

# Table of Contents

## **A Occupation Health & Safety**

- A1 Electric Shock**
  - A1.1 Safety Rules
  - A1.2 Testing Live Equipment
- A2 Cuts**
- A3 Infection**
- A4 Manual Handling**

## **B Workshop Tools**

- B2 Tools**
  - B2.1 Essential tools in your toolbox to take to customer homes
  - B3.2 Essential tools for workshop
  - B2.3 Tools that can be helpful
  - B2.4 Home made tool

## **C Basic AC Electricity**

- C1 House Hold Electricity Supply**
  - C1.1 Electricity Generation
  - C1.2 Definitions/Terms Used
  - C1.3 AC Voltage and Frequency
  - C1.4 Power Losses
  - C1.5 Transformers
- C2 House Connections to Mains**
  - C2.1 Fuses and Circuit Breakers
  - C2.2 Power Points
  - C2.3 Electrical Appliance
  - C2.4 Importance of the Earth Wire
- C3 Testing Appliances**
- C5 Double Insulated Appliances**
- C6 Electric Shock**
- C7 Safety Switches**

## **D General Principles of Fault Finding**

- D1 Observation & Information in Fault Finding**
  - D1.1 Customer Information
  - D1.2 Instruments readings
  - D1.3 Sight
  - D1.4 Hearing
  - D1.5 Touch
- D2 Fault Finding**
  - D2.1 Example

- D3 Circuit Tracing**
  - D3.1 Voltmeter circuit tracing
  - D3.2 Ohmmeter circuit tracing
  - D3.3 Combination circuit tracing
- D4 Ohmmeter use**
- D5 Ohm ( $\Omega$ )**
- D6 Dangers of capacitors**
- D7 Basic Washing Machine Operation**
  - D7.1 Top loading machines
    - D7.1.1 Types of top loading washing machines
    - D7.1.2 Traditional washing machines
    - D7.1.3 Capacitor run washing machines
  - D7.2 Front loading machines
  - D7.3 Dishwashers
  - D7.4 Dryers

**D8 Component Replacement**

**Components**

- E1 Timers and electronic controllers**
  - E1.1 Electronic Controllers
  - E1.2 Timer Faults
  - E1.3 Electronic Controller Faults
- E2 Water valves**
  - E2.1 Water Valve Operation
  - E2.2 Water Hammer
  - E2.3.0 Faults
    - E2.3.1 Slow fill
    - E2.3.2 Slow Turn Off
    - E2.3.3 Not Turning Off
    - E2.3.4 No Water Flow
    - E2.3.5 Body of Valve Leaks
    - E2.3.6 Water Flowing Back Through the Valves
  - E2.4 Types of water valves
    - E2.4.1 Double Phillips valves
    - E2.4.2 Single Valves
    - E2.4.3 Double “Y” valves
    - E2.4.4 USA water valves
    - E2.4.5 Dishwasher valves
  - E2.5 Electrical Connections
- E3 Inlet Hoses**
  - E3.1 Nut & Tails
  - E3.2 Inlet Hose leaks
  - E3.3 Leaking tap problem
  - E3.4 More tap problem
- E4 Drain Hoses**
  - E4.1 Drain hose connections
  - E4.2 Drain hose problems

- E5 Drain pumps**
  - E5.1 Types of pumps
    - E5.1.1 Mechanical pumps
    - E5.1.2 Recirculating pumps
    - E5.1.3 Electric drain pumps
    - E5.1.5 Synchronous pumps
  - E5.2 Pump faults
  - E5.3 Testing electric pumps
  - E5.4 Causes of winding failures
  - E5.5 Slow drain problems
  - E5.6 Pump Replacement
- E6 Water Level Control (Pressure switch systems)**
  - E6.1 Adjustment
  - E6.2 Dishwasher pressure switches
  - E6.3 Water level problems
    - E6.3.1 Water overflowing problems
    - E6.3.2 Testing the pressure switch system
    - E6.3.3 Possible problems
- E7 Out of balance and Lid switch**
  - E7.1 Wiring
  - E7.2 Faults
- E8 Front loader Door Interlock Switch**
- E9 Dishwasher Door Switches**
- E10 Thermostats**
- E11 Seals**
- E12 Microswitches**

## **F Electric Motors**

- F1 General Principles**
- F2 Motor Speeds**
- F3 Motor Bearings**
- F4 Motor Windings**
- F5 Series Motors**
  - F5.1 Carbon Brushes
  - F5.2 Series Motor Tester
  - F5.3 Variations
  - F5.4 Common Faults
- F6 Induction Motors**
- F6 Split Phase Motors**
  - F6.0 Standard Split Phase Motors
  - F6.1 Capacitor Start
  - F6.2 Two Speed Motors
  - F6.3 Other Variations
  - F6.4 Testing
    - F6.4.1 Motor Tester
  - F6.5 Common Faults

- F6.5.1 Motor not starting
- F6.5.2 Motor using excessive current
- F6.5.3 Faulty motor bearings
- F6.6 Other Uses
- F7 Capacitor Run Motors**
  - F7.1 Testing
  - F7.2 Common Faults
    - F7.2.0 Motor does not operate
    - F7.2.1 Motor does not start
    - F7.2.2 Motor uses excessive electrical current
    - F7.2.3 Faulty Motor bearings
  - F7.3 Two speed Motors
  - F7.4 Capacitor Dangers
- F8 Shaded Pole Motors**
- F9 Synchronous Motors**
- F10 Three Phase Motors**
- F11 Inverter Technology**
- F12 Brush-less DC Motors**

## **G Simpson Top Suspension Washing Machines**

- G1 Basic Operation**
- G2 Access to Components**
  - G2.1 Access to bottom components
  - G2.2 Access to control panel
  - G2.3 Removing the top
- G3 Typical Test Procedure**
- G4 Common Problems**
  - G4.1 Water Valve Problems
  - G4.2 Drain Pump problems
  - G4.3 Transmission Problems
  - G4.4 Spin Casting Broken
  - G4.5 Wash One Direction Only
  - G4.6 Spin Solenoid Problems
- G5 Other Problems**
  - G5.1 Water Leaks
    - G5.1.1 Tub to Pump Hose Replacement
  - G5.2 Lid O/B Switch Problems
    - G5.2.1 Lid Repair
  - G5.3 Motor/Controller Electrical Problems
  - G5.4 Belt Problems
  - G5.5 Machine flooding the Laundry
  - G5.6 Timer Knob Problems
  - G5.7 Timer Problems
- G6 Transmission Rebuild**
- G7 Other Transmission Repairs**

- G7.1 Bottom Shaft Drive Block Problems
- G7.3 Bottom Transmission Repairs
- G7.4 Bottom Shaft Repairs
- G8 Motor Electrical Problems and Test**
- G9 Special Tools**
  - G9.1 Spanner
  - G9.2 Transmission Puller
  - G9.3 Spin Seal Fitting Tool

## **Simpson Top Suspension machine Data**

- GD1 General Wiring**
- GD2 Forward & Reversing Motor Controller**
- GD3 Module tester**
- GD4 Testing the Motor and Wiring Harness**
- GD5 Break arm Motor (Dumper Motor)**
- GD6 Some Wiring Diagrams**
- GD7 Simpson With Electronic Controller and Speed Sensor**
  - GD7.1 Resistance Measurements
  - GD7.2 Voltage Measurements
- GD8 Electrolux Help Line**

## **H Hoover Capacitor Run (960+ & 510+)**

- H1 Model Information**
  - H1.1 Operation
- H2 Access (Large Machines)**
  - H2.1 Control Panel
  - H2.2 Front Panel (motor and wash bowl)
  - H2.3 Remove Top
  - H2.4 Remove Wash bowl
- H3 Access (Medium Machines)**
  - H3.1 Control Panel
  - H3.2 Remove Top
  - H3.3 Access to motor and Pump
  - H3.4 Removing the Wash Bowl
- H4 Testing Procedures**
- H5 Common Problems**
  - H5.1 Water Valves
    - H5.1.1 Water Valves Replacement (Large Machines)
    - H5.1.2 Water Valves Replacement (Medium Machines)
  - H5.3 Water Leaks
    - H5.3.1 Water Leaks (Large Machines)
    - H5.3.2 Water Leaks (Medium Machines)
  - H5.4 Spin Problems
    - H5.4.1 No Spin with Zero Electrical Current
    - H5.4.2 No Spin with Electrical Current
    - H5.4.3 Poor Spin Performance

- H5.4.4 Spin Problems
- H5.5 Clothes Wrapping Around Agitator (During Wash cycle)
- H5.6 Water Not Draining
- H5.7 Motor not forward or Reversing (Washing)

## **H6 Some Repairs**

- H6.1 Pump Replacement
  - H6.1.1 Pump Replacement (Large Machines)
  - H6.1.2 Pump Replacement (Medium Machines)
- H6.2 Lid Repair
  - H6.2.1 Hoover Medium and Hitachi Lid Repairs
  - H6.2.2 Hoover 1010 Lid Repair
- H6.3 Belt and Motor Pulley
- H6.4 Brake Arm and Solenoid Faults
  - H6.4.1 Brake Arm Replacement
  - H6.4.2 Solenoid Replacement
- H6.5 Transmission Repairs
  - H6.5.1 Replace agitator Seal and Bearing Only
    - H6.5.1.1 Medium Machines
    - H6.5.1.2 Large Machines
- H6.6 Full Rebuild
- H6.7 Worn Dampener Pad
- H6.8 Timer and Knob Replacement
- H6.9 Hoover capacitor Run Motor Repairs
  - H6.9.1 Motor Bearings Replacement

## **H7 Motor testing Procedures**

## **H8 Special Tools**

- H8.1 Motor Pulley Puller
- H8.2 Spanner to Remove Brake Arm Pivot
- H8.3 Plug for Capacitor Run Motor Tester
- H8.4 Home Made Puller for Hoover Transmission
- H8.5 Slide Hammer

## **HX Hoover Capacitor Run Machine Data**

### **HX1 Hoover Elite 960 Motor Wiring**

### **HX2 Alternative Wiring**

### **HX3 Hoover Motor Wiring**

### **HX4 Hoover 700L Wiring**

## **J Hoover 600 – 900 series**

### **J1 Model Information**

- J1.1 Operation

### **J2 Access**

- J2.1 Access to the control Panel and Timer
- J2.2 Remove the Front Panel (Access to Motor and Other Components)
- J2.3 Water Valves

### **J3 Common Problems**

- J3.1 Water Valves
- J3.2 Pump
- J3.3 Water Leaks
- J3.4 Gearbox Problems
- J3.5 Belts and Related Problems
- J3.6 Noisy bottom Tube Bearing
- J3.7 Motor and Timer Problems
  - J3.7.1 Timer Replacement
- J3.8 Wear on the Drive Block
- J3.9 Agitator Cap bolt Rusted Tight
- J3.10 Lid Switch Problems
- J3.11 Timer Knob Problems
- J4 Some Repairs
  - J4.1 Gearbox Repair
  - J4.2 Hoover Motor Bearing Replacement

## **JD Hoover 600-900 Series Data**

- JD1 Pressure Switch Connections**
- JD2 Water Valve Connections**
- JD3 Motor Connections**
- JD4 Motor Details**
- JD5 Hoover Round Motor Connections Details (520)**

## **K Simpson 144 – 165 & Delta 10**

- K1 Model Information**
  - K1.1 Operation
- K2 Access**
  - K2.1 Motor & Pump
  - K2.2 Control Panel
  - K2.3 Water Valves
- K3 Common Problems**
  - K3.0 Problems to Watch Out For
  - K3.1 Water Valves
  - K3.2 Pump
  - K3.3 Water Leaks
  - K3.4 Gearbox Problems
  - K3.5 belt and Related Problems
  - K3.6 Motor and Timer Problems
  - K3.7 agitator Problems
  - K3.8 Spin bearing Noisy
  - K3.9 Brake Problem
  - K3.10 Timer Knob Problem
- K4 Some Repairs**
  - K4.1 Stem Nut and Seal Replacement
    - K4.1.1 More on the Agitator
  - K4.2 Gearbox Repair

- K5 Special Tools**
  - K5.1 Stem Nut Spanner
  - K5.2 Agitator Removal Tool
  - K5.3 Brake Removal (& alternative)
  - K5.4 Stem Nut Repair Tool
  - K5.5 Metal clip fitting Tool
- K6 Simpson Square Motor Repair**

## **KD Simpson 144-165 & Delta Data**

- KD1 Motor Connections**
- KD2 Replacing a two speed motor with a one speed motor**
- KD3 Simpson Two Speed Motor**

## **L Japanese & Asian Washing Machines**

- I2 Operation/Repair**
- I3 Transmission Repair**
- I5 Some Circuit Diagrams**

## **M Fisher & Paykel**

- M1 Model Information**
- M2.1 Operation**
- M2.2 Components**
  - M2.2.1 Electronic Controller
  - M2.2.2 Motor
  - M2.2.3 Speed Sensor
  - M2.2.4 Pressure Sensor (Water Level)
  - M2.2.5 Put of Balance Switch
- M3 Access**
  - M3.1 Control Panel
  - M3.2 Removing the Top
  - M3.3 Removing the Motor Control Board
  - M3.4 Access Through the Bottom
  - M3.5 Motor Removal
- M4.1 Test Procedures**
  - M4.1.1 Initial Tests
  - M4.1.2 Test for Motor control Board Replacement or Motor Faults
- M4.2 Test Mode**
- M4.3 Error Codes**
- M4.4 Binary Numbers**
- M5 Common Problems**
  - M5.1 Pump Problems
  - M5.2 Out of balance Switch Problems
  - M5.3 Lid Switch
  - M5.4 Circuit Board Failures
  - M5.5 Water Valves
  - M5.6 Noisy Bearings
- M6 Other Problems**



- M6.1 Speed Sensor Failures
- M6.2 Motor Failures
  - M6.2.1 Excessive Current on Spin
  - M6.2.2 Windings Failure
- M6.4 Diverter Valve Failure
- M6.5 Water Level Control
- M6.6 Error Codes on Power Up

**M7 Some Repairs**

- M7.1 Pump Replacement
- M7.2 Out of Balance Switch
- M7.3 Lid Switch
- M7.4 Motor Control Board Replacement
  - M7.4.1 Setting Size of Machine
- M7.5 Water Valve Replacement
- M7.6 Spin Bearing Replacement
- M7.7 Fisher & Paykel Double Valve Replacement

**M8 Special Tools**

- M8.1 Out of balance Bypass Plug
- M8.2 Lid Magnet
- M8.3 Speed Sensor Tester
- M8.4 Socket to Measure Resistance

**M9 Data**

- M9.1 Fisher & Paykel Size

## **N Whirlpool (Top Loaders)**

**N1 Operation**

**N2 Access**

- N2.1 Control Panel
- N2.2 Cabinet Removal
- N2.3 Agitator Removal
- N2.4 Gearbox Removal

**N3 Common Problems**

- N3.1 Broken Coupling
- N3.2 Leaking Pump
- N3.3 Timer Motor Failure
- N3.4 Lid Switch Breaking
- N3.5 No Spin
- N3.5 Clicking Noise on Spin

**N4 Special Tools**

- N4.1 Lid Switch Over Ride Plug
- N4.2 Whirlpool Motor Tester

## **O Kleenmaid**

**O1 Model Information**

**O2 Access**

- O2.1 Remove the Front Panel

- O2.2 Control Panel
- O2.3 Cabinet & Wash bowl
- O2.4 Agitator Removal and Splash Ring
- O2.5 Hinge the Top Up
- O3 Common Problems
  - O3.1 Water Leaks
  - O3.2 Timer Knob
  - O3.3 Belts
- O4 Some Repairs
  - O4.1 Timer Knob
  - O4.2 Pump Replacement
  - O4.3 Spin Seal
  - O4.4 Spin Bearing
  - O4.5 Brake Replacement
  - O4.6 Motor Replacement

## **P Maytag**

### **P1 Model Information**

### **P2 Access**

- P2.1 Remove the Front Panel
- P2.2 Hinge the Top Up
- P2.3 Removal and Fitting the Splash Ring
- P2.4 agitator Removal
- P2.5 Belts

### **P3 Access (Performa)**

- P3.1 Removal of Front Panel and Hinge the top Up
- P3.2 Removal of Splash Ring

### **P4 Common Problems**

- P4.1 Belts

### **P5 Some Repairs**

- P5.1 Stem Nut and Seal Replacement

### **P6 Special Tools**

## **R Front Loader Washing Machines**

### **R1 General Operation**

### **R2 Front Loader Components**

- R2.1 Soap Draws
- R2.2 Heating
- R2.3 Motors
- R2.3 Door Interlock
- R2.4 Timer & Electronic Controllers

### **R3 Access**

### **R4 Common Problems**

### **R5 Some Repairs**

- R5.1 Drum Removal
- R5.2 Door Seal Replacement

## **R6 Model Information**

(Machines are not listed in alphabetical order)

### **R6-H Hoover Front Loader Washing Machine**

- R6-H1 Model Information
- R6-H2 Drum Removal
- R6-H3 Repair to Stainless Steel Barrel
- R6-H4 Hoover Front Loader Data
  - R6-H4.1 Interlock Switch
  - R6-H4.2 Water Valve Connections
  - R6-H4.3 Series Motor Connections
  - R6-H4.4 Capacitors Run Motor Connections

### **R6-S Simpson (Electrolux) Front Loader Machines**

- R6-S1 Model Information
- R6-S2 Drum Removal
- R6-S3 Motor Bearing Replacement
- R6-S4 Series Motor
- R6-S5 Door Interlock Switch

### **R6-LG Front Loader Washing Machines**

- R6-LG1 Model Information
- R6-LG2 Drum Removal
- R6-LG2 Door Seal Replacement
- R6-LG2 Lower Circuit Board Replacement
- R6-LG3 Error codes

### **R6-Bosch**

- R6-B Series Motor Connections/Interlock SW

### **R6-ASKO**

### **R6-X Other Brands of Front Loaders**

- R6-X1 Hotpoint & GE Front Loader Drum Bearing Replacement
- R6-X2 DEC Door Seal Replacement

## **S Dryers**

### **S1 Basic Operation**

- S1.1 Dryer brackets**
- S1.3 Cleaning Inside of Dryer**

### **S2 Simpson Dryer**

- S2.1 Changes**
- S2.2 Access**
- S2.3 Drum Belt Replacement**
- S2.4 Faults & Repairs**
  - S2.4.1 Fan Belt Replacement
  - S2.4.2 No Heat
  - S2.4.3 Element Replacement
  - S2.4.4 Front Drum bearing Replacement
  - S2.4.5 Idler Pulley Replacement
  - S2.4.6 Timer Replacement
  - S2.4.7 Motor Problems
  - S2.4.8 Back Bearing Replacement

**S2.5 New Simpson Dryer**  
**S2.6 Simpson Dryer Data**

**S3 Hoover Dryer**

**S3.1 Changes**

**S3.2 Access**

**S3.4 Faults and Repairs**

S3.4.1 No Heat

S3.4.2 Discomelt Replacement

S3.4.3 Element Replacement

S3.4.4 Drum Bearing Replacement

S3.4.5 Start Switch

S3.4.6 Motor Problems

**S3.5 Hoover Dryer Data**

**S4 Fisher & Paykel Dryer**

**S4.1 Access**

**S4.2 Faults & Repairs**

S4.2.1 Door Switch Not Working

S4.2.2 Back Bearing Failure

S4.2.3 Dryer Not Turning Off

S4.2.4 Motor Problems

**S4.3 Fisher & Paykel Dryer Data**

**S5 New Simpson Dryer**

**S5.1 Access, Faults and Repairs**

**S6 Whirlpool Dryer**

**T Dishwashers**

**T1 General Operation**

**T2 Anti-flood for Dishwashers**

**T3 Do Not Run the Dishwasher With Out Water**

**T4 Other Features**

**T5 Initial Test**

**T6 Access**

**T7 Dishwasher Components**

**T8 Common Problems and Repairs**

**T8.1 Earth Leakage**

**T8.2 No Heat**

**T8.3 Broken Wires on Door Movement**

**T8.4 Switch Failures**

**T8.5 Drain Pump on All the Time**

**T8.6 Wash Motor not Operating**

**T8.7 Door Catch Broken**

**T8.8 Door Seals Leaking**

**T8.9 Water Valves**

**T8.10 No Drain**

**T8.11 Controller Failure**

**T8.12 Soap Dispenser Failure**

**T8.13 Cycle not Completing (Run Continuously)**

**T8.14 No Heat (Another Reason)**

**T9 Dishlex Dishwasher**

**T10 Miele Dishwasher**

**T11 Fisher & Paykel Dishwasher**

**T12 Fisher & Paykel Dishdraw**

**T13 Chinese Dishwasher**

**T14 Blanco Dishwasher**

**T15 ASKO Dishwasher**

## **U Twin Tub Washing Machines**

**U1 Asian and Hoover Twin Tubs**

## **V Vacuum Cleaners**

**V1 General Information**

**V2 access**

**V3 Faults and Repairs**

(Testing, blocked hoses, mains lead failure, switch failures, motor replacement)

**V4 model Information**

## **W Refrigerators**

(Coming soon)

## **Z Related Matters**

**Z1 Records**

**Z2 Customer Advice**

**Laundry Design**

## **Appendix**

### **A1 In-line ammeter**

### **A2 Hoover Timer Wires Colours**

### **A3 Some Techniques**

**A3.1 Rocking Fit.**

**A3.2 Bolts Tight or Rusted.**

**A3.3 Bolts Tight in Aluminum Castings.**

**A3.4 Removing Ball Races**

**A3.5 Parts Replacement**

**A3.6 Wash Bowl Removal (Alternative)**

**A3.10 Electrostatic Discharge**

### **A4 Colours Abbreviations**

(Use in this book)

### **A5 Binary Numbers ^**

(For Fisher & Paykel Error codes)

### **A6 Gray Water Use and Your Washing Machine ^**

### **A7 Pumping Gray Water with a Dishwasher**

### **A8 Ball Bearing ^**

### **A10 Late Entries**

(Late entry that did not get into the main part of the book.)

### **A20 Miscellaneous Motor Connections ^**

### **A21 Reuse of Washing Motors (Part A) ^**

### **A22 Reuse of Washing Motors (Part B) ^**

^ These are not printed to keep cost down, but can be downloaded from my web site .