

Genomics Experiments in Human-Tended Suborbital Spaceflights: Using Shuttle and ISS Sample Handling

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Abstract

Commercial suborbital vehicles present the opportunity to explore the earliest biological adaptations to microgravity. For the first time in spaceflight, the first few minutes of transition from high *g* loads to microgravity will be accessible to human tended experimentation. To bring the operational benefits of human tended experimentation to the study of spaceflight, genomics and gene expression, we suggest the use of Kennedy Space Center Fixation Tubes (KFTs). KFTs can hold biological samples and molecular biology fixative in separate chambers, and then bring the fixative into the sample chamber upon activation by the crew. KFTs are well established flight hardware with ISS and Space Shuttle heritage.

KFTs are paper-towel-tube sized sample and fixative containers that have been used effectively

on the Space Shuttle, the ISS and in several flight environments including parabolic flights on KC-135, C-9, B-272, T-6 and F104 aircraft. KFTs provide all necessary levels of fluid containment for safety in a variable gravity environment.

To activate the KFT and bring the fixative fluid into the same compartment at the sample, a series of twisting and plunging movements releases the seals between the compartments. Once preserved during flight the samples are stable at ambient temperatures for the remainder of flight and recovery operations. Analysis of samples occurs post flight. Spaceflight applications have primarily been with the RNALater preservative for downstream nucleic acid and protein analyses, and microscopy fixatives such as glutaraldehyde.

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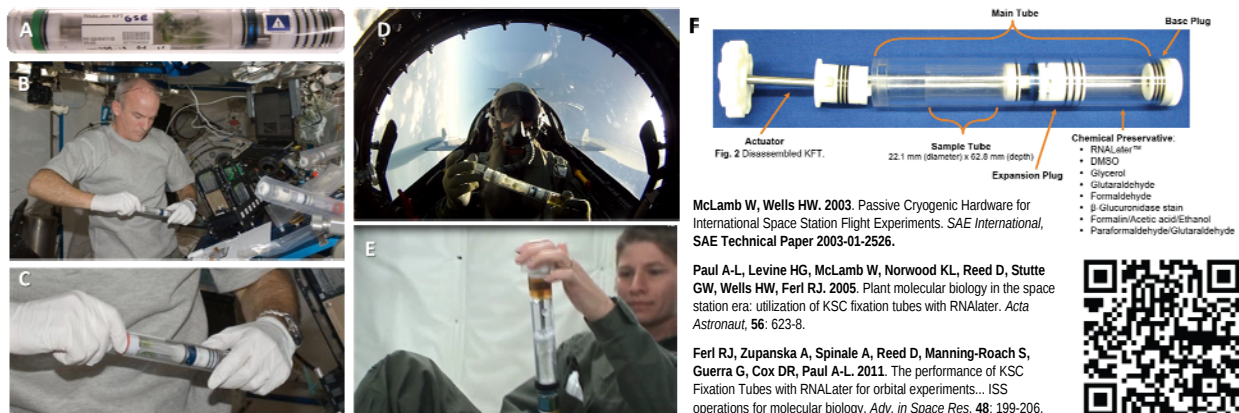


Figure: KFT deployment environments and information. The KSC Fixation Tubes are robust sample holding, sample fixation modules that are small, lightweight and highly effective pieces of spaceflight hardware. (A) The KFT has multiple layers of containment that keeps the preservative safe from the operator and allows a rapid mixing of the preservative and the sample during flight (B and C). In addition to the space shuttle and the ISS, KFT have proven successful in multi-g environments, including F104 flights (D) and in typical parabolic flights as experienced on the C-9 (E). In multi-g (D) and micro-g (E) flight applications such as suborbital flights the KFTs can be transported, activated and then stowed in the leg pockets of flight suits. Additional information can be found in web-based information and publications; literature citations and NASA KFT information QR code provided in (F). See also NASA Technical Report # 20160005191; Kennedy Space Center Fixation Tube (KFT) - S. Richards, H. Levine, V. Romero. <https://ntrs.nasa.gov/search.jsp?R=20160005191> 2017-10-10T02:21:21+00:00Z.