NASA TECHNICAL MEMORANDUM

NASA TM X-58149
January 1975

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

(NASA-TM-X-58149) WATER-COOLED FURNACE
HEADS FOR USE WITH STANDARD MUFFLE TUBE
FURNACES (NASA) 17 p HC $3.25 CSCL 20M

N75-18447

Unclas
G3/31 11056

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS 77058
TM X-58149

2. Government Accession No.  

3. Recipient’s Catalog No.  

4. Title and Subtitle  
WATER-COOLED FURNACE HEADS FOR USE WITH STANDARD MUFFLE-TUBE FURNACES

5. Report Date  
January 1975

6. Performing Organization Code  
JSC-09306

7. Author(s)  

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.  

12. Sponsoring Agency Name and Address  
National Aeronautics and Space Administration  
Washington, D.C. 20546

13. Type of Report and Period Covered  
Technical Memorandum


15. Supplementary Notes  
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))  
Controlled Atmospheres  
Liquid Cooling  
High-Temperature Environments  
Vacuum Furnaces  
Gas Analysis

18. Distribution Statement  
STAR Subject Category:  
31 (Engineering, General)

19. Security Classif. (of this report)  
Unclassified

20. Security Classif. (of this page)  
Unclassified

21. No. of Pages  
17

22. Price*  
$3.25

*For sale by the National Technical Information Service, Springfield, Virginia 22151

JSC Form 1424 (Rev Jul 74)
WATER-COOLED FURNACE HEADS FOR USE WITH
STANDARD MUFFLE-TUBE FURNACES

Richard J. Williams
Lyndon B. Johnson Space Center
Houston, Texas 77058

and

O. Mullins
Lockheed Electronics Company, Inc.
Houston, Texas 77058
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.

*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
1. FABRICATION TOLERANCES AND PRACTICES PER SK236/08755.

NOTES: UNLESS OTHERWISE SPECIFIED.
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**NOTES:**

1. Fabrication Tolerances and Practices per SK236105765.

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**Dimensional Tolerance**: Unless noted otherwise, ±0.001. Angles ±1°. Surface finish: Microinches plus scratches. Otherwise, 620.000.

**Controlled Atmosphere Furnace Assy**

**Please Note**

- Unit: 3.000
- Angle: ±1°
- Surface Finish: Microinches plus scratches. Otherwise, 620.000.

**Drawing Information**

- Sheet 1/1
- Control No. 21356 C
- REV 2-13

**Source**

- N/A
- N/A

**Date**

- 9/4/73
- 9/11/73

**Location**

- JOHNSON SPACE CENTER
- HOUSTON, TEXAS
1. CUT TO FIT.

2. SILVER SOLDER JOINT USING HIGH TEMPERATURE SOFT SILVER SOLDER PER MANUFACTURER'S INSTRUCTIONS.

NOTES:

1. FABRICATION TOLERANCES AND PRACTICES PER SII236103755.

NOTES: UNLESS OTHERWISE SPECIFIED.

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BODY ASSY - CONTROLLED ATMOSPHERE - FURNACE ASSY

DIMENSIONAL TOLERANCE UNLESS NOTED OTHERWISE

SURFACE FINISH IN MICRONS

NOTES: UNLESS OTHERWISE SPECIFIED.
1. Fabrication tolerances and practices per SK236103795.

Notes: Unless otherwise specified.
A/NOTES: UNLESS OTHERWISE SPECIFIED.

1. FABRICATION TOLERANCES AND PRACTICES PER SKZ36103756.

SECTION A
ROTATED 90° CW
SCALE: 10/1
SILVER SOLDER Joint USING HIGH TEMPERATURE, SOFT SILVER SOLDER PER MANUFACTURER'S INSTRUCTIONS.

NOTES:

FABRICATION TOLERANCES AND PRACTICES PER SK236/03155.

NOTES: UNLESS OTHERWISE SPECIFIED.

1. CAP ASSY, BOTTOM - CONTROLLED ATMOSPHERE FURNACE ASSY

NOTES:

-301 CAP ASSY, BOTTOM

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1. FABRICATION TOLERANCES AND PRACTICES
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NOTES: UNLESS OTHERWISE SPECIFIED.