Institut de Tecnologia de la Construcció de Catalunya

Wellington 19
ES08018 Barcelona
T +34 933 09 34 04
qualprod@itec.cat
itec.cat

Designated according to Article 29 of Regulation (EU) No 305/2011

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European Technical Assessment

ETA 13/0309 of 04.03.2020

General part

Technical Assessment Body issuing the ETA: ITeC ITeC has been designated according to Article 29 of Regulation (EU) No 305/2011 and is member of EOTA (European Organisation for Technical Assessment)	
Trade name of the construction product	**PF-ALU-HTR kit**
Product family to which the construction product belongs	Subframe and fixing kit for fastening cladding elements and also external wall elements in ventilated or non-ventilated façades
Manufacturer	**MECANISMOS, ANCLAJES Y SISTEMAS AUTOPORTANTES SL - MASA** C/ Compositor Bach, 14-16 Pol. Ind. Can Jardí ES-08191 RUBÍ Barcelona, Spain
Manufacturing plant(s)	C/ Compositor Bach, 14-16 Pol. Ind. Can Jardí ES-08191 RUBÍ Barcelona, Spain
This European Technical Assessment contains	43 pages including 6 annexes which form an integral part of this assessment.
This European Technical Assessment is issued in accordance with Regulation (EU) 305/2011, on the basis of	European Assessment Document, EAD 090034-00-0404 *Kit composed by subframe and fixings for fastening cladding and external wall elements*.
This version replaces	ETA 13/0309 issued on 09.05.2013.

General comments

Translations of this European Technical Assessment in other languages shall fully correspond to the original issued document and should be identified as such.

Specific parts of the European Technical Assessment

1 Technical description of the product

PF-ALU-HTR kit for fastening skin elements[1] (cladding elements and external wall elements) consists of:

- Skin element fixing device according to Type 5 given in EAD 090034-00-0404:
  1. Special anchors TR-MASA.
  2. Aluminium alloy clamps GR-TR (upper and lower).
  3. Aluminium alloy horizontal profiles PF-AL-HTR.
  4. Stainless steel drilling screws between the fixing devices and the subframe profile.
  5. Ancillary component:
     - Ancillary profiles between horizontal profiles.

  A complete fixing device to support one skin element is composed of:
  - At least four special anchors TR-MASA
  - At least two upper clamps GR-TR-S and two lower clamps GR-TR-I, and
  - At least two horizontal profiles PF-AL-HTR.
- Subframe:
  6. Aluminium alloy vertical profiles PF-AL-U, PF-AL-Tu, PF-AL-T, PF-AL-L and PF-AL-J.
  7. Brackets:
     - Aluminium alloy brackets ES-ALU-A, ES-ALU-V, ES-ALU-E and ES-ALU-L.
     - Stainless steel brackets ES-INOX-E and ES-INOX-A.
  8. Stainless steel drilling screws between the subframe profiles and brackets.

The configuration of the assembled system is shown in Annex 1.

The PF-ALU-HTR kit is made of mechanical components. Adhesives are not needed for assembly.

The PF-ALU-HTR kit is a non-load bearing construction element. It does not contribute to the stability of the structure on which it is installed.

The following ventilated façade elements or components are not considered in this ETA:

- The skin elements[2].
- The fixings between the subframe and the supporting structure[3].
- The other layers of the façade, like insulation and internal layers.

The geometry characteristics and the material properties of each component are given in annexes indicated in the following table:

[1] From now on this term refers to both cladding elements and external wall elements.

[2] If the skin elements are cladding elements, other EADs may apply (e.g. EAD 090062, EAD 090020, etc.).

[3] The term "supporting structure" refers to both of followings descriptions:
- The wall, which in itself already meets the airtightness and mechanical strength requirements (resistance to static and dynamic loads). The substrate walls are made of masonry (clay, concrete or stone), concrete (cast on site or as prefabricated panels), timber or metal frame.
- The supporting structure of the building, which in itself does not meet the airtightness requirement but meets the mechanical strength requirements (resistance to static and dynamic loads). Usually, the supporting structures of the building are made of concrete (cast on site or prefabricated), timber or metal frame.
  In this case, the airtightness requirements are met by the internal leaves of the façade.

Table 1.1: Annexes of geometry characteristics and material properties of the kit components.

Component	Geometry characteristics and material annexes
Skin fixing devices GR-HTR	Annex 2
Vertical Profiles	Annex 3
Brackets	Annex 4
Drilling screws	Annex 5

2 Specification of the intended use(s) in accordance with the applicable European Assessment Document (hereinafter EAD)

PF-ALU-HTR kit is intended to be used as mechanical fastening of skin elements (claddings or external wall elements) in façades with air space, ventilated or not, and intended to be used on supporting structures[3] which meet the mechanical strength requirements.

The PF-ALU-HTR kit is intended to be used for the fixing of skin elements (e.g. natural stone according to EN 1469) with undercut hole (see section A6.1 of Annex 6 for more information on the skin element specifications).

The skin elements are not part of the kit object of this ETA. The safety in use of the skin elements has to be assessed separately.

The provisions made in this European Technical Assessment are based on an assumed working life of at least 25 years for PF-ALU-HTR kit. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

PF-ALU-HTR kit is made of non-load bearing construction components. They do not contribute directly to the stability of the wall on which they are installed.

PF-ALU-HTR kit is not intended to ensure the airtightness of the building envelope.

Detailed information and data regarding design, installation, maintenance and repair criteria are given in Annex 6.

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

The assessment of PF-ALU-HTR kit for the intended use was performed following the EAD 090034-00-0404 *Kit composed by subframe and fixings for fastening cladding and external wall elements*.

Table 3.1: Summary of the PF-ALU-HTR kit performances (see also detailed performances in relevant sections).

Product:	PF-ALU-HTR kit	**Intended use:**	Mechanical fastening of skin elements (claddings or external wall elements) in façades with air space, ventilated or not.

Basic Works Requirement	ETA section	Essential characteristic	Performance
BWR 2 Safety in case of fire	3.1	Reaction to fire	A1
BWR 4 Safety and accessibility in use	3.2	Wind load resistance	3000 Pa (suction) 3600 Pa (pressure)
	---	Resistance to vertical load of the kit	Not assessed
	3.3	Resistance to vertical load of skin element fixing	See table 3.3
	3.4	Resistance to horizontal load of skin element fixing	See table 3.4
	---	Resistance to pulsating load of skin element fixings	Not assessed
	---	Resistance of skin element fixings in case of inaccuracies of installation	Not relevant

Table 3.1: Summary of the PF-ALU-HTR kit performances (see also detailed performances in relevant sections).

Product:	PF-ALU-HTR kit	**Intended use:**	Mechanical fastening of skin elements (claddings or external wall elements) in façades with air space, ventilated or not.

Basic Works Requirement	**ETA section**	**Essential characteristic**	**Performance**
	3.5	Pull-through resistance of fixings from profile	See table 3.5
	3.6	Pull-out resistance of subframe fixings from profile	See table 3.6
	3.7	Inertia and resistance of profiles	See Annex 3
	3.8	Resistance of vertical load of brackets	See table 3.7
	3.9	Resistance of horizontal load of brackets	See table 3.8
	3.10	Mechanical characteristics of subframe fixings	See table 3.6
	3.11	Corrosion	See section 3.11

Complementary information:
Requirements with respect to the mechanical resistance and stability of non-load bearing parts of the works are not included in the Basic Works Requirement *Mechanical resistance and stability* (BWR 1) but are treated under the Basic Works Requirement *Safety and accessibility in use* (BWR 4).
The fire resistance requirement is applicable to the wall (made of masonry, concrete, timber or metal frame) and not to the PF-ALU-HTR kit itself.

3.1 Reaction to fire

Reaction to fire of PF-ALU-HTR kit according to Commission Delegated Regulation (EU) 2016/364 and EN 13501-1 is Class A1 without need of testing according to Decision 96/603/EC as amended.

The plastic material of the special anchors TR-MASA can be considered small component, so it can be ignored and does not need to be tested for its reaction to fire performance.

Note: A European reference fire scenario has not been laid down for façades. In some Member States, the classification of external wall claddings according to EN 13501-1 might not be sufficient for the use in façades. An additional assessment of external wall claddings according to national provisions (e.g. on the basis of a large-scale test) might be necessary to comply with Member State regulations, until the existing European classification system has been completed.

3.2 Wind load resistance

PF-ALU-HTR kit wind load resistance has been determined according to section 2.2.2 of EAD 090034-00-0404 considering the wind suction and pressure resistance tests and the mechanical resistance of the components (see sections 3.3 to 3.10). Test results and calculated values for the tested specimen are given in table 3.2.

For other assembled systems, wind load resistance obtained by calculation on the basis of the mechanical resistance of the kit components should not be higher than the maximum load obtained in the tests.

Table 3.2: Test results and calculated values for tested specimen.

Test results (1)				**Calculated values**
Test	**Maximum load Q (Pa)**	**Deflection under maximum load (mm)**	**Deflection after 1 min recovery (mm)**	**Load (Pa)** (4)
Suction	3000 (2)	17,02 (3)	2,05	2160
Pressure	3600 (2)	10,47 (3)	1,48	

(1) Tests specimen: marble skin element 1200x600x30 mm; three PF-ALU-60 vertical profiles, span 950 mm; four horizontal profiles PF-AL-HTR60 span 600 mm; brackets ES-ALU-A/V 67/100, span 1300 mm. Characteristics of components are indicated in Annexes 2, 3 and 4.
(2) This load has been obtained at the test equipment limit without PF-ALU-HTR kit failure.
(3) Deflection measured at the middle point of the central vertical profile.
(4) Minimum calculated load for the tested specimen taking into account the horizontal resistance of the joint anchor/clamp-horizontal profile (see table 3.4b).

3.3 Resistance to vertical load of skin element fixing

Resistance to vertical load of GR-HTR fixing devices (TR-MASA special anchors and clamps) has been assessed according to section 2.2.4 of EAD 090034-00-0404. Mean and characteristic values are given in tables 3.3a and 3.3b.

Resistance to vertical load of GR-TR-S-I-TM, GR-TR40-I-TM, GR-TR40-S-I-TM and GR-TR60-CR is not relevant. They do not support vertical loads.

Table 3.3a: Resistance to vertical load of special anchors.

Special anchor type	Skin element	Failure load		
		$F_{u,m}$ (kN)	$F_{u,c}$ (kN)	Maximum displacement (mm)
TR MASA 20	granite stone 20 mm thickness	4,53	2,40	7,38
TR MASA 20	marble stone 20 mm thickness	4,89	4,48	9,75
TR MASA 30	granite stone 30 mm thickness	11,10	9,27	14,37
TR MASA 30	marble stone 30 mm thickness	11,28	7,36	8,18

Where: F_m is the mean value.
F_c is the characteristic value given at 75% confidence that 95% of test results will be higher than this value.

Table 3.3b: Resistance to vertical load of clamp-horizontal profile.

Clamp type	Load at 1 mm irreversible deformation		Failure load		
	F_m (kN)	F_c (kN)	$F_{u,m}$ (kN)	$F_{u,c}$ (kN)	Maximum displacement (mm)
GR-TR-S-TM	4,4	4,0	5,6	5,5	10,5
GR-TR40-S-TM	3,6	3,0	4,2	3,6	4,7

Where: F_m is the mean value.
F_c is the characteristic value given at 75% confidence that 95% of test results will be higher than this value.

3.4 Resistance to horizontal load of skin element fixing

Resistance to horizontal load of GR-HTR fixing devices (TR-MASA special anchors and clamps) has been assessed according to section 2.2.5 of EAD 090034-00-0404. Mean and characteristic values are given in table 3.4a and 3.4b.

Table 3.4a: Resistance to horizontal load of special anchors.

Special anchor type	Skin element	Failure load		
		$F_{u,m}$ (kN)	$F_{u,c}$ (kN)	Maximum displacement (mm)
TR MASA 20	granite stone 20 mm thickness	3,89	1,72	3,83
TR MASA 20	marble stone 20 mm thickness	4,89	2,53	3,82
TR MASA 30	granite stone 30 mm thickness	4,99	3,64	6,16
TR MASA 30	marble stone 30 mm thickness	5,42	2,27	4,85

Where: F_m is the mean value.
F_c is the characteristic value given at 75% confidence that 95% of test results will be higher than this value.

Table 3.4b: Resistance to horizontal load of clamps-horizontal profile.

Clamp type	Load at 1 mm irreversible deformation		Failure load		
	F_m (kN)	F_c (kN)	$F_{u,m}$ (kN)	$F_{u,c}$ (kN)	Maximum displacement (mm)
GR-TR-S-TM	0,6	0,3	1,4	1,2	13,6
GR-TR-I-TM	0,3	0,2	1,0	0,8	26,0
GR-TR40-S-TM	0,3	0,2	0,6	0,2	10,5
GR-TR60	2,7	2,4	8,2	7,5	11,5
Combination of GR-TR-S-TM and GR-TR-I-TM	1,1	0,9	1,7	1,6	12,6
Combination of GR-TR40-S-TM and GR-TR40-I-TM (*)	1,0	0,7	2,3	1,6	15,2
Combination of two GR-TR60	7,7	6,9	9,9	6,3	7,7

Where: F_m is the mean value.
F_c is the characteristic value given at 75% confidence that 95% of test results will be higher than this value.
(*) These values are also valid for combination GR-TR40-S-TM / GR-TR-S-I-TM and GR-TR40-S-TM / GR-TR40-S-I-TM.

3.5 Pull-through resistance of fixings from profile

Pull-through resistance of fixings from profiles has been assessed according to section 2.2.8 of EAD 090034-00-0404. Mean and characteristic values are given in table 3.5.

Table 3.5: Pull-through resistance of fixings from horizontal profiles.

Type of horizontal profile (1)	Failure load (2)		Failure mode
	R_s (kN)	R_{sc} (kN)	
PF-AL-HTR40	5,9	5,7	100% screws pass through profile.
PF-AL-HTR60			
PF-AL-HTR120-PS			
PF-AL-HTR120-T			

Where: R_s = mean value; R_{sc} = characteristic value giving 75% confidence that 95% of results will be higher than this value.
(1) The test was carried out with the profile thickness PF-AL-HTR60.
(2) The drilling screw used in the tests is the stainless steel quality A2-70 indicated in section A3.3 of Annex 3.

3.6 Pull-out resistance of fixings from profile

Pull-out resistance of fixings from profiles has been assessed according to section 2.2.9 of EAD 090034-00-0404. Mean and characteristic values are given in table 3.6.

Table 3.6: Pull-out resistance and shear strength of subframe screws.

Profile type	Drilling screw type	Pull-out		Shear strength	
		R_m (kN)	R_c (kN)	R_m (kN)	R_c (kN)
PF-AL-U or PF AL-T-60/80	M6,3x25 PB (*)	3,96	3,47	8,96	7,96
PF-AL-L, PF-AL-T (T-section) or PF-AL-J	M6,3x25 PB (**)	2,10	1,90	NA	NA

Where: R_m is the mean value.
R_c is the characteristic value given at 75% confidence that 95% of test results will be higher than this value.
NA = not assessed.
(*) The drilling screw used in the tests is the stainless steel quality A2-70 indicated in Annex 5.
(**) The drilling screw used in the tests is M4,2x13 of the same material as indicated in Annex 5. Results are valid for M6,3x25.

3.7 Inertia and resistance of profiles

The following characteristics of the profiles are given in Annex 3:

- Form and dimensions of the profiles sections.
- Inertia of the profiles sections.
- Minimum elastic limit of the profiles material.

3.8 Resistance to vertical load of brackets

Resistance to vertical load of brackets has been assessed according to section 2.2.11 of EAD 090034-00-0404. Mean and characteristic values are given in table 3.7.

Table 3.7: Bracket resistance to vertical load.

Bracket type (mm)		**Resistance (kN) at 1 mm of displacement (**)**		**Resistance (kN) at 3 mm of displacement (**)**		**Resistance (kN) at ΔL = 0,2%·L mm of permanent deflection (**)**		**Ultimate resistance (kN) (**)**	
		Fm	**Fc**	**Fm**	**Fc**	**Fm**	**Fc**	**Fm**	**Fc**
ES-ALU-A ES-ALU-V	45/100	3,9	2,7	13,3	10,3	1,8	0,5	25,0	25,0
	67/100 (*) 87/100	2,6	2,2	5,2	4,1	1,8	1,4	13,0	11,2
	117/100	2,6	1,4	5,7	4,8	2,8	0,3	15,0	15,0
	148/100	1,2	0,7	3,1	2,3	1,2	0,1	12,5	12,5
	177/100	1,3	1,1	2,9	2,5	2,4	1,7	10,0	10,0
	208/100	1,0	0,5	2,1	1,5	2,1	0,6	7,5	7,5
	238/100 (*) 267/100	0,7	0,4	1,7	1,5	2,7	1,6	6,5	5,6
ES-ALU-L-A	57/100	1,3	1,2	3,6	3,0	0,6	0,3	11,5	11,0
	77/100	1,3	0,9	3,0	2,6	0,6	0,5	10,0	8,9
	97/100	0,7	0,5	1,9	1,7	0,6	0,3	7,1	6,0
	119/100	0,5	0,3	1,4	1,2	0,8	0,5	5,1	4,7
	137/100	0,5	0,5	1,4	1,4	0,7	0,6	4,4	3,9
ES-INOX-A	238/100 (*) 267/100	0,8	0,6	1,5	1,3	1,5	1,2	2,9	2,8
	296/100 (*) 325/100	0,7	0,4	1,2	1,0	1,7	1,4	2,4	2,2
ES-ALU-E	67/200 (*) 87/200	6,8	5,5	17,4	13,6	4,1	2,8	30,9	28,7
	117/200	4,8	2,7	12,3	8,2	2,4	2,0	25,0	25,0
	148/200	3,2	2,7	8,3	6,3	3,3	3,0	17,5	17,5
	177/200	2,0	1,2	5,5	4,5	1,9	1,2	12,5	12,5
	208/200	2,4	1,7	5,5	3,6	3,1	0,8	13,3	8,5
	238/200 (*) 267/200	2,9	1,6	5,8	3,1	7,5	7,1	20,0	19,4
ES-INOX-E	238/200 (*) 267/200	2,9	2,0	5,8	4,5	6,2	3,4	10,0	8,6
	296/200 (*) 325/200	2,2	2,0	4,5	3,8	5,6	3,9	11,2	8,3

Where:
F_m = mean values; F_c = characteristic values giving 75% confidence that 95% of results will be higher than this value.
(*) Bracket not tested. Values from another representative bracket.
(**) When the bracket includes the thermal bridge break piece (see Annex 4), these resistance values shall be reduced applying a reduction factor = 0,80.

3.9 Resistance to horizontal load of brackets

Resistance to horizontal load of brackets has been assessed according to section 2.2.12 of EAD 090034-00-0404. Mean and characteristic values are given in table 3.8.

Table 3.8: Bracket resistance to horizontal load.

Bracket type (mm)		Resistance (kN) at 1 mm of permanent deflection		Ultimate resistance (kN)	
		Fm	Fc	Fm	Fc
ES-ALU-A ES-ALU-V	45/100 67/100 (*)	5,8	5,1	11,6	9,9
	87/100	8,3	7,0	15,4	14,7
	117/100	10,4	8,4	18,7	15,4
	148/100	10,6	10,3	20,0	17,4
	177/100	10,5	8,2	20,3	18,6
	208/100 238/100 (*)	10,5	8,7	20,1	18,6
	267/100	18,2	15,6	18,8	17,0
ES-ALU-L-A	57/100	3,5	3,3	7,9	7,3
	77/100	5,2	4,4	9,7	9,1
	97/100	4,4	3,9	9,2	8,6
	119/100	5,0	4,1	9,8	9,0
	137/100	5,4	4,7	11,7	11,1
ES-INOX-E	238/100 (*) 267/100 (*) 296/100 (*) 325/100	11,4	7,5	18,1	16,1
ES-ALU-E	67/200 (*)	5,8	5,1	11,6	9,9
	87/200	16,7	14,0	21,7	20,4
	117/200	9,8	6,1	24,6	23,4
	148/200	13,1	9,0	24,2	23,1
	177/200	12,6	9,9	24,9	24,0
	208/200 238/200 (*)	8,5	4,2	25,4	23,3
	267/200	24,5	21,8	25,1	22,3
ES-INOX-E	238/200 (*) 267/200 296/200 (*) 325/200	16,9	13,2	23,6	18,0

Where:
F_m = mean values; F_c = characteristic values giving 75% confidence that 95% of results will be higher than this value.
(*) Bracket not tested. Minimum value is considered.

3.10 Mechanical characteristic of subframe fixings

Shear load strength of subframe fixings has been tested (see table 3.6).

Tensile strength of subframe fixing at least meets the values given in table 3.6 for pull-out resistance.

3.11 Corrosion

The GR-HTR fixing devices are made of various metallic elements, as shown in Annex 2. Special anchor TR MASA are made of stainless steel 1.4305 according to EN 10088, and the threaded screw, set screw, nuts and washers are made of stainless steel, quality A2 or A4 according to EN ISO 3506. In addition, subframe drilling screws are made of stainless steel, quality A2 or A4 according to EN ISO 3506. Besides, horizontal profiles and clamps are made of aluminum alloy AW 6005A EP/O T6 according to EN 573, EN 1999 and EN 755. The durability is class B and the minimum thickness is 2,0 mm.

Therefore, the GR-HTR fixing devices and subframe screws may be used in dry internal conditions or exposure in permanent damp internal conditions and also in external atmospheric exposure with high category of corrosivity of the atmosphere (including industrial and marine environment, C4 as defined in ISO 9223), if no particular aggressive conditions exist. Such particular aggressive conditions are e.g. permanent or alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with extreme chemical pollution (e.g. in desulphurization plants or road tunnels where de-icing materials are used).

The profiles and ES-ALU brackets are made of aluminum alloy AW 6005A EP/O T6 according to EN 573, EN 1999 and EN 755. The durability is class B and the minimum thickness is 2,0 mm. Therefore, these components may be used in the following external atmospheric exposure: rural environment, moderate industrial/urban environment, but excluding industrial marine environment. These components may be used in other external atmospheric conditions exposure if the components are protected as indicated in EN 1999-1-1.

ES-INOX brackets are made of stainless steel 1.4307 according to EN 10088, Therefore, these brackets may be used in dry internal conditions or exposure in permanent damp internal conditions and also in external atmospheric exposure with high category of corrosivity of the atmosphere (including industrial and marine environment, C4 as defined in ISO 9223), if no particular aggressive conditions exist. Such particular aggressive conditions are e.g. permanent or alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with extreme chemical pollution (e.g. in desulphurization plants or road tunnels where de-icing materials are used).

In addition, special attention should be considered in order to prevent the possible galvanic corrosion.

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

According to the decision 2003/640/EC, as amended of the European Commission[4], the systems of AVCP (see EC delegated regulation (EU) No 568/2014 amending Annex V to Regulation (EU) 305/2011) given in the following table apply.

Table 4.1: Applicable AVPC system.

Product	Intended use	Level or class	System
Subframe and fixing kits for fastening cladding and external wall elements	External finishes of walls	Any	2+
	For uses subject to regulations on reaction to fire	A1	4

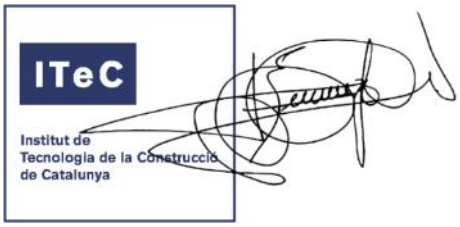
[4] 2003/640/EC – Commission Decision of date 4 September 2003, published in the Official Journal of the European Union (OJEU) L226/21 of 10/09/2003.

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

All the necessary technical details for the implementation of the AVCP system are laid down in the *Control Plan* deposited with the ITeC[5], with which the factory production control shall be in accordance.

Issued in Barcelona on 04 March 2020

by the Catalonia Institute of Construction Technology.



Ferran Bermejo Nualart

Technical Director, ITeC

[5] The *Control Plan* is a confidential part of the ETA and is only handed over to the notified certification body involved in the assessment and verification of constancy of performance.

ANNEX 1: PF-ALU-HTR assembled system

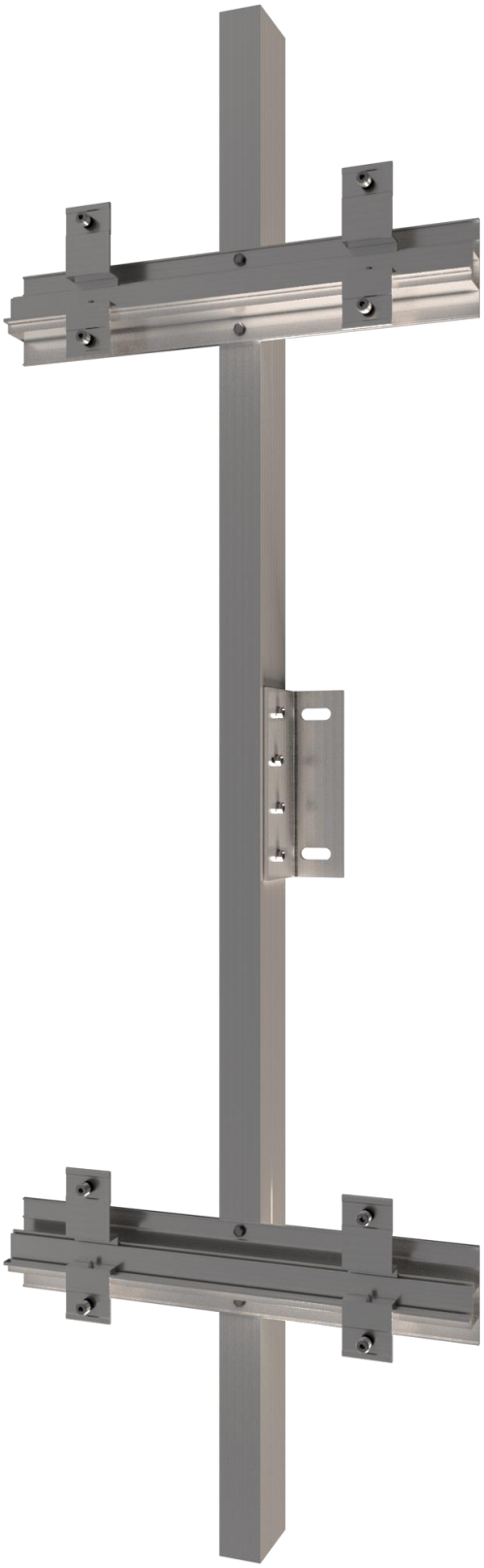


Figure A1.1: PF-ALU-HTR assembled system.

ANNEX 2: Fixing device components

A2.1. TR-MASA special anchors

Geometry characteristics			
TR MASA special anchors	**Designation**	**Components**	
	TR MASA 20	Metallic capsule 12,7 mm length	See figure A2.1.1a
		Polyethylene sleeve 4,6 mm length	
		Three curved washer	
		Three flat washers	
		One screw M6x16	See figure A2.1.2
	TR MASA 30	Metallic capsule 20,9 mm length	See figure A2.1.1b
		Polyethylene sleeve 10,5 mm length	
		Four curved washer	
		Four flat washers	
		One screw M6x22	See figure A2.1.2

Material properties		Values		Reference
Metallic capsule	Type of material	Stainless steel 1.4305 (X8CrNi18-9)		EN 10088-1
	Density (kg/m^3)	7900		
	Modulus of elasticity at 20ºC (MPa)	200000		
	Thermal expansion coefficient at 20 ºC-100 ºC (µm/m·ºC)	16,0		
	Elastic limit $R_{p0,2}$ (MPa)	190		EN 10088-2
	Tensile strength R_m (MPa)	500 - 700		
	Elongation A (%)	35		
	Intergranular corrosion resistance at delivery conditions	No		
Polyethylene sleeve	Type of material	PolyethyleneLDPE 650		ISO 527-2
	Density (g/cm^3)	0,93		
	Modulus of elasticity at 20ºC (MPa)	200		
	Tensile strength R_m (MPa)	9		
	Elongation A (%)	120		
	Shore durometre	44		ISO 868
Screws	Type of material	Stainless steel quality A2-70	Stainless steel quality A4-80	EN ISO 3506-1
	Elastic limit $R_{p0,2}$ (MPa)	450	600	
	Tensile strength R_m (MPa)	700	800	
	Elongation A (%)	0,4·d	0,3·d	
Washers	Type of material	Stainless steel 1.4310 (X10CrNi18-8)		EN 10088-1
	Density (kg/m^3)	8000		
	Modulus of elasticity at 20 ºC (MPa)	210000		
	Modulus of rigidity, G (MPa)	81000		
	Thermal expansion coefficient at 20ºC-100ºC (µm/m·ºC)	16,0		
	Elastic limit $R_{p0,2}$ (MPa)	250		EN 10088-2
	Tensile strength R_m (MPa)	600 - 950		
	Elongation A (%)	40		
	Intergranular corrosion resistance at delivery conditions	No		

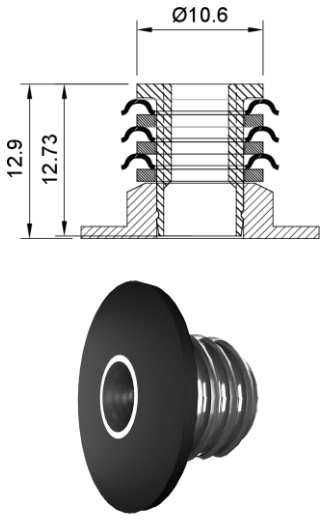


Figure A2.1.1a: TR MASA 20 special anchor.

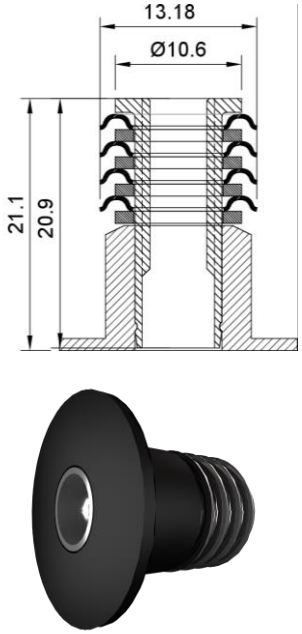


Figure A2.1.1b: TR MASA 30 special anchor.

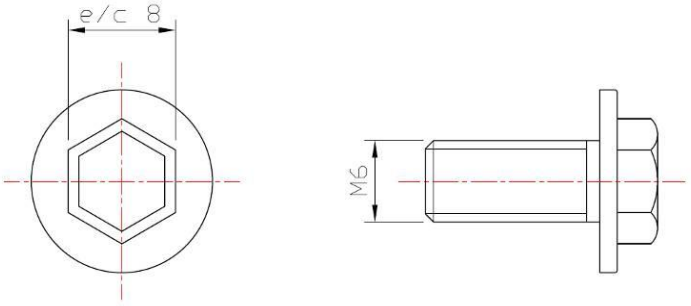
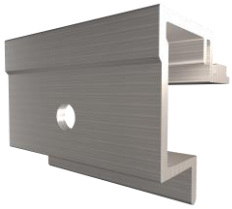


Figure A2.1.2: Screws M6 (M6x10, M6x20 and M6x22).

Figure A2.1.3: TR-MASA positioning into the skin element.

A2.2. Clamps

Geometry characteristics			
Form	 **Figure A2.2.1:** Upper clamp GR-TR-S-TM.	 **Figure A2.2.2:** Lower clamp GR-TR-I-TM.	 **Figure A2.2.3:** Clamp GR-TR60-CR.
Geometry and dimensions (mm)	Clamps	GR-TR-S-TM	See figure A2.2.4
		GR-TR-I-TM	See figure A2.2.5
		GR-TR-S-I-TM	See figure A2.2.6
		GR-TR40-S-TM	See figure A2.2.7
		GR-TR40-I-TM	See figure A2.2.8
		GR-TR40-S-I-TM	See figure A2.2.9
		GR-TR60-CR	See figure A2.2.10
	Screw to adjust the clamp on the horizontal profile	Allen 6x10 DIN 913 A2	See figure A2.2.11

Material properties		**Values**		**Reference**
Clamps	Type of material	Aluminium alloy EN AW-6005A EP/O T6		EN 1999-1-1
	Durability class	Class B		EN 1999-1-1
	Density (kg/m^3)	2700		EN 1999-1-1
	Modulus of elasticity (MPa)	70000		EN 1999-1-1
	Thermal expansion coefficient (µm/m·ºC)	23,0		EN 1999-1-1
	Elastic limit $R_{p0,2}$ (MPa)	225		EN 755-2 & EN 1999-1-1
	Tensile strength R_m (MPa)	270		EN 755-2 & EN 1999-1-1
	Elongation A (%)	8		EN 755-2 & EN 1999-1-1
	Poisson coefficient	0,3		EN 1999-1-1
	Modulus of transversal elasticity, G (MPa)	27000		EN 1999-1-1
Screw	Type of material	Stainless steel Quality A2-70	Stainless steel Quality A4-80	EN ISO 3506-1
	Elastic limit $R_{p0,2}$ (MPa)	450	600	EN ISO 3506-1
	Tensile strength R_m (MPa)	700	800	EN ISO 3506-1
	Elongation A (%)	0,4·d	0,3·d	EN ISO 3506-1

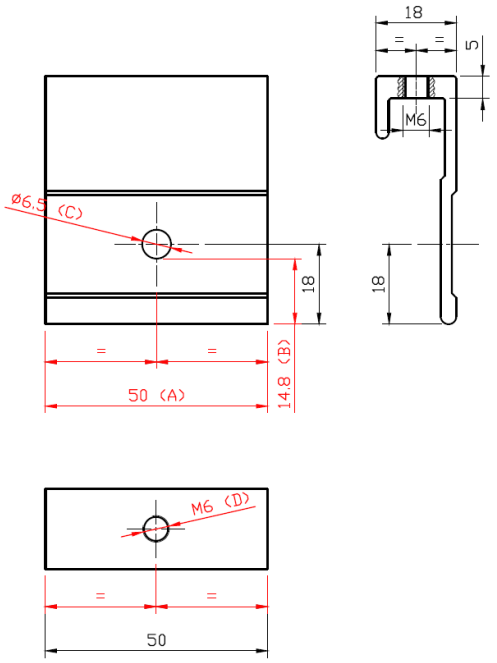


Figure A2.2.4: GR-TR-S-TM clamp.

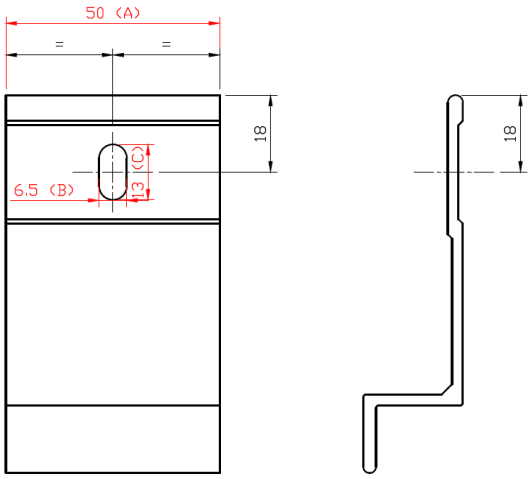


Figure A2.2.5: GR-TR-I-TM clamp.

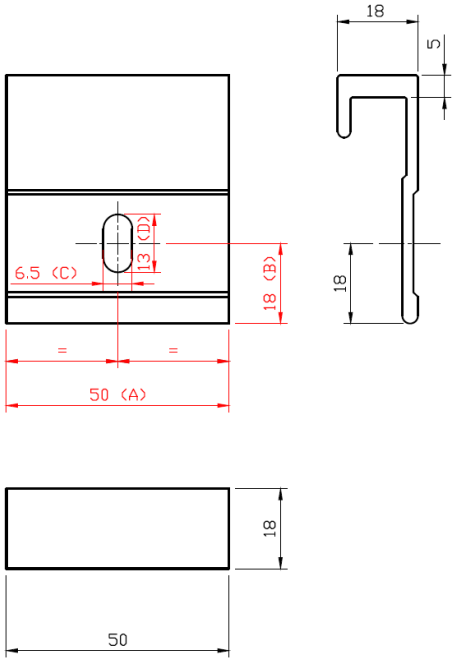


Figure A2.2.6: GR-TR-S-I-TM clamp.

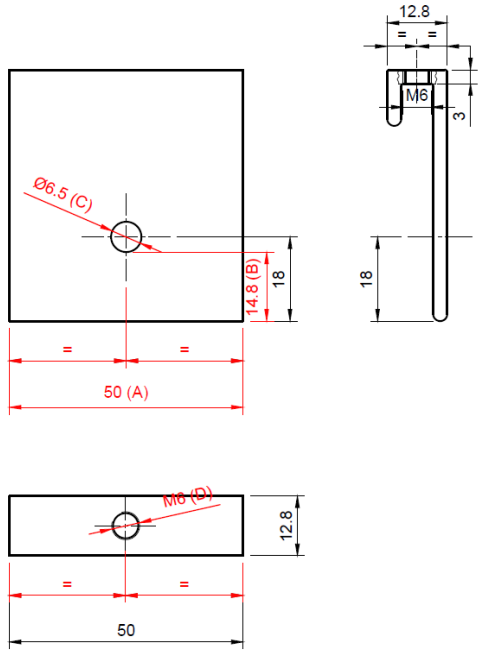


Figure A2.2.7: GR-TR40-S-TM clamp.

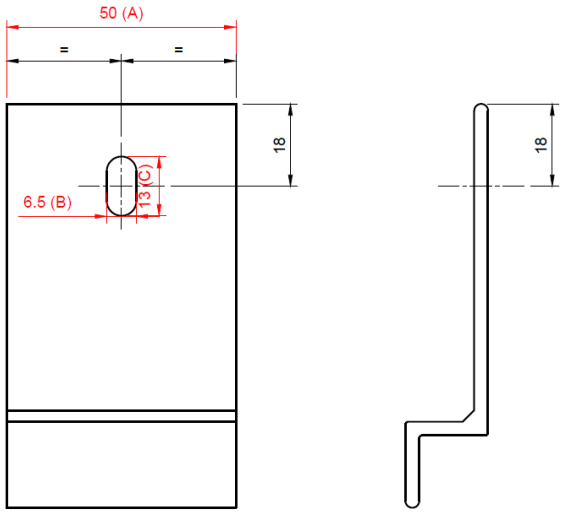


Figure A2.2.8: GR-TR40-I-TM clamp.

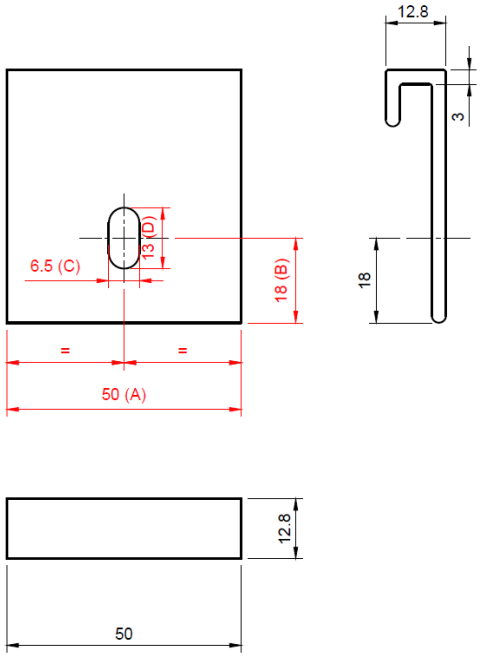


Figure A2.2.98: GR-TR40-S-I-TM clamp.

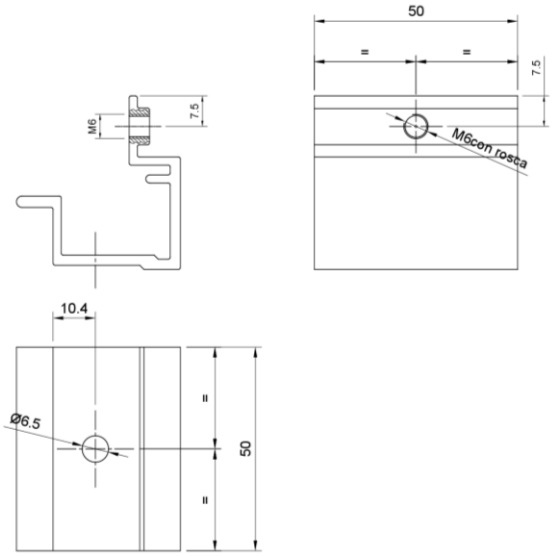


Figure A2.2.10: GR-TR60-CR clamp.

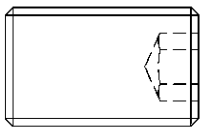


Figure A2.2.11: Screw Allen 6x10 DIN 913 A2.

A2.3. Horizontal profiles

Geometry characteristics		
Form	PF-AL-HTR40	
	PF-AL-HTR60	
	PF-AL-HTR120	

Dimensions (mm)	Horizontal profiles	PF-AL-HTR40	See figure A2.3.1
		PF-AL-HTR60	See figure A2.3.2
		PF-AL-HTR120	See figure A2.3.3
	Ancillary profiles between horizontal profiles	EUP-AL-HTR40	See figure A2.3.4
		EUP-AL-HTR60	See figure A2.3.5
		EUP-AL-HTR120	See figure A2.3.6
	Screw	M6,3x25	See section A3.3.1

Inertia of profile section (cm^4)	**Area (cm^2)**	**Ixx (cm^4)**	**Iyy (cm^4)**
PF-AL-HTR40	3,29	10,31	1,96
PF-AL-HTR60	3,94	11,81	8,56
PF-AL-HTR120	6,53	38,61	17,22

Material properties	**Values**	**Reference**
Type of material	Aluminium alloy EN AW-6005A EP/H T6	EN 1999-1-1
Durability class	Class B	EN 1999-1-1
Density (kg/m^3)	2700	EN 1999-1-1
Modulus of elasticity (MPa)	70000	EN 1999-1-1
Thermal expansion coefficient (µm/m·ºC)	23,0	EN 1999-1-1
Elastic limit $R_{p0,2}$ (MPa)	225	EN 755-2 & EN 1999-1-1
Tensile strength R_m (MPa)	270	EN 755-2 & EN 1999-1-1
Elongation A (%)	8	EN 755-2 & EN 1999-1-1
Elongation $A_{50\ mm}$ (%)	6	EN 755-2 & EN 1999-1-1
Poisson coefficient	0,3	EN 1999-1-1
Modulus of transversal elasticity, G (MPa)	27000	EN 1999-1-1

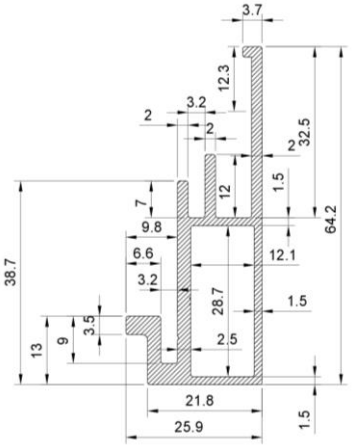


Figure A2.3.1: Horizontal profile PF-AL-HTR40.

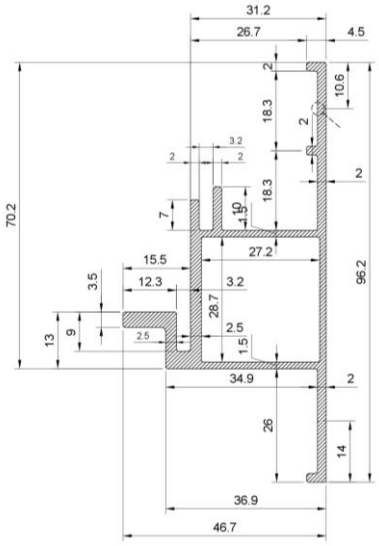


Figure A2.3.2: Horizontal profile PF-AL-HTR60.

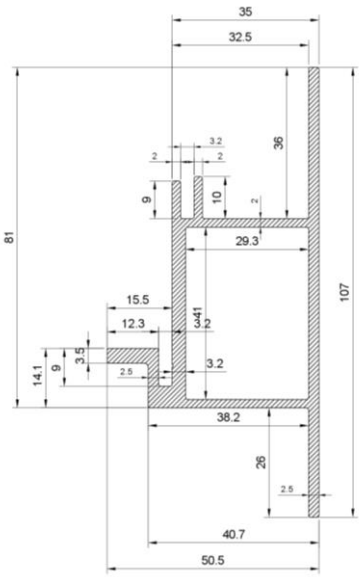
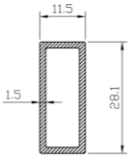


Figure A2.3.3: Horizontal profile PF-AL-HTR120.



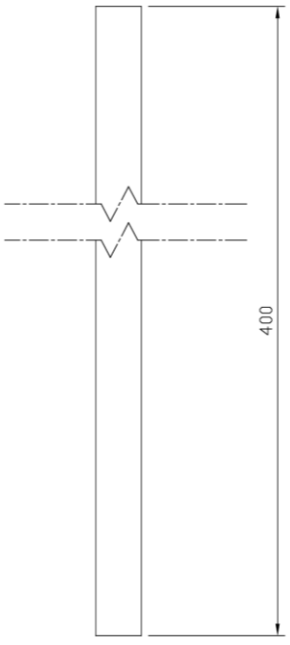
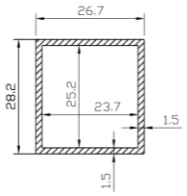


Figure A2.3.4: Ancillary profile EUP-AL-HTR40.



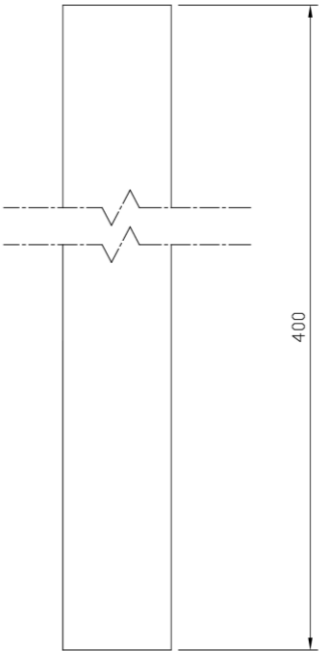
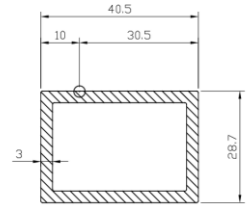


Figure A2.3.5: Ancillary profile EUP-AL-HTR60.



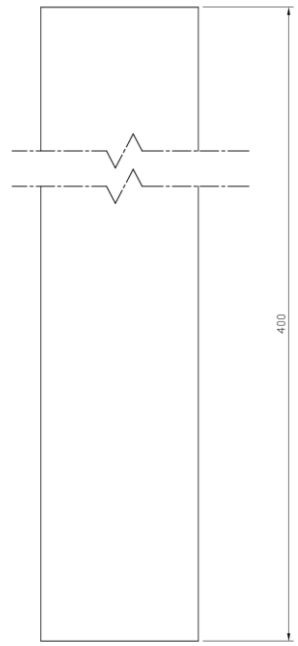


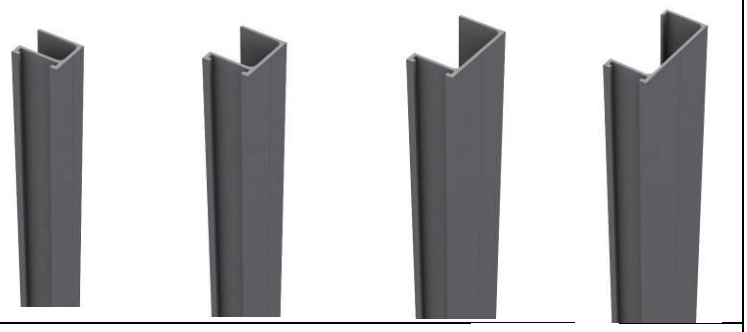
Figure A2.3.6: Ancillary profile EUP-AL-HTR120.

ANNEX 3: Subframe profiles

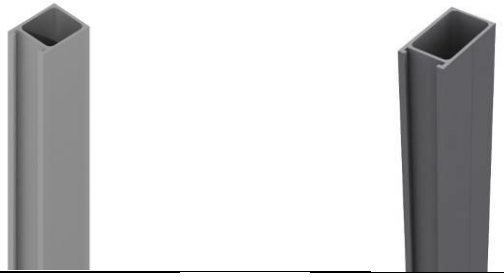
Geometry characteristics

Form

PF-AL-U-40
PF-AL-U-60
PF-AL-U-80
PF-AL-U-100



PF-AL-T-60
PF-AL-T-80



PF-AL-T
PF-AL-L
PF-AL-J

Dimensions	**dx (mm)**	**dy (mm)**	**L (mm)**	**L1 (mm)**	**L2 (mm)**	**Tolerances (mm)**	
PF-AL-U-40	19,8	18,4	40	24,1	15,9	± 0,15	Figure A3.1
PF-AL-U-60	29,4	16,7	60	32,6	24,4	± 0,15	
PF-AL-U-80	41,0	15,0	80	43,2	35,0	± 0,15	
PF-AL-U-100	51,3	14,5	100	54,1	45,9	± 0,15	
PF-AL-T-60	22,5	28,3	57	24,4	32,6	± 0,15	Figure A3.2
PF-AL-T-80	22,6	39,4	78,2	35,0	43,2	± 0,15	
PF-AL-T							Figure A3.3
PF-AL-L							Figure A3.4
PF-AL-J							Figure A3.5
Ancillary profiles between vertical profiles							EUP-ALU-40 — Figure A3.6
							EUP-ALU-60 — Figure A3.7
							EUP-ALU-80 — Figure A3.8
							EUP-ALU-100 — Figure A3.9
							EUP-AL-T-60 — Figure A3.10
							EUP-AL-T-80 — Figure A3.10
							EU-PF-ALT/L — Figure A3.11
							EU-PF-AL-J — Figure A3.12
Ancillary profiles for verticality deviations							ES-AL-O-20 — Figure A3.13
							ES-AL-O-40 — Figure A3.14

Inertia of profile section (cm^4)	**Ixx (cm^4)**	**Iyy (cm^4)**
PF-AL-U-40	9,1	10,8
PF-AL-U-60	22,5	12,2
PF-AL-U-80	49,3	13,5
PF-AL-U-100	94,1	16,3
PF-AL-T-60	25,2	19,8
PF-AL-T-80	57,4	25,5
PF-AL-T	17,6	29,3
PF-AL-L	14,3	6,7
PF-AL-J	25,3	11,9

Material properties	Values	Reference
Type of material	Aluminium alloy EN AW-6005A EP/O T6 EN AW-6005A EP/H T6	EN 1999-1-1
Durability class	Class B	EN 1999-1-1
Density (kg/m^3)	2700	EN 1999-1-1
Modulus of elasticity (MPa)	70000	EN 1999-1-1
Thermal expansion coefficient (µm/m·ºC)	23,0	EN 1999-1-1
Elastic limit $R_{p0,2}$ (MPa)	225	EN 755-2 & EN 1999-1-1
Tensile strength R_m (MPa)	270	EN 755-2 & EN 1999-1-1
Elongation A (%)	8	EN 755-2 & EN 1999-1-1
Poisson's coefficient	0,3	EN 1999-1-1
Modulus of transversal elasticity, G (MPa)	27000	EN 1999-1-1

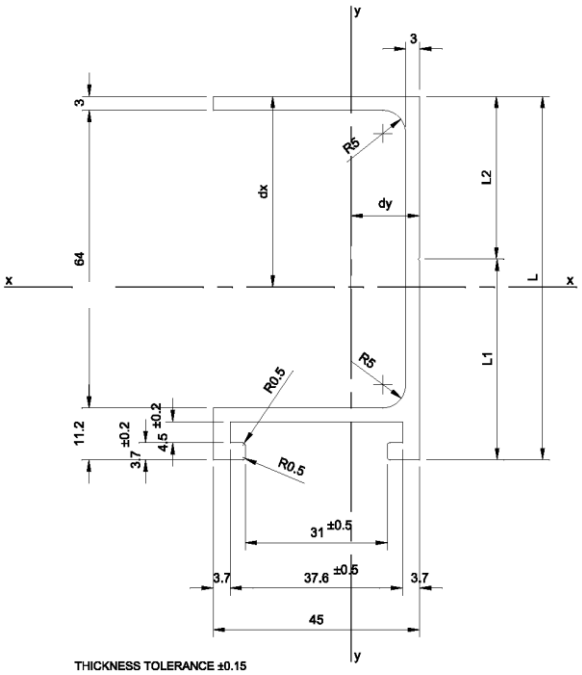


Figure A3.1: Profile PF-AL-U.

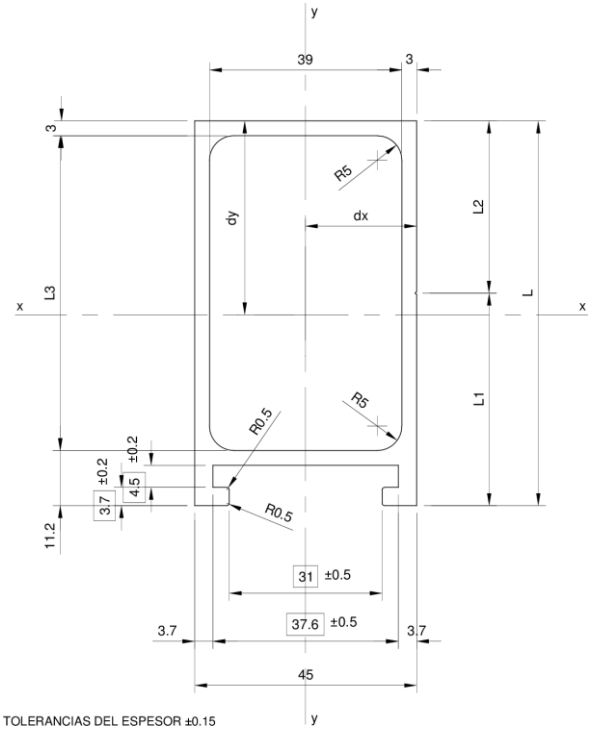


Figure A3.2: Profile PF-AL-Tu.

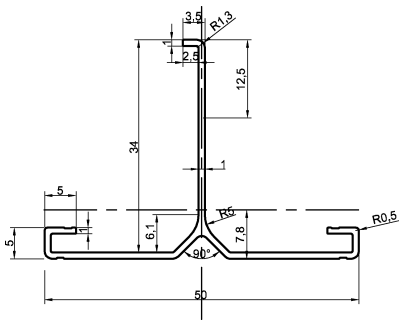


Figure A3.3: Profile PF-AL-T.

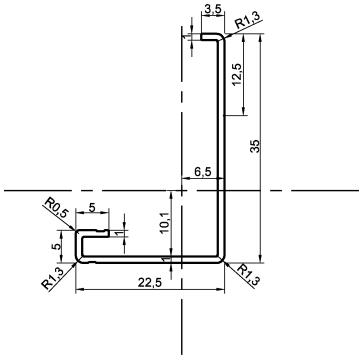


Figure A3.4: Profile PF-AL-L.

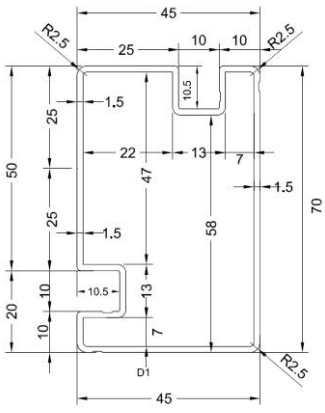


Figure A3.5: Profile PF-AL-J.

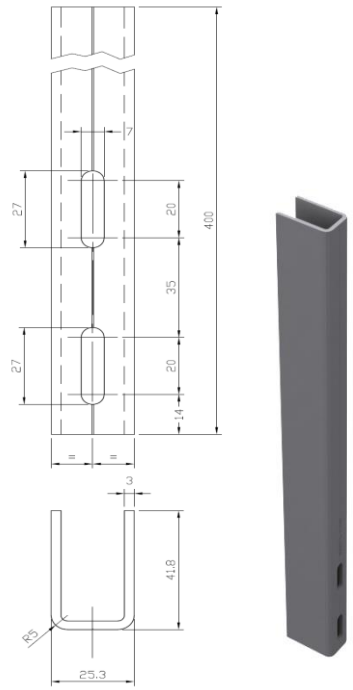


Figure A3.6: Ancillary profile EUP-ALU-40.

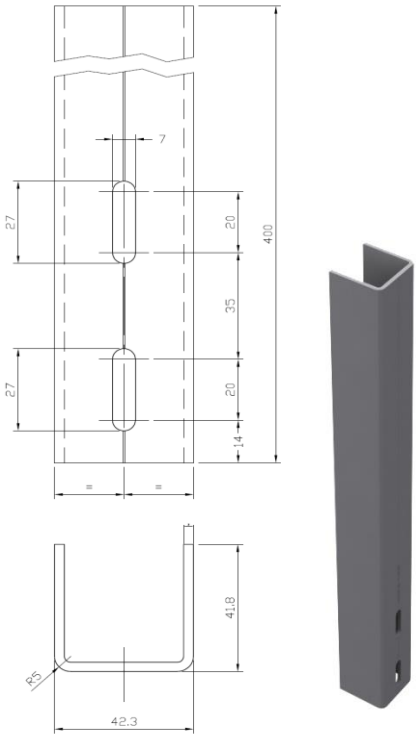


Figure A3.7: Ancillary profile EUP-ALU-60.

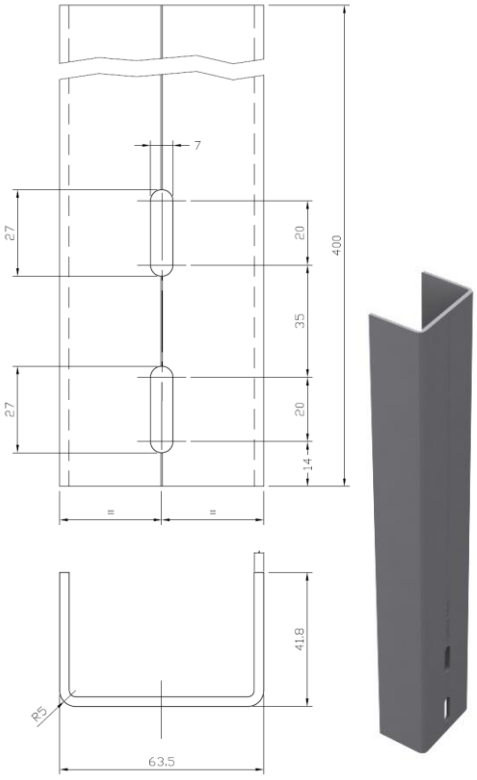


Figure A3.8: Ancillary profile EUP-ALU-80.

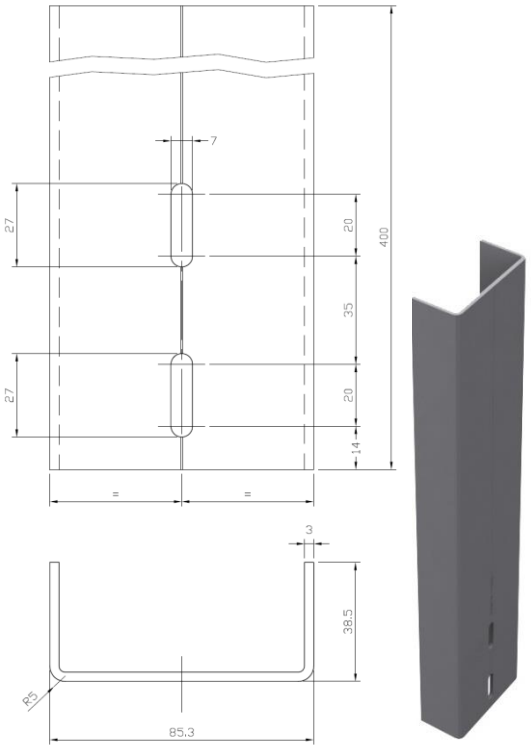


Figure A3.9: Ancillary profile EUP-ALU-100.

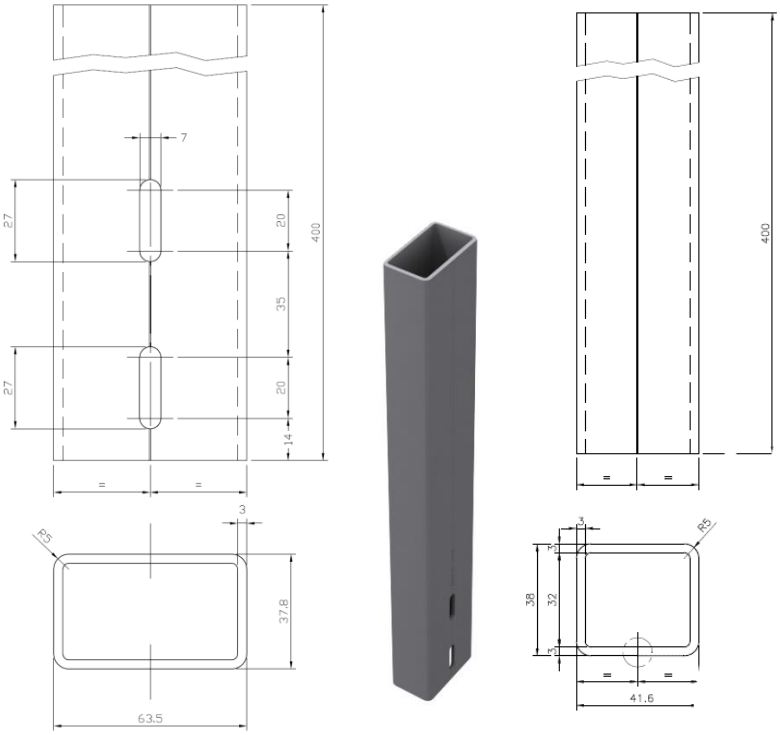


Figure A3.10: Ancillary profile EUP-ALU-T.

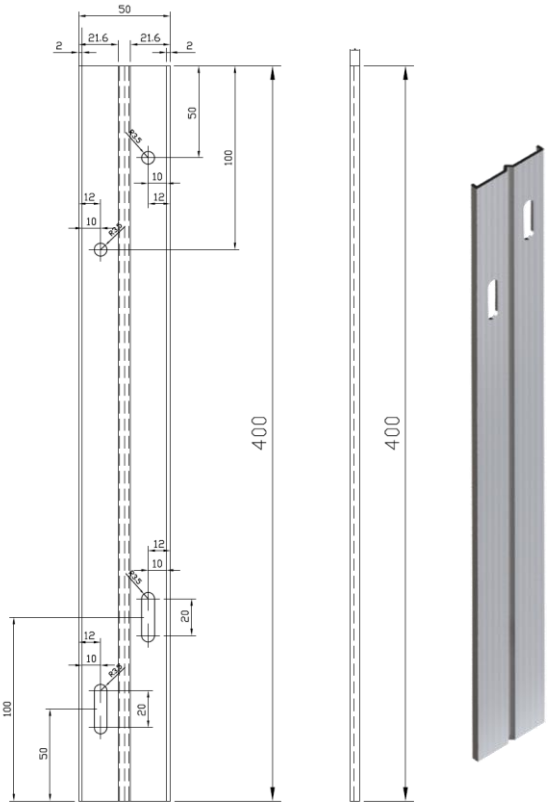


Figure A3.11: Ancillary profile EU-PF-ALT/L.

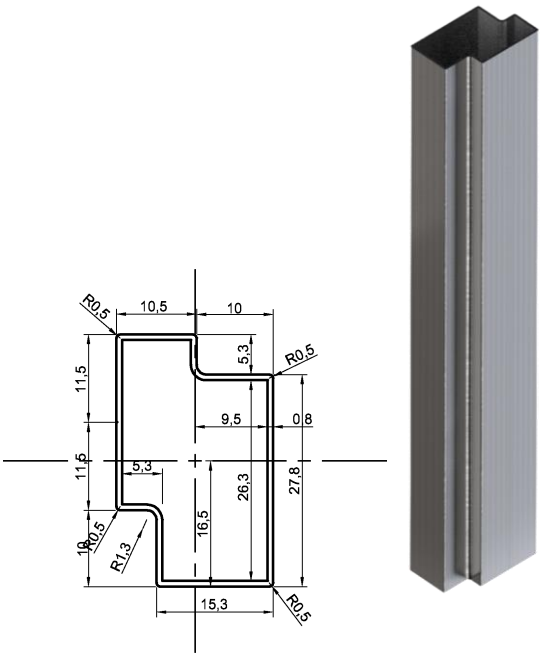


Figure A3.12: Ancillary profile EU-PF-AL-J.

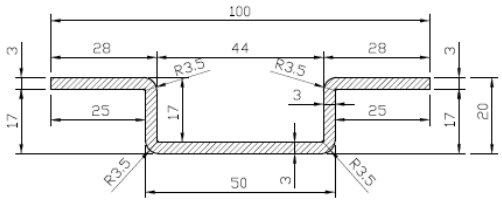


Figure A3.13: Ancillary profile ES-AL-O-20.

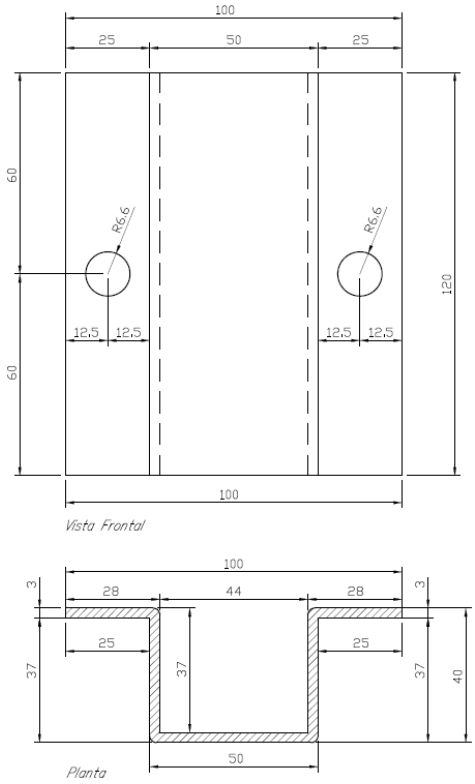


Figure A3.14: Ancillary profile ES-AL-O-40.

ANNEX 4: Subframe brackets

A4.1. Aluminium brackets

Geometry characteristics

Form

ES-ALU-A & ES-ALU-V	45/100 67/100 87/100 117/100 148/100 177/100 208/100 238/100 267/100
ES-ALU-E	67/200 87/200 117/200 148/200 177/200 208/200 238/200 267/200
ES-ALU-L-A	57/100 77/100 97/100 119/100 137/100

ES-ALU-A

ES-ALU-V

ES-ALU-E

ES-ALU-L-A

Dimensions (mm)

		L (mm)	L1 (mm)	Tolerances (mm)	
ES-ALU-A	45/100	---	---	± 0,15	Figure A4.1
	67/100	---	---	± 0,15	Figure A4.2
	87/100	---	---	± 0,15	Figure A4.3
	117/100	117	31	± 0,15	Figure A4.4
	148/100	148		± 0,15	
	177/100	177		± 0,15	
	208/100	208		± 0,15	
	238/100	---	---	± 0,15	Figure A4.5
	267/100	---	---	± 0,15	Figure A4.6
ES-ALU-V	45/100	---	---	± 0,15	Figure A4.7
	67/100	---	---	± 0,15	Figure A4.8
	87/100	---	---	± 0,15	Figure A4.9
	117/100	117	31	± 0,15	Figure A4.10
	148/100	148		± 0,15	
	177/100	177		± 0,15	
	208/100	208		± 0,15	
	238/100	---	---	± 0,15	Figure A4.11
	267/100	---	---	± 0,15	Figure A4.12
ES-ALU-E	67/200	---	---	± 0,15	Figure A4.13
	87/200	---	---	± 0,15	Figure A4.14
	117/200	117	31	± 0,15	Figure A4.15
	148/200	148		± 0,15	
	177/200	177		± 0,15	
	208/100	208		± 0,15	
	238/100	---	---	± 0,15	Figure A4.16
	267/100	---	---	± 0,15	Figure A4.17
ES-ALU-L-A	57/100	57	27,5	± 0,15	Figure A4.18
	77/100	77			Figure A4.19
	97/100	97			Figure A4.20
	119/100	119			Figure A4.21
	137/100	137			Figure A4.22
Ancillary thermal bridge break piece	Termostop 100	---	---	--	Figure A4.25a
	Termostop 200	---	---	--	Figure A4.25b

Material properties	Values	Reference
Type of material	Aluminium alloy EN AW-6005A EP/O T6	EN 1999-1-1
Durability class	Class B	EN 1999-1-1
Density (kg/m^3)	2700	EN 1999-1-1
Modulus of elasticity (MPa)	70000	EN 1999-1-1
Thermal expansion coefficient (µm/m ºC)	23,0	EN 1999-1-1
Elastic limit $R_{p0,2}$ (MPa)	225	EN 755-2 & EN 1999-1-1
Tensile strength R_m (MPa)	270	EN 755-2 & EN 1999-1-1
Elongation A (%)	8	EN 755-2 & EN 1999-1-1
Poisson's coefficient	0,3	EN 1999-1-1
Modulus of transversal elasticity, G (MPa)	27000	EN 1999-1-1

A4.2. Stainless steel brackets

Geometry characteristics						
Form	ES-INOX-A	238/100 267/100 296/100 325/100	 ES-INOX-A			
	ES-INOX-E	238/200 267/200 296/200 325/200	 ES-INOX-E			
			L (mm)	**L1 (mm)**	**Tolerances (mm)**	
Dimensions (mm)	ES-INOX-A	238/100	238	128	± 0,15	Figure A4.23
		267/100	267	157		
		296100	296	186		
		325/100	325	215		
	ES-INOX-E	238/100	238	128	± 0,15	Figure A4.24
		267/100	267	157		
		296100	296	186		
		325/100	325	215		

Material properties	Values	Reference
Type of material	Stainless steel 1.4307 (X2CrNi18-9)	EN 10088-1
Density (kg/m^3)	7900	EN 10088-1
Modulus of elasticity at 20 ºC (MPa)	200000	EN 10088-1
Thermal expansion coefficient at 20 ºC-100 ºC (µm/m ºC)	16,0	EN 10088-1
Elastic limit $R_{p0,2}$ (MPa)	200	EN 10088-2
Tensile strength R_m (MPa)	500-700	EN 10088-2
Elongation A (%)	45	EN 10088-2
Intergranular corrosion resistance at delivery conditions	Yes	EN 10088-2

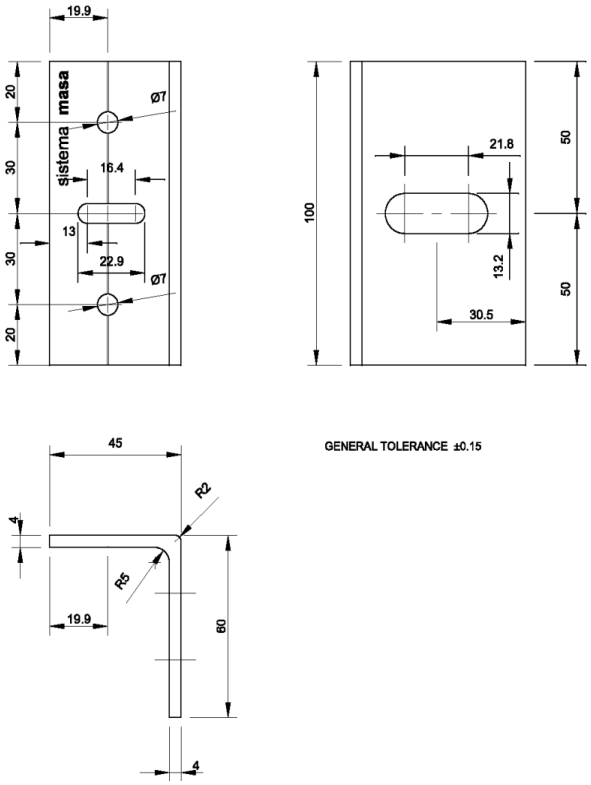


Figure A4.1: Brackets ES-ALU-45/100-A.

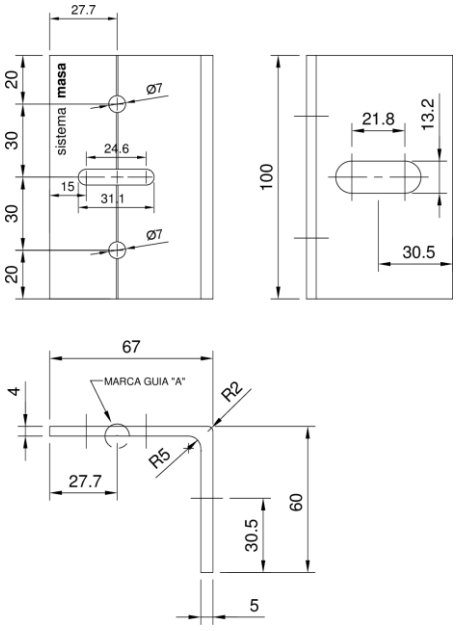


Figure A4.2: Brackets ES-ALU-67/100-A.

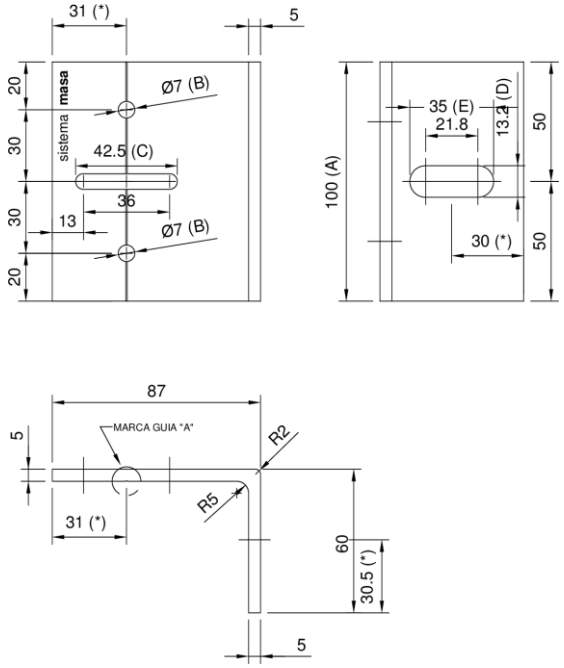


Figure A4.3: Brackets ES-ALU-87/100-A.

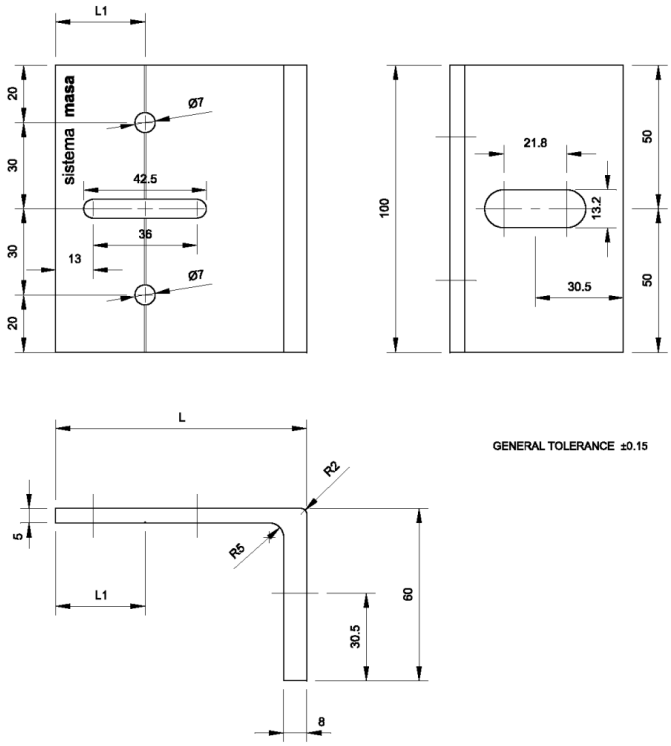


Figure A4.4: Brackets ES-ALU-(117/100; 148/100; 177/100 & 208/100)-A.

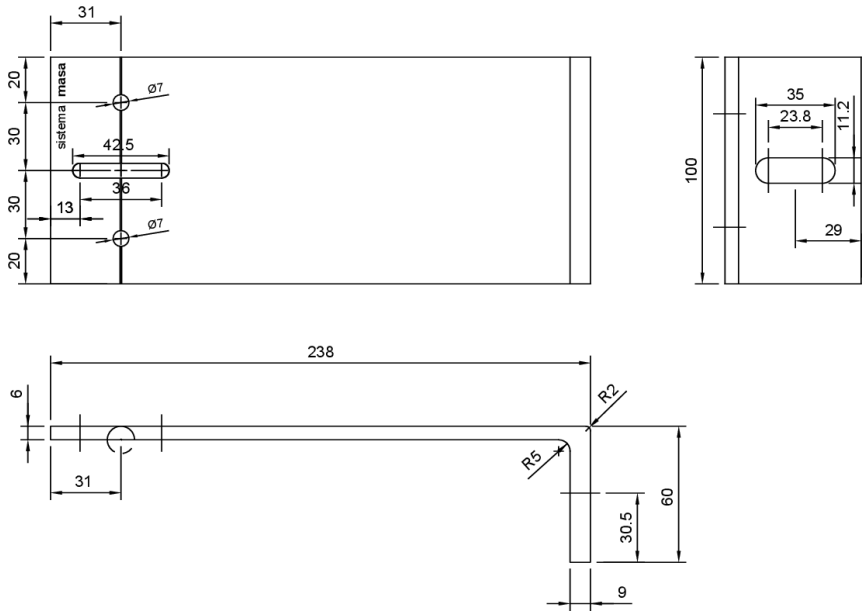


Figure A4.5: Brackets ES-ALU-238/100-A.

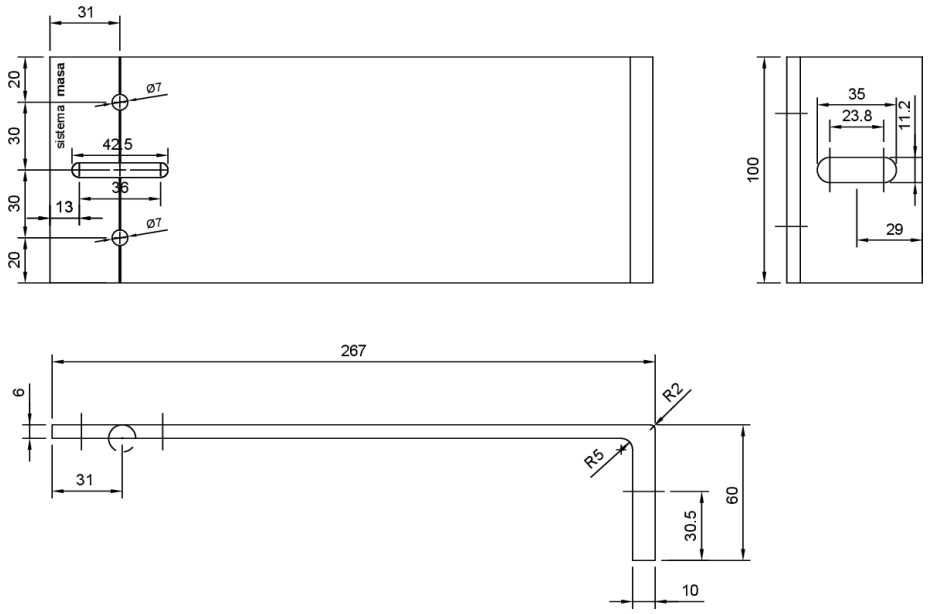


Figure A4.6: Brackets ES-ALU-267/100-A.

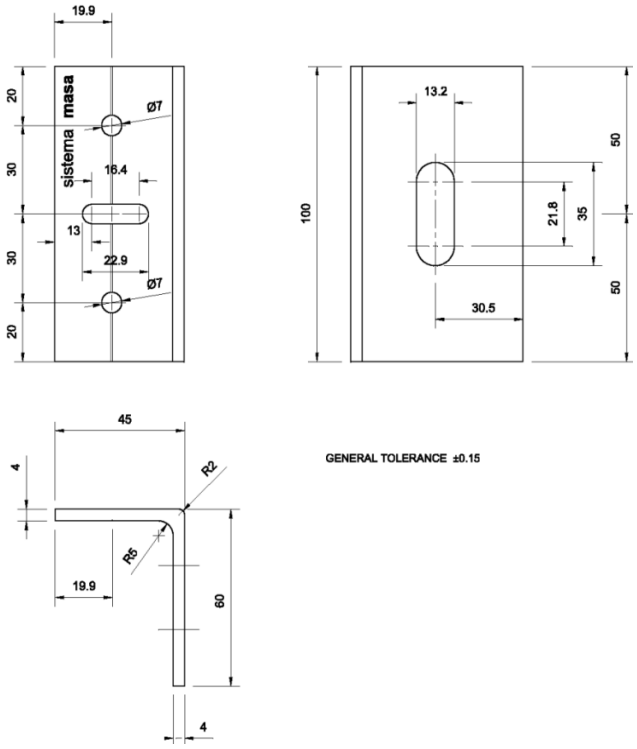


Figure A4.7: Brackets ES-ALU-45/100-V.

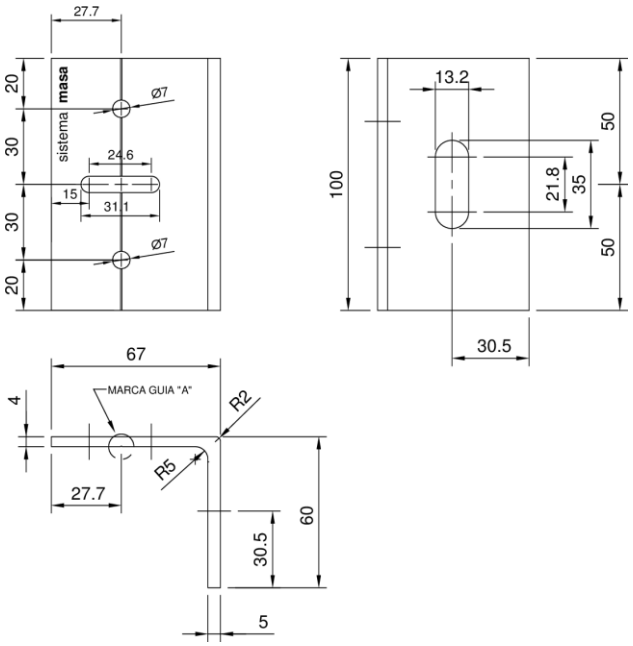


Figure A4.8: Brackets ES-ALU-67/100-V.

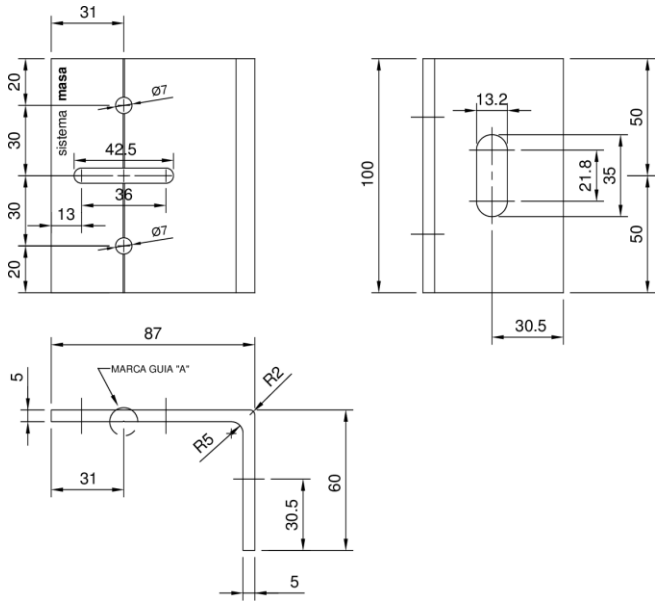


Figure A4.9: Brackets ES-ALU-87/100-V.

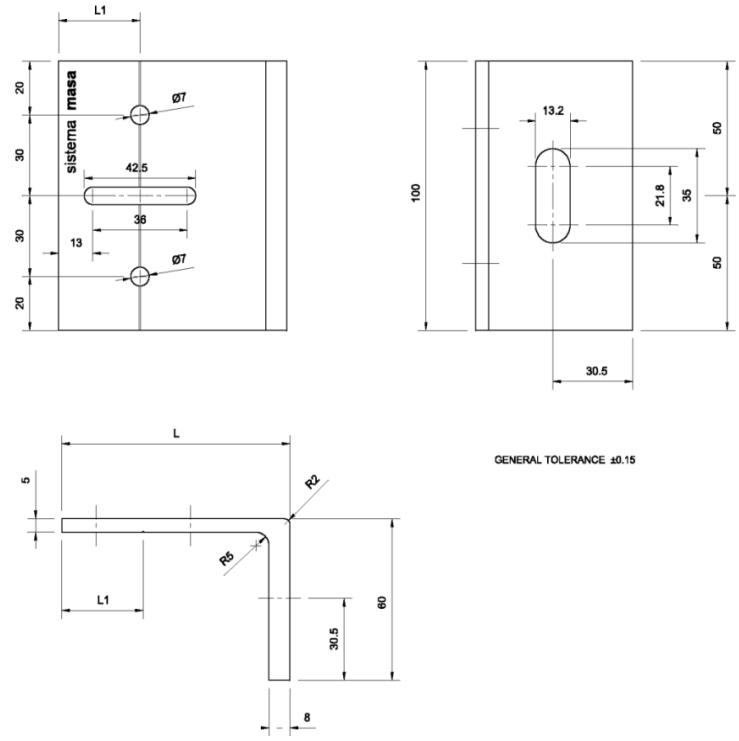


Figure A4.10: Brackets ES-ALU-(117/100; 148/100; 177/100 & 208/100)-V.

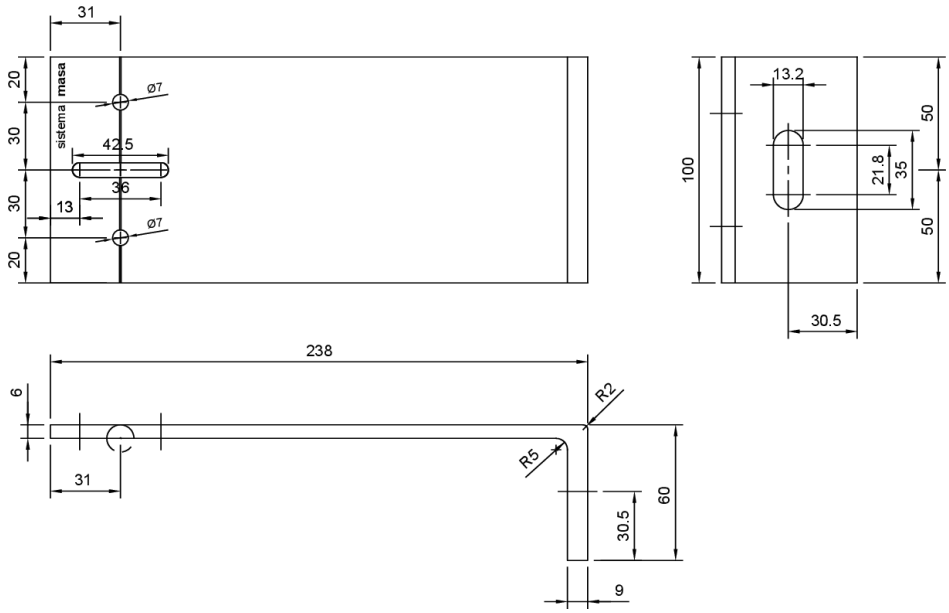


Figure A4.11: Brackets ES-ALU-238-V.

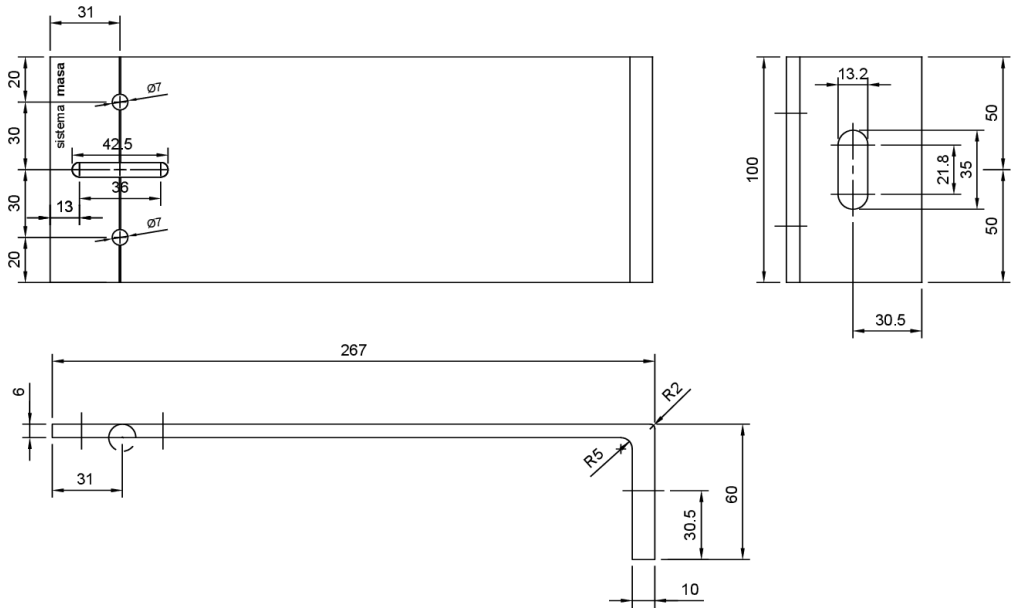


Figure A4.12: Brackets ES-ALU-267-V.

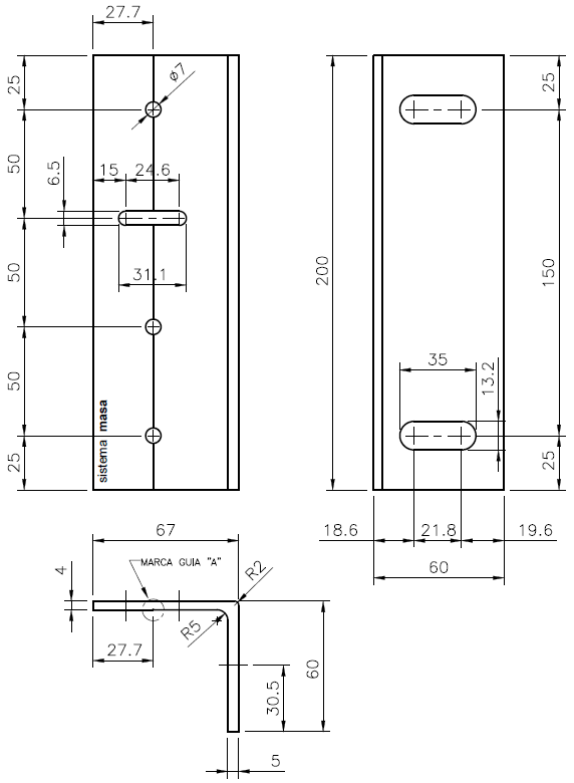


Figure A4.13: Brackets ES-ALU-67/200-E.

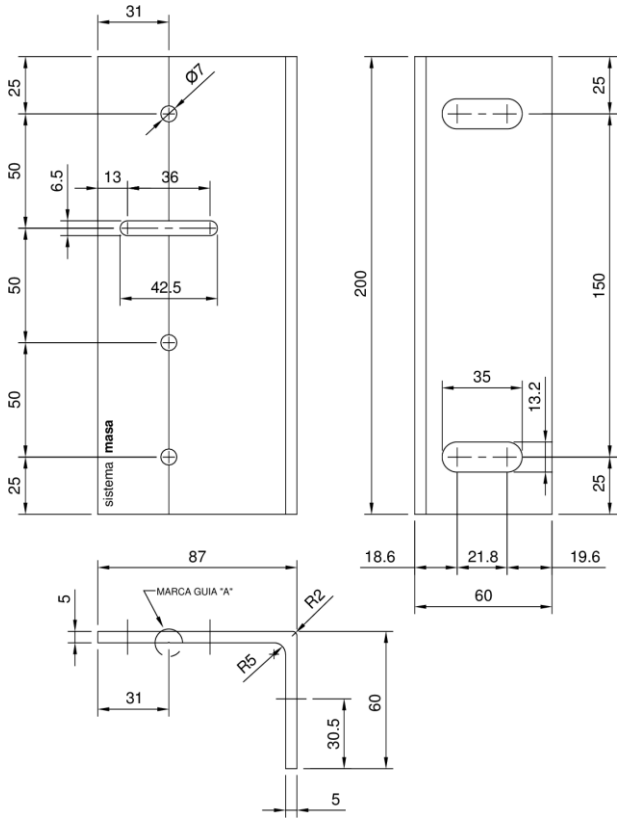


Figure A4.14: Brackets ES-ALU-87/200-E.

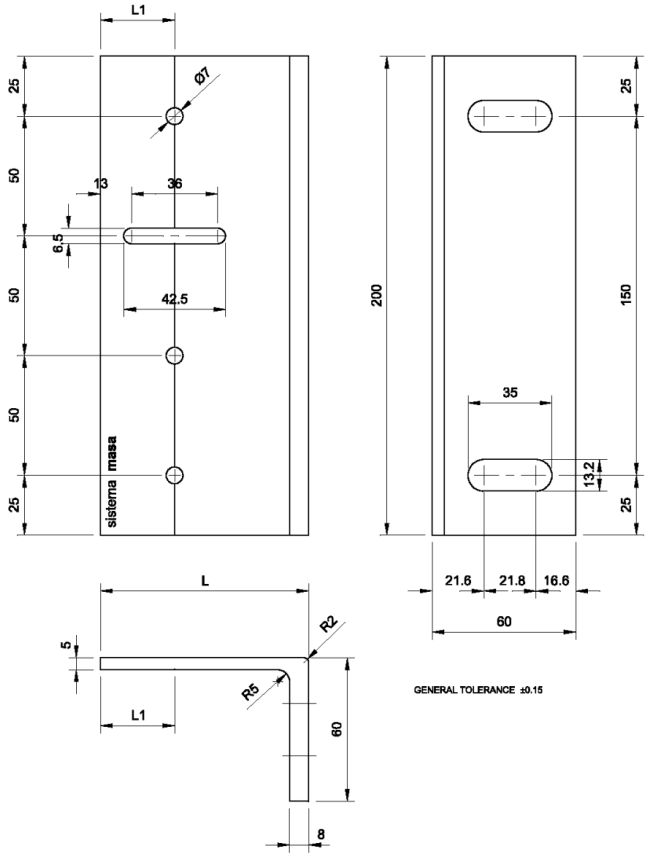


Figure A4.15: Brackets ES-ALU-(117/200; 148/200; 177/200 & 208/200)-E.

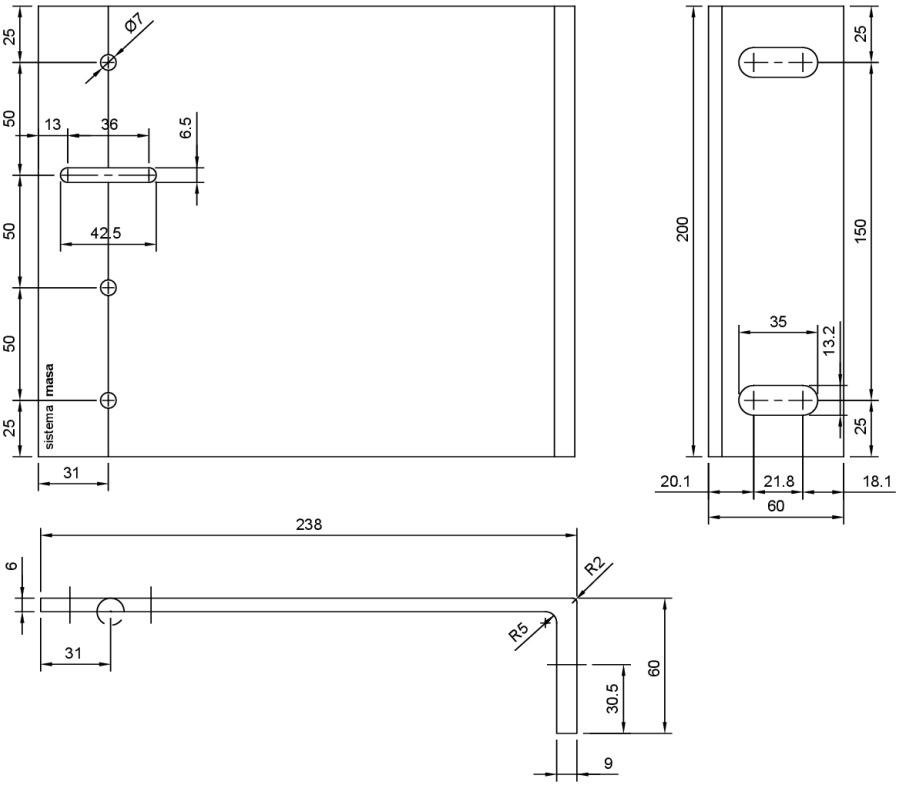


Figure A4.16: Brackets ES-ALU-238/200-E.

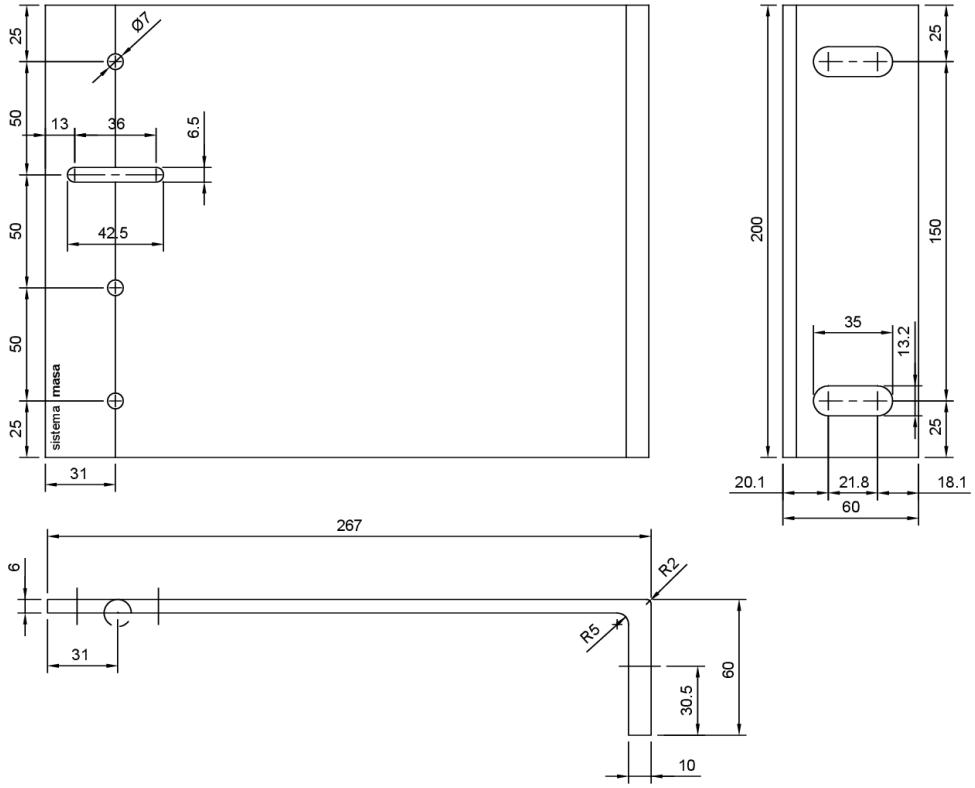


Figure A4.17: Brackets ES-ALU-267/200-E.

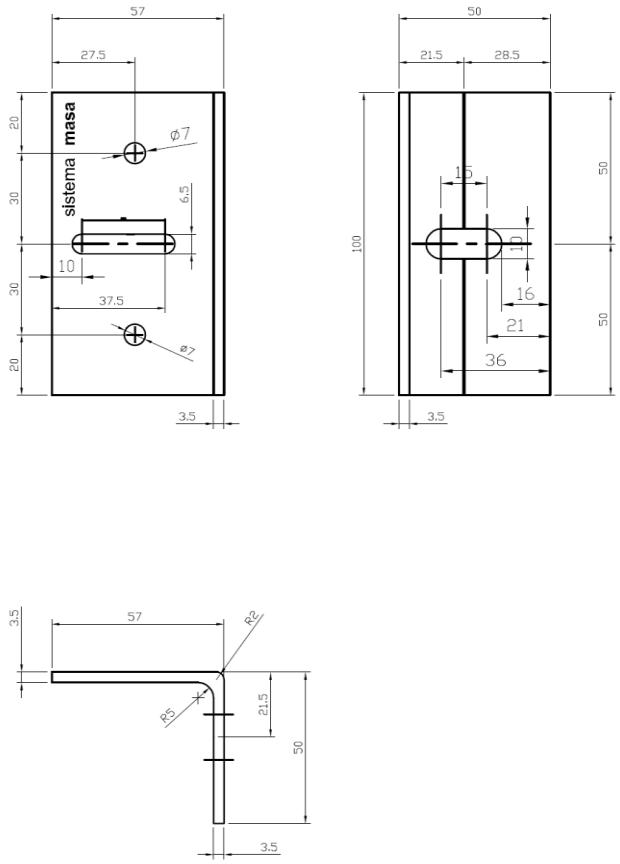


Figure A4.18: Brackets ES-ALU-L-57/100-A.

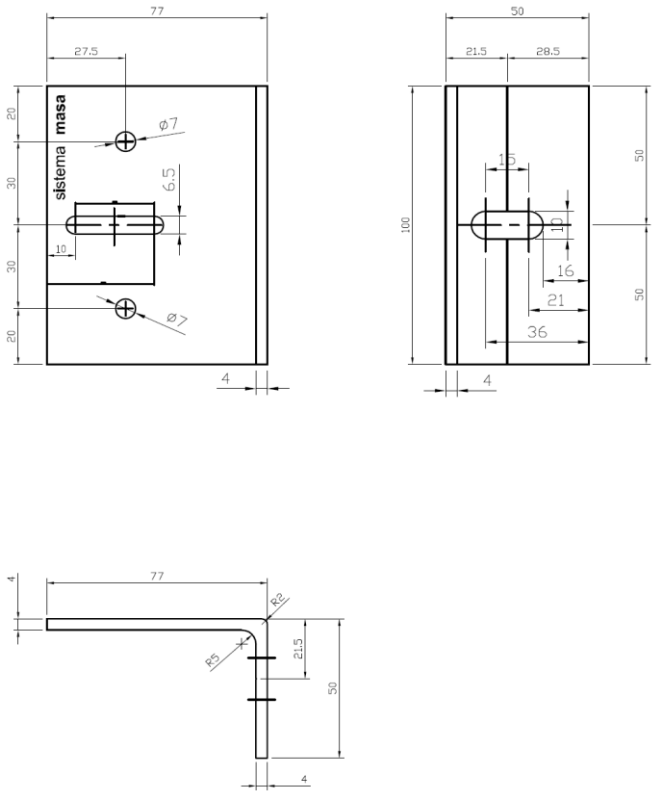


Figure A4.19: Brackets ES-ALU-L-77/100-A.

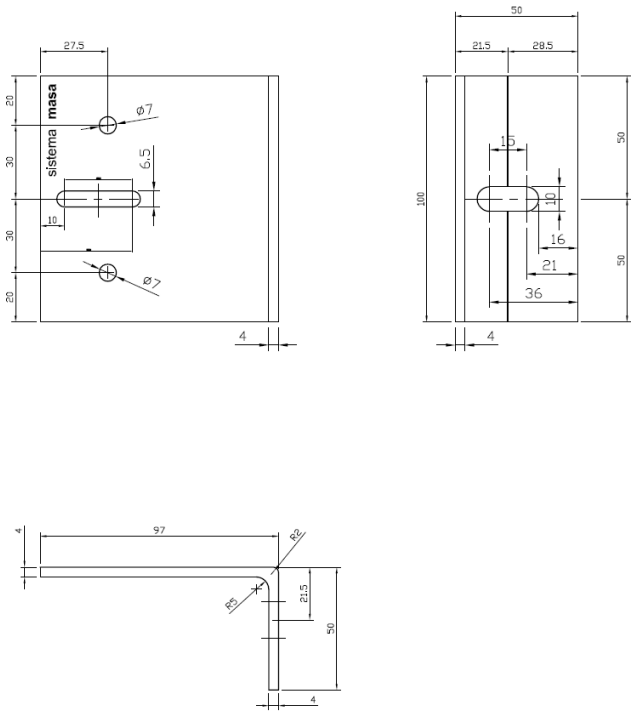


Figure A4.20: Brackets ES-ALU-L-97/100-A.

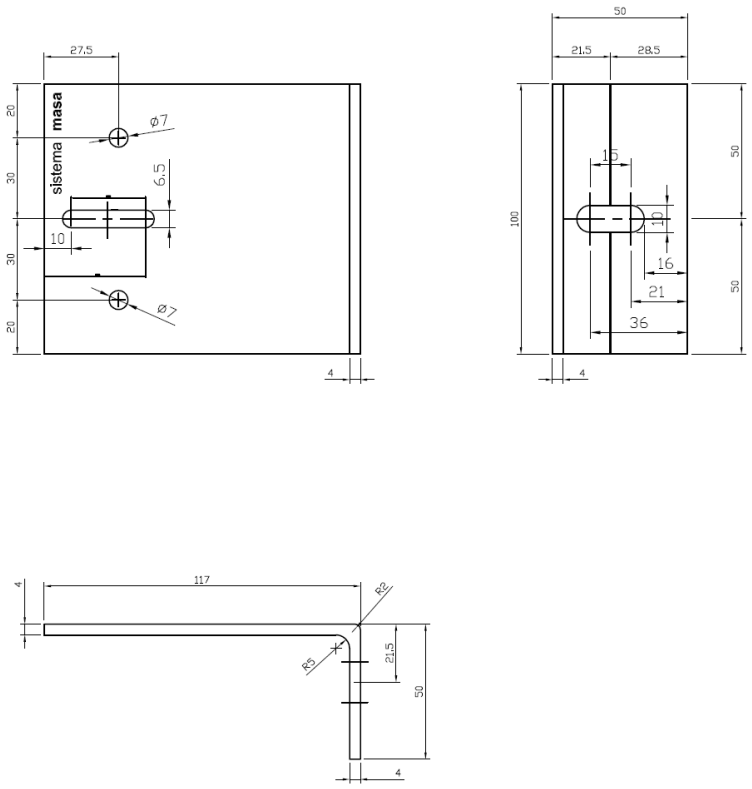


Figure A4.21: Brackets ES-ALU-L-119/100-A.

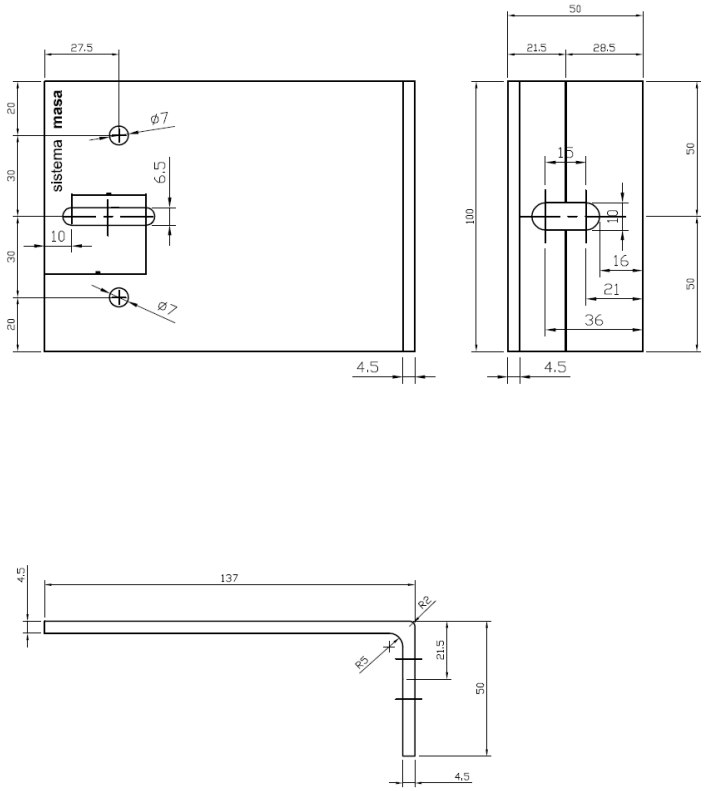


Figure A4.22: Brackets ES-ALU-L-137/100-A.

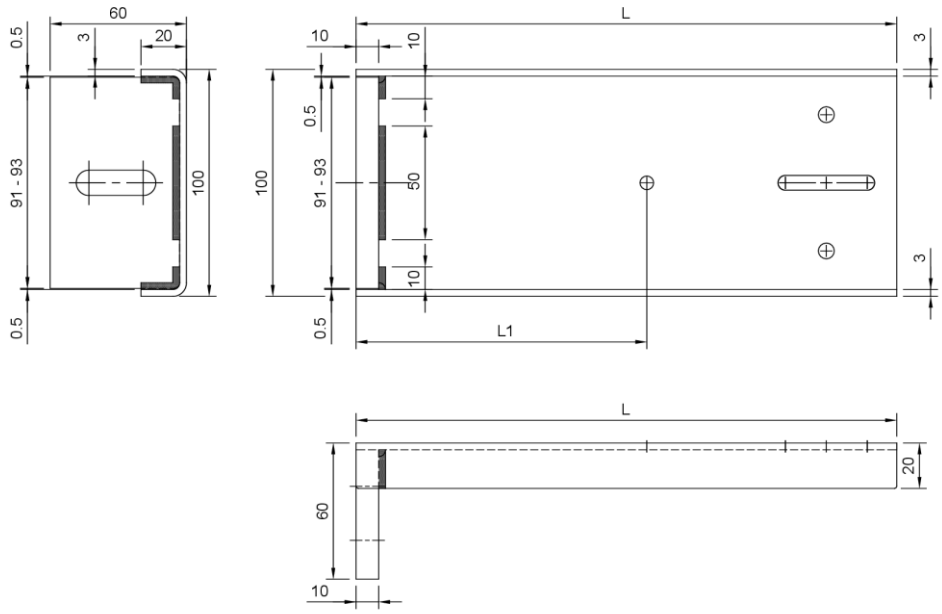


Figure A4.23: Brackets ES-INOX-(238/100; 267/100; 296/100 & 325/100)-A.

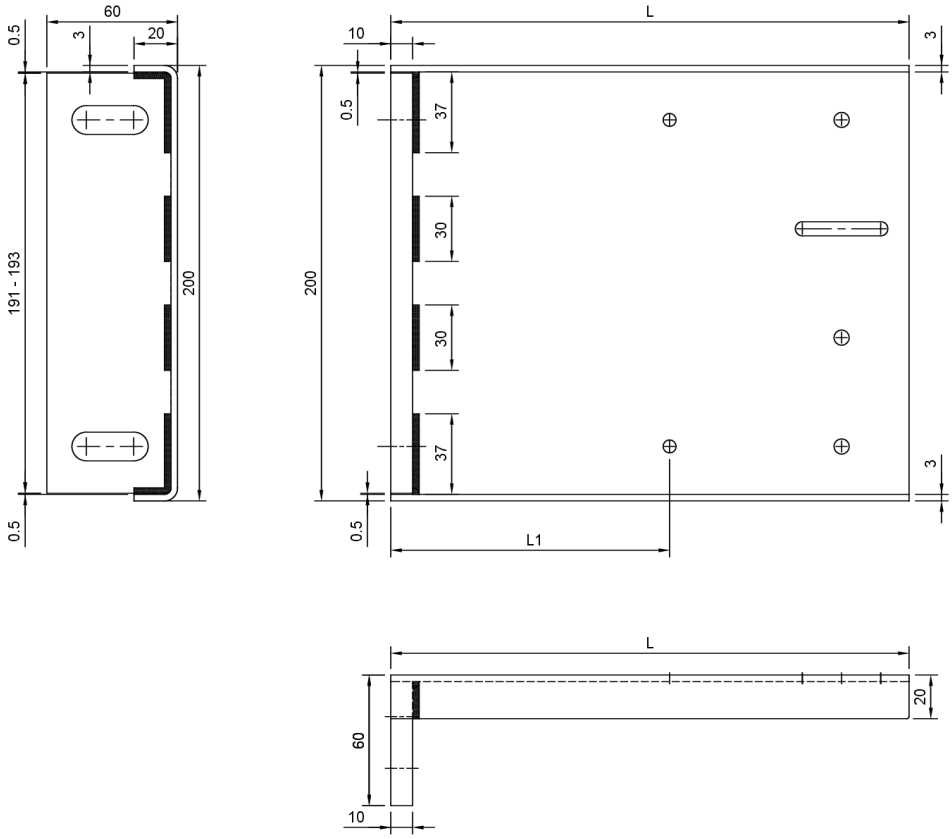


Figure A4.24: Brackets ES-INOX-(238/200; 267/200; 296/200 & 325/200)-E.

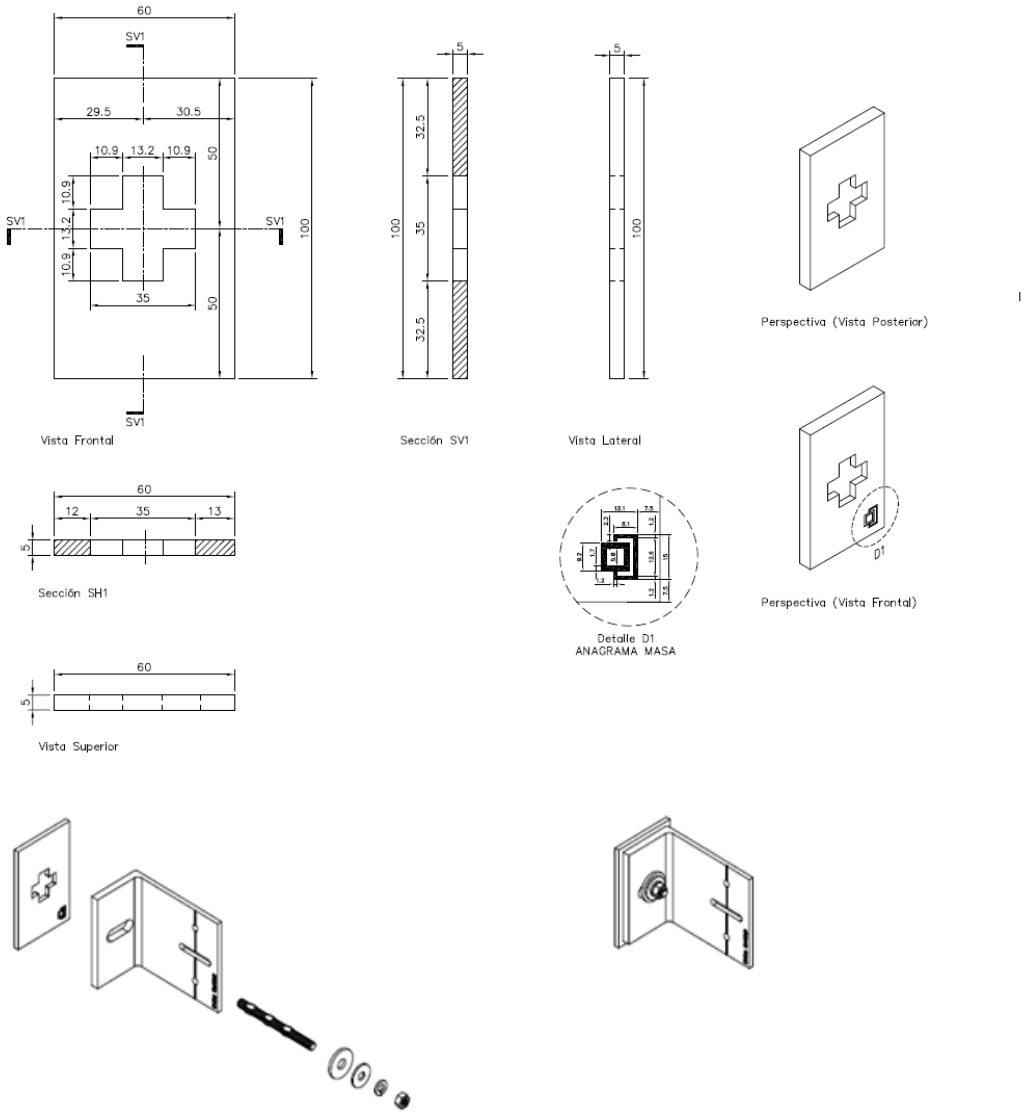


Figure A4.25a: Thermal bridge break piece. Termostop 100.

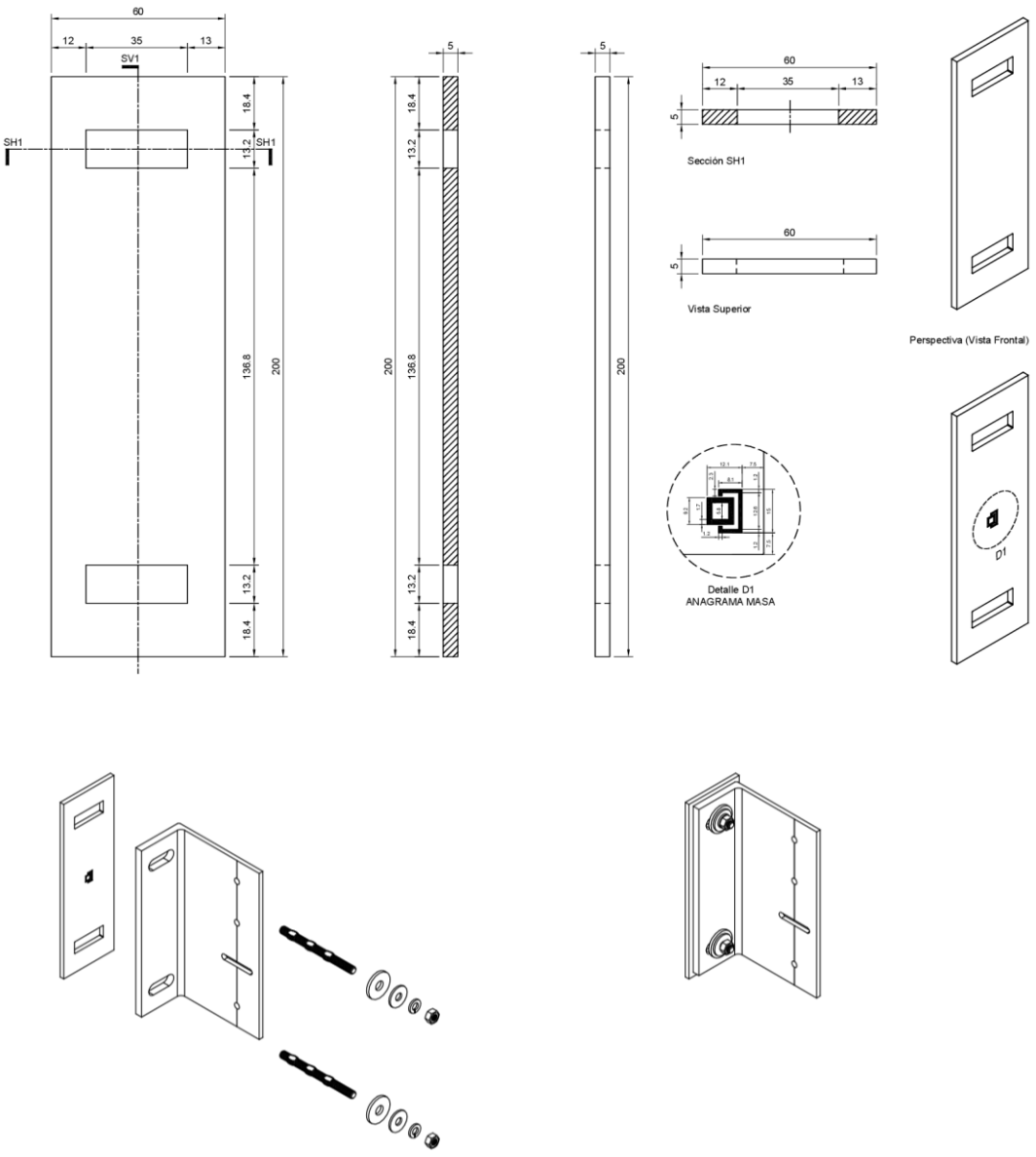


Figure A4.25b: Thermal bridge break piece. Termostop 200.

ANNEX 5: Subframe fixings and other components

A5.1. Subframe screws

Geometry characteristics			
		ST6,3x25 PB	
Form			
Dimensions (mm)	Drilling screw to fix horizontal profile to the vertical profile	ST6,3x25 PB	See figure A3.3.1

Material properties	**Values**		**Reference**
Type of material	Stainless steel Quality A2-70	Stainless steel Quality A4-80	EN ISO 3506-1
Elastic limit $R_{p0,2}$ (MPa)	450	600	EN ISO 3506-1
Tensile strength R_m (MPa)	700	800	EN ISO 3506-1
Elongation A (%)	0,4·d	0,3·d	EN ISO 3506-1
Thread characteristics	According to reference standard		EN ISO 3506-4
Form characteristics of the hexagon washer head screw	According to reference standard		EN ISO 15480
Drill hole characteristics	According to reference standard		EN ISO 10666

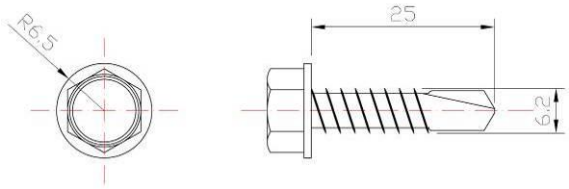


Figure A3.3.1: Screw ST6,3x25 PB.

A5.2. Other components

Other products that do not pertain to the kit but they are needed for the execution of the PF-ALU-HTR kit in the works are the fixings between the brackets and the substrate. The main specifications to be met by these products to be used with the kit are:

- Fixings must be chosen according to the substrate or supporting structure material (concrete, masonry, timber or metal frame, etc.) and the resistance required due to wind load and dead load (pull-out and shear strength respectively).
- Minimum fixing diameter 8 mm. Minimum washer diameter 16 mm.
- Required minimum pull-out strength on substrate material: 4,0 kN.
- Required minimum shear strength: 4,0 kN.
- Fixings between the brackets and the substrate may be CE marked according to an ETA on the basis of the relevant EAD (see www.eota.eu) as long as this CE marking is mandatory in the Member State where the kit is used.

ANNEX 6: Design, installation, maintenance and repair criteria

A6.1 Design

The design of the subframe and fixings for fastener external skin elements using PF-ALU-HTR kit should consider:

- For fastening cladding elements (the subframe is fixed on structural floors and also on a subframe wall), all the kit components defined in Annexes 2 to 5 may be used. However, for the fastening of wall elements, if the subframe is fixed only between structural floors, the vertical profiles and bracket types less than 80 should be avoided (e.g. profiles PF-AL-U-40, PF-AL-U-60, PF-AL-T-60, PF-AL-T, PF-AL-L & PF-AL-J and brackets ES-ALU-45, ES-ALU-67 & ES-ALU-L).
- The vertical profiles must not be used with the brackets of lower dimensions (e.g. profile PF-AL-U-80 can be used with brackets ES-ALU-87 to ES-ALU-325 and ES-INOX-238 to ES-INOX-325 but cannot be used with bracket ES-ALU-67).
- The special anchors TR-MASA are intended to be used with skin elements according to the specifications indicated in table A6.1.

Special anchor	**Skin element specifications**				
	Material	**Thickness range (mm)**	**Distance drill hole - border (mm)**	**Maximum density (kg/m³)**	**Maximum length and height**
TR-MASA-20	Granite and basalt stone acc. EN 1469	20 - 30	40 - 200	3000	(*)
	Marble and limestone acc. EN 1469	20 - 30			
TR-MASA-30	Granite and basalt stone acc. EN 1469	30 - 50			
	Marble and limestone acc. EN 1469	30 - 50			

(*) The maximum height and length of skin elements depend on their bending strength and on the number of special anchors that support one skin element.

Table A6.1: Skin elements specifications.

- It is assumed that the substrate wall meets the necessary requirements regarding the mechanical strength (resistance to static and dynamic loads) and airtightness, as well as the relevant resistance regarding watertightness and water vapour.
- It is assumed that the skin element meets the necessary requirements regarding the mechanical resistance and hygrothermal behaviour.
- The verification of the designed system by means of calculation, taking into account the mechanical characteristic values of the kit components in order to resist the actions (dead loads, wind loads, etc.) applying on the specific works. National safety factors and other national provisions must be followed.
- The selection and verification of the anchors between the brackets and the external walls (substrate), taking into account the substrate material and the minimum resistance required (pull-out and shear resistance) according to the envisaged actions obtained from the mechanical calculation of the designed system.
- The accommodation of the designed system movements to the substrate or structural movements.
- The execution of singular parts of the façade.
- The corrosion protection of the designed system metallic components taking into account the category of corrosivity of the atmosphere of works (e.g. acc. ISO 9223).
- The drainability of the ventilated air space between the skin elements and the insulation layer or the external wall accordingly.
- An insulation layer is usually fixed on the external wall and should be defined in accordance with a harmonized standard or a European technical assessment.

- When the skin element joints are not watertight, the first layer behind ventilated air space (e.g. insulation layer) should be composed by materials with low water absorption.

A6.2 Installation

Installation of the subframe and fixings for fastener external skin elements using PF-ALU-HTR kit should be carried out:

- According to the specifications of the manufacturer and using the components specified in this ETA.
- In accordance with the design and drawings prepared for the specific works. The manufacturer should ensure that the information on these provisions is given to those concerned.
- By appropriately qualified staff and under the supervision of the technical responsible of the specific works.

A6.3 Maintenance and repair

Maintenance of the subframe and fixings for fastener external skin elements using PF-ALU-HTR kit includes inspections on site, taking into account the following aspects:

- the appearance of any permanent irreversible deformation.
- the presence of corrosion or presence of water accumulation.

When necessary, any repair to localized damaged areas must be carried out with the same components and following the repair instructions given by the manufacturer.