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MEMORANDUM

Lyndon B. Johnson Space Center

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TO: LA/Manager, Space Shuttle Program

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W. E. Rice

SUBJ: STS-5 Postflight Reports

Enclosed are the STS-5 summary reports for the DTO/DSO's sponsored by SLSD individuals.

1. DTO 0602 Cabin Atmosphere Verification
2. DSO 0401 Validation of Predictive Tests and Countermeasures for Space Motion Sickness
3. DSO 0402 Cardiovascular Deconditioning Countermeasures Assessment
4. DSO 0408 Near Vision Acuity
5. DSO 0904 Investigation of STS Atmospheric Luminosity

STS 5

DTO 0602 CABIN ATMOSPHERE VERIFICATION

W. J. Rippstein

The purpose of the subject DTO was to obtain a cabin atmospheric sample to allow postflight evaluation of the cabin atmosphere for trace contaminant gas buildup. Because of the toxicity effects of mixtures of trace levels of contaminant gases in the crew cabin, it is imperative that these contaminant gases not exceed established maximum allowable concentrations.

This DTO required the acquisition of one cabin atmospheric sample during the STS-5 mission. The sample was taken by the crew and the time of sampling was recorded on the label provided on the sampling cylinder.

The sampling cylinder was returned to the JSC Toxicology Laboratory postflight for analysis. The attached copy of the laboratory report containes a list of the compounds found in the sample. The quantity of each compound detected is also contained in this listing. Of the seventeen compounds listed, only two were present in sufficient quantities worth discussing. The remaining fifteen compounds are all several orders of magnitude below their respective spacecraft maximum allowable concentrations.

Methane was present again in an unexpectedly elevated concentration. Although this concentration was 114.8 parts per million (ppm) this amount of methane offers no health hazard. Carbon monoxide was present at 1.02 ppm. The spacecraft maximum allowable level is 25 ppm. The 1.02 ppm value is of no toxicity consequence, but is significant in that it has only been detected on one other mission at this level.

From the atmospheric contaminant standpoint, OV-102 has proven to maintain a relatively clean and safe cabin atmosphere.

TABLE 1

STS-5 ATMOSPHERIC ANALYSIS

COMPOUND	S/N-4[a,b]	
Methane	114.774	(75.108)
Carbon Monoxide	1.021	(1.837)
Butene	0.683	(1.563)
1,1,2-Trichloro-1,2,2-Trifluoroethane	0.009	(0.069)
Ethanal	0.016	(0.029)
2-Propanone	0.026	(0.061)
2-Butanone	0.003	(0.010)
Dichloromethane	0.006	(0.021)
2-Propanol	0.004	(0.009)
Ethanol	0.051	(0.096)
Benzene	< 0.001	(< 0.001)
1,4-Dimethylbenzene	< 0.001	(0.002)
1,3-Dimethylbenzene	< 0.001	(0.001)
Toluene	0.002	(0.008)
Siloxane	0.011	(0.174)
Siloxane	0.004	(0.072)
Siloxane	0.002	(0.040)
Total for all compounds	116.615	(79.101)

[a]Concentrations not in parenthesis are in ppm

[b]Concentrations in parenthesis are in mg/m^3

DSO 0401: VALIDATION OF PREDICTIVE TESTS AND COUNTERMEASURES FOR SPACE MOTION SICKNESS

Jerry L. Homick, Ph.D.

PURPOSE AND BACKGROUND

Experience from previous manned space flight indicates that if no corrective actions are taken, up to 40% of Shuttle crewmembers could experience some degree of space sickness during the first few days of flight. Because of its complexity and uniqueness, this biomedical problem cannot be resolved solely with ground based research. It is essential that data be collected systematically on individuals who fly Space Shuttle missions in order to obtain final and valid solutions.

A Detailed Supplemental Objective (DSO) was developed to initiate this data collection process with the STS-1 through STS-4 missions. A nearly identical DSO was implemented for the STS-5 mission. A primary objective of this DSO was to conduct inflight observations, supported by a series of pre and postflight data collection procedures, on STS-5 crewmembers in an effort to validate ground based tests which may be predictive of susceptibility to the space sickness syndrome. An additional objective was to implement crew testing procedures which would enable acquisition of data to be used in validating motion sickness countermeasures.

ACCOMPLISHMENTS

At approximately F-120 days, each crewmember completed a questionnaire designed to elicit pertinent information regarding past experiences with the various types of motion environments and responses to those environments. The questionnaire indicated that all crewmembers had a minimal history of motion sickness susceptibility. During approximately the F-120 to F-30 period of time, the crewmembers were tested for susceptibility to experimentally induced motion sickness in the JSC Neurophysiology Laboratory. The standard Coriolis Sickness Susceptibility Index (CSSI) test was used. The results indicated that there was some variation between crewmembers in terms of their susceptibility to the CSSI test, however, they were all in the moderate to high range of resistance. Between approximately F-120 and F-60 days, the crewmembers conferred with the STS-5 Crew Physician to select a preferred anti-motion sickness medication. Where a need was indicated, the efficacy of the selected medication was confirmed by using the CSSI test.

In accordance with the NASA medical operations policy for the propylaxis and treatment of space sickness, all crewmembers utilized anti-motion sickness medication during the early phase of the mission. One of the crewmembers experienced moderate space sickness symptomatology during the first two days of flight. Another crewmember experienced moderate symptoms during the second and third mission days. None of the crewmembers reported any vestibular disturbances during landing or postflight.

DISCUSSION

With the exception of postflight off-vertical rotation and sudden-stop rotation tests which have yet to be performed, the objectives of this DSO were satisfactorily met. However, significant additional data on future flight crews must be collected in order to resolve the space sickness syndrome issue.

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DSO 0402 CARDIOVASCULAR DECONDITIONING COUNTERMEASURE ASSESSMENT

Michael W. Bungo, M.D.

a. Purpose: To counteraffect the potentially deleterious effects that microgravity has on the cardiovascular system and crew performance.

b. Description: Each crewperson consumed between 24 and 32 oz. of saline prior to entry interface as specified in the experimental protocol. Cardiovascular responses to orthostatic stress were measured during the post-flight physical exam, compared to preflight values, and expressed as a "Cardiovascular Index of Deconditioning" (CID).

c. Results: The attached table lists the CID for all Shuttle crewpersons to date. * indicates a crewmember who utilized the countermeasure. Cardiovascular tolerance to orthostatic stress was improved with the saline loading countermeasure, significant to a $p < .003$.

Space Shuttle

Cardiovascular Index of Deconditioning

Crewmember	CID
1	45
2	66
3	49
4	53
5	33*
6	46
7	38
8	28*
9	2*
10	5*
11	10*
12	33*

* Indicates use of saline countermeasure

Average CID without countermeasure: 49.5 $\pm$9.5

Average CID with countermeasure: 18.5 $\pm$14.4

$p<.003$

STS 5

DSO 0408 NEAR VISION ACUITY

James M. Vanderploeg, M.D.

A. PURPOSE

Changes in visual acuity for near vision were reported by the STS-4 crew. This DSO was developed in order to measure and assess the significance of changes in near vision acuity in weightlessness. The measurements are planned for STS-5 through STS-8.

B. DESCRIPTION

Performance of DSO 0408 on STS-5 involved each crewmember measuring his near vision accommodation with a Krimsky Rule. Each crewmember placed the Krimsky Rule against his cheekbones and held the vision card at the end of the rule. Observing the smallest sized print which he could see clearly, the vision card was moved forward until the print began to blur. The point on the rule at which blurring occurred was recorded on the data card.

The objective was to obtain two preflight measurements, two inflight measurements, and one postflight measurement. Two preflight and one postflight measurements were obtained on all four crewmen. The CDR and MS1 obtained two inflight measurements. The PLT and MS2 obtained one inflight measurement.

C. CONCLUSION

Analysis of the data revealed no significant change in the near point of accommodation for any of the crewmen with the possible exception of one eye of the CDR. The objectives of the DSO were only partially met in that only one inflight data point was obtained on two of the crewmen. Additional data collection on the next three flights will be necessary in order to identify any significant change in near vision acuity from weightlessness.

DSO 0904 INVESTIGATION OF STS ATMOSPHERIC LUMINOSITY (GLOW EXPERIMENT)

Nighttime photographs taken by the crew of STS-3 revealed that there was an observable luminosity or glow of unknown origin enveloping certain parts of the Orbiter. This luminosity was particularly evident on the tail section and on the aft engine pods in directions corresponding to the windward side of the vehicle.

Because of the importance of shuttle glow as an optical contaminant to the high sensitivity astronomy of aeronomy experiments which will be carried on future shuttle mission, further experiments to study the glow were carried out on STS-4 and STS-5.

The STS-4 results indicated that it was possible to obtain spectral measurements of optical emissions in the vicinity of the Orbiter using a simple grating-camera system. During STS-5 spectral measurements were repeated using the 70 mm camera/diffraction grating system and additionally a 35mm camera/image intensifier/diffraction grating system. A not overly favorable velocity vector direction was experienced which reduced the intensity of the spectra obtained. This together with the superimposition of the night glow spectra makes interpretations difficult, however, quantitative analysis is in progress. Preliminary analysis of the prints indicates that the glow spectrum is diffuse and is in the red part of the spectrum. STS-5 results have verified that the glow is dependent on the velocity vector of the vehicle. An investigation of the glow intensity as a function of the angle between the surface normal and the velocity vector is underway.

Ed Michel 1-5-83
SM Coordinator