ZUCCATO ENERGIA®
WE TRANSFORM ENERGY

ZE-150-LT

Low-Temperature Organic Rankine Cycle (LT-ORC) Power Generation Module

EFFICIENT, COMPACT, ENVIRONMENT-FRIENDLY

ZUCCATO ENERGIA
WE TRANSFORM ENERGY

Designed and manufactured using the most advanced technologies including finite element modeling and analysis (FEM/FEA) as well as fluid dynamics simulation and analysis (CFD/CFX), each of our ZE-150-LT modules has been designed from the start to operate within a Low Temperature Organic Rankine Cycle.

Said thermodynamic cycle in fact, thanks to a special fluid medium, can offer optimal performances in a plant this size, as well as having several advantages over the operational cycles of traditional steam engines and turbines:

Low Operational Temperature allowing the use of "weak" thermal sources.

High Condensing Temperature

No Turbine Blade Erosion which gives higher reliability and lower maintenance costs.

Low Operational Pressure (max 20 bar) meaning higher safety levels, less legal implications, and lower plant costs;

No Atmospheric Exhaust as the Rankine cycle is a closed cycle.

No Water or Steam Consumption leading to lower management costs, less bureaucracy, lower plant complexity.

Low Noise Levels allowing operators to work without hearing protection and leading to less controversies in residential installations.

LT-Series modules have been custom designed from scratch with the purpose of becoming the power generation stage of small power CHP (Combined Heat and Power) plants, so to increase efficiency as much as possible we implemented several performance-boosting engineering solutions such as:

Direct Turbine-to-Generator Coupling which eliminates the performance losses inherent in gearboxes.

Use of Ceramic Bearings to prolong operational life and allow non-stop high-speed (15-17,500 rpm) operation.

Custom-Designed Inverters for each model of module, to obtain optimal output performance.

All of this contributes to give our systems a high thermal efficiency, which in optimal conditions allows them as total system efficiency (thermal power input vs electric power output) up to 15%, a very high value for a system this size.

THE WORKING FLUID

The special working medium we use is the key component which made studying and creating these high-tech solutions possible. The organic medium used in the system Zuccato Energia proposes has the following excellent specifications:

Wide working range (60-165°C) which allows exploiting low-temperature heat sources once thought useless, such as geothermal sources and engine cooling.

High condensing temperature

Completely dry in all of its states thus avoiding cavitation and turbine blade erosion.

Non-toxic, non-flammable, 100% bio-degradable and ozone-friendly so even accidental spills are not hazardous.

Requires little or no reintegration as it works in a closed cycle.

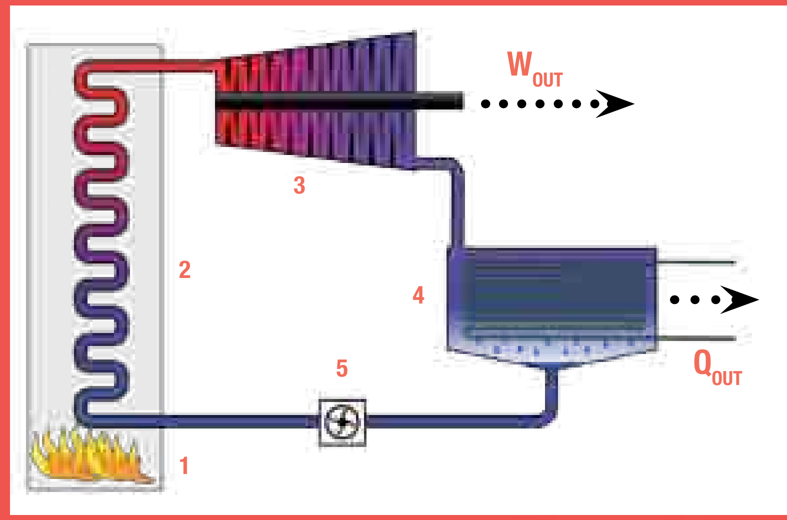
Requires no filtering / reconditioning thus reducing plant complexity and size.

ZUCCATO ENERGIA
WE TRANSFORM ENERGY

THE IDEAL SOLUTION FOR SMALL- SCALE CHP

THE LOW-TEMPERATURE ORGANIC RANKINE CYCLE (LT - ORC)

The Rankine Cycle concept, invented in the 1800s by the scottish physicist William Rankine, is quite simple and easily explained with a diagram like the one on the right: a heat source warms up a heat exchanger (1) which transfers the heat to a liquid organic medium, which –exposed to that heat– becomes a gas, greatly increasing its volume. This expanding gas drives a turbine (2) generating mechanical energy (W_{out}) which can be converted into electric power by a generator connected to the turbine shaft. On leaving the turbine, the medium - in gas form - is conveyed to a condenser (3), where it cools down returning to its liquid state. Collected in a specific tank it is then pumped back (4) to the heat exchanger, thus closing the cycle. The low-temperature excess heat the medium releases in the condenser (Q_{out}) can be efficiently used for other uses such as ambiental heating, fuel dessiccation/preheating and so on (combined generation of heat and power).



Rankine cycle schematic from Wikimedia Commons © Andrew Ainsworth, English Wikipedia. Licensed under GNU FDL

REMOTE MONITORING

Thanks to remote monitoring via the GPRS cellular network, Zuccato Energia can supervise the ORC module operation in real time and act promptly on any malfunction thanks to the received diagnostic codes, thus allowing continued optimal operation.

HEAT EXCHANGERS

The heat exchangers mounted on the Zuccato Energia skids are custom-made, welded-plate type units custom designed to optimize performance with our working fluid. The plates, in 316L stainless steel, thanks to their custom design are able to exchange heat efficiently while keeping load losses low, with a significant impact on thermal consumptions. Use of 316L stainless steel, a material widely used in our systems, guarantees extreme cleanliness and long-term reliability.

CONTROL PANEL

Thanks to the collaboration between the italian computer firm Intecomp and Zuccato Energia it has been possible to create a specific touch-screen control panel, which is mounted on the module and monitors the entire system in real time.

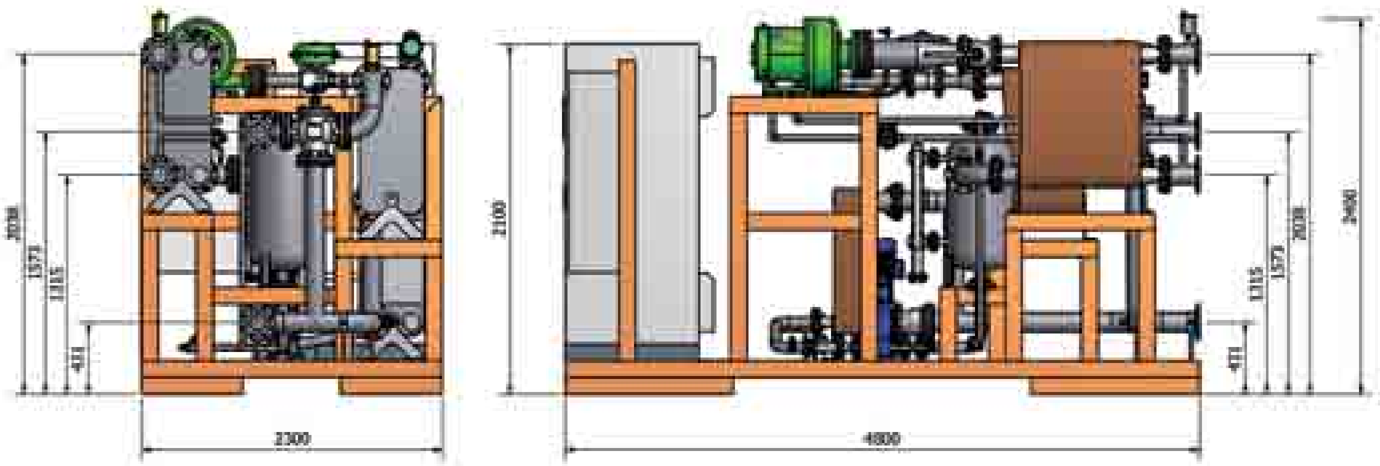
TECHNICAL SPECIFICATIONS

THERMAL SUPPLY	
Vector fluid	Overheated water
Hot water input temperature	≥ 155°C
Hot water output temperature	135°C
Thermal Power Input	$1100kW_T$
GENERATOR	
Type	Water-cooled, PM-excited sychronous generator w/rectifier and grid converter
Cooling	Water jacket
Power Output	$170kW_E$
Nominal rotational speed	17.500 rpm
Output Voltage	480-580 VAC
Required Cooling	$15kW_T$
Coolant	Water-Glycol
Coolant Input Temperature	<40°C
Required Coolant Flow	30 l/min
Additional Cooling	Working fluid injection (opt.)
Generator Seal	Gas-tight to PN 25 bar
NET EFFICIENCY	**15% (typ.)**

TURBINE	
Type	Single-stage, radial with fixed nozzles, directly coupled to generator shaft
Input Temperature	145°C
Output Temperature	~95°C
Test Pressure	24 bar
Turbine Body	Welded Steel
Impeller	Aluminium alloy
Speed Control	Feedback Loop On Generator Output Frequency
Seals	Sealed labyrinth on impeller back (opt.: axial labyrinth seal at generator interface) Static and O-ring environment seals
Working fluid	HFC
Lubrication	Automated, PLC-controlled lubrication system
INVERTER	
Type	IGBT, Grid-Synchronized, Air-Cooled
Power Output	150 kW_E
Output Voltage	400 V (360÷445) @ 50Hz ± (47,5÷51,5)
Environment temperature	<40°C
Braking Chopper	Built-in, 600kJ

DIMENSIONS

All measures are in millimeters.



ZUCCATO ENERGIA
WE TRANSFORM ENERGY

ZUCCATO ENERGIA srl
Via della Consortia, 2
37127 Verona - Italy
Tel. +39 045 8378570
Fax +39 045 8378574
info@zuccatoenergia.it
www.zuccatoenergia.it