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25 June 1970

MEMORANDUM FOR: Director of Special Activities

SUBJECT : Pressure Suit Comparison

Two (2) pressure suits are currently being used in the IDEALIST Program, the MC-3 partial pressure suit for "C" Model flying, and the S1010 full-pressure suit for "R" model flying. The purpose of this Memorandum is to briefly compare and contrast the two (2) systems.

A. Partial pressure suits apply a mechanical pressure (squeezing action) over the body's surface by means of capstan/torso bladders. The torso bladder is inflated to the same pressure as delivered to the oxygen-inflated helmet, and is connected to the helmet so that slight changes in pressure during the breathing cycle are compensated for automatically. The capstans are elongated bladders which, when inflated, apply equal counterpressure by tightening the inelastic material of the pressure suit over the extremities. The partial pressure suit is only capable of maintaining a 40,000 foot equivalent altitude. 100% oxygen is breathed at all altitudes.

B. A full-pressure suit is a pneumatic pressure suit that can be visualized as a man-shaped, form-fitting pressurized cabin. When inflated to balance the required oxygen pressure in the lungs, the full-pressure suit expands away from rather than squeezing the body. Since the oxygen pressure delivered to the lungs is balanced by gas pressure instead of mechanical pressure, comfort in the

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inflated full-pressure suit is greatly improved over the partial pressure suit. The full-pressure suit maintains a 35,000foot equivalent altitude and 100% oxygen is breathed at all times. Full-pressure suits were chosen for this program because of the predicted long-flight plans. These suits provide greater mobility, lessen the chance of decompression sickness, and maintain a sea-level oxygen environment.

C. Physiological protection provided by the partial-pressure suit:

Altitude ft	Equivalent Oxygen Altitude ft	Equivalent Pressure Altitude ft
40,000	10,000	40,000
50,000	"	"
63,000	"	"
100,000	"	"

D. Physiological protection provided by the full-pressure suit:

Altitude ft	Equivalent Oxygen Altitude ft	Equivalent Pressure Altitude ft
35,000	sea level	35,000
40,000	"	"
50,000	"	"
63,000	"	"
100,000	"	"

E. Comparison of exposure altitude unpressurized with suit pressure applied:

Applied Altitude ft	Suit Pressure (psi)
38,000	0.5
42,000	1.0
47,000	1.5
53,000	2.0
62,000	2.5
77,000	3.0
Space	3.5 Ma. pressure

F. Results of Extremely High-Altitude Decompressions

Because of some catastrophic occurrences during high altitude flight in pressure suits, many test programs have been conducted to try and determine survivability in a grossly reduced barometric pressure environment. The loss of a pressure-suit glove in an F-104 resulted in a fatal accident a few years ago because of a faulty glove ring lock. It has been well established that such a leak as would be created from glove loss is more than the pressure suit can build up; therefore, no counterpressure is provided the pilot.

Chimpanzee decompressions have illustrated that some mammals tolerate this hostile environment better than others. For example, chimps have been decompressed to 133,000 feet without fatal results. However, time at altitude has been less than three (3) minutes. Investigators teach us that survivability most likely can be contributed to the tough skin of the Chimp acting as a pressure suit which would not be the case in man.

Project decompressions in chambers have been performed at Detachment G with the urine-collecting device open allowing for a ninety (90) liters per minute leak to ascertain if the suit can maintain pressure and to measure the amount of emergency oxygen required for descent in such a configuration. Both suit pressure and oxygen utilized were nominal.

G. Figure I (attachment) compares the cabin pressure altitude of the "R" Model with the aircraft altitude.

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Office of Special Activities

Attachment
As stated above

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1 - Addee
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Figure 1. Cabin and S-1010 PPA Pressure Schedules