

## **Continuation of pellet cars service life based on the technology of overall repair**

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### Abstract

Improving the efficiency and quality of rail transport depends on the technical and economic indicators of the car such as performance, capital expenditures, operating costs, operational availability and consumption of materials. To make the rail transport successfully continue to compete with other means of transport, it is necessary to constantly maintain its viability at a high technical level. The work carried out in this direction is done by the repair and maintenance of cars, which performance should be planned on the basis of their actual state. Currently, Ukrzaliznytsia has many hopper cars for transportation of pellets and sinter at temperature up to 700 °C (pellet cars) that have completed their specified service life.

The paper presents the characteristics of diagnosis procedures for overall repairs with the extension of the useful life of pellet cars and the requirements for their renovated models. Extension of the pellet

cars service life will allow us to meet the needs of the national economy in the transportation of goods more fully and thus reduce capital expenditures for the purchase of new rolling stock.

Key words: RAILWAY TRANSPORT, PELLET CARS, SERVICE LIFE, OVERALL REPAIR

## Introduction

Improving the efficiency and quality of rail transport depends on the technical and economic indicators of the car such as performance, capital expenditures, operating costs, operational availability and consumption of materials. In the conditions of Ukrainian economy reforming the railway transport in our country have to solve complex problems of adaptation [1-10] to work in market conditions and meet the growing demands on the quality and efficiency of transport services [1-4, 6, 8].

To make the rail transport successfully continue to compete with other means of transport it is necessary to constantly maintain its viability at a high technical level. The work carried out in this direction is done by the repair and maintenance of cars, which performance should be planned on the basis of their actual state.

Currently, Ukrzaliznytsia has many hopper cars for transportation of pellets and sinter at temperature up to 700 °C (pellet cars) that have completed their specified service life.

According to current regulations [11] such cars should be excluded from the inventory, and for ensuring the volume of cargo freight activity the car fleet would have to be replenished through purchases of new rolling stock. As a temporary measure, a decision on the implementation of overall repair (OR) to the extension of the efficient application time of cars with expired service life [12] having a satisfactory technical condition has been taken. Performing OR of pellet cars allows us to meet the needs of the national economy in the transport of goods more fully and thus reduce the capital expenditures for the purchase of new rolling stock.

## The purpose of the article and presentation of main material

The article presents peculiarities of diagnosis procedure at carrying out OR of pellet cars and requirements for their repaired models.

The pellet cars of 20-471 and 20-4015 models with expired designated lifetime are subjected to diagnosing. For this type of rolling stock, lifetime is 15 years. Examination of the technical condition of cars is carried out [12] by means of visual inspection and necessary measurements, thus, the cracks, deformations, corrosion, breaks and other faults are detected. The presence of faults, traces of repair and the actual thickness of the main load-bearing elements of each car have been registered in the maps of technical condition. Sections for thickness measurements have been selected based on the assumption that the thicknesses in such section are minimal for this car element usually due to a result of corrosion damage. Nominal values of wall thickness of sections were defined by the working drawings of the manufacturer plant. Faults that occur the most frequently and their conventional signs (codes) are shown in Table 1 and Figures.

OR is one of the components of the work complex for extending the service life of the pellet cars, which is held on the car-repair plants after technical diagnostics and taking a decision by the special executor-organization of works upon technical diagnostics of cars [12].

Basic parameters and technical characteristics of cars after the OR must meet the requirements of design documentation for the cars of 20-480 and 20-4015 models respectively.

**Table 1.** List and fault codes identified during the diagnosis of pellet cars

Fault Name	Code
<u>Cracks</u>	
Crack of connection seam of base plate and pivot bottom plate	C1
Crack of connection seam of center-sill bottom flange and pivot bottom plate from the automatic coupling side	C2
Crack connection seam of center-sill bottom flange and pivot web plate from the automatic coupling side	C3
Crack of pivot bottom plate in the zone of the bolt hole for center plate attachment	C4

## Machine building

Crack of connection seam of center sill cover plate and pivot top plate from the automatic coupling side	C5
Crack of connection seam of center sill cover plate and pivot top plate from the middle of the car	C6
Crack of connection seam of center-sill bottom flange and pivot bottom plate from the middle of the car	C7
Crack of connection seam of center-sill bottom flange and pivot web plate from the middle of the car	C8
Crack of side sill	C9
<u>Deformations</u>	
Bending of pivoted vertical stay	D1
Dents of side sill	D2
Vertical stays deformation	D3
Deformation of side rail of end wall	D4
Deformation of top cord of end wall	D5
Deformation of top cord of side wall	D6
Deformation of final framing	D7
Deformation of dump door frame	D8
Deformation of end wall frame	D9
<u>Deflection</u>	
Vertical deflection of side sill	D1
Expansion in the upper part of the body	D2
Horizontal deflection of side sill	D3
<u>Corrosion</u>	
Corrosion of side walls lining	C1
Corrosion of end walls lining	C2
Corrosion of bearing elements more than 30%	C3
<u>Breaking</u>	
Breaking of vertical pillar	B1 B2
Breaking of top cord elements	B3
Breaking away of top cord	B4
Breaking of frame crossbeams of end wall from the vertical framing	B5
Breaking of final framing	B5 B6
<u>Other faults</u>	
Weakening of center plate attachment	Wea
Availability of base plate on pivot bottom plate	P1
The presence of features of striker repair or installation of a new one on rivets	P2

Works on OR consist of works in the amount of overall repair carried out in accordance with the Manual of overall repair of “Ukrainian railways freight cars with rail of 1520 mm” TsV - 0016, “Basic conditions for repair and modernization of freight cars in the plants of Railway Transport of Ukraine” TsV-TsProm-0020 and additional work in accordance with the sets of design documents UM0055; UM0056 of

Kiev PKTB (c). Overall repair is carried out on pellet cars, which should be excluded from the inventory due to regulatory service life or on the technical condition of the body in accordance with “Rules of exclusion of freight cars from inventory park” TsV-0063.

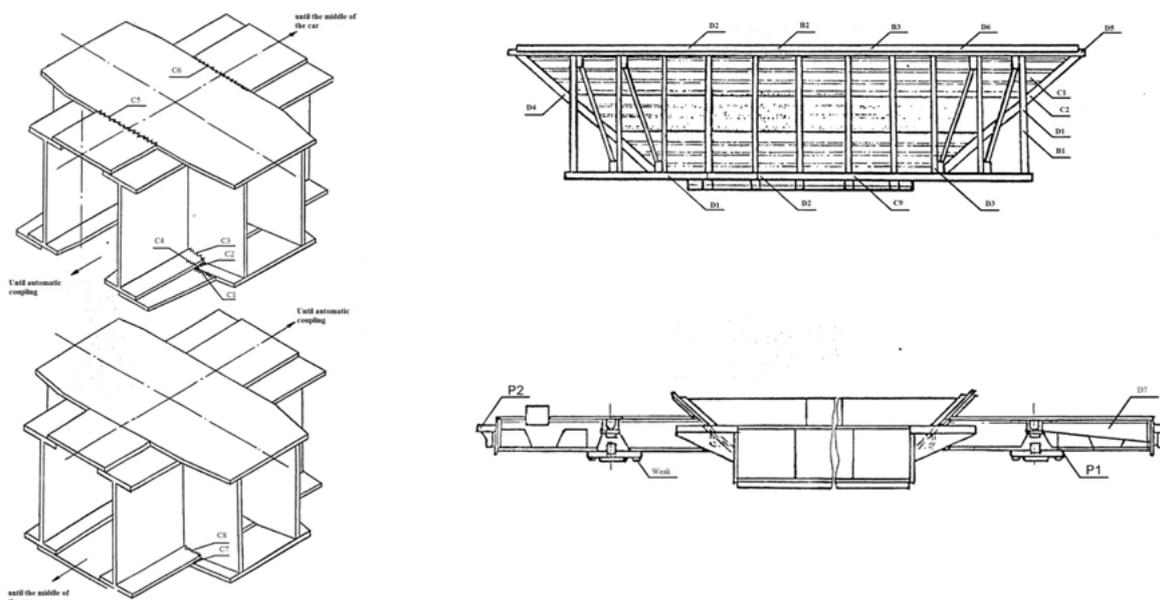
The main flaws of pellet cars bearing systems discovered during flaw detection and require correction

can be classified as following:

- a) vertical deflection of the lower side sills of two side walls is more than 200 mm;
- b) horizontal deflection of the two lower side sills of the side walls is more than 100 mm;

c) corrosion damages (over 30% of the cross-section area) of the lower side sills of side walls or pivot risers that require replacement;

d) mechanical damages of pivot risers or lower side sills that require replacement.



**Figure 1.** Malfunctions of pellet cars and their conventional signs (codes)

The construction of pellet cars must meet the requirements [11].

Center sill should not have the following faults:

- a) cracks, ruptures and fractures of I-sections
- b) corrosion and mechanical I-sections damages of more than 15% of the cross-section.

Elements of pivots and end beams having corrosion damages over 20% of the cross sectional area should be replaced by new once.

Vertical sheets of pivots having cracks or fractures should be replaced with new ones. Variables ridge beams having cracks and corrosion damages more than 20% of the cross section should be also replaced.

Welding and surfacing works at the resumption of the body and frame repair were carried out in accordance with the projects UM0055 and UM0056, "Instruction for welding and surfacing in the repair of freight cars and containers" TsV-0019.

Materials applied at OR must meet the requirements of projects UM0055 and UM0056 as well as they need to have appropriate certificates, comply with the prescribed standards and specifications. All load-bearing elements of the frame and body, brake beams must be made of steel 09G2, 09G2S 12 grades in accordance with GOST 19281. For the production of non-critical parts the carbon steels in accordance with GOST 2651 and GOST 1050 carbon content in

steel should be no more than 0.25% are allowed to use.

Two-axle load trolleys of 18-100 model with a residual life of truck bolsters and side frames of 12 years, the thickness of the wheel rim shall be at least 36 mm, are driven under the pellet car that experienced OR.

New designated service lifetime of pellet cars after the OR is 12 years. The total service life of pellet cars should not exceed 27 years from the date of their construction.

The construction of pellet cars after the OR should provide the ability to perform regular overhaul in a car-repair depots and plants, as well as a visual inspection of all connections and accessibility to parts for repair and maintenance.

Pellet car must fit into the 1-VM rolling stock size in accordance with GOST 9238. Unladen weight should not be more than 22.5 tons.

Materials, semi-finished products and components used in the modernization must be accompanied by documents certifying the quality, compliance with standards or technical specifications for their production.

Checking of the weld connections is carried out in accordance with the "Regulations TsV-0019" by visual inspection and measurement in accordance with

GOST 3242.

Warranty period of operation:

- basic metal parts of the frame and the car body - 3 years;
- side frames of trolleys, bolster, center plate and center bowl - 3 years;
- automatic unit, axle equipment, spring suspension, braking equipment (except brake pads), brake rigging - 2 years;
- Hand over the signing of the act of adopting the car repairs.

The enterprise that performed the OR of pellet cars is responsible for the quality of the repair and operation of pellet cars during the warranty period.

### Conclusions

Considering the economic part of the graduation project and not very good financial condition of Ukrzaliznytsia, we can conclude that currently more profitable is to carry out the OR to those cars that have served their main period of operation than to build new pellet cars. Thus, the manufacturing cost of the car repaired by OR is more than 2.5 times lower than the production cost of a new car. And considering all the profits from the use and maintenance costs, the income in one year of operation of the OR car is by 7.3% more than that of the new car.

Extension of the pellet cars service life will allow us more fully meet the needs of the national economy in the transportation of goods and thus, reduce capital expenditures for the purchase of new rolling stock.

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