NOTICE: WHEN ENGINEERING DRAWINGS, SPECIFICATIONS, OR OTHER DATA ARE USED FOR ANY PURPOSE OTHER THAN IN CONNECTION WITH A DEFINITELY RELATED GOVERNMENT PROCUREMENT OPERATION, THE UNITED STATES GOVERNMENT THEREBY INCURS NO RESPONSIBILITY NOR ANY OBLIGATION WHATSOEVER; AND THE FACT THAT THE GOVERNMENT MAY HAVE FORMULATED, FURNISHED, OR IN ANY WAY SUPPLIED THE SAID DRAWINGS, SPECIFICATIONS, OR OTHER DATA IS NOT TO BE REGARDED BY IMPLICATION OR OTHERWISE AS IN ANY MANNER LICENSING THE HOLDER OF ANY OTHER PERSON OR CORPORATION, OR CONVEYING ANY RIGHTS OR PERMISSION TO MANUFACTURE, USE, OR SELL ANY PATENTED INVENTION THAT MAY IN ANY WAY BE RELATED THERETO.

PART No.	REF	REVISIONS			
		ZONE	SYM	DESCRIPTION	DATE	APPROVAL
			-		- - -

GENERAL NOTES (UNLESS OTHERWISE SPECIFIED)

1. REMOVE ALL BURRS AND BREAK ALL SHARP EDGES.
2. FIELD TO VERIFY ALL TIE-IN CONNECTIONS.
3. ALL PIPE SIZES AND SCHEDULES SHALL CONFORM TO THE DIMENSIONS OF ANSI-B36.10 OR ANSI-B36.19.
4. ALL FITTINGS SHALL CONFORM TO THE DIMENSIONS OF ANSI-B16.9 OR ANSI-B16.28.
5. ALL PIPE FLANGES SHALL CONFORM TO THE DIMENSIONS AND PRESSURE - TEMPERATURE RATINGS OF ANSI-B16.5
6. ALL RING-JOINT GASKETS AND GROOVES FOR PIPE FLANGES SHALL CONFORM TO THE DIMENSIONS OF ANSI-B16.20.
7. ALL NON-METALLIC FLAT GASKETS FOR PIPE FLANGES SHALL CONFORM TO THE DIMENSIONS OF ANSI-B16.21.
8. ALL BEVELS FOR BUTTWELDING ENDS OF PIPE FITTINGS, FLANGES, VALVES, AND COMPONENTS SHALL CONFORM TO ANSI-B16.25.
9. ALL SCREW THREADS SHALL CONFORM TO THE "UNIFIED INCH SCREW THREADS" STANDARD ANSI-B1.1.
10. ALL PIPE THREADS (EXCEPT DRYSEAL) SHALL CONFORM TO ANSI-B2.1.
11. ALL PIPE FLANGE BOLT HOLES SHALL STRADDLE THE CENTERLINE OF THE PIPE.
12. ALL MACHINED PARTS TO HAVE A 125 MICROINCH ROUGHNESS HEIGHT RATING SURFACE FINISH.
13. ALL PIPING SHALL BE IDENTIFIED AND COLOR CODED PER MIL-STD-101.
14. ALL PIPING SYSTEMS SHALL BE HYDROSTATED TO 1.5 TIMES THE WORKING PRESSURE OF THE SYSTEM PER ANSI-B31.3.
15. ALL PIPING SYSTEMS SHALL BE WELDED PER ANSI-B31.3.
16. ALL PIPING SYSTEMS SHALL BE DESIGNED PER ANSI-B31.3.
17. ALL CARBON STEEL PIPE AND CARBON STEEL SUPPORTING STRUCTURE SHALL BE FINISHED AND PAINTED PER PARAGRAPHS 4.1 AND 21.9 OF MIL-STD-171. PAINT COLOR TO BE BATTLESHIP GRAY, NUMBER 26440 OF FED-STD-595.
18. ALL STEEL SUPPORTING STRUCTURE SHALL BE DESIGNED IN ACCORDANCE WITH THE AISC REQUIREMENTS.
19. ALL STRUCTURAL STEEL SHAPES SHALL CONFORM TO THE DESIGNATIONS AND DIMENSIONS OF THE AISC "STEEL CONSTRUCTION MANUAL".
20. ALL CARBON STEEL STRUCTURE SHALL BE WELDED AND 100% VISUALLY INSPECTED IN ACCORDANCE WITH THE "STRUCTURAL WELDING CODE", AWS D1.1, FOR THE DESIGN OF NEW BUILDINGS.
21. ALL STEEL PIPE SUPPORTS SHALL BE WELDED AND 100% VISUALLY INSPECTED PER ANSI-B31.1.
22. ANY STAINLESS STEEL PIPING SUPPORTS OR ANCHORS THAT ARE WELDED TO A STAINLESS STEEL PIPING SYSTEM SHALL BE OF A LOW CARBON CONTENT STAINLESS STEEL MATERIAL ("L" GRADE).
23. SYSTEM OPERATING PRESSURE TO BE 100 PSIG.
24. ALL SST STRUCTURAL WELDS SHALL CONFORM TO MSFC-SPEC-560, CLASS IV, WELDING, STEELS, CORROSION & HEAT RESISTANT ALLOYS.
25. STEEL WELDING, INCLUDING WELDING PROCEDURES & WELDER QUALIFICATION, SHALL BE IN ACCORDANCE WITH AWS "STRUCTURAL WELDINGCODE", ANSI/AWS D1.1-84, INCLUDING SECTION 8 FOR NEW BUILDINGS.

SPECIFIC NOTES

26. **MATERIAL SPECIFICATIONS FOR CARBON STEEL PIPING SYSTEMS**

PIPE:	ASTM-A106-GR.B C.S. - SEAMLESS
PIPE FLANGES:	ASTM-105 C.S.
PIPE FITTINGS:	ASTM-234-GR.B C.S.
HEXAGON NUTS:	ASTM-A194-GR.2H C.S.
STUD BOLTS:	ASTM-A193-B7 C.S.
RING GASKETS:	OCTAGONAL CROSS SECTION, 1/2% MOLYBDENUM 5% CHROME, BRINNEL HARDNESS OF 131 MAXIMUM.
GRAYLOC HUBS:	ASTM-A105-GR.11 C.S.
GRAYLOC SEAL RINGS:	CARBON STEEL, TEFLON COATED.
GRAYLOC CLAMPS:	ASTM-A266-C1-111 C.S.
BAR STOCK:	ASTM-A36 C.S.
WELDOLET:	ASTM-A105-G2 C.S.

27. **MATERIAL SPECIFICATIONS FOR STAINLESS STEEL PIPING SYSTEMS**

PIPE:	ASTM-A312-TP304L SST. - SEAMLESS
PIPE FITTINGS:	ASTM-A403-WP304L SST.
PIPE FLANGES:	ASTM-A182-F304L SST.
STUD BOLTS:	ASTM-A193-B8 SST.
HEXAGON NUTS:	ASTM-A194-GR.8 SST.
RING GASKETS:	OCTAGONAL CROSS SECTION, STAINLESS STEEL. TYPE 304 (18 CR - 8NI), BRINELL HARDNESS OF 160 MAXIMUM.
GRAYLOC HUBS:	ASTM-A182-F316L SST.
GRAYLOC SEAL RINGS:	STAINLESS STEEL, 17-4PH, TEFLON COATED.
GRAYLOC CLAMPS:	ASTM-A182-F304 SST.
TUBE AND TUBE FITTINGS:	TYPE 304 OR 316 SST.
BAR STOCK:	AISI-304L SST.
WELDOLET:	ASTM-A182F 304L SST.

MATERIAL SPECIFICATIONS FOR PIPE SUPPORTS AND SUPPORTING STRUCTURE

28. **CARBON STEEL MATERIAL**

HEX HEAD BOLTS:	ASTM-A325 C.S.
HEX NUTS:	ASTM-A325 C.S.
WASHERS:	ASTM-F436 C.S.
PLATE:	ASTM-A36 C.S.
BAR STOCK:	ASTM-A36 C.S.
STRUCTURAL SHAPES:	ASTM-A36 C.S.
PIPE:	ASTM-A53-GR.B C.S.

29. **STAINLESS STEEL**

HEX HEAD BOLTS:	ASTM-A320-B8 SST.
HEX NUTS:	ASTM-A194-GR.8 SST.
PLATE:	AISI-304L SST.
BAR STOCK:	AISI-304L SST.
PIPE:	ASTM-A312-TP304L SST.

SPECIFIC NOTES

LIQUID OXYGEN AND GASEOUS OXYGEN SYSTEMS

30. FLAT GASKET MATERIAL: GYLON
31. ALL PIPING SYSTEM GIRTH WELD JOINTS SHALL BE 100% VISUALLY AND 10% RADIOGRAPHICALLY EXAMINED PER ANSI-B31.3.
32. THE PIPING SYSTEM SHALL BE CLEANED FOR LIQUID OXYGEN SERVICE PER MSFC-SPEC-164A.
33. ALL MATERIAL IN CONTACT WITH LOX OR GOX SHALL BE COMPATIBLE AS DETERMINED BY NHB-8060.1C.
34. O-RING SEAL GASKET MATERIAL: TEFLON

GASEOUS NITROGEN AND AIR SYSTEM

35. FLAT GASKET MATERIAL: CRANITE OR EQUAL
36. ALL PIPING SYSTEM GIRTH WELD JOINTS SHALL BE 100% VISUALLY AND 10% RADIOGRAPHICALLY EXAMINED PER ANSI-B31.3.
37. THE PIPING SYSTEM SHALL BE CLEANED FOR PNEUMATIC SERVICE PER MSFC-SPEC-164A.

WATER SYSTEMS (REF. DWG. # 90M09266)

38. FLAT GASKET MATERIAL: CRANITE OR EQUAL
39. DETERGENT FLUSH THE PIPING SYSTEM.
40. ALL PIPING SYSTEM GIRTH WELD JOINTS SHALL BE 100% VISUALLY INSPECTED PER ANSI-B31.3.

SPECIFIC NOTES

41. TOP ROLLER TO BE INSTALLED IN FIELD
42. BOSS TO BE STAMPED WITH 1/8" HIGH LETTERS AS FOLLOWS: "SCH. 5S,10S,40S & STD. WT. ONLY".
43. DO NOT DRILL 11/16" DIAM. HOLES IN THE 1/2" PLATE FOR THIS DETAIL NUMBER ONLY.
44. FIELD LOCATE AND DRILL 9/16" DIAM. HOLES IN THE 1/2" PLATE AS REQUIRED FOR THE U-BOLT CONNECTION THROUGH THE EXISTING GRATING.
45. FIELD LOCATE AND DRILL 11/16" DIAM. HOLES IN THE 24 X 13 X 1/2" PLATE AS REQUIRED FOR THE U-BOLT CONNECTION THROUGH THE EXISTING GRATING.
46. VACUUM JACKET INTEGRITY MUST BE REINSTATED AFTER CUTTING.
47. DO NOT REMOVE PRECOMPRESSION BARS ON BELLOWS BEFORE INSTALLATION.
48. REMOVE EXISTING BURST DISK.

REFERENCE DRAWINGS USED

TECHNOLOGY TEST BED SCHEMATIC FOR LOX STORAGE
DWG. #90M09251

WEST TEST AREA LOX STORAGE BATTERY
DWG. #90M03862

TECHNOLOGY TEST BED STAND DRAWINGS
DWG. #FAC-M-4670-XX

LOX TANK DRAWINGS BY CRYO-SONICS,INC.
DWG. #5593-XX

SATURN STATIC TEST STAND DRAWINGS BY AETRON INC.
DWG. #R-11682

SUGGESTED VENDORS

1. ITT GRINNELL
645 NORTHSIDE DR.NW
ATLANTA,GA. 30302
(404)524-6201

2. CRYOSONICS,INC.
300 EAST DEVON AVENUE
BARTLETT,IL. 60103
(312)837-1811

FIND NO.	SHEET NO.	CODE LTR.	NO. REQ'D	PART NO.	DESCRIPTION	VEND. NO.	REMARKS
099	3&9	E	1		TRANSFER LINE SPOOL		
098	3&9	E	1		TRANSFER LINE SPOOL		
097	14	S	6		3/4" WASHER		C.S.
096	14	S	6		3/4" HEAVY HEX NUT		C.S.
095	14	S	6		3/4" BOLT, 3-3/4" THREAD LENGTH		C.S.
094	14	S	5		3/4" STUD, 5-1/2" LG.		304L SST
093	13&14	S	8		1/2" X 3-1/2" U-BOLT W/NUTS, THREAD LENGTH=4.25"	1	GRINNELL FIG.137S OR EQUAL, C.S.
092	13	S	5		1/2" X 3-1/2" U-BOLT W/NUTS	1	GRINNELL FIG.137 OR EQUAL, C.S.
091	11&12	S	10		1/2" HEAVY HEX BOLT, 3" THREAD LENGTH		C.S.
090	11&12	S	16		1/2" WASHER		C.S.
089	11&12	S	16		1/2" HEAVY HEX NUT		C.S.
088	11	S	6		1/2" HEAVY HEX BOLT, 2" THREAD LENGTH		
087	10&13	S	18		3/8" X 2" U-BOLT W/NUTS	1	GRINNELL FIG.137 OR EQUAL
086	10	S	10		7/8" CONTINUOUS THREADED ROD, 19" LG.	1	GRINNELL FIG.146 OR EQUAL
085	10	S	10		SIZE 10 PIPE ROLLER, ZINC COATED	1	GRINNELL FIG.173 OR EQUAL
084	10	S	40		7/8" WASHER		
083	10	S	40		7/8" HEAVY HEX NUT		
082	10	S	10		7/8" CONTINUOUS THREADED ROD, 15" LG.	1	GRINNELL FIG.146 OR EQUAL
081	10	S	10		SIZE 10 PIPE ROLLER, ZINC COATED	1	GRINNELL FIG.173 OR EQUAL
080	10&13	S	136		3/4" WASHER		
079	10&13	S	136		3/4" HEAVY HEX NUT		
078	10&13	S	68		3/4" CONTINUOUS THREADED ROD, 10-3/4" LG	1	GRINNELL FIG.146 OR EQUAL
077	10&13	S	68		SIZE 6 PIPE ROLLER, ZINC COATED	1	GRINNELL FIG.173 OR EQUAL
076	10,11,12,13	S	70		3/4" HEAVY HEX NUT		304L SST
075	10,11,13	S	30		3/4" STUD, 5-1/4" LONG		304L SST
074	10,11,13,14	S	206		1/2" WASHER		C.S.
073	10,11,13,14	S	206		1/2" ANCHOR BOLT, 1-1/8" LONG		C.S.
072	4	S	92		5/8" STUD, 3-3/4" LONG		304L SST
071	4	S	184		5/8" HEAVY HEX NUT		304L SST
070	4	-	23		GYLON GASKET FOR 3" FLANGE CONNECTION		PROVIDED BY TBE
069	5	S	32		3/4" STUD, 4-3/4" LONG		304L SST
068	5	S	64		3/4" HEAVY HEX NUT		304L SST
067	9	-	4		GYLON GASKET FOR 8" FLANGE CONNECTION		PROVIDED BY TBE
066	4	S	96		3/4" STUD, 4-1/2" LONG		304L SST
065	4	S	192		3/4" HEAVY HEX NUT		304L SST
064	4	-	12		GYLON GASKET FOR 6" FLANGE CONNECTION		PROVIDED BY TBE
063	3&6	E	1		8" TO 6" VENT REDUCER SPOOL		
062	3&6	M	1	90M09265-062	8" VENT SPOOL MODIFICATION		
061	14	E	1		ANCHOR BRACKET DETAIL		
060	14	E	1		8" NOM. PIPE ANCHOR DETAIL		
059	11&14	E	2		LEG DETAIL		
058	14	E	1		8" NOM. FLANGE ANCHOR DETAIL		
057	11&14	E	2		LEG DETAIL		
056	3&14	A	1	90M09265-056	8" NOM. VENT FLANGE ANCHOR		
055	13	E	5		SUPPORT LEG DETAIL		
054	5&13	A	2	90M09265-054	SUPPORT ASSY FOR CONCRETE		
053	3&13	A	1	90M09265-053	6" NOM. PIPE ANCHOR		
052	3&13	A	4	90M09265-052	ROLLER ASSY.		
051	3	M	1	90M09265-051	PRESSURIZATION MANIFOLD		
050	3	S	4		35 CONV. 6" NOM. BELLOWS	2	
049	3	S	1		15 CONV. 6" NOM. BELLOWS	2	
048	3&14	A	1	90M09265-048	VENT ANCHOR FOR GRATING		
047	13&14	E	1		MOUNTING PLATE DETAIL		
046	13	A	0	90M09265-046	VENT ANCHOR ASSY.		
045	13	E	0		LEG DETAIL		
044	5&13	A	5	90M09265-044	SUPPORT ASSY. FOR GRATING		
043	12&13	E	7		SUPPORT MOUNT DETAIL		
042	12&13	E	2		SUPPORT LEG DETAIL		
041	10&12	E	2		ROLLER LEG DETAIL		
040	10&12	E	3		ROLLER LEG DETAIL		
039	10&12	E	5		ROLLER MOUNT DETAIL		
038	12	E	1		ANCHOR BRACE DETAIL		
037	12	E	1		ANGLE BRACKET DETAIL		
036	12	E	1		ANGLE BRACKET DETAIL		
035	12	E	1		ANCHOR DETAIL		
034	11&12	A	1	90M09265-034	ELBOW ANCHOR DETAIL		
033	10,11,13,14	E	6		ANCHOR DETAIL		
032	10&12	E	14		ROLLER LEG DETAIL		
031	10&12&13	E	22		ROLLER LEG DETAIL		
030	10&12	E	32		ROLLER LEG DETAIL		
029	10&12&13	E	34		ROLLER MOUNT DETAIL		
028	11	E	1		ANGLE BRACKET DETAIL		
027	11	E	1		ANGLE BRACKET DETAIL		
026	11	E	1		BRACKET DETAIL		
025	11&12&14	E	32		BRACE DETAIL		
024	11&12&14	E	14		BRACE DETAIL		
023	11	A	1	90M09265-023	ANCHOR DETAIL		
022	11	E	1		ANCHOR MOUNT		
021	11&13	E	4		ANCHOR LEG DETAIL		
020	10&11	E	8		ANCHOR LEG DETAIL		
019	3&11	A	1	90M09265-019	6" NOM. TRANSFER ELBOW ANCHOR		
018	3&11	A	1	90M09265-018	6" NOM. TRANSFER TEE ANCHOR		
017	3&11	A	2	90M09265-017	6" NOM. TRANSFER FLANGE ANCHOR		
016	5&10	A	3	90M09265-016	ROLLER ASSY. FOR GRATING		
015	5&10	A	2	90M09265-015	ROLLER ASSY. FOR CONCRETE		
014	3&10	A	14	90M09265-014	6" TRANSFER ROLLER ASSY.		
013	3&10	A	16	90M09265-013	6" VENT ROLLER ASSY.		
012	3&10	A	3	90M09265-012	6" NOM. VENT FLANGE ANCHOR		
011	3 & 9	E	5		2" NOM. BLIND FLANGE		
010	3 & 8	E	N/A		BOSS DESIGN		
009	3 & 8	E	1		VENT SPOOL FOR FIELD FIT		
008	3 & 8	E	1		TRANSFER SPOOL TO PUMPS		
007	3 & 8	E	2		VENT SPOOL WITH BOSSES		
006	3 & 8	E	2		TRANSFER SPOOL WITH BOSSES		
005	3 & 8	E	1		VENT SPOOL		
004	3 & 8	E	2		TRANSFER SPOOL		
003	3 & 7	E	1		TRANSFER LINE END TEE		
002	3 & 7	E	1		TRUCK RELOAD LINE		
001	2	A	1	90M09265-001	TTB LOX STORAGE FACILITY		

LEGEND: A=ASSEMBLY/ALIGNMENT ; S=STOCK ITEM ; F=FABRICATED ITEM ; M=MODIFIED ITEM ; E=EXISTING ITEM/FACILITY

90M09265

TEST ENGINEER	SEE ENGINEERING RECORDS	UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES; TOLERANCES ON FRACTIONS ± 1/32, DECIMALS XX- ±.03, XXX- ±.010, ANGLES ± 1/2°	ORIGINAL DATE OF DRAWING 7-31-89; DRAFTSMAN BRA; CHECKER; CHECKER; STRESS; ENGINEER BRA; ENGINEER RRK; SUPERVISOR; APPROVED
SAFETY ENGINEER		MATERIAL NOTED; HEAT TREATMENT NONE; FINAL PROTECTIVE FINISH NOTED	
	NEXT ASSY / USED ON	APPLICATION	

TECHNOLOGY TEST BED

LOX STORAGE FACILITY BUILDING 4670

WEIGHT CHECKER; DATE 7-10-89; CODE EI35; SCALE NOTED; UNIT WEIGHT

DESIGN CODE

GEORGE C. MARSHALL SPACE FLIGHT CENTER
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
HUNTSVILLE, ALABAMA

DWG SIZE E; 90M09265; SHEET 01 OF 14