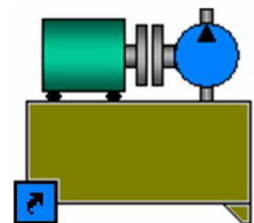


# **Hydraulic Systems Volume 5**

# **Safety and Maintenance**

**Dr. Medhat Kamel Bahr Khalil, Ph.D, CFPHS, CFPAL.**  
**Director of Professional Education and Research Development,**  
**Applied Technology Center, Milwaukee School of Engineering,**  
**Milwaukee, WI, USA.**



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**Safety and Maintenance**

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## PREFACE

Safety and maintenance are very important experience to whoever involved in designing, commissioning, operating, and servicing hydraulic systems. Gaining such experience help to avoid future unexpected shutdowns, hence improve system reliability and safety of work environment. This book introduces the concept and best practices of hydraulic components and system maintenance.

The book presents five sets of best practices for each of the following components: pumps, motors, cylinders valves, accumulators, reservoirs, transmission lines, heat exchangers, and filters. The five sets of best practices are as follows:

- BP-X Components-01-Selection and Replacement
- BP-X Components-02-Maintenance Scheduling
- BP-X Components-03-Installation and Maintenance Practices
- BP-X Components-04-Standard Tests and Calibration
- BP-X Components-05-Transportation and Storage

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 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 1: Introduction to Hydraulics for Industry Professionals.
- Hydraulic Systems Volume 2: Electro-Hydraulic Components and Systems.
- Hydraulic Systems Volume 3: Hydraulic Fluids and Contamination Control.
- Hydraulic Systems Volume 4: Hydraulic Fluids Conditioning. Under Development
- Hydraulic Systems Volume 5: Safety and Maintenance.
- Hydraulic Systems Volume 6: Troubleshooting and Failure Analysis.
- Hydraulic Systems Volume 7: Modeling and Simulation for Application Engineers.
- Hydraulic Systems Volume 8: Design Strategies of Hydraulic Systems. (Under Development).
- Hydraulic Systems Volume 9: Design Strategies of Electro-Hydraulic Systems. (Under Development).
- Hydraulic Systems Volume 10: Hydraulic Components Modeling and Simulation. (Under Development).

**Dr. Medhat Kamel Bahr Khalil**

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## 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 books start by introducing best practices for safe design, commissioning, operating and servicing hydraulic components. The book then presents the maintenance concepts and measuring instruments commonly applicable for hydraulic system maintenance. The book follows that by presenting five sets of best practices for each of the following components: pumps, motors, cylinders valves, accumulators, reservoirs, transmission lines, heat exchangers, and filters. It is to be noted that, the listed best practices and maintenance actions are based on the author's experience and may not be applicable in each case. Therefore, the author is highly recommending reviewing the instructions from component and system manufacturers as considered the main and first source of information. This book is colored and has the size of standard A4. The book contains a total of twelve chapters distributed over 350 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. The book is the fifth in a series that the author plans to publish to offer a complete and comprehensive teaching curriculum for fluid power industry. The book is associated with a separate colored workbook. The workbook contains printed power point slides, chapter reviews and assignments.

### Book Objectives:

#### Chapter 01: Hydraulic System Safety

Hydraulic equipment is widely used daily at almost all industrial sectors. Hydraulic power units range from a simple fraction of horsepower such as in a hydraulic hand tool to a large 500 horsepower machine. Lack of training, understanding how it works, and awareness of the associated hazards are reflected on increasing number of annual related injuries. The objective of this chapter is to increase the awareness about the hydraulic system safety during different phases including system design, startup, normal operation, and servicing. This chapter also explores the safety of the individuals, workplace, equipment, and the public.

#### Chapter 02: Basic Concepts of Hydraulic System Maintenance

This chapter covers basic rules of hydraulic system maintenance and skill set required for service workers. Impact of maintenance on system reliability and various maintenance techniques are presented. Common mistakes and reasons to void warranty are discussed. Best practices of maintaining a specific hydraulic component will be presented in the relevant chapter including guidelines for selection, replacement, installation, storage, maintenance scheduling, and standard testing.

### Chapter 03: Hydraulic Measuring Instruments

This chapter provides an overview of the common measuring devices used in hydraulic systems including devices for measure pressure, flow, temperature, oil level, and load cells. The chapter introduces the difference between a meter, a switch, and a sensor. The chapter also discusses the best practices for measuring devices selection & replacement, maintenance scheduling, installation & maintenance, and standard tests & calibration.

### Chapter 04: Maintenance of Pumps

This chapter provides guidelines for **pumps** selection, replacement, maintenance scheduling, installation, testing, storage and transportation. This chapter is supported by examples and figures provided by leading fluid power manufacturers.

### Chapter 05: Maintenance of Motors

This chapter provides guidelines for **motors** selection, replacement, maintenance scheduling, installation, testing, storage and transportation. This chapter is supported by examples and figures granted by leading fluid power manufacturers.

### Chapter 06: Maintenance of Cylinders

This chapter provides guidelines for **cylinders** selection, replacement, maintenance scheduling, installation, testing, storage and transportation. This chapter is supported by examples and figures granted by leading fluid power manufacturers.

### Chapter 07: Maintenance of Valves

This chapter provides guidelines for **valves** selection, replacement, maintenance scheduling, installation, testing, storage and transportation. This chapter is supported by examples and figures granted by leading fluid power manufacturers.

### Chapter 08: Maintenance of Accumulators

This chapter provides guidelines for **accumulator's** selection, replacement, maintenance scheduling, installation, testing, storage and transportation. This chapter is supported by examples and figures granted by leading fluid power manufacturers.

### Chapter 09: Maintenance of Reservoirs

This chapter provides guidelines for **reservoirs** selection, replacement, maintenance scheduling, installation, testing, storage and transportation. This chapter is supported by examples and figures granted by leading fluid power manufacturers.

### Chapter 10: Maintenance of Transmission Lines

This chapter provides guidelines for **transmission lines** selection, replacement, maintenance scheduling, installation, testing, storage and transportation. This chapter is supported by examples and figures granted by leading fluid power manufacturers.

## Chapter 11: Maintenance of Heat Exchange

This chapter provides guidelines for **heat exchangers** selection, replacement, maintenance scheduling, installation, testing, storage and transportation. This chapter is supported by examples and figures granted by leading fluid power manufacturers.

## Chapter 12: Maintenance of Filters

This chapter provides guidelines for **Filters** selection, replacement, maintenance scheduling, installation, testing, storage and transportation. This chapter is supported by examples and figures granted by leading fluid power manufacturers.

## Book Statistics:

Chapter #	Pages	Figures	Tables	Words	Editing Time (Hours)
Chapter 1	97	116	2	890	88
Chapter 2	17	17	1	3350	108
Chapter 3	34	42	1	4784	118
Chapter 4	42	37	4	8341	330
Chapter 5	7	4	1	1037	91
Chapter 6	32	36	2	5397	121
Chapter 7	20	19	2	3458	119
Chapter 8	15	8	1	2962	106
Chapter 9	6	3	1	1469	95
Chapter 10	26	24	4	4150	121
Chapter 11	11	10	1	2249	107
Chapter 12	31	25	5	4845	120
<b>Total</b>	<b>338</b>	<b>341</b>	<b>25</b>	<b>42932</b>	<b>1,524 Hour = 63 Days</b>

## ABOUT THE AUTHOR



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).