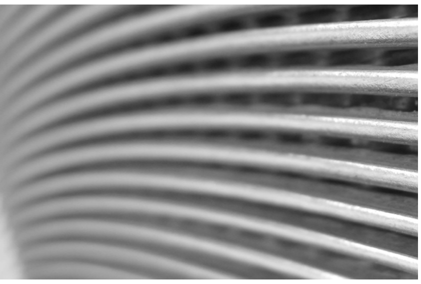
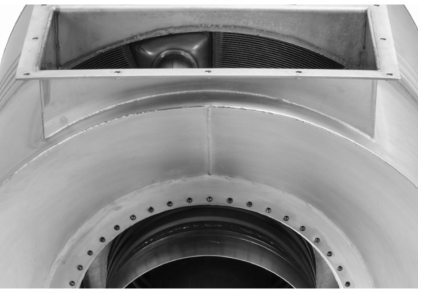
Heat exchangers
design & manufacturing

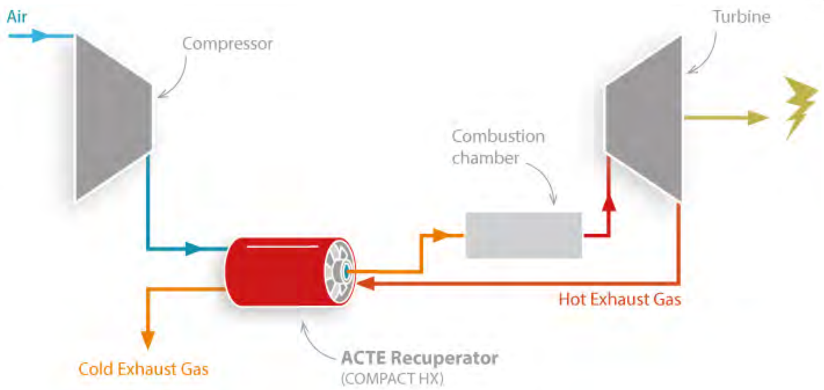




COMPACT 95-9-0

Technical datasheet

Gas-to-air heat exchanger
Designed for micro-gas turbines within a power range from **180 to 250 kWe**
Exhaust gas from 200°C to 700°C
Flow range from **1.2 to 1.8 kg/s**



WHY THE **COMPACT** HEAT RECUPERATORS

The ACTE COMPACT-type heat recuperators are at the cutting edge of micro gas turbine recovery technology. Indeed, these dedicated heat exchangers combine performance, lifetime extension and compactness. Hence, optimising micro gas turbine efficiency turns to be easier and sustainable.

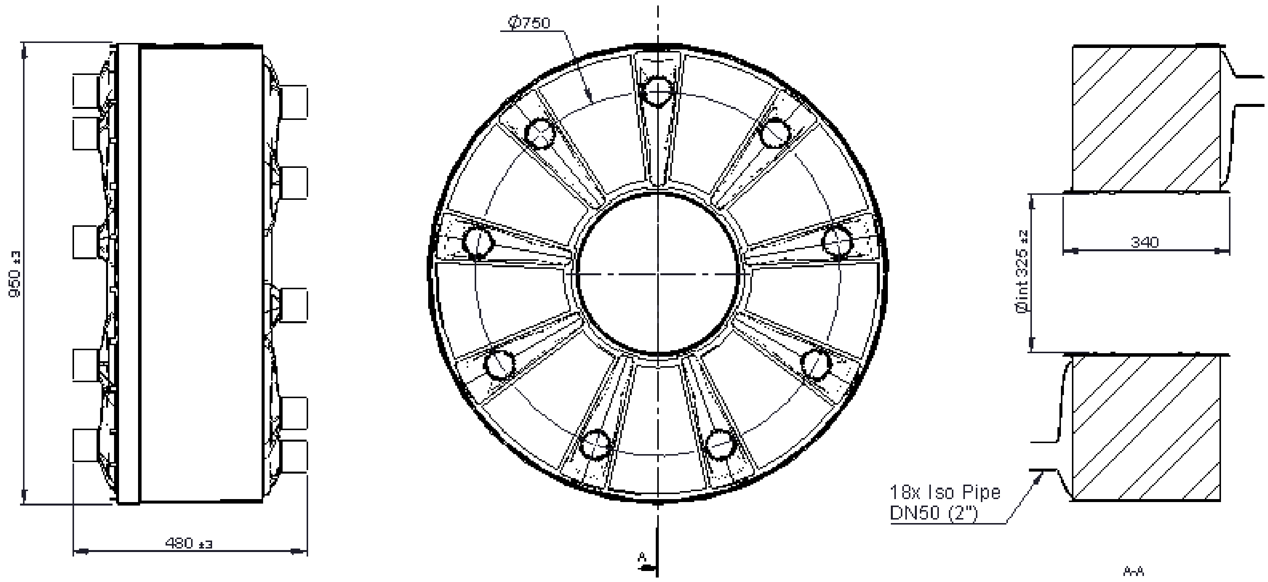
Thermal shocks and lifetime: the issue with flat plates

The main challenge in designing heat recuperators for small gas turbines is ensuring a good lifetime while preventing significant performance losses due to thermal shocks in the transient i.e. when the gas turbine is starting or stopping.
This issue can be attributed to the main component of every plate heat exchanger: the pressure retention system. In order to warrant the heat exchanger pressure resistance, heavy parts are frequently used to hold all the plates in contact. However, those heavy parts have a higher thermal inertia which generates mechanical conflicts with the honey comb primary surface structure.

COMPACT heat recuperators: the benefits from the curvature

Whereas the deformation direction of a flate plate can't be determined in advance, the curvated one is predictable and constant. That is the reason the COMPACT range combines an annular shaped heat exchanger with radial collectors and a local pressure retention system. Thanks to this specific mix, ACTE heat recuperators provide an extended lifetime and high performances by reducing the difference in spare parts thermal inertia and managing the stress due to the thermal shocks involved.

Heat exchanger overview



Mechanical features:

Size and weight:

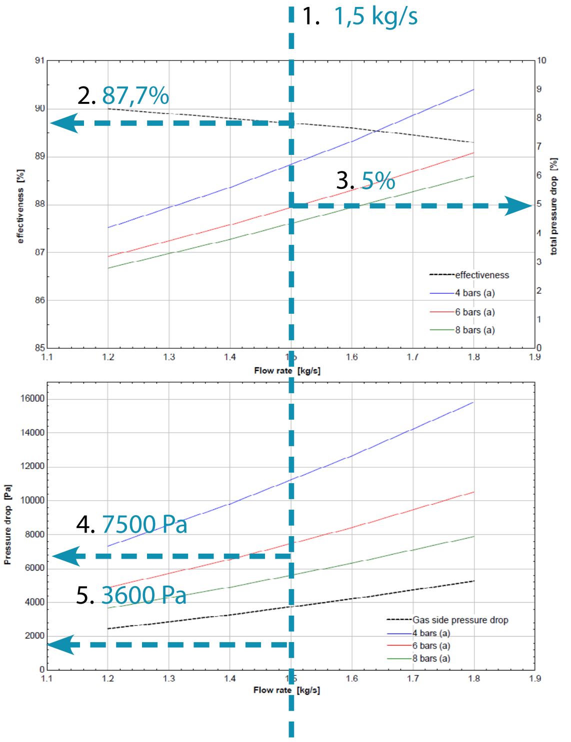
External diameter: 950 mm
Internal diameter: 325 mm
Connexion pipes: DN50

Primary exchange surface:

Projected surface: 107 m^2
Plates thickness: 3/10 mm
Weight: 320 kg

Technical features:

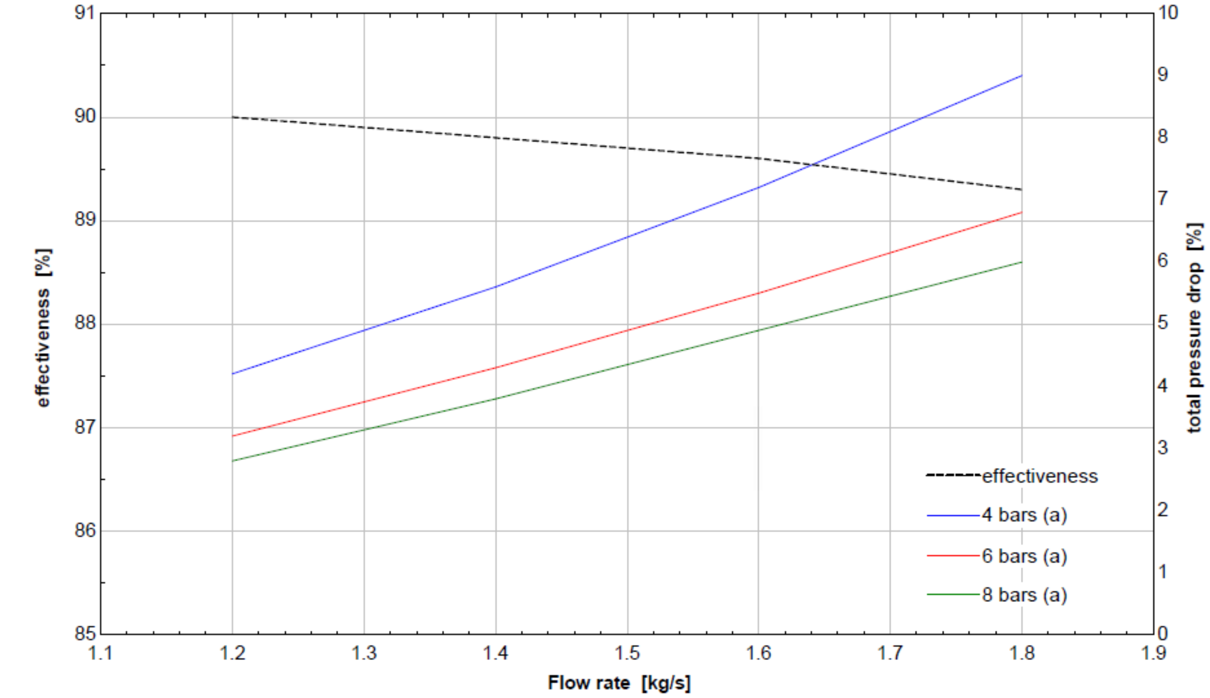
To estimate your recuperator performances, please apply the 5-stages procedure below.

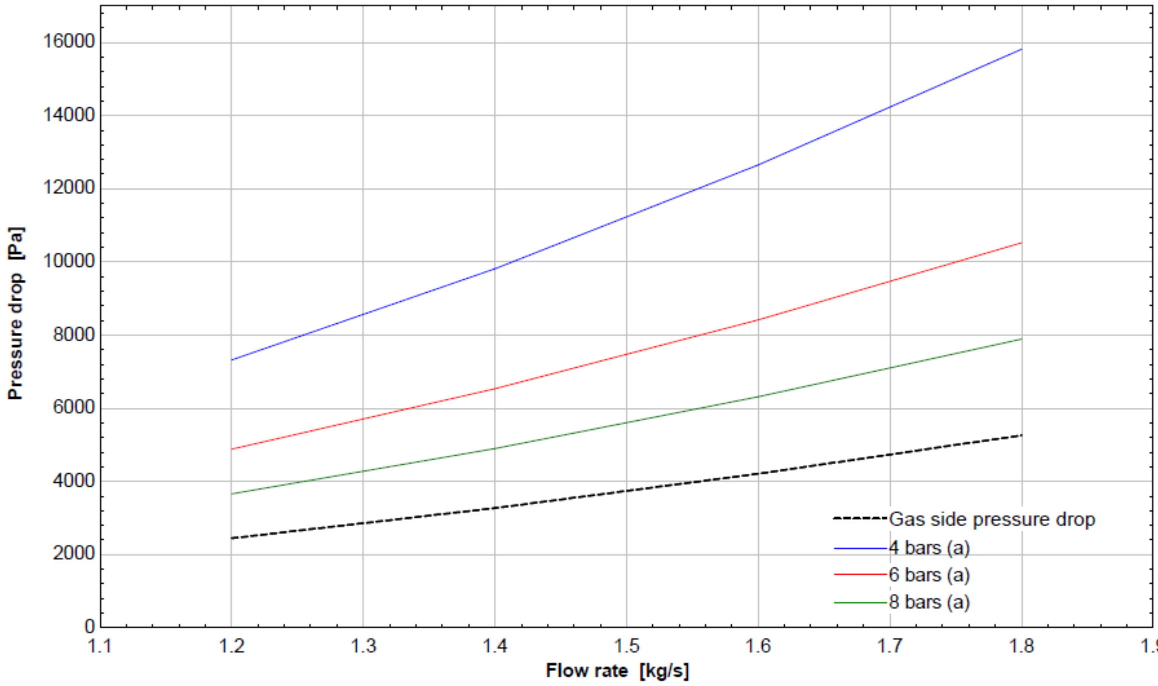


1. Trace a vertical straight line through the two graphs corresponding to the exhaust gas flow rate.
2. On the top graph, read the effectiveness from the black dashed curve and the left axis.
3. Depending on the pressure of the compressed air, read the total pressure drop on the right axis.
4. On the bottom graph, read the air pressure drop on the left axis from the curve corresponding to the pressure of the air.
5. Read the pressure drop on the exhaust gas on the left axis from the black dashed curve.

Example:
Let's consider an exhaust flow rate of 1.5 kg/s and an air pressure of 6 bars (a) :

» The effectiveness is 89,7%
» The total pressure drop is 5%
» The pressure drop on the air side is 7500 Pa
» The pressure drop on the gas side is 3600 Pa





Computation notes:

In the here above charts, the curves are designed with an equivalent gas and air flow rate

The total pressure drop are computed as follows : $\Delta p_{tot} = \left[\frac{\Delta p_{air}}{P_{air}} + \frac{\Delta p_{gas}}{P_{gas}} \right] \cdot 100$

The recuperator thermal power and the outlet temperature can be computed from the charts by resolving the following equations :

$$\dot{Q} = \varepsilon \cdot \dot{M}_{air} \cdot cp_{air} \cdot (T_{in,gas} - T_{in,air})$$

$$\dot{Q} = \dot{M}_{air} \cdot cp_{air} \cdot (T_{out,air} - T_{in,air})$$

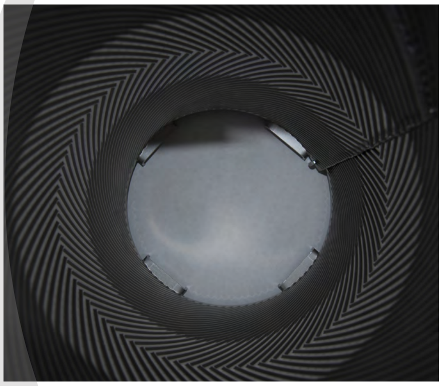
$$\dot{Q} = \dot{M}_{gas} \cdot cp_{gas} \cdot (T_{in,gas} - T_{out,gas})$$

where: the flow rates are in [kg/s], the heat capacity in [J/(kg.K] and the temperature in [C] or [K]

Exchangers in parallel:

If the drop in pressure on the fumes is too great, it is always possible to put two exchangers in parallel, which will have the effect of dividing the fume flow rate by two. The thermal power recovered then represents twice the power given by the graph. The liquid flow rate to be taken into account is also twice that given by the graph.

For instance: for a flow rate of 6000 Nm3 per hour at 450°C, the graph indicates a pressure drop of 2840 Pa, which may be too high according to your specification. By putting two exchangers in parallel the fumes flow rate under consideration is then 3000 Nm3 per hour with the result that the pressure drop is 780 Pa.



Exchangers in line:

If the drop in pressure on the fumes, calculated from the graph, is lower than the acceptable value for your system, it is then possible to recover more heat by using a second exchanger in line with the first one.
The pressure drop on the fumes is then double the initial value. In this case, please contact us for an estimate of other values.

Notes:

1. The graphs shown above give the possibility of drawing up an initial technical validation from the values of your thermal energy source. Please note that you are welcome to contact us for further technical details.

2. For any sizing where hot gas is used to reheat the air or for generating steam, please contact us directly.

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ACTE-SA

Rue Gilles Magnée, 92/1
4430 Ans
Belgium

Tel : +32 4 247 11 24
Fax : +32 4 247 21 87
info@acte-sa.be