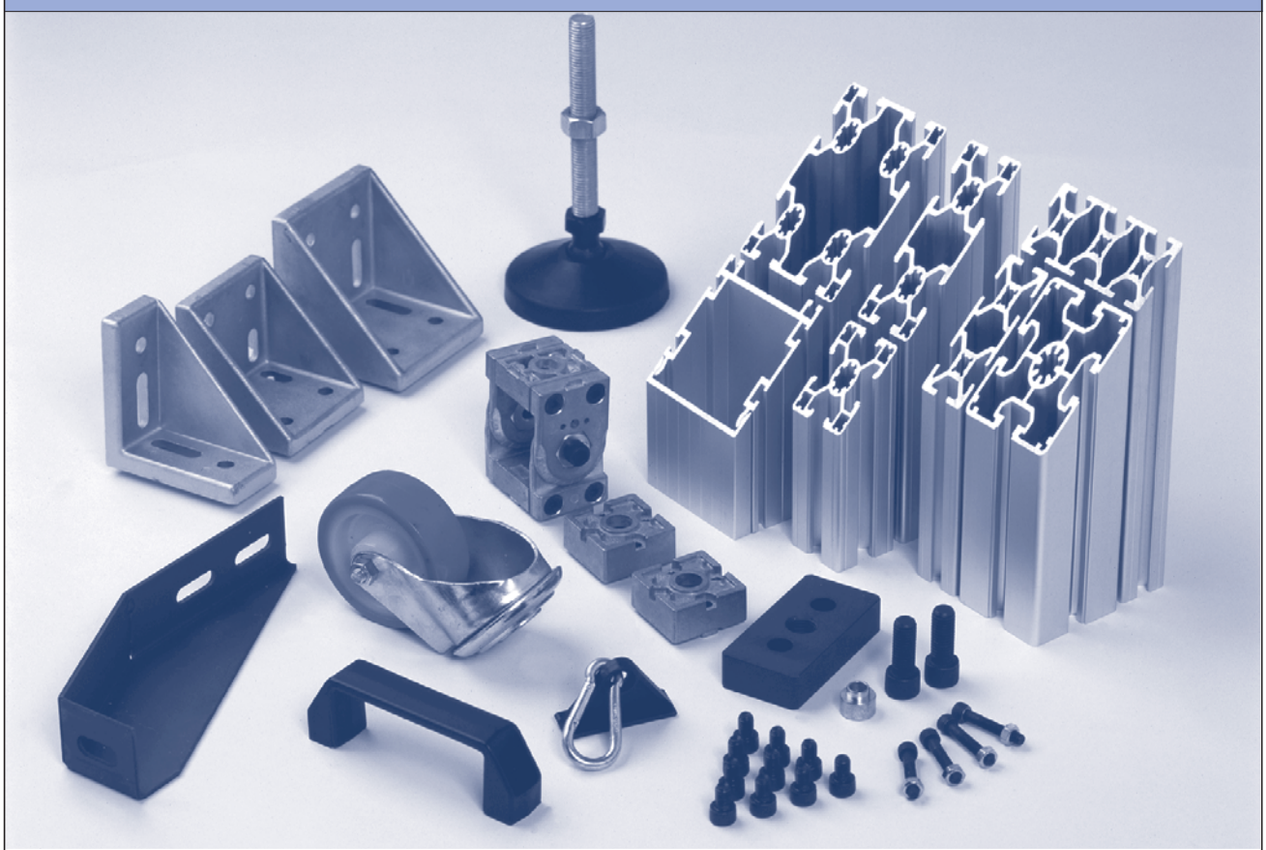
Technical Details



This section of the catalogue contains selection information for both Structural Aluminium Profiles and Profile Connections, plus details of end machining where required.

An important factor in the selection of a structural aluminium profile is the amount of deflection which will be acceptable. This deflection gives rise to a bending stress, which must be less than the maximum allowable figure of 200N/mm^2. A bending stress greater than this figure is likely to cause the profile to fail. In calculating the correct profile, this maximum bending stress figure should be reduced by a safety factor according to the application characteristics.

Deflection may be calculated either by using Moment of Inertia* and Section Modulus** figures in the formulas relevant to an application, or graphically by following a number of steps using the graph and nomograms provided. It should be noted, however, that the graphical method will give a more approximate deflection figure.

As shown in the Profile Connections section of this catalogue, there are a number of methods available for connecting **MCS** profiles and components together. Each of these methods has a different load-bearing ability and various advantages and disadvantages in terms of ease, speed and flexibility of use. The table on page 52 will aid the selection of connection methods based on the criteria most relevant to your application.

The end of this section shows details of how to machine **MCS** profiles to accept various connection methods. This machining can be carried out by Hepco on request - contact our Sales Department for full details.

* Moment of Inertia is the ability of a profile to withstand bending.

** Section Modulus is a ratio which allows calculation of the stress in a profile created by this bending.

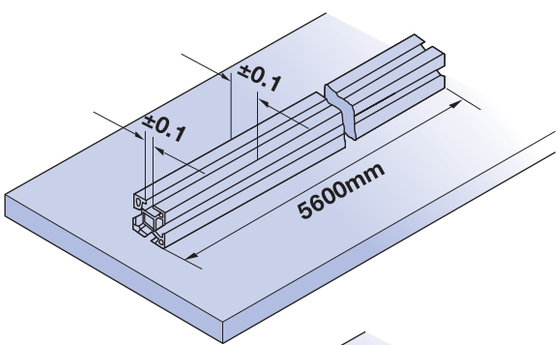
Technical Details

Aluminium Profile

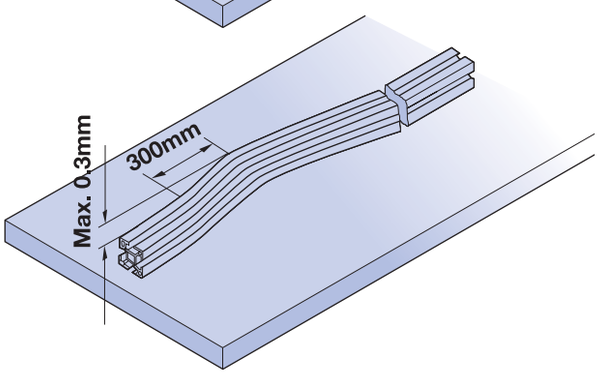
Technical Specification

Material Designation	AlMgSi0.5F25
Material Number	Al6063-T5
Minimum Tensile Strength	250N/mm²
0.2% Proof Stress	160N/mm²
Modulus of Elasticity	70 000N/mm²
Coefficient of Thermal Expansion	(-50...+20°C) = 21.8 x 10^{-6} 1/K (+20...+100°C) = 23.8 x 10^{-6} 1/K
Anodizing Process	E6/EV1 Clear
Thickness of Layer	10 µm
Hardness	300 HV

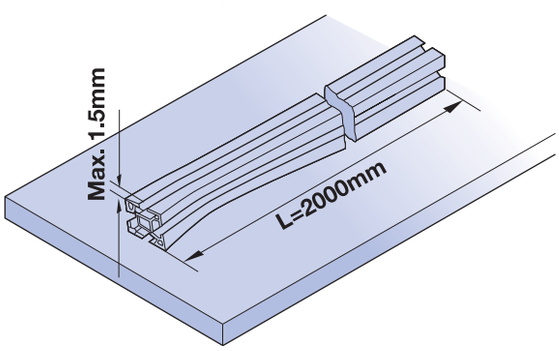
Section faces are parallel within ±0.1mm



Straightness of profile –
maximum deviation of 0.3mm per 300mm



Maximum twist is 1.5mm per 2000mm



Technical Details

Deflection Calculations

Note: These deflection calculations can be replaced by referring to 'Choosing the Correct MCS system profile for your application' (pages 48 and 49), though results achieved graphically will be more approximate.

Deflection of Profile under Static Point Loading:

$$d_1 = \frac{F \times L^3}{3E \times I \times 10^4}$$ ① Cantilever (Rigidly fixed one end)

$$d_2 = \frac{F \times L^3}{48E \times I \times 10^4}$$ ② Simply supported

$$d_3 = \frac{F \times L^3}{192E \times I \times 10^4}$$ ③ Rigidly fixed both ends

Deflection of profile under its own weight (referring to the diagrams above):

$$d_1 = \frac{9.81 \times P \times L^4}{8E \times I \times 10^7}$$

$$d_2 = \frac{5 \times 9.81 \times P \times L^4}{384E \times I \times 10^7}$$

$$d_3 = \frac{9.81 \times P \times L^4}{384E \times I \times 10^7}$$

Maximum allowable bending stress (referring to the diagrams above):

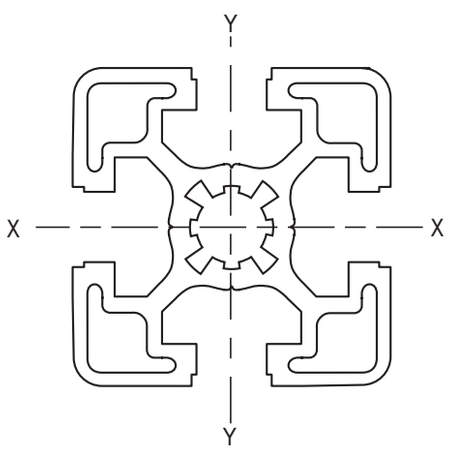
max<200N/mm²

$$s_1 = \frac{F \times L}{W \times 10^3}$$

$$s_2 = \frac{F \times L}{4W \times 10^3}$$

$$s_3 = \frac{F \times L}{8W \times 10^3}$$

E	=	70 000N/mm² (modulus of elasticity)
L	=	Unsupported Length (mm)
F	=	Load (N)
I	=	Moment of Inertia (cm⁴)
D	=	Deflection of profile (mm)
W	=	Section Modulus (cm³)
P	=	Mass of profile (kg/m)



Technical Details

Selection Data

Moment of Inertia, Section Modulus and Mass of MCS System Structural Profile Sections

	Moment of Inertia (cm⁴) Ixx	Iyy	Section Modulus (cm³) Wxx	Wyy	Mass (kg/m)
20 x 20	0.65	0.65	0.65	0.65	0.43
20 x 40	4.5	1.2	2.2	1.2	0.76
30 x 30	3.2	3.2	2.1	2.1	0.87
30 x 60	20.9	5.9	6.9	3.9	1.53
30 x 90	64.1	8.5	14.2	5.7	2.19
40 x 40SL	7.8	7.8	3.9	3.9	1.3
40 x 40L	8.4	8.4	4.2	4.2	1.4
40 x 40	10.2	10.2	5.1	5.1	1.7
40 x 1NS	9.9	10.3	4.9	5.15	1.7
40 x 2NS	10.3	10.3	5.1	5.1	1.7
40LR	6.0	6.0	2.6	2.6	1.2
40 x 80L	52.6	14.3	13.15	7.15	2.1
40 x 80	61.4	17.0	15.3	8.5	2.6
40 x 80 – 2NS	55.8	15.2	13.9	7.6	2.35
40 x 80 – 3NS	54.5	14.8	13.6	7.4	2.32
45 x 45SL	10.1	10.1	4.5	4.5	1.4
45 x 45L	10.4	10.4	4.6	4.6	1.5
45 x 45	14.0	14.0	6.2	6.2	1.9
45 x 1NS	13.0	13.5	5.8	6.0	1.9
45 x 2NS	12.9	12.9	5.7	5.7	1.8
45LR	7.2	7.2	2.8	2.8	1.2
45°	9.6	10.4	4.1	4.7	1.5
45 x 60L	24.3	15.3	8.1	6.8	2.1
45 x 60	35.0	22.0	11.6	9.8	2.8
45 x 90L	93.6	22.0	20.8	9.8	3.13
45 x 90	100.9	29.4	22.4	13.0	3.6
45 x 90 – 2NS	96.3	27.6	21.4	12.3	3.4
45 x 90 – 3NS	94.4	27.3	21.0	12.1	3.4
60 x 60L	37.0	37.0	12.3	12.3	2.9
60 x 60	47	47	15.7	15.7	3.6
60 x 90	129.2	59.8	28.7	19.9	4.4
80 x 80SL	97.6	97.6	29.4	24.4	3.6
80 x 80L	110.7	110.7	27.7	27.7	4.1
80 x 80	124.4	124.4	31.1	31.1	4.7
80 x 80 – 2NS	102	100	25.5	25	3.7
80 x 80 – 4NS	104	104	26	26	3.7
80 x 120	362	176	60	44	6.4
80 x 160	893	262	111	65.5	9.1
90 x 90L	193	193	42.9	42.9	5.6
90 x 90	285	285	63	63	9.3

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Technical Details

Selection Data

Choosing the correct MCS System Profile for your Application

These instructions will aid the selection of an **MCS** System profile when a point load is applied. Steps A to E refer to paths which should be followed on the diagram opposite. The paths will confirm or deny an estimate of the correct **MCS** System profile for any given application. For calculation of other loading types please refer to the relevant mechanical texts.

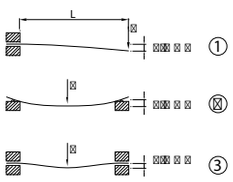
The diagram overleaf is a graphic representation of the deflection calculations on page 46.

It will be necessary to differentiate between the three loading types:

1. Cantilever load (rigidly fixed at one end)

2. Simply supported

3. Rigidly fixed both ends



Procedure for determining the deflection of an MCS System profile when the following details are known:

Applied load, unsupported length, and selected profile size (an estimate will need to be made of the most suitable size at this stage).

A. Find the applied load on the Y1 axis. Draw a horizontal line from that point across the graph.

B. Now find the unsupported length L on the X axis. From this point draw a vertical line upwards through the graph.

C. Find the intended section Moment of Inertia on the Y2 axis (values for MCS System standard sizes are shown in the table to the right of the graph). From this point draw a second horizontal line across the graph.

D. Draw a line through the intersection of the lines A & B, parallel to the diagonal lines running across the graph and intersect this new diagonal with line C.

E. From the point at which line D intersects with line C, draw a vertical line up the graph; this line should cross through the relevant logarithmic scale (load type 1, 2 or 3 above). The deflection for the given loading condition can now be read from the scale.

Steps A to E may also be used in a variety of sequences, depending on the variables shown. See below:

To find the optimum MCS System profile size when maximum deflection, applied load and unsupported length are known, use the following sequence:

A ‹ B ‹ E ‹ D ‹ C

To find the maximum load for a given profile size, when maximum deflection and unsupported length are known, use:

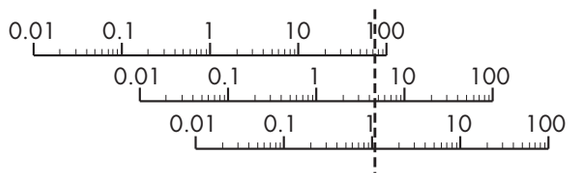
C ‹ E ‹ B ‹ D ‹ A

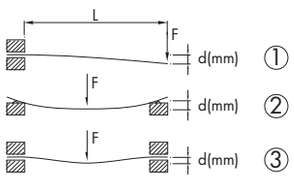
To find the maximum unsupported length, for a given profile size, when maximum deflection and applied load are known, use:

C ‹ E ‹ A ‹ D ‹ B

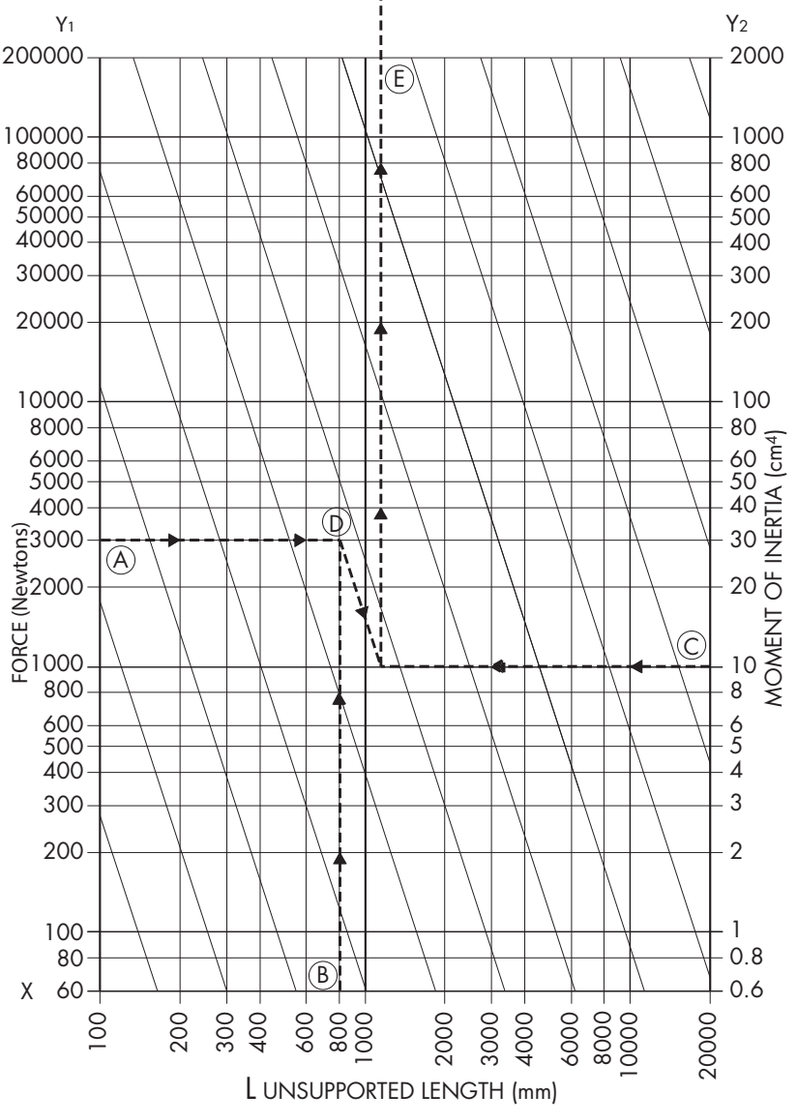
Technical Details

Selection Data





See page 48



Example

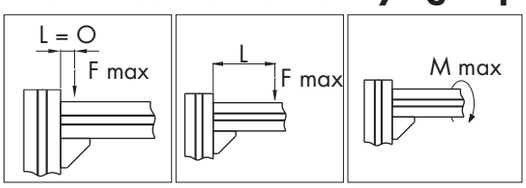
A static point load of 3000N is applied centrally to an **MCS** System profile which is rigidly supported both ends. The total unsupported length is 800mm. It has been estimated that a 45 x 45L profile will suffice for this application. Using the Moment of Inertia figure for this profile, steps A to E are followed in sequence. From nomogram 3 (for rigidly fixed profiles) we can see that deflection will be approximately 1mm, which is deemed to be acceptable for the application.

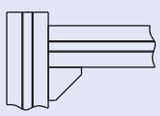
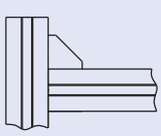
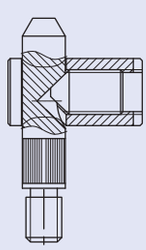
	Moment of Inertia I_{xx} cm⁴	I_{yy} cm⁴
20 x 20	0.65	0.65
20 x 40	4.5	1.2
30 x 30	3.2	3.2
30 x 60	20.9	5.9
30 x 90	64.1	8.5
40 x 40SL	7.8	7.8
40 x 40L	8.4	8.4
40 x 40	10.2	10.2
40 x 1NS	9.9	10.3
40 x 2NS	10.3	10.3
40LR	6.0	6.0
40 x 80L	52.6	14.3
40 x 80	61.4	17.0
40 x 80 – 2NS	55.8	15.2
40 x 80 – 3NS	54.5	14.8
45 x 45SL	10.1	10.1
45 x 45L	10.4	10.4
45 x 45	14.0	14.0
45 x 1NS	13	13.5
45 x 2NS	12.9	12.9
45LR	7.2	7.2
45°	9.6	10.4
45 x 60L	24.3	15.3
45 x 60	35.0	22.0
45 x 90L	93.6	22.0
45 x 90	100.9	29.4
45 x 90 – 2NS	96.3	27.6
45 x 90 – 3NS	94.4	27.3
60 x 60L	37.0	37.0
60 x 60	47	47
60 x 90	129.2	59.8
80 x 80SL	97.6	97.6
80 x 80L	110.7	110.7
80 x 80	124.4	124.4
80 x 80 – 2NS	102	100
80 x 80 – 4NS	104	104
80 x 120	362	176
80 x 160	893	262
90 x 90L	193	193
90 x 90	285	285

Technical Details

Selection Data

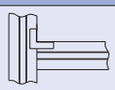
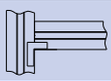
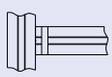
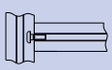
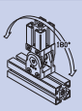
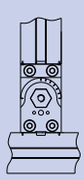
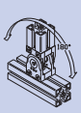
Profile Connection Carrying Capacity



Profile Connections	Direct Load N	Offset Load (LxF) Nm	Twisting Load Nm	Joint Position
Bracket 17 x 25	400	8	2	
Bracket 20 x 28	1200	25	6	
Bracket 36 x 36	1800	60	10	
Bracket 42 x 43	2000	90	12	
Bracket 42 x 88	4000	180	30	
Bracket 57 x 57	2000	90	12	
Bracket 75 x 75	7000	300	90	
Bracket 88 x 88	7000	350	100	
Angle Bracket	2000	80	12	
Bracket 17 x 25	400	20	2	
Bracket 20 x 28	1200	70	6	
Bracket 36 x 36	1800	145	10	
Bracket 42 x 43	2000	180	12	
Bracket 42 x 88	4000	360	30	
Bracket 57 x 57	2000	180	12	
Bracket 75 x 75	7000	700	90	
Bracket 88 x 88	7000	750	100	
Angle Bracket	2000	120	12	
Flexi T (A)	1500	140		
Flexi T (B)	1500	140		
Flexi Angle	1500	140		
Flexi Mitre	1500	140		
Flexi Straight	1500	140		
Flexi Threaded	1500	140		

Technical Details

Selection Data

Profile Connections	Direct Load N	Offset Load (LxF) Nm	Twisting Load Nm	Joint Position Nm
Interior Bracket 	800	80	10	
Interior Bracket 	800	8	10	
Bolt Connector 20 x 39L 	4000	400	25	
Bolt Connector 20 x 59L 	4000	600	50	
Connection Screw M5 x 20 	500	20	–	
Connection Screw M8 x 30 	1500	80	–	
Connection Screw M12 x 30 	3000	200	–	
End Connector Set 	3000	200	50	
Knuckle Joint 45 x 45 	3000	200	50	
Knuckle Joint 45 x 60 	3000	200	50	

Technical Details

Selection Data

Connection Cross-Reference Chart

	Flexi Connector	Angle Brackets	Interior Bracket	Bolt Connector	Connection Screw
Flexibility of Usage	★★★★★	★★★★★	★★	★★	★★★
Adjustability	★★★★★	★★★★★	★★★	★	★
Frame Stiffness	★★★★	★★★★	★★	★★★★★	★★★★★
Vibration Resistance	★★★★	★★	★	★★★★★	★★★★★
Space Requirement	★★★★★	★★	★★★★★	★★★★	★★★★★
Tolerance of Inaccuracy[1]	★★★★★	★★★★★	★★★★	★	★★★★
Cost Effectiveness[2]	★★★★	★★★★★	★★★★	★★	★★★★
Aesthetic Finish	★★★★★	★	★★★★★	★★★★★	★★★★★

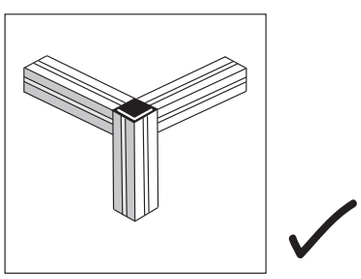
★★★★★ = Highest/Best
★ = Lowest/Worst

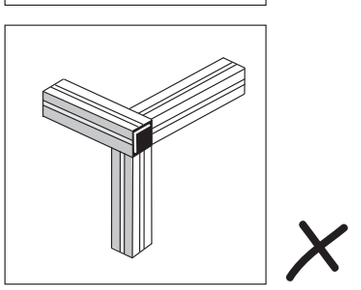
[1] 'Tolerance of Inaccuracy' refers to the time and care needed when building MCS System frames with the various connection methods. For example, Angle Brackets will tolerate low build accuracy, which is quickly and cheaply achieved, whereas Bolt Connectors will not.

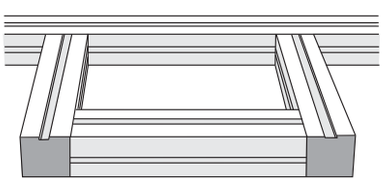
[2] 'Cost effectiveness' is a measure not only of component costs, but also takes into account the time required to build various connection methods into MCS System frames.

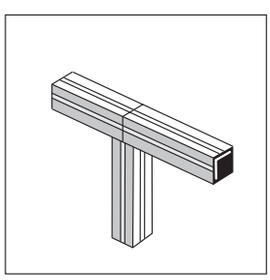
Assembly Hints

Vertical Profiles should run unbroken from the bottom to the top of a frame, with horizontal profiles assembled to the vertical.









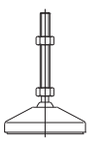
Always support the joint when profiles are butt-fastened.

Technical Details

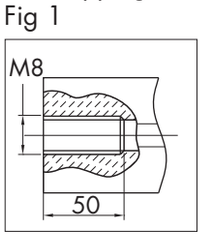
Machining Details

The following machining can be carried out by Hepco on fast turnaround - quotations on request (supply profile part and figure no.)

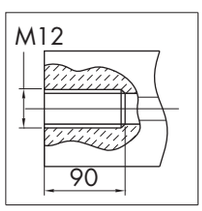
Foot



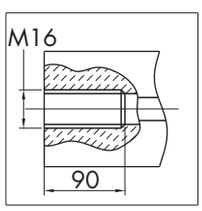
Profile
End Tapping
Fig 1



8mm

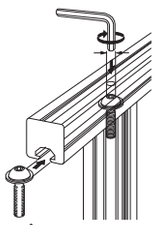


10mm*

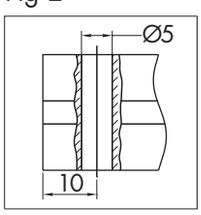


* Exception
0-132-9099

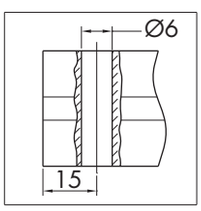
Connection Screw



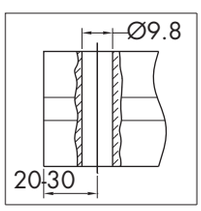
Access Hole
Fig 2



6mm

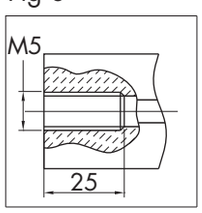


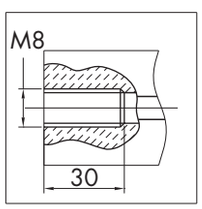
8mm

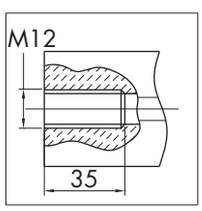


10mm

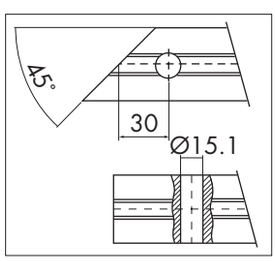
Profile
End Tapping
Fig 3







Flexi Fit Connector
All holes through
Fig 5



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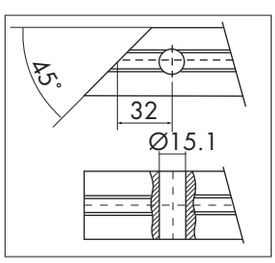
1-242-4556



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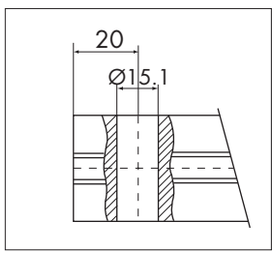

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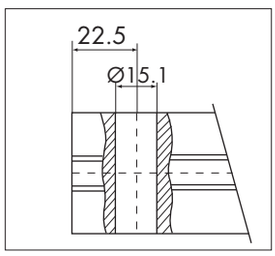

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