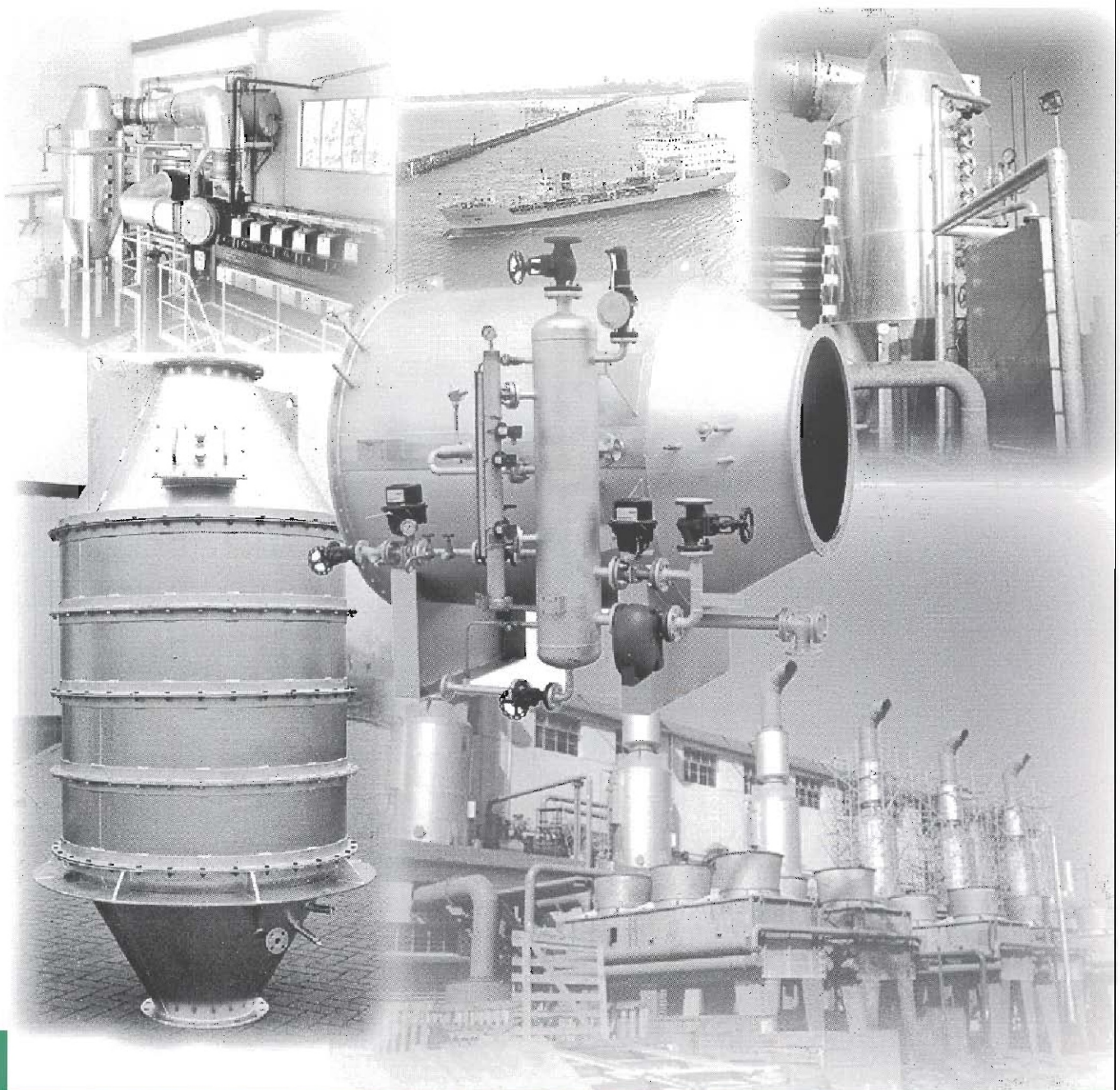
Clayton INDUSTRIES

HEAT RECOVERY SYSTEMS



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INTRODUCTION

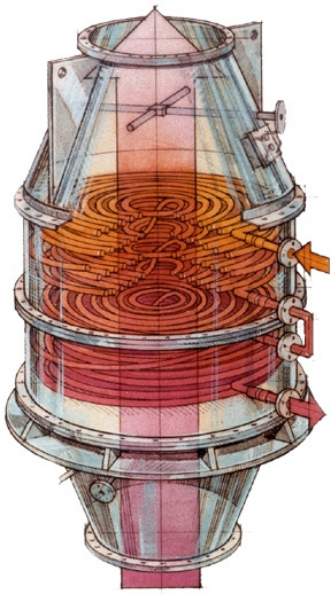
Clayton Industries produces steam generators for more than 70 years now.
For more than 30 years, Clayton exhaust gas boiler systems have contributed to energy savings and recovery all over the world.

Exhaust gas heat recovery systems are used in marine, industrial and power plant applications.

THE ANSWER TO ALL YOUR STEAM NEEDS

For all your steam requirements, by land or by sea, Clayton has the most adequate steam products in the market - steam generators, exhaust gas boilers, and combined boilers. Clayton has more than 70 years experience and over 20,000 land and marine installations worldwide. With manufacturing plants in USA, Belgium and Mexico, a global distributor network and worldwide service availability, Clayton stands ready to respond to your steam needs for all shipboard, offshore and co-generation applications.

STEAM GENERATOR



EXHAUST GAS BOILER

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MARINE APPLICATIONS

Clayton Exhaust Gas Boilers are utilized on dry cargo ships, chemical carriers, passenger ferries, reefer vessels, gas tankers, drilling rigs, fish processing vessels, FPSO's, navy and sea defense ships and wide range of the other types of ships. Generally, an installation consists of a combination of one or more fired steam generators and an exhaust gas steam generator or boiler.

Clayton Industries offers world-wide spare parts delivery and service by a network of Clayton owned companies and trained distributors.

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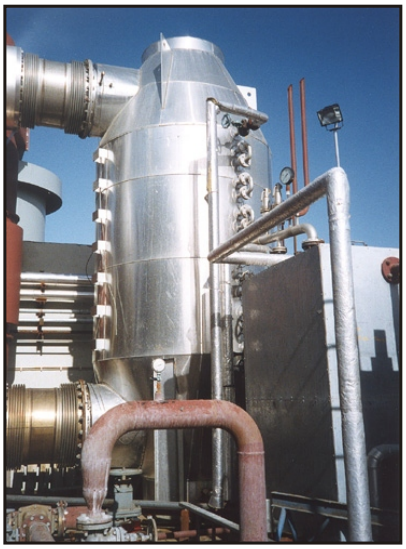
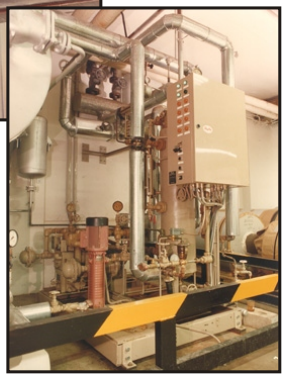
INDUSTRIAL APPLICATIONS

From a practical standpoint, all of the heat in the gas above 200 °C (390 °F) can be recovered and converted to steam or hot water.
Steam can be generated using the heat from ovens, combustion of waste gasses, etc...





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POWERPLANT APPLICATIONS

In powerplants, there are two possible situations:
a) steam generated for own use : the steam is used for:
- heating up of fuel and fuel treatment
- auxiliary steam

b) co-generation :
- maximum generation of steam for industrial process use

Clayton Industries is experienced in the design, engineering and construction of the necessary components to build a complete steam generating system. A list of world-wide references is the prove that Clayton is the correct business partner for this type of projects.World-wide presence of competent Clayton engineers and specialists assures adequate project support.

POWER BARGES

POWER BARGES

INDUSTRIAL POWER PLANT

LARGE DIESEL POWER PLANTS

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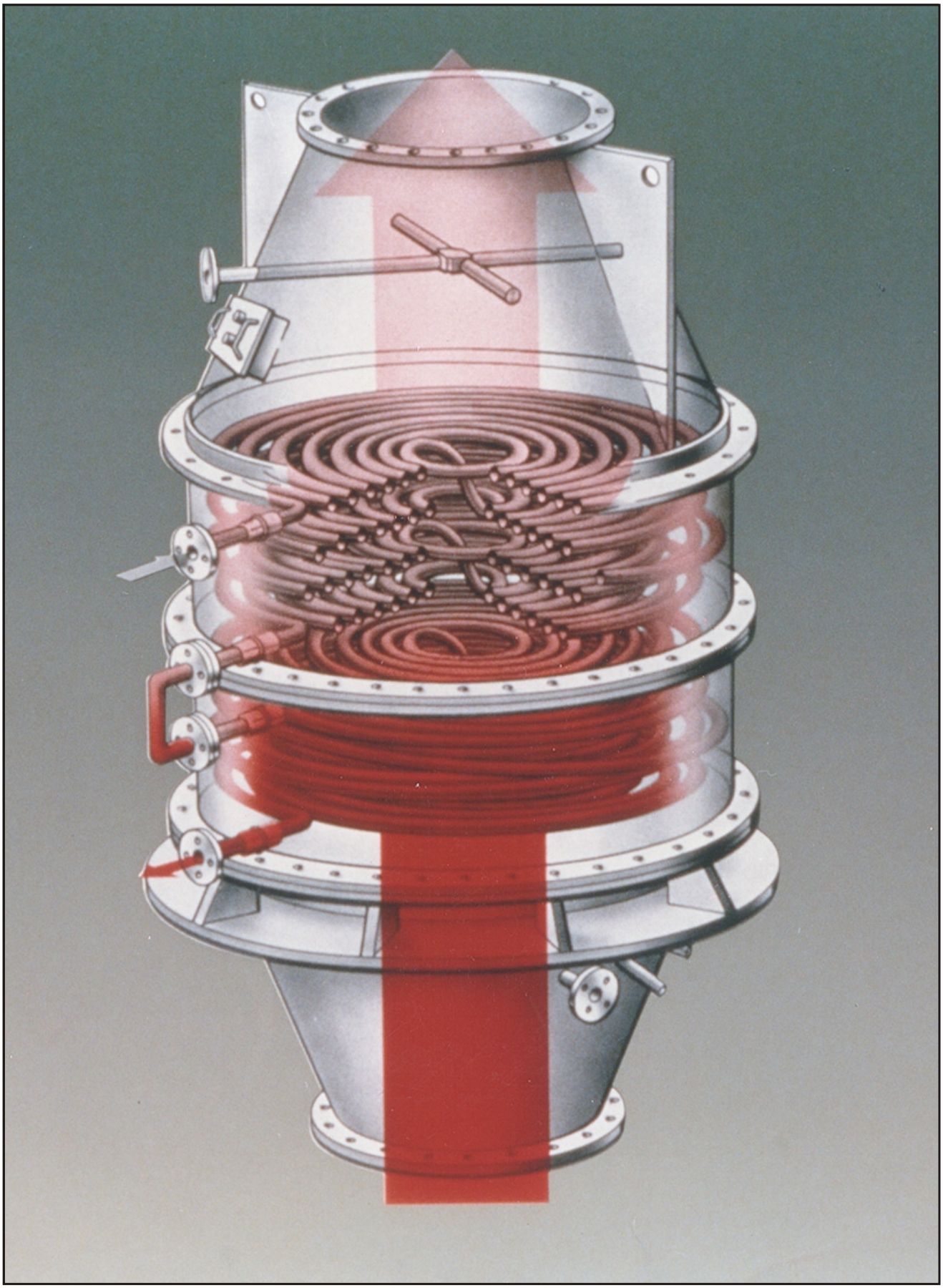

CLAYTON EXHAUST GAS BOILER / SECTIONAL VIEW

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THE CLAYTON EXHAUST GAS BOILER AND PARTICULAR FEATURES

General description :

The exhaust gas boiler consists of a number of cylindrical sections, with each section containing spirally wound layers (so called pancakes), made out of plain steel tube ST.37.8, according to DIN 17177, test pressure 40 bar, stress-relieved at 600 °C.

The number of sections to be applied is depending on the boiler heat output requirements (see also page 23). The staggered configuration of the pancakes one above the other improves the heat transfer.

Each pancake can expand independently to the others, according to the local temperature. A section consists of 4 or 6 pancakes mounted in a gas tight cylindrical shell.
Flanges on top and bottom side of the shells are provided for easy mounting one on top of the other. Bolts, nuts and packing rings are Included in the CLAYTON delivery.

The sections are built together in the CLAYTON works and external inter-connections at the steam or water side are included in the CLAYTON delivery.

The CLAYTON exhaust gas boiler is a mono-tube water tube boiler with forced circulation, similar to the construction of the CLAYTON steam generators.
The spacing between the tubes varies with the exhaust gas boiler model. The free gas section will be a determining factor for the gas side resistance.

The sections as shown above are available in a standardised model range. See dimension table in the technical documentation.

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FEATURES AND ADVANTAGES OF THE CLAYTON EXHAUST GAS BOILER

FEATURE	ADVANTAGE
COUNTER FLOW	- COMPACT DESIGN - MAXIMUM THERMAL EFFICIENCY - LOW WATER CONTENT - RAPID START-UP
PLAIN TUBES	- MINIMUM FIRE RISK - EASY TO CLEAN - LOW SURFACE TEMPERATURE - LOW EXHAUST GAS PRESSURE DROP
STAGGERED CONFIGURATION OF TUBES	- HIGH HEAT TRANSFER - MINIMUM SOOT BUILD-UP
FORCED CIRCULATION	- NO WATER LEVEL INSIDE THE BOILER - FREE CHOICE OF DIRECTION OF BOTH GAS AND WATER - HIGH HEAT TRANSFER
SPIRALLY WOUNDED TUBES	- FREE EXPANSION - DRY RUNNING POSSIBLE UP TO 450° C EXHAUST GAS TEMPERATURE
STANDARD SECTIONS	- AVAILABILITY - SHORT DELIVERY TIME - APPROVED CONSTRUCTION

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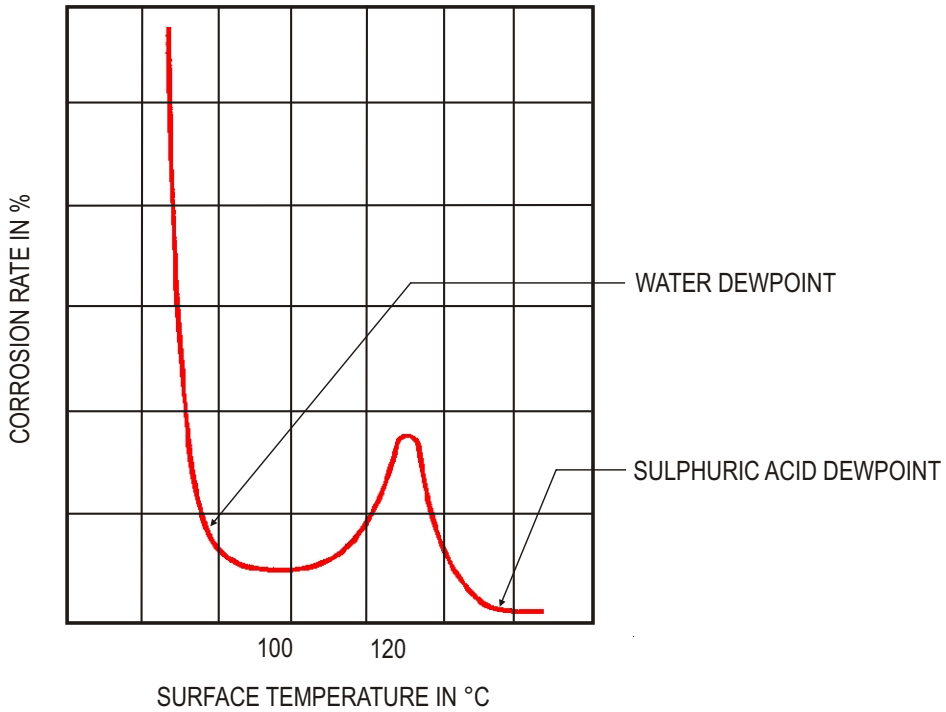
PROTECTION AGAINST OUTSIDE DETERIORATION OF THE TUBES

Exhaust gasses contain substances which under certain conditions can form condensate on the outside of the boiler tubes. This may lead to external pipe deterioration. Corrosion can be caused by sulphur and water in the exhaust gas.
It is clear that those fuels containing high content of sulphur present the highest risk for sulphuric acid corrosion. Besides sulplur, water can cause external pipe corrosion if condensation occurs.
In order to avoid the negative effects in the best way possible, the tube wall temperature has to be above a certain minimum, depending on the type of fuel. The exhaust gas temperature may well be above the dewpoint of the gasses, it is the tube wall temperature which will determine if condensation will occur or not.

The curve below gives an idea of the corrosion rate of a steel pipe for a fuel containing sulphur. It can be seen that for tube wall temperatures above 130°C, the corrosion rate caused by sulphuric acid is minimum.
In general, water condensation will occur on surfaces having a temperature below 70°C. Exhaust gas condensation is a complex process and quite some factors are of influence on the dewpoint of the gasses and corrosion effects.

The Clayton systems as described on the next pages are designed in such a way
that the tube wall temperature is on the safe side, depending on the type of fuel used in the engine.



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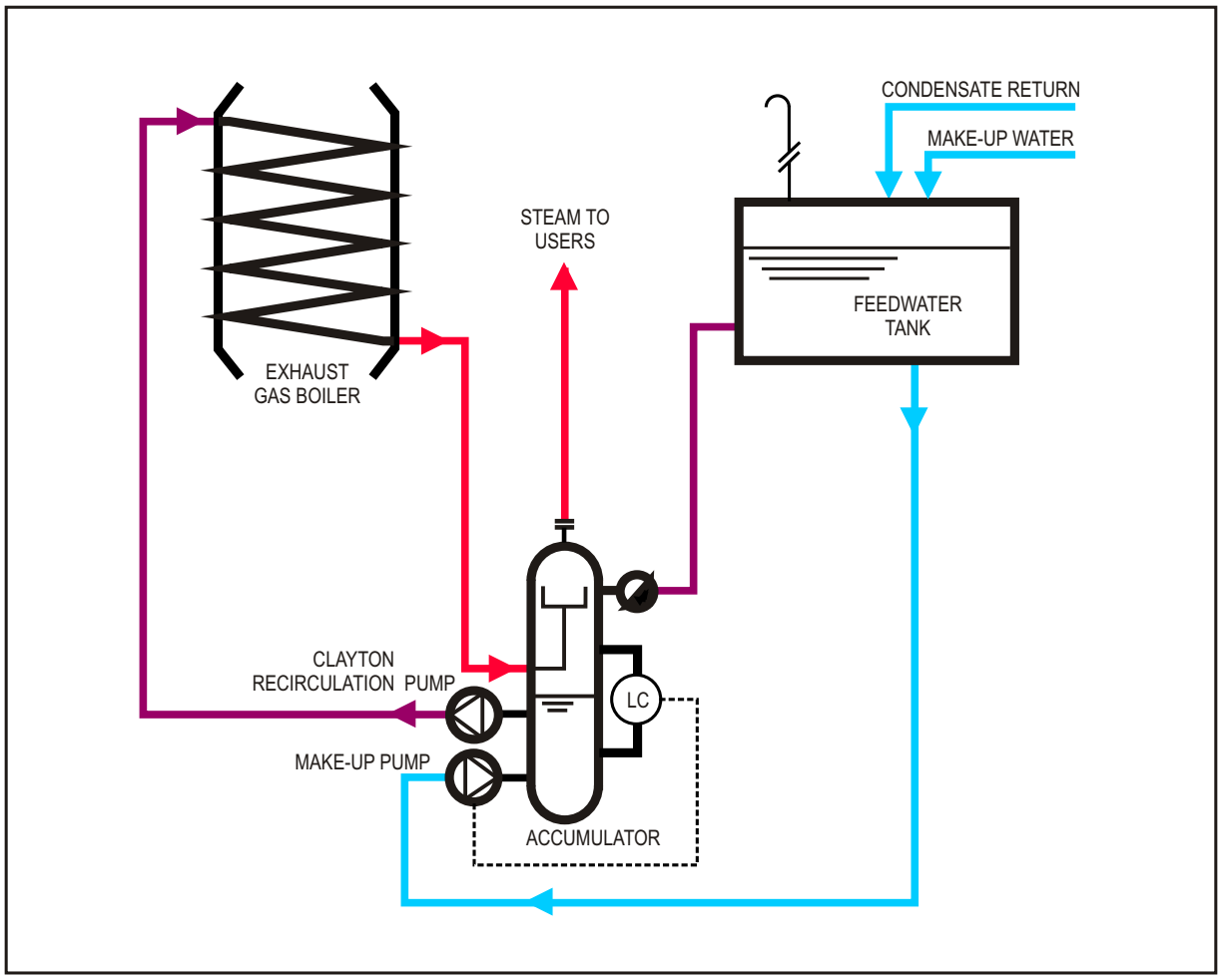
THE CLAYTON R-SYSTEM



Feedwater for the exhaust gas boiler is prepared in a feedwater tank. This vessel can be atmospheric or in case of a deaerator it is pressurised. The feedwater tank is often referred to as "hotwell". In the feedwater tank, fresh make-up water and condensate coming back from the installation are blended. The water in the tank is preheated in a controlled way by steam injection in order to drive out oxygen and non-condensable gasses in a natural way. The water preheating temperature is 95°C. In the same tank, chemicals for water treatment are added to the feedwater. A pump takes water from the feedwater tank to the separator/accumulator. The separator /accumulator is a vessel under steam pressure with controlled water level. The vessel has two basic functions: separation of the steam and water mixture coming from the exhaust gas boiler and preheating of the water going to the exhaust gas boiler. The Clayton waterpump takes water from the separator/accumulator and feeds it to the exhaust gas boiler. This quantity of recirculation water is about twice the steam production of the exhaust gas boiler at full load. The mixture of steam and water coming out of the exhaust gas boiler is going to the separator / accumulator. A system of fixed vanes mounted inside the vessel takes care of the separation of steam and water. The separated water however is at steam saturation temperature and mixes in the vessel with the in-coming water from the feedwater tank. In this way, the water in the bottom of the accumulator has a temperature in-between the steam temperature and the temperature of the water in the feedwater tank. The system assures that the water going to the exhaust gas boiler is well above the acid dewpoint of the exhaust gasses, thus protecting the boiler tubes against outside corrosion. The Clayton R-system offers a compact solution where equipment such as steam drum unit and pump modules are pre-assembled on skids. The Clayton R- system can also be used for multiple boiler installations, up to 3 to 4 boilers.

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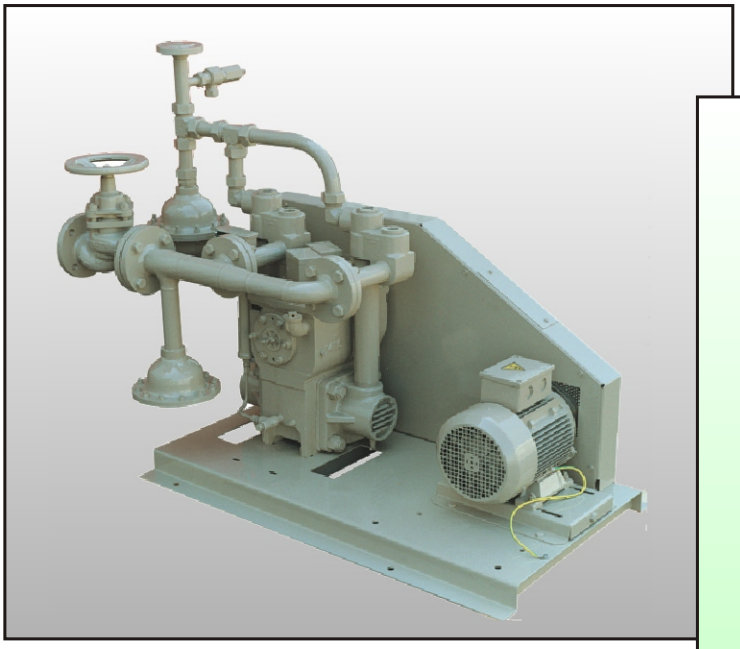
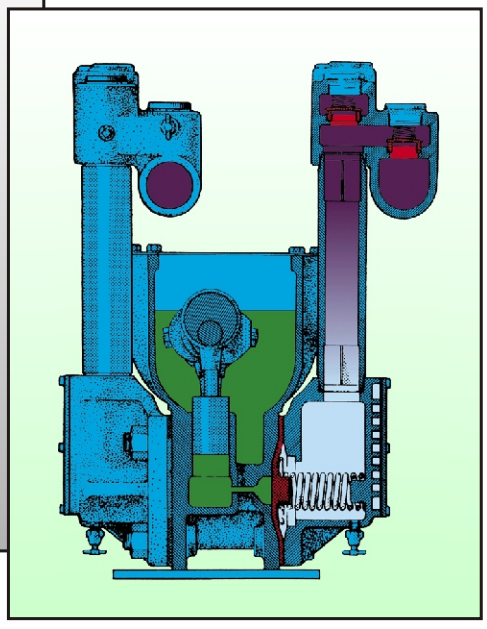
EXHAUST GAS BOILER WITH CONES

SKID WITH STEAM DRUM



WATER PUMP



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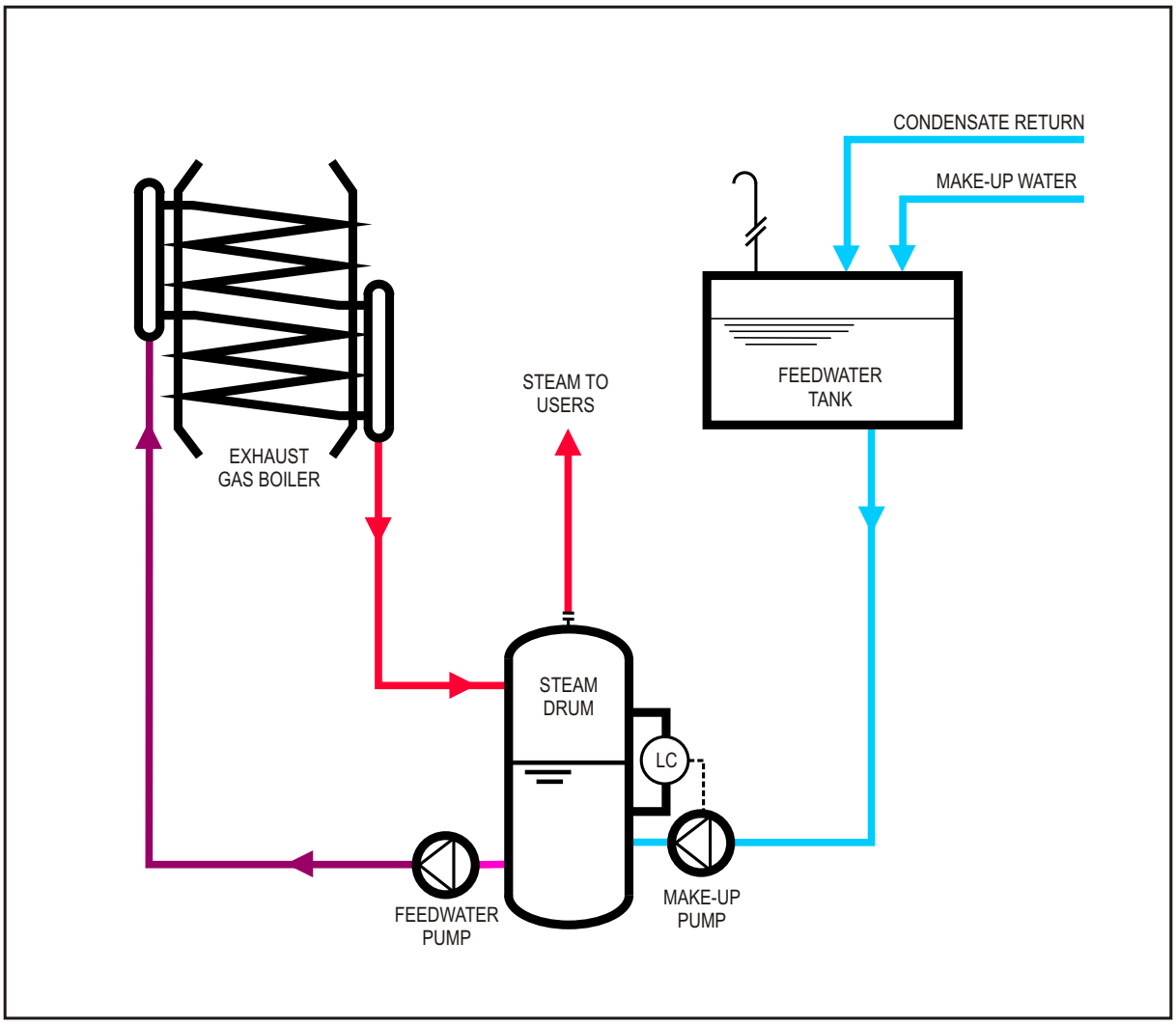
THE CLAYTON LAMONT SYSTEM



This system is used for the larger type of power or cogen plant, or where a multiple boiler system is installed. In the Lamont system, water from the feedwater tank or deaerator is pumped to a steam drum. This drum is half filled with water and has sufficient capacity to deal with the dynamic behaviour of the system. A centrifugal pump takes water from the drum and circulates it over the exhaust gas boiler. The recirculation rate in a Lamont system is much higher than in the Clayton R- system. This results in the fact that the water in the steam drum is virtually at steam saturation temperature. This offers particular good protection against effects of sulphur in the exhaust gasses. In the Lamont system, the boiler tube layers are arranged in parallel, so that the flow resistance on the water side is kept as low as possible, thus limiting the circulating pump's power consumption. An in- and outlet header connect all sections on the water/steam side. The water/steam mixture leaving the boiler returns to the steam drum, where the separation between water and steam takes place. The steam leaves the drum at the top.

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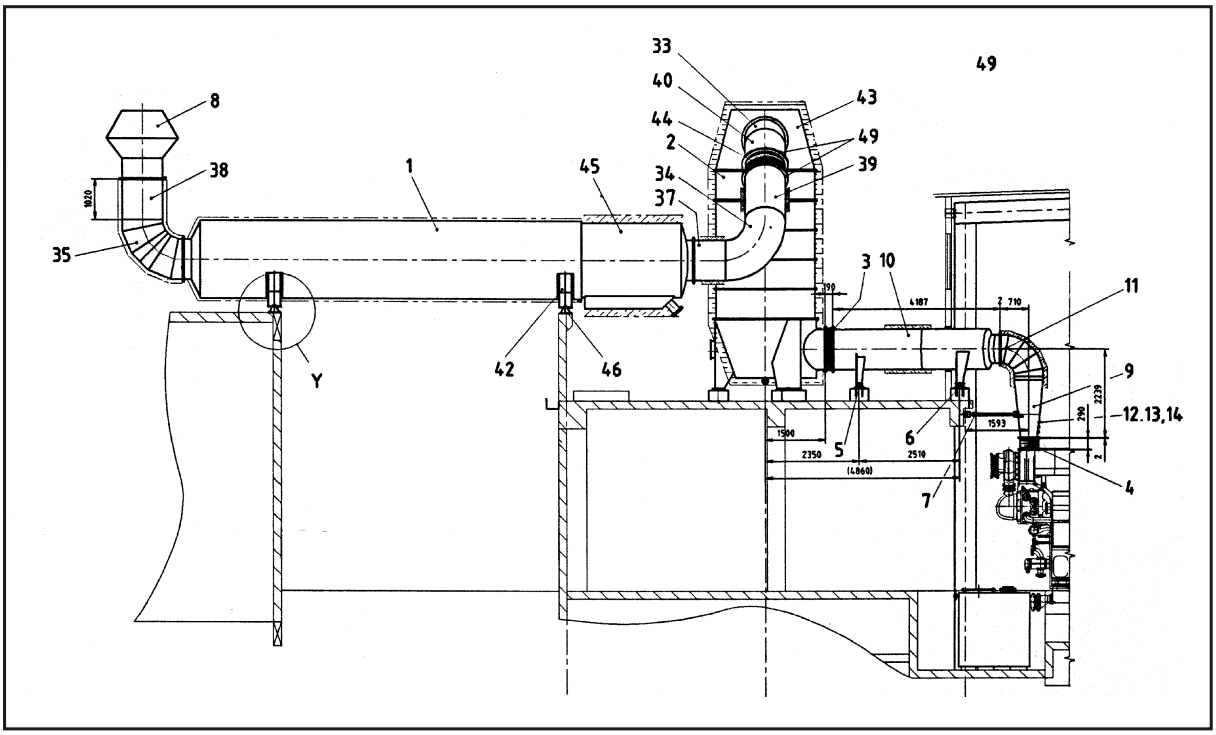
EXHAUST GAS BOILER 4 t/hr. STEAM



EXHAUST GAS BOILER ON PLATFORM

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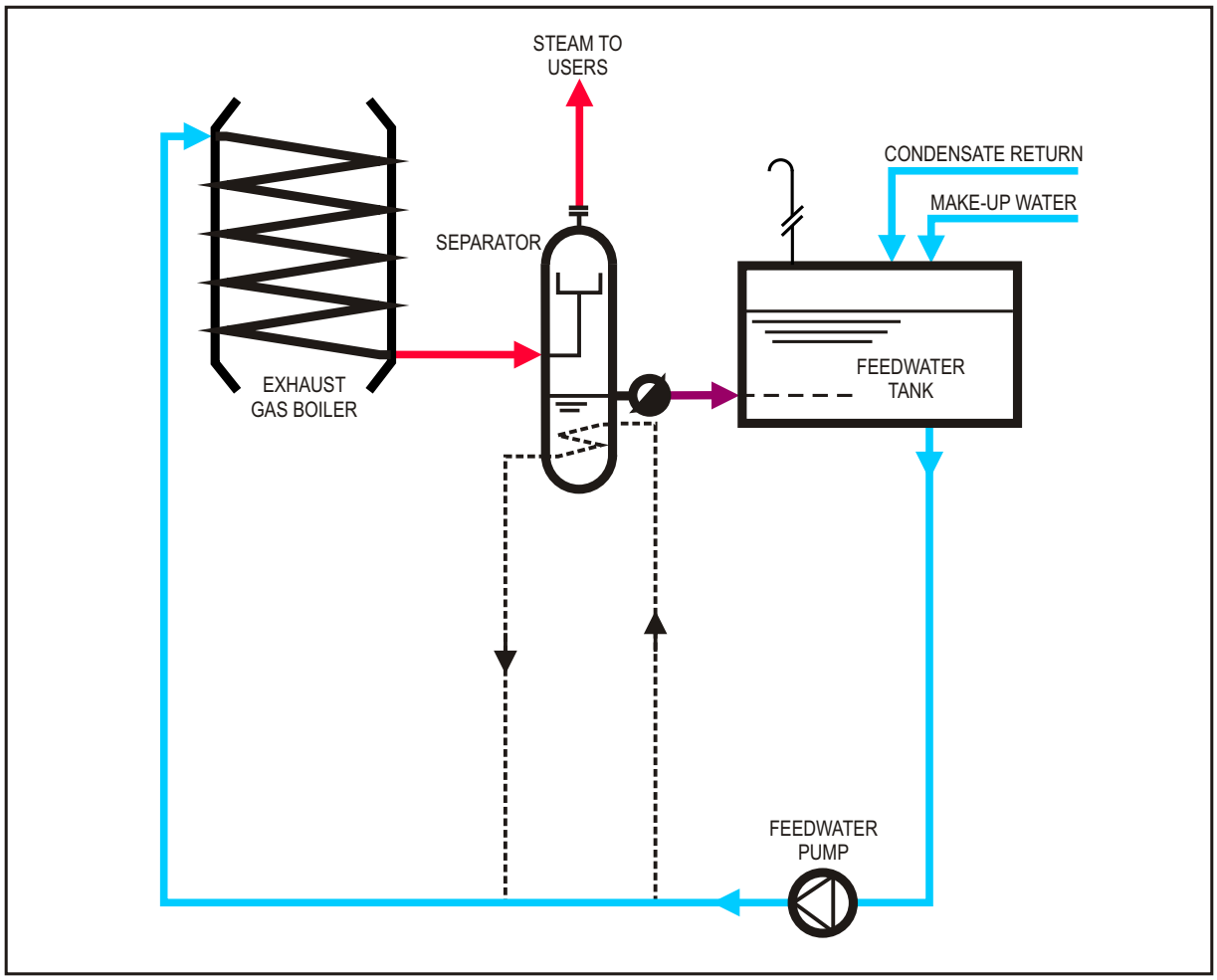
THE CLAYTON E-SYSTEM



Feedwater for the exhaust gas boiler is prepared in a feedwater tank. This vessel can be atmospheric or in case of a deaerator it is pressurised. The feedwater tank is often referred to as "hotwell". In the feedwater tank, fresh make-up water and condensate coming back from the installation are blended. The water in the tank is preheated in a controlled way by steam injection in order to drive out oxygen and non-condensable gasses in a natural way. The water preheating temperature is 95°C. In the same tank, water treatment chemicals are added to the feedwater. A circulation pump then pumps the water through the heating coil of the exhaust gas boiler. A fixed water quantity flows through the boiler, so that there is always an excess water quantity. This is necessary in order to avoid tube overheating and scaling. The excess water quantity is approximately 20% of the steam production. Out of the exhaust gas boiler comes a mixture of water and steam. The water is separated from the steam in a centrifugal separator. Dry steam leaves the separator on the top and goes to the consumers. On the side of the separator, a steam trap is mounted, returning the separated hot water to the hotwell. There, the water plus flash steam are mixed under water level with fresh incoming water and condensate. The Clayton E-system can be used when the exhaust gasses come from gas fired or diesel oil fired engines and when steam is for own use in the power plant. The E-system is suitable when the heat consumption is stable and at sufficient level. Thermal balance of the hotwell is to be checked for partial load conditions, because of the fact that the condensate returned form the separator participates in preheating the water in the hotwell. For systems where partial loads (engine output and/or steam demand) occur frequently, the Clayton R-system or Lamont systems are recommended.

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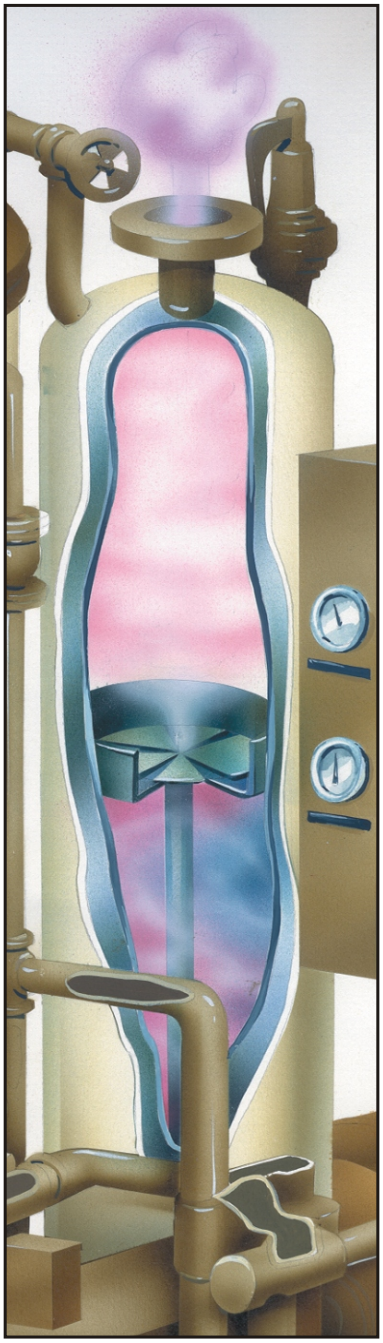
EXHAUST GAS BOILER WITH GAS SIDE BY-PASS

WATER PUMP



SEPARATOR

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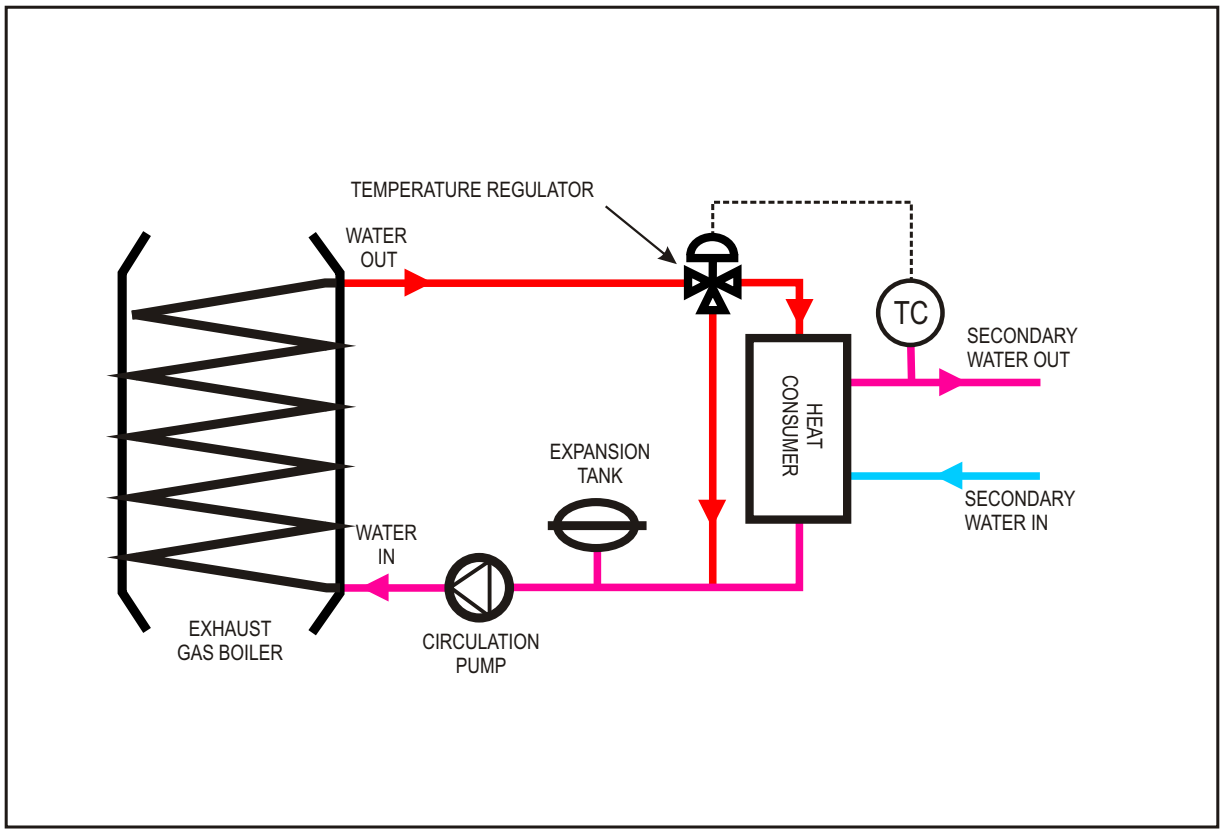
THE CLAYTON HOT WATER SYSTEM



The Clayton exhaust gas boiler can also be used in a closed loop generating hot water. The temperature level of the water depends on the type of fuel. The miminum temperature for the water to enter the boiler however is generally as follows :

- 130° C for heavy fuel oils
- 95° C for diesel fuel oils
- 70° C for gasses coming from a natural gas combustion, clean gas
- 95° C for gasses coming from a natural gas combustion, from a diesel engine or spark ignited engine, gasses containing traces of soot and unburned lubricating oil.

The primary loop contains a circulating pump, expansion vessel and heat exchanger(s) with control valve(s).

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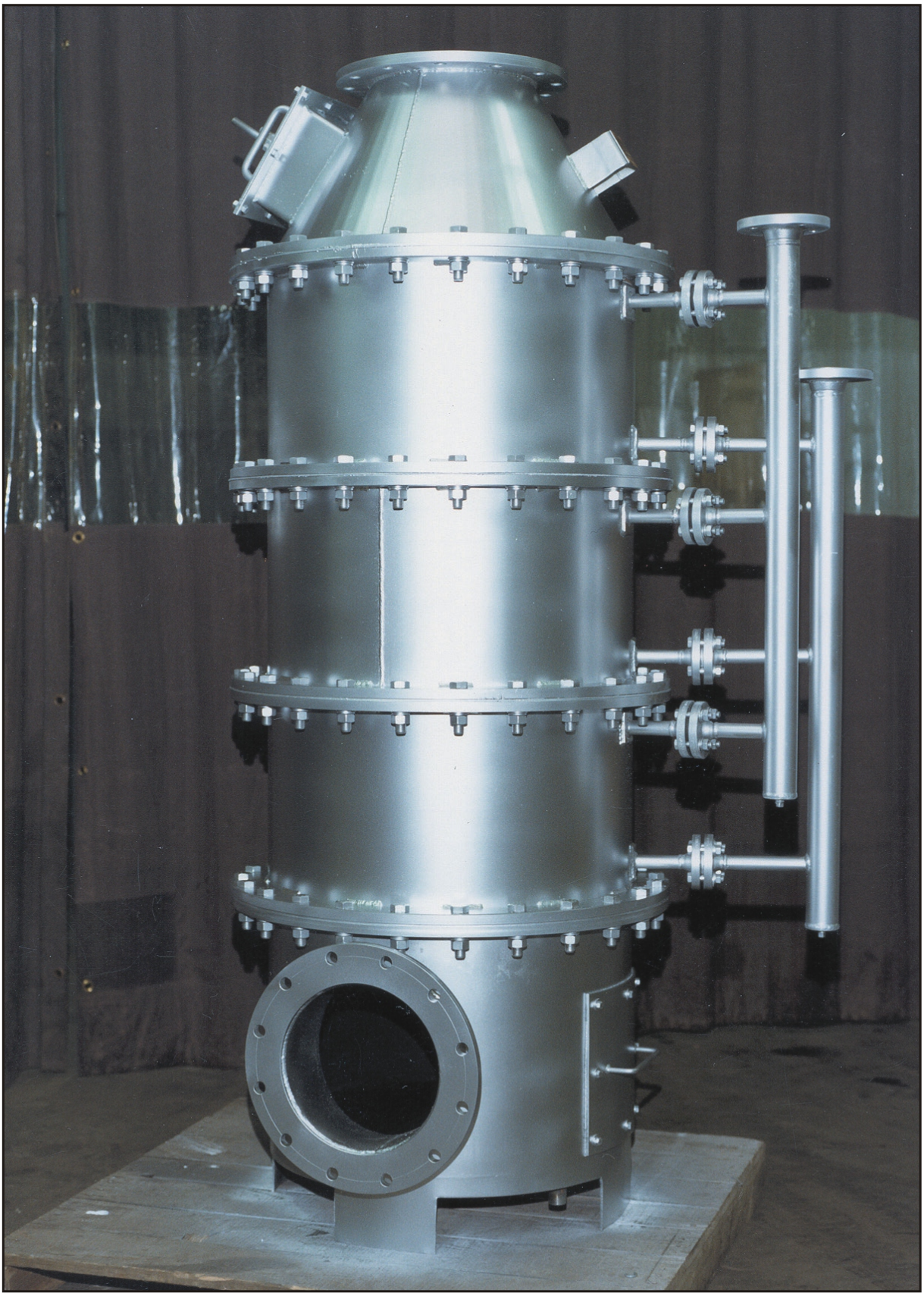

HOT WATER EXHAUST GAS BOILER

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SUMMARY OF APPLICATIONS FOR CLAYTON EXHAUST GAS BOILERS

HEAT SOURCE	TYPE	OUTPUT (electric kW)	EXHAUST GAS QUANTITY APPROX. kg/hr..	EXHAUST GAS TEMP °C	CLAYTON EXHAUST GAS BOILER TYPE	CLAYTON FLOW SYSTEM
Diesel Engine	Medium speed diesel oil + heavy oil	2 to 15 MW	10 000 up to 110 000*	300 - 400	Standard sections	Lamont + R
	Slow speed HFO	Up to 10MW	Up to 110 000*	250	Standard sections	Lamont
	Medium speed	Below 2 MW	Up to 10 000			
	Diesel oil			Up to 350	Standard sections	E***
	Gas			Up to 550	ECO**** sections	E***
Gas fired engine	Natural gas or biogas	Below 2MW	Up to 10 000	Up to 550	ECO**** sections	E***
		Up to 10 MW	Up to 110 000	Up to 550	Standard sections	Lamont + R
Gas turbine	Narural gas	Up to 2 MW**	Up to 45 000	540	Standard sections	Lamont
Industrial ovens and other heat sources			Up to 15 000 at 1000°C	Up to1200	Heating coil fired models	E or R

* exhaust gas quantity may be reduced if maximum heat recovery is requested.

** on gas turbines with output higher than 2 MW, twin exhaust gas boilers can be applied.

*** R - system in case of multiple units

**** ECO-sections: see dimensions in the technical documentation.

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APPLICATIONS WITH HIGH EXHAUST GAS TEMPERATURE

High exhaust gas temperatures occur when an exhaust gas boiler is applied on furnaces and industrial processes where the gasses going into the boiler are above 450°C.

Generally, the concept of standard coil sections can be applied for exhaust gas temperatures up till 450°C. With use of special material for the shells of the boiler, higher gas inlet temperatures can be handled with the concept of standard sections but limited to approx. 550°C. For higher temperatures, Clayton Industries uses the concept of the heating coil as used in the fired steam generator product line. The advantage of this construction is that the shell of the boiler is cooled by a "waterwall" coil. This heating coil type boiler can handle a maximum of approx. 15000 Kg/hr of exhaust gas up to 1200°C, depending on the allowable flow resistance on the gas side.

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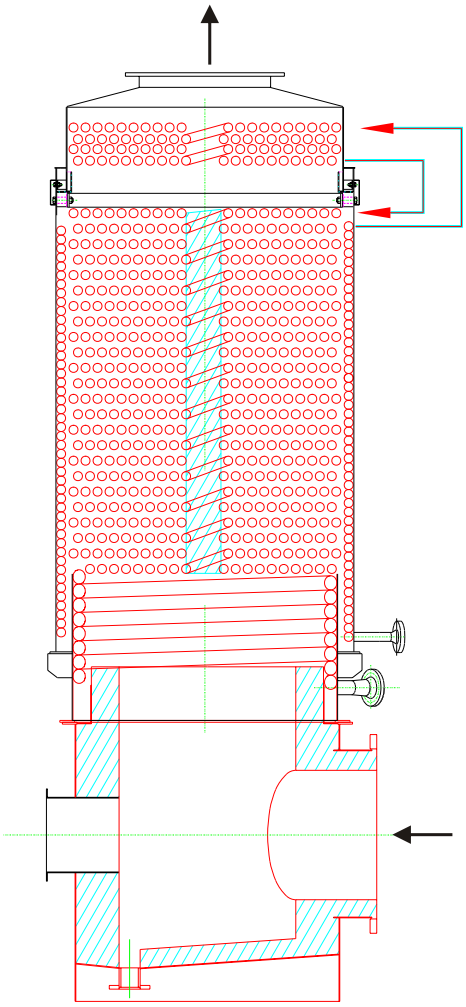

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OUTPUT CONTROL OF THE EXHAUST GAS BOILER

The heat capacity of the exhaust gas boiler is determined by the heat input. The heat input to the exhaust gas boiler is determined by the engine load. At high engine output, heat production is larger then at low engine output. Therefore the steam production of the exhaust gas boiler will vary between certain limits. Either the installation can accept variations in heat output or there are moments where heat demand is smaller then heat production. Both heat production and heat demand have to be in balance. In periods where this is not the case, heat will have to be dissipated or heat input to the boiler should be reduced. Basically, there are two methods in controlling the heat output of an exhaust gas boiler

a) by use of a dumpcooler :

Here, the full quantity of exhaust gas remains flowing through the boiler. At the moments when heat production is larger than the demand, the delivered steam pressure or hot water temperature in the system will increase. Pressure or temperature are measured and a mechanical valve is opened at a certain set-point. The excess steam is condensed in the dumpcooler and recovered as water going back to the feedwater tank. In this way, the excess steam is transformed in good boiler water again, thus limiting the make-up water treatment. By using this method, the regulating system is simple and very reliable. Also, full flow of exhaust gas is maintained inside the boiler, thus minimising risk of soot accumulation.
The dumpcooler is a heat exchanger, cooled by :

a) shipboard installation: sea water
   -power barges: sea water
   -power plants: water from engine cooling system.

b) air : in power plants. In this case the air cooler for the engine cooling will be enlarged with a section acting as condenser for the excess heat or a separate air blown cooler is installed for cooling the excess steam from the exhaust gas boiler(s)

b) by use of a gas-side bypass system :

Here, the exhaust gasses are by-passed over the boiler and in this way the heat input is adapted to the heat demand. This method is often more expensive and more sensitive to service and maintenance.

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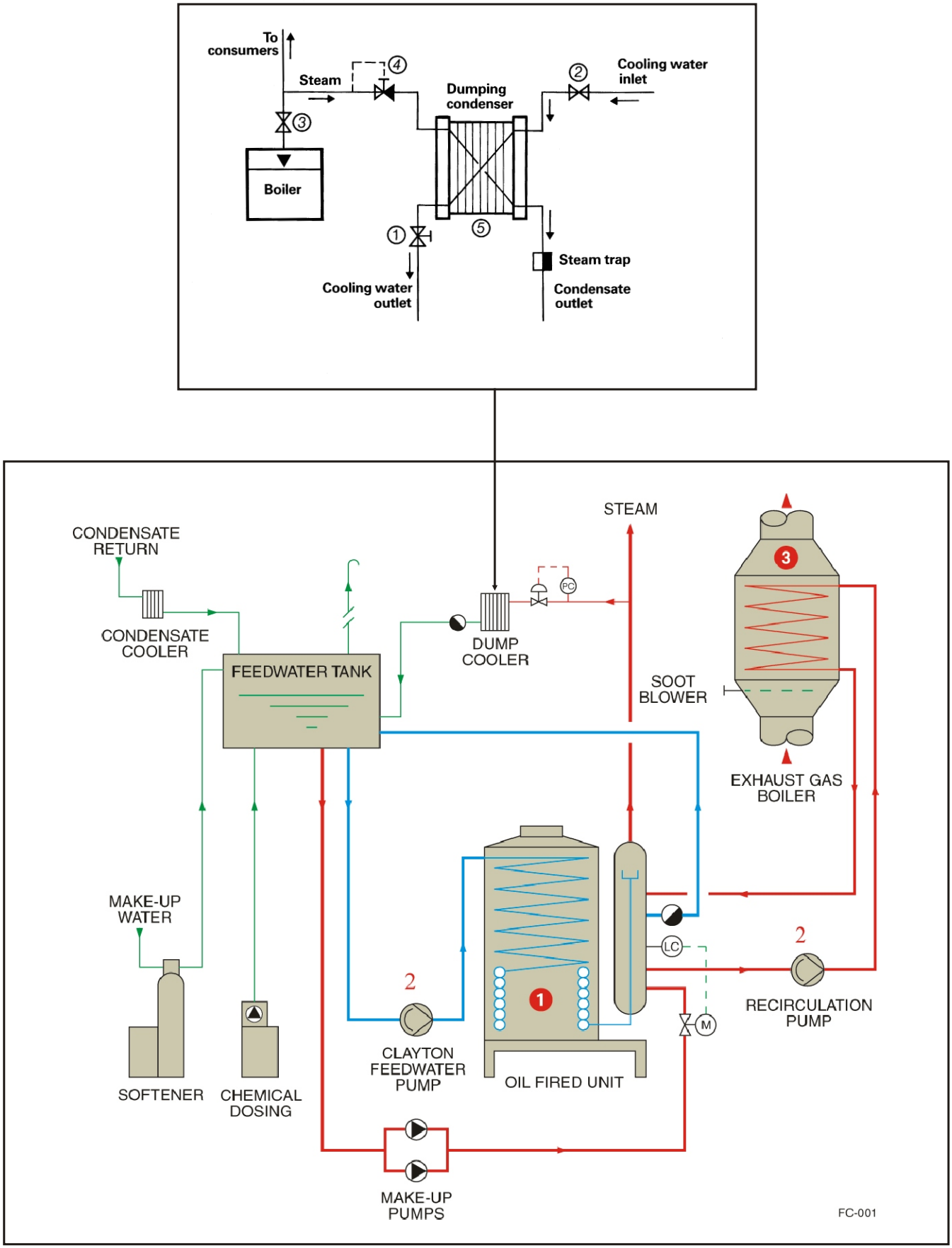

COMBINED SYSTEM FIRED STEAM GENERATOR AND EXHAUST GAS BOILER

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DETERMINATION OF MODEL AND SIZE OF EXHAUST GAS BOILER.

Depending on the amount of flue gasses, the gas temperature and the maximum allowable gas side pressure drop, a certain model of boiler will be chosen. The free space between the tubes depends on the model of boiler. The gas side pressure drop is also determined by the number tube layers and thus by the heating surface. Required heating surface is determined by the required heat output of the boiler. Clayton Industries uses computer programs in order to optimise the sizing of the boilers within the operating parameters as given by the customer.

Following data are requested for proper selection of boiler and auxiliary equipment :

Engine (or turbine): make: .....
type: .....
fuel:
type :
- o diesel oil
- o heavy oil:
  - viscosity: .....
  - composition: .....
- o gas type :
  - o spark ignition
  - o dual fuel

Exhaust gas flow:
quantity in kg/hr.: .....
or
normal m^3/hr.: .....

Exhaust gas temperature (°C): .....

Exhaust gas pressure drop allowed:
mmWC: .....
or
Pa (1Pa = 0.1 mmWC): .....

In case steam is generated :
required output of boiler (kW): .....
or required steam output (kg/hr.): .....
starting from a feedwater temperature (°C): .....
(90 °C if not known)
steam pressure in:
bar gauge: .....
or bar absolute: .....

In case hot water is generated :
required output of boiler (kW): .....
water inlet temperature (°C): .....
water outlet temperature (°C): .....

Special requirements :

When above data are available, a budget proposition for the basic heat recovery equipment can be prepared.

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PARTIAL REFERENCE LIST FOR CLAYTON EXHAUST GAS BOILERS.
HEAT RECOVERY BOILERS ON LAND INSTALLATIONS AND COGENERATION PLANTS.
A selection of customers using Clayton heat recovery boilers world-wide :

ABB

ALSTHOM

BAYER

BEKAERT

HOECHST

DEUTZ-MWM

MAN

CATERPILLAR MAK

CAT ASIA

WARTSILA NSD

ROLLS ROYCE

NIIGATA DIESEL

C.K.D. DIESEL

SONMEZ TEXTILE

BORUSAN TURKEY

POWER BARGES

NEDALO

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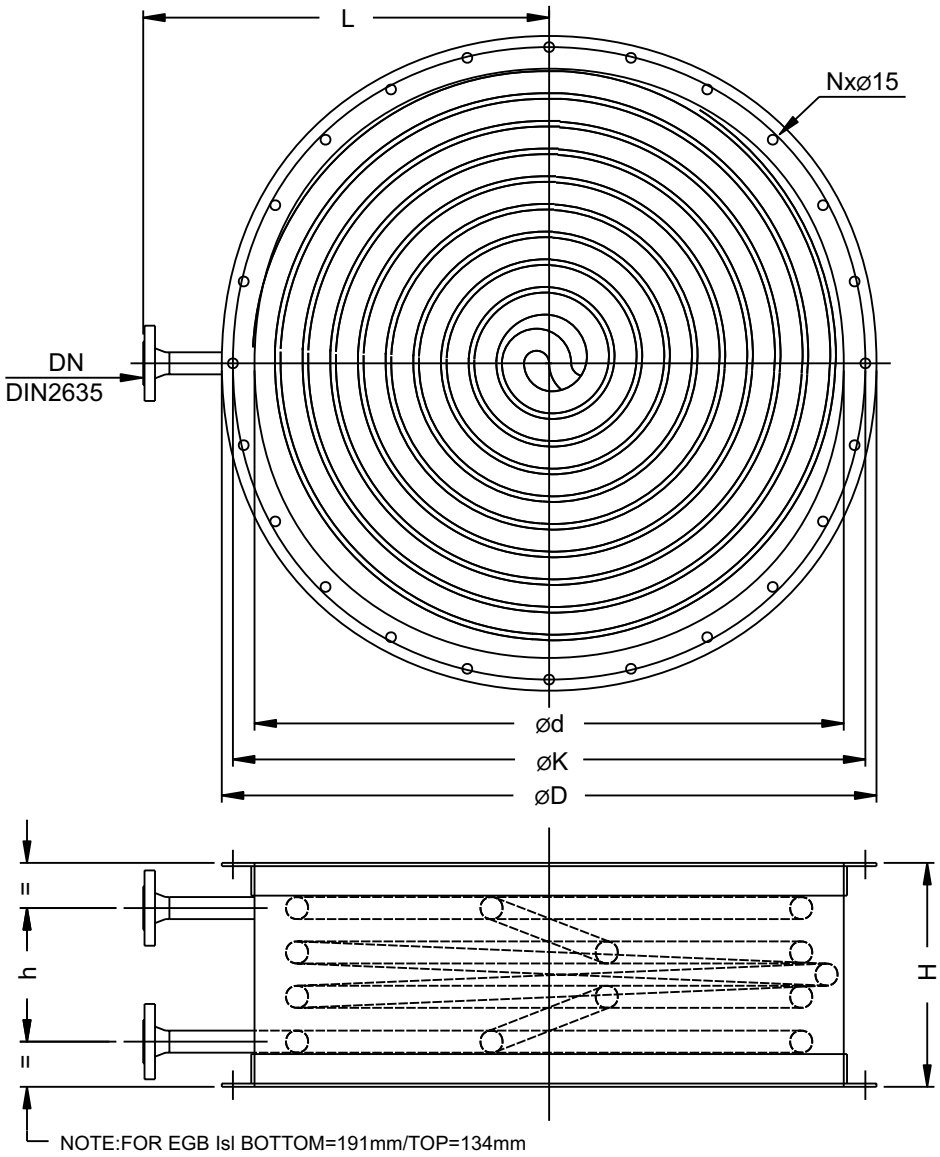

NOTE:FOR EGB Isl BOTTOM=191mm/TOP=134mm

EGB		TYPE EXHAUST GAS BOILER SECTION														
		S	A	D	F	C	G	H	J	K	P	Q	R	I	Is	Isl
DIMENSIONS	D	1000	1350	1350	1350	1830	1830	1830	2087	2087	2087	2087	2250	2640	2640	2930
	K	966	1316	1316	1316	1796	1796	1796	2053	2053	2053	2053	2190	2580	2580	2870
	d	900	1250	1250	1250	1730	1730	1730	1987	1987	1987	1987	2100	2490	2490	2800
	H	342	342	342	342	575	450	342	575	660	342	450	745	660	745	800
	h	204	204	204	204	427	285	204	427	475	204	285	475	475	475	475
	L	620	825	825	798	1060	1035	1060	1190	1190	1190	1190	1250	1420	1420	1625
	DN	25	25	25	32	32	50	32	32	50	32	50	50	50	50	50
	N	24	32	32	32	36	36	36	48	48	48	48	48	48	48	60
WEIGHT kg	EMPTY	110	140	220	250	535	495	580	920	890	850	855	1760	2000	2145	2850
	FILLED	127	180	276	330	690	705	746	1132	1240	1060	1135	2405	2570	2935	3893
HEAT SURF. m^2		4.7	6.5	10	10	20.5	17.5	20.5	28	29.5	27.7	23.5	54.8	48	67	85.1

Nr.	REVISION	BY	DATE	CHQ
A	REM.TYP PI/ADD TYP Isl	HP	22-08-96	

CLAYTON OF BELGIUM N.V.

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name: *PLAN DIMENSIONS EXHAUST GAS BOILERS SECTIONS*		
date: *29-08-95*	by: *HP*	approved:
project:		nr: *HE-9023*

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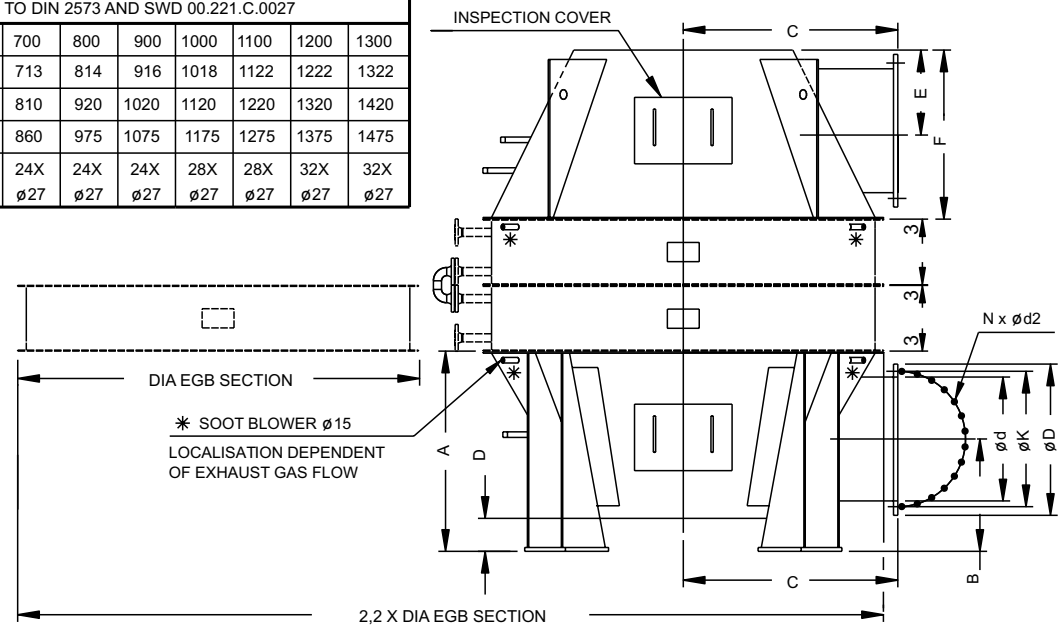
FLANGE DIMENSIONS ACCORDING TO DIN 2573 AND SWD 00.221.C.0027										
DN	450	500	600	700	800	900	1000	1100	1200	1300
ød	457	509	611	713	814	916	1018	1122	1222	1322
øK	550	600	705	810	920	1020	1120	1220	1320	1420
øD	595	645	755	860	975	1075	1175	1275	1375	1475
NX ød2	16X ø22	20X ø23	20X ø27	24X ø27	24X ø27	24X ø27	28X ø27	28X ø27	32X ø27	32X ø27

DWG FOR REFERENCE ONLY



TYPE EGB	DIA EGB	EXHAUST GAS STACK CONNECTIONS DN										DIMENSIONS CONES						WEIGHT kg 2 CONES
		450	500	600	700	800	900	1000	1100	1200	1300	A	B	C	D	E	F	
A D F	1350		(B)									1000	600	800	200	400	800	550
C G H	1830	(X)		(B)	(X)							1300	780	980	200	580	1100	900
J K P Q	2087				(B)	(B)						1500	880	1200	300	580	1200	1200
							(B)	(B)				1500	880	1200	300	580	1200	1300
												1600	950	1200	300	650	1300	1300
R	2250											1500	880	1350	280	600	1220	1400
												1600	950	1350	280	600	1220	1400
												1700	1000	1350	280	650	1300	1400
I IS	2640								(T)	(X)		1900	1140	1500	380	760	1520	1800
ISL	2930									(X)		1985	1030	2150	465	1398	2085	3000

NOTA:(X)
TOP&BOTTOM CONE AVAILABLE
NOTA:(T)
ONLY TOP CONE AVAILABLE
NOTA:(B)
ONLY BOTTOM CONE AVAILABLE

C	UPDATE	HP	05-06-98	
NR.	REVISION	BY	DATE	CHQ

CLAYTON OF BELGIUM N.V.

name: *(FLANGE CONNECTION DIN 2573 AND SWD 00.221.C.0027)*
EXHAUST GAS BOILERS WITH SIDE FLANGE CONNECTION

date:	by:	approved:
18-05-95	*HP*	
project:		nr: *HE-9019*

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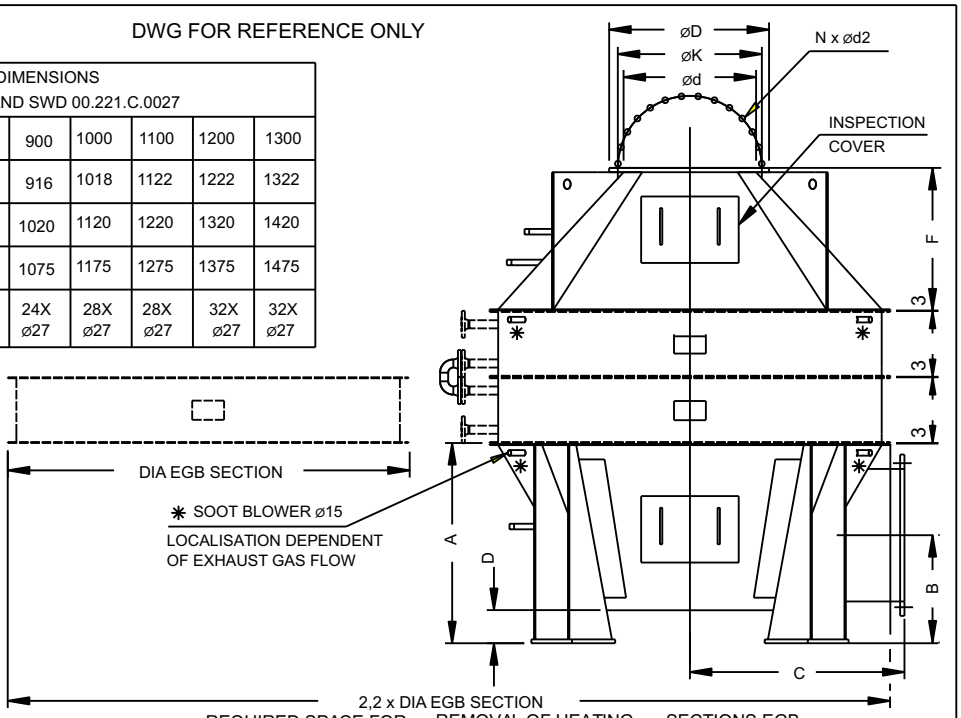
DWG FOR REFERENCE ONLY

FLANGE DIMENSIONS ACCORDING TO DIN 2573 AND SWD 00.221.C.0027										
DN	450	500	600	700	800	900	1000	1100	1200	1300
ød	457	509	611	713	814	916	1018	1122	1222	1322
øk	550	600	705	810	920	1020	1120	1220	1320	1420
øD	595	645	755	860	975	1075	1175	1275	1375	1475
N X ød2	16x ø22	20X ø23	20X ø27	24X ø27	24X ø27	24X ø27	28X ø27	28X ø27	32X ø27	32X ø27



NOTA:(X)
TOP&BOTTOM CONE AVAILABLE
NOTA:(T)
ONLY TOP CONE AVAILABLE
NOTA:(B)
ONLY BOTTOM CONE AVAILABLE

TYPE EGB	DIA EGB	EXHAUST GAS STACK CONNECTIONS DN										DIMENSIONS CONES					WEIGHT kg 2 CONES
		450	500	600	700	800	900	1000	1100	1200	1300	A	B	C	D	F	
A D F	1350		(X)									1000	600	800	200	665	550
				(T)								1000	600	800	200	575	550
C G H	1830	(B)										1300	780	980	200	1120	900
				(X)								1300	780	980	200	1000	900
					(X)							1300	780	980	200	925	900
						(T)						1300	780	980	200	825	900
							(T)					1300	780	980	200	725	900
J K P Q	2087				(X)							1500	880	1200	300	1140	1200
						(X)						1500	880	1200	300	1042	1200
							(X)					1500	880	1200	300	970	1200
								(B)				1500	880	1200	300	855	1200
												1750	1020	1200	330	765	1300
										(X)		1900	1150	1200	390	685	1300
											(T)	1900	1150	1200	390	600	1300
R	2250											1500	880	1350	280	1100	1400
												1600	950	1350	280	935	1400
												1700	1000	1350	280	865	1400
I IS	2640											1750	1000	1500	280	1290	1800
												1750	1000	1500	280	1200	1800
												1750	1000	1500	280	1120	1800
ISL	2930									(B)		1985	1030	2150	465	2155	3000

NR.	REVISION	BY	DATE	CHQ
B	UPDATED	HP	05-06-98	

CLAYTON OF BELGIUM N.V.

name: *(FLANGE CONNECTION DIN 2573 AND SWD 00.221.C.0027)*
EXHAUST GAS BOILERS WITH SIDE & TOP FLANGE CONNECTION

date:	by:	approved:
24-08-95	*HP*	
project:		nr: *HE-9021*

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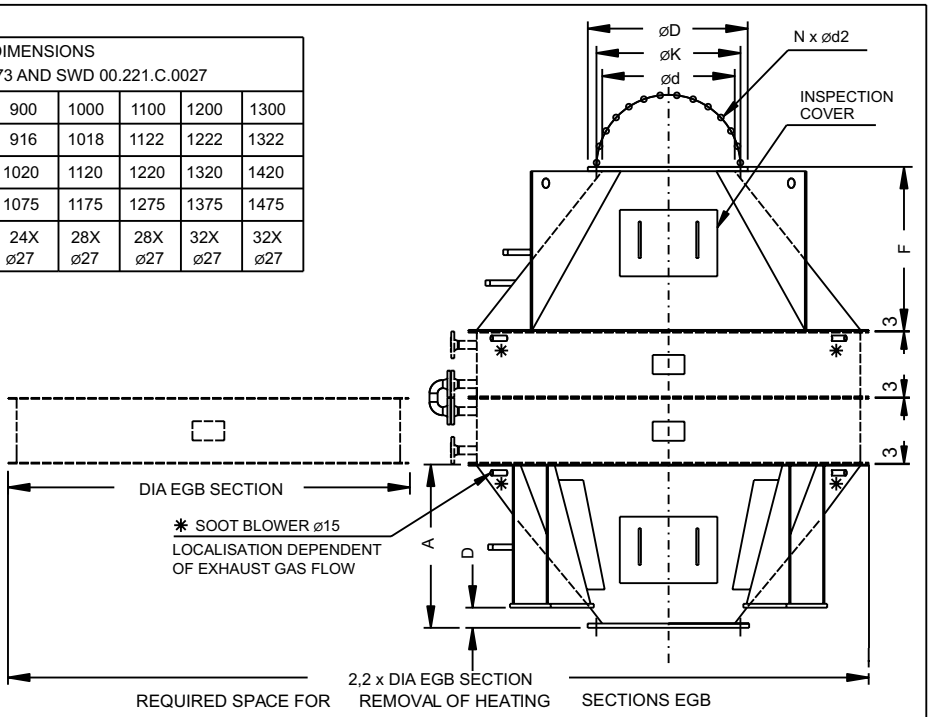
FLANGE DIMENSIONS ACCORDING TO DIN 2573 AND SWD 00.221.C.0027										
DN	450	500	600	700	800	900	1000	1100	1200	1300
ød	457	509	611	713	814	916	1018	1122	1222	1322
øK	550	600	705	810	920	1020	1120	1220	1320	1420
øD	595	645	755	860	975	1075	1175	1275	1375	1475
N X ød2	16X ø22	20X ø23	20X ø27	24X ø27	24X ø27	24X ø27	28X ø27	28X ø27	32X ø27	32X ø27



NOTA:(X)
TOP&BOTTOM CONE AVIILABLE
NOTA:(T)
ONLY TOP CONE AVAILABLE
NOTA:(B)
ONLY BOTTOM CONE AVAILABLE

TYPE EGB	DIA EGB	EXHAUST GAS STACK CONNECTIONS DN										DIM. CONES			WEIGHT kg 2 CONES
		450	500	600	700	800	900	1000	1100	1200	1300	A	D	F	
A D F	1350		(T)									665	285	665	550
				(X)								575	196	575	550
C G H	1830											1125	-	1125	900
				(T)								1000	500	1000	900
					(X)							924	424	924	900
						(X)						825	314	825	900
							(T)					725	-	725	900
J K P Q	2087				(T)							1142	-	1140	1200
						(T)						1042	-	1042	1200
							(T)					970	448	970	1200
												855	-	855	1200
												765	265	765	1300
										(T)		685	-	685	1300
											(X)	600	100	600	1300
R	2250											1100	-	1100	1400
												935	-	935	1400
												865	-	865	1400
I IS	2640											1290	-	1290	1800
												1200	-	1200	1800
												1120	-	1120	1800
ISL	2930											2155	-	2155	3000

NR.	REVISION	BY	DATE	CHQ
B	UPDATED	HP	05-06-98	

CLAYTON OF BELGIUM N.V.

name: *(FLANGE CONNECTION DIN 2573 AND SWD 00.221.C.0027)*
EXHAUST GAS BOILERS WITH BOTTOM & TOP FLANGE CONNECTION

date:	by:	approved:
29-08-95	*HP*	
project:		nr: *HE-9022*

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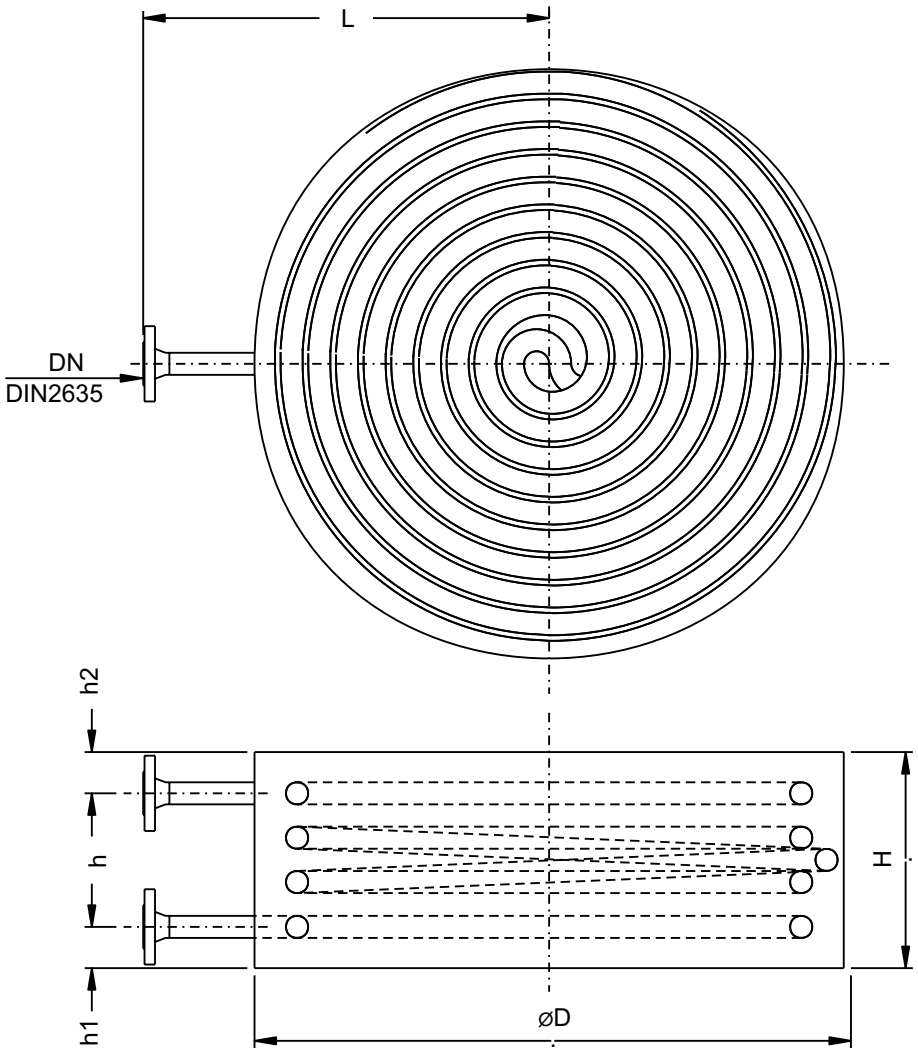

ECO		TYPE ECO SECTION											
		33		60		100		201		304		504	
Nr. PC'S		6	12	6	12	6	12	6	12	6	12	6	12
DIMENSIONS	D	565	565	695	695	900	900	1005	1005	1250	1250	1504	1504
	DN	1/2"	1/2"	DN20	DN20	DN20	DN20	DN25	DN25	DN32	DN32	DN40	DN40
	H	360	564	375	750	437	667	444	720	570	880	620	1000
	h	170	374	250	627	192	442	230	506	377	583	319	699
	h1	65	65	100	100	123	123	87	87	152	166	188	188
	h2	125	125	26	26	123	123	127	127	41	131	113	113
	L	315	315	480	480	640	640	700	700	800	800	960	960
CONTENT L		11	23	26	52	45	90	71	142	152	278	266	532
HEAT SURF. M²		3.2	6.4	5	10	9.2	18.4	12	23.6	19	36.4	27.1	54.2
WEIGHT kg	EMPTY	68	130	160	320	200	360	290	560	500	1050	670	1300
	FILLED	79	153	186	372	245	450	361	702	652	1328	936	1832

A	ORIGINAL DWG	HP	02-06-98	
Nr.	REVISION	BY	DATE	CHQ

CLAYTON OF BELGIUM N.V.

name: *PLAN DIMENSIONS ECO SECTIONS*

date:	by:	approved:
02-06-98	*HP*	
project:		nr: *HE-9079*

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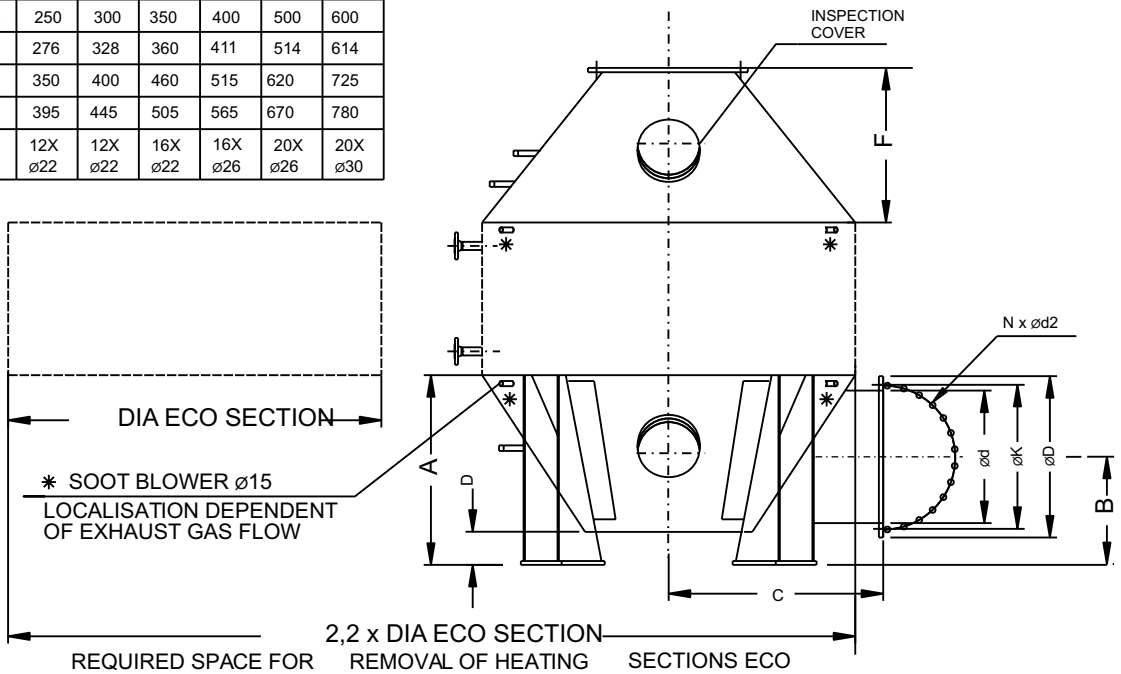
FLANGE DIMENSIONS TO DIN2576 PN10							
DN	200	250	300	350	400	500	600
ød	222	276	328	360	411	514	614
øK	295	350	400	460	515	620	725
øD	340	395	445	505	565	670	780
N X ød2	8X ø22	12X ø22	12X ø22	16X ø22	16X ø26	20X ø26	20X ø30



TYPE ECO	DIA ECO	EXHAUST GAS STACK CONNECTIONS DN							DIM. CONES					WEIGHT kg 2 CONES
		200	250	300	350	400	500	600	A	B	C	D	F	
33	565		(X)						550	360	425	150	265	95
				(X)					570	360	425	150	225	100
60	695													
100	900													
				(X)					790	500	600	270	525	285
201	1005		(X)						797	536	675	315	476	280
					(X)				748	450	675	147	590	370
						(X)			800	527	622	225	435	380
304	1250													
					(X)				750	480	850	220	540	400
						(X)			650	380	800	120	540	380
504	1504													

A	ORIGINAL DWG	HP	02-06-98	
NR.	REVISION	BY	DATE	CHQ

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CLAYTON OF BELGIUM N.V.

name: *ECO SECTIONS WITH SIDE & TOP FLANGE CONNECTION*

date:	by:	approved:
02-06-98	*HP*	
project:		nr: *HE-9081*

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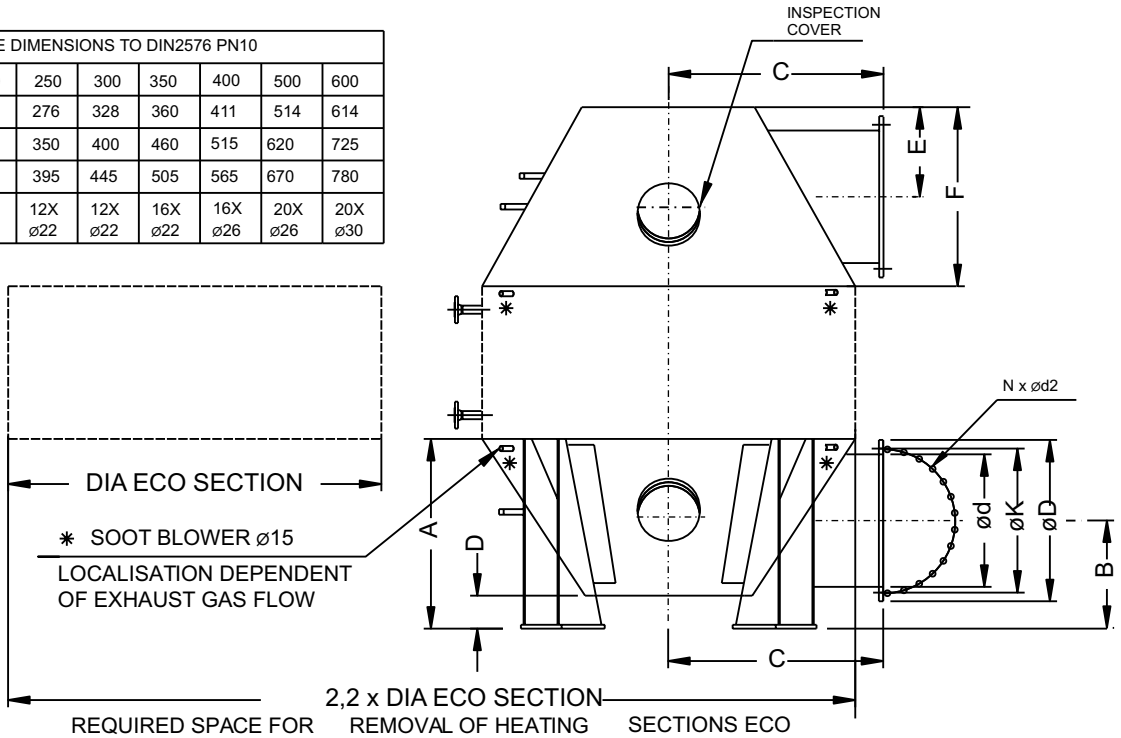
FLANGE DIMENSIONS TO DIN2576 PN10							
DN	200	250	300	350	400	500	600
ød	222	276	328	360	411	514	614
øK	295	350	400	460	515	620	725
øD	340	395	445	505	565	670	780
N X ød2	8X ø22	12X ø22	12X ø22	16X ø22	16X ø26	20X ø26	20X ø30



TYPE ECO	DIA ECO	EXHAUST GAS STACK CONNECTIONS DN							DIM. CONES						WEIGHT kg 2 CONES
		200	250	300	350	400	500	600	A	B	C	D	E	F	
33	565														
60	695														
100	900														
201	1005		(X)						920	675	625	465	210	455	330
					(X)				800	520	675	245	280	555	360
304	1250														
					(X)				1150	840	850	530	310	620	500
						(X)			1060	735	850	420	315	640	550
							(X)		1150	840	850	530	310	620	550
504	1504														
								(X)	750	375	950	-350	375	750	720

NR.	REVISION	BY	DATE	CHQ
A	ORIGINAL DWG	HP	02-06-98	

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CLAYTON OF BELGIUM N.V.

name: *ECO SECTIONS WITH SIDE FLANGE CONNECTION*

date:	by:	approved:
02-06-98	*HP*	

project: | nr: *HE-9082*

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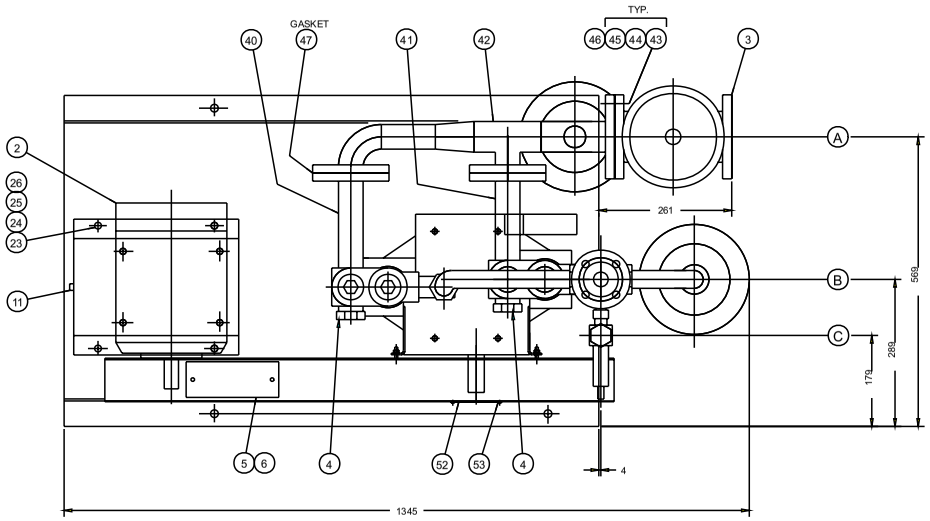
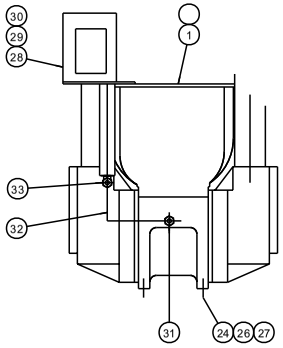
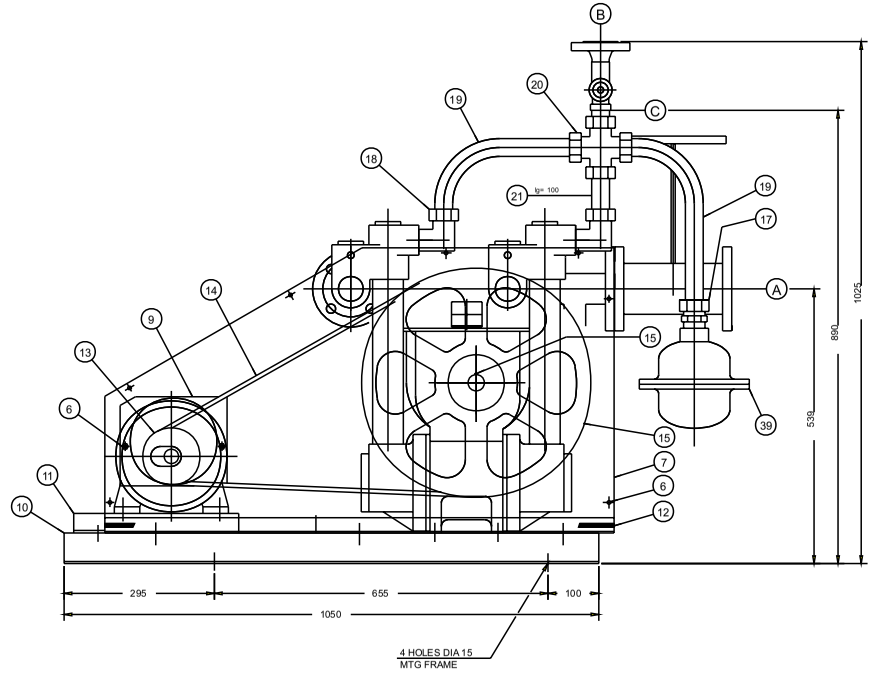


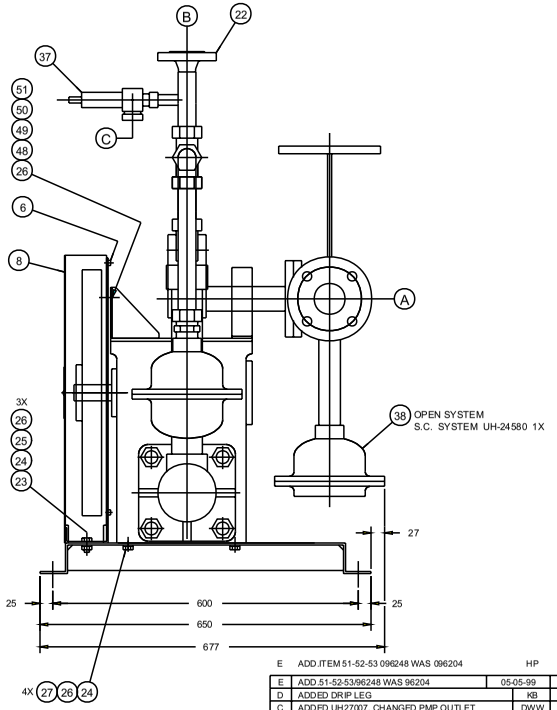


DETAIL FRONT PUMP

A	WATERPUMP INLET DN50 DIN2576
B	WATERPUMP OUTLET DN25 DIN2635
C	RELIEF VALVE OUTLET 1/2" NPT

PUMP TYPE	J-2-150		
FREQUENCY	50	60	Hz
MAX INLET TEMPERATUUR	130		C
MAX INLET PRESSURE	2		bar
MAX OUTLET PRESSURE	35		bar
MIN REQUIRED NPSH	4,5		m WC
NOM. PUMP RPM	360	432	rpm
NOM. PUMP CAPACITY	2485	2982	l/h





ITEM	DESCRIPTION OF PART	STOCK NO.	REQ'D.
53	SCREW SHEET METAL #8 X 3/8"	002679	2
52	PLATE PATCH	UH-11244	1
51	WASHER FLAT 1/4"	008282	2
50	WASHER LOCK 6	096819	2
49	NUT HEX. M6 8	096624	2
48	SCREW M6x30 8.8	096248	2
47	GASKET DN40	110672	2
46	GASKET DN50	110673	1
45	WASH LOCK M16	096829	12
44	NUT M16	096646	12
43	SCREW M16X65	096156	12
42	FEEDWATER INLET PUMP DN50 DIN2576	136294	1
41	FLANGE & NIPPLE DN40 DIN2576	136293	1
40	FLANGE & NIPPLE DN40 DIN2576	136292	1
39	SNUBBER DISCHARGE	UH-24580	1
38	SNUBBER INTAKE	UH27007	1
37	VALVE ASSY RELIEF 1/2"	UH-22198	1
36	SHELL TELLUS OIL	095423	5,5 L
35	BESCHRIJVING	STUK_NR	AANTAL
34	BESCHRIJVING	STUK_NR	AANTAL
33	TUBE ELBOW SCRW NPT 1/4"X8	099188	1
32	TUBE STL PREC. 8X1	098781	3 D
31	CONN TUBE 1/4"XDIA8	099177	1
30	NP FLOAT SWITCH	097239	1
29	RIVET	095159	4
28	FLOAT SWITCH ASSY	CM5823	1
27	SCREW 3/8"-16X3/4"	096008	4
26	WASH FLAT 3/8"	003139	14
25	SCREW M10X25	096218	7
24	WASH LOCK M10	096801	11
23	NUT M10	096630	7
22	FEEDWATER OUTLET PUMP DN25 ASSY	136291	1
21	TUBE DIA 35	191661	1 D
20	TUBE CROSS C PLNG 35	200863	1
19	TUBE BEND 90 DIA35 PUMP HKP	112526	2
18	ELBOW CONN 1 1/4"XDIA35	193198	2
17	TUBE CONN. SCRW NPT 1 1/4"X35	193233	1
16	KEY 1/4"X1/4"X2"	D-3081	1
15	PULLEY STC:450 SPZX2 D:1 1/4"	200593	1
14	BELT-V DENDED XPZ 2160	192011	2
13	PULLEY STC: 112 SPZX2 D:28	200594	1
12	BAND POLYURETHANE 7X3 LG=1000	095455	10 D
11	MOTOR BASE 184T	031421	1
10	BASE WATERPUMP & MOTOR ASSY	136284	1
9	COVER PLATE MOTOR WATERPUMP	112862	1
8	COVER PULLEY & BELT ASSY	136286	1
7	BASE PULLEY & BELT ASSY	136285	1
6	SCREW SM 1/4"X1/2"	010720	11
5	COVER PLATE	111966	1
4	PLUG 1 1/2"	193075	2
3	VALVE DN50 PN16	194044	1
2	MOTOR 4KW 4P	190347	1
1	PUMP ASSY WATER J2 NO BYPASS	UH-28719	1

LTR	REVISION	BY	DATE
E	ADD ITEM 51-52-53 096248 WAS 096204	HP	04-05-99
E	ADD.51-52-53/96248 WAS 96204	05-05-99	HP
D	ADDED DRIP LEG	KB	23-05-95
C	ADDED UH27007, CHANGED PMP OUTLET	DWW	13-12-93
B	REMOVED UH-27007 SNUBBER INTAKE	DWW	18-08-93
A	ITEM 39, UH-24580 WAS UH-25466	DWW	29-06-93

TOLERANCES

WI-001
WELD SPECIFICATION

CLAYTON OF BELGIUM N.V.

name: WATERPUMP & MOTOR ASSY

date: 05-01-93 | scale: 1-5 | model: E 154

dr.by: DWW | chk.by:

AUTHORISED USE FOR | CANCELLED SINCE date | number: 160537

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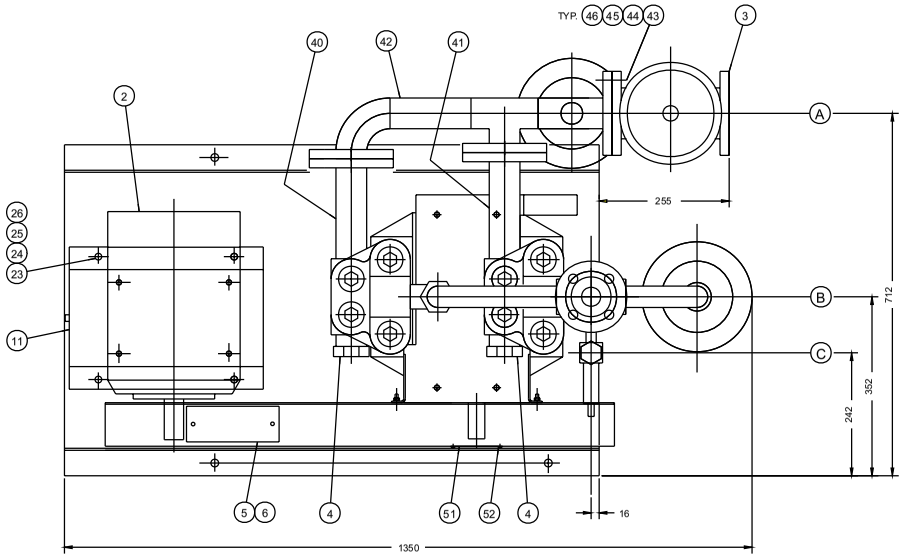
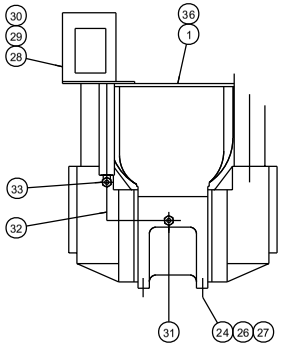
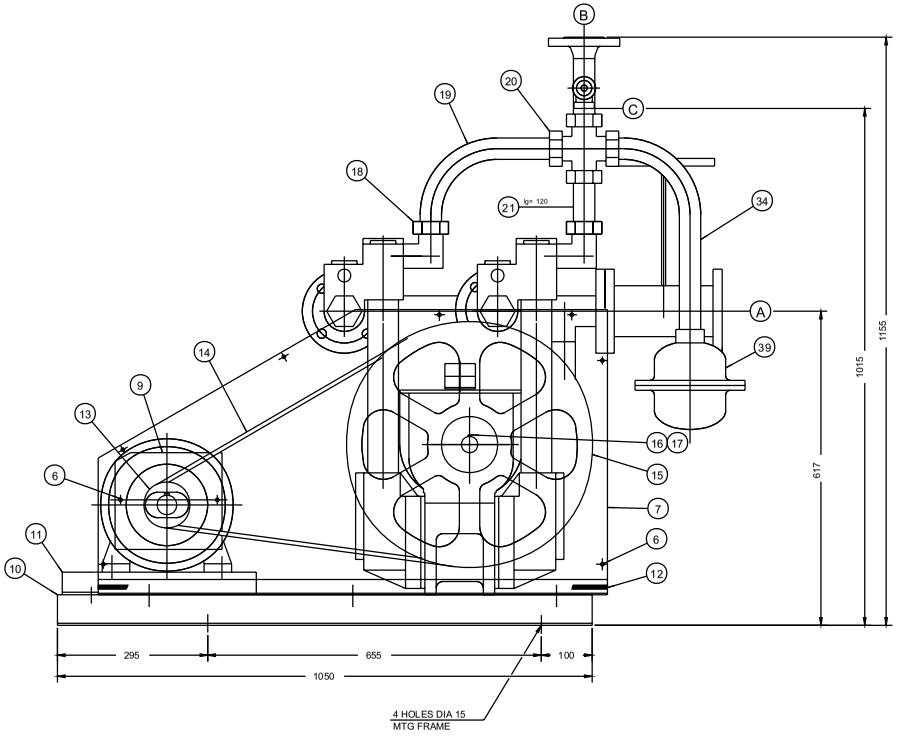


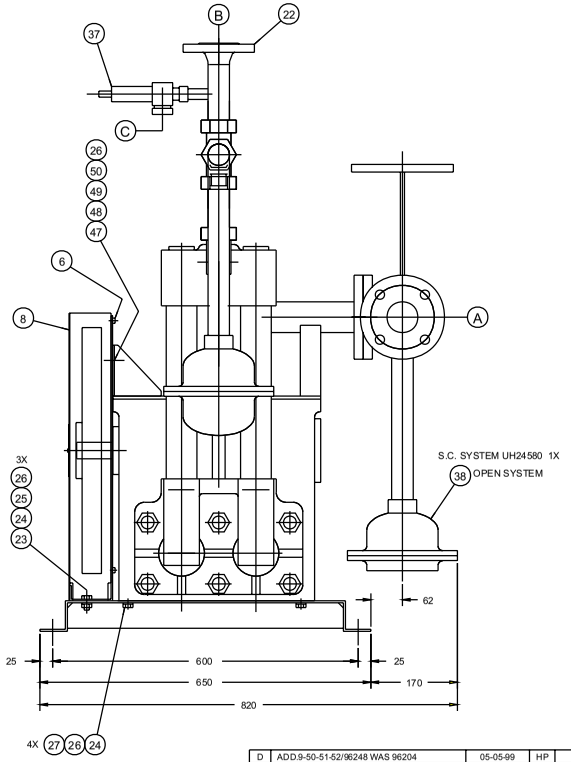


DETAIL FRONT PUMP

A	WATERPUMP INLET DN50 DIN2576
B	WATERPUMP OUTLET DN32 DIN2635
C	RELIEF VALVE OUTLET 1/2" NPT

PUMP TYPE	J-4-500		
FREQUENCY	50	60	Hz
MAX INLET TEMPERATUUR	130		C
MAX INLET PRESSURE	2		bar
MAX OUTLET PRESSURE	38		bar
MIN REQUIRED NPSH	4.5		m WC
NOM. PUMP RPM	241	290	rpm
NOM. PUMP CAPACITY	3401	4081	l/h





52	SCREW SHEET METAL #8 X 3/8"	002679	2
51	PATE PATCH	UH-11244	1
50	WASHER FLAT 1/4"	006282	2
49	WASHER LOCK 6	096819	2
48	NUT HEX. M6 8	096624	2
47	SCREW M6x30 8.8	096248	2
46	GASKET DN50	110673	3
45	WASH LOCK M16	096829	12
44	NUT M16	096646	12
43	SCREW M16X65	096156	12
42	FEEDWATER INLET PUMP DN50 DIN2576	136290	1
41	FLANGE & NIPPLE DN50 DIN2576	136289	1
40	FLANGE & NIPPLE DN50 DIN2576	136288	1
39	SNUBBER DISCHARGE	UH-25468	1
38	SNUBBER INTAKE	UH27007	1
37	VALVE ASSY RELIEF 1/2"	UH-22198	1
36	SHELL TELLUS OIL	095423	7,5 L
35	BESCHRIJVING	STUK_NR	AANTAL
34	TUBE DIA 42 DRIP LEG	112644	1
33	TUBE ELBOW SCRW NPT 1/4"X8	099188	1
32	TUBE STL PREC 8x1	098781	3 D
31	CONN TUBE 1/4"XDIA8	099177	1
30	NP FLOAT SWITCH	097239	1
29	RIVET	095159	4
28	FLOAT SWITCH ASSY	CM5823	1
27	SCREW 3/8"-16X3/4"	096008	4
26	WASH FLAT 3/8"	003139	15
25	SCREW M10X25	096218	7
24	WASH LOCK M10	096801	11
23	NUT M10	096630	7
22	FEEDWATER OUTLET PUMP DN32 ASSY	136287	1
21	TUBE DIA42	191639	2 D
20	TUBE CROSS CPLNG 42	200864	1
19	TUBE BEND 90 DIA 42 PUMP HKP	112541	1
18	ELBOW CONN 1-1/2"XDIA42	193197	2
17	BUSHING TYPE: VT3020	026331	1
16	KEY 1/4"X1/4"X2"	D-3081	1
15	PULLEY 19" OD	026325	1
14	BELT-V DENDED XPZ 2160	192011	3
13	PULLEY STC:80 SPZ X3 D:38	200686	1
12	BAND POLYURETHANE 7X3 LG=1000	095455	10 D
11	BASE MOTOR 213T	030285	1
10	BASE WATERPUMP & MOTOR ASSY	136284	1
9	COVER PLATE MOTOR WATERPUMP	112878	1
8	COVER PULLEY & BELT ASSY	136286	1
7	BASE PULLEY & BELT ASSY	136285	1
6	SCREW SM 1/4"X1/2"	010720	11
5	COVER PLATE	111998	1
4	PLUG 2"	193076	2
3	VALVE DN50 PN16	194044	1
2	MOTOR 5.5KW 4P	200685	1
1	PUMP ASSY WATER J4 NO BYPASS	UH-27939	1
ITEM	DESCRIPTION OF PART	STOCK NO.	REQ'D.

LTR	REVISION	BY	DATE
D	ADD 9-50-51-52/96248 WAS 96204	HP	05-05-99
C	ADDED DRIP LEG	KB	23-05-95
B	136342 WAS 150268	DWW	23-02-95
A	ADDED UH27007, CHANGED PMP OUTLET	DWW	13-12-93

TOLERANCES | WI-001 WELD SPECIFICATION

CLAYTON OF BELGIUM N.V.

name: WATERPUMP & MOTOR 220/380/440

date: 19-08-93 | scale: 1-5 | model: E 204

dr.by: DWW | chk.by:

AUTHORISED USE FOR | CANCELLED SINCE date | number: 160538

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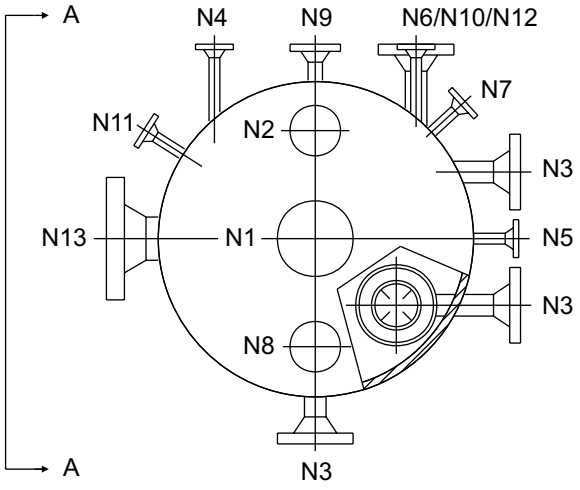
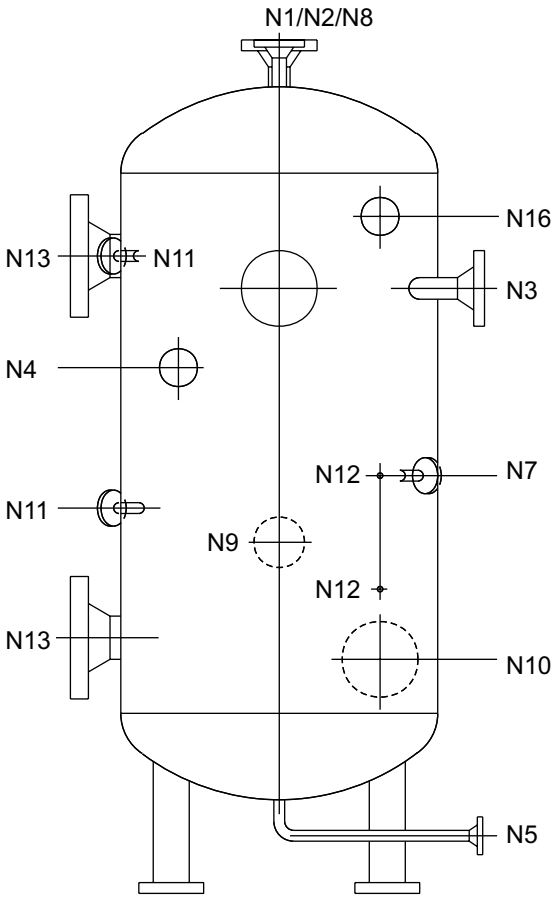
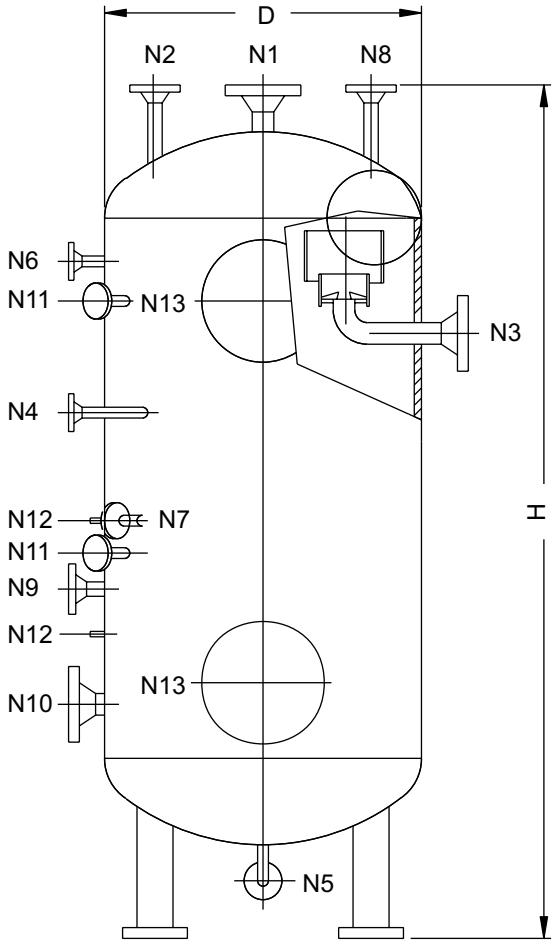


STEAM DRUMS			
DRUM	ϕ D	H	VOLUME
1	500	2450	400
2	650	2450	600
3	900	2800	1300
4	1100	2800	2000
5	1100	3300	2500
6	1100	3300	2500
7	1100	3800	3000





VIEW A-A

N1 STEAM OUTLET
N2 SAFETY VALVE OUTLET
N3 STEAM INLET
N4 STEAMTRAP OUTLET
N5 DRAIN
N6 PRESSURE SWITCH & GAUGE
N7 AUTOMATIC BLOW DOWN
N8 VACUUM BREAKER
N9 FEEDWATER INLET
N10 RECIRCULATION
N11 LEVEL IND./REG./ALARM
N12 THERMOSTAT
N13 INSPECTION OPENING

LTR	REVISION	BY	DATE	CHQ
A	HE-7037 WAS HE-7038	HP	14-03-96	

CLAYTON OF BELGIUM N.V.

NAME	DIMENSION STEAM DRUMS		
DATE 06-10-94	SCALE	MODEL	
DR.BY	CHQ.BY	ORDER	NUMBER HE-7037
PROJECT			

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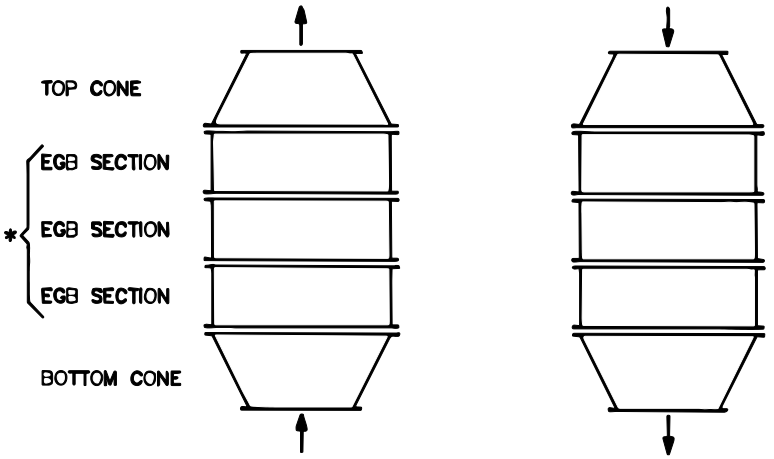
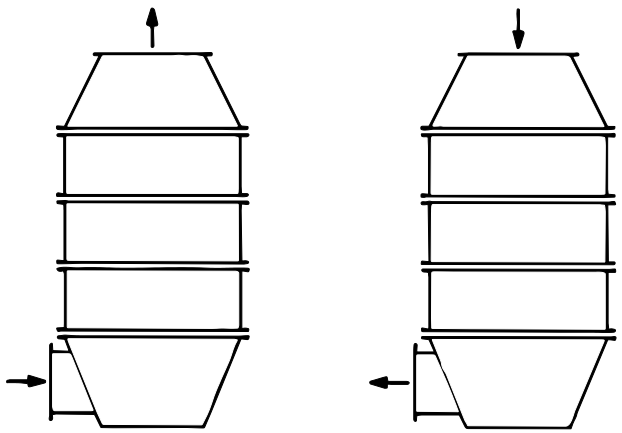
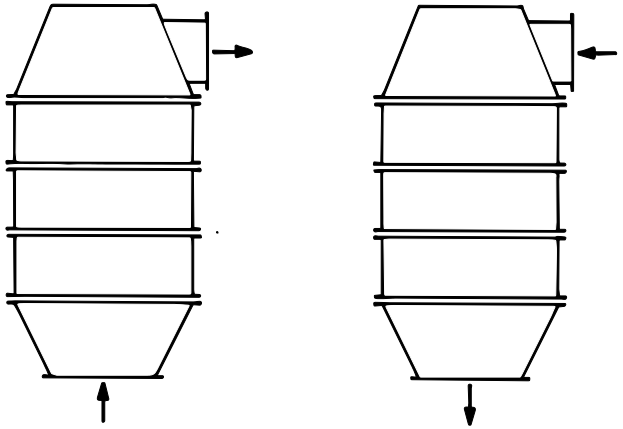
VERTICAL BOTTOM– AND TOP CONE



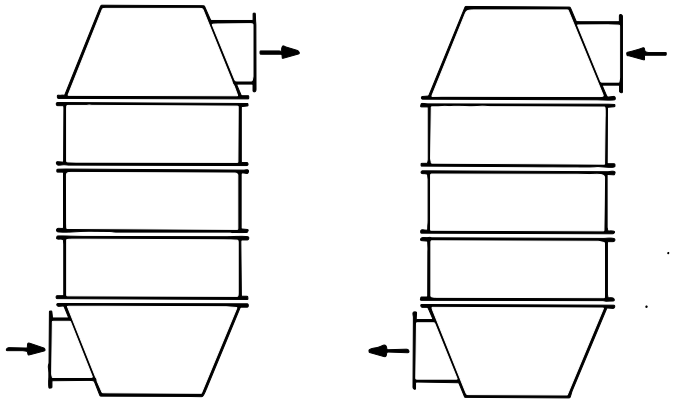
HORIZONTAL BOTTOM– AND VERTICAL TOP CONE



VERTICAL BOTTOM– AND HORIZONTAL TOP CONE



HORIZONTAL BOTTOM– AND TOP CONE



* 3 SECTIONS SHOWN AS EXAMPLE
NUMBERS OF SECTIONS CAN VARY
ACCORDING TO REQUIRED CAPACITY

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CLAYTON OF BELGIUM N.V.

name: POSSIBLE GAS FLOWS EXHAUST GAS BOILERS		
date: 09/09/92	by: GR	approved:
project:		nr: HE–1851

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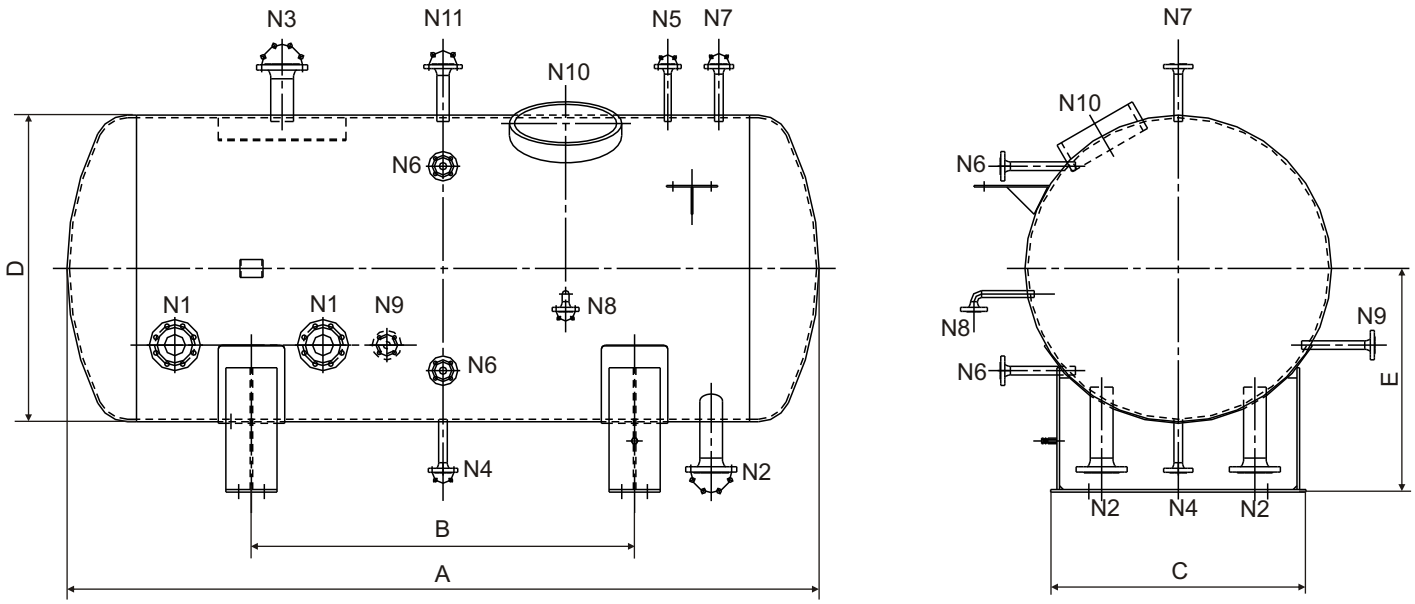

N1	RECIRCULATION INLET
N2	RECIRCULATION OUTLET
N3	STEAM OUTLET
N4	DRAIN
N5	PRESSURE SWITCHES
N6	LEVEL INDICATOR/CONTROLLER
N7	SAFETY VALVE OUTLET
N8	AUTOMATIC BLOWDOWN
N9	FEEDWATER INLET
N10	MANHOLE
N11	VACUUM BREAKER

BOILER OUTPUT			1-600 kW	601-1000 kW	1001-1340 kW	1341-1870 kW	1871-2540 kW	2541-3333 kW	3333-4333 kW	4334-5333 kW
Type			1000 L	1500 L	2000 L	3000 L	4000 L	6000 L	8000 L	10000 L
Dimensions	**A**	(mm)	2,200	2,700	2,860	2,950	3,570	3,520	4,520	4,520
		(in.)	87	106	113	116	141	139	178	178
	B	(mm)	1,500	1,500	1,500	1,500	2,100	1,800	2,400	2,400
		(in.)	59	59	59	59	83	71	94	94
	C	(mm)	700	750	750	1,000	1,000	1,200	1,300	1,300
		(in.)	28	30	30	39	39	47	51	51
	D	(mm)	900	1,000	1,000	1,250	1,750	1,600	1,600	1,800
		(in.)	35	39	39	49	69	63	63	71
	E	(mm)	700	750	750	875	875	1,050	1,050	1,150
		(in.)	28	30	30	34	34	41	41	45
Weight empty		(kg)	450	650	800	1,100	1,500	1,900	2,700	3,300
		(lb)	991	1,432	1,762	2,423	3,304	4,185	5,947	7,269
Weight filled		(kg)	1,450	2,150	2,800	4,100	5,500	7,900	10,700	13,300
		(lb)	3,194	4,736	6,167	9,031	12,115	17,401	23,568	29,295

STEAM DRUM LAMONT SYSTEMS

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