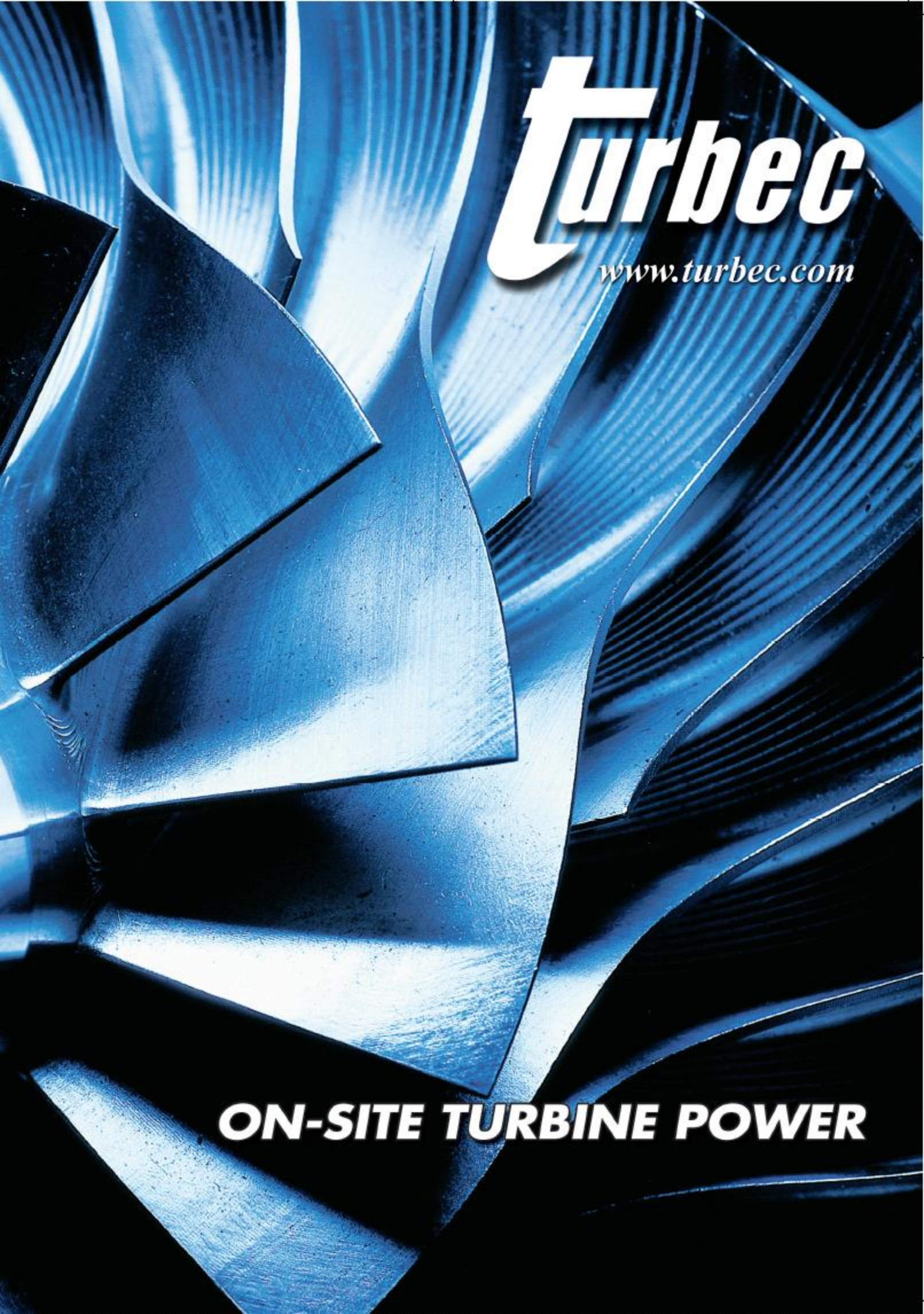

turbec
www.turbec.com
ON-SITE TURBINE POWER

HISTORY

Volvo started the development of small gas turbines for automotive use in the early 70s.

Since the late 1980s Volvo Aero and ABB worked together to develop a microturbine based hybrid system for vehicles. In that co-operation, Volvo provided the microturbine design, and ABB, the high-speed generator and power electronics.
Both companies realised that the same technology could also be applied to produce base load power from static low cost installation, this concept was named "Distributed Energy".

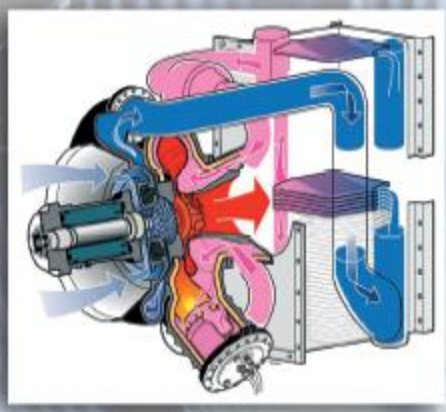
In this way completely new horizons opened up for supplying power and Turbec AB was founded in 1998 as a jointly owned subsidiary of Volvo and ABB.
During the year 1999 and 2000, Turbec AB redesigned the vehicle-based microturbine into a more robust industrial product suited for stationary applications and serial production. At the same time the system was also integrated into a complete CHP package.
The first commercial T100 unit was delivered in September 2000 and commissioned in December of the same year.
Turbec sold all produced T100 Series 1 and 2, which were the first serial produced units from Turbec. These units were very important for learning and improving availability as well as reliability; today Turbec T100 units worldwide averages 97% availability, including downtime for scheduled maintenance.
During year 2003 T100 Serie 3 featuring blackstart and islanding capabilities was finalised and installed on a number of sites in Europe.

On December 30th, 2003 API Com S.r.l., an Italian company, had acquired all share capital of Turbec AB from Volvo Aero and ABB. As a consequence, starting from the end of July 2004 Turbec S.p.A. was founded.

Today Turbec is an organisation capable of competing with all the players on the microturbine market. Its head and administrative office is located in Corporeno di Cento (Ferrara, Italy).
The production plant is in Porto Recanati (Macerata, Italy) where the majority of the T100 components are produced from sheet metal and raw castings which are then manufactured to exacting high quality standards.
The Research & Development group remains in Malmö (Sweden) where they continue to use their knowledge and skills to further develop the T100 concept both in reliability and efficiency which adds to its many competitive advantages.

MICROTURBINE T100 UNIT

Turbec T100 is a CHP (Combined Heat and Power) unit.
The microturbine produces 100 kW of electricity and 155 kW @ 70-90° C of heat fuelled by natural gas and achieving an overall efficiency of 77% (± 1) @ 70-90° C.
The engine is designed for indoor/outdoor installation.



MAIN COMPONENTS

ROTOR SYSTEM

The T100 unit is composed by one high-speed generator, one compressor and turbine wheels that are on the same rotating shaft, the only moving part in the engine. This keeps the physical size to a minimum. The simplicity of the system together with well proven oil lubricated bearings contribute to high reliability for long periods with low maintenance and ultra low oil consumption.

RECUPERATOR

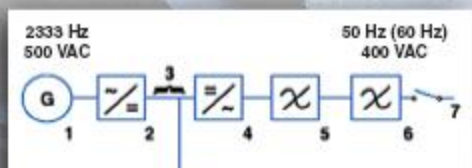
The recuperator is a component that allows the system to achieve high efficiency with simple components and relatively low operating temperatures. The uses of the recuperator greatly increases electrical efficiency to new levels previously unattainable by small turbines.

COMBUSTION CHAMBER

The continuous combustion of the Microturbine T100 distinguishes it from a piston engine's intermittent combustion, in particular it reduces harmful emissions without the need for expensive and complex aftertreatment equipment.

POWER ELECTRONICS

The advanced power electronics system convert the high-frequency electricity generated by the generator to either DC power or AC power with the specified frequency.

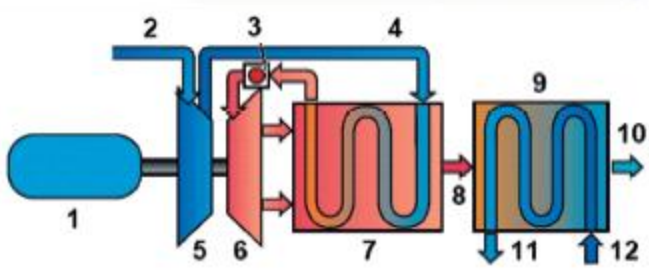


1 Generator
2 Rectifier/Start converter
3 DC bus
4 Converter
5 Line filter
6 EMC filter
7 Main switch
8 Start battery

EXHAUST GAS HEAT EXCHANGER

The heat exchanger is of gas-water counter-current flow type.
The thermal energy from exhaust gases that leaves the turbine is transferred to the hot-water system by the heat exchanger.

1 Generator
2 Inlet air
3 Combustion chamber
4 Air to Recuperator
5 Compressor
6 Turbine
7 Recuperator
8 Exhaust gases
9 Exhaust gas heat exchanger
10 Exhaust gas outlet
11 Hot water outlet
12 Water inlet



Turbec

OUR SU

USAGES

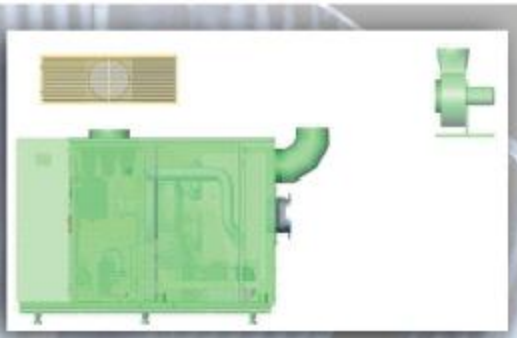
- Office Building
- Swimming pool
- Hospital
- Manifacture
- School
- Green House
- Hotel
- (And much more...)

CCESSES

T100 UNIT SERIE 3

- High availability and reliability
- Low operation and maintenance costs
- No vibrations
- Avoid transmission losses
- Avoid investements in infrastructure
- Invest as you grow
- Cost efficient to install
- Flexible installations
- (And much more...)

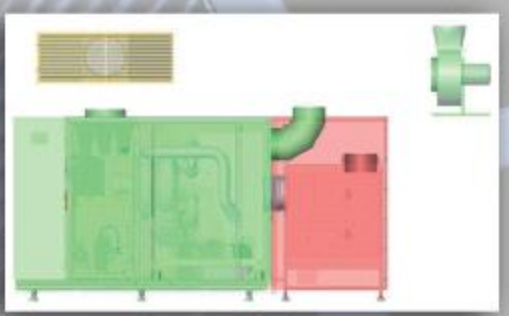
T100 POWER



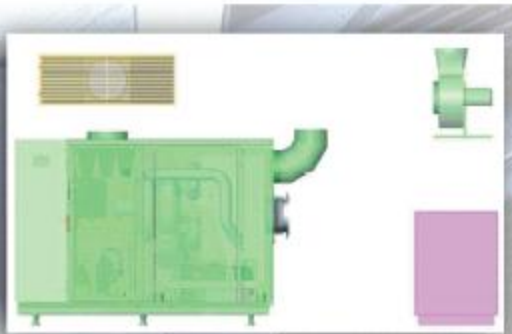
The T100 Power unit produces electrical power. It can be used in processes where the hot exhaust gases are used directly for drying, cooling, etc, or power production only. T100 has a built-in web based remote system. It provides advanced remote trouble shooting and possibility for on line software adjustments, it is very versatile and of Turbec design. T100 also features a built-in gas booster as standard, this is important step towards an easy to install turn-key plant.

T100 POWER and HEAT

The T100 Power and Heat unit (T100 PH) is the T100 Power Module combined with an exhaust gas heat exchanger.
The hot gases that leave microturbine are in this case used to produce hot water.
This combination allows T100 to produce combined heat and power achieving very high overall efficiencies.



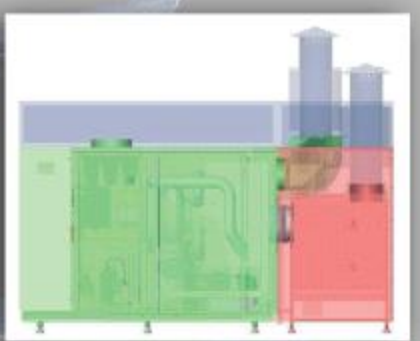
T100 STAND - ALONE



The basic T100 can be extended with a stand-alone function. This function allows T100 to supply protected power loads in case of grid failure. When operating parallel to the grid, the T100 Stand-alone has the same functions as the basic T100. The Stand-alone T100 version is an extension of the standard T100 P (or T100 PH) with modified electrical system and additional power electronics. A battery cabinet with batteries for black-start is included.

OPTIONS

External pre-filter for indoor installation
Heat exchanger by-pass
Outdoor installation
Additional relay protection
50 or 60 Hz
Removal of fuel booster
Load following (Multiple or single)
T100 Cluster Control
Weekly scheduler
Log file decoder
Modbus interface



General identification

Usage	Indoor/ Outdoor
Dimension	Width 900 mm
	Height 1810 mm
	Lenght 2770 mm
Weight	T100 P 2250-2750 kg (*)
	T100 PH 2770-3100 kg (*)
Fuel	Natural gas (**)

(*) Indoor / Outdoor

(**) Different fuel is available with modification on standard unit (biogas, diesel, kerosene, methanol, LPG)

Gas turbine

Compressor type	Centrifugal
Turbine type	Radial
Type of combustion chamber	Lean pre-mix
Number of combustion chamber	1
Pressure in combustion chamber	4,5 bar(a)
Turbine inlet temperature	950 °C
Number of shaft	1
Nominal speed	70000
Consumption of lubrication oil	<3 ltrs/year
	(6000h operation)

Electrical data

Voltage output	400/230 V AC, 3 phases
Frequency output	50 Hz (60 Hz)

Fuel requirements

Pressure min/max	0.02/1.0 bar(g)
Temperature min/max	0/60 °C
Lower heating value	38-50 MJ/kg

Hot water installation (Power & Heat)

Thermal output(hot water)	155 kW (±5) @ 70-90° C
Total efficiency	77% (±1) @ 70-90° C
Min water inlet temperature	50 °C
Max water outlet temperature	150° C
Max water pressure	25 bar (g)
Exhaust gas temperature	90 °C @ 70-90° C

Performance data

Electrical output	100 kW (±3)
Electrical efficiency	30% (±1)
Fuel consumption	333 kW
Exhaust gas flow	0,80 kg/s
Exhaust gas temperature	270 °C
Noise level	70 dBA at 1 meter
Volumetric exhaust gas emission at 15% O_2 and 100% load	
NOx	< 15 ppm/v = 32 mg /MJ fuel
CO	< 15 ppm/v = 18 mg/MJ fuel

Turbec T100 is fully certified by CARB (Californian Air Resource Board)

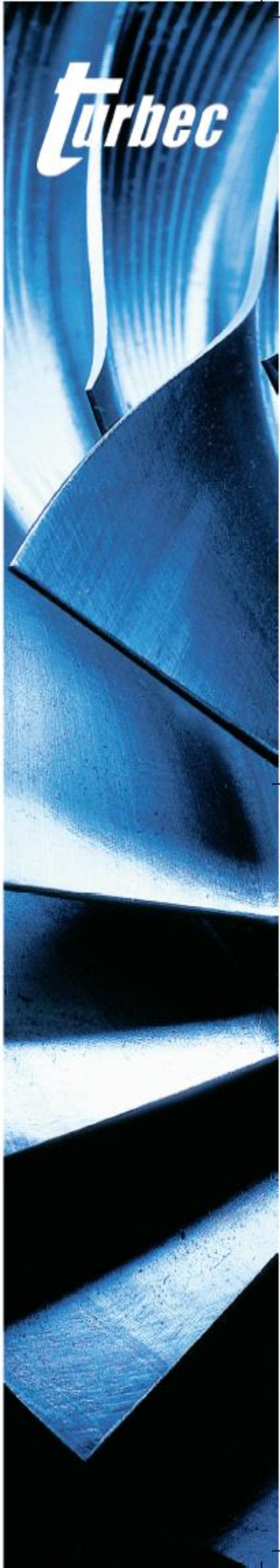
Maintanance

The simple and rugged design of the T100 power module provides for a durable operation during many years. Expected life time of main components are listed below:

Gas turbine engine:	> 60 000 hrs
Recuperator:	> 60 000 hrs
Combustor:	> 30 000 hrs
	(some parts < 30 000 hrs)

The preventive (scheduled) maintenance is divided into two different categories:

	Interval (h)	Outage (h)
Inspection	6 000	2
Overhaul	30 000	8



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