Grupa LOTOS S.A.	**TECHNICAL SPECIFICATION**	Spec. N^{o}
	Loudspeaker system	3840

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1 Subject of specification

This specification used in conjunction with standard technical specifications of LOTOS Group S.A., establishes minimal requirements regarding designing and execution of loudspeaker systems for dispatcher's purposes and particularly sound systems for emergency purposes.

2 Scope of validity

This specification applies to the preparation of tender documents, inquiries and contracts concerning new investments and modernization projects planned by LOTOS Group 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 SA. 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 SA or non-compliance with the referred documents / standards and obtain a written explanation from Grupa Lotos SA.

2.2 Exclusions

This specification does not deal with:

- assembling technology of cables and auxiliaries related to them
- supporting structures for loudspeakers and devices
- audiovisual systems (for example, providing sound in conference rooms)

3 Hierarchy of documents

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 with GLSA
- Data Sheets approved by GLSA
- This specification
- Other Specifications
- Drawings and other documents
- Standards

4 Definitions and abbreviations

4.1 Definitions

CAUTION: Below given definitions are valid for DSO systems

alarm – signal of danger warning or state

danger – damage or destruction hazard

coverage area – the area, where requirements given in Specification 3840 are met by the system

warning – important notification about condition change that demands attention or action

hazard condition – the risk of hazard occurrence or serious hazard for persons or property

loudspeaker zone – the part of coverage area, where information can be transmitted separately

hazard zone – the part of area with buildings, where hazard condition is present

electro-acoustic system – set of equipment and installations, connection of which enables acoustic signals processing and transmission

4.2 Abbreviations

GLSA Grupa Lotos S. A.

CIS Common Intelligibility Scale

DSO sound system for emergency purposes

Ex explosive category

IK degree of mechanical impact protection provided by the enclosure

IP degree of protection against solid objects and liquids provided by the enclosure

PH energy supply continuity in presence of thermal impact

STI speech transmission index

THD harmonic distortions factor

Designation of GLSA objects shall be used according to standard 6120 given in chapter 5.

4.3 Ambient conditions

- Ambient temperature (max/min) +36°C/-25°C
- Average monthly humidity (min/max) 70%/90%
- Elevation above sea level 1m
- Wind speed 26 m/s
- Snowfall 290 mm
- Atmosphere typical for refinery Grupa Lotos S. A. (marine, aggressive industrial, chemical and dusty)

4.4 Supply conditions

Electric supply source accessible on site ~230V, 50 Hz, TN-S system

5 Description

5.1 General requirements

The following systems within GLSA area can be rated among wired sound systems:

- local sound systems
- sound system for emergency purposes
- wired broadcasting system

Local sound systems shall be used on process plants and in process buildings, where there is a need to call a worker staying in the field, from control room. Local sound system on fuel, oil, hydrocracking, power plants, Fire Brigade station, etc., can serve as examples. The systems shall enable transmission of messages in zones of operator's choice in arbitrary configuration (for example, one production plant, two plants, all plants), as well as ensure amplifier and loudspeaker lines operation monitoring. Loudspeaker system is used as well to transmit voice messages on plant area and its periphery in case of danger.

DSO systems are built according to Ministry of Internal Affairs and Administration order – p. 6.1.1. Their purpose is to warn about danger by means of alarm signals transmitting and connected with them voice messages. They must be able to operate at evacuation conditions.

Functionality of wired broadcasting system was discussed in Specification 3850 Sound distribution system.

The systems being specified are electro-acoustic systems in the meaning of standards given in p. 6.2. Components of these systems must fulfil requirements of standards harmonized with Directive 89/106/EEC in that range, in which they are used for warning purposes.

5.2 Designing

Functional assumptions for new system or development of existing one shall be elaborated in agreement with operating services of GLSA. System designing shall be based on building drawings of existing or planned objects. Building interconnecting cable lines shall be included in land development project. Design and cost estimate documentation, conforming to p.7.1. regulation, shall be prepared each time. Hypothetical scope of the documentation is given in p. 4.8.

5.3 Acoustic conditions

5.3.1 Rooms

Some GLSA buildings can be treated as public utility buildings (office buildings, for example). Allowable noise levels for rooms shall result from architectural – building projects. For larger cubatures, reverberation times are also given. In cases, where such data are missing (industrial premises, for example), estimate calculations or measurements shall be done.

5.3.2 Open areas

The sources and levels of noise shall result from development projects. If such data is missing, then estimate calculations or measurements shall be done.

5.3.3 Sound amplification

Analyses shall be completed for 125, 250, 500, 1000, 2000, and 4000 Hz frequencies. Sound level within whole coverage area shall exceed noise level (background hum) by 6 to 20 dBA, and shall be simultaneously higher than 70 dBA. 120 dBA level shall not be exceeded. Adequate selection of loudspeakers shall ensure uniform sound intensity in whole loudspeaker area. If sound system is to be used for music transmission, then it shall fulfil requirements given in Specification 3850 as well.

5.3.4 Intelligibility of speech

System solutions shall guarantee adequate intelligibility of transmitted information. Test points for intelligibility assessment shall be indicated in design documentation. Selection of these points has significant impact on results in industrial environment.

Intelligibility of speech shall exceed 0.65 according to CIS scale. In DSO systems quoted CIS value is obligatory, while in remaining systems attaining of similar intelligibility is recommended.

5.4 System elements

5.4.1 Calling station

This is mounted on dispatcher's post. It shall be equipped with console and keypad for selection of loudspeaker lines (zones) control. The system can be equipped with several calling stations. Information stating readiness of the system, supply and damages shall be accessible on dispatcher's console.

5.4.2 Central unit

It consists of modular set for microphone stations and power amplifiers connection. Regulation of gain and tone quality is required. Central unit can be furnished with audio expanders, signalling modules, alarm generators, recorders, etc. In DSO systems, recorders with mechanical sub-assemblies are impermissible.

5.4.3 Power amplifiers

Requirements:

- Sinusoidal power output — 100 W up to 500 W
- Efficiency — 80% [60% is allowed for small systems]
- Supply — ~230 V [=24V for DSO]
- THD distortions — < 0,2 %
- Inputs [with priority] — 0,5 mV, symmetrical
- Loudspeaker line output — 100 V
- Transmission band [3 dB] — 100 Hz up to 16 kHz
- Protections — thermal, overcurrent, input signal level

Power amplifier units are predominantly mounted together with central unit in 19" rack. Power amplifiers decentralization is not allowed. At least one reserve amplifier shall be provided.

5.4.4 Supply

Basic supply shall be provided from power mains network. Requirements in range of mains supply result from general building regulations. In case of DSO systems, back-up supply from battery unit is also required – it shall back-up supply through period twice as long as evacuation time, but at least 30 minutes. For objects, which do not subject to evacuation, 24-hour back-up supply shall be ensured.

5.4.5 Loudspeaker lines

Reliability of whole electro-acoustic system usually depends on reliability of the lines. All lines shall be terminated on output board in amplifiers room – the board constitutes element of building installation. Terminal boxes shall be mounted in the neighbourhood of loudspeakers installation place.

In the local sound systems and DSO, the lines have to be continuously monitored. In open (ordinary) lines, detectors of line termination shall be installed.

Loudspeaker lines shall be designed for peak power of installed loudspeaker units.

CAUTION: Some cables, wires and equipment in DSO systems shall have adequate fire resistance, adapted to evacuation time (PH parameter). It frequently happens that lines in loop or coincidence layout (parallel lines) are more effective solution, similarly as in fire signalling systems – Specification N° 3810.

5.4.6 Loudspeaker units

These are loudspeakers in housings, furnished with transformers enabling power setting. They shall guarantee adequate transmission quality and IP, IK as well as Ex category – refer to Attachment 7.1. Failure of individual unit cannot result in DSO loudspeaker line switching off.

5.4.7 Equipment used in zones classified as explosion hazardous

All equipment of local sound system, located in explosion hazard zone, must be manufactured and tested according to standards valid for explosion proof equipment. Proper fabrication of equipment shall be confirmed with certificate issued by authorized laboratory. Explosion protection shall fulfil requirements stated by LOTOS Group S.A. in relevant documents, determining explosion hazard zone, equipment group and temperature classes.

5.5 Construction of the system

5.5.1 Hardware rooms

Central units and power amplifiers shall be installed in dedicated telecommunication rooms. Within adaptation works scope, GLSA will provide in these rooms electrical power supply, grounding, ventilation and lighting. Adaptation of specific room can entail change of its utilisation program – decisions relating to, for example, ceiling load-carrying ability may be required. The system overvoltage protections shall be provided. Such protections shall guarantee personnel and equipment safety in the event of pulse electromagnetic discharge, or short-circuits to other systems.

5.5.2 Installations and cable lines

The symmetrical cables and wires shall be routed in adequate distances from electrical cables and telecommunication ones, according to technology described in Specifications N° N° 3720, 3730, 3760. Recommended cables and mounting accessories were specified there. The loudspeaker lines will subject to partial acceptance. Cables of the process unit loudspeakers shall be connected via junction boxes which shall be located under the loudspeaker at the 1.6 m above ground or platform level.

5.5.3 Assembly of loudspeakers

Loudspeaker units shall be fastened to fixed structural elements of objects (buildings). After installation completion, sound system tests shall be executed.

CAUTION: A team independent of Contractor shall execute intelligibility measurements for DSO system. In course of STI index determination one shall check if English language based software of measuring instruments, guarantees reliable results for Polish language.

5.5.4 Co-operation with other systems

Sound system dispatcher shall have much information regarding operation of other telecommunication and process systems. Information regarding failure in DSO system must be reliably transmitted to fire alarm system.

5.5.5 Marking

All equipment shall be marked with producer's name and Supplier's brand, in order to ensure sound system integrity. Each device shall be additionally equipped with tag, indicating (specific) number of the device according to documentation, as well as equipment numbering procedure. Equipment made in explosion-proof version shall have independent designation, according to standards.

Marking of equipment shall specify its service duty. Numbering of devices, boards and cables according to Specification N° 6120.

The descriptions shall be put on by means of stamping on nameplates. The nameplates shall be made of stainless steel, non-corrosive alloy or rigid plastic, and shall be durably fastened to integral part of specific device. Supplier shall submit proposed tag pattern for LOTOS Group S.A. approval prior to production commencement.

5.5.6 Cables, wires and accessories

All cables, wires, plugs, clamps and mechanical protection devices shall be included in scope of delivery. Sound system cabling shall include all connections necessary for equipment provided by Supplier, for example fire control stations, dispatcher stations. All cables and terminal strips shall be marked with use of marking system conforming to GLSA procedure – refer to 5.5.5.

Equipment intended for outdoor operation shall be furnished with cable glands. Furthermore, equipment located in explosion hazard zones shall be furnished with cable glands in explosion-proof version. The Supplier shall make selection of cable glands exactly according to nominal diameters of cables, specified by their manufacturer.

5.6 Services

The Supplier shall provide the following services:

- detailed documentation [factory documentation]
- system software
- factory acceptance test and inspection
- packaging and shipment
- on-site assembly
- functional tests and connections to other systems
- GLSA personnel training
- maintenance during guarantee period

5.7 Design documentation

Prior to detailed designing commencement, the Supplier shall agree requirements for the system with GLSA representatives (i.e. the system functionality, equipment location, cabling layout, interfaces to existing systems). These adjustments shall be prepared in written form.

In case of DSO system, design works shall be based on fire safety plan determining fire zones and escape routes, as well as adjustments with fire safety expert in GLSA The approval issued by expert shall be put on first drawing of routes and elements layout.

The documentation shall consist of at least following parts:

5.7.1 Technical description, including:

- description of existing equipment
- description of parts being designed
- functional description (principles of operation)
- detailed description of system component elements
- operating, installation and maintenance instructions
- specifications of relevant standards and other documents
- analyses of allowable noise levels, reverberation times and other acoustic parameters determined in p. 5.3

5.7.2 Material specifications

5.7.3 Cable lists

5.7.4 Drawings

- statements of graphical symbols
- block diagrams of system
- building layouts showing equipment and cable arrangement on different floors
- field layouts (geodetic maps) showing equipment and signal/power cable arrangement for outdoor areas (e.g. process plants)
- wiring diagrams
- single-line supply diagrams
- console (layout) drawings
- assembly examples

5.7.5 As-built documentation, including updated drawings, reflecting changes introduced to equipment and wiring system.

5.7.6 Start-up check lists

5.7.7 Acceptance report

6 Related documents

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

7 Standards and regulations

It is in each case understood that quoted standards, regulations, directives and orders are of their latest editions, along with amendments, annexes and supplements in force.

7.1 Building regulations

The law of 24 August 1991, on fire protection*(JoL 1991.81.351 as amended)

1 Minister of Internal Affairs and Administration order of 07 June 2010 on fire protection of buildings, other building objects and areas (JoL 2010.109.719)

2 Minister of Internal Affairs and Administration order of 16 June 2003, on adjustments of building projects in relation to fire protection (JoL 2003.121.1137 as amended)

The LAW of 7 June 1994, Building Law*(JoL 1994.89.414 as amended)

3 Minister of Infrastructure order of 12 April 2002 on technical conditions that buildings and their location should comply with (JoL 2002.75.690 as amended)

4 Minister of transport, construction and maritime economy order of 25 April 2012 on detailed scope and form of building project (JoL 2012.462 as amended)

The LAW of 27 March 2003 on spatial planning and development* (JoL 2003.80.717 as amended)

5 Minister of Infrastructure order of 7 May 2004 on method of giving consideration to state defence and safety needs in spatial development (joL 2004.125.1309)

The LAW of 16 April 2004 on building products* (JoL 2004.92.881 as amended)

6 Minister of Infrastructure order of 14 October 2004 on European technical approvals and Polish entities authorized for issuing them (JoL 2004.237.2375)

7 Minister of Infrastructure announcement of 5 July 2004 on list of mandates granted by European Commission for elaboration of European harmonized standards and guidelines to European technical approvals, along with subject matter scope of these mandates (M.P. 2004.32.571)

8 Minister of Infrastructure order of 8 November 2004 on technical approvals and organizational bodies authorized for issuing them (JoL 2004.249.2497 as amended)

The LAW of 31 August 2002, on conformity system assessment* (JoL 2002.166.1360 as amended)

9 Regulation of the Minister of Economy of 21 August 2007 on basic requirements for electrical devices (Journal of Laws, 2007.155.1089).

10 The Law of 13 April 2007 on electromagnetic compatibility (JoL 2007.82.556).

11 Regulation of Minister for Economy of 22 December 2005 on the basic requirements for safety devices and systems designed for application in explosion hazard zones (Journal of Laws, 2005. 263. 2203).

)* *stated in order to indicate legal bases for orders*

7.2 Selected Polish Standards

lp	Nr normy	Tytuł normy
Akustyka budowlana		
1	PN-ISO 1996-1	Acoustics -- Description, measurement and assessment of environmental noise -- Part 1: Basic quantities and assessment procedures
2	PN-ISO 1996-2	Acoustics -- Description, measurement and assessment of environmental noise -- Part 2: Determination of environmental noise levels

3	PN-ISO 1996-3	Acoustics -- Description and measurement of environmental noise -- Part 3: Application to noise limits
4	PN-N-01307	Hałas. Dopuszczalne wartości parametrów hałasu w środowisku pracy. Wymagania dotyczące wykonywania pomiarów
5	PN-N-01341	Hałas środowiskowy. Metody pomiaru i oceny hałasu przemysłowego
6	PN-EN ISO 14257	Acoustics -- Measurement and parametric description of spatial sound distribution curves in workrooms for evaluation of their acoustical performance
Alarmowanie i bezpieczeństwo		
7	PN-EN 50130-4	Alarm systems Electromagnetic compatibility. Product family standard. Immunity requirements for components of fire, intruder, hold up, CCTV, access control and social alarm systems
8	PN-EN 50130-5	Alarm systems. Environmental test methods
9	PN-EN 60849	Sound systems for emergency purposes
10	PN-EN 60417-1	Graphical symbols for use on equipment - Part 1: Overview and application
11	PN-EN 61508-1	Functional safety of electrical/electronic/ programmable electronic safety-related systemsGeneral requirements
12	PN-EN 61508-2	Functional safety of electrical/electronic/ programmable electronic safety-related systems. Requirements for electrical/electronic/ programmable electronic safety-related systems
13	PN-EN 61508-3	Functional safety of electrical/electronic/ programmable electronic safety-related systems. Software requirements
Urządzenia elektroakustyczne		
14	PN-T-04499-01	Urządzenia i systemy elektroakustyczne. Postanowienia ogólne
15	PN-T-04499-02	Urządzenia i systemy elektroakustyczne. Określenia podstawowe i metody obliczeń
16	PN-T-04499-11	Urządzenia i systemy elektroakustyczne. Stosowanie złączy do łączenia zespołów elektroakustycznych
17	PN-T-04499-13	Urządzenia i systemy elektroakustyczne. Badania odsłuchowe głośników
18	PN-EN 60268-16	Sound system equipmentObjective rating of speech intelligibility by speech transmission index
19	PN-EN 61938	Multimedia systems. Guide to the recommended characteristics of analogue interfaces to achieve interoperability

8 Enclosures

- Enclosure No. 1, Selection of loudspeaker units
- Enclosure No. 2, Block diagram – Loudspeaker system

9 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

Grupa LOTOS S.A.	**ENCLOSURE No. 1**	Spec. N^{o}
	Selection of loudspeaker units	3840

Table A

Object	IP*		IK* [housing]	Ex*
Social and office rooms	3	0	IK 07	not applicable
Other rooms	4	0 ÷ 4	IK 08	not applicable
Industrial premises	5	2 ÷ 6	IK 09	not applicable
Field [outside of zones]	6	5 ÷ 6	IK 09	not applicable
Explosion hazard zones	6	5 ÷ 6	IK 09	de IIC T4

* STANDARDS

- IP according to PN-EN 60529
- IK according to PN-EN 50102
- Ex according to PN-EN 50014

Table B

Object	Max. power [W]	Effectiveness [dB] @ 1W, 1m, 1kHz	Transmission band [kHz]
Social and office rooms	2	85	0,2 ÷ 12
Other rooms	6	90	0,3 ÷ 10
Industrial premises	10	90	0,3 ÷ 3,4
Field [outside of zones]	25	105	0,4 ÷ 8
Explosion hazard zones	25	105	0,4 ÷ 8

NOTES

- It is recommended to install loudspeakers and devices outside of explosion hazard area, if possible.
- Parameter values stated only for reference – the system designer shall make a final decision