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R. E. DARLING CO., INC.

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REDAR

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R. E. DARLING CO. TECHNICAL DOCUMENT

FINAL REPORT

Contract NAS 9-7764

STUDY OF HOSE AND CONNECTORS

IN LIFE SUPPORT SYSTEMS

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ABSTRACT

This report constitutes the summation of efforts generated on contract NAS 9-7764. The scope of work covered 1) the investigation of non-flammable materials capable of fabrication into flexible oxygen hose for spacecraft life support systems, 2) the design and prototype fabrication of a hose connector and 3) the fabrication of a flame barrier for protecting oxygen hose.

A rather thorough discussion of flammability testing and material evaluation in contained herein. The R. E. Darling Co., Inc. acknowledges the fine support provided by the Crew Systems Division, NASA Manned Spacecraft Center, Houston, Texas, during this program.

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INTRODUCTION

On August 9, 1967, the R. E. Darling Company, Inc., submitted an unsolicited proposal, REDAR-RBB-091, to NASA, Manned Spacecraft Center, Houston, Texas. The essence of the proposal was the investigation and study of non-flammable oxygen hose and connector concepts for life support systems. Following several months of negotiations relating to the scope of work, a contract (NAS 9-7764) was entered into on February 23, 1968. Work was immediately commenced in the three phases of the program: namely, hose construction, connector design and flame barrier fabrication.

During the first six weeks of the program the preliminary connector design was completed, an extensive elastomeric materials survey was conducted, a flame chamber was designed and built, and a flame barrier material survey was initiated.

Precisely a month after the start of work on NAS 9-7764, the North American Rockwell Corporation, Space Division, initiated an accelerated contract for the design, development, qualification, and manufacture of hardware for the Apollo program which diluted the efforts of our staff relative to the NASA contract. The next several months required the utmost cooperation from NASA, NAR, and REDAR technical staffs to come up with the necessary hose and associated hardware which flew in the Apollo VII spacecraft that once more got our nation's space program in high gear.

During the period that efforts were directed toward flight hardware, considerable material study and evaluation was performed on a number of new elastomeric materials. At this time Fluorel fluoroelastomer was found to possess certain attributes deemed necessary for space use and its properties and handling were refined. At the same time, Viton fluoroelastomer were examined. DuPont, manufacturer of Viton, and the R. E. Darling Company entered a development phase to see what could be gained with this material. It was also during this time that other elastomers were found to be unacceptable for hose use. One highly touted candidate, carboxyl nitroso rubber, was ruled out.

By the end of the summer of 1968, finalization of connector designs and prototype manufacture was concluded. Test and evaluation was conducted an an informal presentation was given to NASA personnel in October of 1968. We also held a joint NASA-DuPont-REDAR briefing of interested personnel on the status of our Viton efforts.

In August of 1968, in an attempt to establish some reasonable conclusion to the efforts, we concurred with an extension to September 30, 1968 for final submission. However, with the rapidly changing state-of-the-art, before we could conclude the efforts, new materials appeared which looked exciting and promising. Further work had to be done, so in December of 1968, a modification to the original contract was agreed upon and a final submission date of March 1, 1969 was determined.

Although new advances of materials, designs, and fabrication techniques are presently within sight, it has been our intent to conclude this phase and then move on to the next logical step. We have made a number of suggestions in the sections on each phase of the effort and in the conclusion. With the rapidly moving pace of the program presently, we suspect that even our suggestions may be out of date before this report is read.

The fabrication of our oxygen atmosphere combustion chamber led our technical staff toward ever increasing utilization of this important and versatile tool in the evaluation of candidate materials. In addition, our testing laboratory staff under the direction of Mr. Robert Dougherty, who designed the chamber, outlines these test programs in the following section. Additionally, we feel that it is both revealing and scientifically important to present those findings of importance. Although many of our results turned out to be less than acceptable for space utilization, the reports contained herein may be of assistance to those who may wish to pursue investigations in like avenues. Inasmuch as we built the chamber with private funds and much of the work conducted was outside the immediate realm of NAS 9-7764 contractural requirements, some results listed are for proprietary materials, the details of which cannot be released.

In comparative studies with chambers at the Manned Spacecraft Center, it was determined that results in the R. E. Darling Company's chamber were remarkably close. On a few occasions, however, the correlation was not apparent when samples from one batch of material was tested by us and another batch at MSC. We believe this is more due to variations in the material than in the test itself. Further testing in most instances with additional batches seemed to bear this out.

The results of this contract appear to be the basis upon which further work can be pursued. We are already conducting further investigative studies in non-flammable elastomeric materials in joint efforts with DuPont, Minnesota Mining & Manufacturing Co., Raybestos-Manhattan Company, and Mosites Rubber Co. A continuing literature search is always a part of the company's operations and as new polymers or important advances are announced, the R. E. Darling Company attempts to evaluate them in relation to its products. In the company's never ending desire to maintain its leadership position in its field of endeavor, a major portion of the efforts expended by the research and development staff are directed toward new fabrication techniques and design concepts. The fruits of our labors are always made known to the space industry as we strive to make our country's space program the most advanced and safest technological field in the world.

FLAMMABILITY INVESTIGATION

A. Chamber Description

As it became apparent that the R. E. Darling Company was to be actively involved in the investigation of the flammability of non-metallic materials, the company's management committed significant funds toward the design and manufacture of a flame chamber. Company personnel spent a week in Houston examining the NASA chambers and test procedures. Upon their return, work commenced on our "oxygen atmosphere combustion chamber." Its completion provided the Materials Testing Division of the R. E. Darling Co., Inc. with an excellent tool for materials research and study.

Physically, the chamber is quite large. The internal dimensions are 60 inches long and 36 inches in diameter. A viewing port is available for visual determinations or for photographing tests on film or closed circuit. Blow-out ports are provided which prevent internal pressures from exceeding 22 psia. Other blow out pressures could be provided if necessary. The chamber is piped to provide entry for as many as three pure gases or three pre-mixed gases at once. Several electrical inputs are available internally.

We have fabricated test setups which are installed in the chamber to provide the form and substance of each test procedure.

Flame Chamber

Selection of fire resistant material and fire propagation are areas which have become increasingly important as our technology advances. As a result, testing specifications are changing and manufacturers must keep pace with updated requirements. To meet this need, the R. E. Darling Company designed and developed the Oxygen Atmosphere Combustion Chamber (Flame Chamber) primarily to simulate fire ignition and propagation in any combination of space capsule environments. This chamber has also proved to be an invaluable tool for selecting and evaluating materials used in other diverse environments such as aircraft interiors and pressurized underwater habitats and vehicles.

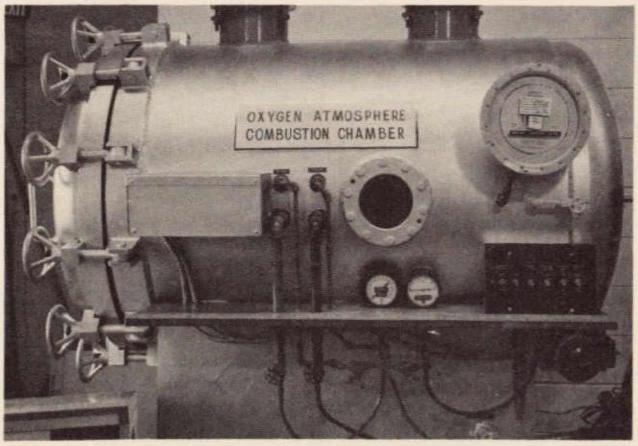
The Materials Testing Division of R. E. Darling Company conducts all of the flame tests required by NASA (MSC-A-D-66-3) on materials used in either the Command or Lunar Excursion module. Inter-laboratory tests between REDAR and NASA-MSC provide an extremely high level of confidence in correlation of test results between the two facilities.

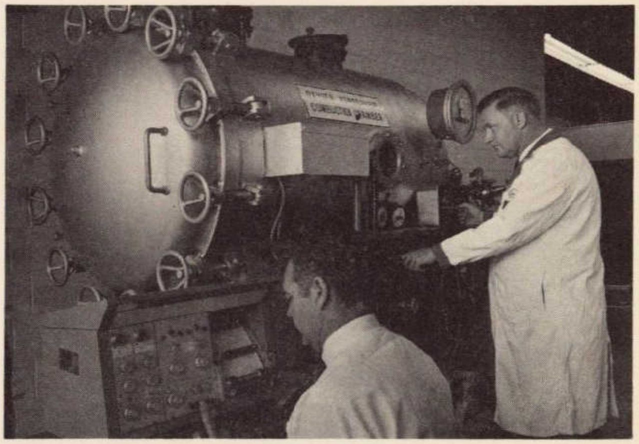
Flame tests may be conducted at any pressure level from 1 to 30 psia. Higher psi testing may be simulated by varying the oxygen partial pressure. The gas mixture used within the chamber can be varied to suit the customer's requirements. This can range from 100 percent oxygen for simulation of space capsule environments to nitrogen-oxygen mixtures of aircraft environments, to oxygen-helium mixtures for simulation of underwater conditions or to meet other specialized needs.

Ignition sources are varied, including nichrome wire igniting either the sample or a supplementary fuel, silicone or pyrotechnic squibes, acetylene-oxygen or propane-oxygen gas flames, or high voltage electrical discharge.

Various configuration of sample holders permit top or bottom ignition, center or side ignition, or raising or lowering the specimen into an open flame.

Instrumentation includes absolute pressure gauges, inlet gas pressure gauges, two high speed (125 mm/sec) temperature continuous recording channels and 24 low speed recording (printout) channels. A view port allows continual visual or closed-circuit television monitoring of the test in progress. In addition, color, black and white, or infrared motion pictures and still pictures of tests can be filmed.





MATERIALS TESTING DIVISION

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B. Test Descriptions

The following test descriptions are numbered to ease identification of test conditions listed in the test results table in the next section. In all instances where standardized test slabs are used, the burn rate is determined from time of ignition until the flame reaches the top of the sample. No downward propagation tests are reported as upward propagation was found to be more severe.

Test No. I(1)

atmosphere: 100% oxygen
pressure: 16.5 psia
ignition source: 1 tissue paper
Note - where 3 or 5 tissues were used as the ignition source, that number appears in parenthesis: i.e., 3 tissues in Test I(3).

Test No. II (1)

atmosphere: 100% oxygen
pressure: 5.0 psia
ignition source: 1 tissue paper
Note - the number of tissues for the ignition again appears in parenthesis.

Test No. III

atmosphere: 100% oxygen
pressure: 16.5 psia
ignition source: silicone squib

Test No. IV

atmosphere: 100% oxygen
pressure: 5.0 psia
ignition source: silicone squib

Test No. V(1)

atmosphere: 60% nitrogen, 40% oxygen
pressure: 16.5 psia
ignition source: 1 tissue paper
Note - the number of tissues for the ignition again appears in parenthesis.

Test No. VI(1)

atmosphere: 60% nitrogen, 40% oxygen
pressure: 5.0 psia
ignition source: 1 tissue paper
Note - the number of tissues for the ignition again appears in parenthesis

Other flammability tests have been generated and these are discussed in the section of this report on our Flame Barrier Study.

C. Flammability Test Results

The accompanying charts give results of a selected number of the more than 320 tests run to date in the "oxygen atmosphere combustion chamber" at the R. E. Darling Co., Inc.

TABLE I. Flammability Evaluation Test Results on Material Samples (cont'd.)

No.	Material Designation	Test Description	Remarks
10	DuPont Elastomers Div. Viton 1389	I(1)	No Burn
	DuPont Elastomers Div. Viton 1389	I(5)	No Burn
11	DuPont F&F Div. Viton 238-12-1	I(5)	No Burn
	DuPont F&F Div. Viton 238-12-1	III	No Burn
12	DuPont F&F Div. Viton 238-12-2	I(3)	.021 "/sec.
	DuPont F&F Div. Viton 238-12-2	I(5)	.022 "/sec.
13	DuPont F&F Div. Viton 238-13-1	I(3)	No Burn
	DuPont F&F Div. Viton 238-13-1	I(5)	.023 "/sec.
14	DuPont F&F Div. Viton 238-13-2	I(3)	Self Ext. 45 sec.
	DuPont F&F Div. Viton 238-13-2	I(5)	Self Ext. 3 min./ 18 sec.
15	DuPont F&F Div. Viton 238-15-1	I(3)	No Burn
	DuPont F&F Div. Viton 238-15-1	I(5)	.056 "/sec.
16	DuPont F&F Div. Viton 238-21-1 30hr p.c.@300°F	I(3)	.060 "/sec.
	DuPont F&F Div. Viton 238-21-1 30hr p.c.@300°F	II(5)	Self Ext. 27 sec.
17	DuPont F&F Div. Viton 238-26-1 24hr p.c.@400°F	I(3)	.027 "/sec.
	DuPont F&F Div. Viton 238-26-1 24hr p.c.@400°F	II(3)	Self Ext. 12 sec.
	DuPont F&F Div. Viton 238-26-1 24hr p.c.@400°F	II(5)	Self Ext. 14 sec.
	DuPont F&F Div. Viton 238-26-1 24hr p.c.@400°F	V(3)	Self Ext. 9 sec.
	DuPont F&F Div. Viton 238-26-1 24hr p.c.@400°F	V(5)	Self Ext. 17 sec.

TABLE I Flammability Evaluation Test Results on Material Samples (cont'd.)

No.	Material Designation	Test Description	Results
18	DuPont F&F Div. Viton 238-32-1 24hr p.c.@300°F	II(3)	No Burn
19	DuPont F&F Div. Viton 238-32-1 24hr p.c.@400°F	I(3)	.025 "/sec.
	DuPont F&F Div. Viton 238-32-1 24hr p.c.@400°F	II(5)	Self Ext. 19 sec.
	DuPont F&F Div. Viton 238-32-1 24hr p.c.@400°F	V(3)	Self Ext. 9 sec.
	DuPont F&F Div. Viton 238-32-1 24hr p.c.@400°F	V(5)	Self Ext. 16 sec.
20	Dow Corning Corp. Silicone x-32038 4hr p.c.@325°F	II(3)	.088 "/sec.
21	REDAR-SI0503-00	V(1)	.23 "/sec.
	REDAR-SI-503-00	II(1)	.16 "/sec.
	REDAR-SI-503-00	I(1)	.42 "/sec.

TABLE II

Flammability Evaluation Test Results
on Hose Construction Samples

No.	I. D. Length	Hose Description	Test Description	Results
1	1.25 x 6"	Beta glass covered REDAR-SI-503-00	I(1)	No Burn
2	1.25 x 6"	Beta glass covered REDAR-SI-503-00	I(5)	No Burn
3	1.25 x 6"	Beta glass painted with REDAR-FL-300-00 over REDAR-SI-503-00	I(1)	No Burn
4	1.25 x 6"	REDAR-FL-300-00 over REDAR-SI-503-00	I(5)	Complete Combustion in 3 seconds
5	1.25 x 7"	F&F Viton 238-12-1 not postcured	I(3)	Complete Combustion
6	1.25 x 20"	F&F Viton 238-12-1 23 hr. p.c. @ 400^{o}F	I(3)	Self Ext. in 25 sec.
7	1.25 x 20"	F&F Viton 238-12-1 23 hr. p.c. @ 400^{o}F	I(5)	Self Ext. in 30 sec.
8	1.25 x 6"	REDAR-FL-300-00 wrapped with Chromel-R Fabric	I(5)	Complete Combustion

TABLE II Flammability Evaluation Test Results on Hose Construction Samples (cont'd)

No.	I. D. Length	Hose Description	Test Description	Results
9	1.25 x 6"	REDAR-SI-503-00	V(1)	Complete Combustion
10	1.25 x 6"	F&F Viton 238-26-1	V(3)	Self Ext. in 20 sec.
			V(5)	Self Ext. in 34 sec.
			II(5)	Self Ext. in 34 sec.
			I(5)	Self Ext. in 27 sec.
			III	Complete Combustion in 10 minutes

HOSE CONSTRUCTION STUDY

A. Material Study

The first step in the study of hose constructions was a thorough review of available literature on elastomeric materials. At the onset of the program three materials were under prime consideration. They were Fluorel, Kil-F, and silicone. A more complete definition can be found accompanying the Elastomer Evaluation Chart on the following pages. However, prior to the conclusion of the project, Viton was also considered of real significance.

Prior to initiation of the contract, the R. E. Darling Co., Inc. had done substantial investigation on many characteristics of CNR and had gone on record as indicating its serious shortcomings as an oxygen carrying tube. Of major concern was its toxic outgassing at elevated temperatures. We had not had exposure to extruding the material, a necessity for the manufacture of hose assemblies, but knew it could be molded. A small sample of CNR was scheduled for a trial extrusion but, upon direction of NASA, was cancelled when Fluorel appeared to be more promising and substantially less costly.

It must be acknowledged that Kel-F was never fully evaluated. Indications were that it would not meet flammability requirements and, again the impetus was placed on the Fluorel effort. Thus, the paper study as depicted by the Elastomer Evaluation Chart was the essence of our Kel-F examination.

An integral part of the construction of hose is fabric reinforcing. Pior to this program all fabric had been of nylon 6,6. However, the high temperature post-cures necessary to produce nonflammable elastomers exceeded the capabilities of nylon and alternate materials were examined. The initial thoughts turned to fiberglass and beta glass. The concern here was the splintering or fracturing of the fabric producing hazardous conditions in a breathing system.

It was finally determined that Nomex (high temperature nylon) would not degrade under post-cure conditions, provided the needed flexibility, and was totally safe for inclusion in this product. Beta glass is still considered a candidate in some instances but only when proper precautions are taken to see that its filaments cannot contaminate the gas carrying tube. PBI fabric was also evaluated and found suitable. However, its high cost and limited availability did not make it a practical production item. PBI was not found to offer any advantages over Nomex and therefore was not pursued further than the prototype stage.

TABLE III

Elastomer Evaluation Chart
Apollo Oxygen Hose Assembly

Property	Units	Silicone REDAR-SI-503-00	Fluorel L-2231	Fluorel 1071	Fluorel 1076	Viton 238-26-1	Viton 238-12-1	Dexsil 201 (A)	Kel-F 5500 (A)	CNR (A)
Durometer (±5)	Shore A	60	75	55	45	55	60	60	45	65
Ult. Elongation	%	430	210	200	350	230	300	250	400	550
Tensile Strength	psi	1100	1900	1370	1250	1100	1200	400	2500	1000
Specific Gra[illegible]ty	-	1.43	2.01	2.03	1.97	-	-	1.10	1.85	-
Abrasion Resistance	(B)	Fair	Good	Good	Good	Good	Good	Poor	-	-
Brittle Point	°F	-130	-13	-50	-85	-	-	-40	-70	-7
Flexibility (C)	at 70°F	Good	Fair	-	-	Good	Fair	Good	-	Good
Flexibility (C)	at 20°F	Good	Stiff	-	-	Stiff	Stiff	-	-	-
Flexibility (C)	at 0°F	Good	None	-	-	None	None	-	-	-

TABLE III Elastomer Evaluation Chart Apollo Oxygen Hose Assembly (cont'd.)

Property	Units	Silicone REDAR-SI-503-00	Fluorel L-2231	Fluorel 1071	Fluorel 1076	Viton 238-26-1	Viton 238-12-1	(A) Dexsil 201	(A) Kel-F 5500	(A) CNR
Oxygen Permeability		(G) 30×10^{-9}	(G) 28×10^{-11}	-	-	(H) 11×10^{-9}	-	-	-	-
Flammability	in/sec	.50	.039	.021	-	.060	(D)	-	-	-
Flammability Test	(E)	I(1)	I(3)	I(5)	-	I(3)	I(5)	-	-	-
Toxicity	(F)	None	None	-	-	None		None	-	-
Molding Characteristics		Good	Fair	Good	Good	Good	Good	-	-	Good
Extrusion Characteristics		Good	Fair	Poor	Poor	Good	Fair	-	-	-
Usable High Temperature	^{o}F	500	(J) 250	-	-	400	-	700	400	350
Tear Strength	ppi	(K) 100	(L) 122	(L) 55	(L) 77			(K) 25	-	-
Approx. lb. Vol. Cost		$5.70	$36.18	-	-		-	$110	-	-

Guide to Coding Used on Elastomer Evaluation Chart

A - Information taken from various published sources, not verified by actual tests

B - Subjective value only

C - Subjective value only relative to hose utilization

D - Sample did not ignite

E - See Test descriptions in Flammability Discussion sectior

F - TGA results per NASA reports both verbal and written

G - $cc/m\text{-}cm^2\text{-}sec\text{-}cmHg$

H - $cc/cm\text{-}cm^2\text{-}sec\text{-}atm$

J - Thermoplastic nature of material precludes dynamic use above this temperature. In static application, usable to 400°F continuous.

K - Die B

L - Die C

Description of Materials Listed on Elastomer Evaluation Chart

REDAR-SI-503-00

A silicone rubber manufactured by the R. E. Darling Co., Inc. Original material used in fabrication of oxygen hose for space programs.

L-2231

A "Fluorel" fluorelastomer, originally produced by 3M Co. as L-2231, then licensed for manufacutre by Raybestos-Manhattan as L-2317-1 and by Mosites Rubber Co. as 1059.

1071

A "Fluorel" fluoroelastomer manufactured by Mosites Rubber Co.

1076

A "Fluorel" fluorelastomer manufactured by Mosites Rubber Co.

238-26-1

A "Viton" fluorelastomer manufactured by the F&F Division of DuPont.

238-12-1

A "Viton" fluoroelastomer manufactured by the F&F Division of DuPont.

Dexsil 201

Polycarboranesiloxane elastomer manufactured by Olin Mathieson Chemical Corporation.

5500

A "Kel-F" fluoroelastomer manufactured by 3M Company.

CNR

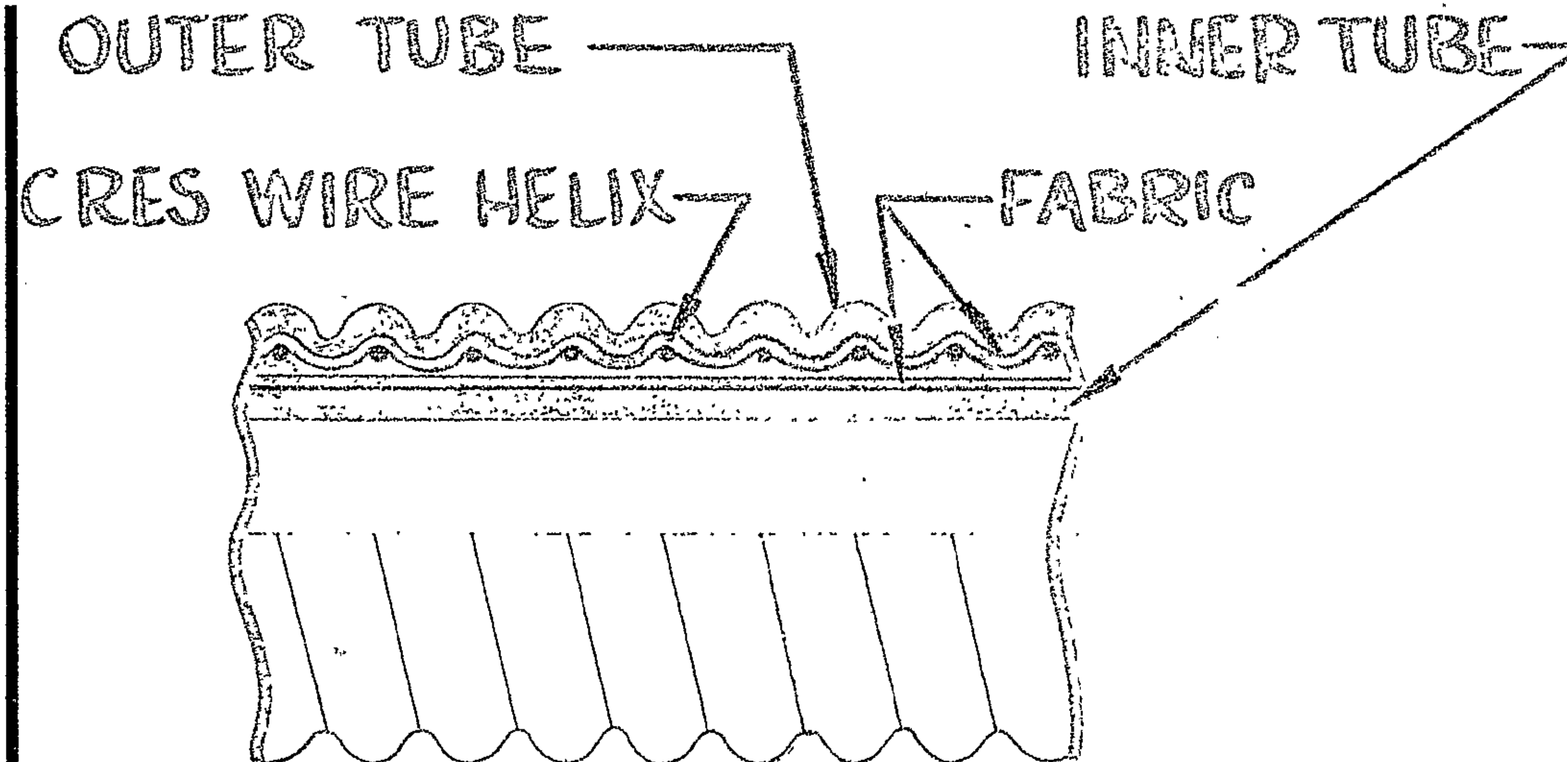
Carboxyl Nitroso Rubber manufactured by Thiokol Chemical Company

B. Construction Study

The accompanying figure shows the basic constituants of the oxygen hose construction. In the sketch, both the inner tube and outer tube are continuous extrusions with approximately a 1/32" wall. The hose are mandrel built and, in the case of the oxygen hose for the LEM and Apollo programs, are 1.25 inches inside diameter. The extrusion of several of the various elastomers under consideration presented a rather formidable production problem. To provide a smooth tube normal procedures require significant oils or similar plasticizers in the rubber compound. Most of these materials turned out to be quite flammable. The removal of them created a rough, non-uniform tube which adversely affected flow, pressure drop, temperature rise, leakage and flexibility. This roughness could not be tolerated on the inner surface. The outer tube could tolerate some irregularities as long as a minimum thickness could assure flame resistance.

Two approaches were similtaneously undertaken. The first was to use the various materials under consideration as a single_material construction and, through various techniques, attempt to provide the smoothest inner surface possible. The second idea was to use a silicone inner tube which gave a very smooth surface and excellent properties except for flame resistance and provide a non-flammable material as the outer tube. The latter was much easier said than done since a key to proper construction is the bonding of inner layers to outer layers as one continuous entity. The very nature of the elastomers under consideration precluded doing this. Most of them have excellent release properties and find commercial application because of it. The problem found its resolution in the use of the fabric layer as a substrate to which both elastomers would adhere under the proper conditions.

The only other major problem area was in the molding of some of the elastomers. In the construction of end configurations on the hose, a cuff is normally molded integrally over the outside of the finished tube. This provides a clamping surface which protects the hose proper from cutting and chafing. In the use of Fluorel, we found the thermoplastic nature of the material caused it to flow away from the molded area during the molding cycle. To overcome this problem we ended up molding the cuffs separately and installing them with a cement. The post curing cycle then produced a satisfactory bond.



HOSE CROSS-SECTION

C. Submissions

Four hose have been submitted for evaluation under this contract. Each hose was 72" long and 1.25" inside diameter. Each hose was made of a different construction material as follows:

1. All Fluorel L-2231 material throughout.

2. Fluorel L-2231 external material, REDAR-SI-503-00 silicone inner tubing.

3. All Viton 238-26-1 material throughout.

4. Viton 238-26-1 external material, REDAR-SI-503-00 silicone inner tubing.

These items were sent to NASA, Manned Spacecraft Center on January 29, 1969, on R. E. Darling Co., Inc. Packing Slip No. 9A-065.

D. Test Results

For clarification purposes, the following definitions shall apply. Viton is DuPont F and F Division No. 238-26-1, Silicone is REDAR-SI-503-00, Fluorel is 3M No. L2231. All hose are 1.25 I.D. x 72" long. All test slabs are ASTM plaques .070 thick. Flame samples are 2.5" x 5". Low temperature samples are 1" x 6".

1. Test: Oxygen permeability.
   Test conditions: Hose subjected to 10.4 psig for 2 minutes then 15 minutes at 6.4 psig oxygen. Measurement taken at 6.4 psig. Values are cc for 15 minutes per 6 ft length.
   Results:

Silicone/Fluorel Laminate Hose	8.4 cc total
All Fluorel Hose	0.0 cc total
Silicone/Viton Laminate Hose	10.2 cc total
All Viton Hose	1.5 cc total

2. Test: Weight
   Results:

Silicone/Fluorel Laminate Hose	1098 gms
All Fluorel Hose	1388 gms
Silicone/Viton Laminate Hose	1360 gms
All Viton Hose	1282 gms

   Comment: Due to prototype manufacturing variances and limited material, we feel the above results are inconclusive and not to be used as guidance for weight calculations.

3. Test: Low Temperature Flexibility (Hose)
   Test Conditions: Hose samples were conditioned in cold box at temperatures indicated. Hose were coiled around 4 inch diameter mandrel at temperature indicated. Subjective evaluation given by two people. Constructions listed in order of stiffness, most stiff first to least stiff last.

Results:

Temperature + 70°F
All Fluorel Hose
Fluorel/Silicone Laminate Hose
All Viton Hose

Temperature + 40°F
All Fluorel Hose
Fluorel/Silicone Hose and
All Viton Hose same stiffness

Temperature + 25°F
All Fluorel Hose
Fluorel/Silicone Hose and
All Viton Hose same stiffness

Temperature + 15°F
All hose found to be too stiff
to be considered operational.

Comment: An all silicone hose was considered to be flexible at all temperatures listed. None was submitted to test at this time since it had been done on many previous occasions.

4. Test: Low Temperature Flexibility (Slab)
Test Conditions: Test slabs were conditioned in cold box at temperature indicated. Slabs coiled around 2" diameter mandrel. Subjective evaluation given.
Results:
Only Viton was tested. At 0°F sample bent with little pressure. At -25°F sample stiff but flexed, no cracking.

Comment: From the results of Tests 3 and 4 it is obvious that little can be gained from evaluating the materials except in a hose construction.

5. Test: Flame Test
Results: Only Vit tested.

Pressure	Gas	Igniter	Results
5.0 psia	100% oxygen	3 tissues	Self Ext. 12 sec
5.0 psia	100% oxygen	5 tissues	Self Ext. 14 sec
16.5 psia	100% oxygen	3 tissues	Complete Burn 3min/9sec
16.5 psia	60/40 O-N	3 tissues	Self Ext. 9 sec
16.5 psia	60/40 O-N	5 tissues	Self Ext. 17 sec

6. Test: Flammability on hose section 1.25 I.D. x 6" long.
Material - Viton
Results:

Pressure	Gas	Igniter	Results
16.5 psia	60/40 O-N	3 tissues	Self Ext. 20 sec.
16.5 psia	60/40 O-N	5 tissues	Self Ext. 34 sec.
5.0 psia	100% oxygen	1 tissue	No Burn
5.0 psia	100% oxygen	3 tissues	Self Ext. 17 sec.
5.0 psia	100% oxygen	5 tissues	Self Ext. 34 sec.
16.5 psia	100% oxygen	1 tissue	Self Ext. 9 sec.
16.5 psia	100% oxygen	3 tissues	Self Ext. 19 sec.
16.5 psia	100% oxygen	5 tissues	Self Ext. 27 sec.
16.5 psia	60/40 O-N	1"sil.squib	Self Ext. 3 min. 14 sec
5.0 psia	100% oxygen	1"sil.squib	Self Ext. 5 min.*
16.5 psia	100% oxygen	1"sil.squib	Complete Combustion 10

*Did not burn through inner tube. Hose still capable of carrying oxygen.

General Comment:
Due to the lack of sufficient material, only two hose utilizing Viton were fabricated and three test ASTM plaques were molded.

CONNECTOR STUDY

A. Connector Objectives

In both space chamber applications and non-pressurized test work, there were sufficient times when connecting devices in hose were not properly retained to cause true concern for the safety of the personnel using the hose. To provide interchangeability, most large bore hose are supplied with soft, molded cuffs into which connectors may be slipped and clamped in place. There have been instances when incorrectly sized connectors have been installed in hose. On occasion these connectors have slipped out of the hose, thus creating a very hazardous condition.

Under these circumstances, the R. E. Darling, Co., Inc. determined that two design factors should be paramount. The first aspect was retention into the hose and a design goal of 300 lb. tensile load in any direction without leakage or separation. The second factor was that only the proper sized mating insert as defined by MS33658 could be installed. An additional feature deemed desirable was that the mechanism be capable of engaging and disengaging with one gloved hand.

The following drawings show two designs which were prototyped and submitted under Contract NAS 9-7764. In both instances they meet the two basic design criteria established. Since both connectors are installed as a permanent installation into the hose end they meet the tensile load requirement. This was verified by actual testing of the prototypes. Secondly neither connector will accept any beaded fitting except that diameter it is designed to accept.

The difference between the two connector designs revolves about the other desirable feature, that of a one-handed operation. The REDAR-C10794 is capable of meeting the criteria but is much more bulky than its smaller, light-weight, two-handed counterpart, REDAR-C10784. In review of the two designs we felt both should be presented as either could be used in specific applications.

One additional design feature should be noted. Our drawings illustrate a series of connectors which will accept only an MS33658-20 beaded insert, when installed in any sized hose. Needless to say, this same retention concept can be made for MS33658-12, -14, -16, and -18, each to fit into a specific sized hose.

The following tests were conducted on a prototype REDAR-C10794-1 connector. We believe the results listed are quite significant.

1. Leakage at 4 psig nitrogen for 15 minutes - 0.

2. Leakage at 8 psig nitrogen for 2 minutes - 0.

3. Leakage after 10 engagement cycles at 4 psig - 0.

4. 300 lb. axial pull, 2 minutes at 8 psig - 0.

5. 300 lb. pull 90° to centerline, 2 minutes at 8 psig - 50 cc total.

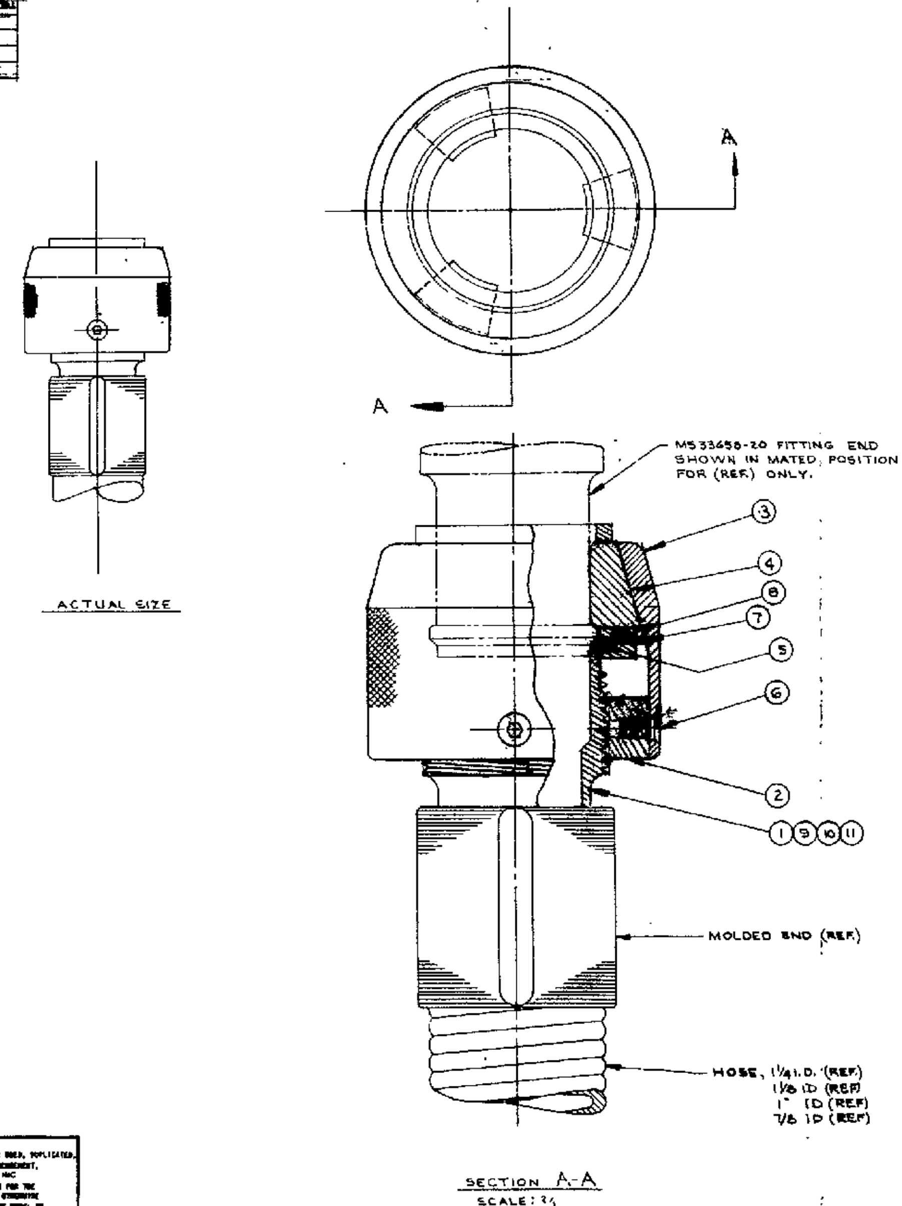
B. Connector Drawings

In this section are found the following drawings:

REDAR-C10794	Connector Assembly
-C10795	Insert
-C10796	Sleeve Assembly
-C10797	Adapter
-C10850	Insert
-C10851	Insert
-C10852	Insert
-C10897	Spring Washer
-C10898	Pressure Ring
-C10900	Ring Nut
REDAR-C10784	Connector Assembly
-C10785	Sleeve
-C10786	Insert
-C10787	Collar Assembly
-C10788	Ring
-C10789	Segment
-C10790	Screw

PART NO.	DESCRIPTION
REDAR-C10794-1	1¼ INSERT
-2	1⅛ "
-3	1" "
-4	7/8 "

REVISIONS



SECTION A-A
SCALE: 2/1

QTY REQD -4	QTY REQD -3	QTY REQD -2	QTY REQD -1	PART OR IDENTIFYING NO.	ITEM	NOMENCLATURE OR DESCRIPTION	MATERIAL OR NOTE
1	—	—	—	REDAR-C10850-1	11	INSERT, 7/8 ID HOSE	AL ALY 7075 T6
—	1	—	—	-C10851-1	10	INSERT 1" ID HOSE	AL ALY 7075 T6
—	—	1	—	-C10852-1	9	INSERT 1⅛ ID HOSE	AL ALY 7075 T6
1	1	1	1	-C10838-1	8	WASHER, FLAT	CRES
1	1	1	1	REDAR-C10837-1	7	WASHER, SPRING	CRES
4	4	4	4	COM'L	6	[illegible]	CRES
1	1	1	1	MS9068-27	5	O-RING	SILICONE
3	3	3	3	REDAR-C10797-1	4	JAW	AL ALY 7075-T6
1	1	1	1	REDAR-C10796-1	3	SLEEVE	AL ALY 7075-T6
1	1	1	1	REDAR-C10900-1	2	NUT, RING	AL ALY 7075-T6
—	—	—	1	REDAR-C10795-1	1	INSERT 1¼ ID HOSE	AL ALY 7075-T6

LIST OF MATERIALS OR PARTS LIST

	SIGNATURE	DATE
DR.	T. DORSETT	4-30-6[illegible]
CHK.	M.A.	[illegible]
APPROVED	FSC M.A.	[illegible]

REF.: NASA 9-7764

R. E. DARLING CO., INC.
GAITHERSBURG, MARYLAND
TUCSON, ARIZONA

CONNECTOR ASSEMBLY,
FOR MS33658-20 END FITTING
TO 1¼ ID HOSE

SIZE D | REDAR-C10794 | REV A

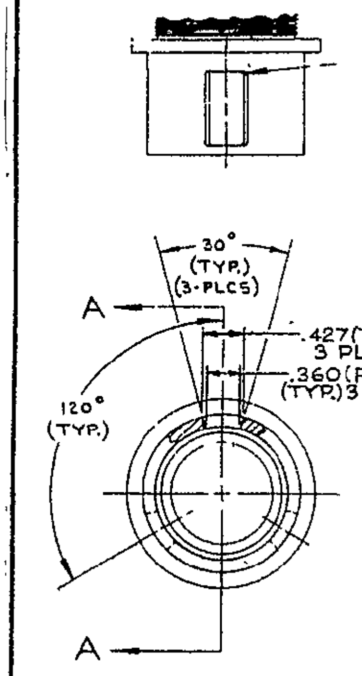
SCALE AS NOTED

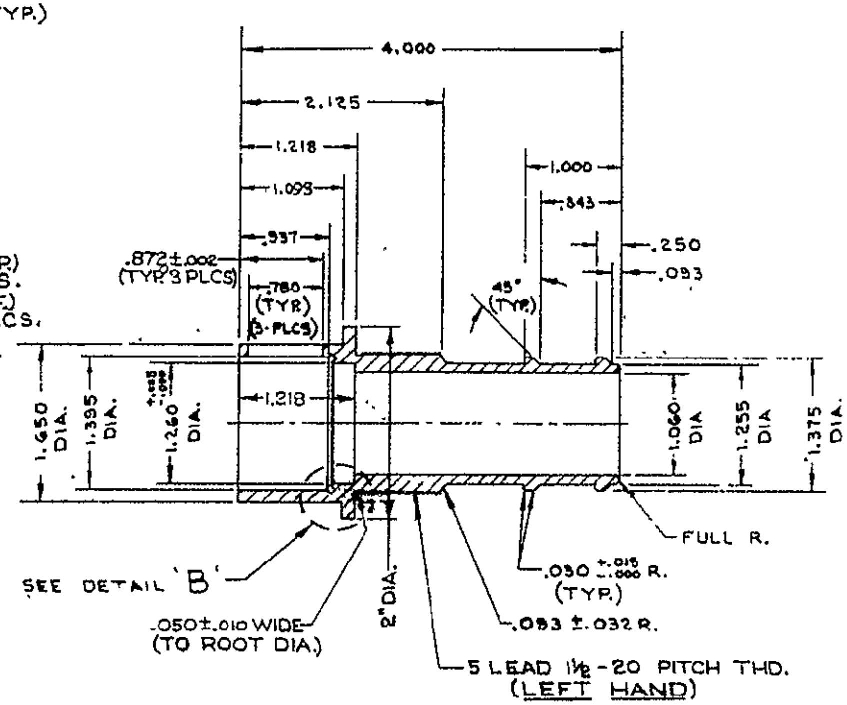
40-100

PART NO.
REDAR- C10795

REVISIONS

SYM.	DESCRIPTION	DATE	APPROVAL
A	FIRST ISSUE	2/12/68	mg

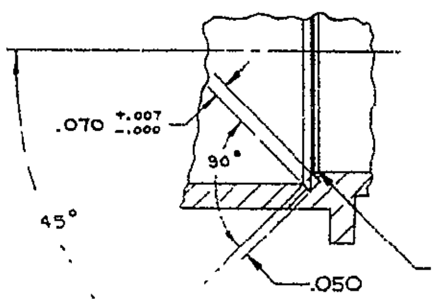




SECTION A-A

NOTES

1. REMOVE ALL BURRS & BREAK SHARP EDGES.
2. ALL DIA'S TO BE CONCENTRIC .005 T.I.R.
3. (△) SURFACE TREATMENT: ANODIZE PER MIL-A-8625, TYPE II, CLASS 1 (CLEAR)



DETAIL 'B'
SCALE 2/1

QTY. REQD	PART OR IDENTIFYING NO	ITEM	NOMENCLATURE OR DESCRIPTION	MATERIAL OR NOTE

LIST OF MATERIALS OR PARTS LIST

FURNISHED UNDER UNITED STATES GOVERNMENT CONTRACT NO.
SHALL NOT BE EITHER RELEASED OUTSIDE THE GOVERNMENT, OR USED, DUPLICATED OR DISCLOSED IN WHOLE OR IN PART FOR MANUFACTURE OR PROCUREMENT, WITHOUT THE WRITTEN PERMISSION OF R. E. DARLING CO., INC EXCEPT FOR: (I) EMERGENCY REPAIR OR OVERHAUL WORK BY OR FOR THE GOVERNMENT, WHERE THE ITEM OR PROCESS CONCERNED IS NOT OTHERWISE REASONABLY AVAILABLE TO ENABLE TIMELY PERFORMANCE OF THE WORK, OR (II) RELEASE TO A FOREIGN GOVERNMENT, AS THE INTEREST OF THE UNITED STATES MAY REQUIRE; PROVIDED THAT IN EITHER CASE THE RELEASE, USE, DUPLICATION OR DISCLOSURE HEREOF SHALL BE SUBJECT TO THE FOREGOING LIMITATIONS. THIS LEGEND SHALL BE MARKED ON ANY REPRODUCTION HEREOF IN WHOLE OR IN PART.

DASH NO.	NEXT ASSY	USED ON
-1	C10794-1	C10794-1

APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
Tolerances on: Fractions ± 1/64; Decimals ± .005; Angles ± 0°-30'

125 √ SURFACE ROUGHNESS

MATERIAL: AL ALY 7075-T6

SURFACE TREATMENT: △3

	SIGNATURE	DATE
DR	BR	5-28-68
CHK	mg	5/29/68
CARD	J. B. W.	7/11/68
APPROVED	FEC mg	5/29/68

REF

[redacted]

R. E. DARLING CO., INC.
GAITHERSBURG, MARYLAND
TUCSON, ARIZONA

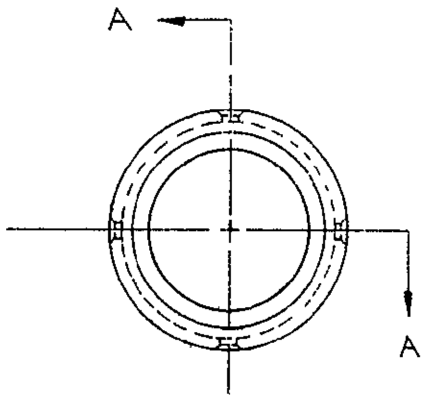
INSERT
FOR 1¼ ID HOSE

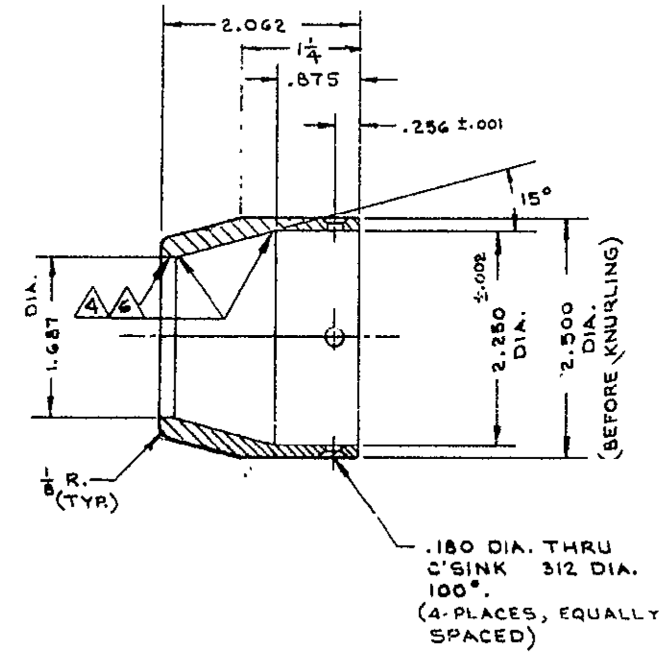
CODE IDENT	SIZE		REV
83452	C	REDAR-C10795	A

SCALE 1/1 | SHEET

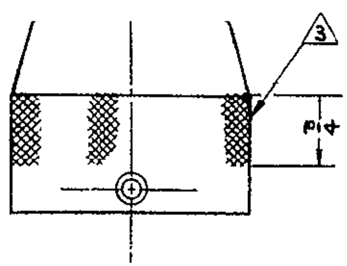
PART NO.	SURFACE TREATMENT (5)				
	TREATMENT	TYPE	CLASS	COLOR & NO.	
REDAR-C10796-1	ANODIZE	II	1	————	

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL
A	FIRST ISSUE	1/12/69	mg





SECTION A-A



NOTES

1. REMOVE ALL BURRS & BREAK SHARP EDGES.
2. ALL DIA'S TO BE CONCENTRIC .005 TIR.
3. (3) KNURL: COARSE DIAMOND (SAND LIGHTLY)
4. (4) SAND BLAST INTERNAL SURFACES INDICATED WITH FINE ABRASIVE GRIT, AFTER ANODIZING.
5. (5) SURFACE TREATMENT: ANODIZE PER MIL-A-8625 (SEE TABULATION FOR TYPE, CLASS & COLOR PER FED. STD. 595 WHEN REQ'D.)
6. (6) COAT INTERNAL SURFACES INDICATED WITH TEFLON DUPONT 850-311(TFE) .0005 TO .0010 THICK. (AFTER ANODIZING & SAND BLASTING)
7. (7) ALL DIMENSIONS TO BE HELD AFTER MACHINING.

QTY. REQD	PART OR IDENTIFYING NO.	ITEM	NOMENCLATURE OR DESCRIPTION	MATERIAL OR NOTE

LIST OF MATERIALS OR PARTS LIST

DASH NO.	NEXT ASSY	USED ON
-1	C10794-1	C10794-1
APPLICATION		

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
Tolerances on: Fractions ± 1/64, Decimals ±.005, Angles ± 0°30'

125 √ SURFACE ROUGHNESS

MATERIAL: AL ALY 7075-T6

SURFACE TREATMENT: (4)(5)(6)

	SIGNATURE	DATE
DR.	B.R.	5-23-68
CHK.	mg	6/3/68
CARD	J.G.B.	7/11/68
APPROVED	FTC mg	7/12/68

REF

[redacted]

R. E. DARLING CO., INC.
GAITHERSBURG, MARYLAND
TUCSON, ARIZONA

SLEEVE

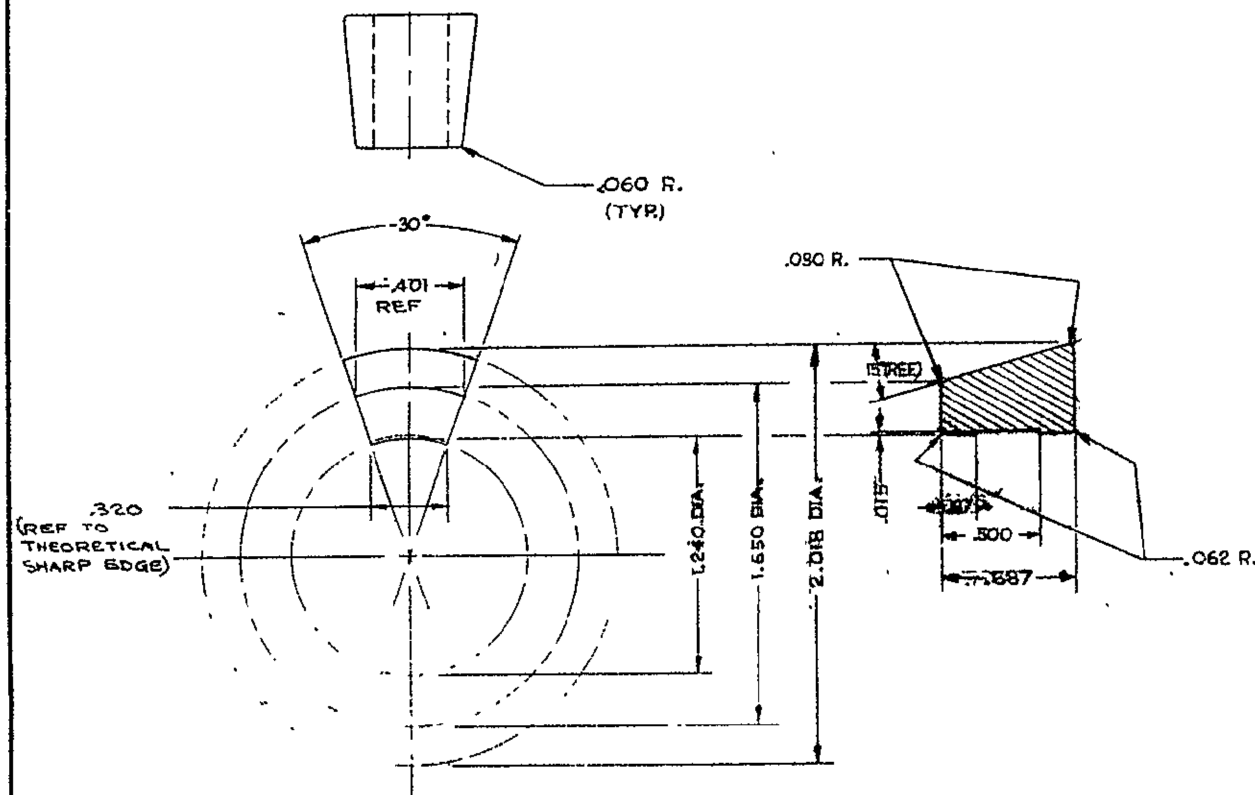
CODE 83452 | SIZE C | REDAR-C10796 | REV A

SCALE: 1/1 | SHEET

PART NO.	SURFACE TREATMENT 4			
	TREATMENT	TYPE	CLASS	COLOR & NO.
REDAR-C10797-1	ANODIZE	III	1	———

REVISIONS

SYM	DESCRIPTION		APPROVAL
A	FIRST ISSUE		



NOTES:

1. ALL DIAMETERS TO BE CONCENTRIC WITHIN .005 TIR.
2. REMOVE ALL BURRS AND BREAK SHARP EDGES.
3. SANDBLAST ALL SURFACES WITH FINE ABRASIVE GRIT, AFTER ANODIZING.
4. SURFACE TREATMENT-ANODIZE PER MIL-A-8625 (SEE TABULATION FOR TYPE, CLASS & COLOR PER FED. STD. 595 WHEN REQD.
5. COAT ALL SURFACES WITH TEFLON DUPONT 850-311(TFE).0005 TO .0010 THICK. (AFTER ANODIZING & SAND BLASTING)

QTY REQD	PART OR IDENTIFYING NO	ITEM	NOMENCLATURE OR DESCRIPTION	MATERIAL OR NOTE

LIST OF MATERIALS OR PARTS LIST

DASH NO	NEXT ASSY	USED ON
-1	C10794-1	C10794-1

APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
Tolerances on: Fractions ± — Decimals ±.005 Angles ±½°

125 √ SURFACE ROUGHNESS

MATERIAL: AL ALY 7075-T6

SURFACE TREATMENT: 3 4 5

	SIGNATURE	DATE
DR	E.A.B.	5-22-68
CHK		5/23/68
C.A.R.D.		7/12/68
APPROVED	FSC	9/26/68

R. E. DARLING CO., INC.
GAITHERSBURG, MARYLAND
TUCSON, ARIZONA

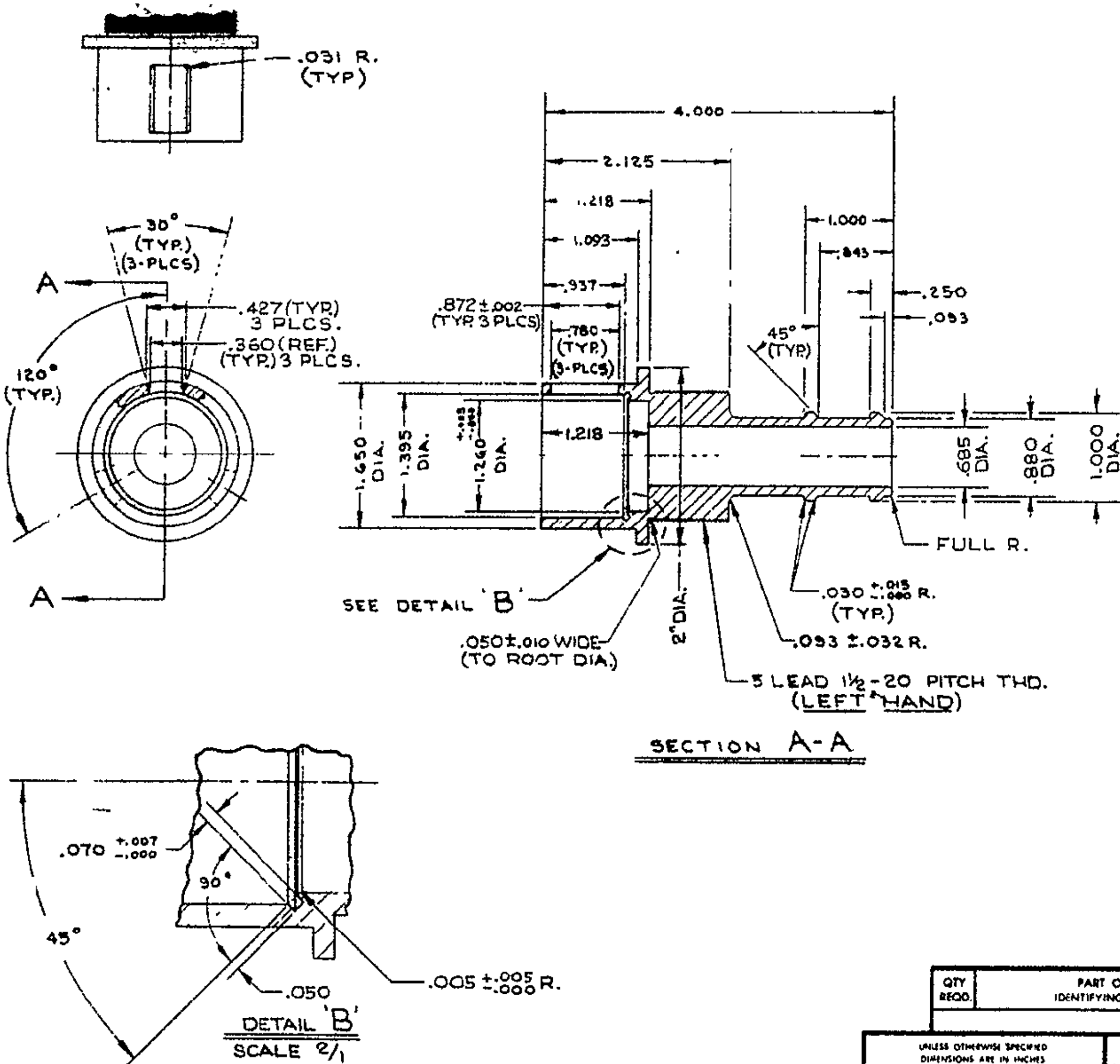
JAW -

CODE IDENT	SIZE	DWG NO	REV
03452	C	REDAR-C10797	A

SCALE 2/1 SHEET 1

PART NO.
REDAR-C10850

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL
A	FIRST ISSUE	2/11/69	



NOTES

1. REMOVE ALL BURRS & BREAK SHARP EDGES.
2. ALL DIA'S TO BE CONCENTRIC .005 T.I.R.
3. (△3) SURFACE TREATMENT: ANODIZE PER MIL-A-8625, TYPE II, CLASS 1 (CLEAR)

QTY REQD.	PART OR IDENTIFYING NO	ITEM	NOMENCLATURE OR DESCRIPTION	MATERIAL OR NOTE

LIST OF MATERIALS OR PARTS LIST

DASH NO.	NEXT ASSY	USED ON
-1	C10794-4	C10794-4
APPLICATION		

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
Tolerances on: Fractions $\pm 1/64$ Decimals $\pm .005$ Angles $\pm 0°30'$
125 √ SURFACE ROUGHNESS

MATERIAL: AL ALY 7075-T6

SURFACE TREATMENT: △3

	SIGNATURE	DATE
DR	J.G.B.	9/20/68
CHK	M.R.	9/23/68
CARD	J.G.B.	9/20/68
APPROVED	FSC M.H.	9/24/68

REF

[redacted]

R. E. DARLING CO., INC.
GAITHERSBURG, MARYLAND
TUCSON, ARIZONA

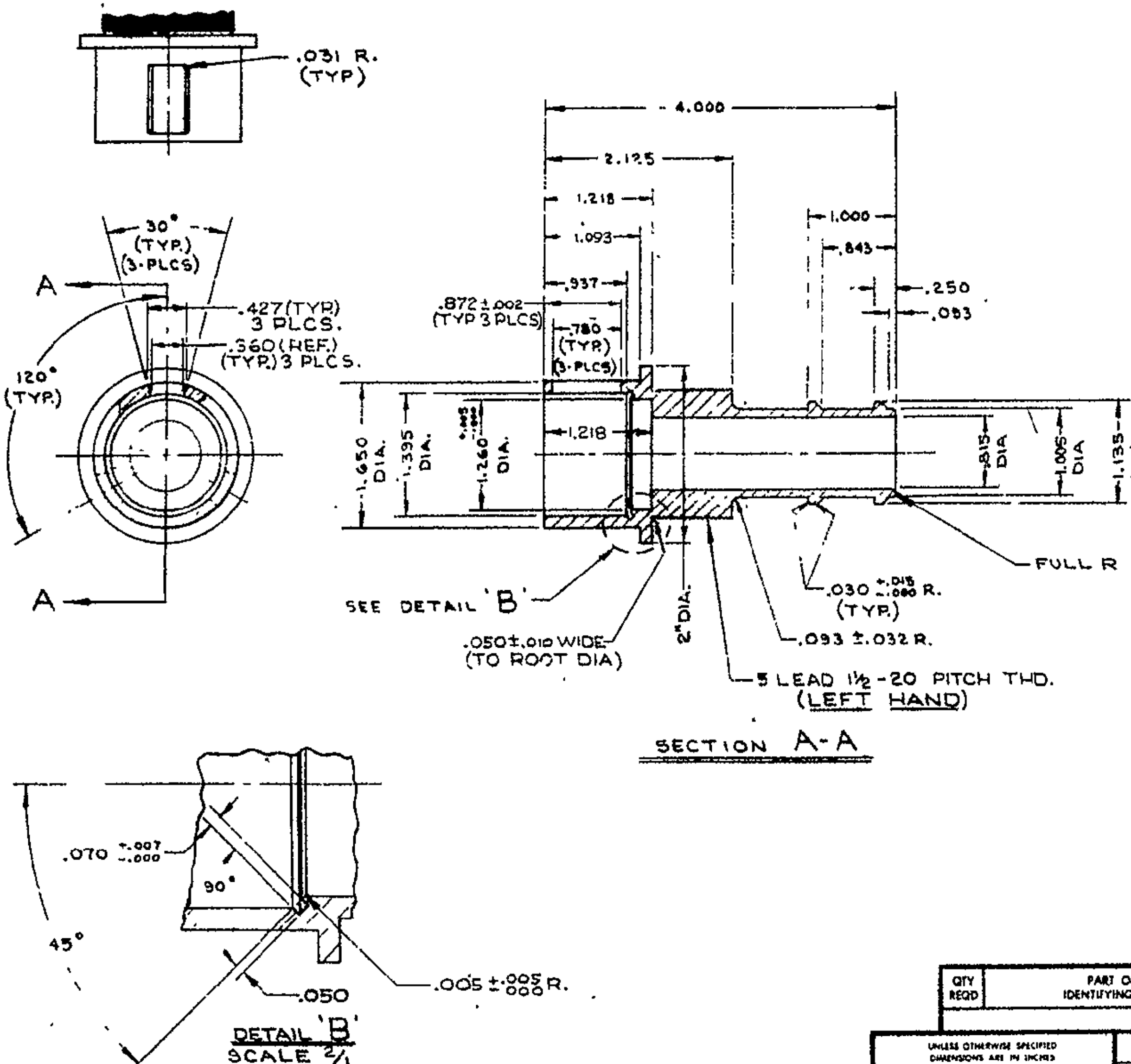
INSERT
FOR 7/8 ID HOSE

CODE 83457	SIZE C	REDAR-C10850	REV. A

SCALE: 1/1 SHEET

PART NO.
REDAR-C10851-1

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL
A	FIRST ISSUE	2/11/69	M.G.



NOTES

1. REMOVE ALL BURRS & BREAK SHARP EDGES.
2. ALL DIA'S TO BE CONCENTRIC .005 T.I.R.
3. (3) SURFACE TREATMENT: ANODIZE PER MIL-A-8625, TYPE II, CLASS 1 (CLEAR)

QTY REQD	PART OR IDENTIFYING NO	ITEM	NOMENCLATURE OR DESCRIPTION	MATERIAL OR NOTE

LIST OF MATERIALS OR PARTS LIST

DASH NO	NEXT ASSY	USED ON
-1	C10794-3	C10794-3
APPLICATION		

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
Tolerances on: Fractions ± 1/64; Decimals ± .005; Angles ± 0°-30'

125 √ SURFACE ROUGHNESS

MATERIAL: AL ALY 7075-T6

SURFACE TREATMENT: (3)

	SIGNATURE	DATE
DR	J.G.B.	9/20/68
CHK	M.G.	
CARD	J.G.B.	9/20/68
APPROVED	F.G. M.G.	9/24/68

[redacted] R. E. DARLING CO., INC.
GAITHERSBURG, MARYLAND
TUCSON, ARIZONA

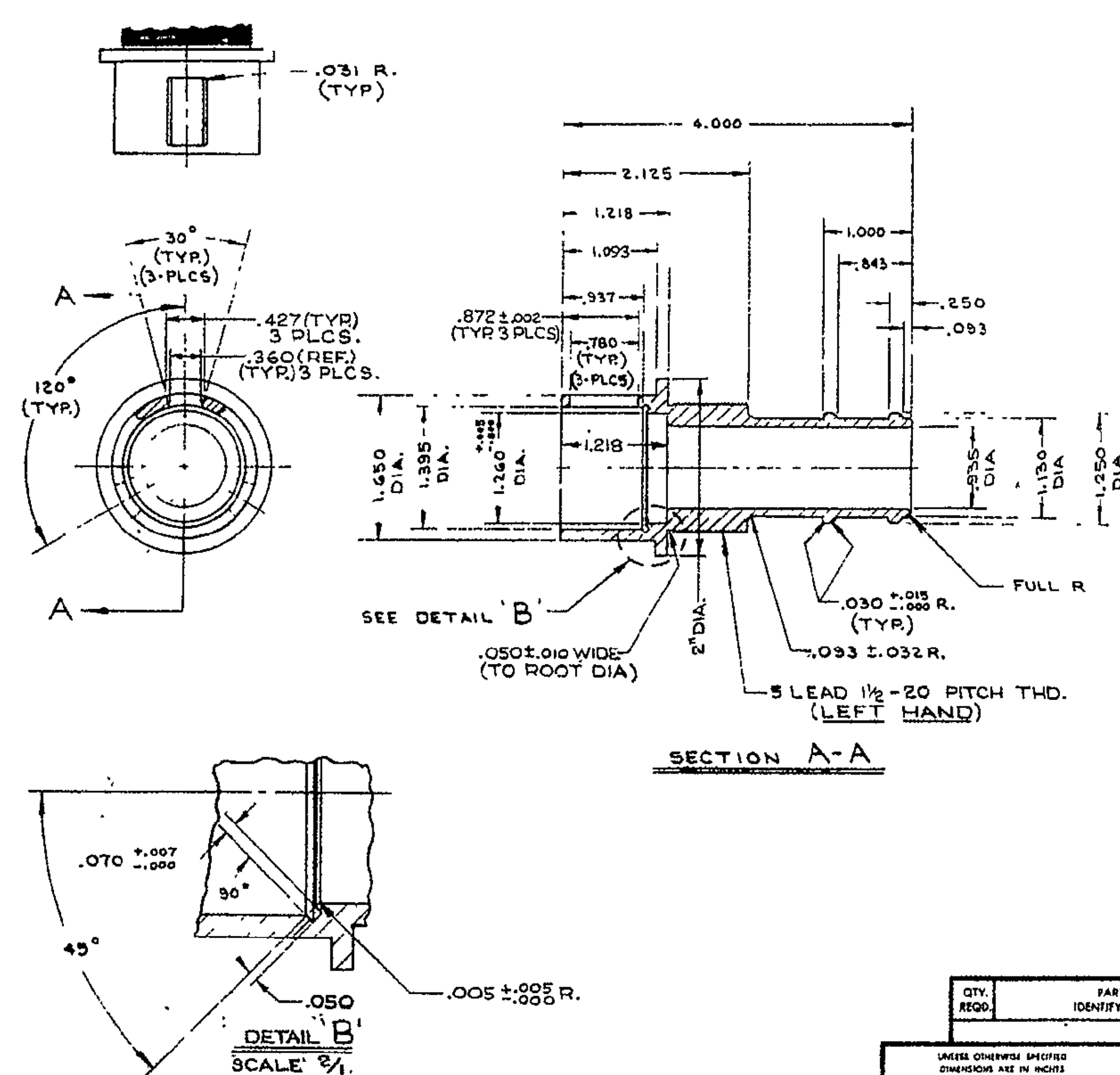
INSERT
FOR 1" ID HOSE

CODE 03452	SIZE C	REDAR-C10851	REV A

SCALE 1/1 SHEET

PART NO.
REDAR- C10852-1

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL
A	FIRST ISSUE	2/13/69	M.J.



NOTES

1. REMOVE ALL BURRS & BREAK SHARP EDGES.
2. ALL DIA'S TO BE CONCENTRIC .005 T.I.R.
3. (△) SURFACE TREATMENT. ANODIZE PER MIL-A-8625, TYPE II, CLASS 1 (CLEAR)

QTY. REQD.	PART OR IDENTIFYING NO	ITEM	NOMENCLATURE OR DESCRIPTION	MATERIAL OR NOTE

LIST OF MATERIALS OR PARTS LIST

FURNISHED UNDER UNITED STATES GOVERNMENT CONTRACT NO. SHALL NOT BE EITHER RELEASED OUTSIDE THE GOVERNMENT, OR USED, DUPLICATED, OR DISCLOSED IN WHOLE OR IN PART FOR MANUFACTURE OR PROCUREMENT, WITHOUT THE WRITTEN PERMISSION OF R. E. DARLING CO., INC. EXCEPT FOR: (1) EMERGENCY REPAIR OR OVERHAUL WORK BY OR FOR THE GOVERNMENT, WHERE THE ITEM OR PROCESS CONCERNED IS NOT OTHERWISE REASONABLY AVAILABLE TO ENABLE TIMELY PERFORMANCE OF THE WORK; OR (II) RELEASE TO A FOREIGN GOVERNMENT, AS THE INTEREST OF THE UNITED STATES MAY REQUIRE; PROVIDED THAT IN EITHER CASE THE RELEASE, USE, DUPLICATION OR DISCLOSURE HEREOF SHALL BE SUBJECT TO THE FOREGOING LIMITATIONS. THIS LEGEND SHALL BE MARKED ON ANY REPRODUCTIONS HEREOF IN WHOLE OR IN PART.

DASH NO.	NEXT ASSY	USED ON
-1	C10794-2	C10794-2
APPLICATION		

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
Tolerances on: Fractions ± 1/64, Decimals ±.005, Angles ± 0°-30'

125 √ SURFACE ROUGHNESS

MATERIAL: AL ALY 7075-T6

SURFACE TREATMENT: △3

	SIGNATURE	DATE
DR.	E.R.B.	9/20/68
CHK	M.A.	9/25/68
CARD	E.G.B.	9/20/68
APPROVED	FSC. M.A.	9/20/68
REF		

[redacted]

R. E. DARLING CO., INC.
GAITHERSBURG, MARYLAND
TUCSON, ARIZONA

INSERT
FOR 1 1/8 ID HOSE

CODE 83182	SIZE C	REDAR-C10852	A

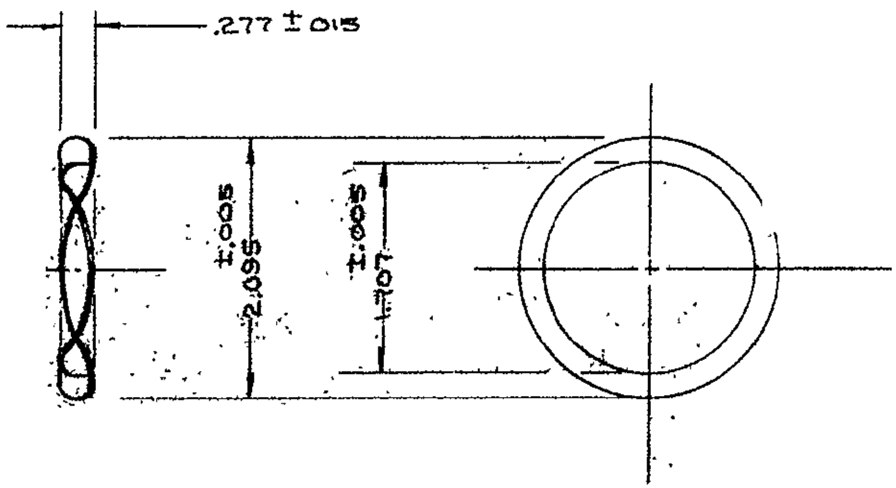
SCALE 1/1

REDAR-C10852

PART NO
REDAR-C10897-1

REDAR-C10897

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL
A	FIRST ISSUE	2/12/69	



1. MATERIAL - .015 THK. CRES, 302 OR 410 TYPE

2. REMOVE ALL BURRS & BREAK SHARP EDGES.

3. SURFACE TREATMENT - PASSIVATE

4. SUGGESTED VENDOR:
SHAKEPROOF
DIV. OF ILLINOIS TOOL WORKS INC.
ELGIN, ILL.
(STYLE G)
PN 5513-47-01 (EXCEPT MATL TO BE CRES)

-1	C10794	C10794
DASH NO.	NEXT ASSY	USED ON
APPLICATION		

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
Tolerances on Fractions ± 1/64 Decimals ± .005 Angles ± —

MATERIAL: ⚠1

FINISH:

SIGNATURE		DATE
DR.	MG	
CHK.		
ENG.		
APPROVED	ESC	

WASHER, SPRING
"WAVY WASHER"

R. E. DARLING CO., INC.
[redacted]
GAITHERSBURG, MD.
TUCSON, ARIZ.

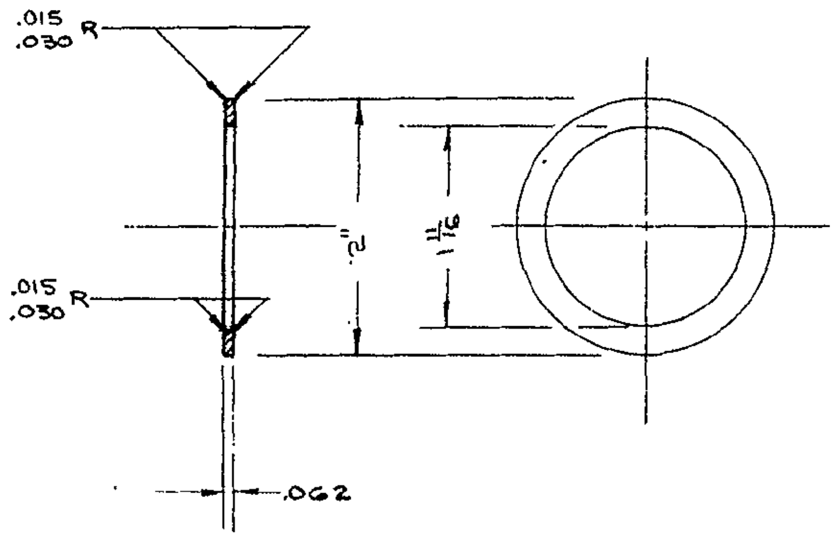
REDAR-C10897

CODE | SCALE | SHEET —

PART NO.
REDAR-C10898-1

REDAR-C10898

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL
A	FIRST ISSUE	2/12/63	M.J.



NOTE:

1. MATERIAL - CRES 302, OR 304 TYPE
2. SURFACE TREATMENT - PASSIVATE

DASH NO.	NEXT ASSY.	USED ON
-1	C10794	C10794

FURNISHED UNDER UNITED STATES GOVERNMENT CONTRACT NO. SHALL NOT BE EITHER RELEASED OUTSIDE THE GOVERNMENT, OR USED, DUPLICATED, OR DISCLOSED IN WHOLE OR IN PART FOR MANUFACTURE OR PROCUREMENT, WITHOUT THE WRITTEN PERMISSION OF R. E. DARLING CO., INC. EXCEPT FOR: (I) EMERGENCY REPAIR OR OVERHAUL WORK BY OR FOR THE GOVERNMENT, WHERE THE ITEM OR PROCESS CONCERNED IS NOT OTHERWISE REASONABLY AVAILABLE TO ENABLE TIMELY PERFORMANCE OF THE WORK; OR (II) RELEASE TO A FOREIGN GOVERNMENT, AS THE INTEREST OF THE UNITED STATES MAY REQUIRE; PROVIDED THAT IN EITHER CASE THE RELEASE, USE, DUPLICATION OR DISCLOSURE HEREOF SHALL BE SUBJECT TO THE FOREGOING LIMITATIONS. THIS LEGEND SHALL BE MARKED ON ANY REPRODUCTION HEREOF IN WHOLE OR IN PART.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

Tolerances on: Fractions ± 1/64 Decimals ± .0015 Angles ± —

MATERIAL: 1

FINISH: —

SIGNATURE		DATE
DR.	M.G	9/20/62
CHK.	M.J.	9/20/62
ENG		
APPROVED	FSC. M.J.	9/20/62

WASHER, FLAT

SCALE: 1/1

R. E. DARLING CO., INC.
GAITHERSBURG, MD.
TUCSON, ARIZ.

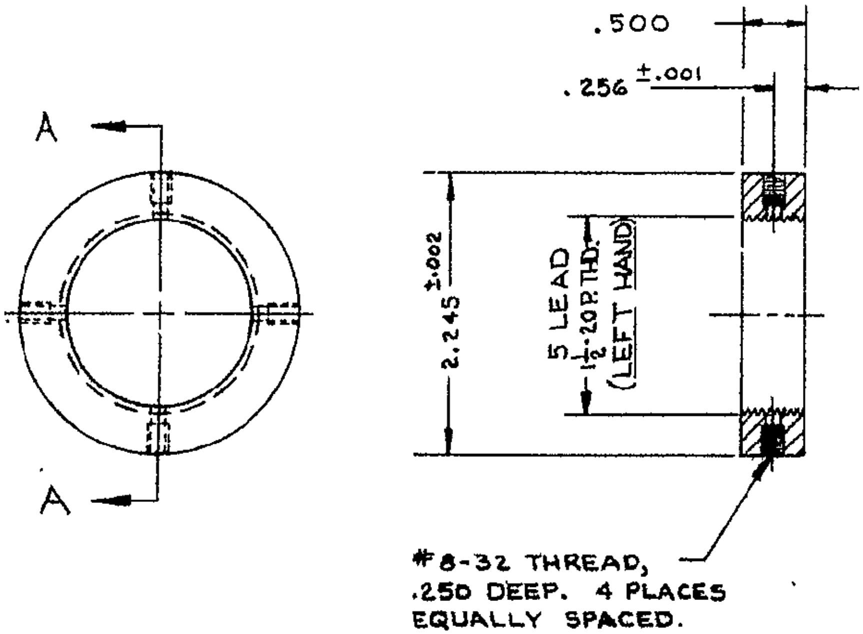
REDAR-C10898

CODE 83452 SHEET —

PART NO.	SURFACE TREATMENT ⚠3			
	TREATMENT	TYPE	CLASS	COLOR & NO.
REDAR-C10900-1	ANODIZE	II	1	———

REDAR-C10900

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL
A	FIRST ISSUE	2/12/69	MA



SECTION A-A

NOTES

1. REMOVE ALL BURRS & BREAK SHARP EDGES.
2. ALL DIA'S TO BE CONCENTRIC .005 TIR.
3. (⚠) SURFACE TREATMENT:
   ANODIZE PER MIL-A-8625 (SEE TABULATION FOR TYPE, CLASS & COLOR PER FED. STD. 595 WHEN REQ'D)

-1	C10794-1	C10794-1
DASH NO	NEXT ASSY	USED ON
APPLICATION		

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
Tolerances on: Fractions ±1/64 | Decimals ±.005 | Angles ±0°30'

MATERIAL: AL ALY 7075-T6

FINISH: 125 √ SURFACE ROUGHNESS

SIGNATURE		DATE
DR.	BR	5-31-68
CHK.	MA	2/11/69
ENG.		
APPROVED	ASC MA	2/12/69

SCALE: 1/1

NUT, RING

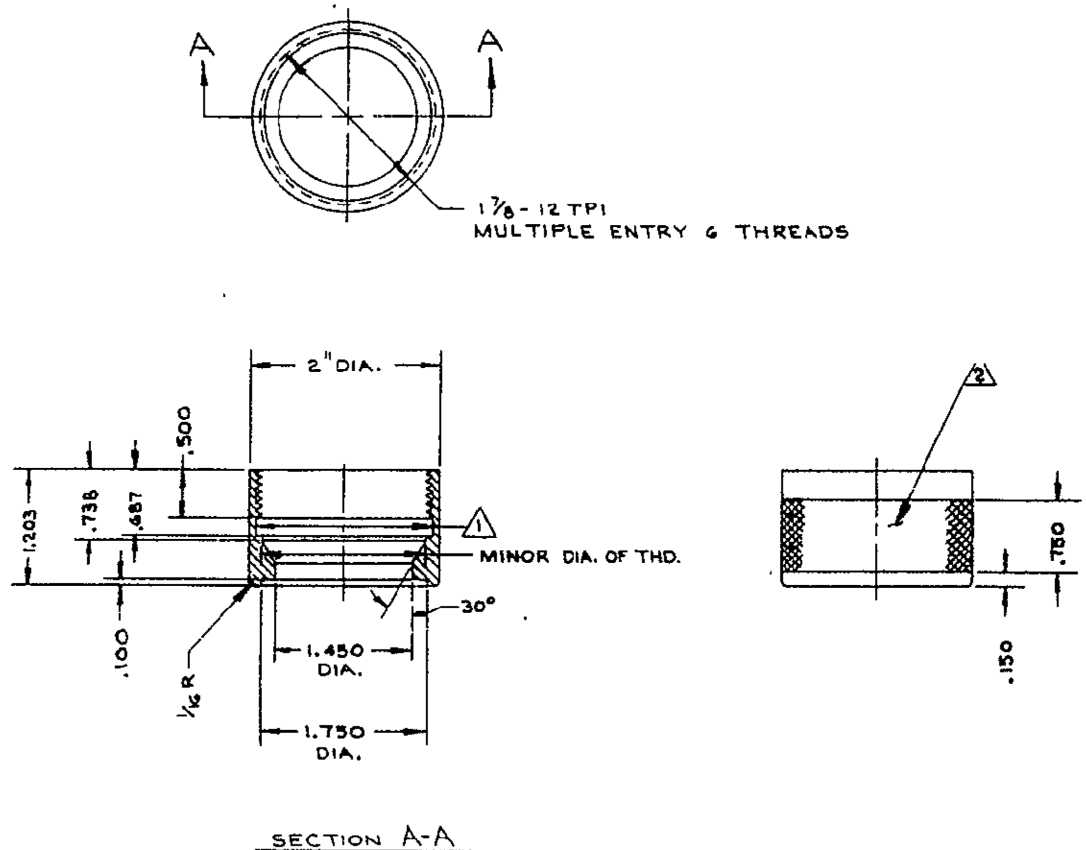
R. E. DARLING CO., INC.
GAITHERSBURG, MD.
TUCSON, ARIZ.

REDAR-C10900

CODE 83462 | SHEET ——

PART NO.
REDAR-C10785

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL
A	FIRST ISSUE	2/12/69	M.J.



NOTES

1. RELIEVE TO MAJOR DIA.
2. KNURL: COARSE DIAMOND (SAND LIGHTLY)

QTY REQD	PART OR IDENTIFYING NO	ITEM	NOMENCLATURE OR DESCRIPTION	MATERIAL OR NOTE

LIST OF MATERIALS OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
Tolerances on: Fractions ± 1/16, Decimals .005, Angles ± 1/2°

125 √ SURFACE ROUGHNESS

MATERIAL: AL ALY 7075-T6

SURFACE TREATMENT: ANODIZE PER MIL-A-8625, TYPE II, CLASS 1

	SIGNATURE	DATE
DR	BR	5-20-68
CHK	M.J.	5/28/68
CARD	J.A.B.	7/12/66
APPROVED	FSC M.J.	2/12/69

[redacted]

R. E. DARLING CO., INC.
GAITHERSBURG, MARYLAND
TUCSON, ARIZONA

SLEEVE

CODE IDENT | SIZE C | REDAR-C10785 | REV A

SCALE 1/1 | SHEET

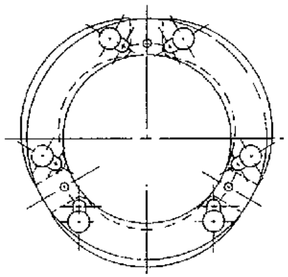
-1 | C10784-1 | C10784-1

NEXT ASSY | USED ON

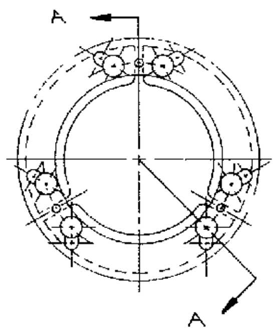
APPLICATION

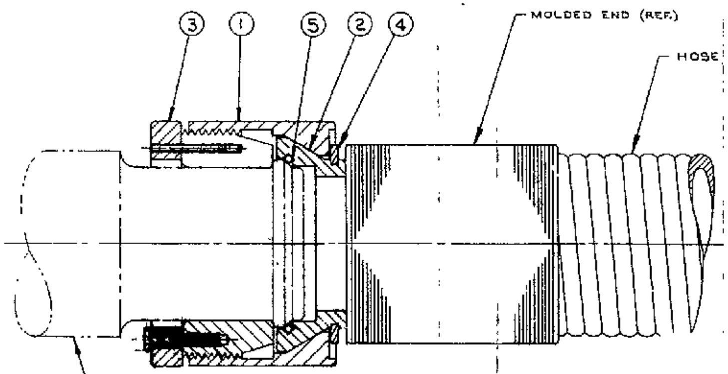
PART NO.
REDAR-C10784-1

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL
A	FIRST ISSUE	2/12/69	[illegible]



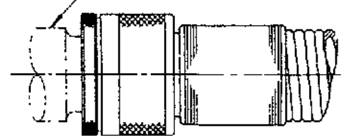
COLLAR ASSY SHOWN IN OPEN POSTION





SECTION A-A
SCALE: 2/1

MS33658-20 END CONFIGURATION (REF) SHOWN IN MATED POSITION



ACTUAL SIZE

QTY. REQD.	PART OR IDENTIFYING NO.	ITEM	NOMENCLATURE OR DESCRIPTION	MATERIAL OR NOTE
1	MS3068-27	5	O-RING	
1	COM'L	4	RING, RETAINING	[illegible]
1	REDAR-C10787-1	3	COLLAR ASSY	AL ALY 7075-T6
1	REDAR-C10786-1	2	INSERT	AL ALY 7075-T6
1	REDAR-C10785-1	1	SLEEVE	AL ALY 7075-T6

LIST OF MATERIALS OR PARTS LIST

	SIGNATURE	DATE
DR.	DR	5-21-68
CHK.	M.A.	2/12/69
APPROVED	RC M.A.	2/12/69

REF.: NASA 9-7744

[redacted] R. E. DARLING CO., INC.
BALTIMORE, MARYLAND
TUCSON, ARIZONA

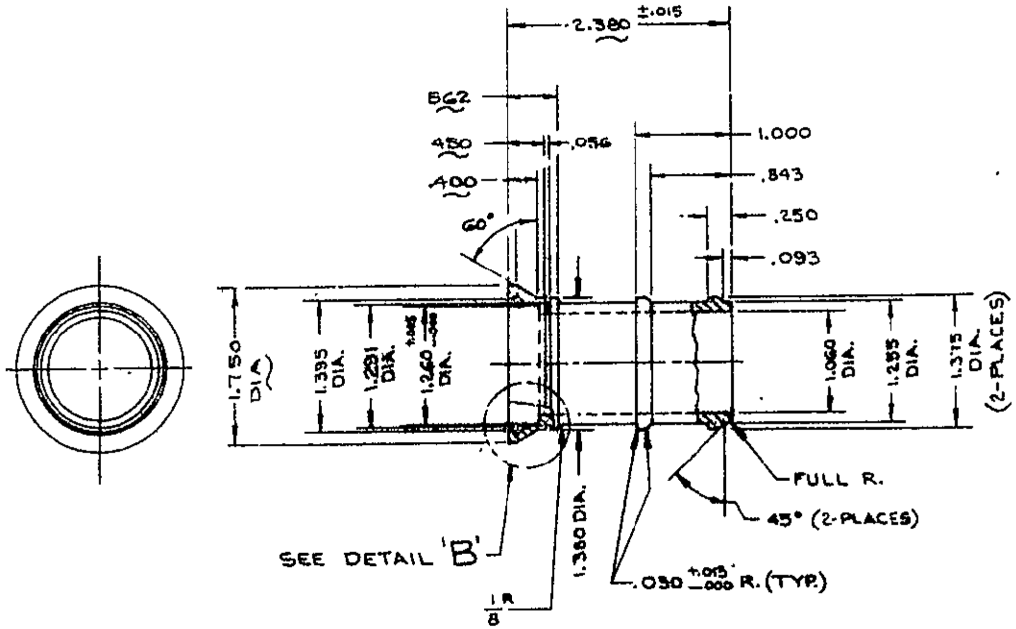
CONNECTOR ASSEMBLY - MS33658-20 CONNECTOR END TO 1 1/4 ID HOSE

SIZE D REDAR-C10784 A

SCALE AS NOTED

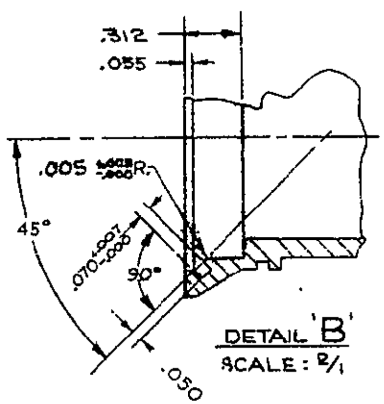
PART NO
C10786-1

REVISIONS			
SYM	DESCRIPTION		APPROVAL
A	FIRST ISSUE	2/14/63	M.F.



NOTES

1. REMOVE ALL BURRS & BREAK SHARP EDGES.
2. ALL DIA'S. TO BE CONCENTRIC .005 T.I.R..
3. (△) SURFACE TREATMENT: ANODIZE PER MIL-A-8625, TYPE II, CLEAR.



DETAIL 'B'
SCALE: 2/1

QTY REQD	PART OR IDENTIFYING NO	ITEM	NOMENCLATURE OR DESCRIPTION	MATERIAL OR NOTE

LIST OF MATERIALS OR PARTS LIST

-1	C10784	C10784-1
	NEXT ASSY	USED ON

APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
Tolerances on: Fractions ± — Decimals ±.005 Angles ±0°-30'

125 √ SURFACE ROUGHNESS

MATERIAL: AL ALY 7075-T6

SURFACE TREATMENT: (△3)

	SIGNATURE	DATE
DR	BR	5-3-63
CHK	M.F.	5/7/63
CARD	J.S.B.	7/1/63
APPROVED	FSC	2/13/63

[redacted]

R. E. DARLING CO., INC.
GAITHERSBURG, MARYLAND
TUCSON, ARIZONA

INSERT

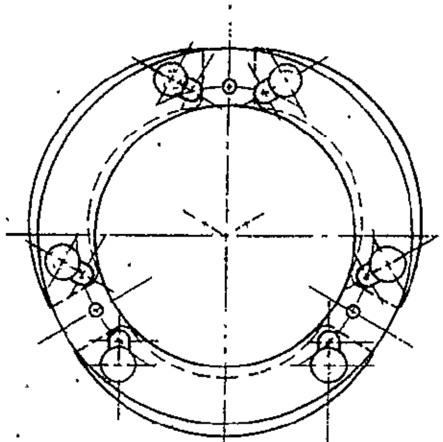
CODE 83452 | SIZE C | REDAR-C10786 | REV A

SCALE 1/1 | SHEET

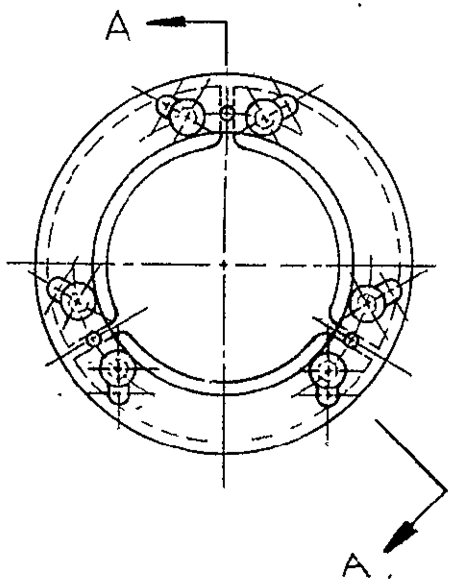
REDAR-C10786

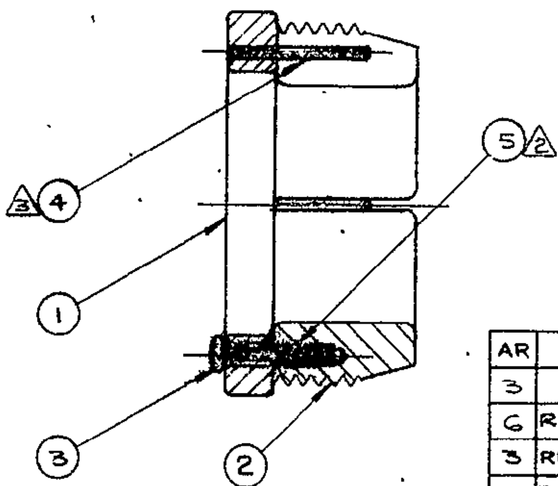
PART NO.
REDAR-C10787-1

SYM.	REVISIONS DESCRIPTION	DATE	APPROVAL
A	FIRST ISSUE	2/12/63	m.t.



VIEW SHOWING OPEN POSITION





SECTION A-A

NOTE

1. ASSEMBLE ALL PARTS IN RELATIVE POSITIONS SHOWN
2. APPLY SEVERAL DROPS OF ITEM 5 TO THREADS OF ITEM 3 AND TORQUE INTO PLACE, ALLOWING ENOUGH SLACK TO PERMIT ITEM 1 TO MOVE FREELY.
3. PRESS ITEM 4 INTO ITEM 1

QTY REQD	PART OR IDENTIFYING NO	ITEM	NOMENCLATURE OR DESCRIPTION	MATERIAL OR NOTE
AR	COML	5	LOCTITE	GRADE 'B'
3	COML	4	PIN, DOWEL	.0626 +.0002/-.0002 DIA x 3/4 LONG CRES
6	REDAR-C10790 -1	3	SCREW	
3	REDAR -C10789 -1	2	SEGMENT	
1	REDAR-C10788 -1	1	RING	

LIST OF MATERIALS OR PARTS LIST

FURNISHED UNDER UNITED STATES GOVERNMENT CONTRACT NO.
SHALL NOT BE EITHER RELEASED OUTSIDE THE GOVERNMENT, OR USED, DUPLICATED OR DISCLOSED IN WHOLE OR IN PART FOR MANUFACTURE OR PROCUREMENT, WITHOUT THE WRITTEN PERMISSION OF R. E. DARLING CO, INC EXCEPT FOR: (I) EMERGENCY REPAIR OR OVERHAUL WORK BY OR FOR THE GOVERNMENT, WHERE THE ITEM OR PROCESS CONCERNED IS NOT OTHERWISE REASONABLY AVAILABLE TO ENABLE TIMELY PERFORMANCE OF THE WORK, OR (II) RELEASE TO A FOREIGN GOVERNMENT, AS THE INTEREST OF THE UNITED STATES MAY REQUIRE; PROVIDED THAT IN EITHER CASE THE RELEASE, USE, DUPLICATION OR DISCLOSURE HEREOF SHALL BE SUBJECT TO THE FOREGOING LIMITATIONS. THIS LEGEND SHALL BE MARKED ON ANY REPRODUCTION HEREOF IN WHOLE OR IN PART.

DASH NO	NEXT ASSY	USED ON
-1	C10784-1	C10784-1

APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
Tolerances on Fractions ± — Decimals . — Angles ± —

√

MATERIAL

SURFACE TREATMENT

	SIGNATURE	DATE
DR.	MG	5/17/6
CHK	mR	2/12/63
CARD	J. G. B.	7/12/68
APPROVED	FSC mt	2/12/63

REF:

R. E. DARLING CO., INC.
GAITHERSBURG, MARYLAND
TUCSON, ARIZONA

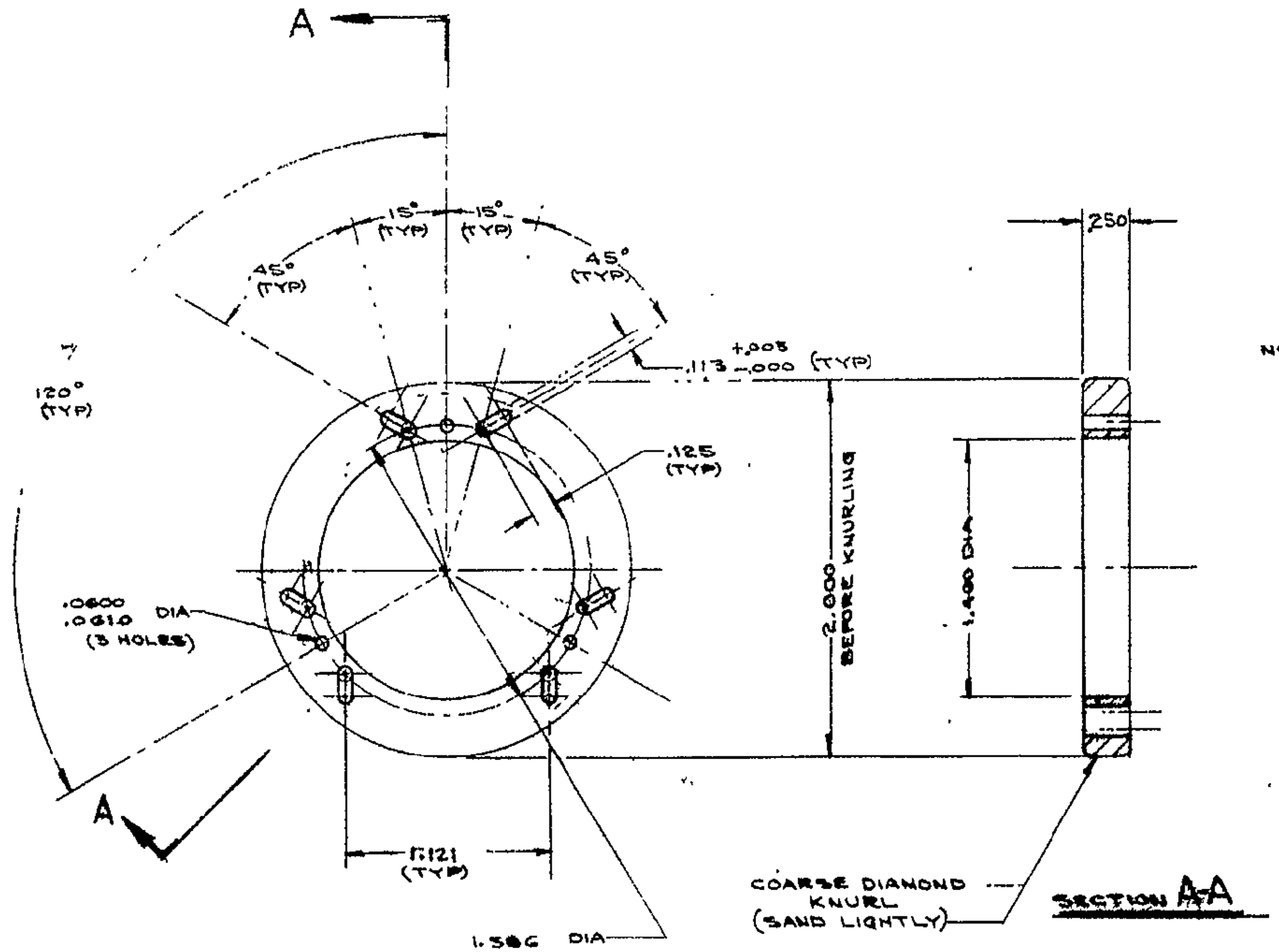
COLLAR ASSY—

CODE 83452 | SIZE C | REDAR-C10787 | REV A

SCALE: 2/1 | SHEET

REDAR-C10787

SYM	DESCRIPTION	DATE	APPROVED
A	FIRST ISSUE		



NOTE:
1. REMOVE ALL BURRS & BREAK SHARP EDGES.

QTY. REQD	PART OR IDENTIFYING NO	ITEM	NOMENCLATURE OR DESCRIPTION	MATERIAL OR NOTE

LIST OF MATERIALS OR PARTS LIST

	NEXT ASSY	USED ON
-1	C10187-1	C10784-1
DASH NO	APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
Tolerances on Fractions ± — Decimals ±.005 Angles ±0°-15'
125 √

MATERIAL AL ALY 7075-T6

SURFACE TREATMENT ANODIZE PER MIL-A-8625 TYPE II CLASS 1

	SIGNATURE	DATE
DR	M.G.	
CHK	M.R.	
CARD	J.S.B.	
	FSC	
APPROVED		
REF		

[redacted]

R. E. DARLING CO., INC.

RING

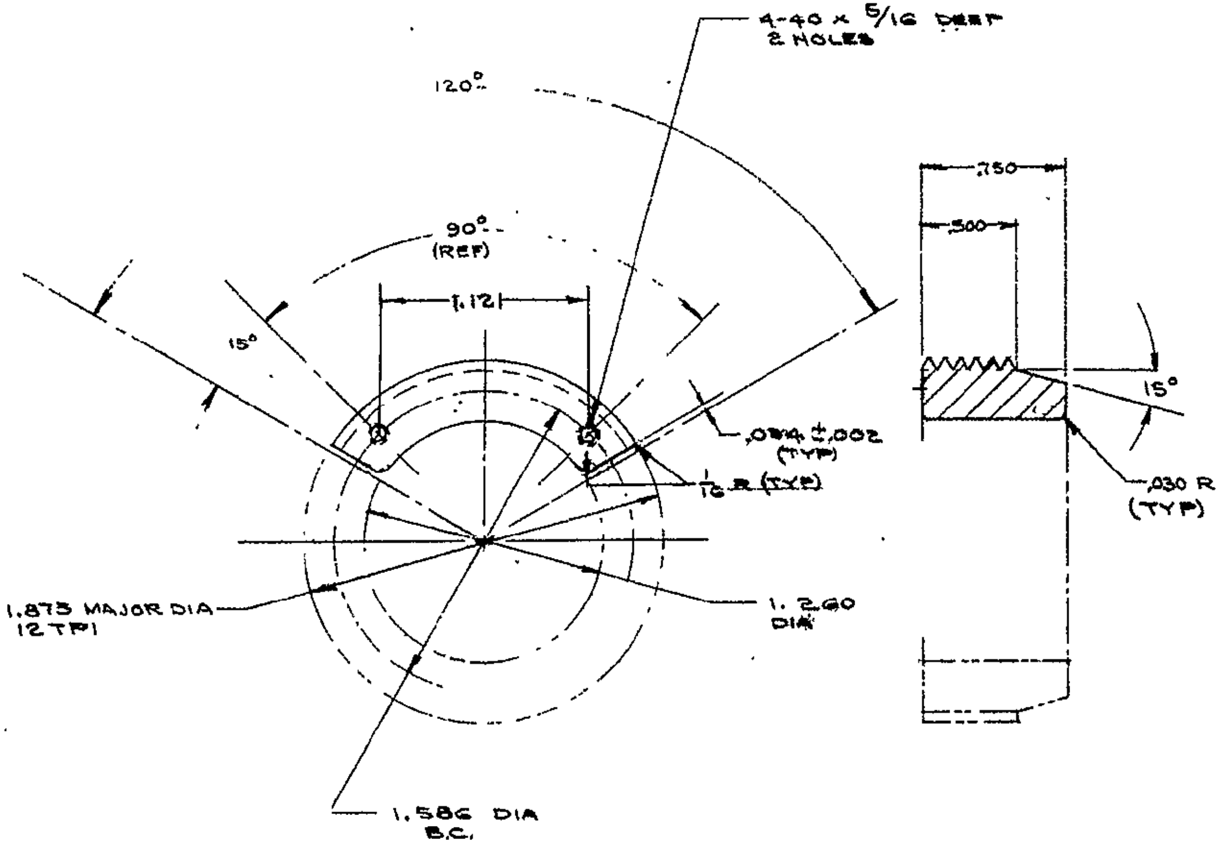
CODE 83453 SIZE C RE[redacted]-C10188 A

SCALE 2/1

PART NO.
REDAR C10789-1

REVISIONS

SYM.	DESCRIPTION	DATE	APPROVAL
A	FIRST ISSUE	2/14/68	[illegible]



NOTE
1. REMOVE ALL BURRS & BREAK SHARP EDGES.

QTY REQD.	PART OR IDENTIFYING NO.	ITEM	NOMENCLATURE OR DESCRIPTION	MATERIAL OR NOTE

LIST OF MATERIALS OR PARTS LIST

FURNISHED UNDER UNITED STATES GOVERNMENT CONTRACT NO.
[illegible]
WITHOUT THE WRITTEN PERMISSION OF R. E. DARLING CO., INC.
[illegible]
LIMITATIONS. THIS LEGEND SHALL BE MARKED ON ANY REPRODUCTION HEREOF IN WHOLE OR IN PART.

DASH NO.	NEXT ASSY	USED ON
-1	C10789-1	C10789-1

APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
Tolerances on
Fractions ± 1/64 Decimals ± .005 Angles ± 0°-15'
125 √

MATERIAL AL ALY, 7075 (T6)

SURFACE TREATMENT ANODIZE PER MIL-A-8625 TYPE II CLASS 1

	SIGNATURE	DATE
DR.	MG	5/16/[illegible]
CHK.	[illegible]	2/14/68
CARD.	F. B. B.	7/14/68
APPROVED	[illegible]	2/14/68

REF.

[redacted]

R. E. DARLING CO., INC.
GAITHERSBURG, MARYLAND
TUCSON, ARIZONA

SEGMENT

CODE [illegible] SIZE C **REDAR**-C10789 REV A

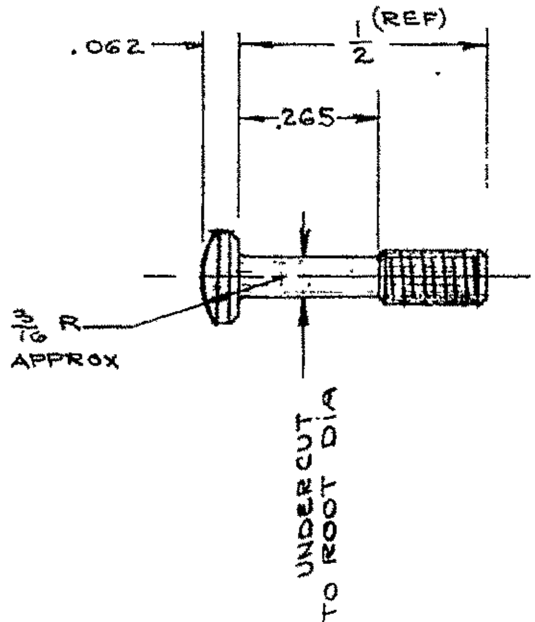
SCALE 2/1 SHEET [illegible]

PART NO.
REDAR-C10790-1

REV. A

REDAR-C10790

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVAL
A	FIRST ISSUE	2/12/69	M.G.



NOTE:

1. MATERIAL - 4-40 x 1/2 L SOCKET HEAD CAP SCREW (CRES).
2. MODIFY AS SHOWN.

-1	C10787-1	C10784-1
DASH NO	NEXT ASSY	USED ON
APPLICATION		

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

Tolerances on: Fractions ± — Decimals ±.010 Angles ± —

MATERIAL: 1

FINISH:

SIGNATURE		DATE
DR.	MG	5/17/68
CHK.	M.G.	2/12/69
ENG.		
CARD	J.S.B.	7/12/68
APPROVED	FSC MA	2/12/69

SCREW - MODIFIED

SCALE: 4/1

R. E. DARLING CO., INC.
GAITHERSBURG, MD.
TUCSON, ARIZ.

REDAR-C10790

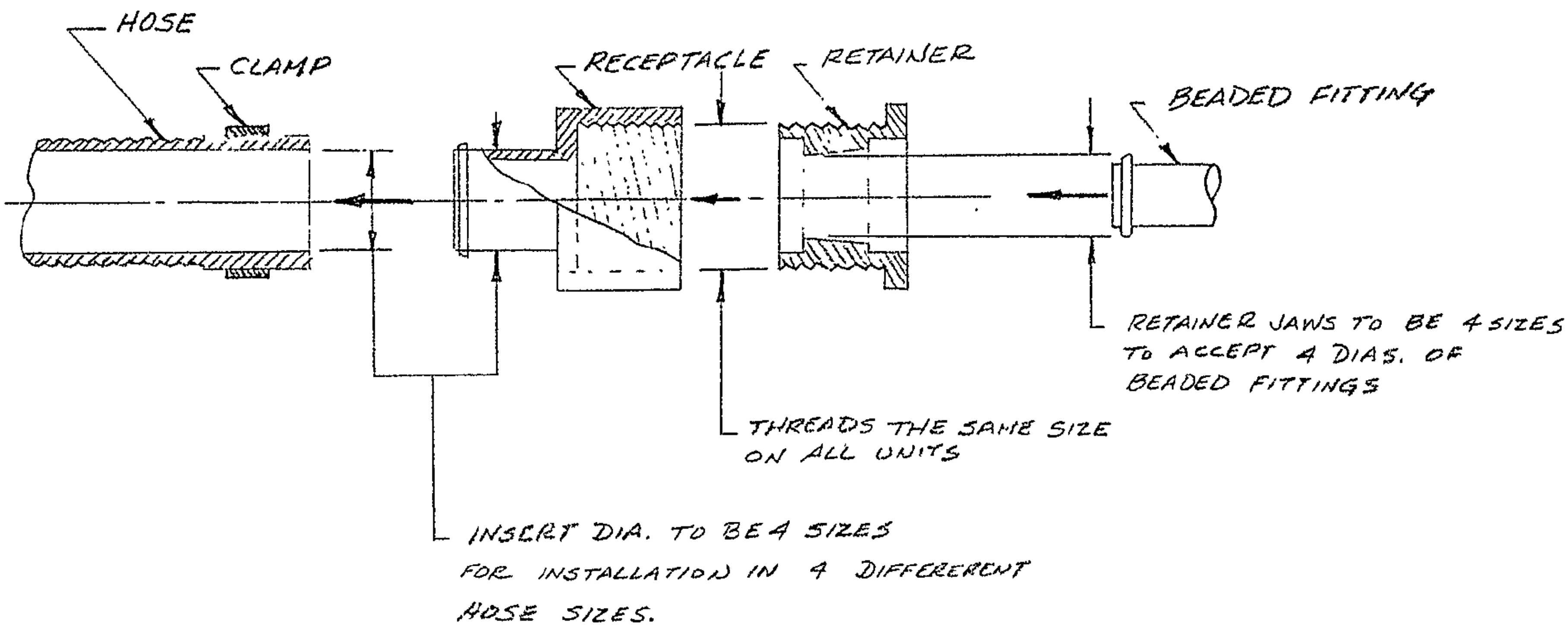
CODE 65482 | SHEET —

C. Suggestions and Comments

After a review of the preceding designs in an informal presentation to NASA technical personnel, it would appear that from our concepts an extremely versatile connector could be fabricated. The connector would be installed in existing hose through the use of a tinnerman type hose clamp. Our experience with this type of clamp shows that an omnidirectional tensile pull of 250 pounds could be expected if proper torquing methods are used. The accompanying "schematic of two-piece connector" is illustrative of this connector. The unit would consist of a receptacle section for permanent installation into the hose. This section would be made in four insert sizes - for installation into 3/4", 7/8", 1", and 1¼" I.D. soft end hose. A second portion of this connector would also be made in 4 sizes to receive 3/4", 7/8", 1" and 1¼" O.D. MS33658 type fittings. The second portion would be interchangeable and thread into the receptacle section to retain and seal the fitting.

A "one-piece connector", similar to the concept shown on drawing REDAR-C10794, could be used as a hard point connector in vacuum chambers. The difference would be in the portion shown on the REDAR-C10794 drawing which installs into the hose. In this instance either an MS27073 or AN818 swivel nut or an MS33657 flared bulkhead fitting would be used in place of the insert. The nut size or male portion might be supplied in two or three sizes as would the opposite, chuck portion, to allow a number of variations.

Both of the foregoing suggestions have been made in recent, less formal documents. They are included here to complement the work done to date and suggest that this is one way of bringing this endeavor to fruition.



SCHEMATIC OF "TWO-PIECE CONNECTOR

R.E. DARLING CO., INC.
W.A. SYLVESTER 10/31/68