



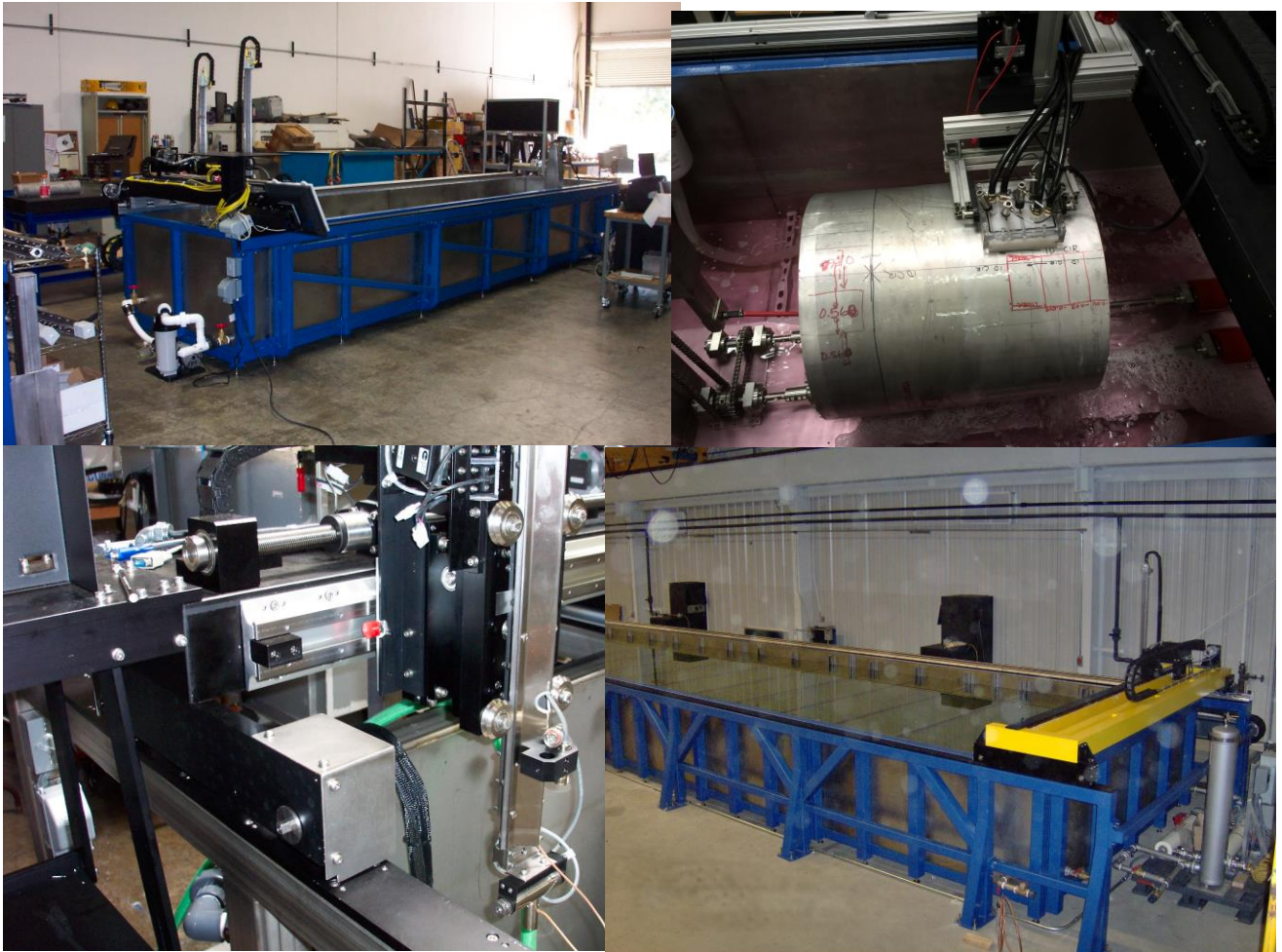
**Structural
Diagnostics, Inc.**

Technical Specification

TECHNICAL SPECIFICATION

SDI-5230

Automated Ultrasonic Bar Inspection System With C-Scan Acquisition Sub-System



Revision E 6/24/13

Note: This specification is for the standard SDI-5230-CS Bar Inspection System and is for information only. The details may differ significantly from those proposed for specific customer requirements. The specification provided in the Statement of Compliance and formal quotation supersede this document.



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Specification for an Advanced Ultrasonic Immersion System with Heavy Duty Rotator

1. INTRODUCTION

This specification is for an advanced rotator system for the inspection of aero engine components. The equipment components include a heavy duty precision bridge mounted on a stainless steel immersion tank fitted with one of the SDI-1330 series rotators. The precision search tube is configured to accept a range of gimbal options. The equipment will operate with any system level ultrasonic instrumentation. It is designed to achieve the accuracy and resolution required at high throughput speeds in a harsh operating environment. SDI have supplied systems of this type for testing product from all major aero engine and rocket motor producers.

In addition to being approved by all major aero-engine manufacturers, the following advanced features of SDI systems give major advantage over competitor's equipment in terms of ease of use and inspection setup and test time;

- Automatic multi-transducer inspection with different transducers on dual search tubes performing simultaneous or sequential independent scans on the same part.
- Multiple scan inspection with a series of scans being performed without operator intervention. Each scan can have a different instrument setting and produces a different data file. The scan sequence, or script, can include automatic DAC setup, and transducer characterization. If SDI instruments are used the instrument parameters, such as gate position and gain, can be changed during the scan at rep rate speeds and coordinated with the motion.
- System functional axes where the operator is able to move the transducer along its axis, or change the angle of incidence without moving the sound entry point, with a single control.
- Automatic identification of defects with the cluster analysis feature.
- Import/Export of scan plans to CAD.
- Automatic normalization and water path adjustment.
- Advanced complex contour following capabilities
- Automatic teaching of component scan plans.
- Nested scan plans where multiple parts in different locations can be tested in the same sequence.
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Although the SDI 5230 will operate with most system flaw detectors, incorporating one of the SDI USPC-7100 high performance systems instruments gives the following additional benefits.

- Nested scan plans where multiple parts in different locations can be tested in the same sequence.
- Change instrument parameters at rep rate speeds
- Back wall following gates
- Coordination of instrument parameters with complex scan plan i.e. integrate variable gain with on-the-fly scanning of complex shapes



2. SYSTEM DESCRIPTION

The system consists of floor mounted heavy gauge stainless steel tank with a re-enforced base suitable for supporting rotators up to 35ft (10m) long. A variety of transducer holders and bar followers is available. These range from a single channel dual axis motorized gimbal to a multi-channel bar follower where the transducers are mounted in-line in a housing which rides in contact with the bar. The bar to be tested is loaded onto the rollers and the transducer/follower assembly positioned above it. As the bar is rotated, the transducer assembly traverses the entire length of the bar. All test parameters, including rotator speed, helix pitch etc are controlled by the SDI-1830-UTB system controller. The time to test a bar is dependent on the test standard defect size and the bar diameter.

The 1335 and 1336 series rotators consist of separate drive and idler units providing, in most cases, two point support for the bar under test. This provides greater tolerance to slightly bent bars than the multiple roller designs. The drives are installed in oil filled underwater housings. Both the drive and idler stations can be relocated to any point along tracks mounted to the support frame. Adjustable height idler stations allow the inspection of cylindrical parts with multiple varying diameters. The modular design allows rapid reconfiguration of the system to accommodate different lengths and diameters of bar. The lower cost 1334 bar rotator type is a standard multi roller configuration mounted on two parallel shafts. The roller spacing can be adjusted to accommodate different bar diameters. The drive is mounted on an above water extension.

2.1 Gantry-X Axis.

The gantry is fabricated from heavy steel box section with a high redundancy outrigger design calculated to provide the required rigidity and stability for the large accelerating mass of the bridge and search tubes. The gantry is fitted with ground tracks with leveling jack screws and guide bars. Mounted to the tracks are the linear ways and heavy duty rack and pinion drive components to provide precise positioning and encoder feedback. The gantry also carries the cable distribution components. All drives are closed loop d.c. servos with encoders/resolvers.

2.2 Bridge Y Axis

The bridge is fabricated from heavy aluminum box section with a rigid box girder construction. Mounted to it are the precision V ways for the Y-axis carriages which support the Z-axis vertical drive housings. The design incorporates methods of adjusting the orthogonality and alignment of the X, Y and Z axes.

2.3 Search Tubes Z-Axis

The search tubes incorporate several novel design features to provide the required adjustments and accuracy to maintain the alignment of two independent search tubes during high speed 3D contour following. The stainless steel cruciform construction, precision rack and pinion drive and V ways provide single search tube systems with these benefits even



though the alignment requirement does not exist.

2.4 Gimbals

The gimbals are closed loop servos with integral high precision resolvers. The units are housed in oil filled stainless steel enclosures. The transducer is attached to the gimbals by a UHF mount.

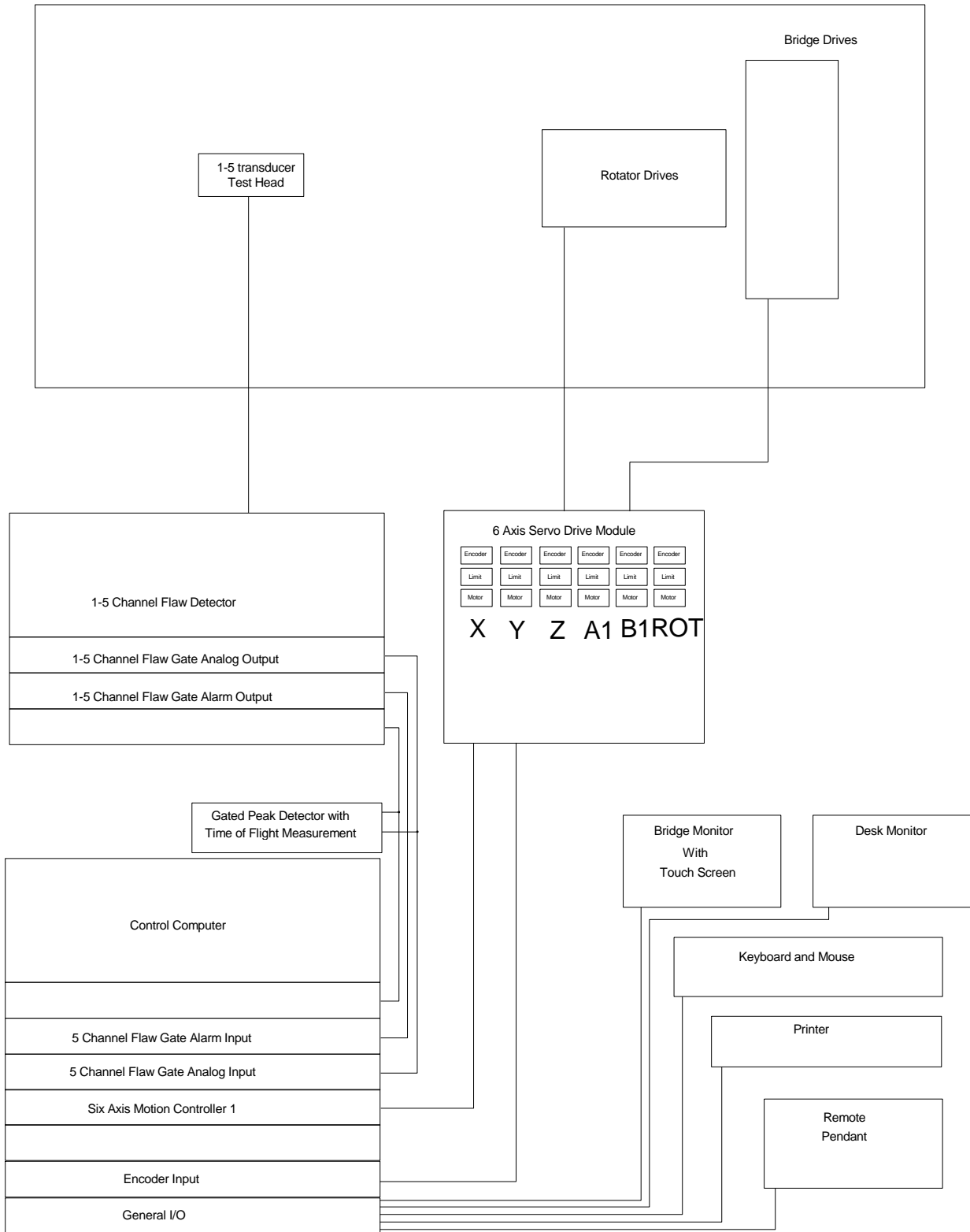
3. ELECTRICAL CONFIGURATION

The electrical configuration describes the components and interconnections for the motion control, drive, instrumentation and data acquisition sub systems. The majority of the components are housed in the system console. All system components meet applicable US and International safety codes. Apart from the very low current ultrasonic signals, no voltages greater than 70 volts are present anywhere on the system outside the control console.

3.1 Control Console.

The mobile control console can be positioned anywhere within reasonable distance from the system. Current SDI systems have similar remote consoles up to 80 ft. from the scanner. The system can be configured with two 19 inch LCD monitors linked in the Windows operating environment to allow windows to be dragged from one screen to the next, or expanded over two screens. The console requires a single 110V 60 Amp single phase supply. SDI will install the necessary transformers to achieve this from the customer's supply. The console houses all the computing, drive and instrumentation components required to operate the system. The enclosure includes a filtration and refrigeration unit where required

The electrical layout is shown below





4. SYSTEM CONTROL – GENERAL

The SDI MasterScan/WinScan suite is one of the most powerful motion control and acquisition packages available. The well structured modular software has evolved by incorporating customer's motion control and acquisition requests into the standard product. With a user base of over 200 systems, incorporating the suggestions of technicians who spend all their time operating our equipment has resulted in the most versatile, user friendly, package in the industry. Targeted primarily at high volume test lab users, the principal operational criteria are ease of use and fastest possible inspection times.

5. MOTION CONTROL

The motion control is provided by the SDI-1830 MasterScan advanced controller. Designed specifically for ultrasonic applications, it features ultrasonic functional axes and scripted scan plans. This means that complex motion control and acquisition activities unique to ultrasonic inspection techniques are available to the operator through simple commands using ultrasonic terminology. The operator can construct complex scans by chaining together individual motion commands, scan plans and instrument set-ups. Full details of MasterScan are given in the data sheet. Some of the key features are:-

- Functional axes using standard UT terminology
- Import/Export of scan plans to CAD programs
- Automated normalization
- Auto teach of scan plans
- Integrated instrument control coordinated with the motion along a scan trajectory.
- Scripted scan plans
- Chained scans
- Dual independent search tubes performing different scans simultaneously.
- Stop on defect
- Return to defect
- Display of scan progress and time to finish.

6. DATA ACQUISITION

The system is supplied with the latest SDI-WinScan multi-tasking acquisition and analysis package designed for high throughput production applications. A technical description of the features and benefits of this high performance industrial package is attached. Some of the key features are :-

- High-speed pan and zoom through entire data file
- High speed, high quality 1:1 plotting of all or selected areas of the data file.
- Scan comments stored with the data file.



- Multi-channel operation.
- True multi-tasking to allow scanning, plotting and viewing of stored files to be performed simultaneously without a reduction in speed.
- Numerous analysis features such as histograms, in dB and linear scales, cluster analysis providing automatic defect identification, image smoothing and filtering with operator defined kernels.

Another time saving feature of the fully integrated motion control and data acquisition package is the ability to perform mini-scans. Areas of interest can be tagged on the data file and the system will automatically drive back to them and re-scan the area using selected defect evaluation scan parameters such as full waveform capture.

7. INSTRUMENTATION

All SDI systems are able to operate with a variety of flaw detectors. Systems have been installed using instruments supplied by all major instrument manufacturers. Incorporating one of the SDI USPC-7100 high performance systems instruments gives the following additional benefits.

- Nested scan plans where multiple parts in different locations can be tested in the same sequence.
- Change instrument parameters at rep rate speeds
- Back wall following gates
- Coordination of instrument parameters with complex scan plan i.e. integrate variable gain with on-the-fly scanning of complex shapes

8. SYSTEM ACCEPTANCE/INSTALLATION

The system will be available for customer acceptance trials prior to shipment. The details of the Acceptance Test Procedure (ATP), are in accordance with the customer's requirements. The system will then be installed at the customer's site. It is understood that the customer will provide suitable single-phase power, water supply and drainage. Full installation drawings will be provided shortly after receipt of order. It is also recommended that a dedicated phone line be installed in close proximity to the system to allow modem communication for remote diagnostics, upgrades etc.

9. TRAINING

Training is generally performed both at SDI prior to shipment, and at the customer site after installation. Operators presented for training should have an understanding of ultrasonics, and the Windows operating system, i.e. how to save files and the directory structure. For most applications four days operator training, and two days maintenance training is adequate. For complex contour scanning additional training is required. Training should be limited to no more than four people at a time.



10. CUSTOMER SUPPORT

The service, maintenance and technical support facilities offered by SDI can be tailored to meet a wide range of customer requirements. Customers who purchase our equipment receive the complete range of services free of charge for the first year following equipment installation.

10.1 Service

Our Customer Support Department coordinates all customer activities internally from installation to on site service calls. SDI has a field service organization to provide post installation service and maintenance on installed systems throughout the world. SDI manufactures and stocks large quantities of spare parts for current and earlier models of equipment. Recommended spare parts can be purchased with the original equipment or on an as needed basis. SDI is able to provide the parts at significant discounts to service contract customers.

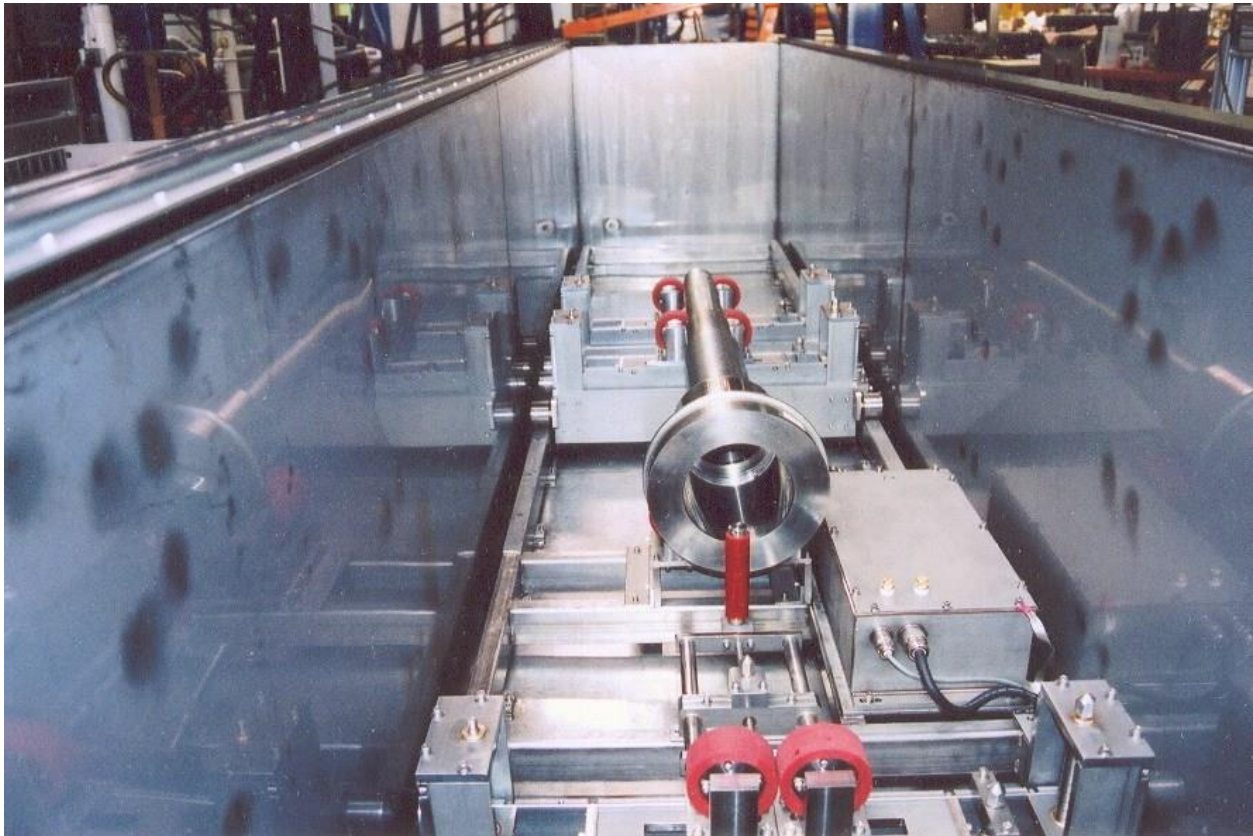
10.2 Technical Support

Field service personnel are complimented by the technical support and engineering staff at the SDI facility. The technical support staff is available to customer engineering and service personnel for free consultation via phone, fax and modem.



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SDI-5230 Tank showing multiple adjustable height idler stations for a complex part with several changes in diameter.