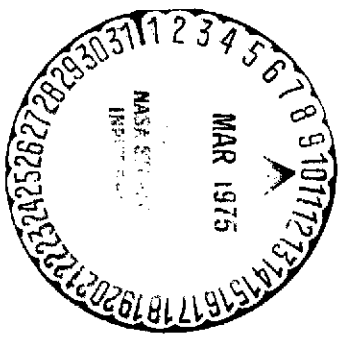
JSC-09306

NASA TECHNICAL MEMORANDUM

NASA TM X-58149
January 1975

WATER-COOLED FURNACE HEADS FOR USE WITH STANDARD MUFFLE-TUBE FURNACES



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

LYNDON B. JOHNSON SPACE CENTER

HOUSTON, TEXAS 77058

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WATER-COOLED FURNACE HEADS FOR USE WITH STANDARD MUFFLE-TUBE FURNACES	January 1975
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7. Author(s): Richard J. Williams, JSC, and O. Mullins, Lockheed Electronics Company, Inc.	8. Performing Organization Report No.: NASA TM X-58149
9. Performing Organization Name and Address: Lyndon B. Johnson Space Center, Houston, Texas 77058	10. Work Unit No.: 383-35-00-00-72
	11. Contract or Grant No.
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The JSC Director waived the use of the International System of Units (SI) for this Technical Memorandum because, in his judgment, the use of SI units would impair the usefulness of the report or result in excessive cost.

16. Abstract

The design of water-cooled furnace seals for use in high-temperature controlled-atmosphere gas and vacuum studies is presented in detailed engineering drawings. Limiting design factors and advantages are discussed.

17. Key Words (Suggested by Author(s))	18. Distribution Statement
*Controlled Atmospheres *Liquid Cooling *High-Temperature Environments *Vacuum Furnaces *Gas Analysis	STAR Subject Category: 31 (Engineering, General)

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*
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NASA TM X-58149

WATER-COOLED FURNACE HEADS FOR USE WITH STANDARD MUFFLE-TUBE FURNACES

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Lyndon B. Johnson Space Center
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WATER-COOLED FURNACE HEADS FOR USE WITH STANDARD MUFFLE-TUBE FURNACES

By Richard J. Williams and O. Mullins*
Lyndon B. Johnson Space Center

SUMMARY

A water-cooled furnace-head system has been designed at the NASA Lyndon B. Johnson Space Center to facilitate studies involving the use of high temperatures in controlled atmospheres. The system incorporates O-ring seals and is useful in noncritical vacuum and gas atmospheres. Although expensive to construct, the design permits adaptation to a wide variety of samples and sensors and has proved to be free of problems during a 2-year period of constant use.

INTRODUCTION

In metallurgical, chemical, and geological studies, sealing ceramic or glass muffle tubes is often necessary so that controlled gas atmospheres or vacuums can be produced and maintained over extended periods. Because such experiments often require the maintenance of high process temperatures, the sealing device must incorporate water cooling. Also, the sealing method should be adaptable to a wide variety of samples and sensors required by various experiments.

FURNACE-HEAD DESIGN

The detailed engineering specifications necessary to build a water-cooled sealing system similar to that designed at the NASA Lyndon B. Johnson Space Center (JSC) are shown in the eight attached engineering drawings. To construct the furnace heads, the following design factors should be considered.

To obtain maximum effect from water cooling, all O-ring grooves should be milled so that all metal parts press tightly against each other. This design enables the running of all processes at a temperature of 1300° C while all parts of the heads are maintained at only slightly warm temperatures.

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*Lockheed Electronics Company, Inc.

The end plates were modified for use with a solid ceramic oxygen electrolyte cell and a vertical quenching capacity. End plates can be designed to meet individual experiment requirements.

Despite their heavy weight, brass heads were used because all joints can be sealed with soft solder. However, aluminum can be used if lighter heads are desired. (Aluminum joints must be heliarc welded.)

All heads should be plumbed for series water flow with the flow running from top to bottom. This method of circulation ensures preheating of the cooling water to prevent thermal shocking of the muffle tube. Any clogging within the series flow system will be noticed immediately because the water outflow will decrease.

The eight drawings are scaled for a muffle tube having an outside diameter of 1.5 inches. This system is the smallest that can conveniently be used with both the ceramic electrolyte cell and vertical quenching. However, the design can be scaled to include larger or smaller muffle tubes if necessary.

The drawings provided should supply investigators with enough data to build furnace-head systems similar to those used at the JSC. Although the heads are expensive, their adaptability provides the investigator with almost complete freedom for experiment design. Several sets of these highly dependable heads have been in almost continuous use for more than 2 years at the JSC without problems.

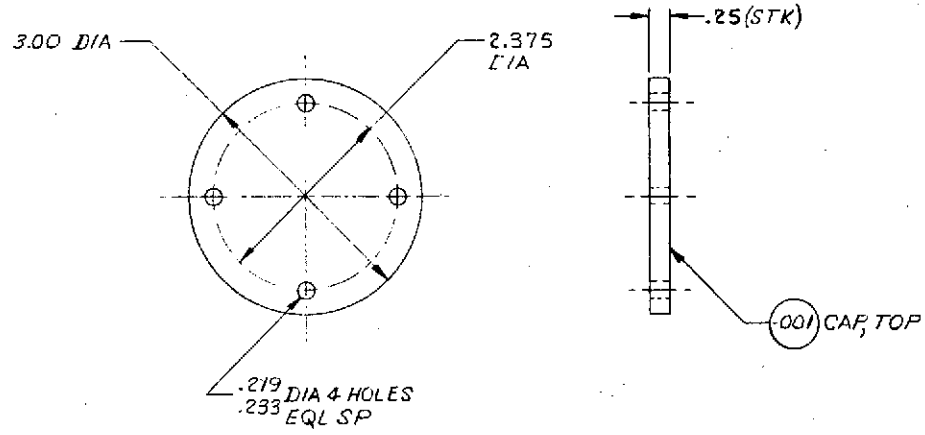
CONCLUDING REMARKS

The water-cooled furnace-head system designed at the NASA Lyndon B. Johnson Space Center has been in use for 2 years and has proved to be free of problems. Although expensive to construct, the system is adaptable to a wide variety of samples and sensors and permits the investigator complete freedom in experiment design.

Lyndon B. Johnson Space Center
National Aeronautics and Space Administration
Houston, Texas, January 16, 1975
383-35-00-00-72

LTR	ZONE	REVISION	DATE	APPROVAL

RELEASED Date 1-31-74 Rev. NC Init.



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-001	CAP, TOP	BRASS COMP 2 (COML) .25 x 3.1 x 3.1 PL	QQ-B-613A	NONE

DIMENSIONAL TOLERANCE UNLESS NOTED OTHERWISE
.0 = .10
.00 = .02
.000 = .005
ANGULAR = —

SURFACE FINISH IN MICROINCHES RMS UNLESS NOTED OTHERWISE √

SEB36112460
NEXT ASSEMBLY

SIGNATURES		DATE
DR	R. CLARKSON	9-5-73
ENG		
CH	R. CLARKSON	9-5-73
		9-10-73
APP		11-26-76
AUTH		12-7-76

WR4436

NATIONAL AERONAUTICS & SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER · HOUSTON, TEXAS

CAP, TOP—
CONTROLLED ATMOSPHERE
FURNACE ASSY

CODE IDENT NO.	SIZE	DWG NO.
21356	C	SDB36112459

SCALE 1/1 | ENGRG DIV JN4 | SHEET

1. FABRICATION TOLERANCES AND PRACTICES PER SKZ36103755.

NOTES: UNLESS OTHERWISE SPECIFIED.

LTR	ZONE	REVISION	DATE	APPROVAL
		RELEASED per 1-31-74 NC		

QTY	PART NUMBER	DESCRIPTION	MATERIAL	SPECIFICATION	ZONE
16	-502	SCREW, CAP, FLH, 82°CSK	STEEL 8-32UNC-2A x 1.0L	COML	CD PL	
8	-501	SCREW, CAP, SOC HD	STEEL 8-32UNC-2A x 7/16 L	COML	CD PL	
2	SDB36112456-001	FLANGE				C3 3
1	SDB36112465-301	CAP ASSY, BOTTOM				B3 4
4	SDB36112464-001	SPACER				D3 3
1	SDB36112463-001	PLUG, QUENCH TUBE				A3 4
1	SDB36112462-001	PROBE TUBE				A4 4
4	SEB36112461-301	BODY ASSY				D3 3
1	SDB36112459-001	CAP, TOP				D3 3
1	-001	FEEDTHRU	MAKE FROM 4UT-1-2 FITTING	2	NONE	
	-301	CONTROLLED ATMOSPHERE FURNACE ASSY			NONE FLUSH	

3 CRAWFORD FITTING COMPANY, CLEVELAND, OHIO OR EQUAL.

2 CAJON COMPANY, CLEVELAND, OHIO OR EQUAL.

1 PARKER SEAL COMPANY, CULVER CITY, CALIFORNIA OR EQUAL.

NOTES:

1. FABRICATION TOLERANCES AND PRACTICES PER SKZ36103755.

NOTES: UNLESS OTHERWISE SPECIFIED.

DIMENSIONAL TOLERANCE UNLESS NOTED OTHERWISE
.0 ± .10
.00 ± .02
.000 ± .005
ANGULAR ± 2°

SURFACE FINISH IN MICROINCHES RMS UNLESS NOTED OTHERWISE √

NEXT ASSEMBLY

SIGNATURES	DATE
DR E. CLARKSON	9-4-73
ENG	
CH P Kane	9-10-73
SR K	9-10-73
APP 10	11/30/74
AUTH	12/4/74

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CONTROLLED ATMOSPHERE FURNACE ASSY

CODE IDENT NO.	SIZE	DWG NO.
21356	C	SEB36112460

SCALE 1/1 · ENGRG DIV JN4 · SHEET 1 OF 4

JSC Form 1616 (1-1 (REV OCT 65)

NASA-JSC

LTR	ZONE	REVISION	DATE	APPROVAL
		RELEASED 1-24-74 MC		

QTY	PART NUMBER	DESCRIPTION	MATERIAL	SPECIFICATION	ZONE
12	B-400-1-2	TUBE FITTING		3	
8	2-325-S455-70	O-RING		1	
2	2-113-S455-70	O-RING		1	
2	2-032-S455-70	O-RING		1	
1	2-010-S455-70	O-RING		1	
8	-504	SCREW, CAP, SOC HD	STEEL 1/4-20UNC-2A x 7/16 L	COML	CD PL
8	-503	SCREW, CAP, FLH, 82° CSK	STEEL 8-32UNC-2A x 7/16 L	COML	CD PL FINISH

DIMENSIONAL TOLERANCE UNLESS NOTED OTHERWISE
.0 = .10
.00 = .02
.000 = .005
ANGULAR ±

SURFACE FINISH IN MICROINCHES RMS UNLESS NOTED OTHERWISE

NEXT ASSEMBLY

SIGNATURES	DATE
DR R. CLARKSON	9-4-73
ENG	
CH R KANZ	9-10-73
<R to	9-13-73
APP	
AUTH	9/13/74

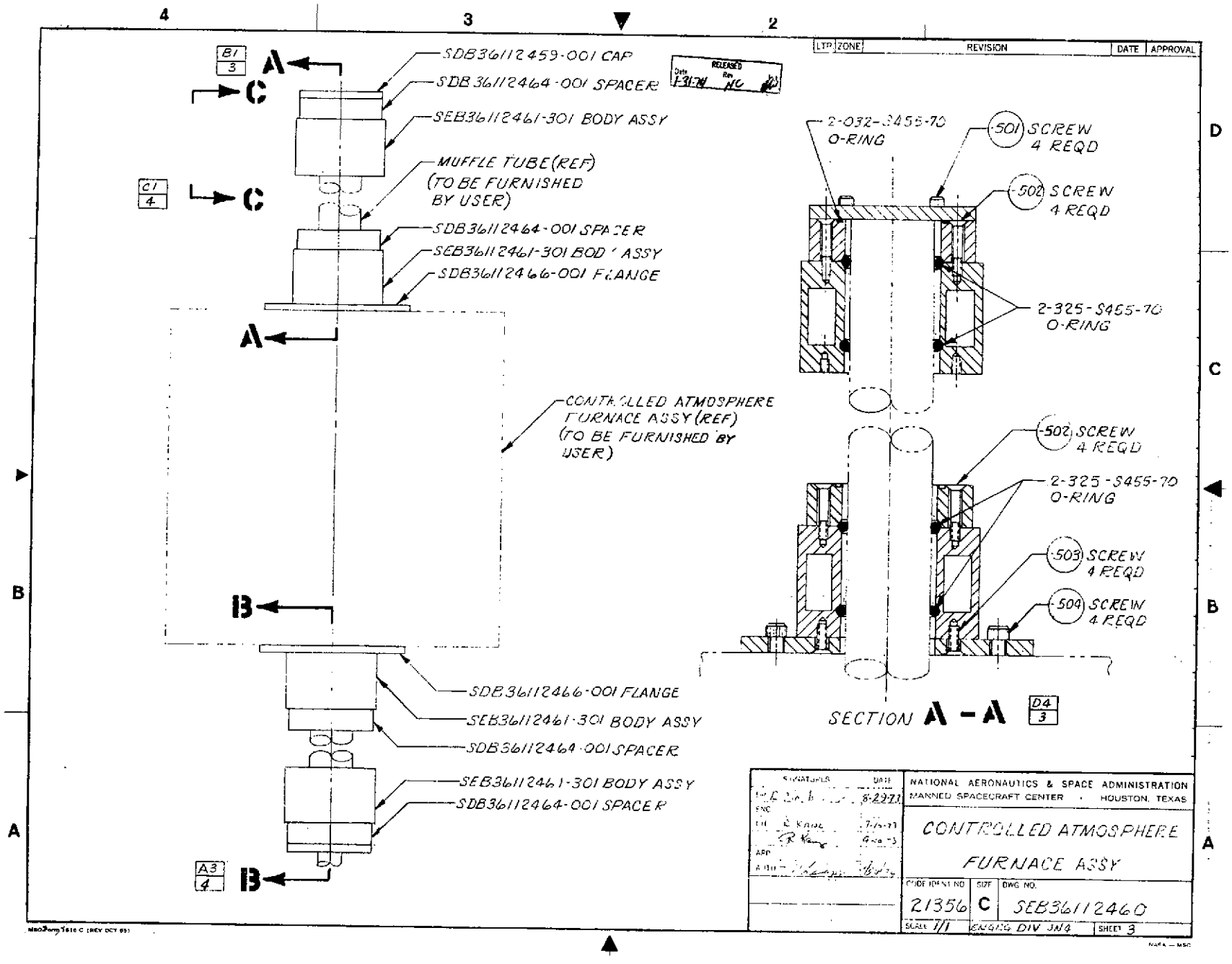
NATIONAL AERONAUTICS & SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER · HOUSTON, TEXAS

CONTROLLED ATMOSPHERE FURNACE ASSY

CODE IDENT NO.	SIZE	DWG NO.
21356	C	SEB36112460

SCALE 1/1 | ENGRG DIV JN4 | SHEET 2

NASA-JSC



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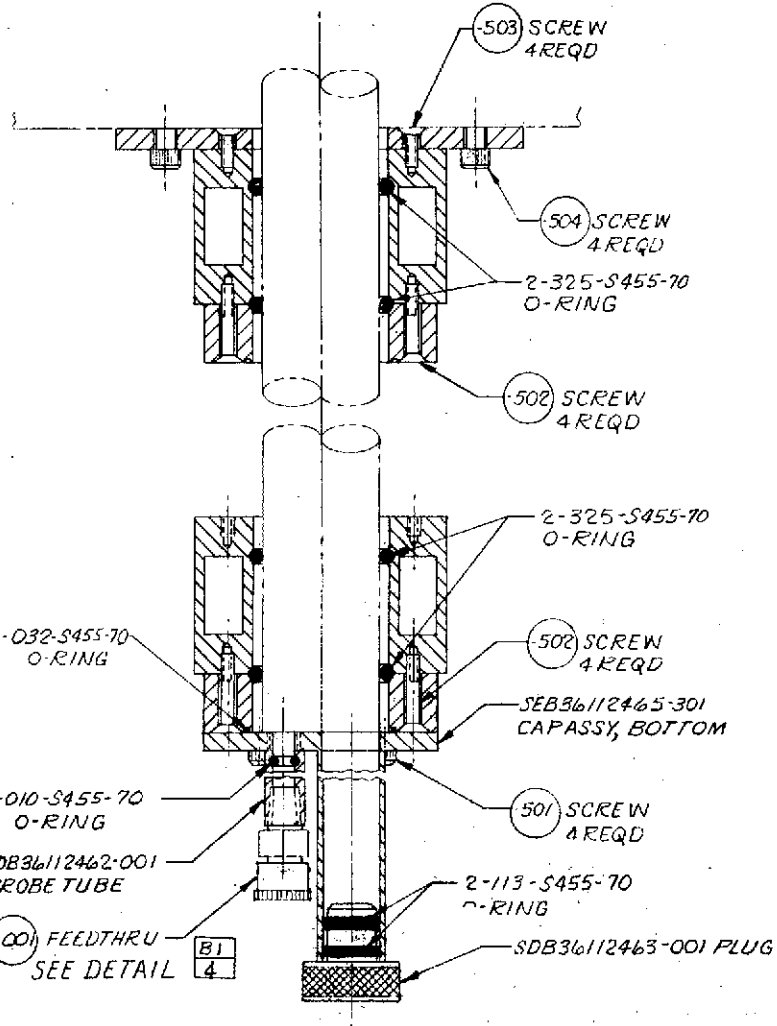
RELEASED 8-31-73



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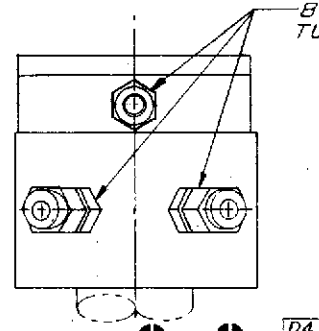
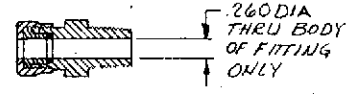


VIEW C - C D4 3
APPLICABLE 4 PLACES



DETAIL OF 001 A4 4

SIGNATURES	DATE
DR R Clark	8-31-73
ENG	
CH R. Kanz	9-10-73
R Kanz	9-10-73
APP	
AUTH M Leap	10/4/74

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CONTROLLED ATMOSPHERE FURNACE ASSY

CODE IDENT NO.	SIZE	DWG NO.
21356	C	SEB36112460

SCALE 1/1 | ENGRG DIV JN4 | SHEET 4

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LTR	ZONE	REVISION	DATE	APPROVAL

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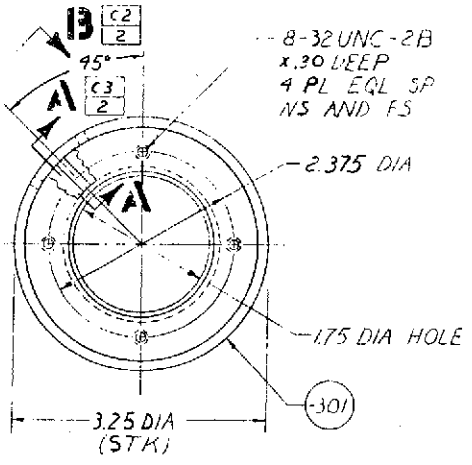

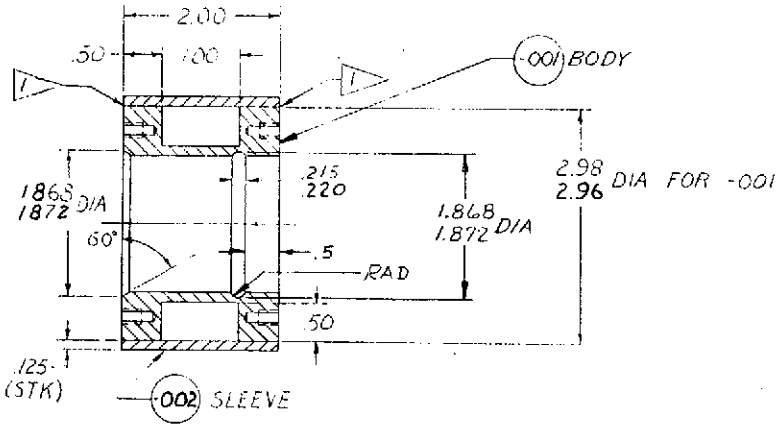

QTY	PART NUMBER	DESCRIPTION	MATERIAL	SPECIFICATION		ZONE
1	-003	BAFFLE	BRASS-COMP 2 (COML) 1/8 x .6 x 1.1 SHEET	QQ-B-613A	NONE	D4 2
1	-002	SLEEVE	BRASS ALLY NO. 218 3.250D x .125 WALL x 2.1 TBG	COML	NONE	C2 1
1	-001	BODY	BRASS-COMP 22 (COML) 3.0 DIA x 2.1 BAR	QQ-B-626A	NONE	C2 1
	-301	BODY ASSY			NONE FNSH	C3 1

2> CUT TO FIT.

1> SILVER SOLDER JOINT USING HIGH TEMPERATURE SOFT SILVER SOLDER PER MANUFACTURERS INSTUCTIONS.

NOTES.

1 FABRICATION TOLERANCES AND PRACTICES PER SK Z36103755.

NOTES: UNLESS OTHERWISE SPECIFIED.

DIMENSIONAL TOLERANCE UNLESS NOTED OTHERWISE
.0 ± .10
.00 ± .02
.000 ± .005
ANGULAR ± 2°

SURFACE FINISH IN MICROINCHES RMS UNLESS NOTED OTHERWISE 63

SEB36112460
NEXT ASSEMBLY

SIGNATURES		DATE
DR	G. GREEN	8-24-73
ENG		
CH	R. CLARKSON	9-6-73
		9-10-73
APP		1/30/74
AUTH		2/4/74

WR4436

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MANNED SPACECRAFT CENTER · HOUSTON, TEXAS

BODY ASSY — CONTROLLED ATMOSPHERE FURNACE ASSY

CODE IDENT NO.	SIZE	DWG NO.
21356	C	SEB3611246 1

SCALE 1/1 | ENGRG DIV JN4 | SHEET 1 OF 2

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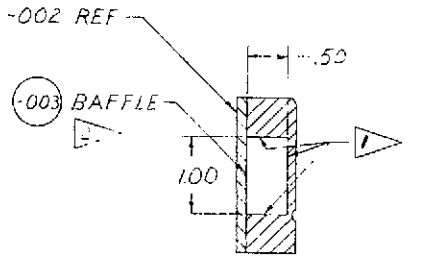
LTR	ZONE	REVISION	DATE	APPROVAL

RELEASED Date 12-31-74 Rev NC Init



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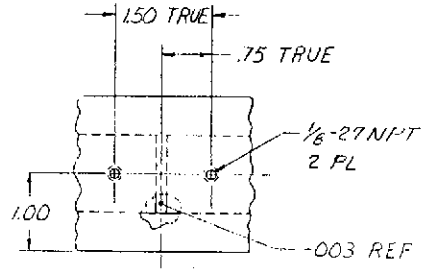

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ROTATED 45° CW

SIGNATURES	DATE
DR G. GREEN	8-27-73
ENG	
CH L. Clarke	9-6-73
R King	9-10-73
APP	
AUTH J.K. Boyce	11-14-74

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MANNED SPACECRAFT CENTER , HOUSTON, TEXAS

BODY ASSY-
CONTROLLED ATMOSPHERE
FURNACE ASSY

CODE IDENT NO.	SIZE	DWG NO.
21356	C	SEB3611246I

SCALE 1/1 | ENGRG DIV JN4 | SHEET 2

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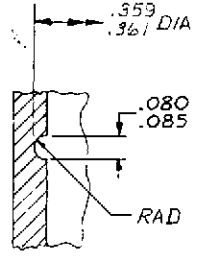
Date 1-31-74 Rev NC



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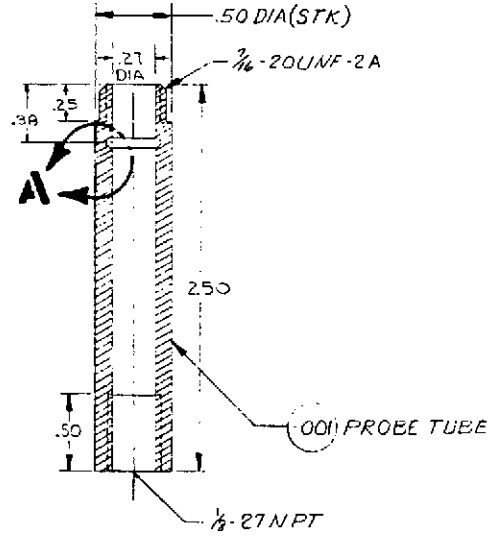

1. FABRICATION TOLERANCES AND PRACTICES PER SKZ36103755.

NOTES: UNLESS OTHERWISE SPECIFIED.

-001	PROBE TUBE	BRASS COMP 2 (COMM) .50 DIA x 2.6 BAR	QQ-B-626A	NONE FINISH
PART NUMBER	DESCRIPTION	MATERIAL	SPECIFICATION	

DIMENSIONAL TOLERANCE UNLESS NOTED OTHERWISE
.0 ± .10
.00 ± .02
.000 ± .005
ANGULAR ± —

SURFACE FINISH IN MICROINCHES RMS UNLESS NOTED OTHERWISE √

SEB36112460
NEXT ASSEMBLY

SIGNATURES	DATE
DR J. JACKSON	8-27-73
ENG	
CH [illegible]	9-5-73
[illegible]	9-10-73
APP [illegible]	1/30/74
AUTH [illegible]	1/31/74

WR4436

NATIONAL AERONAUTICS & SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER · HOUSTON, TEXAS

PROBE TUBE —
CONTROLLED ATMOSPHERE
FURNACE ASSY

CODE IDENT NO.	SIZE	DWG NO.
21356	C	SDB36112462
SCALE 2/1	ENGRG DIV JN4	SHEET

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LTR	ZONE	REVISION	DATE	APPROVAL

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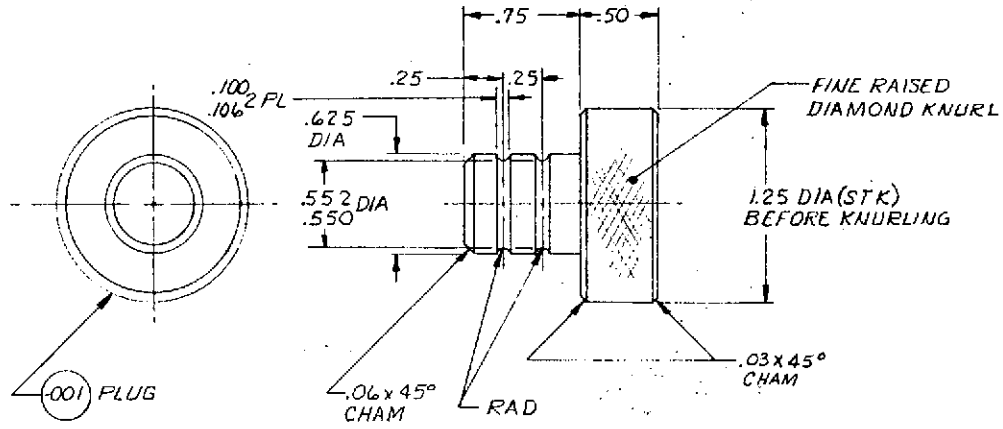

1. FABRICATION TOLERANCES AND PRACTICES PER SKZ36103755.

NOTES: UNLESS OTHERWISE SPECIFIED.

PART NUMBER	DESCRIPTION	MATERIAL	SPECIFICATION
-001	PLUG, QUENCH TUBE	BRASS COMP22(COM) 1¼ DIA X 1.3 BAR	QQ-B-626A; NONE; FNSH

DIMENSIONAL TOLERANCE UNLESS NOTED OTHERWISE
.0 = .10
.00 = .02
.000 = .005
ANGULAR = 1°

SURFACE FINISH IN MICROINCHES RMS UNLESS NOTED OTHERWISE √

SIGNATURES		DATE
DR	R. CLARKSON	9-7-73
ENG		
CH	R. KAST	9-12-73
	R. Kast	9-12-73
APP	W. Lyon	11/20/74
AUTH	M. Lapp	12/4/74

NATIONAL AERONAUTICS & SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER - HOUSTON, TEXAS

PLUG, QUENCH TUBE — CONTROLLED ATMOSPHERE FURNACE ASSY

CODE IDENT NO.	SIZE	DWG NO.
21356	C	SDB36112463

SEB36112460 — NEXT ASSEMBLY

WR4436

SCALE 2/1 — ENGRG DIV JA14 — SHEET

JSC Form 1618 C-1 (REV OCT 65)

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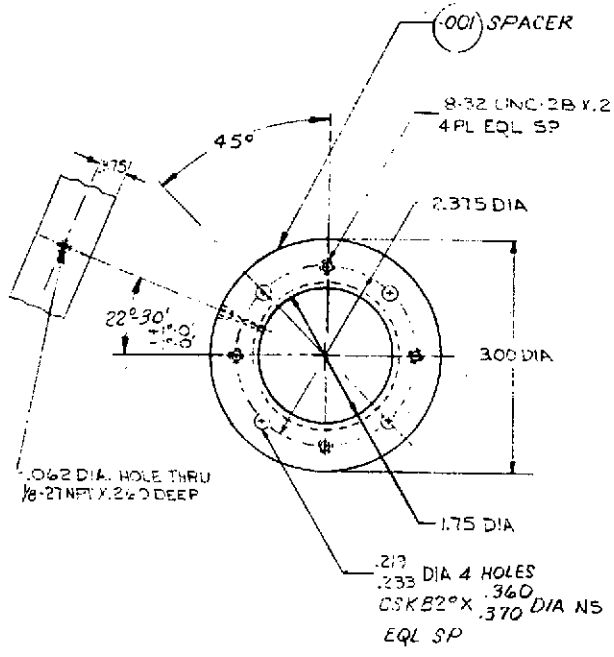
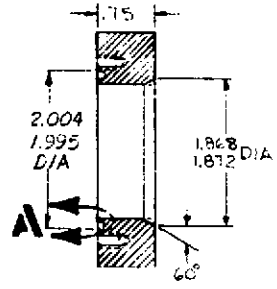
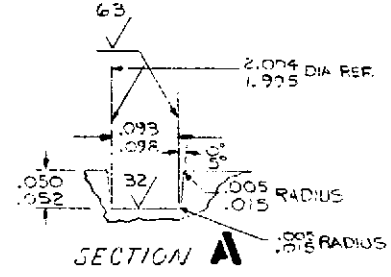
RELEASED Dwg 1-24-74 RC







SECTION A
ROTATED 90° CW
SCALE: 10/1

1. FABRICATION TOLERANCES AND PRACTICES PER SKZ36103755.

NOTES: UNLESS OTHERWISE SPECIFIED.

PART NUMBER	DESCRIPTION	MATERIAL	SPECIFICATION
-001	SPACER	BRASS, COMP 32 (COM) 3.0 D/A x .8 BAR	QQ-B-626A NONE FINISH

DIMENSIONAL TOLERANCE UNLESS NOTED OTHERWISE
.0 ± .10
.00 ± .02
.000 ± .005
ANGULAR ± 1°

SURFACE FINISH IN MICROINCHES RMS UNLESS NOTED OTHERWISE √

SIGNATURES		DATE
DR	J. JACKSON	8-24-73
ENG		
CH	R. CLARKSON	9-6-73
		9-10-73
APP		1/20/74
AUTH		1/24/74

NATIONAL AERONAUTICS & SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER · HOUSTON, TEXAS

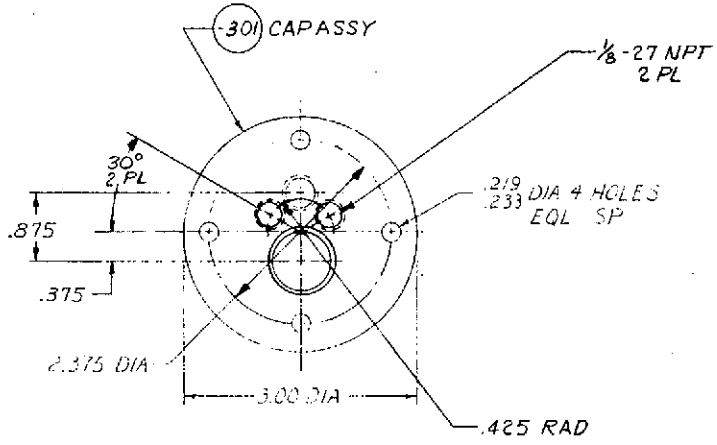
SPACER - CONTROLLED ATMOSPHERE FURNACE ASSY

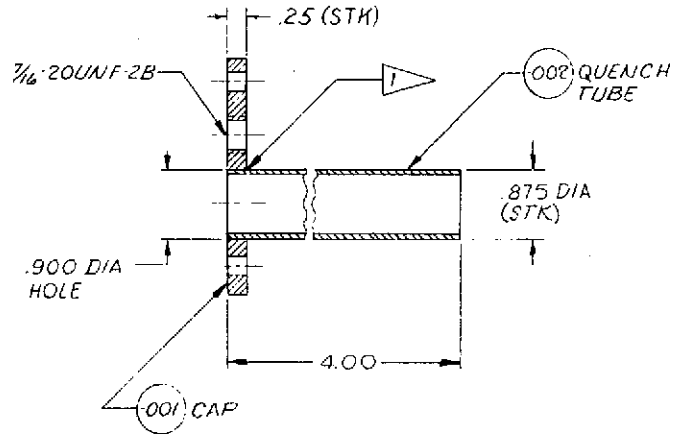
NEXT ASSEMBLY		CODE IDENT NO	SIZE	DWG NO.
SEB36112460	WR4436	21356	C	SDB36112464
		SCALE 1/1	ENGR & DIV JN4	SHEET

MSC Form 1616 C-1 (REV OCT 65)
NASA — MSC

LTR	ZONE	REVISION	DATE	APPROVAL

RELEASED





QTY	PART NUMBER	DESCRIPTION	MATERIAL	SPECIFICATION	
1	-002	QUENCH TUBE	BRASS ALY NO 218 7/8 O D x .045 WALL x 4.1 TBG	COML	NONE
1	-001	CAP	BRASS COMP 2 (COML) .25 x 3.1 x 3.1 PL	QQ-B-613A	NONE
	-301	CAP ASSY, BOTTOM			NONE FINISH

1 ▷ SILVER SOLDER JOINT USING HIGH TEMPERATURE, SOFT SILVER SOLDER PER MANUFACTURERS INSTRUCTIONS.

NOTES:

1. FABRICATION TOLERANCES AND PRACTICES PER SKZ36103755.

NOTES: UNLESS OTHERWISE SPECIFIED.

DIMENSIONAL TOLERANCE UNLESS NOTED OTHERWISE	SIGNATURES	DATE
.0 ± .10	DR G. GREEN	8-27-73
.00 ± .02	ENG	
.000 ± .005	CH R CLARKSON	9-6-73
ANGULAR ± 2°		9-14-73
SURFACE FINISH IN MICROINCHES RMS UNLESS NOTED OTHERWISE √	APP	
	AUTH	9-6-73
SEB36112460		
NEXT ASSEMBLY	WR4436	

NATIONAL AERONAUTICS & SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER - HOUSTON, TEXAS

CAP ASSY, BOTTOM — CONTROLLED ATMOSPHERE FURNACE ASSY

CODE IDENT NO.	SIZE	DWG NO.
21536	C	SEB36112465

SCALE 1/1 | ENGRG DIV JN4 | SHEET

MSC Form 1618 C-1 (REV OCT 65)

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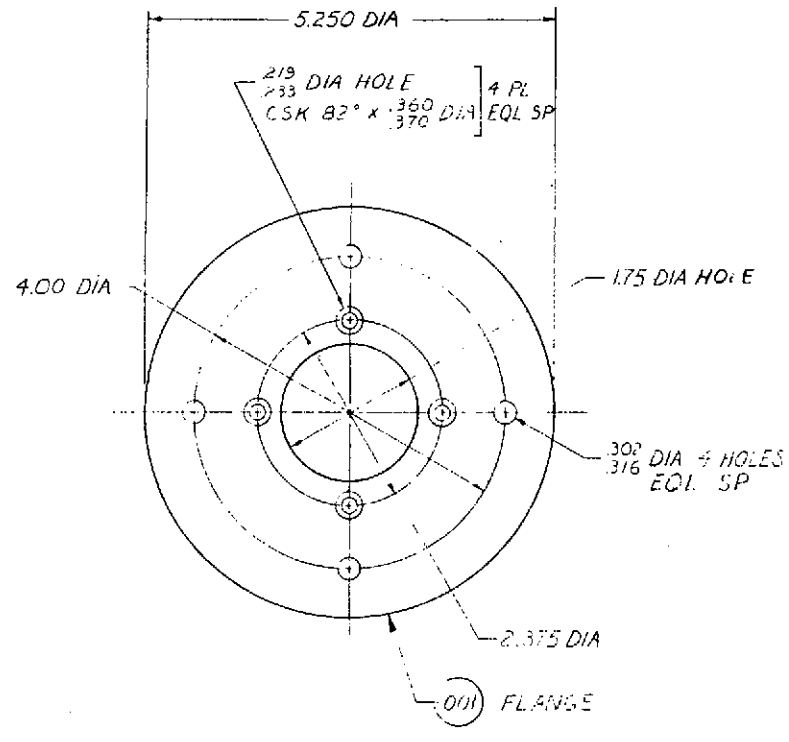
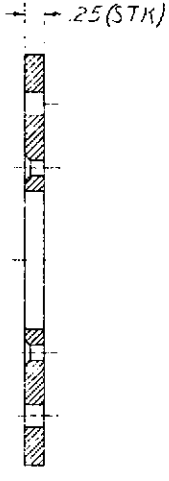
LTR	ZONE	REVISION	DATE	APPROVAL





1. FABRICATION TOLERANCES AND PRACTICES PER SKZ3b103755.

NOTES: UNLESS OTHERWISE SPECIFIED.

PART NUMBER	DESCRIPTION	MATERIAL	SPECIFICATION	FINISH
-001	FLANGE	BRASS, COMP 2 (COML) 1/4 X 5.3 X 5.3 - HEET	QQ-B-613A	NONE

SIGNATURES		DATE
DR	G. GREEN	8-23-73
ENG		
CH	R. CLARK	9-5-73
		9-10-73
APP		11/30/M
AUTH		12/3/74

WR4436

NATIONAL AERONAUTICS & SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER · HOUSTON, TEXAS

FLANGE - CONTROLLED ATMOSPHERE FURNACE ASSY

CODE IDENT NO.	SIZE	DWG NO.
21356	C	SDB3611246b

SCALE 1/1 | ENGRG DIV JN4 | SHEET

MSC Form 1816 C (REV OCT 68)

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