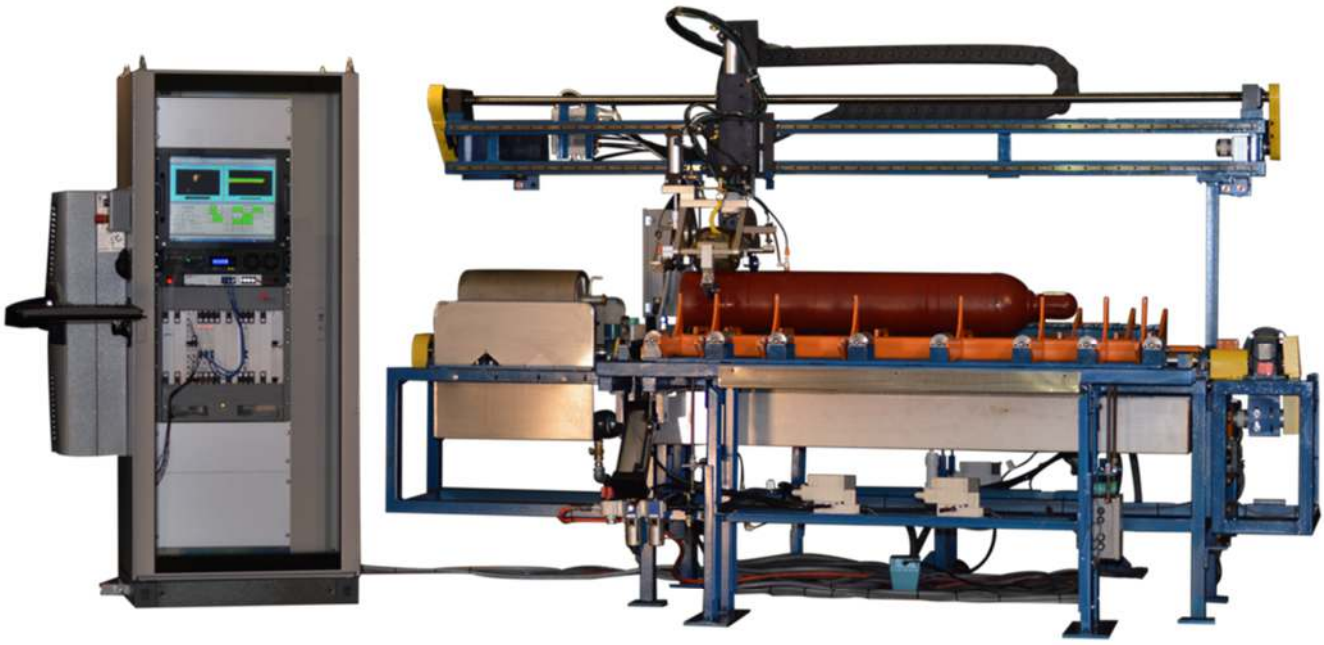
USERS MANUAL

Industrial Cylinder Inspection System



1 Waterview Drive
Suite 102A
Shelton, CT 06484
Phone: +1 (203) 438-9696

Document: MAN-0011

Contents

1 Introduction

1.1 Overview

The Nordco DSP500 Ultrasonic Cylinder Inspection System has been designed to conduct a 100% sidewall exam of a cylinder scanning for defects of a giving size and measuring wall thickness, with the ultrasonics immersion wheel technology. It is an original product of Nordco Rail Services and Inspection Technologies of Shelton, Connecticut. This document, both the printed hard-copy and the on-line help file, constitutes the main operator "Operation and Maintenance Manual" for the DSP500 system. On-line procedures are included in this document for both the operation and maintenance of the electronics subsystem.

The documentation in this help file describes the functionality of the DSP500 ultrasonic, nondestructive, in-line, full-body Cylinder inspection system. Specifically discussed in the content are the inspection method (ultrasonic), assembly (transducer wheels), transducer control and related signal processing modules, testing process, control computers, flaw detection capabilities and exception reporting, and general system operation.

The equipment, electronics, and methods discussed herein are proprietary and are covered by the following Nordco U.S. and foreign patents and other patents pending:

4,004,455, 4,222,275, 4,229,978, 4,429,576, 4,487,071, 4,615,218, 4,763,526, 4,785,668, 4,872,130, 1,031,194 (Canada), 8,503,345.4(EPO)

The DSP500 system, including the transducer wheel assembly mounting mechanics, was designed and manufactured by Nordco Rail Services and Inspection Technologies (1 Waterview Drive, Suite 102A, Shelton, CT 06484).

Nordco Cyl-Sonic software versions will vary depending on time of purchase and whether customer subscribes to software updates after initial licensing period expires. The current manual is built on the latest version of Cyl-Sonic software, CylSonic Industrial v5.0.0.0. Nordco has provided custom software to customers in the past. This manual demonstrates use of Nordco's standard version of the software.

Nordco acknowledges the trademarks of other organizations for their products or services where mentioned in this documentation.

1.2 DSP System Architecture

1.2.1 Digital Signal Processing Considerations

The DSP system uses a state-of-the-art digital signal processing architecture combining FPGA (Field Programmable Gate Array) devices for implementing high-speed sequential signal processing tasks in real-time with a Digital Signal Processor (DSP) executing software algorithms processing less time critical operations. The initial high-speed sequential processing tasks implemented in the FPGA are the Haar Wavelet Transforms and Inverse Wavelet Transforms used in the ultrasonic signal de-noising process. The architecture

is also capable of implementing future signal correlation and discrimination techniques to support enhanced and/or new testing applications.

With the FPGA acting as a hardware accelerator, freeing up more time for the DSP to execute its targeted algorithms, an increased firing rate of the ultrasonic pulsers is achieved. The ability to fire the ultrasonic pulsers more rapidly translates into the ability to test faster and implement applications not possible with the previously restricted pulser firing rates.

In addition, the hybrid FPGA/DSP architecture enables the simultaneous processing of multiple ultrasonic test channels through a single set of processing hardware, thereby decreasing the system cost per channel. The goal of the hybrid FPGA/DSP development was to process four (4) ultrasonic test channels through a single FPGA/DSP combination within a 100 microsecond test frame.

The DSP provides an Ultrasonic Channel Density of four (4) channels per card. The system Pulser/Pre-Amp card and DSP card each support four (4) ultrasonic channels, so there is a one-to-one relationship between the Pulser/Pre-Amp and DSP cards. Therefore, a 32 Channel RIS System is made up of eight (8) Pulser/Pre-Amp and eight (8) DSP cards (4 X 8=32). The 48 Channel RIS System is configured from twelve (12) Pulser/Pre-Amp and twelve (12) DSP cards.

1.2.2 Digital Signal Processing (DSP) Card Design

The design goal for the DSP Card was to produce a Digital Signal Processing Card in the Compact PCI Express 6U form factor, capable of simultaneously processing four (4) 5 MHz ultrasonic test channels. Each ultrasonic test channel sampled at a minimum signal sampling rate of 20 MHz, producing a signed (2's complement) 12 Bit quantized value for each signal sample. All real-time signal processing functions complete their execution within a maximum ultrasonic test frame of 100 microseconds. In order to meet the real-time processing requirements, the card uses a state-of-the-art digital signal processing architecture combining FPGA (Field Programmable Gate Array) hardware processing with a 6-Core DSP (Digital Signal Processor). Each of the four (4) ultrasonic channels on the card has one DSP Core dedicated to processing the received ultrasonic RF signals. The remaining two (2) DSP Cores are used for inter-card communications and communicating to the application software. The DSP is also capable of producing synthesized ultrasonic test signals/frames used for manual and automatic system calibration functions. In each of the FPGA devices, a 32 bit custom RISC processor has been implemented to provide for configuration and control of system parameters.

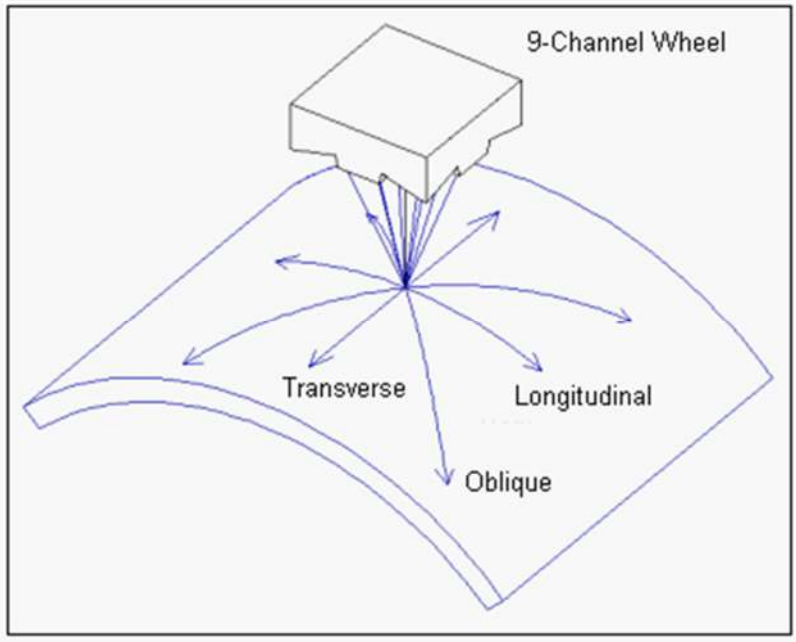
1.3 DSP500 System Specifications

The DSP500 ultrasonic gas Cylinder inspection system is designed to meet or exceed the following capabilities.

1.3.1 Test Coverage

The transducer orientations are determined by the types of probes that are installed with the system. Some of the standard probe types are the 5-channel, 9-channel and 12-channel wheel probes. The five channel probe provides thickness and shear angle testing in the longitudinal and transverse directions. The nine channel probe provides thickness and shear angle testing in the longitudinal, transverse and oblique directions. The twelve channel probe provides thickness and shear angle testing in the longitudinal direction. In addition, custom probe assemblies are often designed to meet a customer's specific test requirements. The standard gas Cylinder system configuration uses one 9-channel wheel probe that is designed to cover a preset distance of the Cylinder's surface on each revolution of the Cylinder to meet scan plan requirements.

The system is capable of testing one hundred percent of the Cylinder's sidewall depending on the mechanical and probe arrangements used. Note that the type of probe assembly utilized, and the total number of probes determines the overall system throughput.



1.3.2 Testing Sensitivity

The DSP500 system provides for independent sensitivity levels to be set for each data channel using independent amplifier gains, gates, thresholds, and flaw alarm counters for each channel. The channel settings are typically selected to provide alarm conditions for known references such as a notch depth of 5-10% of minimum designed wall thickness (TminD) on a calibration standard as required by applicable regulatory body. The DSP500 system is capable of meeting or exceeding the requirements of most standard specifications from API, DIN, ASTM, etc.

1.3.3 Cylinder Inspection Speed

Normal system operation for all sensitivity settings is guaranteed for Cylinder surface speeds of up to three hundred surface feet per minute (FPM) (1.5 meters per second) at test pulse densities of 1/16" (1.58 mm) resolution.

1.3.4 Completeness of Testing

The Cylinder is tested for up to 100% of coverage of side wall of cylinder as determined by the mechanical system constraints and the probe designs used.

1.3.5 Channel Configuration

In the default system configuration, the DSP500 In-line, full-body gas Cylinder inspection system utilizes nine transducer data channels contained in a single wheel probe. There is one thickness measurement transducer, one clockwise-looking longitudinal defect detection channel, one counterclockwise-looking longitudinal defect detection channel, one forward-looking transverse defect detection channel, one rearward-looking

transverse defect detection channel, four oblique shear-angle defect detection channels oriented to look at 45 degree angles relative to the main Cylinder axes.

The DSP500 system provides outputs that can be used to drive both an audible and a visual alarm represented in the Defect Map(C-scan) when defects are detected.

1.3.6 Operator-Assisted Automatic Calibration

Automatic calibration may be done for job definitions that may be stored in the DSP500 system at any time. The total number of jobs that may be stored is limited by the available the disk space on the system's hard disk. A typical job requires approximately 22-KBYTES of disk storage. The automatic calibration is achieved by having the previously set values for the amplifier gains, threshold settings, gates, etc. saved and restored to and from a serialized file on the main computer's hard disk. The initial definition of these values must be determined by an experienced UT operator which authorized by the company's written practice to set up test methods. These initial calibrations are accomplished by having the operator change the existing values while monitoring the analog data and test results on an oscilloscope and the color graphics monitor, respectively. NOTE: adjustments to controls located on printed circuit boards are only necessary during periodic maintenance checks and should only be attempted by qualified personnel.

1.3.7 Test Map Reports

A test map report is provided for each Cylinder after it has been tested with the DSP500 system. The test map with provide indication details as seen in the defect list as well as a copy of the thickness map and defect map.

1.3.8 Time Corrected Gain

A time corrected gain control feature (TCG) can be used in the amplifiers to offset the attenuation factor of the signals in the steel. This feature is sometimes referred to as "distance amplitude correction" (or DAC) and attempts to cause defects of the same size to appear with the same signal strength regardless of their depth in the steel.

1.3.9 Cylinder Sizes

The Cylinder sizes supported by the DSP500 system range from 1.9" (48.26mm) through 48" (1219.2mm) and are a function of the design of the system's mechanical handling system.

1.3.10 System Setup

System setup for Cylinder size changes shall typically be accomplished in less than five minutes by a Level II trained operator when using pre-calibrated job settings.

1.4 Industrial Cylinder Inspection System at a glance

The Cyl-Sonic Industrial performs ultrasound examinations (UE) of seamless metallic compressed gas cylinders with 4"-12" outside diameters and a length of 11"-72". The Cyl-Sonic Industrial system's innovative probe head design quickly inspects and evaluates the integrity of the cylinder's sidewall and sidewall-to-base (SBT) region to ensure acceptability from the cylinder's exterior surface. The Industrial is ideal for facilities specializing in larger industrial gas-type cylinders containing welding, specialty, or electronic-type gases. Test operators do not need to submerge the cylinder or spend time removing the valve, filling, draining, drying, and replacing the valve in order to requalify it, therefore, increasing productivity and increasing daily throughput. This higher efficiency allows for a lower cost-per-cylinder test than hydrostatic testing. The system's configurable decks easily fit within most existing hydrostatic test areas and allow simultaneous

loading/unloading of cylinders while the cylinder testing process continuously operates - meeting your high-volume, high-productivity needs.

1.5 Site Prep & System Requirements

1.5.1 Electrical Requirements

3 POLE / 4 WIRE GROUNDING, 230±20VAC 50A 50/60 Hz 1ø (phase)

1.5.2 Pneumatic Requirements

The system requires 80 psi.

1.5.3 Water Requirements

The system requires a water supply nearby to fill the tank when it is emptied and cleaned.

The system requires a drain nearby to empty the tank periodically.

1.5.4 Cylinder Requirements

The cylinders that can be tested on this system can range from 4”-12” outside diameter and 11”-72” in length.

1.5.5 System Foot Print

Once system location and orientation has been determined adequate load and unload space can be assessed.

1.5.5.1 1105581 ASSY, ICIS CABINET COMPLETE AB CONFIG 1

LOAD CONVEYOR, DOWNENDER

Length – 77in, Width – 130in, Height – 85in with Electrical Enclosure 32.5 x 32.5 x 71

1.5.5.2 1105582 ASSY, ICIS CABINET COMPLETE AB CONFIG

UPENDER, INLET, OUTLET, DOWNENDER

Length – 214in, Width – 130in, Height – 85in with Electrical Enclosure 32.5 x 32.5 x 71

1.5.5.3 1105583 ASSY, ICIS CABINET COMPLETE AB CONFIG 3UPENDER, DOWNENDER

Length – 85in, Width – 130in, Height – 85in with Electrical Enclosure 32.5 x 32.5 x 71

1.5.5.4 1105584 ASSY, ICIS CABINET COMPLETE AB CONFIG 4

UPENDER, INLET OPTION, INLET, OUTLET, OUTLET OPTION, DOWNENDER

Length – Consult Nordco engineering with required options, Width – 130in, Height – 85in with Electrical Enclosure 32.5 x 32.5 x 71

2 Safety Advice

2.1 Safety Guidelines

Failure to adhere to Safety precautions could result in bodily injury and/or property damage.

A. It is necessary for all personnel and users to be aware of and familiar with the safety regulations included in this manual.

B. It is also necessary for all personnel and users to be aware of and familiar with the safety regulations of the equipment to which the Cyl-Sonic Industrial System is linked to as well as those of any facility in which work is to be performed.
C. All persons working on the Cyl-Sonic Industrial System must comply with any applicable safety regulations.

2.2 Scope of Documentation

A. The documentation included in this manual applies only to the portions of the Cyl-Sonic Industrial System supplied by Nordco Rail Services.
B. Where possible we mention references to possible safety hazards posed by other systems, but it is not the purpose of this documentation to note all hazards associated with the environment in which work will take place.

2.3 Safety Devices Guidelines

A. Safety equipment must be in good, working condition.
B. Safety equipment must be properly installed and functioning before running the Cyl-Sonic Industrial System.
C. Safety equipment must not be removed unless appropriate procedures to ensure a safe working environment are followed, the cylinder inspection system is turned off, appropriate signage is in place, and lockouts have been activated to ensure the Cyl-Sonic Industrial System cannot be accidentally restarted.

2.3.1 List of Mechanical & Electrical Safety Devices

A. All enclosure covers.
B. Redundant bolting/fasteners.
C. Wire ways, tie-downs, and cable covers.
D. Electrical fuses.
E. Placards and signage indicating possible dangers or ongoing maintenance.

2.4 Safety Equipment Guidelines

A. Safety equipment must be clean and in good, working condition.
B. Safety equipment must be worn/used whenever maintenance is to be performed on the Cyl-Sonic Industrial System.
C. Safety equipment must not be removed until all safety devices are properly installed and functioning.

2.4.1 List of Required Safety Equipment

A. Safety glasses must be worn at all times when performing maintenance tasks.
B. Ear protection must be worn as needed depending on the environment in which work is to be performed.
C. Proper foot protection (specifically rubber-capped, steel-toed boots.)
D. Proper-fitting protective garments are to be worn when performing maintenance activities.

3 Installation

3.1 Inspection

Inspect all equipment during arrival and after placement to ensure there is no visible damage.

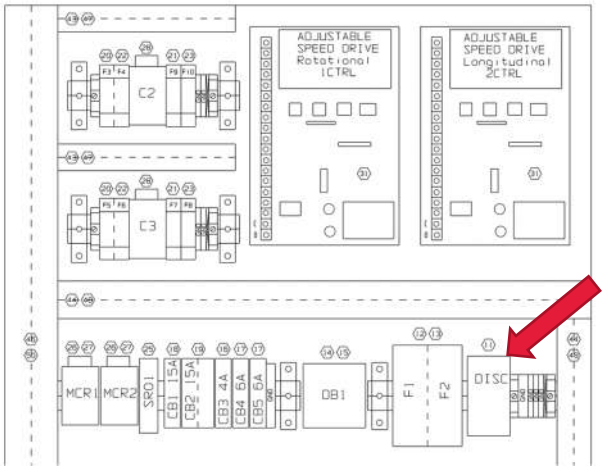
The following areas should be checked:

- Structural frame of equipment and accessories
- Cables and cables end connectors
- Electrical boxes and panel mounted connectors
- Air prep unit and pneumatic plumbing
- Water pan and water plumping
- Pneumatic cylinder fittings and cylinder mounted sensors

If any damage is found, Nordco's shipping department must be notified.
Photo documentation of the damage must be sent to Nordco immediately.

3.2 Power Connection

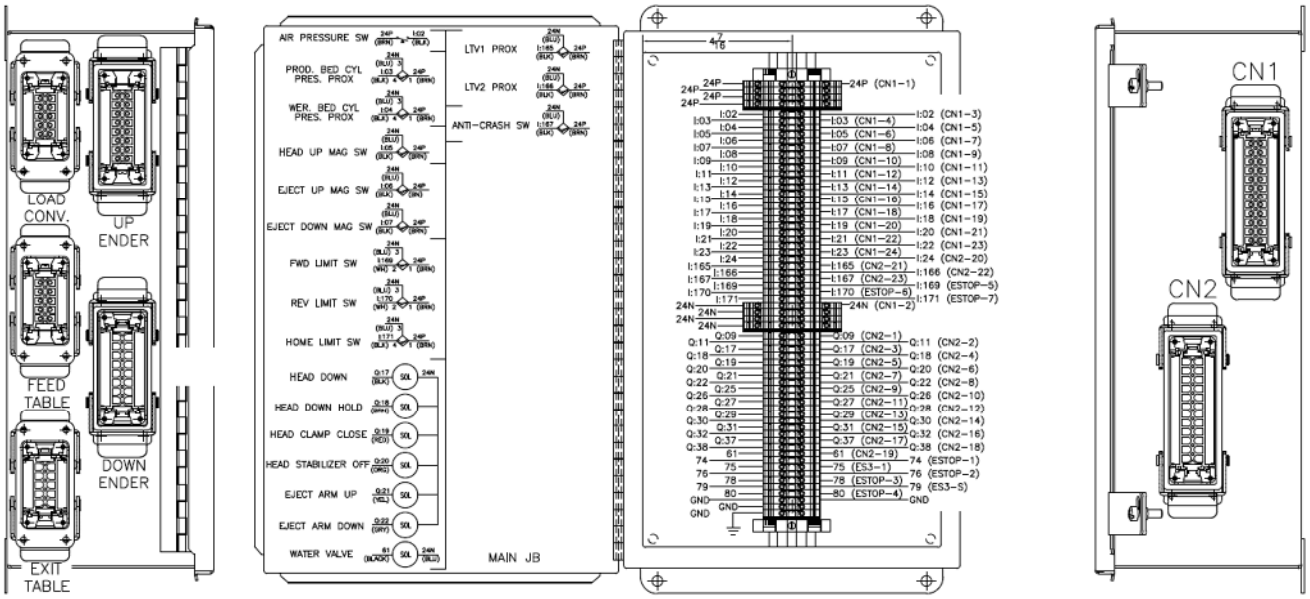
Qualified electrician will connect specified power to the main disconnect and ground block in the electrical enclosure.



3.3 System Connections

3.3.1 Main Machine Connections

Connect the infeed and exit accessory cables to the appropriate main machine connection points on both sides of the junction box, as shown below. See system diagram E-DWG-0012.

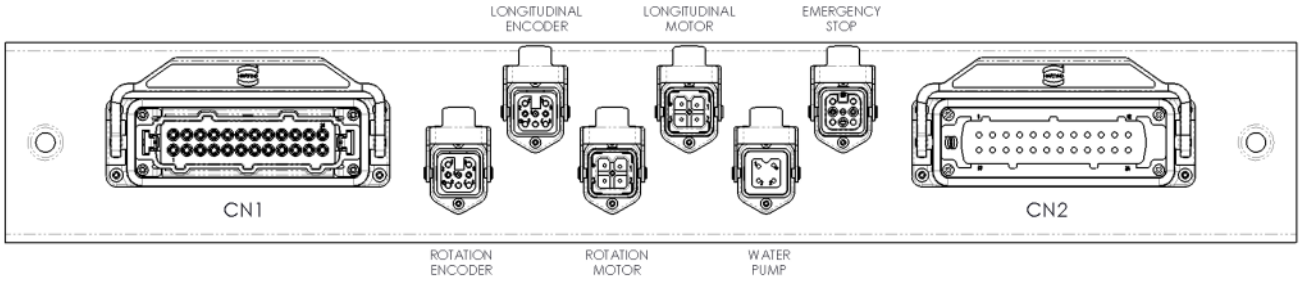


3.3.2 Electrical Enclosure Connections

3.3.2.1 Rear Plinth Panel

Connect the following cables:

1. CN1 from rear plinth to main machine
2. CN2 from rear plinth to main machine
3. Rotational encoder from rear plinth to main machine cylinder bed drive encoder.
4. Longitudinal encoder from rear plinth to main machine test head drive encoder.
5. Rotational motor from rear plinth to main machine cylinder bed drive motor.
6. Longitudinal motor from rear plinth to main machine test head drive motor.
7. Water pump from rear plinth to main machine cylinder bed drive encoder.
8. E-Stop from rear plinth to main machine E-Stop box encoder.



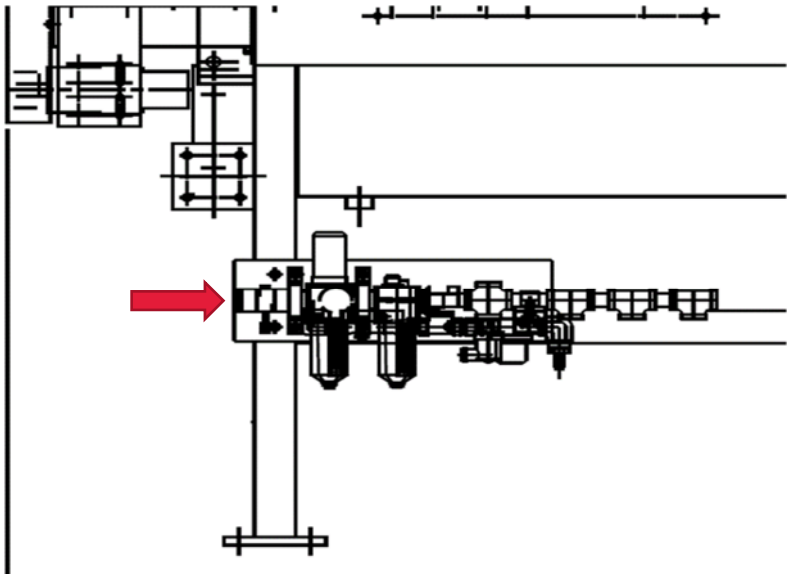
3.3.2.2 Side Plinth Panel

Connect the following cables:

1. Ultrasonic test wheel from main machine to side plinth of electrical enclosure.

3.4 Pneumatic Connection

Attach 80 psi dry shop air to 1/2 NPT air input fitting located on the main machine.



3.5 Water Level

Fill water pan 1" above pump inlet pipe.

3.6 Load Conveyor Connections (Configuration Dependent)

If Nordco personnel perform site set up and acceptance test, they will likely perform the following. Information provided here for those cases when customer elects not to use Nordco services. The Nordco shot transfer table can receive cylinders for inspection from a shot blaster machine. To enable this, two components provided with the Nordco shot transfer table need to be connected to the shot blaster machine.

3.6.1 Proximity Sensor

There is a proximity sensor to mount on shot blaster. This sensor is shipped temporarily attached to the shot transfer table. It must be detached from there and mounted in the appropriate place on the shot blaster to sense when a cylinder is ready for transfer. The sensor is factory wired to the shot transfer table and should not be altered.

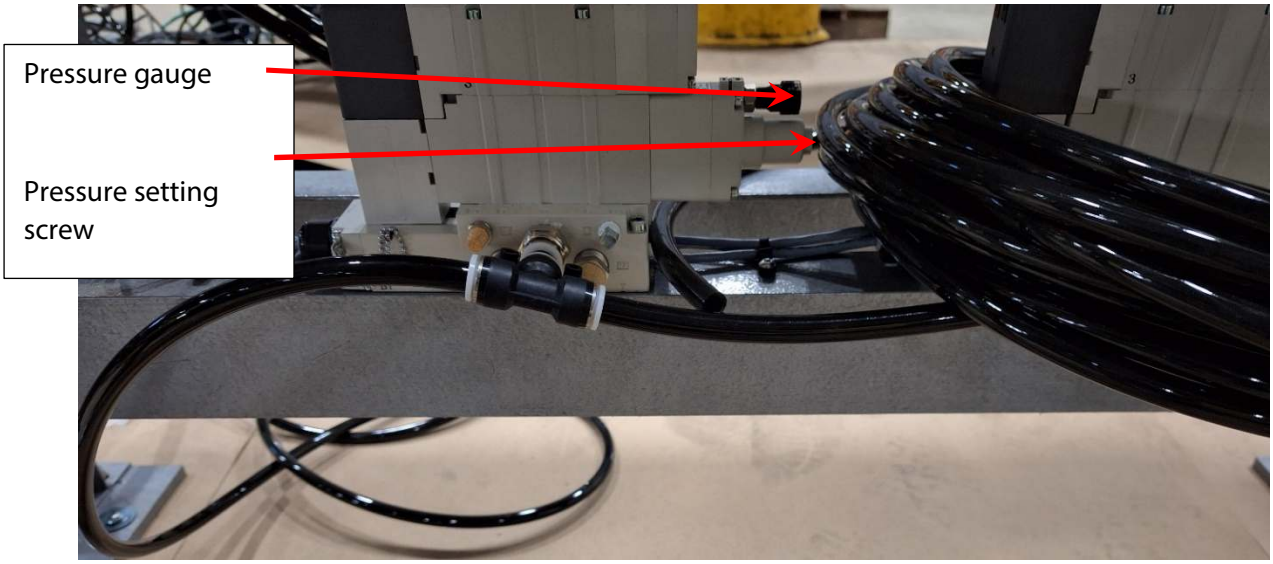
Proximity Sensor for Shot Blaster.

Shown strapped down for shipping.

3.6.2 Pneumatic Connection

Connect the source and return pneumatic hoses to shot blaster pneumatic cylinder that ejects cylinder to transfer table. Refer to Figure 2 and Figure 3 for the following discussion.
Extra pneumatic hose is shipped with the Nordco shot transfer table. Connect hose to the source and return between the appropriate ports of the shot blaster pneumatic cylinder and the transfer table pneumatic control valve.

Then connect source air line to load conveyor control valve.
After supply pressure has been applied, the regulator pressure must be set. The amount of pressure will be site specific. Suggested starting pressure is 5 psi. Adjust up or down as appropriate to get cylinder ejection that is desired speed and force.



3.7 Internet Connection

For remote troubleshooting, software updates, and oversite compliance, system requires a LAN connection to computer with 6e/5e cable with internet access for remote control via team viewer software or other customer provide access. System speeds/bandwidth must support real time audio, video, and remote control from OEM as well as system data back up and file transfer for system and oversite specific functions.

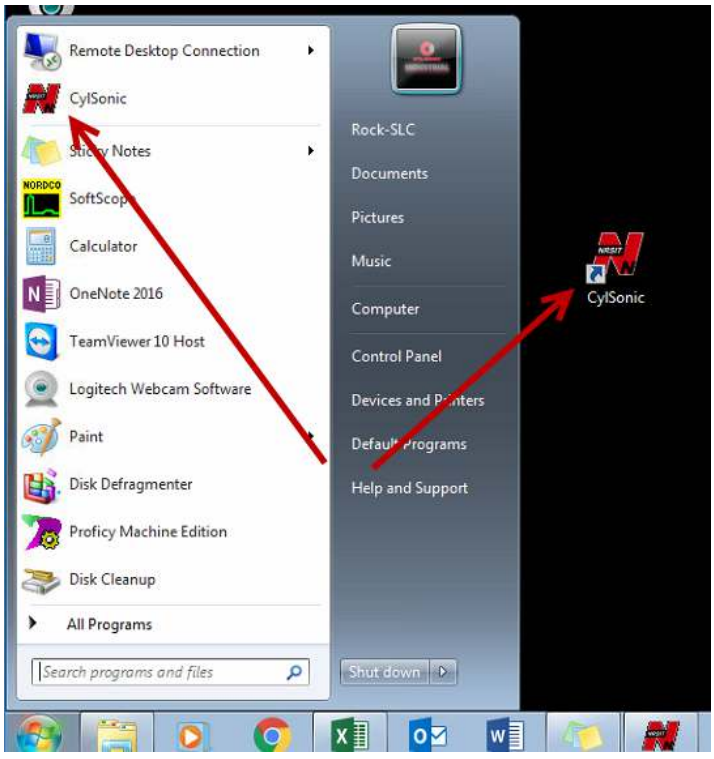
4 Operation

4.1 System Startup

1. Turn on the power switch for the DSP system located next to the router.
2. Turn on the computer by pressing the power button on the computer.
3. Verify that all E-Stops are not pressed by rotating them counterclockwise.
    a. One on the main electrical cabinet on the left side.
    b. One on the UpEnder if present.
    c. One on the DownEnder if present.
4. Press the Start button on the box on the left of the main electrical cabinet.
5. Log into the computer with the password _____.

4.2 Starting up the DSP500 System

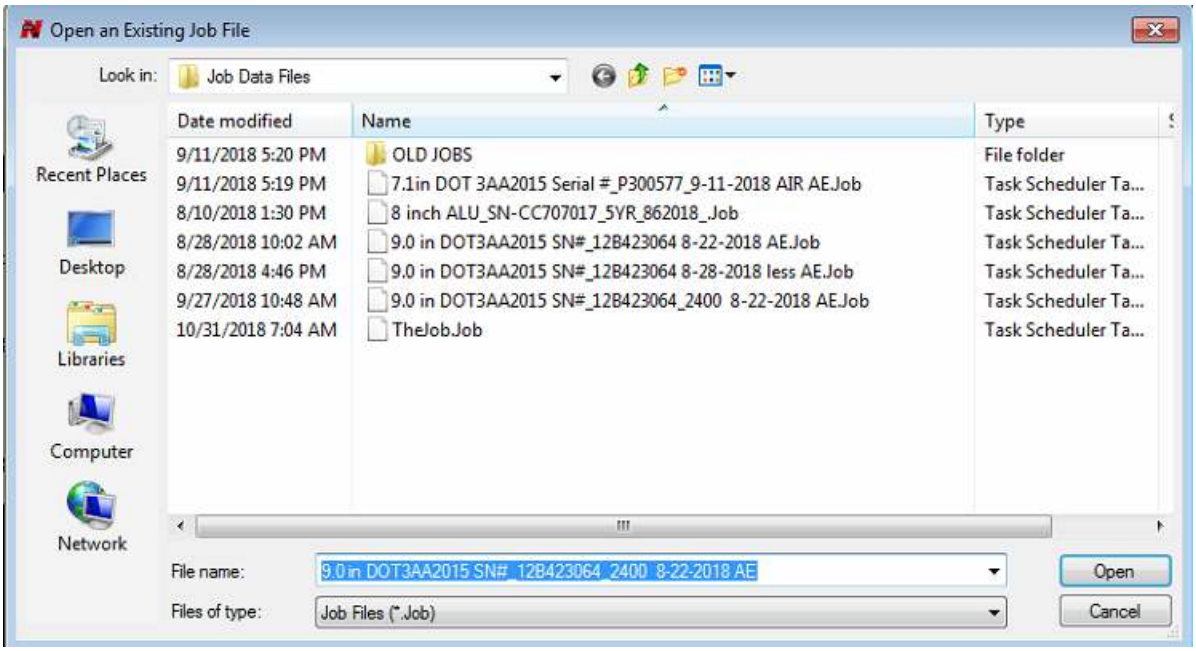
1. The DSP500 system is started by double-clicking the program's shortcut icon that is typically included on the desktop during the installation of the system software.



2. When the program is started the screen with the Nordco Logo and program name will appear for a few seconds or can be removed by pressing any key.

3. Once the screen is closed, a File Open dialog box for job files will appear in the center of the display.

4. Select the appropriate job file for the cylinder standard and cylinder specification, service pressure and dimensions to be tested.



a. Reference a copy of the system CylSonicPreTable for the selected cylinder specifications, pressure ratings and diameters allowed set up to be tested under that calibrations standard. The below are examples of Department of Transportation cylinder specifications.

5. CylSonicPreTable allows the system to store physical testing setting for a variety of cylinder specification, service pressure, and dimensions allowed to be run under each calibration cylinder.

JobCo	ReferenceCo	AKA Part #-Spec-PSI-Dia-LG-Period	Diamet	Leng	CylinderSp	ServicePressu
10	CAL	Part #1100304-3AL-1800-7.25-18.00	7.25	18.0	3AL	1800
10	C10	C10-3AL-1800-6.89-16.6	6.89	16.6	3AL	1800
10	C15	C15-3AL-1800-6.89-23.2	6.89	23.2	3AL	1800
10	C20	C20-3AL-1800-8.00-23.2	8.00	23.2	3AL	1800
10	C35	C35-3AL-1800-8.00-38.0	8.00	38.0	3AL	1800
10	C50	C50-3AL-1800-8.60-46.3	8.60	46.3	3AL	1800
10	M33-N33	N33-3AL-2216-6.9-15.9	6.89	23.5	3AL	2216
10	M60	M60-3AL-2216-7.25-23.5	7.25	23.5	3AL	2216
10	M90-N88	M90/M88-3AL-2216-7.25-32.6	7.25	32.6	3AL	2216
10	M150-N150	M150-N150-3AL-2015-8.00-47.8	8.00	47.8	3AL	2015
10	M122-MM	M122-3AL-2216-8.00-36.2	8.00	36.3	3AL	2216
10	N265	N265-3AL-2216-9.8-51.7	9.80	51.7	3AL	2216

6. The company's written practice will designate the appropriate personnel to establish these settings, but they include starting and ending set down points, minimum wall thickness, helix, rotational speed etc.

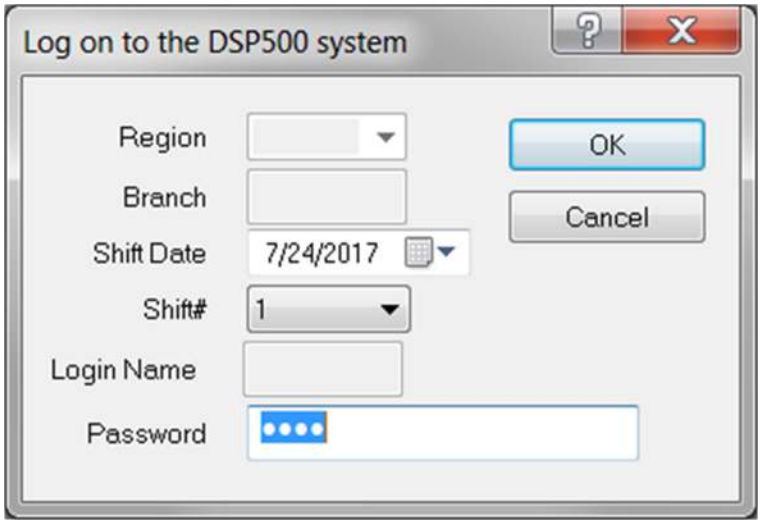
   Note: If the cancel button is clicked a default set of test parameters will be created using the file name "TheJob.Job". If the cancel button is clicked and the job is then saved to disk, all of the original parameters will then be lost! If a job filename is entered for a job that does not exist in the currently selected directory, the default set of test parameters will be used, and a new job file will be created. If an existing job filename is entered, the test parameters that were last saved using that job filename will be read in from the disk.

   NOTE: Do not use the default filename "TheJob" as a working set of job parameters since they are easily overwritten with default values when starting up the system.

7. When a job file has been selected or created (either the OK or Cancel button has been clicked) the main application window will appear in its maximized state (e.g. it will take up the entire screen). At this point the system is still not ready to inspect cylinders. When first starting up the system a dialog will appear to prompt the operator for his or her password. An operator must logon to the DSP500 system by entering a valid Access Code (e.g. password). Once a valid password has been entered the operator will be able to operate those features of the system that his or her Access Level allows access to.

4.2.1 Log on to the DSP500 System

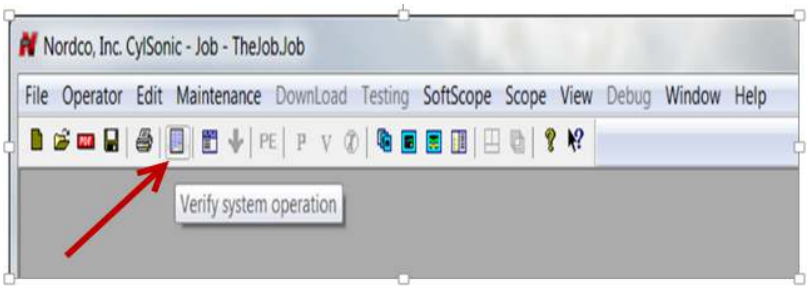
1. Enter Password – (Tab) Required
2. Enter Region – (00) (Set up at install by level 10 or higher)
3. Enter Branch Code (Set up at install by level 10 or higher)
4. Enter Shift- As required by test facility
5. Select “OK” Button



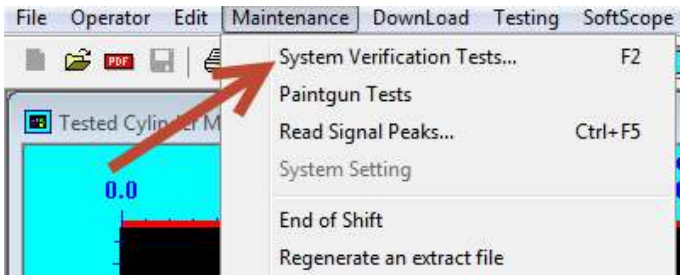
At this point the test parameters (gates, gains, etc.) have not been downloaded to the DSP500 system electronics and thus testing of cylinders is not allowed. EXTREMELY IMPORTANT: before downloading the test parameters, a parallel communications test must be run so the system knows which data channels are active, or "linked up". Only those data channels that pass the parallel communications test will be sent test parameters during a job download, and thus only those channels will be setup to inspect cylinders for defects.

4.2.2 Parallel Communications Test

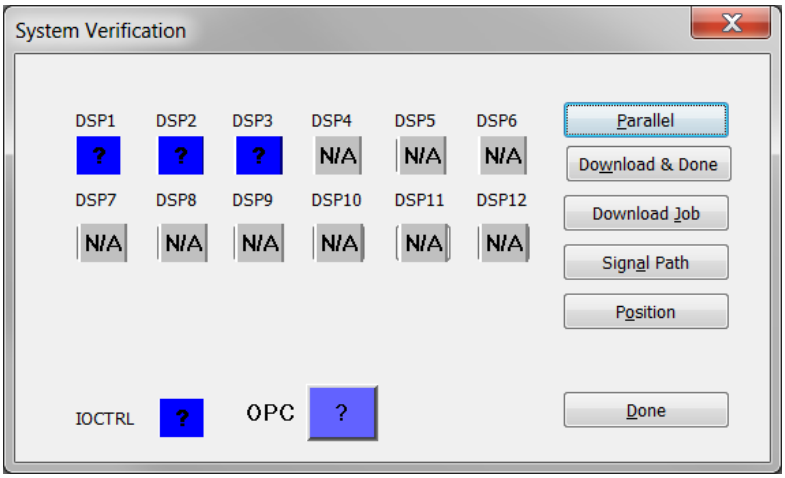
1. Select "Verify system operation" icon or press the F2 key or Maintenance Drop Down



or



2. Select "Parallel"
3. DSP1, DSP2, DSP3 – Should change from Blue to Green. *Note: If the built-in self-test fails, a problem with the hardware components should be suspected Repeat step 2 a couple times to confirm.*
4. Select "Download & Done"



The DSP500 system will not allow the testing mode of operation to be entered unless:

1. A parallel communications test has been successfully passed,
2. A job parameter data file has been opened and the data downloaded to the DSP500 electronics,

4.3 Setting up an DSP500 Job

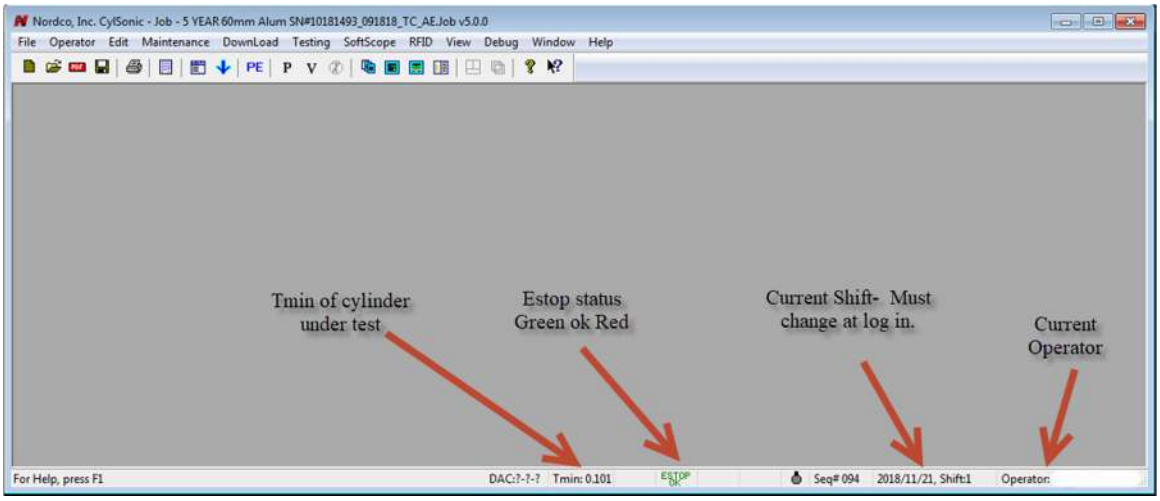
Correctly setting up a DSP500 Job for optimal inspection of cylinders requires a working knowledge of the DSP500 system menus and controls and a thorough understanding of ultrasonic principles is needed for setting the ultrasonic parameters. Once the job parameters have been set, however, an operator need only know the basics of running the DSP500 system in order to test cylinders. Once set up properly, inspection of cylinders for defects takes place in a semi-automatic/automatic fashion.

Customers can request Nordco to set up jobs as part of our Oversite services or request as part of the equipment purchase. For those providing their own oversite or Job set up, further training can be provided from Nordco with Advance Operator Training which covers calibration cylinder standards set up and job files.

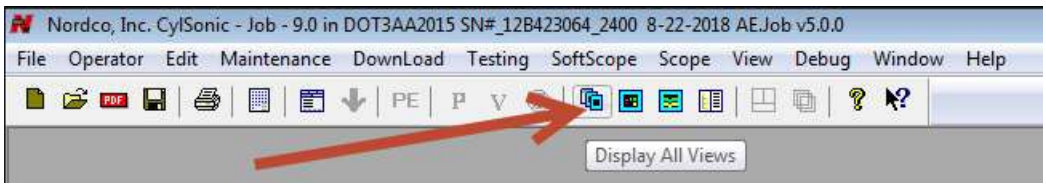
Once a job has been set up and the parameters are sent down to the electronics, the system can then be placed into a testing mode of operation using the Testing menu selection located on the mainframe window's menu bar. The typical scenario from this point is to first select the verification testing mode of operation and then run a calibration standard through the system in order to verify the job parameter settings. Adjustments to the job parameters are made as needed until the test results meet the specifications set by the user's standard operating procedures (SOP's). After the system setup has been verified, the production testing mode of operation can be selected and the Cylinder product can then be inspected.

4.3.1 Software Menu Display set up and Navigation

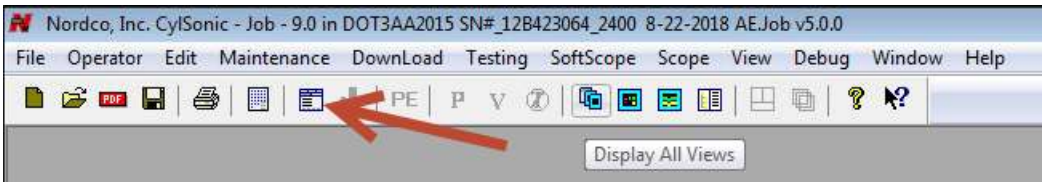
After System verification the following will display.



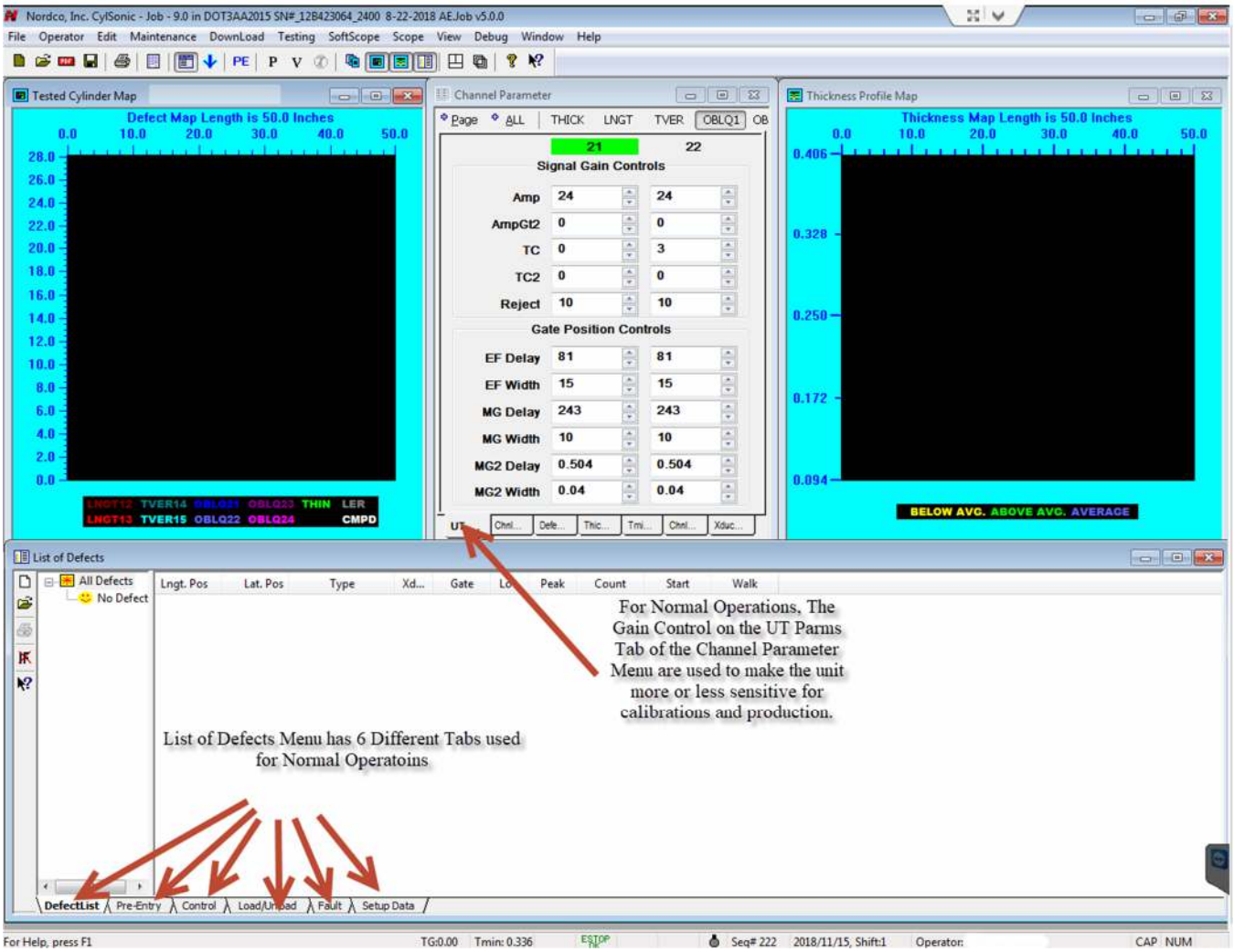
Open the C scan (Tested Cylinder Map) display, B scan (Thickness map) display, and defect menu by clicking on the Display all Views icon.



Opening the channel parameter menu by clicking on the Channel Parameter icon.

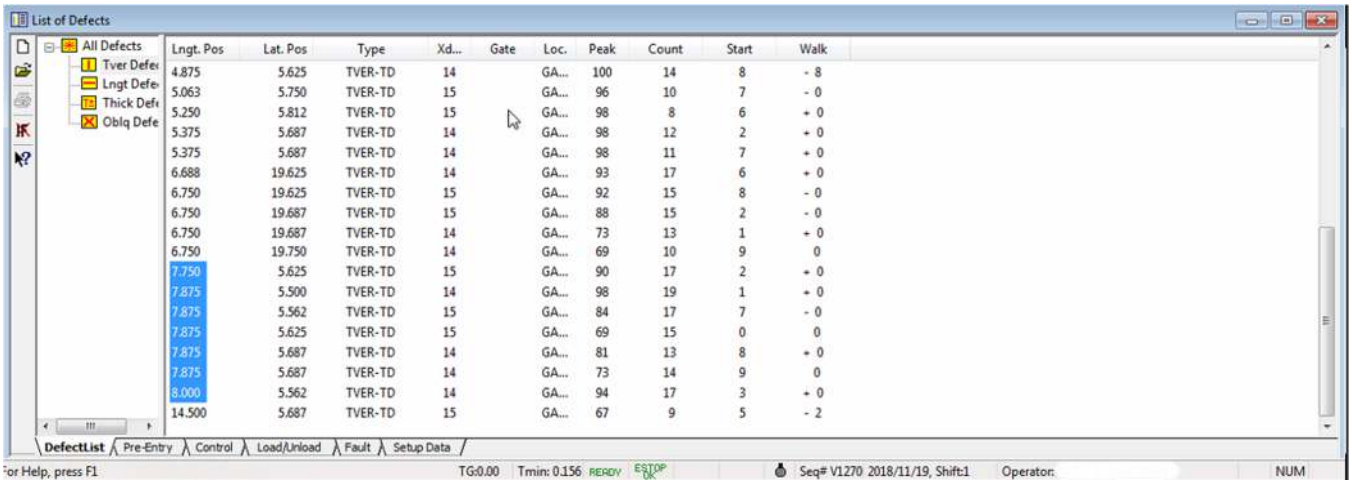


Arrange menu and display to suit by dragging them to desired location inside the screen.

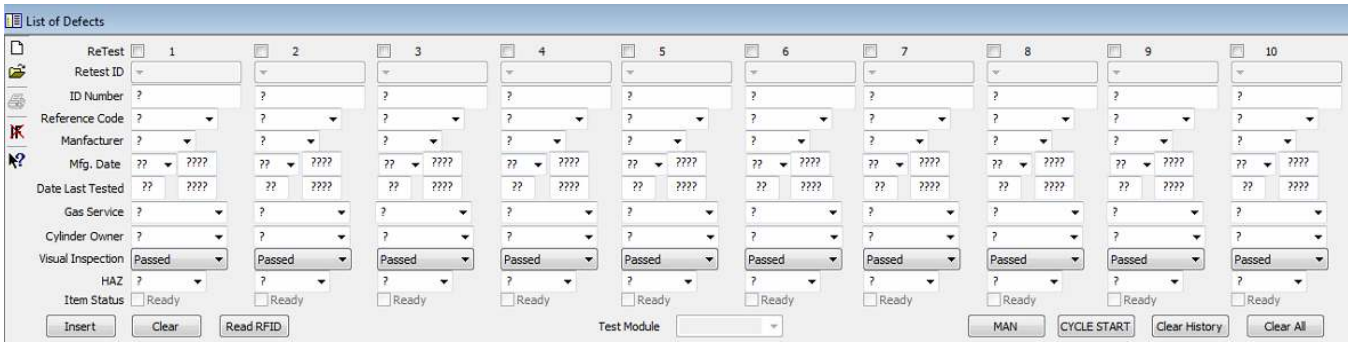


List of Defect Menu Tables

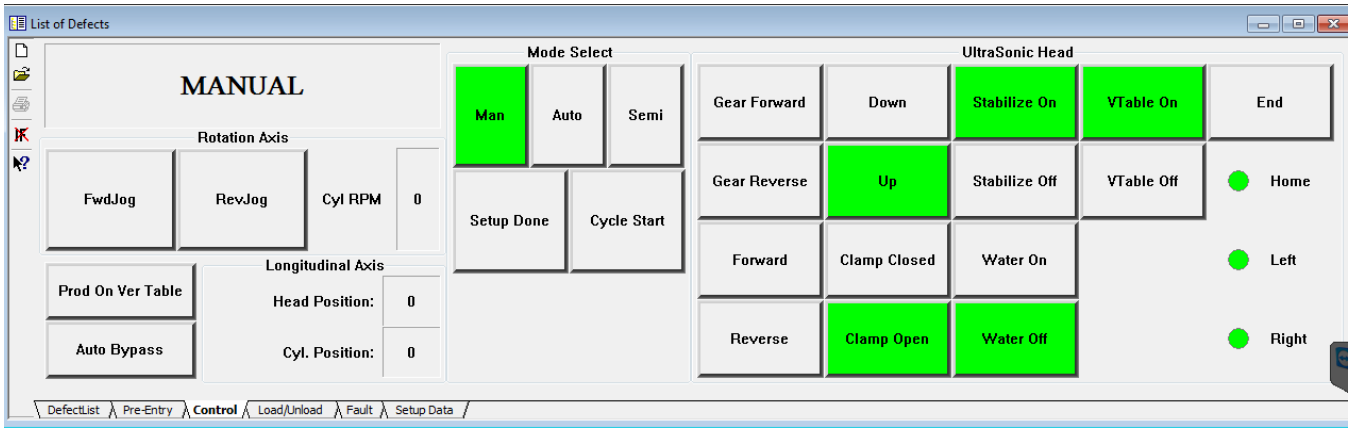
Defect List Displays details of defects including position, type transducer, location, Gate, Peak (FSH), Alarm count, starting position in the gate and walk of defect through the gate.



Cylinder Data Tab is where operator enters the required data for the cylinder to be tested.

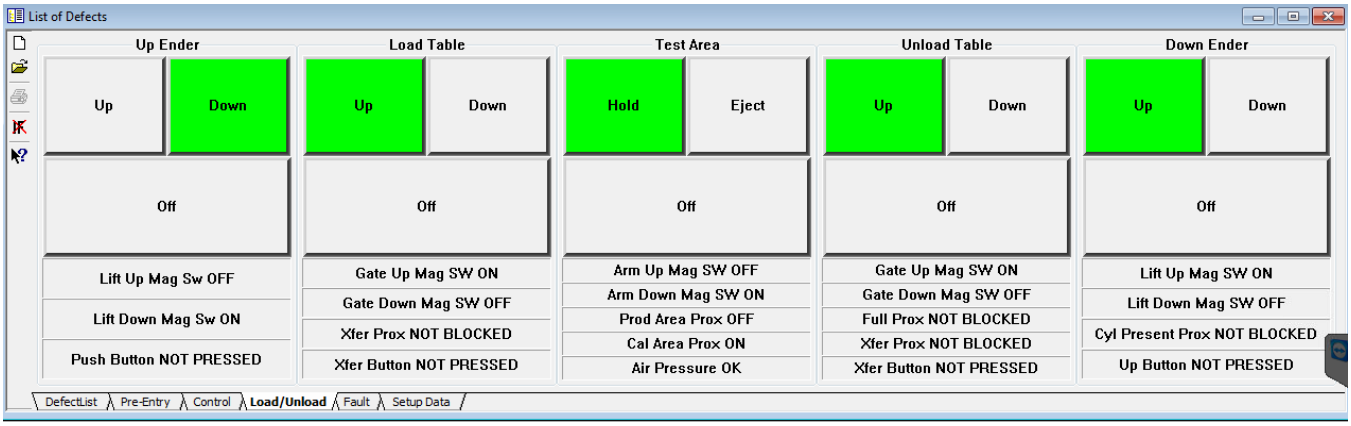


Control Tab controls the movement of the RSU, rollers, and water

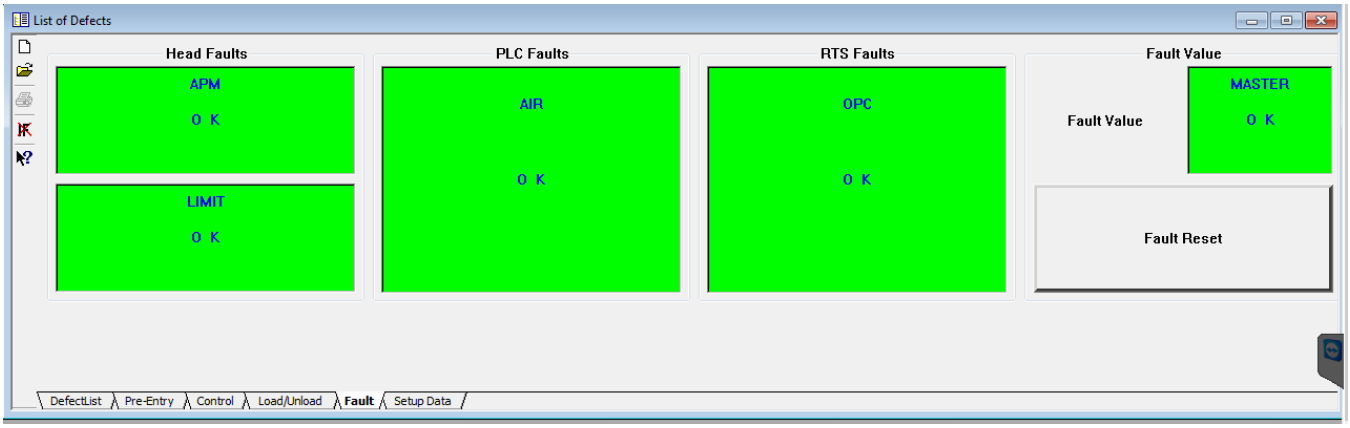


Load/Unload is where operator would control cylinder movement in manual and semi mode as well as trouble shoot magnetic and proximity switches that ensure safe operations of unit. Green denotes current

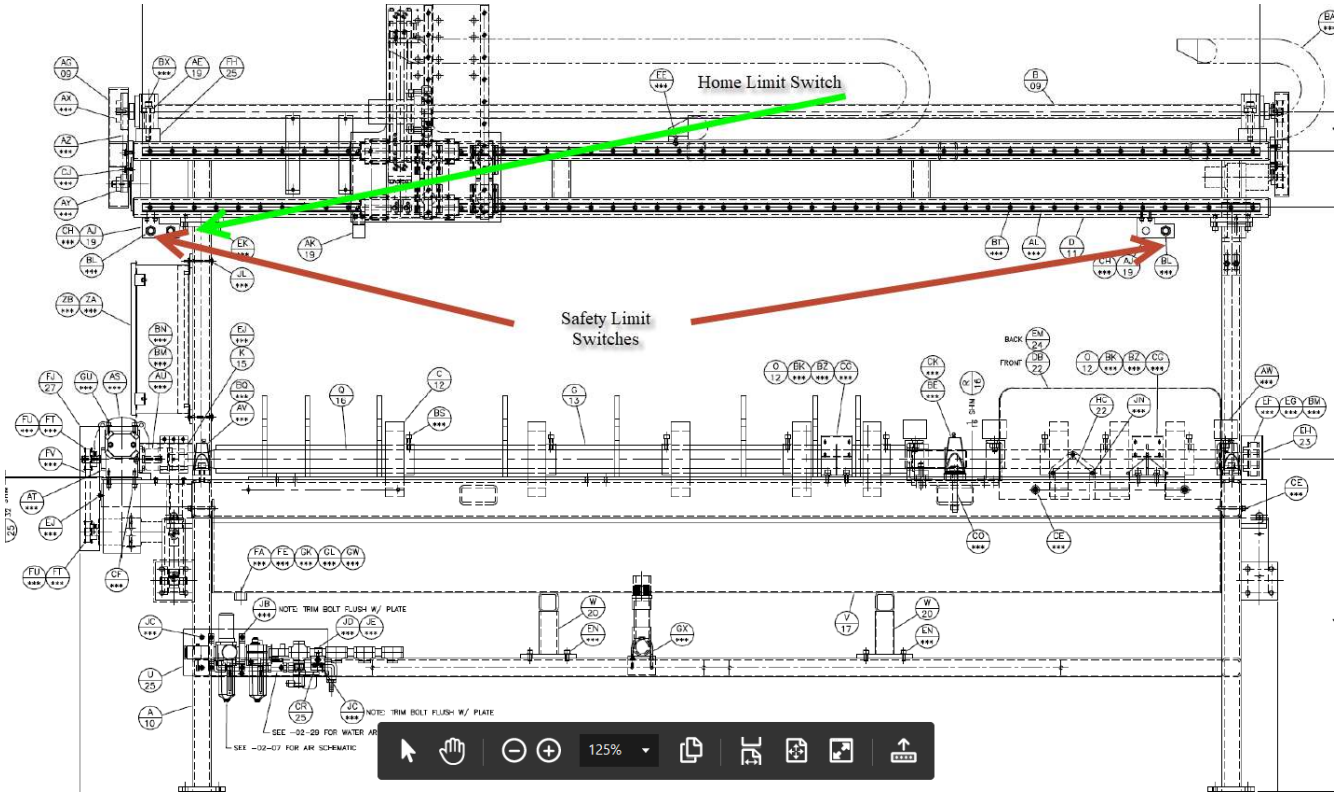
position of the equipment. Individual controls of each section of equipment is given in detail. (Your window may look different than below)



Fault Tab is where you reset a fault and display control alarms

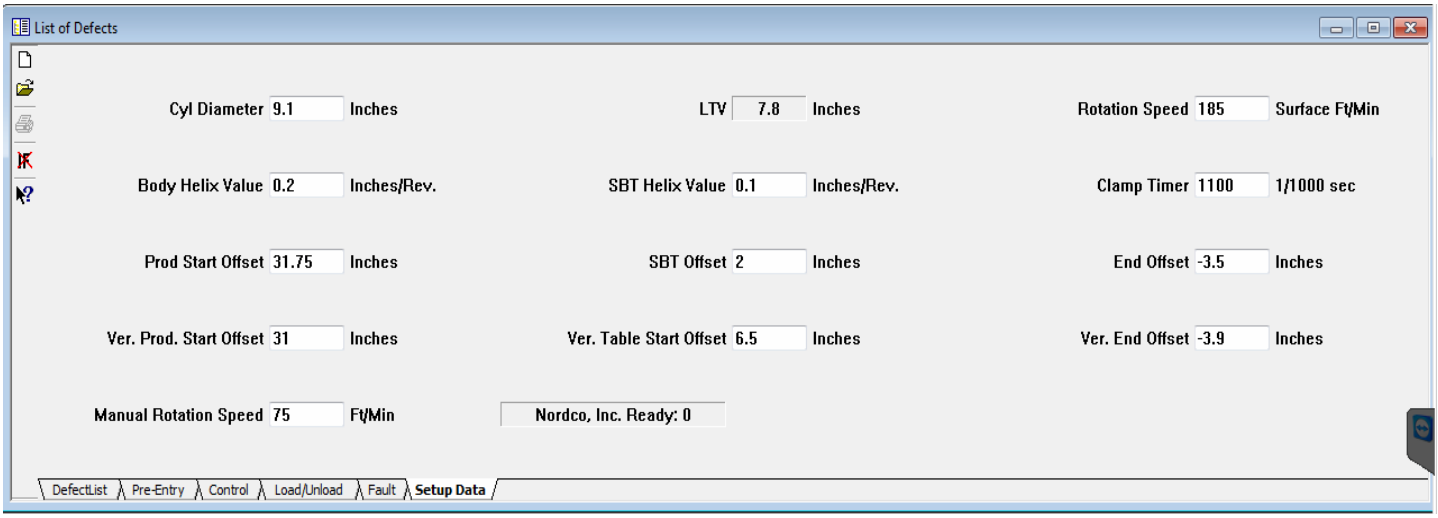


Head Fault would turn red if Safety Limit Switches are activated by the RSU traveling too far in either direction on the screw drive.



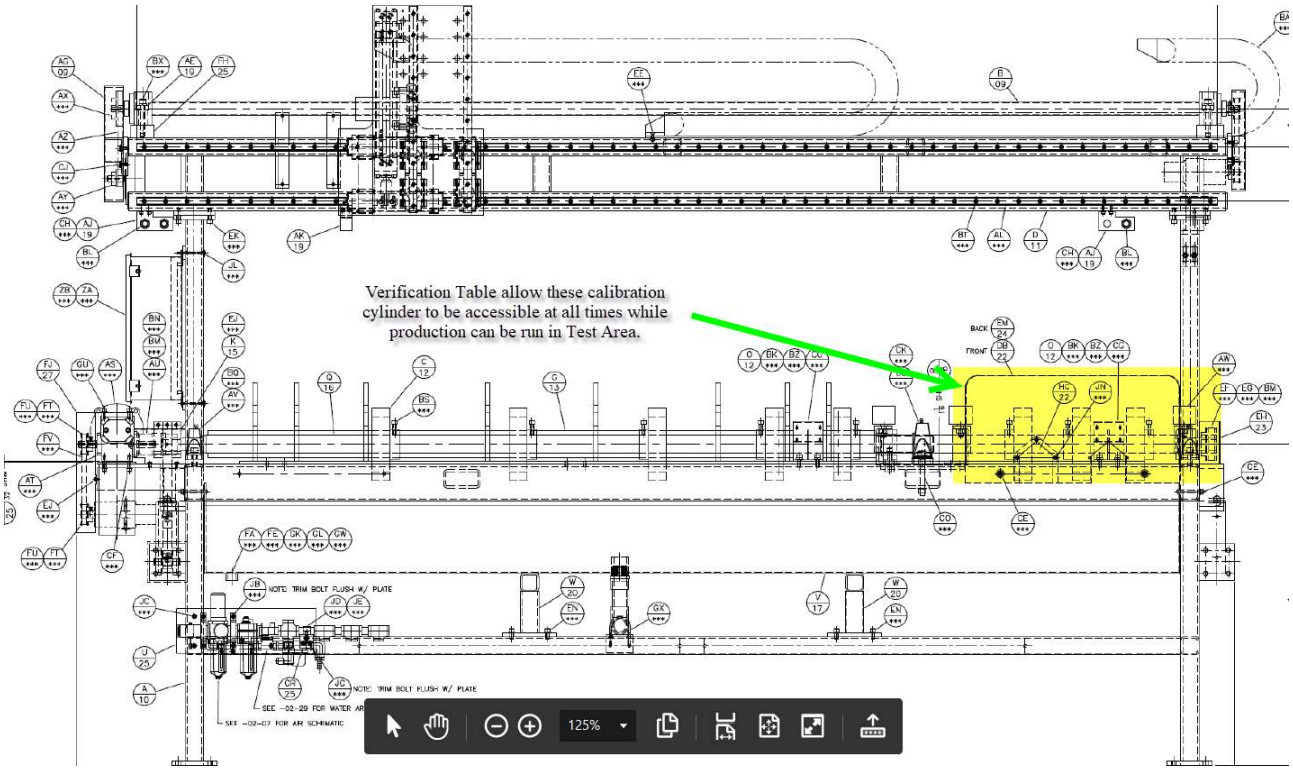
Setup Data is the physical test setting of the cylinder under test. The data is loaded from the CylSonicPreTable.

Under typical operations only the production offset and end offset are controlled by operator to adjust starting and ending points of non-standard length cylinders.

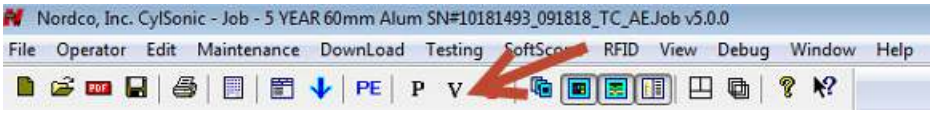


4.3.2 Verification

1. Place the calibration cylinder for the Job file selected onto the verification table



2. Select verification mode



3. The following pop up window will verify

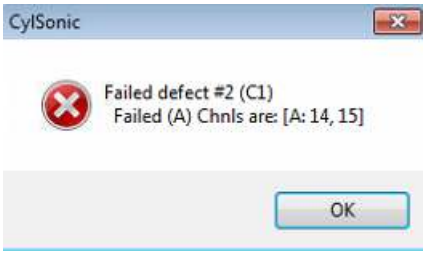
4. From Control Tab ensure system is in Semi mode or Auto.

a. If it cannot be selected, ensure faults are clear and estop is showing green then select Man Mode then Setup to send RSU to Home Limit Switch.

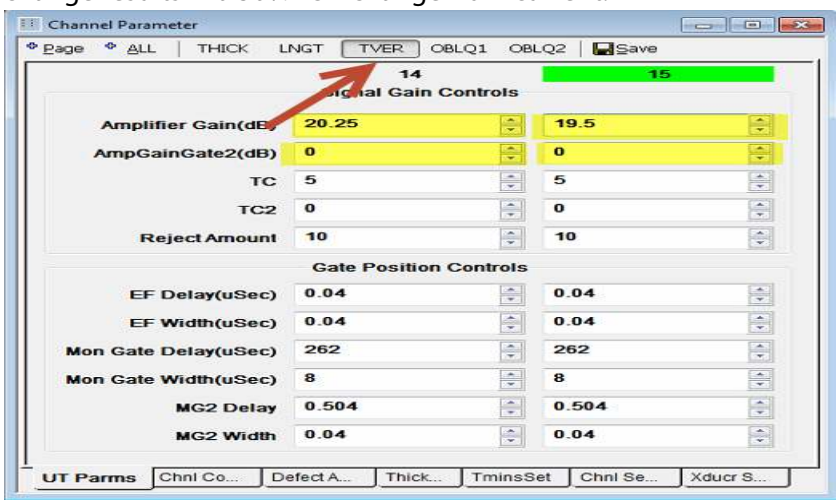
b. Once the unit verifies the RSU is at the home position, select Semi or Auto.

5. Select Cycle Start from the Control Tab or the Cyl Data Tab.

6. After the calibration has run, the system will provide a pop up for any required defect not found by the system.

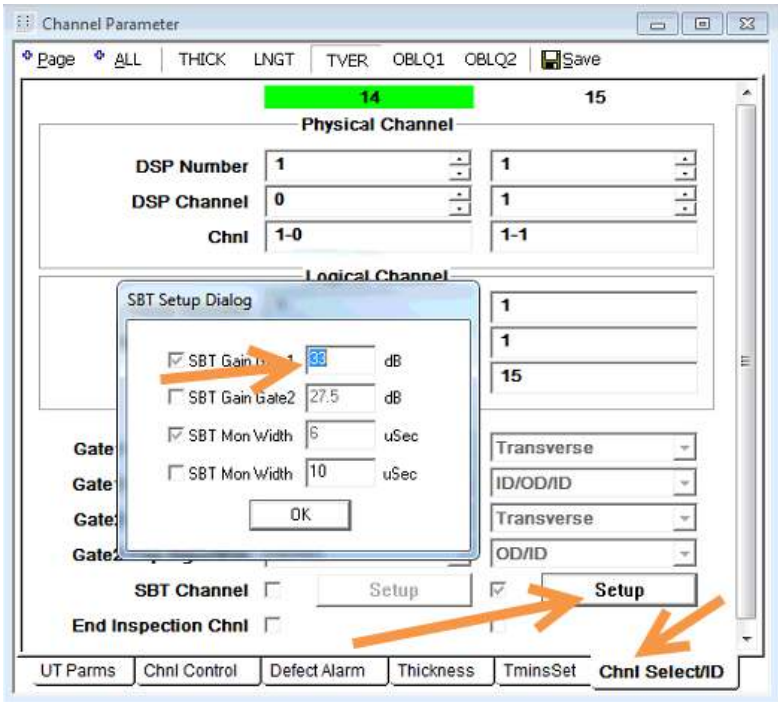


7. You will also notice that the defect was not seen in the Cylinder Tested Map. For normal day to day operations, the gain will need to be adjusted to raise the sensitivity of the system to detect the flaw. Select the corresponding transducer set of the channel noted from the pop up to be adjusted:
    a. Parameter Menu ----> UT Parms Tab and raise the gain appropriately. Remember a 6db gain change results in a 50% FSH change from current.



    b. For steel cylinders that require gain adjustments for the side to base transition area (SBT) flaw, gain control location is separated. To detect the circumferential flaw in the SBT, increased gain above regular side wall gain setting is required due to the thickening of cylinder wall for Channel 15.

Parameter Menu-→Channel Select/ID-→SBT Channel Setup-→SBT Gain Gate 1 or 2

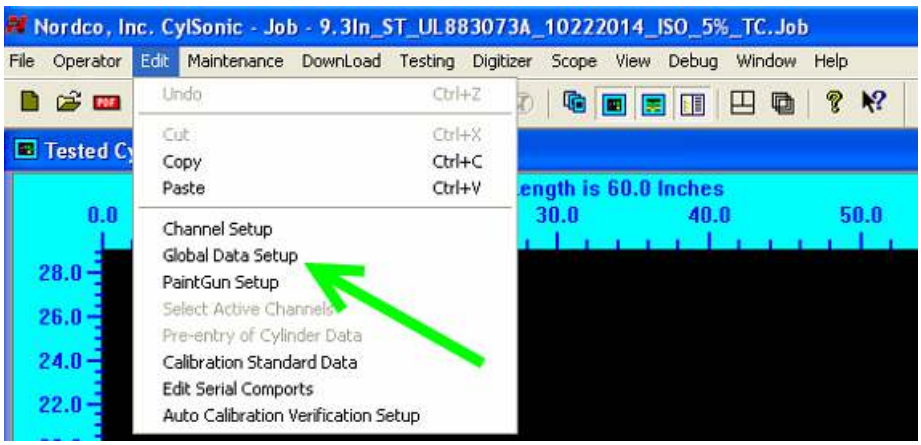


Optionally gain control can be enabled for SBT length on other channels. Typically it is enabled for Thick Channel #11 Gate 1 or 2 to increase gain for thicker SBT regions in certain cylinders. This is to reduce loss of thickness readings or LER during testing.

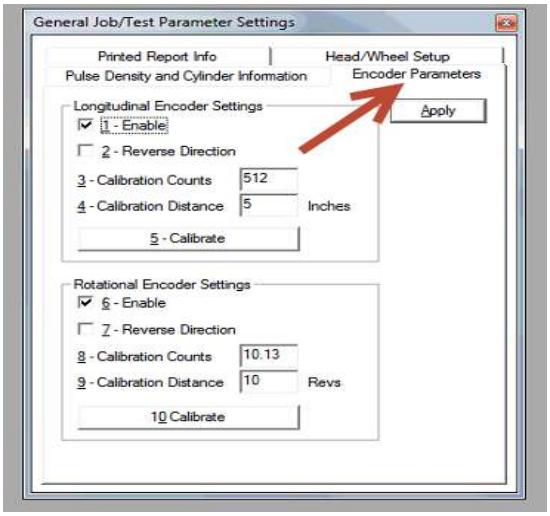
8. The Rotational (Circumferential) Encoders may get out of calibration causing the series of defects in your calibration cylinder to appear to move up or down the Tested Cylinder Map(C-scan).

   To correct the encoder:

   a. Select Global Data Menu from Edit Drop Down.



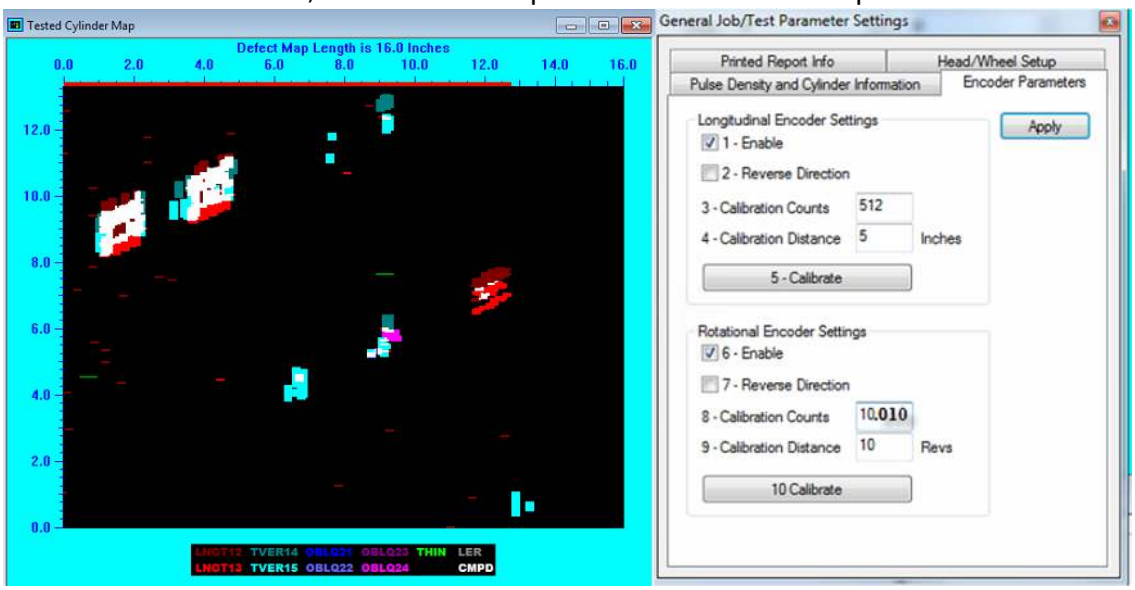
b. Select Encoder Parameters from the General Job /Test Parameter Setting Menu.

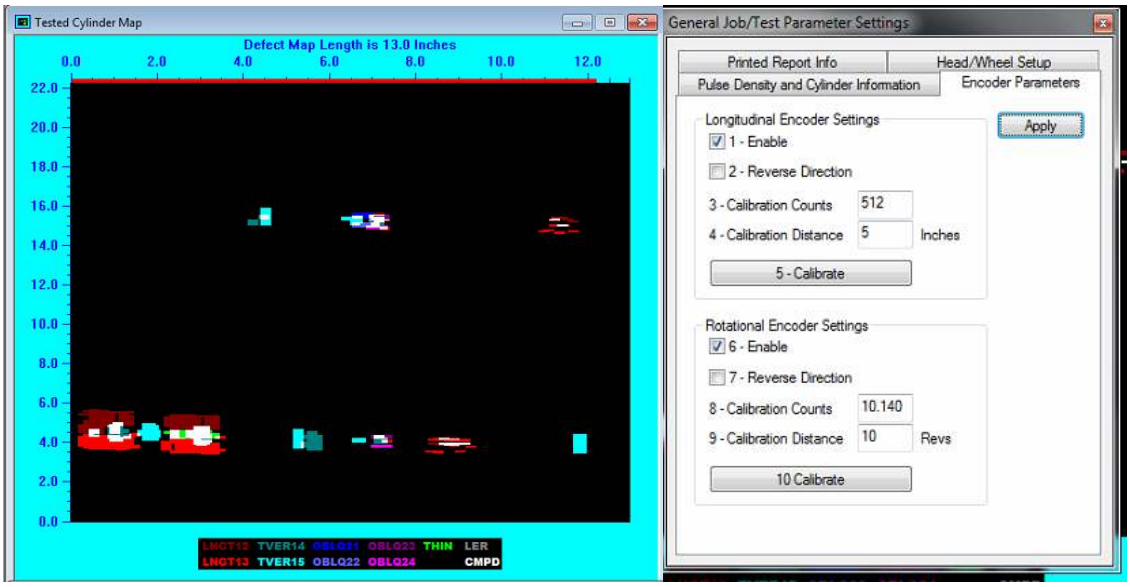


c. In the Rotational Encoder Setting 8- Calibration Counts, adjust the number to straighten the flaws. If the line flaws are moving up on the Cylinder Tested Map as the head moves down the cylinder, you must increase the count. The opposite holds true if the line of flaws are moving down.

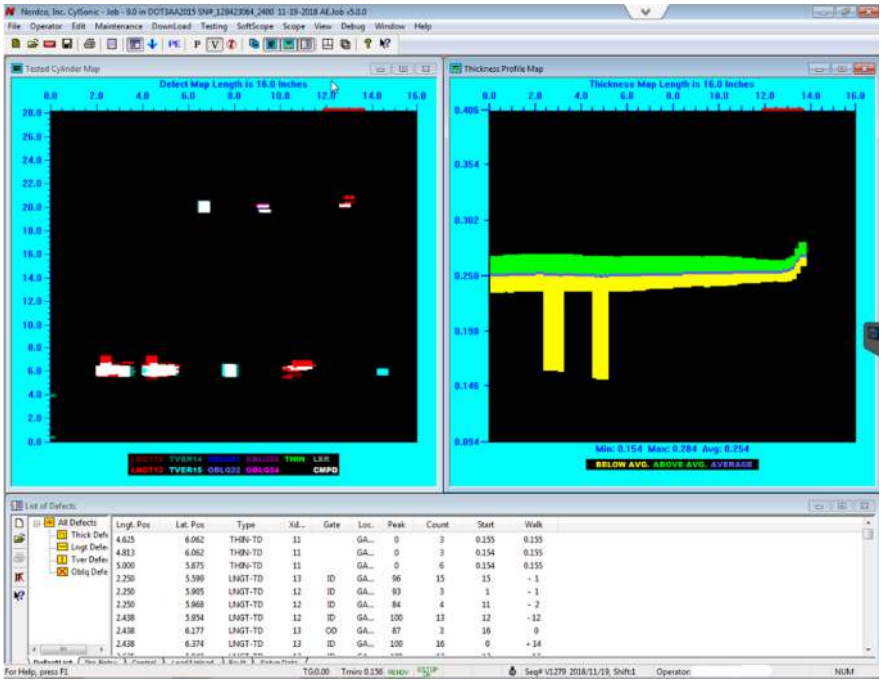
d. If it is a large movement, increase by a hundredth of an inch.

e. If it is a small amount, use thousandths place to correct. See Example in Table below.

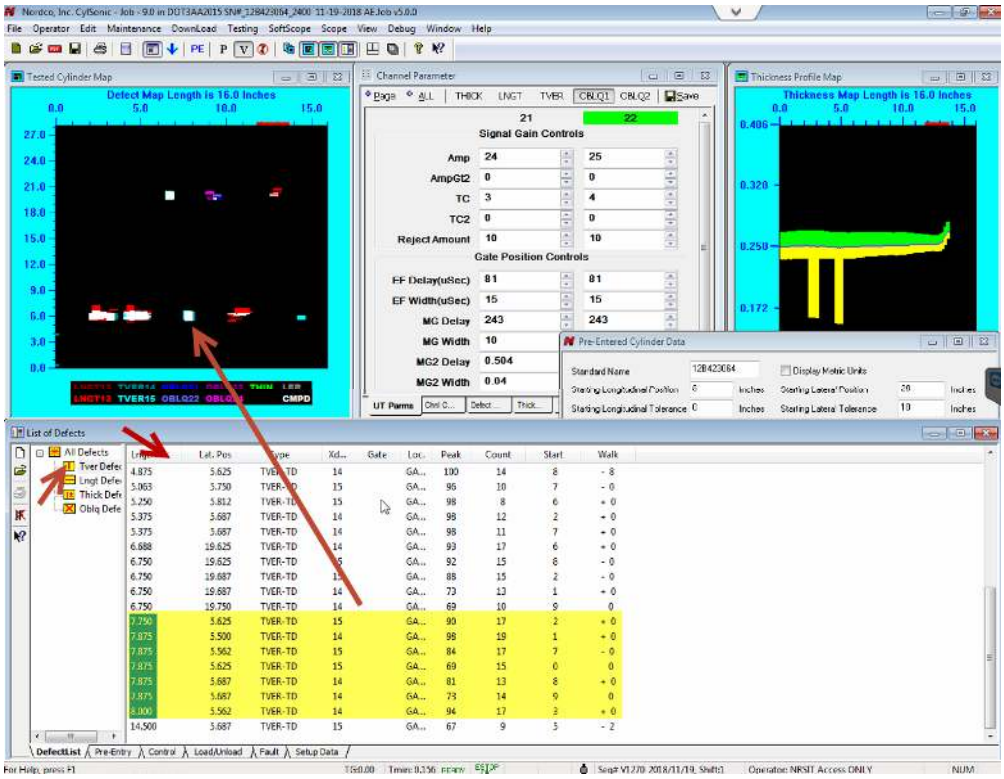




9. Rerun the calibration by selecting cycle start. A successful calibration will not provide any pop ups and all required defects will be displayed on Tested Cylinder Map and Thickness Profile Map visually. The details are shown in the List of Defects menu→ Defect List tab. It is recommended that you verify the results against the calibration standard certificate for the calibration standard and job being used.

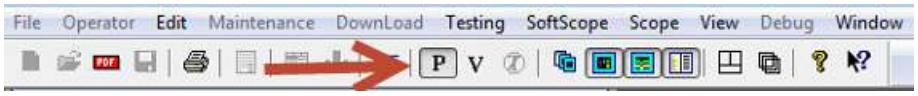


10. Defect List can be sorted to display all defects or defect by channel or type. For example, to look at the second transverse defect, select Tver Defects in Defect List Tab then sort by Lngt Pos.

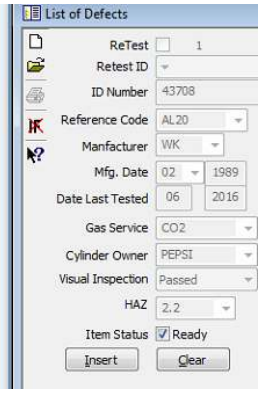


4.3.3 Production

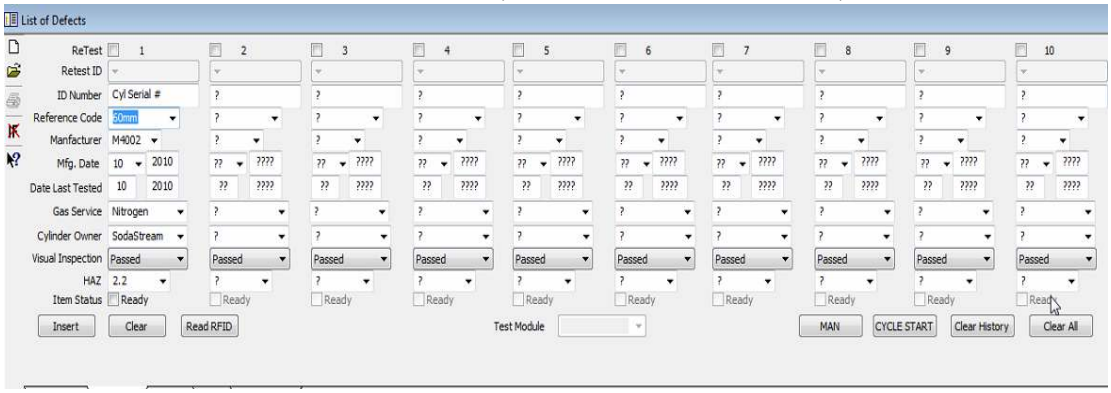
1. Select Production Mode Icon from Menu.



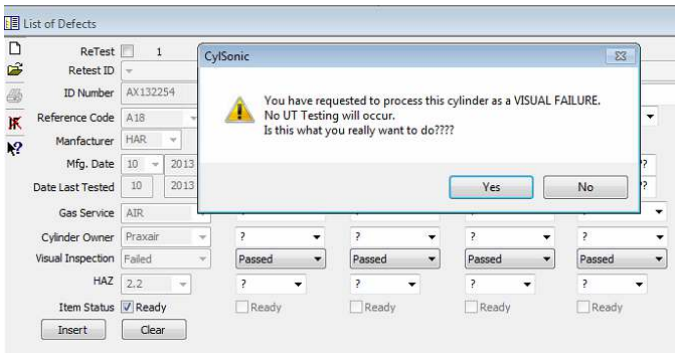
Note: If the next cylinder to be tested in the Cyl Data Tab of the Defect List menu is ready, the system will automatically switch to Production Mode upon a successful calibration. The below pop-up message will confirm the switch.



1. Enter Cylinder Data for cylinder to be test. Complete visual inspection in accordance with applicable standards. Operator can enter up to 10 cylinder to be tested in the Cyl Data Tab.



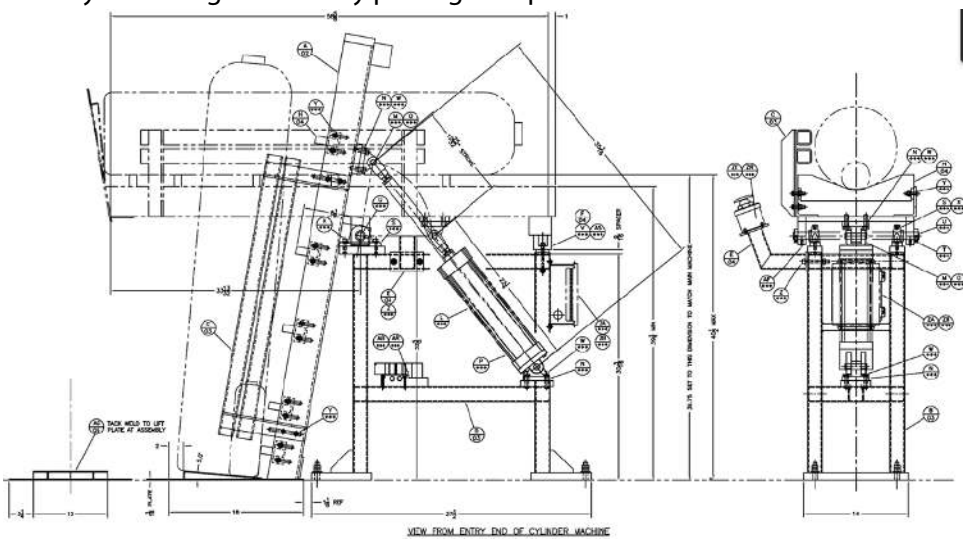
   a. Required fields are:
      i. ID # which is the cylinder # of the cylinder
      ii. Reference code corresponding to the cylinder specification, service pressure, dimensions of the cylinder to be tested. See CylSonicPreTable for reference.
      iii. Cylinder Manufacturer either the Name for order cylinders or the M # as assigned by the DOT
      iv. Cylinder Manufacturer Date
      v. Last Tested Date(if required)
      vi. Gas Service cylinder if known
      vii. Cylinder Owner
      viii. Visual Inspection Results-System will visually fail a cylinder if it is set to fail. It will not run a test but record the results in shift data.



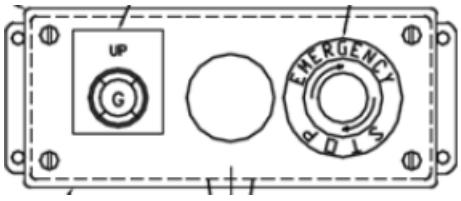
      ix. Ready the cylinder for test by clicking on the Item Status.

b. If for any reason you try to rerun a cylinder that has previously been failed, you will get the following popup message.

3. Load cylinder to get tested by placing on UpEnder.

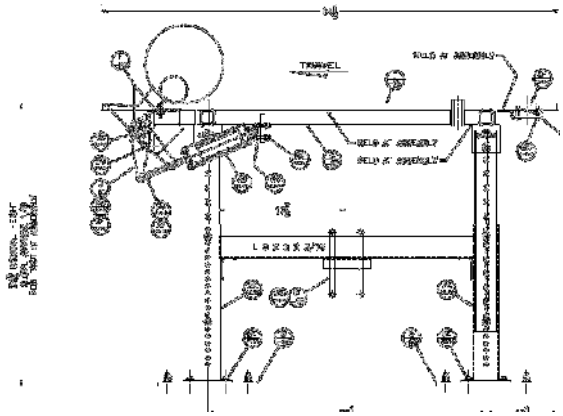


4. Raise the Up Ender and roll cylinder onto Load Table with base close to rail by pressing Up control on the Up Ender. Lower after removing the cylinder by Pressing Up.

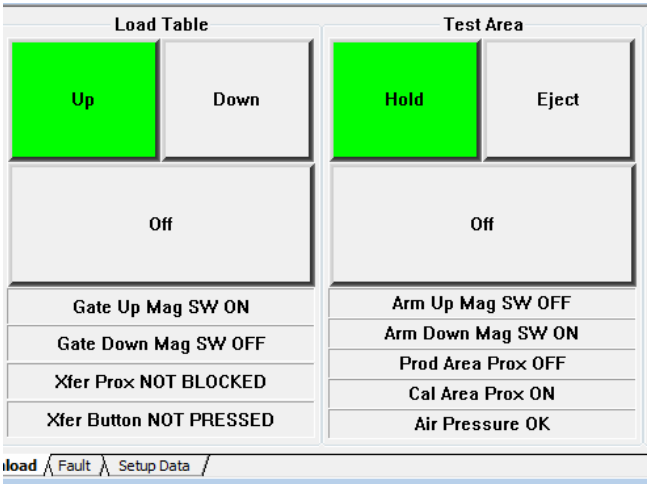


NOTE: The home position for the Up Ender is down and will automatically move there if you send the unit to the home position by Selecting Manual and Set Up.

a. If in Auto Mode the cylinder will be detected by the proximity switch and loaded onto the test area.



b. If in Semi Mode or Man, the operator will load the cylinder onto the test area by:
   i. Ensuring Test Area is in Hold Position
   ii. A cylinder is in queue on load table
   iii. Select Down on Load Table.

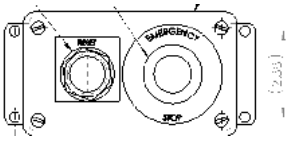


5. While loading ensure that the base of the cylinder is close to the end stop.
   c. If in Auto Mode, the proximity switch will detect the cylinder on the test table and start the test cycle.
   d. If in Semi or Man Mode, return the load to ready position for next test by selecting Up on Load Table and start the test cycle from Pre-entry Tab or Control Tab by clicking on the Cycle Start icon.

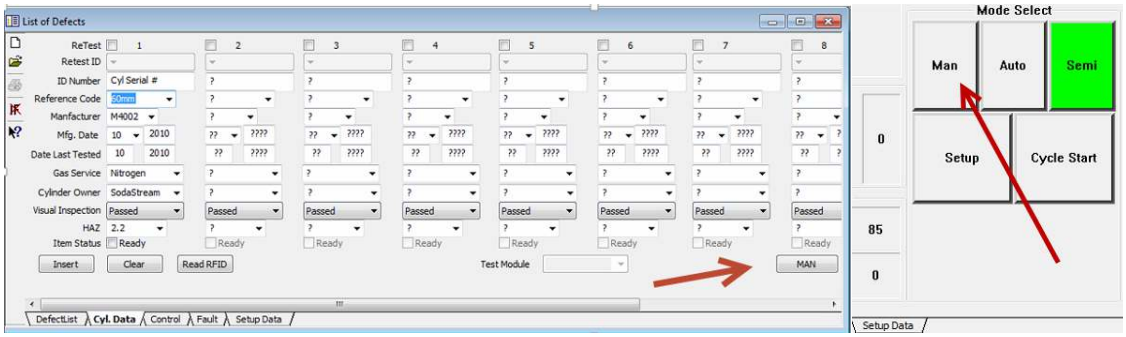
6. Data Entry can continue while the cylinder is running.

Note: If the test needs to be stopped in emergency the operator can:

e. Depress the Emergency stop switch mounted cabinet and on Up Ender/Down Ender Control.



f. Click on Man in either the Cyl Data or Control Tab for the List of Defect



Note: If the test needs to be stopped in emergency, the operator can push the E-Stop button.

This will stop the water and rollers and lift the RSU straight Up. To reset if the emergency button has been pressed, turn emergency top button to the left and push the reset button which should turn green both on the button and on the lower screen of testing unit 

. You will get a pop up that stating "Electronics have been reset".

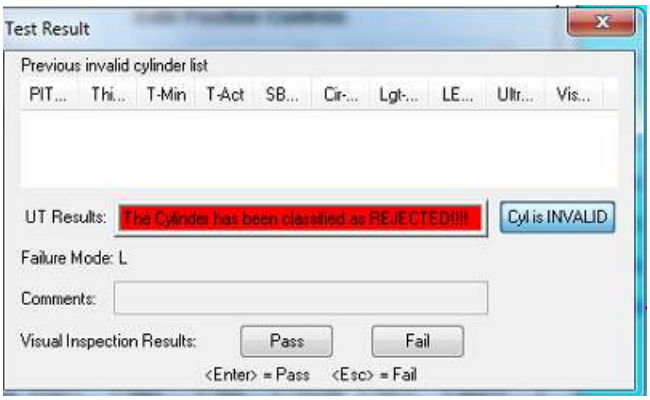
Then you must send the head home by clicking Man on Control Tab if not already done then Setup 

. Once the RSU is set back up on the Home Switch, Select Semi or Auto to start testing again after addressing issue. Depending on the method employed you may need to open Job file again and repeat system verification. If gain parameters are the same or know, testing can continue. If changed and unknown, Operators must retest all cylinder process since the last sucessful calibration out.

7. At the end scan, the Test Results pop up window will display the disposition of the cylinder.

g. If passed no relevant defects were found in accordance with the job parameters and the UT Results will be in green. To accept the operator must confirm the Visual Inspections Results by clicking PASS or Enter. The cylinder must then be place into quarantine awaiting successful calibration out prior to release to production.

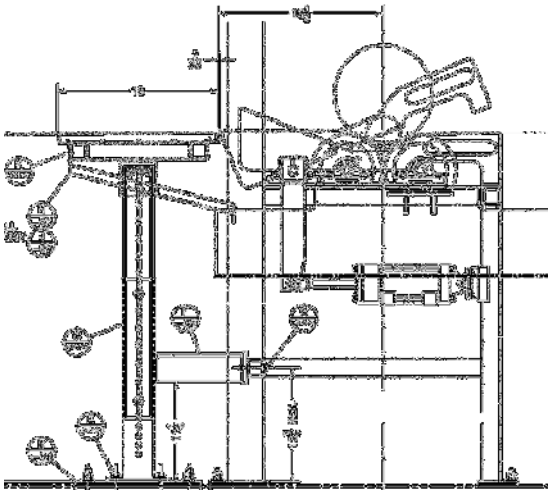
h. For any reason the operator may want retest the cylinder, they can set the cylinder invalid up to 3 times prior to being required a final disposition (Pass or Fail) by clicking on Set Cyl Invalid. An example for using this feature when test results pass is when the operator realized that he placed the wrong production cylinder on to the test table requiring it to be rerun with the correct serial # or the production start or end of test did not ensure 100 % scanning of the sidewall.



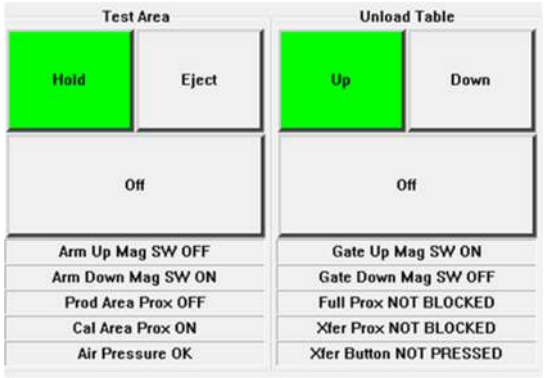
i. If failed, it means a relevant defect was found in accordance with the job parameters and the UT results will be red and the Failure Mode will be indicated showing which flaws were found. For details you can view in the Defect List tab in the List of Defects menu. If the same cylinder had previously been rejected, it will list how many times and the previous reason it was invalidated.

j. An operator can set the test result to invalid by clicking Set Cyl Invalid in order to attempt to lower the sensitivity of the tested while still passing calibration or address a false indication such as water or debris inside cylinder. The cylinder should be marked with relevant defect(s) and place into quarantine to be rerun later in the shift. Operator is still required to confirm Visual Inspection Results by clicking on Pass or hitting the enter key.

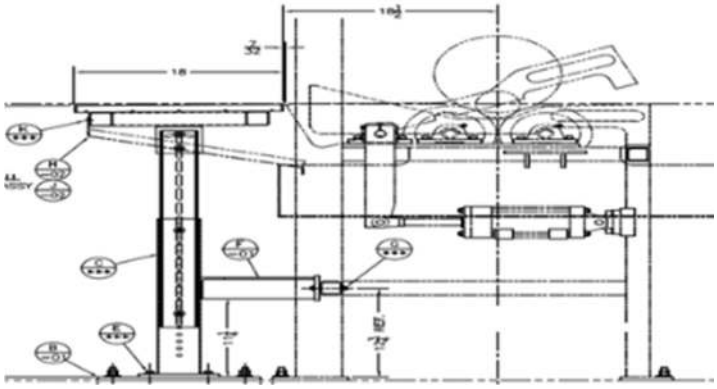
8. Remove the cylinder and Continue Testing:
    k. If in Auto, the machine will unload the cylinder from the test area to the unload table as well as load a cylinder onto the test area from the load table.



    l. If in Semi or Man Mode, the operator will move the cylinder from the test table to the unload table and loading the next cylinder to be tested.
    m. After accepting the test results of the previous cylinder, make sure the Unload Table Transfer is Up.

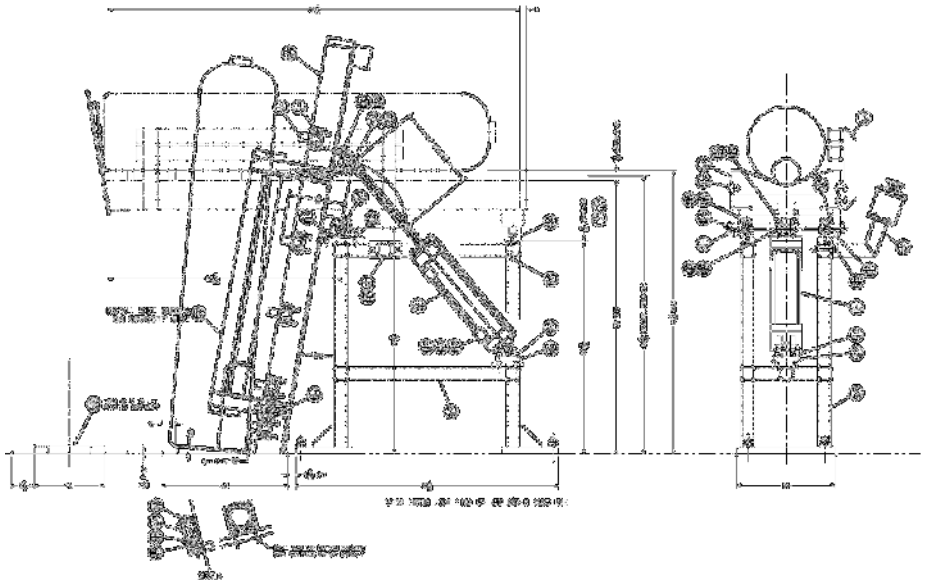


n. Press Eject icon on Test Area which transfers the cylinder from Test Area to Unload table.

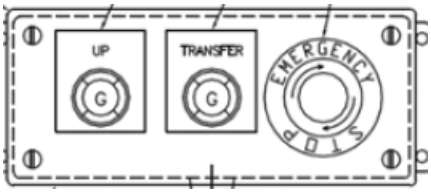


o. After cylinder in on the Unload Table, return the Test Area arm to the down position by selecting Hold in Test Area

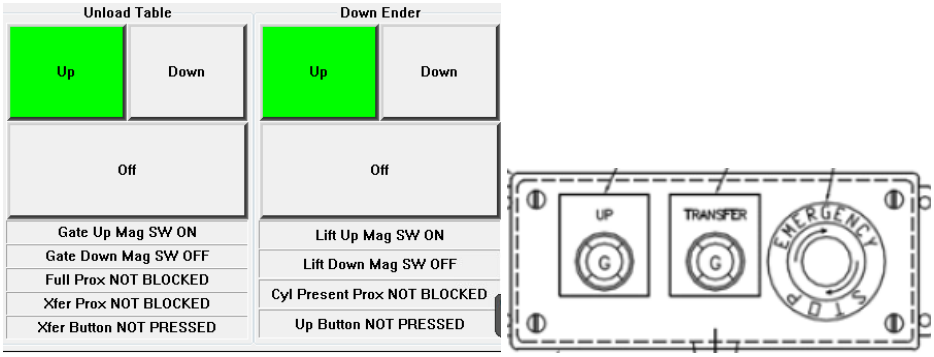
9. Load next cylinder by pressing Down on Load Table.
10. Start step 3 Again.
11. While making sure you track the disposition of the cylinders (Passed, Failed or Invalidated), transfer the tested cylinders from Unload Table to Down Ender by using controls on the Down Ender or the Unload Load Tab of the List of Defect Menu:



12. If in Auto Mode, the cylinder will transfer automatically via transfer assembly to the Down Ender if in the up position with no cylinder detected on the Down Ender Proximity Switch and a cylinder is detected on the Transfer Switch. After Transfer, the transfer assembly automatically resets. Lower the Down Ender by pressing the Up button, remove the cylinder and Return to the Up position for the next cylinder by pressing Up button again.

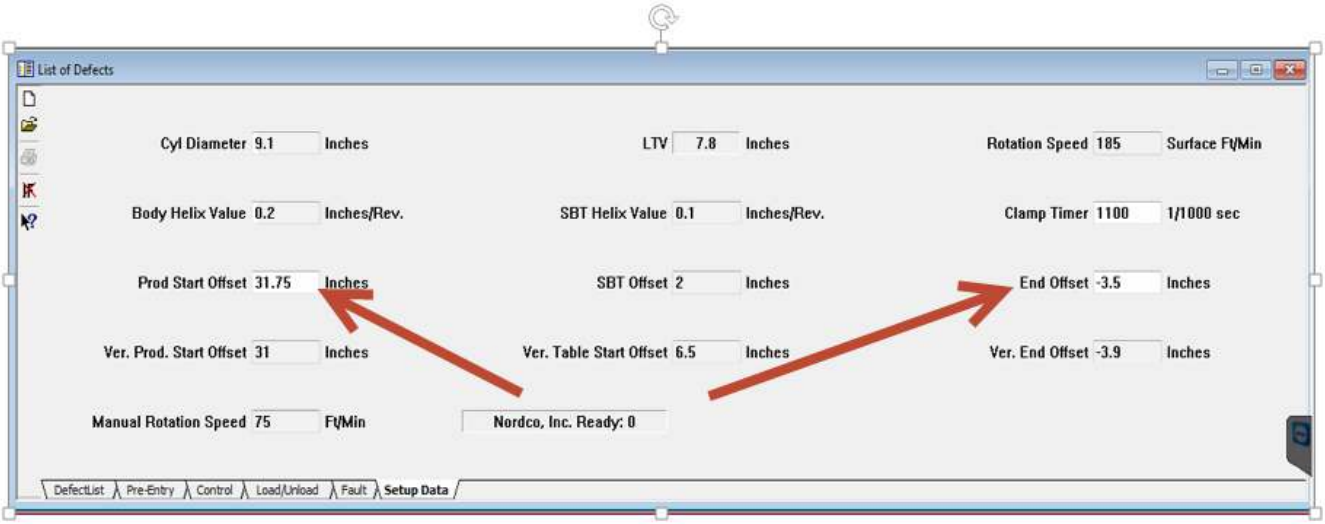


13. If in Semi or Man Mode, ensure the Down Ender is in the UP position, select Down on Unload Table in Control Tab to place the cylinder on the Down Ender or press Transfer button on the control box. Then Lower the Down Ender by Pressing Up and removing the cylinder. Return the DownEnder to the up position by pressing UP again and the transfer assembly back to ready position by pressing Transfer button again.

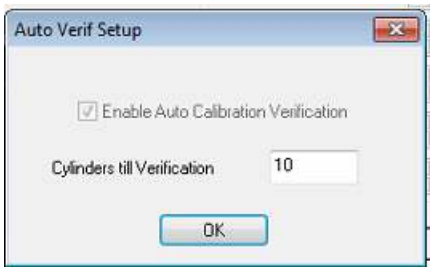


NOTE: The home position for the Down Ender is up and will automatically move there if you send the unit to the home position by Selecting Manual and Set Up.

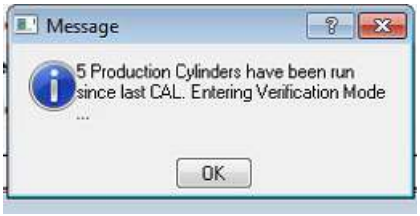
Note: Not all cylinders with the same reference code are exactly alike so even though the operator selects the correct reference code he many need to start production sooner or run the test longer to ensure the scan plan is meet. This method can be used also if the cylinder has the same specification and service pressure, and diameter but is just longer. This is best completed in Semi Mode. Once the cylinder in question is placed on to the test table and the cylinder needing adjustment is ready in slot #1 of the Cyl Data Tab while in Production Mode, the operator can adjust just those two physical test setting by selecting the Setup Data Tab and adjust the Prod Start (inches from home RSU travels prior to set down) or End Offset (inches up form Stop the cylinder stops test). This should be done only by an experience and certified operator.



Typically, the calibration cylinder will need to be verified after X number of test as set up in the unit software. This number is usually set at 10 but can be changed with the appropriate security setting.



In the below example the number is set at 5. After the 5 cylinders in production have run, the system will notify via Pop up, that a verification is required and switch to Verification mode after clicking on OK.



At the end of shift regardless of the number of cylinder test or prior to testing another cylinder specification that requires another job and calibration cylinder, the operator should run verification by selecting verification mode.

If calibration passes, the operator shall release cylinder from quarantine awaiting successful calibration out to be marked in accordance with national authority regulations and continue with the process or end shift.

Systems with later versions for CylSonic software may allow retry of a failed calibration as stipulated by oversight. System will not allow changes to any system parameters. If this function is available and enabled by responsible Level III overseeing the company's testing and a calibration passes as specified is achieved, production will be valid.

If calibration does not pass, the system will mark all cylinders tested since the last successful calibration as invalid and they will need to be retest. This also includes any cylinders that were invalidated after a relevant indication was noted by the system.

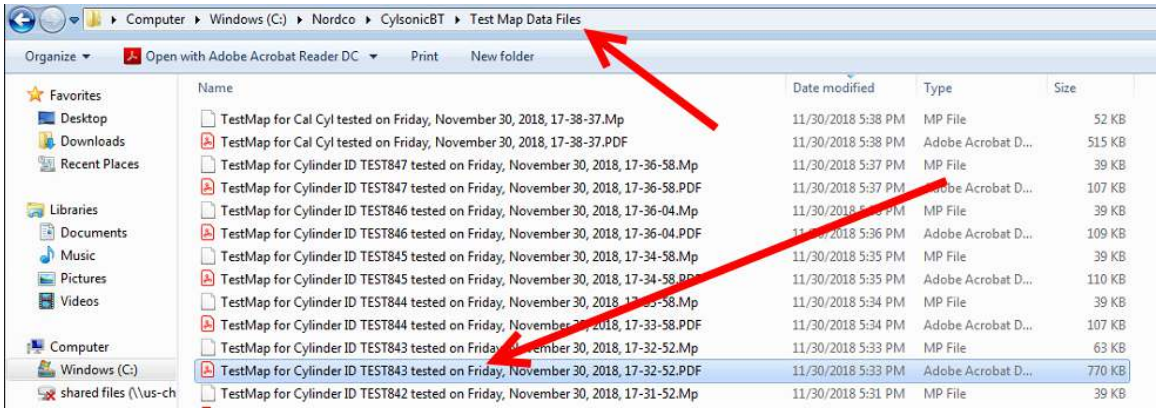
Since the cylinder information has already been entered into the system, the operator can pull up the cylinder data by selecting the serial number from the drop down by checking ReTest

on the Cyl. Data Tab. The system will not count invalids produced by missing calibration against the allowable quantity of 3 invalid test per cylinder. Ensure calibration is achieved and reviewed (See 4.4.2) prior to retesting.

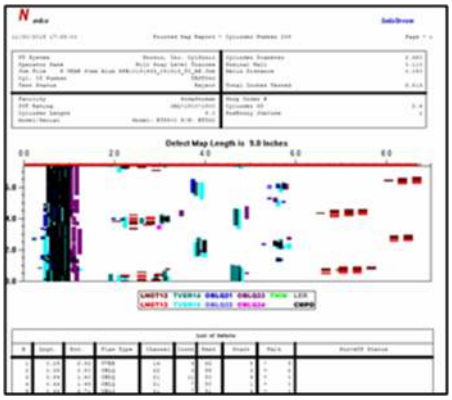
4.3.3.1 Processing Invalids:

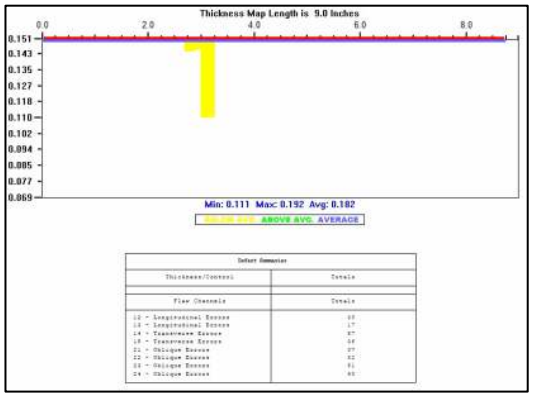
1. Cylinders that have been set invalid in the system due to relevant indications, must be retested.
2. Cylinder Condition: Depending on the indication and cylinder condition, the operator must take appropriate action to address the physical condition of the cylinder that may cause a false indication such as label, paint, water in the cylinder etc. If by taking the appropriate action, the cause of the invalid is not seen in the retesting of the cylinder and all other conditions are the same, we know the indication was false. Such actions include but are not limited to:
    a. Blasting to remove paint and rust
    b. Removing labels
    c. Internal washing of cylinders
    d. Internal blasting

3. Sensitivity of UE System: Depending on the indication, size have calibration cylinders reference notches and the cylinder condition, the operator may need to adjust the sensitivity of the unit set up at calibrations. Many times, during normal operations, the unit is running by default at a higher sensitivity that needed. If during normal operations, the invalids are manageable, then running higher sensitivity ensure calibrations pass consistently. During invalid processing the operator should identify which set of transducers triggered the relevant indication. This can be done by pulling up the PDF version (.mp files are meant to be opened in the software) of the cylinder test map from the follow menu path. C:\Nordco\CylsonicBT\Test Map Data Files



4. The cylinder should be marked with the indication type (thickness, Pit, etc.) from the previous test(s) but operator can find details in the test by selecting cylinder serial number in the test map folder and opening it. In this case, Test843 was the calibration cylinder.

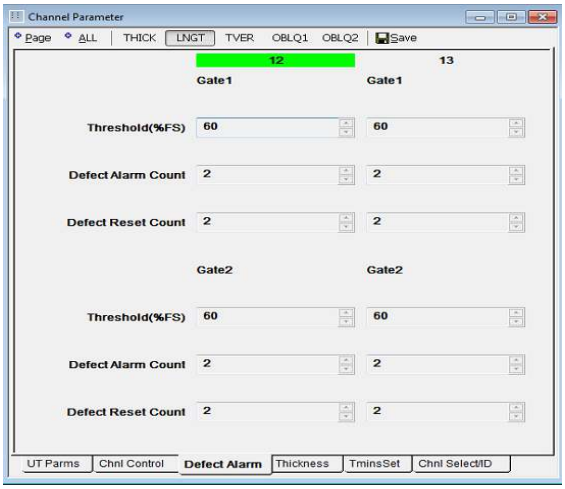


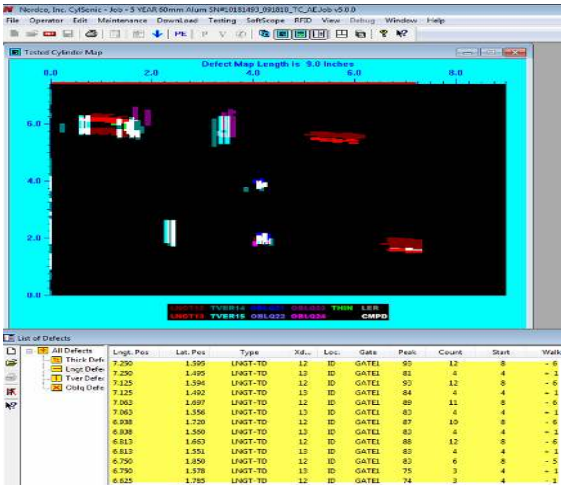


The Test Map will have the Cylinder Test Map, Cylinder Thickness, the list of relevant defects found and a Defect Summary

5. Recalibrate the unit and review the FSH and the Counts for the transducer(s) of the relevant indication. In this example we will look at Longitudinal channels 12/13 indication vs their Alarm Threshold and Counts as set on the Defect Alarm Tab of Channel Parameters Menu. The Threshold is 60 % Full Screen and alarm count 2. Actual reading from calibration is upper 80's to lower 90's with counts of up to 12. You can see that most of the higher FS and Alarm counts are on channel 12. In this case rerun the

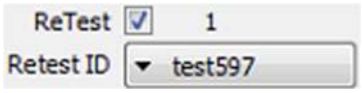
calibration with a 3db lower gain on both 12/13 and continue to lower until Alarm counts are 3-4 and FS is 65-75 db.





6. Longitudinal Threshold as set on Defect Alarm Tab of Channel Parameters Menu is a Threshold of 60 % Full Screen and alarm count 2. Actual reading from calibration is upper 80's to lower 90's with counts of up to 12. You can see that most of the higher FS and Alarm counts are on channel 12. In this case it is recommended to rerun the calibration with a 3db lower gain on both 12/13 and continue to lower until Alarm counts are 3-4 and FS is 65-75 db.

7. After lowering the gain and successful calibration rerun the invalid cylinder. Since the cylinder information has already been entered into the system, the operator can pull up the cylinder data by selecting the serial number from the drop down by checking ReTest



on the Cyl. Data Tab.

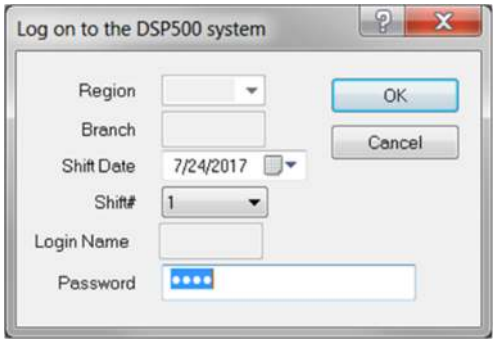
8. If it passes, release cylinder after successful calibrations. If not, continue to lower sensitivity or address physical condition on cylinder in order to pass. If the conditions continue, the operator must reject the cylinder as per there written practice.

4.3.4 Shift Report Printing.

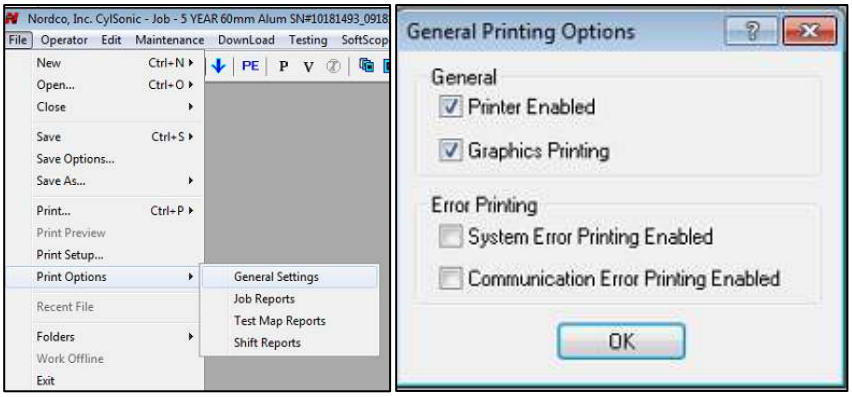
After the completion of testing for that day/shift and depending on the procedure followed for record keeping, the operator should print, review then sign a shift report. Level of Certification to sign off on test

results depends on the standard implemented and the national authority but typically a Level II UE operator is required. Best operating practice suggest you have one over one signatures from a supervisor or another Level II operator and the shift report is formatted for this.

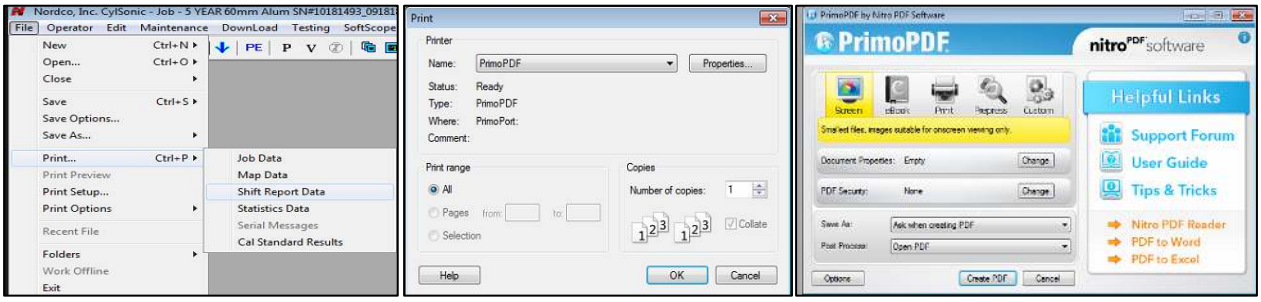
A shift report is created for the date and the shift entered at login to the unit.



1. From the file menu select Printer Options→ General Setting→Enable printing.



2. Nordco installed PrimoPDF (prior to Win 10 print to pdf function) for customers who would like to print shift reports to a PDF document and retain electronically but can also print directly to printer. From File menu select Print→Shift Report Data→Printer ID or PDF



3. Review shift report for accuracy, sign and file according to requirements of national authority and implemented standards.

Nordco

SodaStream

2018/12/03 11:25:13

Page - 1

CYLINDER TESTING RECORD

Facility: SodaStream REGION: BF BRANCH: 01
TEST OPERATOR: Will Gray Level Trainee
DATE OF TEST: 2018/11/30

Disposition Codes: P=Passed,F=Failed,C=Cal.,I=Invalid
Failure Mode Codes: P=Pit,C=Circ,L=Long,T=Thin,S=SBT,Z=LER

Time Tested	Op. Name	Cylinder Number	Cylinder OD	Cylinder Length	Svc Gas	Cylinder Mfg.	Cylinder Date	Type/ Rating	Owner	Disp U/V	Failure Mode	TMin	TAct
13:43	Will Gray Level Traine	10181493	2.4	9.0			/	3AL-1800-1800		C/P			
13:44	Will Gray Level Traine	test701	2.4	9.0	c02	ss	1/2011	3AL-1800-1800	SodaSt	P/P			
13:45	Will Gray Level Traine	TEST702	2.4	9.0	c02	M4002	1/2012	3AL-1800-1800	SodaSt	P/P			
13:46	Will Gray Level Traine	TEST703	2.4	9.0	c02	ss	1/2013	3AL-1800-1800	SodaSt	P/P			
13:47	Will Gray Level Traine	TEST705	2.4	9.0	c02	ss	1/2014	3AL-1800-1800	SodaSt	F/P	T	0.106	0.101
13:49	Will Gray Level Traine	TEST706	2.4	9.0	c02	ss	1/2015	3AL-1800-1800	SodaSt	F/P	P,C,L		
13:53	Will Gray Level Traine	TEST707	2.4	9.0	c02	ss	1/2016	3AL-1800-1800	SodaSt	I/F	Z		
13:56	Will Gray Level Traine	TEST708	2.4	9.0	c02	ss	1/2017	3AL-1800-1800	SodaSt	P/P			
13:58	Will Gray Level Traine	TEST709	2.4	9.0	c02	ss	1/2010	3AL-1800-1800	SodaSt	P/P			
13:59	Will Gray Level Traine	TEST710	2.4	9.0	c02	ss	1/2009	3AL-1800-1800	SodaSt	P/P			
14:00	Will Gray Level Traine	TEST711	2.4	9.0	c02	ss	3/2009	3AL-1800-1800	SodaSt	P/P			
14:03	Will Gray Level Traine	10181493	2.4	9.0			/	3AL-1800-1800		C/P			
14:05	Will Gray Level Traine	TEST712	2.4	9.0	c02	ss	3/2010	3AL-1800-1800	SodaSt	P/P			
14:06	Will Gray Level Traine	TEST713	2.4	9.0	c02	ss	3/2011	3AL-1800-1800	SodaSt	P/P			
14:07	Will Gray Level Traine	TEST714	2.4	9.0	c02	ss	10/2011	3AL-1800-1800	SodaSt	P/P			
14:09	Will Gray Level Traine	TEST715	2.4	9.0	c02	ss	1/2014	3AL-1800-1800	SodaSt	P/P			
14:12	Will Gray Level Traine	TEST716	2.4	9.0	c02	ss	1/2011	3AL-1800-1800	SodaSt	I/P			
14:14	Will Gray Level Traine	TEST717	2.4	9.0	c02	ss	1/2011	3AL-1800-1800	SodaSt	P/P			
14:16	Will Gray Level Traine	TEST718	2.4	9.0	c02	ss	11/2011	3AL-1800-1800	SodaSt	P/P			
14:19	Will Gray Level Traine	TEST719	2.4	9.0	c02	ss	5/2011	3AL-1800-1800	SodaSt	P/P			
14:20	Will Gray Level Traine	TEST716	2.4	9.0	c02	ss	1/2011	3AL-1800-1800	SodaSt	P/P			
14:25	Will Gray Level Traine	TEST719	2.4	9.0	c02	ss	1/2012	3AL-1800-1800	SodaSt	P/P			
14:26	Will Gray Level Traine	10181493	2.4	9.0			/	3AL-1800-1800		C/P			
14:28	Will Gray Level Traine	TEST720	2.4	9.0	c02	ss	1/2012	3AL-1800-1800	SodaSt	P/P			
14:30	Will Gray Level Traine	TEST721	2.4	9.0	c02	ss	2/2010	3AL-1800-1800	SodaSt	P/P			
14:32	Will Gray Level Traine	tEST722	2.4	9.0	c02	ss	12/2011	3AL-1800-1800	SodaSt	P/P			

Nordco, Inc. CylSonic Ultrasonic Cylinder Inspection System Model: RTS500 S/N: BTU32

Transducer	Frequency	Size	Manufacturer	Transducer	Frequency	Size	Manufacturer
Thickness	5.0 Mhz	1/2 in dia	Nordco, Inc.	Transversal	3.5 Mhz	5/8 in dia	Nordco, Inc.
Longitudinal	3.5 Mhz	5/8 in dia	Nordco, Inc.	Oblique	2.25 Mhz	5/8 in dia	Nordco, Inc.

OPERATOR SIGNATURE: _____ CERT LEVEL: _____ DATED: _____

I hereby certify that all the above tests were made under my supervisor and in accordance with DOT/TC regulations.

SUPERVISOR SIGNATURE: _____ CERT LEVEL: _____ DATED: _____

4. Prior to login out for next shift or shutting down for the day, disable printer by deselecting print enabled from the Print Options→General Setting.

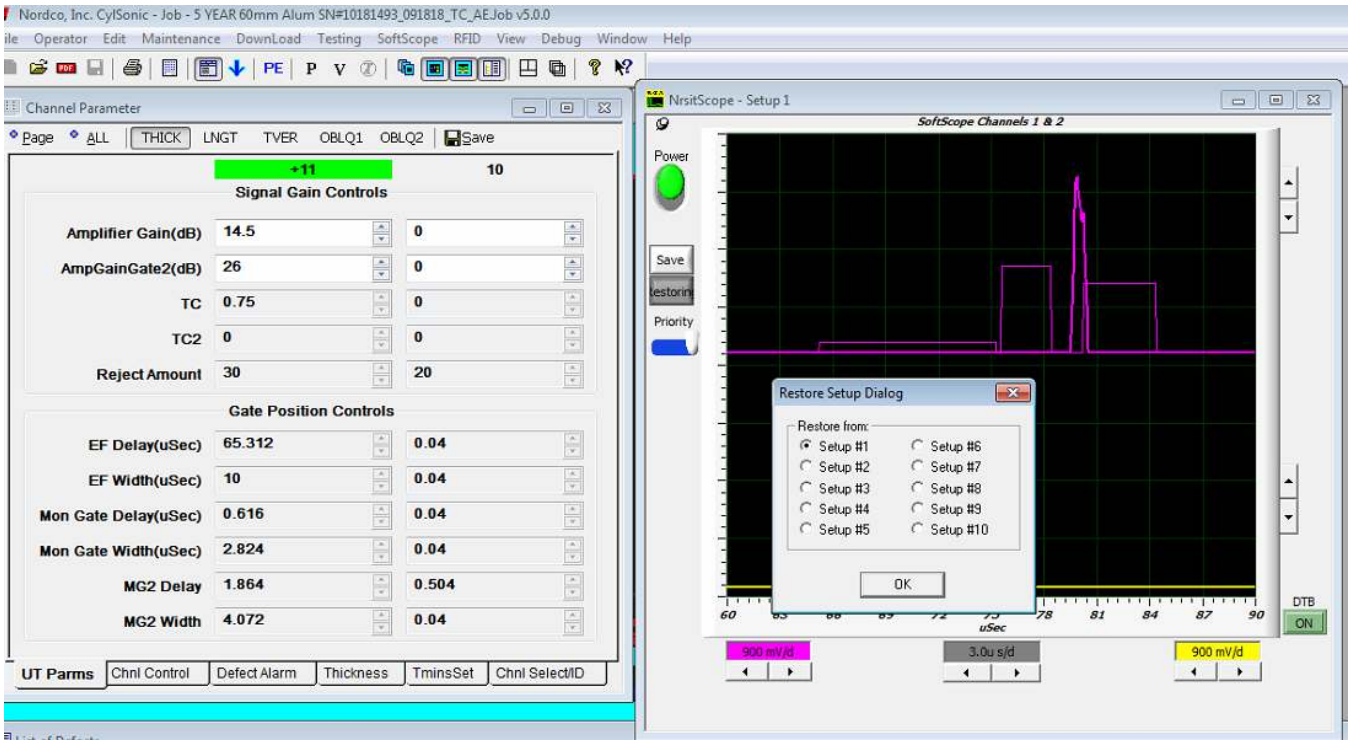
Warning: If not disabled, each test map will print automatically after running a production or verification on the unit.

4.4 Probe Wheel Zeroing Procedure

This probe wheel zeroing procedure only applies to systems that use the Nordco wheel probe(s) as the sensor housing. Self-aligning shoes, etc. do not require zeroing.

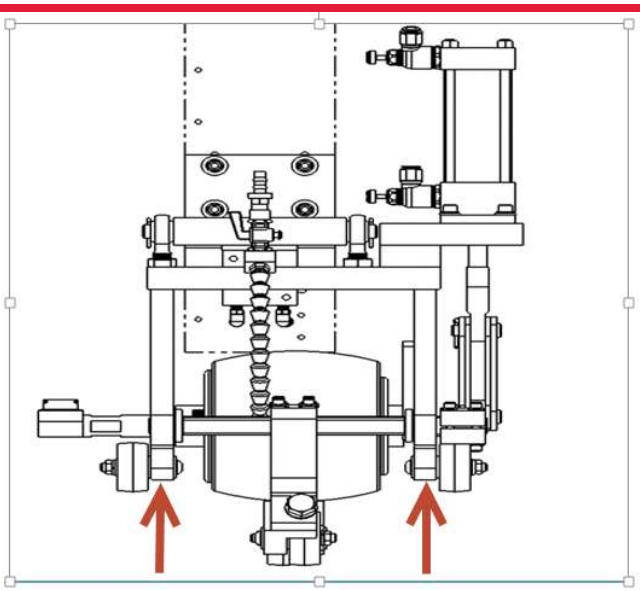
IMPORTANT: Verify that all mechanical adjustments on the test head are properly set. Perform the following steps to zero the wheel:

1. Start Up and Login as normal. Open the A-Scan by selecting SoftScope→ Open→ Toggle Power to On. Select Thick Transducer in Channel Parameter to display a scan for transducer 11. Typically Thickness Channel SoftScope display settings can be Restored from Setup#1.
    a. Note: To display gates and threshold in softscope, you may need to click on another channel and back onto Thick Channel Parameter to bring up proper channel view on softscope.
    b. You can pin the softscope menu to stay open by selecting the push pin symbol on top right of NRISTSCOPE menu.

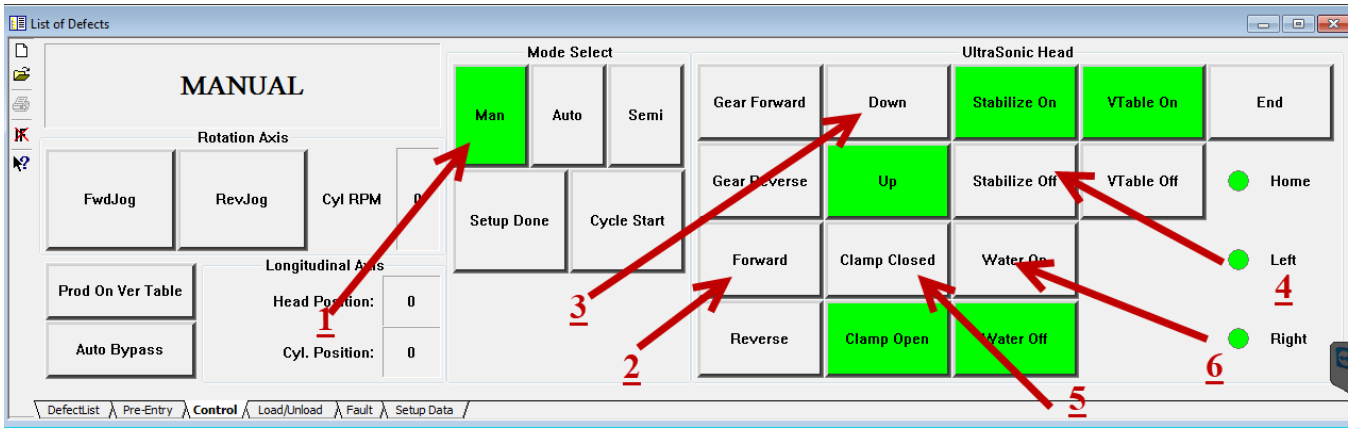


2. Loosen the wheel probe bracket just enough so that the wheel can be turned freely yet is still secure and has a resistance.

NOTE: Be careful not to loosen the wheel axle from the wheel flange. Align the transducer by eye as close to vertical to the shell's surface as possible.

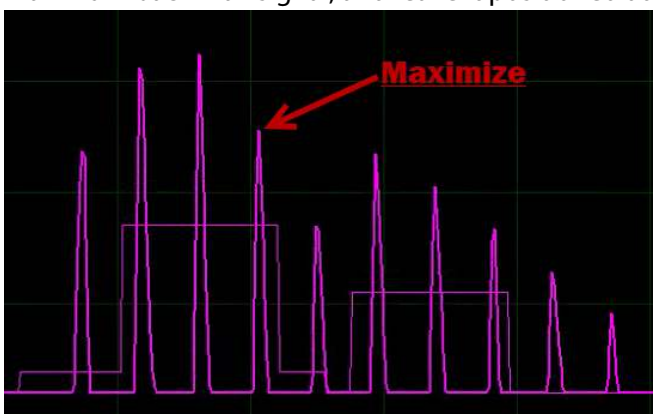


3. With the calibration cylinder on the verification table, place the RSU onto the spot on the smallest diameter calibration cylinder for that unit. In the Control Tab of the List of Defect Menu, move the RSU but selecting MAN, then move the RSU forward until the RSU is over the calibration standard. Make sure the wheel is not on a flaw to peak the back wall thickness signal and that it has ample couplant beneath it.
   This can be done by Clicking on 1-Man in the Control Tab, Clicking 2-forward until the RSU is over the spot to peak, then clicking 3-down, 4 Stabilize Off, 5-Clamp Closed and 6-water on.



4. Using Channel Parameters, Turn down Gain for Gate 1 on thickness channel 11 to 50-80% FSH so that you can see the peak maximize in the zero position (software does not display peaks over 100% even

though it may actually be higher). Using a wrench, rotate the wheel back and forth to find the maximum back-wall signal, and leave it positioned at the maximum.



NOTES:

*1) **DO NOT** grip cable connector to rotate axle.*

*2) **DO NOT** rotate axle beyond the range which the cable connector will allow.*

5. Prior to raising the RSU, tighten the wheel brackets, making sure that the amplitude of the back wall signals does not decrease. If it decreases, go back to step 4, re-loosening wheel brackets only if necessary. After Securing, return the RSU to home be selecting Setup in Control Tab.

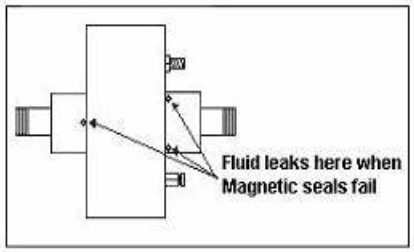
4.5 Preventive Maintenance

The DSP500 system requires little in the way of maintenance for the electronics system. Maintenance procedures associated with the mechanical components are listed as following.

4.5.1 Daily Inspection

1. Ensure carriage wheels and idler wheels turn free and smooth.
2. Make sure that LED on DSP and I/O board are on and sequencing (No LED or improper sequencing may indicate an issue).
3. Observe the belt wheel to the helix to ensure that it is not rubbing against the upper frame or alignment block.
4. Ensure endstop wheel is not damaged and turning freely.
5. Ensure that the air gauge on the main LP regulator is pressurized to 80 psi.
6. Check the air gauge at the top of the valve bank to ensure it reads 10 psi + 1 psi during operation.
7. Check the air gauge one down from top of the valve bank to ensure it reads 15 psi + 2 psi and -0 psi during operation.
8. Check the bottom gauge of the valve bank to ensure that it reads 20 psi + 2 psi and -0 psi.
9. Ensure that RSU is properly pressurized to 3.75 psi with no bubbles visible or damage to membrane.

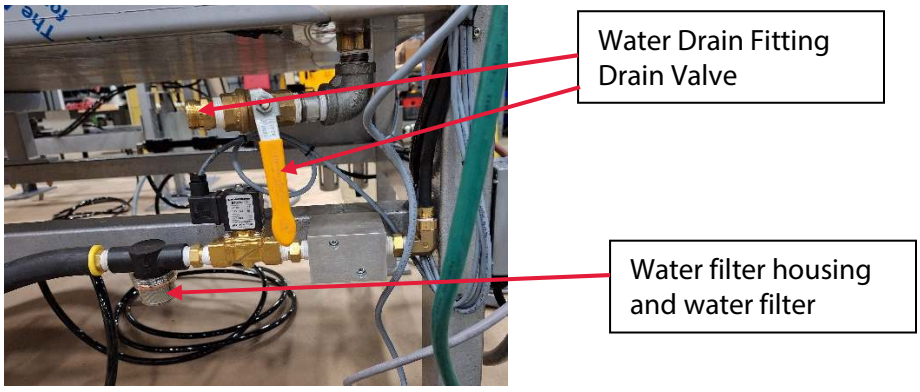
10. Ensure magnetic seals are not failing by inspecting weep holes to make sure they are free of probe fluid.



11. Ensure water is clean and free of debris and couplant is flowing properly. See drain and replace water under "Monthly Inspection".

4.5.2 Monthly Inspection

1. Grease "zerk" fittings located at the following areas: (Locations may vary due to system configuration.)
    a. Eject arm shaft, 2 each
    b. Cylinder driven rotation shaft, 4 each
    c. Cylinder idler rotation shaft, 4 each
    d. Conveyor loading arm, 3 each
    e. Unloading UpEnder, 2 each
    f. Carriage horizontal track (on carriage), 4 each
    g. Carriage vertical track (on carriage), 2 each
2. Ensure the helix drive shaft is lightly spotted with WD40 or light tool oil.
3. Check the tool oil level at the LP air regulator reservoir sight glass.
4. Check the moisture level at the LP air regulator reservoir sight glass.
5. Check the water couplant drain for any suspected stoppage.
6. Recommended to drain and replace couplant water. This may need to be done more frequently if environmental conditions are less clean or with high throughput of cylinders tested.
    a. Connect a hose to the water drain fitting (see photo). Route hose to a drain.
    b. Open the drain valve. Let water drain from the pan until pan is empty.
    c. Place a pan under the water filter housing and filter to catch residual water.
    d. Remove the water filter housing and filter. Clean the housing and filter.
    e. Reinstall the water filter housing and filter after water has drained from the system.
    f. Shut off the drain valve and disconnect the draining hose.
    g. Refill the water pan with clean water to level listed in "Installation: Water Level" section earlier in this manual.



7. Check calibration cylinders for moisture.
8. Check Probe Membrane for cracking, wear, and distention (recommended replacement 3-6 months depending on use and conditions).

4.5.3 Annual Inspection

Nordco recommends an annual full system functionality check (aka Annual Calibration). This check includes a number of system tests and calibrations including Gain Control Accuracy.

4.5.4 3 Year Inspection

1) Nordco recommends evaluation of test table pillow block bearings, shafts and wheels.
2) Nordco recommends RSU maintenance performed:
   a. By transducer replacement
   b. By verification of transducer performance
   c. By RSU exchange program

4.6 Testing DSP500 System Hardware Components

Testing the hardware components of the DSP500 system is mainly a matter of running the system verification tests that are designed to automatically detect and locate the majority of system hardware failures. If the built-in self-test fails, a problem with the hardware components should be suspected.

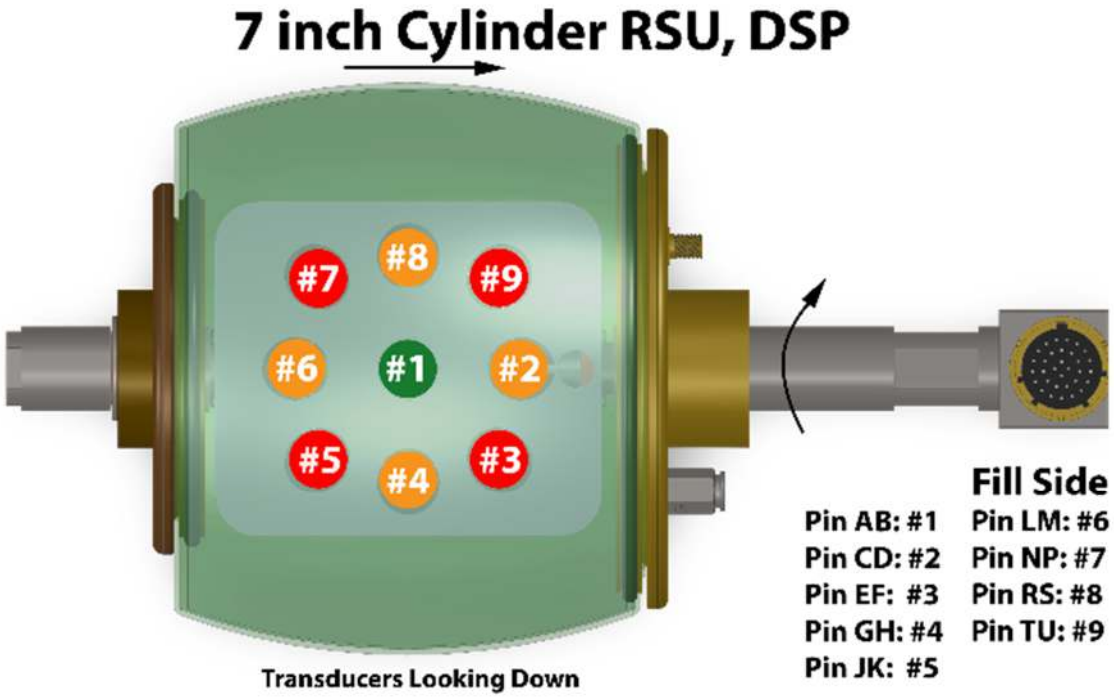
5 Customer Service & Spare Parts

All parts can be found in the Cyl-Sonic Industrial Parts Book PB-0005

5.1 1102465 - ASSY, RSU 7IN, CYL INDUSTRIAL, 9CH, DSP

The Industrial 9 channel wheel is equipped with the following transducers:

#1	Thickness	5 MHz-S
#8, #4	Longitudinal	3.5 MHz
#2, #6	Transversal	3.5 MHz
#5, #7, #9, #3	Oblique	2.25 MHz



ITEM NO.	PART NO.	DESCRIPTION	QTY.
1	4003025	MEMBRANE, WHEEL, LC, 317	1
2	1000961	FLUID, WHEEL, CLEAR, 1 GL	1
3	8001570	O-RING, # 338 BUNA N, SMALL	1
4	8001571	O-RING, # 346 BUNA N, LARGE	1
5	1103640	SCREW, 100 PACK, CSCS 6-32 X 0.5IN, BRASS	1
6	1104572	SCREW, 100 PACK, CSCS 6-32 X 0.56IN BRASS	1

6 Technical Data

More in depth information can be found in the software online help.

7 Appendices

7.1 Mechanical Drawings

1100615 - ASSY, INDUSTRIAL UE, VERTICAL LIFT, RH
1100616 - ASSY, INDUSTRIAL UE, VERTICAL LIFT, LH
1104001 - ASSY, MAIN TEST BED, RH CONFIG
1104002 - ASSY, UPENDER, STANDARD, RH CONFIG
1104003 - ASSY, UPENDER, PASS THROUGH, RH CONFIG
1104004 - ASSY, LOAD CONVEYOR, RH CONFIG
1104005 - ASSY, INLET TABLE, 65IN LG, SINGLE OPT, RH CONFIG
1104006 - ASSY, INLET TABLE, 65IN LG, DUAL OPT, RH CONFIG
1104007 - ASSY, OUTLET TABLE, 18IN LG, SINGLE OPT
1104008 - ASSY, OUTLET TABLE, 65IN LG, SINGLE OPT, RH CONFIG
1104009 - ASSY, OUTLET TABLE, 65IN LG, DUAL OPT, RH CONFIG
1104010 - ASSY, DOWNENDER, STANDARD, RH CONFIG
1104011 - ASSY, MAIN TEST BED, LH CONFIG
1104012 - ASSY, UPENDER, STANDARD, LH CONFIG
1104013 - ASSY, UPENDER, PASS THROUGH, LH CONFIG
1104014 - ASSY, LOAD CONVEYOR, LH CONFIG
1104015 - ASSY, INLET TABLE, 65IN LG, SINGLE OPT, LH CONFIG
1104016 - ASSY, INLET TABLE, 65IN LG, DUAL OPT, LH CONFIG
1104018 - ASSY, OUTLET TABLE, 65IN LG, SINGLE OPT, LH CONFIG
1104019 - ASSY, OUTLET TABLE, 65IN LG, DUAL OPT, LH CONFIG
1104020 - ASSY, DOWNENDER, STANDARD, LH CONFIG

7.2 Electrical Drawings

E-DWG-0012 SYSTEM DIAGRAM CYL-SONIC IND
E-DWG-0034 ICIS GEN 3 AB CONFIG 1 (LOAD, DOWN)
E-DWG-0049 ICIS GEN 3 AB CONFIG 2 (UP, IN, OUT, DOWN)
E-DWG-0050 ICIS GEN 3 AB CONFIG 3 (UP, DOWN)
E-DWG-0051 ICIS GEN 3 AB CONFIG 4 (UP, 2IN, 2OUT, DOWN)

7.3 Reference Material

Verification and Gain Adjustment Manual