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DEVELOPMENT OF A TOOL FOR MULTI-LAYER INSULATION MANIPULATION AND  
HANDLING**Abstract**

Most active satellites run out of propellants before any defects that inhibit their functionality occur. Refueling those satellites with on-orbit servicing missions would allow for significant lifetime extensions. A NASA project report from 2010 estimates a number of about 140 satellites that will be put out of service by 2020 and would have profited from such an extension. Outlined here is the design and testing of a tool for the cutting and handling of multi-layer insulation used in the thermal design of satellites. This task is required to expose the fuel ports on traditional satellite designs, where on-orbit servicing was not intended, rendering it an important part of the refueling procedure. For this purpose, multiple concepts were developed and rated through a technical assessment as suggested by the Association of German Engineers (VDI) product development guidelines. The solution that was found to be the best fit to the requirements consists of a heating wire for thermal cutting and a holding utility based on gecko adhesion. The adhesive approach, while only holding on to the topmost layer of the thermal blanket, works due to a heat-sealing of the cutting edges, effectively fusing the layers of the cut-out into one piece. This tool has been manufactured as a prototype to perform multiple tests in which the functional reliability has been validated. Finally, a demonstration using a satellite replication and a robotic manipulator has been performed. Due to the very good cut quality, relatively easy implementation, great flexibility and a reliable connection between the holding utility and the created cut-out, the tool has to be considered as a viable option to perform (on-orbit) manipulations on a satellites thermal blanket.