



U. S. Chemical Safety and Hazard Investigation Board RECOMMENDATIONS STATUS CHANGE SUMMARY

Report:	NDK Crystal, Inc. High Pressure Vessel Rupture
Recommendation Number:	2010-04-I-IL-R1
Date Issued:	November 14, 2013
Recipient:	American Society of Mechanical Engineers (ASME)
New Status:	Open – Unacceptable Response/No Response Received
Date of Status Change:	April 15, 2019

Recommendation Text:

Revise the ASME Boiler and Pressure Vessel Code to include specific material thickness limitations for the design of pressure-containing components to ensure proper heat treatment and avoid environmentally induced damage mechanisms. Clarify required vessel wall thickness limitations for SA-723 steel in the following code sections:

- a) ASME BPVC Section II, Part A, Material Requirements*
- b) ASME BPVC Section VIII, Division III, Article KM-400, Material Design Data*

Board Status Change Decision:

A. Rationale for Recommendation

On December 7, 2009, a 50-foot pressure vessel used to manufacture synthetic crystals ruptured due to internal stress corrosion cracking at the NDK Crystal facility in Belvidere, Illinois. The vessel, located in an enclosed building, generated several projectiles when it ruptured that resulted in one fatality and one injury to members of the public, as well as significant property damage to the NDK Crystal facility and an adjacent business.

As a part of its investigation, the U.S. Chemical Safety and Hazard Investigation Board (CSB) reviewed the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section II, Part A, which contains ferrous material specifications for pressure-retaining components, and Section VIII, Division 3, Alternate Rules for Construction of High Pressure Vessels (2001 edition), which applies to vessels operating at pressures greater than 10,000 psig, such as the vessels at NDK Crystal.

The CSB determined that these sections of the ASME Code do not include specific limitations of material thickness for the design of heavy pressure vessels made with carbon and low-alloy steels, such as the Grade 2 steel used at NDK. Also, while Article KM-400, Material Design Data, includes a table of required mechanical properties for each material covered under the section, the material listing used for the NDK vessels has no required thickness limit.

Consequently, the Board voted to issue a recommendation to the ASME.

B. Response to the Recommendation

In January of 2014, ASME referred the CSB recommendation to two internal subgroups for evaluation and response. The subgroup on High Pressure Vessels proposed some action, but the results of this action have not been communicated to the CSB to date. The Subgroup on Ferrous Specifications examined the CSB recommendation and noted that the material specifications for which the CSB sought a change in the B&PV Code were adopted from the American Society of Testing and Materials (ASTM) requirements.

In November of 2016, ASME contacted the ASTM concerning these material specifications; ASTM in turn reviewed their specifications and saw no need for any changes based on the CSB recommendation and communicated this to the ASME subgroup. In light of ASTM's response, the ASME subgroup concluded that no change was needed to the B&PV Code and communicated this to the CSB in November of 2017. Follow-up questions concerning the ASME response by CSB have not been addressed to date.

C. Board Analysis and Decision

As the CSB has yet to learn what action, if any, the Subgroup on High Pressure Vessels has taken and still seeks clarification on the response from the Subgroup on Ferrous Specifications from the ASME pertaining to this recommendation, the Board voted to change the status of CSB Recommendation No. 2010-04-I-IL-R1 to: **“Open - Unacceptable Response/No Response Received.”**