

Tube Thickness Evaluation Repair or Replacement Guideline

Purpose

This bulletin was written to assist customers in evaluating existing boiler tube wall thicknesses and defining when repair or replacement is recommended.

Background

Experience has shown that many tubes do not necessarily fail when operating at thicknesses below the minimum wall calculated, according to the ASME Code. However, operation in this manner encroaches on the ASME Code design margin. A tube that is below minimum wall thickness may or may not be tolerant of temperature excursions, thermal cycling, mechanical loading and other stresses.

Cognizant of this, some operators have elected to take a practical approach, based on actual operating experience, to determine when to repair or replace thinned tubes. A practical minimum wall thickness criterion can be established through a record-keeping process, to track the wall thickness of various boiler tubes over time and to relate tube failure history of those tubes to tube thicknesses. This is an effective method for locating troubled areas before they lead to forced outages. With this method, the decision to take action for thinned tubes is based on a percentage of the original wall thickness (t) of the tubes.

Since high-temperature (steam-cooled) tubes usually fail by creep-rupture, and water-cooled tubes usually operate below the creep-rupture regime, a different set of evaluation criteria is required for each of these two types of tubes. Furnace tubes of once-through boilers operate at high temperatures and therefore are classified as steam-cooled tubes when evaluating tube thickness. A guideline for determining what course of action to take is shown in Table I.

Many factors were used and taken into consideration for establishing the usable thickness guideline. One of these factors is the need to avoid material yielding as the tube thins in service.

The decision to repair or replace tubing that is under the original specified minimum wall thickness

Location	Actual Tube Wall Thickness Relative to Percent Specified Wall Thickness, t	Course of Action
1. Furnace Support Tubes and Economizer Stringer Support Tubes	Tubes equal to or greater than 85% t	Monitor thickness
	Tubes less than 85% t	Restore tube wall thickness or replace tube*
2. Economizer, Furnace Wall and other Water-Cooled Tubes	Tubes equal to or greater than 70% t	Monitor thickness
	Tubes less than 70% t	Restore tube wall thickness or replace tube*
3. Superheater, Reheater and Other Steam-Cooled Tubes	Tubes equal to or greater than 85% t	Monitor thickness
	Tubes less than 85% t	Restore tube wall thickness or replace tube*

*It is difficult to restore the wall thickness for tubes below .090 inch due to possible weld burn through and distortion. On Kraft Recovery boilers, Refuse boilers, and boilers operating below 1000 psig the tubes should be replaced when below the ASME minimum wall thickness.

should be evaluated by the operating company and discussed with the local jurisdiction and/or insurance carrier. This evaluation should consider the following:

1. History of previous failures of similar tubes
2. Wastage rate
3. Susceptibility to temperature excursion
4. Thermal cycling
5. Mechanical loading
6. Scheduling of outages of sufficient length to replace tubes
7. Risk of injury to personnel from primary failure or subsequent reactions

(Continued on reverse side)

Recommendations

Customers should develop a program for their individual boilers using this as a guide to collect the specific information needed for reliable maintenance planning.

When replacing short tube segments, it is recommended that replacement tubing be the same OD, thickness and material specification as the original. When replacing large sections, an engineering review should be made to determine the advisability of upgrading to the latest design criteria or to apply other design changes that may eliminate existing problems. Arbitrarily increasing the tube wall thickness or alloy grade is not recommended, as it may lead to additional problems.

All boiler tubes may be replaced without weld restriction providing a qualified welding procedure is employed, together with a welding filler metal that is appropriate for the alloy content, tensile strength and service temperature of the tubing.

ALL REPAIRS MUST BE ACCEPTABLE TO THE GOVERNING CODE JURISDICTION AND/OR INSURANCE CARRIER.

Support

If you elect to follow the above guidelines, Babcock & Wilcox can assist in developing the specific information needed for an individual unit. Contact Babcock & Wilcox Field Service Engineering if you have any questions or need assistance.

For more information...

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