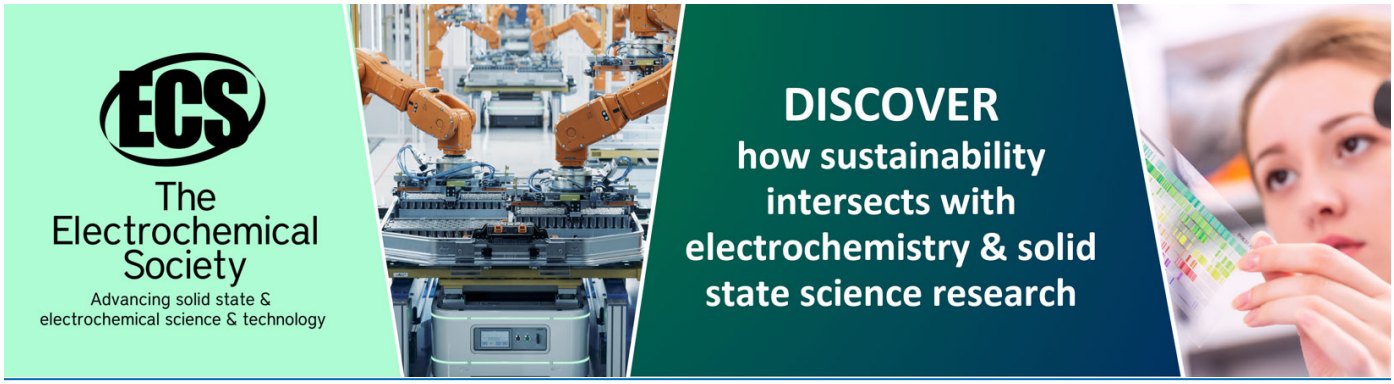
# The study of automotive vehicles technical operation indicators





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# The study of automotive vehicles technical operation indicators

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**Abstract**. Nowadays automobile transport plays the main role nationwide. That's why transport efficiency increasing is the pressing issue of technical automobile transport operation. To assess and compare the different enterprises' operation vehicle (automobile) fleets efficiency, the production coefficients, automobile vehicles and vehicle (automobile) fleets technical readiness and other. The proposed type of expressions facilitates the calculation and relationship understanding for determining the technical readiness coefficient and determines the main factors relationship characterizing the automobile vehicles and vehicle (automobile) fleets operation efficiency.

Nowadays automobile transport plays the main role not only in agricultural passenger transfer and cargo transportation but nationwide. This mean of transport can change railway and river transport, ensuring reliability and regularity of product delivery from provider to consumer [1]. That's why transport efficiency increasing is the pressing issue of technical automobile transport operation [2]. To assess and compare the different enterprises' operation vehicle (automobile) fleets efficiency, the production coefficients, automobile vehicles and vehicle (automobile) fleets technical readiness, as well as the non-working days coefficient is used.

In modern scientific and educational sources, these indicators have the following definition and calculation formula[3]:

The output coefficient($\alpha_{out}$) determines the calendar proportion time during which the vehicle (automobile) or fleet performs transport work on the line:

$$\alpha_{out} = \frac{D_e}{D_e+D_r+D_n} = \frac{D_e}{D_c}; \quad (1)$$

where $D_e$ is the number of vehicle (automobile) exploitation days;

$D_r$ is the number of automobile vehicle idle time in repair and maintenance service days;

$D_n$ is the number of downtime in good condition for organizational reasons days;

$D_c$ is the number of cycle days.

The technical readiness coefficient ($\alpha_t$) determines the proportion of working time during which the vehicle (automobile) or fleet is operational and can be used in the transport process:

$$\alpha_t = \frac{D_e}{D_e+D_r}; \quad (2)$$

The non-working days ($\alpha_n$) coefficient defines the calendar time share during which the serviceable automobile (automobile group) is not used in the transport process for organizational reasons (days off, vacation, lack of work, etc.):

$$\alpha_n = \frac{D_n}{D_c}; \quad (3)$$

In determining these coefficients for vehicle (automobile) fleets, days (D) are replaced in vehicle (automobile) days (AD) formulas.

It is worth noting that in determining the technical readiness ($\alpha_t$) coefficient they determine the working time proportion and the other two factors – the calendar time share. Because of this difference, there are often discrepancies and errors in these indicators calculation, as it turns out that the automobile vehicle idle time in good condition for organizational reasons is not taken into account in the technical readiness coefficient ($\alpha_t$) calculation. And in many literary sources, it is accurately specified that automobile vehicles stand idle in technically serviceable condition [3]. Therefore, in order to find the total number of days when the automobile vehicle is in good technical condition, the number of downtime days for organizational reasons $D_n$ should be added to the number of operation days $D_e$ [4].

The expression (2) denominator is the days sum when the vehicle is in a technically sound condition $D_e$ and the days when the vehicle is in a technically defective condition $D_r$. As it was established, the technically serviceable car condition is characterized by the operation days sum and idle time in good condition for organizational reasons days, this means that in the denominator for the calculations accuracy it is necessary to add the number of idle time for organizational reasons days $D_n$. In this case, the denominator will be given to the number of days in the $D_c$ operating cycle [4].

Then expression (2) takes the form:

$$\alpha_t = \frac{D_e+D_n}{D_e+D_r+D_n} = \frac{D_e+D_n}{D_c} \quad (4)$$

where $D_e+D_n$ is the number of days per cycle when the automobile vehicle is in good technical condition.

In most of the literature the ratio $\alpha_{out}$ to $\alpha_t$ is considered as one of the operation vehicle (automobile) fleets efficiency indicators:

$$\frac{\alpha_{out}}{\alpha_t} = \frac{D_e+D_n}{D_e+D_r+D_n} = \frac{D_c-D_n}{D_c} = 1 - \frac{D_n}{D_c} = 1 - \alpha_n; \quad (5)$$

From the expression (5) it can be concluded that the ratio $\alpha_{out}$ to $\alpha_t$ is in direct connection with the non-working days coefficient $\alpha_n$. And the expression for determining the output coefficient has the form:

$$\alpha_{out} = \alpha_t(1 - \alpha_n) \quad (6)$$

In our case, this ratio $\alpha_{out}$ to $\alpha_t$will have the following form:

$$\frac{\alpha_{out}}{\alpha_t} = \frac{\frac{D_e}{D_e+D_r+D_n}}{\frac{D_e+D_n}{D_e+D_r+D_n}} = \frac{D_e}{D_e+D_r+D_n} \times \frac{D_e+D_r+D_n}{D_e+D_n} = \frac{D_e}{D_e+D_n} \quad (7)$$

If we change the numerator and denominator in the formula (7), we get a more convenient expression for the analysis:

$$\frac{\alpha_t}{\alpha_{out}} = \frac{D_e+D_n}{D_e} = 1 + \frac{D_n}{D_e}; \quad (8)$$

Based on the formulas (1) and (3) we get:

$$\frac{\alpha_n}{\alpha_{out}} = \frac{D_n}{D_c} : \frac{D_e}{D_c} = \frac{D_n}{D_e};$$

Then expression (8) takes the form:

$$\frac{\alpha_t}{\alpha_{out}} = 1 + \frac{\alpha_n}{\alpha_{out}}; \quad (9)$$

As a transformation expression result (9), we get the final expression form to determine the main coefficients relationship characterizing the automobile vehicle and vehicle (automobile) fleets operation efficiency:

$$\alpha_t = \alpha_{out} + \alpha_n; \quad (10)$$
$$\alpha_{out} = \alpha_t - \alpha_n; \quad (11)$$

To check the formula correctness (10), substitute the coefficients values into it (1), (3), (4):

$$\frac{D_e+D_n}{D_c} = \frac{D_e}{D_c} + \frac{D_n}{D_c} = \frac{D_e+D_n}{D_c}; \quad (12)$$

Expression (12) confirms the main indicators relationship efficiency theoretical analysis correctness of automobile vehicles and vehicle (automobile) fleets operation among themselves.

Now it is necessary to check the results in practice. To do this, let us resolve the issue of determining the automobile vehicle and vehicle (automobile) fleets operation efficiency during the calendar year in two ways: standard and using the derived expressions.

**Task 1.** Truck ZIL-130 had carried out transport work during the calendar year ($D_c$ =365 days). With a five-day working week, the non-working days' number for the year was $D_n$ =118 days, while in maintenance service and repair the automobile vehicle stood idle $D_r$ =25 days. Determine the release coefficients values, technical readiness and non-working days.

Standard solution:

$$\alpha_{out} = \frac{D_e}{D_e+D_r+D_n} = \frac{D_e}{D_c} = \frac{D_c-D_r-D_n}{D_c} = \frac{365-25-118}{365} = \frac{222}{365} = 0{,}608;$$
$$\alpha_t = \frac{D_e}{D_e+D_r} = \frac{222}{222+25} = 0{,}899;$$
$$\alpha_n = \frac{D_n}{D_c} = \frac{118}{365} = 0{,}323;$$

Proposed solution:

$$\alpha_{out} = \frac{D_e}{D_e+D_r+D_n} = \frac{D_e}{D_c} = \frac{D_c-D_r-D_n}{D_c} = \frac{365-25-118}{365} = \frac{222}{365} = 0{,}608;$$
$$\alpha_t = \frac{D_e+D_n}{D_e+D_r+D_n} = \frac{D_e+D_n}{D_c} = \frac{222+118}{365} = 0{,}932;$$
$$\alpha_n = \frac{D_n}{D_c} = \frac{118}{365} = 0{,}323;$$

It is visible that the non-working days account increases technical readiness coefficient value as automobile vehicles on storage and their idle time waiting for transport work statement is allowed only in technically serviceable condition.

**Task 2.** Truck ZIL-130 had carried out transport work during the calendar year ($D_c$ =365 days). With a six-day working week, the non-working days' number for the year was $D_n$ =65 days, while in maintenance service and repair the automobile vehicle stood idle $D_r$ =50 days. Determine the release coefficients values, technical readiness and non-working days.

Standard solution:

$$\alpha_{out} = \frac{D_e}{D_e+D_r+D_n} = \frac{D_e}{D_c} = \frac{D_c-D_r-D_n}{D_c} = \frac{365-50-65}{365} = \frac{250}{365} = 0{,}685;$$
$$\alpha_t = \frac{D_e}{D_e+D_r} = \frac{250}{250+50} = 0{,}833;$$
$$\alpha_n = \frac{D_n}{D_c} = \frac{65}{365} = 0{,}178;$$

Proposed solution:

$$\alpha_{out} = \frac{D_e}{D_e+D_r+D_n} = \frac{D_e}{D_c} = \frac{D_c-D_r-D_n}{D_c} = \frac{365-50-65}{365} = \frac{250}{365} = 0{,}685;$$
$$\alpha_t = \frac{D_e+D_n}{D_e+D_r+D_n} = \frac{D_e+D_n}{D_c} = \frac{250+65}{365} = 0{,}863;$$
$$\alpha_n = \frac{D_n}{D_c} = \frac{65}{365} = 0{,}178;$$

Let us check the main indicators value, based on the expressions (6) and (11):

$$\alpha_{out} = \alpha_t(1-\alpha_n) = 0{,}833(1-0{,}178) = 0{,}685;$$

and

$$\alpha_{out} = \alpha_t - \alpha_n = 0{,}863-0{,}178 = 0{,}685;$$

Based on the calculations, it can be concluded that using the presented technical readiness coefficient calculation version is possible to determine this indicator, like the rest, for the entire operating cycle without additional calculations. It should be noted that the calculation result is more important than the conventional calculation version. This is due to the fact that the downtime days for organizational reasons imply the downtime of technically serviceable rolling stock.

The proposed expressions type for determining the technical readiness coefficient and to determine the main coefficients relationship characterizing the automobile vehicle and vehicle (automobile) fleets operational efficiency facilitates their calculation and relationship understanding.

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