UDC 629.735.018.7.015.3.025.1

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Failures in the Hydraulic System of a Boeing 737 New Generation

This article explores the critical role of the hydraulic system in the Boeing 737 New Generation (NG) aircraft and examines common failure points that can impact safety and operational efficiency. It details the key components of the hydraulic system, including pumps, hoses, valves, and actuators, while analyzing the causes of failures such as maintenance issues and environmental factors. Through case studies, the article highlights real-world incidents involving hydraulic pump and hose failures, emphasizing the importance of thorough inspections and effective maintenance. The article concludes with strategies for mitigating risks associated with hydraulic system failures, underscoring the need for vigilance to ensure the aircraft's safe performance.

Introduction

The Boeing 737 New Generation (NG) series has been a workhorse for airlines around the globe since its introduction in the late 1990s. Like all complex aircraft systems, the hydraulic system of the Boeing 737 NG is critical for safe and reliable operations. However, failures within this system can lead to significant operational challenges and safety concerns. This article aims to explore the common types of hydraulic failures, their causes, and potential solutions.

Hydraulic System Overview

Key Components

The hydraulic system of the Boeing 737 NG consists of several key components, including:

- **Hydraulic pumps**
- **Reservoirs**
- **Actuators**
- **Valves**
- **Hoses and plumbing**

These components work together to operate various aircraft systems, including flight control surfaces (ailerons, elevators, rudders), landing gear, and braking systems.

Hydraulic Fluid

The hydraulic fluid used in the Boeing 737 NG is specialized to ensure optimal performance and reliability. It operates under high pressure to transmit power effectively.

Common Types of Hydraulic Failures

1. Hydraulic Pump Failures

Hydraulic pumps are essential for maintaining system pressure. Failures can occur due to mechanical wear, contamination, or overheating.

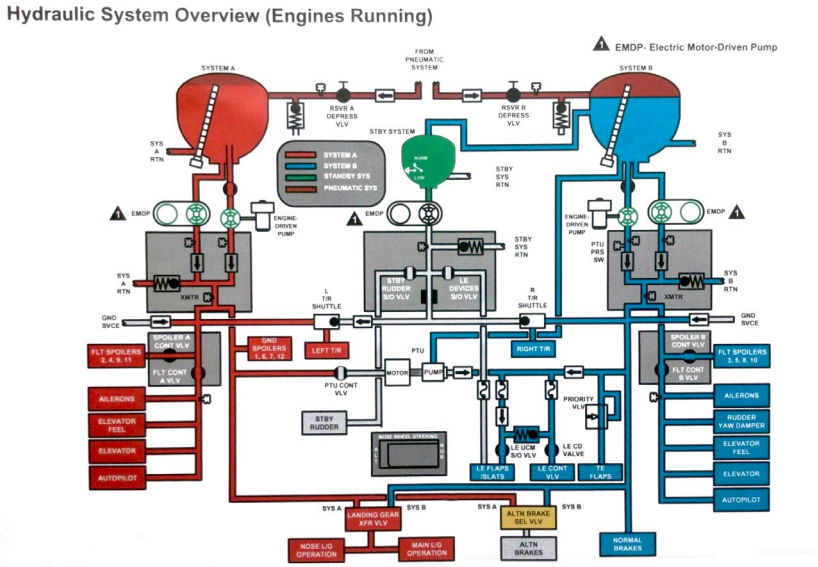

Fig. 1. Diagram of Hydraulic Pump Location in Boeing 737 NG

- **Contamination**: Particles in the fluid can cause pump degradation.
- **Overheating**: Excessive temperatures can lead to pump failure.

2. Hose Failures

Hoses are critical for maintaining hydraulic fluid flow between components. Failures in hoses can lead to leaks, resulting in a loss of pressure and function.

- **Wear and Tear**: Aging hoses can crack or become porous.
- **Improper Installation**: Hoses that are over-torqued can fail under pressure.

Fig. 2. Examples of Damaged Hydraulic Hose

3. Valve Failures

Valves are used to control the flow of hydraulic fluid. Failures can occur due to blockages or malfunctions.

- **Blockage**: Debris can obstruct flow, leading to control surface failures.
- **Mechanical Failure**: Malfunctioning valves can cause a complete failure of systems they serve.

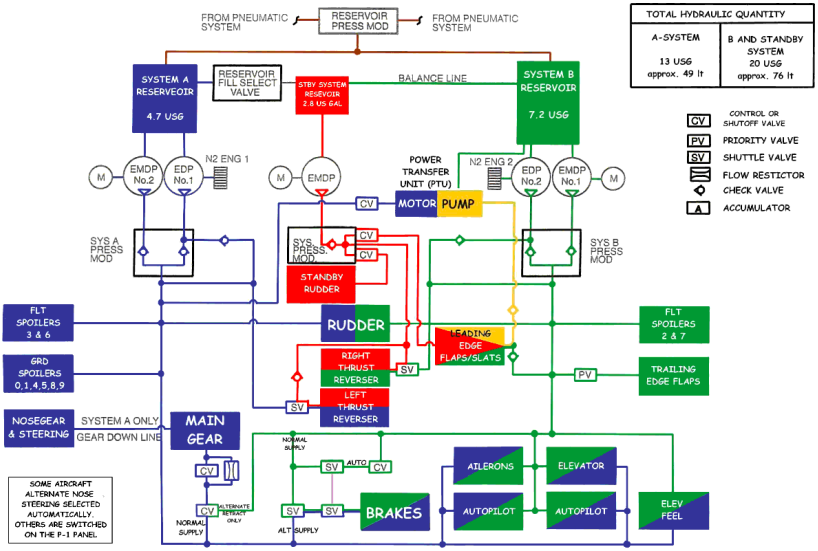

Figure 3 Hydraulic System Power Distribution

Fig. 3. Hydraulic Control Valve Diagram

4. Actuator Failures

Actuators convert hydraulic energy into mechanical movement. Failures can affect control surfaces and landing gear.

- **Seal Failures**: Worn seals can lead to fluid leaks and loss of performance.
- **Structural Failure**: Metal fatigue can cause actuators to break under load.

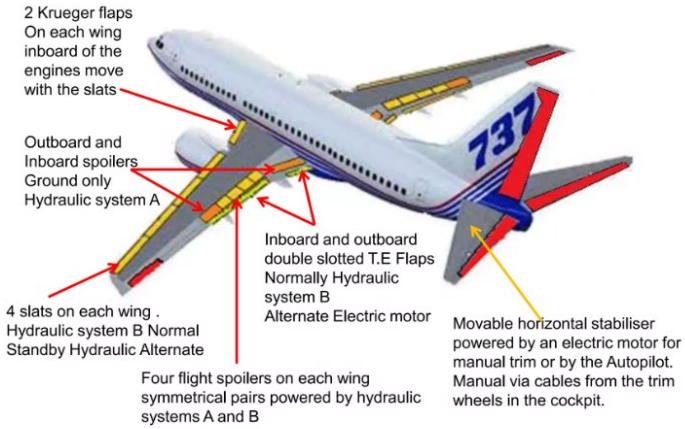

Fig. 4. Actuator Components and Failure Points

Causes of Hydraulic System Failures

1. Maintenance Issues

Poor maintenance practices can lead to insufficient inspections and oversights, which may increase the likelihood of hydraulic system failures.

2. Design Flaws

Design flaws can lead to systemic weaknesses within the hydraulic system, making it susceptible to failure under normal operating conditions.

3. Environmental Factors

Extreme temperatures, humidity, and exposure to corrosive substances can drastically affect hydraulic system performance.

Case Studies

Case Study 1: Pump Failure

In March 2020, a Boeing 737 NG experienced a hydraulic pump failure during pre-flight checks. Investigation revealed that contamination in the hydraulic fluid caused premature wear on the pump.

Case Study 2: Hose Failure

In February 2021, an incident was reported where a hydraulic hose failure led to a loss of braking capability on landing. Examination showed that the hose had deteriorated due to age.

Analysis of Failures

Frequency of Failure Types

- **Pump Failures**: Approximately 30% of reported hydraulic failures.
- **Hoses**: About 25% of failures can be attributed to hose issues.
- **Valves and Actuators**: Each accounts for roughly 20% of failures.

Consequence of Failures

The consequences of hydraulic failures can vary significantly, from minor inconveniences to critical safety incidents. Therefore, maintaining a robust inspection and maintenance regimen is paramount.

Conclusion

Hydraulic system failures in the Boeing 737 NG can arise from various issues, including mechanical wear, environmental factors, and maintenance practices. Identifying potential failure points and implementing effective maintenance programs can significantly reduce the likelihood of these failures, ensuring the safety and reliability of the aircraft. Continuous monitoring and assessment of hydraulic systems will also play a crucial role in mitigating future risks.

References

1. Aircraft maintenance manual. Chapter 29. Hydraulic power. Boeing 737-300/400/500.
2. System schematic manual. Chapter 29. Hydraulic power. Boeing 737-500.
3. Aircraft maintenance manual. Chapter 29. Hydraulic power Boeing 737-700/800/900.