Temperature Measurement with the Mechanical Space Thermometer for the Tanpopo Mission

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Temperature in the space is very interesting as astrobiology because it control the life and death of the creature in space environment. The mechanical thermometer using a bimetallic strip coil was developed for the Tanpopo mission. The Tanpopo mission is a multi-year passive exposure experiment for astrobiology exposure and micrometeoroid capture onboard the Exposed Experiment Handrail Attachment Mechanism (ExHAM) at the Japanese Experiment Module 'Kibo' (JEM) Exposed Facility (EF) on the International Space Station (ISS). The Tanpopo mission apparatuses were launched by the SpaceX-6 Dragon CRS-6 on April 14 2015, from the Cape Canaveral Air Force Station in the U.S.A. Since its microbial exposure experiment requires recording the maximum temperature that the Tanpopo exposure panel experiences, we have developed a mechanical thermometer with no electric power supplied from the ExHAM. At a given time and orbital position of the ISS, the thermometer indicator was video-imaged by the extravehicular video camera attached to the Kibo-EF and controlled from the ground. With these images analyzed, we were able to derive the temperatures of the Tanpopo exposure panels on the space pointing face of the ExHAM as shown in Fig.1. Nine times of observation of the thermometer was carried out in 2015. The maximum temperature was 26.4±5 ℃. Now this passive and mechanical thermometer is available to other space missions with no electric supplies required and thus highly expands the possibility of new extravehicular experiments and explorations for both human and robotic missions.

Keywords: International Space Station, Tanpopo, Mechanical Space Thermometer

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No.	Observation Time GMT (2015/D/T)	Sun Beta Angle (degree)	Max. Temp. (℃)	Min. Temp. (℃)
1	153/01:00 ～ 08:00	73.772 ～ 73.738	−8.8±5	−12.5±5
2	159/09:50 ～ 16:50	53.874 ～ 52.542	−11.1±5	−21.0±5
3	164/13:00 ～ 20:00	29.963 ～ 28.611	16.4±5	−0.6±5
4	170/21:00 ～ 171/06:00	1.747 ～ 0.179	17.5±5	−3.4±5
5	184/00:00 ～ 06:00	−28.325 ～ −28.170	23.9±5	−1.6±5
6	194/17:15 ～ 23:40	0.845 ～ −0.263	20.9±5	3.4±5
7	349/03:30 ～ 11:00	−15.081 ～ −16.486	26.4±5	6.9±5
8	355/11:40 ～ 18:00	−45.075 ～ −46.313	−8.9±5	−20.9±5
9	362/11:40 ～ 18:40	−73.652 ～ −74.172	−27.2±5	−35.3±5

Fig.1 Results of Temperature Measurement

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