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25 May 1979

USSR

# TRANSLATIONS ON USSR INDUSTRIAL AFFAIRS
# (FOUO 5/79)

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# TRANSLATIONS ON USSR INDUSTRIAL AFFAIRS

(FOUO 5/79)

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AGRICULTURAL MACHINERY

## TECHNICAL, ECONOMIC INDICATORS OF OVERHAULED TRUCKS

Minsk EKONOMIKA I ORGANIZATSIYA ISPOL'ZOVANIYA TEKHNIKI V SEL'SKOM KHOZYAYSTVE in Russian 1973 pp 110-137

/Section 3, Chapter 5 of the book "Ekonomika i organizatsiya ispol'zovaniya tekhniki v sel'skom khozyaystve" (The Economics and Organization of the Use of Equipment in Agriculture) by Yu. M. Khusainov and A. V. Yalovik, Izdatel'stvo "Uradzhay"/

/Text/ 3. The Technical and Economic Indicators of the Operation of Overhauled Trucks

Many years of practice show that the overhaul of a truck, which is performed even with a high quality, cannot completely reestablish its initial technical parameters. The annual mileage of overhauled trucks is increased slightly as compared with the mileage before repair, but then it decreases sharply.

Overhauled trucks have a shorter operating time than new trucks, and the rate of its decrease declines rapidly. At the same time, although the level of expenditures on current repairs and maintenance following an overhaul might decrease slightly as compared with the technical level at the end of the preceding period, still it is considerably higher than for the initial period of operation of a new truck. In this case, following the overhaul the growth rate of the expenditures on current repairs occurs more rapidly. This attests to the fact that from the standpoint of the minimum expenditures on vehicle maintenance it is economically advantageous to perform an overhaul after a certain mileage. In the case of the individual method of repair at the end of each subsequent period the mileage of the truck is lower, while the amount of expenditures is greater than the corresponding value for the preceding period of operation.

Under the conditions of mass pooled overhauling the nature of the change in the annual mileage and expenditures on maintenance and repair has another regularity. During an overhaul only the frame of the former truck usually remains, the other units are installed in a pooled manner, and it can be presumed that, given a specific technical equipment, technological discipline and skill of the collective of the repair plant, all the units have an averaged reserve of operating time. In this case, when overhauled a truck receives an averaged service life depending on the organization of the repair works. Thus, the vehicle operating time is characterized by the operating period of a new truck until overhauling, within which the annual mileage decreases according to a descending curve to a specific minimum, while the change of expenditures occurs according to an ascending curve to a specific maximum, and by periods between overhauls, in which the mileage is characterized by an increase and the expenditures by a decrease after the overhaul to a constant averaged level, with subsequent change according to a specific law.

Overhauled trucks have a lower annual productivity. The change in the annual mileage of overhauled trucks occurs according to a curve which can be expressed by the equation of a secondary parabola

$$l_{\kappa} = A_1 + B_1 t + C_1 t^2.$$

The values of the factors of the equation for individual makes of trucks are cited in Table 43.

Table 43

Factors of the Equations of the Changes in the Annual Mileage of Trucks Depending on the After-Overhaul Term of Their Operation

| Designated Factors | Make of Truck | | |
|---|---|---|---|
| | GAZ-51A | GAZ-93 | ZIL-555 |
| $A_1$ | 32.95 | 35.13 | 35.2 |
| $B_1$ | -1.88 | -4.62 | -3.61 |
| $C_1$ | 0.10 | 0.30 | 0.13 |

As is evident from the table, the factors of the equation have negligible numerical differences according to the makes, which indicates the overall regularity of the decrease of the annual mileage after overhauling for all trucks. The rates of the decrease in the annual mileage of overhauled trucks are cited in Table 44.

Table 44

Change in Annual Mileage of Trucks After Overhauling

| Service Life After an Overhaul, Years | Rates of Decrease of Annual Mileage, percent | | | | | |
|---|---|---|---|---|---|---|
| | of first year | | | in preceding year | | |
| | GAZ-51A | GAZ-93 | ZIL-555 | GAZ-51A | GAZ-93 | ZIL-555 |
| 2 | 5.1 | 12 | 10.4 | 5.1 | 12 | 10.4 |
| 3 | 9.6 | 22 | 19.8 | 4.8 | 11.4 | 10.5 |
| 4 | 13.1 | 30 | 28.2 | 4.5 | 10.4 | 10.5 |

On the basis of the data of the table it can be concluded that the rates of decrease of the annual mileage of trucks with sides are considerably lower than for dump trucks. Whereas the average annual rate of decrease for

GAZ-51A trucks is equal to 4.5-5.1 percent, for dump trucks it is 10.4-12 percent. This can be explained by two factors: first, the truck repair plants of the Sel'khoztekhnika system have mastered better the technology of repairing GAZ-51A trucks than ZIL-585 dump trucks and, second, trucks with sides do not have such a complicated mechanism as a hydraulic system for raising the truck beds, which after overhauling usually breaks down and thereby decreases the annual operating time of dump trucks.

The following correction factors, which take into account the change in the annual mileage, are recommended for trucks which have been overhauled (Table 45).

Table 45

Correction Factors Which Take Into Account the Influence of the Service Life of Trucks on the Change of the Annual Mileage After Overhauling

| Service Life | Correction Factors | |
|---|---|---|
| | for first year after overhaul | for new truck |
| Up to 1 year | 1.0 | 0.75 |
| Over 1 year up to 2 years | 0.95 | 0.70 |
| Over 2 years | 0.80 | 0.60 |

The ratio of the mileage for a specific service life of overhauled trucks to the mileage for the same operating period of new trucks is the indicator of the quality of repair and can be expressed by the following coefficient:

$$\psi = \frac{\sum_{i=1}^{t} l_{\kappa_i}}{\sum_{i=1}^{t} l_i}.$$

Overhauled trucks operate at farms at best for 3-4 years, and then are written off or are sent to be overhauled again. Therefore, when determining the coefficient of the quality of repair at this stage it is necessary to assume a period between overhauls, which is equal to 2-4 years. In this case for GAZ-51A and GAZ-93 trucks the coefficient of the quality of repair will be equal to 0.65, for ZIL-585 trucks it will be equal to 0.60.

Consequently, the service life of overhauled trucks at specialized plants of the republic, given the present repair technology, is equal to only 60-65 percent of a new truck.

In practice, in order to determine the minimum operating life of trucks before overhauling (from the point of view of losses of productivity) it is necessary to take the mileage of an overhauled truck during the first year to be greater than the mileage of a truck which is being operated with an overhaul, that is, it is necessary to observe the condition

$$l_{K_1} \geqslant l_{i+1},$$

where $l_{K_1}$ is the mileage during the first year of operation of a truck after overhauling; $l_{i+1}$ is the mileage of a truck without overhauling during the i+1 year of operation; i is the service life of a truck, during which an overhaul was performed.

Taking this condition into account, disregarding the expenditures of capital on repair it is possible to determine the minimum service life and mileage of a truck prior to overhauling.

A graphic calculation of the minimum service life of a GAZ-51A truck prior to overhauling is presented in Figure 15. As is evident from the graph, the line k-$k_1$ corresponds to the operating time during the first year of overhauled trucks. Point κ of the curve of the change in the annual mileage depending on the age of the truck $l = f(t)$ shows that the mileage of a truck which has been operating without an overhaul at the age of 4.7 years is equal to the mileage of a truck of the first year after overhauling, that is, $l_{i+1} = l_{K_1}$. Consequently, the minimum service life before overhauling for the GAZ-51A according to this indicator will be equal to 3.7 years, which corresponds to the mileage of a truck before overhauling of 145,000 km.

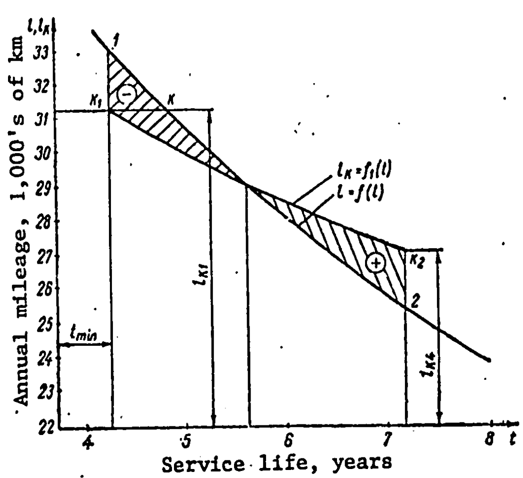


Figure 15. Calculation of the Minimum Service Life of GAZ-51A Trucks Before Overhauling According to the Mileage of the First Year

In this case the minimum service life of trucks before overhauling can also be determined on the basis of the equation

$$l_{t+1} = A + B(t_{min} + 1) + C(t_{min} + 1)^2 = l_{K_1}.$$

By reducing the equation to the form

$$C(t_{min} + 1)^2 + B(t_{min} + 1) + A - l_{K_1} = 0,$$

the minimum service life before overhauling will be equal to

$$t_{min} = \frac{-\frac{B}{2} \pm \sqrt{\left(\frac{B}{2}\right)^2 - C(A - l_{K_1})}}{C} - 1.$$

When determining according to this formula the minimum service life of GAZ-51A trucks before overhauling, we obtained $t_{min} = 3.7$ years, which corresponds to the graphic method of determination. For GAZ-93 trucks the minimum service life before overhauling is equal to 3.2 years, which corresponds to a total mileage of 116,000 km, and for ZIL-585 and ZIL-555 trucks--4 years, or 166,000 km.

However, when determining the minimum service life of a truck according to the mileage during the first year after overhauling, it is possible to make a mistake, if we do not take into account the regularity of the decrease of the mileage during subsequent years of use of the truck, as well as the expenditures on repair and maintenance. Therefore, it is necessary to consider the minimum service life of trucks according to the mileage before overhauling as satisfying the condition

$$\sum_{t=0}^{n} l_K = \sum_{t_{K-1}}^{t_{K-1}+n} l_t,$$

where n is the period between overhauls (in years); $t_{K-1}$ is the minimum service life of the truck before overhauling.

When examining the graphs of the decrease in the operating time of overhauled trucks it is evident that, depending on the quality of repair, the nature of the decrease in the mileage of vehicles during subsequent years can have three forms:

1) the rate of decrease of the mileage of trucks is greater than that of trucks that have not been overhauled;

2) the rate of decrease of the mileage of trucks is equal to the rate of decrease of the annual mileage of trucks which are being operating without an overhaul;

3) the rate of decrease of the annual mileage of trucks is lower than the decrease of the mileage of trucks which have not been overhauled.

By analyzing the regularities of the change in the annual mileage of overhauled trucks of different makes it can be concluded that the nature of the change in the mileage of GAZ-93, ZIL-585 and ZIL-555 trucks corresponds to the first type, while that of GAZ-51A trucks corresponds to the third type.

Having examined the second type of the nature of the decrease in the operating time, we see that if the regularity of the mileage of an overhauled truck is identical to the mileage of a truck without an overhaul for the period ($t_K + n$), during each year of operation over n years their mileages are equal, that is,

$$l_{\kappa_1} = l_{t_\kappa};\ l_{\kappa_2} = l_{t_\kappa+1};\ l_{\kappa_n} = l_{t_\kappa+(n-1)},$$

and then

$$\sum_{i=0}^{n} l_\kappa = \sum_{t_{\kappa-1}}^{t_{\kappa-1}+n} l_t.$$

Consequently, the minimum period for overhauling can be determined from the condition

$$l_{\kappa_1} = l_{t_{\min}+1}.$$

The economic expedience of overhauling a GAZ-51A truck (the third type of the nature of the decrease of operating time) is examined in the graph (Figure 16). The operating time of GAZ-51 trucks during the first year after overhauling is equal to 31,200 km and corresponds to line 1-3.

If the overhaul of the truck was performed three years after the start of operation, then, as is evident from the graph, during the fourth year of its operation ($\sigma_1$) the operating time of the truck will be $l_{K1}$, which is less than for trucks which have not been overhauled by the amount 1-1′.

When the overhaul is performed at a later date this difference decreases and at point κ equals zero. When a truck is overhauled during the fourth ($\sigma_2$) and fifth year ($\sigma_3$) of operation, which corresponds to the operating time during the first year of an overhauled truck (points 2 and 3), the mileage will be greater correspondingly by the amount 2-2′ and 3-3′.

Thus, given the equality $l_{K1} = l_{t_K}$ (on the graph point κ) the total mileage of the overhauled truck after n years will be greater than the mileage after the period from $t_{K-1}$ to $t_{K-1}+n$ years, that is,

$$\sum_{0}^{n} l_\kappa > \sum_{t_{\kappa-1}}^{t_{\kappa-1}+n} l_t.$$

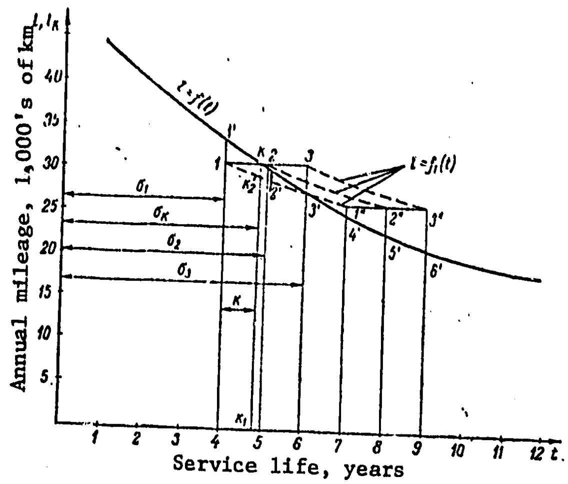


Figure 16. Determination of the Minimum Service Life of GAZ-51A Trucks Before Overhauling According to the Total Mileage

In order to find the point $\kappa_1$ (the minimum service life) it is necessary to observe the equation

$$\sum_{0}^{n} l_{\kappa} = \sum_{t_{\kappa-1}}^{t_{\kappa-1}+n} l_t .$$

From the graph (see Figure 15) it is evident that during the first period the mileage for an overhauled truck is lower, and during the second period is higher, and the loss of mileage during the first period of operation is offset by the gain during the second period. Thus, the following integral equation is typical for trucks with the third type of decrease of the operating time:

$$\int_{0}^{n} f_1(t) = \int_{t_{\kappa-1}}^{t_{\kappa-1}+n} f(t).$$

The time of repair can be earlier than it is defined by the equation

$$l_{\kappa_1} = l_{t_{\kappa-1}}.$$

However, as was already noted earlier, over the interval к₁-к the mileage of an overhauled truck is less than that of a truck which has not been overhauled. Consequently, it is economically expedient to perform the overhaul only on this minimum date, when during the first year of operation of the truck after overhauling the condition is observed

$$l_{\kappa_1} = l_{t_{\kappa-1}} = l_{t\,\min+1}\,.$$

The nature of the change in the annual mileage is slightly different for GAZ-93 (Figure 17), ZIL-585 and ZIL-555 dump trucks.

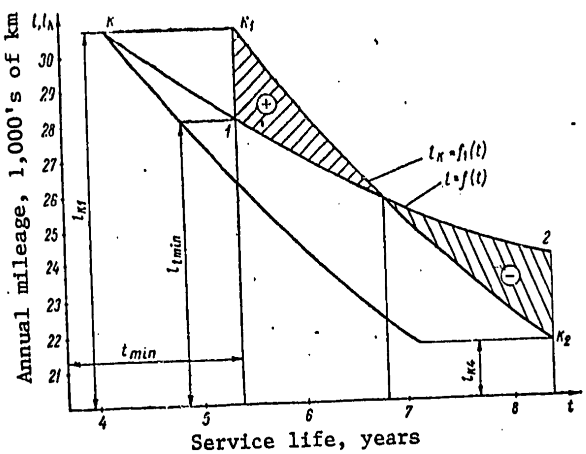


Figure 17. Determination of the Minimum Service Life ($t_{min}$) of GAZ-93 Trucks Before Overhauling

As is evident from the graph, in spite of the equality of the mileages of overhauled trucks during the first year and trucks which have not been overhauled during the year t, subsequently the mileage of overhauled trucks decreases more rapidly.

Point к (see Figure 17) on the curve characterizes the equality of the mileages during the first year of overhauled trucks and during year t of the operation of trucks which have not been overhauled. With further operation the total operating time over n years for overhauled trucks is lower than for trucks which have not been overhauled.

Point $\kappa_1$ with an age of the truck of $(t_{min} + 1)$ corresponds to the equation $l_{\kappa_n} - l_n = 0$ after a period of n years.

Although at this point the mileage of trucks without an overhaul is less than that of an overhauled truck by the amount which corresponds to points l and $\kappa_1$, later the gain in the mileage of the latter is counterbalanced by its more rapid decrease at the end of the period between overhauls (up to point $\kappa_2$). Consequently, in this case overhauling will be expedient from the point of view of the increase of the productivity of the trucks, if the condition is observed

$$l_\kappa - l = \int_0^n f_1(t) - \int_{t_{min}}^{t_{min}+n} f(t) \geqslant 0,$$

where $l_\kappa$ is the total mileage of the overhauled trucks during the period between overhauls; l is the mileage of trucks which have not been overhauled during this period, in the period from $t_{min}$ through $t_{min}+$; $t_{min}$ is the age of the truck, at which it was overhauled; n is the service life after overhauling, in years.

By knowing the regularity of the change in the annual mileage of trucks, depending on the period of operation it is possible to determine the critical point of the expedient date of overhauling according to the formula

$$\int_0^n A_1 + B_1 t + C_1 t^2 - \int_t^{t+n} A + Bt + Ct^2 = 0.$$

On the basis of the equation of the mileage of overhauled trucks, the total mileage of a truck after n years of operation following the overhaul is determined according to the formula

$$l_{\kappa_n} = \int_0^n A_1 + B_1 t + C_1 t^2.$$

By knowing the total mileage $l_{\kappa_n}$ of the overhauled trucks, we determine the minimum possible period of operation of new trucks to the first overhaul, on the basis of the condition of the equivalent mileage of the overhauled trucks and trucks which have not been overhauled

$$\int_t^{t+n} (A + Bt + Ct^2) - l_{\kappa_n} = 0.$$

After integration and transforms we will obtain the following equation:

$$nCt^2 + (nB + n^2C)t + \left(nA + \frac{n^2}{2}B + \frac{n^3}{3}C - l_{\kappa_n}\right) = 0.$$

Then

$$t_{min} = \frac{-(nB + n^2C) \pm \sqrt{(nB + n^2C)^2 - 4\left(nA + \frac{n^2}{2}B + \frac{n^3}{3}C - l_{K_n}\right)nC}}{2nC} - 1,$$

where $l_{K_n}$ is the total mileage of the overhauled truck n years after the overhaul; A, B, C are factors of the equations of the change in the annual mileage.

In order to determine the optimum service lives of overhauled trucks 743 trucks of sovkhozes were inspected and it was established that only 1.5 percent of the trucks were in operation at the farms after overhauling for more than four years and 15 percent for more than three years. Taking into account that the quality of repair at the plants will be improved, it is possible to take as the maximum service life of trucks after overhauling four years, then, by inserting the value $n = 4$ in the formula, we will obtain:

$$t_{min} = \frac{-(B + 4C) \pm \sqrt{(B + 4C)^2 - C\left(4A + 8B + \frac{64}{3}C - l_{K_4}\right)}}{2C} - 1.$$

With a three-year service life of trucks after overhauling the formula will assume the form

$$t_{min} = \frac{-(3B + 9C) \pm \sqrt{(3B + 9C)^2 - 12C\left(3A + \frac{9}{2}B + 9C - l_{K_3}\right)}}{6C} - 1.$$

By inserting in the equation the value of the factors A, B, and C and the value of the total mileage of the trucks after overhauling ($l_{K_4}$) we determine that the possible period until the performance of the first overhaul for GAZ-93 trucks is equal to 4.3 years, for ZIL-585 and ZIL-555 trucks--4.9 years and for GAZ-51A trucks--3.1 years.

Consequently, these periods differ from the standards which were determined according to the condition of the equality of the mileages of overhauled trucks during the first year of operation and the $t_K$-th year of operation of a truck without an overhaul. For GAZ-51A trucks they are 0.6 year shorter, while for GAZ-93 trucks they are 1.1 years longer, ZIL-585 and ZIL-555 trucks--0.9 year longer.

In order to determine the minimum periods for overhauling trucks it is possible to use the equation

$$t_{min} = \frac{-\frac{B}{2} \pm \sqrt{\left(-\frac{B}{2}\right)^2 - C(A - l_K)}}{C} - 1 + D,$$

where D is a factor which characterizes the regularity of the change in the mileage of trucks after overhauling, and for trucks, for which the nature of the changes in the annual mileage occurs according to the second and third types, it is equal to zero, for GAZ-93 trucks--1.1, ZIL-585 and ZIL-555 trucks--0.9. Thus, the minimum service life before overhauling is equal to: 2.7 years for GAZ-51A trucks, 3.3 years for GAZ-93 trucks and 3.9 years for ZIL-585 and ZIL-555 trucks.

The coefficient of the restoration of the working capacity of a truck after overhauling, which characterizes its minimum service life until overhauling, can be represented by the ratio

$$k_p = \frac{l_{K_1}}{l_1}.$$

In this case $k_p$ varies over the range $0 < k_p < 1$. This means that given $k_p = 1$ the working capacity of the overhauled truck is equal to the working capacity of a new truck. As is known, motor vehicle repair plants determine the guaranteed service life of a vehicle depending on the quality of repair. As the repair technology is improved, the guaranteed period of the repair is increased, and this means that $k_p \rightarrow 1$. Designating $l_{K1} = l_1 k_p$, let us substitute this value in the formula of the mileage of a truck

$$l_1 = A + Bt + Ct^2.$$

After the appropriate transforms the formula for determining the minimum service life of a truck before overhauling with allowance for the coefficient of the restoration of the working capacity will have the form

$$t_{min} = -\frac{B}{2C} + (D - 1) \pm \sqrt{\frac{l_1}{C} k_p - \frac{1}{C}\left(A - \frac{B^2}{4C}\right)},$$

where $k_p$ is the coefficient of the restoration of the working capacity of trucks by overhauling; $l_1$ is the mileage of the truck during the first year of operation, thousands of km.

By substituting the values of the known quantities we will obtain the functions:

for GAZ-51A trucks

$$t_{min} = 12{,}7 - \sqrt{276 k_p - 114};$$

for GAZ-93 trucks

$$t_{min} = 11{,}1 - \sqrt{234 k_p - 133};$$

for ZIL-585 and ZIL-555 trucks

$$t_{min} = 11{,}9 - \sqrt{218 k_p - 95}.$$

In general form for trucks which operate in agriculture the formula for determining the minimum service life of the trucks until overhauling depending on the coefficient of the restoration of the working capacity can be represented in the form

$$t_{min} = \alpha - \sqrt{\delta k_p - \omega},$$

where $\alpha$, $\delta$, $\omega$ are coefficients which depend on the make and conditions of operation of the truck. In this case $\alpha = 11.1$, $\delta = 218\text{-}276$, $\omega = 95\text{-}135$.

Depending on the coefficient of the restoration of the working capacity the service lives of an overhaul are cited in Table 46.

Table 46

Minimum Periods of the Performance of the First Overhaul of Trucks Depending on the Coefficient of Restoration of the Working Capacity

| (1) Коэффициент восстановления работоспособности | (2) Минимальный срок службы до капитального ремонта автомобиля, лет | | | (3) Минимальный пробег автомобиля до первого капитального ремонта, тыс. км | | |
|---|---|---|---|---|---|---|
| | (4) ГАЗ-51А | (5) ГАЗ-93 | ЗИЛ-585, ЗИЛ-555 (6) | (4) ГАЗ-51А | (5) ГАЗ-93 | ЗИЛ-585, ЗИЛ-555 (6) |
| 0,85 | 1,8 | 2,9 | 2,4 | 78 | 106 | 108 |
| 0,80 | 2,4 | 3,7 | 3,0 | 100 | 131 | 131 |
| 0,75 | 3,2 | 4,6 | 3,6 | 128 | 157 | 152 |
| 0,70 | 3,8 | 5,6 | 4,3 | 148 | 185 | 175 |
| 0,65 | 4,7 | 6,6 | 5,1 | 186 | 211 | 202 |

Key:
1. Coefficient of restoration of working capacity
2. Minimum service life before overhaul of truck, years
3. Minimum mileage of truck before first overhaul, thousands of km
4. GAZ-51A
5. GAZ-93
6. ZIL-585, ZIL-555

Consequently, from the economic point of view the motor vehicle repair enterprises should ensure a mileage of a truck during the first year after overhauling of not less than 38,000-40,000 km, that is, the coefficient of restoration of the working capacity should be not less than 0.75. With a low coefficient of restoration of the working capacity the annual mileage of a truck, which is operated until overhauling, will be higher than that of a truck which has been overhauled, which contradicts the task of performing the latter.

The quality of the repair of trucks at specialized repair enterprises plays a decisive role when determining the service lives of trucks. From the point of view of obtaining the maximum output during the entire service life of trucks at the farm it is expedient to perform one overhaul on the condition of ensuring a coefficient of the working capacity of not less than 0.75-0.85.

The economic feasibility of performing an overhaul cannot be examined without regard for the expenditures on performing current repairs and maintenance of trucks. The expenditures on maintaining trucks in working condition after overhauling are considerably higher than for new trucks, and they increase more rapidly.

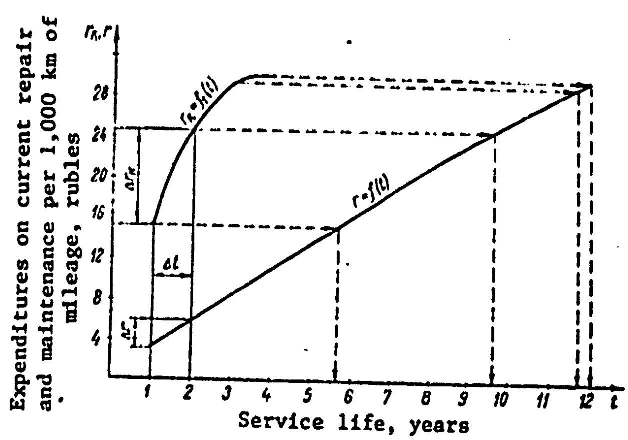


Figure 18. Change of Expenditures on Current Repair and Maintenance of Trucks Depending on the Service Lifes: $r_K$ is the specific expenditures after overhauling; r is the specific expenditures before overhauling.

The nature of the change of the specific expenditures on repair and maintenance after overhauling of ZIL-585 and ZIL-555 trucks (Figure 18) is governed by a law which, in much the same way as new trucks, has the form of a secondary parabola:

$$r_K = a + bt_K + ct_K^2,$$

where a, b, c are factors which depend on the make of truck and the conditions of their operation; $t_K$ is the service life of the truck after overhauling.

The values of the factors of the equations are cited in Table 47.

Table 47

Factors of the Change of the Specific Expenditures on the Current Repair and Maintenance of Trucks After Overhauling

| Make of Truck | a | b | c |
|---|---|---|---|
| GAZ-51A | 9.45 | 2.52 | -0.20 |
| GAZ-93 | 6.35 | 6.02 | -0.70 |
| ZIL-585, ZIL-555 | 1.55 | 1.60 | -2.21 |

The specific expenditures on current repair and maintenance during the first year after overhauling are considerably higher than for new trucks. Thus, for GAZ-51A trucks during the first year after overhauling they are 11 rubles 90 kopecks, while the expenditures during the first year of new trucks are equal to only 3 rubles 54 kopecks, correspondingly for GAZ-93 trucks--11 rubles 60 kopecks and 3 rubles 53 kopecks, ZIL-585 and ZIL-555 trucks--15 rubles 34 kopecks and 3 rubles 44 kopecks. The nature of the increase of these expenditures during the process of operation is different than for new trucks. Thus, during the fourth year of operation of overhauled trucks the expenditures increase for the GAZ-51A to 16 rubles 70 kopecks, or 1.4-fold as compared with the first year of operation after overhauling, for the GAZ-93--to 19 rubles 3 kopecks, or 1.65-fold, for the ZIL-585 and ZIL-555--to 30 rubles 19 kopecks, or 1.95 fold.

During the first year after overhauling the specific expenditures on current repair and maintenance for GAZ-51 and GAZ-93 trucks are approximately the same (11 rubles 90 kopecks and 11 rubles 60 kopecks) (Table 48), while subsequently the rate of their increase for GAZ-93 trucks is considerably higher than for GAZ-51A trucks. Thus, during the third year of operation for the GAZ-51A they are 15 rubles 50 kopecks, while for the GAZ-93 they are 18 rubles 10 kopecks, during the fourth year they are respectively 16 rubles 70 kopecks and 19 rubles 30 kopecks per 1,000 km of mileage.

The higher expenditures on current repair and maintenance of ZIL-585 and ZIL-555 dump trucks are explained by the low quality of repair at motor vehicle repair plants. As was already indicated, at present the coefficient of restoration of the working capacity for this make of truck is only 0.66. In connection with this the annual expenditures on current repair and maintenance are extremely high. Thus, for the ZIL-585 truck in three years of operation after overhauling the annual expenditures are 1,931 rubles with a price of a new truck, excluding the cost of tires, of 1,202 rubles, for the GAZ-51A--respectively 1,221 rubles and 785 rubles, for the GAZ-93--1,218 rubles and 916 rubles.

Table 48

Change of Expenditures on Current Repair and Maintenance of Trucks Depending on Their Service Life After Overhauling

| (1) Марка автомобиля | (2) Срок службы после кап. ремонта, лет | (3) Число автомобилей в группе, шт. | (4) Удельные затраты на 1000 км пробега, руб. | (5) Затраты нарастающим итогом, руб. | (6) Средние удельные затраты с начала эксплуатации на 1000 км пробега, руб. | (7) Коэффициент увеличения затрат |
|---|---|---|---|---|---|---|
| (8) ГАЗ-51А | 1 | 204 | 11,90 | 372 | 11,90 | 1,00 |
| | 2 | 128 | 13,90 | 784 | 12,85 | 1,17 |
| | 3 | 48 | 15,50 | 1221 | 13,70 | 1,30 |
| | 4 | 25 | 16,70 | 1673 | 14,40 | 1,40 |
| (9) ГАЗ-93 | 1 | 99 | 11,60 | 358 | 11,60 | 1,00 |
| | 2 | 61 | 15,60 | 783 | 13,50 | 1,34 |
| | 3 | 35 | 18,10 | 1218 | 14,92 | 1,56 |
| | 4 | 10 | 19,30 | 1633 | 15,80 | 1,66 |
| (10) ЗИЛ-585 | 1 | 64 | 15,34 | 487 | 15,34 | 1,00 |
| (11) ЗИЛ-555 | 2 | 25 | 24,71 | 1191 | 19,80 | 1,61 |
| | 3 | 20 | 29,66 | 1931 | 22,50 | 1,93 |
| | 4 | 8 | 30,19 | 2618 | 24,20 | 1,98 |

Key:
1. Make of truck
2. Service life after overhauling, years
3. Number of trucks in group
4. Specific expenditures per 1,000 km of mileage, rubles
5. Expenditures by cumulative total, rubles
6. Average specific expenditures since start of operation per 1,000 km of mileage, rubles
7. Coefficient of increase of expenditures
8. GAZ-51A
9. GAZ-93
10. ZIL-585
11. ZIL-555

Specific expenditures on current repair and maintenance during the first year of operation of trucks after overhauling with allowance for the increase of the quality of their repair can be recommended for the GAZ-51A--11 rubles, the GAZ-93--11 rubles 60 kopecks, the ZIL-585 and ZIL-555--14 rubles 10 kopecks. The standards of the specific expenditures on current repair and maintenance for trucks operated in subsequent years can be calculated by means of the correction factors which are cited in Table 49.

Table 49

Correction Factors Which Take Into Account the Influence of the Service Life of Trucks on the Change of the Specific Expenditures on Current Repair and Maintenance After Overhauling

| Service Life | Correction Factor for First Year of Overhauled Truck |
|---|---|
| Up to 1 year | 1.00 |
| Over 1 year to 2 years | 1.30 |
| Over 2 years | 1.50 |

The outlay of spare parts for the current repair and maintenance of trucks operated after overhauling is cited in Table 50.

Table 50

Change of the Outlay of Spare Parts for the Current Repair and Maintenance of Trucks Depending on Their Service Life After Overhauling

| (1) Марка автомобиля | (2) Срок службы после капремонта, лет | (3) Число автомобилей в группе, шт. | (4) Удельный расход запчастей на 1000 км пробега, руб. | (5) Расход запасных частей, руб. | | (8) Средний расход запчастей с начала эксплуатации на 1000 км пробега, руб. | (9) Коэффициент увеличения расхода запчастей |
|---|---|---|---|---|---|---|---|
| | | | | (6) годовой | (7) нарастающим итогом | | |
| (10) ГАЗ-51А | 1 | 209 | 5,05 | 157 | 157 | 5,05 | 1,0 |
| | 2 | 122 | 7,39 | 218 | 375 | 6,18 | 1,46 |
| | 3 | 50 | 9,02 | 254 | 629 | 7,09 | 1,78 |
| | 4 | 25 | 9,93 | 268 | 897 | 7,70 | 1,97 |
| (11) ГАЗ-93 | 1 | 104 | 5,04 | 155 | 155 | 5,04 | 1,0 |
| | 2 | 60 | 7,63 | 207 | 362 | 6,26 | 1,51 |
| | 3 | 31 | 9,38 | 225 | 587 | 7,19 | 1,86 |
| | 4 | 10 | 10,29 | 222 | 809 | 7,80 | 2,04 |
| (12) ЗИЛ-585, ЗИЛ-555 | 1 | 64 | 6,03 | 192 | 192 | 6,03 | 1,0 |
| | 2 | 25 | 10,64 | 304 | 496 | 8,21 | 1,76 |
| | 3 | 20 | 13,95 | 356 | 852 | 9,95 | 2,31 |
| | 4 | 8 | 15,96 | 364 | 1216 | 11,20 | 2,66 |

Key:
1. Make of truck
2. Service life after overhauling, years
3. Number of trucks in group
4. Specific outlay of spare parts per 1,000 km of mileage, rubles
5. Outlay of spare parts, rubles
6. Annual
7. Cumulative total
8. Average outlay of spare parts since start of operation per 1,000 km of mileage, rubles
9. Coefficient of increase of outlay of spare parts
10. GAZ-51A
11. GAZ-93
12. ZIL-585, ZIL-555

As is evident from the table, the specific outlay of spare parts per 1,000 km of mileage during the first year after overhauling for GAZ-51A and GAZ-93 trucks is 5 rubles 5 kopecks and 5 rubles 4 kopecks, for ZIL-585 and ZIL-555 trucks--6 rubles 3 kopecks, while during the fourth year of operation it increases respectively to 9 rubles 93 kopecks, 10 rubles 29 kopecks and 15 rubles 96 kopecks.

It should be noted that the specific outlay of spare parts for GAZ-93 trucks after overhauling is slightly higher than for GAZ-51A trucks (up to 4 percent). This, as was already stated earlier, is mainly explained by the presence of an additional unit--a hydraulic lift. The proportion of spare parts in the total specific expenditures on the current repair and maintenance of trucks after overhauling changes for GAZ-51A trucks from 43 percent during the first year of operation to 59 percent during the fourth year, for GAZ-93 trucks respectively from 43 to 54 percent, for ZIL-585 and ZIL-555 trucks from 39 to 54 percent.

For convenience of the planning of work of motor transport and the determination of the material expenditures, as well as their economy or overexpenditure by individual drivers and the farm as a whole it is possible to take during the first year of operation of a truck after overhauling the following standards of the outlays of spare parts: for the GAZ-51A--4 rubles 60 kopecks, for the GAZ-93--5 rubles, for the ZIL-585 and ZIL-555--6 rubles per 1,000 km of mileage.

The outlay of spare parts in subsequent years of operation of trucks is determined by using correction factors (Table 51).

Table 51

Correction Factors Which Take Into Account the Influence of the Service Life of Trucks on the Change of the Specific Outlay of Spare Parts for Current Repair and Maintenance After Overhauling

| Service Life | Correction Factor for First Year of Operation of Overhauled Truck |
|---|---|
| Up to 1 year | 1.00 |
| Over 1 year to 2 years | 1.50 |
| Over 2 years | 2.00 |

The high initial expenditures on maintaining trucks in working condition after overhauling can be explained by its low quality. As the quality of overhauling increases, the specific expenditures on current repair and maintenance and the nature of their changes might approach the specific expenditures for these purposes of a new truck. The nature and magnitude of these expenditures will be closer to the corresponding indicators for a new truck, the higher the quality of the repair is. Since overhauling makes it possible to decrease slightly the expenditures on current repair at the start of operation, it is necessary to examine the economic feasibility of performing it.

By examining the periods of performance of the overhaul of a truck from the point of view of the minimum expenditures on current repair and maintenance, it is possible to conclude that the minimum period for performing an overhaul corresponds to the condition

$$r_K \leq r.$$

However, as is known, the overhauling of trucks causes additional expenditures in the form of amortization, consequently its performance might be expedient economically from the point of view of the minimum adjusted expenditures after a certain mileage.

The overhauling of a truck should be considered economically efficient on the condition that the cost of a unit of mileage after overhauling is equal to or less than the cost of a unit of mileage of a new truck.

It is apparently necessary to take the depreciation life of a truck in this case to be equal to one period of operation, that is, in this instance four years after overhauling. The average cost of an overhaul according to the results of the inspection of 405 GAZ-51A trucks is 912 rubles, for 205 GAZ-93 trucks--1,008 rubles, for 117 ZIL-585 trucks--1,390 rubles. Taking into account that the cost of overhauling a truck includes their fitting with missing parts and the cost of new tires, which should not be taken into account when determining the efficiency of repair, the cost of an overhaul is taken according to price list No 26.02.03, which was approved by the Committee for Prices attached to the Belorussian SSR Gosplan and was put into effect on 1 January 1970. According to the price list, the cost of repairing truck tires is not included in the wholesale price of an overhaul.

A comparative analysis of the expenditures of overhauled and new trucks is cited in Table 52.

In order to determine the specific capital investments of new trucks the entire cost of the truck was conditionally attributed to its mileage before the first overhaul. It was assumed that the truck went completely through the depreciation period during the period of operation prior to the first overhaul. The specific investments of overhauled trucks were determined in much the same way. The depreciated cost of the truck was not taken into account, since in both instances the truck continued to be operated after the lapse of the periods between overhauls.

From the table it follows that the specific expenditures for overhauled GAZ-51A and GAZ-93 trucks are quite close to new trucks and are 84-87 percent and slightly less for ZIL-585 (75 percent), ZIL-555 and GAZ-53A trucks (67 percent).

Let us examine the total specific adjusted expenditures with allowance for the expenditures on current repair and maintenance and the specific one-time expenditures of new and overhauled trucks (Figure 19).

As was noted earlier, the economic feasibility of performing an overhaul should satisfy the condition

$$d_{\text{п.к}} \leq d_{\text{п}}.$$

Table 52

Comparative Analysis of Expenditures of New and Overhauled Trucks

| (1) Показатели | (2) Единица измерения | (3) Марки автомобилей (4) ГАЗ-51А | (5) ЗИЛ-555 | (6) ГАЗ-93 | (7) ГАЗ-53А | (8) ЗИЛ-585 |
|---|---|---|---|---|---|---|
| (9) Оптовая цена | (10) руб. | 1145 | 2900 | 1260 | 2200 | 2105 |
| (11) Торговая наценка 12,8% | » | 146 | 372 | 162 | 282 | 270 |
| Отпускная цена (12) | » | 1291 | 3272 | 1422 | 2482 | 2375 |
| (13) Единая оптовая цена за покрышку с камерой | » | 64 | 114 | 64 | 99 | 114 |
| (14) Стоимость комплекта шин (7 шт) | » | 448 | 798 | 448 | 693 | 798 |
| (15) Наценка на шины 12,8% | » | 58 | 105 | 58 | 86 | 105 |
| (16) Итого стоимость комплекта шин | » | 506 | 903 | 506 | 779 | 903 |
| (17) Отпускная цена автомобиля за минусом стоимости шин | » | 785 | 2368 | 916 | 1702 | 1472 |
| (18) Оптовая цена за капитальный ремонт | » | 585 | 1320 | 650 | 975 | 925 |
| (19) Отношение стоимости капитального ремонта к стоимости нового автомобиля | % | 75 | 50 | 71 | 57 | 63 |
| (20) Действующая норма пробега нового автомобиля при эксплуатации на дорогах II категории | (21) тыс. км | 105 | 95 | 95 | 105 | 95 |
| (22) Норма межремонтного пробега автомобиля, прошедшего капитальный ремонт | » | 90 | 80 | 80 | 90 | 80 |
| (23) Удельные капитальные вложения нового автомобиля на 1000 км пробега | (10) руб. | 7,47 | 24,60 | 9,65 | 16,20 | 15,50 |
| (24) Удельные капитальные вложения автомобиля, прошедшего капитальный ремонт | » | 6,50 | 16,50 | 8,10 | 10,80 | 11,55 |

Key:

1. Indicators
2. Unit of measurement
3. Makes of trucks
4. GAZ-51A
5. ZIL-555
6. GAZ-93
7. GAZ-53A
8. ZIL-585
9. Wholesale price
10. Rubles
11. 12.8-percent markup for trade organization
12. Wholesale factory price
13. Unified wholesale price for tire with inner tube
14. Cost of a set of tires (7)
15. 12.8-percent markup for tires
16. Total cost of a set of tires
17. Wholesale factory price of truck less the cost of tires
18. Wholesale price for overhaul
19. Ratio of cost of overhaul to cost of a new truck

/Key continued on following page/

Key:

20. Actual mileage standard of new truck when operated on roads of category II
21. Thousands of km
22. Standard of mileage between overhauls of a truck which has been overhauled
23. Specific capital investments of new truck per 1,000 km of mileage
24. Specific capital investments of a truck which has been overhauled

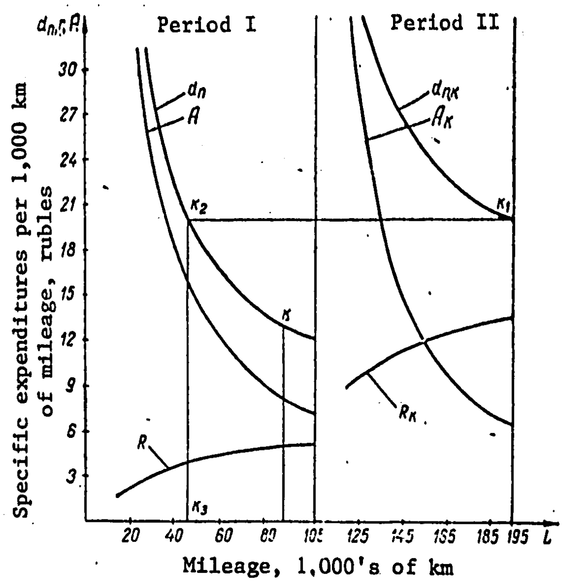


Figure 19. Graph of the Comparison of the Adjusted Total Expenditures of New ($d_П$) and Overhauled GAZ-51A Trucks ($d_{П.К}$): R, $R_К$ are the average specific adjusted expenditures on the current repair and maintenance of new and overhauled trucks; A is the specific adjusted cost of a truck; $A_К$ is the specific adjusted cost of an overhauled truck.

For GAZ-51A trucks during the second period (the mileage after overhauling) the minimum specific total expenditures after a mileage of 90,000 km are expressed by the ordinate $\kappa_1$ and are equal to 20 rubles 20 kopecks, while for a new truck with the same mileage the specific total expenditures are 13 rubles (the ordinate κ). Thus, even on the condition of the complete amortization of the cost of the new truck during the first period (before the first overhaul) it is economically inexpedient to overhaul GAZ-51A trucks, for which the ratio of the cost of an overhaul to the cost of a new truck (excluding the tires) is 75 percent. As the calculations show, similar conclusions can be drawn for the economic efficiency of overhauling the GAZ-93.

Given the established quality and cost of an overhaul of ZIL-555 trucks the adjusted specific expenditures at the end of the second period between overhauls (a mileage of 80,000 km) are 38 rubles, while the specific adjusted total expenditures of a new truck during the same period (point F) are 33 rubles 40 kopecks (Figure 20).

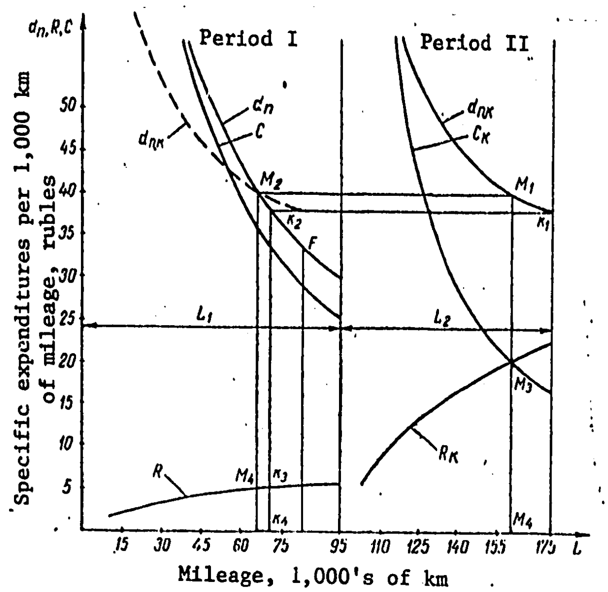


Figure 20. Graph of the Comparison of the Adjusted Total Expenditures of New ($d_{\Pi}$) and Overhauled ZIL-555 Trucks ($d_{\Pi.K}$): R, $R_K$ are the average specific adjusted expenditures on the current repair and maintenance of new and overhauled trucks; C is the specific adjusted cost of the truck; $C_K$ is the specific adjusted cost of the overhaul of a truck.

If it is presumed that during the first period between overhauls a new truck has completely recovered it cost, the adjusted total specific expenditures change according to the curve

$$d_{\Pi} = f(l_{\Pi}).$$

Moreover,

$$d_{\text{п}} = \frac{C}{l_{\text{п}}} + R_{\text{п}}.$$

Presuming that the balance sheet cost of an overhauled truck is equal to the wholesale price for an overhaul, which will also recover its cost during the second period between overhauls, the specific total adjusted expenditures during this period ($d_{\text{п.к}}$) will be equal to:

$$d_{\text{п.к}} = \frac{C_{\text{к}}}{l_{\text{к.п}}} + R_{\text{п.к}}.$$

The plotting of the curve of the adjusted specific total expenditures $d_{\text{п.к}}$ on the curve $d_{\text{п}}$ yields the point of intersection $M_2$, which determines the service life of a new and an overhauled truck, at which their specific adjusted total expenditures are equal, that is, $d_{M_2} = d_{M_1}$. If all the expenditures connected with capital investments are attributed to this period (the mileage equals 66,000 km), that is, if it is arbitrarily assumed that the capital investments have completely transferred their value to the product, the equation

$$d_{\text{п.к}} = d_{\text{п}}$$

will be observed. If these trucks are used subsequently, the expenditures on maintaining the new truck in running condition will change beginning at point $M_4$ on the curve of the specific adjusted expenditures for current repair and maintenance (R); for an overhauled truck, at the point $M_3$ on the curve $R_{\text{к}}$. Since $R_{\text{к}} > R$ within the period in question, on the basis of the condition of the equality of the specific expenditures it can be concluded that in this period between overhauls it is economically inexpedient to operate the overhauled truck.

In order to determine the optimum cost of the overhaul of trucks, for which during operation the adjusted total expenditures would approach or be equal to the minimum adjusted specific expenditures for trucks which have not been overhauled, let us examine the graph (Figure 20).

The nature of the change of the adjusted expenditures for the repair and maintenance of ZIL-585 trucks depending on the after-overhaul service life and the cost of the overhaul is represented in the graph.

When constructing the graph the condition was adopted that the depreciated cost of the truck (taken according to the price of metal scrap and the value of the parts suitable for rebuilding) at the beginning and end of the period between overhauls is equal and therefore is excluded from the calculation.

Thus, the change of the total adjusted expenditures during the period between overhauls follows a curve which is similar to the change of the expenditures of a new truck, and with an increase of the cost of overhauling the minimum value of the adjusted expenditures occurs at a later date of operation of the truck after overhauling. Thus, for example, with the cost of an overhaul of 600 rubles, even given an unsatisfactory quality of the overhaul, the overhauled truck has the lowest specific expenditures over the interval of 3-3.5 years, with a cost of 800 rubles--after 4 years and so on.

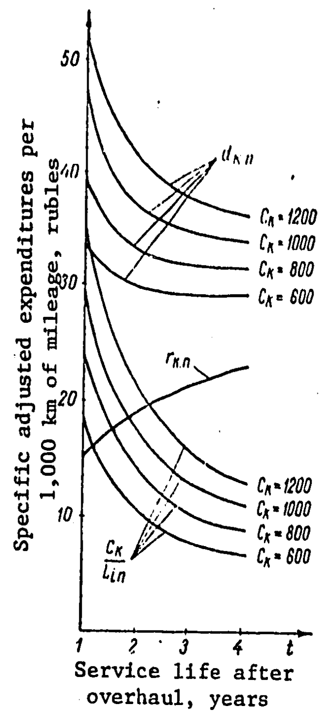


Figure 21. Change of the Adjusted Expenditures for Repair and Maintenance After the Overhaul of ZIL-585 Trucks

Typical of each period of operation of a truck after overhauling is its own minimum specific adjusted expenditures, which can be regarded as the economic substantiation of the mileage of a truck after overhauling.

Let us examine, at what prices for an overhaul it is possible to have the condition

$$d_{п_К \min} = d_{п\min}.$$

For this purpose let us analyze the change in the specific adjusted total expenditures of trucks of various makes after overhauling in comparison with the minimum expenditures of new trucks, which are operated without overhauling to the economically expedient dates (Table 53).

Table 53

Determination of the Economic Expedience of Overhauling Trucks According to the Specific Adjusted Expenditures Depending of the Cost of an Overhaul

| (1) Марка автомобиля | (2) Минимальные удельные приведенные затраты на 1000 км пробега, руб. | (3) Стоимость капитального ремонта, руб. | (4) Удельные приведенные затраты капитально отремонтированных автомобилей на 1000 км пробега, руб. |
|---|---|---|---|
| ЗИЛ-585 (5) | 16,95 | 925 | 33,40 |
| | | 800 | 32,10 |
| | | 600 | 29,90 |
| ЗИЛ-555 (6) | 22,0 | 1320 | 38,30 |
| | | 800 | 32,10 |
| | | 600 | 29,90 |
| ГАЗ-51А (7) | 12,66 | 585 | 19,70 |
| | | 450 | 18,50 |
| | | 350 | 17,70 |
| ГАЗ-93 (8) | 15,07 | 650 | 22,15 |
| | | 550 | 21,30 |
| | | 450 | 20,40 |
| | | 350 | 19,40 |

Key:
1. Make of truck
2. Minimum specific adjusted expenditures per 1,000 km of mileage, rubles
3. Cost of overhaul, rubles
4. Specific adjusted expenditures of overhauled trucks per 1,000 km of mileage, rubles
5. ZIL-585
6. ZIL-555
7. GAZ-51A
8. GAZ-93

As is evident from the table, given the current wholesale prices for an overhaul and the existing quality of the overhaul, the minimum specific adjusted total expenditures for the ZIL-555 are equal to 38 rubles 30 kopecks, which is 1.75 times greater than the minimum specific adjusted total expenditures of trucks which are being operated without overhauling, correspondingly for the ZIL-585--33 rubles 40 kopecks, or 1.9 times greater, for the GAZ-51A--19 rubles 70 kopecks, or 1.65 times greater, for the GAZ-93--22 rubles 15 kopecks, or 1.65 times greater. Even the considerable reduction of the wholesale price of an overhaul, given its existing quality, does not ensure the condition of the equation cited above. This is explained primarily by the low quality of overhauling of trucks. Indeed, since

$$\frac{C_к}{l_к} + r_к = \frac{C_к}{k_p l} + r_к,$$

the improvement of the quality of the overhauling of trucks is a decisive condition for decreasing the expenditures per unit of mileage, in this case both terms decrease (in the former due to an increase of the coefficient of restoration of the working capacity $k_p$).

Thus, given the quality of repair work, which has formed at this time, and the wholesale factory prices, the use of complete-assembly overhauling cannot be considered economically justified. The introduction of the unit method of repair with the replacement of the assemblies and units, which have operated for the established service life, at service stations is more expedient.

The objective need to replace the latter is determined by means of technical diagnostic equipment.



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CSO: 8144/1207

AGRICULTURAL MACHINERY

DESIGN, MAINTENANCE OF AIR CLEANER D-160

Moscow SEL'SKIY MEKHANIZATOR in Russian No 3, Mar 79 pp 22

[Article by A. Lazarev, candidate of technical sciences; V. Lukin, G. Klebanov, S. Puzhevskiy, engineers, Chelyabinsk Tractor Plant imeni V. I. Lenin: "Design and Maintenance of the Air Cleaner D-160"]

[Text] The tractor motor operates in conditions that produce a great deal of dust. Suffice it to say that if the motor of the Chelyabinsk Tractor Plant D-160 was not equipped with an air cleaner, in 1,000 hours of work with 0.1 $g/m^3$ of dust in the air, about 50 kilograms of dust would enter the motor.

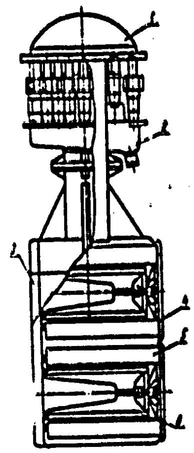
The amount of dust in the air in the region of the air cleaner resulting from various types of operations, the type of ground and atmospheric conditions (strength and direction of winds, humidity, temperature) are presented in the table.

The dust that enters the motor results in the abrasive wear of parts that come into contact with the air (barrel sleeve of cylinder, piston, piston rings, intake valves) as well as of other parts which it reaches together with the oil (crankshaft, bushing, parts of gas-distribution mechanism and others).

The D-160 motor air cleaner consists of two stages--the multicyclone and the paper filter (see drawing).

The multicyclone contains 30 plastic double (screw thread) cyclones distributed in two rows.

There are two main filter-cartridges and 2 safety filters in the filter of the second stage. The same filter cartridges are used here and for motors of the SMD family in order to standardize and to make it easier to obtain spare parts. The basic and safety filter-cases compose a unit in which the elements work in succession. In this way a sufficient dust capacity is achieved for the air cleaner and also a high dependability factor for protecting the motor from dust.



Air Cleaner
1--Multicyclone
2--Dust collector with nozzle for blowing dust
3--Body of paper filter
4--Cover
5--Main filter-cartridge
6--Safety filter-cartridge

Plant bench tests showed that the multicyclone lets only 4 percent of the dusty air pass through. After the filter with the paper cartridge the air is practically clean. The coefficient of non-filtration is 0.1 percent for the air cleaner as a whole.

Since dust is removed from the first stage of the air cleaner automatically using negative pressure created by an ejector, care for the multicyclone involves examinations and (if necessary) washing at a rate of 960 motor-hours (during the third technical service).

With a moderate degree of dust, the basic (external) filter-cartridges should be blown out for 240 hours of work: the safety (internal)--for 480 hours using compressed air at a pressure of 15-20 kH (1.5-2.0 atm.). The stream of air is directed from within. In order to avoid a tear in the paper blind the nozzle should be placed no closer than 30 mm from the paper at a 30-45° angle to the vertical axis of the filter-cartridge. The filter-cartridge should not be cleaned by means of shaking or tapping. This can result in damage to the edges of the paper and a dislodging of the covers. It is categorically prohibited to blow through the filter-cartridges using the exhaust gases of the motor because this will result in the paper becoming greasy.

After 720 hours of work (after the filter-cartridges are blown through 2-3 times) or for lubrication the basic filter-cartridges are washed in a 2-percent water solution of OP-7 or OP-10 GOST 8433-57 paste (20 grams of paste per 1 liter of water). The temperature of the solution is 50°C. The safety

| | (1) Вид работы и условия | Запыленность (г/м³) (2) |
|---|---|---|
| (3) | Работа трактора с бульдозером на планировке поля. Температура воздуха 45°. Ветер встречный | 1,7 |
| (4) | Работа трактора с бульдозером на планировке поля. Температура воздуха 42°. Ветер боковой | 0.88 |
| (5) | Пахота. Почва сухая. Температура 22°. Ветер умеренный по ходу трактора | 0.043 |
| (6) | Пахота после небольшого дождя | 0.031 |
| (7) | Пахота. Почва сухая. Температура воздуха 25°. Ветер умеренный боковой | 0.005 |
| (8) | Боронование. Почва сухая. Температура воздуха 25°. Ветер слабый по ходу трактора | 0.005 |
| (9) | Боронование. Почва сухая. Температура воздуха 30°. Ветер умеренный по ходу трактора | 0.033 |
| (10) | Движение трактора по проселочной дороге с толстым слоем пыли или по сухой песчаной почве в зависимости от климатических условий | 0.3–1.0 |

Key to Table:

1. Type of operation and conditions
2. Degree of dustiness (grams per $m^3$)
3. Tractor and bulldozer operations to plan field. Atmospheric temperature 45°. Headwind.
4. Tractor and bulldozer operations to plan field. Atmospheric temperature 42°. Side wind.
5. Plowing. Dry soil. Temperature 22°. Moderate wind in direction of tractor's movement.
6. Plowing after short rain.
7. Plowing. Dry soil. Atmospheric temperature 25°. Moderate side wind.
8. Harrowing. Dry soil. Atmospheric temperature 25°. Slight wind in direction of tractor's movement.
9. Harrowing. Dry soil. Atmospheric temperature 30°. Moderate wind in direction of tractor's movement.
10. Tractor movement along a dirt road with a heavy dust cover or along dry sandy soil depending upon climactic conditions.

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filter-cartridge is washed with the same solution for 1,440 hours. This is how it is done. The filter-cartridge is immersed in a prepared solution for 2 hours and swilled for 10-20 minutes. Then the filter-cartridge is washed in clean water and carefully dried in a warm facility at room temperature for 24 hours. If the paste is unavailable the filter-cartridge can be washed in a solution of laundry detergent or in warm clean water if blown through first. However, it should be kept in mind that clean water will not remove grease. If there is no compressed air available, a washing in clean water can be employed instead of the blowing through, but it should be remembered that washing wears filter paper away more quickly than blowing through does.

The intervals at which the filter-cartridges are blown through or washed can be increased or decreased as recommended according to the degree of dust in the air, the type of operation being performed, the atmospheric humidity, the moisture content of the soil, and other factors. With the transition to different operations it is recommended to examine the filter-cartridges monthly in order to establish the best interval for servicing the filter-cartridges for the specific conditions involved.

The life of the main filter-cartridges is 1,500 motor-hours if they are washed and blowed through on schedule and if the degree of dustiness is moderate; of the safety filter-cartridges--3,000 motor-hours.

Before they are installed in the body, the filter-cartridges must be carefully examined. Filter-cartridges should not be installed if the paper is torn, if the edging is not correct or if the seals on the rubber rings are damaged. The filter-cartridges are examined in the light by putting an electric lamp inside. Levers should not be used to remove the filter-cartridges in order not to damage the paper blinds or to loosen the covers. Before securing the filter-cartridges in the body of the air cleaner one should make sure that they have been placed properly and that there are no foreign bodies or loose dirt between the shared surfaces. The couplings of the filter-cartridge supports should be secured well. It is mandatory to have washers with liners underneath them. Special angle bars are welded to the tops of the air filter to avoid the unscrewing of the wing nuts securing the main filter-cartridges. If the angle bar juts into the wing nut it should be turned one-fourth of a turn.

If the tractor is operating on sandy soil during dry weather, in a quarry or in desert conditions the amount of dust in the air can be very great, over 1 $g/m^3$ or in some cases 5 $g/m^3$ and higher. Under such conditions the air cleaner gets dirty rapidly. Consequently, the interval for servicing it must be shortened to a significant degree. Every 500 hours of work the air cleaner should be examined and if necessary the bottom plate of the multicyclone and the ejection pipes for dust removal must be cleaned. Every 10-60 hours (depending on the amount of dust in the air) the filter-cartridges must be blown through. They are restored by means of blowing through or washing (washing after 2-3 blow-throughs), as under normal dust conditions.

If the degree of dust is particularly great, the life of the filter-cartridges is 80-480 hours.

It should be remembered that if the filter-cartridges, the covers of the air cleaner and all joints of the intake system are sealed well there will be less chance that unpurified air will enter the cylinders and the life of the air cleaner will be longer. The dirty filter-cartridges should be blown through and washed at the recommended intervals because dirty filtration paper raises the resistance of the air cleaner and can be the reason for smoking, seaming of piston rings and decrease in capacity.

The air cleaner dependably protects the D-160 motor from dust and in order that its operations be effective it must be serviced on schedule and carefully.



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CSO: 1821

CONSTRUCTION, CONSTRUCTION MACHINERY AND BUILDING MATERIALS

## STROYBANK OFFICIAL DISCUSSES REDUCTIONS IN CONSTRUCTION SCHEDULES

Moscow VOPROSY EKONOMIKI in Russian No 3, Mar 79 pp 3-12

[Article by P.D. Podshivalenko, professor and Deputy Chairman of USSR Stroybank: "Task of Reducing Construction Schedules"]

[Text] During the November (1978) Plenum of the CC CPSU, L.I. Brezhnev commented upon the tremendous contribution made by the builders in strengthening the country's economic might. More than 700 large industrial enterprises and facilities were built. During the Ninth Five-Year Plan and compared to the Eighth Five-Year Plan, the increase in placing fixed capital in operation (in terms of production projects) was somewhat greater (44 percent) than the increase in the volume of capital investments (42 percent) and unfinished construction (40 percent).

However, the achievements in capital construction could have been considerably greater if greater use had been made of the advantages offered by the planned economy and intraenterprise reserves and if the shortcomings had been corrected in a timely manner. During the November (1978) Plenum of the CC CPSU, it was emphasized that the situation in capital construction is slowly improving. Up until now, no success has been achieved in halting the process of dispersion of capital investments among numerous construction projects. The amount of unfinished construction work is increasing.

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Among the components for highly effective capital investments, first place is occupied by reductions in the construction schedules. In this regard, certain approaches employed in determining the economic results of such reductions are deserving of special attention.

The belief is rather widespread that an acceleration in construction work leads to an increase in production capital in the construction organizations per million rubles of construction-installation work and thereafter to an increase in the production cost of the construction work owing to raised amortization and increased expenditures for the operation of machines and equipment and it also raises the payments into the production funds. The need has clearly been singled out for making more extensive use of additional resources -- manpower, increased number of temporary buildings and installations, use of a greater quantity of equipment and so forth. In this regard, the proposal has been made to introduce special appropriations for compensating the construction organizations for the mentioned additional expenses caused by reduced construction schedules and even to allocate additional funds for the awarding of bonuses. This position merits a critical evaluation.

Despite the fact that construction delays occurred in past years, compared to the norms and plans, R. Merkin believes that this lag will be overcome more rapidly to the extent that greater compensation is made available for doing so. He even forecasts that in 20 years a requirement will exist for increasing the fund for the degree of equipping of construction organizations (by 23-25 percent), raising profitability (by 50 percent) and reducing the average duration of construction (by 30-40 percent). As a result, it turns out that even over the course of such an extended period of time the duration of construction work will still be greater than the norm by 10-15 percent. According to his computations and assuming an increase in the fund for degree of equipping of 80 percent, the construction schedule will barely reach the proposed optimum average construction schedule*. In other words, a reduction in the existing construction schedules appears to be a prolonged and expensive measure.

Meanwhile it is impossible to increase the fund for degree of equipping over such an extended period of time without taking into account the growth, development and improvements in the technical-economic characteristics of the equipment, machines and other equipment, structures, materials, technologies, production organization, the level of skills possessed by the personnel and economic management. The time factor, as pointed out during the 25th CPSU Congress, must be fully taken into account in all of the work concerned with improving economic management. Labor productivity will subsequently increase as improvements are realized in the fund for the degree of equipping during the scientific-technical revolution. As pointed out by Karl Marx: "Improved labor productivity derives from the fact that the proportion of live labor decreases while the proportion of past labor increases; however, it increases in a manner such that the overall amount of labor embodied in the goods decreases and thus it follows that the amount of live labor decreases to a greater extent than the amount of past labor increases"**. As a result, a greater amount of products may be

* See R.M. Merkin. "Ekonomicheskiye problemy sokrashcheniya prodolzhitel'nosti stroitel'stva" [Economic Problems Associated With Reducing the Duration of Construction]. Izd. "Ekonomika," 1978.

** K. Marx and F. Engel's, Works, Vol. 25, Part I, p 286.

produced at the same time and a greater amount of construction work carried out in the case cited. This is an example of the action of the overall law concerned with realizing a savings in time.

According to the forecasts of R. Merkin, it would appear that even with a twofold reduction in the construction cycle the production cost for construction-installation work will still be 3 percent higher than that for today's construction schedules. Then by what means can it become higher? If it takes place as a result of an increase in amortization and in expenditures for the use of equipment, then this would signify the introduction of uneconomical and costly machines and equipment, the current expenses for which increase to a greater degree than the wage expenses for workers decrease. It is noted that quite often such incorrect ratios are accepted as being inevitable. Thus the conclusion is drawn that scientific-technical progress at the present time is leading simultaneously towards a reduction in the duration and an increase in the cost of construction-installation work, since the cost of materials clearly increase to a considerably greater degree than the expenses for basic wages decrease*.

It is interesting to note that in the proposal mentioned above the question concerning sources of compensation is for all practical purposes ignored. A completely incomprehensible situation develops. The estimated cost increases as an increase takes place in the construction schedules. National income is a source for covering an increase in the cost of construction. But its use for this purpose decreases socialist savings. All of this takes place with complete impunity, since those guilty of having caused the losses bear no responsibility from an economic accountability standpoint. It is obvious that compensation must also be furnished for increased costs caused by a reduction in the construction schedules**. Such proposals are considered to be extremely questionable.

By way of confirming the feasibility of issuing compensation for alleged additional expenditures, when reducing the construction schedules, references are made in many instances to the practice of capitalist firms. Actually, the firms increase the cost of the work associated with a contract depending upon how soon the customer requires the projects to be completed and delivered. Hence the conclusion is drawn that the cost of a construction

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* For example, see V.A. Zakharov. "Improving Evaluations of Final Results in Construction" PROMYSHLENNOYE STROITEL'STVO [Industrial Construction], No. 7, 1978. It is possible that the authors of this point of view are not taking into account the changes in prices for individual means of production.

** A proposal has been made calling for the introduction of a system of fines for violations of the planned schedules for placing projects in operation. These fines must be greater than the actual amount of additional expense caused by a violation. The question concerning the sources for covering these expenses remains unanswered. The essence of the system of fines also has not been clarified.

project is dependent upon a reduction in the time required to erect it. But the situation is quite different at times: the employer-builder, in raising the price, expects to obtain a portion of the same profit to be realized by his customer -- the industrial enterprise -- in view of accelerating the schedules for expanding the volume of goods produced.

The authors of the concept of "high prices" for accelerating construction work maintain that excessive strain and rush work by no means represent a typical phenomenon with regard to plans for reducing the schedules for capital construction. Hence we have the concept of "prices" for such haste, that is, additional expenses associated with accelerated construction work. Actually, when the question is raised concerning measures for accelerating construction, then a prime requirement is that of introducing scientific-technical achievements in all branches associated with construction. Here we have in mind not only the construction industry but also industrial enterprises engaged in the production of equipment, construction structures and other commodity-material values, organizations which prepare production technologies and so forth. Improvements in the efficiency of their operations serve as the foundation for reducing the construction schedules and lowering the cost of construction. If this is not done, a truly absurd situation is created -- both the reduction in construction schedules and an increase in such schedules result in an increase in the estimated cost.

It appears that a system is required wherein the guilty party, owing to above-normal duration of construction work, must make reimbursement for the additional expenses incurred at his own expense, with no change in the budget and, understandably, with no increase in the estimated cost. This will ensure a strengthening of economic accountability, a correct evaluation of the fixed production capital and improvements in price formation in all branches of the economy and in industry. In the event of a reduction in the construction schedules, the additional profit realized should be directed towards stimulating the planners, builders, equipment suppliers and customers, proportional to the contribution they made to the results achieved. Certainly, a portion of the profit must be retained and employed in the operation of the enterprise.

It may develop that the guilty party lacks the resources required for covering the increased cost of construction. In such a situation it is legal to employ bank credit so as to obtain profit equal to the total amount of compensation, throughout the planned periods for making reimbursement for capital investments. In the case on non-fulfillment of obligations, the loan percentages should ideally be increased depending upon the specific reasons for non-fulfillment.

A search is being carried out in the USSR and in other socialist countries for a rational method for distributing the total amount of savings realized from the ahead-of-schedule placement of capabilities in operation. For example, USSR Stroybank [All-Union Bank for the Financing of Capital

Investments] is conducting an experiment on the basis of which the contractual organizations are receiving reimbursement for their expenses from the customers after the latter have accepted their enterprises and installations that are prepared for producing output. The total amount of savings realized, compared to the estimate, remains at the disposal of the contractual organization. A portion of the profits (up to 50 percent) obtained by an enterprise as a result of ahead-of-schedule placement in operation of that enterprise is placed at the disposal of the contractor.

In 1971 a system was established in the GDR for developing price lists for capital work, with the construction schedules and the distribution of profits obtained from such construction being taken into account. This system is rather complicated and thus is not always used.

An experiment carried out in the Belorussian SSR represents a considerable forward step in the search for methods for reducing the construction schedules. Minpromstroy and Minmontazhspetsstroy for the Belorussian SSR turn over to the customers fully completed marketable construction products representing the cost of the construction-installation work for enterprises and installations prepared for operations. Up until completion of the installations, the unfinished production is credited by Stroybank. The experiment reveals that the contractual organizations are interested in concentrating their efforts on a limited number of projects under construction, in reducing the duration of construction operations and in raising labor productivity. The number of projects under construction simultaneously by contractual organizations of Minpromstroy for the Belorussian SSR decreased by almost 25 percent in 1976, reductions took place in the relative volume of work and in the amount of unfinished production and the number of production capabilities and installations placed in operation annually increased by 20 percent. Compared to the previous year, the duration of construction operations decreased by 6 percent.

During the 1976-1978 period, the experiment carried out in the Belorussian SSR reached construction organizations in the Ukrainian SSR, the Uzbek SSR, the Lithuanian SSR and also Moscow, Leningrad and a number of other economic regions of the RSFSR. The results achieved from the introduction of this experience will obviously serve as an important starting point for carrying out measures aimed at further improving construction work throughout our country.

* * *

A sharp reduction in the construction schedules requires solutions for problems concerned with radically improving the planning of capital construction, reorganizing design work for such construction and introducing an appropriate and modern level of development for the socialist economy in the organization of construction work.

It is our opinion that the tasks for placing production capabilities, installations and fixed capital in operation should ideally be established by the contractual organizations at all levels (from the ministry to the primary echelon), from the standpoint of the branches and for each individual construction project; no change should take place in the volumes of capital investments and construction-installation work to be placed in operation, as called for in the five-year plans and the title lists by construction years; the annual plans for capital construction and contractual work must include measures for carrying out the tasks of the five-year plan for a given year and for making compensation for underfulfillment during the previous year (if such took place) and also for employing reserves uncovered during the course of plan fulfillment.

The present system which holds that the ministries and departments of the USSR and the councils of ministers of the union republics are authorized, up until 15 February of each year, to carry out so-called "refinements" in the approved plans for capital construction should obviously be abolished. Experience has shown that such refinements amount to a repeated working over of plans, title lists and other documentation, since they touch upon 75-90 percent or more of the construction projects included in the plan. However, a reduction in the number of projects under construction still does not fully solve the problem of reducing the construction schedules, since extended schedules for erecting facilities and shortcomings in planning lead to increased costs for the facilities being built.

According to analytic data supplied by the USSR Stroybank on approximately 50 percent (according to the annual volume of capital investments) of the construction projects of a production nature begun prior to 1966, an interrelationship can be traced during the Eighth and Ninth Five-Year Plans in the delays in construction schedules and the increases in construction costs (not taking into account the investments which earlier were classified as non-centralized). During the period studied, the estimated cost of construction increased by more than 20 percent. Moreover, of the overall amount of increase in the estimated cost, 77 percent concerned projects the construction of which commenced prior to 1966, 21 percent -- for projects included in the plans for 1966-1970 and approximately 2 percent -- for projects called for during the Ninth Five-Year Plan. The extending of construction schedules is associated with an insufficient concentration of resources at the carry-over construction projects. As a result, the annual increase in capital investments is employed to a considerable degree for compensating to a considerable degree for the difference in the estimated cost, in connection with the increase in costs, and this results in nonfulfillment of the pilot program and in an increase in unfinished construction.

In the plans for the contractual organizations, construction projects and ministries -- customers and contractors -- an index should be introduced for the "readiness of the construction stockpile." In addition to controlling the amount of unfinished production, it will also prevent a dispersion of capital investments and increases in the estimated cost of construction projects and facilities included in the plan. The fact of the matter is that, in changing the volumes of capital investments or increasing the estimated cost of construction, the ministries, departments and USSR Gosplan will have to take into account the need for maintaining the prescribed level of readiness for the construction stockpile.

Interest is being displayed in a proposal to include in the state plan for capital construction, in the form of an approved index, the estimated cost of work required for completing projects called for in the plan. This implies that it will be difficult to commence the construction of new projects before carry-over ones are completed; an increase in the estimated cost will occur depending upon the reduction in the number of projects under construction.

Another variant is also deserving of attention; it calls for the establishment of a capital investment volume for the five-year plan and for each year of the five-year plan in the form of a maximum amount (limit). All changes in the five-year and annual limits, including an increase in the estimated cost, can be carried out only within the limit ranges. In the final analysis, such a system also leads to a reduction in the volume of unfinished construction.

Much of the information found in the plans and estimates for construction projects should be re-examined. For example, the trend towards creating production installations in the form of large monumental buildings requiring expensive architectural designs has still not been overcome. It is believed that such buildings should have large areas protected against atmospheric effects and such that it will be possible to reorganize a technological system. However, modernization in this instance requires not just the supplying of an enterprise with new equipment and technology, but also alterations and the adaptation of production areas to new programs. As a result, the technological structure of capital investments for modernized enterprises actually does not differ from the structure for new construction projects. Very little production of light structures, prefabricated-sectional production buildings and cheap local materials is being carried out.

Importance is also attached to regulating price formation for machines and equipment. The capabilities of the new machines are constantly increasing and this is in keeping with the requirements for a developing socialist economy. Meanwhile, there are individual cases of the prices for new equipment, per unit of capability or other useful effect, turning out to be higher than those for obsolete machines. Similar facts can be cited for construction structures and new materials.

The changes taking place in the national economy of the USSR are raising the need for thoroughly re-examining the practice of price formation in construction. The scales and schedules (over a period of 2-3 years) for converting over to the erection of modern types of industrial buildings should be defined, the norms for planning, the estimate norms and the fund for standard planning solutions should be re-examined and the estimated cost of construction should be lowered on this basis.

Practical work, experiments carried out by construction organizations, scientific institutes and bank and also foreign experience have outlined the paths to be followed for introducing progressive forms of construction. The fact of the matter is that the organizational forms of construction which prevailed during the 1930's and 1940's no longer fully conform to the modern tasks of the construction industry. The functioning of contractual organizations during these years as enterprises which carried out construction and installation work was to a certain degree sound, since machine-building was still in a stage of formation and could not undertake other functions with the exception of equipment production. The contractual organizations did not concern themselves with the technologies for the enterprises erected by them. The situation has changed in recent decades. But the repeated attempts to convert the index for the placing of capabilities and fixed capital into operation into the principal operational index of the contractual organizations remained unrealized. The lack of coordination between the construction organizations and also enterprises engaged in equipment production and supply serves as the principal reason for the unpreparedness of the contractors to adopt the new index.

The existing norms call for completed enterprises and installations to be turned over to the customers and state committees, for adjustments to be carried out in the technological processes, for preparations to be made for the production of goods and so forth. The contractors, planning organizations and equipment suppliers, on the basis of joint participation, bear moral responsibility only for the placing in operation of capabilities and projects. In the majority of cases, they ensure only the intermediate results: construction enterprises -- production and other buildings, planning enterprises -- plans and estimates and machine-building enterprises -- equipment. Experience has shown that in roughly 60 percent of the cases delays in the placing of installations in operation are caused by the contractors and mainly owing to equipment installation delays caused chiefly by specialized enterprises which are not dependent upon the general contractors and which are not associated with the planning organizations and suppliers. In 20 percent of the cases the placing of installations in operation is delayed through fault on the part of the customers (equipment deliveries and other factors) -- as is known, the economic effect of the contractors on them is not very great. The planners are responsible for approximately 10 percent of the capabilities not being placed in operation in a timely manner. But the contractors do not generally have economic accountability relationships with the planners. It bears emphasizing that the opportunities of the general contractors for organizing the timely placing in operation of installations are at times extremely limited.

The results of the Ninth Five-Year Plan are typical in this regard. Some of the production areas created stood empty for an extended period of time. At the end of each year of the five-year plan, the contractors had large above-normal supplies of materials at their disposal. The customers had accumulated uninstalled equipment at their warehouses valued at several billions of rubles, including above-normal equipment. The planning organizations expanded their preparation of technical documentation and yet a portion of it (for hundreds of millions of rubles) was not used. This underscores the great lack of coordination in the plans for and work by those participating in the investment process. Meanwhile, as revealed in the data cited, the overall bulk of resources, all other conditions being equal, was adequate for the carrying out of the pilot program.

A need exists for bringing about radical changes in this situation. In developed capitalist countries, the work of erecting installations is being carried out by planning-construction, engineering-consultative, engineering-estimates and other firms. Large firms conclude contracts for the complete carrying out of industrial construction, including planning, construction work, the installation of technological equipment and so forth. Many industrial firms are creating production areas and installing equipment which they have produced themselves in these areas.

Such experience is available in our socialist countries. In the GDR, a number of customer functions have been transferred over to the general contractor. He is responsible for planning, for ensuring the delivery and installation of equipment, the timely carrying out of the construction work and the turning over of a tested installation to the customer. The general contractor relies upon the principal contractors for the carrying out of definite functions: equipment deliveries, types of work, services and so forth. In industrial construction the construction organizations or machine-building enterprises -- suppliers of technological equipment -- perform in the role of the general contractor. The Soviet Union employs roughly the same system for carrying out construction work as is used abroad. Many features of this method of production work, in one way or another, were embodied in the organization of construction for VAZ [Volzhskiy Avtomobil'niy Zavod; Volga Automobile Plant].

At the present time, we have adopted a system which calls for enterprises of the machine-building branches to be responsible mainly for the timely shipping of equipment. They do not participate in subsequent work concerned with the completion, installation or placing in operation of the equipment (excluding work associated with installation assistance for certain types of equipment). In essence, they are not associated with the carrying out of these operations, despite the fact that the equipment will not operate until they are in fact carried out.

In order to raise interest and intensify the responsibility of the plant-suppliers for timely and complete deliveries of equipment to the construction projects, USSR Stroybank, jointly with a number of ministries and departments, will conduct an accounting experiment concerned with the complete staffing and installation of equipment by the plant-suppliers. This experiment will bring about substantial changes in the interrelationships between the customers and the equipment suppliers. Based upon the title list, developed for the entire period of construction in conformity with the technical plan and estimate, the customer concludes a general agreement with the construction organization for the entire volume of construction work, for the delivery of the technological lines and units and for their installation -- a direct contract with the leading plant -- the supplier of the principal technological equipment.

Other plants -- equipment sub-suppliers and completion and installation organizations -- can be employed on a contractual basis for equipment completion work and for the carrying out of installation work by the leading plant-supplier. The savings realized compared to the contractual cost of the equipment and the completion and installation expenses, following completion of the work and acceptance by the customer, remain with the leading plant.

The conditions of the experiment call for interest to be maintained among the leading plant-suppliers and other participating organizations in accelerating the placing in operation of the enterprises (pilot complexes, production eforst and installations), since they are entitled to receive bonuses from the customers for having placed such facilities in operation either on schedule or ahead-of-schedule.

At the same time, those participating in the experiment are materially responsible for observance of the contractual conditions. When these conditions are violated, reimbursement for losses sustained is required in addition to forfeits, fines and penalties being imposed. Hence the matter of obtaining profits and the formation of the economic incentive funds of plants -- the equipment suppliers in this instance -- are dependent not only upon the equipment shipments, but also upon the complete nature of the equipment and the carrying out of work concerned with installation and turning over to the customer.

The cost of the manufactured technological lines, units and assemblies located in a warehouse and also installed, but not turned over to the customer, is accounted for on the balance of the leading plant-supplier and not the construction project customer. The accounts between a customer and the leading plant-supplier are carried out for fully completed and installed equipment for an installation, individual production efforts, pilot complexes, phases or an enterprise on the whole. A study of the experiment testifies to the effectiveness of this new organizational form for construction.

The decisions handed down during the 25th CPSU Congress emphasize the need for "raising the role and responsibility of the machine-building ministries and enterprises for ensuring complete deliveries, the installation and the mastering of the equipment produced by them." A general supplier of equipment should ideally be designated for each modernized, expanded or newly built enterprise. This must be reflected in the plan. The general suppliers (production associations and independent enterprises with the rights of associations) must be entirely responsible for the technical level, quality and completeness of the equipment supplied. The funds for the equipment will be transferred to them after it has been placed in operation.

The country's powerful machine-building enterprises, such as Uralmashzavod, are fully capable of serving not only as the general suppliers but also as the general contractors and the construction organizations (Ministry of Construction, Ministry of Installation and Special Construction Work and others) -- as their sub-contractors. Under such a system, Uralmashzavod could supply the equipment for a construction site on the basis of a contract, organize the completion, adjustment and testing of the equipment, include the builders and installation personnel in its work and turn over to the customers operational ready plants or phases, pilot complexes, individual types of production efforts or installations which produce output independently. Changes would take place in the index (and the very concept) for the sale of all machine-building products, in the formation of the economic incentive funds for the branch and also in the methods employed for management, supply and financing. This could be reflected in the indices of those construction organizations collaborating with the machine-building associations (plants).

The Ministry of Chemical and Petroleum Machine-Building has achieved positive progress in improving equipment deliveries. During the Ninth Five-Year Plan, it converted over from a system of supplying equipment on a "scattered" basis to supplying the construction projects with complete technological lines. Overall, for example, the duration of installation of complete technological lines for weak nitric acid and ammonium nitrate was reduced from 17.2 to 6.4 months and the delivery period -- from 21.6 to 5 months. The principal factor that made it possible to achieve such progress -- the establishment of a leading plant responsible for complete deliveries of technological lines*.

Among the organizations of the general construction ministries there are subunits which could display concern for the procurement and installation of equipment. For example, construction organizations specializing in a definite branch or definite type of production effort are capable of placing orders for equipment, installing it and delivering operationally complete production capabilities and various installations (for example, organizations of the Ministry of Power Engineering and Electrification could undertake these functions when installing electric power transmission lines, organizations of the Ministry of Construction of Enterprises for the

* The associations and plants of this ministry are not performing work concerned with the installation of equipment. They maintain accounts with the customers not for complete sets but for individual units of equipment -- as they are supplied. The output is accounted for and sold in the same manner. This represents the principal shortcoming of the system adopted by Minkhimmash, one which reduces its efficiency to a considerable degree.

petroleum and gas industry -- when installing petroleum and gas pipelines, organizations of the Ministry of Transport Construction -- when building railroads and highways, organizations of the Ministry of Land Reclamation and Water Economy -- when erecting land reclamation and irrigation installations, organizations of all of the ministries and departments carrying out civil-housing construction work).

The inclusion of planning organizations in the investment process -- from the beginning to the end of this process -- will promote improvements in the contractual relationships. At the present time, the planning organizations, once they have developed the required documentation, are subsequently eliminated from participation in the investment process and this can hardly be considered as being correct.

In actual practice, the planning organizations in some instances are transferred over to construction associations or combines; in other instances -- associations appear (for example, in Moscow) in which the leading element is a planning institute, that is, it has its own type of planning-construction contractual organizations. The planning organization, after composing the plan, carries it out in actual practice and delivers the operationally ready enterprise, installation or project to the customer. There is no need for proving the vitality of such associations. They are very similar to the scientific-production associations in industry. Their creation will be an important goal for converting over to modern industrial construction methods that meet the requirements for scientific-technical progress.

A greater amount of attention should be given to reorganizing the work of the plant construction combines. The first plant construction combine was organized by Glavkiyevgorstroy in Brovary (Ukrainian SSR) in the 1960's. It was responsible for erecting the above-ground portion of industrial buildings. General construction (zero cycle) and special operations were carried out by contractual trusts and specialized organizations. The product of the combine was an industrial installation (department) that was fully prepared for carrying out finishing and special construction and installation work.

However, such combines subsequently began to perform the role of conventional suppliers, only rarely installing the structures which they produced. Under present day conditions, marked by the development throughout the country of a network of mobile construction organizations equipped with the required equipment and the accelerated conversion of construction over to an industrial basis, methods should ideally be defined for achieving further development for the plant construction combines. The combines must be transformed into plant construction firms responsible for carrying out an entire complex of operations, beginning with planning and ending with the turning over of operationally complete industrial installations.

In summarizing the above, it can be stated that our country has all of the conditions at its disposal for converting over to carrying out work concerned with placing capabilities in operation, using the resources of large machine-building enterprises and employing general construction and specialized construction organizations as sub-contractors (this variant is more suitable for enterprises having a high proportion of equipment in their technological structures); contractual organizations, including plant construction firms which undertake not only construction obligations but also the placing of orders for equipment and its installation (mainly for projects and installations having large equipment expenditures); planning-construction organizations which carry out work during all stages of the investment process (mainly for civil housing construction).

In all cases where the final output is produced by plants -- equipment suppliers, contractual construction organizations, plant construction combines (if there are no planning subunits in their structure) -- control over the completion and timely delivery of equipment and also over equipment orders must be entrusted to the planning organizations. Quite understandably, this applies to those enterprises which require complicated technological equipment, power engineering units, control-measurement equipment, automatic equipment and so forth. Many years of experience have shown that the customers do not cope adequately with such complicated and frequently changing (owing to the appearance of new machines, improvements made in the plans and so forth) tasks.

Some ministries have already commenced introducing the method of complex placing in operation of construction projects. Thus the Ministry of the Chemical Industry has tasked the planning organizations with developing and presenting specifications and other technical documentation and accounts required for ordering equipment for enterprises under construction (modernization) and also responsibility for concluding contracts for equipment deliveries. The experience of this particular ministry is already producing positive results: improvements have been realized in completing the equipment, equipment deliveries have been accelerated and capabilities are being introduced into operations more rapidly. A similar system is being employed at certain construction projects of the light and food industry and at the production base for USSR Minsel'stroy [Ministry of Rural Construction] in the nonchernozem zone. Although various deviations can be made in the mentioned systems and in refining and further developing them, nevertheless they reflect progressive changes in the organizational forms for construction as brought on by the scientific-technical revolution.

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Thus the principal guarantee for achieving reductions in the construction schedules must include: using an index for the placing in operation of capabilities and fixed capital for evaluating the work of construction organizations; ensuring stability in estimated costs and a considerable reduction in construction costs during the next few years; introducing modern organizational forms into the construction complex. The importance of these tasks is borne out by the fact that a reduction in the construction schedules of just 1 year will furnish an additional increase in national income of more than 10 billion rubles.



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ELECTRONICS AND PRECISION EQUIPMENT

UDC 681.2

NEW CATALOG OF INSTRUMENTS DESCRIBED

Minsk KATALOG PRIBOROV in Russian 1978 signed to press 29 Mar 78 pp 2-4, 157-160

[Annotation, preface and table of contents from book by the Scientific Council on Instrument Making attached to the Presidium of the Academy of Sciences BSSR, edited by Doctor of Physical and Mathematical Sciences V. S. Burakov and Candidate of Technical Sciences K. N. Tsvetayev, Nauka i Tekhnika, 3,450 copies, 160 pages]

[Text] The catalog contains descriptions of devices developed by scientific institutions of the Academy of Sciences and by higher educational institutions of the Belorussian SSR. These instruments are designed for scientific research and for use in the national economy. The catalog includes optical instruments and elements, radio spectrometers, computer facilities, electronic measuring equipment, instruments for testing materials and quality control, thermophysical devices and the like.

The catalog is intended for scientific workers and for the engineering and technical personnel of industrial enterprises.

Tables 3, figures 128.

## Preface

The Twenty-Fifth Congress of the CPSU has put increased production of instruments, automation facilities and computer equipment among the major problems of development of the national economy. Along with the production of general-purpose and control complexes, instruments and devices for automated systems for control of technological processes, an important place is being given to the production of instruments and equipment for scientific research and medicine, agricultural needs and environmental control, for mechanizing and automating engineering and administrative work. The scientific institutions of the Soviet Academy of Sciences and the academies of sciences of the Soviet republics are making a considerable contribution to the development of these areas of instrument making.

Instrument making began to be developed with particular intensity in the Academy of Sciences and higher educational institutions of the Belorussian SSR in 1969. This period saw the beginning of formation of special design offices in scientific institutions, an expansion of their experimental base, reinforcement of ties with leading science centers of the nation, a sharp increase in the volume of work on orders of ministries and agencies.

By now, specialization in the field of instrument making has been established for the scientific institutions of the Academy of Sciences and the higher educational institutions of the Belorussian SSR, possibilities have arisen for cooperation and unification of efforts of various science centers. The models of instruments that have been made are of great interest to scientific institutions, industrial enterprises and design organizations. A knowledge of the parameters, purpose and fields of application of instruments that have been developed is important to scientific workers in selecting measurement facilities and instruments for organizing research, and also to the workers in plant laboratories in selecting systems for monitoring and measurement. These are the factors that have been chiefly responsible for the preparation and publication of this catalog.

The catalog includes developments of ten scientific institutions of the Belorussian Academy of Sciences and the special design offices with experimental production that are subordinate to them, the Central Design Office with experimental plant of the Belorussian Academy of Sciences, and also two higher educational institutions in which instrument making work is most widely represented -- Belorussian State University imeni V. I. Lenin and Minsk Radio Engineering Institute. With respect to subject area, the catalog consists of 17 divisions that cover more than 120 developments. Of these, about 40% are intended for scientific research, approximately 30% are instruments and facilities for production purposes. The remaining devices and facilities are of interest both to scientific institutions and to plant laboratories and shops.

The most extensive divisions are those that give descriptions of optical instruments, computer equipment, devices for nondestructive quality control of materials, electronoic measuring instruments and devices for vibration measurement. The catalog also includes optical elements necessary for setting up research and industrial facilities.

Represented among the optical instruments are spectrometers and spectrophotometers, radiometers and gas analyzers, lasers and power supplies for them. The computer facilities are mainly devices for automating design and scientific research. Most completely represented in the division "Instruments for Nondestructive Quality Control of Materials" are coercimeters and thickness gages. The electronic measuring instruments shown in the catalog are intended chiefly for measuring the characteristics of semiconductor elements and radio receivers.

Most of the instruments are original developments, while others expand the possibilities of industrial analogs.

Design documentation is available for the instruments included in the catalog. Experimental models that have been made are being used in scientific laboratories and industrial enterprises. Familiarization of science workers and specialists in enterprises and ministries with the developments presented in this catalog should play a positive role in further development of instrument making in the scientific and higher educational institutions of Belorussia, bringing new items into series production and expanding their fields of application.

The catalog was compiled by the Scientific Council on Instrument Making attached to the Presidium of the Academy of Sciences BSSR. We request that all comments and suggestions be addressed to the Council (220072, g. Minsk, Leninskiy pr., 70, Sovet po priborostroyeniyu).

V. S. Burakov, K. N. Tsvetayev

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