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SURVEY OF THE SINGLE-SHELL TANK THERMAL HISTORIES

P. F. Mercier and M. D. Wonacott
C. DeFigh-Price

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SURVEY OF THE SINGLE-SHELL TANK THERMAL HISTORIES

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Systems Engineering Department
Research and Engineering

December 1981

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Rockwell International
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CONTENTS

Introduction and Purpose 1

Storage Facilities 2

Operating Practices. 2

Discussion 5

Temperature Records. 8

Specified Temperature Limits 9

Conclusion 10

Acknowledgment 11

References 11

Appendices:
A. Documents Used in Obtaining Thermal History Data A-1
B. Graphs of Temperature Data B-1

FIGURES:
1. Waste Storage Tank Designs 3
2. Compressive Strength Versus Temperature and Time (3,000 psi-concrete). 6
3. Thermal Expansion Behavior of Typical Concrete Mixes Structural Steel, and Hanford Concrete 7

TABLES:
1. Single-Shell Tank Structure Specifications 4
2. Tanks with Thermocouples on the CASS System. 9

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INTRODUCTION AND PURPOSE

Radioactive waste, resulting from the chemical processing of reactor fuel for recovery of special nuclear materials (primarily plutonium), has been accumulating at Hanford since 1944. The high-level defense waste is currently being stored in underground waste tanks and in capsules stored in water basins.

Current U.S. Department of Energy (DOE) strategy is to emphasize development and implementation of technology for removal, solidification, and final disposition of high-level defense waste at the Savannah River Site first, followed by the Hanford Site. Consequently, high-level waste will continue to remain in the existing underground tanks at Hanford for several more decades, resulting in a storage life exceeding 50 years for most of the waste tanks.

To ensure the safe storage of the waste, the single-shell storage tanks are being evaluated for continued service. Technical studies and laboratory tests have been conducted to determine the effect of the contained chemicals and temperature on the reinforced concrete.[1,2] Based on the results of the laboratory testing, it can be concluded that elevated temperatures are the dominant factor in the reduction of concrete strength.

As the elevated temperature history of each tank is so critical to the long-term integrity of the waste tanks, an effort was made to locate the thermal history record of the waste tanks. Information on waste tank temperatures prior to 1974 was not documented or stored in a consistent and retrievable manner. Hence, much thermal data is now irretrievably lost. Data that were available were found in personal files of individuals within Rockwell or gleaned down from previous reports (see Appendix A). The purpose of this report is to formally document (and thus preserve) thermal data that have been recovered and to explain the need for retaining these type of data.

This work was performed with funding from the Long-Term High-Level Defense Waste Program (AR-05-15-10).

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STORAGE FACILITIES

The radioactive wastes from the chemical processing facilities are stored as alkaline slurries in underground tanks. These tanks are in groups, called Tank Farms, located within the 200 East and 200 West Areas. The basic containment concept in the tank design was to provide a carbon-steel liner for the walls and bottom of a reinforced concrete shell; only 26 leaks have occurred in the 149 tanks in 38 years of operation. An improved tank design, comprising a complete carbon-steel tank enclosing a second stress-relieved carbon-steel tank within a reinforced concrete shell, not only provides an extra barrier against the release of radioactive liquids but also provides for air cooling and liquid recovery in the annular space between the carbon-steel tanks. Construction of these tanks began in 1968 to provide 20 additional tanks in 5 new tank farms. The cross-section and capacities of the storage tanks are shown in Figure 1. The single-shell tank structures were designed to the specifications shown in Table 1.

OPERATING PRACTICES

The single-shell non-boiling tanks in the tank farms are of three sizes: 55,000 gallons, 530,000 gallons, and 750,000 gallons. The 530,000 gallon and 750,000 gallon tanks were originally arranged in cascades of three tanks, i.e., the tanks were arranged in such a manner than when the first tank in a cascade was filled, it overflowed to the second tank, then to the third tank. Many of the overflows between tanks in the various cascades have been removed, modified, or blanked. A number of the tanks were equipped with air-cooled reflux condensers. Dry wells located within the tank farms are used to monitor the soil for radioactivity, thus serving as a leak detection system. These dry wells extend to a depth varying from approximately 75 to 150 feet.

The routing of non-boiling liquid waste from the operating building to the tank farms is done by means of underground lines and diversion boxes. Leaks occurring in the diversion boxes, or into the surrounding

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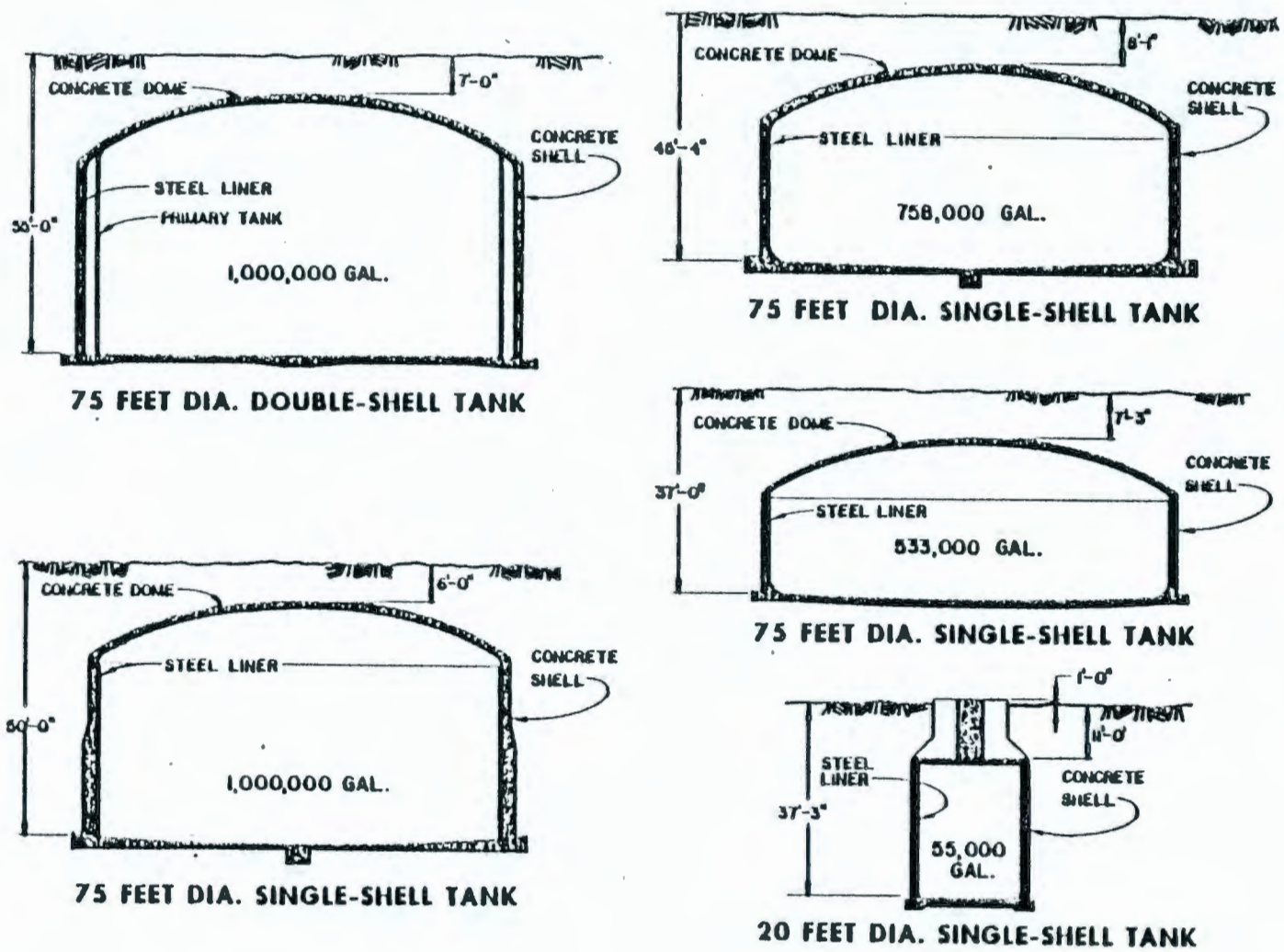

FIGURE 1. Waste Storage Tank Designs.

TABLE 1. Single-Shell Tank Structure Specifications.

Concrete	
Compressive Strength (psi)	3,000 - 3,500
Tensile Strength (psi)	300
Density (lb/ft^3)	150
Coefficient of Thermal Expansion ($in./in./^oF$)	0.0000065
Steel	
Bending Stress (psi)	20,000
Tensile Stress (psi)	16,000
Density (lb/ft^3)	480
Coefficient of Thermal Expansion ($in./in./^oF$)	0.0000065
Soil	
Density (lb/ft^3)	110
Allowable Soil Bearing (lb/ft^2)	6,000
Foundation Modulus (lb/in^2)	200
Liquid Waste	
Specific Gravity (max. hot)	1.2 - 2.0
Maximum Temperature (^oF)	180 - 300
Allowable Vapor Pressure (in inches of H_2O)	60
Alkalinity (pH)	8 - 10
Liquid Depth	Variable
Sludge Depth (ft)	1 - 5

line encasement, drain to catch tanks which are then pumped to the large underground storage tanks. Catch tanks and waste storage tanks are inventoried by taking electrode readings of the liquid levels.

There are five tank farms designated for aging waste (self-boiling): 241-A, -AX, -AY, -AZ, and -SX. The SX Tank Farm, used for storing Redox wastes, was the first to be equipped (through special ventilation systems) for handling vapors from boiling waste solutions; of the 15 tanks in the farm, Tank 241-SX-101, -104, -105 plus -107 through -115 were so equipped.

The 241-A, -AX, -AY, and -AZ Tank Farms were built to store Purex and B Plant (Waste Fractionization) aging wastes. The capacity of these tanks, as well as 241-SX Tanks, is 1,000,000 gallons. Vapors from the boiling action (or self-concentration) are routed through headers to condensers which are vented to the atmosphere through filters. Condensate is either discarded to cribs or returned to the waste tank where it is used to maintain the desired liquid level.

In the aging waste tanks, heat is generated when the fission products decay radioactively. Most of the heat generated is dissipated by boiling the supernatant, although a small amount of heat is conducted to the ground. The rate of heat generation in a tank is dependent upon the quantity of fission products present.

The 241-SY, -AW, and -AN double-shell tank farms have been placed into service for the storage of concentrated supernatant. Current plans call for the storage of all tank farm liquid waste in double-shell tanks.

DISCUSSION

Laboratory tests have been conducted to determine the effect of storing the waste in the underground storage tanks on the concrete and reinforcing steel. The data show that elevated temperatures are the dominant factor in the degradation of concrete strength and elastic properties. Figure 2 illustrates the reduction in compressive strength with increased temperature after 900 days (approximately 2-1/2 years); the reduction in strength approaches the minimum design value while that of the control specimens at 73°F has increased.

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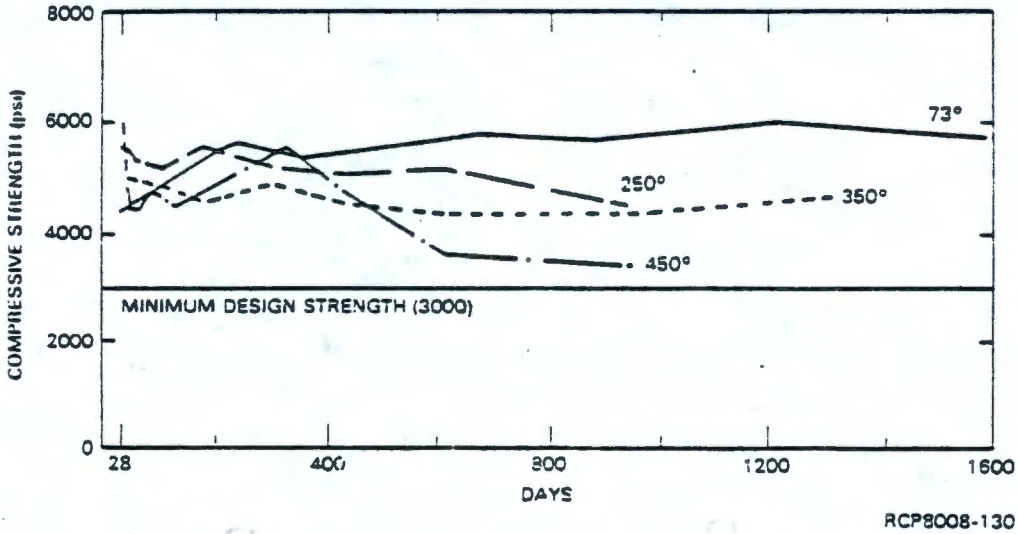

FIGURE 2. Compressive Strength Versus Temperature and Time (3,000-psi-concrete).

In a reinforced concrete structure, the concrete is designed to support the compressive load and the reinforcing steel is designed to support the tensile load. The two materials are bonded by adhesion to provide a functional structural member. If the bonding fails, deterioration of the structure will result. At ambient temperatures, bond failure does not occur in a well designed structure. In a structure subjected to large temperature variations, the effect of thermal expansion or contraction should be considered. The value of the coefficient of thermal expansion used is generally 5.5×10^{-6} for concrete and 6.5×10^{-6} for reinforcing steel. The difference is considered insignificant and actual structural experience supports this assumption. Laboratory testing has shown that Hanford concrete expands at a rate approximately one-half that of steel with average rates shown in Figure 3. The significance of the different expansion rates on the tank structures is to be determined by computer-aided structural analysis. The design parameters for the single-shell tanks used a value of 6.5×10^{-6} in./in./^{o}F for both the concrete and reinforcing steel.[3]

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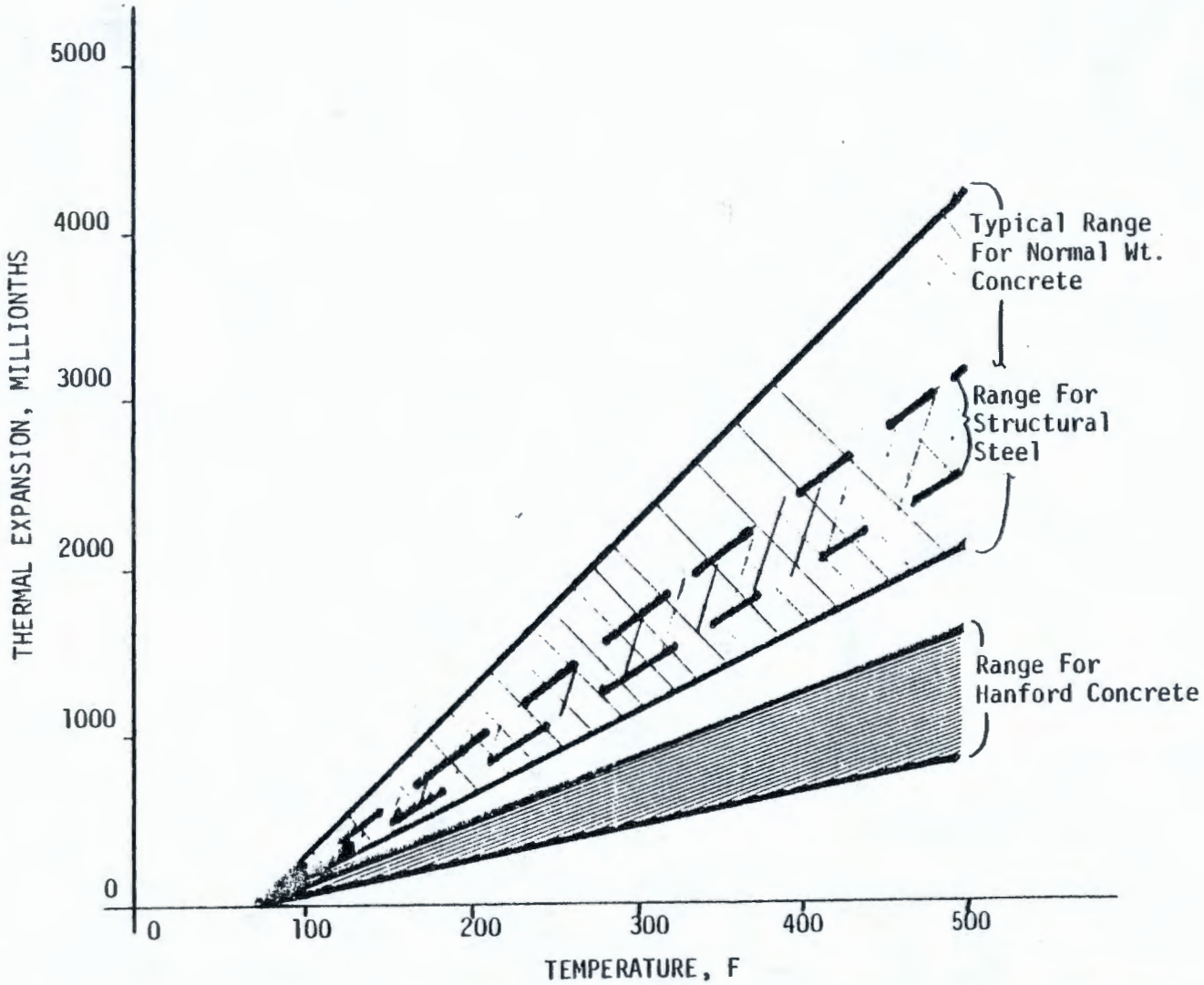

FIGURE 3. Thermal Expansion Behavior of Typical Concrete Mixes, Structural Steel, and Hanford Concrete.

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TEMPERATURE RECORDS

Liquid levels, chemical analysis, molarity, radiation levels, and temperature date of the waste in the storage tanks have been recorded since the chemical processing and waste storage operations began in 1944. All data not required to be included in the "General Electric Business Records" or for operation of the plants were either placed in storage for a limited time or were destroyed.

Efforts to retrieve recorded temperature data for the single-shell tanks have been completed. The earliest temperature data found begins with startup of the Redox-process waste storage tanks, 241-S-101, -104, -107, and -110. The time period is limited to January 1952 through October 1953. Most of the data retrieved have similar time gaps. The data for the 241-A and -AX tanks are more complete than any other examined but also have time gaps. Of the 12 tank farms, only the four associated with the Redox (241-S and -SX) and Purex (241-A and -AX) processes have a significant amount of retrieved data. The data for the remaining eight tank farms are very limited and essentially nonexistent.

The collection of single-shell tank thermal history data included Department of Energy - Richland Operations Office's records from the storage warehouse in Seattle, Washington, and discussions with 14 Rockwell Hanford Operations employees. Extensive data records were obtained from Messrs. B. W. Anderson and G. L. Hanson. From these personal contacts and the contents of recorded data, the conclusion is that liquid levels were of primary importance and temperatures secondary until the self-boiling concept of in-tank solidification was started. At that time, temperature began to play a much more significant role.

Since 1974, tank temperature data have been collected and stored using the Computer Automated Surveillance System (CASS), with automatic reading, recording, and storing capability for 76 tanks (8 double-shell and 68 single-shell), using approximately 1,500 thermocouple points (see Table 2). Data have been entered manually for the data available between 1968 and 1974. Retrievability of storage tank data appears assured with this system.

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TABLE 2. Tanks with Thermocouples on the CASS System.

Tank Farm	Type	Tank Designation
A	SS	101-104, 106
AX	DS	101-104
AY	DS	101,102
AZ	DS	101,102
B	SS	112
BX	SS	105, 106, 108, 110-112
BY	SS	103-106, 108, 109, 112
S	SS	101-103, 105-112
SX	SS	101-112, 114
TX	SS	102-112, 118
TY	SS	101-104
U	SS	102, 103, 105-111

Key: DS = Double Shell
SS = Single Shell

SPECIFIED TEMPERATURE LIMITS

The waste temperature entering the tank is relatively low (100° to 130°F) but reaches the boiling point in about one month and continues to rise with self-concentration. Water is added to the stored waste to control the concentration and hence, the temperature.

Operating temperature limits were established and a rate of temperature rise specified. A maximum waste temperature limit of 350°F or lower is presently specified for the tanks. Maximum temperatures in the non-boiling tanks ranged from 120° to 140°F. It was recognized that temperatures were not readily controllable and recorded data indicate that as much as two weeks would be needed to stop a thermal increase. The highest temperature noted in the tank temperature data retrieved was 312°C (594°F) in Tank 241-A-106 on May 15, 1963.

Appendix B to this report contains all data prior to 1972 that have been recovered shown in graphical form. The data itself consist of log book entries, input to monthly reports, etc. For the bulk of the early

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data, only one or two temperature points were given and the location of the point not specified. Where a number of data points were available, the high and the average value were plotted. There were no thermocouples in the wall of the tank; hence, the temperatures would be of the air or the waste in the tank.

CONCLUSION

Reconstructing a thermal history of the single-shell tanks will be difficult at this late date. What has been retrieved contains time gaps that may be significant in determining an operating temperature range for structural analyses. The bulk of the data retrieved has been recorded in tabular form and makes a sizeable volume. Graphs of this data are shown in Appendix B of this report.

It is evident that temperature operating limits have been exceeded in the past. A structural analysis of the tank is needed to evaluate the effect on structural stability. An evaluation of structural integrity cannot be complete without sampling the tank concrete in the regions critical to structural stability.

A designated repository for the scattered tank temperature data is required until pertinent information has been collected and recorded. An analysis of the interaction of liquid level and temperature on the tank structure is essential for postulating a failure mode. Two computer programs, SAFECRACK and NONSAP-C, are being modified for use in the structural analyses. The data in Appendix B have been summarized into quarterly values and input into a computerized data retrieval system developed by Rockwell which also contains other tank information[4] such as operating and liquid level histories. This will allow a person to access via a computer terminal any combination tank history data for any particular time period, allowing for a more rapid and accurate determination of any particular waste tank's history.

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L. W. Roddy
B. J. Saueressig
R. E. Van der Cook

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3. R. W. Harvey, et al., Management of Radioactive Wastes Stored in Underground Tanks at Hanford, ARH-R-43, Rev. 2, Atlantic Richfield Hanford Company, Richland, Washington (April 1970).

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APPENDIX A

DOCUMENTS USED IN OBTAINING THERMAL HISTORY DATA.

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APPENDIX B

GRAPHS OF TEMPERATURE DATA

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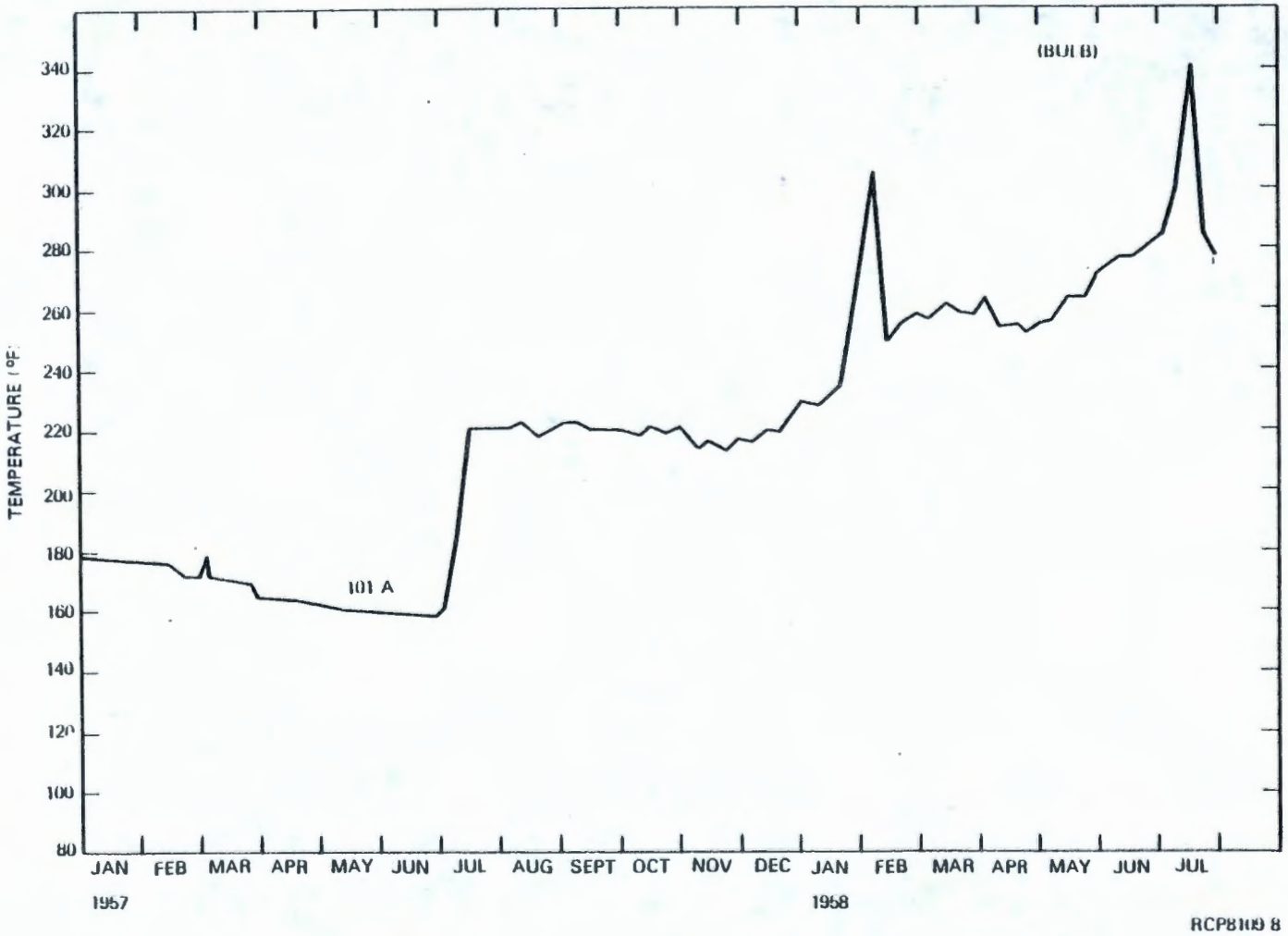

FIGURE B-1. 241-A-101 (Bulb Temp.*)
January 1957 thru July 1968

* = Bulb Temp. = Temp. of annulus air

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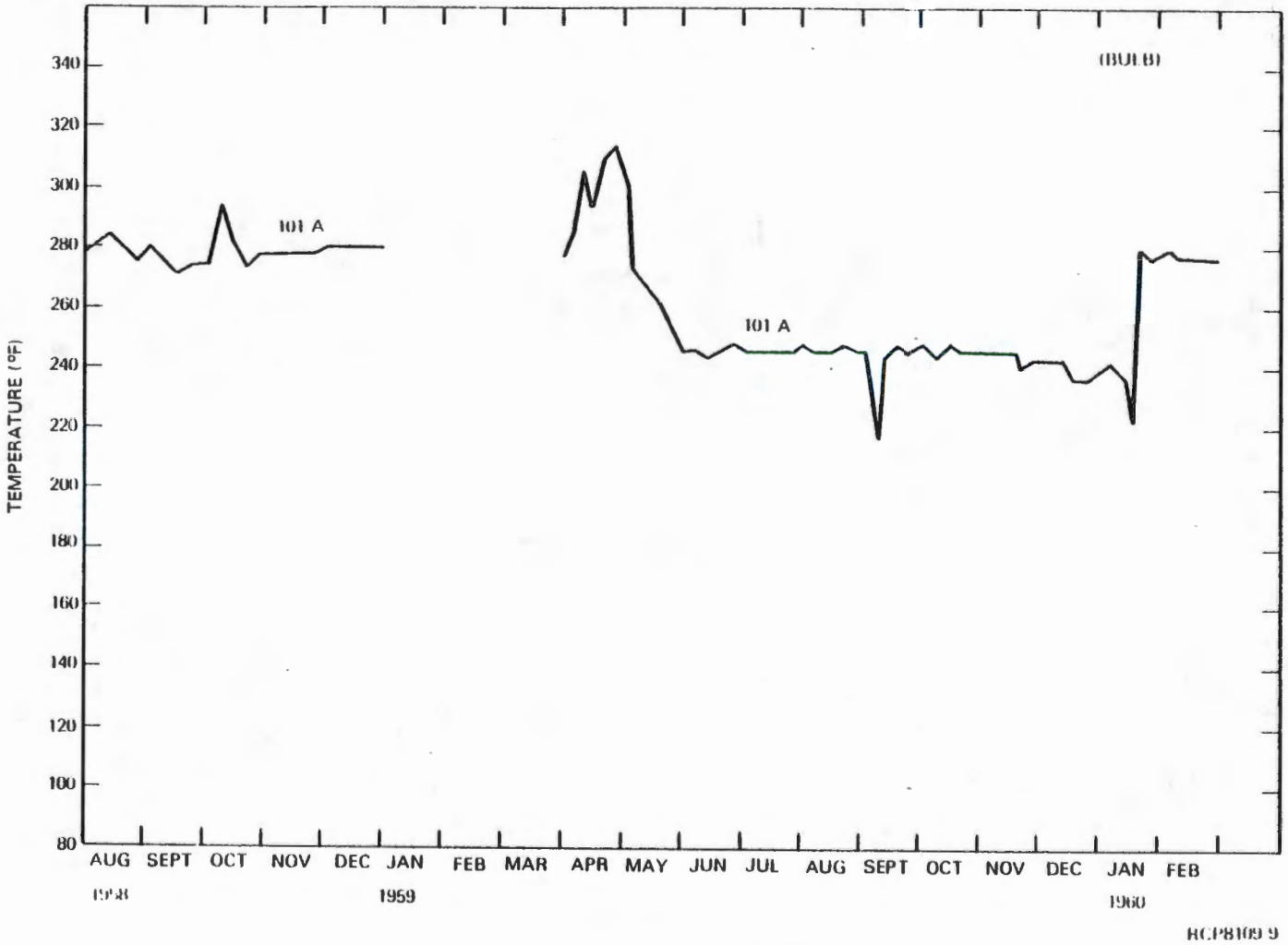

FIGURE B-2. 241-A-101 (Bulb Temp.)
August 1968 thru February 1960

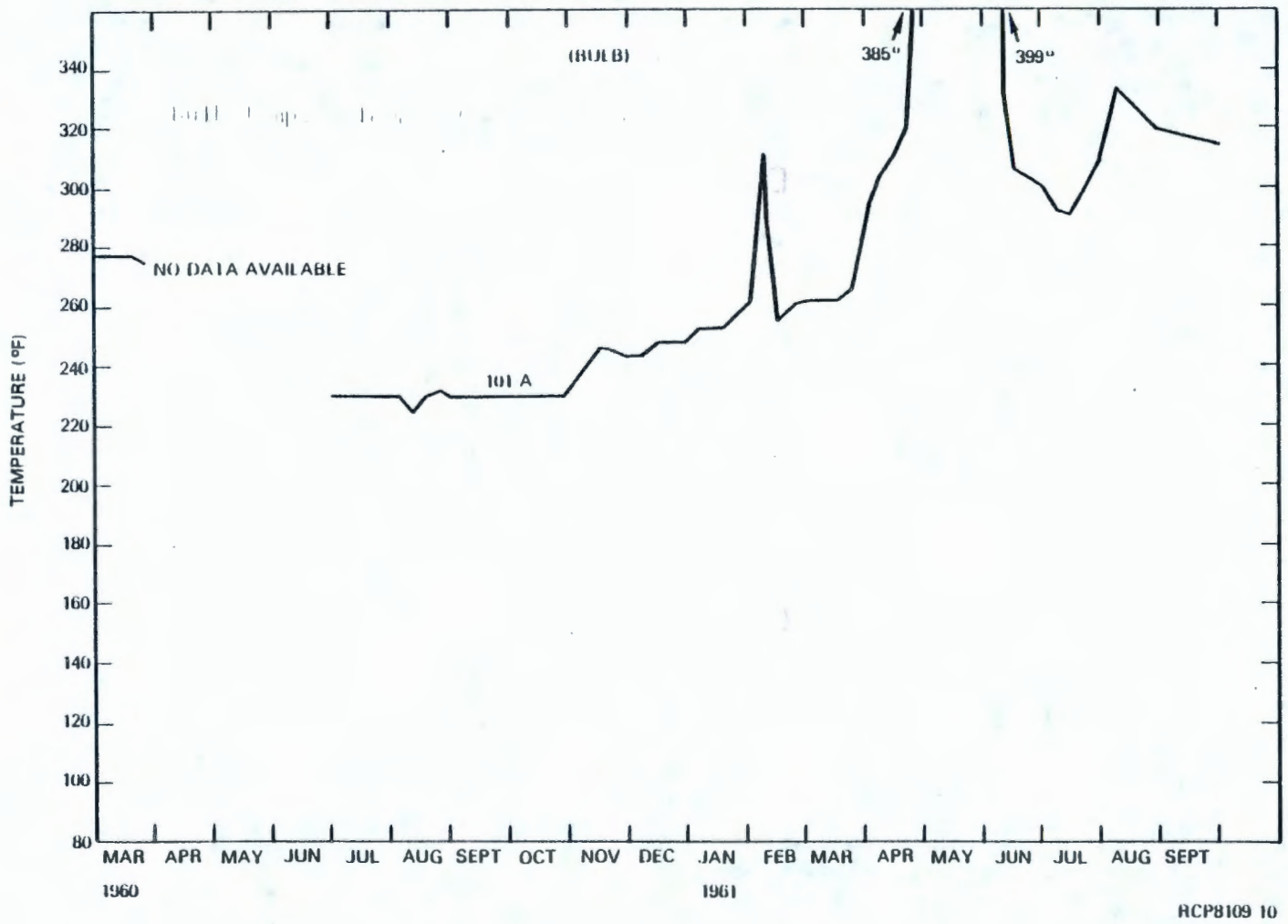

FIGURE B-3. 241-A-101 (Bulb Temp.)
March 1960 thru September 1961

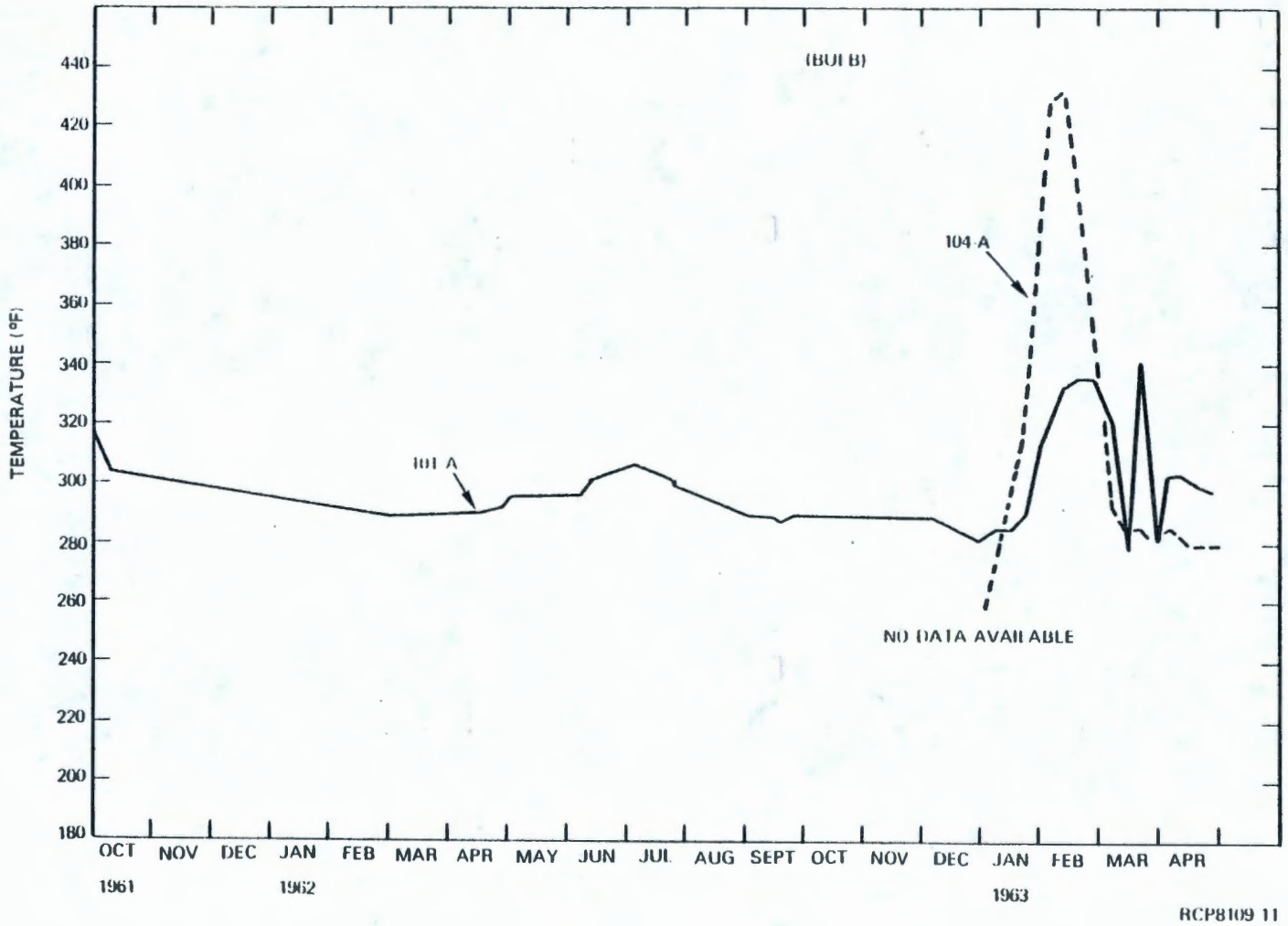

FIGURE B-4. 241-A-101 and -104 (Bulb Temp.)
October 1961 thru April 1963

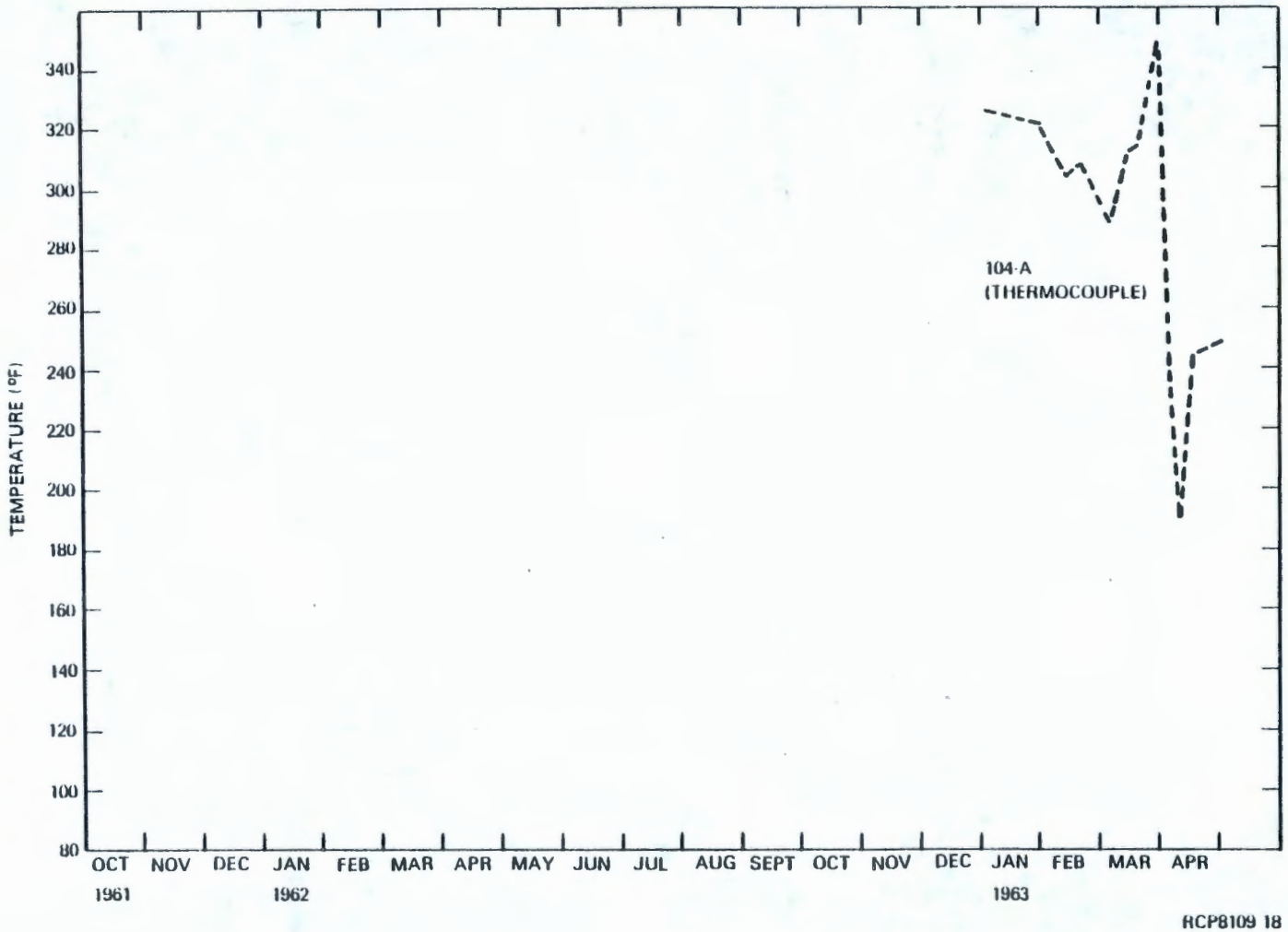

FIGURE B-5. 241-A-104 (Waste Temperature)
October 1961 thru April 1963

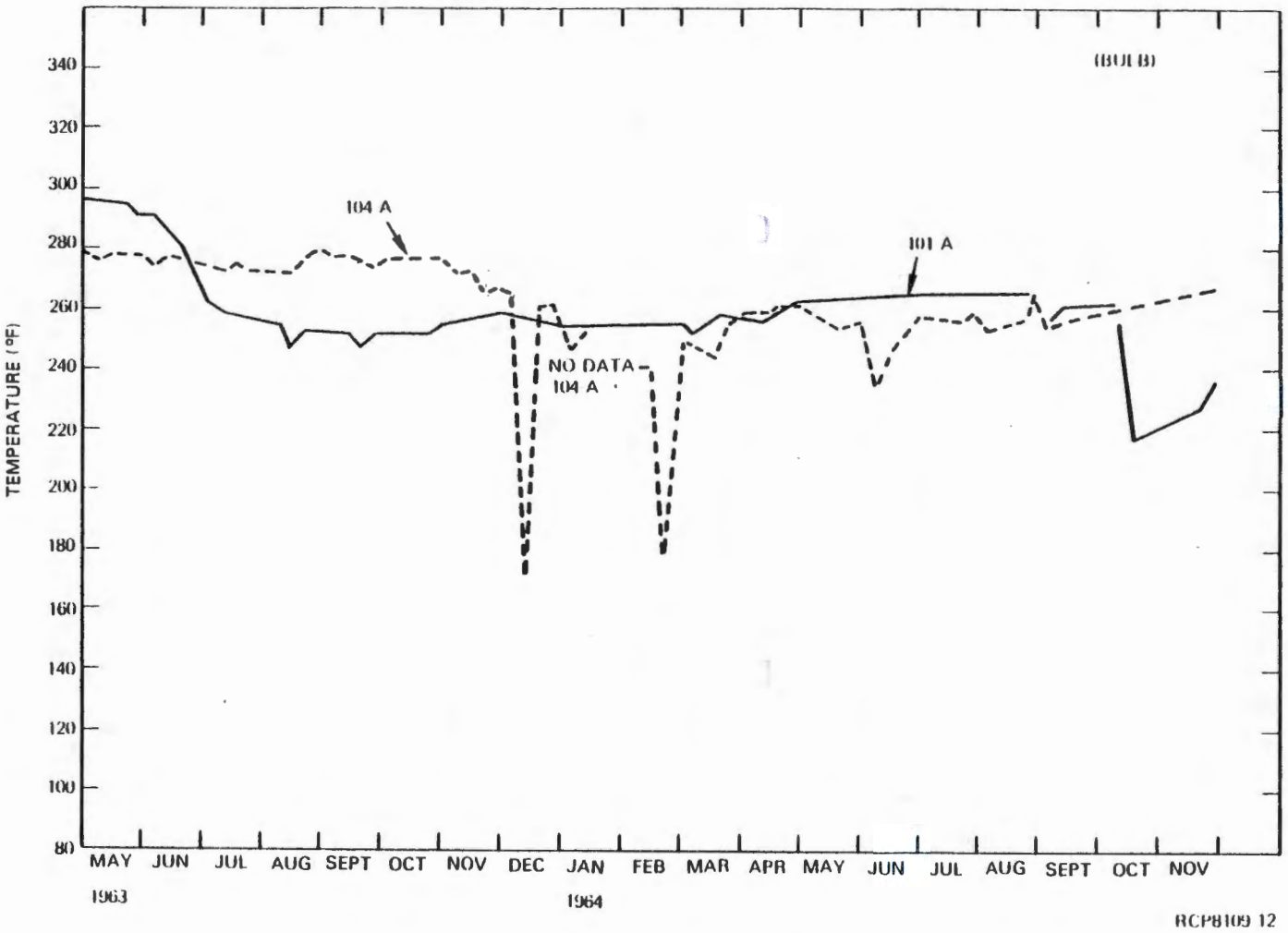

FIGURE B-6. 241-A-101 and -104 (Bulb Temp.)
May 1963 - November 1964

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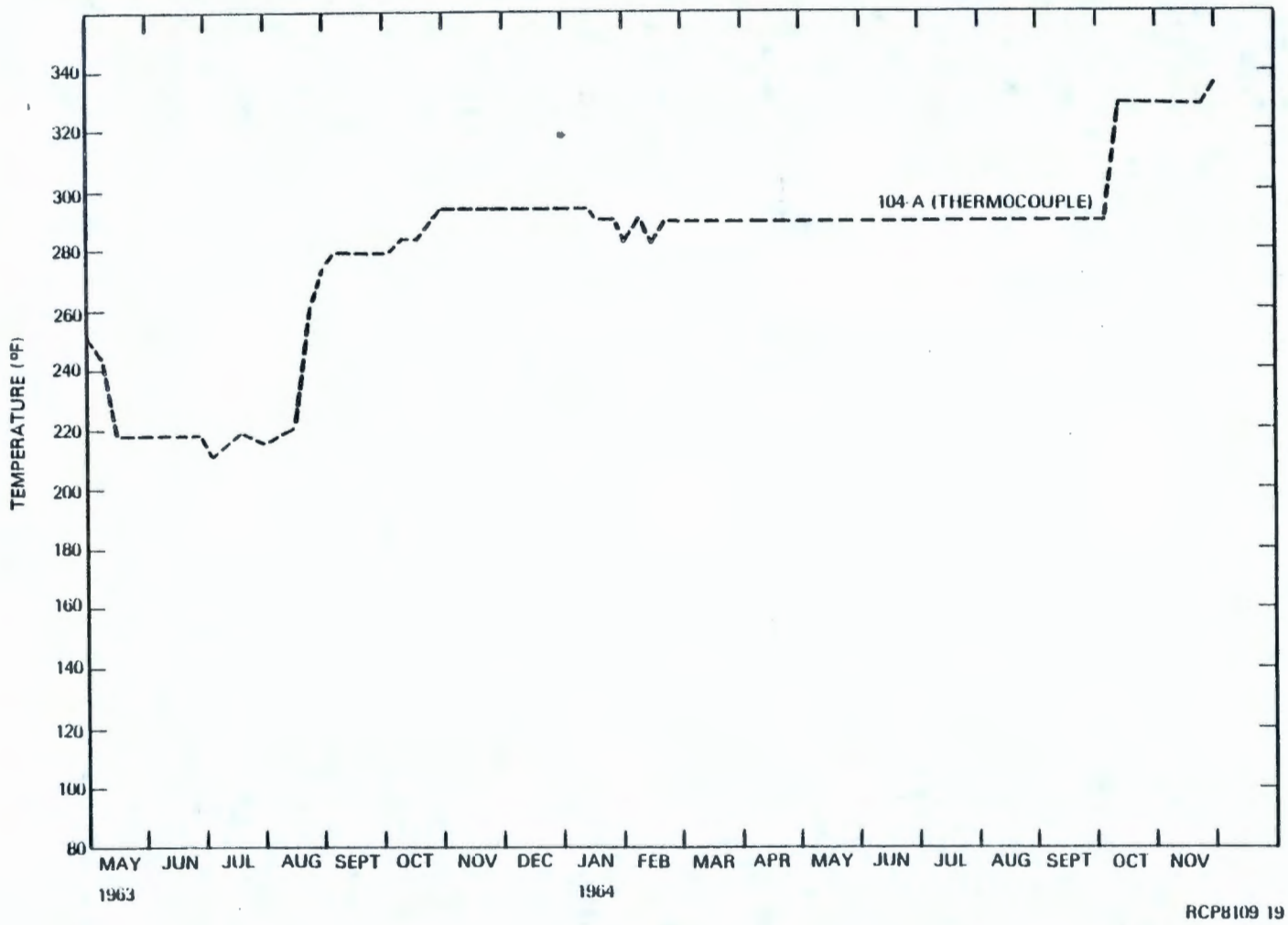

FIGURE B-7. 241-A-104 (Waste Temp.)
May 1963 thru November 1964

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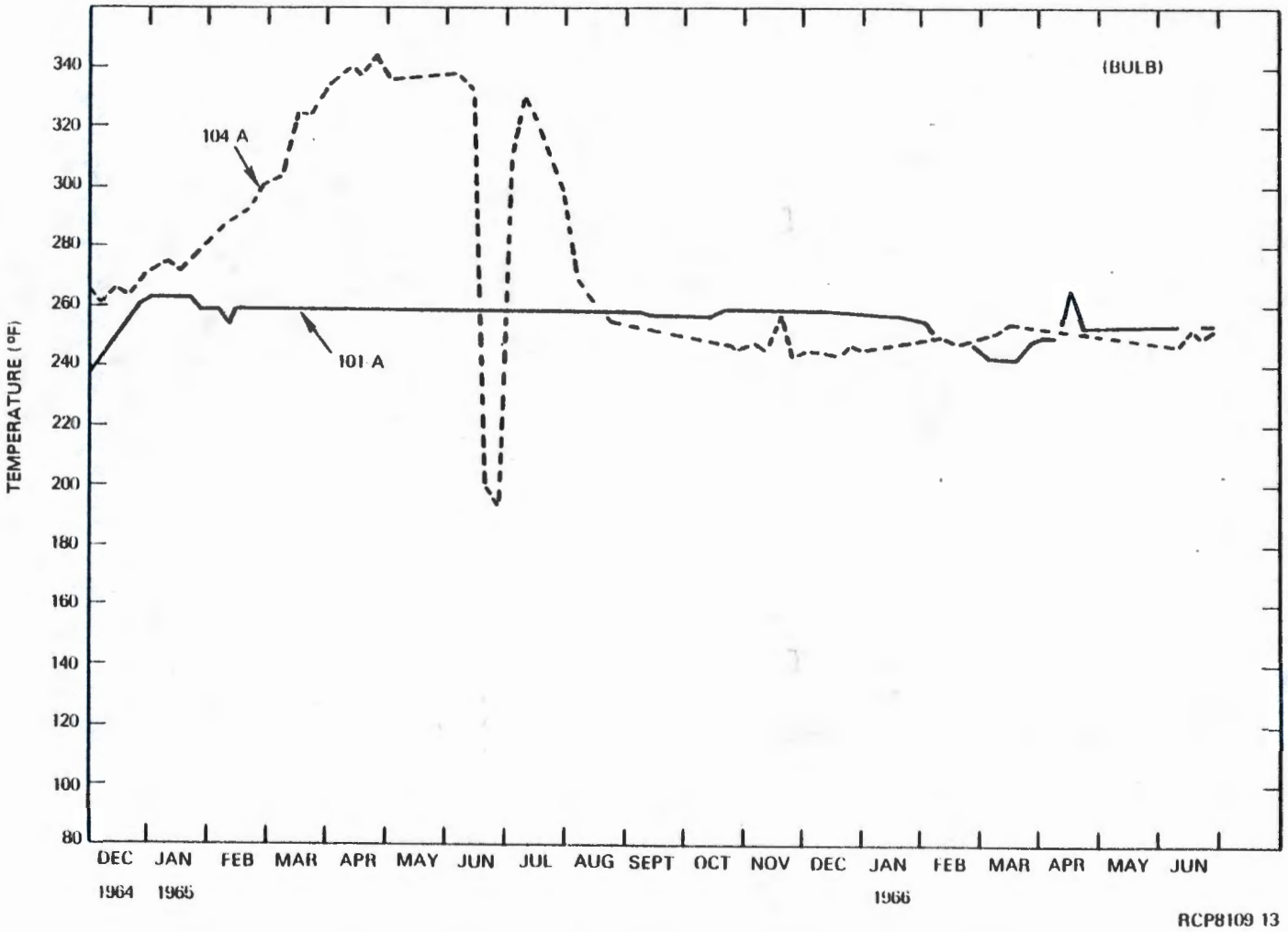

FIGURE B-8 241-A-101 and -104 (Bulb Temp.)
December 1964 - June 1966

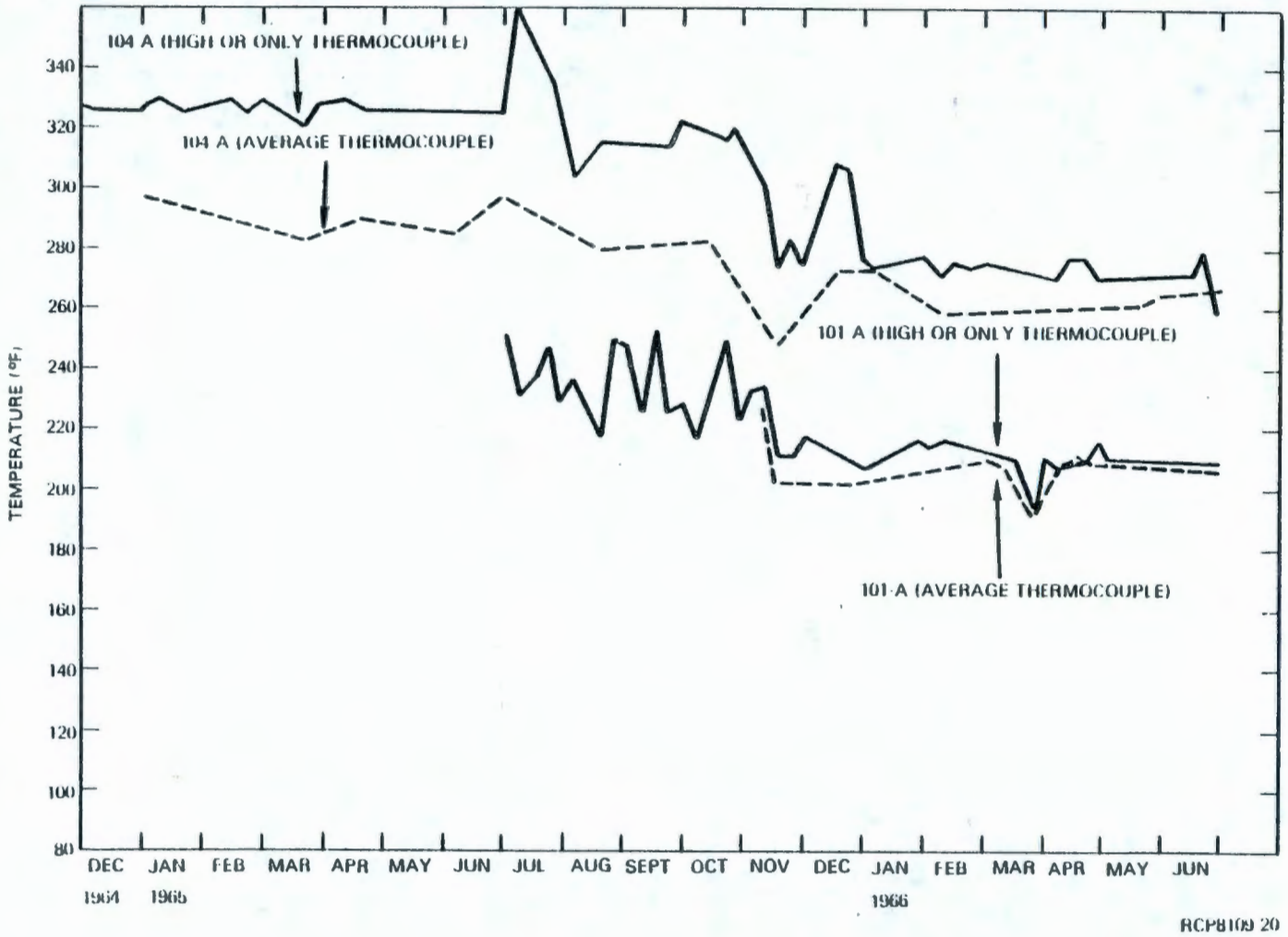

FIGURE B-9. 241-A-101 and -104 (Waste Temp.)
December 1964 thru June 1966

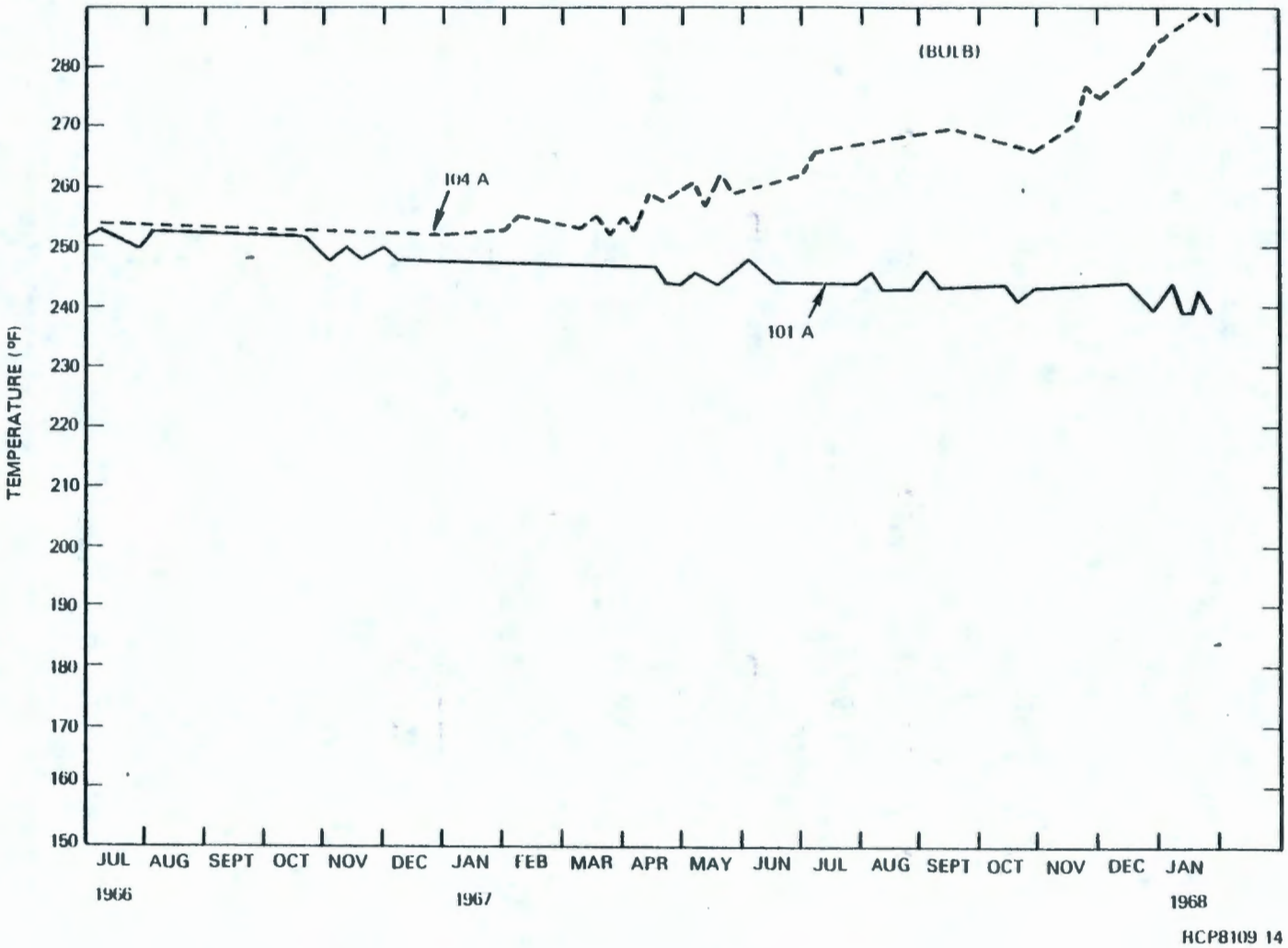

FIGURE B-10. 241-A-101 and -104 (Bulb Temp.)
July 1966 thru January 1968

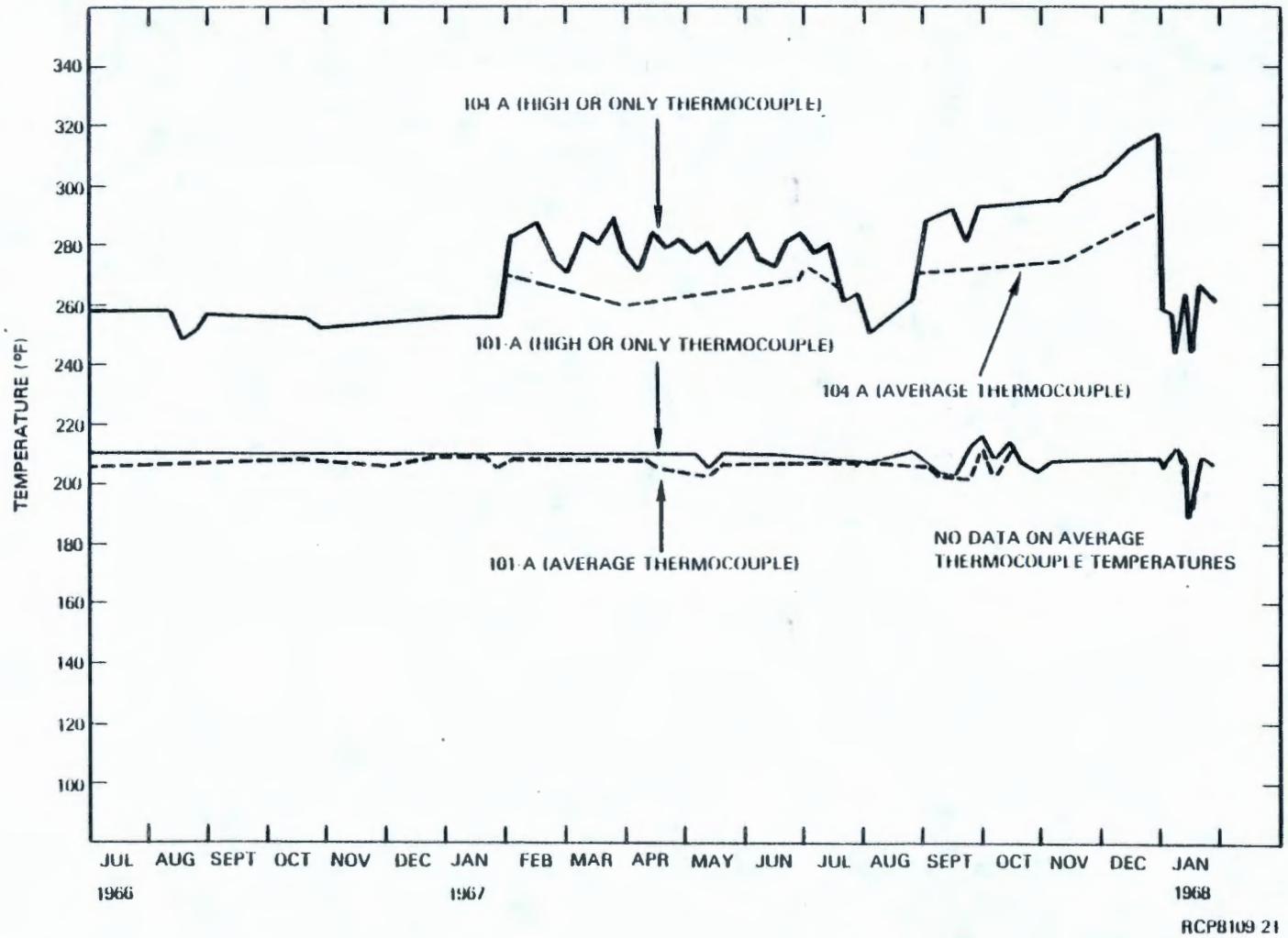

FIGURE B-11. 241-A-101 and -104 (Waste Temp.)
July 1966 thru January 1968

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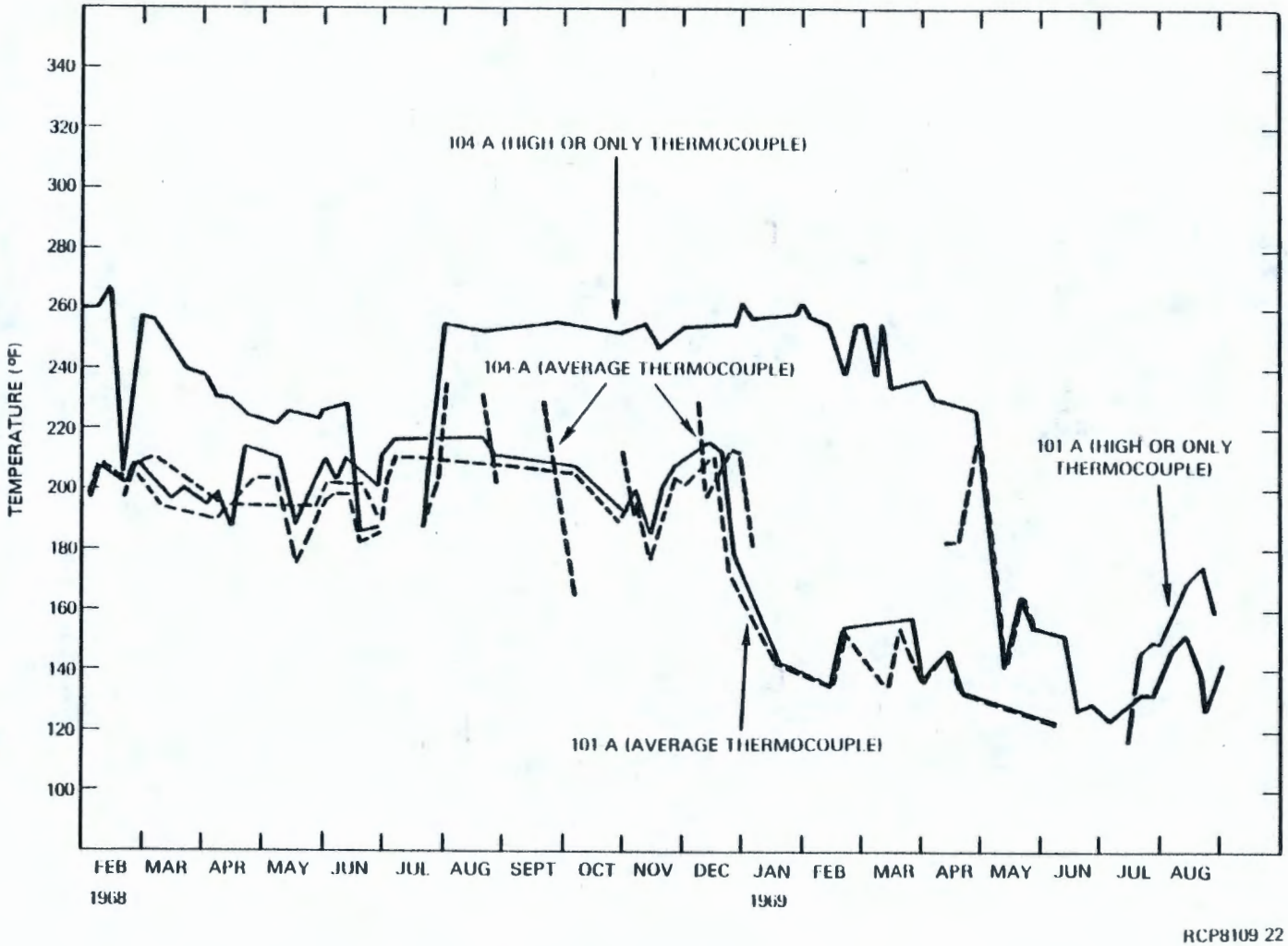

FIGURE B-12. 241-A-101 and -104 (Waste Temp.)
February 1968 - August 1969

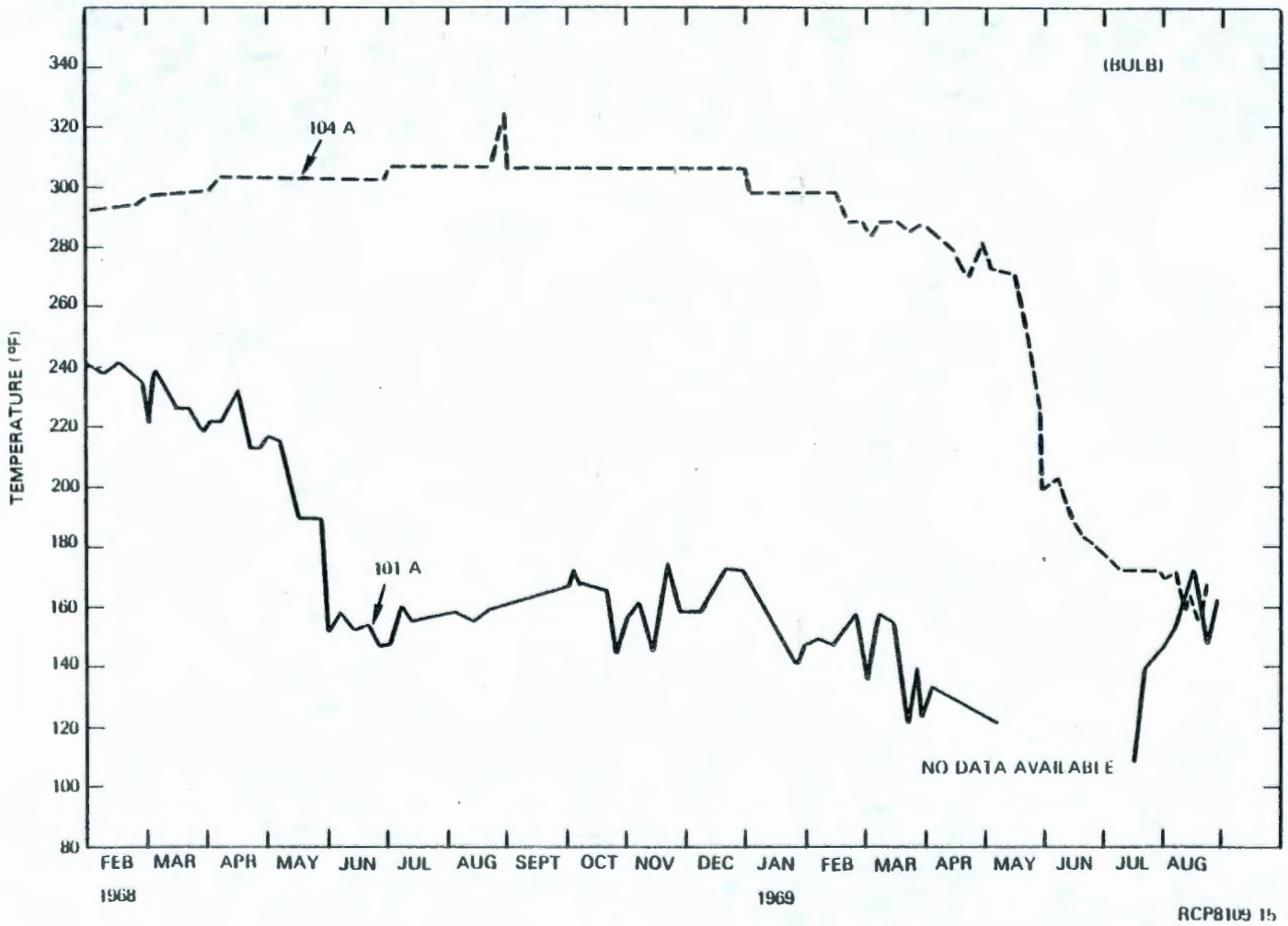

FIGURE B-13. 241-A-101 and -104 (Bulb Temp.)
Feb. 1968 - Aug. 1969

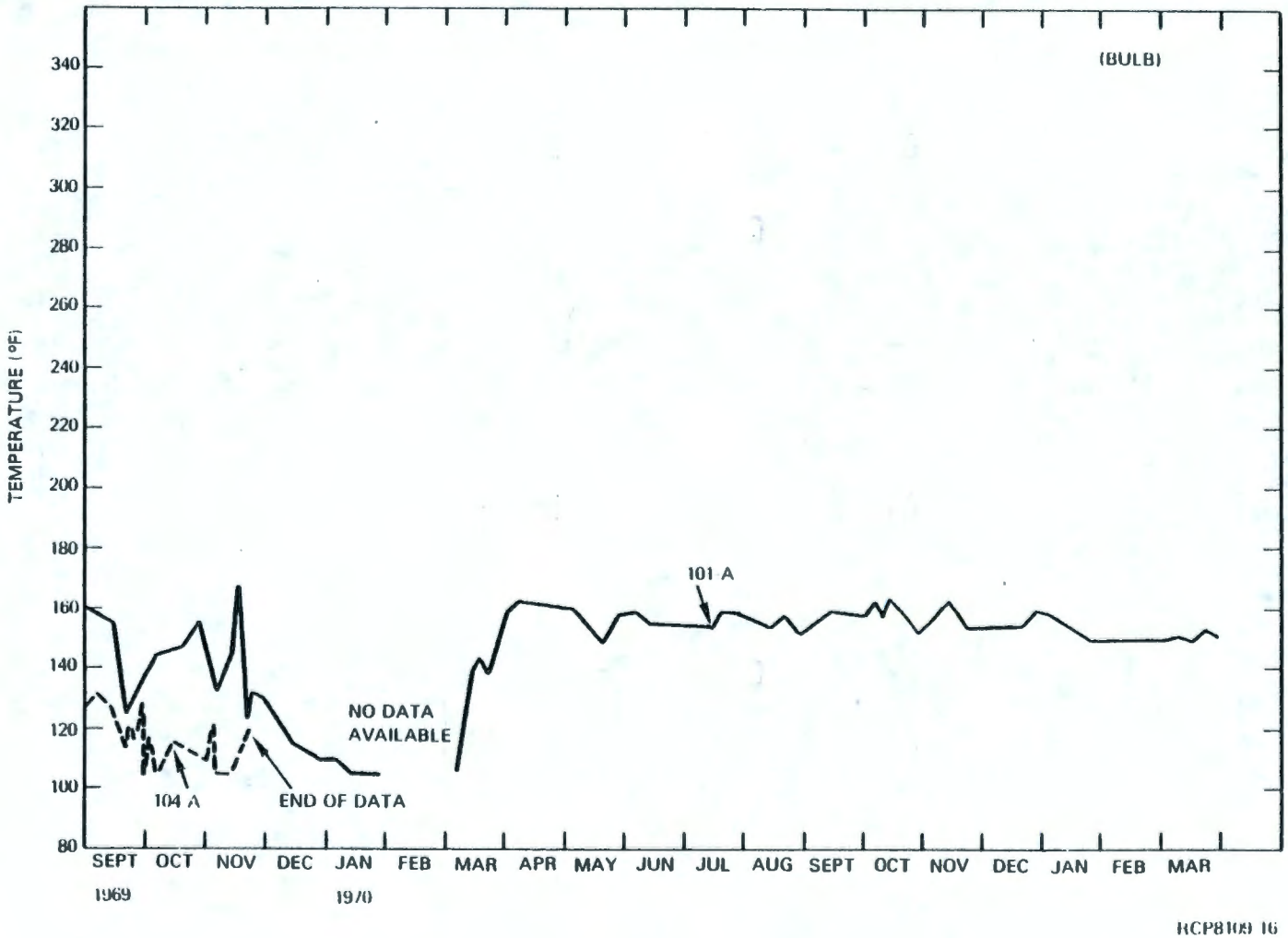

FIGURE B-14. 241-A-101 and -104 (Bulb Temp.)
Sept. 1969 thru Mar. 1970

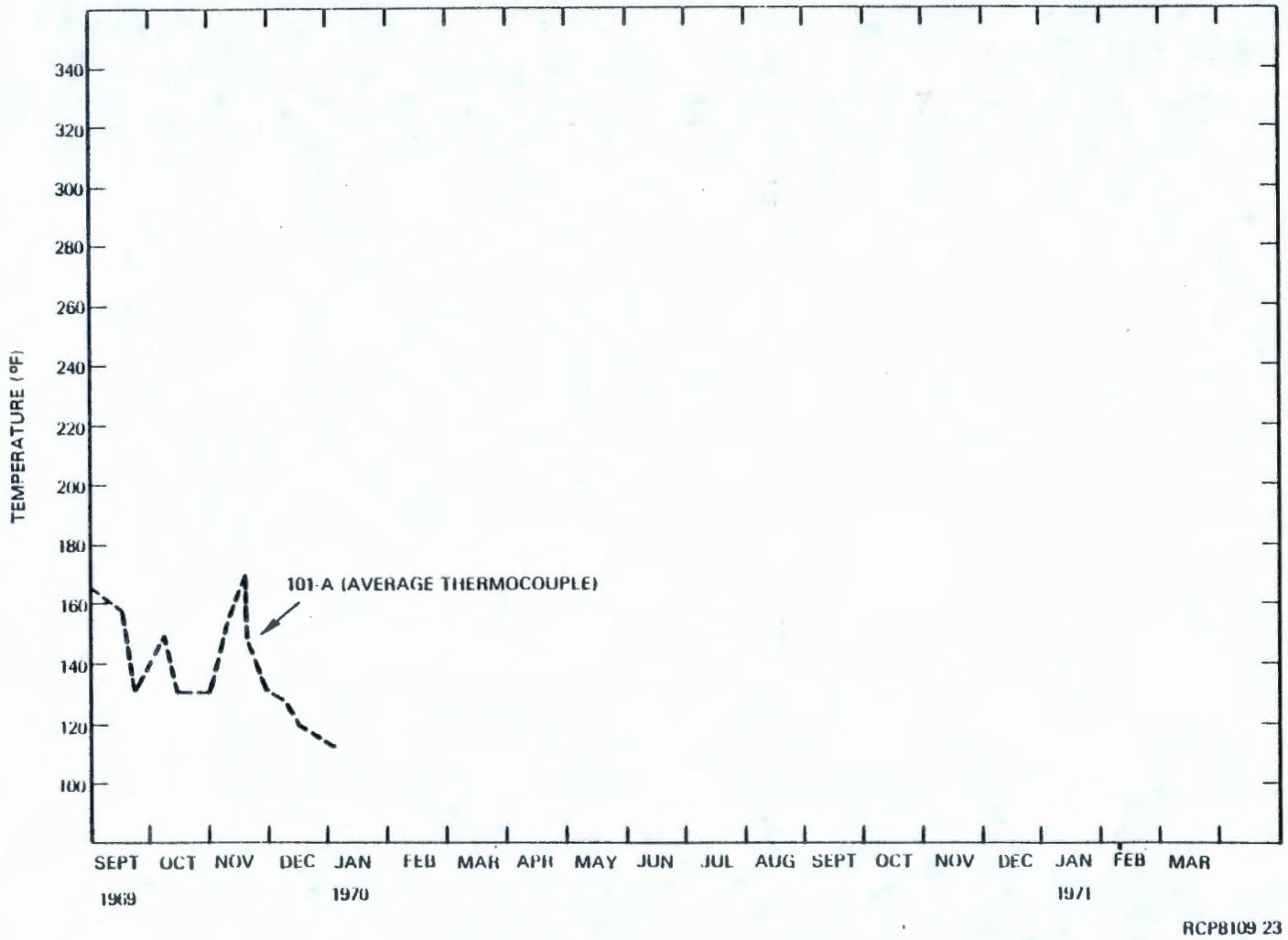

FIGURE B-15. 241-A-101 (Waste Temp.)
September 1969 thru January 1970

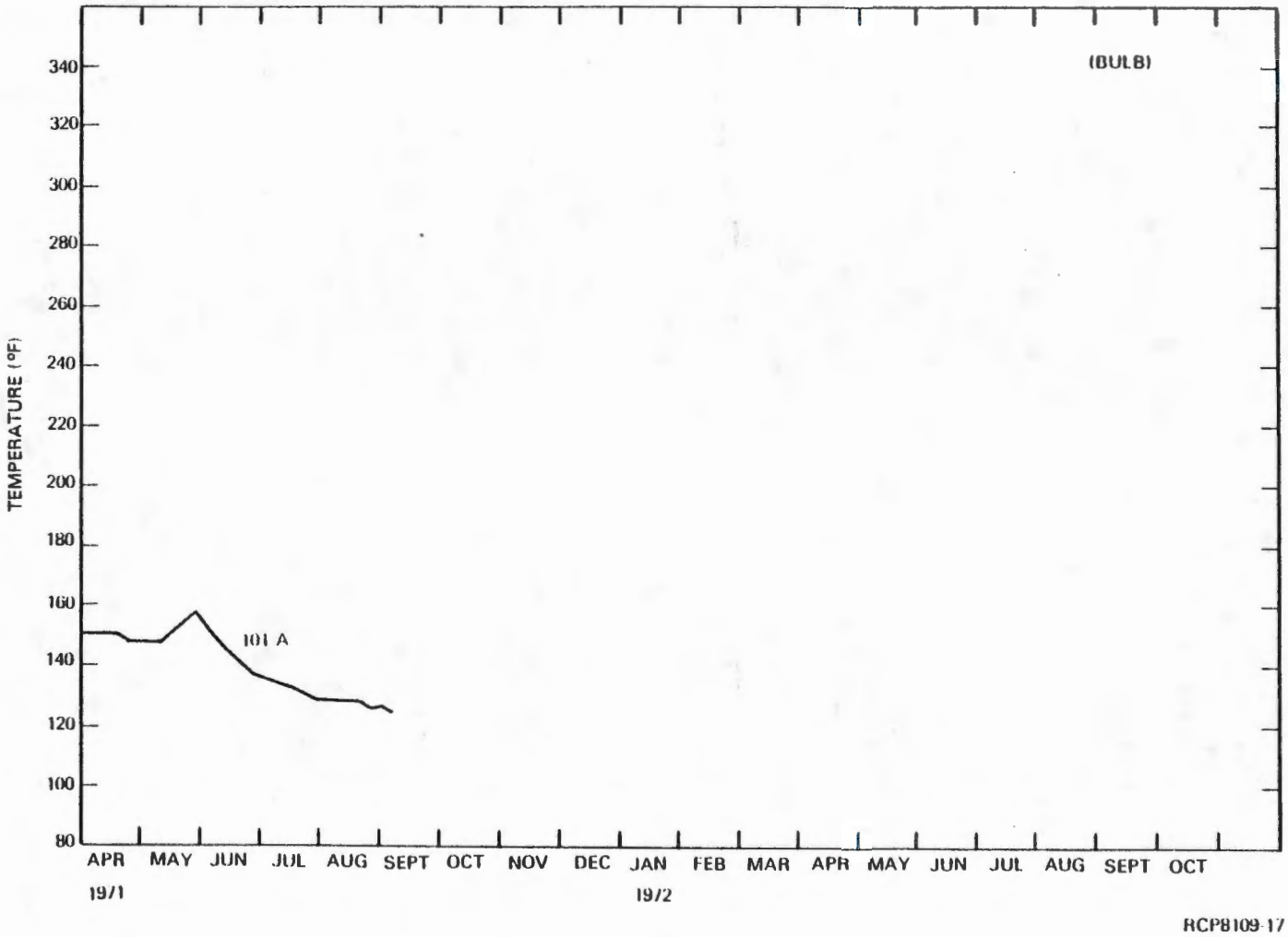

FIGURE B-16. 241-A-101 (Bulb Temp.)
April 1971 - September 1971

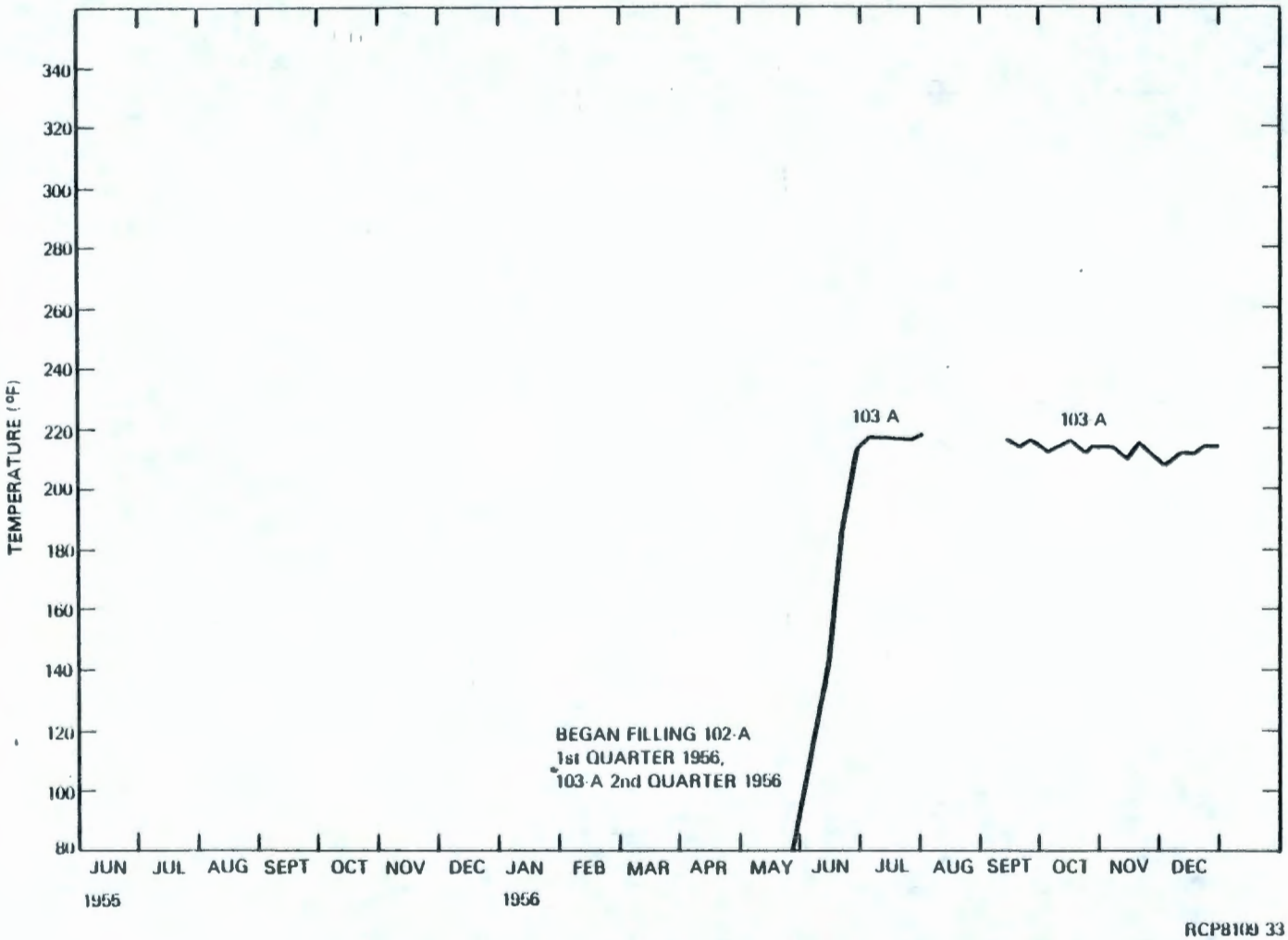

FIGURE B-17. 241-A-102 and -103 (Bulb Temp.)
May 1956 - December 1956

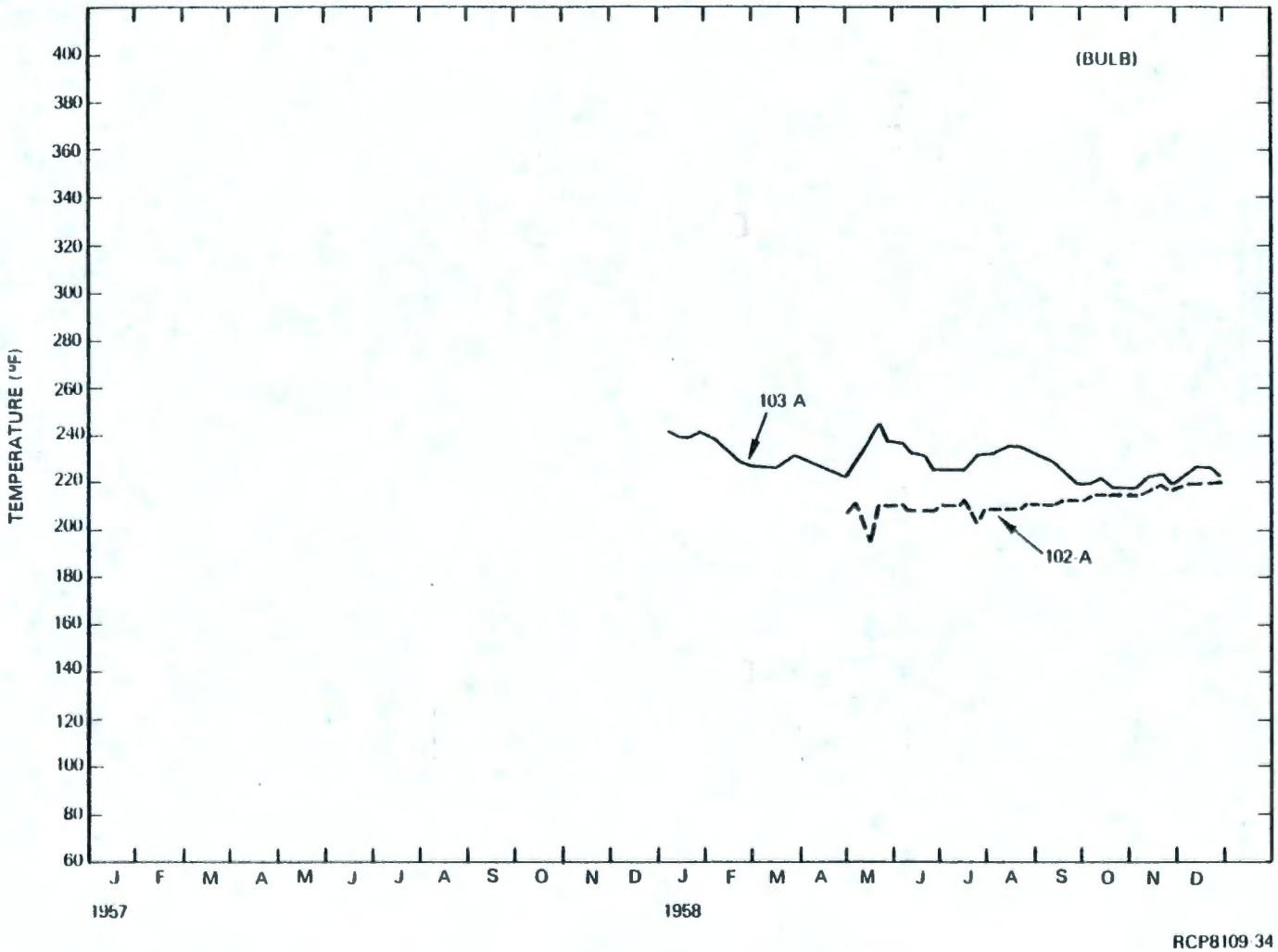

FIGURE B-18. 241-A-102 and -103 (Bulb Temp.)
December 1957 - December 1958

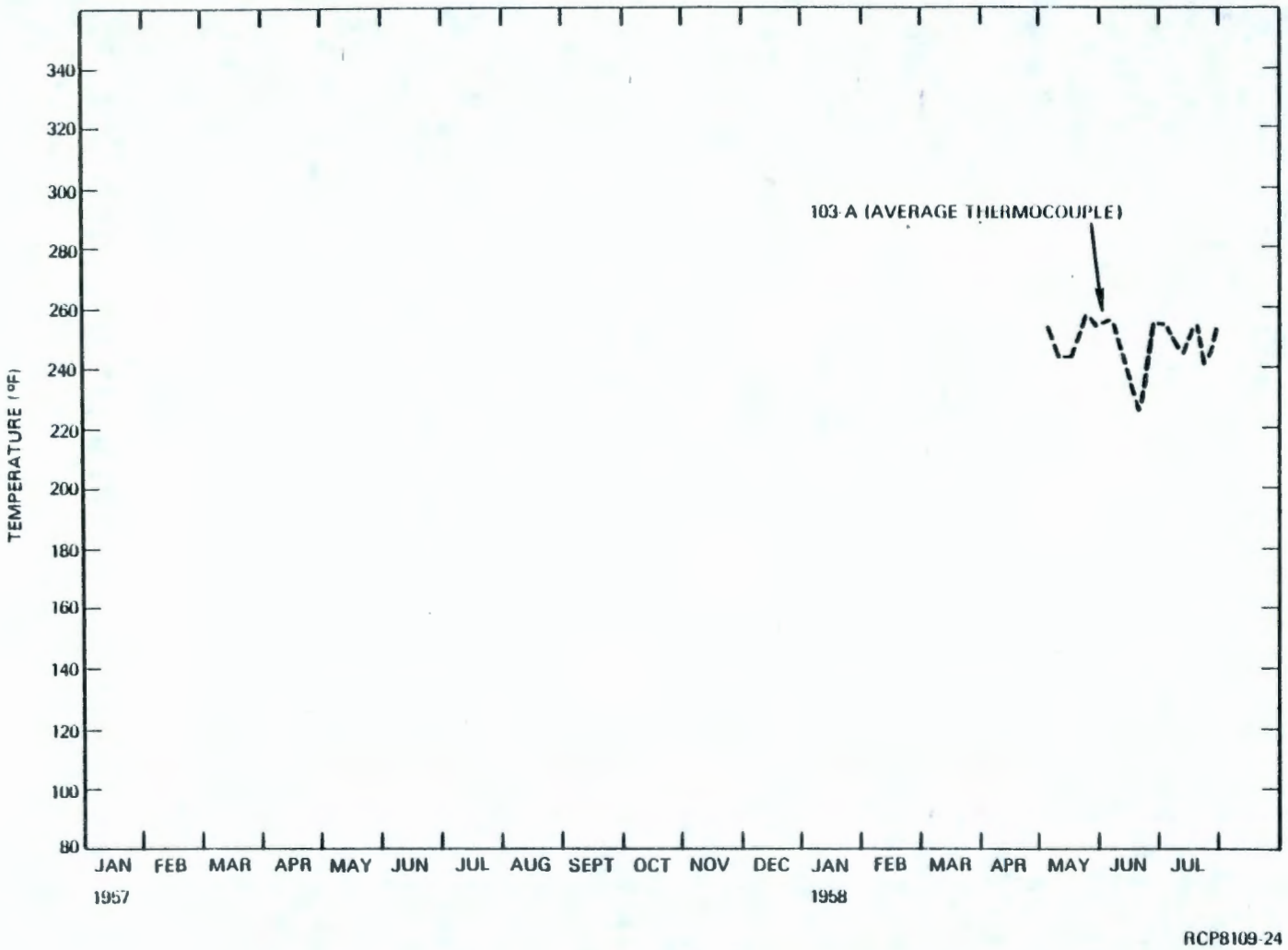

FIGURE B-19. 241-A-103 (Waste Temp.)
January 1957 - July 1958

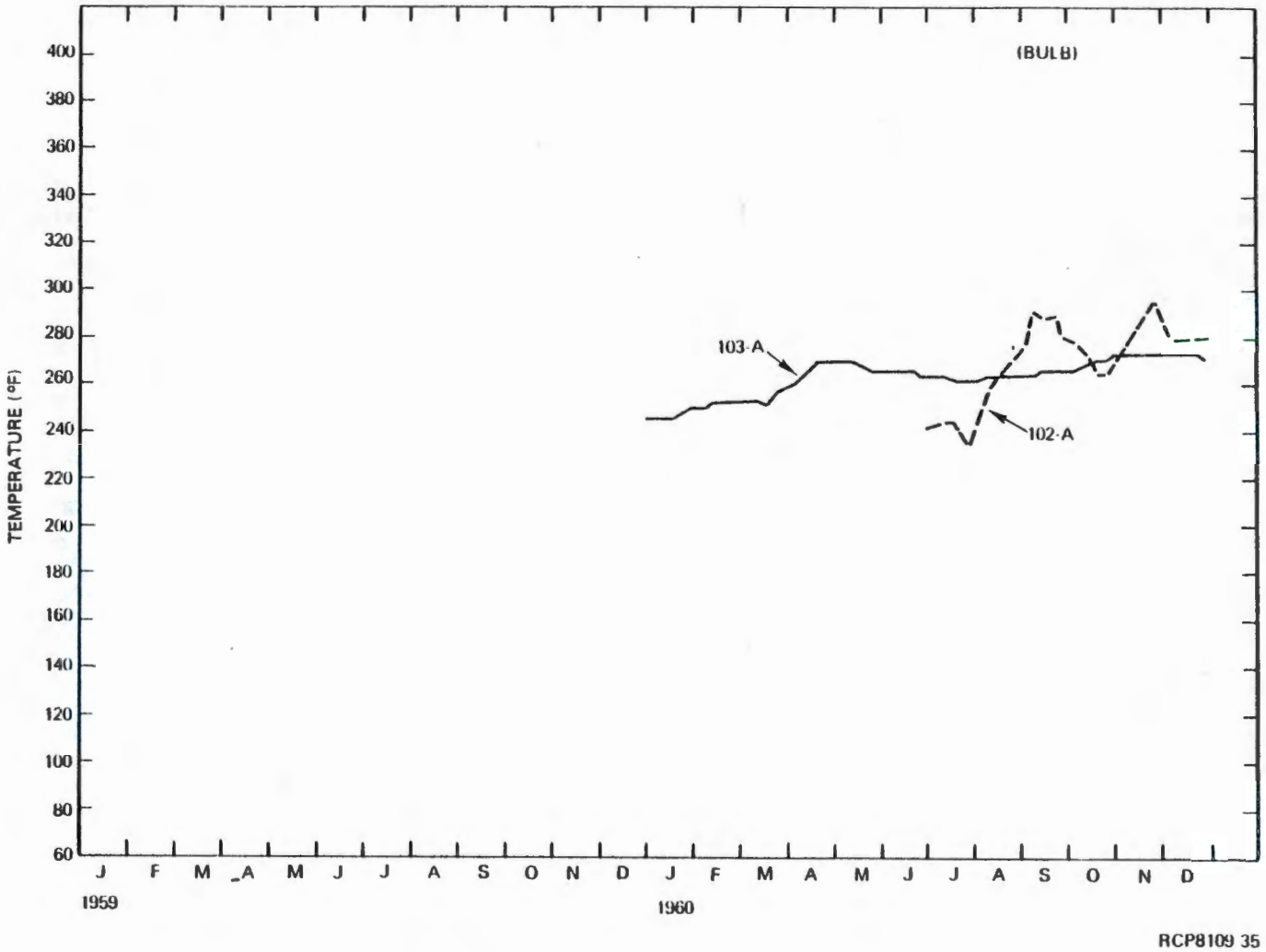

FIGURE B-20. 241-A-102 and -103 (Bulb Temp.)
January 1959 thru December 1960

9 1 1 2 0 5 4 0 6 2 3

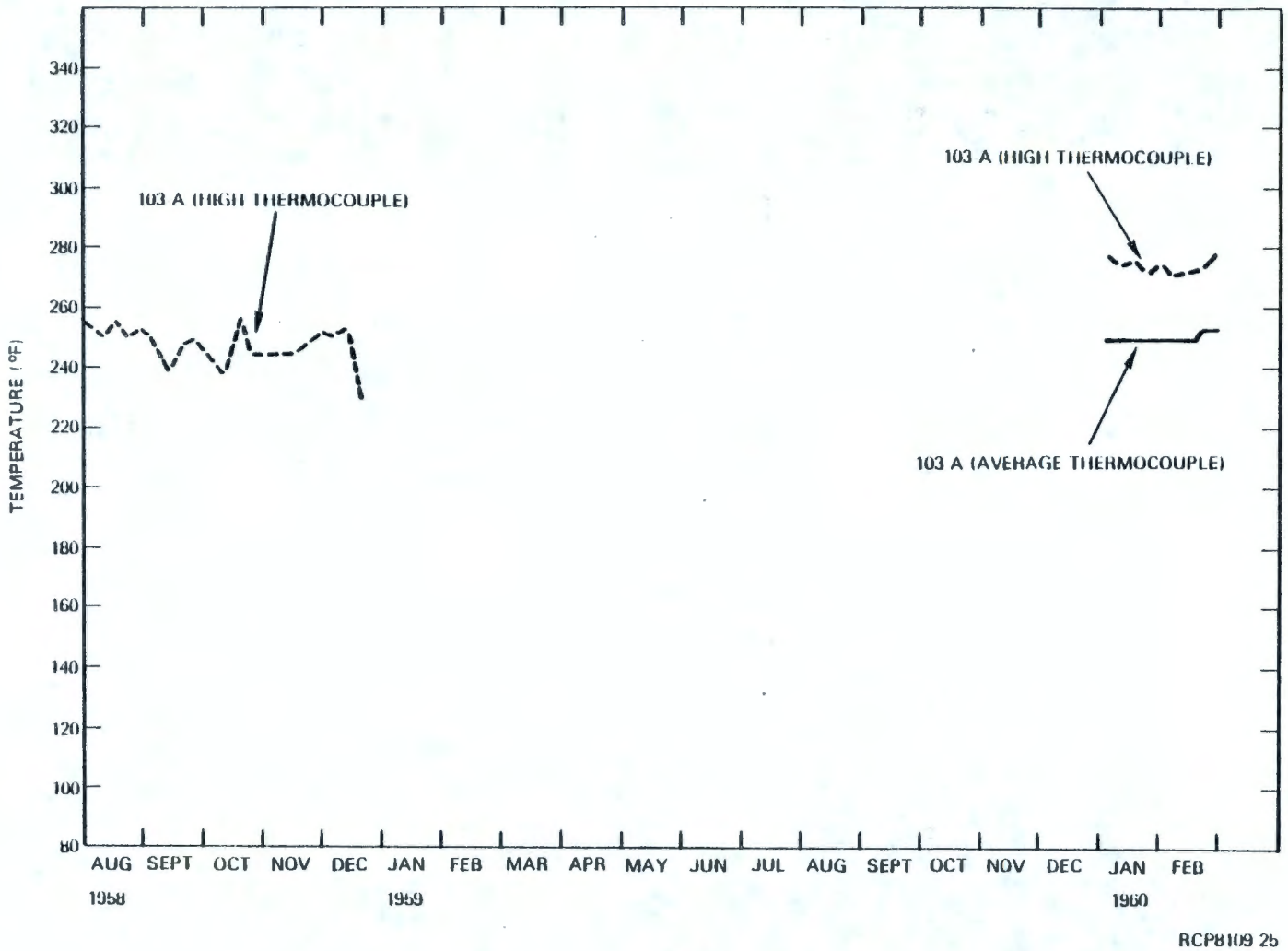

FIGURE B-21. 241-A-103 (Waste Temp.)
August 1958 - February 1960

T00293

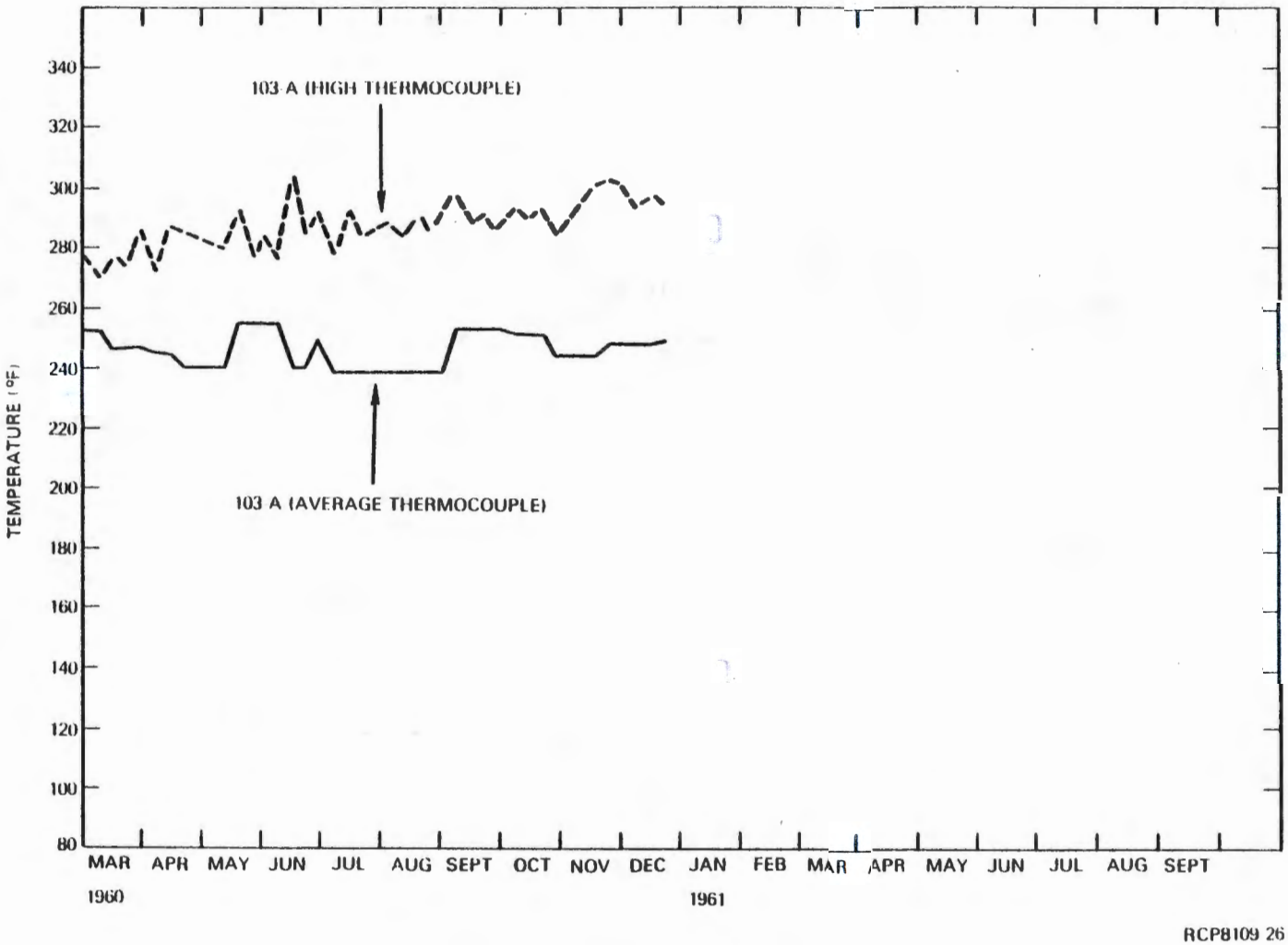

FIGURE B-22. 241-A-103 (Waste Temp.)
March 1960 - January 1961

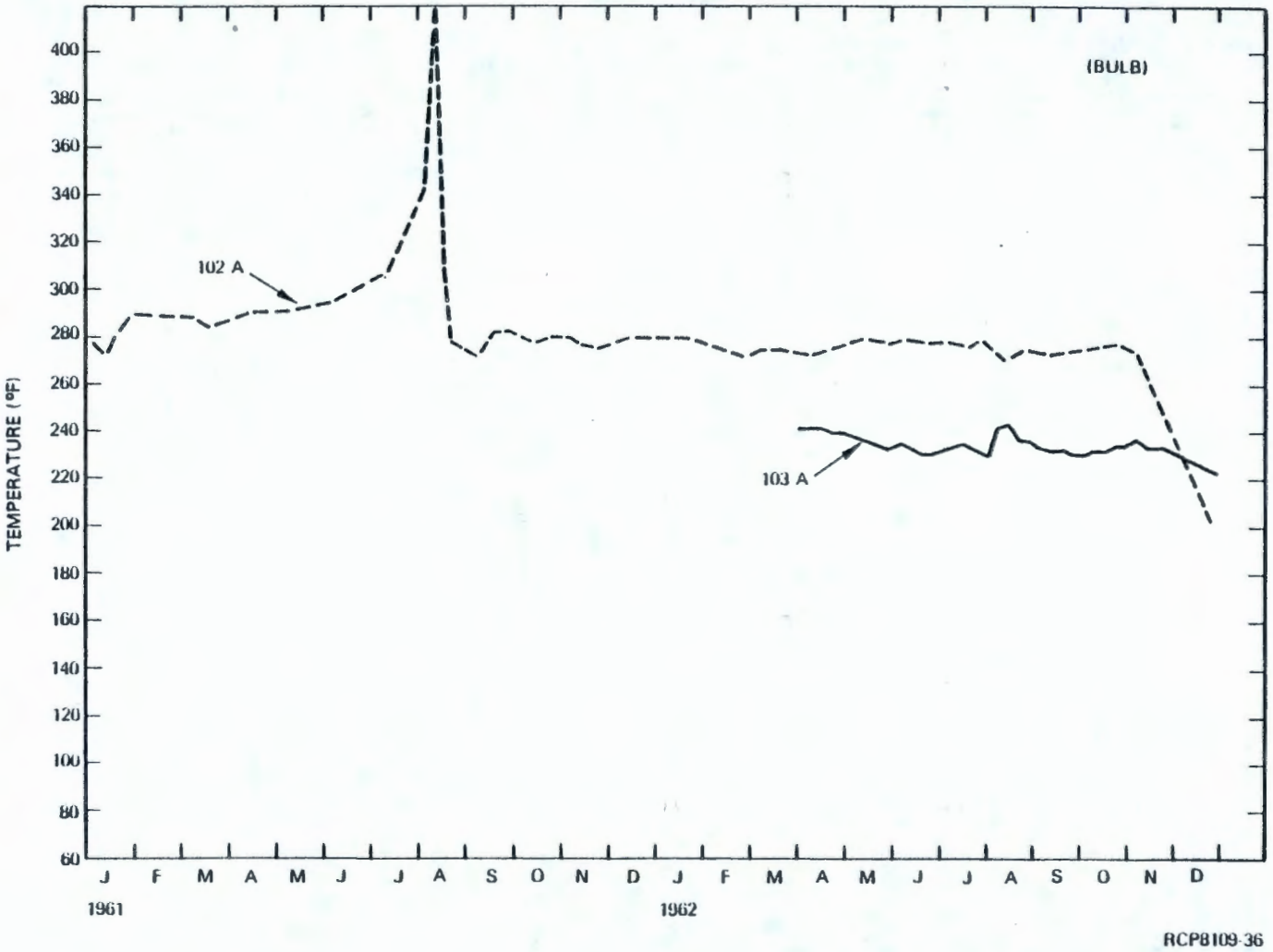

FIGURE B-23. 241-A-102 and -103 (Bulb Temp.)
January 1961 - December 1962

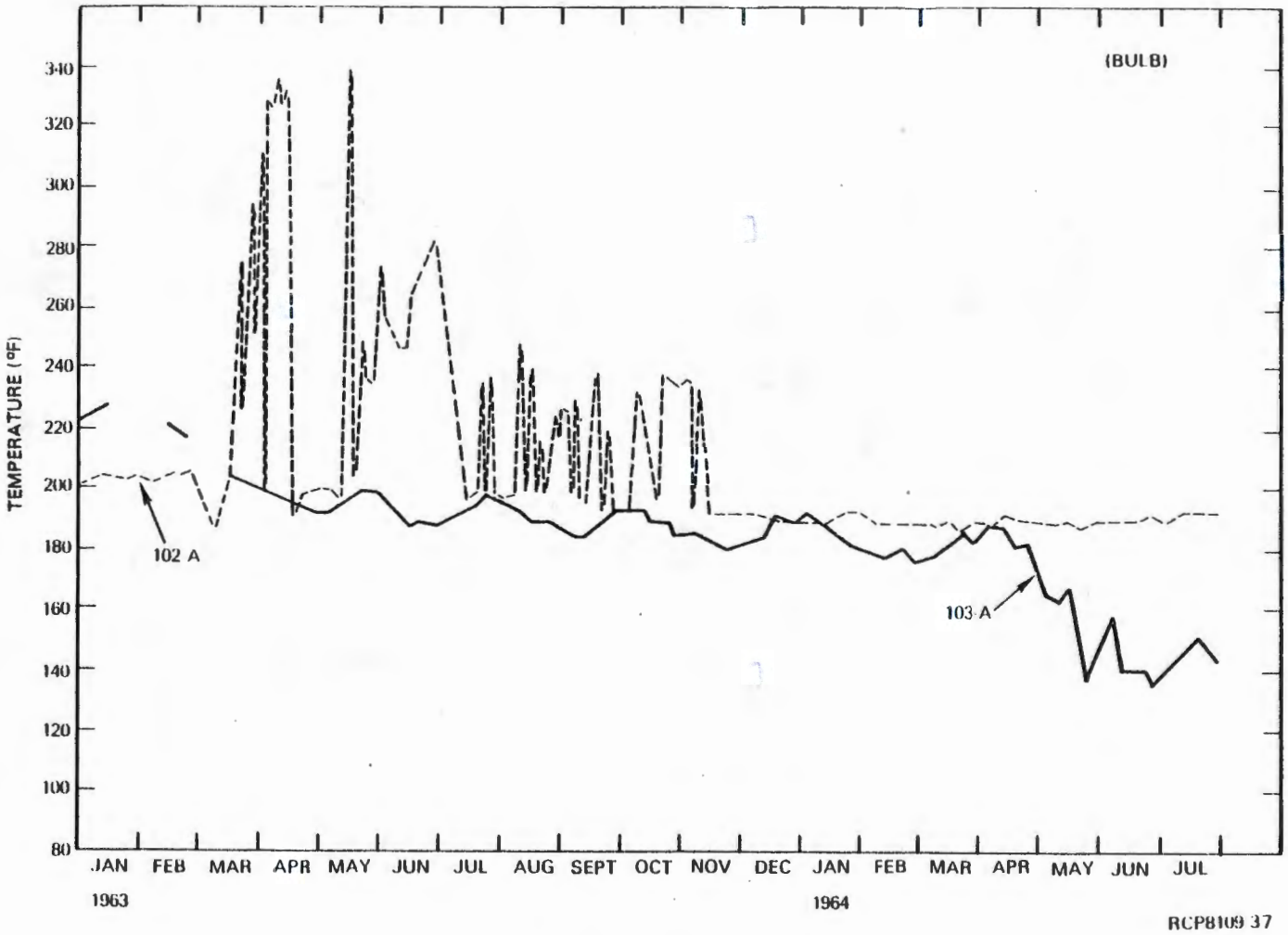

FIGURE B-24. 241-A-102 and -103 (Bulb Temp.)
Jan. 1963 - July 1964

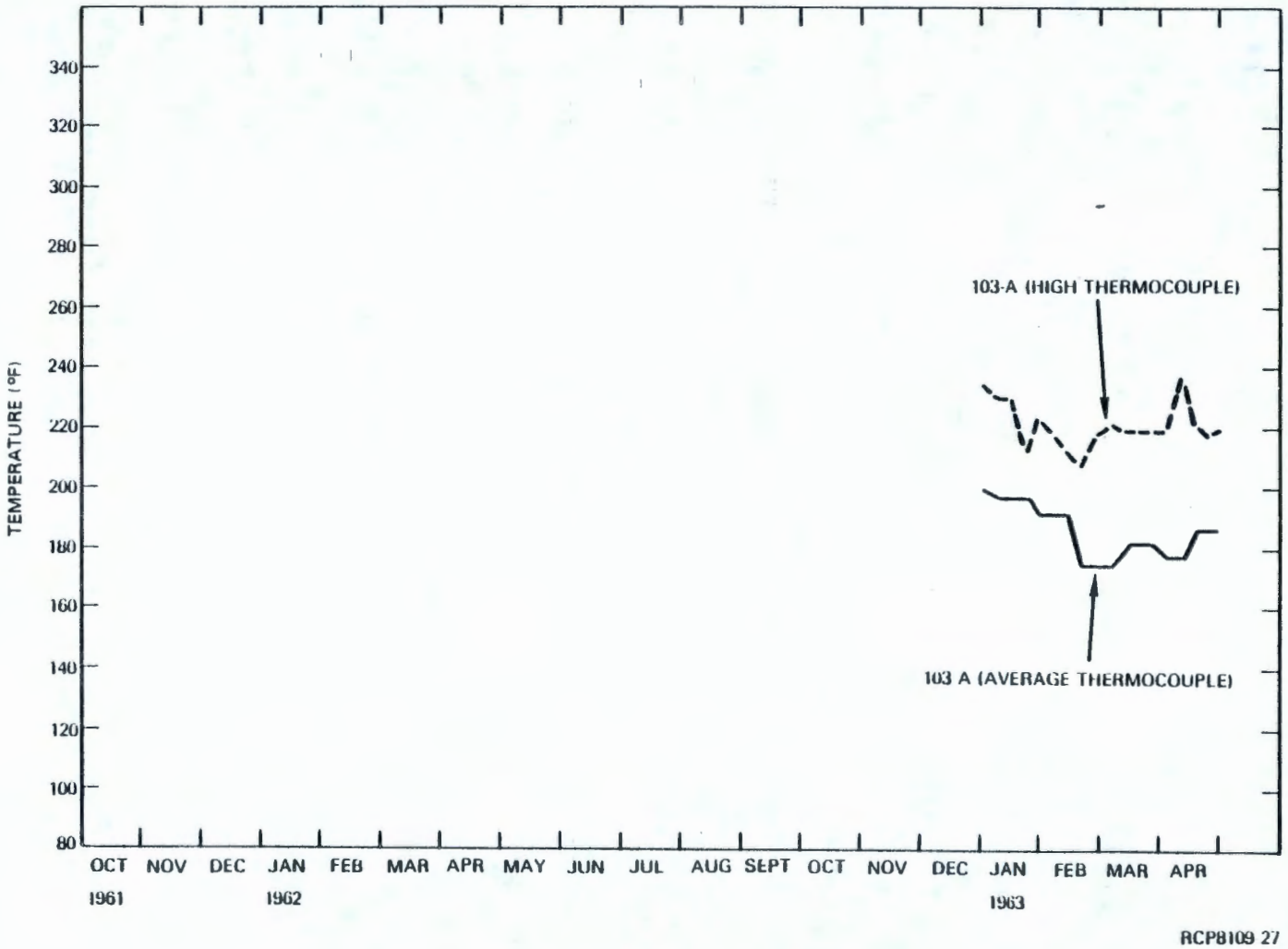

FIGURE B-25. 241-A-103 (Waste Temp.)
December 1962 - April 1963

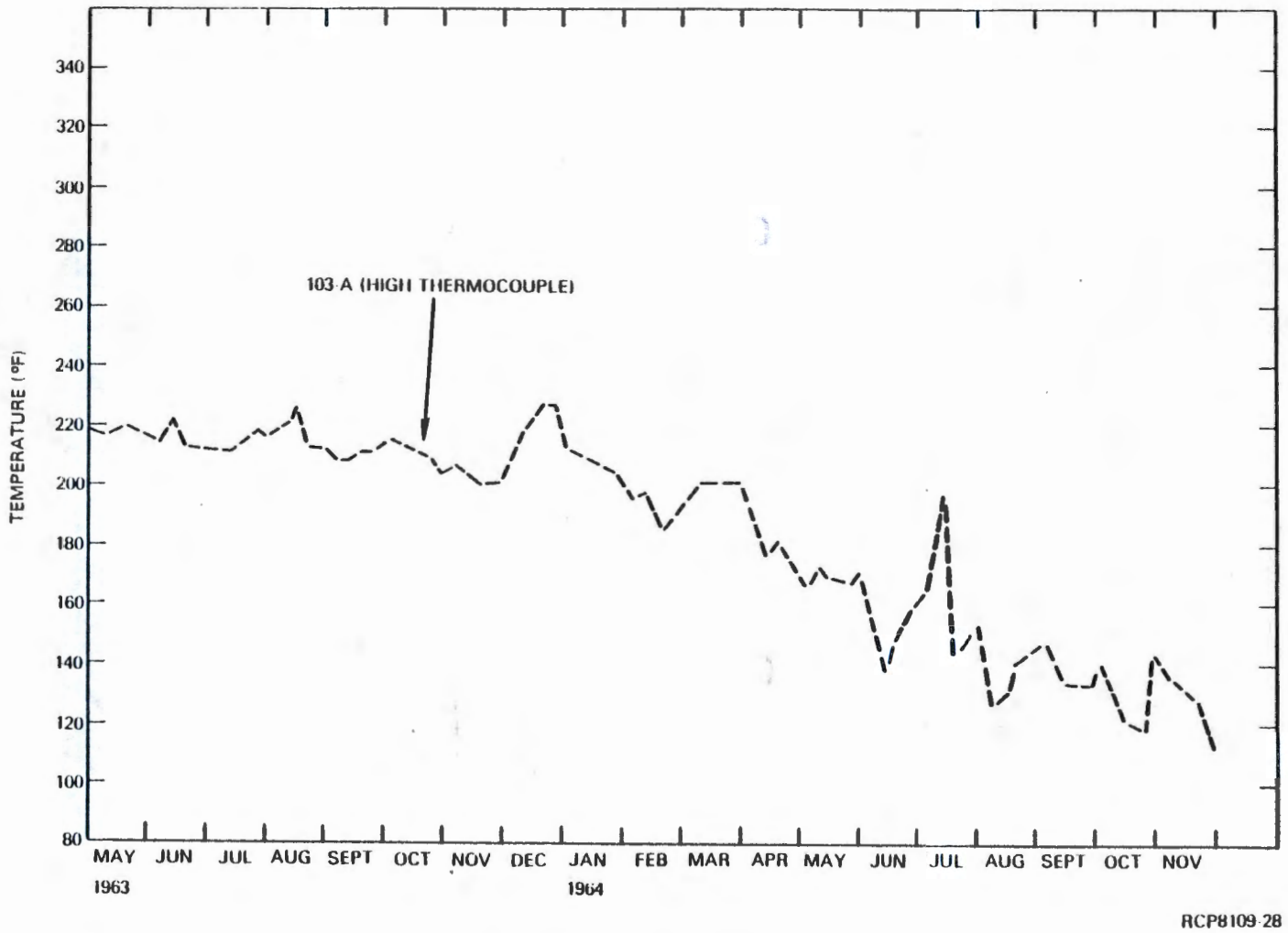

FIGURE B-26. 241-A-103 (Waste Temp.)
May 1963 - November 1964

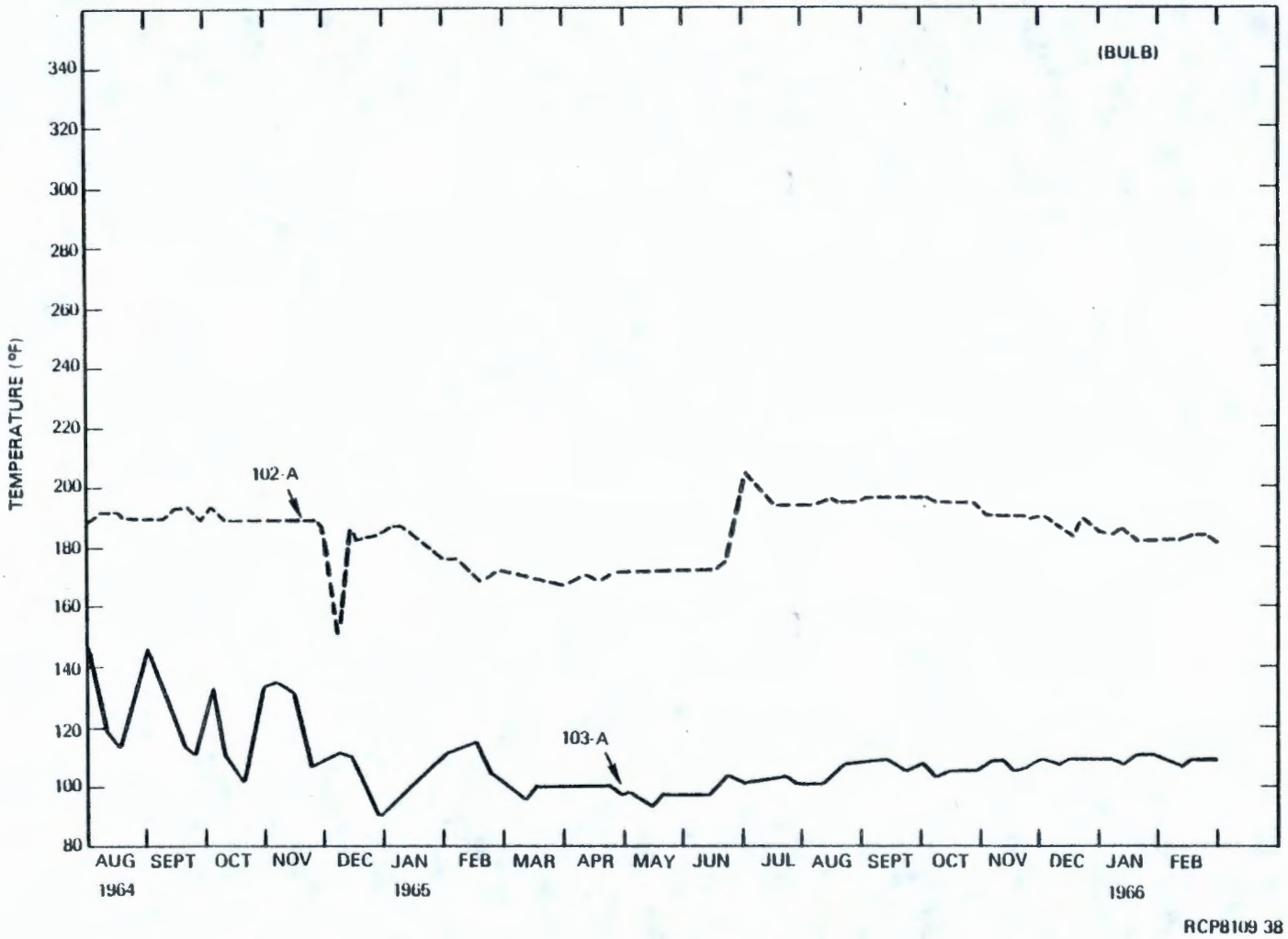

FIGURE B-27. 241-A-102 and -103 (Bulb Temp.)
Aug. 1964 - Feb. 1966

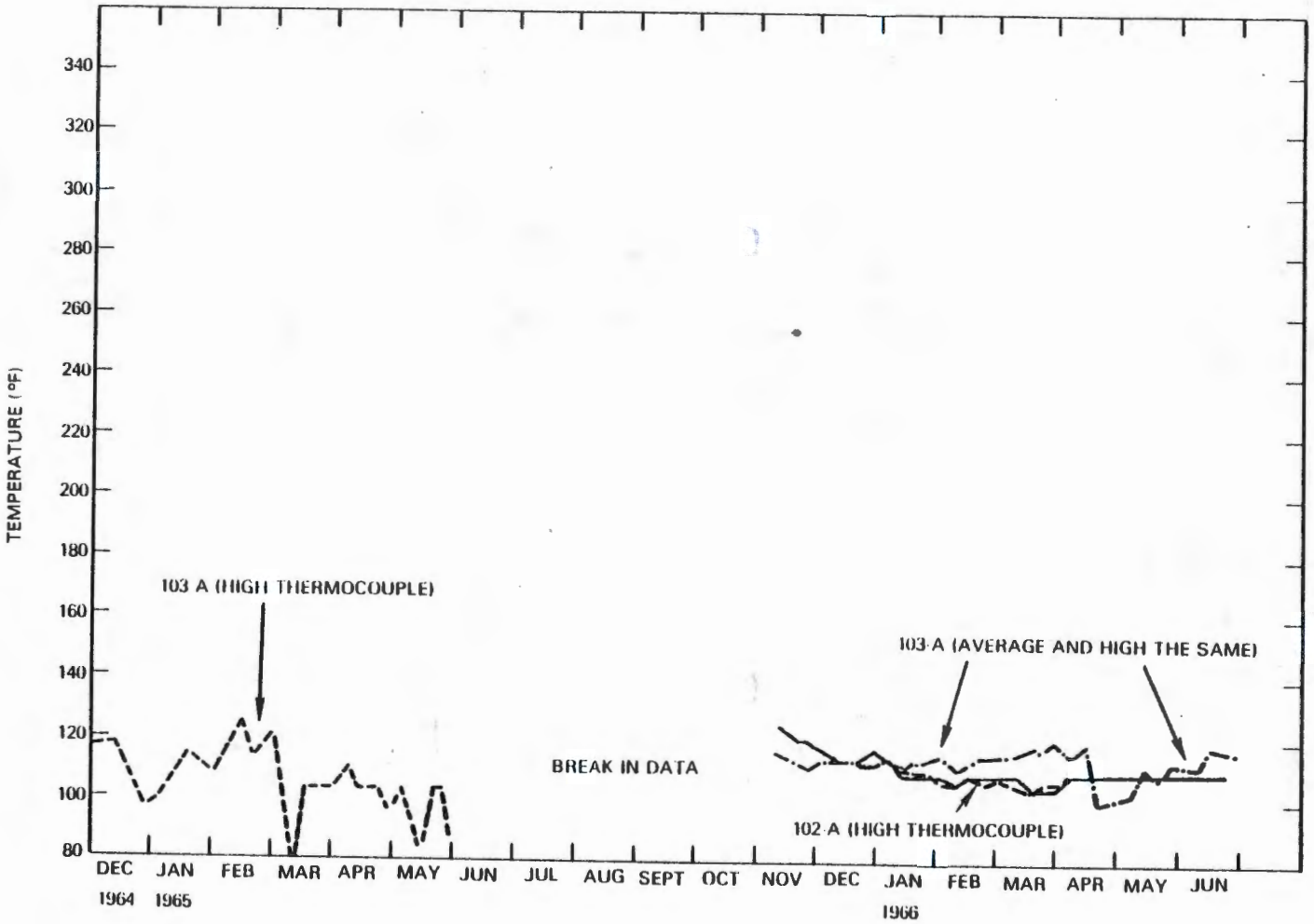

FIGURE B-28. 241-A-102 and -103 (Waste Temp.)
December 1964 - June 1966

9 1 1 2 0 5 4 0 6 3 1

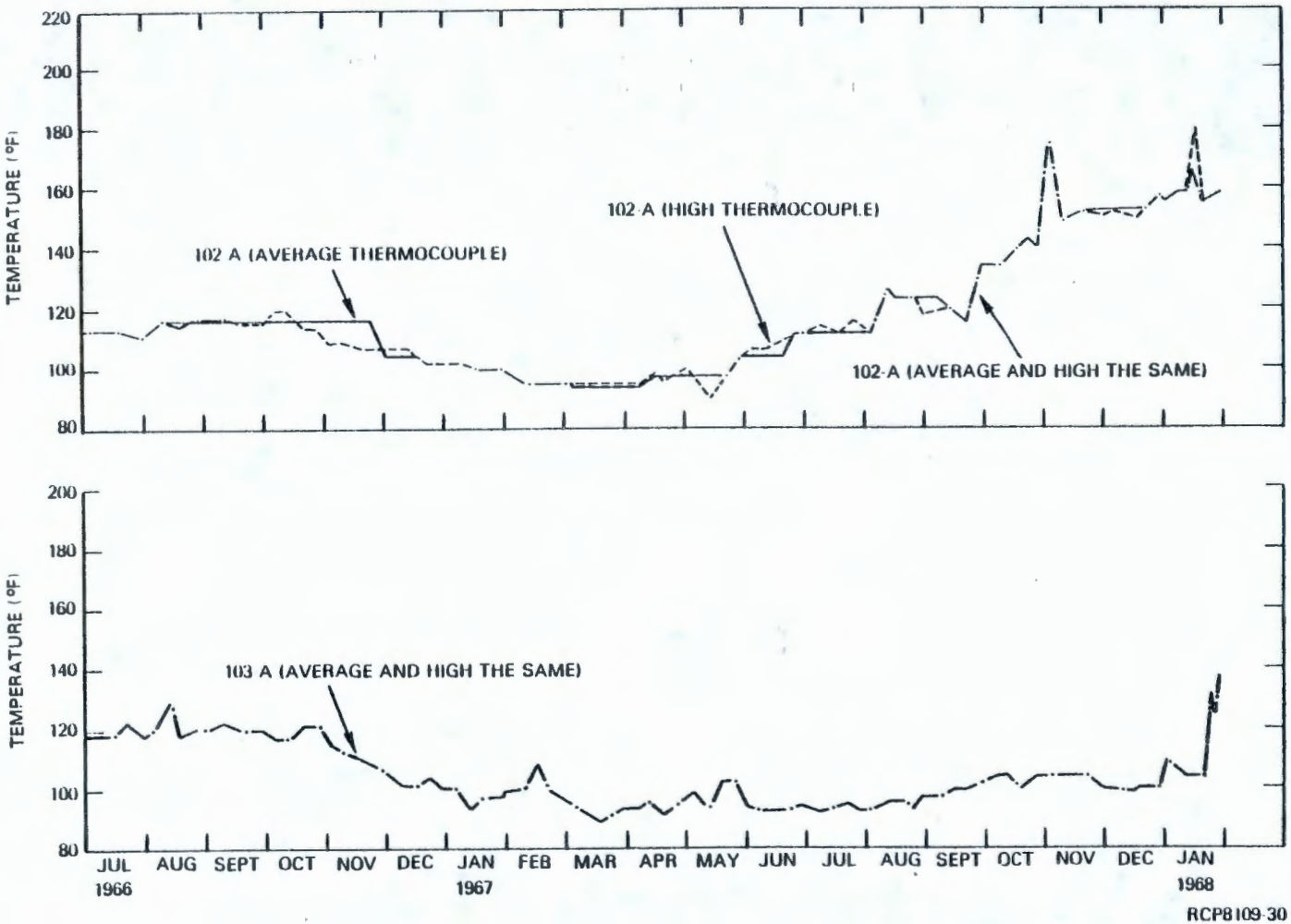

FIGURE B-29. 241-A-102 and -103 (Waste Temp.)
July 1966 - January 1968

T00293

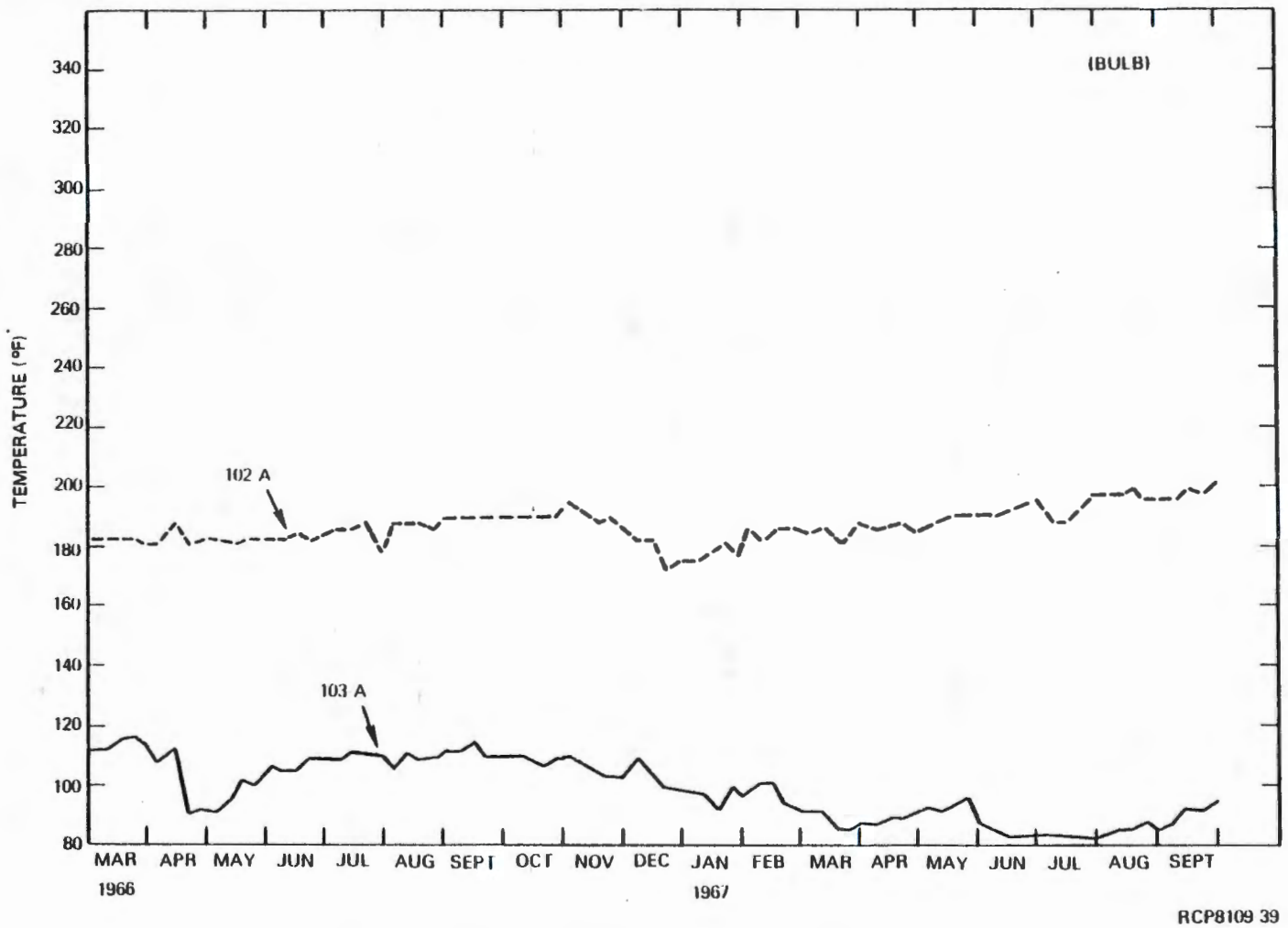

FIGURE B-30. 241-A-102 and -103 (Bulb Temp.)
March 1966 - September 1967

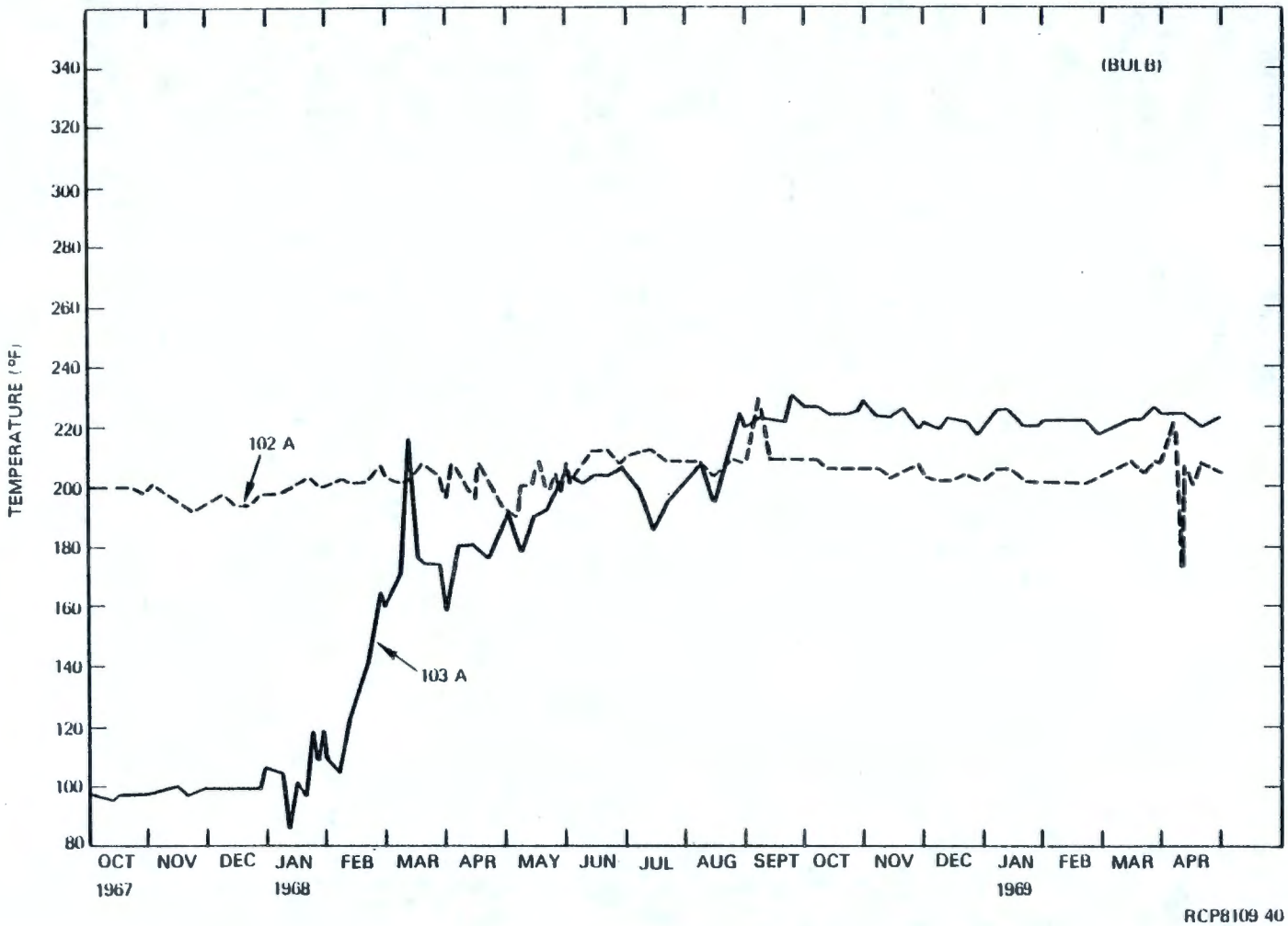

FIGURE B-31. 241-A-102 and -103 (Bulb Temp.)
October 1967 - April 1969

T00293

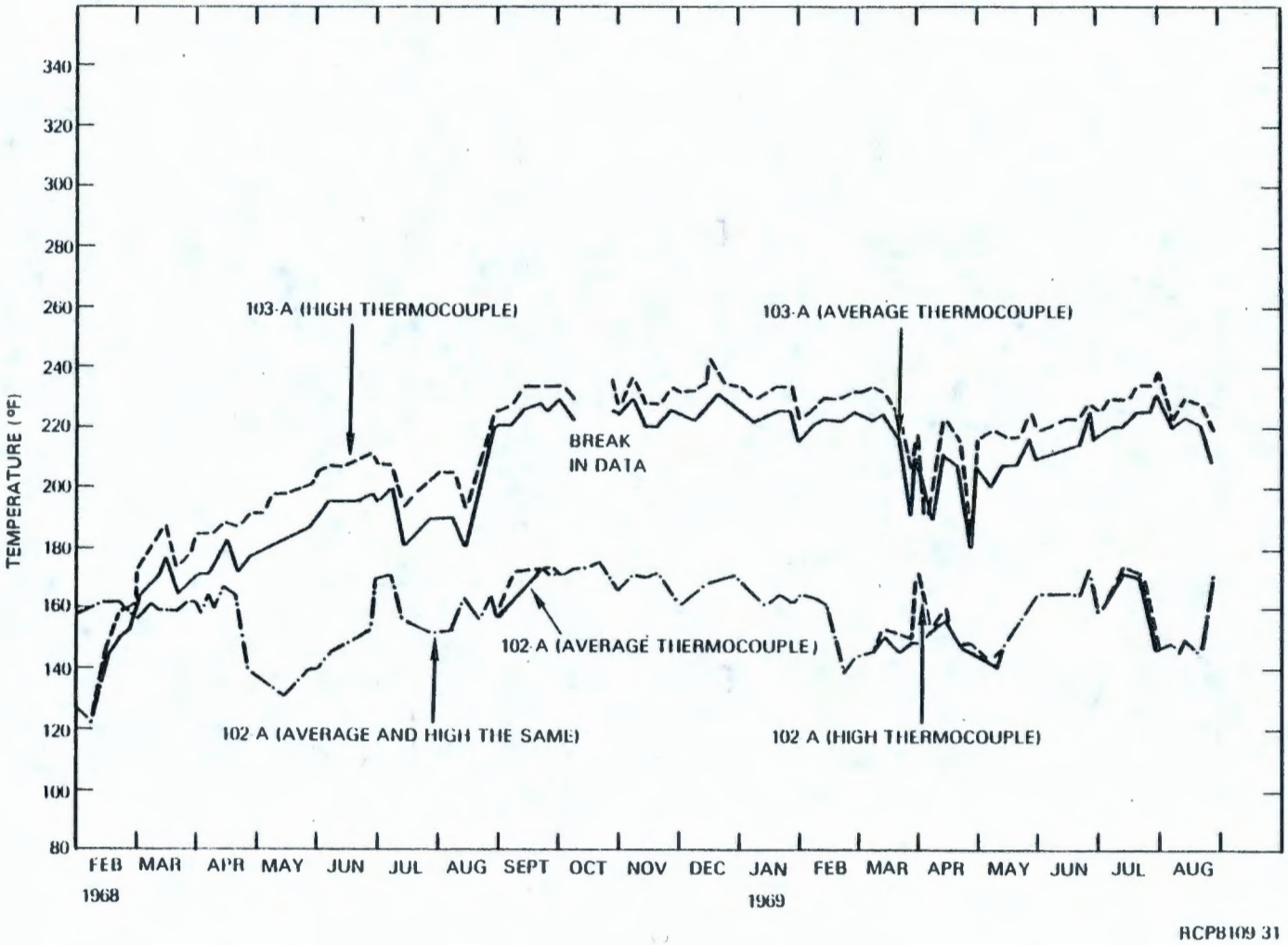

FIGURE B-32. 241-A-102 and -103
February 1968 to August 1969

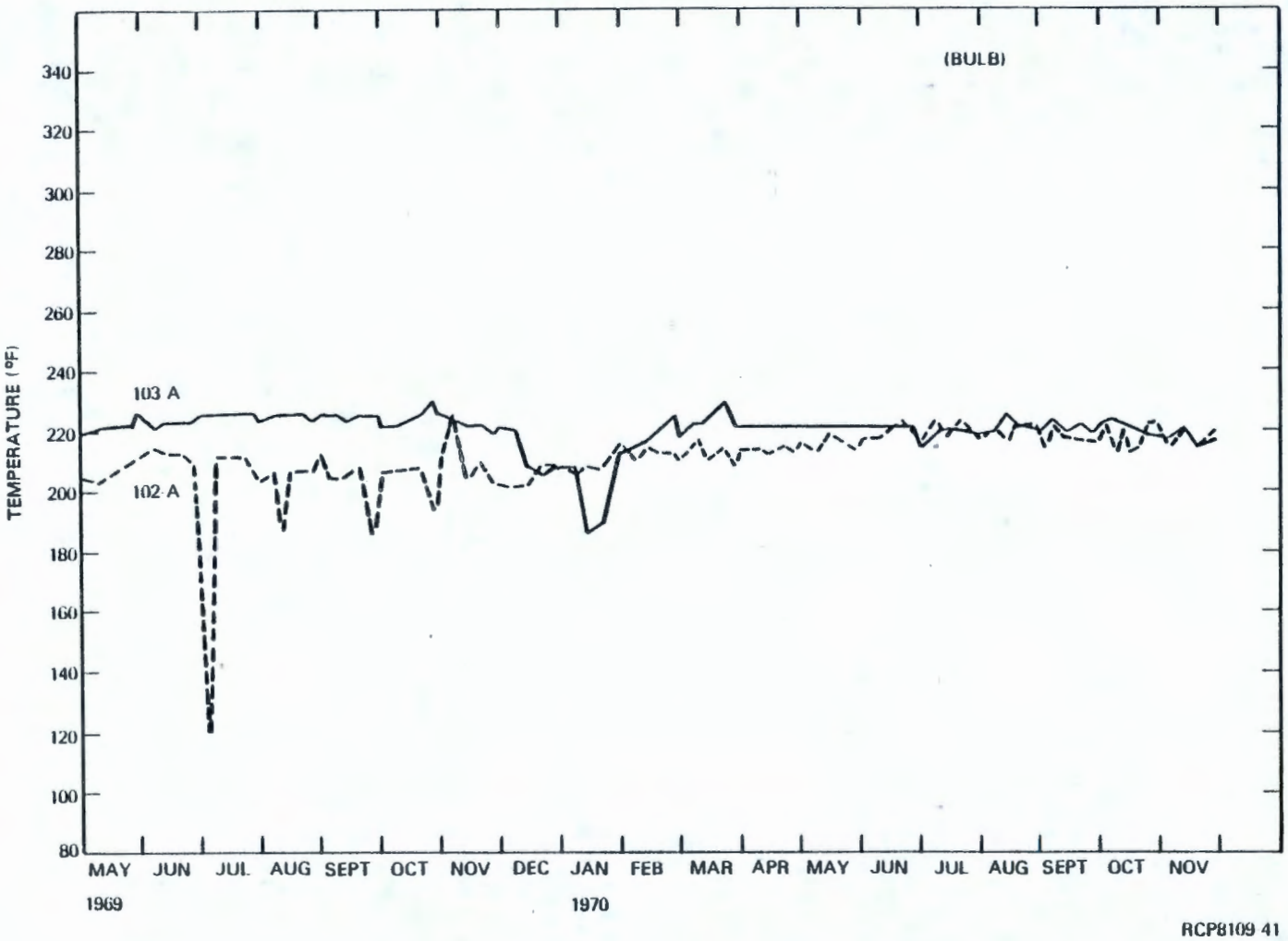

FIGURE B-33. 241-A-102 and -103 (Bulb Temp.)
May 1969 - November 1970

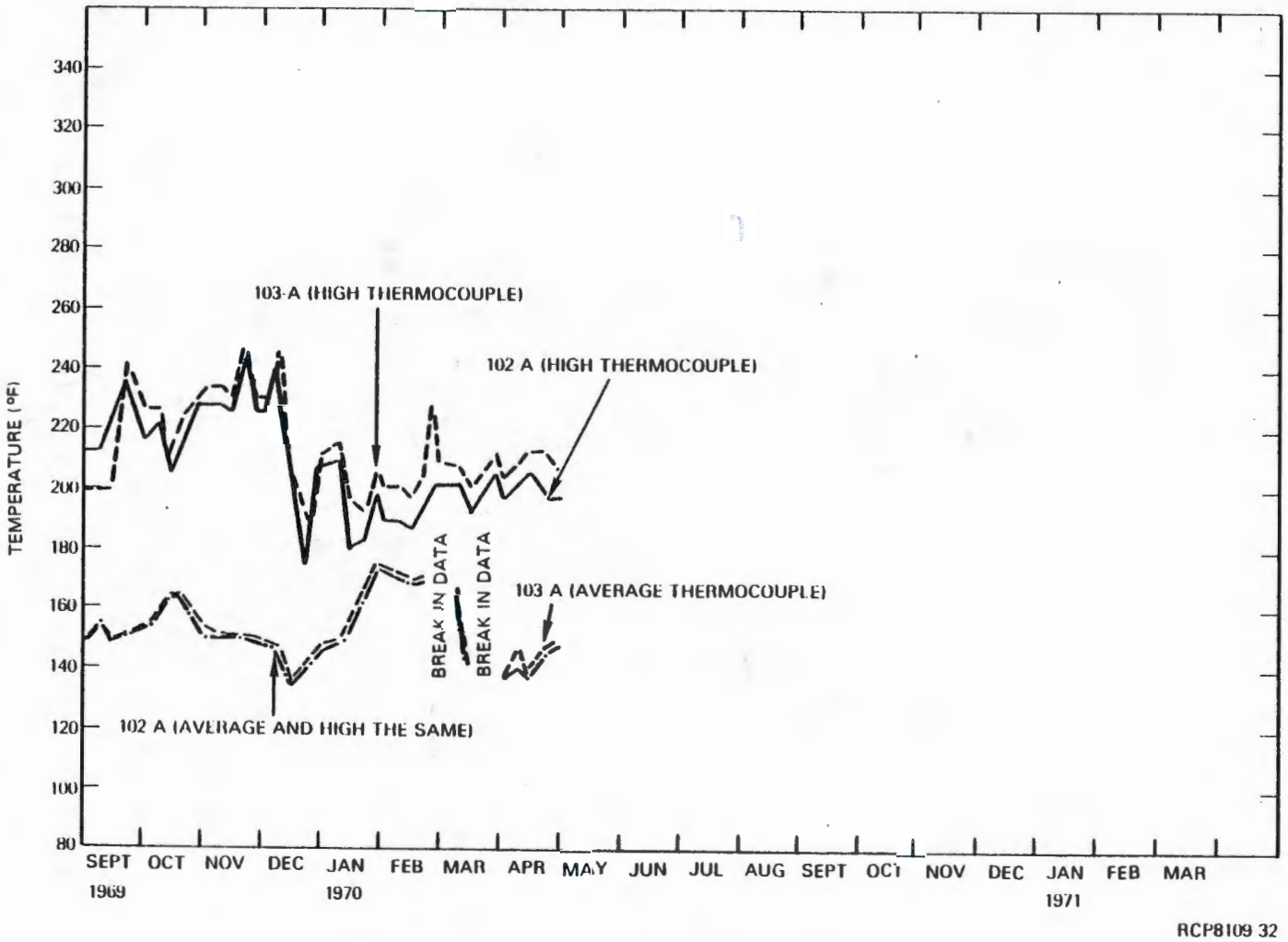

FIGURE B-34. 241-A-102 and -103 (Waste Temp.)
September 1969 to March 1971

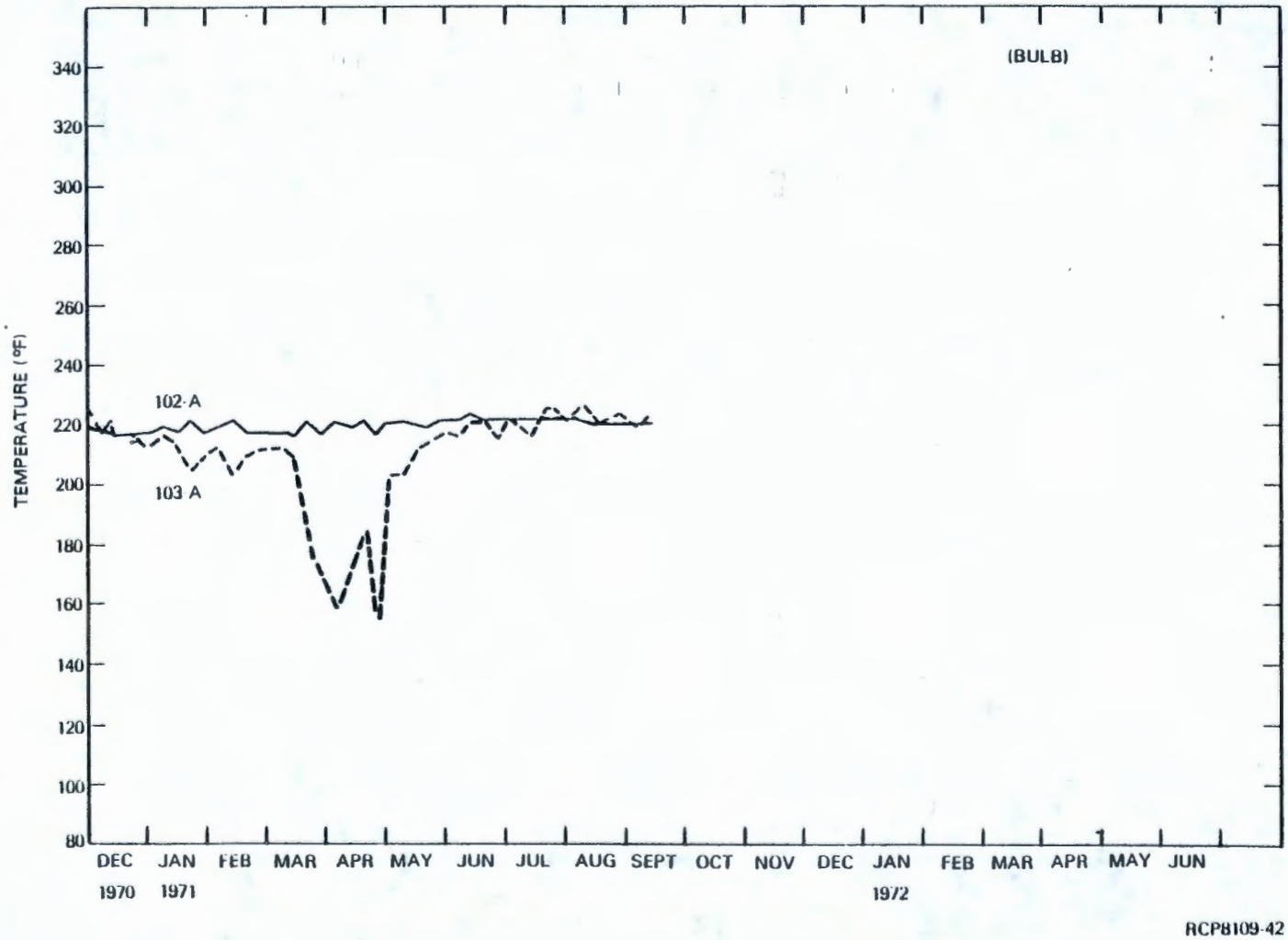

FIGURE B-35. 241-A-102 and -103 (Bulb Temp.)
April 1971 to September 1971

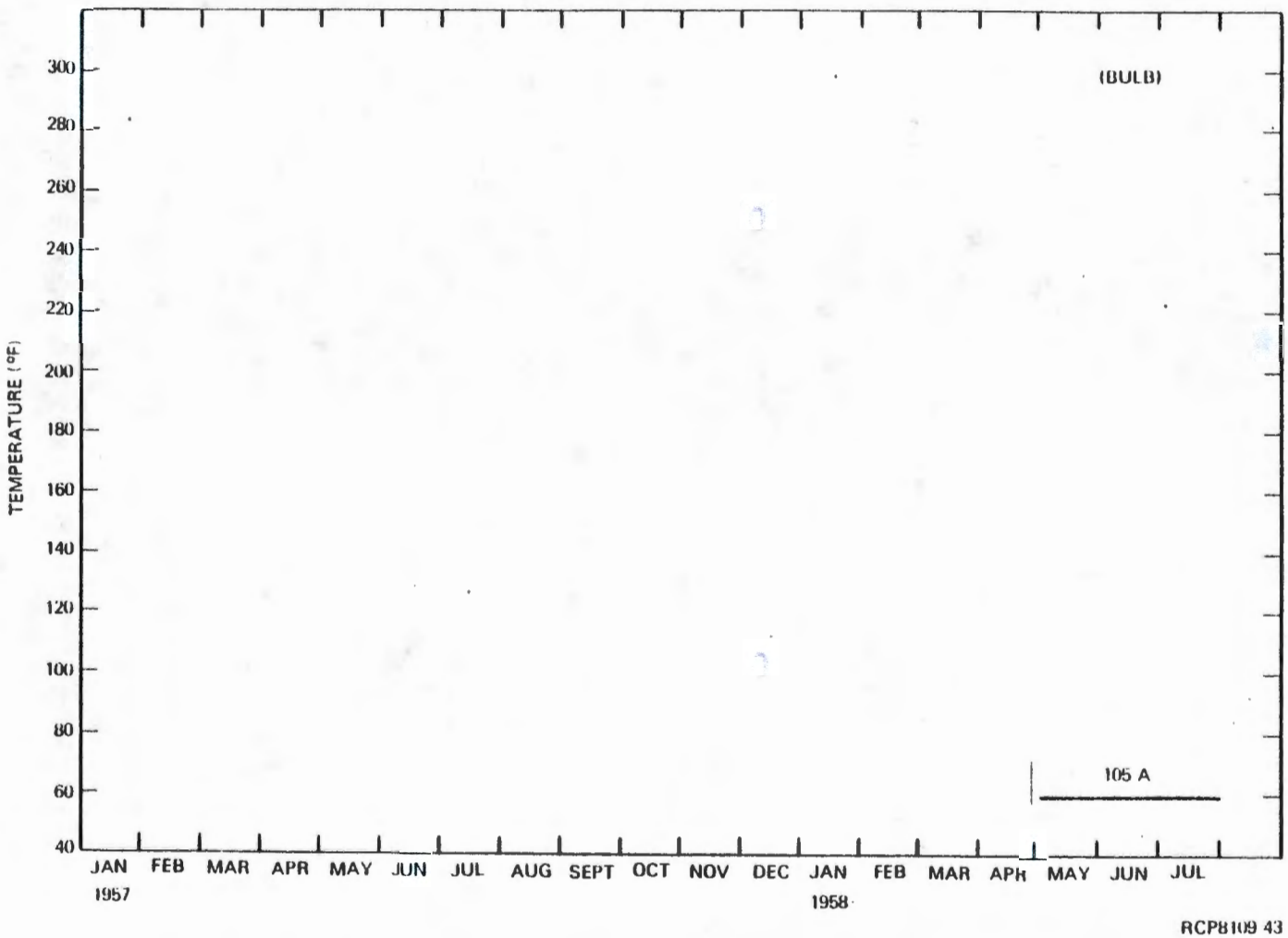

FIGURE B-36. 241-A-105 (Bulb Temp.)
April 1958 - July 1958

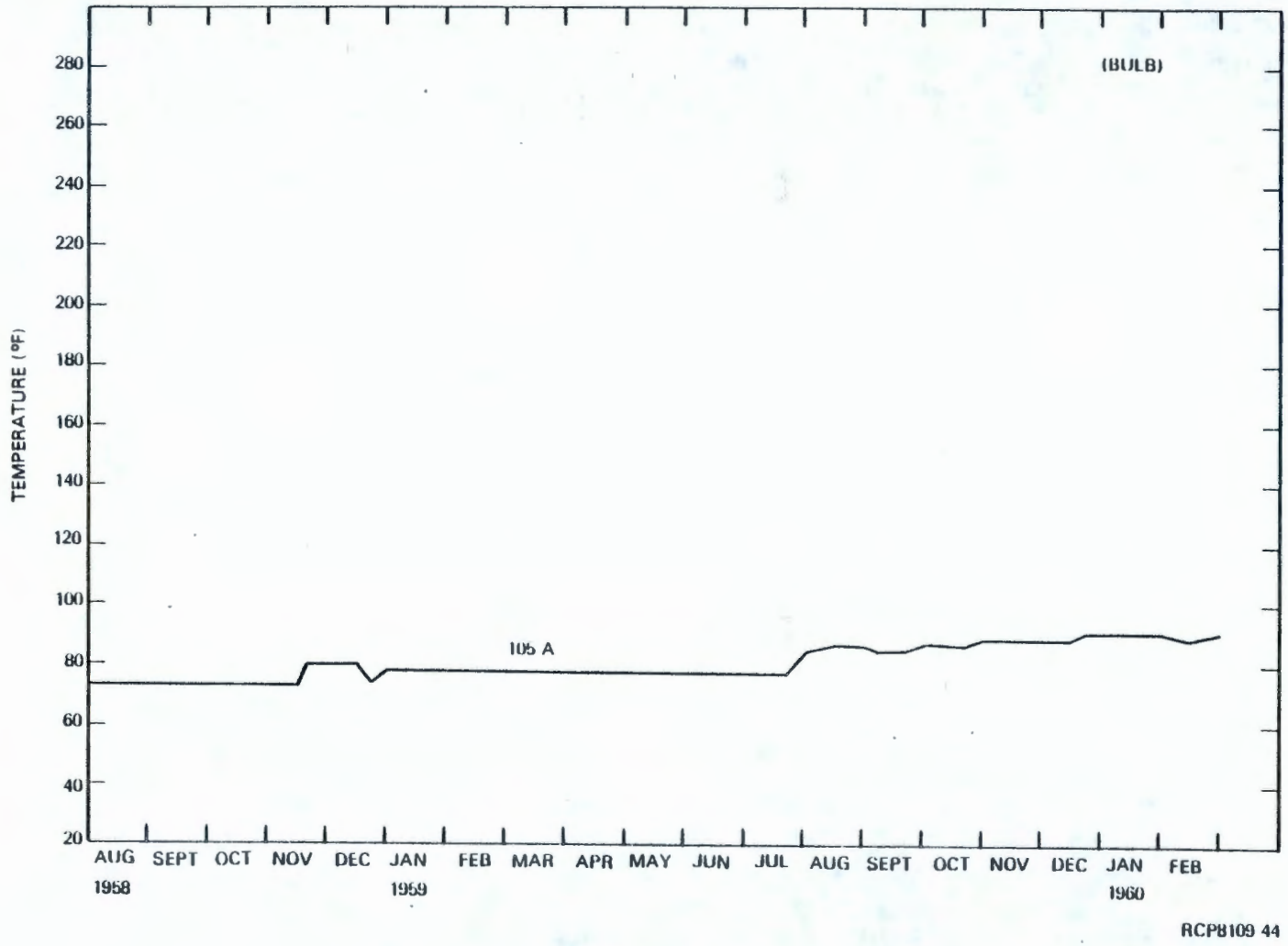

FIGURE B-37. 241-A-105 (Bulb Temp.)
August 1958 - February 1960

T00293

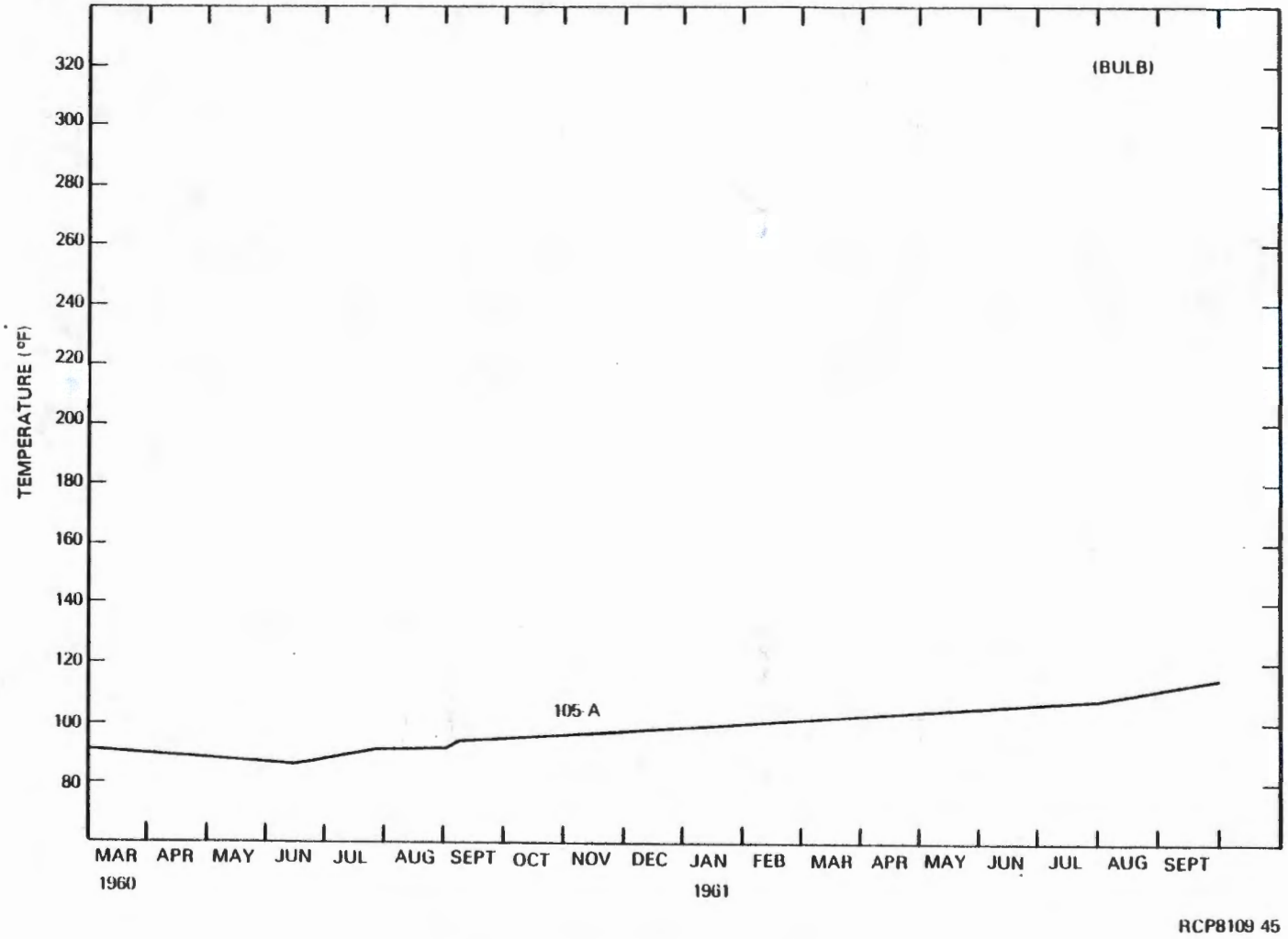

FIGURE B-38. 241-A-105 (Bulb Temp.)
Mar. 1960 - Sept. 1961

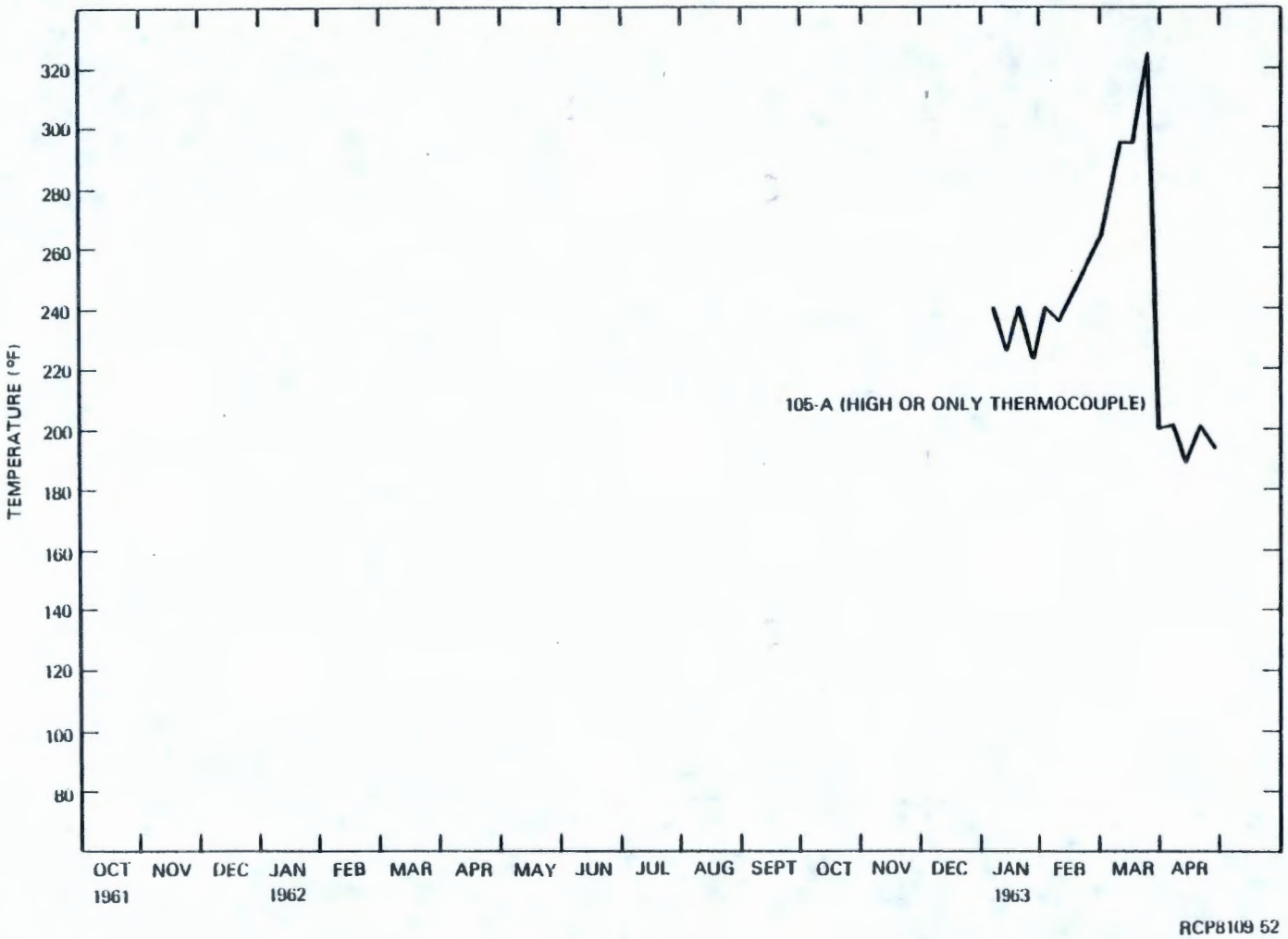

FIGURE B-39. 241-A-105 (Waste Temp.)
January 1963 - April 1963

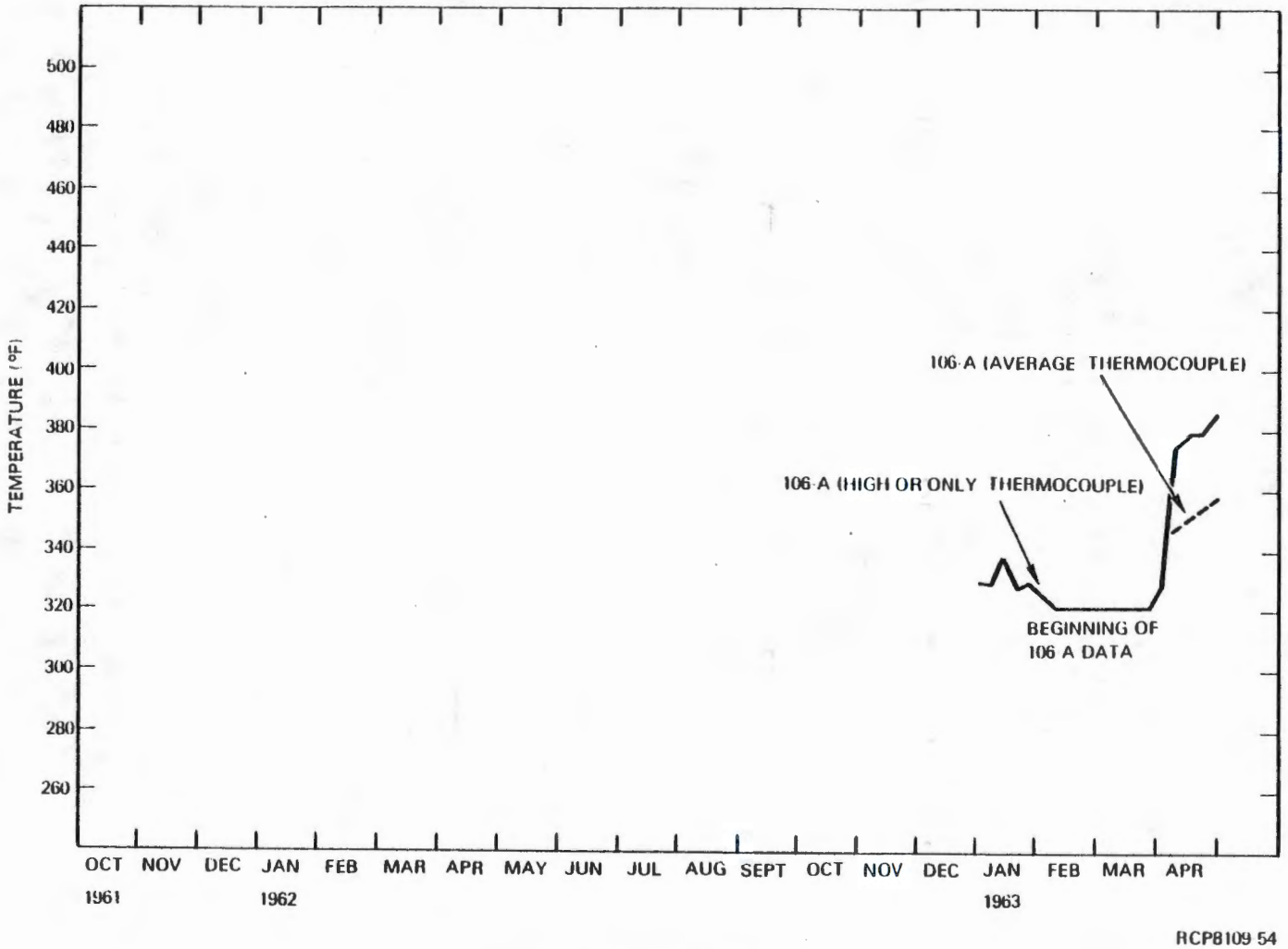

FIGURE B-40. 241-A-106 (Waste Temp.)
Jan 1963 - April 1963

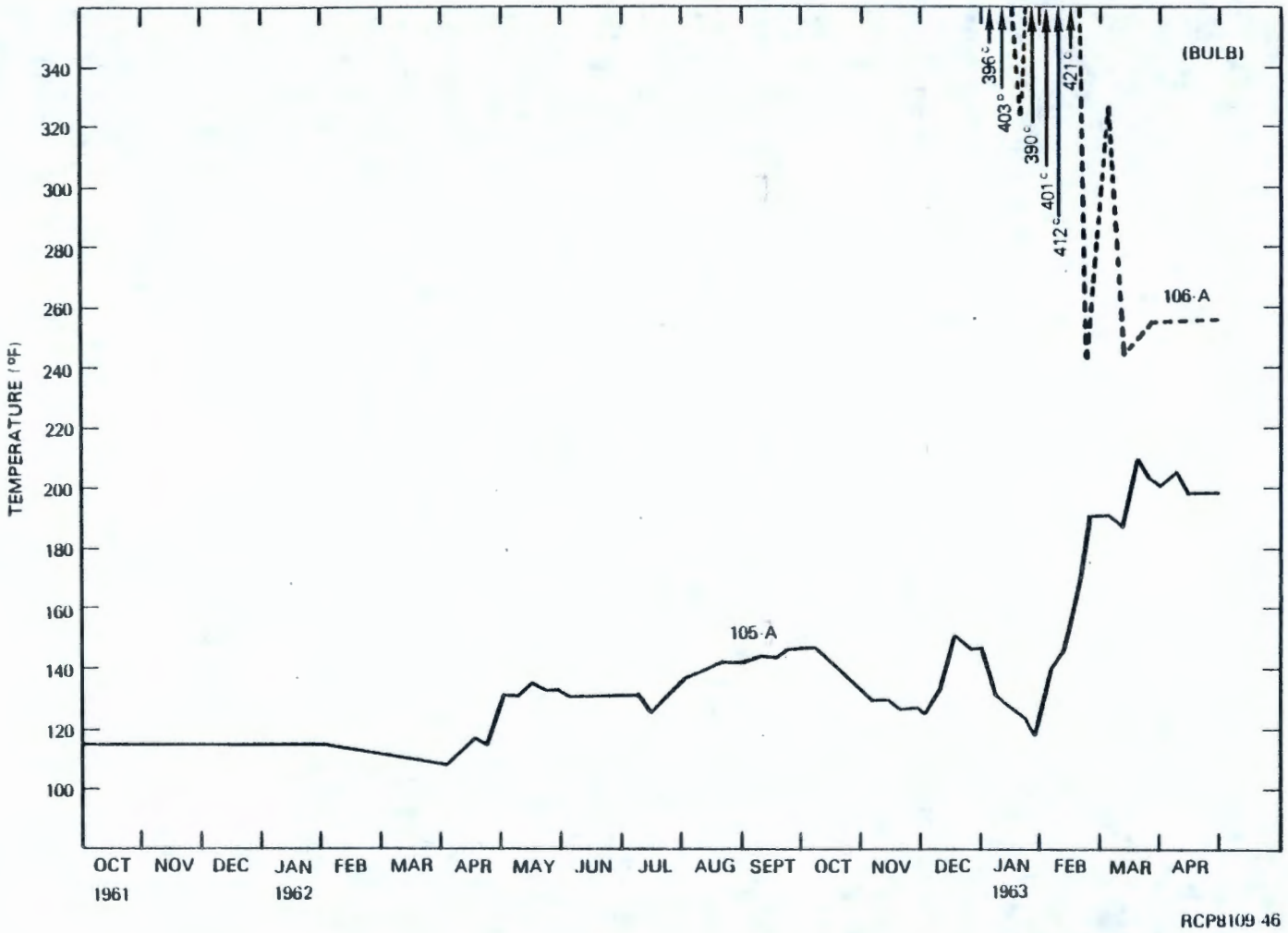

FIGURE B-41. 241-A-105 and -106 (Bulb Temp.)
October 1961 - April 1963

T00293

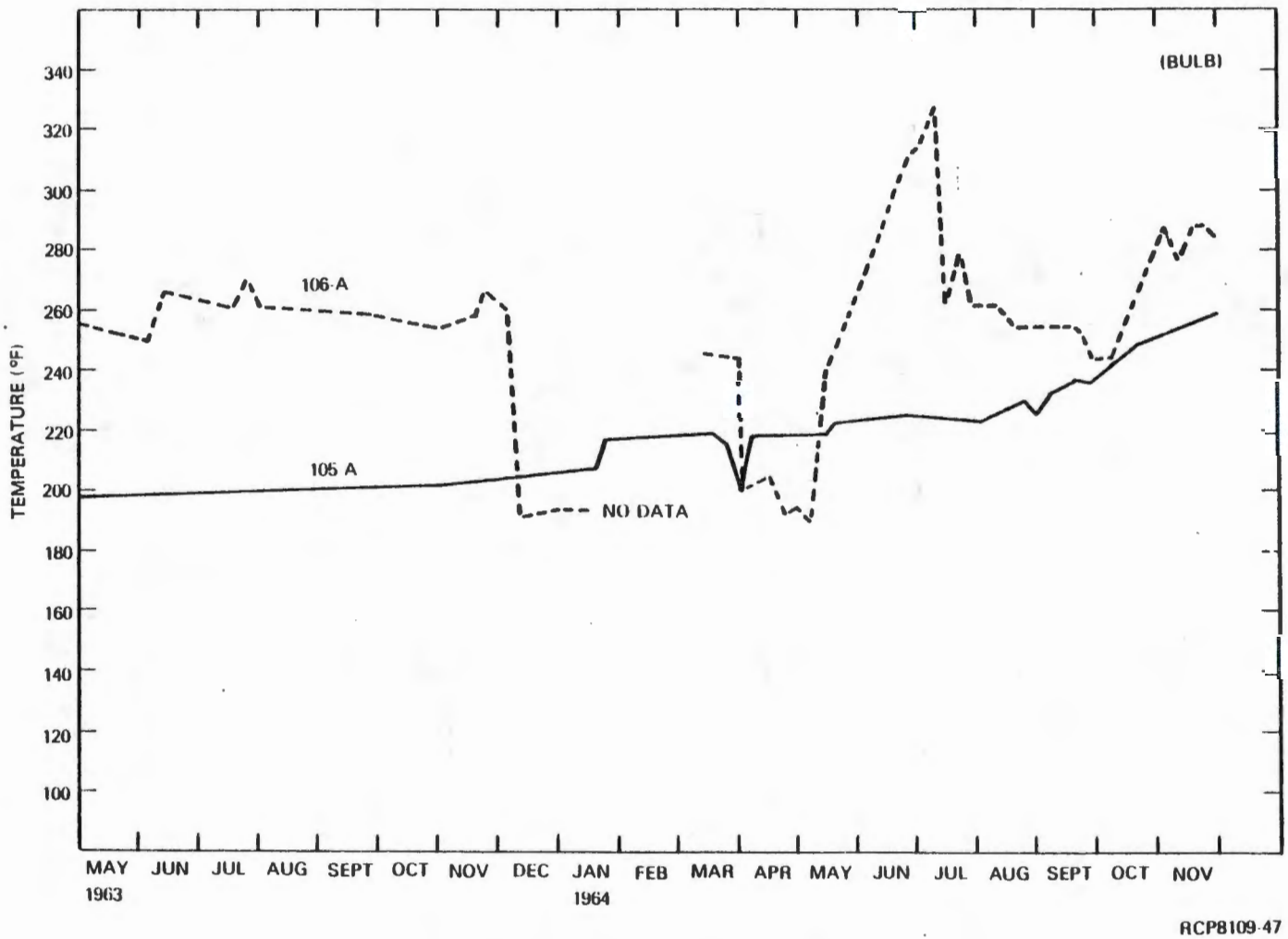

FIGURE B-42. 241-A-105 and -106 (Bulb Temp.)
May 1963 - Nov. 1964

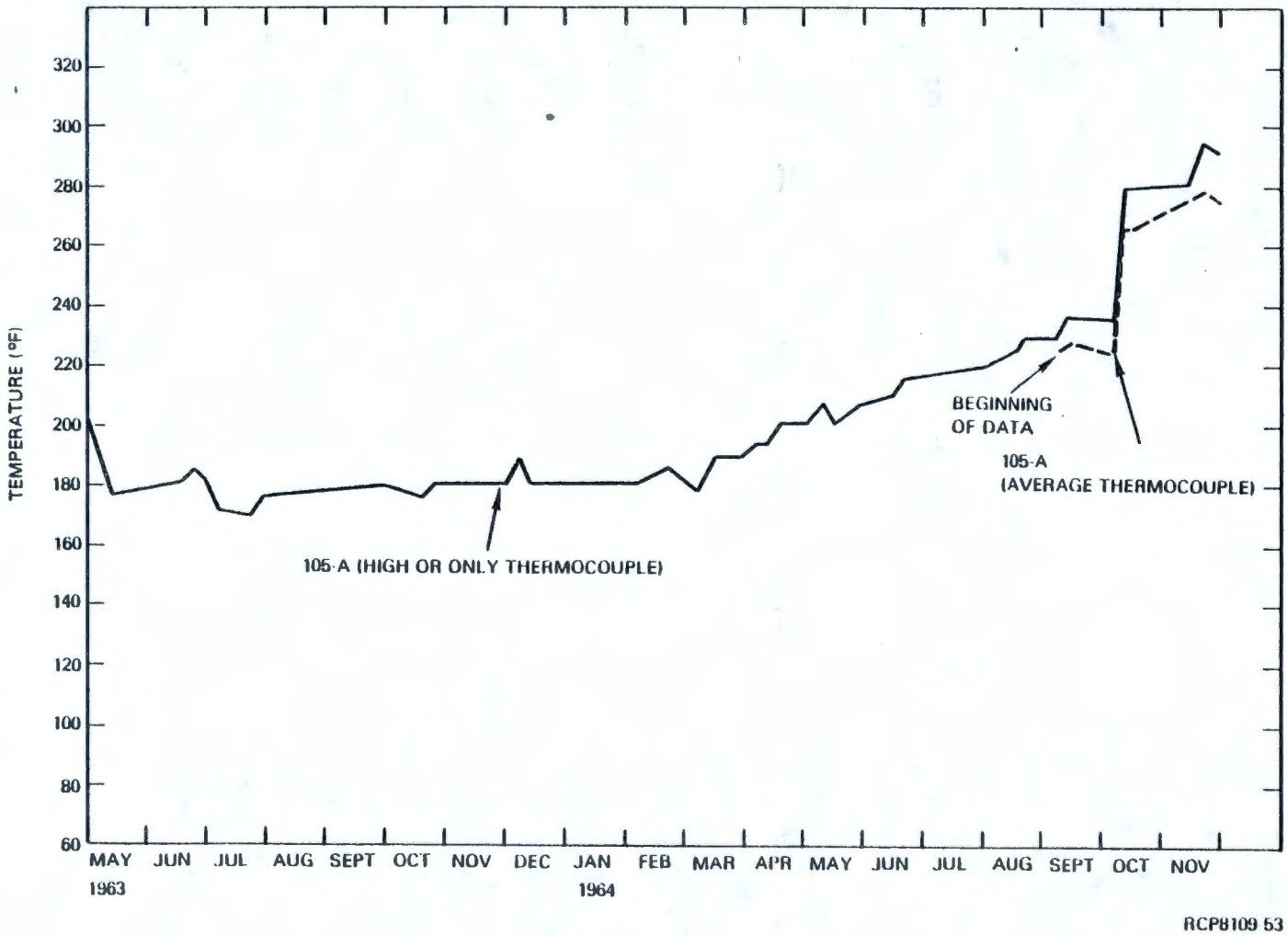

FIGURE B-43. 241-A-105 (Waste Temp.)
May 1963 - November 1964

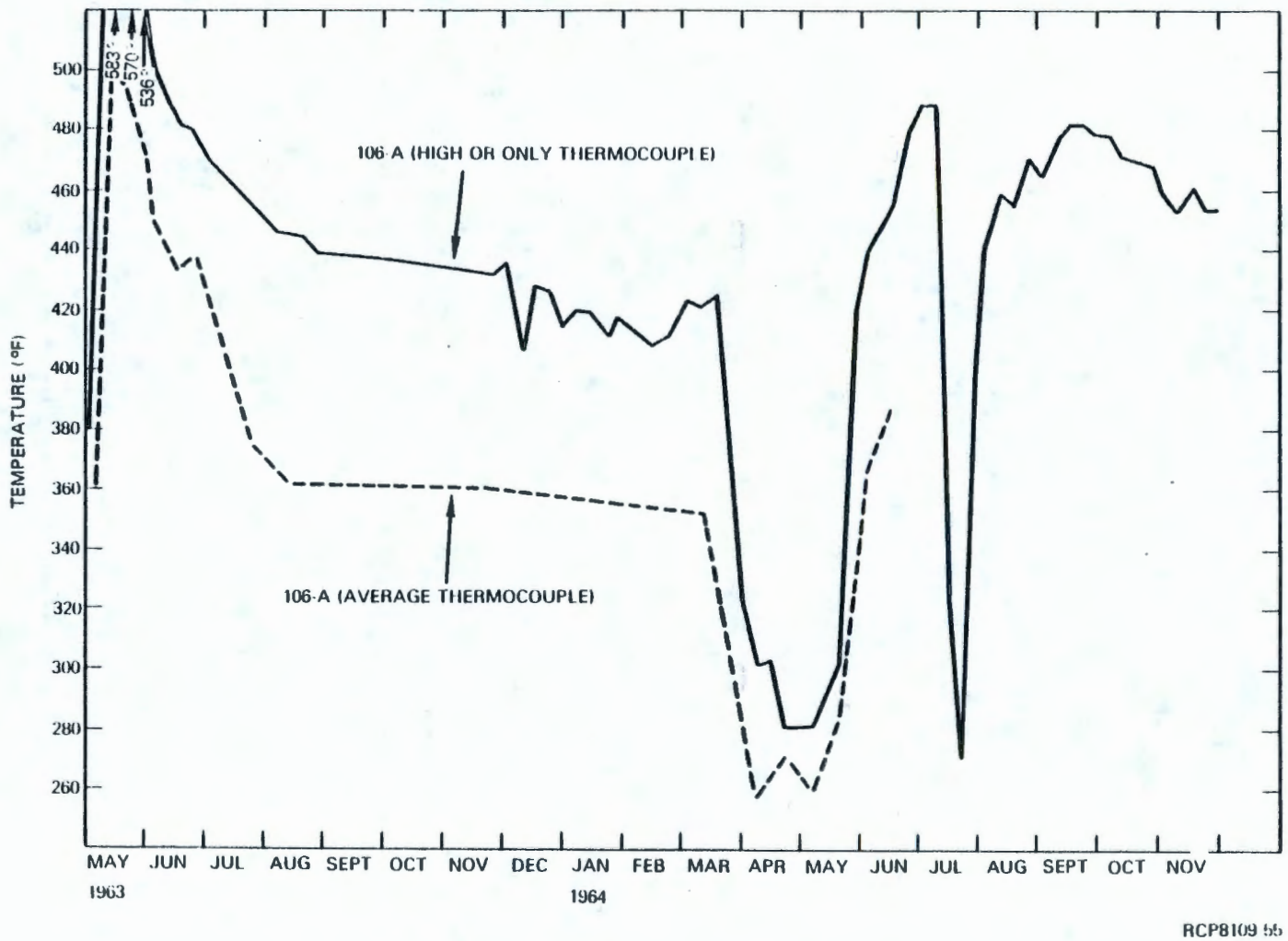

FIGURE B-44. 241-A-106 (Waste Temp.)
May 1963 - November 1964

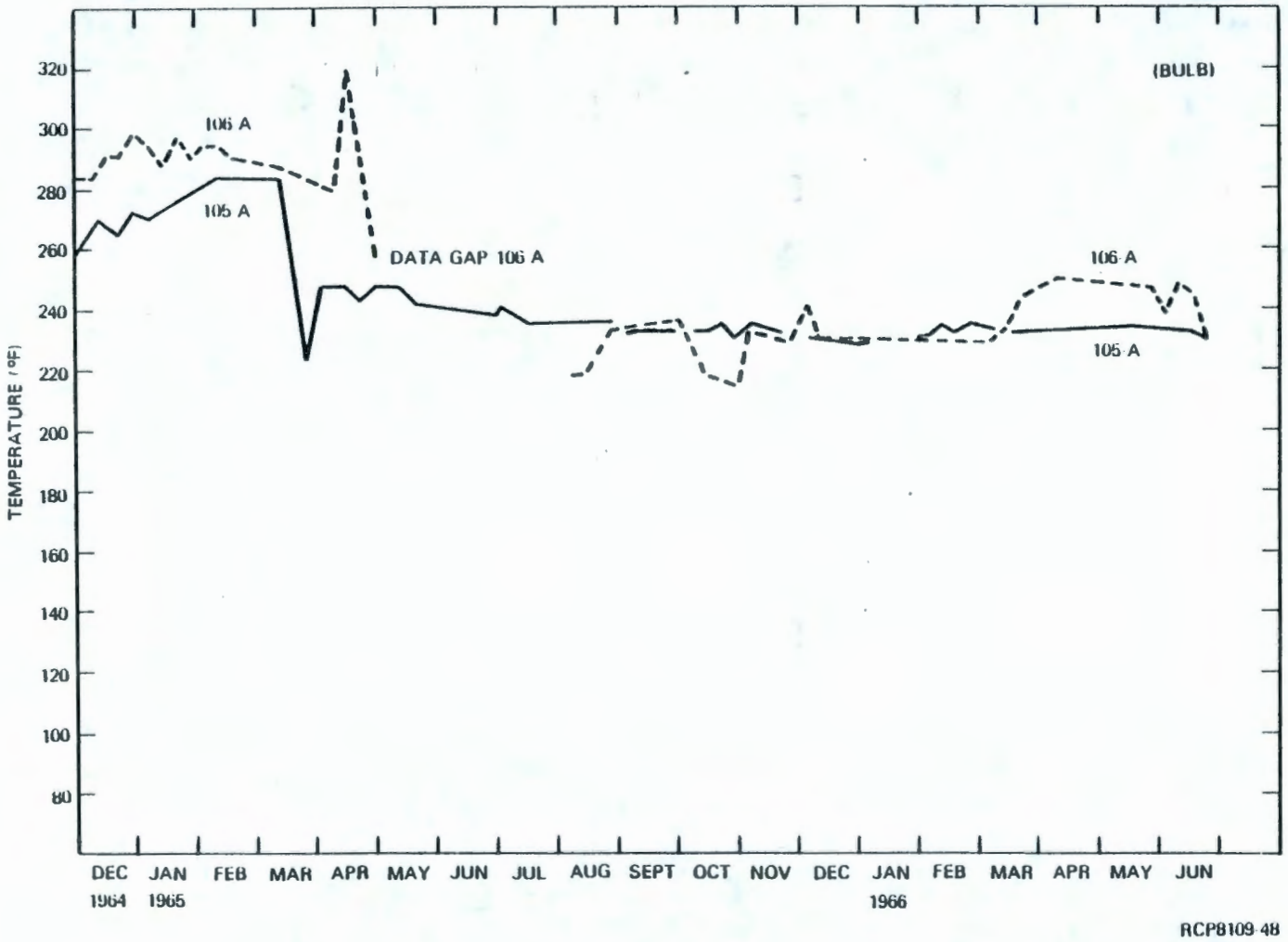

FIGURE B-45. 241-A-105 and -106 (Bulb Temp.)
Dec. 1964 - June 1966

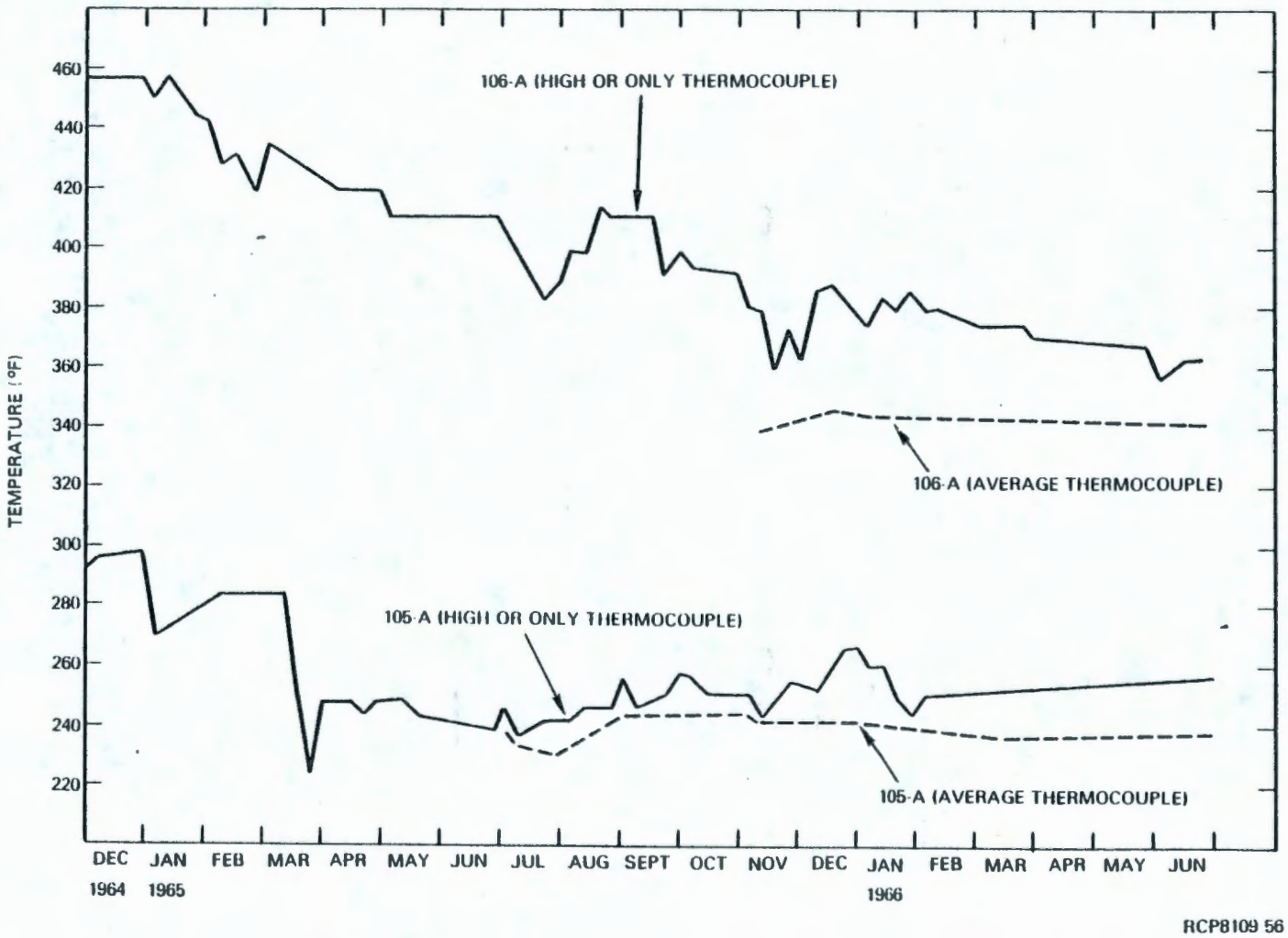

FIGURE B-46. 241-A-105 and -106 (Waste Temp.)
December 1964 thru June 1966

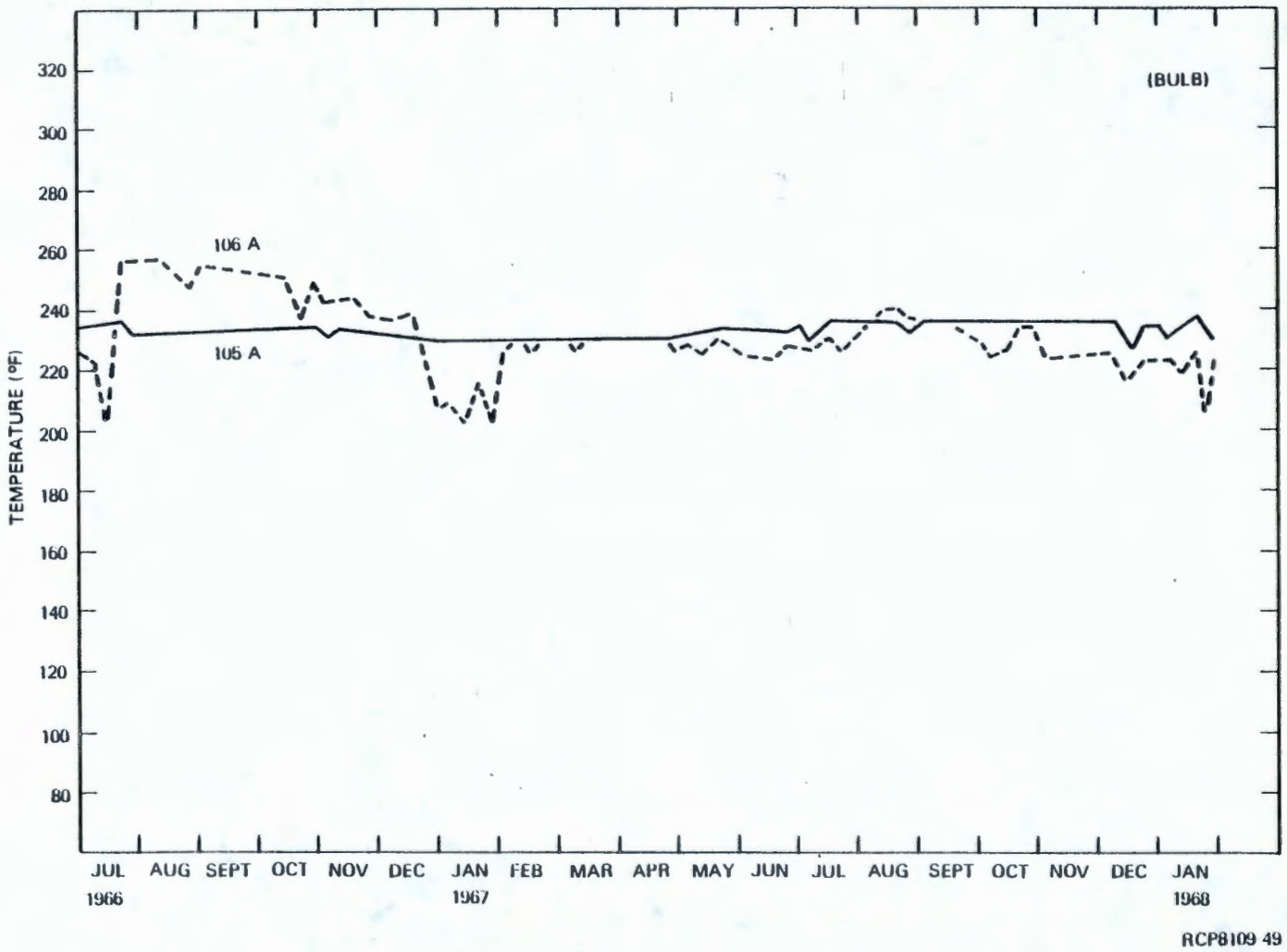

FIGURE B-47. 241-A-105 and -106 (Bulb Temp.)
July 1966 - Jan. 1968

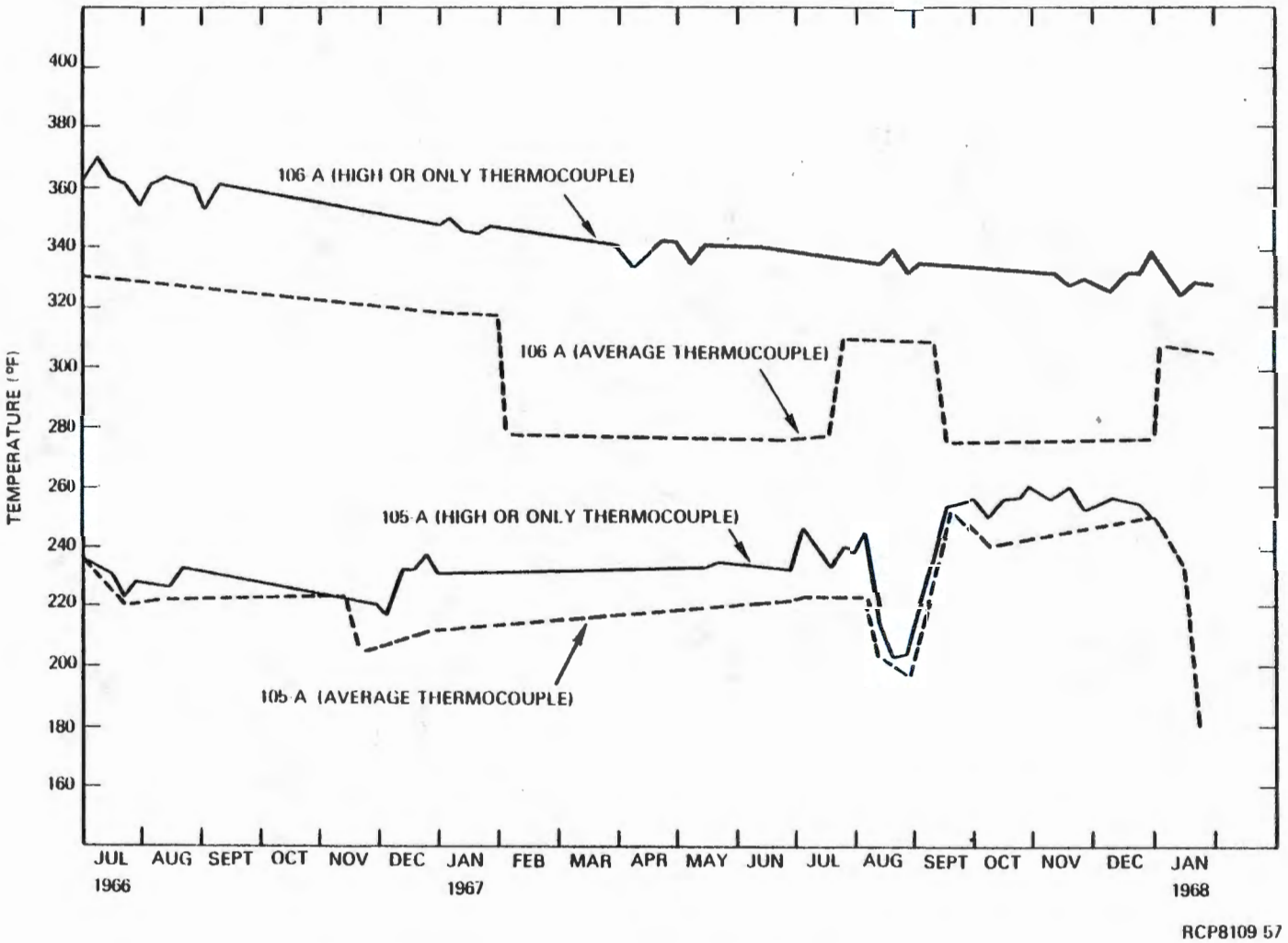

FIGURE B-48. 241-A-105 and -106 (Waste Temp.)
July 1966 thru January 1968

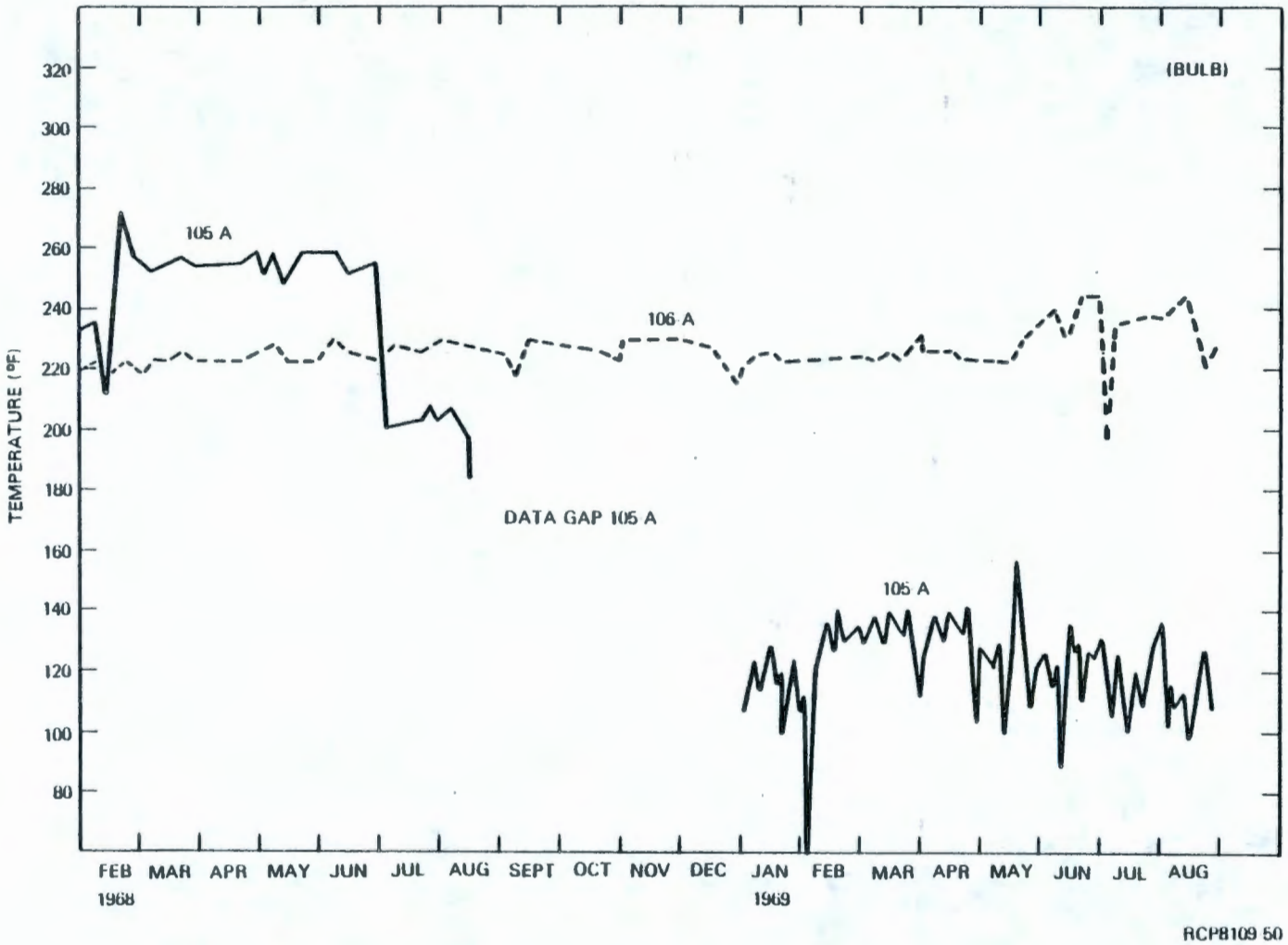

FIGURE B-49. 241-A-105 and -106 (Bulb Temp.)
February 1968 thru August 1969

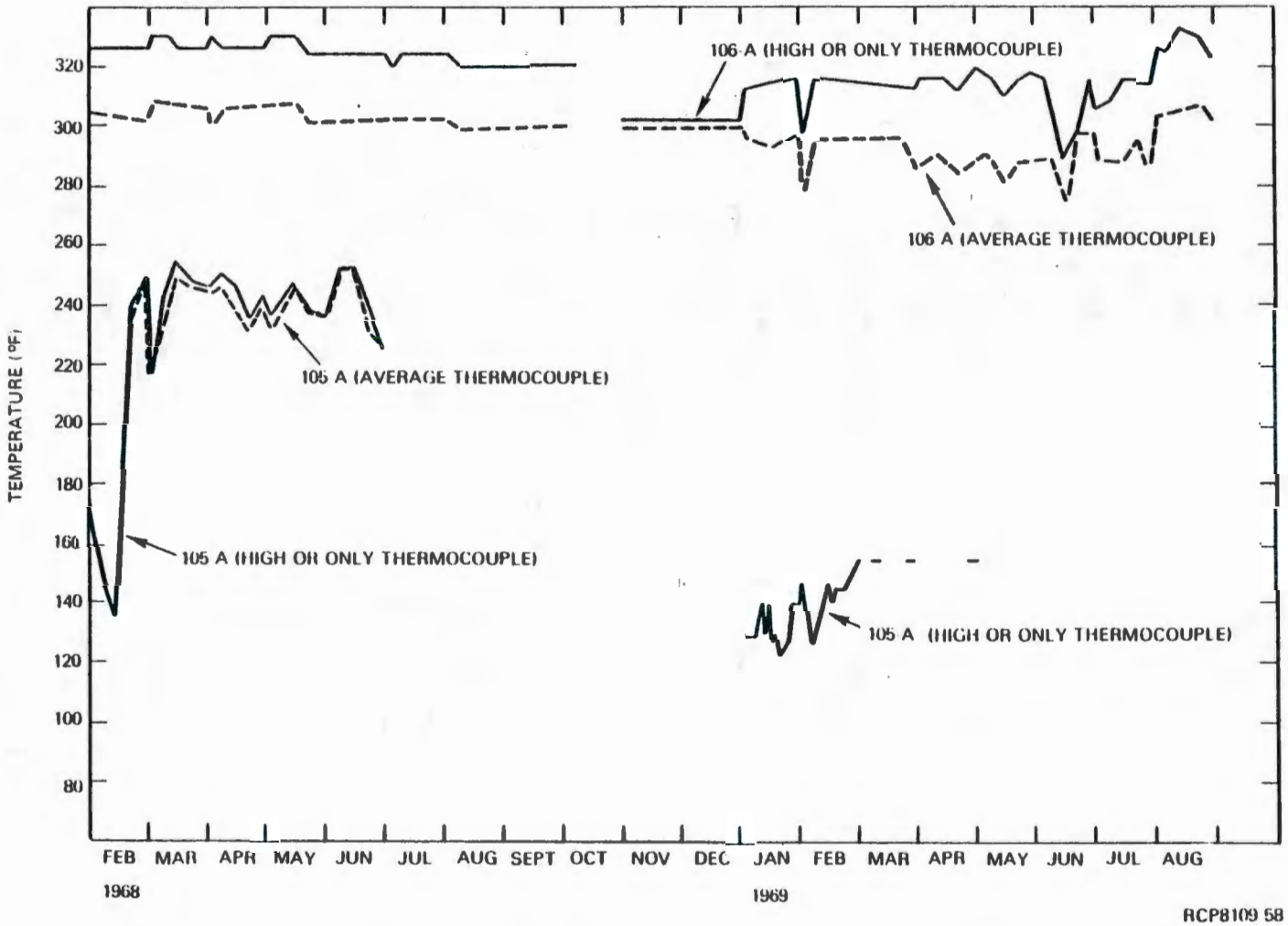

FIGURE B-50. 241-A-105 and -106 (Waste Temp)
Feb. 1968 - Aug. 1969

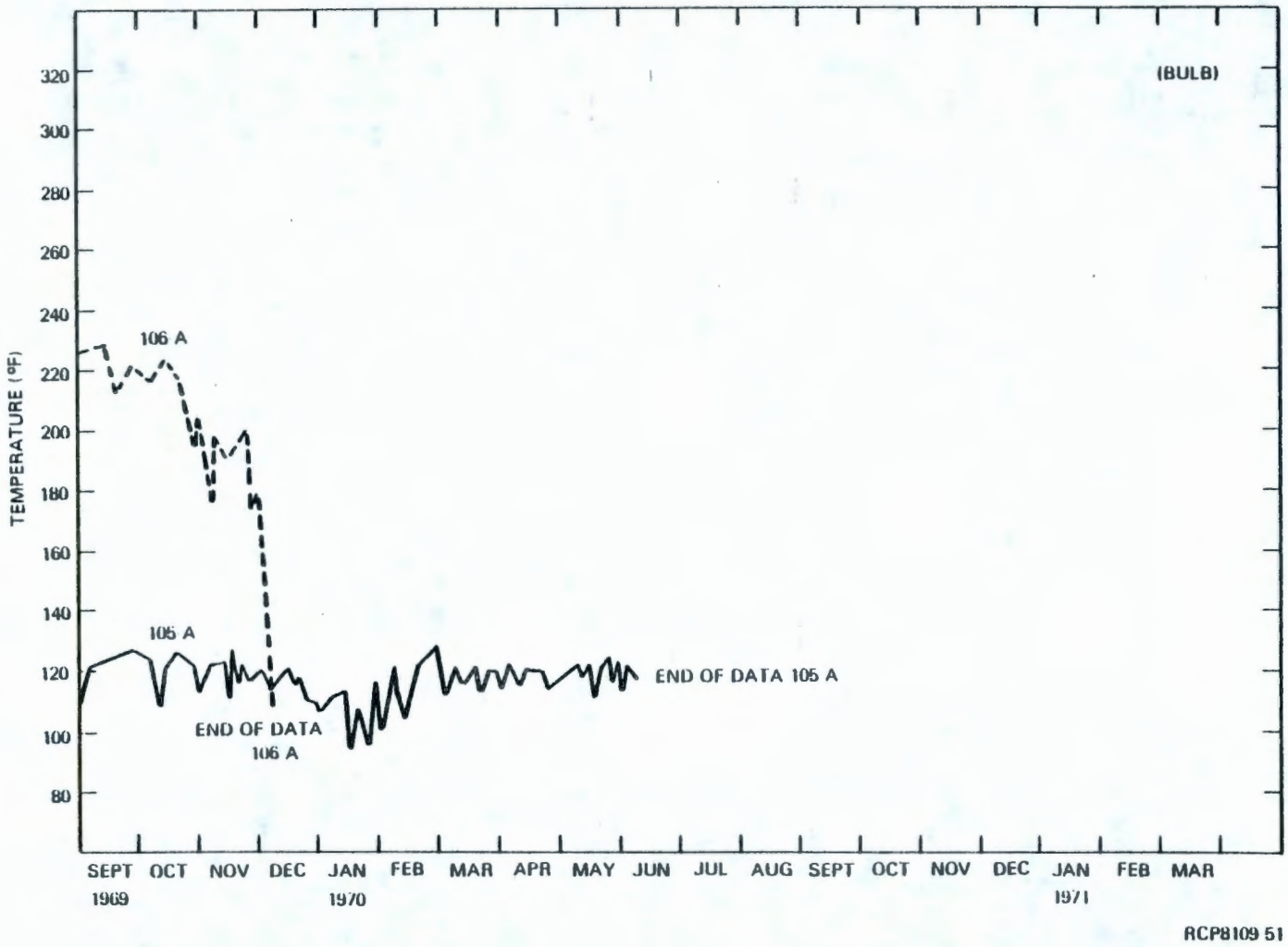

FIGURE B-51. 241-A-105 and -106 (Bulb Temp.)
September 1969 - June 1970

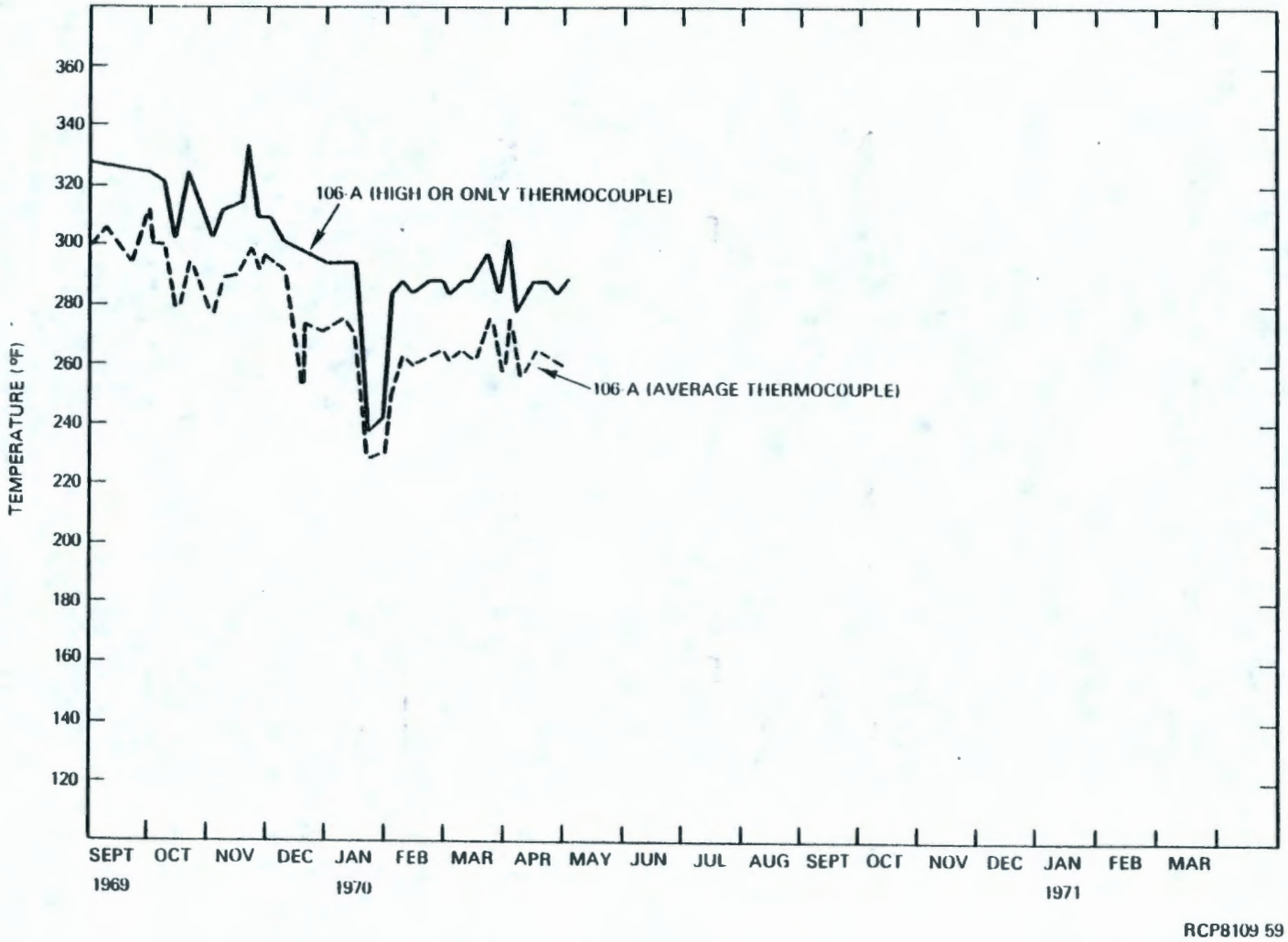

FIGURE B-52. 241-A-106 (Waste Temp.)
September 1969 thru April 1970

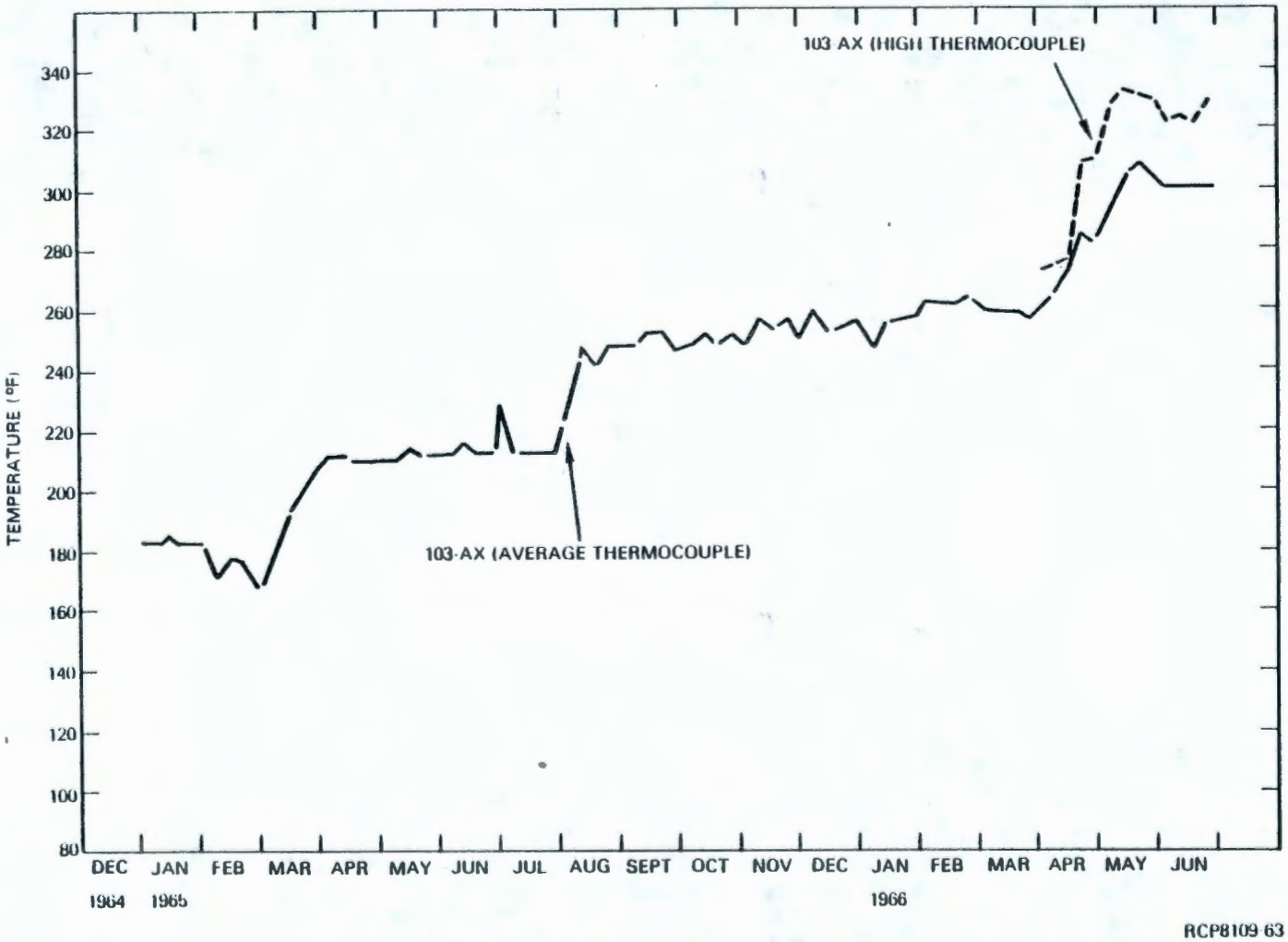

FIGURE B-53. 241-AX-103 (Waste Temp.)
December 1964 - June 1966

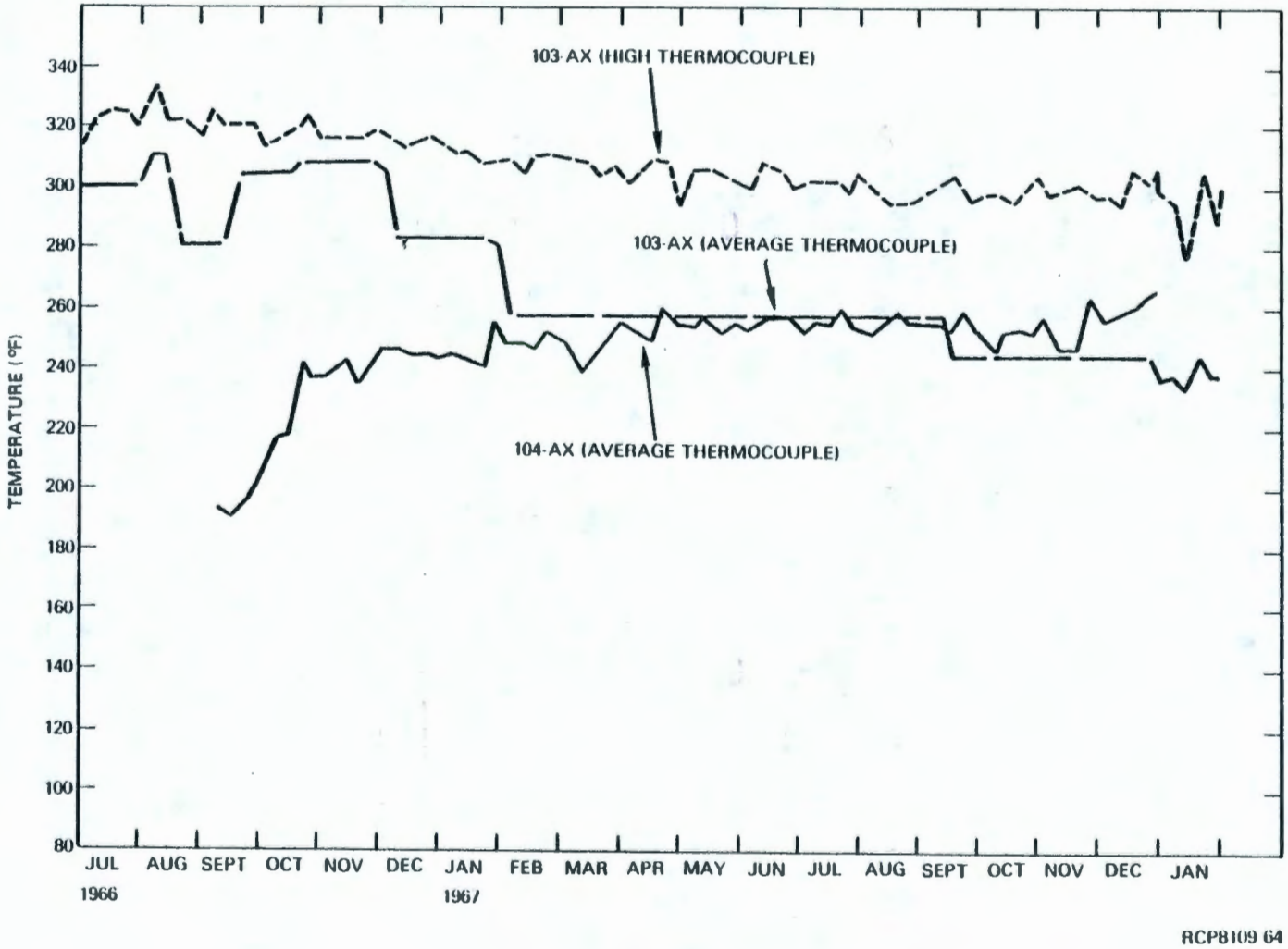

FIGURE B-54. 241-AX-103 and -104 (Waste Temp.)
July 1966 thru January 1968

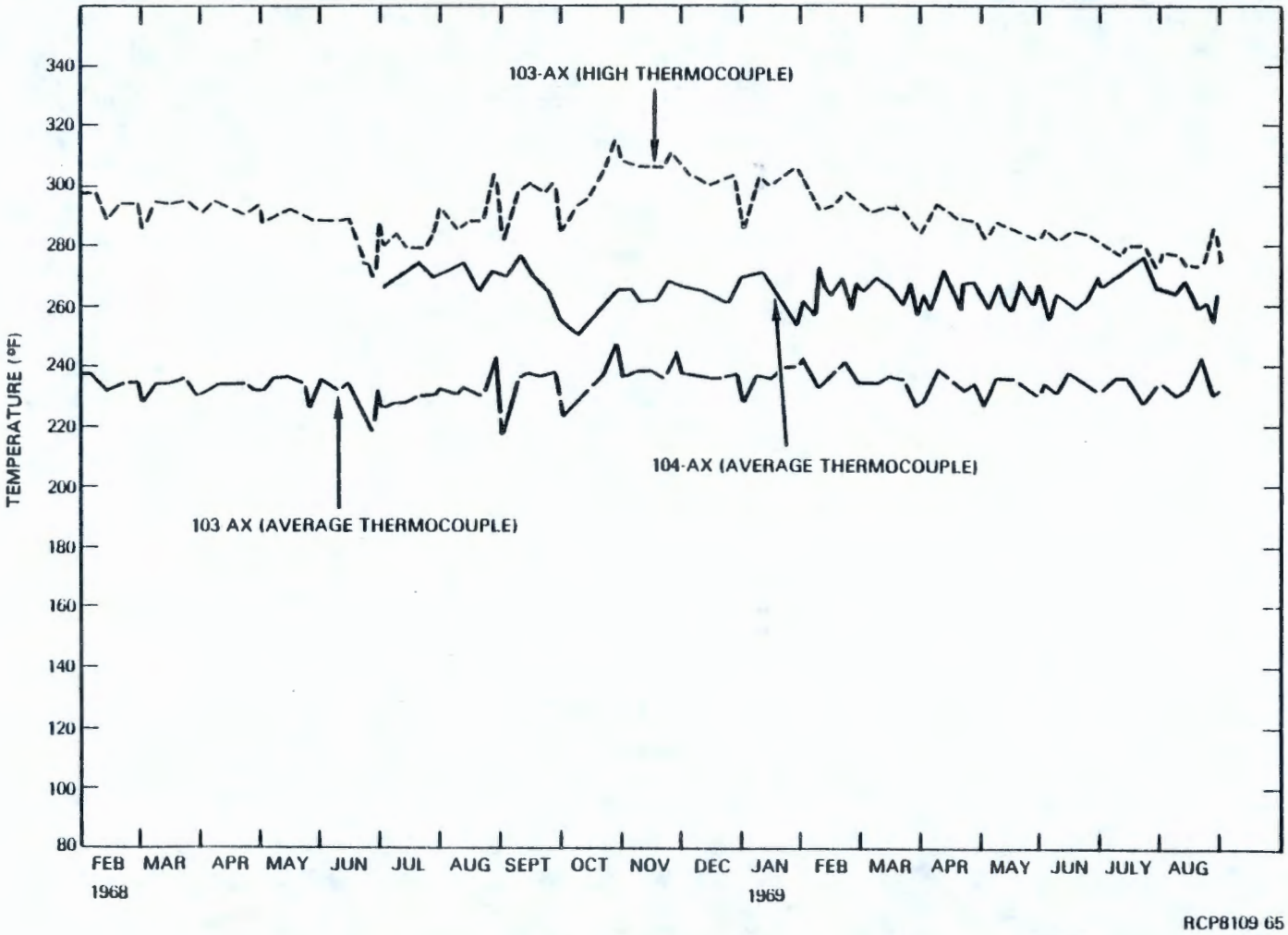

FIGURE B-55. 241-AX-103 and -104 (Waste Temp.)
February 1968 thru August 1969

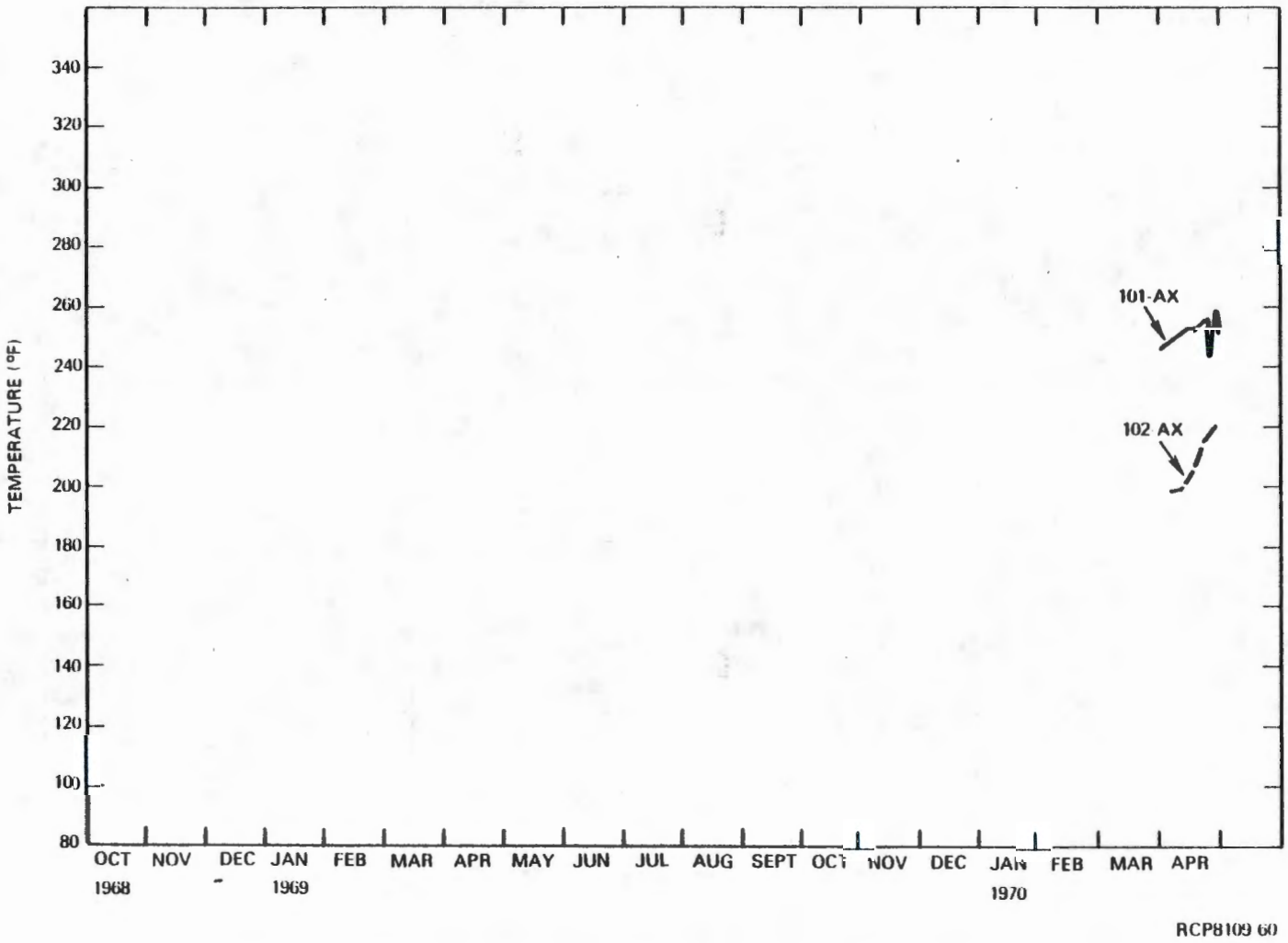

FIGURE B-56. 241-AX-101 and -102 (Waste Temp.)
April 1970

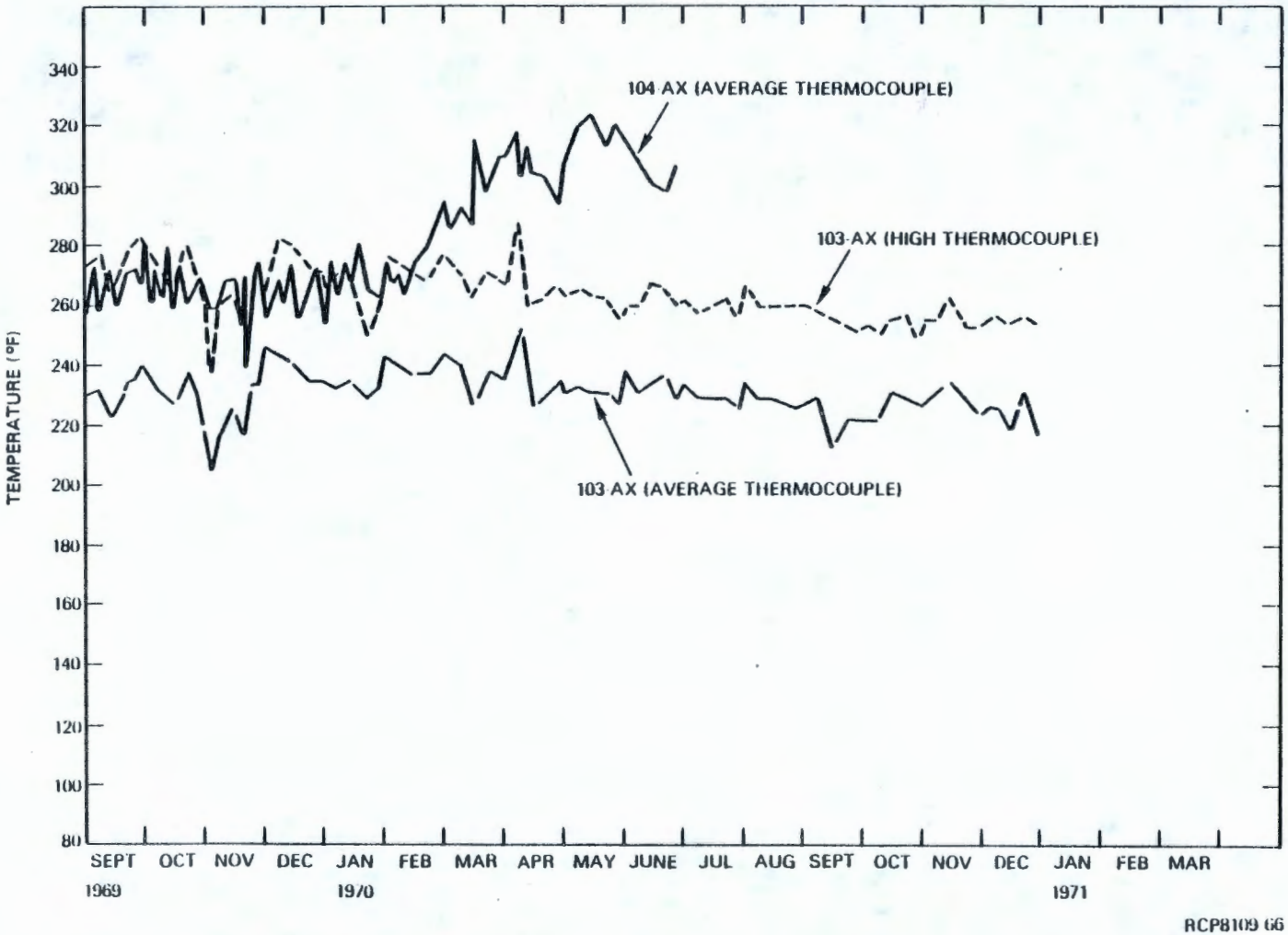

FIGURE B-57. 241-AX-103 and -104 (Waste Temp.)
September 1969 thru December 1970

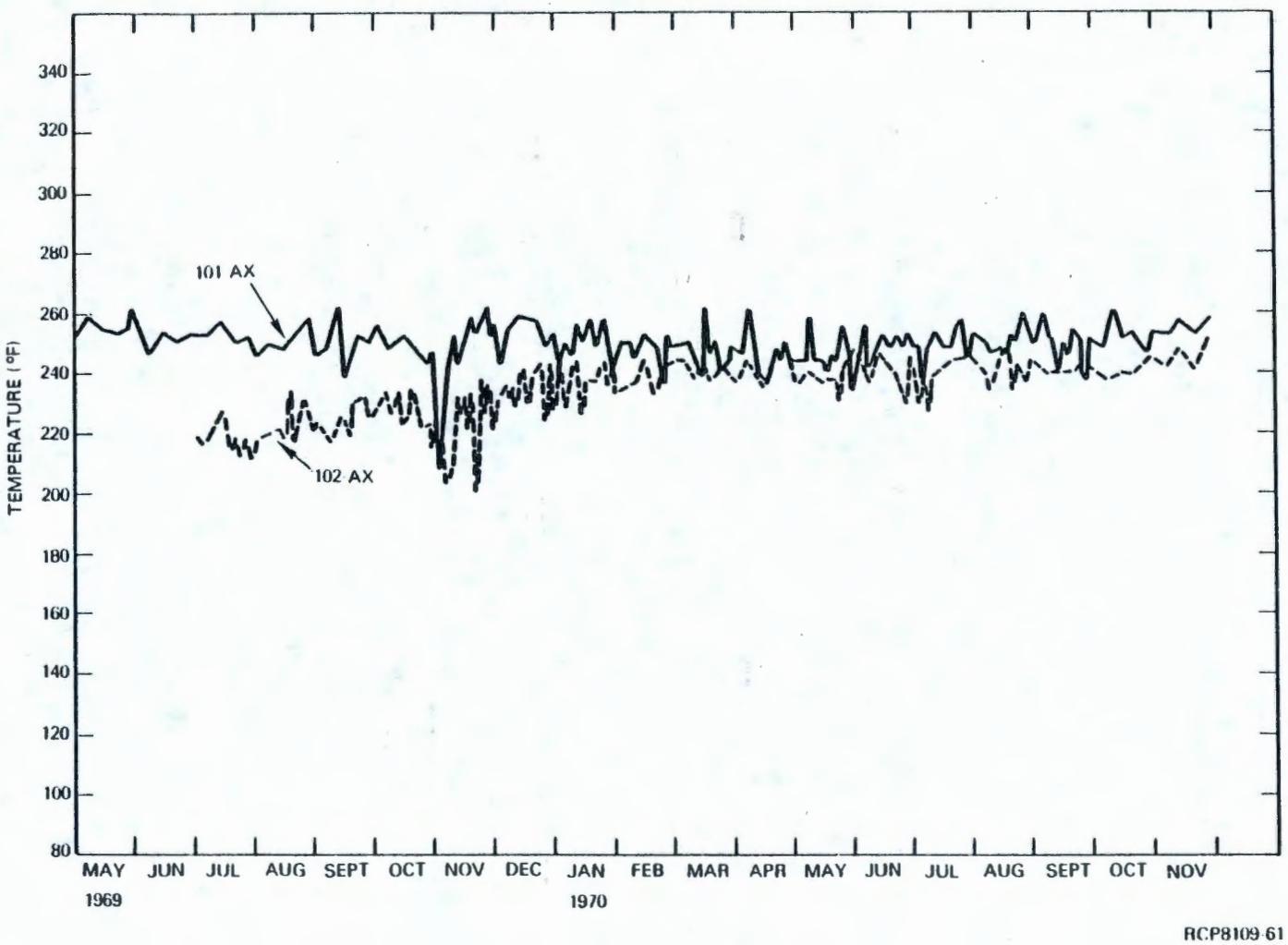

FIGURE B-58. 241-AX-101 and -102 (Waste Temp.)
May 1969 thru November 1970

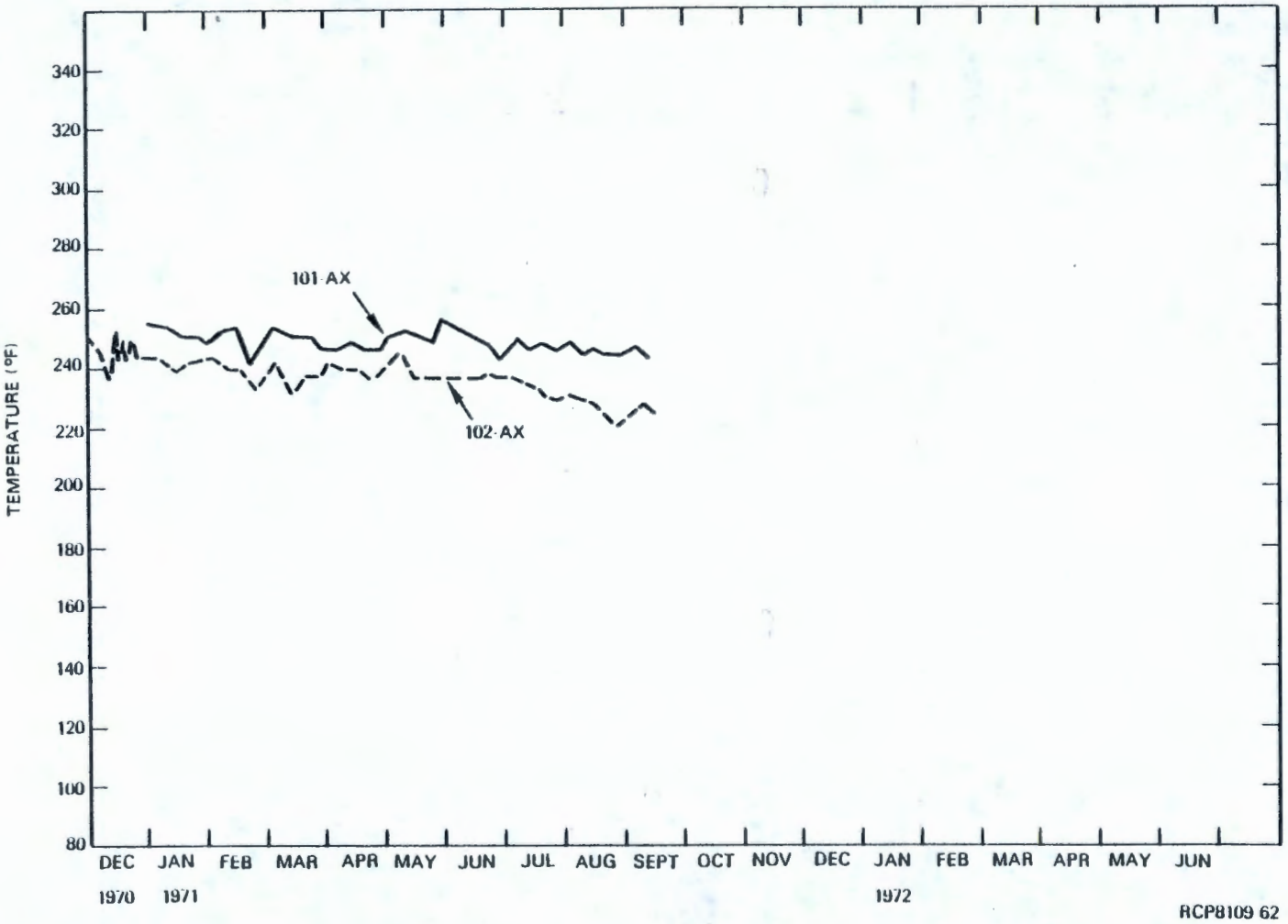

FIGURE B-59. 241-AX-101 and -102 (Waste Temp.)
December 1970 thru September 1971

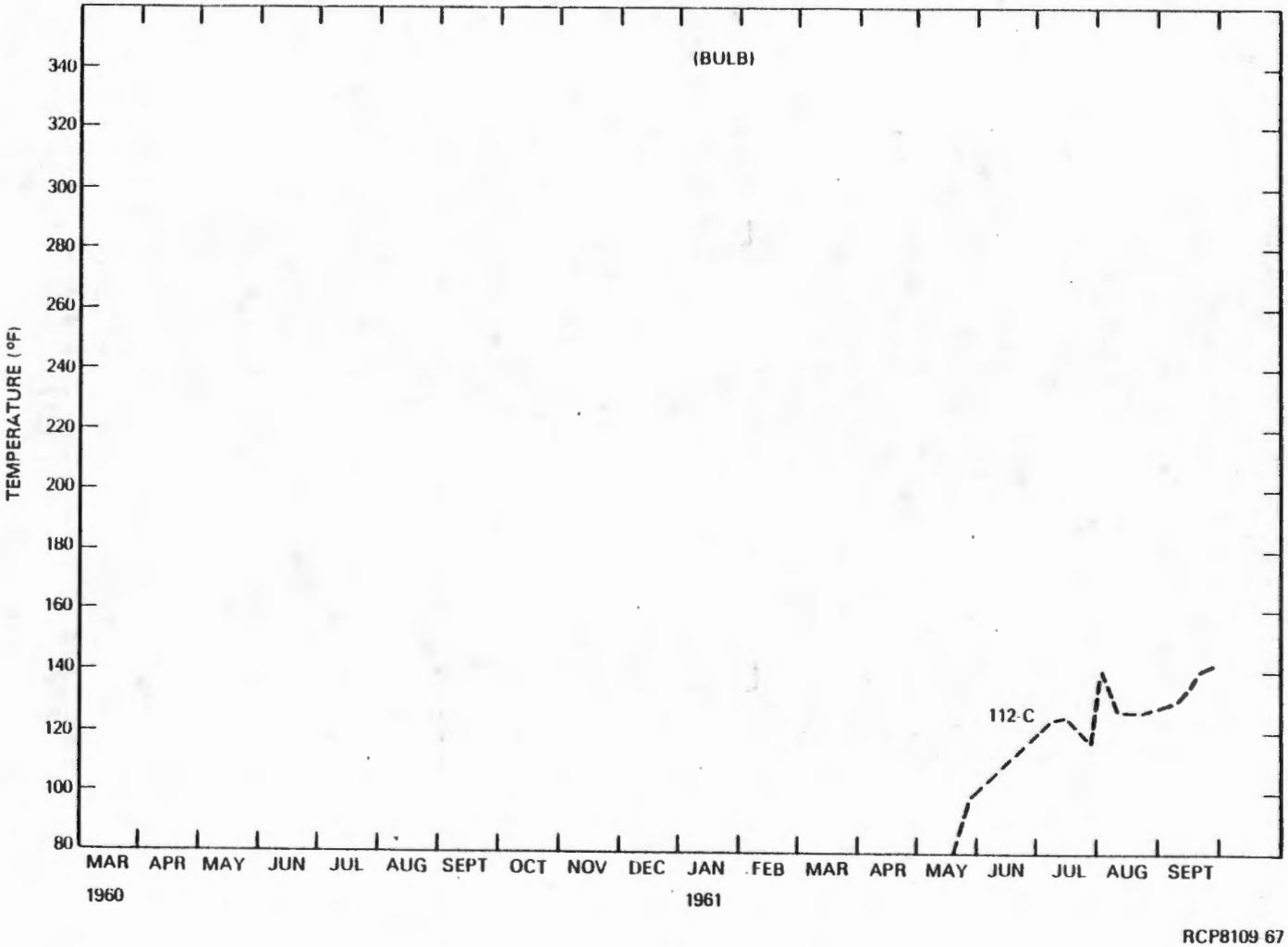

FIGURE B-60. 241-C-112 (Bulb Temp.)
May 1961 thru September 1961

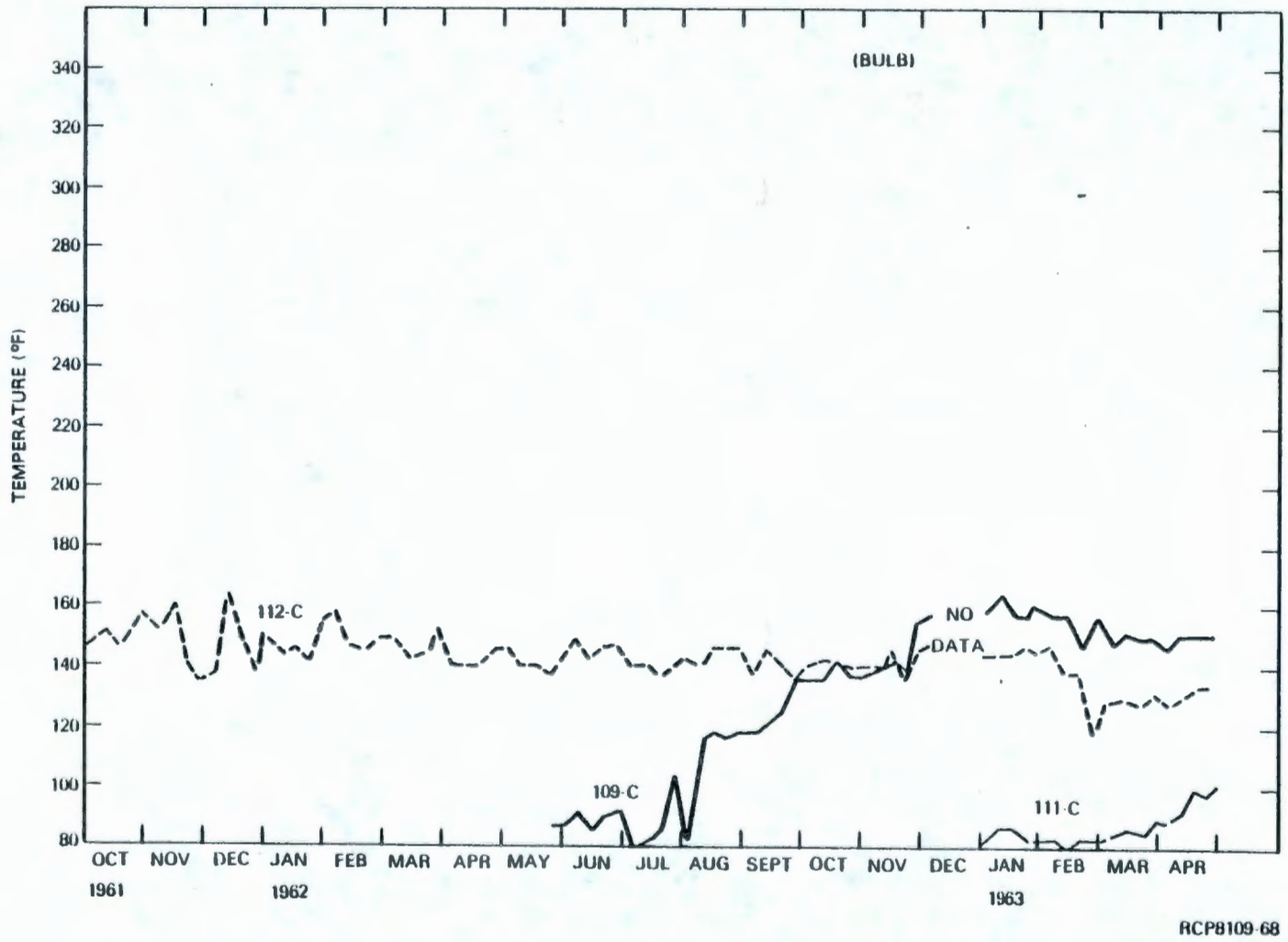

FIGURE B-61. 241-C-109, -111, and -112 (Bulb Temp.)
October 1961 - April 1963

T00293

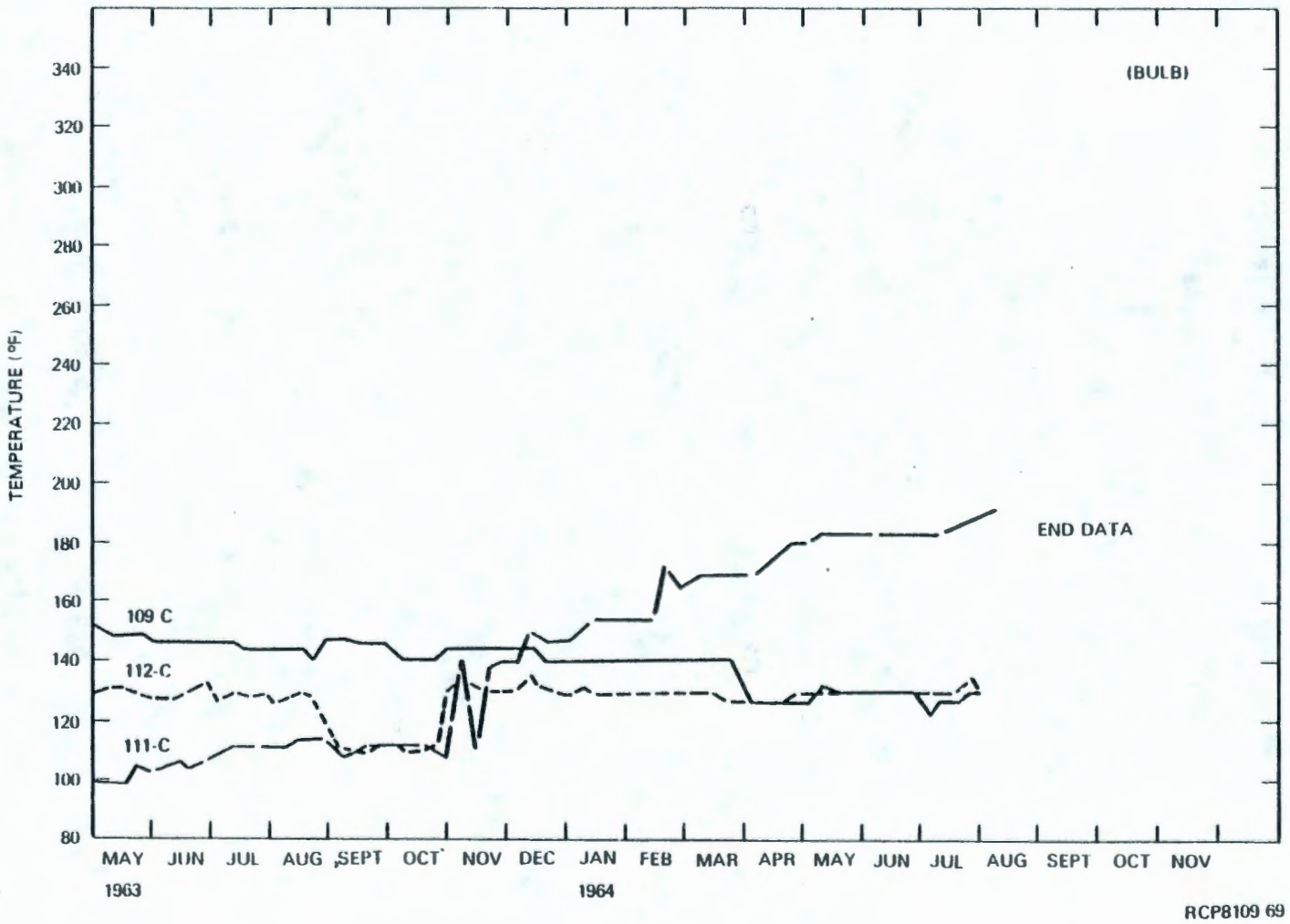

FIGURE B-62. 241-C-109, -111, and -112 (Bulb Temp.)
May 1963 thru July 1964

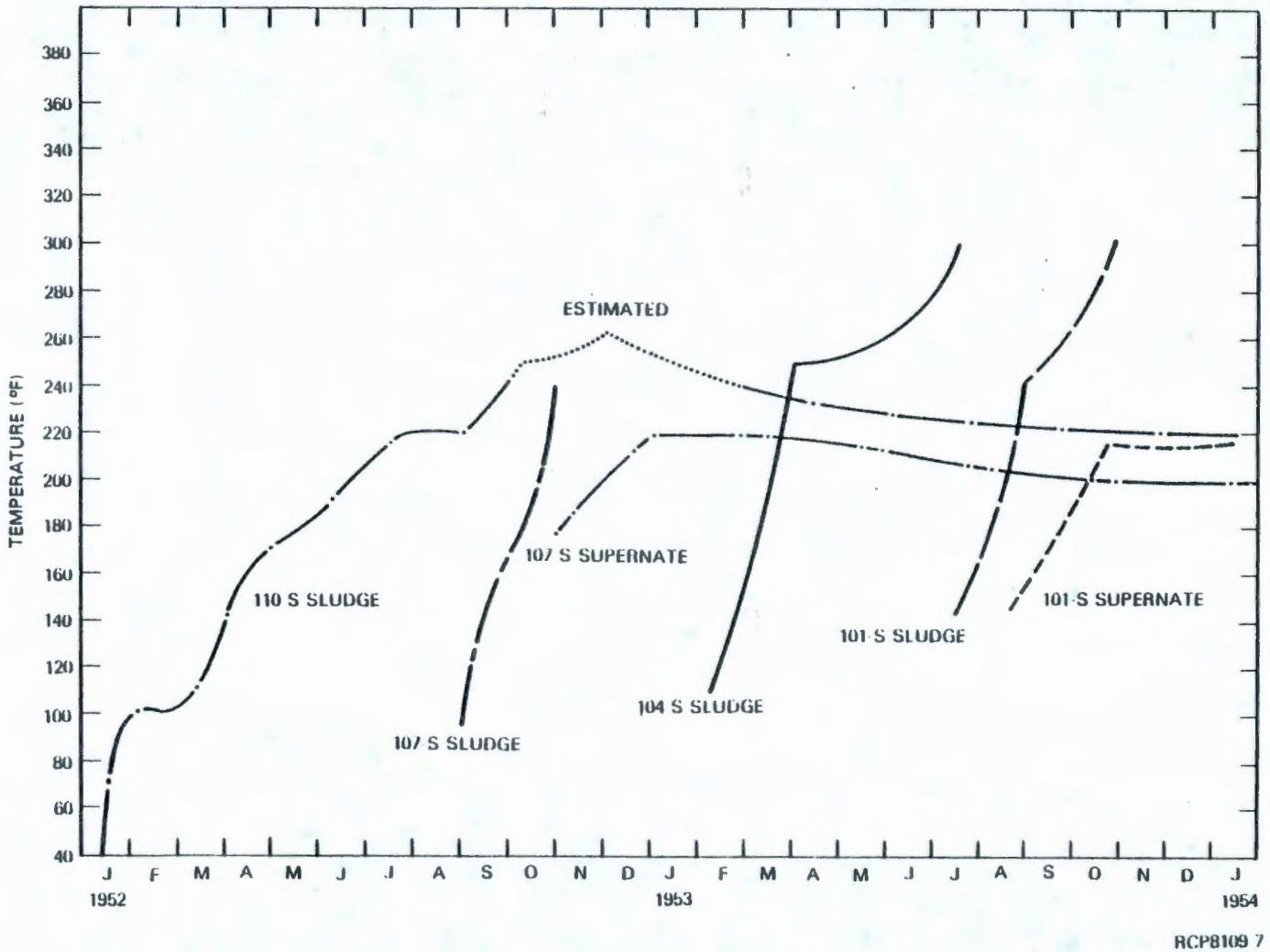

FIGURE B-63. 241-S-101, -104, -107, and -110 (Waste Temp.)
January 1952 thru January 1954

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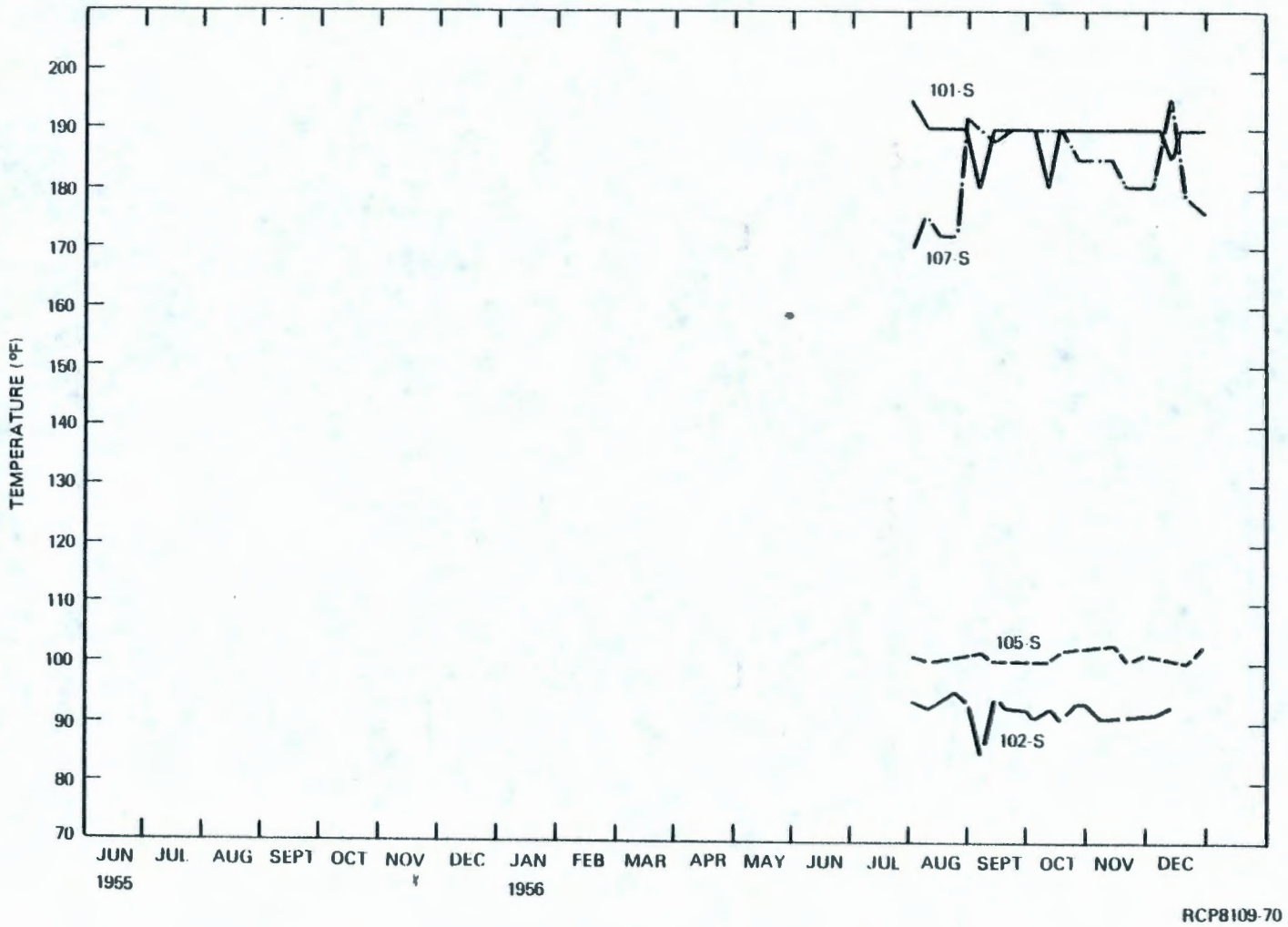

FIGURE B-64. 241-S-101, -102, -105, and -107 (Waste Temp.)
August 1956 thru December 1956

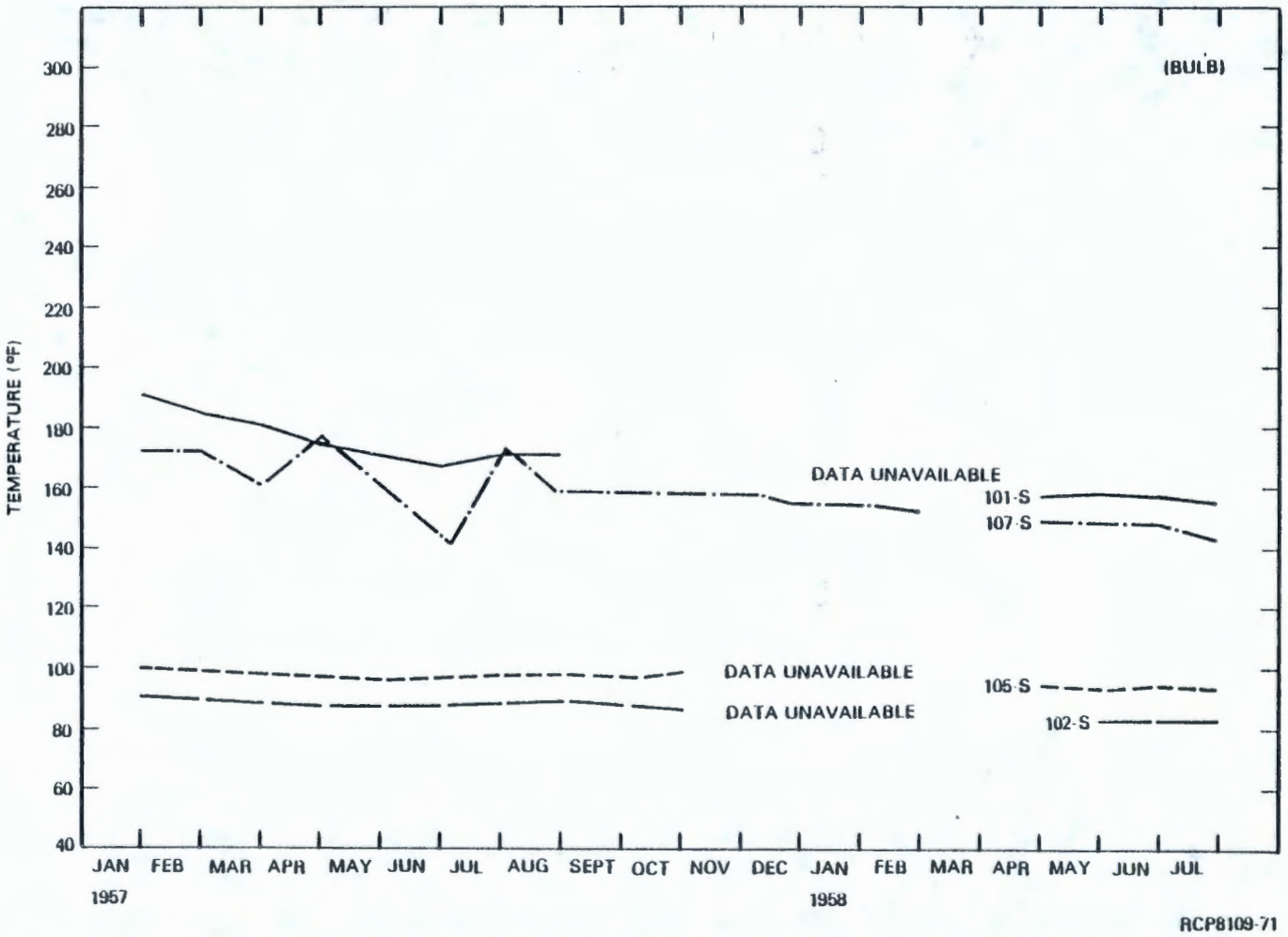

FIGURE B-65. 241-S-101, -102, -105, and -107 (Bulb Temperature)
January 1957 thru July 1958

T00293

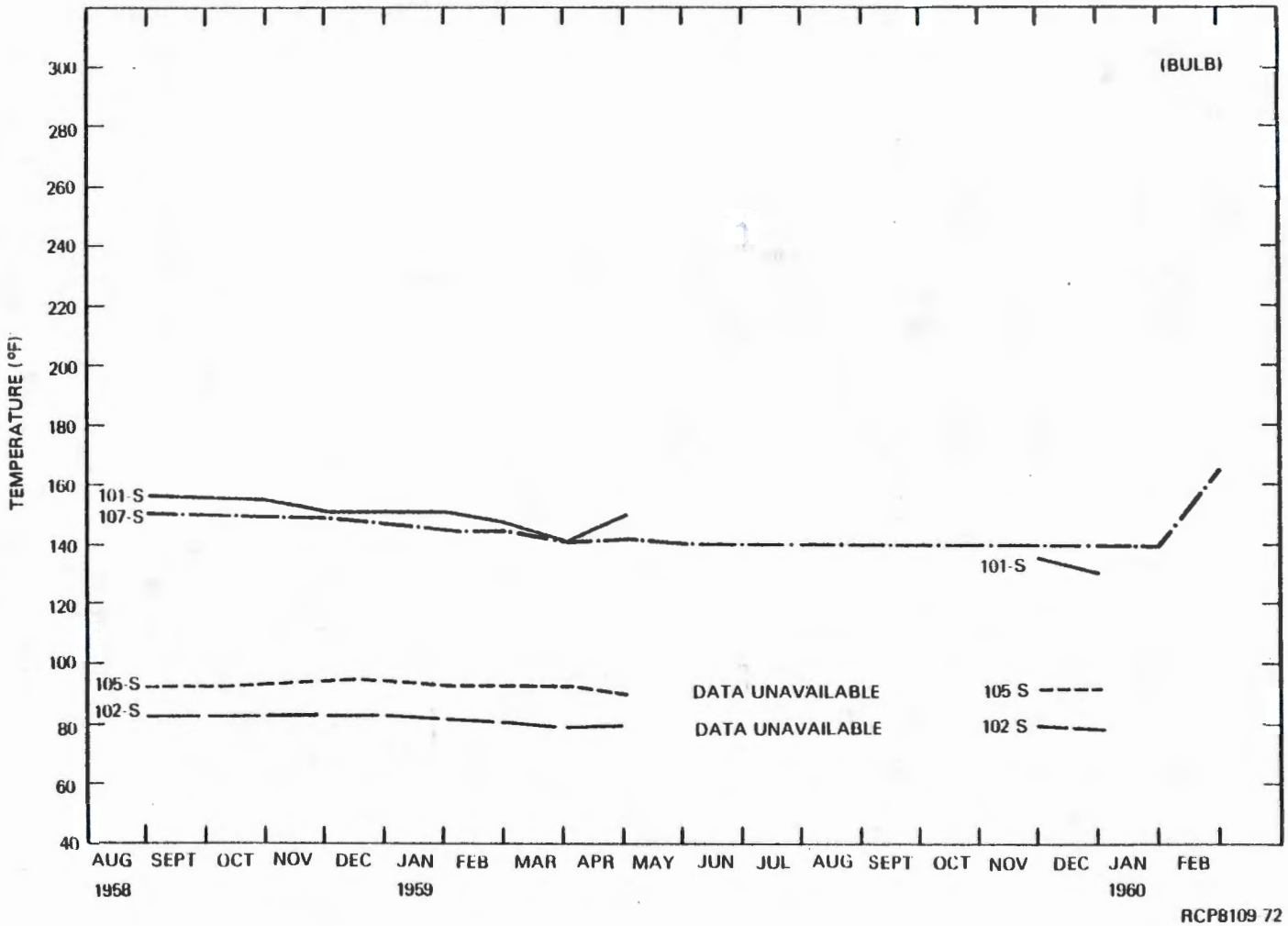

FIGURE B-66. 241-S-101, -102, -105, and -107 (Bulb Temp.)
August 1958 thru February 1960

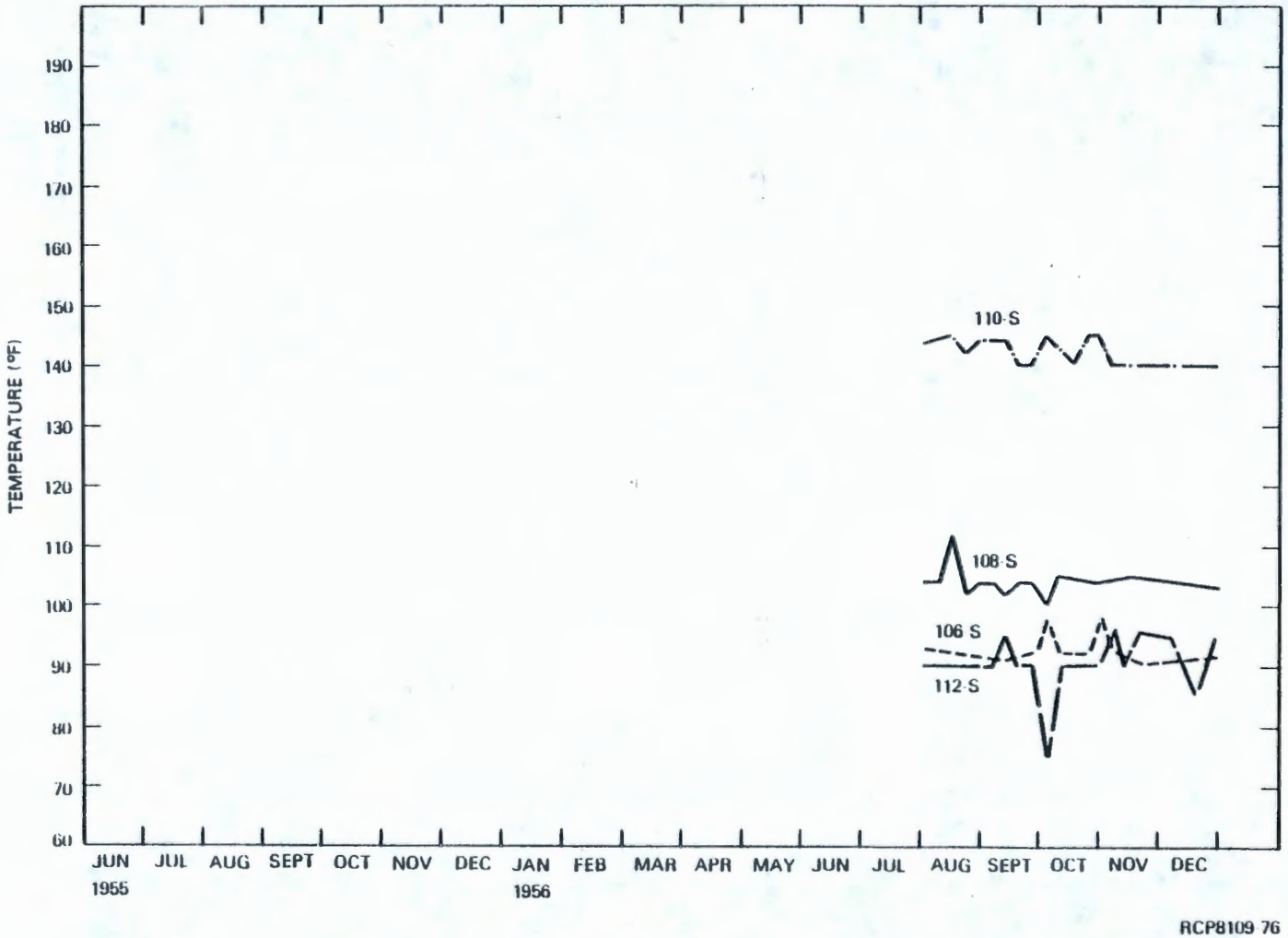

FIGURE B-67. 241-S-106, -108, -110, and -112 (Waste Temp.)
August 1956 thru December 1956

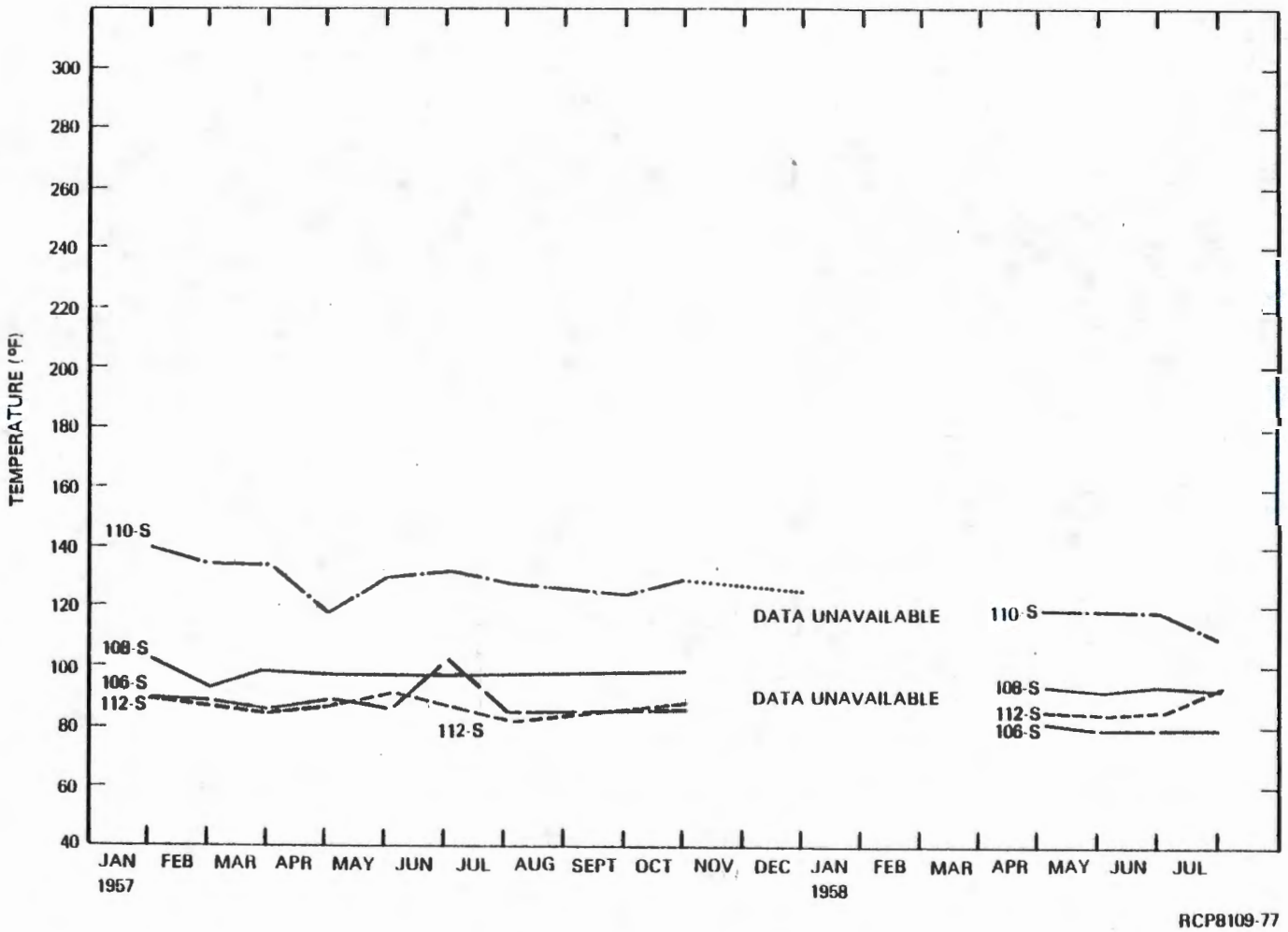

FIGURE B-68. 241-S-106, -108, -110, and -112 (Bulb Temp.)
January 1957 thru July 1958

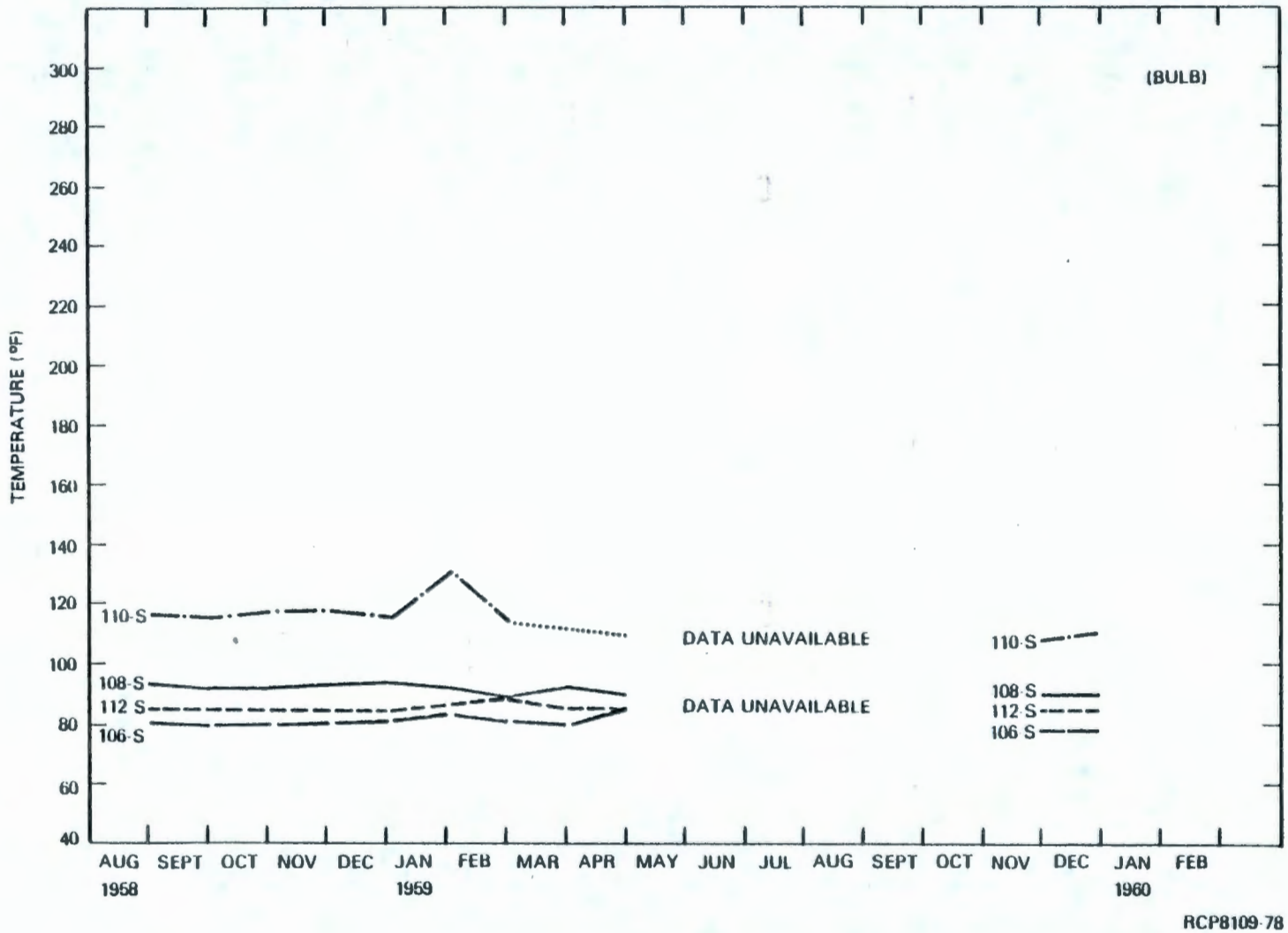

FIGURE B-69. 241-S-106, -108, -110, and -112 (Bulb Temp.)
August 1958 thru December 1959

T00293

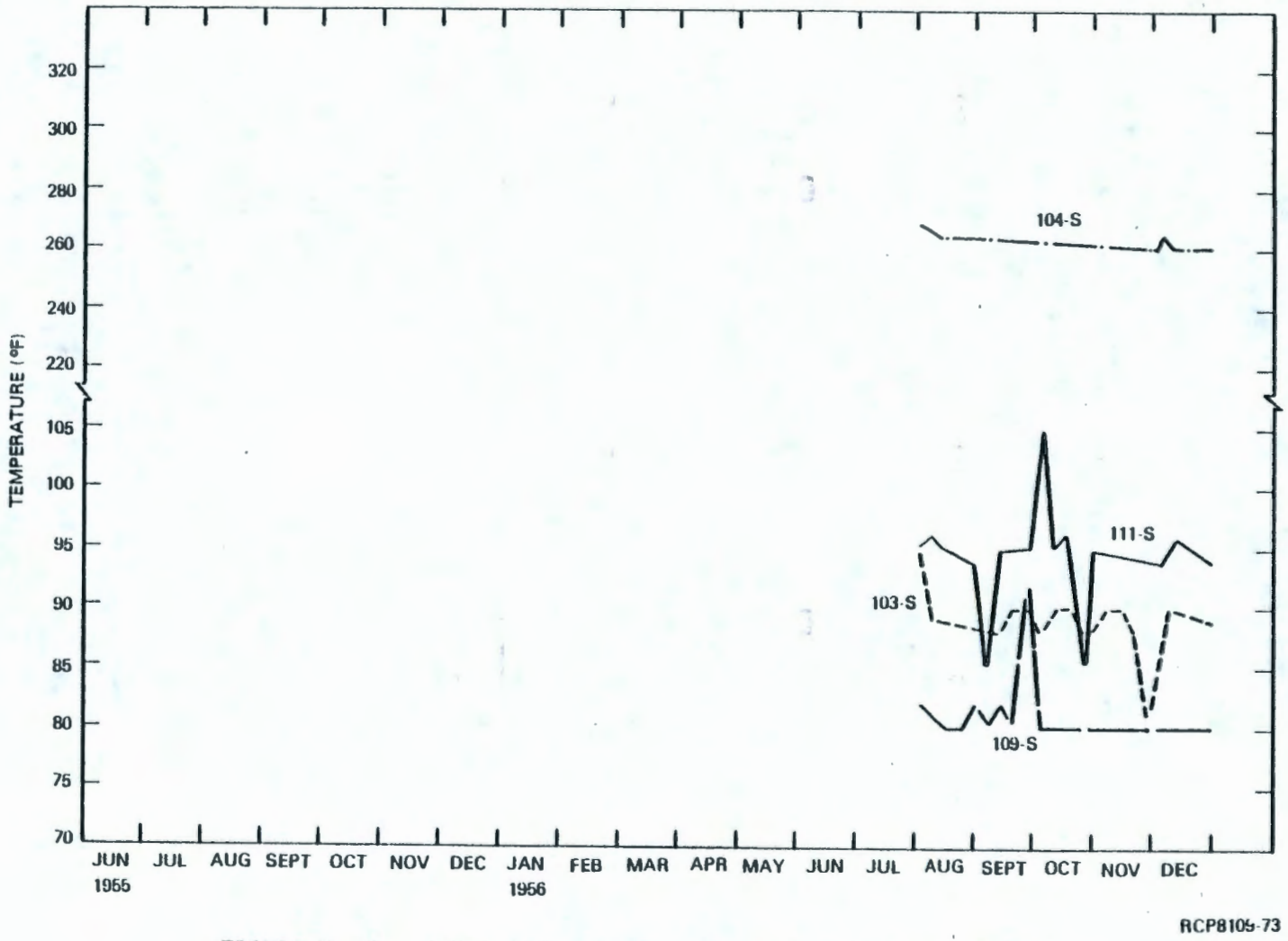

FIGURE B-70. 241-S-103, -104, -109, and -111 (Bulb Temp.)
July 1956 thru Dec. 1956

9 1 1 2 0 5 4 0 6 7 3

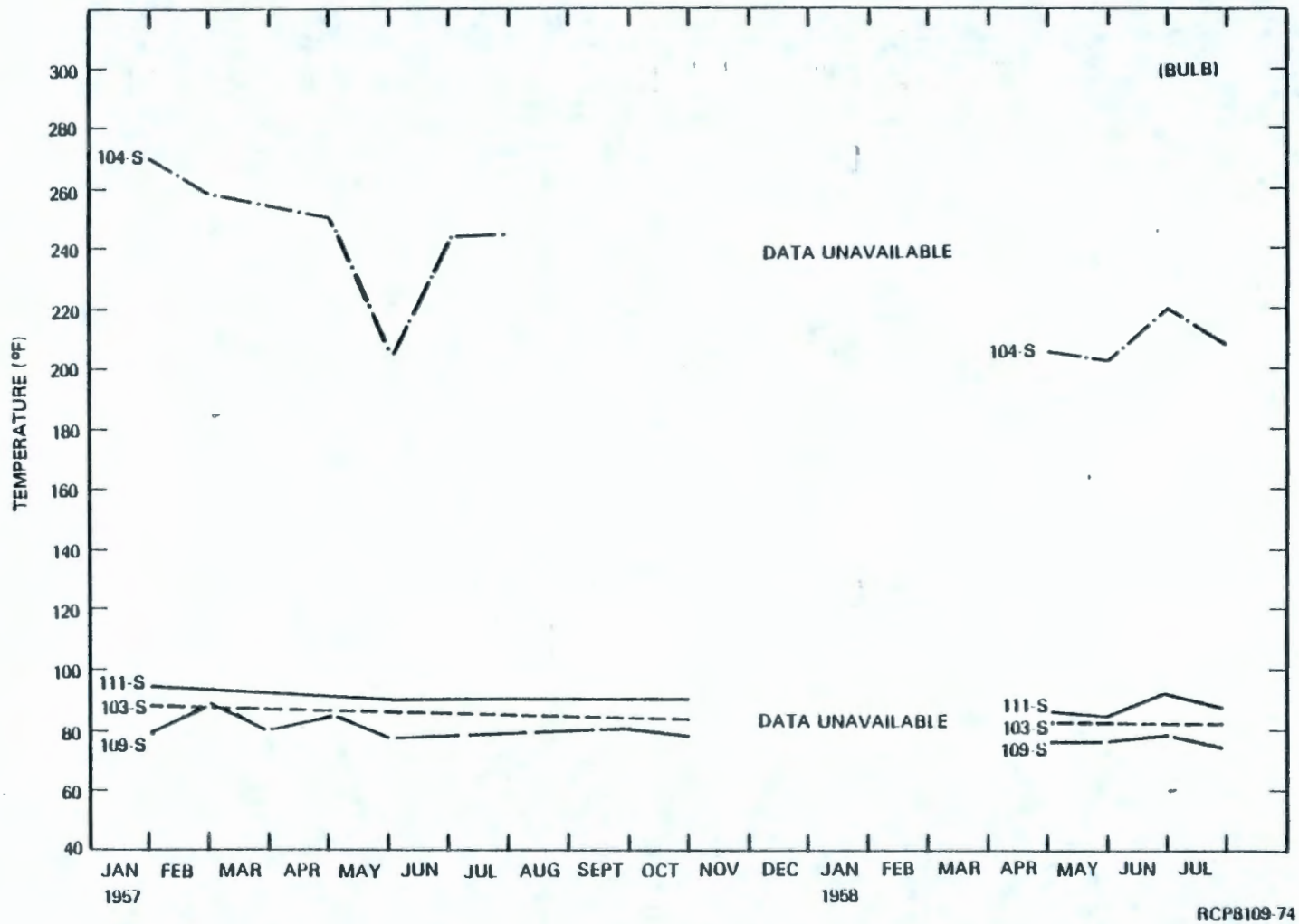

FIGURE B-71. 241-S-103, -104, -109 and -111 (Bulb Temp.)
January 1957 thru July 1958

T00293

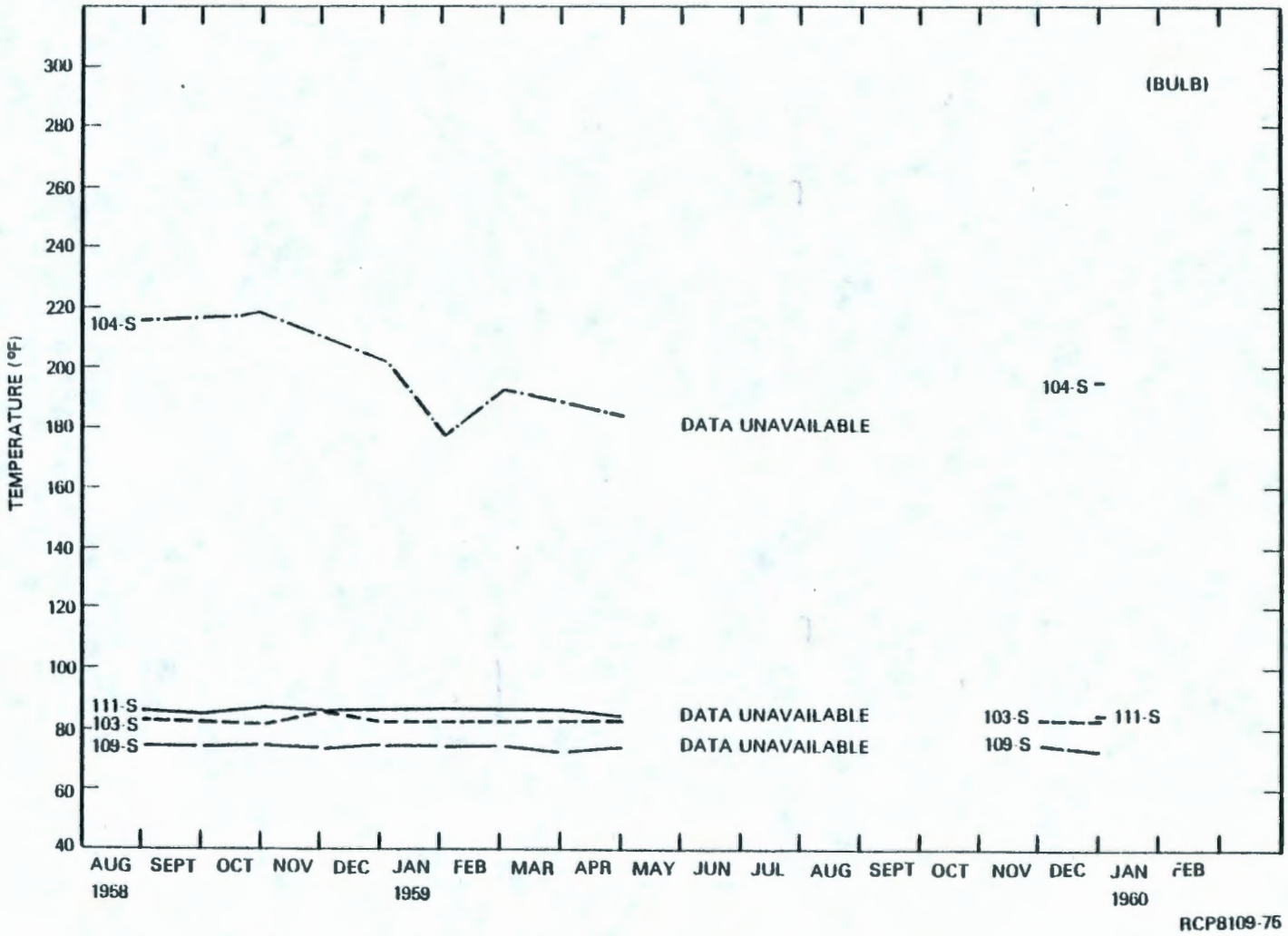

FIGURE B-72. 241-S-103, -104, -109, and -111 (Bulb Temp.)
August 1958 thru January 1960

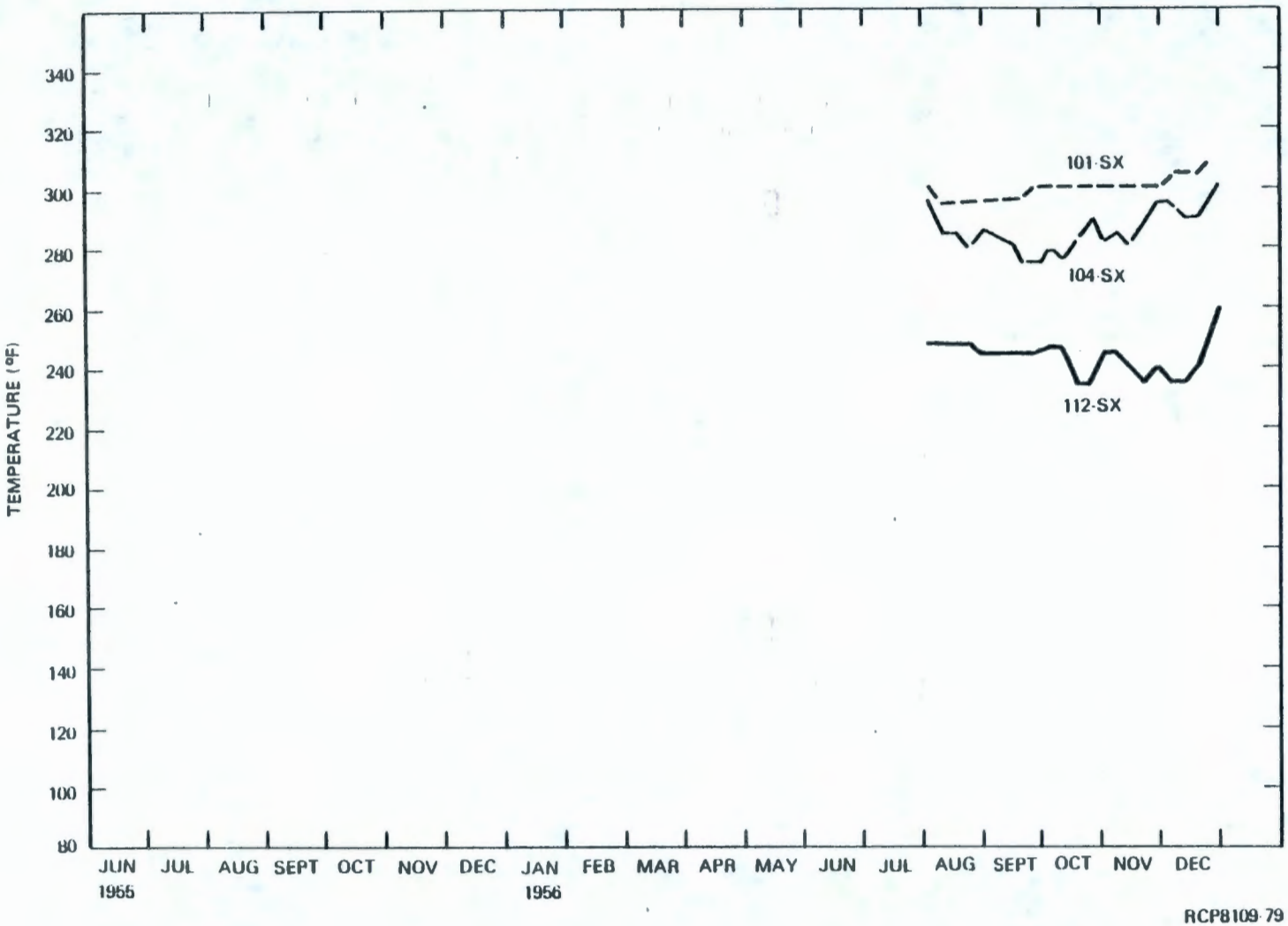

FIGURE B-73. 241-SX-101, -104, -112 (Bulb Temp.)
August 1956 - December 1956

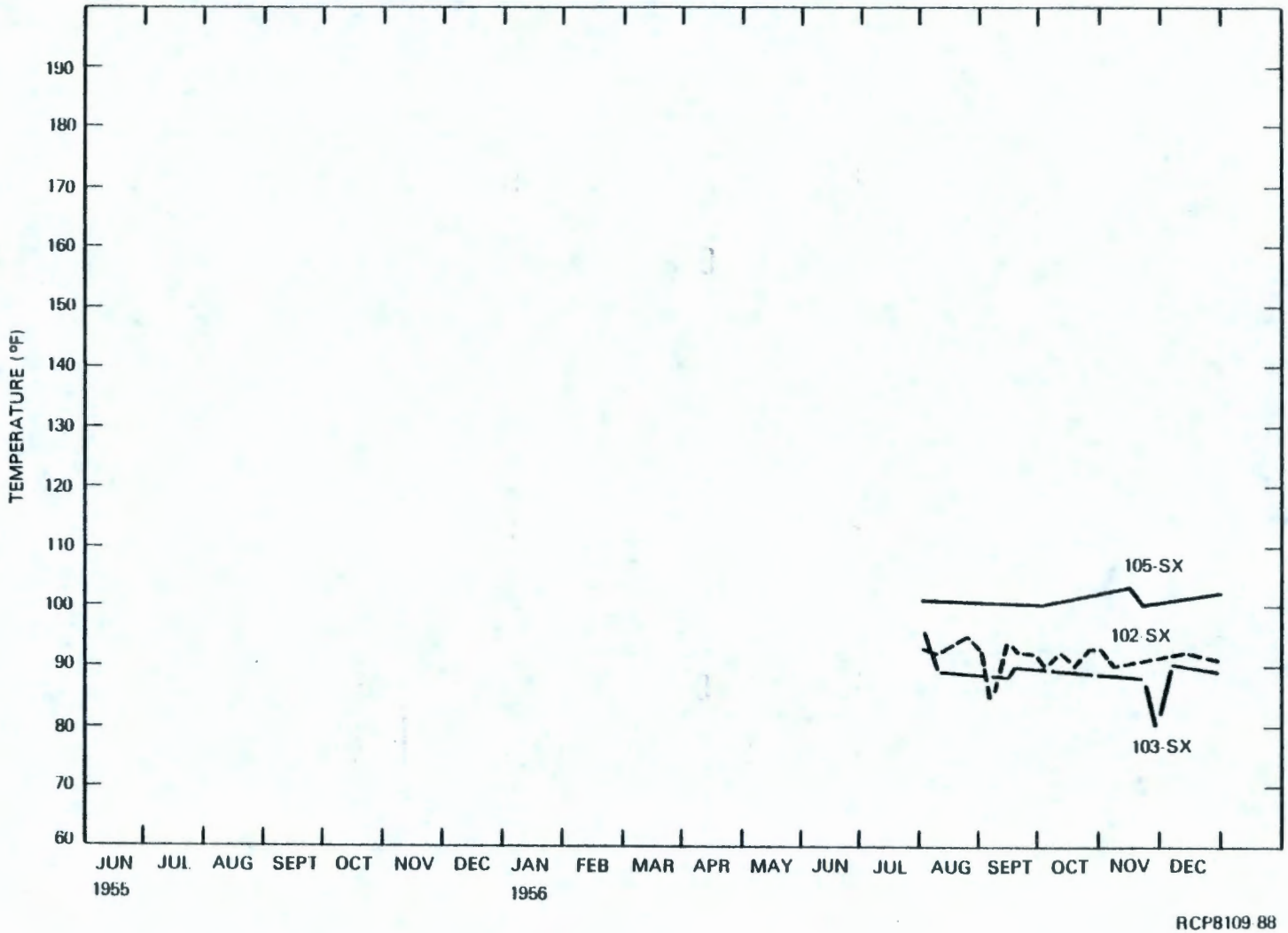

FIGURE B-74. 241-SX-102, 103, and -105 (Bulb Temp.)
August 1956 - December 1956

9 1 1 2 0 5 4 0 6 7 7

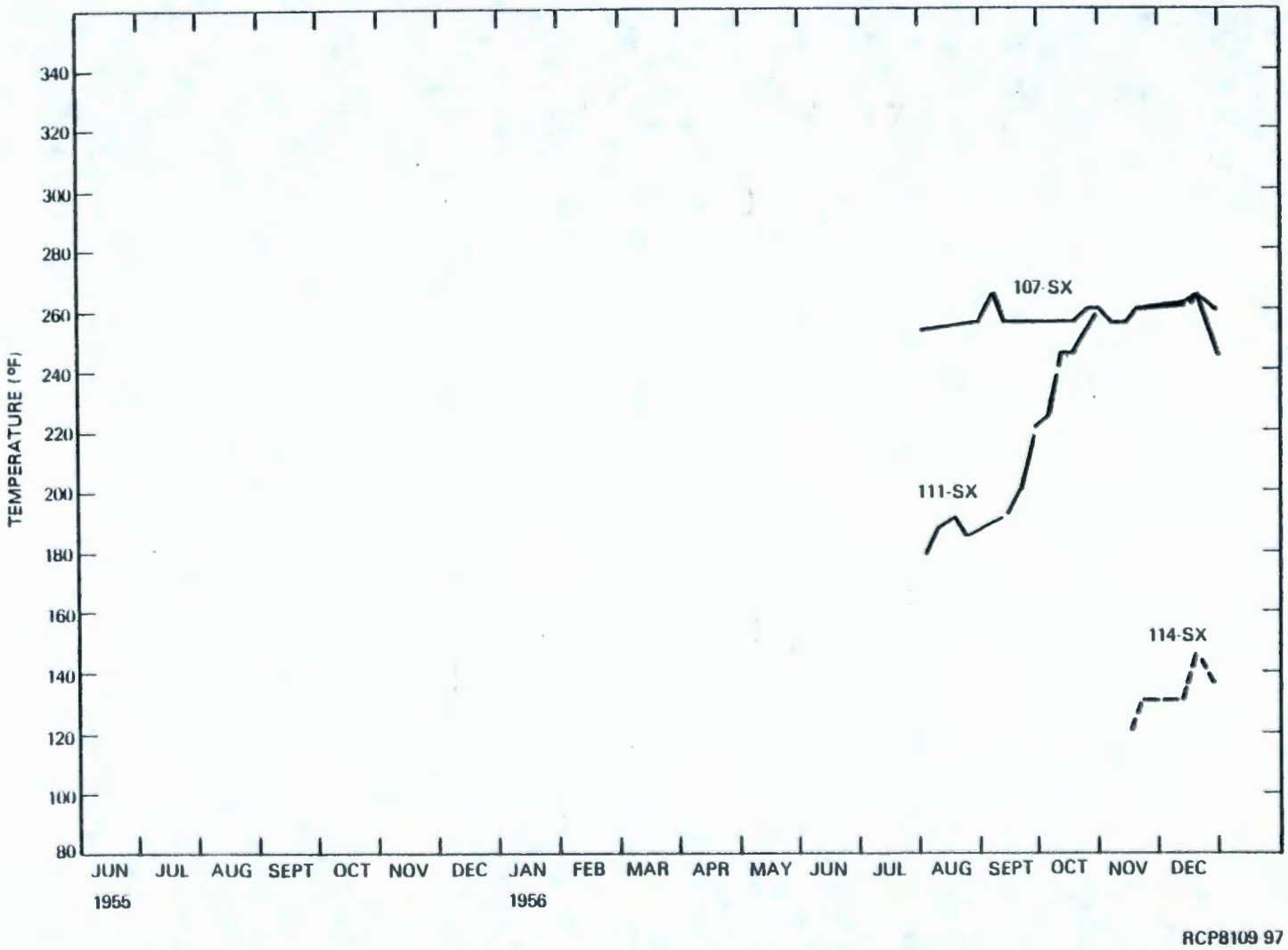

FIGURE B-75. 241-SX-107, -111, and -114 (Bulb Temp.)
August 1956 thru December 1956

T00293

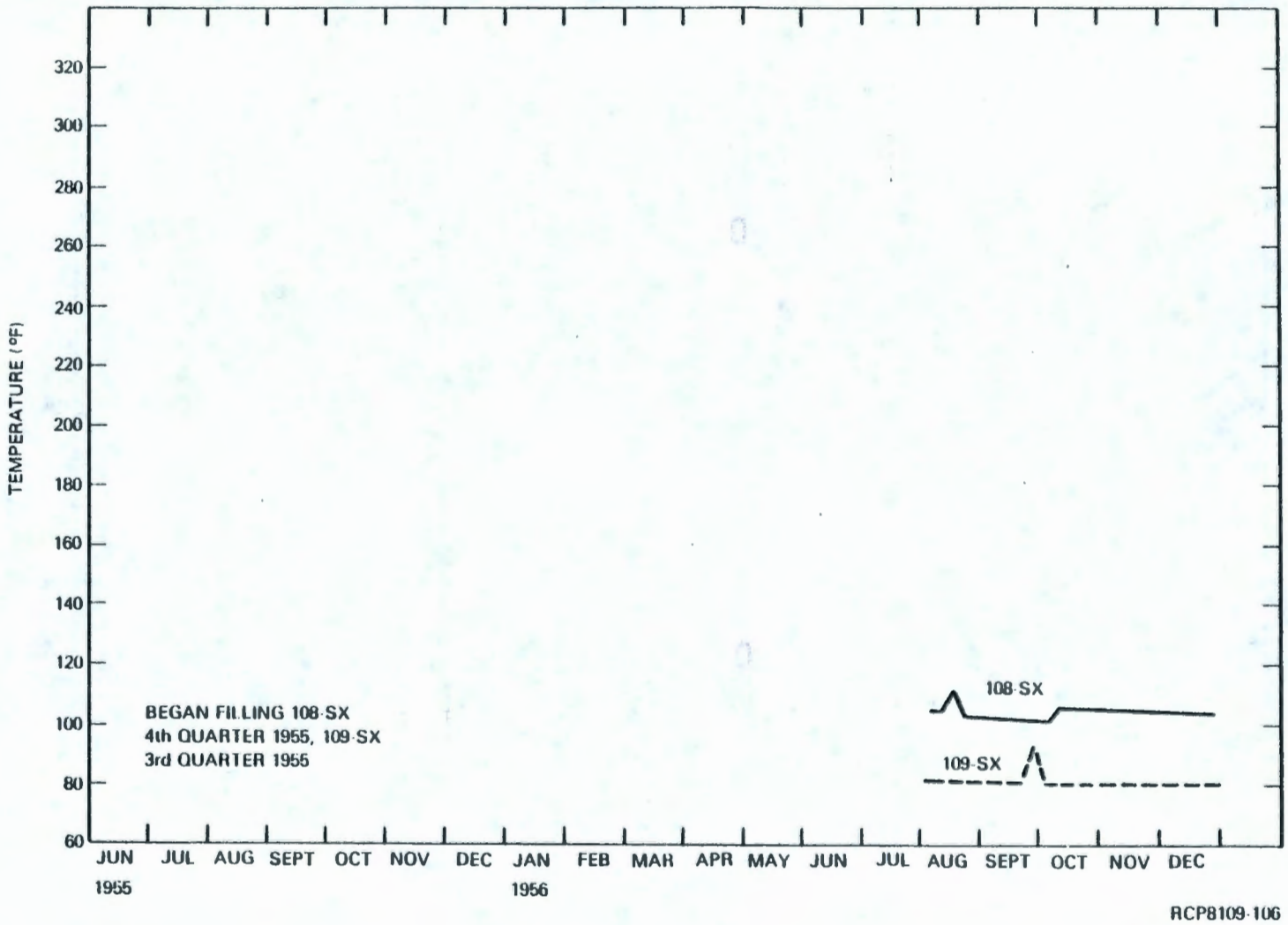

FIGURE B-76. 241-SX-108 and -109 (Bulb Temp.)
August 1956 thru December 1956

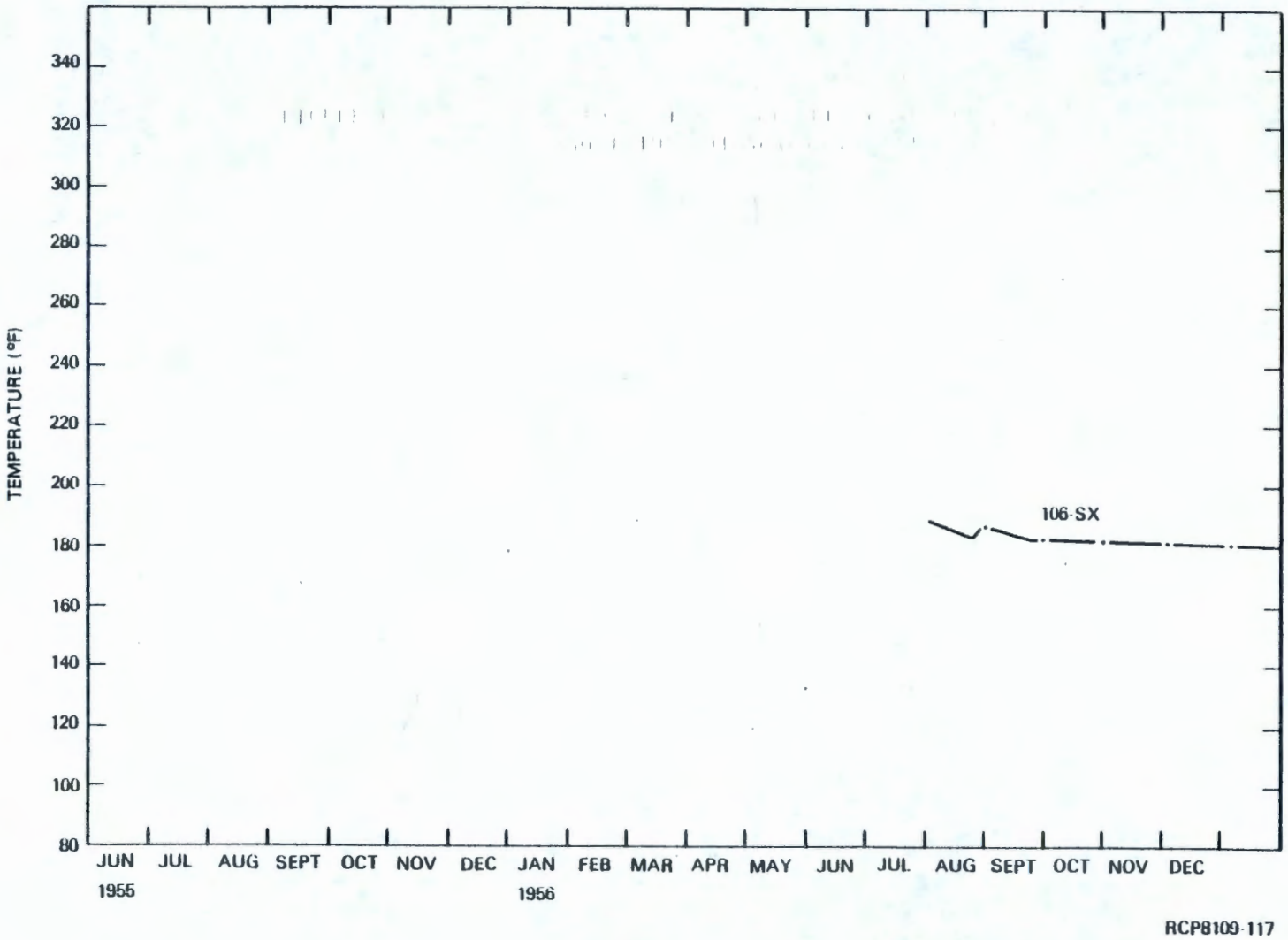

FIGURE B-77. 241-SX-106 (Bulb Temp.)
August 1956 - December 1956

T00293

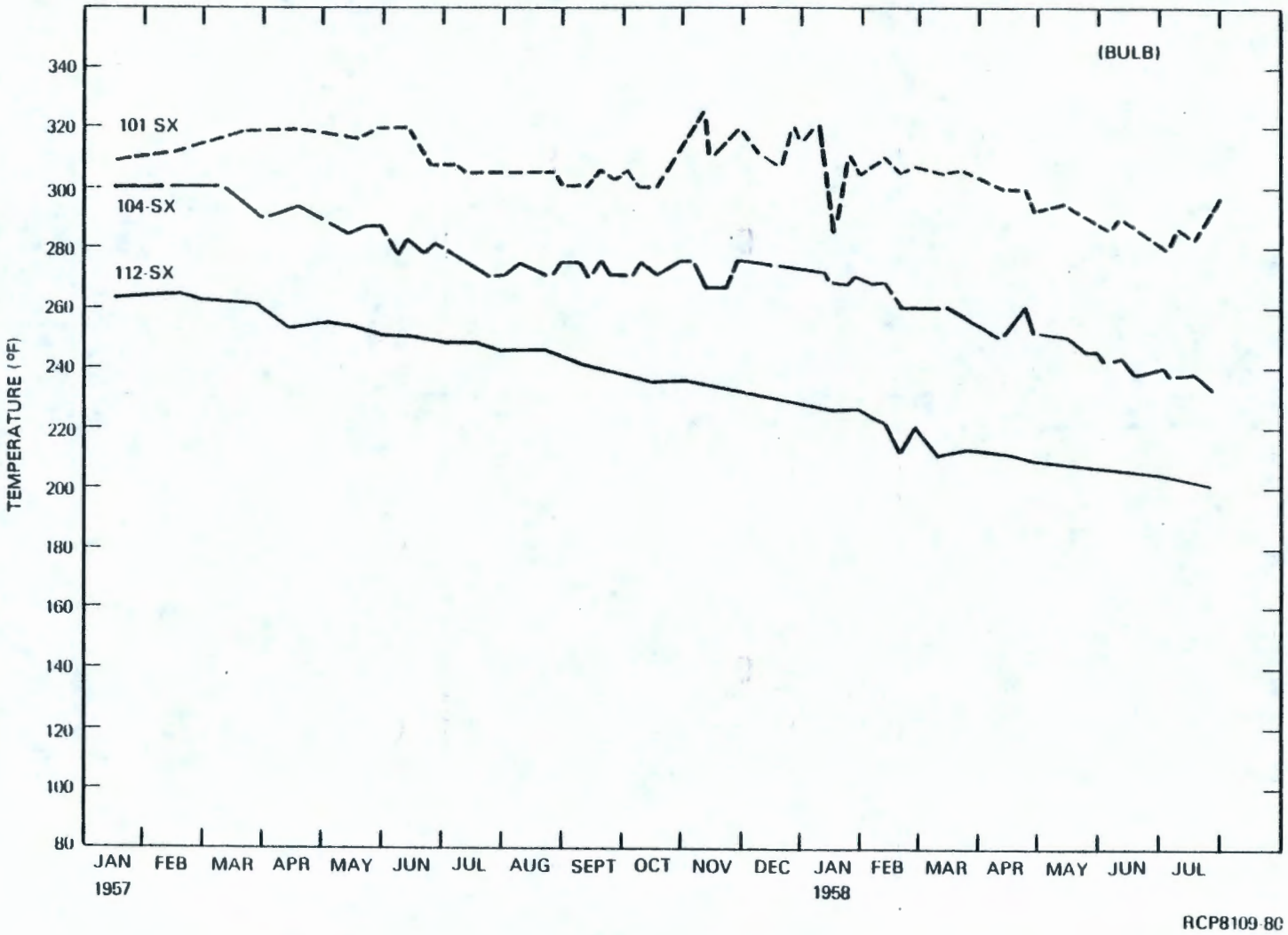

FIGURE B-78. 241-SX-101, -104, and -112 (Bulb Temp.)
January 1957 thru July 1958

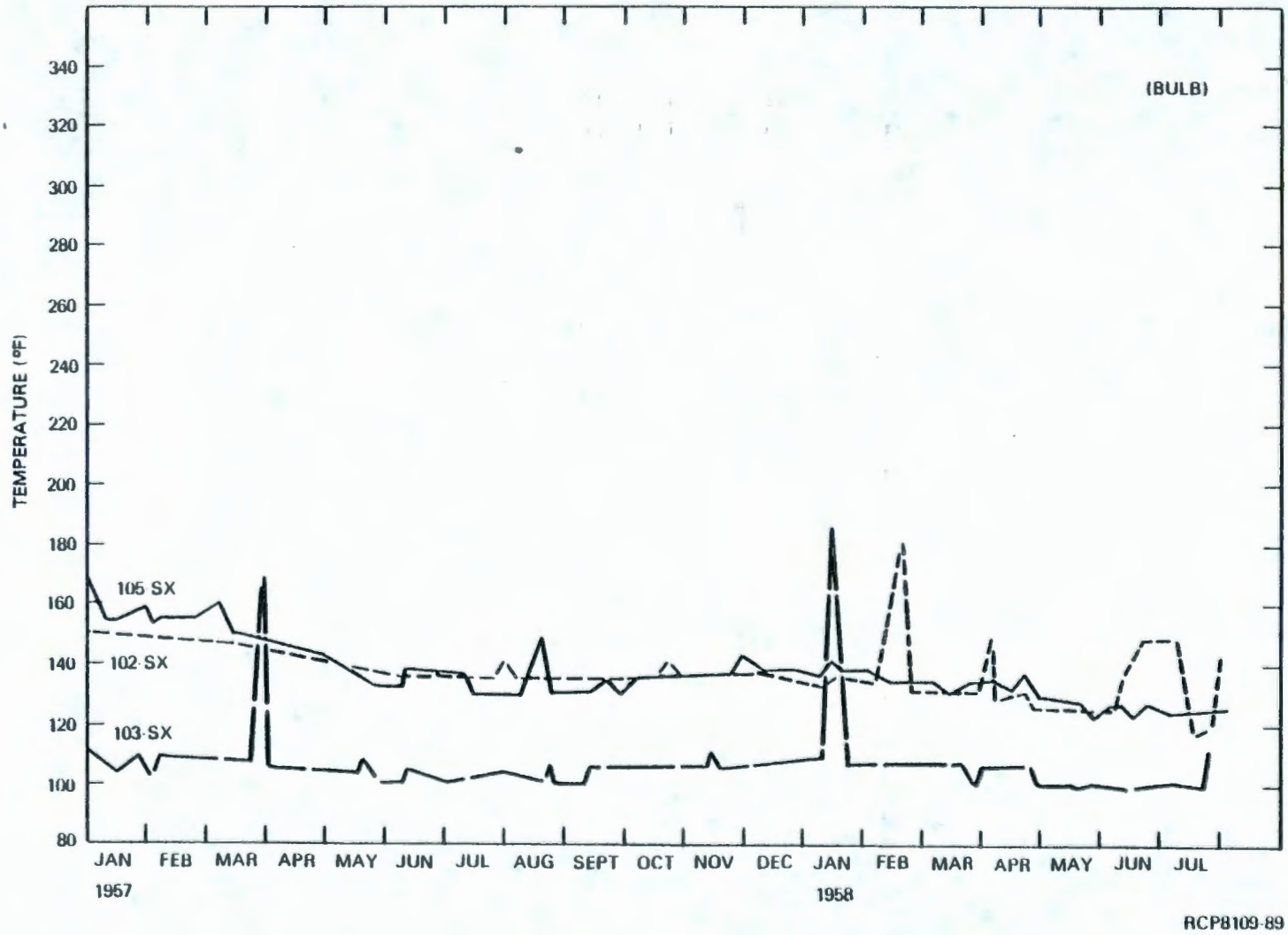

FIGURE B-79. 241-SX-102, -103, and -105 (Bulb Temp.)
January 1957 thru July 1958

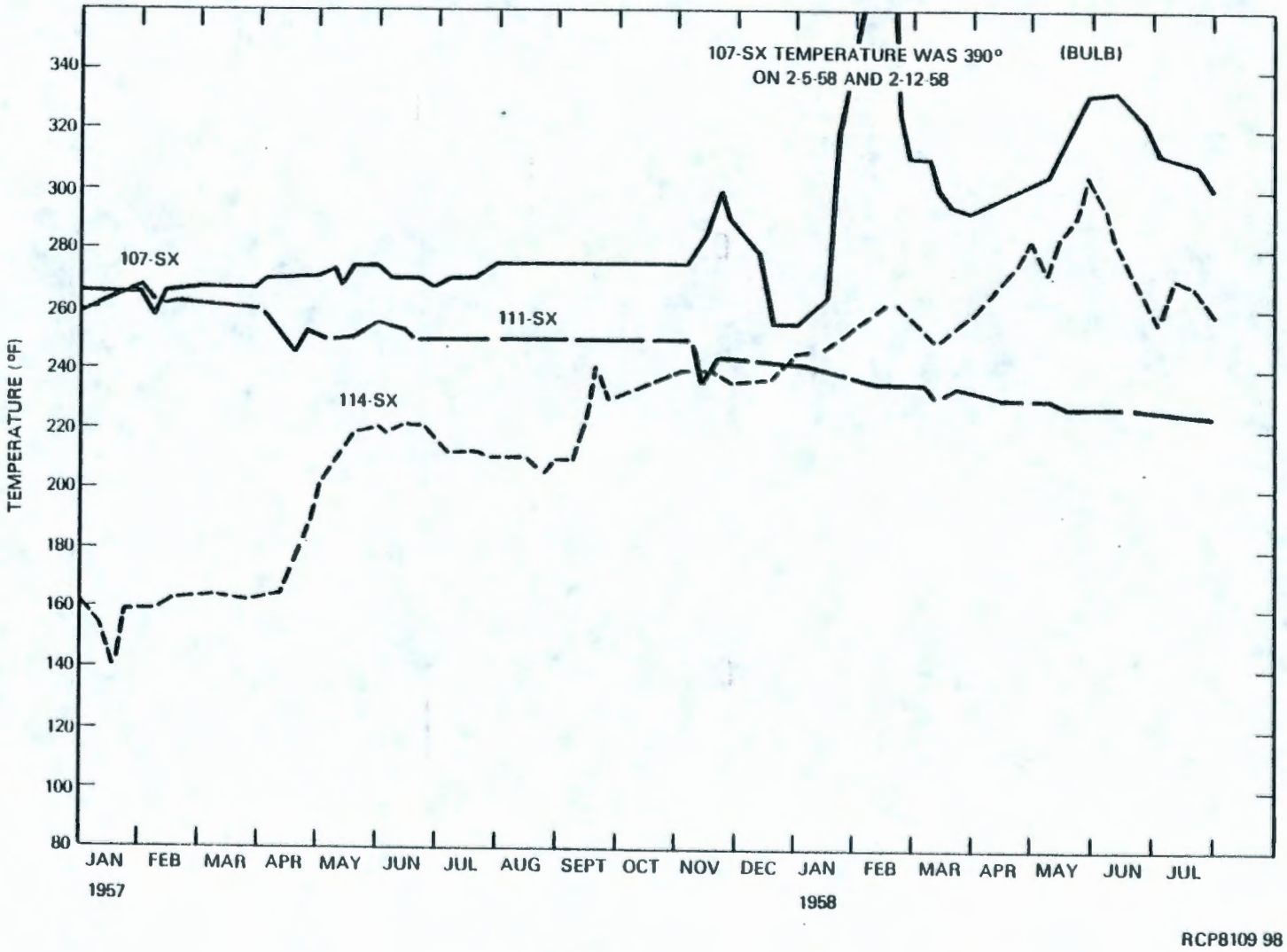

FIGURE B-80. 241-SX-107, -111, and -114 (Bulb Temp.)
January 1957 thru July 1958

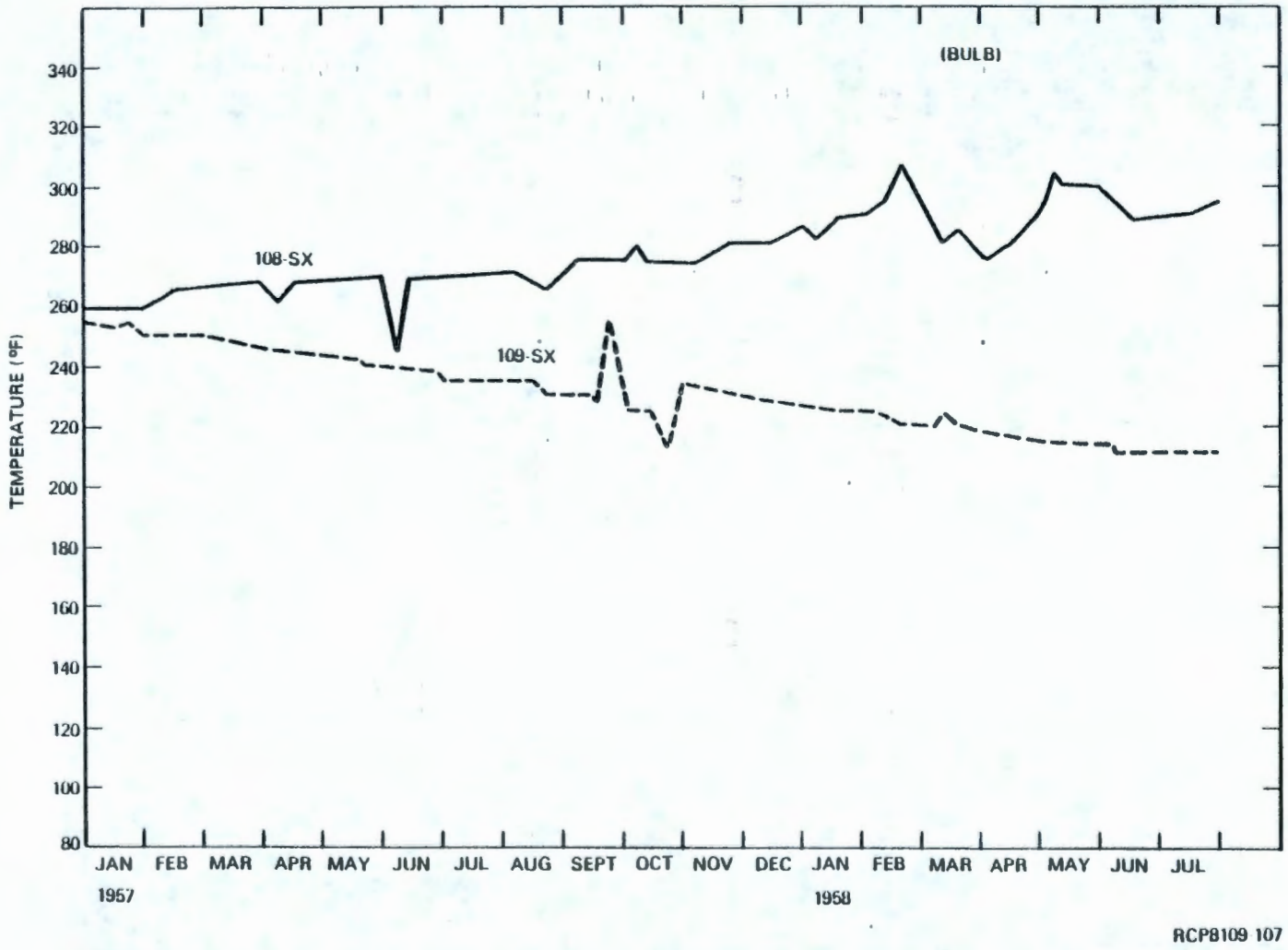

FIGURE B-81. 241-SX-108 and -109 (Bulb Temp.)
January 1957 thru July 1958

T00293

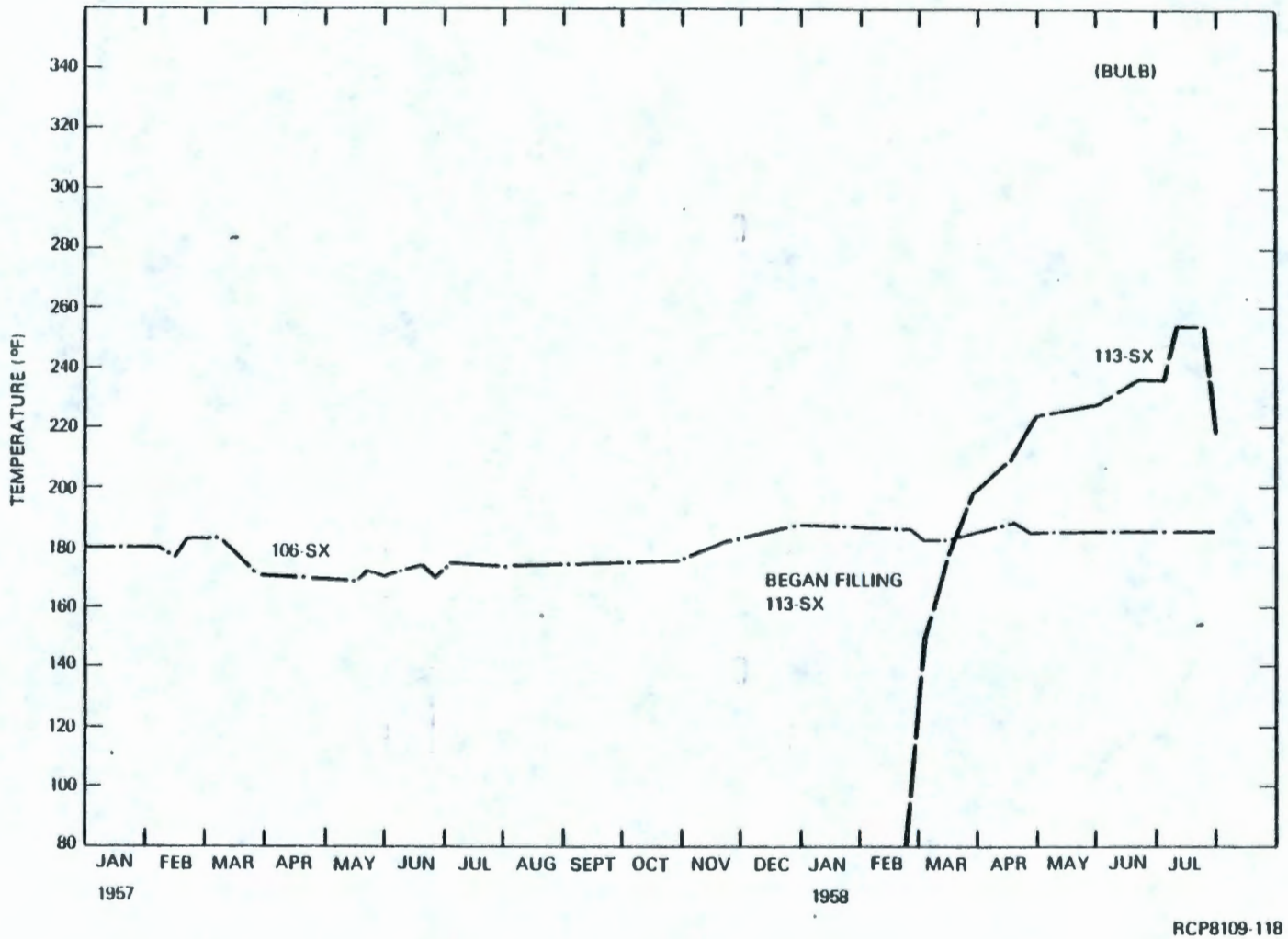

FIGURE B-82. 241-SX-106 and -113 (Bulb Temp.)
January 1957 thru July 1958

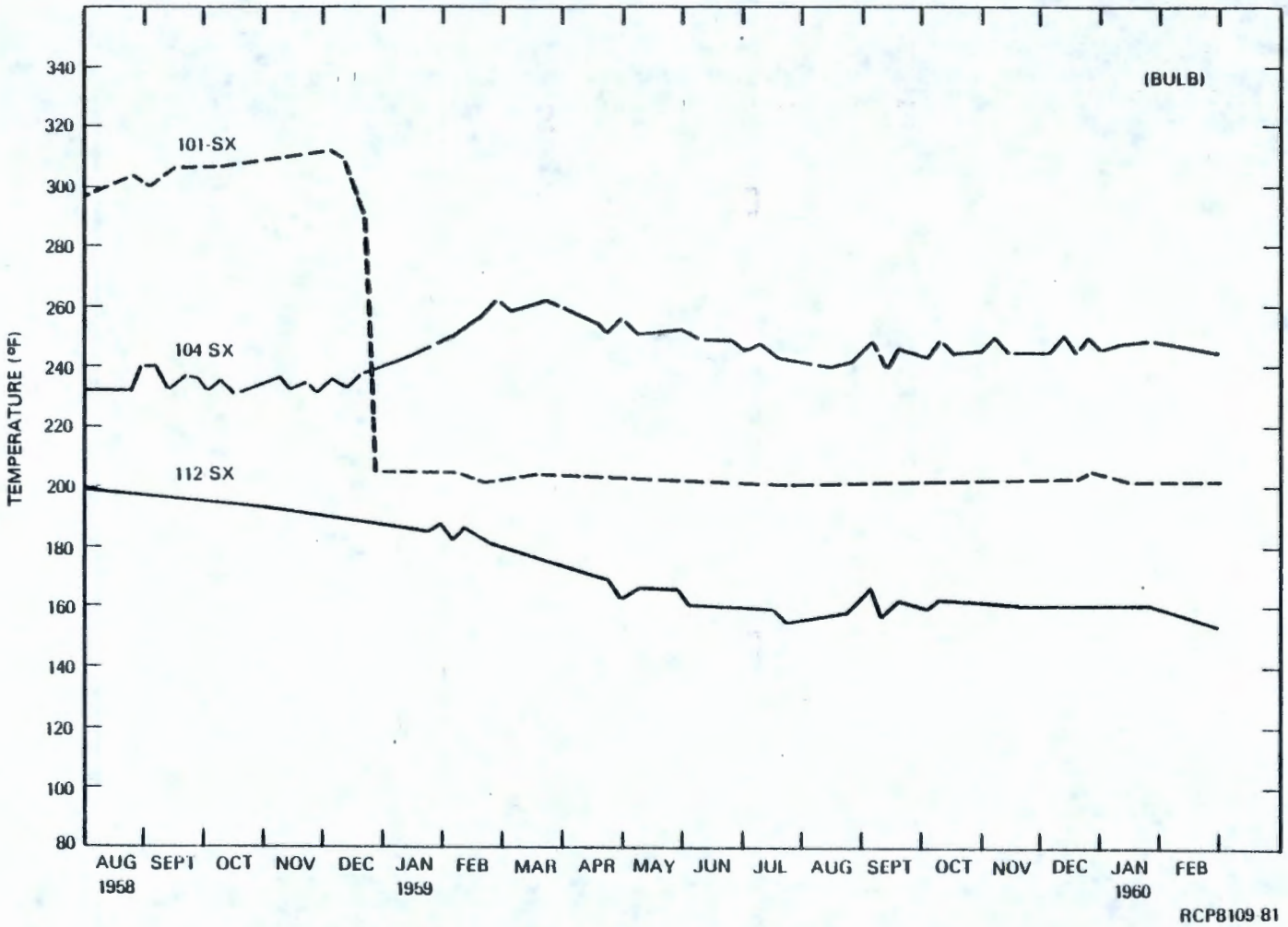

FIGURE B-83. 241-SX-101, -104, and -112 (Bulb Temp.)
August 1958 thru February 1960

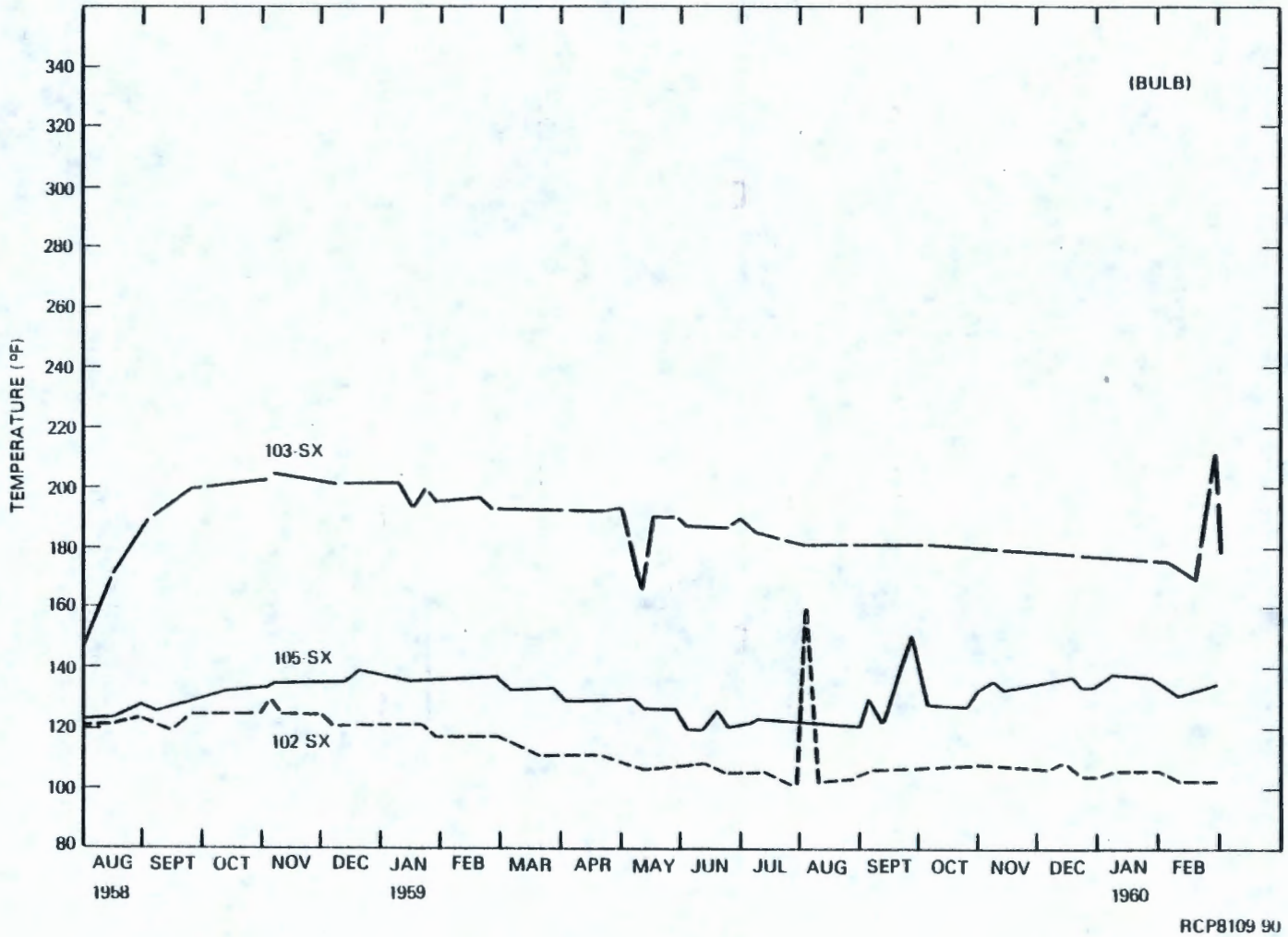

FIGURE B-84. 241-SX-102, -103 and -105 (Bulb Temp.)
August 1958 thru February 1960

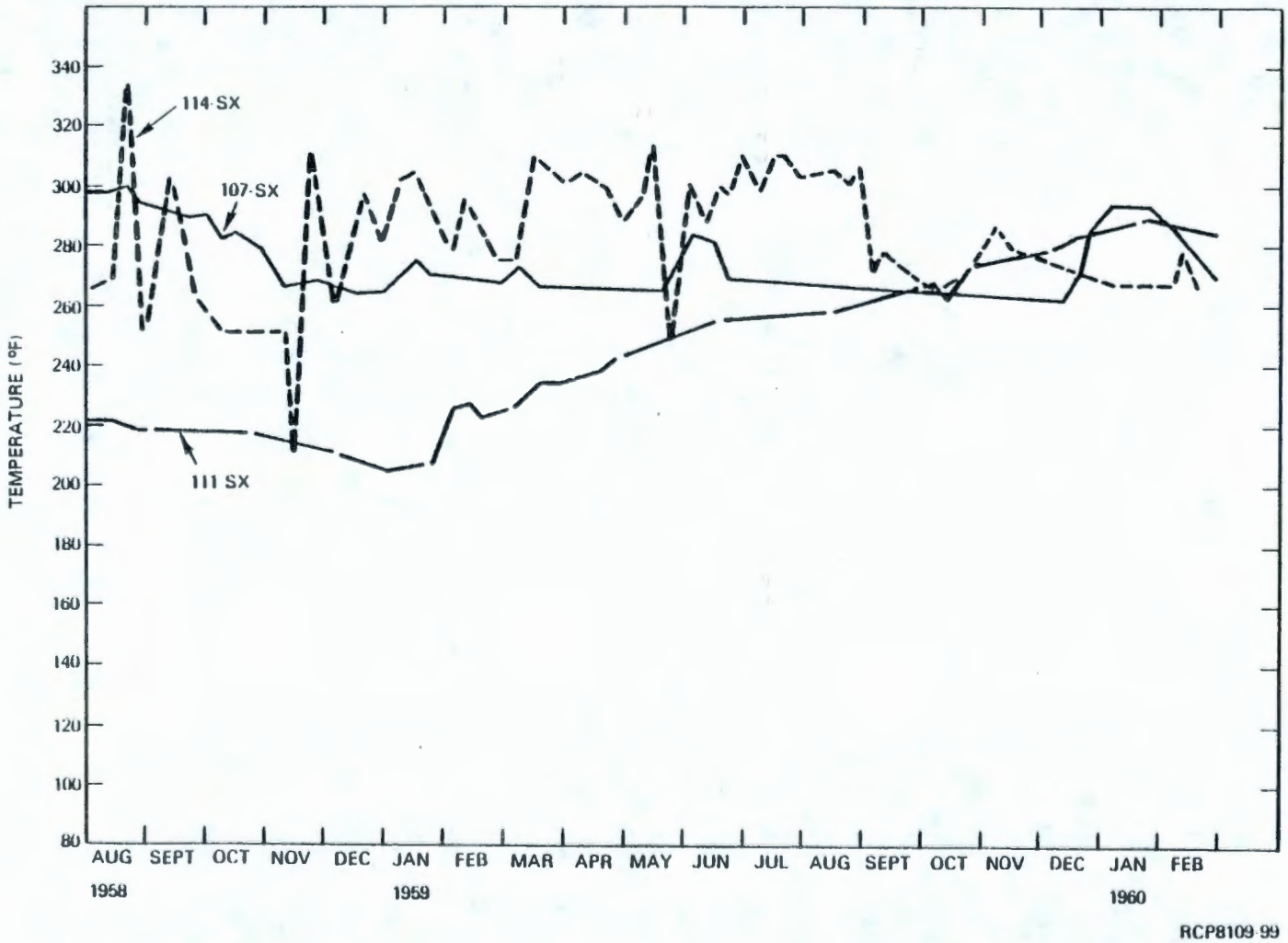

FIGURE B-85. 241-SX-107, -111, and -114 (Bulb Temp.)
August 1958 thru February 1960

T00293

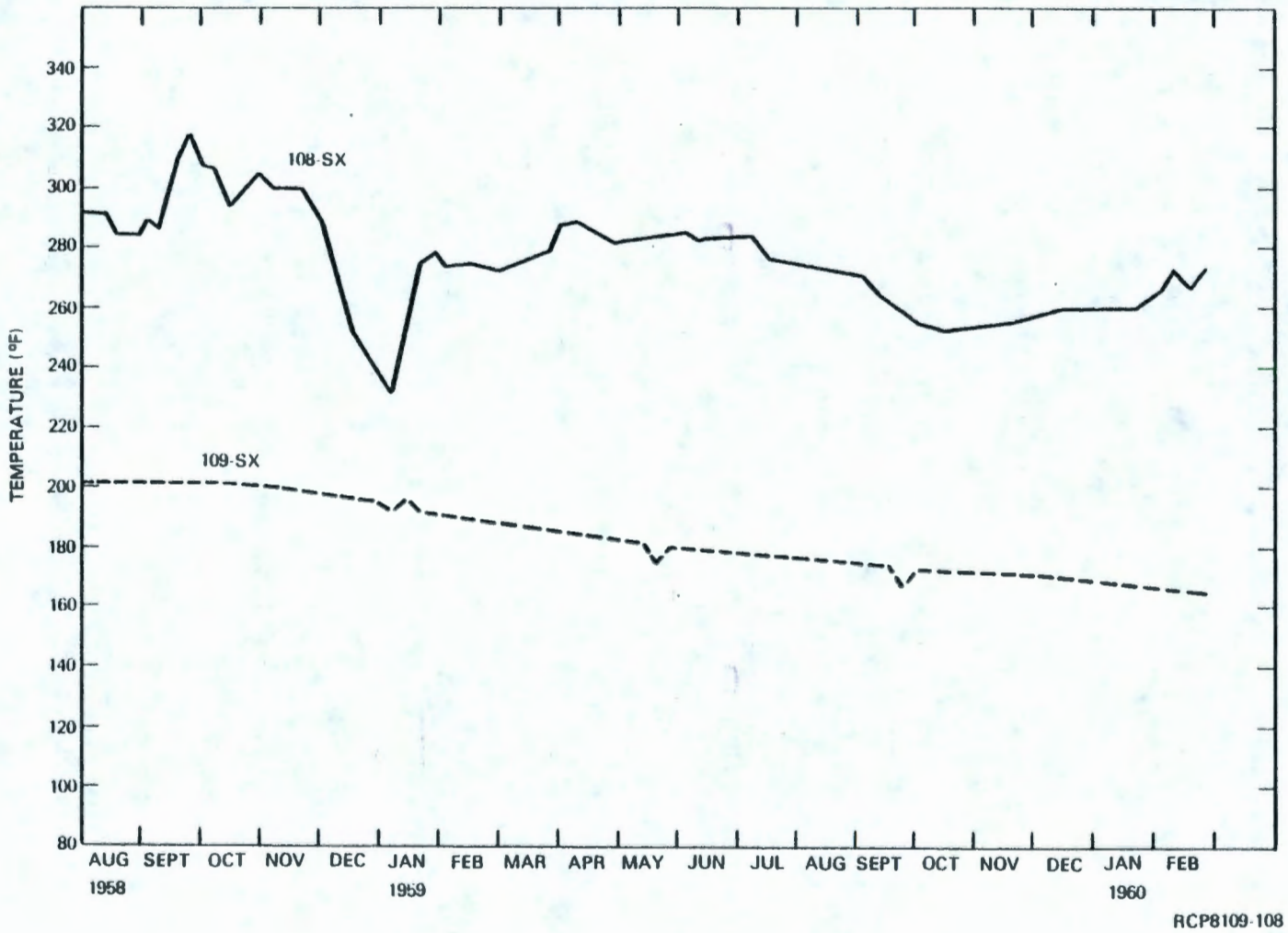

FIGURE B-86. 241-SX-108 and -109 (Bulb Temp.)
August 1958 thru February 1960

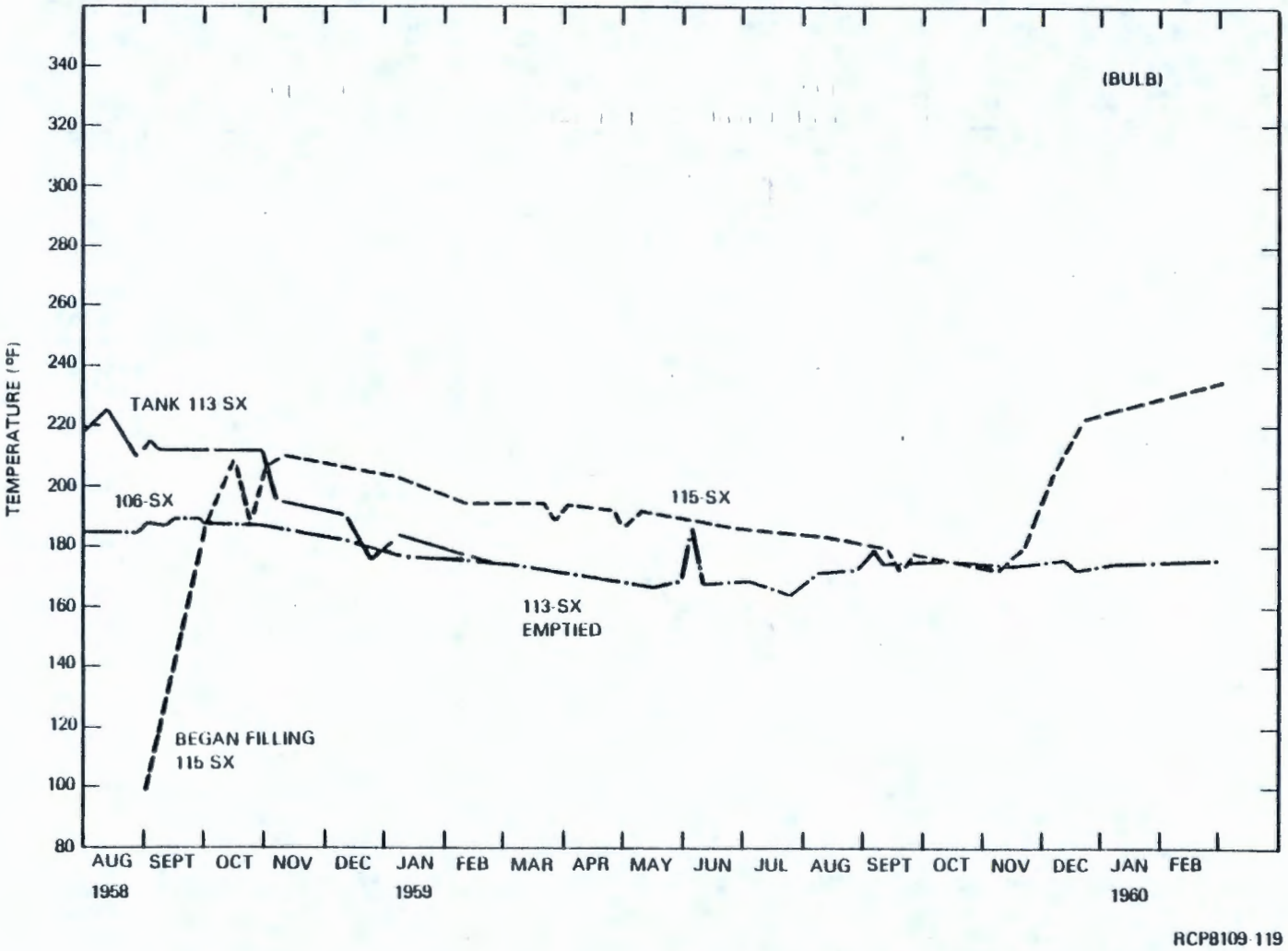

FIGURE B-87. 241-SX-106, -113, and -115 (Bulb Temp.)
August 1958 thru February 1960

T00293

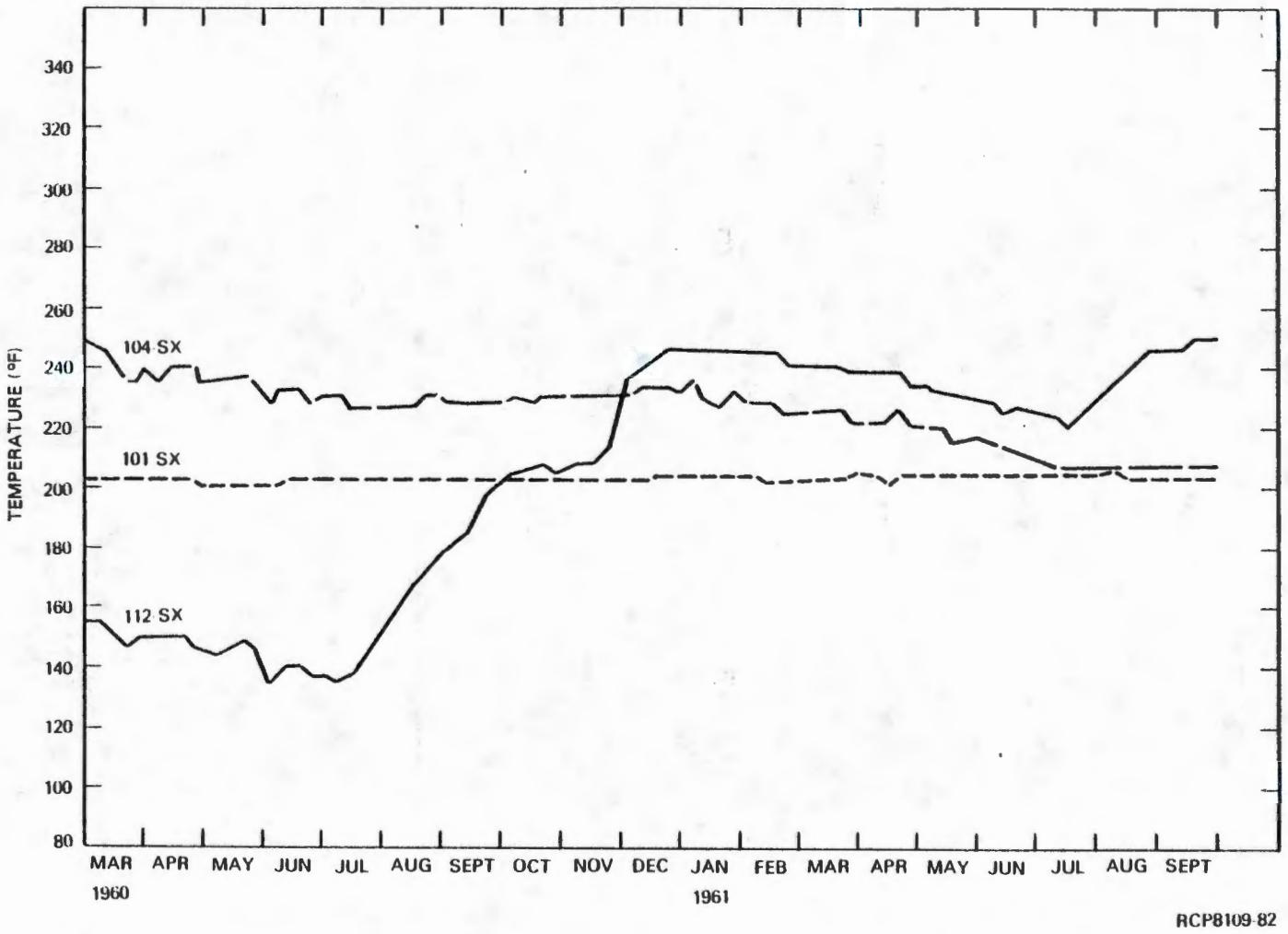

FIGURE B-88. 241-SX-101, -104, and -112 (Bulb Temp.)
March 1960 thru September 1961

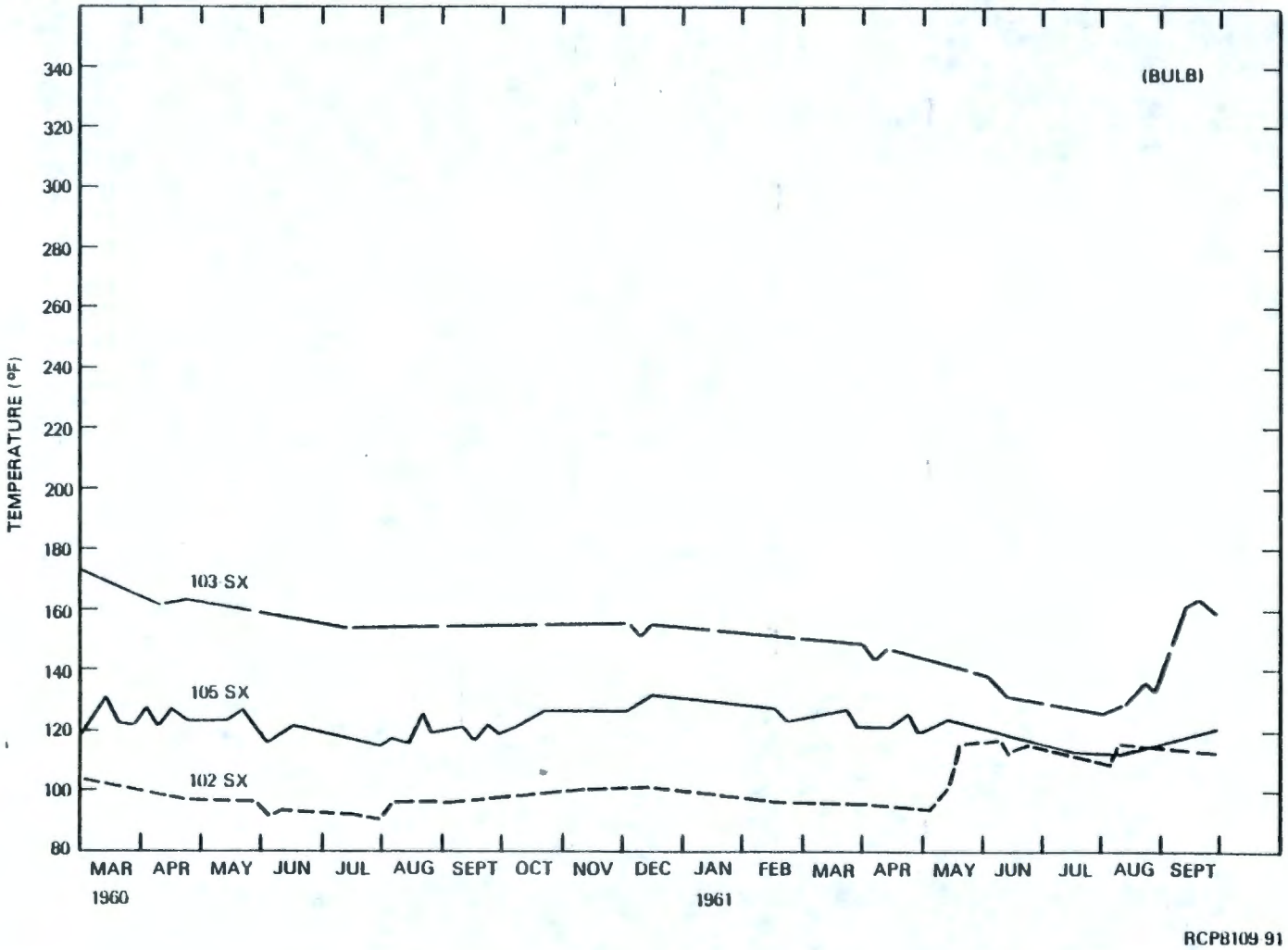

FIGURE B-89. 241-SX-102, -103, and -105 (Bulb Temp.)
March 1960 thru September 1961

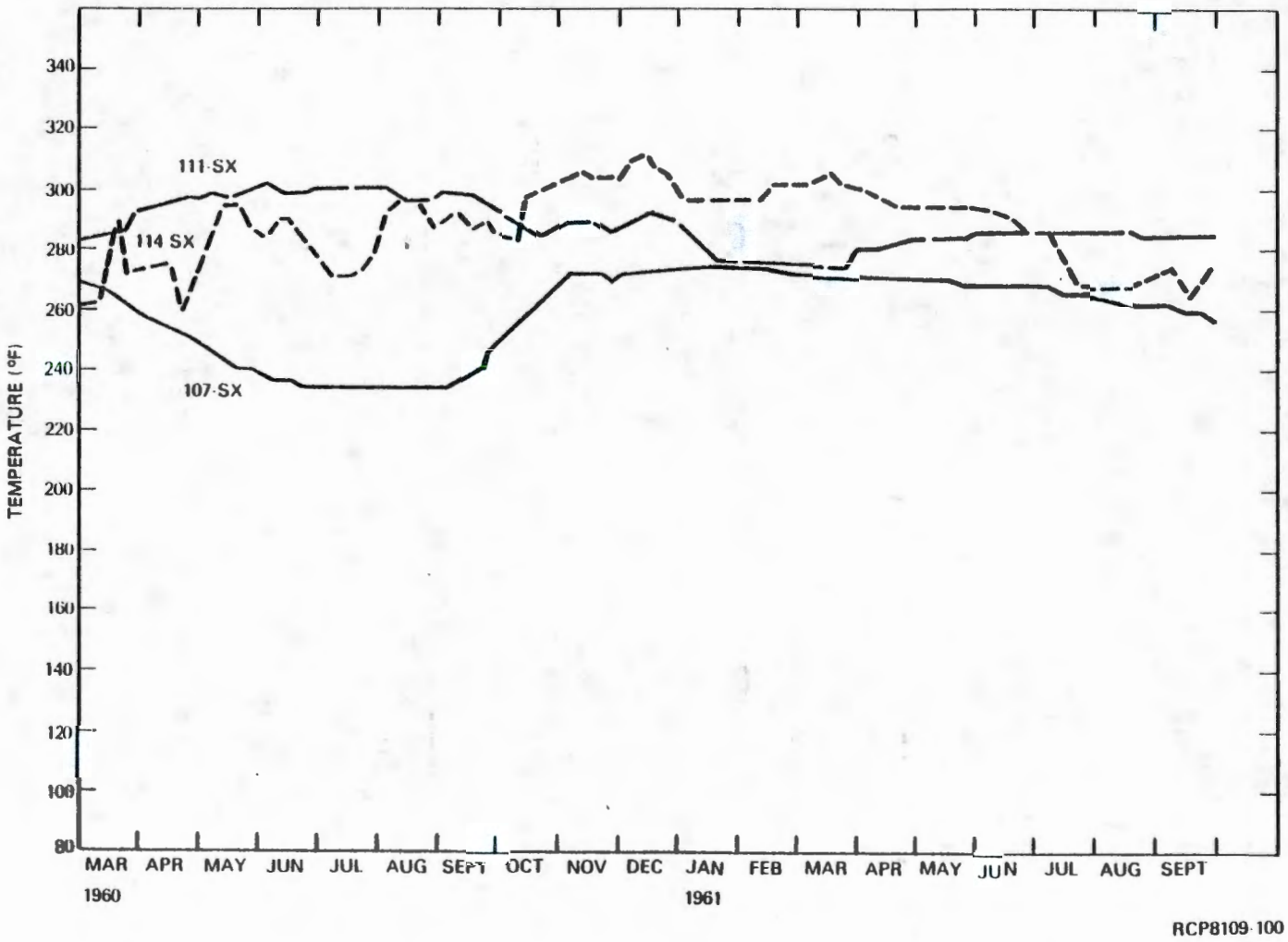

FIGURE B-90. 241-SX-107, -111, and -114 (Bulb Temp.)
March 1960 thru September 1961

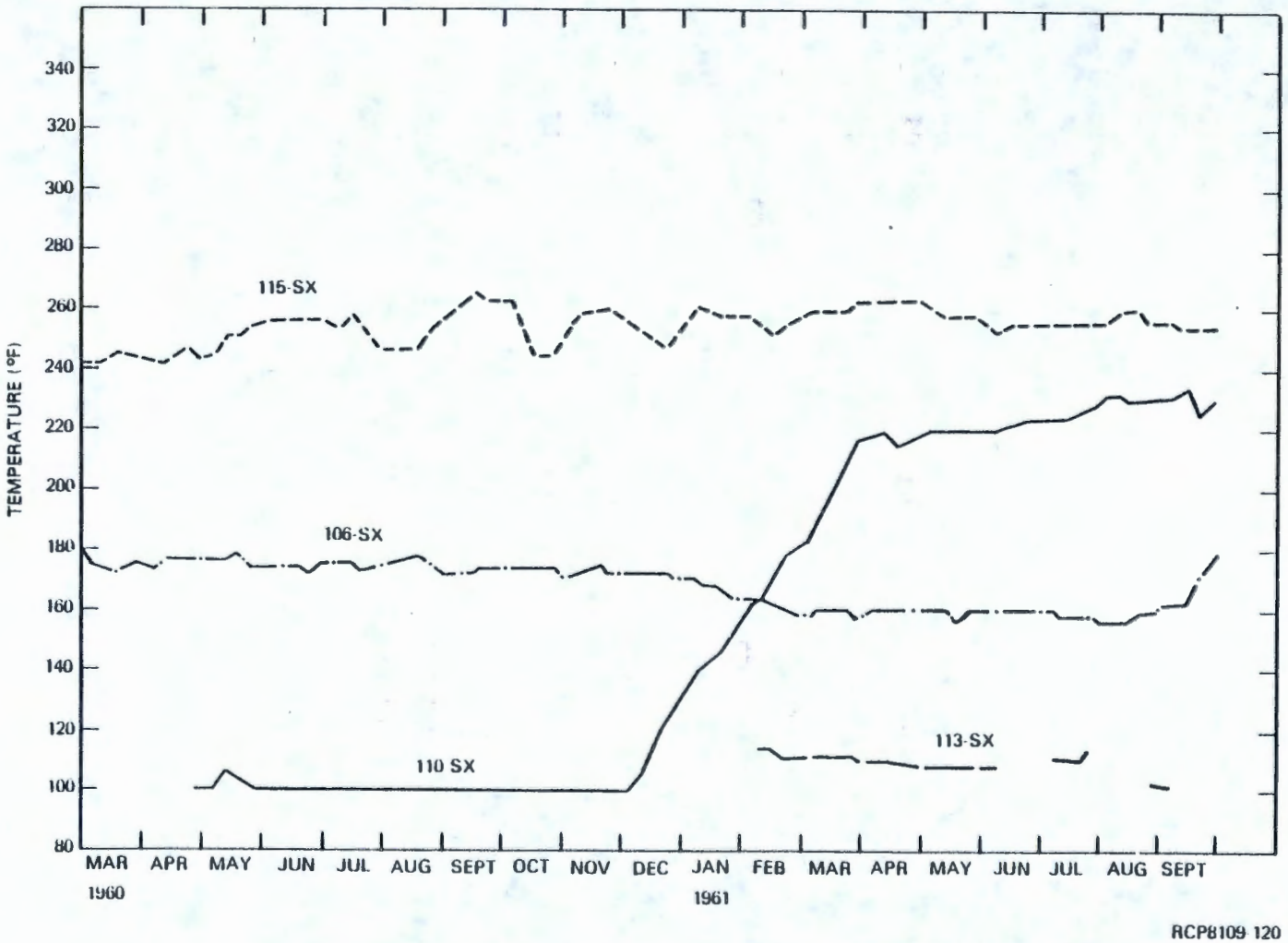

FIGURE B-91. 241-SX-106, -110, -113, and -115 (Bulb Temp.)
March 1960 thru September 1961

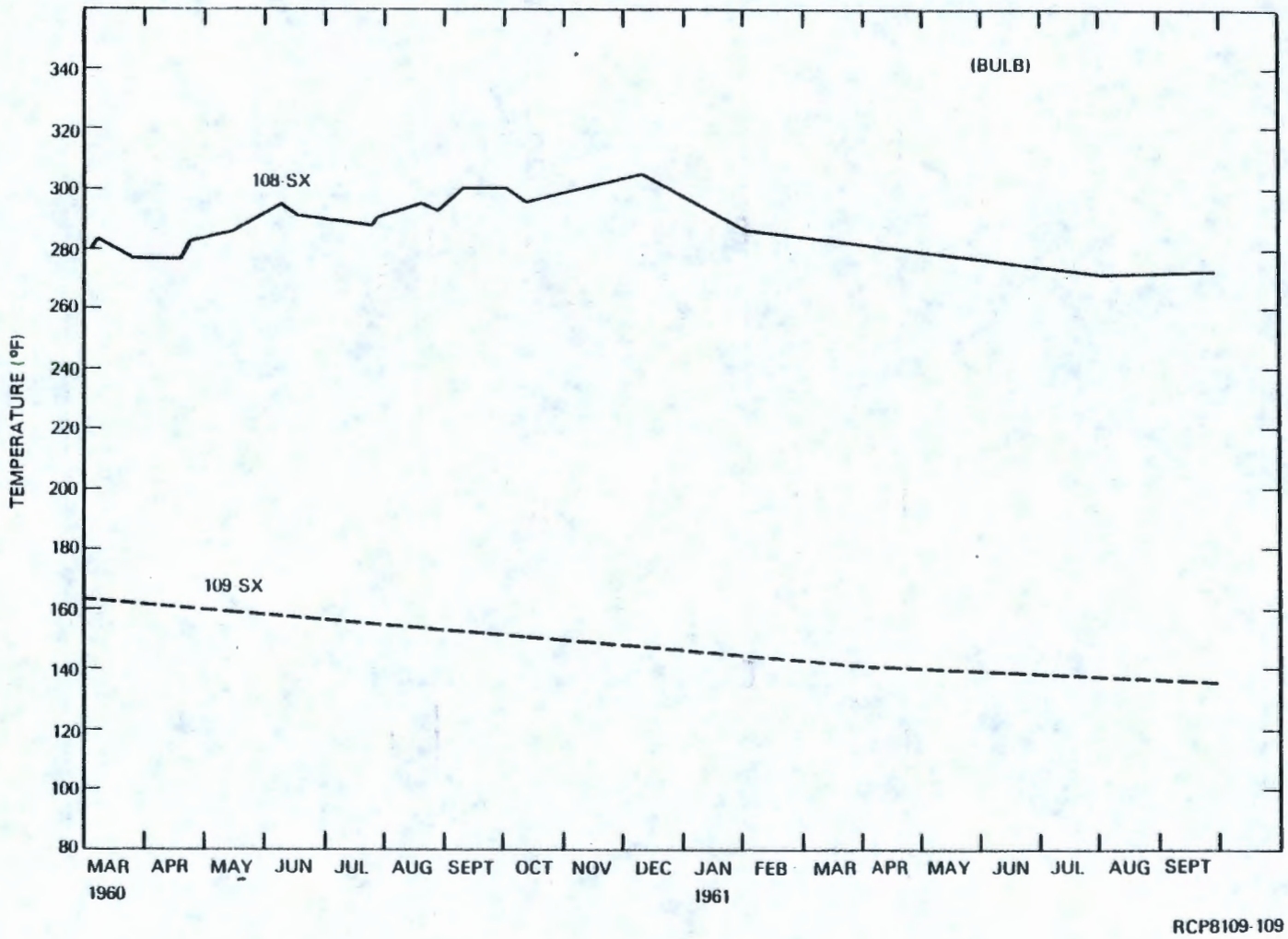

FIGURE B-92. 241-SX-108 and -109 (Bulb Temp.)
March 1960 thru September 1961

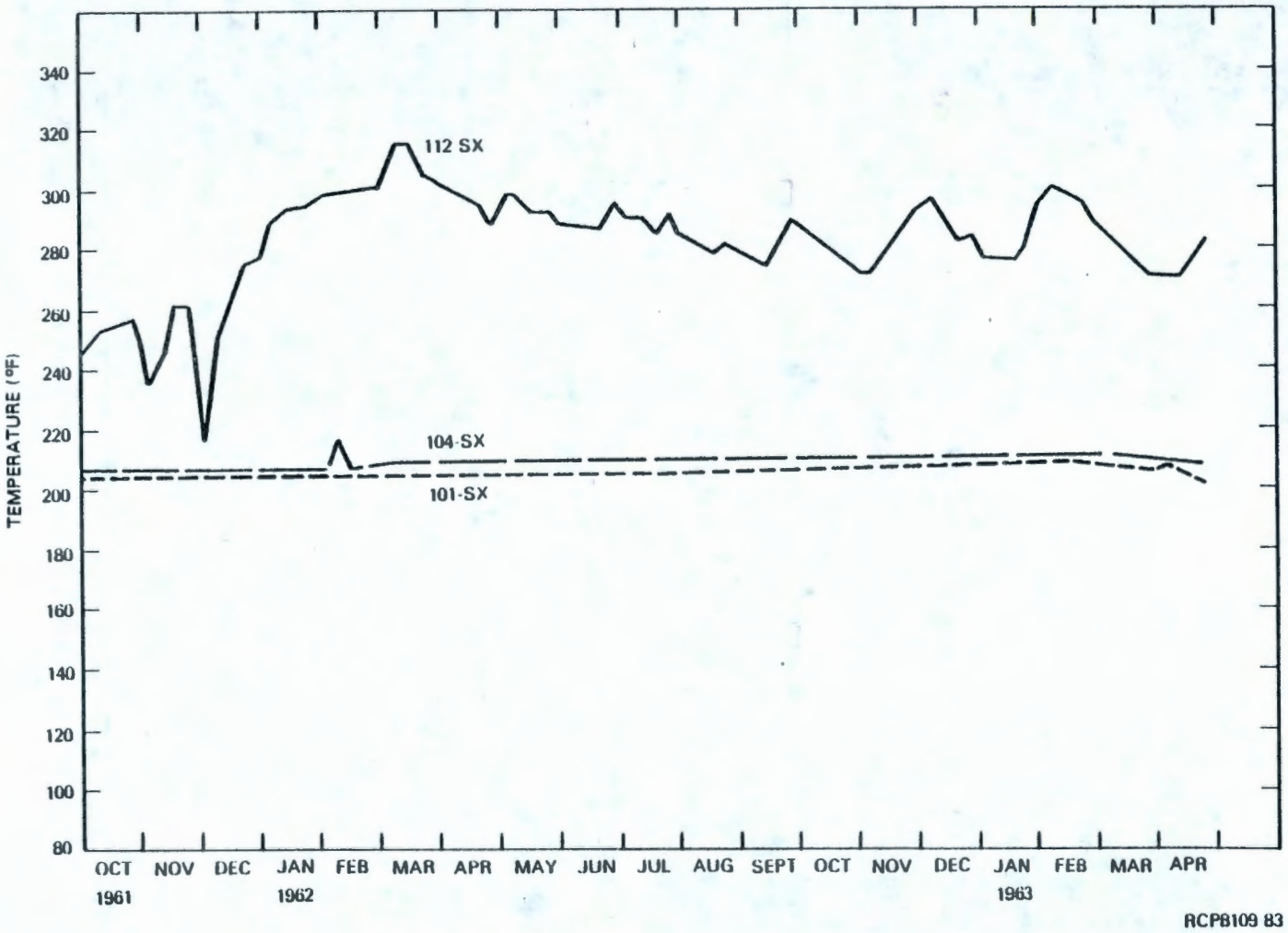

FIGURE B-93. 241-SX-101, -104, and -112 (Bulb Temp.)
October 1961 thru April 1963

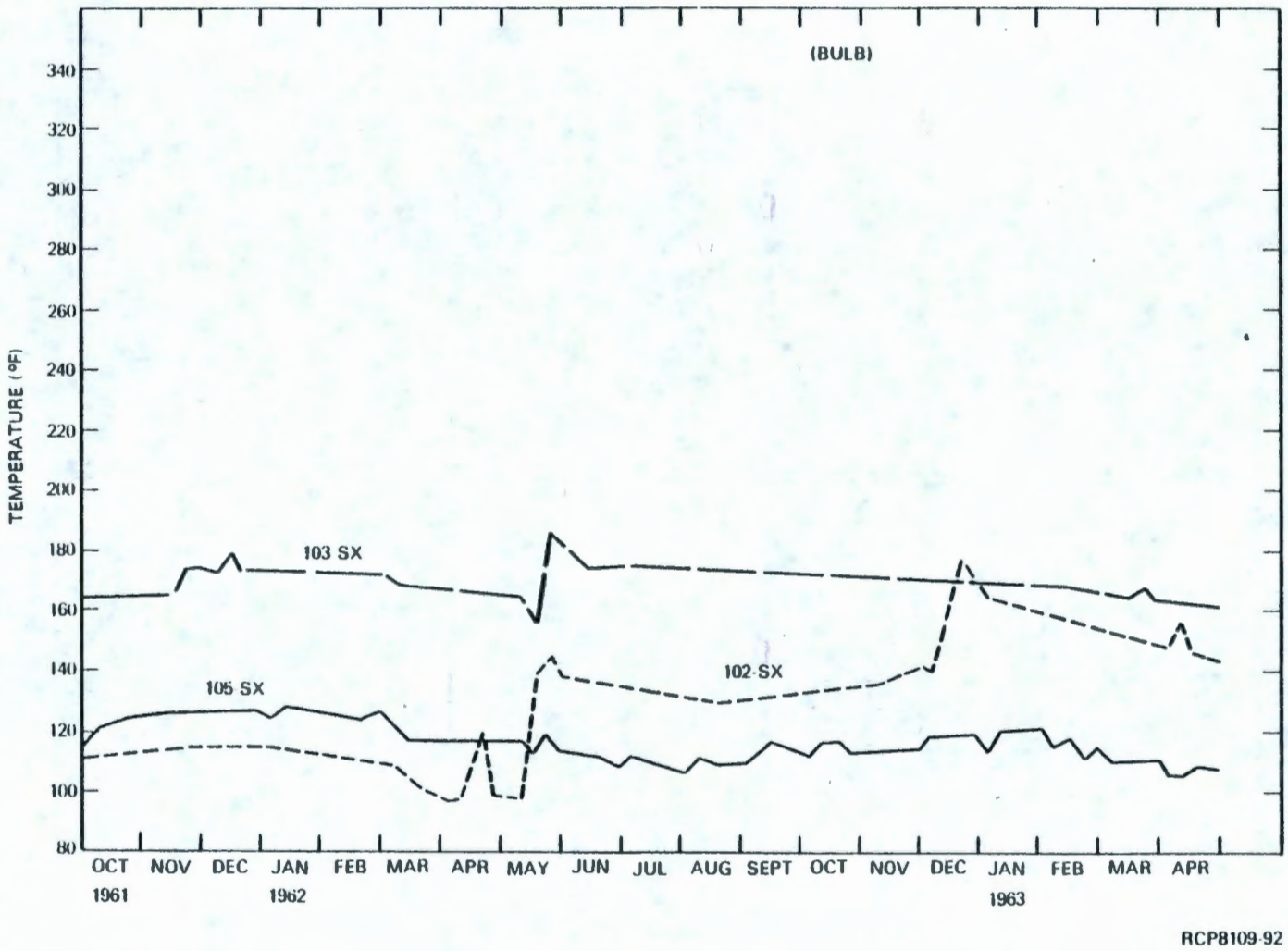

FIGURE B-94. 241-SX-102, -103, and -105 (Bulb Temp.)
October 1961 thru April 1963

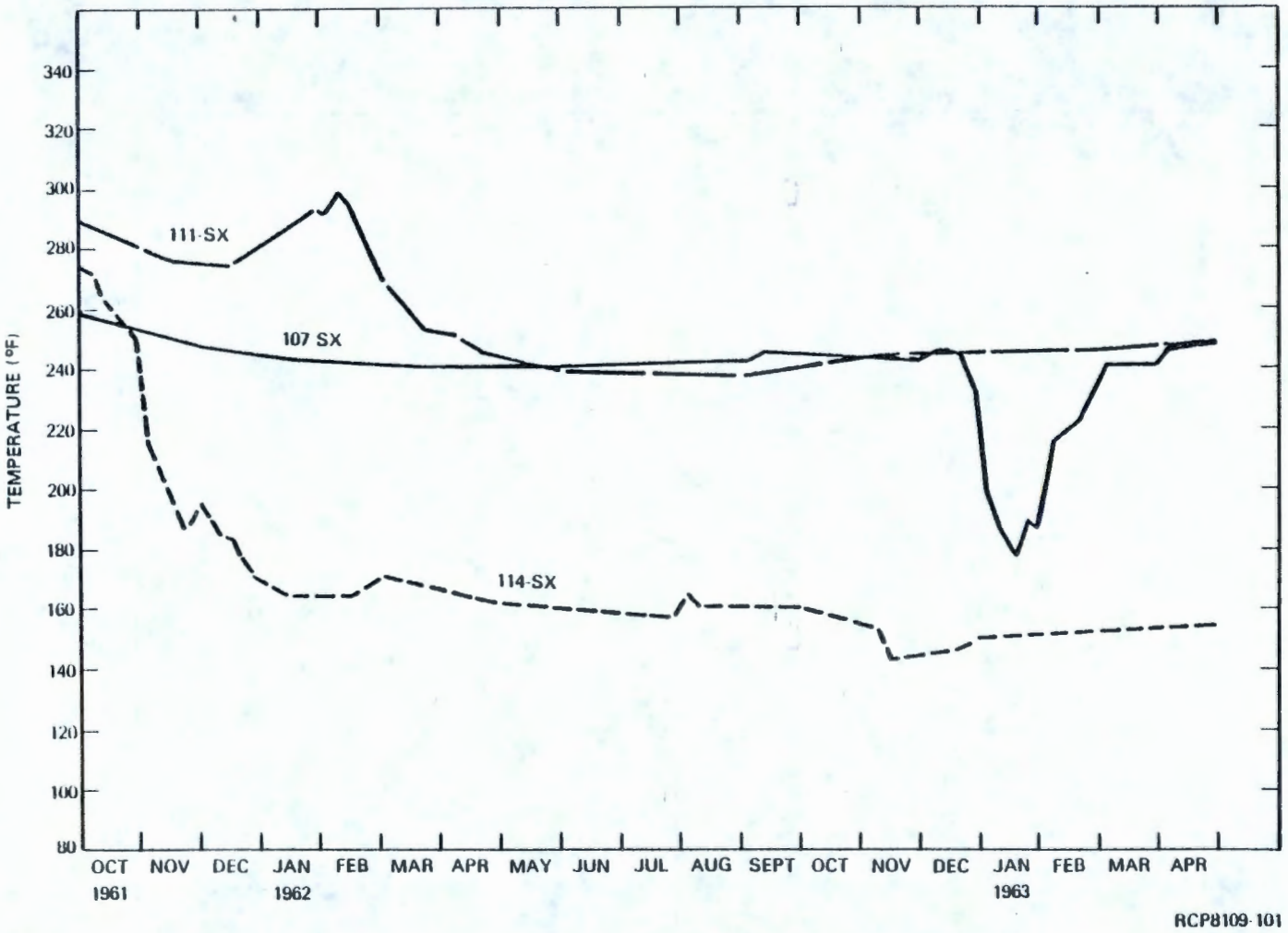

FIGURE B-95. 241-SX-107, -111, and -114 (Bulb Temp.)
October 1961 thru April 1963

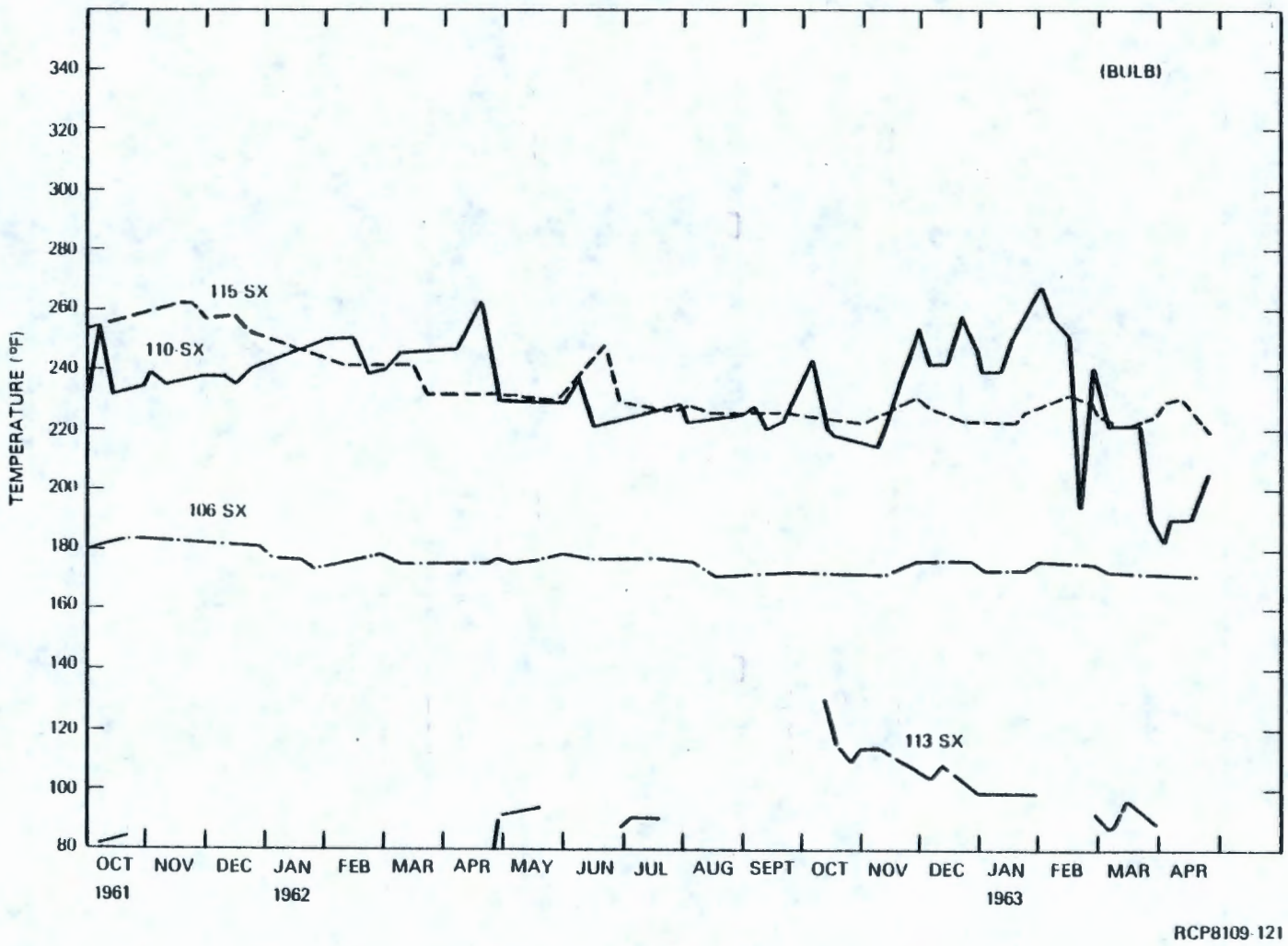

FIGURE B-96. 241-SX-106, -110, -113, and -115 (Bulb Temp.)
October 1961 thru April 1963

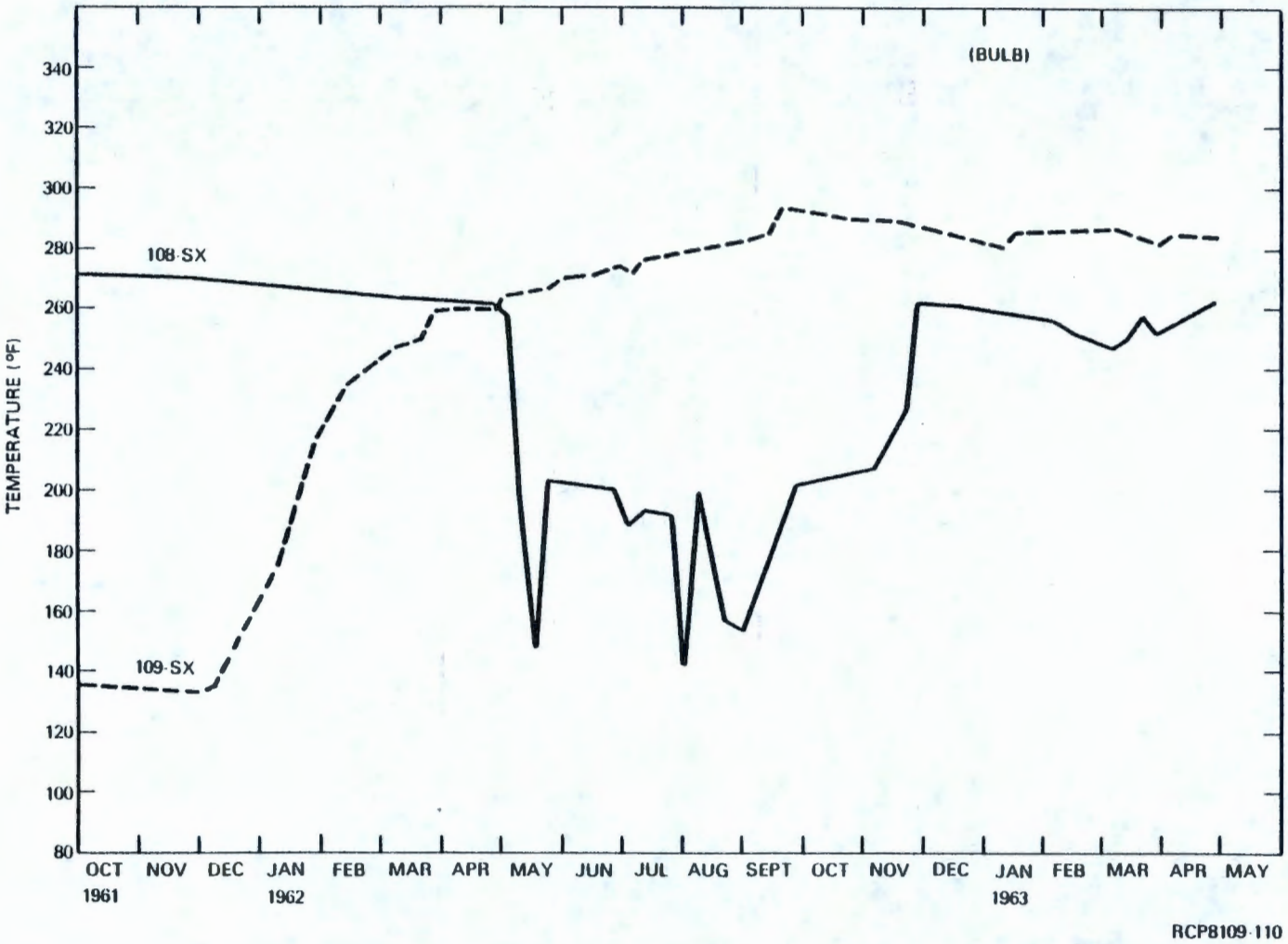

FIGURE B-97. 241-SX-108 and -109 (Bulb Temp.)
October 1961 thru May 1963

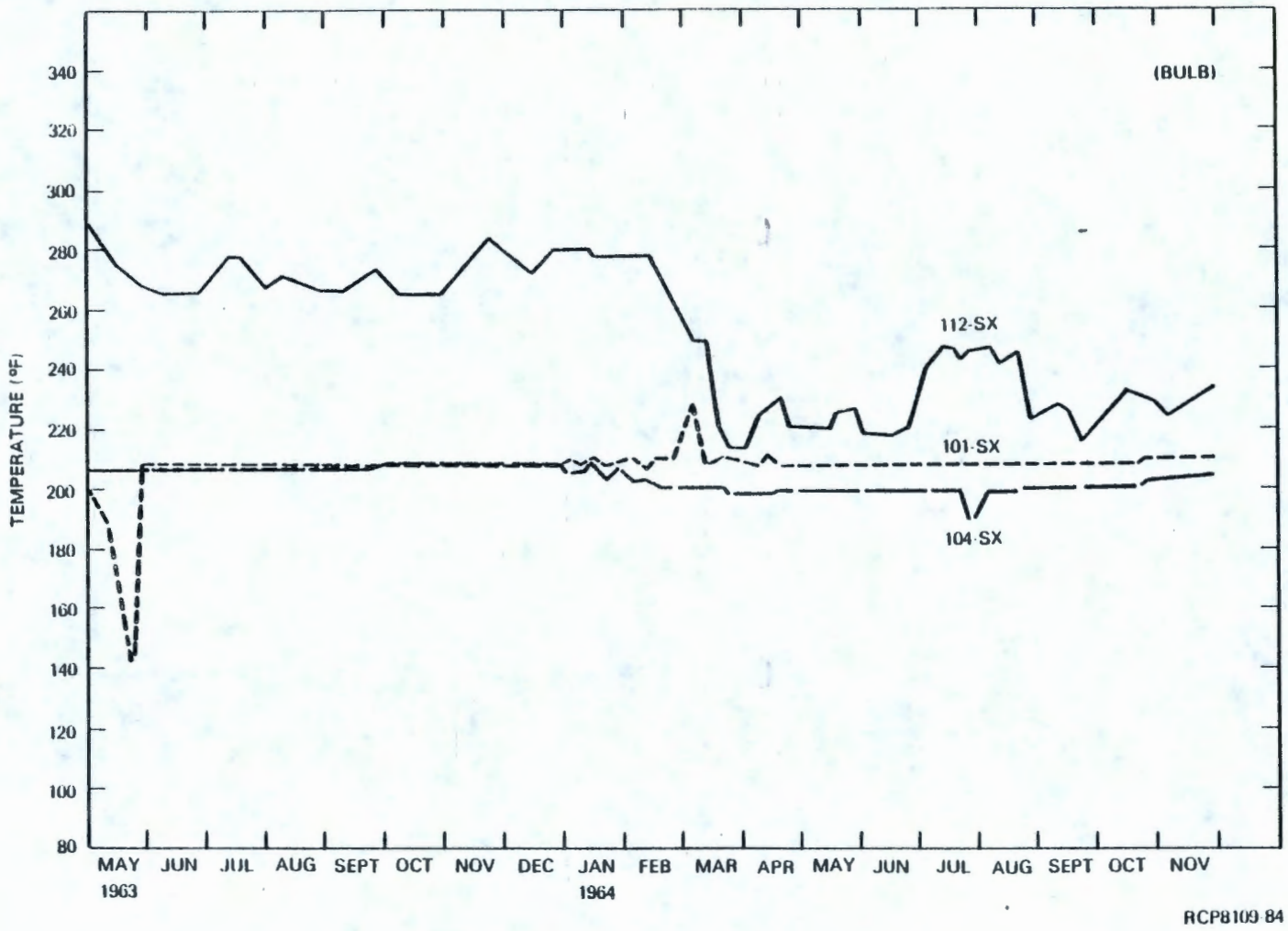

FIGURE B-98. 241-SX-101, -104, and -112 (Bulb Temp.)
May 1963 thru November 1964

T00293

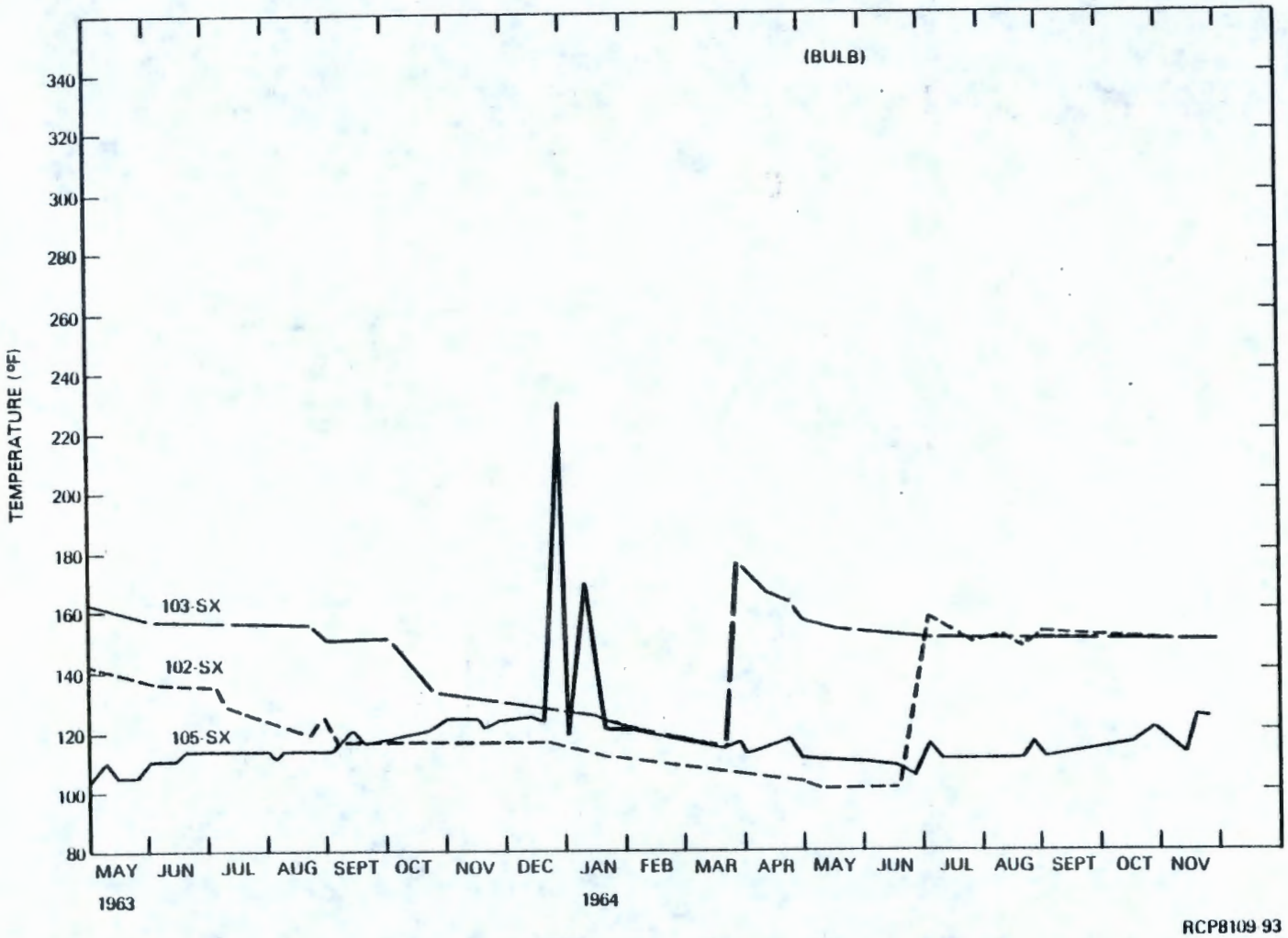

FIGURE B-99. 241-SX-102, -103, and -105 (Bulb Temp.)
May 1963 thru November 1964

T00293

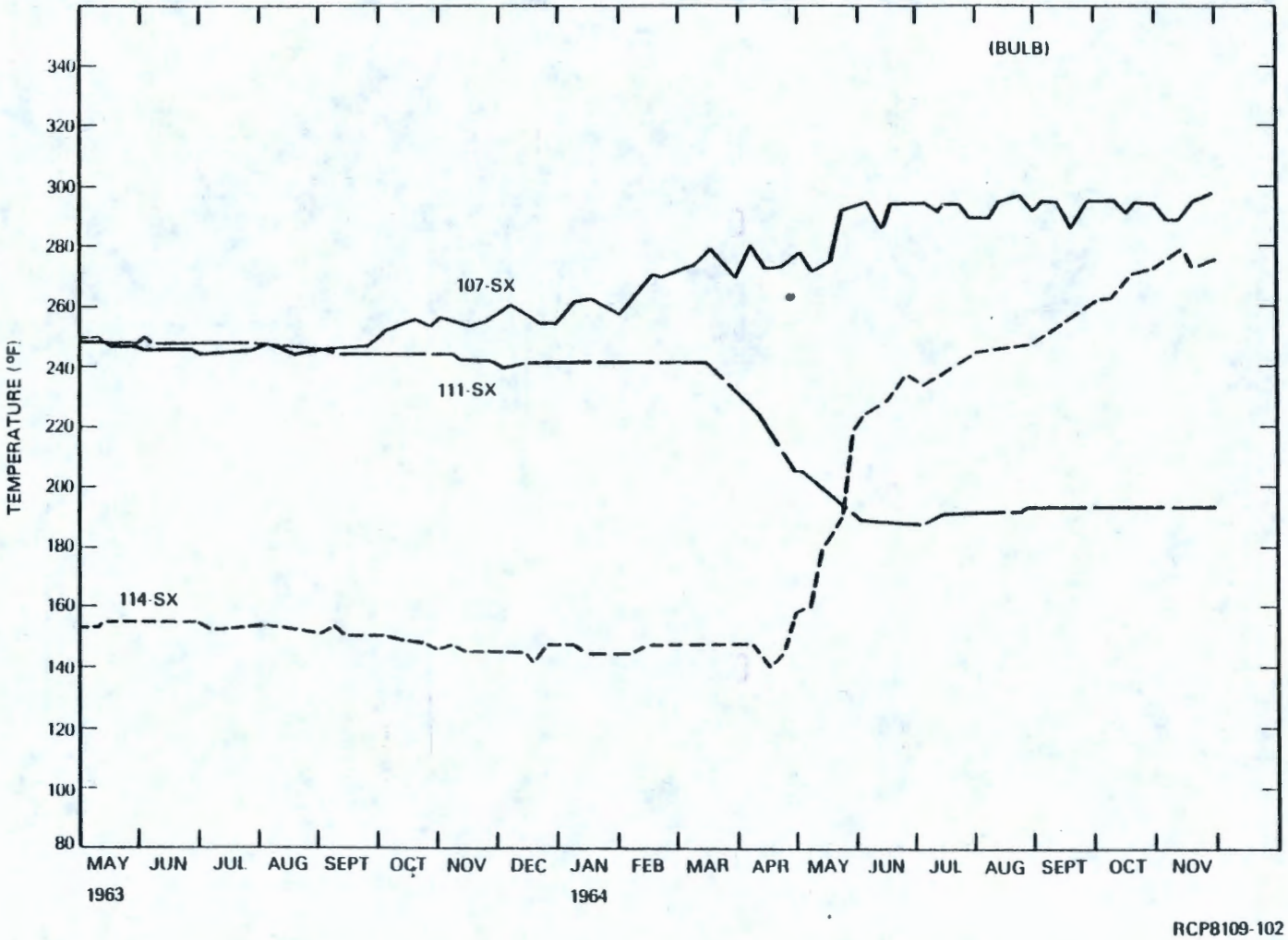

FIGURE B-100. 241-SX-107, -111, and -114 (Bulb Temp.)
May 1963 thru November 1964

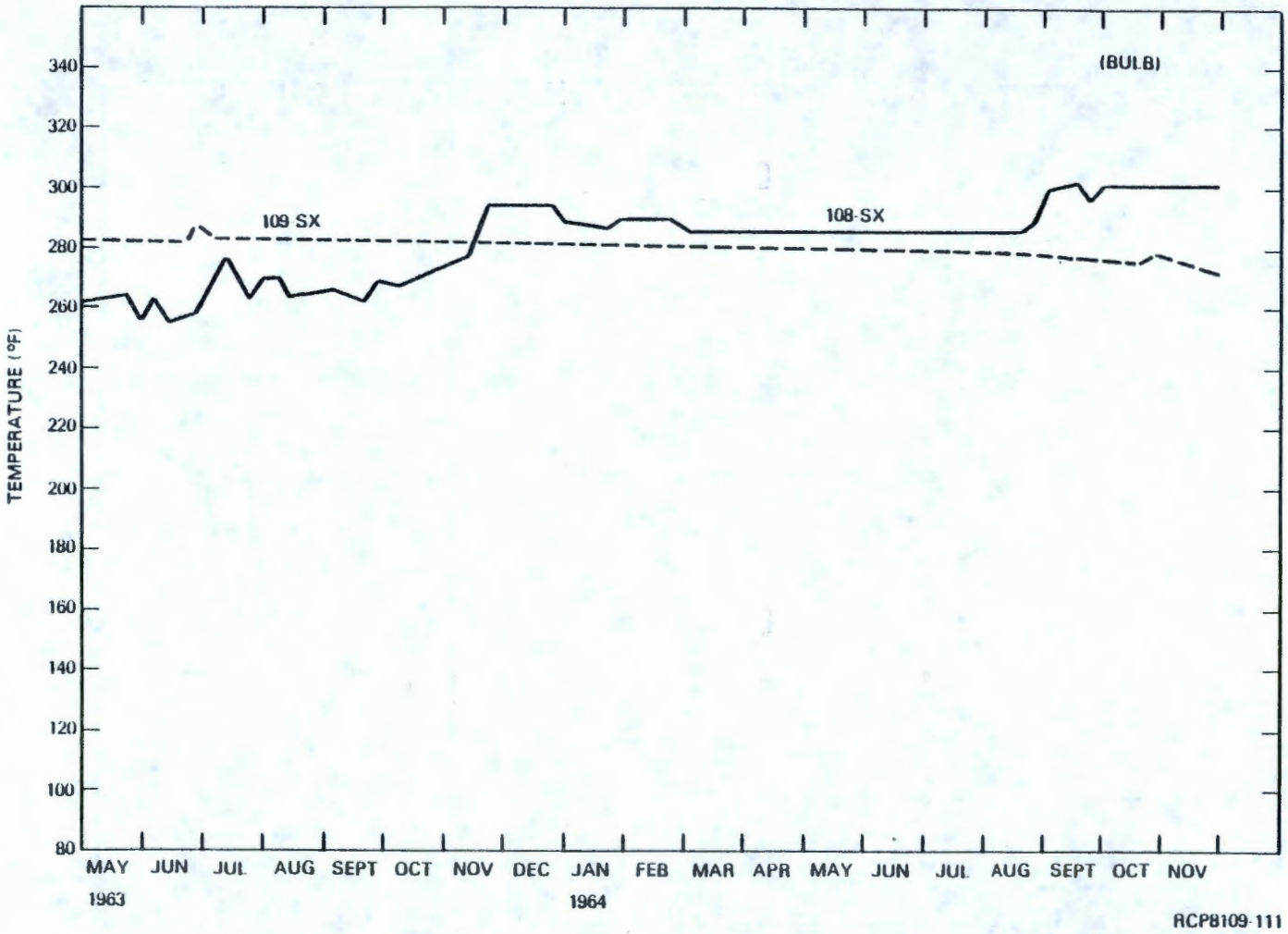

FIGURE B-101. 241-SX-108 and -109 (Bulb Temp.)
May 1963 thru November 1964

T00293

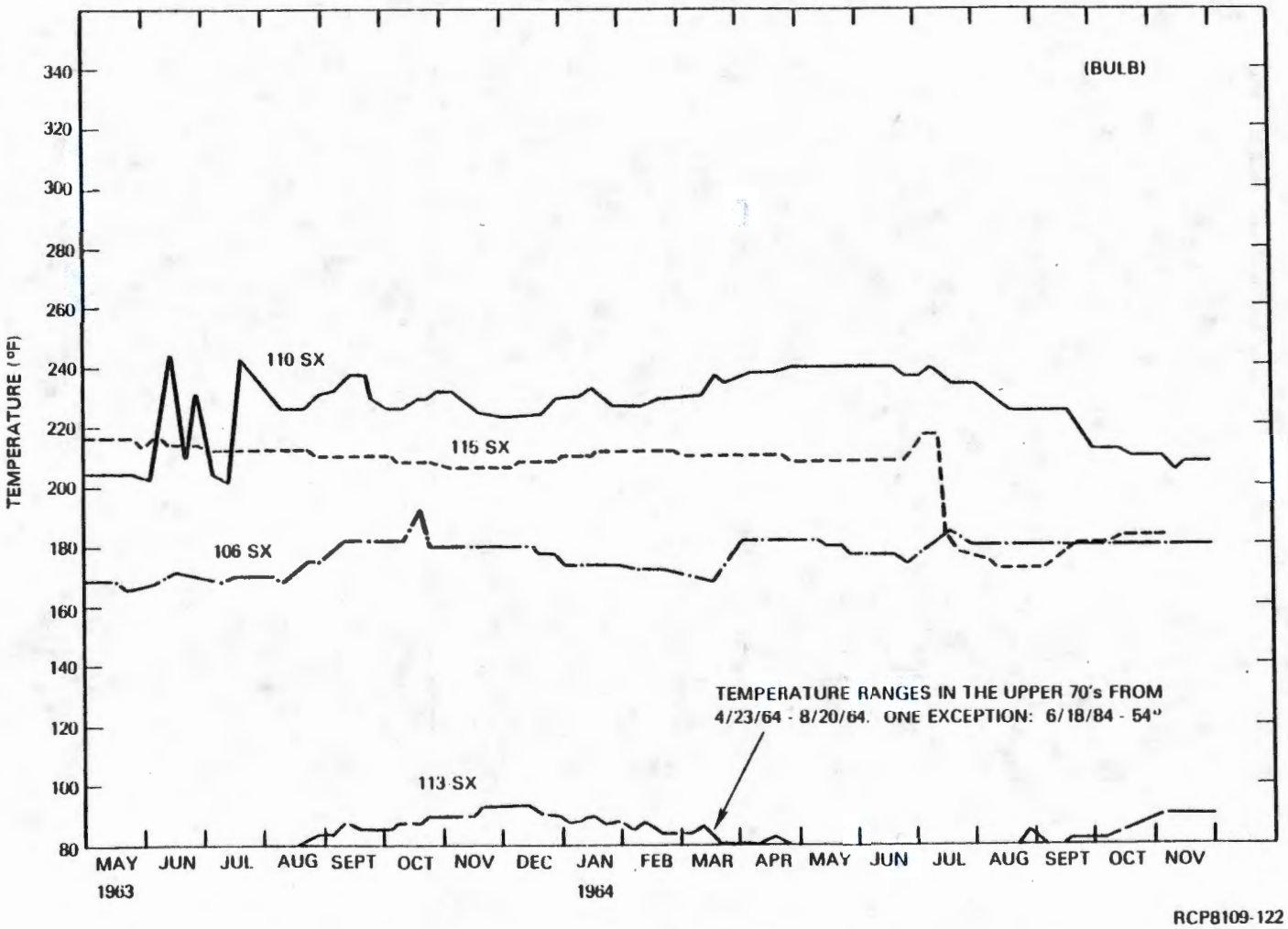

FIGURE B-102. 241-SX-106, -110, -113, and -115 (Bulb Temp.)
May 1963 thru November 1964

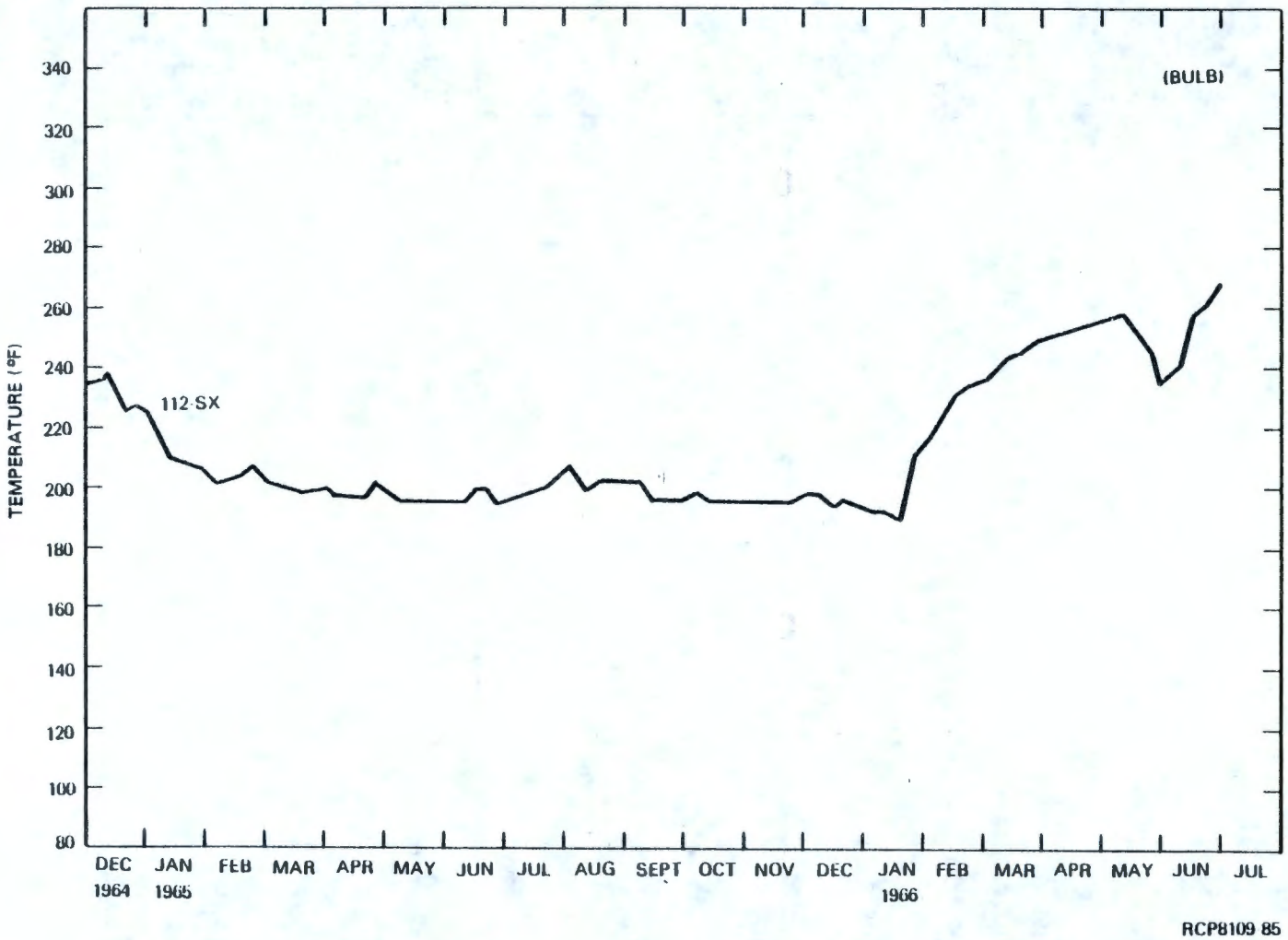

FIGURE B-103. 241-SX-112 (Bulb Temp.)
December 1964 thru July 1966

T00293

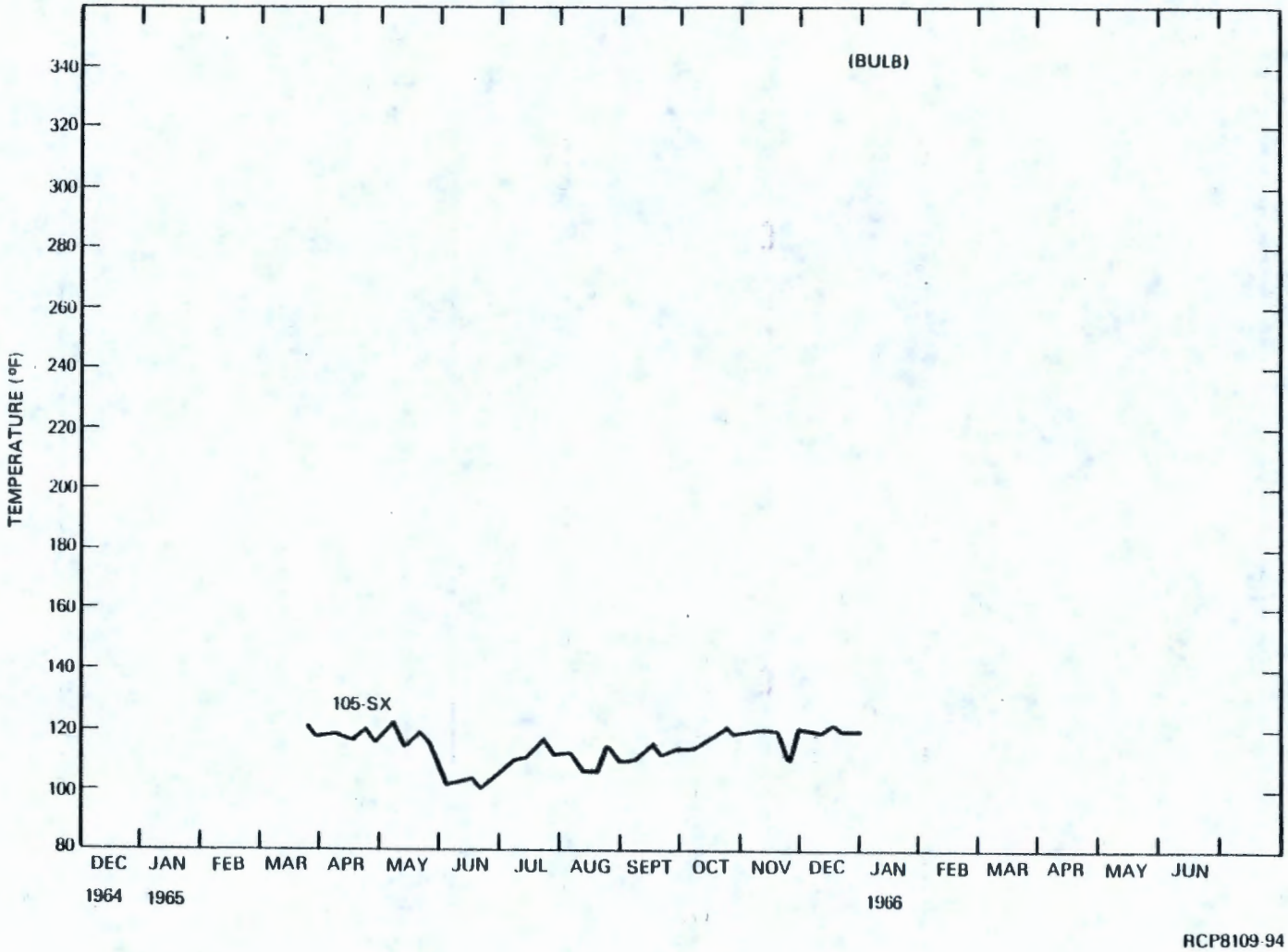

FIGURE B-104. 241-SX-105 (Bulb Temp.)
March 1965 thru December 1966

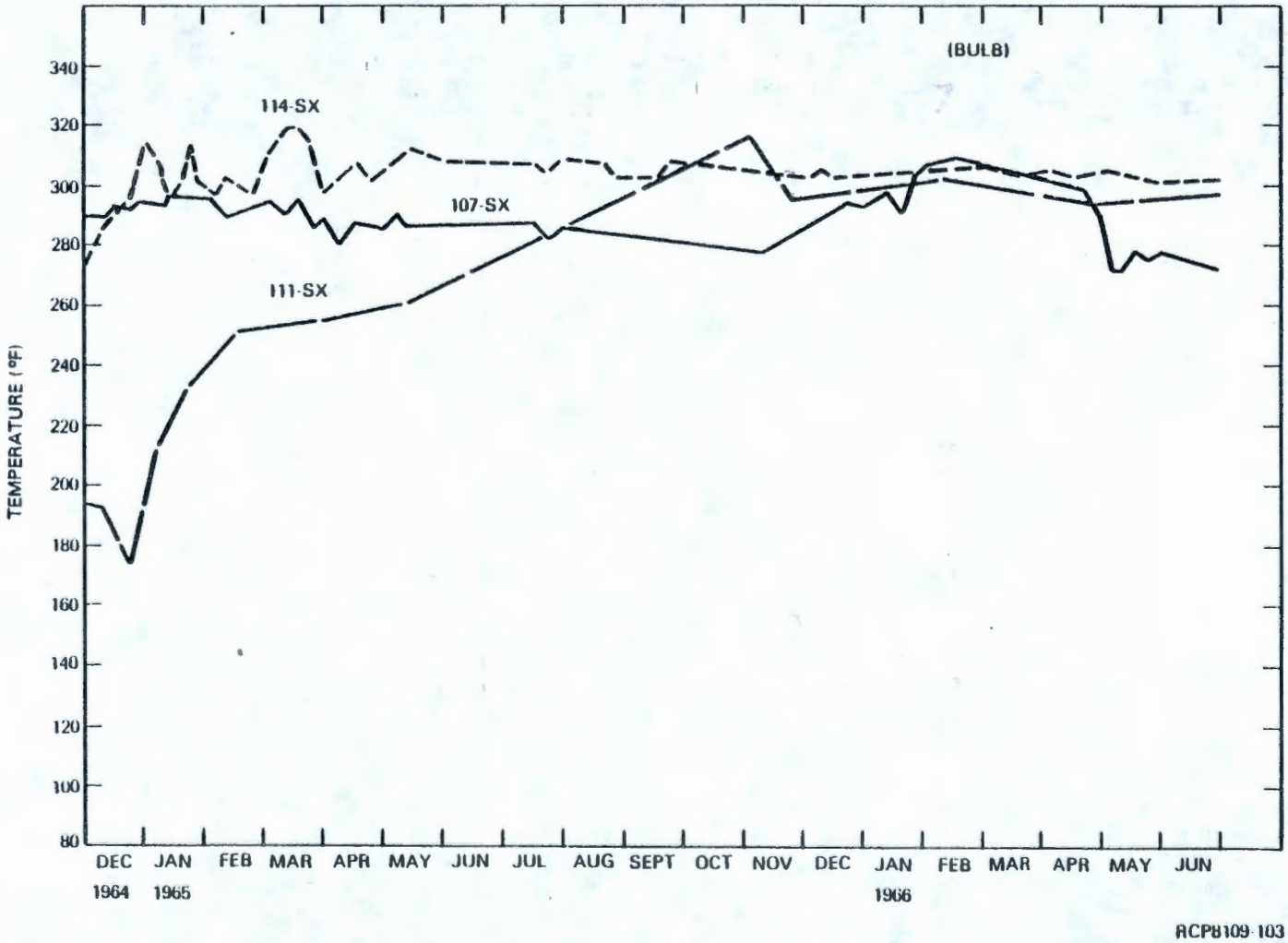

FIGURE B-105. 241-SX-107, -111, and -114 (Bulb Temp.)
December 1964 thru June 1966

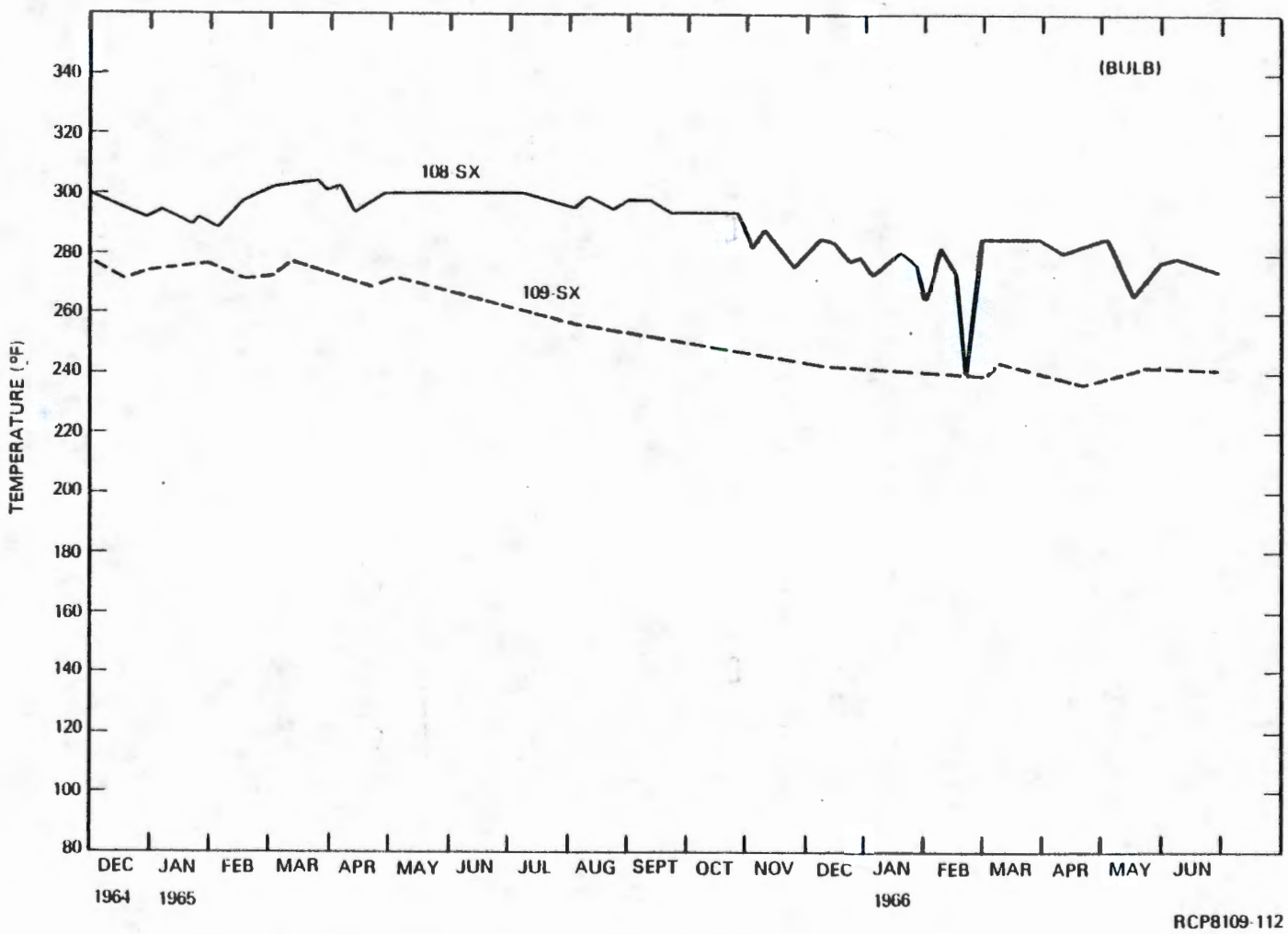

FIGURE B-106. 241-SX-108 and -109 (Bulb Temp.)
December 1964 thru June 1966

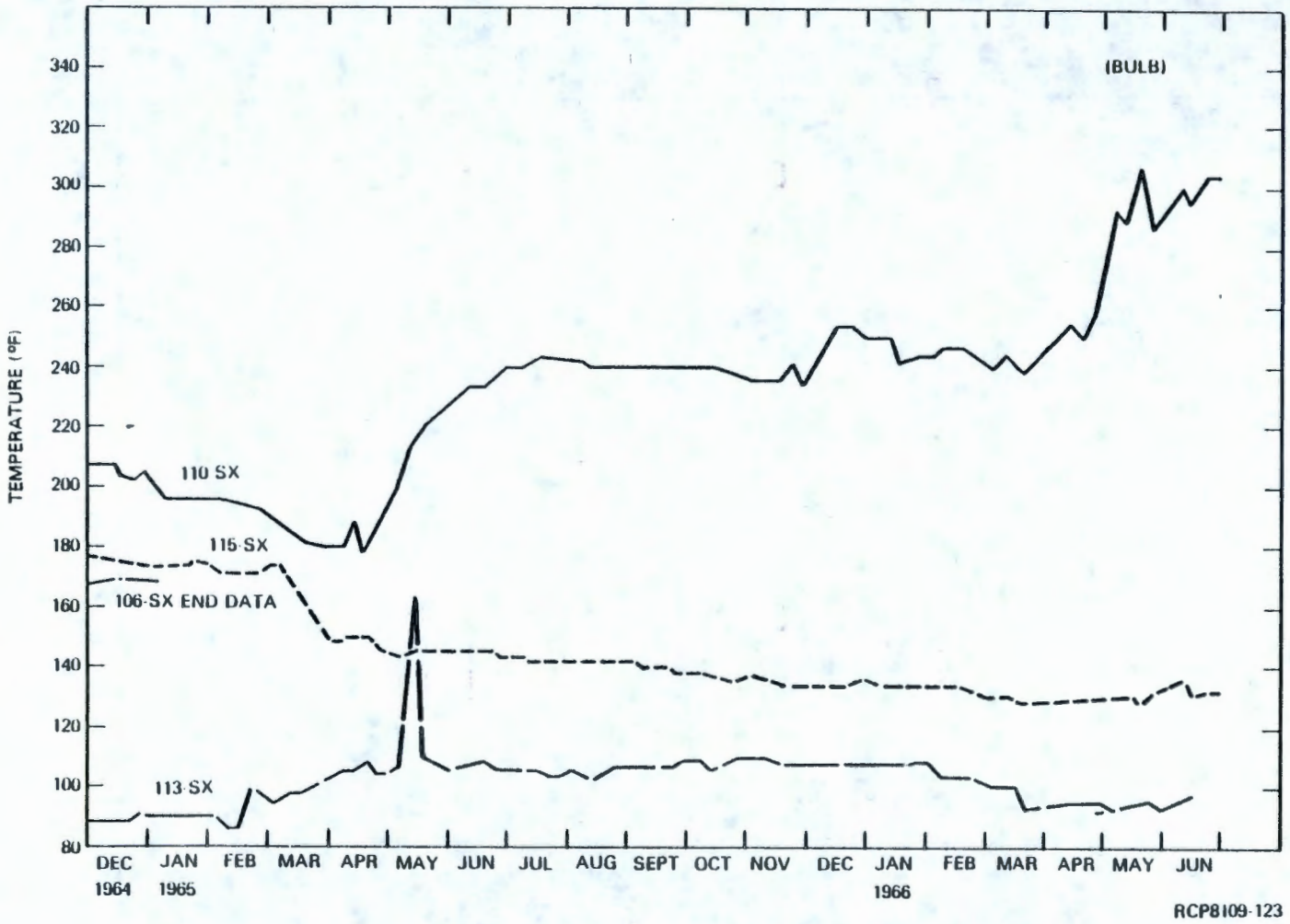

FIGURE B-107. 241-SX-106, -110, -113, and -115 (Bulb Temp.)
December 1964 thru June 1966

T00293

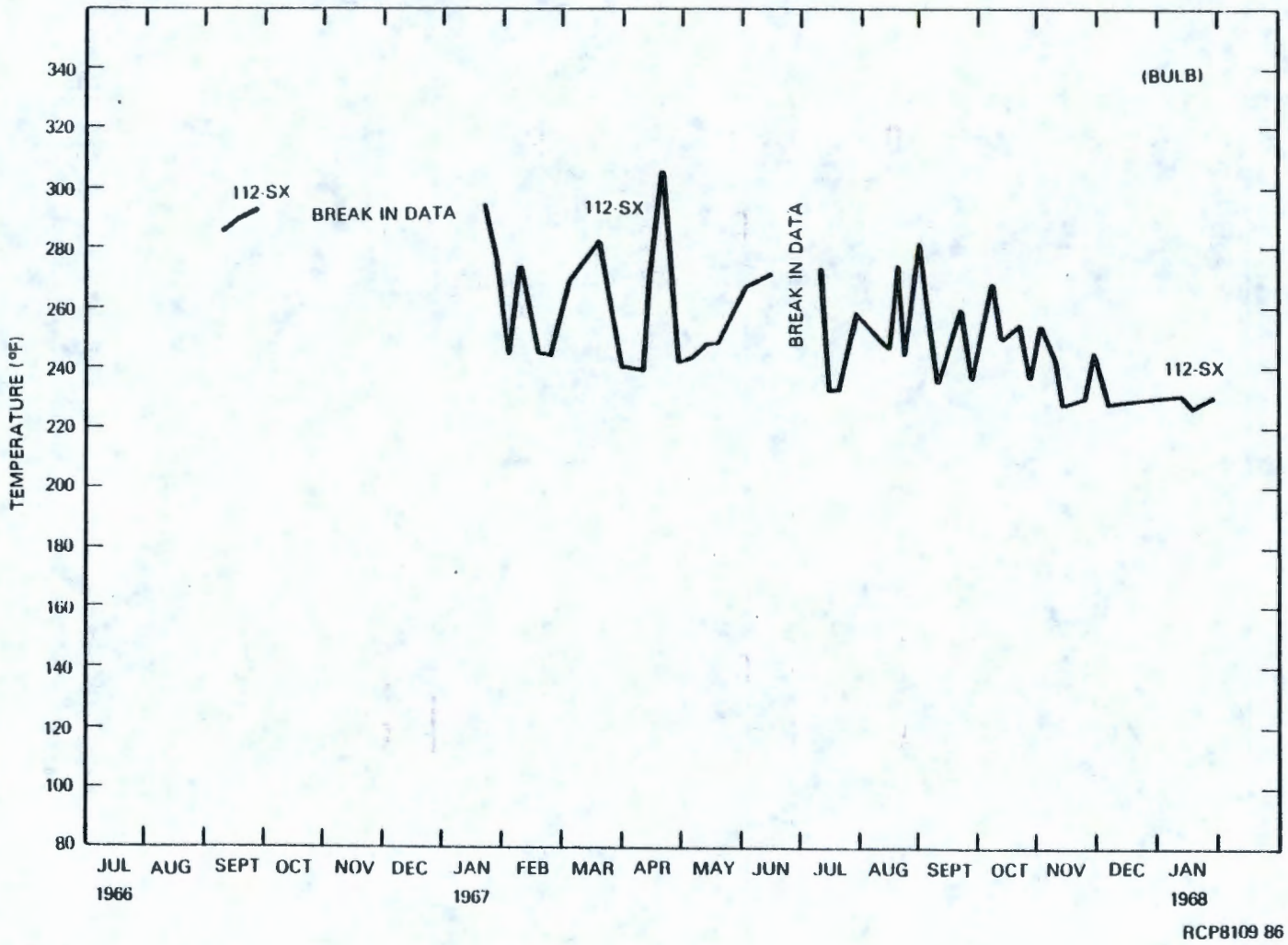

FIGURE B-108. 241-SX-112 (Bulb Temp.)
July 1966 thru January 1968

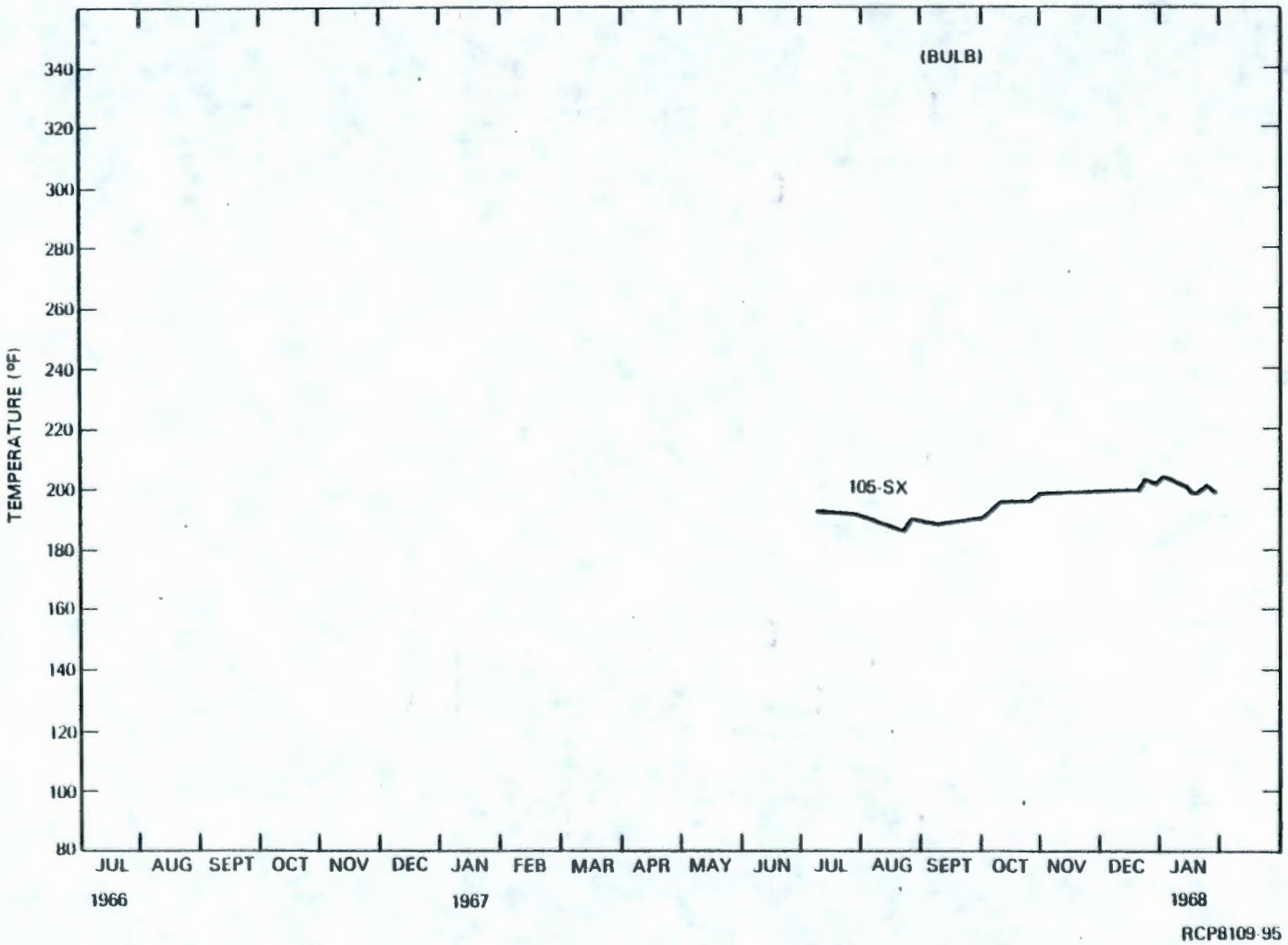

FIGURE B-109. 241-SX-115 (Bulb Temp.)
July 1967 - January 1968

T00293

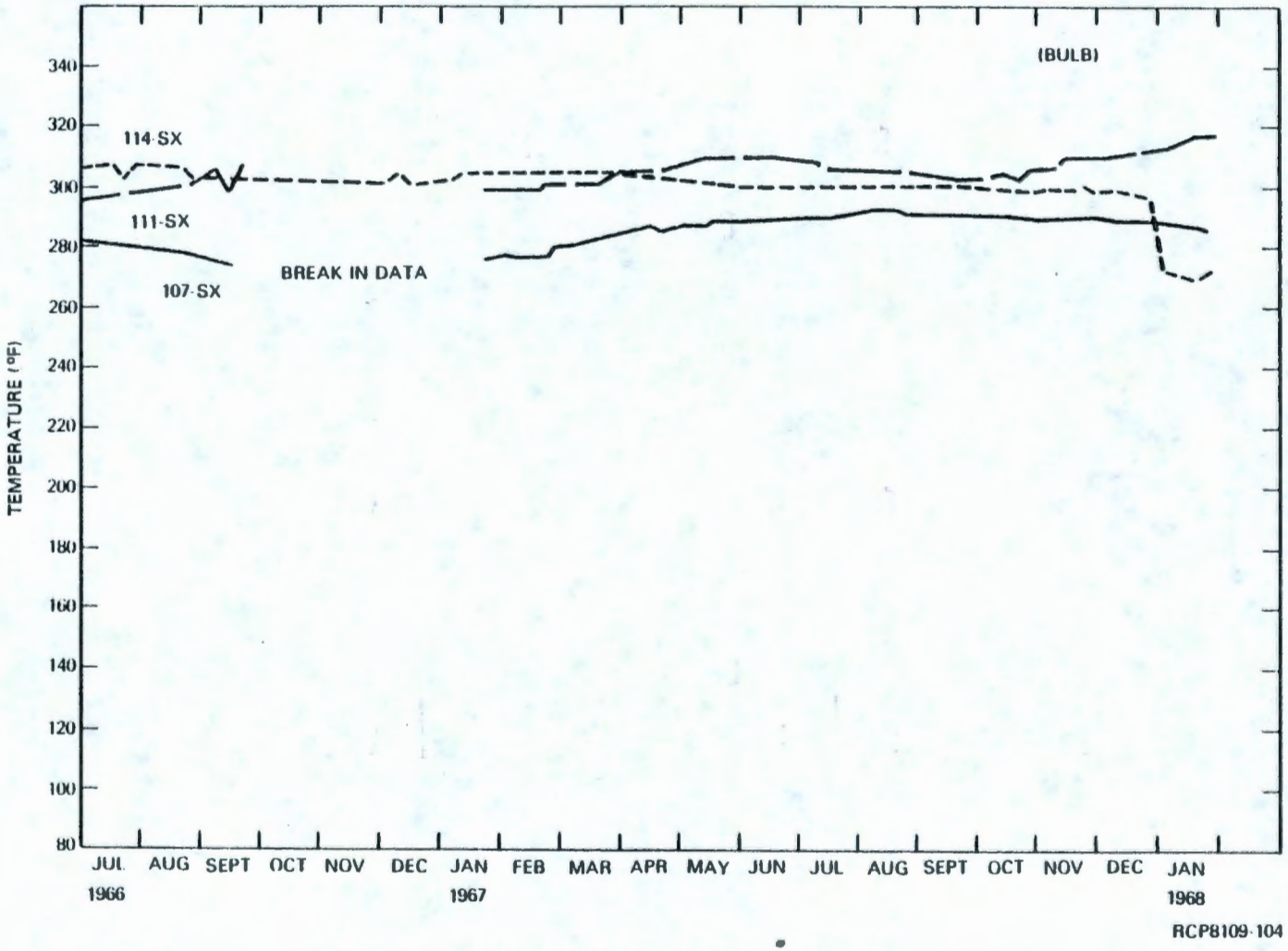

FIGURE B-110. 241-SX-107, -111, and -114 (Bulb Temp.)
July 1966 - January 1968

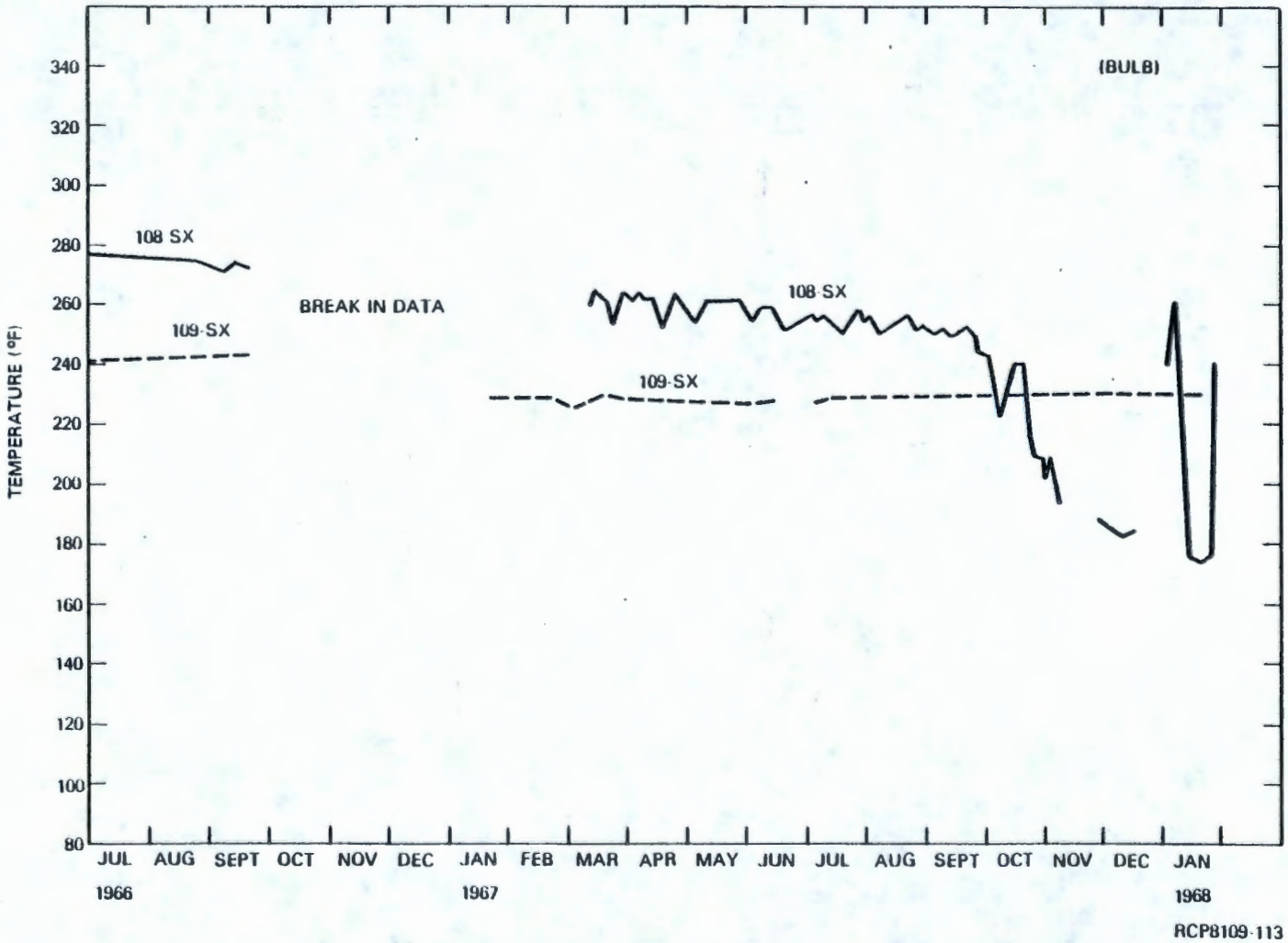

FIGURE B-111. 241-SX-108 and -109 (Bulb Temp.)
July 1966 thru January 1968

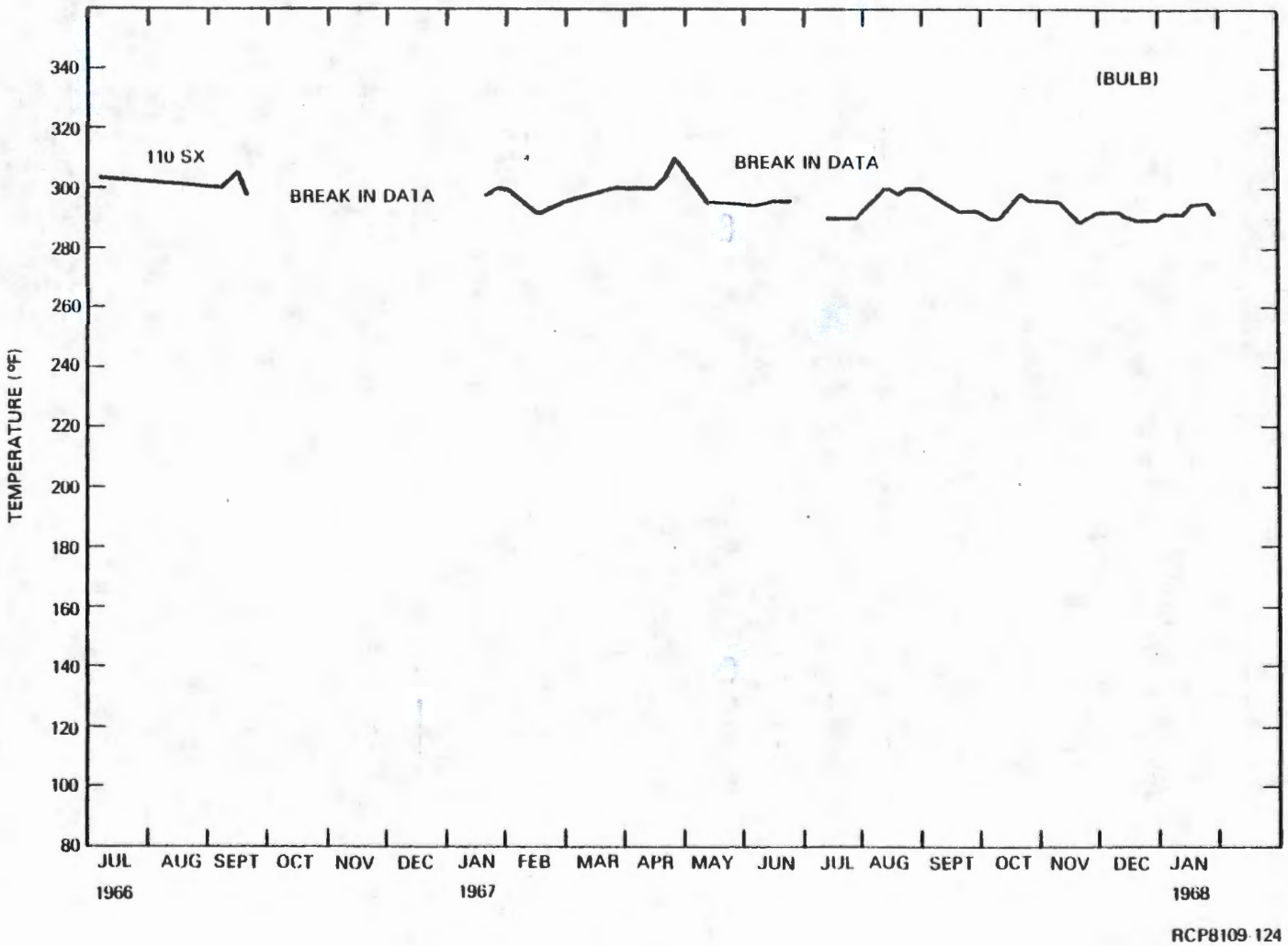

FIGURE B-112. 241-SX-110 (Bulb Temp.)
July 1966 - January 1968

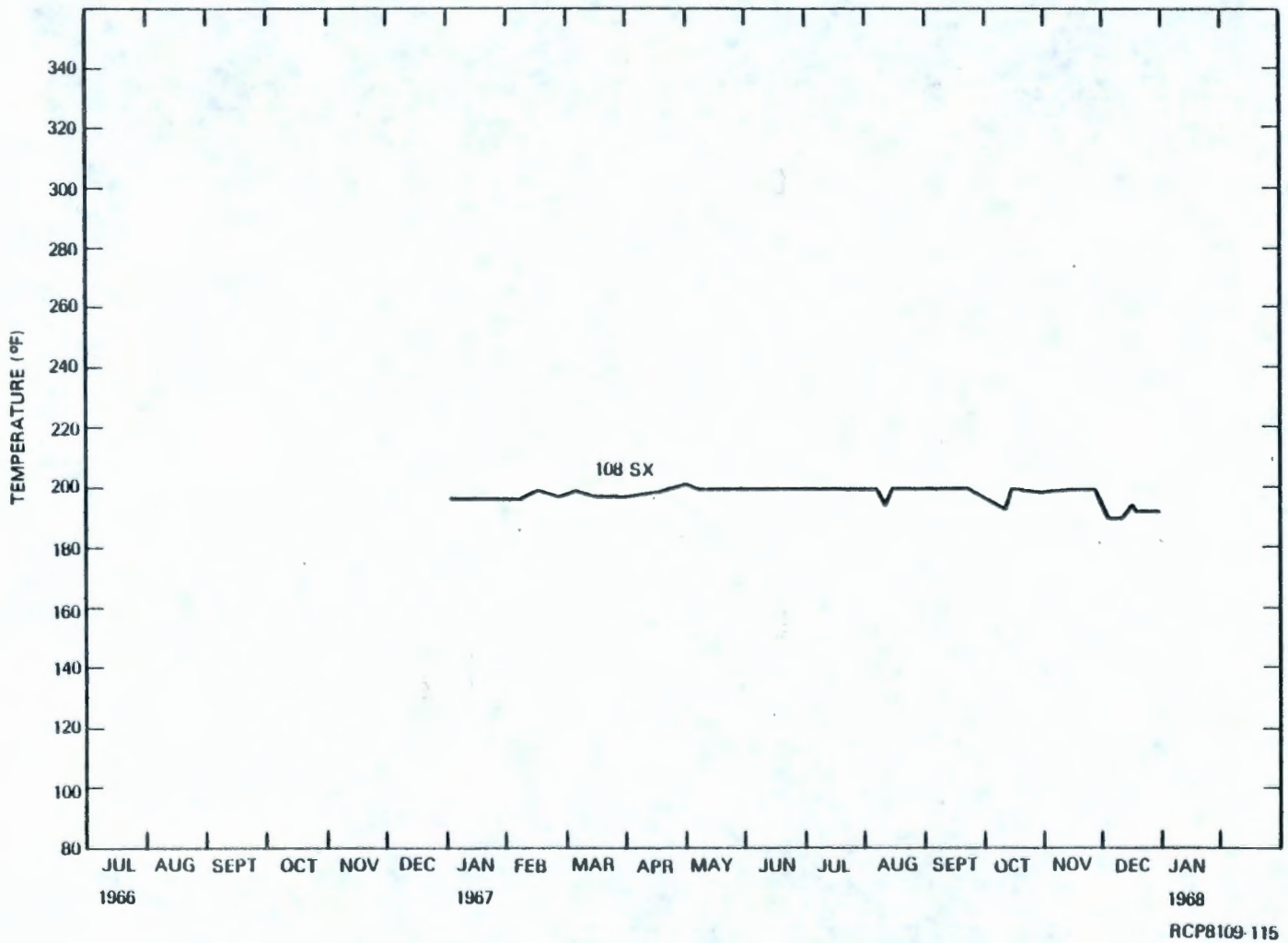

FIGURE B-113. 241-SX-108 (Bulb Temp.)
January 1967 - December 1967

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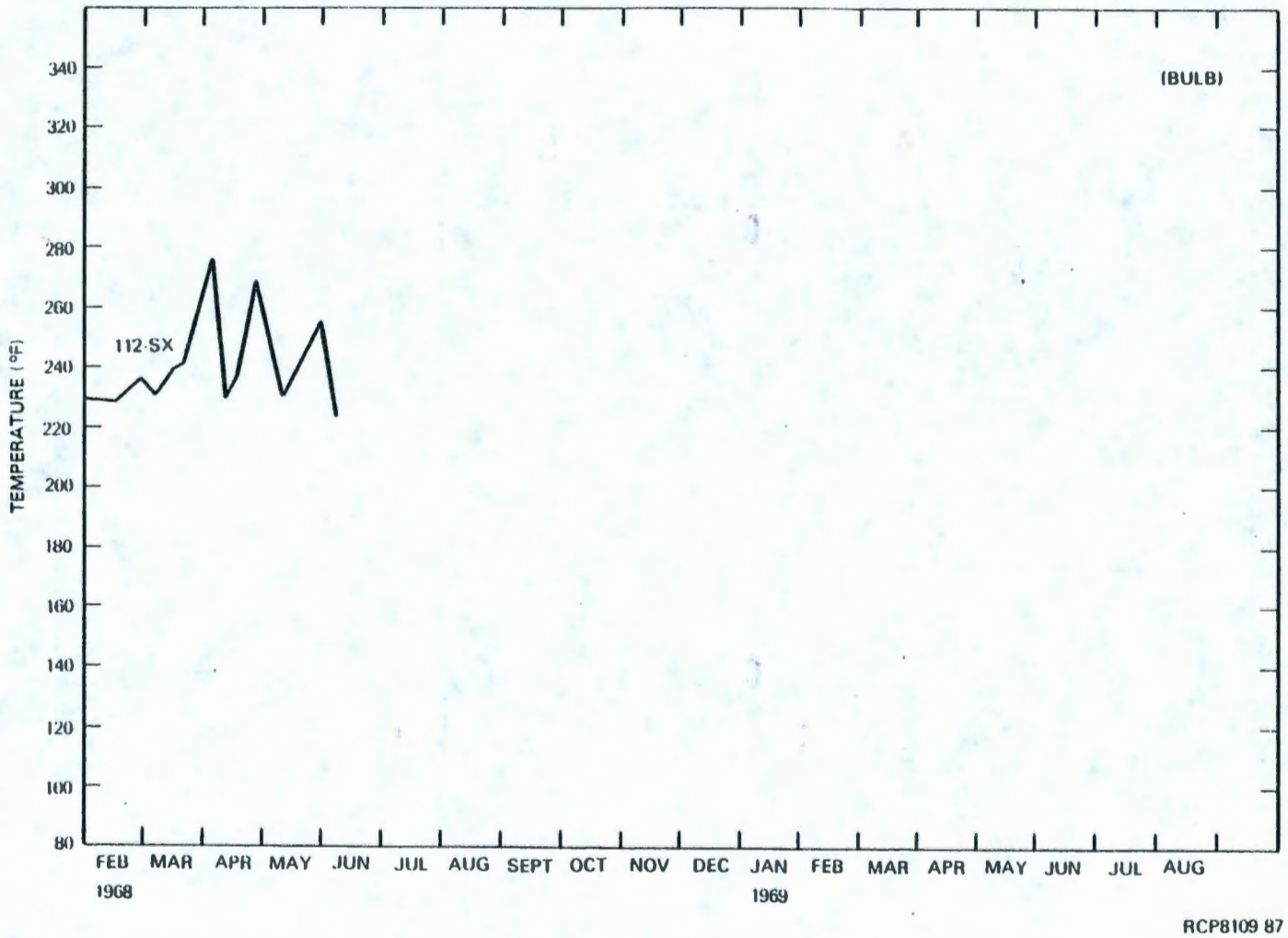

FIGURE B-114. 241-SX-112 (Bulb Temp.)
February 1968 - June 1968

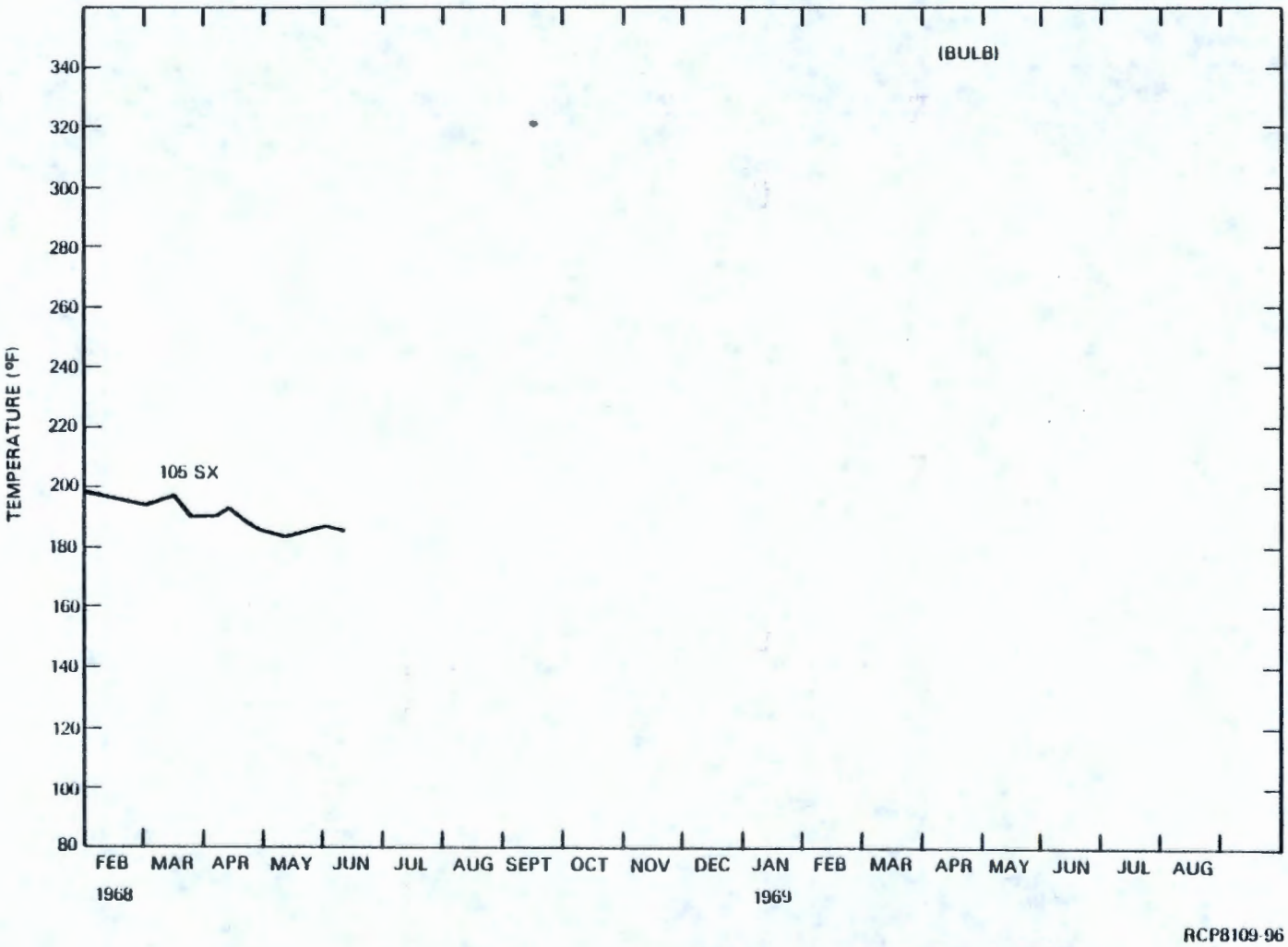

FIGURE B-115. 241-SX-105 (Bulb Temp.)
February 1968 - June 1968

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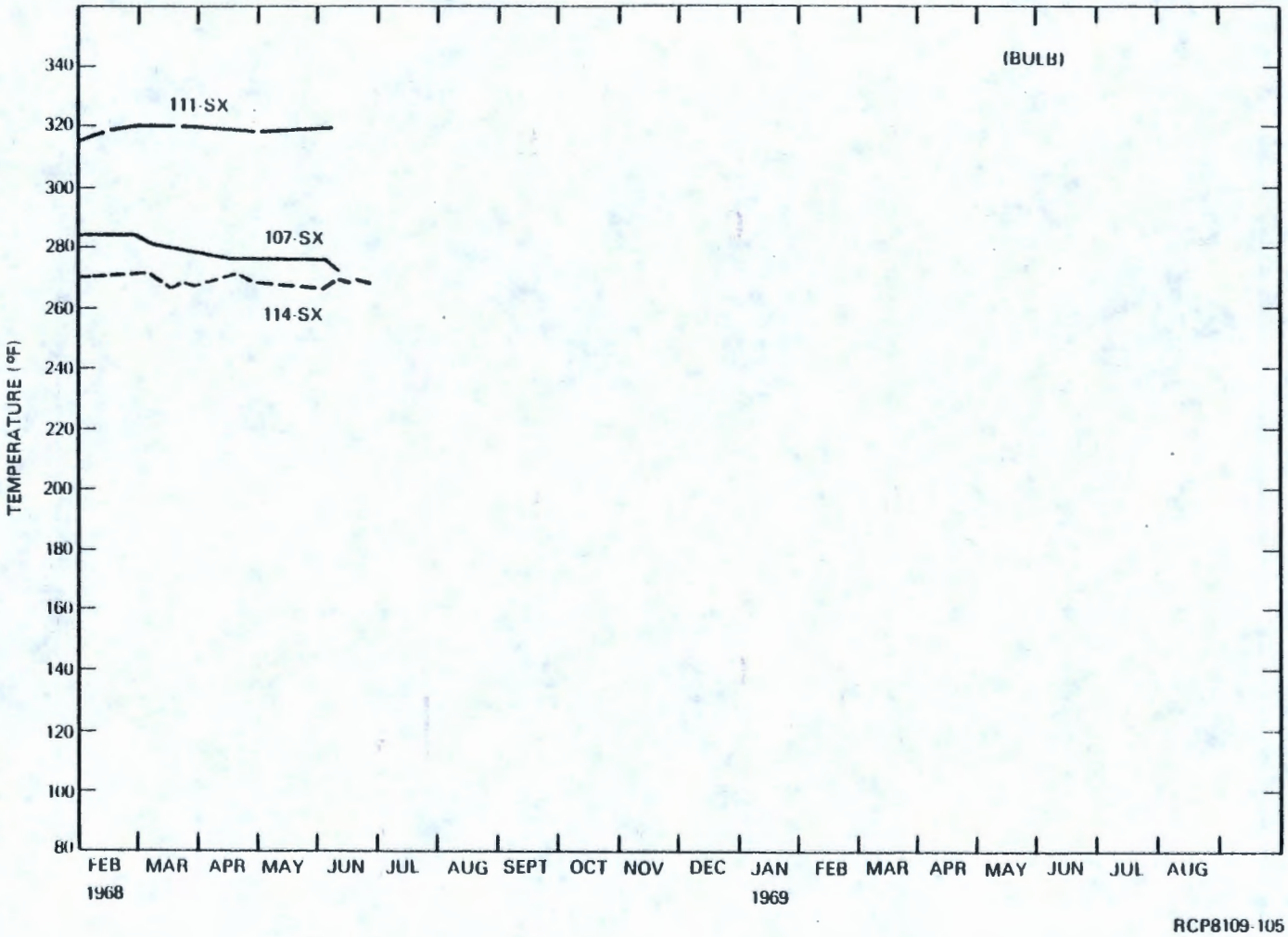

FIGURE B-116. 241-SX-107, -111, and -114 (Bulb Temp.)
February 1968 thru June 1968

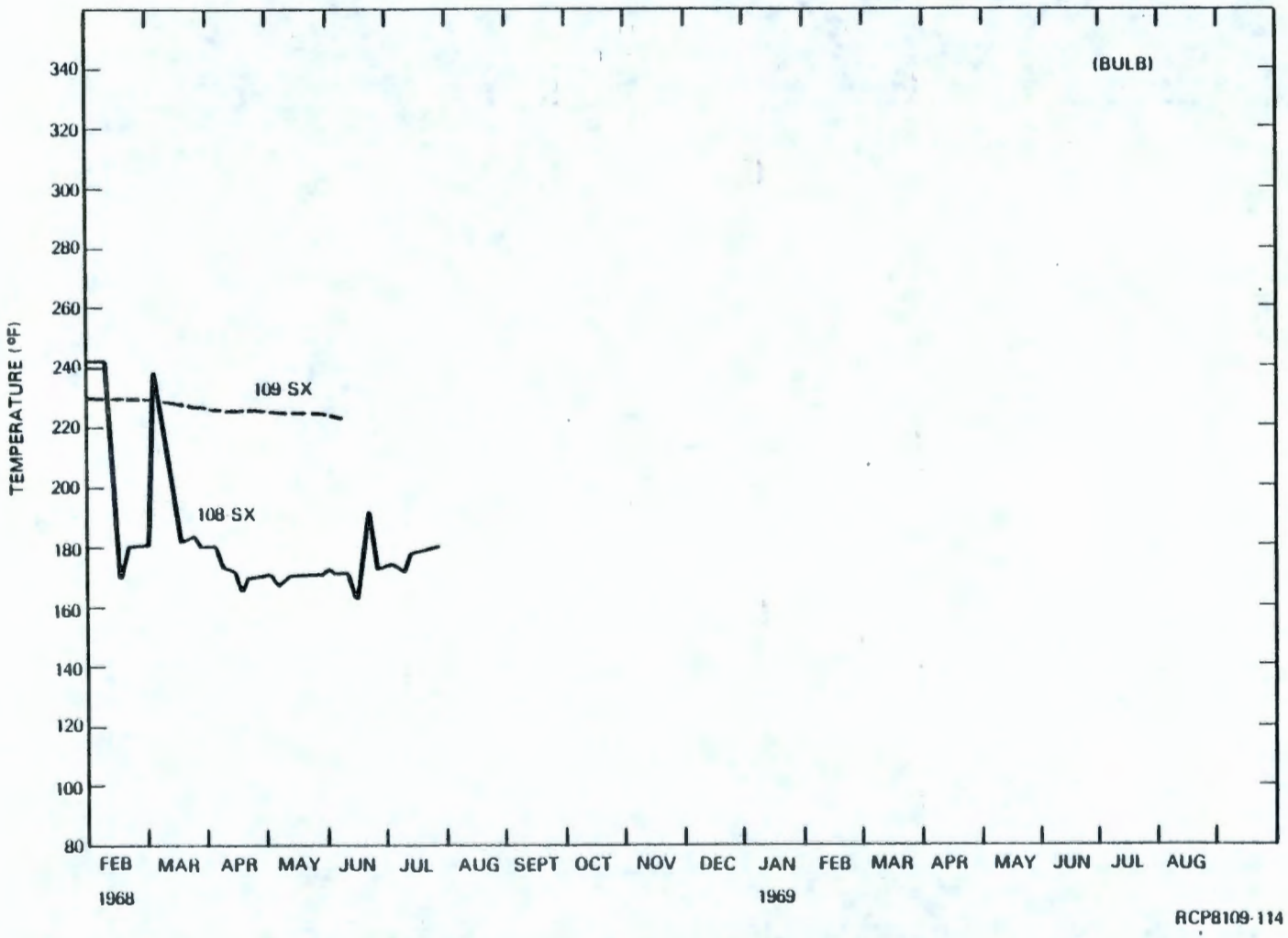

FIGURE 117. 241-SX-108 and -109 (Bulb Temp.)
February 1968 - July 1968

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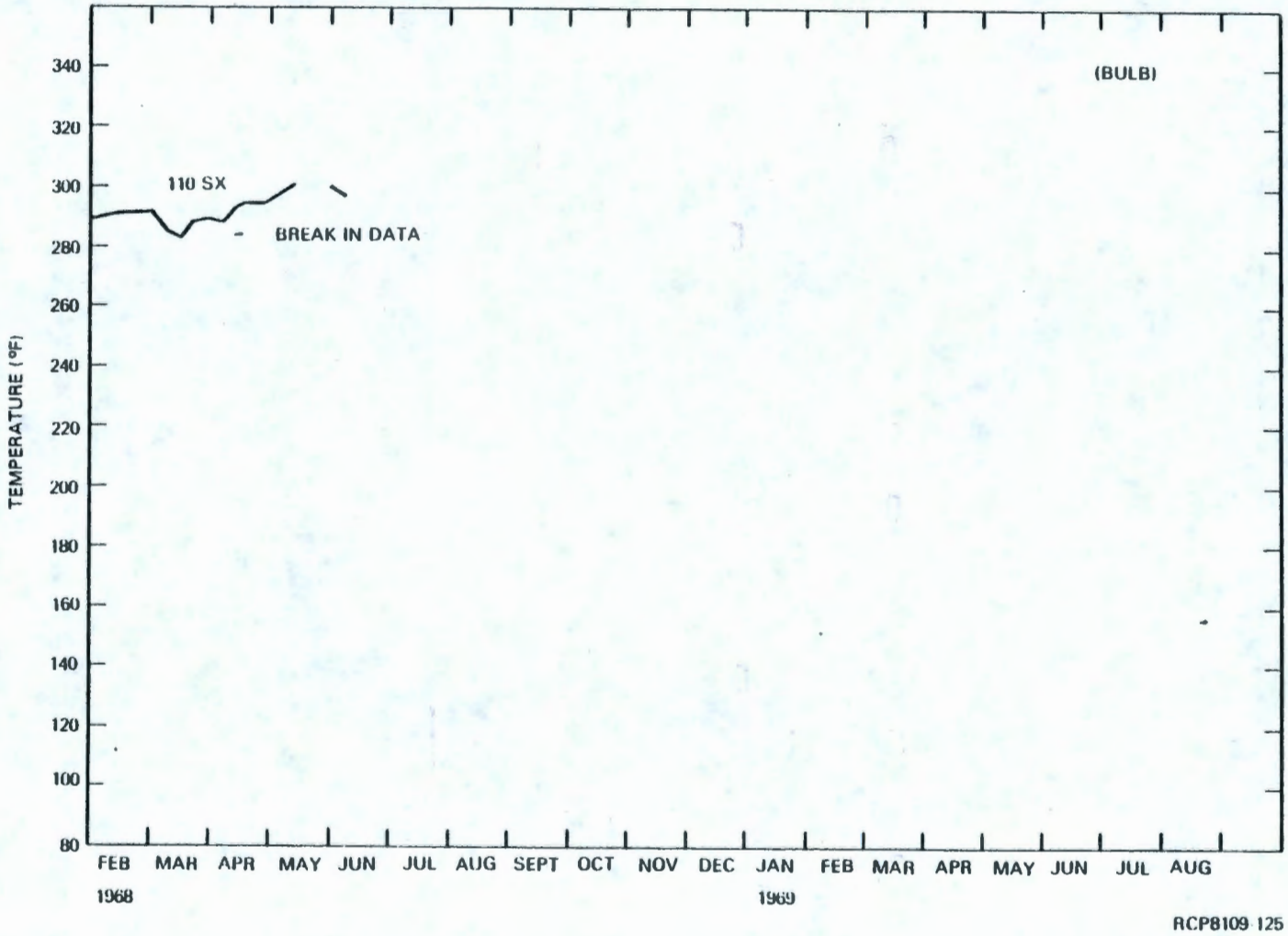

FIGURE B-118. 241-SX-110 (Bulb Temp.)
February 1968 - June 1968

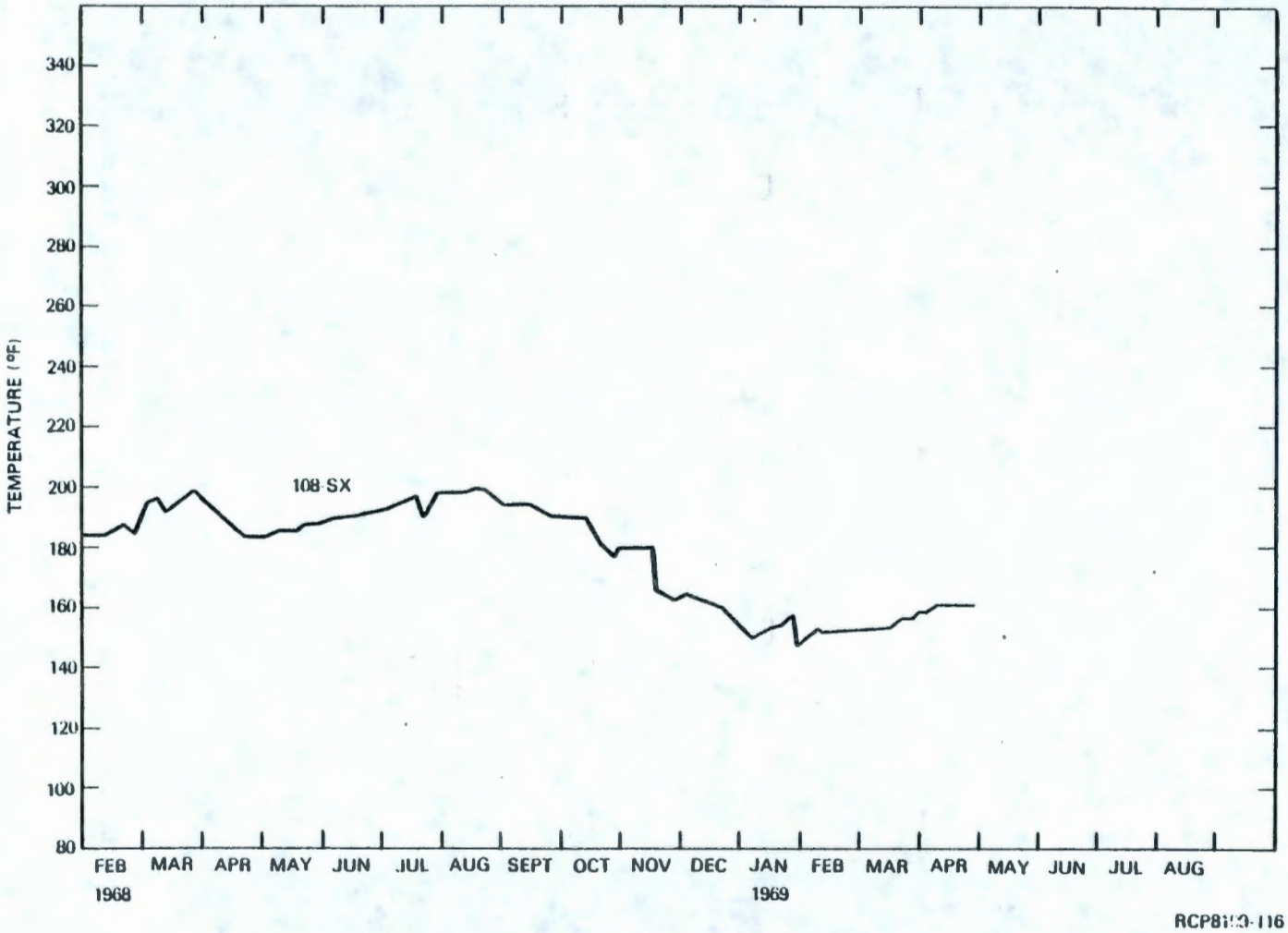

FIGURE B-119. 241-SX-108 (Bulb Temp.)
February 1968 thru April 1969

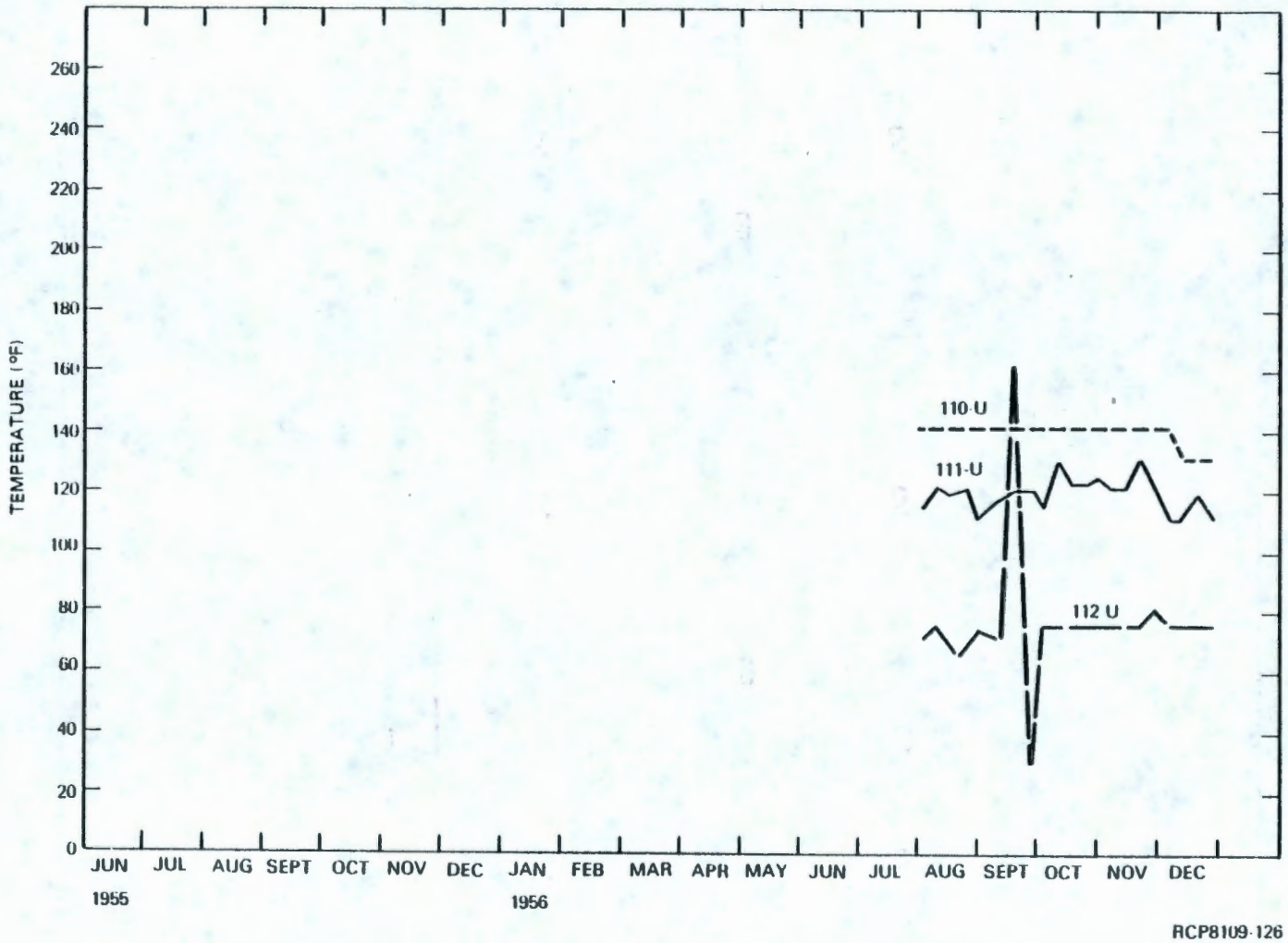

FIGURE B-120. 241-U-110, -111, and -112 (Bulb Temp.)
August 1956 - December 1956

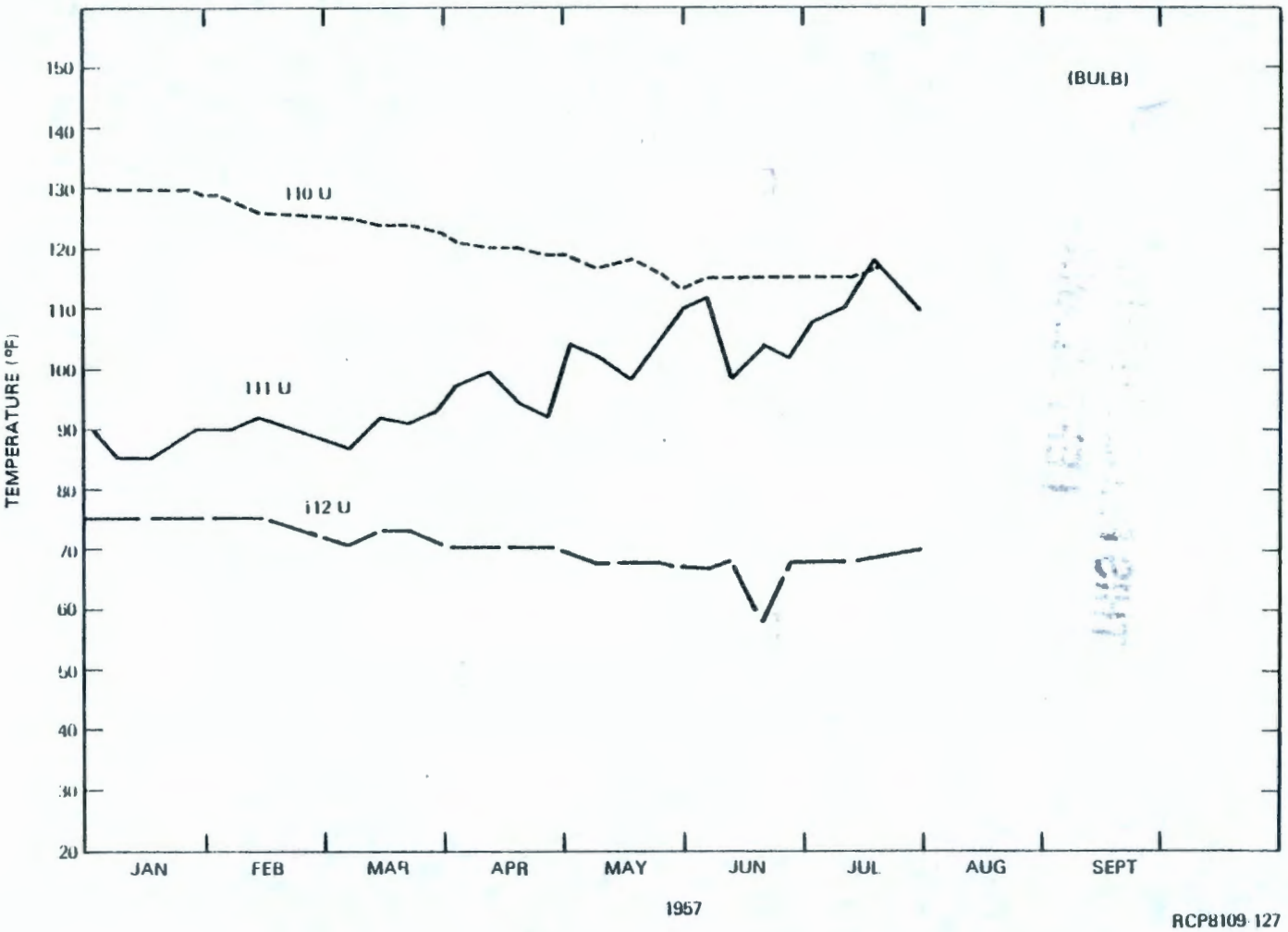

FIGURE B-121. 241-U-110, -111, and -112 (Bulb Temp.)
January 1957 thru July 1957

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133

Author(s): P. F. Mercier, M. D. Wonacott and C. DeFigh-Price

Description of Document: ☐ Quarterly ☐ Monthly ☐ Manual ☐ Progress ☒ Topical ☐ Other

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Rockwell International

Date

To: D. L. Samples
F&IS/REC
Fed/352/700 Area

From: C. DeFigh-Price
Engineering Mechanics
2750E/D277/200 East
373-3603

Subject: RHO-CD-1172

Mr. M. P. Gillen of Portland Cement Assoc., which is a Rockwell Hanford Operations subcontractor, has requested information on tank thermal histories. This information is covered in the subject report. It is requested that the report be cleared for limited distribution and sent to:

Mr. M. P. Gillen
Construction Technology Laboratories
Portland Cement Assoc.
5420 Old Orchard Road
Skokie, Ill. 60077

C. DeFigh-Price

C. DeFigh-Price, Engineer
Engineering Mechanics
Engineering Technology
& Analysis

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