Document—

Troubleshooting Basket Speed Errors on Single-motor Washer-extractors

Troubleshooting Basket Speed Errors on Single-motor Washer-extractors

This document describes the proper procedure for troubleshooting errors related to basket motor speed on machines equipped with a single motor, an inverter, and a digital-to-analog (D-to-A) board.

1. As the basket rotates, a photoeye sees each spoke of the main drive pulley. The photoeye sends a pulse representing each pulley spoke to an input/output board (I/O #1).

2. I/O #1 determines the time between pulses and communicates this to the machine processor board.

3. The processor board calculate the RPM and compares this value to the digital value corresponding to the programmed basket speed. If the speed is incorrect, the processor board signals the digital-to-analog (D-to-A) board to slightly increase or decrease the basket speed.

4. The D-to-A board converts the digital signal from the processor board to an analog voltage of 0 to 10 volts and sends it to the inverter. The speed at which the inverter drives the motor is directly related to the voltage output of the D-to-A board.

5. The inverter interprets the voltage from the D-to-A board and adjusts the voltage and frequency of the motor supply to drive the motor at a different speed.

6. The motor speed changes, causing the spokes on the main pulley to pass the photoeye at a different rate, and the speed control circuit is complete.
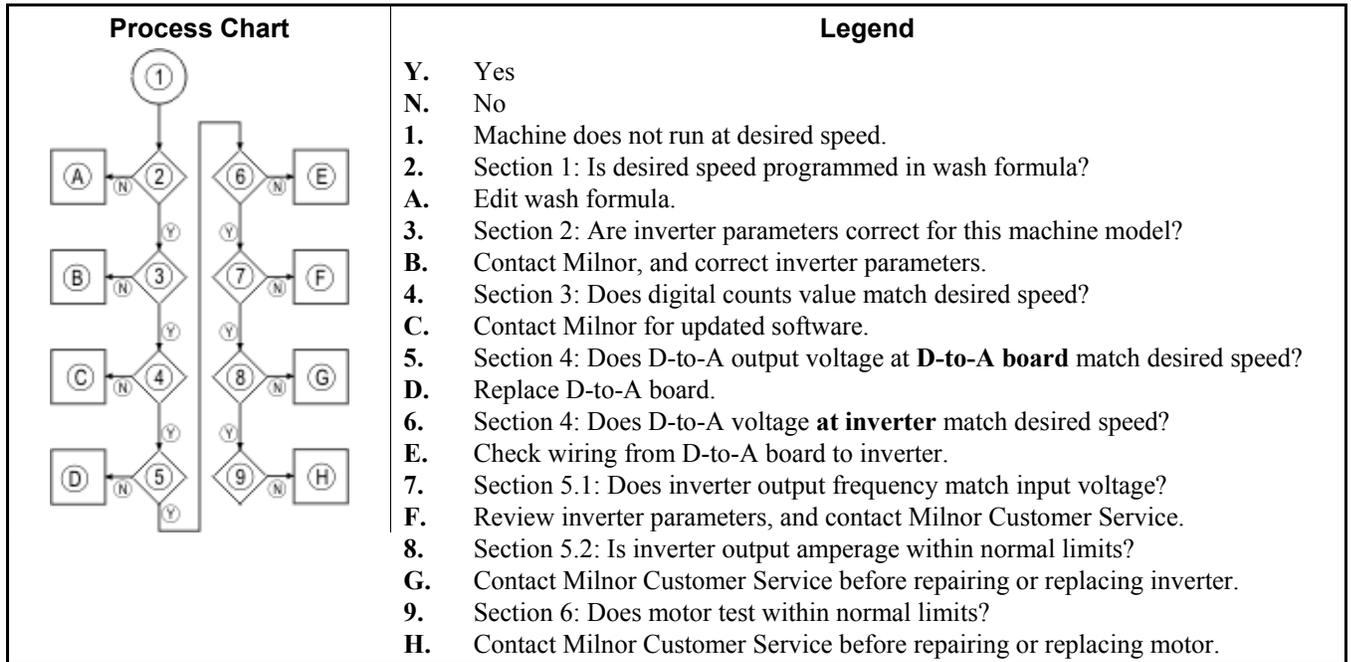
The most common indicator of a problem somewhere in the speed control circuit is that the basket does not turn at the desired speed, or does not turn at all. The chart in Figure 1 describes the overview of the troubleshooting process.

WARNING 1 : Electrocution and Electrical Burn Hazards—Hazardous voltages can cause sever injury or death.

- Whenever possible, lock all power sources feeding the inverter in the "OFF" position.
- The status indicator LEDs and the inverter display will be extinguished when the DC voltage inside the inverter is below 50VDC. Wait at least one additional minute for voltages to further dissipate.

Figure 1: Troubleshooting Speed Errors

Process Chart	Legend
	Y. Yes
	N. No
	1. Machine does not run at desired speed.
	2. Section 1: Is desired speed programmed in wash formula?
	A. Edit wash formula.
	3. Section 2: Are inverter parameters correct for this machine model?
	B. Contact Milnor, and correct inverter parameters.
	4. Section 3: Does digital counts value match desired speed?
	C. Contact Milnor for updated software.
	5. Section 4: Does D-to-A output voltage at **D-to-A board** match desired speed?
	D. Replace D-to-A board.
	6. Section 4: Does D-to-A voltage **at inverter** match desired speed?
	E. Check wiring from D-to-A board to inverter.
	7. Section 5.1: Does inverter output frequency match input voltage?
	F. Review inverter parameters, and contact Milnor Customer Service.
	8. Section 5.2: Is inverter output amperage within normal limits?
	G. Contact Milnor Customer Service before repairing or replacing inverter.
	9. Section 6: Does motor test within normal limits?
	H. Contact Milnor Customer Service before repairing or replacing motor.

1. Verify Programmed Speed

Verify that the machine is programmed correctly. The desired basket speed is programmed on the second page of each wash formula step.

Display or Action	Explanation
🔑	Insert the programming key into the *Run/Program* keyswitch and turn the key 1/4 turn to the right. This accesses the *Program Menu*.
PROGRAM 0 MENU OK TURN KEY TO RUN	*Program Menu* item *0* indicates that it is safe to turn the key to the *Run* position. If you make any changes to a wash formula or machine configuration, do not turn the key to the *Run* position unless this menu item is displayed.
⬆	Press the up and down arrow keys to select other items from the *Program Menu*.

Display or Action	Explanation
PROGRAM 1 MENU ADD/CHANGE FORMULA	Select *Program Menu* item *1* to view the programmed steps in the wash formula.
ENTER	Press *Enter/Next* to confirm your selection and prompt for the desired wash formula number,

or

CANCEL	press *Cancel/Escape* to return to *Program Menu* item *0*.

Display or Action	Explanation
ADD/CHANGE FORMULA 00	This display prompts for the number of the formula in which the error occurs. If the error appears in several formulas, only one needs to be verified.
0 , 1	Enter the formula number. An incorrect formula number can be changed at the next display.
ADD/CHANGE FORMULA 01 FORMULA 01	The cursor flashes on "CHANGE" and the first digit of the number for any existing formula. "ADD" flashes if the formula does not exist, prompting you to program a new formula.
	If the selected formula is not correct, enter another formula number at this display.
ENTER	Confirms the selected formula and advances to the next display.
F01 FORMULA 01 S01 00 STEP 01	The cursor flashes on the first character of the name for step 01.
ENTER	Accepts the formula name and advances to the overview display for step 01.
F01 TMMQFFFHC3WLL S S01 2050150133110 0	The overview display for step 01. Notice that there is no cursor flashing.
ENTER	Advances to the step decisions for step 01.

Display or Action	Explanation
| ```
F01 TMMQFFFHC3WLL   S
S01 2050150133110   0
``` | The first page of step decisions includes the type and duration of the step, the desired temperature, water valves, fill action, bath level, and steam code. |
| **ENTER** | Press **ENTER** several times to advance to the second page of decisions. |
| ```
F01 CCNNWSSS*RPMDRC
S01 000000000-30000
``` | The second page of step decisions includes the prompt for the desired basket speed. If the value shown here is not the desired value, change it. The complete procedure for programming a wash formula is described in the reference manual for your machine. |

2. Verify Inverter Parameters

The machine processor board adjusts the speed of the motor by communicating with the inverter. The inverter contains several values, called *constants* or *parameters*, that control how the inverter interprets signals from the machine processor. These parameters were programmed into original equipment inverters at the Milnor factory before the machine was shipped, but replacement inverters must be programmed with the correct constants for machine type, inverter type, and voltage. If these parameters are incorrect, the inverter will not work as expected.

The procedure for verifying the inverter parameters varies among inverters, but is described in detail in the documentation provided by the inverter manufacturer. Replacement manuals for several inverter models are available at `http://www.drives.com`.

Inverter constants for specific inverters and Milnor machine models are available in the *Customer Service* area of `http://www.milnor.com`.

3. Verify Digital Value of Programmed Speed

If the desired value is correctly programmed, view the speed diagnostics to verify that the machine controller is commanding the programmed speed. The machine must be running a step in which the speed is wrong.

Supplement 1

Creating a Test Formula

When a wash step begins, the beginning value sent to the inverter is calculated according to this equation:

$$V_0 = [RPM_d * (C/RPM)] + D$$

Where:

V_0 = beginning value sent to inverter
RPM_d = Desired basket speed in RPMs
C/RPM = Counts per RPM
D = Offset

If all motors, inverters, and digital-to-analog boards could be manufactured to exactly the same specifications, adjustment of the basket speed would not be necessary. However, manufacturing tolerances allow minor variances in these components, so a feedback system is used to monitor the basket speed and make adjustments to achieve the desired value.

If a speed adjustment is required during a wash step, the machine controller signals the inverter

---

to increase the basket speed by two RPMs or decrease the speed by one RPM at each adjustment. These adjustments are made three seconds before the end of the programmed *basket On time* (programming decision *XXX*). Because the speed is adjusted only one time per *On time* period, formulas programmed with *On times* near the maximum may require several minutes to achieve the programmed speed.

To give the machine sufficient time to achieve a steady speed state and to maintain that speed during troubleshooting, it is often a good idea to program a special test formula. To troubleshoot a speed error in a bath step, the test formula should contain a bath of moderate to long duration with relatively brief *basket On* and *Off times*.

1. For step 01, set the *Type of Step* to a *Wash* with basket rotation (*T = 1* or *2*).

2. Set the *Step Time* to about 10 minutes (*MMQ = 100*).

3. Do not set a temperature (*FFF* or *CCC = 000*).

4. Program the machine to fill with cold water (*C = 1*) to a low level (*LL = 04*).

5. Program no chemical injection (*CC = 00*).

6. Program the speed in RPMs (e.g., *RPM = 018*) that is used in the erroneous production formula.

7. Program the basket *On time* to 20 seconds (*XXX = 020*) and the basket *Off time* to 3 seconds (*YYY = 003*).

8. End the formula (*E = 0*).

Use the formula created in Supplement 1 or a similar formula to evaluate other possible sources of the problem.

Display or Action	**Explanation**
〔**6**〕	With a step running in which the problem occurs, press this key to view the speed diagnostics data. Press this key a second time to close the speed diagnostics and display the normal run data.

```
10:38 F0005S03 02:37
0195 RPM=A029/D030
```

The top line of the speed diagnostics display is the same as when the formula is running normally. All speed diagnostics are contained on the second line.

The leftmost number is the calculated digital **counts** value. You can determine the initial digital count for the programmed basket speed from Table 1 and the equation below:

$$C_d = [RPM_d * (C/RPM)] + D$$

Where:

C_d = Desired digital counts value

RPM_d = Desired basket speed in revolutions per minute

C/RPM = Counts per RPM

D = Offset value

Table 1: Model-Specific Data

Machine Model	Maximum Frequency	Maximum Wash RPM	Counts per RPM (C/RPM)	Offset (D)
30022F_W	155	40	5	15
30022X_W	155	40		
36030F_S	186	43		
36030F_W	205	43		
42026V_W	155	40		
42032F_S	178	40		
42032F_W	195	40		
48040F_W	170	38	6	
68036F_N	170	32	7	
Important: Values shown are subject to change without notice. Contact Milnor Customer Service for verification.				

> **Note 1:** The counts and offset values are configurable in controller software WUWESME, used in single-motor E-style and divided cylinder washer-extractors. Contact your dealer or the Milnor service department for assistance with these machines.

Display or Action	Explanation
| ```
10:38 F0005S03 02:37
0195 RPM=A029/**D030**
``` | The rightmost number of the bottom line indicates the desired (programmed) basket speed for this step. This value matches the value programmed in the wash formula. |
| ```
10:38 F0005S03 02:37
0195 RPM=**A029**/D030
``` | The middle number of the bottom line indicates the current calculated basket speed. Input/output board #1 determines the time between each main pulley spoke passing the photoeye and reports this data to the processor board at each communication cycle, which is usually more often than once per second. The processor board filters the raw data from the input/output board and displays the most recent valid value. |

> **Tip:** Large variations in the achieved RPM value are possible early in extract steps because the valid range includes values from 0 RPMs to the maximum extract RPM of the machine. These variations have no effect on how the machine operates because of the frequency with which new data is reported.

4. Verify Output Voltage of D-to-A Board

If the microprocessor is displaying the correct calculated digital value, the next step is to verify that the digital-to-analog board is putting out the appropriate signal voltage.

1. Calculate the voltage of the signal that the D-to-A board should deliver to the inverter:

$$V_d = C_d / 409.5$$

Where:

V_d = Desired voltage
C_d = Desired counts per RPM

For example, assume the machine is configured as a 48040F_W and the desired wash speed is 24 RPMs.

a. From Table 1, we see that this machine model makes six counts per revolution and has an offset of 15.

b. Calculate the desired counts for a basket speed of 24 RPMs:

$$C_d = [RPM_d * (C/RPM)] + D$$

$$C_d = [24\ RPMs * (6\ counts\ per\ RPM)] + 15$$
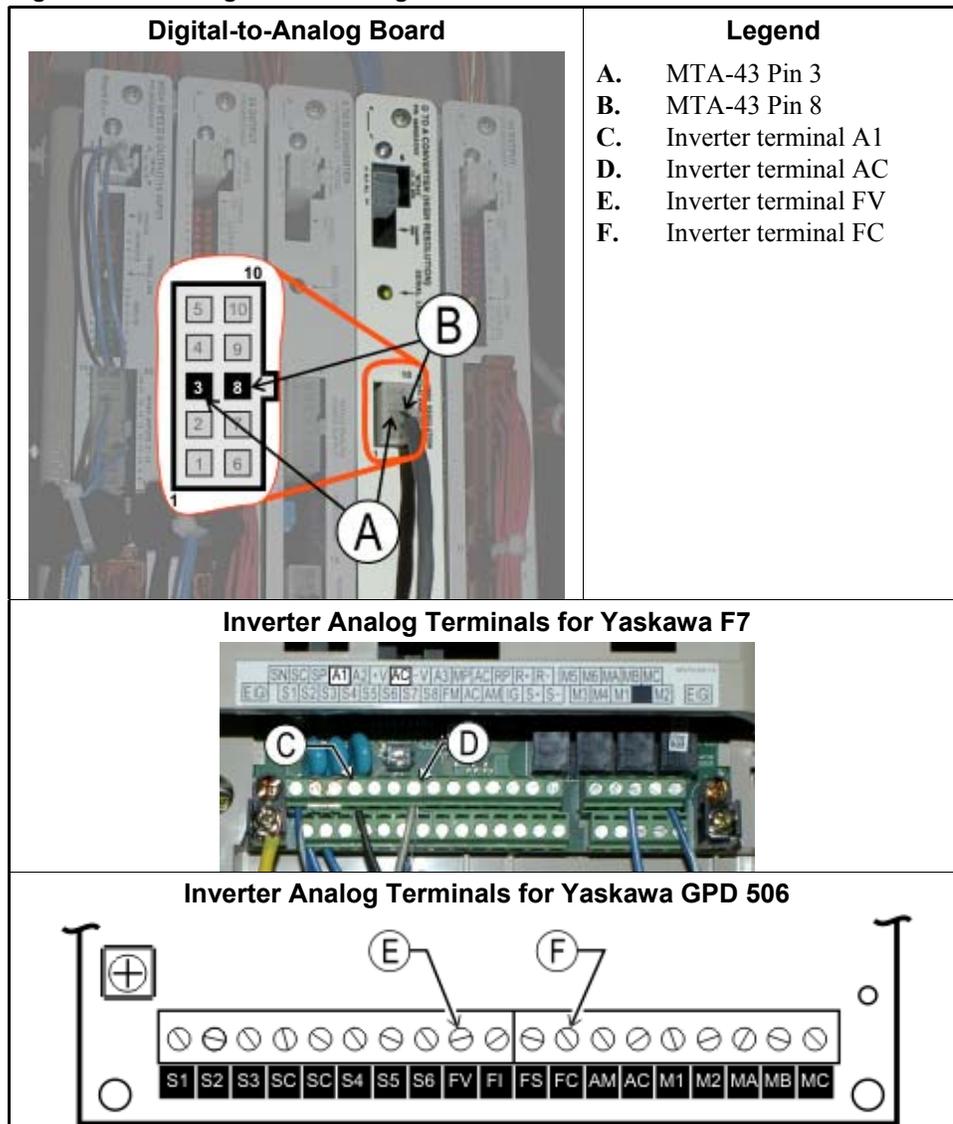
$$\mathbf{159} = 144 + 15$$

c. Calculate the desired voltage:

$$V_d = C_d / 409.5$$

$$0.3883 = 159 / 409.5$$

2. The DC voltage measured at the output terminals of the D-to-A board and at analog voltage input terminals FV and FC on the inverter (shown in Figure 2) should match this number. You may see a small voltage drop from the D-to-A board to the inverter.

Figure 2: Measuring Control Voltage at D-to-A Board and Inverter

Digital-to-Analog Board	Legend
	A. MTA-43 Pin 3
	B. MTA-43 Pin 8
	C. Inverter terminal A1
	D. Inverter terminal AC
	E. Inverter terminal FV
	F. Inverter terminal FC

Inverter Analog Terminals for Yaskawa F7

Inverter Analog Terminals for Yaskawa GPD 506

3. If this value is wrong at the D-to-A board, replace the board.

4. If the value is correct at the D-to-A board but wrong at the inverter, check the wiring between the board and the inverter.

5. If the value is correct at both sets of terminals, troubleshoot the inverter.

5. Troubleshooting the Inverter

5.1. Verify Inverter Output Frequency—Use the inverter keypad to display the current desired frequency. This frequency should correspond to the input voltage according to this equation:

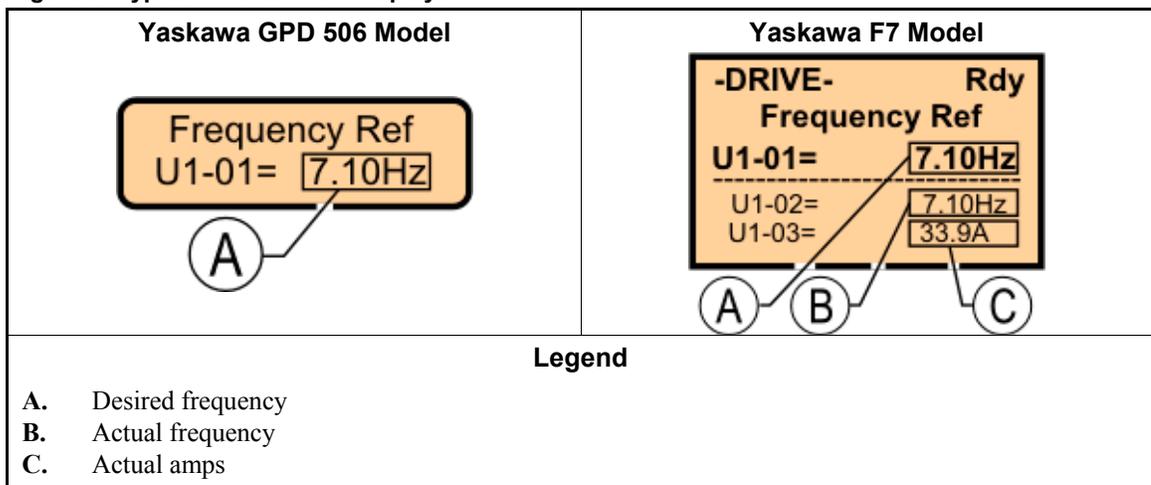$$F_d = (V_{out} / 10) * F_{max}$$

Where:

F_d = Desired frequency
V_{out} = DC voltage output from D-to-A board
F_{max} = Maximum inverter frequency (see Table 1)

When the machine is running normally, the inverter display appears similar to one of the illustrations in Figure 3.

Figure 3: Typical Inverter Run Displays

Yaskawa GPD 506 Model	Yaskawa F7 Model
Frequency Ref U1-01= 7.10Hz (A)	-DRIVE- Rdy Frequency Ref U1-01= 7.10Hz U1-02= 7.10Hz U1-03= 33.9A (A) (B) (C)

Legend	
A.	Desired frequency
B.	Actual frequency
C.	Actual amps

The specific procedure for viewing the inverter operating parameters varies among inverter models.

- For Yaskawa F7 models, the actual and desired frequencies and the actual amperage are visible on the normal operating display.
- For Yaskawa GPD 505 and 506 models, press the *DSPL* button on the inverter once to advance from the *Desired Frequency* display to the *Actual Frequency* display.

5.2. Verify Inverter Output Amperage—Verify the current being delivered to the motor. Contact the Milnor® Customer Service department for guidelines on the acceptable amperage for the conditions.

For Yaskawa GPD 505 and 506 models, press the *DSPL* button on the inverter once to advance from the *Actual Frequency* display to the *Actual Amperage* display.

6. Testing the Motor

If the procedures described earlier in this document do not eliminate the error, have the motor tested by a reputable facility.

— End of BICWUT01 —