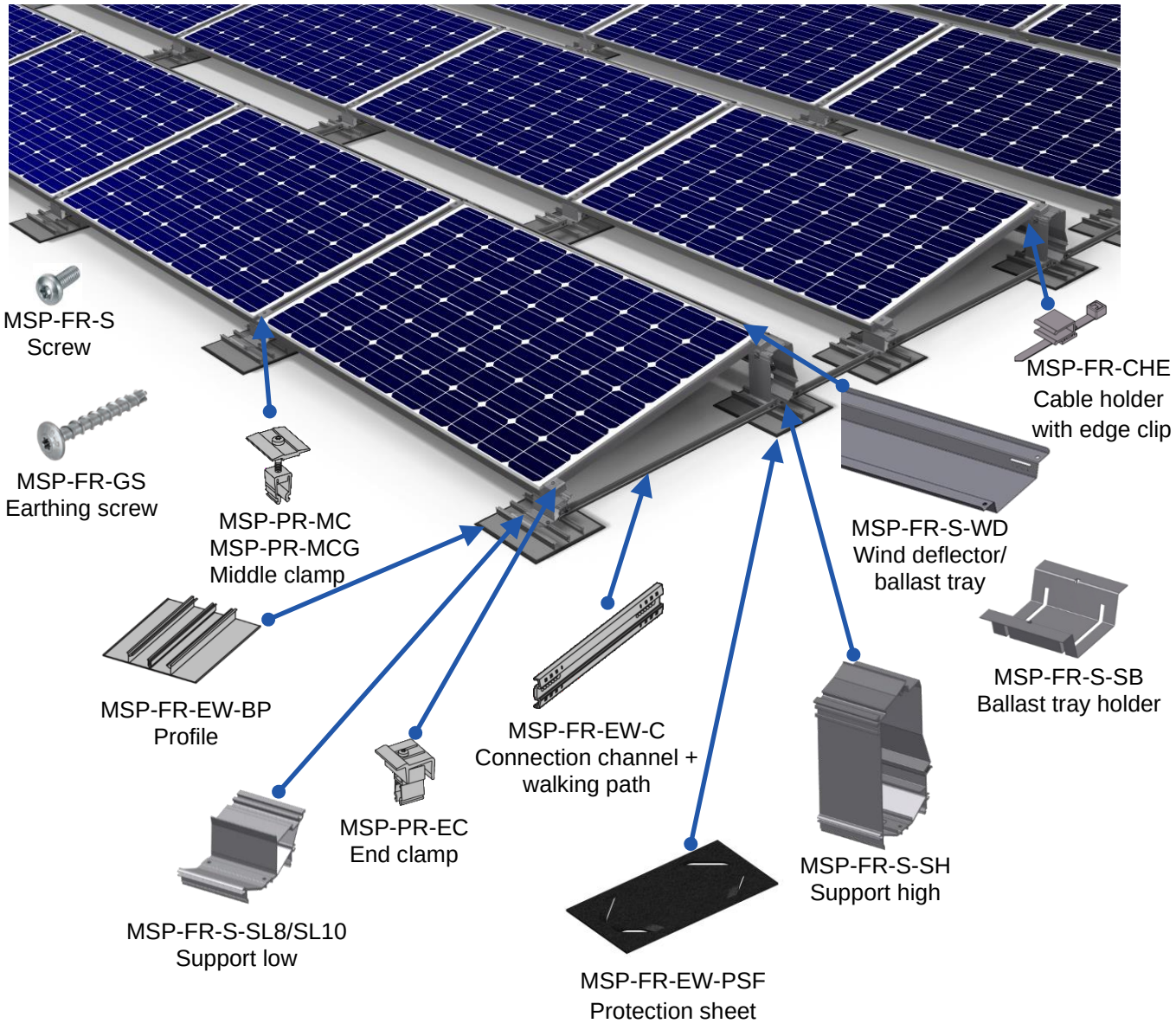
Solar Systems of Schweizer:
Technical data - MSP-FR-S
PV Mounting System Flat Roof South



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Solar Energy Systems of Schweizer:
Technical data – PV mounting system flat roof south

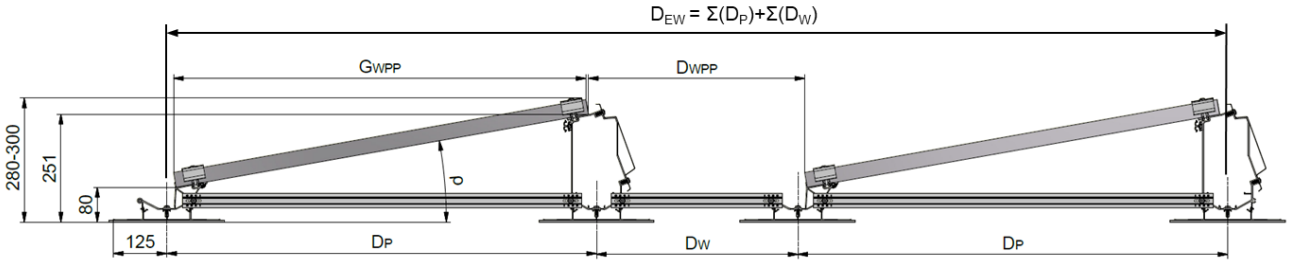
1 Roof requirements

Pitch	≤3.0°
Unevenness	≤+2,5°, ≤-2,5°, ≤±1,25°
Sealing membrances materials	TPO/FPO, PVC, EVA, ASA, PVC-P, ECB, PIB, Beton, Bitumen
Friction coefficient	0,3 bis 0,8 (Standard values in SPT, determine object-related for other material components)
Insulation material	EPS/XPS, Mineral woll, PUR, PIR, foam glass
Long-term pressure resistance	≥ ca. 10 kN/m² (depending on boudary conditions)

2 Systeme properties

Max. block size	14,0 m x 14,0 m
Min. block size, stand alone	No general restriction (wind load dependent)
System hight	280 – 300 mm
Ground clearance	80 mm
Min. edge distance	1500 mm (Standard), 500 mm with increased wind power coefficients
Inclination angle of the module	8° – 10° (depending on module with)
Panel width	950 mm – 1335 mm
Panel length	1620 mm – 1814 mm
Panel highgt	28 mm – 45 mm
Ballast stone width	100 mm
Ballast stone length	200 mm
Ballast stone hight	40 mm – 80 mm

2.1 System geometry, dimensions in north-south direction



Dimension walking path

Article	Scale	D_W	D_{WPP}	Ahading angel	Scala
MSP-FR-C 300-360	15	301 mm	336 mm	26°	15
MSP-FR-C 470-530	15	471 mm	506 mm	18°	15
MSP-FR-C 950-1010	15	1006 mm	1041 mm	9°	15

Solar Energy Systems of Schweizer:
Technical data – PV mounting system flat roof south

Dimension gable, scale setting connecting channel
Tilt angle nominal 10°

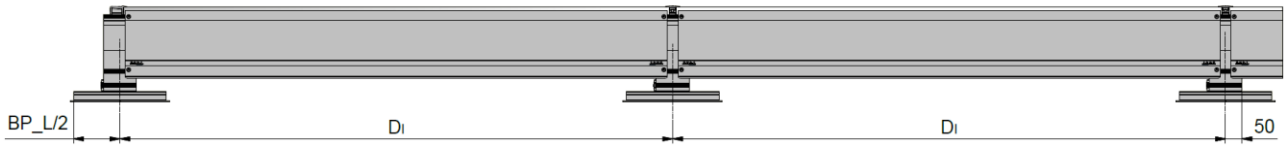
	Min. module width	Max. module width	Scale support hight	Scale support low	Tilt angle	D_P MSP-FR-S	D_P MSP-FR-EW
950 - 1010 mm	950 mm	951 mm	0	0	10.3 °	976 mm	1952 mm
	952 mm	956 mm	0	5	10.3 °	981 mm	1962 mm
	957 mm	961 mm	5	5	10.2 °	986 mm	1972 mm
	962 mm	966 mm	5	10	10.1 °	991 mm	1982 mm
	967 mm	971 mm	10	10	10.1 °	996 mm	1992 mm
	972 mm	976 mm	10	15	10.0 °	1001 mm	2002 mm
	977 mm	981 mm	15	15	10.0 °	1006 mm	2012 mm
	982 mm	986 mm	15	20	9.9 °	1011 mm	2022 mm
	987 mm	990 mm	20	20	9.9 °	1016 mm	2032 mm
	991 mm	995 mm	20	25	9.8 °	1021 mm	2042 mm
	996 mm	1000 mm	25	25	9.8 °	1026 mm	2052 mm
	1001 mm	1005 mm	25	30	9.7 °	1031 mm	2062 mm
	1006 mm	1010 mm	30	30	9.6 °	1036 mm	2072 mm
1011 - 1075 mm	1011 mm	1015 mm	0	0	9.6 °	1042 mm	2083 mm
	1016 mm	1020 mm	0	5	9.5 °	1047 mm	2093 mm
	1021 mm	1025 mm	5	5	9.5 °	1052 mm	2103 mm
	1026 mm	1030 mm	5	10	9.4 °	1057 mm	2113 mm
	1031 mm	1035 mm	10	10	9.4 °	1062 mm	2123 mm
	1036 mm	1040 mm	10	15	9.3 °	1067 mm	2133 mm
	1041 mm	1045 mm	15	15	9.3 °	1072 mm	2143 mm
	1046 mm	1050 mm	15	20	9.2 °	1077 mm	2153 mm
	1051 mm	1055 mm	20	20	9.2 °	1082 mm	2163 mm
	1056 mm	1060 mm	20	25	9.2 °	1087 mm	2173 mm
	1061 mm	1065 mm	25	25	9.1 °	1092 mm	2183 mm
	1066 mm	1070 mm	25	30	9.1 °	1097 mm	2193 mm
	1071 mm	1075 mm	30	30	9.0 °	1102 mm	2203 mm

Solar Energy Systems of Schweizer:
Technical data – PV mounting system flat roof south

Tilt angle nominal 8°

	Min. module width	Max. module width	Scale support hight	Scale support low	Tilt angle	D_P MSP-FR-S	D_P MSP-FR-EW
1076 - 1140 mm	1076 mm	1080 mm	0	0	9.1 °	1107 mm	2213 mm
	1081 mm	1085 mm	0	5	9.0 °	1112 mm	2223 mm
	1086 mm	1090 mm	5	5	9.0 °	1117 mm	2233 mm
	1091 mm	1095 mm	5	10	8.9 °	1122 mm	2243 mm
	1096 mm	1100 mm	10	10	8.9 °	1127 mm	2253 mm
	1101 mm	1105 mm	10	15	8.8 °	1132 mm	2263 mm
	1106 mm	1110 mm	15	15	8.8 °	1137 mm	2273 mm
	1111 mm	1115 mm	15	20	8.8 °	1142 mm	2283 mm
	1116 mm	1120 mm	20	20	8.7 °	1147 mm	2293 mm
	1121 mm	1125 mm	20	25	8.7 °	1152 mm	2303 mm
	1126 mm	1130 mm	25	25	8.6 °	1157 mm	2313 mm
	1131 mm	1135 mm	25	30	8.6 °	1162 mm	2323 mm
	1136 mm	1140 mm	30	30	8.6 °	1167 mm	2333 mm
1141 - 1205 mm	1141 mm	1145 mm	0	0	8.5 °	1173 mm	2345 mm
	1146 mm	1150 mm	0	5	8.5 °	1178 mm	2355 mm
	1151 mm	1155 mm	5	5	8.4 °	1183 mm	2365 mm
	1156 mm	1160 mm	5	10	8.4 °	1188 mm	2375 mm
	1161 mm	1165 mm	10	10	8.3 °	1193 mm	2385 mm
	1166 mm	1170 mm	10	15	8.3 °	1198 mm	2395 mm
	1171 mm	1175 mm	15	15	8.3 °	1203 mm	2405 mm
	1176 mm	1180 mm	15	20	8.2 °	1208 mm	2415 mm
	1181 mm	1185 mm	20	20	8.2 °	1213 mm	2425 mm
	1186 mm	1190 mm	20	25	8.2 °	1218 mm	2435 mm
	1191 mm	1195 mm	25	25	8.1 °	1223 mm	2445 mm
	1196 mm	1200 mm	25	30	8.1 °	1228 mm	2455 mm
	1201 mm	1205 mm	30	30	8.1 °	1233 mm	2465 mm
1206 - 1270 mm	1206 mm	1210 mm	0	0	8.0 °	1239 mm	2477 mm
	1211 mm	1215 mm	0	5	8.0 °	1244 mm	2487 mm
	1216 mm	1220 mm	5	5	7.9 °	1249 mm	2497 mm
	1221 mm	1225 mm	5	10	7.9 °	1254 mm	2507 mm
	1226 mm	1230 mm	10	10	7.9 °	1259 mm	2517 mm
	1231 mm	1235 mm	10	15	7.8 °	1264 mm	2527 mm
	1236 mm	1240 mm	15	15	7.8 °	1269 mm	2537 mm
	1241 mm	1245 mm	15	20	7.8 °	1274 mm	2547 mm
	1246 mm	1250 mm	20	20	7.7 °	1279 mm	2557 mm
	1251 mm	1255 mm	20	25	7.7 °	1284 mm	2567 mm
	1256 mm	1260 mm	25	25	7.7 °	1289 mm	2577 mm
	1261 mm	1265 mm	25	30	7.6 °	1294 mm	2587 mm
	1266 mm	1270 mm	30	30	7.6 °	1299 mm	2597 mm
1271 - 1335 mm	1271 mm	1275 mm	0	0	7.6 °	1305 mm	2609 mm
	1276 mm	1280 mm	0	5	7.5 °	1310 mm	2619 mm
	1281 mm	1285 mm	5	5	7.5 °	1315 mm	2629 mm
	1286 mm	1290 mm	5	10	7.5 °	1320 mm	2639 mm
	1291 mm	1295 mm	10	10	7.4 °	1325 mm	2649 mm
	1296 mm	1300 mm	10	15	7.4 °	1330 mm	2659 mm
	1301 mm	1305 mm	15	15	7.4 °	1335 mm	2669 mm
	1306 mm	1310 mm	15	20	7.4 °	1340 mm	2679 mm
	1311 mm	1315 mm	20	20	7.3 °	1345 mm	2689 mm
	1316 mm	1320 mm	20	25	7.3 °	1350 mm	2699 mm
	1321 mm	1325 mm	25	25	7.3 °	1355 mm	2709 mm
	1326 mm	1330 mm	25	30	7.2 °	1360 mm	2719 mm
	1331 mm	1335 mm	30	30	7.2 °	1365 mm	2729 mm

2.2 System geometry, dimensions in east-west direction



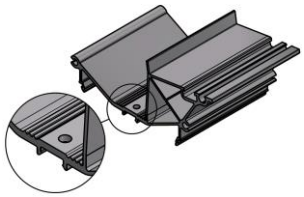
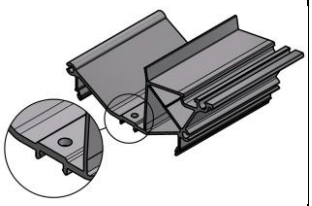
Dimension base profile

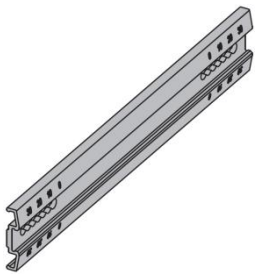
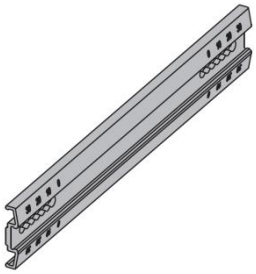
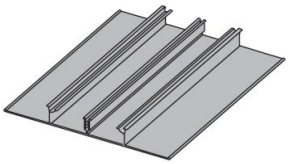
Nominal length Basic profile	BP_L/2	Area
150 mm	67,5 mm	0,034 m²
300 mm	140 mm	0,070 m²
450 mm	215 mm	0,108 m²
600 mm	290 mm	0,145 m²
900 mm	440 mm	0,220 m²
1200 mm	590 mm	0,295 m²

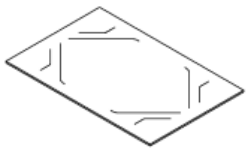
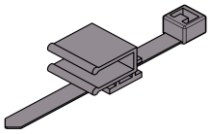
Grid dimensions, scale setting wind deflector

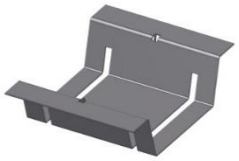
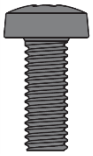
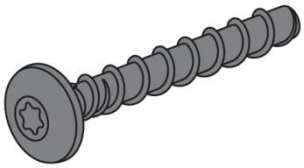
	Min. module width	Max. module width	Scale support left	Scale support right	D_I
1620 - 1684 mm	1620 mm	1623 mm	0	0	1642 mm
	1624 mm	1628 mm	0	5	1647 mm
	1629 mm	1633 mm	5	5	1652 mm
	1634 mm	1638 mm	5	10	1657 mm
	1639 mm	1643 mm	10	10	1662 mm
	1644 mm	1648 mm	10	15	1667 mm
	1649 mm	1653 mm	15	15	1672 mm
	1654 mm	1658 mm	15	20	1677 mm
	1659 mm	1663 mm	20	20	1682 mm
	1664 mm	1668 mm	20	25	1687 mm
	1669 mm	1673 mm	25	25	1692 mm
	1674 mm	1678 mm	25	30	1697 mm
	1679 mm	1684 mm	30	30	1702 mm
1685 - 1749 mm	1685 mm	1688 mm	0	0	1707 mm
	1689 mm	1693 mm	0	5	1712 mm
	1694 mm	1698 mm	5	5	1717 mm
	1699 mm	1703 mm	5	10	1722 mm
	1704 mm	1708 mm	10	10	1727 mm
	1709 mm	1713 mm	10	15	1732 mm
	1714 mm	1718 mm	15	15	1737 mm
	1719 mm	1723 mm	15	20	1742 mm
	1724 mm	1728 mm	20	20	1747 mm
	1729 mm	1733 mm	20	25	1752 mm
	1734 mm	1738 mm	25	25	1757 mm
	1739 mm	1743 mm	25	30	1762 mm
	1744 mm	1749 mm	30	30	1767 mm
1750 - 1814 mm	1750 mm	1753 mm	0	0	1772 mm
	1754 mm	1758 mm	0	5	1777 mm
	1759 mm	1763 mm	5	5	1782 mm
	1764 mm	1768 mm	5	10	1787 mm
	1769 mm	1773 mm	10	10	1792 mm
	1774 mm	1778 mm	10	15	1797 mm
	1779 mm	1783 mm	15	15	1802 mm
	1784 mm	1788 mm	15	20	1807 mm
	1789 mm	1793 mm	20	20	1812 mm
	1794 mm	1798 mm	20	25	1817 mm
	1799 mm	1803 mm	25	25	1822 mm
	1804 mm	1808 mm	25	30	1827 mm
	1809 mm	1814 mm	30	30	1832 mm

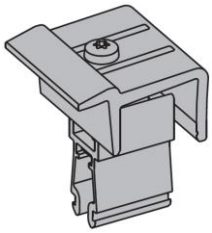
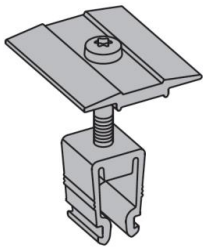
3 Components

Description	Support	Support	Support
Designation	MSP-FR-S-SH	MSP-FR-S-SL8	MSP-FR-S-SL10
Figure			
Material **Coating**	EN AW-6063 T66 - EN 755-2	EN AW-6063 T66 - EN 755-2	EN AW-6063 T66 - EN 755-2

Description	Connection channel across	Connection channel long since	Profile
Designation	MSP-FR-EW-C 300-360 MSP-FR-EW-C 470-530 MSP-FR-EW-C 950-1010 MSP-FR-EW-C 1011-1075 MSP-FR-EW-C 1076-1140 MSP-FR-EW-C 1141-1205 MSP-FR-EW-C 1206-1270 MSP-FR-EW-C 1271-1335	MSP-FR-EW-C 1555-1619 MSP-FR-EW-C 1620-1684 MSP-FR-EW-C 1685-1749 MSP-FR-EW-C 1750-1814 MSP-FR-EW-C 1815-1879 MSP-FR-EW-C 1880-1944 MSP-FR-EW-C 1945-2009 MSP-FR-EW-C 2010-2074 MSP-FR-EW-C 2075-2139 MSP-FR-EW-C 2140-2204 MSP-FR-EW-C 2205-2269 MSP-FR-EW-C 2270-2334 MSP-FR-EW-C 2335-2399	MSP-FR-EW-BP 150 MSP-FR-EW-BP 300 MSP-FR-EW-BP 450 MSP-FR-EW-BP 600 MSP-FR-EW-BP 900 MSP-FR-EW-BP 1200
Figure			
Material	EN AW-6063 T66 - EN 755-2	EN AW-6063 T66 - EN 755-2	EN AW-6060 T66 - EN 755-2

Description	Protection sheet (plugged)	Wind deflector/ballast tray	Cable holder with edge clip
Designation	MSP-FR-PSF 150 MSP-FR-PSF 300 MSP-FR-PSF 450 MSP-FR-PSF 600 MSP-FR-PSF 900 MSP-FR-PSF 1200	MSP-FR-S-WD 1620-1684 MSP-FR-S-WD 1685-1749 MSP-FR-S-WD 1750-1814	MSP-FR-CHE
Figure			
Material	PES-Vlies 450 g/m^2 3-4mm thickness, slotted	Sheet steel / ZM-coated	PA6.6

Description	Ballast tray holder	Screw	Screw
Designation	MSP-FR-S-SB	MSP-FR-S M6x16	MSP-FR-GS 6x60
Figure			
Material	Sheet steel / SVZ/ZM-coated	Carbon steel ZnNi galvanised Layer thickness >10µm + Dry lubricant film	Stahl ZnNi galvanisiert Layer thickness >10µm + Dry lubricant film

Description	End clamp	Middle clamp
Designation	MSP-PR-EC 28-45mm MSP-PR-ECB 28-45mm	MSP-PR-MC 28-45mm MSP-PR-MCB 28-45mm MSP-PR MCG 28-45mm MSP-PR-MCBG 28-45mm
Figure		
Material	Clamp: EN AW-6063 T66 - EN 755-2 Screw: A2-70 - ISO 3506-1 Securing washer: PE-HD Nut: A4-70 - ISO 3506-2	Clamp: EN AW-6063 T66 - EN 755-2 Screw: A2-70 - ISO 3506-1 Nut: PE-HD

4 Design resistances of components (ultimate limit state)

For the resistance verification of MSP-FR applications the following component design resistances have to be considered individually:

– Resistance of the roof structure – Compressive strength of the thermal insulation – Friction coefficient between the roof membrane and the protective layer – Rated value of the module according to manufacturer's specifications	– By the costumer
– Support low MSP-FR-EW-SL8/SL10 – Support high MSP-FR-EW-SH – Connection channel MSP-FR-EW-C – Ballast tray MSP-FR-S-WD – Middle and end clamps MSP-PR-MC/MCB/EC/ECB	– According to this factsheet

The component with lowest resistance limits the application.

All resistances are calculated according to the following codes and guidelines:

- DIN EN 1990 (EC1)
- DIN EN 1993-1-1 (EC3)
- DIN EN 1999-1-1 (EC9)
- VDI 2230 Sheet 1

The resistances are valid as long as the full MSP-FR-S system from Schweizer is used and the installation is built according to the MSP-FR-S flat roof PV mounting system's mounting instructions.

4.1 Design resistances of support low MSP-FR-EW-SL8/SL1

Pressure design resistance	N_{Rd} in kN	3,75
Suction design resistance	N_{Rd} in kN	-5,20
Shear design resistance	V_{Rd} in kN	±1,95
Shear design resistance	S_{Rd} in kN	+1,95 -0,24

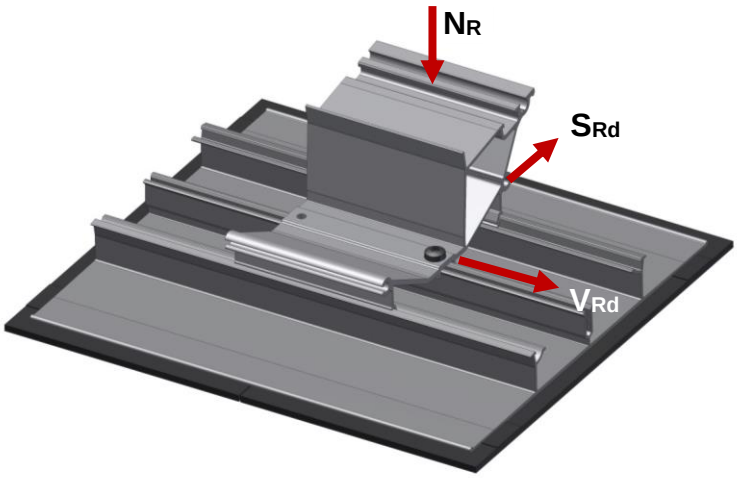


Figure 1: Vectors of design resistance of MSP-FR-EW-SL8/SL10

4.2 Design resistances of support high MSP-FR-S-SH

Pressure design resistance	N_{Rd} in kN	3,75
Suction design resistance	N_{Rd} in kN	-4,08
Shear design resistance	V_{Rd} in kN	±1,95
Shear design resistance	S_{Rd} in kN	±1,95

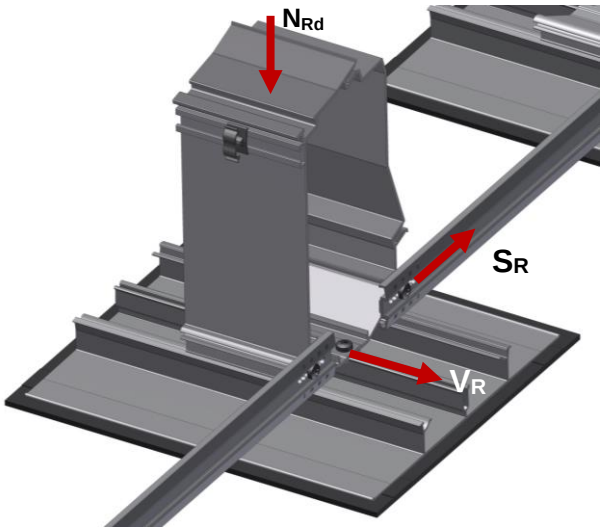


Figure 2: Vectors of design resistance of MSP-FR-S-SH

4.3 Design resistances of connection channels MSP-FR-EW-C

Pressure design resistance (stones)	**N_{Rd} in kN**	0,34
Pressure design resistance stiffened (with ballast tray)	**N_{Rd} in kN**	1,08

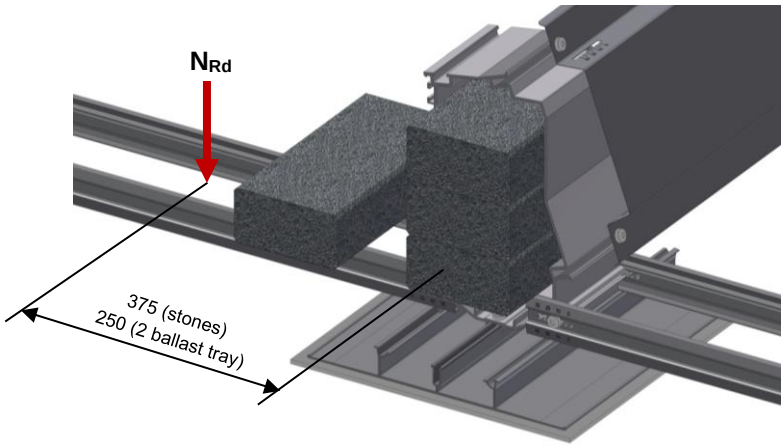


Figure 3: Vectors of design resistance of MSP-FR-EW-C

4.4 Permissible design resistance for wind deflector MSP-FR-S-WD

		MSP-FR-S-WD 1620-1684	MSP-FR-S-WD 1695-1749	MSP-FR-S-WD 1750-1814
Pressure design resistance	N_{Rk} in kN	0,80	0,80	0,80
Suction design resistance	V_{Rk} in kN	±0,80	±0,80	±0,80

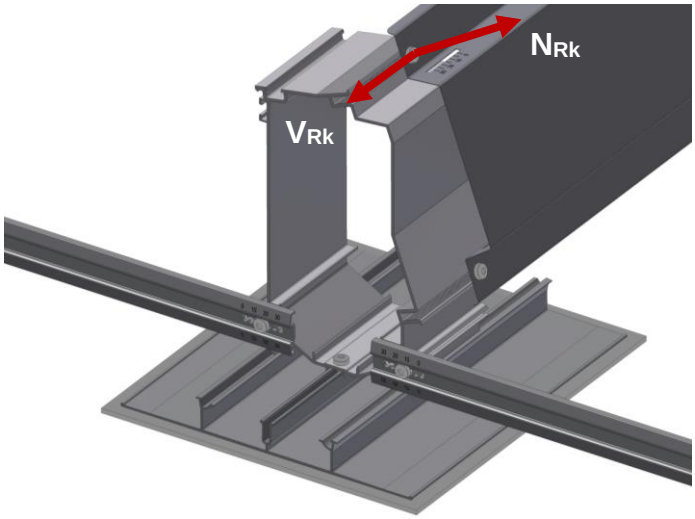


Figure 4: Vectors of design resistance of fastening the wind deflector MSP-FR-S-WD

		MSP-FR-S-WD 1620-1684	MSP-FR-S-WD 1695-1749	MSP-FR-S-WD 1750-1814
Pressure design resistance	N_{Rd} in kN	0,49	0,49	0,39
Suction design resistance	N_{Rd} in kN	-0,49	-0,49	-0,39

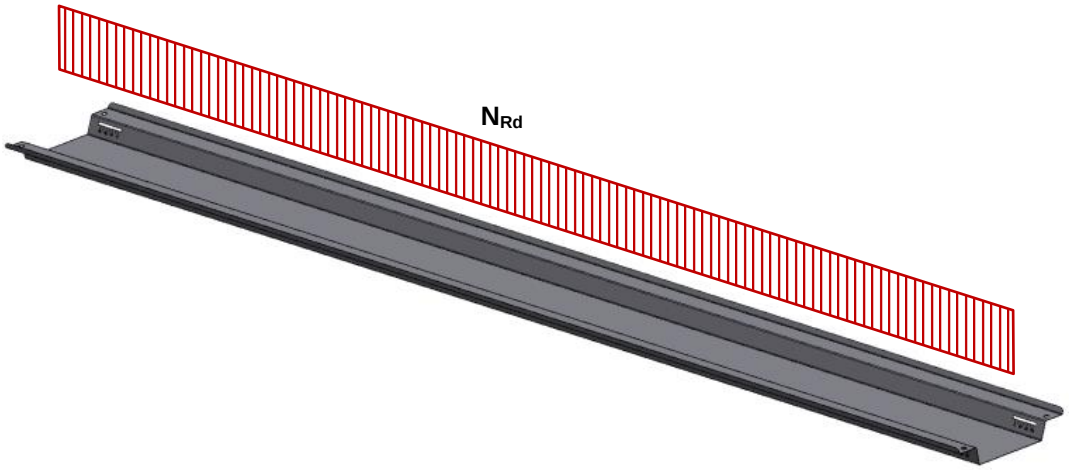


Figure 5: Illustration of the load effect on the ballast tray

4.5 Design resistances of the middle clamp MSP-PR-MC/G & MSP-PR-MCB/G

Suction design resistance	N_{Rd} in kN	-5,17
Shear design resistance	V_{Rd} in kN	1,29
Shear design resistance	S_{Rd} in kN	1,29

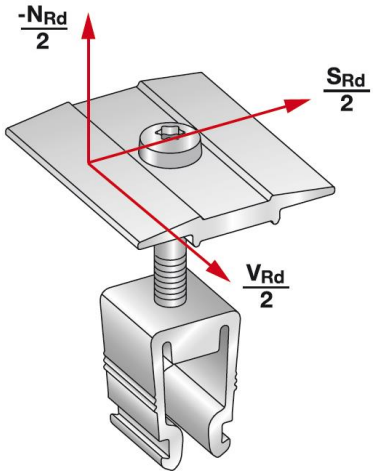


Figure 6: Vectors of design resistance of middle clamp MSP-PR-MC/G & MSP-PR-MCB/G

4.6 Design resistances of the MSP-PR-EC/B end clamp

Suction design resistance	N_{Rd} in kN	-1,90
Shear design resistance	V_{Rd} in kN	0,51
Shear design resistance	S_{Rd} in kN	0,51

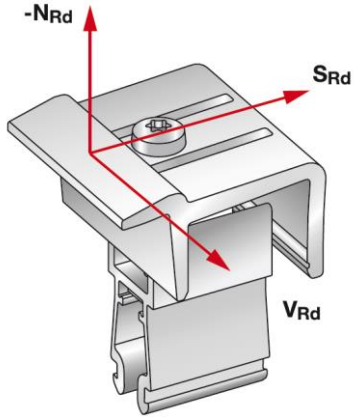


Figure 7: Vectors of design resistance of end clamp MSP-PR-EC/B