TRANSLATION

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Your reference:	Your message from	Our reference:	Date:
Order by Mr. Dipl.-Ing. Meindlhumer	23.10.2006	06-UWC/Wels-EX-295/2 SD/SD	29.06.2007

Betrifft: Type test of the pellets boiler type P 4 Pellet 8 in accordance with ÖNORM EN 303-5

R E P O R T

of the accredited testing laboratory and supervisory board

concerning the tests performed in the period of 23.10. – 25.10.2006

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Test report no.:	06-UWC/Wels-EX-295/2
Test report date:	29.06.2007

Test report concerning the type test of the pellets boiler type P 4 Pellet 8
in accordance with ÖNORM EN 303-5

Client:	Fröling Heizkessel- und Behälterbau GesmbH, Industriestraße 12, A-4710 Grieskirchen.
Manufacturer:	Fröling Heizkessel- und Behälterbau GesmbH, Industriestraße 12, A-4710 Grieskirchen.
Test place:	Test rig of the company Fröling Heizkessel- und Behälterbau GesmbH, Industriestraße 12, A-4710 Grieskirchen
Kind of testing:	Type test of a pellets boiler biomass heating system
Order number:	Verbal order by Mr. Dipl.-Ing. Meindlhumer
Date of order:	23.10.2006
Day of testing:	23.10. – 25.10.2006
Contents:	57 Pages 5 Enclosures

Task:	Type test performance of the pellets boiler type P 4 Pellet 8 in accordance with ÖNORM EN 303-5.

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Enclosure 2: Sectional view of the pellets boiler type P 4 Pellet 8
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Enclosure 4: Diagram of the operating conditions of the boiler during the period of measurements (4 pages).
Enclosure 5: Table of test documents given to TÜV AUSTRIA by the boilermaker

1. TASK DEFINITION

1.1 CLIENT

Fröling Heizkessel- und Behälterbau GesmbH, Industriestraße 12, A-4710 Grieskirchen.

Contact: Mr. Dipl.-Ing. Meindlhumer, Mr. Gruber
Telephone number: 0043-(0)7248-606-0

1.2 MANUFACTURER

Fröling Heizkessel- und Behälterbau GesmbH, Industriestraße 12, A-4710 Grieskirchen.

1.3 LOCATION / TEST

Test rig of Fröling Heizkessel- und Behälterbau GesmbH, Industriestraße 12, A-4710 Grieskirchen.

1.4 UNIT

The subject unit is a pellets boiler unit of the make Fröling, type P 4 Pellet 8, with a nominal heat output of 10.5 kW and with the objective of producing useful heat for the purpose of room heating and water heating.

Currently the unit is covered in Austria by regulations of ÖNORM EN 303-5 and the regulations of the agreement of the Austrian Federal States according to article 15a of the Federal Constitution about "Schutzmaßnahmen betreffend Kleinfeuerungen" (art. 15a B-VG) and about "Einsparung von Energie" respectively.

The heating boiler is designed for firing wood pellets as per manufacturer information (in accordance to ÖNORM M 7135 HP1 respectively DIN 51731 HP5).

1.5 DATE OF TESTS

The test of the boiler type was performed in the period of 23.10. up to 25.10.2006.
The exact measuring times are given at the measuring results.

1.6 CAUSE OF TEST

(a) Type test performance in accordance to ÖNORM EN 303-5

(b) Verification of the compliance with the regulations of the agreement of the Austrian Federal States according to article 15a of the Federal Constitution about "Schutzmaßnahmen betreffend Kleinfeuerungen" and about "Einsparung von Energie" respectively at test date.

1.7 TASK

a) Type test performance in accordance to ÖNORM EN 303-5

b) Verification of the compliance with the regulations of the agreement of the Austrian Federal States according to article 15a of the Federal Constitution about "Schutzmaßnahmen betreffend Kleinfeuerungen" and about "Einsparung von Energie" respectively at test date.

Furthermore, in the context of the type test, a determination of the auxiliary power consumption should be done in the following modes of operation and key consumers:

- Nominal heat output (average value, measuring time ≥ 6 h)
- Minimum heat output (average value, measuring time ≥ 6 h)
- Sleeping operation (average value, measuring time ≥ 10 min)
- Ignition process (electrical work)
- Key consumers
    - fan motor
    - motor for cleaning of heating surfaces and to discharge flue ash
    - fuel discharge (suction device)
    - stoker screw conveyor
    - back-burning damper motor

The tests should take place at the test rig which is set up at the Fröling Heizkessel- und Behälterbau GesmbH, which was equivalent with the requirements of ÖNORM EN 303-5 at test date.

As test fuel the fuel wood pellets should be fired, which is used as manufacturer information in the biomass boiler type.

1.7.1 Emission limit values and requirements of the boiler efficiencies

The emission limit values underlying the evaluation of the emission behaviour and the boiler efficiency are mentioned below.

Limit values in accordance with ÖNORM EN 303-5, deviations from Austria

parameter	limit values in accordance with ÖNORM EN 303-5, boiler class 3 (related to 10 % O_2)	limit values in accordance with ÖNORM EN 303-5, deviations from Austria
Dust	150 mg/m³	60 mg/MJ
Carbon monoxide (CO)	3000 mg/m³	500 mg/MJ
Nitrogen oxides (NO_x, shown as NO_2)	-	150 mg/MJ
Organic gaseous substances (OGC, shown as carbon)	100 mg/m³	40 mg/MJ
Boiler efficiency	≥ 73.1 % ($67+ 6\log Q_N$)	≥ 76.2 % ($68.3+ 7.7\log Q_N$)

The emission limits for CO, NO_x and OGC are calculated as arithmetic average values of the emission over the entire test period (test duration at nominal heat output and test duration at minimum heat output shall be at least 6 hours, all determined emissions are related to a dry flue gas basis at standard condition at 0°C and 1013 mbar).

To determine the dust content the test period has to be divided into at minimum 4 equal time sections as per ÖNORM EN 303-5.
The measurements begin in each case at the start of the sections, with the first measurement taken when the test begins. The suction time per filter is limited to 30 min. The average dust content is determined from the 4 half-hour values at minimum.
At minimum heat output the proof of keeping the emission limit values for CO and OGC is to be only furnished.

The limit value for the boiler efficiency is calculated as arithmetic average value over the entire duration of test.

Limit values in accordance with the regulations of the agreement of the Austrian Federal States according to article 15a (art. 15a B-VG) of the Federal Constitution about "Schutzmaßnahmen betreffend Kleinfeuerungen" and about "Einsparung von Energie respectively

Parameter	Limit values in accordance with art. 15a B-VG
Dust	60 mg/MJ
Carbon monoxide (CO)	500 mg/MJ
Nitrogen oxides (NO_x, shown as NO_2)	150 mg/MJ
Organic gaseous substances (OGC, shown as carbon)	40 mg/MJ
Boiler efficiency	≥ 76.2 % ($68.3+ 7.7\log Q_N$)

The emission limits for CO, NO_x and OGC are calculated as arithmetic average values of the emission over the entire test period (test duration at nominal heat output and test duration at minimum heat output shall be at least 3 hours, all determined emissions are related to a dry flue gas basis at standard condition at 0°C and 1013 mbar).
The emission value for dust is the arithmetic average determined from 3 half-hour values at minimum in the test period.
At minimum heat output the proof of keeping the emission limit values for CO and OGC is to be only furnished.
The limit value for the boiler efficiency is calculated as arithmetic average value over the entire duration of test.

1.8 COORDINATION

Coordination regarding date, measuring scope and procedure took place in the run-up of the measurements with Mr. Dipl.-Ing. Meindlhumer and Eng. Gruber from the client.

1.9 LIST OF ALL PERSONS WHO LOCALLY TOOK PART AT SAMPLING

On the part of TÜV Austria: Mr. Schrögendorfer
On the part of the manufacturer: Mr. Dipl.-Ing. Meindlhumer
Mr. Eng. Gruber

1.10 PARTICIPATION OF FURTHER INSTITUTES

The elementary analysis and the determination of the calorific value of the fuel samples taken by TÜV Austria in the context of the measurements were performed by the company Holzforschung Austria in Vienna.
All other tasks were performed by TÜV Austria.

1.11 TECHNICALLY RESPONSIBLE PERSONS

Ing. Mair, Tel. 0043-(0)7242/61383, direct dial 8208,
Ing. Schrögendorfer, Tel. 0043-(0)7242/61383, direct dial 8215.

2. DESCRIPTION OF THE UNIT

2.1 KIND OF UNIT

The subject unit is a pellets boiler unit of the make Fröling, type P 4 Pellet 8, with a nominal heat output of 10.5 kW and with the objective of producing useful heat for the purpose of room heating and water heating.
Currently the unit is covered in Austria by regulations of ÖNORM EN 303-5 and the regulations of the agreement of the Austrian Federal States according to article 15a of the Federal Constitution about "Schutzmaßnahmen betreffend Kleinfeuerungen" (art. 15a B-VG) and about "Einsparung von Energie" respectively.
The heating boiler is designed for firing wood pellets as per manufacturer information (in accordance to ÖNORM M 7135 HP1 respectively DIN 51731 HP5).

2.2 TECHNICAL DESCRIPTION OF THE UNIT

The subject unit is a pellets boiler unit of the make Fröling, type P 4 Pellet 8, with a nominal heat output of 10.5 kW.

The heating boiler is designed for firing wood pellets as per manufacturer information (in accordance to ÖNORM M 7135 HP1 respectively DIN 51731 HP5 with d = 6 mm).

The subject unit consists basically of an outside fully insulated steel plate boiler with built-in special retort for combustion of wood pellets, a vertical heat exchanger with three passes and a side-arranged automatic feeding device with a pellets hopper.

The main components of the combustion retort are the combustion chamber made of alloyed steel with integrated air feed, automatic ignition device, moveable grate with drive and an ash chamber situated below.

An evaluation of the fire protection systems used in the boiler unit will be compiled in a separate expertise by the Institute for Fire Protection Engineering and Research Ltd...

The combustion air is sucked in at the rear of the boiler by means of the exhaust gas fan into an air jacket, giving the division in primary and secondary air.

The air supply takes place primary through the rust and secondary above the firebed by several symmetrical splitted secondary air tubes, which are integrated in the combustion chamber.

A microprocessor-operated boiler control ensures the automatically operation of the entire heating unit.

After the occurrence of a heat requirement the fuel is transported to the retort and ignited automatically.

The difference between actual and desired boiler temperature controls within the prescribed limits of flue gas temperature the amounts of combustion air and fuel.

The regulation of the oxygen content in the flue gas takes place by means of a lambda probe via variation of fuel feeding. In this connection an indirect adaptation to the fuel qualities is performed.

The fuel feeding takes place diagonally top down through a downpipe, which can be sealed by a closing slide from further fuel for back-burn safety.

The flue gas is transported from the retort through a down-swept flue directly to the counter-current passed through heat exchanger with three passes, which can be used according to manufacturer information for operation without external increasing of return.

To optimize heat transfer and for cleaning the third pass of the heat exchanger tubes is equipped with automatically operated Wirbulatoren (efficiency optimization system WOS).
The cleaning of the first and second pass takes place manually with cleaning tools.

The resulting rust and flue ash is discharged with ash trays through an ash tray door situated behind the boiler insulation on the boiler front.

For test performance the needed pellets amount for combustion is weighed and manual filled in the pellets hopper.

In normal operation the input of pellets into the pellets hopper takes place with a pneumatic conveying system.

A sectional view of the pellets boiler unit of the type P 4 Pellet 8 is given to the test report in enclosure 2.

2.2.1 Technical data of the tested boiler (as per manufacturer data)

2.2.1.1 Boiler

Manufacturer:	Fröling Heizkessel- und Behälterbau GesmbH
Type:	pellets boiler P 4 Pellet 8
Year of construction:	2006
Nominal heat output/-range:	10.5 kW / 3.1 – 10.5 kW
Allowable fuels:	wood pellets (in accordance with ÖNORM M 7135 HP1 respectively DIN 51731 HP5)
Maximum allowable operating temperature:	75°C
Maximum allowable operating pressure:	3 bar
Water content:	70 l
Boiler class:	3
Electrical connection:	230V; 50Hz; 16 A; 96 W

Main dimensions

Boiler – total height:	1660 mm (incl. suction cyclone)
Boiler – total width:	1185 mm (incl. suction cyclone)
Boiler – total length:	930 mm (incl. exhaust fan)
Boiler height:	1280 mm
Boiler width:	700 mm
Boiler length:	740 mm
Weight of the boiler:	approx. 320 kg (without ash discharging module)
Flue gas pipe connection:	d = 130 mm

2.2.1.2 Firing

Manufacturer:	Fröling Heizkessel- und Behälterbau GesmbH
Design:	pellets firing with special retort
Type:	P 4 Pellet 8
Year of construction:	2006
Air supply for combustion:	primary and secondary by air dampers
Fuel feeding:	regulated by lambda probe control
Boiler control:	Lambdatronic P 3200

2.2.1.3 Heat exchanger, integrated in the boiler

Manufacturer:	Fröling Heizkessel- und Behälterbau GesmbH
Design:	counter-current passed through heat exchanger with three passes

2.2.1.4 Appliances for emission collection

Exhaust fan (appliance for emission collection)

Motor:	Manufacturer:	Lafert
	Type:	LM 63S2B5
	Serial-no:	467687
	Speed:	2850 min^{-1}
	Power requirement:	0.09 kW

2.2.1.5 Appliances for emission reduction

Efficiency optimization system (WOS):

Manufacturer:	Fröling Heizkessel- und Behälterbau GesmbH
Intended use:	for cleaning the third pass of the heat exchanger tubes and to discharge flue ash
Reduced pollutants:	dust

2.2.1.6 Data of emission source

Design:	stainless steel
Connected units:	up to 3 test stands
Number of stack drafts:	1
Stack height over ground:	8 m
Outlet diameter:	D = 0.20 m
Outlet sectional area:	A = 0.03 m^2

3. BASES

3.1 STANDARDS OF THE ACCREDITED TESTING LABORATORY AND SUPERVISORY BOARD

- ÖNORM EN 303-5 - "Heating boilers – Part 5: Heating boilers for solid fuels, hand and automatically stocked, nominal heat output of up to 300 kW – Terminology, requirements, testing and marking"; 01.07.1999. (Accredited scope of the testing laboratory limited to activities in accordance to point 5, no limitation in the accredited scope of the supervisory board).

- ÖNORM M 5861-1 - "Manual determination of particle concentrations in fluid gases; Gravimetric Method, General requirements"; April, 01, 1993.

- ÖNORM M 9415 "Measuring technique; Measurement of the emission of substances into the atmosphere", 01.01.2004.

- VDI 2066, Part 1 - "Particulate matter measurement; measuring of particulate matter in flowing gases; gravimetric determination of dust load; Oversight", October 1974.

- VDI 2456, Part 5 - "Gaseous emission measurement; measurement of nitrogen monoxide; chemiluminescence unit; thermo electron model 10;" May 1978.

- VDI 2456, Part 6 - "Gaseous emission measurement; determination of the sum of nitrogen monoxide and nitrogen dioxide as nitrogen monoxide by use of a converter;" May 1978.

- VDI 2459, Part 6 - "Gaseous emission measurement; measurement of carbon monoxide concentration; non-dispersive infrared absorption method"; November 1980.

- ÖNORM EN 12619 – "Stationary source emissions – Determination of the mass concentration of total gaseous organic carbon at low concentration in flue gases – Continuous flame ionisation detector method"; 01.01.1997.

- VDI 3481, Part 1 - "Gaseous emission measurement; determination of hydrocarbon concentration; flame-ionization-detector (FID);" August 1975.

- VDI/VDE 2640, Part 3, "Measurement of gas flow in circular, annular or rectangular sections of conduits velocity area method"; Nov. 1983.

- DIN 51718 – "Testing of solid fuels - Determination of the water content and the moisture of analysis sample"; 01.06.2002.

3.2 OTHER BASES

- 7. Revision of the accreditation decree of the TÜV Austria, issued by the Austrian Minister of Economics and Labour, No. 92714/0212-I/12/2005 from 03.05.2005.

- 9. Revision of the accreditation decree of the TÜV Austria, issued by the Austrian Minister of Economics and Labour, No. 92714/0543-I/12/2006 from 19.02.2007.

- Quality assurance system of TÜV Austria.

- ÖNORM EN 304 - "Heating boilers – Test code for heating boilers for atomizing oil burners"; 1992/A1:1998.

- BGBl. II No. 331/1997 – "331. Federal Law Gazette of the Minister of Economic Matters on the construction, the mode of operation, the equipment and the permissible extent of the emission from units to the firing of solid, liquid and gaseous fuels in commercial plants (regulation concerning heating systems – FAV), November, 18, 1997.

- OÖ LGBl. 56/1995 – "Agreement according to article 15 a B-VG about "Schutzmaßnahmen betreffend Kleinfeuerungen"", July 18, 1995.

- BGBl. No. 388/1995 – "Agreement between the Austrian Federation and the Austrian Federal States according to article 15a B-VG about "Einsparung von Energie"", June 9, 1995.

- ÖNORM M 7510-4 – "Checking of heating systems for solid fuels with nominal heat output up to 300 kW", 01.05.1997.

- DIN 4702-2 - "Central heating boilers; test code; March 1990.

- ÖNORM CEN/TS 14774-1, prestandard – "Solid biofuels – Methods for determination of moisture content – Oven dry method – Part 1: Total moisture – Reference method"; 01.11.2004.

- DIN 43710 - "Measurement and control; electrical temperature sensors, reference tables and materials of thermocouples"; September 77.

- DIN 1942 - " Acceptance test code for steam generators (VDI-rules for steam generators)"; February 1994.

- Test report of Holzforschung Austria about the analysis of wood samples, order no. 1601/2006-RB, from 06.12.2006.

- Test documents, drawings, operating instructions and installation instructions of the Fröling Heizkessel- und Behälterbau GesmbH for the pellets boiler type P 4 Pellet 8.

4. TEST OF THE GENERAL REQUIREMENTS

4.1 CONSTRUCTION REQUIREMENTS

For the subject pellets boiler type of the make Fröling, type P 4 Pellet 8, an EC-Conformity Declaration of the manufacturer was handed over to TÜV Austria, in which

- the EC-Directives 89/392/EEC, 73/23/EEC and 89/336/EEC
- ÖNORM EN 303-5 and ÖNORM EN ISO 3834-2 as used harmonised standard
- DIN 4702-2 and TRVB H118 as national technical guideline

are mentioned.

A copy of the production documentation, in which the corresponding drawings, the manufacturing controls, the execution of welding work, the welding seams and welding fillers, the wall thicknesses and the safety designs are comprehended, were handed over the TÜV Austria and can be looked into in the test centre Thalheim/Wels.

In looking over the production documentation, which was handed over the TÜV Austria, no difference to the construction requirements of ÖNORM EN 303-5 could be ascertained. An evaluation of the fire protection systems used in the boiler unit will be compiled in a separate expertise by the Institute for Fire Protection Engineering and Research Ltd...

The essential construction requirements of ÖNORM EN 303-5 for the subject boiler type are described in extracts below.

4.1.1 General requirements

Boilers shall be fire-resistant and safe to operate. They shall be made of non-combustible materials and shall be resistant to deformation and shall be such that

- they shall withstand the stresses arising during normal operation;
- the heat carrier (water) shall not become heated to a dangerous extent;
- gases shall not leak from the boiler in dangerous quantities into the place of installation;
- when the boiler is operated correctly flames do not flare out and embers do not fall out;
- dangerous accumulations of combustible gases in the combustion chamber and in the flues are prevented;

Component parts of covers, operating controls, safety devices and electrical accessories shall be arranged in such a way that their surface temperature, under steady state conditions, do not exceed those specified either by the manufacturer or in the component part standard.

The materials for the parts subject to pressure shall be in accordance with generally accepted technical requirements. They shall be suitable for the purpose and treatment intended.
The mechanical and physical properties as well as the chemical composition of the materials shall be guaranteed by the relevant material producer.

In addition the range of the draught stated by the manufacturer in the technical documentation shall be observed.
In the operating instructions the proper, safe operation of the unit has to be described and the risks in the case of incorrect noted.

At the tested pellets boiler type P 4 Pellet 8 no difference to the general requirements which are mentioned in point 4.1.1. of ÖNORM EN 303-5 could be ascertained.

4.1.2 Production documentation

4.1.2.1 Drawings

In the drawings of the pellets boiler type and in the corresponding documents handed out to the TÜV Austria are specified:

- the materials used;
- the welding process, the seam type and the welding fillers;
- the maximal allowable operating temperature in °C;
- the maximal allowable operating pressure in bar;
- the test pressure in bar;
- the nominal heat output in kW in accordance with the fuel

4.1.2.2 Manufacturing controls

A Quality Manual shall be compiled on the inspections and tests necessary during the manufacturing process.
Before starting the production and in the serial production the manufacturer has to see for himself, that according to his Quality Assurance System, the execution of construction work corresponds to the construction regulations, the specified materials has been used in the manufacturing, the welding has been done correctly and all needed tests were performed successfully.

A Quality Manual and a quality management system certified after EN ISO 9001:2000 do exist at the boiler manufacturer for the entire product range.

4.1.3 Heating boilers made of steel and non-ferrous materials

The boiler manufacturer was in possession of a certificate with the No. A/050/04, issued by TÜV Austria at 10.01.2005, that the regulations of § 14 Kesselgesetz (Austrian Federal Law Gazette No. 211/1992) are fulfilled.

4.1.3.1 Execution of welding work

Boiler manufacturers who carry out welding work shall meet the requirements of EN 287, part 1 and part 2.

There are to be used here:

- only welders who are qualified in the welding of the materials to be processed may be used
- equipment shall be available to allow defect free welding to be carried out
- supervision of the welding shall be carried out by staff qualified in welding (at least 1 supervisor shall be so qualified, here: 1 welding technologist and 1 welding foreman)

4.1.3.2 Welding seams and welding fillers

The used materials shall be suitable for welding.
In executing the welding seams the adherence of the requirements of the ÖNORM EN 303-5 has to be observed and be ensured by appropriate controls.

The used welding fillers have to be suitable for the material being used.

The used materials are suitable for welding and do not require additional heat treatment after welding.

In executing the welding seams the adherence of the requirements of the ÖNORM EN 303-5 has to be observed and be ensured by appropriate controls.

The used welding fillers allow a welding connection which matches to the base material.

The terms underlying at the subject boiler type are in accordance with EN 22553, the reference numbers of welding processes are in accordance with ISO 857 and EN 24063.

4.1.3.3 Parts of steel subject to pressure

The steels listed in table 1 of the ÖNORM EN 303-5 shall be used.
The specifications of the materials used in the subject boiler type are documented by works certificates (in accordance with EN 10204, with the exception of small parts) by the boiler manufacturer.

4.1.3.4 Minimum wall thicknesses

The minimum wall thicknesses comply with the thicknesses listed in ÖNORM EN 303-5, table 3, point 4.1.3.4. by taking account of

- the maximum allowable operating pressure,
- the nominal heat output and
- the material properties

In the perusal of the documents of the tested pellets boiler type P 4 Pellet 8, which were handed over to the TÜV Austria, no deviations to the requirements of ÖNORM EN 303-5, mentioned in the points 4.1.2 and 4.1.3, could be ascertained at test time for execution of welding work, welding seams, welding fillers, parts of steel subject to pressure and minimum wall thicknesses.

4.1.4 Safety and design requirements

4.1.4.1 Venting of the water sections and gas flue passages

The boiler and its components shall be designed in such a way that their respective water sections can be fully vented.

The boiler shall be so designed that under normal operation in accordance with the manufacturer's instructions no undue boiling noises occur.

At the subject pellets boiler type a ½ inch-connection at the highest place of the heat exchanger tube is installed for water-section venting.

The boiler installation shall carry out increasing towards the flow connection. In accordance to the manufacturer's specification the venting of the water section shall be provided by customer with a venting appliance.

The correct installation of the heating boiler (increasing towards the flow connection), the preparation of a corresponding connection in the flow needed by customer and the venting procedure has to be included in the installation instructions and in the operation instructions.

The combustion chamber and the flue gas passages shall be designed in such a way that no dangerous accumulation of combustible gases is possible (here: realized by exhaust fan with adequate run-down times after boiler shutdown and with O_2-control).

4.1.4.2 Cleaning of heating surfaces

The heating surfaces shall be accessible from the flue gas side for inspection and cleaning with chemical agents and brushes. A sufficient number and appropriate arrangement of cleaning openings shall be provided. If special tools (for example special brushes) are required for cleaning and maintenance of the boiler these should be supplied.

At the heating boiler type P 4 Pellet 8 the cleaning of the first two passes takes place with brushes supplied by manufacturer. The automatic cleaning of the third pass is made by the integrated WOS-system.
Further at the top side of the boiler a cleaning cover port is situated behind the boiler insulation for the annual maintenance at boiler shutdown.

In accordance to the manufacturer's specification the special tools for cleaning and maintenance are included.

4.1.4.3 Inspection of the flame

A facility shall be provided which allows inspection of the flame or fire bed. If this facility is a door, then hazard-free inspection shall be possible.

A facility shall be provided which allows inspection of the flame or fire bed. If this facility is a door, then hazard-free inspection shall be possible (here: sheet with metallised film, set on edge, situated in the zone of filling duct/downcomer of the stoker screw conveyor with the possibility of fire-bed inspection.

4.1.4.4 Water tightness

Holes for screws and similar components which are used for the attachment of removable parts shall not enter into spaces through which water flows. This does not apply to pockets for measuring or control and safety equipment.

4.1.4.5 Replacement parts

Replacement and spare parts (e.g. inserts, shaped firebricks, Wirbulatoren etc.) shall be designed, made or marked in such a way that their installation in accordance with the manufacturer's instructions shall be correct.

4.1.4.6 Water side connections

Adaptor nipples shall comply with the Standards ISO 7-1 ISO 7-1, ISO 7-2, ISO 228-1 and ISO 228-2 and flange connections shall comply with ISO 7005-1, ISO 7005-2 and ISO 7005-3. The arrangement of the connections shall be such that they are easily accessible and the function of each respective connection can be adequately fulfilled. There shall be sufficient space around the connection to allow the installation of the connecting pipes (flanges, bolts) with necessary tools.

Threaded pipe connections above DN 50 should not be recommended. Threaded pipe connections with nominal diameters above DN 80 are not permissible. If connections are fitted with flanges, the mating flanges and seals shall also be supplied except standardized flanges are available.

The boiler shall have at least one connection for filling and emptying. This connection may be common. The size of the connection shall be as minimum

- G 1/2 for nominal heat outputs up to 70 kW

At the pellets boiler type P 4 Pellet 8 are installed:

- Feed and return: 1 connection each, with 1 inch in each case
- Filling/emptying: 1 connection ½ inch

4.1.4.7 Connections for control and indicating equipment, and safety thermostat

Every boiler shall be equipped with at least one connection for an immersion pocket for temperature control, safety-temperature limiter and thermometer. Its minimum nominal diameter shall be G ½.

Deviations are allowed, provided that the control devices are supplied with the boiler, and that they can not be substituted by other components.

The position of the connections shall be chosen in such a way that the temperature of the boiler water is recorded with sufficient accuracy. Where additional connections for safety devices such as a pressure detector, monometer, low water cut-out device or a safety valve are provided for, their size, especially the safety valve is to be determined according to the output of the boiler.

At the water-side of the pellets boiler type P 4 Pellet 8 two immersion pocket sockets, with a nominal diameter ½ inch each, are installed.

4.1.4.8 Thermal insulation

All boilers shall be fitted with thermal insulation. The thermal insulation shall withstand normal thermal and mechanical stresses. It shall be made of non-combustible material and shall not give off fumes during normal running (here: aluminium-coated multi-disc-insulating mat, size 50 mm).

4.1.4.9 Water side resistance of the boiler

The water side resistances was determined for those flows which correspond to the nominal heat output with two temperature differences of 10 K and 20 K between the flow and return connections of the boiler. The results are mentioned in the test report in point 6.3.

4.1.4.10 Temperature control and limiting devices

The control and safety devices described in the sections below and the appropriate installation options shall be provided for each boiler, depending on the type of firing system and the type of protection provided for the installations in which the boiler is to be fitted. The equipment required in each case shall be supplied by the boiler manufacturers along with the boiler; if not precise specifications shall be given in the installation instructions, in particular the limit values and time constants for safety temperature limiter.

Temperature control and limiting devices for closed vented system

When used in thermostatically protected heating installations the firing system shall either rapidly or partly disconnectable, and/or the heat or residual heat output not absorbed by the heating system shall be dissipated reliably using a safety heat exchanger or equivalent devices.

At the subject pellets boiler type a rapidly disconnectable firing system is installed, which equipment consists of a temperature controller and a safety temperature limiter in accordance to ÖNORM EN 303-5.

4.1.4.11 Combustion chamber

The combustion chamber shall be designed in such a way that the fuel moves freely and the duration of the combustion period is assured.
In the context of the type test the fulfilment of the requirement was proven.

4.1.4.12 Ash chamber

The capacity of the ash chamber shall be adequate for a combustion period of at least 12 hours using the stipulated fuel and at nominal heat output – taking into account the unobstructed flow of air under the grate.
If – like in this case – the system is designed with devices for automatic ash and clinker removal, the requirement mentioned above shall be considered as met.

4.1.4.13 Stoking devices

It is assumed that automatic stoking systems shall be designed with a safety device to prevent back-burning into the feeder or metering device or creating a blow-back.
In the subject case the fuel feeding takes place diagonally top down through a downpipe, which can be sealed by a closing slide from further fuel feed for back-burn safety.
Confirmations for the proper fire protection of the unit will be **compiled in a separate expertise according to boiler manufacturer statement.**

4.1.4.14 Heating boiler accessories

If the boiler is factory equipped with additional fittings and if they need to be serviced to ensure the correct operation and safety of the boiler, the design should not require extensive dismantling work.

4.1.4.15 Electrical safety

The requirements of electrical safety are to be conducted on the basis of EN 60335-1.

(1) General specifications
- type of the boiler protection (in accordance with EN 60529);
- specifications concerning electrical components (e.g. switches, relays).

(2) Certificates of conformity:
Detailed certification is to be supplied by the equipment manufacturer for:

- heating;
- operation of equipment with electrical heating elements under overload condition;
- interference suppression;
- thermal endurance, resistance to creeping.

An appropriate CE-Conformity Declaration concerning the low voltage directive made by the boiler manufacturer are hand on at TÜV Austria with the test documents.

An EMC-compatibility test of the forerunner control model used in the pellets boiler type (type Lambdatronic 3100 according to EN 60335-1 and EN 50165) was hand on at TÜV Austria in the context of type test.
An EMC-compatibility test of the used heating boiler control Lambdatronic P 3200 was not on hand by TÜV Austria at test time. This EMC-compatibility test shall be initiated by the boiler manufacturer.

4.1.4.16 Surface temperatures

In the context of the nominal heat output test the surface temperatures of the boiler and the boiler parts shall not exceed the room temperature by more than the following temperatures in accordance to point 5.12 of ÖNORM EN 303-5:

- mean surface temperature of boiler doors and cleaning port covers on the operator side: 100 K
- surface temperature on the outside of the boiler bottom: 65 K
- surface temperature of operating levers and all parts which shall be touched by hand during operation of the heating boiler:
  - 35 K for metals and similar materials
  - 45 K for porcelain and similar materials
  - 60 K for plastic and similar materials

At the subject boiler type the internal boiler components which are arranged at the boiler front are fully covered by an insulation door which protects against the possibility of direct contact.

In the context of type test the tested pellets boiler type P 4 Pellet 8 showed in case of conventional and appropriate use no deviations to the safety and design requirements of the ÖNORM EN 303-5 mentioned in point 4.1.4 of the report.

4.2 PRESSURE TESTS

The type test pressure is 2 x p_1 using hydraulic pressure (p_1 is the maximum permissible operating pressure, here: p_1 = 3 bar).

The test period shall be at least 10 minutes and if it is to apply to a range of boilers, the test shall be carried out on at least 3 boiler sizes (smallest, medium and largest size).

No leakage or noticeable permanent deformation shall occur during the test.

A record shall be made of the test giving the following details:

- exact description of the boiler tested stating the drawing number;
- test pressure in bar and test duration;
- test result and
- place and date of the test including the names of the persons carrying out the test. The test report shall be signed by, as minimum the works tester responsible and one witness.

An adequate record of a rating test of the pellets boiler type P 4 Pellet 8 with no complaints is on hand the TÜV Austria (test pressure 2 x p_1 = 6 bar, test duration 15 minutes).

4.2.1 Test during production

During production the test pressure of the pellets boiler type P 4 Pellet 8 shall be according to ÖNORM EN 303-5 a minimum of 4 bar.

The requirements of ÖNORM EN 303-5, mentioned in point 4.3, 4.4.1 and 4.4.2, represent information from TÜV Austria to the boiler manufacturer, which specifications has to be enclosed in the technical documents being supplied with the boiler.

4.3 DESIGNATION

Each heating boiler shall have a data plate. The boiler data plate shall be written in the language of the boiler's country of destination and be affixed in an accessible spot.

4.3.1 Information on the boiler plate

a) name and company domicile of the manufacturer and, where available, the manufacturer's symbol;
b) trade designation, type under which the boiler is marketed;
c) production number and year of construction (coding is permissible at the manufacturer's discretion);
d) nominal heat output and heat output range in kW for each type of fuel;
e) boiler class;
f) maximal allowable operating pressure in bar;
g) maximal allowable operating temperature in °C;
h) water content in l;
i) electrical connection (V, Hz, A) and wattage in W.

4.3.2 Data plate requirements

The material and labelling used for the plate shall be durable. The labelling shall be abrasion-proof. Under normal operating conditions the plate shall not discolour so as to make its information difficult to read.

4.4 TECHNICAL DOCUMENTATION, SUPPLIED WITH THE BOILER

For each boiler the documents listed below shall be available, preferably in the language of the boiler's country of destination; the documents specified under point 4.4 shall be enclosed with every boiler.

The heating boiler type P 4 Pellet 8 showed exhaust gas temperatures below 160 K above room temperature in the context of the type tests performed by TÜV Austria at nominal heat output (see point 6.1.1).
Therefore the boiler manufacturer shall make recommendations in the installation instructions regarding the flue installation in order to ensure sufficient draught and to prevent sooting up of the chimney and condensation.

Furthermore the range of the draught in accordance to the design shall be specified, and the correct and safe operation of the unit and information about the risks caused by improper operation has to be noted in the operating instructions.

The correct installation of the heating boiler (increasing towards the flow connection), the preparation of a corresponding connection in the flow needed by customer and the venting procedure has to be included in the installation instructions and in the operation instructions.

A copy of the technical information (operating instructions and installation instructions) was hand over TÜV Austria in the context of the tests and can be looked into in the test centre Thalheim/Wels.

The technical documents being enclosed with the heating boiler shall contain the indications mentioned in point 4.4 and has to be updated.

Other documents (brochures, etc.) shall not contain any information that is in contradiction with those of the operating instructions.

4.4.1 Technical information and installation instructions

These documents shall contain at least the following indications in addition to the data listed in point 4.4:

- necessary draught in mbar;
- water content in l;
- exhaust gas temperature at nominal heat output and minimum heat output in °C;
- exhaust mass flow nominal heat output and minimum heat output in kg/s;
- flue pipe diameter in mm;
- water-side resistance in mbar;
- nominal heat output and heat output range for each type of fuel in kW;
- boiler class;
- combustion period in hours for each type of fuel at Q_N;
- setting range fort he temperature controller in °C;
- minimal return temperature at boiler return tapping in °C;
- fuel type and water content as well as fuel size;
- filling chamber capacity in litres and filling opening dimensions in mm;
- necessary accumulator storage in litres if $Q_{min} > 0{,}3\ Q_N$;
- auxiliary power requirement in W;
- cold water temperature and pressure for safety heat exchanger in bar;
- electrical connections including appliance- and main-switch-off.

The installation instructions shall contain information concerning:

- the on-site assembly of the boiler (if necessary) and the required pressure test;
- the installation;
- the commissioning, with information on the boiler output to be set in the output range;
- instructions on the location and fitting of the sensors for the control, display and safety equipment.

In addition the documents shall general contain references to the Standards and Regulations has to be observed on the safety equipment of the installation.

4.4.2 Operating instructions

The operating instructions shall contain references to:

- the operation of the boiler, stoking and opening doors without risk;
- cleaning and cleaning intervals, including the equipment required fort he cleaning operations;
- measures to be taken in the event of malfunction;
- the reasons for recommending a regular, competent maintenance service and the necessary maintenance intervals;
- the type of fuel and water content and the fuel size (with the direction of the layers in the case of split logs);
- the maximum filling height for fuel in the filling chamber;
- the combustion period for fuel types at nominal heat output.

5. TEST OF THE BOILER PERFORMANCE REQUIREMENTS

5.1 BOILER PERFORMANCE TEST

5.1.1 Choice and condition of the tested boiler

Fittings and accessories supplied by the manufacturer have been installed and used correctly at the tested boiler. The operating and installation instructions were considered.
The condition and the equipment of the boiler to be tested were conforming to the future normal supply specification in accordance with the manufacturer's instruction and the documents provided to TÜV Austria.

Additional thermal insulation to parts in contact with water, products of combustion and fire were not used.

The boiler manufacturer shall ensure that all boilers of the tested pellets boiler type P 4 Pellet 8 conform to the requirements of ÖNORM EN 303-5.

5.1.2 Setting up the test rig

The boiler performance test has been carried out at the test rig of the Fröling Heizkessel- und Behälterbau GesmbH in Grieskirchen.
The test rig and the flue gas measuring section corresponded with the requirements of ÖNORM EN 303-5.

The measuring instruments and the measuring methods corresponded with the requirements of ÖNORM EN 303-5.

The useful heat output transmitted to the water was determined by a calibrated heat meter by measuring the flow of the water circulating in the boiler circuit and its temperature rise.
The determination of the boiler efficiency of the biomass heating system has been performed following the formalism of the direct method expressed in ÖNORM EN 303-5.

5.1.3 Measured quantities

One-off measurement:

- water content of the fuel;
- fuel mass added;
- combustion period;
- surface temperatures (at nominal heat output in a typical operating condition in accordance with ÖNORM EN 303-5)
- auxiliary power consumption in sleeping operation, at ignition process (electrical work) and from the key consumers (fan motor, motor for cleaning of heating surfaces and to discharge flue ash, fuel discharge (suction device), stoker screw conveyor, back-burning damper motor)

Continuous measurement:

- heat output;
- flow temperature;
- return temperature;
- flow;
- ambient temperature;
- exhaust temperature;
- oxygen concentration (O_2);
- carbon monoxide concentration (CO);
- concentration of organic gaseous substances (OGC, shown as organically bound carbon);
- nitrogen oxides concentration (sum of NO and NO_2, shown as NO_2);
- auxiliary power consumption of the entire unit;
- draught (static pressure in the flue gas pipe)

Discontinuous measurement:

- dust content

5.1.4 General test conditions

To determine the heat output, boiler efficiency, combustion period, composition of the combustion gas, exit flue temperature, draught and emission properties, the boiler has been operated throughout the tests within the specified heat output range.

The boiler heat output is the average of the output recorded during the test period.

At nominal heat output the boiler was operated in such a way that continuous running was possible without thermostat cut-off.
The minimum heat output was regulated by a control device.

The boiler was brought to operating temperature before the start of measurements, the draught was adjusted in accordance with the manufacturer instruction and the boiler was operated during the test in accordance with the manufacturer instructions.

The test duration and thus also the combustion period duration was both at nominal heat output and at minimum heat output at least 6 hours.

The continuously registering measuring instruments for the determination of pollutant concentrations of the flue gas were taken at the test rig the day before the test.

The ambient temperature values were between 15°C and 30°C.

During tests at nominal heat output it was made certain that the mean value of flow temperature lay between 70°C and 90°C, whereby the mean temperature difference lay between flow and return between 10 K and 25 K.

Further during tests at nominal heat output the temperature mentioned below was maintained:

$$\frac{t_V + t_A}{2} - t_L \geq 40{,}0K$$

Where:

t_V flow temperature in °C
t_A return temperature in °C
t_L ambient temperature in °C

During tests at minimum heat output this was regulated before starting the test and also made certain that the mean value of flow temperature lay between 70°C and 90°C.

5.1.5 Determination of the boiler efficiency

The efficiency of the biomass heating system was determined according to the formalism of the direct method shown in ÖNORM EN 303-5 and related on the basis of the net calorific value H_u of the fuels being used.

During the test duration the boiler heat output was determined as average of the recorded values of the output.

The determination of the fuel mass fed to the biomass heating system took place via weighing with a calibrated top-pan balance (owner: TÜV Austria) of the type Mettler PM 4600,
maximum weight 4100 g, resolution 0.1 g.

Procedure for determination of fuel mass, added in the test period:

For this purpose in the lower zone of the pellets hopper, installed at the boiler unit, was fixed a mark before test start.

At test start and at test end the fuel filling height was pulled off on the mark.

The batchwise added amounts of fuel has been weighed by the balance mentioned above.

The useful heat output transmitted to the water was determined by a calibrated heat meter by measuring the flow of the water circulating in the boiler circuit and its temperature rise, whereby calibrated temperature sensors were installed in the flow and the return.

Technical data of the heat meter including calculation unit

Manufacturer:	Kamstrup
Type:	66C43B1372
Serial number:	4938240/2006
Flow/pulse ratio:	q_P 3.5 m³/h / 50.0 impulses/l
Location of flow measuring system:	in the horizontal return
Temperature measurements:	Pt 500
Last calibration:	2006

Calculation of the boiler efficiency

$$Q_B = \frac{m_B.Hu}{3600} \qquad \eta_K = \frac{Q}{Q_B}.100$$

Q.....	heat output, the useful heat to water delivered by a boiler per unit time	in kW
Q_B.....	heat input, the amount of heat in unit time which is supplied to the furnace of the heating boiler by the fuel based on its net calorific value H_U.	in kW
H_u.....	net calorific value of the test fuel, as fired basis	in kJ/kg
η_K.....	boiler efficiency, ratio of the delivered useful heat output to the heat input	in %
m_B.....	fuel mass added to the heating boiler in the test period	in kg

The estimated measurement uncertainty of the total procedure for the determination of the boiler efficiency is ± 2 per cent.

5.1.6 Determination of the exhaust gas loss (loss through sensible heat of the products of combustion)

The exhaust loss of the biomass heating system was calculated by the formalism mentioned below in accordance to the 331. Federal Law Gazette of the Minister of Economic Matters on the construction, the mode of operation, the equipment and the permissible extent of the emission from units to the firing of solid, liquid and gaseous fuels in commercial plants (regulation concerning heating systems – FAV) from 18.11.1997:

Exhaust gas loss (%) $q_A = (t_A - t_L) . [A_2/(21 - O_2) + B]$

t_A..... exhaust gas temperature °C (measured on the measuring point after flue exit of the boiler)
t_L..... ambient temperature in °C
O_2..... dry oxygen content of the flue gas in % of vol.
A_2..... 0.6644 for biomass with the test fuel wood pellets (water content of the fuel: 6.5 %)
B..... 0.0102 for biomass with the test fuel wood pellets (water content of the fuel: 6.5 %)

The input data used for the calculation of the exhaust gas loss at the measuring point after flue exit of the boiler are mentioned in point 6.1.1.

The estimated measurement uncertainty of the total procedure for the determination of the exhaust gas loss is ± 0.5 per cent.

5.1.7 Determination of the emission values

The average O_2, CO, OGC and NOx contents are determined over the entire test period.

To determine the dust content the test period was divided into at minimum 4 equal time sections and the suction time per filter was limited to 30 minutes.
The average dust content was determined from the 4 half-hours values at minimum.

The volume of combustion gas was calculated by means of combustion gas calculation using the DIN 4702 on the basis the chemical elementary analysis of the test fuel and the amount of fuel fired in the test period.

The velocity of the flue gas at the measurement point used to determine dust emissions was calculated from the volume of combustion gas, taking into account of pressure, temperature and moisture content.

For the calculation of the mean value of the emissions of O_2, CO, OGC and NOx the measured concentrations have to be weighted of the flue gas volume.
In accordance to ÖNORM EN 303-5 the acceptable approximation for the calculation of the mean value – the calculation of the mean value of the period independent of the volume stream of the flue gas – was used.

The part of organic gas parts was determined and given as organically bound carbon (OGC) in dry flue gas.

The determination of the part of organic gas parts (OGC) was performed without splitting the individual components with a flame ionization detector (FID) for which calibration propane was used.

The sum of nitrogen oxides (NO_x), measured as sum of nitrogen monoxide (NO) and nitrogen dioxide (NO_2), is calculated and shown as nitrogen dioxide (NO_2).

5.1.8 Surface temperatures

For the determination of the mean surface temperature at nominal heat output the boiler surface was divided in 11 incremental areas, whereby a total of 62 measuring points were regarded.

Under the same conditions the critical surface temperatures (e.g. boiler doors, operating levers etc.) and the surface temperature on the outside of the boiler bottom were measured at nominal heat output (under the same conditions).

5.2 DETERMINATION OF THE WATER SIDE RESISTANCE

The water side resistance was determined for the flow which is equivalent to the rated output of the healing boiler at a temperature difference of Δt = 10 K and Δt = 20 K between the flow and the return.

5.3 TEST FUEL

The tests were performed with the test fuel of commercial quality mentioned below.
The supply of the test fuel took place via the boiler manufacturer.

Test fuel: wood pellets, producer company Hot'ts, d = 6 mm (15-kg-bags)

5.3.1 Fuel analysis

In the test period samples of the test fuels were taken by the specialist of the TÜV Austria (Mr. Schrögendorfer).

The determination of the water content of the fuel samples took place via drying process in a drying oven in accordance to DIN 51718 and ÖNORM CEN/TS 14774-1, prestandard, Part 1, in the test centre Thalheim/Wels of the TÜV Austria.

The elementary analysis and the determination of the net calorific value of the fuel samples were performed by the company Holzforschung Austria in Vienna. The results of the fuel analysis are shown in the test reports of the company Holzforschung Austria about the analysis of wood samples, order no. 1601/2006 – RB from 06.12.2006.

The results of the fuel analysis of the test fuel fired in the test period performed by TÜV Austria and Holzforschung Austria are mentioned below (related to raw condition).

	fuel wood pellets	
Net calorific value of the fuel (H_u):	17.420	kJ/kg
Water content of the test fuel (W):	6.5	% of mass
Carbon content of the test fuel (C):	47.2	% of mass
Hydrogen content of the test fuel (H):	6.3	% of mass
Oxygen content of the test fuel (O):	39.6	% of mass
Nitrogen content of the test fuel (N):	0.09	% of mass

5.4 MEASUREMENT INSTRUMENTS AND METHODS

5.4.1 Flue gas boundary conditions

5.4.1.1 Flue gas volume and flue gas velocity

The volume of combustion gas was calculated by means of combustion gas calculation using the DIN 4702 on the basis the chemical elementary analysis of the test fuel and the amount of fuel fired in the test period.
The velocity of the flue gas at the measurement point used to determine dust emissions was calculated from the volume of combustion gas, taking into account of pressure, temperature and moisture content.

5.4.1.2 Static pressure in the flue gas pipe (draught)

Measuring Method:	determination of differential pressure between static pressure in the flue gas pipe and ambient pressure
Guideline:	VDI 2066, Part 1
Instrument:	Prandtl's pitot tube in combination with a calibrated micromanometer
Manufacturer:	Special Instruments
Type:	Digima FP auto zero
Range:	0 – 5 hPa
Uncertainty:	± 5 % of the measured value

5.4.1.3 Air pressure at the height of the sampling point

Instrument:	calibrated precision barometer for the measurement of the absolute air pressure
Manufacturer:	Lufft
Type:	Model 2039, transportable
Uncertainty:	± 1 hPa

5.4.1.4 Flue gas temperature

Measuring method:	thermoelectric
Guideline:	DIN 43710
Sensor:	Fe-Cu-Ni thermocouples
Instrument:	digital display instrument
Manufacturer:	Mesa Electronic
Type:	A009.411.40.40
Uncertainty:	range ≤ 150°C: ± 2°C range > 150°C: ± 1.5 % of the measured value

5.4.1.5 Ambient air and combustion air temperature

Instrument:	electronic hand measuring instrument
Sensor:	Pt 100
Manufacturer:	Testo
Type:	Testo 925
Uncertainty:	± 1°C

5.4.1.6 Proportion of water vapour in the flue gas (flue gas humidity)

The flue gas humidity was calculated taking into account the elementary analysis of the test fuel and the continuously recorded measured flue gas composition on the basis of DIN 1942.

5.4.1.7 Flue gas density

Calculated taking into account the flue gas proportions of O_2, CO_2, N_2, CO, flue gas humidity, flue gas temperature and the pressure in the flue gas duct.

5.4.2 Gaseous and vaporous emissions

5.4.2.1 Continuously recorded measurement instruments

O_2	Manufacturer:	Servomex
	Type:	OA570
	Measurement method:	paramagnetism
	Range:	0-25 % of vol.
	Uncertainty:	± 0.2 % of vol.

CO_2	Manufacturer:	Siemens
	Type:	Ultramat 22P
	Measurement method:	non-dispersive infrared absorption
	Range:	0-20 % of vol.
	Uncertainty:	± 0.2 % of vol.

CO

CO-range up to 1000 ppm:

	Manufacturer:	Siemens
	Type:	Ultramat 22P
	Measurement method:	non-dispersive infrared absorption
	Range:	0-1000 ppm
	Uncertainty:	range up to 100 ppm: ± 2 ppm range 100-1000 ppm: ± 2 % of the measured value

CO-range up to 10 vol.-%:

	Manufacturer:	Maihak
	Type:	Unor 6 N
	Measurement method:	non-dispersive infrared absorption
	Range:	0-10 vol-%
	Uncertainty:	range > 1000 ppm: ± 2 % of the measured value

NO_x	Manufacturer:	Monitor Labs
	Type:	Model 8840
	Measurement method:	chemiluminescence
	Converter:	stainless steel converter (thermostated on 750°C)
	Used range:	0-500 ppm
	Uncertainty:	± 1.5 % of range performance

C	Manufacturer:	Testa
	Type:	FID 123
	Measurement method:	flame ionisation
	Used ranges:	0-100 and 0-1000 ppm C_3H_8
	Uncertainty:	± 1.5 % of range performance

5.4.2.2 Measurement location design

The measurement location design for the determination of the gaseous components of flue gas at the measuring point is mentioned below.

Sampling probe:	Material/heating:	stainless steel, heated by flue gas
	Length:	approx. 0.5 m
	Inside diameter:	6 mm
	Outside diameter:	8 mm
Filter:	Manufacturer:	M & C
	Type:	PSP 4000 H/C
	Heating:	heated on 180°C
	Pore size:	2 µm (ceramic)

Sampling line 1 before gas conditioning:

Manufacturer:	Winkler
Material/heating:	teflone, heated on 180°C
Length:	5 m
Inside diameter:	4 mm
Outside diameter:	6 mm

After the sampling line 1 the sampling line was divided after the gas conditioning in the sampling lines mentioned below:

- sampling line 2: for determination of the concentration of organic gaseous substances (C)
- sampling line 3: for determination of the concentrations of O_2, CO, CO_2 and NO_x

Sampling line 2:

Manufacturer:	Winkler
Material/heating:	Teflon, heated on 180°C
Length:	5 m
Inside diameter:	4 mm
Outside diameter:	6 mm

Sampling line 3:

Material/heating:	silicone, unheated
Length:	0.05 m
Inside diameter:	4 mm
Outside diameter:	6 mm

Gas conditioning: combined suction, filter, cooling and controlling unit

Manufacturer:	M & C
Type:	PSS 10-1
Material cooler:	glass
Temperature cooler:	approx. 4°C
Condensate removal:	automatically

Sampling line 4 (situated after gas treatment):

Material/heating:	Teflon, unheated
Length:	approx. 25 m
Outside diameter:	6 mm
Inside diameter:	4 mm

5.4.2.3 Recording of the measured values

Logging software:	software Dasylab, company Dewetron
Module:	ISM 100 intelligent sensor module V.2.O., company Gantner
Scanning rate:	1 second
Resolution A/D-transducer:	16 bit
Uncertainty:	± 0.3 % of the measured value

5.4.2.4 Adjustment of the measurement instruments

Before starting the test periods the reference points of the gas analysis instruments were adjusted by feeding test gases of the companies Messer Austria and Siad mentioned below.

Parameter	Test gas concentration as per certificate of analysis	Manufacturer	Tolerance of test gas analysis in accordance to the manufacturers specification
CO	766 ppm CO	Siad VTG	± 2 % of test gas concentration
CO_2	15.77 % of vol. CO_2	Siad VTG	± 2 % of test gas concentration
NO_x	384 mg NO/m^3	Siad VTG	± 2 % of test gas concentration
C	92.6 ppm C_3H_8	Messer Austria	± 2 % of test gas concentration

The adjustment of the reference point of the O_2-measuring instrument was taken by ambient air. The adjustment of the zero points of the gas analysis instruments was taken by nitrogen of the quality 5.0.

5.4.2.5 Check of the instrument characteristic

In accordance to the quality assurance manual of the TÜV Austria the check of the instrument characteristics is done once a year. Recordings can be looked into in the test centre Thalheim/Wels.

5.4.2.6 Response time of the overall measuring apparatus

The response time (t_{90} – time) of all continuously recorded measured flue gas components amounted below 180 seconds.

5.4.3 Particulate emissions

5.4.3.1 Dust

Sampling probe:	titanium, heated by flue gas
Position of the filter holder:	outlying the duct
Particle filter:	plane filter made of quartz fibre
Quartz flat filter: Manufacturer:	Munktell Filter AB, Sweden
Type:	MK 360
Extraction capacity:	99.998 % related to 0.3 µm in accordance to DOP-test
Temperature stability:	max. 950°C work temperature
Material:	maximum pure silicia-fibre
Characteristics:	not hydrophobic, no organic bonding agents
Differential pressure:	180 Pa at 3 cm/s exhaust velocity
Transfer of the samples:	the time period between sampling and weighing of the used dust filters amounted to 5 – 6 days
Uncertainty:	± 5 % of the measured value, ± 0.74 mg/m³ at minimum
Sampling and analysis:	in accordance to ÖNORM M 5861-1
Drying temperature of the collection medium	
before exposure:	110 °C
after exposure:	110 °C
Drying time of the collection medium (equilibration)	
before and after exposure:	approx. 12 hours (in the dessiccator)

Gas volume meter for the determination of the flue gas sucked off during dust sampling:

Manufacturer:	Elster
Type:	dry design, G 2.5
Uncertainty volume:	± 2 % of the measured value

Analysis balance:

Manufacturer:	Mettler
Type:	AE 163
Graduation:	0.01 mg
Weighing range:	0 – 31 g

The leakage test of the apparatus for dust measurement took place via applying a vacuum before the performance of the single measurements.
The determination of the oxygen concentration at the measuring point dust was performed at the sample gas outlet of the gas volume meter with an oxygen meter of the type Servomex OA 570 (see point 5.4.2.1).

5.4.4 Surface temperatures

Manufacturer:	Testo	
Type:	Instrument:	KM 330
	Sensor:	SK 21M
Uncertainty:	± 1°C	

5.4.5 Water side resistance

Instrument:	measuring instrument for differential pressure
Manufacturer:	CBI
Production number:	S 501 0806 60404
Range:	- 5 up to + 205 hPa
Last calibration:	2002
Uncertainty:	± 5 % of the measured value

5.4.6 Auxiliary power consumption

Manufacturer:	ABB
Type:	three phase current meter type EE 22
Pulse ratio:	10 imp./kWh
Uncertainty:	± 2 % of the measured value, ± 5 W at minimum

5.5 SAMPLING POINTS FOR THE DETERMINATION OF THE EMISSION VALUES

The measurements took place at the measuring points mentioned below.

Measuring point after the flue exit of the boiler for determination of the flue gas temperature
The measuring point was situated directly after the flue exit of the boiler in the horizontal flue gas duct.

Measuring point for the determination of the gaseous pollutants
The sampling took place from the approx. 15° upwards inclined flue gas duct between the flue gas exit of the boiler and the inlet of the flue gas into the chimney.

Length of the straight inlet:	0.46 m
Length of the straight outlet:	0.69 m
Circular cross section:	D = 0.13 m

Measuring point dust
The sampling for the determination of the dust concentration of the flue gases took place approx. 0.2 m after the measuring point for the determination of the gaseous pollutants from the approx. 15° upwards inclined flue gas duct between the flue gas exit of the boiler and the inlet of the flue gas into the chimney.

Length of the straight inlet:	0.77 m
Length of the straight outlet:	0.38 m
Circular cross section:	D = 0.13 m

5.6 OPERATING CONDITIONS OF THE UNIT DURING THE MEASUREMENTS

The pellets boiler of the type P 4 Pellet 8 set up at the test rig of the Fröling Heizkessel- und Behälterbau GesmbH in Grieskirchen became fired at nominal heat output (full load) and at maximum 30 % of the heat output of the biomass heating system (minimum heat output in accordance to the manufacturers instructions, partial load) with the test fuel mentioned below in the period of 23.10. up to 25.10.2006.

Test fuel: wood pellets, producer company Hot'ts, d = 6 mm (15-kg-bags)

The determination of the amount of heat input which was supplied to the furnace of the boiler by fuel took place analytically after weighing the supplied fuel mass and with the analysis data determined from the fuel analysis of the samples by the TÜV Austria and the Holzforschung Austria.

The useful heat output transmitted to the water was determined by a calibrated heat meter by measuring the flow of the water circulating in the boiler circuit and its temperature rise.

The operating conditions of the pellets boiler type during the measurements are shown below.

Diagrams of the continuous recorded operating data of the unit during the test period are given to the report in extracts in enclosure 4.

Operating conditions of the unit during the measurements – pellets boiler P 4 Pellet 8

Parameter	Nominal heat output	Minimum heat output
Date of measurements	25.10.2006	24.10.2006
Measuring time (from – to)	13:11-19:11	09:57-15:57
Test duration (hours)	6.0	6.0
Air temperature, external the test rig (C)	18	17
Boiler temperature (°C)	74.9	75,5
Feed (%)	45	9.1
Exhaust gas fan (%)	52	19
Flow (m^3/h)	905	264
Flow temperature (°C)	75.3	75.5
Return temperature (°C)	64.4	64.5
Temperature difference flow-return (°C)	10.9	11.0
Heat output useful generated (kW)	11.30	3.14
Heat output in % of nominal heat output	107.6	29.9
Fuel mass added (kg)	15.300	4.232
Fuel mass fired per hour (kg/h)	2.550	0.7053

6. TEST RESULTS

6.1 EMISSION BEHAVIOUR OF THE BIOMASS BOILER

All given pollutant emissions are calculated as mass of the components in the dimension mg/MJ as average values over the mentioned measuring periods.
They are related to the energy content of the fuel used in the furnace as well as related to a dry flue gas basis at 0°C, 1013 hPa.

Additional the concentrations of the components related to a dry flue gas basis at 0°C, 1013 hPa at actual oxygen content and calculated on hypothetical oxygen contents of 10 % O_2, of 11 % O_2 and 13 % O_2 are given as average values in the dimension mg/m³ over the mentioned measuring periods.

The measurement uncertainty of the used measurement instruments and the measurement methods are given in point 5 of the test report.
With „<" marked values represent the relative detection limits of the used measurement instruments.

6.1.1 Flue gas boundary conditions

Pellets boiler type P 4 Pellet 8

Parameter	Nominal heat output	Minimum heat output
Date of measurements	25.10.2006	24.10.2006
Measuring time (from – to)	13:11-19:11	09:57-15:57
Test duration (hours)	6.0	6.0
Air pressure at the height of the sampling point (hPa)	976	968
Ambient air temperature (°C)	21.7	19.6
Flue gas temperature at the measuring point after the flue exit of the boiler (°C)	120	81
Flue gas temperature at the measuring point dust (°C)	117	78
Static pressure in the flue gas pipe (hPa)	- 0.09	- 0.04
Oxygen concentration (% of vol.)	8.8	10.2
Carbon dioxide concentration (% of vol.)	11.4	10.3
Flue gas humidity (kg/m³)	0.082	0.074
Specific volume of dry flue gas (m³/kg fuel)	7.66	8.48
Fuel mass fired per hour (kg/h)	2.550	0.7053
Dry flue gas volume (m³/h)	19.5	6.0
Flue gas velocity at the measuring point dust (m/s)	0.7	0.2

6.1.2 Dust

Nominal heat output

Biomass boiler type: pellets boiler type P 4 Pellet 8
Date of measurements: 25.10.2006
Test period: 13:11 – 19:11
Heat output useful generated: 11.3 kW

Measuring time from – to	actual O2-concentration % of vol.	Dust concentration related to actual O2 mg/m³	10 % O2 mg/m³	11 % O2 mg/m³	13 % O2 mg/m³	Dust emission mg/MJ
13:11-13:41	8.7	27	24	22	18	12
14:11-14:41	9.0	29	27	24	19	13
15:11-15:41	8.9	29	26	24	19	13
16:11-16:41	8.7	33	30	27	21	15
17:11-17:41	8.9	31	28	26	20	14
18:11-18:41	8.8	31	28	25	20	14
Average	8.8	30	27	26	20	14

Minimum heat output

Biomass boiler type: pellets boiler type P 4 Pellet 8
Date of measurements: 24.10.2006
Test period: 09:57 – 15:57
Heat output useful generated: 3.14 kW

Measuring time from – to	actual O2-concentration % of vol.	Dust concentration related to actual O2 mg/m³	10 % O2 mg/m³	11 % O2 mg/m³	13 % O2 mg/m³	Dust emission mg/MJ
09:58-10:28	10.1	21	21	19	15	10
10:57-11:37	10.6	12	13	12	9	6
11:57-12:27	10.6	20	21	19	15	10
12:57-13:27	9.4	31	29	27	21	15
13:57-14:39	10.4	24	25	23	18	12
14:57-15:27	10.5	29	30	28	22	15
Average	10.3	23	23	21	17	11

6.1.3 Carbon monoxide (CO), nitrogen oxides (NOx) and gaseous organic substances (OGC)

Biomass boiler type: pellets boiler type P 4 Pellet 8

Parameter	Nominal heat output	Minimum heat output
Date of measurements	25.10.2006	24.10.2006
Measuring time (from – to)	13:11-19:11	09:57-15:57
Test duration (hours)	6.0	6.0
Heat output useful generated (kW)	11.30	3.14
Oxygen concentration (% of vol.)	8.8	10.2
Emission of carbon monoxide (CO)		
at actual O_2 (mg/m^3)	53	152
related to 10 % O_2 (mg/m^3)	48	155
related to 11 % O_2 (mg/m^3)	43	141
related to 13 % O_2 (mg/m^3)	35	113
related to the energy content (mg/MJ)	24	77
Emission of nitrogen oxides (NOx)		
at actual O_2 (mg/m^3)	166	137
related to 10 % O_2 (mg/m^3)	150	140
related to 11 % O_2 (mg/m^3)	136	127
related to 13 % O_2 (mg/m^3)	109	101
related to the energy content (mg/MJ)	74	69
Emission of gaseous organic substances (OGC)		
at actual O_2 (mg/m^3)	< 1	2,8
related to 10 % O_2 (mg/m^3)	< 1	2,9
related to 11 % O_2 (mg/m^3)	< 1	2,6
related to 13 % O_2 (mg/m^3)	< 1	2,1
related to the energy content (mg/MJ)	< 1	1,4

6.2 BOILER EFFICIENCY AND COMBUSTION PERIOD

The efficiency of the biomass heating system was determined on the basis of the formalism of the direct method shown in ÖNORM EN 303-5 (see point 5.1.5).

Below the calculated results as average of the recorded average values are given for the respective test duration.

Boiler efficiency and combustion period – pellets boiler P 4 Pellet 8

Parameter	Nominal heat output	Minimum heat output
Date of measurements	25.10.2006	24.10.2006
Measuring time (from – to)	13:11-19:11	09:57-15:57
Test duration (hours)	6.0	6.0
Combustion period (hours)	6.0	6.0
Fuel mass added (kg)	15.300	4.232
Fuel mass fired per hour (kg/h)	2.550	0.7053
Net calorific value of the test fuel, related to raw condition (H_u, kJ/kg)	17420	17420
Heat output useful generated (Q, kW)	11.30	3.14
Heat output (Q_B, kW)	12.34	3.41
Boiler efficiency, direct (%)	91.6	92.0

6.2.1 Exhaust gas loss (loss through sensible heat of the products of combustion)

The exhaust gas loss (loss through sensible heat of the products of combustion) calculated by the formalism in accordance to the BGBl. II No 331/1997 (see point 5.1.6), is mentioned below.

Input data used for the calculation:

t_A..... exhaust gas temperature °C (measured on the measuring point after flue exit of the boiler)
t_L..... ambient temperature in °C
O_2..... dry oxygen content of the flue gas in % of vol.
A_2..... 0.6644 for biomass with the test fuel wooden pellets (water content of the fuel: 6.5 %)
B..... 0.0102 for biomass with the test fuel wooden pellets (water content of the fuel: 6.5 %)

The input data used for the calculation of the exhaust gas loss at the measuring point after flue exit of the boiler are mentioned in point 6.1.1 of the test report.

Calculated exhaust gas loss, pellets boiler type P 4 Pellet 8

Operating condition nominal heat output q_A = 6.4 %
Operating condition minimum heat output: q_A = 4.4 %

6.3 WATER SIDE RESISTANCE

The water side resistance of the pellets boiler P 4 Pellet 8 was determined for the flow which is equivalent to the rated output of the boiler at a temperature difference of Δt = 10 K and Δt = 20 K between the flow and the return on 25.10.2006.

Flow (l/h)	Temperature difference (K)	Differential pressure (hPa)
480	20	4.3
950	10	8.2

6.4 SURFACE TEMPERATURES

For the determination of the mean surface temperature at nominal heat output the boiler surface was divided in 11 incremental areas, whereby a total of 62 measuring points were regarded.

The critical surface temperatures (e.g. boiler doors, operating levers etc.) were measured at nominal heat output (under the same conditions).

Operating condition	Covering panel	Doors, cleaning port covers	Outside of the boiler bottom	Operating levers (plastic)	Room-temp.
	maximum value	maximum value	maximum value	maximum value	
Nominal heat output	44°C	64°C	46°C	36°C	22°C

In all tests the mean surface temperature of boiler doors and cleaning port covers on the operator side did not exceed the permissible temperature difference of 100 K against room temperature in accordance to ÖNORM EN 303-5.

The surface temperature on the outside of the boiler bottom did not exceed the room temperature by more than 65 K.

The surface temperatures of the operating levers and all parts which shall be touched by hand during operation of the boiler did not exceed the room temperature by more than 35 K.

6.5 AUXILIARY POWER CONSUMPTION

Biomass boiler type: pellets boiler P 4 Pellet 8
Test period: 24.10. and 25.10.2006

Date	Parameter	Measuring time from – to	Test duration	Measuring result
25.10.2006	Nominal heat output (11.30 kW)	13:11-19:11	6.0 h	Average: 95 W
24.10.2006	Minimum heat output (3.14 kW)	09:57-15:57	6.0 h	Average: 89 W
24.10.2006	Ignition process (electrical work)	17:40-17:48	8 min	83 Wh
24.10.2006	Sleeping operation (average)	16:40-17:02	22 min	8 W
24.10.2006	Key consumers - fan motor (exhaust fan) – 100 % - motor for cleaning of heating surfaces and to discharge flue ash - fuel discharge (suction device) - stoker screw conveyor - grate cleaning motor - back-burning damper motor			 114 W 56 W 1225 W 56 W 16 W 6W

6.6 FUNCTION CHECK OF THE TEMPERATURE CONTROLLER, THE SAFETY TEMPERATURE LIMITER AND ON THE DEVICE FOR DISSIPATING EXCESS HEAT

The function check of the temperature controller, the safety limiter and on the device for dissipating excess heat of the biomass heating system of the pellets boiler type P 4 Pellet 8 was performed on the basis of ÖNORM EN 303-5 in the context of the emission behaviour tests and the boiler efficiency tests of the unit.

For the determination of the flow temperatures and the boiler temperatures the temperature sensors of the boiler manufacturer installed at the unit were used.

Before test execution these sensors were compared with a calibrated Pt100-temperature sensor of the TÜV Austria and found in order.

At the subject boiler type the temperature sensor of the safety temperature limiter (STB) is situated at the highest point of the heat exchanger-inner shell.

6.6.1 Function check of the temperature controller and the safety temperature limiter being installed at the heating boiler

Before starting the test the water-side flow rate was fixed to the specified flow rate for the rated output test. Afterwards the firing of the unit was adjusted that it corresponds to the rated heat output of the boiler.
At the start of the test the flow temperature did not exceed a value of 75°C and the boiler temperature controller was adjusted to the maximum set value of 75°C + 3°C which was specified by the boiler manufacturer.

Afterwards the dissipated output was limited to approx. 40 % of the nominal heat output.
The test was continued up to responding the temperature controller, and afterwards the temperature was observed at which the boiler maximum temperature was reached.

The same test was repeated with the temperature controller out of function. This time it was checked if the safety temperature limiter switches off the heating at the highest specified value (maximum 110°C).

6.6.2 Test results

6.6.2.1 Function check of the temperature controller being installed at the pellets boiler of the type P 4 Pellet 8

Conditions at test start:

Water-side flow rate:	flow rate equal the flow rate for the rated output test
Heat input:	according to nominal heat output of the heating boiler
Flow temperature:	75°C
Temperature STB-position:	84°C
Boiler temperature controller:	set value 75°C + 3°C (as specified by manufacturer)
Dissipated output:	approx. 40 % of the nominal heat output
Safety temperature limiter:	response point for switch off at 110 – 4°C

Test results

The temperature controller installed at the heating switched off the firing at a temperature of 78°C, measured at the measuring point boiler temperature, whereas the temperature at the temperature position STB amounted 88°C.

Afterwards the temperature at the measuring point boiler temperature still rose up to 82°C and the temperature at the STB-position to 92°C.
The safety temperature limiter (STB) did not trigger.

The requirements of the ÖNORM EN 303-5 regarding function of the temperature controller were thus fulfilled by the tested pellets boiler type P 4 Pellet 8.

6.6.2.2 Function check of the safety temperature limiter being installed at the heating boiler

Conditions at test start:

Water-side flow rate:	flow rate equal the flow rate for the rated output test
Heat input:	according to nominal heat output of the heating boiler
Flow temperature:	74°C
Temperature STB-position:	78°C
Boiler temperature controller:	temperature controller deactivated
Dissipated output:	approx. 40 % of the nominal heat output
Safety temperature limiter:	response point for switch off at 110 – 4°C

Test results

The safety temperature limiter switched off the firing of the pellets boiler at a temperature of 104°C, measured on the STB-position.

The maximum temperature at STB-position still rose up to a maximum value of 106°C.

The requirements of the ÖNORM EN 303-5 regarding function of the safety temperature limiter were thus fulfilled by the tested pellets boiler type P 4 Pellet 8.

6.7 CO-SAFETY

Within the measurements for the determination of the emission behaviour given in point 6 and the function checks of the safety devices given in point 6.6 the highest measured CO-value amounted to 0.7 % of vol at the measuring point for the determination of the gaseous flue gas components after the flue exit of the boiler.

6.8 RADIATION LOSS

The radiation loss was calculated on the basis to DIN 4702-2 from the surface temperatures of the unit being measured in the context of the emission behaviour tests.
The calculated values are given below.

The uncertainty of the given radiation loss can be estimated with ± 0.2 %.

The stated percentage-wise value of the radiation loss is referred to the useful generated heat output in the test period.

Calculated radiation losses, date of measurements 24.10. – 25.10.2006:

Nominal heat output, pellets boiler type P 4 Pellet 8:	q_S = 1.45 %
Minimum heat output, pellets boiler type P 4 Pellet 8:	q_S = 3.33 %

7. SUMMARY

The Fröling Heizkessel- und Behälterbau GesmbH assigned the TÜV Austria with the test of the pellets boiler type P 4 Pellet 8 in the extent mentioned below.

a) Type test performance according to ÖNORM EN 303-5

Furthermore, in the context of the type test, a determination of the auxiliary power consumption should be done in the following modes of operation and key consumers:

- Nominal heat output (average value, measuring time ≥ 6 h)
- Minimum heat output (average value, measuring time ≥ 6 h)
- Sleeping operation (average value, measuring time ≥ 10 min)
- Ignition process (electrical work)

b) Verification of the compliance with the regulations of the agreement of the Austrian Federal States according to article 15a of the Federal Constitution about "Schutzmaßnahmen betreffend Kleinfeuerungen" and about "Einsparung von Energie".

The tests took place at the test rig which is set up at the Fröling Heizkessel- und Behälterbau GesmbH, which was equivalent with the requirements of the ÖNORM EN 303-5 at test date.

As test fuel the fuel wood pellets was fired in the biomass boiler type which corresponded to the layout given in the manufacturer information.

For the subject pellets boiler type of the make Fröling, type P 4 Pellet 8, an EC-Conformity Declaration of the manufacturer was handed over to TÜV Austria, in which ÖNORM EN 303-5 is mentioned as used harmonised standard.

A copy of the production documentation, in which the corresponding drawings, the manufacturing controls, the execution of welding work, the welding seams and welding fillers, the wall thicknesses and the safety designs are comprehended, were handed over the TÜV Austria and can be looked into in the test centre Thalheim/Wels.

In looking over the production documentation, which was handed over the TÜV Austria, no difference to the construction requirements of ÖNORM EN 303-5 could be ascertained.

Furthermore the temperature of the boiler surfaces determined at nominal heat output, where is a possibility for direct touch, and the checked safety equipment (temperature controller, safety temperature limiter (STB)) correspond to the requirements of ÖNORM EN 303-5 (see point 6.4 and 6.6 of the test report).

Within the type test determined values of water-side resistance are given in point 6.3, the measured values of auxiliary power consumption are given in point 6.5 and the ascertained radiation losses are given in point 6.8 of the test report.

The pellets boiler type P 4 Pellet 8 showed exhaust gas temperatures below 160 K above room temperature in the context of the type tests performed by TÜV Austria at nominal heat output (see point 6.1.1).
Therefore the boiler manufacturer shall make recommendations in the installation instructions regarding the flue installation in order to ensure sufficient draught and to prevent sooting up of the chimney and condensation.
Furthermore the range of the draught in accordance to the design shall be specified, and the correct and safe operation of the unit and information about the risks caused by improper operation has to be noted in the operating instructions.

The boiler installation shall carried out increasing towards the flow connection. For venting the water section a venting appliance shall be provided by costumer according to manufacturer information.

The correct installation of the heating boiler (increasing towards the flow connection), the preparation of a corresponding connection in the flow needed by customer and the venting procedure has to be included in the installation instructions and in the operation instructions.

An EMC-compatibility test of the used heating boiler control Lambdatronic P 3200 was not on hand by TÜV Austria at test time. This EMC-compatibility test shall be initiated by the boiler manufacturer.

An evaluation of the fire protection systems used in the boiler unit will be compiled in a separate expertise by the Institute for Fire Protection Engineering and Research Ltd...

The emission values, boiler efficiencies and exhaust gas losses (losses through sensible heat of the products of combustion) determined in the context of the tests are shown below in accordance to the ÖNORM EN 303-5 as arithmetic average values over the entire test duration.

7.1 EMISSION VALUES – PELLETS BOILER P 4 PELLET 8

The emission values, given in the table below in summary, are stated as arithmetic average values over the entire test duration and they are related to a dry flue gas basis at 0°C and 1013 hPa.

Parameter	Nominal heat output	Minimum heat output
Date of measurements	25.10.2006	24.10.2006
Measuring time (from – to)	13:11-19:11	09:57-15:57
Test duration (hours)	6.0	6.0
Heat output useful generated (kW)	11.30	3.14
Oxygen concentration (% of vol.)	8.8	10.2
Emission of dust		
related to 10 % O_2 (mg/m^3)	27	23
related to 11 % O_2 (mg/m^3)	26	21
related to 13 % O_2 (mg/m^3)	20	17
related to the energy content (mg/MJ)	14	11
Emission of carbon monoxide (CO)		
related to 10 % O_2 (mg/m^3)	48	155
related to 11 % O_2 (mg/m^3)	43	141
related to 13 % O_2 (mg/m^3)	35	113
related to the energy content (mg/MJ)	24	77
Emission of nitrogen oxides (NOx)		
related to 10 % O_2 (mg/m^3)	150	140
related to 11 % O_2 (mg/m^3)	136	127
related to 13 % O_2 (mg/m^3)	109	101
related to the energy content (mg/MJ)	74	69
Emission of gaseous organic substances (OGC)		
related to 10 % O_2 (mg/m^3)	< 1	2,9
related to 11 % O_2 (mg/m^3)	< 1	2,6
related to 13 % O_2 (mg/m^3)	< 1	2,1
related to the energy content (mg/MJ)	< 1	1,4

7.2 BOILER EFFICIENCY AND EXHAUST GAS LOSS –PELLETS BOILER P 4 PELLET 8

Fuel	Operating condition	Heat output useful generated	Exhaust gas loss	Boiler efficiency (direct method)
wood pellets	Nominal heat output	11.30 kW	6.4 %	91.6 %
	Minimum heat output	3.14 kW	4.4 %	92.0 %

7.3 INTERPRETATION OF THE TEST RESULTS

The results of the test of the pellets boiler type P 4 Pellet 8 of the company Fröling Heizkessel- und Behälterbau GesmbH, adhered to the limits of emission values, the boiler efficiencies and the exhaust gas losses of the following regulations and standards by firing the fuel type wood pellets, which are valid at the time of the test period and that are mentioned in point 1.7:

- ÖNORM EN 303-5, boiler class 3
  (including the deviations for Austria as country of destination)
- Article 15a B-VG of the Austrian Federal Constitution – agreement of the Austrian federal states about "Schutzmaßnahmen betreffend Kleinfeuerungen" and about "Einsparung von Energie"

TÜV Austria
Test centre Wels
Division Environmental Technology and Chemistry

The division leader: The examiner:

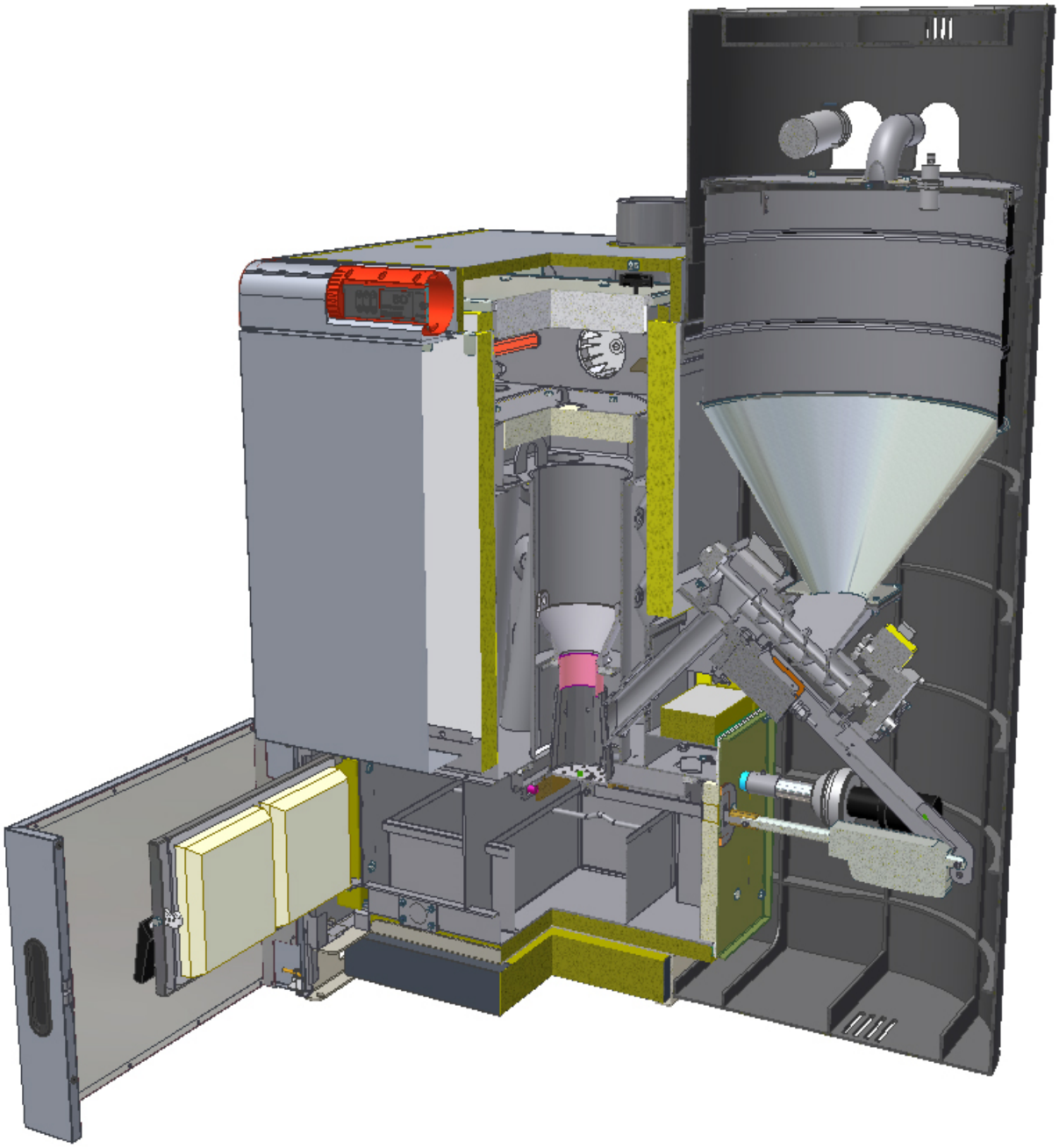
Technischer Überwachungs-Verein TÜV ÖSTERREICH Österreich

Eng. L. Pointner Eng. G. Schrögendorfer

Photo pellets boiler type P4 Pellet 8

TÜV ÖSTERREICH

Sectional view
pellets boiler type P 4 Pellet 8



	O2	CO	CO2	NOx	C
Minimum	5.4	15	8.4	132	0.4
Mittelwert	8.8	53	11.4	166	0.7
Maximum	12.0	1962	14.6	230	16.3
Einheit	%	mg/m3	%	mg/m3	mg/m3

Betreiber: Fröling
Anlage: P4 Nennlast
Meßdatum: 25.10.2006
Datei: FROEP42C

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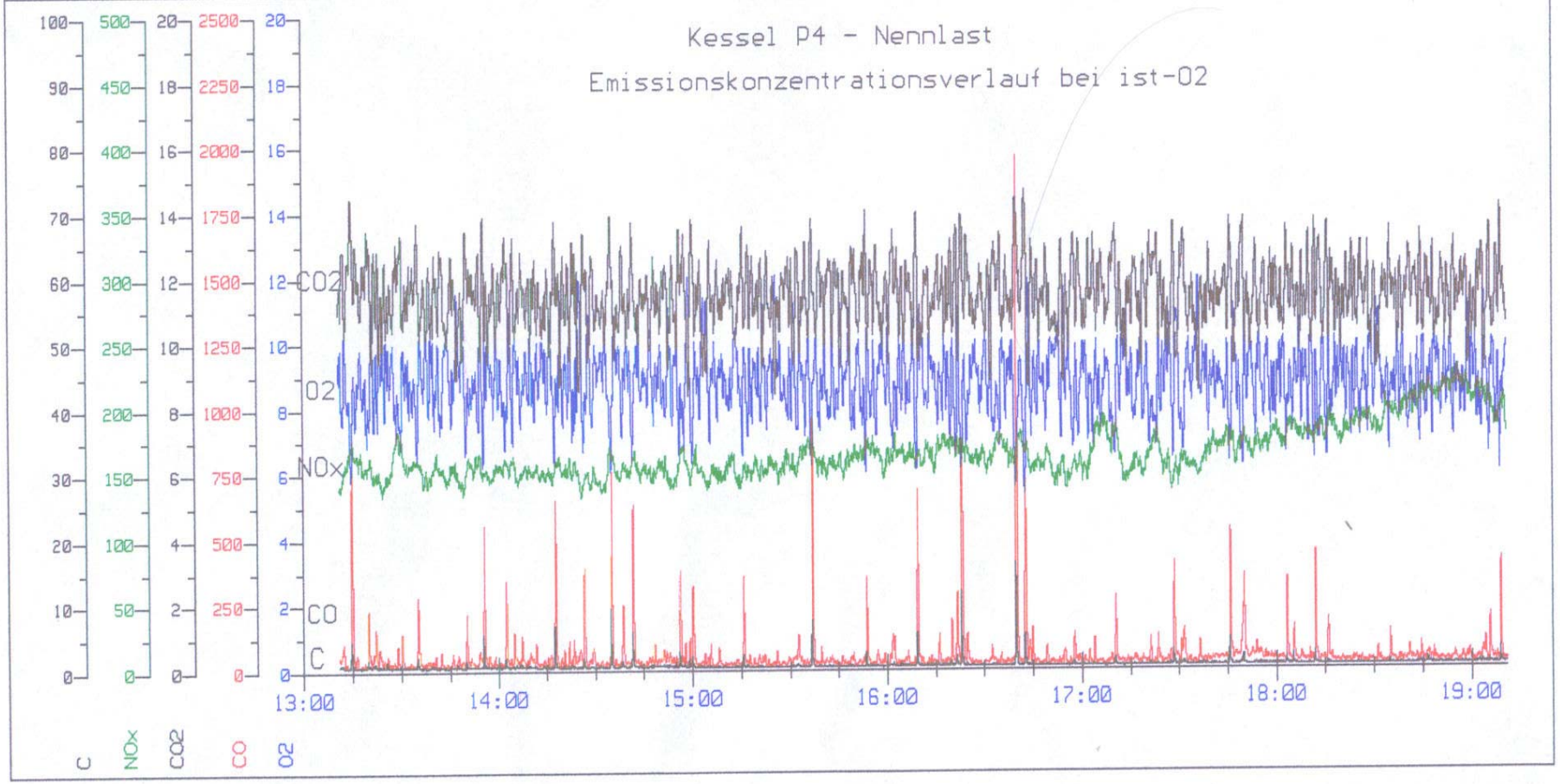
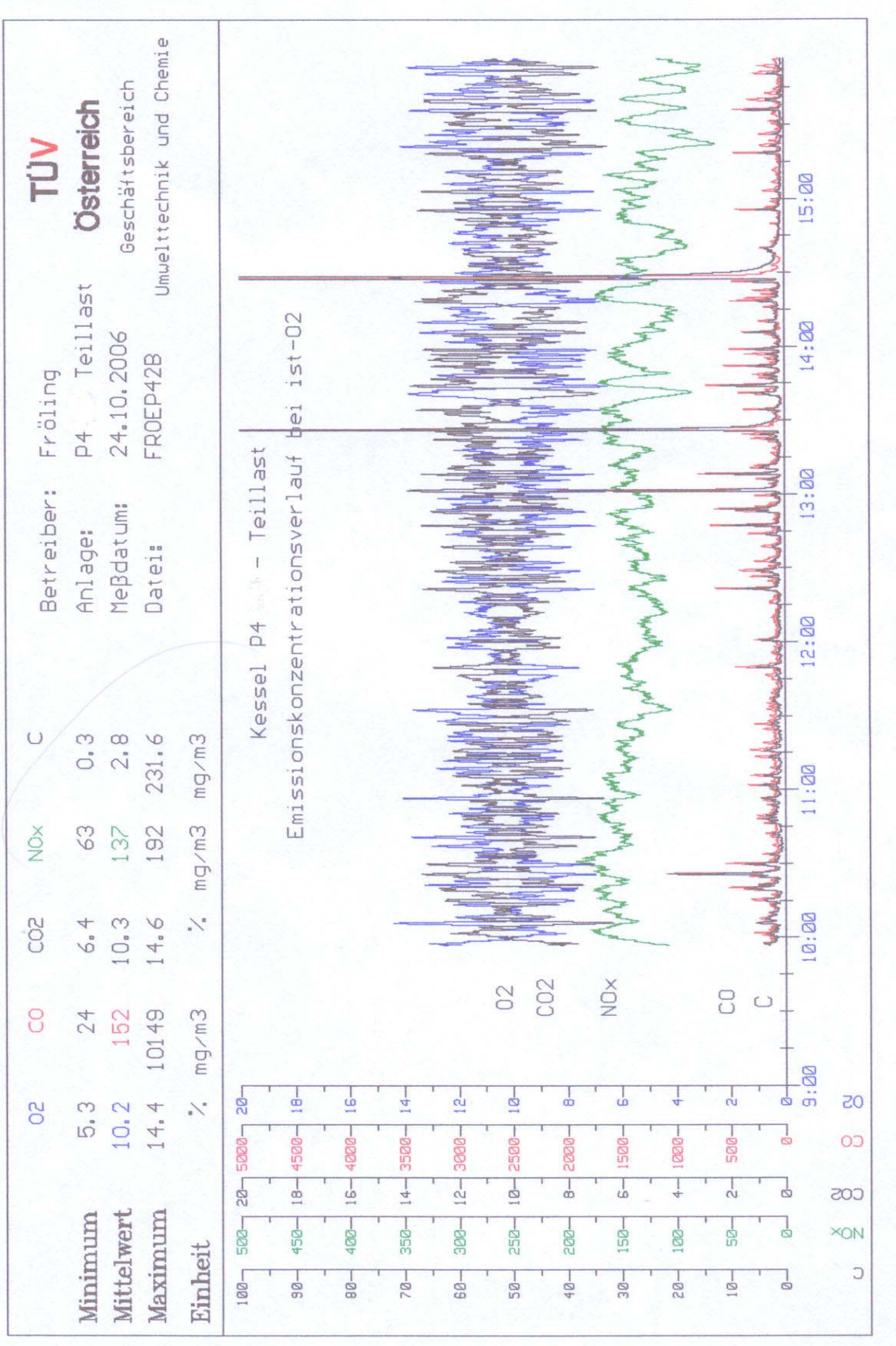
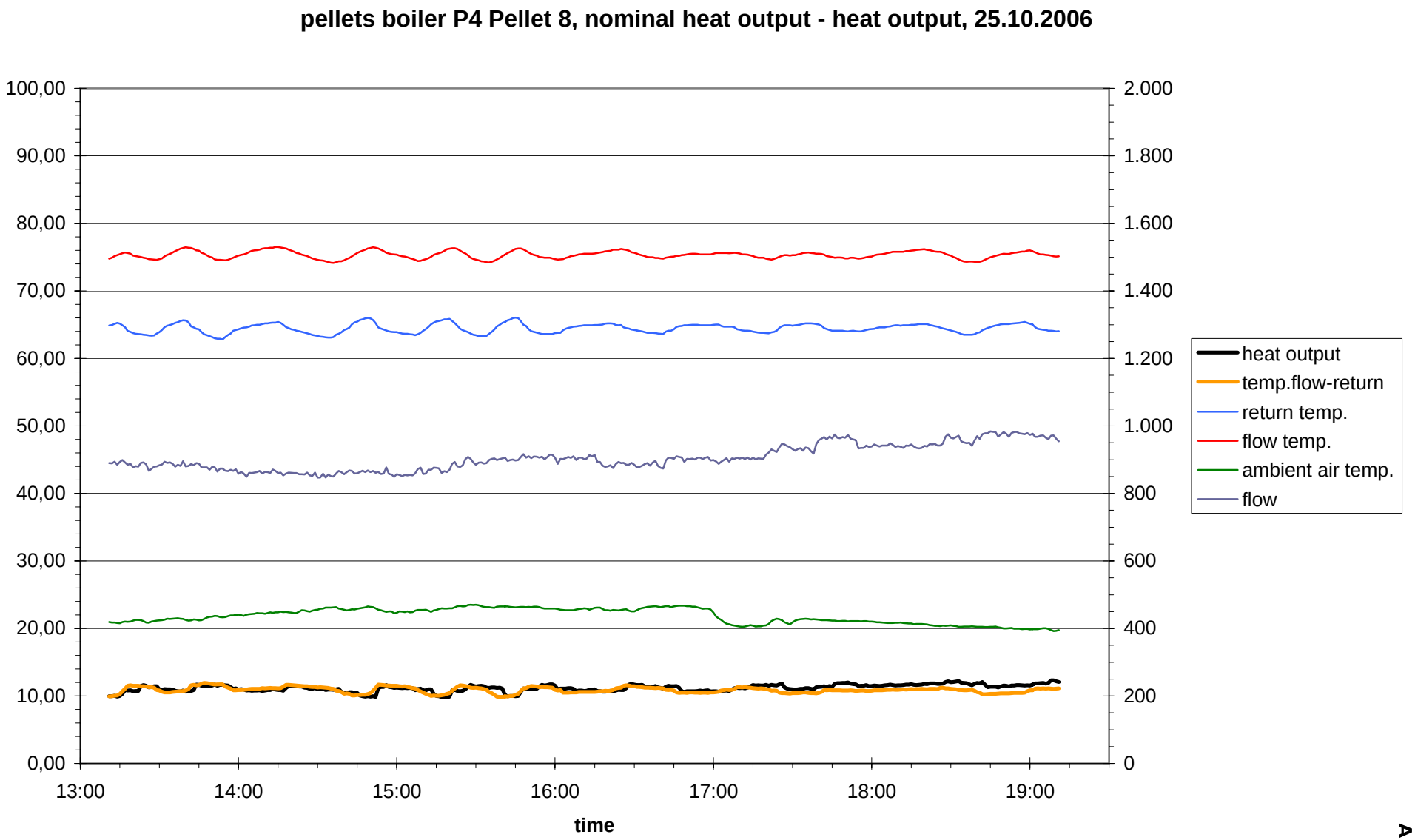
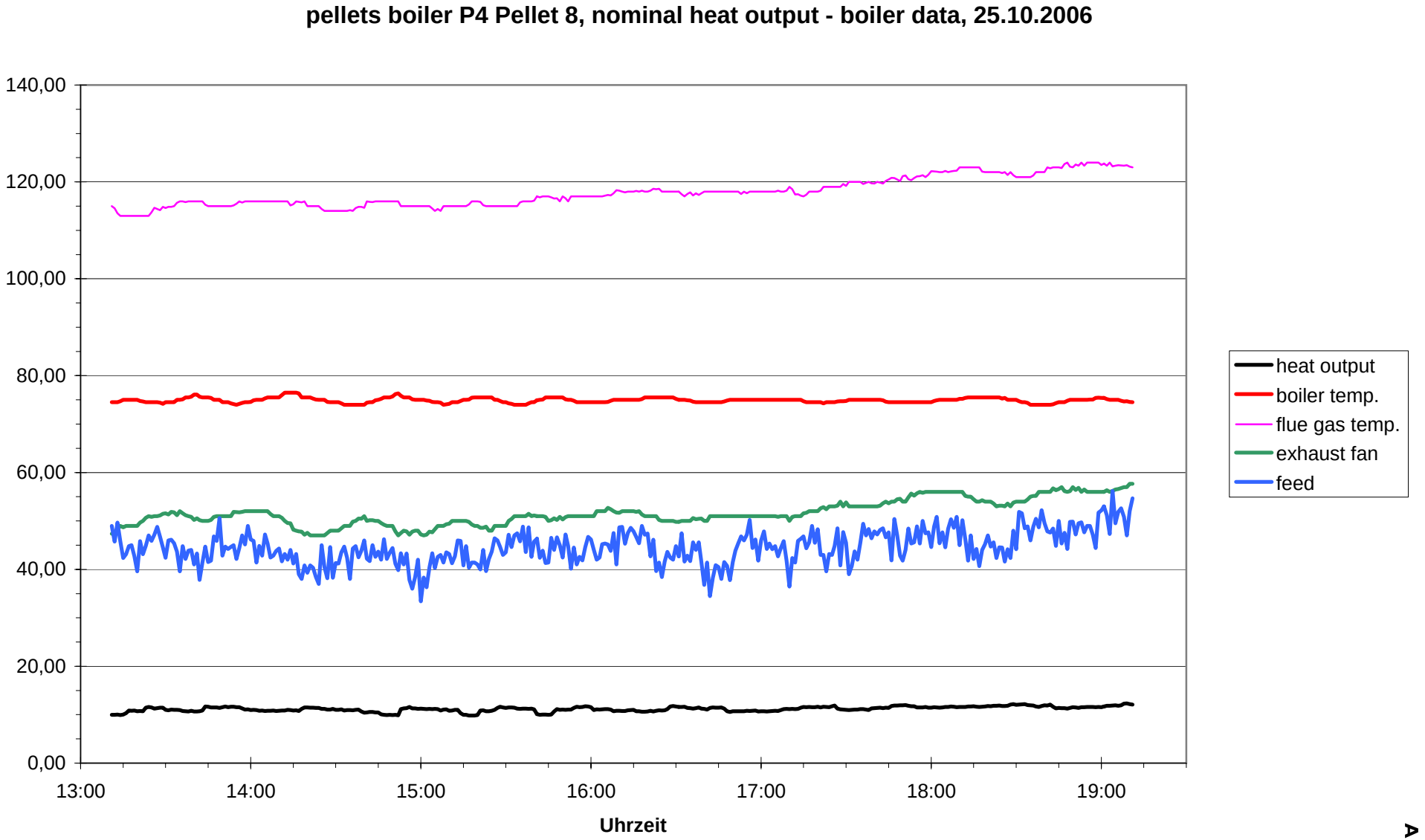
Geschäftsbereich Umwelttechnik und Chemie




TÜV Österreich
Geschäftsbereich Umwelttechnik und Chemie
Betreiber: Frölin
Anlage: P4 Teillast
Meßdatum: 24.10.2006
Datei: FROEP42B
O2 CO CO2 NOx C
Minimum 5.3 24 6.4 63 0.3
Mittelwert 10.2 152 10.3 137 2.8
Maximum 14.4 10149 14.6 192 231.6
Einheit % mg/m3 % mg/m3 mg/m3
Kessel P4 - Teillast
Emissionskonzentrationsverlauf bei ist-O2
O2
CO2
NOx
CO
C
9:00
10:00
11:00
12:00
13:00
14:00
15:00


pellets boiler P4 Pellet 8, nominal heat output - heat output, 25.10.2006
100,00
90,00
80,00
70,00
60,00
50,00
40,00
30,00
20,00
10,00
0,00
2.000
1.800
1.600
1.400
1.200
1.000
800
600
400
200
0
13:00
14:00
15:00
16:00
17:00
18:00
19:00
time
heat output
temp.flow-return
return temp.
flow temp.
ambient air temp.
flow


pellets boiler P4 Pellet 8, nominal heat output - boiler data, 25.10.2006
140,00
120,00
100,00
80,00
60,00
40,00
20,00
0,00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
Uhrzeit
heat output
boiler temp.
flue gas temp.
exhaust fan
feed

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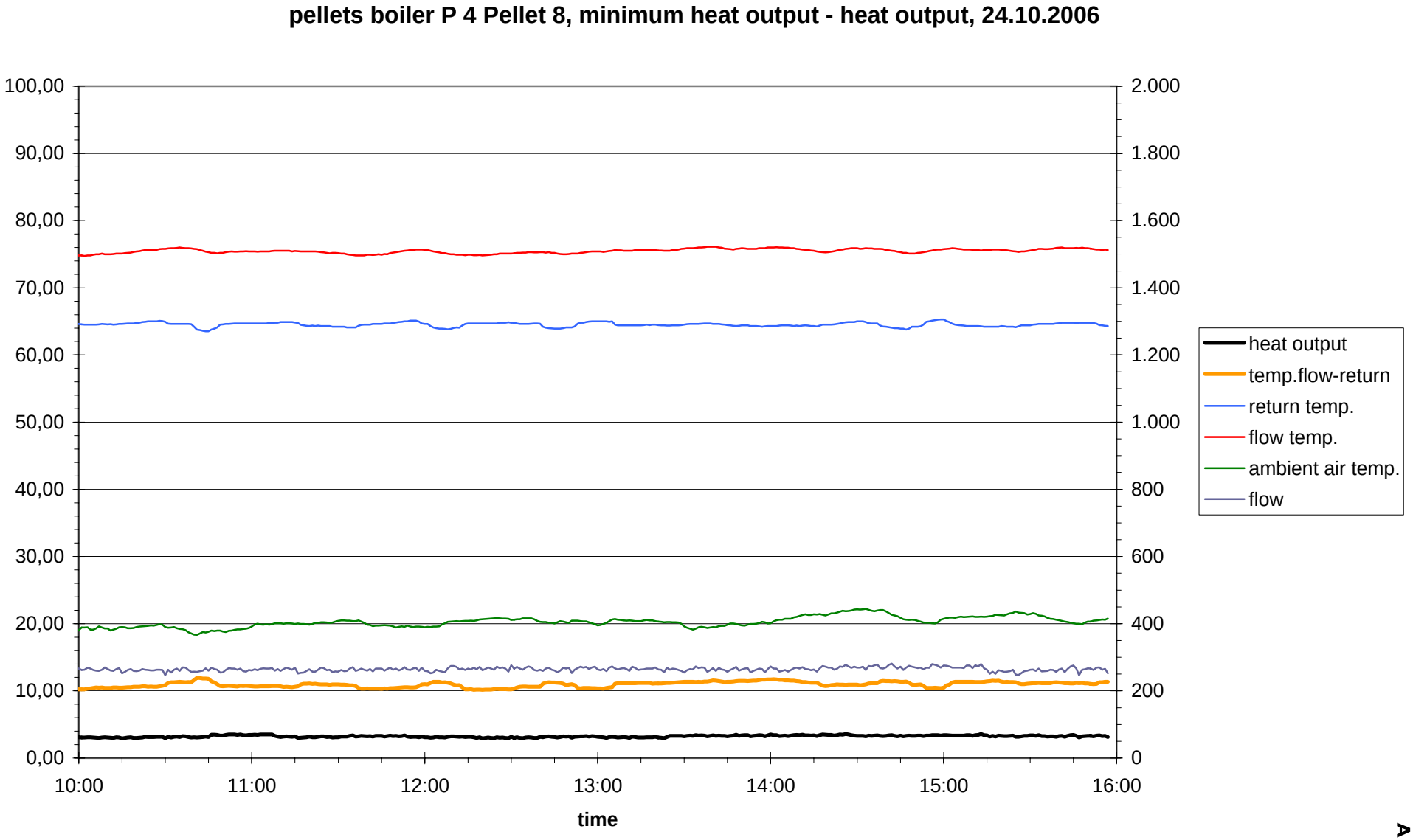
pellets boiler P 4 Pellet 8, minimum heat output - heat output, 24.10.2006
100,00
90,00
80,00
70,00
60,00
50,00
40,00
30,00
20,00
10,00
0,00
2.000
1.800
1.600
1.400
1.200
1.000
800
600
400
200
0
10:00
11:00
12:00
13:00
14:00
15:00
16:00
time
heat output
temp.flow-return
return temp.
flow temp.
ambient air temp.
flow

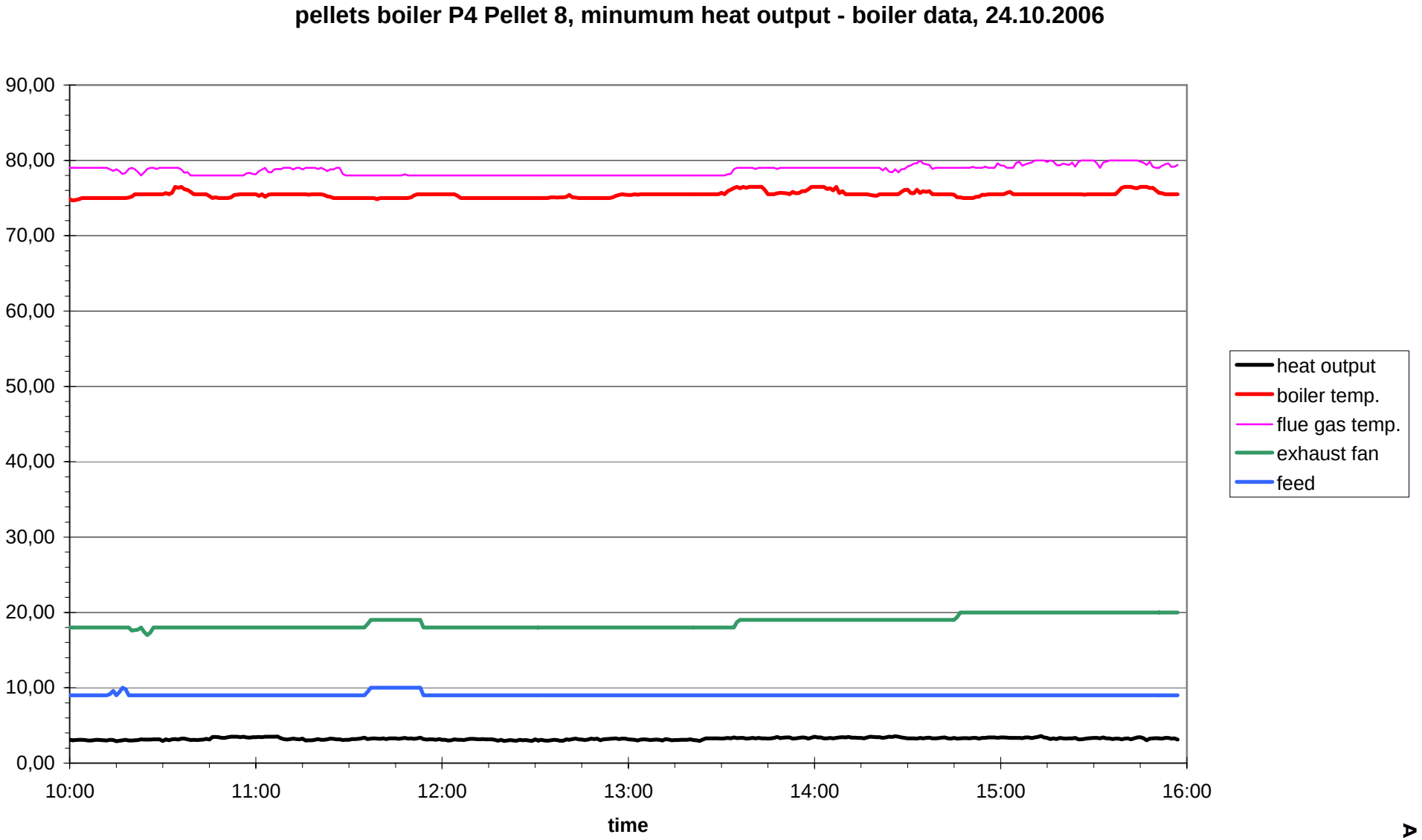
pellets boiler P4 Pellet 8, minumum heat output - boiler data, 24.10.2006
90,00
80,00
70,00
60,00
50,00
40,00
30,00
20,00
10,00
0,00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
time
heat output
boiler temp.
flue gas temp.
exhaust fan
feed

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Table of documents of the pellets boiler type P 4 Pellet 8 given to TÜV Austria by the boilermaker

- Bedienungsanleitung Pelletskessel P4 Pellet 8 – 38, Dok.-Nr. B 043 0207
- Montageanleitung Pelletskessel P4 Pellet 8 – 38, Fröling Dok.-Nr. B 043 0207 (M 093 0207)
- Typenschild Pelletskessel P4 Pellet 8, Fabrikationsnummer 8.0001.R.20
- Konstruktionszeichnungen Pelletskessel P 4, Zeichnungsdatum 11.08.2004 – 24.10.2006
- Bedienungsanleitung Lambdatronic P 3200 (Version 50.04), Fröling Dok.-Nr. B 037 02 06
- Datenblatt des Sauzuggebläses
- Datenblatt der Lambdasonde Typ LSM 11, Fabrikat Bosch
- Produktinformation des Verstellantriebes Fabrikat Linak LA12 PLC und des Motors Fabrikat Mellor FB T3
- Datenblatt des ABB Mini Meter zur Messung der elektrischen Leistungsaufnahme
- Werkszeugnisse der Voest Alpine Stahl GmbH nach EN 10204
- Beglaubigungszertifikat der Kamstrup A/S vom 31.01.2006 über die Prüfung des eingesetzten Wärmemengenzählers inkl. Rechenwerk
- Prüfbericht über die elektromagnetische Verträglichkeit der Steuerung der Type S 3100, ausgestellt von der Fa. EMV Consulting, Report EMVC 20000809
- Technischer Bericht des TÜV Süddeutschland über die Prüfung der Steuerung der Type S 3100 nach EN 60335-1/A14:98 und EN 50165:97
- Abnahmeprüfzeugnis der Bemessungsprüfung der Kesseltype Pelletskessel P4 Pellet 8 vom 24.10.2006, ausgestellt von Fa. Fröling
- EG-Konformitätserklärung vom 01.09.2006 für das Produkt Pelletskessel, Type Pelletskessel P4-14, ausgestellt von Fa. Fröling
- TÜV Cert Zertifikat, Reg.Nr. 20 100 6394, Nachweis der Forderungen gemäß EN ISO 9001:2000 für die gesamte Produktpalette
- Zertifikat Nr. A/050/04 des TÜV Österreich, Bescheinigung der Erfüllung der Bestimmungen des § 14 Kesselgesetz (BGBl. Nr. 211/1992)
- Prüfbuch gemäß ÖNORM M 7812, Beiblatt 1
- Zertifikat Nr. PZ/04/S/148/BS des TÜV Österreich hinsichtlich der Erfüllung der schweißtechnischen Qualitätsanforderungen mit der ÖNORM EN 729-2
- Zertifikatslisten der Material Standards der Fa. Fröling, Datei „Eingesetzte Werkstoffe.xls/Material Standards“, F&E/Mei, ausgedruckt am 05.09.2006
- Prospekt Pelletskessel P4 Pellet