Syllabus specific to Ultrasonic Testing of Welds using Time of Flight Diffraction

1. Level 1 Specific Theory

1.1 Background to the importance of the TOFD Technique
1.2 History of TOFD development
1.3 Principles of TOFD
1.4 Diffraction process
1.5 Basic TOFD set-up
1.6 Types of TOFD scan
1.7 Summary of advantages and disadvantages of TOFD, including limitations
1.8 Basic hardware
1.9 Advantage of digital recording
1.10 Digitisation of the analogue ultrasonic signals
1.11 Amplitude
1.12 Sampling rate
1.13 Selection of frequencies for filtering
1.14 Amount of data collected during an inspection
1.15 Grey scale imaging and B-scans
1.16 Signal averaging
1.17 Pulse width control
1.18 Software
1.19 On-line
1.20 Analysis and off-line facilities
1.21 Precision and resolution
1.22 Beam spread considerations
1.23 Basics for calculation of beam spread
1.24 Example of selection of number of scans for an inspection
1.25 Choice of probe angle
1.26 Transducer size and frequency
1.27 Choice of probe centre separation
1.28 Calibration of setting of gain
1.29 Digitisation rate
1.30 Signal averaging and pulse width
1.31 No signals – common faults
1.32 Manual versus mechanical scanning
1.33 General
1.34 Manual scanning
1.35 Mechanical scanning
1.36 Sampling interval
1.37 Summary of choice of parameters for TOFD Scan
1.38 Introduction
1.39 Timing errors
1.40 Near surface problems
1.41 Off-axis error and back wall blind zone
1.42 Off-axis depth error
1.43 Back wall blind zone
1.44 Errors in couplant thickness, surface height variations and velocity
1.45 Large grained materials
1.46 Overall errors and monitoring growth
1.47 Overall errors

1.48 Monitoring defect growth
1.49 Data assessment – flaw characterisation
1.50 Shear waves
1.51 Pores and slags in TOFD records
1.52 Internal cracks
1.53 Upper surface breaking cracks
1.54 Lower surface breaking cracks
1.55 Effect of changing defect profile
1.56 Weld root flaws
1.57 Check transparency
1.58 Transverse flaws
1.59 Analysis software
1.60 Linearisation
1.61 Lateral/back wall straighten and removal
1.62 Parabolic cursor
1.63 Synthetic aperture focusing technique (SAFT)
1.64 Split spectrum processing
1.65 Curved surface
1.66 Complex geometry

2. Level 2 Specific Theory

As Level 1 but in addition:

2.1 Flaw sizing with the pulse echo technique
2.2 Comparison of flaw sizing accuracy for different techniques
2.3 Angular variation of diffraction signals
2.4 Effect of change in probe separation and importance of calibration with lateral and back wall signals
2.5 Change in probe separation
2.6 Importance of calibration
2.7 Error due to variations in couplant depth
2.8 Error due to variations in surface profile
2.9 Velocity error
2.10 Index point migration errors
2.11 Other errors
2.12 Multiple arcs
2.13 Procedure writing
2.14 Equipment and probe checks
2.15 Equipment checks
2.16 Screen height linearity
2.17 Amplitude linearity
2.18 Time base linearity
2.19 Probe index emission point
2.20 Beam angle
2.21 Beam spread
2.22 TOFD combined probe delay
2.23 Sensitivity
2.24 Resolution
2.25 Probe checks
2.26 Material velocity measurement
2.27 Probe frequency
2.28 Probe pulse length

