Technical Approval

SP The Technical Research Institute of Sweden (SP SITAC) hereby confirms that

Steel Profile TP/VP128 with fire resistance R15-R60

has been deemed to fulfil the building regulations (BBR) of the Swedish Nation Board of Housing, Building and Planning in accordance with and under the conditions specified in this certificate.

SITAC Approval certificate

No. 0006/06

date: 2012/06/01

1) Holder

Areco Sweden AB, VAT no.: SE556266451501
Vinkelgatan 13, 211 24 Malmö, Sweden www.areco.se

2) Manufacturer

Steel Profiles TP/VP 128 S420GD+Z/AZ and S420GD+ZMA are manufactured by Areco Sweden AB in Malmö.

3) Product description

3.1 Construction system

The type approval includes the Areco construction system for roofing with cantilever profiled steel sheeting, where the roof construction must have documented fire resistance. The principle of construction for the roofing structure is shown in **figure 1**. The structure is mounted at the building site.

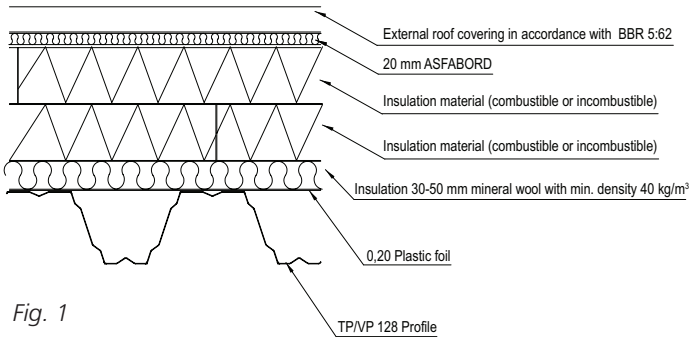

Fig. 1

3.2 Profiled Steel sheeting TP/VP 128

The load bearing steel sheets consist of standard trapezoidal profiled sheeting of type TP/VP 128 in accordance with **figure 2**. The sheet thickness is between 0.65 mm and 1.2 mm and comprises cold-rolled steel of quality S420GD+Z/AZ and S420GD+ZMA, the plastic yield limit is minimum 420-450N/mm^2

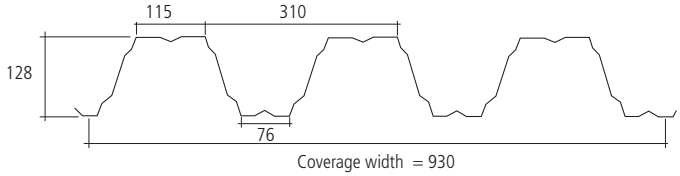

Fig. 2

The sheeting can also be supplied with 15µm polyester lacquer or ZMA140 g/m^2 + 25 µm polyester lacquer. Steel sheeting with lowest fire resistance class B-s1,d0 according to EN 13501-1.

3.3 Fixing material

Mounting of the steel sheeting is performed with galvanised steel fixing material. The following material is used as part of the construction system:

- *For the side overlap of the sheets*
  Ø 6,3x20/32 self-tapping screws

- *For fixing the sheeting to steel supports*
  Ø 5,5x25/40 self-tapping screws
  Ø 4,5x19/20 impact nails

- *For fixing the sheeting to wooden supports*
  Ø 6,5x51 self-tapping screws

- *For fixing the sheeting to concrete supports*
  Ø D06-6,3x38 Nails or equivalent

When fixing to other materials than steel, the withdrawal force from the supporting member must be calculated separately.

3.4 Insulating materials

Insulation and vapour barrier are not supplied by Areco as part of the construction system. The variant specified in point 6 as incombustible insulation must be of at least class A2-s1,d0 according to EN 13501-1.

4) Intended use

Areco roofing construction with fire resistance complying with R15-R60 can be used on both flat and pitched roofs, but should not be used on buildings containing a high degree of moisture, such as swimming baths, without appropriate measures to control humidity security.

5) Properties

5.1 Load bearing

The cross sectional data for the different TP/VP128 profiles is given in Table 1. The values in the table and calculations are based on material data and cross sectional data specified on Areco datasheet TP128.

5.2

Table 2 Properties TP/VP128 when exposed to fire. The table shows the maximum distributed load at ultimate tensile strength during a fire and with regard to the span. The calculations have been made with respect to EN 1991:2009, loads on supporting structures, Loads on supporting structures exposed to fire and EN 1993:2005 General regulations and regulations for buildings exposed to fire.

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Table 1 - Areco TP128-420 Cross sectional data

Sheet thickness, nominal	t_{nom}	mm	0,65	0,70	0,75	0,80	0,90	1,00	1,20
Sheet thickness, in calculation	t_{ber}	mm	0,590	0,665	0,713	0,760	0,866	0,955	1,144
Yield point	f_{ty}	N/mm^2	420	420	420	420	420	420	420
Massa	m	kg/m	7,80	8,40	9,00	9,60	10,80	12,00	14,40
Dead weight incl. side overlap	g	kN/m^2	0,084	0,090	0,097	0,103	0,116	0,129	0,155
Bearing resistance l_s=100 mm	R_d	kN/m	16,70	21,60	25,00	28,50	37,10	45,10	64,10
Narrow flange under pressure	M_d	kNm/m	11,51	13,70	15,10	16,35	19,16	21,54	28,17
2nd moment of area	I_{def}	mm^4/mm	2206	2486	2666	2841	3238	3570	4277
Wide flange under pressure	M_d	kNm/m	8,58	10,50	11,75	13,01	15,97	18,58	24,39
2nd moment of area	I_{def}	mm^4/mm	2062	2372	2574	2774	3235	3570	4277

Table 2 - Areco TP128 Capacity under influence of fire

Thickness (mm)	Fire class	**Capacity kN/m^2**											
		Span width (m)											
		4,2	4,5	4,8	5,1	5,4	5,7	6,0	6,3	6,6	6,9	7,2	7,5
0,65	R15	5,84	5,45	5,11	4,81	4,54	4,31	4,09	3,90	3,72	3,56	3,41	3,27
0,65	R30	2,95	2,75	2,58	2,43	2,30	2,17	2,07	1,97	1,88	1,80	1,72	1,65
0,65	R60	1,77	1,65	1,55	1,46	1,38	1,30	1,24	1,18	1,13	1,08	1,03	0,99
0,70	R15	6,58	6,14	5,75	5,42	5,12	4,85	4,60	4,38	4,19	4,00	3,84	3,68
0,70	R30	3,33	3,11	3,91	2,74	2,59	2,45	2,33	2,22	2,12	2,03	1,94	1,86
0,70	R60	2,00	1,86	1,75	1,64	1,55	1,47	1,40	1,33	1,27	1,21	1,16	1,12
0,75	R15	7,07	6,59	6,18	5,82	5,50	5,21	4,95	4,71	4,50	4,30	4,12	3,96
0,75	R30	3,57	3,33	3,13	2,94	2,78	2,63	2,50	2,38	2,27	2,17	2,08	2,00
0,75	R60	2,14	2,00	1,87	1,76	1,66	1,58	1,50	1,43	1,36	1,30	1,25	1,20
0,80	R15	7,55	7,04	6,60	6,21	5,87	5,56	5,28	5,03	4,80	4,59	4,40	4,23
0,80	R30	3,81	3,56	3,33	3,14	2,96	2,81	2,67	2,54	2,42	2,32	2,22	2,13
0,80	R60	2,28	2,13	2,00	1,88	1,77	1,68	1,60	1,52	1,45	1,39	1,33	1,28
0,90	R15	8,64	8,06	7,56	7,11	6,72	6,37	6,05	5,76	5,50	5,26	5,04	4,84
0,90	R30	4,35	4,06	3,80	3,58	3,38	3,20	3,04	2,90	2,77	2,65	2,54	2,43
0,90	R60	2,60	2,43	2,28	2,14	2,02	1,92	1,82	1,73	1,66	1,58	1,52	1,46
1,00	R15	9,56	8,93	8,37	7,88	7,44	7,05	6,69	6,38	6,09	5,82	5,58	5,36
1,00	R30	4,80	4,48	4,20	3,95	3,73	3,54	3,36	3,20	3,05	2,92	2,80	2,69
1,00	R60	2,87	2,68	2,51	2,36	2,23	2,11	2,01	1,91	1,83	1,75	1,67	1,61
1,20	R15	11,56	10,78	10,11	9,52	8,99	8,51	8,09	7,70	7,35	7,03	6,74	6,47
1,20	R30	5,76	5,38	5,04	4,75	4,48	4,25	4,03	3,84	3,67	3,51	3,36	3,23
1,20	R60	3,44	3,21	3,01	2,83	2,67	2,53	2,41	2,29	2,19	2,09	2,01	1,93

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Table 3 - Areco TP128
Horizontal forces with different thicknesses with R15-R60

Thickness (mm)	Fire resistance	Horizontal Force kN
0,65	R15	53,41
0,65	R30	25,24
0,65	R60	14,26
0,70	R15	60,45
0,70	R30	28,49
0,70	R60	16,08
0,75	R15	64,99
0,75	R30	30,57
0,75	R60	17,25
0,80	R15	69,47
0,80	R30	32,61
0,80	R60	18,39
0,90	R15	79,65
0,90	R30	37,22
0,90	R60	20,96
1,00	R15	88,31
1,00	R30	41,11
1,00	R60	23,13
1,20	R15	107,05
1,20	R30	49,41
1,20	R60	27,72

Areco TP/VP 128 Calculated maximum value for horizontal forces with different sheet thicknesses and different exposure times.

The temperature in the sheet is calculated with regard to standard temperature/time as given in EN 1991-1-2:2002. It is assumed that the sheeting can absorb transverse forces via the rope effect, see **figure 3**, and that the joints and fixtures can transfer these forces.

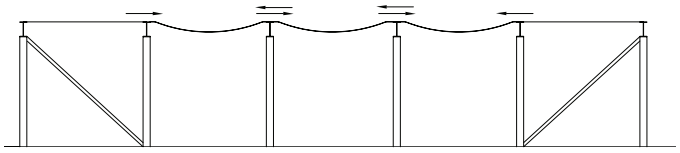
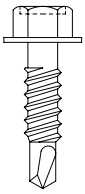


Fig. 3

5.4 Capacity of the fixing materials



The capacity for the fixtures per l_m (S_d) of sheeting is assumed to be:
Fire resistance corresponding to R15: $S_{dR15}=S_{d0} * 0,19$
Fire resistance corresponding to R30: $S_{dR30}=S_{d0} * 0,09$
Fire resistance corresponding to R60: $S_{dR60}=S_{d0} * 0,05$
Where S_{d0} is the capacity of the fixtures per l_m of sheeting at normal room temperature given by the manufacturer of the fixing material.

The above instructions take into consideration that the sheeting is unprotected from fire from below. When the roof beams, side beams and roof sheeting are protected from fire according to **figure 4**, it can be assumed that the fixing material retains the capacity stated at room temperature.

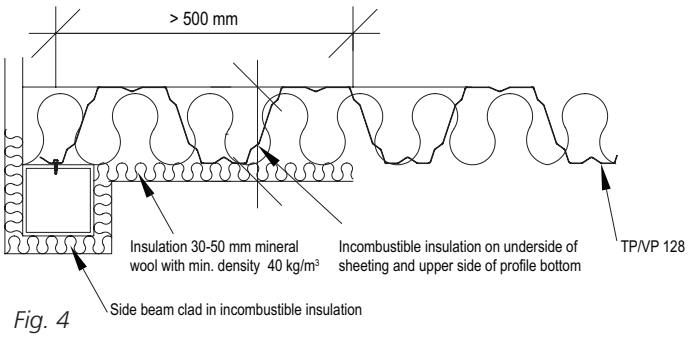


Fig. 4

6) Regulations for implementation

6.1 Project planning of roof sheeting

Every object in an Areco roof structure with fire resistance R15-R60 must be calculated and dimensioned by Tunnplåts Konstruktion i Sverige AB. Including fixtures and joints. Special calculations must be made for roof panels that extend more than 1/6th (but no more than 1m) to ensure the capacity of the sheeting.

Capacity and deformation are to be calculated with respect to EN 1993-1-2:2005, with loads that are stated in EN 1991:2009 with a deformation limit of l/200. The roof construction may be used for bracing with rigid sheets.

The following checks and calculation must be performed for every project.

Checking that roof load does not exceed the values in tables 2-3 and that the load at the ends and intermediate support do not exceed the capacity for the sheet given in Areco datasheet TP/VP 128. Alternately, specific calculations shall be made for this purpose.

- Calculation for the fixing elements of the sheet with regard to wind loads.
- Calculation of large extensions.
- Calculation of any stressed skin forces in the sheet and associated fixing materials.
- Calculation of end bay plates and connecting structural parts to absorb rope effect forces that occur during fires due to sagging.
- Calculation of joining components during accidental conditions such as fires.
- When making all calculations, consideration must be taken to the conditions for the main construction.

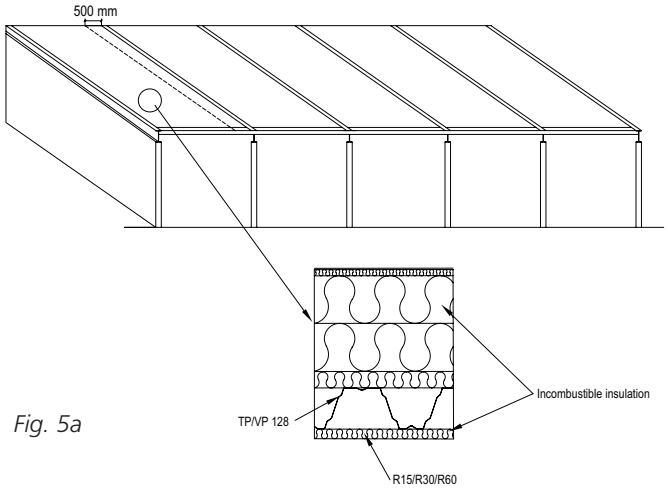


Fig. 5a

- Calculation of end bays and connecting structural parts shall be performed so that they can absorb rope effect forces by:
- Protecting the steel sheets and roof beams in the end bays from fire, see **figure 5a.**
– Fire insulation shall be implemented using incombustible insulation in one or several layers. Insulation shall reach a minimum of 500 mm past the end bays.

Protect latticework in the roof at the end bays from fire, see **figure 5B.** Fire insulation of latticework shall be executed according to EN 1993-1-2:2005. Anchor to "neighbouring property" in situations where the neighbouring property permits.

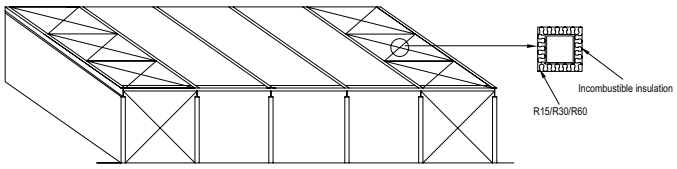
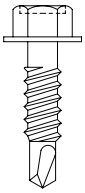


Fig. 5b

6.2 Calculation of fixing material
Calculation of the fixing material is to be performed according to the following regulations that apply to anchoring of the end bays as well as side overlaps and sheet joints over supports that are to transfer twisting forces.



Fixing materials must be calculated to handle withdrawal forces that occur. Breakage at edges of holes must be eliminated by over-dimensioning fixing materials.

The fixing capacity per meter of width must be greater than the forces that occur from the rope effect.

The principle of the rope effect forces can be simplified $S_f = \sum Q_f \times l$ where $\sum Q_f$ is the calculated load and l = the span of the steel sheet.

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