1 INTRODUCTION

In our country we have at our disposal several million tons of firewood and wooden wastes per year.

Generally in Poland we produce about 30 million tons of straw, of which about 20 million tons are used for agricultural purposes, but about 10 million tons could be used for energetic purposes.

It is estimated that with full use of available biomass for energetic purposes in our country we can meet about 8% of full demand for primary energy in the future. Thus it is very serious source of renewable energy, which should be absolutely used.

Now three technologies of straw burning are experienced:

- cyclic burning of complete straw bales - charging boilers
- burning of cut straw - boilers of continuous operation
- so called "cigar burning technology" - continuous operation boilers

Development of thermal energy industry based on straw creates new favorable conditions and possibilities for people living in rural areas. It is known fact that now there is very high unemployment in villages that incomes of farmers are very low and development of that energy industry will create new working places both in organization of collection and supply of straw, in boiler houses and in companies which produce straw boilers and involved equipment as well. Farmers and rural companies will have savings in virtue of replacement of fossil fuels, which were purchased by them, with straw produced by themselves. Till now the straw was burned in swathes. Money paid to producers of fossil fuels in other regions or abroad will remain in their own communes.

2 ECOLOGICAL EFFECT

The most important effect of the use of biomass, including straw, for energetic purposes is reduction of emission of CO_2 to the atmosphere. When burning straw CO_2 is produced of course which comes to the atmosphere but only such amount of CO_2 is produced as was taken over by the plants from the atmosphere in photosynthesis process when the plants were growing.

Thus, it is only return of CO_2 to the atmosphere which was previously taken over from the same. Therefore straw is treated as removable energy source, which does not emit any additional amount of CO_2 to the atmosphere, as it is when burning any fossil fuels, such as coal, oil or gas. This is very important, because CO_2 is the most dangerous greenhouse gas, responsible for the greenhouse effect on earth, causing very dangerous climatic changes on the whole globe, which are more and more serious.

The use of straw as the renewable energy source should be treated as replacement of fossil fuels for energetic needs. The following effects result from that fact.

According to practice, a boiler house with straw boilers of total heat power 1 MW burns out about 800 tons of straw during one heating season. The energetic conversion factor of straw in relative to black coal is 1.5, thus 1.5 kg of straw replaces 1.0 kg of black coal in the energetic process. This means that 800 tons of straw replaces 800 : 1.5 = 533 tons of black coal. Burning out 1 ton of black coal produces 2.05 ton of CO_2, thus burning out 533 tons of black coal will produce 533 tons x 2.05 ton/ton = 1,093 tons of CO_2. Then boiler house with straw boilers of heat power 1 MW causes reduction of CO_2 emission by 1,093 tons per year.

The next ecological effect of the use of straw for energetic purposes is reduction of SO_2 emission. Taking in consideration that content of sulphur in black coal is only 0.8% (black coal of high quality) and in the straw the content of sulphur is maximum 0.1%, reduction of SO_2 emission from the boiler house of 1 MW heat power is as follows:

533 tons x 0.008 - 800 tons x 0.001 = 3.46 tons of SO_2 / year.

Till the end of 2000 EKOPAL RM boilers were installed in different customers for the total heat power of about 9 MW. Taking in consideration the above mentioned calculation way we obtain the annual reduction of CO_2 emission in the amount of 9840 tons and reduction of SO_2 emission in the amount of 31.2 tons. Burning the straw gives also lower emission of CO, NOx and dust comparing with burning brown and black coal.

It should be emphasized also that when using the straw boilers no wastes, such as slags, which are created when burning coal, because the ash of straw is a good mineral fertilizer containing potassium, calcium dna phosphorue. The ash is taken by farmers and spread on fields.

TECHNICAL ANALYSIS OF OF THE ECOLOGICAL EFFECT OBTAINED CONCERNING ENERGETIC CONTAMINATIONS EMITTED TO ATMOSPHERE, BY REPLACEMENT OF COAL BOILER WITH STRAW BOILER, ON THE GROUNDS OF ONE BOILER HOUSE OF METALERG COMPANY, PREPARED BY REGIONAL INSPECTORATE OF ENVIRONMENT PROTECTION IN POZNAŃ

On the grounds of presented materials and calculations the Voivode Inspectorate of Environment Protection in Poznań informs that in virtue of modernization of the heating system, consisting in replacement of RUMIA 350 and ES-KA/S boilers which burned about 200 tons of black coal per year, by EKOPAL RM boiler with heat power 0.5 MW (with settlement chamber), in which 320 tons of straw were burned per year, on the grounds of informational and instruction materials No. 1/96 of Ministry of Environment Protection, Natural Resources and Forestry under the title "Factors of emission of contaminating substances introduced to air from processes of energetic burning fuels" and on the grounds of informational materials of manufacturer of straw boilers - METALERG company as well as on the grounds of articles contained in branch additions of "Przegląd Komunalny" of 2001 the Inspectorate ascertained reduction of the emission of the following types of contaminations in the amounts:

Type of contamination	Emission from coal burning (kg per year)	Emission from straw burning (kg per year)	Ecological effect (kg per year)	% of reduction
Sulfur dioxide	2144	256	1888	88
Nitrogen dioxide	300	205	95	32
Carbon monoxide	9000	1920	7080	79
Total dust	3900	2218	1682	43

The total reduction is in emission of carbon dioxide when burning straw - in this case emission of carbon dioxide is not higher than the amount of carbon dioxide which was taken from the air when growing the corn.

Thus, the above mentioned investment contributed to achievement of a high ecological effect described with the above mentioned figures. Achievement of the above mentioned effects is possible when burning "grey" wheat straw with humidity of about 15 - 18%.

"Yellow" (fresh) straw contains considerable amount of chlorine and when burning the same with considerable humidity causes decrease of boiler efficiency. Therefore straw bales must stored under roof before burning.

Emission of gases from a boiler house with one EKOPAL RM 10 boiler with nominal heat power 65 kW comparing with emission of gases from coal boiler with the same heat power (danish sources)

Components of waste gases		Heat production = 65 kWh						Final effect	
		Coal burning			Straw burning			for 65 kWh	for 130 MWh (2000 h in a year)
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Component	Weight Volume kg/m3	Coal consumption kg/h	Emission in waste gases m3/kg	Emission in waste gases kg/h	Straw consumption kg/h	Emission in waste gases m3/kg	Emission in waste gases kg/h	Reduction of emission kg/h	Reduction of emission kg/year
CO_2	1,977	10,00	1,0387	20,53	15,00	0,73349	21,75	-1,22	-2440
SO_2	2,9267	10,00	0,00683	0,1998	15,00	0,00109	0,04785	0,152	304
Dust				2,03			0,46	1,57	3140

With assumed average working time in a year (2000 h) and with average consumption of coal and straw per hour we obtain:

- the total amount of CO_2 emitted in waste gases in a year is: for coal 41016 kg per year and for straw 43500 kg per year, thus the amount of CO_2 from the straw is higher relating to the amount of CO_2 from coal by 2440 kg per year. However the total amount of CO_2 from straw is only returned to the air, from which it was taken over when growing the corn. Thus, the amount of CO_2 in the atmosphere was not increased because of straw burning, but the total amount of CO_2 from the coal, i.e. 41016 kg is added to the amount of CO_2 in the atmosphere. This causes increase of greenhouse effect.
- the total amount of SO_2 from the coal is 399.6 kg per year, but the amount of SO_2 from straw is only 95.7 kg per year, thus the difference for disadvantage of coal is 303.9 kg per year.
- the total amount of dust emitted is 3140 kg per year for disadvantage of coal.

3 ECONOMIC EFFECT

The use of straw boilers gives not only ecological effects but also considerable economic effects. Erection of boilers houses with our straw boilers is fully profitable investment.

According to projects for erection of boiler houses with our straw boilers and according to opinions of our customers a simple return of capital expenditure takes place in 2 - 5 years. This depends on boiler house size and intensity of boilers operation as well as on replaced amounts of coal, prices of straw purchased etc. The most profitable investments are where usera have their own straw, e.g. the farmer from Chrzelice (Opole region) - Mr. Tadeusz Tarach who uses the EKOPAL RM straw boiler already for 6 years says that his capital expenditure for that investment was returned in three years. The Chairman of Cooperative Agricultural Company in Świerkówki (near Poznań), where EKOPAL RM 02 boiler is installed, said that his capital expenditure was returned already in 2 years.

Users of our boilers, which do not have their own straw and which must buy the straw from farmers, say also that their investments are very profitable. In the Primary School No. 2 in Milicz (Lower Silesia Region) 3 EKOPAL RM 02 boilers were installed in (total heat power 1200 kW). In the first heating season of operation the total direct costs of heating the school were 60,000 PLN instead of 260,000 PLN in the previous season when the school was heated by municipal boiler house where black coal is used as a fuel. The capital expenditure born for erection of the boiler house will be returned in 4-5 years.

It should be also emphasized that life of straw boilers is longer that life of coal boilers because in the straw there is much less sulphur amount than in coal. In Poland we have not still experience in that field but Danish experience shows that straw boilers operate for 20 years and more.

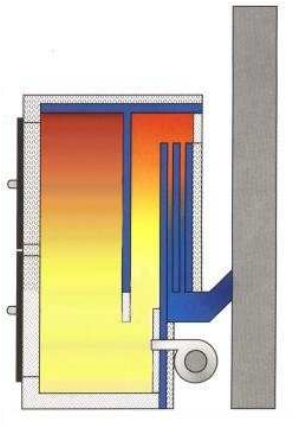
CALORIFIC VALUE OF DIFFERENT FUELS AND COST OF PRODUCTION OF 1 kWh HEAT ENERGY

Fuel type	Measur. unit	Calorific value kJ/unit	Price PLN/kWh
Liquid gas	l	25848	**0,37**
Fuel oil	l	35610	**0,34**
Natural gas	m^3	34440	**0,20**
Coal [5)]	kg	25000	**0,15**
wood	kg	15000	**0,08**
Fine coal	kg	20000	**0,08**
Straw [4)]	kg	14000	**0,04**
Straw [3)]	kg	14000	**0,02**

1) Cost of fuels according to prices on 01.02.2011;
2) 1 kWh = 3600 kJ;
3) Straw humidity 16% - straw price according to harvest cost;
4) Straw humidity 16% - straw price according purchase price (market price)
5) Efficiency of existing boilers;

4 EKOPAL RM BOILERS

EKOPAL RM boiler is equipped with high pressure fan with automatically adjusted throttling valve and with microprocessor control system which carries on the burning process according to set parameters. The boiler operates in cyclic system. Depending on boiler type its burning chamber is loaded with cubicoid straw bales with dimensions 80x40x40 cm or 250x120x80 cm or with round bales with diameters Ø 125 - 170 cm. After closing the chamber door, straw is burned out through a special hole on the boiler side and the control system is started which also switched the fan. The fan blows air through nozzles to the burning chamber. The air amount is adjusted (automatically) by opening and closing the throttling valve according to set temperature of waste gases coming out to chimney. The air blown through the nozzles is divided automatically to two streams. The first stream comes to the burning chamber and takes part in the burning process creating gas and then the gas comes back and meets the air of the second stream creating the final burning process, in which waste gases are produced. This system is called "countercurrent burning system" which gives a low content of carbon monoxide (CO) in the waste gases.



On the grounds of the basic EKOPAL RM 10 boiler during the last years we have designed next sizes of EKOPAL RM boilers. In the all new sizes of EKOPAL RM boilers the countercurrent burning system remains the same as in the EKOPAL RM 10 boiler. Changes concern only shapes and sizes of straw burning chambers, sizes of pipe heat exchangers (heat exchange surfaces), sizes and types of high pressuer fans and profiles of refractory linings. The control system and cyclic operation system is not changed. Sizes of necessary accumulation tanks for hot water should be also changed. Now we have the series of boiler sizes with heat powers from 40 kW up to 700 kW.

Furthermore, in all sizes of EKOPAL RM boilers any wooden wastes and chips as well as textile wastes, saw dust and other biomass types can be burned.

TECHNOLOGICAL SYSTEM OF THE BOILER HOUSE AND HEAT RECEIPT SYSTEM

The charge straw boilers are designed for production of hot water with temperature up to 95°C and can operate **only in open heating systems.**

A basic feature of each charge straw boiler is burning process carried on with stable velocity according to set temperature of waste gases in the control system (e.g. 230°C). In relatively short time such heat amount is produced which could not be normally accumulated by a heating system. Therefore in the technological system of boiler house provided with charge boilers there an accumulation tank for hot water is inevitable to accumulate the heat produced in the process of burning the straw charges. Such accumulation tank ensures total receipt of the heat from burning the succeeding straw charges.

Hot water is taken from that tank by the heating system according to required needs. The accumulation tank should have as good heat insulation as possible to reduce heat waste to the environment. Tank capacity is dependent on boiler size.

For boilers of EKOPAL RM series the following minimum capacities of accumulation tanks are recommended (higher capacities ensure more comfortable operation of boiler house):

RM 2 – min. 2.000 litres
RM 5 - min. 3.000 litres
RM 20 - min. 4,000 litres
RM 30 - min. 6,000 litres
RM 38 – min. 8.000 litres
RM 40 - min. 10.000 litres
RM 01 - min. 15,000 litres
RM 02 - min. 20,000 litres
RM 03-2 - min. 22,000 litres
RM 03-3 - min. 25,000 litres

To carry out a burning cycle of a straw charge it is necessary:

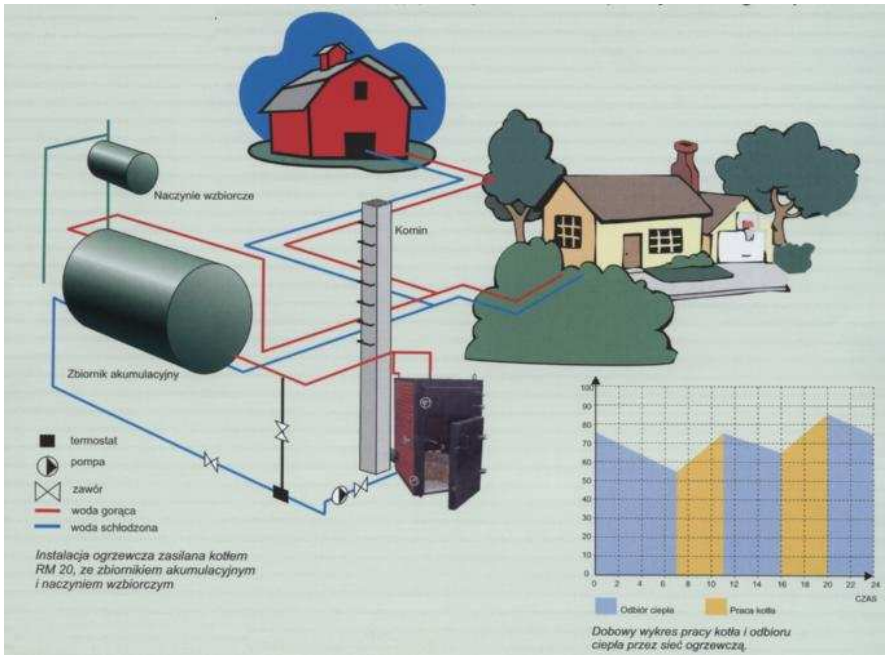
- to load straw in the form of bales (cubicoid bales - manually to boilers with heat power 30 kW - 100 kW or round bales and great cubicoid bales - with mechanical equipment to boilers with heat power 180 - 700 kW)
- to close the burning chamber of the boiler and to burn out the straw through a special opening in the side wall of the boiler

- to set required temperature of waste gases (it is recommended 230°C) on the control box display and to switch on the control system by pushing a suitable pushbutton in the control box of the automatic control system for burning process. Then the fan which blows air to the boiler and circulating pump which pumps water between boiler and accumulation tank are switched on automatically.

After making the above mentioned actions, the boiler does not require any further attendance, because the process of straw charge burning is carried on automatically by the microprocess control system. When the whole straw charge is burned out (temperature of waste gases comes down beneath 150°C), then the fan and circulating pump are switched off automatically.

Depending on straw charge size and boiler heat power the boiler operation cycle (burning out one straw charge) lasts 1 - 4 hours. Heat receipt from the accumulation tank to the heating system is carried on during boiler operation and in the next hours.

DIRECTIONS FOR INSTALLATION OF EKOPAL RM BOILERS



A distance between boiler and chimney should be as short as possible. The diameter of connecting tube between boiler and chimney must not be reduced. The connecting tube between boiler and chimney should be mounted under 45° angle. It is recommended to have the distance between boiler and chimney not greater than 1/3 of the chimney height.

REMARK:

For the boiler should be installed 3 - or 4-way valve thermoregulation in such a way that the minimum temperature of the water returning to the boiler 55 ° C.

Recommended circulating pumps:

- EKOPAL RM 5 i 10 boilers - Grundfos UPS Series - 100 32-60
- EKOPAL RM 20 boiler - Grundfos UPS Series - 100 25-80
- EKOPAL RM 30 boiler - Grundfos UPS Series - 100 32-80
- EKOPAL RM 40, 01 and 02 - Grundfos UPS Series - 200 40-60/2F or 40-180/F
- EKOPAL RM 03-2 boiler - Grundfos UPS Series - 200 50-60/2F, 65-30/F or 65-60/F

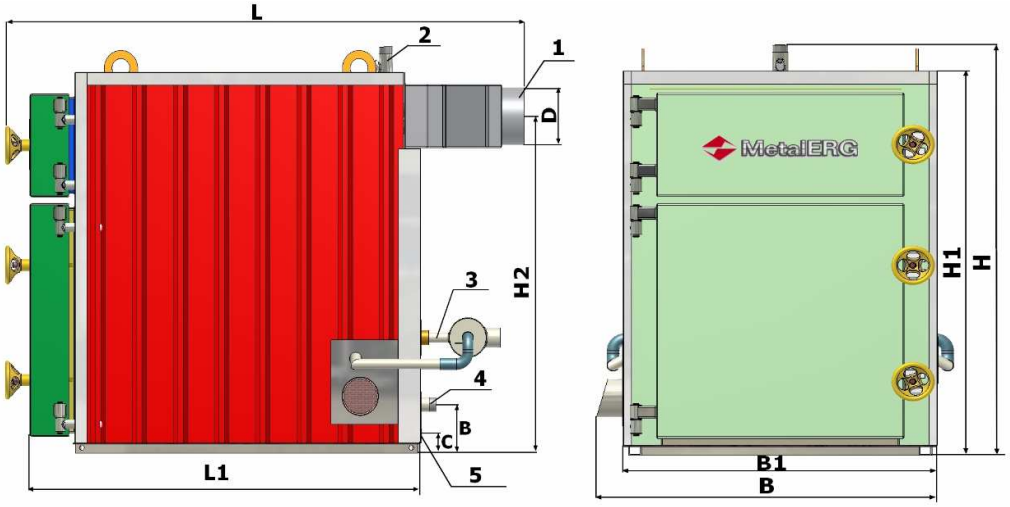
Recommended chimney diameters:

- EKOPAL RM 5, 10, 20, 30 boilers - ∅250 mm
- EKOPAL RM 01, 02, 03-2, 03-3 boilers - ∅500 mm

4.1 THE USE OF EKOPAL RM SERIES STRAW BOILERS

Consignees of our straw boilers are individual farmers, gardeners, poultry breeders, swine breeders as well as there are built boiler houses with our boilers in schools and other village objects.
There are also erected boiler houses, in which 2 or 3 our boilers are installed with the heat power of 300 - 500 kW. E.g. in the Primary School No.2 in Milicz the boiler house contains 3 boilers with the heat power of 400 kW each - the total heat power is 1200 kW and in the Primary School in Jemielno there are 2 our boilers with the heat power 400 kW and 500 kW. In the housing estate Łabiszynek there are 3 our boilers with 500 kW heat power each - the total heat power is 1500 kW. Totally in our country different types of EKOPAL RM straw boilers are installed with total heat power about 11,5 MW (data for the end of 2012) and has already exported more than 1000 units of boilers include Denmark, Sweden, Norway, Germany, France, Scotland, Ireland, Kazakhstan, Romania, Slovakia, Czech Republic, Austria, Russia and the Ukraine, Lithuania, Belarus and Hungary.Practically during the heating season about 800 tons of straw is burned out in the boiler house with heat power 1 MW, thus the amout of straw burned out in our boilers installed during the heating season is about 7200 tons.

4.2 CATALOGUE CHART FOR BOILERS EKOPAL RM TYPE

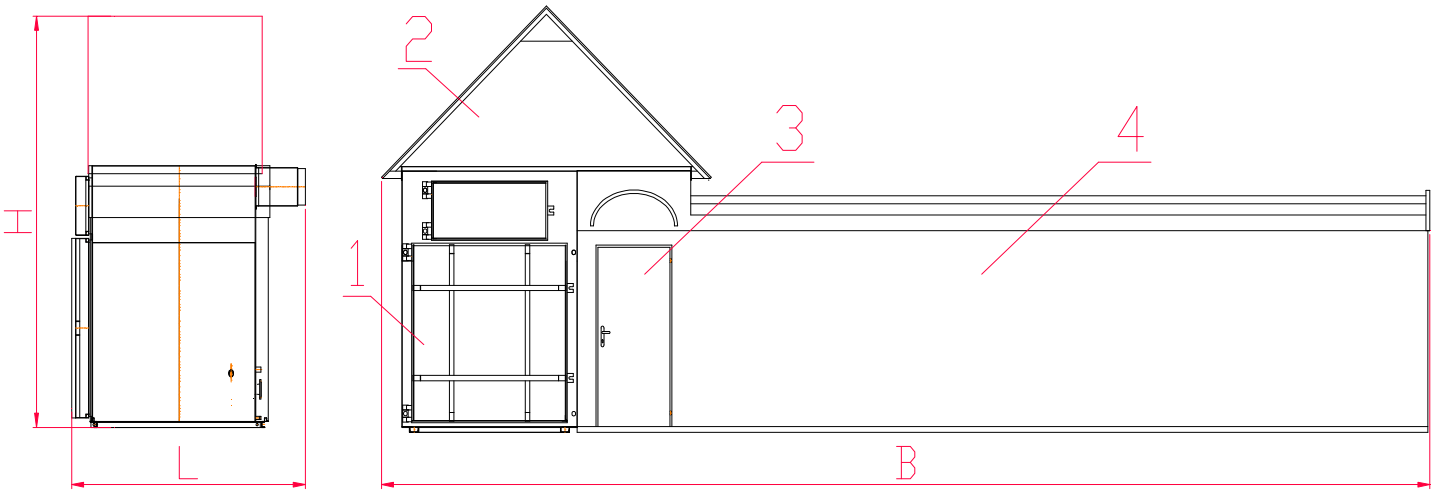


1 – stub pipe for waste gases to chimney
2 – stub pipe for water feeding central heating system
4 – stub pipe for water coming back from central heating system
5 – stub pipe from water draining
6 – opening for burning start

Specification	Unit	RM 2	RM 5	RM 20	RM 30	RM 38	RM 40	RM 01	RM 02	RM 03-2	RM 03-3
Max. heat power *:	kW	25	40	70	100	120	180	300	400	500	600
Max. cubale of heated rooms:	m^3	350	500	1 000	1 500	2 500	3 000	6 000	8 000	10 000	12 000
Heat efficiency:	%	82									
Max. water pressure:	MPa	0,15									
Boiler's water volume:	m^3	0,3	0,5	0,7	0,8	1,0	1,5	2,4	2,5	2,7	3,1
Min. capacity of accumulation tank required	m^3	2,0	3,0	4,0	6,0	8,0	10,0	15,0	20,0	22,0	25,0
Approximate straw consumption with boiler operation with nominal power	kg/h	8	12	21	30	40	55	100	130	160	192
Single straw charge: - bales 80x40x40 cm - round bale ∅ 125x120 cm - round bale ∅ 140x150 cm - round bale ∅ 181x150 cm - bales 180x80x120 cm - bales 250x80x120	szt.	2	3	4	6	8 1	12 1 1	ok. 20 1 1 1	ok. 20 1 1 1	ok. 20 1 1 1 2	ok. 40 2 2 2
Power of fan motor:	kW	0,55	0,55	0,55	0,75	1,5	1,5	2,2	4	4	7,5
Boilers dimensions:											
Height of boiler	H (mm) H1 (mm)	1 560 1 460	1 930 1 830	1 725 1 625	2 110 2 010	2 100 2 000	2 450 2 350	2 875 2 760	2 875 2 760	3 045 2 890	3 045 2 930
Width of boiler	B (mm) B1 (mm)	1021 920	1021 920	1 275 1 200	1 275 1 200	1 655 1 575	1 860 1 800	2 200 2 200	2 200 2 200	2 415 2 335	3 220 3 220
Depth of boiler	L (mm) L1 (mm)	1 975 1 555	1 975 1 555	2 280 1 860	2 280 1 860	2 605 2 185	3 075 2 655	3 240 2 820	3 240 2 820	3 190 2 770	3 280 2 860
Height of chimney	H2 (mm)	1 280	1 635	1 428	1 845	1 828	2 100	2 506	2 506	2 600	2 684
Out of water - supply	H (mm)	1 570	1 930	1 725	2 110	2 150	2 405	2 871	2 871	3 050	3 015
Back water - back	B (mm)	210	210	210	210	280	225	360	360	423	423
Drain connector	C (mm)	83	83	83	83	83	100	270	270	100	100
Heating water connection		Króciec 2"	Króciec 2"	Króciec 2"	Króciec 2"	Króciec 2"	Króciec 2"	Flansza Ø 108	Flansza Ø 108	Flansza Ø 108	Flansza Ø 108
Combustion smoke conduit	D (mm)	Ø 245	Ø 245	Ø 245	Ø 245	Ø 245	Ø 356	Ø 405	Ø 405	Ø 405	Ø 405
Burning chamber: - width - height - depth	mm	 620 850 950	 620 1 200 950	 900 900 1 140	 900 1 250 1 150	 1 300 1 300 1 250	 1 500 1 550 1 500	 ∅ 1 900 ∅ 1 900 1 690	 ∅ 1 900 ∅ 1 900 1 690	 2 000 1 900 1 600	 2 900 1 900 1 600
Boiler weight without water:	kg	1 100	1 500	1 800	2 200	3 200	5 000	5 200	5 600	8 000	10 000

- The power and quality of the combustion in the boiler is dependent on the quality and humidity of the straw. Biomass fuel is not normative.

4.3 CONTAINER BOILER WITH EKOPAL RM



1 – boiler EKOPAL RM
2 – expansion tank
3 – control room
4 – accumulation tank

Specification	Unit	RM 5	RM 20	RM 30	RM 38	RM 40P	RM 01	RM 02	RM 03-2	RM 03-3
Max. heat power *:	kW	40	70	100	120	180	300	400	500	600
Max. cubale of heated rooms:	m^3	600	1200	1800	2500	3000	6000	8000	10000	12000
Heat efficiency:	%	82	82	82	82	82	82	82	82	82
Boiler's water volume:	litr	500	700	800	1000	1500	2400	2500	2700	3100
Min. capacity of accumulation tank required	litr	ok. 3500	ok. 5.000	ok. 8.000	ok. 10.000	ok. 12.000	ok. 15.000	ok. 20.000	ok. 22.000	ok. 25.000
Min. capacity of expansion tank	litr	ok. 120	ok. 170	ok. 260	ok. 330	ok. 400	ok. 500	ok. 650	ok. 750	ok. 850
Recommended chimney draft	Pa	30	30	30	30	40	50-60	50-60	50-60	50-60
Power of fan motor:	kW	0,55	0,55	0,55	2,2	2,2	2,2	4	5,5	7,5
Container weight without water:	kg	~2350	~2630	~3400	~4900	~7100	~7900	~8000	~11300	~15000
Dimensions of the team (we can customize for customer needs):										
L	mm	1875	2220	2320	2650	3100	3350	3350	3250	3252
H	mm	~2200	~1970	~2300	~2550	~3350	~4100	~4150	~4770	~4650
B	mm	~5500	~5900	~7200	~7150	~11000	~11600	~12500	~13550	~15350
Combustion smoke conduit:	mm	∅ 245	∅ 245	∅ 245	∅ 245	∅ 350	∅ 405	∅ 405	∅ 405	∅ 405

- The power and quality of the combustion in the boiler is dependent on the quality and humidity of the straw. Biomass fuel is not normative.

5 Nagrzewnice powietrza na słomę typu EKOPAL S

On the base of straw boilers of EKOPAL RM type in METALERG Co. a type range of air heaters has been designed, in which air can be heated up to 110^0C.

The straw burning system in those heaters is identical as in EKOPAL RM boilers, it is the counterccurrent system with preliminary straw gasification and final burning of generated gas.

The type range of the air heaters inccludes 8 models with heat power from 60 kW to 1000 kW adapted to all shapes and sizes of straw bales, beginning from the smallest square bales with dimensions 80x40x40 cm through round bales with the diameter 120 - 180 cm up to square bales with dimensions 250x120x80 cm. Dimensions of straw burning chambers are being adapted to real straw bale sizes possessed by customers. Of course, similarly as in EKOPAL RM boilers, in the air heaters also lump wood and each other biomass available in a given territory can be burned.

The EKOPAL S type air heater can be characterized with popularized in last time qualification "2 in 1", because there is a boiler and tubular heat exchanger:

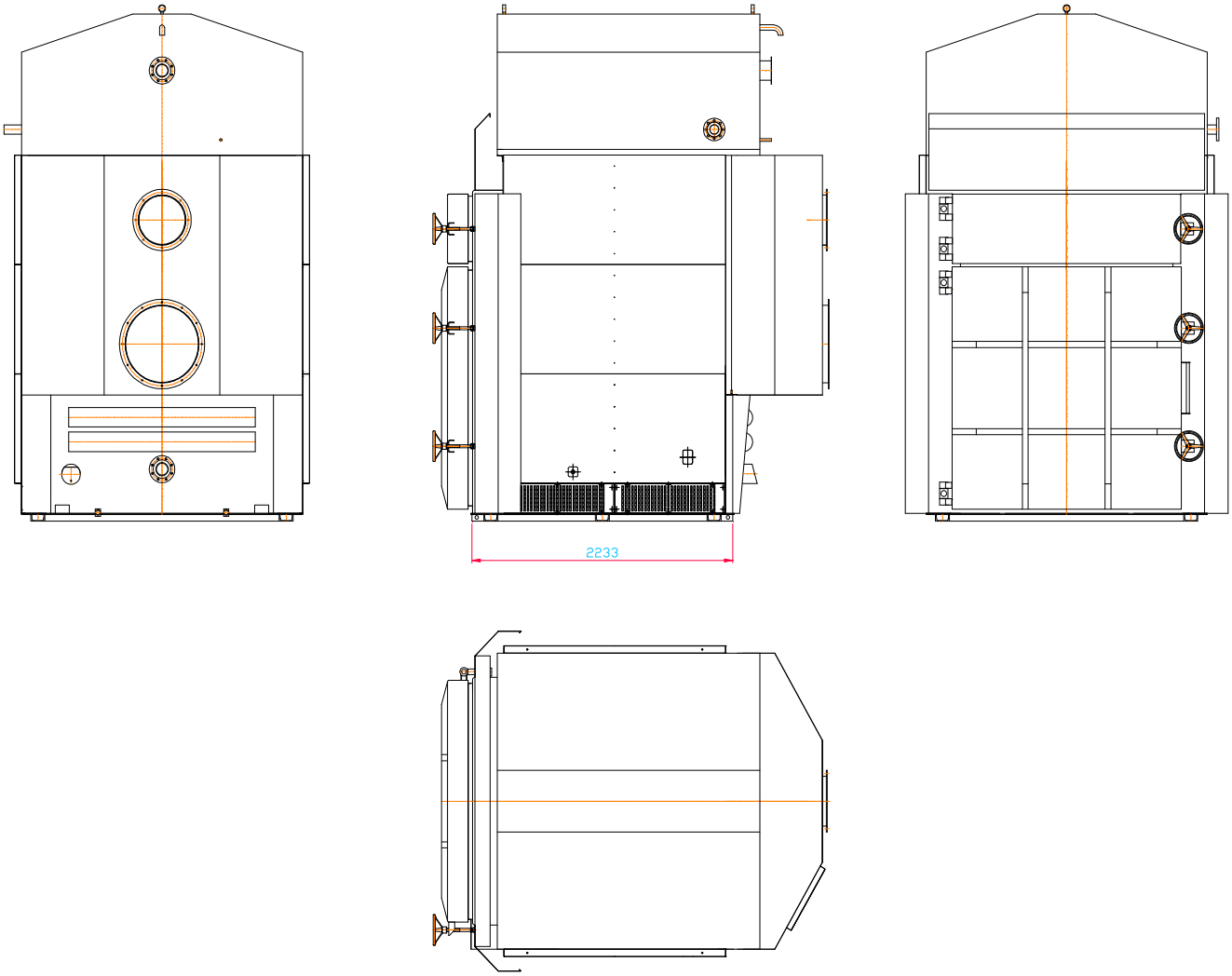
1. Boiler. It is the same straw boiler as EKOPAL RM, in which water is replaced with other liquid. Heat transferred with straw waste gases through flue tubes is transmitted to the liquid, and the same is heated up to high temperature.

2. Tubular heat exchanger "liquid - air". In the boiler there tubes are incorporated, through which air drawn from the outside is flowing and taking over the heat from the liquid heated. The air is sucked to the tubes of the heat exchanger by a fan located behind the heater. When the heater is used to a grain dryer this function can be performed also by the dryer fan.

The air heater design ensures convectional circulation of the liquid, due to which a forced liquid circulation is eliminated. As a result, we deliver a system in one unit without any pumps, valves, additional fans etc. The unit should be only connected to a system collecting hot air and to a chimney to carry away waste gases.

Advantages:

- replacement of expensive fuel (oil, gas etc.) by straw, wood or other biomass fuels in 100%,
- high thermal efficiency, up to 85%
- easy temperature control and small air temperature drop between individual loadings (max. 5^0 C),
- fuel conversion factor: 1l of oil = 3 kg of straw,
- easy and confortable operation,
- high durability and quality,
- durable maintenance by heat carrier,
- no need of liquid draining after heating season,
- the use: drying of different cereals, maize, herbs, vegetables, wood etc. (without contact of waste gases with products).



Features of EKOPAL S air heater (example):

	EKOPAL S-100	EKOPAL S-140	EKOPAL S-300	EKOPAL S-400	EKOPAL S-700	EKOPAL S-1000
Heat power:	100 kW	140 kW	300 kW	400 kW	700 kW	1000 kW
Max. air temp.	120 °C	120 °C	120 °C	120 °C	120 °C	120 °C
Dimensions:						
width	1400 mm	1500 mm	2200 mm	2300 mm	2450 mm	3400 mm
height	2600 mm	3200 mm	3650 mm	3700 mm	4600 mm	4420 mm
length	2300 mm	2500 mm	3200 mm	3200 mm	3200 mm	3550 mm
Burning chamber:						
width	900 mm	900 mm	1300 mm	1500 mm	1900 mm	2800 mm
height	1000 mm	1350 mm	1350 mm	1550 mm	1900 mm	1900 mm
length	1000 mm	1150 mm	1350 mm	1550 mm	1700 mm	1550 mm
Air heater weight:	2 800 kg	3 200 kg	9 000 kg	9 500 kg	11 000 kg	16 000 kg
Oil weight:	~1000 kg	~1200 kg	~3000 kg	~3200 kg	~4000 kg	~5000 kg
Thermal efficiency:	do 85%	do 85%	do 85%	do 85%	do 85%	do 85%

- The power and quality of the combustion in the boiler is dependent on the quality and humidity of the straw. Biomass fuel is not normative.

RESULTS OF OPERATION OF EKOPAL S HEAT EXCHANGER WITH "PEDROTTI 690 kW" DRYER

- previous fuel: - fuel oil
- heat power of oil burners: - 690 kW
- one maize charge: - 20 tons
- drying time of one charge - 10-11 h with fuel oil
  10-11 h with straw
- consumption of fuel for drying one charge: - ab. 750 l of fuel oil
  ab. 2000 kg of straw

FREQUENTLY INVESTMENT RETURNS AFTER DRYING 1-2 seasons

6 BIOWAT BOILERS

BIOWAT boilers are chargeable boilers assigned to heat houses up to 320 m^2 of usable area by means of straw and wood, without accumulation tanks. Capacity of fuel chamber is designed in such a manner that in worst winter conditions (-20°C, wind) there is no need to add fuel during the night. The fuel is burned in the boilers slowly. The burning velocity is regulated with manually adjustable throttling valve for primary air. Experience indicates that users have no troubles with the same. The boilers operate on natural draught, without fans. The primary air is consumed without full content of oxygen for complete burning out. in lower chamber. Some people call this process gasification.

The fuel chamber is lined completely with refractory bricks. The na chamber bottom is without water jacket and it could be unbolted forrepair purposes. Gas from he fuel chamber flows through a device which is named by ourselves “carburretor” to the upper ceramic chamber for after-burning. In the carburretor gas is being mixed with initially heated secondary air. The after-burning chamber is lined with catalytic material. Waste gases from the after-burning chamber flow to box heat exchange chamber. If the waste gases flap is opened, waste gases flow through short way to the smoke conduit. If the same is closed waste gases flow around the after-burning chamber. The waste gases flap is opened fully when burning is started up in the boiler and at the emergency condition when water temperature is increased above 95°C.

BIOWAT boilers are mounted directly to existing heating system, instead of coal boiler or parallelly to the same. The boilers operate in open water system (necessirilly).

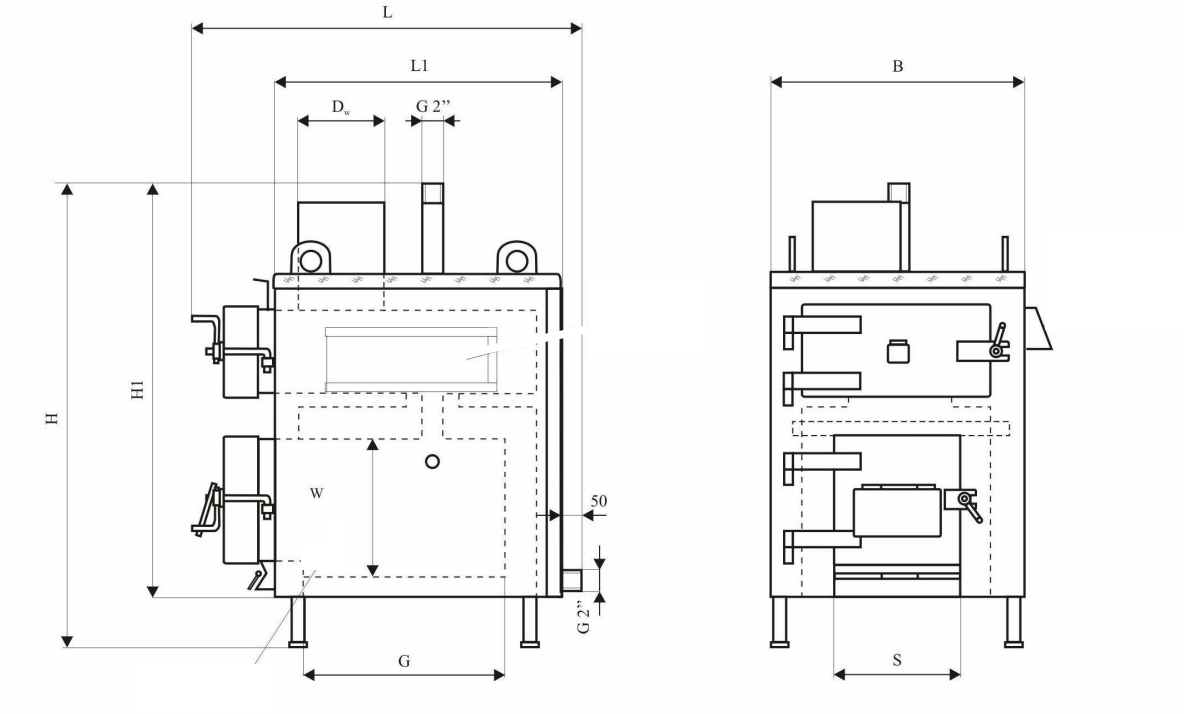
D-150 boilers, exclusively for wood and "U" (universal) boilers for wood but also for straw because in their fuel chamber one straw bale with dimensions 40x40x80 cm could be placed, could be installed in cellars. Then they could operate in gravitational system, without circulatinf pump. Basic fuel for them is wood. U-300 boiler allows for burning 1 m long logs. U-360 boiler allows for burning 1.2 m long logs. Basic fuel for "S" boilers is straw but wood also could be the fuel for those boilers. Because a house of ab. 230 - 250 m^2 needs for night (in heavy winter conditons) four straw bales, S boilers are big and heavy.

It is theoretically possible to place them underheath zero level, such possibility is favourable in exclusive cases (e.g. in lowered garage). Basicly the boilers are positioned on zero level, near a house or in existing buildings. It is sufficient to shield the boiler with roof and side and rear walls as well.

At average winter temperatures the boilers are charged two times in 24 hours. A house with 250 m^2 area needs yearly straw from 4.5 - 5 ha. Ash removal is made once in a few days. The ash is a good phosphorus - potassium fertilizer. Fuel and after-burning chambers are not to be cleaned. Ceramic lining of those chambers burnes out each biomass particles.Heat exchanger surface is cleaned by means of larry. The larry is used also for ash removal.

Waste gases of wood and straw spoil mortar. The chambers are to be chielded with pipes. If this is neglected, waste gases will spoil the mortar and chimney will have leakages. Wet wood can be burned in the boilers, it does not matter what kind of wood or straw is used. Only saw dust could not be burned. The saw dust must be mixed with wood pieces or with straw. The fuel could be maked up during boiler operation. Start up of burning in cold boiler should be made with dry fuel. After heating up the boiler big wood logs could be burned.

CATALOGUE CHART OF BIOWAT BOILERS

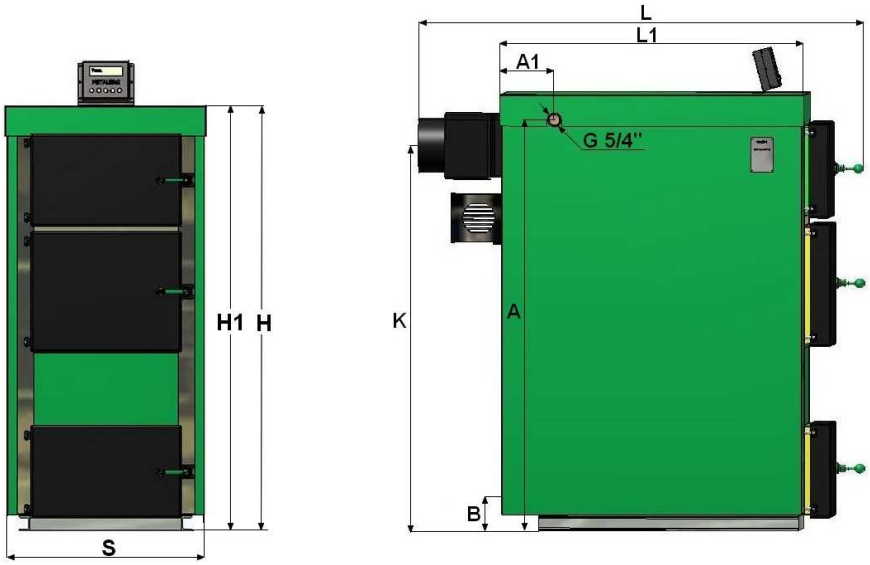


Boiler type	L	B	H	L1	H1	D_w	Fuel chamber				Weight [kg]	Area heated [m^2]	Power [kW]
							G	W	S	Capacity [l]			
U245	1470	898	1482	1200	1135	250	926	530	546	245	1000	250	25
U300	1525	898	1482	1325	1135	250	1050	530	546	300	1100	280	28
U360	1795	898	1482	1525	1135	250	1250	530	546	360	1250	320	32
U420	1525	898	1482	1325	1135	250	1050	530	760	420	1300	400	40
S4	1470	1402	1892	1200	1545	250	926	934	1050	4 straw balles	1800	250	25
S6	1870	1402	1892	1600	1545	250	1326	934	1050	6 straw balles	2200	300	30

7 BOILERS EKOPAL D

- steel heating boiler EKOPAL D is assigned for burning coniferous and deciderous wood, wooden chips, saw dust and energetic willow
- principle of burning is based on counter-current biomass burning system (waste gases temperature is 800 - 950°C)
- the boilers are provided with burning control system, connected with fan, which allows for flexible operation of the whole system and for complete burning out wood and collecting the whole thermal energy included in the same
- the boilers of EKOPAL D type have a heat exchanger of pipe type with sufficient heat exchange surface to collect the heat and to obtain low thermal losses (low temperatures of waste gases going to chimney - 130 - 200°C)
- EKOPAL D boiler can operate in two different heating systems:
  - as a boiler with continuous operation
  - as cyclic boiler operating in the system with an accumulation tank:

    The heating system with accumulation tank is most popular in Western Europe amongst all types of boilers burned with wood. The accumulation tank allows for prolonged heating after burning out a charge of wood in the boiler. Additionally the accumulation tank allows for savings in wood consumption up to 25%.



Specification	Unit	D - 25	D - 35	D - 45	D - 65
Nominal heat power *	kW	25	35	45	65
Heat efficiency	%	78-85			
The volume of the combustion chamber	litr	150	220	290	440
Dimensions charging holes	mm	400x250	510x250	510x250	510x250
The maximum length of a wood log	mm	550	550	650	650
Max. water pressure	MPa	0,15			
Maximum water temperature	°C	95			
Required chimney draft	Pa	20	24	28	30
Overall height Height without control	H (mm) H1 (mm)	1 590 1 430	1 690 1 530	1 790 1 630	2 200 1 950
Boiler width	S (mm)	610	720	720	720
Boiler depth	L (mm) L1 (mm)	1 540 1 230	1 540 1 230	1 640 1 330	2 170 1 500
The height of exhaust flue	K (mm)	1 180	1 350	1 440	1 970
Heating water connection		G 5/4” wewnętrzne			2”
Size flue exhaust	∅ (mm)	159	193,7	193,7	245
Boiler Wright without water	kg	600	670	750	1100
Approximate consumption of wood for heating season	m^3	12	18	25	35
Min. capacity of accumulative tank required	litr	1200	1500	2000	3000

8 PRIZES AND AWARDS

9 . CERTIFICATES

DNV

DET NORSKE VERITAS

CERTYFIKAT SYSTEMU ZARZĄDZANIA

Certyfikat Nr 68071-2009-AQ-POL-FINAS

Niniejszym potwierdza się, że

Obróbka Metali i Przetwórstwo Tworzyw Sztucznych "Metalerg" J.M.J. Cieślak Spółka Jawna

w

ul. Pułaskiego 2, 55-200 Oława, Polska

spełnia wymagania normy Systemu Zarządzania:

ISO 13485:2003

Certyfikat obejmuje następujący zakres wyrobów / usług:

PROJEKTOWANIE I PRODUKCJA URZĄDZEŃ GRZEWCZYCH. USŁUGI W ZAKRESIE OBRÓBKI METALI. PROJEKTOWANIE I PRODUKCJA REGULATORÓW CIŚNIENIA TLENU I ELEMENTÓW PRZYŁĄCZENIOWYCH DO DYSTRYBUCJI GAZÓW MEDYCZNYCH.

Data pierwszej certyfikacji: 6 października 2006

Certyfikat jest ważny do: 31 października 2012

Miejsce i data: Sopot, 28 grudnia 2009

W imieniu Jednostki Akredytowanej: DNV CERTIFICATION OY/AB, FINLAND

FINAS Finnish Accreditation Service S001 (EN ISO/IEC 17021)

Audyt został przeprowadzony pod nadzorem: Krzysztof Sołtyski *Audytor Wiodący*

Tomasz Słupek *Pełnomocnik Zarządu*

Niespełnienie wymagań wymienionych w Umowie o Certyfikację może spowodować utratę ważności certyfikatu.

DNV

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CERTYFIKAT SYSTEMU ZARZĄDZANIA

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w

ul. Pułaskiego 2, 55-200 Oława, Polska

spełnia wymagania normy Systemu Zarządzania:

ISO 9001:2008

Certyfikat obejmuje następujący zakres wyrobów / usług:

PROJEKTOWANIE I PRODUKCJA URZĄDZEŃ GRZEWCZYCH. USŁUGI W ZAKRESIE OBRÓBKI METALI. PROJEKTOWANIE I PRODUKCJA REGULATORÓW CIŚNIENIA TLENU I ELEMENTÓW PRZYŁĄCZENIOWYCH DO DYSTRYBUCJI GAZÓW MEDYCZNYCH.

Data pierwszej certyfikacji: 25 września 2007

Certyfikat jest ważny do: 31 października 2012

Miejsce i data: Sopot, 28 grudnia 2009

W imieniu Jednostki Akredytowanej: DNV CERTIFICATION OY/AB, FINLAND

IAF

FINAS Finnish Accreditation Service S001 (EN ISO/IEC 17021)

Audyt został przeprowadzony pod nadzorem: Krzysztof Sołtyski *Audytor Wiodący*

Tomasz Słupek *Pełnomocnik Zarządu*

Niespełnienie wymagań wymienionych w Umowie o Certyfikację może spowodować utratę ważności certyfikatu.

Urząd Dozoru Technicznego

Jednostka Notyfikowana UDT-CERT Nr 1433

CERTYFIKAT BADANIA PROJEKTU WE

Certificate of design examination

Jednostka Notyfikowana UDT-CERT Nr 1433

po przeprowadzeniu badania projektu WE
- moduł B1 – urządzenia ciśnieniowego:
Notified body no 1433 after design examination – module B1 - pressure equipment:

Rodzaj urządzenia: *Description of pressure equipment* **Kotły wodne na paliwa stałe zasilane ręcznie typu EKOPAL RM (RM 2, RM 5, RM 10, RM 20, RM 30, RM 38, RM 40, RM 01, RM 02, RM 03-2, RM 03-3)**

Wytwórca: *Manufacturer* **METALERG J.M.J. Cieślak Sp.j. , PUŁASKIEGO 2, 55-200 OŁAWA**

Kategoria zagrożenia: *Hazard category* **97/23/We art.3.2.3**

Nr protokołu badań: *Test report No* **18515/JN/001/02/2**

niniejszym poświadcza, że dokumentacja spełnia wymagania

Dyrektywy 97/23/WE
wdrożonej do prawa polskiego rozporządzeniem Ministra Gospodarki z dnia 21 grudnia 2005 r. w sprawie zasadniczych wymagań dla urządzeń ciśnieniowych i zespołów urządzeń ciśnieniowych

we hereby certify that the design documentation satisfies the requirements of Directive 97/23/EC

Dokumentacja została oznaczona:
The documentation has been marked as follows

Sygnaturą JN UDT i numerem certyfikatu na każdej stronie dokumentacji.

Warunki wydania certyfikatu oraz wykaz odpowiednich części dokumentacji podano w wymienionym powyżej protokole badań załączonym do niniejszego certyfikatu
The conditions of the certificate and the specification of adequate parts of documentation are described in mentioned above test report enclosed to this certificate

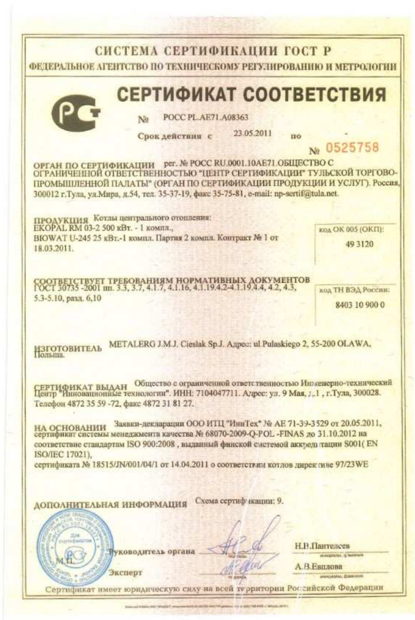
CEOC INTERNATIONAL

Wrocław, 14.04.2010
Miejsce i data wydania *Location, date*

Urząd Dozoru Technicznego UDT-CERT

W imieniu JN UDT-CERT *On behalf of UDT's Notified Body*

UDT-CERT, 02-353 WARSZAWA, UL. SZCZĘŚLIWICKA 34



СИСТЕМА СЕРТИФИКАЦИИ ГОСТ Р

ФЕДЕРАЛЬНОЕ АГЕНТСТВО ПО ТЕХНИЧЕСКОМУ РЕГУЛИРОВАНИЮ И МЕТРОЛОГИИ

СЕРТИФИКАТ СООТВЕТСТВИЯ

№ РОСС PL.AE71.A08363

Срок действия с 23.05.2011 по

№ 0525758

ОРГАН ПО СЕРТИФИКАЦИИ рег. № РОСС RU.0001.10AE71.ОБЩЕСТВО С ОГРАНИЧЕННОЙ ОТВЕТСТВЕННОСТЬЮ "ЦЕНТР СЕРТИФИКАЦИИ" ТУЛЬСКОЙ ТОРГОВО-ПРОМЫШЛЕННОЙ ПАЛАТЫ" (ОРГАН ПО СЕРТИФИКАЦИИ ПРОДУКЦИИ И УСЛУГ). Россия, 300012 г.Тула, ул.Мира, д.54, тел. 35-37-19, факс 35-75-81, e-mail: np-sertif@tula.net.

ПРОДУКЦИЯ Котлы центрального отопления:
EKOPAL RM 03-2 500 кВт. - 1 компл.,
BIOWAT U-245 25 кВт.-1 компл. Партия 2 компл. Контракт № 1 от 18.03.2011.

код ОК 005 (ОКП): 49 3120

СООТВЕТСТВУЕТ ТРЕБОВАНИЯМ НОРМАТИВНЫХ ДОКУМЕНТОВ
ГОСТ 30735 -2001 пп. 3.3, 3.7, 4.1.7, 4.1.16, 4.1.19.4.2-4.1.19.4.4, 4.2, 4.3, 5.3-5.10, разд. 6,10

код ТН ВЭД России: 8403 10 900 0

ИЗГОТОВИТЕЛЬ METALERG J.M.J. Cieslak Sp.J. Адрес: ul.Pulaskiego 2, 55-200 OLAWA, Польша.

СЕРТИФИКАТ ВЫДАН Общество с ограниченной ответственностью Инженерно-технический Центр "Инновационные технологии". ИНН: 7104047711. Адрес: ул. 9 Мая, д.1 , г.Тула, 300028. Телефон 4872 35 59 -72, факс 4872 31 81 27.

НА ОСНОВАНИИ Заявки-декларации ООО ИТЦ "ИнnТех" № АЕ 71-39-3529 от 20.05.2011, сертификат системы менеджмента качества № 68070-2009-Q-POL -FINAS до 31.10.2012 на соответствие стандартам ISO 900:2008 , выданный финской системой аккредитации S001(EN ISO/IEC 17021),
сертификата № 18515/JN/001/04/1 от 14.04.2011 о соответствии котлов директиве 97/23WE

ДОПОЛНИТЕЛЬНАЯ ИНФОРМАЦИЯ Схема сертификации: 9.

М.П.

Руководитель органа Н.В.Пантелеев

Эксперт А.В.Евплова

Сертификат имеет юридическую силу на всей территории Российской Федерации

WOJSKOWE CENTRUM NORMALIZACJI, JAKOŚCI I KODYFIKACJI
Military Center for Standardization, Quality and Codification
ODDZIAŁ KODYFIKACJI WYROBÓW OBRONNYCH
Codification Branch for Defence Products
43 KRAJOWE BIURO KODYFIKACYJNE
43 National Codification Bureau

ZAŚWIADCZENIE

CERTIFICATE

Zaświadcza się, że na podstawie złożonego wniosku jednostka organizacyjna o nazwie:
This is to certify that:

OBRÓBKA METALI I PRZETWÓRSTWO TWORZYW SZTUCZNYCH "METALERG" J.M.J. CIEŚLAK Spółka Jawna

z siedzibą w:
located in:

55-200 OŁAWA UL. PUŁASKIEGO 2

otrzymała
was given

Natowski Kod Podmiotu Gospodarki Narodowej:
NATO Commercial and Government Entity Code NCAGE:

1822H

DYREKTOR WOJSKOWEGO CENTRUM NORMALIZACJI, JAKOŚCI I KODYFIKACJI
mgr inż. Marian PŁAWIAK
podpis

Warszawa, dnia 2 września 2009 r.

10. ORDER FORM BOILER

.....
(PLACE AND DATA)

I hereby order the boiler:

□ EKOPAL RM	□ BIOWAT	□ EKOPAL D	□ EKOPAL S
□ RM 5 (40 kW)	□ U-245 (25 kW)	□ D-25 (25 kW)	□ S-50 (50 kW)
□ RM 20 (70 kW)	□ U-300 (28 kW)	□ D-35 (35 kW)	□ S-60 (60 kW)
□ RM 30 (100 kW)	□ U-360 (32 kW)	□ D-45 (45 kW)	□ S-100 (100 kW)
□ RM 38 (120 kW)	□ U-420 (40 kW)		□ S-140 (140 kW)
□ RM 40 (180 kW)	□ S-4 (25 kW)		□ S-300 (300 kW)
□ RM 01 (300 kW)	□ S-6 (30 kW)		□ S-400 (400 kW)
□ RM 02 (400 kW)			□ S-450 (450 kW)
□ RM 03-2 (500 kW)			□ S-550 (550 kW)
□ RM 03-3 (700 kW)			□ S-750 (750 kW)
			□ S-1000 (1000 kW)

Please select the appropriate type and model by ticking □

The boiler will be made within a period:

Price of boiler: zł. + % VAT = zł.
and does not change within the aforementioned period.

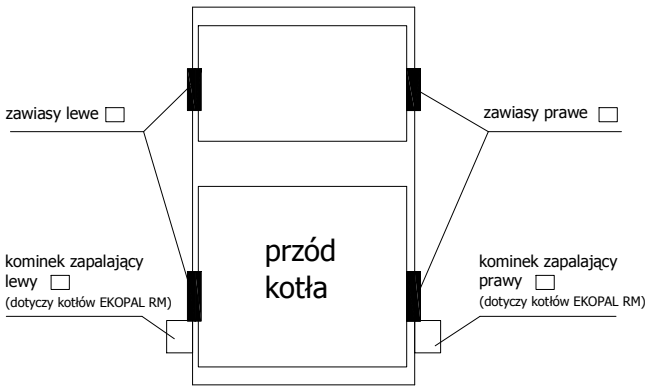
Transportation boiler cost:	

When ordering the boiler must pay a down payment of 20%: zł.
Performance of the contract is started on the day of payment of the deposit. The rest of the amount must be paid to the day of receipt of the boiler.

In case of cancellation of the buyer ordered the boiler for reasons beyond the control of the manufacturer, the buyer loses the deposit paid. If the reception of the boiler will be postponed for a reason ordering from one month to three months from the date entered in the contract, the contracting authority will be burdened with the costs of storage. Failure of the boiler within three months from the date on the contract is tantamount to resignation of contract.

Name or company name:	
Address the contracting authority:	
Phone:	
Delivery address of the boiler:	

□ boiler EKOPAL RM
□ container boiler EKOPAL RM



Please select a direction of opening doors and igniting the fire place by ticking □

□ the outer color plates - red RAL 3016
□ the outer color plates - green RAL 6029
□ the outer color plates - other RAL ……..