



HOUSTON
OPERATIONS

Thornton



SHUTTLE WASTE COLLECTOR SUBSYSTEM (WCS)

DESIGN REVIEW

SEPTEMBER 16 AND 17, 1985



SHUTTLE WASTE COLLECTOR SUBSYSTEM (WCS) DESIGN REVIEW AGENDA

MONDAY, SEPTEMBER 16, 1985

- 8:30 1. PROGRAM PREVIEW AND SCHEDULE
- 8:45 2. WCS PERFORMANCE IMPROVEMENTS
 - SOLID WASTE MANAGEMENT
 - LOW PROFILE IMPELLER
 - INTERNAL COMPACTOR (MANUAL)
 - PASSIVE TRAP
 - INCREASED AIR FLOW
 - AIRRESEARCH, IMC, GE
 - AIRRESEARCH BOOSTER
 - WCS DESIGN CHANGES
 - BAG LINER
 - MINIMIZE BY-PASSING
 - SLIDE VALVE TOLERANCE
 - GASKET ON INLET ORIFICES
 - REDUCE SEAT HEIGHT
- 1:00 3. CONCEPT DEMONSTRATIONS
- 2:00 4. OTHER TASKS
 - URINAL HOSE
 - ZERO "G" TEST RESULTS
- 3:00 5. PRE-BOARD RID SCREEN
- 4:00 6. BOARD REVIEW



HOUSTON
OPERATIONS



DESIGN REVIEW AGENDA

(SECOND DAY)

TUESDAY, SEPTEMBER 17, 1985

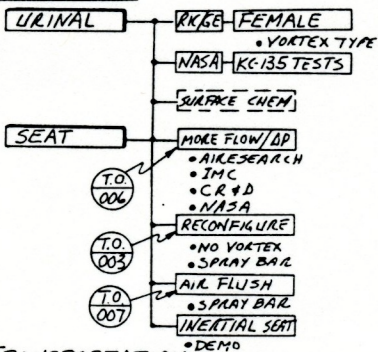
- 8:30 1. WCS UPDATE IMPROVEMENTS
- LIQUID WASTE MANAGEMENT
 - URINALS AND PLUMBING
 - ADDED CAPACITY
 - BALLAST FITTING AND SELECTOR VALVE
 - ADDED TRASH VENT
 - DELAY SHUT-OFF FAN SEPARATOR
 - STRENGTHEN STRUCTURE
 - REFINEMENTS
 - QUIET MOTOR DTO
 - SWITCH GUARDS
 - COMMON FAN SEPARATOR CONFIGURATION
2. BOARD REVIEW

TODAY

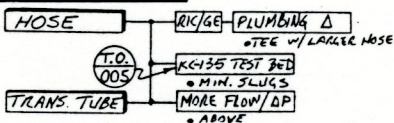
WMS DEVELOPMENT FLOW

8/16/85

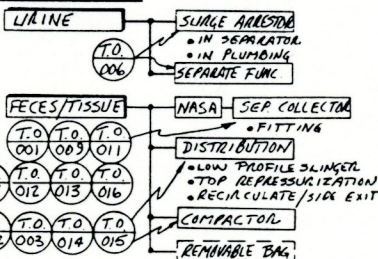
SEPARATION



TRANSPORTATION



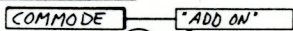
MANAGEMENT



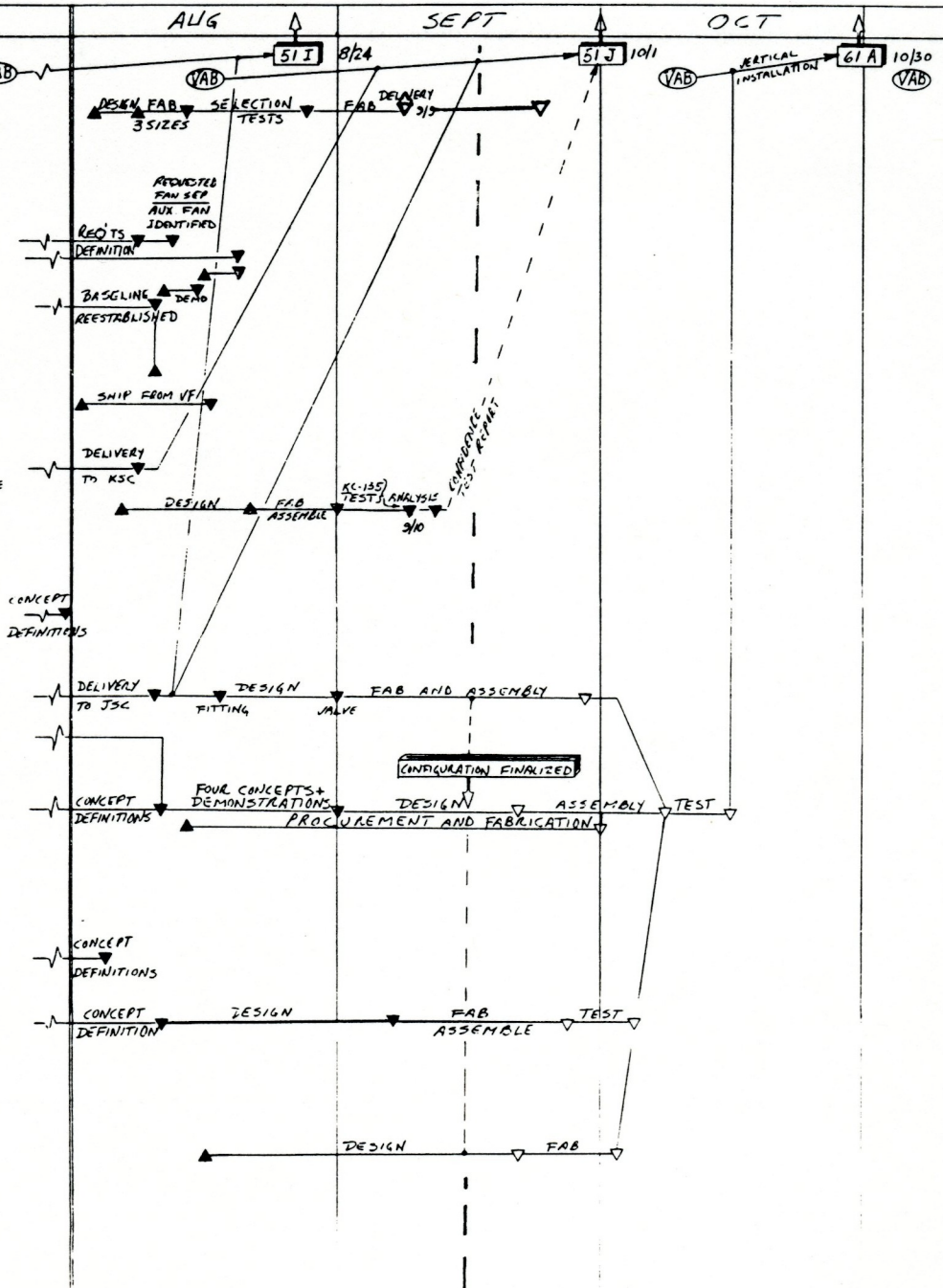
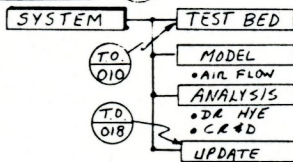
SANITIZATION



CONTINGENCY



OVERALL

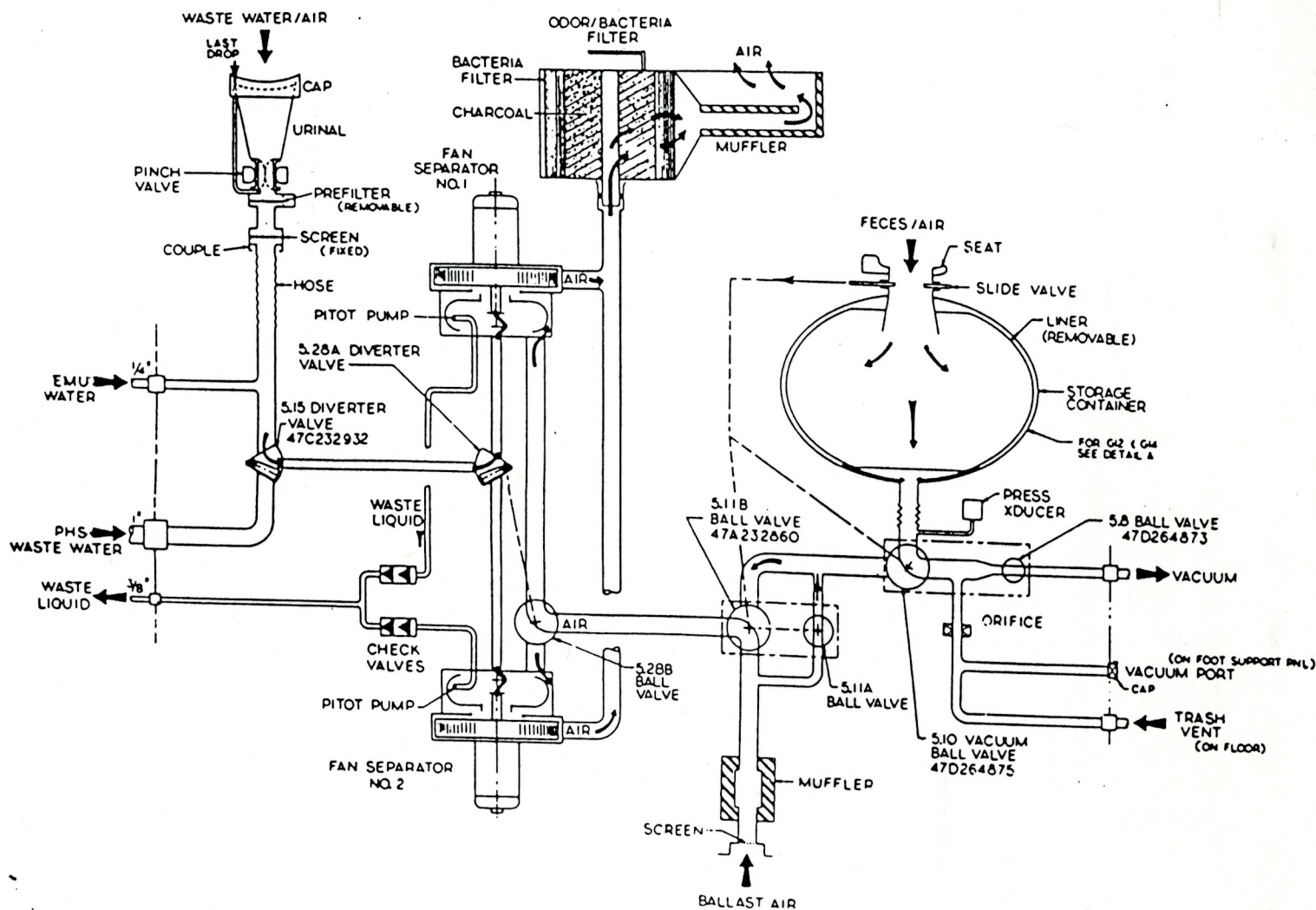


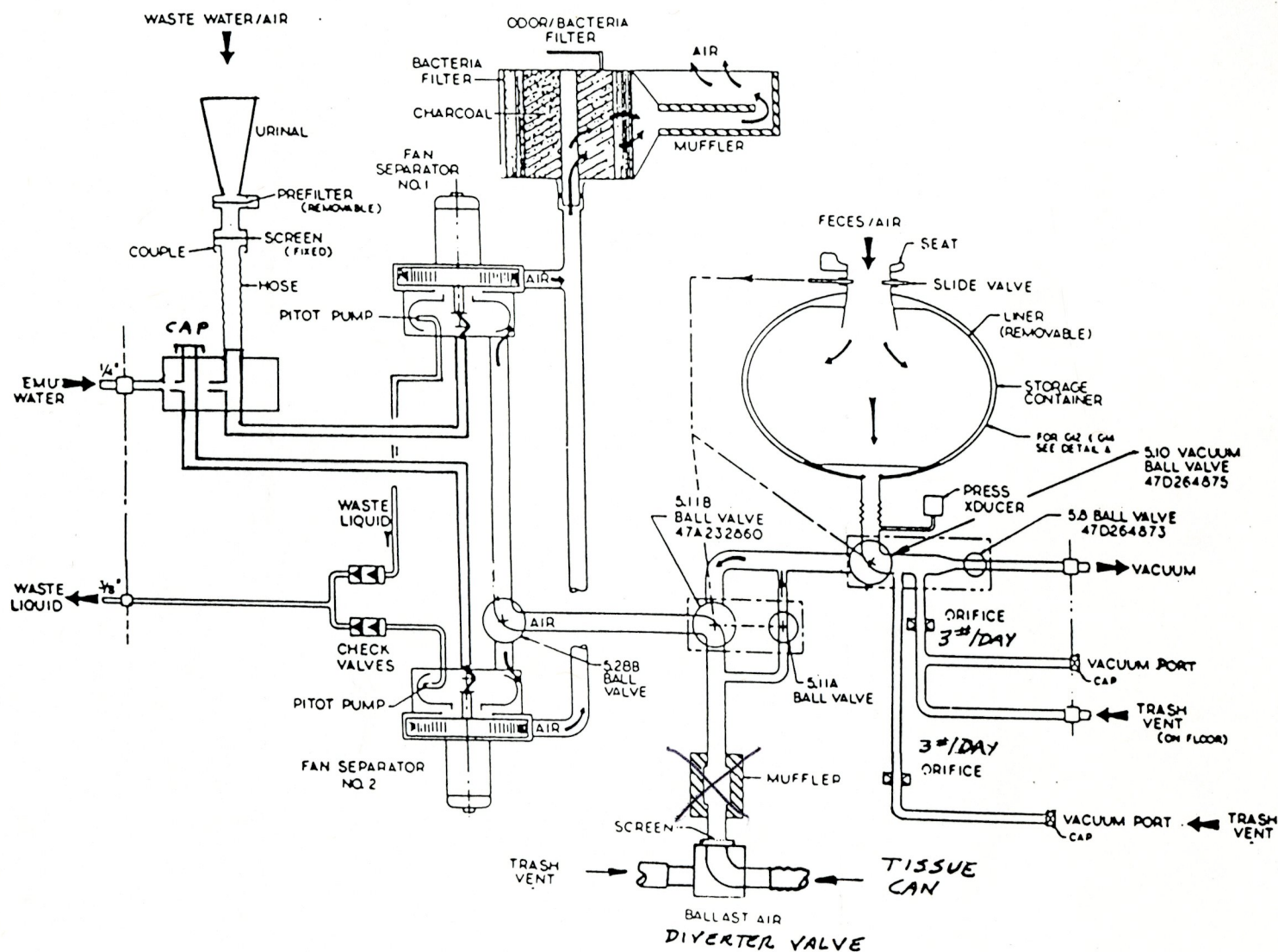


HOUSTON
OPERATIONS

SSD
SPACE SYSTEMS DIVISION

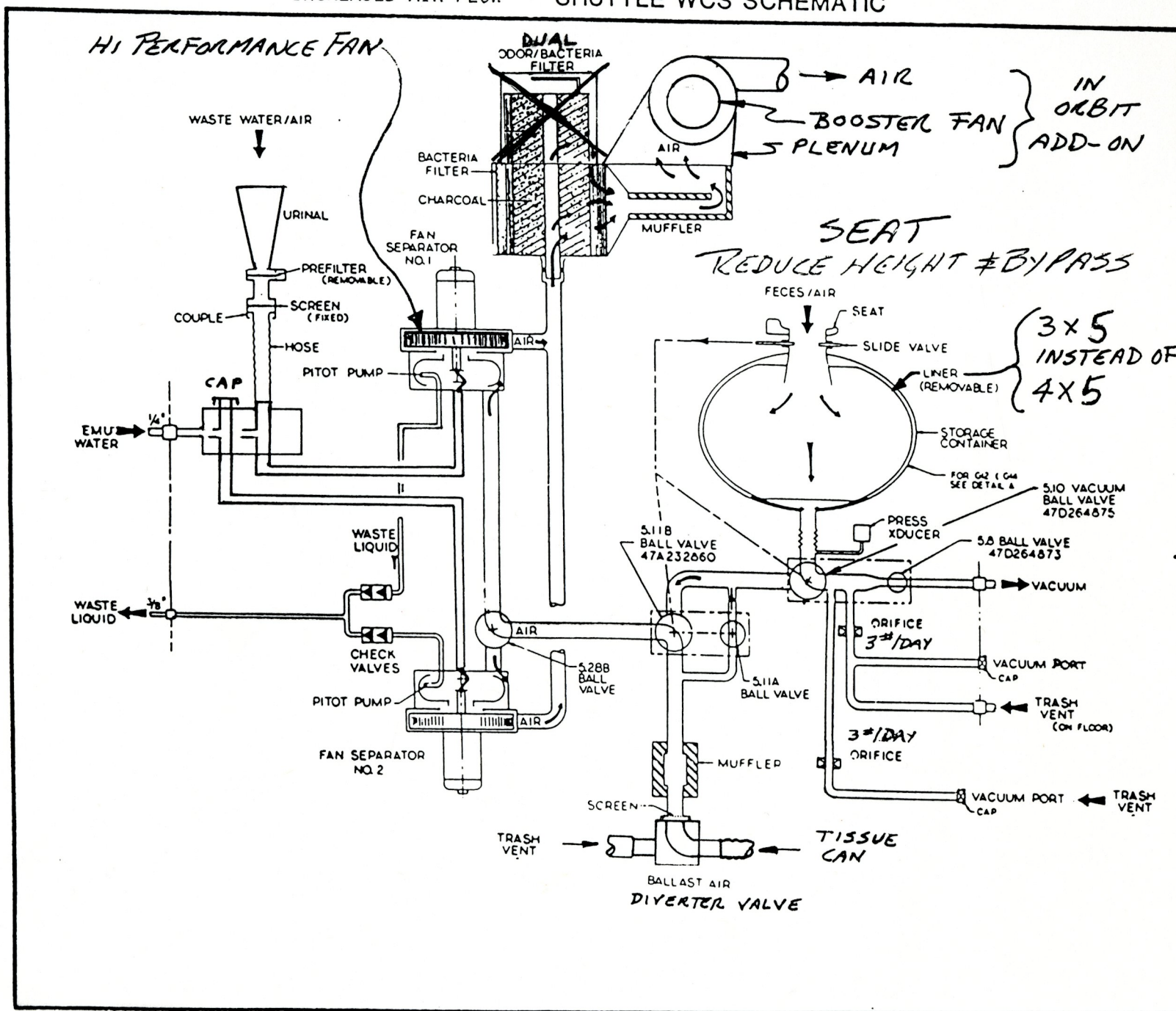
OLD BASELINE - SHUTTLE WCS SCHEMATIC







INCREASED AIR FLOW - SHUTTLE WCS SCHEMATIC



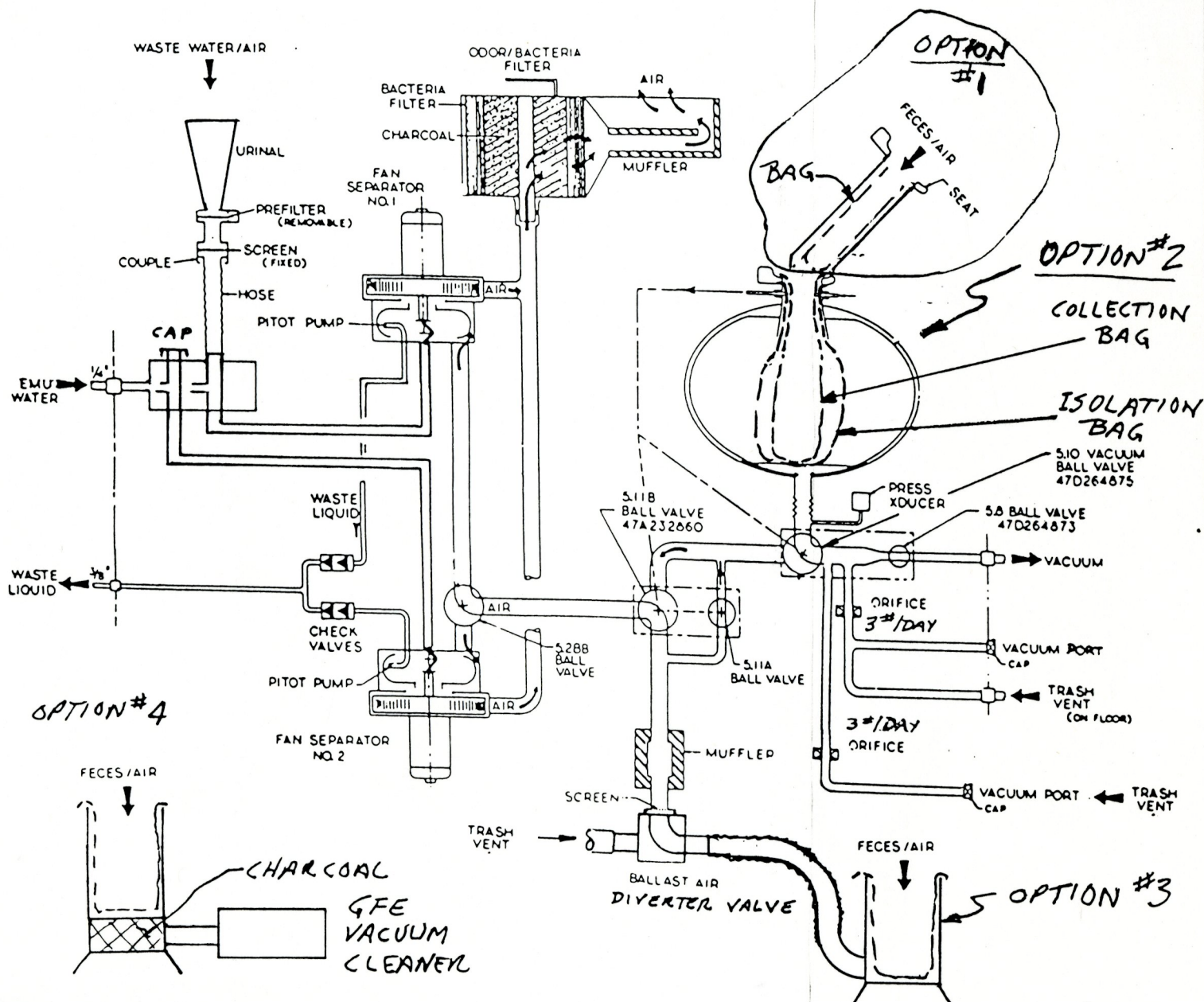
PERFORMANCE IMPROVEMENT

- LINER
 - REDUCE NUMBER OF LAYERS (4 x 5 to 3 x 5)
 - GAIN APPROXIMATELY 1 CFM FLOW AT SYSTEM LEVEL
- HIGH PERFORMANCE FAN
 - IMPROVED ENTRANCE - REDUCES RECIRCULATION
 - GAIN APPROXIMATELY 3 CFM FLOW AND 15% IMPROVEMENT IN ΔP
- SEAT
 - REDUCE HEIGHT ABOVE INLET JETS (1.4 to 0.9 INCHES)
 - REDUCE SLIDE VALVE GAPS
 - DOUBLES STOOL SEPARATION FORCES



HOUSTON
OPERATIONS

CONTINGENCY OPTIONS - SHUTTLE WCS SCHEMATIC





STS-61A RECOMMENDATIONS

CERTIFY NEW CONCEPTS BY BEST EFFORT ANALYSIS AND SIMILARITY

- ZERO "G" AIRCRAFT TESTS NOT A SURE PROOF OF CONCEPT
- GROUND TESTING NOT A SURE PROOF OF CONCEPT
- ONLY IN-ORBIT OPERATION CERTIFIES THE APPROACH

DELETE BALLAST AIR FLOW MUFFLER

- NOT NEEDED WITH NEW BALLAST DIVERTER VALVE
- SAVES 2 LBS WEIGHT
- ENHANCES VACUUM VENT INTERFACING WITH NEW ROCKWELL TRASH MODULE
- INCREASES AIR FLOW

MINIMIZE GE EFFORT ON NEW CONTINGENCY OPERATION DESIGNS

- SEVERAL MODES ALREADY IN PLACE
- NASA-DTO PROVIDES ADDITIONAL CONTINGENCY MODE
- RESUME ACTIVITY AFTER 61A WCS DELIVERY



HOUSTON
OPERATIONS

SSD
SPACE SYSTEMS DIVISION

STS-61A RECOMMENDATIONS (CONTINUED)

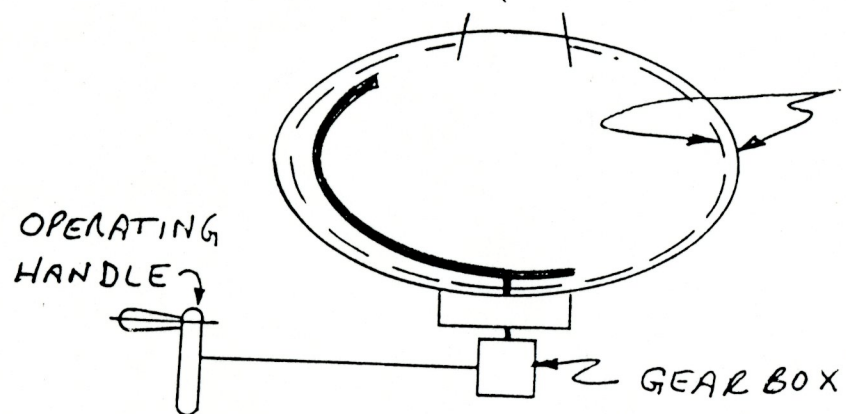
- DON'T OVERWHELM SYSTEM WITH HIGH PRESSURE SUCTION FAN EXCEPT AS DTO LATE IN MISSION
 - CAUSES HIGH TURBULENCE IN COMMODE
 - OTHER SYSTEM IMPACTS UNKNOWN
 - SYSTEM PERFORMANCE IS NEARLY ADEQUATE
 - STS-51G AND 51I CREW COMMENTS

SOLID WASTE MANAGEMENT

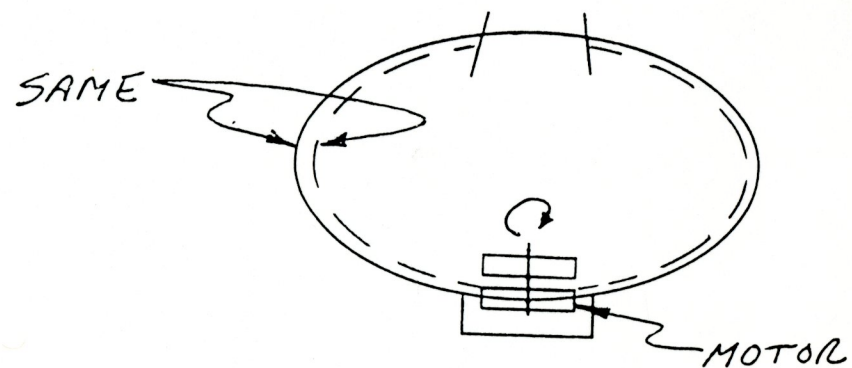
- POSSIBLE SHORT TERM IMPROVEMENTS
 - LOW PROFILE IMPELLER
 - PASSIVE TRAP
 - MANUAL INTERNAL COMPACTOR
- IMPLEMENTATION PLAN
 - STORAGE CONTAINER WITH
 - STRENGTHENED LINER
 - COMMON INTERFACE



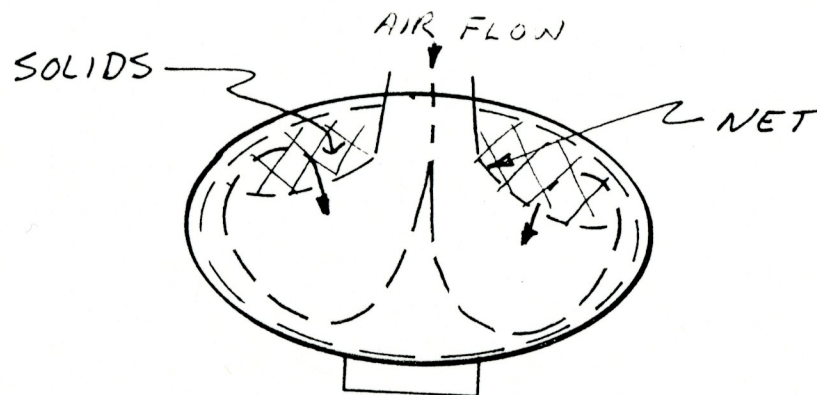
SOLID WASTE MANAGEMENT



MANUAL COMPACTOR



LOW PROFILE IMPELLER



PASSIVE TRAP



LOW PROFILE IMPELLER

FUNCTION:

- KEEP AREA BELOW SEAT CLEAR OF WASTE MATERIAL
- REDUCE POSSIBILITY OF PREMATURE BLOCKAGE

MECHANICAL CONFIGURATION:

- STORAGE CONTAINER WITH REINFORCED LINER
- INTERMEDIATE MOUNTING PLATE
- MODIFIED LOWER CONTAINER COVER
- HIGH TORQUE (1.7 LB-FT), LOW SPEED (400 RPM) MOTOR
- HOUSING DESIGNED TO FIT LOW PROFILE (PANCAKE)
- BEARINGS SHIELDED, LUBRICATED SAME AS SEPARATOR

ELECTRICAL CONFIGURATION:

- SAME CONTROL AND SUPPRESSION CIRCUITRY AS SLINGER MOTOR
- NORMAL POWER 20 WATTS
- 3.55 AMP
- LOCKED ROTOR - 101 WATTS



HOUSTON
OPERATIONS



MOTOR COMPARISON

	<u>SLINGER</u>	<u>LOW PROFILE IMPELLER</u>
NOMINAL SPEED	1800 RPM (RATED)	400/414 RPM
NOMINAL POWER	80 WATTS	20 W (ESTIMATE)
RUN CURRENT	2.85 AMP	0.2 TO 0.7 A (ESTIMATE)
PEAK CURRENT	8 AMP < 1 SEC.	3.26 A (STALL)
PEAK POWER	120 @ 1300 RPM 224 @ STALL (CALC.)	101 W (STALL)
MAX SPEED (NO LOAD 30V)	3000	460 RPM
PEAK TORQUE	78 OZ-IN (CALC.)	326 OZ-IN

INTERNAL COMPACTOR

FUNCTION:

- LIMITED COMPACTION NEAR END OF MISSION TO MINIMIZE VOLUME OF WASTE ACCUMULATED IN THE STORAGE CONTAINER

MECHANICAL CONFIGURATION:

- STORAGE CONTAINER WITH REINFORCED LINER
- INTERMEDIATE MOUNTING PLATE WITH WIPER ARM SUPPORT
- LOWER CONTAINER COVER WITH MANUAL DRIVE
- STATIONARY INTERNAL VANE
- MOVING VANE WITH SPRING LOADED NET

PASSIVE TRAP

- FUNCTION:
 - TO TAKE ADVANTAGE OF THE INTERNAL FLOW PATTERN TO ACCUMULATE WASTE AWAY FROM AREA BELOW SEAT
- MECHANICAL CONFIGURATION:
 - CURVED STAVES ATTACHED TO TRANSPORT TUBE AND INTER-CONNECTED BY WIRE
 - SPACE BETWEEN WIRE AND STAVES BRIDGED WITH NETTING
- ADVANTAGES:
 - OPTIMUM COMPATIBILITY WITH PRESENT TANK CONFIGURATION (SHAPE)
 - MINIMAL IMPACT ON HARDWARE
 - EASY TO IMPLEMENT
 - LOW RISK



HOUSTON
OPERATIONS

SSD
SPACE SYSTEMS DIVISION

INCREASED AIR FLOW

GE INCREASED AIR FLOW

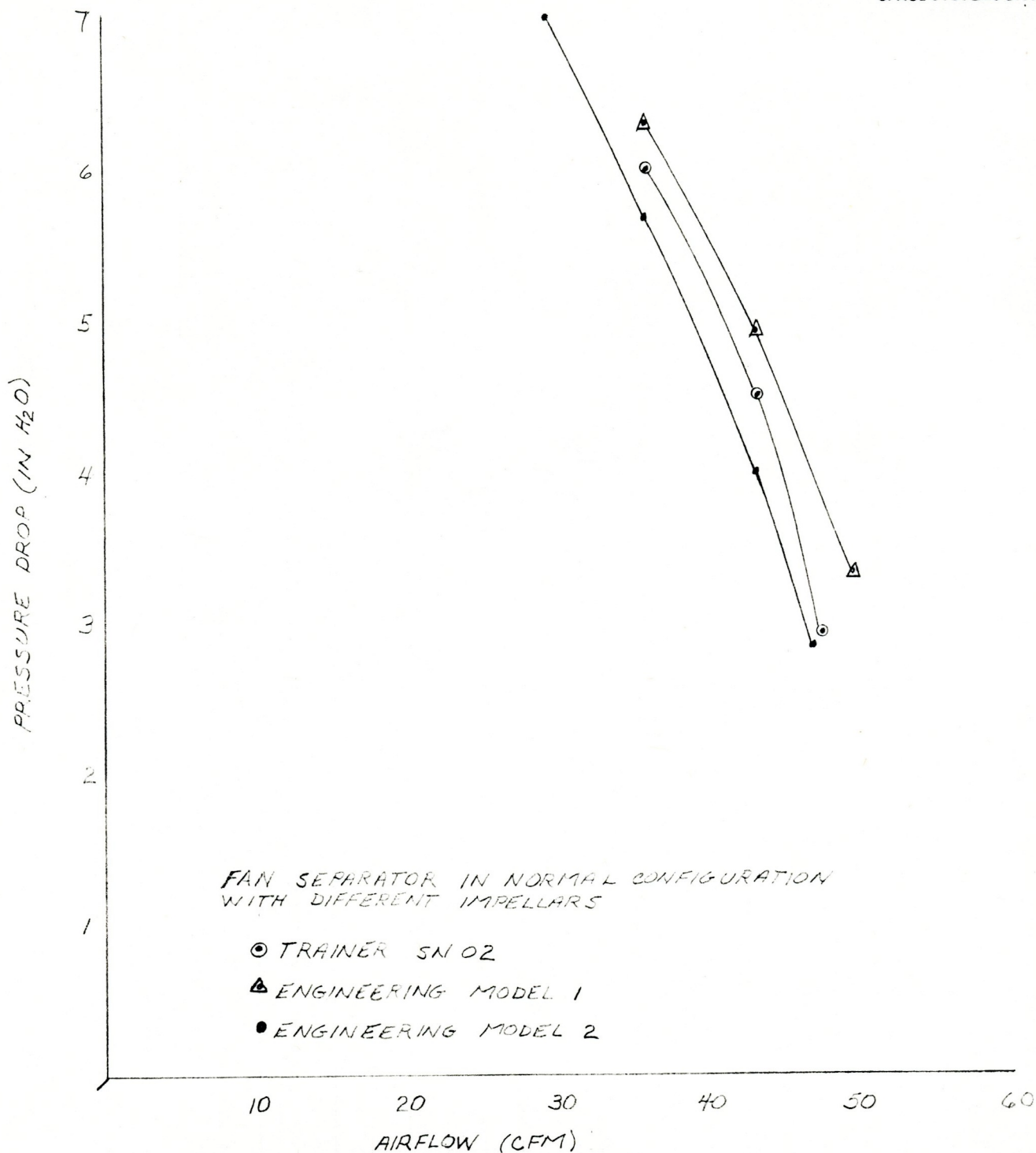
- PROVIDING TECHNICAL SUPPORT FROM CORPORATE RESEARCH AND DEVELOPMENT
- EVALUATING EFFECT OF AIR FLOW ON SEPARATION FORCE
- IMPROVING UTILIZATION OF AIR FLOW
 - IN CRITICAL URINAL FUNNEL DESIGN
 - SEAT/SLIDE VALVE CONFIGURATION
- FABRICATED TWO ADVANCE PROTOTYPE FAN WHEELS



HOUSTON
OPERATIONS

SSD
SPACE SYSTEMS DIVISION

FAN WHEEL CHANGES



NOTE: COMPARATIVE DATA ONLY -
TRAINER UNIT NOT TO
FLIGHT CONFIGURATION

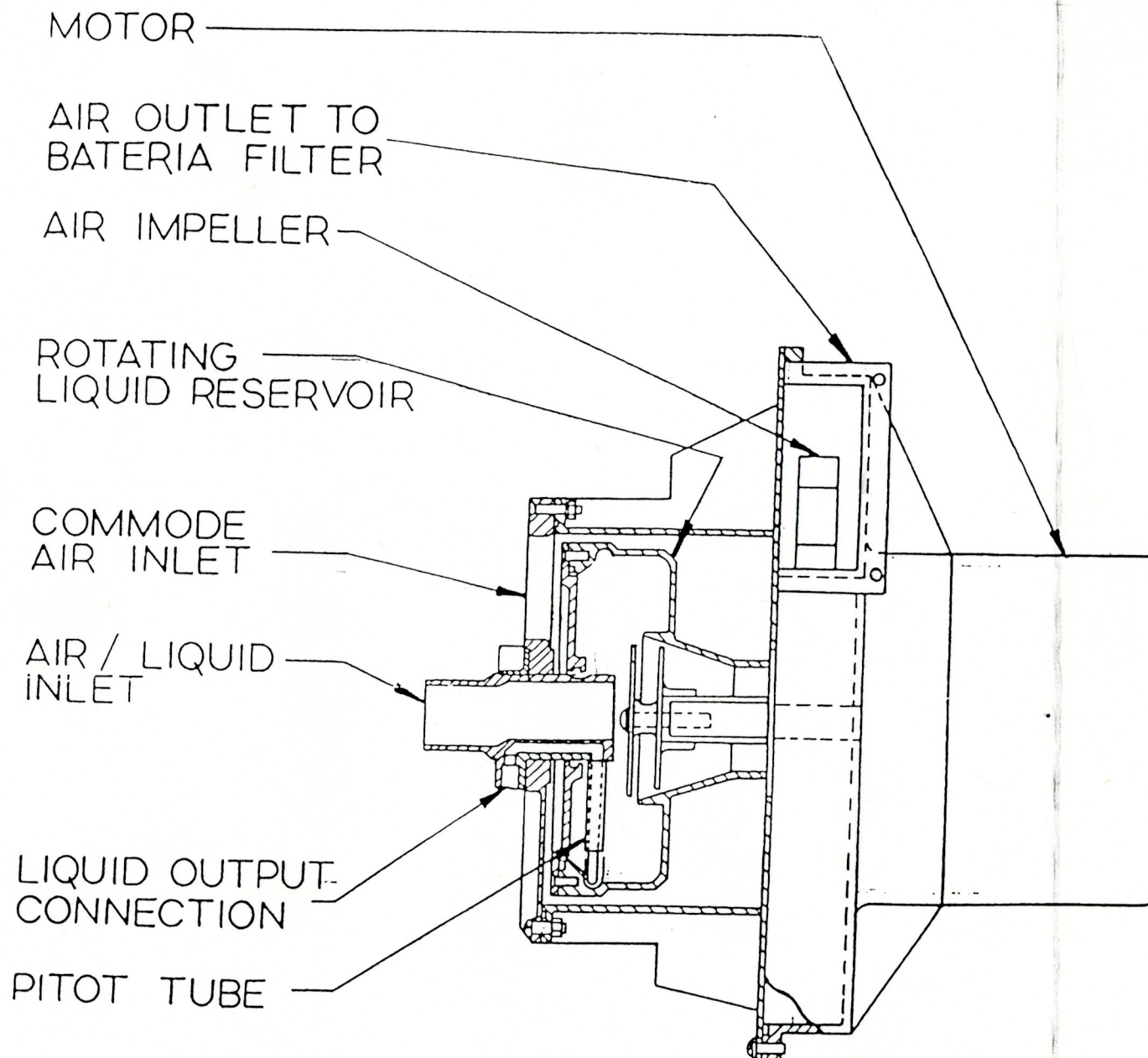


AIRRESEARCH TEST DATA



HOUSTON
OPERATIONS

FAN SEPARATOR ASSY

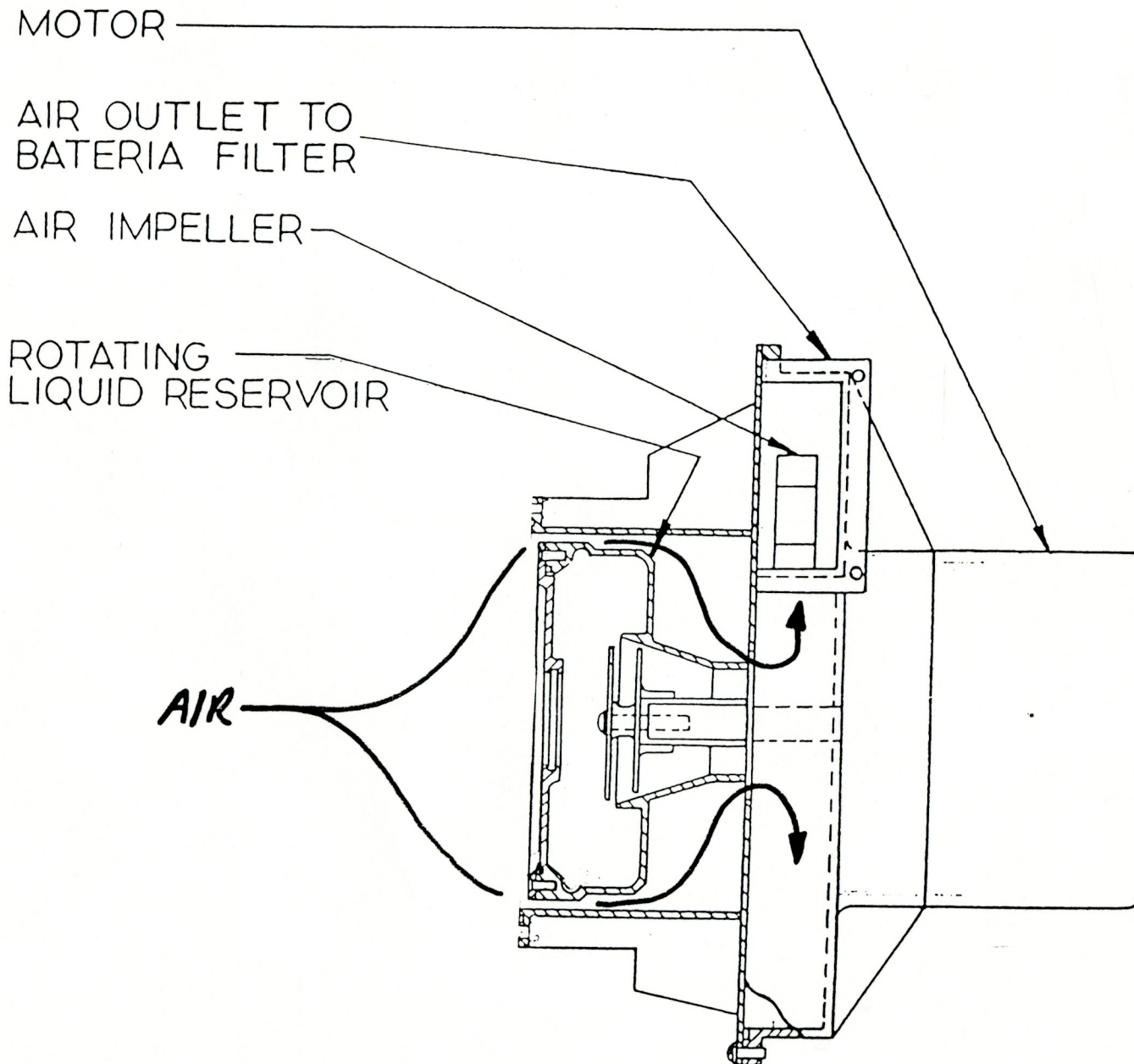




HOUSTON
OPERATIONS

SSD
SPACE SYSTEMS DIVISION

FRONT COVER REMOVED

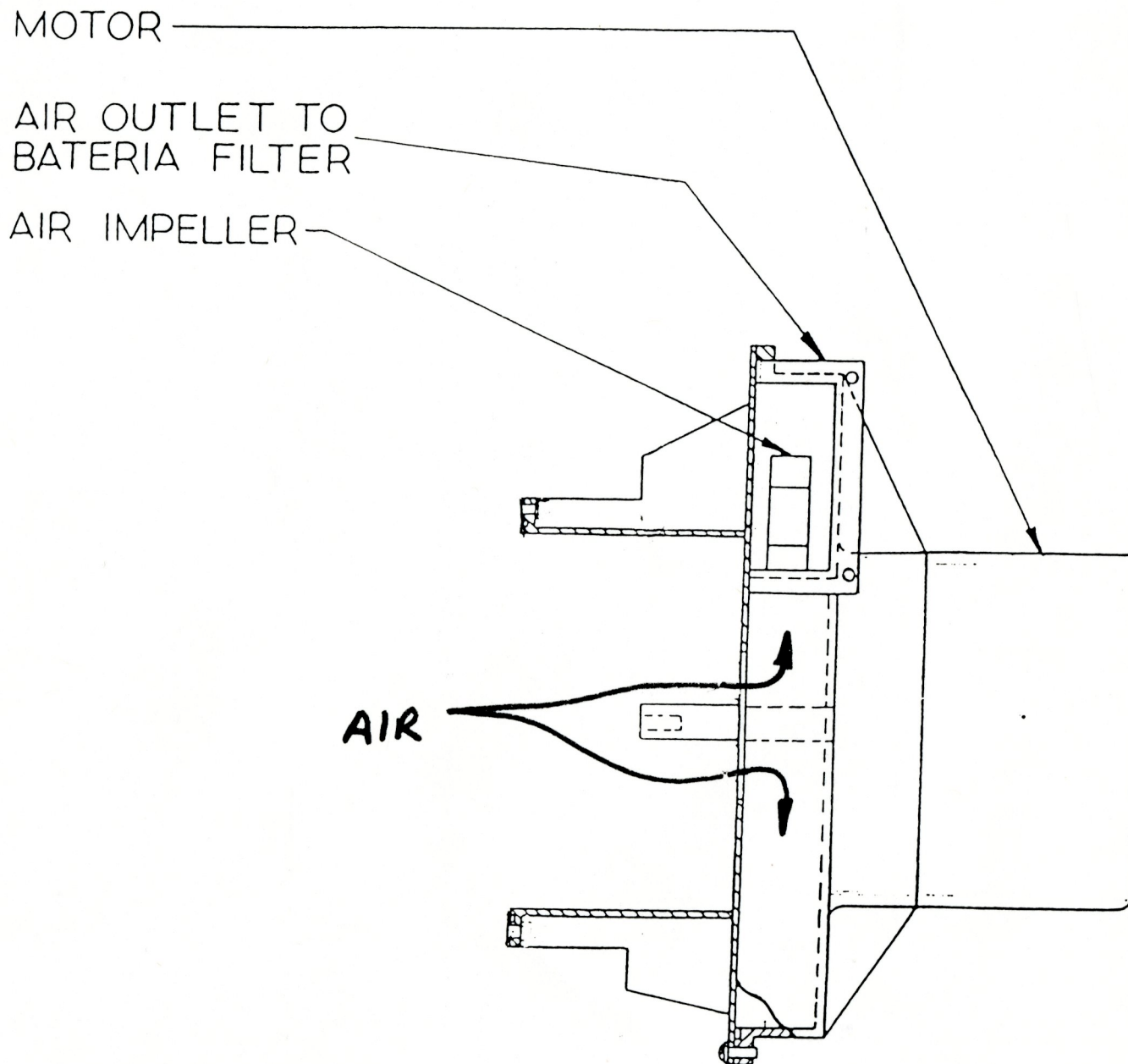


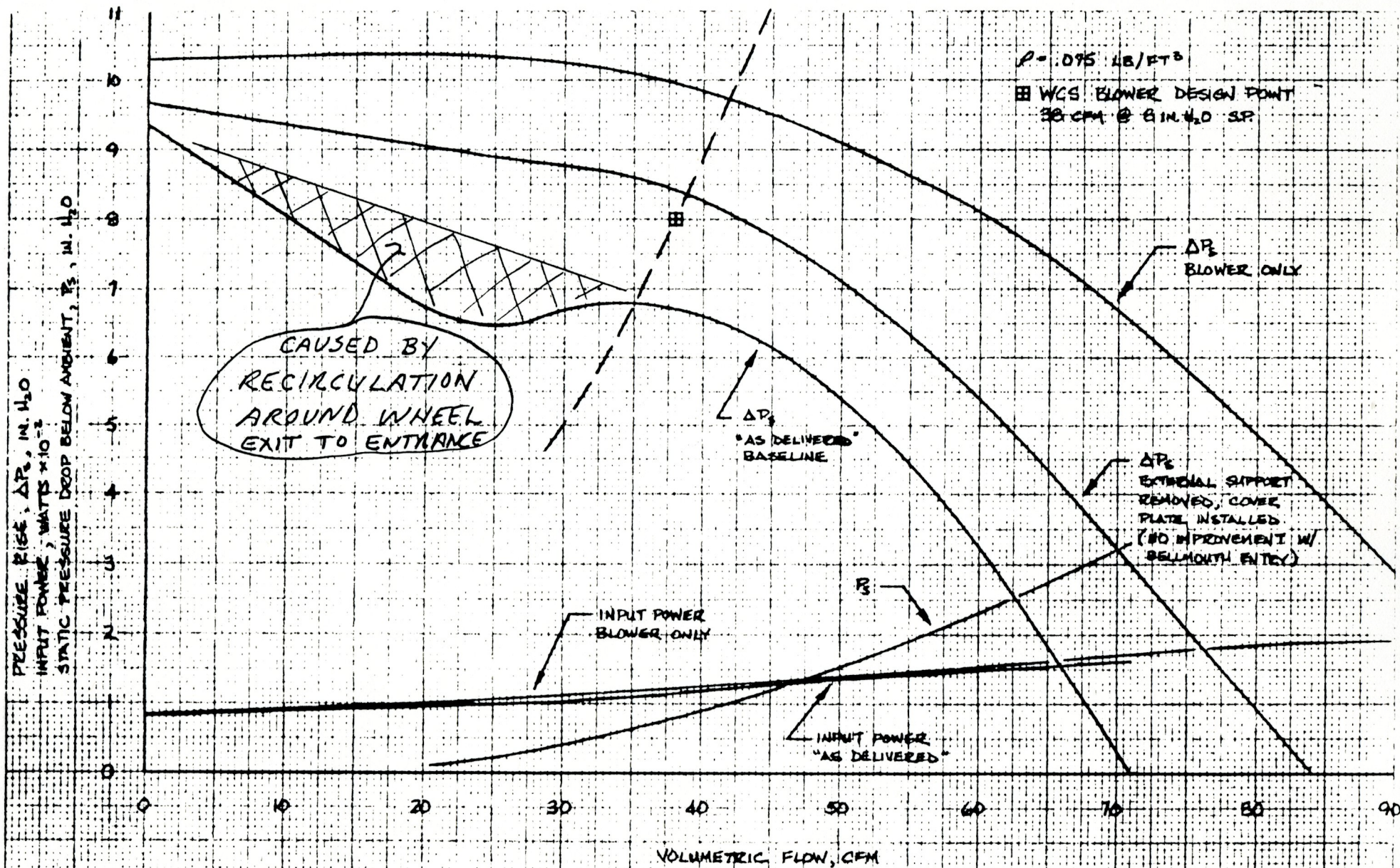


HOUSTON
OPERATIONS

SSD
SPACE SYSTEMS DIVISION

FAN WITHOUT SEPARATOR





CALCULATED BY R. SAKURADA

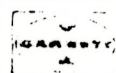
TRACED BY

CHECKED BY

APPROVED BY

UNIT NO

GE WASTE COLLECTOR SUBSYSTEM (WCS) FAN
AERODYNAMIC / ELECTRICAL PERFORMANCE



AIR RESEARCH AND ENGINEERING COMPANY OF CALIFORNIA

9-9-85

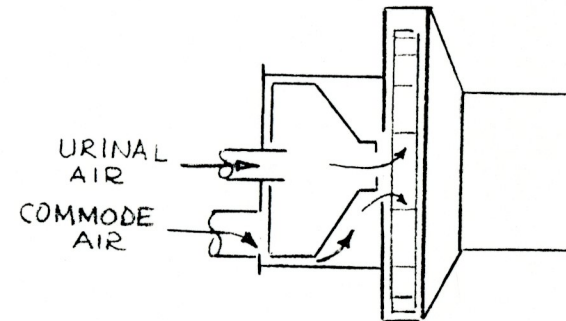


COMMODE AIR INLET IMPROVEMENT

0 PRESENT DESIGN

ESTIMATED LOSS

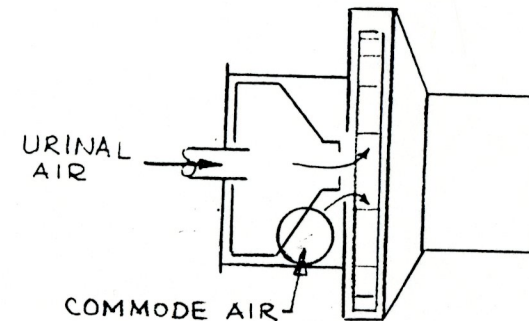
APPROX 6%



0 REDESIGN BY LOCATING INLET TO SIDE OF HOUSING

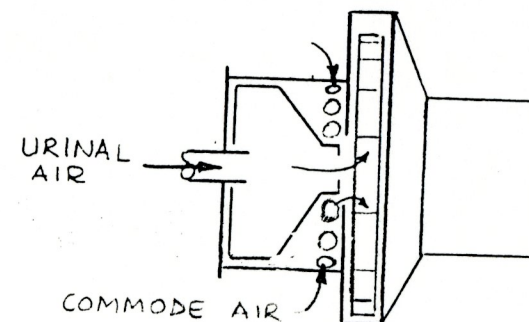
NEGATIVE
RESULT

LOSS OF ~30%



0 REDESIGN BY MANIFOLDING AROUND THE INLET AWAY FROM THE ROTATING BOWL

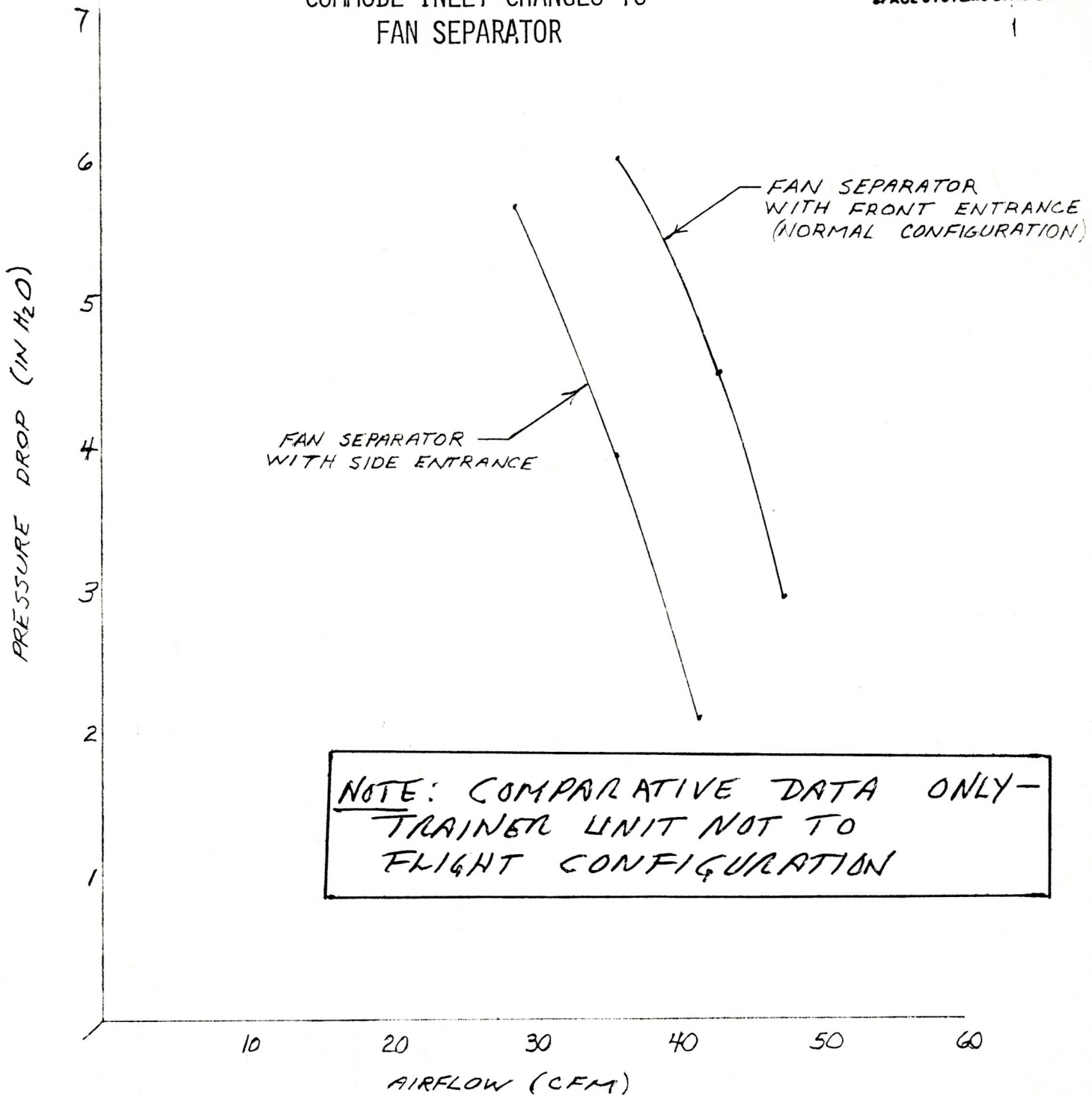
PRELIMINARY TEST DATA SHOW NO
SIGNIFICANT IMPROVEMENT



0 INTERNAL SHIELD MANIFOLD TO BE TESTED



COMMODE INLET CHANGES TO FAN SEPARATOR





HOUSTON
OPERATIONS



IMC SHORT TERM IMPROVEMENTS

REDESIGN WHEEL INLET TO:

- IMPROVE INLET CONFIGURATION
- MINIMIZE INTERNAL LEAKAGE

EVALUATE AND POSSIBLY REDESIGN:

- NUMBER OF BLADES
- BLADES PITCH

INCREASE SIZE OF WHEEL (1/4 INCH ON DIAMETER) TO
INCREASE AIR FLOW

DELIVERY BY SEPTEMBER 30TH

IMC LONG TERM IMPROVEMENTS

MODIFIED MOTOR TO INCREASE SPEED TO 7,500 RPM RESULTING IN:

- ~ 30% AIR FLOW INCREASE
- ~ 70% ΔP INCREASE

DELIVERY BY NOVEMBER 18, 1985

NOTE: HIGHER SPEED REQUIRES MODIFICATION/RECERTIFICATION OF ROTATING BOWL/PITOT
TUBE ASSEMBLY



HOUSTON
OPERATIONS

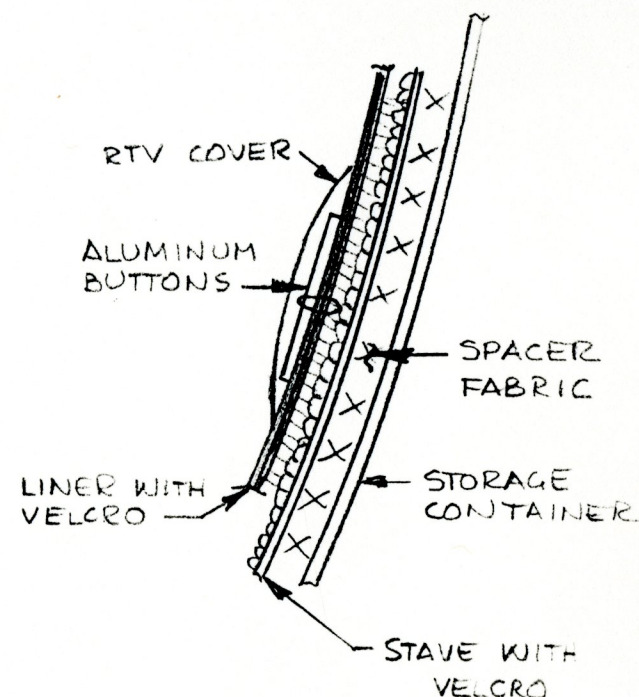


OTHER WCS DESIGN CHANGES

BAG LINER

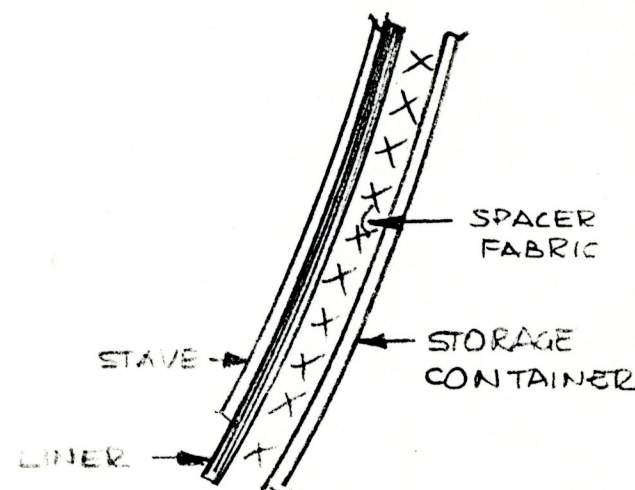
● PRESENT DESIGN:

- SINGLE TOP OPENING (4" DIA.)
- VELCRO ATTACHMENT
- METALLIC REINFORCEMENT
- APM MATERIAL 4 x 5 WHDC
- ΔP @ 30 CFM = .5 TO .6 INCH H_2O



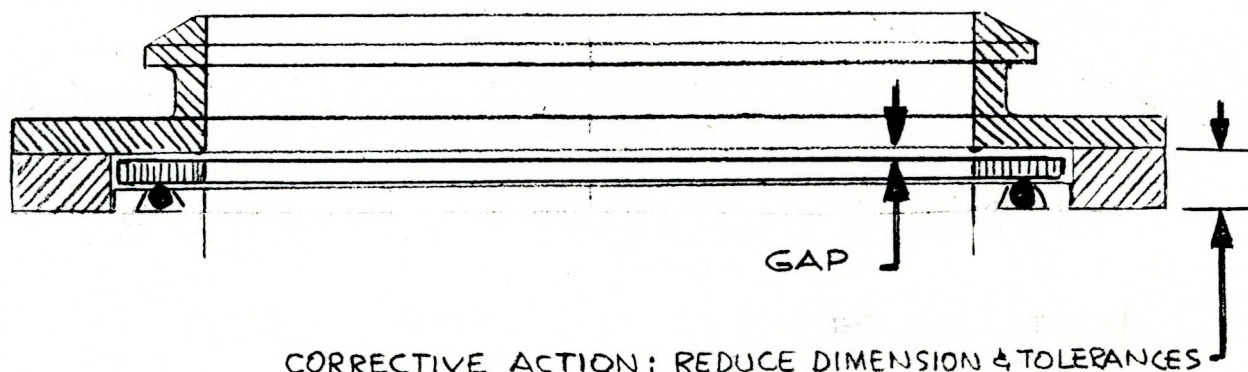
● IMPROVED DESIGN:

- TOP & BOTTOM OPENING (7" DIA.)
- INTERNAL STAVES
- APM MATERIAL 3 x 5 WHDC + REINFORCING LAYER INSIDE
- ΔP @ 30 CFM = .3 INCH H_2O
- SIGNIFICANT DECREASE IN MANUFACTURING TIME $\approx 80\%$ SAVINGS

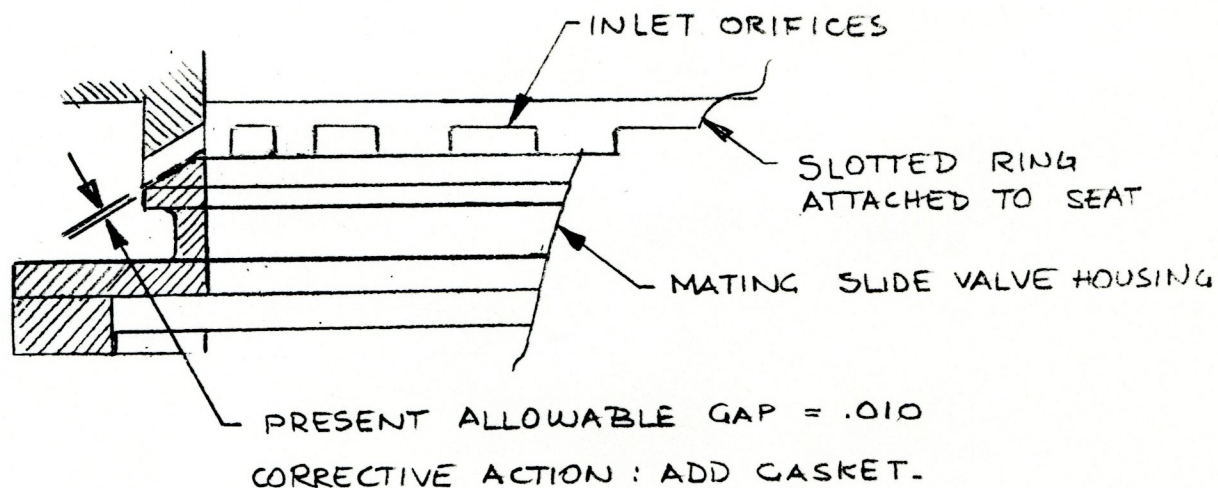


OTHER IMPROVEMENTS

SLIDE VALVE TOLERANCE



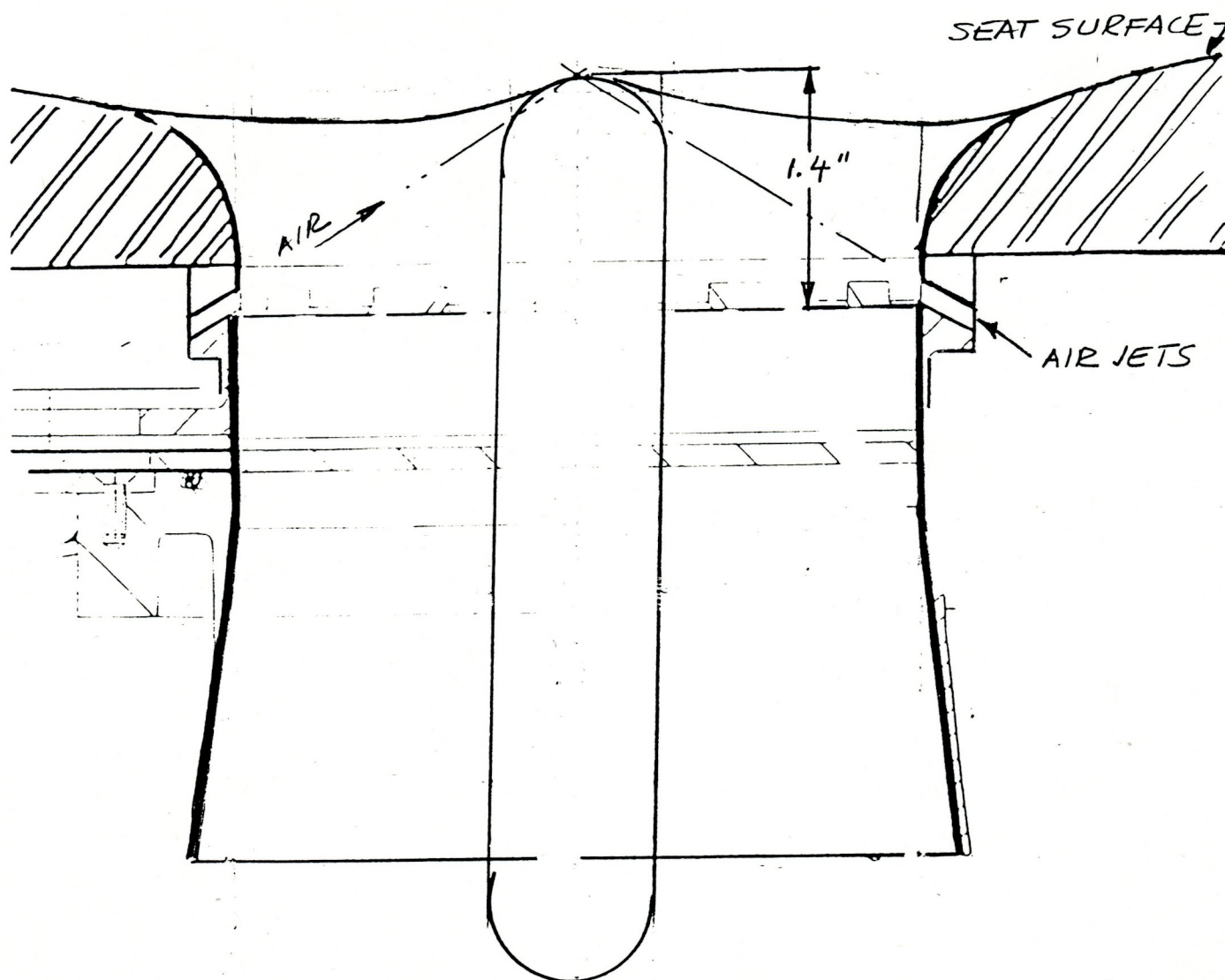
GASKET ON INLET ORIFICES





REDUCED SEAT HEIGHT

PRESENT SPACING BETWEEN AIR JETS & BODY $\approx 1.4''$
RECOMMENDED SPACING = $.9''$ OR LESS.



IMPLEMENTATION : MOLD NEW SEAT IN SOFT RTV 630
~ 25 DUROMETER - SAME BASIC CONTOUR



HOUSTON
OPERATIONS

SSD
SPACE SYSTEMS DIVISION

1

FLEXIBLE SILICONE HOSE

- PROCESS & TOOLING BEING DEVELOPED & PROTOTYPES HAVE BEEN MADE
- ALL MATERIALS USED HAVE BEEN FLIGHT CERTIFIED
 - RTV 630, MODIFIED
 - 302 CRES WIRE
- HOSES BEING SUPPLIED TO NASA FOR CERTIFICATION

PRELIMINARY ZERO "G" TEST RESULTS

- MINIMAL DIFFERENCES BETWEEN 5/8 AND 7/8 PLUMBING
- VORTEX URINALS
 - ALL SUCCESSFUL-OVAL SHAPE LEAST EFFECTIVE
BUT TESTS MAY NOT HAVE BEEN COMPARABLE