

# RATIONAL SYSTEM OF EVALUATING FUEL AND OIL SERVICE PROPERTIES

N. G. Puchkov and V. D. Reznikov

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The proposals of K. K. Papok on modernizing the existing system of evaluating fuel and oil service properties [1] embrace a wide circle of complex questions that, in our opinion, should be discussed in detail with the aim of developing a unified viewpoint for all those interested in resolving this problem.

The principal change in the existing four-stage system of testing fuels and lubricants, in the opinion of K. K. Papok, should pertain to the final stage, i.e., service tests. K. K. Papok proposes a departure from service tests as the fourth and concluding stage, in favor of carrying out observations over a one or two year period on the operation of engines using a fuel or oil that has been standardized after the third-stage tests.

About 10 years ago, we put forward a proposal [2], based on experimental data, for doing away with the service testing of motor oils in several new engines of the same type. Unfortunately, at that time, our proposal did not receive any support. We proposed that service approval of candidate oils for use in a given type of engine should be based solely on an evaluation of the operability of such oils in these engines, without any quantitative evaluation of their effectiveness. In comparison with the present method of service testing, our proposal would give a number of advantages, the most important of which would be the large number of engines, all in different condition, that would participate in the tests. Thus, our proposal is in agreement with that of K. K. Papok; however, we consider it inadvisable to standardize a product prior to completion of the service testing. It is well known that the quality of a fuel or lubricant that is manufactured on a trial-production basis for test-stand or service tests in a small number of test units is often quite different from the quality of the same product when produced on a commercial scale. Therefore, until several plant batches of a new product have been manufactured, there are no statistical production data available on the physical and chemical properties of this product that can be used in a standard. Under these conditions, it is a sounder procedure to produce a new fuel or lubricant for service testing for a limited time under a VTU or MRTU\* limited-coordination specification, which will then become the basic standard if the product passes the service test. A product manufactured under the VTU or MRTU should be distributed to strictly limited areas of consumption (or fleets), where a record is kept over a set period of time on all service difficulties or breakdowns that are directly or indirectly related to the use of the fuel or lubricant. The probability of an unsatisfactory result in such service testing of a petroleum product will be reduced by careful selection of materials in the preceding test stages and by proper selection of test-stand conditions.

The unification of test methods for new petroleum products in the form of a "State Complex of Methods" as proposed by K. K. Papok, mandatory for all interested parties, reduces in the end to supplementing the complex of existing and newly developed laboratory test methods by engine tests in single-cylinder units and full-scale engines. However, up to the present, motor oil test methods have not been standardized, and the numbers obtained in these tests are not supported by strictly controlled or uniformly applied test procedures.

Screening and classification test methods using special units probably can be standardized after suitable development work, either in their present form or with some modification of individual elements.

We believe that a suitable basis can be found in the demerit ratings of oils in single-cylinder engines (in accordance with Standard 334-T); a summary of these ratings is shown in the table.

For each unit, test methods have been developed and tentatively approved; these can then be standardized after appropriate testing (for the UIM-6 unit, the test method has already been standardized). The immediate problem, then, is to organize a limited production run of the units (about 10 units of each type), to check these units out, and to standardize the oil test methods.

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\* VTU's are "temporary" (interim) or "departmental" specifications; MRTU's are "inter-republic" specifications, i.e., those applicable only in certain republics of the Soviet Union—Publisher.

Oil group or series	Demerit rating in single-cylinder engine				
	NAMI-1 100 h	UIM-6 120 h	UIM-6N, 120 h	IM (8.5/11), 120 h	DK-2 (SPDK), 36 h
A (Premium) .	10	—	—	—	—
B (HD) . . . . .	5	20	—	—	—
C (Series I) . .	2	12	25	—	—
D (Series II) . .	—	—	15	25	—
E (Series III) . .	—	—	—	15	10
F (Series IV for marine diesels)	—	—	—	—	15

It is also important to resolve the question of standardizing fuel and lubricant test methods using full-scale engines. Long-term test-stand evaluations using one new engine are inaccurate to the same degree as are service tests in several engines of the same type. Therefore, long-term test-stand evaluations of fuels and lubricants in full-scale engines should be conducted mainly to evaluate the reliability of engine operation on a new fuel or oil. Before starting long-term test-stand evaluations, a quantitative as well as a qualitative evaluation of individual service characteristics of new products in comparison with reference materials that have proved

themselves in service should be obtained during the course of special functional tests in single-cylinder and full-scale engines.

In contrast to the multipurpose tests that are used widely at the present time, functional tests give an evaluation of only one or a few properties of oils by deliberately aggravating specific operating conditions. For example, one test may give a characterization of oil corrosivity and oxidation susceptibility at high temperature; others may evaluate the tendency of the oil toward low-temperature deposit formation, filterability, sensitivity to water, etc. The complex of short-term functional tests that are used should include all typical cases of operation that the given product will encounter; naturally, the more universal the application of the particular fuel or oil, the greater the number of functional tests to which it should be subjected. Foreign (non-Soviet) experience demonstrates that fuels or oils that have performed equally well in the standard engine tests provided by specification will often display significant differences in actual service properties; therefore many large users develop functional test methods applicable to engines manufactured or operated by them. The development and unification of functional test methods to give the most reliable result in a short time and under optimum conditions is, in our opinion, an extremely urgent problem. Unfortunately, we have left this approach without any attention for a long time, and there is little backlog of experimental work on functional test method development on which we can draw. Without a serious study of fuel and lubricant service properties by means of functional methods, conversion to a shortened (three-stage) evaluation system would be a premature measure, since in its existing form the third stage, as noted above, has all of the shortcomings of the repudiated fourth stage.

We should dwell especially on the question of optimum duration of long-term test-stand evaluations. K. K. Papok correctly notes that there is today a tendency toward longer tests. This tendency also affects functional tests, since it has arisen not only from the increased service life of engines, but also from the increase in fuel and lubricant quality, e.g., the trend toward longer oil change periods. For example, in tests on automotive oils that are intended for long-term service without oil change, the test duration will have to be two or even three times that normally used [3]. The user always wants to be confident that a given fuel or oil can ensure normal engine operation throughout the service life of the engine. Therefore, some plants conduct motor oil tests for 2000-3000 h, in certain cases up to 6000 h. An increase in the duration of functional tests probably will be unavoidable. In long-term test-stand evaluations, the test period can be shortened by special preconditioning of the engine or by aggravated wear of the engine during run-in prior to the oil test, which itself will usually run for 500-1000 h. These tests should be run in duplicate to increase the reliability of the results.

## SUMMARY

1. A set of standard tests, including both laboratory and engine methods, should be developed and coordinated for the evaluation of service properties of new fuels and oils intended for production-line engines.

2. The following should be done in order to shorten the time consumed in conducting the tests:

- a) Develop and standardize methods for short-term functional test-stand evaluations in special single-cylinder units and in full-scale engines, keeping in view the fact that the investigation in breadth and depth of all of the service properties of new fuels and oils is carried out during this stage, whereas the subsequent stages evaluate mainly the reliability of engine operation on the fuel or lubricant in question.

- b) Develop methods for preconditioning full-scale engines prior to test-stand evaluations in such a manner as to provide good precision of results without increasing the test period, achieving this by increasing the severity of test conditions.

c) Produce fuels and oils to VTU's (limited-coordination specifications) for a limited time after they have passed the standard set of tests, and supply these materials only to users that are conducting the service testing.

3. Standardization of new petroleum products is advisable after the service testing.

#### LITERATURE CITED

1. K. K. Papok, Khim. i tekhnol. topliv i masel, No. 1 (1966).
2. V. D. Reznikov, Trudy VNII NP, No. 6, Gostoptekhizdat (1957).
3. K. M. Selk, Mineraloel-Technik, No. 16/17 (1963).

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All abbreviations of periodicals in the above bibliography are letter-by-letter transliterations of the abbreviations as given in the original Russian journal. *Some or all of this periodical literature may well be available in English translation.* A complete list of the cover-to-cover English translations appears at the back of the first issue of this year.

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