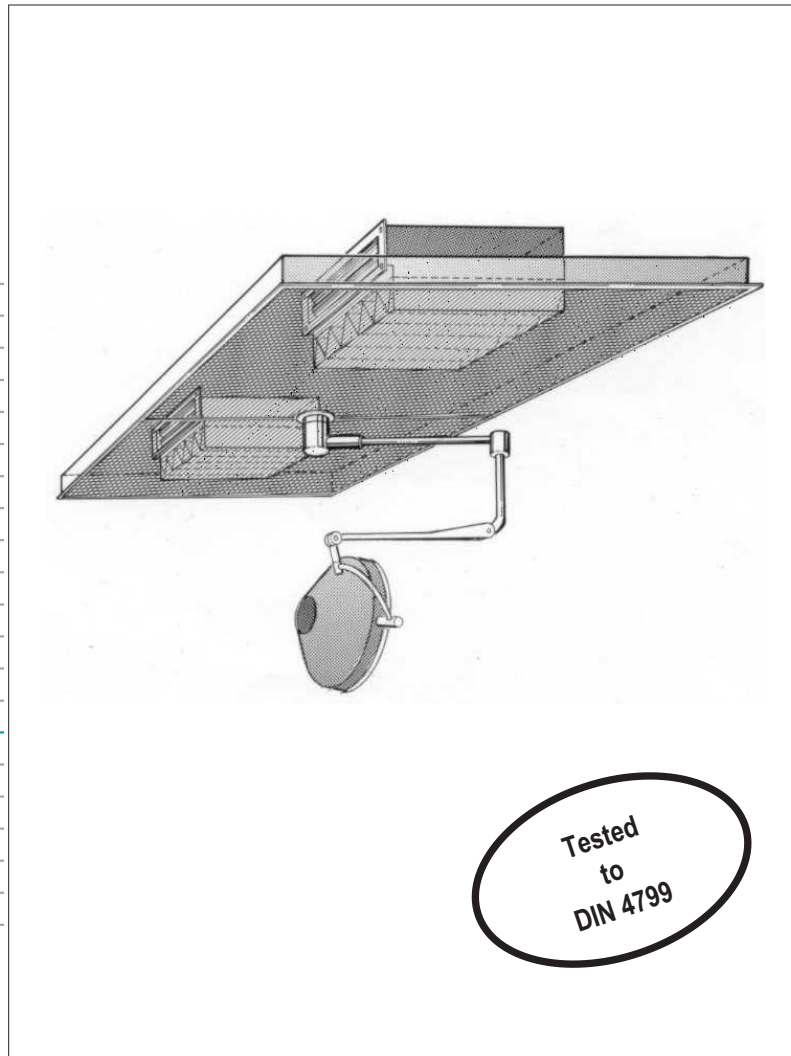


## Technical Selection



Laminar outlet for operating theatres  
OP....

## Preliminary remarks

Apart from maintaining thermal comfort, the task of air distribution in operating theatres is primarily the reduction of germ and particle concentration. For this purpose conditioned air is purified in HEPA filters before it enters the operating theatre. Of major importance here is the selection of a suitable air distribution system, as this is decisive for the quality of air flow in the operating zone.

The laminar outlet for operating theatres from KRANTZ KOMponenten ensures excellent air flow in the operating zone. It is designed so that the filtered, sterile supply air flows through the operating zone without an admixture of indoor air. The germs and aerosols released by occupants are displaced into the adjacent room zone and removed with the exhaust air.

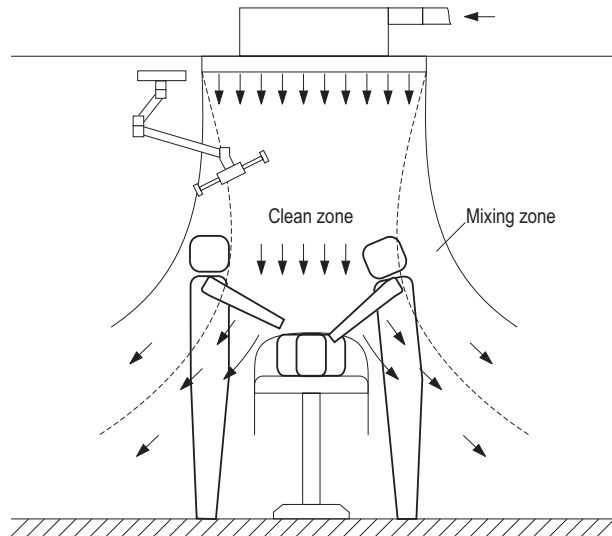


Figure 1: Air flow pattern produced by the laminar outlet for operating theatres

## Construction design

The main components of the laminar outlet are the rectangular air outlet housing 1 with air outlet frame 1a and air discharge element 2 on the underside and two housings 3 on the top side each with a built-in HEPA filter 4.

Depending on the placement of surgical lighting in the operating theatre, the air discharge element is either split with a feedthrough 7 for the lighting (in built-in surgical lighting 7a) or undivided (with external surgical lighting).

The air discharge element can be removed or folded downwards. This makes the housing interior easily accessible for cleaning and disinfection. Equally easy to reach are the HEPA filters, which can be replaced from the room.

The sealing frames 11 (Figure 4) for the filter cells have a test groove 11a (to DIN 1946, Part 4). The leakage

test point 12 and the measurement point 13 for filter pressure loss are easily accessible from below with downfoldable air discharge elements.

As a standard fixture, air-tight shutoff dampers 9 with an electric servomotor 9a are built into the connection spigots 5 of the filter housings. On power loss the dampers close automatically. The dampers can be closed for maintenance work.

As an alternative, air-tight shutoff dampers 10 are available for attachment to the connection spigots 5 (dimensions on request). The connected servomotors 10a are external and accessible from below via an inspection opening 17 when the air discharge element is folded down.

The air discharge element 2 is made of fine-mesh laminar fabric (polyester) with a surrounding stainless steel frame. The air outlet housing is made of stainless steel and the filter housing of powder-coated sheet steel <sup>1)</sup>.

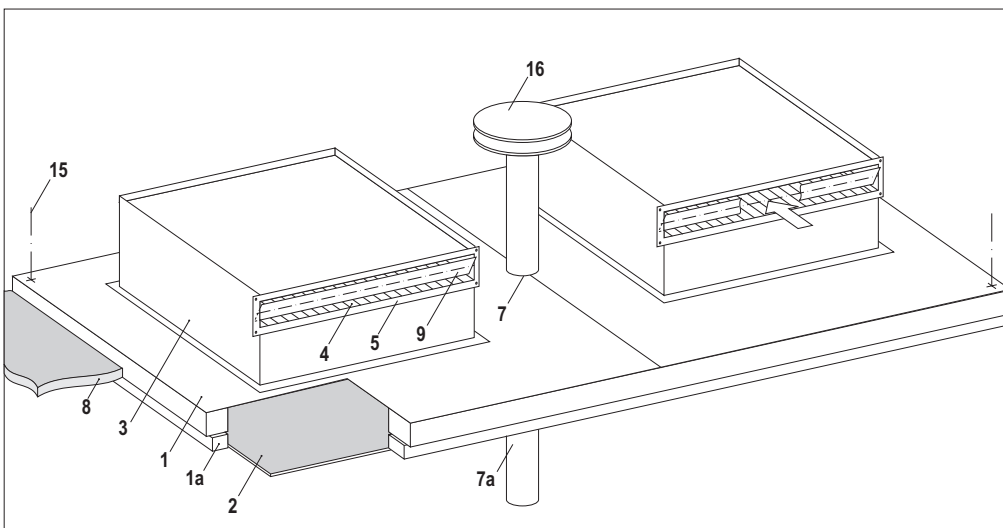
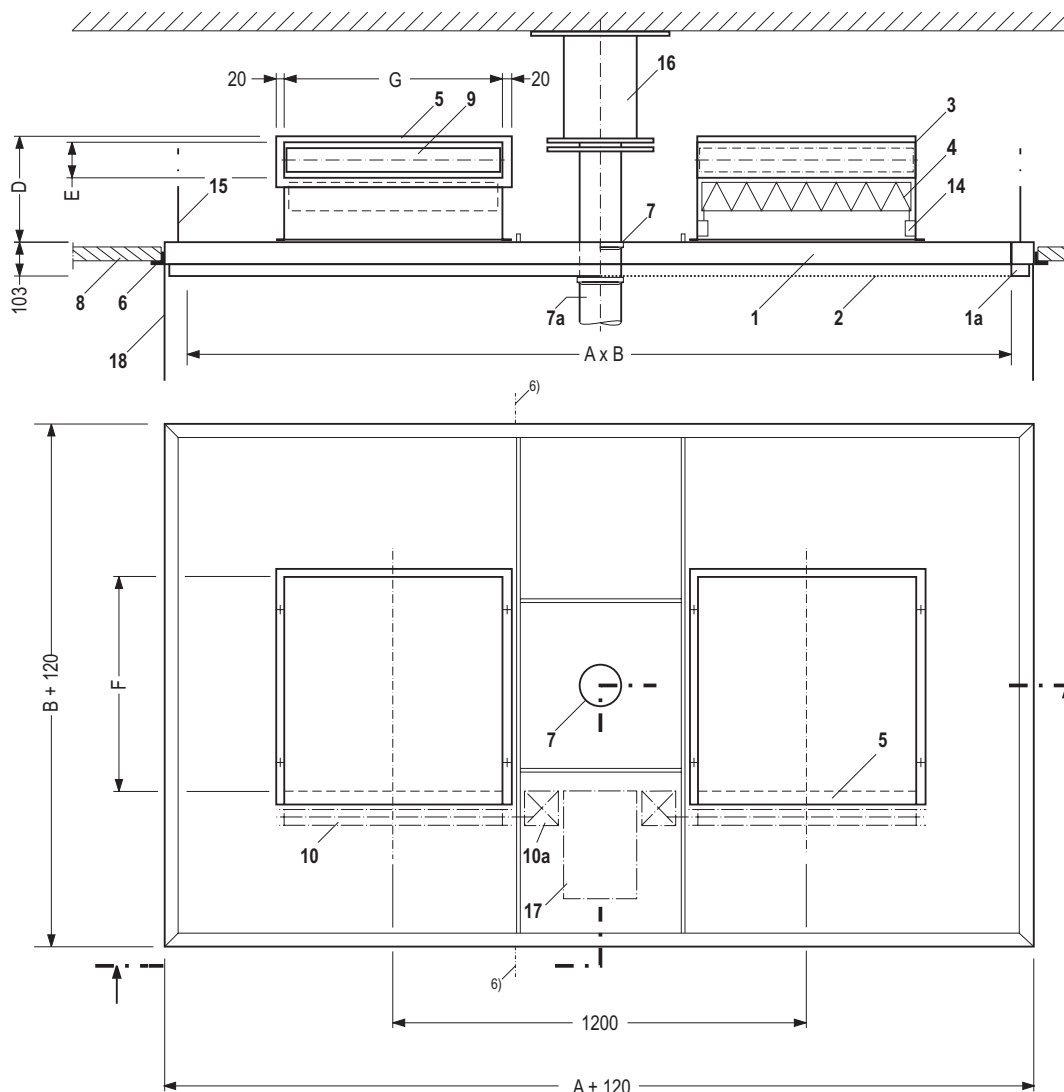


Figure 2: Outlet for operating theatres, construction

The air outlet housing 1 is usually installed flush with the ceiling. The air discharge element 2 is situated below the ceiling (Figure 5). If required, the air outlet housing is also available for building onto (Figure 6) or into (Figure 7) the ceiling.

1) Stainless steel on request



- Key for all pages:**
- 1 Air outlet housing
  - 1a Air outlet frame
  - 1b Perforated metal sheet
  - 2 Air discharge element
  - 3 Filter housing
  - 4 HEPA filter
  - 5 Connection spigot
  - 6 Ceiling connection profile
  - 6a End frame
  - 7 Throughfeed for surgical lighting
  - 7a Surgical lighting (at customer's expense)
  - 8 False ceiling
  - 9 Built-in shutoff damper
  - 9a Servo motor
  - 10 External shutoff damper (optional)
  - 10a External servomotor
  - 11 Sealing frame
  - 11a Test groove
  - 11b Dry sealing
  - 12 Leakage measuring point
  - 13 Pressure measuring point
  - 14 Contact pressure fixture
  - 15 Suspension
  - 16 Ceiling connection for surgical lighting (at customer's expense)
  - 17 Inspection opening, if using with built-on dampers 10
  - 18 Air guiding curtain<sup>5)</sup>

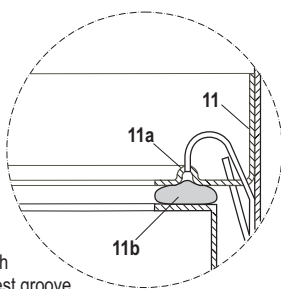
Figure 3: Outlet for operating theatres, dimensions

## Technical data

The air outlet is available in four sizes with the following dimensions<sup>1)</sup> and data:

Size	1	2	3	4
A	mm 2400	2400	2400	2400
B	mm 1400	1800	2200	2400
D	mm 405	405	425	425
E	mm 160	160	180	180
F	mm 787	787	940	940
G	mm 787	940	940	940
Filter cell <sup>2)</sup>				
Width	mm 762	762	915	915
Length	mm 762	915	915	915
Height	mm 110	110	110	110
Volume flow rate	650 - 830	860 - 1030	1050 - 1250	1140 - 1390
$\dot{V}$	l/s			
	m <sup>3</sup> /h	2400 - 3000	3100 - 3700	3800 - 4500
Discharge velocity <sup>3)</sup> u	0.20 - 0.24			
Pressure loss of filter cell <sup>4)</sup> $\Delta p_t$	Pa 127	130	135	145

- 1) Other dimensions on request
- 2) Per size 2 filter cells Class H14, DIN EN 1822-1
- 3) Related to A x B
- 4) Initial pressure loss  $\Delta p$ -initial with uncontaminated filter cell related to  $\dot{V}_{max}$ , Recommendation: filter change at  $\Delta p$ -final = 2 x  $\Delta p$ -initial.
- 5) Air guiding curtain on request
- 6) Housing for sizes 3 and 4 is split



Detail II  
Sealing frame with dry sealing and test groove

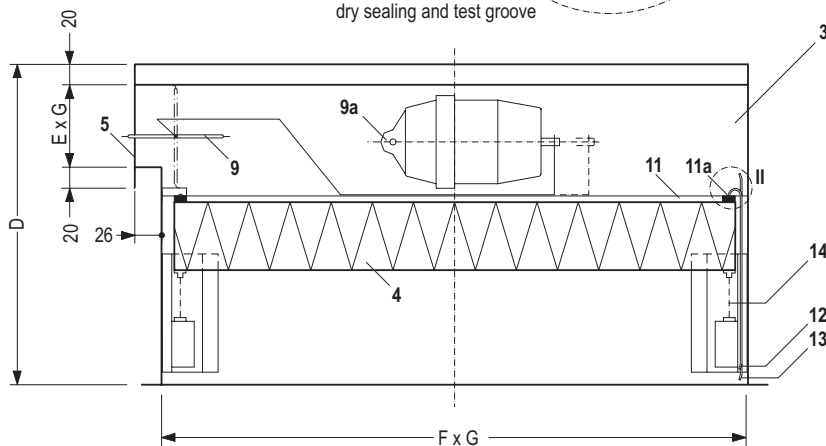


Figure 4: Detail of filter housing

## Connection to false ceiling

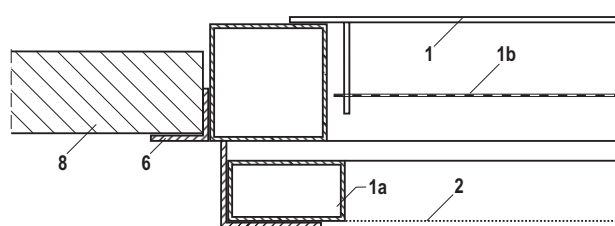


Figure 5: Air outlet housing 1 installed flush with ceiling, false ceiling 8 placed on ceiling connection profile 6, standard design

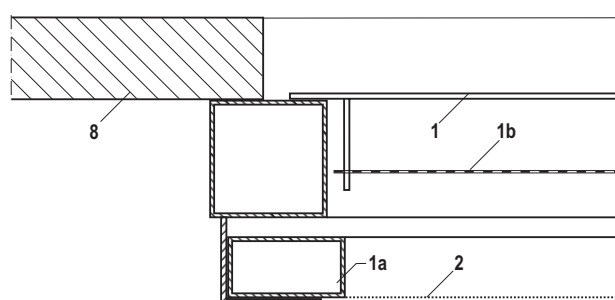


Figure 6: Air outlet housing 1 built onto ceiling, false ceiling 8 placed around air outlet housing

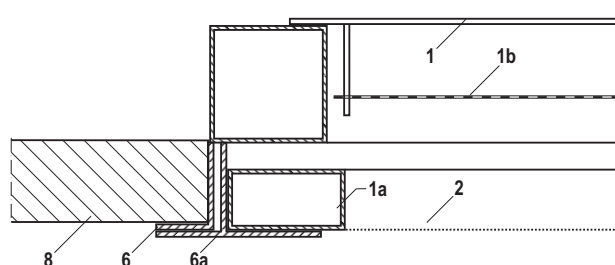


Figure 7: Air outlet housing 1 built into ceiling, false ceiling 8 placed around ceiling connection profile 6; lower end terminated with frame 6a

The connection of the false ceiling as in Figures 5 and 6 produces a more advantageous flow pattern.

## Mode of operation

The air discharge element generates a laminar displacement flow directed vertically downwards to the operating zone. At a discharge velocity of 0.15 m/s the displacement flow is already stable and remains so in the presence of operating personnel performing their usual activity.

- 1) DIN 4799 Ventilation and air conditioning; air distribution systems for operating theatres; Issue June 1990
- 2) Test report on a single and divided air distribution system to DIN 4799, Lübeck Medical University, Institute for Hygiene, July 1992
- 3) The degree of contamination is defined as the ratio of germ concentration in the clean zone (protected zone) to germ concentration in the remainder of the operating theatre

With the operating theatre outlet from KRANTZ KOMponenten any tangential flows caused by centrally placed lighting can be prevented reliably with the help of a diaphragm.

In the marginal zone of the supply air jet admixture with indoor air is generally unavoidable. The jet constricts in this mixing zone. The construction of the air outlet, however, ensures that the operating area is flushed with filtered and sterile supply air only. The mixing zone lies outside this area.

Supply air temperature should be 0.5 to 4 K below room temperature.

Hygiene tests based on DIN 4799 <sup>1)</sup> confirm extremely low germ concentrations in the operating zone <sup>2)</sup>, where the number of colony-forming units (CFU) can be reduced to less than 5 per m<sup>3</sup> of air. This amounts to a degree of contamination < 0.1 <sup>3)</sup>.



Figure 8: Air outlet housing installed flush with ceiling (not visible); discharge element downstanding under the false ceiling, split with lighting throughfeed

## Sound power level and pressure loss

The sound power level depends on the shape and size of the duct connection. It has been ascertained for three typical duct connection types (see sketches below) and is shown in the graph and table. Pressure losses are also indicated.

The air velocity in the ducts and fittings of the connection system should not exceed 3.5 m/s.

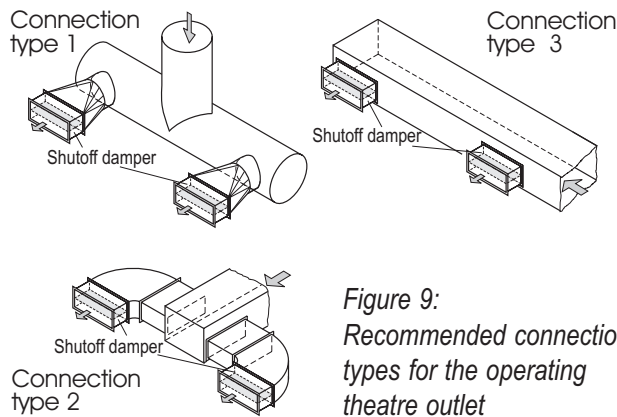
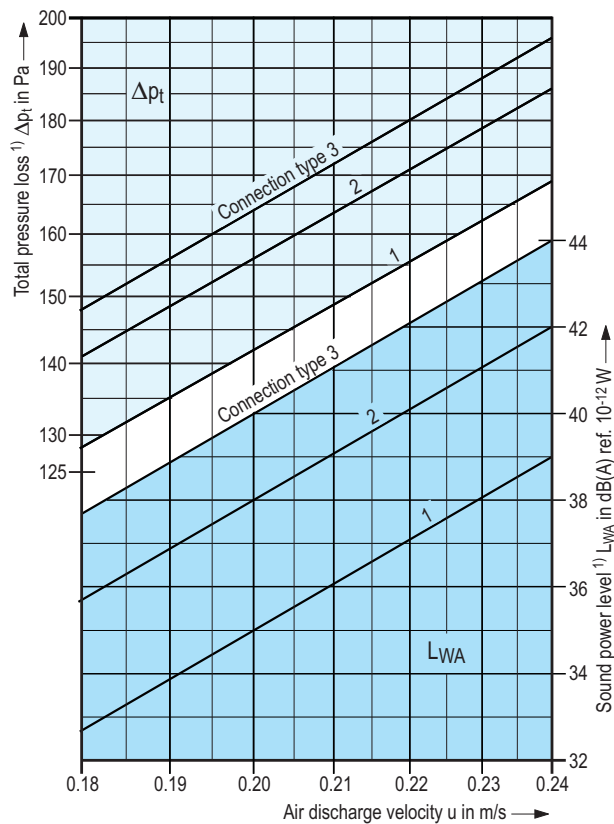


Figure 9:  
Recommended connection  
types for the operating  
theatre outlet



Air discharge velocity u m/s	Total pressure loss <sup>1)</sup> $\Delta p_t$ Pa	Sound power level <sup>1)</sup> $L_{WA}$ in dB ref. $10^{-12}$ W						
		$L_{WA}$ dB(A)	Octave band centre frequency in Hz					
		63	125	250	500	1 K	2 K	4 K
<b>Connection type 1</b>								
0.20	142	35	46	50	30	26	25	21
0.22	155	37	48	52	32	28	27	23
0.24	169	39	50	54	35	30	29	26
<b>Connection type 2</b>								
0.20	156	38	49	48	38	33	32	28
0.22	171	40	51	50	40	35	34	30
0.24	186	42	54	52	43	38	36	32
<b>Connection type 3</b>								
0.20	164	40	48	46	39	36	36	32
0.22	180	42	50	48	42	38	39	35
0.24	196	44	52	50	45	41	41	38

## Features

- Operating zone free of germs and aerosols through laminar displacement flow
- No induction of indoor air pollutants in the clean zone
- Degree of contamination in operating zone < 0.1
- Stable jet pattern already at discharge velocities of 0.2 m/s
- Low air velocities and temperature differences in the occupied zone
- Tested to DIN 4799
- Air discharge element either split (with built-in surgical lighting) or undivided (with external operating lighting)
- Air outlet frame made of stainless steel and air discharge element made of fine-meshed laminar fabric
- Air outlet housing made of stainless steel and filter housing of galvanized sheet steel<sup>2)</sup> with powder coating
- HEPA filter cell H14 to DIN-EN 1822-1
- Connection for pressure differential measurement, particle sampling on the untreated air side and leakage testing to DIN 1946, Part 4
- Air outlet housing available in the three options: for installation flush with ceiling with protruding air discharge element (standard), built onto ceiling or fully built into ceiling
- Easy access for maintenance
- Low height
- Airtight dampers to DIN 1946, Part 4, with built-in electric servomotor, alternative shutoff dampers built on with external servomotor
- Discharge height 2.5 to 3.5 m

1) Sound power level and pressure loss contain the values for the operating theatre outlet including the duct connection type

2) Stainless steel on request

## Type code

OP - \_\_\_\_ - \_\_\_\_

Operating theatre outlet  
Function / Kind  
Size

### Function/Kind:

Air discharge element:  
E = undivided  
(external surgical lighting)  
Z = divided  
(with throughfeed for surgical lighting)

### Size

1 = 2400 mm x 1400 mm  
2 = 2400 mm x 1800 mm  
3 = 2400 mm x 2200 mm <sup>1)</sup>  
4 = 2400 mm x 2400 mm <sup>1)</sup>

### Example

Operating theatre outlet, size 2, with divided discharge element for lighting throughfeed:

**OP - Z - 2**

## Tender text

..... Unit  
Air outlet for the supply of sterile air to the operating zone using the laminar flow principle, consisting of:  
Housing  
 without lighting throughfeed,  
 with throughfeed for surgical lighting at customer's expense.  
Air discharge element with fine-meshed fabric for laminar displacement flow.  
Air-tight filter housing to accommodate filter cells, with built-in sealing frame and surrounding test groove to DIN 1946, Part 4,  
Connection for leakage detector and measurement point for pressure differential and particle sampling on the untreated air side.  
Rectangular connection spigot,  
 with air-tight shutoff dampers to DIN 1946, Part 4 including  
 electrical spring-return motor.  
HEPA filter cells,  
Filter class H14, DIN EN 1822-1.  
 Built-in lighting <sup>2)</sup>.  
 Surrounding lighting <sup>2)</sup>.

### Technical data:

Volume flow rate: ..... l/s (m<sup>3</sup>/h)  
Perm. sound power level: ..... dB(A) ref. 10<sup>-12</sup> W  
Total pressure loss for uncontaminated filter cell: ..... Pa

### Materials

Air outlet housing: Stainless steel, 1.4301  
Filter housing:  Galvanized steel <sup>3)</sup> with powder coating  
Air outlet frame: Stainless steel 1.4301  
Air discharge element (laminar fabric): Polyester  
Ceiling connection profile: Stainless steel, 1.4301  
Air-tight shutoff dampers: Galvanized steel  
Dimensions:  
Air outlet housing A x B: ..... mm x ..... mm  
Total height: ..... mm  
Filter cells: ..... mm x ..... mm  
Make: KRANTZ KOMPONENTEN  
Type: OP - \_\_\_\_ - \_\_\_\_

Subject to technical alterations!



The TÜV CERT Certification Body of TÜV Anlagentechnik GmbH  
Unternehmensgruppe TÜV Rheinland/Berlin-Brandenburg  
hereby certifies in accordance with TÜV CERT procedures that



KRANTZ TKT GmbH  
Geschäftseinheit Komponenten  
Uersfeld 24  
D-52072 Aachen

has established and applies a quality system for  
**air distribution systems, cooling and heating systems, cleanroom components and systems, air handling units and systems.**

An audit was performed.  
Report No. 4237  
Proof has been furnished that the requirements according to

**DIN EN ISO 9001:1994**

are fulfilled. This certificate is valid in conjunction with the main certificate until **August 2003**  
Certificate Registration No. **09 100 4237/2**



Cologne, 2000-08-31

First certification 1994

TÜV Rheinland/  
Berlin-Brandenburg



1) Housing for sizes 3 and 4 is split  
2) On request  
3) Stainless steel on request