Hydraulic Systems Volume 6

Troubleshooting and Failure Analysis

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Troubleshooting and Failure Analysis

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Troubleshooting and failure analysis are very important experience to resolve hydraulic systems problems and to find the root causes of such problems. Gaining such experience help to avoid future unexpected shutdowns, hence improve system reliability. This book introduces the approach of logic and analytical troubleshooting fault detection methodologies.

This book is targeting industry professionals who are in charge for operating, maintaining, and troubleshooting hydraulic systems. This book is also a great resource for mechanical engineers and service manuals technical writers.

The book presents more than 40 troubleshooting charts to cover system-level and components-level troubleshooting including hydraulic fluids, pumps, motors, valves, cylinders, accumulators, reservoirs, transmission lines, heat exchanges, filters, and sealing elements. The book also contains proposed inspection sheets for the aforementioned components and investigations for the typical types of failures for each component.

The author is working hard to finish his goal of supporting fluid power professional education by developing the following series of volumes and relevant software:

- Hydraulic Systems Volume 7: Modeling and Simulation for Application Engineers.

Dr. Medhat Kamel Bahr Khalil
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This book was written during the hardship of Covid-19 Virus.

All praises are to Allah who granted me the knowledge, resources and health to finish this work

To the soul of my parents who taught me the values of believe in God

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- metroforensics.blogspot.com
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- www.fluiddynamics.com
About the Book

Book Description:

This book is targeting industry professionals who are in charge of operating, maintaining, and troubleshooting hydraulic systems. This book is also a great resource for mechanical engineers and service manuals technical writers. The book presents more than 40 troubleshooting charts to cover system-level and components-level troubleshooting including hydraulic fluids, pumps, motors, valves, cylinders, accumulators, reservoirs, transmission lines, heat exchanges, filters, and sealing elements. The book also contains proposed inspection sheets for the aforementioned components and investigations for the typical types of failures for each component. This book is colored and has the size of standard A4. The book is associated with a separate colored workbook. The workbook contains printed power point slides, chapter reviews and assignments. This book is the sixth in a series that the author plans to publish to offer complete and comprehensive teaching references for the fluid power industry. The book contains a total of fourteen chapters distributed over 250 pages with very demonstrative figures and tables. The contents of the book are brand non-biased and intends to introduce the latest technologies related to the subject of the book.

Book Objectives:

Chapter 1: Hydraulic Systems Troubleshooting Logical Methodology
This chapter discusses the common methodologies applied for hydraulic system fault detection. This chapter introduces, in a step-by-step, the logic methodology for hydraulic system troubleshooting.

Chapter 2: Basic Troubleshooting Equipment
Servicing staff for hydraulic-driven machines should be aware of the troubleshooting equipment that are used in detecting faults of hydraulic systems. This chapter presents examples of troubleshooting equipment for hydraulic systems.

Chapter 3: Troubleshooting and Failure Analysis of Sealing Elements
This chapter presents guidelines for inspecting and troubleshooting hydraulic sealing elements. The chapter also presents 26 different failure modes, their causes and suggested solutions.

Chapter 4: Troubleshooting and Failure Analysis of Pumps
This chapter discusses hydraulic pumps inspection, troubleshooting, and failure analysis. In this chapter, troubleshooting charts for twelve different faults of hydraulic pumps are presented. The chapter also presents examples of defective pumps due to contamination, overheating, cavitation, and fatigue stress for gear, vane, and piston pumps.
Chapter 5: Troubleshooting and Failure Analysis of Motors
This chapter discusses hydraulic motors inspection, troubleshooting, and failure analysis. In this chapter, a troubleshooting chart for motor faults is presented. The chapter also presents examples of defective motors due to various reasons such as contamination, clogged case drain, shaft failure, etc.

Chapter 6: Troubleshooting and Failure Analysis of Cylinders
This chapter discusses hydraulic cylinders inspection, troubleshooting, and failure analysis. In this chapter, a troubleshooting chart for cylinder faults is presented. The chapter also presents examples of defective cylinders due to various reasons such as contamination, improper mounting, improper load attachment, side loading, overpressure, overheating, fluid incompatibility, saltwater, external leakage, etc.

Chapter 7: Troubleshooting and Failure Analysis of Valves
This chapter discusses hydraulic valves inspection, troubleshooting, and failure analysis. In this chapter, a troubleshooting chart for valve faults is presented. The chapter also presents examples of defective hydromechanical and electrohydraulic valves due to various reasons such as particulate and chemical contamination, solenoid burning due to inrush current, etc.

Chapter 8: Troubleshooting and Failure Analysis of Accumulators
This chapter discusses hydraulic accumulators inspection, troubleshooting, and failure analysis. In this chapter, a troubleshooting chart for accumulator faults is presented. The chapter also presents examples of defective accumulators caused by various reasons such as vessel explosion due to material defects and pressure shocks etc.

Chapter 9: Troubleshooting and Failure Analysis of Reservoirs
This chapter discusses hydraulic reservoirs inspection, troubleshooting, and failure analysis. In this chapter, a troubleshooting chart for reservoirs faults are presented. The chapter also presents examples of defective reservoirs.

Chapter 10: Troubleshooting and Failure Analysis of Transmission Lines
This chapter discusses hydraulic transmission lines inspection, troubleshooting, and failure analysis. In this chapter, a troubleshooting chart for transmission line faults is presented. The chapter also presents examples of defective transmission lines.

Chapter 11: Troubleshooting and Failure Analysis of Heat Exchangers
This chapter discusses hydraulic heat exchangers inspection, troubleshooting, and failure analysis. In this chapter, a troubleshooting chart for heat exchanger faults is presented. The chapter also presents examples of defective heat exchangers.
Chapter 12: Troubleshooting and Failure Analysis of Filters
This chapter discusses hydraulic filters inspection, troubleshooting, and failure analysis. In this chapter, a troubleshooting chart for filter faults is presented. This chapter also presents examples of defective filter.

Chapter 13: Hydraulic Systems Troubleshooting
This chapter introduces troubleshooting charts for failures of generic hydraulic systems. Each troubleshooting chart includes relevant notes and examples for better understanding.

Chapter 14: Examples of Hydraulic Systems Troubleshooting
In this chapter several case studies are presented as examples of applying the logic troubleshooting methodology for hydraulic systems fault detection. In addition, troubleshooting case studies following analytical fault detection methodology are presented. Examples were chosen from both industrial and mobile applications.

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ABOUT THE AUTHOR (IFPS Hall of Fam Reciepient)

Medhat Khalil, Ph.D. is Director of Professional Education & Research Development at the Applied Technology Center, Milwaukee School of Engineering, Milwaukee, WI, USA. Medhat has consistently been working on his academic development through the years, starting from bachelor’s and master’s Degrees in Mechanical Engineering in Cairo Egypt and proceeding with his Ph.D. in Mechanical Engineering and Post-Doctoral Industrial Research Fellowship at Concordia University in Montreal, Quebec, Canada. He has been certified and is a member of many institutions such as: Certified Fluid Power Hydraulic Specialist (CFPHS) by the International Fluid Power Society (IFPS); Certified Fluid Power Accredited Instructor (CFPAI) by the International Fluid Power Society (IFPS); Member of Center for Compact and Efficient Fluid Power Engineering Research Center (CCEFP); Listed Fluid Power Consultant by the National Fluid Power Association (NFPA); and Listed Professional Instructor by the American Society of Mechanical Engineers (ASME). Medhat has balanced academic and industrial experience. Medhat has vast working experience in Fluid Power teaching courses for industry professionals. Being quite aware of the technological developments in the field of fluid power, Medhat had worked for several world-wide recognized industrial organizations such as Rexroth in Egypt and CAE in Canada. Medhat had designed several hydraulic systems and developed several analytical and educational software. Medhat also has considerable experience in modeling and simulation of dynamic systems using Matlab-Simulink. Medhat has been selected among the inductees for Pioneers in fluid Power by NFPA (2012) and Hall of Fam in fluid Power by IFPS (2021).