Grupa LOTOS S.A.	**TECHNICAL SPECIFICATION**	Spec. No 2110
	Burners for Fired Heaters and Boilers	

Contents

1 Subject of specification 2
2 Scope of validity 2
2.1 Deviations 2
2.2 Order of Precedence 2
3 Burners design requirements 2
3.1 Burner selection 3
3.2 Burner turndown 3
3.3 Excess air 3
3.4 Mechanical design considerations 3
4 Burner piping 5
5 Burner Management System 6
5.1 Flame monitoring 6
6 Fabrication and Installation 6
6.1 Fabrication 6
6.2 Installation 6
7 Inspection and testing 7
7.1 Design Check 8
7.2 Rejection 8
7.3 Burners test requirements 8
8 Painting and Corrosion protection 10
9 Documentation 10
10 Relevant documents 10
11 Norms and standards 10
12 Record of changes 12

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1 Subject of specification

This specification and other documents referenced herein establish the minimum requirements for the design, fabrication, installation, inspection and tests for burners.

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2 Scope of validity

This specification applies to the preparation of tender documents, inquiries and contracts for newly planned investment or modernization projects of Grupa LOTOS S.A.

It shall also be a basis for preparing both detailed specifications and inquiries for individual or package unit supplies.

2.1 Deviations

Any deviation from this specification and the relevant specifications, standards and related documents including proposals, which the bidder claims to be economically and / or technically superior solutions must be submitted in writing for review and approval by Grupa LOTOS S.A. Non-approved exceptions are not acceptable by Grupa LOTOS S.A.

The supplier must report in writing any ambiguity in this or any other specifications of Grupa LOTOS S.A. or non-compliance with the referred documents / standards and obtain a written explanation from Grupa LOTOS S.A.

2.2 Order of Precedence

In case of conflicts existing between this specification and other documents, the following order of precedence shall govern:

- The current Polish legislation
- Terms of purchase order / contract and other requirements agreed in writing Grupa LOTOS S.A.
- Data Sheets approved by Grupa LOTOS S.A.
- This specification
- Other Specifications
- Drawings and other documents
- Standards

3 Burners design requirements

The burners and their control and protection systems as well as the fuel feed system shall meet the requirements of API RP 535, PN-EN 746, and Grupa LOTOS S.A. specification no. 8500.

3.1 Burner selection

Following shall be considered during burner selection:

- Stable and predictable flame patterns for each predicted in inquiry/purchase order fuel and range of heat release
- Turndown ratio (the greatest possible)
- Low NO_x emission
- Low solids emission.
- Low excess air operation
- Process requirements

The burner type shall be selected by firing equipment (eg. Heater, boiler, incinerator etc.) Manufacturer / Supplier based on above considerations and Petrochemical Plant Practice.

Burners shall be designed to prevent flash back (premixing is not permitted). During burner design/selection designer shall consider that in some cases fuel gas may contain more than 60 % of hydrogen.

3.2 Burner turndown

The burner flexibility shall be in the range of 30 to 120% of the design capacity.

3.3 Excess air

The burner must be sized to ensure that the air required for good combustion will be available at the burner's maximum capacity.

Natural draft burners should be capable of operating based on:

15% excess air for gas fuel

20% excess air for liquid or combination gas/liquid fuels

Forced draft burners should be capable of operating based on:

10% excess air for gas fuels

15% excess air for heavy fuel oils

Emission and air excess shall comply with current environmental protection legislation and cannot exceed values permitted in Integrated Permit Environment Prevention and Control (Pozwolenie Zintegrowane).

3.4 Mechanical design considerations

3.4.1 Burner tips/guns

The tip holes should be large enough to avoid plugging by any entrained particles.

The gas firing burner tips shall be designed to remain in place when firing only fuel oil.

The gas burners shall be cleanable (removable for maintenance) when firing fuel oil (injector of premixing burners, tips of other burners).

For the oil fuel firing, centrally located atomised burners guns are recommended. All burner guns for the same heater shall be identical and interchangeable.

The burner tips shall be made of high alloys. When liquid fuel containing abrasive particles tips should be nitrogen hardened.

3.4.2 Air register

The combustion air register should ensure proper airflow control in entire range of burner operation. Air register should to have locking possibility in each position between closed and open.

For forced draft burners, pressure measurement connections up and downstream air register/damper shall be provided.

3.4.3 Windbox

The minimum thickness of wind box walls shall be 5 mm. Inside surface of the windbox shall be painted before insulating.

Appropriate noise insulation shall be provided to meet requirements of the relevant noise standard.

For burners working on preheated air, internal thermal insulation should be provided. The quality of mineral wool shall be selected to reach the highest insulation property and temperature resistance. The inside of insulation shall be covered with perforated stainless steel. Type of mineral wool and the calculated windbox wall outside temperature shall be presented for Grupa LOTOS S.A. approval.

For forced draft application to use burners with individual wind boxes is recommended where possible.

Windshields shall be provided for natural draft burners air inlet.

3.4.4 Muffle block

Preliminary fired muffles shall be provided with a minimum 60% Al_2O_3 . Higher aluminium content can be required in case of high temperature or corrosive applications.

For liquid fuels with vanadium content above 50 ppm high density, low cement refractory shall be used.

3.4.5 Pilot burner

Pilot burners shall be selected for minimum 1% of the main burner heat release, but not less, than 30kW.

All burners shall be furnished with an individual pilot burner equipped with HV ignition system and flame detection if not otherwise agreed with Grupa LOTOS S.A..

Direct main flame ignition using portable igniter is allowed by Grupa LOTOS S.A. agreement for multiburners furnaces like reformers etc.

The pilot flame shall be stable and remain lit even when the registers are in the fully opened position.

For pressurised fireboxes it is recommended to supply compressed air to the pilot to assure stable flame.

3.4.6 Other accessories

The following shall be provided on the burner lid:

- Ignition port (for portable igniter) with threaded cap (as well in case of burners with stationary igniter)
- Inspection port with glass
- Pressure tap with cap
- Flame scanner nozzles

Appropriate moveable platform adjustment shall be provided for burners installed in the furnace floor if air registers are not accessible directly from ground.

4 Burner piping

Burner piping shall be designed and made according to ASME B31.3 and Grupa LOTOS S.A. piping standard No 2600 in accordance with all regulations, codes, and standards, including amendments, additions and explanatory notes published at the time of the purchase order.

Piping handling hazardous fluids (gas and oil burner piping) above 1" is subject of Notified Body approval according European Directive 97/23. The vendor/manufacturer shall obtain, for his account, the entire necessary code, stamps, certificates (acc. to Directive 97/23).

Impact test certificate for piping elements is in this case obligatory.

The piping system shall be designed as welded with flanged connections, allowing complete draining and venting.

The burner piping should be designed for zero loadings on the burner connection. Piping terminals at battery limit shall be designed to accept forces and moments coming from outside piping. During job execution the external loads and moments given by Grupa LOTOS S.A. have to be checked and confirmed.

The fuel piping from the header to the burner should be connected to the header vertically upward for to reduce the possibility of burners entering by liquids (gas fuels) or solids (liquid fuels).

Fuel header shall be sufficiently sized to equalize the flows to individual burners.

Piping shall be routed to allow easy disconnecting and burner maintenance/removal and should not interfere in any way with the operator's access to the burner sight/ignition points or operating functions. There should be enough flexibility in the piping for easy positioning burner gas and oil tips in the burner without piping disconnecting.

Flexible hose connections shall be avoided wherever possible. The hoses if provided should have braided armour covering to resists impact and rough handling.

The valves on the fuel oil and gas burner supply lines shall be located close to the observation door of the corresponding burner.

Fuel piping shall be steam heat traced up to the connection at burner.

5 Burner Management System

The complete Burner Management and Safety Interlock System design shall be according to PN-EN-746 – 1,2,3, PN+EN-676; PN-EN-61508 and PN_EN-61511 and is a subject of Notified Body approval (for approval requirements and procedure see Grupa LOTOS specification no 8500).

All instruments and devices shall be supplied in accordance with instrument specification No 3220.

5.1 Flame monitoring

Requirements of flame monitoring in furnaces and boilers and flame scanners/detectors are to be in accordance with Grupa LOTOS S.A. standards no. 3220 "Fired heaters and boilers control and safety interlock system" and no. 3230 "Burner flame monitoring".

6 Fabrication and Installation

6.1 Fabrication

If required by Grupa LOTOS S.A. the manufacturer shall organize a pre-inspection meeting at the place of fabrication under participation of his own inspection department and Grupa LOTOS S.A. representative's prior start of fabrication.

The burner shall be delivered to the site as a fully prefabricated with loose muffle block shapes and mortar for its installation.

Each burner shall be provided with manufacturer nameplate, containing as minimum following information's:

- Manufacturer's name or trade mark
- Factory number
- Grupa LOTOS S.A. item number
- Year of production
- Burner type
- Type of fuel
- Minimum and maximum capacity
- CE mark

All delivered elements shall have unequivocal marking allowing for their identification at site.

6.2 Installation

Installation shall be performed under Grupa LOTOS S.A. inspector permanent supervision only, strictly based on burner manufacturer recommended procedure and burner drawing.

The critical dimensions (cut-out, bolt circle and size, surface flatness etc) and orientations of the burner shall be checked before installation. Any necessary work shall be completed prior to burner installation.

Special care shall be taken during the muffle block installation. If muffle blocks are fabricated in more than one piece all of them shall be checked and selected for dimensional similarity, than marked and pre-assembled on each burner. Distances from burner tips/oil gun shall be checked according to the drawing.

Before mortar application burner parts shall be protected using plastic foil.

Gaps between muffle block parts to be filled with mortar shall be as small as possible. During final installation with mortar, muffle block location in comparison to the burner tips shall be permanently observed. The inside muffle block lute with mortar is not allowed as mortar parts can fall down during burner operation.

Ceramic fiber filled expansion gap shall be made around of the muffle block according to the burner manufacturer drawing.

After installation burners shall be cleaned out inspected (final inspection protocol shall be issued) and protected until heater/boiler mechanical completion.

7 Inspection and testing

The Inspection and Test Plan (ITP) shall be completed and submitted to Grupa LOTOS S.A. for fixing the notification, review, witness and hold points.

The manufacturer will grant for Grupa LOTOS S.A. representatives unrestricted access to all steps of fabrication and testing in own or his sub-suppliers shops and laboratories.

The manufacturer and his sub-suppliers will provide the necessary assistance for Grupa LOTOS S.A. inspection as manpower, tools, instruments, cranage etc. The assistance will be at the expense of the Vendor.

All parts of the burners presented for the inspection shall be subject of a previous dimensional check by the manufacturer. The manufacturer shall prepare a dimensional record indicating the actual dimensions of each and submit it to Grupa LOTOS S.A. before inspection. Any deviations from the specified tolerances shall be clearly marked in this record for clarification.

All loose components included in the scope of supply shall be kept ready for the inspection before dispatch.

Inspection by Grupa LOTOS S.A. shall in no way relieve the Manufacturer/Supplier from the responsibility to meet the requirements of the purchase documents.

The records listed below shall be available for review by Grupa LOTOS S.A. representative at the time of inspection:

- Mill test reports pressure parts. The test reports shall state the specification to which the material complies, the heat, lot or heat number, and the heat treatment (if any) and the results of chemical analysis and mechanical tests in accordance with the requirements of the relevant code
- Certificates for non-pressure part
- Certificates for bolting material
- Welding procedure specifications, procedure qualification records and welder qualification tests.

- Radiographic films of required radiographic test incl. the expert's assessment and records of the results of any required magnetic particle, fluid penetrant, or other method of examination.
- Charts or other records of required hydrostatic, pneumatic, and other tests.
- Certificates for valves and instrumentation (if applicable)
- Certificates for electrical parts

7.1 Design Check

Authorized inspector of the heater/firing equipment vendor shall check the conformity of burners and material used for fabrication.

The compliance of design with the additional requirements of this specification will be checked and confirmed by Grupa LOTOS S.A.

7.2 Rejection

Equipment or parts thereof and materials entering therein, indicating irremediable or injurious defect, improper fabrication, excessive repairs, or they are not in accordance with the requirements of the relevant codes or Grupa LOTOS S.A. specifications shall be subject to rejection. They shall be subject to rejection at any time or place by Grupa LOTOS S.A. or Grupa LOTOS S.A. representative if such conditions are discovered after acceptance of the items at the supplier's shop.

7.3 Burners test requirements

In general all non-standard burners shall be tested. Burner test can be considered for larger supply of the some type of standard burners as well. Test necessity and procedure to be agreed with Grupa LOTOS S.A.

Following criteria shall be considered for burners test:

- The composed fuel should closely simulate the heating value, specific gravity, flame temperature and major components of the fuels to be used during burners normal operation. If there is significant difference in fuels, both low and high LHV fuels shall be simulated. The Wobbe index may be used as criteria for specifying a test fuel.
- The selected test furnace shall be large enough to contain the flame without impingement on the walls or ceiling of the furnace.
- Where air preheat, external flue gas recirculation, steam injection or other special features are applied test shall be performed with these in service.
- It is recommended to use original pilot burner, inlet damper or plenum or register arrangement.
- During emission measurement the gas temperature in the test furnace shall be close to the temperature expected during future normal operation.

The test data should validate the heat release vs. fuel pressure curve and the draft requirement curve.

Stability test should be done using the fuel composition with the lowest flame velocity, narrowest flammability limits and highest ignition temperature.

Flame stability shall be checked under the following conditions:

- Start-up - Cold firebox, low heat release
- Cold firebox with rapid load change up to the maximum heat release
- Hot firebox, over firing and high excess air

For fuels with high flame velocity components burner test shall identify the minimum fuel pressure and draft required to avoid flashback.

Following test data shall be collected:

- Fuel composition
- Fuel flow
- Fuel pressure
- Fuel temperature
- Firebox draft at burner level
- Firebox temperature
- Heat flux profiles
- Windbox or plenum chamber pressure or draft
- Air pressure drop
- Air temperature
- Air humidity
- Emissions (O_2, CO, CO_2,NO_x, unburned hydrocarbons)
- Flame dimension and position
- Flame stability observations
- Ignition reliability
- Amount of recirculating flue gas or injected material (if applicable)
- Burner register position
- Burner tip dimensions
- Noise level

Summary report shall be issued.

8 Painting and Corrosion protection

Burners shall be shop finally painted according to Manufacturer standards.

Burners shall be packed suitable for transport conditions and under roof storage on site in wooden boxes or on pallets protected with plastic foil.

Plastic caps shall close all nozzles. Flanges shall be protected.

Other small parts shall be packed in wooden boxes.

9 Documentation

The documentation shall be delivered in the quantity fixed in the specifications No 6400, 6500 and purchase order documents.

Manufacturer files shall be prepared with all drawings, data sheets, operating manuals, manuals and description of components, electrical and instrument documents and brochures necessary for the operating, maintenance, repair and spare part ordering.

The following documentation shall be given with the burner as a minimum:

- Technical data sheet comprise
- Gas pressure and consumption of the pilot burner;
- Atomising steam consumption;
- Acceptable pressure range of atomising steam;
- Acceptable viscosity range of fuel oil;
- Detail drawings of burners, with tag numbers of different parts;
- Installation drawings;
- Diagram showing the fuel gas/oil consumption vs pressure;
- List of spare parts;
- Instructions for operation, cleaning and maintenance in English and Polish language.

10 Relevant documents

Any “Technical Specification” issued by Grupa LOTOS S.A. listed in Contract Files.

11 Norms and standards

Codes and standards listed below form part of this specification. Each publication shall be the latest revision and addendum in effect at the Contract award, unless otherwise specified:

- PN-EN 125 Flame supervision devices for gas burning appliances. Thermoelectric flame supervision devices
- PN-EN 746-1 Industrial thermoprocessing equipment. Common safety requirements.

- PN-EN 746-2 Industrial thermoprocessing equipment. Safety requirements for combustion and fuel handling systems
- PN-EN 746-3 Industrial thermoprocessing equipment. Safety requirements for the generation and use of atmosphere gases
- PN-EN 12952 Water tube boilers
- PN-EN 12953 Shell boilers
- PN-EN 61508 Functional safety of electrical/electronic/ programmable electronic safety related system (all parts)
- PN-EN 61511 Safety instrumented systems for the process industry sector (all parts)
- API 560 Fired heaters for general refinery service.
- API RP 535 Burners for Fired Heaters in General Refinery Services
- API 556 Instrumentation and control systems for fired heaters and steam generators.
- ASME B31.3 Process piping.

12 Record of changes

No.	Date	Description	Introduced by
1	30-11-2013 (rev.1)	Review, update, standardize and changes to the Standard within scope of order No. OK/990/2012	Editorial board coordinated by T.Wróbel
-	31-08-2015	Page layout corrections, no contents changes.	T. Wróbel