NOTICE OF CHANGE

MIL-STD-331B
NOTICE 2
1 December 1991

MILITARY STANDARD
FUZE AND FUZE COMPONENTS, ENVIRONMENTAL AND PERFORMANCE 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NEW PAGE	DATE	SUPERSEDED PAGE	DATE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	1 December 1991	v	1 May 1991
vi	1 December 1989	vi	REPRINTED WITHOUT CHANGE
vii	1 May 1991	vii	REPRINTED WITHOUT CHANGE
viii	1 December 1991	viii	1 December 1989
D5-1 thru D5-5	1 December 1991	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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TEST D5

RAIN IMPACT

1. PURPOSE

This is a safety and performance test used during fuze development to demonstrate that the impact sensing element will not function as a result of traversing a specified rain environment and will then function reliably on impact with the test target.

2. DESCRIPTION OF TEST

2.1 General. The test applies to all fuzes with an impact sensing element located in the nose of the fuze.

2.2 Number of fuzes to be tested. The number of fuzes shall be at least the minimum required to demonstrate the specified system safety or reliability at the minimum desired confidence level for this test and shall be stated in the test plan.

2.3 System configuration. The fuze is assembled to a specified munition which is fired from a selected launcher through a simulated rain environment to impact on a target of appropriate material and size.

2.4 Explosive components. The test shall be conducted with the minimum number of explosive components in the fuze and to reduce the risk of damage to the test facility. The fuze booster shall be replaced by an auxiliary spotting charge. The auxiliary charge must be of sufficient size to reliably identify the fuze functioning either in the rain curtain or on the target. Inert munitions shall be used as test vehicles. Whenever possible, the munitions should be vented to allow the spotting charge gasses to exit the munition and minimize munition fragmentation.

2.5 Temperature. The test shall be performed with the fuzed munition at ambient temperature, unless some other temperature is considered more severe with respect to safety or reliability and is specified in the test plan.

2.6 Launcher orientation. The launcher shall be oriented to produce the optimum trajectory through the rain field to minimize changes in the rain drop size distribution.

2.7 Rain field location. For fuzes with arming delays, the distance between the muzzle and the rain environment shall be greater than the arming distance of the fuze. For fuzes without arming delays, the rain field should begin as close to the muzzle as practical and safe.

2.8 Rain field specification. The fuze shall be fired through 305 m (1,000 ft) of simulated rain that has an accumulated rain rate of 711 mm (28 in)/hr as measure by a standard rain gauge and a liquid water content (LWC) of 24.4 grams per cubic meter. The rain rate and LWC tolerance shall be plus or minus 35 percent. The resulting drop size distribution shall conform to Table D5-1.

Table D5-1. Drop Size Distribution.

Drop Size Group	Minimum percent of LWC contributed	Maximum percent of LWC contributed
0.0 to 1.0 mm	0	5
1.1 to 2.0 mm	17	27
2.1 to 3.0 mm	24	44
3.1 to 4.0 mm	18	32
4.1 to 5.0 mm	9	14
5.1 mm and up	2	7

2.9 Target. The target size, material and location shall be specified in the test plan.

2.10 Determination of response. Functional responses will be determined by visual observation, photography, telemetry, a combination of these or any other method determined suitable.

2.11 Test documentation. Test documentation shall conform with Section 4.8 of the general requirements to this standard. The following specific data shall be recorded for each test:

a. launch velocity;

b. recording of the selected measurable rain facility parameters (nozzle exit pressure, water flow rate, and so forth);

c. pre- or post-test measurement of rain rate or droplet size distribution as a function of the measurable rain facility parameter selected in b., above;

d. wind speed and direction;

e. measured range to an early fuze function;

f. fuze functioning on target; and

g. ambient air pressure and temperature.

3. CRITERIA FOR PASSING TEST

A fuze passes the test if it does not function while traversing the simulated rain and then functions as expected on the target located beyond the rain curtain. A fuze fails the test if it either functions while within the simulated rain or it fails to function on the target due to rain-caused damage to the fuze.

4. EQUIPMENT

4.1 Test weapon and munitions. A weapon and inert munitions for which the fuze is standard shall be used. If the fuze is standard for several munitions, weapons, or both, the weapon-munition combination shall be the one that produces the maximum launch velocity and minimum angular velocity (spin) about the munition's longitudinal axis as the munition traverses the rain environment.

4.2 Rain environment. The firing range shall provide a simulated rain environment in the flight path of the munition which meets the requirement of Paragraph 2.8.

4.3 Target. The target size, material and location shall be specified in the test plan.

5. PROCEDURE

5.1 Compliance with operational procedures. The tests shall be performed in accordance with established operational, safety and countdown procedures of the test facility.

5.2 Wind data. Wind measurement instruments will be observed and data recorded.

5.3 Launch velocity. The fuze munition, when fired at the selected temperature, shall use the maximum service charge or an augmented service charge to produce the maximum launch velocity associated with the weapon at maximum operating temperature. Launch velocity shall be measured on five test items to confirm service charge velocity prior to test.

5.4 Projectile trajectory. The test munition shall be fired through the 305 m (1,000 ft) rain curtain specified in Paragraph 2.8 at a quadrant elevation and height to ensure the projectile remains within the rain curtain for the full 305 m (1,000 ft). After passing through the curtain, the munition shall impact the intended target. Location of all fuze functioning shall be recorded, no matter where it occurs, whether on the intended target, behind the target, or as a result of traversing the rain field.

6. ALTERNATE AND OPTIONAL TESTS

6.1 Overtest. Tests of intensified severity performed by increasing the munition velocity above the maximum tactical velocity may provide information on the reliability of the fuze impact element in rain. If the functioning velocity can be bracketed, the Bruceton Up and Down, Langlie, Churchill Two Stimuli, or the One Shot Transformed Response (OSTR) are some methods that may provide useful information regarding the confidence level and reliability for any given velocity. This information can usually be generated with a sample size between 30 and 50 rounds.

7. RELATED INFORMATION

7.1 Background. The need for this test arises from the fact that functioning of the projectile due to rain impact within and close to the weapon is hazardous to equipment and personnel. In addition, a launched munition loses its combat effectiveness when it detonates prematurely or duds on target impact.

7.2 Rain rate. The rain rate of 711 mm (28 in)/hr was determined experimentally as that rain rate which produced the malfunction rate of the M557 PD Fuze when fired in heavy rain in Vietnam. Additional information on this subject can be found in Technical Report 3966. See Paragraph 7.11.1.

7.3 Rain drop size distribution. The drop size distribution specified in paragraph 2.8 is based on the Tattelman/Willis Formula described in AFGL-TR-85-0200. See Paragraph 7.11.2.

7.4 Limitation. A test such as this can be a useful development tool, but it can be related only in a general manner to performance in natural rains. It is very impractical, if not impossible, to set up a general field type test that will supply precise information about the conditional functioning probability of the fuze. The information obtained, therefore, is an estimate or an indication of the safety and operability of the fuze when fired through natural rains. Initiation of the fuze may occur only on impact with very large drops. The prediction of the number of drops impacted in any trajectory is statistical.

7.5 Failure modes. As noted in paragraph 7.4, the failure mode addressed by this test is initiation of the fuze due to a collision with large raindrops. Erosion cannot be evaluated by this technique and the effect of multiple drop collision or cumulative water ingestion effects would be very difficult to compare to a single, long-range firing through rain.

7.6 Sample size. A minimum sample size of 30 fuzes is recommended. Except for the effects of multiple drop collisions and the cumulative effects of water ingestion on a given sample, this is similar to firing one munition along a 9,150 m (30,000 ft) (30 munitions x 305 m (1,000 ft) range) trajectory at essentially maximum velocity through an intense tropical rain or thundershower. A sample size of 50 or more is preferred to attain a higher confidence in fuze safety and operability.

7.7 Munition trajectory. In an artificial rain field, the height of the rain curtain above the ground is limited and the rain density changes with elevation above the ground. Therefore, the test customer should provide the test facility with a detailed definition of the munition trajectory to ensure the elevation of the munition above ground is known along its 305 m (1,000 ft) path through the simulated rain curtain and to define required test target size.

7.8 Other applications. While the test principally applies to munition fuzes having an impact sensing element situated in the nose of the fuze, it can optionally be used to conduct tests on those items where the impact element is not contained at that location.

7.9 Proximity and time fuzes. The rain sensitivity characteristics of impact sensing elements in proximity and time fuzes can also be tested.

7.10 Rain test facility at Holloman AFB, New Mexico. The test track at Holloman AFB, New Mexico, (commercial telephone (505) 679-2133, DSN 349-2133) operates two rain simulation facilities that generate artificial rain environments in support of erosion and fuze sensitivity testing. One facility is set up along the track to support rain testing by means of rocket sleds. The other facility is a ballistic rain test facility for firing artillery munitions from field weapons through simulated rain. The ballistic rain test facility not only produces rain meeting the conditions described in Section 2, but others as well. The wind restriction for the 711 mm (28 in)/hr rain rate at this facility is 1.5 knots cross range and 5.0 knots down range.

7.11 Bibliography.

7.11.1 Rain Sensitivity Tests on M557 and M557E1 (XM712E2) Point Detonating Fuzes, by Eugene M. Ivankoe, Technical Report 3966, U. S. Army Armament Research, Development and Engineering Center, Picatinny Arsenal, New Jersey, 1969.

7.11.2 Model Vertical Profiles of Extreme Rainfall Rate, Liquid Water Content, and Drop-Size Distribution, P. Tattleman and P. T. Willis, Technical Report 85-0200, U. S. Air Force Geophysics Laboratory, 1985.