

Chapter 10

Fire-Containment Test of Waste Stowage Compartments

10.1 Scope

10.1.1 These methods are intended for use in determining the fire containment capability of containers, carts, and compartments used to store combustible waste materials according to the requirements of 14 CFR 25.853(h) through Amendment 116.

10.1.2 Parts construction used for the top, bottom, and sides of these compartments must meet the requirements of 14 CFR 25.853 and 14 CFR 25.855. These tests are covered elsewhere in this handbook in chapter 1, Vertical Bunsen Burner Test for Cabin and Cargo Compartment Materials, chapter 2, 45-Degree Bunsen Burner Test for Cargo Compartment Liners and Waste Stowage Compartment Materials (see 10.2.11 for applicable materials), and chapter 4, 60-Degree Bunsen Burner Test for Electrical Wire.

10.1.3 There are multiple test arrangements covered in this specification: Entree Carts, Meal Carts, Waste Carts, and Waste Compartment Meal Boxes (see **Table 10-1** for meal boxes). (Note: Industry regularly interchange the terms ‘cart’, ‘trolley’ and ‘trolley cart’.)

Table 10-1. Meal box test arrangements

Equipment Description	Meal Box Stowed in Open* Galley Compartment	Meal Box Stowed in Enclosed** Galley Compartment	Meal Box Stowed in Open* Cart	Meal Box Stowed in Enclosed** Cart
Metallic meal box, complete enclosure	No test required	No test required	Test meal box within cart compartment	Test Cart
Metallic meal box, incomplete enclosure	Uncertifiable for waste storage	Test meal box within the compartment	Uncertifiable for waste storage	Test meal box within cart compartment
Nonmetallic meal box, complete enclosure	Test meal box (unstowed)	Test meal box (unstowed)	Test meal box within cart compartment	Test cart compartment with and without meal box
Nonmetallic meal box, incomplete enclosure	Uncertifiable for waste storage	Test meal box within the compartment	Uncertifiable for waste storage	Test cart compartment with and without meal box

* Open compartment/cart is a compartment/cart with volume surrounded by panels on less than 6 sides.

**Enclosed compartment/cart is a compartment/cart with the volume completely surrounded by panels/doors on all 6-sides.

10.2 Definitions

10.2.1 Air Ducting

Air ducting is used for conveying chilled air to and from carts.

10.2.2 Waste Cart/Trolley

An enclosure on wheels that provides a means of accumulating and/or storing waste.

10.2.3 Meal Cart/Trolley

An enclosure on wheels used to store food and used or unused service trays that might contain waste.

10.2.4 Entree Cart/Trolley

An enclosure on wheels used to cook or store food at elevated temperatures and transport/store unused or used food service trays that might contain waste.

10.2.5 Integral Floor

The bottom panel of a waste compartment. It is a component of the galley/cart waste compartment. It is not the aircraft floor panel.

10.2.6 Waste Compartment (Galley or Lavatory Module)

An enclosure or shell structure with access provisions, such as a waste chute opening or doors, designed for the purpose of accumulating or storing waste.

10.2.7 Waste Container

A removable receptacle stored within a waste compartment or waste cart designed to accumulate or store waste within the compartment or cart.

10.2.8 Meal Box

A removable enclosure located in a meal trolley or galley compartment used to store food and used or unused service trays that might contain waste.

10.2.9 Split Line

A separation between two panels to facilitate the assembly of a panel that is too large to fit through the aircraft door. It is common to assemble lavatory and galley components on the airplane. Split lines can occur between waste compartment panels.

10.2.10 Misalignment

Misalignment generally refers to maximum air gaps, maximum seal interfaces, minimum overlaps, etc., allowed by drawing tolerances. Misalignment must be simulated during testing because with repeated waste receptacle handling, seals are unlikely to remain airtight. Misalignment may be represented during the test by using shims per paragraph 10.4.2 to support the door opening representing the allowable tolerance in the design drawings.

10.2.11 Waste compartment/trolley materials/components applicable to the 45-degree Bunsen burner test (see chapter 2 in the Fire Test Handbook)

10.2.11.1 Panels and substrates that make up the ceiling and vertical walls (test side to represent internal surfaces with applicable finishes- external finishes on the non-test side are optional.).

10.2.11.2 Sealant*/seals or other materials used to fill gaps that create a barrier to exit the waste compartment or trolley. [Recommend testing actual parts or 10 in x 10 in (254 mm x 254 mm) rubber sheet or sealant plaque at thickness of seal/sealant. Actual parts can be mounted in an applicable design gap or tested independently if wide enough to clearly view the results- minimal flame wrap around.]

10.2.11.3 Waste containers installed in compartments that require waste containers to be installed for flight. (Typically placarded that the waste container must be installed for flight)

*Note: Panel joints such as mortise and tenon, tab & slot, T-joints, etc. (with or without sealant applied) do not require compliance to the 45-degree Bunsen burner test requirements.

10.2.12 Electronic Touchless Waste Flap

Motorized waste flap that is activated by waving the hand above the top of the waste flap.

10.3 Test Apparatus/Equipment

10.3.1 Thermocouple(s)

A thermocouple is required to monitor internal test unit temperature. [Recommend Type K (30-gauge, sheath diameter 1/16th-inch, exposed junction) to ensure peak temperature is captured.]

10.3.1.1 The thermocouple used for meal or entree carts must be installed 1.5 in (38.1 mm) to 2 in (50.8mm) above the top-most tray. A second thermocouple must be placed on the bottom tray in a similar manner.

10.3.1.2 For waste compartments/carts, a single thermocouple is inserted through the waste flap and placed 1.5 in (38.1 mm) to 2 in (50.8mm) above the waste combustibles surface. It is additionally acceptable to drill a hole and apply aluminum tape or insert through an existing hole (e.g., lavatory waste compartment fire extinguisher hole).

10.3.2 Thermocouple Readout/Recording

Connect thermocouple(s) to a system that is capable of providing continuous temperature readings. A recording system will be used so that temperatures can be recorded continuously or at intervals not exceeding 1 second.

10.3.3 Galley

Galley structure is used to simulate the interface needed for the stowed cart test arrangements.

10.3.3.1 The galley structure will be equipped with power outlets and air inlet/outlet ducting to circulate ambient air at the design-specified airflow to the cart when set up to conduct testing.

10.3.4 Waste Materials

10.3.4.1 Combustibles

[Store in a conditioned area 24-hours prior to test. An air-conditioned office environment is acceptable as it limits high humidity and extreme heat/cold conditions. Combustible material sizes vary by country and region- similar sizes to those noted below are acceptable.]

10.3.4.1.1 The meal cart arrangement includes the following combustibles:

- One set of plastic eating utensils
- One cup
- One salad dish
- One salad dressing container
- One entree dish
- One dessert dish
- One crumpled 2-ply paper napkin, approximately 16 in x 16 in (406.4 mm x 406.4 mm)

The trays, each loaded with the above combustibles or equivalent representative materials found in service, will be inserted into the cart so that 75 percent of the trays are loaded in the cart starting from the bottom.

10.3.4.1.2 For the entree cart test arrangement, combustibles will consist of the same items per tray as for the meal cart for the stowed test. For fire source, the bottom tray will have an entree dish half filled with methyl alcohol to simulate grease. The

napkin will not be located near the alcohol source. For the unstowed test, treat the entree cart as a meal cart.

10.3.4.1.3 For the waste compartment/waste cart, combustibles must be crumpled in a similar fashion as shown below and each set of materials must be randomly added to the test unit until reaching the applicable 75 percent fill line. Each set must be comprised of materials (or equivalent) in the following proportions:

- Eight 2-ply paper and towels, approximately 10 in x 11 in (254 mm x 279.4 mm) (40 percent by number)
- Five 2-ply paper napkins, approximately 16 in x 16 in (406.4 mm x 406.4 mm) (25 percent by number)
- Five 8-ounce (236.6 mL) paper hot drink cups (25 percent by number)
- Two 3-ounce (88.7mL) paper cold drink cups (10 percent by number)

Trash Density- Recommend crumpling trash materials similar to as shown:



Figure 10- 1 Representative Trash Crumpling

10.4 Test Unit

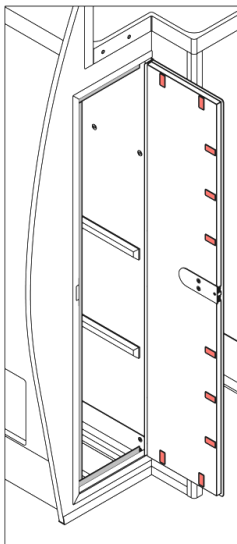
10.4.1 The unit to be tested will be equivalent to an actual production unit, built to drawing specifications and tolerances. [External finishes or placards may be omitted]

10.4.2 Shimming: Test units may need to be shimmed to ensure worse-case drawing tolerances

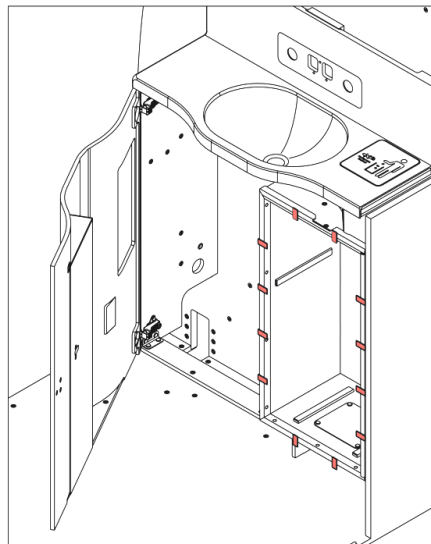
- Shims must be approximately 1x 0.5 x {thickness} inches [25.4 x12.7 x {thickness} (mm)]. Shim thickness is determined by worse case drawing tolerances for proposed air gaps. Shimming guidelines (as applicable):
 - Door/Drawer- Shims must be at least 1 in (25.4 mm) from corners and latches with 5-10 inches (127-254 mm) between shims

- Waste flap- 2 shims on the sides or 1 shim centered on the side opposite the hinged side
 - All shims must be placed with the 0.5 in (12.7 mm) width inserted into the gap to be shimmed.
 - Door seals do not need shimming if shown that the compressed seal creates a 'zero' gap AND the seal material meets the 45-Degree Bunsen Burner Test for Cargo Compartment Liners and Waste Stowage Compartment Material (chapter 2 of Fire Test Handbook).
 - No shims are required for features such as access panels if the access panel overlaps the compartment panel by a minimum of 0.5 in (12.7 mm) all around.
 - Do not shim sealed split line features. Shim non-sealed split line features per maximum gap on drawing
 - Aluminum tape has been shown to be an acceptable solution for mounting shims and the thickness of the tape may be figured into the overall shim thickness.
- The test plan must define shim placements.
 - Shim placement tips: **Figure 10-2** below shows shimming examples with a nested door (door that closes flush with the door surround panels), overlapping door and a door with trims that overlap the door surround panels.

Nested Doors:
Place shims on door



Overlapping Door:
Place shims on surround panels



Door Trim overlaps
surround panels:
Place shims on surround panels

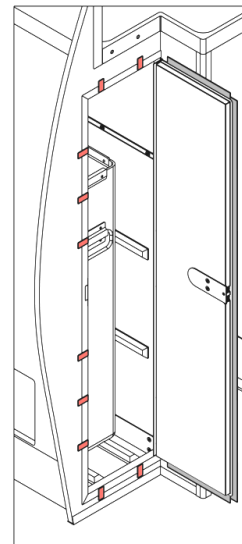


Figure 10- 2 Shimming Examples

10.4.3 A statement of conformity will be obtained for each test unit prior to testing.

10.4.4 Panel Joint Sealant

Many waste compartments/trolleys specify a sealant (usually silicone sealant) to be applied to all panel-to-panel joints. Such compartments must be tested without the sealant in the joint (worse-case for potential ventilation through the joint), but with a representative bead of sealant applied next to the joint [within 1-2 inches (25mm-50mm) from the joint] to represent the fire load in the compartment/trolley. All sealant beads must terminate within 1-2 inches (25mm – 50mm) to the next panel interface. Only one bead of sealant is required per joint. Test plans must note the surfaces requiring this bead of sealant.

Note - this does not apply to adhesive fillets using the same adhesive as used to bond the panels together.

10.4.4.1 Vertical joints - Apply one bead on either vertical panel (see **Figure 10-3**)

10.4.4.2 Horizontal joints (floor/sidewall & ceiling/sidewall) - for ease of application apply sealant bead on the applicable sidewall panel. (see **Figure 10-3**)

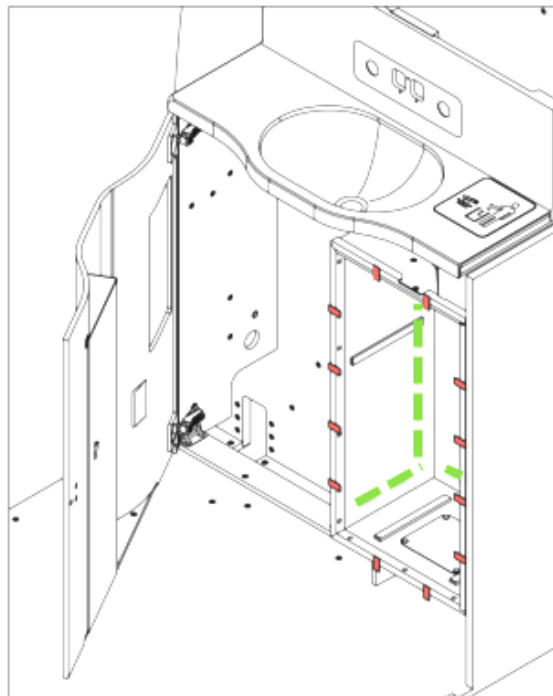


Figure 10- 3 Sealant Application

10.5 Test Arrangements

10.5.1 Meal Cart Test Arrangements

10.5.1.1 The unstowed meal cart arrangement requires a condition where the cart is tested in a freestanding position. Photographs (refer to paragraph 10.6.3) will show the door with the chilled air duct interfaces (if applicable).

10.5.1.2 Stowed Meal Cart

The stowed meal cart test arrangement requires the cart be installed in the galley cart compartment with the air inlet/outlet openings connected to the air ducting. During the test, air is to be circulated through the cart at the design flow rate. Unless another value is justified, a standard flowrate of 65 (+0, -10) cfm is recommended. To simulate the cart/galley interface, photographs of the meal cart should be taken from the side to show the cart vendor. The maximum cart/galley misalignment will be reproduced during the test.

10.5.2 Waste Cart Arrangements

Testing both with and without the waste container is required if the waste container is nonmetallic. The waste cart interface with the galley (i.e., galley waste flap and waste chute) is also required to be simulated if the waste chute enters the cart enclosure and/or keeps the cart waste flap open.

10.5.2.1 An unstowed waste cart (waste container not installed) test arrangement requires a freestanding position at room temperature and still air. Photographs must be taken showing the cart door and flap.

10.5.2.2 An unstowed waste cart (waste container installed) test arrangement requires that the cart be in a freestanding position, per paragraph 10.5.2.1, with the waste container installed.

10.5.2.3 A stowed waste cart (waste container not installed) test arrangement requires that the interface of the galley structure with the cart be simulated. The cart will be stowed in a galley mockup that completely simulates the galley/cart interface. Photographs must be taken that clearly show the waste chute/waste cart interface and the cart door during the test.

10.5.2.4 The stowed waste cart (waste container installed) arrangement is equivalent to 10.5.2.3, except that a waste container is installed.

10.5.3 Entree Cart Arrangement

10.5.3.1 An unstowed entree cart test arrangement requires that the cart be tested in a freestanding position at room temperature and still air.

10.5.3.2 A stowed entree cart test arrangement requires that the cart be connected to the galley power and, if applicable, air ducting outlets. Power will be supplied to the cart for the duration of the test. All heaters and fans will be switched on with any timers set to the maximum duration. If the cart receives air from the galley ducting when the power is switched off, then a third test (stowed meal cart test arrangement) is required.

10.5.4 Waste Compartment Arrangements

10.5.4.1 The only condition in which waste compartments without an integral bottom or base panel are to be tested is with the waste container installed within the waste compartment. If a type design liner is used within the waste container, the test will be conducted both with and without the liner installed (trash bags are not considered liners). Ambient condition will be room temperature and still air. Photographs will show the compartment door and the waste flap.

10.5.4.2 Waste compartments may be tested without a waste container for waste compartments with an integral floor. If the waste container is nonmetallic, then a waste compartment with an integral floor must be tested both with and without the waste container installed. If a type design liner is used within the waste container, the test will be conducted both with and without the liner installed (trash bags are not considered liners).

10.5.5 Meal Box Arrangements

The different types and arrangements of meal boxes that require testing are defined in **Table 10-1**. Meal boxes are to be tested in the same manner as a meal cart (see paragraph 10.6.1.1).

10.5.6 Test Facility

10.5.6.1 The test facility must be relatively draft free. Drafts cause worse-case test conditions and should be minimized. Draft free implies a condition of no air currents in a closed in space.

10.5.6.2 The test unit must be observable from outside the test cell on all sides. May use mirrors, cameras, etc. to observe the back of the tested unit.

10.5.6.3 Recommended (but not required) to test within a chamber with similar dimensions as in **Table 10-2** below to help standardize smoke observations:

Table 10-2. Test Cell Size Recommendations

Test Cell Size	Height (feet/ meters)	Width (feet/ meters)	Depth (feet/ meters)
Minimum	8 / 2.5	10 / 3	10 / 3
Maximum	21 / 6.5	20 / 6	20 / 6

Labs outside this recommendation are acceptable, but still note the smoke rate and color observations per paragraph 10.7.2. Smaller test cells will visually exaggerate total smoke emissions while larger test cells will visually diminish total smoke emissions.

10.6 Procedure

10.6.1 Ignition [start the temperature data logger 10-15 seconds prior to ignition]

10.6.1.1 Meal Cart

10.6.1.1.1 Stowed Meal Cart Test Arrangement

Ignite two crumpled 2-ply paper napkins, approximately 16 in x 16 in (406.4 mm x 406.4 mm) Place them side by side adjacent to the combustibles, defined in paragraph 10.3.4, already in place on the bottom tray the greatest possible distance from the air inlet/outlet openings of the cart. Allow a good flame front to develop by allowing approximately 50 percent of the surface of the waste materials to ignite. Insert the tray into the cart, record the temperature, and close the door. Place the cart into the simulated galley structure so that it is connected with the galley duct/cart interface. See paragraph 10.5.1.2 for airflow recommendations.

10.6.1.1.2 Unstowed Meal Cart Test Arrangement

Ignite two crumpled 2-ply paper napkins, approximately 16 in x 16 in (406.4 mm x 406.4 mm). Place them side by side adjacent to the other combustibles, defined in paragraph 10.3.4, already on the bottom tray. Allow a good flame front to develop by allowing approximately 50 percent of the surface of the waste materials to ignite. Insert the tray into the cart and simultaneously close the door and begin recording the temperature.

10.6.1.2 Entree Cart

10.6.1.2.1 Stowed Entree Cart

Connect the entree cart filled with the combustibles of paragraph 10.3.4.1.2 to the power source and energize all heaters and/or fans. Ignite the methyl alcohol in the entree dish on the bottom tray by placing a burning napkin onto the tray. Insert the tray into the cart, close the cart door, and simultaneously begin recording the temperature.

10.6.1.2.2 Unstowed Entree Cart

Proceed per the unstowed meal cart test configuration of paragraph 10.6.1.1.2.

10.6.1.3 Waste Cart

10.6.1.3.1 Stowed Waste Cart With Waste Container

Ignite a paper napkin and place it in the waste container through the waste flap. Allow a good flame front to develop by allowing 50 percent of the surface of the waste materials to ignite. Close the waste flap and simultaneously record the starting temperature.

10.6.1.3.2 Stowed Waste Cart Without Waste Container

Proceed per paragraph 10.6.1.3.1, except that no waste container is used.

10.6.1.3.3 Unstowed Waste Cart With Waste Container

Proceed per paragraph 10.6.1.3.1.

10.6.1.3.4 Unstowed Waste Cart Without Waste Container

Proceed per paragraph 10.6.1.3.1, except that no waste container is used.

10.6.1.4 For the waste compartment with and without waste container, proceed per applicable waste can arrangement, paragraph 10.6.1.3.1 and 10.6.1.3.2.

Alternatively, Igniting the waste and verifying a 50 percent flame front can be challenging with many compartment designs where line-of-sight through the waste flap is obscured. Following are techniques that may be considered (10.6.1.4.1 & 10.6.1.4.2):

10.6.1.4.1 With Waste Container installed - As an alternate to igniting through the waste flap, opening the waste container access door and partially pulling the trash can out of the compartment to ignite is acceptable. Care must be taken to ensure the back wall of the waste container is not pulled out far enough to disturb the test thermocouple location. After ignition and 50% flame-front observation, push the waste container into place and close the waste compartment door.

10.6.1.4.2 Without waste container installed - As an alternate to igniting through the waste flap, a thin removable barrier can be used to hold the trash in place with the waste compartment door open. Ignite the trash and after the 50 percent flame-front is achieved, simultaneously remove the trash barrier and close the waste compartment door.

10.6.1.4.3 The following test requirements are for waste compartments with electronic touchless waste flaps:

10.6.1.4.3.1 Test with flap powered & controlled- demonstrate flap is functional before the test. Flap shims must not be conductive- or may cause the flap to open.

10.6.1.4.3.2 Video the test showing the flap during the test.

10.6.1.4.3.3 Uncommanded opening during the test is unacceptable.

10.6.1.4.3.4 Validate the flap stays closed for 2 hours after passing the test (after temperature falls below 150°F (66°C))

10.6.1.4.3.5 Touchless waste flap must be able to be operated mechanically whether powered or unpowered (flap may be depressed and return to position to close out waste compartment- essential for firefighting activities)

10.6.1.5 For the meal box, proceed per paragraph 10.6.1.1.

10.6.2 Temperature

The temperature will rise rapidly, peak, and then fall below 150°F (66°C) as the flame dies out. The peak in temperature assists to identify that combustion has taken place, but the primary responsibility of the test witness is to ensure a 50 percent flame front before starting the test. An example of this temperature peak is visualized in the temperature versus time plot shown in **Figure 10-4**. It is common and acceptable to see variations in the time/temperature plot (multiple peaks). If no peak is visible or a good flame front cannot be achieved, the test will be repeated up to three times with replenished trash (see 10.3.4.1) in the same test unit to demonstrate that sufficient effort has been made to produce such a temperature peak or flame front.

The primary purpose for monitoring the temperature is to standardize when the test is completed. When the temperature indicated by the thermocouple falls below 150°F (66°C), the test is terminated and the item examined for damage.

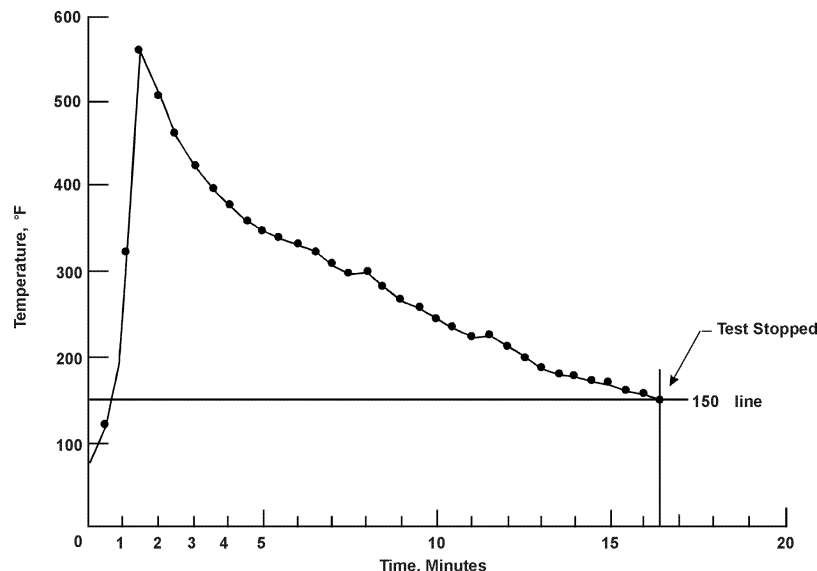


Figure 10- 4 Sample Fire Containment Temperature versus Time Plot

10.6.3 Photographs

Photographs, preferably in color, are required to document the progress of the test. Suggested photographs that may be taken include the test unit before test, test setup, at time of ignition (with door or flap closed), at 30 seconds, 1 minute, 2 minutes, 3 minutes, 5 minutes, 7 minutes, and 10 minutes into the test, and at 5-minute intervals thereafter. Include

detailed photographs showing any damage sustained as a result of the fire. Photographs taken during the test shall have a dark background to show smoke in contrast.

10.6.4 Inspection

After the test has been terminated, the test unit will be inspected for damage. The doors will be opened and the extent of combustion of the waste materials will be noted. Photographs will be taken of these waste materials and any damage to the cart or compartment, or lack of damage. Care must be taken to completely document any damage, from simple smoke stains and melting of trays to major burn through of any panels.

10.7 Report

10.7.1 Identification of Specimen

Completely identify the unit being tested and its intended use, e.g., the test unit's drawing number and revision date or the production part number and serial number.

10.7.2 Description

The results of the test will be described in a concise manner regarding any observable smoke or fire from within the item. Any deterioration, burn through, or deformation of the panels caused by heat or flame will be noted and described along with the time of occurrence. Any damage to the item and/or surrounding structures during the test will be noted. Any damage to the contents will be described, including the degree of combustion of the articles placed within the unit, and damage to trays, seals, etc.

Test photographs will help note qualitative smoke volume and color observations. Gray/white smoke is expected- especially since the test unit is shimmed to allow drawing tolerance ventilation. Thick black smoke is undesirable as it may suggest the test unit walls are combusting.

10.7.3 Temperature Versus Time Plot

A temperature versus time plot may be supplied in the report. An example of a temperature versus time plot is shown in **Figure 10-4**.

10.7.4 Test Photographs

The photographs taken (per paragraph 10.6.3) of the test method will be included with the report. Photocopies of photographs are not acceptable. A short description will accompany each photograph.

10.7.5 Acceptance of Results

A statement as to whether the acceptance criteria are met will be made in the report.

10.7.6 Statement of Conformity

The statement of conformity sheet will be included with the test report.

10.7.7 Summary of Data

A summary may be prepared and included with the test report.

10.8 Requirements

10.8.1 The test unit must be able to contain a fire within the enclosure.

10.8.2 Damage to the waste compartment/container is acceptable provided the waste compartment does not burn through or ignite surrounding materials or no flame issues from the waste compartment or cart.¹

10.8.2.1 Visual observations of the outside of the compartment can demonstrate surrounding materials won't be negatively impacted if the exterior of the compartment panels shows no/minor visible heat damage. Alternatively, thermocouples/temperature tabs in high heat zones may be used to validate.

10.8.3 Damage to carts and contents are acceptable provided the container portion of the cart does not burn through.¹

10.8.3.1 Refer to section 10.8.2.1

¹ Note: Some OEMs/ Product end users may have additional pass/fail damage requirements to consider related to damage that increases compartment ventilation. Ensure these requirements are known in advance of testing. Example: "Flame or heat induced damage to the tested enclosure such as a breakdown of the seal retaining structure causing seal disengagement or excessive door or flap warpage that in the judgment of the test witness could significantly increase the ventilation airflow during a waste fire are unacceptable even when fire escapement did not directly result during testing. Hazardous smoke quantities can result from this type of damage due to increased fire intensity or duration."