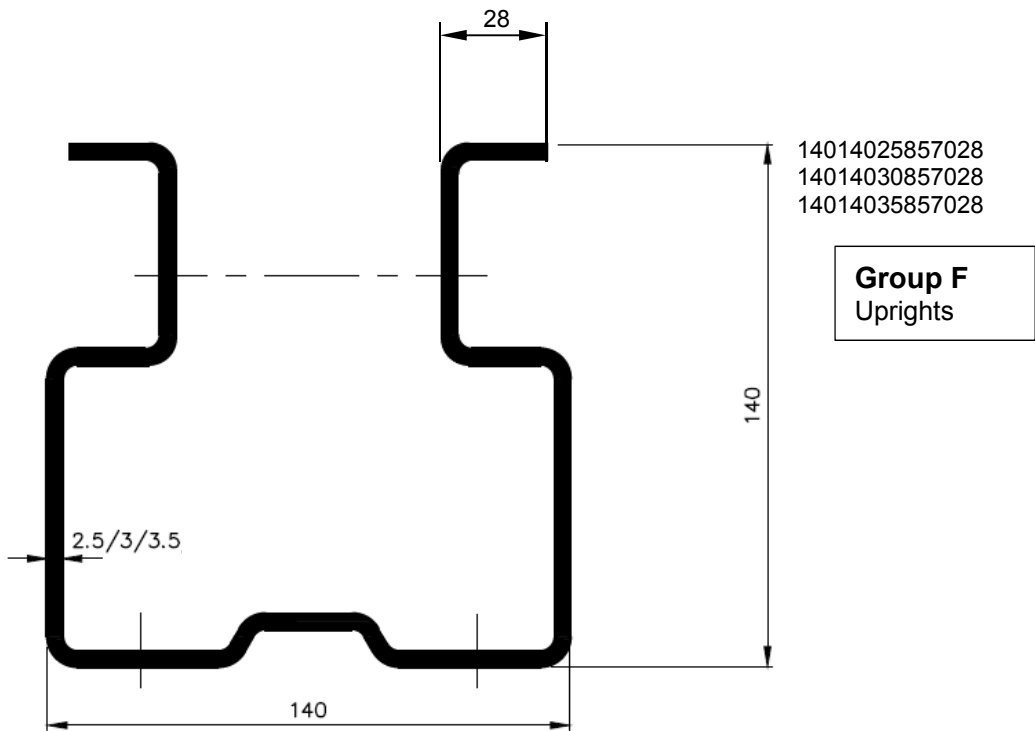
all dimensions in mm

detailed component information
deposited with DIBt

Pallet Racking System NR

Uprights (Group D and E)
Width 140mm

Annex 2.6

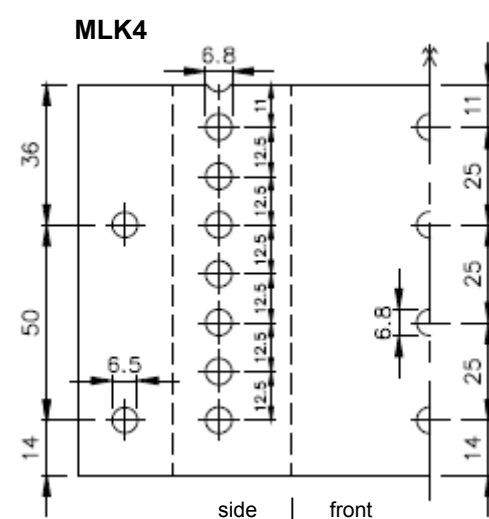
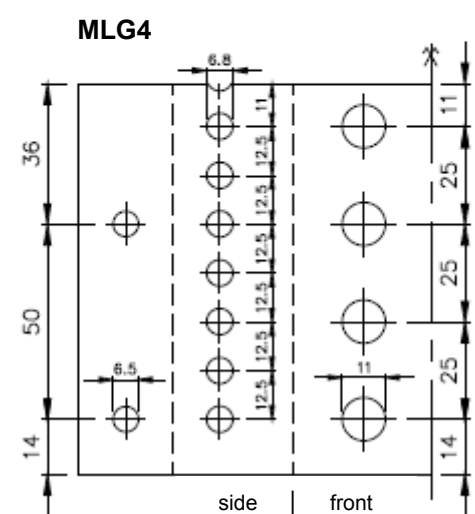
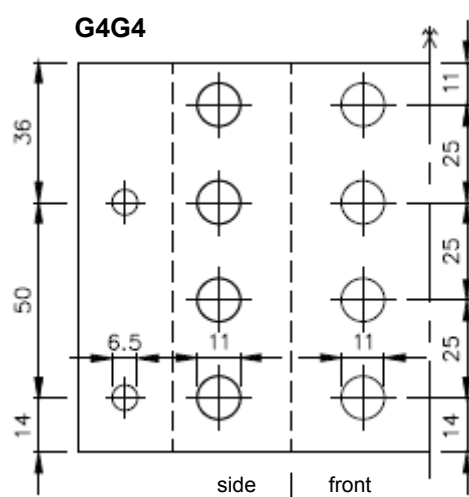
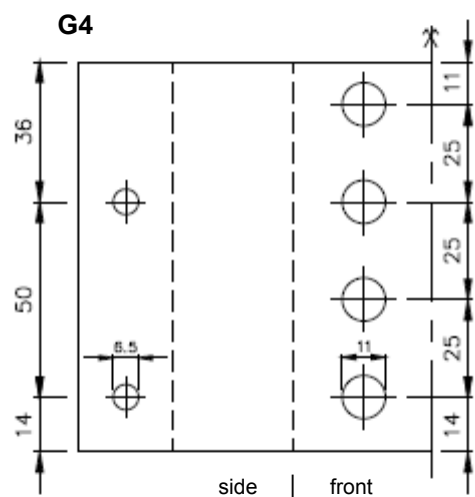
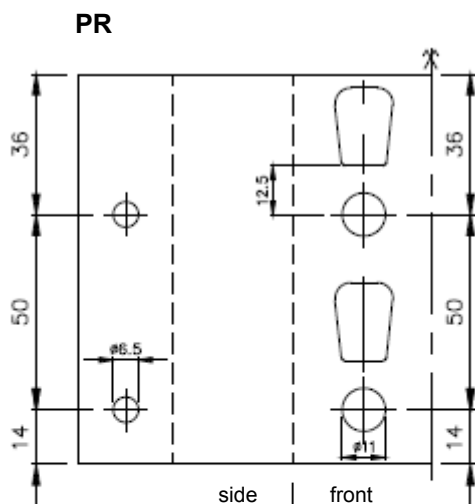


all dimensions in mm

detailed component information
deposited with DIBt

Pallet Racking System NR	Annex 2.7
Uprights (Group F) Width 140mm, HD Uprights	

detailed component information
deposited with DIBt



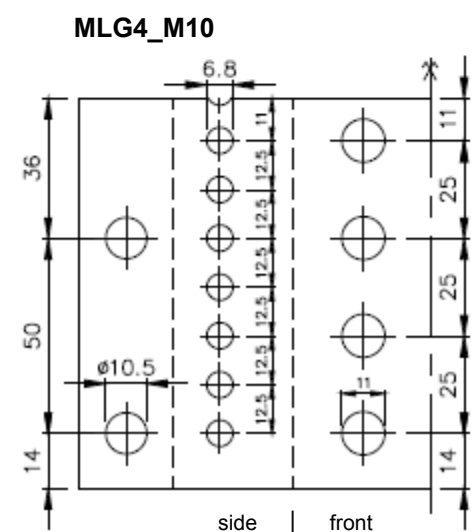
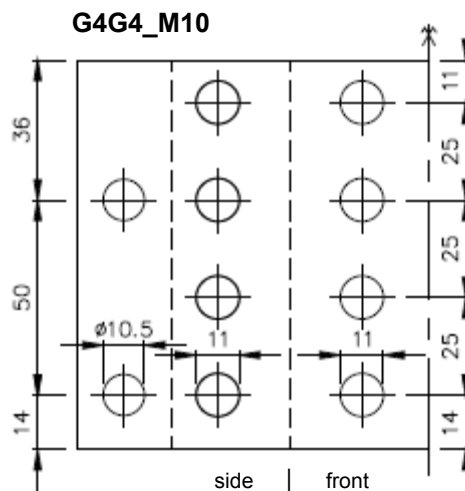
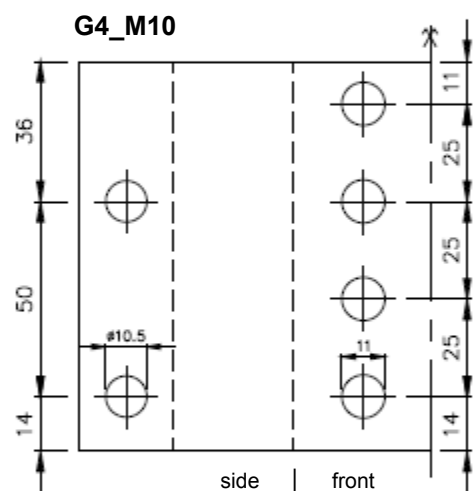
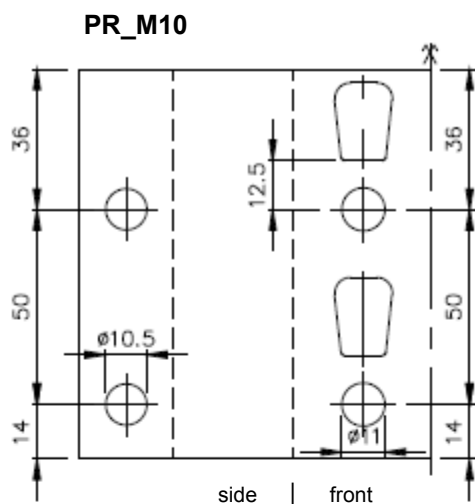
all dimensions in mm

Pallet Racking System NR

Uprights
Perforation types (M6-holes for bracing connections)

Annex 2.8

detailed component information
deposited with DIBt

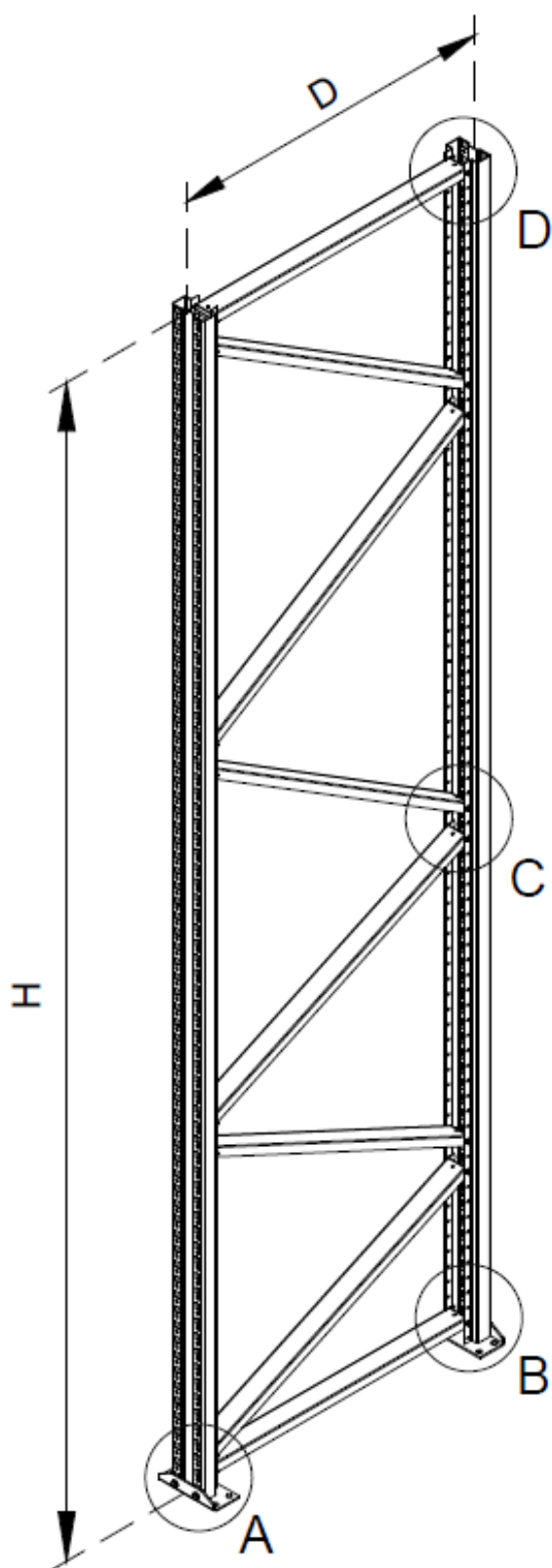


all dimensions in mm

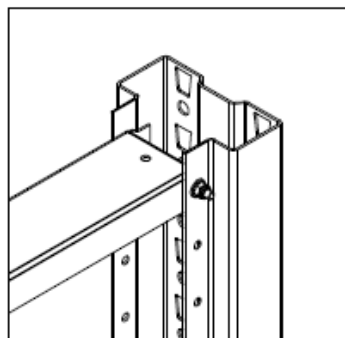
Pallet Racking System NR

Uprights
Perforation types (M10-holes for bracing connections)

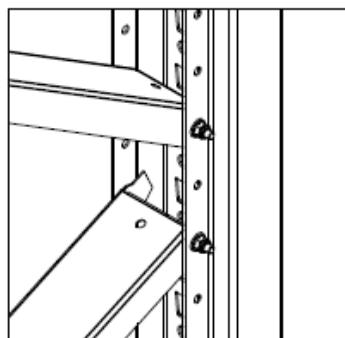
Annex 2.9



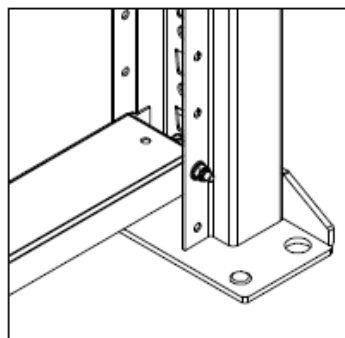
D



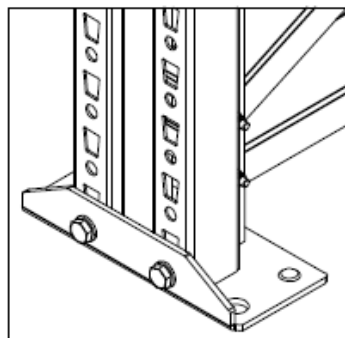
C



B



A

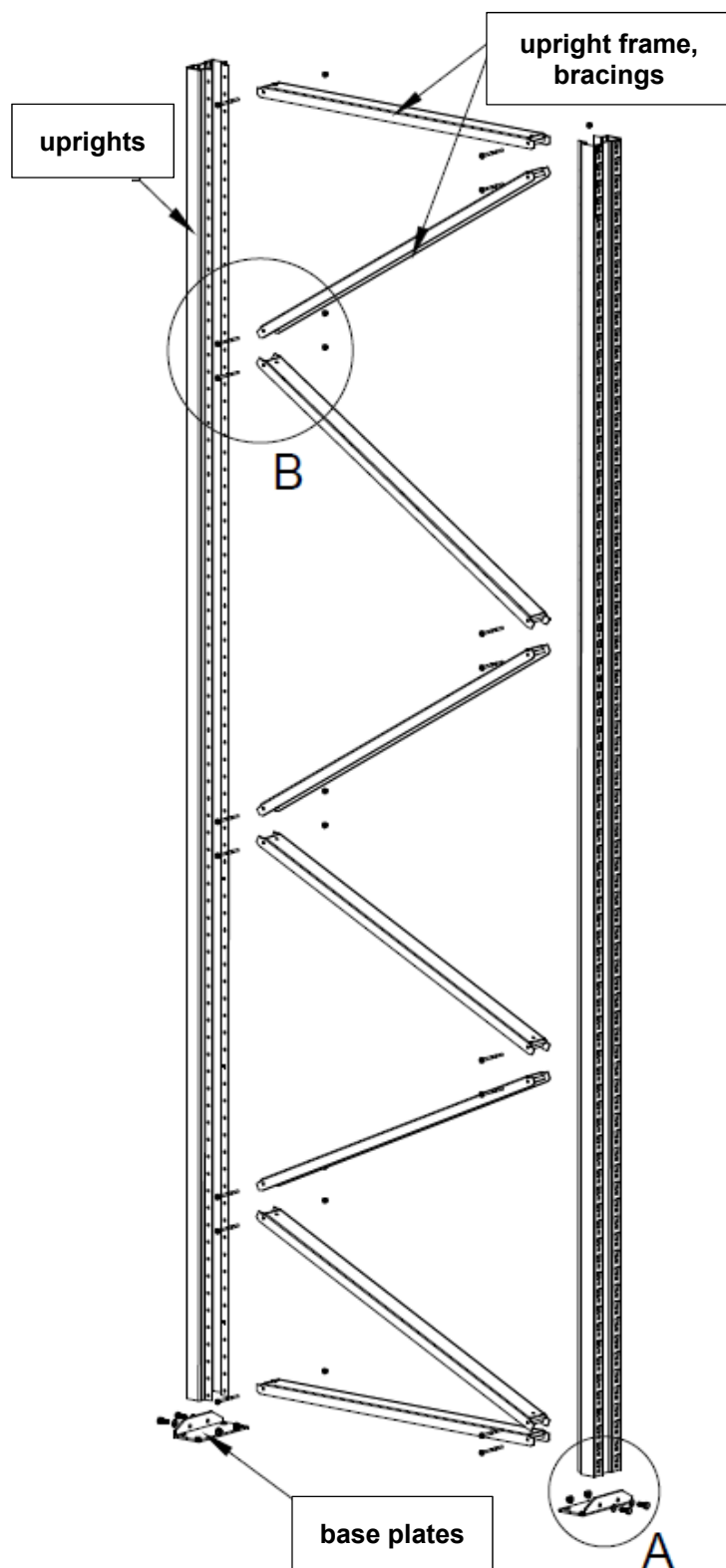


detailed component information
deposited with DIBt

Pallet Racking System NR

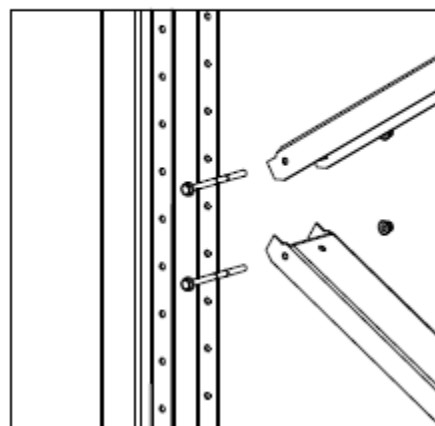
Upright frame
Overview

Annex 3.1



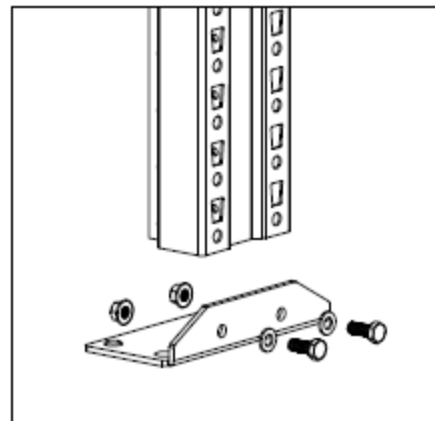
upright – diagonal bracing
bolted connection

B



upright – base plate
bolted connection

A

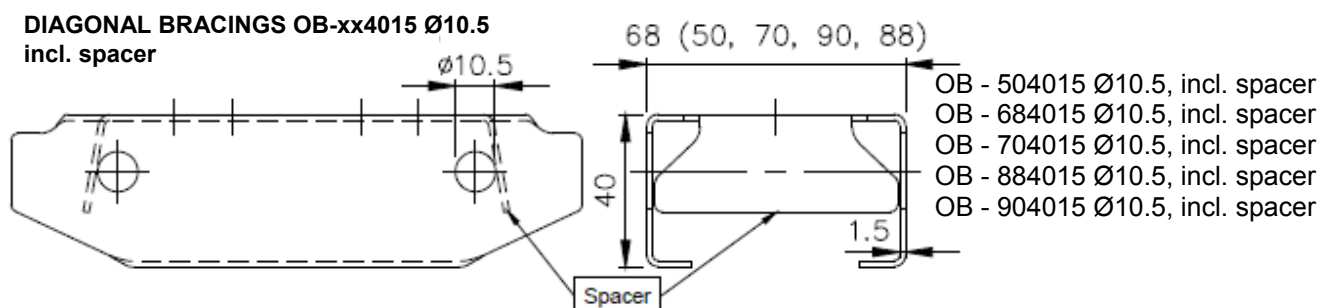
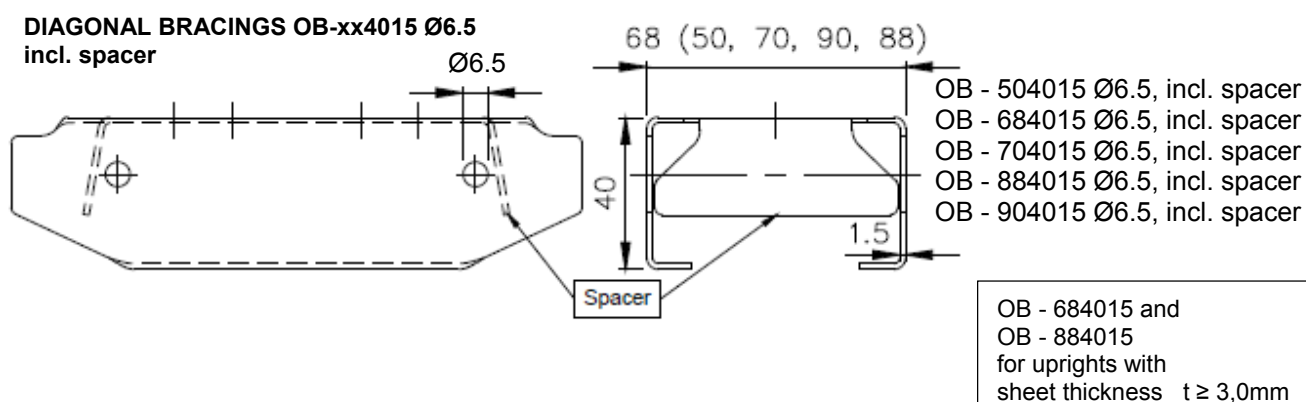
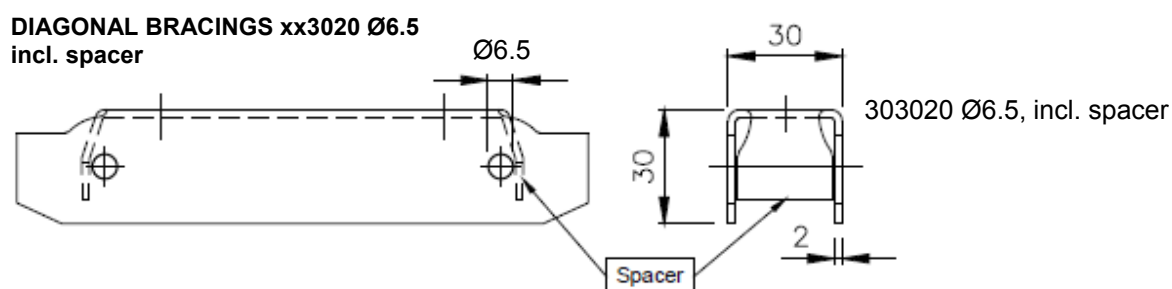
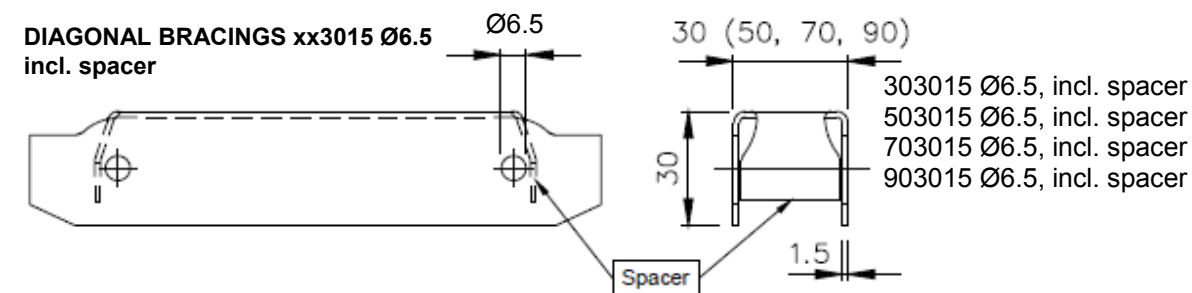


detailed component information
deposited with DIBt

Pallet Racking System NR

Upright frame
Overview

Annex 3.2



all dimensions in mm

detailed component information
deposited with DIBt

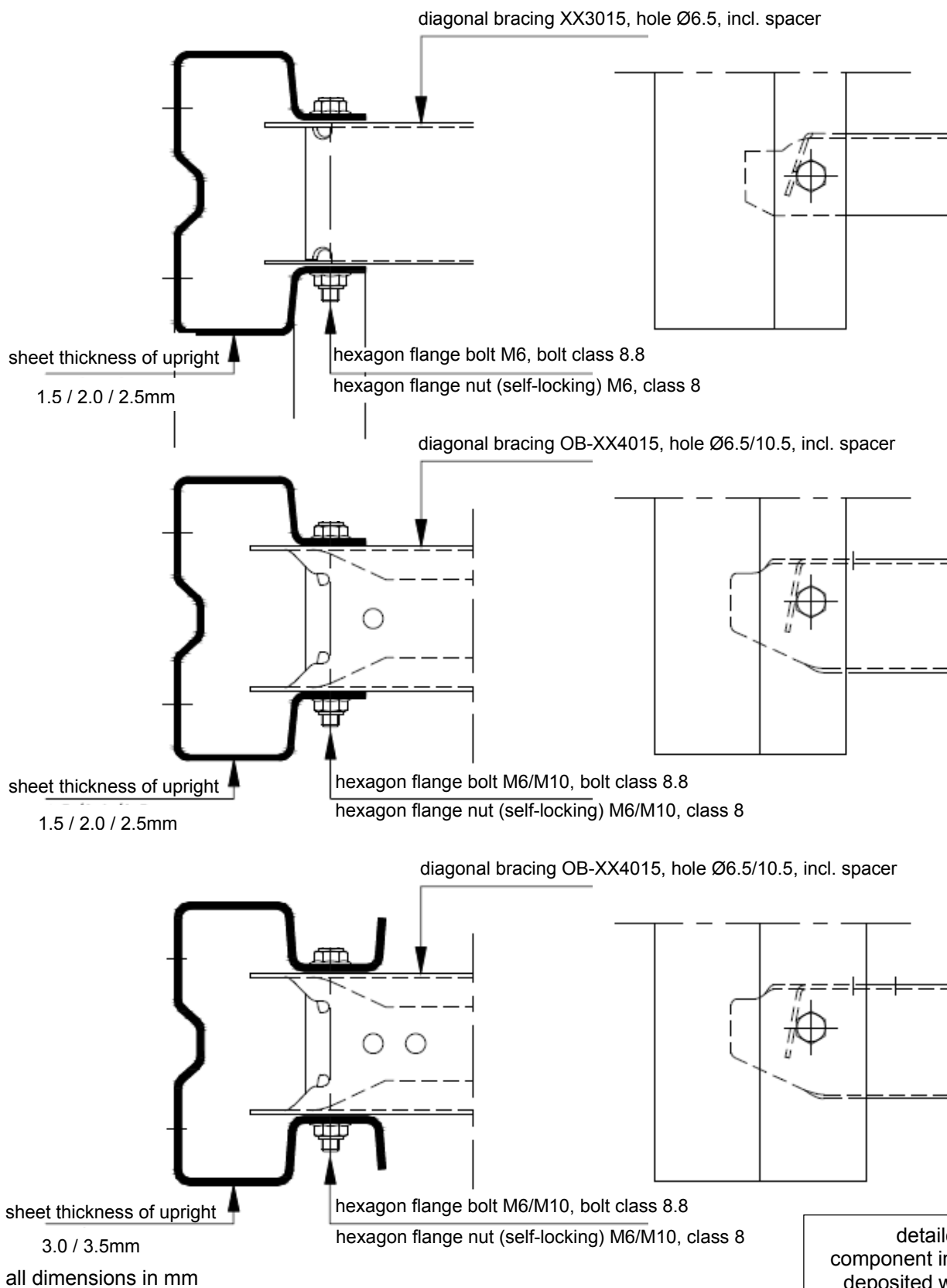
Pallet Racking System NR

Upright frame
Diagonal types (bracings)

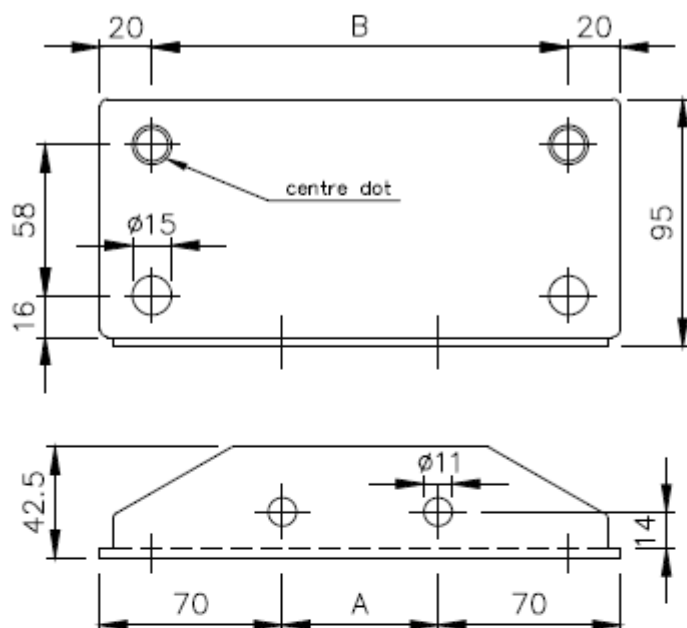
Annex 3.3

detailed
component information
deposited with DIBt

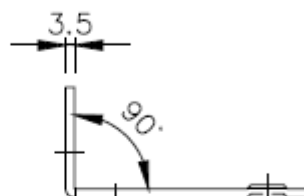
Pallet Racking System NR	Annex 3.4
Upright frame Layout of the diagonals (bracings)	

 diagonal bracing XX3015, hole Ø6.5, incl. spacer sheet thickness of upright 1.5 / 2.0 / 2.5mm hexagon flange bolt M6, bolt class 8.8 hexagon flange nut (self-locking) M6, class 8 diagonal bracing OB-XX4015, hole Ø6.5/10.5, incl. spacer sheet thickness of upright 1.5 / 2.0 / 2.5mm hexagon flange bolt M6/M10, bolt class 8.8 hexagon flange nut (self-locking) M6/M10, class 8 diagonal bracing OB-XX4015, hole Ø6.5/10.5, incl. spacer sheet thickness of upright 3.0 / 3.5mm all dimensions in mm hexagon flange bolt M6/M10, bolt class 8.8 hexagon flange nut (self-locking) M6/M10, class 8	detailed component information deposited with DIBt
Pallet Racking System NR Upright frame Upright - diagonal (bracing) - connection	Annex 3.5

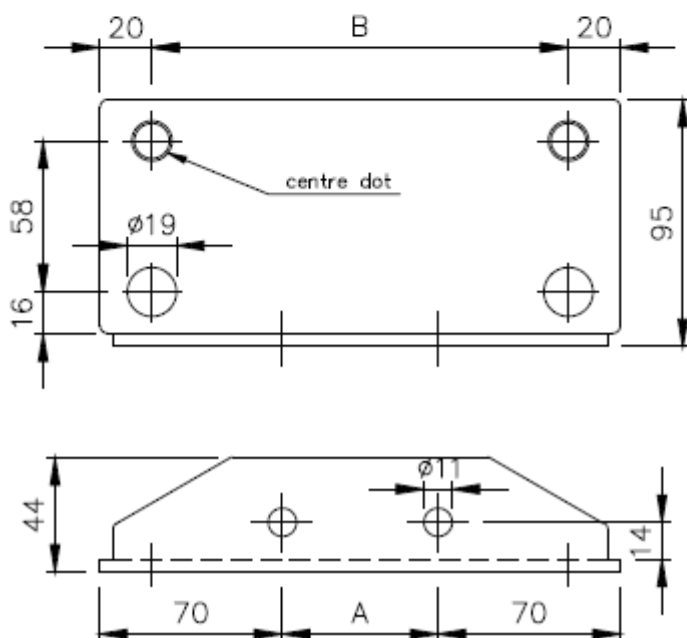
base plate Low 3.5 mm



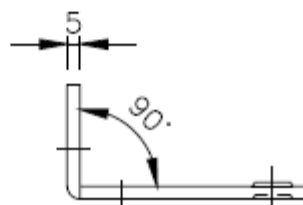
upright	A	B
080	40	140
100	60	160



base plate Low 5.0 mm



upright	A	B
080	40	140
100	60	160
120	80	180
140	100	200



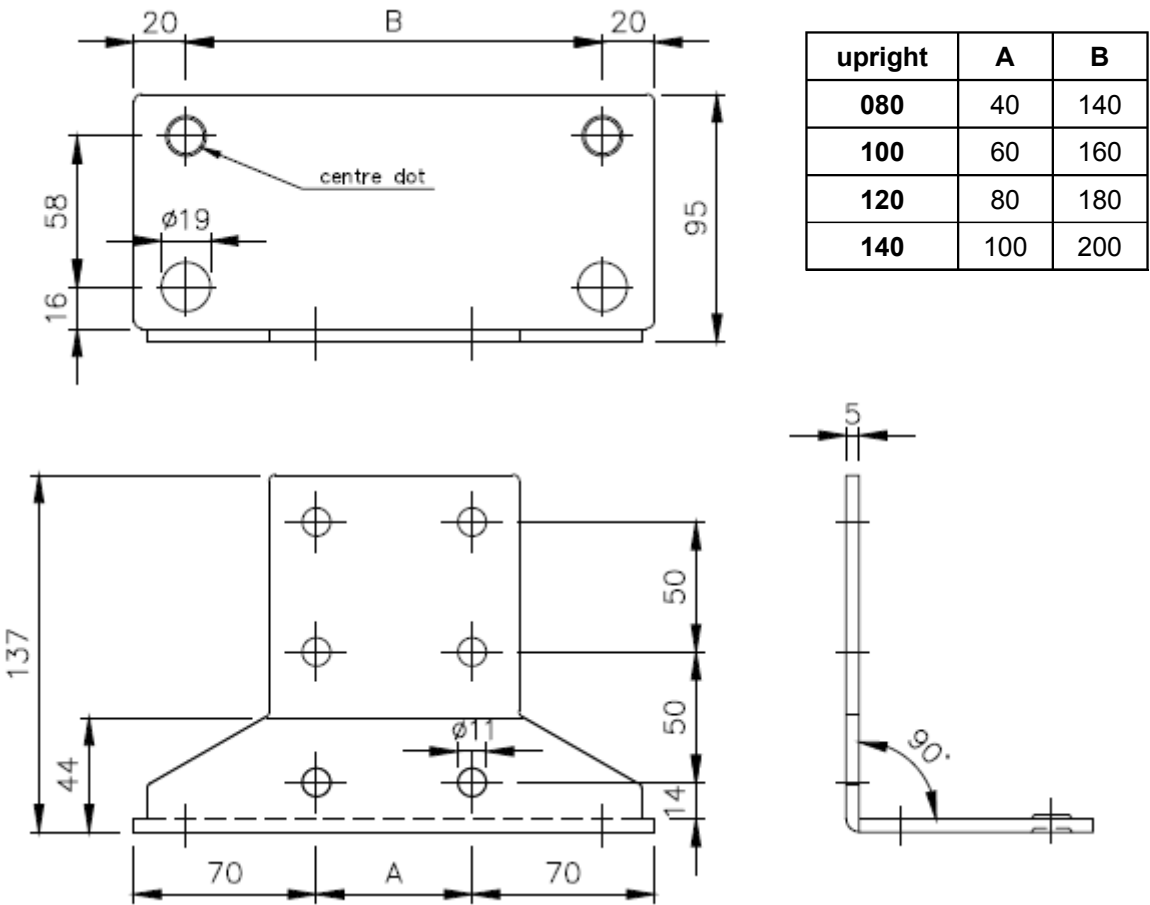
all dimensions in mm

detailed component information
deposited with DIBt

Pallet Racking System NR

Base plates
Types Low 3.5 and 5.0 mm

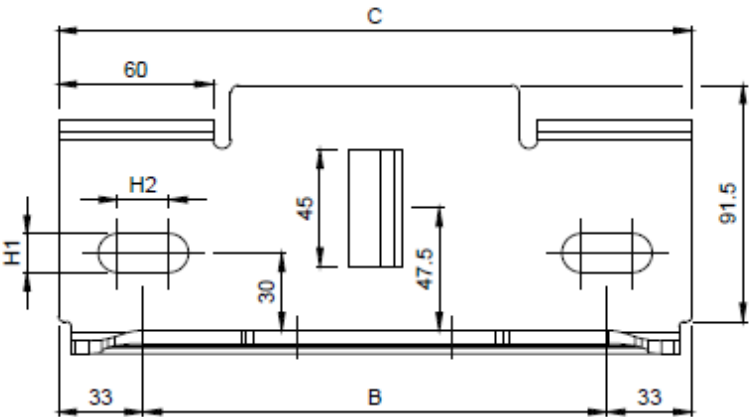
Annex 4.1



all dimensions in mm

detailed component information
deposited with DIBt

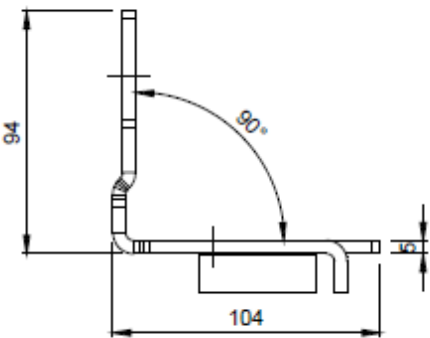
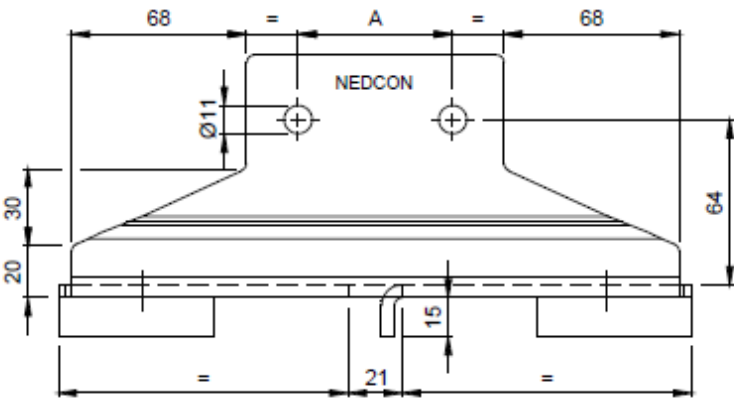
Pallet Racking System NR	Annex 4.2
Base plates Types High 5.0 mm	



anchor hole		
anchor	H1	H2
M12	15	20
M16	20	24
M16 only for uprights 100, 120 u. 140		

upright	A	B	C
080	40	160	226
100	60	180	246
120	80	200	266
140	100	220	286

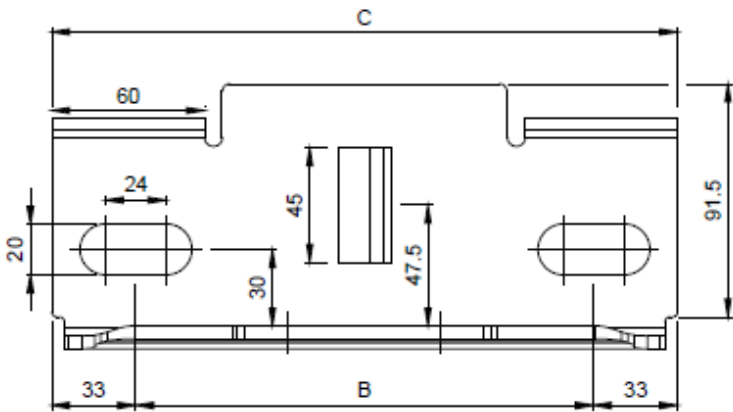
(shown is the base plate
for upright 100
with M12 holes for the anchorage)



all dimensions in mm

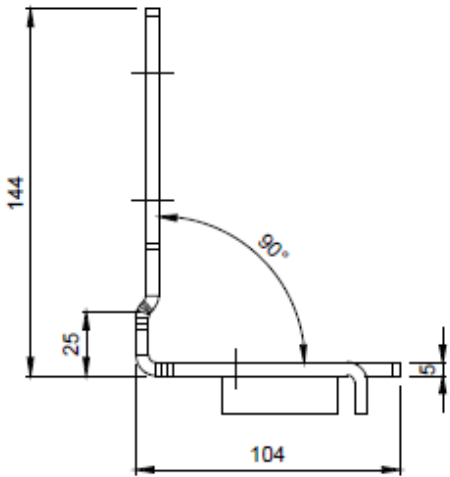
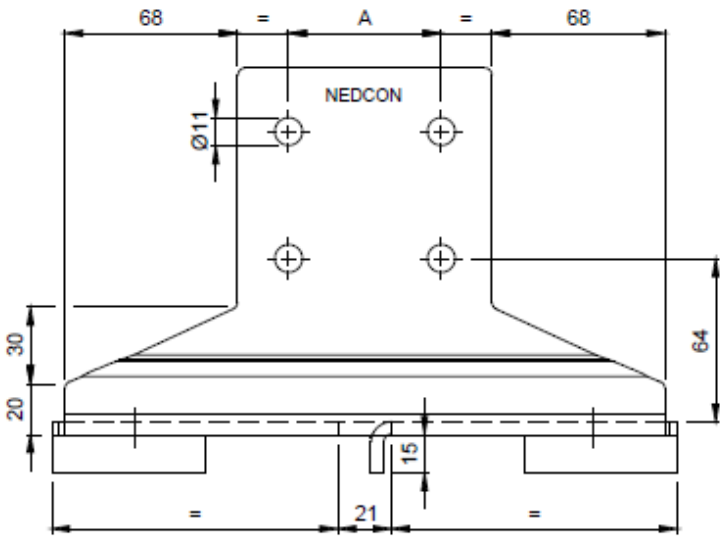
detailed component information
deposited with DIBt

Pallet Racking System NR	Annex 4.3
Base plates Types AUT Low 5.0 mm	



upright	A	B	C
080	40	160	226
100	60	180	246
120	80	200	266
140	100	220	286

(shown is the base plate
for upright 100)



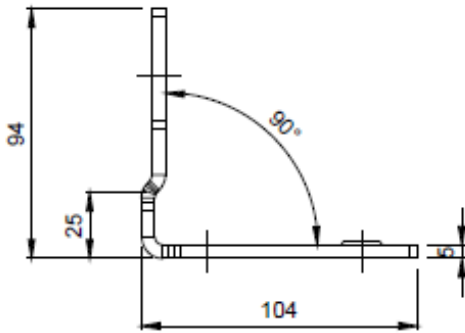
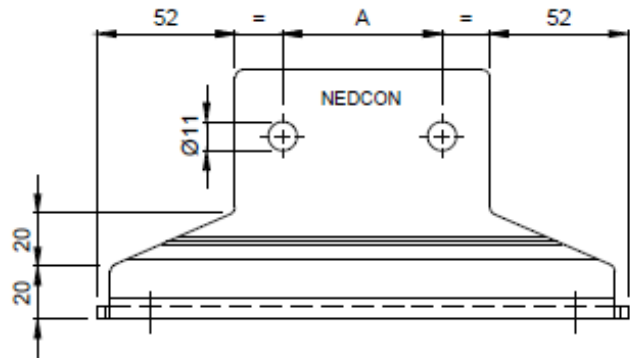
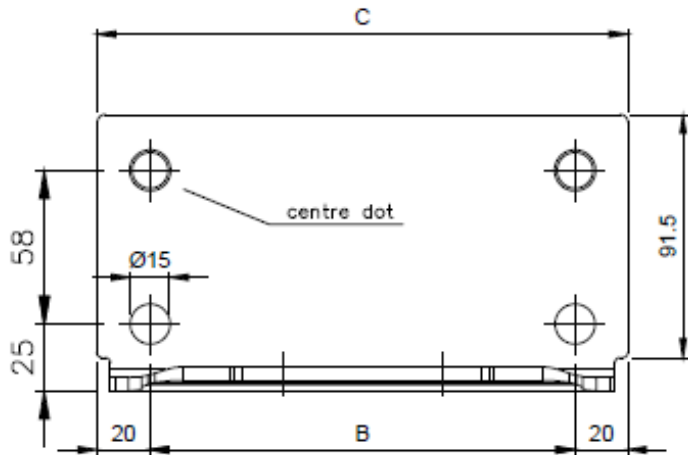
all dimensions in mm

detailed component information
deposited with DIBt

Pallet Racking System NR	Annex 4.4
Base plates Types AUT High 5.0 mm	

upright	A	B	C
080	40	140	200
100	60	160	220
120	80	180	240
140	100	200	240

(shown is the base plate for upright 100)



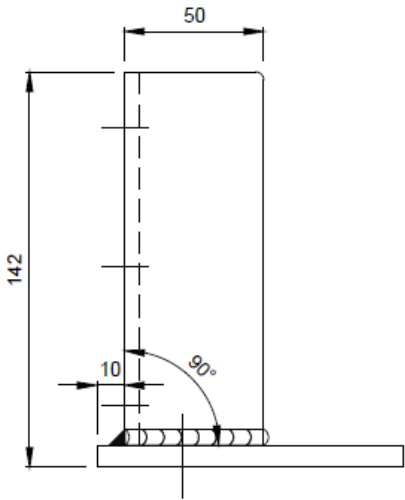
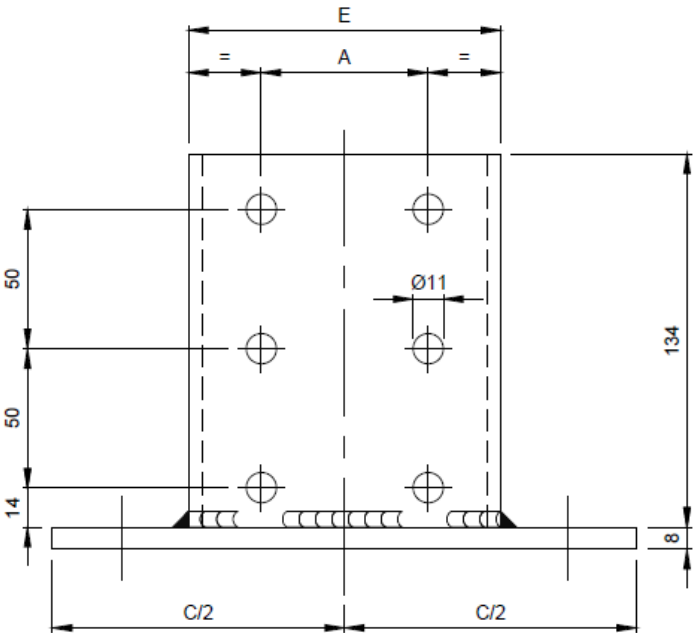
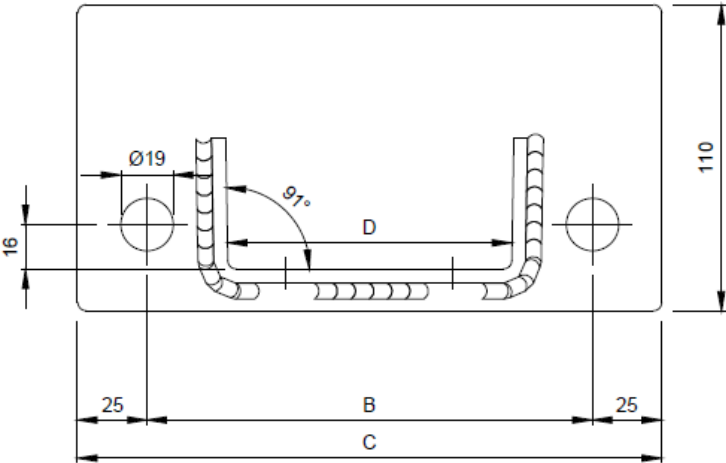
all dimensions in mm

detailed component information
deposited with DIBt

Pallet Racking System NR	Annex 4.5
Base plates Types MAN Low 5.0 mm	

upright	A	B	C	D	E	F
100	60	160	210	102	112	40
120	80	180	230	122	132	60
140	100	200	250	142	152	80

(shown is the base plate for upright 100)



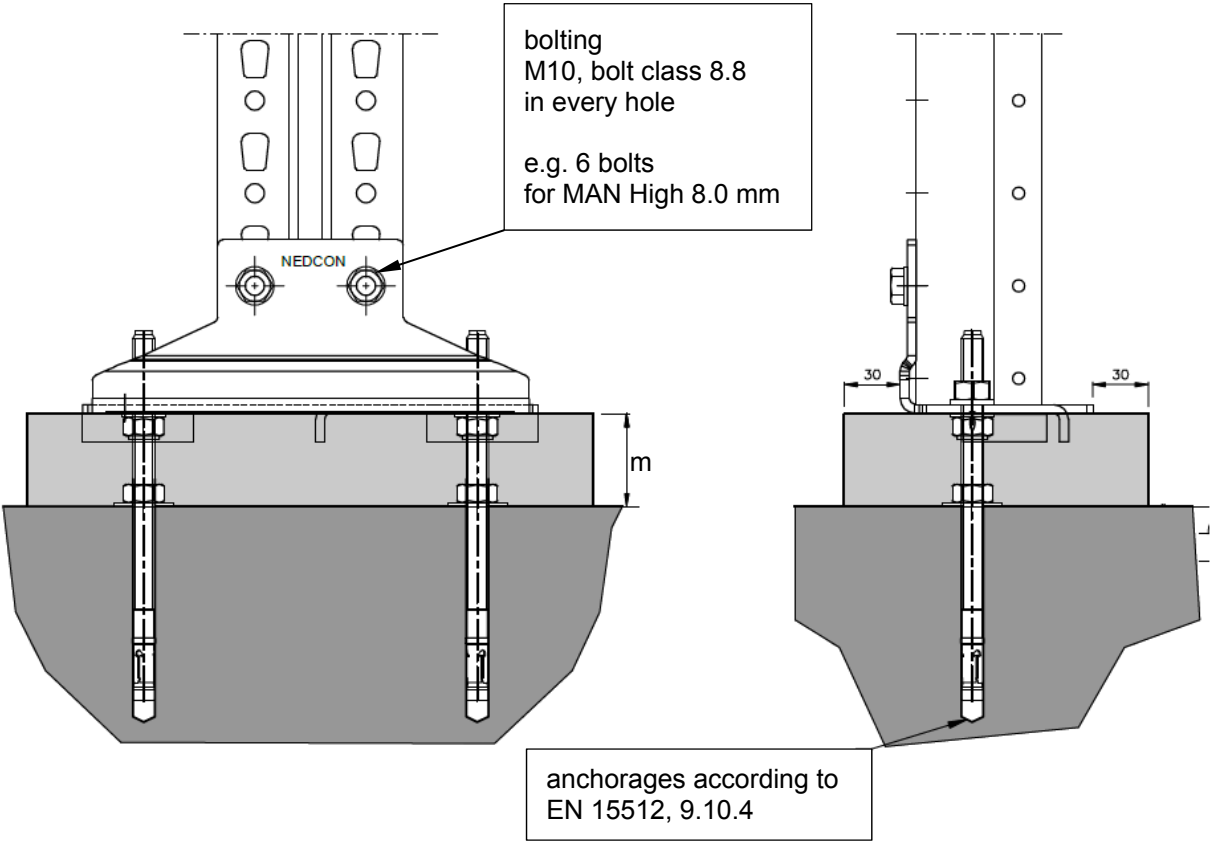
all dimensions in mm

detailed component information
deposited with DIBt

Pallet Racking System NR

Base plates
Types MAN High 8.0 mm

Annex 4.6



Key

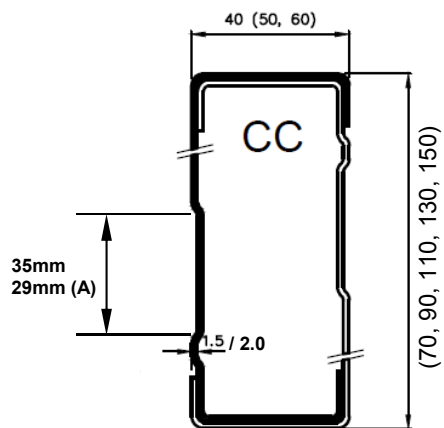
m ≥ 20mm grout

all dimensions in mm

detailed component information
deposited with DIBt

Pallet Racking System NR	Annex 4.7
Base plates Construction details	

beam type CC (A)



CC0704015 (A)
CC0904015 (A)
CC1104015 (A)
CC1304015 (A)
CC1504015 (A)

CC1105015 (A)
CC1305015 (A)
CC1505015 (A)

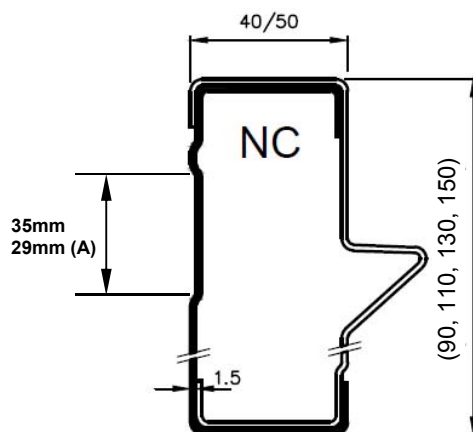
CC1505020 (A)

CC1506020 (A)

CC 110 40 15 A

beam type
beam height
beam width
sheet thickness
2013 version

beam type NC (A)



NC0904015 (A)
NC1104015 (A)
NC1304015 (A)

NC1505015 (A)

NC 110 40 15 A

beam type
beam height
beam width
sheet thickness
2013 version

all dimensions in mm

detailed component information
deposited with DIBt

Pallet Racking System NR

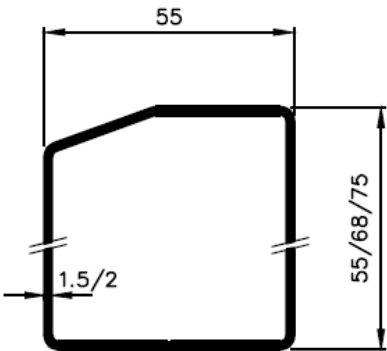
Beams
Types CC (A) and NC (A) (...corresponding CC, ACC, NC and ANC)

Annex 5.1.1

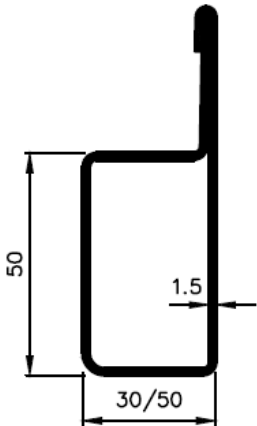
beam type ML3

555515 ML3
685515 ML3
755515 ML3

685520 ML3
755520 ML3



beam type ML3 with back-stops



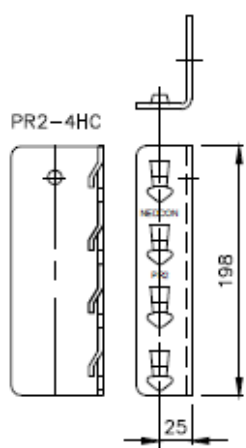
503015 BS ML3
505015 BS ML3

all dimensions in mm

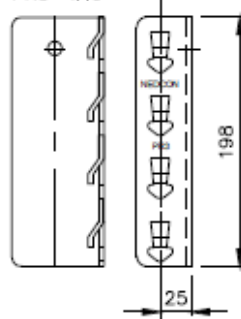
detailed component information
deposited with DIBt

Pallet Racking System NR	Annex 5.1.2
Beams Types ML3 and BS ML3	

4 hook BEC



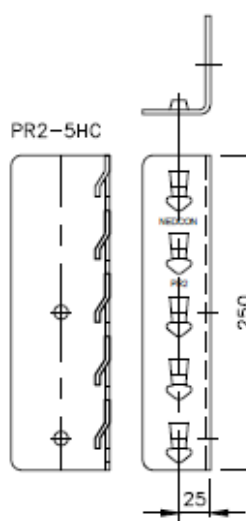
PR3-4HC



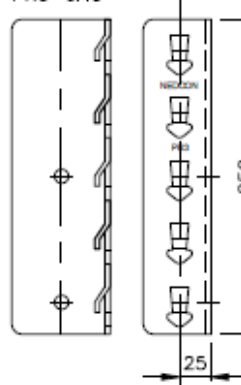
perforation – type (PR)
upright – strength (2mm)
number of hooks (4HC)

PR2-4HC

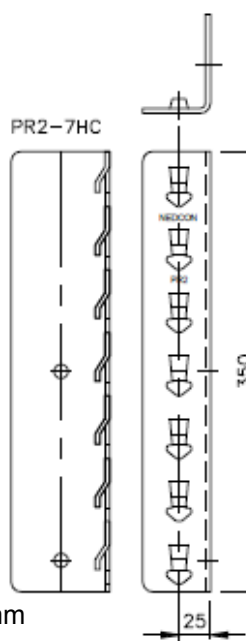
5 hook BEC



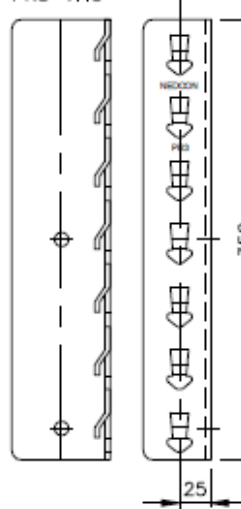
PR3-5HC



7 hook BEC



PR3-7HC



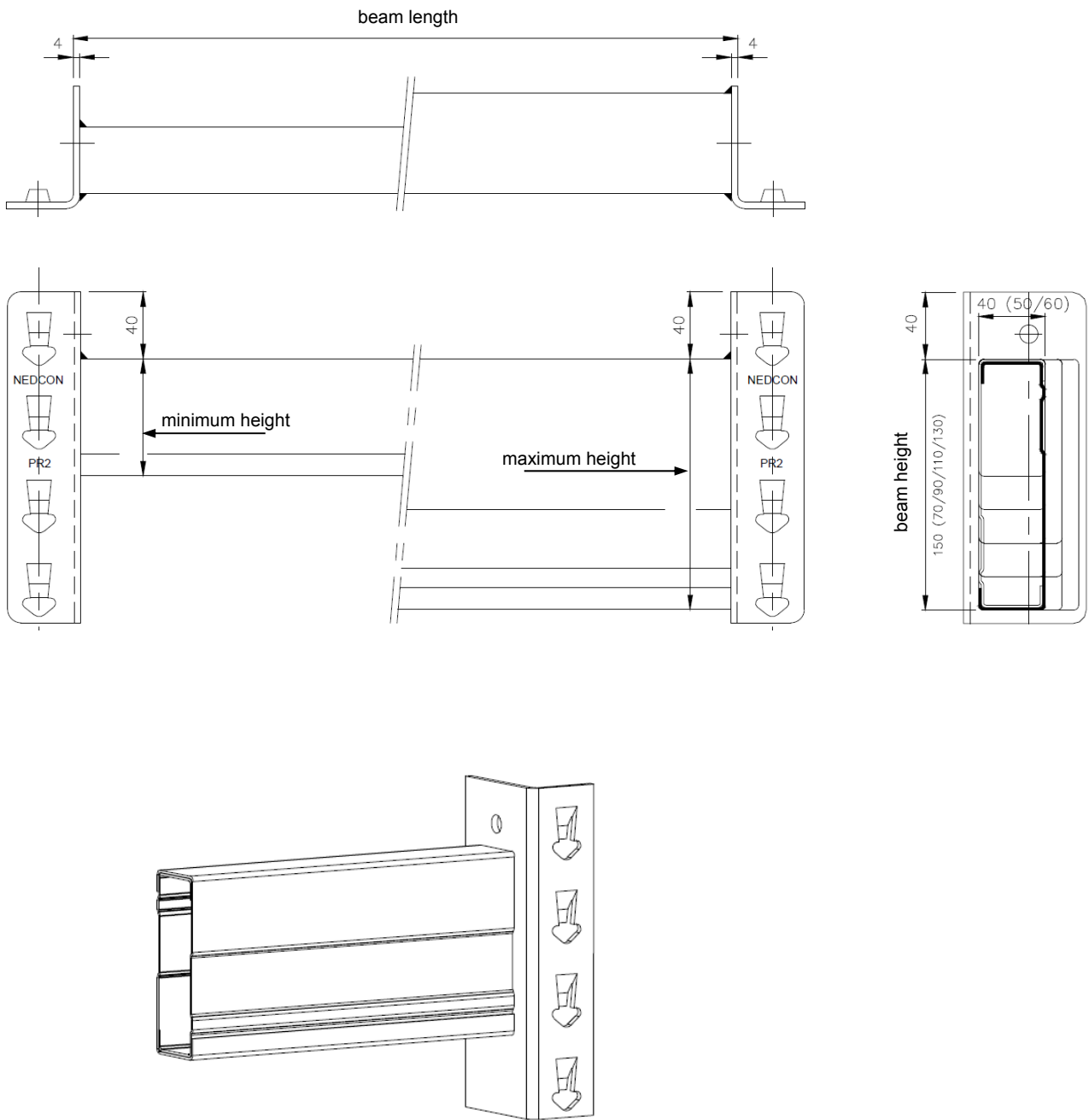
all dimensions in mm

detailed component information
deposited with DIBt

Pallet Racking System NR

Beam end connectors (BEC)
Types of BEC

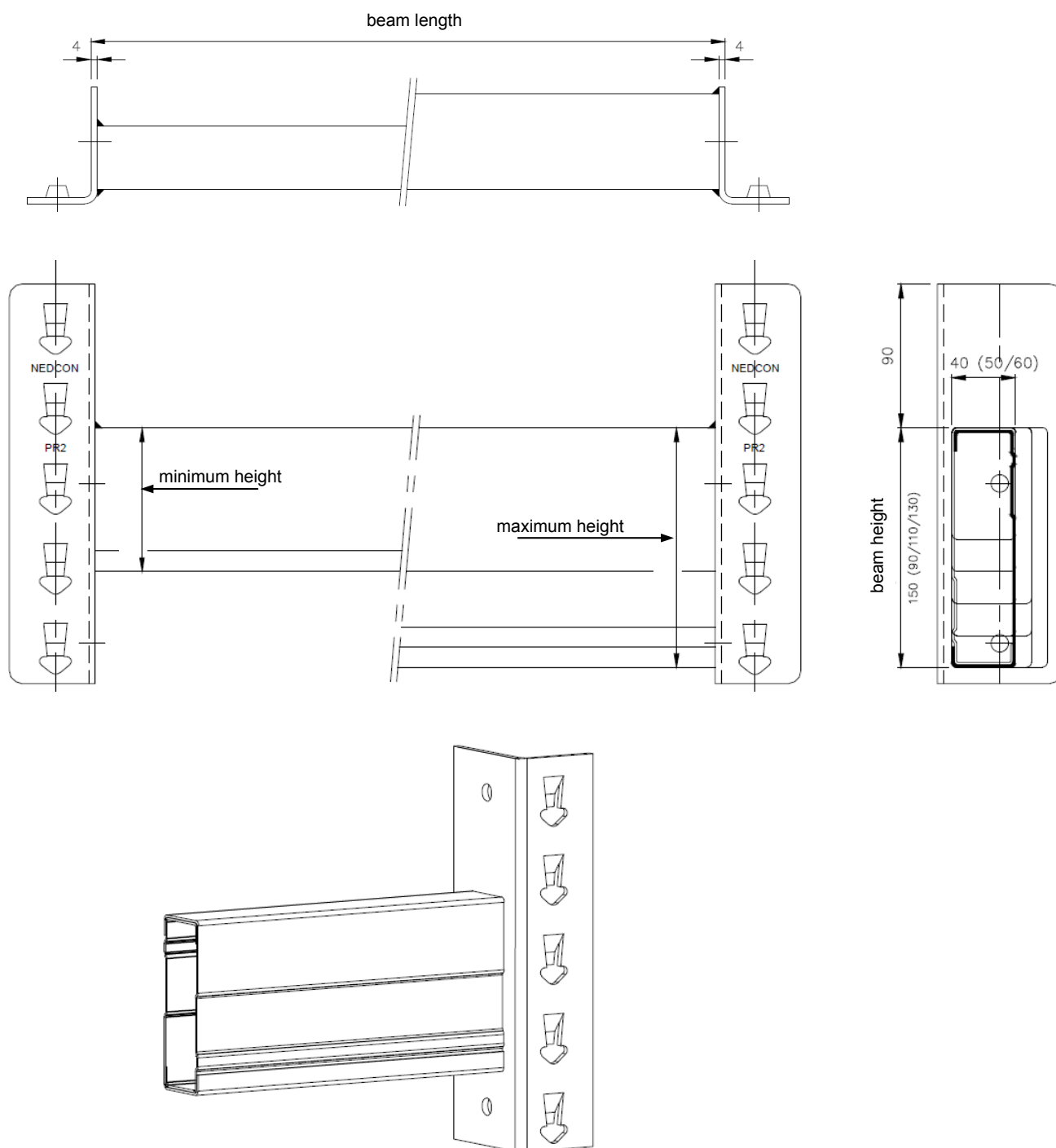
Annex 5.2



all dimensions in mm

detailed component information
deposited with DIBt

Pallet Racking System NR	Annex 5.3.1
Beams with 4 hook BEC	



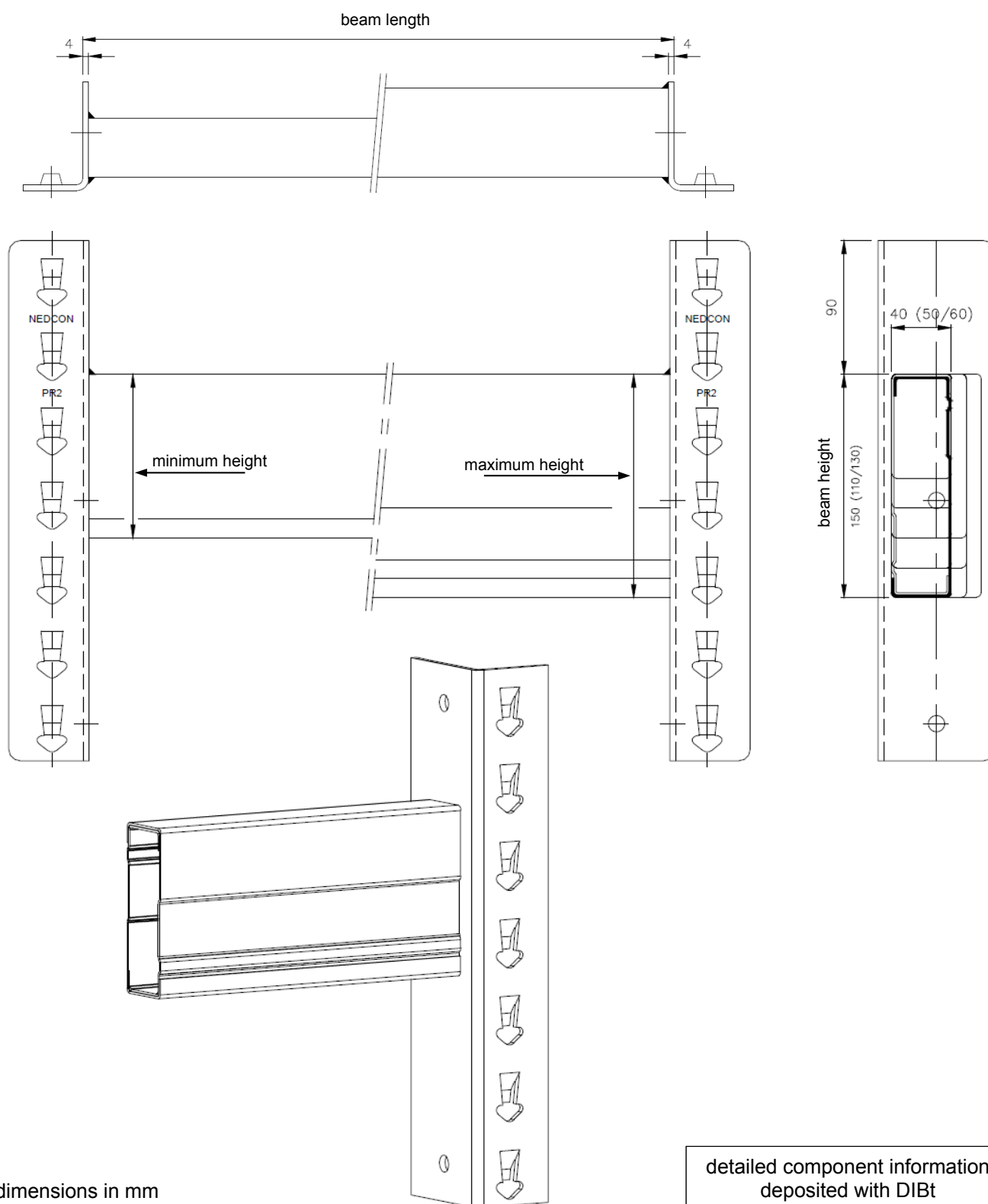
all dimensions in mm

detailed component information
deposited with DIBt

Pallet Racking System NR

Beams
with 5 hook BEC

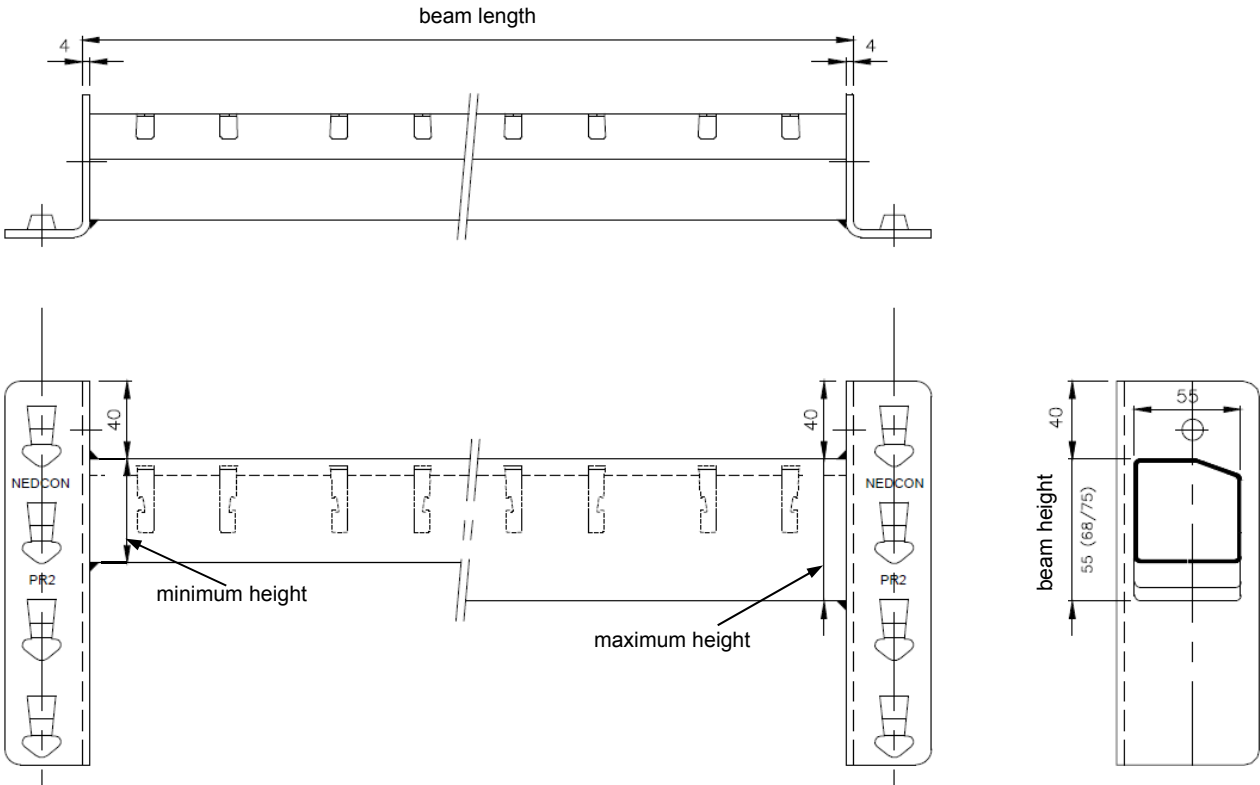
Annex 5.3.2



Pallet Racking System NR

Beams
with 7 hook BEC

Annex 5.3.3



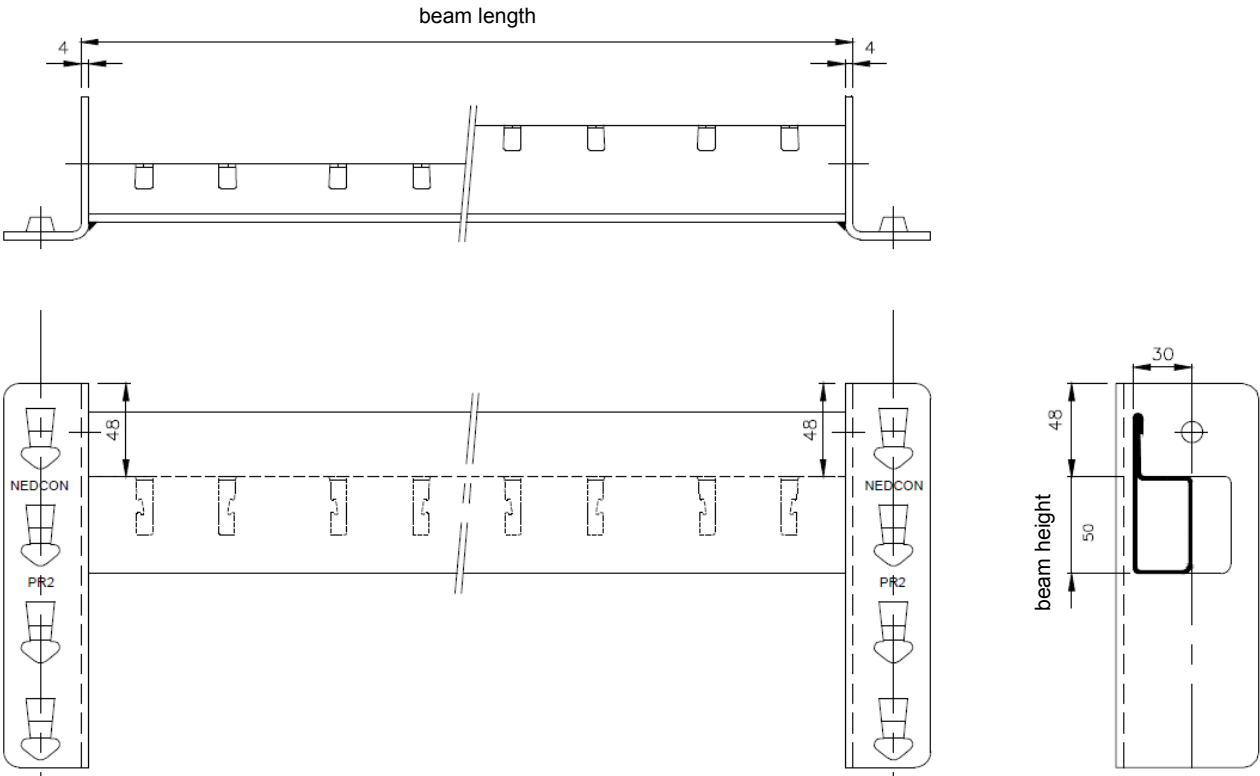
all dimensions in mm

detailed component information
deposited with DIBt

Pallet Racking System NR

Beams (ML3)
with 4 hook BEC

Annex 5.3.4



all dimensions in mm

detailed component information
deposited with DIBt

Pallet Racking System NR	Annex 5.3.5
Beams (BS ML3) with 4 hook BEC	

Use conditions

Within the scope of the inspection intervals specified in EN 15635:2008, the racking constructions shall be checked. Any damage detected shall be eliminated in accordance with EN 15635:2008, clause 9.7.3.

Preferably, damaged components should be replaced by original components.

If this is not possible in individual cases, a new stability check and verification of the racking construction is compulsory taking into account the repair measure of the damaged components.

Design

For the planning and design of pallet racking systems, EN 15512:2009 may be used, if other national regulations are missing. Verification of the structural safety of the pallet racking system is to be provided in each individual case or by structural calculations for types of racking systems.

For the verification of structural safety according to EN 15512:2009, the characteristics compiled in the following sections of Annex 6 may be used.

Ultimate limit state

Checks on the ultimate limit state may be carried out in accordance with EN 15512:2009, sections 9 and 10.

The redistribution of bending moments in accordance with EN 15512:2009, clause 9.4.3.2, is not allowed.

Serviceability limit state

Checks on the serviceability limit state may be carried out in accordance with EN 15512:2009, section 11.

Actions

The actions in accordance with EN 15512:2009, section 6, may be used.

Load combination rules

The load combination rules in accordance with EN 15512:2009, sections 6 and 7, may be used.

Partial factors

The partial factors in accordance with EN 15512:2009, section 7, may be used, taking into account national deviations, if existing (e.g. Annex I.2).

Pallet Racking System NR

Characteristics
Use conditions and design

Annex 6

Effective areas of cross section A_{eff} and effective section moduli W_{eff}

Uprights made of S355MC and S350GD

M6-holes for upright frame bracings	effective area of cross section A_{eff} (mm ²)					effective section moduli									
						$W_{y,\text{eff}}$ (mm ³)					$W_{z,\text{eff}}$ (mm ³)				
	perforation types														
Uprights	PR	G4	G4G4	MLG4	MLK4	PR	G4	G4G4	MLG4	MLK4	PR	G4	G4G4	MLG4	MLK4
045 39 15 2032					135					1.270					952
055 39 15 2032					168					2.180					1.210
060 67 15 4030		234		234			4.580		4.580			2.660		2.660	
060 67 20 4030		309		309			6.000		6.000			3.780		3.780	
080 67 20 4050	324	324	297	311		6.990	6.990	7.890	8.000		3.820	3.820	3.820	3.840	
100 68 20 4050	457	457	450	446		11.100	11.100	11.000	11.600		5.860	5.860	5.970	5.990	
100 73 25 4050	707	707				17.200	17.200				13.300	13.300			
100 78 20 5050	498	498	486			12.800	12.800	12.600			8.090	8.090	8.110		
100 78 25 5050	631	631	607			17.400	17.400	15.900			9.980	9.980	10.000		
100 83 25 5050	656	656	723			18.000	18.000	17.200			14.500	14.500	13.700		
120 78 20 5070	524	524				14.800	14.800				7.110	7.110			
120 78 25 5070	655	655				20.900	20.900				10.200	10.200			
120 83 20 5070	635	635	577			17.400	17.400	17.200			12.500	12.500	10.000		
120 83 25 5070	797	797	778			24.700	24.700	21.300			17.200	17.200	12.800		
120 83 30 5070	957	957	918			30.800	30.800	24.700			19.800	19.800	14.700		
120 83 35 5070	1.120	1.120	1.050			34.700	34.700	27.800			22.000	22.000	16.400		
120 98 35 6570	1.300	1.300	1.230			35.300	35.300	35.400			29.700	29.700	29.800		
140 83 20 5090	655	655	611			20.900	20.900	18.500			11.800	11.800	9.140		
140 83 25 5090	818	818	763			27.300	27.300	24.200			16.700	16.700	11.700		
140 83 35 5090	1.210	1.210	1.130			44.100	44.100	35.300			21.500	21.500	15.000		
140 98 35 6590	1.350	1.350	1.280			45.900	45.900	47.700			30.300	30.300	30.400		

Pallet Racking System NR

Upright characteristics
 A_{eff} , W_{eff} , ($\chi(\bar{\lambda})$ no performance assessed)

Annex 6.1.1

Effective areas of cross section A_{eff} and effective section moduli W_{eff}

Uprights made of S420MC															
M6-holes for upright frame bracings	effective area of cross section A_{eff} (mm²)					effective section moduli									
						$W_{y,\text{eff}}$ (mm³)					$W_{z,\text{eff}}$ (mm³)				
	perforation types														
Uprights	PR	G4	G4G4	MLG4	MLK4	PR	G4	G4G4	MLG4	MLK4	PR	G4	G4G4	MLG4	MLK4
080 67 20 4050				305					8.000					3.840	
100 68 20 4050			441					11.000					5.970		
100 78 20 5050			482					12.600					8.110		
100 78 25 5050			602					15.900					10.000		
100 83 25 5050			723					17.200					13.700		
120 78 20 5070	508					14.800					7.110				
120 83 20 5070			577					17.200					10.000		

Pallet Racking System NR

Upright characteristics
 A_{eff} , W_{eff} , ($\chi(\bar{\lambda})$ no performance assessed)

Annex 6.1.2

Effective areas of cross section A_{eff} and effective section moduli W_{eff}

Uprights made of S355MC and S350GD

M10-holes for upright frame bracings	effective area of cross section A_{eff} (mm²)					effective section moduli									
						$W_{y,\text{eff}}$ (mm³)					$W_{z,\text{eff}}$ (mm³)				
	perforation types														
Uprights	PR	G4	G4G4	MLG4	MLK4	PR	G4	G4G4	MLG4	MLK4	PR	G4	G4G4	MLG4	MLK4
100 73 25 4050	687	687				16.900	16.900				12.700	12.700			
100 83 25 5050	639	639	703			17.800	17.800	16.900			13.900	13.900	13.100		
120 83 20 5070	619	619	562			17.200	17.200	16.900			12.000	12.000	9.540		
120 83 25 5070	778	778	758			24.300	24.300	20.900			16.500	16.500	12.300		
120 83 30 5070	934	934	894			30.300	30.300	24.300			18.900	18.900	14.000		
120 83 35 5070	1.090	1.090	1.020			34.200	34.200	27.300			20.900	20.900	15.600		
120 98 35 6570	1.270	1.270	1.200			34.800	34.800	34.800			28.200	28.200	28.300		
140 83 20 5090	640	640	596			20.500	20.500	18.200			11.200	11.200	9.680		
140 83 25 5090	800	800	745			26.800	26.800	23.800			16.000	16.000	12.400		
140 83 35 5090	1.180	1.180	1.100			43.300	43.300	34.500			20.400	20.400	15.800		
140 98 35 6590	1.330	1.330	1.250			45.200	45.200	46.900			28.800	28.800	28.900		
140 140 25 857028	983					36.100					33.700				
140 140 30 857028	1.310					41.800					38.600				
140 140 35 857028	1.530					48.400					44.600				

Uprights made of S420MC

M10-holes for upright frame bracings	effective area of cross section A_{eff} (mm ²)					effective section moduli									
						$W_{y,\text{eff}}$ (mm ³)					$W_{z,\text{eff}}$ (mm ³)				
	perforation types														
Uprights	PR	G4	G4G4	MLG4	MLK4	PR	G4	G4G4	MLG4	MLK4	PR	G4	G4G4	MLG4	MLK4
100 83 25 5050			703					16.900					13.100		
120 83 20 5070			562					16.900					9.540		

Pallet Racking System NR

Upright characteristics
 A_{eff} , W_{eff} , ($\chi(\bar{\lambda})$ no performance assessed)

Annex 6.1.3

The orientation of the moments M_y and M_z , acting on the effective section moduli W_{eff} of annexes 6.1.i, is shown in annex 2.1.

The effective areas of cross sections A_{eff} within annexes 6.1.i may be used independently of the node distances within the upright frames (see annex 3) of the racking system.

The effective section moduli W_{eff} may be used up to a maximum node distances of 2.25 m within the upright frames (see annex 3) of the racking system. The values may be used for the verification of stability in accordance with EN 15512:2009.

For the verification of stability in accordance with EN 15512:2009, 9.7.6.4 χ_{LT} may be set 1.

Pallet Racking System NR	
Upright characteristics A_{eff} , W_{eff} , χ_{LT} , ($\chi(\lambda)$ no performance assessed)	Annex 6.1.4

Bending strength M_{Rk} and rotational stiffness of BECs
for downward bending moments in accordance with EN 15512:2009, A.2.4

Beams (all widths)		Upright	characteristics						
height	material (f _y)		sheet thickness	M _{Rk}	k _d ^{*2)}	M _{Rd} ^{*1)}	k _d ^{*2)}	M _{Rd} ^{*1)}	k _d ^{*2)}
mm	N/mm ²	mm	kNm	kNm/rad	kNm	kNm/rad	kNm	kNm/rad	kNm
CC (A) - and NC (A) - beams - 4 hook connector for NC (A) – beams only η = 0,85 and 0,75 characteristics may be used									
70	235	2,0	1,340	29,2	1,220	41,8	1,040	49,5	0,915
90			2,350	40,1	2,140	56,4	1,820	64,8	1,610
110			2,500	72,4	2,270	84,7	1,930	90,4	1,710
130			2,620	86,9	2,380	97,8	2,020	101,0	1,780
150			2,730	96,2	2,480	108,0	2,110	110,0	1,860
70	275		1,560	32,1	1,420	45,0	1,200	52,5	1,060
90			2,430	40,8	2,210	57,2	1,880	65,5	1,660
110			2,660	74,1	2,420	86,1	2,060	91,5	1,810
130			2,780	88,7	2,530	98,9	2,150	102,0	1,900
150			2,870	98,1	2,610	109,0	2,220	111,0	1,960
70	355		1,970	36,8	1,790	49,8	1,520	57,0	1,340
90			2,430	40,8	2,210	57,2	1,880	65,5	1,660
110			2,660	74,1	2,420	86,1	2,060	91,5	1,810
130			2,780	88,7	2,530	98,9	2,150	102,0	1,900
150			2,870	98,1	2,610	109,0	2,220	111,0	1,960
90	235	2,5 3,0 3,5	2,570	38,1	2,340	54,2	1,990	65,6	1,750
110			2,980	64,8	2,710	85,6	2,300	94,9	2,030
130			3,080	92,3	2,800	114,0	2,380	119,0	2,100
150			3,050	131,0	2,770	141,0	2,360	142,0	2,080
90	275		2,650	38,9	2,410	54,9	2,050	66,4	1,810
110			3,170	66,8	2,880	87,3	2,450	96,4	2,160
130			3,280	94,6	2,980	115,0	2,530	120,0	2,230
150			3,210	134,0	2,920	141,0	2,480	142,0	2,190
90	355		2,650	38,9	2,410	54,9	2,050	66,4	1,810
110			3,170	66,8	2,880	87,3	2,450	96,4	2,160
130			3,280	94,6	2,980	115,0	2,530	120,0	2,230
150			3,210	134,0	2,920	141,0	2,480	142,0	2,190
*1) For the calculation of the design moment M _{Rd} in accordance with EN 15512:2009 (A.10) and EN 15512:2009, Table 3 a partial factor of γ _M = 1,1 ^{*3)} was used.			*2) For the calculation of the design value of the rotational stiffness k _d the procedure in accordance with EN 15512:2009 (Figure A.6) using a partial factor of γ _M = 1,1 ^{*3)} was executed.			*3) In case of absence of other national regulations.			

Pallet Racking System NR

BEC characteristics
 M_{Rk} , ($k(\eta)$, $k(\theta)$ no performance assessed)

Annex 6.2.1

Bending strength M_{Rk} and rotational stiffness of BECs
for downward bending moments in accordance with EN 15512:2009, A.2.4

Beams (all widths)		Upright	characteristics						
				$\eta = 1,0$		$\eta = 0,85$		$\eta = 0,75$	
height	material (f_y)	sheet thickness	M_{Rk}	$k_d^{*2)}$	$M_{Rd}^{*1)}$	$k_d^{*2)}$	$M_{Rd}^{*1)}$	$k_d^{*2)}$	$M_{Rd}^{*1)}$
mm	N/mm ²	mm	kNm	kNm/rad	kNm	kNm/rad	kNm	kNm/rad	kNm
CC (A) - and NC (A) - beams - 5 hook connector for NC (A) – beams only $\eta = 0,85$ and $0,75$ characteristics may be used									
	235	2,0							
90			2,560	47,3	2,330	71,7	1,980	87,2	1,750
110			3,080	68,6	2,800	103,0	2,380	120,0	2,100
130			3,510	80,4	3,190	115,0	2,710	141,0	2,390
150	3,720		129,0	3,380	153,0	2,880	154,0	2,540	
	275								
90			2,650	48,1	2,410	72,6	2,050	87,9	1,800
110			3,280	70,8	2,980	104,0	2,530	121,0	2,240
130			3,730	93,6	3,390	129,0	2,880	141,0	2,540
150	3,920		132,0	3,560	154,0	3,030	155,0	2,670	
	355								
90			2,650	48,1	2,410	72,6	2,050	87,9	1,800
110		3,280	70,8	2,980	104,0	2,530	121,0	2,240	
130		3,730	93,6	3,390	129,0	2,880	141,0	2,540	
150	3,920	132,0	3,560	154,0	3,030	155,0	2,670		
90	235	2,5 3,0 3,5	2,730	41,9	2,480	60,6	2,110	77,2	1,860
110			3,210	79,8	2,920	107,0	2,480	123,0	2,190
130			3,650	99,4	3,320	143,0	2,830	156,0	2,490
150			4,130	156,0	3,750	187,0	3,190	189,0	2,810
90	275		2,820	42,8	2,560	61,6	2,170	78,2	1,920
110			3,410	82,4	3,100	109,0	2,640	125,0	2,330
130			3,750	109,0	3,410	144,0	2,890	157,0	2,550
150			4,350	159,0	3,950	187,0	3,350	190,0	2,960
90	355		2,820	42,8	2,560	61,6	2,170	78,2	1,920
110			3,410	82,4	3,100	109,0	2,640	125,0	2,330
130			3,750	109,0	3,410	144,0	2,890	157,0	2,550
150			4,350	159,0	3,950	187,0	3,350	190,0	2,960
*1) For the calculation of the design moment M_{Rd} in accordance with EN 15512:2009 (A.10) and EN 15512:2009, Table 3 a partial factor of $\gamma_M = 1,1^{*3)}$ was used.			*2) For the calculation of the design value of the rotational stiffness k_d the procedure in accordance with EN 15512:2009 (Figure A.6) using a partial factor of $\gamma_M = 1,1^{*3)}$ was executed.			*3) In case of absence of other national regulations.			

Pallet Racking System NR

BEC characteristics
 M_{Rk} , ($k(\eta)$, $k(\theta)$ no performance assessed)

Annex 6.2.2

Bending strength M_{Rk} and rotational stiffness of BECs
for downward bending moments in accordance with EN 15512:2009, A.2.4

Beams (all widths)		Upright	characteristics						
				$\eta = 1,0$		$\eta = 0,85$		$\eta = 0,75$	
height	material (f_y)	sheet thickness	M_{Rk}	$k_d^{*2)}$	$M_{Rd}^{*1)}$	$k_d^{*2)}$	$M_{Rd}^{*1)}$	$k_d^{*2)}$	$M_{Rd}^{*1)}$
mm	N/mm ²	mm	kNm	kNm/rad	kNm	kNm/rad	kNm	kNm/rad	kNm
CC (A) - and NC (A) - beams - 7 hook connector for NC (A) – beams only $\eta = 0,85$ and $0,75$ characteristics may be used									
110	235	2,0	3,080	80,4	2,800	122,0	2,380	146,0	2,100
130			3,880	139,0	3,530	193,0	3,000	224,0	2,650
150			4,280	188,0	3,890	251,0	3,300	267,0	2,920
110	275		3,280	83,1	2,980	125,0	2,540	148,0	2,240
130			3,880	139,0	3,530	193,0	3,000	224,0	2,650
150			4,500	192,0	4,090	253,0	3,480	267,0	3,070
110	355		3,330	94,8	3,030	130,0	2,580	146,0	2,270
130			4,080	159,0	3,710	187,0	3,150	197,0	2,780
150			4,610	215,0	4,190	247,0	3,560	256,0	3,140
110	235	2,5 3,0 3,5	3,360	78,4	3,050	114,0	2,590	146,0	2,280
130			3,660	124,0	3,330	165,0	2,830	203,0	2,500
150			4,380	173,0	3,980	235,0	3,380	262,0	2,980
110	275		3,560	81,5	3,240	117,0	2,750	149,0	2,430
130			3,910	128,0	3,550	169,0	3,010	206,0	2,660
150			4,610	177,0	4,190	237,0	3,560	264,0	3,140
110	355		3,600	83,2	3,270	113,0	2,780	148,0	2,450
130			4,190	181,0	3,810	215,0	3,240	229,0	2,860
150			5,480	210,0	4,980	272,0	4,240	294,0	3,740
ML3 - beams - 4 hook connector for every ML3 - beam - material, for every upright sheet thickness									
55			1,000	22,3	0,912	27,8	0,775	31,8	0,684
68			1,130	37,9	1,030	46,0	0,871	49,4	0,769
75			1,380	40,7	1,250	50,6	1,060	54,8	0,938
BS ML3 - beams - 4 hook connector for every BS ML3 - beam - material, for every upright sheet thickness									
			1,300	44,7	1,180	55,5	1,000	59,9	0,885
*1) For the calculation of the design moment M_{Rd} in accordance with EN 15512:2009 (A.10) and EN 15512:2009, Table 3 a partial factor of $\gamma_M = 1,1^{*3)}$ was used.			*2) For the calculation of the design value of the rotational stiffness k_d the procedure in accordance with EN 15512:2009 (Figure A.6) using a partial factor of $\gamma_M = 1,1^{*3)}$ was executed.			*3) In case of absence of other national regulations.			

Pallet Racking System NR

BEC characteristics
 M_{Rk} , ($k(\eta)$, $k(\theta)$ no performance assessed)

Annex 6.2.3

Bending strength M_{Rk} and rotational stiffness of BECs for upward bending moments and looseness ϕ_i for upward and downward bending moments

Beams	Uprights	$k_d^{*2)}$	$M_{RK}, M_{Rd}^{*1)}$	φ_{ℓ}
		kNm/rad	kNm	rad
as in annex 6.2.1 to 6.2.3		50% ^{*)}	65% ^{*)}	0
^{*)} ... of the values of annex 6.2.1 to 6.2.3				
^{*)1,2)} ...as in annex 6.2.1 to 6.2.3				

Shear strength V_{Rk} for downward shear loads
(The characteristics may be used for all beams of annex 5)

Hook connector	Upright sheet thickness t (mm)							
	2,0		2,5		3,0		3,5	
	V_{Rk}	$V_{Rd}^{*1)}$	V_{Rk}	$V_{Rd}^{*1)}$	V_{Rk}	$V_{Rd}^{*1)}$	V_{Rk}	$V_{Rd}^{*1)}$
number of hooks	kN	kN	kN	kN	kN	kN	kN	kN
4	27,8	25,3	27,0	24,5	24,1	21,9	24,1	21,9
5	35,8	32,5	34,7	31,5	32,2	29,3	32,2	29,3
7	53,0	48,2	50,5	45,9	50,5	45,9	50,5	45,9
¹⁾ For the calculation of the design value of the shear strength V_{Rd} a partial factor of $\gamma_M = 1,1^{*2)}$ was used. ²⁾ In case of absence of other national regulations.								

The design value of the shear strength V_{Rd} represents the maximum downward shear load of the BEC bearable for the upright. Separate verifications of shear strength are required for the beams themselves and the welded joints between the beams and the BEC.

For verifications in accordance with EN 15512:2009, clause 9.5.4, a distance $a = 40\text{cm}$ may be used.

Pallet Racking System NR

BEC characteristics
 M_{Rk} , $(k(\eta), k(\theta))$ no performance assessed ϕ_i , V_{Rk}

Annex 6.2.4

Ultimate moment of resistance $M_{y,Rk}$ and stiffness
for a range of axial loads N

(Information concerning the orientation of the axes can be found with the upright characteristics)

Upright(s)	Base plate(s)	N (kN)	$M_{y,Rk}$ (N) (kNcm)	$M_{y,Rd}$ (N) ^{*1)} (kNcm)	$k_{y,d}$ (N) ^{*2)} (kNcm/rad)
080 67 20 4050 PR and G4	Low 3.5mm Low 5.0mm AUT Low 5.0mm AUT High 5.0mm MAN Low 5.0mm	0	0,0	0,0	0
		10	52,1	47,4	6.220
		25	122,0	111,0	14.700
		40	179,0	163,0	22.300
		55	221,0	201,0	28.900
		70	243,0	221,0	34.400
		81	244,0	222,0	37.900
		104	0,0	0,0	37.900

as a formula (input of N in kN)

$$M_{y,Rd} \text{ (N)} \quad \text{(kNcm)} \quad = -0,0001508 N^3 - 0,01438 N^2 + 4,899 N$$

$$k_{y,d} \text{ (N)} \quad \text{(kNcm/rad)} \quad = -2,172 N^2 + 644,04 N$$

for $0 \leq N \leq 81 \text{ kN}$

^{*1)} For the calculation of the design moment M_{Rd} in accordance with EN 15512:2009 (A.10)
a partial factor of $\gamma_M = 1,1$ ^{*3)} was used.

^{*2)} For the calculation of the design value of the rotational stiffness k_d the procedure in accordance with
EN 15512:2009 (Figure A.6) using a partial factor of $\gamma_M = 1,1$ ^{*3)} was executed.

^{*3)} In case of absence of other national regulations.

Both the table values, between which linear interpolation is allowed

and the formulas given under the tables for $k_{y,d}(N)$ und $M_{y,Rd}(N)$ may be used.

If the formulas are used, the range of the upright's axial load N given below the formulas must be taken into account.

Pallet Racking System NR

Floor connection characteristics
 M_{Rk} (N), (k (N) no performance assessed)

Annex 6.3.1

Ultimate moment of resistance $M_{y,Rk}$ and stiffness
for a range of axial loads N

(Information concerning the orientation of the axes can be found with the upright characteristics)

Upright(s)	Base plate(s)	N (kN)	$M_{y,Rk}$ (N) (kNcm)	$M_{y,Rd}$ (N) ^{*1)} (kNcm)	$k_{y,d}$ (N) ^{*2)} (kNcm/rad)
100 68 20 4050 PR and G4	Low 3.5mm Low 5.0mm AUT Low 5.0mm AUT High 5.0mm MAN Low 5.0mm MAN High 8.0mm	0	0,0	0,0	0
		20	142,0	129,0	12.600
		40	241,0	219,0	25.200
		60	301,0	274,0	37.800
		80	327,0	297,0	50.400
		100	320,0	291,0	62.900
		127	266,0	242,0	79.900
		147	0,0	0,0	79.900

as a formula (input of N in kN)

$$M_{y,Rd} \text{ (N)} \quad \text{(kNcm)} \quad = \quad 0,0000677 N^3 - 0,05228 N^2 + 7,456 N$$

$$k_{y,d} \text{ (N)} \quad \text{(kNcm/rad)} \quad = \quad -0,00694 N^2 + 630,00 N$$

for $0 \leq N \leq 127 \text{ kN}$

^{*1)} For the calculation of the design moment M_{Rd} in accordance with EN 15512:2009 (A.10)
a partial factor of $\gamma_M = 1,1$ ^{*3)} was used.

^{*2)} For the calculation of the design value of the rotational stiffness k_d the procedure in accordance with
EN 15512:2009 (Figure A.6) using a partial factor of $\gamma_M = 1,1$ ^{*3)} was executed.

^{*3)} In case of absence of other national regulations.

Both the table values, between which linear interpolation is allowed

and the formulas given under the tables for $k_{y,d}(N)$ und $M_{y,Rd}(N)$ may be used.

If the formulas are used, the range of the upright's axial load N given below the formulas must be taken into account.

Pallet Racking System NR

Floor connection characteristics
 M_{Rk} (N), (k (N) no performance assessed)

Annex 6.3.2

Ultimate moment of resistance $M_{y,Rk}$ and stiffness
for a range of axial loads N

(Information concerning the orientation of the axes can be found with the upright characteristics)

Upright(s)	Base plate(s)	N (kN)	$M_{y,Rk}$ (N) (kNcm)	$M_{y,Rd}$ (N) ^{*1)} (kNcm)	$k_{y,d}$ (N) ^{*2)} (kNcm/rad)
100 73 25 4050 PR and G4	Low 3.5mm Low 5.0mm AUT Low 5.0mm AUT High 5.0mm MAN Low 5.0mm MAN High 8.0mm	0	0,0	0,0	0
		35	222,0	202,0	25.500
		70	360,0	327,0	47.400
		115	439,0	399,0	70.200
		140	447,0	406,0	80.400
		175	430,0	391,0	91.600
		206	400,0	364,0	98.500
		228	0,0	0,0	98.500

as a formula (input of N in kN)

$$M_{y,Rd} \text{ (N)} \quad (\text{kNcm}) \quad = \quad 0,00005969 \text{ N}^3 - 0,03784 \text{ N}^2 + 7,028 \text{ N}$$

$$k_{y,d} \text{ (N)} \quad (\text{kNcm/rad}) \quad = \quad -1,45948 \text{ N}^2 + 778,61 \text{ N}$$

for $0 \leq N \leq 206\text{kN}$

^{*1)} For the calculation of the design moment M_{Rd} in accordance with EN 15512:2009 (A.10)
a partial factor of $\gamma_M = 1,1$ ^{*3)} was used.

^{*2)} For the calculation of the design value of the rotational stiffness k_d the procedure in accordance with
EN 15512:2009 (Figure A.6) using a partial factor of $\gamma_M = 1,1$ ^{*3)} was executed.

^{*3)} In case of absence of other national regulations.

Both the table values, between which linear interpolation is allowed

and the formulas given under the tables for $k_{y,d}(N)$ und $M_{y,Rd}(N)$ may be used.

If the formulas are used, the range of the upright's axial load N given below the formulas must be taken into account.

Pallet Racking System NR

Floor connection characteristics
 M_{Rk} (N), (k (N) no performance assessed)

Annex 6.3.3

Ultimate moment of resistance $M_{y,Rk}$ and stiffness
for a range of axial loads N

(Information concerning the orientation of the axes can be found with the upright characteristics)

Upright(s)	Base plate(s)	N (kN)	$M_{y,Rk}$ (N) (kNcm)	$M_{y,Rd}$ (N) ^{*1)} (kNcm)	$k_{y,d}$ (N) ^{*2)} (kNcm/rad)
100 78 20 5050 PR and G4	Low 3.5mm Low 5.0mm AUT Low 5.0mm AUT High 5.0mm MAN Low 5.0mm MAN High 8.0mm	0	0,0	0,0	0
		25	158,0	144,0	17.300
		50	279,0	254,0	33.000
		75	353,0	321,0	46.900
		100	370,0	336,0	59.200
		125	317,0	288,0	69.800
		148	199,0	181,0	78.100
		160	0,0	0,0	78.100

as a formula (input of N in kN)

$$M_{y,Rd} \text{ (N)} \quad \text{(kNcm)} \quad = -0,0001025 N^3 - 0,01904 N^2 + 6,285 N$$

$$k_{y,d} \text{ (N)} \quad \text{(kNcm/rad)} \quad = -1,34311 N^2 + 726,31 N$$

for $0 \leq N \leq 148 \text{ kN}$

^{*1)} For the calculation of the design moment M_{Rd} in accordance with EN 15512:2009 (A.10)
a partial factor of $\gamma_M = 1,1$ ^{*3)} was used.

^{*2)} For the calculation of the design value of the rotational stiffness k_d the procedure in accordance with
EN 15512:2009 (Figure A.6) using a partial factor of $\gamma_M = 1,1$ ^{*3)} was executed.

^{*3)} In case of absence of other national regulations.

Both the table values, between which linear interpolation is allowed

and the formulas given under the tables for $k_{y,d}(N)$ und $M_{y,Rd}(N)$ may be used.

If the formulas are used, the range of the upright's axial load N given below the formulas must be taken into account.

Pallet Racking System NR

Floor connection characteristics
 M_{Rk} (N), (k (N) no performance assessed)

Annex 6.3.4

Ultimate moment of resistance $M_{y,Rk}$ and stiffness
for a range of axial loads N

(Information concerning the orientation of the axes can be found with the upright characteristics)

Upright(s)	Base plate(s)	N (kN)	$M_{y,Rk}$ (N) (kNcm)	$M_{y,Rd}$ (N) ^{*1)} (kNcm)	$k_{y,d}$ (N) ^{*2)} (kNcm/rad)
100 78 25 5050 100 83 25 5050 PR and G4	Low 3.5mm Low 5.0mm AUT Low 5.0mm AUT High 5.0mm MAN Low 5.0mm MAN High 8.0mm	0	0,0	0,0	0
		30	185,0	168,0	19.900
		60	331,0	301,0	37.900
		90	428,0	389,0	54.000
		120	465,0	423,0	68.100
		150	432,0	393,0	80.200
		179	323,0	294,0	90.100
		203	0,0	0,0	90.100

as a formula (input of N in kN)

$$M_{y,Rd} \text{ (N)} \quad (\text{kNcm}) \quad = -0,00005996 N^3 - 0,01402 N^2 + 6,071 N$$

$$k_{y,d} \text{ (N)} \quad (\text{kNcm/rad}) \quad = -1,08065 N^2 + 697,02 N$$

for $0 \leq N \leq 179\text{kN}$

^{*1)} For the calculation of the design moment M_{Rd} in accordance with EN 15512:2009 (A.10)
a partial factor of $\gamma_M = 1,1^{*3)}$ was used.

^{*2)} For the calculation of the design value of the rotational stiffness k_d the procedure in accordance with
EN 15512:2009 (Figure A.6) using a partial factor of $\gamma_M = 1,1^{*3)}$ was executed.

^{*3)} In case of absence of other national regulations.

Both the table values, between which linear interpolation is allowed

and the formulas given under the tables for $k_{y,d}(N)$ und $M_{y,Rd}(N)$ may be used.

If the formulas are used, the range of the upright's axial load N given below the formulas must be taken into account.

Pallet Racking System NR

Floor connection characteristics
 M_{Rk} (N), (k (N) no performance assessed)

Annex 6.3.5

Ultimate moment of resistance $M_{y,Rk}$ and stiffness
for a range of axial loads N

(Information concerning the orientation of the axes can be found with the upright characteristics)

Upright(s)	Base plate(s)	N (kN)	$M_{y,Rk}$ (N) (kNcm)	$M_{y,Rd}$ (N) ^{*1)} (kNcm)	$k_{y,d}$ (N) ^{*2)} (kNcm/rad)
120 78 20 5070 120 83 20 5070 PR and G4	Low 5.0mm AUT Low 5.0mm AUT High 5.0mm MAN Low 5.0mm MAN High 8.0mm	0	0,0	0,0	0
		25	194,0	176,0	26.600
		50	338,0	307,0	51.500
		75	433,0	394,0	74.800
		100	479,0	435,0	96.500
		125	473,0	430,0	117.000
		158	386,0	351,0	140.000
		169	0,0	0,0	140.000

as a formula (input of N in kN)

$$M_{y,Rd} \text{ (N)} \quad \text{(kNcm)} \quad = -0,000008163 N^3 - 0,03465 N^2 + 7,9 N$$

$$k_{y,d} \text{ (N)} \quad \text{(kNcm/rad)} \quad = -1,30858 N^2 + 1095,93 N$$

for $0 \leq N \leq 158 \text{ kN}$

^{*1)} For the calculation of the design moment M_{Rd} in accordance with EN 15512:2009 (A.10)
a partial factor of $\gamma_M = 1,1$ ^{*3)} was used.

^{*2)} For the calculation of the design value of the rotational stiffness k_d the procedure in accordance with
EN 15512:2009 (Figure A.6) using a partial factor of $\gamma_M = 1,1$ ^{*3)} was executed.

^{*3)} In case of absence of other national regulations.

Both the table values, between which linear interpolation is allowed

and the formulas given under the tables for $k_{y,d}(N)$ und $M_{y,Rd}(N)$ may be used.

If the formulas are used, the range of the upright's axial load N given below the formulas must be taken into account.

Pallet Racking System NR

Floor connection characteristics
 M_{Rk} (N), (k (N) no performance assessed)

Annex 6.3.6

Ultimate moment of resistance $M_{y,Rk}$ and stiffness
for a range of axial loads N

(Information concerning the orientation of the axes can be found with the upright characteristics)

Upright(s)	Base plate(s)	N (kN)	$M_{y,Rk}$ (N) (kNcm)	$M_{y,Rd}$ (N) ^{*1)} (kNcm)	$k_{y,d}$ (N) ^{*2)} (kNcm/rad)
120 78 25 5070 120 83 25 5070 PR and G4	Low 5.0mm AUT Low 5.0mm AUT High 5.0mm MAN Low 5.0mm MAN High 8.0mm	0	0,0	0,0	0
		25	175,0	159,0	27.400
		50	325,0	295,0	52.100
		75	443,0	403,0	74.200
		100	521,0	474,0	93.600
		130	551,0	501,0	113.000
		165	481,0	437,0	132.000
		211	0,0	0,0	132.000

as a formula (input of N in kN)

$$M_{y,Rd} \text{ (N)} \quad \text{(kNcm)} \quad = -0,00007546 N^3 - 0,01209 N^2 + 6,699 N$$

$$k_{y,d} \text{ (N)} \quad \text{(kNcm/rad)} \quad = -2,12998 N^2 + 1148,54 N$$

for $0 \leq N \leq 165 \text{ kN}$

^{*1)} For the calculation of the design moment M_{Rd} in accordance with EN 15512:2009 (A.10)
a partial factor of $\gamma_M = 1,1$ ^{*3)} was used.

^{*2)} For the calculation of the design value of the rotational stiffness k_d the procedure in accordance with
EN 15512:2009 (Figure A.6) using a partial factor of $\gamma_M = 1,1$ ^{*3)} was executed.

^{*3)} In case of absence of other national regulations.

Both the table values, between which linear interpolation is allowed

and the formulas given under the tables for $k_{y,d}(N)$ und $M_{y,Rd}(N)$ may be used.

If the formulas are used, the range of the upright's axial load N given below the formulas must be taken into account.

Pallet Racking System NR

Floor connection characteristics
 M_{Rk} (N), (k (N) no performance assessed)

Annex 6.3.7

Ultimate moment of resistance $M_{y,Rk}$ and stiffness
for a range of axial loads N

(Information concerning the orientation of the axes can be found with the upright characteristics)

Upright(s)	Base plate(s)	N (kN)	$M_{y,Rk}$ (N) (kNcm)	$M_{y,Rd}$ (N) ^{*1)} (kNcm)	$k_{y,d}$ (N) ^{*2)} (kNcm/rad)
120 83 30 5070 PR and G4	Low 5.0mm AUT Low 5.0mm AUT High 5.0mm MAN Low 5.0mm MAN High 8.0mm	0	0,0	0,0	0
		50	211,0	192,0	42.400
		100	424,0	385,0	81.300
		150	595,0	541,0	117.000
		200	690,0	627,0	148.000
		260	647,0	588,0	182.000
		309	0,0	0,0	182.000

as a formula (input of N in kN)

$$M_{y,Rd} \text{ (N)} \quad \text{(kNcm)} \quad = -0,00004701 N^3 + 0,007017 N^2 + 3,614 N$$

$$k_{y,d} \text{ (N)} \quad \text{(kNcm/rad)} \quad = -0,71101 N^2 + 884,04 N$$

for $0 \leq N \leq 260 \text{ kN}$

^{*1)} For the calculation of the design moment M_{Rd} in accordance with EN 15512:2009 (A.10)
a partial factor of $\gamma_M = 1,1$ ^{*3)} was used.

^{*2)} For the calculation of the design value of the rotational stiffness k_d the procedure in accordance with
EN 15512:2009 (Figure A.6) using a partial factor of $\gamma_M = 1,1$ ^{*3)} was executed.

^{*3)} In case of absence of other national regulations.

Both the table values, between which linear interpolation is allowed

and the formulas given under the tables for $k_{y,d}(N)$ und $M_{y,Rd}(N)$ may be used.

If the formulas are used, the range of the upright's axial load N given below the formulas must be taken into account.

Pallet Racking System NR

Floor connection characteristics
 M_{Rk} (N), (k (N) no performance assessed)

Annex 6.3.8

Ultimate moment of resistance $M_{y,Rk}$ and stiffness
for a range of axial loads N

(Information concerning the orientation of the axes can be found with the upright characteristics)

Upright(s)	Base plate(s)	N (kN)	$M_{y,Rk}$ (N) (kNcm)	$M_{y,Rd}$ (N) ^{*1)} (kNcm)	$k_{y,d}$ (N) ^{*2)} (kNcm/rad)
120 83 35 5070 120 98 35 6570 PR and G4	Low 5.0mm AUT Low 5.0mm AUT High 5.0mm MAN Low 5.0mm MAN High 8.0mm	0	0,0	0,0	0
		60	363,0	330,0	44.100
		120	699,0	635,0	83.000
		180	945,0	859,0	117.000
		240	1040,0	944,0	145.000
		300	915,0	832,0	168.000
		360	510,0	464,0	186.000
		361	0,0	0,0	186.000

as a formula (input of N in kN)

$$M_{y,Rd} \text{ (N)} \quad \text{(kNcm)} \quad = -0,00004462 N^3 + 0,004728 N^2 + 5,369 N$$

$$k_{y,d} \text{ (N)} \quad \text{(kNcm/rad)} \quad = -0,72577 N^2 + 779,02 N$$

for $0 \leq N \leq 360 \text{ kN}$

^{*1)} For the calculation of the design moment M_{Rd} in accordance with EN 15512:2009 (A.10)
a partial factor of $\gamma_M = 1,1$ ^{*3)} was used.

^{*2)} For the calculation of the design value of the rotational stiffness k_d the procedure in accordance with
EN 15512:2009 (Figure A.6) using a partial factor of $\gamma_M = 1,1$ ^{*3)} was executed.

^{*3)} In case of absence of other national regulations.

Both the table values, between which linear interpolation is allowed

and the formulas given under the tables for $k_{y,d}(N)$ und $M_{y,Rd}(N)$ may be used.

If the formulas are used, the range of the upright's axial load N given below the formulas must be taken into account.

Pallet Racking System NR

Floor connection characteristics
 M_{Rk} (N), (k (N) no performance assessed)

Annex 6.3.9

Ultimate moment of resistance $M_{y,Rk}$ and stiffness
for a range of axial loads N

(Information concerning the orientation of the axes can be found with the upright characteristics)

Upright(s)	Base plate(s)	N (kN)	$M_{y,Rk}$ (N) (kNcm)	$M_{y,Rd}$ (N) ^{*1)} (kNcm)	$k_{y,d}$ (N) ^{*2)} (kNcm/rad)
140 83 20 5090 140 83 25 5090 PR and G4 140 140 25 8570 28 140 140 30 8570 28 PR	Low 5.0mm AUT Low 5.0mm AUT High 5.0mm MAN Low 5.0mm MAN High 8.0mm	0	0,0	0,0	0
		30	251,0	228,0	47.300
		60	451,0	410,0	88.900
		90	591,0	537,0	125.000
		120	655,0	595,0	155.000
		150	631,0	574,0	179.000
		180	507,0	461,0	198.000
		211	0,0	0,0	198.000

as a formula (input of N in kN)

$$M_{y,Rd} \text{ (N)} \quad \text{(kNcm)} \quad = -0,00007156 N^3 - 0,01849 N^2 + 8,207 N$$

$$k_{y,d} \text{ (N)} \quad \text{(kNcm/rad)} \quad = -3,1896 N^2 + 1672,26 N$$

for $0 \leq N \leq 180 \text{ kN}$

^{*1)} For the calculation of the design moment M_{Rd} in accordance with EN 15512:2009 (A.10)
a partial factor of $\gamma_M = 1,1$ ^{*3)} was used.

^{*2)} For the calculation of the design value of the rotational stiffness k_d the procedure in accordance with
EN 15512:2009 (Figure A.6) using a partial factor of $\gamma_M = 1,1$ ^{*3)} was executed.

^{*3)} In case of absence of other national regulations.

Both the table values, between which linear interpolation is allowed

and the formulas given under the tables for $k_{y,d}(N)$ und $M_{y,Rd}(N)$ may be used.

If the formulas are used, the range of the upright's axial load N given below the formulas must be taken into account.

Pallet Racking System NR

Floor connection characteristics
 M_{Rk} (N), (k (N) no performance assessed)

Annex 6.3.10

Ultimate moment of resistance $M_{y,Rk}$ and stiffness
for a range of axial loads N

(Information concerning the orientation of the axes can be found with the upright characteristics)

Upright(s)	Base plate(s)	N (kN)	$M_{y,Rk}$ (N) (kNcm)	$M_{y,Rd}$ (N) ^{*1)} (kNcm)	$k_{y,d}$ (N) ^{*2)} (kNcm/rad)
140 83 35 5090 140 98 35 6590 PR and G4 140 140 35 8570 28 PR	Low 5.0mm AUT Low 5.0mm AUT High 5.0mm MAN Low 5.0mm MAN High 8.0mm	0	0,0	0,0	0
		60	466,0	424,0	74.800
		120	831,0	755,0	135.000
		180	1080,0	978,0	181.000
		240	1190,0	1080,0	213.000
		300	1160,0	1050,0	231.000
		360	960,0	873,0	234.000
		391	0,0	0,0	234.000

as a formula (input of N in kN)

$$M_{y,Rd} \text{ (N)} \quad \text{(kNcm)} \quad = -0,00001037 N^3 - 0,01113 N^2 + 7,775 N$$

$$k_{y,d} \text{ (N)} \quad \text{(kNcm/rad)} \quad = -1,98277 N^2 + 1365,14 N$$

for $0 \leq N \leq 360 \text{ kN}$

^{*1)} For the calculation of the design moment M_{Rd} in accordance with EN 15512:2009 (A.10)
a partial factor of $\gamma_M = 1,1$ ^{*3)} was used.

^{*2)} For the calculation of the design value of the rotational stiffness k_d the procedure in accordance with
EN 15512:2009 (Figure A.6) using a partial factor of $\gamma_M = 1,1$ ^{*3)} was executed.

^{*3)} In case of absence of other national regulations.

Both the table values, between which linear interpolation is allowed

and the formulas given under the tables for $k_{y,d}(N)$ und $M_{y,Rd}(N)$ may be used.

If the formulas are used, the range of the upright's axial load N given below the formulas must be taken into account.

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Floor connection characteristics
 M_{Rk} (N), (k (N) no performance assessed)

Annex 6.3.11

Transverse shear stiffness **S**
and range of transverse shear stiffness validity **V_{max}** of the upright frame

Upright frame (structure)				characteristics		
Upright group(s) + perforation type	Diagonal (bracing)	D _{fr} (mm)	V _H (mm)	S (kN/rad)	C _v (kN/mm)	V _{max} (kN)
A MLK4	303015 or larger	400	450	399	7,3	4,9
		400	1.050	183	9,5	2,2
		1.100	450	451	2,3	5,4
		1.100	1.050	655	3,8	3,8
B1 MLG4 and G4	303015 or larger	400	450	371	6,2	5,5
		400	1.050	177	7,8	2,0
		1.100	450	624	3,3	6,3
		1.100	1.050	796	4,9	3,9
B2 PR and G4	503015 or larger (also OB) only S275 material	500	450	649	7,7	8,1
		500	1.050	395	9,5	3,5
		1.100	450	919	4,8	7,2
		1.100	1.050	1.070	5,6	4,6
C, D, E u. F PR and G4	503015 or larger (also OB) only S275 material (when D _{fr} = 1.100mm also S235 and S250 may be used)	500	450	648	7,5	5,9
		500	1.050	404	9,5	2,8
		1.100	450	1.050	5,7	6,3
		1.100	1.050	1.280	7,3	4,7
		1.700	600	1.330	5,3	8,0
		1.700	1.050	2.000	7,2	7,0

V_{max} is the maximum permissible design value of the lateral force in the frame,
it limits the validity of S (see EN 15512:2009, Figure A.13).

Linear interpolation of the characteristics
for intermediate dimensions of the upright frame depths D_{fr}
or of the vertical dimension of diagonal bracing V_H is allowed.
Extrapolation is not allowed.

S and V_{max} may be used up to a maximum upright frame depth of D_{fr,max} = 2.500mm
also for upright frame depths D_{fr} ≥ 1.100mm, or ≥ 1.700mm,
the characteristic for the spring C_v must be redetermined for this range of frame depths

The characteristics may be used both for connections with M6- and M10-bolts.

Pallet Racking System NR

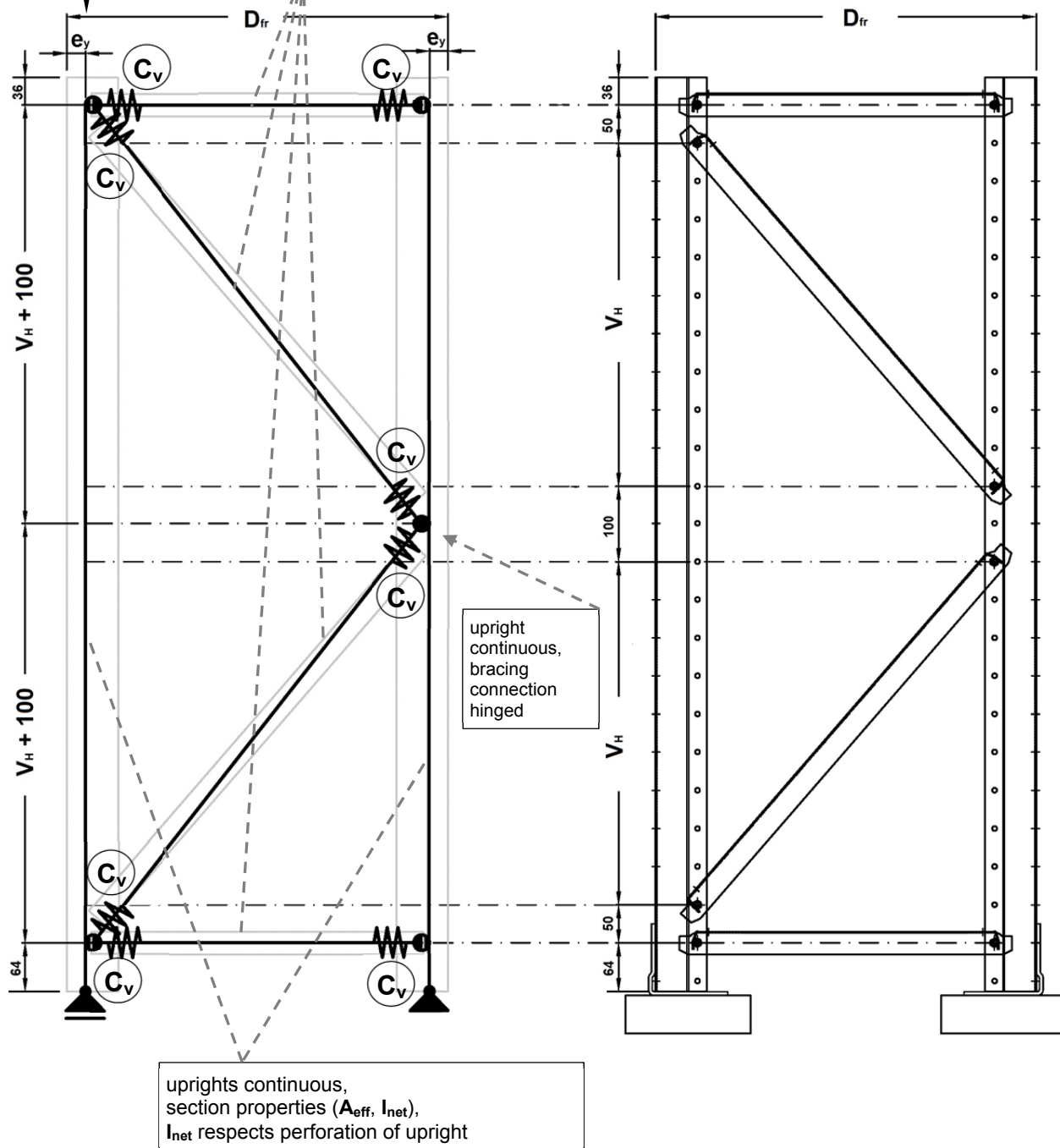
Upright frame characteristics
S, V_{max}

Annex 6.4.1

upright centre line

hinged connection
of bracings

Concerning eccentricities of bracing connections
EN 15512:2009, 8.6 must be regarded



Pallet Racking System NR

Upright frame characteristics
Static model

Annex 6.4.2

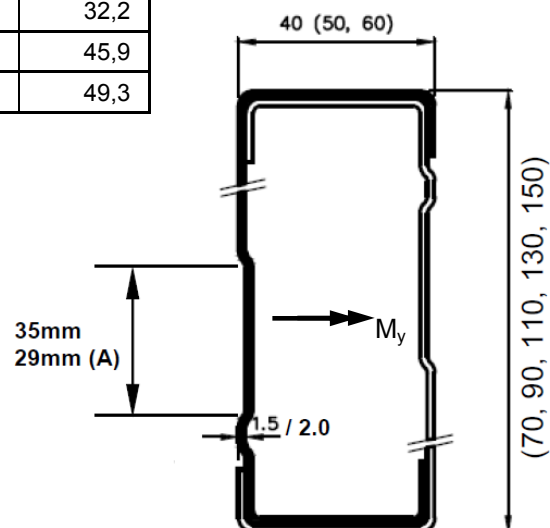
Effective section moduli W_{eff}

Beams			effective section moduli			
height	width	sheet thickness	$W_{y,el}$	$W_{y,eff}$		
				S235	S275	S355
mm			cm ³			

CC - beams						
90	40	1,5	14,6	17,9	17,9	16,6
110			19,3	24,1	23,1	21,9
130			24,4	30,4	28,8	26,6
150			29,9	37,3	34,4	30,6
110	50	1,5	22,4	25,9	25,1	24,0
130			28,1	32,3	30,6	28,3
150			34,2	36,9	35,1	32,6
150	50	2,0	44,8	48,4	47,8	47,0
150	60		50,5	50,5	50,5	50,5

ACC - beams						
90	40	1,5	14,6	17,9	17,9	16,6
110			19,3	24,1	23,1	21,9
130			24,4	30,4	28,8	26,6
150			29,9	37,3	34,4	30,5
110	50	1,5	22,4	25,9	25,1	23,9
130			28,1	32,3	30,6	28,1
150			34,2	36,9	35,1	32,2
150	50	2,0	43,7	47,3	46,7	45,9
150	60		49,4	49,5	49,5	49,3

beam type CC (A)



Pallet Racking System NR

Beam characteristics
 W_{eff}

Annex 6.5.1