Development of Guidelines on Brittle Crack Arrest Design  
- Brittle Crack Arrest Design for Large Container Ships -1 -

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**ABSTRACT**

Brittle fractures of the hull structure cause serious structural damage, with the potential for both fatalities and environmental damage, once it happens. In recognition of this, ships are designed and constructed so as to ensure that brittle crack initiation does not occur. Further, if by chance a brittle crack is initiated, it is essential that a back-up brittle crack arresting function has been included in the ship’s construction in order to ensure structural reliability and hull integrity.

However, recent studies and large-scale crack arrest test results have suggested that the present requirements for brittle crack arrest may not be effective for the extremely thick steel plates which have recently begun to be used in the construction of large container ships (Yamaguchi, et al., 2006). In order to address these concerns, comprehensive research has been carried out on brittle crack arrestability from a number of different perspectives, including the use of both numerous large-scale crack arrest tests and numerical calculations. The introduction of brittle crack arrest concept in addition to brittle crack initiation control makes it possible to achieve “double integrity” by preventing both brittle crack initiation and propagation.

This research was conducted by the Brittle Crack Arrest Design Committee of Nippon Kaiji Kyokai (ClassNK) and the results have been summarized and incorporated in ClassNK “Guidelines on Brittle Crack Arrest Design” (Nippon Kaiji Kyokai, 2009).

**KEY WORDS:** Brittle crack arrest design; large container ships, extremely thick steel plates; K_{c,r}; brittle fracture; large-scale crack arrest tests

**INTRODUCTION**

In addition to the globalization of markets and the continuous increase of maritime transport volumes on a global scale, the need to reduce both environmental burdens and operating costs have led to increased demand for larger and higher performance vessels. This is especially noticeable with regards to the increased size of container ships, and large container ships in the 10,000TEU class are now being constructed worldwide.

Figure 1 shows an overview of the strength deck structure of a container ship, i.e. the hatch side coaming, strength deck, sheer strake, and the uppermost strake of the longitudinal bulkhead. For container ships, the hull girder strength must be ensured by using a limited number of longitudinal strength members because of the large openings in the strength deck. Therefore, thick steel plates are used for the strength deck structures. In particular, extremely thick steel plates