

EVALED™ RV

Technical Report



TC 10000

**Mechanical vapour recompression
vacuum evaporator with
forced circulation**



1 Technical characteristics

<i>Nominal production of distillate with water:</i>	10000 [l/24h]
<i>Model available:</i>	TC 10000 FF# (superduplex stainless steel) TC 10000 AA# (austenitic stainless steel)
<i>Electrical equipment:</i>	TC 10000 --3 (400 [V] 50 [Hz] 3F) TC 10000 --4 (460 [V] 60 [Hz] 3F)
<i>Construction:</i>	single module on a painted carbon steel frame
<i>Evaporation type:</i>	conveyed vacuum flash
<i>Evaporation conditions:</i>	absolute pressure 70 kPa temperature 90 [°C]
<i>Distillate outlet temperature:</i>	30-90 [°C] depending on feeding temperature and on the discharge mode chosen (e.g. manual discharge)
<i>Concentrate outlet temperature:</i>	30-90 [°C] depending on working mode (discharge frequency) and on feeding temperature if concentrate thermal recovery device is present
<i>Drops separator:</i>	demister, grate type with packing elements
<i>Technology of heating/cooling:</i>	MVR (mechanical vapour recompression)
<i>Primary /distillate heat exchanger:</i>	external shell and tube with forced circulation (heating through the tubes, condensing through the shell)
<i>Circulation pump:</i>	centrifugal with fluxed mechanical seal
<i>Blower:</i>	Positive displacement blower (handled by a variable frequency drive)
<i>Vacuum system:</i>	created by the blower
<i>Control:</i>	automatic, continuous 24/24h 7/7 days by PLC possibility to make remote the functioning state signal starting and shutdown of machine;
<i>Operator panel:</i>	electronic keypad with digital display
<i>Electrical cabinet rating:</i>	IP 54
<i>Noise:</i>	< 78 [dB(A)]
<i>In compliance with standards: (CE marking)</i>	Machinery Directive Electromagnetic compatibility Electrical safety

2 Nominal performance

The data reported in the following table refer to the performances achieved during FAT (Factory Acceptance Test) with clean machine fed with tap water in standard atmospheric conditions.

Model	TC 10000 --3	TC 10000 --4
<i>Electrical feed</i>	400 [V] 50 [Hz] 3F	460 [V] 60 [Hz] 3F
<i>Maximum production of distillate</i>	10459 [l/24h] ± 10%	10300 [l/24h] ± 10%
<i>Absorbed power in steady state working</i>	24 [kW] ± 10%	26 [kW] ± 10%
<i>Power factor</i>	[cosφ] 0,90	[cosφ] 0,90
<i>Electrical specific consumption per litre of distillate</i>	55 [Wh/l] ± 10%	60 [Wh/l] ± 10%
<i>Thermal power emitted by evaporator</i>	24 [kW] ± 10%	26 [kW] ± 10%

3 Functional description

The machine TC 10000 is a mechanical vapour recompression evaporator for the treatment of water based liquids. For component identification refer to figure 1.

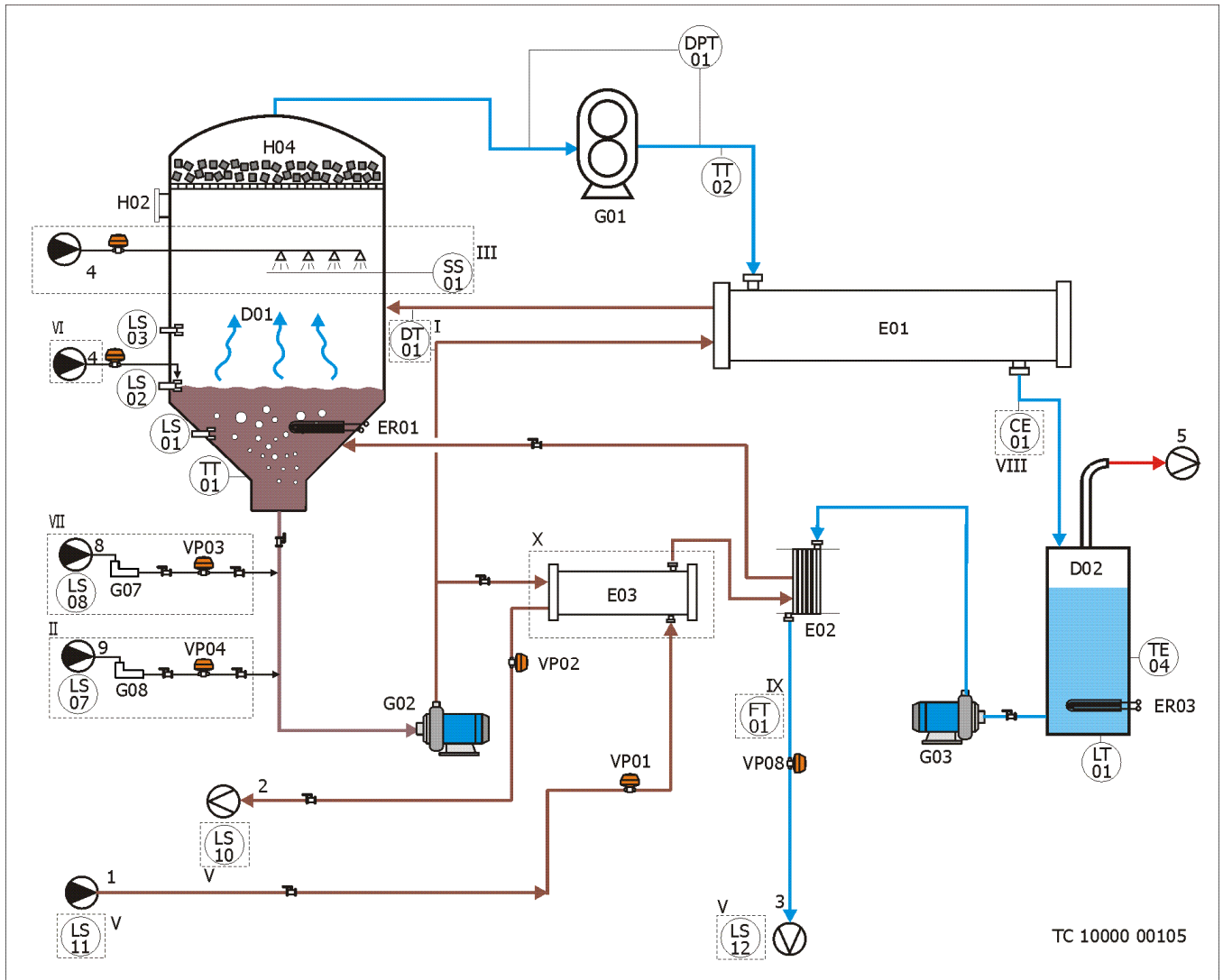


Figure 1

The numbers within a circle are the main sensors of the machine. The Roman numerals and the dashed lines indicate the optional components. The numbers near the inlet and the outlets indicate the connection to the process lines.

3.1 Process liquids

The liquid to be treated is preheated in the heat exchangers **E03** from the concentrate (if the optional system **X** is installed) and **E02** from the discharging distillate. The feed is controlled by the level sensor **LS01** which controls the valve **VP01**. Within **D01** the pressure is 70 kPa and the temperature is 90°C and liquid can be therefore sucked inside the evaporator. The process liquid is recycled by the pump **G02** which pumps it through the primary heat exchanger **E01**. Within **E01** the liquid receives the heat necessary to boil. The heated liquid returns to the boiling chamber **D01**, where, as a result of the vacuum, a portion of the liquid immediately boils (flash evaporation). The produced vapour passes through a packed bed in order to eliminate suspended liquid drops and improve the separation. The blower **G01** compresses the vapour and sends it to the heat exchanger **E01** where it releases the latent heat to the process liquid. The distillate is collected in the tank **D02** and then it's discharged by the pump **G03** after a heat exchange in **E02**. The sensor **CE01** measures the conductivity of the distillate: high conductivity means high entrainment of liquid in the boiling chamber and the machine shows an alarm to the operator.

The concentrate is discharged automatically according to a pre set timer through the valve **VP02**.

During the starting machine the liquid in the boiler is heated by the resistor **ER01** and the pump **G02**, keeping stirred the liquid inside the boiling chamber. In similar way sensor **TE04** measures temperature inside **D02** and controls the activation of **ER03** resistance if temperature is too low.

3.2 Mechanical vapour recompression

The produced vapour in the boiling chamber **D01** is sucked into the positive displacement blower **G01** that, by means of the compression, raises the temperature; than the vapour passes through the shell of the exchanger **E01** where it condenses and releases the latent heat to the recycled liquid of the boiling chamber.

3.3 Thermal recovery systems

Thermal recovery is realised through the exchangers **E03** (if the optional system **X** is installed) and **E02**. The liquid to be treated crosses both of them and warm up before entering in the boiling chamber.

The concentrate passes through the exchanger **E03** and cools down before its discharging.

The distillate enters in **E02** and cools down before its discharging.

3.4 Auxiliary liquids

Antifoam, supplied by the opening of the valve **VP03**.

Tap water, for internal washing of the level controls of the evaporation chamber **D01**.

Additive metering by the opening of the valve **VP04** if the optional system **II** is installed.

Bactericide metering in the delivery pipeline of distillate discharge pump, if the optional system **IV** is installed.

4 Current equipment

(*1)	Code	Description
V	-	Arrangement for level control on the tanks of process liquids: improves the level of automation of the system
VI	OW TW	Internal washing of the level switch in the evaporation chamber
VII	OM AF F	Anti-foam metering for liquids which produce foam during the treatment.
VIII	OC CN D	Distillate conductivity sensor

*1) See the diagram in the figure 1.

5 Options and Accessories on request

(*1)	Code	Description
I	OC DN C	Measurement device of concentrate density
II	OM AD F	Additive metering device
III	OC AF	Automatic foam control device in boiling chamber (*2)
	AM BT D	Bactericide metering device: allows the metering of bactericide product
IX	OC FM D	Flow rate transmitter of the distillate
X	OR HE C	Concentrate recovery heat exchanger device(*2)
	AF FC F	Feed prefiltration device
	OC RC	Remote control device via modem on PLC
[-]	OC EN	Communication device with Ethernet module (*2)
[-]	OC PB	Communication device with Profibus module (*2)
[-]	OW CH	Automatic chemical washing system (*2)

*1) See the diagram in the figure 1. *2) To be requested in the order.

If the optional **OC RC** is installed, the user can receive an SMS to a prefixed mobile phone number in case of alarm of the machine and profit by VWS Italia assistance for monitoring and upgrading the software (the SIM enabled for data transfer is at customer care and expenses).

As regards the automatic chemical washing system **OW CH** refer to the specific technical report.

6 Construction materials

INOX 304/L	Austenitic stainless steel AISI 304 (EN 1.4301) / AISI 304L (EN 1.4306)
INOX 316/L	Austenitic stainless steel AISI 316 (EN 1.4436) / AISI 316L (EN 1.4404)
INOX 316Ti	Austenitic stainless steel AISI 316Ti (EN 1.4581)
DUPLEX	Superduplex stainless steel UNS S32750/UNS S32760 (EN 1.4410/EN 1.4501)
INOX	Stainless steel alloy
INOX NiCr	High quality alloy austenitic stainless steel UNS N08028 (EN 1.4563)
PP	Polypropylene
IRON	Cast iron (UNI-ISO 185 G 200)
Fe painted	Carbon steel (Fe 360 - S235JR) treated with a special paint RAL 9006 to protect it from atmospheric agents

Component	ID	TC 10000 FF#	TC 10000 AA#
<i>Lower wall of evaporation chamber</i>	D01	DUPLEX	INOX 316/L
<i>Dome of evaporation chamber</i>	D01	INOX 316/L	INOX 316/L
<i>Distillate storage tank</i>	D02	INOX 316/L	INOX 316/L
<i>Tube and shell heat exchanger (tube – shell)</i>	E01	DUPLEX - INOX 316/L	INOX 316/L
<i>Thermal recovery exchanger (plate type)</i>	E02	INOX 316/L	INOX 316/L
<i>Thermal recovery exchanger</i>	E03	DUPLEX	INOX 316/L
<i>Circulation pump</i>	G02	DUPLEX	INOX 316/L
<i>Distillate discharge pump</i>	G03	INOX 316/L	INOX 316/L
<i>Blower</i>	G01	INOX	IRON / INOX
<i>Structure and frame</i>	-	Fe painted	Fe painted
<i>Piping and line parts</i>	-	DUPLEX + PP+ INOX 316/L	INOX 316/L + PP
<i>Level switches inside the boiling chamber (blades)</i>	LS01 LS02 LS03	INOX 316Ti	INOX 316Ti

7 Dimensions and clearance zones

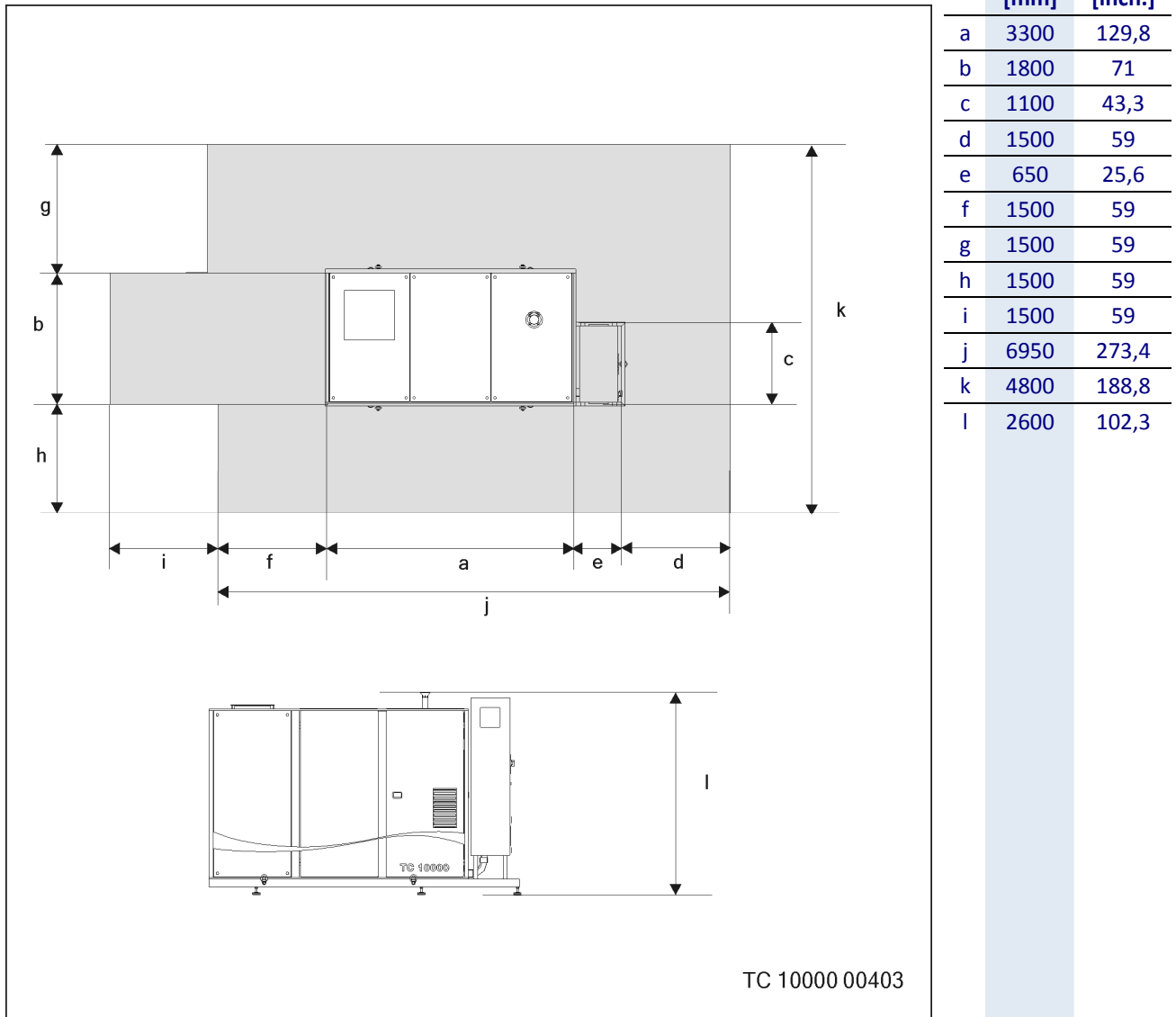


Figure 2

8 Dimensions, weight, packaging, storage and handling

The machine is projected for working indoor.

Type	Dimensions [mm]	Weight [Kg]
Standard packaging	4000 x 1850 x 2500 h	3000
Packaging with wooden crate	4300 x 1970 x 2870 h	3650
Machine assembled in normal stationary conditions	see figure 2	3500

The temperature of storage site may be within **+5 e +45°C**.

The evaporator may be handled by a self-propelled crane or overhead travelling crane with adequate weight equalizer; previously machine shall be hooked to the provided eyebolts. Weight equalizer must have a length **≥ 2000 mm**, in order not to harm the panel covering.

9 Working temperature

The running of machine produces warm air which should be evacuated to avoid overheating of the installation site. For this reason it is provided a suitable ventilation system in order to ensure sufficient air exchange.

Ambient temp.	Working conditions
5÷45 [°C]	Normal conditions
0÷5 [°C]	Start up allowed only with precautions
>45 [°C]	Contact VWS Italia

The nominal performances stated in this document are guaranteed with a feed temperature between **+20** and **+70°C** and a concentrate discharge $\leq 20\%$ facing the liquid to be treated; these performances are guaranteed for an atmospheric pressure of the installation environment of 1013 mbar (about 14.7 psi corresponding to 0 meters above the sea level)

10 Installation requirements

The machine has to be installed in a level position in a location that can support the weights listed in section 7. Around the machine perimeter it is necessary to set some clearance zones to allow the personnel and the maintenance operators to work with no obstacles and to keep the air transit free (shown in Figure 2). The features of the liquid connections and pipes are hereafter listed:

(*1)	Description	Type	DN [mm]	(*2) [m]	(*3) [m]	(*4) [wcm]
1	Liquid to be treated	Flanged	25	10	15	2
2	Concentrate discharge	Flanged	25	10	20	~10
3	Distillate discharge	Flanged	25	20	20	10

*1) See Figure 1 *2) Maximum distance of the tank *3) Maximum pipe length *4) Difference in height / Maximum head.

The machine needs a 2 m minimum hydrostatic head for suction of feed liquid.

Coarse material in the liquid to be treated has to be a diameter lower than 800µm.

The machine requires compressed air, dehydrated and without oils, to operate the pneumatic valves. The inlet connection to the pneumatic equipment needs a polyethylene connection tube with external diameter 12 mm. The supply pressure needs to be **600 kPa** and the line should be capable of supplying **7 Nm³/h**.

The total maximum absorbed current is **90 A**; this value has to be used for cables dimensioning and for upstream protection system of the machine. The electric cables are at customer care and need to be connected to a switch suitably designed by a qualified technician, following the good working regulation and respecting the electric cabinet rating.

The machine is supplied with a vent for vapour and incondensable gases (see output 5 in figure 1) that must be advisably canalized, if necessary, in respect of the regulations regarding safety in workplace.

11 Environmental Impact Reduction: CO2 emissions

Below are the results of our Carbon Footprint study and a comparison with an extreme case of pollution:

kgCO _{2eq} /m ³ liquid waste treated	30,02
Percentage of emissions avoided with respect to incineration of the liquid waste	-97,6%

The first data value represents an average between the various industrial uses considering a use of the machine 24h/d, 330 d/y, for 10 years, road transport of the machinery to 1000 km from production site of the manufacturer and road transport of the chemical products for a distance of 100 km from the customer's site. The data of the comparison with incineration was weighted on the yield of the machine, i.e., the ratio between the initial liquid waste to be treated and the residual concentrate to be disposed of.

Notes

- For details concerning the safety and the installation of the machine refer to the use and maintenance manual.

- The data in this document are indicative. VWS Italia reserves the right to change any data without prior notice. The front-page photograph is neither representative of all versions nor models.