NATIONAL TRANSPORTATION SAFETY BOARD
Office of Research and Engineering
Materials Laboratory Division
Washington, D.C. 20594

November 16, 2011

MATERIALS LABORATORY FACTUAL REPORT

Report No. 11-133

A. ACCIDENT INFORMATION

Place	:	Fitchburg, Massachusetts
Date	:	November 6, 2010
Vehicle	:	North American T-6
NTSB No.	:	ERA11LA050
Investigator	:	Ralph Hicks, AS-ERA

B. COMPONENTS EXAMINED

Carburetor from Pratt and Whitney R-1340 radial engine

C. DETAILS OF THE EXAMINATION

Various views of the as-received carburetor are shown in Figure 1. As indicated in Figure 2 the carburetor has the following identification markings: Bendix Stromberg Carburetor S/N 5774256, Model NA-Y9E1, Parts List 18639-7, manufactured by Bendix Products Aerospace Division, South Bend IN. The carburetor-to-engine mounting flanges are fractured in several locations, consistent with impact forces associated with the accident. The wall of the carburetor body is perforated though one of the float chambers as indicated in Figures 3 and 4. The perforation damage is consistent with an object perforating the wall from the exterior towards the interior. The float in the perforated chamber was not damaged or contacted by the perforating object or displaced metal. As indicated in Figure 4, one of the floats exhibited a fracture in the circumferential solder joint that affixes the two halves of the float.

Figure 5 shows two views of the float assembly and the typical location of the circumferential solder joints on the floats. The surfaces of the float assembly were clean and the surfaces of the solder joints used to assemble the float components had a rippled surface texture consistent with mechanical cleaning (the surface of solder joints typically have a smooth, as-fused surface). The lower float in the images exhibited a few dents and the circumferential solder joint appeared free from cracks or injurious defects when examined under a 5X to 50X stereo zoom optical microscope. The upper float in the figure exhibits a fracture in the circumferential solder joint immediately adjacent to a dent in the surface of the float. Figures 6 and 7a are higher magnification images of the dent and the solder joint fracture.

Two samples were cut from the float with the solder joint fracture as indicated in Figure 7b. One sample contained the dent and the fractured solder joint as shown in

Figure 8. The other sample is an exemplar sample of the solder joint. The examplar sample was fractured at the solder joint in the laboratory as indicated in Figure 9.

Examination of the fracture surface of the fractured solder joint sample using a 5X to 50X stereo zoom optical microscope revealed primarily areas of wetted solder interspersed with regions of dewetted voids and gas porosity. White salt corrosion product was present on the solder-wetted areas of the fracture surface on the fractured solder joint. The white salts on the fracture surface of the fractured solder joint were examined by semi-quantitative standardless energy dispersive x-ray spectroscopy (EDS) in accordance with ASTM E1508[1] (see Figure 8). Significant concentrations of carbon (C), oxygen (O), and lead (Pb) are present and minor concentrations of iron (Fe), sodium (Na), and potassium (K) are present as indicated in the typical spectrum in Figure 10. Similarly, corrosion product scraped from a soldered surface inside the float (see Figure 7b) contains significant concentrations of carbon, oxygen, and lead and minor concentrations of iron, sodium, and potassium as indicated in the typical EDS spectrum in Figure 11.

Examination of the fracture surface of the lab-fractured solder joint on the exemplar sample using a 5X to 50X stereo zoom optical microscope revealed primarily areas of wetted solder interspersed with regions of dewetted voids and gas porosity. EDS analysis of a faying surface of the example solder joint lab fracture (See Figure 9) revealed significant concentration of tin (Sn), copper (Cu), lead, and minor concentrations of oxygen, carbon, and iron as indicated in the typical spectra in Figure 12.

The chemical composition of the float base metal, as determined by EDS and x-ray fluorescence[2], is consistent with type 304 austenitic stainless steel.

Michael K. Budinski
Chief, Materials Laboratory Division

[1] American Society for Testing Materials E 1508 Standard Guide for Quantitative Analysis by Energy-Dispersive Spectroscopy, 2008.
[2] Thermo Scientific Niton XL3t-980 x-ray fluorescence (XRF) alloy analyzer.

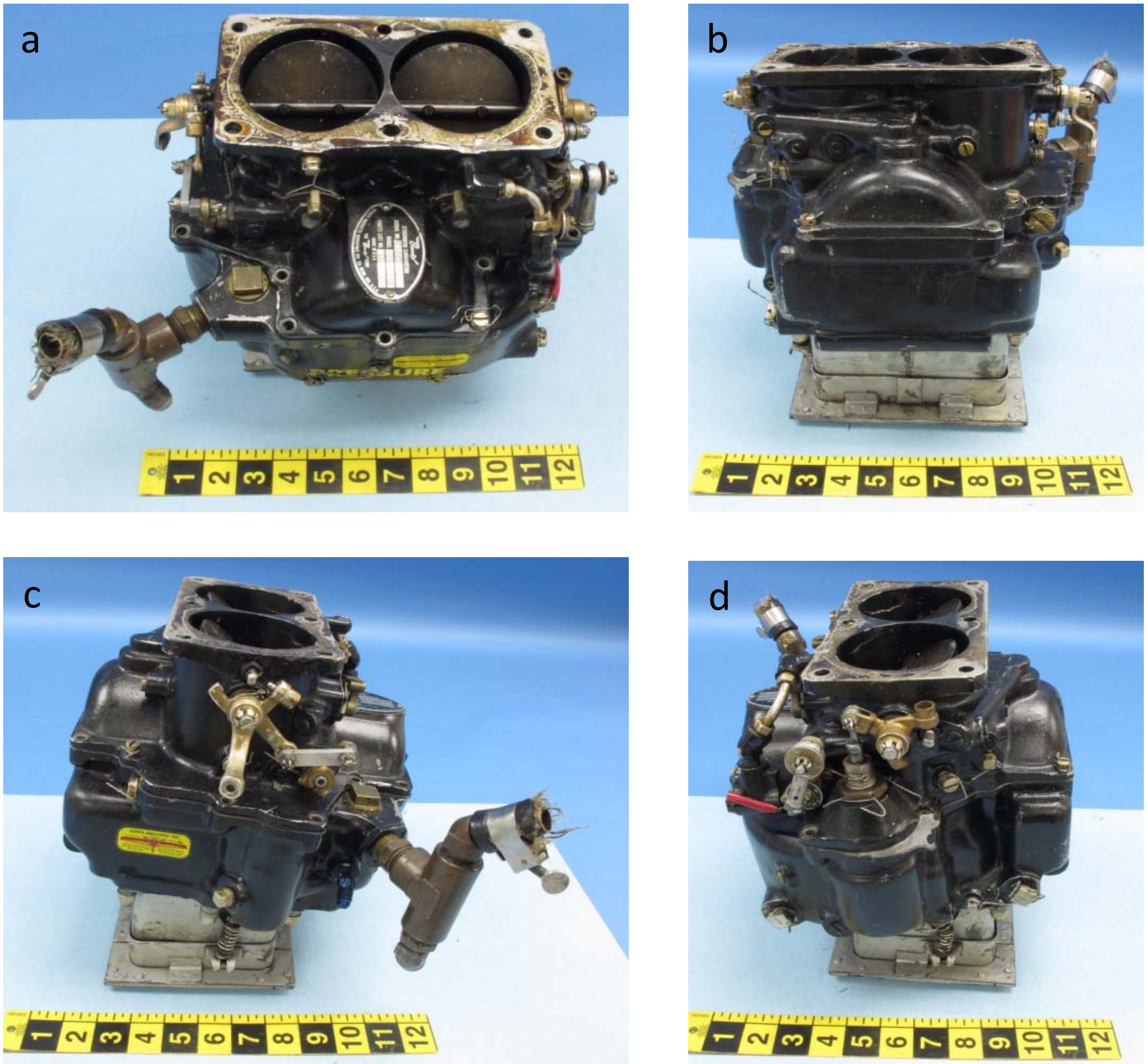

Figure 1 Picture is oriented in a manner normally mounted to the engine (the upper flange mounts to the engine intake and the bottom flange mounts to the air intake system.

Figure 2 Picture of the carburetor data plate.

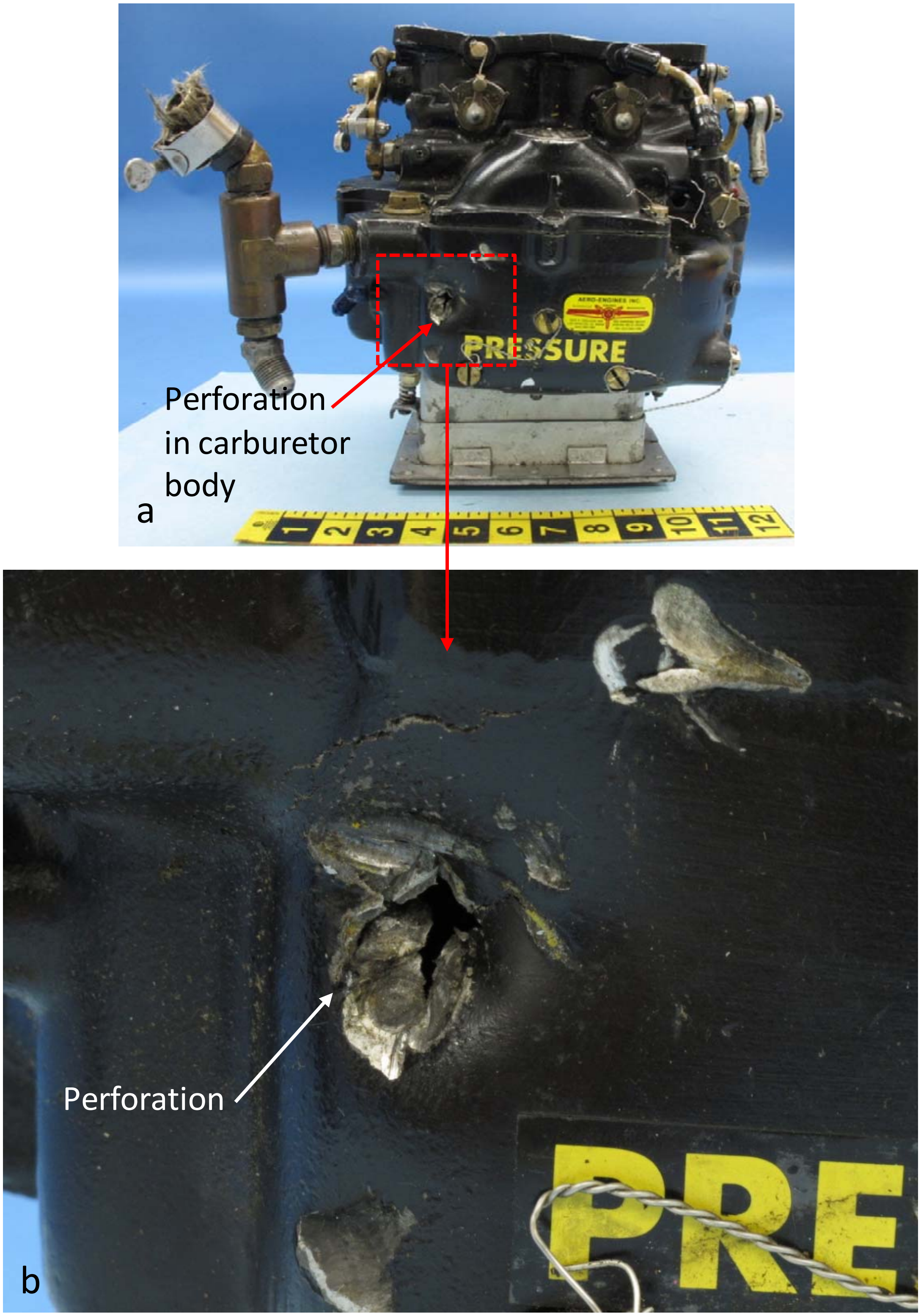

Figure 3 Images showing the perforation through the wall of the carburetor body into a float chamber.

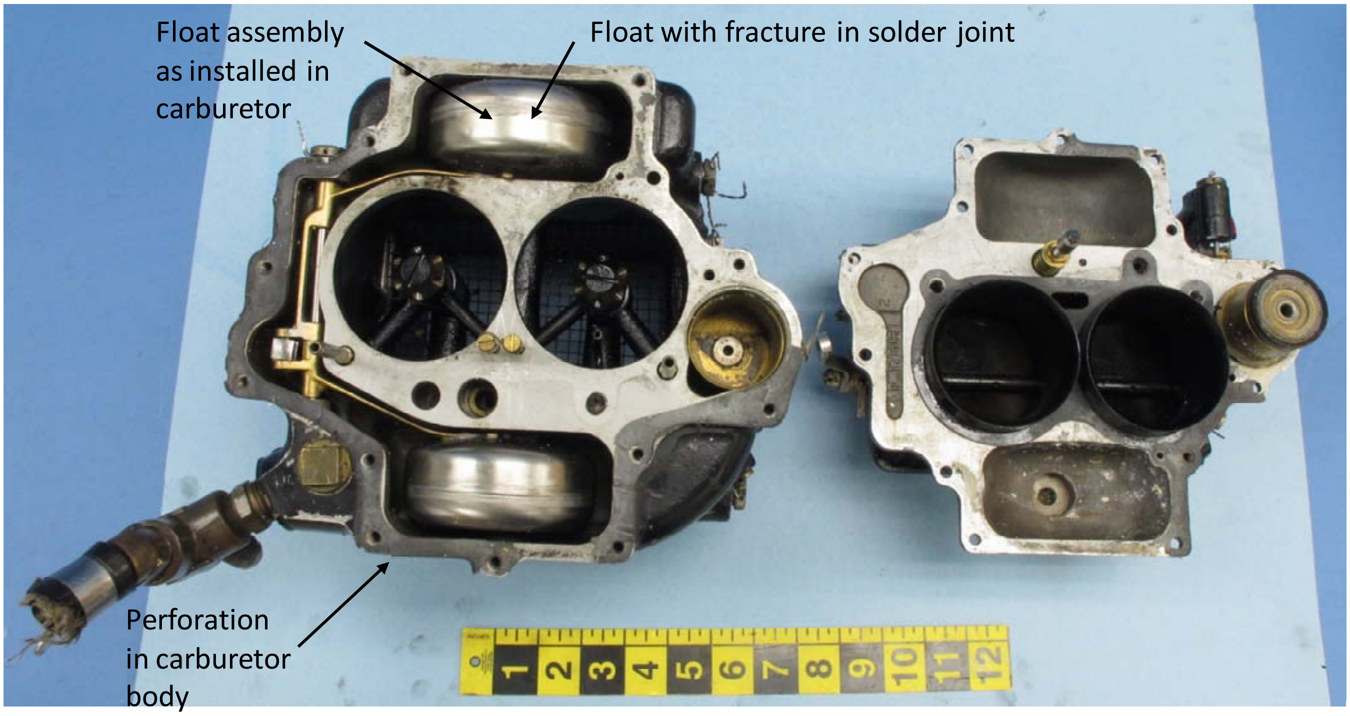

Figure 4 Top down view of the partially disassembled carburetor showing the location of the float assembly.

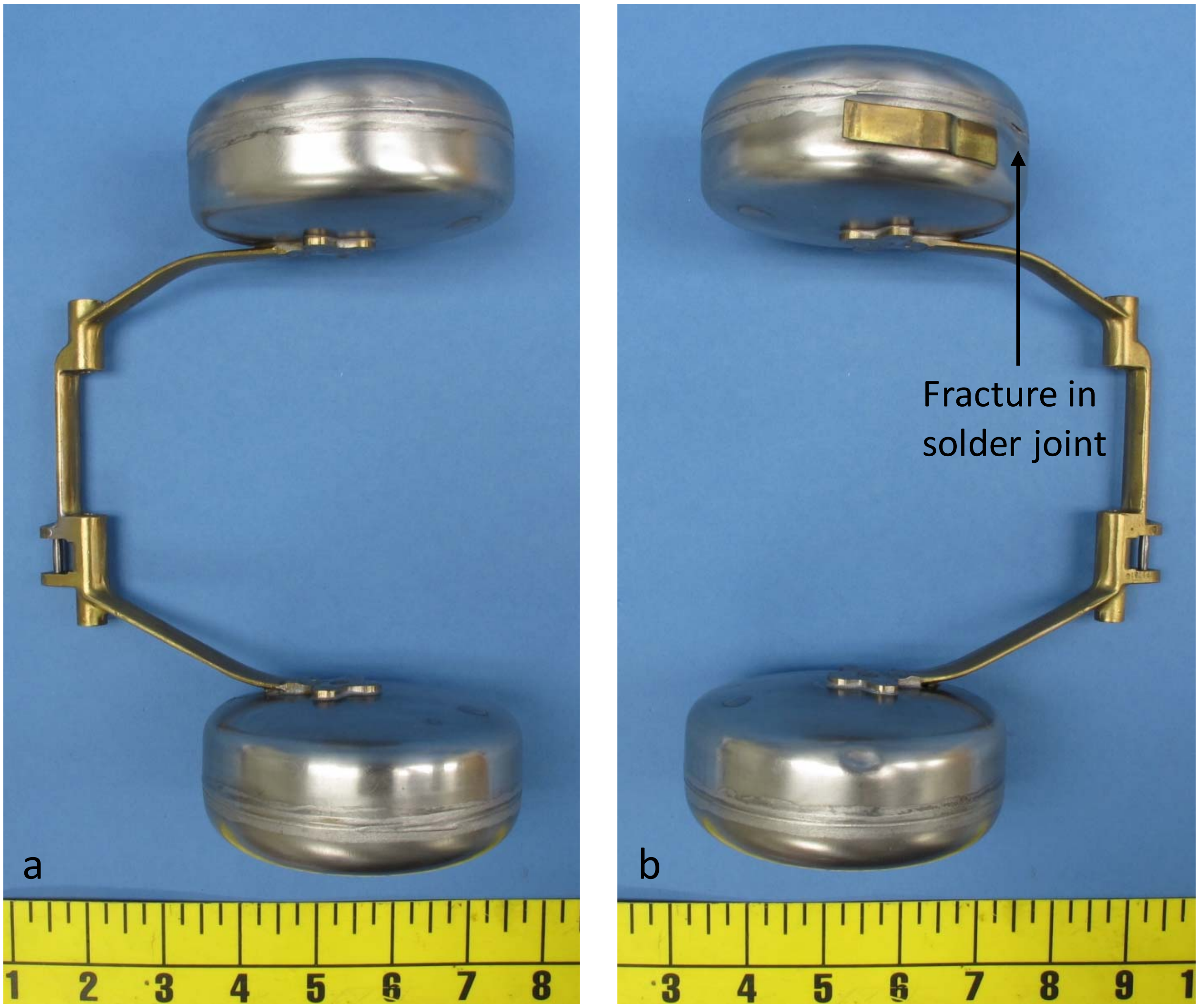

Figure 5 Two views of the float assembly. The fracture in the solder joint of the upper float is identified in view (b).

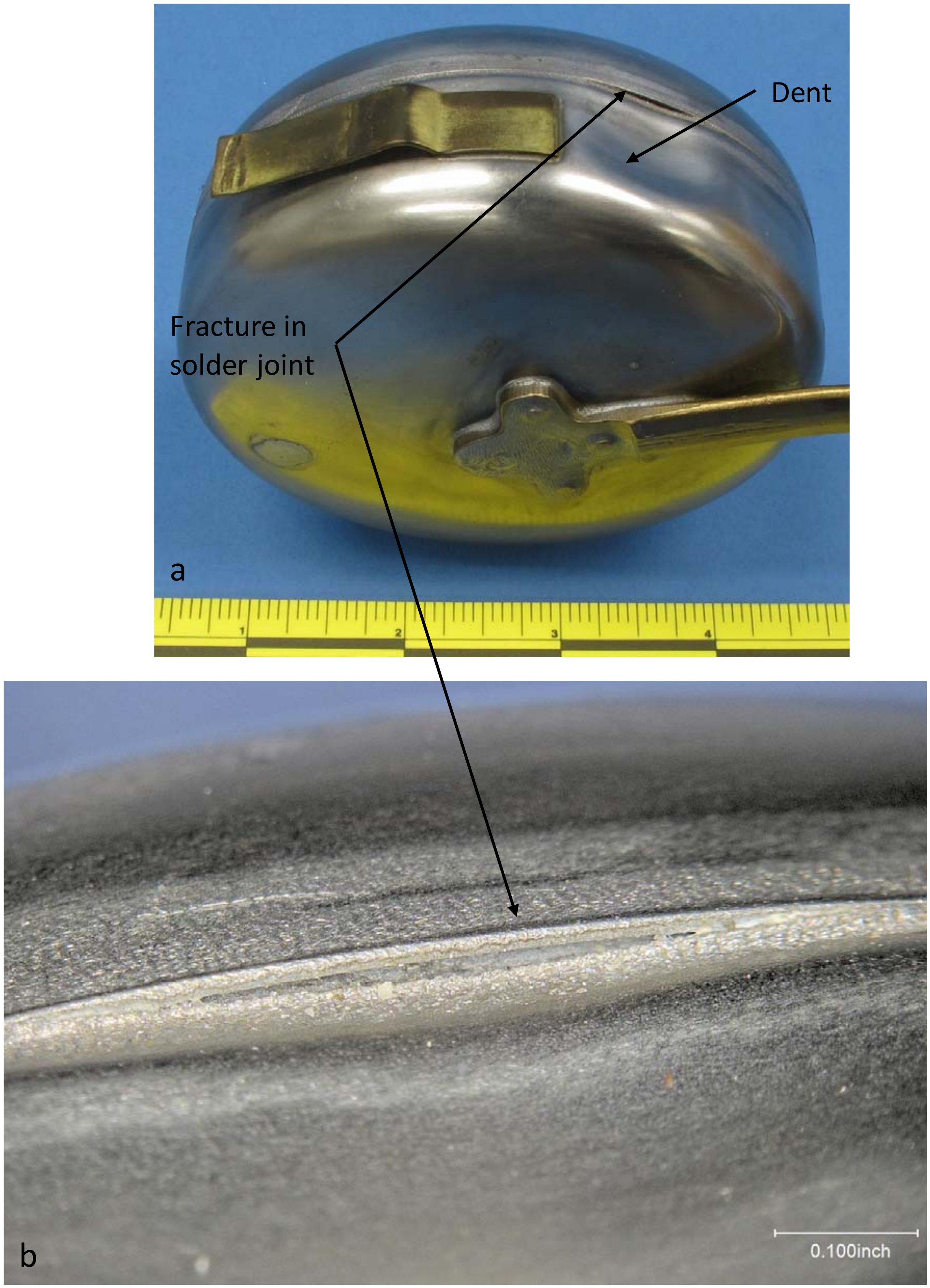

Figure 6 View (a) showing a dent on the surface of the float and a fracture in the solder joint. View (b) is a closer image of the solder joint fracture.

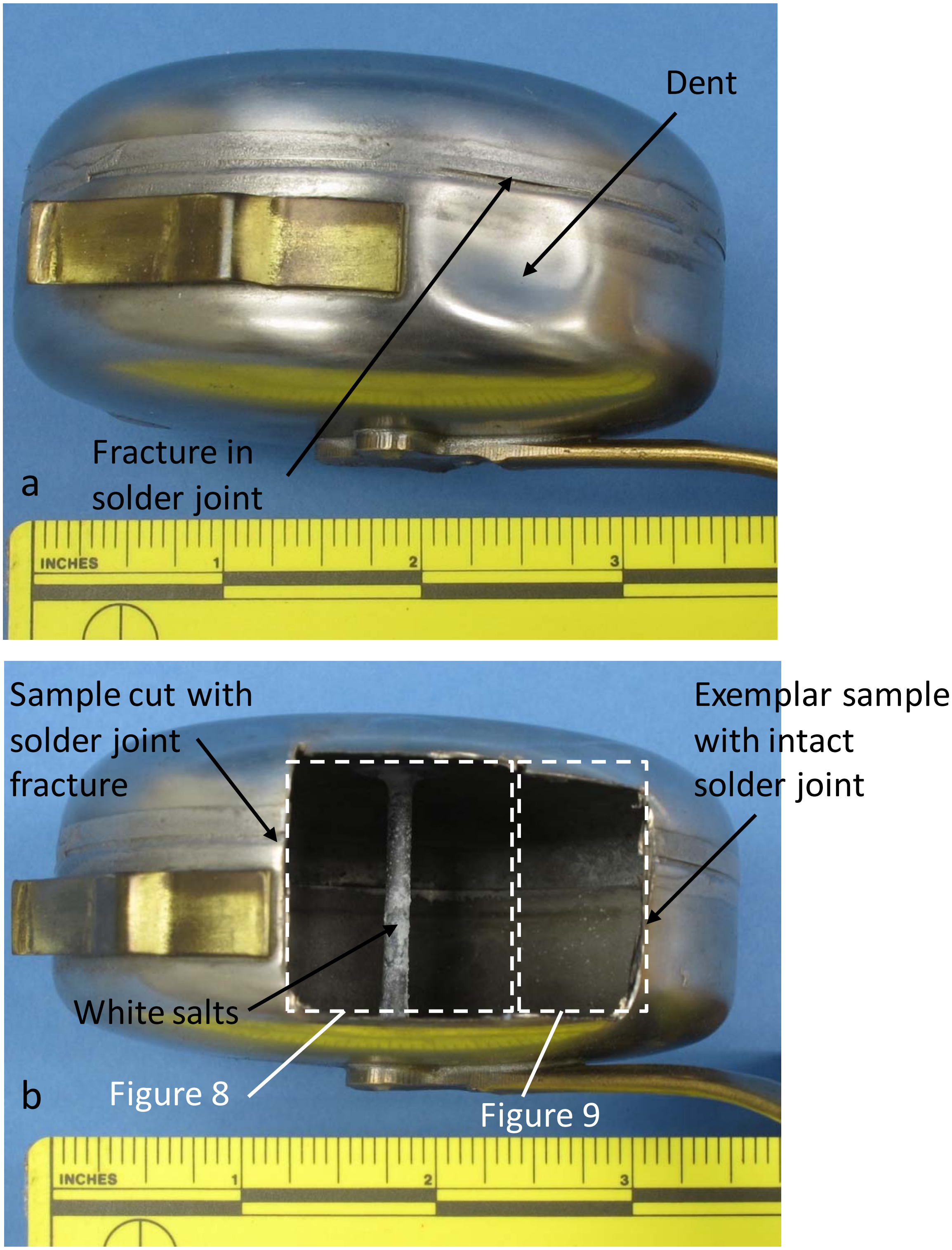

Figure 7 Images of the float with the fractured solder joint before (View (a)) and after (View (b)) removal of samples for further examination.

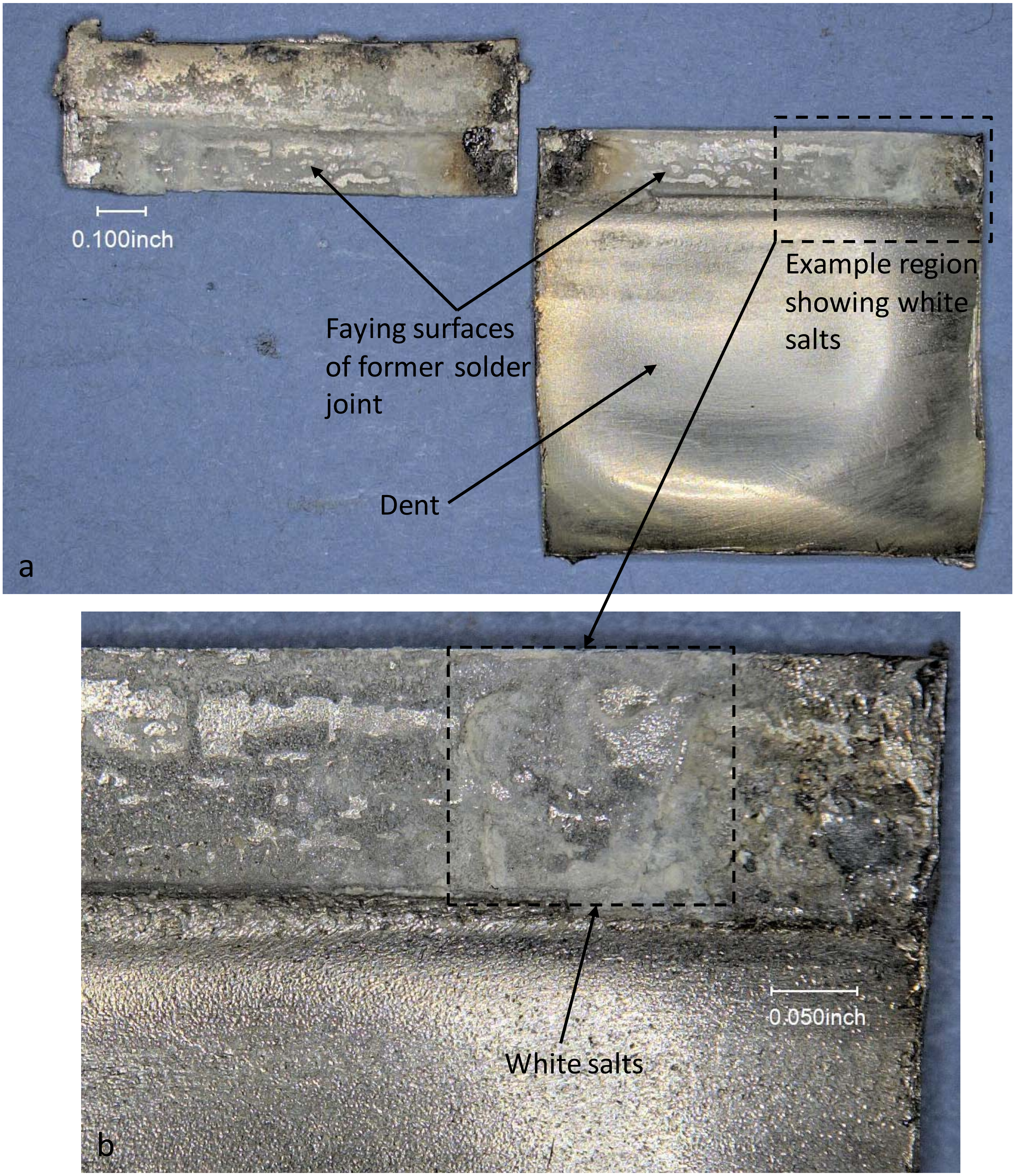

Figure 8 The fracture surfaces of the fractured solder joint after removal from the float is indicated in Figure 7.

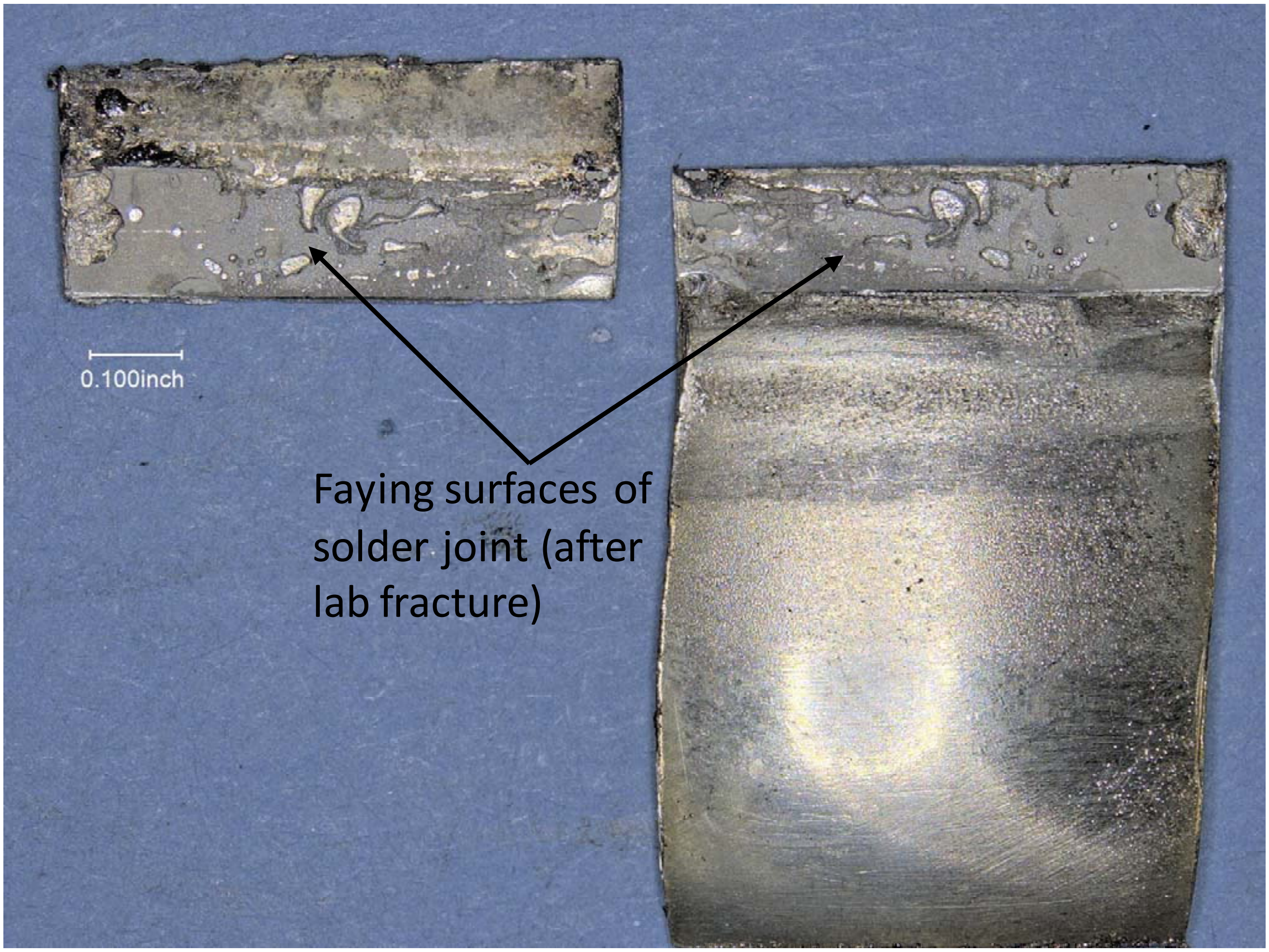

Figure 9 Sample removed adjacent to the area with the fracture solder joint (See Figure 7) showing fractured surfaces created by lab fracturing.

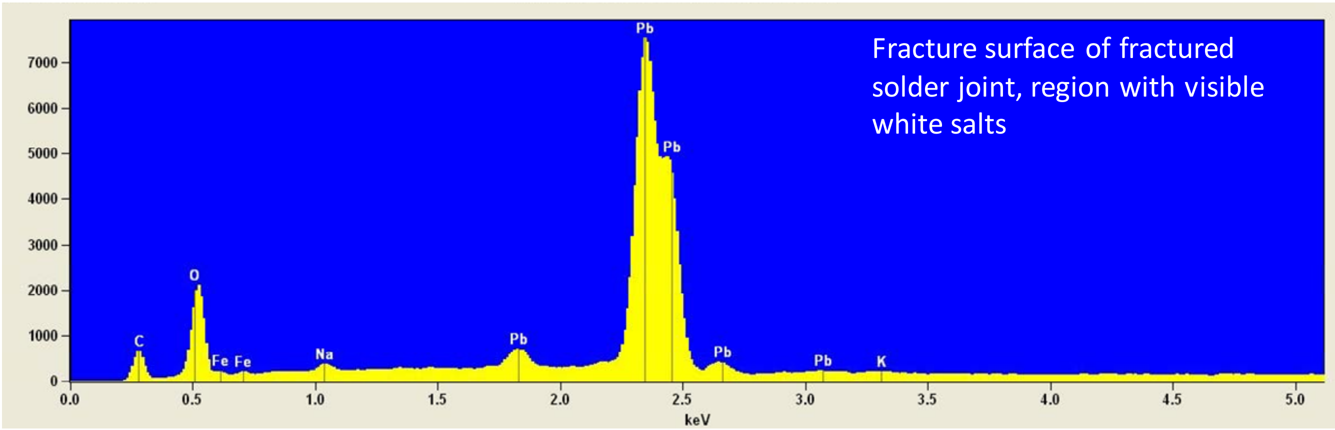

Figure 10 EDS spectra from an area on the fracture face of the fractured solder joint exhibiting significant white salts.

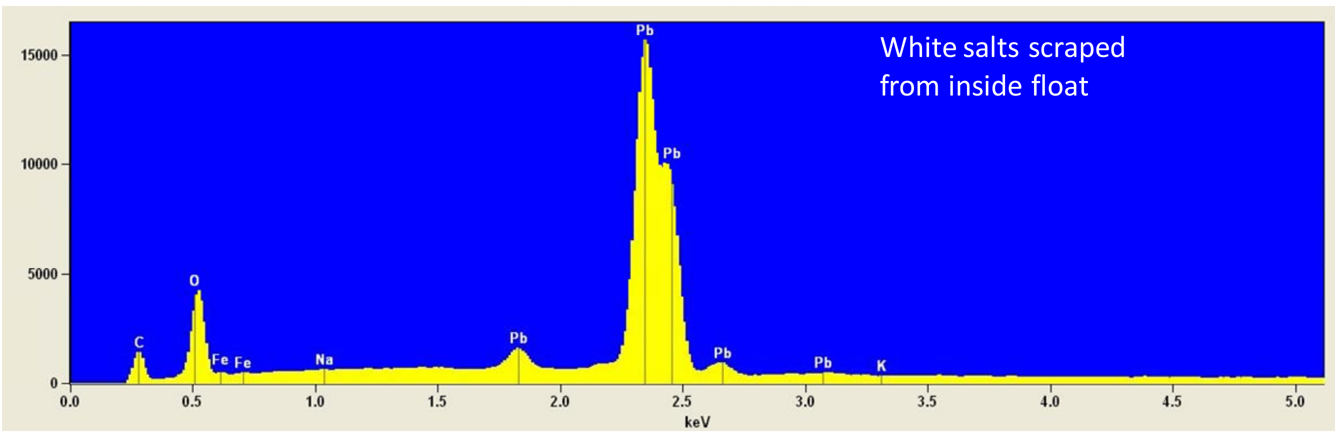

Figure 11 EDS spectra of white salts scraped from a soldered surface inside the cracked float.

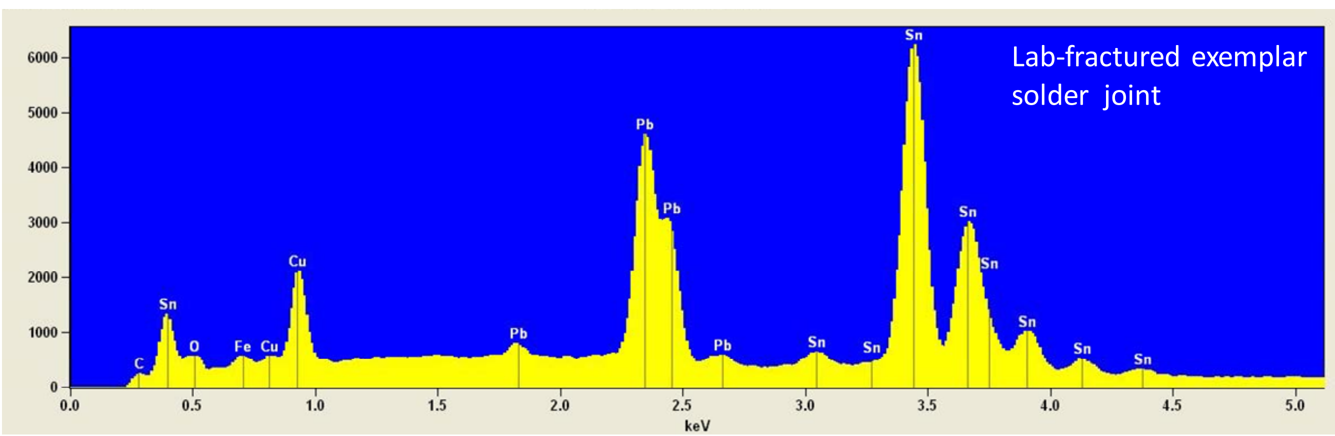

Figure 12 EDS spectra of the fracture surface of the example solder joint.