Section 6: Test Procedures
Evaluation of the Effect of Promethazine on Performance of Crewmembers Using the Portable In-Flight Landing Operations Trainer (PILOT) Ground-based Protocol

Training Sessions

1. Verify that the subject briefing was conducted, subject information handout was read and signed, informed consent was read and signed, and subject was screened for contraindications to Promethazine (PMZ) administration.
2. Complete Test Readiness Checklist before proceeding.
3. Complete the front and back of subject pretest questionnaire. (On subsequent visits only the front side will be filled out)
4. Familiarize subject with the different tasks. See:
   PILOT operating procedures for setup and operation
   Intuous Graphics Pad for setup and operation

5. Direct subject to perform landing task six times
6. Perform motor-coordination tests

The landings and motor-coordination tests can be conducted up to four times in one day. There also must be a 10-minute break between each training session. Additional training sessions must be scheduled within 48 to 72 hours of previous training session.

Eight training sessions must be completed before the subject may proceed to the Experimental phase. Once all training sessions have been completed, schedule subject for Experimental Session 1.

Experimental Session 1

7. Post the "Testing in Progress" sign on the cypher lock. (The electronic keypad allowing access to the main door of the PATDOME)
8. Verify Test Readiness Checklist is complete before proceeding.
9. Complete the front side of the subject pretest questionnaire.
10. Measure and record blood pressure, pulse rate and respiration rate.

    NOTE: If at any time during the experiment, the subject's pulse and/or blood pressure is not within the corresponding range listed below, vital signs will be remeasured in 5 minutes. If at that time any measurement remains outside the recommended range, the medical monitor will be contacted and clearance from him/her will be required before proceeding with the remainder of the experiment.

Systolic blood pressure:	$90 \leq x \leq 140$ *mm Hg*
Diastolic blood pressure:	$50 \leq x \leq 90$ *mm Hg*
Pulse:	$50 \leq x \leq 100$ *beats/min*

11. Review protocol and potential side effects of promethazine
12. Complete symptom checklist, collect saliva sample and perform sleepiness scale.
13. Direct subject to perform landings
14. Perform motor-coordination tests
15. Administer 50-mg promethazine (or placebo, depending on group assignment) orally and also provide a small cup of water to the subject to take pill with.
    Note time of administration.

NOTE: During the next 8.25 hours, the steps outlined under "Post-Drug Assessment" will be conducted periodically. No subject activities are scheduled in the time between assessments; however, the subject **will not** be allowed to leave the laboratory until after 4 hours post drug administration. Prior to the session, the subject will be instructed to bring something to occupy his time during these periods.

16. At 1-hr post drug administration, measure and record blood pressure, respiration rate and pulse rate.

17. **Begin Post-Drug Assessment (steps 18-21) one hour after administration of drug/placebo.

Post-Drug Assessment

**Note: Post-Drug Assessment times are scheduled at 1-, 2-, 3-, 4-, 6- and 8-hrs post-drug administration. When directed to start a post-drug assessment, please start the procedures ~10-min prior to the actual hour. This will ensure that PILOT and motor-coordination tests will be performed as close to the hour as possible.

18 Collect saliva sample and conduct sleepiness scale
19. Complete symptoms checklist
20. Direct subject to perform six landings
21. Perform motor-coordination tests.

22. Two-hour post drug assessment procedure.

The 2-hr post-drug assessment procedures are identical to previous post-drug assessment procedures with a Stair Velocity Motion Test (SVMT) added.

Note: The SVMT will initially begin at a velocity of 2-RPM. As the chair rotates, the subject will execute 5 standardized head movements over a 20-second period. Chair velocity will be increased incrementally by 4RPM after every 40-head movements (8 sets). The test will be terminated once the subject reaches mild to moderate nausea or after 40 head movements have been performed at 30 RPM, whichever comes first.

Perform steps 18 thru 21, then proceed with step 22.1.

22.1 Make sure the main power switch for the "Operator Station," the "shortest" of the two red racks in front of you once you have entered the PAT Lab, is turned on. Power up the rotator prior to placing subject in rotator. The power box is mounted on the platform next to the silicon graphics machines, between the stairs and the wall. Flip the main power switch to "on" (this is a red switch that can be turned on by pushing upward on it) and then turn the key to the "enable" position. Once the DOME has been enabled, the light inside of the rotator should turn on. The subject can then be placed into the DOME chair.

Make sure that the step that allows the subject to easily get in and out of the DOME is in place on the platform, just in front of the rotating floor. To properly place the subject in the rotator chair, first remove the front head pad by loosening the knob that holds it in place and then taking the rod out of the housing. Place the subject in the chair, replace the front head pad and adjust all head pads to where the subject can comfortable rest their head at a 45 degree angle to the front, rear, left, and right. Ensure that subject is properly restrained which includes latching the seat belt and connecting the interlock safety system, the wires attached to the seatbelt. Once the head pads have been properly adjusted and the subject has been safely secured in rotator chair, have subject put on headphones. Step out of

DOME and place stanchions across door to prevent someone from entering the DOME while it is rotating.

Press the start button on the power box. A green light should be illuminated. If the green light is on, the rotator is ready to run. If not, something is not connected properly and the rotator will not rotate (this would most likely be the interlock system attached to the seatbelt). Bootup the desktop PC and start the Rotator Software. Perform a communication test with the subject, using the headphones, while the PC is booting up. Set the initial speed of rotator (2-rpm), the number of head movements (40), head movement interval (1-sec), and stage-step-size(4-rpm). Next, ensure that the rotator will turn in the clockwise (cw) direction. Finally, *give the file name box a file name for the subject so that the file created by the session can be analyzed at a later date.* Click the start button and the rotator will begin moving. Keep in constant communication with subject. Track all symptoms. Stop the test when subject has reached the criterion symptom level, has performed all head movements at the highest speed of rotation (40-rpm), or upon subject request.

Once subject has completed test, check vitals and then begin post-drug assessment (steps 18 thru 21).

Note: The post-drug assessment landings and motor coordination tests may count for the 3-hr post-drug assessment. If more than 20 minutes exists between the completion of the post-drug assessment tests after SVMT and the 3-hr post-drug assessment procedures, then the post-drug assessment tests after the SVMT ***will not*** *count for the 3-hr post-drug assessment. However, if there are less than 20 minutes before the 3-hr post-drug assessment, than the tests* ***will*** *count as the 3-hr post-drug assessment.*

23. Begin Post-Drug Assessment 3 hours after administration of drug/placebo (steps 18 thru 21).

24. Begin Post-Drug Assessment 4 hours after administration of drug/placebo (steps 18 thru 21).

25 After the 4 hour Post-Drug Assessment the subject is allowed to leave as long as they remain on site and do not drive or operate heavy machinery. The subject must return to the testing facility for the 6-hour session 15 minutes prior to the next scheduled testing time.

26. Begin Post-Drug Assessment 6 hours after administration of drug/placebo (steps 18 thru 21).

27. After the 6-hour session the subject is again allowed to leave as long as they stay on site and do not drive or operate heavy machinery. The subject must return back to the testing facility for the 8-hour session 15 minutes prior to the next scheduled testing time.

28. Begin Post-Drug Assessment 8 hours after administration of drug/placebo (steps 18 thru 21). Once the symptoms checklist has been completed, measure and record blood pressure, pulse rate and respiration rate.

29. Schedule Experimental Session 2 (1 wk – 10 days after Experimental Session 1 drug/placebo administration)

Experimental Session 2

1. Complete steps 1 – 28 of Experimental Session 1 administering the opposite preparation (i.e., if drug was administered at Experimental Session 1, placebo will be administered at session 2. If placebo was administered at Experimental Session 1, drug will be administered at session 2).

The IBM ThinkPad 760 XD setup instructions for the Portable In-flight Landing Operations Trainer (PILOT) software with a Rotational Hand Controller (RHS)

In order to run the PILOT software you must have an IBM ThinkPad (resembles a laptop computer) and a RHC which resembles the landing hand control that is used in space flight.

The RHC has a serial connector and a power cord. The serial port connector plugs into the back of the ThinkPad and fits into one plug. The power cord plugs directly into a standard wall plug. The RHC should be plugged into the ThinkPad and wall prior to turning on the ThinkPad.

The ThinkPad should then be turned on and booted to the Windows 95 interface. Once the system is setup, click Start and go to Shutdown. Once the shutdown menu appears restart the ThinkPad in MS_DOS mode.

In order to get to PILOT you must load the software into the C:\pilot\pilot_D2 directory. To get to this directory type cd \pilot\pilot_D2 at the C:\windows cursor. The directory should appear. Once in the directory, type pilot and hit enter.

In order to begin PILOT you must first calibrate the RHC. Follow the onscreen directions for pitch. You must pitch down then up and also roll to the left then right. Once through the calibration screen, the main menu will appear.

When the main menu appears there will be 8 categories on screen. Categories 1-2 and 6-8 are to remain constant; however, categories 3-5 can be changed. In order to change any of the following categories type in the number of the category and then press enter twice.

Category 3 ''Ic location'

Gives you the option of landing at various altitudes
(3500 ft, 10,000 ft, 50,000ft from the left and 50,000 from the right)

Category 4 ''Landing site'

Gives the option of landing runways and the type of day.
All landings occur at Kennedy Space Center (KSC), however you can chose runway 15 or 33 day or night.

Category 5 ''Wind file'

Gives the option of wind conditions for landing.
Options include: no wind, modest wind, or severe wind conditions.

After you have chosen your conditions for landing press enter and you will see another menu. Follow the instructions. Press enter to begin simulation.

In order to ensure a successful landing keep the triangle enclosed inside of the circular target. In order to do this use the RHC to pitch up or down or roll from right to left.
When landing is complete and the shuttle is on the runway, it will flow smoothly on the runway without control from the RHC. The speed should decelerate after landing. When the speed reaches about 180-165 slightly pitch the RHC forward to bring the nose down.
The screen will then go to statistical information. Press the space bar after each screen. After the statistical information the main menu should appear .

**If the landing does not run smoothly the ThinkPad will shut down and you must reboot by typing the word pilot into the directory and recalibrating the RHC.

If there are any questions refer to the Flight Procedures Handbook

LIFE SCIENCES TEST READINESS REVIEW BOARD

1. PROTOCOL TITLE
Evaluation of the Effect of Promethazine on Performance of Crewmembers Using the Portable In-Flight Landing Operations Trainer (PILOT): Ground Based Protocol.

2. SHEET 1 OF 10

3. TRRB DATE 01-03-04

APPROVALS

The Test Readiness Review Board approves conduct of this protocol upon certification by the Principal Investigator and TRRB Chair of closure of all open items listed below.

4. TRRB CHAIR Jacob J. Bloomberg, Ph.D.	5. PRINCIPAL INVESTIGATOR Deborah L. Harm, Ph.D; Lakshmi Putcha, Ph.D
6. QUALITY ENGINEERING (If Flight Hardware) N/A	7. MEDICAL OFFICER Joseph E. Stuteville, M.D. 1/5/01
8. TEST SAFETY OFFICER ~~John Byard~~ ~~Art Wood~~ 1/22/01	9. FACILITY MANAGER (If Required by JPG 1700.1) Hanan Harpster (SA); Mary Petrovics (SD)

NO.	10. OPEN ITEMS	ASSIGNEE	CLOSED
1	RAC Codes added from FRR	B. Sakwa	1/8/01
2.	Change names accordingly (Patterson and Dietlein)	B. Sakwa	1/8/01
3.	Place correct call lists on wall	B. Sakwa	1/8/01

11. OPEN ITEMS CLOSURE APPROVALS

PRINCIPAL INVESTIGATOR (Or Designee)	TRRB CHAIR (Or Designee)
	1/9/01

Form SA-TRRB (September 1999)

TO: Test Readiness Review Board
FROM: Brian K. Sekula
SUBJECT: Delta TRR

The enclosed packet contains documentation for the delta TRR tentatively scheduled for January 3, 2001 (time to be determined) in room 1000c, building 241. Section 3 of the packet contains a brief summary of the hazards presented by the medication, PAT DOME, PILOT and motor coordination test hardware. Appendix A contains the complete Hazard Analysis of the PAT DOME, which was approved on August 27, 1998. Also, in Appendix A, information that is pertinent to this particular study has been bolded for easy identification.

Finally, this packet is identical to the one that was handed out for the previous TRR, conducted on 6-18-99. This is a delta TRR. The PAT-DOME has been relocated from building 29 to building 241. There are no changes in the setup or operation of the DOME when comparing the two configurations. All that has changed is location.

EVALUATION OF THE EFFECT OF PROMETHAZINE ON PERFORMANCE OF CREWMEMBERS USING THE PORTABLE IN-FLIGHT LANDING OPERATIONS TRAINER (PILOT)

Ground-based Protocol

Test Readiness Review

Test Summary:

The overall goal of the proposed research is to estimate, noninvasively, the bioavailability and cognitive effects of an operational dose of promethazine (PMZ) on the ground and during space flight. This Test Readiness Review is for the ground-based protocol ONLY. The specific aims of the ground-based protocol are to assess the effects of PMZ and motion sickness on cognitive performance parameters using the Portable In-flight Landing Operations Trainer (PILOT) and a motor-coordination test. The study will also evaluate the pharmacodynamics of PMZ from its concentrations in saliva and the performance results from the PILOT and motor-coordination tests.

This study will be conducted as a double-blind, placebo-controlled crossover design. Subjects will be asked to provide saliva samples before and at several times after receiving a 50-mg oral dose of PMZ or placebo. Drug concentrations in saliva will be determined and effects on psychomotor function, information processing, and alertness will be tested with both the PILOT device and the motor-coordination tests before and after dosing and motion sickness testing. The results from this ground-based protocol will be used to refine, verify, and validate data collection procedures for the flight investigation.

Test Readiness Review Board (TRRB) Approval:

The undersigned certify that the experiment as defined by the test plan is ready to proceed, and that the test configuration, staffing, operation, procedures and safety assessments are approved.

SD3 TRRB, Jacob J. Bloomberg, Ph.D., Chairman — Date

SD3 Joint Principal Investigator, Deborah L. Harm, Ph.D. (Neuroscience) — Date

SD3 Joint Principal Investigator, Lakshmi Putcha, Ph.D., (Pharmacology) — Date

SD Medical Monitor, Joseph Stuteville, M.D. — Date

NA3 Safety Officer, Robert Harris — Date

Test Plan Prepared By:

SD3 (Wyle) Research Scientist (Neuroscience) — Date

SD3 (Wyle) Senior Research Scientist (Pharmacology) — Date

Remaining actions which need closure prior to testing:

Test Plan Contents

Section 1. Institutional Review Board Approval

The investigation entitled "Bioavailability and Performance Effects of Promethazine During Space Flight" was first approved by the Johnson Space Center Institutional Review Board for Human Research n August 3, 1995 and then renewed on October 10, 1996. It was also approved on June 10, 1999. It was most recently approved by the Institutional Review Board this year on July 28, 2000.

Section 2. Test Personnel

Joint Principal Investigators:

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Wyle Life Sciences Technical Support Personnel:
Brian K. Sekula

Subjects:

Ten male pilots and shuttle simulator trainers and 10 male non-pilots/trainers will be recruited by the Test Subject Facility.

1.0 Medications.

Promethazine (PMZ), a phenothiazine and an H-1 antihistamine, is used before and after surgery as a adjunct to analgesia and for its sedative and antihistaminic effects. PMZ can be given intravenous (IV), orally (PO), IM, or as a suppository. PMZ's moderate anticholinergic effects are thought to be th source of its antimotion sickness activity. Typical side effects include dizziness, drowsiness, sedatic and impaired psychomotor performance (all typical of anticholinergics); extrapyramidal and dyston reactions are typical of phenothiazines and other dopaminergic receptor antagonists.

The pharmacokinetics of PMZ have been characterized after PO, IV, and IM doses. IV doses result biexponential declines in plasma levels, with a terminal elimination half-life of 7 to 14 hours. PMZ ha a large volume of distribution (970 L) and is about 80 percent protein bound. Its clearance is main metabolic; promethazine sulfoxide is a major metabolite and desmethylpromethazine a min metabolite. Less than one percent of the drug is eliminated unchanged in the urine. Bioavailabili after an oral dose is low, averaging approximately 22-25 percent, with plasma concentrations peaking to 3 hours after PO or IM doses. Peak plasma concentrations after IM dosing are about 4 times tho after PO administration of the same dose. The saliva (parotid) to whole blood ratio is about 0.24 aft IM and 0.20 after PO administration.

The identifiable risks, which fall into the category of reasonable physical risks, are those associat with drug administration. No alternative procedures which provide the same information exist to o knowledge.

The following risks/countermeasures apply to drug administration:

Risk:	Protective Countermeasure:
Adverse reaction	Subjects will be required to pass an Air Force Class III equivalent physical examination prior to participation in the study and will be screened for contraindications for administration of the drug. A JSC physician will be informed of all scheduled tests and the nurse will notify the physician of the date and time of planned drug administrations. The physician will be called prior to drug administration and will remain on-call throughout the test procedure. Subjects will remain in the lab for several hours post-dosing and will be given a pager number for the JSC physician should the subject feel contact is necessary after leaving the lab.
Side effects	Subjects will be briefed on the possible side effects of the study medication. Subjects will remain in the lab for several hours post-dosing and will be given a pager number for the JSC physician should the subject feel contact is necessary after leaving the lab. Subjects will not be allowed to drive a motor vehicle following any test session involving drug administration.

3.0 PILOT Description.

The PILOT was developed to assist the Shuttle Commander and pilot in maintaining the high possible level of proficiency for the end of mission approach and landing task on Extended Durati Orbiter (EDO) flights. It uses an on-orbit trainer/simulator which strongly reinforces visual cues o the temporal, proprioceptive, and otolithic cues.

The PILOT is a software package that is run on an IBM Thinkpad 760 XD. This is standard off-t shelf equipment and provides no known hazards. A joystick will also be used for the flight simulatio The joystick is manufactured by Thrustmaster, and is also off-the-shelf equipment and presents known hazards.

4.0 Motor Coordination Test Device Description.

The motor coordination test device consists of three devices: a graphics pad digitizer, a non-inking pe and a laptop computer. The graphics pad and digitizer are standard off-the-shelf equipment that provide no known hazards. The laptop computer, Inspiron 3200 manufactured by Dell Computer, is standard off-the-shelf equipment and presents no known hazards.

Section 4. Subject Informed Consent Package

All potential subjects will receive the attached subject handout at the subject briefing. During that briefing, the contents of the handout will be reviewed and all questions will be answered. After the briefing has concluded, the person wishing to participate as a test subject will sign the attached informed consent form (NASA Form 1416). The briefing must be completed and informed consent obtained **prior to** the initiation of any testing.

SUBJECT INFORMATION HANDOUT

Bioavailability and Performance Effects of Promethazine During Space Flight

Ground-Based Protocol

Most crewmembers experience at least some symptoms of space motion sickness early on-orbit. For symptoms severe enough to require medication, the drug of choice is currently promethazine (PMZ). Although anecdotal reports of PMZ use during space flight suggest that the side effects of this drug are less in microgravity than on Earth, an objective assessment of performance-related effects, in combination with bioavailability, is necessary to establish safe, effective doses for PMZ in space.

We plan to use the Portable In-flight Landing Operations Trainer (PILOT), a shuttle landing simulator device, to assess the effects of PMZ on performance both before and during flight in astronaut subjects. However, the study you are asked to participate in is being conducted to determine the effects of PMZ and motion sickness on performance parameters measured by PILOT and a set of motor coordination tests.

Protocol

This experiment consists of eight training sessions and two experimental test sessions. The experimental sessions will begin early in the morning, last most of the day, and will be separated by one week.

Training Sessions:

In order to assess performance decrements due to drug administration and motion sickness, it is necessary that you practice both the PILOT landing task, until your performance reaches a stable level, and the motor-coordination tests, until you become comfortable with the experimental procedures. Eight training sessions will be required. At each of the sessions, you will perform both the landing task and the motor-coordination tests six times. Within each motor-coordination test, there are four different tasks: 1) coordination, 2) tracking, 3) handwriting, and 4) switching. There are six trials for both the handwriting and coordination tasks for each session. There is only one trial per session for both the tracking and switching tasks. Each training session will be approximately 25 – 30 minutes in duration and can be scheduled at any time of day that is mutually convenient. Up to four training sessions can be conducted for one day. However, there must be a 10-minute rest break between sessions; and subsequent training sessions should be 24 – 48 hours after the previous training session.

Experimental Sessions:

Your first experimental session will be scheduled within 48 hours of the last training session. At each of the experimental sessions, there will be seven data collection sessions. The first will be a pre-drug administration, and the following six will be at 1-, 2-, 3-, 4-, 6-, and 8-hr post drug administration. Each data collection session will last approximately 25 – 30 minutes and will include a saliva sample, 6 landings, the motor-coordination tests, and a PILOT checklist. No other activities will be required, so please bring something to occupy yourself during the time between data collections. You will not be allowed to leave the building between arrival and completion of the 1-, 2-, 3- and 4-hr sessions. You will be allowed to leave the building after the 4- and 6-hr sessions. However, you will be restricted to walking only, and you must stay on site.

Upon arrival, you will complete a brief questionnaire. The protocol and potential side effects of PMZ will be reviewed at that time. You will then perform a "warm-up" landing and 6 additional landing simulations as well as the motor-coordination tests. You will then be asked to complete a PILOT

checklist to record any symptoms which might be induced by the landing simulator, and provide a saliva sample. A 50-mg oral dose of PMZ or placebo will then be administered.

At one-hour post drug administration, you will provide a saliva sample, perform six PILOT landings, the motor-coordination tests and then fill out the PILOT checklist. The same procedures will be followed at the 2-hr post drug administration session. However, after the PILOT checklist for this session, you will then go through a motion sickness provocation test.

The motion sickness provocation test will be conducted in a rotating chair using a modified Stair Velocity Motion Test (SVMT) protocol. In this test, you will make head movements while seated in a rotating chair. Initially, the chair will be accelerated at $6^0/sec^2$ to a velocity of 2 RPM. As the chair rotates, you will execute 5 standardized head movements (front, right, back, left, front) over a 20-second period. Each head movement will be made to one of four pads positioned at each final stop location. Before the test, the pads will be adjusted such that you will attain an angle of approximately 40^0—45^0 to the rotating axis with each head movement. Chair velocity will be increased incrementally by 4 RPM after every 40-head movements (8 sets). You will remain in the upright seated position between sets of head movements for a 20-second period.

During the test, you will report symptoms to an experienced and trained test operator after each block of 40 head movements. The test operator will also watch for external signs of motion sickness (sweating, pallor). The reported or observed symptoms will be scored for severity using the Graybiel scale of motion sickness symptoms. The test will be terminated when you reach the Malaise III (8 points) or mild to moderate nausea endpoint of motion sickness or after 40 head movements have been performed at the maximum chair velocity of 30 RPM, whichever comes first.

Once the motion sickness provocation test has been conducted, you will begin the post-motion sickness protocol, which consists of 6 PILOT landings, the motor-coordination tests and a PILOT checklist. Depending upon the length of the motion sickness provocation test, these landing trials may serve as the 3-hr data collection trials.

The remaining data collection sessions (3- or 4-hr, 6-hr and 8-hr) will be conducted identically to previous data collection sessions (pre-drug and 1-hr). The experimental session will be repeated one week later. You will receive PMZ at one session and placebo at the other. The order of administration of PMZ or placebo will be random. Additionally, the order of PILOT landing tasks and the motor-coordination tests will be balanced to eliminate changes in performance due to experimental order.

Risks

Your participation in this project involves some risk.

1. Drug administration: Drug administration always involves some risk. Allergic reactions and side effects are always possible. An allergic reaction usually consists of a mild rash, but can be more severe and even life threatening. Fortunately, the drug used in this project has been used in medicine for a number of years and experience suggests that severe allergic reactions are extremely rare. Side effects are more common. The most common side effects for promethazine are drowsiness, sedation, dizziness, impaired psychomotor performance and movement disorders. These side effects are transient. Another potential risk of taking drugs is that they can sometimes worsen certain pre-existing conditions. It is extremely important that you inform us if you have a history of any of the following:
    a. Asthma or glaucoma
    b. Difficulty in urinating
    c. Seizure disorders
    d. Kidney, gastrointestinal or liver disease

e. Heart disease, allergies or a respiratory disorder.

It is also **extremely** important that you not take any other medication at the same time as the study drug. The interaction of one drug with another is potentially very dangerous and even if the medication you are taking does not interact with the study drug, it can adversely affect the quality of the data we obtain. We ask that you not take any medications (over-the-counter or prescription) within 48 hours of a scheduled test (including the practice sessions); however, if this is unavoidable, please contact the lab to reschedule your test. Also, please refrain from consuming alcohol, caffeine, or nicotine for the 24 hours preceding any session for the same reasons.

2. Motion Sickness: Symptoms of motion sickness can include stomach awareness, nausea, sweating, headache, dizziness, and/or vomiting.

Feel free to ask any questions regarding the experimental procedure at any time. A doctor will be available for consultation.

Benefits

We cannot and do not guarantee that you will receive any benefits from this study; however, you will receive a thorough physical examination before this study and the results will be available to you.

Confidentiality

Any information obtained during this study and identified with you will remain confidential and will be disclosed only with your permission. The Food and Drug Administration of the U.S. Government may inspect the records regarding your participation in this study, but confidentiality will be maintained.

Reimbursements and Costs

You will receive $10 per hour to compensate you for the time you spend in the laboratory, if allowed by your employer.

Nonparticipation or Withdrawal

Your decision whether or not to participate will not prejudice your future relationship with the Johnson Space Center or NASA. If you decide to participate, you are free to discontinue your participation at any time and you will receive compensation for time already invested in the project.

Read this handout carefully and if you have any questions, PLEASE ASK! If after reading this information you are willing to participate in the study, please sign the attached consent form. We will contact you soon to schedule dates for the experiments.

Date: _____

_____

Signature of Investigator

_____

Signature of Subject

NASA/JSC HUMAN RESEARCH INFORMED CONSENT*

1. I, the undersigned, do voluntarily give my informed consent for my participation as a test subject in the following research study, test, investigation, or other evaluation procedure:

NAME OF INVESTIGATION BIOAVAILABILITY AND PERFORMANCE EFFECTS OF PROMETHAZINE DURING SPACE FLIGHT

FLIGHT TO WHICH ASSIGNED N/A

PRINCIPAL INVESTIGATOR Deborah L. Harm, Ph.D. and Lakshmi Putcha, Ph.D.

RESPONSIBLE NASA PROJECT SCIENTIST Deborah L. Harm, Ph.D.

I understand or acknowledge that:

(a) This procedure is part of an investigation approved by NASA.

(b) I am performing these duties as part of my employment with _____.

(c) This research study has been reviewed and approved by the JSC Institutional Review Board (IRB) which has also determined that the investigation involves reasonable risk to the subject.
(minimal or reasonable)

(d) Definitions:

"Minimal risk" means that the probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests.

"Reasonable risk" means that the probability and magnitude of harm or discomfort anticipated in the research are greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests, but that the risks of harm or discomfort are considered to be acceptable when weighed against the anticipated benefits and the importance of the knowledge to be gained from the research.

(e) The research procedures were explained to me prior to the execution of this form. I was afforded an opportunity to ask questions, and all questions asked were answered to my satisfaction. A layman's description was provided to me. **

(f) I am medically qualified to participate in the investigation.

(g) I know that I can refuse to participate in the tests at any stage of their performance, and my refusal will be honored, except in those cases when, in the opinion of the responsible physician, termination of the tests could have detrimental consequences for my health and/or the health of the other subjects. I further understand that my withdrawal or refusal to participate in this investigation will not result in any penalty or loss of benefits to which I am otherwise entitled.

(h) In the event of physical injury resulting from this study and calling for immediate action or attention, NASA will provide or cause to be provided, the necessary treatment. I also understand that NASA will pay for any claims of injury, loss of life or property damage to the extent required by the Federal Employees Compensation Act or the Federal Tort Claims Act. My agreement to participate shall not be construed as a release of NASA or any third party from any future liability which may arise from, or in connection with, the above procedures.

(i) Except as provided for by Agency-approved routine uses under the Privacy Act, the confidentiality of any data obtained as a result of my participation as a research subject in this study shall be maintained so that no data may be linked with me as an individual. I understand, however, that if a "life-threatening" abnormality is detected, the investigator will notify me and the JSC Flight Medicine Clinic. Such information may be used to determine the need for care or medical follow-up, which, in certain circumstances, could affect my professional (flight) status.

Signature: Signature:

Test Subject Date Witness Date

2. I, the undersigned, the Principal Investigator of the investigation designated above, certify that:

(a) I have thoroughly and accurately described the research investigation and procedures to the test subject and have provided him/her with a layman's description of the same.

(b) The test setup involves reasonable (minimal or reasonable) risk to the test subject. All equipment to be used has been inspected and certified for safe and proper operation.

(c) The test subject is medically qualified to participate.

(d) Except as provided for by Agency-approved routine uses under the Privacy Act, the confidentiality of any data obtained as a result of the test subject's participation in this study shall be maintained so that no data may be linked to him/her as an individual.

(e) The test protocol has not been changed from that originally approved by the JSC IRB.

Signature: Signature:

Principal Investigator Date NASA Project Scientist Date

Notes:

* This form is valid for the period including preflight, in-flight and postflight data collection sessions for the mission. Before the first baseline data collection, the Principal Investigator will repeat the briefing concerning risks involved in the investigation. A signed, dated copy of this form with attachments must be forwarded to Chairperson, Johnson Space Center Institutional Review Board, Attn: Dr. Charles Sawin, Mail Code SA, Lyndon B. Johnson Space Center, Houston, Texas 77058.

** A detailed description of the investigation will be attached to this consent form. The Principal Investigator is responsible for formulating this document, which should be in layman's terms such that the subject clearly understands what procedures will be required of him/her and the risks associated therewith.

The detailed description of the research must, at a minimum, include the following:

(1) An explanation of the purposes of the research and the expected duration of the subject's participation, a description of the procedures to be followed, and identification of any procedures which are experimental;

(2) A description of any reasonably foreseeable risks or discomforts to the subject, including, but not limited to, possible adverse reactions of all medications to be administered and any risks/hazards resulting from exposure to ionizing radiation;

(3) A description of any benefits to the subject or to others which may reasonably be expected from the research;

(4) A disclosure of appropriate alternative procedures or courses of treatment, if any, that might be advantageous to the subject;

(5) A statement describing the extent, if any, to which confidentiality of records identifying the subject will be maintained;

(6) Clarification of all forms of behavior, if any, interdicted by the research protocol (e.g., exercise, diet, medications, etc.); and

(7) An explanation of whom to contact for answers to pertinent questions about the research and research subjects' rights, and whom to contact in the event of a research-related injury to the subject.

When appropriate, the following information shall also be provided in the detailed description:

(8) A statement that the particular treatment or procedure may involve risks to the subject (or to the embryo or fetus, if the subject is or may become pregnant) which are currently unforeseeable;

(9) Anticipated circumstances under which the subject's participation may be terminated by the investigator without regard to the subject's consent;

(10) Any additional costs to the subject that may result from participation in the research;

(11) The consequences of a subject's decision to withdraw from the research and procedures for orderly termination of participation by the subject;

(12) A statement that significant new findings developed during the course of the research which may relate to the subject's willingness to continue participation will be provided to the subject; and

(13) The approximate number of subjects involved in the study.

Section 5. Medical Monitoring

This testing requires Level 3 medical monitoring as defined by the SD medical coverage guidelines. This level requires that an ACLS-certified physician be within 15 minutes of the testing area and can be summoned by pager, if needed. Dr. Joseph E. Stuteville or another SD-designated physician will serve as the primary medical monitor for this experiment.

For each subject, a Test Readiness Checklist (Appendix B) will be completed prior to initiation of testing. Vital signs will be monitored and recorded at various times following drug/placebo administration. These records, along with pre-test and post-test questionnaires, will be available to the medical monitor.

Section 6: Test Procedures
Evaluation of the Effect of Promethazine on Performance of Crewmembers Using the Portable In-Flight Landing Operations Trainer (PILOT) Ground-based Protocol

Training Sessions

1. Verify that the subject briefing was conducted, subject information handout was read and signed, informed consent was read and signed, and subject was screened for contraindications to Promethazine (PMZ) administration.
2. Complete Test Readiness Checklist before proceeding.
3. Complete the front and back of subject pretest questionnaire. (On subsequent visits only the front side will be filled out)
4. Familiarize subject with the different tasks. See:
   PILOT operating procedures for setup and operation
   Intuous Graphics Pad for setup and operation

5. Direct subject to perform landing task six times
6. Perform motor-coordination tests

The landings and motor-coordination tests can be conducted up to four times in one day. There also must be a 10-minute break between each training session. Additional training sessions must be scheduled within 48 to 72 hours of previous training session.

Eight training sessions must be completed before the subject may proceed to the Experimental phase. Once all training sessions have been completed, schedule subject for Experimental Session 1.

Experimental Session 1

7. Post the "Testing in Progress" sign on the cypher lock. (The electronic keypad allowing access to the main door of the PATDOME)
8. Verify Test Readiness Checklist is complete before proceeding.
9. Complete the front side of the subject pretest questionnaire.
10. Measure and record blood pressure, pulse rate and respiration rate.

    NOTE: If at any time during the experiment, the subject's pulse and/or blood pressure is not within the corresponding range listed below, vital signs will be remeasured in 5 minutes. If at that time any measurement remains outside the recommended range, the medical monitor will be contacted and clearance from him/her will be required before proceeding with the remainder of the experiment.

Systolic blood pressure:	$90 \leq x \leq 140$ *mm Hg*
Diastolic blood pressure:	$50 \leq x \leq 90$ *mm Hg*
Pulse:	$50 \leq x \leq 100$ *beats/min*

11. Review protocol and potential side effects of promethazine
12. Complete symptom checklist, collect saliva sample and perform sleepiness scale.
13. Direct subject to perform landings
14. Perform motor-coordination tests
15. Administer 50-mg promethazine (or placebo, depending on group assignment) orally and also provide a small cup of water to the subject to take pill with.
    Note time of administration.

NOTE: During the next 8.25 hours, the steps outlined under "Post-Drug Assessment" will be conducted periodically. No subject activities are scheduled in the time between assessments; however, the subject **will not** be allowed to leave the laboratory until after 4 hours post drug administration. Prior to the session, the subject will be instructed to bring something to occupy his time during these periods.

16. At 1-hr post drug administration, measure and record blood pressure, respiration rate and pulse rate.

17. **Begin Post-Drug Assessment (steps 18-21) one hour after administration of drug/placebo.

Post-Drug Assessment

**Note: Post-Drug Assessment times are scheduled at 1-, 2-, 3-, 4-, 6- and 8-hrs post-drug administration. When directed to start a post-drug assessment, please start the procedures ~10-min prior to the actual hour. This will ensure that PILOT and motor-coordination tests will be performed as close to the hour as possible.

18 Collect saliva sample and conduct sleepiness scale
19. Complete symptoms checklist
20. Direct subject to perform six landings
21. Perform motor-coordination tests.

22. Two-hour post drug assessment procedure.

The 2-hr post-drug assessment procedures are identical to previous post-drug assessment procedures with a Stair Velocity Motion Test (SVMT) added.

Note: The SVMT will initially begin at a velocity of 2-RPM. As the chair rotates, the subject will execute 5 standardized head movements over a 20-second period. Chair velocity will be increased incrementally by 4RPM after every 40-head movements (8 sets). The test will be terminated once the subject reaches mild to moderate nausea or after 40 head movements have been performed at 30 RPM, whichever comes first.

Perform steps 18 thru 21, then proceed with step 22.1.

22.1 Make sure the main power switch for the "Operator Station," the "shortest" of the two red racks in front of you once you have entered the PATL Lab, is turned on. Power up the rotator prior to placing subject in rotator. The power box is mounted on the platform next to the silicon graphics machines, between the stairs and the wall. Flip the main power switch to "on" (this is a red switch that can be turned on by pushing upward on it) and then turn the key to the "enable" position. Once the DOME has been enabled, the light inside of the rotator should turn on. The subject can then be placed into the DOME chair.

Make sure that the step that allows the subject to easily get in and out of the DOME is in place on the platform, just in front of the rotating floor. To properly place the subject in the rotator chair, first remove the front head pad by loosening the knob that holds it in place and then taking the rod out of the housing. Place the subject in the chair, replace the front head pad and adjust all head pads to where the subject can comfortable rest their head at a 45 degree angle to the front, rear, left, and right. Ensure that subject is properly restrained which includes latching the seat belt and connecting the interlock safety system, the wires attached to the seatbelt. Once the head pads have been properly adjusted and the subject has been safely secured in rotator chair, have subject put on headphones. Step out of DOME

and place stanchions across door to prevent someone from entering the DOME while it is rotating.

Press the start button on the power box. A green light should be illuminated. If the green light is on, the rotator is ready to run. If not, something is not connected properly and the rotator will not rotate (this would most likely be the interlock system attached to the seatbelt). Bootup the desktop PC and start the Rotator Software. Perform a communication test with the subject, using the headphones, while the PC is booting up. Set the initial speed of rotator (2-rpm), the number of head movements (40), head movement interval (1-sec), and stage-step-size(4-rpm). Next, ensure that the rotator will turn in the clockwise (cw) direction. Finally, *give the file name box a file name for the subject so that the file created by the session can be analyzed at a later date.* Click the start button and the rotator will begin moving. Keep in constant communication with subject. Track all symptoms. Stop the test when subject has reached the criterion symptom level, has performed all head movements at the highest speed of rotation (40-rpm), or upon subject request.

Once subject has completed test, check vitals and then begin post-drug assessment (steps 18 thru 21).

Note: The post-drug assessment landings and motor coordination tests may count for the 3-hr post-drug assessment. If more than 20 minutes exists between the completion of the post-drug assessment tests after SVMT and the 3-hr post-drug assessment procedures, then the post-drug assessment tests after the SVMT ***will not*** *count for the 3-hr post-drug assessment. However, if there are less than 20 minutes before the 3-hr post-drug assessment, than the tests* ***will*** *count as the 3-hr post-drug assessment.*

23. Begin Post-Drug Assessment 3 hours after administration of drug/placebo (steps 18 thru 21).

24. Begin Post-Drug Assessment 4 hours after administration of drug/placebo (steps 18 thru 21).

25 After the 4 hour Post-Drug Assessment the subject is allowed to leave as long as they remain on site and do not drive or operate heavy machinery. The subject must return to the testing facility for the 6-hour session 15 minutes prior to the next scheduled testing time.

26. Begin Post-Drug Assessment 6 hours after administration of drug/placebo (steps 18 thru 21).

27. After the 6-hour session the subject is again allowed to leave as long as they stay on site and do not drive or operate heavy machinery. The subject must return back to the testing facility for the 8-hour session 15 minutes prior to the next scheduled testing time.

28. Begin Post-Drug Assessment 8 hours after administration of drug/placebo (steps 18 thru 21). Once the symptoms checklist has been completed, measure and record blood pressure, pulse rate and respiration rate.

29. Schedule Experimental Session 2 (1 wk – 10 days after Experimental Session 1 drug/placebo administration)

Experimental Session 2

1. Complete steps 1 – 28 of Experimental Session 1 administering the opposite preparation (i.e., if drug was administered at Experimental Session 1, placebo will be administered at session 2. If placebo was administered at Experimental Session 1, drug will be administered at session 2).

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
2101 NASA Road 1
Houston, Texas 77058-3696

JUL 2 0 2000

Reply to Attn of:

July 20, 2000

Lakshmi Putcha, Ph.D./SD3
Life Sciences Research Laboratories
Lyndon B. Johnson Space Center
Houston, TX 77058

RE: Renewal of Approval

DSO 490 "Evaluation of the Effect of Promethazine on Performance of Crewmembers Using the Portable In-Flight Landing Operations Trainer (PILOT)

Approval valid from July 20, 2000 to July 20, 2001

Dear Dr. Putcha:

1. The Johnson Space Center (JSC) Institutional Review Board (IRB) has taken the following action with respect to the above named proposal:

   (X) Proposal is approved for 1-year.
   ( ) Proposal is approved with minor Board recommendations (See IRB minutes).
   ( ) Proposal is tabled with Board recommended actions (See IRB minutes).
   ( ) Proposal is rejected (See IRB minutes).
   (X) Medical Monitoring designation: ( ) Not Required; ( ) Level I; ( ) Level II; (X) Level III; ( ) Level IV

2. Additional review of this proposal will be required:

   (X) Annually.
   (X) If there is any substantive change in protocol.
   (X) Should unexpected problems or unusual complications develop.

3. Method of review utilized:

   ( ) JSC Institutional Review Board.
   (X) Expedited Review.

Jerry L. Homick, Ph.D.
Alternate Chair, JSC Institutional Review Board

7/20/00
Date

Section 7. Test Termination Criteria and Emergency Stop Procedures

Test Termination Criteria

Testing will be terminated early in the event of either:

1. Subject request at any time.
2. Determination by the medical monitor that the subject should not continue in the study.

Subject Request: If the subject expresses a desire to withdraw from testing before any drug is administered or more than 8 hours after drug administration (e.g., between experimental sessions), the subject will be dropped from the study without further action. To maintain subject safety, a request for withdrawal made less than 8 hours after drug administration will require a release by the medical monitor. Under these circumstances, the following action will be taken:

1. Operator will summon the medical monitor.
2. Medical monitor will consult the previously provided study schedule for identification of drug or placebo administration and will examine the subject.
3. Upon authorization by the medical monitor that no more observation of the subject's condition is necessary, the subject will be given the pager number of the JSC physician and will be released from the lab. (NOTE: Subject's mode of transportation will be verified prior to release from the lab.)

Physician Request: A physician request implies that the medical monitor has already been contacted. Under these circumstances, the following action will be taken:

1. Medical monitor will authorize appropriate care.
2. If appropriate care is not available in the lab, transportation to a site with adequate facilities will be arranged.
3. If care is provided in the lab, the subject will be given the pager number of the JSC physician upon release by the medical monitor. (NOTE: Subject's mode of transportation will be verified prior to release from the lab.)
4. Appropriate follow-up contact will be made by the medical monitor or by the operator at the instruction of the medical monitor.

Emergency Stop Procedures

In the event of an emergency requiring evacuation of the facility, testing will be temporarily suspended and the operator will assist the test subject from the test area to a safe area as follows:

1. The operator will direct the subject to leave the test room immediately, providing assistance if necessary. NOTE: Equipment power down is not necessary for emergency subject egress.
2. The operator will accompany the subject along the primary or secondary (if circumstances warrant) evacuation route for the building to the assembly area designated for that purpose.
3. The operator will remain with the subject until reentry of the building is allowed by authorized safety personnel.
4. Testing may or may not continue depending upon the reason for and the duration of the evacuation. The medical monitor will be contacted if the situation warrants.

Hazard Analysis Report for the PAT DOME

Preflight Adaptation Trainer -
Device for Orientation and Motion Environments
(previously called the Mode A Preflight Adaptation Trainer)

August 27, 1998

Location:
Building 29 / Room 159
NASA - JSC
Houston, Texas 77058

Organization:
Life Sciences Research Laboratories / SD-3

Prepared by:

William G. Crosier, Wyle Laboratories
Project Engineer
Telephone (713) 641-4941

Approved by:

Dr. Deborah Harm, NASA SD3
Head / Manager; Neuroscience Laboratories
Telephone (281) 483-7222

James Cooley, NT224/HEI
Safety Engineer

8/27/98

System Purpose

The Preflight Adaptation Trainer - Device for Orientation and Motion Environments (PAT DOME) will be used to expose astronauts and other human subjects to visual, vestibular, and other sensory stimuli analogous to sensory relationships experienced by astronauts in weightless spaceflight. The goal is to develop a trainer and procedures that will help crew members adapt to those sensory relationships before flight. When astronauts experience the altered sensory relationships again inflight, the symptoms of space motion sickness will hopefully be reduced in both intensity and duration because of this training before flight. This will help improve the astronauts' sense of well-being, improve their work efficiency, and make them better able to handle any emergency situations which may arise.

System Functional Description

The DOME PAT consists of several subsystems. In this PAT, the trainee is restrained in one of four different positions or orientations, using one of two adjustable restraints. The orientations are: (1) sitting upright, (2) supine (lying on one's back), (3) lying on the right side, and (4) lying on the left side. A chair-like restraint is used for the sitting orientations, and a trough-like restraint, with a support structure underneath, is used for the other orientations. **For this study, subjects will be in the upright sitting position.** Two video projectors are mounted above and behind the trainee or positioned on the floor, with their position depending on the trainee orientation. The projectors display a wide angle view of video images on the interior of the dome. When the trainee is supine, the operator will position the projectors such that they project up onto the top of the dome. For other orientations, they will project horizontally onto the "sides" of the dome. **The projectors will not be used for the current study, they will be maintained in the upright position.**

The trainee restraint and projector assembly are mounted on a 71-inch diameter rotating turntable, driven by a variable speed motor. A 12-foot diameter spherical dome encloses the trainee and projectors. The dome rests on a 20 foot square support platform. Neither the dome nor the support platform move; only the turntable moves with the trainee and projectors inside the dome. A door in the side of the dome, which can be opened from either the inside or outside, allows easy entry or exit. **For this study, the door will remain open during motion sickness testing.**

Power, data, and control signals are passed between the trainee/projector area (on top of the turntable) and the operator/computer area via multi-conductor slip rings mounted under the turntable. Displays and controls for the operator and for an astronaut instructor are located at the operator and instructor consoles. These consoles will be located adjacent to each other, and near the dome, to allow one person to operate the entire system when a separate instructor is not needed. Voice communication between the trainee, operator, and instructor will be provided via an intercom system. **For this study, verbal communication exchange can also occur between the subject and the tester because the door will remain open during motion sickness testing.**

Hazard Analysis Summary

Potential Hazard: Electrical Shock
Causes: Improperly grounded instrumentation, or failure of electrical protection circuitry
Effects: Subject injury
Assessment – Severity = Critical; Probability = Extremely Low
RAC – Before controls = IA(1) After Controls = ID(3)
Protection to minimize risks = Continuity of electrical ground (i.e., ground fault check) is performed as part of the pre-test certification process, and confirmed through scheduled preventative maintenance. All cables are insulated and properly strain-relieved to avoid breakage during voluntary movements.

Potential Hazard: Fire
Causes: Overheating or malfunction of electrical equipment
Effects: Subject/personnel injury, equipment damage
Assessment – Severity = Critical; Probability = Extremely Low
RAC – Before controls = ID(3) After Controls = IID(3)
Protection to minimize risks = Flammable materials kept to a minimum with possible ignition sources in a separate location. Smoke alarms located above DOME and over platform.

Potential Hazard: Motion Sickness
Causes: Sensory stimulation of sensitive subjects
Effects: Subject discomfort
Assessment – Severity = Marginal; Probability = Extremely Low
RAC – Before controls = IIIA(2) After Controls = IID(4)
Protection to minimize risks = Subject monitored at all times; test stopped at subject request and/or if subject reaches sickness severity termination criteria (mild or moderate nausea).

Potential Hazard: difficulty with Emergency Egress
Causes: Non-operational equipment or subject illness
Effects: Subject Injury
Assessment – Severity = Marginal; Probability = Extremely Low
RAC – Before controls = IIIB(3) After Controls = IID(4)
Protection to minimize risks = Rotation speed and deceleration rates limited. Simple-to-operate releases on restraints, helmet, and cables. Emergency power supply maintains operation and illumination in DOME if building power fails. Operator-assisted egress if necessary.

Potential Hazard: Falling
Causes: Slipping and/or tripping
Effects: Subject Injury
Assessment – Severity = Marginal; Probability = Extremely Low
RAC – Before controls = IIIB(1) After Controls = IID(4)
Protection to minimize risks = Walking surfaces have non-skid surfaces and stairs have handrails. Lip under DOME door prominently marked and warning signs posted; trained operator escorts all personnel.

Safety has been stressed as an important consideration throughout the design of the system. A minimum of flammable materials were used. The dome is constructed of fiberglass layers over an aluminum honeycomb, approximately 1/2 inch thick. The dome material was tested in accordance with, and meets the requirements of FAR 25.853(a), which is a federal flammability standard for aircraft interior panels. The support platform for the dome is constructed of 2-inch steel tubing with 3/4 inch thick plywood decking, covered with flame-retardent carpeting. The restraints are made primarily of painted aluminum. Polyurethane foam cushions, covered with polyester fabric, and a moldable "bean bag" are used for the trainee to sit or lie upon. The bean bag consists of a vinyl bag filled with small polystyrene beads, with a fitting for a vacuum hose so that a partial vacuum can be applied to the bag to enable it to retain its shape once the trainee is in place. This type of bag is used frequently to restrain injured patients when they need to be transported with an ambulance. Since the trainee only lies on top of the bean bag, it does not hamper his or her ability to quickly get out of the restraint in case of an emergency. A fire extinguisher is also located inside the dome for quick access in case of a fire in the trainee area.

The projector tilt support has a counterweight to allow the operator to easily and safely reposition the projectors. The tilting projector / counterweight assembly weighs approximately 1000 pounds. The counterweight allows the operator to reposition the projectors easily, but because of this large mass which rotates with the trainee, a mechanical stress analysis was performed to verify the design of the projector support assembly. See references 7 and 12 for this analysis. The analysis considered static stresses due to gravity, as well as dynamic stresses due to constant speed rotation and acceleration / deceleration. The

smallest safety factor found was 3.9. After this analysis was performed, however, the main (upright) projector support member was changed from two pieces of welded aluminum channel to 6" x 12" x 3/"8 wall rectangular steel tubing to minimize any deflections that might affect the stability of the projected images during rotation. This change potentially increases the safety factor even more, although only by a minor amount.

An additional analysis was performed of the entire motor drive/pedestal - rotating assembly to determine if it might turn over during rotation, due to the unbalanced rotating load. See reference 8 for this analysis. This analysis showed that even with only 4 bolts holding the assembly to the floor, the smallest safety factor was 4.5, so there was no danger of the assembly turning over. However, 8 bolts are used to provide an extra margin of safety.

After repositioning for a different trainee/projector orientation (if needed), the projector tilt support assembly is locked in place with two 5/8 inch diameter ball lock pins, to prevent movement of the projectors during normal use or maintenance. Maintenance and operational procedures and warning labels near projector mounts will remind personnel to lock the projector tilt mechanism when projectors are repositioned or removed for servicing. Four screws are used to hold each projector safely in place. Possible pinch points in the supports for the trainee restraints and projectors have been avoided during the mechanical design process. Seat belts keep the trainee in the restraint while the system is in operation. All walking surfaces, including the turntable and stair steps, will be slip-resistant.

Dual interlocks on the dome door and another one on the seat belt must all be closed for power to be applied to the motor drive for the turntable. All interlocks must first be closed, and then the operator must press the Start/Enable button before the computer can control the rotation. Opening any of the interlocks, or operating a Stop switch on the trainee restraint or a switch at the operator's console will interrupt all power to the motor drive and the motor controller. Thus, even if the motor controller failed, the system can be rapidly and safely stopped. If the dome door is opened by the operator or another person during rotation, or if the trainee unlatches the seat belt, or if a power failure occurs, friction in the motor drive and bearings stop the turntable quickly but smoothly within about five seconds. During normal operations, rotation starting and stopping is controlled by a computer. The operator must specifically enable rotation before it can occur, however, and may stop rotation via the computer (producing a smooth, controlled stop) at any time. Rotation cannot be resumed until all interlocks and other switches are closed, and the operator instructs the computer to start a session. **These procedures are for normal PAT DOME operation, however, for our study the door to the DOME will stay open. This will require the inter-lock system to be by-disabled.**

Although the dome door may be opened from the inside by simply pushing on it, the operator or another person must be outside the dome to close the door, since there are no handles on the inside. Since the door is interlocked, it is not possible for someone to accidentally start the rotation if the operator is standing on the turntable inside the dome, since the door would have to be shut first. If for some reason the door must be shut with someone inside the dome, but not in the trainee restraint (when adjusting the projectors, perhaps), then the seat belt interlock will prevent the motor drive from being energized. In addition, a key switch located at the edge of the square platform by the steps leading up to the dome platform prevents power from being supplied to the motor drive except when the system is in normal use.

If the motor itself or its drive amplifier fails, the rotation will stop anyway, but the restraint may not be positioned in the optimum orientation for the fastest egress. The trainee can still get out of the dome, though, but it could take as much as 10 seconds longer than usual (see next paragraph), since he or she might have to walk around the trainee restraint and projectors, depending on the stopping position. The interior dome light illuminates automatically whenever one of the interlock switches is opened or when the operator or trainee presses a stop button, to facilitate egress from the dome. Under worst case conditions, the trainee can get out of the dome within 20 to 30 seconds, including the time to stop from the maximum rotational speed, get out of the restraint, go around the projectors or restraint, and push open the dome door.

For the trainee to get out of the dome quickly, the following is necessary. First, rotation should be disabled. This can be done by the operator or the trainee with either of their emergency stop switches. (If either one forgets to do this, rotation will be stopped anyway when the trainee takes off the seat belt.) The seat belt is then unlatched, using a single quick release latch like the ones used in the Shuttle Orbiter. If necessary, the trainee may push the hand control (joystick or push plate) out of the way, if it is positioned in the way in front of the restraint. A simple locking knob, accessible to the trainee, may be loosened if desired, to make it easier to push the hand control out of the way. The trainees will be trained to perform this task when they are shown how to adjust the control placement to their preferences, if the hand control is to be used. Next, the trainee climbs out of the restraint, and steps onto an elevated floor around the restraint. The elevated floor is 18 inches above the platform surface. If necessary, the trainee can walk around the restraint if it stopped in other than the normal position. When the trough- like restraint is used (for the lying-down orientations), the trainee climbs down out of it using an extra step that is mounted securely next to the trough. If the projectors are in the way, the trainee can lean over to go around or under them. This only requires a few seconds at most. If the operator has not opened the door from the outside, the trainee may simply push on the door to open it. As described earlier, the time required to perform this worst case emergency egress is 30 seconds or less, and this time will be verified during acceptance testing before the trainer is placed into use.

The motor drive and gear box for the turntable, along with all associated mechanical components, are located in an enclosed steel pedestal under the turntable. No gears or other moving parts are exposed during normal operation. The motor drive operates from 208 VAC three phase power, and all high voltage wiring is insulated and separated from moving components or combustible materials, such as the wooden floor of the stationary platform. Although the motor pedestal is enclosed during normal operation, access panels on the sides of the pedestal, together with a crawl space under the stationary platform, allow access to the motor drive for maintenance purposes. Even with the access panels open, though, the gears are still enclosed to keep them clean and prevent injury to maintenance personnel. Connectors on cables to the motor drive allow power to be easily removed from the system if it is necessary to work inside the pedestal. The pedestal is electrically grounded to reduce potential shock hazards to personnel, even if a short or other malfunction occurred in the motor. Additionally, all exposed and uninsulated surfaces inside the dome are grounded to reduce potential shock hazards to the trainees or operational personnel. The quality (resistance) of the grounds will be checked during acceptance testing and periodically thereafter during routine maintenance checks. The items to be grounded include the trainee restraints and other supports, the projector mounts, each projector chassis, and electrical connector junction boxes. This is necessary because 120 VAC power is supplied to the projectors inside the dome.

The projectors each contain about 5 pints of an optical coupling fluid between their cathode ray tubes (CRT's) and the first lens element. If this fluid should leak, it is unlikely to cause any safety problems. It is relatively non-toxic unless aspirated (if it enters the lungs), and will never be hotter than 20° F. above ambient. The fluid is a hydrocarbon (a transparent mineral oil), having a fairly high flash point (340° F) and low vapor pressure at room temperature (<1 mm Hg), and is relatively safe in most situations, even if ingested, unless it enters the lungs. Refer to the attached material safety data sheet (Appendix B). However, the fluid is potentially harmful in aerosol form. The data sheet states that "On rare occasions, prolonged and repeated exposure to oil mist poses a risk of pulmonary disease such as chronic lung inflammation." The data sheet further states that the Threshold Limit Value for the fluid in an oil mist form is 5 mg/m^3. The projectors are designed to prevent any fluid leaks from reaching the blades of the projector ventilation fans, if that might cause atomization and misting of the fluid. However, the fans blow air into, not out of the projectors, and this would tend to cause any fluid which somehow reached the fan blades to be deposited inside the projectors, rather than blown directly into the dome interior. Regular inspections of the projectors will also be made to check for small leaks.

There are four ventilation holes in the dome just above the turntable. Filtered, fan-forced air at 150 cfm is supplied to two of these vents, and the other two are used as exhaust vents. Ambient room air from around the outside of the dome will be used for ventilation. Failure of the fans should not result in a hazardous condition, because of the relatively large volume of the 12-foot diameter dome. However, an airflow switch, attached to a small vane inside the air duct downstream from the fan and air filter, turns on a red light at the operator station if the fan fails or the air flow is limited due to an excessively dirty air filter. Operating procedures will require the function of the airflow switch and light to be checked before use of the trainer each day, and will require any run in progress to be terminated and the dome door to be opened if the ventilation fails.

The platform, if it is rotating when a loss of power or an emergency occurs, will stop within a few seconds to allow quick egress. However, the deceleration rate is limited to prevent trainee injury from a stop that is too sudden. The maximum operational speed of the turntable is 120°/sec, and the maximum operational acceleration and deceleration rates are both 200°/sec/sec, in either direction. For reference, speeds of up to 360°/sec and accelerations up to 500°/sec/sec have been used in certain tests previously on human subjects in the Neuroscience laboratory, with no safety problems. Deceleration when motor power is removed (if one of the interlock switches is opened or an emergency stop switch is pressed) is less than 200°/sec/sec, but still fairly rapid. The only real potential problem is that if a person is stopped from a high speed with a high deceleration rate, it takes several seconds before one can maintain one's balance properly. For this PAT, the speeds to be used should not cause significant problems in this regard. If the motor controller fails in such a manner as to cause an overspeed condition (rotation significantly higher than 120°/sec), then a mercury tilt interlock switch will automatically and immediately cut power to the motor amplifier, using the power relay. This tilt interlock switch is installed at an angle, off the axis of rotation, to sense centripetal acceleration and hence rotational speed. It also cuts power if a sudden acceleration (jerk) occurs, which might indicate an abnormal condition with the motor control.

The intercom system allows constant communication between the trainee, the instructor (when present), and the operator. The operator and instructor have push-to-talk switches so they can confer privately without using the intercom, and without distracting the trainee. Normally, the trainee's intercom control will be set to keep the microphone active all the time, so the trainee does not need to operate any switches to talk. Operational procedures will require frequent communication with the trainee, and if he or she does not respond, the training session will be terminated immediately, and the operator will open the dome door and check on the trainee. The trainee helmet has two earphones to prevent interruptions in communication if one of the earphones fails.

Periodic maintenance checks will be made of the entire system to ensure proper performance of all functions, with special attention given to those with safety implications. These checks will include: (1) visual inspections of screws and other fasteners, welds, mechanical positioning and locking devices, seat

belts, etc, (2) functional checks of all safety interlocks, switches, and related components, (3) continuity checks for verifying proper grounding of all exposed conductive surfaces inside and outside of the dome, especially of the controls which the trainee and operational personnel are likely to use, (4) ventilation fan functioning, (5) inspections for leaks and secure fastening of the projectors, (6) visual inspections of cables and connectors, and (7) other items of possible concern which become apparent as the system is being used. These checks will also be made during acceptance testing.

In summary, no uncontrolled safety problems are currently foreseen for this PAT. A small amount of flammable materials are used in the system, but they are well separated from possible ignition sources. Quick egress is possible under all circumstances for the system, and will be verified during acceptance testing. The turntable is limited in angular velocity and acceleration, and is interlocked to prevent injury to trainees or operational or maintenance personnel. Additional interlocks will be added later if needed. Since this is a ground trainer which has no interfaces to analog to flight hardware, no flight or GSE requirements apply.

Written procedures & checklists cover normal and contingency system usage and maintenance operations. These procedures will be modified if necessary before regular use is underway. They cover system startup, trainee briefings, interchange and adjustment of trainee restraints, repositioning of projectors, maintenance and calibration of the electronics, normal and emergency procedures, other inspections and tests, and any other items related to safety. However, the system has been designed such that failure to follow the proper procedures should not make the system unsafe, as much as possible. All operators and maintenance personnel will be required to learn this material before using or working on the system. All personnel will be trained to recognize, report, and correct possible safety problems. Additionally, all safety requirements discussed in this report, such as proper grounding, lack of pinch points, operation of interlocks, etc., will be verified during acceptance testing for the system and periodically thereafter during special safety inspections.

Part of the laboratory test personnel's regular duties is to monitor motion sickness symptoms during all tests or training sessions, and to encourage trainees and test subjects to always report them as they develop, so that appropriate decisions can be made about when to terminate a session. Constant communication between the trainee and the test operator allows the operator to quickly recognize and respond to any problem areas, whether they are related to motion sickness or hardware problems.

References

1. Preflight Adaptation Trainer Preliminary Design Review Data Package, from Honeywell, 24 June 1988

2. Preflight Adaptation Trainer Engineering Design Note #2 (PAT EDN2), from Honeywell, May 31, 1988

3. Preflight Adaptation Trainer Critical Design Review Data Package, from Honeywell, 4-5 Oct. 1988

4. Preflight Adaptation Trainer Critical Design Review Data Package, from Payload Systems Inc. (a subcontractor to Honeywell), 4 Oct. 1988

5. Instructions for Preparations of Hazard Analysis for JSC Ground Operations, JSC lr///3, Rev. B, Dec. 1984.

6. Material Safety Data Sheet (dated Nov. 13, 1985) and cover letter (dated June 19, 1989) from Triuniplex Display Systems, Inc. (the manufacturer of the projectors).

7. "Structural and Deflection Analysis of the Preflight Adaptation Trainer", a report from Wentworth Institute of Technology, under contract to Payload Systems, Inc., who is under contract to Honeywell, undated (received July, 1989).

8. "Overturning Moment Analysis-Rotating Assembly, Mode A Preflight Adaptation Trainer", KRUG International, Revised August 18, 1989.

9. "NDT and Inspection Data for the Preflight Adaptation Trainer", a report from Wentworth Institute of Technology, under contract to Payload Systems, Inc., who is under contract to Honeywell, undated (received July, 1989).

10. Mechanical and Electrical Drawings from Payload Systems, Inc. / Wentworth Labs, Veda / Emro, and Nordam (see attached list for drawing numbers).

11. Nordam Material Description and Burn Test Results for Dome Material, 17 Nov. 1988, Nordam Manufacturing Division.

12. Update, Mechanical / Structural Stress Analysis, Mode A Preflight Adaptation Trainer (PAT), KRUG International, August 17, 1989.

PAT DOME
Safety Systems Acceptance Test Procedure

0.1 Purpose

This Safety Systems Acceptance Test Procedure documents a standard method for verifying the integrity of all safety-related factors for the PAT DOME. This procedure should be followed before starting routine testing or training with human subjects. It may also be used to re-verify safety parameters after modifications are performed to the trainer.

0.2 Procedures

Each step listed below should be performed in the order listed. Each person witnessing each step should initial in the space to the right of each step, and sign and date the bottom of each page.

0.3 Discrepancies

Discrepancies observed during performance of this test procedure should be noted on the Discrepancy Report Form at the end of this procedure. The PAT project engineer shall be responsible for correcting any discrepancies and repeating appropriate sections of this procedure if discrepancies are found.

1.0 Inspection

1.1 Verify that the bevelled kick plate/foot deflector is in place in front of the dome door.

1.2 Verify proper grounding of all exposed conductive surfaces in dome & at Instructor-Operator Station using an ohmmeter. The resistance between any two exposed and uninsulated surfaces should be less than 0.5 ohms. Record the Model and Serial number of the meter:

_____

1.3 Verify that all 4 locking pins on the projector tilt support are inserted in the appropriate holes and that they prevent the projectors from tilting when pushing by hand on any part of the projectors.

1.4 Verify by inspection that there are no exposed sharp edges or corners, or unpleasant odors in the dome.

1.5 Visually inspect the projector supports & their mounting, and verify all screw fasteners are secure.

1.6 Visually inspect the supports & mounting for the adjustable height table (for the trainee restraint), and verify all screw fasteners are secure.

Note: The steps related to use of the trainee trough support (1.7 through 1.9) do not need to be verified if the trough is not to be used. If this is the case, write "skipped" beside each step which is not performed.

1.7 Install the trough support and the trough in the dome, for the supine trainee orientation. Verify that all four clamps (holding the trough support to the adjustable height table) are secure, that the trough is held firmly in place on its support, and that the step is mounted securely to the false floor.

1.8 Verify that the footrest for the trough is restrained from accidentally coming up & hitting the dome due to rotation of the turntable. When pulling up and out on the footrest, it should not come loose.

1.9 Verify that the footrest & other restraint components are strong enough to support the trainee's weight. With a 200 pound (or larger) person standing on the footrest, the edge of it should not deflect more than 1 inch.

1.10 Verify, by visual inspection, that the seat belts on both the chair and the trough are securely mounted, and that they are in good condition. The latches should easily engage and disengage.

1.11 Verify that the fire extinguisher is securely mounted inside the dome, in such a way to prevent it from accidentally coming loose due to rotation, but such that it may be removed for emergency use.

1.12 Verify that there is a smoke alarm mounted under the platform near the power amplifier.

2.0 Operation of Safety Features

2.1 Verify each smoke alarm operates correctly by pressing the test button and listening for a loud audible alarm.

2.2 With one person inside the dome, verify that the door can be opened from the inside by that person without assistance, by pushing on the door.

Note: The steps related to use of the trainee helmet, helmet force transducer assembly, and trough support (2.3 through 2.7) do not need to be verified if these items are not to be used. If this is the case, write "skipped" beside each step which is not performed.

2.3 Install the helmet force transducer on the trough support. Set the spring tension on the helmet release appropriately for the trough. Engage and lock the helmet into the bracket on the helmet force transducer. Verify that the helmet can be released without unlocking it by pulling upward on the helmet.

2.4 Re-engage and lock the helmet into the bracket on the helmet force transducer. Verify that the helmet can be released easily by unlocking it with the quick release lever extending from the bracket.

2.5 Verify that a test subject can safely climb up into and down out of the trough without assistance.

2.6 Measure the egress time from the trough for a subject with a helmet on his or her head, starting with the helmet engaged into the bracket on the helmet force transducer, with the seat belts fastened, and with the joystick/force plate in its normal use position (in front of the subject) for the trough. Measure the time for three different angular positions of the turntable relative to the door of the dome, with no assistance for the test subject. The dome door should be shut before each measurement. The time, measured from when the subject is told to egress until he or she steps out onto the platform around the dome, should be less than 30 seconds for each trial.

time for first trial: _____sec.

time for second trial: _____sec.

time for third trial:_____sec.

2.7 Remove the helmet force transducer, trough, trough support, and step from the dome. Install the chair on the adjustable height table. Install the helmet force transducer mounting assembly on the projector support, and then install the helmet force transducer for the upright (sitting) orientation.

2.8 Measure the egress time from the chair for a subject with the seat belts fastened, and with the

joystick/force plate in its normal use position (in front of the subject) for the chair (if the joystick/force plate is to be used). Measure the time for three different angular positions of the turntable relative to the door of the dome, with no assistance for the test subject. The dome door should be shut before each measurement. The time, measured from when the subject is told to egress until he or she steps out onto the platform around the dome, should be less than 30 seconds for each trial.

time for first trial: _____sec.

time for second trial:_____sec.

time for third trial: _____sec.

3.0 Interlocks and Operator Controls

3.1 Power up the computer image generator, the Instructor station, and the Operator station. Verify that the motor amplifier power cable is plugged in to is 3 phase receptacle.

3.2 Close all interlock switches. Place the keyswitch in the Operate/Enable position. Open each interlock, one at a time, and verify that the Motor Power Relay opens each time one of the interlock switches is opened, as listed below. The Motor Relay status can be verified by observing the green Motor light. It is off when the Motor Relay is open. The relay should stay opened even when the interlock is closed, until the Start/Operate/Enable push button switch is closed.

3.2.1 Verify that the Motor Enable/Disable keyswitch, when placed in the Disable position, opens the motor relay as described above.

3.2.2 Verify that the trainee Stop switch opens the motor relay, as described above.

3.2.3 Verify that the trainee seat belt interlock opens the motor relay, as described above.

3.2.4 Verify that the dome door switch opens the motor relay, as described above.

3.2.5 Verify that the Operator station push-button Stop switch opens the motor relay, as described above.

3.2.6 Verify that the Instructor station push-button Stop switch opens the motor relay, as described above.

3.3 Remove any loose items from the dome and verify that the projector supports and restraint supports are secure. Run the normal PAT computer software, close all interlock switches, enable rotation, and accelerate the turntable to the maximum normal speed (20 RPM = 120° / sec = 1 revolution every 3 seconds). Select the Stop function at the operator computer and verify that the time required to stop rotation is less than 10 seconds.

Stop time: _____ sec.

3.4 Verify that the stopping position (from the previous test) provides for easy egress from the dome.

3.5 Repeat the previous test except with rotation in the opposite direction, and verify that the stop time is less than 10 seconds and that the stopping position provides for easy egress from the dome.

Stop time: _____ sec.

3.6 Close all interlock switches, enable rotation, and accelerate the turntable to the maximum speed (20 RPM = 120°/sec = 1 revolution every 3 seconds). Open the motor relay by pressing the Stop push button switch at the operator station, and verify that the time required to stop the rotation is less than 5 seconds.

Verify that it is not necessary to select the Stop function at the computer display; thus, the interlocks override the computer command.

Stop time: _____ sec.

3.7 Terminate the PAT computer program, and run SMC_SAFT, the motor drive safety test program. Close all interlocks, and accelerate the turntable to a speed of approx. 120°/sec. Verify that the turntable can remain rotating at that speed for at least 10 seconds without actuating the overspeed switch.

3.8 With the turntable still rotating from the previous step, attempt to accelerate the turntable to a speed of 180°/sec. Verify that the overspeed switch causes the motor relay to open and stop the rotation before the speed reaches 180°/sec.

3.9 Turn on the ventilation fan switch (on the air duct under the platform) and the video projectors using the switches on the projector console panel at the Operator station. Verify that both projectors can be turned off by operating those switches.

3.10 Verify that both projectors can be turned off by removing the fuses on the projector control panel. Also verify that the fuses have a current rating equal to or less than 5 amps. Replace the fuses in the fuse holders.

3.11 With the switches for the fan and projectors all on, block the airflow into the air duct with a piece of paper or cardboard. Verify that the Ventilation Failure warning light on the projector control panel illuminates until the air blockage is corrected.

3.12 Leave the projectors turned on, but turn off the fan switch. Verify that the Ventilation Failure warning light on the projector control panel illuminates and flashes until the fan is turned back on.

3.13 Connect a headset to the intercom adapter inside the dome. Verify that a person wearing the headset can communicate clearly with a person at the operator station, using the intercom.

3.14 Close all interlocks and enable rotation by turning the Motor key switch to the Enable position, and pressing the Start switch on the Motor relay box. Verify that the green Motor light illuminates. Open the motor relay by pressing a red Stop switch at the Operator station. Verify that this action turns on the light in the dome.

Discrepancy Report Form
PAT DOME
Safety Systems Acceptance Test Procedure

For each item in the acceptance test procedure in which the results were other than expected, note below the step number (paragraph number), the expected results, and the observed results.

PAT DOME Operating Procedures/ Checklist

Power up system
- Silicon Graphics Computers
- Instructor Station & Operator Station
- Auxiliary computer, if used for platform rotation control

Conduct Daily Equipment Readiness Diagnostics (DRED) & Checks
(Trainees & subjects are not to assist with moving/setup of restraints or projectors)

- Verify function of ventilation fan & warning indicator
- Inspect inside of dome for foreign objects, oil on floor, etc.
- Install and verify secure mounting of proper restraint (chair or trough)
- Install and verify secure mounting of steps for trough (if applicable)
- Position projectors for desired orientation
- Verify all 4 locking pins are installed
- Verify that mounting hardware *is* secure
- Mount helmet force transducer assembly, if applicable, in proper orientation
- Set rotation limits as required for the session, if applicable
- Set 3 spring adjustments for proper breakaway force of helmet force transducer for orientation used, if applicable
- Power up projectors & drive motor system & check interlocks
- Verify computer & control functioning
- Verify / adjust computer image generator & projector functioning & alignment

Get subject information:
- Name, Birth date, handedness, weight, height, etc. Select session protocol to be used.
- Trainee orientation and control type, visual database, etc. Brief trainee.
- Training/test purpose, tasks to be performed, etc.
- Ingress/egress procedures
- Describe & demonstrate operation of dome door, chair, trough, helmet & release
- Conditions & procedures for stopping a training session
- When & how to stop (press Stop button)
- Procedures to follow in emergencies
- Conduct simulated emergency egress
- Emergency stop switches & interlocks - operation
- Stress need for constant communication with operator
- Describe motion sickness precautions, symptom reporting
- Describe adjustment of restraints & control placement (joystick, force plate)
- Record adjustment settings
- Helmet fitting, if applicable

Strap trainee in restraint
- Escort & assist trainee into dome & restraint
- Verify intercom function
- Check restraint height, control placement, etc & record changes in settings, if applicable

Instructor / Operator Station Activities:
- Operator login
- Enter trainee and session information
- Select session ID
- Modify session parameters as desired for particular training / test run
- Remove locking pin from turntable (if used), shut door, verify warning sign is on

- Enable rotation, if appropriate for test/training session, with keyswitch
- Ask trainee if ready to begin
- Press Start Enable switch on interlock relay box
- Select "Start" function on operator computer display

Abort session at operator computer if:
- Trainee wants to stop
- Low Airflow / Ventilation Malfunction indicator illuminates
  - After rotation stops, open door to dome until ventilation is corrected.
- Smoke alarm or other possible hardware malfunction

Abort with emergency stop switch if:
- "Stop" command above doesn't work, or
- the computer does not appear to control the speed properly

Fire emergency procedures:
Select "Stop" function at Operator Station computer.
Instruct trainee / test subject to evacuate.
Assist trainee / test subject in egress if necessary.
Dial 33333 to announce fire.
Power down system.
Evacuate Building.

When finished:
Select "Stop" function at Operator Station computer.
Disable rotation with keyswitch after platform returns to Home position.
Open door, assist trainee in egress .
Power down projectors, Silicon Graphics and other computers, Instructor & Operator stations when finished for the day.

PAT DOME Periodic Maintenance Requirements

Before subject testing on each test day:

1. Conduct visual inspection of test area, and check for and clean up/correct:
- any oil leaks or other spills in dome or surrounding area
- secure mounting of subject restraints and projectors
- damaged or loose cables
- trip hazards
- proper installation of locking pins for:
    - projector
    - removable floor grating section
    - helmet force transducer support (when used)
    - movable step for trough (when trough is used)

2. Verify operation of ventilation fan warning indicator.

3. Verify proper startup of computer systems

4. Verify operation of safety interlocks for motor drive and dome light control (see DOME Operations checklist).

Every 6 months:

1. Verify proper grounding of all conductive surfaces in dome (see Safety Systems Test Procedure).

2. Check fire extinguishers in dome and by Instructor/Operator Station.

3. Check oil level in speed reducer under turntable.

4. Check operation of smoke alarms under platform by motor amp.

5. Check for and tighten any loose screws or other abnormal conditions in dome, including adjustable height table, trainee restraints, projector supports, projectors, and lenses.

APPENDIX B

MATERIAL SAFETY DATA SHEET (MSDS)

This MSDS should be attached or kept with the respective product with which it is associated

MATERIAL SAFETY DATA SHEET 7S018

F33
0
L CORPORATION MATERIAL SAFETY DATA BULLETIN
RE...ED:08/30/93

I. PRODUCT IDENTIFICATION
MOBIL DTE 24
SUPPLIER: 24-HOUR EMERGENCY (CALL COLLECT):
MOBIL OIL CORP. (609) 737-4411
CHEMICAL NAMES AND SYNONYMS: CHEMTREC:
PET. HYDROCARBONS AND ADDITIVES (800) 424-9300
USE OR DESCRIPTION: PRODUCT AND MSDS INFORMATION:
HYDRAULIC OIL (800) 662-4525

II. TYPICAL CHEMICAL AND PHYSICAL PROPERTIES
APPEARANCE: Amber Liquid ODOR: Mild PH: NA
VISCOSITY AT 40 C, CS: > 29.0
VISCOSITY AT 100 C, CS: 5.3
FLASH POINT F(C): > 395(202) (ASTM D-92)
MELTING POINT F(C): NA
POUR POINT F(C):-10(-23)
BOILING POINT F(C): > 600(316)
VOC: < 3.00(Wt. %); 0.215 lbs/gal
RELATIVE DENSITY 15/4 C: 0.874
SOLUBILITY IN WATER: Negligible
VAPOR PRESSURE-mm Hg 20C: < 0.1

NA-Not Applicable NE-Not Established D-Decomposes
FOR FURTHER INFORMATION, CONTACT YOUR MARKETING REPRESENTATIVE.

III. POTENTIALLY HAZARDOUS INGREDIENTS
None

SEE SECTIONS XII AND XIII FOR REGULATORY AND FURTHER COMPOSITIONAL DATA.

IV. HEALTH HAZARD DATA
--- INCLUDES AGGRAVATED MEDICAL CONDITIONS, IF ESTABLISHED ---
THRESHOLD LIMIT VALUE: 5.00 MG/M3 Suggested for Oil Mist
EFFECTS OF OVEREXPOSURE: No significant effects expected.

V. EMERGENCY AND FIRST AID PROCEDURES
--- FOR PRIMARY ROUTES OF ENTRY ---
EYE CONTACT:
Flush thoroughly with water. If irritation occurs, call a physician.
SKIN CONTACT:
Wash contact areas with soap and water. High pressure accidental injection through the skin requires immediate medical attention for possible incision, irrigation and/or debridement.
INHALATION: Not expected to be a problem.
INGESTION:
Not expected to be a problem. However, if greater than 1/2 liter(pint) ingested, immediately give 1 to 2 glasses of w... and call a physician, hospital emergency room or ...control center for assistance. Do not induce ... or give anything by mouth to an unconscious

VI. FIRE AND EXPLOSION HAZARD DATA
FLASH POINT F(C): > 395(202) (ASTM D-92)
FLAMMABLE LIMITS: LEL: 0.6% UEL: 7.0%
EXTINGUISHING MEDIA: Carbon dioxide, foam, dry chemical and water fog.
SPECIAL FIRE FIGHTING PROCEDURES:
Water or foam may cause frothing. Use water to keep fire exposed containers cool. Water spray may be used to flush spills away from exposure. For fires in enclosed areas, firefighters must use self-contained breathing apparatus. Prevent runoff from fire control or dilution from entering streams, sewers, or drinking water supply.
UNUSUAL FIRE AND EXPLOSION HAZARDS: None.
NFPA HAZARD ID: Health: 0, Flammability: 1, Reactivity: 0

VII. REACTIVITY DATA
STABILITY (Thermal, Light, etc.): Stable
CONDITIONS TO AVOID: Extreme heat.
INCOMPATIBILITY (Materials to Avoid): Strong oxidizers
HAZARDOUS DECOMPOSITION PRODUCTS: Carbon monoxide. Metal oxides. Elemental oxides.
HAZARDOUS POLYMERIZATION: Will not occur.

VIII. SPILL OR LEAK PROCEDURE
ENVIRONMENTAL IMPACT:
Report spills as required to appropriate authorities. U.S. Coast Guard regulations require immediate reporting of spills that could reach any waterway including intermittent dry creeks. Report spill to Coast Guard toll free number (800) 424-8802. In case of accident or road spill notify CHEMTREC (800) 424-9300.
PROCEDURES IF MATERIAL IS RELEASED OR SPILLED:
Adsorb on fire retardant treated sawdust, diatomaceous earth, etc. Shovel up and dispose of at an appropriate waste disposal facility in accordance with current applicable laws and regulations, and product characteristics at time of disposal.
WASTE MANAGEMENT:
Product is suitable for burning in an enclosed, controlled burner for fuel value or disposal by supervised incineration. Such burning may be limited pursuant to the Resource Conservation and Recovery Act. In addition, the product is suitable for processing by an approved recycling facility or can be disposed of at any government approved waste disposal facility. Use of these methods is subject to user compliance with applicable laws and regulations and consideration of product characteristics at time of disposal.

IX. SPECIAL PROTECTION INFORMATION
EYE PROTECTION: Normal industrial eye protection practices ... be employed.
...TECTION: No special equipment required. However, good hygiene practices should always be followed.
...ORY PROTECTION: No special requirements under ordinary ...ions of use and with adequate ventilation.
VENTILATION: No special requirements under ordinary conditions of use and with adequate ventilation.
USE OF THE PRODUCT ARE THEREFORE ASSUMED BY THE USER AND WE EXPRESSLY DISCLAIM ALL WARRANTIES OF EVERY KIND AND NATURE, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE IN RESPECT TO THE USE OR SUITABILITY OF THE PRODUCT. NOTHING IS INTENDED AS A RECOMMENDATION FOR USES WHICH

X. SPECIAL PRECAUTIONS
HANDLING: High pressure injection under the skin may occur due to the rupture of pressurized lines. Always seek medical attention.

XI. TOXICOLOGICAL DATA
--- ACUTE TOXICOLOGY ---
ORAL TOXICITY (RATS): Practically non-toxic (LD50: greater than 2000 mg/kg). --- Based on testing of similar products and/or the components.
DERMAL TOXICITY (RABBITS): Practically non-toxic (LD50: greater than 2000 mg/kg). --- Based on testing of similar products and/or the components.
INHALATION TOXICITY (RATS): Not applicable --- Harmful concentration of mists and/or vapors are unlikely to be encountered through any customary or reasonably foreseeable handling, use, or misuse of this product.
EYE IRRITATION (RABBITS): Practically non-irritating. (Draize score: greater than 6 but 15 or less). ---Based on testing of similar products and/or the components.
SKIN IRRITATION (RABBITS): Practically non-irritating. (Primary Irritation Index: greater than 0.5 but less than 3). ---Based on testing of similar products and/or the components.
OTHER ACUTE TOXICITY DATA: The acute toxicological results summarized above are based on testing of representative Mobil products.
--- SUBCHRONIC TOXICOLOGY (SUMMARY) ---
Representative Mobil formulations have been tested at the Mobil Environmental and Health Sciences Laboratory by dermal applications to rats 5 days/week for 90 days at doses significantly higher than those expected during normal industrial exposure. Extensive evaluations, including microscopic examination of internal organs and clinical chemistry of body fluids, showed no adverse effects.
--- REPRODUCTIVE TOXICOLOGY (SUMMARY) ---
Dermal exposure of pregnant rats to representative formulations did not cause adverse effects in either the mothers or their offspring.
--- CHRONIC TOXICOLOGY (SUMMARY) ---
The base oils in this product are severely solvent refined and/or severely hydrotreated. Chronic mouse skin painting studies of severely treated oils showed no evidence of carcinogenic effects. These results are confirmed on a continuing basis using the Mobil Modified Ames Test. Representative Mobil formulations have not caused skin sensitization in guinea pigs.

XII. REGULATORY INFORMATION
GOVERNMENTAL INVENTORY STATUS: All components comply with TSCA and EINECS/ELINCS.

Transport Information: Please see Section XIV.

US OSHA HAZARD COMMUNICATION STANDARD: Product assessed in accordance with OSHA 29 CFR 1910.1200 and determined not be hazardous.
RCRA INFORMATION: The unused product, in our opinion, is not specifically listed by the EPA as a hazardous waste (40 CFR, Part 261D), nor is it formulated to contain materials which are listed hazardous wastes. It does not exhibit the hazardous characteristics of ignitability, corrosivity, or reactivity, and is not formulated with contaminants as determined by the Toxicity Characteristic Leaching Procedure (TCLP). However, used product may be regulated.
U.S. Superfund Amendments and Reauthorization Act (SARA) TITLE III:
This product contains no "EXTREMELY HAZARDOUS SUBSTANCES".
SARA (311/312 -FORMERLY 302) REPORTABLE HAZARD CATEGORIES: NONE

This product contains no chemicals reportable under SARA (313) toxic release program.

THE FOLLOWING PRODUCT INGREDIENTS ARE CITED ON THE LISTS BELOW:

CHEMICAL NAME	CAS NUMBER	LIST CITATIONS
ZINC (ELEMENTAL ANALYSIS) (0.10%)	7440-66-6	22
PHOSPHORODITHOIC ACID, O,O-DI	68649-42-3	22
C1-14-ALKYL ESTERS, ZINC SALTS (2:		
1) (ZDDP) (0.67%)		

--- REGULATORY LISTS SEARCHED ---

1-ACGIH ALL	6-IARC 1	11-TSCA 4	17-CA P65	22-MI 293	
2-ACGIH A1	7-IARC 2A	12-TSCA 5a2	18-CA RTK	23-MN RTK	
3-ACGIH A2	8-IARC 2B	13-TSCA 5e	19-FL RTK	24-NJ RTK	
4-NTP CARC	9-OSHA CARC	14-TSCA 6	20-IL RTK	25-PA RTK	
5-NTP SUS	10-OSHA Z	15-TSCA 12b	21-LA RTK	26-RI RTK	

CARC - CARCINOGEN; SUS - SUSPECTED CARCINOGEN
NOTE: MOBIL PRODUCTS ARE NOT FORMULATED TO CONTAIN PCBS.

XIII. INGREDIENTS

INGREDIENT DESCRIPTION	PERCENT	CAS NUMBER
CONTAINS ONE OR MORE OF THE FOLLOWING	> 95.00	
BASE OILS:		
DISTILLATES (PETROLEUM), HYDROTREATED HEAVY PARAFFINIC		64742-54-7
DISTILLATES (PETROLEUM), SOLVENT-DEWAXED HEAVY PARAFFINIC		64742-65-0
MAY CONTAIN THE FOLLOWING ADDITIVE COMPONENT:		
PHOSPHORODITHIOIC ACID, MIXED O,O-BIS(ISO-BU AND ISOCTYL AND PENTYL) ESTERS, ZINC SALTS	0.63	68988-46-5

XIV. TRANSPORT AND LABEL INFORMATION
USA DOT: NOT REGULATED BY USA DOT.
IMO: NOT REGULATED BY IMO.
IATA: NOT REGULATED BY IATA.

APPENDIX
PRECAUTIONARY EEC LABEL TEXT:-
* - EC labeling not required.
FOR MOBIL USE ONLY: PHC: 1* 1* NA 1* 1*, PPEC: A, PPEC:,
US93-513
APPROVE CODE:13 08/30/93 REQ: US - MARKETING

****

INFORMATION GIVEN HEREIN IS OFFERED IN GOOD FAITH AS ACCURATE, BUT WITHOUT GUARANTEE. CONDITIONS OF USE AND SUITABILITY OF THE PRODUCT FOR PARTICULAR USES ARE BEYOND OUR CONTROL; ALL RISKS OF

U.S. GOV'T

OIL SALES, INC., 1212 W. Second Street, Oconomowoc, Wisconsin 53066
-7523

L SAFETY DATA SHEET

ION DATE: 02-15-90
PRODUCT TRADE NAME: Dayton Hydraulic Jack Oil #6Z144
Dayton Hydraulic Oil #4Z991
CHEMICAL IDENTITY: Petroleum Lubricating Mineral Oil
CAS #64742650 - Range % 95.00 - 99.99
TRANSPORTATION EMERGENCY PH NO: 414/567-7523
NFPA CODE: Health: 0 Fire: 1 Reactivity: 0 Additive: Proprietary

SECTION 1 - HAZARDOUS INGREDIENTS

- This material does not contain any chemical listed as a carcinogen or potential carcinogen by OSHA, IARC Monographs or National Toxicology Program.
- 2SF04 -
- None -

SECTION 2 - FIRE AND EXPLOSION HAZARDS

FLASH POINT: 330 - 360 (F)
UPPER FLAMMABLE LIMIT: Not Determined LOWER FLAMMABLE LIMIT: Not Determined
EXTINGUISHING MEDIA: CO2, dry chemical, foam, water spray; water fog
SPECIAL FIREFIGHTING PROCEDURES: Wear self-contained breathing apparatus with full face piece
UNUSUAL FIRE & EXPLOSION HAZARDS: None

SECTION 3 - HEALTH HAZARD DATA

ORAL TOXICITY: Greater than 5000 mg/kg in rats. Based on data from components
EYE IRRITATION: Not expected to cause eye irritation. Based on data from components
SKIN IRRITATION: Not expected to cause skin irritation. Based on data from components
OTHER: Unknown TLV: None established. Oil mist - 5 mg/cu meter
Emergency First Aid Procedures
SKIN: Wash with soap & water EYE: Flush with water for 15 minutes
INHALATION: Remove to fresh air. See physician if irritation persists
ORAL: Call a physician. DO NOT induce vomiting. ADDITIONAL: None

SECTION 4 - SPECIAL PROTECTION INFORMATION

VENTILATION PROCEDURE: Mechanical ventilation recommended.
EYE PROTECTION: Safety Glasses
GLOVES PROTECTION: Neoprene or nitrile rubber gloves recommended
OTHER PROTECTION: None

SECTION 5 - PHYSICAL DATA

SSURE: Not Determined pH: Not determined
GRAVITY: .875 approx WATER SOLUBILITY: In soluble
VOLATILE: Not Determined
ENSITY: Not Determined EVAPORATION RATE: Not Determined
O[illegible] Mild
APPEARANCE: Amber Li quid

SECTION 6 - STABILITY

STABILITY: Stable INCOMPATIBILITY: Oxidizing agents
POLYMERIZATION: Will not occur
THERMAL DECOMPOSITION: Oxides of carbon

SECTION 7 - SPILL OR LEAK PROCEDURES

SPILL PROCEDURES: Prevent entry into sewers and waterways. Pick up free liquid for recycle/disposal. Absorb small amounts on inert material for disposal.
WASTE DISPOSAL: If disposal of, this material is believed to be non-hazardous. Disposal should be in compliance with federal, state and local laws.

SECTION 8 - SPECIAL PRECAUTIONS

SPECIAL PRECAUTIONS: Remove contaminated clothing and launder before reuse.

SECTION 9 - TRANSPORTATION AND LABELING

DOT PROPER SHIPPING NAME: Not Applicable
DOT HAZARD CLASS: Not Applicable DOT ID NUMBER: None
IMO CLASS: None ICAO CLASS: None EPA HAZARDOUS SUBSTANCES: None
PRECAUTIONARY LABELS: None

The information presented herein has been compiled from sources considered to be dependable and is accurate to the best of Moraine Oil Sales' knowledge; however, Moraine makes no warranty whatsoever, expressed or implied, of MERCHANTABILITY or FITNESS FOR THE PARTICULAR PURPOSE, regarding the accuracy of such data or the results to be obtained from the use thereof. Moraine assumes no responsibility for injury to recipient or to third persons or for any damage to any property and recipient assumes all such risks.

TEST READINESS CHECKLIST

Investigation: Bioavailability and Performance Effects of Promethazine During Space Flight

Subject ID: _____

IRB Approval Date: 28 Jul 2000

Principal Investigator: Deborah L. Harm, Ph.D./Lakshmi Putcha, Ph.D. **Date:** _____

		YES	N/A	COMMENT
1.	Subject Briefing	_____	_____	_____
2.	Subject Signed Informed Consent	_____	_____	_____
3.	Biological Hazard Containment Present and in Use	_____	X	_____
4.	Other Medical Check (Pregnancy, Orthopedic, etc.)	_____	_____	No sulfite allergy, previous rxn to PMZ, contraindicated medical condition
5.	Name of Medical Monitor: Joseph E. Stuteville, M.D.			

Level of Monitoring Required (circle one): I II (III) IV Not Reqd

_____

Test Supervisor (Signature)

Graphics Pad Procedures

1. Check that the Eutron Smartkey is properly inserted into the parallel port on the laptop. It is a small gray connector that ensures the Oasis software is not stolen.
2. Check that the serial port connector that supplies the pad with power and serves as a link from the graphics pad to the computer is properly connected in the serial port of the laptop.
3. Power-up Graphics Pad using the lavender switch on the right side of the pad near the top (must be turned on before you launch the software).
4. Make sure the extra monitor is connected to the laptop and turn it on.
5. Power-up Dell laptop.
6. Launch the latest version of the Oasis software (shortcut should be on desktop).
7. Begin session:

Training session - Fill in appropriate information.

Subject number: number assigned to subject as they enter the study
Age
Gender
Session (1-8)

Experimental session - Fill in appropriate information:

Subject number
Age
Gender
Group: 1=non-pilot, 2=pilot
Session is actually the trial number for that day: 1=pre-drug administration, 2=one hour post-drug administration, 3=two hours post-drug,. 4=three hours post-drug, 5=four hours post-drug, 6=six hours post-drug, 7=eight hours post-drug
Day is the experimental session (1 is the first day the subject has come in for testing and 2 is the second day…it does not have any bearing on which medication they were administered)

DO NOT PRESS **ACCEPT** UNTIL SUBJECT IS READY TO BEGIN!

8. The program will automatically step through the tasks…EXCEPT switching. You must press the space bar to begin the switching task. It is randomized by subject, so you will just have to pay attention to when the program pauses.
9. If at any time during the experiment you wish to stop, press "Q" for quit or escape.
10. Once all of the tasks have been run,

NOTES

RANDOM: If the program has a glitch and shows an error, try choosing resume first. If that does not work, quit the program. Check to see if it has opened a file for that task and delete it if it has (do not worry about any tasks successfully completed before the glitch). Restart the data collection with the same info. The program will beep at you for the tasks that have already been completed, and then finish out.

TRACKING: If the red circle does not appear for tracking, try pressing the escape key and then choose resume (or run). If that does not work, follow the previous instructions for a random glitch.

HANDWRITING: Sometimes the program will not prompt the subject to stop and he/she will have reached the edge of the pad. Instruct the subject to pick up the pen, go back to the left-hand side and begin again. The program will eventually stop. Make a note of this to aid in analysis!

HNDWR/COORD: Sometimes the subject will forget the task and pick up the pen after only one stroke or try to restart. Make a note of this to aid in analysis!

BAD DATA: If you would like the subject to repeat a task because they did not follow instructions or "messed up", you can choose the "redo" button IMMEDIATELY after the bad task. If it does not restart, then the

computer will save the bad data. You can still repeat that trial. Once the entire trial is over (all four tasks), you can simply follow the instructions for the random glitch.

11. The data is automatically saved on the C drive in the Nasa-asu folder in a task subfolder indicating the subject number. (e.g. S14)

The filenames for all the tasks are the same: A########.pen
The "A" and ".pen" are constant. The first two numbers are the subject number (1-99). The 3rd number is the group (1=non-pilot, 2=non-pilot, 3=training for both groups). The 4th and 5th numbers are the session or day (01 or 02). The 6th number is the trial number (1-7 or 8). The last number is the task condition: tracking (always 1), switching (always 1), handwriting (1=le, 2=ti), coordination (1=horizontal, 2=45 degrees, 3=vertical, 4=135 degrees).

12. Move the data into 3 separate folders: Training, Exp1, Exp2.
13. Once all of the data is collected for a folder (i.e. all the training is completed or at the end of an experimental day), you can export the data.
14. Launch the Oasis software.
15. Choose EXPORT and the task you want to export
16. Change the directory to the folder where the pen files are located.
17. Choose USE (make sure the "current directory" is highlighted) (Example: the following folder would be chosen as the "current directory", c:\Nasa-asu\coordina\S03\Exp1\ , so all of the pen files in that folder would be exported into one file)
18. The program will begin to export the data and then save a new file in the folder where the pen files are located. The data file will have the same name as the first file in that folder with the extension ".dat" instead of ".pen". It will also create backup files of each pen file with the extension ".bak". EXCEPT handwriting.....for some reason the exported files are ##.dat with the two numbers being the subject number. You must go in by hand and change the filenames to ##tr.dat ##e1.dat and ##e2.dat
19. Matlab scripts have been written to analyze each task separately.
    These files export all of the parameters. The first file exports the primary params and the second file exports the secondary params.
    a. coord.m/coordsec.m
    b. handwr.m/handwrsec.m
    c. switch.m/switchsec.m
    d. track.m/tracksec.m

    These files concatenate the data, so there is in one file for each subject for each task.
    a. gpas_sum.m
    b. gpas_sumsec.m

20. After the files have been run through the Matlab scripts, they are then exported to Excel where they are arranged in a manner that is more suitable for statistical analysis. There are templates for the individual task spreadsheets.
    a. The template files are: coord_template.xls, hndwr_template.xls, switch_template.xls, track_template.xls
    b. The existing data files by subject are: coord_data.xls, hndwr_data.xls, switch_data.xls, track_data.xls
    c. The existing data files by parameter are: coord_param.xls, hndw_param.xls, switch_param.xls, track_param.xls
    d. The above data are placed into allpmzdata.xls. Then it is manipulated to make the graphs by omitting subjects with missing data in the file gpas_graphs.xls. It is modified one more time for presentation (dark background) in the file gpas_graphs_forpres.xls

Software updates: If Arend sends you updates or if you down load newer versions of Oasis, you must make sure the correct paths and settings are used in the shell script.

To get the correct GUI after downloading a new version of Oasis: launch the software and then choose :load" (upper right corner) and make sure you select "pmz.set" which is in the Oasis_exe\Oasis823 subfolders.

To update the macro files (*.mac): select each menu item and then choose "alias" (bottom menu). Then simply put the correct path to the new macro file. The current paths are (## equals the version number):

Pen File Viewer (2show.mac)	c:\oasis##\macros\general\2show.ac
Export pen files to ascii files	c:\ oasis##\macros\general\export.mac
Demos	c:\oasismac\nasa\demos.mac
Training Session	c:\oasismac\nasa\training.mac
Experimental Session	c:\oasismac\nasa\nasamen1.mac
Export to Text (Handwriting)	c:\oasismac\nasa\new_hwr2.mac
Export to Text (Coordination)	c:\oasismac\nasa\cooanal3.mac
Export to Text (Switching)	c:\oasismac\nasa\new_swit.mac
Export to Text (Tracking)	c:\oasismac\nasa\traanal2.mac

You also need to check the settings.

Go into Settings (right side vertical menu).

Set to medium (normal or high) resolution.

Go to Digitizer : Switch 3 and 4 off and switch 1, 2, and 5 on.

Go to Mouse: Switch 4 and 6 off.

Go to Options: Switch 2, 4, 6, 8, and 9 off.

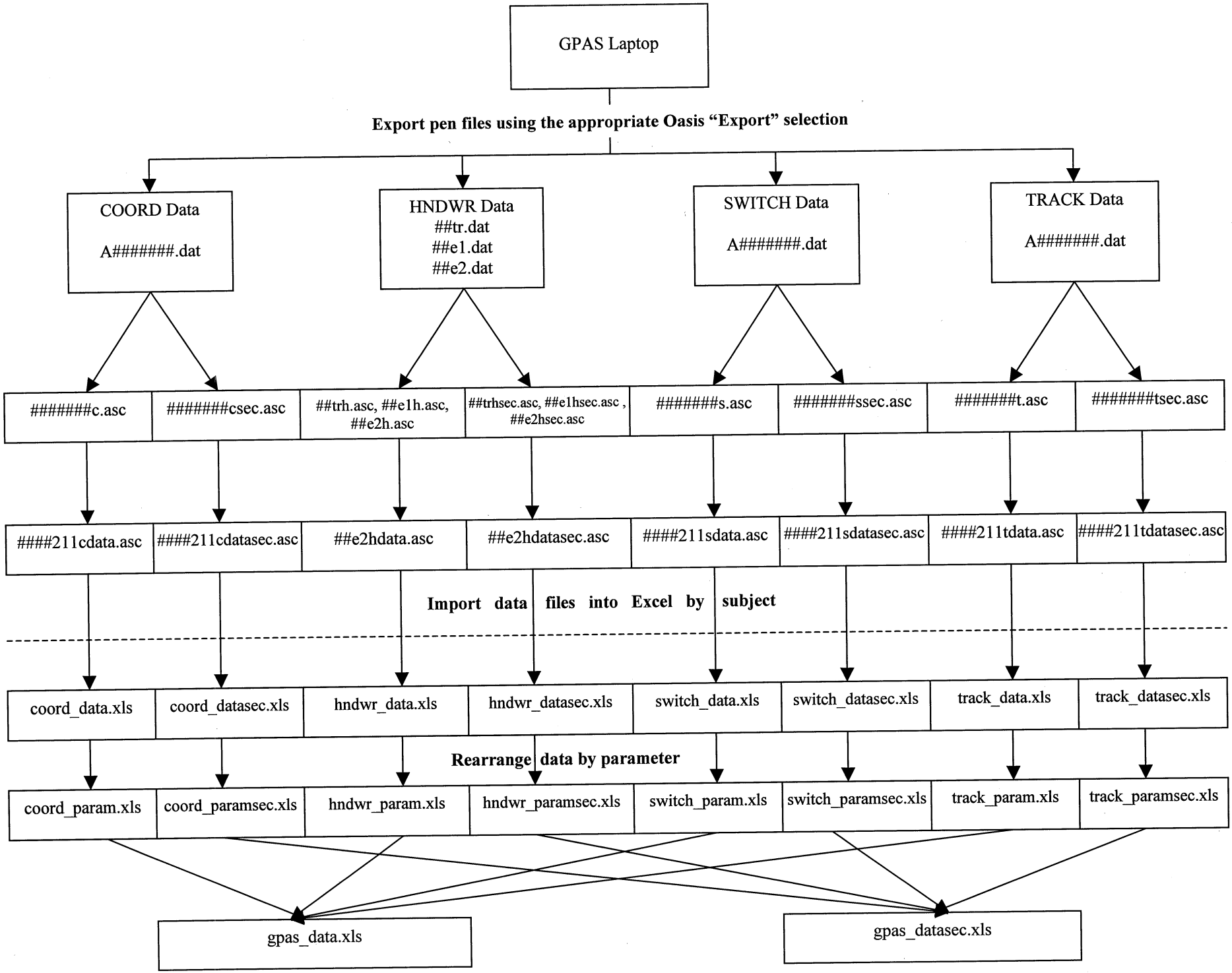
Go to Filtering: Switch New Pen filter method on.

Go to velocity -> Switch Butterworth on -> Dual pass -> put order on 4 (or higher if you like) -> I suggest to use Low Pass 7 Hz instead of 15 Hz. 7 Hz is for fine motor movements usually to most efficient filter frequency.

Go to Calibration -> Pen Channel 1 -> Auto Detect Device -> Follow instructions on screen.

Go to Manual Edit Point : Put the graph line on 0 and select manual edit point change it to 12. This means that an input of 12 bits would be detected as 0 grams. Then set the line at 350 grams, select again manual edit point and change the value 1023.

Status: Eighteen subjects began the study and 17 have finished (10 non-pilots and 7 pilots). Only the primary parameters have been exported and analyzed.


GPAS Laptop
Export pen files using the appropriate Oasis "Export" selection
COORD Data
A#######.dat
HNDWR Data
##tr.dat
##e1.dat
##e2.dat
SWITCH Data
A#######.dat
TRACK Data
A#######.dat
#######c.asc
#######csec.asc
##trh.asc, ##e1h.asc, ##e2h.asc
##trhsec.asc, ##e1hsec.asc , ##e2hsec.asc
#######s.asc
#######ssec.asc
#######t.asc
#######tsec.asc
####211cdata.asc
####211cdatasec.asc
##e2hdata.asc
##e2hdatasec.asc
####211sdata.asc
####211sdatasec.asc
####211tdata.asc
####211tdatasec.asc
Import data files into Excel by subject
coord_data.xls
coord_datasec.xls
hndwr_data.xls
hndwr_datasec.xls
switch_data.xls
switch_datasec.xls
track_data.xls
track_datasec.xls
Rearrange data by parameter
coord_param.xls
coord_paramsec.xls
hndwr_param.xls
hndwr_paramsec.xls
switch_param.xls
switch_paramsec.xls
track_param.xls
track_paramsec.xls
gpas_data.xls
gpas_datasec.xls

PILOT Software Data Analysis

Notes

Control Stick Steering (CSS)- manual steering of the PILOT

At any time the space bar can be used to hide the runway overlay, the altitude, and the guidance diamonds.

If landing at 10K

5K- radar will appear.

4K- Pitch up to stay in front of guidance diamonds (switch from outer to inner glide slope.)

3K- Gears are deployed.

2.2K- red guidance bar appears.

50 ft- pull nose up (keep wingtips on the horizon)

185 knots- start sloping nose down with a _ pitch deflection.

- Outer Glide Slope
  - 18° (heavy weight)
  - 20° (light weight)

Graphs

- RHC Pitch – always positive (graph should remain above line)
- RHC Roll- try to keep to minimal or at 0
- H(Ft) and H(Dot) (Vertical Velocity)- graph should come to a point and meet at 2500 ft
- Rate Command in Degrees per Second (Rate CMD-QC)
- RHC Output and RHC Pitch have similar graphs. A line that remains on the axis then a smooth pitch down at a 45° angle then goes to a straight line that runs parallel with the axis. This is only true for manual landing.

Data

- Vertical Velocity at Landing (VVL)
  - Nom. values (-2.0- -3.0) (max. value 4.0)

- Equivalent Air Speed (EAS)
  - Nom. values (195-205 knots)
  - 195 knots (light weight) and 205 knots (heavy weight)

Left/ Right Off of Centerline (YPS)

- Nom. Value (0 ft- +/-12 ft)

- Roll Angle (ROL)
  - Nom. Value (0°)

- Normalized Touchdown Position (XNM)
  - Nom. Values (2500 ft +/- 1000ft)

Runway Exposition (XPS)

Height of Gear Crossing (HGR)
Nom. values (23-29 ft)

Glide Slope

Glide slope should resemble glide path on the PILOT software Keep the diamond inside the circle and stay in between the two guidance diamonds. When the other two guidance diamonds appear from the bottom of the screen at 4K you must pitch up and lead the guidance diamonds to get nominal results. Stay _- _ in front of the guidance diamonds.

Other Information

At 2.2K the red bar will appear with a white ball bearing that tracks if you stay on the inner glide slope. The white ball is to remain on the red bar for nominal results. If the white ball is above the bar then you are below the inner glide slope. If it is below the red line, then you are higher than the desired glide slope

RATING CRITERIA

APPROACH @ RUNWAY THRESHOLD

PARAMETER	DESIRED	ADEQUATE
Altitude @ threshold (X = 0 ft)	20 to 28 ft	10 to 30 ft

LANDING PERFORMANCE CRITERIA (at Main Gear Touchdown)

PARAMETER	DESIRED	ADEQUATE
KEAS (Knots Equivalent Airspeed)	(205, 195, 185)* +5 / -10 KEAS	+10 / -15 KEAS
	* depends on mass properites and speedbrake	
KGS (Knots Ground Speed)	< 214 KGS	< 225 KGS
H-DOT (Sink Rate)	< 3 fps	< 4.5 fps
XRW (0 ft =threshold)	1700 to 3000 ft	1000 to 3500 ft
YRW (0 ft = centerline)	± 12 ft	± 50 ft

DEROTATION PERFORMANCE CRITERIA

PARAMETER	DESIRED	ADEQUATE
INITIATION (185 keas)	± 5 KEAS	± 10 KEAS
Y Deviation from Touchdown	± 20'	± 50'
RATE	1.0 to 2.0 deg/sec	0.75 to 2.5 deg/sec
ONSET	0.75 to 1.25 deg/sec	0.5 to 2.0 deg/sec

PILOT Operating Instructions
(portable inflight landing operations trainer)

SET-UP:
1.) Ensure that P2100 is plugged in and the switch on the back is ON.
2.) Push the green button on the left side.
3.) IDPROM: b [boot] <return>
4.) PILOT login: pilot [KSC day] / pilot61 [KSC night] / pilot58 [Edwards day] <return>
5.) date/time: <return> [default correct] / <YYMMDDHHmm> [enter correct] <return>
6.) subject's initials: <lowercase initials> <return>
7.) follow directions to calibrate RHC (rotational hand controller)
   - pitch down: *push RHC toward computer*
   - pitch up: *pull RHC away from computer*
   - detent: *no hands on RHC*
   * DO NOT RECALIBRATE BEFORE 1ST LANDING!!!
8.) PILOT menu
   - 8: *auto-steer at touchdown*
   - 7: *auto-pilot for demonstration*
9.) to change IC (initial conditions) location: 3 <return> <choose initial position> <return>
10.) main menu: <return>
11.) begin: S

LANDING: abort <CONTROL-a>
- RHC
  - pitch is sensitive: *revolution around lateral axis and change of direction*
  - roll is sluggish: *rotation around longitudinal axis without changing direction*
- Square/circle guide
  - square changes to circle just before coming out of HAC (heading alignment cone)
  - keep diamond perfectly centered as it nudges out of square/circle
- HUD (heads-up display): use altitude tape (on right) and airspeed tape (on left)
  - spacebar: *3 levels to de-clutter HUD*
  - Z: *switch between HUD and instruments*

4000 ft: 2 triangles rise from bottom of screen to meet fixed triangles
- use triangles as a vertical guide (more important) and diamond for centering

- Flare: keep white ball superimposed on red bar on left of runway
  - bar below ball: *shuttle too low*
  - bar above ball: *shuttle too high*
- Triangles move up the runway
  - altimeter=50 ft.: pull nose up half-way between black line on runway and horizon for half the distance to touchdown
  - airspeed=185 knots: push stick toward computer to bring down nosegear

RESULTS:
- JNM: overall indicator of performance (ideal: higher is better)
- VVL: vertical velocity at touchdown (ideal ≤ 3 ft/s)
- EAS: equivalent airspeed at touchdown (ideal ≈ 210)
- XPS: X-position at touchdown (ideal ≈ 2000 ft)

SHUTDOWN: NEVER TURN OFF POWER SWITCH IN BACK OF P2100!!!
1.) main menu: q <return>
2.) PILOT login: <push green button to turn off>

PROBLEMS: computer - Al Strahan (x36122)
RHC - Jim Brock (x45922)
general - Gwen Sandoz (212-6415)

Data Analysis
for the
Life Sciences Version
of the
Portable In-Flight Landing Operations Trainer
(PILOT)
Fall 1999.

INTRODUCTION

This document contains instructions for using the Matlab scripts R_text.m, S_text.m and T_text.m to read in the files that are exported by the Life Sciences Version of the PILOT software. The PILOT software (*version 2.0, used on-orbit*) did not save and export parameters for further analysis, did not allow for multiple landings and did not allow the implementation of random wind files for off-nominal landing conditions. The Life Sciences Version of the PILOT software meets each of these requirements. Al Strahan of EA implemented the changes to the software. It is identical to the *on-orbit, version 2.0* PILOT software, with the exceptions noted above. This document also covers how the data is stored for statistical and/or other analysis. For further information on the development of the Life Sciences Version of the PILOT software, see the "Portable In-Flight Landing Operations Trainer (PILOT)" document dated October 7, 1999. The document also contains detailed descriptions of the output data files generated by the Life Sciences Version of the PILOT software.

The three different files that are exported by the software use a naming convention that allows the files to be identified with each subject. For each session run of the software, there are three files exported. Each of the three files exported for a particular session will have identical names. A distinguishing first character allows quick identification of the file type. The first character is an 'r', 's', or 't'. An 'r' indicates that the file contains rotational hand control (RHC) input values for each simulation. An 's' indicates that the file is an 'STA' table file containing configuration parameters and JNM and ONM scores. Finally, a 't' indicates that the file contains tabular data which includes static or snapshot data at seven discrete transition points and dynamic data taken at 1 sec intervals above 50ft of altitude and 0.2 second intervals below 50ft of altitude to wheel stop during the simulation. The remaining characters of the file names indicate the day the data was collected, the time the data was collected and a three-letter extension unique to each subject.

The day the data was collected is a three-digit number from 001 to 365 or 366. The time the data was collected is a four-digit number with the first two characters representing the hour (00 - 23) and the last two characters representing the minutes (00 - 59). The time is defined as Greenwich Mean Time (GMT). The filename's extension is defined as the first letter of the subjects' first, middle and last names. If a subject does not have a middle name, the convention has been to use the letter 'x' for the middle name. An example filename is **r3361627.jds**. This would be an RHC file collected on day 336 at 16 hundred and 27 hours. The 'jds' extension represents **J**ohn **D**oe **S**mith. The 's' and 't' files would be named identically with either the 's' or 't' used as the first character.

Finally, the Life Sciences Version of the PILOT software allows the user to run an unlimited number of landings and also invokes random wind files to present off-nominal landing conditions for the subjects. Previous protocols have used six landings per session. The Matlab scripts are setup up to read files that contain six different landings. One of six different wind files is also randomly invoked into each of the landings. There are three types of wind files: 1) none or nominal, 2) moderate and 3) severe. In order to get six different wind files; there are two of each type. The wind file used for a particular landing is identified in the 's' file.

GENERAL SCRIPT USAGE

This section details the information that is common among the three different scripts, including user prompts, naming conventions for the output files, and the format in which the data is saved.

The three different scripts, R_text.m, S_text.m and T_text.m, are setup to analyze the three different file types described above. When a script is invoked, the first thing the user will be prompted to do is to select a file to analyze. The scripts are setup to allow the user to select a file that can be analyzed by a particular script. For example, the **r3361627.jds** file cannot be analyzed with the T_text.m script. Initially, the scripts seek the same information from the user. This information is used in naming the files, and includes whether or not the file is from a training session or an experimental session. If the file is from a training session, the user is prompted to enter in the training session number (1 - 8). If the file is from an experimental session, the user is prompted to enter in the experimental session (1 or 2).

The output filenames are nine characters long with a three-character extension. The first three characters of the filename are equivalent to the extension of the filename analyzed. The

fourth character is 'R', 'S' or 'T'. The next three characters represent the day the data was collected. The eighth character indicates whether the file was from a training (= 1) or experimental session (= 2), while the ninth character indicates session number. The three-letter extensions further indicate the type of data contained in the file, and will be explained in more detail in the specific script usage section. Using the example filename from earlier (**r3361627.jds**), and assuming that the file is training session 1, the output files would be named **jdsR33611.rpc** and **jdsR33611.rpf**. This naming convention allows the output files grouped by subject.

All output files from the three different scripts are saved in tab-delimited text format. This format was chosen because all software packages that could be used for further analysis are capable of reading this format.

SPECIFIC SCRIPT USAGE

This section details the differences between the scripts. Specifically, the manner in which the data is saved, the layout of the data, and the different ways in which it is saved.

R_text.m. This script reads in the data from the r*.* files. These files contain the RHC data from the simulation runs in the roll and pitch planes. The data is collected at 25hz.

There are two different files that are saved by this script. Each of the files contains 12 columns of data. The first six columns contain the roll data from landings 1 - 6, while columns 7 - 12 contain the pitch data from landings 1 - 6 (See Figure 1). All data in the '*.rpc' file have the same number of rows. The length of the shortest dataset determines the number of rows. The 'r' and 'p' stand for roll and pitch while the 'c' stands for cropped. All data in the '*.rpf' file contain the same number of rows as well. However, the length of the longest dataset determines the number of rows. The value of '2' was used to fill in the blanks to make the various datasets be of the same length. The roll and pitch values vary from -1 to +1, so a value of two is not expected to occur. The 'r' and 'p' stand for roll and pitch while the 'f' stands for full.

Figure 1. Data Layout for RHC files from R_text.m script.

Roll						Pitch					
T1	T2	T3	T4	T5	T6	T1	T2	T3	T4	T5	T6

S_text.m. This script reads in the data from the s*.* files. These files contain data from the 'STA' table, the configuration parameters and the JNM and ONM scores.

There are two files saved by this script. Each file contains identical information; however, the *.uns file is "unsorted by wind file. This means that the third column of data includes the wind file number for each of the successive, six landings. The *.sor file contains data that was sorted by windfile, which means that within each training (or experimental) session, the third column is sorted 1-6 (by windfile). The corresponding number in column two is the landing number associated with that windfile. Each file contains the configuration and landing parameter data. The final text file will be a 48 x 50 matrix (training sessions) or 42 x 50 matrix (experimental sessions). The first 16 columns of each of the files contains the configuration data while the remaining 34 columns contain landing/parameter data.

The configuration file contains the following data:

1) Session Number
2) Trial number (1 - 6)

Orbital Mass Properties

3) Orbital Mass
4) X-cg
5) Y-cg
6) Z-cg
7) Position IC
8) HAC angle used (if position IC 1 or 2 is used)
9) Scene selected
10) Aim point used
11) Status of Auto vs. CSS at the start of the run
12) Weight on Wheels (WOW) steering after main gear touchdown (1-engaged; 0-not engaged)
13) Estimated Airspeed for automatic drug chute deploy (after main gear touchdown) in knots.
14) Altitude for automatic gear deploy
15) Wind option used (1-standard PILOT wind, 2-random STA wind)
16) Selected wind if standard PILOT wind is used (1-no wind, 2-modest 1, 3-modest 2, 4-stress, 5-modified)
17) Selected STA wind if random wind is used, note that the no-wind case repeats in the list (1-STA_WND0, 2-STA_WND3, 3-STA_WND7, 4-STA_WND0, 5-STA_WND4, 6-STA_WND6).

The parameter file contains the following data:

18) JNM -Self correlation number (Justiz Number)
19) ONM -Orbiter Navigation Number
20) AS3 -Estimated airspeed at 3000ft (knots)
21) SB3 -Speedbrake position at 3000ft (%)
22) SBC -Speedbrake command just after 3000ft (%)
23) GM3 -Glideslope angle (gamma) at 3000ft (deg)
24) XP3 -X-position error at 3000ft (ft)
25) AST -Estimated airspeed at threshold (beginning of runway pavement)(knots)
26) HGR -Altitude of wheels at threshold (ft)
27) VVL -Vertical velocity of vehicle center of mass at main gear touchdown (ft/sec)
28) WDR -Vertical velocity of wheels at main gear touchdown (ft/sec)
29) EAS -Estimated airspeed at main gear touchdown (knots)
30) VGD -Ground speed at main gear touchdown
31) XPS -X position of vehicle at main gear touchdown (ft)
32) YPS -Y position of vehicle at main gear touchdown (ft)
33) XNM -Normalized X position at touchdown (ft)
34) PIT -pitch angle at main gear touchdown (deg)
35) AOA -Angle of attach at main gear touchdown (deg)
36) ROL -Roll angle at main gear touchdown (deg)
37) HDG -Heading error at main gear touchdown (deg)
38) LAV -Y velocity at main gear touchdown (ft/sec)
39) SB1 -Speedbrake position at 150ft (%)
40) MDX -X navigation error at Microwave Scanning Beacon Landing System (ft)
41) MDY -Y navigation error at Microwave Scanning Beacon Landing System (ft)
42) MDZ -Z navigation error at Microwave Scanning Beacon Landing System(ft)
43) RDZ -Z navigation error at radar altitude
44) GMT -Glideslope angle (gamma) at threshold (deg)
45) MAS -Maximum estimated airspeed experienced in trajectory (knots)
46) MAL -Altitude where maximum estimated airspeed experienced (ft)

47) MQB -Maximum dynamic pressure (q-bar) experienced below 5000 ft (lbf/ft^2)
48) GRA -Altitude when gear deployment started (ft)
49) ALT -Altitude for approach and land transition (ft)
50) XCN -Normalized X position minus X position error at 3000ft (XNM - XP3)(ft)

T_text.m. This script reads in the data from the t*.* files and exports two different types of files - a *dynam*.asc or *static*.asc file. The length of the dynamic file varies by the number of rows within each landing of each session. The file is so-named because it is collected in an on-line format from the beginning of the landing to nose-wheel touchdown. The static data file should be 48 (or 42) x 112. The rows constitute 6 landings for each of the eight (or 7 for experimental) sessions. The columns represent a repeating format for the 16 parameters extracted as snapshots during each landing. There are seven different snapshots and they are listed below. Below the seven snapshots of data are the 16 parameters that are extracted. There are 112 columns of data because each of the seven snapshots of data contain the 16 parameter; therefore, the 7 'datasets' with 16 columns of data each are repeated (7 x 16 = 112).

SNAPSHOT DATA POINTS

1) Entry into the Heading Alignment Cone (HAC Entry)
2) Exit from the Heading Alignment Cone (HAC Exit)
3) Starting the Outer Glide Slope (OGS), typically at 10000ft.
4) Starting the Pre-Flare, typically at 2000ft (pre-f)
5) Starting the Final-Flare, typically at 50-100ft (fin-f)
6) Crossing the runway threshold (beginning of the paved runway) (t-hold).
7) Main Gear Touchdown (mn_gtd).

16 PARAMETERS

1) Time since the beginning of the simulation run (seconds).
2) Runway X position of the vehicle center of mass (ft)
3) Runway Y position of the vehicle center of mass (ft)
4) Runway Z position of the vehicle center of mass (ft)
5) X velocity in the vehicle body frame (ft/sec)
6) Y velocity in the vehicle body frame (ft/sec)
7) Z velocity in the vehicle body frame (ft/sec)

8) Roll attitude of vehicle (deg)
9) Pitch attitude of vehicle (deg)
10) Roll rate of vehicle (deg/sec)
11) Pitch rate of vehicle (deg/sec)
12) Error between guidance roll command and actual for the vehicle (deg)
13) Error between guidance pitch command and actual for the vehicle (deg)
14) RHC Roll deflection (-1.0 for full left, +1.0 for full right)
15) RHC Pitch deflection (-1.0 for full forward, +1.0 for full aft)
16) Estimated Airspeed (knots)

Portable In-Flight Landing Operations Trainer (PILOT)
Life Sciences Version
Oct 7, 1999

Included here is a high-level description of the changes made to the standard load (version 2.0, used on-orbit) of the Portable In-Flight Landing Operations Trainer (PILOT) software in support of Life Sciences test objectives. The standard load of the PILOT software is itself a Pentium based shuttle landing simulation that is used on the Payload General Support Computer (PGSC) on orbit to aide crews in maintaining orbiter landing proficiency. This text also includes a detailed description of the output data files generated by the Life Sciences version of the PILOT software.

New files specific to the Life Sciences PILOT s/w load

The Life Sciences PILOT (LF-PILOT) unique files are designed to be interspersed within the standard PILOT 2.0 directory structure, and to only require different 'batch' files for program invocation. No PILOT 2.0 files need to be deleted for the execution of the LF-PILOT load, though some of them will not be used. All new files are described below as well as there relative path from the top of the PILOT 2.0 directory:

..\PIL_MED.BAT (size 58, time-stamp 10-07-99 7:06p), this batch file invokes the LF-PILOT routine without a Rotation Hand Controller (RHC) connected
..\PILR_MED.BAT (size ~~60~~ 66, time-stamp 10-07-99 ~~7:07~~ 4:15p), this batch file invokes the LF-PILOT routine with a Rotation Hand Controller (RHC) connected
..\GRAPHICS\LF_PILOT.EXE (size 2921890, time-stamp 10-05-99 6:50p), this is the PILOT executable with the Life Sciences modifications
..\GRAPHICS\WINDS\STA_WND0 (size 396, time-stamp 10-01-99 1:37p), this is a zero magnitude wind file used as part of the random STA wind set
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..\GRAPHICS\WINDS\STA_WND6 (size 54000, time-stamp 10-01-99 1:40p), this is a stress STA wind file used as part of the random STA wind set
..\GRAPHICS\WINDS\STA_WND7 (size 54000, time-stamp 10-01-99 1:41p), this is a modest STA wind file used as part of the random STA wind set

Configuration and Execution of the Life Sciences PILOT s/w

The LF-PILOT s/w can be initiated with either batch script (PIL_MED or PILR_MED) though the program must be executed in the DOS only mode for smooth graphics performance. This can be achieved by shutting down Windows into DOS and entering the batch script file name, or by making an alias icon to the batch script in Windows,

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configuring it to have a quit-to-DOS attribute, and then selecting the alias icon. If the PILR_MED script is executed, an RHC must be connected to the serial port of the host computer and must have the 'rhcport' number in the batch script equal to the com port number assigned to the serial port, in order for the program to work. Also if using an IBM Thinkpad computer, the rear Infrared port must be disabled and the serial port enabled in order for the LF-PILOT software to work with an RHC.

Com port 2

Once the LF-PILOT program is initiated, it will automatically request a 3 letter identifier for the test subject being used. NOTE, the 'q' key will not work but rather will exit the program, while any other lower case letter is acceptable. These letters will be used as the suffix for the data files generated during the session. If the PILR_MED script is invoked, on screen instructions will then appear to guide the user through an RHC calibration. Otherwise, the 'START simulation' screen will appear. At this point, the user can enter an 'm' key to go the main configuration menu, or the user can just press enter to start the run.

in any order or just first

If the main menu has been selected, the following options are available, and are listed with default values:

Category 1 – allows the user to change the altitude at which the gear automatically deploys, or to change the air speed (once main gear touchdown has occurred) at which the drag chute will deploy. These are defaulted to 350 ft and 195 knots respectively.

Category 2 – allows the user to change the orbiter mass properties, which in turn will automatically adjust the outer glide slope angle. These are defaulted to a light weight orbiter with Mass = 217696.2 lbm, Xcg = 1081.7 in, Ycg = 0.0 in and Zcg = 373.3 in.

Category 3 – allows the user to change the 'Initial Condition' location of the simulation, starting either at Mach 0.95 around 50,000 ft (where the Heading Alignment Cone direction and angle can be selected), or at 10000 ft or at 3500 ft. This is defaulted to a 10000 ft Initial Condition.

Category 4 – allows the user to change the landing scene to be either end of the KSC runway (15 or 33) and to land with a day or night scene. The default here is for a runway 15 day time scene.

a stress?

Category 5 – allows the user to select a wind profile. The options here include four pre-defined wind files with the standard PILOT load, including a 'No wind', two 'modest' winds and a 'stress' wind, though all are defined with only 6 to 8 altitude set points (interpolated in between) and as such these winds change very gradually with altitude. There is also an option to modify any of these four standard PILOT winds and select that for use as a 'modified' wind. In addition, there is the defaulted option for the LF-PILOT software is to use a 'randomly' selected wind, which will chose one of the four STA non-zero winds or the STA zero magnitude wind.

different from the Mals

Category 6 – toggles between the close and nominal aim point, with the nominal being the default.

Category 7 – toggles between initiating a run in auto or Control Stick Steering (CSS). This defaults to OFF though it can be changed back and forth during flight.

Category 8 – toggles between auto-steering being engaged or not at main gear touchdown. If engaged, then the lateral control channel will go back into auto mode at main gear touchdown, leaving the pitch channel in manual, If this is not set to engage, then both longitudinal and lateral control will remain in manual at touchdown. The default here is to have 'auto steer' engaged at touchdown.

C key - can be entered at the main menu to perform the RHC calibration procedure, in the event that the calibration appears off or a bias is suspected in the RHC commands.

Once a landing simulation run has been initiated, there are some active 'hot' keys that can be invoked to change the graphics or other aspects of the run. These are listed on the 'START simulation' page, and are listed below:

Z key - toggles between the out-the-window and heads down display, with the latter providing instrument displays including the Attitude Direction Indicator (ADI), the Horizontal Situation Indicator (HSI), and the graphical portion of the SPEC-50 display showing Heading Alignment Cone and predictor 'bugs' at 20, 40 and 60 seconds out.

Space Bar – cycles through the various de-clutter states of the Heads Up Display (HUD) until main gear touchdown, then it deploys the drag chute (unless it has already been deployed based on main gear touch down and air speed).

P key – will pause the simulation graphics (for either out-the-window or heads down) indefinitely until the p key is again pressed, then the run will continue.

A key – commands the software to fly both channels in auto, requiring no RHC inputs.

C key – commands the software to fly Control Stick Steering (CSS) where RHC inputs are used to fly the vehicle.

A simulation run will continue until Nose-Wheel touchdown. After a simulation run, post-run feedback plots and tables are displayed presenting information on the flight just completed. The first page entitled 'TOCHDOWN PLOTS' includes plots of RHC pitch and roll inputs, as well as elevon, altitude and altitude rate as a function of runway-X position, starting at 50 ft altitude until main gear touchdown. The second page entitled 'DEROTATION PLOTS' includes plots of RHC pitch, total pitch rate command (combining commands from the RHC pitch deflection and the 'beeptrim' button) and the actual pitch rate, all as a function of time, starting after main gear touchdown and at the initiation of a pitch down command. The third page entitled 'GLIDESLOPE PLOT' provides a plot of the 'design-eye height' (a point just behind the command's window in the orbiter) as a function of runway-X position, co-plotted against a design reference glideslope (of 1.5 deg) in red, and is always bounded by –5000 and 0 ft runway-X. The fourth page without a title is the STA table page, presenting specific 'snap shot' parameters captured along the flight. The space bar is used to proceed forward through these pages while the 'b' key proceeds backwards.

After proceeding past the last 'STA table' page, the 'START simulation' page appears again and the post-run plots are no longer accessible ~~for~~ from the previous run. At this point,

another run can be initiated, or the menu page can be called up (with the 'm' key) to change the configuration or to perform an RHC calibration.

The program quits at any time from any screen, display or even from the active simulation if the 'q' key is pressed. This will return the user to the DOS prompt (or to Windows if LF-PILOT was initiated by selecting an alias icon to one of the LF-PILOT batch scripts).

Random Wind Selection

As described in the configuration and execution discussion, four non-zero STA wind files were added, along with a zero magnitude STA formatted wind, for use by the LF-PILOT program. These are utilized if the Main Menu Wind Category is set to RANDOM, which is the default for the LF-PILOT software. For each run, the software will randomly select one of the four non-zero STA wind files, or will select the no-wind STA file. On successive simulation runs during the same session, the software will keep track of what STA wind files have been selected and will not repeat any until all four have been used along with two selections of the no-wind file. After six runs have been completed, where all four non-zero STA winds have been selected once and the no-wind STA file selected twice, then the process will repeat with any of the STA wind files again eligible for selection on the seventh run, and with the cycle of availability continuing to repeat every six runs. Also, the software continues to randomly select STA wind files for each simulation run even if the Wind Category is set to use a standard PILOT wind in the silmulation, such that STA wind eligibility is reset every six runs regardless of their use.

In addition, it should be noted that these STA wind files are defined with a much finer resolution then the standard PILOT wind files, varying in magnitude and direction every foot to every few feet in altitude. This provides for a somewhat more realistic and more challenging wind to fly then that experienced with the selection of the standard PILOT winds.

Output Data

One of the significant changes for the LF-PILOT software was adding the ability to generate output files to capture parameters to help define the run performance. This included the generation of three unique files for every unique session with the LF-PILOT software, where a single session consist of however many runs are performed from the initiation the LF-PILOT software until it is exited with the 'q' command. The three files are defined in the same directory where the executable resides (..\GRAPICS), and all

three have the same name except for the first distinguishing character. The format of the file names is:

#dddhhmm.XXX

Where # is the distinguishing character, ddd is the current numeric day of the year (001 to 365, or 366), hh is the current hour (00 to 23), mm is the current minute (00 to 59) and XXX is the three letter identifier entered at the beginning of the session. The time is defined in Universal or Greenwich Mean Time (GMT) rather than local time (though is only as accurate as the host computer's awareness of local time and its conversion to GMT).

The output files are first written for a session at the first transition from the post-run 'STA table' to the 'START simulation' page, so if a session is quit before then, the files will not be generated. Similarly, additional data for each additional simulation run during the same session is appended to these three data files at subsequent transitions from the post-run 'STA table' to the 'START simulation' page. So again, if a run is quit before that transition, data from that last run will not be appended to the output files but will be lost. These three ouput files are defined below.

Sdddhhmm.XXX – Is the 'STA table' file. It lists the run configuration parameters and then lists all the parameters displayed in the STA table, plus the JNM and ONM numbers. This data format defined below will repeat for each simulation run during a session. A detailed description of each line starting with the first, follows:

1- trial number
- run number followed by a blank line

2,3,4,5 - orbiter mass properties listed in 4 lines (mass, Xcg, Ycg and Zcg)

6 - Position IC (1 – mach = 0.95 Left HAC, 2 – mach = 0.95 Right HAC, 3 – 10000 ft, 4 – 3500 ft)

7 - HAC angle used (if position IC 1 or 2 is used)

8 - Scene selected (1 - KSC 15 at day, 2 – KSC 15 at night, 3 – KSC 33 at day, 4 – KSC 33 at night)

9 - Aim point used (1 - Nominal, 0 - Close)

10 - Status of Auto vs CSS at the start of the run (1 - starting in auto, 0 - starting in CSS)

11 - Weight on Wheels (WOW) steering after main gear touchdown (1 – engage auto steering at touchdown, 0 – do not engage auto steering at touchdown)

12 - Estimated Airspeed for automatic drag chute deploy (after main gear touchdown) in knots

13 - Altitude for automatic gear deploy

14 - Wind option used (1 – standard PILOT wind, 2 – random STA wind)

15 - Selected wind if standard PILOT wind is used (1 – no wind, 2 – modest 1, 3 – modest 2, 4 – stress, 5 – modified)

16 - Selected STA wind if random wind is used, note that the no-wind case repeats in the list (1 – STA_WND0, 2 – STA_WND3, 3 – STA_WND7, 4 – STA_WND0, 5 –

STA_WND4, 6 – STA_WND6). Here the STA_WND0 is a no wind file, STA_WND3 & 7 are modest wind files, STA_WND 4 & 6 are stressful wind files.

- Test subject identifier (3 letters initially entered)

- a blank line followed by another text line announcing STA number

2 - JNM - Self Correlation Number (Justiz number)
3 - ONM - Orbiter Navigation Number
4 - AS3 - Estimated Airspeed at 3000 ft (knots)
5 - SB3 - Speedbrake position at 3000 ft (%)
6 - SBC - Speedbrake command just after 3000 ft (%)
7 - GM3 - Glideslope angle (gamma) at 3000 ft (deg)
8 - XP3 - X position error at 3000 ft (ft)
9 - AST - Estimated Airspeed at threshold (beginning of runway pavement), (knots)
10 - HGR - Altitude of wheels at threshold (ft)
11 - VVL - Vertical velocity of vehicle center of mass at main gear touch down (ft/sec)
12 - WDR - Vertical velocity of wheels at main gear touchdown (ft/sec)
13 - EAS - Estimated Airspeed at main gear touchdown (knots)
14 - VGD - Ground speed at main gear touchdown (knots)
15 - XPS - X position of vehicle at main gear touchdown (ft)
16 - YPS - Y position of vehicle at main gear touchdown (ft)
17 - XNM - Normalized X position at touchdown (ft)
18 - PIT - Pitch angle at main gear touchdown (deg)
19 - AOA - Angle of attack at main gear touchdown (deg)
20 - ROL - Roll angle at main gear touchdown (deg)
21 - HDG - Heading error at main gear touchdown (deg)
22 - LAV - Y-velocity at main gear touchdown (ft/sec)
23 - SB1 - Speedbrake position at 150 ft (%)
24 - MDX - X navigation error at Microwave Scanning Beacon Landing System (ft)
25 - MDY - Y navigation error at Microwave Scanning Beacon Landing System (ft)
26 - MDZ - Z navigation error at Microwave Scanning Beacon Landing System (ft)
27 - RDZ - Z navigation error at radar altitude (ft)
28 - GMT - Glideslope angle (gamma) at threshold (deg)
29 - MAS - Maximum estimated airspeed experienced in trajectory (knots)
30 - MAL - Altitude where maximum estimated airspeed experienced (ft)
31 - MQB - Maximum dynamic pressure (q-bar) experienced below 5000 ft (lbf/ft^2)
32 - GRA - Altitude when gear deployment started (ft)
33 - ALT - Altitude for Approach and Land transition (ft)
34 - XCN - Normalized X position minus X position error at 3000 ft (XNM-XP3),(ft)

Note that only the first 24 parameters after ONM and up to RDZ, along with an unlisted parameter (x-velocity at main gear touchdown) are used in the calculation of the JNM and ONM values.

Rdddhhmm.XXX – Is the 'RHC' file. It lists the RHC input values for the entire duration of the simulation, if the RHC is utilized. The first line lists the run number while the second lists column names (RHC Roll and RHC Pitch), followed by a listing of the RHC inputs with each line capturing one 25 hz data cycle. Roll values vary from –1.0 for a maximum left deflection to +1.0 for a maximum right deflection. Pitch values vary from –1.0 for a maximum forward (nose-down) deflection to +1.0 for a maximum aft (nose-up) deflection. This data format repeats for subsequent simulation runs during a session.

Tdddhhmm.XXX – Is the 'Tabular' file. It lists tabulated flight data for a given simulation run. This includes 'Static' data, a snap shot of 16 parameters recorded at seven discrete transition points, and 'Dynamic' data, a snap shot of the same 16 parameters at one second intervals above 50 ft altitude, and at 0.2 second intervals once below 50 ft.

The format of the data begins with a line of text identifying the run number, followed by a line identifying Static data, followed by a line listing column titles for the 16 parameters. This is followed by seven lines of data, each beginning with text identifying the specific event transition.

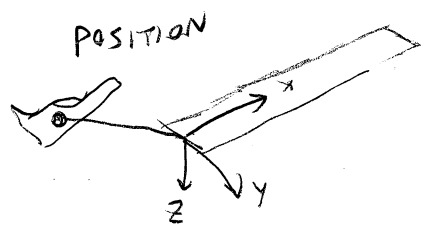
These seven transitions listed in the static data are:

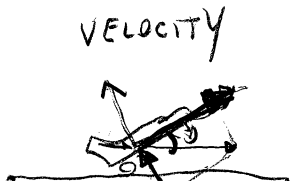
- Entry into the Heading Alignment Cone (HAC)
- Exit from the Heading Alignment Cone (HAC)
- Starting the Outer Glide Slope (OGS), typically at 10000 ft
- Starting the pre-flare, typically at 2000 ft
- Starting the final flare, typically at 50 – 100 ft
- Crossing of the runway threshold (beginning of paved runway)
- Main Gear Touchdown

The static data block is followed by the listing of the dynamic data block, which begins with a line of text identifying it as dynamic data, followed by a listing of column titles for the 16 parameters, followed by the actual lines of data. As with the other two output files, this pattern of data repeats for every additional simulation run in a given session.

The 16 parameters listed both in the static and dynamics data blocks, in order from left to right, are as follows:

3 - Time since the beginning of the simulation run (seconds)
4 - Runway-X position of the vehicle center of mass (ft)
5 - Runway-Y position of the vehicle center of mass (ft)
6 - Runway-Z position of the vehicle center of mass (ft)
7 - X velocity in the vehicle body frame (ft/sec)
8 - Y velocity in the vehicle body frame (ft/sec)
9 - Z velocity in the vehicle body frame (ft/sec)





10 - Roll attitude of vehicle (deg)
11 - Pitch attitude of vehicle (deg)
12 - Roll rate of vehicle (deg/sec)
13 - Pitch rate of vehicle (deg/sec)
14 - Error between guidance roll command and actual for the vehicle (deg)
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16 - RHC Roll deflection (-1.0 for full left, +1.0 for full right)
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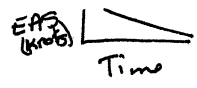
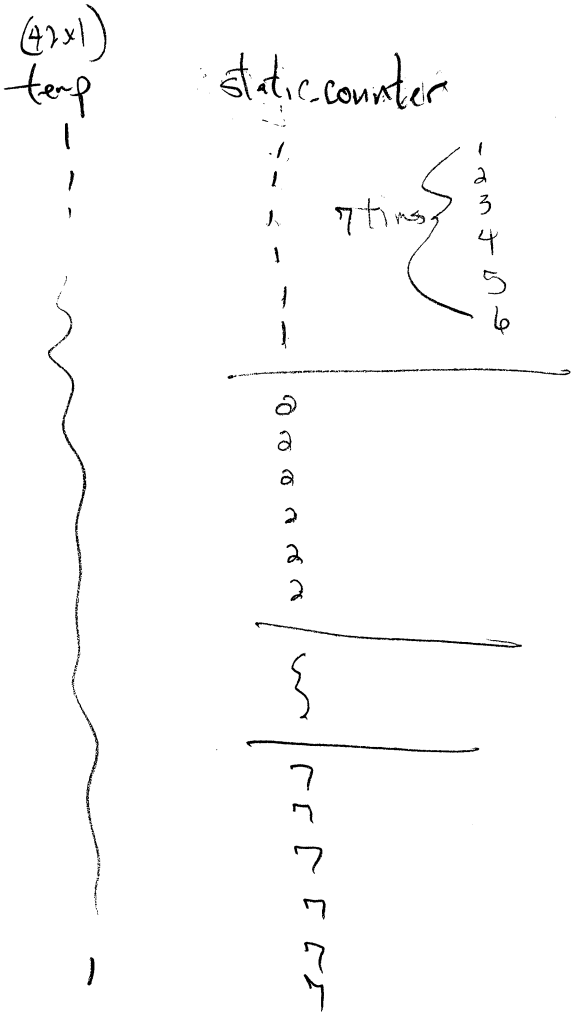
18 - Estimated Airspeed (knots)



maybe test D in slope

The runway coordinate system is centered on the runway center line at the runway threshold (at the edge of the pavement, not including the under run). The X-axis is positive along the runway away from the approaching orbiter, the Y-axis is positive to the right of the runway centerline while the Z-axis is positive down (below ground), so recorded Z values (altitudes) are always negative.



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..\GRAPHICS\WINDS\STA_WND6 (size 54000, time-stamp 10-01-99 1:40p), this is a stress STA wind file used as part of the random STA wind set
..\GRAPHICS\WINDS\STA_WND7 (size 54000, time-stamp 10-01-99 1:41p), this is a modest STA wind file used as part of the random STA wind set

Configuration and Execution of the Life Sciences PILOT s/w

The LF-PILOT s/w can be initiated with either batch script (PIL_MED or PILR_MED) though the program must be executed in the DOS only mode for smooth graphics performance. This can be achieved by shutting down Windows into DOS and entering the batch script file name, or by making an alias icon to the batch script in Windows,

configuring it to have a quit-to-DOS attribute, and then selecting the alias icon. If the PILR_MED script is executed, an RHC must be connected to the serial port of the host computer and must have the 'rhcport' number in the batch script equal to the com port number assigned to the serial port, in order for the program to work. Also if using an IBM Thinkpad computer, the rear Infrared port must be disabled and the serial port enabled in order for the LF-PILOT software to work with an RHC.

Once the LF-PILOT program is initiated, it will automatically request a 3 letter identifier for the test subject being used. NOTE, the 'q' key will not work but rather will exit the program, while any other lower case letter is acceptable. These letters will be used as the suffix for the data files generated during the session. If the PILR_MED script is invoked, on screen instructions will then appear to guide the user through an RHC calibration. Otherwise, the 'START simulation' screen will appear. At this point, the user can enter an 'm' key to go the main configuration menu, or the user can just press enter to start the run.

If the main menu has been selected, the following options are available, and are listed with default values:

Category 1 – allows the user to change the altitude at which the gear automatically deploys, or to change the air speed (once main gear touchdown has occurred) at which the drag chute will deploy. These are defaulted to 350 ft and 195 knots respectively.

Category 2 – allows the user to change the orbiter mass properties, which in turn will automatically adjust the outer glide slope angle. These are defaulted to a light weight orbiter with Mass = 217696.2 lbm, Xcg = 1081.7 in, Ycg = 0.0 in and Zcg = 373.3 in.

Category 3 – allows the user to change the 'Initial Condition' location of the simulation, starting either at Mach 0.95 around 50,000 ft (where the Heading Alignment Cone direction and angle can be selected), or at 10000 ft or at 3500 ft. This is defaulted to a 10000 ft Initial Condition.

Category 4 – allows the user to change the landing scene to be either end of the KSC runway (15 or 33) and to land with a day or night scene. The default here is for a runway 15 day time scene.

Category 5 – allows the user to select a wind profile. The options here include four pre-defined wind files with the standard PILOT load, including a 'No wind', two 'modest' winds and a 'stress' wind, though all are defined with only 6 to 8 altitude set points (interpolated in between) and as such these winds change very gradually with altitude. There is also an option to modify any of these four standard PILOT winds and select that for use as a 'modified' wind. In addition, there is the defaulted option for the LF-PILOT software is to use a 'randomly' selected wind, which will chose one of the four STA non-zero winds or the STA zero magnitude wind.

Category 6 – toggles between the close and nominal aim point, with the nominal being the default.

Category 7 – toggles between initiating a run in auto or Control Stick Steering (CSS). This defaults to OFF though it can be changed back and forth during flight.

Category 8 – toggles between auto-steering being engaged or not at main gear touchdown. If engaged, then the lateral control channel will go back into auto mode at main gear touchdown, leaving the pitch channel in manual, If this is not set to engage, then both longitudinal and lateral control will remain in manual at touchdown. The default here is to have 'auto steer' engaged at touchdown.

C key - can be entered at the main menu to perform the RHC calibration procedure, in the event that the calibration appears off or a bias is suspected in the RHC commands.

Once a landing simulation run has been initiated, there are some active 'hot' keys that can be invoked to change the graphics or other aspects of the run. These are listed on the 'START simulation' page, and are listed below:

Z key - toggles between the out-the-window and heads down display, with the latter providing instrument displays including the Attitude Direction Indicator (ADI), the Horizontal Situation Indicator (HSI), and the graphical portion of the SPEC-50 display showing Heading Alignment Cone and predictor 'bugs' at 20, 40 and 60 seconds out.

Space Bar – cycles through the various de-clutter states of the Heads Up Display (HUD) until main gear touchdown, then it deploys the drag chute (unless it has already been deployed based on main gear touch down and air speed).

P key – will pause the simulation graphics (for either out-the-window or heads down) indefinitely until the p key is again pressed, then the run will continue.

A key – commands the software to fly both channels in auto, requiring no RHC inputs.

C key – commands the software to fly Control Stick Steering (CSS) where RHC inputs are used to fly the vehicle.

A simulation run will continue until Nose-Wheel touchdown. After a simulation run, post-run feedback plots and tables are displayed presenting information on the flight just completed. The first page entitled 'TOCHDOWN PLOTS' includes plots of RHC pitch and roll inputs, as well as elevon, altitude and altitude rate as a function of runway-X position, starting at 50 ft altitude until main gear touchdown. The second page entitled 'DEROTATION PLOTS' includes plots of RHC pitch, total pitch rate command (combining commands from the RHC pitch deflection and the 'beeptrim' button) and the actual pitch rate, all as a function of time, starting after main gear touchdown and at the initiation of a pitch down command. The third page entitled 'GLIDESLOPE PLOT' provides a plot of the 'design-eye height' (a point just behind the command's window in the orbiter) as a function of runway-X position, co-plotted against a design reference glideslope (of 1.5 deg) in red, and is always bounded by –5000 and 0 ft runway-X. The fourth page without a title is the STA table page, presenting specific 'snap shot' parameters captured along the flight. The space bar is used to proceed forward through these pages while the 'b' key proceeds backwards.

After proceeding past the last 'STA table' page, the 'START simulation' page appears again and the post-run plots are no longer accessible for the previous run. At this point,

another run can be initiated, or the menu page can be called up (with the 'm' key) to change the configuration or to perform an RHC calibration.

The program quits at any time from any screen, display or even from the active simulation if the 'q' key is pressed. This will return the user to the DOS prompt (or to Windows if LF-PILOT was initiated by selecting an alias icon to one of the LF-PILOT batch scripts).

Random Wind Selection

As described in the configuration and execution discussion, four non-zero STA wind files were added, along with a zero magnitude STA formatted wind, for use by the LF-PILOT program. These are utilized if the Main Menu Wind Category is set to RANDOM, which is the default for the LF-PILOT software. For each run, the software will randomly select one of the four non-zero STA wind files, or will select the no-wind STA file. On successive simulations runs during the same session, the software will keep track of what STA wind files have been selected and will not repeat any until all four have been used along with two selections of the no-wind file. After six runs have been completed, where all four non-zero STA winds have been selected once and the no-wind STA file selected twice, then the process will repeat with any of the STA wind files again eligible for selection on the seventh run, and with the cycle of availability continuing to repeat every six runs. Also, the software continues to randomly select STA wind files for each simulation run even if the Wind Category is set to use a standard PILOT wind in the silmulation, such that STA wind eligibility is reset every six runs regardless of their use.

In addition, it should be noted that these STA wind files are defined with a much finer resolution then the standard PILOT wind files, varying in magnitude and direction every foot to every few feet in altitude. This provides for a somewhat more realistic and more challenging wind to fly then that experienced with the selection of the standard PILOT winds.

Output Data

One of the significant changes for the LF-PILOT software was adding the ability to generate output files to capture parameters to help define the run performance. This included the generation of three unique files for every unique session with the LF-PILOT software, where a single session consist of however many runs are performed from the initiation the LF-PILOT software until it is exited with the 'q' command. The three files are defined in the same directory where the executable resides (..\GRAPICS), and all

three have the same name except for the first distinguishing character. The format of the file names is:

#dddhhmm.XXX

Where # is the distinguishing character, ddd is the current numeric day of the year (001 to 365, or 366), hh is the current hour (00 to 23), mm is the current minute (00 to 59) and XXX is the three letter identifier entered at the beginning of the session. The time is defined in Universal or Greenwich Mean Time (GMT) rather than local time (though is only as accurate as the host computer's awareness of local time and its conversion to GMT).

The output files are first written for a session at the first transition from the post-run 'STA table' to the 'START simulation' page, so if a session is quit before then, the files will not be generated. Similarly, additional data for each additional simulation run during the same session is appended to these three data files at subsequent transitions from the post-run 'STA table' to the 'START simulation' page. So again, if a run is quit before that transition, data from that last run will not be appended to the output files but will be lost. These three ouput files are defined below.

Sdddhhmm.XXX – Is the 'STA table' file. It lists the run configuration parameters and then lists all the parameters displayed in the STA table, plus the JNM and ONM numbers. This data format defined below will repeat for each simulation run during a session. A detailed description of each line starting with the first, follows:

- run number followed by a blank line
- orbiter mass properties listed in 4 lines (mass, Xcg, Ycg and Zcg)
- Position IC (1 – mach = 0.95 Left HAC, 2 – mach = 0.95 Right HAC, 3 – 10000 ft, 4 – 3500 ft)
- HAC angle used (if position IC 1 or 2 is used)
- Scene selected (1 - KSC 15 at day, 2 – KSC 15 at night, 3 – KSC 33 at day, 4 – KSC 33 at night)
- Aim point used (1 - Nominal, 0 - Close)
- Status of Auto vs CSS at the start of the run (1 - starting in auto, 0 - starting in CSS)
- Weight on Wheels (WOW) steering after main gear touchdown (1 – engage auto steering at touchdown, 0 – do not engage auto steering at touchdown)
- Estimated Airspeed for automatic drag chute deploy (after main gear touchdown) in knots
- Altitude for automatic gear deploy
- Wind option used (1 – standard PILOT wind, 2 – random STA wind)
- Selected wind if standard PILOT wind is used (1 – no wind, 2 – modest 1, 3 – modest 2, 4 – stress, 5 – modified)
- Selected STA wind if random wind is used, note that the no-wind case repeats in the list (1 – STA_WND0, 2 – STA_WND3, 3 – STA_WND7, 4 – STA_WND0, 5 –

STA_WND4, 6 – STA_WND6). Here the STA_WND0 is a no wind file, STA_WND3 & 7 are modest wind files, STA_WND 4 & 6 are stressful wind files.

- Test subject identifier (3 letters initially entered)

- a blank line followed by another text line announcing STA number
- JNM - Self Correlation Number (Justiz number)
- ONM - Orbiter Navigation Number
- AS3 - Estimated Airspeed at 3000 ft (knots)
- SB3 - Speedbrake position at 3000 ft (%)
- SBC - Speedbrake command just after 3000 ft (%)
- GM3 - Glideslope angle (gamma) at 3000 ft (deg)
- XP3 - X position error at 3000 ft (ft)
- AST - Estimated Airspeed at threshold (beginning of runway pavement), (knots)
- HGR - Altitude of wheels at threshold (ft)
- VVL - Vertical velocity of vehicle center of mass at main gear touch down (ft/sec)
- WDR - Vertical velocity of wheels at main gear touchdown (ft/sec)
- EAS - Estimated Airspeed at main gear touchdown (knots)
- VGD - Ground speed at main gear touchdown (knots)
- XPS - X position of vehicle at main gear touchdown (ft)
- YPS - Y position of vehicle at main gear touchdown (ft)
- XNM - Normalized X position at touchdown (ft)
- PIT - Pitch angle at main gear touchdown (deg)
- AOA - Angle of attack at main gear touchdown (deg)
- ROL - Roll angle at main gear touchdown (deg)
- HDG - Heading error at main gear touchdown (deg)
- LAV - Y-velocity at main gear touchdown (ft/sec)
- SB1 - Speedbrake position at 150 ft (%)
- MDX - X navigation error at Microwave Scanning Beacon Landing System (ft)
- MDY - Y navigation error at Microwave Scanning Beacon Landing System (ft)
- MDZ - Z navigation error at Microwave Scanning Beacon Landing System (ft)
- RDZ - Z navigation error at radar altitude (ft)
- GMT - Glideslope angle (gamma) at threshold (deg)
- MAS - Maximum estimated airspeed experienced in trajectory (knots)
- MAL - Altitude where maximum estimated airspeed experienced (ft)
- MQB - Maximum dynamic pressure (q-bar) experienced below 5000 ft (lbf/ft^2)
- GRA - Altitude when gear deployment started (ft)
- ALT - Altitude for Approach and Land transition (ft)
- XCN - Normalized X position minus X position error at 3000 ft (XNM-XP3),(ft)

Note that only the first 24 parameters after ONM and up to RDZ, along with an unlisted parameter (x-velocity at main gear touchdown) are used in the calculation of the JNM and ONM values.

Rdddhhmm.XXX – Is the ' RHC' file. It lists the RHC input values for the entire duration of the simulation, if the RHC is utilized. The first line lists the run number while the second lists column names (RHC Roll and RHC Pitch), followed by a listing of the RHC inputs with each line capturing one 25 hz data cycle. Roll values vary from –1.0 for a maximum left deflection to +1.0 for a maximum right deflection. Pitch values vary from –1.0 for a maximum forward (nose-down) deflection to +1.0 for a maximum aft (nose-up) deflection. This data format repeats for subsequent simulation runs during a session.

Tdddhhmm.XXX – Is the 'Tabular' file. It lists tabulated flight data for a given simulation run. This includes 'Static' data, a snap shot of 16 parameters recorded at seven discrete transition points, and 'Dynamic' data, a snap shot of the same 16 parameters at one second intervals above 50 ft altitude, and at 0.2 second intervals once below 50 ft.

The format of the data begins with a line of text identifying the run number, followed by a line identifying Static data, followed by a line listing column titles for the 16 parameters. This is followed by seven lines of data, each beginning with text identifying the specific event transition.

These seven transitions listed in the static data are:

- Entry into the Heading Alignment Cone (HAC)
- Exit from the Heading Alignment Cone (HAC)
- Starting the Outer Glide Slope (OGS), typically at 10000 ft
- Starting the pre-flare, typically at 2000 ft
- Starting the final flare, typically at 50 – 100 ft
- Crossing of the runway threshold (beginning of paved runway)
- Main Gear Touchdown

The static data block is followed by the listing of the dynamic data block, which begins with a line of text identifying it as dynamic data, followed by a listing of column titles for the 16 parameters, followed by the actual lines of data. As with the other two output files, this pattern of data repeats for every additional simulation run in a given session.

The 16 parameters listed both in the static and dynamics data blocks, in order from left to right, are as follows:

- Time since the beginning of the simulation run (seconds)
- Runway-X position of the vehicle center of mass (ft)
- Runway-Y position of the vehicle center of mass (ft)
- Runway-Z position of the vehicle center of mass (ft)
- X velocity in the vehicle body frame (ft/sec)
- Y velocity in the vehicle body frame (ft/sec)
- Z velocity in the vehicle body frame (ft/sec)

- Roll attitude of vehicle (deg)
- Pitch attitude of vehicle (deg)
- Roll rate of vehicle (deg/sec)
- Pitch rate of vehicle (deg/sec)
- Error between guidance roll command and actual for the vehicle (deg)
- Error between guidance pitch command and actual for the vehicle (deg)
- RHC Roll deflection (-1.0 for full left, +1.0 for full right)
- RHC Pitch deflection (-1.0 for full forward, +1.0 for full aft)
- Estimated Airspeed (knots)

The runway coordinate system is centered on the runway center line at the runway threshold (at the edge of the pavement, not including the under run). The X-axis is positive along the runway away from the approaching orbiter, the Y-axis is positive to the right of the runway centerline while the Z-axis is positive down (below ground), so recorded Z values (altitudes) are always negative.

Presented @ 1st Biennial Meeting Jan. 11th 1999 Houston, TX

Effects of Promethazine on Performance During Simulated Shuttle Landings

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BACKGROUND

- Promethazine (PMZ) is the current drug of choice for prevention and treatment of SMS
  - PMZ is a phenothiazine and has CNS depressant effects
    - On Earth, oral doses as little as 12.5mg have produced impaired psychomotor performance and information processing
    - Oral doses of 25mg impair performance to the same degree as 1-2 alcoholic drinks
  - PMZ peak effects occur within 3-4 hr after dosing and may last for 8-9 hrs

BACKGROUND Cont'd

- PMZ treatment of SMS is usually 50mg IM
  - Peak plasma levels after IM dosing are about 4 times greater than after oral dosing
  - Performance impairments inflight are an important safety concern
- Effects of PMZ on performance inflight are unknown at this time

GOALS & OBJECTIVES

- Goal: To determine, noninvasively, the bioavailability and performance effects of an operational dose of PMZ on the ground and during space flight
- Specific Objective: Assess psychomotor impairment effect of PMZ 50mg IM using an operationally relevant task - the Portable Inflight Landing Operations Trainer (PILOT) - in a ground-based study

METHODS

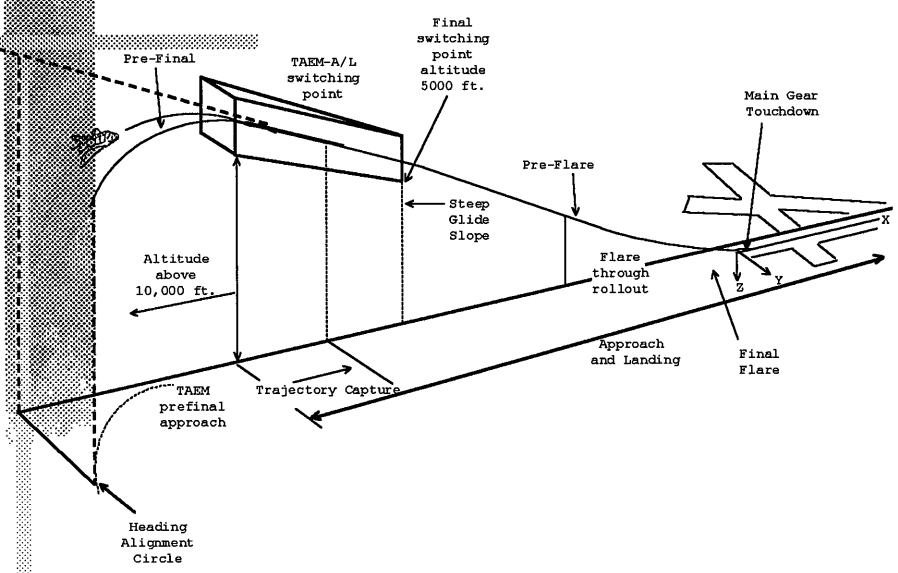
- Subjects
  - Nine subjects participated in the study
    - 6 Southwest Airline pilots
    - 3 Shuttle simulator trainers
- Study Design
  - Double-blind crossover where each subject received PMZ 50mg IM in one session and Placebo (saline) IM in the other session
  - Drug/placebo order was counterbalanced across subjects

METHODS Cont'd

- Study Design Cont'd
  - Training Sessions
    - 4 sessions of 6-7 landings each to ensure stable performance on PILOT
  - PMZ/Placebo Sessions
    - 6 landings performed, and saliva samples collected before and at 1, 2, 4, 8, 24, 32 and 48 hrs after dosing

METHODS Cont'd

- PILOT Task
  - Simulated Shuttle approach and landing starting just prior to the heading alignment cone (HAC) - 50k ft
  - Daytime landing at KSC
  - All conditions nominal (no crosswinds)
  - Landings performed in quiet room to minimize distractions



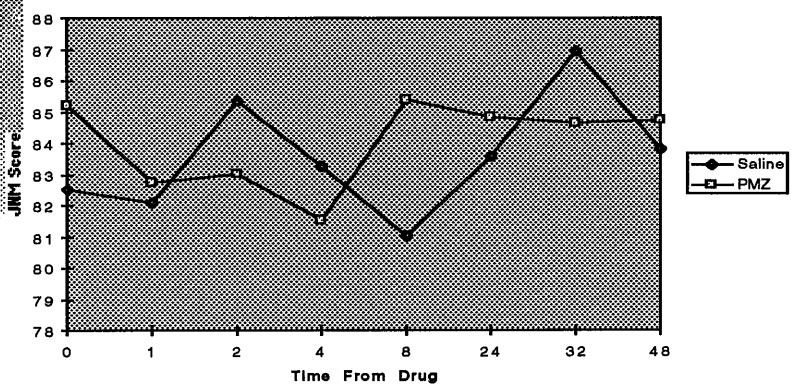
RESULTS

- PILOT Parameters
  - One composite score (JNM) - weighted score of the parameters - provides a score of overall landing performance
  - > 30 individual parameters are collected at various points in time during the approach and landing
  - Analyses focused on the composite score, pitch and roll errors during approach and landing, speed and runway position at touchdown

RESULTS Cont'd

- Analyses
  - All parameters were analyzed using repeated measures ANOVA
  - Comparisons were made between PMZ and Placebo and across time
  - Due to technical problems with the PILOT system, data for 3 of the 9 subjects was unavailable for analysis
- No significant differences between PMZ and Placebo were observed for the JNM composite score

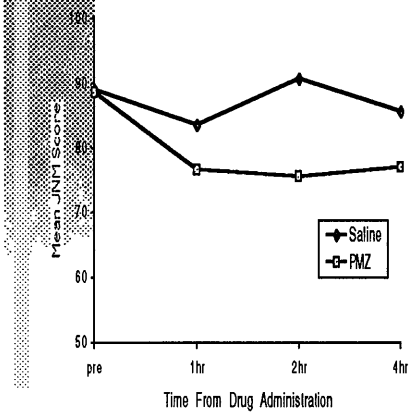
Effects of PMZ on PILOT Performance

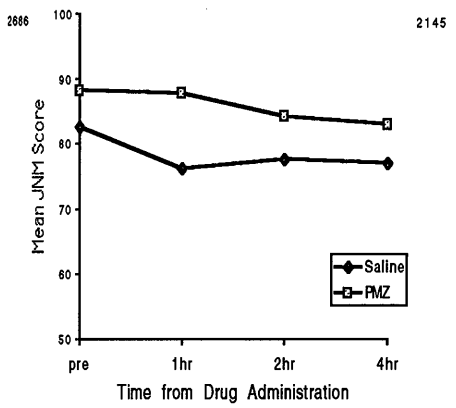


RESULTS Cont'd

- Significant performance decrements were observed in several individual parameters at altitudes of 5k ft or higher
  - These were, however, not operationally significant as they did not affect more critical touchdown parameters
- Large individual differences were observed in effects of PMZ on overall performance

INDIVIDUAL DIFFERENCES in JNM Scores





CONCLUSIONS/DISCUSSION

- PMZ did not significantly affect overall landing performance
  - Strictly nominal conditions
  - Participants were highly skilled pilots
  - Small n due to loss of data
  - Large individual differences in effect of PMZ
- Inflight, during off-nominal conditions or conditions where there are numerous distractions, or during performance of less well-practiced tasks, performance decrements due to PMZ could have serious consequences

FUTURE PLANS

- Repeat the ground-based study under off-nominal approach and landing conditions
- Implement the space flight investigation

DSO 490 (PROTOCOL B), BIOAVAILABILITY & PERFORMANCE EFFECTS OF PROMETHAZINE (PMZ) DURING SPACE FLIGHT

DSO 634, SLEEP-WAKE ACTIGRAPHY

ASAP after entry into orbit:

A. DON ACTILIGHT WATCH

MF43C

1. Unstow: Actilight Watch
   FLIGHT SLEEP LOG

NOTE

If necessary to remove Actilight Watch, record doff/don time on FLIGHT SLEEP LOG

2. Don Actilight Watch on non-dominant arm and wear continuously throughout mission

3. Deploy FLIGHT SLEEP LOG and record required information daily (within 15 min after waking)

NOTE

Perform B. PMZ PROTOCOL if SMS is experienced. If unable to collect saliva sample before taking PMZ dose, collect saliva sample at some other drug-free time during mission

B. PMZ PROTOCOL

MF43C

1. Unstow: Saliva Sample Kit
   SALIVA/KSS LOG

2. Temp stow SALIVA/KSS LOG w/Saliva Sample Kit

Cont next page

3. Collect Baseline saliva sample:
   a. Unstow appropriate saliva tube

NOTE
Do not touch cotton w/fingers.
Do not bite/chew cotton

   b. Place small cotton roll in mouth and lightly roll w/tongue ~2 min
   c. Replace saturated cotton roll into tube
   d. Tighten cap
   e. Record MET on tube and on SALIVA/KSS LOG
   f. Record additional information required on SALIVA/KSS LOG
   g. Stow tube in Saliva Sample Kit
   h. Temp stow Saliva Sample Kit

4. Take PMZ

If PMZ dose taken less than 8 hrs prior to sleep but before pre-sleep:

5. Collect saliva samples per SALIVA/KSS LOG until sleep time, then pick up with next sample (24 hrs) following wakeup

6. Collect remaining saliva samples per SALIVA/KSS LOG following steps 3a-h

If PMZ dose is taken during pre-sleep:

7. Collect saliva samples pre-dose (Baseline sample) just before sleep, immediately upon wakeup, 1 hr after wakeup, and at 24,36, and 48 hrs post-dose

If second PMZ dose is taken within 48 hrs:

8. Begin PMZ protocol again; record MET in second column of SALIVA/KSS LOG

MF43C

9. If last saliva sample, stow Saliva Sample Kit

Cont next page

C. DOFFING ACTILIGHT WATCH

On final day of orbit:

MF43C 1. Remove Actilight Watch, stow

NOTE

If mission length extended, continue to wear Actilight Watch and complete FLIGHT SLEEP LOG as timeline permits

FLIGHT SLEEP LOG

Crew ID: _____ Actilight Watch Dot Color: _____

Current Time: _____ [ddd:hh:mm (MET)]

Lights Out: _____ [ddd:hh:mm (MET)]

Lights On: _____ [ddd:hh:mm (MET)]

1. How long did you take to fall asleep last night? _____ (hrs) _____ (mins)
2. How long did you sleep last night? _____ (hrs) _____ (mins)
3. How many times did you awaken during the night? _____
4. After the end of your sleep period, how long did you remain in bed before getting up?
   _____ (hrs) _____ (mins)
5. Where did you sleep last night? [Flight deck / Middeck / Spacehab / Sleepstation]
6. Was your sleep disturbed: [Yes / No] (If Yes, check all that apply)
   ☐ shuttle noise ☐ mission duties ☐ voids, # of voids:_____ ☐ other crew
   ☐ physical discomfort ☐ too hot ☐ too cold ☐ other _____
7. How did you sleep last night?
   poorly |——————————————| great
8. How do you feel right now?
   sleepy |——————————————| alert
9. Did you have any caffeine yesterday? [Yes / No] (If Yes, indicate how much)
   coffee _____ (cups) caffeine pills _____ (100mg) _____ (200mg)
   tea _____ (cups) caffeinated soft drinks _____ (glasses)
   Indicate how long before bed your last caffeine intake was: _____ (hrs) _____ (mins)
10. Did you take any medications yesterday? [Yes / No / Decline] (If Yes, list all)
    _____

Comments:

Crew Member	Circle dosage form: 25mg Tablet 50mg Injectable 25mg Suppository

SALIVA / KSS LOG

Note: To be used only if PMZ is taken.

	PMZ Dose One		PMZ Dose Two	
Activity Time (hr) Post-PMZ Dose	**KSS**	**Saliva Sample MET**	**KSS**	**Saliva Sample MET**
Baseline				
1				
2				
4				
8				
24				
36				
48				

(1) Rate sleepiness during last 5 mins using key (2) Record saliva collection MET

KSS Key

1	2	3	4	5	6	7	8	9
very alert		alert normal level		neutral neither alert/sleepy		sleepy, no effort to stay awake		very sleepy, great effort to stay awake

SDD46108178-601

Space Shuttle Program
FLIGHT DATA FILE

JSC-48036-114

Orbit Operations Checklist

STS-114 Flight Supplement

Mission Operations Directorate
Operations Division

Final, Rev A
April 14, 2005

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
Houston, Texas

United Space Alliance

Verify this is the correct version for the pending operation (training, simulation or flight).
Electronic copies of FDF books are available. URL: http://mod.jsc.nasa.gov/do3/FDF/index.html

STS Short 97 March 2000

PILOT WITH RHC

NOTE

It is assumed Thinkpad (760XD w/STS load) has been set up without expansion unit

EQUIPMENT SET-UP

1. Unstow:
   PILOT HC
   PILOT Y-Cable
   Elastic Strap (1)
   Tie Wraps (2)

Towel Rack/ Handhold

2. Secure elastic strap to Towel Rack and Window Handhold (Rt or Left, to match seat used) with tie wraps

CAUTION

Once secure, pushing buckle will allow it to release, freeing RHC.
When pushing buckle lever to release, keep thumb clear from underneath (pinch hazard)

PILOT HC

3. Extend (pull) PILOT HC straps and position HC on aft portion of orbiter RHC pedestal. Secure lower strap over pedestal, pull taut and pull up on buckle, repeat with upper strap

PGSC

4. Shut down Windows

PWR SPLY

5. DC PWR SPLY PWR sw1 - off

F1

6. DC UTIL PWR - OFF (utility outlet for PGSC)

PGSC

7. If present, disconnect any cable from PGSC RS-232 port and secure

8. Disconnect DC PWR SPLY cable from PGSC pwr port

Cont next page

PILOT HC 9. PILOT HC pwr - OFF (down position)

PILOT Y-Cable 10. Connect PILOT Y-Cable to PGSC RS-232 port
Connect PILOT Y-Cable to PGSC pwr port
Connect PILOT Y-Cable to PILOT HC
(refer to set up drawing at end of section)

11. Connect DC PWR SPLY cable to PILOT HC

PGSC 12. Position and Secure PGSC in front of HUD and behind elastic strap (top of display touching bottom of eyebrow panel). Duct tape can be used as needed to secure PGSC.

F1 13. DC UTIL PWR - ON (utility outlet for PGSC)

PWR SPLY 14. DC PWR SPLY PWR sw1 - ON

PILOT OPERATION WITH RHC

PGSC 1. PGSC pwr - on

PILOT HC 2. PILOT HC pwr - ON (up position)

PGSC 3. Double-click 'PILOT w/ RHC' icon from 'Shuttle Apps' folder. Agree to quit all Windows Apps

4. Follow instructions for HC calibration (after ~30 sec)

5. Menu Selection Values:
Modify as desired
'Enter' twice to run simulation

6. Simulation Begins (~15 sec)
'z' - toggles between instruments & out-the-window displays
[space bar] - HUD declutter or if WOW, drag chute deploy
'a' - switch to auto
'c' - switch to CSS (same as HC break out)
'p' - pause sim, 'p' again resumes

Cont next page

7. Post Simulation
   [space bar] - cycles through data to main menu
   'b' - cycles back through post run data

8. Terminate PILOT
   Enter 'q' to quit (returns to Windows)

PILOT HC

9. PILOT HC pwr - OFF (down position)

NOTE

PGSC will function w/HC off. If cable configuration is changed, all power must be off

PILOT DISCONNECT AND STOWAGE

PILOT HC

1. Confirm PILOT HC pwr - OFF (down position)

PGSC

2. Shut down Windows

PWR SPLY

3. DC PWR SPLY PWR sw1 - OFF

F1

4. DC UTIL PWR - OFF (utility outlet for PGSC)

PILOT Y-cable

5. Disconnect cables from PGSC and HC (remove PGSC from behind elastic if necessary)

CAUTION

When pushing buckle lever to release, keep thumb clear from underneath (pinch hazard)

PILOT HC

6. Unsecure HC, press buckle on top strap, loosen strap, repeat for bottom strap

7. Stow PILOT HC and Y-Cable in original locker

Cont next page

8. Cut loose tie wraps and elastic strap from window and secure after final on-orbit PILOT session

PGSC 9. Reconfigure PGSC as desired

TROUBLESHOOTING

1. If HC appears to have bias, Calibrate HC at main menu - enter 'c', follow on-screen instructions

2. If DOS prompt appears (sometimes after bad sim crash), enter 'win' to restart Windows

3. If program hangs:
   enter [CTRL]/[C] to get to DOS prompt, once at prompt, restart Windows (step 2), restart PILOT normally
   if [CTRL]/[C] doesn't work, force Windows restart with [CTRL]/[ALT]/[DELETE] simultaneously

PILOTWITHOUTRHC

NOTE

No PILOT equipment reqd, only
Thinkpad 760XD w/STS load

PILOT OPERATION WITHOUT RHC

PGSC 1. Double-click 'PILOT w/out RHC' icon from 'Shuttle Apps' folder. Agree to quit all Windows Apps

2. Menu Selection Values:

NOTE

Sim must be in 'auto' to keep from crashing:
Select 'Auto' at start up (item 7)
Otherwise, modify as desired
'Enter' twice to run simulation

3. Simulation Begins (~15 sec)
   - 'z' - toggles between instruments and out-the-window displays
   - [space bar] - HUD declutter or if WOW, drag chute deploy
   - 'p' - pause sim, 'p' again resumes

4. Post Simulation
   - [space bar] - cycles through data to main menu
   - 'b' - cycles back through post run data

5. Terminate PILOT
   Enter 'q' to quit (returns to Windows)

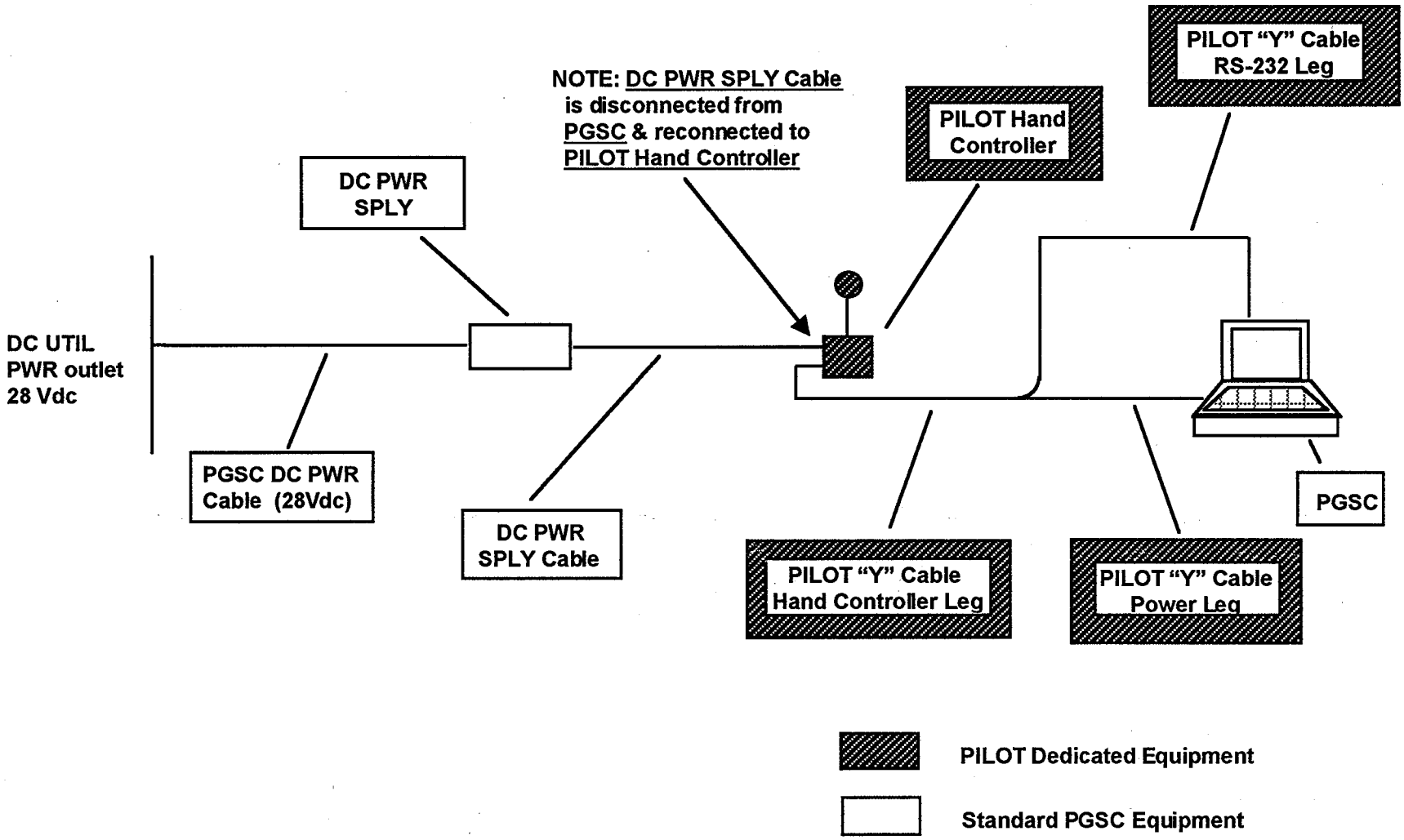
TROUBLESHOOTING

1. If get DOS prompt, (sometimes after bad sim crash), enter 'win' to restart Windows

Cont next page

2. If program hangs:
   enter [CTRL]/[C] to get to DOS prompt, once at prompt, restart Windows (step 1), restart PILOT normally
   if [CTRL]/[C] doesn't work, force Windows restart with [CTRL]/[SLT]/[DELETE] simultaneously

PILOT with RHC Setup



PILOT WITH RHC

NOTE
It is assumed Thinkpad (760XD w/STS load) has been set up without expansion unit

EQUIPMENT SET-UP

	1.	Unstow: PILOT HC (? RHC) PILOT Y-Cable Elastic Strap (1) Tie Wraps (2)
Towel Rack/ Handhold	2.	Secure elastic strap to Towel Rack and Window Handhold (Rt or Left, to match seat used) with tie wraps
RHC		CAUTION Once secure, pushing buckle will allow it to release, freeing When pushing buckle lever to release, keep thumb clear from underneath (pinch hazard)
PILOT HC	3.	Extend (pull) PILOT HC straps and position HC on aft portion of orbiter RHC pedestal. Secure lower strap over pedestal, pull taut and pull up on buckle, repeat with upper strap
PGSC	4.	Shut down Windows
PWR SPLY	5.	DC PWR SPLY PWR sw1 - off
F1	6.	DC UTIL PWR - OFF (utility outlet for PGSC)
PGSC	7.	If present, disconnect any cable from PGSC RS-232 port and secure
	8.	Disconnect DC PWR SPLY cable from PGSC pwr port
PILOT HC	9.	PILOT HC pwr - OFF (down position)
PILOT Y-Cable	10.	Connect PILOT Y-Cable to PGSC RS-232 port Connect PILOT Y-Cable to PGSC pwr port Connect PILOT Y-Cable to PILOT HC (refer to set up drawing at end of section)

	11.	Connect DC PWR SPLY cable to PILOT HC
PGSC	12.	Position and Secure PGSC in front of HUD and behind elastic strap (top of display touching bottom of eyebrow panel). Duct tape can be used as needed to secure PGSC.
F1	13.	DC UTIL PWR – ON (utility outlet for PGSC)
PWR SPLY	14.	DC PWR SPLY PWR sw1 - ON

PILOT OPERATION WITH RHC

PGSC	1.	PGSC pwr - on
PILOT HC	2.	PILOT HC pwr - ON (up position)
PGSC	3.	Double-click 'PILOT w/ RHC' icon from 'Shuttle Apps' folder. Agree to quit all Windows Apps
	4.	Follow instructions for HC calibration (after ~30 sec)
	5.	Menu Selection Values: Modify as desired 'Enter' twice to run simulation
	6.	Simulation Begins (~15 sec) 'z' - toggles between instruments & out-the-window displays [space bar] - HUD declutter or if WOW, drag chute deploy 'a' switch to auto 'c' - switch to CSS (same as HC break out) 'p'- pause sim, 'p' again resumes
	7.	Post Simulation [space bar] - cycles through data to main menu 'b' - cycles back through post run data
	8.	Terminate PILOT Enter 'q' to quit (returns to Windows)

PILOT HC	9.	PILOT HC pwr - OFF (down position)

NOTE
PGSC will function w/HC off. If cable configuration is changed, all power must be off.

PILOT DISCONNECT AND STOWAGE

PILOT HC	1.	Confirm PILOT HC pwr - OFF (down position)
PGSC	2.	Shut down Windows
PWR SPLY	3.	DC PWR SPLY PWR sw1 - OFF
F1	4.	DC UTIL PWR - OFF (utility outlet for PGSC)
PILOT Y-cable	5.	Disconnect cables from PGSC and HC (remove PGSC from behind elastic if necessary)

CAUTION
When pushing buckle lever to release, keep thumb clear from underneath (pinch hazard)

PILOT HC	6.	Unsecure HC, press buckle on top strap, loosen strap, repeat for bottom strap
	7.	Stow PILOT HC and Y-Cable in original locker
	8.	Cut loose tie wraps and elastic strap from window and secure after final on-orbit PILOT session
PGSC	9.	Reconfigure PGSC as desired

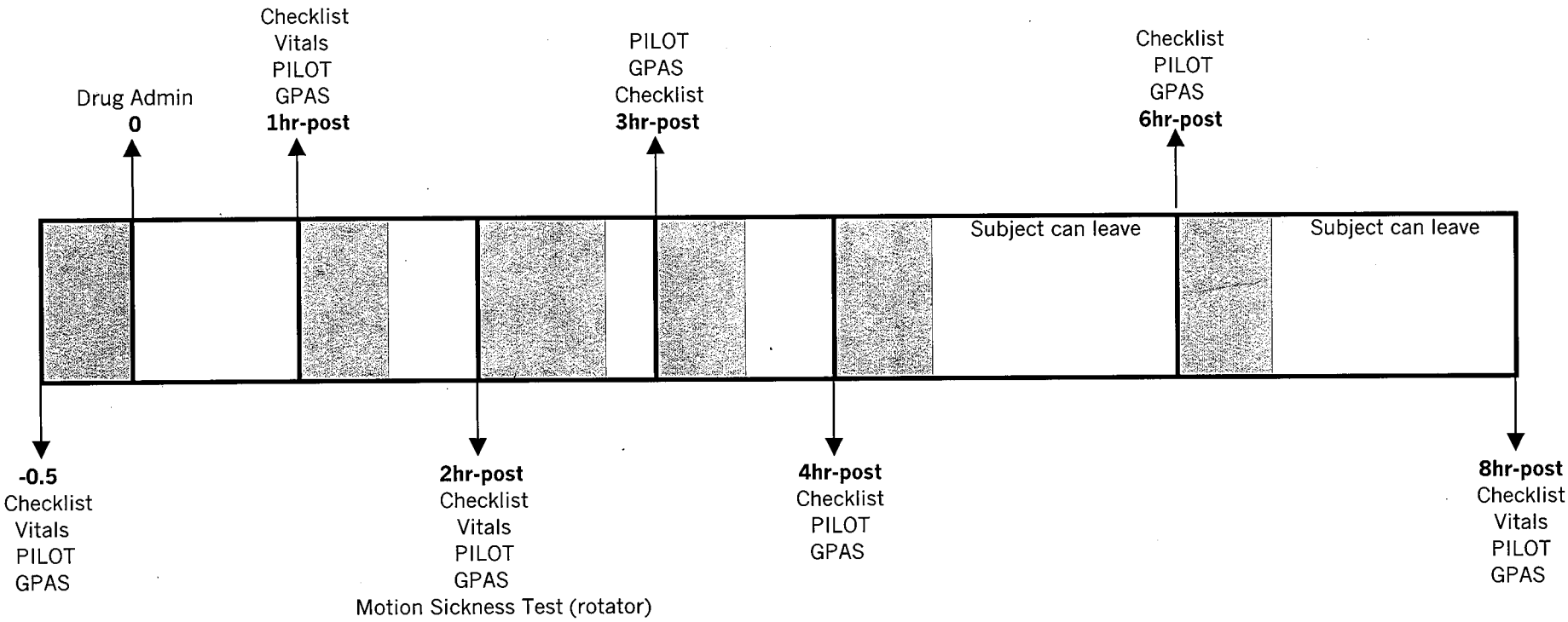
TROUBLESHOOTING

1. If HC appears to have bias, Calibrate HC at main menu
   - enter 'c', follow on-screen instructions

2. If DOS prompt appears (sometimes after bad sim crash), enter 'win' to restart Windows

3. If program hangs:
   enter [CTRL]/[C] to get to DOS prompt, once
   at prompt, restart Windows (step 2),
   restart PILOT normally
   if [CTRL]/[C] doesn't work, force Windows to
   restart with [CTRL]/[ALT]/[DELETE] simultaneously

PILOT/PMZ Experimental Session Timeline



start time	drug admin	1hr-post	2hr-post	3hr-post	4hr-post	6hr-post	8hr-post
6.5	7	8	9	10	11	1	3
7	7.5	8.5	9.5	10.5	11.5	1.5	3.5
7.5	8	9	10	11	12	2	4
8	8.5	9.5	10.5	11.5	12.5	2.5	4.5
8.5	9	10	11	12	1	3	5
9	9.5	10.5	11.5	12.5	1.5	3.5	5.5
9.5	10	11	12	1	2	4	6

NOTE: One test session consists of 6 PILOT landings and 4 graphics pad tasks. Each lasts ~30 minutes. You must complete 8 test sessions before the first experimental session. Each test session should be separated by no more than 48 hours. You may complete up to 4 test sessions in one day. There may only be 48 hours from the LAST test session to the first experimental session. The second experimental session should be completed one week after the first.

PILOT Operating Instructions

(Portable In-flight Landing Operations Trainer,Version STS-62)

SET-UP:

1) Ensure that P2100 is plugged in and the switch on the back is ON.

2) Push the green button on the left side of the P2100. "Quick-start" is not functioning, so it takes longer to boot.

3) A message saying that the IDPROM contents are invalid will appear. At the prompt, boot by typing: **b<return>**

4) At the "PILOT login#" prompt, type: **pilot <return>.**
This runs a landing at KSC in the daytime. (KSC night=pilot61, Edwards day=pilot58)

5) The current date and time will be displayed. If the date and time are correct, press **<return>.** Otherwise, type in the correct date and time in the form **"YYMMDDHHmm"** where "MM" is month and "mm" is minutes. e.g., type "9703261525 for March 26, 1997 at 3:15 PM.

6) Enter the subject's initials in lowercase letters when requested.

7) Follow the directions on the screen to calibrate the rotational hand controller (RHC):
"pitch down" = pushing the RHC toward the computer
"pitch up" = pulling the RHC away from the computer
"detent" = the position achieved with no hands on the RHC.

CAUTION!! Despite the statement during calibration about recalibrating if an error occurs, **DO NOT** recalibrate the RHC or quit out of the main menu before performing at least one landing. The preferred procedure is to type "Q" at the main menu after a landing to return to the PILOT login prompt and begin the login again. Recalibration of the RHC is possible, but choosing that option without performing at least one landing with the settings just chosen will cause the computer to crash and outside help will be needed to recover!!!!

8) The PILOT menu will appear on-screen. Press "8" to toggle Auto-steer at touchdown to ON. Pressing "7" will turn on the auto-pilot which runs a demonstration for instructional purposes (i.e., pointing out important features of the display to a new subject) if the RHC is not moved.

9) IC location (Category 3) defaults to Mach=0.95. If you need to change this, press "3" and return. Choose an initial position for the trial from the menu by pressing the corresponding number and return. Press return again to go back to the main menu.

LANDING:

10) Press return and then "S" to begin the landing. Note that hitting the spacebar during the landing will declutter the heads-up display (HUD). There are three levels that the spacebar toggles through. The "Z" key toggles between the HUD and instruments.

11) Use the RHC to keep the square/circle (changes from a square to a circle just before coming out of the HAC) perfectly centered over the diamond (computer guidance).

12) Pitch is very sensitive and roll is sluggish. Pulse inputs are best for slight position adjustments (which excludes entering and exiting the HAC). This is especially true for roll which has a delayed response. The RHC's breakout forces mimic those of the orbiter's RHC. The RHC is a rate command rather than position. It has auto-trim and holds attitude (stays where you leave it).

13) The diamond does not go directly to the position where the shuttle should be headed. It generally moves to the edge of the circle in an attempt to "nudge" the user to the correct heading.

14) At 4000 feet, two triangles will rise up from the bottom of the screen and meet the fixed triangles. When they meet, the green line coming out of the runway (aimpoint) and triangles are more important guides than the diamond. Use the green line as a horizontal guide and the triangles as a vertical guide. This is the "flare", as indicated at the bottom of the HUD.

15) During the flare, a red bar with a white ball on it (for guidance) will become visible to the left of the runway: bar below ball = shuttle too low, bar below ball = shuttle too high.

16) The triangles will come up to the runway. When the altimeter reads 50 feet, pull the nose up to a distance halfway between the black line on the runway and the horizon. Continue to half the distance until touchdown.

17) At 20 feet, pull the nose to the horizen, but not above it (loft). Minimal stick inputs will lead to a better touchdown.

18) The decluttering of the HUD indicates touchdown WOW (weight on wheels).

19) When the airspeed indicator reads 185, push the stick toward the computer to slowly bring down the nose.

RESULTS:

20) When the nosegear touches the runway (or upon crashing), the display will change to several graphs. These depict pitch and roll RHC inputs, horizontal descent rate, etc.

21) Press the spacebar to toggle to the parameters for the run.
JNM: an overall indicator of performance (higher is better)
XPS: X-position at touchdown (2000 ft or more, longer is better)
VVL: vertical velocity at touchdown (3 ft/s or less, lower is better)
EAS: equivalent airspeed at touchdown (around 210)

22) Press the spacebar to go to the main menu.

23) Press return to perform another landing or press "Q" to quit the program and return to the PILOT login prompt.

24) On the STS-61 version, the data of every landing is automatically stored. Follow the UNIX TO MAC INSTRUCTIONS to view, delete, save, and convert files.

25) Upon returning to the PILOT login prompt, press the green button on the side of the computer to shut the system down. A box will appear with the message "Resume exiting." After a time, the computer will shut off and the screen will blank.

PROBLEMS:

If the computer freezes and displays error messages, and it does not shutdown when the green button is pushed, first seek help from any of the contacts listed below. **ONLY AS A LAST RESORT**, turn off the computer using the power switch on the back, and then switch it back on. This may cause file corruption problems!

The computer may reboot normally. If an error message says to run fsck, then do the following:
at login# prompt: **fsck <return>**
(it will ask questions):
ADJUST? **Y**
UNREF FILE RECONNECT? **Y**
(it will ask for each file that was in cache)
FREE BLK WRONG SALVAGE? **Y**

it will say to reboot system: **# reboot <return>**
check to make sure /usr/pilot_data directory is still there:**# cd /usr/pilot_data <return>**
 # ls -al | more <return>
(files from cache will be in /usr/lost+found but with incorrect name)

CONTACTS:

Computer problems: **Al Strahan (wk: x36122** / hm: 326-3539 EMERGENCY ONLY!)
He is very difficult to get a hold of - leave a message and tell him that Gwen told you to call.
Wally Kulecz (rm. 203B) and **Bill Worthington (x30488)** are also good sources of UNIX help.

RHC problems: **Jim Brock (x45922)**. He works in B9 across the street and has previously repaired broken pins in the RHC. These are obvious as the feel of the stick changes dramatically and cocks off to one side when not being held. Tell him that you took over for Gwen.

General questions: **Gwen Sandoz (wk: 212-6415** / hm: 713-645-5746 EMERGENCY ONLY!)

Presented @ 1st Biennial Meeting Jan. 11th 1999 Houston, TX

Effects of Promethazine on Performance During Simulated Shuttle Landings

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R.S. Kennedy, Ph.D.

BACKGROUND

- Promethazine (PMZ) is the current drug of choice for prevention and treatment of SMS
  - PMZ is a phenothiazine and has CNS depressant effects
    - On Earth, oral doses as little as 12.5mg have produced impaired psychomotor performance and information processing
    - Oral doses of 25mg impair performance to the same degree as 1-2 alcoholic drinks
  - PMZ peak effects occur within 3-4 hr after dosing and may last for 8-9 hrs

BACKGROUND Cont'd

- PMZ treatment of SMS is usually 50mg IM
  - Peak plasma levels after IM dosing are about 4 times greater than after oral dosing
  - Performance impairments inflight are an important safety concern
- Effects of PMZ on performance inflight are unknown at this time

GOALS & OBJECTIVES

- Goal: To determine, noninvasively, the bioavailability and performance effects of an operational dose of PMZ on the ground and during space flight
- Specific Objective: Assess psychomotor impairment effect of PMZ 50mg IM using an operationally relevant task - the Portable Inflight Landing Operations Trainer (PILOT) - in a ground-based study

METHODS

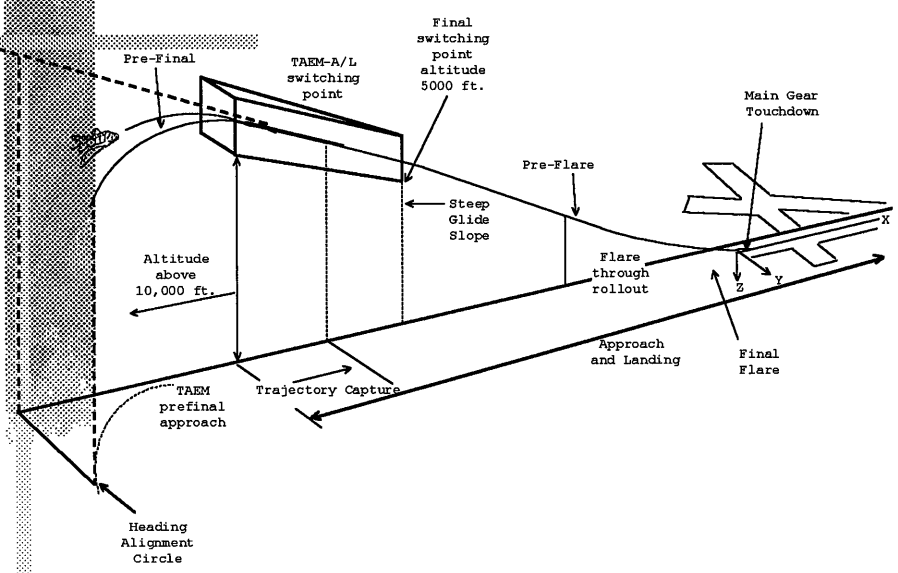
- Subjects
  - Nine subjects participated in the study
    - 6 Southwest Airline pilots
    - 3 Shuttle simulator trainers
- Study Design
  - Double-blind crossover where each subject received PMZ 50mg IM in one session and Placebo (saline) IM in the other session
  - Drug/placebo order was counterbalanced across subjects

METHODS Cont'd

- Study Design Cont'd
  - Training Sessions
    - 4 sessions of 6-7 landings each to ensure stable performance on PILOT
  - PMZ/Placebo Sessions
    - 6 landings performed, and saliva samples collected before and at 1, 2, 4, 8, 24, 32 and 48 hrs after dosing

METHODS Cont'd

- PILOT Task
  - Simulated Shuttle approach and landing starting just prior to the heading alignment cone (HAC) - 50k ft
  - Daytime landing at KSC
  - All conditions nominal (no crosswinds)
  - Landings performed in quiet room to minimize distractions



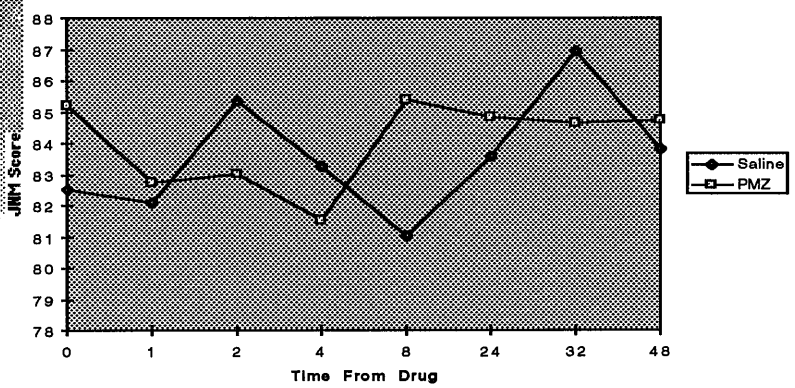
RESULTS

- PILOT Parameters
  - One composite score (JNM) - weighted score of the parameters - provides a score of overall landing performance
  - > 30 individual parameters are collected at various points in time during the approach and landing
  - Analyses focused on the composite score, pitch and roll errors during approach and landing, speed and runway position at touchdown

RESULTS Cont'd

- Analyses
  - All parameters were analyzed using repeated measures ANOVA
  - Comparisons were made between PMZ and Placebo and across time
  - Due to technical problems with the PILOT system, data for 3 of the 9 subjects was unavailable for analysis
- No significant differences between PMZ and Placebo were observed for the JNM composite score

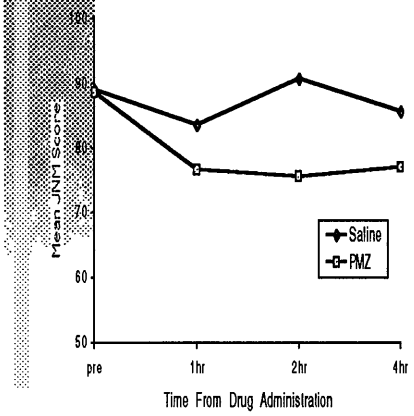
Effects of PMZ on PILOT Performance

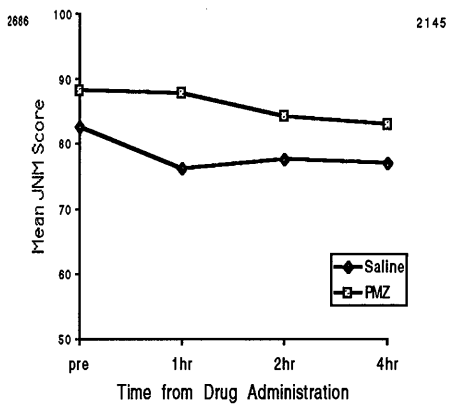


RESULTS Cont'd

- Significant performance decrements were observed in several individual parameters at altitudes of 5k ft or higher
  - These were, however, not operationally significant as they did not affect more critical touchdown parameters
- Large individual differences were observed in effects of PMZ on overall performance

INDIVIDUAL DIFFERENCES in JNM Scores





CONCLUSIONS/DISCUSSION

- PMZ did not significantly affect overall landing performance
  - Strictly nominal conditions
  - Participants were highly skilled pilots
  - Small n due to loss of data
  - Large individual differences in effect of PMZ
- Inflight, during off-nominal conditions or conditions where there are numerous distractions, or during performance of less well-practiced tasks, performance decrements due to PMZ could have serious consequences

FUTURE PLANS

- Repeat the ground-based study under off-nominal approach and landing conditions
- Implement the space flight investigation