

KASTOR

KARHU HOME Wood-Burning Heater Series Installation and User Manual



Karhu Home

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KARHU Wood-Burning Heater Series

Installation and User Manual

Save this manual for later reference.

After installation, the User Manual must be given to the owner of the sauna or the person in charge of its use.

Read and understand the Manual before installation and use.

KARHU WOOD-BURNING HEATERS

Thank you for trusting our Karhu product. We have manufactured wood-burning heaters longer than any other company in the world – almost for a century. Over the decades we have learned a great deal of fire and handling the delicate element. Lighting a fire is a skill everyone should know, and nurturing a fire is an art of its own. We have two guidelines in the design and manufacturing of our products, following our past master craftsmen's lead: there is nothing redundant in our products and we only use the best materials. Even though our products are simplified and dependable, there's nothing simple in the solutions on the background, building on decades of experience and modern technology.

HIGH-GRADE MATERIALS

We only use the best materials in our products, and only from our trusted long-term suppliers. We use Finnish structural steel for its uniform quality – it's highly versatile and keeps its strength. In our fire doors, we use Ceram special glass that can take 800°C, yet still lets through that lovely warm glow of live fire.

WE KNOW FIRE

Our products are heavy, which is a good sign of fire-resistant materials. It's not the thickness of the steel that does it, but the way it's used. We must know how fire moves and where the heat goes. The hottest spot that has to endure the greatest heat is not, as you might expect, right above the flames but where the heat is being conducted. Fire also needs air to burn clean and provide heat economically.

SUPERIOR TECHNOLOGY

Fill the furnace, burn it up and our heaters are ready to keep warm long after the last little flame has gone out. This unique feature is a result of our quality materials and other factors, such as Coanda air circulation system, large and deep stone compartment and sturdy doors. You can read more about the above features, our other technical innovations and our large range of installation accessories at www.sauna360.com and our brochures.

1. Before installing

Check the product and the package contents straight after delivery. Let the driver know about any transport damage immediately.

1.1. Contents of the package and checking

Contents of the heater package:

- Sauna heater
- In the furnace:
 - Installation instructions
 - Grate
 - Connection pipe
 - Door handle, mounting screw and nuts
 - Two steel caps (one for the soot hatch in the stone compartment, one for the back wall flue hole – bolted into place using a drilling screw drilled through the cover).
- Ash pan

1.2. Considerations and instructions

Check the suitability of the heater for the sauna, refer to the maximum and minimum cubic volumes (Table 1).

When there's stone, tile or glass surfaces, add 1.5 m³ to the volume for each square metre.

In saunas with timber walls, 25% is added to the calculated volume.

In order to avoid damages during transport, the heater must be transported in an upright position.

All sticker labels and packaging material must be removed before the sauna stove is used.

The type plate and the CE marking must not be removed.

The ash pan must be closed during heating.

BURN IN THE HEATER OUTDOORS BEFORE INSTALLING IN THE SAUNA.

In addition to these instructions, all local regulations must be followed, including those referring to local and European standards. They must be complied with when installing the heater.

You must also find out about any necessary building planning permissions and the floor load capacity before installing the heater.

Before installing the chimney, you must also check the chimney's temperature class.

- Average temperature of combustion gas on nominal output (Table 2)
- Maximum temperature of combustion gas in safety test (Table 2)
- Temperature classification for the chimney is T 600

Check the following issues and choose the location for the heater accordingly:

- Safety distances to flammable and non-flammable structures (Table 1)
- Location of the chimney connection (the height of the old chimney connection, if any, from the floor, or installation route for a new chimney)
- Floor material (flammable, non-flammable, tiled, waterproofed).
- If the heater will be connected to a divided chimney (another stove has already been connected to the chimney), each connection must have its own damper. The chimney must be sized according to the larger stove.
- Before beginning heating, also make sure that the smoke flue draft is sufficient and that the heater is not damaged.
- Draft in the chimney is -12Pa on nominal output.
- Draft can be roughly checked for example by burning a bit of newsprint in the heater.
- Before lighting, switch off equipment causing negative pressure, such as hood or machine-operated ventilation. If the ventilation system has been equipped with a fireplace switch, use it according to the system instructions.
- If heater has its own external delivery pipe for combustion air, make sure it is open and that there are no items causing a blockage in front of it and that there is a supply of air. The delivery pipe can be located down by the heater on the wall or floor. It must be equipped with a grille which can be closed or a disc valve. The minimum pipe diameter is 100 mm.
- Karhu heaters are meant for heating a sauna. They must not be used for any other purpose.
- The heater is not meant for continuous 24 hour use.
- Sea water, rainwater or water containing chlorine must not be thrown onto the stones, use clean water only.
- In the proximity of sea water, there is also the risk of corrosion for the heater; operating life may be shorter.
- Decorative or other items must not be placed on the heater. The heater must not be covered when it is heated, or when it is hot. E.g. drying clothes or other flammable material on the heater is forbidden due to fire risk.
- In order to guarantee full output and safety, the fire door must always be kept shut when heating. The fire door can be open during heating only when adding more firewood, and the heater must be continuously observed. Monitor sauna temperature so that the heater will not overheat. If the heater becomes overheated, open the sauna door and allow ventilation.
- Fire doors and glass surfaces must be handled carefully.
- Fire door handle may be hot; use a tool when opening. (glove)
- If the heater has not been used for a long time and is located in a damp space (e.g. an unheated holiday house), it must be carefully checked before use for corrosion damage and to make sure the chimney is not blocked, for example by a bird's nest.
- If a chimney fire occurs, or if there is a risk of one, close the fire doors but leave the damper on the flue open.
- Call the fire brigade if you need help with putting the fire out. *After a chimney fire, a local chimney sweeper must always check the condition of the flue.*
- A chimney fire, even one that was put out, must always be reported to the fire authorities.
- Be careful! Handles, fire door glass and the surface of the heater, as well as recirculated air may be hot!
- Do not let children light fire or stay near burning fire unless supervised by adults.
- Follow the instructions when heating and installing the heater.
- The heater can only be heated using unprocessed firewood.
- Structural changes must not be made to the heater.
- Only use original equipment and parts approved by the manufacturer.

2. Installation and preparations for use

2.1. Bringing into service condition and burn-in

- Install the handle to the door.
- Place the heater on a non-flammable surface outdoors, without stones.
- Models with a water tank: attach the tap and the cap, fill the tank with water.
- Remove all extra stickers and protective plastic (NOT the CE mark sticker).
- Make sure that the grate is in place.
- Install the included connecting pipe to the flue opening above the heater, the shorter section into the heater.
- Check the caps for the soot hatches and the flue opening.
- BURN-IN: The purpose of burn-in is to burn the protective agents off the stove outdoors, and cure the heater finish. Burn a furnace-full of small chopped wood, re-stoke full once or twice. Continue burning the heater outdoors until the heater emits no odour.
- Let the heater cool down and move it indoors to the sauna.
- Make sure there's ample ventilation during the first heatings.

2.4. Heater stones, placing the stones

Use peridotite or dunite stones over 10 cm in diameter. Wash the stones before placing them into the stone compartment. *Do not place the stones too tightly or pile them too high.* Leave enough space between the stones.

Place the stones vertically instead of horizontally to allow hot air flow from underneath all the way to the top stones. Fill the entire stone compartment, place flat stones vertically, pay attention to the maximum amount of stones (Table 1)

More balanced heat properties can be reached by using a mix of differently sized and different types of stones and adjusting the amount of stones. As stones and layouts are unique, there are no generally applicable rules. Try placing the stones in different ways to find the ideal layout for your needs.

In order to operate properly, it is vital that the hot flue gases can flow freely in between the stones and heat them up quickly. If the stones are too small or incorrectly laid, the air in the sauna space will heat up, but the stones won't (Figure 3).

2.5. Heater base

Install the heater on a level, fixed and solid base, which is inflammable or insulated against fire. If the floor is of a flammable material, a protective base for Karhu sauna heaters must be used (includes 4 adjustable feet). A spark protection sheet must be installed on the floor next to the protective base, so that it covers the floor 400 mm from the heater and extends a minimum of 100 mm to the sides, as measured from the fire door. **IT IS FORBIDDEN TO INSTALL THE HEATER WITHOUT THE PROTECTIVE BASE ON A FLAMMABLE FLOOR.**

The heater can be installed directly to a concrete floor, given that the thickness of the slab is at least 60 mm. Make sure the poured floor under the heater does not include electrical wires or water pipes.

Installing the heater directly on a tiled floor is not recommended, because moisture seals and tile adhesives may include substances that are non-resistant to heat. In this case, a protective base for Karhu heaters must be used.

2.6. Safety distances and protection

2.6.1. Safety distances: (Figure 8)

Safety distance to a stone wall is 50 mm from the outer surface of the heater. 100 mm is preferable to allow sufficient air flow. Therefore, a heater can be installed in a bay corresponding to the heaters width + 200 mm.

Safety distance to flammable materials is 300 mm from the outer surface of the heater. In consideration of heat radiation and sufficient space for operating and servicing the heater, a 1,000 mm safety space should be left in front of the heater. A minimum safety distance in the front is 500 mm.

Safety distance upwards is 1,300 mm, measured from the stone surface. A protective plate with a 30 mm air slot must be placed on the ceiling if the measurements are not sufficient.

If the smoke flue has a non-insulated interconnecting pipe or a bended pipe above the heater, the safety distance is 400 mm on sides and 400 mm upwards as measured from the horizontal surface.

Safety distance to the water tank in heater models including one, is 150 mm from flammable materials (Table 1).

2.6.2. Reducing safety distances:

Karhu protective walls and protective base are available. The chimney's isolated part must reach the protective wall. In that case other protection is not needed (Figure 7).

If the floor in the front of the heater is flammable, the floor must be protected with a min 1 mm metal sheet (spark protection sheet) at the distance of 400 mm to the front and 100 mm to the sides, as measured from the fire door.

If the heater is installed in a corner, with a brick wall or chimney breast behind the heater and on one of the sides, the safety distance is 50-100 mm on the side and 50 mm at the back. If there's a brick wall or chimney breast on both sides and at the back, a safety distance of 100 mm to both sides is recommended to allow sufficient air flow. At the back, the previously mentioned 50 mm will suffice.

In a sauna, the chimney must be always be insulated 400 mm below the ceiling (Figure 6).

For chimneys, safety distances to flammable materials are product-specific. Check the manufacturer's instructions. If in doubt, contact the local fire authorities.

2.7. Heater connection to a smoke flue

Karhu heater can be connected to the smoke flue (brick chimney) from the back or from the top. For connection to a brick chimney, pay attention to the safety distances and protection in section 2.6. and brick laying instructions for brick chimneys.

2.7.1. Back connection:

Make a hole in the brick chimney which is 20–30 mm bigger than the connecting pipe.

Remove the plate covering the round hole at the back of the heater cover by using a screwdriver or the end of a hack saw. Install the plate to cover the hole for top connection instead. Place the included connection pipe to the smoke flue opening at the back of the heater. Push the heater in place. Make sure that the connection pipe sits well in the opening at the chimney. Seal the empty space between the connection pipe and the chimney by using flexible, fire-resistant material, such as fire wool.

The connection is finished by using a Karhu cover plate, available from a hardware store. Fix the cover plate to the chimney

by metal fixtures or fire-resistant putty (Figure 4).

2.7.2. Top connection:

Install the heater's own connection pipe to the upper flue opening on top of the heater, the shorter section into the heater. Make a hole in the brick chimney which is 20–30 mm bigger than the connecting pipe.

Top connection is made by using a bended pipe, which can be turned to match the chimney. Bended pipes are available at a hardware store. A bended pipe can be extended, when necessary. Install the heater's own connection pipe to the upper flue opening, and install the bended pipe on top of the connection pipe. Use a saw to adjust the length of the bended pipe and extension, if any. Make sure the pipe goes deep enough into the chimney (not too far, the chimney may be blocked).

Seal the empty space between the pipe and the brick chimney by using flexible, fire-resistant material, such as fire wool. The connection is finished by using a Karhu cover plate, available from a hardware store. Fix the cover plate to the chimney by metal fixtures or fire-resistant putty (Figure 5).

2.8. Connection to a ready-made flue

The heater can be connected from the top to a ready-made flue.

Select the correct ready-made flue in accordance with the heater model, the height of the flue, the external conditions, temperature class T 600 etc. For best performance, installing a damper is always recommended.

- Install the heater's own connection pipe to the upper flue opening on top of the heater, the shorter section into the heater.
- On top of the connection pipe, install a non-insulated interconnecting pipe and an extension, if needed. Use a saw to adjust the length of the interconnecting pipe and extension, if any.
- Install the damper between the non-insulated and insulated part, or alternatively, into the first insulated chimney flue module.
- Continue using insulated modules on top of the damper. There should be at least 400 mm of insulated chimney flue below the ceiling. Follow the installation and user instructions for ready-made flues (Figure 6).

Adhere to the above mentioned safety distances to flammable and non-flammable materials.

2.9. Heater door and changing left/right-handedness

The door's opening direction can be changed by turning the door over.

Changing the door's left/right-handedness:

- Open the door and push the hinge pin from below to release it from its hole.
- Pull the hinge pin down to release it from the upper hole; the door is now detached. Pay attention to the washer and locking nail.
- Turn the door around so that the handle is on the preferred side.
- Firstly, push the hinge pin into the upper hole in the frame, and insert the washer to the pin on top of the frame (the part of the pin with notches should face down).
- Insert the upper hole of the door to the hinge pin above the frame.
- Finally, guide the hinge pin into the lower holes in the frame and the door.

2.9.1. Grate

There is a grate in the heater's stove. Place it on the brackets on the bottom of the stove. Clean the grate from ash before the next heating to allow air through the grate to the furnace (Figure 9).

2.9.2. General advice to prevent damage

When you bring the heater into the sauna room, burn another full batch of wood before placing the stones and make sure that there's plenty of ventilation. This way any residual protective agents will burn off and the finish is properly cured.

Read the instructions below and make sure to follow them:

- Maximum wood quantities can be found in Table 2.
- In cold conditions, avoid heating in full power. The brick chimney may crack.
- Avoid throwing water straight onto the glass door.
- Do not heat the sauna heater so that the cover is red-hot.
- Exposure to saltwater will shorten the heater's life cycle significantly. Please note that even water from a well can contain salt in the vicinity of sea.
- The warranty does not apply, if saltwater is used for the heater.
- Other factors contributing to the heater life-cycle are correct size to the space, the fuel used, the number of heating times, operating against the user instructions, and general diligence.
- Karhu heaters are carefully designed and tested. If a heater becomes damaged in use in an unreasonably short time (e.g. the covers or top part are torn or burned through etc.), can fairly say on the basis of research data, that the heater has not been used as instructed. Sauna360 will not be liable for damage in result of misuse or use against instructions.

3. Using the heater

3.1. Fuels

Use only unprocessed wood in Karhu heaters, preferably chopped birch or alder (maximum amounts in Table 2). The length of a single piece of firewood is approximately 35 cm. Dampness 12–20%. NOTE! Damp or decayed wood does not provide heat very well and emissions are higher.

The amounts of wood mentioned in Table 2 correspond to the values of a nominal output test in compliance with EN-15821, where the volume of the sauna room is the maximum volume. Therefore, use a smaller amount of wood first to find the suitable amount of wood for your sauna.

Do not exceed the amounts of wood mentioned in the Table.

The following materials are not allowed in the heater furnace: impregnated wood, wood containing nails, chip board, plastic, plastic coated board or paper. Liquid fuels are not allowed, not even when starting the fire because of the risk of a flash fire.

Do not burn large amounts of small pieces of wood, such as chips or small pieces because of their high temporary heating effect.

Firewood must not be stored immediately next to the heater. Pay attention to the safety distances.

3.2. Adjusting the air flow

The heater has been designed to perform best when the negative pressure of the flue is approximately -12 Pa. If the chimney is long, this optimal negative pressure limit may be exceeded. Adjust the draft and combustion air flow using a damper so that it is suitable. Be careful of carbon monoxide. The damper must not be closed too far!

When lighting the fire, the door may be kept slightly open for a moment. The ash pan must be closed. It is not opened during burning. Combustion air comes from another source. The ash pan has a catch to prevent opening, when there's fire.

3.3. Adjusting heating efficiency

The amount of wood when stoking determines the heating efficiency. Table 2 shows the correct amounts of wood which guarantee burning in accordance with the CE marking.

The heating efficiency is up to the quality and the amount of fuel. Do not burn too long pieces of wood in the furnace.

Do not heat red-hot.

3.4. Lighting

- Set the first batch of wood loosely into the furnace. (Maximum amount, refer to Table 2)
- Add kindlings between the logs and light them.
- You can keep the fire door open for a moment while the logs start to burn.

3.5. Stoking the furnace

Add the actual heating batch when the fire has nearly burned down to embers. (Maximum amount, refer to Table 2).

Add the wood lengthwise, similarly to the grate openings. Close the fire door.

Sauna is normally ready for bathing in 40 to 50 minutes, and it is not necessary to add more wood for one sauna bath.

3.6. Continuing heating

If the bathing session is longer, the conditions are cold etc., another batch of wood may be necessary for prolonged heating. Once the first batch has burned down to embers, add more wood into the furnace parallel to the grate. (Maximum amount, refer to Table 2)

4. Maintenance and repairs

4.1. Cleaning the heater

The surface of the heater may be cleaned with mild detergent and moist, soft cloth.

Clean the fire door glass with a soot cleaner agent (e.g. Noki Pois) available from hardware stores.

4.2. Removing the ashes

Excess ash will shorten the grate's life cycle and weaken burning. Remove only cold ash before starting the next heating, to a metal bucket or similar to avoid risk of fire. Open the door to pull out the ash pan for emptying.

4.3. Chimney sweeping

The opening in the stone compartment is a soot hatch (covered with a cap).

The inner parts of the heater are cleaned through the soot hatch 2 to 6 times a year according to use.

For this, you need to empty the stone compartment. You can take the opportunity to check the condition of the stones. The soot hatch will open by tapping the cap sideways.

If the cap has stuck because of temperature fluctuation, use a bending iron or a hammer.

4.4. Cleaning the heater glass

Handle the glass door carefully. Do not bang the door shut or use it for pushing wood into the furnace. Clean the glass with Noki Pois or similar soot cleaning agent.

4.5. Changing broken glass

- Remove the door as instructed in section 2.9.
- Remove all pieces of broken glass.
- Straighten the tabs at the corners and remove the four (4) locking springs inside the mouldings.
- Push the glass into the upper moulding and insert it into the lower moulding by sliding the glass. Adjust the glass to the centre.
- Push the locking springs in at the ends of the mouldings, and bend the tabs against the glass.
- Attach the door to the heater.

5. Troubleshooting

If the heater or the sauna doesn't perform as you think they should, check according to the list below. Make sure you have selected the correct heater to match the sauna room's properties. Our website has instructions for selecting a suitable heater: www.sauna360.com

The heater is too hot (red-hot)

The draft exceeds -12Pa

- lower the draft with the damper
The stones are laid too tightly or they are too small.
- place the stones more loosely and use stones that are min 100 mm in diameter.
There's too much wood, or the pieces are too small.
- Table 2 has the maximum amounts of wood for the heater, do not use more.
- Do not burn large amounts of small pieces of wood, because their temporary heating effect is high.
- Let the previous batch of wood become embers before adding the next batch.

There's smoke in the sauna room, the draft is bad.

Turn off all equipment that may cause low pressure.

Is the damper open?

Is the connection pipe sealed against the heater and the flue?

Is the alternative flue opening sealed with the included cover?

Are the heater's soot hatches securely shut?

Is there ash in the heater channels?

Is the interconnecting pipe from the heater to the flue free from ash?

Is the flue completely open? Is it unswept, filled with snow, covered with winter cover etc.

Is the chimney in good condition? Cracks, weathering.

Is the draft height (chimney height) sufficient to the surrounding environment?

- If there are trees close by, a steep hill etc., the chimney needs to be over 3.5 m measured from the floor.

Is the flue size correct?

- A minimum of ½ a brick chimney or, depending on the heater model, either a 115 mm or 130 mm round flue.

The stones do not become hot enough.

Have you burned enough wood in the furnace?

Burn enough wood in the heater, refer to the amounts of wood in Table 2.

Is the draft too weak?

Is the amount of stones correct?

- At the sides, there should be stones to the level of the sides, and in the middle, only half a stone can raise above the side level.

Are the stones too tightly packed?

- Place the stones loosely, so there will be enough space between the stones.

Are the stones of good quality and the right size?

- Use peridotite or dunite stones, min 100 mm in diameter. Place flat stones vertically.

The sauna room won't become warm enough.

Are the doors, windows and air conditioning closed, and the combustion air opening open?

Is the sauna new, are the wooden structures damp for some other reason?

Is the heater used correctly?

Have you burned enough wood in the furnace?

- Burn according to instructions.

Is the draft too strong?

- Use the damper to adjust the draft.

Is the draft too weak?

Has the heater been sized correctly?

Is the draft height (chimney height) sufficient to the surrounding environment?

- If there are trees close by, a steep hill etc., the chimney needs to be over 3.5 m measured from the floor.

Is the amount of stones correct?

- At the sides, there should be stones to the level of the sides, and in the middle, only half a stone can raise above the side level.

Are the stones too tightly packed?

- Place the stones loosely, so there will be enough space between the stones.

Are the stones of good quality and the right size?

- Use peridotite or dunite stones, min 100 mm in diameter. Place flat stones vertically.

The sauna heats up quickly, but the stones are not hot.

Is the amount of stones correct?

- At the sides, there should be stones to the level of the sides, and in the middle, only half a stone can raise above the side level.

Are the stones too tightly packed?

- Place the stones loosely, so there will be enough space between the stones.

Is the heater too big?

- Keep the ventilation valve open to keep extra heat out. This way the stones will have time to heat up as well. It will take a bit longer to heat the sauna this way.

There are black flakes under the heater.

The stones may be weathered.

The flakes can be metallic anvil cinder, fallen off the heater. The heater has been heated too much red-hot; the metal will flake and the heater will break prematurely.

There's a smell of sulphur in the sauna.

The stones have sulphur residues from blasting, or the stone includes sulphur naturally.

6. Manufacturer's declaration

This product fulfils claims mentioned in the certificate of approval and documents related to it.

7. Warranty and manufacturer identification**WARRANTY**

Karhu products are of high quality and reliable. Sauna360 grants a 2v year factory warranty to its Karhu wood-burning sauna heaters covering manufacturing defects.

Damages caused by incorrect use or use which is not in accordance with instructions will not be covered by the warranty.

MANUFACTURER

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Phone. 0207 560300, e-mail: sales.fi@sauna360.com

Table 1

Model	Volume of the sauna room m ³	Output (kW)	Dimensions (mm)			Safety distance to flammable material (mm)				Weight (Kg)	Amount of stones (Kg)
			width	depth	height	Front	Side	Back	Up		
Karhu Home	8-20	12	435	475	730	500	300	300	1300	45	35-40

When there's stone, tile or glass surfaces, add 1.5 m³ to the volume for each cubic metre.

If the sauna walls are uninsulated log, add 25 % to the volume.

Model	Flue opening, inside diameter (mm)	Distance to the centre of flue opening from the floor (mm)	Distance from the back of the heater to the centre of the flue opening, top connection (mm)	Water tank volume Lt	Sauna room min height (mm)	Max length of fire wood (mm)
Karhu Home	115	560	125	-	2100*	380

*Less than min height, use a protective plate in the ceiling

Table 2

Model	Fuel	Temperature of the combustion gas in nominal output (ka)	Carbon monoxide emissions 13% O ₂	Efficiency %	Flue draft Pa
Karhu Home	Wood	379°C	0.32	72%	12

Model	First batch	Stoking batch	Stoking batch 2	Maximum temperature of combustion gas	Temperature class of the flue
Karhu Home	4 Kg – 7 pcs	3 Kg – 6 pcs	2 Kg – 4 pcs	479°C	T-600

Figures

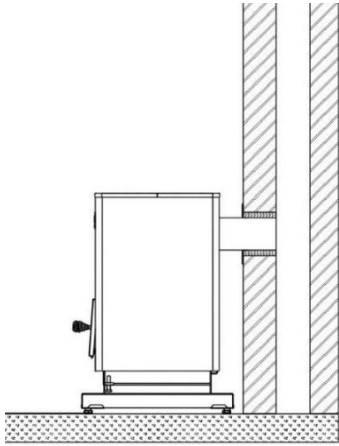


Figure 3

*Placing the stones, a cross-section of the heater stone compartment
Place the stones loosely, so there will be enough space between the stones*

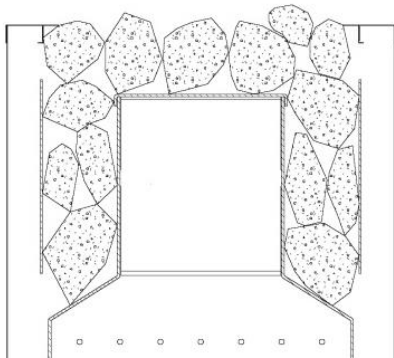
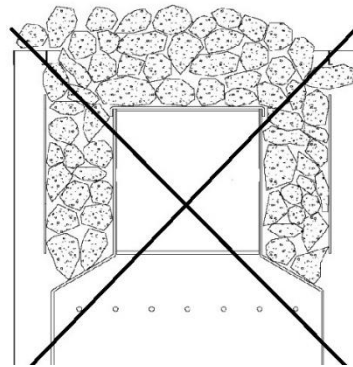


Figure 4

Heater back connection to a brick flue.

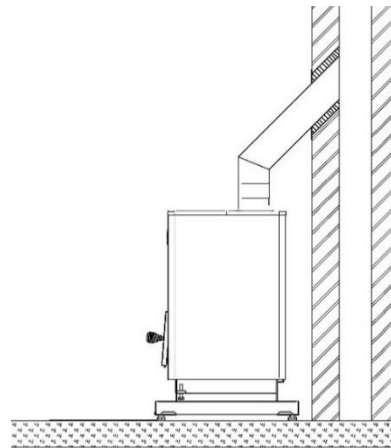


Figure 5

Heater top connection to a brick flue.

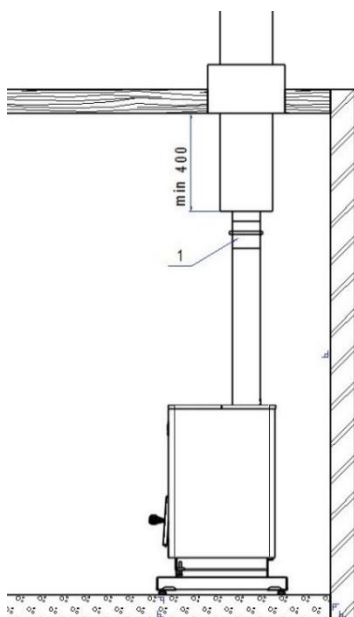


Figure 6

Connection to a Kastor/Karhu ready-made flue.

1. Damper

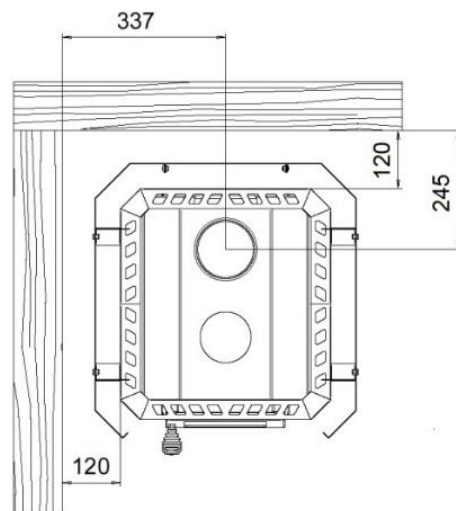


Figure 7

Installation of Karhu heater and a Karhu protective wall

Heater safety distances

1. Flammable material
 2. Non-flammable material
 3. Uninsulated interconnecting pipe
-
- A. Uninsulated interconnecting pipe, safety distance to flammable material 400 mm.
 - B. Heater safety distance to flammable material, side and back, 300 mm.
 - C. Heater minimum distance to non-flammable material 50 mm.
 - D. Heater safety distance to front, 500 mm.

Figure 8

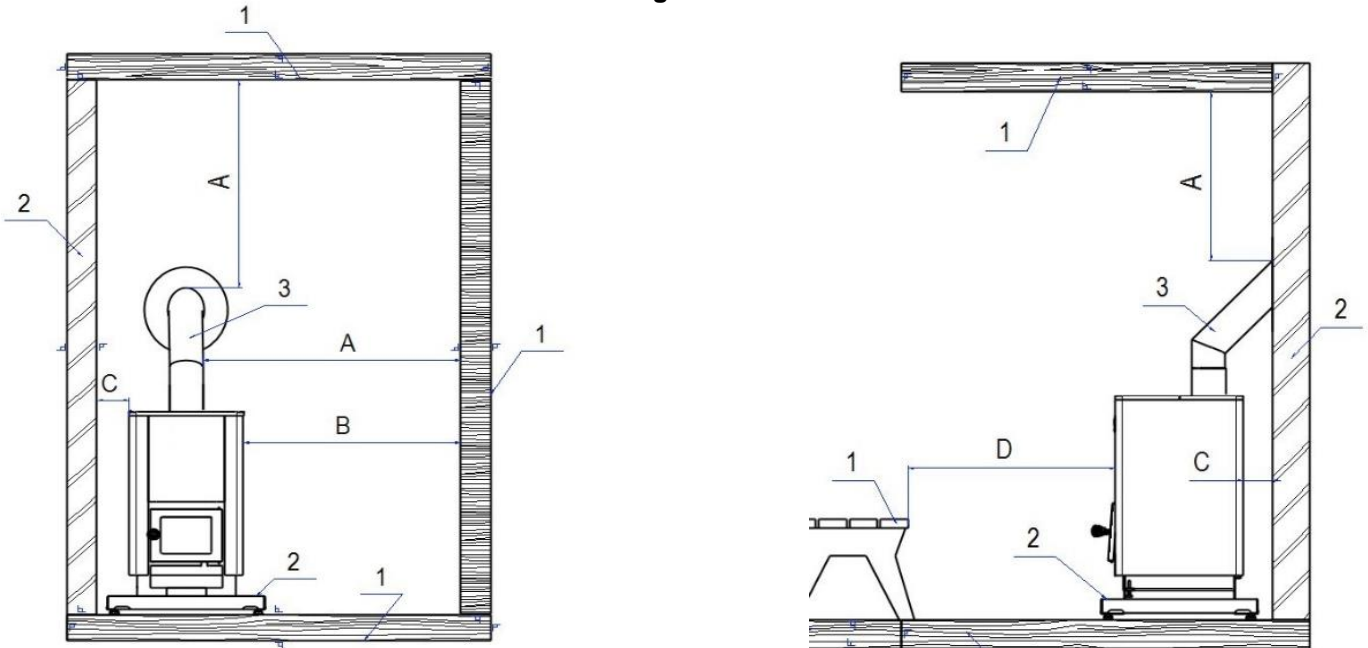
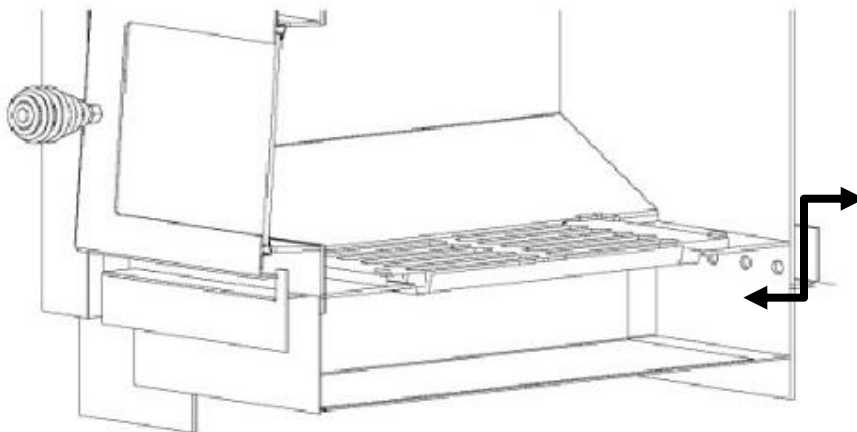


Figure 9



NOTE!

For best performance, it is important to empty the heater's ash pan at least before every second heating to keep the combustion air opening under the grate open.