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NAVIFLASH–NSWCCD-Developed Fuel Flashpoint Tester Now World Recognized

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Fuel flashpoint acceptance testing - a critical shipboard fuel flammability safety test which is presently required to be applied to all incoming shipboard fuels - was critically evaluated approximately 10 years ago by chemists and engineers within the fuel laboratories of the Division´s Materials Engineering and Fluid Processing Branch (622) in Philadelphia. At that time, an engineering decision was made to attempt to improve the older, onboard Fleet test method used for fuel flammability assessment. The final product of that concerted NSWCCD-SSES development effort resulted in a new, commercially-produced, vastly-improved fuel tester.

The new tester has been accepted worldwide and is considered an optimal test method for all types of fluid flammability testing. The new test method is presently accepted, not only by the U.S. Navy, but by the military forces of the North Atlantic Treaty Organization (NATO) and safety engineers in the Department of Transportation (DoT) and has become an official method endorsed by the American Society of Testing and Materials (ASTM). In addition, the new flashpoint tester is also fully recognized and is accepted by fuel authorities in many countries in Europe and Asia. It is a modern, automated replacement for the older, cruder fluid flammability testing methods formerly used.

Most of the NSWCCD-SSES engineering development decisions for the flashpoint tester were made by a team of dedicated chemists and instrument engineers, who thoroughly examined the accepted standard shipboard testing method called the "Pensky-Martins Closed Cup Flashpoint" test. This test was universally applied for many years aboard ships in the Fleet and was accepted without question. Although recognized, Pensky-Martins flashpoint testing is an extremely crude test method. Despite its crudeness, its operational behavior, as well as its deficiencies were widely understood. It is still the benchmark product flammability safety test and was used by most industrial testing laboratories world-wide. Today, the test remains widely applied and is routinely prescribed, especially for testing fuel flammability, an important safety requirement.

NSWCCD-SSES chemists and engineers concluded, however, that Pensky-Martins fuel testing was really not satisfactory for a ship. They viewed the test as potentially unsafe to be used shipboard and decided that flashpoint testing aboard ship needed substantial modern improvements. These improvements were thought to be capable of being included in a new device that would employ modern innovative design ideas - mainly applying microcomputer based electronics. These capabilities would improve its operation considerably. It was believed that new tester designs, when made commercially available, would make routine Fleet flashpoint testing of shipboard fuels reliable, safe, simple, Sailor-friendly, and above all accurate. It was further concluded that test results generated by this new tester would have to be equivalent to those produced by the older test and performed aboard ship. This equivalency would make the unit completely acceptable to the Fleet.

Basically, the old Pensky-Martins shipboard test requires the use of an open flame, fragile hardware, and mercury thermometers, which all had to be combined with good operator judgement. The old test also requires a fairly substantial fuel sample to complete. These test characteristics were judged to be no longer acceptable in the modern Navy by NSWCCD-SSES fuel engineers. Also, most importantly, the old test is difficult to run effectively aboard ship and often produced doubtful data. To produce acceptable data with Pensky-Martins testing, considerable ships´ force training, laboratory experience and extreme care in fuel handling techniques are essential.

Based on these perceived and recognized engineering and scientific challenges, engineers in Philadelphia decided to attempt to improve routine flashpoint testing by convincing manufacturers to explore new tester designs. A new tester would be built using these ideas and also by integrating emerging electronic technologies into the designs. If successful, the newly conceived instrument could then be used to test shipboard fuels and eventually replace the unsafe Pensky-Martins testing.

After approximately three years of intense engineering effort, a prototype version of a modern, commercial instrument was produced. The prototype's operational behavior was studied and improved through engineering, laboratory and Fleet testing. These all validated its design. Moreover, the tester proved successful commercially. A commercially-produced tester resulted by synthesizing the ideas of the Navy engineering team, with those of a well-known instrument supplier. Although the supplier at that time had only limited experience with the needs of Fleet hardware, the company readily accepted many of the Navy-originated suggestions and operational innovations. It built a commercial device that could be economically produced and operated well.

After completion, the resulting tester was judged suitable for shipboard use and contained many of the Navy-originated, engineering ideas, resulting in a modern, safe, potentially-useful shipboard device. Commercial success with the tester also resulted because, with the help of the NSWCCD-SSES engineering team, the manufacturer also recognized the problems and limitations of the older test methods. The company produced various engineering designs and used them in their commercial device. It recognized a commercial market for an improved, compact, streamlined flashpoint test that could be eventually applied industrially.

The resulting commercial flashpoint tester was called "MINIFLASH" by its supplier. MINIFLASH was, however, originally manufactured to contain very wide operational and functional flexibilities that went substantially beyond Fleet requirements. These were characteristics believed by its manufacturer to be useful mainly within commercial testing laboratories, and many of them were considered not necessary for Fleet use. Further, MINIFLASH's flashpoint detection method was selected and incorporated by the tester manufacturer as a result of his own research. The final flashpoint detection method was selected. The technique proved unique, and the unit functioned well.

The detection method gave MINIFLASH's flashpoint measurement many of the excellent operation characteristics needed by the Fleet. The detection method basically functioned by automatically sensing the slight increase in vapor pressures, developed when very small quantities of fuel (only about one milliliter) were electronically combusted by a spark within a totally-contained, special combustion chamber. The resulting fuel vapor pressure developed in the tester chamber was systematically sensed by a controlled, electronically-managed, pressure transducer that was coupled to readout electronics.

The Navy's Fleet version of MINIFLASH was special. To identify the device, the commercial name was modified and termed "NAVIFLASH." NAVIFLASH is MINIFLASH, but the commercial unit was improved before the unit was given the new name.

NAVIFLASH contains special software that permits the device to be routinely used shipboard for all present and future Navy-specific, fuel testing requirements. It includes dedicated, Navy operating programs that can be changed when required. These programs were especially designed by NSWCCD-SSES for testing shipboard fuels (F-76 and JP-5). Additionally, the unit contains in its software all of the current stringent shipboard operation requirements as specified in the Fleet onboard testing guide, Naval Ships Technical Manual (NSTM). It also is equipped with Navy-specific calibration and automated data collection programs. Using this software, flashpoint data can be off-loaded to a computer and tracked for future reference.

NAVIFLASH is now widely used by the Fleet and is currently aboard more than 100 ships. Acceptance of the method has become so widespread that an even more advanced design flashpoint tester may soon become available from the manufacturer. The newest unit will be renamed MILLIFLASH when MINIFLASH is used by the military. Various MILLIFLASH designs are under consideration by the MINIFLASH manufacturer.

MILLIFLASH will be a completely militarized version of MINIFLASH and so it will be even more versatile than NAVIFLASH. MILLIFLASH will be an automated flashpoint testing device that will be specifically targeted for use, not only by the Navy, but also by the Air Force, Army and Marine personnel. To this end, it will contain specialized, dedicated military test programs, each specifically geared for a designated military service. Thus, new programs will be considered that would be useful, specifically for each of these other military services just as NAVIFLASH was designed especially for the Navy.

NAVIFLASH's success was based on forward, advanced engineering ideas generated within NSWCCD-SSES and the commercial instrument supplier. Its present world-wide acceptance demonstrates its commercial excellence and usefulness in maintaining Fleet safety.

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