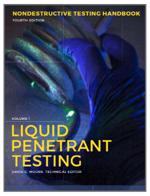

Liquid Penetrant Testing NDT Handbook
Fourth edition

Errata – 1st Printing 10/16

The following text correction pertains to the *Liquid Penetrant Testing Classroom NDT Handbook*. Subsequent printings of the document will incorporate the corrections into the published text.

The attached corrected pages apply to the first printing. In order to verify the print run of your book, refer to the copyright page. Ebooks are updated as corrections are found.

Page	**Correction**
5	**Figure 2.** Aftermath of material failures: (a) defective welds in gas pipelines led to explosion and destruction in San Bruno, California, 2010; (b) boiler explosion; (c) problems in pipe seam welds, including hook cracks, led to major oil spill in Mayflower, Arkansas, 2013; (d) ~~corrosion and fatigue cracks led to failure of pin and hanger assembly of the Mianus Bridge in Greenwich, Connecticut, 1983;~~ collapse of I-35W Bridge in Minneapolis, Minnesota, 2007;(e) inadequate inspection of rails and switches led to train derailment and sulfuric acid spill in Farragut, Tennessee, 2002.
35	Smith Sparling enlisted the help of a Northrop chemist by the name of ~~Loyola~~ **Loy** Sockman (Figure 23) (Mooz 1992), as well as a young man by the name of Elliot Brady, and pursued the development of this idea.

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(a)

(b)

(c)

(d)

(e)

Figure 2. Aftermath of material failures: (a) defective welds in gas pipelines led to explosion and destruction in San Bruno, California, 2010; (b) boiler explosion; (c) problems in pipe seam welds, including hook cracks, led to major oil spill in Mayflower, Arkansas, 2013; (d) collapse of I-35W Bridge in Minneapolis, Minnesota, 2007; (e) inadequate inspection of rails and switches led to train derailment and sulfuric acid spill in Farragut, Tennessee, 2002.

Increased Demand on Machines

In the interest of greater performance and reduced cost for materials, the design engineer is often under pressure to reduce weight. Mass can be saved sometimes by substituting aluminum alloys, magnesium alloys, or composite materials for steel or iron, but such light parts may not be the same size or design as those they replace. The tendency is also to reduce the size. These pressures on the designer have subjected parts of all sorts to increased stress levels. Even such commonplace objects as sewing machines, saucepans, and luggage

DEVELOPMENT OF DYE LIQUID PENETRANT

During this period, a need arose for a less complex technique of surface crack testing for nonferrous components. The fluorescent penetrant test process as it existed required holding tanks, a water supply, electricity, and a darkened area for viewing the indications. A great deal of development work was going on in fluorescent penetrant test technology: sensitivity and reliability were significantly improved, but the techniques were becoming more complex in the process. The water washable technique was relatively simple and reasonably fast, but something even simpler was needed.

A Northrop metallurgist named Rebecca Smith (later Rebecca Smith Sparling) in the mid-1940s had developed a process that satisfied these needs (ASNT 2000; Betz 1963). This was the dye penetrant test technique, which has become commonly used for surface discontinuity detection.

Smith Sparling (Figure 22) graduated from Vanderbilt University, Nashville, Tennessee, in 1932 with a master's degree in physical chemistry. During the next ten years, she worked at a number of forging companies and in 1941 was in southern Wisconsin, working for Lakeside Malleable Casting. At this location, she had her first detailed introduction to the oil-and-whiting technique. Lakeside was involved in the manufacture of castings for both the railroad and the automotive industries. She became familiar with the process (Flaherty 1986).

In the mid-1940s, Smith Sparling was working in the Turbodyne Engine Division of Northrop Corporation. She was involved in the final testing of jet engines and was concerned with certain crack formation occurring on turbine blades during the test cycle. The engines were located at the top of a gantry some 3 m (10 ft) off the floor, close to the ceiling where overhead windows were located. The area was very bright in the California daylight. Smith Sparling tried various ways to use the fluorescent techniques, but to no avail. She remembered her experience with the oil-and-whiting technique in her early railroad days. She decided to try to improve the process.

She stated in one conversation, "All housewives know this about cleaning porcelain sinks. Dirt will remain in the cracks in the sink and will be highlighted against the white background of the porcelain." Smith Sparling enlisted the help of a Northrop chemist by the name of Loy Sockman (Figure 23) (Mooz 1992), as well as a young man by the name of Elliot Brady, and pursued the development of this idea.

Smith Sparling would suggest an approach, and the chemists would work on it. She would then evaluate and comment on their progress, and they would modify and innovate. This process continued for a number of years and resulted in the first

Figure 22. Rebecca Smith Sparling (1949).

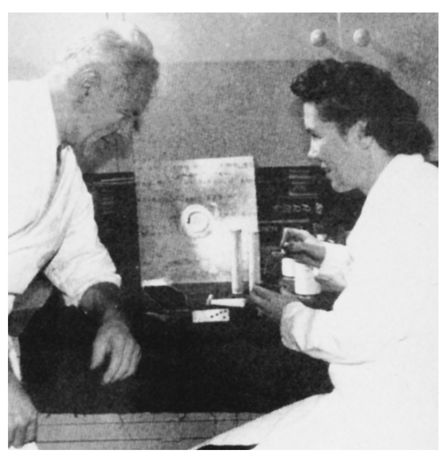

Figure 23. Rebecca Smith Sparling and Loy Sockman (1950).