NOTICE OF CHANGE

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MIL-STD-331B
NOTICE 6
15 April 1996

MILITARY STANDARD
FUZE AND FUZE COMPNENTS
ENVIRONMENTAL AND PERFROMANCE TESTS FOR

TO ALL HOLDERS OF MIL-STD-331B:

1. THE FOLLOWING PAGES OF MIL-STD-331B HAVE BEEN REVISED AND SUPERSEDE THE PAGES LISTED:

NEW PAGE	DATE	SUPERSEDED PAGE	DATE
v	15 April 1996	v	1 August 1995 (Notice 5)
vi	15 April 1996	vi	1 May 1994 (Notice 4)
vii	1 August 1995	vii	Reprinted Without Change (Notice 5)
viii	15 April 1996	viii	1 August 1995 (Notice 5)
C10-1 thru C10-8	15 April 1996	None	New Pages

2. RETAIN THIS NOTICE AND INSERT BEFORE TABLE OF CONTENTS.

3. Holders of MIL-STD-331B will verify that page changes and additions indicated above have been entered. This notice page will be retained as a check sheet. This issuance, together with appended pages, is a separate publication. Each notice is to be retained by stocking points until the military standard is completely revised or canceled.

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FIGURES

FIGURES - Continued

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TEST C10

SOLAR RADIATION

1. PURPOSE:

This is a laboratory safety and reliability test to determine the effects of solar radiation on packaged or unpackaged fuzes or fuzed munitions that may be exposed to sunshine during operation or unsheltered storage.

2. DESCRIPTION:

2.1 General. A solar radiation chamber is used to subject fuzes or fuzed munitions to high temperatures and solar radiation for specified periods. The solar radiation exposure procedure provides two options, one of which (Paragraph 2.1.1 or 2.1.2) must be specified in the test directive. MIL-STD-810, Method 505 provides expanded discussion/rationale.

2.1.1 Cycling for heat effects. This option is used if the fuze or fuzed munition is expected to withstand the heat from exposure in the open in hot climates and still be able to perform without degradation both during and after exposure. (see paragraph 7.5)

2.1.2 Steady state for actinic/photo degradation effects. This option is used if the fuze or fuzed munition is expected to withstand the actinic effects of long periods of exposure to sunshine and still be able to perform without degradation both during and after exposure. (See paragraphs 7.3 and 7.6)

2.2 Fuze/munition configuration. The test item configuration depends on how the fuze or fuzed munition is delivered and used. "Fuze" as used throughout this test shall refer to the fuze or a fuzed munition as applicable.

2.2.1 Unpackaged, fuzed munition. The fuze is assembled to the munition and the assembly is shipped unpackaged, or is unpackaged and subjected to unsheltered storage prior to its use.

2.2.2 Packaged, fuzed munition. The fuze is assembled to the munition and the assembly is shipped in a service package.

2.2.3 Packaged fuze. The fuze is shipped separately from the munition in the service package.

2.2.4 Bare fuze. The fuze is shipped separately from the munition in the service package, and is removed and subjected

2.3 Explosive components. Warheads are to be inertly loaded. The fuze may contain an inert lead and booster during production acceptance testing, when permitted by the item specification, or when use of a live booster constitutes an excessive hazard.

2.4 Applicable publications. All standards, specifications, drawings, procedures and manuals which form a part of this test are listed in Section 2 of the introduction to this standard. Special attention is directed to MIL-STD-210 and Army Regulation 70-38 (see paragraph 7.6), which give climatic data.

2.5 Test documentation. Test plans, performance records, equipment conditions, results, and analysis shall be documented in accordance with Section 4.8 of the general requirements to this standard.

3. CRITERIA FOR PASSING TEST:

3.1 Fuze condition. At the completion of this test, the fuze shall be safe for transportation, storage, handling and use, as well as operable in accordance with paragraphs 4.6.2.1a and 4.6.2.2 of the general requirements to this standard.

3.2 Steady state test. Failure of the steady state test requires further investigation to determine the failure mechanism. If the failure is due to photo degradation effects, the fuze has failed the test; if the failure is due to exaggerated heating effects, the fuze has not failed.

3.3 Decision basis. Breakdown, inspection, other appropriate tests and engineering judgment shall form the basis for the decision that fuzes have passed or failed the test.

4. EQUIPMENT:

4.1 Chamber. The equipment required to conduct this test consists of a chamber together with auxiliary instrumentation capable of maintaining and continuously monitoring the required conditions of temperature and solar radiation throughout an envelope of air surrounding the test item. The test chamber and solar radiation sources shall conform to the criteria of MIL-STD-810, Method 505. The floor of the chamber will be covered with light-colored desert sand, or other material that is realistic to produce the severest condition. (See paragraph 7.7.)

4.2 Temperature control. The term "temperature" used throughout this test is defined unless otherwise specifically stated, as the temperature of the air surrounding the test item. Continuous records of chamber temperature are required. The sensors should be shielded to prevent the direct impingement of radiation and conditioned air. It is essential to control and measure the rate of chamber airflow to preclude the cooling effects of airflow over the test items(s). The air velocity shall be maintained between 0.25 and 1.5 m/s (50 to 300 ft/min). Specific information regarding temperature maintenance and measurement is provided in MIL-STD-810, Method 505.

4.3 Instrumentation. Instrumentation shall be installed to measure the following as applicable:

a. Total irradiance at the test item upper surface or at the level of the most critical location, before and after test.

b. Temperature of critical parts or components.

c. Air temperature in the vicinity of the test item (sensor protected as in paragraph 4.2).

Refer to MIL-STD-810 for more detailed information.

5. PROCEDURE:

5.1 Selecting the test options and related conditions. Paragraph 7.4 provides factors to consider with respect to the choice of test option and conditions. Choose the test option, test duration, fuze configuration, and any additional relevant conditions at which to conduct the test.

5.2 Positioning the test items. Place the test items(s) in the chamber at room temperature and in a manner that will simulate service usage, unless the storage configuration is specified in the test directive. As appropriate, the test items shall be positioned in accordance with the following:

a. As near the center of the test chamber as practical and so that the surface of the test item is no closer than 0.3 m (1 ft) to any wall or 0.76 m (2.5 ft) to the radiation source.

b. Oriented to expose, within the confines of realistic orientations, its most vulnerable parts to the solar radiation unless a prescribed orientation sequence is to be followed.

c. Separated from other items that are being tested simultaneously to ensure that there is no shading of each other or blocking of air flow.

5.3 Cycling. (See paragraph 7.5.) If the "cycling for heat effects" is selected in paragraph 10.2.1:

a. Expose the test items(s) to continuous 24-hour cycles of controlled temperature and simulated solar radiation following the diurnal cycle in Table C10-1 unless otherwise specified. Since relative humidity at high temperature is difficult to control, the levels listed in Table C10-1 should be regarded as desirable.

b. The solar radiation intensity variation may be approximated by a minimum of four steps up and four steps down as shown in Figure C10-1.

c. A minimum of three continuous cycles shall be performed. It is suggested that, for most applications, the maximum test duration be seven cycles.

5.4 Steady state. (See paragraph 10.7.6.) If the "actinic/photo degradation effects" is selected in paragraph 2.1:

a. Raise the test chamber temperature to 49°C (120°F), and maintain this temperature during testing.

TABLE C10-1. Temperature-Solar Radiation Diurnal Cycle

Time	Temperature			Solar Radiation	
	°C	°F	RH(%)	W/m²	BTU/ft²/hr
0000	37	98	6	0	0
0300	34	93	7	0	0
0600	32	90	8	55	18
0900	38	101	6	730	231
1200	44	112	4	1120	355
1500	48	119	3	915	291
1600	49	120	3	730	231
1800	48	118	3	270	85
2100	41	105	5	0	0
2400/ 0000	37	98	6	0	0
Max	49	120	8	1120	355
Min	32	90	3	0	0

b. Expose the test items(s) to solar radiation at the rate of 1120 W/m² (355 BTU/ft²/hr) in accordance with Figure C10-2.

c. A duration of ten 24-hour cycles is suggested to simulate the outdoor exposure of fuzes on a short term basis. A test duration of 56 cycles or longer is suggested for long term outdoor exposure.

5.5 Return to ambient temperature. At the end of the test, allow the test chamber to return to room ambient conditions and remove the test items(s). Room temperature is +23±10°C (+73±18°F).

5.6 Compliance. Analyze the test results and determine whether or not the test article meets the pass/fail criteria in paragraph 10.3.

6. ALTERNATE AND OPTIONAL TESTS:

None.

7. RELATED INFORMATION:

7.1 Basis of test. This adaptation to fuzes of the MIL-STD-810 solar radiation test originated from the concerns with the impact of high temperature and solar radiation on the functioning and safety of weapons and ammunition which occurred during Operation Desert Storm (ODS). Weather data available for various locations within the ODS region indicated that air temperature often exceeded 46°C (115°F). This is air temperature only and is not indicative of the temperature of the internal components of ammunition items due to solar radiation. Solar loading may cause the internal temperature of exposed materiel to be significantly higher than the ambient air temperature. Available desert test data from an

Australian study conducted in 1983 show that, due to solar radiation, temperatures can be as much as 33°C (60°F) higher than the ambient air temperature when materiel is exposed to the sun, 35°C (63°F) higher when materiel is covered with tarpaulins in contact with the ammunition, and 10°C (18°F) higher when materiel is shaded.

7.2 Heating effects. The heating effects of solar radiation differ from those of high air temperature alone in that the amount of heat absorbed or reflected depends on the roughness, color, and reflectivity of the surface on which the radiation is incident. Also, directional heating induces temperature gradients across materiel. In addition to the differential expansion between dissimilar materials, changes in the intensity of solar radiation may cause components to expand or contract at different rates, which can lead to severe stresses and loss of structural integrity. Possible heating effects of solar radiation include:

a. Mechanical - Expansion may cause jamming or loosening of moving parts. Soldered seams may weaken. Lubricants may evaporate or migrate.

b. Electronic/electrical - Resistance, inductance and capacitance parameters may change. Contacts may open or close by warping under expansion.

c. Lenses - Lenses or glass covers may become opaque.

d. Explosives - Explosive material may exude.

7.3 Actinic effects. While heating effects are caused by the infrared portion of the solar spectrum, physical degradation from solar energy can also occur from the ultraviolet or even the visible portions of the spectrum. Possible actinic effects of solar radiation include deterioration of natural and synthetic elastomers and polymers through photochemical reactions. Photo degradation can cause fading of paints which, in turn, can cause increased heating.

7.4 Selection of test options and conditions.

7.4.1 Options. The choice of test procedures is based on the following:

a. The anticipated exposure circumstances.

b. The expected problem areas within the test item.

c. The duration of exposure to solar radiation.

7.4.2 Conditions. The related test conditions that are used during the test are determined by:

a. The anticipated areas of deployment.

b. The test item configuration.

7.5 Diurnal cycle. The diurnal cycle is used to determine realistic response temperatures and limited actinic effects. It has a peak temperature of 49°C (120°F) and a solar radiation intensity of 1120 W/m² (355 BTU/ft²/hr), and represents the hottest conditions exceeded not more than one percent of the hours I the most extreme month at the most severe locations in those portions of the earth identified in

Army Regulation (AR) 70-38, STANAG 2895, and MIL-STD-210. The are primarily low latitude deserts, which in addition to very high temperatures, concurrently experience very low relative humilities and intense solar radiation. These conditions are found seasonally in the deserts of northern Africa, the Middle East, Pakistan and India, southwestern United States, and northern Mexico.

7.6 Steady state option. This procedure is used to determine possible actinic (photochemical) effects of long term exposure to sunshine due primarily to the ultraviolet and sometimes, the visible portions of the solar spectrum. When simulating such effects, it is inefficient to use the cycling option since this could take months to conduct. The approach, therefore, is to use an accelerated test which is designed to reduce the time to reproduce the integrated effects of long periods of exposure. This method will give an acceleration factor of 2.5 as far as the total energy received by the test item is concerned. One 24-hour cycle as shown in Figure C10-2 provides approximately 2.5 times the solar energy experienced in one 24 hour diurnal cycle plus a 4-hour light off period to allow alternating thermal stressing and for the so-called "dark" processes to occur. To simulate 25 days of natural exposure, for instance, perform ten cycles as shown in Figure C10-2. The cycles mentioned in paragraph C10.5.4c (ten and 56) would simulate 25 and 140 days, respectively. Increasing irradiance above the specified level is not recommended because of the danger of overheating, and there is presently no indication that attempting to accelerate the test in this way gives results that correlate with equipment response under natural solar radiation conditions. Sufficient cooling air should be maintained to prevent the test item from exceeding temperatures that would be attained under natural conditions (such as the cycling option simulates), so that this will not be an exaggerated test which unfairly penalizes the test item. Care must be taken to assure that the air flow is not high enough to cause unnatural cooling. Temperature sensors immediately adjacent to the test item (but far enough away not to be affected by thermal radiation from the test item) and properly shaded to negate direct solar loading effects, can be used to ensure the ambient air temperature is as required. Since the effects of ultraviolet radiation are highly dependent upon the solar radiation spectrum (as well as intensity and duration), the spectrum must be as close as possible to that of natural sunlight. The 4-hour "lights-off" period of each 24 hour cycle allows for test item conditions (physical and chemical) to return toward "normal" and provide some degree of thermal stress exercising.

7.7 Depth of sand. A depth of sand of two inches is recommended. This is not a firm requirement, but is based on the judgment that portions of the test item should not be able to penetrate the sand layer to contact the chamber floor and thus permit heat transfer. Tests conducted at ARDEC in 1995 showed that, with the required air flow, the air temperature one inch above the sand remained within 3°C of the bulk air temperature, the temperature of the sand one inch below the surface had no discernible effect on air temperature, and that the sand surface and air temperatures responded very quickly to changes in incident radiation. The principle effect of the sand appears to be reflection of radiation and the creation of a vertical temperature gradient in the air near the sand. The gradient is influenced strongly by air velocity. These observations apply to both steady state and diurnal variation tests.

7.8 Bibliography.

7.8.1 AR70-38, Research, Development, Test and Evaluation of Materiel for Extreme Climatic Conditions. 1 August 1979

7.8.2 MIL-STD-210, Climatic Information to Determine Design and Test Requirements for Military Systems and Equipment. 9 January 1987.

7.8.3 MIL-STD-810, Environmental Test Methods and Engineering Guidelines. 14 July 1989.

7.8.4 NATO STANAG 2895, Extreme Climatic Conditions and Derived Conditions for Use in Defining Design Test Criteria for NATO Forces Materiel.

7.8.5 Department of Defense, Australian Ordnance Council, Proceeding 14/83, Effects of Solar Radiation on Ammunition. 12 July 1983.

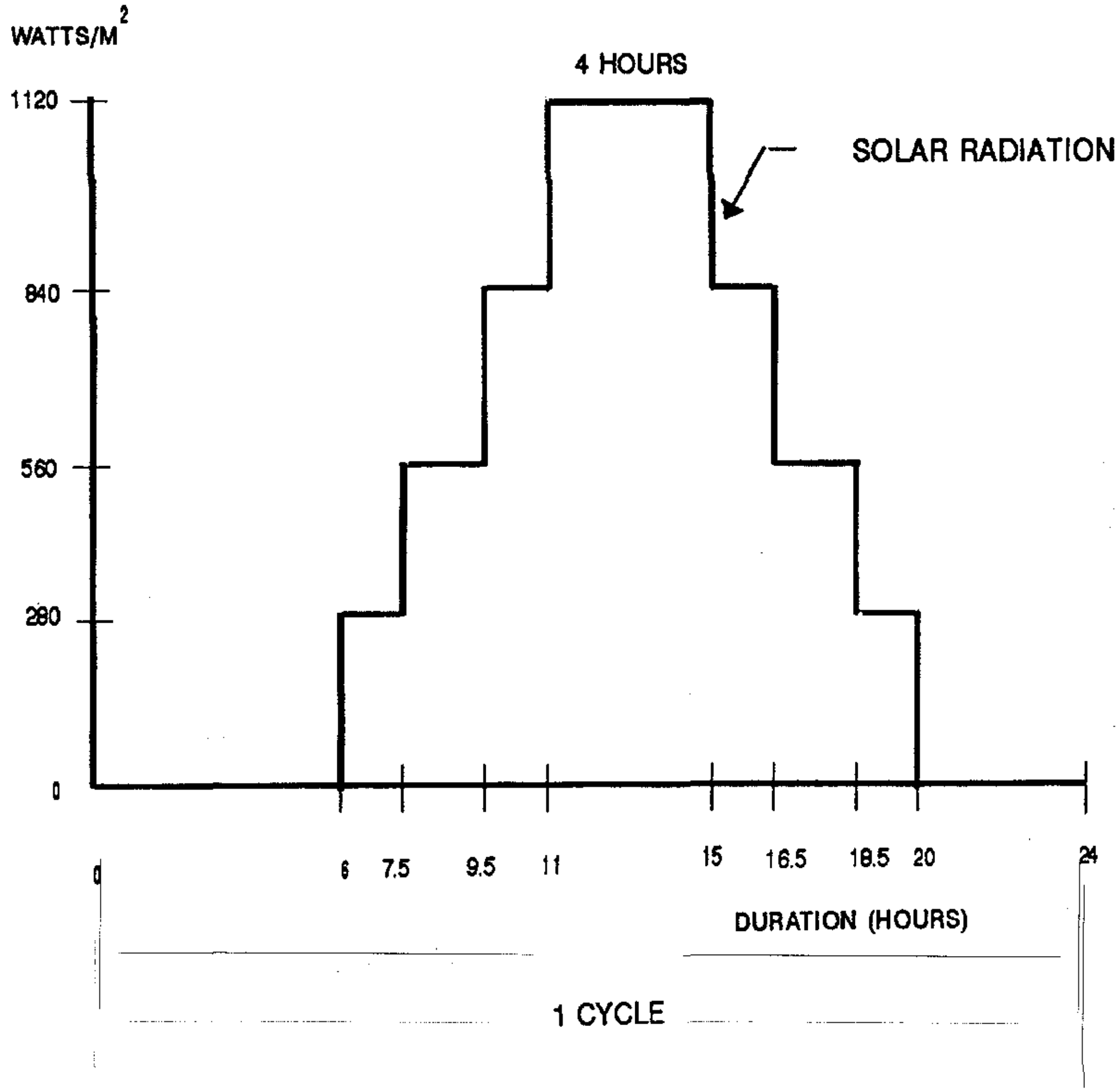

FIGURE C10-1. Simulated Solar Radiation Cycle

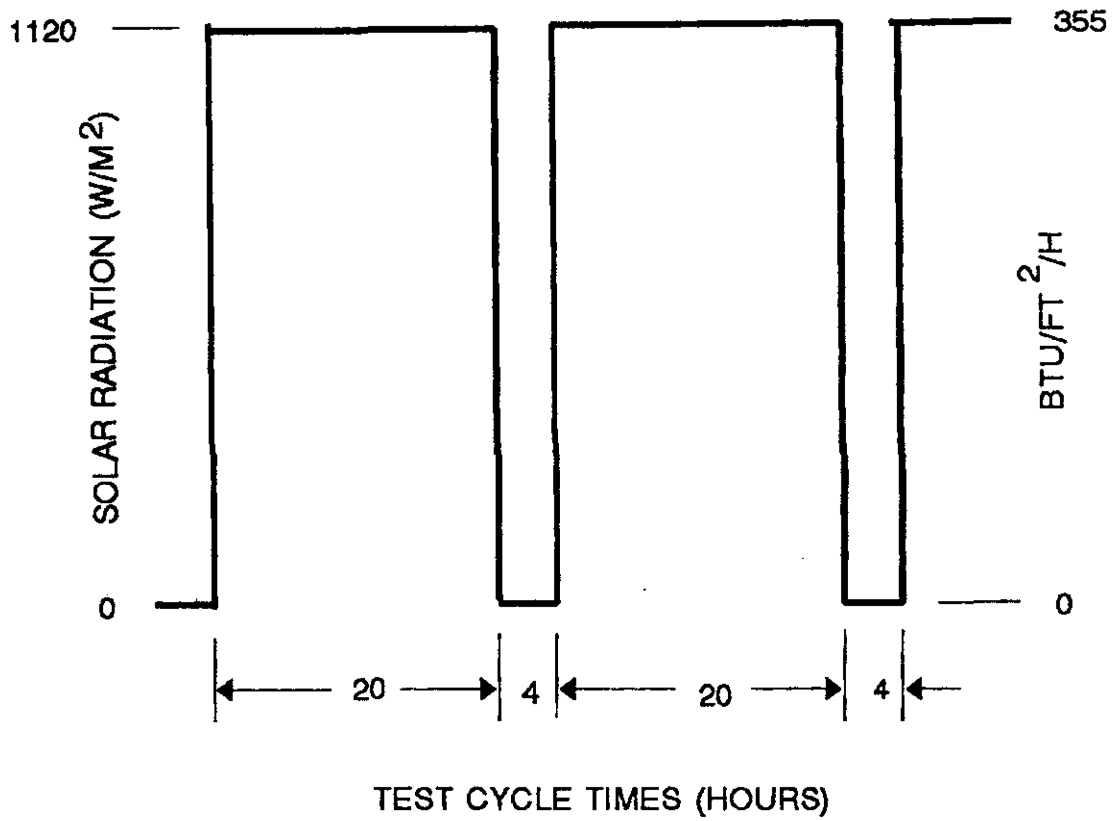

FIGURE C10-2. Two Steady State Cycles