

Ministry of Infrastructure of Ukraine
Kyiv-Moscow Branch
“PrJSC Kyiv-Dniprovske MPPZT”

Testing of the fuel catalyzer КП-14Д for diesel internal combustion engines on the locomotive of series ЧМЕЗ No. 404



Kyiv 2015

APPROVED
Director General of
LLC Scientific-Production Firm “Eko-Avto-
Titan”
(signature) Liubenko P.I.
January 05, 2015
Seal: Ukraine, Kyiv region, Limited
Liability Company Scientific-Production
Firm “Eko-Avto-Titan”, Identification code
31909330

APPROVED
Acting Director of
Kyiv-Moscow Branch
“PrJSC Kyiv-Dniprovske MPPZT”
(signature) Boyko S.M.
December 31, 2014
Seal: Ukraine, Private Joint Stock Company
Kyiv-Dniprovske MPPZT, Kyiv-Moscow
Branch, identification code 000000

Act
of departmental testings of the fuel catalyzer for diesel internal combustion engines KII-14Д
for the compliance with the requirements of TY Y 34.3 -31909330.002-002

AGREED
Deputy-Director of Locomotive Depot Darnytsa
(signature) Kovalchuk O.M.
31.12.2014
AGREED
Director of LKS EcoDynamics (USA)
(signature) V. Khlon
12.01.2015
Seal: LKS EcoDynamics (USA)

CONTENT

1 General Provisions	2
2 Object of Testing	3
3 Purpose of Testing	4
4 Program of Testing	4
5 Methods of Testing, Measurement Equipment and Means of Measurement Techniques	7
6 Results of Testing	10
7 Conclusions	10
Protocol No. 1	12



1 General Provisions

1.1 The organization, where the testing was carried out, its address, terms of testings.
Separated Subdivision “Locomotive Depot Darnytsa” of Southern-Western Railways. Kyiv city,
Zroshchuvalna St., 31
Departmental acceptance testing of the fuel catalyzer КП-14Д (hereinafter referred to as КП) for
engines of locomotive of series ЧМЕ3 before and after КП installation was carried out on
25.12.2014

1.2 Grounds for testing.

The commission of the Director General of PrJSC "Kyiv-Dniprovske MPPZT" Pankratov V.I. The testing was carried out according to the State Standard ДСТУ 32.0.08.011 "The order of development and delivery of products for production for the needs of railway transport in the system of Ministry of Transport of Ukraine".

The testing commission in its work also followed the Program and methods of testing КБ.2.966.001ПМ (hereinafter referred to as ПМ), approved by Senior Administration of Locomotive Economy of Ukrainian Railways, Senior Administration of Traffic Safety and Ecology of Ukrainian Railways, Administration of Armed Security of Ukrainian Railways, PKTB rl, Department of Rolling Stock repair of UkrDAZT, LLC "Plant of Gas Equipment" Alpha-Gaspromkomplekt" and other regulatory documents.

The commission according to the regulatory document ІТ-0131 "Specific fuel consumption upon rheostat testing of locomotive diesels of all types of locomotives after current repairs ПП-1, ПП-2, ПП-3" approved by the Order of Ukrainian Railways of 30.12.2005 No. 441-ІІ, made the decision to carry out the testing under weighting method according to the said document.

The commission could not carry out the control measurements of emissions of harmful substances CO, CmHn, NOx due to the lack of gas analytical equipment in the locomotive depot "Darnytsa" limited to the control measurements of the opacity of the locomotive diesel.

1.3 For the commission examination were given:

- Program and methods of testing КБ.2.966.001ПМ;
- Technical specifications ТУ У 34.3 - 31909330.002;

2 OBJECT OF TESTING

The fuel catalyzer КП-14Д for diesel engine is developed by the LLC Scientific-Production Firm "Eko-Avto-Titan" and manufactured by LLC "Plant of Gas Equipment "Alpha-Gaspromkomplekt".

The КП is intended to improve the technical and economic performance and reduce the content of pollutant emissions by catalytic preparation of fuel before its combustion in engine cylinders and has the following basic characteristics.

Reducing the content of pollutants:

- Opacity - not less than by 20%;
- Carbon monoxide (CO) - not less than by 30%;
- Amounts of carbohydrates (CmHn) - not less than by 20%;
- Decrease of specific fuel consumption - not less than by 5%;
- Increase of compression in cylinders – not less than by 5%.

The КП is a device of body constructions of chamber type. In the chambers, pre-purification of fuel is carried out, activation of fuel molecules by granular catalyzers, which contributes to its more complete combustion, fuel saturation at the molecular level of metal salts, which, when combustion of the mixture in the working space of the engine, creates a "weeping" effect, which compensates for the compression on the engine cylinders.

Upon the testing was used the diesel fuel GASOIL (the analogue of ДПЛ-0.10- 62 ДСТУ 3868-99/3 the sulfur content 0.0926%).

3 PURPOSE OF TESTING

The purpose of the testing is to test performance and to confirm the efficiency of using the fuel catalyzer КП-14Д according to the requirements of ТУ У 34.3-31909330.002 in diesel locomotives under their operational conditions.

4 PROGRAM OF TESTING

4.1 Motor testing program.

4.1.1. Definition of the change of fuel consumption by the engine of diesel generator of locomotive in idle mode, XX, 25%, 50%, from the maximum capacity at the stand of rheostat tests of A455.01 type of the locomotive depot, respectively, at 0.3 and 5 positions of the driver's controller (ПКМ) before and after the КП installation and 20 minutes of work with it before the КП installation using the weighing method.

The measurements are executed with the help of scales of mark VEST-12A-200 and the electronic stopwatch.

4.2 The control measurements of opacity were executed on the rheostat stand of the depot in the modes stated above according to ДСТУ 321.00.1-94 before and after the КП installation on the locomotive engine with the opacimeter ИДП -2.

4.3 The installation of the fuel catalyzer was carried out by the depot workers, in the place designated by the specialists of the technical department of the locomotive depot and LLC Scientific-Production Firm "Eko-Avto-Titan", according to the scheme shown in Fig. 1

The КП along with the input cranes 2,3 and the output crane 1 (Fig. 1) is installed in the separation (rupture) of the fuel pipeline between the fuel filter of fine purification (FFFP) and the fuel collector.

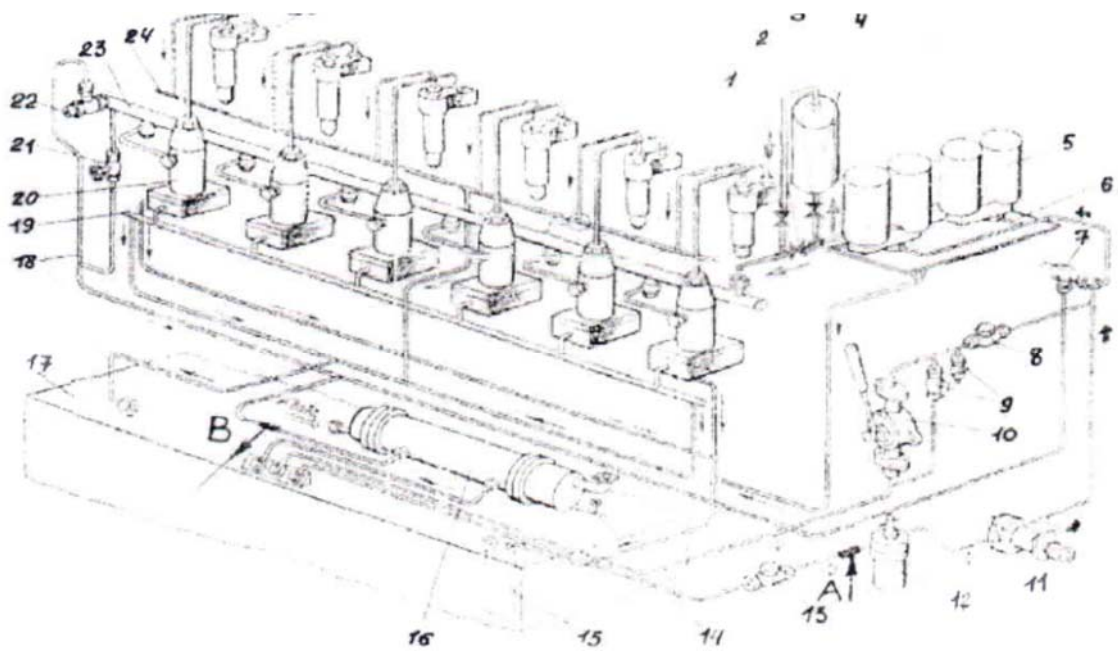


Fig. 1 – The fuel system of the locomotive ЧМЕЗ with the built-in fuel catalyzer КП-14Д:

- 1 - outlet crane; 2.3 - input cranes; 4 - fuel catalyzer;
- 5 - fuel filter of fine purification; 6 - plate under the filter;
- 7 - safety valve; 8.13 - check valves; 9 - crane;
- 10 - manual pump; 11 - fuel-injection pump;
- 12 - primary purification filter; 14 - suction pipe;
- 15 - dirt collector; 16 - fuel heater; 17 - fuel tank;
- 18 - drain pipes; 19, 24 - drainage collectors; 20 - high pressure fuel pump;
- 21 - valve; 22 - bypass valve; 23 - fuel collector;
- 25 - nozzle.

A - the place of connection of fuel supply from the measuring tank to the fuel system of the locomotive.
 B – the place of connection of the pipeline of drainage of residual fuel into the measuring tank.



Photo 1 Binder of the catalyzer КП-14Д

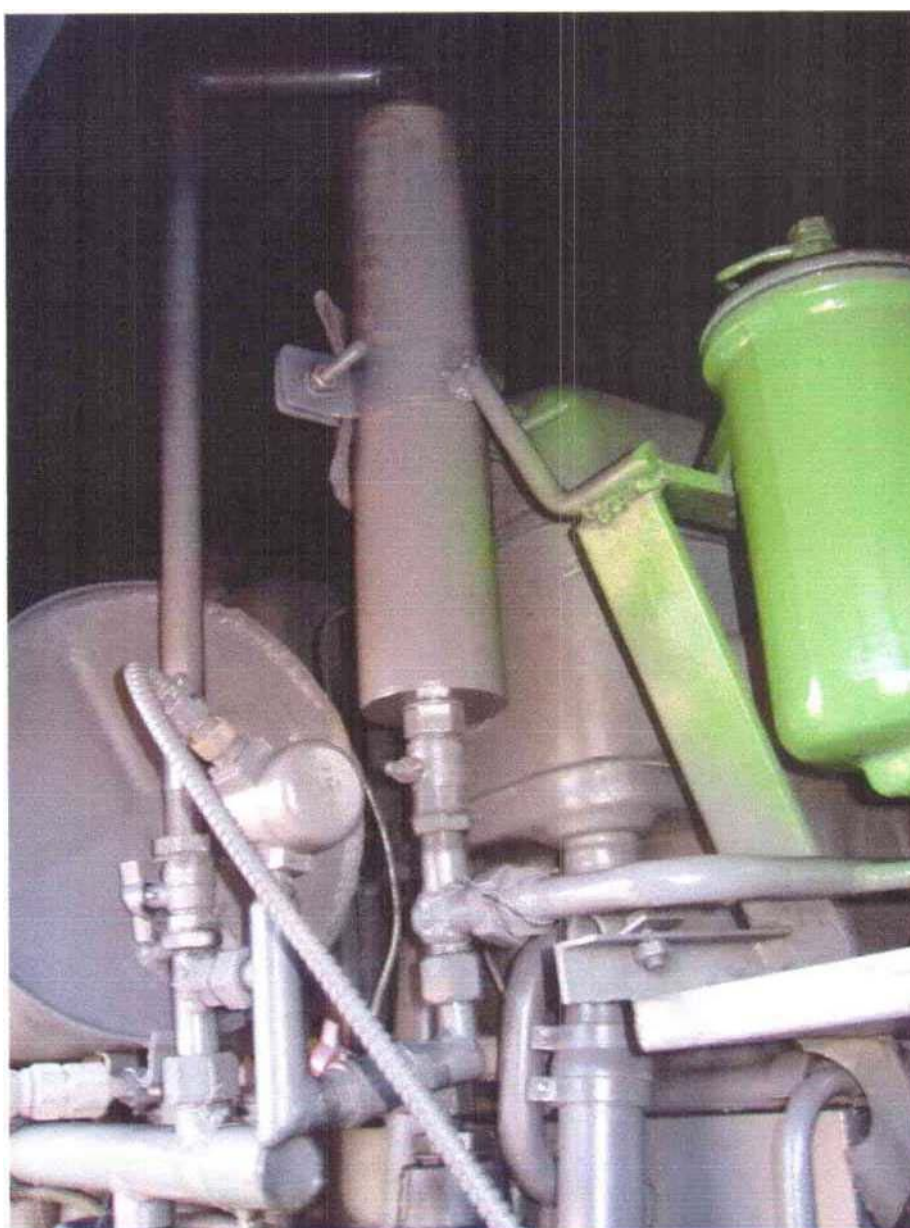


Photo 2 Placement of the catalyzer in locomotive

5 METHODS OF TESTING, MEASUREMENT EQUIPMENT AND MEANS OF MEANS OF MEASUREMENT TECHNIQUES

5.1 Motor tests

For the execution of control measurements the change of fuel consumption and opacity of the engine the locomotive ЧМЕ3 No. 404 with disconnected КП, is supplied and connected to the stand of rheostats tests of type А455.01.

5.1.1. To the diesel fuel system, with the installed КТ, the following changes were additionally made according to the scheme shown on Fig. 1:

- The fuel supply pipeline at the point "A" is disconnected from the fuel tank and is put into the measuring tank with the volume of 200 liters;
- The pipeline of drainage of residual fuel at the point "B", also allocated to the measuring tank.



Photo 3 Places of connection of pipelines supplying and discharging fuel to the tank

After controlling the quality of the installation works, the cranes 1,3 are closed, the crane 2 (Fig. 1) is left opened, which provides the direct (regular) fuel supply to the engine.

5.1.2 The measuring tank is installed on the scales, the zero value of the scales readings is fixed, after which the tank is filled with fuel.

5.1.3. The control measurements of the fuel weight consumed by the locomotive engine in the modes 0, 3 and 5 of the driver's controller positions for the fixed time of its operation, 10 and 10 minutes, respectively, were executed using the scales WEST-12A-200 No. 2111 and the stopwatch.

The measurement results are recorded in the protocol No. 1.



Photo 4. Tank with fuel on the scales

5.1.4 The measurement of the opacity of exhaust gases of the diesel locomotive in the modes 0, 3 and 5 positions of the driver's controller was executed by the opacimeter ИДП -2 No. 199.

The results are recorded in the protocol No. 1.



Photo 5. Emissions of pollutants on 5 ПКМ before installation of the КП

5.2 For the purpose of performing the control measurements, after the fuel catalyzer has been switched on, the direct supply of fuel to the engine by the crane 2 was blocked, and the cranes 1, 3 (Fig. 1) provided the fuel supply through the fuel catalyzer. When the КП is switched on, the work is done within 20 minutes.

The term of work from 15 hours on ПМ to 20 minutes is changed by the decision of the testing commission in order to reduce fuel consumption and time.

5.2.1. At the end of the specified period of operation with the КТ, the control measurements of changes in fuel consumption and opacity were carried out.

The results are recorded in the protocol No. 1.

All measurement devices were certified and verified in the established order.



Photo 5. Emissions of pollutants on 5 ПKM after installation of the КП

6 RESULTS OF TESTING

6.1. The results of testing of the КП on the locomotive ЧМЕ3 No. 404

6.1.1. The results of check of mass, overall dimensions and tightness for all proven indices met the technical requirements of ТУ У 34.3 -319909330-002.

6.1.2. The control measurements were executed on 25.12.2014 – the stage 1 and the stage 2. The change of fuel consumption on the diesel locomotive ЧМЕ3 No. 404 before and after the installation of КП and working within 20 minutes, constitutes in the modes:

0 ПKM for 30 min. without КП 6.4 kg, with КП 5.6 kg, or - 12.5%

3 ПKM for 10 min. without КП 7.7 kg, with КП 6.9 kg, or - 10.4%

5 ПKM for 10 min. without КП 16.5 kg, with КП 15.0 kg, or - 9.1%

The arithmetic mean value of the change in fuel consumption reduction constitutes 10.67%. The Protocol No. 1.

6.1.3 The results of the opacity measurement are the following in the modes, in %:

0 ПKM without КП 39.0 with КП 20.0 or decrease - 48.7%

3 ПKM without КП 96.0 with КП 37.0 or decrease - 56.2%

The arithmetic mean value of the opacity decrease constitutes 52.4%, or almost in 2 times. The Protocol No. 1.

6.2 Calculations of the specific fuel consumption were made from the formula $Q = N \cdot g$, where $g = Q/N$ per hour of the engine work.

7. CONCLUSIONS

7.1 The Commission shall note:

- under the indices of economy, the reduction of the specific fuel consumption at the average constitutes 10.7%, which exceeds the declared in TU values in 2 times.
- the engine's opacity has decreased at the average for 52.4%, or in 2 times.

7.2 The Commission examined the results of the departmental acceptance tests and established that the sample of the catalyzer that passed the test, meets the requirements of ТУ У 34.3 -319909330-002.

7.3 Commissions decided:

- to consider the fuel catalyzer КП-14Д such that it has passed the test for compliance with ТУ У 34.3 -319909330-002;
- to recommend the application of the fuel catalyzers КП-14Д on locomotives and other railway vehicles equipped with internal combustion engines.

Annex: the Protocol No. 1 of departmental acceptance tests

Members of the commission

Senior Engineer of “PrJSC Kyiv-Dniprovske MPPZT” (signature) I.V. Gurinenko

Master of rheostat tests of the Locomotive Depot “Darnytsa” (signature) M.T. Petryk

Master of the Locomotive Depot “Darnytsa” (signature) V.V. Kukoba

Chief of department of Institute of General Energy National Academy of Sciences of Ukraine,
candidate of technical sciences (signature) B.A. Kostiukovskyi

Senior Engineer of Scientific-Production Firm “Eko-Avto-Titan” (signature) P.S. Solovey

Engineer-Mechanic of Scientific-Production Firm “Eko-Avto-Titan” (signature) V.K. Vitiuk

Senior Constructor of Scientific-Production Firm “Eko-Avto-Titan” (signature) Iu.O.
Kravchenko

Deputy-Senior Technologist of LLC “Plant of Gas Equipment Alpha-Gaspromkomplekt”
(signature) V.A. Bondarenko

PROTOCOL No. 1 of December 25, 2014

Testing of the fuel catalyzer КПІ 14-Д on the locomotive of series ЧМЕ3

Name of enterprise and place of tests:

Locomotive Depot "Darnytsa", Kyiv city, Zroshchuvalna St., 31

Mark, series of the locomotive: ЧМЕ3 No. 404

Depot of registration – Kyiv-Moscow Branch of PrJSC Kyiv-Dniprovske MPPZT

Date of the control measurements 25.12.2014

Atmosphere indices: t-6 C

Stages of tests	Fuel consumption		Generator capacity	Specific fuel consumption	Change of fuel consumption	Opacity	
	t, min.	Q,kg	N, kWt	g/kg/kWt*h	%	N, %	Change, %
1	2	3	4	5	6	9	8
stage I – before installation of КПІ in the mode of the controller position: 0 ПІКМ 3 ПІКМ 5 ПІКМ	30 10 10	6,4 7,7 16,5	128 338	0,361 0,293		39 96	
stage I – after installation of КПІ and work of 20 minutes in the mode: 0 ПІКМ 3 ПІКМ 5 ПІКМ	30 10 10	5.6 6,9 15,0	128 338	0,323 0,266	-12,5 - 10,5 - -9,2	20 42	-48,7 -56,2
Average mean value of change of testing results, %					- 10,7		-52,4

Decrease of the specific fuel consumption – 10.7%

Decrease of the engine opacity – 53.4%

Decrease of the engine noises

Conclusions and proposals of the commission:

The efficiency of the fuel catalyzer work was confirmed.

The commission considers necessary to implement the fuel catalyzers КП 14-Д.

Senior Engineer of “PrJSC Kyiv-Dniprovske MPPZT” (signature) I.V. Gurinenko

Master of rheostat tests of the Locomotive Depot “Darnytsa” (signature) M.T. Petryk

Master of the Locomotive Depot “Darnytsa” (signature) V.V. Kukoba

Chief of department of Institute of General Energy National Academy of Sciences of Ukraine, candidate of technical sciences (signature) B.A. Kostiukovskyi

Senior Engineer of Scientific-Production Firm “Eko-Avto-Titan” (signature) P.S. Solovey

Engineer-Mechanic of Scientific-Production Firm “Eko-Avto-Titan” (signature) V.K. Vitiuk

Senior Constructor of Scientific-Production Firm “Eko-Avto-Titan” (signature) Iu.O. Kravchenko

Deputy-Senior Technologist of LLC “Plant of Gas Equipment Alpha-Gaspromkomplekt” (signature) V.A. Bondarenko

At the testing was present the journalist – Khomiakov L.L.