

System Test

Overview

System Test is a feature that was released in software versions 8.23 (DOS) and 1.10 (CNC10). The purpose of the System Test is to check basic machine functionality and to verify key parameters are set correctly. If the System Test has not run and passed, a message will be displayed on the screen at power up (see figure 1). This message will continue to be displayed at power up, until the System Test has been run successfully.

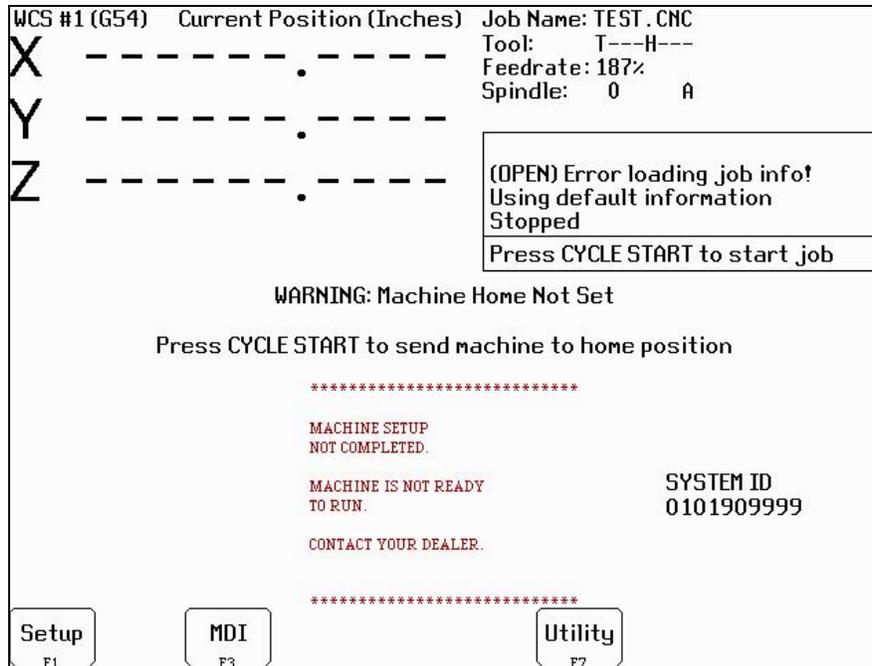


Figure 1 - Warning message displayed until system test is completed successfully or machine has been homed.

Requirements before running System Test

1. Make sure control is fully integrated.
2. Check direction of each axis and change direction reversal (refer to TB137) and limits as required.
3. Setup/calibrate motor rev.'s/per (refer to TB36) and backlash (refer to TB37) for each axis.
4. Set travel limits. (Note: To save time in the home switch test, zero out the inputs that aren't being used for home switches.)
5. Run auto tune and drag tests.
6. Make sure machine table is cleared of all items.
7. Empty the spindle of any tools, and verify that the spindle face cannot run into the worktable at the bottom of its travel. **DO NOT START** the system test with a tool in the spindle.

Addition requirements for ATC systems

8. ATC systems need to have their tool changers setup and verified by running tool changes.
9. Insert at least four tools into the tool carousel. Load one into bin #1 and another into the maximum bin number (ex. Load into bin 16 if a 16 – Tool ATC). The other two tools should be loaded into the carousel to balance it out. In the case of a 16 - Tool ATC load bins 5 and 10. The tools must have lengths that differ by at least 0.010 inches (0.25 mm). Do **NOT** use fly cutters, diamond tip tools or none conductive tools.
10. Position a TT1 on the worktable and connect the TT1 cable. Position the spindle over the TT1 then press **F1 - Setup, F1 - Part, F9 - WCS Table** and **F1 - Return**. Enter the X and Y values displayed on the screen in return point #3 and set the Z value to zero. Note; make sure the spindle face will not run into the TT1 at the bottom of its travel (if it doesn't clear, do **NOT** run the System Test).

Running the System Test

1. To run the System Test, press **F1 - Setup, F3 - Config**, enter the correct password, and then press **F5 - Test**. The control will load the systest.cnc file located in the CNC10 directory. If for any reason the systest.cnc file does not load, go to the CNC10 directory and manually load it.
2. Before System Test starts running any tests it moves the Z-axis to home. The travel limits and machine home are verified that they are set. Travel limits are not tested for axes that are labeled as M, N, or S, or that have the rotary bit set in parameters 91-94 (axes 1-4) and or 166 (5th axis). The test also checks parameter 6 and 160, if P6 is set to 1 and 160 is set to a non-zero value the System Test will display a menu where you can select a single test or run all tests.
3. Here is a quick list of the Tests; below you can read about them in more detail.
 - i.) ATC - TT1 Test
 - ii.) Quick Home Switch Test
 - iii.) ATC – Spindle Test
 - iv.) ATC – Tapping Test
 - v.) Home Switch and Travel limit Test
 - vi.) ATC – Tool Change Test
 Note: Non-ATC system will automatically run tests 2 and 5.
4. If System test fails at any time while testing you will see “Missing parameter, line 989” on the Config Screen. Go back to the main screen where you will see the following screen (see figure 2 below). Load the systest.out file located in the CNC10 directory and press **F6 – Edit** to see exactly what failed (See figure 3).

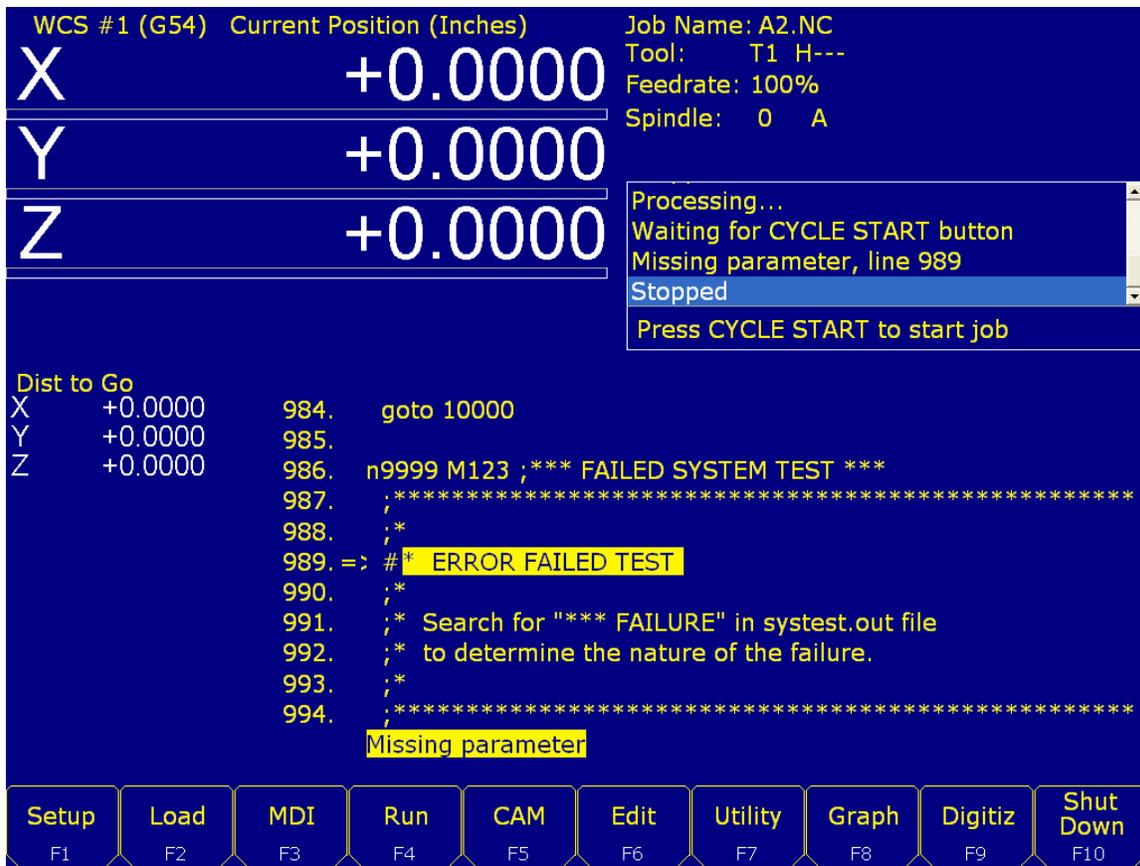


Figure 2: Example of what you'll see at the main menu when a test fails.

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;*****
; Checking travel limits and home set
*** FAILURE: AXIS 1 INVALID TRAVEL LIMITS
*** FAILED ***
  
```

Figure 3: Systest.out example of failure message

Test Definitions:

1. **ATC TT1 Test.** This test starts with the following G-code message displayed on the screen:

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5. ; * Connect TT-1 and verify the XY location of the TT-1
6. ; * is set in return point #3. Verify that the spindle
7. ; * face is above the TT-1 when at the Z minus travel
8. ; * limit. After pressing CYCLE START,
9. ; * trigger the TT-1 twice.
10. M0
11. if [#9044 != 0] the #[a] = #9044
12. if [#9044 == 0] the #[a] = #9011
13. M123 L1 ; TT-1 set to be input
14. M123 q0 p#a
15. M101/#a
  
```

After pressing Cycle Start, the TT1 needs to be manually triggered twice. The best way to do this is by touching an electrically conductive material to the worktable and the top of the TT1. A right-angled Allen-wrench about six inches long works well.



How to trigger TT1

Before triggering the TT1 you will notice in the message window the message “Waiting for input #15 (M101)”. If the TT1 parameters are set correctly the program will stop at a M0 after triggering the TT1. If the program doesn’t reach the second M0 shortly after triggering the TT1, stop the program. Press <Alt + I> to turn on Live PLC debugging and trigger the TT1 to see which input is actually toggling and then change parameter 44 to the input being tripped. If no input is tripped check the TT1 wiring.

2. **Home Switch Test.** This test checks to see if the machine can be homed reliably by making sure the home switches are not too close to the index pulse of the motors. If this test fails and you get a “home switch too close to index pulse” error message, refer to Tech bulletin 92 for a description of how to correct the problem.
3. **ATC Spindle Test.** This test is made up of three parts:
 - 3.1. First parameter 78 (Spindle Speed Display) is set to 1.0 to enable live measurement and calculated spindle speed to be displayed in the CNC status window. Parameter 36 (Rigid Tapping Enable/Disable) is set to 1.0 to enable rigid tapping and parameter 33 (Spindle Motor Gear Ratio) is checked to see if it’s set to 1.0. If not set to 1.0, it will be changed to a 1.0 and a warning will be logged.
 - 3.2. The program turns the spindle on for a few seconds and looks for any change in the absolute encoder position of all axes. If no changes are detected, the test will error out and log the failure. In which case the spindle encoder wiring and connections need to be checked. If movement is detected, parameter 35 is verified that it’s set correctly. A wrong value will result in a failure; the failure message in the systest.out file will indicate the correct value. Change P35 and run test again. A quick check for spindle direction is made, where the spindle is

turned on with an M3 to see in the spindle is counting up or counting down. If counting up nothing happens, counting down will result in a minus sign being added or removed from parameter 34 (Spindle Encoder Counts/Revolution) and a warning logged.

- 3.3. The test now records the average spindle deceleration time from 2000RPM. Then spindle speeds of 10%, 20%, 30%, ..., up to 100% of maximum spindle speed set in the Control Configuration are checked and recorded in systest.out. The spindle speeds are commanded and then the actual speeds are recorded after several seconds. The commanded speeds are compared to the actual and must be within 3% to pass. If a failure occurs check P34 is set correctly and that the inverter has been programmed for the correct maximum output frequency. To check parameter 34 turn the spindle 10 times by hand and divide the difference in encoder counts by 10. The absolute encoder position can be read off the PID screen.
4. **ATC Tapping Test.** Starts at machine home and taps down three inches at 1000RPM. The Z-axis movement should be very smooth, however if you notice a jerky motion it is probably due to P34 having the wrong sign (+/-). For example, if P34 is set to 4096 and you have jerky motion on Z-axis change P34 to -4096. Another problem could occur with a “Z axis cannot follow the spindle” error. This means you have the wrong number of counts in P34 (i.e. 8000 instead of 4096), although the correct value for P34 should have been determined in spindle test.
5. **Machine Home Switch and Travel Limit Test.**
 - 5.1. **Home Switch test.** The machine home test starts by checking the values stored in the plus/minus home switch fields in the Machine Configuration – Motor screen.
There are two checks made before the test begins. The program first checks the “Machine home at pwrup” setting in the Control Configuration. If set to “Jog” the test is skipped and a warning is logged in systest.out. In most cases it should be set to “Home switch” or “Ref Marks - HS”. The second check looks for any axis that has at least one home switch input defined except for, rotary configured axes or axes with an “M”, “N”, or “S” label. Reference Mark homing will have both plus/minus home switches set to zero. So any axes that fail this check will generate a warning in the systest.out file.

Review of homing process when homing to a switch:

- 1.) The axis moves toward the home switch at the slow jog rate until the home switch is tripped.
- 2.) The axis moves away from the switch until the home switch closes.
- 3.) The axis moves further away by a small amount (0.0025 inches).
- 4.) The axis moves in small increments away from the switch until the encoder index pulse is located.

Axes with a minus home switch defined will have multiple measurements taken

of the home position (found by using an M91/ command) and the position after step (3) in the homing procedure. The measurements are logged along with error measurements and other data. To pass the test, all home position measurements must be within 0.0005 inches of the first measurement. If the test fails and the error is within 0.0010 inches of a motor revolution, the follow message will be logged “SUSPECTED LIMIT SWITCH PROBLEM”. Otherwise, “SUSPECTED ENCODER INDEX PROBLEM” will be logged.

Now the distance between the home position and the off-switch position (position after step 3) are checked to ensure that they are not less than $1/8$ or greater than $7/8$ of a motor revolution. If less than $1/8$ or greater than $7/8$ of a motor revolution a failure occurs and a “Home position too close to encoder index pulse” message is logged (See figure 4). To correct this failure, move the limit switch or trip dog a distance that corresponds to a $1/2$ revolution of the motor. The full turn distance is recorded in the systest.out file. If unable to move, decouple the motor and rotate the motor shaft 90° clockwise. When attempting to resolve the problem by rotating the motor shaft, note that this method will affect the results of the home switch test at the other end of travel, which means that it is possible when the test is repeated that the opposite end which passed will now fail. In this case, you must rotate the motor shaft 90° clockwise once again.

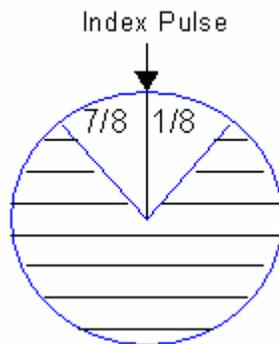


Figure 4: The index pulse in this position would produce an error. The correct position would be in the shaded region of the circle.

If an axis has a plus home switch set the same measurements and analysis are performed on it.

- 5.2. **Travel limits test.** When there are two home switches, the overall travel defined in the Machine Configuration – Jog parameters must be less than or equal to the distance between the minus and plus home positions, but within 1.0 inch (25.4mm). For example, the distance between the plus and minus home positions is 24.135 inches, which means the travel limit must be within 23.135 – 24.135 inches to pass the test.

If only one or no home switches set for an axis, two moves are made. One from the home position out to the minus travel limit and another from the home position out to the plus travel limit. If the travel limits are too long, the test will

be stopped by either a “Full power without motion” or “ limit tripped” message.

After the travel limits are tested and have passed, all axes move to the center of the travel limits.

6. **ATC Tool Changing Test.** Starts by performing a series of tool changes. These tool changes are done in such a way to alternate carousel directions and maximize carousel travel. For example, a 16 – Tool setup would run a series of tool changes like T1, T8, T2, T9, T3, T10 etc., and would continue in this manner until 48 tool changes (3x the maximum number of bins) have been completed.

After every tool change, the tool height is checked using the TT1. The first time a tool is measured, the Z-axis machine position is recorded. On subsequent tool checks, the machine position is compared to the initial recorded position. The test will fail if subsequent tool measurements are not within 0.005 inches of the initial position.

Assuming a few tool changes have been completed, some possible causes for the wrong tool being picked up are:

- Parameter 161 (ATC Maximum Tool Bins) is set wrong. Ex. P161 = 16 but the tool carousel holds 20 tools.
- Not using a brake motor for the carousel or there is a faulty brake motor.
- The state of the tool counter sensor after a tool change is not electrically open. This can be caused when the wrong type of tool counter sensor (Normally Open or Normally Closed) is matched to the mechanical setup of the counting mechanism.
- The tool counter sensor or wiring is faulty.
- Electrical noise.

Completed System Test

If the control runs through the complete test and passes everything the systest.out file will say passed and the “Machine setup not completed” message will no longer appear at machine power up.

WARNING: If you run the system test after it’s already passed, the systest.out file will be wiped out and the control will need to run through the complete test again.