

TIP 0416-08

ISSUED – 2002
□2002 TAPPI

The information and data contained in this document were prepared by a technical committee of the Association. The committee and the Association assume no liability or responsibility in connection with the use of such information or data, including but not limited to any liability under patent, copyright, or trade secret laws. The user is responsible for determining that this document is the most recent edition published.

TIP Category Automatically Periodically Reviewed (Five-year review)
TAPPI

Guidelines for replacement of generating bank tubes with expanded joints in two-drum boilers

Scope

This Technical Information Paper provides guidelines for the removal and replacement of generating bank tubes

with expanded joints in two-drum power and recovery boilers. In a two-drum boiler, the seal between the generating tubes and the drums is created by either mechanically rolling or hydraulically expanding the tubes into

the tube seats. Replacement of the tubes requires removal of the existing tubes, reconditioning the tube seats in the

drum, and rolling or expanding in new tubes. There are numerous problems that can result from this process. These

include:

- Leaking tube seats due to tube seat damage, or insufficient expansion or wall reduction of the tubes
- Shoulders on tube counter bores, providing stress risers for tube cracking
- Severe cutting from rolling equipment, providing stress risers for tube cracking
- Non-concentric tube counter boring resulting in inconsistent tube wall thickness and reduced corrosion allowances

The objective of these guidelines is to minimize the potential for these and other problems by providing mill

personnel with the information necessary to develop a well-defined material specification, project scope, and

necessary quality control measures for proper execution of this work.

These guidelines include discussion of both the traditional mechanical rolling method for expanding generating

tubes into drums as well as recent developments in the use of hydraulic expansion.

Safety precautions

Beyond normal safety precautions undertaken when performing work on a boiler, there are no additional precautions required for tube rolling.

Early contractor involvement

Involvement of the installation contractor during the early stages of a project can significantly improve the chance

for having a successful project. Because of the long lead times for replacement tubing, mills will often order tubing

before getting input from the installation contractor. Contractors know the limitations of the rolling or expanding

equipment and can provide valuable input on various tubing parameters such as recommended grades of material, maximum wall thickness, preferred method of swaging, and maximum material hardness. Matching the tube material to rolling/expanding equipment will minimize the potential for problems during tube installation or during future operation. If it is necessary to order material before selecting a contractor, the material specifications should still be reviewed with the perspective contractors to obtain their input.

TIP 0416-08 Guidelines for replacement of generating bank / 2 tubes with expanded joints in two-drum boilers

Project scope

A well-defined project scope is necessary for a successful project. All project participants including the original equipment manufacturer (OEM), the tube supplier, and the boilermaker contractor should be involved in planning and review. The project scope should include detailed descriptions and specifications. The use of generic, subjective or descriptive terminology, such as “snug, secure, tight, clean, round,” etc. should be avoided and replaced by quantitative measures wherever practical.

Contractor selection

Contractor qualifications and how the contractor trains and qualifies the workers employed on the project are extremely important. Detailed discussions with each potential contractor should cover the following points:

- *Contractor performance on previous projects of similar scope.* This is the most effective method of evaluating a contractor. References for previous projects should be contacted directly. A check of the contractor’s safety record should be included.
- *Supervisors and their previous relevant experience.* The experience and qualifications of the on-site supervision is one of the most important criteria for selection of a contractor.
- *Work force size and experience.* This includes proposed crew sizes, number of supervisors per crew and worker qualification procedures.
- *Use of mock-ups.* Mock-ups that simulate conditions in the boiler can be used to great advantage, especially for qualifying workers for removal of tube stubs and for tube rolling.
- *Written procedures and documented training.* The contractor should have written procedures covering the following process steps:
 - New tube inspection
 - Tube removal including physical removal from boiler
 - Drum hole cleaning and inspection
 - Drum hole measurement
 - Drum hole repair procedures, including applicable welding procedures
 - Tube end cleaning

- Tube placement and alignment
- Tube expansion and quality control methods

These written procedures should be used for training of the work force.

- *Quality procedures and staffing.* It is important that the owner and contractor are in agreement on the QA procedures. The technique dependence of most of the procedures employed makes it highly advisable to require a complete QA staff on all shifts. Lack of adequate QA staffing on the night shift can have an adverse affect on the project schedule.

- *Amount and condition of the equipment to be provided.* An adequate number of properly functioning tools such as expanders, replacement rollers, mandrels, rolling motors, tuggers, etc. must be on hand to meet the job schedule. Equipment should be inspected and tested prior to shipment to the job site.

- *Subcontracted work.* The owner should retain the right to approve all subcontractors.

Once a contractor has been selected, a detailed job plan and schedule should be developed and agreed upon. The job plan should include a detailed safety program.

3 / Guidelines for replacement of generating bank TIP 0416-08 tubes with expanded joints in two-drum boilers

Tube material specification

The tubing specification should contain two sections – one covering manufacture of the straight tubing and the

second covering fabrication into generating bank tubes. The tube material specification applies to manufacture of

the straight tubing by the tubing manufacturer and covers basic tube material properties and quality requirements.

The tube fabrication portion of the specification covers fabrication of the straight tubing into generating bank tubes

and covers the bending, swaging and annealing processes. Normally the generating tubes are ordered from the

fabricator who in turn orders straight tubing from a tubing manufacturer. The specification should emphasize that it

is the fabricators responsibility to insure that the tubing meets the tube material specification, however the owner

should maintain an active involvement in the QA/QC program including tube manufacturing.

When developing the tube material specification, consideration should be given to upgrading the tube material

and/or increasing the wall thickness to address the specific problems that made tube replacement necessary. (Check

with the contractor for any issues related to changes in material grade or thickness.) TAPPI TIS 0402-13, “Guidelines for specification and inspection of electric resistance welded (ERW) and seamless boiler tube for

critical and non-critical service,” should be consulted if ERW tubing is to be used. The tube material specification

should include:

- Material type, per ASME/ASTM standards
- Wall thickness
- Tubing supplier restrictions, if any
- Acceptability of unscheduled butt welds to achieve length (generally not accepted)
- Quality requirements, including non-destructive examination (NDE) procedures and acceptance criteria
- Requirements for on-site inspection by the Owner or Owner’s representative during the manufacturing process.

Generating bank tube fabrication

The specification for fabrication of the generating bank tubes should include the following:

Scope

The scope should specify how much of the generating bank is to be replaced, whether the generating bank side

wall tubes are to be included, and how much spare tubing should be ordered. (Spare tubing is required in case

of problems during fabrication or damage during shipping or installation.) The scope should also include quantity and materials of construction of required non-pressure parts such as vibration bars, lugs, U-bolts, casing, etc.

Drum dimensions, drum centerlines, tube hole details

Fabricators other than the OEM will require information including drum dimensions, drum centerlines, tube hole

dimensions, use of counterbores, etc. in order to design and fabricate replacement generating bank tubes.

Detailed drawings should be included in the specification if they are available.

Tube lengths

Tubes must be accurately characterized with respect to their true length, which may differ from the nominal length on the drawings if the drums have shifted. The most direct method to determine this is to measure actual

tube lengths with a tape measure down the inside of different tubes at several locations along the length of the

drum. An alternative method is to survey the drums. If there is any uncertainty regarding the length of replacement tubes, it is good practice to add an inch or two of length. Once some of the tubes are stuck in the

drum and the required length is determined, the other matching tubes should be trimmed prior to staging rather