

MIL-STD-202G

METHOD 210F

RESISTANCE TO SOLDERING HEAT

1. **PURPOSE.** This test is performed to determine whether wire and other component parts can withstand the effects of the heat to which they will be subjected during the soldering process (solder iron, solder dip, solder wave, or solder reflow). The heat can be either conducted heat through the termination into the component part, or radiant heat from the solder bath when in close proximity to the body of the component part, or both. The solder dip method is used as a reasonably close simulation of the conditions encountered in wave soldering, in regard to radiated and conducted heat. This test also is intended to evaluate the impact of reflow techniques to which components may be exposed. The heat of soldering can cause solder reflow which may affect the electrical characteristics of the component part and may cause mechanical damage to the materials making up the part, such as loosening of terminations or windings, softening of insulation, opening of solder seals, and weakening of mechanical joints.

2. **APPARATUS.**

2.1 **Solder pot.** A static solder pot, of sufficient size to accommodate the mounting board (see 2.4) and to immerse the terminations to the depth specified for the solder dip (without touching the bottom of the pot), shall be used. This apparatus shall be capable of maintaining the solder at the temperature specified. The solder bath temperature shall be measured in the center of the pot at a depth of at least .500 inch (12.7 mm), but no deeper than 1 inch (25.4 mm) below the surface of the solder.

2.2 **Heat sinks or shielding.** The use of heat sinks or shielding is prohibited except when it is a part of the component. When applicable, heat sinks or shielding shall be specified in the individual specification, including all of the details, such as materials, dimensions, method of attachment, and location of the necessary protection.

2.3 **Fixtures.** Fixtures, when required, shall be made of a non-solderable material designed so that they will make minimum contact (i.e., minimum heat sink) with the component. Further, they shall not place undue stress on the component when fixtured.

2.4 **Mounting board.** A mounting board, in accordance with NEMA grade FR-4 of IPC-4101, 9 square inches (i.e., 3 x 3, 1 x 9, etc.), minimum area, .062 inch \pm .0075 inch (1.57 mm \pm .191 mm) thick, shall be used, unless otherwise specified. Component lead holes shall be drilled such that the diametrical clearance between the hole and component terminals shall not exceed .015 inch (0.38 mm). Metal eyelets or feed-throughs shall not be used. Surface mount boards, when specified in the individual specification, shall have pads of sufficient size and number to accommodate the component being tested.

2.5 **Solder iron.** A solder iron, capable of maintaining a temperature of 350°C \pm 10°C, shall be used.

2.6 **Reflow chambers.** The reflow chambers or equivalent (Vapor Phase Reflow (VPR) chamber, Infrared Reflow (IRR) oven, air circulating oven, etc.) shall be of sufficient size to accommodate the mounting board and components to be tested. The chamber shall be capable of generating the specified heating rate, temperatures, and environments.

2.7 **Temperature measurement.** Low mass thermocouples that do not affect the heating rate of the sample shall be used. A temperature recording device is recommended. The equipment shall be capable of maintaining an accuracy of \pm 1°C at the temperature range of interest.

3. **MATERIALS.**

3.1 **Solder.** The solder or solder paste shall be tin-lead alloy with a nominal tin content of 50 percent to 70 percent in accordance with ANSI/J-STD-006, "Requirements for Electronic Grade Solder Alloys and Fluxed and Non-Fluxed Solid Solders for Electronic Soldering Applications" or ANSI/J-STD-005, "Requirements for Soldering Pastes". When specified in the individual specification, other solders can be used provided they are molten at the specified temperature.

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3.2 Flux. When flux is used, it shall conform to type A of ANSI/J-STD-004, "Requirements for Soldering Fluxes", or as specified in the individual specification.

3.3 VPR fluid. A perfluorocarbon fluid that has a boiling point of 215°C shall be used.

4. PROCEDURE.

4.1 Special preparation of specimens. Any special preparation of specimens prior to testing shall be as specified in the individual specification. This could include specific instructions such as bending or any other relocation of terminations, cleaning, application of flux, pretinning, or attachment of heat sinks or protective shielding (see 2.2), prior to the solder immersion.

4.2 Preparation of solder bath. The molten solder shall be agitated to assure that the temperature is uniform. The surface of the solder shall be kept clean and bright.

4.3 Application of flux. When flux is used, the terminations to be tested shall be immersed in the flux (see 3.2), which is at room ambient temperature, to the depth specified for the solder dip. The duration of the immersion shall be from 5 seconds to 10 seconds.

4.4 Test conditions. Unless otherwise specified in the individual specification, the test shall be performed on all solder terminations attached to the component part. There are six types of soldering techniques covered by these test conditions. The test conditions are outlined below and in table I.

Test condition A:	Solder iron - Hand soldering of solder cups, through hole components, tab and post terminations, solder eyelet terminations.
Test condition B:	Solder dip - Simulates hot solder dipping (tinning) of leaded components.
Test condition C:	Wave solder - Simulates wave solder of topside board mount product.
Test condition D:	Wave solder - Simulates wave solder of bottomside board mount product.
Test condition H:	VPR - VPR environment without preheat.
Test conditions I, J, K:	Infrared/Convection reflow - Simulates IRR, natural convection, and forced air convection reflow environments.

4.4.1 Test condition A: Solder iron.

- a. When testing a solder cup, tab and post termination, or solder eyelet termination, the applicable wire size, properly prepared for the solder termination, shall be attached in the appropriate manner.

When testing a board mount component, the component shall be placed on a mounting board (see 2.4).

- b. When specified, the components shall be fluxed (see 4.3).
- c. Unless otherwise specified, a solder iron in accordance with 2.5 shall be used.
- d. The solder iron shall be heated to 350°C ±10°C and applied to the termination for a duration of 4 seconds to 5 seconds as specified in table I. The solder and iron shall be applied to the area of the assembly closest to the component body that the product is likely to experience. For surface mount components, the iron shall be placed on the pad only.

- e. Remove the iron and allow the component to cool and stabilize at room ambient conditions. If flux was used, the component shall be cleaned using an appropriate cleaning solution.
- f. The component shall be visually examined under 10X magnification.

4.4.2 Test condition B: Solder dip.

- a. Place the component in an appropriate fixture (see 2.3).
- b. When specified, the leads shall be fluxed (see 4.3).
- c. The specific combination of temperature, immersion and emersion rate, immersion duration, and number of heats shall be as specified in table I. Unless otherwise specified, terminations shall be immersed to within .050 inch (1.27 mm) of the component body. Terminations shall be immersed simultaneously, if the geometry of the component permits.
- d. After the solder dip, the component shall be allowed to cool and stabilize at room ambient conditions. If flux was used, the component shall be cleaned using an appropriate cleaning solution.
- e. The component shall be visually examined under 10X magnification.

4.4.3 Test condition C: Wave solder - topside board mount component.

- a. The component under test shall be mounted on a mounting board (see 2.4).

Wire leads: Wire leads shall be brought through the board holes and bent at least 30 degrees from a line perpendicular to the board. Leads shall extend from .050 inch to .100 inch (1.27 mm to 2.54 mm) from the bottom of the board. Axial leads shall be bent at a 90° angle at a point between .06 inch and .08 inch (1.5 mm and 2.1 mm) from the body, eyelet fillet or weld unless otherwise specified (see figure 210-1).

Pin leads: Where the component is designed with rigid pin leads, the full length of the termination shall be retained. Pin leads shall not be cut or bent (see figure 210-1).

- b. When specified, the leads shall be fluxed (see 4.3).
- c. The specific combination of temperature, duration, and number of heats shall be as specified in table I.
- d. The components, mounted on the board, shall be immersed in the solder pot so that the bottom of the board floats on the molten solder.
- e. After the float, the components shall be allowed to cool and stabilize at room ambient conditions. If flux was used, the components shall be cleaned using an appropriate cleaning solution.
- f. The components shall be visually examined under 10X magnification.

4.4.4 Test condition D: Wave solder - bottomside board mount product.

- a. Place the component in an appropriate fixture (see 2.3).
- b. When specified, the terminations shall be fluxed (see 4.3).
- c. The specific combination of temperature, preheat conditions, immersion and emersion rates, immersion duration, and number of heats shall be as specified in table I.

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- d. The component shall be preheated and fully immersed in the solder bath in accordance with 4.4.4c.
- e. After the immersion, the component shall be allowed to cool and stabilize at room ambient conditions. If flux was used, the component shall be cleaned using an appropriate cleaning solution.
- f. The component shall be visually examined under 10X magnification.

4.4.5 Test condition H: Vapor phase reflow soldering.

- a. Components shall be mounted on a mounting board (see 2.4). Through-hole mounted components shall have their terminals inserted into the termination holes. Surface mount components shall be placed on top of the board.
- b. A test chamber (see 2.6) shall be used which is large enough to suspend the mounting board without touching the sides or the solution. The VPR fluid shall be placed in the test chamber and shall be heated until it is boiling. The solution shall be allowed to boil for 5 minutes prior to suspending the mounting board.
- c. The specific combination of temperature, duration of exposure, and number of heats shall be as specified in table I.
- d. After chamber equalization, the mounting board shall be suspended into the vapor in a horizontal plane. The mounting board shall not touch the solution.
- e. After the heat, the components shall be allowed to cool and stabilize at room ambient conditions. If a solder paste was used, the component shall be cleaned using an appropriate solution.
- f. The components shall be visually examined under 10X magnification.

4.4.6 Test conditions I, J, K: Infrared/convection reflow soldering.

- a. Components shall be mounted on a mounting board (see 2.4). Through-hole mounted components shall have their terminals inserted into the termination holes. Surface mount components shall be placed on top of the board.
- b. A test chamber as specified in 2.6 shall be used.
- c. A low mass thermocouple shall be attached tightly to the component at an appropriate position away from the edges.
- d. The specific combination of temperature, preheat, duration, and number of heats shall be as specified by test condition I, J, or K in table I and the individual procurement document.
- e. The board shall be placed into the test chamber and the temperature of the component ramped at a rate of 1°C/s to 4°C/s as measured by the thermocouple. The assembly shall be above 183°C for 90 seconds to 120 seconds and held at the final temperature and time designated by the test condition. The assembly shall then be allowed to cool to room ambient temperature. This constitutes one heat cycle. The assembly shall be exposed to three heat cycles.
- f. The components shall be visually examined under 10X magnification.

5. EXAMINATIONS AND MEASUREMENTS. Examinations and measurements to be made before and after the test, as applicable, shall be as specified in the individual specification. After the procedure, the specimens shall be allowed to cool and stabilize at room ambient conditions, for the time specified in the individual specification.

5.1 Internal examination. When specified, internal examination of the part shall be made after the test to check for solder reflow or heat damage.

6. SUMMARY. The following details are to be specified in the individual specification:

- a. The use of heat sinks or shielding is prohibited except when they are part of the component (see 2.2).
- b. Mounting board, if different from that specified (see 2.4).
- c. Solder, if different from that specified (see 3.1).
- d. Flux, if applicable and if different from that specified (see 3.2, 4.1, and 4.3).
- e. Solder terminations that are not to be tested, if applicable (see 4.4).
- f. Special preparation of specimens if applicable (see 4.1).
- g. Depth of immersion in the molten solder, if different from that specified (see 4.4.2).
- h. Test condition letter (see 4.4).
- i. Cooling time prior to final examinations and measurements (see 4.4 and 5).
- j. Examinations and measurements before and after test, as applicable (see 5).
- k. Method of internal inspection, if required (see 5.1).

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TABLE I. Test conditions.

Solder technique simulation	Test condition	Temperature (°C)	Time (s)	Temperature ramp/ immersion and emersion rate	Number of heat cycles
Solder iron	A	350 ±10 (solder iron temp)	4 - 5		1
Dip	B	260 ±5 (solder temp)	10 ±1	25mm/s ±6 mm/s	1
Wave: Topside board-mount product	C	260 ±5 (solder temp)	20 ±1		1
Wave: Bottomside board-mount product	D	260 ±5 (solder temp)	10 ±1	Preheat 1°C/s-4°C/s to within 100°C of solder temp. 25 mm/s ± 6 mm/s	1
	E	CANCELLED			
	F	CANCELLED			
	G	CANCELLED			
Vapor phase reflow	H	215 ±5 (vapor temp)	60 ±5		1
IR/convection reflow	I	215 ±5 (component temp)	30 ±5	1°C/s-4°C/s; time above 183°C, 90 s - 120 s	3
	J	235 ±5 (component temp)	30 ±5	1°C/s-4°C/s; time above 183°C, 90 s - 120 s	3
	K	250 ±5 (component temp)	30 ±5	1°C/s-4°C/s; time above 183°C, 90 s - 120 s	3

Test condition E is cancelled; use test condition C.
 Test condition F is cancelled; use test condition B.
 Test condition G is cancelled.

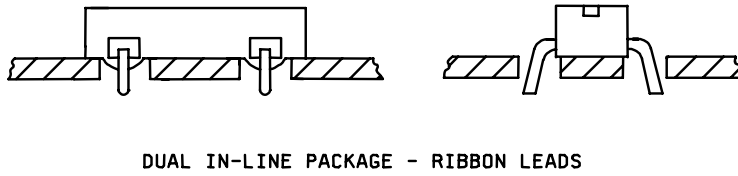
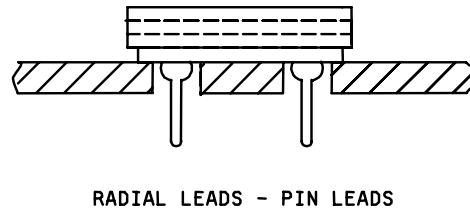
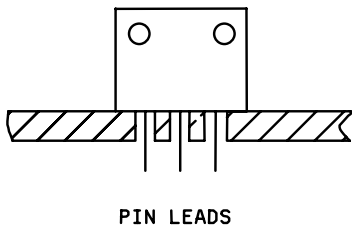
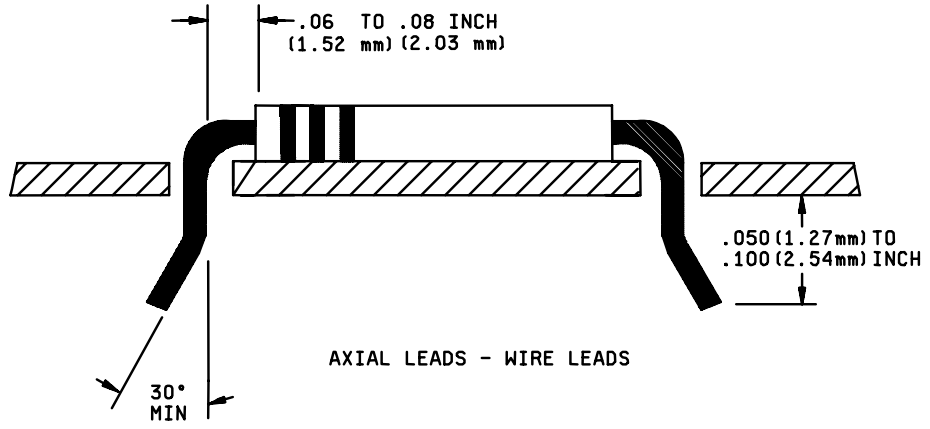


FIGURE 210-1. Component lead and mounting examples.