

Analysis of Malfunctions of Diesel-Electric Transmission Locomotives (DET) and Methods of their Diagnostics and Elimination

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Abstract:

The article discusses the main malfunctions of diesel-electric transmission (DET) locomotives and methods for their diagnostics and elimination. Special attention is given to typical malfunctions of diesel engines, electrical transmission, cooling system, braking system, and mechanical components. The causes of these malfunctions and their consequences for safety and operational efficiency are presented. The article also describes modern diagnostic methods, including the use of diagnostic equipment, thermographic cameras, vibration sensors, and predictive diagnostics. Methods of fault elimination and recommendations for preventive maintenance to improve the reliability of DET locomotives are also discussed. The article aims to improve the operational characteristics of locomotives and reduce the risks of emergency situations.

Keywords: Malfunctions, locomotives, diesel-electric transmission, DET, diagnostics, fault elimination, cooling system, braking system, thermographic camera diagnostics, predictive diagnostics, preventive maintenance, operational characteristics, safety.

Introduction:

Diesel-electric transmission (DET) locomotives are widely used on railroads, especially on sections with limited electrification. These machines are known for their high power and reliability, but like any complex technical equipment, they are subject to various malfunctions during operation. The main task is the timely diagnosis and elimination of these faults to prevent accidents and increase operational reliability.

Diagnosing faults in DET locomotives requires the use of modern equipment and methods, such as vibration sensors, thermographic cameras, and predictive diagnostic systems. These methods allow for accurate identification of fault causes and prompt corrective actions to address them.

Literature Review and Research Methods:

In recent years, the issue of diagnosing malfunctions in diesel-electric transmission (DET) locomotives has become the subject of numerous studies. Various works discuss diagnostic methods, including mechanical, electrical, and thermal examination of components and aggregates. There are methods used to assess the condition of the diesel engine, its auxiliary systems, and electrical transmission.

The main diagnostic tool is the use of various sensors and devices, such as vibration sensors, thermographic cameras, and data collection systems integrated with central servers for real-time monitoring of equipment condition. This allows not only to detect malfunctions but also to predict their occurrence based on analyzing trends in parameter changes.

Main Malfunctions of DET Locomotives:

1. Diesel Engine Malfunctions:

- ✓ Insufficient compression in the cylinders.
- ✓ Engine overheating due to cooling system malfunction.
- ✓ Fuel system malfunctions.

2. Electrical Transmission Malfunctions:

- ✓ Wear of generator brushes and collector.
- ✓ Failures in power semiconductor components.
- ✓ Damaged cables and connections, which may lead to overload.

3. Braking System:

- ✓ Malfunctions in the pneumatic braking system.
- ✓ Wear of brake pads and discs.
- ✓ Insufficient brake fluid in the system.

4. Mechanical Malfunctions:

- ✓ Wear or damage to transmission components.
- ✓ Suspension and shock absorber malfunctions.

To eliminate malfunctions in diesel-electric transmission locomotives (DET), it is necessary to take comprehensive measures aimed at diagnostics, preventive maintenance, and addressing identified issues. Below are the main steps to take for fault elimination:

1. Fault Diagnosis:

- **Use of diagnostic equipment:** Regular inspection of all key systems of the locomotive using modern diagnostic equipment, including thermal cameras, vibration sensors, and monitoring systems for electrical and mechanical components.
- **Visual inspection:** Checking for visible damage, fuel or oil leaks, brake pad wear, and other components.
- **Signal and indicator analysis:** Using predictive diagnostics to analyze sensor data (such as temperature, pressure, and vibration) to forecast potential failures.

2. Diesel Engine Faults:

- **Cooling system inspection:** Check the cooling system for leaks, radiator blockages, and low coolant levels. If necessary, replace faulty components such as pumps, radiators, or thermostats.

- **Fuel system inspection:** Inspect fuel filters and pumps for blockages or damage, and check the system pressure. Clean or replace filters and inspect injectors for blockages or damage.
 - **Compression check:** Measure the compression in the engine cylinders. Low compression may indicate the need for repairs or replacement of piston rings or cylinders.
3. **Electrical Transmission Faults:**
- **Generator and collector inspection:** Check the generator brushes and collector for wear. If necessary, replace them or resurface the collector.
 - **Power semiconductor component inspection:** Check the integrity of power semiconductor components (e.g., diodes, thyristors). If damaged, replace them.
 - **Wiring and connection inspection:** Check the condition of wiring for damage, corrosion, or overheating. Repair damaged connections or replace the wiring.
4. **Braking System Faults:**
- **Pneumatic system inspection:** Check air reservoirs, valves, and pipes for air leaks. Replace damaged components if leaks are found.
 - **Brake pad and disc inspection:** Inspect brake pads and discs for wear. Replace them if necessary.
 - **Brake fluid inspection:** Check the brake fluid level and top it off or replace it if needed.
5. **Mechanical Faults:**
- **Transmission inspection:** Inspect the transmission for wear or damage. If faults are found, perform repairs or replace the damaged components.
 - **Suspension and shock absorber inspection:** Check the condition of the suspension and shock absorbers. Replace any damaged or worn components.
6. **Preventive Maintenance:**
- **Regular technical inspections:** Conduct regular inspections and preventive maintenance on locomotives, including cleaning and lubricating moving parts, checking chain and belt tension, and monitoring fluid levels (oil, coolant, brake fluid).
 - **Use of high-quality consumables:** Use high-quality fuel, oil, and filters to prevent contamination and wear on components.
 - **Staff training:** Train operators and maintenance personnel in the proper handling of the locomotive, including using diagnostic equipment and timely reporting of identified faults.
7. **Electrical Fault Elimination:**
- **Replacement of damaged conductors and cables:** If wiring or cables are damaged, they need to be replaced or repaired to avoid short circuits and other electrical problems.
 - **Fault rectification in control units:** Check control units and monitoring systems for errors or malfunctions. If necessary, reprogram or replace faulty components.
8. **Technical Improvement and Modernization:**
- **Upgrading control and diagnostic systems:** Implement new technologies for real-time monitoring of locomotive conditions. This may include the use of sensors to analyze the condition of the engine, transmission, braking system, and other critical components.
 - **Continuous software updates for diagnostics:** Update and optimize diagnostic system software to enhance the accuracy of fault detection.

Methods of Diagnostics and Fault Elimination: Modern diagnostic methods for locomotives with diesel-electric transmission include several approaches:

1. **Thermographic Diagnostics:** This method allows for precise identification of overheating areas, which may indicate faults in the electrical system or cooling system.
2. **Vibration Diagnostics:** Vibration sensors help detect anomalies in mechanical components, such as the transmission and engines. These sensors capture vibrations that may be related to wear or damage.
3. **Use of Predictive Diagnostics System:** The system collects data from various sensors and predicts the likelihood of faults based on analysis, enabling preventive maintenance to be carried out in advance.

Recommendations for Preventive Maintenance: To improve the reliability of locomotives with diesel-electric transmission, it is recommended to implement regular inspections and timely preventive maintenance. It is crucial to perform diagnostics on all major systems, including the cooling system, transmission, brakes, and diesel engine. The condition of the electrical transmission and cable connections should also be regularly checked, as faults in these areas may lead to significant breakdowns.

Conclusion: The diagnosis and elimination of faults in locomotives with diesel-electric transmission are an essential part of the railway transport operation process. Modern diagnostic methods such as thermography, vibration diagnostics, and predictive diagnostics allow for effective detection of faults at early stages, reducing accident risks and extending the service life of locomotives. Regular preventive maintenance and the use of advanced diagnostic technologies significantly enhance the safety and operational performance of locomotives.

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