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Ultrasonic technician performance test for boiler tube inspection

Scope

This procedure has been developed by a TAPPI Task Group to offer a basis for evaluating the skills of technicians who measure the thickness of boiler tubes from the external surface using manual instruments. The evaluation includes a background interview of each technician, as well as an operative test to objectively determine the technician's ability to accurately calibrate an ultrasonic thickness unit and measure a boiler tube test panel. This procedure is written for bare carbon steel tubes but can be applied to other materials if representative test panels are prepared (*e.g.* chromized, composite, weld overlaid). Specialized ultrasonic test equipment, such as semi-automated scanners, could be addressed by appropriate modifications to this procedure.

Safety precautions

This performance test is designed for individuals expected to perform work in a boiler. This requires the following:

- Safe entry procedures, including maintaining air quality in the boiler spaces, following lockout/tagout procedures, and protection from falling material
- Use of required personal protective equipment
- Access platforms and scaffolding must conform to government and industry standards
- Functionality and proper use of electrical safety devices

Personnel

The personnel qualification and certification program of the contracting organization shall be in accordance with ASNT's SNT-TC-1A (latest edition) or CAN/CGSB's 48.9712. It is recommended that at a minimum, all ultrasonic thickness technicians be experienced and have training equivalent to that of an ASNT Level I ultrasonic technician. In addition, Level II or III technicians shall be on the job site to instruct, supervise, and verify appropriate performance by the Level I technicians. In addition to Level I certification, experience in actual boiler tube thickness measurement is important.

It is recommended that all ultrasonic thickness technicians be qualified by the mill through the testing procedure. The test should be conducted by a mill representative knowledgeable of ultrasonic testing. Qualification should be effective for one year providing the technician maintains employment with the same contractor and performs satisfactorily in the field. The mill should retest any technician whose performance is questionable, and revoke his/her qualification if warranted by either unacceptable test or field performance.

Fabrication of test panels

It is recommended that the test panels used in the evaluation of the technician be fabricated from tubes of the same thickness, diameter, and configuration as those in the boiler to be surveyed. In some cases, it may be more

practical to adopt a standard membrane test panel configuration. The standard panel should be of membrane-wall construction if it is to be used for any membrane-wall boilers. Details of test panels are shown in Figs. 1-3.

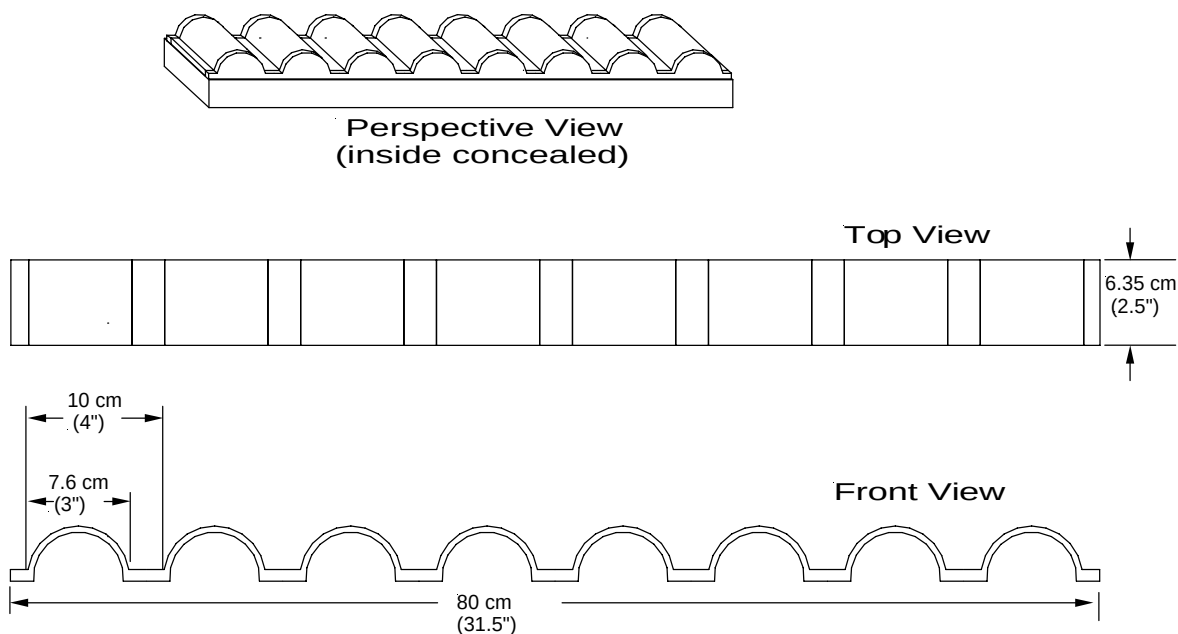


Fig. 1. Boiler tube thickness test panel membrane wall construction.

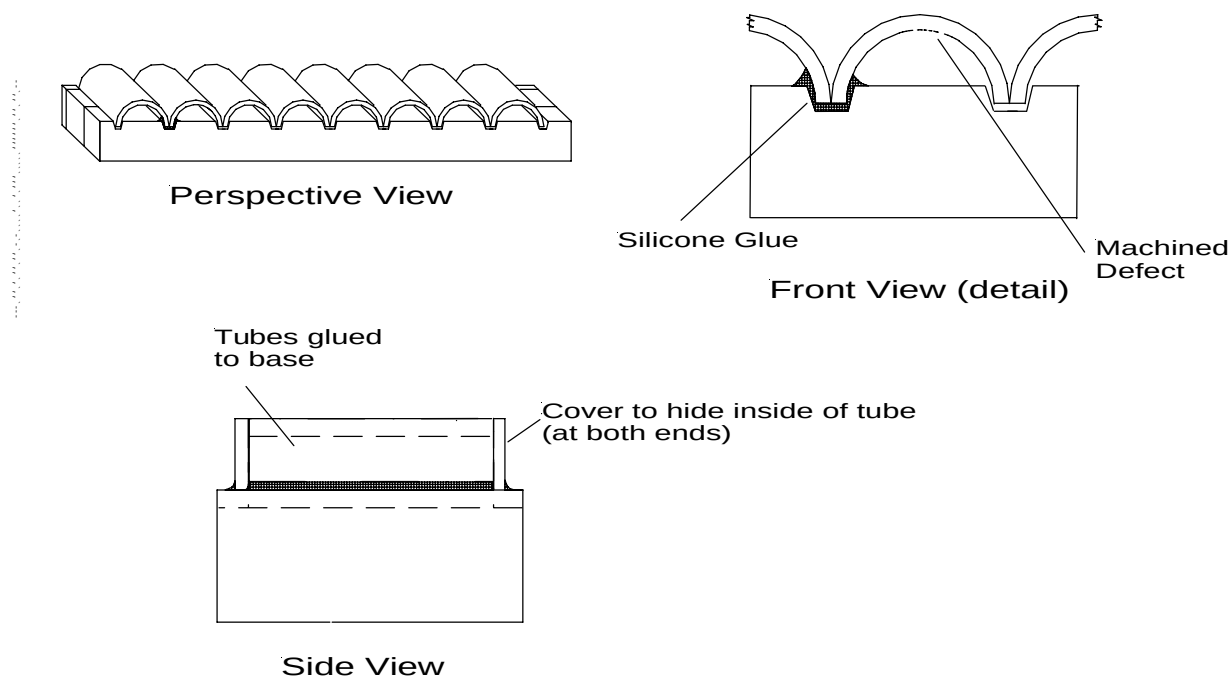


Fig. 2. Boiler tube thickness test panel tangent tube construction.

Each panel should consist of eight tube sections approximately 63.5 mm (2.5 in.) long.

It is often convenient to make the test panels from tube sections removed from service. Used tubes will have a natural wear pattern, as well as the same sound entry surface as those in the boiler. Extremely pitted tubes are unlikely to provide a representative surface.

The tubes should be sectioned to gain access to the interior surface. When using membrane panel tubes, the tubes should be cut flush with the cold side of the membrane (see Fig. 1). When using loose tubes, slightly less than half the tube circumference should be removed (see Fig. 2). This will facilitate fabricating a test panel with the same surface area as found in the tangent tube boiler.

The tube panel should be deburred and sandblasted after cutting to size. The interior surface of the tubes should then be ground to varying degrees, to give a wide deviation in thicknesses throughout the panel. The minimum thickness should not be less than 1.25 mm (0.050 in.). This thickness approaches the lower measurement limit of the typical transducer used to perform surveys.

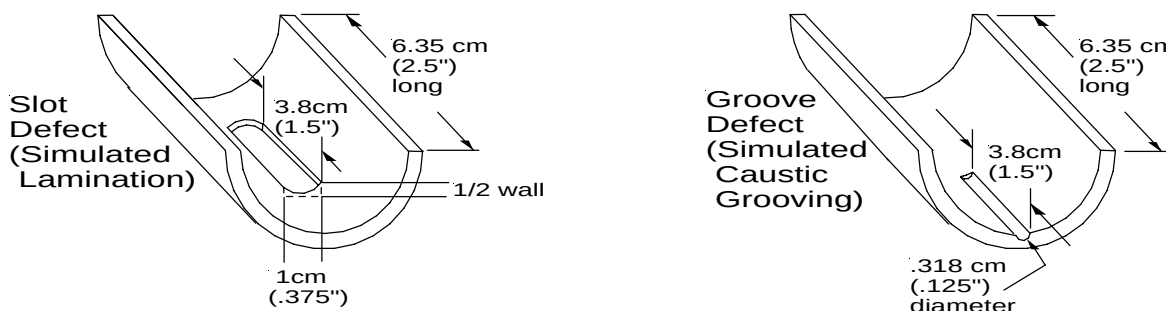


Fig. 3. Suggested machined defects for boiler tube thickness test panels.

In addition to thinning the tubes by grinding, a minimum of two defects should be machined into the test area of the test panel (see Fig. 3). One defect should be a simulated lamination, produced by milling a 10 mm × 40 mm (0.375 × 1.5 in.) longitudinal slot into the tube, from the interior surface. This simulated lamination must be on the interior surface and have a flat bottom. A second defect, simulating localized caustic gouging, should be produced by milling a 1 in. long, longitudinal slot in the tube, using a 3.18-mm (0.125 in.) diameter, rounded cutter. The depths of these slots should be approximately one half the tube wall thickness.

The interior surface of the tube panel should be concealed, for example by mounting within a wooden frame, to hide the defects and thinned areas.

The test area should consist of a 25-mm (1 in.) wide band in the center of the tube section. The band should be defined by painting the extremities adjacent to the inspection area. The band should be equally divided into left, center, and right sectors. These sectors should also be defined by painting or vibratory etching the dividing points on each tube. The tubes should be numbered left to right as numbers 1 through 8. Each tube panel also should have a permanent serial number attached.

The completed test panel should be ultrasonically examined by a number of ultrasonic technicians to establish a consensus-based thickness key sheet. This process has been found to be advantageous over physical measurements of the tubes.

Pretest preparation

Mill responsibilities

The technician qualification test requirements should be stipulated in all bid and contract specifications. A copy of the mill's qualification test procedure should be provided in advance to the contractor.

A mill representative should be responsible for administering the qualification test to each technician before that technician begins work in the boiler. It is recommended that the test administrator be a qualified ultrasonic technician, or at least knowledgeable in the testing method.

The ultrasonic technician interview and practical examination should be conducted at a convenient indoor location, and in a manner that is not disruptive to the boiler inspection. The location should not be distractive to the technician who will be testing under time constraints. It is recommended that a table and chair be provided for the