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A New Documentation System for the Mississippi Test Facility

Richard D. Harlow
General Electric Co. Bay St. Louis, Miss.

A NEW DOCUMENTATION SYSTEM FOR THE MISSISSIPPI TEST FACILITY

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Lost--lost in a maze--some of the finest technical minds in the space program hampered and confused by the labrinyth of disorganized, unreliable documentation.

The National Aeronautics and Space Administration (NASA), as a vital part of its Apollo Program mission of landing a man on the moon and returning him safely within this decade, authorized the construction of the Mississippi Test Facility (MTF). This facility was designed to captive test fire the first and second stages of the Apollo moon rocket--the Saturn V. The construction and subsequent activation of MTF was accomplished thru the Corps of Engineers, who, as NASA's prime contracting agency, subcontracted the design, construction and installation with various firms. Each contract was made to accomplish a specific task and the documentation generated was restricted to reflect only the contract task.

The acres of swampland have now disappeared. The scars of the bulldozers have become roads and canals, the gaping holes left by the giant shovels are filled with massive structures of concrete and steel--MTF is operational.

We now examine the documentation evolved by the over sixty separate, independent contractors involved, for adaptation to the new role of MTF as an operational facility. We find the twelve thousand facility and technical systems drawings, perfectly suitable for construction and installation, unable to support the overall site-wide systems operations, and with no traceability between interfacing contracts. To compound these problems the Facility has seen many changes during activation that were never recorded on the drawings.

The General Electric Company was selected as the support contractor for NASA. One of the many tasks handed to General Electric/Mississippi Test Support Department (GE/MTSD) was the updating and continued maintenance of this construction documentation. The GE/MTSD Design Engineering section's solution to this problem--Project SORD.

Project SORD

Project SORD (Site-wide Operational and Repair Documentation) first analyzed the site, its facilities and equipment to determine the most logical "building blocks" to assemble each component part into the final MTF. Emphasis was placed on the new operational phase of MTF and the documentation required to support it. Fabrication information was considered unnecessary to support this phase.

Next a documentation "family tree" was developed.

Family Tree

The purpose of the family tree was to place each of the "building blocks" or "categories" in their proper position to document MTF. (Exhibits A & B).

The family tree provides a complete top to bottom breakdown of all the drawings and specifications to be maintained to reflect current modifications against the facilities and systems of MTF. Each drawing and specification is given a specific location on the tree, with each document carrying a reference to its location, for ease of traceability throughout the documentation system.

Each category shown on the family tree requires definition for complete understanding of the SORD system. The individual kinds of documentation required to support these categories are also needed. Both of these definitions are contained in the following sections.

Category Definitions

Systems

An assembly or composite of items, such as piping or wiring, forming a network for distributing or serving a common purpose to more than one structure or area.

Test Support Utilities. Piping systems, including their controls and monitors necessary for direct support of any stage vehicle contractor testing. The systems include all Propellants, High Pressure Gases, and High Pressure Industrial Water.

Documents Req'd:
- Drawing Lists
- Site Distribution Plans
- Piping Schematics & Parts Lists
- Block Diagrams
- Advanced Schematics
- Master Components List

Site Support Utilities. The general utilities not directly essential to support the test mission, but vital for overall site operations.

Documents Req'd:
- Drawing Lists
- Site Distribution Plans

Communications. The intercommunication systems capable of individual or combined usage for communication during site operation.

Documents Req'd:
- Drawing Lists
- Block Diagrams
- Advanced Schematics

Instrumentation. All systems required to provide timing and to synchronize, record and/or monitor data in support of test requirements.

Documents Req'd:
- Drawing Lists
- Block Diagrams
- Advanced Schematics

Sensing & Alarms. The systems which monitor critical data and areas at a site-wide level and whose negative inputs could result in automatic or manual termination of testing.

Documents Req'd: Drawing Lists
Block Diagrams
Advanced Schematics

Buildings

This category includes buildings and structures and consists of the brick and mortar documentation which describes the complete structure. It includes utility systems and equipment attached to, or a part of, the structure.

Documents Req'd: Drawing Lists
Site Plan-Building Numbers
Building/Area-Index List
Architectural
Mechanical
Electrical-Facility
Tech. Sys.-Instl. & Equip.
Tech. Sys.-Wiring Diagrams
Tech. Sys.-Wiring Terminations
Tech. Sys.-Cable & Wire Schedule
Tech. Sys.-Conduit Schedule

Equipment

Marine and land mobile equipment in addition to tools and test equipment for test and site support. There are separate categories for water-borne equipment, land based equipment, and portable tools or serverable test equipment which is not an integral part of a building or system.

Documents Req'd: Drawing Lists
Architectural
Mechanical
Electrical-Facility
Tech. Sys.-Instl. & Equip.
Tech. Sys.-Wiring Diagrams
Tech. Sys.-Wiring Terminations
Tech. Sys.-Cable & Wire Schedule
Tech. Sys.-Conduit Schedule
*Piping Schematics & Parts List
*Block Diagrams
*Advanced Schematics
*Master Components List

*For equipment with Test Support Utility Systems such as the LOX & LH_2 Barges.

Sitework

All groundwork outside of a building.

Documents Req'd: Drawing Lists

Roads & Parking; Railroads; Waterways. The transportation networks throughout the site.

Documents Req'd: Drawing Lists
Site Distribution Plans

Underground. All underground piping, electrical wireways and communication ducts.

Documents Req'd: Drawing Lists
Site Distribution Plans
Plans & Profiles
Interconnection Wiring Diagrams

Landscaping. All surface groundwork outside of the buildings, defining contours, drainage, trees and shrubs.

Documents Req'd: Drawing Lists
Plans & Profiles

Standards

Any drawing or procurement specification having multiple applications.

Documents Req'd: Drawing Lists
Procurement Specifications

Arch., Civil, Elect., Tech. Systems & Mech.. Self-explanatory by discipline.

Documents Req'd: Drawing Lists
Discipline Drawings
(Arch., Civil, Elect., Tech. Sys., Mech.)

Electrical Components. Any critical electrical assembly or unit specifically purchased for MTF and requiring configuration control to insure performance, interchangeability and reliability.

Documents Req'd: Drawing Lists
Specification Control Drawings

Electrical Parts. Any critical electrical piece part specifically purchased for MTF and requiring configuration control to insure performance, interchangeability and reliability.

Documents Req'd: Drawing Lists
Specification Control Drawings

Mechanical Components. Any critical mechanical component which comes in direct contact with any Test Support Utility System and is specifically purchased for MTF and requiring configuration control to insure performance, interchangeability and reliability.

Documents Req'd: Drawing Lists
Specification Control Drawings

Documentation Definitions

Each drawing or specification required to support each category of the family tree is defined as follows:

Advanced Schematics (Exhibit C)

An advanced schematic diagram shows by means of graphic symbols, the electrical connections and functions of a specific circuit arrangement. This schematic diagram facilitates tracing the circuit and its functions without regard to the actual physical size, shape, or location of the component device or parts within an assembly. The advanced schematics are developed so that they can be read functionally top to bottom. Only one specific "system" is shown on each set of advanced schematics. All "Building" category assembly and sub-assembly drawings defining actual component identification data are referenced.

Architectural/Structural

The normal building trade drawings including floor plans, elevations, sections and details.

Block Diagram (Exhibit D)

A block diagram is a single line drawing with block outlines to designate units of functional groups for system definition. The block diagram is sheet one in the package of system advanced schematics. Only one specific "system" is shown on a block diagram. The drawing is developed from top to bottom.

Building/Area - Index List (Exhibit E)

A cross-index list providing reference from the existing four digit building number to the SORD drawing list number which includes all of various trade discipline drawings required for each building.

Cable Schedules & Wire Schedules

Cable schedules are a tabulation listing of all cables installed for technical systems usage. Each cable is listed by cable type. Length of the cable, its routing, terminations and "from and to" information is provided.

Wire schedules are tabulation sheets of point to point terminations. This information is shown on termination sheets or wiring diagrams where they exist in lieu of wire schedules. New systems or facilities are documented by termination sheets & wiring diagrams not wire schedules.

Both of these drawings are designated as drawing type (V).

Civil

The normal trade drawings including area plans, landscaping, road plans & profiles, contours, etc.

Conduit Schedules

A tabulation listing of all new conduit installed for technical systems usage. Each conduit is listed by size and approx. length "From and to" information is also provided.

Cross Index List (Exhibit F)

Every baseline document previously identified by a construction contractor number is entered on the cross-index list. The disposition column indicates whether the old drawing is active and renumbered to a SORD drawing; or inactive, see a new SORD drawing; or cancelled by a new SORD drawing.

Drawing Lists (Exhibit G)

Each document is listed on a drawing list (DL). This DL provides drawing number control for all drawings and specifications of the same family or category.

Electrical - Facility

The normal trade drawings including lighting plans, reflected ceiling plans, conduit installation diagrams, one-line power distribution schematics, wiring diagrams, panel schedules, conduit schedules, equipment layouts, etc.

All electrical-facility drawings are identified by drawing type (E).

Installation & Equipment Drawings

The various misc. drawings required to document the technical systems "Building" category. The drawings include the following:

Installation Drawings. An installation drawing depicts the physical installation information of the equipment.

Assembly Drawings. An assembly drawing depicts the delineation of each sub-assembly and/or part in their physical arrangement and identifies each item. (ie: Bays & Racks)

Sub-Assembly Drawings. A sub-assembly drawing depicts each part in their physical arrangement and identifies each item. (ie: Chassis and panel layouts, their wiring diagrams and termination sheets.)

The physical location of equipment is presented on layout drawings which may encompass an area as small as a panel or relay rack or as large as a building or complex. Where appropriate the panel sub-assemblies are combined with the internal wiring diagram. Where large areas are involved, the equipment layout is of the installation type, with location of the equipment clearly identified with regard to adjacent buildings or portions thereof.

All these drawings are designated as drawing type (F).

Interconnection Wiring Diagrams

This type of drawing is a form of connection or wiring diagram which shows only external connection between unit assemblies, system components, or equipment. The internal connections of these unit assemblies, system components, or equipments are not included on this drawing unless absolutely required for clarity.

Master Components List (MCL)

A listing of all mechanical components defined on the Test Support Utility System Piping Schematics and Parts Lists. The MCL has four sections. One groups the components by system locator number; one by component specification; one by SORD drawing number used on; and one by manufacturer.

Mechanical

The normal trade drawings including heating, ventilating, and air conditioning plans & elevations; plumbing plans and profiles; other utility plans & elevations.

Piping Schematic (Exhibit H)

Piping schematics are piping diagrams drawn in single line flow schematic form, depicting & defining all components used in the piping system. Each schematic represents general field routing of the piping. Only one specific "system" is shown on a piping schematic. Purge lines are shown on the prime system only to the first check valve restricting intermix of systems.

Location Grid Key Block. All test stand piping schematics have a location grid key block per Exhibit H. Key components are assigned references to it to help locate them on the stands.

Parts List. (Exhibit J) Piping schematics parts lists (PL) are prepared for each piping schematic. Each component is listed by its system locator number. (i.e.: VA-2A21-GN).

Reference is made to the SORD specification control drawing number for complete description of these components.

Plan & Profile

Plan and profile drawings are engineering drawings which delineate on one drawing both the horizontal (plan) and the vertical (profile) location of utilities such as underground drain lines, roads, railroads, overhead steam lines, etc. The drawings are used to show the relative elevation of points along the utilities route (plan) in relation to the ground elevation. These drawings provide construction data for roads, railroads, pipe lines, etc.

The profile is a "stretched out" elevation at the centerline of the road, railroad, or pipe line being shown in plan view.

Procurement Specification (Exhibit K)

Procurement specifications are prepared for equipment to be specifically purchased for MTF which cannot be obtained thru standard manufacturers stock. These specifications are prepared in accordance with MTF Standards and are numbered consistent with the SORD system.

Critical components which require configuration control to insure performance, interchangeability, and reliability are prepared on Specification Control Drawings.

Site Distribution Plan (Exhibits L & M)

Site maps, drawn to scale, showing the distribution of a system throughout the site. Only one system is shown on each set of site distribution plans. System distribution is shown only from building to building. Distribution within the building is shown on the utility drawings within the "Building" category.

The "Underground-Sitework" drawings providing the details of construction are referenced. For the "Test Support Utility Systems," reference is also made to the piping schematics for each area. Locations are given of all accessways for service through which the system passes. (ie: Valve Pits & Manholes).

Site Plan - Building Numbers (Exhibit N)

A map of the entire fee area of MTF drawn to a scale of 1" = 1000'. Each building or structure is shown with its NASA approved building name and building number. Each building or structure having its own sign is so identified.

Specification Control Drawings (Exhibit O)

Drawings prepared to define the specifications required for critical components purchased for MTF. They provide adequate information to effectively control the configuration to insure the components performance, interchangeability and reliability.

Wiring Diagram

This type of drawing delineates the point to point wiring within an item of equipment, component, assembly, enclosure, or panel. The general physical arrangement of terminations is correct but there is no requirement for a detailed physical routing or wiring.

Wiring Termination Sheets

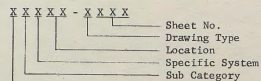
These wiring drawings depict the wiring interconnections between bays, rack and terminal boxes. They show each terminal (used or spare) and the wire termination with a reference to the cable schedule or installation drawing for routing. The destination & drawings to terminate the other ends of the wires and cables are referenced. Where wiring termination sheets exist, wire schedules are not used.

Numbering System

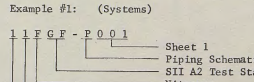
The family tree was developed in matrix format to provide a uniform numbering system for all documentation elements of MTF. Each drawing and specification is given a number, derived from this matrix. (Exhibit B).

The matrix has been designed to provide for unlimited expansion as the site develops and has been tailored for computer processing.

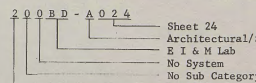
The document number is derived as follows:



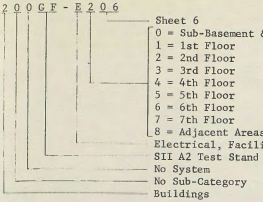
Example #1: (Systems)



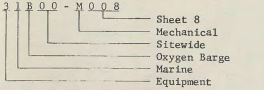
Example #2: (Buildings - Arch/Struct.,Civil, Mech)



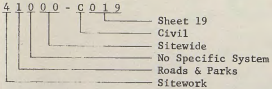
Example #3: (Buildings-Electrical, Facility)
(Buildings - Tech. System)



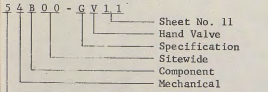
Example #4: (Equipment)



Example #5: (Sitework)



Example #6: (Standards)



Implementation Considerations

Personnel

The personnel assigned to the SORD program are design and detail draftsmen. No new designs are being generated, however a through knowledge of documentation practices and the ability to research thru the reams of paper dictates the use of highly qualified design draftsmen. The SORD personnel have been permanently assigned to only this program to assure continuity of the tasks required.

Reference Drawing Files

Review of all existing drawings was required to assure each piece of data applying to a given category or location was considered and cataloged. Prints were obtained reflecting this cataloging, for each task to be worked.

Documentation Release

The existing documentation is used wherever possible for adaptation to the new SORD system, updated to reflect current modifications, and released to NASA for approval and subsequent release. SORD personnel are kept informed of current modifications being made, thru changes posted against the existing contract documentation. The transistion from the contract documentation system to SORD is kept an orderly one by releasing blocks of the SORD data, with complete cross-referencing to the old contract data. Existing, interfacing contract data is revised concurrently to eliminate duplication or overlap of information.

All mechanical systems are field verified by engineering and reviewed by operational personnel before issuance. Confidence in the documentation is thereby established, and the understanding of purpose and future cooperation of affected personnel greatly enhanced.

Summary

The SORD program is scheduled for completion by September, 1969, two and one-half years after its inception. We began reaping its benefits however, shortly after its approval. We significantly reduced the documentation maintenance required, by identification of the drawings and specifications to be maintained, thus weeding out the unnecessary one-shot construction details. As our documentation is revised and renumbered a "used-on" reference is added to provide traceability up and down the family tree. All drawings are being reviewed to elimate duplication, assure proper interfacing, and provide maximum standardization.

The "Systems" approach to our documentation has been vital in supporting operating and trouble-shooting procedures. Maintenance procedures and spares provisioning rely heavily on our systems documentation for identification of end items.

The unique numbering system, utilizing computer processing, provides rapid identification and retrevial of all documentation by specific system, location or document type.

Project SORD is providing us with a documentation system for MTF, streamlined for our operational role, providing complete traceability throughout the site and with unlimited expansion capability as the site develops.

This documentation system has provided GE/MTSD with 250,000 dollars worth of NASA approved Cost Improvements and inquiries from other NASA installations on possible adaptation of its principles.

The success enjoyed by MTF with project SORD could easily be experienced by other facilities, both government sponsored and privately promoted. The ultimate acheivement of a program like SORD has yet to be realized. This site-wide systematic approach should be adopted during the planning stage of a new facility, not after construction has been completed. Augment this operational documentation with construction and installation details of course, but design the overall documentation system to keep these easily severable, to provide for the ultimate purpose of efficiently, effectively defining the configuration of the operational facility.

EXHIBITS

TITLE	EXHIBIT NO.
FAMILY TREE	A
FAMILY TREE MATRIX	B
ADVANCED SCHEMATIC	C
BLOCK DIAGRAM	D
BUILDING/AREA - INDEX LIST	E
CROSS INDEX LIST	F
DRAWING LIST	G
PIPING SCHEMATIC	H
PIPING SCHEMATIC - PARTS LIST	J
PROCUREMENT SPECIFICATION	K
SITE DISTRIBUTION PLAN - INDEX	L
SITE DISTRIBUTION PLAN - REF. SH.	M
SITE PLAN - BUILDING NUMBERS	N
SPECIFICATION CONTROL DWGS	O

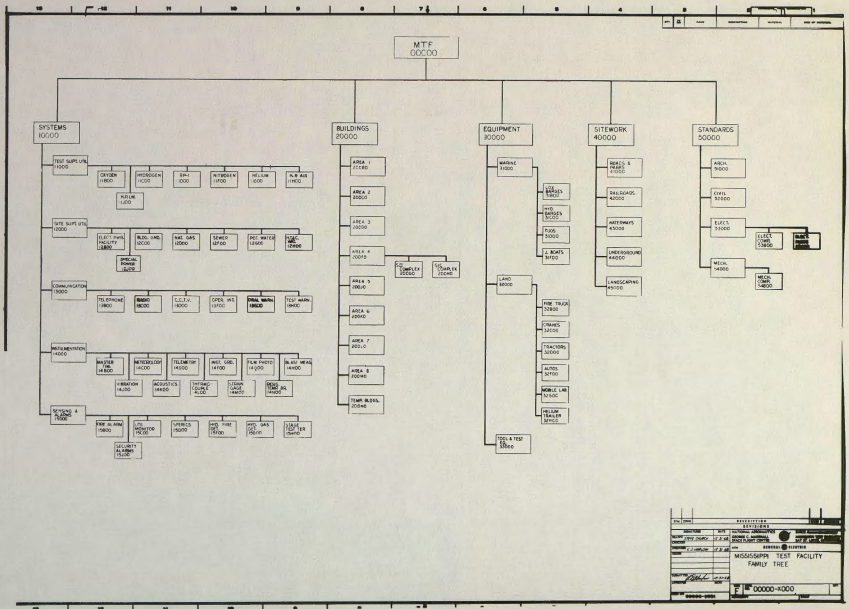

MTF
00000
SYSTEMS
10000
BUILDINGS
20000
EQUIPMENT
30000
SITEWORK
40000
STANDARDS
50000
MISSISSIPPI TEST FACILITY
FAMILY TREE
00000-X000

EXHIBIT NO. A

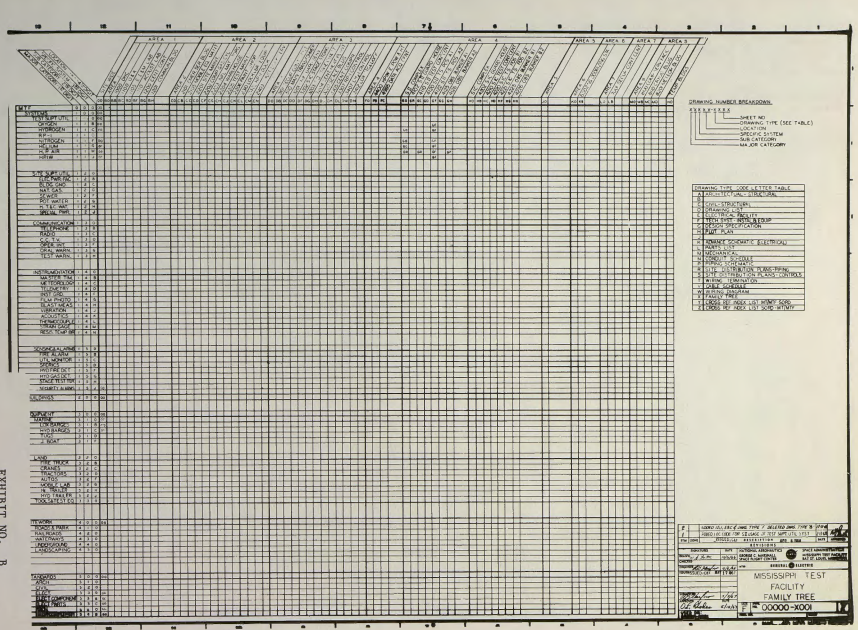
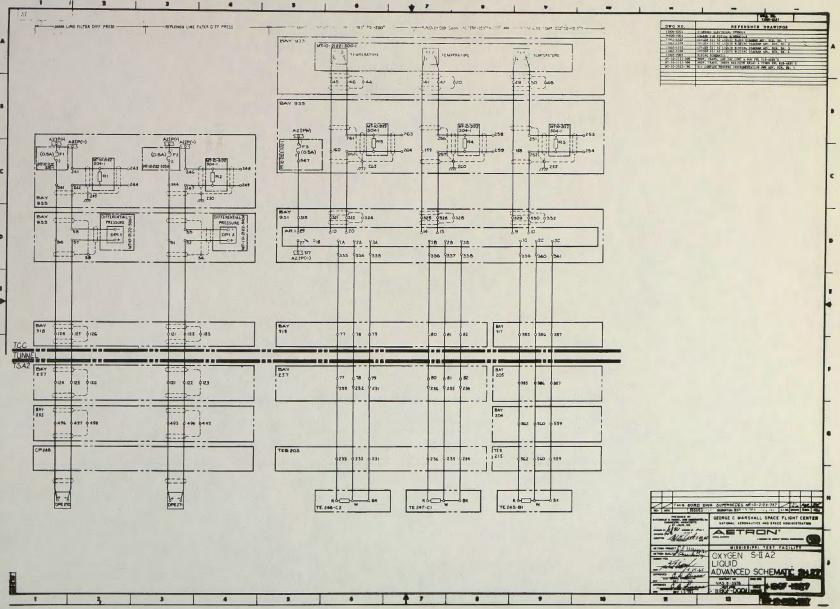

AREA 1
AREA 2
AREA 3
AREA 4
AREA 5
AREA 6
AREA 7
AREA 8
DRAWING NUMBER BREAKDOWN
SHEET NO.
DRAWING TYPE (SEE TABLE)
LOCATION
SYSTEM OR SYSTEM SUB-CATEGORY
MAJOR CATEGORY
DRAWING TYPE CODE LETTER TABLE
A ARCHITECTURAL - STRUCTURAL
B
C CIVIL - STRUCTURAL
D DRAWING TREE
E ELECTRICAL FACILITY
F PIPING SYST - INSTR. & EQUIP.
G EQUIP. SPECIFICATION
H PLANT PLANS
I
J
K KINEMAT. SCHEMATIC (ELECTRICAL)
L PARTS LIST
M MECHANICAL
N NUCLEAR FACILITIES
P PIPING - DIAGRAMS
R SITE DISTRIBUTION, TUBING-PIPING
S SCHEMATIC DIAGRAMS - CONTROLS
T WIRING - TERMINATION
U WIRING DIAGRAMS
V WIRING DIAGRAM
X FAMILY TREE
Z INDEX TO DRAWING LIST, SCHMTC SUBS.
1 INDEX TO INDEX LIST SUBS. WITHIN
SYSTEM
SUPPLY UTIL
OXYGEN
HYDROGEN
AIR
NITROGEN
HELIUM
H B GAS
HiTHM
SITE SUPPLY UTIL
LIQUID METAL
BLDG. GAS
NAT. GAS
WATER
POT. WATER
N.Y.E.C. WAT.
SPECIAL PWR.
COMMUNICATION
TELEPHONE
RADIO
C.C.T.V.
PAGE SYST.
DATA WAITN.
TELE WRITN.
INSTRUMENTATION
MASTER TIM.
METEOROLOGY
TEMPERATURE
PRESSURE
FLOW RATE
ELECTRICAL
VIBRATION
RADIATION
THERMOCOUPLE
THERM. COUP.
RESIS. TEMP. DET.
SECURITY ALARMS
FIRE ALARM
DTA MONITOR
SPRINKLER
INTRUSION DET.
HOT SPOT DET.
SMOKE DETECT.
SECURITY ALARMS
CLOSED
SUPPLY UT
SYSTEM
LINE DRAWG.
MISC DRAWGS.
TYPE
SCHAT
YARD
ROAD
SERVICE TRUCK
CRANES
TRACTORS
AUTOS
MOBILE LAB
FORK LIFT
MISC TRAILER
TOOL DETECT DEV.
TRAINING
TRADE & TRADE
RAILROADS
TRAINING AIDS
AUDIOVISUAL
LABORATORY
RECORDS
AUTO
SYSTEM
ITEM
ITEM COMPONENT
SPEC. PARTS
TEST
DRAWING
ISSUED TO USE FOR ISSUANCE OF TEST SUPT. UTIL SYST
ISSUED TO USE FOR RELEASE OF TEST SUPT. UTIL SYST
APPROVALS
CONTRACTOR DATE CONTRACTOR REPRESENTATIVE
APPROVED
DRAWING MATERIAL NOT TO BE CHANGED WITHOUT WRITTEN AUTHORIZATION OF THE ENGINEER
GENERAL ELECTRIC
MISSISSIPPI TEST
FACILITY
FAMILY TREE
00000-X001

EXHIBIT NO. B



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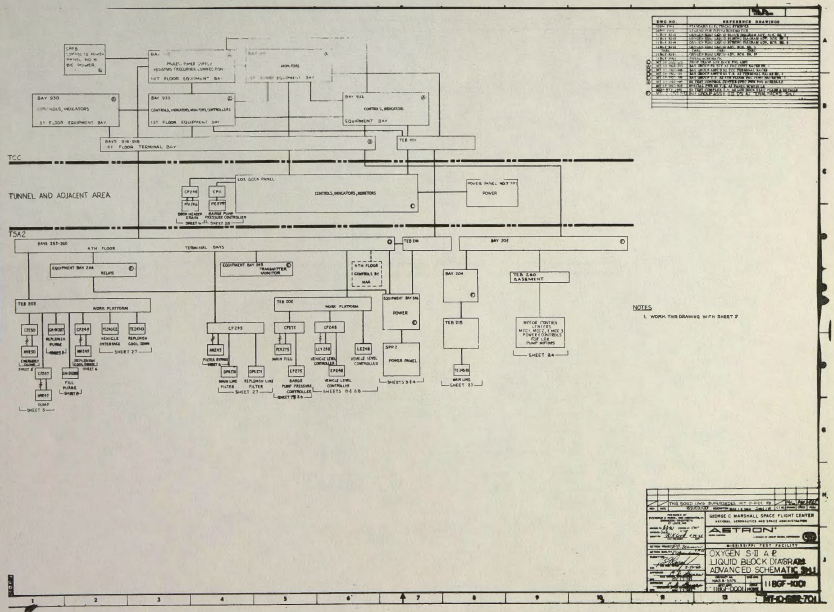

TUNNEL AND ADJACENT AREA
TCC
FSA2
LOX SOCK PANEL
CONTROLS, INDICATORS, MONITORS
POWER PANEL NO 1 PT 1
POWER
BAY 205
BAY 204
BAY 207
BAY 208
BAY 209
BAY 210
BAY 211
BAY 212
TCB 205
TCB 206
TCB 207
TCB 208
TCB 209
TCB 210
TCB 211
TCB 212
EQUIPMENT BAY 206
EQUIPMENT BAY 208
EQUIPMENT BAY 210
RELAYS
MONITOR
POWER
WORK PLATFORM
4TH FLOOR
TERMINAL BAYS
CONTROLS
PANEL
SHEET 27
SHEET 4
SHEET 5
SHEET 84
SHEET 21
NOTES
1. WORK THIS DRAWING WITH SHEET 2
GEORGE C MARSHALL SPACE FLIGHT CENTER
ASTRON
OXYGEN S I A R
LIQUID BLOCK DIAGRAMS
ADVANCED SCHEMATIC SH 1
11BGF-1001
MT-D-SSB-701

EXHIBIT NO. D

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER
MISSISSIPPI TEST FACILITY
BAY ST. LOUIS, MISSISSIPPI

PREPARED BY MTSO — GENERAL ELECTRIC

INDEX LIST

WING TITLE: BUILDING/AREA

DRW.NO. 20000-D002

REV. NO.

DRAWN:	CHECKED:	ENGINEER:	SUBMITTED:	APPROVED:	AUTHORITY:	ISSUED CEF
[illegible] 8/9/67			[illegible] 8/9/67	[illegible] 8-10-67	Amend 90	[illegible]

NO.	TITLE	BUILDING NO.	CODE	SORD DWG. NO.
1		SITEWIDE		20000-D001
2		AREA 1		200B0-D001
3	DATA HANDLING CENTER	BUILDING 1000		200BB-D001
4	DATA HANDLING CENTER COOLING TOWER	BUILDING 1001		200BB-D001
5	ENGINEERING AND ADMINISTRATION BUILDING	BUILDING 1100		200BC-D001
6	ENGINEERING AND ADMINISTRATION BUILDING COOLING TOWER	BUILDING 1101		200BC-D001
7	ELECTRONICS, INSTRUMENTATION AND MATERIALS LABORATORY	BUILDING 1105		200BD-D001
8	COOLING TOWER (1105 BUILDING)	BUILDING 1106		200BD-D001
9	BOTTLE TANK AREA (1105 BUILDING)	BUILDING 1107		200BD-D001
10	ACOUSTICS LABORATORY	BUILDING 1110		200BF-D001
11	ACOUSTICS LABORATORY COOLING TOWER	BUILDING 1111		200BF-D001
12	CENTRAL CONTROL BUILDING	BUILDING 1200		200BG-D001
13	COMMUNICATIONS BUILDING	BUILDING 1201		200BH-D001
14	CENTRAL CONTROL COOLING TOWER	BUILDING 1202		200BG-D001
15	COMMUNICATIONS BUILDING COOLING TOWER	BUILDING 1203		200BH-D001
16		AREA 2		200C0-D001
17	EMERGENCY SERVICES BUILDING	BUILDING 2101		200CB-D001
18	MOBILE EQUIPMENT MAINTENANCE BUILDING	BUILDING 2105		200CC-D001
19	PAINT STORAGE BUILDING	BUILDING 2106		200CC-D001
20	FUEL STORAGE TANK AREA (MOBILE EQUIPMENT BUILDING)	BUILDING 2107		200CC-D001
21	SITE MAINTENANCE BUILDING	BUILDING 2201		200CD-D001
22	COMPRESSED GAS CYLINDER BUILDING	BUILDING 2202		200CF-D001

REVISIONS				LEGEND	
NO.	DESCRIPTION	APPROVAL	ISSUED CEF	CODE	DESCRIPTION
1				A	ACTIVE - RENUMBERED TO
2					
3					
4					

EXHIBIT NO. E

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER
MISSISSIPPI TEST FACILITY
BAY ST. LOUIS, MISSISSIPPI

PREPARED BY MTSO — GENERAL ELECTRIC

SORD CROSS INDEX LIST MT/MTF-SORD

DRAWING TITLE: S-II TEST COMPLEX, TEST STAND

DRW. NO. 00000 - ZL30

REV. NO. SHT. 5 OF 8

AWN:	CHECKED:	ENGINEER:	SUBMITTED:	APPROVED:	AUTHORITY:	ISSUED CEF
D Story		D. Story	11-5-68		Mod. 20	104 6 1968

NO.	TITLE	MT/MTF DWG. NO.	CODE	SORD DWG. NO.
1	HT VENT AIR CONDER	MTF 2380	A	200GF-M010
2	ELEC SYM SH 1	2381	A	200GF-E001
3	ELEC SYM SH 2	2382	A	200GF-E002
4	ELECTRICAL ONE LINE DIAGRAM	2383		200GF-E807
5	POWER PANEL SCHEDULES	2384		200GF-E808
6	MOTOR CONTROL CENTER SCHEDULES	2385		200GF-E809
7	CONDUIT & GROUNDING PL SUB-BAS	2386		200GF-E013
8	CND GRD PLAN	2387		200GF-E014
9	CONDUIT & GROUNDING	2388		200GF-E050
10	CONDUIT & GROUNDING PL DFL ARA	2389		200GF-E051
11	CND GRD PLAN 1 FL	2390		200GF-E100
12	CND GRD PLAN	2391		200GF-E101
13	CND GRD PLAN 2 FL	2392		200GF-E200
14	CONDUIT & GROUNDING PL 3 FL	2393		200GF-E300
15	CONDUIT & GROUNDING PL 4 FL	2394		200GF-E400
16	CND GRD PLAN PLATF	2395		200GF-E401
17	CONDUIT & GROUNDING PL 5 FL	2396		200GF-E500
18	CND GRD PLAN PLATF	2397		200GF-E501
19	CONDUIT & GROUNDING PL 6 FL	2398		200GF-E600
20	CND GRD PLAN	2399	A	200GF-E601
21				
22				

REVISIONS

	DESCRIPTION	APPROVAL	ISSUED CEF
1	ADDED NO 4-20 PER SORD REL 297		DEC 30 1968
2			
3			
4			

LEGEND

CODE	DESCRIPTION
A	ACTIVE - RENUMBERED TO

EXHIBIT NO. F

MSFC-F - 1554-4 (2-67)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER
MISSISSIPPI TEST FACILITY
BAY ST. LOUIS, MISSISSIPPI

PREPARED BY MTSD — GENERAL ELECTRIC

SORD DRAWING LIST

ING TITLE: BUILDING - S II A2 TEST STAND - BLDG 4122

DRW NO: 200GF-D001

ECO NO: SH. A01

DRAWN: G Story | CHECKED: | ENGINEER: | SUBMITTED: 10-31-68 | APPROVED: | AUTHORITY: Amend. 90 | ISSUED CEF: NOV 5 196

Used On: 200G0-D001

NO.	TITLE	DRAWING NUMBER INDEX NUMBER	DRAWING NUMBER SHEET NUMBER
1	EXCAVATION OF A2	200GF - A 001	
2	PILING PLAN A2		- A 002
3	BASE SLAB-TOP LIFT		- A 003
4	" " " "		- A 004
5	BASE SLAB-MID LIFT		- A 005
6	" SLAB-BOTTOM LIFT		- A 006
7	PAVEMENT DETAILS FOR HARDSTANDS		- A 007
8	GENERAL & SPECIAL DETAILS		- A 008
9	BASE STRUCTURE FLOOR PLANS		- A 009
10	SERVICE CORE FLOOR PLAN		- A 010
11	ROOM FINISH MATERIALS & COLOR SCHEDULE		- A 011
12	DOOR SCHEDULE & DETAILS		- A 012
13	BASE STRUCTURE & SERVICE CORE STAIR DETAILS		- A 013
14	ELEVATOR DETAILS		- A 014
15	ELEVATOR & MISCELLANEOUS DETAILS		- A 015
16	BASE STRUCTURE & SERVICE CORE PARTITION DET.		- A 016
17	" " " " " " "		- A 017
18	SERVICE CORE SHOP LAYOUTS		- A 018
19	GENERAL ARRANGEMENT	200GF - A 019	
20			
21			
22			

REVISIONS

NO.	DESCRIPTION	APPROVAL	ISSUED CEF	NO.	DESCRIPTION	APPROVAL	ISSUED CEF

EXHIBIT NO. G

MSFC/MTF - 178-2 (3-67)

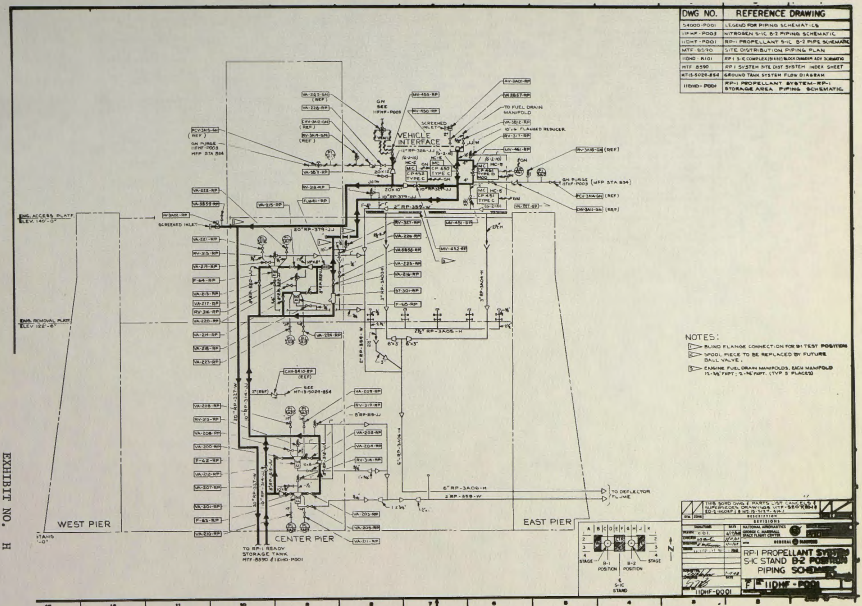

DWG NO. REFERENCE DRAWING
1H000-P001 LEGEND FOR PIPING SCHEMATICS
1H-P-P003 NITROGEN S-I, S-2 PIPING SCHEMATIC
1OH-P-P001 RP-1 PROPELLANT S-I, S-2 PIPE SCHEMATIC
MTF 8590 SITE DISTRIBUTION PIPING PLAN
1DH0 A101 RP-1 SYSTEM PIPING DISTRIBUTION ARRANGEMENT
MTF 8590 RP-1 SYSTEM SITE DISTRIBUTION INDEX SHEET
MTF-S-5009-854 GROUND TANK SYSTEM FUEL DRAINAGE
1DH0-P001 RP-1 PROPELLANT SYSTEM-RP-1 STORAGE AREA PIPING SCHEMATIC
VEHICLE INTERFACE
WEST PIER
CENTER PIER
EAST PIER
TO RP-1 REMOTE STORAGE TANK MTF-8590 # 1DH0-P001
TO DEFLECTOR FLAME
NOTES:
1. BLIND FLANGE CONNECTION FOR BI-TEST POSITION
2. SPOOL PIECE TO BE REPLACED BY FUTURE SHELL VALVE.
3. EXPAND FUEL DRAIN MANIFOLDS, EACH MANIFOLD (1-1/4" FIPT - 5-1/4" NPT,) TYP 2 PLACES
RP-1 PROPELLANT SYSTEM
S/C STAND B-2 POSITION
PIPING SCHEMATIC
1DH-P-P001

EXHIBIT NO. H

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER
MISSISSIPPI TEST FACILITY
BAY ST. LOUIS, MISSISSIPPI

PREPARED BY MTSD — GENERAL ELECTRIC

SORD PARTS LIST

TITLE: RP-I PROPELLANT SYS. S-IC TEST STAND POSITION B-2 PIPING SCHEMATIC

DRWG. NO.: PL-11DHF-P001

EO NO.: Sh 1 of 5

DRAWN:	CHECKED:	ENGINEER:	SUBMITTED:	APPROVED:	AUTHORITY:	ISSUED CEF:
CDI 4-18-68					AMEND 90	JUN 26 1968

PT. NO.	NAME	SORD DOC. NO. - PT. NO.	REFERENCE	QTY.
	VALVES, HAND		VA-200-RP 8"-VA-304	
	"		VA-201-RP 8"-VA-304	
	"		VA-202-RP 8"-VA-304	
	"		VA-203-RP 8"-VA-304	
	"		VA-204-RP 3/4"-VA-300	
	"		VA-205-RP 3/4"-VA-300	
	"		VA-206-RP 1/2"-VA-300	
	"		VA-207-RP 1/2"-VA-300	
	"		VA-208-RP 1/4"-VA-301	
	"		VA-209-RP 1/4"-VA-301	
	"		VA-210-RP 1/4"-VA-301	
	"		VA-211-RP 1/4"-VA-301	
	"		VA-212-RP 10"-VA-304	
	"		VA-213-RP 8"-VA-304	
	"		VA-214-RP 8"-VA-304	
	"		VA-215-RP 8"-VA-304	
	"		VA-216-RP 8"-VA-304	
	"		VA-217-RP 3/4"-VA-300	
	"		VA-218-RP 3/4"-VA-300	
	"		VA-219-RP 1/2"-VA-300	
	"		VA-220-RP 1/2"-VA-300	
	"		VA-221-RP 1/4"-VA-301	

REVISIONS

NO.	DESCRIPTION	APPROVAL	ISSUED CEF	NO.	DESCRIPTION	APPROVAL	ISSUED CEF

EXHIBIT NO. J

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER — MISSISSIPPI TEST FACILITY, BAY ST. LOUIS, MISSISSIPPI

PREPARED BY MTSD — GENERAL ELECTRIC

SORD PARTS LIST

WLG. TITLE: RP-1 PROPELLANT SYS. S-IC TEST STAND POSITION B-2 PIPING SCHEMATIC

DRWG. NO: PL-11DHF-P001

EO NO.: Sh 2 of 5

DRAWN:	CHECKED:	ENGINEER:	SUBMITTED:	APPROVED:	AUTHORITY:	ISSUED CEF:
CDI 4-18-68	W B Corbin	R Mckinnon	7-17-68		AMEND 90	JUL 0 0 1968

PT. NO.	NAME	SORD DOC. NO. - PT. NO.	REFERENCE		QTY.
	VALVES, HAND		VA-222-RP	1/4"-VA-301	
	"		VA-223-RP	1/4"-VA-301	
	"		VA-224-RP	1/4"-VA-301	
	"		VA-225-RP	10"-VA-304	
	"		VA-226-RP	1/2"-VA-300	
	"		VA-227-RP	1/2"-VA-300	
	"		VA-228-RP	1/2"-VA-300	
	"		VA-3A12-RP	3/8"-VA-JD	
	"		VA-3B57-RP	2"-VA-JL	
	"		VA-3B58-RP	3/4"-VA-JM	
	"		VA-3B59-RP	1/4"-VA-JN	
	VALVES, HAND		VA-3B71-RP	1/2"-VA-300	

REVISIONS

NO.	DESCRIPTION	APPROVAL	ISSUED CEF	NO.	DESCRIPTION	APPROVAL	ISSUED CEF

MSFC-MTF - 1745-S (6-67)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER
MISSISSIPPI TEST FACILITY
BAY ST. LOUIS, MISSISSIPPI

PREPARED BY MTSD — GENERAL ELECTRIC

SORD PARTS LIST

WING TITLE: RP-I PROPELLANT SYS. S-IC TEST STAND POSITION B-2 PIPING SCHEMATIC

DRWG. NO.: PL-11DHF-P001

EO NO.: Sh 3 of 5

DRAWN:	CHECKED:	ENGINEER:	SUBMITTED:	APPROVED:	AUTHORITY:	ISSUED CEF:
CDI 4-18-68					AMEND 90	JUL 26 196

PT. NO.	NAME	SORD DOC. NO. - PT. NO.	REFERENCE		QTY.
	VALVES, RELIEF		RV-313-RP	1/2"x 1" RV-DG	
	VALVES, RELIEF		RV-314-RP	1/2"x 1" RV-DG	
	"		RV-315-RP	1/2"x 1" RV-DG	
	"		RV-316-RP	1/2"x 1" RV-DG	
	"		RV-317-RP	1/2"x 1" RV-DG	
	"		RV-318-RP	1/2"x 1" RV-DG	
	"		RV-319-RP	1/2"x 1" RV-DG	
	VALVES, RELIEF		RV-327-RP	1/2"x 1" RV-DG	
	VALVES, MOTOR		MV-450-RP	10"-MV-ACO	
	"		MV-451-RP	2"-MV-ACO	
	"		MV-452-RP	10"-MV-ACO	
	"		MV-453-RP	12"-MV-ACO	
	VALVES, MOTOR	54B00-GM10-1 54B00-GM20-2	MV-461-RP	4"	

REVISIONS

NO.	DESCRIPTION	APPROVAL	ISSUED CEF	NO.	DESCRIPTION	APPROVAL	ISSUED CEF

MSFC-MTF-4 (1-67)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL MISSISSIPPI TEST FACILITY
SPACE FLIGHT CENTER BAY ST. LOUIS, MISSISSIPPI

PREPARED BY MTSO **GENERAL ELECTRIC** **SORD PARTS LIST**

WING TITLE: RP-1 PROPELLANT SYS. S-IC TEST STAND POSITION B-2 PIPING SCHEMATIC
DRWG. NO.: PL-11DHF-P001
ECO NO.:
Sh 4 of 5

DRAWN: CDI 4-18-68
CHECKED: W.B. Carter
ENGINEER: K.D. McEwen
SUBMITTED: 7-17-68
APPROVED:
AUTHORITY: AMEND 90
ISSUED CEF: JUL 26 196

PT. NO.	NAME	SORD DOC. NO. - PT. NO.	REFERENCE		QTY.
	FILTERS	54B00-GL20-1	F-62-RP	8"	
	"	54B00-GL20-1	F-63-RP	8"	
	"	54B00-GL20-2	F-64-RP	8"	
	FILTERS	54B00-GL20-2	F-65-RP	8"	
	STRAINER		ST-301-RP	10"-ST	
	FLOW METER		FIM-61-RP	10"	
	CONTROL PACKAGE		CP-450	TYPE C	
	"		CP-451	TYPE C	
	"		CP-452	TYPE C	
	CONTROL PACKAGE		CP-461	TYPE D (MODIFIED)	
	AIR VENT		AV-3A01-RP	2"-AV-A	
	AIR VENT		AV-3A02-RP	1/2"-AV-B	

REVISIONS

NO.	DESCRIPTION	APPROVAL	ISSUED CEF	NO.	DESCRIPTION	APPROVAL	ISSUED CEF

MSFC/MTF - 178-5 (6-67)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER
MISSISSIPPI TEST FACILITY
BAY ST. LOUIS, MISSISSIPPI

PREPARED BY MTSD — GENERAL ELECTRIC

SORD PARTS LIST

DRAWING TITLE: RP-1 PROPELLANT SYS. S-IC TEST STAND POSITION B-2 PIPING SCHEMATIC

DRWG. NO.: PL-11DHF-P001

ECO NO.: SH. 5 OF 5

DRAWN:	CHECKED:	ENGINEER:	SUBMITTED:	APPROVED:	AUTHORITY:	ISSUED CEF:
CDI 4-18-68	WB Corbin	K. McKenzie	[illegible]	[illegible]	AMEND 90	JUL 26

PT. NO.	NAME	SORD DOC. NO. - PT. NO.	REFERENCE	QTY.
	PRESSURE INDICATOR		PI-3A16-RP	
	"		PI-3A17-RP	
	"		PI-3A18-RP	
	"		PI-3A19-RP	
	"		PI-3A20-RP	
	"		PI-3A21-RP	
	"		PI-3A22-RP	
	PRESSURE INDICATOR		PI-3A23-RP	

REVISIONS

	DESCRIPTION	APPROVAL	ISSUED CEF	NO.	DESCRIPTION	APPROVAL	ISSUED CEF

MSFC/MTF - 178-R (6-67)

200DG-GM03
Specification No.

ISSUED/CEF OCT 22 1968
Rev, 1
NOV 18 1968

SPECIFICATION

FOR

PROCUREMENT OF

AIR CONDITIONING EQUIPMENT

FOR

S-II STAGE STORAGE ENCLOSURE

October 15, 1968

Prepared by: R. L. Morey, Jr.

General Electric Company
Mississippi Test Support Department
Bay Saint Louis, Miss.

Approved:

J. P. McCormick, Manager
Design Engineering

Submitted:

L. Terrey, Manager
Facilities Engineering

9/9/68
Quality Assurance Review

10-21-68
NASA, I-MT-SF

EXHIBIT NO. K

1.0 SCOPE:

1.1 This specification covers the type, size, and capacity requirements for air conditioning units to be used for the S-II Stage horizontal environmental storage enclosure.

2.0 APPLICABLE DOCUMENTS:

2.1 The following publications, of the latest issue, form a part of this specification.

a. American Society of Heating, Refrigeration and Air Conditioning Engineers.

Guide and Data Book, Systems and Equipment

b. Air Moving and Conditioning Association.

Bulletin No. 210 Standard Test Code for Air Moving Devices

c. American Refrigeration Institute.

Standard No. 210 Standard for Unitary Air Conditioning Equipment

d. USAS Standards.

Standard B9.1 Safety Code for Mechanical Refrigeration

e. National Electrical Code

3.0 GENERAL DESCRIPTION:

3.1 The air conditioners shall be split-system types consisting of factory fabricated and assembled air handler and condensing unit combinations for installation by the buyer.

3.2 The equipment to be provided shall be standard products of vendors regularly engaged in the manufacture of such products. The general desired arrangement is shown on Sketch #1.

4.0 TECHNICAL REQUIREMENTS:

4.1 AIR HANDLING EQUIPMENT

4.1.1 General

Air handling unit shall be a factory fabricated and assembled unit. The unit shall be a floor mounted horizontal draw thru type complete with insulated casing, water proof drain pan, direct expansion cooling coil, fan motor, belt drives, belt guards, mixing box and vibration isolation supports. The unit shall operate from 440 volt, 3 phase, 60 cycle power.

4.1.2 Casing

Casing shall be constructed of not lighter than 18 gage steel treated inside with rust inhibitor. Drain pans shall be of not lighter than 16 gage steel, waterproofed by coating with a noncombustible waterproofing material. Casing shall be insulated at the factory acoustically and thermally, and internally with not less than 1" thick - 3/4 density semi-rigid fibrous-glass insulation material. Drain pan shall be insulated at the factory with not less than ½" thick cellular rigid foam insulation material. Access doors or removable panels shall be provided in each casing section with same insulation as casing.

4.1.3 Direct Expansion Coil

Direct expansion coils shall be fin-and-tube type constructed of seamless copper tubes and copper or aluminum fins mechanically bonded to tubes. Casing shall be not lighter than 16 gage galvanized steel. Suction header shall be seamless copper tubing. Supply header shall distribute the refrigerant liquid through seamless copper tubing, to all circuits in the coil equally. Tubes shall be circuited to insure minimum pressure drop and maximum heat transfer. Circuiting shall provide downward flow from liquid inlet to suction outlet. Each coil shall be tested at the factory under water at not less than 300 psi air pressure and shall be suitable for 250 psi working pressure. Each coil shall be completely dehydrated and sealed at the factory upon completion of pressure tests.

4.1.4 Fans

Fans shall be double width-double inlet centrifugal type. Fans shall be statically and dynamically balanced at the factory after fan assembly. Fans shall be mounted on steel shaft, ground and polished, and supported in ball type bearings provided with lubrication facilities outside of the unit or permanently lubricated ball type bearings. Fans and scrolls shall be furnished with an approved rush-inhibitor treatment. Fans shall be driven by a unit-mounted motor connected to fans by V-belt drive complete with belt guard. Belt drives shall be designed for not less than 150 percent of the connected motor capacity, and sheaves shall be adjustable to provide not less than 20 percent speed variation from design point. Fan motors shall have open drip-proof enclosures. Fan tip speed and outlet velocity shall not exceed the recommendations of ASHRAE Guide. Fans shall be tested at the factory and rated in accordance with AMCA Standards.

4.1.5 Mixing Box

A combination filter-mixing box shall be furnished by the unit manufacturer. Filters to be 2" steel type permanent high velocity filters snugly mounted in steel tracks to prevent air by-pass. Access doors shall be provided on each end of the unit. Dampers shall be opposed blade with extended shafts for manual or modulating control. Dampers shall be locked to steel rods which rotate on nylon bushings. Air inlets shall be at rear & top. With each unit a magnelhelic pressure gage with a 0 to 0.5 inch w.g. range shall be furnished. The complete unit shall be suitable for attaching directly to air handler.

4.2 AIR COOLED CONDENSING EQUIPMENT

4.2.1 General

All condensing unit components shall be factory assembled on a common base. Unit shall be completely weatherproofed and include; hermetic compressor(s), condensor coil, fan(s) and motor(s), refrigerant reservoir, charging valves, all controls, and holding charge of R-22. Unit must comply with ARI Standard 210. The units shall operate on 440 volt, 3 phase, 60 cycle power.

4.2.2 Cabinet

Unit casing shall be constructed of a weather and corrosion protected steel, finished with a factory baked on enamel. Condenser coil shall be protected by a guard. Unit shall have mounting rails and casing shall be provided with drain holes.

4.2.3 Condenser Fan(s)

Fan(s) shall be upflow, direct drive, propeller type, statically and dynamically balanced. Fan motors shall be permanently lubricated, permanently split capacitor type for all weather service.

4.2.4 Compressor(s)

The compressors shall be hermetic sealed types, capable of operating at partial load conditions without vibration, and shall be capable of continuous operation under all load conditions. Each compressor shall be provided with high-low pressure safety cut-offs, and crankcase heaters.

4.2.5 Condensing Coil(s)

Condensor coils shall be copper with mechanically bonded aluminum fins. Coil shall be factory pressure and leak tested to assure tightness at pressures no less than 400 psig.

4.2.6 Controls

Controls shall include automatically resetting internal overload protection for all motors, high and low pressure controls, internal compressor winding thermostat, non-recycling relay, and 24 volt transformer & control circuit.

4.2.7 Accessories

Accessories shall include a filter drier (standard or same units), refrigerant sight glass and moisture indicator, liquid line solenoid valve, and any other device deemed necessary by the manufacturer to satisfactorily complete the installation and assure the operation of the unit.

4.3 REHEAT COILS

4.3.1 Construction

Electric duct heaters shall have 80% nickel, 20% chromium resistance coils, insulated by floating ceramic bushings & supported in an aluminized steel frame. Bushings shall be recessed into embossed openings & staked into supporting brackets spaced 3½" maximum center-to-center. Coils shall be machine-crimped into stainless steel terminals, and insulated with phenolic bushings. Heater shall be listed by the Underwriters Laboratories for zero clearance to combustible surfaces.

4.3.2 Type

Heater casing shall be slip-in type for installation through the side of the air handling unit.

4.3.3 Protection

Bulb and capalliary type thermal cutouts shall be furnished for primary and secondary protection.

4.3.4 Electrical

Heater shall be 440 volt, 3 phase, 25 kw, with 4 heating stages. Three phase heaters to have equal, balanced three phase circuits. Circuits to be rated at 40 amps maximum. Heater shall be tested dielectrically at 2000 volts before shipment. Heater shall be sized to fit as closely as possible to fit the opening in the air handling unit with appropriate block-offs to prevent air by-pass. The heaters shall be approved by the Underwriters Laboratory and shall meet the requirements of the National Electrical Code.

4.3.5 Built-in Accessories

Built-in components shall be factory-wired to terminal blocks for field connection. All internal wiring shall be suitable for 105 degrees C.

a. Magnetic contactors shall disconnect all ungrounded conductors.

b. Control transformer shall be dry industrial type, sized to carry the full contactor holding coil load.

c. Fuses shall be provided in each circuit to protect all ungrounded conductors. Line side of all fuses to be factory wired to a common terminal block. Type NON or NOS fuses to be factory installed in phenolic fuse blocks.

4.3.6 Special Constructions

Insulated terminal box to have ½" asbestos millboard sandwiches between two pieces of sheet metal. Side-mounted terminal box cover to be provided on right-hand side facing direction of air flow.

4.4 CAPACITIES:

4.4.1 The air conditioning system covered by this specification requires a total nominal rating of 20 tons. The values listed below are based on meeting this requirement with two, 10 ton units, each complete in itself.

Cooling Capacity

127,300	BTU/HR	Total Capacity
102,400	BTU/HR	Sensible Capacity
24,900	BTU/HR	Latent Capacity

Air Capacity

3250	CFM	Total Air
325	CFM	Outside Air

Reheat Coil Capacity

25	KW	Total
6.25	KW	Per Stage

Cooling Coil Data

95 degrees F	Ambient
88 degrees F	EDB
69.5 degrees F	EWB
59 degrees F	LDB
57 degrees F	LWB

5.0 SUBMITTALS:

5.1 DRAWINGS

The Contractor shall submit to the Purchaser six (6) sets of drawings and/or data sheets showing capacity, arrangement, construction details and recommended spare parts for approval. The Contractor shall not proceed with fabrication before approval of the drawings. Following final approval, the Contractor shall furnish the Purchaser three (3) certified prints of all drawings.

5.2 DOCUMENTS

The Contractor shall provide the Purchaser with three (3) copies of maintenance and operating manuals for all equipment plus descriptive material on purchased components.

6.0 QUALITY ASSURANCE PROVISIONS:

6.1 CERTIFICATIONS

6.1.1 Where materials or equipment are specified to be constructed, tested, or approved in accordance with standards of specified agencies, the equipment shall have the agency's stamp or label as evidence of conformance. In lieu of such a stamp or label, a certificate or published statement by the manufacturer that the equipment or material meets required standards or tests will be accepted.

6.2 MARKING

6.2.1 Each major component shall have the manufacturer's name, address, catalog, model, or drawing number, and other appropriate data such as size, capacity, pressure, electrical rating, etc. clearly shown. The data shall be applied by etching, metal stamping, or nameplates. Nameplates shall be made of aluminum or corrosion resistant steel.

7.0 GUARANTY:

7.1 All equipment to be furnished under this specification shall be guaranteed against defective materials, design, and workmanship for a period of one year from date of final acceptance. Upon receipt of notice from the Purchaser of the failure of any part or equipment, under the conditions of guaranty during the guaranty period, new replacement parts shall be furnished and installed promptly by the Contractor at no additional cost to the Purchaser. The Contractor shall acknowledge his responsibility under these guaranty provisions by letter, stating that the equipment and materials referred to herein are guaranteed and the inclusive dates of the guaranty period.

GENERAL ARRANGEMENT
SKID MOUNTED, 10 TON, AIR CONDITIONING UNIT
FOR
SII STAGE, HORIZONTAL STORAGE ENCLOSURE
SPECIFICATION 200DG-GM03

SKETCH 1

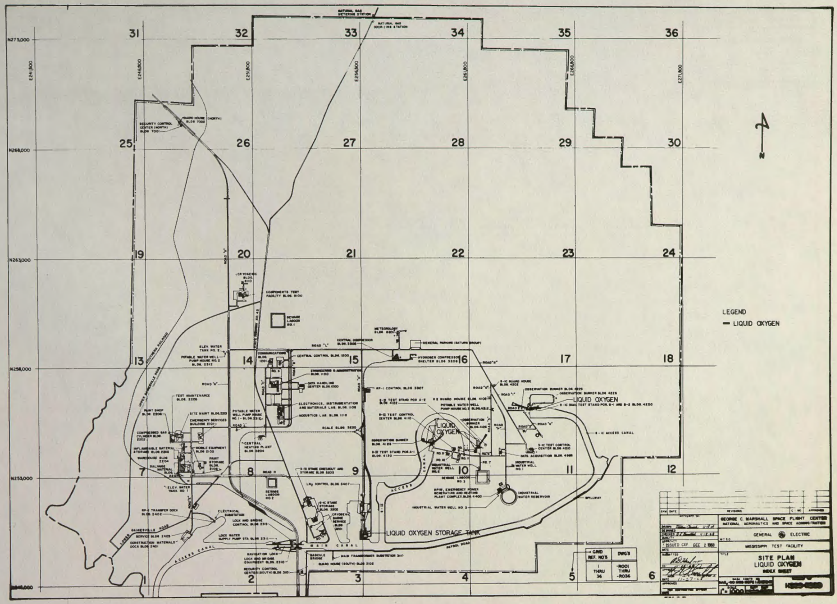
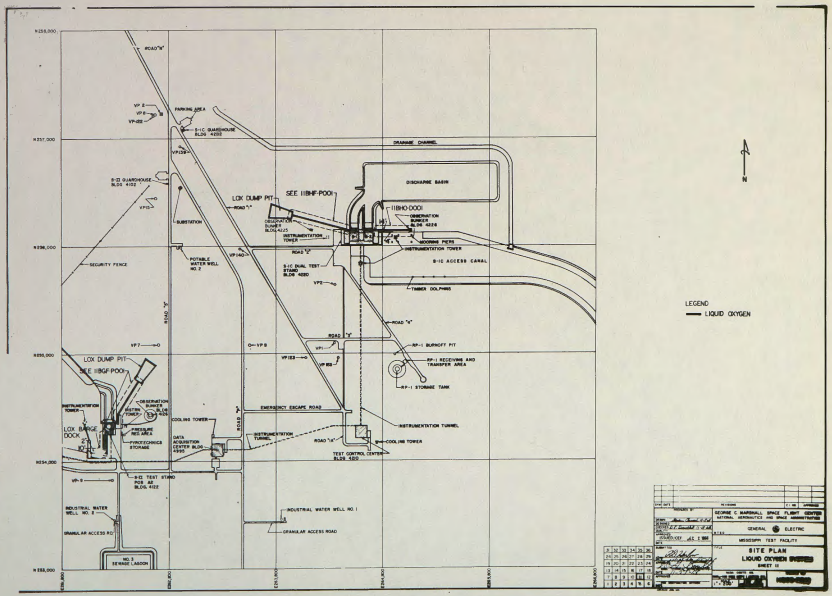

LEGEND
LIQUID OXYGEN
LIQUID OXYGEN STORAGE TANK
LIQUID OXYGEN
GEORGE C. MARSHALL SPACE FLIGHT CENTER
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GENERAL ELECTRIC
MISSILE TEST FACILITY
SITE PLAN
LIQUID OXYGEN
MAY 1967
MSFC-MERC

EXHIBIT NO. L

EXHIBIT NO. M


LEGEND
LIQUID OXYGEN
SITE PLAN
LIQUID OXYGEN (HYDS)
SHEET 11
GEORGE C MARSHALL SPACE FLIGHT CENTER
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GENERAL ELECTRIC
MISSISSIPPI TEST FACILITY
LOX DUMP PIT
SEE 119HP POOL
SEE 119UP POOL
LOX BARGE DOCK
SEE 119HO POOL
DRAINAGE CHANNEL
DISCHARGE BASIN
SECURITY FENCE
SUBSTATION
ROTABLE WATER WELL NO. 2
INDUSTRIAL WATER WELL NO. 2
INDUSTRIAL WATER WELL NO. 1
GRANULAR ACCESS RD
EMERGENCY ESCAPE ROAD
COOLING TOWER
TIMBER DOLPHINS
MOORING PIERS
INSTRUMENTATION TOWER
INSTRUMENTATION TUNNEL
TEST CONTROL CENTER BLDG 4220
B-1C ACCESS CANAL
B-1C GUARDHOUSE BLDG 4222
B-2D GUARDHOUSE BLDG 4232
B-1C BURNOFF PIT
B-1C RECEIVING AND TRANSFER AREA
B-1C STORAGE TANK
B-1C DUAL TEST STAND BLDG 4230
B-2C TEST STAND BLDG 4122
PARKING AREA A
PARKING AREA B
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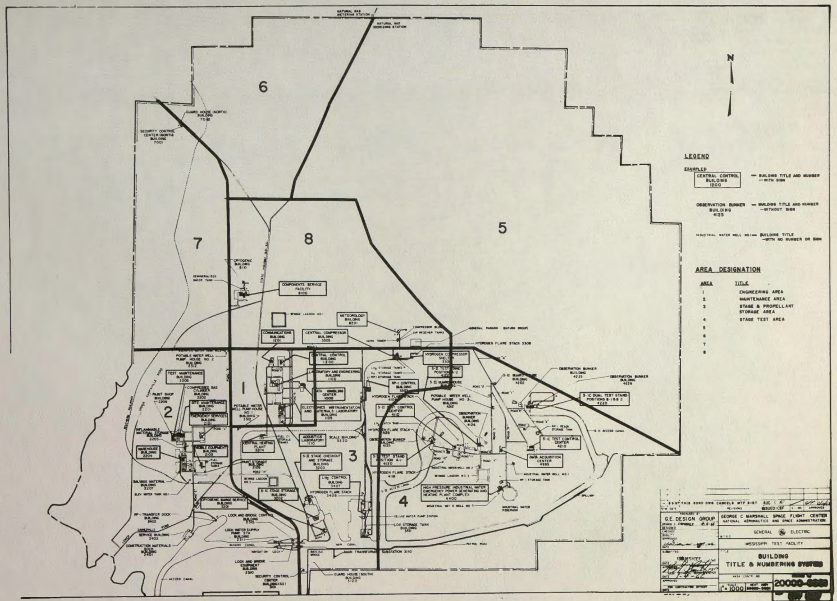
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LEGEND
CENTRAL CONTROL BUILDING 1800
BUILDING TITLE AND NUMBER — WITH DSN
OBSERVATION BUNKER BUILDING 4120
BUILDING TITLE AND NUMBER — WITHOUT DSN
BUILDING TITLE — WITH NO NUMBER OR DSN
AREA DESIGNATION
AREA TITLE
1 ENGINEERING AREA
2 MAINTENANCE AREA
3 STAGE & PROPELLANT STORAGE AREA
4 STAGE TEST AREA
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GE DESIGN GROUP
GEORGE C MARSHALL SPACE FLIGHT CENTER
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GENERAL ELECTRIC
MISSISSIPPI TEST FACILITY
BUILDING
TITLE & NUMBERING SYSTEM
20000-320

EXHIBIT NO. N

1. DESCRIPTION

LOUDSPEAKER ASSEMBLY, WEATHERPROOF, BI-ACOUSTIC IS A SELF CONTAINED HORN SYSTEM WITH A 30WATT DRIVER AND A 70.7 VOLT LINE TRANSFORMER HAVING POWER TAPS OF 3.75 TO 15 WATTS IN A WEATHER-PROOF JUNCTION BOX AT REAR OF HORN. HORN IS CO-AXIAL, BI-ACOUSTIC HAVING A FOLDED LOW FREQUENCY LENGTH OF NOT LESS THAN 36", AND A STRAIGHT HIGH FREQUENCY LENGTH OF AT LEAST 14"; OF 3/16" MOLDED FIBER GLASS CONSTRUCTION HAVING A RECTANGULAR CROSS SECTION SECTION.

2. SERVICE

LOUDSPEAKER ASSEMBLY IS USED IN ORAL WARNING SYSTEM OF S-IC, S-II, AND SITE-WIDE.

3. VOLTAGE

LOUDSPEAKER ASSEMBLY: OPERATES FROM A 70.7 VOLT AUDIO LINE, WITH CONSTANT POWER LEVELS OF 3.75 TO 15 WATTS.

4. INSTALLATION ENVIRONMENT

EXTERIOR OR INTERIOR ENVIRONMENT. NOT ACCEPTABLE FOR CLASS I, GROUP I, DIVISION "B" OR "D" AREAS.

5. DESIGN REQUIREMENTS

A. HORN AND DRIVER:
- (1) THE LOUDSPEAKER HORN SYSTEM SHALL BE A TWO-WAY CO-AXIAL TYPE USING BI-ACOUSTIC SOUND DISTRIBUTION.
- (2) THE LOW FREQUENCY HORN SHALL BE FOLDED AND NOT LESS THAN 36" TOTAL LENGTH. THE HIGH FREQUENCY HORN SHALL BE STRAIGHT AND AT LEAST 14" LONG.
- (3) SOUND DISTRIBUTION SHALL BE UNIFORM OVER A 70° HORIZONTAL AND A 40° VERTICAL FIELD.
- (4) SOUND PRESSURE LEVEL AT 30 FEET WITH 30 WATT INPUT SHALL BE 100 DB.
- (5) THE FREQUENCY RESPONSE SHALL BE UNIFORM FROM 175 TO 12,000 HZ, WITH A CONTINUOUS POWER CAPABILITY OF 30 WATTS.
- (6) THE DRIVING ELEMENT SHALL BE OF ALNICO V MAGNET STRUCTURE, AND AN ALUMINUM VOICE COIL WITH A RIGID PHENOLIC DIAPHRAGM, HAVING AN 8 OHM IMPEDANCE.
- (7) THE WEATHERPROOF ENCLOSURE FOR THE DRIVER SHALL HAVE SPACE AVAILABLE AND MOUNTING PROVISIONS FOR THE LINE TRANSFORMER.
- (8) A UNIVERSAL BRACKET FOR MOUNTING TO A BUILDING OR A POLE SHALL BE FURNISHED.

ASSEMBLY SHALL BE EQUIVALENT TO ALTEC LANSING P/N 50A.

B. LINE TRANSFORMER:
- (1) WILL OPERATE FROM A 70.7 VOLT LINE GIVING POWER LEVELS OF 3.75, 7.5 AND 15 WATTS INTO A SPEAKER LOAD OF 8 OHMS.
- (2) WILL HAVE A FREQUENCY RESPONSE OF 200 TO 15,000 HZ ± 2 DB.
- (3) WILL HAVE INSERTION LOSS OF 0.6 DB MINIMUM.

SHALL BE EQUIVALENT TO ALTEC LANSING P/N 15075A.

6. TERMINALS

WIRE PIGTAILS ON LINE TRANSFORMER.

7. BASIC COMPONENTS

A. HORN ASSEMBLY WITH DRIVER: ALTEC LANSING P/N 50A.

B. LINE TRANSFORMER: ALTEC LANSING P/N 15075A.

8. DIMENSIONS

SEE SHEET NO. 3.

THIS SORD DWG SUPERSEDES AETRON EDS LSP-D AND LEAR SIEGLER EDS 13LSP-D.

SYM	ZONE	DESCRIPTION	DATE	APPROVED
		REVISIONS		

SIGNATURES	DATE	NATIONAL AERONAUTICS	SPACE ADMINISTRATION
DRAWN	10/16/68	GEORGE C. MARSHALL SPACE FLIGHT CENTER	MISSISSIPPI TEST FACILITY BAY ST. LOUIS, MISS.
CHECKED	10/29/68	MTSD	GENERAL ELECTRIC
ENGINEER	10/31/68		
ISSUED ICEF	NOV 13 1968	LOUDSPEAKER ASSEMBLY WEATHERPROOF, BI-ACOUSTIC	
SUBMITTED	10-29-68		
APPROVED	11-12-68	SIZE: A	DWG. NO.: 53B00-GS02
USED ON	53B00-D001	AUTHORITY: NAS-410 MOD. MSFC-1 AMEND. 90	SHEET: 1 OF 3

8-41

EXHIBIT NO. O

9. APPROVED SOURCE AND PART NO. (OR EQUIVALENT)

LTV LING-ALTEC INC.
1515 S MANCHESTER AVE.
ANAHEIM, CALIF. 92802
CODE IDENT. NO. 05614

UNIVERSITY SOUND
9500 W. RENO AVE.
OKLAHOMA CITY, OKLA. 73126
CODE IDENT. NO. 87771

ELECTRO VOICE INC.
600 CECIL ST.
BUCHANAN, MICH. 49107
CODE IDENT. NO. 81134

SEE SECTION 7 FOR ORIGINAL VENDOR PART NUMBERS.

10. OTHER REQUIREMENTS

MANUFACTURER SHALL IDENTIFY FINAL ASSEMBLY WITH 53B00-GS02 IN A MANNER SELECTED BY THE MANUFACTURER AND LOCATED IN SUCH A MANNER AS TO BE EASILY READ BUT NOT DETRIMENTAL TO THE APPEARANCE OF THE UNIT.

8-42

REFER TO SHEET NO. 1

SYM	ZONE	DESCRIPTION	DATE	APPROVED

REVISIONS

SIGNATURES	DATE
DRAWN	10/24/68
CHECKED	10/24/68
ENGINEER	10-31-68
ISSUED	ISSUED: NOV 13 1968
SUBMITTED	10-31-68
APPROVED	11-1-68
USED ON	53B00-D001

NATIONAL AERONAUTICS
GEORGE C. MARSHALL SPACE FLIGHT CENTER

SPACE ADMINISTRATION
MISSISSIPPI TEST FACILITY
BAY ST. LOUIS, MISSISSIPPI

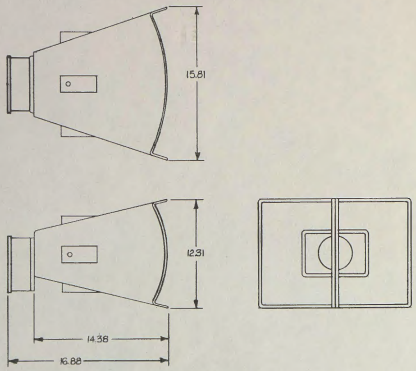
MTSD GENERAL ELECTRIC

LOUDSPEAKER ASSEMBLY
WEATHERPROOF, BI-ACOUSTIC

SIZE	DWG. NO.	REV.
	53B00-GS02	

AUTHORITY: NASw-410 MOD.
SHEET: 2 OF 3

MEFC-1 AMEND. 90



NOTES

1. ALL DIMENSIONS IN INCHES UNLESS OTHERWISE SHOWN.
2. ALL DIMENSIONS ARE REFERENCE FOR IDENTIFICATION PURPOSE ONLY

REFER TO SHEET NO. 1

SYM.	ZONE	DESCRIPTION	DATE	APPROVED

REVISIONS

SIGNATURES	DATE
DRAWN: J. Doughit	10-30-68
CHECKED: W. Bell	10-31-68
ENGINEER: Wells	10-31-68
ISSUED: CEF NOV 13 1968	
SUBMITTED:	10-11-68
APPROVED:	10-12-68
USED ON: 53B00-D001	

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER
MISSISSIPPI TEST FACILITY
BAY ST. LOUIS, MISSISSIPPI

MTSO GENERAL ELECTRIC

LOUDSPEAKER ASSEMBLY WEATHERPROOF, BI-ACOUSTIC

SIZE | DWG. NO. 53B00-GS02 | REV.

AUTHORITY NAS-M-410 MOD MSFC-1 | SHEET 3 OF 3

AMEND. 90