

Contact cooling ceiling system KKS-4/GK
for gypsum board ceilings

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Preliminary remarks

The KKS-4/GK contact cooling ceiling system is designed for use with perforated or unperforated gypsum board panels from various manufacturers to make radiant cooling or heating ceilings. The design options for gypsum board ceilings integrating the KKS-4/GK system are manifold: with painted or coated finish, perforated or unperforated, sound absorbing or reflecting, etc. KKS-4/GK elements can also be used to make chilled sails in a variety of designs. The KKS-4/GK system serves to remove medium cooling loads in office spaces, meeting rooms, foyers, exhibition spaces, libraries and such like.

Construction design

Each KKS-4/GK element consists of:

- serpentine pipework made from copper tube (from a coil), with connection ends for chilled water inflow and outflow,
- an aluminium heat conducting plate with aluminium pipe saddles to bond the pipework to the aluminium plate and optimize thermal conduction between copper and aluminium,
- suspensions.

The main dimensions of a KKS-4/GK element are given in [Figs. 1 and 2](#). Further technical data is contained in the [table](#) below.

[Fig. 1](#) shows the construction design of an unperforated gypsum board cooling ceiling while [Fig. 2](#) represents that of a perforated, sound-absorbing gypsum board cooling ceiling.

The sketches in [Figs. 1 and 2](#) clearly show that

- the KKS-4/GK elements are integrated into the ceiling suspension structure and thus are subject to the relevant specifications from the German Institute for Standardization (DIN) and from the trade associations and manufacturers concerned,
- the ceiling suspension structure can be fitted with gypsum panels from various manufacturers, made out of different materials and in different designs.

In this brochure we can consider only few gypsum panel types which are best compatible with the function of cooling and heating elements. As an example we have selected the Knauf Thermo-board Plus K766 owing to its high thermal conductivity; this panel is being considered in two design options (unperforated/perforated). The instructions for installation and treatment of the cooling ceiling system are given on [page 7](#). More detailed information – even on other panel brands – can be provided on request.

The ceiling suspension structure shall be an anti-lift double-channel structure. Basically, thermal insulation should be provided for on the backside of the active areas. It is no problem to integrate lighting fixtures, air diffusers, loudspeakers and such like in gypsum board cooling ceilings, preferably between the KKS-4/GK elements in passive areas. The cooling elements can also be fitted with cutouts of various shapes and dimensions, depending on the spacing of the furring channels (see [Figs. 1 and 2](#)). The exact positions of these cutouts can be seen from the architect's ceiling layout. The cooling ceiling system design is carried out by KRANTZ KOMPONENTEN using a CAD system and taking account of the general ceiling layout (see sections 'Design specifications' and 'Installation instructions').

Main dimensions and materials

	Standard
Serpentine pipework:	copper tube 12 mm x 0.35 mm ¹⁾
Heat conducting plate:	1.0 mm aluminium plate (99.5% aluminium)
Pipe connections:	ø 12 mm ± 0.1 mm, press fittings: ø 12 mm + 0.05 / – 0.10 mm ¹⁾ pipe ends ≥ 50 mm, inclined at 35° to the ceiling plane
Pipe spacing:	90 mm ¹⁾
Nominal length (L):	500 mm ≤ L ≤ 2,500 mm (in 100 mm steps)
Nominal width (B):	unperforated: 420 mm perforated: 250 mm
Nominal height:	15 mm
Overall system height:	≥ 80 mm
Allowable operating pressure:	6 bars ¹⁾ (up to 16 bars is possible)
Total weight:	approx. 27 kg/m ² for KKS-4/GK element filled with water including 30 mm insulation and Knauf Thermo-board Plus K766

¹⁾ Other types/values subject to enquiry

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Dimensions - Unperforated elements

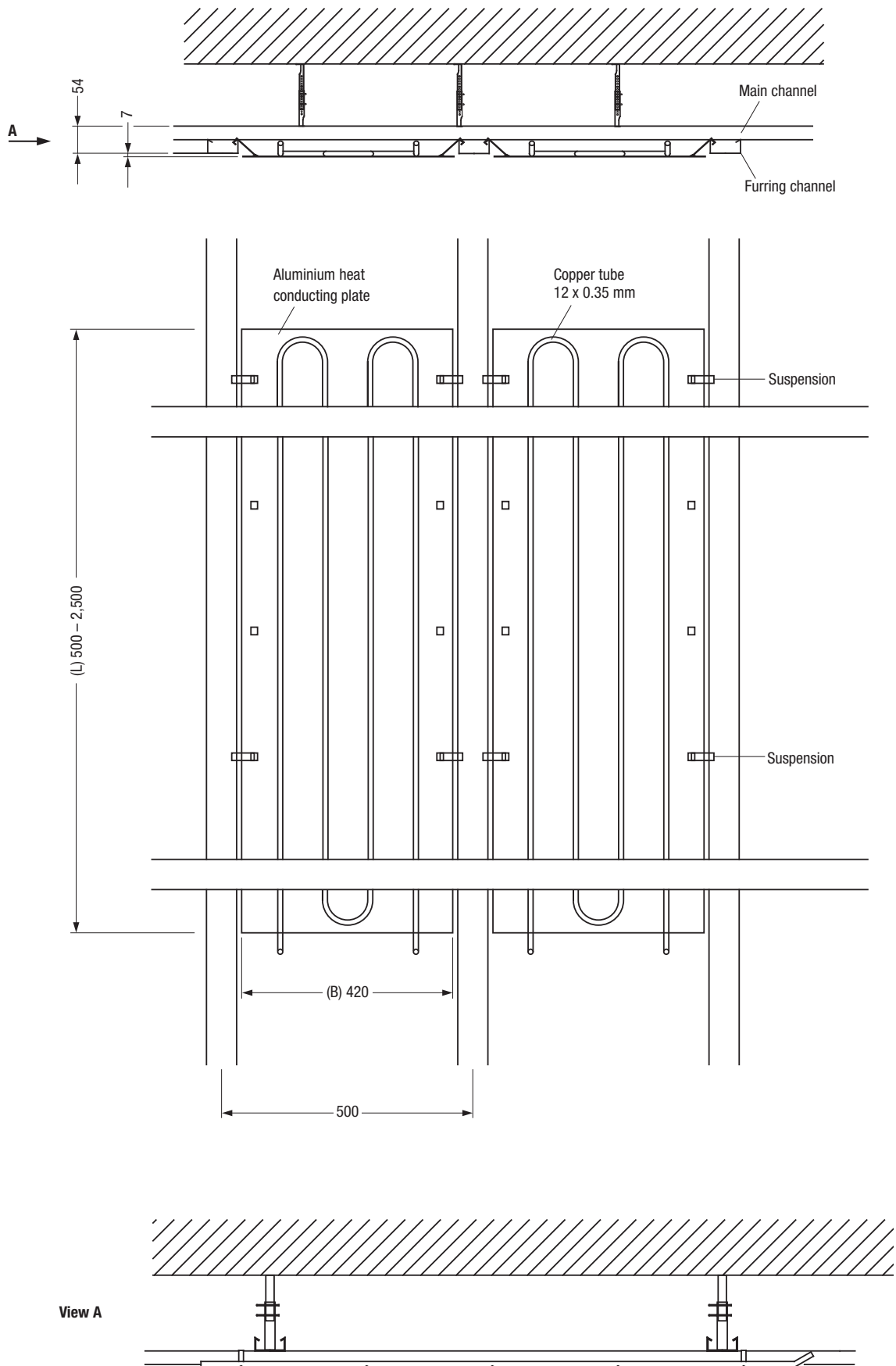


Fig. 1: KKS-4/GK/U shown without gypsum board panels

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Dimensions - Perforated elements

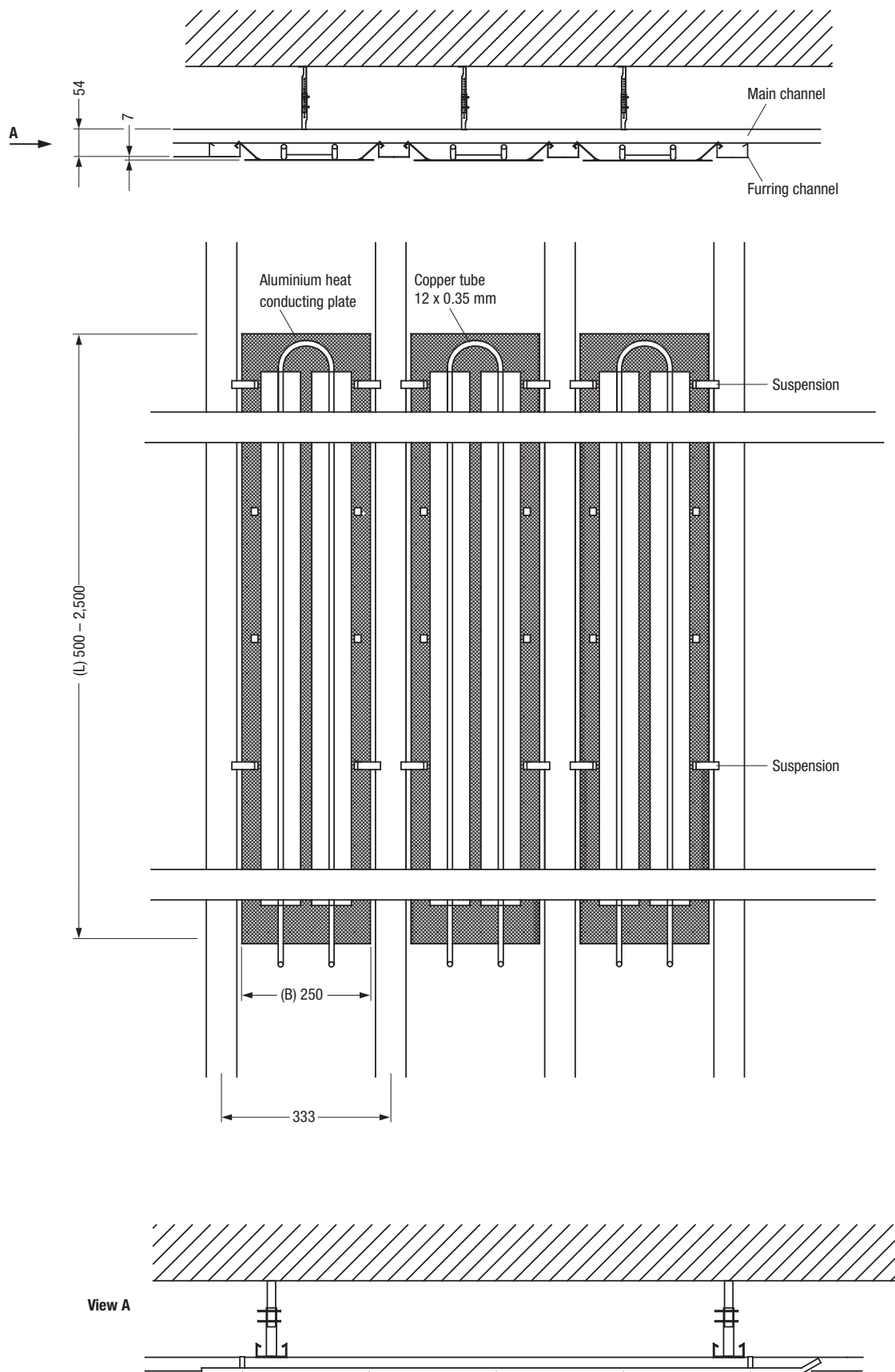


Fig. 2: KKS-4/GK/G shown without gypsum board panels

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Layout data

The cooling output of KKS-4/GK elements was determined with two design options:

A: Gypsum board cooling ceiling system with 10 mm thick Thermoboard, unperforated, without finish, with mineral fibre insulation ≥ 30 mm on the backside.

Type: KKS-4/GK/U

Cooling output: 89 W/m² (at $\Delta\vartheta = 10$ K)

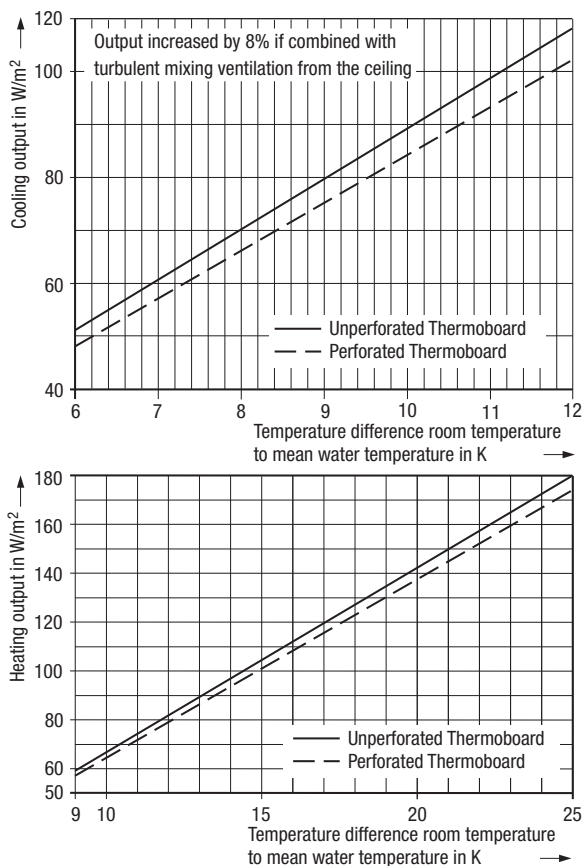
B: Gypsum board cooling ceiling system with 10 mm thick Thermoboard, both KKS-4/GK element and Thermoboard perforated – and thus sound absorbing –, without finish, with mineral fibre insulation ≥ 30 mm on the backside.

Type: KKS-4/GK/G

Cooling output: 84 W/m² (at $\Delta\vartheta = 10$ K)

The reference surface area is the surface area (L x B) of the KKS-4/GK elements, see sketches on pages 3 and 4.

The following graphs help to roughly assess the output:



Graph 1: Cooling and heating output of KKS-4/GK

To be on the safe side for determining the system output, we would recommend having the layout made by our product specialists who use specific software. Please also contact them if you wish any change to the system arrangement or materials, and for specific conditions of use.

Design specifications

This section deals with details of importance for the design of a gypsum board cooling ceiling, taking account of various design options.

The design work on a gypsum board cooling ceiling requires detailed consultation with the project's architect and design consultant. The following questions must be answered from the beginning:

- What cooling output is to be delivered by the cooling ceiling?
- What services will be integrated into the ceiling and where?
- What will be the ceiling surface finish?
- To what extent is the ceiling area required for sound absorption?

This information is essential for the general ceiling design and for determining what ceiling area can be fitted with KKS-4/GK elements. Besides room configuration and number and location of ceiling services, level differences in the ceiling and expansion joints (required in large areas) have a substantial influence on the effective surface area of KKS-4/GK elements and the effective cooling output.

The KKS-4/GK system enables to make sound-absorbing gypsum board cooling ceilings with visible or invisible perforations. For the type with visible standard perforations 12/25 and 20 mm sound-absorbing material on the backside, the noise reduction coefficient (NRC) in the active area is approx. 0.70, see sound absorption measurement curve (Graph 2). Thus, according to the German guideline VDI 3755 (2000-02) our KKS-4/GK system is highly absorptive and can meet high acoustic requirements; relevant test certificates are available.

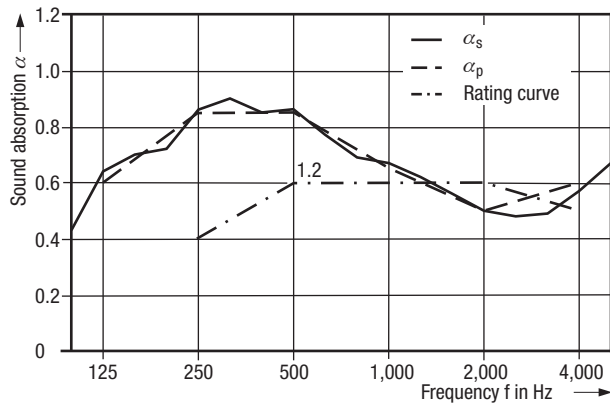
The final finish to the gypsum board cooling ceiling, e.g. full-surface skim coat of joint compound and coat of alkyd resin paint or such like, or coat of wallpaper or acoustic plaster, affects the achievable cooling output. Common types of paint do not significantly reduce the cooling output.

For rough assessment we would recommend to apply an output reduction of

- 3 – 5%** on a finish with full-surface skim coat of joint compound and coat of paint or wallpaper,
- 5 – 10%** on a finish with coat of paint or wallpaper, etc., ≤ 2 mm.

As gypsum board producers have developed a variety of panel designs and shapes, it is now possible to make not only flat, jointless ceilings but also ceiling systems with curved gypsum panels. The latter are particularly suitable for custom-built chilled sails fitted with KKS-4/GK elements. If they are properly designed, e.g. entirely flushed with indoor air and with no insulation on the backside, much higher cooling outputs can be achieved.

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		Reverberation room	
		with test object	empty
Temperature	°C	21.5	21.1
Relative humidity	%	42.9	46.1
Air pressure	kPa	99.0	99.2
Volume of reverberation room	m ³	198.3	
Test area	m ²	12.0	

f Hz	α_s	α_p ¹⁾	f Hz	α_s	α_p ¹⁾	f Hz	α_s	α_p ¹⁾
100	0.43	0.60	400	0.85	0.85	1,600	0.56	0.50
125	0.64		500	0.86		2,000	0.50	
160	0.70		630	0.77		2,500	0.48	
200	0.72	0.85	800	0.69	0.65	3,150	0.49	0.60
250	0.86		1,000	0.67		4,000	0.57	
315	0.90		1,250	0.62		5,000	0.67	

¹⁾ in compliance with EN ISO 11654:1997

Ratings

Sound absorption rating to EN ISO 11654:1997	$\alpha_w = 0.60$ (L, M)
Sound absorption class to EN ISO 11654:1997	C
Verbal rating to German VDI 3755:2000-02	highly absorptive
Noise Reduction Coefficient to ASTM C423:1989	NRC = 0.70

α_s = sound absorption coefficient

α_p = practical sound absorption coefficient

α_w = sound absorption rating

L ⇒ absorption predominantly in the low frequency region

M ⇒ absorption predominantly in the mid frequency region

Graph 2: Sound absorption measurement

The system layout shall be carried out in line with the prevailing regulations and standards (in Germany mainly DIN 1946, Part 2), the local weather conditions as well as the actual building's conditions (e.g. mechanical ventilation or openable windows).

Usual layout conditions in Germany are:

operative room temperature $\vartheta_R = 26$ °C

chilled water supply temperature $\vartheta_{VL} = 16$ °C

chilled water return temperature $\vartheta_{RL} = 18$ °C,

i.e. an output-determining temperature difference of 9 K between operative room temperature and mean chilled water temperature. As the cooling output is lower than that of other chilled ceiling types, we are usually required to fit the largest possible ceiling area with KKS-4/GK elements. This highly depends on room configuration and ceiling design.

The chilled water supply temperature must be chosen above the dew point temperature of the room air. To prevent condensation, dew point sensors shall be fitted to the water supply pipes or to the heat conducting plates very close to the supply connections. It is essential that the dew point sensors be sufficiently flushed by air at the prevailing indoor conditions.

The waterside pressure drop of a cooling element is determined by its specific cooling output, size (length x width) and the selected chilled water temperature difference. As a rule, several KKS-4/GK elements are mounted in series. On the one hand the pressure drop of a series should be $\leq 20 - 30$ kPa, on the other hand it should be much higher than the resistance to flow in the piping system within the control loop in order to ensure a steady water distribution in line with the system layout.

KRANTZ KOMPONENTEN's system design draft will include proposals on how to connect several cooling elements in series.

The general influence of chilled ceilings on thermal comfort – with or without mechanical ventilation – is described in detail in our brochure 'Cooling ceiling system description' (ref. DS 4076 e) and in other publications. These also contain information on the combination of our cooling ceiling systems with different air distribution systems. We do recommend such combination for most applications.

Cooling ceiling systems make for great satisfaction of room occupants because they provide:

- nearly constant temperatures over the room height,
- low room air velocities,
- comfortable heat removal by both radiation and convection,
- noiseless operation, etc.

For heating purposes with this system, please ask us for the relevant design specifications.

Installation instructions

The basis document for the installation of KKS-4/GK elements is the ceiling layout (generated by CAD) approved by the client. KRANTZ KOMPONENTEN will provide therein the following details:

- arrangement of KKS-4/GK elements with length x width,
- suspension structure (provided by the client) with furring channels – to which the KKS-4/GK elements will be hooked – and main channels with clearance required between one another and spacing to a reference point in the room,
- connection points for chilled water supply and return,
- positions of all cutouts and ceiling services plotted on the architect's ceiling layout,
- proposal for making equivalent hydraulic groups of KKS-4/GK elements.

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Drywall specifications such as maximum spacing between individual furring channels and main channels shall be complied with.

On the basis of these details and further information required for drywall construction, any drywall contractor will be able to make a gypsum board cooling ceiling with KKS-4/GK elements.

The client has to perform the following:

- to supply the anti-lift double-channel suspension structure, e.g. D112 Knauf system, with hangers suitable for total weight > 27 kg
- to adjust and level the suspension structure upon installation of KKS-4/GK elements.

Only upon complete installation of the KKS-4/GK elements and adjustment and levelling of the suspension structure can the chilled water system be completed. As gypsum board ceilings are not accessible for inspection, we would recommend using copper pipework with press fittings and flexible hoses.

Upon completion of pressure and leak-tightness tests, the drywall contractor will fit the ceiling with unperforated or perforated gypsum board panels according to manufacturer's specifications, with the water pipework being depressurized but filled with water. The panels are basically screwed to the furring channels of the suspension structure.

At the same time (or immediately before), at least the KKS-4/GK elements should be fitted at the back with suitable thermal insulation; this should cover the whole element surface and be jointless.

All other operations like applying joint compound, smoothing, painting, etc., shall be performed according to relevant specifications. Acceptance testing of the gypsum board ceiling, e.g. check of levelness, shall be performed to German DIN 18202 and others. The cooling ceiling system and its function should be tested to EN 12599.

Further information relating to installation will be provided with the confirmation of order and/or consignment.

The main specifications relating to drywall construction are contained in DIN 18168, DIN 18202, and in the technical papers of the BAKT federal working group on drywall.

Operation and maintenance

To prevent condensation, the operation of condensate probes and control systems along with the associated fittings will be checked following the manufacturers' specifications.

Main features

- Heat transfer mainly by radiation, resulting in high thermal comfort
- Standard cooling output complies with EN 14240
- Suitable for offices and exhibition spaces with medium cooling loads
- Only slight temperature differences in the occupied zone
- Combinable with any air distribution system
- Also suitable for heating
- Enables to make jointless ceiling systems with different types of finish and integrated ceiling services
- Noise reduction coefficient of sound-absorbing type: NRC = 0.70 (highly absorptive)
- Low overall system height, thus
 - well suited for refurbishment projects,
 - savings on construction costs or building volume on new-build projects
- The technical layout including CAD drawings is done by KRANTZ KOMponenten; this ensures
 - a reliable integrated solution using large-size elements and installation methods in use in building services and drywall construction
 - ease of installation
 - short installation time
- The core of the system is copper serpentine pipework, which means
 - no special requirements for chilled water quality
 - low system costs
 - long service life
 - assured quality
 - operating pressure up to 6 bars
- Elements manufactured to ISO 9001, using quality-controlled copper tube
- No combustible components

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Type code ¹⁾



Design of aluminium heat conducting plate ('Al plate')

U = unperforated

G = perforated

Nominal length

500 = Nominal length 500 mm	1500 = Nominal length 1,500 mm
600 = Nominal length 600 mm	1600 = Nominal length 1,600 mm
700 = Nominal length 700 mm	1700 = Nominal length 1,700 mm
800 = Nominal length 800 mm	1800 = Nominal length 1,800 mm
900 = Nominal length 900 mm	1900 = Nominal length 1,900 mm
1000 = Nominal length 1,000 mm	2000 = Nominal length 2,000 mm
1100 = Nominal length 1,100 mm	2100 = Nominal length 2,100 mm
1200 = Nominal length 1,200 mm	2200 = Nominal length 2,200 mm
1300 = Nominal length 1,300 mm	2300 = Nominal length 2,300 mm
1400 = Nominal length 1,400 mm	2400 = Nominal length 2,400 mm
	2500 = Nominal length 2,500 mm

Tender text

..... units

Contact cooling ceiling system KKS-4/GK consisting of single, compact cooling elements for mounting in gypsum board ceilings.

Each element is composed of:

- serpentine pipework made from copper tube 12 x 0.35 mm featuring a smooth, neat and dry inside surface, copper to DIN 1787 and pipework tolerances to DIN 8905, with connection ends for chilled water inflow and outflow,
- an aluminium heat conducting plate with aluminium pipe saddles to bond the pipework to the aluminium plate and optimize thermal conduction between copper and aluminium,
- suspensions.

The KKS-4/GK elements are hooked to the furring channels of the ceiling suspension structure using specially shaped suspensions. The exact arrangement of the elements along with all dimensions and the information plotted on the architect's ceiling layout are part of our design work and delivery.

Technical data

Specific cooling output:	.....	W/m ²
Cooling output of each element:	.....	W
Water supply temperature:	.....	°C
Water return temperature:	.....	°C
Room temperature:	.....	°C
Max. operating pressure (standard):		6 bars
Water quality:		mains water
Standard dimensions		
Nominal width:		unperforated: 420 mm perforated: 250 mm
Nominal length:	.....	mm
Connection type		
Pipe end for press fitting:		dia 12 mm
Make:		KRANTZ KOMponentEN
Type:		KKS-4/GK / __ - __

Subject to technical alteration.

¹⁾ More details will be provided with delivery specifications or upon request