

## Chapter 1—HYDRAULICS—HOW IT WORKS

Basic Principles of Hydraulics . . .	1-1
How A Hydraulic System Works . .	1-2
Comparing Open- and Closed- Center Systems . . . . .	1-4
Variations on Open- and Closed- Center Systems . . . . .	1-8
The Uses of Hydraulics . . . . .	1-12

## Chapter 2—HYDRAULIC PUMPS

Displacement of Pumps . . . . .	2-1
Types of Pumps . . . . .	2-2
Gear Pumps . . . . .	2-3
Vane Pumps . . . . .	2-5
Piston Pumps . . . . .	2-7
Pump Efficiency . . . . .	2-13
Pump Failures and Remedies . . .	2-19

## Chapter 3—HYDRAULIC VALVES

Relief Valves . . . . .	3-2
Pressure Reducing Valves . . .	3-3
Pressure Sequence Valves . . .	3-5
Unloading Valves . . . . .	3-5
Check Valves . . . . .	3-6
Rotary Valves . . . . .	3-7
Spool Valves . . . . .	3-7
Electro-Hydraulic Valves . . .	3-10
Flow Control Valves . . . . .	3-14
Flow Divider Valves . . . . .	3-15
Miscellaneous Valves . . . . .	3-17
Valve Failures and Remedies . .	3-18

## Chapter 4—HYDRAULIC CYLINDERS

Piston Cylinders . . . . .	4-1
Vane Cylinders . . . . .	4-6
Maintenance of Cylinders . . . .	4-7

## Chapter 5—HYDRAULIC MOTORS

Gear Motors . . . . .	5-2
Vane Motors . . . . .	5-4
Piston Motors . . . . .	5-5
Motor Efficiency . . . . .	5-7
Motor Failures and Remedies . .	5-10

## Chapter 6—HYDRAULIC ACCUMULATORS

Uses of Accumulators . . . . .	6-1
Pneumatic Accumulators . . . . .	6-2
Weight-Loaded Accumulators . . .	6-6
Spring-Loaded Accumulators . . .	6-6

## Chapter 7—HYDRAULIC FILTERS

How and Why Filters Are Used . . .	7-1
Types of Filters . . . . .	7-3
Contamination . . . . .	7-5
Maintenance of Filters . . . . .	7-7

## Chapter 8—RESERVOIRS, OIL COOLERS, HOSES, PIPES, TUBES AND COUPLERS

Reservoirs . . . . .	8-1
Coolers . . . . .	8-2
Hoses . . . . .	8-3
Pipes and Tubes . . . . .	8-12
Quick Disconnect Couplers . . . .	8-16

## Chapter 9—HYDRAULIC SEALS

Uses of Seals . . . . .	9-1
Types of Seals . . . . .	9-2
Seal Failures and Remedies . . . .	9-3

## Chapter 10—HYDRAULIC FLUIDS

Properties of Fluids . . . . .	10-1
Maintenance of Fluids . . . . .	10-4
Keeping Fluids Clean . . . . .	10-5

## Chapter 11—GENERAL MAINTENANCE

Cleanliness . . . . .	11-1
Cleaning and Flushing Systems . .	11-4
Preventing Leaks . . . . .	11-5
Preventing Overheating . . . . .	11-6
Preventing Air-In-Oil Problems . . .	11-7
Checking System Before Operation .	11-8
Safety Rules . . . . .	11-9

## Chapter 12—DIAGNOSIS AND TESTING OF HYDRAULIC SYSTEMS

Seven Basic Steps . . . . .	12-1
Testing the Machine . . . . .	12-4
Trouble Shooting Charts . . . . .	12-8

## DEFINITIONS OF TERMS AND SYMBOLS

## INDEX