NASA TECHNICAL MEMORANDUM

NASA TM X-62,515

NASA TM X-62,515

(NASA-TM-X-62515) HIGH PRESSURE SPACE SUIT ASSEMBLY (NASA) 20 p HC $3.50 CSCL 06K

N76-19813

Unclas

G3/54 08508

HIGH PRESSURE SPACE SUIT ASSEMBLY

Hubert C. Vykukal and Bruce W. Webbon

Ames Research Center
Moffett Field, California 94035

December 1975

1. Report No. TM X-62,515	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle HIGH PRESSURE SPACE SUIT ASSEMBLY		5. Report Date
		6. Performing Organization Code
7. Author(s) Hubert G. Vykukal and Bruce W. Webbon		8. Performing Organization Report No. A-6393
		10. Work Unit No.
9. Performing Organization Name and Address Ames Research Center Moffett Field, Calif. 94035		11. Contract or Grant No.
		13. Type of Report and Period Covered Technical Memorandum
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, D.C. 20546		14. Sponsoring Agency Code
15. Supplementary Notes		

16. Abstract

An effort is underway to incorporate advanced suit and LSS components into a functional suit in order to assess the performance of these components. A brief description of the suit configuration is presented in the following text.

17. Key Words (Suggested by Author(s))		18. Distribution Statement	
Space suit Pressure suit Liquid cooling garment Life support systems		Unlimited STAR Category - 54	
19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*
Unclassified	Unclassified	18	$3.25

*For sale by the National Technical Information Service, Springfield, Virginia 22161

HIGH PRESSURE SPACE SUIT ASSEMBLY

Hubert C. Vykukal and Bruce W. Webbon
Environmental Control Research Branch
Ames Research Center
Moffett Field, California 94035

ABSTRACT

An effort is underway to incorporate advanced suit and LSS components into a functional suit in order to assess the performance of these components. A brief description of the suit configuration is presented in the following text.

SUIT SYSTEM

Figure 1 shows the space suit assembly (SSA) which is currently being developed. A detailed review of advanced suit configurations, component developments, and mobility exercises in the AiResearch AES, Ames AX-2 and Litton RX-4 suits provided the basis for selection of the configuration shown. The SSA can be considered as a hybrid suit in that it incorporates both hard and soft suit components.

The torso configuration employs hard structure both above and below the suit entry closure and in the briefs section between the waist and hip joint. The torso closure, currently under fabrication by Air Lock, Inc., is geometrically similar to the dual plane closure used on the RX-4 hard suit. This torso configuration provides maximum area on the back of the suit for mounting the LSS components and allows for easier entry into the suit as compared to the rotary bearing waist closure used in the Ames AX-2. An off-the-shelf hemispherical helmet and connector assembly will be utilized. Waist mobility will be provided by a single axis, "elliptical," dual opposed rolling convolute joint having a 56° forward flexion range.

Since maximum mobility, minimum leakage, long operational life, and ease of fabrication at low cost are of primary concern in this development, special attention has been given to the selection of extremity joints. The shoulder joint employs three sealed bearings with an internal linkage rolling convolute in the first element of the joint. The elbow incorporates a two-segment, dual-opposed soft rolling convolute with sizing ring attachments at both ends of the joint (all sizing segments shown shaded). The hip is similar to the AES configuration which consists of two sealed bearings and a two-axis, dual-opposed soft rolling convolute. The knee incorporates a two-segment soft toroidal joint with sizing ring attachments at both ends. A two-axis, dual-opposed soft rolling convolute is utilized at the ankle. A universal fit pressure boot similar to that used in the Ames AX-2 suit will be utilized.

The sealed bearing concept developed under contract NAS 2-8442 will be used at all rotary interfaces of the suit. Phase V gloves, which utilize the tucked fabric technique for the thumb and finger assembly, are currently being developed under contract NAS 2-8846.

All soft component hardware fabrication will consist of a multiple laminate structure of neoprene coated Kevlar fabric and rip stop materials.

Configuration drawings of the suit components are shown in the appendix.

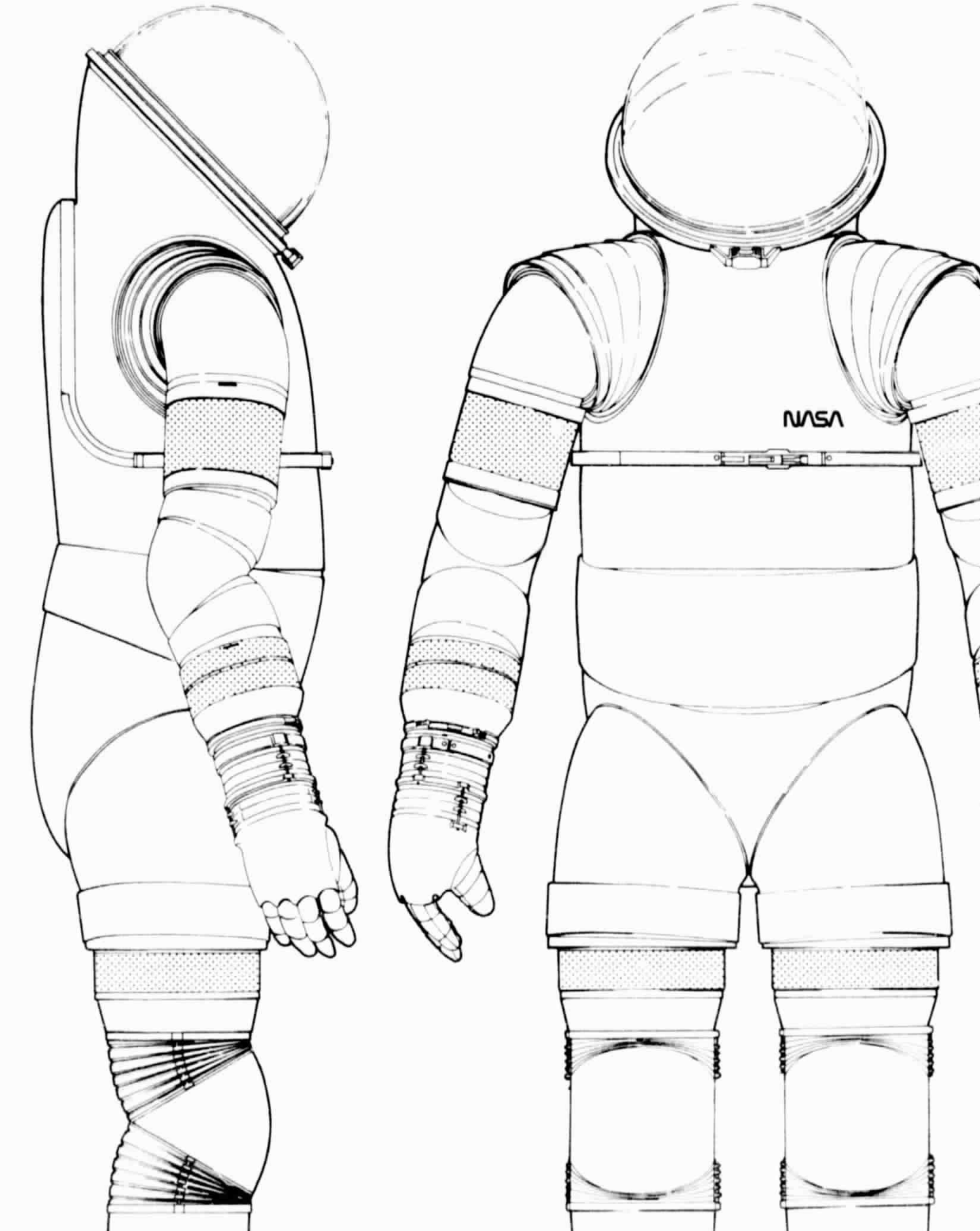


Figure 1.— Space suit assembly.

SUIT DUCT SCHEMATIC

The layout of the internal suit plumbing is shown in figure 2. A single suit pressure shell penetration provides the interface for all suit-LSS connections. The LCG feed and return lines and the vent garment feed line are then internally routed to a multiple connector at the front of the torso. This multiple connector, which is being built by Airlock, Inc., is the only plumbing connection that must be made in donning the system.

The gas distribution in the vent system is different than has been used on other suits. The entire gas flow to the suit enters a small plenum chamber built into the torso. Approximately 90 percent of the flow is ducted to the helmet to remove CO_2 and prevent visor fogging. This gas then flows back around the upper torso to an exhaust vent near the inlet plenum. The remaining 10 percent of the flow is fed through the multiple connector into the vent garment (fig. 3), which distributes the gas to the hands and feet. This dehumidified gas, which has been warmed by heat exchange through the vent ducts, flows back over the limbs to the exhaust vent. This arrangement should be very effective in evaporating any sweat on the extremities so that comfort will be improved. In addition, the total gas pressure drop through the suit will be reduced, since only a small part of the flow must be forced through the small ducts.

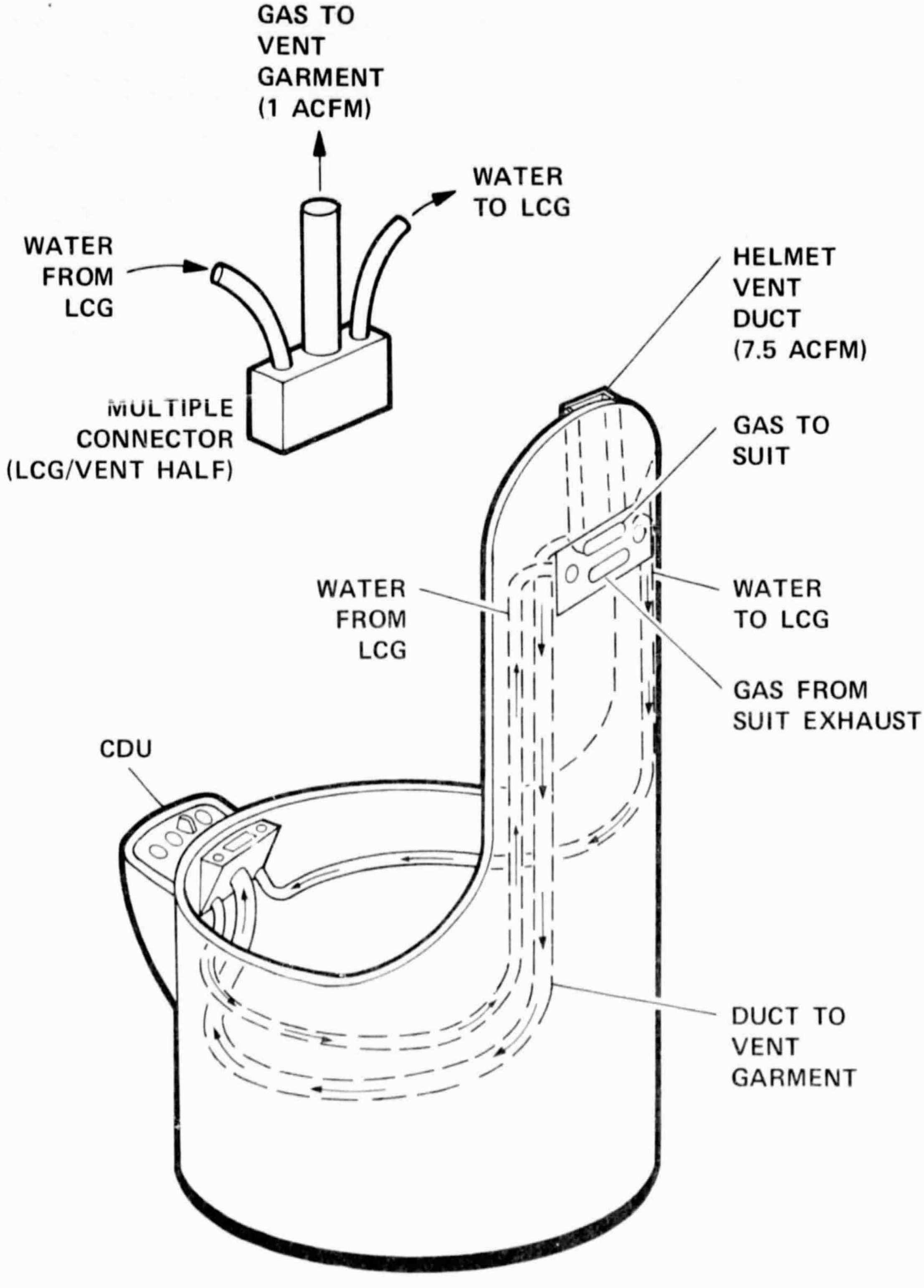


Figure 2.– Suit duct schematic.

LCG/VENT/COMMUNICATIONS ASSEMBLY

Figure 3 shows the integrated liquid cooling, gas distribution, and communications garment assembly. The gas vent ducts are attached to the garment rather than to the pressure suit assembly. This provides for a positive means of keeping the ducts in position as compared to tying them to rotary suit segments.

Liquid cooling, utilizing the highly effective patch approach developed for Ames under contract NAS 2-7485 is provided at the head and torso only. Preliminary testing at Ames has indicated that this approach will provide all of the cooling necessary for thermal comfort at the metabolic rates expected during orbital EVA's. Two garments are currently being fabricated for a more thorough evaluation at Ames.

A standard Apollo communications carrier assembly will be integrated with the head part of the garment.

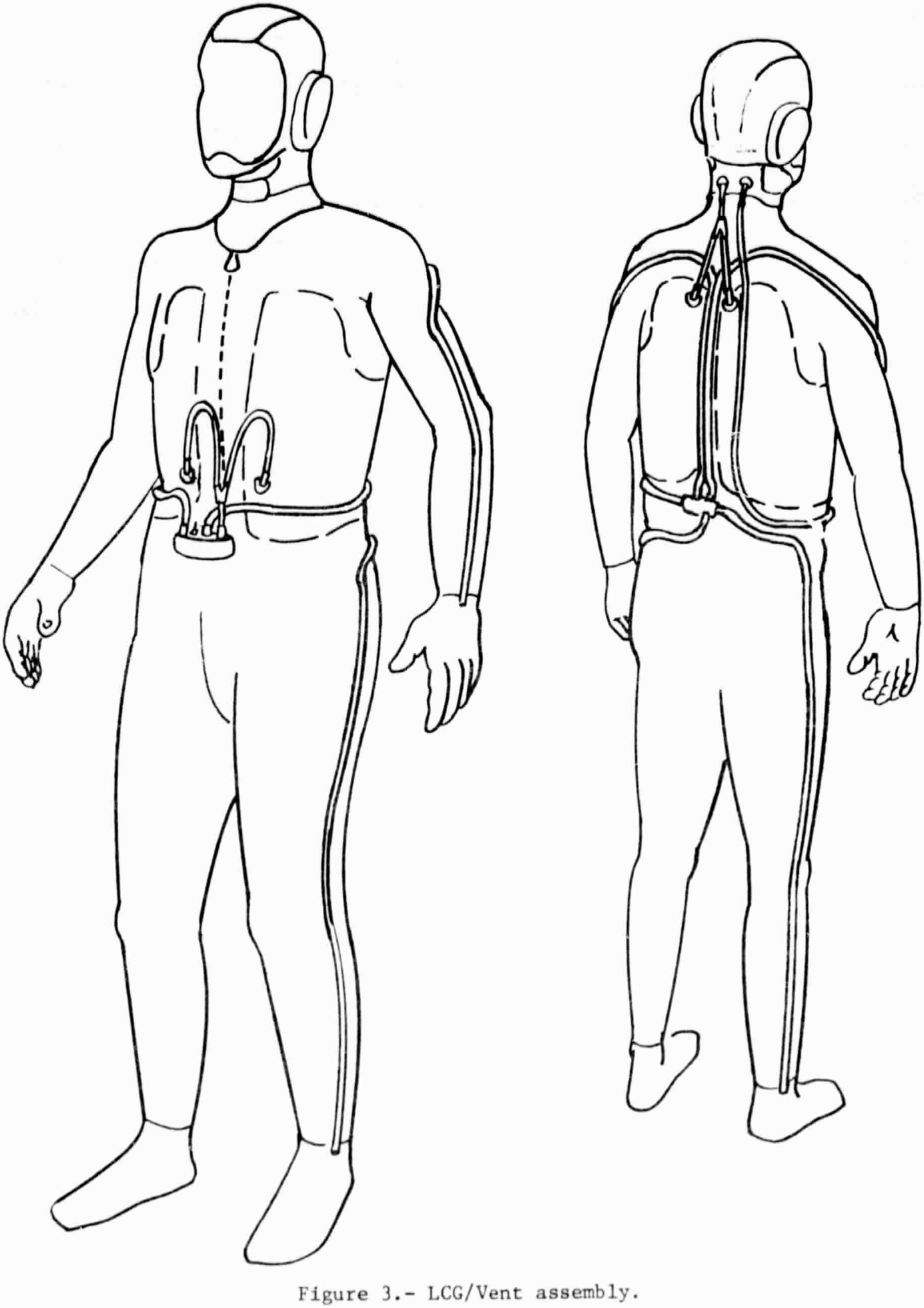


Figure 3.- LCG/Vent assembly.

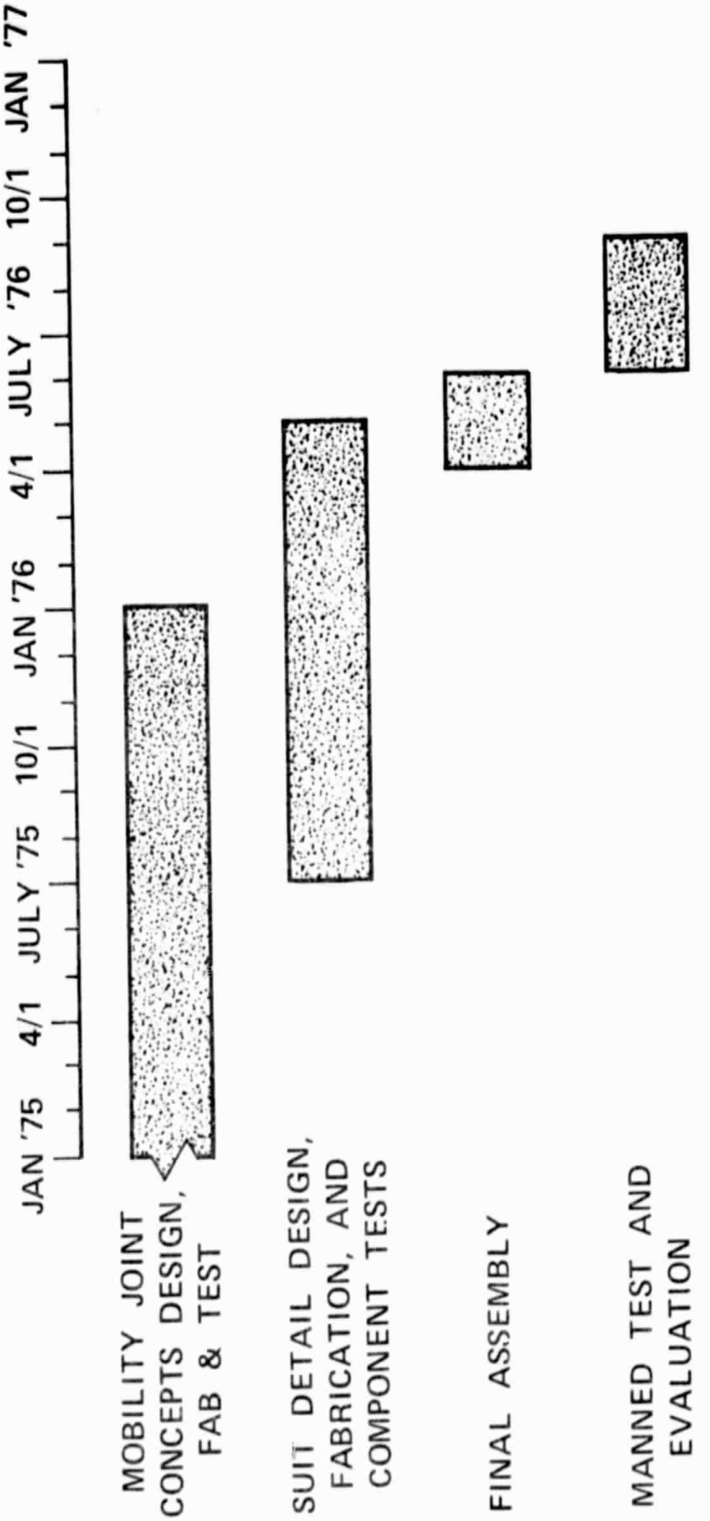
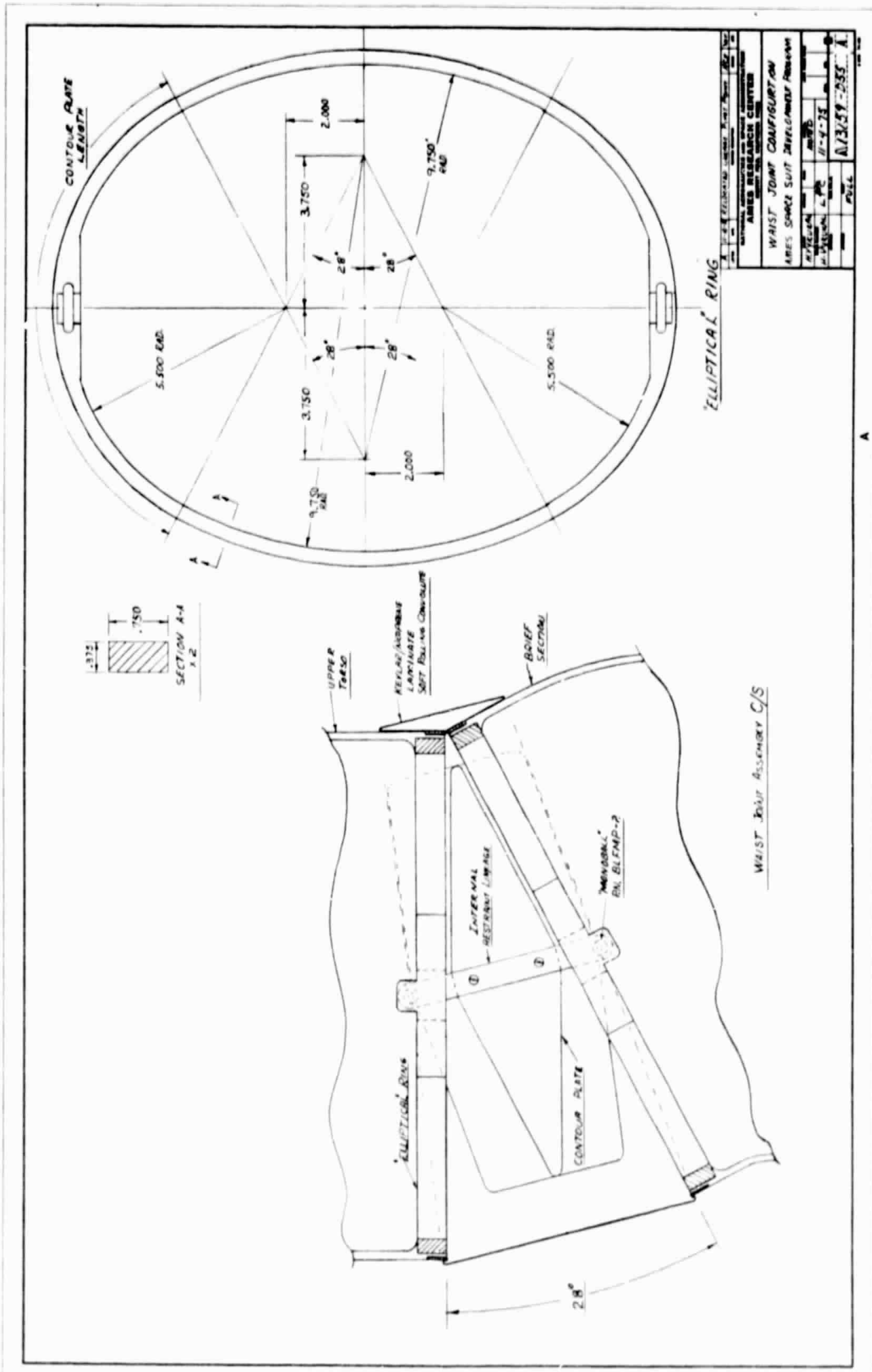
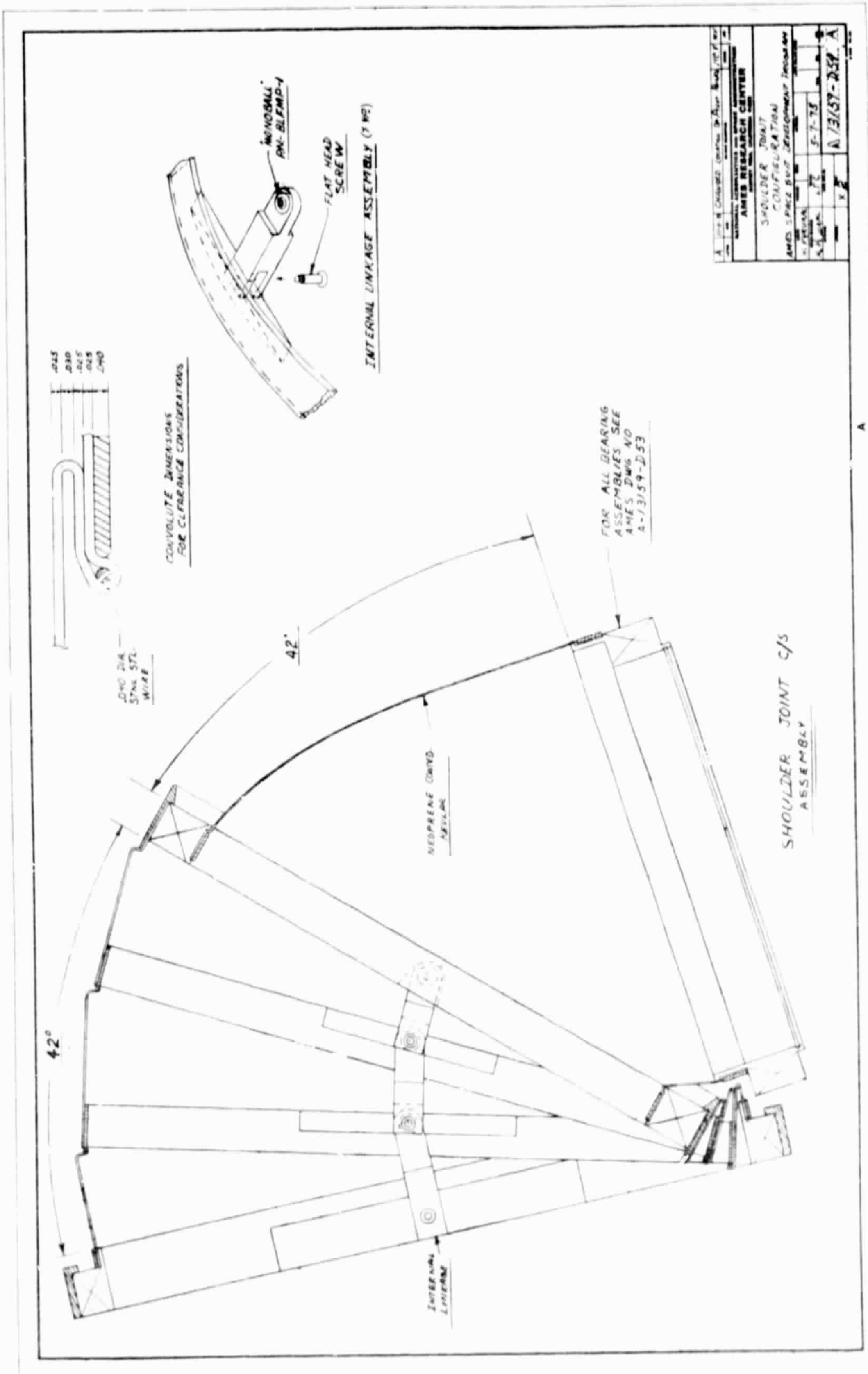


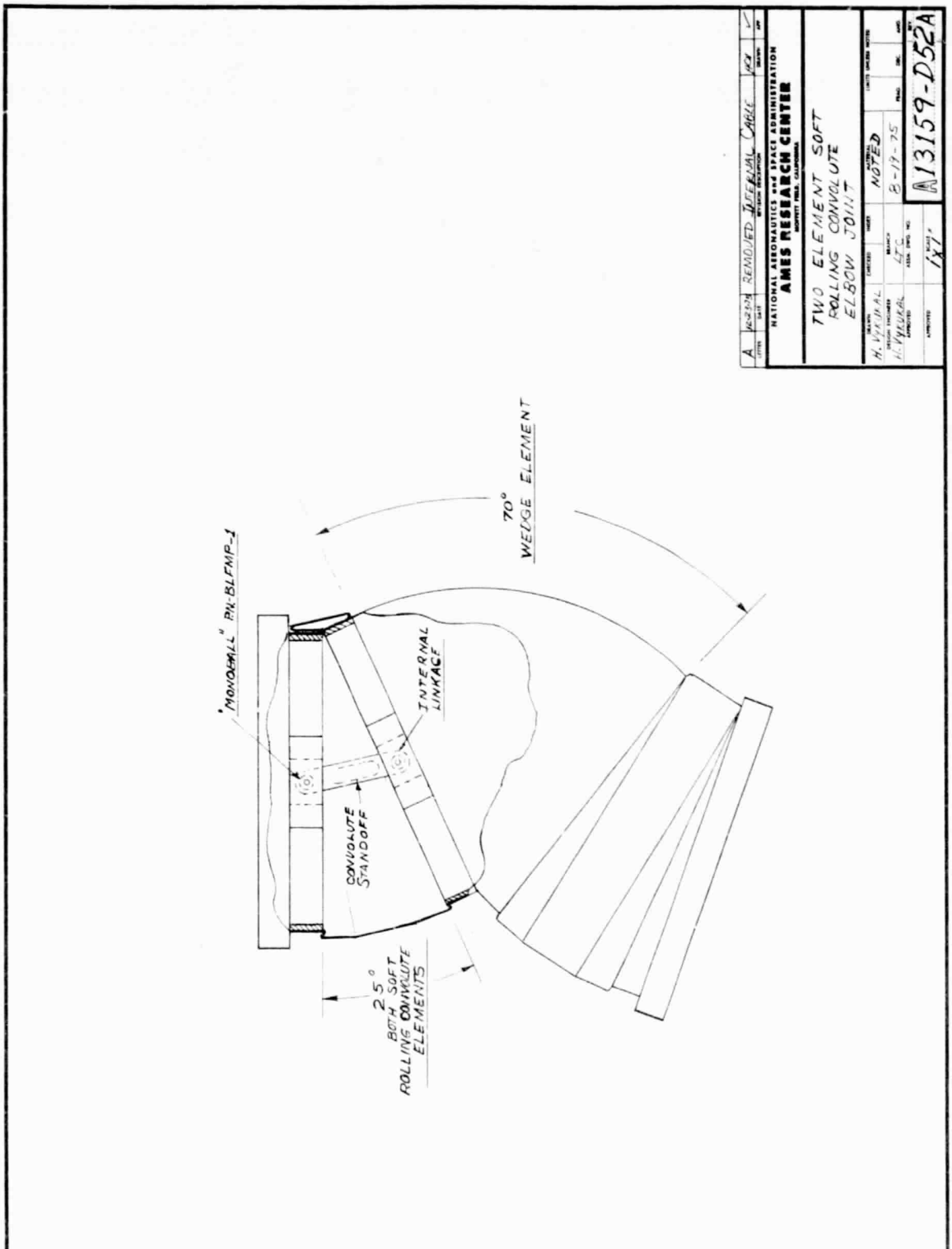
Figure 4.- High Pressure Suit Program Schedule.

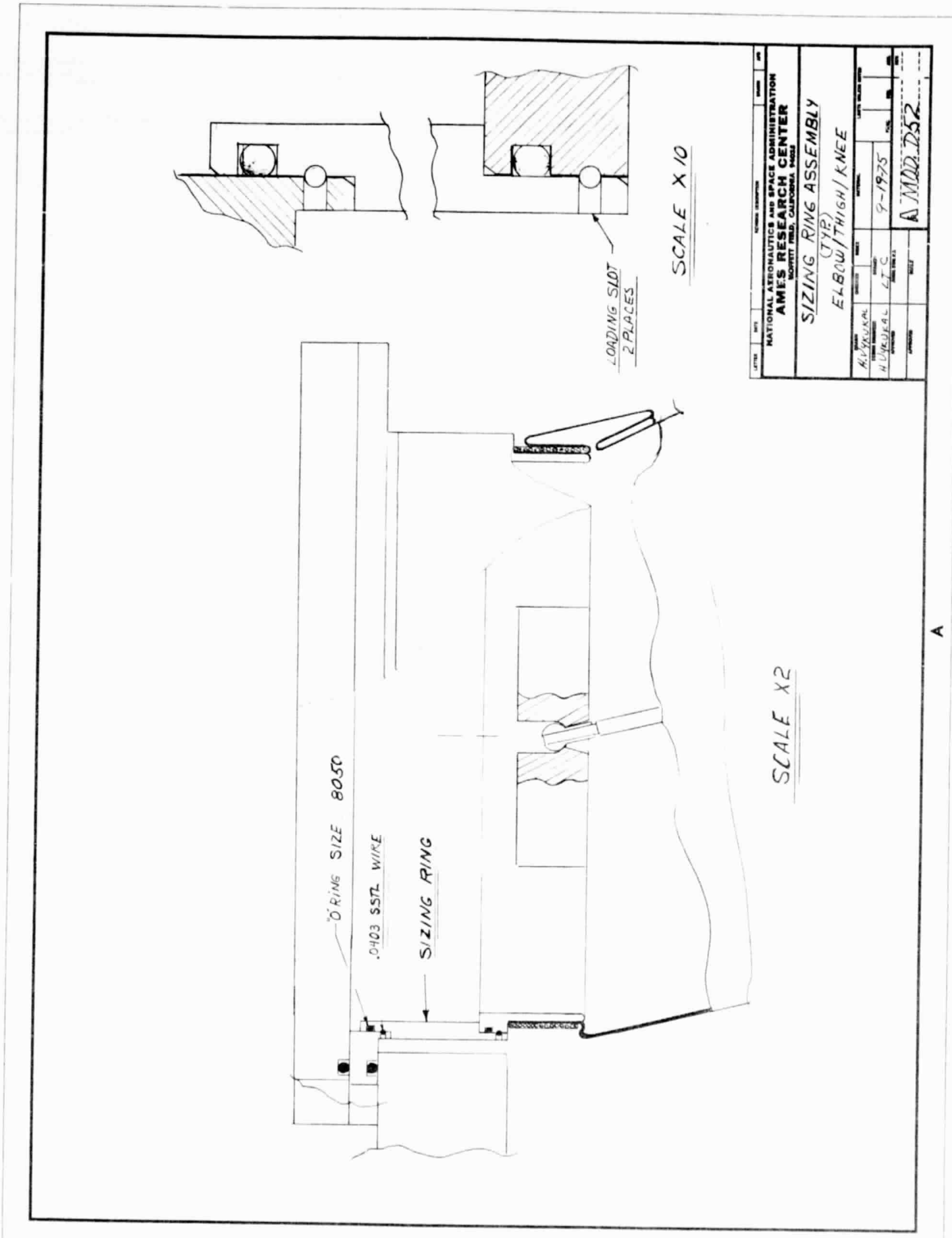
APPENDIX

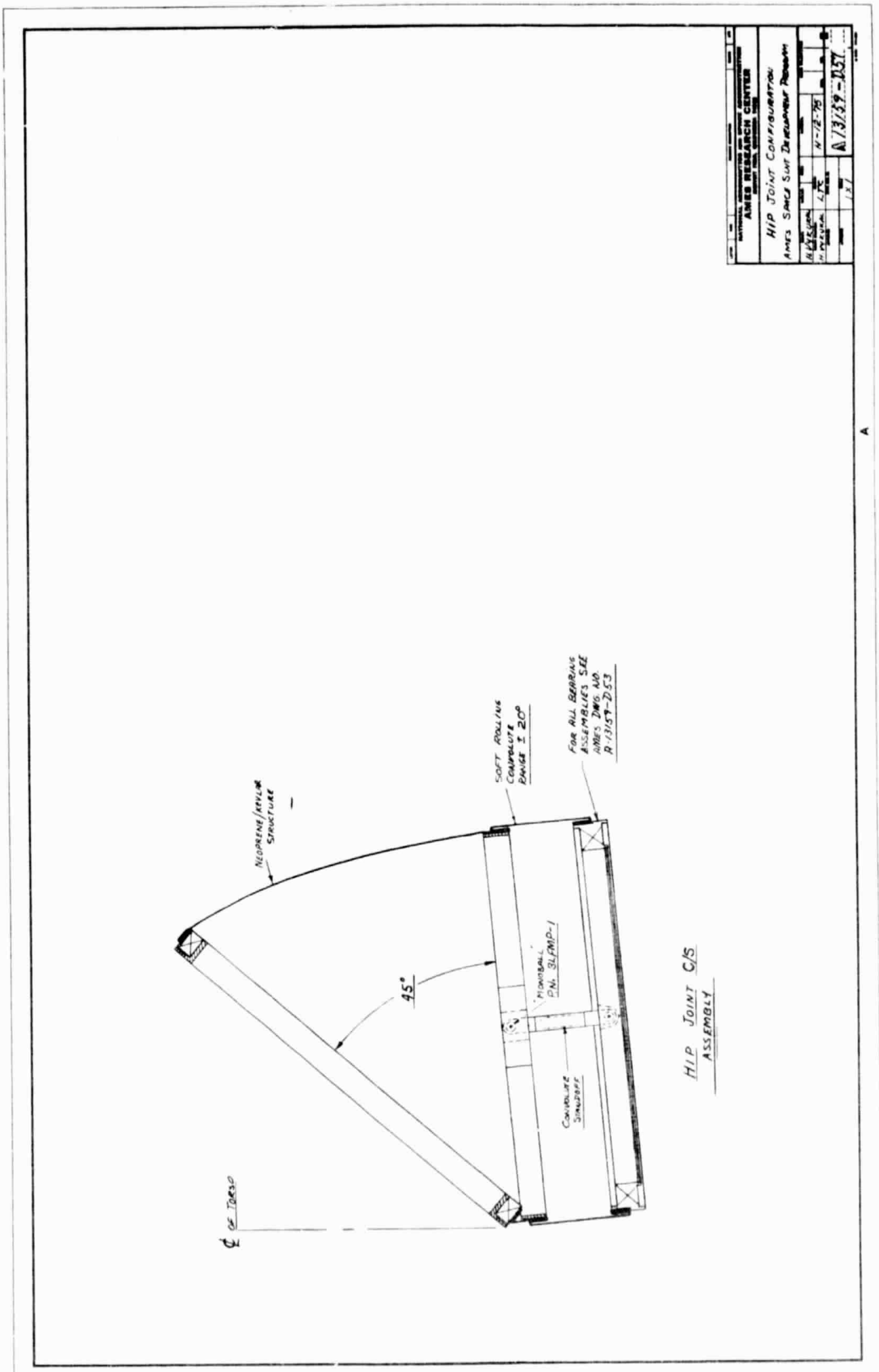
COMPONENT CONFIGURATION DRAWINGS


CONTOUR PLATE LENGTH
"ELLIPTICAL" RING
5.500 RAD.
5.500 RAD.
9.750 RAD
9.750 RAD
3.750
3.750
2.000
2.000
28°
SECTION A-A
x 2
.750
.375
UPPER TORSO
KEVLAR/NEOPRENE LAMINATE SOFT ROLLING CONVOLUTE
BRIEF SECTION
INTERNAL RESTRAINT LINKAGE
"ELLIPTICAL" RING
CONTOUR PLATE
WAIST JOINT ASSEMBLY C/S
AMES RESEARCH CENTER
WAIST JOINT CONFIGURATION
AMES SPACE SUIT DEVELOPMENT PROGRAM

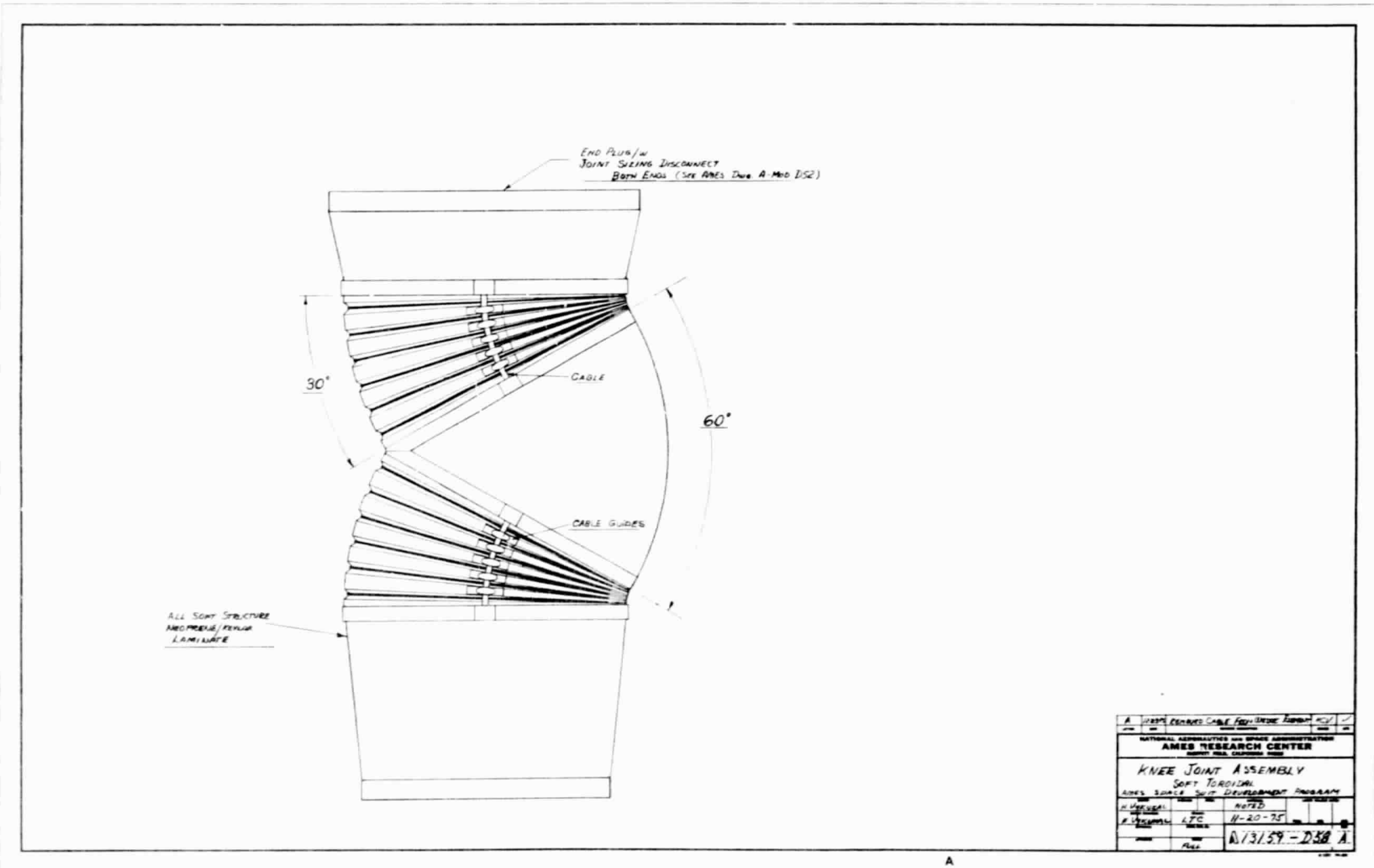

SHOULDER JOINT C/S
ASSEMBLY
INTERNAL LINKAGE ASSEMBLY
FLAT HEAD SCREW
CONVOLUTE DIMENSIONS FOR CLEARANCE CONSIDERATIONS
FOR ALL BEARING ASSEMBLIES SEE AMES DWG NO A-13159-D53
NEOPRENE CONVO. KEVLAR
INTERNAL LINKAGE
42°
42°
AMES RESEARCH CENTER
SHOULDER JOINT CONFIGURATION
AMES SPACE SUIT DEVELOPMENT PROGRAM

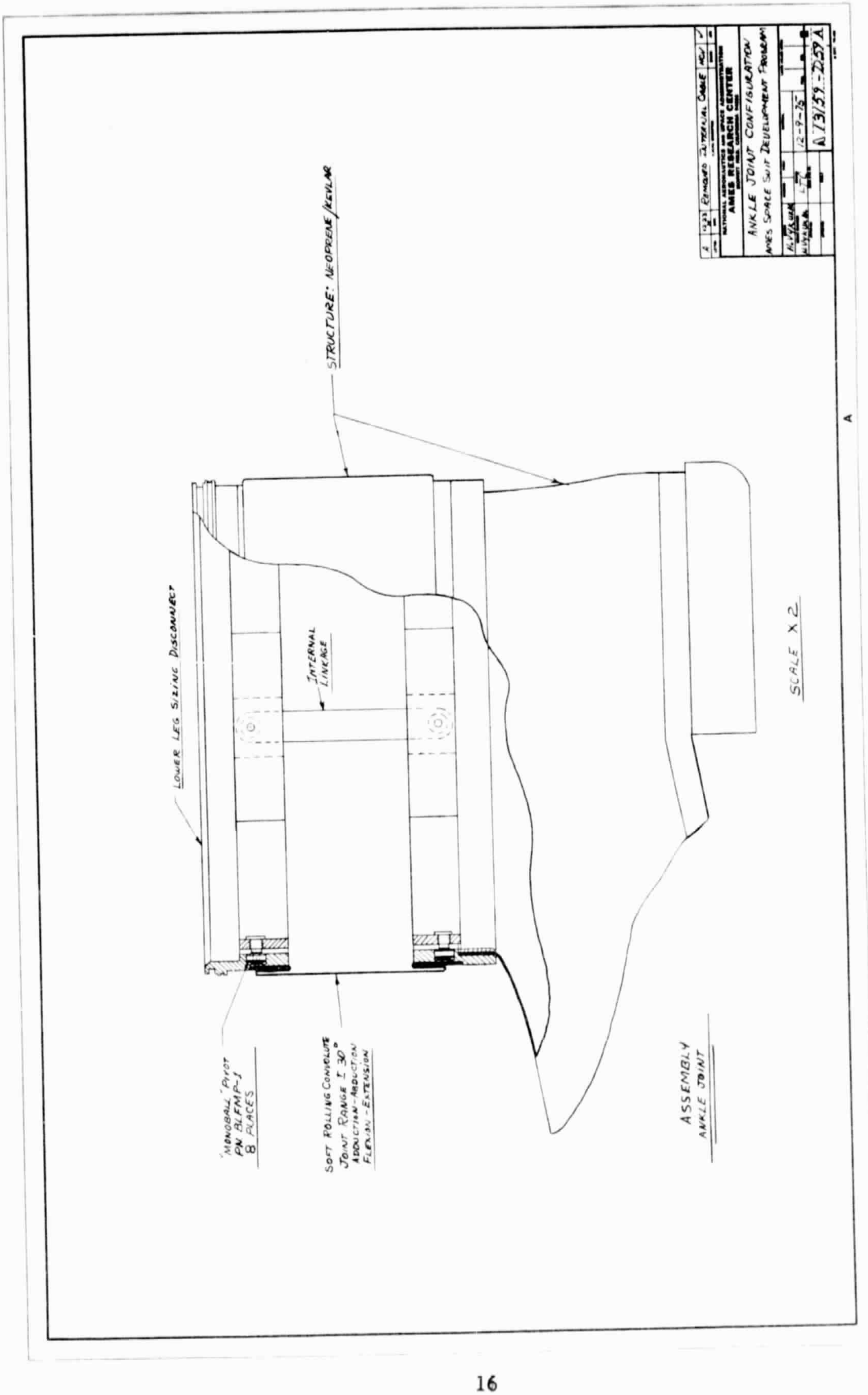

A
REMOVED INTERNAL CABLE
NATIONAL AERONAUTICS and SPACE ADMINISTRATION
AMES RESEARCH CENTER
MOFFETT FIELD, CALIFORNIA
TWO ELEMENT SOFT
ROLLING CONVOLUTE
ELBOW JOINT
H. VYKUKAL
H. VYKUKAL
NOTED
8-19-75
LTC
1X1
A13159-D52A
70°
WEDGE ELEMENT
"MONOBALL" P/N-BLFMP-1
INTERNAL
LINKAGE
CONVOLUTE
STANDOFF
25°
BOTH SOFT
ROLLING CONVOLUTE
ELEMENTS


NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
AMES RESEARCH CENTER
MOFFETT FIELD, CALIFORNIA 94035
SIZING RING ASSEMBLY (TYP.)
ELBOW/THIGH/KNEE
H. VYKUKAL
H. VYKUKAL
L.C.
9-1975
A MDD D52
SCALE X 10
LOADING SLOT
2 PLACES
SCALE X2
"O" RING SIZE 8050
.0403 SSTL WIRE
SIZING RING
A

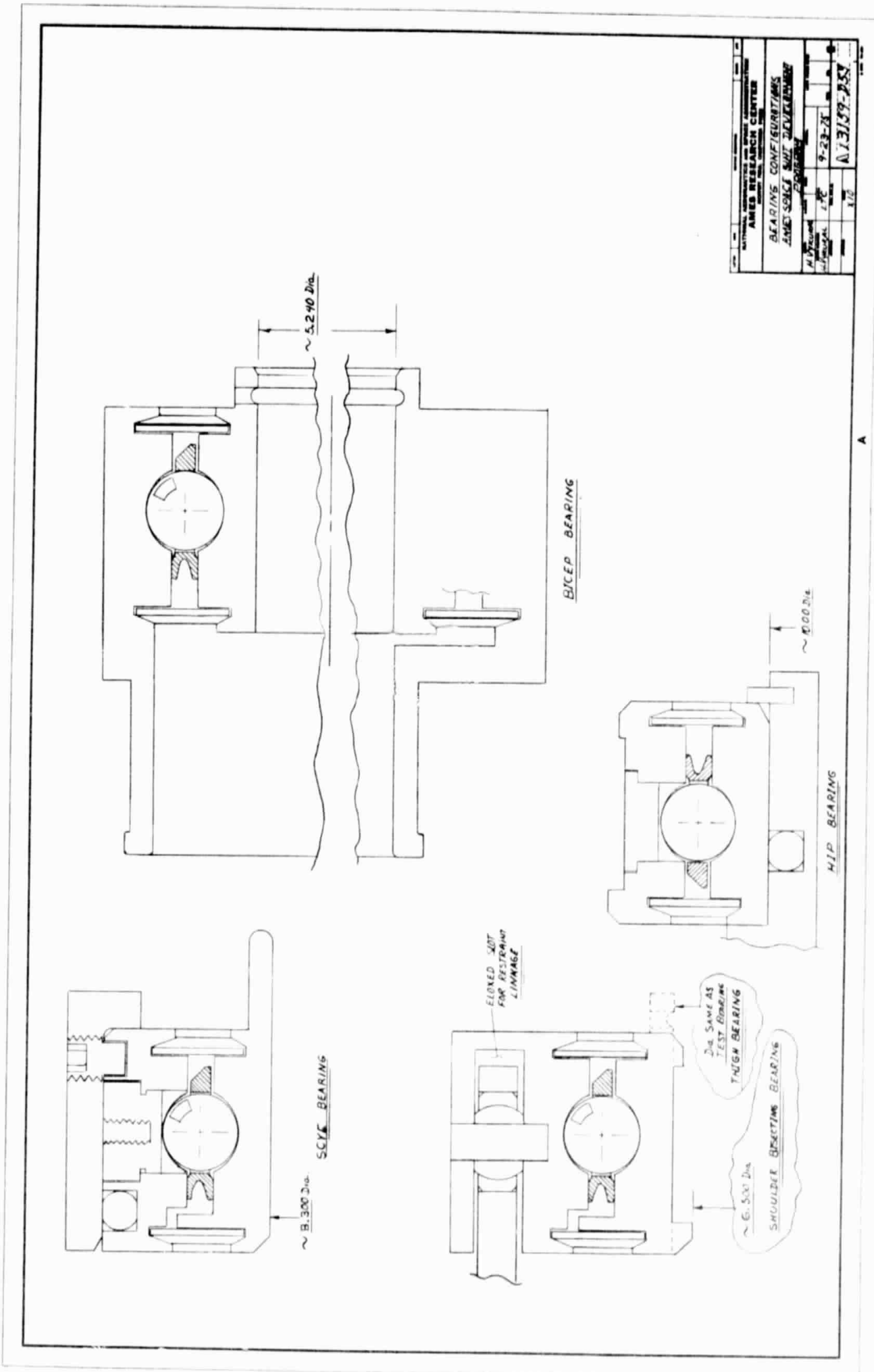


AMES RESEARCH CENTER
HIP JOINT CONFIGURATION
AMES SPACE SUIT DEVELOPMENT PROGRAM
A13159-D57
NEOPRENE/KEVLAR STRUCTURE
SOFT ROLLING CONVOLUTE RANGE ± 20°
FOR ALL BEARING ASSEMBLIES SEE AMES DWG NO. A-13159-D53
45°
MONOBALL P/N 3LFMP-1
CONVOLUTE STANDOFF
HIP JOINT C/S ASSEMBLY
℄ OF TORSO


END PLUG/W
JOINT SIZING DISCONNECT
BOTH ENDS (SEE AMES DWG A-MOD DS2)
30°
60°
CABLE
CABLE GUIDES
ALL SOFT STRUCTURE
NEOPRENE/KEVLAR
LAMINATE
AMES RESEARCH CENTER
KNEE JOINT ASSEMBLY
SOFT TOROIDAL
AMES SPACE SUIT DEVELOPMENT PROGRAM
NOTED
11-20-75
FULL
A


STRUCTURE: NEOPRENE/KEVLAR
LOWER LEG SIZING DISCONNECT
INTERNAL LINKAGE
SCALE X 2
"MONOBALL" PIVOT
PN BLFMP-1
8 PLACES
SOFT ROLLING CONVOLUTE
JOINT RANGE ± 30°
ABDUCTION-ADDUCTION
FLEXION-EXTENSION
ASSEMBLY
ANKLE JOINT
REMOVED INTERNAL CABLE
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
AMES RESEARCH CENTER
ANKLE JOINT CONFIGURATION
AMES SPACE SUIT DEVELOPMENT PROGRAM
12-9-75
A 73159-D59 A

Universal-fit boot.


AMES RESEARCH CENTER
BEARING CONFIGURATIONS
~ 5.240 Dia.
BICEP BEARING
~ 10.000 Dia.
HIP BEARING
ELOXED SLOT FOR RESTRAINT LINKAGE
Dia. SAME AS TEST BEARING
THIGH BEARING
SCYE BEARING
~ 8.300 Dia.
~ 6.500 Dia.
SHOULDER BRACING BEARING