FIRE ENDURANCE TEST OF BULKHEAD ASSEMBLY

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FIRE RESISTANCE TEST OF BULKHEAD PANELS

INTRODUCTION

A bulkhead assembly was subjected to a standard fire test to determine its suitability for approval by the U. S. Coast Guard for use on merchant vessels. The joint and mounting assembly has been designed to allow for thermal expansion of the members. The unexposed surface temperatures remained within the specified limits for over 19 minutes and the specimen retained an effective barrier to flame passage for the full 60 minute test period.

1. INTRODUCTION

At the request of the U. S. Coast Guard (letter of 26 September 1957), a bulkhead specimen was subjected to fire test in compliance with subpart 165.600-3(b) of specification for Bulkhead Panels for Merchant Vessels.

2. TEST SPECIMEN

The specimen was submitted by, and shipped from, the Nippon Zelotes Co., Ltd., Tokyo, Japan. It bore two labels which read: 1) Test No. 6400, marine board 60-3 (test sample) and, 2) Test No. 6400, 6 ft x 6 ft x 7/8 in. (test sample). The specimen was received completely assembled and ready for placement in the furnace test frame. Therefore, the description is based primarily on examination after test. The bulkhead material was a hard white smooth-finished board that appeared to be a
cement-asbestos material. No attempt was made to establish
the composition further. The board was in two pieces, one
17 in. and the other 30 1/2 in. wide, both 7/8 in. thick.
The thickness was determined along an edge protected by
the mounting details. The thickness over most of the
specimen had been reduced to as little as 5/32 in. as a
result of the fire exposure. The two pieces of marine
board were in a frame made up of four lengths of 0.072 in.
thick sheet steel formed into 1 in. deep channel sections
with the sheet bent back 1/2 in. inside each lip of the
channel. The width between these turned back edges was
such that the marine board fit between snugly. The two
pieces of board were supported along the joint between
them by a joint member made up of two T-section pieces
bolted together into an -section. The pieces were of
0.064 in. thick steel and were held together by five 1/4 in.
bolts, at about 18 in. on. The flanges of the T-section
(or tops of the individual T-section pieces) were 2 9/16
in. across and the space between flanges was such that the
marine board fit between snugly. The top and bottom ends
of the T-section and vertical channel sections along
the sides fit into the horizontal channel sections across
top and bottom of the marine board. The vertical members
were welded to the top channel but merely fit into the
bottom one to a distance of about 1/2 in., thereby
leaving about 7/16 in. allowance for thermal expansion
of the vertical members. The bottom channel was welded
to an assembly of 1/4 in. steel plates to form a part of
the system for mounting the specimen in the test furnace.
Details of the test specimen are shown in figure 1.

3. TEST SETUP

The specimen was mounted in the center opening of a
three-opening test frame, each opening being about
6 ft 2 in. high by 4 ft 2 in. wide. Care was taken that
the overall specimen was restrained against vertical
movement or expansion, so that the only relief for thermal
expansion would be that provided for by the design and
fabrication of the specimen. Eight thermocouples were
placed on the unexposed surface of the specimen, three on
the metal joint member and the other five distributed on
the sides of the two marine board panels. A 6-x 6-x 0.1 in.
sealed asbestos pad was placed to cover the junction and
several inches of the wires of each thermocouple. The
furnace fires were controlled to produce temperatures as
close as feasible to those defined by the standard time-
temperature curve of A359 E-119, which include: 1000°F
at 5 min, 1300°F at 10 min, 1550°F at 30 min, and 1700°F
at 1 hr. The furnace temperatures were indicated by self-
balancing potentiometers connected to thermocouples, which
were encased in porcelain insulators and iron pipes, in
the furnace chamber.

4. RESULTS

The fire test was conducted November 25, 1957. In
addition to personnel of the US Fire Protection Section,
the following were among those witnessing the test:

L. Coluccello, Lt., USCG, Washington, D. C.
S. Shima, Nippon Asbestos Co., Tokyo, Japan

The point on the exposed surface of the joint
member was blistered in the first few minutes and that
on the unexposed surface darkened by 1 h. By 32 min
there was some slight wrinkling of the exposed surface
joint member in the top 3 ft, and the center of the
specimen had bowed 0.3 in. from the fire. By 19 min
there was a noticeable bulge in the sides marine board
panel, and the specimen center deflection had increased to
0.6 in. This deflection increased to about 0.9 in. by the
end of the 60 min test period.

The fire exposure severity was 101.3 percent. Flames
did not pass through the specimen at any time. An 250 degree
F rise of the unexposed surface average temperature was
reached at 19.9 min on the marine board and 7.9 min on the
joint member; one-point rises of 325 degrees F at 23.9
min and 8.6 min on the marine board and joint member, re-
spectively.
The results of the test indicated that the particular marine board panel had resistance to heat transmission sufficient to keep the unexposed surface temperatures within the allowed limits for over 19 min. The combination of marine board, joint member, and mounting system, including provisions for thermal expansion, was such that the specimen remained an effective barrier to the passage of flame throughout the 60 min test period.
Figure 1. Construction details, thermocouple locations on unexposed surface, and time-temperature curves.