

Europäische Technische Bewertung ETA für MPR-Systemschienen

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Europäische Technische Bewertung

ETA-25/0296 vom 28/04/2025

Deutsche Übersetzung erstellt vom CSTB - Originalversion in französischer Sprache

Allgemeiner Teil

Technische Bewertungsstelle, die Europäische Technische Bewertung ausstellt:

Centre Scientifique et Technique du Bâtiment (CSTB)

Handelsname des Bauprodukts:	MÜPRO Systemschiene
Produktfamilie, zu der das Bauprodukt gehört:	Produkte für Installationssysteme für technische Gebäudeausrüstung
Hersteller:	MÜPRO Services GmbH Borsigstrasse 14 65205 Wiesbaden Germany
Herstellungsbetrieb:	UBB Umformtechnik GmbH Im Grund 1 91593 Burgbernheim Germany
Diese Europäische Technische Bewertung enthält:	45 Seiten, davon 44 Seiten Anhänge, die fester Bestandteil dieser Bewertung sind
Diese Europäische Technische Bewertung wird ausgestellt gemäß der Verordnung (EU) Nr. 305/2011, auf der Grundlage von:	European Assessment Document (EAD) 280016-00-0602 Version Juni 2020
Diese Fassung ersetzt:	-

Die Europäische Technische Bewertung wird von der Technischen Bewertungsstelle in ihrer Amtssprache ausgestellt. Übersetzungen dieser Europäischen Technischen Bewertung in andere Sprachen müssen vollständig mit dem Originaldokument übereinstimmen und als solche gekennzeichnet sein. Die Weitergabe dieser Europäischen Technischen Bewertung, einschließlich der Übermittlung auf elektronischem Wege, muss in ihrer Gesamtheit erfolgen. Eine teilweise Wiedergabe ist jedoch nur mit schriftlicher Zustimmung der ausstellenden Technischen Bewertungsstelle zulässig. Jede teilweise Wiedergabe muss als solche gekennzeichnet sein. Diese Europäische Technische Bewertung kann von der ausstellenden Technischen Bewertungsstelle insbesondere auf Grundlage von Informationen der Europäischen Kommission gemäß Artikel 25(3) der Verordnung (EU) Nr. 305/2011 zurückgezogen werden.

Spezifischer Teil

1 Spezifischer Teil

Gegenstand dieser Europäischen Technischen Bewertung sind die MÜPRO Installationsschienen, die in Tabelle A1, bis Tabelle A5 beschrieben ist.

Die MÜPRO Schienen MPR 41/21/1,5, MPR 41/21/2,0, MPR 41/41/2,0, MPR 41/41/2,5 und MPR 41/62/2,5 sind aus dünnwandigem Stahl in C-Form gefertigt. Aussparungen in Form von Langlöchern und Rundlöchern ermöglichen die Verwendung von Befestigungs- und Montagematerial.

Die MÜPRO Schienen MPR 41/42/2,0 H, MPR 41/82/2,0 H, MPR 41/82/2,5 H und MPR 41/124/2,5 H bestehen aus zwei Profilen des gleichen Typs, die im Bereich der Rückseite der Schienen form- und kraftschlüssig miteinander verbunden sind. Aussparungen in Form von Langlöchern und Rundlöchern ermöglichen die Verwendung von Befestigungs- und Montagematerial.

Die MÜPRO Schienen können entlang der gesamten Länge gemäß den Herstelleranweisungen zugeschnitten werden, ohne die angegebenen Leistungen zu beeinträchtigen.

Anhang A beschreibt die Zeichnungen, Abmessungen und Werkstoffe der MÜPRO Installationsschienen.

2 Spezifizierung des Verwendungszwecks gemäß dem anwendbaren Europäischen Bewertungsdokument

Von den Leistungen in Abschnitt 3 kann nur ausgegangen werden, wenn die MÜPRO Systemschiene entsprechend den Angaben und unter den Randbedingungen nach Anhang B verwendet wird.

Die Prüf- und Bewertungsmethoden, die dieser Europäischen Technischen Bewertung zu Grunde liegen, führen zur Annahme einer Nutzungsdauer der Schienen von mindestens 50 Jahren. Die Angabe der Nutzungsdauer kann nicht als Garantie des Herstellers verstanden werden, sondern ist lediglich ein Hilfsmittel zur Auswahl des richtigen Produkts in Bezug auf die angenommene wirtschaftlich angemessene Nutzungsdauer des Bauwerks.

Gemäß dem Europäischen Bewertungsdokument EAD 280016-00-0602 ist das Produkt unter der Voraussetzung vorgesehen, dass es in folgenden Bereichen verwendet wird:

- a) Für Produkte für Installationssysteme zur vorgesehenen Verwendung als Halterung von Komponenten ortsfester Brandbekämpfungssysteme,
- b) Für Produkte für Installationssysteme zur vorgesehenen Verwendung als Halterung von technischer Gebäudeausrüstung im Allgemeinen,
- c) Für Produkte für Installationssysteme zur vorgesehenen Verwendung als Halterung von Leitungen zum Transport von anderem Wasser als Trinkwasser,
- d) Für Produkte für Installationssysteme zur vorgesehenen Verwendung als Halterung von Leitungen zum Transport von Gas/Brennstoff zur Versorgung von Heiz-/Kühlsystemen von Gebäuden

3 Leistung des Produkts und Angabe der Methoden ihrer Bewertung

3.1 Brandschutz (BWR 2)

No.	Wesentliches Merkmal	Leistung
1	Brandverhalten	Klasse A1
2	Abreißfestigkeit der Rücklochoöffnungen der Schiene bei Brandbelastung	Keine bewertete Leistung
3	Biegeeigenschaften bei Brandbelastung	Keine bewertete Leistung

3.2 Sicherheit bei der Anwendung (BWR 4)

No.	Wesentliches Merkmal	Leistung
4	Form	siehe Anhang A
5	Abmessungen	siehe Anhang A
6	Werkstoff und Querschnittseigenschaften	siehe Anhang A und B
7	Charakteristische Zugfestigkeit der Rücklochoffnungen der Schiene bei Umgebungstemperaturen	Keine bewertete Leistung

4 **Für die Durchführung des Systems zur Bewertung und Überprüfung der Leistungsbeständigkeit erforderliche technische Einzelheiten gemäß anwendbarem Europäischen Bewertungsdokument**

Gemäß dem Europäischen Bewertungsdokument EAD 280016-00-0602, gilt folgende Rechtsgrundlage:

- Im Falle der Voraussetzung a) gemäß Abschnitt 2:
96/577/EC, geändert durch 2002/592/EC:
Folgendes System ist anzuwenden: 1
- Im Falle der Voraussetzung b) gemäß Abschnitt 2:
97/161/EC:
Folgendes System ist anzuwenden: 2+
- Im Falle der Voraussetzung d) gemäß Abschnitt 2:
1999/472/EC, geändert durch 2001/596/EC:
Folgendes System ist anzuwenden: 3
- Im Falle der Voraussetzung c) gemäß Abschnitt 2:
1999/472/EC, geändert durch 2001/596/EC:
Folgendes System ist anzuwenden: 4

5 **Für die Durchführung des Systems zur Bewertung und Überprüfung der Leistungsbeständigkeit erforderliche technische Einzelheiten gemäß anwendbarem Europäischen Bewertungsdokument**

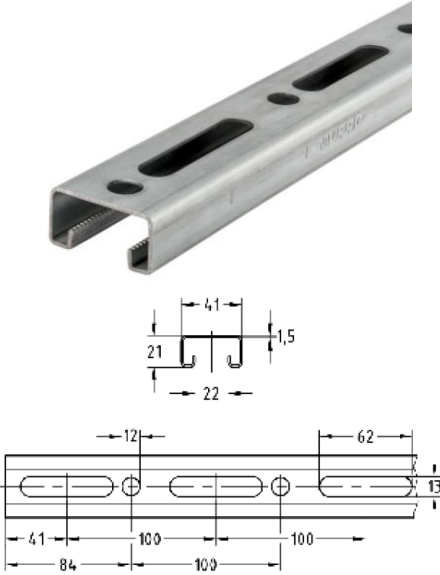
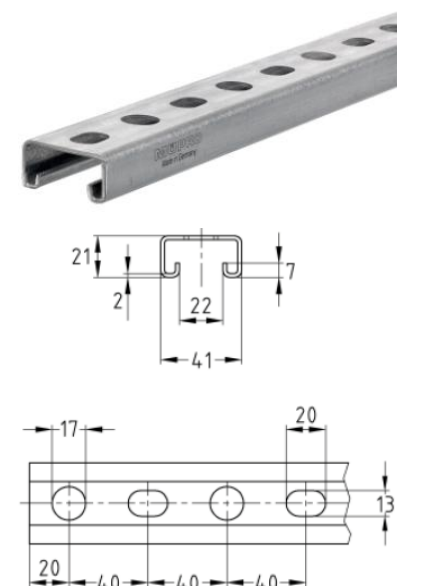
Technische Einzelheiten, die für die Durchführung des Systems zur Bewertung und Überprüfung der Leistungsbeständigkeit notwendig sind, sind Bestandteil des Prüfplans, der beim Centre Scientifique et Technique du Bâtiment hinterlegt ist.

Der Hersteller beauftragt auf vertraglicher Basis eine auf dem Gebiet der Installationsschienen zugelassene notifizierte Stelle mit der Ausstellung der CE-Konformitätsbescheinigung entsprechend dem Kontrollplan.

Die originale französische Version ist unterzeichnet von:

Loic PAYET
Head of the Structure, Masonry, Partition Division

Tabelle A1: Abmessungen und Materialien der MÜPRO MPR 41/21/1.5 und MPR 41/21/2.0 Schienen

Zeichnungen (Abmessungen in mm)	Bezeichnung	Artikelnummer	Länge [mm]	Werkstoff und Beschichtung
	MÜPRO Schiene MPR 41/21/1.5	175787	3 000	S250GD + Z275NA Gemäß EN 10346
		175788	6 000	
	MÜPRO Schiene MPR 41/21/2.0	150930	2 000	S250GD + Z275NA Gemäß EN 10346
		150931	3 040	
		150932	6 000	
		154173	2 000	S235JR, Feuerverzinkter Stahl Gemäß EN 10025-2
		154174	3 040	
		154175	6 000	
		154393	2 000	V4A (1.4404) Gemäß EN 10088-2
		154394	3 040	
		154395	6 000	

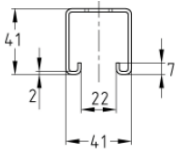
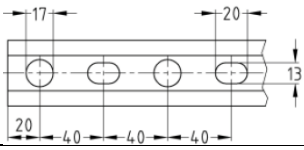
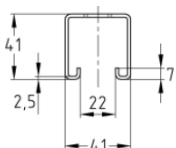
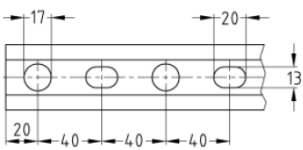
MÜPRO Schienen

Produktbeschreibung

Form, Abmessungen und Werkstoff

Anhang A1

Tabelle A2: Abmessungen und Materialien der MÜPRO MPR 41/41/2.0 und MPR 41/41/2.5 Schienen

Zeichnungen (Abmessungen in mm)	Bezeichnung	Artikelnummer	Länge [mm]	Werkstoff und Beschichtung
  	MÜPRO Schiene MPR 41/41/2.0	150933	2 000	S250GD + Z275NA gemäß EN 10346
		150934	3 040	
		150935	6 000	
		154176	2 000	S235JR, Feuerverzinkter Stahl Gemäß EN 10025-2
		154177	3 040	
		154178	6 000	
		154396	2 000	V4A (1.4404) Gemäß EN 10088-2
		154397	6 000	
  	MÜPRO Schiene MPR 41/41/2.5	150864	2 000	S250GD + Z275NA Gemäß EN 10346
		150937	3 040	
		150938	6 000	
		154179	2 000	S235JR, Feuerverzinkter Stahl Gemäß EN 10025-2
		154180	3 040	
		154181	6 000	

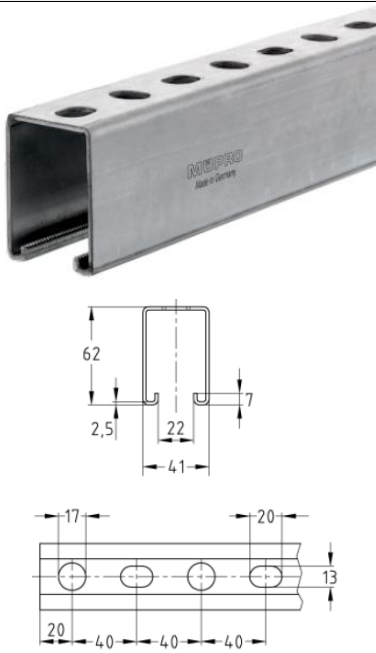
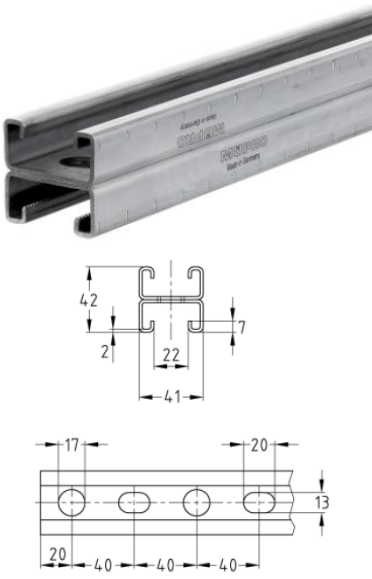
MÜPRO Schienen

Produktbeschreibung

Form, Abmessungen und Werkstoff

Anhang A2

Tabelle A3: Abmessungen und Materialien der MÜPRO MPR 41/62/2.5 und MPR 41/42/2.0 H Schienen

Zeichnungen (Abmessungen in mm)	Bezeichnung	Artikelnummer	Länge [mm]	Werkstoff und Beschichtung
	MÜPRO Schiene MPR 41/62/2.5	150936	2 000	S250GD + Z275NA Gemäß EN 10346
		150978	3 040	
		150979	6 000	
		154182	2 000	S235JR, Feuerverzinkter Stahl Gemäß EN 10025-2
		154183	3 040	
		154184	6 000	
		154404	6 000	V4A (1.4404) Gemäß EN 10088-2
	MÜPRO Schiene MPR 41/42/2.0 H	150968	6 640	S250GD + Z275NA Gemäß EN 10346
		154185	6 640	S235JR, Feuerverzinkter Stahl Gemäß EN 10025-2

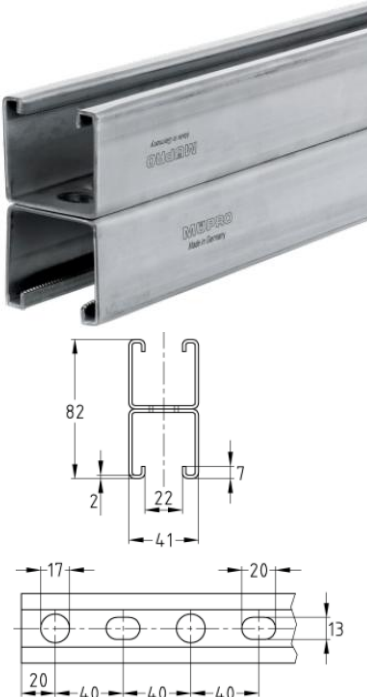
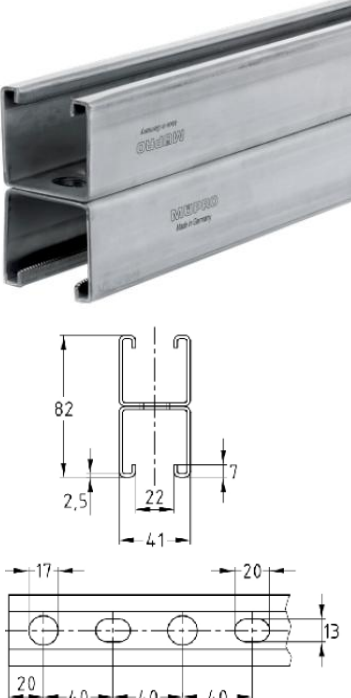
MÜPRO Schienen

Produktbeschreibung

Form, Abmessungen und Werkstoff

Anhang A3

Tabelle A4: Abmessungen und Materialien der MÜPRO MPR 41/82/2.0 H und MPR 41/82/2.5 H Schienen

Zeichnungen (Abmessungen in mm)	Bezeichnung	Artikelnummer	Länge [mm]	Werkstoff und Beschichtung
	MÜPRO Schiene MPR 41/82/2.0 H	150969	6 640	S250GD + Z275NA Gemäß EN 10346
		154186	6 640	S235JR, Feuerverzinkter Stahl Gemäß EN 10025-2
		154406	6 000	V4A (1.4404) Gemäß EN 10088-2
	MÜPRO Schiene MPR 41/82/2.5 H	177352	6 000	S250GD + Z275NA Gemäß EN 10346

Doppelschienen bestehen aus zwei MPR 41/41/2,5 Einzelschienenprofilen, die auf der Rückseite form- und kraftschlüssig miteinander verbunden sind, beispielsweise durch eine gestanzte oder geschweißte Verbindung.

MÜPRO Schienen

Produktbeschreibung

Form, Abmessungen und Werkstoff

Anhang A4

Tabelle A5: Abmessungen und Materialien der MÜPRO MPR 41/124/2.5 H Schienen

Zeichnungen (Abmessungen in mm)	Bezeichnung	Artikelnummer	Länge [mm]	Werkstoff und Beschichtung
	MÜPRO Schiene MPR 41/124/2.5 H	151050	6 640	S250GD + Z275NA Gemäß EN 10346
		154187	6 640	S235JR, Feuerverzinkter Stahl Gemäß EN 10025-2
		154407	6 000	V4A (1.4404) Gemäß EN 10088-2

Doppelschienen bestehen aus zwei MPR 41/62/2,5 Einzelschienenprofilen, die auf der Rückseite form- und kraftschlüssig miteinander verbunden sind, beispielsweise durch eine geclinchte oder geschweißte Verbindung.

MÜPRO Schienen

Produktbeschreibung

Form, Abmessungen und Werkstoff

Anhang A5

Voraussetzung für die Leistungsbemessung

- MÜPRO MPR-Schienen werden zur Übertragung von Lasten aus gebäudetechnischen Komponenten wie Rohrleitungen und Anlagen für Wasser-, Heizungs-, Kühl-, Lüftungs-, Elektro- und andere Systeme verwendet. Die MÜPRO MPR-Schienen übernehmen diese tragende Funktion unter den in Abschnitt 2 dieser Europäischen Technischen Bewertung beschriebenen Bedingungen.
- MÜPRO MPR-Schienen (unabhängig von Länge und Beschichtung) im Geltungsbereich dieser Europäischen Technischen Bewertung werden für Anwendungen bei Umgebungstemperatur verwendet.

MÜPRO Schienen	Anhang B1
Verwendungszweck Voraussetzungen für die Leistungsbemessung	

Tabelle B1: Querschnittseigenschaften der MÜPRO-Schienen MPR 41/21/1,5, Lochbereich, Rundloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	131,28	mm ²	
	A _{geom}	131,28	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	39,22	mm ²	
	A _z	42,59	mm ²	
Centroid position	y _{S,0}	20,50	mm	relative to zero point
	z _{S,0}	11,13	mm	
Moments of inertia	I _y	7776,64	mm ⁴	about centroidal axes y
	I _z	35532,19	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	43308,83	mm ⁴	
	I _{p,M}	104828,94	mm ⁴	about shear center M
Radii of gyration	i _y	7,70	mm	relative to centroid C
	i _z	16,45	mm	
Polar radii of gyration	i _p	18,16	mm	
	i _{p,M}	28,26	mm	about shear center M
Warping radius of gyration	i _{ω,M}	7,01	mm	
Cross-section weight	G	1,03	kg/m	
Cross-section perimeter	U	181,02	mm	incl. inner side of cells
Torsional constant	I _t	87,34	mm ⁴	calculated analytically
Secondary torsional constant	I _{t,s}	26165,15	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	32,78	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	21,65	mm	
Warping constants	I _{ω,S}	2,181E+07	mm ⁶	relative to centroid C
	I _{ω,M}	5,157E+06	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	787,95	mm ³	in distance 9.87 mm
	W _{y,min}	-698,67	mm ³	in distance -11.13 mm
	W _{z,max}	1733,28	mm ³	in distance 20.50 mm
	W _{z,min}	-1733,28	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	14435,36	mm ⁴	in node 40
	W _{ω,M,min}	-14449,92	mm ⁴	in node 28
Torsional section modulus	W _t	58,22	mm ³	
Stability parameters	r _u	-2,88	mm	
	r _{M,v}	-46,17	mm	
Reduction factor	λ _M	0,00	1/mm	

MÜPRO Schienen

Querschnittseigenschaften der Montageschienen

Anhang B2

Tabelle B2: Querschnittseigenschaften der MÜPRO-Schienen MPR 41/21/1,5, Lochbereich, Langloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	129,78	mm ²	
	A _{geom}	129,78	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	39,19	mm ²	
	A _z	42,88	mm ²	
Centroid position	y _{s,0}	20,50	mm	relative to zero point
	z _{s,0}	11,03	mm	
Moments of inertia	I _y	7650,17	mm ⁴	about centroidal axes y
	I _z	35473,56	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	43123,73	mm ⁴	
	I _{p,M}	104651,83	mm ⁴	about shear center M
Radii of gyration	i _y	7,68	mm	relative to centroid C
	i _z	16,53	mm	
Polar radii of gyration	i _p	18,23	mm	
	i _{p,M}	28,40	mm	about shear center M
Warping radius of gyration	i _{ω,M}	7,01	mm	
Cross-section weight	G	1,02	kg/m	
Cross-section perimeter	U	179,02	mm	incl. inner side of cells
Torsional constant	I _t	87,34	mm ⁴	calculated analytically
Secondary torsional constant	I _{t,s}	26174,55	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	32,80	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	21,77	mm	
Warping constants	I _{ω,S}	2,197E+07	mm ⁶	relative to centroid C
	I _{ω,M}	5,148E+06	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	766,94	mm ³	in distance 9.97 mm
	W _{y,min}	-693,89	mm ³	in distance -11.03 mm
	W _{z,max}	1730,42	mm ³	in distance 20.50 mm
	W _{z,min}	-1730,42	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	14419,31	mm ⁴	in node 40
	W _{ω,M,min}	-14434,05	mm ⁴	in node 28
Torsional section modulus	W _t	58,22	mm ³	
Stability parameters	r _u	-2,34	mm	
	r _{M,v}	-45,89	mm	
Reduction factor	λ _M	0,00	1/mm	

MÜPRO Schienen

Querschnittseigenschaften der Montageschienen

Anhang B3

Tabelle B3: Querschnittseigenschaften der MÜPRO-Schienen MPR 41/21/1,5, nicht gelochter Bereich

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	149,28	mm ²	
	A _{geom}	149,28	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	39,33	mm ²	
	A _z	39,06	mm ²	
Centroid position	y _{s,0}	20,50	mm	relative to zero point
	z _{s,0}	12,23	mm	
Moments of inertia	I _y	9096,32	mm ⁴	about centroidal axes y
	I _z	35748,19	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	44844,51	mm ⁴	
	I _{p,M}	107407,44	mm ⁴	about shear center M
Radii of gyration	i _y	7,81	mm	relative to centroid C
	i _z	15,47	mm	
Polar radii of gyration	i _p	17,33	mm	
	i _{p,M}	26,82	mm	about shear center M
Warping radius of gyration	i _{ω,M}	6,95	mm	
Cross-section weight	G	1,17	kg/m	
Cross-section perimeter	U	202,02	mm	incl. inner side of cells
Torsional constant	I _t	88,40	mm ⁴	calculated analytically
Secondary torsional constant	I _{t,s}	26122,70	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	32,70	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	20,47	mm	
Warping constants	I _{ω,S}	2,018E+07	mm ⁶	relative to centroid C
	I _{ω,M}	5,191E+06	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	1037,33	mm ³	in distance 8.77 mm
	W _{y,min}	-743,71	mm ³	in distance -12.23 mm
	W _{z,max}	1743,81	mm ³	in distance 20.50 mm
	W _{z,min}	-1743,81	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	14494,55	mm ⁴	in node 37
	W _{ω,M,min}	-14507,29	mm ⁴	in node 25
Torsional section modulus	W _t	58,93	mm ³	
Stability parameters	r _u	-8,39	mm	
	r _{M,v}	-49,33	mm	
Reduction factor	λ _M	0,00	1/mm	

MÜPRO Schienen

Querschnittseigenschaften der Montageschienen

Anhang B4

Tabelle B4: Querschnittseigenschaften der MÜPRO-Schienen MPR 41/21/1,5, durchschnittlicher Querschnitt

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	136,02	mm ²	
	A _{geom}	136,02	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	24,10	mm ²	
	A _z	41,50	mm ²	
Centroid position	y _{S,0}	20,50	mm	relative to zero point
	z _{S,0}	11,45	mm	
Moments of inertia	I _y	8156,93	mm ⁴	about centroidal axes y
	I _z	35561,44	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	43718,37	mm ⁴	
	I _{p,M}	105541,42	mm ⁴	about shear center M
Radii of gyration	i _y	7,74	mm	relative to centroid C
	i _z	16,17	mm	
Polar radii of gyration	i _p	17,93	mm	
	i _{p,M}	27,86	mm	about shear center M
Warping radius of gyration	i _{ω,M}	6,99	mm	
Cross-section weight	G	1,07	kg/m	
Cross-section perimeter	U	204,06	mm	incl. inner side of cells
Torsional constant	I _t	74,25	mm ⁴	calculated analytically
Secondary torsional constant	I _{t,s}	25909,94	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	32,77	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	21,32	mm	
Warping constants	I _{ω,S}	2,133E+07	mm ⁶	relative to centroid C
	I _{ω,M}	5,162E+06	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	854,01	mm ³	in distance 9.55 mm
	W _{y,min}	-712,48	mm ³	in distance -11.45 mm
	W _{z,max}	1734,70	mm ³	in distance 20.50 mm
	W _{z,min}	-1734,70	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	14443,60	mm ⁴	in node 39
	W _{ω,M,min}	-14457,64	mm ⁴	in node 27
Torsional section modulus	W _t	49,50	mm ³	
Stability parameters	r _u	-4,61	mm	
	r _{M,v}	-47,25	mm	
Reduction factor	λ _M	0,00	1/mm	

MÜPRO Schienen

Querschnittseigenschaften der Montageschienen

Anhang B5

Tabelle B5: Querschnittseigenschaften der MÜPRO-Schienen MPR 41/21/2.0, Lochbereich, Rundloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	160,32	mm ²	
	A _{geom}	160,32	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	51,97	mm ²	
	A _z	57,42	mm ²	
Centroid position	y _{S,0}	20,50	mm	relative to zero point
	z _{S,0}	10,64	mm	
Moments of inertia	I _y	8783,35	mm ⁴	about centroidal axes y
	I _z	44901,68	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	53685,03	mm ⁴	
	I _{p,M}	128104,27	mm ⁴	about shear center M
Radii of gyration	i _y	7,40	mm	relative to centroid C
	i _z	16,74	mm	
Polar radii of gyration	i _p	18,30	mm	
	i _{p,M}	28,27	mm	about shear center M
Warping radius of gyration	i _{ω,M}	6,76	mm	
Cross-section weight	G	1,26	kg/m	
Cross-section perimeter	U	168,31	mm	incl. inner side of cells
Torsional constant	I _t	196,26	mm ⁴	calculated analytically
Secondary torsional constant	I _{t,s}	32712,83	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	32,19	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	21,54	mm	
Warping constants	I _{ω,S}	2,671E+07	mm ⁶	relative to centroid C
	I _{ω,M}	5,856E+06	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	848,08	mm ³	in distance 10.36 mm
	W _{y,min}	-825,25	mm ³	in distance -10.64 mm
	W _{z,max}	2190,33	mm ³	in distance 20.50 mm
	W _{z,min}	-2190,33	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	17539,77	mm ⁴	in node 41
	W _{ω,M,min}	-17558,05	mm ⁴	in node 29
Torsional section modulus	W _t	98,13	mm ³	
Stability parameters	r _u	-0,46	mm	
	r _{M,v}	-43,55	mm	
Reduction factor	λ _M	0,00	1/mm	

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Querschnittseigenschaften der Montageschienen

Anhang B6

Tabelle B6: Querschnittseigenschaften der MÜPRO-Schienen MPR 41/21/2.0, Lochbereich, Langloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	168,32	mm ²	
	A _{geom}	168,32	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	52,22	mm ²	
	A _z	55,94	mm ²	
Centroid position	y _{S,0}	20,50	mm	relative to zero point
	z _{S,0}	11,09	mm	
Moments of inertia	I _y	9453,09	mm ⁴	about centroidal axes y
	I _z	45354,35	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	54807,43	mm ⁴	
	I _{p,M}	128886,01	mm ⁴	about shear center M
Radii of gyration	i _y	7,49	mm	relative to centroid C
	i _z	16,41	mm	
Polar radii of gyration	i _p	18,04	mm	
	i _{p,M}	27,67	mm	about shear center M
Warping radius of gyration	i _{ω,M}	6,78	mm	
Cross-section weight	G	1,32	kg/m	
Cross-section perimeter	U	176,31	mm	incl. inner side of cells
Torsional constant	I _t	196,26	mm ⁴	calculated analytically
Secondary torsional constant	I _{t,s}	32651,89	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	32,07	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	20,98	mm	
Warping constants	I _{ω,S}	2,590E+07	mm ⁶	relative to centroid C
	I _{ω,M}	5,922E+06	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	953,73	mm ³	in distance 9.91 mm
	W _{y,min}	-852,53	mm ³	in distance -11.09 mm
	W _{z,max}	2212,41	mm ³	in distance 20.50 mm
	W _{z,min}	-2212,41	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	17662,60	mm ⁴	in node 39
	W _{ω,M,min}	-17679,88	mm ⁴	in node 27
Torsional section modulus	W _t	98,13	mm ³	
Stability parameters	r _u	-2,75	mm	
	r _{M,v}	-44,71	mm	
Reduction factor	λ _M	0,00	1/mm	

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Querschnittseigenschaften der Montageschienen

Anhang B7

Tabelle B7: Querschnittseigenschaften der MÜPRO-Schienen MPR 41/21/2.0, Nicht gelochter Bereich

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	194,32	mm ²	
	A _{geom}	194,32	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	52,40	mm ²	
	A _z	50,80	mm ²	
Centroid position	y _{S,0}	20,50	mm	relative to zero point
	z _{S,0}	12,28	mm	
Moments of inertia	I _y	11250,15	mm ⁴	about centroidal axes y
	I _z	45720,51	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	56970,66	mm ⁴	
	I _{p,M}	132304,96	mm ⁴	about shear center M
Radii of gyration	i _y	7,61	mm	relative to centroid C
	i _z	15,34	mm	
Polar radii of gyration	i _p	17,12	mm	
	i _{p,M}	26,09	mm	about shear center M
Warping radius of gyration	i _{ω,M}	6,72	mm	
Cross-section weight	G	1,53	kg/m	
Cross-section perimeter	U	198,31	mm	incl. inner side of cells
Torsional constant	I _t	199,62	mm ⁴	calculated analytically
Secondary torsional constant	I _{t,s}	32577,93	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	31,97	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	19,69	mm	
Warping constants	I _{ω,S}	2,371E+07	mm ⁶	relative to centroid C
	I _{ω,M}	5,975E+06	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	1290,38	mm ³	in distance 8.70 mm
	W _{y,min}	-916,02	mm ³	in distance -12.30 mm
	W _{z,max}	2230,27	mm ³	in distance 20.50 mm
	W _{z,min}	-2230,27	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	17759,81	mm ⁴	in node 36
	W _{ω,M,min}	-17774,69	mm ⁴	in node 24
Torsional section modulus	W _t	99,81	mm ³	
Stability parameters	r _u	-8,83	mm	
	r _{M,v}	-48,21	mm	
Reduction factor	λ _M	0,00	1/mm	

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Querschnittseigenschaften der Montageschienen

Anhang B8

Tabelle B8: Querschnitteigenschaften der MÜPRO-Schienen MPR 41/21/2.0, Durchschnittlicher Querschnitt

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	183,10	mm ²	
	A _{geom}	183,10	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	43,86	mm ²	
	A _z	52,46	mm ²	
Centroid position	y _{S,0}	20,50	mm	relative to zero point
	z _{S,0}	11,81	mm	
Moments of inertia	I _y	10532,80	mm ⁴	about centroidal axes y
	I _z	45450,30	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	55983,10	mm ⁴	
	I _{p,M}	130945,54	mm ⁴	about shear center M
Radii of gyration	i _y	7,58	mm	relative to centroid C
	i _z	15,76	mm	
Polar radii of gyration	i _p	17,49	mm	
	i _{p,M}	26,74	mm	about shear center M
Warping radius of gyration	i _{ω,M}	6,73	mm	
Cross-section weight	G	1,44	kg/m	
Cross-section perimeter	U	199,63	mm	incl. inner side of cells
Torsional constant	I _t	167,92	mm ⁴	calculated analytically
Secondary torsional constant	I _{t,s}	32546,82	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	32,04	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	20,23	mm	
Warping constants	I _{ω,S}	2,456E+07	mm ⁶	relative to centroid C
	I _{ω,M}	5,936E+06	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	1145,89	mm ³	in distance 9.19 mm
	W _{y,min}	-891,99	mm ³	in distance -11.81 mm
	W _{z,max}	2217,09	mm ³	in distance 20.50 mm
	W _{z,min}	-2217,09	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	17689,06	mm ⁴	in node 37
	W _{ω,M,min}	-17704,92	mm ⁴	in node 25
Torsional section modulus	W _t	83,96	mm ³	
Stability parameters	r _u	-6,66	mm	
	r _{M,v}	-47,13	mm	
Reduction factor	λ _M	0,00	1/mm	

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Querschnitteigenschaften der Montageschienen

Anhang B9

Tabelle B9: Querschnittseigenschaften der MÜPRO-Schienen MPR 41/41/2.0, Lochbereich, Rundloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	240,32	mm ²	
	A _{geom}	240,32	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	44,26	mm ²	
	A _z	136,15	mm ²	
Centroid position	y _{S,0}	20,50	mm	relative to zero point
	z _{S,0}	20,39	mm	
Moments of inertia	I _y	49227,59	mm ⁴	about centroidal axes y
	I _z	75348,35	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	124575,94	mm ⁴	
	I _{p,M}	560274,16	mm ⁴	about shear center M
Radii of gyration	i _y	14,31	mm	relative to centroid C
	i _z	17,71	mm	
Polar radii of gyration	i _p	22,77	mm	
	i _{p,M}	48,28	mm	about shear center M
Warping radius of gyration	i _{ω,M}	7,41	mm	
Cross-section weight	G	1,89	kg/m	
Cross-section perimeter	U	248,31	mm	incl. inner side of cells
Torsional constant	I _t	302,92	mm ⁴	calculated analytically
Secondary torsional constant	I _{t,s}	78591,10	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	62,97	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	42,58	mm	
Warping constants	I _{ω,S}	1,675E+08	mm ⁶	relative to centroid C
	I _{ω,M}	3,078E+07	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	2388,89	mm ³	in distance 20.61 mm
	W _{y,min}	-2413,94	mm ³	in distance -20.39 mm
	W _{z,max}	3675,53	mm ³	in distance 20.50 mm
	W _{z,min}	-3675,53	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	41486,76	mm ⁴	in node 43
	W _{ω,M,min}	-41511,21	mm ⁴	in node 31
Torsional section modulus	W _t	151,46	mm ³	
Stability parameters	r _u	0,76	mm	
	r _{M,v}	-84,39	mm	
Reduction factor	λ _M	0,00	1/mm	

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Querschnittseigenschaften der Montageschienen

Anhang B10

Tabelle B10: Querschnittseigenschaften der MÜPRO-Schienen MPR 41/41/2.0, Lochbereich, Langloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	248,32	mm ²	
	A _{geom}	248,32	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	44,46	mm ²	
	A _z	135,16	mm ²	
Centroid position	y _{S,0}	20,50	mm	relative to zero point
	z _{S,0}	21,03	mm	
Moments of inertia	I _y	52206,58	mm ⁴	about centroidal axes y
	I _z	75801,01	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	128007,59	mm ⁴	
	I _{p,M}	562100,73	mm ⁴	about shear center M
Radii of gyration	i _y	14,50	mm	relative to centroid C
	i _z	17,47	mm	
Polar radii of gyration	i _p	22,70	mm	
	i _{p,M}	47,58	mm	about shear center M
Warping radius of gyration	i _{ω,M}	7,43	mm	
Cross-section weight	G	1,95	kg/m	
Cross-section perimeter	U	256,31	mm	incl. inner side of cells
Torsional constant	I _t	302,92	mm ⁴	calculated analytically
Secondary torsional constant	I _{t,s}	78504,84	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	62,84	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	41,81	mm	
Warping constants	I _{ω,S}	1,636E+08	mm ⁶	relative to centroid C
	I _{ω,M}	3,102E+07	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	2613,61	mm ³	in distance 19.97 mm
	W _{y,min}	-2483,06	mm ³	in distance -21.03 mm
	W _{z,max}	3697,61	mm ³	in distance 20.50 mm
	W _{z,min}	-3697,61	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	41715,30	mm ⁴	in node 38
	W _{ω,M,min}	-41738,90	mm ⁴	in node 26
Torsional section modulus	W _t	151,46	mm ³	
Stability parameters	r _u	-0,77	mm	
	r _{M,v}	-84,39	mm	
Reduction factor	λ _M	0,00	1/mm	

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Querschnittseigenschaften der Montageschienen

Anhang B11

Tabelle B11: Querschnittseigenschaften der MÜPRO-Schienen MPR 41/41/2.0, Lochbereich, Nicht gelochter Bereich

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	274,32	mm ²	
	A _{geom}	274,32	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	44,62	mm ²	
	A _z	129,72	mm ²	
Centroid position	y _{S,0}	20,50	mm	relative to zero point
	z _{S,0}	22,82	mm	
Moments of inertia	I _y	60688,80	mm ⁴	about centroidal axes y
	I _z	76167,18	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	136855,98	mm ⁴	
	I _{p,M}	573636,69	mm ⁴	about shear center M
Radii of gyration	i _y	14,87	mm	relative to centroid C
	i _z	16,66	mm	
Polar radii of gyration	i _p	22,34	mm	
	i _{p,M}	45,73	mm	about shear center M
Warping radius of gyration	i _{ω,M}	7,38	mm	
Cross-section weight	G	2,15	kg/m	
Cross-section perimeter	U	278,31	mm	incl. inner side of cells
Torsional constant	I _t	306,28	mm ⁴	calculated analytically
Secondary torsional constant	I _{t,s}	78421,05	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	62,73	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	39,90	mm	
Warping constants	I _{ω,S}	1,526E+08	mm ⁶	relative to centroid C
	I _{ω,M}	3,121E+07	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	3339,02	mm ³	in distance 18.18 mm
	W _{y,min}	-2658,95	mm ³	in distance -22.82 mm
	W _{z,max}	3715,47	mm ³	in distance 20.50 mm
	W _{z,min}	-3715,47	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	41898,91	mm ⁴	in node 36
	W _{ω,M,min}	-41920,23	mm ⁴	in node 24
Torsional section modulus	W _t	153,14	mm ³	
Stability parameters	r _u	-5,30	mm	
	r _{M,v}	-85,10	mm	
Reduction factor	λ _M	0,00	1/mm	

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Querschnittseigenschaften der Montageschienen

Anhang B12

Tabelle B12: Querschnittseigenschaften der MÜPRO-Schienen MPR 41/41/2.0, Lochbereich, Durchschnittlicher Querschnitt

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	263,10	mm ²	
	A _{geom}	263,10	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	38,83	mm ²	
	A _z	131,81	mm ²	
Centroid position	y _{s,0}	20,50	mm	relative to zero point
	z _{s,0}	22,09	mm	
Moments of inertia	I _y	57229,73	mm ⁴	about centroidal axes y
	I _z	75896,96	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	133126,69	mm ⁴	
	I _{p,M}	569291,22	mm ⁴	about shear center M
Radii of gyration	i _y	14,75	mm	relative to centroid C
	i _z	16,98	mm	
Polar radii of gyration	i _p	22,49	mm	
	i _{p,M}	46,52	mm	about shear center M
Warping radius of gyration	i _{ω,M}	7,39	mm	
Cross-section weight	G	2,07	kg/m	
Cross-section perimeter	U	279,63	mm	incl. inner side of cells
Torsional constant	I _t	274,58	mm ⁴	calculated analytically
Secondary torsional constant	I _{t,s}	78348,31	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	62,81	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	40,72	mm	
Warping constants	I _{ω,s}	1,570E+08	mm ⁶	relative to centroid C
	I _{ω,M}	3,107E+07	mm ⁶	about shear center M
Auxiliary value for warp rotation	Γ _{ω,M}	0,000		
Section moduli	W _{y,max}	3026,68	mm ³	in distance 18.91 mm
	W _{y,min}	-2590,57	mm ³	in distance -22.09 mm
	W _{z,max}	3702,29	mm ³	in distance 20.50 mm
	W _{z,min}	-3702,29	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	41764,32	mm ⁴	in node 39
	W _{ω,M,min}	-41786,58	mm ⁴	in node 27
Torsional section modulus	W _t	137,29	mm ³	
Stability parameters	r _u	-3,52	mm	
	r _{M,v}	-84,95	mm	
Reduction factor	λ _M	0,00	1/mm	

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Querschnittseigenschaften der Montageschienen

Anhang B13

Tabelle B13: Querschnittseigenschaften der MÜPRO-Schienen MPR 41/41/2.5, Lochbereich, Rundloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	294,51	mm ²	
	A _{geom}	294,51	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	54,98	mm ²	
	A _z	168,69	mm ²	
Centroid position	y _{S,0}	20,50	mm	relative to zero point
	z _{S,0}	20,50	mm	
Moments of inertia	I _y	58672,28	mm ⁴	about centroidal axes y
	I _z	90855,46	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	149527,74	mm ⁴	
	I _{p,M}	661360,94	mm ⁴	about shear center M
Radii of gyration	i _y	14,11	mm	relative to centroid C
	i _z	17,56	mm	
Polar radii of gyration	i _p	22,53	mm	
	i _{p,M}	47,39	mm	about shear center M
Warping radius of gyration	i _{ω,M}	7,19	mm	
Cross-section weight	G	2,31	kg/m	
Cross-section perimeter	U	245,49	mm	incl. inner side of cells
Torsional constant	I _t	581,57	mm ⁴	calculated analytically
Secondary torsional constant	I _{t,s}	92350,95	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	62,19	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	41,69	mm	
Warping constants	I _{ω,S}	1,923E+08	mm ⁶	relative to centroid C
	I _{ω,M}	3,421E+07	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	2861,86	mm ³	in distance 20.50 mm
	W _{y,min}	-2862,27	mm ³	in distance -20.50 mm
	W _{z,max}	4431,97	mm ³	in distance 20.50 mm
	W _{z,min}	-4431,97	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	48581,49	mm ⁴	in node 42
	W _{ω,M,min}	-48608,53	mm ⁴	in node 30
Torsional section modulus	W _t	232,63	mm ³	
Stability parameters	r _u	0,47	mm	
	r _{M,v}	-82,91	mm	
Reduction factor	λ _M	0,00	1/mm	

MÜPRO Schienen

Querschnittseigenschaften der Montageschienen

Anhang B14

Tabelle B14: Querschnittseigenschaften der MÜPRO-Schienen MPR 41/41/2.5, Lochbereich, Langloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	304,51	mm ²	
	A _{geom}	304,51	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	55,24	mm ²	
	A _z	167,40	mm ²	
Centroid position	y _{S,0}	20,50	mm	relative to zero point
	z _{S,0}	21,13	mm	
Moments of inertia	I _y	62261,90	mm ⁴	about centroidal axes y
	I _z	91421,29	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	153683,20	mm ⁴	
	I _{p,M}	663510,83	mm ⁴	about shear center M
Radii of gyration	i _y	14,30	mm	relative to centroid C
	i _z	17,33	mm	
Polar radii of gyration	i _p	22,47	mm	
	i _{p,M}	46,68	mm	about shear center M
Warping radius of gyration	i _{ω,M}	7,21	mm	
Cross-section weight	G	2,39	kg/m	
Cross-section perimeter	U	253,49	mm	incl. inner side of cells
Torsional constant	I _t	581,57	mm ⁴	calculated analytically
Secondary torsional constant	I _{t,s}	92249,79	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	62,05	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	40,92	mm	
Warping constants	I _{ω,S}	1,877E+08	mm ⁶	relative to centroid C
	I _{ω,M}	3,450E+07	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	3133,63	mm ³	in distance 19.87 mm
	W _{y,min}	-2946,46	mm ³	in distance -21.13 mm
	W _{z,max}	4459,58	mm ³	in distance 20.50 mm
	W _{z,min}	-4459,58	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	48867,65	mm ⁴	in node 40
	W _{ω,M,min}	-48893,74	mm ⁴	in node 28
Torsional section modulus	W _t	232,63	mm ³	
Stability parameters	r _u	-1,06	mm	
	r _{M,v}	-82,90	mm	
Reduction factor	λ _M	0,00	1/mm	

MÜPRO Schienen

Querschnittseigenschaften der Montageschienen

Anhang B15

Tabelle B15: Querschnittseigenschaften der MÜPRO-Schienen MPR 41/41/2.5, Nicht gelochter Bereich

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	337,01	mm ²	
	A _{geom}	337,01	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	55,45	mm ²	
	A _z	160,43	mm ²	
Centroid position	y _{s,0}	20,50	mm	relative to zero point
	z _{s,0}	22,93	mm	
Moments of inertia	I _y	72458,46	mm ⁴	about centroidal axes y
	I _z	91879,00	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	164337,46	mm ⁴	
	I _{p,M}	677255,43	mm ⁴	about shear center M
Radii of gyration	i _y	14,66	mm	relative to centroid C
	i _z	16,51	mm	
Polar radii of gyration	i _p	22,08	mm	
	i _{p,M}	44,83	mm	about shear center M
Warping radius of gyration	i _{ω,M}	7,16	mm	
Cross-section weight	G	2,65	kg/m	
Cross-section perimeter	U	274,49	mm	incl. inner side of cells
Torsional constant	I _t	589,77	mm ⁴	calculated analytically
Secondary torsional constant	I _{t,s}	92155,83	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	61,94	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	39,01	mm	
Warping constants	I _{ω,S}	1,747E+08	mm ⁶	relative to centroid C
	I _{ω,M}	3,473E+07	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	4009,30	mm ³	in distance 18.07 mm
	W _{y,min}	-3160,35	mm ³	in distance -22.93 mm
	W _{z,max}	4481,90	mm ³	in distance 20.50 mm
	W _{z,min}	-4481,90	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	49097,77	mm ⁴	in node 38
	W _{ω,M,min}	-49121,29	mm ⁴	in node 26
Torsional section modulus	W _t	235,91	mm ³	
Stability parameters	r _u	-5,59	mm	
	r _{M,v}	-83,61	mm	
Reduction factor	λ _M	0,00	1/mm	

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Querschnittseigenschaften der Montageschienen

Anhang B16

Tabelle B16: Querschnitseigenschaften der MÜPRO-Schienen MPR 41/41/2.5, Durchschnittlicher Querschnitt

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	322,90	mm ²	
	A _{geom}	322,90	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	48,12	mm ²	
	A _z	163,09	mm ²	
Centroid position	y _{S,0}	20,50	mm	relative to zero point
	z _{S,0}	22,19	mm	
Moments of inertia	I _y	68275,21	mm ⁴	about centroidal axes y
	I _z	91539,19	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	159814,40	mm ⁴	
	I _{p,M}	672055,17	mm ⁴	about shear center M
Radii of gyration	i _y	14,54	mm	relative to centroid C
	i _z	16,84	mm	
Polar radii of gyration	i _p	22,25	mm	
	i _{p,M}	45,62	mm	about shear center M
Warping radius of gyration	i _{ω,M}	7,17	mm	
Cross-section weight	G	2,53	kg/m	
Cross-section perimeter	U	276,15	mm	incl. inner side of cells
Torsional constant	I _t	527,62	mm ⁴	calculated analytically
Secondary torsional constant	I _{t,s}	92108,61	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	62,02	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	39,83	mm	
Warping constants	I _{ω,S}	1,799E+08	mm ⁶	relative to centroid C
	I _{ω,M}	3,456E+07	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	3630,10	mm ³	in distance 18.81 mm
	W _{y,min}	-3076,58	mm ³	in distance -22.19 mm
	W _{z,max}	4465,33	mm ³	in distance 20.50 mm
	W _{z,min}	-4465,33	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	48928,27	mm ⁴	in node 42
	W _{ω,M,min}	-48952,85	mm ⁴	in node 30
Torsional section modulus	W _t	211,05	mm ³	
Stability parameters	r _u	-3,80	mm	
	r _{M,v}	-83,46	mm	
Reduction factor	λ _M	0,00	1/mm	

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Querschnitseigenschaften der Montageschienen

Anhang B17

Tabelle B17: Querschnittseigenschaften der MÜPRO-Schienen MPR 41/62/2.5, Lochbereich, Rundloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	399,51	mm ²	
	A _{geom}	399,51	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	46,25	mm ²	
	A _z	269,34	mm ²	
Centroid position	y _{S,0}	20,50	mm	relative to zero point
	z _{S,0}	30,89	mm	
Moments of inertia	I _y	173330,48	mm ⁴	about centroidal axes y
	I _z	129819,21	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	303149,70	mm ⁴	
	I _{p,M}	1,894E+06	mm ⁴	about shear center M
Radii of gyration	i _y	20,83	mm	relative to centroid C
	i _z	18,03	mm	
Polar radii of gyration	i _p	27,55	mm	
	i _{p,M}	68,85	mm	about shear center M
Warping radius of gyration	i _{ω,M}	7,10	mm	
Cross-section weight	G	3,14	kg/m	
Cross-section perimeter	U	329,49	mm	incl. inner side of cells
Torsional constant	I _t	800,32	mm ⁴	calculated analytically
Secondary torsional constant	I _{t,s}	143682,79	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	93,99	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	63,10	mm	
Warping constants	I _{ω,S}	6,129E+08	mm ⁶	relative to centroid C
	I _{ω,M}	9,540E+07	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	5571,64	mm ³	in distance 31.11 mm
	W _{y,min}	-5611,11	mm ³	in distance -30.89 mm
	W _{z,max}	6332,64	mm ³	in distance 20.50 mm
	W _{z,min}	-6332,64	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	85117,90	mm ⁴	in node 40
	W _{ω,M,min}	-85150,41	mm ⁴	in node 28
Torsional section modulus	W _t	320,13	mm ³	
Stability parameters	r _u	0,67	mm	
	r _{M,v}	-125,52	mm	
Reduction factor	λ _M	0,00	1/mm	

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Querschnittseigenschaften der Montageschienen

Anhang B18

Tabelle B18: Querschnittseigenschaften der MÜPRO-Schienen MPR 41/62/2.5, Lochbereich, Langloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	409,51	mm ²	
	A _{geom}	409,51	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	46,45	mm ²	
	A _z	269,05	mm ²	
Centroid position	y _{s,0}	20,50	mm	relative to zero point
	z _{s,0}	31,62	mm	
Moments of inertia	I _y	182033,75	mm ⁴	about centroidal axes y
	I _z	130385,05	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	312418,79	mm ⁴	
	I _{p,M}	1,898E+06	mm ⁴	about shear center M
Radii of gyration	i _y	21,08	mm	relative to centroid C
	i _z	17,84	mm	
Polar radii of gyration	i _p	27,62	mm	
	i _{p,M}	68,08	mm	about shear center M
Warping radius of gyration	i _{ω,M}	7,11	mm	
Cross-section weight	G	3,21	kg/m	
Cross-section perimeter	U	337,49	mm	incl. inner side of cells
Torsional constant	I _t	800,32	mm ⁴	calculated analytically
Secondary torsional constant	I _{t,s}	143591,82	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	93,85	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	62,23	mm	
Warping constants	I _{ω,s}	6,015E+08	mm ⁶	relative to centroid C
	I _{ω,M}	9,602E+07	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	5991,89	mm ³	in distance 30.38 mm
	W _{y,min}	-5756,92	mm ³	in distance -31.62 mm
	W _{z,max}	6360,25	mm ³	in distance 20.50 mm
	W _{z,min}	-6360,25	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	85541,55	mm ⁴	in node 40
	W _{ω,M,min}	-85573,24	mm ⁴	in node 28
Torsional section modulus	W _t	320,13	mm ³	
Stability parameters	r _u	-0,51	mm	
	r _{M,v}	-124,96	mm	
Reduction factor	λ _M	0,00	1/mm	

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Querschnittseigenschaften der Montageschienen

Anhang B19

Tabelle B19: Querschnitteigenschaften der MÜPRO-Schienen MPR 41/62/2.5, Nicht gelochter Bereich

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	442,01	mm ²	
	A _{geom}	442,01	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	46,61	mm ²	
	A _z	264,05	mm ²	
Centroid position	y _{S,0}	20,50	mm	relative to zero point
	z _{S,0}	33,76	mm	
Moments of inertia	I _y	207600,37	mm ⁴	about centroidal axes y
	I _z	130842,75	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	338443,12	mm ⁴	
	I _{p,M}	1,928E+06	mm ⁴	about shear center M
Radii of gyration	i _y	21,67	mm	relative to centroid C
	i _z	17,21	mm	
Polar radii of gyration	i _p	27,67	mm	
	i _{p,M}	66,05	mm	about shear center M
Warping radius of gyration	i _{ω,M}	7,08	mm	
Cross-section weight	G	3,47	kg/m	
Cross-section perimeter	U	358,49	mm	incl. inner side of cells
Torsional constant	I _t	808,52	mm ⁴	calculated analytically
Secondary torsional constant	I _{t,s}	143522,71	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	93,73	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	59,97	mm	
Warping constants	I _{ω,S}	5,677E+08	mm ⁶	relative to centroid C
	I _{ω,M}	9,652E+07	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	7351,96	mm ³	in distance 28.24 mm
	W _{y,min}	-6148,83	mm ³	in distance -33.76 mm
	W _{z,max}	6382,57	mm ³	in distance 20.50 mm
	W _{z,min}	-6382,57	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	85883,25	mm ⁴	in node 38
	W _{ω,M,min}	-85912,59	mm ⁴	in node 26
Torsional section modulus	W _t	323,41	mm ³	
Stability parameters	r _u	-4,31	mm	
	r _{M,v}	-124,25	mm	
Reduction factor	λ _M	0,00	1/mm	

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Querschnitteigenschaften der Montageschienen

Anhang B20

Tabelle B20: Querschnittseigenschaften der MÜPRO-Schienen MPR 41/62/2.5, Durchschnittlicher Querschnitt

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	427,90	mm ²	
	A _{geom}	427,90	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	41,53	mm ²	
	A _z	266,24	mm ²	
Centroid position	y _{s,0}	20,50	mm	relative to zero point
	z _{s,0}	32,87	mm	
Moments of inertia	I _y	196969,22	mm ⁴	about centroidal axes y
	I _z	130502,94	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	327472,16	mm ⁴	
	I _{p,M}	1,917E+06	mm ⁴	about shear center M
Radii of gyration	i _y	21,45	mm	relative to centroid C
	i _z	17,46	mm	
Polar radii of gyration	i _p	27,66	mm	
	i _{p,M}	66,93	mm	about shear center M
Warping radius of gyration	i _{ω,M}	7,08	mm	
Cross-section weight	G	3,36	kg/m	
Cross-section perimeter	U	360,15	mm	incl. inner side of cells
Torsional constant	I _t	746,37	mm ⁴	calculated analytically
Secondary torsional constant	I _{t,s}	143465,26	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	93,82	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	60,94	mm	
Warping constants	I _{ω,S}	5,815E+08	mm ⁶	relative to centroid C
	I _{ω,M}	9,615E+07	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	6762,28	mm ³	in distance 29.13 mm
	W _{y,min}	-5991,94	mm ³	in distance -32.87 mm
	W _{z,max}	6366,00	mm ³	in distance 20.50 mm
	W _{z,min}	-6366,00	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	85631,07	mm ⁴	in node 40
	W _{ω,M,min}	-85661,39	mm ⁴	in node 28
Torsional section modulus	W _t	298,55	mm ³	
Stability parameters	r _u	-2,74	mm	
	r _{M,v}	-124,63	mm	
Reduction factor	λ _M	0,00	1/mm	

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Querschnittseigenschaften der Montageschienen

Anhang B21

Tabelle B21: Querschnitseigenschaften der MÜPRO-Schienen MPR 41/42/2.0 H, Lochbereich, Rundloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	320,65	mm ²	
	A _{geom}	320,65	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	103,94	mm ²	
	A _z	122,77	mm ²	
Centroid position	Y _{S,0}	20,50	mm	relative to zero point
	Z _{S,0}	21,00	mm	
Moments of inertia	I _y	51931,06	mm ⁴	about centroidal axes y
	I _z	89803,35	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	141734,42	mm ⁴	
	I _{p,M}	141734,42	mm ⁴	about shear center M
Radii of gyration	i _y	12,73	mm	relative to centroid C
	i _z	16,74	mm	
Polar radii of gyration	i _p	21,02	mm	
	i _{p,M}	21,02	mm	about shear center M
Warping radius of gyration	i _{ω,M}	13,88	mm	
Cross-section weight	G	2,52	kg/m	
Cross-section perimeter	U	302,62	mm	incl. inner side of cells
Torsional constant	I _t	916,96	mm ⁴	calculated analytically
Secondary torsional constant	I _{t,s}	64783,04	mm ⁴	
Location of the shear center	Y _{M,0}	20,50	mm	relative to zero point
	Z _{M,0}	21,00	mm	
	Y _M	0,00	mm	relative to centroid C
	Z _M	0,00	mm	
Warping constants	I _{ω,S}	2,732E+07	mm ⁶	relative to centroid C
	I _{ω,M}	2,732E+07	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	2472,91	mm ³	in distance 21.00 mm
	W _{y,min}	-2472,91	mm ³	in distance -21.00 mm
	W _{z,max}	4380,65	mm ³	in distance 20.50 mm
	W _{z,min}	-4380,65	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	54240,20	mm ⁴	in node 63
	W _{ω,M,min}	-54242,93	mm ⁴	in node 51
Torsional section modulus	W _t	272,00	mm ³	
Reduction factor	λ _M	0,00	1/mm	

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Querschnitseigenschaften der Montageschienen

Anhang B22

Tabelle B22: Querschnitteigenschaften der MÜPRO-Schienen MPR 41/42/2.0 H, Lochbereich, Rundloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	336,65	mm ²	
	A _{geom}	336,65	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	104,43	mm ²	
	A _z	122,78	mm ²	
Centroid position	y _{s,0}	20,50	mm	relative to zero point
	z _{s,0}	21,00	mm	
Moments of inertia	I _y	51952,39	mm ⁴	about centroidal axes y
	I _z	90708,69	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	142661,08	mm ⁴	
	I _{p,M}	142661,08	mm ⁴	about shear center M
Radii of gyration	i _y	12,42	mm	relative to centroid C
	i _z	16,41	mm	
Polar radii of gyration	i _p	20,59	mm	
	i _{p,M}	20,59	mm	about shear center M
Warping radius of gyration	i _{ω,M}	13,84	mm	
Cross-section weight	G	2,64	kg/m	
Cross-section perimeter	U	310,62	mm	incl. inner side of cells
Torsional constant	I _t	916,96	mm ⁴	calculated analytically
Secondary torsional constant	I _{t,s}	64781,66	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	21,00	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	0,00	mm	
Warping constants	I _{ω,s}	2,733E+07	mm ⁶	relative to centroid C
	I _{ω,M}	2,733E+07	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	2473,92	mm ³	in distance 21.00 mm
	W _{y,min}	-2473,92	mm ³	in distance -21.00 mm
	W _{z,max}	4424,81	mm ³	in distance 20.50 mm
	W _{z,min}	-4424,81	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	54241,68	mm ⁴	in node 61
	W _{ω,M,min}	-54244,28	mm ⁴	in node 85
Torsional section modulus	W _t	272,00	mm ³	
Stability parameters	r _u	-2,75	mm	
	r _{M,v}	-44,71	mm	
Reduction factor	λ _M	0,00	1/mm	

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Querschnitteigenschaften der Montageschienen

Anhang B23

Tabelle B23: Querschnittseigenschaften der MÜPRO-Schienen MPR 41/42/2.0 H, Nicht gelochter Bereich

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	388,65	mm ²	
	A _{geom}	388,65	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	104,80	mm ²	
	A _z	122,81	mm ²	
Centroid position	y _{s,0}	20,50	mm	relative to zero point
	z _{s,0}	21,00	mm	
Moments of inertia	I _y	52021,72	mm ⁴	about centroidal axes y
	I _z	91441,02	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	143462,74	mm ⁴	
	I _{p,M}	143462,74	mm ⁴	about shear center M
Radii of gyration	i _y	11,57	mm	relative to centroid C
	i _z	15,34	mm	
Polar radii of gyration	i _p	19,21	mm	
	i _{p,M}	19,21	mm	about shear center M
Warping radius of gyration	i _{ω,M}	13,80	mm	
Cross-section weight	G	3,05	kg/m	
Cross-section perimeter	U	328,62	mm	incl. inner side of cells
Torsional constant	I _t	923,68	mm ⁴	calculated analytically
Secondary torsional constant	I _{t,s}	64780,47	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	21,00	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	0,00	mm	
Warping constants	I _{ω,S}	2,733E+07	mm ⁶	relative to centroid C
	I _{ω,M}	2,733E+07	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	2477,23	mm ³	in distance 21.00 mm
	W _{y,min}	-2477,23	mm ³	in distance -21.00 mm
	W _{z,max}	4460,54	mm ³	in distance 20.50 mm
	W _{z,min}	-4460,54	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	54243,00	mm ⁴	in node 57
	W _{ω,M,min}	-54245,25	mm ⁴	in node 81
Torsional section modulus	W _t	272,00	mm ³	
Reduction factor	λ _M	0,00	1/mm	

MÜPRO Schienen

Querschnittseigenschaften der Montageschienen

Anhang B24

**Tabelle B24: Querschnittseigenschaften der MÜPRO-Schienen MPR 41/42/2.0 H,
Durchschnittlicher Querschnitt**

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	366,21	mm ²	
	A _{geom}	366,21	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	87,71	mm ²	
	A _z	122,76	mm ²	
Centroid position	y _{S,0}	20,50	mm	relative to zero point
	z _{S,0}	21,00	mm	
Moments of inertia	I _y	51983,44	mm ⁴	about centroidal axes y
	I _z	90900,59	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	142884,03	mm ⁴	
	I _{p,M}	142884,03	mm ⁴	about shear center M
Radii of gyration	i _y	11,91	mm	relative to centroid C
	i _z	15,76	mm	
Polar radii of gyration	i _p	19,75	mm	
	i _{p,M}	19,75	mm	about shear center M
Warping radius of gyration	i _{ω,M}	13,84	mm	
Cross-section weight	G	2,87	kg/m	
Cross-section perimeter	U	365,26	mm	incl. inner side of cells
Torsional constant	I _t	763,33	mm ⁴	calculated analytically
Secondary torsional constant	I _{t,s}	64858,03	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	21,00	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	0,00	mm	
Warping constants	I _{ω,S}	2,738E+07	mm ⁶	relative to centroid C
	I _{ω,M}	2,738E+07	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	2475,40	mm ³	in distance 21.00 mm
	W _{y,min}	-2475,40	mm ³	in distance -21.00 mm
	W _{z,max}	4434,18	mm ³	in distance 20.50 mm
	W _{z,min}	-4434,18	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	54313,00	mm ⁴	in node 63
	W _{ω,M,min}	-54315,45	mm ⁴	in node 87
Torsional section modulus	W _t	182,24	mm ³	
Stability parameters	r _u	-6,66	mm	
	r _{M,v}	-47,13	mm	
Reduction factor	λ _M	0,00	1/mm	

MÜPRO Schienen

Querschnittseigenschaften der Montageschienen

Anhang B25

Tabelle B25: Querschnittseigenschaften der MÜPRO-Schienen MPR 41/82/2.0 H, Lochbereich, Rundloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	480,65	mm ²	
	A _{geom}	480,65	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	88,51	mm ²	
	A _z	272,10	mm ²	
Centroid position	y _{S,0}	20,50	mm	relative to zero point
	z _{S,0}	41,00	mm	
Moments of inertia	I _y	302445,57	mm ⁴	about centroidal axes y
	I _z	150696,69	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	453142,26	mm ⁴	
	I _{p,M}	453142,26	mm ⁴	about shear center M
Radii of gyration	i _y	25,08	mm	relative to centroid C
	i _z	17,71	mm	
Polar radii of gyration	i _p	30,70	mm	
	i _{p,M}	30,70	mm	about shear center M
Warping radius of gyration	i _{ω,M}	18,04	mm	
Cross-section weight	G	3,77	kg/m	
Cross-section perimeter	U	462,62	mm	incl. inner side of cells
Cross-section outer perimeter	U _o	462,62		
Cross-section inner perimeter	U _i	0,00		
Torsional constant	J	1130,29	mm ⁴	calculated analytically
Torsional constant St. Ven.	J _{St.Ven.}	616,51		
Torsional constant, Bredt portion.	J _{Bredt}	513,78		
Secondary torsional constant	I _{t,s}	136202,24	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	41,00	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	0,00	mm	
Warping constants	I _{ω,S}	1,474E+08	mm ⁶	relative to centroid C
	I _{ω,M}	1,474E+08	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	7376,72	mm ³	in distance 41.00 mm
	W _{y,min}	-7376,72	mm ³	in distance -41.00 mm
	W _{z,max}	7351,06	mm ³	in distance 20.50 mm
	W _{z,min}	-7351,06	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	141870,08	mm ⁴	in node 70
	W _{ω,M,min}	-1,419E+05	mm ⁴	in node 58
Torsional section modulus	W _t	272,00	mm ³	
Reduction factor	λ _M	0,00	1/mm	

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Querschnittseigenschaften der Montageschienen

Anhang B26

Tabelle B26: Querschnitteigenschaften der MÜPRO-Schienen MPR 41/82/2.0 H, Lochbereich, Langloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	496,65	mm ²	
	A _{geom}	496,65	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	88,92	mm ²	
	A _z	272,11	mm ²	
Centroid position	Y _{S,0}	20,50	mm	relative to zero point
	Z _{S,0}	41,00	mm	
Moments of inertia	I _y	302466,90	mm ⁴	about centroidal axes y
	I _z	151602,03	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	454068,93	mm ⁴	
	I _{p,M}	454068,93	mm ⁴	about shear center M
Radii of gyration	i _y	24,68	mm	relative to centroid C
	i _z	17,47	mm	
Polar radii of gyration	i _p	30,24	mm	
	i _{p,M}	30,24	mm	about shear center M
Warping radius of gyration	i _{ω,M}	18,02	mm	
Cross-section weight	G	3,90	kg/m	
Cross-section perimeter	U	470,62	mm	incl. inner side of cells
Cross-section outer perimeter	U _o	470,62		
Cross-section inner perimeter	U _i	0,00		
Torsional constant	J	1130,29	mm ⁴	calculated analytically
Torsional constant St. Ven.	J _{St.Ven.}	616,51		
Torsional constant, Bredt portion.	J _{Bredt}	513,78		
Secondary torsional constant	I _{t,s}	136201,54	mm ⁴	
Location of the shear center	Y _{M,0}	20,50	mm	relative to zero point
	Z _{M,0}	41,00	mm	
	Y _M	0,00	mm	relative to centroid C
	Z _M	0,00	mm	
Warping constants	I _{ω,S}	1,474E+08	mm ⁶	relative to centroid C
	I _{ω,M}	1,474E+08	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	7377,24	mm ³	in distance 41.00 mm
	W _{y,min}	-7377,24	mm ³	in distance -41.00 mm
	W _{z,max}	7395,22	mm ³	in distance 20.50 mm
	W _{z,min}	-7395,22	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	141870,81	mm ⁴	in node 60
	W _{ω,M,min}	-1,419E+05	mm ⁴	in node 48
Torsional section modulus	W _t	272,00	mm ³	
Reduction factor	λ _M	0,00	1/mm	

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Querschnitteigenschaften der Montageschienen

Anhang B27

Tabelle B27: Querschnittseigenschaften der MÜPRO-Schienen MPR 41/82/2.0 H, Nicht gelochter Bereich

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	548,65	mm ²	
	A _{geom}	548,65	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	89,24	mm ²	
	A _z	272,12	mm ²	
Centroid position	y _{s,0}	20,50	mm	relative to zero point
	z _{s,0}	41,00	mm	
Moments of inertia	I _y	302536,24	mm ⁴	about centroidal axes y
	I _z	152334,36	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	454870,59	mm ⁴	
	I _{p,M}	454870,59	mm ⁴	about shear center M
Radii of gyration	i _y	23,48	mm	relative to centroid C
	i _z	16,66	mm	
Polar radii of gyration	i _p	28,79	mm	
	i _{p,M}	28,79	mm	about shear center M
Warping radius of gyration	i _{ω,M}	18,00	mm	
Cross-section weight	G	4,31	kg/m	
Cross-section perimeter	U	488,62	mm	incl. inner side of cells
Cross-section outer perimeter	U _o	488,62		
Cross-section inner perimeter	U _i	0,00		
Torsional constant	J	1137,01	mm ⁴	calculated analytically
Torsional constant St. Ven.	J _{St.Ven.}	623,23		
Torsional constant, Bredt portion.	J _{Bredt}	513,78		
Secondary torsional constant	I _{t,s}	136200,95	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	41,00	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	0,00	mm	
Warping constants	I _{ω,s}	1,474E+08	mm ⁶	relative to centroid C
	I _{ω,M}	1,474E+08	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	7378,93	mm ³	in distance 41.00 mm
	W _{y,min}	-7378,93	mm ³	in distance -41.00 mm
	W _{z,max}	7430,94	mm ³	in distance 20.50 mm
	W _{z,min}	-7430,94	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	141871,47	mm ⁴	in node 56
	W _{ω,M,min}	-1,419E+05	mm ⁴	in node 44
Torsional section modulus	W _t	272,00	mm ³	
Reduction factor	λ _M	0,00	1/mm	

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Querschnittseigenschaften der Montageschienen

Anhang B28

Tabelle B28: Querschnitteigenschaften der MÜPRO-Schienen MPR 41/82/2.0 H, Durchschnittlicher Querschnitt

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	526,21	mm ²	
	A _{geom}	526,21	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	77,66	mm ²	
	A _z	272,10	mm ²	
Centroid position	y _{s,0}	20,50	mm	relative to zero point
	z _{s,0}	41,00	mm	
Moments of inertia	I _y	302498,02	mm ⁴	about centroidal axes y
	I _z	151793,93	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	454291,95	mm ⁴	
	I _{p,M}	454291,95	mm ⁴	about shear center M
Radii of gyration	i _y	23,98	mm	relative to centroid C
	i _z	16,98	mm	
Polar radii of gyration	i _p	29,38	mm	
	i _{p,M}	29,38	mm	about shear center M
Warping radius of gyration	i _{ω,M}	18,03	mm	
Cross-section weight	G	4,13	kg/m	
Cross-section perimeter	U	525,26	mm	incl. inner side of cells
Cross-section outer perimeter	U _o	489,94		
Cross-section inner perimeter	U _i	35,32		
Torsional constant	J	976,66	mm ⁴	calculated analytically
Torsional constant St. Ven.	J _{St.Ven.}	559,83		
Torsional constant, Bredt portion.	J _{Bredt}	416,83		
Secondary torsional constant	I _{t,s}	136278,41	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	41,00	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	0,00	mm	
Warping constants	I _{ω,s}	1,476E+08	mm ⁶	relative to centroid C
	I _{ω,M}	1,476E+08	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	7378,00	mm ³	in distance 41.00 mm
	W _{y,min}	-7378,00	mm ³	in distance -41.00 mm
	W _{z,max}	7404,58	mm ³	in distance 20.50 mm
	W _{z,min}	-7404,58	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	141969,27	mm ⁴	in node 62
	W _{ω,M,min}	-1,420E+05	mm ⁴	in node 50
Torsional section modulus	W _t	182,24	mm ³	
Reduction factor	λ _M	0,00	1/mm	

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Querschnitteigenschaften der Montageschienen

Anhang B29

Tabelle B29: Querschnittseigenschaften der MÜPRO-Schienen MPR 41/82/2.5 H, Lochbereich, Rundloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	589,03	mm ²	
	A _{geom}	589,03	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	109,97	mm ²	
	A _z	340,00	mm ²	
Centroid position	y _{s,0}	20,50	mm	relative to zero point
	z _{s,0}	41,00	mm	
Moments of inertia	I _y	364791,97	mm ⁴	about centroidal axes y
	I _z	181710,92	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	546502,89	mm ⁴	
	I _{p,M}	546502,89	mm ⁴	about shear center M
Radii of gyration	i _y	24,89	mm	relative to centroid C
	i _z	17,56	mm	
Polar radii of gyration	i _p	30,46	mm	
	i _{p,M}	30,46	mm	about shear center M
Warping radius of gyration	i _{ω,M}	17,59	mm	
Cross-section weight	G	4,62	kg/m	
Cross-section perimeter	U	456,99	mm	incl. inner side of cells
Cross-section outer perimeter	U _o	456,99		
Cross-section inner perimeter	U _i	0,00		
Torsional constant	J	2178,91	mm ⁴	calculated analytically
Torsional constant St. Ven.	J _{St.Ven.}	1189,18		
Torsional constant, Bredt portion.	J _{Bredt}	989,73		
Secondary torsional constant	I _{t,s}	161880,90	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	41,00	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	0,00	mm	
Warping constants	I _{ω,s}	1,691E+08	mm ⁶	relative to centroid C
	I _{ω,M}	1,691E+08	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	8897,36	mm ³	in distance 41.00 mm
	W _{y,min}	-8897,36	mm ³	in distance -41.00 mm
	W _{z,max}	8863,95	mm ³	in distance 20.50 mm
	W _{z,min}	-8863,95	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	168325,35	mm ⁴	in node 78
	W _{ω,M,min}	-1,683E+05	mm ⁴	in node 90
Torsional section modulus	W _t	425,00	mm ³	
Reduction factor	λ _M	0,00	1/mm	

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Querschnittseigenschaften der Montageschienen

Anhang B30

Tabelle B30: Querschnittseigenschaften der MÜPRO-Schienen MPR 41/82/2.5 H, Lochbereich, Langloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	609,03	mm ²	
	A _{geom}	609,03	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	110,49	mm ²	
	A _z	340,01	mm ²	
Centroid position	y _{S,0}	20,50	mm	relative to zero point
	z _{S,0}	41,00	mm	
Moments of inertia	I _y	364833,54	mm ⁴	about centroidal axes y
	I _z	182842,59	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	547676,13	mm ⁴	
	I _{p,M}	547676,13	mm ⁴	about shear center M
Radii of gyration	i _y	24,48	mm	relative to centroid C
	i _z	17,33	mm	
Polar radii of gyration	i _p	29,99	mm	
	i _{p,M}	29,99	mm	about shear center M
Warping radius of gyration	i _{ω,M}	17,57	mm	
Cross-section weight	G	4,78	kg/m	
Cross-section perimeter	U	464,99	mm	incl. inner side of cells
Cross-section outer perimeter	U _o	464,99		
Cross-section inner perimeter	U _i	0,00		
Torsional constant	J	2178,90	mm ⁴	calculated analytically
Torsional constant St. Ven.	J _{St.Ven.}	1189,17		
Torsional constant, Bredt portion.	J _{Bredt}	989,72		
Secondary torsional constant	I _{t,s}	161879,53	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	41,00	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	0,00	mm	
Warping constants	I _{ω,S}	1,691E+08	mm ⁶	relative to centroid C
	I _{ω,M}	1,691E+08	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	8898,38	mm ³	in distance 41.00 mm
	W _{y,min}	-8898,38	mm ³	in distance -41.00 mm
	W _{z,max}	8919,15	mm ³	in distance 20.50 mm
	W _{z,min}	-8919,15	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	168326,70	mm ⁴	in node 76
	W _{ω,M,min}	-1,683E+05	mm ⁴	in node 88
Torsional section modulus	W _t	425,00	mm ³	
Reduction factor	λ _M	0,00	1/mm	

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Querschnittseigenschaften der Montageschienen

Anhang B31

Tabelle B31: Querschnittseigenschaften der MÜPRO-Schienen MPR 41/82/2.5 H, Nicht gelochter Bereich

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	674,03	mm ²	
	A _{geom}	674,03	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	110,90	mm ²	
	A _z	340,03	mm ²	
Centroid position	y _{S,0}	20,50	mm	relative to zero point
	z _{S,0}	41,00	mm	
Moments of inertia	I _y	364968,96	mm ⁴	about centroidal axes y
	I _z	183758,00	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	548726,97	mm ⁴	
	I _{p,M}	548726,97	mm ⁴	about shear center M
Radii of gyration	i _y	23,27	mm	relative to centroid C
	i _z	16,51	mm	
Polar radii of gyration	i _p	28,53	mm	
	i _{p,M}	28,53	mm	about shear center M
Warping radius of gyration	i _{ω,M}	17,56	mm	
Cross-section weight	G	5,29	kg/m	
Cross-section perimeter	U	480,99	mm	incl. inner side of cells
Cross-section outer perimeter	U _o	480,99		
Cross-section inner perimeter	U _i	0,00		
Torsional constant	J	2195,30	mm ⁴	calculated analytically
Torsional constant St. Ven.	J _{St.Ven.}	1205,58		
Torsional constant, Bredt portion.	J _{Bredt}	989,72		
Secondary torsional constant	I _{t,s}	161878,41	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	41,00	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	0,00	mm	
Warping constants	I _{ω,S}	1,691E+08	mm ⁶	relative to centroid C
	I _{ω,M}	1,691E+08	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	8901,68	mm ³	in distance 41.00 mm
	W _{y,min}	-8901,68	mm ³	in distance -41.00 mm
	W _{z,max}	8963,81	mm ³	in distance 20.50 mm
	W _{z,min}	-8963,80	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	168327,91	mm ⁴	in node 68
	W _{ω,M,min}	-1,683E+05	mm ⁴	in node 84
Torsional section modulus	W _t	425,00	mm ³	
Reduction factor	λ _M	0,00	1/mm	

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Querschnittseigenschaften der Montageschienen

Anhang B32

Tabelle B32: Querschnittseigenschaften der MÜPRO-Schienen MPR 41/82/2.5 H, Durchschnittlicher Querschnitt

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	645,81	mm ²	
	A _{geom}	645,81	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	96,23	mm ²	
	A _z	339,99	mm ²	
Centroid position	y _{S,0}	20,50	mm	relative to zero point
	z _{S,0}	41,00	mm	
Moments of inertia	I _y	364893,88	mm ⁴	about centroidal axes y
	I _z	183078,37	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	547972,26	mm ⁴	
	I _{p,M}	547972,26	mm ⁴	about shear center M
Radii of gyration	i _y	23,77	mm	relative to centroid C
	i _z	16,84	mm	
Polar radii of gyration	i _p	29,13	mm	
	i _{p,M}	29,13	mm	about shear center M
Warping radius of gyration	i _{ω,M}	17,58	mm	
Cross-section weight	G	5,07	kg/m	
Cross-section perimeter	U	518,31	mm	incl. inner side of cells
Cross-section outer perimeter	U _o	482,65		
Cross-section inner perimeter	U _i	35,66		
Torsional constant	J	1884,96	mm ⁴	calculated analytically
Torsional constant St. Ven.	J _{St.Ven.}	1081,28		
Torsional constant, Bredt portion.	J _{Bredt}	803,69		
Secondary torsional constant	I _{t,s}	162026,91	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	41,00	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	0,00	mm	
Warping constants	I _{ω,s}	1,694E+08	mm ⁶	relative to centroid C
	I _{ω,M}	1,694E+08	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	8899,85	mm ³	in distance 41.00 mm
	W _{y,min}	-8899,85	mm ³	in distance -41.00 mm
	W _{z,max}	8930,65	mm ³	in distance 20.50 mm
	W _{z,min}	-8930,65	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	168513,19	mm ⁴	in node 79
	W _{ω,M,min}	-1,685E+05	mm ⁴	in node 90
Torsional section modulus	W _t	283,90	mm ³	
Reduction factor	λ _M	0,00	1/mm	

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Querschnittseigenschaften der Montageschienen

Anhang B33

Tabelle B33: Querschnittseigenschaften der MÜPRO-Schienen MPR 41/124/2.5 H, Lochbereich, Rundloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	799,03	mm ²	
	A _{geom}	799,03	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	92,50	mm ²	
	A _z	528,27	mm ²	
Centroid position	y _{s,0}	20,50	mm	relative to zero point
	z _{s,0}	62,00	mm	
Moments of inertia	I _y	1,120E+06	mm ⁴	about centroidal axes y
	I _z	259638,43	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	1,379E+06	mm ⁴	
	I _{p,M}	1,379E+06	mm ⁴	about shear center M
Radii of gyration	i _y	37,43	mm	relative to centroid C
	i _z	18,03	mm	
Polar radii of gyration	i _p	41,55	mm	
	i _{p,M}	41,55	mm	about shear center M
Warping radius of gyration	i _{ω,M}	18,97	mm	
Cross-section weight	G	6,27	kg/m	
Cross-section perimeter	U	624,99	mm	incl. inner side of cells
Cross-section outer perimeter	U _o	624,99		
Cross-section inner perimeter	U _i	0,00		
Torsional constant	J	2616,40	mm ⁴	calculated analytically
Torsional constant St. Ven.	J _{St.Ven.}	1626,68		
Torsional constant, Bredt portion.	J _{Bredt}	989,72		
Secondary torsional constant	I _{t,s}	241187,79	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	62,00	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	0,00	mm	
Warping constants	I _{ω,s}	4,962E+08	mm ⁶	relative to centroid C
	I _{ω,M}	4,962E+08	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	18059,12	mm ³	in distance 62.00 mm
	W _{y,min}	-18059,12	mm ³	in distance -62.00 mm
	W _{z,max}	12665,29	mm ³	in distance 20.50 mm
	W _{z,min}	-12665,29	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	319229,22	mm ⁴	in node 76
	W _{ω,M,min}	-3,192E+05	mm ⁴	in node 88
Torsional section modulus	W _t	425,00	mm ³	
Reduction factor	λ _M	0,00	1/mm	

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Querschnittseigenschaften der Montageschienen

Anhang B34

Tabelle B34: Querschnittseigenschaften der MÜPRO-Schienen MPR 41/124/2.5 H, Lochbereich, Langloch

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	819,03	mm ²	
	A _{geom}	819,03	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	92,90	mm ²	
	A _z	528,27	mm ²	
Centroid position	y _{S,0}	20,50	mm	relative to zero point
	z _{S,0}	62,00	mm	
Moments of inertia	I _y	1,120E+06	mm ⁴	about centroidal axes y
	I _z	260770,10	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	1,380E+06	mm ⁴	
	I _{p,M}	1,380E+06	mm ⁴	about shear center M
Radii of gyration	i _y	36,97	mm	relative to centroid C
	i _z	17,84	mm	
Polar radii of gyration	i _p	41,05	mm	
	i _{p,M}	41,05	mm	about shear center M
Warping radius of gyration	i _{ω,M}	18,96	mm	
Cross-section weight	G	6,43	kg/m	
Cross-section perimeter	U	632,99	mm	incl. inner side of cells
Cross-section outer perimeter	U _o	632,99		
Cross-section inner perimeter	U _i	0,00		
Torsional constant	J	2616,40	mm ⁴	calculated analytically
Torsional constant St. Ven.	J _{St.Ven.}	1626,67		
Torsional constant, Bredt portion.	J _{Bredt}	989,72		
Secondary torsional constant	I _{t,s}	241187,06	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	62,00	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	0,00	mm	
Warping constants	I _{ω,S}	4,962E+08	mm ⁶	relative to centroid C
	I _{ω,M}	4,962E+08	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	18059,79	mm ³	in distance 62.00 mm
	W _{y,min}	-18059,79	mm ³	in distance -62.00 mm
	W _{z,max}	12720,49	mm ³	in distance 20.50 mm
	W _{z,min}	-12720,49	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	319230,10	mm ⁴	in node 76
	W _{ω,M,min}	-3,192E+05	mm ⁴	in node 88
Torsional section modulus	W _t	425,00	mm ³	
Reduction factor	λ _M	0,00	1/mm	

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Querschnittseigenschaften der Montageschienen

Anhang B35

Tabelle B35: Querschnittseigenschaften der MÜPRO-Schienen MPR 41/124/2.5 H, Nicht gelochter Bereich

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	884,03	mm ²	
	A _{geom}	884,03	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	93,21	mm ²	
	A _z	528,28	mm ²	
Centroid position	Y _{s,0}	20,50	mm	relative to zero point
	Z _{s,0}	62,00	mm	
Moments of inertia	I _y	1,120E+06	mm ⁴	about centroidal axes y
	I _z	261685,51	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	1,382E+06	mm ⁴	
	I _{p,M}	1,382E+06	mm ⁴	about shear center M
Radii of gyration	i _y	35,59	mm	relative to centroid C
	i _z	17,21	mm	
Polar radii of gyration	i _p	39,53	mm	
	i _{p,M}	39,53	mm	about shear center M
Warping radius of gyration	i _{ω,M}	18,95	mm	
Cross-section weight	G	6,94	kg/m	
Cross-section perimeter	U	648,99	mm	incl. inner side of cells
Cross-section outer perimeter	U _o	648,99		
Cross-section inner perimeter	U _i	0,00		
Torsional constant	J	2632,80	mm ⁴	calculated analytically
Torsional constant St. Ven.	J _{St.Ven.}	1643,08		
Torsional constant, Bredt portion.	J _{Bredt}	989,72		
Secondary torsional constant	I _{t,s}	241186,46	mm ⁴	
Location of the shear center	Y _{M,0}	20,50	mm	relative to zero point
	Z _{M,0}	62,00	mm	
	Y _M	0,00	mm	relative to centroid C
	Z _M	0,00	mm	
Warping constants	I _{ω,S}	4,962E+08	mm ⁶	relative to centroid C
	I _{ω,M}	4,962E+08	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	18061,97	mm ³	in distance 62.00 mm
	W _{y,min}	-18061,97	mm ³	in distance -62.00 mm
	W _{z,max}	12765,15	mm ³	in distance 20.50 mm
	W _{z,min}	-12765,15	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	319230,89	mm ⁴	in node 69
	W _{ω,M,min}	-3,192E+05	mm ⁴	in node 85
Torsional section modulus	W _t	425,00	mm ³	
Reduction factor	λ _M	0,00	1/mm	

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Querschnittseigenschaften der Montageschienen

Anhang B36

Tabelle B36: Querschnittseigenschaften der MÜPRO-Schienen MPR 41/124/2.5 H, Durchschnittlicher Querschnitt

Description	Symbol	Value	Unit	Comment
Cross-sectional area	A	855,81	mm ²	
	A _{geom}	855,81	mm ²	geometric cross-sectional area (not ideal)
Shear areas	A _y	83,06	mm ²	
	A _z	528,26	mm ²	
Centroid position	y _{S,0}	20,50	mm	relative to zero point
	z _{S,0}	62,00	mm	
Moments of inertia	I _y	1,120E+06	mm ⁴	about centroidal axes y
	I _z	261005,88	mm ⁴	
Inclination of principal axes	α	0,00	°	clockwise
Polar moments of inertia	I _p	1,381E+06	mm ⁴	
	I _{p,M}	1,381E+06	mm ⁴	about shear center M
Radii of gyration	i _y	36,17	mm	relative to centroid C
	i _z	17,46	mm	
Polar radii of gyration	i _p	40,17	mm	
	i _{p,M}	40,17	mm	about shear center M
Warping radius of gyration	i _{ω,M}	18,97	mm	
Cross-section weight	G	6,72	kg/m	
Cross-section perimeter	U	686,31	mm	incl. inner side of cells
Cross-section outer perimeter	U _o	650,65		
Cross-section inner perimeter	U _i	35,66		
Torsional constant	J	2322,46	mm ⁴	calculated analytically
Torsional constant St. Ven.	J _{St.Ven.}	1518,78		
Torsional constant, Bredt portion.	J _{Bredt}	803,69		
Secondary torsional constant	I _{t,s}	241335,40	mm ⁴	
Location of the shear center	y _{M,0}	20,50	mm	relative to zero point
	z _{M,0}	62,00	mm	
	y _M	0,00	mm	relative to centroid C
	z _M	0,00	mm	
Warping constants	I _{ω,S}	4,968E+08	mm ⁶	relative to centroid C
	I _{ω,M}	4,968E+08	mm ⁶	about shear center M
Auxiliary value for warp rotation	r _{ω,M}	0,000		
Section moduli	W _{y,max}	18060,76	mm ³	in distance 62.00 mm
	W _{y,min}	-18060,76	mm ³	in distance -62.00 mm
	W _{z,max}	12731,99	mm ³	in distance 20.50 mm
	W _{z,min}	-12731,99	mm ³	in distance -20.50 mm
Warping section moduli	W _{ω,M,max}	319477,47	mm ⁴	in node 76
	W _{ω,M,min}	-3,195E+05	mm ⁴	in node 88
Torsional section modulus	W _t	283,90	mm ³	
Reduction factor	λ _M	0,00	1/mm	

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Querschnittseigenschaften der Montageschienen

Anhang B37