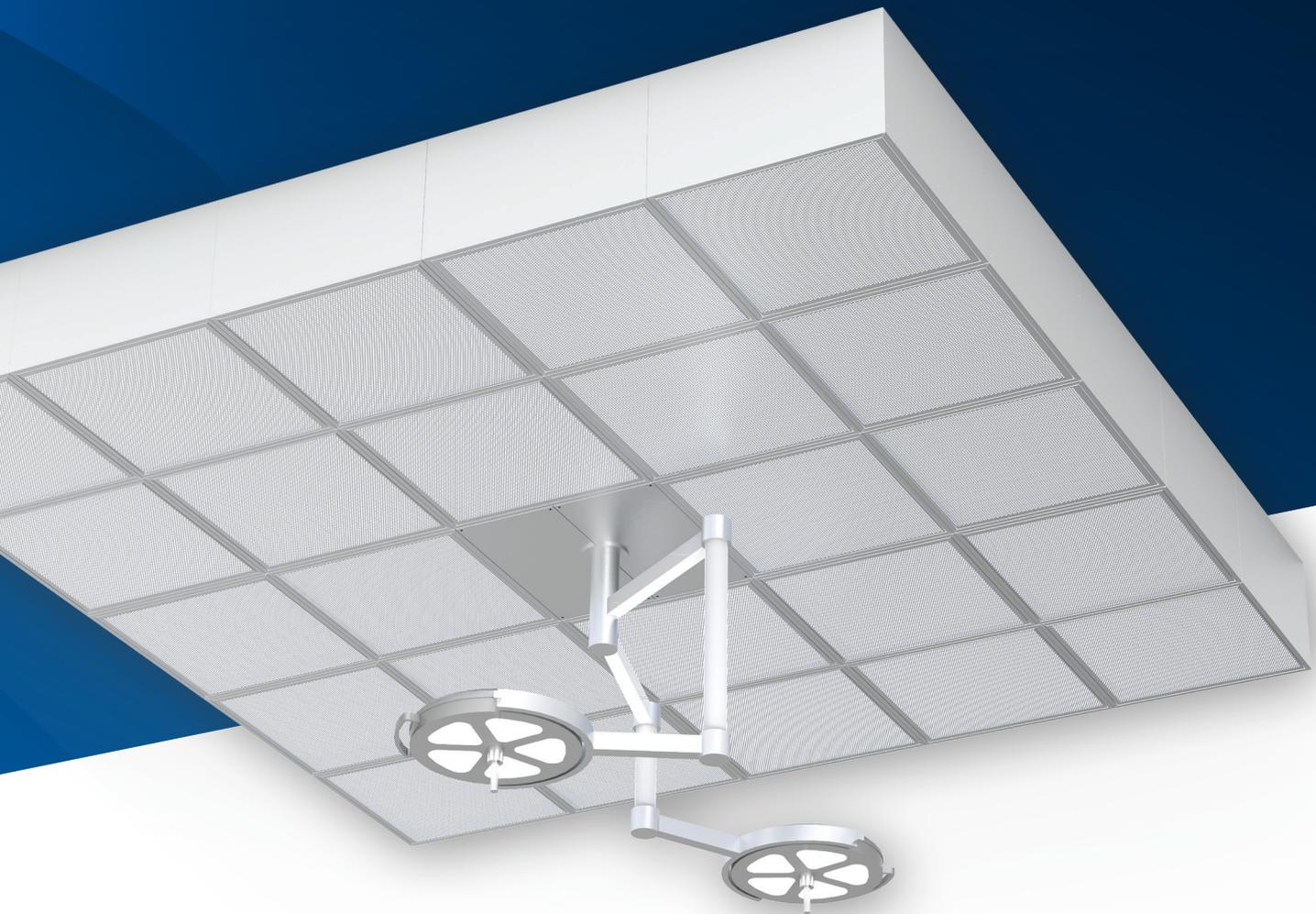


# Klimör

# NSL

Laminar flow ceiling



**SPECIALISED EQUIPMENT FOR**  
AIR CONDITIONING AND VENTILATION OF CLEANROOMS

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# NSL

## Laminar flow ceiling

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Laminar flow ceiling NSL supply clean air to operating rooms in hospitals and areas where appropriate microbiological and particulate matter classifications are required

  
EFFICIENCY [m<sup>3</sup>/h]  
250 ÷ 16 500

**14** OF THE BASIC  
SIZES

# Intended use, construction and principle of operation of NSL ceiling

## Intended use

NSL- type laminar flow ceiling are highly specialised devices designed to supply cleaned air to operating rooms as well as protected rooms and zones with a defined and controlled level of contamination. They are characterized by high reliability, which ensures long-term operation. They enable the maintenance of dust and microbiological cleanliness at an appropriate level.

The NSL series of ceiling diffusers has been designed and manufactured in accordance with the strict requirements set out in regulations, standards, and guidelines.

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## Construction

The sealed casing is made of stainless steel sheet metal with internally smooth surfaces, resistant to disinfectants. It is equipped with tightly fitted filters. The HEPA filters are clamped to the diffuser casing using hanger brackets. The laminar flow panel consists of an easily removable perforated sheet metal screen (optionally, a fabric lamination can be used). The diffuser features an external decorative trim 25 mm wide.

By default, the diffuser is equipped with test ports for measuring pressure differences, used to assess the degree of HEPA filter contamination, as well as ports for measuring test aerosol concentration during validation. The filtration unit consists of high-efficiency H13 filters with a filtration efficiency of 99,95% (according to PN-EN 1822-1:2019-05), confirmed by the manufacturer's quality certificate. Upon customer request, E11 or H14 class filters can be installed.

The diffuser is designed with a split masking cover allowing the „passage“ of the operating lamp column through the unit. The masking cover features a centrally located opening with a diameter of  $\varnothing 125$  mm. During installation in the operating theatre, attention should be paid to the central positioning of the NSL ceiling relative to the shadowless lamp column to ensure a tight connection between the masking cover and the shadowless lamp.

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## Operation principle

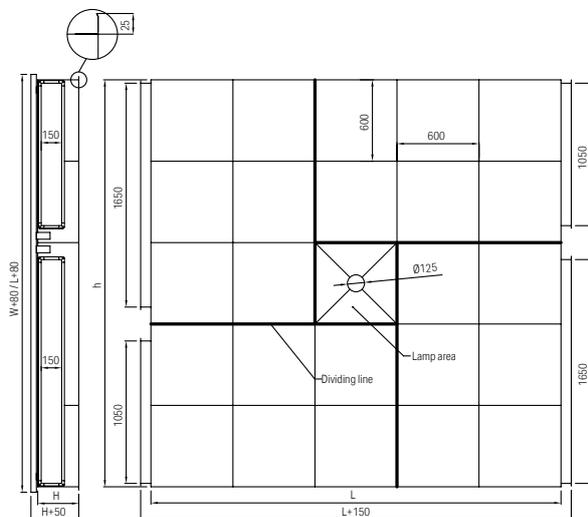
The NSL diffuser supplies air cleaned by high-efficiency filters to the protected area. Air delivered from the supply system, after passing through the inlet manifold, is evenly distributed in the upper section of the diffuser. Subsequently, due to the overpressure created by the flow resistance of the filters and the laminar flow panel, the air flows evenly toward the operating table or other designated protected zone. Proper distribution of filters across the entire supply area is crucial for maintaining a stable laminar airflow with a uniform velocity in the range of 0,2 to 0,3 m/s. For the stability of the laminar airflow, it is recommended that the supply velocity not fall below 0.2 m/s. This method of air supply meets the highest hygienic standards. Characteristic features of the NSL diffuser include uniform airflow distribution, low flow resistance, and extended service life of high-efficiency filters. With regular replacement of filters in the air handling unit and proper operational control, the service life of HEPA filters in the diffuser can be extended up to 3 years. The condition of the filters should be monitored based on the readings of the pressure switch. The signal indicating the need for replacement of high-efficiency filters is the doubling of their initial resistance. At the same time, dust and microbiological cleanliness must be monitored in accordance with the requirements of standards, regulations, and internal hygiene procedures applicable to the type of facility and its intended use.

# Technical data

Model and size	Nominal flow rate	Efficiency range	Outer dimension			Connection dimension		Weight	
	for v=0,24m/s		[m³/h]	W [mm]	L [mm]	H [mm]	w [mm]	h [mm]	[kg]
	65/60	65/60		65/60	30/35	65/60	30/35	65/30/35	60/30/35
NSL-1/1	360/310	250÷680	650/600	650/600	300/350	600/550	150/200	19/25	16/19
NSL-1/2	730/620	510÷1360	650/600	1300/1200	300/350	600/550	150/200	37/49	30/34
NSL-1/3	1090/930	770÷2050	650/600	1950/1800	300/350	600/550 (2)	150/200	55/73	51/57
NSL-1/4	1460/1240	1030÷2730	650/600	2600/2400	300/350	600/550 (2)	150/200	68/96	64/73
NSL-2/2	1460/1240	1030÷2730	1300/1200	1300/1200	300/350	1250/1150	150/200	68/90	66/75
NSL-2/3	1820/1550	1290÷3420	1300/1200	1950/1800	300/350	1250/1150 (2)	150/200	90/115	85/96
NSL-2/4	2550/2170	1810÷4790	1300/1200	2600/2400	300/350	1250/1150 (2)	150/200	130/167	116/132
NSL-2/5	3280/2790	2330÷6160	1300/1200	2350/3000	300/350	1250/1150 (2)	150/200	132/171	148/168
NSL-3/3	2920/2480	2070÷5470	1950/1800	1950/1800	300/350	1900/1750	150/200	136/178	132/150
NSL-3/4	4010/3420	2850÷7520	1950/1800	2600/2400	300/350	1900/1750 (2)	150/200	194/251	181/205
NSL-3/5	5110/4350	3620÷9580	1950/1800	3250/3000	300/350	1900/1750 (2)	150/200	254/324	227/258
NSL-4/4	5470/4660	3880÷10260	2600/2400	2600/2400	300/350	1150/1050 (4)	150/200	270/345	242/275
NSL-4/5	6930/5900	4920÷13000	2600/2400	3250/3000	300/350	1150/1050 (4)	150/200	348/445	301/342
NSL-5/5	8760/7460	6220÷16420	3250/3000	3250/3000	300/350	1800/1650(2) 1150/1050(2)	150/200	451/571	382/434

65, 60 – segment size  
30, 35 – height of the diffuser

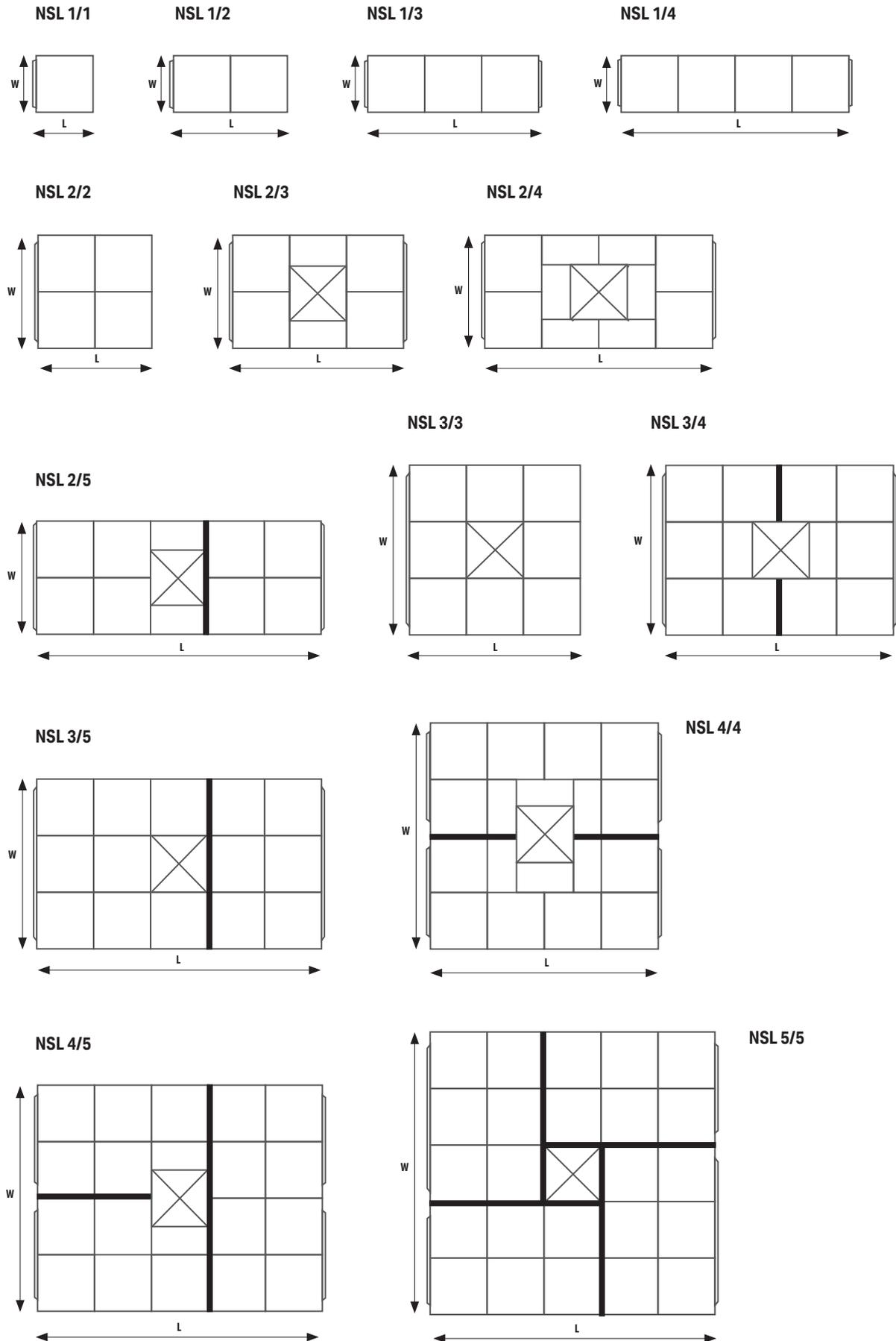
Detailed technical data according to the diffuser selection sheet



- Range of efficiency at stream speed  $v=0,2\div0,45\text{m/s}$  measured in the outlet area
- Nominal flow rate at stream speed  $v=0.24\text{m/s}$  measured in the outlet area
- The air speed at the connection port should not exceed 3 m/s

Diffuser NSL-5/5-60...

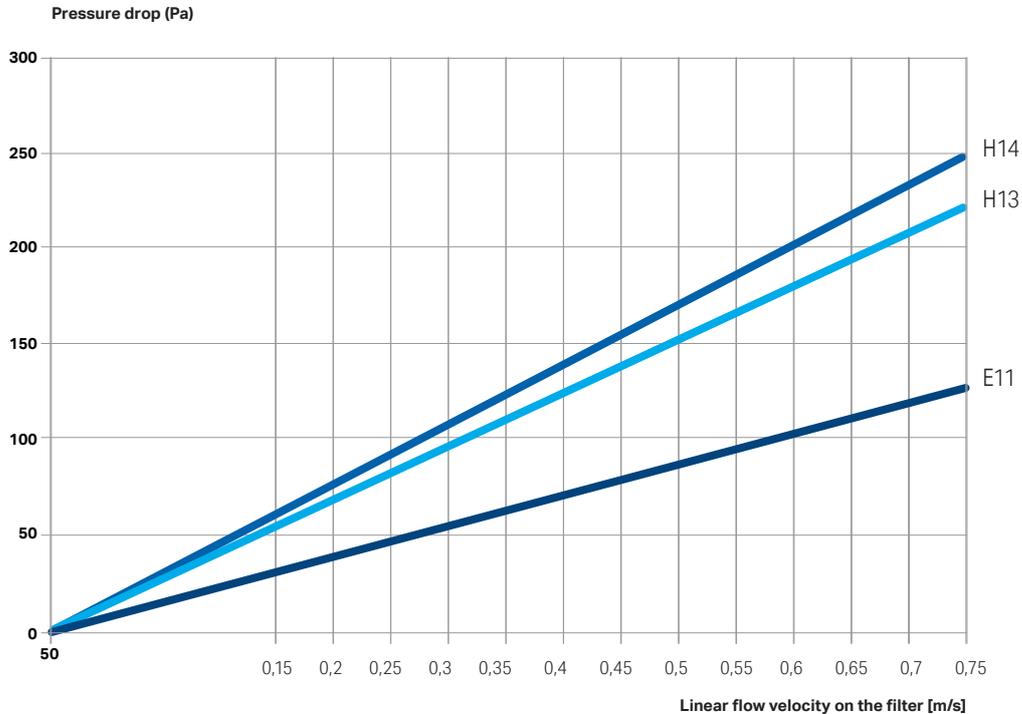
## Sizes



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## Flow resistance

The airflow resistance in the diffuser is mainly generated by the high-efficiency filters installed in the diffuser body. For a given air velocity, the initial resistance in a clean filter is specified.



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## Acceptance and operation tests for NSL diffuser

In accordance with standards and guidelines, we recommend tests to confirm correct installation and operation of NSL diffusers:

- Sealing and integrity of HEPA filters installed in the NSL diffuser,
- Measurement of pressure drop across the HEPA filters under the operating conditions of the given installation.

These measurements should be performed both during acceptance testing of newly commissioned installations and after each filter replacement during the system's operation.

### Measuring ports

The NSL diffuser is standardly equipped with Measuring Ports that allow:

- Measurement of pressure drop across the filters,
- Measurement of test aerosol concentration.

The measurement ports are located either in the area of the shadowless lamp cover or on the side of the diffuser, depending on the device configuration.

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## Installation of NSL diffuser

Transport, storage and installation of NSL diffusers must be carried out in accordance with the installation instructions supplied with each diffuser.



# Operating recommendations

## Maintaining a constant air flow through HEPA filters

1. To avoid the possibility of bacteria growing on the surface of the filters and diffuser, it is necessary to maintain a constant air flow through the diffuser with HEPA filters installed. Shutting down the system may cause convection currents to entrain particles, which will settle on the clean side of the filter or laminar flow panel.
2. It is permissible to reduce the airflow in situations when treatments or processes are interrupted (e.g. at night or during longer breaks between treatments or processes).
3. It must be ensured that the reduction in capacity does not result in a change in the direction of the air flow. The designed pressure cascade (min. 5 Pa). The following applies: The air flow direction from the room with the higher air quality class to the room with the lower air quality class. Highly aseptic rooms of the highest cleanliness class must maintain a positive air balance relative to all adjacent rooms.
4. In case of emergencies or filter changes in the air handling unit, the downtime should be limited to the necessary minimum.
5. After a period of operation with reduced supply airflow, the system should operate at 100% of its capacity for at least 60 minutes before commencing subsequent operations.
6. In case of longer intervals, remember that the class of the room can be verified by microbiological and dust cleanliness analysis.

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## Maintenance and cleaning

The NSL ceiling has smooth surfaces resistant to disinfectants. Cleaning and disinfection should be carried out using agents approved for use and marketed in accordance with current regulations.

### **Cleaning of air diffusers, including perforated screens, should be carried out after dismantling.**

Dismantling and assembling of air diffuser elements is to be carried out by qualified technical personnel. The frequency of cleaning is based on current regulations, the hygiene plan and ad hoc situations resulting from day-to-day use.

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## HEPA Filter replacement

1. Air filters that meet the requirements of the standards must be used in ceiling:
  - EN 1822-1:2019-05 High efficiency air filters (EPA,HEPA and ULPA) – Part 1: Classification, performance testing, marking,
  - PN-EN ISO 29463-2:2018-11 Highly efficient filters and filter materials for the removal of particles from air – Part 2: Aerosol generation, measuring devices and particle counting statistics,
  - PN-EN ISO 29463-3:2018-11 Highly efficient filters and filter materials for the removal of particles from air – Part 3: Testing of flat sheet filter materials,
  - PN-EN ISO 29463-4:2018-11 Highly efficient filters and filter materials for the removal of particles from air – Part 4: Method for testing the tightness of filter elements - scanning method,
  - PN-EN ISO 29463-5:2022-10 Highly efficient filters and filter materials for the removal of particles from air – Part 5: Test method for filter elements.
  
2. Due to the essential role of filters in the air conditioning process, their correct installation and validation should be entrusted to qualified personnel.
  
3. HEPA filters must be replaced in the following cases:
  - when the filter(s) reach the final resistance specified in the installation design and indicated in the diffuser selection sheet (this should not be confused with the final resistance provided by the manufacturer in the filter certificate),
  - when the permissible levels of dust microbiological contamination are exceeded (in accordance with the Regulation of the Minister of Health of 26 March 2019. ventilation and air - conditioning systems in hospitals must be inspected at least once every 12 months),
  - In the event of extraordinary situations, such as system failure that affects the efficiency of the filters.
  
4. Procedure after filter replacement:
  - check the tightness and integrity of the filters (assessment of the homogeneity of the filter media),
  - perform validation in accordance with the methodology described in PN-EN ISO 14644-3:2020-03,
  - prepare a report of the conducted inspection.
  
5. We do not recommend the use of filters in casing made of MDF board.
  
6. With proper operation, the service life of a HEPA filter can be up to 3 years, provided its effectiveness is confirmed annually, including through:
  - inspection of the tightness of installation and integrity of high- efficiency filters,
  - measurement of the pressure cascade,
  - measuring the pressure drop across the filter.

Hepa filters are the last barrier against microbiological contaminants which are transported with the supply air. This is why it is so important to have them professionally installed and validated. Simply replacing the filters without checking their correct installation is not sufficient.

## Method of designation



### Ceiling size

### Segment dimensions

60-600 mm • 65-650 mm

### Ceiling height

30-300 mm or 35-350 mm

### Filter class

E11\* • H13 • H14\*

### Type of laminarizer

P – perforated sheet • F – fabric

### Curtain

C\* – with curtain • O – no curtain

E11\*, H14\* – as option

C\* – as option (separate item in order)

### Example of marking

#### **NSL-5/5-65-35-H13-P**

means a laminar flow ceiling with a nominal flow rate of 8760m<sup>3</sup>/h, dimensions WxLx H3250x3250x350 with 4 connection spigots 1800x200 (2 pcs.) + 1150x200 (2 pcs.), with HEPA H13 filters and perforated sheet metal laminarizer.

#### **NSL-5/5-60-30-H13-F-C**

means a laminar flow ceiling with a nominal flow rate of 7460m<sup>3</sup>/h, dimensions WxLx H3000x3000x325 with 4 connection spigots 1650x150 (2 pcs.) + 1050 x 150 (2 pcs.) with HEPA H13 filters with fabric a lamination and a curtain.

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If you have not found the right solution, please contact us.

**We will create an individual product for you.**

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Information subject to change without notice.



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