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# Evaluation of Volumetric Efforts for Galley Cart Fire Containment Criteria

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# EXECUTIVE SUMMARY

Galley carts and waste compartments are required by Federal Aviation Regulations (FAR) 25.853e to be constructed such that any normal type fire would be contained within the cart/compartment. In some cases full-scale tests are required to show compliance; however, other cases are approved based on similarity to a cart already tested. The tests reported in this document were designed to determine the effect of volume when based on similarity.

Tests were conducted with three different size galley carts having the same ventilation area. Internal compartment temperature and weight loss were monitored. The results showed that the volume had little effect on the fire, when the fire was ventilation controlled.

# INTRODUCTION

## PURPOSE.

Tests were conducted to determine the effect of volume on the fire containment of "similar" galley carts.

## BACKGROUND.

Galley carts and other waste stowage compartments must meet the requirements of Federal Aviation Regulations (FAR) 25.853e. "Each disposal receptacle for towels, paper, or waste must be fully enclosed and constructed of at least fire resistant materials, and must contain fires likely to occur in it under normal use. The ability of the disposal receptacle to contain those fires under all probable conditions of wear, misalignment, and ventilation expected in service must be demonstrated by test." In order to limit the number of full-scale tests, carts/waste containers can be approved based on "similarity." Although similarity leaves a wide range of interpretation, advisory material defines a similar cart or container as one that (1) is constructed of the same materials (thicknesses must be equal or greater), (2) has equal or less leakage area, and (3) has equal or less volume.

# DISCUSSION

## TEST DESCRIPTION.

In order to study the effect of volume, three similar carts were constructed. The top, bottom, front, and back were thin steel, and the two sides were made of a fiberglass faced, 1/4-inch, Nomex™ honeycomb composite, finished with Tedlar™. The leakage area and construction materials were the same for each of the carts with only the volume being varied (refer to figure 1). The cart set as the standard was 34 inches high, 13 inches wide, and 18 inches deep. The other two carts were the same height and width, with one 24 inches deep and the other only 12 inches deep. The leakage area was simulated by 0.25- and 0.5 inch diameter holes drilled as shown in figure 1.

The fire load for each of the carts was shredded newspaper. The paper filled the carts 3/4 full and was comprised of the following weight:

12-inch cart --- 4.5 pounds
18-inch cart --- 6.75 pounds
24-inch cart --- 9.0 pounds

The ignition source for all tests was a 6-foot length of nichrome wire wrapped around a sheet of newspaper, remotely activated. Temperatures were monitored in the cart, above the fire load, using three evenly spaced thermocouples. For the first three tests, a thermocouple was inserted 1 inch into the fire load from the front face approximately 4 inches down from the top. During the final three tests, the cart was mounted on a load cell and weight loss was monitored. The cart was sealed, except for the leakage holes, prior to the start of all the tests. The fire was remotely ignited and the cart monitored for at least 90 minutes. A total of six tests were conducted, two with each size cart.

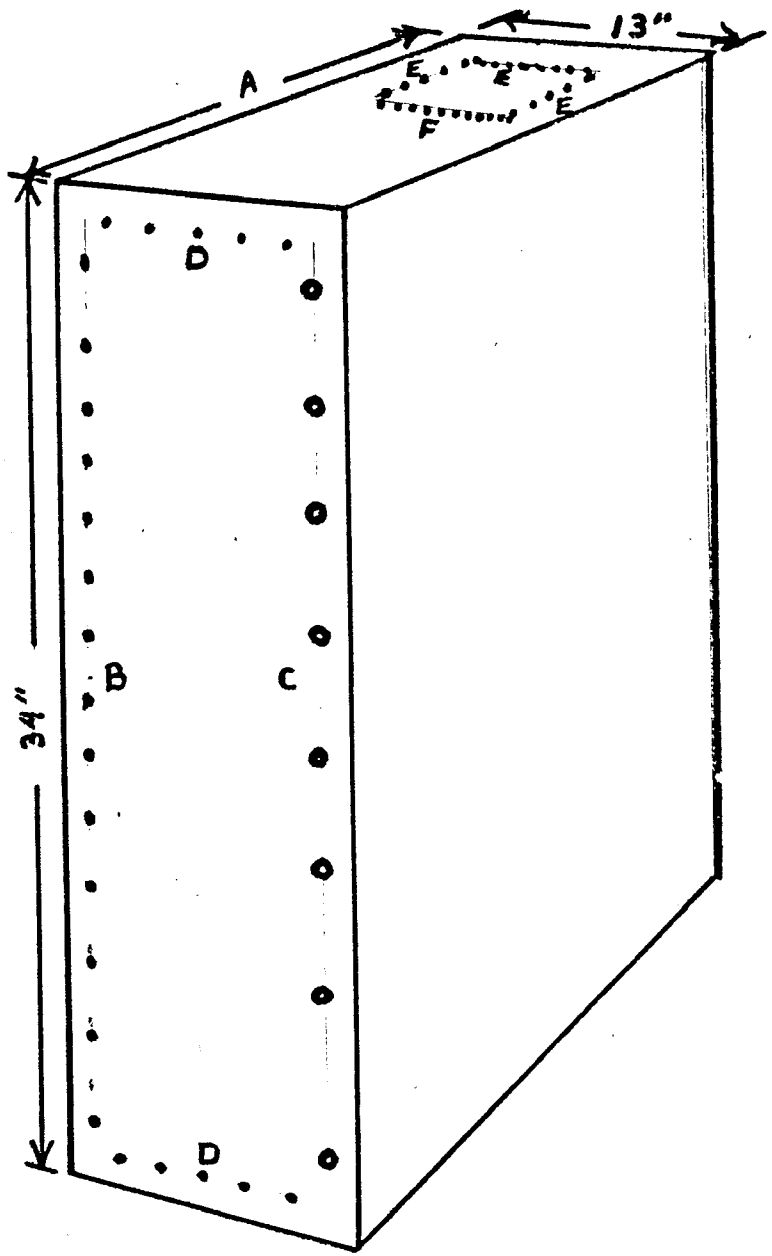
TEST RESULTS.

The highest recorded temperature above the fire load for all six tests is plotted in figure 2. The two tests with the highest temperatures were the largest and smallest carts. The lowest temperatures were also tests of the largest and smallest carts. Even though there was a controlled ignition source, each fire was a little different. The randomness appeared to be due to the nature of fire and not related to the volume of the container. Visual observations indicated that there was more flaming combustion during the first few minutes with the larger volumes. This is also seen in figures 3, 4, and 5. Note the tight grouping of the temperatures (between 400 and 500 $^{o}$F) in the 12-inch cart (figure 3). With the 18-inch cart, one area showed temperatures above 800 $^{o}$F (figure 4); and with the 24-inch cart, two areas showed elevated temperatures (figure 5). For all tests the fire was seen to progress down the front of the fire load adjacent to the leakage holes. Figure 6 shows the temperature rise for the thermocouple located in the fire load 1 inch from the front of the cart.

Figure 7 shows the weight loss for the last three tests (one of each size). It shows no relationship between the volume of the cart and the burning rate. The burning is controlled by the ventilation rate and randomness of fire. In none of the tests did the fire burn through the container or ignite the outer facing.

## CONCLUSIONS

Although initial fire size can be volume dependent, overall temperatures, burning rate, and fire growth are ventilation controlled for compartments of the size tested. That is to say, varying the volume up or down (within the range of volumes tested) should have little effect on fire containment of a cart as long as the ventilation rate through the cart is not increased.




CART #1 A= 18 inches
CART #2 A= 24 inches
CART #3 A= 12 inches

B= 14 .25D Holes - air gap of 443mm$^2$
C= 8 .5D Holes --- air gap of 1013mm$^2$
D= 5 .25D Holes -- air gap of 158mm$^2$
E= 5 .25D Holes -- air gap of 158mm$^2$
F= 11 .25D Holes - air gap of 348mm$^2$

FIGURE 1. GALLEY CART CONSTRUCTION

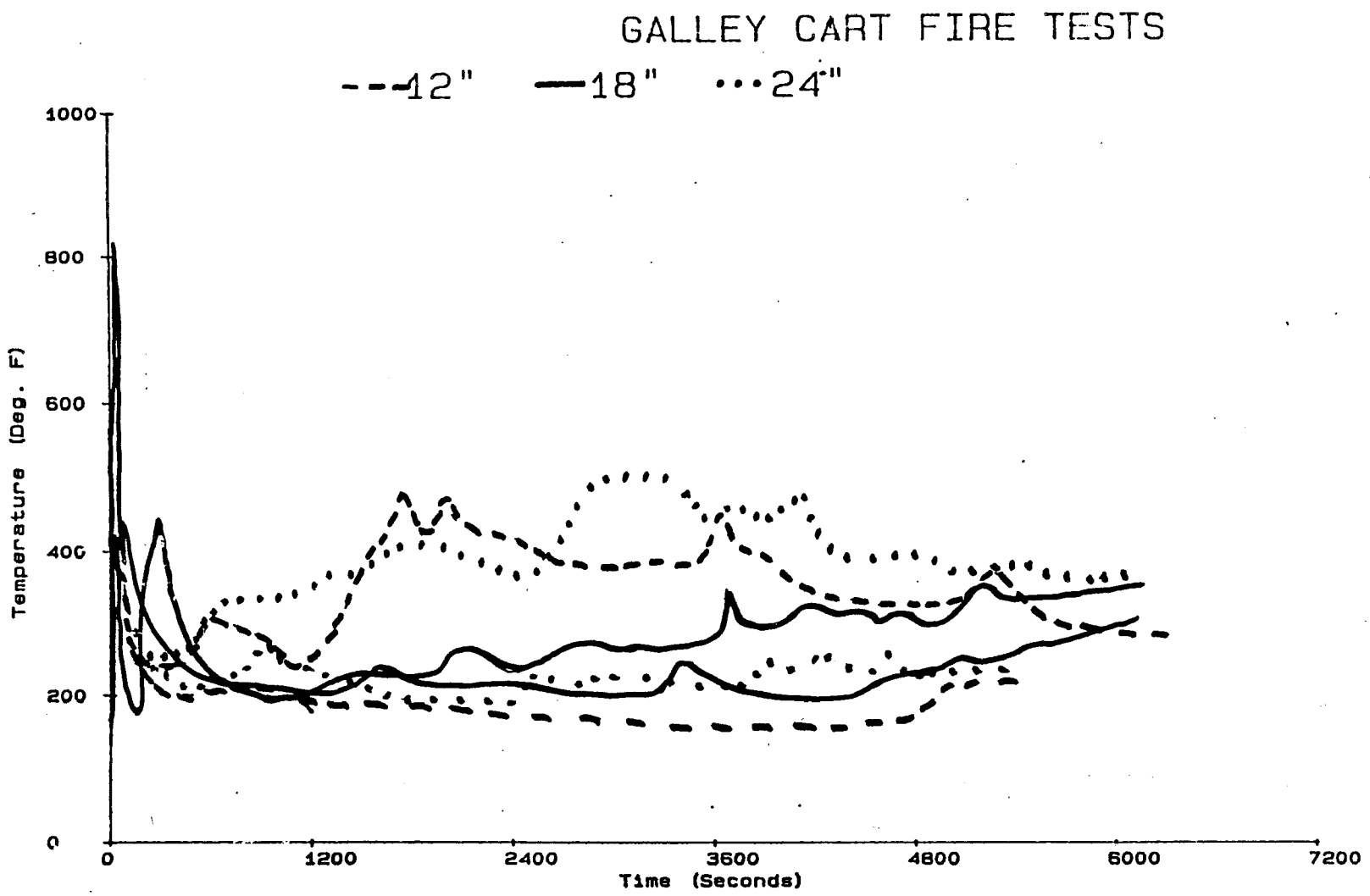



FIGURE 2. TEMPERATURE COMPARISONS

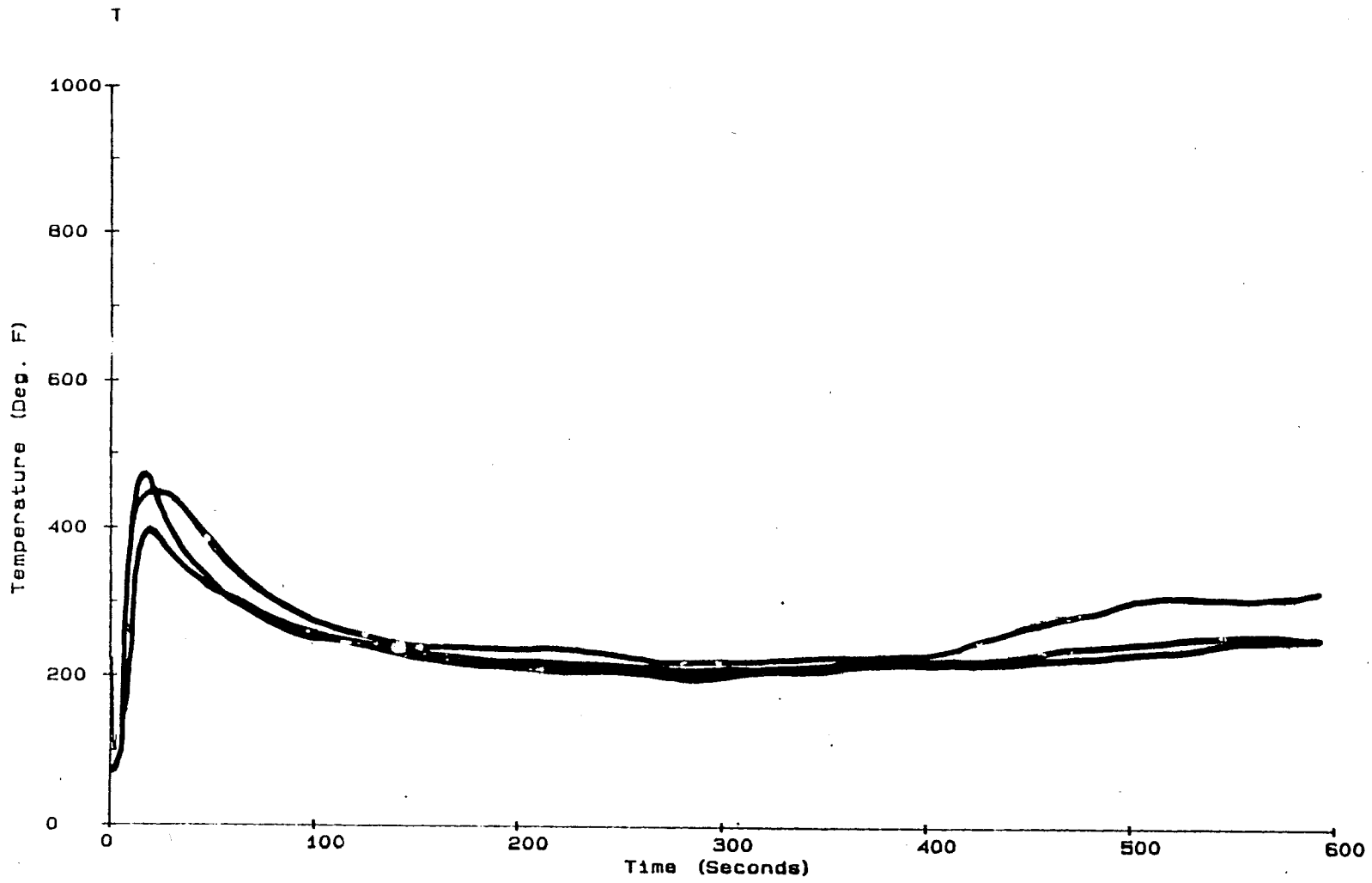



FIGURE 3. TEMPERATURE PROFILE FOR 12-INCH CART

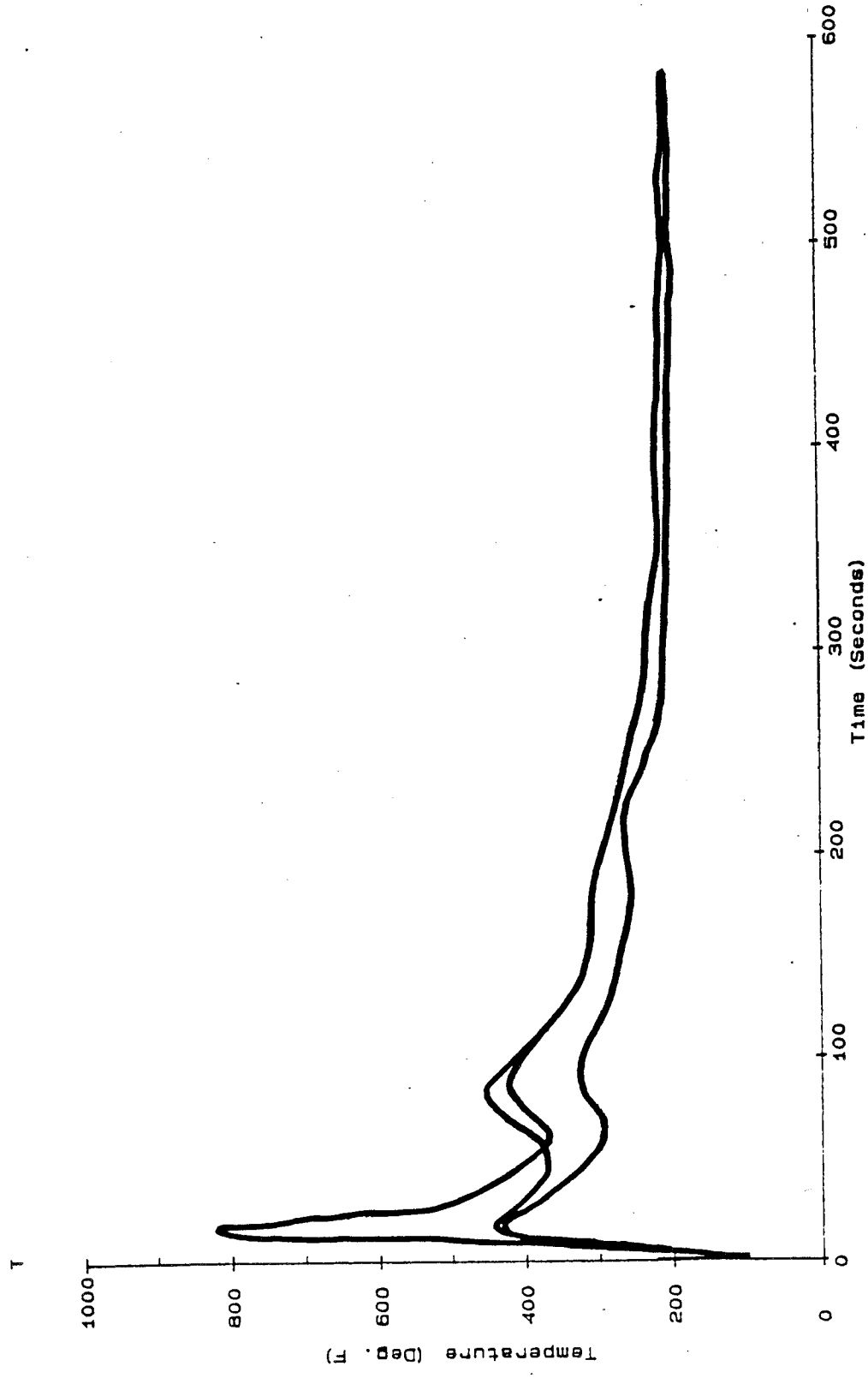



FIGURE 4. TEMPERATURE PROFILE FOR 18-INCH CART

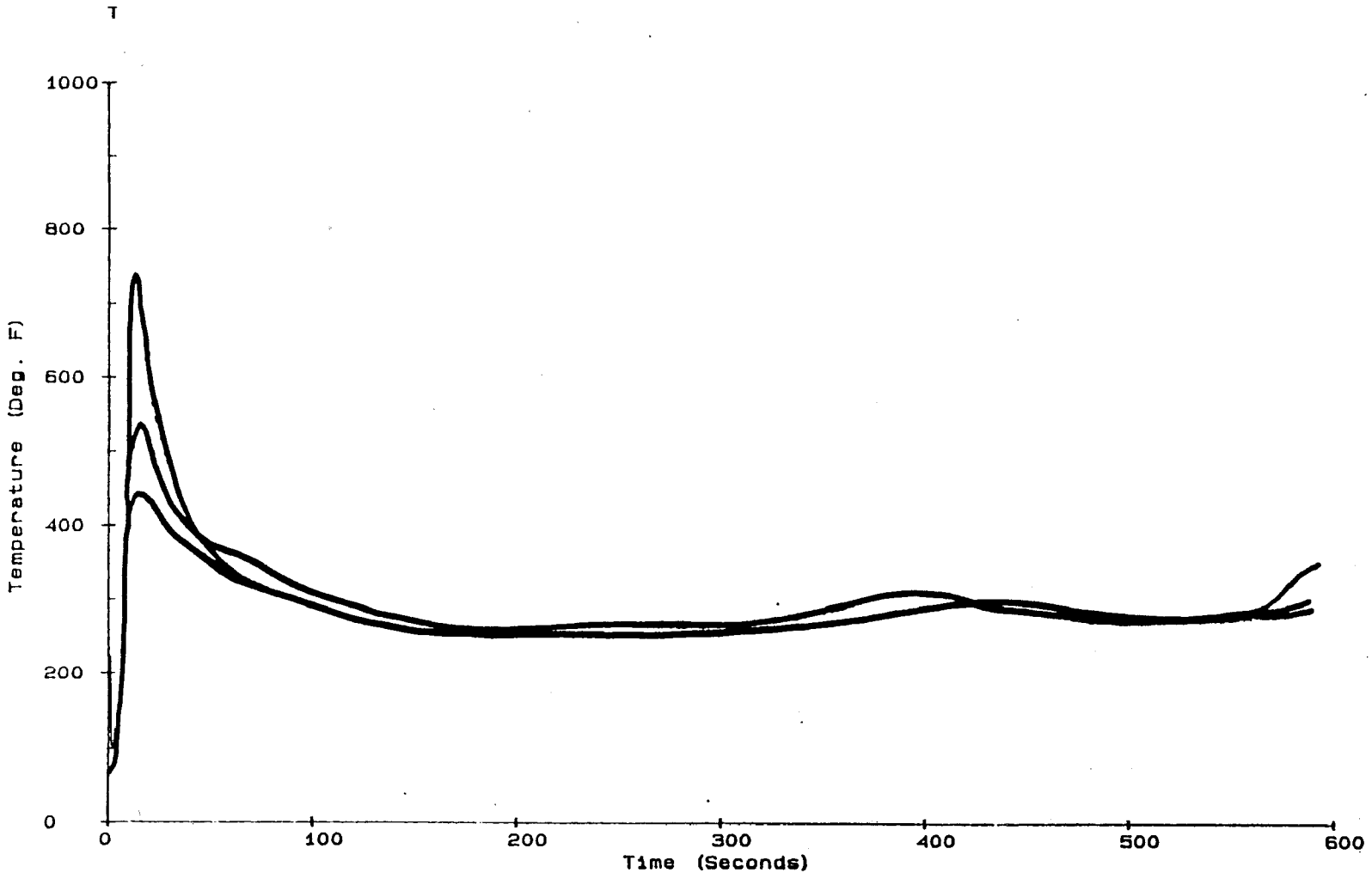



FIGURE 5. TEMPERATURE PROFILE FOR 24-INCH CART

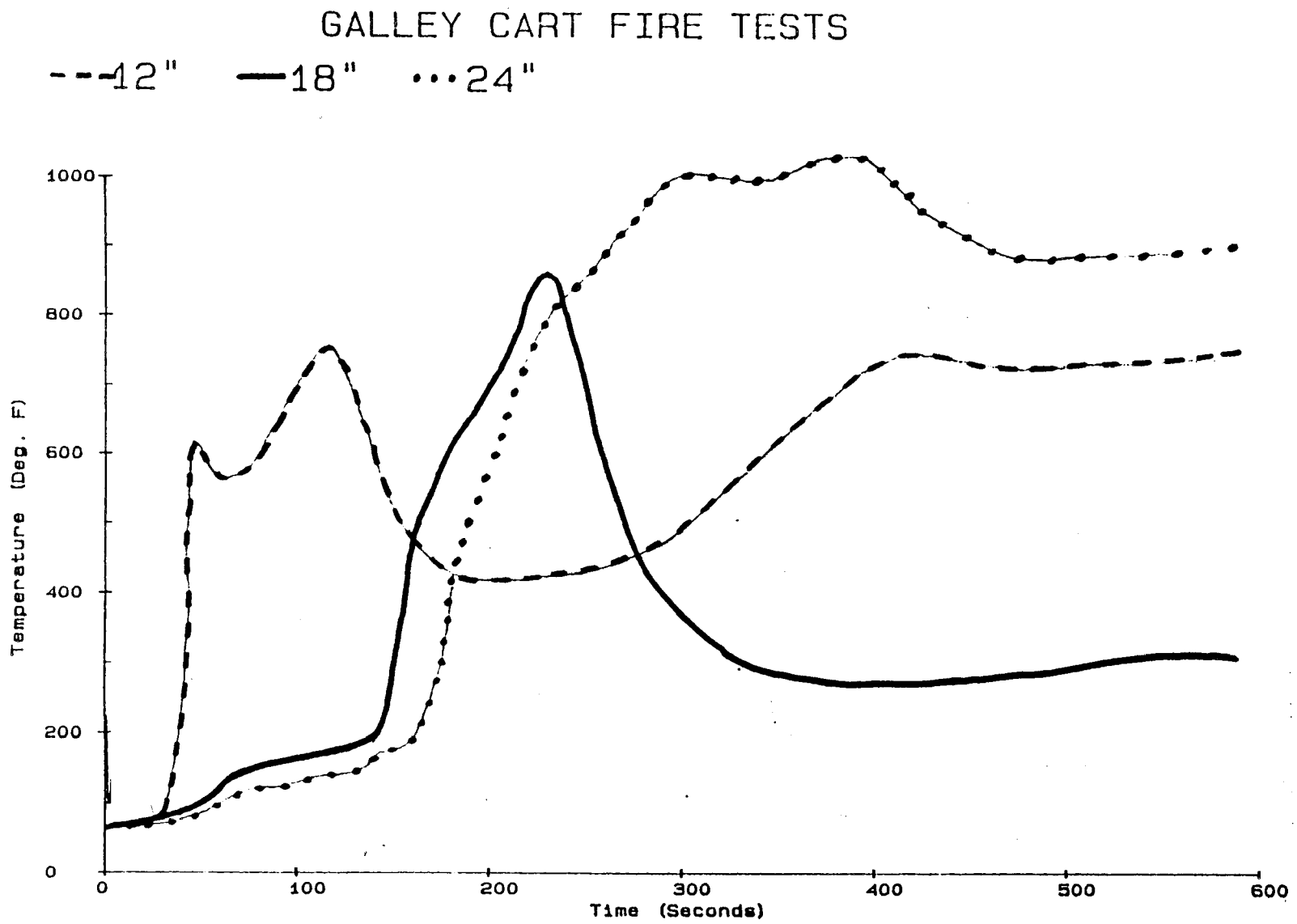



FIGURE 6. TEMPERATURES IN FIRE LOAD 1-INCH FROM FRONT FACE

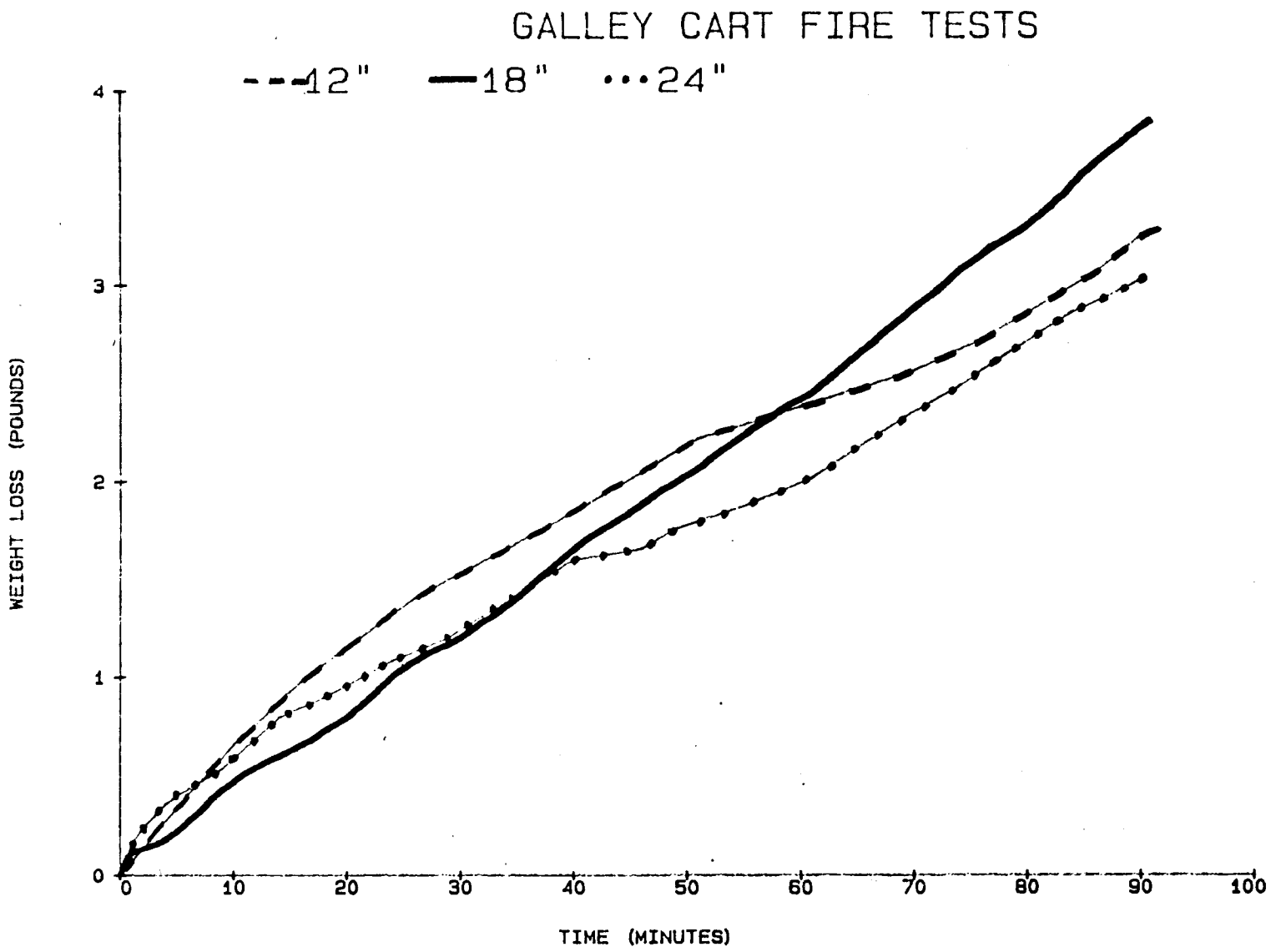



FIGURE 7. WEIGHT LOSS COMPARISONS FOR THREE SIZE GALLEY CARTS