Safety Manual

on

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Introduction

The static test is an exercise that entails the firing a rocket motor mounted in a stationary structure for the purpose of obtaining information on the motor's performance. The motor is a high power device that poses risks to the personnel involved with the test, therefore it is necessary to create a safety manual in order to address potential hazards and procedures of mitigating them as well as protocols to be followed in case of any accidents or abnormalities.

1 Static Test

1.1 Locating the Test Site

A suitable location is an area of level ground and open space. The area should be clear of buildings or other structures. It shouldn't be an area that is frequented by humans and animals.

1.2 Personnel Control

Success of the test area safety is highly dependent on proper conduct of personnel in the test environment. Below are procedures that are regarded as minimum requirements for safe control of personnel within the test area.

(a) An observer is required to visit the site to confirm the worthiness of the site.

(b) An appropriate location of placing the setup is chosen based on the minimum personnel distance.

(c) Non-involved parties around the test area should be warned of the test and marshaled to or further away from the minimum safe distance.

(d) If possible a warning sign can be placed on the site entrance informing people of the test

(e) Only authorized personnel should be allowed to handle potentially hazardous materials during transportation and assembly.

(f) Before commencing the set up process, any personnel smoking should be directed to a designated smoking area.

(g) The personnel setting up the test should be in proper gear for the tasks.

(h) Before firing the motor, a suitable audio warning system should be activated a few minutes into the start of the test

1.3 Preparation of the Setup

(a) The components should be inspected for any lose connections and mended.

(b) The components should be cleaned and rid of any unnecessary objects before being transported to the test site.

(c) A checklist should be used for every assembly of components in the setup. It is recommended that the checklist be used during and after assembly of the components.

(d) After the test unit is restrained, the strength of the restraint should be checked by a couple of personnel and approved for sound strength.

(e) It is at this point that the connection of the electrical firing circuit is done to the test unit from the bay. All personnel except arming crew must be evacuated from the test bay and area will be cleared before arming procedures are started.

1.4 Firing the Motor

(a) Countdown will start after everyone is within the approved safe areas. It should consist of verbal communication. In distant areas from the test unit, a public address system should be used.

(b) The motor is fired on the command “Ignition!”

2 Abnormal Test Conditions

2.1 Missfire

A misfire is defined as any failure to ignite the test unit. After several ignition attempts fail, below are the steps to be followed.

(a) In the event of a misfire, a wait will be required as determined by the test conductor in case of a hanging fire (ideally 2-5 minutes).

(b) After the approved waiting period, the ignition circuit is disarmed and only qualified personnel will proceed to the test unit site for inspection and fault diagnosis.

(c) Only after the setup is deemed safe personnel in the site is when other additional parties will be allowed to access the test site.

2.2 Hang Fire

A hang fire is defined as a firing with undue ignition delay. The hang fire will be treated as a normal firing after the motor has been fired.

3 Malfunction

A malfunction involves case separation, nozzle & bulkhead failure and detonation.

(a) In the event of a malfunction, the area will be checked for fires by the test personnel and appropriate action will be taken to suppress the fire. In case of a large fire, the nearest fire alarm should be triggered.

(b) A wait will be required as determined by the test personnel in order to assess the safety of accessing the site where the malfunction has occurred.

(c) After the approved waiting period, an inspection team will proceed to the test site to investigate the hazardous conditions.

(d) Hazardous debri will be cleared before the “all clear” is sounded.

(e) A thorough inspection for any unburned propellant should be done and isolated from any hot objects.[1]

4 Electrical Safety

To be Completed

5 Chemical Safety

5.1 Storage of Chemicals

(a) All chemicals should be stored in their proper container that is well-sealed and clearly labeled in a dry, well-aerated cabinet or room.

(b) Chemicals should be stored by hazard class i.e flammable liquids, organic substances, oxidisers.[1][2]

(c) Ensure you follow the manufacturer's specifications on storage of the chemical.[3]

5.2 Safe handling of Chemicals

(a) Don't ingest, inhale or taste directly any chemicals.[4]

(b) Prefer using gloves when working with chemicals, as well as wearing closed shoes and overalls.[5]

(c) Keep your working area clean and tidy before, during and after working with chemicals.[6]

5.3 Waste Disposal

(a) All chemical waste should be conveyed to the Chemical and/or Engineering Labs for safe disposal.[2]

(b) Ensure that waste is separated in terms of ignitablility, corrosivity, reactivity and toxicity, in addition to being well labeled.[3]

[1] Flammable liquids are mostly Organic substances like alcohols and ketones. Oxidisers could be acids and some salts

[2] Never store a ketone with hydrogen peroxide in not well sealed containers. Trust me.

[3] It's usually at indicated on the container. If not, then that is a poor product.

[4] Avoid having consumables in the Prototyping lab to reduce the risk of contamination

[5] Remember that hearing and noise protection, as well as goggles is advised while working with volatile compounds

[6] This will help you have room to manoeuvre the apparatus and reagents you're currently working with. You'll prevent chances of spillage and damaging equipment, also.

References

[1] C. P. I. Agency, *Static Test Safety Manual*. Defense Documentation Center for Scientific and Technical Information, 1962.

[2] N. E. M. Authority, *Waste Management Regulations*. National Environment Management Authority of Kenya(NEMA-K), 2006.

[3] A. C. Society, *Chemical Safety Manual for Small Businesses: GUIDES FOR MANAGERS, ADMINISTRATORS, AND EMPLOYEES*, 3rd ed., S. Pine H., Ed. American Chemical Society, 2007.