

INSTALLATION & MAINTENANCE MANUAL FOR FLUE RENOVATION SYSTEM – HT1000

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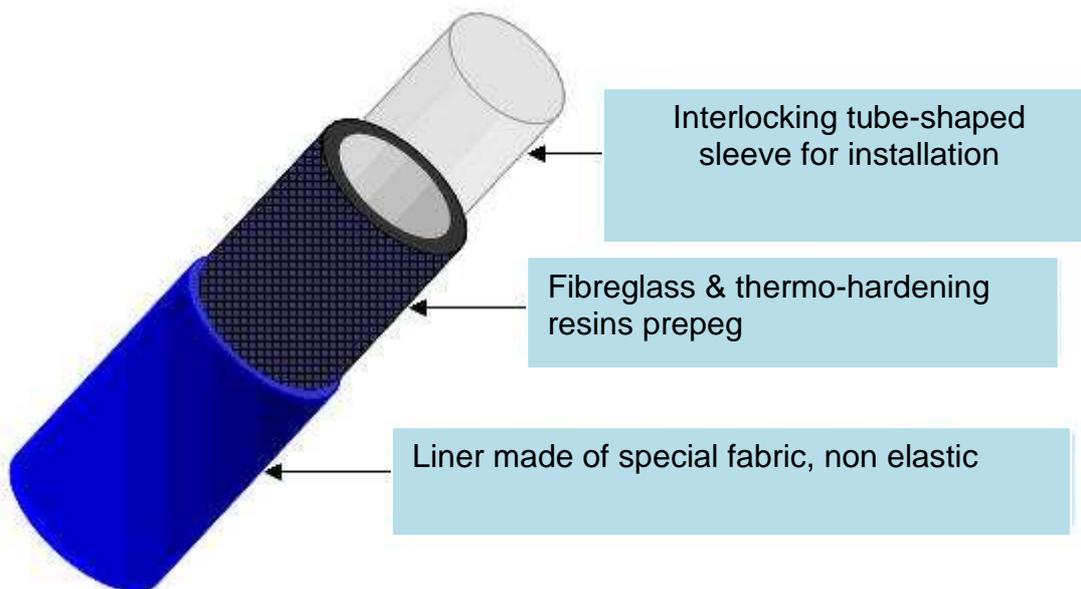
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Purpose

The purpose of this document is to offer Ht1000 installers a clear and unambiguous document that specifies instructions and steps to properly install the system.

Introduction

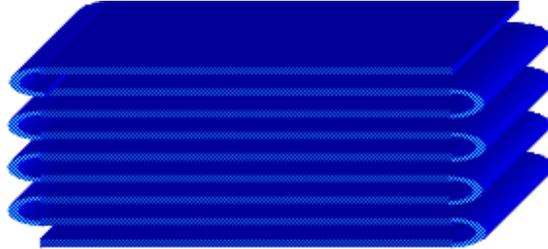
Ht1000 is an innovative system to renew old flues of solid combustible boilers , wood stoves and wood-fired ovens by lining an old duct using a new sheath. The Ht1000 sheath mainly consists of thermo-hardening, heat-resistant, water-based resins that does not contain furan, furfuryl alcohol and antimony trioxide. Ht1000 is environmentally friendly and not toxic for installers.



Thermo-hardening, water-based resins are intrinsically reactive; therefore, the following instructions should be strictly observed:

- The product must not be stored to direct sunlight or temperatures over 25°C.
- Do not wash the sheath with water before installing. Otherwise, it can get damaged and no longer suitable for installation. Only once polymerised can the sheath get in contact with water.
- Do not wet the sheath with any other kind of liquids before installing it. Store in a dry place.

- Do not store longer than 2 weeks at 20°C.



Use

Ht1000 is suitable for conveying outdoors combustion gases of boilers and stoves which use solid combustible materials. The system features the characteristics below and has been certified as compliant to them:

- N1 negative pressures
- Maximum temperature class: 1000 (A1 fire reaction class)

It is highlighted that the Ht1000 system is category G soot-fire resistance.

Good Occupational Health Practices

- Wear suitable gloves when handling/working with the sheath
- If your hands are dirty with the product, do not use them to eat.
- Strictly observe the instructions specified in the MSDS.

Installation

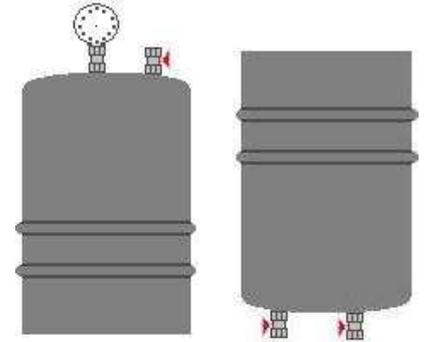
Video inspect the status of existing flues so that you can successfully apply the sheath.

- The flue interiors should not be rough, show blunt points or any other defect that may damage the sheath while it is being inserted.
- Flues should not have 90° bends; only two 45° bends or two 30° bends maximum are allowed.
- The interiors should not show any water leaks or drips; otherwise, the sheath itself and the polymerisation are compromised.

List of materials and equipment needed for proper installation

The following materials and equipment are needed for installing the sheath properly:

- Ht1000 sheath of suitable size and diameter for the flue to be renewed. In general it should be around 2 m longer than the existing flue.
- Sockets of suitable diameter for the sheath to be installed
- Check that the pressure gauge on the upper socket works properly.
- Socket clamps and protective rubber rings (at least 3 per socket)
- As many steam boilers as needed for sheath polymerisation. Diesel fuel and distilled water as required for proper boiler functioning.
- Steam suitable pipes and fittings to connect the boiler sockets.
- Tripods to anchor the sheath to the roof.
- Assorted supporting devices such as assorted tools and condensate collection bucket.
- Digital thermometer, if necessary, to check sheath temperature at polymerisation.
- Standard-compliant grinders to cut sheath at both ends once the polymerisation process finishes.



Preparation of boiler room and roof

It is of almost importance to properly prepare the boiler room for a successful installation.

a) Boiler room:

- Work so that the existing flue is easily reached; the mouth through which the Ht1000 sheath will be introduced should be wide enough to facilitate insertion operations. If the already existing flue has a union tee, use a new tee fitting for the sheath to go through. It is advisable that the insertion mouth be as straight as possible, thus avoid 90° accesses, so that the sheath can expand/extend easily when inflated.

b) Roof:

- Position the sheath anchoring system at the mouth; extend tripod legs according to the sheath diameter and the existing flue mouth.
- Put a tensioning cable through the existing flue up to the lower mouth. This cable will be needed when the sheath is inserted.

How to insert the sheath

Inserting the sheath is a highly delicate, key operation and the success of a proper installation totally depends on it. Strictly follow the steps below. A sheath can be inserted either by pulling it from bottom to top or by lowering it from top to bottom.

- The first solution is often used when the sheath is heavy and has proven useful when it is not safe or too difficult to work on the roof.
- The second solution is used in less complex and demanding cases. Anyway, the installer should be able to assess each case and choose the most suitable solution for the flue to be renewed.
- While the sheath is being inserted (by either method above), pay utmost attention so that the sheath is as straight as possible, does not get coiled or twisted in a 'candy-wrapper'-like manner.
- While the sheath is being inserted, always follow it through the duct and fold it to form a U-shape.



Caution. Do not use cold or hot water trying to soften the sheath. Under no circumstances can a wet sheath be used as it is irreparably damaged. Should this occur, the warranty shall be rendered void.

- Follow the steps below:
 1. If you are inserting the sheath from bottom to top, fasten tight the sheath to the cable already fitted inside the flue at the boiler room.
 2. The installer on the roof is to operate the winch (it is advisable to do so at a low speed) or pull the sheath slowly by hand.
 3. The installer in the room must always follow the sheath through the duct and fold it to form a U-shape.
 4. When the end of the sheath reaches the roof, insert the socket plus the pressure gauge needed to inflate the sheath.
 5. Fit the pipe clamps (3 minimum) to fasten the sheath to the socket. Also fit as many rubber rings as needed between clamp and sheath; if these rings are used the sheath is not 'pinched' and the internal plastic sleeve is not damaged.



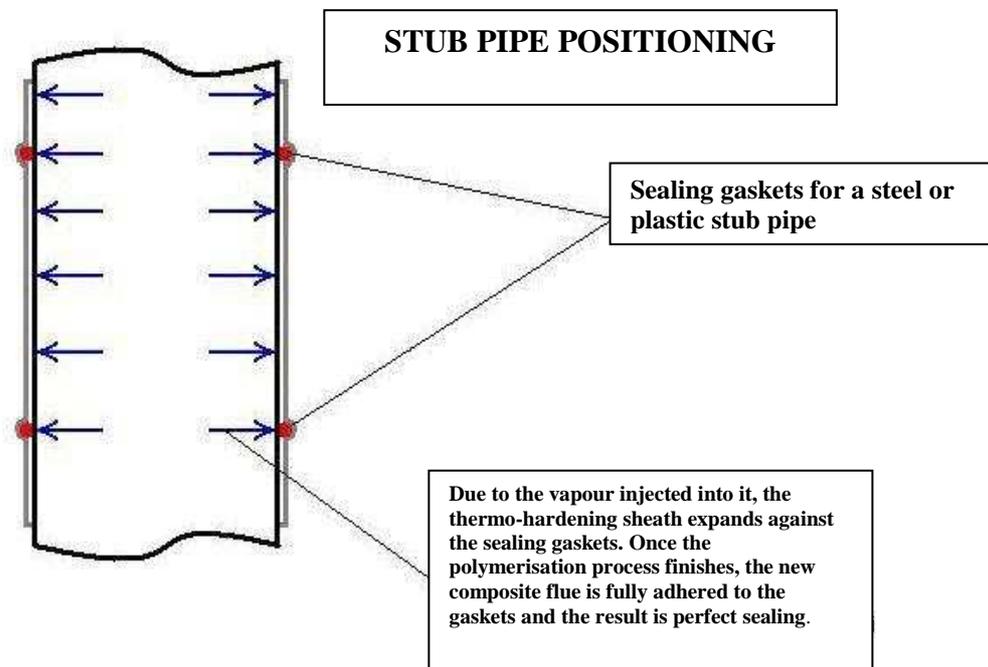
Caution: Before fitting the clamp around the sheath already on the socket, carefully fold the excess sheath around the socket so that no wrinkles are formed when the clamps are tightened.

6. Couple the socket, already connected to the sheath, to the anchoring system already installed on the roof. Always be careful not to twist the sheath.
7. In the boiler room, connect the other end of the sheath to the lower socket as shown in point 5. All clamps must be well tightened so that they do not get unexpectedly detached at the inflation stage and compromise the whole installation.
8. Now the sheath is ready to be inflated.

Positioning accessories such as Tees or stub pipes

Follow the steps below to properly position a T-shaped element at the base of the flue that will connect the fumes duct to the sheath:

1. Before inserting the sheath, position a commercially available steel or plastic stub pipe suitable for the boiler type; its diameter should match that of the sheath. Also fit the gaskets supplied together with the stub pipe.
2. While the sheath is being inserted into the existing flue, also cause it to go through the stub pipe as shown in the figure below.



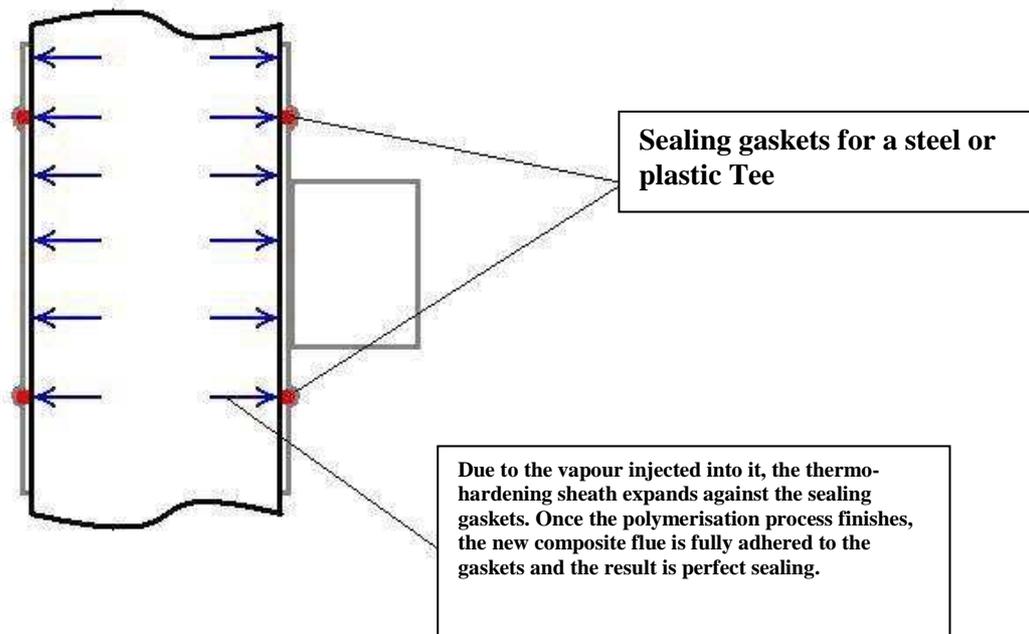
Only after all the steps described are carried out and completed can you install on the stub pipe a T-shaped element or condensate collection accessories.

Positioning intermediate T-shaped elements

Follow the steps below to properly position intermediate T-shaped elements.

1. Before inserting the sheath, position a commercially available steel or plastic T-shape element suitable for the boiler type; its diameter should match that of the sheath. Also fit the gaskets supplied together with the stub pipe.
2. While the sheath is being inserted into the existing flue, also cause it to go through the stub pipe as shown in the figure below.

T-SHAPED ELEMENT POSITIONING



3. Only after all the steps described are carried out and completed can you cut an opening in the sheath (using a hollow cutter) matching the T-shaped element and connect the fumes duct to this T or as planned.

How to inflate the sheath



The Ht1000 system needs two different phases of inflation, the first one with the Geyser (vapour machine) and the second with a generator of hot air.

1st phase of thermo-hardening

You must give this step your utmost attention. All equipment such as pressure gauges that detect and read pressure at the upper socket must work properly. Make sure that machines work properly and use distilled water.

If the pressure gauge does not work properly, pressure may go beyond the maximum working value allowed and so the sheath can get irreparably damaged. Pressure must be checked throughout the inflation procedure. Pay attention to the following steps:

1. Take the vapour pipe coming from the geyser generator nearby and screw in the fitting to the lower socket on the mouth in order to inject vapour
2. Switch on the vapour generator as described in the user manual for the Geyser generator
3. Make the vapour maximum temperature on the generator reach 150°C.

4. Once the generator is under pressure and has reached the desired temperature, open the cock about $\frac{1}{4}$ of a turn to slowly start inflating the sheath.
5. Once the pressure starts to expand, take the inflation pressure to 0.15 bar:
 - First, fully open the vapour vent cock at the upper socket
 - Open the vapour cock a little more, up to $\frac{3}{4}$ of a turn
 - Adjust the vent cock at the upper socket and check pressure level on the pressure gauge on the upper socket.



CAUTION: Follow these rules so that heat is not disperse:

- If there are gaps or interspaces between the sheath and the existing flue, put some cloth either from the boiler room side or the roof side. This will prevent a constant air flow through the interspaces that transfers heat to the sheath.
- Never use vapour pipes longer than 10 m from the sheath to the generator, especially in winter. In case you do, insulate pipes so that not much heat is lost before they reach the sheath.

6. Keep the pressure indicated above until the sheath starts to have a 'gummy' consistency. When this occurs, take the pressure indicated by the pressure gauge to 0.18 bar and keep it until the resin is completely polymerised (about 2h). Always make sure that the resin has hardened by checking it is fully hard and not 'sticky' when it is still warm.



CAUTION: The polymerisation time mentioned is indicative only under normal conditions. This time normally depends on several factors:

- External temperature
- Machine proper functioning: Use of distilled water, clean combustion chamber
- Moisture at the existing duct.

Therefore, make sure that the sheath has hardened properly by touching it or by using a durometer with indenter.



CAUTION: Do not turn off the machine if the sheath has not polymerised since if it is hot and still soft, once it cools off, it may seem to be hard when it is not, and therefore proper functioning is compromised. That is the reason why you should wait until it hot hardens.

7. Once the sheath has completely polymerised, use a grinder to cut it on the roof side below the socket on the circular section, and cut the insulation at the centre, above the socket.
8. Remove the internal plastic sleeve from the polymerised sheath.



CAUTION: verify that all the tubular plastic has been removed, otherwise during the second phase of thermo-hardening at high temperature the remained plastic material would melt and the sheath would result compromised.

2nd phase of thermo-hardening

1. Put a cap on the top of the sheath side roof (as that of condensation drainage) in order to guarantee the recirculation of the warm air during the second phase of polymerisation . Keep the cap closed till the achievement of the right temperature.
2. Position the hot air generator nearby the entrance of the fireplace or solid combustible boiler.



3. Connect the steel pipe long 1 meter to exit mouth of hot air generator.
4. Connect one end of the flexible steel pipe to the entrance of Ht1000 sheath (fireplace side) and the other to the steel pipe fixed to the hot air generator (as did before).



CAUTION: verify that the steel pipes connected to the generator of hot air are not close to inflammable material or however that could be ruined with the heat since the hot air reaches temperatures of 800°C

5. Connect the wires of the thermocouple of the sheath with the clamps of the generator of hot air as from figure.
6. Set the temperatures of the two regulators thermostats as from manual of the hot air generator :
 - a. the first regulator set the temperature of the first stadium of heating that must be put to around 500°C with alarm to 600°C, for the formulation and the setting see the manual of the hot air generator;
 - b. the second regulator set the temperature of the second stadium of heating based on of the thermocouple inside the sheath, it must be put to around 600°C with alarm to 700°C, for the formulation and the setting see the manual of the hot air generator;
7. verify every 10min the temperature of the thermocouple and once reached the temperature of around 180-200°C maintain it for around 2h.
8. the whole second phase of thermo-hardening is the fundamental phase to confer to the system mechanical resistance and above all to form of a chemically irreversible material.



CAUTION: if this phase is not correctly performed, the material doesn't reach the complete thermo-hardening, therefore the correct functioning of the system cannot be guaranteed.

9. After the second thermo-hardening the flue is totally renewed.

Once you finish installing the system, carry out the N1 tightness test to 40Pa.



Maintenance

Maintaining a Ht1000 system implies cleaning the flue whenever necessary using plastic, not metal, brushes so that the system is not damaged. It also includes checking the system for proper condition regularly.