**Specification document (short) for Adveco Totem mCHP**

# PERFORMANCE OBJECTIVES

The Mechanical contractor shall include for the supply, delivery, installation and commissioning of a Combined Heat and Power (CHP) package. The chosen CHP package shall be independently tested and certified as meeting relevant CHP design standards; all works shall comply with relevant installation standards and meet the following criteria:

## Engine emissions

The engine emissions shall be independently verified and not exceed the following values:

|  |  |
| --- | --- |
| NOx Emissions – 0% O2 | 7.5 mg/kWh Gas Input |
| NOx Emissions – 0% O2 | 8.8 mg/Nm3 |
| NOx Emissions – 5% O2 | 6.7 mg/Nm3 |
| CO Emissions – 0% O2 | 8.6 mg/Nm3 |

## technical specification

The operating efficiency and output shall be independently verified and not less than the following values:

|  |  |  |  |
| --- | --- | --- | --- |
| CHP electrical output | 10 kW | 20 kW | 25 kW |
| Minimum net CHP electrical export efficiency (excluding consumption of CHP controls and primary pumps) | 29.6% | 31.2% | 32.5% |
| Minimum net CHP unit overall efficiencies at maximum output (35°C return temperature) | 104.3% | 106.8% | 107.4% |
| Minimum net CHP unit overall efficiencies at minimum output (35°C return temperature) | 101.5% | 105.0% | 105.0% |
| Minimum CHP unit heat output to LTHW at maximum output (35°C return temperature) | 25.0 kW | 48.5 kW | 57.6 kW |
| Minimum CHP unit heat output to LTHW at minimum output (35°C return temperature) | 16.4 kW | 30.9 kW | 30.9 kW |
| Maximum flue gas temperature under normal operating conditions | 77°C | 77°C | 77°C |
| Flue system safety shut-down temperature | 100°C | 100°C | 100°C |

# SYSTEM DESCRIPTION

The CHP Package shall include the following items:

* Natural gas fired four-stroke internal combustion engine.
* Asynchronous generator.
* Heat recovery system.
* Flue system.
* Control and monitoring systems.
* Base frame.
* Acoustic enclosure.

## Internal Combustion Engine

The CHP engine unit will be a natural gas fuelled, water-cooled, 4 stroke, reciprocating type, spark ignition engine. The engine design shall be tested for compliance with European emissions standard stage ‘Euro 6’ and include the following features:

### Lubricating system

The engine lubricating system shall be designed to automatically discard used engine oil after a period of 500 hours of engine operation. An automatic system shall then replenish the engine oil to the required level. The CHP shall include – within the appliance casing – reservoirs for the storage of clean and used engine oil. The reservoirs shall be of sufficient capacity to meet the manufacturer’s recommended engine oil volume and recommended service interval.

### Engine control unit

An automotive electronic-type engine speed and load governor shall be used to increase the response frequency and give greater control over engine emissions. The Engine Control Unit (ECU) shall be connected to 2 lambda sensors, located on the engine exhaust manifold and downstream of the catalytic converter to allow real-time monitoring of exhaust gas ratios and adjustment of fuel/air mixture.

### Starting system

The engine shall be equipped with a 12V electric starter motor, starter solenoid and auxiliary start relays. A 12V lead acid maintenance free battery shall be contained within a ventilated compartment with an overheat monitoring system. All cables and clamps for connection to the starter motor shall be integral to the appliance wiring.

### Ignition system

The engine shall be equipped with an electronic ignition system, ignition coil(s), ignition leads and suitable spark plugs with a life expectancy greater than 3000 hours. All components shall be situated to prevent damage from engine heat

## asynchronous Generator

The CHP shall be equipped with an induction generator that is directly driven by the engine. The generator shall be a brushless, asynchronous, 2-bearing type, suitable for 400V, 50Hz, 3ph operation.

## HEAT RECOVERY SYSTEM

### Primary cooling system

The CHP primary cooling system shall be integral to the appliance recover heat from the following components:

* Asynchronous generator
* Internal combustion engine
* High-temperature exhaust gas heat exchanger
* Engine oil [DELETE FOR 10 kW MODEL]

The cooling system shall incorporate to following:

* Mechanically operated three-way thermostatic valve.
* Electrically driven primary circulation pump.
* Coolant feed and expansion tank.
* Flexible engine connections.
* Water level sensor.
* Water temperature sensor

Heat exchange from the primary cooling system to the LTHW system shall be via an integral plate heat exchanger, selected by the manufacturer and installed within the appliance acoustic casing.

### Condensing Heat exchanger

The CHP shall incorporate – within the appliance casing – a shell and tube type low temperature condensing heat exchanger within the LTHW circuit and located within the engine exhaust system downstream of the catalytic converter. The heat exchanger shall be sizer to lower the exhaust gas temperature to within 10 K of the LTHW return temperature.

## flue system

### GENERAL

The CHP shall be designed to operate with an exhaust temperature no greater than 100°C.

### FLUE MATERIAL

The CHP shall be fitted with a flue system CE marked to EN14471 T120 H1. Where the CHP is to be installed with a flue other than the manufacturer’s recommended system, an equivalent level of construction shall be maintained.

### APPLIANCE CONNECTION

The appliance manufacturer’s flue connection kit shall be used in all circumstances and will include the following:

* Adapter for connection to the appliance
* Flexible connection section.
* Exhaust gas silencer,
* Condensate drainage water trap,
* Adapter for connection to the flue system.

### FLUE SIZE

The CHP shall be connected to a flue system with an outside diameter of at least 110 mm.

## Control Systems

### Gas controls

The CHP gas control system shall comply with current regulations and include a manual shutoff valve, 200-micron gas filter, safety shut-off valve, gas pressure sensor and low pressure alarm.

### Engine controls

An automotive electronic-type engine speed and load governor shall be used to increase the response frequency and give greater control over engine emissions. The Engine Control Unit (ECU) shall be connected to 2 lambda sensors, located on the engine exhaust manifold and downstream of the catalytic converter to allow real-time monitoring of exhaust gas ratios and adjustment of fuel/air mixture.

### Power Controls

The CHP control panel shall include following power controls:

* A generator synchronisation contactor.
* A charger for the engine starter battery.
* A contactor for the motor starter.
* A contactor for the engine water circulation pump.
* A contactor for the appliance cooling fan.
* A contactor for the secondary water circulation pump
* Fuses, auxiliary power relays, terminal strips and current transformers as necessary for automatic control and protection.

### OPERATIONAL CONTROLS

The CHP control panel shall include following operational control connections:

* Safety interlock connection.
* Thermostat enable connection.
* BMS enable connection.
* Generator output status connection.
* Engine alarm status connection.
* Engine service notification.

### interface protection control

The CHP shall be supplied with an ‘Interface Protection’ control panel containing an interface protection relay that complies with the requirements of the Distribution Network Operator

## frame

The engine and generation sections of the CHP unit shall be installed on a suitably rigid steel base frame, through resilient mounts to limit vibration transmission. Additional resilient mounts shall be provided with the CHP to be used between the steel frame and building structure to further reduce the transmission of vibration.

## Acoustic Enclosure

The CHP appliance casing shall be acoustically shielded and constructed to give a maximum noise level of 56.7 dB(A) [DELETE FOR 20/25 kW MODEL] 61.1 dB(A) [DELETE FOR 10 kW MODEL] at a distance of 1.0 m. Unless specifically required, no additional acoustic protection shall be installed.

Unless access is shown on the contract drawings to be sufficient, the CHP shall be sized to allow the appliance to pass through an 850mm accessible doorway and have a maximum height (including service clearance) of less than 2300mm

# system control requirements

To reduce engine wear, once ignition has been proven, the CHP shall operate at a low engine speed until such a time as the engine and associated components have reached the optimum working temperature. When the optimum engine temperature has been reached, the microprocessor control will increase engine speed and command the generator controls to synchronise.

During normal operation, the CHP return temperatures shall be monitored by the internal microprocessor control system and the CHP shall operate until the return temperature reaches the CHP ‘T-off’ temperature. To reduce excessive cycling and wear of the internal combustion engine, once the CHP stops the engine shall be shut down until the LTHW return temperature drops to the ‘T-On’ temperature. The volume of the buffer vessel and the value of ‘T-On’ shall be configured to promote operational cycle times in excess of 1 hour.

To extend operational hours and reduce engine wear due to cycling, the CHP control system shall be designed to reduce engine power output from 100% to 85% when the LTHW return temperature is within 5 K of the CHP’s ‘T-Off’ value. The CHP shall also contain the controls to allow the modulation of engine power output in relation to site electrical demand where electrical load has been shown to be less than the maximum output of the appliance.