Designation: E2775 – 16 (Reapproved 2023)

Standard Practice for Guided Wave Testing of Above Ground Steel Pipework Using Piezoelectric Effect Transduction[1]

This standard is issued under the fixed designation E2775; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice provides a procedure for the use of guided wave testing (GWT), also previously known as long range ultrasonic testing (LRUT) or guided wave ultrasonic testing (GWUT).

1.2 GWT utilizes ultrasonic guided waves, sent in the axial direction of the pipe, to non-destructively test pipes for defects or other features by detecting changes in the cross-section or stiffness of the pipe, or both.

1.3 GWT is a screening tool. The method does not provide a direct measurement of wall thickness or the exact dimensions of defects/defected area; an estimate of the defect severity however can be provided.

1.4 This practice is intended for use with tubular carbon steel or low-alloy steel products having Nominal Pipe size (NPS) 2 to 48 corresponding to 60.3 mm to 1219.2 mm (2.375 in. to 48 in.) outer diameter, and wall thickness between 3.81 mm and 25.4 mm (0.15 in. and 1 in.).

1.5 This practice covers GWT using piezoelectric transduction technology.

1.6 This practice only applies to GWT of basic pipe configuration. This includes pipes that are straight, constructed of a single pipe size and schedules, fully accessible at the test location, jointed by girth welds, supported by simple contact supports and free of internal, or external coatings, or both; the pipe may be insulated or painted.

1.7 This practice provides a general procedure for performing the examination and identifying various aspects of particular importance to ensure valid results, but actual interpretation of the data is excluded.

1.8 This practice does not establish an acceptance criterion. Specific acceptance criteria shall be specified in the contractual agreement by the responsible system user or engineering entity.

1.9 *Units*—The values stated in SI units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.10 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.11 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E543 Specification for Agencies Performing Nondestructive Testing

E1065 Practice for Evaluating Characteristics of Ultrasonic Search Units

E1316 Terminology for Nondestructive Examinations

E1324 Guide for Measuring Some Electronic Characteristics of Ultrasonic Testing Instruments

2.2 Equipment Manufacturer's User's Manual

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *circumferential extent*—the length of a pipe feature in the circumferential direction, usually given as a percentage of the pipe circumference.

3.1.2 *coherent noise*—indications caused by real discontinuities causing a background noise, which exponentially decays with distance.

3.1.3 *Cross-Sectional Area Change (CSC)*—the CSC is calculated assuming that a reflection is purely caused by a

[1] This practice is under the jurisdiction of ASTM Committee E07 on Nondestructive Testing and is the direct responsibility of Subcommittee E07.10 on Specialized NDT Methods.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

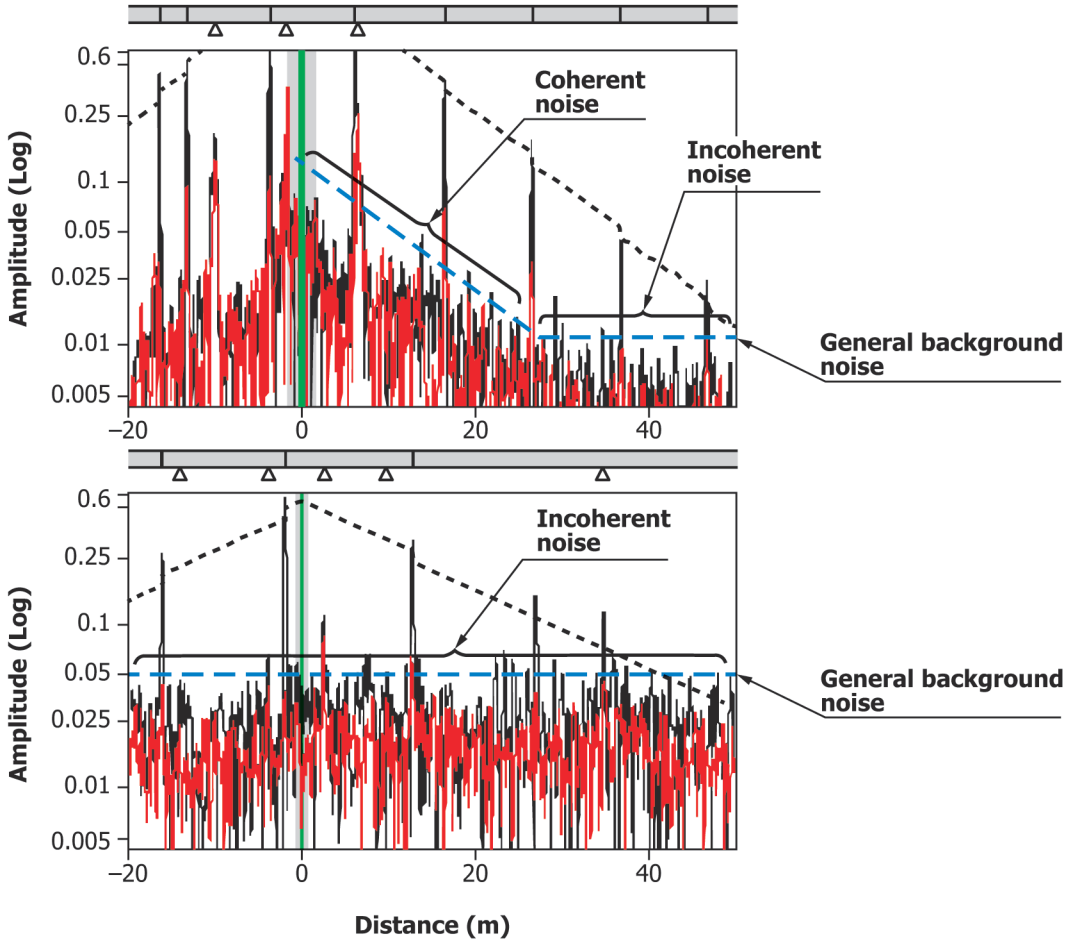

FIG. 1 Typical GWT Results Collected in Normal Environment (Top) and in High Ambient Noise Environment (Bottom). (Both results are displayed in the logarithmic amplitude scale.)

change in cross-section. It is given as a percentage of the total cross-section. However it is commonly used to report the relative amplitude of any signal regardless of its source.

3.1.4 *Distance Amplitude Correction (DAC) curve*—a reference curve plotted using reference reflections (for example, weld reflections) at different distances from the test position. This curve corrects for attenuation and amplitude drops when estimating the cross-section change from a reflection at a certain distance.

3.1.5 *Estimated Cross-Sectional Loss (ECL)*—this is sometimes used instead of cross-sectional area change, where the feature is related to a flaw.

3.1.6 *flexural wave*—wave propagation mode that produces bending motion in the pipe.

3.1.7 *Guided Wave (GW)*—stress waves whose characteristics are constrained by the system material, geometry and configuration in which the waves are propagating.

3.1.8 *Guided Wave Testing (GWT)*—non-destructive test method that utilizes guided waves.

3.1.9 *longitudinal wave*—wave propagation mode that produces compressional motion in the pipe.

3.1.10 *incoherent noise*—random indications caused by electrical and ambient signal pollution, giving rise to a constant average noise floor. The terms “ambient noise” and “random noise” are also used.

3.1.11 *pipe feature*—pipe components including but not limited to weld, support, flange, bend and flaw (defect) cause reflections of a guided wave due to a change in geometry.

3.1.12 *reflection amplitude*—the amplitude of the reflection signal typically reported as CSC.

3.1.13 *reflector orientation*—the circumferential position of the feature on the pipe. This is reported as the clock position or degrees with regards to the orientation of the transducer ring.

3.1.14 *Signal-to-Noise-Ratio (SNR)*—Ratio of the amplitude of any signal of interest to the amplitude of the average background noise, which includes both coherent and non-coherent types of noise as defined in Fig. 1.

3.1.15 *torsional wave*—wave propagation mode that produces twisting motion in the pipe.

3.1.16 *transducer ring*—a ring array of transducers that is attached around the circumference of the pipe to generate GW. It is also commonly known as the ring.