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MAKING OF THE VENUS CONCEPT WATCH 1.0

Abstract

Over the past year we have celebrated the 50th anniversary of planetary exploration, which started with the Venus flyby of Mariner-2; and the 35th anniversary of the Pioneer-Venus multi-probe mission where one large and three small probes descended to the surface of Venus, encountering extreme environmental conditions. At the surface of Venus the temperature is about 460C, and the pressure is 92 bar, with a highly corrosive supercritical CO_2 atmosphere. At a Venusian altitude of 50 km the pressure and temperature conditions are near Earth-like, but the clouds carry sulfuric acid droplets. Deep probe missions to Jupiter and Saturn, targeting the 100 bar pressure depth encounter similar pressure and temperature conditions as the Pioneer-Venus probes did. Mitigating these environments is highly challenging and requires special considerations for designs and materials. While assessing such space mission concepts, we have found that there is an overlap between the extreme environments in planetary atmospheres and the environments experienced by deep-sea explorers back on Earth. Consequently, the mitigation approaches could be also similar between planetary probes and diver watches. For example, both need to tolerate about 100 bars of pressure – although high temperatures are not factors on Earth. Mitigating these environments, the potentially used materials are: titanium for the probe and the watch housing; sapphire for the window and glass; resin impregnated woven carbon fiber for the aeroshell's thermal protection system and for the face of the watch; and nylon ribbon for the parachute and for the watch band. Planetary probes also utilize precision watches, thus there is yet another crosscutting functionality with diver watches. Our team, from the Innovation Design Engineering Program of the Royal College of Art, have designed and built a concept watch to commemorate these historical events, while highlighting advances in manufacturing processes over the past three to five decades, relevant to both future planetary mission designs and could be use to produce deep diver watches. In this paper we describe our design considerations; give a brief overview of the extreme environments these components would experience on both Venus and Earth; the manufacturing techniques and materials we used to build the Venus Watch; and its outreach potential to bring a distant concept of planetary exploration closer to Earth. We will also address lessons learned from this project and new ideas forward, for the next generation of this concept design.