SHUTTLE ORBITER
HABITABILITY STUDY

CONTRACT SUMMARY REPORT
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PREPARED FOR NASA BY

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FOREWORD

II
Convenient access to hygiene compartment throughout entire
Call out location which is readily accessible to space couches.

Flush with deck personnel.
Flush engineer provided with ability to maintain visual contact
Social orientation of space couches.
Reorientation of crew compartment component to improve
Emergency hatch.

Provisions for adequate escape aisle (passageway) from couches to

In the mock-up for this configuration were as follows:
The design recommendations which were developed and incorporated

X-axis docking crew compartment/X-axis docking
Shuttle Orbiter Crew compartment/X-Axis Docking

DESCRIPTION
TASK
SECTION
deck area with much more versatile hardware.

We illustrated that to accomplish this goal, we would require a larger flight

meant of separate leisure and sleep facilities in that area.

area we were requested to look into with the objective being the establish-

The isolation of the flight deck from the crew compartments was another

convenience during launch, reentry and zero-G flight.

convenience. A flexible compartment system for the compartment was suggested

out the passenger compartment, and into space craft related activities.

important to consider less strenuous techniques of maneuverability through-

With the knowledge that future space flights may include the elderly, it was


during the various flight modes.

In developing concepts aimed at solving the problems of space craft access

In the passenger compartment study, lowrey/sandro was primarily interested

Shuttle Orbiter Passenger Compartment and Flight Deck Flexibility

DESCRIPTION

TASK

SECTION
不可能做出有效且自愿的使用一次性使用装置，使患者遭受不必要的痛苦，从痛苦中解脱。

为了探索在第II阶段可能的解决方案，虽然在第II阶段提出了一些有趣的想法，但设计的目的是各种解决方案的系统化，旨在消除洗碗柜内手洗用具的不必要使用，通过将洗碗柜/洗碗机收集器和手洗用具放在相邻的洗碗机中，节省了空间并减少了更换的需要。
The privacy screen is in place, all are located within arm's length of the crewman and obtainable while mental controls and emergency equipment are organized for quick retrieval.

This change allows the support planes to be designed to the maximum allowed space frame rather than being contained within it as in early concepts. The small passenger coach body support plane ride on top of the structural launch.

It adjusts from flat for sleeping, to upright, for in flight leisure and

than the larger coach.

maneuvers into the same orbitations, and carries more storage space limited to 77.5" L X 27.5" W X 14" D. It performs the same functions and couch helped establish the design direction for the smaller one which was experience and knowledge gained from the development of a large passenger.

Small Passenger Coach
concepts as explained in the final report. Partition were achieved by incorporating specialized packaging and graphic 80 cubic feet, the desired goal. Reductions in food retention and pre-

mination dead air space and reduced the overall volume to less than

than retrieved U-shaped face as in the MSC system. This modification

layout was that we recommended that a single data work face be used rather

resulting in three concept systems. A significant change in the system

preparation process. Two-dimensional sketch and layout studies conducted

a reduction in overall volume and a simplification of the food retrieval.

a design concept they had developed for the operator with the goal being

MSC requested that Raymond Lowey/William Shank, Inc. review

Order Food System and Cartel

DESCRIPTION

TASK

SECTION

6
When not in use, and collapsible units which would totally or partially fold out of sight. Concerns for the overhead storage units included both fixed units and ease of access.

The clothing resterums were organized for maximum space efficiency. Areas by order level to prevent soiling of relatively clean items. Recommended that the garments should be segregated into isolated placed on the prevention of odor transfer between garments. We placed emphasis on the development of the overhead clothing storage unit.

Temporary Clothing Restatum

DESCRIPTION

TASK

SECTION
P1 - Two accepted clothing layouts and article sizing

P2 - Clothing restraint using rotating rods to lock

P3 - Partitioned cavity restraint - netting restraints

P4 - Minimum area restraints - rotary wire frames
Concepts presented included the use of non-porous, easily cleaned belts

Physical access and minimum body contact.
area of the restraint across the chest area for optimum visual and
were established and emphasis was placed on minimizing the surface
parameters for an efficient seat belt to be used in the hygiene facility

The system which was maximum simplicity.

An adjustable restraint device which we felt defined the objective of
variations in their elbow and shoulder which necessitated the design of
system was to accommodate a full range of body sizes. The dimensional
additional study demonstrated that the concept was unrealistic. If the
95% made crew personnel when a seat belt restraint was not required.
An elbow and shoulder restraint was able by 5% female through and including
As a result of the study, interest was developed in investigating

DESCRIPTION

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SECTION

(Phase II)
Reconfiguration

used to their fullest extent because of present requirements placed on
able relationship between compartments. Special volumes have not been
lowery/morillo does not feel that this solution adequately produces a work-

orbieter, if prevents effective of the available space.
usbable space in the compartment. Positioned through the center of the
orbieter was constructed to analyze the impact of the skewed-
between dimensions. The model illustrated that a negative habitability factor
A 1/20 scale model of an MSF layout of the Z-axis docking Airlock Shuttle

Skewed Z-axis Docking/Airlock Shuttle Orbiter

DESCRIPTION

TASK

SECTION
The concepts developed were to allow the restricted individual to walk parallel to a work bench utilizing various movable or random access points selected. Therefore, were the wrist and both feet.

natural bending and limit the reach of a restricted individual. The re- and that any rigid restricting device above the waist would inhibit.

It was decided that a three point restraint was necessary for stability.

both areas are required to adequately produce a positive restraint.

Although individual illustrations centered on either the foot or waist area,

as necessary to complete a particular task.

It was lowery’s finding that a successful flexible positive restraint

particular task.

of the necessary for restraint, thus allowing him to converse fully on this

aimed to cover the largest work area possible without a conscious awareness.

a limited amount of controlled movement was pursued in order to allow

the development of a flexible positive restraint which will allow a crewman

Flexible Positive Work Station Restraint (Phase I)
Adjustment
14 - Foot Restraint with Foam Pad and Tension

Floor Area of Workbench
13 - Matting Restraint Devices on Sole of Shoe and

Coupled with Belt Loops
12 - Horizontally Adjustable Restraint Arm Which

Fastener on Belt
11 - Flexibly Restraint Arm Which Adjustable to Bullet
slope configuration of the crewman's shoe.

and reverse movement along a track. The foam-covered bar conforms to

An adjustable toe bar located near the base of the unit allows forward

bench.

Length adjustment allows the crewman to adjust his distance from the

The track allows the arms to slide the length of the bench while the arm

In use, the arms fold out of a recess and couple into the crewman's belt.

sliding track with couplers located on adjustable fold-away arms. When

From the bench, the front surface of the bench also incorporates a

free lateral movement with slack adjustment to enable movement away

belts system was located on the front surface of the bench which allowed

was constructed incorporating all of the selected concepts. A closed loop

To better evaluate the effectiveness of each system, a presentation model

selected location.

reversing back and an adjustable toe bar resistant to restraint feet in a

including a wider belt which incorporates with fold-away arms, continuous

In Phase I, a lower/ammunition layout illustrated the practicality of several concepts

DESCRIPTION

TASK

SECTION
out screen which folds away when not in use.

house features and personal effects. Privacy is provided for by a roll
visions, which are accessible while on the space couch are included to
support for crew members during launch and reentry. Storage pro-
during leisure, sleeping, eating periods in zero-G and provide proper

The couch is designed to provide all immediate needs of the crewman
neutral buoyancy testing.

The purpose of this model was to demonstrate and evaluate the features

Shuttle Orbiter Passenger Couch - Full Scale Mock-Up

DESCRIPTION

TASK

SECTION
K3 - Full Size Demonstration Model in Sleep Mode

K2 - Full Size Demonstration Model in Sleep Mode

K1 - Full Size Demonstration Model in Leisure Mode

With Privacy Screen
The data format card is designed to serve as a guide to SkyLab astronauts for evaluation of tasks and equipment at scheduled intervals in the Skylab missions. All responses to questions on the data format sheet are volce.

**Description**

**Task**

**Section**
sent to MSC.

A light visual scale model of the selected concept was fabricated and pre-

rector mock-ups.

The design of the unit was developed with the aid of full scale human

build it a container becomes punctured.

their use priority, and are entirely enclosed to prevent dispersion of

for carrying cleaning agents and wipers have been designed accordingly to

may be carried as one or separately. The storage units within the caddy

The caddy and vacuum unit were designed as two interlocking units which

activities.

supply of wipes, disinfectants, etc. to support General housekeeping

vacuum unit and a portable "caddy" section equipped with a limited

three basic parts: a master storage unit for central supply, a portable

The housekeeping equipment stored in the galley facility consists of

Housekeeping Equipment Storage

DESCRIPTION

TASK

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23
Threaded latches arranged in a matrix in the structure.

These latches are attached to the simple structure by inserting threaded fasteners into the outer case based on the physical constraints of that location. The larger storage option would be to provide the largest storage size possible for each storage size.

The object of the master locker size able in various sizes based on a set modular growth pattern (i.e. 24'' X 16'', 48'' X 24'', etc.). The storage locker which would be available.

The system developed utilizes standard storage locker which is interchangeable.

The trays sizes are dependent on the size of the storage locker being used. However, the components on the trays are restricted using various techniques. The unit to a location within the space.

Single tray or several as a unit, if necessary, to transport that particular

This gives a common option in order to remove an entire locker, a

trunk (mounted horizontally, vertically), as a unit or individually.

Inside the storage lockers is a system of trays (slid into "C" shaped ex-

not designed as a single component.

Design of each piece of equipment which are single mission related and

is that a flexible storage system will reduce requirements for custom

transporting a variety of experiments, equipment and mission supplies

therefore, a locker system must be developed which will lend itself to

mission storage requirements may vary from one mission to another.

DESCRIPTION  

SECTION

TASK  

N
contain, may be removed as desired. The system from which individual trays lie in local storage as required. The end result of this system is that a totally flexible storage arrangement between horizontal trays allows one to subdivide the case horizontally as required. Stacking vertical trays enables it to be subdivided vertically at one-inch increments into any proportions desired relative to mission storage. Letter trays slot together in the same manner. Using trays as wide and interlock with each other to interlock with the extruded inside walls by using interlocking inserts which interlock with the extruded inside walls of the interior of the master storage locker is then divided up as required.