ZE – ZERO EMMISSIONS

Introducing
ZE95 & ZE130
Organic Rankine Cycle
Zero Emissions Electricity Generators

ZE International Group
P.O. Box 1642
Salisbury
Wiltshire
SP2 0SE

Contact:
Telephone +44 (0) 1722 746800
Email: sales@zeintlplc.com
Web: http://www.zeintlplc.com

Description

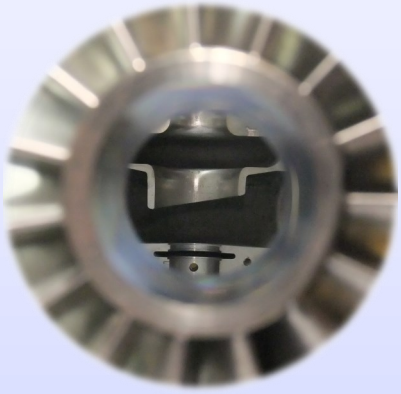
The ZE group design engineers have developed a world leading range of ORC electricity generating solutions to harvest a variety of waste heat sources, such as those naturally produced by the sun (solar thermal CSP), or Waste (biogas, biomass, pyrolysis and gasification), or process heat (industrial, chemical, high temperature Oxidisers, Oil and Gas). The team is committed to producing a range of high quality, robust solutions for customers to benefit from reliable electricity & energy production for increased revenues, utility savings, grid independence and carbon reduction programmes.

The range has been specifically designed to operate harvesting thermal energy from heat sources, to include biomass boilers, gas engine and gas turbine exhausts, and industrial flues and furnaces. The tables on the next page provide sample indications of the waste heat and mass flows requirements to deliver a variety of electrical outputs at different efficiency levels (from almost 18% down to 14.5%).

ZE Group has designed turnkey equipment for practical applications where the ORC generators are able to maintain their efficiency over a wide range of ambient conditions, from –10ºC to 40ºC for a sustainable electrical and energy solution.

The power plant of the ORC range consists of a bespoke micro-turbine that has been specifically designed to suit the thermodynamic cycle of a chosen working fluid. This provides superior efficiency compared to using off the shelf modified compressors or turbo chargers. The turbine is coupled with a bespoke permanent magnet generator specifically designed to convert the energy from the turbine for the best efficiency.

The power output stage is also custom designed to match the generator output, to produce high quality 3 phase AC to feed directly into the grid.



The ORC products/equipment can be installed as a single unit, or in parallel for modular installations, where higher thermal availability would provide higher electrical and energy outputs.

Additional to the electrical output, the energy referred to as the energy rejected by the ORC, can be used for heating, (co-generation) or for heating and/or chilling, (tri-generation) to provide heating for hot water or space heating (co-generation) or heating/hot water & chilling, through the incorporation of adsorption chillers, (tri-generation). Efficiency levels using this capability rise to 98%. Resulting ROI is improved.

The ZE ORC has the thermal energy delivered through a secondary thermal oil circuit. ZE Group has developed integrated, standardised thermal oil & cooling circuit skids that are matched to the heat energy and cooling requirements of the ZE ORC range, for a turnkey solution to simplify installation These skids provide the integration of the ORC units with the primary circuit (which includes the main heat harvesting exchanger) and eliminate additional complicated control system integration. These are supplied as single or twin versions depending on requirements. The Primary Circuit operates independently from the secondary circuit.

NOTE: Thermal oil is heated through a primary circuit thermal oil heat exchanger, with bypass control, integrated into the flue or exhaust of the heat source. The primary circuit maintains a fixed temperature and fixed flow regardless of the heat energy being extracted by the ORC. The thermal oil is then demanded through the ZE standard, integrated secondary skid's closed loop oil and cooling circuits to effectively manage the operation of the ZE ORC. Apply to ZE Group for more information.

The ORC process requires condensing as part of the cycle, ZE Group's ORC generators have been designed to ensure that this cooling duty is achievable at a wide range of ambient temperatures. The ZE ORC units require an inlet temperature of 43ºC for the closed loop cooling circuit. This is achievable with standard dry air cooling in ambient temperatures up to 40ºC with no need for cooling towers. If the energy in the cooling circuit can be used on site, it will reduce or even eliminate the need for dry air cooling.

The ZE Group has also developed an integrated remote control and monitoring solution which provides a browser based control and monitoring console for the operator as well as sending detailed logging information to ZE, enabling us to provide swift customer support.

The ZE Group prides itself on exceptional customer service and is committed to providing professional support throughout the planning, purchasing and implementation of a project. The ZE team will work to support your project, from first thoughts of energy efficiency through detailed plans, to an effective operating solution.

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ZE130 Performance Details

Thermal Oil Temperature to Electrical Power Generated for a Thermal Oil Flow Rate of 1.95 kg/s						CO_2 (tonnes) Annual Savings (Electricity Only)	CO_2 (tonnes) Annual Savings (CHP)
Heat Input Of (kW)	Thermal Oil Inlet Temperature Of (deg C)	Gross Electrical Power Generated (kW)	ORC Efficiency (%)	Heat Rejected In Cooling System In 43ºC out 64ºC (kW)	CHP Efficiency (%)	95% Availability	95% Availability
742	280	130	17.5	613	98.5	490	2,799
630	270	110	17.5	509	98.1	415	2,305
546	260	94	17.2	422	97.9	354	1,895
486	250	77	15.8	349	97.6	290	1,552
422	240	67	15.9	288	97.3	253	1,269
Thermal Oil Temperature to Electrical Power Generated for a Thermal Oil Flow Rate of 2.48 kg/s						**CO_2 (tonnes) Annual Savings (Electricity Only)**	**CO_2 (tonnes) Annual Savings (CHP)**
Heat Input Of (kW)	**Thermal Oil Inlet Temperature Of** (deg C)	**Gross Electrical Power Generated** (kW)	**ORC Efficiency** (%)	**Heat Rejected In Cooling System In 43ºC out 64ºC** (kW)	**CHP Efficiency** (%)	95% Availability	95% Availability
742	270	130	17.5	613	98.5	490	2,799
652	260	113	17.3	539	98.2	426	2,735
558	250	93	16.7	465	97.8	350	2,102
487	240	77	15.8	410	97.5	290	1,834
424	230	67	15.8	357	97.2	252	1,597
380	220	55	14.5	325	96.8	207	1,431

ZE95 Performance Details

Thermal Oil Temperature to Electrical Power Generated for a Thermal Oil Flow Rate of 1.34 kg/s						CO_2 (tonnes) Annual Savings (Electricity Only)	CO_2 (tonnes) Annual Savings (CHP)
Heat Input Of (kW)	Thermal Oil Inlet Temperature Of (deg C)	Gross Electrical Power Generated (kW)	ORC Efficiency (%)	Heat Rejected In Cooling System In 43ºC out 64ºC (kW)	CHP Efficiency (%)	95% Availability	95% Availability
514	280	92	17.9	422	97.7	347	1,936
448	270	78	17.6	370	97.3	294	1,688
389	260	67	17.3	322	96.9	252	1,465
336	250	55	16.4	281	96.4	207	1,266
294	240	47	15.8	247	95.9	177	1,107
257	230	38	14.8	219	95.3	143	968
Thermal Oil Temperature to Electrical Power Generated for a Thermal Oil Flow Rate of 1.68 kg/s						**CO_2 (tonnes) Annual Savings (Electricity Only)**	**CO_2 (tonnes) Annual Savings (CHP)**
Heat Input Of (kW)	**Thermal Oil Inlet Temperature Of** (deg C)	**Gross Electrical Power Generated** (kW)	**ORC Efficiency** (%)	**Heat Rejected In Cooling System In 43ºC out 64ºC** (kW)	**CHP Efficiency** (%)	95% Availability	95% Availability
520	270	92	17.7	428	97.7	347	1,959
444	260	78	17.6	366	97.3	294	1,672
381	250	65	17.1	316	96.9	245	1,435
330	240	55	16.7	275	96.4	207	1,243
288	230	45	15.6	243	95.8	170	1,085
262	220	39	14.9	223	95.4	147	987

ZE Group makes every effort to ensure that these figures are accurate, however, every installation is unique and will have different losses depending on the layout of the equipment. These figures are intended as a guide in a typical application.

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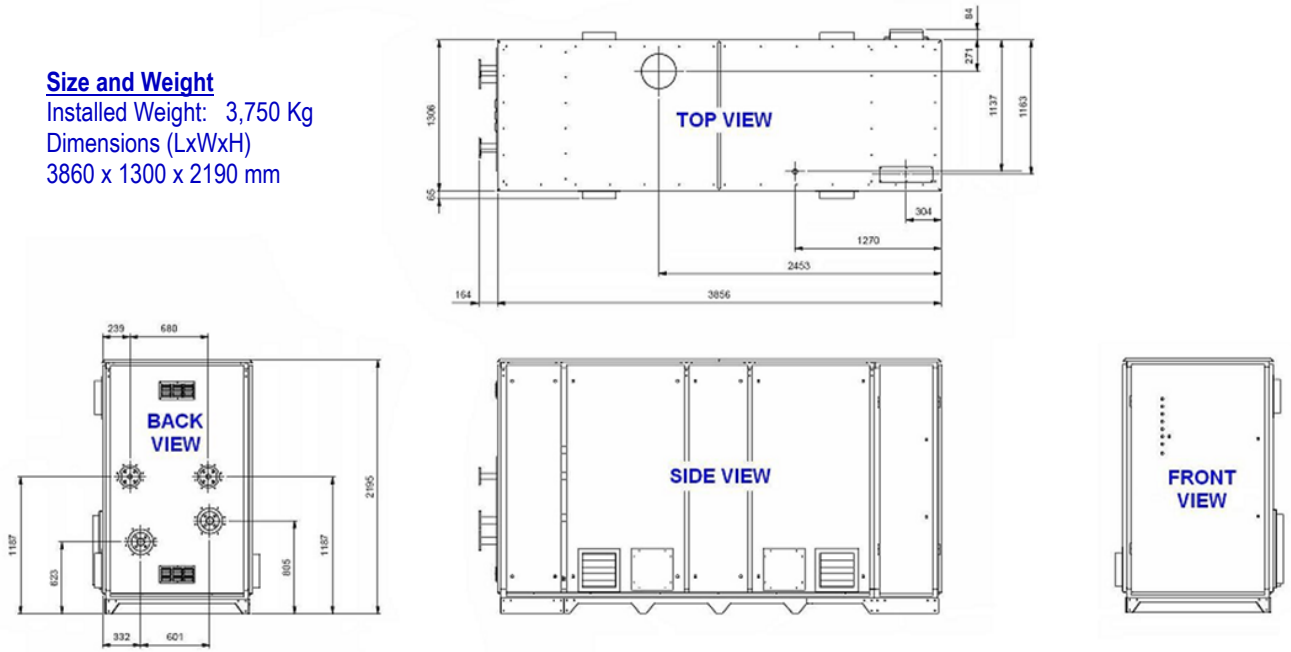
ZE ORC Dimensions

Size and Weight
Installed Weight: 3,750 Kg
Dimensions (LxWxH)
3860 x 1300 x 2190 mm



Specifications

Turbine Specifications	
Type	Multi-Stage Radial Inflow With Magnetic Coupling
Working Fluid Inlet Temp	210ºC
Working Fluid Exit Temp	146.5ºC
Inlet Pressure (Max)	24 bar abs (Tested to 1.43 times in accordance with PED)
Inlet Pressure (Working)	20 bar abs
Shaft Power (Max)	141kW
Turbine Casing Material	SG42012 Cast Iron
Impeller Material	Stainless Steel 17-4PH H1150+H1150
Speed Control	Variable Load supplied by generator according to algorithm based on Rectified DC Link Voltage. Multiple independent speed & pressure monitoring employed to detect any over speed or over pressure events.
Shaft Seals	Shaft seals Labyrinth seals, a Peek can at rear of turbine encloses the male magnetic coupling and seals the working fluid circuit. Turbine input is hydraulic coupling
Casing Seal	Clamshell turbine casing sealed using a Loctite compound
Generator Specification	
Type	4 pole, 6 phase, permanent magnet, water cooled,
Rotational Speed (Design Point)	30,000 rpm
Output Power Max	134kW$_E$
Output Voltage (Max)	1200V$_{AC}$
Output Frequency (Design Point)	1000Hz
Required Cooling Duty	2.8kW$_T$
Cooling Water Temperature	43ºC
Cooling Water Flow Rate	8l/min
Inverter Specification	
Type	IGBT mains-synchronised, air & water cooled
Power Output	130kWE
Output Voltage	380 – 480 V$_{AC}$ 3 phase
Output Frequency	50 / 60 Hz
Cooling Duty Required for IGBT	5.5kW$_T$
Cooling Duty Required for Filters (Forced Air)	15.33 kg/s @ 15ºC

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