FÉG SPIREC HEAT EXCHANGERS
KN, KNV and KT TYPES

Instructions for Use

Manufacturer: Fégtherm Gázkészülékgyártó Rt. 1095 Budapest, Soroksári út. 158

Importer: Thermo|solar Žiar s.r.o. P.O.Box 45, 965 03 Žiar nad Hronom

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Ask the seller to date the Warranty Certificate.
The user shall keep safely the "Instructions for Installation". We ask the customer to read carefully the Instructions before using the equipment. In case of loss of the Instructions, the user should ask for a copy.

Accessories:
- Instructions for Use
- Warranty Certificate, a claim to replacement of goods under warranty.

**IMPORTANT INFORMATION**

FÉG SPIREC Heat Exchangers of KN, KNV and KT types are designed to operate with various heat transfer fluids. Its most common applications include heat exchange systems with water filled primary and secondary circuits intended for both preparation of domestic hot water (DHW) and heating.
The dimensions of KN, KNV and KT heat exchangers are very small. Their heat exchange capacity per one heat exchanger is as high as 100 kW for heating, or 3 to 75 l/min of domestic hot water. Provided that the heat exchangers are connected in parallel, multiples of the above outputs can be obtained. When appropriately connected, considerable quantity of domestic hot water can be produced even if small-size heat exchanger is used. The heat exchanger design enables heat-transfer coefficients as high as 3 to 6 kW/m² °C to be achieved. Owing to its permissible operating pressures and permissible operating temperatures, this heat exchanger is suitable for using in municipal heating applications. When preparing domestic hot water, to prevent from scaling, we recommend DHW temperatures up to 50°C and a primary circuit water temperature not higher than 65°C. When working at higher temperatures, the water flow velocity should be approximately 1 m/s; when using hard water with heavy scale formation, suitable water treatment method should be used.

Materials of construction ensure the exchanger’s long service life. Both anticorrosive materials and seals used have no adverse effect on the drinking water quality. The heat exchangers are made from pairs of 0.8 mm thick polished corrugated strips, which are wound together into a coil to form a heat-exchange surface.
The KN heat exchanger has threaded connections while the KT heat exchanger is of flange type. Both the KN exchanger and the KT exchanger are to be mounted vertically. The KNV heat exchanger has threaded connections and is to be mounted horizontally.

Possible applications include:
- Domestic hot water preparation using steam at a positive pressure of 0.4 bar or hot water within the primary circuit
- Solar energy utilization
- Heat exchangers for heat pumps
- Floor heating
- Food-stuff industry
- Chemical industry
- Cooling plants – as a vaporizer or condenser with chloroprene (neoprene) seal
- Cooling or heating of oil
- Warming up water in swimming pools.

**Design parameters**

The main part of the heat exchanger is made from coiled stainless steel strip 0.8 mm thick.
MATERIALS USED

- KO 41 MS2 4360 or X2CrNi 189 DIN 17440, WNr. 1.4306
- KO 38 MS2 4360 or X2CrNiMo 1810 DIN 17440, WNr. 14404
- KO 36 MS2 4360 or X10CrNiTi 189 DIN 17440, WNr. 14541
- Silicon hose (PMÜsZIL)
- Chloroprene hose.

DIMENSIONS

<table>
<thead>
<tr>
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<th>D</th>
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<th>full</th>
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<td>210</td>
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<td>3.2</td>
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HYDRAULIC RESISTANCE OF HEAT EXCHANGER

The heat exchanger hydraulic resistance on the jacket side (inlet DN25 or G1)
Mean temperature: 60°C.

Figure 1

The heat exchanger hydraulic resistance on the coil side (inlet DN20 or G 3/4)
Mean temperature: 30°C.

Figure 2
**TECHNICAL DATA**

Maximum operating pressure: 16 bar on both sides
Maximum temperature: 150°C on both sides

<table>
<thead>
<tr>
<th></th>
<th>Type [10⁻³ m²]</th>
<th>K0</th>
<th>K1</th>
<th>K2</th>
<th>K3</th>
<th>K4</th>
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</thead>
<tbody>
<tr>
<td><strong>Coil side</strong></td>
<td>Cross-sectional area of flow</td>
<td>1.46</td>
<td>1.57</td>
<td>2.75</td>
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<tr>
<td></td>
<td>Liquid flow at 1 m/s v₁ [m³/h]</td>
<td>5.25</td>
<td>5.66</td>
<td>9.9</td>
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<td><strong>Jacket side</strong></td>
<td>Cross-sectional area of flow [10⁻³ m²]</td>
<td>0.114</td>
<td>0.24</td>
<td>0.366</td>
<td>0.515</td>
<td>0.515</td>
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<tr>
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<td>Liquid flow at 1 m/s v₂ [m³/h]</td>
<td>0.41</td>
<td>0.86</td>
<td>1.32</td>
<td>1.85</td>
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<tr>
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<td>Heating surface A [m²]</td>
<td>0.167</td>
<td>0.351</td>
<td>0.536</td>
<td>0.73</td>
<td>1.4</td>
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**HEAT EXCHANGERS’ CAPACITY**

Transferred heat: S x U (surface area x heat-transfer coefficient).

<table>
<thead>
<tr>
<th>A [m³/h]</th>
<th>B [m³/h]</th>
<th>J0</th>
<th>K0</th>
<th>K1</th>
<th>K2</th>
<th>K3</th>
<th>K4</th>
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<td>0.3</td>
<td>500</td>
<td>840</td>
<td>1040</td>
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<td>-</td>
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<tr>
<td></td>
<td>0.6</td>
<td>580</td>
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<td>1280</td>
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<td>2</td>
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<td>1240</td>
<td>1400</td>
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<td></td>
<td>0.6</td>
<td>790</td>
<td>1300</td>
<td>1610</td>
<td>1900</td>
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</tr>
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<td></td>
<td>1.5</td>
<td>-</td>
<td>1600</td>
<td>2060</td>
<td>2530</td>
<td>3900</td>
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<tr>
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<td>0.6</td>
<td>1050</td>
<td>1610</td>
<td>2000</td>
<td>2330</td>
<td>4000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.5</td>
<td>-</td>
<td>2130</td>
<td>1730</td>
<td>3320</td>
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<tr>
<td></td>
<td>2.5</td>
<td>-</td>
<td>-</td>
<td>3100</td>
<td>3840</td>
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<tr>
<td>10</td>
<td>0.6</td>
<td>1220</td>
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<tr>
<td></td>
<td>2.5</td>
<td>-</td>
<td>-</td>
<td>3720</td>
<td>4500</td>
<td>7600</td>
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</table>

In this table W/°C values for water-water operation are given for domestic hot water at a temperature of 50°C.

A = rate of flow on the jacket side (C or DN 25), Figure 1
A = rate of flow on the coil side (D or DN 20), Figure 1.

Quantity of heat transferred:

\[ Q = S \times U \times DTm, \] where \( DTm = \) logarithmic temperature difference.

Example:

DHW at a rate of flow of 2 m³/h is prepared by heating fresh water from 10°C to 60°C.
Primary circuit has a rate of flow of 5 m³/h, input temperature of 85°C, output temperature of 65°C
i.e. \( DTm = 36.5°C \)
\[ Q = Qv \times \Delta T = 5000 \text{ l/h x } 20°C = 100000 \text{ kcal/h} = 116.3 \text{ kW/°C} \]

\[ \frac{Q}{S \times U} = \frac{116.3}{36.5} = 3.18 \text{ kW/°C} \]

The K.3 heat exchanger’s S x U value as calculated according to the above relationships is 3.58 kW/°C.

Pressure losses at the above rates of flow (Figure 2) are as follows:
- on the jacket side: \( \Delta p_j = 25 \text{ kPa (0.25 bar) } \)
- on the coil side: \( \Delta p_s = 40 \text{ kPa (0.40 bar) } \).
**DESIGN CONSIDERATIONS**

The heat exchanger shall be installed in accordance with relevant standards and regulations (e.g. fittings, pipes, etc.) Depending on its type, the heat exchanger has to be mounted horizontally or vertically. These heat exchangers should not be used for domestic hot water temperatures higher than 50°C, mainly in systems without return piping. To avoid scale deposits on wetted surfaces, it is necessary that suitable means (e.g. Hydrogel) is used in areas with hard water. The DHW preparation system shall be designed in such a way that all the control principles are taken into account, namely:

- Using proportional action controller or proportional plus reset controller.
- The maximum control valve opening time is 120 s.
- For proper/accurate operation, it is necessary that the exchanger’s secondary side temperature sensor be installed so that the entire sensor is in contact with measured medium under all operating conditions.
- The two-way valve size shall be selected in accordance with the DHW rate of flow. The pressure drop across the open valve shall be selected so that this pressure drop is a half of the pressure drop across the branch with varying flow, the pump delivery head is 4-5 times the pressure drop and, both the bypass and the branch with varying flow have approximately the same pressure drop.
- It is advisable to equip the system with a thermostat to stop the primary circulating pump when a preset maximum temperature is exceeded. The pump restart will have to be performed manually by the heat exchanger operator.

**STEAM HEATING DESIGN**

Steam at a positive pressure of 1.4 bar and a maximum flow velocity of 70 m/s can be used. (The heat exchanger can also operate at different steam pressures). Values given in the table below apply to both the exchanger’s coil side as an input part and the feed water velocity of 70 m/s. The second values for exchangers K.2 – K.4 apply to steam flow velocity in the inlet branch.

<table>
<thead>
<tr>
<th>Type</th>
<th>Steam [m³/h]</th>
<th>Steam [kg/h]</th>
<th>Heat output [10³ kcal/h]</th>
<th>Water (10°C - 55°C) [l/min]</th>
</tr>
</thead>
<tbody>
<tr>
<td>K0</td>
<td>104</td>
<td>83</td>
<td>41</td>
<td>15</td>
</tr>
<tr>
<td>K1</td>
<td>208</td>
<td>166</td>
<td>82</td>
<td>30</td>
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<tr>
<td>K2</td>
<td>312</td>
<td>249</td>
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<td>45</td>
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<tr>
<td></td>
<td>208</td>
<td>166</td>
<td>82</td>
<td>45</td>
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<tr>
<td>K3</td>
<td>396</td>
<td>316</td>
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<tr>
<td>K4</td>
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<tr>
<td></td>
<td>270</td>
<td>216</td>
<td>107</td>
<td>40</td>
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</tbody>
</table>

*basic value
SCHEMATIC DIAGRAM OF THE HEAT EXCHANGER

![Figure 3](image)

K - Heat exchanger  
fe - Input heating water  
P - Pump  
fv - Return heating water  
B - Bypass control valve  
h - Cold water  
A - Flow switch  
m - Hot water  
T - Thermostatic valve

HORIZONTALLY MOUNTED HEAT EXCHANGER

![Figure 4](image)

K - Heat exchanger  
k - Boiler  
A - Flow switch  
fe - Input heating water  
V - Change-over valve  
fv - Return heating water  
P - Pump  
h - Cold water  
F - Heating system  
m - Hot water  
R,N – Electrical connection
HEAT EXCHANGER WITH RESERVOIR

Figure 5

PARALLEL-CONNECTED HEAT EXCHANGERS

Figure 6

Legend (Figures 5 and 6)

1. Cold water inlet
2. Shut-off valve
3. Back-flow valve
4. Relief valve
5. Filter
6. DHW circulating pump
7. Bypass (regulating valve)
8. Thermometer
9. Temperature sensor
10. Heating water circulating pump
11. Automatic control valve
12. Cleaning branch
13. DHW circulating pump
MOUNTING INSTRUCTIONS

Depending on the exchanger type, the heat exchangers are to be mounted horizontally or vertically. An in-line filter has to be installed in heat exchanger’s inlet pipe between the exchanger inlet and circulating pump pipe inlet. Avoid exceeding maximum permissible operating pressure and temperature values during operation.

MAINTENANCE

If properly designed and installed, the heat exchanger does not need much maintenance. A decline of heat exchanger’s output during operation may indicate scale deposited by hard water inside the heat exchanger. To remove the deposits follow the instructions below. Disconnect the heat exchanger from the system. The quantity of deposits removed can be determined by weighing the exchanger before and after cleaning, or by comparison with weight of a new heat exchanger. Because the materials of construction of wetted parts of the exchanger, i.e. stainless steel and silicon rubber are resistant to acids, repeated acid cleaning can be carried out.

DEPOSIT REMOVAL

To remove deposits from the exchanger’s inner surfaces, use acidic agents. The cleaning time should be as short as possible (in case of slight deposits the cleaning takes 5 minutes, in case of almost completely clogged exchanger, cleaning times up to 1 hour have to be used). Dissolving deposits can be conducted at temperatures ranging from 10°C to 20°C; higher solution temperatures result in shorter dissolving times.

CLEANING AGENTS

To remove deposits from inner surfaces of the heat exchanger, we recommend using 10%wt. sulphamic acid solution H$_2$N-SO$_2$-OH (NH$_2$SO$_3$H).

In spite of a relatively high price, this agent has the following advantages:

- Good deposit solubility
- No adverse effects to anticorrosive materials
- No inhibitors are required
- Higher degree of safety in comparison with that of hydrochloric acid.

Exercising caution, hydrochloric acid solution with corrosion inhibitors such as 24%±1% hydrazine hydrate or 4% tin dichloride can be also used.

Avoid using: sulphuric acid
- nitric acid.

CLEANING PUMP

The cleaning pump to be used must be resistant to chemical corrosion and have both a minimum total head of 10 m and a delivery of 1–1,5 m$^3$/h.

SCALE DEPOSIT REMOVAL PROCEDURE

The dissolving solution shall be pumped through the section of heat exchanger to be cleaned. Stop washing when no foam is observed on the cleaning solution flowing from the heat exchanger. Check the cleaning solution by means of reagent paper. The solution is reusable to pH 2.
SAFETY INSTRUCTIONS

When removing scale deposits, wear personal protective devices (safety goggles, apron, gloves).

HEAT EXCHANGER RINISING

Rinse the heat exchanger immediately after deposit removal has been complete.

PASSIVATION

To prevent from adverse effects, possible rests of dissolving solution can be removed from the heat exchanger with 4% hydrazine hydrate solution or 2% calcium carbonate solution. Use a pump of the above type. Neutralization will be complete after pumping the solution through the exchanger for 10 minutes. Use indicator paper to check the solution. Values of pH 9 should be indicated. After passivation has been finished, rinse the heat exchanger with drinking water.

WARRANTY CONDITIONS

The supplier gives a warranty for a warranty period of 12 months from date of sale. Should the FEG-SPIREC heat exchanger you have purchased appear to have a defect or fail during normal use within the warranty period, we will replace the faulty exchanger with a faultless one. The supplier of installation work shall ensure this replacement within 3 days after receiving the complaint in writing. If such a replacement is not possible, we will offer services at the same price or return amount of the heat exchanger price to the customer’s bank, or deliver other goods after the price difference has been paid. Not covered by the warranty are losses caused by operating the exchanger outside of design limits, which do not comply with the Instructions for Use, external and/or internal damages to the heat exchanger and damages to the heat exchanger caused by influence of other external conditions. If no settlement as to the cause of a particular defect is reached, the decisive is an opinion of a Testing Institute according to provisions of the Commerce Code. Before bringing action for damages, the customer may ask for opinion the Testing Institute. If the damage occurred outside the limits of the warranty, the customer will pay the price of service company’s opinion. The provisions of the Commerce Code govern both the customer’s claims and the supplier’s obligations arising from the contract of sale. Any change in the Warranty Certificate such as overwriting, crossing, erasure, etc., cause the warranty to become null and void. In case of loss of a Warranty Certificate, ask FEGTERM – PARTNER Kft. for a new one.