

Filter units for nuclear power stations

Field of Application

The filter unit is mainly designed for the collection of radioactive aerosols, iodine and compounds of iodine in the air-handling systems of nuclear power plants and equipments with similar nature of operation.

Description of Equipment

The filter unit is of modular type, which enables to combine individual parts to be assembled according to the requirements for filtration quality. Individual parts, except connecting parts VSN, are made of stainless steel without any further surface protection.

With regard to the direction of flow of the medium to be filtrated and access of operating staff the filter units and thus also assembly parts are designed in left and right workmanship.

The assembly of filter units from individual necessary parts is performed at place of installation. Individual parts of the filter unit are assembled immediately in right sequence and connected together by means of bolted flanged connections.

Filter unit is anchored to the foundation by means of anchor bolts.

Basic assembly parts of the filter unit

- a) Mist separation filter VSO, designed for the separation of water mist and drops.
- b) Electric heater VSE, designed to heat air to be filtrated with the aim of the reduction of relative humidity before entering iodine filter.
- c) Aerosol pre-filter VSP for gross filtration of aerosols.
- d) Aerosol filters VSA with high efficiency to collect aerosols.
- e) Iodine filters VSJ to collect radioactive iodine and its compounds in gaseous state.
- f) Connecting parts VSS and connecting parts VSN for the connection of the filter unit to the system of air-handling distributing pipeline.

The casings of aerosol pre-filters (VSP) and aerosol filters with high-efficiency (VSA) are fitted with removable filter inserts.

The casing of iodine filter (VSJ) is designed for the filling of loose activated carbon (sor bent) with the thickness of absorptive layer 250 mm.

The filter unit is fitted with the sockets to connect necessary monitoring and measuring instruments and the sockets to supply and drain decontaminant solutions.

The filter unit is operated during the replacements of functional filling and elements without any attendance.

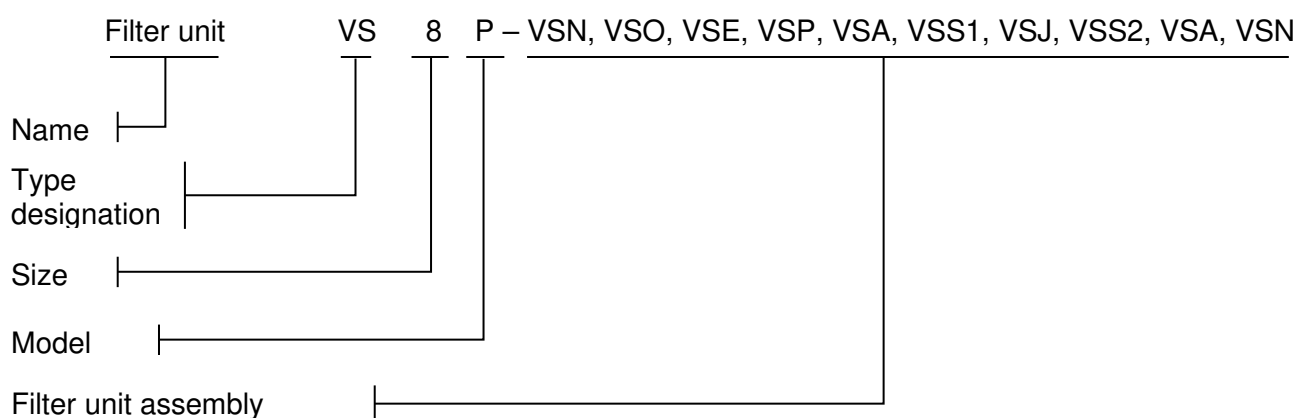
Lifetime of the filter unit is 50 years, except replaceable functional elements, the lifetime of which depends on operating conditions.

Technical parameters and dimensions

1. Performance and dimensional series of the filter units consists of five (5) sizes for nominal flow rates of air 2000, 4000, 8000, 12000, 16000 m³.h⁻¹.
2. Main dimensions and weights of the filter units are given by the number, dimension and weight of assembly parts, used in the assembly of the filter units – see table 1.
3. Initial pressure loss of the filter units depends on the number and type of used assembly parts. At nominal flow rate of air it does not exceed 2000 Pa in full assembly. Initial pressure losses of individual assembly parts at nominal flow rate of air are as follows:
 - VSO 300 Pa
 - VSP 160 Pa
 - VSA 290 Pa
 - VSJ 900 Pa
4. The efficiency of the collection of radioactive aerosols at nominal flow rate is min. 99,95 %. Initial efficiency of the collection of organic compounds of radioactive iodine is min. 99,99 %.
5. Admissible value of leakage of the housing of the filter units (after assembly) at the differential pressure 2000 Pa is max. 0,003 % of nominal flow rate of air.
6. The efficiency of filter inserts of aerosol filters VSA with high-efficiency at nominal flow rate of air 4000 m³.h⁻¹ is min. 99,99 % to oil mist with solid particles 0,3 μm.
7. With filter inserts of aerosol pre-filters VSP at nominal flow rate of air 4000 m³.h⁻¹ the efficiency is min. 75 % to oil mist with solid particles 0,3 μm.
8. The efficiency of absorptive iodine filters VSJ at nominal flow rate of air is min. 99,99 % to organic compounds of methyl iodide 131.
9. Admissible value of leakage of the housings of all assembly parts of the filter units and as well of fastening frames in aerosol filters is max. 0,003 % of nominal flow rate of air at differential pressure 2000 Pa.
10. The filter units are designed for the operation at the suction side of the fan and their structure is dimensioned for underpressure 10 kPa.
11. Material and structure of all parts of the filter units steadily withstand temperature + 100 °C, relative humidity of air 100 % and in the short term, they withstand steam-air mixtures with temperature up to + 150 °C including for the time period min. 10 hours.
12. The filter units meet requirements for higher fire safety. Any of materials used at manufacture of their assembly parts and functional elements do not facilitate combustion with exception of sorbent, the ignition temperature of which is higher than + 330 °C. The filter inserts used in the pre-filter have permanent temperature resistance + 250 °C, filter inserts with high efficiency permanently + 125 °C, in the short term + 185 °C. The filter unit is classified between selected equipment acc. to the decree of government 214/1997 of Coll.
13. The surface of the filter units enables decontamination by deactivating solutions and water washing. The material of the casings of the filter units withstands the effects of the medium to be filtrated and contaminants to be collected under all operating modes of corresponding ventilation systems and further it withstands the effects of ordinary decontamination agents.
14. The filter units meet the conditions for the equipments of I. category with seismic resistance for maximum design earthquake (8° according to MSK 64) and accordingly the spectrum of response in particular area.

Data for ordering

- Volumetric flow rate (m³.hour⁻¹)
- Inlet air temperature (°C)

Designation
1. An example of the designation of the filter unit of size 8 of right design:

2. Analogously when ordering the individual assembly parts:

High-efficiency filter VSA 8 P

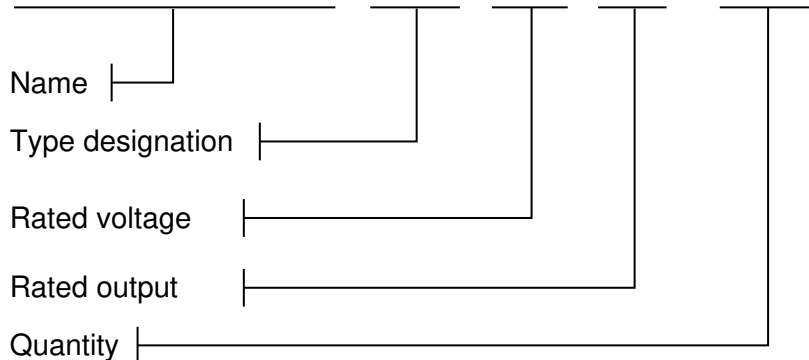
Electric air heater VSE 8

3. When ordering functional elements:

Filter inserts VSA 8 – 2 pieces

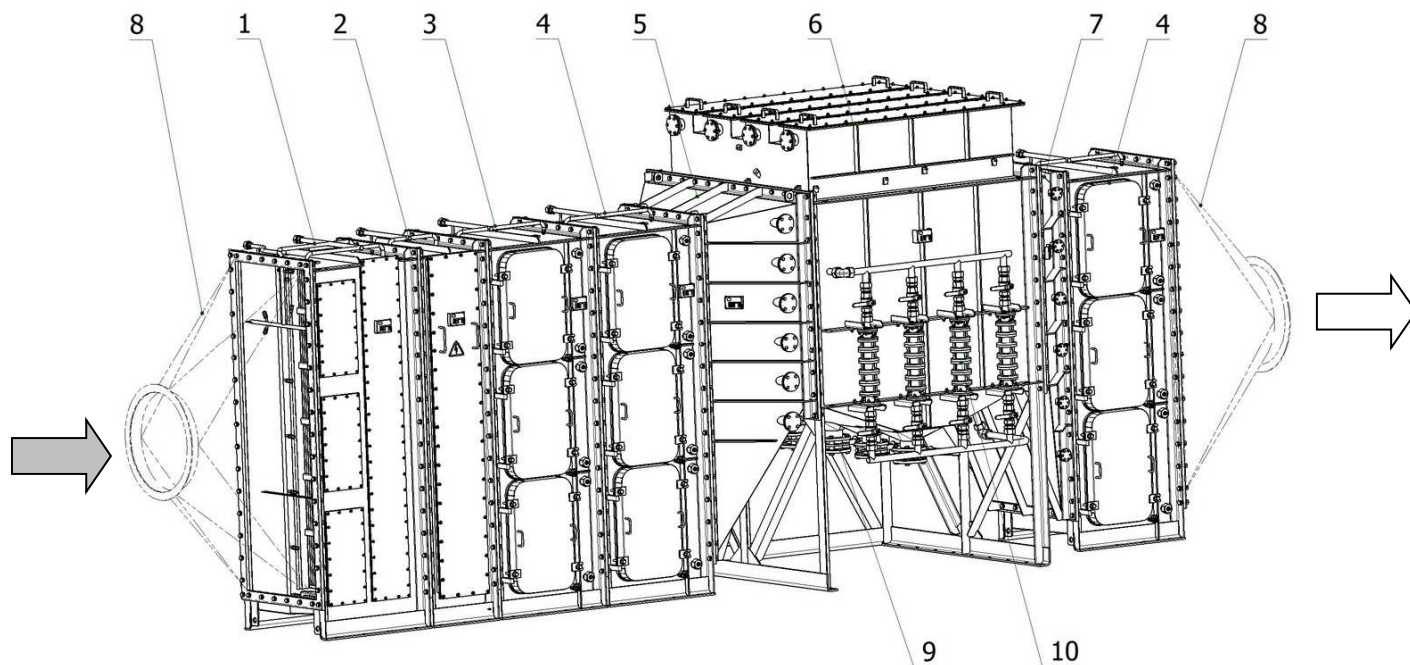
Sorbent VSJ 8 – full filling

Electric heating elements VSE 8 230 V 700 W – 2 pieces



Tab. 1 Main parameters and dimensions

		VS 16	VS 12	VS 8	VS 4	VS 2		
VSO	Dimension l x w x h (mm)	800 x 900 x 3100	800 x 900 x 2400	800 x 900 x 1680	800 x 900 x 960	800 x 900 x 960		
	Weight of casing (kg) without Inserts	447	362	272	183	183		
	Weight of frame (kg)	-	-	-	103	103		
	Height of centre of gravity (mm)	1550	1200	840	480	480		
	Inserts - dimension (mm)	710 x 346 x 83	710 x 346 x 83	710 x 346 x 83	710 x 326 x 83	710 x 326 x 83		
		- number (pcs)	14+2	12	6+2	4	4	
		- weight of 1 pc (kg)	8	8	8	8	8	
Nozzles for - regeneration (pcs)	25	21	17	13	13			
	- decontamination (pcs)	16	12	8	4	4		
VSE	Dimension l x w x h (mm)	500 x 900 x 3100	500 x 900 x 2400	500 x 900 x 1680	500 x 900 x 960	500 x 900 x 960		
	Weight of casing (kg)	340	272	204	137	137		
	Weight of frame (kg)	-	-	-	90	90		
	Height of centre of gravity (mm)	1550	1200	840	480	480		
	Elements – number (pcs)	4x9	3x9	2x9	1x9	1x9		
	Element output (W)	700	700	700	700	700		
	Total heater output (W)	25 200	18 900	12 600	6 300	6 300		
	Cross section of conductors between terminal boards (mm ²)	6	4	2	-	-		
		(4 sekce)	(3 sekce)	(2 sekce)	(1 sekce)	(1 sekce)		
	Cross section of conductors to elements (mm ²)	2,5	2,5	2,5	2,5	2,5		
	Recommended supply cable	5C x 10	5C x 6	5C x 4	5C x 2,5	5C x 2,5		
	Cable terminal – type for cable with diameter (mm)	Pg 29	Pg 21	Pg 21	Pg 16	Pg 16		
		18 – 25	13 – 18	13 – 18	10 – 14	10 – 14		
Nozzles for decontamination (pcs)	12	12	12	12	12			
VSP	Dimension l x w x h (mm)	800 x 900 x 3100	800 x 900 x 2400	800 x 900 x 1680	800 x 900 x 960	800 x 900 x 960		
	Weight of casing (kg) without Inserts	482	383	285	188	188		
	Weight of frame (kg)	-	-	-	103	103		
	Height of centre of gravity (mm)	1550	1200	840	480	480		
	VSA	Inserts - dimension (mm)	610 x 610 x 292	610 x 610 x 292	610 x 610 x 292	610 x 610 x 292	610 x 610 x 292	
			- number (pcs)	4	3	2	1	1
			- weight of VSP 1 pc (kg)	10	10	10	10	10
- weight of VSA 1 pc (kg)			20	20	20	20	20	
Nozzles for decontamination (pcs)	13	13	13	13	13			
VSJ	Dimension of VSJ l x w x h (mm)	2200 x 1800 x 2970	1700 x 1800 x 2970	1700 x 1800 x 2535	1700 x 968 x 2535	1700 x 968 x 1900		
	Weight of casing (kg) without sorbent	1605	1305	1190	755	635		
	Sorbent filling (dm ³)	4 x 1000	4 x 740	4 x 570	2 x 570	2 x 400		
	Weight of sorbent (kg)	2000	1480	1140	570	400		
VSS	Weight (kg)	2x225 = 450	2 x 190 = 380	2 x 155 = 310	2 x 85 = 170	2 x 70 = 140		
VSN	Weight (kg)	2x115 = 230	2 x 95 = 190	2 x 75 = 150	2 x 55 = 110	2 x 55 = 110		
VS total assembly	Dimension of VS l x w x h (mm)	7040 x 1800 x 3260	6540 x 1800 x 2970	6540 x 1800 x 2535	6540 x 968 x 2535	6540 x 968 x 1900		
	Weight of - unit (kg) without VSN	4780	3860	3110	2480	2325		
		- sorbent (kg)	2000	1480	1140	570	400	
		- total (kg)	6780	5340	4250	3050	2725	



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|-------------------------------|--------------------------|
| 1. VSO fog eliminating filter | 6. VSJ iodine filter |
| 2. VSE electric heater | 7. VSS2 connecting part |
| 3. VSP aerosol pre-filter | 8. VSN adapter |
| 4. VSA aerosol filter | 9. Valve |
| 5. VSS1 connecting part | 10. Measuring instrument |

Fig. 1 General assembly of a VS filter unit, solid right-hand model – description of individual parts

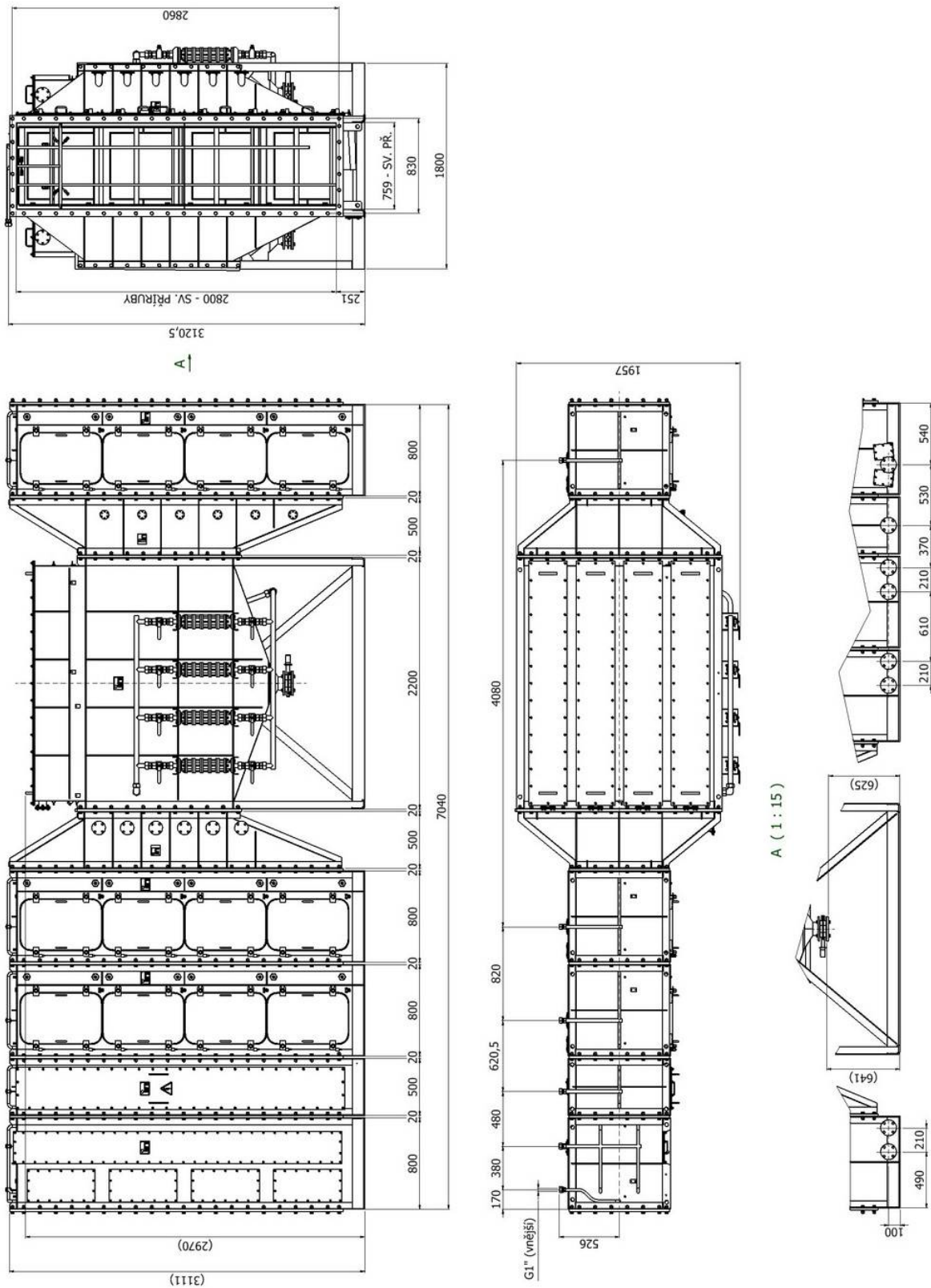


Fig. 2 Main dimensions of the filter unit 16, solid right-hand model

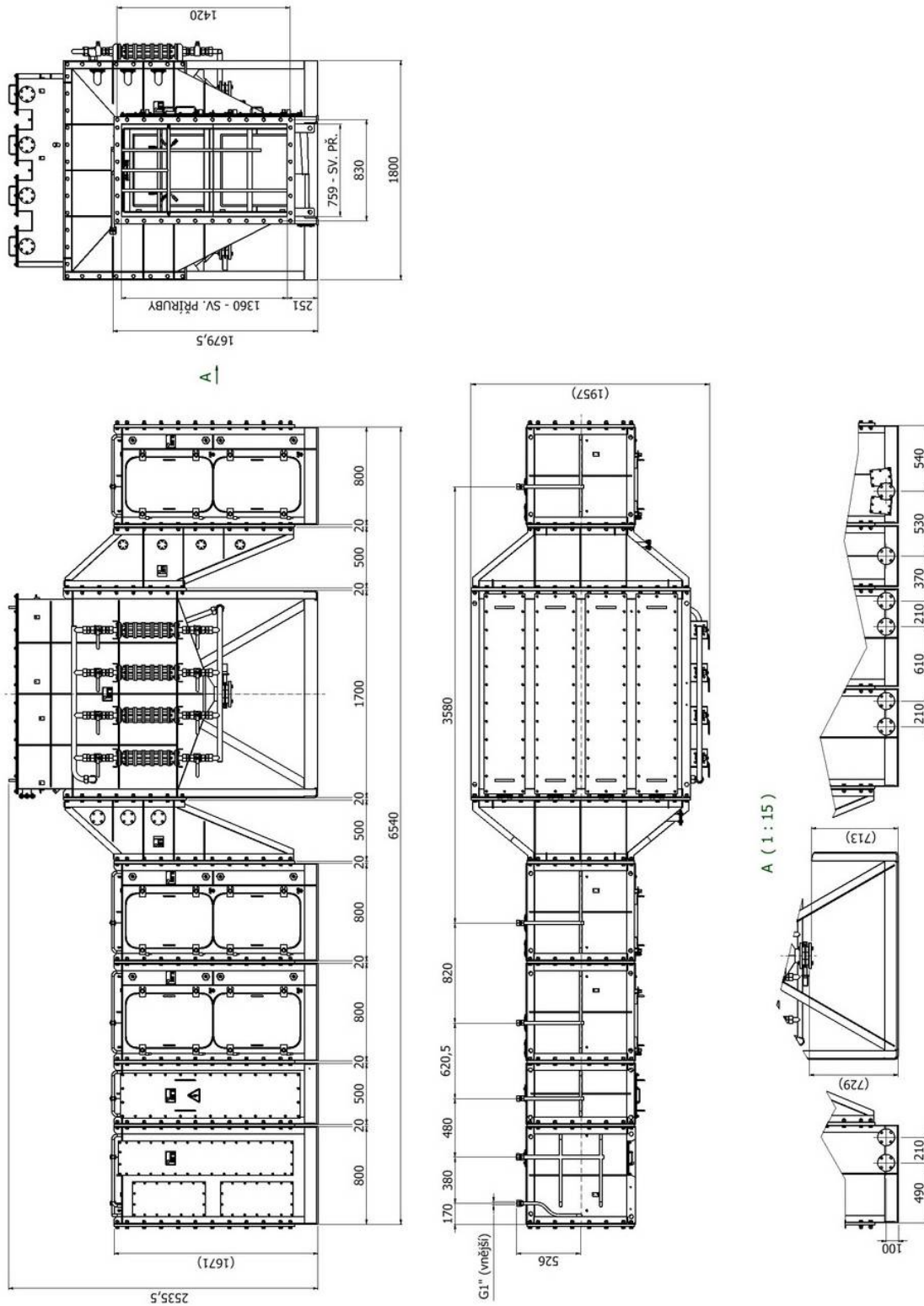


Fig. 4 Main dimensions of the filter unit 8, solid right-hand model

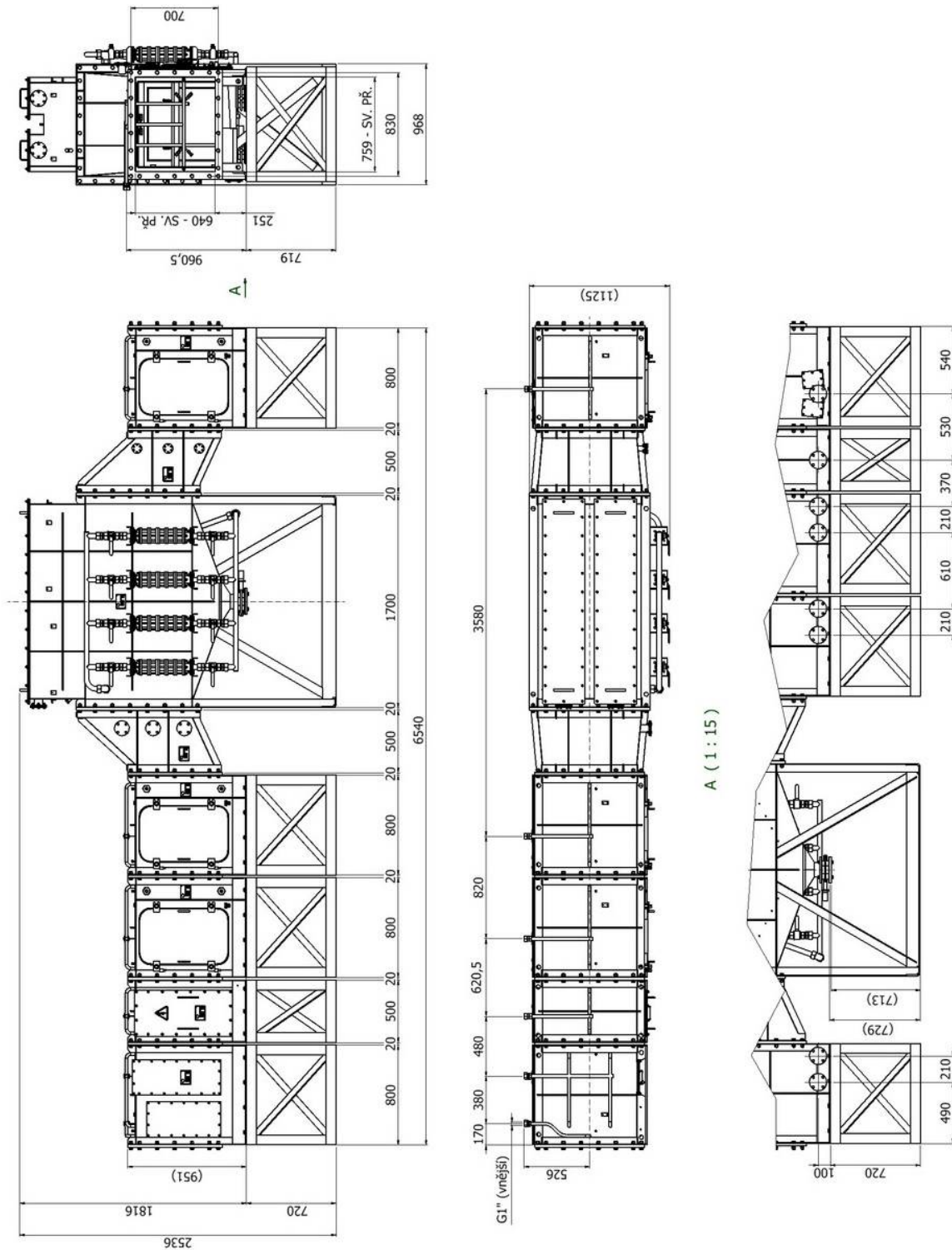


Fig. 5 Main dimensions of the filter unit 4, solid right-hand model

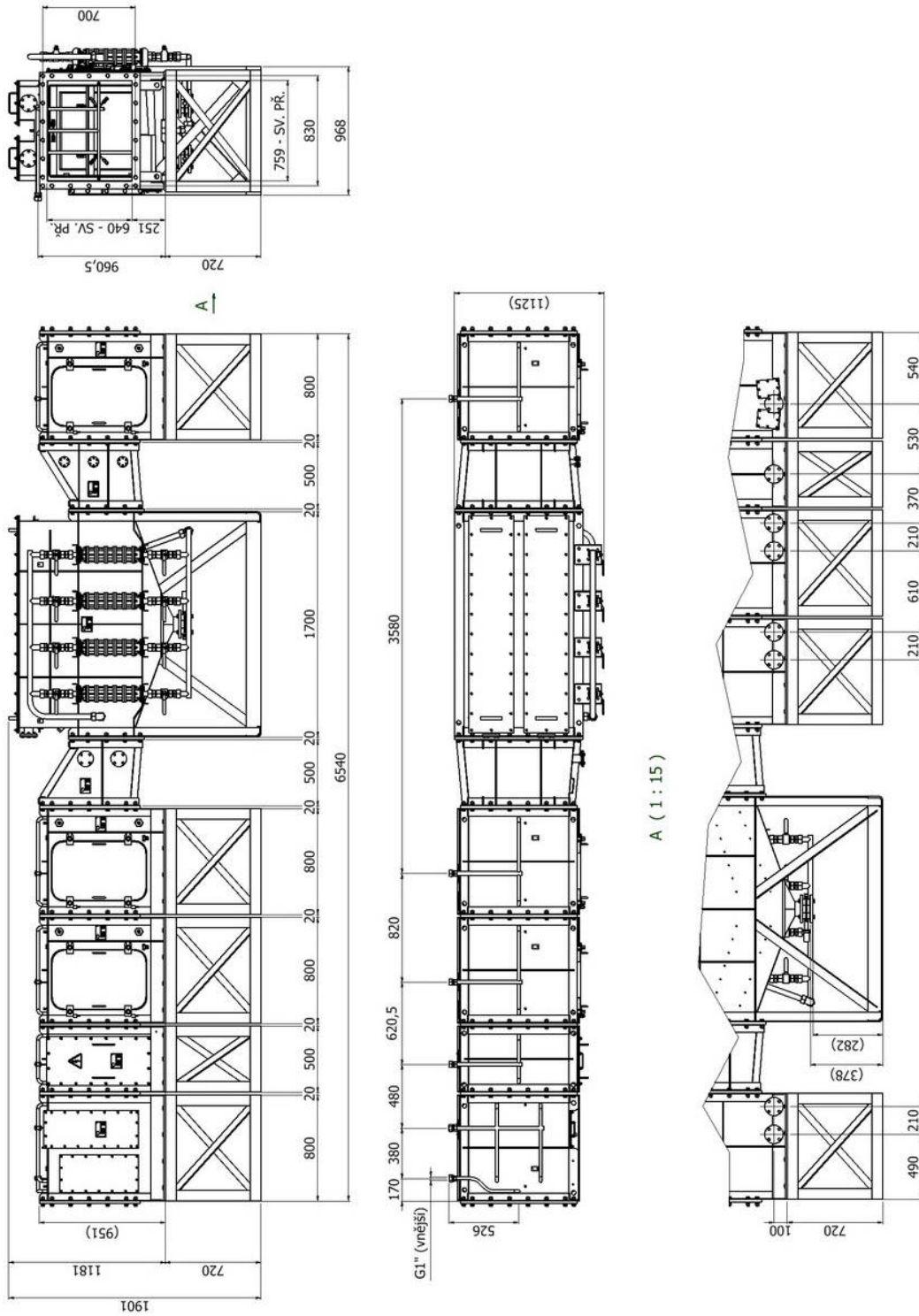


Fig. 6 Main dimensions of the filter unit 2, solid right-hand model