Ultrasonic Phased Array Inspection of Composites Course Outline

1.0 Introduction and course objectives

1.1 Brief history of phased array
1.2 Capabilities / advantages of phased array
1.3 Course objectives
1.4 Phased Array Inspector Certification requirements
1.5 Refresher of basic ultrasonic principles

2.0 Ultrasonic phased array digitization principles

2.1 Advantages of digital recording
2.2 Digital amplitude
2.3 Sampling rate
2.4 Time for one wavelength
2.5 Minimum sampling requirements
2.6 Ideal sampling requirements
2.7 Pulse shape
2.8 Pulse duration principles for signal optimization
2.9 Signal averaging
2.10 Element excitation
2.11 Number of A scans needed to create an S-scan
2.12 PRF / Scan speed relationship
2.13 Effect of averaging on scan speed
2.14 PRF issues
2.15 Probe frequency spectrum
2.16 Bandwidth
2.17 Bandpass filters
2.18 Video smoothing filters
2.19 Gray scale palette
2.20 Color scale palette
2.21 Swept angle imaging
2.22 Data collection rate
2.23 Display options - A scan - B scan - C scan - S scan

3.0 Introduction to phased array principles

3.1 What are phased arrays
3.2 Why use phased arrays
3.3 Phased array terminology
3.4 Probe parameters
3.5 Probe manufacturing, composite crystal technology
3.6 Phased array probe design
3.7 Wedge parameters
3.8 Comparison with conventional versus phased array wave forming technology
3.9 Beam forming using phased array principles
3.10 Transmitting delays
3.11 Receiving delays
3.12 Focal law generation
3.13 Focal law calculation
3.14 Beam focusing
3.15 Dynamic Depth Focusing (DDF)
3.16 Beam steering

3.17 Sectorial scanning
3.18 Element size effects on beam steering
3.19 Electronic scanning
3.20 Summary of scan types
3.21 Array selection
3.22 Frequency and aperture type
3.23 Element size summary
3.24 How many elements to use
3.25 Power of the elements
3.26 Design compromise
3.27 Choosing the pitch and aperture size
3.28 Array lobes

4.0 Instrument specific orientation and basic operating instructions

4.1 Available modules
4.2 Module specifications
4.3 Software screen
4.4 User interface options
4.5 Direct access buttons
4.6 Main menu
4.7 The menu structure
4.8 Using Gate / Alarms
4.9 Calibration Wizards
4.10 User options

5.0 Programming and process control procedures for the Equipment.

(Group practical session following Instructors presentation).

5.1 General user information
5.2 Basic connections and powering up
5.3 Probe / Part calibration
5.4 Focal Law calibration
5.5 UT settings calibration
5.6 Display selection
5.7 Probe array dead element check
5.8 Element sensitivity calibration procedure
5.9 Wedge delay calibration procedure
5.10 TCG (Time Corrected Gain) calibration procedure
5.11 Sound velocity calibration procedure
5.12 Encoder calibration procedure
5.13 Flaw sizing procedure
5.14 Creating a report
5.15 Storing the set up file
5.16 Creating a defect table

6.0 Composite Manufacturing Technology

6.1 Material Types - Composites, Plastics, GRP
6.2 Resin types
6.3 Fibre lay-up options
6.4 Resin application processes – Pre-preg, Brush applications, RTM/RTI
6.5 Pre-preg manufacturing
6.6 Lay-up and curing

6.7 Ply stacking and orientation
6.8 Autoclave cure cycle
6.9 Honeycomb core CFC
6.10 Co-curing
6.11 Co-bonding
6.12 Bonding
6.13 Product Forms
6.14 CFC honeycomb stiffened assemblies
6.15 Blade stiffened skins
6.16 Spar stiffened assemblies
6.17 Spar stiffened and honeycomb stiffened assemblies
6.18 Discontinuity / Flaw types
6.19 Definition of discontinuities and defects
6.20 Defect origins
6.21 Defect types and nature
6.22 Retained backing material
6.23 Porosity
6.24 Un-bonds
6.25 Honeycomb defects
6.26 Core splice
6.27 Distorted cells
6.28 Blistered cells
6.29 Blistered skins
6.30 Impact damage

7.0 Practical exercises

7.1 Practical exercises using pre-programmed set-up files
7.2 Process control checks:
7.3 Setting up the equipment for specific inspections per SB's, AD's and NTM requirements. (Impact damage detection and plotting, scarf patch inspection).
7.4 Performing scans.
7.5 Storing the set-up files.
7.6 Creating saving and analyzing data files
7.7 Defect sizing
7.8 Building and printing a report.
7.9 Developing new PA procedures for the OmniScan.

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