



PRODUCT CATALOG

INNOVATIVE NDT TECHNOLOGIES
iU INTERUNIS-IT

Dear colleagues!

In this catalogue we would like to bring the products of «INTERUNIS-IT» to your attention.

«INTERUNIS-IT» Ltd. Co. was established on the basis of Research & Development and Production Departments of «INTERUNIS» Ltd. Co. during company rearrangement into «INTERUNIS» Group of Companies.

Our staff members are professionals of the highest class having more than 25 years' experience in the field of non-destructive testing.

Company's activities are as follows:

- Development and manufacture of nondestructive testing equipment;
- Development and manufacture of integrated diagnostic monitoring systems;
- Conducting of applied scientific research, intellectual support of non-destructive testing;
- Development of regulatory guidance documents.

Our main business is development and manufacture of unique acoustic emission equipment.

The company's products are registered in the State Register of Measuring Instruments of the Russian Federation, the Republic of Belarus, and the Republic of Kazakhstan.

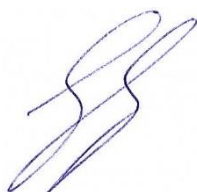
For many years the company's products have been successfully used at enterprises of the fuel and energy sector, in oil, gas and chemical industries, in companies of the transport, construction and energy industry, and in research institutes, both in Russia and abroad.

Our customers:

AO «Ventamonjaks» (Latvia), Electrical Systems and Technology FZE (United Arab Emirates), TGE Taegwang E&C (Korea), AED Polska (Poland), Mantenimiento Integral Rational (Spain), S.A. de S.V. (MIRSA) (Mexico), E.Q.S. Servicos de Engenharia, Qualidade e Seguranca LDA (Portugal), Teknik Olcum Cihazlari Imlt. San. ve Tic. Ltd. Sti. (Turkey), Politechnika Krakowska, Wydział Mechaniczny Instytut Technologii Maszyn i Automatykacji Produkcji M-6 (Poland), NUINFRA CONSOLIDATED SDN BHD (Malaysia).

We shall be glad to see your company among our customers and partners.

Director General
Elizarov Sergey



SYSTEMS OF THOROUGH DIAGNOSTIC
AND CORROSION MONITORING OF
INDUSTRIAL OBJECTS

LeI-M /A-Line 32D (DDM-M)/

Lel-M /A-Line 32D (DDM-M)

Lel-M /A-Line 32D (DDM-M)- a system of continuous monitoring of the technical condition of hazardous industrial objects of the enterprises of oil and gas producing, oil and gas treating, petrochemical, chemical and other industries dependent on Rostekhnadzor of the Russian Federation.

Lel M/A-Line 32D (DDM-M)/ is hardwarely implemented as a distributed system of diagnostic data acquisition and processing and incorporates the central computer station (CCS), wiring closet of galvanic isolation and power supply (WCGI), control, measuring and switching units (CMSU), concentrators and a set of digital multipurpose measuring modules in explosion-proof version (MMEPV).

Lel M/A-Line 32D (DDM-M)/, the system of thorough diagnostic monitoring (TDM) is certified for conformity to the requirements of the All-Union State Standard (GOST) R 51330.0-99 (IEC 60079-0-98), GOST R 51330.1-99 (IEC 60079-1-98), GOST R 51330.10-99 (IEC 60079-11-99), regulating the application of electrical equipment in the explosion hazard zone and is certified flameproof 1Exd[ib]IICT6, or 1Exd[ib]IIBT6, or 1Exd[ib]IIAT6.

Different variants of configuration of systems intended for solving a wide spectrum of problems can be implemented on the base of Lel-M /A-Line 32D (DDM-M)/.



PRIMARY SYSTEM MEMBERS

Lel-M /A-Line 32D (DDM-M)/ system incorporates basic single-type devices and possesses a common kernel operation based on the central computer station.

Central computer station



Central computer station provides accumulation and thorough analysis of all the data received, their display, decision-making and formation of operating commands for multipurpose measuring modules and the executive equipment.

Wiring closet



Wiring closet is a device designed for power supply and galvanic isolation of concentrators and measuring lines. WCGI carries out galvanic isolation between the primary voltage 220V/50Hz and the secondary voltage of the direct current of 48V delivered to the line of cascading MMEPV, as well as optron galvanic isolation to the data transmission channel.

Control, measuring and switching units



Control, measuring and switching unit is designed for measurement of analog signals coming from gauges, formation of command analog signals for external executive devices and switching of measuring and executive circuits. Structurally CMSU represents a holder with the established motherboard with channel boards installed in the slots:

MC is a current loop measuring channel for registration of slowly varying parameters, from the primary or secondary converters equipped with a current output of 4-20 mA;

CC is a current loop command channel for management of various devices equipped with a command current input of 4-20 mA;

SC is a switching channel providing switching of external circuits by means of the relay in a controlled pattern.



Measuring line



Measuring line (cascading line of MMEPV) is a channel of command, management, synchronization, data transmission and power supply providing connection of multipurpose measuring units to the concentrator or WCGI.

Concentrator



Concentrator is an explosion-proof communication device providing securing support of several measuring lines for connection of multipurpose measuring units and equipped with high-speed digital communication channel (Ethernet) for communication with the central computing station.

Multifunctional measuring unit



Multifunctional measuring unit is a device providing galvanic isolation of measuring channels, reception of analog signals from diagnostic and parametrical sensors, their transformation into a digital form and the subsequent processing.

Each unit can contain a combination of up to three blocks of measurement or formation of signals of the executive equipment command:

AE is a channel for registration of acoustic waves; the channel contains analog and digital frequency filters, an amplifier, an analog-digital transducer, a digital amplitude comparator, computers for calculation of characteristics of AE signals;

MCC is the current loop measuring channel for registration of slowly varying parameters from the primary or secondary transducers equipped with a current output of 4-20 mA;

CCC is the current loop command channel for command of different devices equipped with the command input of 4-20 mA;

PB is the power bridge channel for measurement of drift of resistance in of the resistive bridge sensor arm from the originally established rate.



Sensors

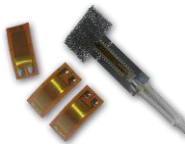
Sensors are primary transducers of physical quantities into electric signals.



- **acoustic emission sensor (AES)** are applied to registration of acoustic emission signals coming from plastic strain of solid media, development of defects (cracks, microcracks, delamination, corrosion, hydrogen embrittlement, etc.), friction, leak (escape of liquid and gaseous media through defects).



- **pressure transducers** are used for registration of values of superfluous pressure, underpressure, superfluous pressure-underpressure, absolute pressure, the difference of pressures and hydrostatic pressure (level) of liquid and gaseous, including corrosive media in the control objects under investigation.



- **strain gages (resistive strain sensors)** are applied to estimation of the stress-strain state of a structure and also for increase of reliability of the results of the acoustic emission control and other methods of monitoring used in TDM system.



- **vibration sensors (current output vibration velocity sensors)** are intended for transformation of average mean values of vibration velocity in controllable points of the units and equipment into direct current.



- **corrosion sensors** serve for measurement of the corrosion speed by the method of electric resistance (ER) or the method of linear polarization resistance (LPR).



- **temperature sensors** (resistance sensors, thermoelectric transducers) for measurement of the temperature of liquid and gaseous media.



- **temperature sensors** (resistance sensors, thermoelectric transducers) for measurement of the working surface temperature of the object under control.

OPTIONAL SYSTEM ELEMENTS

Automated workplace



Automated workplace (AWP) is a device used for remote access to the central computer station for reserve copying of the information and the unit setting. The automated workplace also is used for monitoring data processing and preparation of reports on the system operation.

Display



Display is an additional device for visual image of the information on the object state. It is delivered if you need to provide a higher level of details and the visual image of the results of work of monitoring systems.

Printer



Printer is a printing device, a component of the automated workplace providing output of the information in the form of printed copies of the text or schedules.

Uninterruptible power supply



Uninterruptible power supply is an automatic device placed between the energy source and the equipment and intended for protection of the equipment against short-term and pulse voltage swing, transients in the power network and network power-off.

Weather station



Weather station is a complex of measuring devices for test of temperature and air humidity, atmospheric pressure, speed and direction of the wind, presence of precipitation. It is delivered in case of need to account the influence of meteorological factors on the work of monitoring system or the object under control.

SPECIFICATIONS DESCRIPTION

GENERAL PARAMETERS

VALUE

Supply voltage of CCS, WCGI, intermediate station (technological junction)	220 V / 50 Hz
Maximum number of MMEPV in the	≤768 ps
Maximum number of MC in the system of TDM	2304 ps

WIRING CLOSET

Output voltage	48 V
Cable-transmitted ac signal amplitude	≤3 V
Maximum power supply	480 watts
Rated supply voltage	220 V
Supply frequency	50 ± 3 Hz
Power-off operation	0,5 sec
Time before buffer power supply shutdown (unloaded)	≤10 sec

CONTROL, MEASURING AND SWITCHING UNIT

Number of SC channels	2
Total number of two-channel MC junctions and single-channel CC junctions	6
Supply voltage	24 ± 5 V
Power consumption	≤10 watts

MULTIFUNCTIONAL MEASURING UNIT

Maximum number of simultaneously used channels of measuring, command, communication and switching	3
Type of data transmitted	digital self-synchronizing code
Cable type	twisted pair
Maximum cable segment length (between neighboring MMEPV)	120 m
Galvanic isolation of measurement units of breakdown voltage	≥500 V
Category temperature range	-40 ÷ +60 C°
Supply voltage	48 V
Power consumption	≤10 watts
Weight	5 kg

ACOUSTIC EMISSION CHANNEL (MMEPV)

Category temperature range (*standard model)	1 ÷ 1000 kHz (*15 ÷ 500 kHz)
Filters gain slope:	
- analog	22 dB/octave
- digital	60 dB/octave
In-band ripple	+1/-3 dB
Maximum AE signal amplitude at the preamplifier input	94 dB
Measurement accuracy of AE signal amplitude	± 1 dB

Self-noise level at preamplifier input within bandwidth	≤5 mkV
Dynamic range	≥66 dB
Timing accuracy	1 μs
AE signals registration speed	≥1000 hits/channel

CURRENT LOOP MEASURING CHANNEL (in MMEPV, CMSU)

Current measurement range	4 ÷ 20 mA
Basic measurement accuracy	0,2 %

CURRENT LOOP COMMAND CHANNEL (in MMEPV, CMSU)

Output current range	0 ÷ 20 mA
Maximum load resistance	600 Ohm
Basic accuracy of current establishment	0,2 %

BRIDGE MEASURING CHANNEL (in MMEPV)

Modifications for operation modes	¼ of the bridge, ½ of the bridge, bridge
Connected bridge arm terminal resistance	120 Ohm
Basic measuring accuracy between bridge offset and supply voltage	0,1 % of measuring range

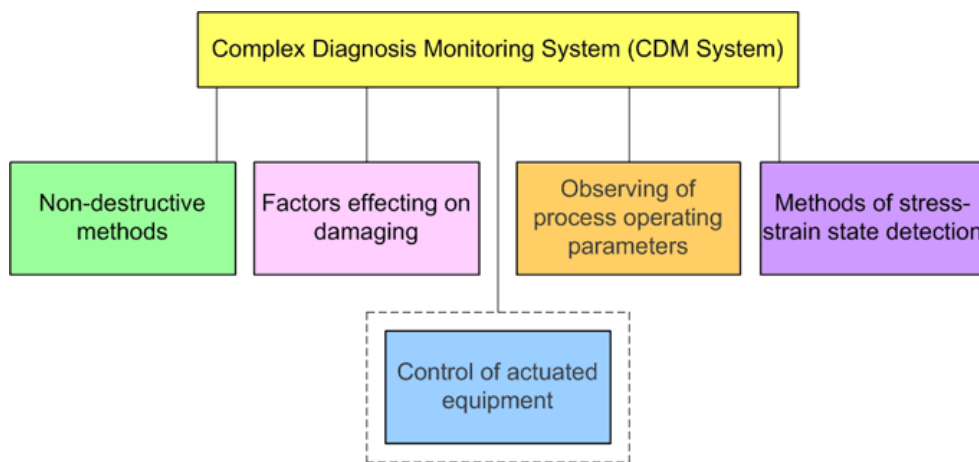
SYSTEMS OF COMPLEX DIAGNOSTIC MONITORING

Systems of complex diagnostic monitoring (CDM) are based on several methods of non-destructive testing providing a highly reliable and timely detection of all kinds of constructional and operational defects of the zones under control.



PURPOSE

- Increase in the level of operating safety of objects due to revealing of changes of the technical condition in real time.
- Timely detection of places of accumulation of damages and establishment of their character and hazard evaluation.
- Continuous control (monitoring) of the technical condition of objects on-stream through various methods of non-destructive testing, stress-strain state, measurement of working parameters of the technological process and tracking the factors influencing damageability of the object.

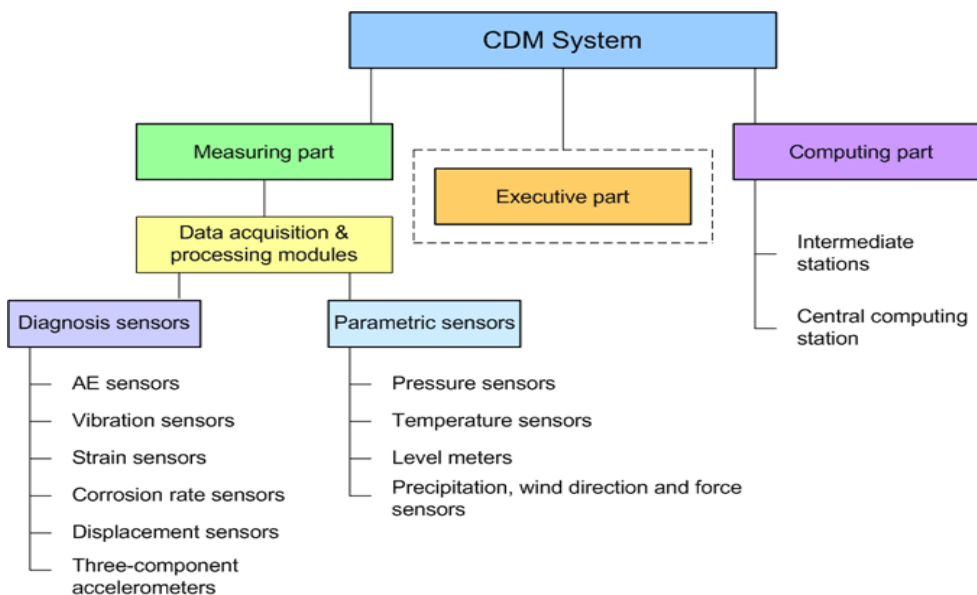


Concept of CDM System Construction

Systems of thorough diagnostic monitoring constructed based on Lei-M /A-Line 32D (DDM-M)/, functionally consist of three basic parts: the measuring, computing and executive ones.

The measuring part consists of various diagnostic and parametrical sensors.

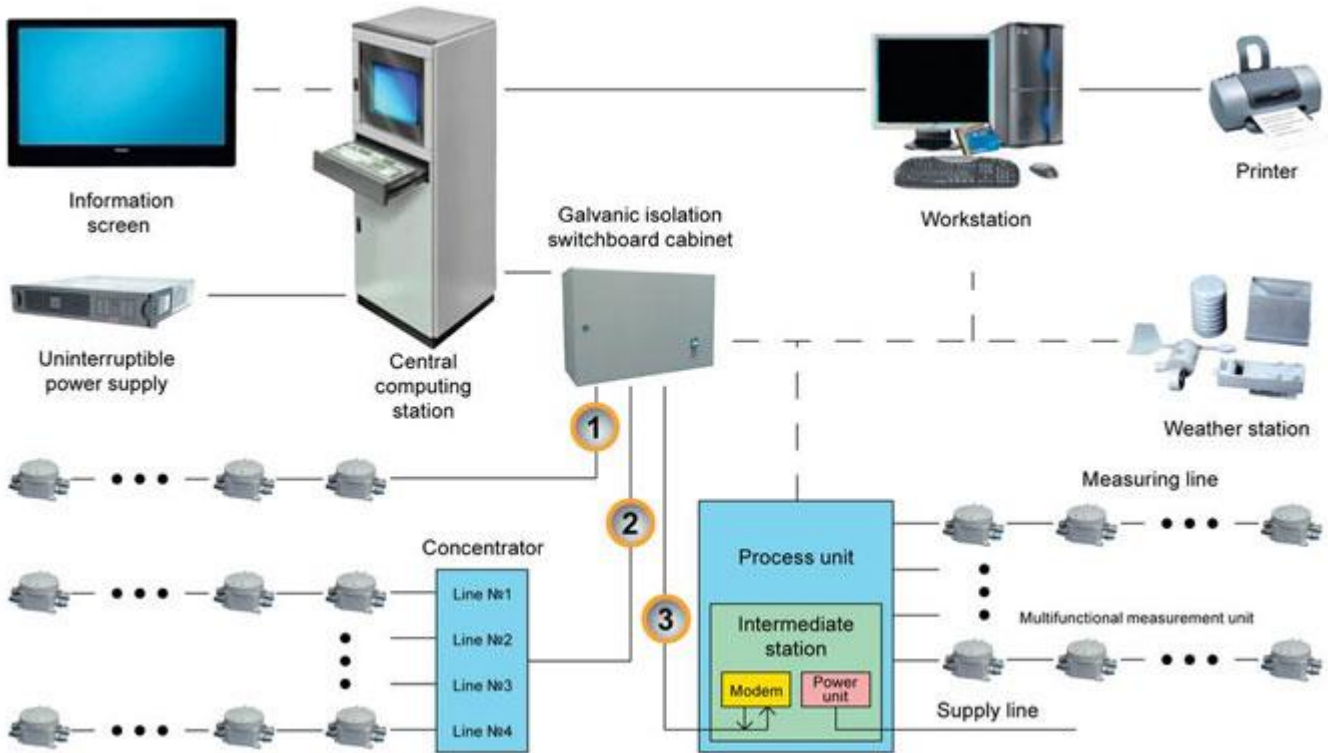
The computing part is implemented in the central computer station.



CDM System Functional Diagram

Filling, i.e. methods and means, of each component varies depending on the object under control and the goals of monitoring.

A flexible structure characteristic of systems of distributed type allows using various modifications.



Structure Flowchart of A-Line 32D (DDM-M) CDM System

- ① – one or several measuring lines joining up to ten MMEPV each, going directly from the central computer station. It is applied at monitoring of a small amount of constructions within the limits of one object;
- ② – many measuring lines joined by concentrators transferring data to the central computer station. It is applied at monitoring of a large volume of constructions of a large object or several local groups of objects under control;
- ③ – a large volume of measuring lines or several concentrators joined by intermediate stations transferring data to the central computer station. It is applied for covering a complex of close-spaced objects by the TDM system.

FEATURES

- Intellectual equipment of TDM system developed in view of the results of preliminary natural testing, theoretical calculations and modeling.
- Lossless and distortionless remote digital data transmission from measuring units.
- Location of MMEPV in the required places of the objects and digitization of AE signals directly at the object under control.
- Opportunity of system expansion up to the necessary number of measuring channels with preservation of time synchronization
- Accessible perception and estimation of the results of monitoring by means of mnemonic schemes of visualization and command of the TDM system.
- Integration with control stations for increase in efficiency of reaction in critical situations.
- Usability.
- High reliability and long-term service.

Automated systems of corrosion monitoring

Automated systems of corrosion monitoring (CM) comply with the general concept of construction of TDM systems for control of hazardous production facilities with the purpose of their operation in the current technical condition and serve for regulation of corrosion behavior speed and optimization of chemical agents supply applied for protection of the instrumentation from internal corrosion.



PURPOSE

- Optimization of chemical agents supply for protection of the instrumentation from internal corrosion
- Timely reaction to change of corrosion rate
- Accumulation of data for the subsequent analysis and long-term forecasting of the instrumentation corrosive wear.
- Automation of actions for protection of instrumentation against internal corrosion and lowering of the human factor function on estimation of the results of corrosion monitoring.

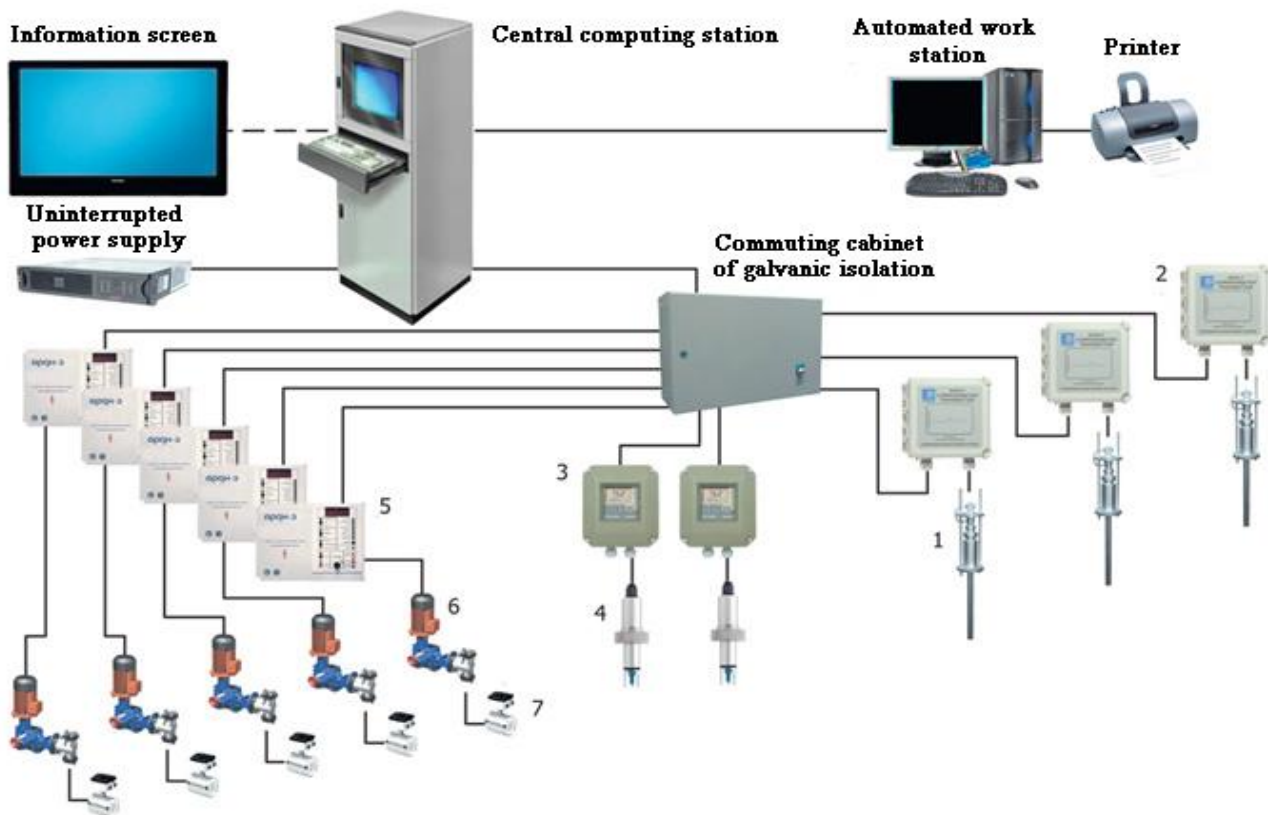
DESCRIPTION

Automated systems of CM based on of Iel-M /A-Line 32D (DDM-M)/ functionally consist of three basic parts: the measuring, computing and executive ones.

The measuring part, as a rule, incorporates corrosion sensors, pH sensors, patterns, flowmeters and AE transducers.

The computing part is implemented in the central computer station.

The executive part consists of automatic dosing pumps controllers, pumps and chemical agent supply jets.



Structure chart of thorough corrosion monitoring of ADU facility at oil refining enterprises

1. **Corrosion sensors** are primary transducers intended for measurement of corrosion rate through the method of electric resistance (ER) or the method of linear polarization resistance (LPR);
2. **Transmitters** are secondary converters connected to ER or LPR corrosion sensors, serve for measurement of corrosion sensor readings and their further transfer to standard interfaces in the analog or digital form;

3. **pH measurement complexes** are devices intended for technological process inspection and finding solutions to the problems of measurement and command of the executive instrumentation;
4. **pH sensors** are devices measuring pH level in aqueous phase (including in corrosive nature solutions);
5. **Dosing pump automatic controllers (DPAC)** is an electronic control unit of the dosing pump allowing control of corrosion protection agents supply;
6. **Dosing pumps** are electric pumps providing corrosion protection agents supply;
7. **Flowmeters** are devices intended for measurement of the corrosion protection agents consumption and allowing to supervise the result of DPAC control action.

FEATURES

- Opportunity of forecasting of epy current corrosion condition of the object under control.
- Measurement of the corrosion rate and on-line display of the received results.
- Noninuforn corrosion data acquisition
- Characterization of current corrosion processes and their statistical evaluations.
- Full-function command of DPAC operation modes and the dose level of chemical agents.
- Integration with control stations for increase in efficiency of reaction in critical situations.
- Usability.
- High reliability and long-term service.

ACOUSTIC EMISSION SYSTEMS

Acoustic emission systems

Many years' work experience in the field of non-destructive testing and technical diagnostics has allowed us to create a whole family of AE (acoustic emission) systems - A-Line series, which has become a company's trademark.

In 1992-1993 the first multi-channel acoustic emission systems A-Line 8S and A-Line 16S based on personal computer IBM PC were yielded, which initiated a family of multi-channel AE instruments of A-Line series.

Simultaneously with the yield of the first AE systems, a software support for them appeared. The first program version included a basic set of functions required for enquiring and subsequently processing the AE data.

One of the lines of instruments development is the continued production of multi-channel AE systems of traditional architecture ALine 16D (ISA), ALine 32D (PCI), A-Line 32D (PCI-N), A-Line 32D (PCI-8) and A-Line 32D (PCI-8E) with a centralized data processing circuit. The AE systems of such architecture are multi-channel boards for recording and processing the AE data, which operate on the basis of an industrial computer.

Presently, A-Line 32D (PCI-8E) AE systems of traditional architecture based on 8-channel AE recording boards for computers with a full-speed PCI interface are produced in lots.

Along with the development of AE systems of traditional architecture, an AE system Lel' /A-Line 32D (DDM)/ with a digital transmission of data has been designed and manufactured, which differs fundamentally from all previous representatives of the A-Line 32D family. The main feature of this AE system is transfer of the entire recording and computational part from the central computer to a device to be installed directly on the test object, named an AE module.

Representatives of the modular AE systems with distributed architecture are characterized by high noise immunity, digital transmission of data and galvanic isolation of measurement channels as compared to the AE systems of traditional architecture, and are an ideal decision for use on long and bulky objects.

To satisfy customers demands, since 2012 production of the A-Line 32D acoustic emission systems has been also launched in an explosion-proof version.

The basic principle of our work is continuous improvement of equipment with provision for advanced scientific notations about the AE nature and up-to-date technical requirements for the hardware-and-software part.

A-Line 32D (PCI-8)

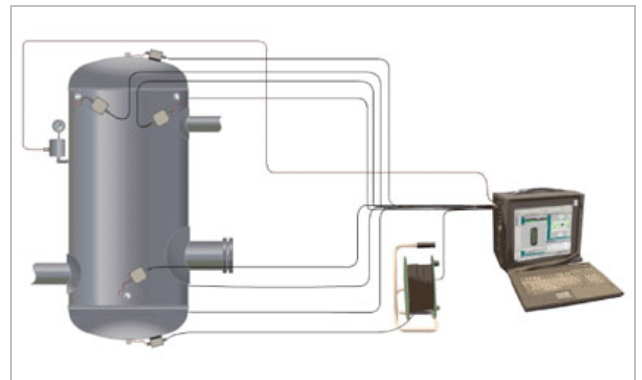
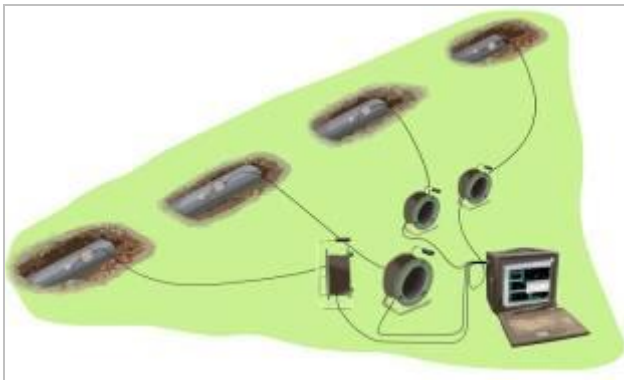


A-Line 32D (PCI-8E) are multichannel digital acoustic emission systems of traditional structure. AE research data are transmitted from the object under test through preamplifiers via the coaxial cable to the analog central computer station.

Multichannel AE systems thus constructed are characterized by high performance capabilities, high speed of data processing and are equally suitable both for field operating conditions and scientific research.



Structure scheme of A-Line 32D (PCI-8) AE system



Examples of installation of A-Line 32D (PCI-8) AE system at the object under test

PURPOSE

- Non-destructive testing by means of the acoustic emission method without withdrawal: pipelines, pressure vessels, reservoirs, boilers, derricks, cranes, bridges and other objects
- Detection of crack initiations and extensions
- Search of corrosion spots, leak and high stress level zones
- Localization and estimation of defects parameters
- Real-time tracking of various technological processes and estimation of the technical condition of critical large-scale structures

FEATURES

- Eight AE channels and two parametric channels per PCI board for one computer slot
- Full speed PCI interface providing 120 thousand hits per 8 channels
- System comprises 64 AE channel at the most (the number of channels can be increased due to connecting several system units to one measuring complex)
- Wide amplitude measurement range – up to 100 dB
- High-quality programmable digital filters
- A-Line 32D (PCI-8E) software, common for all A-Line 32D systems family, operates under Windows-9X/XP

SPECIFICATIONS

GENERAL PARAMETERS

VALUE

Maximum number of channels per system	64
Number of channels per data processing board	8
Number of parametric channels per data processing board	2
Channel-to-Channel Crosstalk	-66 dB
Maximum PK50 coaxial cable length	250 m
System performance with maximum number of channels:	
- registration of average parameters of AE signals	≥ 15000 hits/s per channel
- registration of parameters of each AE signal	≥20000 hits/s per system

PAEF-014 PREAMPLIFIER

Gain	26 dB
Noise (for bandwidth 30 ÷ 500 kHz)	≤5 μV RMS
Load resistance	50 Ohm
Bandpass flatness	+0,5/-3 dB
Standard cut-off frequencies of cartridge filters (± 10 %):	
- LF filters	500 kHz
- HF filters	25 kHz
LF filters gain slope	24 dB/octave
HF filters gain slope	24 dB/octave

AE PARAMETERS MEASURING CHANNEL

Bandwidth	1 ÷ 500 kHz
ADC resolution	16 bit
ADC sample rate	2 MHz
Dynamic range of AE signal amplitude measurement	≥84 dB
Maximum AE signal amplitude	100 dB
Measurement accuracy of maximum AE signal amplitude	± 0,5 dB
Dynamic range of AE signal energy	≥120 dB

MEASURED AE PARAMETERS

AE signal energy resolution	48 bits
AE signal timing accuracy	± 1 μs
AE signal duration range	1 ÷ 65535 μs
AE signal rise-time range	1 ÷ 65535 μs
Counts (threshold crossings) range	32768

ADDITIONAL PARAMETERS

ADC overflow flag	
Maximum duration flag	
Waveform presence flag	

PROGRAMMABLE PARAMETERS

Threshold range	10 ÷ 100 dB
Standard cut-off frequencies for digital filters:	
- LF filters (≥50 dB/octave)	500 kHz
- HF filters (≥30 dB/octave)	30 kHz
Maximum duration range	1 ÷ 65535 μs
Hit definition time-range	1 ÷ 65535 μs
Hit lockout time range	1 ÷ 65535 μs

PARAMETRIC CHANNELS

Maximum number of parametric channels	2 per PCI-8 board
ADC resolution	12 bits
ADC sample rate	50 Hz
Bandwidth	0 ÷ 10 Hz
Measurement accuracy	± 5%

LIST OF CERTIFICATES

Pattern Approval Certificate for Measuring Instruments of the State Standard of Russia RU.C.28.036.A No. 15512, registration No. 17333-98 of July 25, 2003

Pattern Approval Certificate for Measuring Instruments of the State Committee of Belarus No. 2752, registration No. ПБ 03 12 1749 04 of September 17, 2002

Pattern Approval Certificate for Measuring Instruments of the State Committee of Ukraine UA-MI/3p-554-2003, registration No. 17333-98 of October 24, 2003

Acoustic Emission Application Approval for Hazardous Industrial Facilities of the Federal Service for Ecological, Technological and Atomic Supervision No. PPC 00-17039 of July 26, 2005

Lel /A-Line 32D (DDM)/

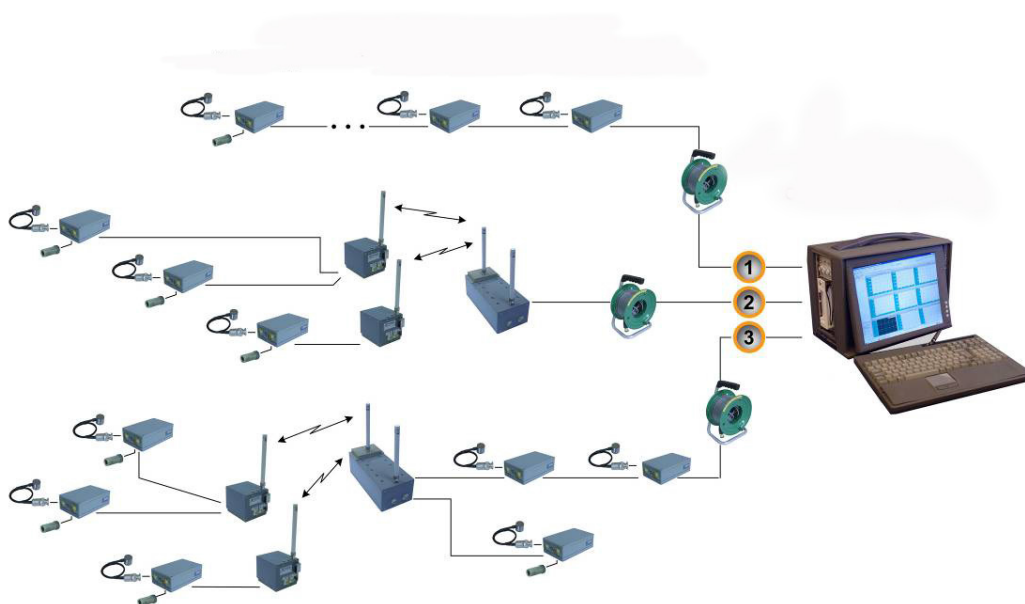
Lel /A-Line 32D (DDM)/ are multichannel module systems of AE data acquisition and processing with a serial high-speed digital data transmission channel.

AE systems of the given series comprise the central computer station and several measuring lines uniting consistently connected modules of AE data acquisition and processing (AE modules).

Strengthening of AE signals, filtration, digitization by means of ADC, registration, the subsequent digital processing and calculation of AE parameters is carried out in the AE module which is located near to the AE sensor directly at the object under test.

Use of digital data transmission has enabled the engineers of INTERUNIS to equip Lel /A-Line 32D (DDM) / AE system with a full set of wireless communication Lel /A-Line 32D (DDM/R)/.

The speed of data transmission via wireless flowline is highly competitive with a cable for data transmission and allows to fully exploit the opportunities of Lel /A-Line 32D (DDM)/.



Structure scheme of A-Line 32D (DDM)/ AE system



- acoustic emission sensor (AES);



- line terminator;



- AE module. It receives AE signals from AES, measures AE power and time parameters, provides data sending and digital data transmission via the flowline to the central computer station;



- transmit/receive station (TRS). TRS are equipped with a built-in accumulators providing up to 8 hours of autonomous work of the device with a connected AE module;



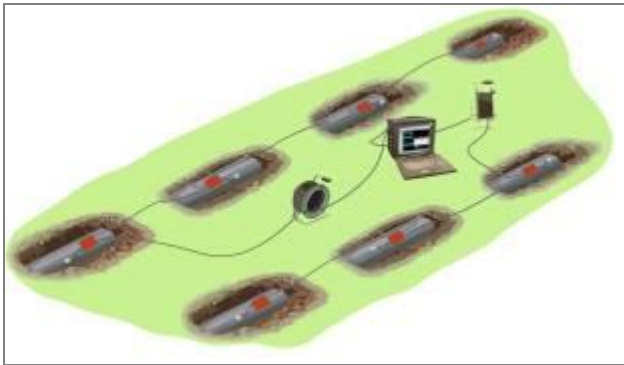
- central transmit/receive station (CRTS) is intended for data reception from AE modules and data control. A CRTS can provide wireless data transmission from 16 TRS, each of which allows to connect one or two AE modules;



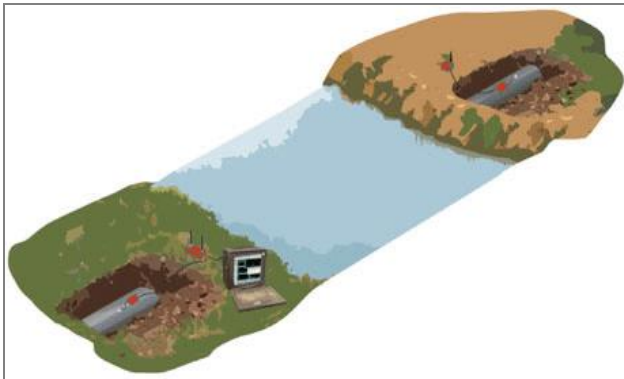
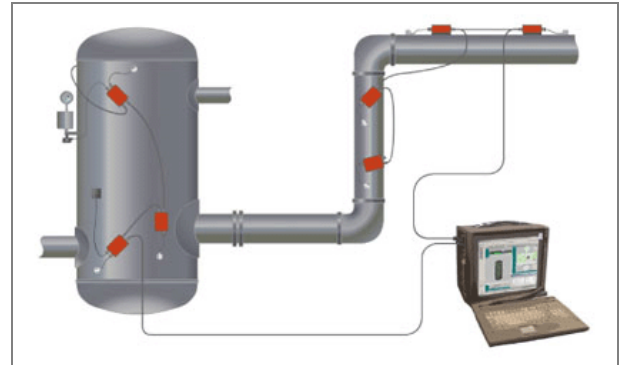
- UTP cable. The cable segments connecting modules can be different in length at the Customer's option depending on the features of the objects under test and use of standard adapters enables to increase the segment length if necessary.

Possible variants of construction of measuring lines of LeI /A-Line 32D (DDM) / system are presented in the scheme:

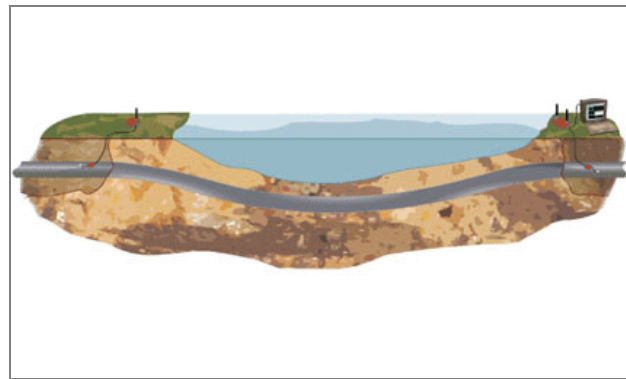
- 1 - one or several measuring lines uniting up to 12 channels each and connected by cables directly to the central computer station;
- 2 - a variant of construction using a full set of wireless communication (radiochannel);
- 3 - a combined variant of connection with the opportunity of data transmission both via a cable and a radio channel.



a.



b.



*Examples of location of LeI/A-Line 32D (DDM) AE system at the object under test:
a - cable connection of measuring lines; b - connection of measuring lines using wireless communication*

Uniqueness of LeI /A-Line 32D (DDM) / AE system is confirmed by the patent for invention RU 2267122 and the patent for utility model RU 44390.

PURPOSE

- Non-destructive testing by means of the acoustic emission method without withdrawal: pipelines, pressure vessels, reservoirs, boilers, derricks, cranes, bridges and other objects
- Detection of crack initiations and extensions
- Search of corrosion spots, leak and high stress level zones
- Localization and estimation of defects parameters
- Real-time tracking of various technological processes and estimation of the technical condition of critical large-scale structures

FEATURES

- Galvanic isolation of each module
- High speed of data acquisition, processing and transmission - more than 15 thousand events per each channel
- Range of working frequencies from 30 up to 500 kHz; from 1 kHz to order
- Real-time data analysis
- Opportunity of automatic control of the process of testing
- Testing of extensive objects of total length up to 5 km with one system at one measurement
- Opportunity to equip the system with a full set of digital wireless communication (radiochannel)
- Each AE channel incorporates:
 - adjustable gain factor;
 - programmatically switched filters;
 - pulse mode;
 - digital oscilloscope with the opportunity of installation of an independent threshold and adjustable image sweep;
 - three parametric channels with the opportunity of reconfiguring in control outputs;
 - temperature sensor built in AE module;
 - two-colour indicator of the condition of AE module.
- Software implemented in Russian Windows environment

LIST OF CERTIFICATES

Pattern Approval Certificate for Measuring Instruments of the State Standard of Russia RU.C.28.036.A No.15492, registration No. 25330-03 of July 25, 2003

Pattern Approval Certificate for Measuring Instruments of the State Committee of Belarus No. 2752, registration No. ПБ 03 12 1749 04 of September 17, 2002

Pattern Approval Certificate for Measuring Instruments of the State Committee of Ukraine UA-MI/3p-554-2003, registration No. 17333-98 of October 24, 2003

Acoustic Emission Application Approval for Hazardous Industrial Facilities of the Federal Service for Ecological, Technological and Atomic Supervision No. PPC 00-17039 of July 26, 2005

SPECIFICATIONS

GENERAL PARAMETERS

VALUE

Maximum number of channels per line	16
Maximum cable segment length (between AE modules)	≤100 m
Maximum line length	1600 m
System performance with maximum number of channels:	
- registration of average parameters of AE signals	≥ 15000 hits/s per AE module
- registration of parameters of each AE signal	≥16000 hits/s per line

ANALOG SECTION

Gain range (1 dB step)	20 ÷ 60 dB
Noise (for bandwidth 30 ÷ 500 kHz)	≤5 μV
Standard cut-off frequencies for Switch-selectable filters (± 10 %):	
- LF filters	100, 250, 350, 500 kHz
- HF filters	30 (1*), 50, 100, 150 kHz
LF filters gain slope	≥24 dB/octave
HF filters gain slope	≥24 dB/octave
Bandpass flatness	+0,5 / -3 dB
Pulse amplitude range (in pulse mode)	10 ÷ 140 V
Pulse amplitude accuracy	± 10 %
Pulse rate	1 Hz

MEASURING SECTION

Bandwidth	30 (1*) ÷ 500 kHz
ADC resolution	14 bit
ADC sample rate	1(2*) MHz
Dynamic range of AE signal amplitude measurement	≥ 72 dB

DIGITAL OSCILLOSCOPE CHANNEL

Number of oscilloscope channels	1 per AE module
Sample rate	25, 50, 100, 250, 500, 1000 kHz
Waveform length	1000 / 2000 samples
Pre-triggering range	0 ÷ 2000 samples

MEASURED AE PARAMETERS

Maximum AE signal amplitude	≥100 dB
Measurement accuracy of maximum AE signal amplitude	± 0,5 dB
Dynamic range of AE signal energy measurement	≥ 120 dB
Counts (threshold crossings) range	1 ÷ 32768
Duration range	1 ÷ 65535 μs
Rise-time range	1 ÷ 65535 μs
Timing accuracy	± 1 μs

ADDITIONAL PARAMETERS

ADC overflow flag

Maximum duration flag

Waveform presence flag

PROGRAMMABLE PARAMETERS

Threshold range	0 ÷ 108 dB
Maximum duration range	10 μ s ÷ 65535 μ s
Hit definition time-range	10 μ s ÷ 65535 μ s
Hit lockout time range	30 μ s ÷ 65535 μ s

PARAMETRIC CHANNELS

Maximum number of parametric channels	4 per AE module
ADC resolution	12 bit
ADC sample rate	50 Hz
Bandwidth	0 ÷ 5 Hz
Measurement accuracy	\pm 5%

* - custom-made

Distinctive features of the systems

Lel /A-Line 32D (DDM)/



Lel /A-Line 32D (DDM) / is a **distributed system** of AE data acquisition and processing with a serial high-speed digital data transmission channel. Registration, processing and digitization is carried out in the AE module which is located near to the AE sensor directly at the object under test. Then the obtained data are transferred to the computer station based on the industrial computer.

Data is **digitally** transmitted to the computer station.

System Lel /A-Line 32D (DDM) / can be used both with wire data transmission (basic variant) and with a **full set of wireless communication (radiochannel)** preserving a high efficiency enabling to register up to 1000 AE events per second for each channel and to transfer the oscillogram of signals simultaneously from all the AE modules.

System Lel/A-Line 32D (DDM) / allows to test extensive objects of total length up to **5 km** at one measurement.

In Lel /A-Line 32D (DDM) / each channel (AE module) is **galvanically isolated**, which in aggregate with the applied digital data transmission provides a **high noise immunity**.

Lel /A-Line 32D (DDM) / system possesses the opportunity of switching each channel to the pulse mode with a preset amplitude.

Maximum number of parametric channels is **4 per each AE module**.

A-Line 32D (PCI-8E)



A-Line 32D (PCI-8E) is an AE system of traditional structure with a **centralized scheme** of data processing. The signal from an AE sensor gains strength in the preamplifier and is transferred to the computer station via a separate coaxial cable. Digitalization and the subsequent processing are carried out in the computer station based on the industrial computer.

Data is transmitted to the computer station **in the analog form**.

System A-Line 32D (PCI-8E) cannot be used simultaneously with a radiochannel. The AE signal is transferred from the object under test to the computer station via a coaxial cable.

In A-Line 32D (PCI-8E) system the maximum coaxial cable length makes 250-300 m, hence, the maximum distance between the extreme points (AE sensors) at the object of test does not exceed **600 m**.

In A-Line 32D (PCI-8E) system each channel is galvanically connected with the chassis of the computer station.

Basic variant of A-Line 32D (PCI-8E) system can be upgraded with a special simulator of AE signals.

Maximum number of parametric channels is **2 per PCI-8E board**.

1

2

3

4

5

6

7

AE systems configuration

BASIC INSTRUMENTATION

Computer stations

Portable

Compact portable AE system in the industrial computer intended for measurements in field conditions.



PARAMETERS

Offered with	A-Line 32D (PCI-8E)	LEL /A-Line 32D (DDM)/
Case material	Chassis of aluminum alloy in plastic protective (shock-resistant, water-resistant) covering	
Dimensions	400x291x213 mm	
Electronic module mass (16 channels)	15 kg	
Maximum number of channels (basic configuration)	24	48
Power supply	~220 V ± 5%, 50 ± 1 Hz	
Power consumption (16 channels)	≤500 watts	
Working temperatures range	5 ÷ 40 °C	

Portable XL

Compact portable AE system in the industrial computer intended for measurements in field conditions.



PARAMETERS

Offered with	A-Line 32D (PCI-8)	
Case material	Chassis of aluminum alloy in plastic protective (shock-resistant, water-resistant) covering	
Dimensions	445x333x245 mm	
Electronic module mass (16 channels)	17 kg	
Maximum number of channels (basic configuration)	40	
Power supply	~220 V ± 5%, 50 ± 1 Hz	
Power consumption (16 channels)	≤600 watts	
Working temperatures range	5 ÷ 40 °C	

Industrial

Multichannel AE system in failure-safe chassis of an industrial computer (19" Computer Chassis), intended for stationary measurements and mobile diagnostic laboratories.



PARAMETERS

Offered with	A-Line 32D (PCI-8E)
Case material	steel
Dimensions	482x177x452 mm
Electronic module mass (24 channels)	25 kg
Maximum number of channels (basic configuration)	64
Power supply	~220 V ± 5%, 50 ± 1 Hz
Power consumption (16 channels)	≤600 watts
Working temperatures range	5 ÷ 40 °C

Ethernet Box

Portable AE system of data acquisition with the possibility of Ethernet 10/100 Base-T Remote Access. It is intended to be shared with any computer.



PARAMETERS

Offered with	A-Line 32D (PCI-8E)	Lel /A-Line 32D (DDM)/
Case material	steel	
Dimensions	166x170x393 mm	
Electronic module mass (16 channels)	10 kg	
Maximum number of channels (basic configuration)	24	48
Power supply	~220V ± 5%, 50 ± 1 Hz	
Power consumption (16 channels)	≤300 watts	
Working temperatures range	5 ÷ 40 °C	

Ethernet Box XL

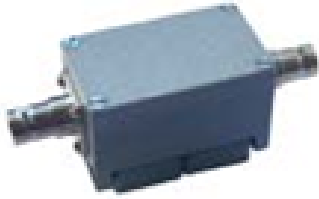
- portable AE system of data acquisition with the possibility of Ethernet 10/100 Base-T Remote Access. It is intended to be shared with any computer.



PARAMETERS

Offered with	A-Line 32D (PCI-8E)	Lel /A-Line 32D (DDM)/
Case material	steel	
Dimensions	173x315x410 mm	
Electronic module mass (16 channels)	6 kg	
Maximum number of channels (basic configuration)	40	64
Power supply	~220V ± 5%, 50 ± 1 Hz	
Power consumption (16 channels)	≤300 watts	
Working temperatures range	5 ÷ 40 °C	

PAEF-014 preamplifier with magnetic chuck



PARAMETERS	VALUE
Offered with	A-Line 32D (PCI-8E)
Dimensions	50x30x35 mm
Mass	120 g
Preamplifier supply voltage	24 V
Gain factor	26 dB
Noise (for bandwidth 30 ÷ 500 kHz)	≤5 μV
Load resistance	50 Ohm
Bandpass flatness	+0,5/-3 dB

You can find more detailed characteristics in section Specifications of A-Line 32D (PCI-8E) AE system

Data acquisition module with magnetic chuck



PARAMETERS	VALUE
Offered with	Lel /A-Line 32D (DDM)/
Dimensions	149x45x85 mm
Mass	710 g
Conditions of AE module operation:	
- ambient temperature	-20 ÷ +50 °C
- relative humidity at +25° C	≤95%
- atmospheric pressure	460 ÷ 960 mm of mercury
Power consumption	≤2 watts

You can find more detailed characteristics in section Specifications of Lel /A-Line 32D (DDM)/ AE system

ACOUSTIC EMISSION SENSORS

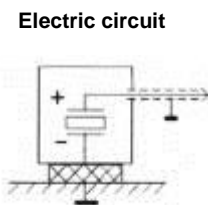
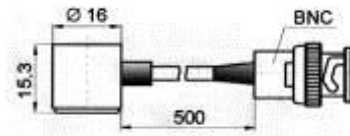
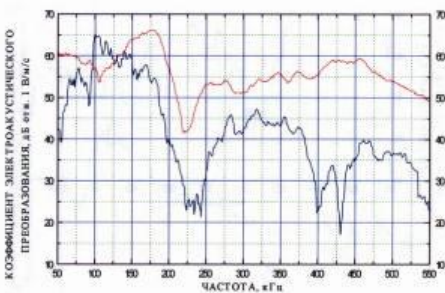
The basic configuration of A-Line 32D AE system incorporates GT200 sensors.

PARAMETERS

VALUE



Sensor model	GT200
Operating frequency	165 kHz
Bandwidth	130 ÷ 200 kHz
Capacitance	400 ÷ 500 pF
Insulation resistance	>100 MOhm
Temperature range	-40 ÷ +150 °C
Case material	titanium alloy
Built-in cable length	0,5 m
Mass (without cable)	15 g
Connection type	BNC (CP-50-74ФВ)



At the Customer's request systems can be configured with the following sensors:

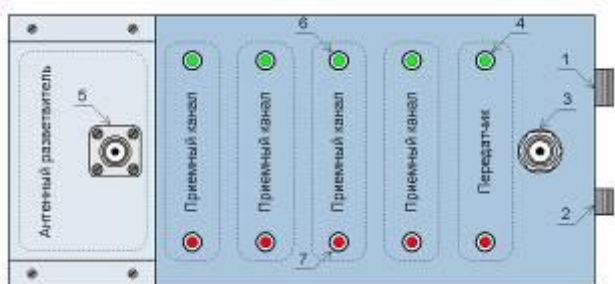
	AES model	Type	Operating frequency	Bandwidth	Temperature range	Built-in cable length	Mass (without cable)
GlobalTest Ltd.	GT205	low-frequency	50 kHz	40 ÷ 100 kHz	-40 ÷ +150 °C	0,5 m	45 g
	GT200B	resonant, explosion-proof (Exib II CT4)	165 kHz	130 ÷ 200 kHz	-40 ÷ +150 °C	0,5 m	20 g
	GT300	broadband	280 kHz	100 ÷ 800 kHz	-40 ÷ +150 °C	0,5 m	15 g
	GT301	broadband	220 kHz	50 ÷ 500 kHz	-40 ÷ +120 °C	0,5 m	14 g
	GT200U	resonant with amplifier	165 kHz	130 ÷ 200 kHz	-40 ÷ +100 °C	0,5 m	70 g
	GT250	low-frequency with amplifier	50 kHz	40 ÷ 100 kHz	-40 ÷ +100 °C	0,5 m	80 g
	GT350	broadband with amplifier	120 kHz	100 ÷ 800 kHz	-40 ÷ +100 °C	0,5 m	15 g
Donskiye izmeritelniye sistemy Ltd.	ПК 3-60	bandpass, low-frequency	...	3 ÷ 60 kHz	-60 ÷ +70 °C	0,3; 0,6 m	220 g
	ПК 30-300	bandpass	...	30 ÷ 300 kHz	-60 ÷ +60 °C	0,3; 0,6 m	50 g
	ПЭКМ 30-300	bandpass, with magnet	...	30 ÷ 300 kHz	-60 ÷ +70 °C	...	120 g
	ПЭГМ 30-300	bandpass, airtight, with magnet	...	30 ÷ 300 kHz	-60 ÷ +70 °C	up to 100 m	140 g
	ПЭКМ 20-300	bandpass, with magnet	...	20 ÷ 300 kHz	-60 ÷ +70 °C	...	140 g
	ПЭ 50-300	bandpass	...	50 ÷ 300 kHz	-60 ÷ +70 °C	...	70 g
	ПК 01-05	bandpass	...	01 ÷ 05 kHz	-60 ÷ +50 °C	0,3; 0,6 m	60 g
	ПК 02-05	bandpass	...	02 ÷ 05 kHz	-60 ÷ +50 °C	0,3; 0,6 m	60 g
BT1	resonant, high temperature	160 kHz	...	-60 ÷ +250 °C	0,3; 0,6 m	55 g	

INSTRUMENTATION FOR WIRELESS COMMUNICATION IN CONFIGURATION OF LeI /A-Line 32D (DDM/R/)

Central transmit/receive station



PARAMETERS	VALUE
Number of radiochannels:	
- transmitting	1
- receiving	from 1 till 4
Channel division	frequency, time
Channel type	digital
Supply	48 V
Power consumption	≤24 watts
Dimensions	300x140x135 mm
Mass	3,8 kg



- 1 – input slot of PC-19 line;
- 2 – output slot of PC-10 line;
- 3 – transmitting antenna slot;
- 4 – transmitter operation indicator;
- 5 – receiving antenna slot;
- 6 – receiving channel operation indicator;
- 7 – reception error indicator.

Receive/transmit station



PARAMETERS	VALUE
Number of radiochannels:	
- transmitting	1
- receiving	1
Channel division	frequency, time
Channel type	digital
Supply	Storage battery 12 V / 4,5 Ah/kg
Power consumption	≤5 watts
Continuous work time with storage battery	≥8 hours
Storage battery Voltage and charging rate	15 V / 0,2 A
Dimensions	145x120x115 mm
Mass	2,8 kg

- 1 – battery connector guard;
- 2 – RTS on/off switch;
- 3 – battery charge indicator;
- 4 – battery charger connector slot;
- 5 – PC-19 slot for connection of AE module;
- 6 – extra slot PC-19;
- 7 – receive/transmit antenna slot;
- 8 – RTS operation indicator;
- 9 – reception error indicator;
- 10 – magnet chuck.

Omnidirectional antenna BD-18OV-3-2



Omnidirectional antenna BD-18OV-3-2 (3dBi) belongs to the class of wave vibrators which provides high power parameters at small dimensions and little weight. Antennas are characterized by high reliability, durability and stability of characteristics in different weather conditions. It is applied to construction of radio networks of data transmission to the equipment of DECT standard.



PARAMETERS

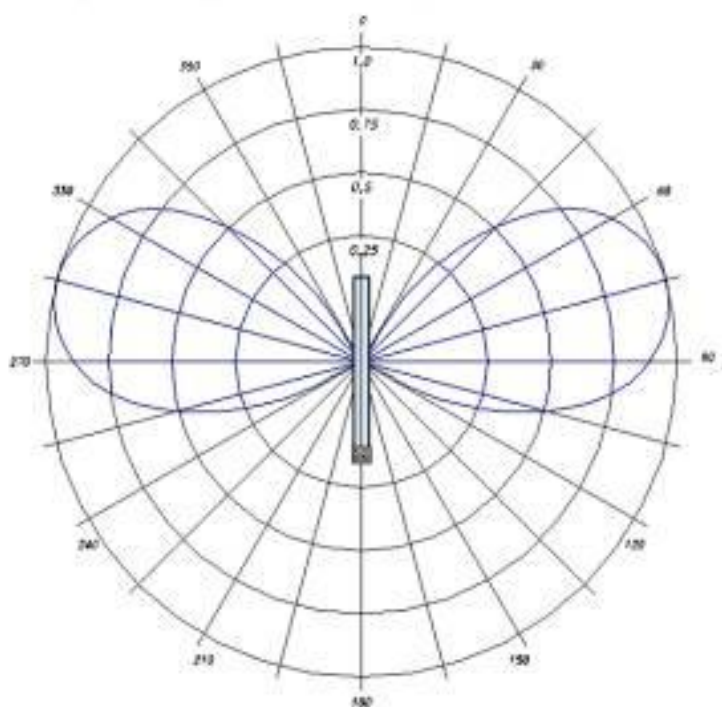
VALUE

Operating band	1 880 - 1 890 MHz
Gain factor	3 dBi
Directivity graph width at -3 dB	60°
Wave resistance	50 Ohm
Slot	N-type Male
Polarization	vertical
Dimensions	Ø20 × 197 mm
Mass (with mount)	90 g
Material	PVC

Antenna



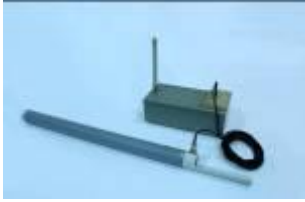
Vertical directivity graph



Omnidirectional antenna BD-18OV-8-2



Omnidirectional antenna BD-18OV-8-2 (8 dBi) belongs to the collinear class which provides high power parameters. Antennas are characterized by high reliability, durability and stability of characteristics under various weather conditions. It is applied to construction of radio networks of data transmission to the equipment of DECT standard. It is connected to CRTS.



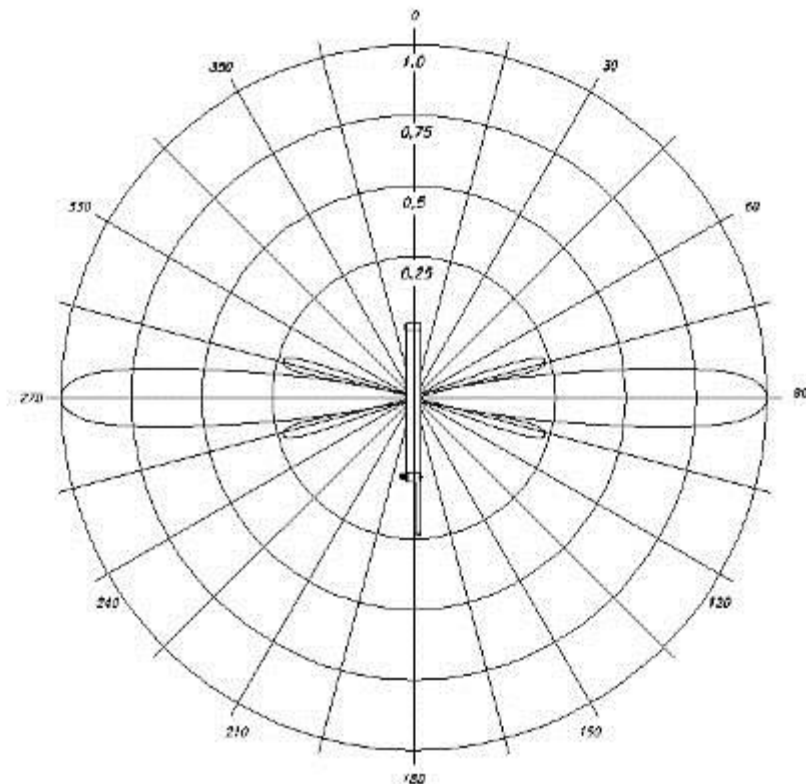
PARAMETERS

VALUE

Operating band	1 880 - 1 900 MHz
Gain factor	8 dBi
Directivity graph width at -3 dB	15°
Wave resistance	50 Ohm
Slot	N-type Female
Polarization	vertical
Dimensions	Ø50 × 800 mm
Mass (with mount)	1,3 kg
Material	Steel, polypropylene
Maximum wind speed	50 m/s
Mast diameter	Ø40 ÷ Ø60 mm

Installation of antenna at the mast

Vertical directivity graph



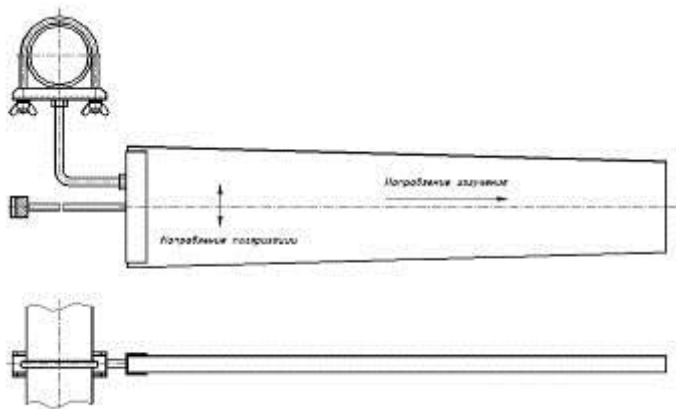
Directional antenna BD-18S45-10



Directional antenna BD--18s45-10 (10dBi) is constructed according to "the wave channel" scheme. The antenna has high characteristics of orientation, signal attenuation in the backward semisphere and gain factor. The antenna is covered with a plastic case and characterized by high reliability, durability and stability of characteristics under various weather conditions. It is applied to construction of radio networks of data transmission to the equipment of DECT standard. It is connected to RTS.

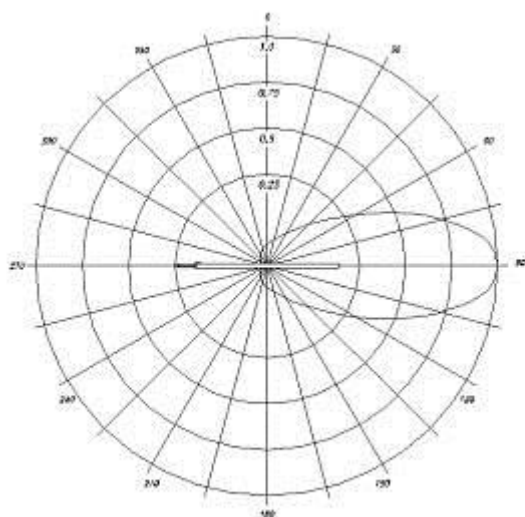
PARAMETERS	VALUE
Operating band	1 880 - 1 900 MHz
Gain factor	10 dBi
Directivity graph width at -3 dB	45° × 45°
Wave resistance	50 Ohm
Slot	N-type Male
Polarization	vertical, horizontal
Dimensions without mount	532 × 120 × 20 mm
Mass (with mount)	1,1kg
Material	Steel, polystyrene
Maximum wind speed	50 m/s
Mast diameter	Ø40 ÷ Ø60 mm

Installation of antenna at the mast

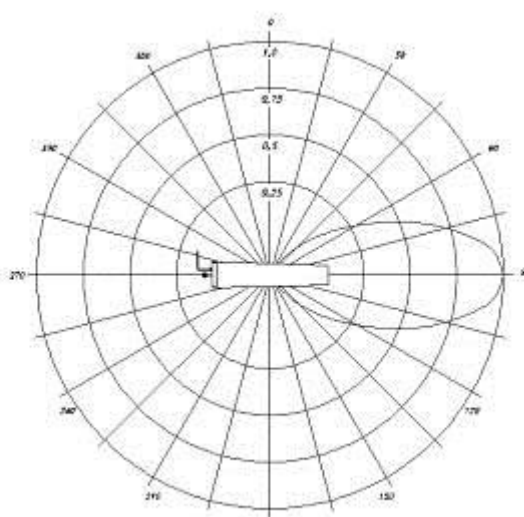


Directivity graph:

a. horizontal



b. vertical



OPTIONAL INSTRUMENTATION

Magnet chuck for GT200



PARAMETERS

Pressing force	20 N
Dimensions	84x20x70 mm
Weight	200 g

Offered for A-Line 32D (PCI-8E) and Iel/A-Line 32D (DDM)/

Cable PK-50 on cathead



PARAMETERS

Cable type	PK 50-2-16 /coaxial/
Central conductor	copper, tinned multistranded
Isolation	polyethylene
External diameter	3,2 mm
Wave resistance	50 Ohm
Connection type	CP50-74ΦB
Temperature range	-30 ÷ +80 °C

Offered for A-Line 32D (PCI-8E)

Bundle (adapter for PK-50 cable connection to the module)

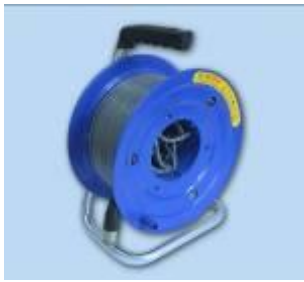


PARAMETERS

PARAMETERS	VALUE
Cable type	RG-174 A/U
Central conductor	copper, tinned multistranded
Isolation	polyethylene
External diameter	2,8 mm
Wave resistance	50 Ohm
Type of connection to module	DHS-26F
Type of connection to cable PK-50	CP50-1ΦB
Maximum number o channels connectable via bundle	8
Temperature range	-40 ÷ +75 °C

Offered for A-Line 32D (PCI-8E)

UTP type cable on cathead



PARAMETERS

Cable type	shielded twisted pair (7 pairs)
Isolation	PVC
Cover	PVC
Conductor section, AWG	24
Wave resistance	75 Ohm
Type of connection to module input	PC-19ATB
Type of connection to module output	PC-10ATB
Temperature range	-20 ÷ +50 °C

Offered for Lel/A-Line 32D (DDM)/



Adapter



PARAMETERS

Connection type 1	PC-10ATB
Connection type 2	PC-19ATB
Case	aluminum alloy

Offered for Lel/A-Line 32D (DDM)/

Line terminator



Line terminator represents a reciprocal part to module slot RS-10 TB with a special wiring.

Charger for RTS



PARAMETERS

Charger type	БПС 15-0,35
Mains supply	220 V
Frequency	50 Hz
Output voltage	15 V
Load current	0,35 A
Pin power connector (with shock absorber)	DJK-11A

Offered for Lel/A-Line 32D (DDM)/

Su Nilsen Imitator

The break of the graphite core creates elastic fluctuations simulating AE signals in the object under test.



PARAMETERS

Graphite rod diameter	0,3 or 0,5 mm
Graphite rod solidity	2T (2H)
Offered for A-Line 32D (PCI-8E) and Lel/A-Line 32D (DDM)/	

Bags



PARAMETERS

Capacity	16 modules or preamplifiers
Dimensions	500x240x300 mm



PARAMETERS

Capacity	8 modules or preamplifiers
Dimensions	470x220x180 mm



PARAMETERS

Capacity	5 small catheads with cable
Dimensions	800x300x250 mm



PARAMETERS

Capacity	3 large catheads with cable
Dimensions	560x350x300 mm

EXAMPLES
OF INDUSTRIAL APPLICATION
OF AUTOMATED SYSTEMS
BASED ON
A Line 32D

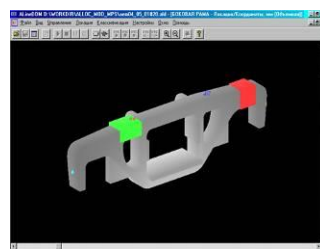
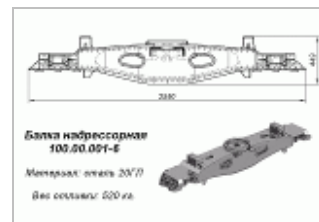
Automated system for lateral frames and bolsters diagnostics

Automated complex of diagnostics of lateral frames and bolsters of freight wagons represents a test multichannel information and measuring acoustic emission system comprising two elements:

- loading stand intended for creating a test load of the objects under test (lateral frames and bolsters);
- hardware based on Lel/A-Line 32D (DDM)/, a multichannel module system of AE data acquisition and processing.



General view of automated acoustic emission complex



Software image of lateral frame

PURPOSE

- Non-destructive testing by means of acoustic emission of lateral frames and bolsters of truck model 18-100 of freight wagons
- Detection of type of cracks developing under defects load
- Calculation of coordinates and estimation of defect parameters
- Classification of the defected defects according to level of danger for further operation of the object under test

LIST OF CERTIFICATES

Pattern Approval Certificate for Measuring Instruments of the State Standard of Russia RU.C.28.036.A No. 15492, registration No. 25330-03 of July 25, 2003

Pattern Approval Certificate for Measuring Instruments of the State Committee of Belarus No. 2752, registration No. ПБ 03 12 1749 04 of September 17, 2002

Pattern Approval Certificate for Measuring Instruments of the State Committee of Ukraine UA-MI/3p-554-2003, registration No. 17333-98 of October 24, 2003

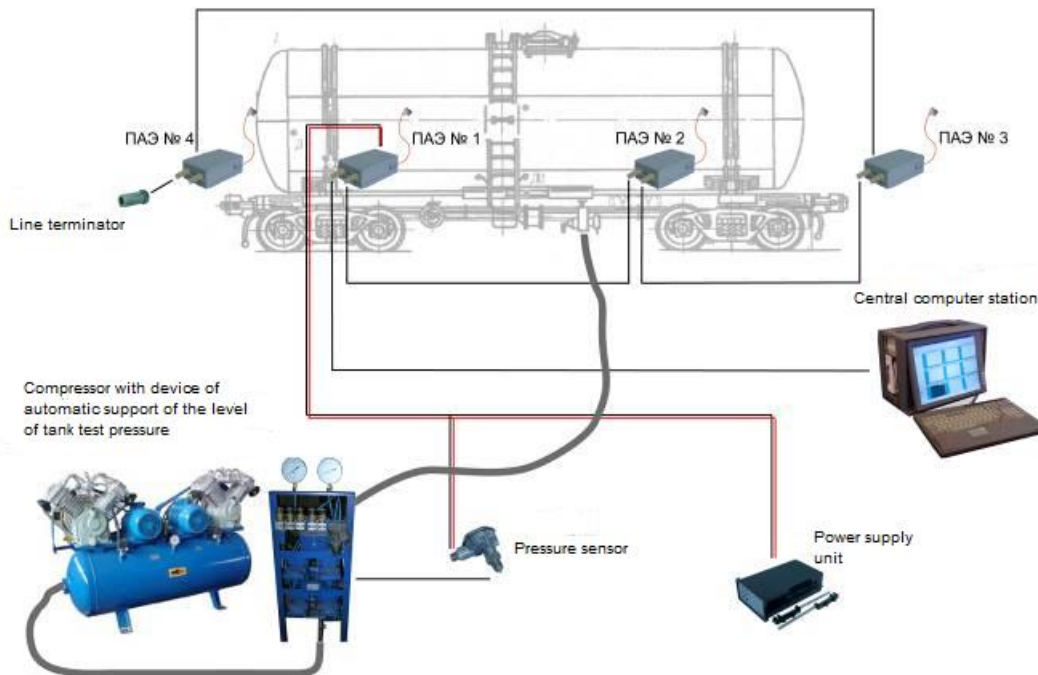
Registration Certificate in branch Register of Measuring Equipment of Federal State Unitary Enterprise *All-Russian Scientific Research Institute of Railway Transport under Ministry of Railways of Russia* for Automated complex of diagnostics of lateral frames and bolsters of freight wagons, registration No. MT 137.2003 of December 25, 2003

Acoustic emission unit for railway tank cars testing

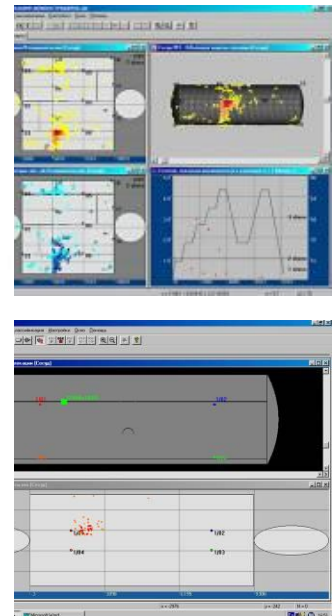
Acoustic emission unit for railway tank cars testing represents a test multichannel information and measuring acoustic emission system comprising two elements:

- devices for creating a test load of the tank under test;
- hardware based on LeI /A-Line 32D (DDM)/, a multichannel module system of AE data acquisition and processing.

Acoustic emission unit for railway tank cars testing is registered in the branch Register of Measuring Equipment admitted for use at railway transportation at **No. MT 102.2003**.



Structure scheme of acoustic emission unit for railway tank cars testing



Software image of tank

PURPOSE

- Non-destructive testing and estimation of the technical condition of railway tank cars (models 15-1427, 15-1428, 15-1443) by means of acoustic emission at plants repairing and modernizing freight wagons
- Detection of through defects (leaks) and progressive cracks at pneumatic testing
- Calculation of coordinates and estimation of defect parameters

LIST OF CERTIFICATES

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Pattern Approval Certificate for Measuring Instruments of the State Committee of Belarus No. 2752, registration No. ПБ 03 12 1749 04 of September 17, 2002

Pattern Approval Certificate for Measuring Instruments of the State Committee of Ukraine UA-MI/3p-554-2003, registration No. 17333-98 of October 24, 2003

Registration Certificate in branch Register of Measuring Equipment of Federal State Unitary Enterprise *All-Russian Scientific Research Institute of Railway Transport under Ministry of Railways of Russia* for Acoustic emission unit railway tank cars testing, registration No. MT 102.2003 of August 06, 2003

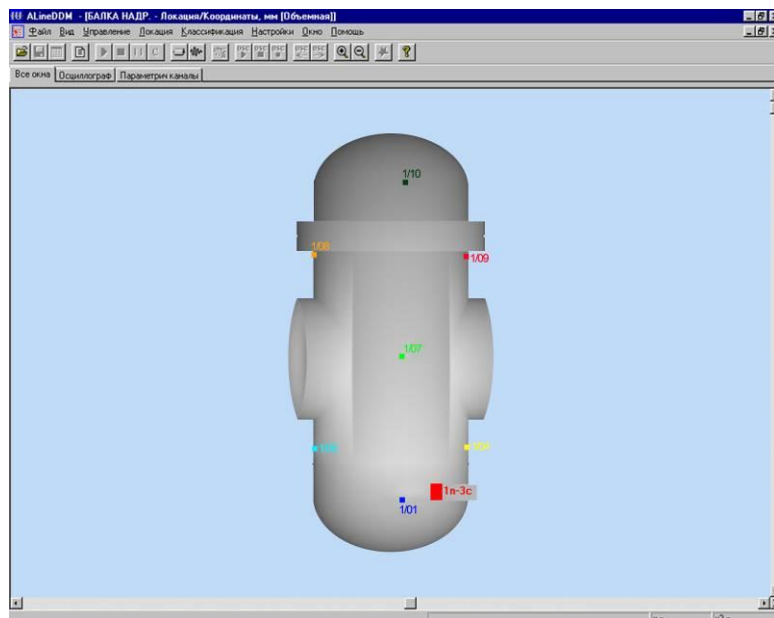
Automated system for gate valves testing

Automated system for gate valves testing represents a multichannel information and measuring acoustic emission system comprising two elements:

- hydraulic test stand for internal pressure loading of gate valves on testing soundness and strength of the basic material and welds
- hardware based on Lei/A-Line 32D (DDM)/, a multichannel module system of AE data acquisition and processing



Gate valve under test



Software image of gate valve

PURPOSE

- Non-destructive testing and estimation of the technical condition of gate valves of DN 700-1200 PN 8.0-15.0 and DN 350-500 PN 8.0-10.0 classes with cylindrical section case and DN 500-1200 PN 1.6-6.4 class with oval section case by means of acoustic emission
- Detection of metal discontinuity (fatigue and hardening cracks, pores, etc.) in welds and basic metal of gate valves at hydraulic tests
- Calculation of coordinates and estimation of progressive defect parameters

LIST OF CERTIFICATES

Pattern Approval Certificate for Measuring Instruments of the State Standard of Russia RU.C.28.036.A No. 15492, registration No. 25330-03 of July 25, 2003

Pattern Approval Certificate for Measuring Instruments of the State Committee of Belarus No. 2752, registration No. ПБ 03 12 1749 04 of September 17, 2002

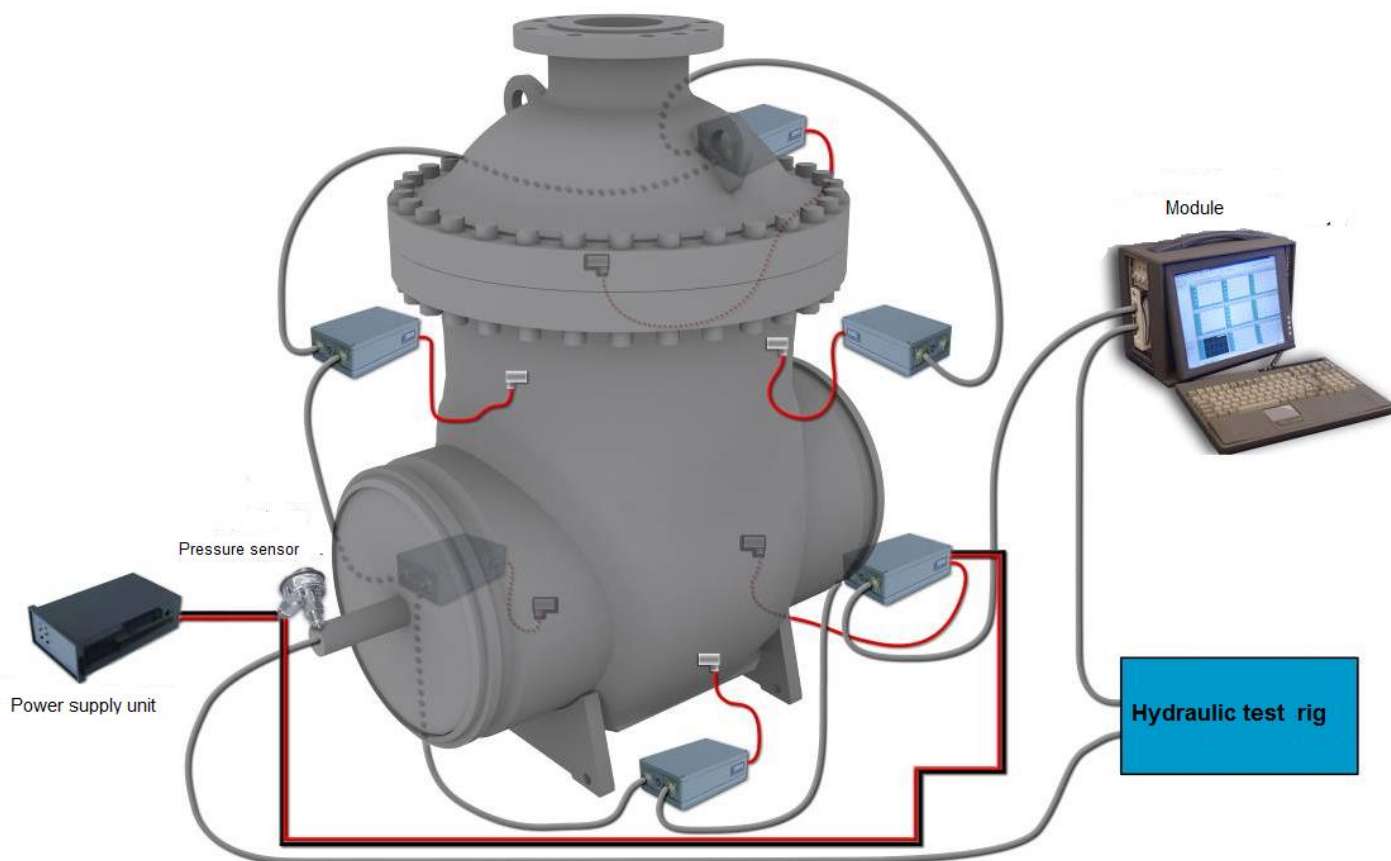
Pattern Approval Certificate for Measuring Instruments of the State Committee of Ukraine UA-MI/3p-554-2003, registration No. 17333-98 of October 24, 2003

Expert opinion of VNIIST JSC No. T1/4-47 of March 20, 2007 on "Technique of acoustic emission testing of gate valves at durability hydrotesting" No. 0707.25203.00005 by Tyazhpromarmatura JSC

Automated system wedge gate valves testing

Automated system wedge gate valves testing represents a multichannel information and measuring acoustic emission system comprising two elements:

- hydraulic test stand for internal pressure loading of wedge gate valve on testing soundness and strength of the basic material and welds
- hardware based on multichannel modular system of gathering and processing AE of information LeI/A-Line 32D (DDM)/.



Scheme of acoustic emission testing of wedge gate valves

PURPOSE

- Non-destructive testing and estimation of the technical condition of wedge gate valves of the following classes by means of acoustic emission:
 - DN 80-150 PN 1.6; 2.5; 4.0; 6.3; 10.0;
 - DN 200, 250, 300, 400 PN 1.6; 2.5; 4.0; 6.3;
 - DN 350 PN 1.6; 2.5; 4.0; 6.3; 8.0;
 - DN 500 PN 1.6; 2.5; 6.3; 8.0;
 - DN 600, 700, 800, 1000, 1200 PN 1.6-2.5;
 - DN 700 PN 8.0.
- Detection of metal discontinuity (fatigue and hardening cracks, pores, etc.) in welds and basic metal of wedge gate valves at hydraulic tests
- Calculation of coordinates and estimation of progressive defect parameters

LIST OF CERTIFICATES

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Pattern Approval Certificate for Measuring Instruments of the State Committee of Belarus No. 2752, registration No. ПБ 03 12 1749 04 of September 17, 2002

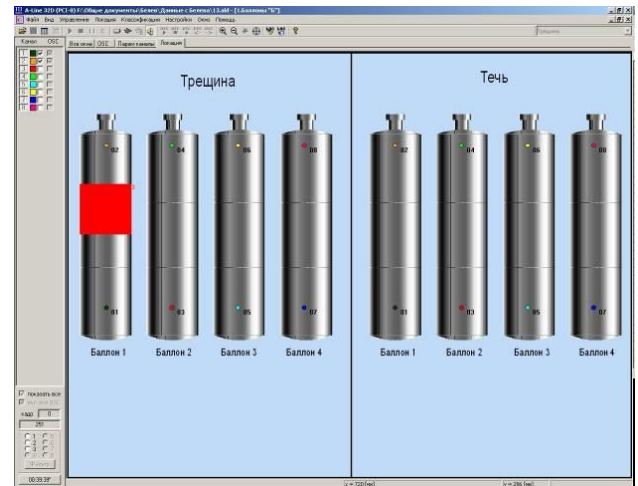
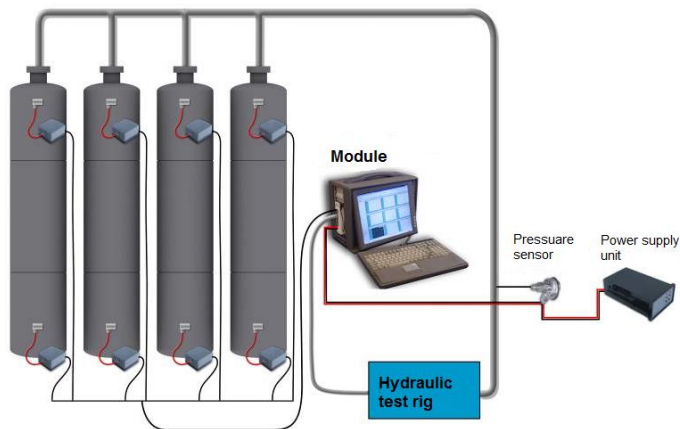
Pattern Approval Certificate for Measuring Instruments of the State Committee of Ukraine UA-MI/3p-554-2003, registration No. 17333-98 of October 24, 2003

Expert opinion of VNIIST JSC No. T1/4-53 of June 01, 2007 on "Technique of acoustic emission testing of gate valves at durability hydrotesting" No. 0707.25009.00178.

Automated system for high pressure cylinders testing

Automated system for high pressure cylinders testing represents a multichannel information and measuring acoustic emission system comprising two elements:

- hydraulic test stand for internal pressure loading of cylinders on testing soundness and strength of the basic material and welds
- hardware based on multichannel modular system of gathering and processing AE of information A-Line 32D (PCI-8).



Scheme of acoustic emission testing of high pressure cylinders

Software image of cylinders with detected defect

PURPOSE

- Non-destructive testing of high pressure cylinders of one weld (A series cylinder) and two welds (B series cylinder) by means of acoustic emission
- Detection of inadmissible internal discontinuity (fatigue and hardening cracks, pores, incomplete fusions, undercuttings, etc.) and through defects (leaks) in the basic metal and welds of cylinders at hydraulic testing
- Calculation of coordinates and estimation of progressive defect parameters

LIST OF CERTIFICATES

Pattern Approval Certificate for Measuring Instruments of the State Standard of Russia RU.C.28.036.A No. 15512, registration No. 17333-98 of July 25, 2003

Pattern Approval Certificate for Measuring Instruments of the State Committee of Belarus No. 2752, registration No. ПБ 03 12 1749 04 of September 17, 2002

Pattern Approval Certificate for Measuring Instruments of the State Committee of Ukraine UA-MI/3p-554-2003, registration No. 17333-98 of October 24, 2003

UNISCOPE

The universal NDT instrument outlined below, named «UNISCOPE», is the company's state-of-the-art design, intended to satisfy the highest requirements of NDT experts. At present, on the basis of a single hardware platform the instrument incorporates the two-channel AE system with advanced features, the acoustic leak detector, the tensometer and the vibrometer. Furthermore, additional functions of «UNISCOPE» are under development, which in the long view will allow for using this device as an ultrasonic thickness meter, a generator of test electric and elastic impulses, an integrated thickness meter, a measuring instrument of electrochemical potentials and terrestrial currents, an eddy-current scanner and a magnetometer. Such universality is reached through using various external measuring units to be connected to the common computing device, provided with generic software with the modern friendly interface.

For information visualization, the device is equipped with a display protected with a transparent plate from mechanical and climatic impacts. Battery charging (p. 3, fig. 2) and electric supply state (p.4, fig. 2) LED indicators are located on the face side of the device. The electric supply switch (p. 3, fig. 1), two connectors for sources of analog systems (p.4a, 4b fig. 1), two connectors for external digital blocks (p. 6a, 6b fig. 1), as well as the section of interface connectors protected with a plug (p. 5, fig.1) are located on the side of the device containing, in particular, a connector for storage batteries charging.

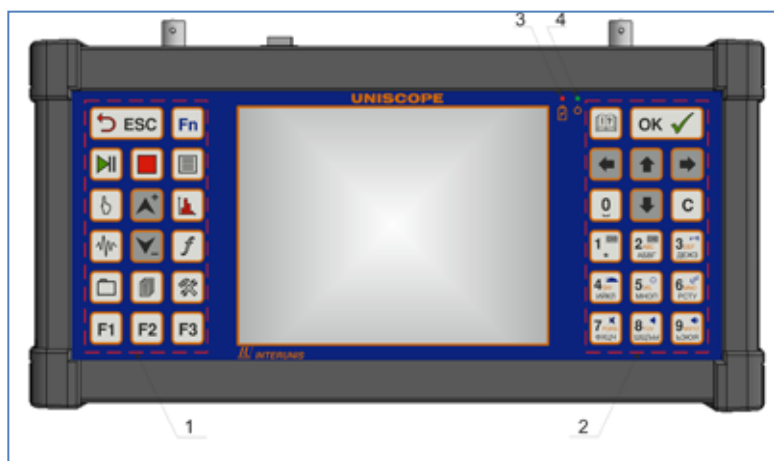


Fig. 1. Face panel

(1 – panel of control push buttons; 2 –panel of adjustment push buttons; 3 – battery charging indicator; 4 – electric supply state indicator).

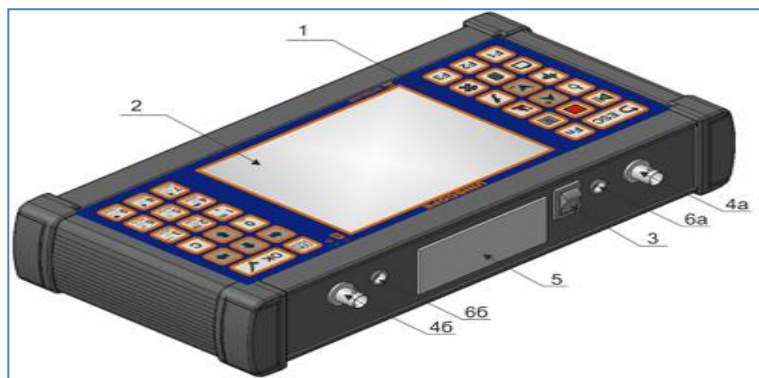


Fig. 2 General view of the device

(1 – keyboard; 2 – display; 3 – ON/OFF push button; 4a – Channel No. 1 connector for registration of analog signals; 4b – Channel No. 2 connector for registration of analogue signals; 5 – plug of interface connectors section; 6a – digital channel No. 1 connector; 6b –digital channel No. 2 connector).

Description of main operation modes

In the mode of AE measurements «UNISCOPE» is intended for nondestructive control without decommission of industrial and technological pipelines, adapters and jumpers, gate valves and pressure regulators, vessels and cylinders, hoisting mechanisms and other industrial equipment along with possible linear localization and operative assessment of danger degree of AE sources.

Main specifications of the AE registration analog channel are shown in table 2. Besides, in order to improve quality of useful signal separation at the background of various noises charge digital frequency filters and preliminary hardware filtration of input data by parameters of AE impulses are used. In parallel with AE registration by two analog channels parametric information can be recorded and by two digital channels in the single time scale for higher quality of the diagnostic information analysis.

In the leakage detection mode the «UNISCOPE» makes it possible to detect and quantitatively assess the values of gate valves leakages of various types and intention, working pressure and diameter for liquid and gaseous working environment. The leakage detection function is implemented on the basis of registration channels of AE impulses. The typical shape of leakage signals is identified by the system software. The value of medium consumption is evaluated on the basis of

parameters of these signals. Depending on the type of the working medium, passage diameter and operating pressure of gate valves the average error of leakage may be equal from 0.1 to 20 l/min.

In the strain measurement mode the «UNISCOPE» is used for measuring the object nominal diameter in the real time scale. An important operation peculiarity in this mode is its possible use along with AE measurements for parametric control accompaniment by means of observation of the changed value and loading character.

For resistive bridge connection a six-wire circuit is used in the «UNISCOPE», what makes it possible to measure the nominal diameter at a distance up to 10 m from the basic block. The main specifications of the strain measuring channel are shown in table 3.

Distinctive peculiarities of «UNISCOPE» (see also Table 1):

- small weight and optimal ergonomics for field operation;
- reliable protection from unfavourable external impacts;
- possible operation at negative temperatures;
- high modern level of hardware and software;
- two wide-band analog and two digital channels for connection of external measuring blocks;
- graphic image of results at the LCD display with light diode illumination;
- storage of big volumes of data at easily accessible information carriers;
- possible unification of two and more devices for multichannel measurements;
- prolonged operation from two built-in storage batteries.

SPECIFICATIONS

General parameters of the mainframe

Display	TFT LED, 5,7", 640x480 pixels, 262 144 colors
Battery endurance	8 hours
Supported interface	SD/SDHC, Ethernet, USB2.0
Processor	ARM
Software operating system	Linux
Operating temperature range	- 20 ÷ + 40 °C
Environmental protection	IP 65
Overall dimensions	300x170x60 mm
Weight	2,6 kg

Analog channel AE and vibration

Number of independence analog channels	2
Preamplifier supply voltage	6 V
Versions of switchable lengths of cable lines	up to 100 m
Operating frequency range	0,5 Hz ÷ 1 MHz
Versions of switchable frequency bands	0,5 Hz ÷ 30 kHz, 1 kHz ÷ 100 kHz, 30 kHz ÷ 1MHz
Possibility to load different digital filters	yes
ADC resolution	16 bits
Maximum ADC sampling rate	20 MHz
Size of oscilloscope record buffer of each channel	8 Mb
Operation synchronism of analog channel	± 1 µs

Digital channel to connect external measurement blocks

Number of independence digital channels	2
Transmitting interface	RS 485
Maximum baudrate	500 kBauds
External measurement block supply voltage	5 V
Operation synchronism of digital channel	± 1 µs
Operation synchronism of digital and analog channel	± 1 µs

External block for parametric measurements

Number of universal measurements channels	2
Switchable operating modes for universal measurements channels: -current loop - voltage measurements	active / passive $\pm 1 \text{ V} / \pm 10 \text{ V}$
Measurements accuracy for universal channel	0,2 %
Output voltage to supply external sensors and devices	12 V / 24 V
Variants of external connecting devices	- pressure, displacement, inclination channels; - tensometric amplifier.
Number of temperature measurement channels	1
Measurement accuracy for temperature channel	$\pm 0,5 \text{ }^{\circ}\text{C}$
Supply voltage of the block	5 V
Maximum power consumption	2,5 W

Tensometric amplifier (MC3)

Operating modes	«sensor» / «bridge»
Resistance range for strain-gauges usage	300 Ohm ÷ 1400 Ohm
Input signal range	$\pm 5 \text{ B} / 4 \div 20 \text{ mA}$

Leak detection mode

Minimum detectable leak rate	1 l/min
Minimum differential pressure	3 bar
Applicable valve inlet diameter	25–1000 mm
Leak rate estimation error	20 %
Inspection time	less than 15 min

IMITATOR OF AE SIGNALS

Imitator of AE signals

Imitator of acoustic emission signals (AE signals) is a device intended for generation of elastic waves imitating acoustic emission signals at the object under test. It is recommended for A-Line 32D (PCI-8E) AE systems.

AE signals imitator is incorporated in the following instrumentation sets:

- Automated complex of diagnostics of lateral frames and bolsters of freight wagons;
- Acoustic emission unit for railway tank cars testing.



PURPOSE

- Check of AE system operational status
- Calibration of acoustic emission sensors installed at the objects under test
- Measurement of elastic waves propagation speed and attenuation in the material of the object under test
- Verification of acoustic emission sources location coordinates calculated by AE system prior to testing

SPECIFICATIONS

PARAMETERS	VALUE
Pulse amplitude range	10 ÷ 300 V
Pulse rate range	1 ÷ 10 Hz
Adjustable pulsing time	1 ÷ 60 min
Display type	LCD
Working temperature range	-20 ÷ +50 °C
Power supply	<i>Krona</i> battery or Adapter for 9 V
Dimensions	155x80x30 mm
Weight	300 g

BASIC CONFIGURATION

NAME	QUANTITY
Electronic module	1 piece
GT200 Sensor	1 piece
Magnet chuck for GT200	1 piece
<i>Krona</i> battery	1 piece

STRAIN GAUGE

Strain gauge

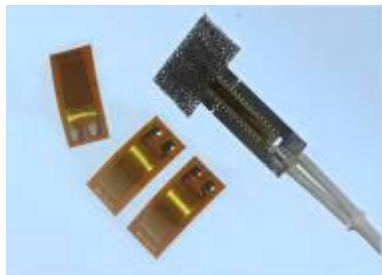
Strain gauge (Two-channel tensometric measuring instrument) is a device intended for measurement of deformation of resistance strain gauges which can be caused by change of force, loading, twisting moment, pressure, weight, vibration and other mechanical and physical parameters.



Strain gauge can be used both independently and together with A-Line 32D acoustic emission (AE) system by means of signal injection into the relative system parametric input.

PURPOSE

- Examination of the stress-strain state of the object under test
- Measurement of actual values of pressure in the material of the object under test
- Automation of the process of identification of the kind of defect according to the acoustic emission testing



SPECIFICATIONS

PARAMETERS

VALUE

Number of measuring inputs

2

Mode

sensor/bridge

Resistance of the strain gauge:

- *sensor* mode

120 Ohm

- *bridge* mode

≥120 Ohm

Input range

± 10, 20, 40, 80 mV

ADC resolution

16 bit

Filter cut-off frequency (at -3 dB)

2 Hz

Number of outputs

1

Output range

± 4096 mV

Gain factor

50, 100, 200, 400

Preset time of measurement delay time

0 ÷ 900 s

Interval delay time change

10 s

Adjustable measurement type:

- minutes

1 ÷ 59

- hours

1 ÷ 100

Display type

LCD

Working temperatures range

-20 ÷ +50 °C

Power supply

Krona battery or
Adapter for 9 V

Dimensions

155x80x30 mm

Weight

300 g

Resistance strain gauge 10/120-LY41

Resistance strain gauges are used as primary transducers of means of measurement of details deformation, for static and dynamic loadings and also for application as intermediate measuring transducers for measurement instruments of mechanical quantities.



PARAMETERS	VALUE
Rated resistance	120 Ohm
Resistance deviation	± 0,3 %
Tensotransduction coefficient	2,08 ± 1%
Linear expansion coefficient	10,8 x [10 ⁻⁶ /°C]
Length of measuring lattice	10 mm

BASIC CONFIGURATION

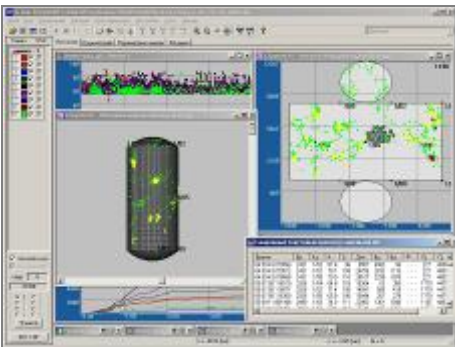
NAME	QUANTITY
Electronic module	1 piece
Output connector counterpart	1 piece
Resistance strain gauge 10/120-LY41	10 ps
<i>Krona</i> battery	1 piece

SOFTWARE



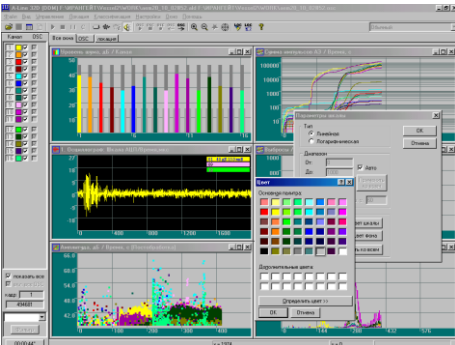
A-Line 32D software, developed for acoustic emission systems of various modifications and systems of CDM, is implemented in Windows environment, is based on general verified principles of hardware and dataflows command, is uniform in style regarding visual representation of graphic and text information and methods of set-up, is supplied with a detailed user's guide and is easily learnt.

Simple and convenient well known user-friendly interface in Russian fully realizes the ample opportunities of AE complexes and CDM systems on measurement, processing and representation of the results of testing both on-line and in the mode of the subsequent in-depth analysis the received data (postprocessing).

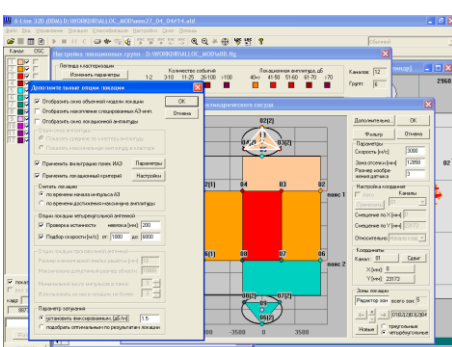
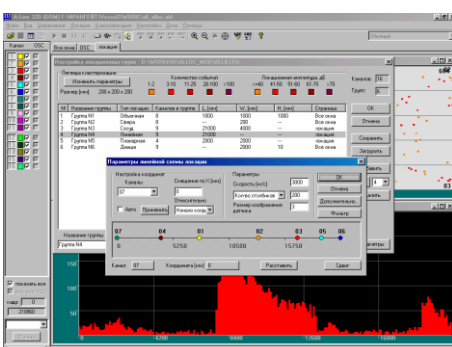
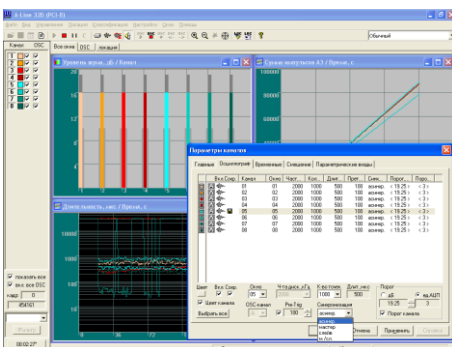
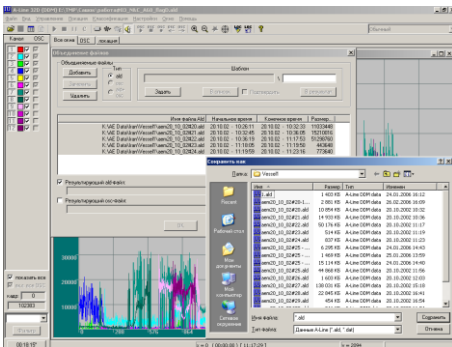
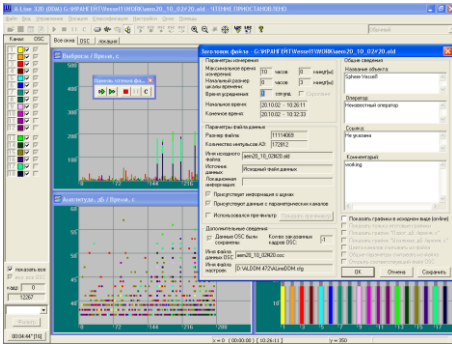


INTERFACE

- The usual multiwindow and multipage interface for graphic and text representation of the data received in the course of data acquisition and in postprocessing is easily and independently set-up by the operator proceeding from peculiarities of a personal perception of information and the chosen methodical aspects of analysis.
- The convenient control menu for setting up the parameters of graphic and text display: forms of data output, color palette, automatic or fixed axes scaling, automatic scrolling of visibility scope, linear or logarithmic type of schedules and coordinate grid, increase mode, etc., satisfies any various users' preferences regarding data representation.
- Compatibility of text and graphic data representation with other Windows applications makes data transfer to other information environments for carrying out of their individual extra analysis easy and accessible.
- Simplicity of set-up and control of the system alongside with ample opportunities of change of operation modes and characteristics of the complex is provided by application of modern elements of Windows control.
- At the client's option the software interface can be translated into any language. English and Russian versions are currently available.



PERFORMANCE CAPABILITIES



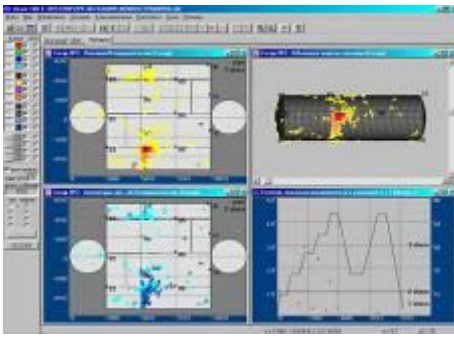
- All the data received in the course of the complex operation: AE data, readings of the sensors connected to parametric channels, characteristics of the condition and settings of the hardware component, the operator's command and actions are automatically saved in specialized files of binary format, reading which it is possible not only to completely restore the testing resultant pattern, but also to repeat in detail all the process of data acquisition on a second-to-second basis. The received files can be divided into separate parts or vice versa to unite several parts in a unified whole as well as restore them in case of possible damage, for instance, as a result of power failure in the central block of data acquisition and processing.

- Settings of the hardware and software parts of the complex can be changed by the operator directly in the course of working as there is no need to stop of the process of measurements or restart the complex and can be saved in a separate file of configuration for convenience of further use. Thus, it is preferable to create in advance several various copies of settings, the so-called "instrumentation profiles", so as in the process of data acquisition to on-the-fly react to changes of the emission process character or other factors with the choice of the appropriate profile. Besides, to facilitate the subsequent data analysis, the operator can fix any events on-line which took place during the inspection by means of time markers supplied with text comments.

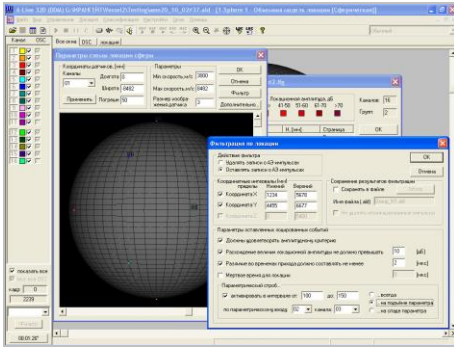
- Various locations of AE sources: linear and planar, zone and 3-dimensional (3D), on the surface of cylindrical, conic and spherical vessels, tank bottoms and walls allow to calculate the defects coordinates for object of any dimensions. Simultaneous formation and use of any number of various location groups is available, the same channel in various location groups can also be simultaneously used.

- A wide variety of classical methods of coordinates calculation implemented in software: AE arrival or maximum amplitude time difference; triangular (via three AE channels), rectangular (via four AE channels) with adjustable velocity or arbitrary (via the whole set of AE impulses registered during a characteristic time interval), etc., provides ample opportunities of location analysis of the data acquired.

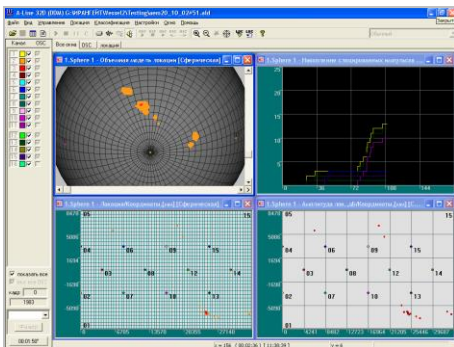
- Developed by the company employees, a new revolutionary method of the fuzzy location by freeform antenna, in turn has a number of essential advantages over classical procedures of location: it does not impose restrictions on sensors arrangement, is less sensitive to accuracy in impulse arrival time evaluation, accuracy of the assignment of AE impulses distribution velocity and anisotropy of the object material, etc.



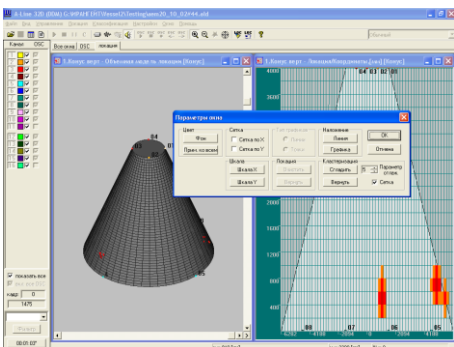
- Graphic representation of the location results is implemented in the form of their overlay on maps and 3D models of the tested objects. Besides, to additionally illustrate the site of the revealed sources we overlay a graphic mask, representing a joints map or features of the composite construction of 2D or 3D object, on location windows.



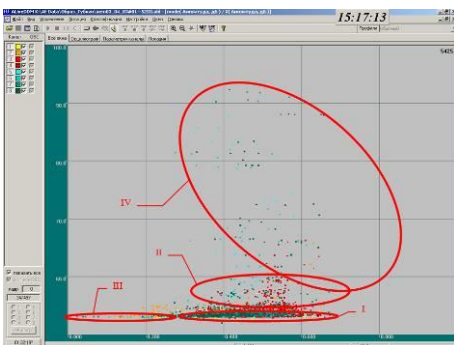
- Application of flexible criteria of automatic rejection of false AE sources caused by electromagnetic noise, interference of different sort and re-reflections of signals, both in data acquisition mode and postprocessing considerably raises reliability of control. Besides, use of "a parametrical strobe" is available, and namely, the opportunity to remove or keep only those events which in time coincided with the certain set value of the measured external parameter, for instance, the object load.



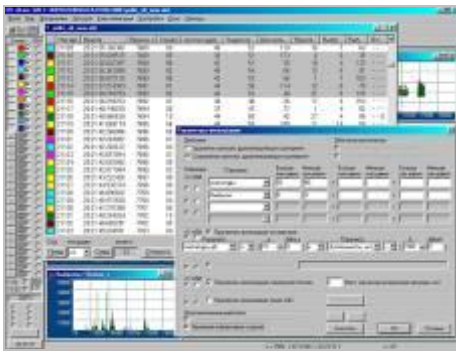
- Proceeding from the given model of waves attenuation in the object material, alongside with coordinates of AE sources, a location amplitudes map (impulse amplitudes at the radiation point) is calculated and displayed in a special window and is an important initial parameter for danger level evaluation of the revealed sources in terms of amplitude criterion and additional factor for the analysis of physical reliability of the results.



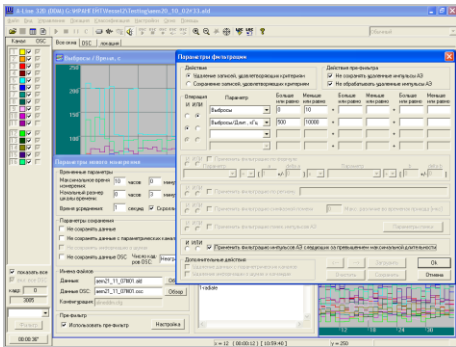
- According to the dynamics of accumulation of the located events, separately noted for each location group, conclusions are drawn on the current danger level of the revealed AE sources in terms of local dynamic criterion and decision-making on expediency of the further object load in the course of testing.



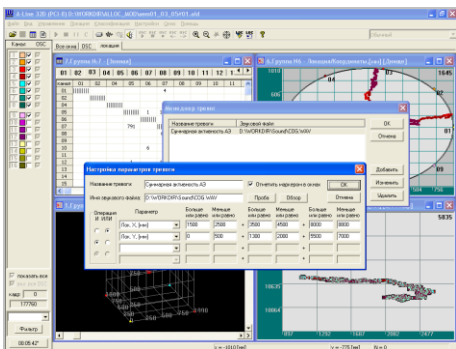
- Location object clusterization (segmentation) can be carried out both on the number of located events and on the AE sources calculated amplitude which makes demonstrative the danger level in terms of concentration criterion and allows to evaluate the size of radiation region. The cluster location picture can be smoothed for elimination of casual and weak AE sources from the subsequent consideration.
- Alongside with classical methods of classification of AE sources by danger level executed according to PB 03-593-03: the amplitude, local dynamic and integrated ones, a new statistical criterion for differentiation of AE sources has been developed in our software in cooperation with the company experts. Its application, unlike other criteria, does not require preliminary data filtration.
- In the event that characteristics of acoustic waves distribution in the material of the tested object are unknown in advance, they can be evaluated using the built-in utility for AE impulses velocity and attenuation measurement in the environment.



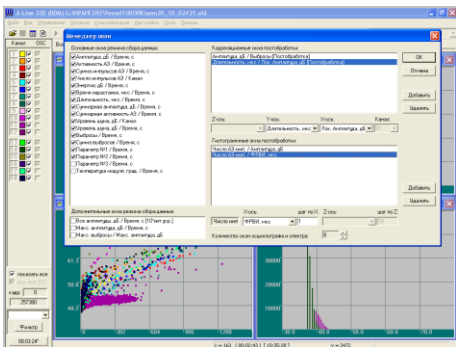
- Ample opportunities for experimental data filtration: by any AE parameter and their combinations, by results of location and clusterization, by any highlighted graphic area on any diagram and functional formula connecting various characteristics of AE impulses as well as connecting them with external parameters, on removal of common-mode interference and leakage signals, etc. allow to apply the most complex methodical recommendations for useful signals extraction from the main stream of information. The applied sets of filters can be saved in separate specialized files and loaded for newly-received data analysis.



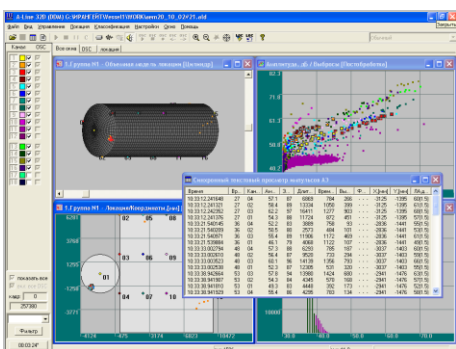
- Often we find it very useful to apply a special class of filters loaded before the commencement of measurements directly in the hardware of the complex, the so-called prefilters. In this case extraction of characteristic AE impulses occurs on-line in the computer part of the hardware and, hence, only an obviously useful signals are exposed to the program analysis and display, which considerably facilitates perception of the information and often allows to draw conclusions about the object state on-the-fly. That, alongside with the mode of automatically adjustable threshold, is a key moment for organization of a continuous monitoring and analysis in CDM systems.

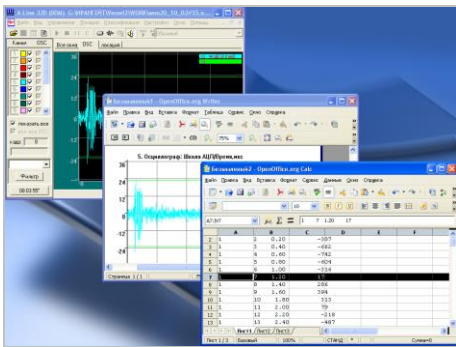


- The use of audio alarm is an important element of diagnostics security and a means of additional indication of its certain stages and events. For this purpose, in the course of set up various probable events in the system, ranges of AE parameters registration, location coordinates, external parameters values, etc. are assigned to this or that wave file which is played at the moment of fulfillment of the specified conditions, attracting additional attention of the complex operators and the staff of the tested object. Besides, it is possible to connect specialized executive equipment, which at the command of the operator or automatically in alarm conditions, will receive the stipulated set of commands from the software with the purpose of exclusion of a possible failure.



- The software opportunities are best fulfilled in postprocessing. In this mode all the measured and calculated AE impulses parameters can be shown related to one another, to time, location coordinates and parametric channels data, as well as to histograms of distribution of signals number to AE parameters and emission flow properties. Plus quickview of characteristics of the impulses extracted in one window in text and oscillographic mode is available as well as their parallel extraction on other diagrams including location windows.

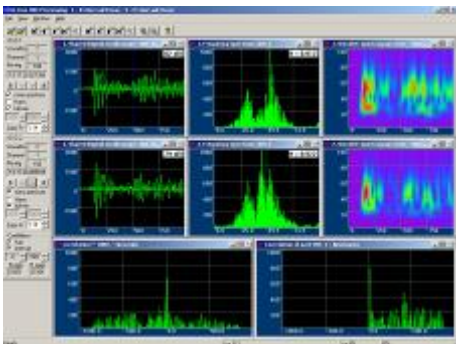




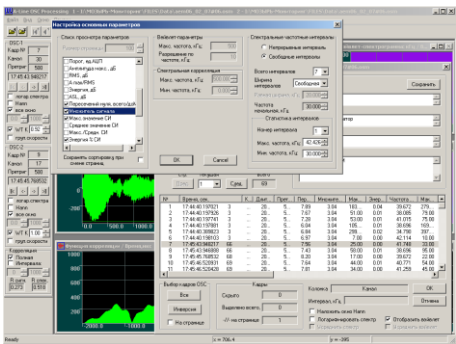
- The opportunity of copying any graphic and text information from the software to Windows clipboard with the subsequent insert into windows-documents of popular text and graphics editors, alongside with wide internal opportunities of printing charts in the type and color at the user's option make the process of report generation by the AE testing results easy and convenient.
- Export of all kinds of data and contents of any graphic diagram both to ASCII format and in Statistica (*.sta) data package format enables to use our clients' own various algorithms for data processing in specialized software of statistical and mathematical analysis.

AL_OSC Software

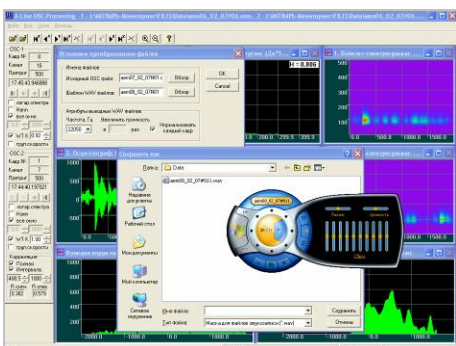
Features of AL_OSC, the specialized software for acoustic emission wave forms processing



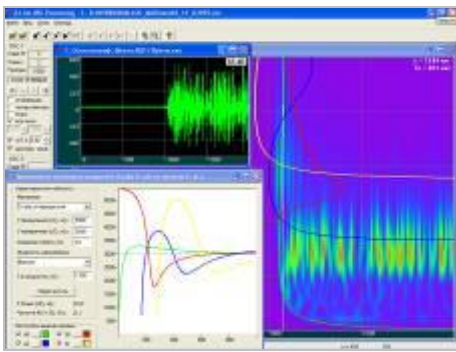
- The opportunity of convenient joint comparative analysis of two AE impulses wave forms registered by two different channels or one and the same channel, but at different time, is provided by a special pair window interface.
- AE signals spectrum analysis based on fast Fourier transformation allows to make the analysis of frequency components of both a whole AE signal and its parts. It makes the program suitable not only for studying the emission nature in the course of the object testing, but also for laboratory research. Averaging of the chosen spectrum range is stipulated to ensure statistical reliability of the results.



- The presented correlation processing of AE signals waveforms and their spectra allowing to identify emission acts registered by different transducers from one source is an important element of the pattern recognition system.
- Statistical processing of both signals and set spectral frequency intervals enables carrying out of the statistical analysis under the set characteristics of the signals form and the spectrum frequency areas. Besides, calculation of partial power characteristics is available for each interval.



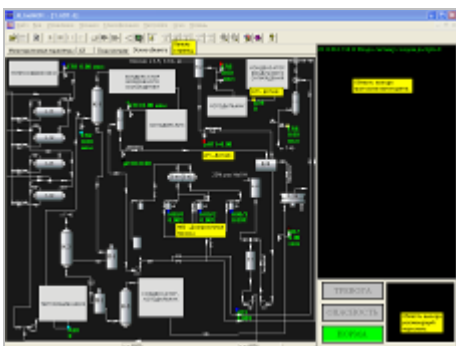
- Transformation of AE signals oscillograms into Windows sound files with various sampling rates gives the unique opportunity "to hear" emission.



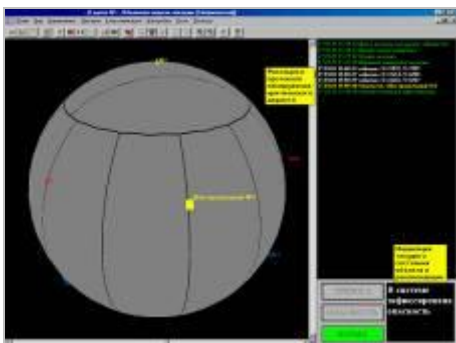
- Calculation of wavelet-spectrograms of waveforms represents a powerful modern method of the time-and-frequency analysis of the AE data received.
- Dispersive curves calculating in various environments together with the opportunity of its flexible imposing on the wavelet-spectrogram of the chosen AE impulse allows to define the type of the registered elastic wave and, at the same time, such important characteristics as the source occurrence depth and the distance to it.
- All the results of waveforms processing can be saved and exported to graphic or text format for simplification of their use at reporting, writing articles, etc.

A-Line Mon Software

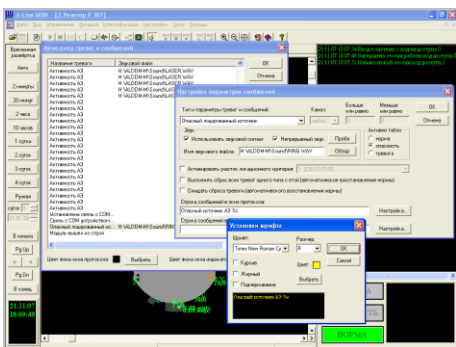
Features of **A-Line Mon** software for thorough monitoring systems



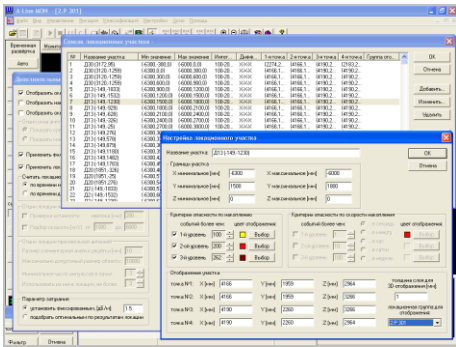
- Trouble-free and reliable automatic registration, processing, analysis, display and long-term storage of a large number of sensor readings are the priority tasks of the software part of the monitoring systems which it perfectly fulfills.
- Detailed display of the object of monitoring diagram with the indicated measuring and control devices and the opportunity to operatively receive detailed data on the current state of each of its key elements is one of the advantages of the offered system of monitoring results display.



- Extended opportunities of hardware registration of sensor readings connected to parametric channels of the complex allow to deeply analyze the respective data including calculation of trends and fulfillment of the algorithms of regulation for feedback systems controls.

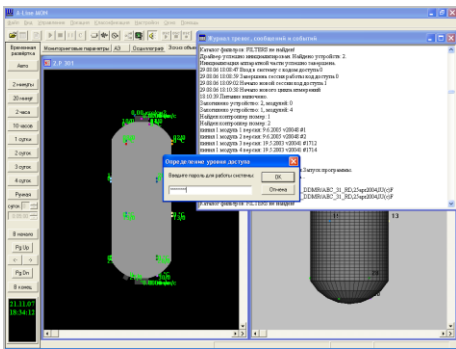


- Multilevel system of alarm and information messages alongside with the opportunity of significant events time and place details on the general layout, and in more detail on an individual model of the problem element makes the basis of the range of measures for the object of monitoring security assurance. In case of hazard the software automatically activates the warning system including sound and light alarms, specifies the site and type of the possible damage, gives staff operation recommendations, notifies the appropriate services and persons in charge via the available channels and assumes other measures stipulated for accident prevention.



- Multifactor thorough data analysis received from various type measuring units and a deep statistical processing of the database allow to objectively evaluate the current technical state of the object and to forecast development of the situation for the future on the basis of the physical concept of solid strength.

- Minimization of the human factor in estimation of the performance results is an important feature of the monitoring systems software.



- Unauthorized data access protection and tamper resistance are implemented in compliance with the requirements imposed on automated systems of protection class 1G (Rus) set forth in relevant guidelines of Gostekhcommissiya: differentiation of access levels has been made, identification and check of authenticity of subjects' access by code and password, registration of login attempts, startup (termination) of processes and issuing of commands, data requests, etc. are carried out.

- For convenience of the system maintenance the opportunity of automatic archiving and optical media data preservation are stipulated in the software as well as remote access to file archive for a certain group of the customer's experts.

SUPPORT

- Free training to use the program at purchase of the instrumentation
- Free consultations concerning the instrumentation performance, software, data processing and interpretation of the received results

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