SERIES 4

PROGRAMMABLE   LOGIC

CONTROLLER

(APL 619990587)

TROUBLESHOOTING   GUIDE

```
                                              INPUTS:
              |  |  |  |  |  |  |  |  |         -FORMULA PB
              |  |  |  |  |  |  |  |  |         -LEVEL SWITCH
          +----+--+--+--+--+--+--+--+--+-----+ -TEMP GAUGE
          |    +---------------------------+ |
          |    |                           | |
          |    |       INPUT BOARD         | |
          |    +---------------------------+ |
+---------+ |        +---------------+       |
|         +----|      |               |       |
| POWER   +----|      |     CPU       |       |
| SUPPLY  +----|      |               |       |
+---------+ |        +---------------+       |
          |    +---------------------------+ |
          |    |                           | |
          |    |      OUTPUT BOARD         | |
          |    +---------------------------+ |
          +----+--+--+--+--+--+--+--+--+-----+
              |  |  |  |  |  |  |  |  |
              |  |  |  |  |  |  |  |  |       OUTPUTS:
                                              -BRAKE
                                              -CLUTCH
                                              -MOTOR
                                               STARTER
                                              -SOLENOID
                                               VALVES
                                              -INDICATOR
                                               LIGHTS
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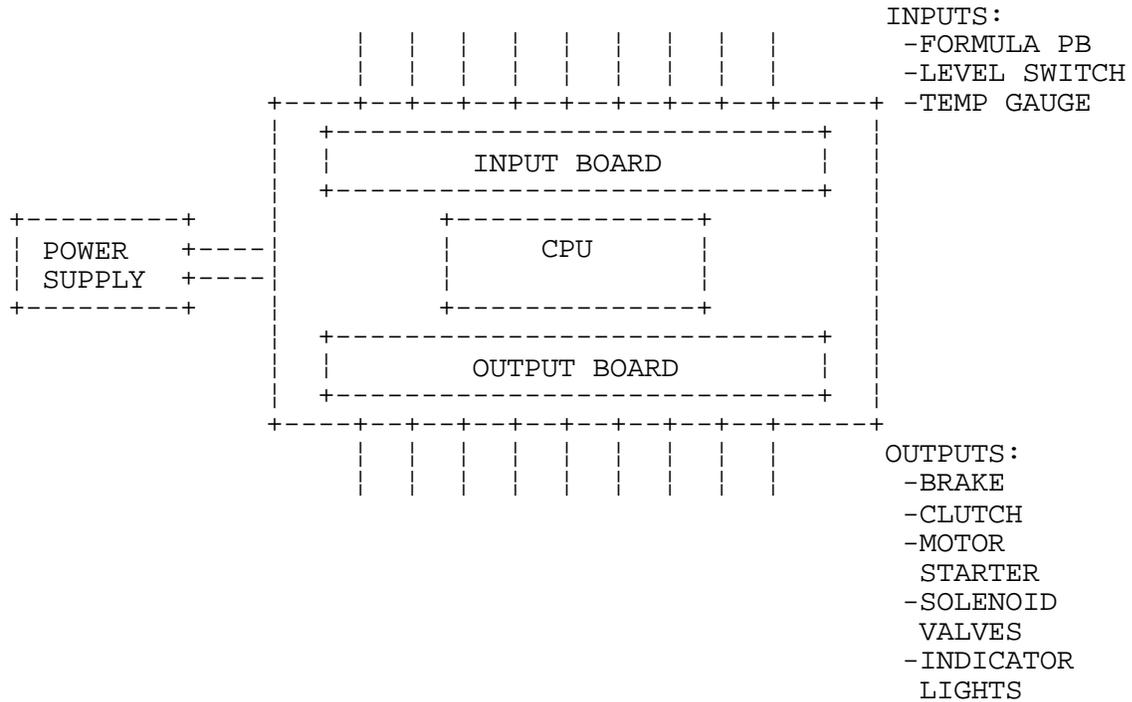
TROUBLESHOOTING

The technology inherent in the Programmable Logic Controller (PLC) eliminates the requirement for electro-mechanical devices such as control relays and timers and allows for exact operation of the pre-programmed formulas through electronic circuits, timers and counters. The programming logic of the PLC is a sequence design method for applications where outputs (motor starters, solenoid valves, etc.) are controlled according to a sequence of achieved events or inputs (limit switches, push buttons, operator controls, etc.).

When a PLC controlled machine or process stops, it is almost invariably a field device, such as a limit switch, solenoid valve or tripped overload, that has caused the process to shut down. These field devices can be on the input or output side of the PLC. PLCs have proven themselves to be very reliable and have a wide range of complex applications, such as controlling machinery on automotive assembly lines, to simple applications such as controlling traffic signals. However, PLCs do sometimes fail. If a failure does occur it is important to be able to first make a decision as to whether the problem is in the PLC or in the field.

The first thing to check when troubleshooting a PLC is to confirm the PLC power and run lights are on and the fault light is off. If the PLC power light is off there is likely an open circuit in the field power or control circuitry (see troubleshooting chart No. 1). The run light and fault light (PROG-E/CPU-E) on the PLC will identify if the program is running or has a fault. If the CPU run light is on and the fault light is out you can be confident the PLC has not failed internally. If the CPU is not running and/or the fault light is on, disconnect power to the machine for a few seconds and then switch it back on and attempt to run the formula. This may clear the fault on the PLC.

If the PLC still does not run the battery backup for program memory may be dead **if the PLC is <u>not</u> programmed with EEPROM type memory**. The PLC uses a battery backup for **RAM** program memory when power is lost or disconnected to the PLC. The battery is not used while the PLC is energized. If the battery is dead the program is lost and the program must be replaced. This can be easily accomplished by installing a preprogrammed EEPROM chip supplied by the OEM into the appropriate pin terminal located in the recess behind the PLC's cover. EEPROM memory will not require replacement of the battery as the program memory is permanently burnt into the EEPROM chip. The life cycle of the battery is dependent on how often the power to the PLC is disconnected. The battery should last a minimum of three years without power to the PLC and up to ten years if the PLC is continually energized. (NOTE: THE COMPLETE CONTROL CIRCUIT MUST BE CLOSED TO ENERGIZE THE PLC AND OVERRIDE THE BATTERY BACKUP)

If it is determined the battery backup is not dead and the PLC fault remains, the problem is inside the PLC and the PLC input/output unit must be replaced.

If the PLC is running and not in the fault mode,

troubleshooting of the field devices connected to the PLC must be accomplished. In order to facilitate troubleshooting, the maintenance personnel must have an understanding of the operation of the machine corresponding to the programmed formulas (i.e. knowing what the machine is supposed to be doing at a certain point in the formula and why). The enclosed formula chart provides the specific program sequence.

If an output such as a solenoid valve, motor contactor, etc. is not activated and the corresponding PLC LED output indicator light is off you must search backwards to determine what sequence or input is preventing the output from coming on. In most cases the search will lead to an input (level or bath temperature) that is not in the correct state to satisfy the programming logic.

When an input, such as the formula push button, level switch or temperature gauge, is found that is preventing the formula from proceeding, the specific physical input must be checked. Check the LED indicator light and corresponding voltage at the specific input terminal. If the LED light is out and no voltage is present physically make the contact on the switch if possible. Monitor the corresponding PLC LED input indicator light. If the light goes on and the program advances as anticipated the problem is in the switch. If light does not illuminate recheck the voltage at the input terminal. If no voltage is present on the input terminal the problem is an open circuit in the field wiring likely due to a loose connection on a terminal board. If voltage is present on the input terminal point (and all other inputs are in the correct state) but the output status does not change, as indicated by the output devices themselves or the output indicator lights, the PLC input board and/or input relay is faulty preventing the program from advancing and the PLC must be replaced.

If the inputs are in the correct state (i.e. water level and bath set point temperature attained) and an output does not energize as shown by the PLC LED output indicator light, check the corresponding voltage at the output terminal. If voltage is not present the PLC output board and/or output relay is faulty and the PLC must be replaced. If voltage is present on the output terminal the problem is an open circuit in the field wiring or a faulty field device such as a stuck solenoid or a tripped overload.

Although the PLC LED indicator lights corresponding to each individual output are a convenient troubleshooting tool they do not guarantee the PLCs internal output relay has closed. The LED indicator lights are internally wired in **parallel** with the corresponding output relay therefore the light only indicates the program has sent the signal to close the output relay. Therefore, the actually voltage must be measured at the specific output terminal in question in order to verify the state of the output. For example, if the machine is supposed to be filling with hot water, output Y12 should be energized opening the hot water solenoid valve and the corresponding led indicator light illuminated. If the LED light is on but no voltage is present at the Y12 output terminal the internal relay is damaged and the PLC

must be replaced. The internal relays can not be repaired. If voltage is present, there is either a break in the circuit going to the solenoid or the valve itself is stuck closed.

If an internal input or output relay is damaged it is possibly the result of an electrical short in the field device it is connected to. Therefore, it is imperative to troubleshoot and correct any potential electrical problem with the field device prior to replacing the PLC otherwise the new PLC may also fail.

In the majority of troubleshooting cases the underlying cause of the problem will be in the field devices or an open circuit in the field input/output wiring to the PLC. There may be instances when the operation of the machine appears to be dormant (not timing out) or does not extract at the specified formula times. This is likely due to the following programmed interlocks:

1. Heater (set point 2) will not energize until low water level is attained.

2. Timing of the program will not advance until the water level and set point 2 (heater) are attained.

3. The machine will not extract with a water level of approximately four inches or more in the shell (Input terminal X7).

For information concerning the contents of this troubleshooting guide or additional operational or troubleshooting assistance contact Mr. Joe Bowen, NSWCCD-SSES c/9790, Life-Cycle-Equipment-Manager, at 215-897-7925, or Mr. Dave Powell, NEXCOM c/A3, Habitability Branch Manager, at 757-444-4748/34739.

TABLE 7-2
PLC TROUBLESHOOTING GUIDE

SYMPTOM	CORRECTIVE ACTION
1. FORMULA DOES NOT ACTIVATE PLC POWER/RUN LIGHTS OFF	• Check power supply/control circuit • Check 440V/220V transformer • Check fuses • Check vibration switch; reset if tripped • Check Emergency Stop push-button • Check 24V relay • Check door switch • Check 220V/24V transformer • Check power ON/OFF switch • Check low air switch
PLC POWER/RUN LIGHTS ON	• Check LED input indicator light corresponding to formula push-button (X1 for Formula 1). • If LED is illuminated, verify voltage to corresponding input terminal. • If voltage is present at input terminal corresponding to formula, check LED output lights and terminal voltages corresponding to wash motor, clutch, water valves, etc.
2. MACHINE QUICKLY CYCLES ON AND OFF WITH LOUD HAMMERING NOISE	• Verify air pressure gauge setting of 85 PSI (80 PSI minimum - 100 PSI maximum). • Verify low-pressure air switch setting of 50 PSI.
3. MACHINE DOES NOT FILL	• Check LED input indicator light corresponding to level (X5 for low) and LED output lights corresponding to drain (Y27) and water valve (Y12 for HOT). • X5 should be OFF indicating level has not been reached, Y27 should be ON indicating drain is closed, Y12 should be ON indicating solenoid valve is open. • Verify corresponding voltages. • If X5 is ON, level switch may be broken or out of adjustment. • If Y27 is ON and drain is open, check drain solenoid valve and air supply to drain cylinder. • If Y12 is ON, check voltage at water solenoid valve or valve may be stuck closed.

TABLE 7-2
PLC TROUBLESHOOTING GUIDE-CONT.

SYMPTOM	CORRECTIVE ACTION
4. MACHINE CONTINUES TO FILL	• Check LED input indicator light corresponding to level (X5 for low) and LED output light corresponding to water valve (Y12 for HOT). • X5 should be ON indicating level has been reached, Y12 should be OFF indicating solenoid valve is closed. • Verify corresponding voltages. • If X5 is OFF, pressure bowl may be clogged or level switch may be broken or out of adjustment. • If Y12 is OFF, solenoid valve is likely stuck open.
5. WASH MOTOR WILL NOT START IN AUTOMATIC MODE	• Check LED output indicator lights corresponding to disk brake (Y0), wash motor (Y4 FWD, Y5 REV) and clutch (Y1). • Y0 should be ON indicating brake is disengaged. Y4 or Y5 should be ON indicating wash motor contactor has been energized. Y1 should be ON indicating clutch has engaged. • Check clutch. Check for sufficient air pressure. Check for leakage from clutch exhaust valve. • Check motor starter and heater coils. • Check brake. • Check is motor operates in JOG. • Check door switch circuit.
IN JOG	• Check door switch circuit. • Check vibration switch and Emergency Stop button. • Check clutch. Check for sufficient air pressure. Check for leakage from clutch exhaust valve. • Check brake.

NOTE
JOG function is independent of PLC circuit.

TABLE 7-2
PLC TROUBLESHOOTING GUIDE-CONT.

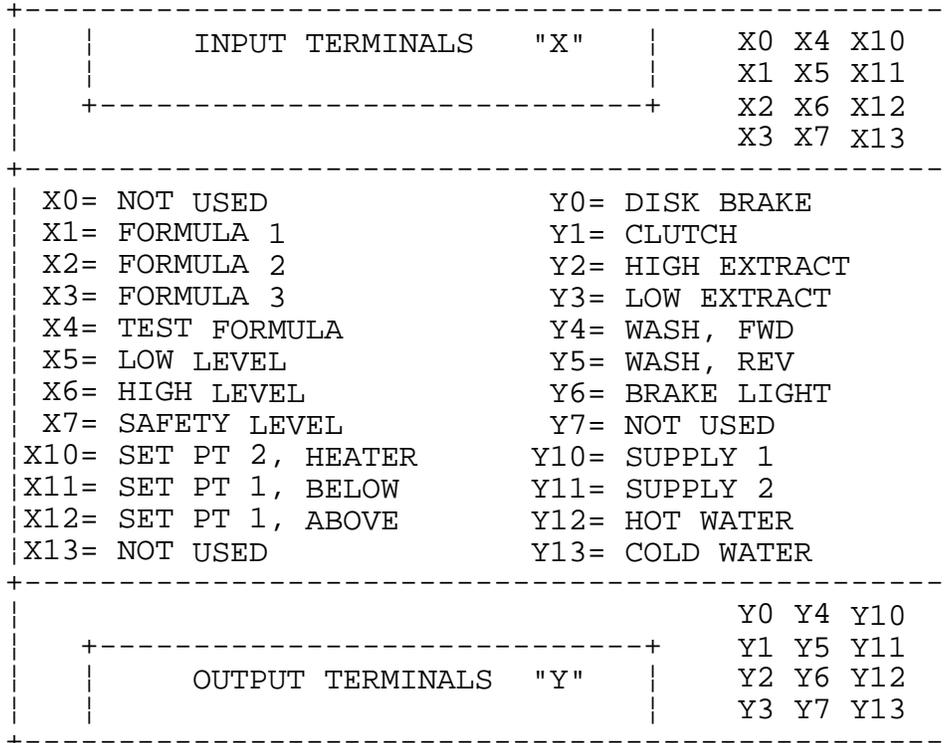| SYMPTOM	CORRECTIVE ACTION
6. HEATER DOES NOT ENERGIZE WHEN BATH TEMPERATURE IS BELOW SET POINT 2	• Verify set point 2 (SP + AL) is above bath temperature. • Check LED input indicator light corresponding to level (X5 for low) and set point 2 (X10) and LED output light corresponding to heater (Y21). • X5 should be ON indicating level has been reached (heater will not energize until level is reached), X10 should be OFF indicating set point has not been reached. If X5 is ON and X10 is OFF, Y21 should be ON indicating heater is energized. • Verify corresponding voltages. • If X5 is OFF, see No. 4 above. • If X10 is ON, wire connections may be loose or temperature probe or gauge is likely broken. • If Y21 is ON, heater should be energized. Check heater solenoid valve or contactor.
7. HEATER DOES NOT DEENERGIZE WHEN BATH TEMPERATURE REACHES SET POINT 2 (TIMER WILL NOT ADVANCE)	• Verify bath temperature is above set point 2 (SP + AL). • Check LED input indicator light corresponding to set point 2 (X10) and LED output light corresponding to heater (Y21). • X10 should be ON indicating set point 2 has been reached and Y21 should be OFF indicating heater is OFF. • If X10 remains OFF and Y21 remains ON, wire connections may be loose or probe or gauge is likely broken.
8. FORMULA DOES NOT ADVANCE	• Formula time will not advance until water level and set point 2 are attained. • Heater (Y21) will not energize until low level is reached. • Check LED input indicator lights corresponding to low level (X5) and set point 2 (X10). • X5 and X10 should be ON **IF** water level and set point 2 were attained. Formula time should advance. • If X5 is OFF, check water level switch. • If X10 is OFF, check temperature gauge and probe.

TABLE 7-2
PLC TROUBLESHOOTING GUIDE-CONT.

SYMPTOM	CORRECTIVE ACTION

8. (CONT.)

> *NOTE*
>
> If inlet water temperature is well below set point 2 and/or heater does not boost bath temperature at an acceptable rate (10-15^0 F/minute) due to inadequate ship services, set point 2 (SP + AL) can be reduced below the actual bath temperature in order for timing to advance.

9. MACHINE WILL NOT EXTRACT
   LOW EXTRACT

- Check LED input indicator light corresponding to safety level (X7) and LED output light corresponding to low extract (Y3).
- X7 should be ON indicating the water level is below a preset safety level (normally less than 4") and Y3 should be ON indicating the low extract contactor is energized.
- Verify corresponding voltage.
- If X7 is OFF and machine is empty, pressure bowl may be clogged or water level switch may be broken or out of adjustment.
- If Y3 is ON check motor contactor, overloads, motor thermoguards, etc.
- Check clutch releases.

   HIGH EXTRACT

- Check LED output indicator light corresponding to high extract (Y2).
- Y2 should be ON indicating high extract contactor is energized.
- Verify corresponding voltage.
- If Y2 is ON, check contactor, overloads, motor thermoguards, etc.

> *NOTE*
>
> If extract motors do not start or trip out, it is very likely due to a tripped heater coil due to excessive current drawn by the motor. This condition **WILL NOT** interrupt the timing of the formula. Cause of overload condition must be determined and corrected to eliminate tripping of contactor.
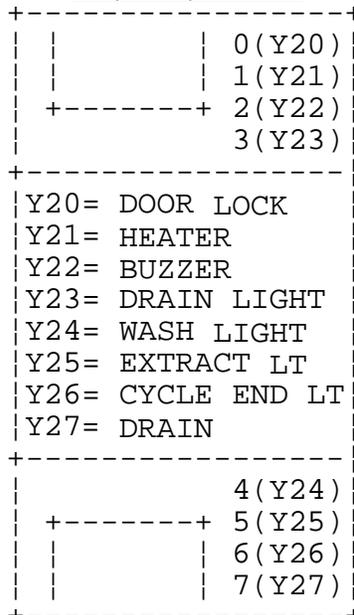
TABLE 7-2
PLC TROUBLESHOOTING GUIDE-CONT.

SYMPTOM	CORRECTIVE ACTION
10. EXTRACT MOTOR CYCLES ON AND OFF INTERMITTENTLY.	• Check LED input indicator light corresponding to water safety level (Y7). • X7 must remain ON during extract. • If LED input light corresponding to X7 is cycling ON and OFF during extract, the set screw in the water level switch is loose and has backed out too far causing the switch to cycle under vibration. Reset the screw.
11. FORMULA IS INTERRUPTED SIMULTANEOUSLY WITH A FIELD DEVICE BEING ENERGIZED AND EITHER SKIPS TO NEXT STEP OR RESETS TO BEGINNING OF FORMULA.	• Interruption is likely caused by an electrical short in a field device being energized by the corresponding PLC output. This situation will cause the PLC to shut down for a split second and result in either a reset to the next step in the formula or reset to the beginning of the formula.

CAUTION
The machine should be secured until corrective action is taken to repair the field devise causing the problem, or the PLC output relay will be permanently damaged.

12. TIMER/COUNTER DISPLAY IS ERRONEOUS AND ERRATIC	• Check wire connections. • Check dip switch settings.

NOTE
Timer/Counter failure will not effect machine operation or proper sequencing of formulas.

13. MAIN DOOR PROBLEMS **DOES NOT OPEN**	• Check door-locking pin. Y20 should be OFF indicating pin is released. • Check if door pin is bent or stuck on opening in main door.
DOES NOT CLOSE PROPERLY	• Check and replace door gasket as necessary. • Adjust the locking nut on the door handle to provide the proper pressure when closed.

FIGURE 7-1
PLC INPUT/OUTPUT DIAGRAM

Programmable Logic Controller:

```
+-----------------------------------------------------+
|       |                               |             |
|       |      INPUT TERMINALS    "X"   |    X0 X4 X10 |
|       |                               |    X1 X5 X11 |
|       +-------------------------------+    X2 X6 X12 |
|       |                                    X3 X7 X13 |
|                                                      |
+-----------------------------------------------------+
|  X0= NOT USED              Y0= DISK BRAKE            |
|  X1= FORMULA 1             Y1= CLUTCH                |
|  X2= FORMULA 2             Y2= HIGH EXTRACT          |
|  X3= FORMULA 3             Y3= LOW EXTRACT           |
|  X4= TEST FORMULA          Y4= WASH, FWD             |
|  X5= LOW LEVEL             Y5= WASH, REV             |
|  X6= HIGH LEVEL            Y6= BRAKE LIGHT           |
|  X7= SAFETY LEVEL          Y7= NOT USED              |
| X10= SET PT 2, HEATER     Y10= SUPPLY 1             |
| X11= SET PT 1, BELOW      Y11= SUPPLY 2             |
| X12= SET PT 1, ABOVE      Y12= HOT WATER            |
| X13= NOT USED             Y13= COLD WATER           |
+-----------------------------------------------------+
|                                            Y0 Y4 Y10 |
|       +-------------------------------+    Y1 Y5 Y11 |
|       |                               |    Y2 Y6 Y12 |
|       |      OUTPUT TERMINALS   "Y"   |    Y3 Y7 Y13 |
|       |                               |             |
+-----------------------------------------------------+
```

Output Expander #1:   Output Expander #2:

```
+----------------+     +----------------+
| |          | 0(Y20)|     | |          | 0(Y30)|
| |          | 1(Y21)|     | |          | 1(Y31)|
| +-------+ 2(Y22)|     | +-------+ 2(Y32)|
| |          | 3(Y23)|     | |          | 3(Y33)|
+----------------+     +----------------+
|Y20= DOOR LOCK  |     |Y30= COUNTER    |
|Y21= HEATER     |     |Y31= COUNTER    |
|Y22= BUZZER     |     |Y32= NOT USED   |
|Y23= DRAIN LIGHT|     |Y33= NOT USED   |
|Y24= WASH LIGHT |     |Y34= COUNTER    |
|Y25= EXTRACT LT |     |Y35= COUNTER    |
|Y26= CYCLE END LT|    |Y36= COUNTER    |
|Y27= DRAIN      |     |Y37= COUNTER    |
+----------------+     +----------------+
|          4(Y24)|     |          4(Y34)|
| +-------+ 5(Y25)|     | +-------+ 5(Y35)|
| |          | 6(Y26)|     | |          | 6(Y36)|
| |          | 7(Y27)|     | |          | 7(Y37)|
+----------------+     +----------------+
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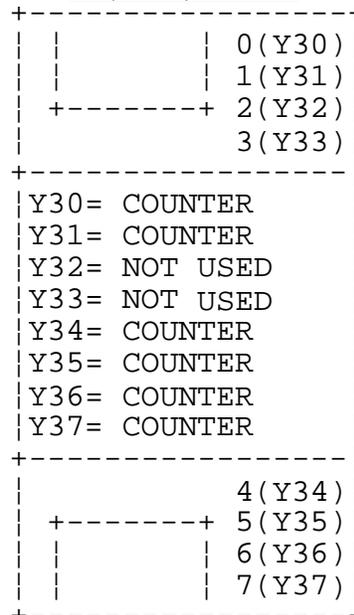
TABLE 7-1
PLC INPUT/OUTPUT FUNCTIONAL DESCRIPTION

The EDRO Series 4 PLC may be monitored and diagnosed by looking at the input LEDs labeled with X's and output LEDs labeled with Y's.

INPUTS TO THE PLC:

        X1 : Formula 1. - When push-button for formula 1 is pushed in X1 LED should be ON. If LED does not go ON check the push-button it may be defective.

        X2 : Formula 2. - When push-button for formula 2 is pushed in X2 LED should be ON. If LED does not go ON check the push-button it may be defective.

        X3 : Formula 3. - When push-button for formula 3 is pushed in X3 LED should be ON. If LED does not go ON check the push-button it may be defective.

        X4 : Test formula. - When the key for test formula is turned to ON X4 LED should be ON. If LED does not go ON check the key switch it may be defective.

        X5 : Low water level. - When X5 LED is ON it is showing that the low water level has been reached. If low water level is reached and the LED fails to go ON first check the pressure bowl, it may be blocked. Then check the plastic tube connecting pressure bowl to the water level switch it should be air tight. Finally check the wire connection from water level switch to the PLC. If all is O.K. water level switch is broken or needs adjustment.

        X6 : High water level. - When X6 LED is ON it is showing that the high water level has been reached. If high water level is reached and the LED fails to go ON first check the pressure bowl, it may be blocked. Then check the plastic tube connecting pressure bowl to the water level switch it should be air tight. Finally check the wire connection from water level switch to the PLC. If all is O.K. water level switch is broken or needs adjustment.

        X7 : Safety water level. - When X7 LED is OFF it is showing that there is water in the machine. In this case the machine will not go into extract until the water is drained. If machine has no water but the X7 LED is OFF first check the pressure bowl, it may be blocked. Then check the plastic tube connecting pressure bowl to the water level switch it may be blocked. Finally check the wire connection from water level switch to the PLC. If all is O.K. water level switch is broken or needs adjustment.

        X10 : Steam temperature set-point 2. - When X10 LED is ON set point 2 has been reached and steam should be turned OFF. If set point 2 has been reached and LED is not ON check the wire connections from temperature probe to temperature controller and from temperature controller to the PLC. If connections are O.K. than your temperature probe or your temperature controller is broken.
        Also if X10 LED is ON before set point 2 is reached check the above connections if connections are O.K. than your temperature probe or your temperature controller is broken.

        X11 : Both X11 and X12 signal temperature set point 1. When below set point 1 X11 should be ON and X12 should be OFF. When above set-point 1 X11 should be OFF and X12 should be ON. If these conditions are not true check the wire connections from temperature probe to temperature controller and from temperature controller to the PLC. If connections are O.K. then your temperature probe or your temperature controller is broken.

        X12 : SEE X11.

OUTPUTS OF THE PLC:

Y0: Main Brake: When LED is ON brake should be disengaged. If brake is engaged check the brake solenoid.

Y1: Clutch: When LED is ON clutch should be engaged. If clutch is disengaged check the clutch solenoid.

Y2: High Extract: When LED is ON machine should be in high extract. If machine is not in high extract first check the overloads in the starter, then check the thermal overloads in the motor, and finally check the high extract starter.

Y3: Low Extract: When LED is ON machine should be in low extract. If machine is not in low extract first check the overloads in the starter, than check the thermal overloads in the motor, and finally check the low extract starter.

Y4: Wash Forward: When LED is ON machine should be washing in clockwise direction. If machine is not washing first check the overloads in the starter, then check the normally closed contact on the wash reverse contactor, and finally check the wash contactor.

Y5: Wash Reverse: When LED is ON machine should be washing in counter clockwise direction. If machine is not washing first check the overloads in the starter, than check the normally closed contact on the wash forward contactor, and finally check the wash contactor.

Y6: Brake Light: If brake light does not go ON check the light bulb.

Y10: Supply 1: When LED is ON supply one should be ON. If supply 1 does not work check the supply 1 inlet valve.

Y11: Supply 2: When LED is ON supply two should be ON. If supply 2 does not work check the supply 2 inlet valve.

Y12: Hot Water: When LED is ON hot water should be coming IN. If Hot water fails to come IN check the hot water inlet valve. If the LED does not light up when hot water is needed check the water level switch.

Y13: Cold Water: When LED is ON cold water should be coming IN. If cold water fails to come IN check the cold-water inlet valve. If the LED does not light up when cold water is needed check the water level switch.

Output Expander 1

Y20 (Y0): Door lock: When LED is ON door is locked. If door fails to lock check the door Solenoid.

Y21 (Y1): Heater: When LED is ON steam valve is open. If steam fails to come in check the steam valve.

Y22 (Y2): Buzzer: When LED is ON buzzer should be ON. If buzzer fails check the buzzer.

Y23 (Y3): Drain Light: If DRAIN light fails to go ON check the light bulb.

Y24 (Y4): Wash Light: If WASH light fails to go ON check the light bulb.

Y25 (Y5): Extract Light: If EXTRACT light fails to go ON check the light bulb.

Y26 (Y6): Cycle End Light: When LED is ON the formula has finished and FINISH light should be on. If light does not go ON check the light bulb.

Y27 (Y7): Drain: When ON drain should be closed. If drain fails to open check the drain solenoid.

Output Expander 2

Y30 (Y0) through Y37 (Y7) are controlling the step and time counter. If the step counter is not working properly replace the entire step counter unit.

TABLE 1-1
STANDARD NAVY WASH FORMULAS

FORMULA I and II - WHITE COLORFAST COTTON, SYNTHETIC, AND BLENDED FABRICS,
COLORED COTTON, SYNTHETIC, AND BLENDED FABRICS.

Step	Operation	Step Time	Descending Time	Water	Set Point / Temp. Setting	Water Level Steam/Electric	Supplies
1	Break/Suds	10	37	Hot	Set Pt. 2/130 °F	Low - 4"/8"	Supply 1
	Drain	1	27				
2	Flush/Suds	6	26	Hot	Set Pt. 2/130 °F	Low - 4"/8"	
	Drain	1	20				
3	Extract	1.5	19				
4	Rinse	3	18	Hot	Set Pt. 2/130 °F	Low - 4"/8"	
	Drain	1	15				
5	Rinse	3	14	Hot	Set Pt. 2/130 °F	Low - 4"/8"	
	Drain	1	11				
6	Rinse	4	10	C. Temp	Set Pt. 1/130 °F	Low - 4"/8"	Supply 2
	Drain	1	6				
7	Extract	4.5	5				

FORMULA III - WOOLENS AND NONFAST COLORS

Step	Operation	Step Time	Descending Time	Water	Set Point / Temp. Setting	Water Level Steam/Electric	Supplies
1	Break/Suds	5	31	Blend	Set Pt. 2/90 °F	High - 9"	Supply 1
	Drain	1	26				
2	Flush/Suds	5	25	Blend	Set Pt. 2/90 °F	High - 9"	
	Drain	1	20				
3	Extract	1.5	19				
4	Rinse	3	18	Blend	Set Pt. 2/90 °F	High - 9"	
	Drain	1	15				
5	Rinse	3	14	Blend	Set Pt. 2/90 °F	High - 9"	
	Drain	1	11				
6	Rinse	4	10	C. Temp	Set Pt. 1/90 °F	High - 9"	Supply 2
	Drain	1	6				
7	Extract	4.5	5				

KEY SWITCH – Maintenance Test Formula (Must clear or complete prior to running other formula)

Hot = Incoming hot water only, independent of Set Points.
C. Temp = Controlled Temperature, incoming hot/cold water regulates bath temperature to Set Point 1.
Blend = Incoming hot/cold water mix independent of Set Points.
Set Point 1 = Controlled Temperature = "SP".
Set Point 2 = Heater = "SP" + "AL" (Note: Timer will not advance until Set Point temperature is reached).