



A Review of Hygroscopic Data of PBXN-5

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Background

The explosive booster used in the LLNL designed KEP Warhead uses PBXN-5 explosive. The Vandenberg 30th Space Wing range Safety Group requested information on the hygroscopic properties of PBXN-5. The document summarizes the available data.

PBXN-5 and LX-10

The term “PBXN-5” stands for “Plastic Bonded Explosive” that was certified by the Navy. There are several PBXN explosives, the “5” suffix is an arbitrary identifier which is assigned sequentially. The material is composed of 95% HMX and 5% Viton Binder. The original formulation of 95% HMX with a 5% Viton Binder was developed at LLNL and was designated LX-10. This designation stands for “Livermore Explosive” with the arbitrary identifier also assigned sequentially. PBXN-5 is controlled by DoD publication MIL-E-81111B while LX-10 is controlled by DOE Publication RM253511

Although the two materials are controlled by different agencies and under different publications, the constituents remain the same as do the explosive, chemical and mechanical properties. The similarity between PBNX-5 and LX-10 make the use of hygroscopic data on LX-10 applicable to PBXN-5.

Review of Data

The available data comes in three areas, the first is qualitative assessment based the chemical properties of the constituents. The binder is composed of a fluoropolymer elastomer known as Viton. The name Viton is a registered trademark of DuPont. One of the common commercial of Viton is in the manufacture of high quality O-rings. The subject matter experts at LLNL summarized their expectation of the hygroscopic properties of LX-10 as “Neither the fluorocarbon binder nor the nitroamine energetic have a strong affinity for water and are relatively stable towards hydrolysis”¹

The second area is a study² done by LLNL on the hygroscopic properties of LX-10 and LX-17 which indicated that uptake and release of water in LX-10 is very low which is in agreement with the assessment by the subject matter experts. As stated earlier, due to the similarity of LX-10 and PBXN-5, this data should be directly applicable to the performance of PBXN-5.

¹ E-mail communication with George Overturf, LLNL Subject Matter Expert on Chemical Compatibility and Aging of Explosives. December 14, 2011.

² Rigdon, L.P., D.L. Seaton, A.J. Pane, LX-10 and LX-17 Moisture Content and Release, UCRL-53533, August 17, 1984

The third set of data comes from the DoD publication MIL-E-81111B which specifies the use of water as a cooling agent during machining operations in paragraph 3.1.2.9 and again as a note in 4.4.4.10. Both of these paragraphs are transcribed below.

3.1.2.9 Machinability. The PBXN-5 shall be machinable with water as a coolant and shall not crumble or fracture during such operation and not be defective as determined by 4.4.4.10.1.

4.4.4.10 Machinability ... NOTE: The pellet shall be faced and then turned to diameter. Machining shall be done with water as a cooling agent. Cooling water shall be applied to the cutting tip of the tool and surface of the sample.

The fact that water is specified as a cooling agent and specifies its application directly to the explosive indicates the lack of significant reaction between PBXN-5 and water which is, again, in agreement with the earlier data.

Summary

In summary, all the available data indicates that PBXN-5 explosive is minimally hygroscopic.