USERS MANUAL

Cyl-Sonic Micro

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Contents

1 Introduction

1.1 Overview

The Nordco DSP500 Ultrasonic Cylinder Inspection System has been designed to conduct a full-body test of a cylinder's integrity, with the ultrasonic echoes generated by the weld automatically masked out under operator control. It is an original product of Nordco Rail Services and Inspection Technologies of Beacon Falls, 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 (125 Railroad Avenue, Beacon Falls, CT 06403).

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.

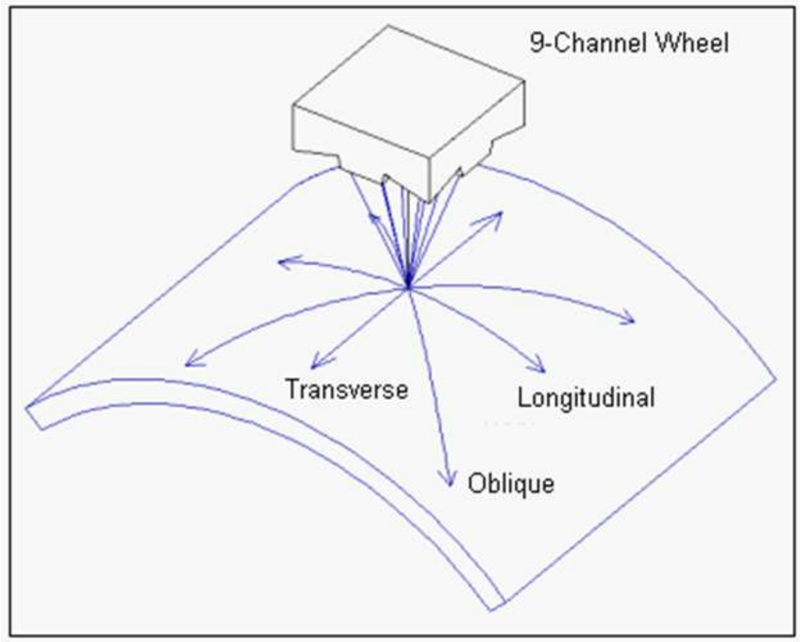
1.3 DSP500 System Specifications

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 approximately a one inch swipe of the Cylinder's surface on each revolution of the Cylinder.

The system is capable of testing one hundred percent of the Cylinder depending on the mechanical and probe arrangements used. Note that the type of probe assembly used 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 5% notch on a calibration standard. 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 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. One additional data channel is used for loss of couplant detection (LER) and echo-following control. 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, and one control/LER channel.

1.3.6 Cylinder Marking

The Cylinder is marked using paint guns to indicate the Cylinder's test status and the location of defects. Painting is not part of the standard system.

1.3.7 Audible and Visual Alarms

The DSP500 system provides outputs that can be used to drive both an audible and a visual alarm when defects are detected.

1.3.8 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. 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.

1.3.9 Hard Copy Exception Reports

A hard-copy exception report is provided for each Cylinder after it has been tested on the dot-matrix printer provided with the DSP500 system. A coded set of the defect indications that represents a pseudo-hard-copy of the graphics screen can be included on the printed report when requested. Also, a list of the defect reports as well as a summary of the total number of defects of each type may be optionally included on the report as desired.

1.3.10 Automatic Gain Control

An automatic gain control feature (AGC) can be used in the data channel amplifiers to compensate for fluctuations in signal strength of reference back wall signals caused by varying Cylinder surface conditions. This facility occurs at all normal gain settings, and includes a mechanism to prevent gain surges when a flaw might mask the reference signal. Note that this feature is only useful on channels that provide a known, stable reference signal such as the back wall echo of the zero degree transducer probes.

1.3.11 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.

1.3.12 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.

1.3.13 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 Cyl-Sonic Micro at a glance

The Cyl-Sonic Micro performs ultrasound examinations (UE) of seamless metallic compressed gas cylinders with 3.2″-8″ outside diameters and a length of 4″-30". The Cyl-Sonic Micro 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 Micro 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

220VAC 50A with neutral

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 3.2″-8″ outside diameter and 4″-30" in length.

1.5.5 System Foot Print

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

1102504 – ASSY, BENCHTOP FRAME

Length – 77in, 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 Micro 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 Micro 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 Micro 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 Micro 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 Micro System cannot be accidentally restarted.

2.3.1 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 Micro 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 insure there is no visual 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 220VAC 50A with neutral to the main disconnect in the electrical enclosure.

3.3 System Connections

3.3.1 Main Machine Connections

Connect the junction box connection points to the appropriate main machine connection points as shown in system diagram E-DWG-0019.

3.3.2 Electrical Enclosure Connections

3.3.2.1 Rear Enclosure Section

Connect the following cables:

1. I/O & AC Power Cable (4 pin) from rear enclosure section to machine junction box.
2. Motor control cable (9 pin) from rear enclosure section to machine junction box.
3. I/O & DC Power Cable (10 pin) from rear enclosure section to machine junction box.
4. Encoder cable (19 pin) from rear enclosure section to machine junction box.
5. Incoming power

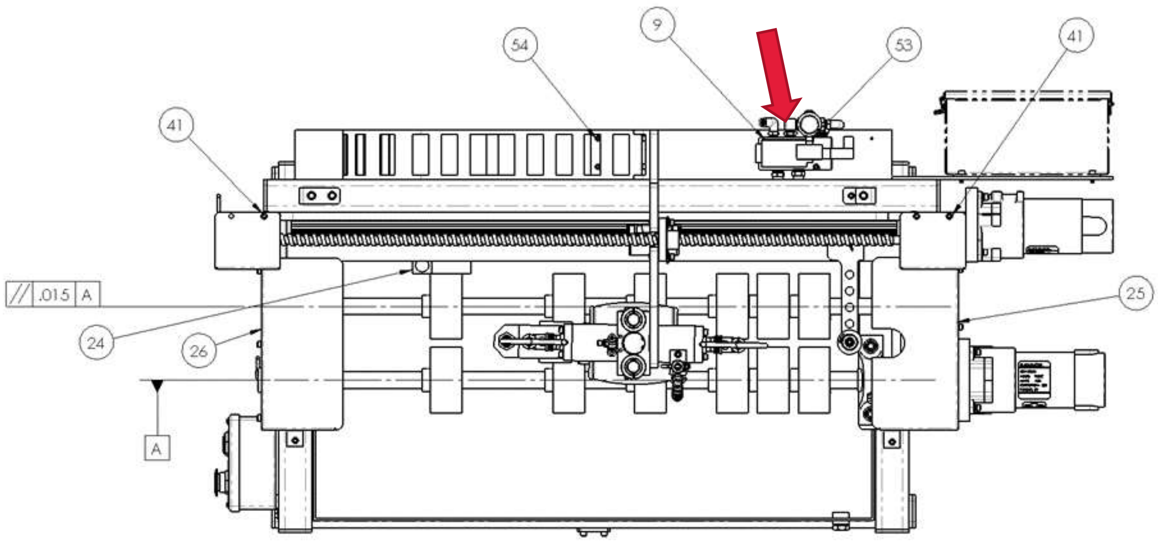
3.3.2.2 Junction Box Wiring

Connect the following cables:

1. Upper encoder cable to machine junction box.
2. Lower encoder cable to machine junction box.
3. Roller motor cable to machine junction box.
4. Screw motor cable to machine junction box.
5. Pneumatic din cable to machine junction box.
6. Home proximity sensor cable to machine junction box.
7. End of stroke proximity sensor cable to machine junction box.
8. Over travel proximity sensor cable to machine junction box.
9. Water pump cable to machine junction box.

3.4 Pneumatic Connection

Attach 80 psi dry shop air to 3/8 hose air input fitting located on the main machine.



3.5 Water Level

Fill water pan 1.5″ below top of pan edge.

4 Operation

4.1 System Startup

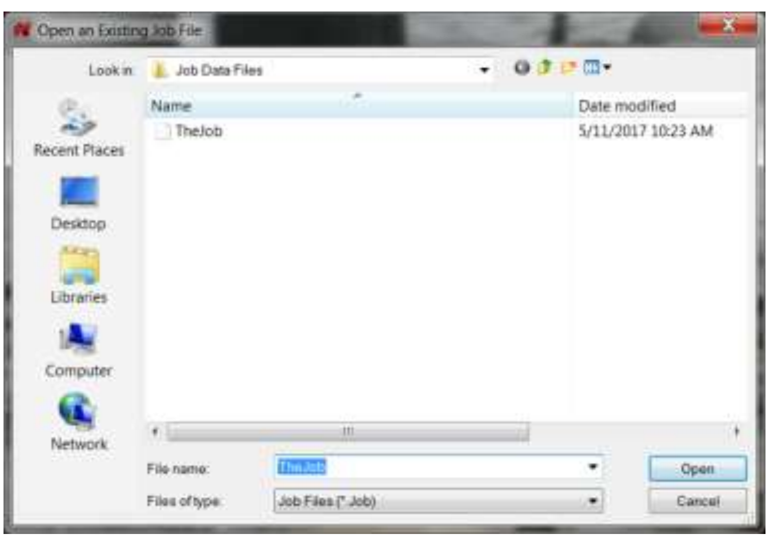
A. Turn on the power switch for the DSP system located next to the router.
B. Turn on the Computer by pressing the power button on the computer.
C. Verify that all E-Stops are not pressed by rotating them counterclockwise.
    a. One on the main cabinet on the left side.
D. Press the Start button on the box on the left of the main cabinet.
E. Log into the computer with the password ________________.

4.2 Starting up the DSP500 System

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. When the program is started the splash screen with the Nordco Logo and program name will appear for a few seconds. It can also be cleared by pressing any key or clicking on it with the mouse.

Once the splash screen is closed, a File Open dialog box for job files will appear in the center of the display. The DSP500 system requires that a valid set of job parameters be read in before it can be used. 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.

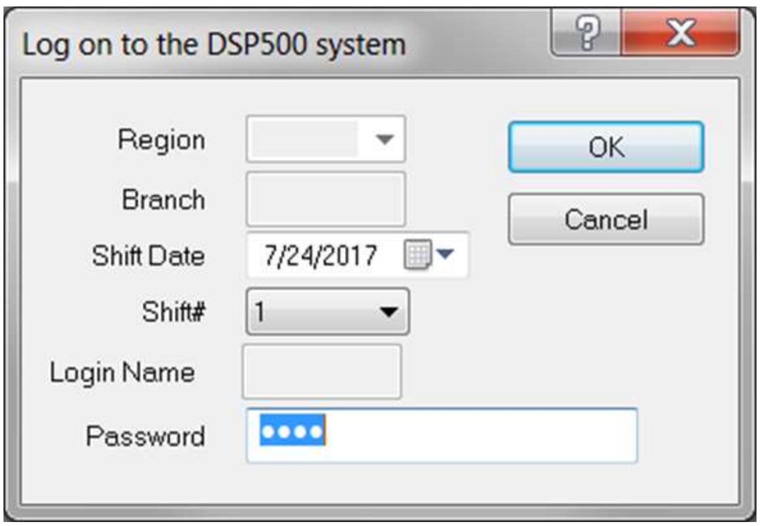
NOTE: Do not use the default filename "TheJob" as a working set of job parameters since they are easily overwritten with default values when starting up the system.



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. An operator must logon to the DSP500 system by entering a valid Access Code (e.g. password). When first starting up the system a dialog will appear to prompt the operator for his or her 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

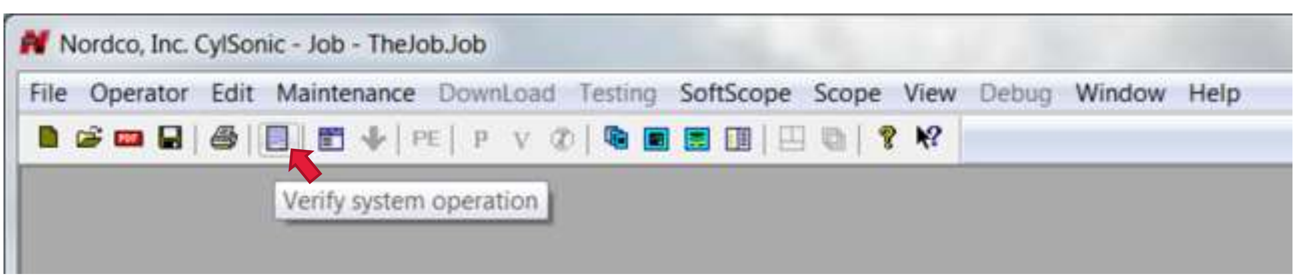
1. Enter Password – (Tab)
2. Enter Region – (00)
3. Enter Branch Code
4. Enter Shift
5. Select "OK" Button



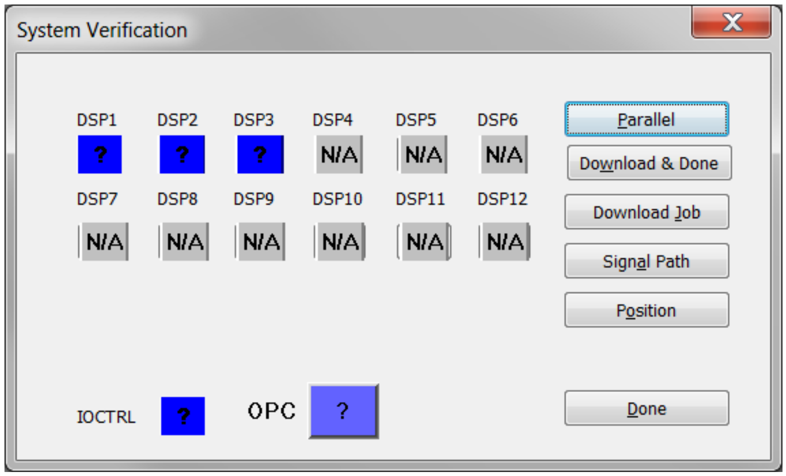
At this point the test parameters (gates, gains, etc.) have not been downloaded to the DSP500 system electronics and thus testing of cylinders is not allowed. EXTREMELY IMPORTANT: before downloading the test parameters, a parallel communications test must be run so the system knows which data channels 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

Select "Verify system operation" icon or press the F2 key.



1. Select "Parallel"
2. DSP1, DSP2, DSP3 – Should change from Blue to Green. *<u>Note: If the built-in self-test fails, a problem with the hardware components should be suspected.</u>*
3. Select "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,
3. A shift report data file has been created or opened.

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 for defects.

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 fashion.

The first step in setting up the system job parameters is to set the system global settings that normally will not change after the initial system installation and thus would be set to the same values for all jobs. This category of global job settings include the number of active data channels, head and wheel physical properties and the paint gun definitions. The active data channels are a function of the number of sensors used by the system and where the individual transducers are physically connected to the DSP500 system. These are set on the Select Active Channels dialog. The head and wheel properties include the numbers of each and their physical offsets relative to the 0 reference point of the system. These are all set on the Physical Wheel Probe Settings property page. The paint gun settings are set via the Paint Gun Settings property pages. These are set according to the number of paint guns physically installed in the system and for the desired function (e.g. good/bad Cylinder, type of defect, etc.).

The second step is to set the system global settings that are typically set based on the physical properties of the Cylinder and inspection specifications. For example, the size of the Cylinder is entered in terms of the Cylinder Diameter and Nominal Wall Thickness parameter located on the Pulse Density and Cylinder Sizing Information property page.

Once all of the global settings have been entered, the next step is to set up all of the ultrasonic data channels. This is normally done using known calibrated "defects" such as EDM notches on a calibration standard Cylinder. The transducer being setup is manually placed over the notch and the Cylinder rotated in place. The parameters on the Ultrasonic Parameter Settings property sheet, such as the Amplifier Gain, Mon Gate Width, etc. are then adjusted by a trained operator for optimum signal detection.

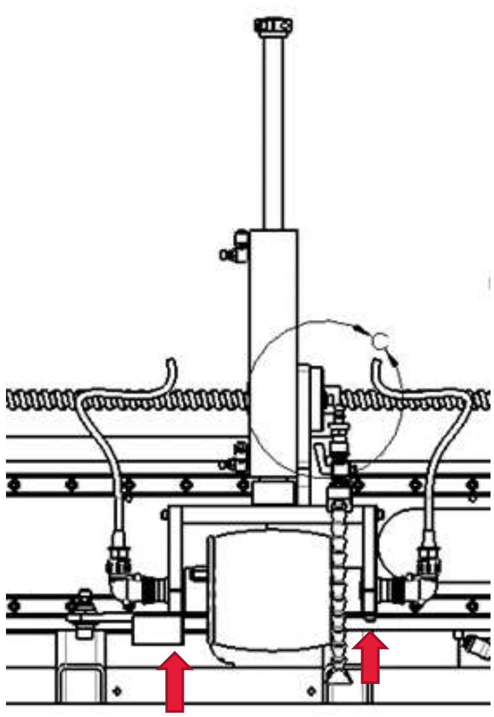
When all of the ultrasonic channels have been initially set up, the next step is to run the calibration standard through the machine in verification mode of testing. The parameters are adjusted if necessary and the calibration standard re-run through the machine until it successfully passes the test and all defects have been found. If the parameters are properly adjusted there should be no false indications.

After the job parameters have been set to successfully pass the calibration standard test, the job should always be saved to the disk using the Save menu item on the File menu selection located on the menu bar of the mainframe window.

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. Loosen the wheel probe bracket just enough so that the wheel can be turned freely yet is still secure.

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.

2. Make sure the wheel is on a good cylinder area and that it has ample couplant beneath it.

3. Make sure that an oscilloscope is hooked up on the proper channel. Note that a portable ultrasonic flaw detector can be used here as long as it will pulse and receive. To use a portable flaw detector,

disconnect the input from the wheel probe to the RPA and plug the BNC connector into the portable flaw detector. This is the recommended practice. If a portable flaw detector is not used, the best place to monitor the signal with an oscilloscope. Alternatively, the normal oscilloscope monitoring output for the channel can be used if the location of system components allows it to be viewed while making the adjustment.

4. Using a wrench, rotate the wheel back and forth to find the maximum back-wall signal, and leave it positioned at the maximum. If the back wall response cannot be found in this range and step 2 has been done, it may be necessary to change the angle of one or both of the cable connectors.

***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. 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.

4.5 Echo-Following Setup Procedure

The echo-following setup procedure describes how to set up a channel for proper echo-following. In some systems, echo-following is very important because if it is not properly set up signals that were not intended to be in the gated area may show up in the gated area. This is especially important for thickness channels where improper echo-following can corrupt the thickness readings. The following steps are for the general case and should be taken for each channel used being used.

1. Select the channel being setup.

    - EF Gate Width : 0.040
    - Mon Gate Delay : 0.040
    - Mon Gate Width : 0.0

2. Locate the interface echo and the end of the echo-following delay period. The echo-following delay period begins at the 'main bang' (the time the transducer is pulsed) and ends at the first step seen on the oscilloscope output signal trace.

3. Adjust the EF Gate Delay period so it ends at least 10 microseconds before the interface echo. In this case it is much better to err on the high side (i.e. 20 microseconds before the interface is better than 5).

4. Increase the EF Gate Width parameter setting until it 'locks in' (e.g. when you increase the value, the gate does not continue to move to the right). Now directly enter a value that is double the current value of the echo-following width gate. Again, it is better to be a little high than a little low.

The echo-following is now set up for that channel. Now the Mon Gate Delay and the Mon Gate Width parameters can be used to position the gate around the desired back-wall echo, notch, etc.

4.6 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.

4.6.1 Monthly Inspection

Grease "zerk" fittings located at the following areas:

1. Cylinder driven rotation shaft, 2 each
2. Cylinder idler rotation shaft, 2 each
3. Carriage horizontal track (on carriage), 2 each
4. Carriage screw, 2 each

Ensure the helix drive shaft is lightly spotted with WD40 or light tool oil.

Check the water couplant drain for any suspected stoppage.

Check calibration cylinders for moisture.

4.6.2 Daily Inspection

Ensure carriage wheels and idler wheels turn free and smooth.

Check motor couplings

Check encoder couplings

Observe paper feed to the printer to ensure that there is no misalignment or blinding.

Check the shade of the printed characters and determine if the ribbon cartridge or Laser requires replacement.

Ensure that the air gauge on the main LP regulator is pressurized to 80 psi.

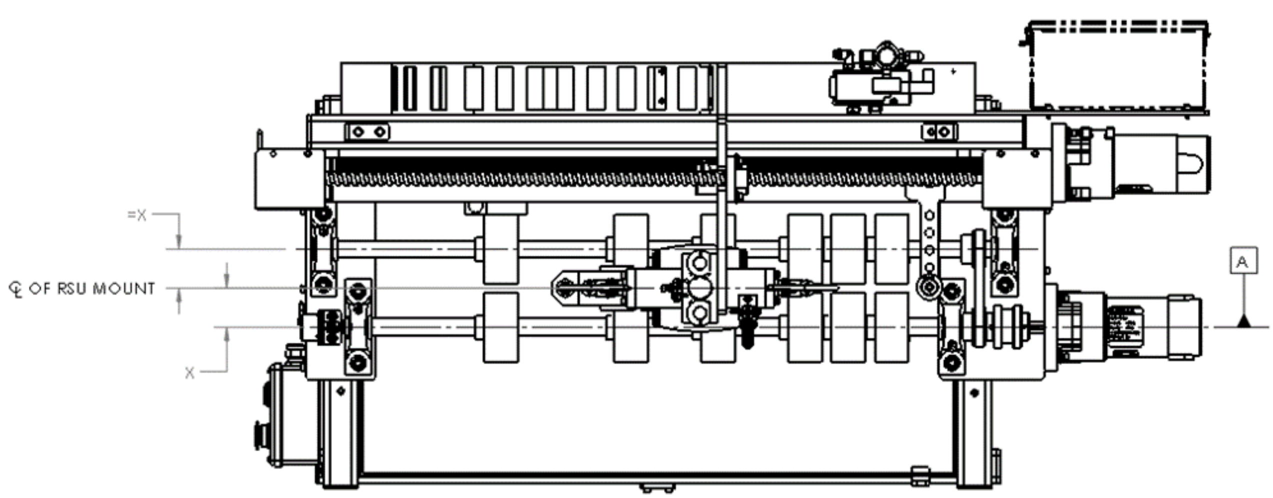
Check the air gauge at the top of the valve bank to ensure it reads 5 psi + 1 psi during operation.

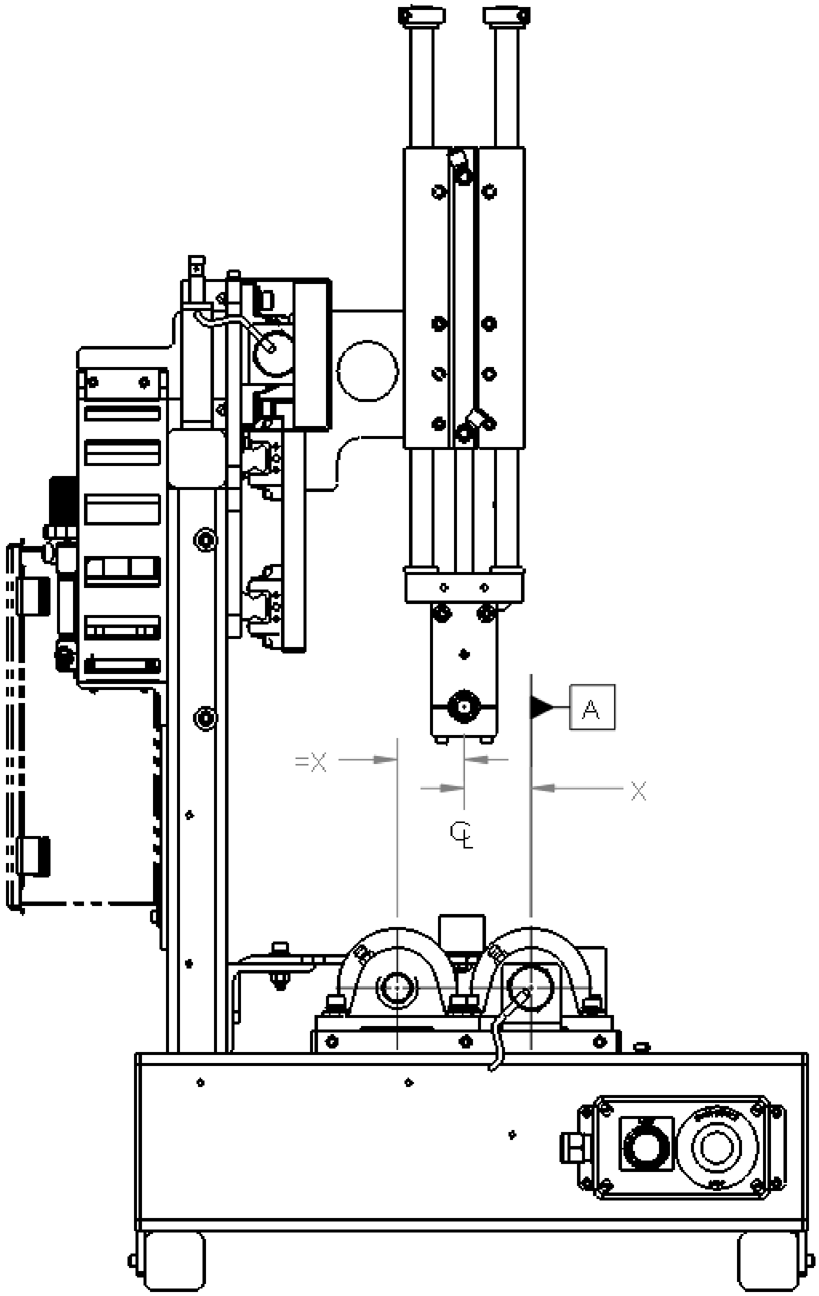
4.6.3 Roller Bed Alignment

The roller bed must be aligned to the RSU any time the rollers, roller shafts or bearings are replaced.

The procedure below should be used for alignment.

1. Install drive belt on drive shaft.
2. Install drive shaft with and align with motor with motor coupling. (*Leave pillow block fasters loose*)
3. Move the RSU head to the motor end of the roller bed.
4. Using a plumb line hanging from the RSU mounting hole find the dimension "x" from the drive shaft area closes to the motor to the center of the RSU mount.
5. Move the RSU head to the encoder end of the roller bed.
6. Using a plumb line hanging from the RSU mounting hole set the dimension "x" from the drive shaft area closes to the encoder to the center of the RSU mount.
7. Tighten drive shaft bearing pillow block screws and double check all dimensions.
8. Mount drive belt on idler shaft pulley.
9. Install idler shaft and align parallel with drive shaft. (Leave pillow block fasters loose)
10. With the RSU head at the encoder end of the roller bed.
11. Using a plumb line hanging from the RSU mounting hole set the dimension "x" from the idler shaft area closes to the encoder to the center of the RSU mount.
12. Move the RSU head to the motor end of the roller bed.
13. Using a plumb line hanging from the RSU mounting hole set the dimension "x" from the idler shaft area closes to the motor to the center of the RSU mount.
14. Tighten idler bearing pillow block screws and double check all dimensions.





4.7 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.

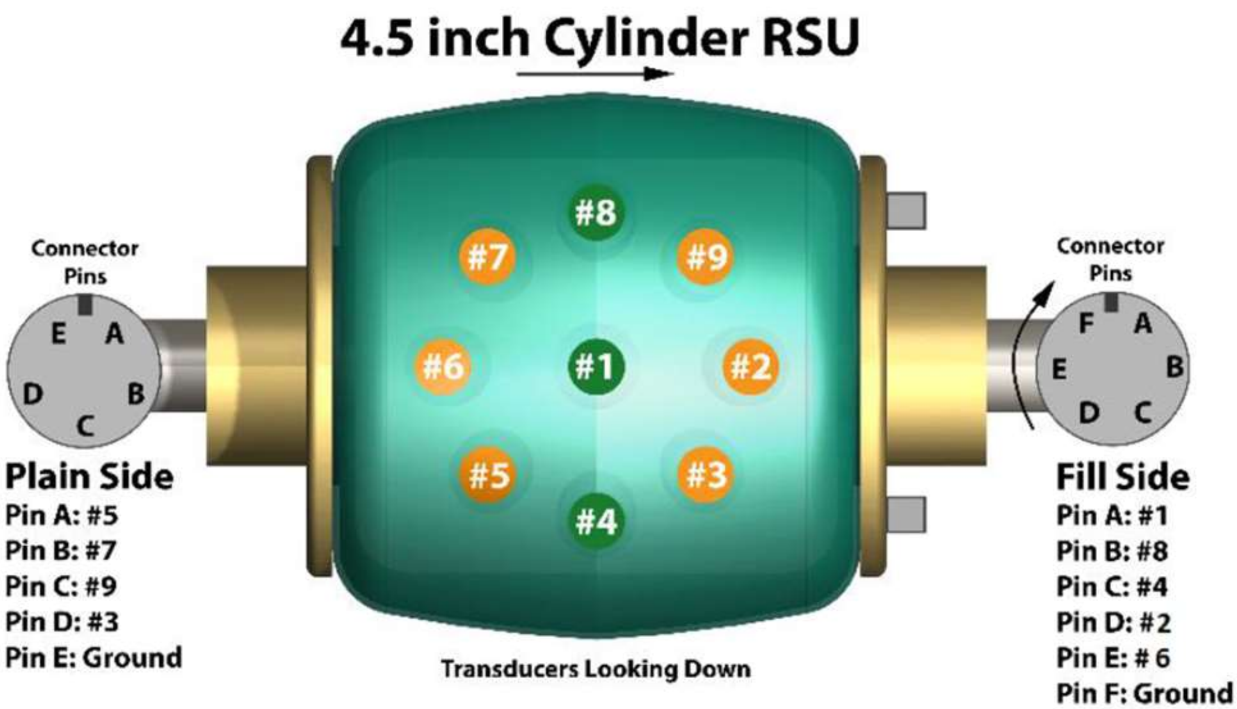
5 Customer Service & Spare Parts

All parts can be found in the Cyl-Sonic Micro Parts Book PB-0003

1000259 - ASSY, RSU 4.5IN, CYL MICRO, 9CH

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

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



ITEM NO.	PART NO.	DESCRIPTION	QTY.
1	4003001	MEMBRANE, BT WHEEL, TH-309	1
2	1000961	FLUID, WHEEL, CLEAR, 1 GL	1
3	8001570	O-RING, # 338 BUNA N, SMALL	2
4	1103640	SCREW, 100 PACK, CSCS 6-32 X 0.5IN, BRASS	1

6 Technical Data

More in depth information can be found in the software on line help.

7 Appendices

7.1 Mechanical Drawings

1102504_A ASSY, CYLSONIC MICRO FRAME

7.2 Electrical Drawings

E-DWG-0018_A ELEC SCHEMATICS, CYLSONIC MICRO
E-DWG-0019_A SYSTEM DIAGRAM, CYLSONIC MICRO