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# LABORATORY REACTOR UNITS

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# AUTOMATIC ATTRITION TESTER BY AIR JET FOR FCC CATALYSTS FOR FLUIDIZED BED CRACKING BY ASTM D5757-11

## Application

Automatic attrition fluidized bed tester by air jet for various catalysts including FCC designed to determine the comparative characteristics of attrition of FCC by friction of an air jet according to ASTM D5757-11.

It is used for testing with particles of spherical or irregular shape (size from 10 to 180 microns).

Abrasion is achieved by fluidizing the sample with moist air jets. The percentage of fines (less than 20 microns) after the 5 hour test is the Air Jet Abrasion Index (AJI).

## Device advantages:

- Strictly complies with the new ASTM D5757-11 method
- Suitable for FCC catalysts (with and without steam) and analogs.
- Automatically maintains with high accuracy the values of mass air flow, humidity, has a system for automatic removal of catalyst residues from the walls of the settling chamber before the end of the analysis and a minimum spread of sapphire nozzle diameters that meet the requirements of ASTM 57-57-11, which together provides independence from conditions environment and has the highest repeatability of the analysis results of no more than 0.1% and the minimum time to reach the operating mode (no more than 10 minutes) in comparison with all currently produced abrasion testers.
- The unit has wheels with foot operated locks and can be easily moved around the room, i.e. moved out when not needed and roll out for analysis.
- The unit is equipped with the necessary tools and expendable materials for operation for two years, including replaceable filters.
- The tester is certified as a test facility.



Specifications	Value
Operating pressure range, MPa for apparatus gas supply	0,8±0,1
Range of air flow for apparatus gas supply, at least (l / min)	20
Absolute deviation of maintaining air flow at a flow rate of 10 l / min., l / min.	±0,05
Input power no more than, kW	0,2
Overall dimensions, mm	730×850×1900, 30
Abrasion pipe made of steel 12x18 h10t with dimensions, mm	710±10, 35±0,5
Three sapphire nozzles, diameter and length, mm	0,381±0,005, 6±1,0
Mode	continuous
Control: microprocessor with tactile control for setting the display and automatic maintenance of the installation parameters and mathematical processing of the analysis results	
Convergence of results when testing the same catalyst	not more than 0,1%

# AUTOCLAVE LABORATORY REACTOR OF SYNTHESIS 10L

## Application

The autoclave is designed to simulate various chemical processes that take place at elevated temperatures and pressures.

## Specifications

The autoclave is a flask with a spherical bottom made of stainless steel, equipped with a jacket through which the coolant circulates.

The flask is hermetically sealed with a stainless steel spherical lid, on which a magnetic coupling of the stirrer drive, a gateway for loading bulk, liquid product, a safety valve, a pressure sensor, a pressure relief valve, a demountable liquid phase sampler, and a thermocouple for measuring the temperature in the autoclave reactor is placed. The flask with the lid is fixed on the bed, which includes the bracket for attaching the stirrer drive, an electric lift to help provide installation and dismantling of the autoclave flask, and a panel with elements for indicating the autoclave operation parameters.

The autoclave is made in the form of a compact modular design, designed for use in a dry, heated room with forced ventilation.

Operating conditions:

- environmental temperature from от +10 до +35°C;
- relative humidity not more than 80% at a temperature of 25° C;
- power supply - single-phase AC network with voltage of 230-240 V and frequency of 50-60 Hz.



Specifications of hydrotreating and hydrogenation unit	Value
Range of operating pressures, MPa	0,1÷2
Reactor operating temperature range, °C	30÷200
Autoclave flask volume, l	10
Range of regulation of turns of the mixer, rpm	20÷120
Diameter of the drain bottom valve, mm	20
Flask connection and flange caps	
Power supply, single phase	230-240 V 50-60 Hz
Input power no more than, kW	1
Overall dimensions, mm	555x1880x705
Mode	continuous



## Application

Cryoconcentration unit CCU-6 (hereinafter referred to as CCU-6) is an integral part of an automated chromatographic complex based on a Crystallux -4000M gas chromatograph and is intended for quality control of helium 99,9999 and hydrogen 99,9999 for trace amounts of Ne, CH<sub>4</sub>, O<sub>2</sub>+Ar, N<sub>2</sub>, CO, CO<sub>2</sub>, H<sub>2</sub>.

CCU-6 concentrates gaseous impurities (Ne, H<sub>2</sub>, O<sub>2</sub>+Ar, CH<sub>4</sub>, CO, CO<sub>2</sub>) in helium and hydrogen in sorption columns at the temperature of liquid nitrogen, which are afterwards focused and desorbed and introduced into GC (equipped with FID-TCD and TCD- CCD detectors) to determine their qualitative and quantitative composition.



Specifications	Value
Test gas	helium, hydrogen
The temperature of the sorption columns during adsorption, °C	-196
Maximum thermal desorption temperature, °C	400
Pressure of the analyzed gas, no more than MPa	0,4
Inlet gas pressure, not more than MPa	1,0
Total analysis time, no more than minutes	17
The volume of the vessel with liquid nitrogen, l	6
Automatic refill of liquid nitrogen	before each concentration cycle
Power supply	230-240 V, 50-60Hz
Input power no more than, kW	2000
Overall dimensions, mm	510x600x1550
Weight, no more than kg	30
Weight with GC's, kg	210

CCU-6 is made for the determination of trace elements not only in helium, but also in hydrogen.

In CCU-6, liquid nitrogen is added automatically, which minimizes the contact with such dangerous substance.

The detection limits of the installation are shown in tables 1 and 2.

Table 1 Unit detection limits for helium analysis.

Name	Value
% vol. He , %, no less	99,9999
% vol. O <sub>2</sub> +Ar, %, no less	0,000015
% vol Ne, %, no less	0,000015
% vol N, %, no less	0,000045
% vol CO <sub>2</sub> , %, no less	0,00001
% vol CH <sub>4</sub> , %, no less	0,000005
% vol CO, %, no less	0,000005
% vol H <sub>2</sub> , %, no less	0,000005

Table 2 Unit detection limits for hydrogen analysis

Name	Value
% vol H <sub>2</sub> , %, no less	99,9999
% vol O <sub>2</sub> +Ar, %, no less	0,000015
% vol N, %, no less	0,00006
% vol CH <sub>4</sub> , %, no less	0,00001
% vol CO + CO <sub>2</sub> , %, no less	0,000015

# TWO-CHANNEL LABORATORY UNIT FOR EVALUATING THE ACTIVITY OF CATALYSTS DURING HYDROTREATING AND HYDROCRACKING

## Application

A two-channel laboratory unit (hereinafter referred to as the unit) is intended for evaluating the activity of catalysts intended for hydrotreating and hydrocracking.

## Specifications

Unit is a compact modular design designed to work in a dry, heated room with forced ventilation.

Operating conditions:

- environmental temperature from +10 to +35°C;
- relative humidity not more than 80% at a temperature of 25°C;
- power supply - a three- or single-phase AC network with a voltage of 230-240 V with a frequency of 50-60 Hz.



Specifications	Value
Range of operating pressures, MPa	0,1÷10
Reactor operating temperature range, °C	50÷600
The range of flow rates of the pump forming the examine flow of raw materials, ml / min	0,1÷10
The volume of the tank for raw materials, l	More than 5
Tank for raw materials operating temperature range, °C	30÷80
Operating temperature range of high and low pressure separators, °C	30÷80
Flow rate range H <sub>2</sub> , mm / min	50÷3000
Maximum pressure at the output of the regulator H <sub>2</sub> , MPa	10
Input power no more, kW	6
Overall dimensions, mm	800×1300×2000
Mode	continuous

## Structure of unit

Unit includes:

- containers for storage and heating of raw materials;
- system of forced supply of raw materials from the tank to the inlet of the high pressure pump;
- high pressure liquid pumps;
- two four-zone ovens with reactors;
- two condensers with a coolant circulation system and a refrigerator;
- two high pressure separators with level sensor;
- two sampling systems from a high pressure separator;
- two overflow systems from the high pressure separator to the low pressure separator;
- two low-pressure separators with bubbler;
- two systems of control and automatic maintenance of pressure in the unit;
- two systems for automatic compensation of pressure drop during automatic overflow of liquid from a high-pressure separator to a low-pressure separator;
- temperature control system for high and low pressure separators;
- control systems.



## Application

The facility is designed to simulate and study the processes of delayed coking that take place at heightened temperature and pressure in a stainless steel reactor made in the form of a flask with a spherical bottom and a removable lid. The unit allows you to obtain experimental data, to select and optimize the parameters of the process, to test various options for raw mixtures, to determine the material balance of the process, the characteristics of the product.

This Unit is designed to study the processes of thermal decomposition of various organic substances, not just coke. The task to be solved is to determine the qualitative and quantitative composition of liquid and gaseous products formed during heating under pressure. In addition, along with the product loaded into the reactor, catalysts for acceleration and the degree of decomposition of the product loaded into the reactor can be poured, filled and blown in.

## Specifications

The unit is a compact frame design designed for operation in a dry, heated room.

Operating conditions:

- environmental temperature from +10 to + 35°C;
- relative humidity not more than 80% at a temperature of 25°C;
- power supply - single-phase AC network with voltage of 230-240 V and frequency of 50-60 Hz.



Specifications	Value
Range of operating pressures, MPa	0÷0,6
Reactor operating temperature range, °C	50÷550
Accuracy of a task of temperature, °C	1
Absolute deviation of maintaining temperature, °C	±0,2
Reactor material	stainless steel
Input power no more than, kW	3
Overall dimensions, mm	1600x1100x495
Weight, kg	240
Mode	continuous

# AUTOMATIC ATTRITION TESTER BY AIR JET FOR FLUIDIZED BED CRACKING CATALYSTS BY EXPRESS-METHOD DI BY GRACE STANDARD

## Application

Automatic attrition fluidized bed tester by air jet for various catalysts including FCC designed to determine the comparative characteristics of attrition.

Automated attrition tester for express determination of various catalysts including FCC designed for fluidized bed cracking.

It is used to test spherical or irregular parts (sizes from 10 to 180 microns), in a time not more than 20 minutes.

Attrition is achieved by tangentially feeding a moist air jet into a cylindrical abrasion chamber 26 mm in diameter and 50 mm in height. The percentage of fines (less than 20 microns) after a 20 minute test is the Air Jet Abrasion Index (AJI).

### Operating conditions

- environmental temperature from +10 to + 35°C;
- relative humidity not more than 80% at a temperature of 25°C;
- atmospheric pressure from 84 to 107 kPa (from 630 to 800 mm Hg);
- power supply – single-phase AC network with voltage of 230-240V and frequency of 50-60 Hz.

## Device advantages:

- Analysis time no more than 20 minutes.
- Suitable for FCC catalysts (with and without steam) and analogs.
- Automatically maintains with high accuracy the values of the mass flow of air, humidity, has a system for automatic removal of catalyst residues from the walls of the settling chamber before the end of the analysis, which together provides independence from environmental conditions and has the highest repeatability of analysis results no more than 0.1% and the minimum time to reach the operating mode (no more than 10 minutes) in comparison with all currently produced attrition testers.
- The unit has wheels with foot operated locks and can be easily moved around the room, i.e. moved out when not needed and roll out for analysis.
- The unit is equipped with the necessary tools and expendable materials for operation for two years, including replaceable filters.
- The tester is certified as a test facility.



Specifications	Value
Operating pressure range, MPa for apparatus gas supply	0,8±0,1
Range of air flow for apparatus gas supply, at least (l/ min)	20
Absolute deviation of maintaining air flow at a flow rate of 10 l / min., l / min.	±0,05
Input power no more than, kW	0,2
Overall dimensions, mm	560x760x1700, 30
Mode	continuous
Control: microprocessor with tactile control for setting the display and automatic maintenance of the installation parameters and mathematical processing of the analysis results	
Convergence of results when testing the same catalyst	not more than 0,1%



## Application

The laboratory unit is designed to determine the activity and selectivity of the isobutene dehydrogenation catalyst (KDI, KDI-M) in a fluidized bed. Continuous automatic operation mode allows to carry out tests of KDI, KDI-M resource and to explore the physico-chemical properties of pulverized catalysts as well as the technological parameters of the fluidized bed.

## Technical specifications

- 800mm long reactor with an internal diameter of  $30 \pm 1$ mm and an operating temperature range from 50 to 800°C
- Four gas flows formation (isobutane, nitrogen, air, hydrogen), based on electronic regulators of gas mass flow;
- Power supply 230V 50Hz;
- Dimensions (W x D x H): 800x800x2000mm;
- The unit is placed in a protective ventilated cabinet with a glass lockable door.

## Features

- The reactor is made of titanium or nickel-free steel;
- Control thermocouples are located in 4 reactor zones;
- Reactor casement oven with 4 heated zones and operating temperature range from 50 to 800°C;
- Oven automatic accelerated cooling system;
- Gas flow formation error is less than 0.5%;
- Gas flows automatic setting required for the supply and mixing of gases entering the reactor;
- Reactor pressure monitoring to assess the degree of filter clogging;
- Filters' reverse purging for its cleaning;
- Catalyst automatic loading and unloading;
- Heated reactor automatic filling with nitrogen in case of an abnormal power outage;
- Automatic hydrogen supply for KDI, KDI-M regeneration;
- Gas flow heater before the reactor with a temperature range from 20 to 500°C.

## Conducting of test

- The user's software allows you to create an unlimited number of KDI, KDI-M test profiles;
- Synchronization of the Chromatograph with the Net Chrome software allows analyzing the product without user participation;
- Chromatographic determination of the qualitative and quantitative composition of permanent (H<sub>2</sub>, O<sub>2</sub>, N<sub>2</sub>, CO, CO<sub>2</sub>) and hydrocarbon (alkanes, alkenes up to C<sub>6</sub>) gases with an assessment of activity and selectivity;
- Execution of an unlimited number of tests cycles;
- Automatic injection of the required amount of one or different catalysts;
- Automatic unloading of the catalyst after the tests completion.



## Application

The unit is designed to simulate and study pyrolysis processes that pass at elevated temperatures and pressures. The unit allows to obtain experimental data, select and optimize the parameters of the technological process, testing various options for raw mixtures, determining the material balance of the process, the characteristics of the process products.

## Specifications

The unit is a compact frame structure on wheels with brakes designed for operation in a dry heated room.

Operating conditions:

- environmental temperature from +10 до +35°C;
- relative humidity not more than 80% at a temperature of 25°C;
- power supply - single-phase 220-240V 50-60Hz.



Specifications	Value
Operating pressure range, MPa	0÷2
Flask oven with independent heating of the bottom and walls, equipped with an automatic lifting mechanism, volume, liter	3,6
Flask oven operating temperature range, °C	50÷650
Pyrolyzer operating temperature range, °C	50÷900
Temperature setting accuracy, °C	1
Relative error of maintaining temperature, °C	±0,2
Reactor material	stainless steel
Refrigerator tube in tube with flow turbulator	
Separator with a cover made of steel 12x18 H10T, volume, liter	1,2
Power consumption, kW	no more than 3,5
Overall dimensions, mm	1600 x 900 x 580
Mass, kg	100
Work mode	continuous



# HYDROTREATING-REFORMING UNIT

## Purpose

The laboratory unit is designed to evaluate the activity of heterogeneous catalysts in a fixed bed reactor for the hydrotreating process.

## Specifications

The unit is a rack with unit assemblies fixed to it, housed in a ventilated cabinet with a glass lockable door, a service door and easily removable side walls.

Operating conditions:

- ambient temperature from +10 to +35 °C;
- relative air humidity not more than 80% at temperature 25 °C;
- single-phase AC network with voltage of 230 V  $\pm$  10% and frequency of 50 Hz.



Technical characteristics	Value
<b>Reactor: pcs</b>	1
Reactor volume, ml	240
Material	stainless steel
Inner diameter, mm	24
Length, mm	500
Operating temperature range, °C	20÷600
Working pressure range, MPa	0÷10
Removable pocket for thermocouples, mm	600
<b>Reactor oven: pcs</b>	1
Oven type	Winged
Number of temperature controlled zones, pcs	3
Length of the complete heated zone of the furnace, mm	450
Length of each of the four thermostatically controlled zones, mm	150
The length of the isothermal zone of the oven, mm	300
Power consumed by each isothermal zone, W	800
Power consumed by all three zones of the oven, W	2400
Discreteness of setting the temperature, °C	1

Technical characteristics	Value
<b>Raw material volume: pcs</b>	1
Volume, l	4
Maximum pressure, atm	4
Working pressure, atm	0,2 -1
Raw materials	Oil
<b>Unit: pcs</b>	1
Installation working cycle, h	120
Calculated input gas pressure H <sub>2</sub> , N <sub>2</sub> , MPa	10
Supply voltage	230V 50Hz
Power consumption of the entire installation, no more, kW	3
Weight without cabinet, kg	120
Overall dimensions, mm	1800x865x550
Overall dimensions of the cabinet, mm	2000x800x880

## Purpose

Stand laboratory unit for testing the adsorption properties of silica gels, protective layers and selective hydrogenation catalysts.

## Specifications

The unit is a rack with the unit assemblies fixed on it.

Operating conditions:

- ambient temperature from +10 to +35°C;
- relative air humidity not more than 80% at temperature 25 °C;
- power supply - three- or single-phase AC voltage 230 V±10% and frequency of 50 Hz.; air 0,4 — 0,8 MPa.



Technical characteristics of the hydrotreating and hydrogenation unit	Value
Working pressure range, MPa	0÷6
Reactor operating temperature range, °C	20÷600
Internal diameter of the reactor, mm	20
Internal length of the reactor, mm	690
A thermocouple pocket with a movable filter and a support mesh fixed on it for adjusting the volume of the tested catalyst	Available
Isothermal zone length, mm	300
Oven type	Winged
Number of thermostated independent zones	4
Power consumed by each of the four independent thermostatic zones, W	≤ 400
Discreteness of setting the temperature, °C	0,1
Flow range C <sub>2</sub> H <sub>4</sub> , l / min	0,02÷1,7
Flow range C <sub>3</sub> H <sub>6</sub> , l / min	0,02÷1,7
Flow range H <sub>2</sub> , l / min	0÷0,02
Flow range N <sub>2</sub> , ml / min	0,02÷1,7
Opening pressure of mechanical safety valves, MPa	6,8
Supply voltage	220V 50Hz
Power consumption, no more, kW	5
Discreteness of temperatures and costs displayed on displays	0,01
Unit weight, kg	230
Overall dimensions of the unit, mm	1680x1480x580
Length of supply pipelines, m	20



## Application

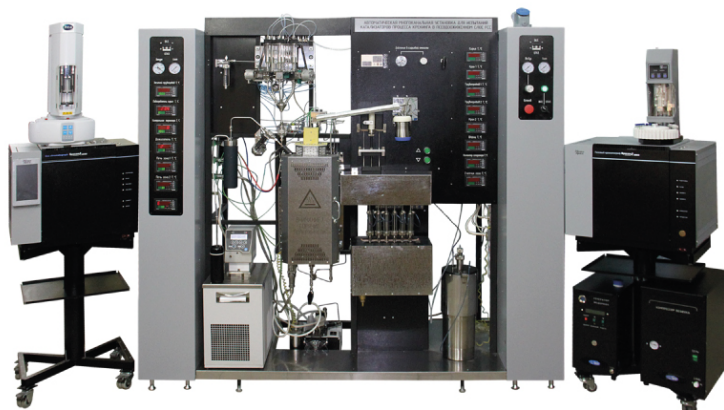
The unit is designed to test the activity of fresh catalysts, deactivated in laboratory environment and balanced (used in industry).

The volume of the catalyst being loaded is from 5 to 12 grams (from 0,18 to 0,42 oz), the loading of raw materials (vacuum gas oil) is from 1 to 3 grams (from 0,035 to 0,106 oz). The Conradson carbon residue should not exceed 10%.

The catalyst coking rate is determined directly in the unit after cracking. Liquid and gaseous cracking products are analyzed by three gas chromatographs with automatic samplers, that allows you determining the conversion rate and the catalyst selectivity.

Unit is autonomous in supplying itself and GCs with gases. It includes a built-in compressor with an air purification system, a high-purity hydrogen generator, a filter for catalytic nitrogen purification up to 99.999%. A high-purity nitrogen generator can be supplied if required.

Nine thermally independent channels for the forming of gas flows make it possible to maintain a constant gas flow rate or constant pressure in this line in any of them. By the pressure deviation, the system automatically determines the leakage or obstruction of the gas main. While maintaining the pressure, the gas flow rate is monitored, which also makes it possible to automatically monitor the presence of leaks or blocking in the line. In the required places, mechanical cleaning filters are installed, which are automatically regenerated during operation by backflushing.



## The unit can be used for the following tasks:

- Determination of the activity of the cracking catalyst by the degree of conversion of raw materials at different catalyst/raw material ratios.
- Determination of the selectivity of cracking catalysts by the composition of cracking products, calculation of gas and coke factors at different catalyst/raw material ratios.
- Assessment of the suitability for processing of various types of raw materials.
- Studies of the kinetic parameters of the cracking process and the construction of a mathematical model.

## The unit also includes:

### - System for the analysis of gaseous products of catalytic cracking based on the GC "Crystallux-4000M» and gas meter

The system analyzes the gaseous products of the catalytic cracking process by determining the amount of hydrogen and C1-C6 + hydrocarbons.

The analysis is carried out directly at the end of the test of each portion of the catalyst. Based on the results of the analyses, the gas factor of the catalyst is determined.

### - System for determining the fractional composition of liquid petroleum products based on the gas chromatograph "Crystallux-4000M» by Simulated Distillation method

The system allows you to simulate the determination of the fractional composition of medium fractions of oil and petroleum products in accordance with ASTM D7213. The obtained results of the analysis are comparable to the fractional composition measured according to ASTM D86 and ASTM D1160. The analyzed objects are petroleum products that boil down to 615oC under normal conditions (gasoline, kerosene, diesel fractions, atmospheric gas oils, products of secondary oil refining processes, etc.).

### - System for detailed analysis of the hydrocarbon composition of gasoline and gasoline fractions based on the gas chromatograph "Crystallux-4000M»

The system is designed for quantitative analysis by the PIONA method of individual hydrocarbons up to C9, indicating their physical characteristics and boiling points. In addition to hydrocarbons, it is possible to determine oxygen-containing compounds. Based on the analysis results, specialized software calculates the octane number of the analyzed fraction.

## Application

The pyrolyzer is designed to simulate the process of pyrolysis and obtain synthesis gas



Specifications	Value
Operating temperature range of the reactor, °C	20÷1100
Inner diameter of reactor, mm	22
Reactor length, mm	1350
Thermocouple pocket	Presence
Isothermal zone length, mm	700
Oven type	Swing
Number of independent temperature-controlled zones	1
Temperature setting resolution, °C	1
Liquid pump flow range, ml/min	0,0048÷36
Power supply voltage	220V 50Hz
Power consumption, no more than, kW	3,3
Resolution of displayed temperatures and flow rates	0,1
Unit weight without cabinet, kg	100
Overall dimensions, mm	1400x400x1250
Mass, kg	60



# DEVICE FOR TESTING FRICTION AND ABRASION OF CATALYSTS "PTI-1"

Device "PTI-1" allows to determine the resistance of granular catalysts and adsorbents to friction and abrasion according to SPENCE and ASTM D4058 standards.

Figure - Device for testing friction and abrasion of catalysts "PTI-1" **1** with an installed drum nozzle. **2** On the right is a cylindrical nozzle.

## Application of the device "PTI-1" for testing a granular sample for friction / abrasion (drum nozzle, ASTM D4058 -96 method).

The granulated sample (catalyst, catalyst carrier, adsorbent) is loaded into the drum nozzle. The drum nozzle makes 60 rpm for 30 minutes. At the end of the process, the tested sample is separated from the dust by sieving through a sieve (ASTM N°20 mesh 0.85 mm). By weighing the original sample and the residue on the sieve, the attrition loss of the granular sample is determined.



Calculation:

$$\text{Abrasion loss \%} = \frac{M1-M2}{M1} \times 100$$

where  $M1$  – is the mass of a fresh sample after sieving;  
 $M2$  – is the mass of the tested sample after sieving.

## Application of the device "PTI-1" for testing a granular sample for abrasion (cylindrical nozzle, SPENCE method).

Granular sample from 1 to 4 pieces, 25 grams each, is loaded into four cylinders. The cylindrical nozzle makes 25 rpm for 60 minutes. At the end of the process, the contents of the cylinders are sifted through a sieve (the mesh size is 2/3 of the smallest granule size). The initial sample, the sifted sample, and the remaining fines ("dust") are weighed. Based on the measured masses, the abrasion loss and abrasion resistance are calculated. This method has a wider particle size range than the ASTM method.



Calculation formulas:

$$\text{Abrasion loss \%} = \frac{M3}{M1} \times 100$$

$$\text{Abrasion resistance \%} = \frac{M2}{M1} \times 100$$

where  $M1$  – initial mass of a fresh sample after sieving;  
 $M2$  – mass of the tested sample after sieving;  
 $M3$  – mass of dust.

## Device advantages

The device "PTI-1" performs smooth acceleration and deceleration of the nozzle in order to avoid the effects of shock loads on the test sample, has the flexibility to set the parameters of the test process, thanks to the ability to set custom nozzle rotation speeds, test duration (from 1 min. to 7 days) and direction rotation regardless of the nozzle used, with the ability to save modes.

The device is run by a controller, all settings are made using the buttons on the front panel. Information is displayed with an intuitive user interface.

The design of the device provides three fixed positions of the nozzle for quick loading, testing and unloading of the test sample. The device has low consumption (up to 18 W) and low weight (12.5 kg). The use of a stepper motor with a gearbox provides a small error in maintaining speed ( $\pm 0.3$  rpm).

## Device Specifications

Specifications		Value
Basic operating modes:		<ul style="list-style-type: none"> <li>• Preset rotating drum method (ASTM D4058 -96) (60 rpm, 30 min).</li> <li>• Preset rotating cylinder method (SPENCE) (25 rpm, 60 min).</li> <li>• User mode with arbitrary setting of rotation frequency (from 10 to 60 rpm) and test duration (from 1 minute to 7 days).</li> </ul>
Electric motor		Stepper motor with gearbox
Speed maintenance error, rpm		$\pm 0,3$
Control		Digital (controller)
Power supply		100-240 V, 50/60Hz
Power consumption		18 W
Allowed sample weight		Not more than 100 g.
Mass		12.5 kg with cylindrical nozzle 10.8 kg with drum head
Overall dimensions, cm		with cylindrical nozzle: 38,9x31,4x45,9 with drum attachment: 48,5x30,4x45,4
Sieve mesh sizes, mm:	by ASTM method	ASTM No20 0.85
	according to the SPENCE method	2/3 of the minimum granule size. At the request of the customer.
Scales		at the request of the customer
Operating conditions		laboratory
Ambient temperature		from 10 °C to 35 °C
Relative air humidity at 25°C, %		no more than 80%
Atmosphere pressure		84 to 107 kPa (630 to 800 mmHg)



## Purpose

The laboratory catalytic dewaxing unit is designed to remove normal paraffinic hydrocarbons from oil fractions. Since normal hydrocarbons have a high pour point, their removal lowers the pour point of the oil fraction.

Catalytic dewaxing is characterized by the fact that at high pressure, temperature and excess hydrogen, long molecules of normal paraffins are split and isomerized.

## Technical Specifications

The unit is a rack with shut-off valves, a heating reactor and a control unit attached to it.

Operating conditions:

- environmental temperature from +10 to +35°C
- relative humidity not more than 80% at a temperature of 25 °C (77 °F);
- power supply - single-phase AC network with voltage of 230 V  $\pm$  10% and frequency of 50 Hz.



Technical characteristics	Value
<b>Reactor:</b> pcs	1
Reactor volume, ml	365
Material	stainless steel
Inner diameter, mm	24
Length, mm	900
Operating temperature range, °C	20÷600
Operating pressure range, MPa	0÷10
Removable pocket for thermocouples, mm	660
<b>Reactor oven:</b> pcs	1
Oven type	Swing
Number of temperature-controlled zones, pcs	4
Length of the complete heated zone of the oven, mm	700
The length of each of the four temperature-controlled zones, mm	150 (2 pcs) 200 (2 pcs)
The length of the isothermal zone of the oven, mm	400
Power consumed by each isothermal zone, W	400
Power consumed by all three furnace zones, W	2000
Temperature setting resolution, °C	1
<b>Raw material container:</b> pcs	1
Volume, l	3
Maximum pressure, bar	1
Working pressure, atm	0,2-0,5
Raw materials	gasoline
<b>Unit:</b> pc	1
Operating cycle of the unit, h	120
Calculated inlet gas pressure H <sub>2</sub> , N <sub>2</sub> , MPa	10
Actuation pressure of mechanical safety valves, bar	36
Supply voltage	230V 50Hz
Power consumption of the entire unit, no more than, kW	4
Weight, kg	120
Overall dimensions, mm	1800x865x550

The technical characteristics of the purchased units used are given in the technical documentation for these units supplied with the unit.

## Purpose:

Production of high pressure hydrogen

## Application:

- hydrogen supply for technological units and other devices demanding gas purity;
- filling of cylinders with hydrogen, guaranteed quality.

## Advantages:

1. The hydrogen station can be used as an independent source of high pressure hydrogen;
2. User independence from bottled hydrogen supplies;
3. No risks of unpredictable hydrogen quality from the supplier;
4. No need for warehouse storage of hydrogen cylinders;
5. The resulting hydrogen purity is 99,995% ;
6. Ability to control the output pressure of hydrogen.

## Contents of delivery:

- Hydrogen generator HG-75 - 2 pieces;
- Low pressure receiver - 1 pc;
- High pressure receiver - 1 pc;
- Gas compressor (booster) - 1 piece;
- Air compressor not less than 3m<sup>3</sup>/hour performance is an option;
- A device for obtaining deionized water for hydrogen generators is an option.



Specifications	Value
Performance, l/h	150
Purity	99,995
Moisture contents, ppm	No more than 5
Maximum working pressure of hydrogen, MPa	15 (150)

Operating conditions:

- ambient temperature from +10 to +35 °C
- relative air humidity no more than 80% at a temperature of 25 °C;

Supply:

- single-phase AC network with voltage 230 V (+/- 10%) 50 Hz;
- compressed air 2.5 m<sup>3</sup> / min at a pressure of 0.4 ... 0.8 MPa.





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