# Quantitative Assessment of Operation of Ship Main Diesel Engine

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## ABSTRACT

Operation of ship propulsion system is associated with realization of definite operational goals. However decision to reject application of the strategy (even if hypothetical) becomes obvious with a view of necessity of ensuring an acceptable level of safety to ship and environment as well as presence of associated formal and legal limitations. Therefore complexity of operational reality makes that means intended for operation may be used in various ways. Objectivity and rationality in making decision, assumed optimal in given conditions, forces to apply an evaluating (quantitative) approach to the problem, hence to search for such their parameters (indices) which, in a given decision situation, can be deemed most adequate.

And, to precisely determine the task it is necessary to specify also its duration time, apart from conditions in which it will be realized. When considering propulsion engine, i.e. the main element of ship propulsion system, especially important becomes not only the problem which amount of energy could be at one's disposal but also within which time interval it could be delivered. Therefore apart from applying the commonly used reliability indices, it seems sensible to consider the operation in such evaluating approach as it could be determined by energy and time simultaneously.

In this case the operation (*D*) in the time interval [0, t] can be interpreted as a physical quantity determined by the product of the time-variable energy $E = f(t)$ and time *t*, which can be generally expressed as follows [1]:

$$D = \int_0^t E(\tau)\, d\tau \qquad (2)$$

In the case of a general analysis of operation of self-ignition engine it can be considered that the energy produced due to combustion of fuel in engine cylinders makes it possible to generate torque of the engine.

In this case, the engine's operation can be determined by the following expression:

$$D = 2\pi \int_0^t M_0\, n\, t\, dt \qquad (2)$$

Further by introducing the notions of :

- *the required operation* $D_W$, i.e. that necessary for realization of a task (e.g. transportation of a cargo by sea within a given time, which is equivalent to keeping a given mean speed of ship, hence also power output developed by main propulsion engine (-s) ;
- *the possible operation* $D_M$, i.e. that possible to be realized by an engine being in a given technical state and in given functioning conditions ;

and as a result of satisfying the relation:

$$D_M \geq D_W \quad , \qquad (3)$$

the assessment criterion of degree of serviceability is obtained in accordance with the principles presented in detail in [1]. The presented method may be deemed a valuable supplement to the ways have been applied so far of description of reliability features of main propulsion engine. Its basic advantage consists in connecting energy assessment with duration of time in which a task is realized. The time is very important in the case of sea shipping tasks usually long lasting.

## REFERENCES

[1] Girtler, J., Kuszmider, S., Plewiński, L., *The selected problems of the exploitation of sea ships in the aspect of the navigation safety*, Maritime University, Szczecin 2003. (in Polish)