



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

<b>Report:</b>	NDK Crystal, Inc. – High Pressure Vessel Rupture
<b>Recommendation Number:</b>	2010-04-I-IL-R1
<b>Date Issued:</b>	November 14, 2013
<b>Recipient:</b>	American Society of Mechanical Engineers (ASME)
<b>New Status:</b>	Closed – Acceptable Alternative Action
<b>Date of Status Change:</b>	January 29, 2020

### 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 Code did 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, included a table of required mechanical properties for each material covered under the section, the material listing used for the NDK vessels had no required thickness limit. Consequently, the Board voted to issue a recommendation to the ASME.

#### B. Response to the Recommendation

In response to this recommendation, ASME added a requirement to the forgings section (KM-211.2) for ASME Section VIII, Division 3 vessels to ensure large heat treated vessels receive mechanical tests to prove that the material has received proper heat treatment in the areas of

highest stress in the vessel where cracking could occur. However, the ASME declined to make the requested changes to material and thickness requirements specified in the CSB recommendation because the NDK vessel which exploded and which prompted this recommendation, could not be certified to the existing ASME Code SA-723 steel requirements. In addition to the fact that no justification was provided for changing the material and thicknesses, the current thickness requirements are informational only as noted by the word “typical” and, thus, not requirements.

C. Board Analysis and Decision

Based on the above actions taken by the ASME, the Board voted to change the status of CSB Recommendation No. 2010-04-I-IL-R1 to: “Closed—Acceptable Alternative Action.”