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Standard Practice

Prevention, Detection, and Correction of Deaerator Cracking

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Foreword

NACE Task Group T-7H-7 on Deaerator Cracking (now Task Group [TG] 244 on Deaerators: Prevention, Detection, and Correction of Cracking—Revision of NACE Standard RP0590) was formed in 1984 to conduct an organized study into the cause of the high incidence of serious deaerator cracking problems in steam generating plants. The task group had previously sponsored technical symposia in which several papers were published on deaerator cracking.[1-8]

This standard is intended to be the primary source of information on deaerator cracking and is directed toward operators and designers of deaerator equipment used in steam generation. Information presented in this standard reflects the work of the many individuals involved in documenting the deaerator cracking problem and is based on studies of carbon steel units. Similar cracking has been found in blowdown flash tanks, sedimentation tanks, hot water storage/disengaging vessels, and steam and feedwater piping.

In developing this standard, the TG considered the case of a southeastern U.S. paper mill that had experienced loss of life as a result of a ruptured deaerator storage tank. The catastrophic failure resulted in an increase in deaerator inspections and widespread concern for vessel reliability and personnel safety. A "Deaerator Advisory," published by the Engineering Division of TAPPI,[(1)] reported that 68 vessels (approximately 50% of the vessels inspected in 1983) showed cracking in welds and adjacent heat-affected zones (HAZ) resulting from corrosion fatigue.[9] Of the three reported storage vessel ruptures, one resulted in fatalities and considerable plant downtime. Other literature on deterioration of deaerators noted that investigations of various systems indicated that cracks in the welds and HAZ of longitudinal and circumferential seams were the cause of some of the problems.[10] Corrosion, another major cause, had occurred at a more rapid rate in the weld HAZ in some instances, and problems had reportedly occurred in both the welds and the base metal caused by shell thinning to levels that could not support the load. Periodic internal inspections combined with nondestructive examinations (NDE) were recommended to detect deaerator deterioration. Other reports of the seriousness of deaerator weld cracking also were published at this time.[11-15]

TG 244 has continued to actively collect data and information on reinspections. The information obtained from the reinspections has been used to update this standard.

This standard practice was originally prepared in 1990 by T-7H-7 under the guidance of NACE Unit Committee T-7H on Corrosion and Its Control in Steam Generating Systems and issued by NACE under the auspices of NACE Group Committee T-7 on Corrosion by Waters. It was revised by T-7H-7 in 1996, and in 2006 by TG 244 on Deaerators: Prevention, Detection, and Correction of Cracking—Review of NACE Standard RP0590. TG 244 is administered by Specific Technology Group (STG) 11 on Water Treatment and is sponsored by STG 34 on Petroleum Refining and Gas Processing, STG 36 on Process Industry: Materials Performance in Chemicals, STG 38 on Process Industry: Pulp and Paper, STG 41 on Energy Generation, and STG 60 on Corrosion Mechanisms. This standard is issued by NACE under the auspices of STG 11. The root causes of deaerator cracking have not been determined; therefore, this standard is based on good practices.

> In NACE standards, the terms *shall*, *must*, *should*, and *may* are used in accordance with the definitions of these terms in the *NACE Publications Style Manual*, 4th ed., Paragraph 7.4.1.9. *Shall* and *must* are used to state mandatory requirements. *Should* is used to state something considered good and is recommended but is not mandatory. *May* is used to state something considered optional.

(1) Technical Association of the Pulp and Paper Industry (TAPPI), 15 Technology Parkway South, Norcross, GA 30092.

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Contents

Section 1: General

1.1 The objective of this section is to identify important factors influencing boiler feedwater (BFW) deaerator cracking based on literature references and case history analyses.

1.2 Deaerator Design

1.2.1 The function of the deaerator in the steam plant cycle is to reduce oxygen and other dissolved gases in the feedwater to acceptable levels. Usually, oxygen content can be reduced to less than 10 µg/L (ppb) as shown in Table A1 (see nonmandatory Appendix A). Two typical designs of mechanical feedwater deaerators are shown in Figures 1a and 1c. Figures 1b and 1d show the weld areas associated with each type of unit. The steam used in these systems raises feedwater temperature, which lowers the solubility of oxygen. With proper venting, the steam also serves as the stripping gas, removing the oxygen from the system. In these systems, the deaerator provides feedwater storage and proper mechanical conditions for the feedwater pump.

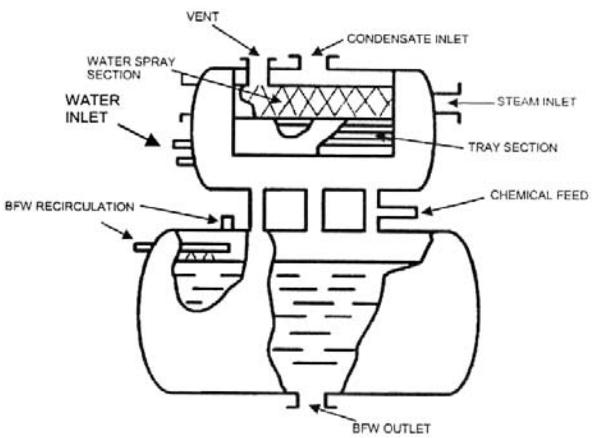


FIGURE 1a
Typical Mechanical Feedwater Deaerator

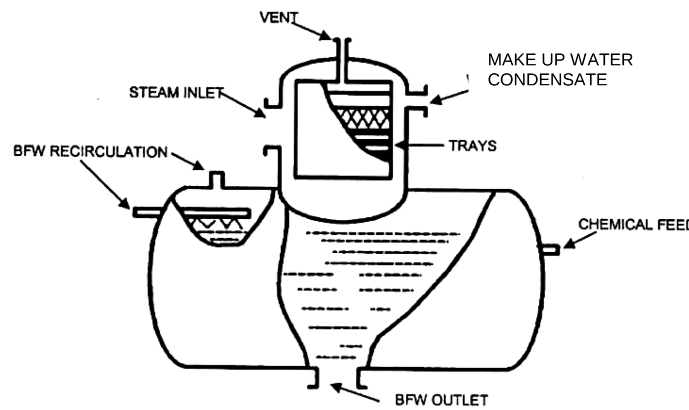


FIGURE 1c
Saddle-Type Mechanical Deaerator

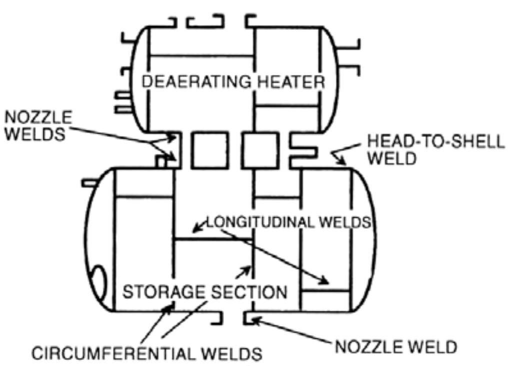
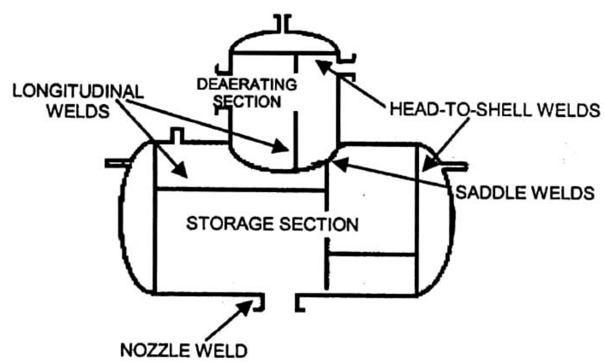


FIGURE 1b
Weld Areas Associated with Typical Unit



When a vertical heater is welded directly to the storage vessel, the saddle weld is of particular interest because of the fabrication stresses possible.

FIGURE 1d
Weld Areas Associated with Saddle-Type Unit