

# APPENDIX **D**

The DF-4 Control Blade/Channel Box  
Fuel Damage Experiment

NUREG/CR-4671

SAND86-1443

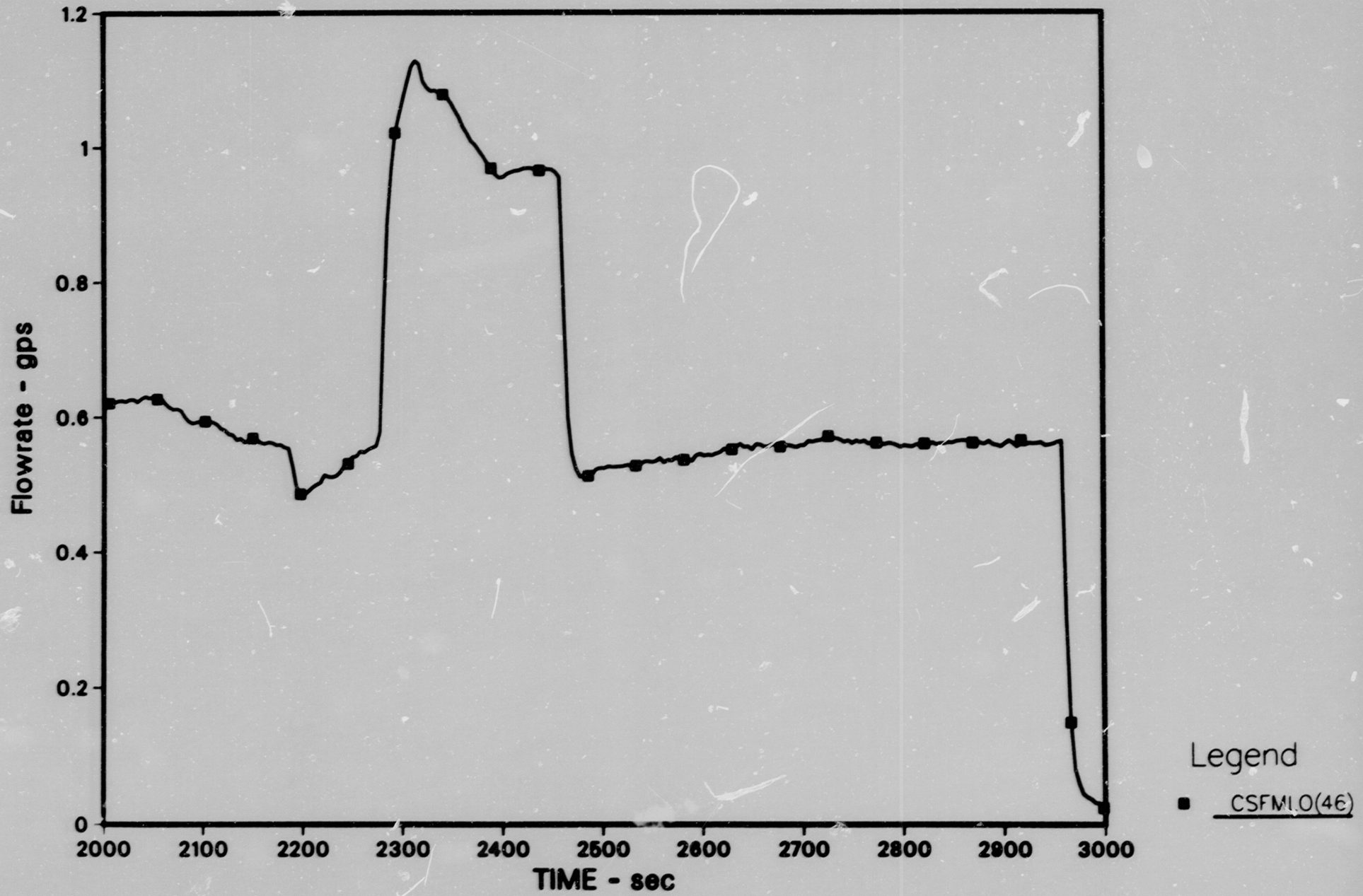
DF-4 Measured Data

DF-4

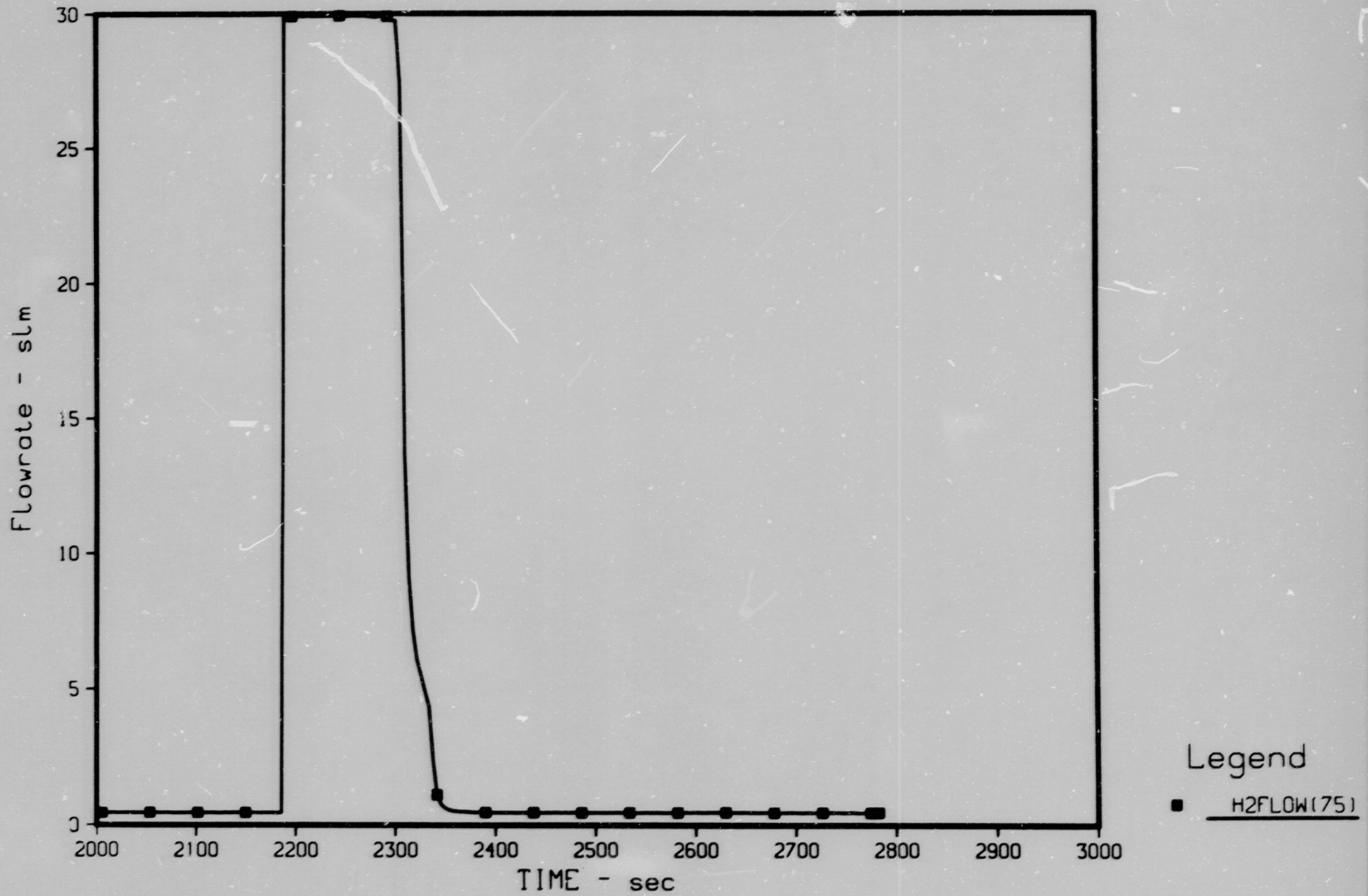
HYDROGEN CALIBRATION

PHASE

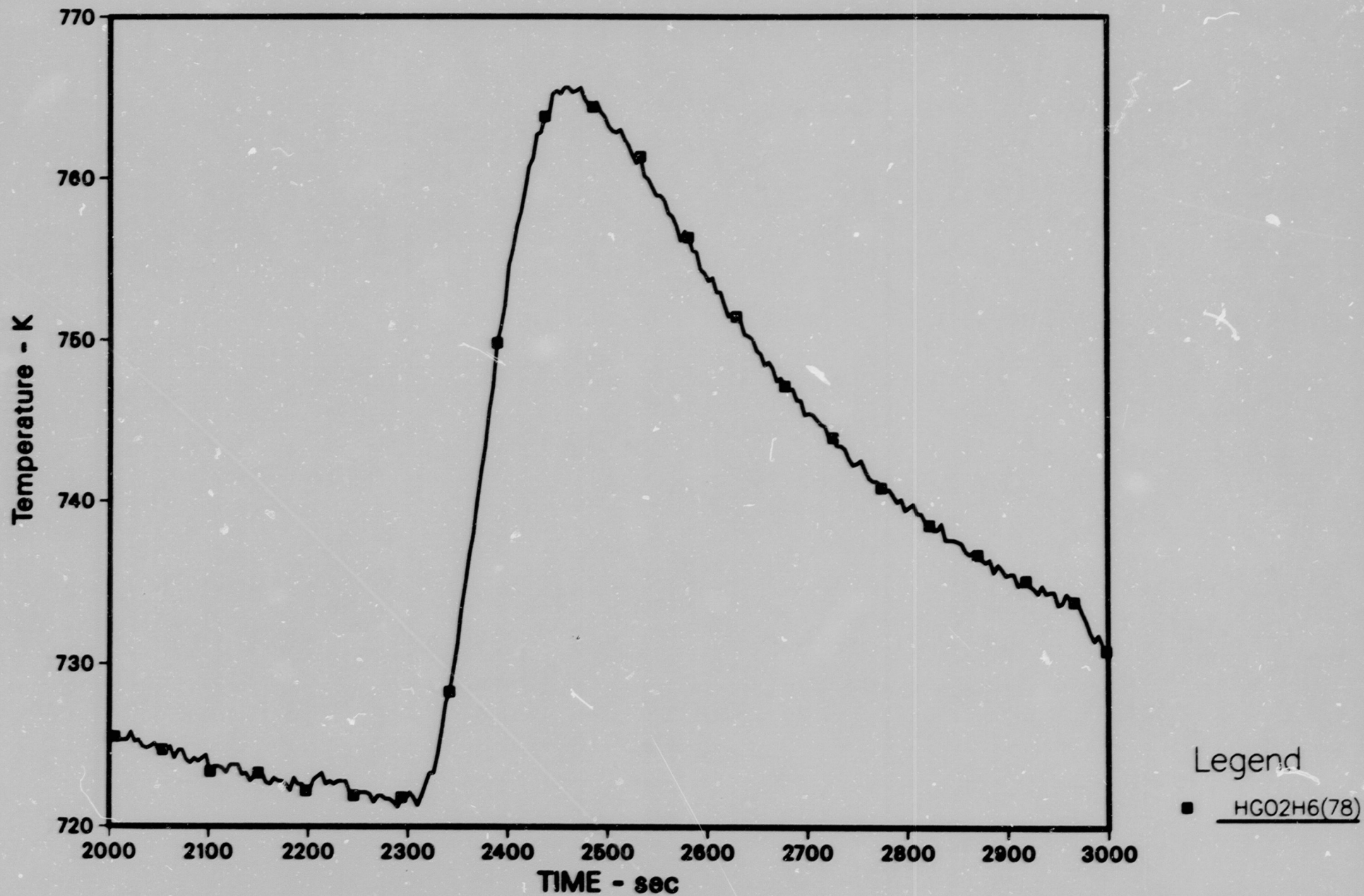
# DF-4 Cool Steam Flow Meter



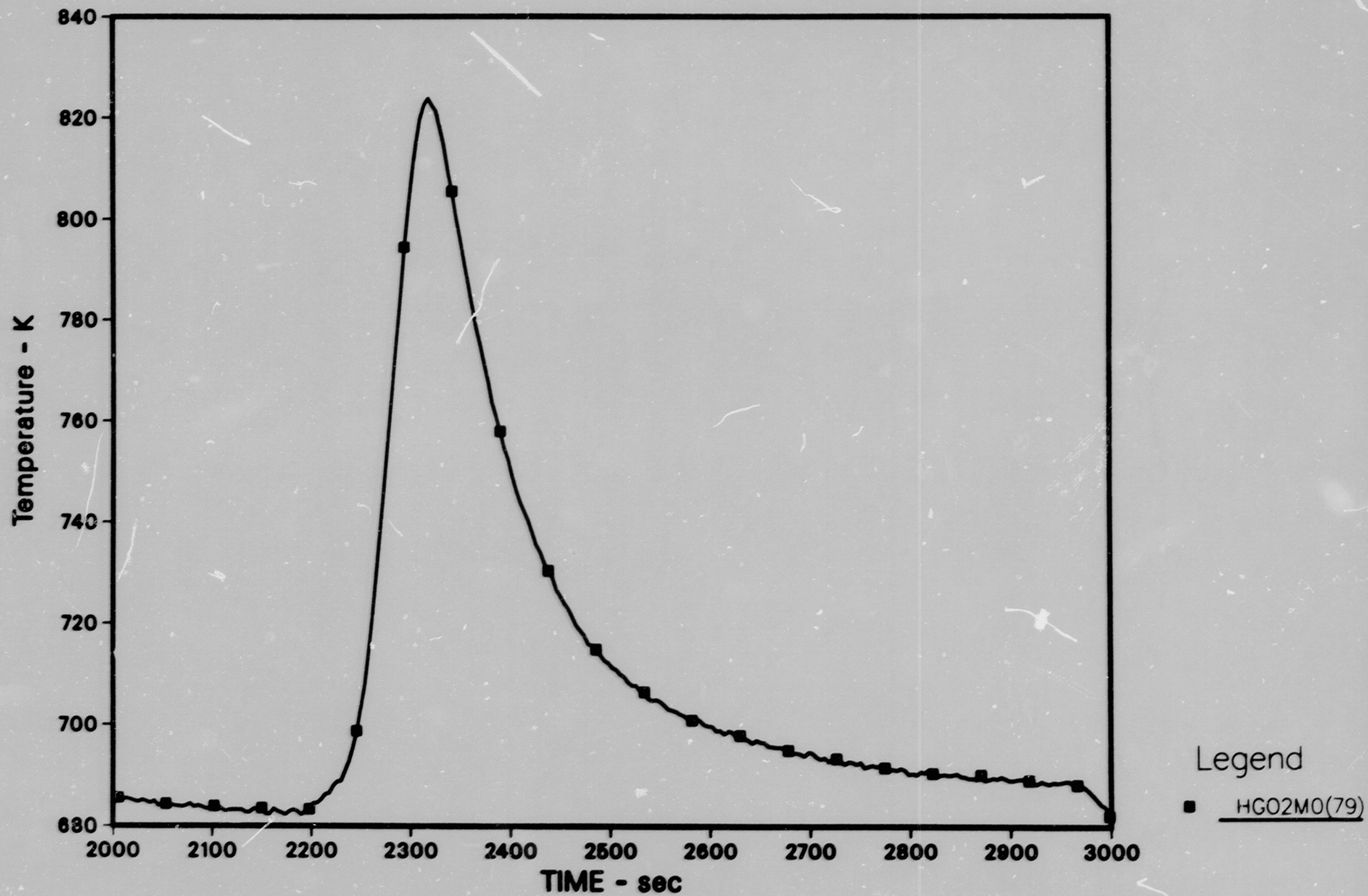
# DF-4 Hydrogen Flow Meter Output During H2 Getter Calibration



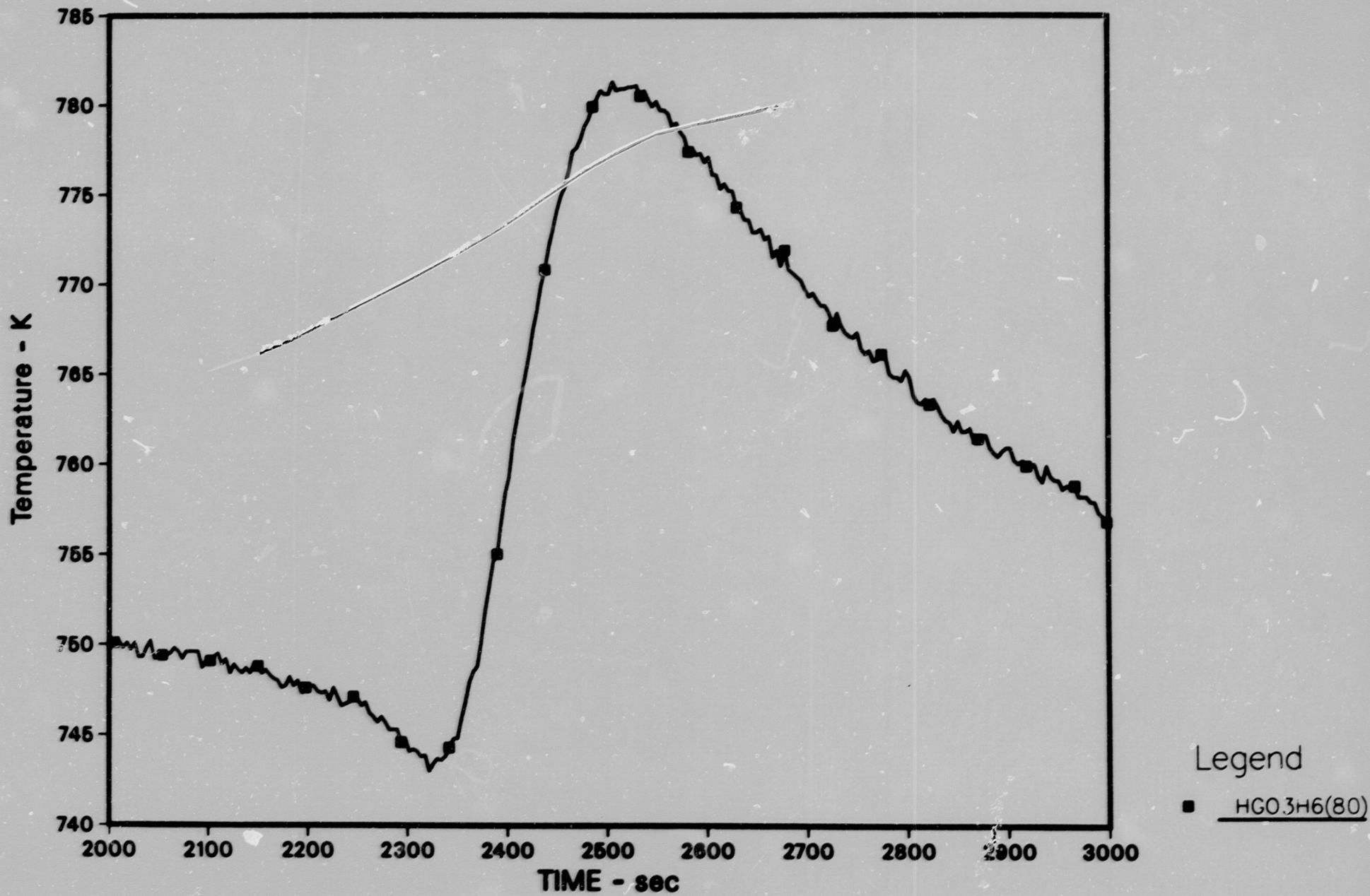
# DF-4 H2 Getter Tube 2, Heater Location 6in Above Bottom



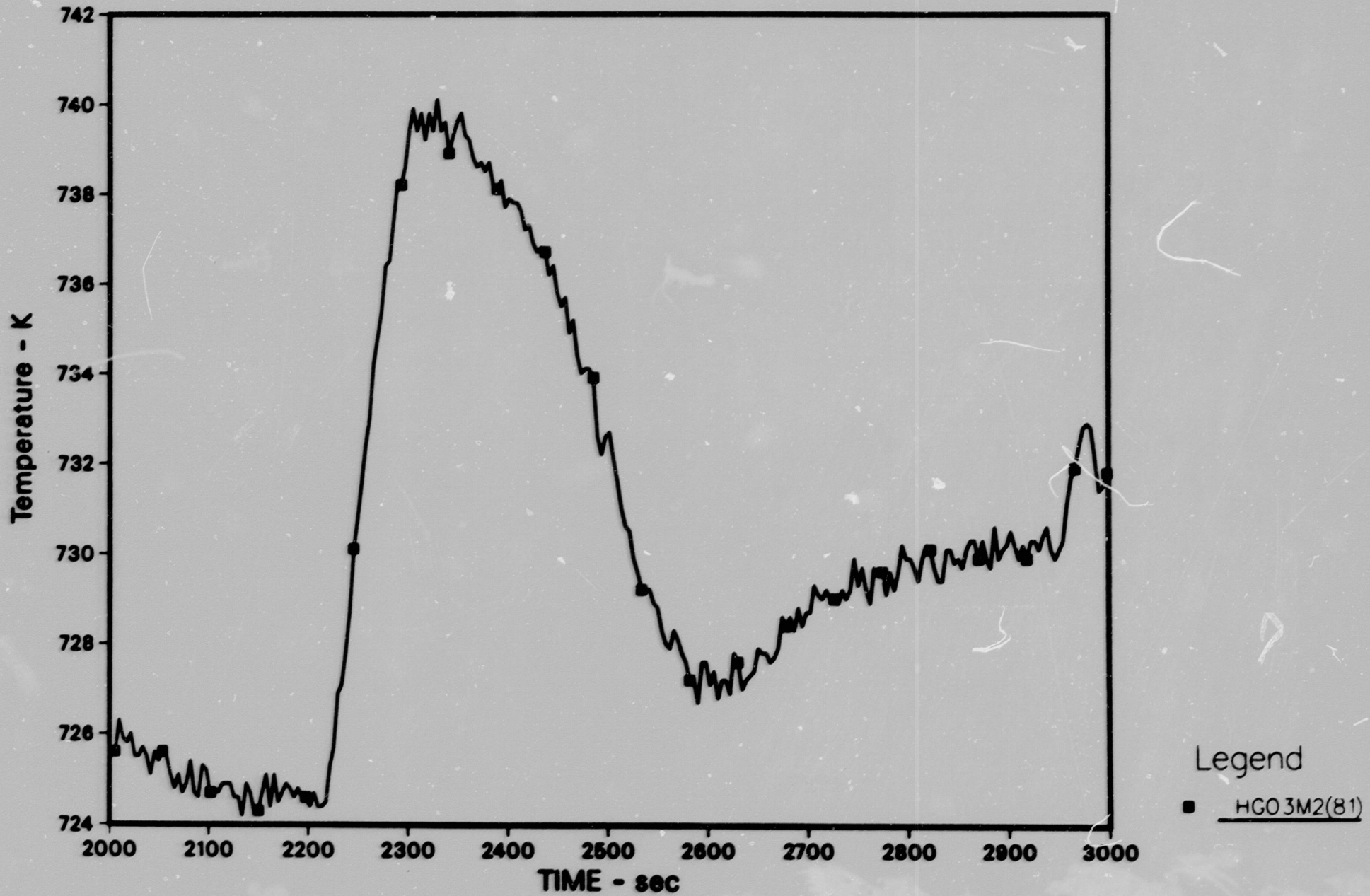
# DF-4 H2 Getter Tube 2, Mixing Tube Side 0in Above Bottom



# DF-4 H2 Getter Tube 3, Heater Location 6in Above Bottom

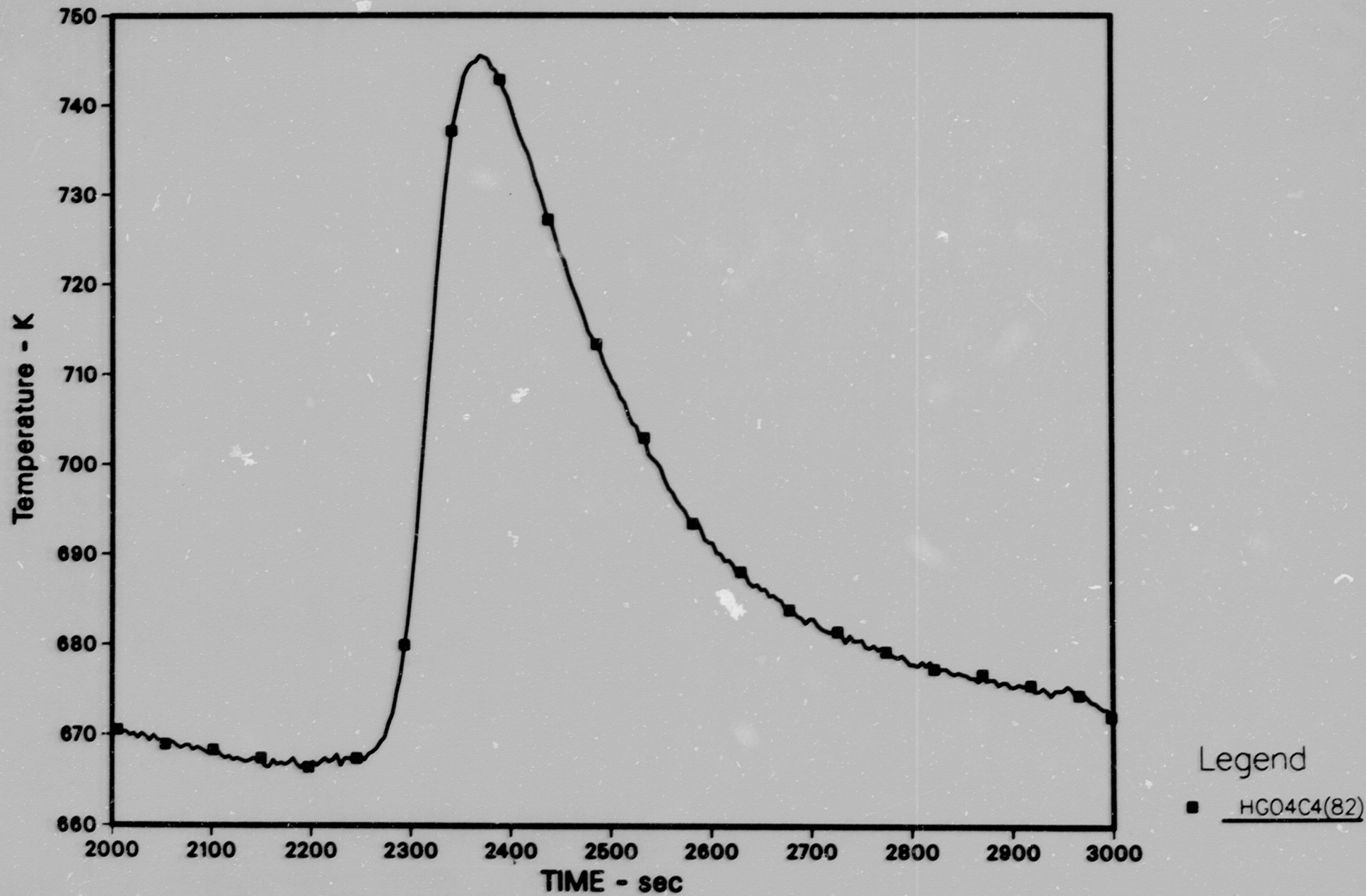


# DF-4 H2 Getter Tube 3, Mixing Tube Side 2in Above Bottom

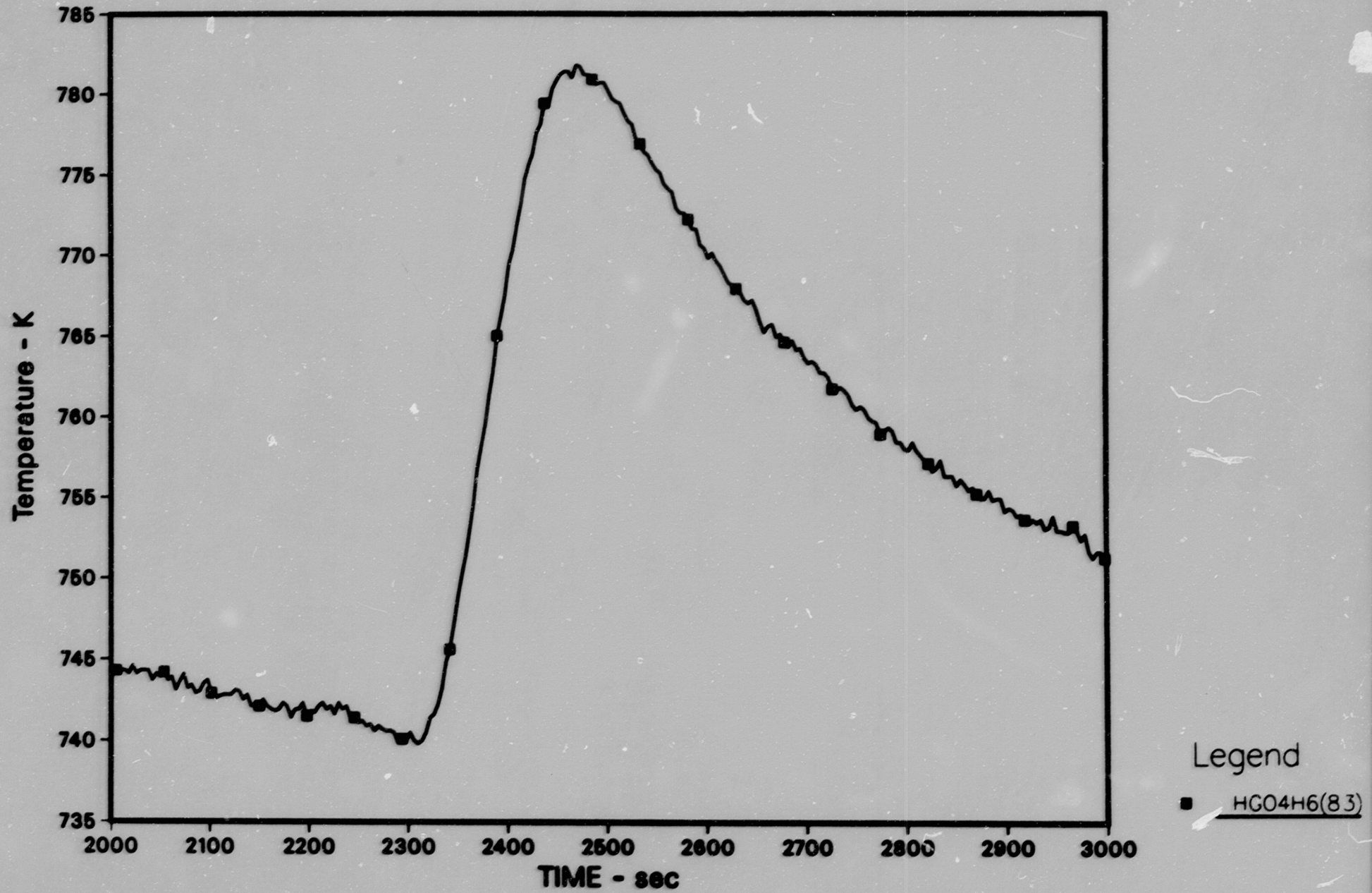




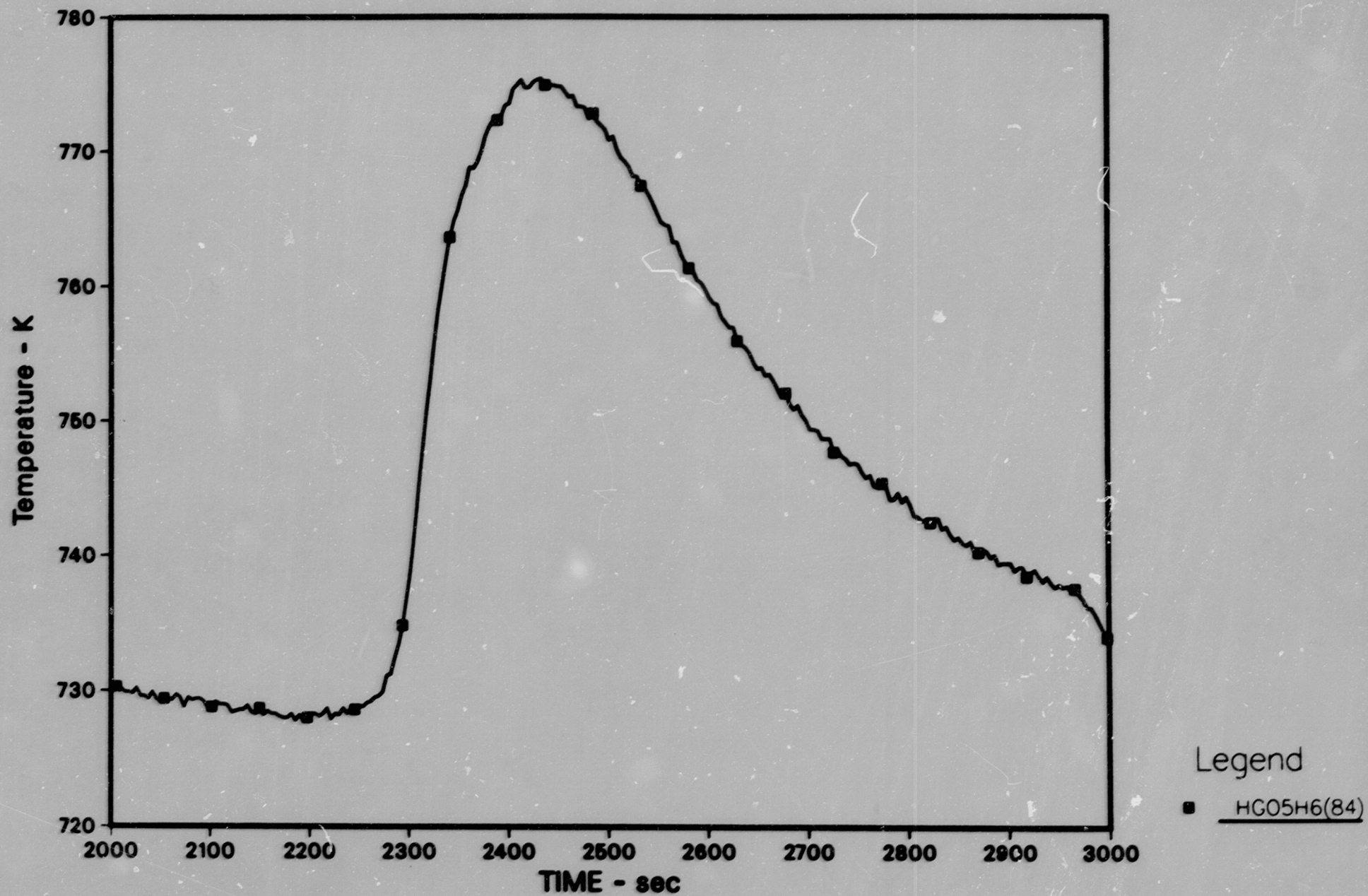
# DF-4 H2 Getter Tube 4, Condenser Side 4in Above Bottom



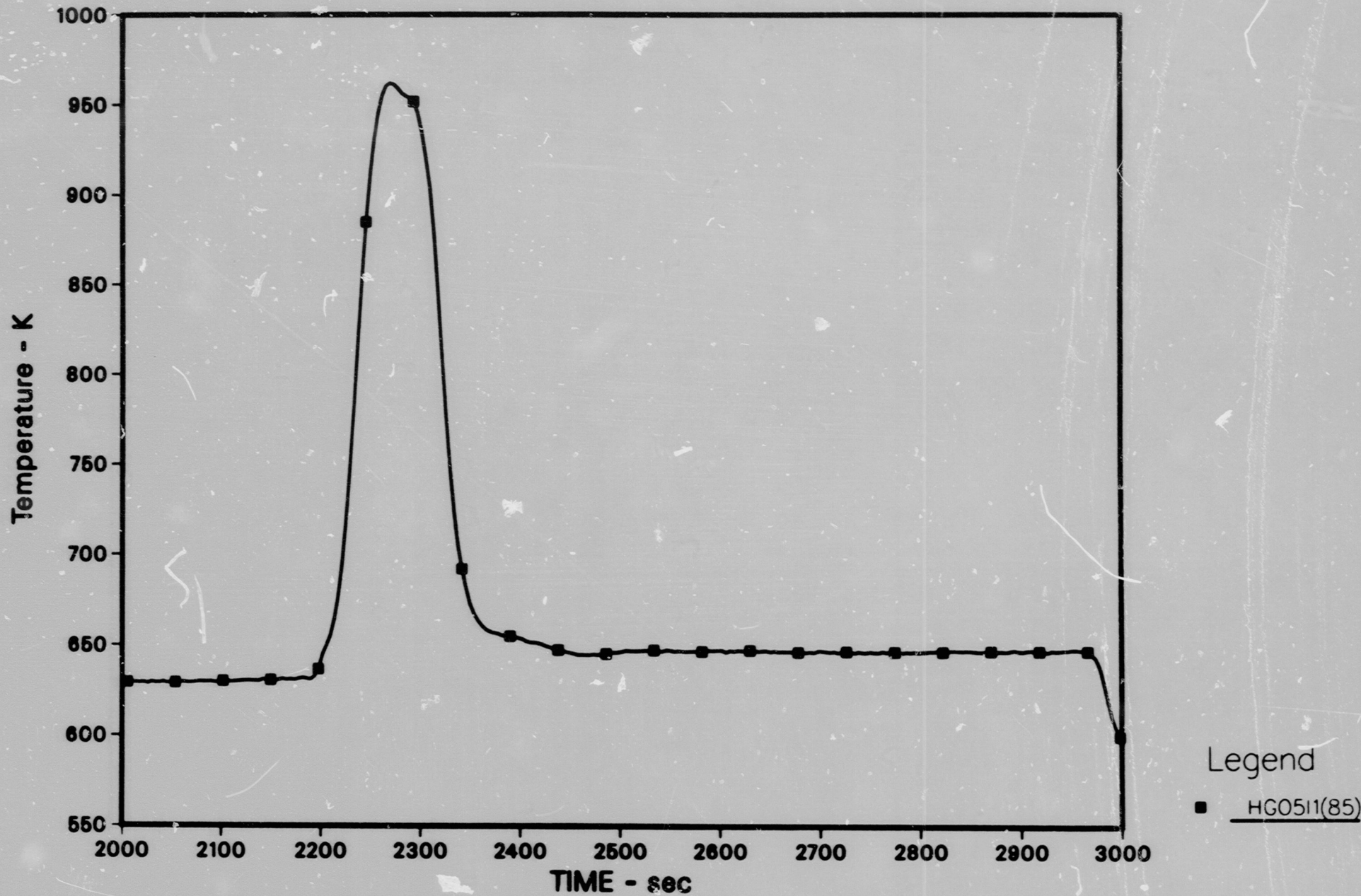
# DF-4 H2 Getter Tube 4, Heater Location 6in Above Bottom



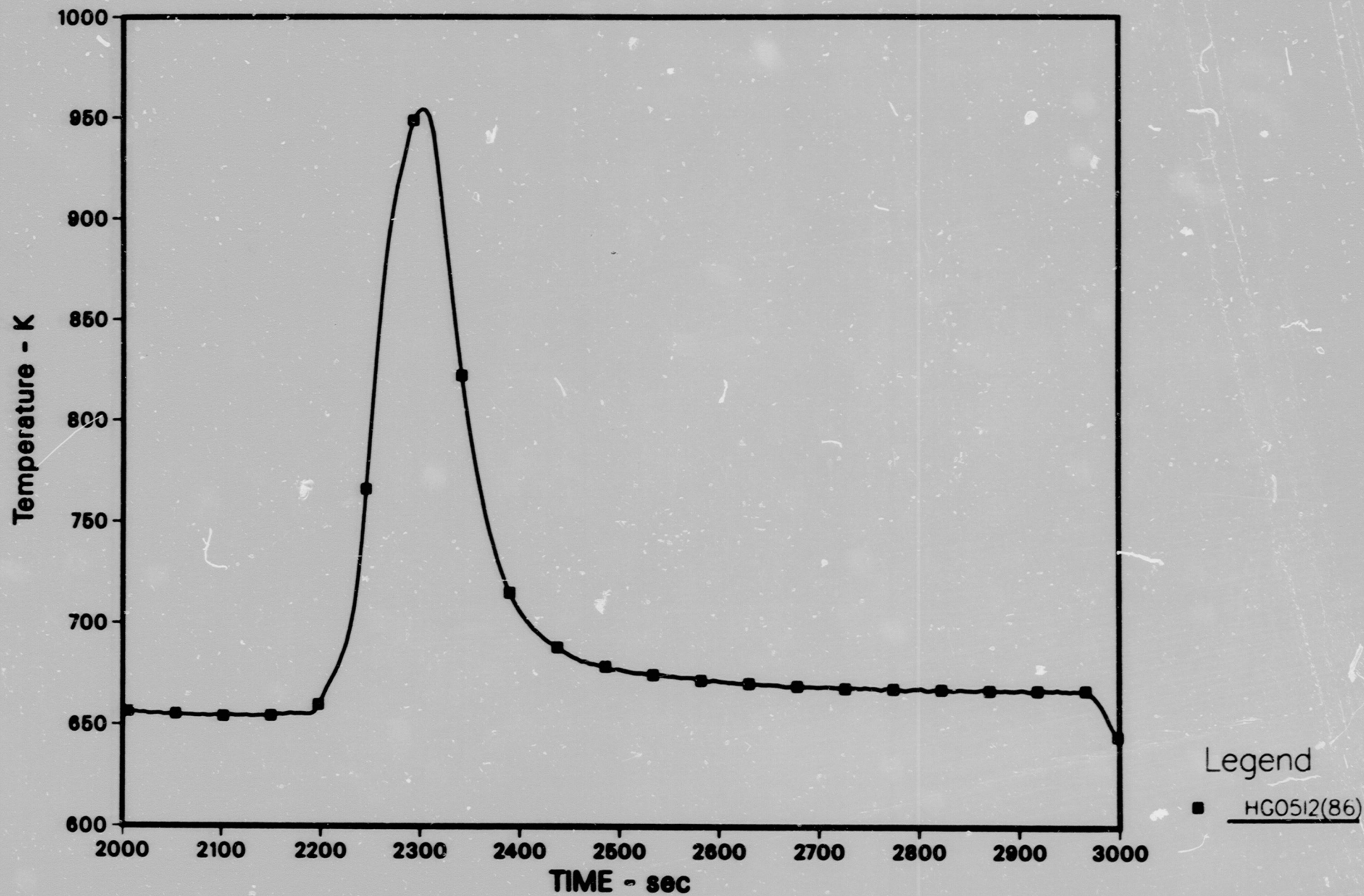
# DF-4 H2 Getter Tube 5, Heater Location 6in Above Bottom



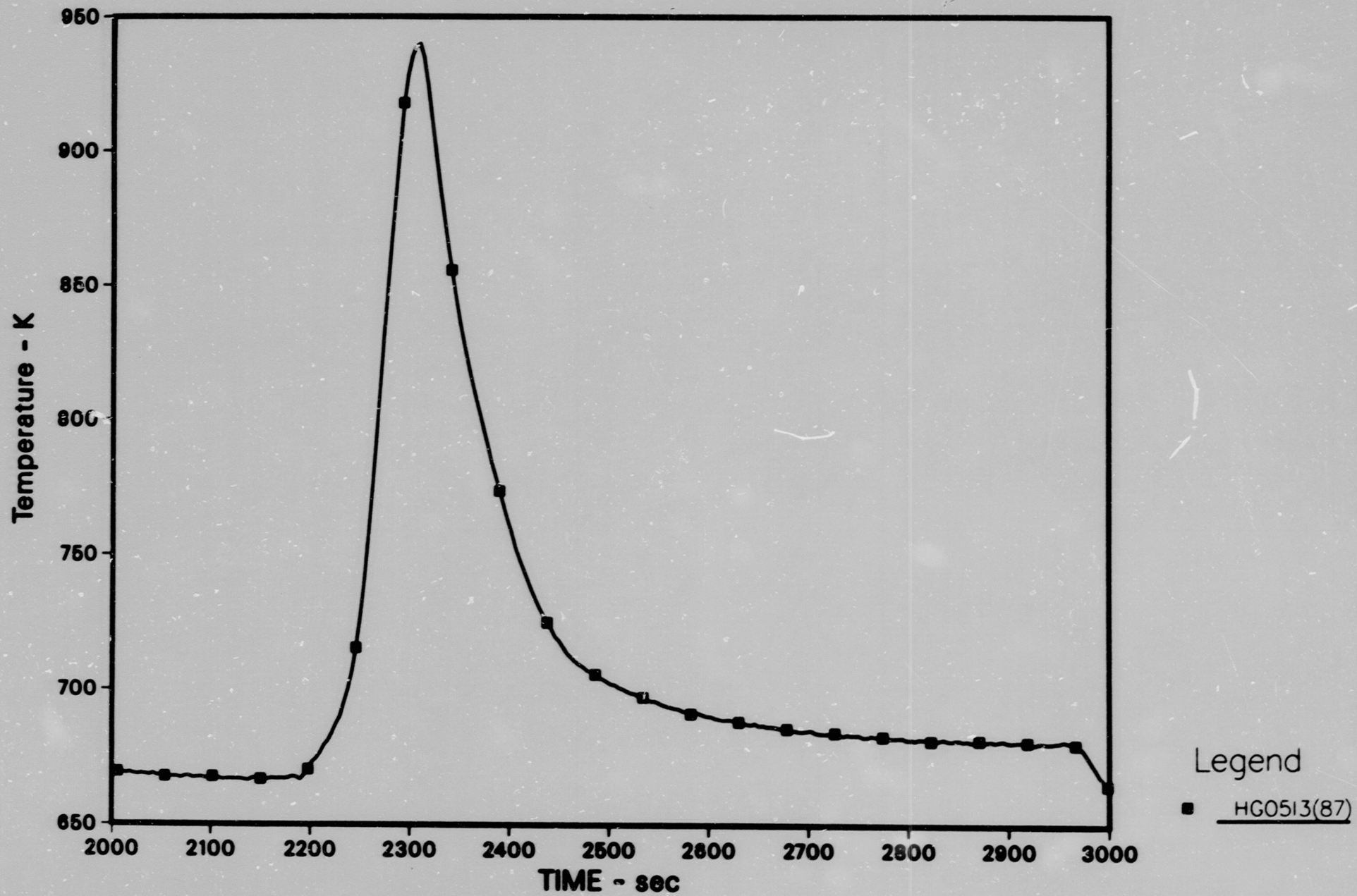
# DF-4 H2 Getter Tube 5, Internal 1in Above Bottom



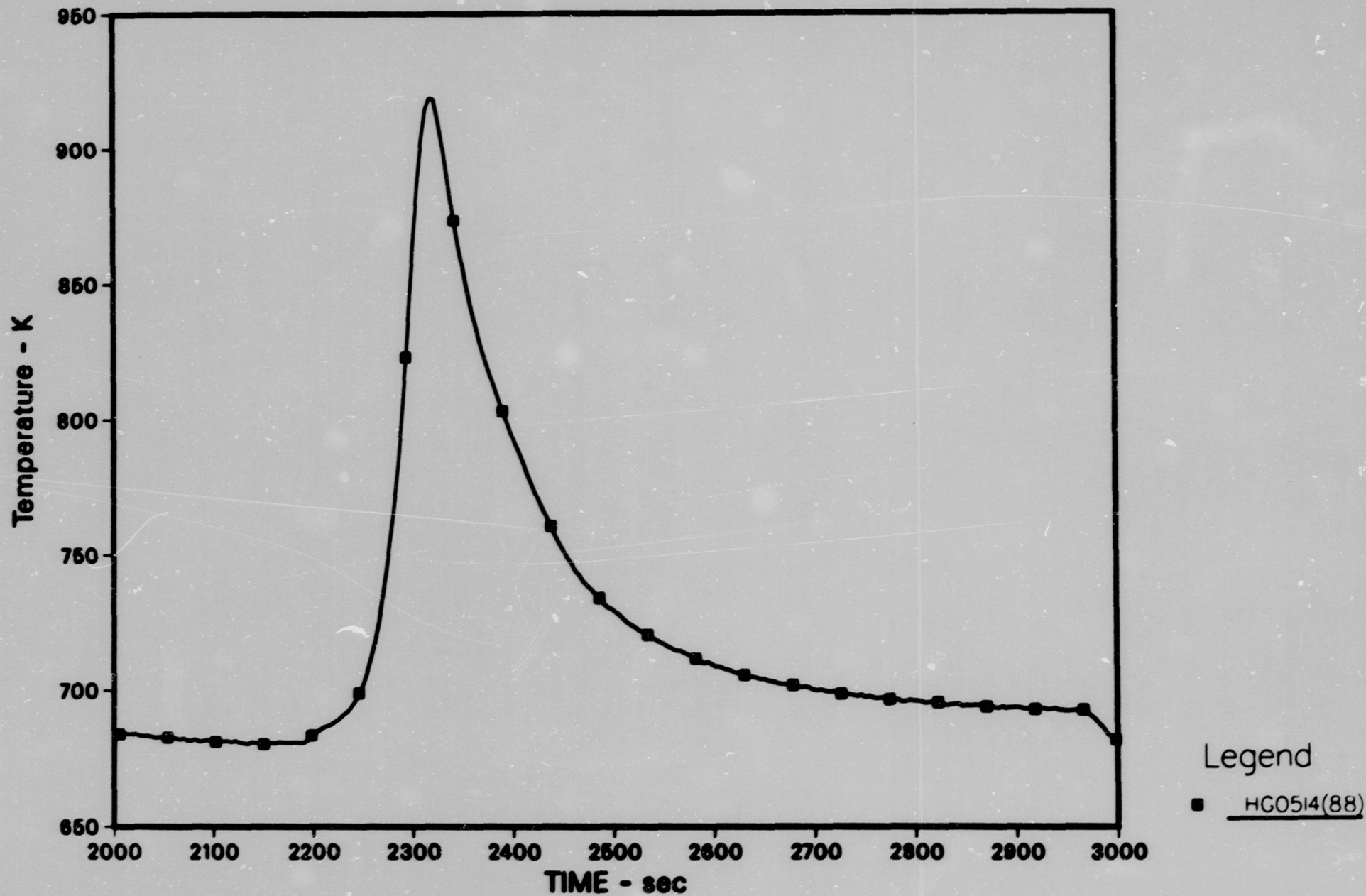
# DF-4 H2 Getter Tube 5, Internal 2in Above Bottom



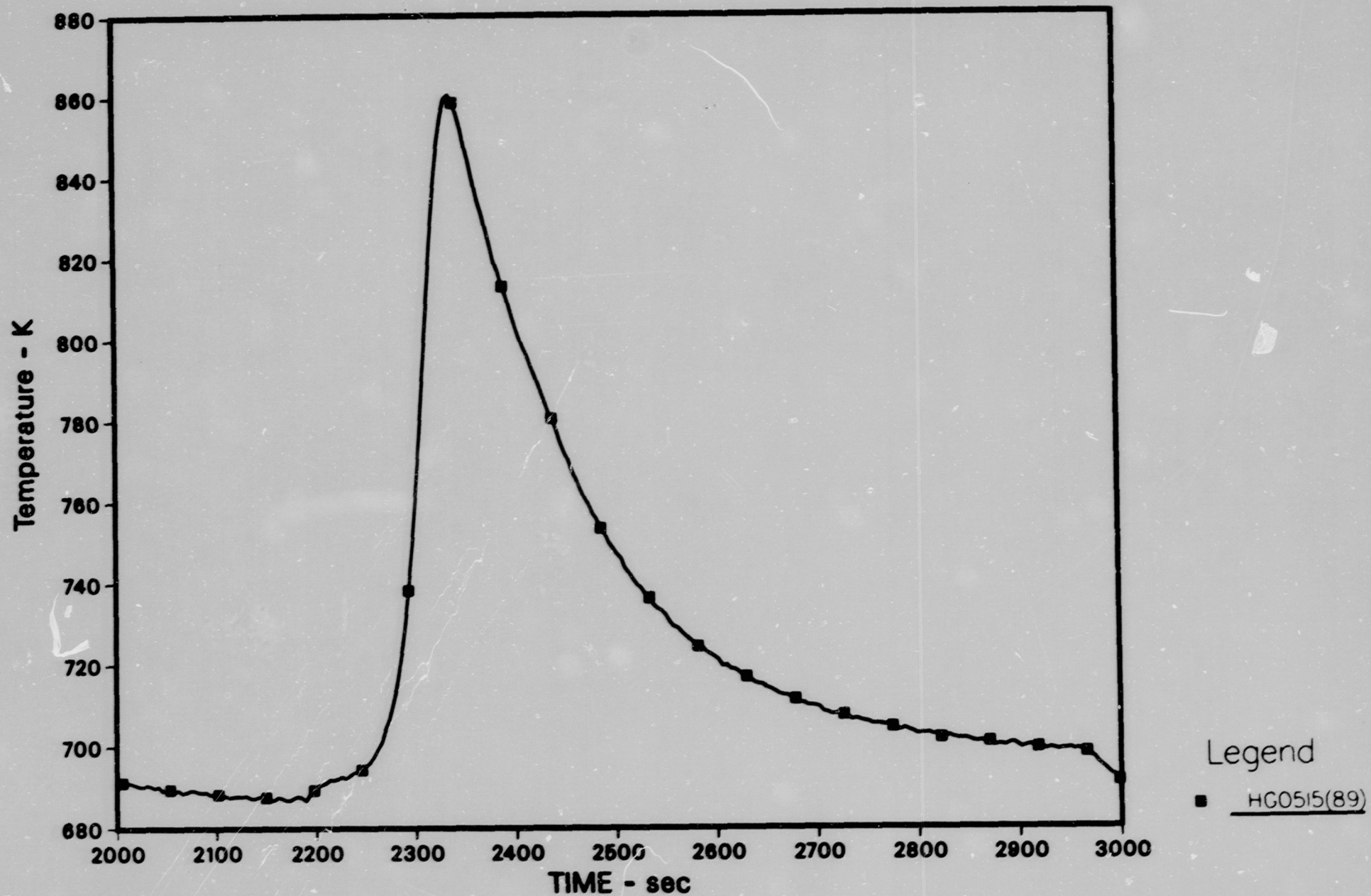
# DF-4 H2 Getter Tube 5, Internal 3in Above Bottom



# DF-4 H2 Getter Tube 5, Internal 4in Above Bottom

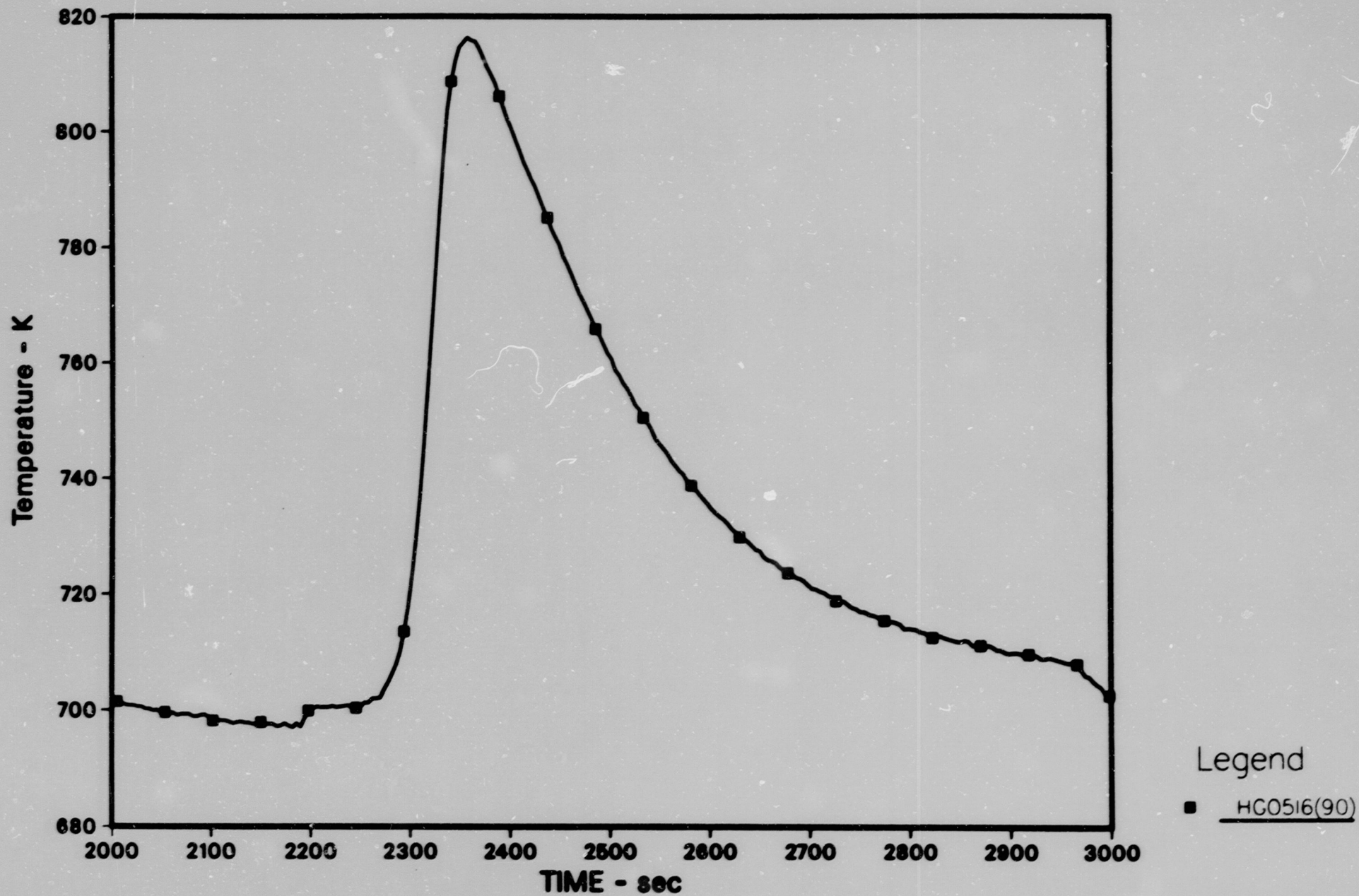


# DF-4 H2 Getter Tube 5, Internal 5in Above Bottom

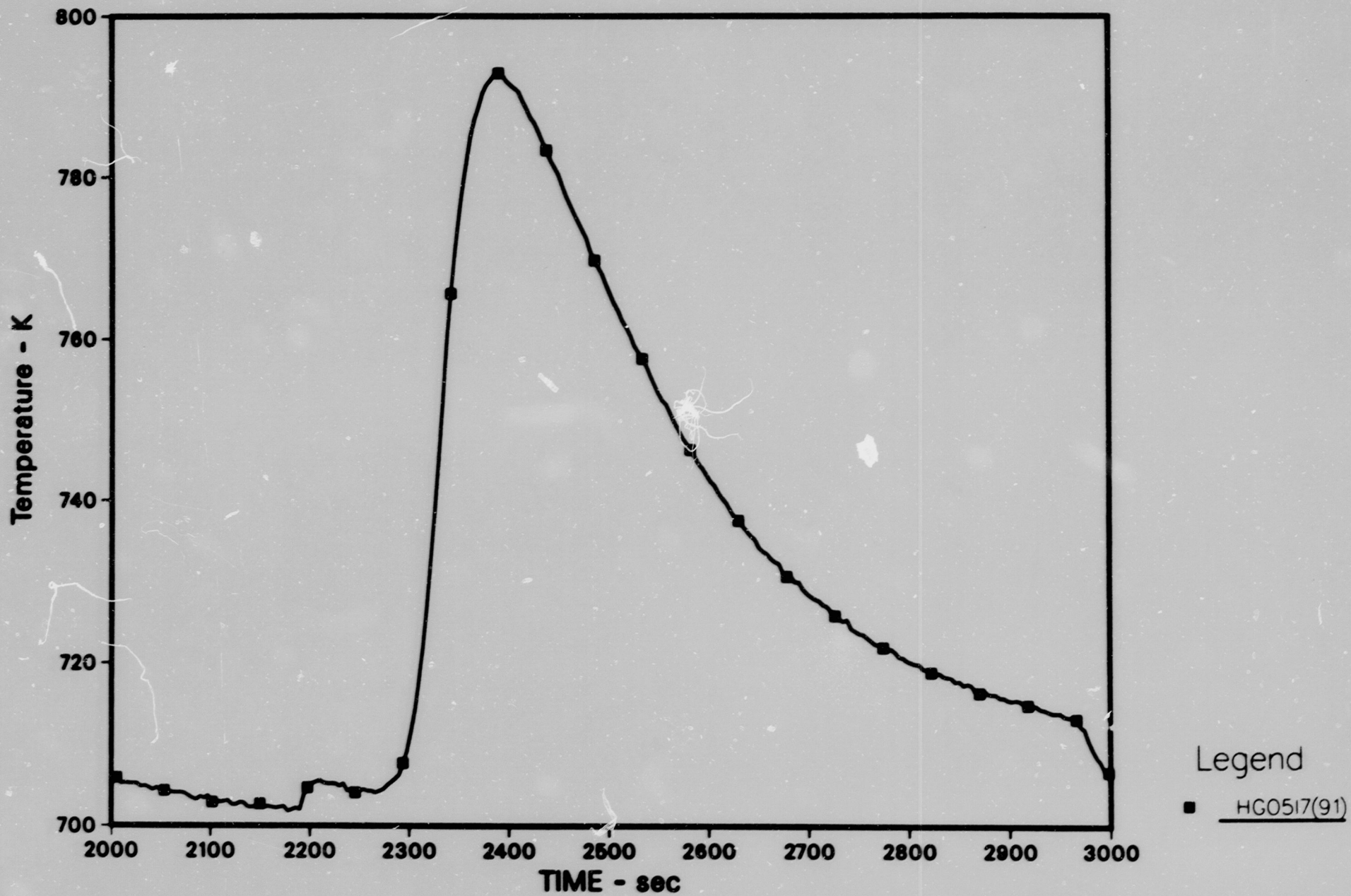




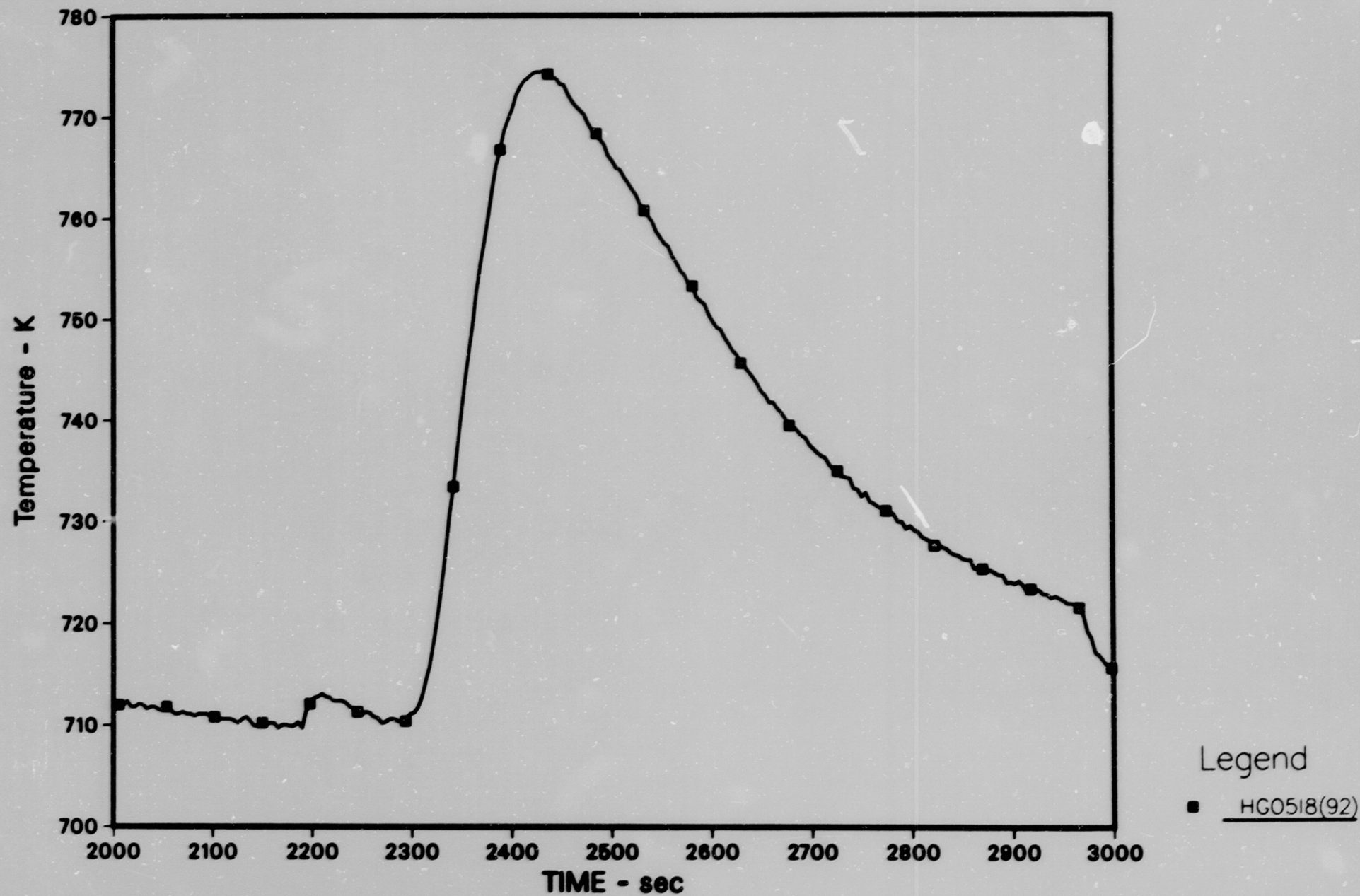
# DF-4 H2 Getter Tube 5, Internal 6in Above Bottom



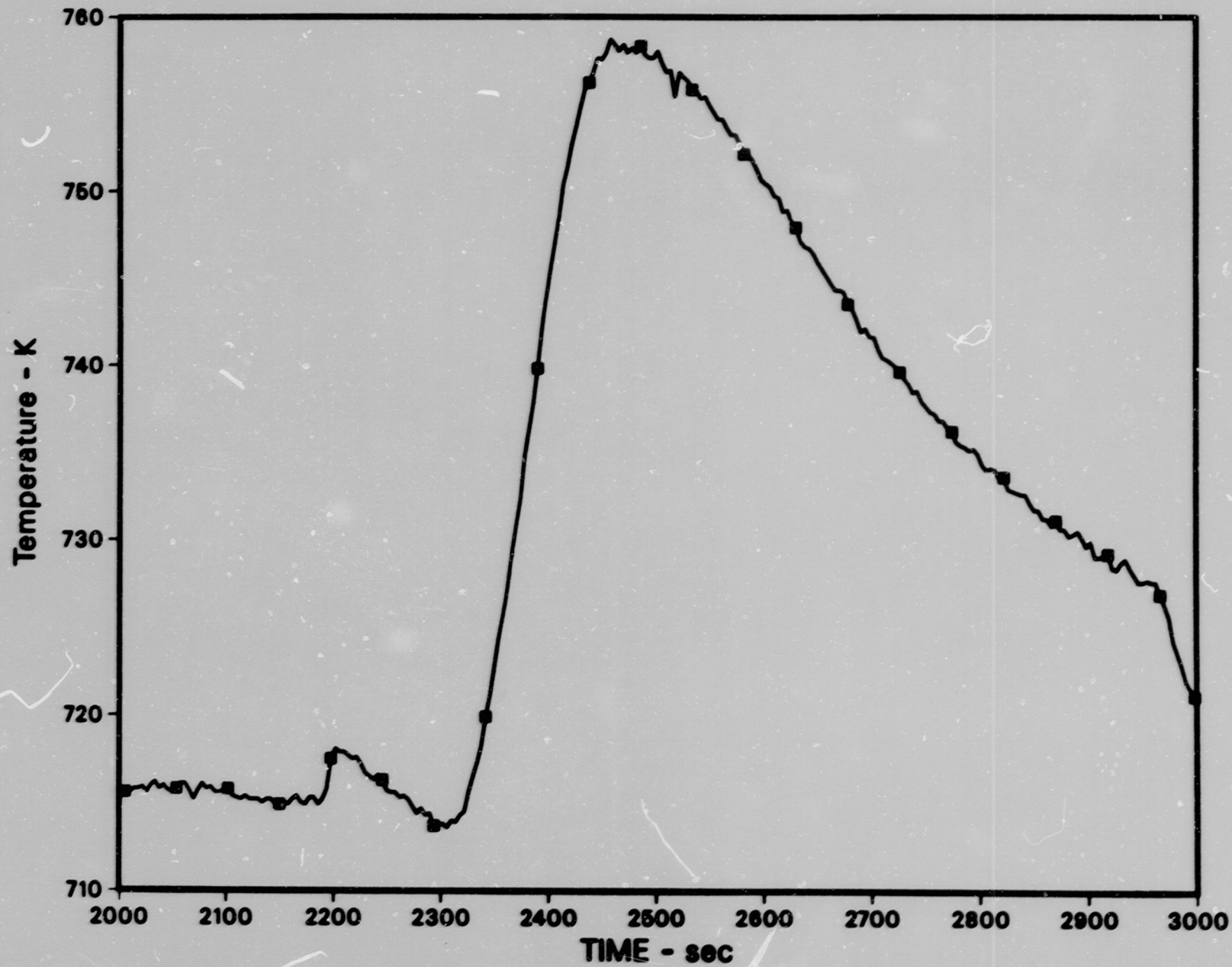
# DF-4 H2 Getter Tube 5, Internal 7in Above Bottom



# DF-4 H2 Getter Tube 5, Internal 8in Above Bottom

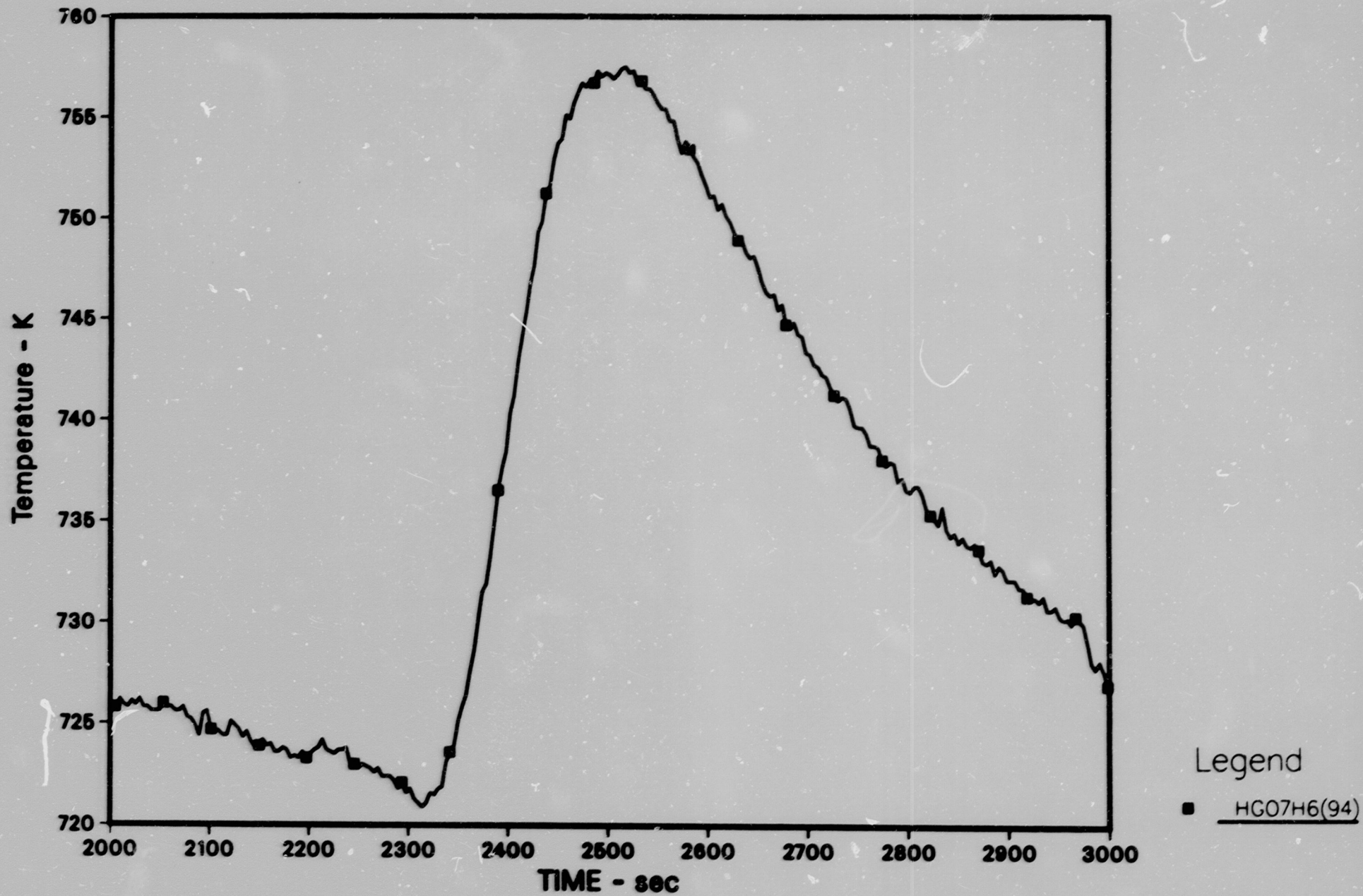


# DF-4 H2 Getter Tube 5, Internal 9in Above Bottom

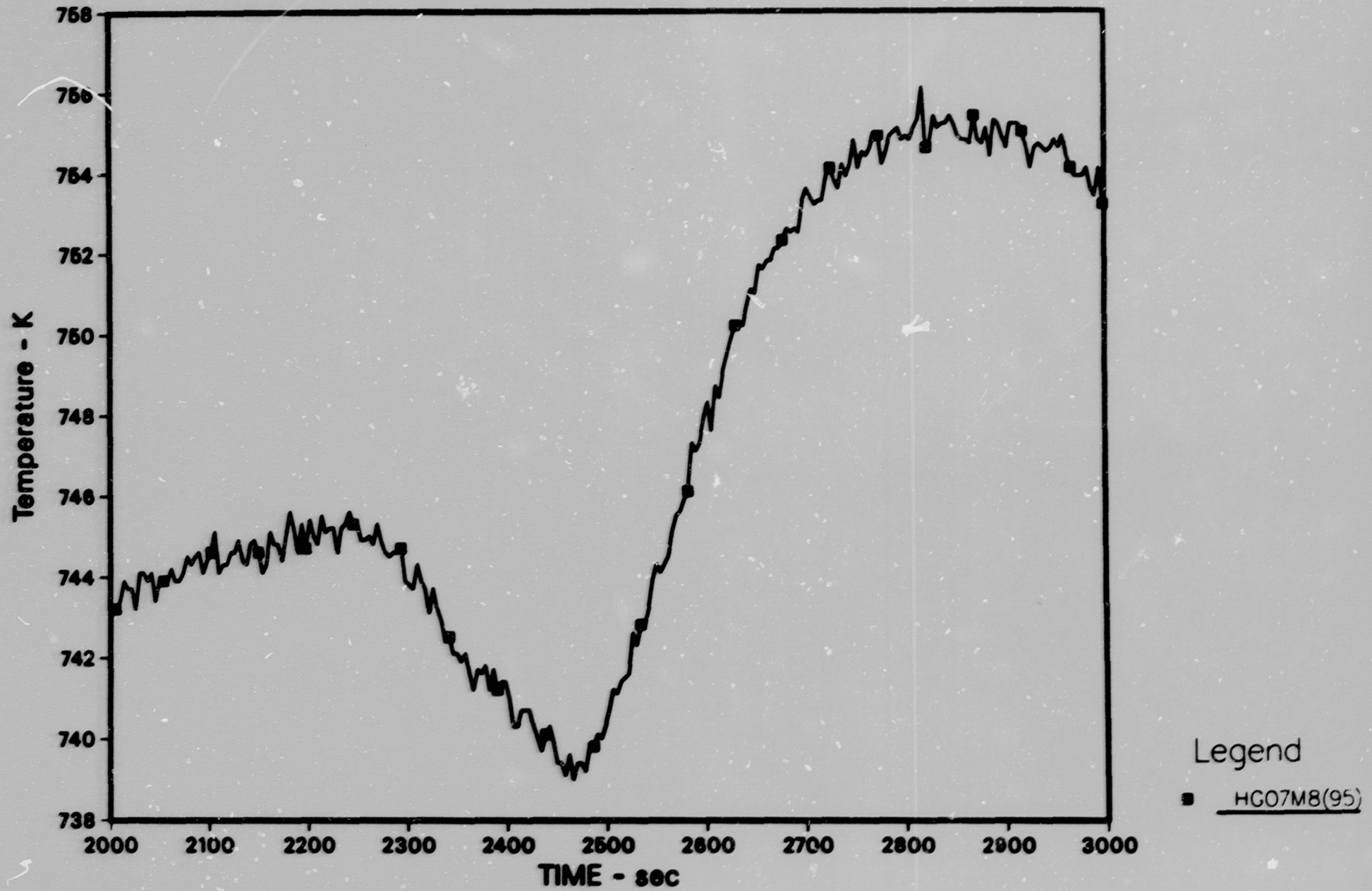


Legend  
■ HC0519(93)

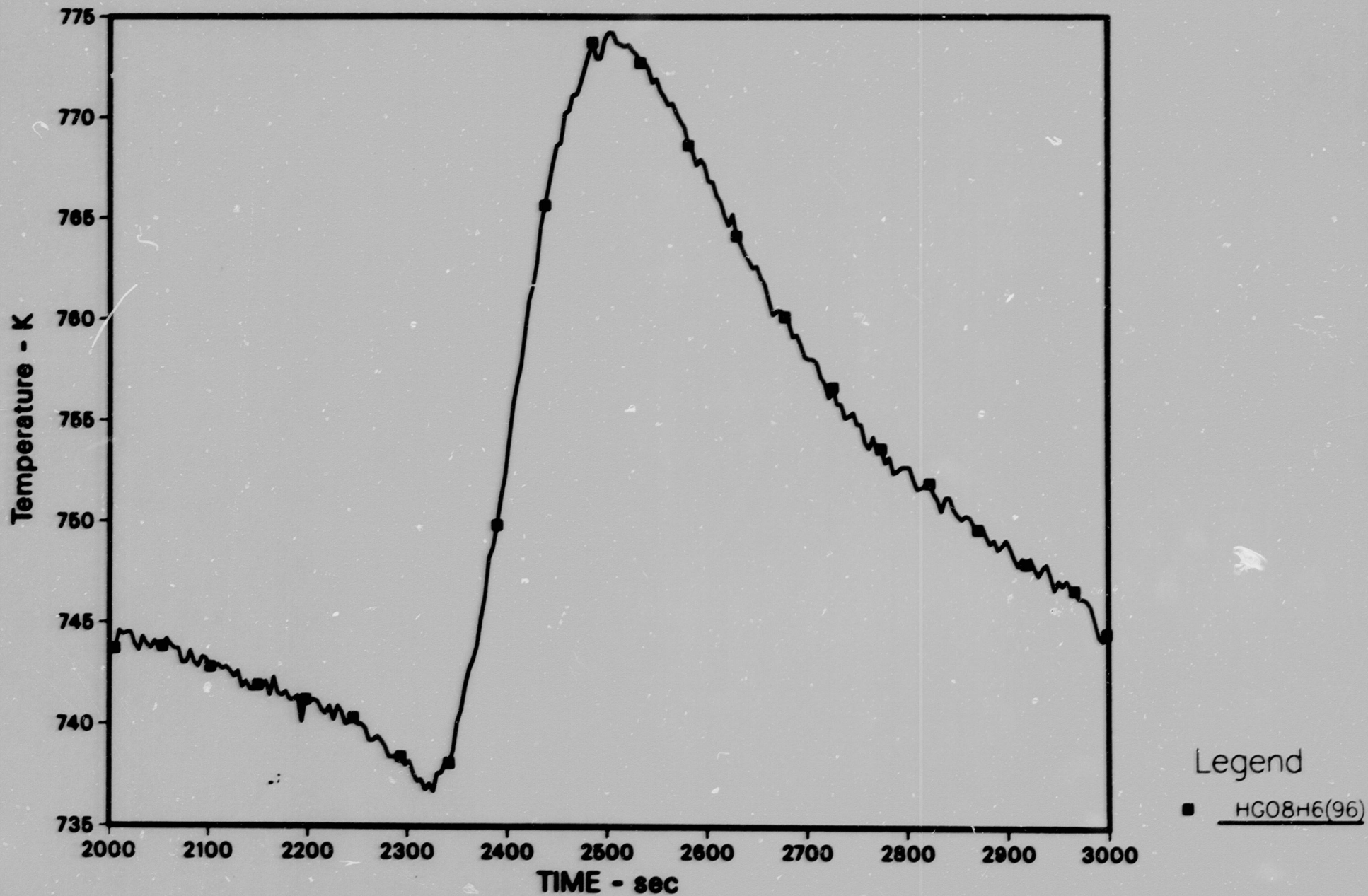
# DF-4 H2 Getter Tube 7, Heater Location 6in Above Bottom



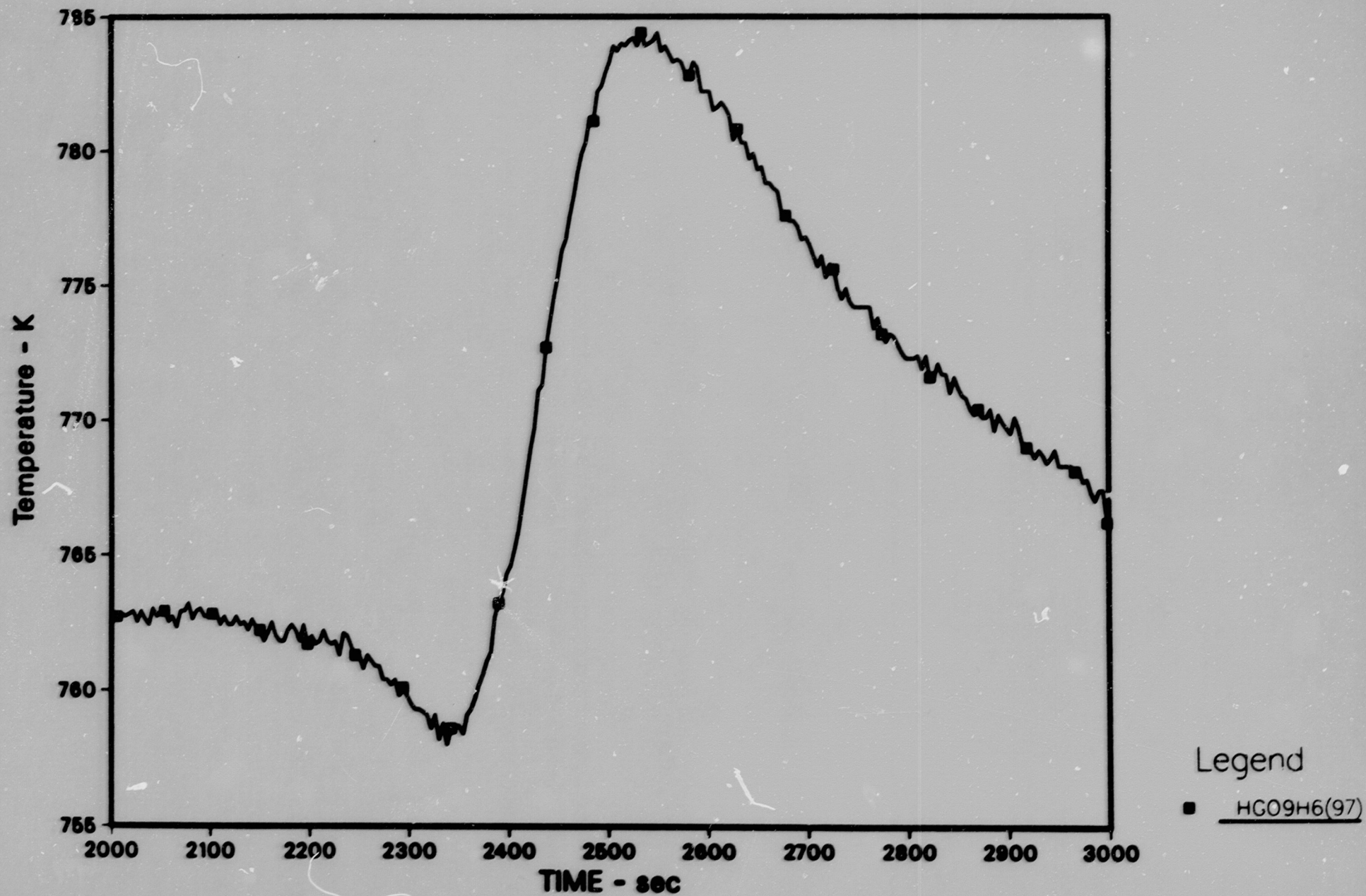
# DF-4 H2 Getter Tube 7, Mixing Tube Side 8in Above Bottom



# DF-4 H2 Getter Tube 8, Heater Location 6in Above Bottom

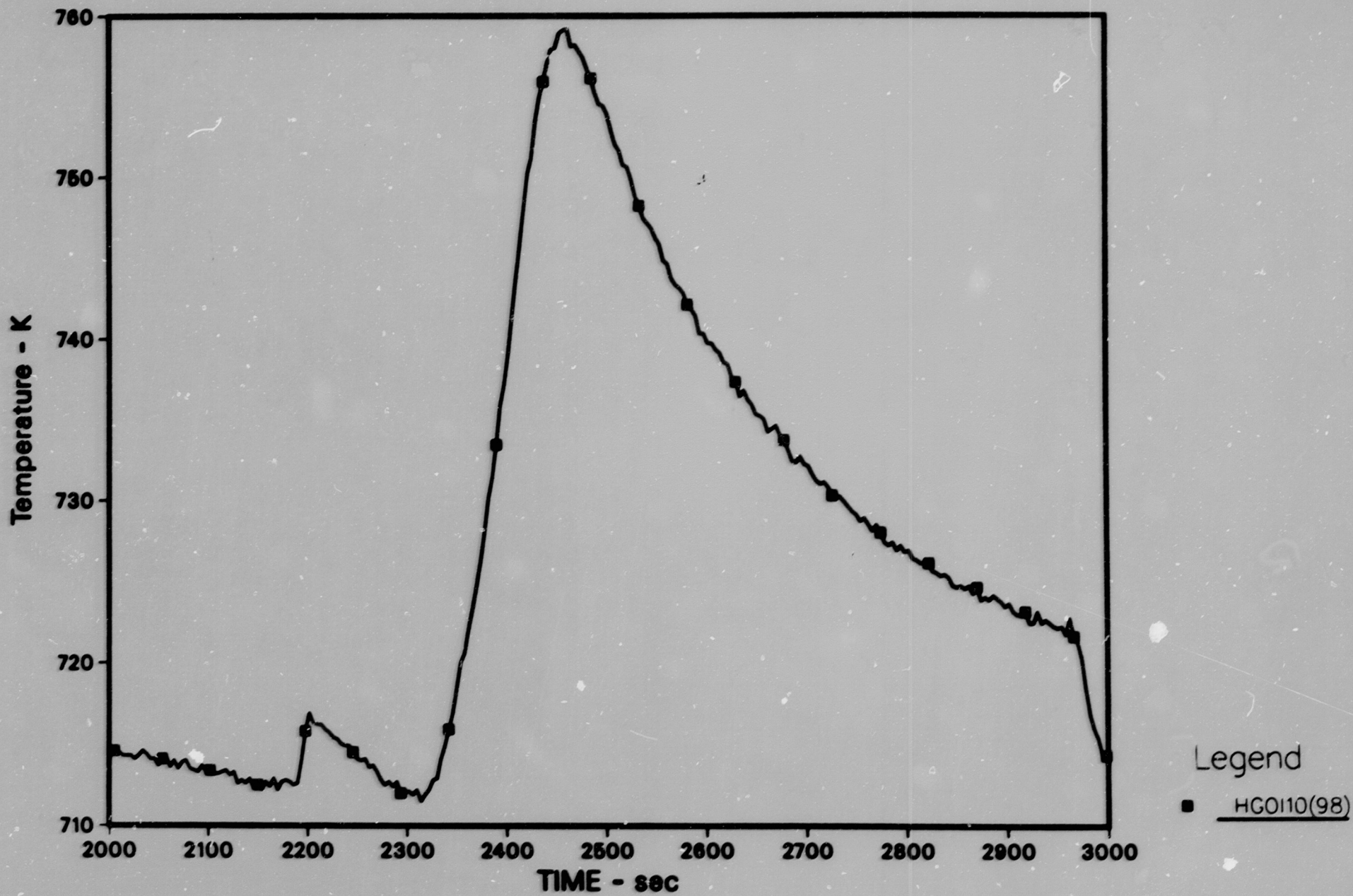


# DF-4 H2 Getter Tube 9, Heater Location 6in Above Bottom

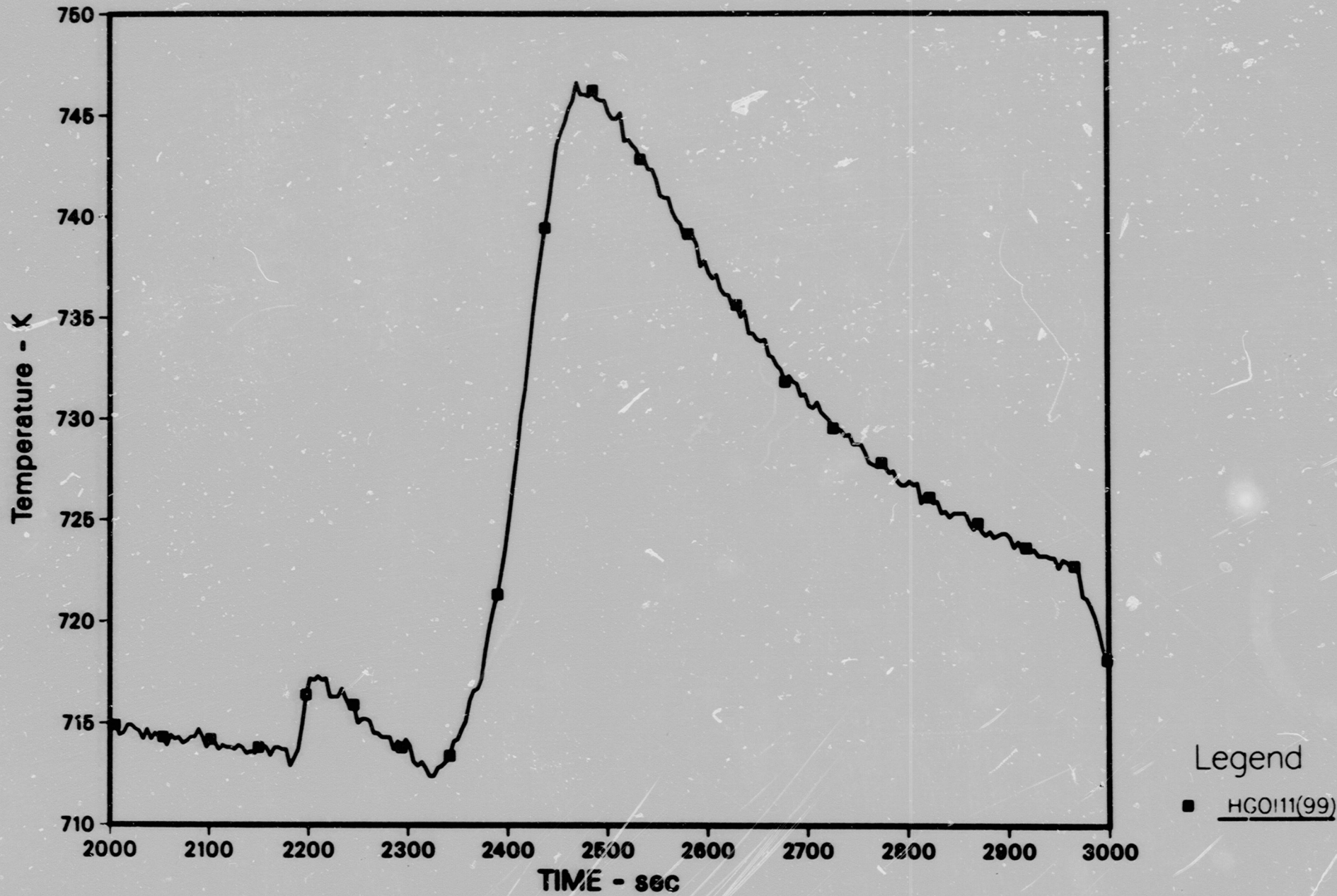




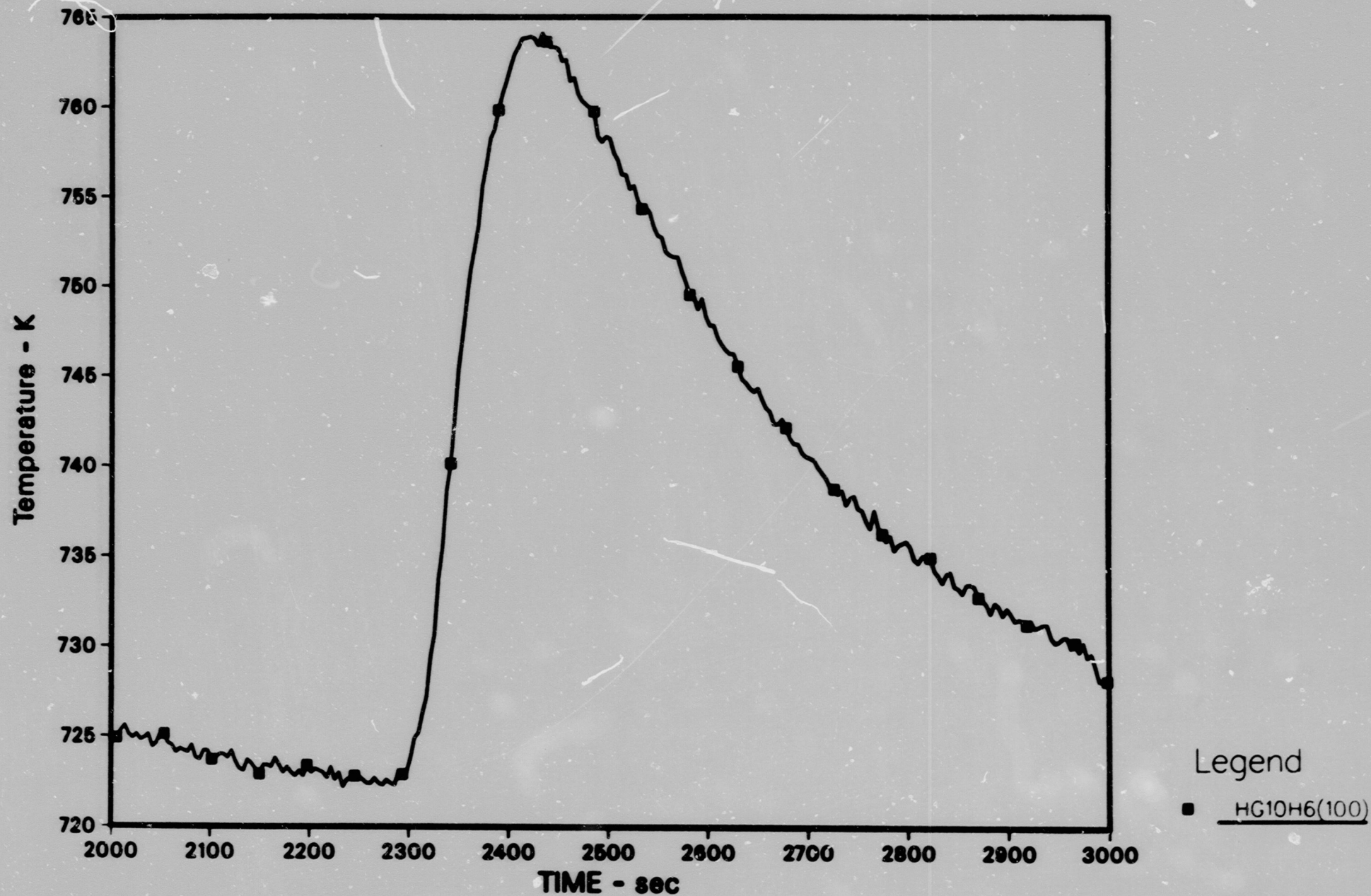
# DF-4 H2 Getter Tube 10, Internal 10In Above Bottom



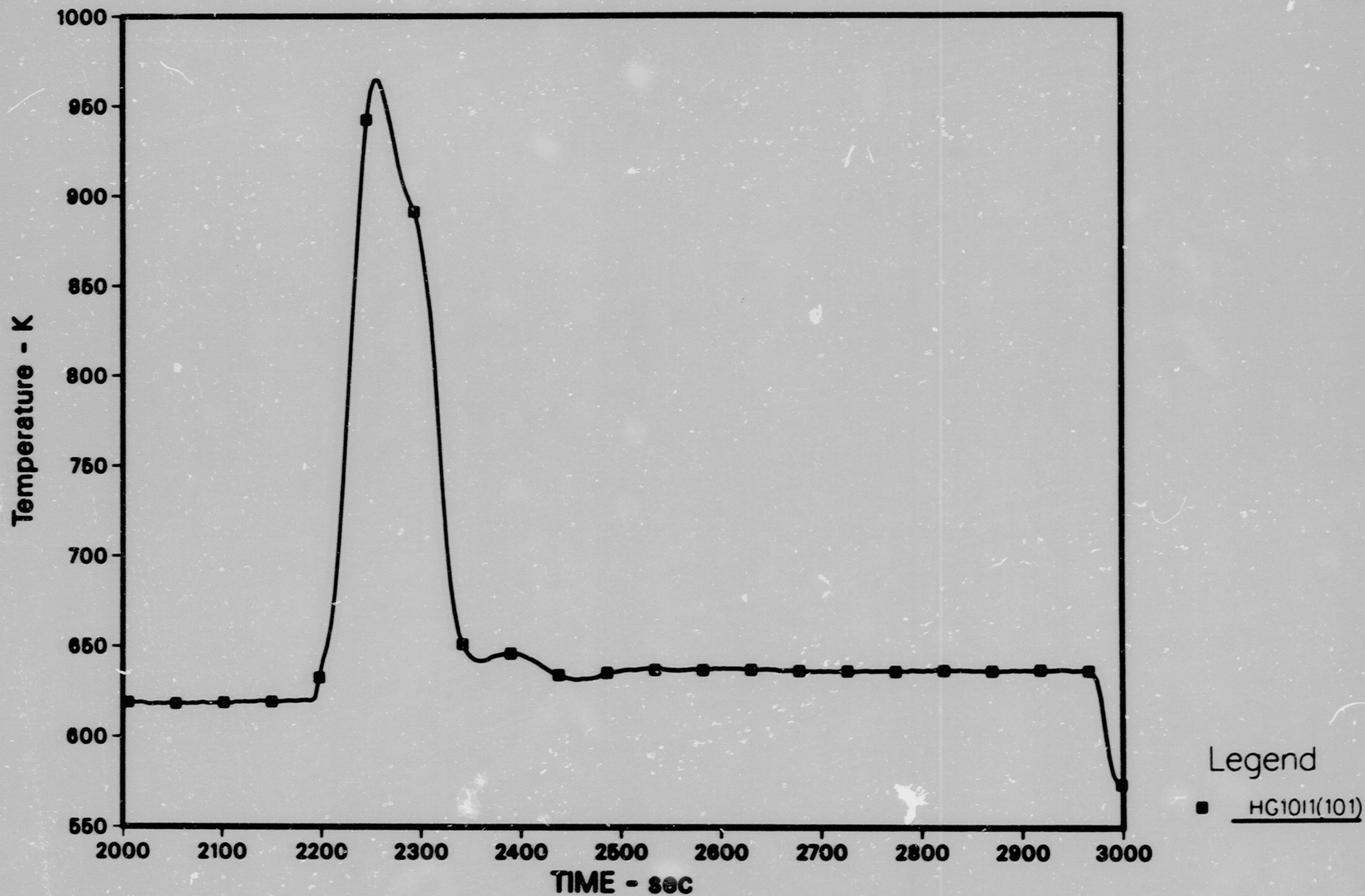
# DF-4 H2 Getter Tube 10, Internal 11in Above Bottom



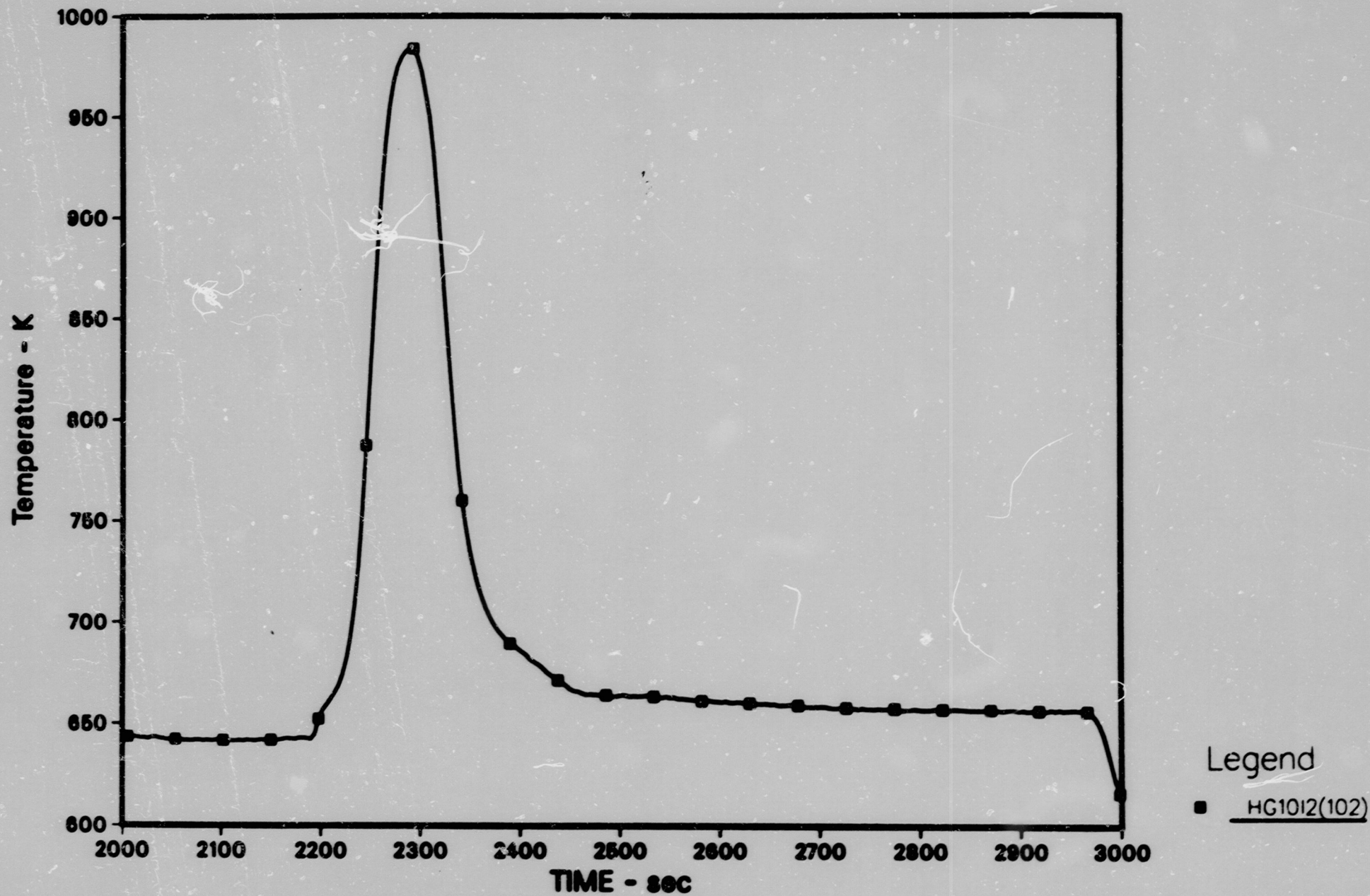
# DF-4 H2 Getter Tube 10, Heater Location 6in Above Bottom



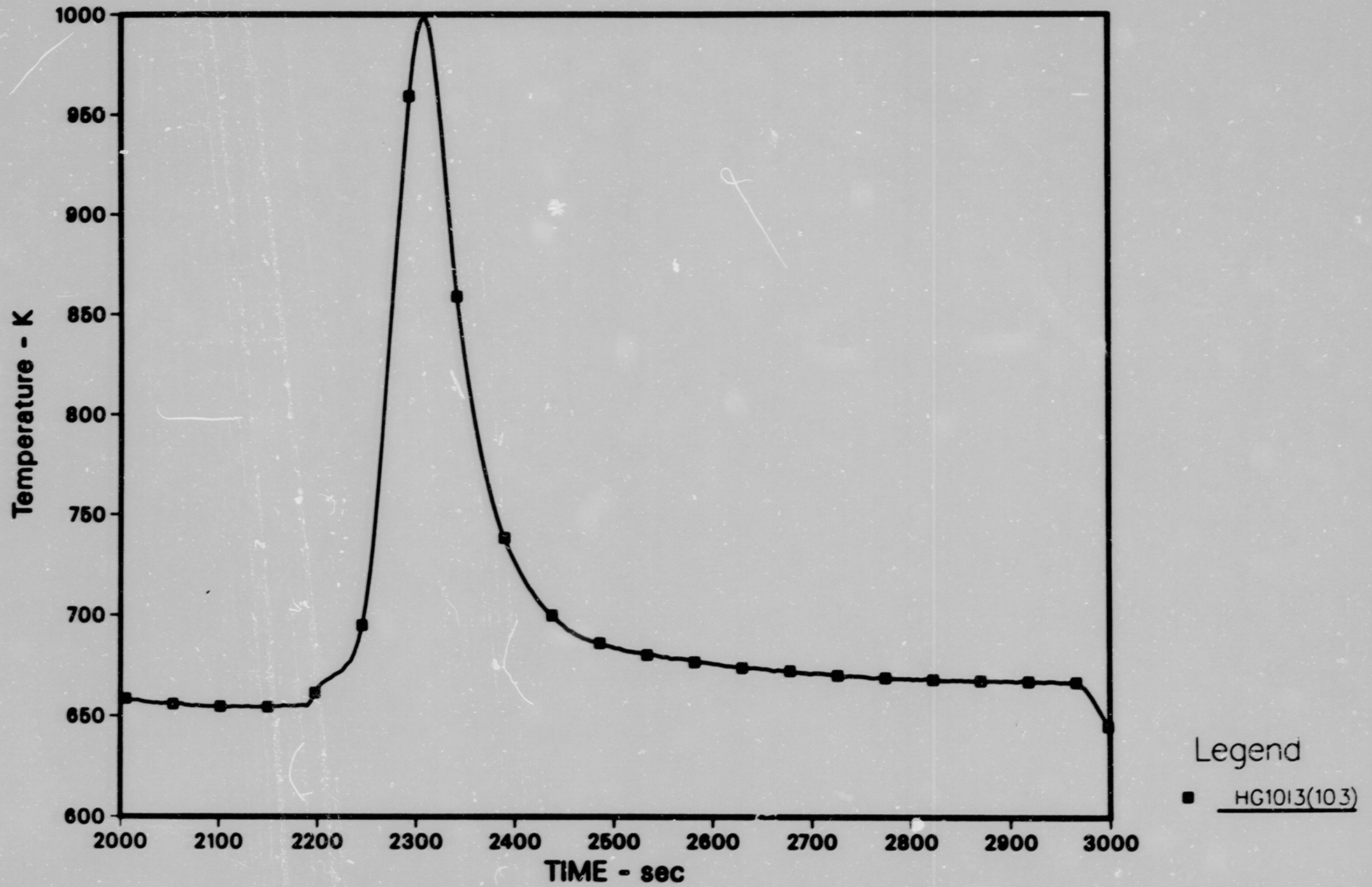
# DF-4 H2 Getter Tube 10, Internal 1in Above Bottom



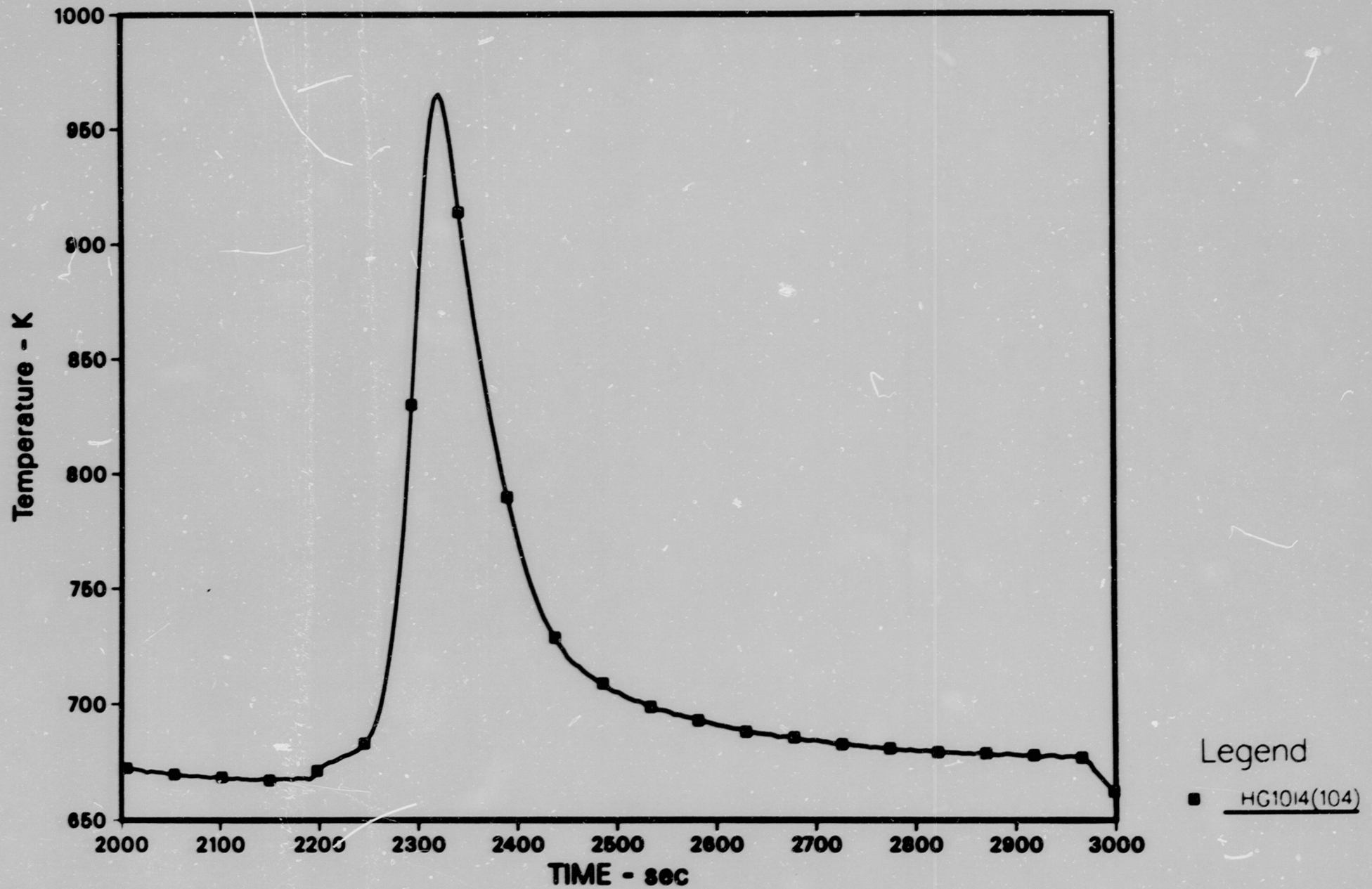
# DF-4 H2 Getter Tube 10, Internal 2In Above Bottom



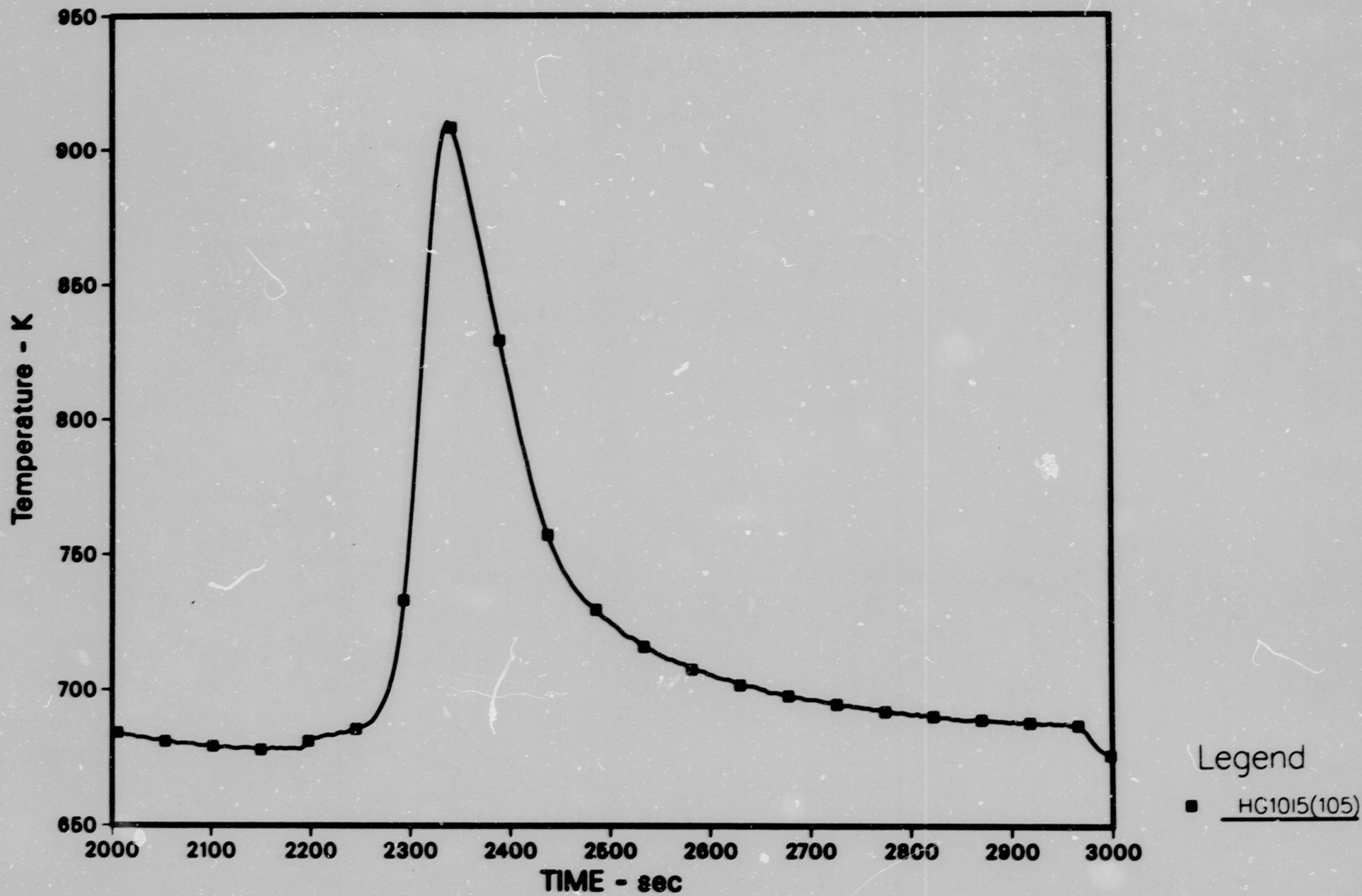
# DF-4 H2 Getter Tube 10, Internal 3In Above Bottom



# DF-4 H2 Getter Tube 10, Internal 4In Above Bottom

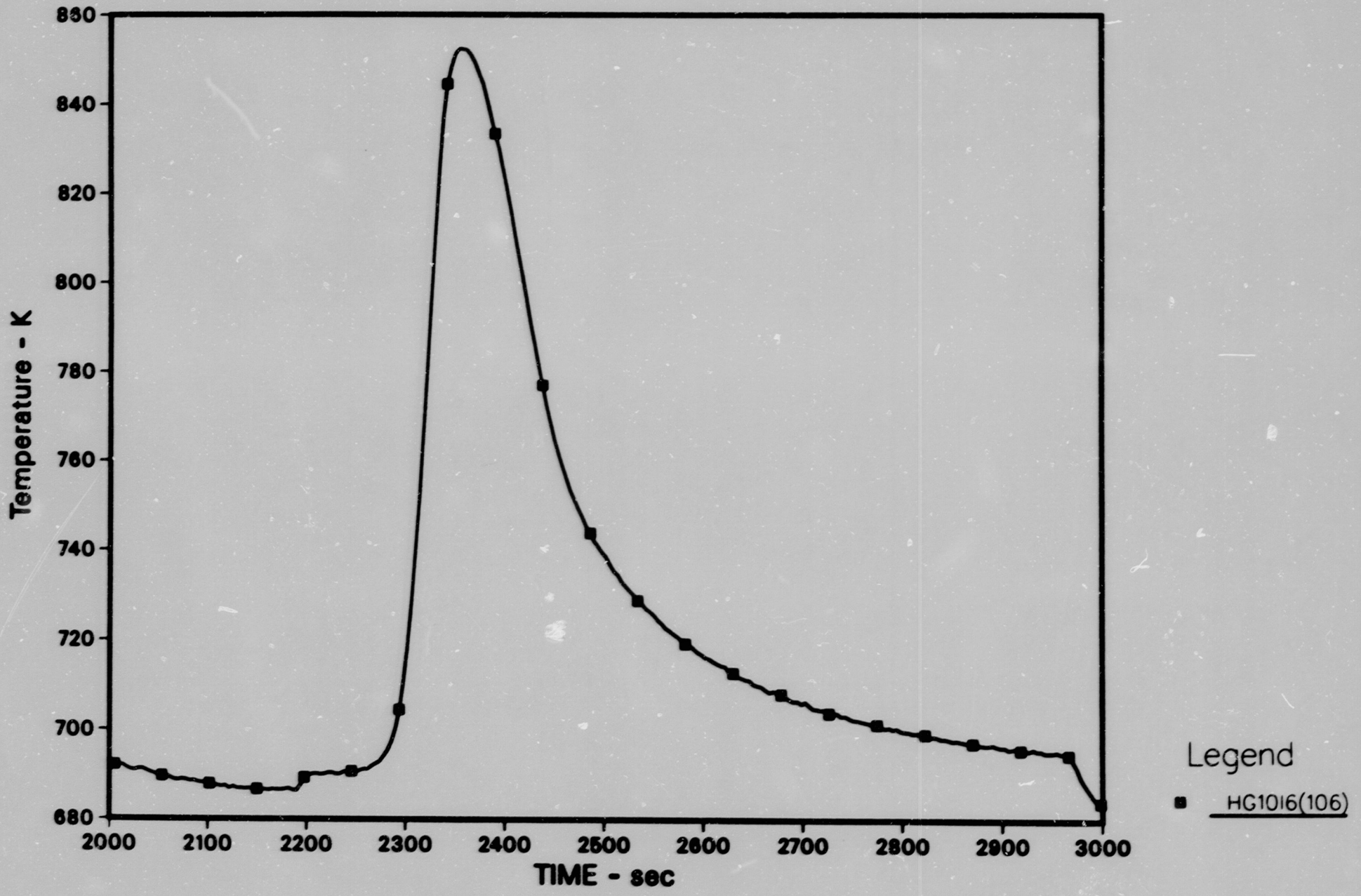


# DF-4 H2 Getter Tube 10, Internal 5in Above Bottom

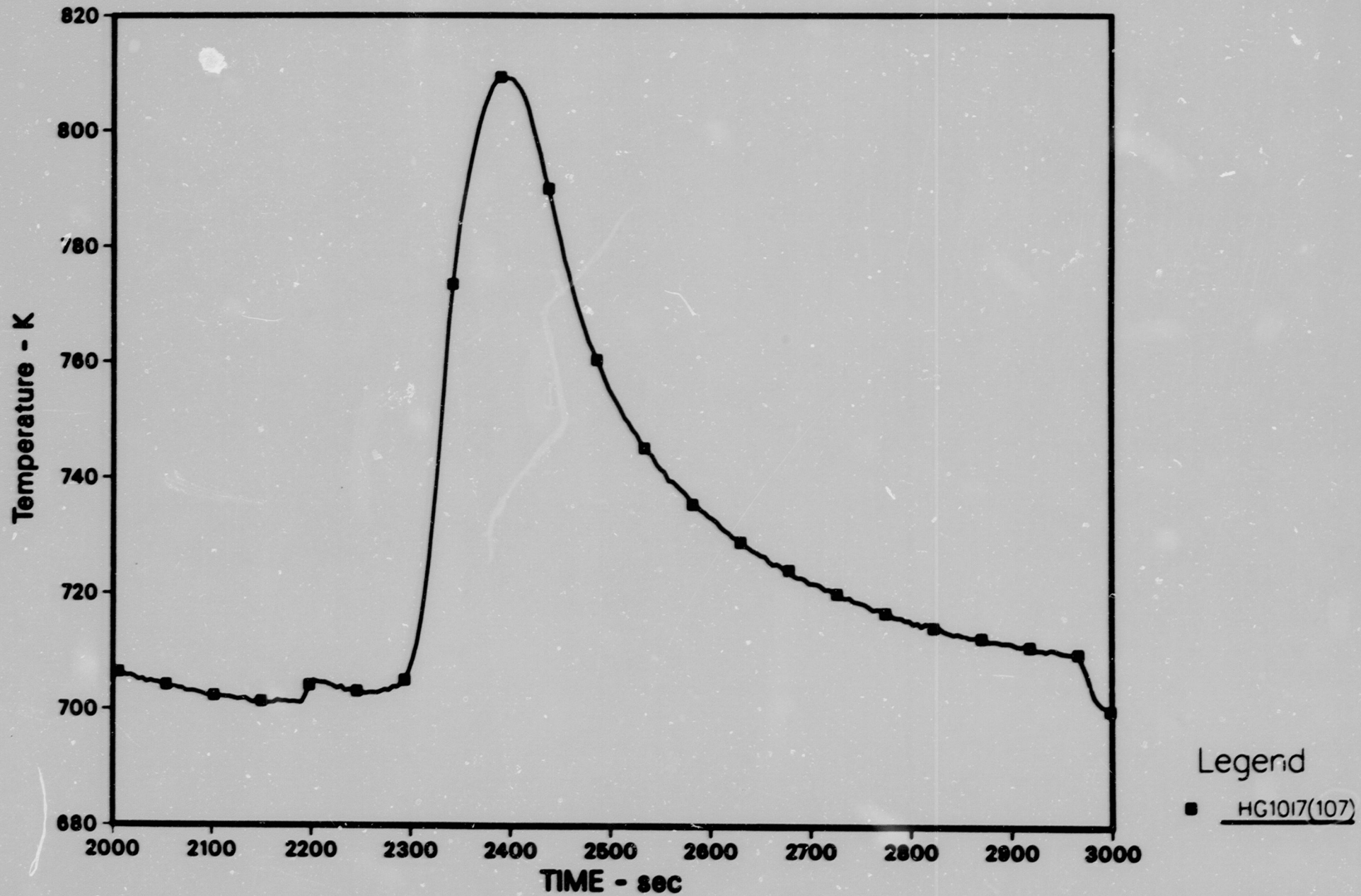




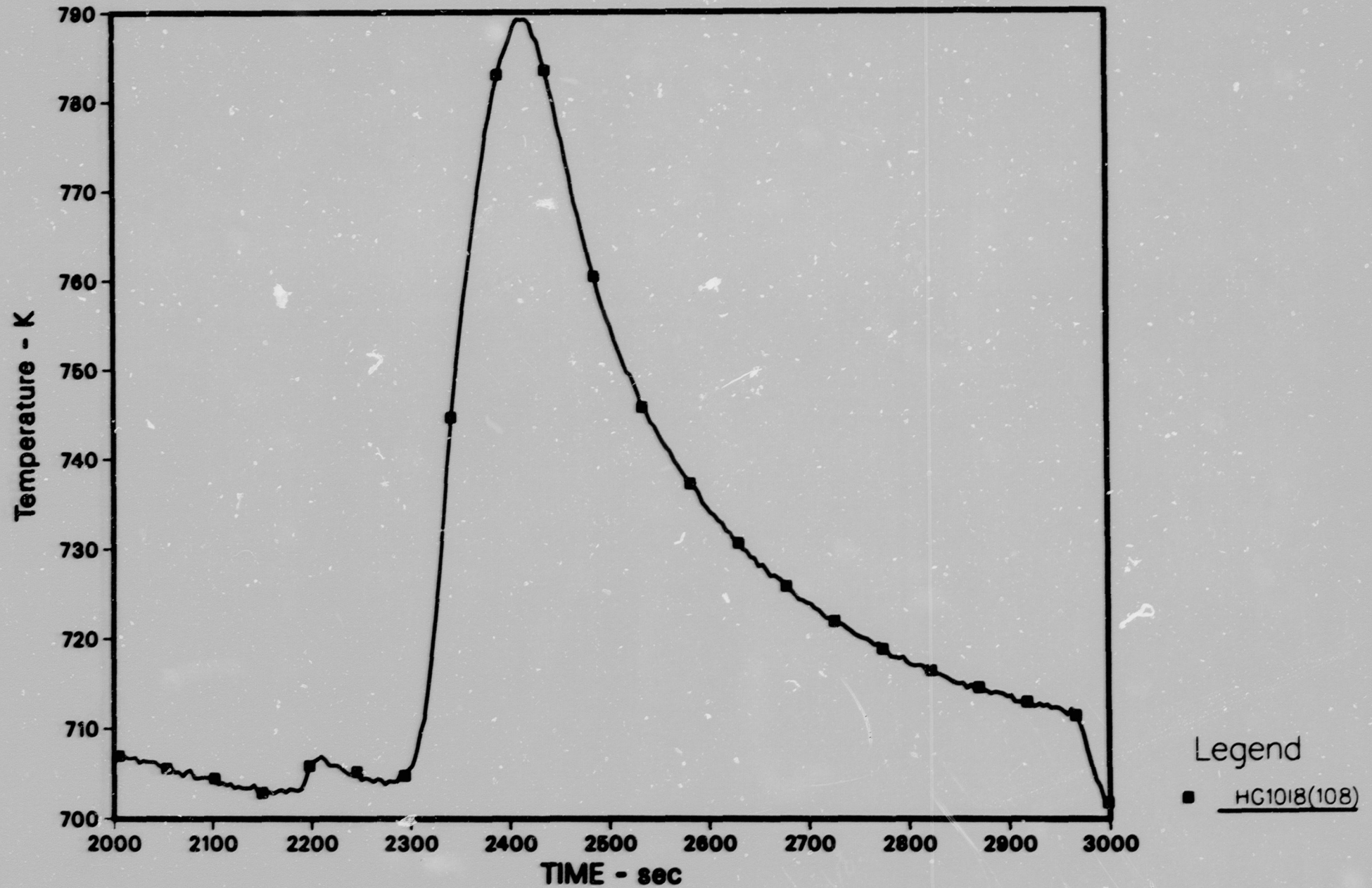
# DF-4 H2 Getter Tube 10, Internal 6in Above Bottom



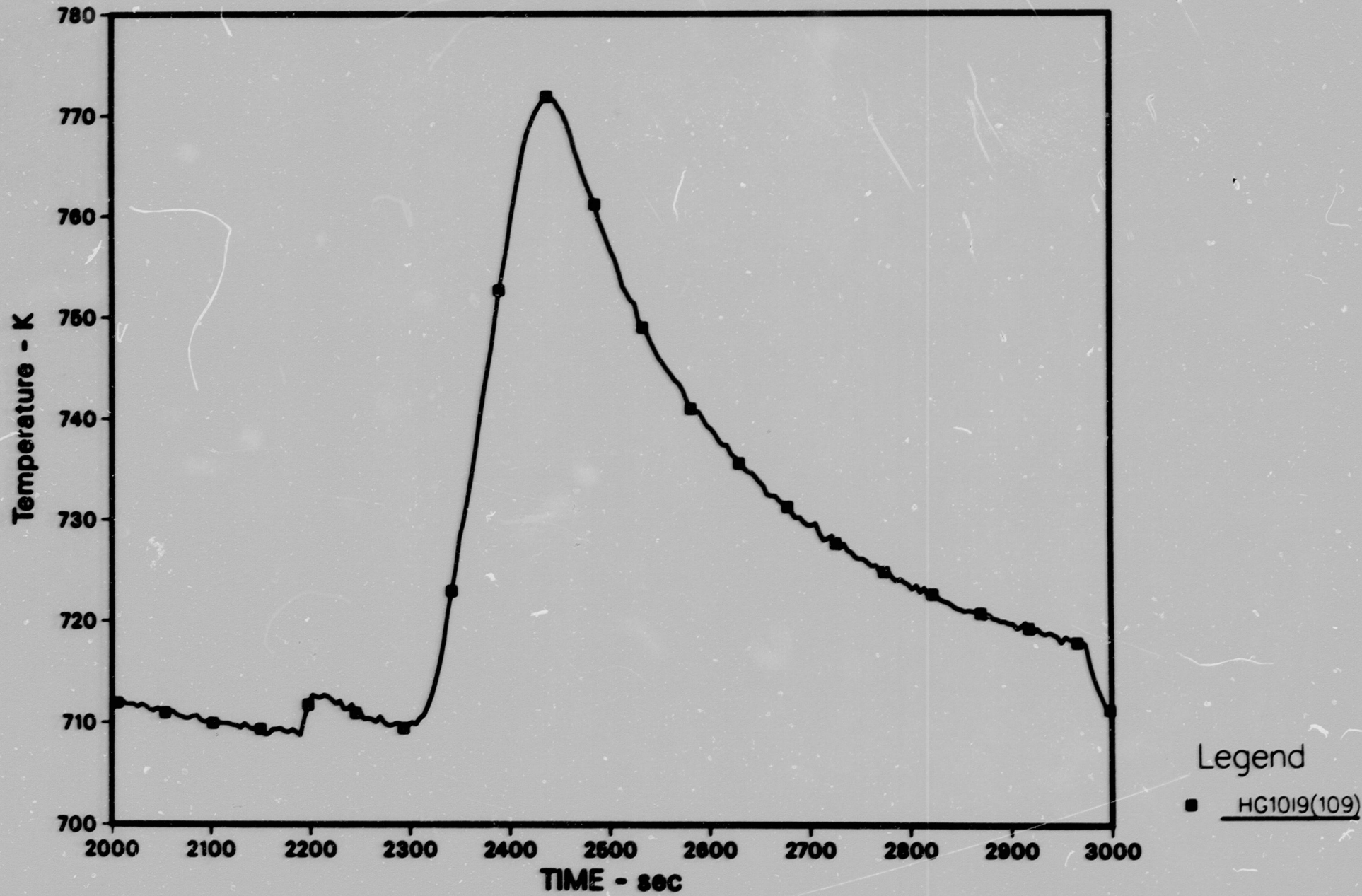
# DF-4 H2 Getter Tube 10, Internal 7in Above Bottom



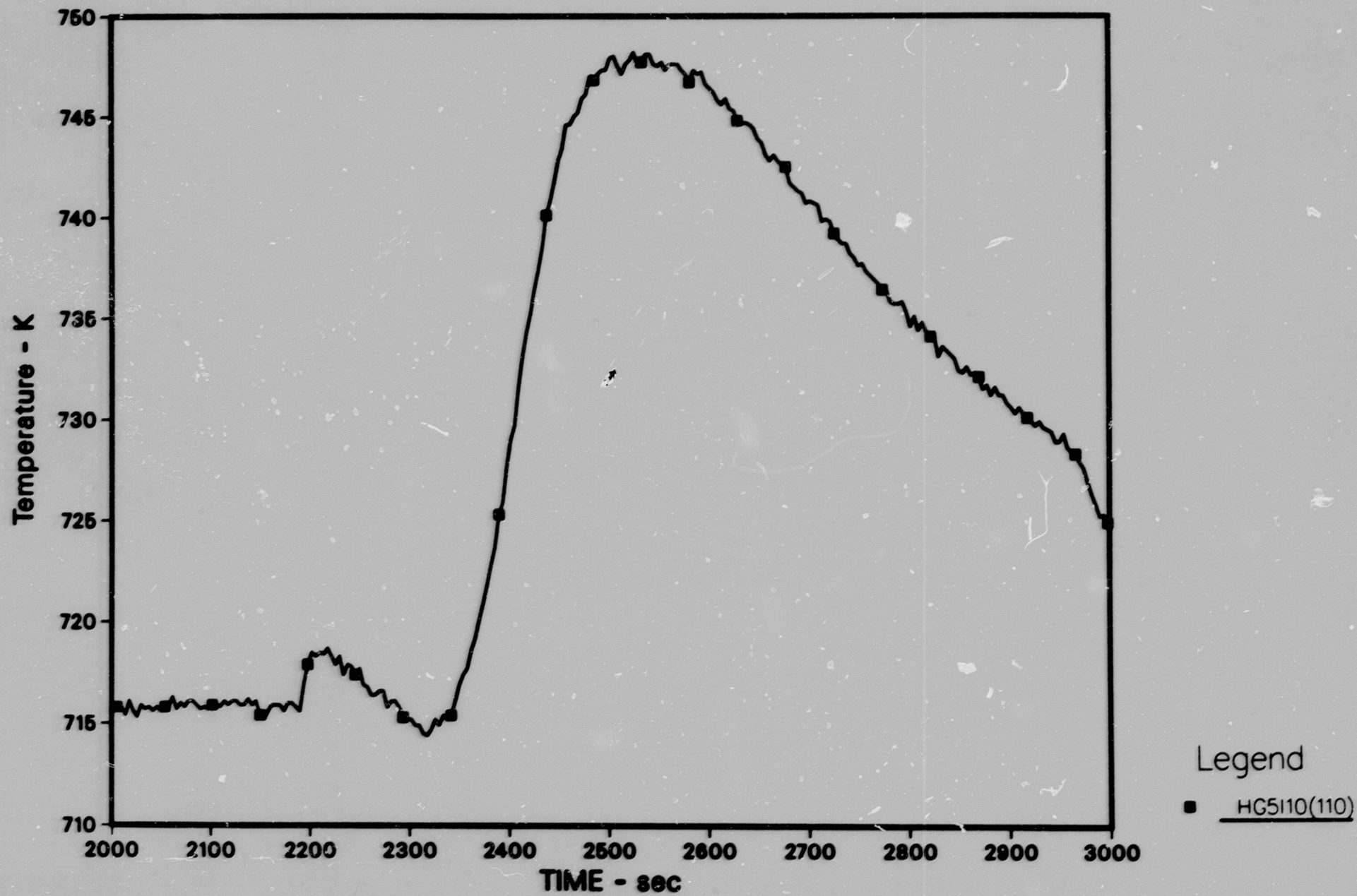
# DF-4 H2 Getter Tube 10, Internal 8in Above Bottom



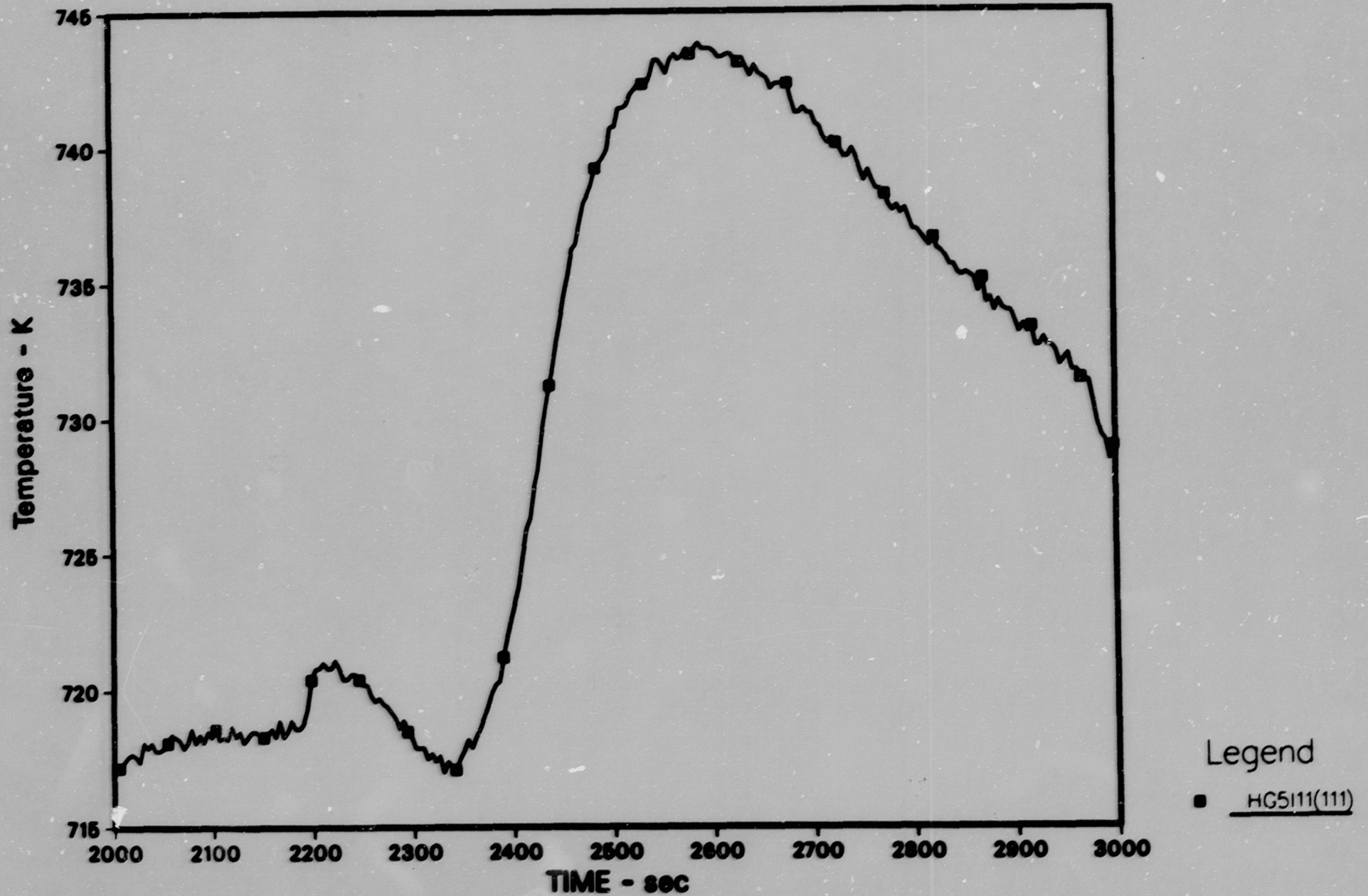
# DF-4 H2 Getter Tube 10, Internal 9in Above Bottom



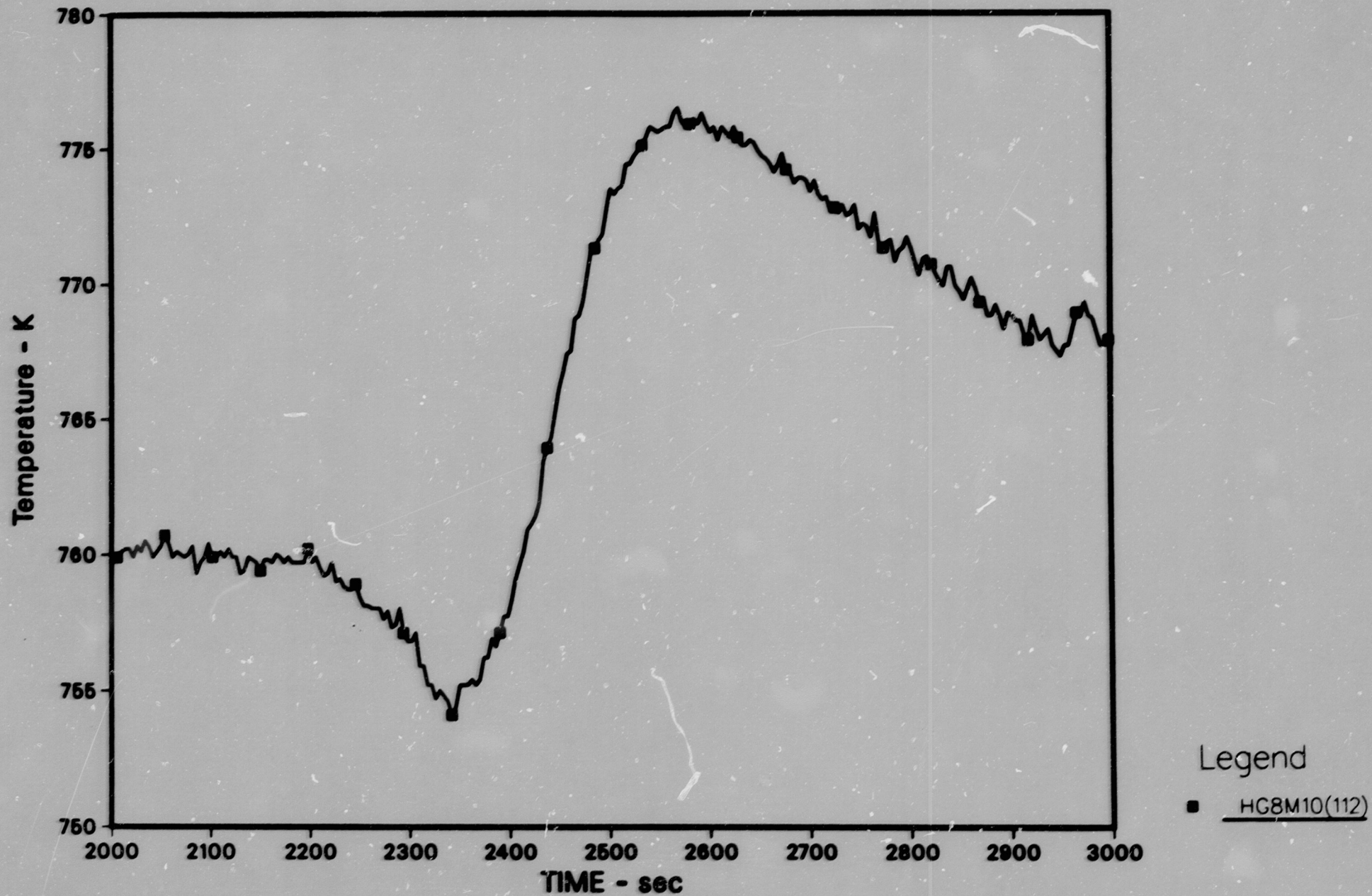
# DF-4 H2 Getter Tube 5, Internal 10in Above Bottom



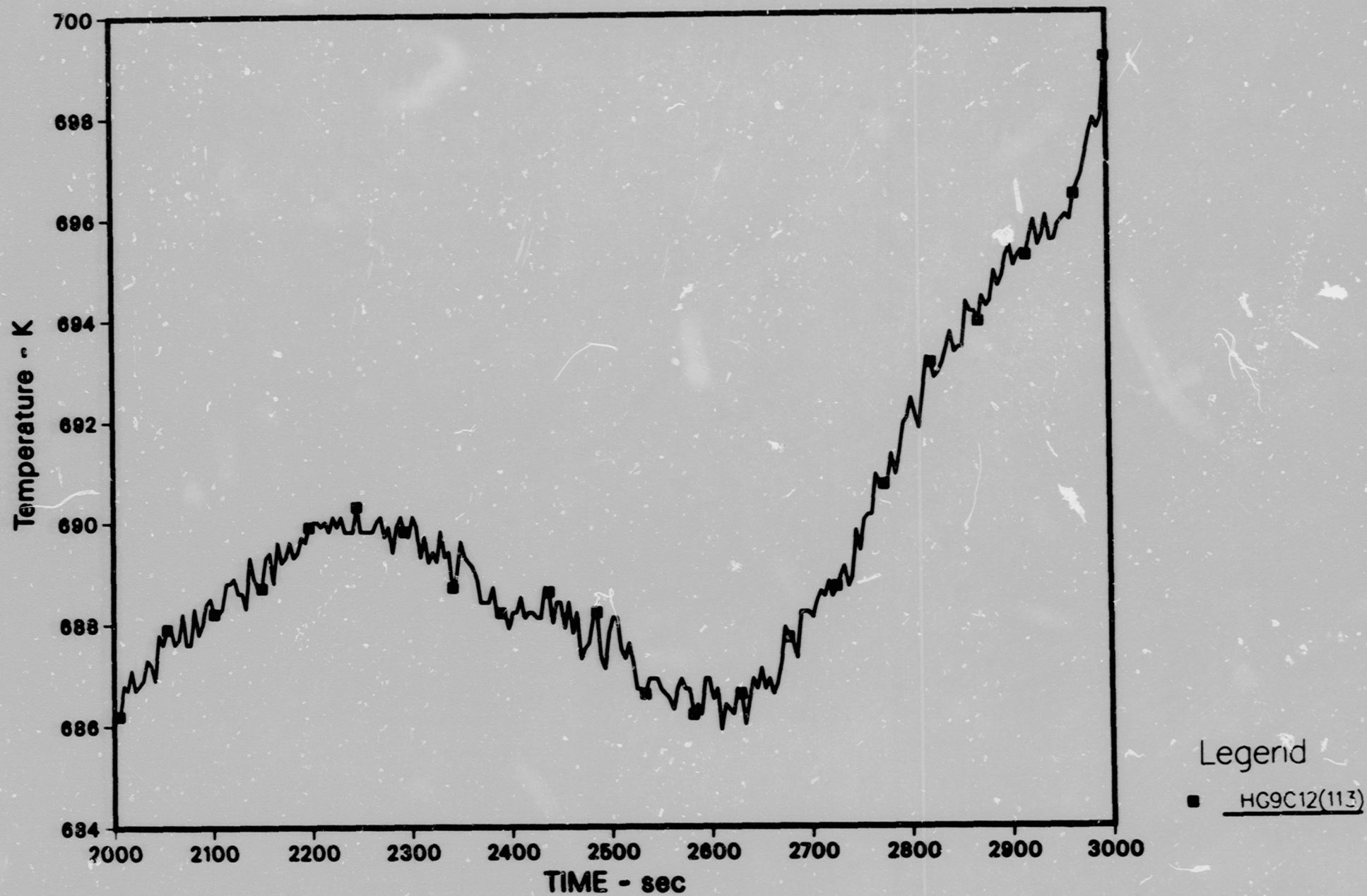
# DF-4 H2 Getter Tube 5, Internal 11in Above Bottom



# DF-4 H2 Getter Tube 8, Mixing Tube Side 10In Above Bottom

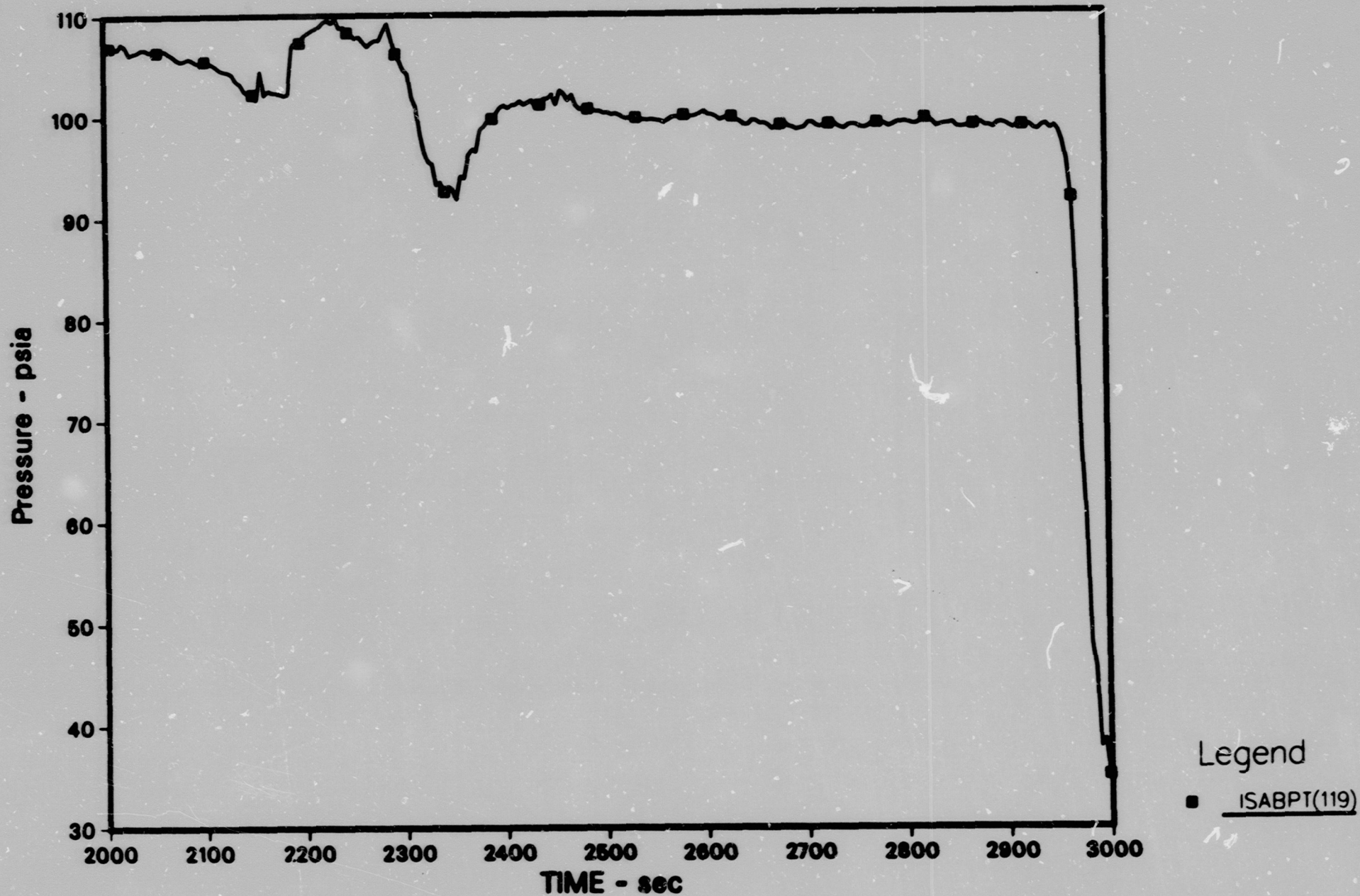


# DF-4 H2 Getter Tube 9, Condenser Side 12in Above Bottom

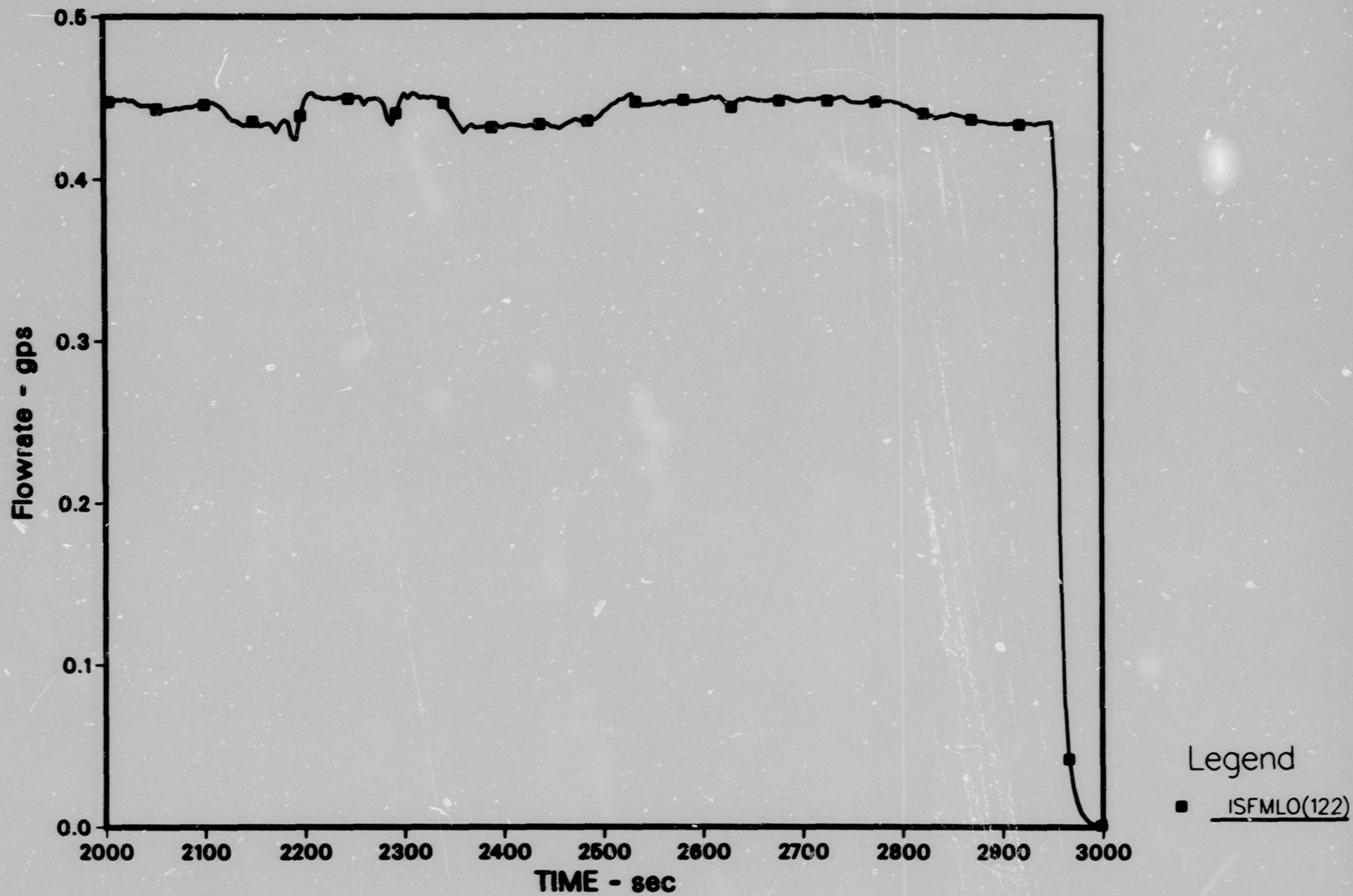




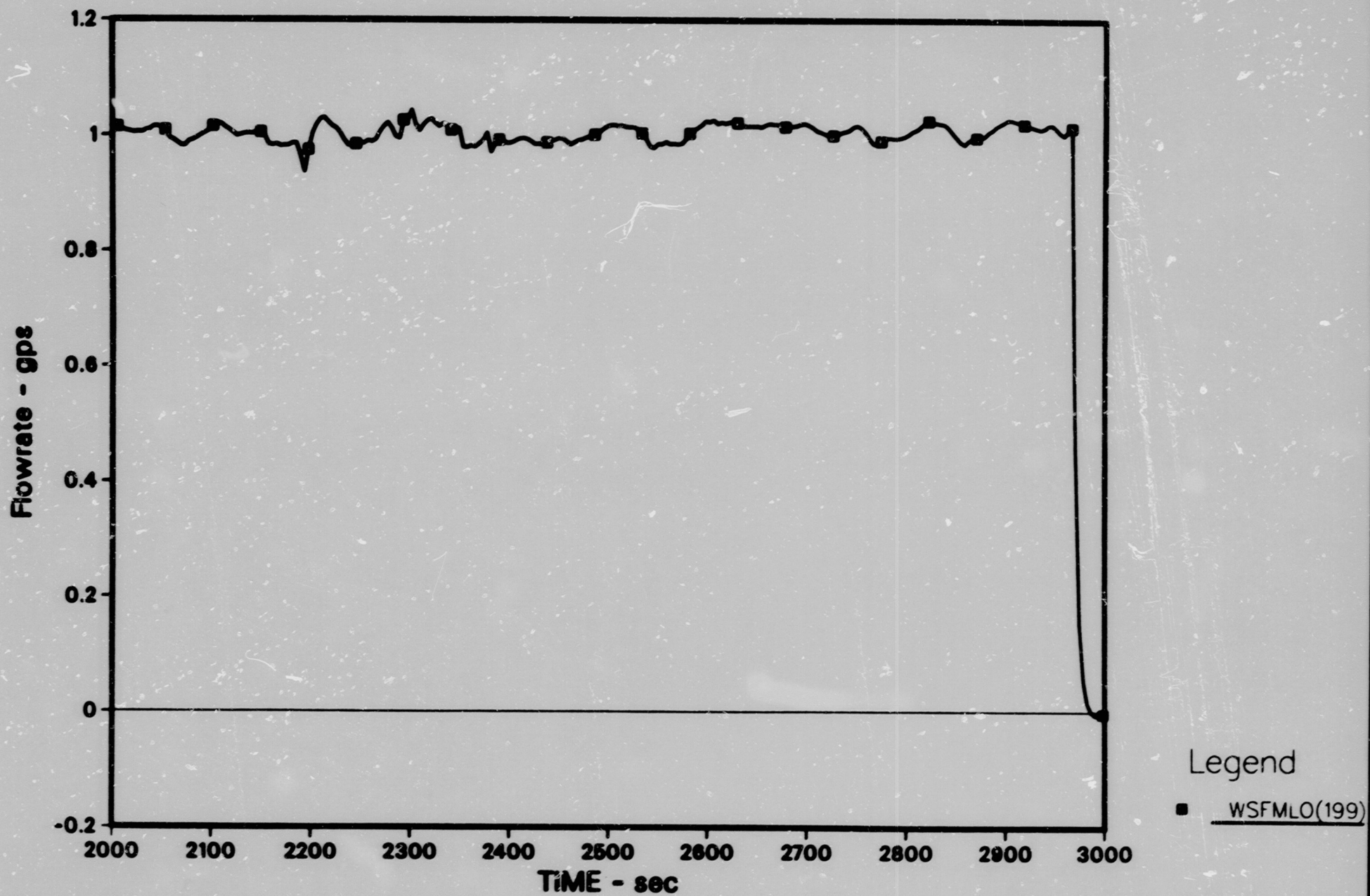
# DF-4 Inlet Steam Pressure



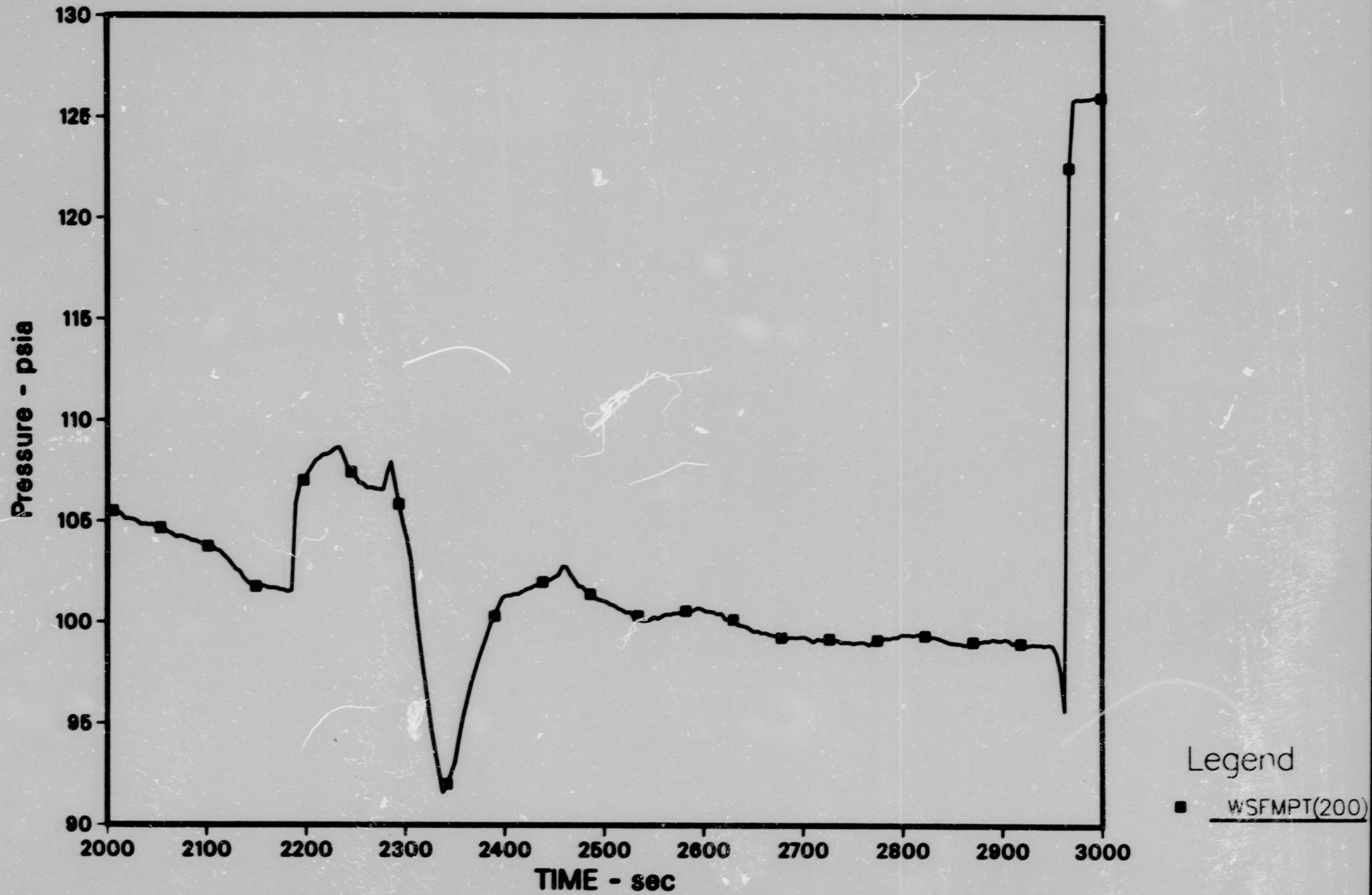
# DF-4 Inlet Steam Flow Meter



# DF-4 Window Steam Flow Meter



# DF-4 Window Steam Pressure

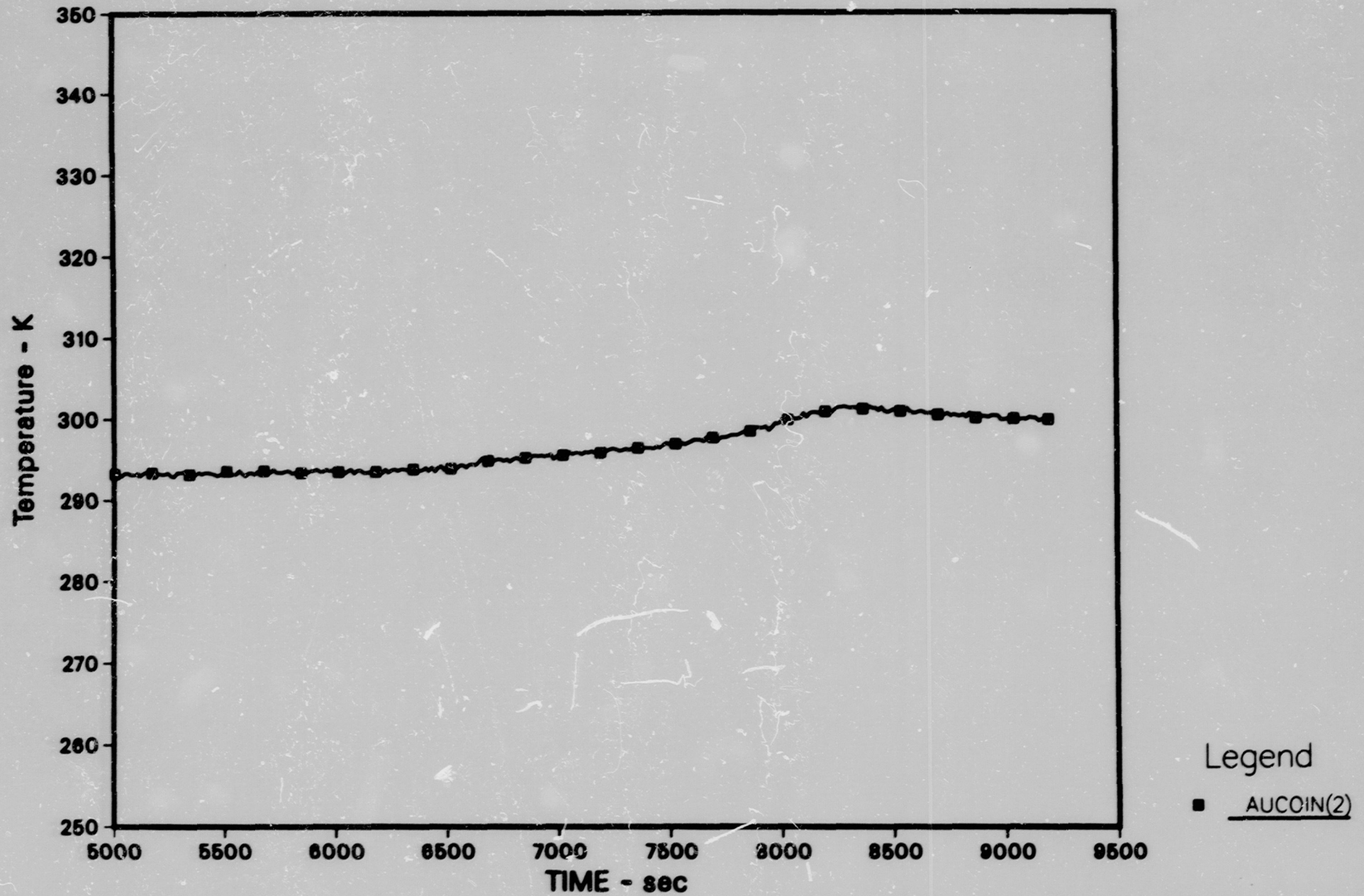


DF-4

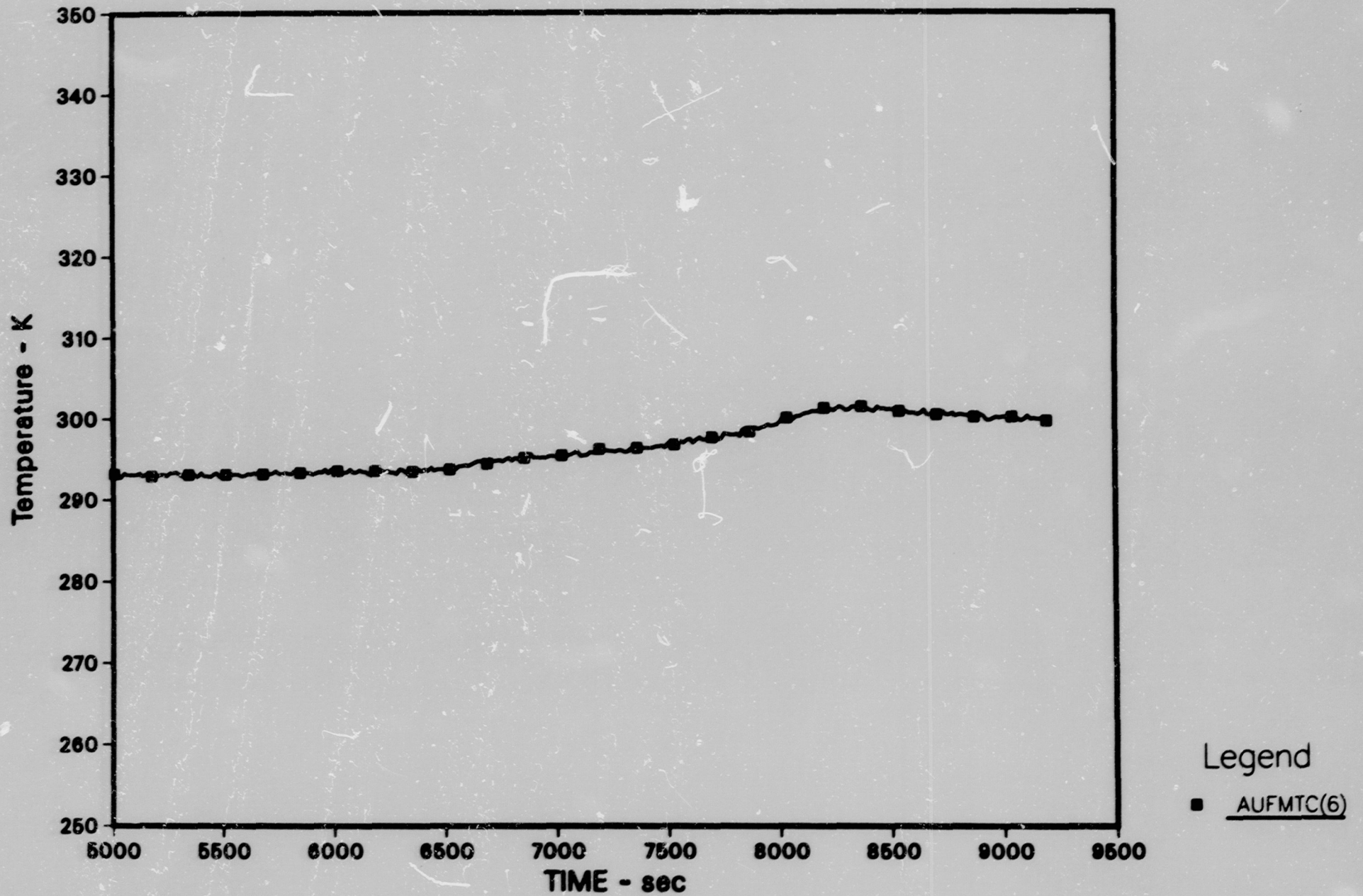
EXPERIMENT TRANSIENT

PHASE

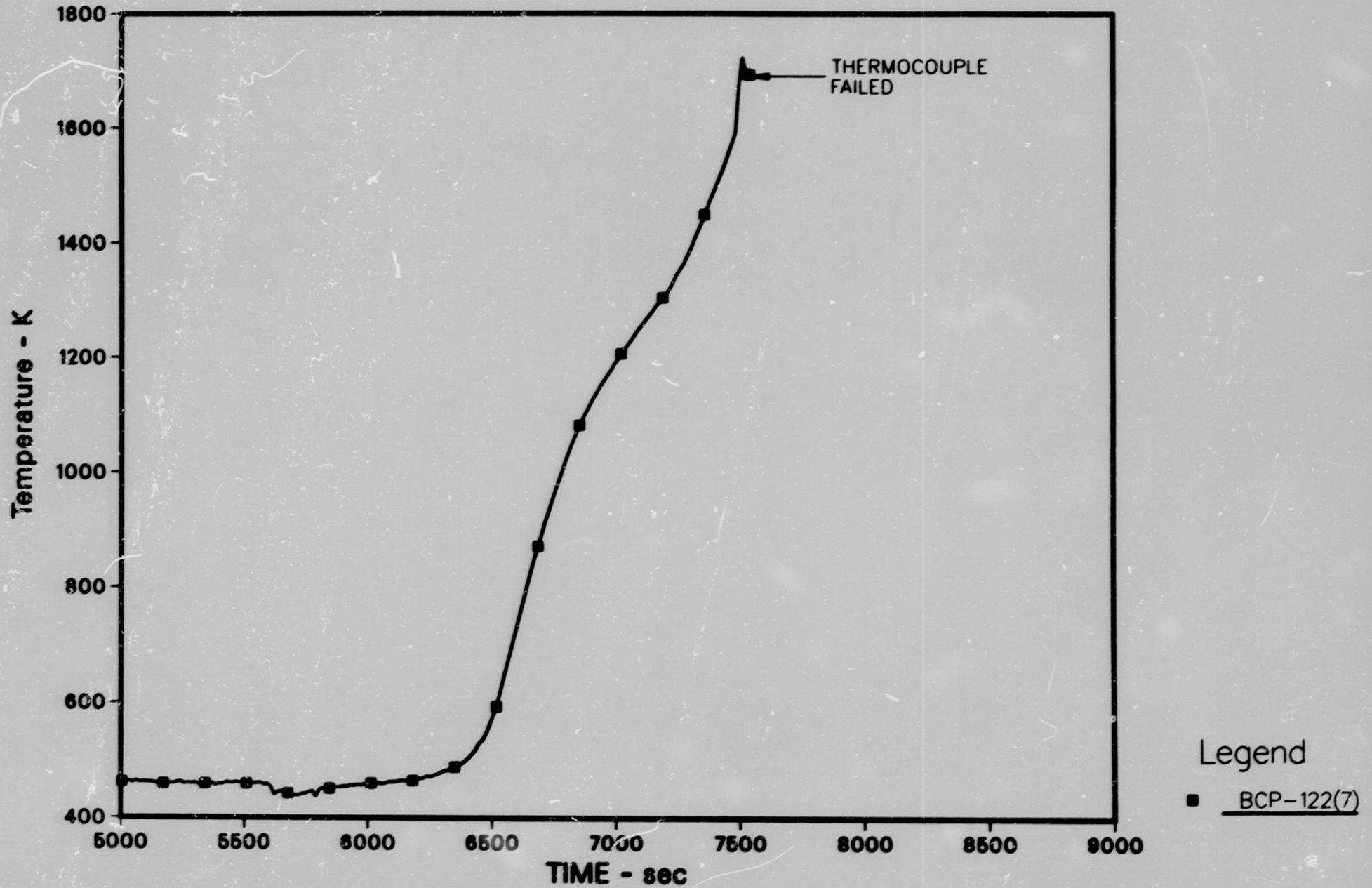
# DF-4 Inside Auxillary Coolant Water Inlet Line



# DF-4 Auxillary Cooling Water Temp (for FM)

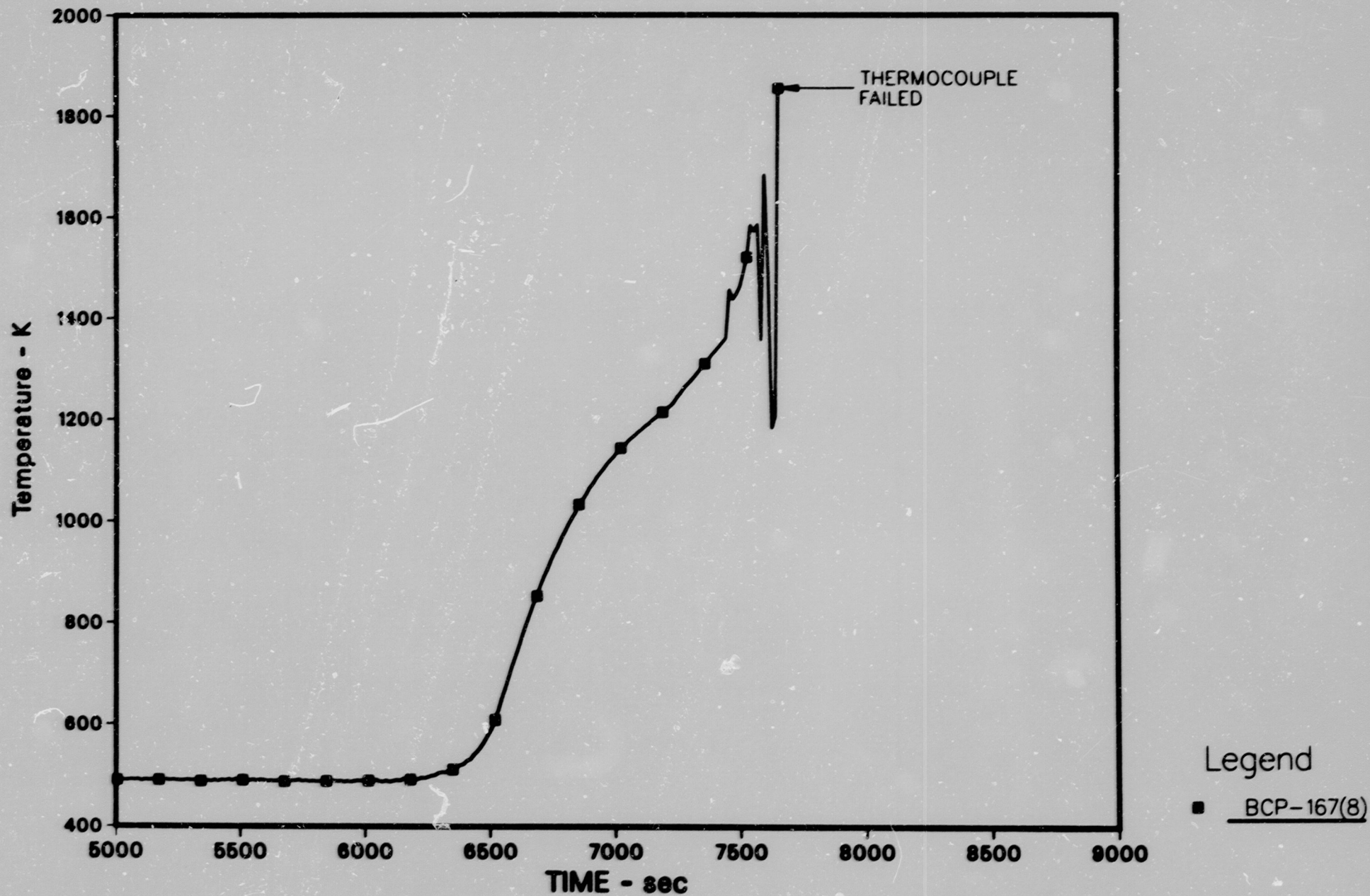


# DF-4 Control Blade (180 Deg) 12.2 in Below Fuel Support

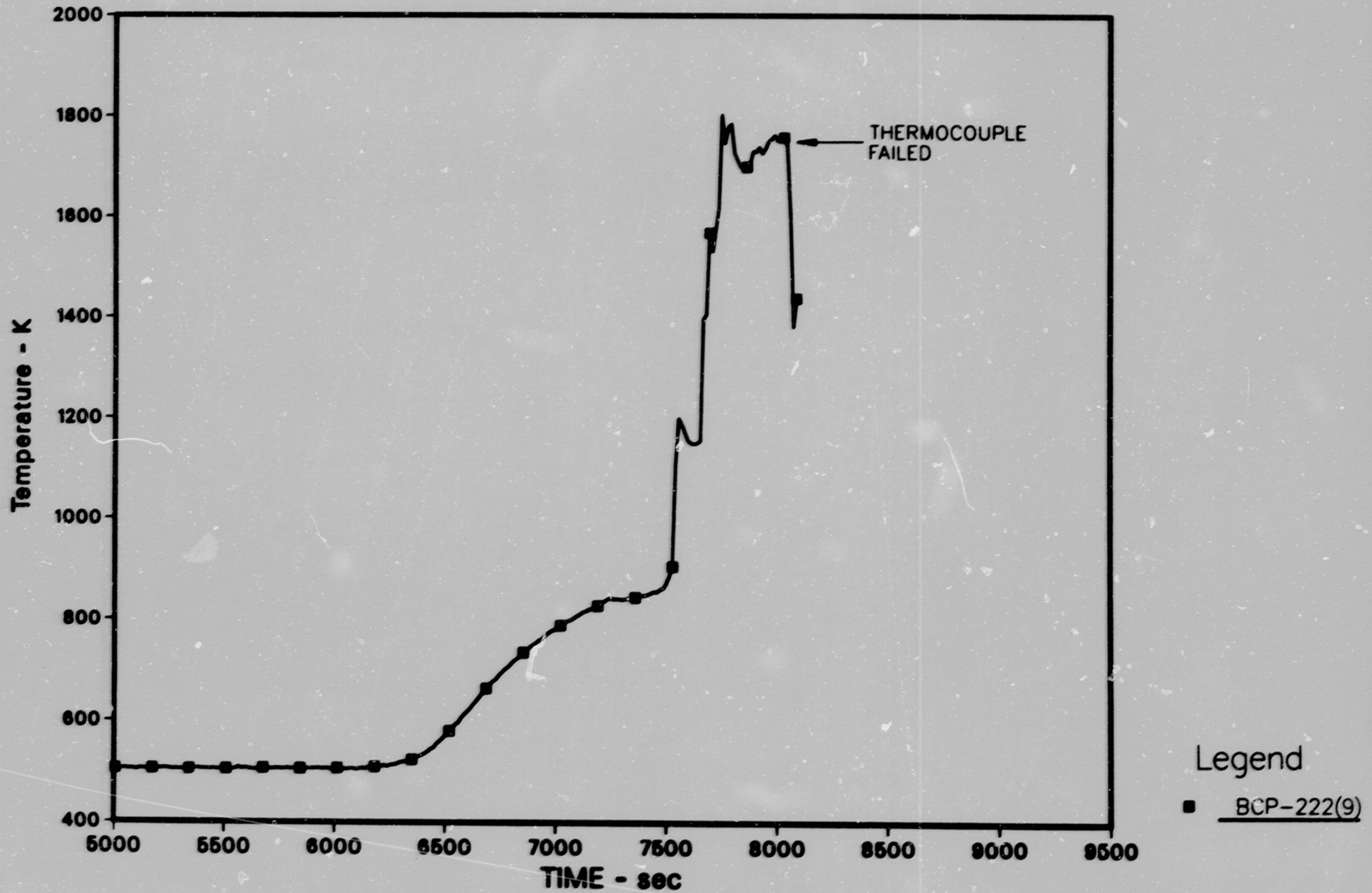




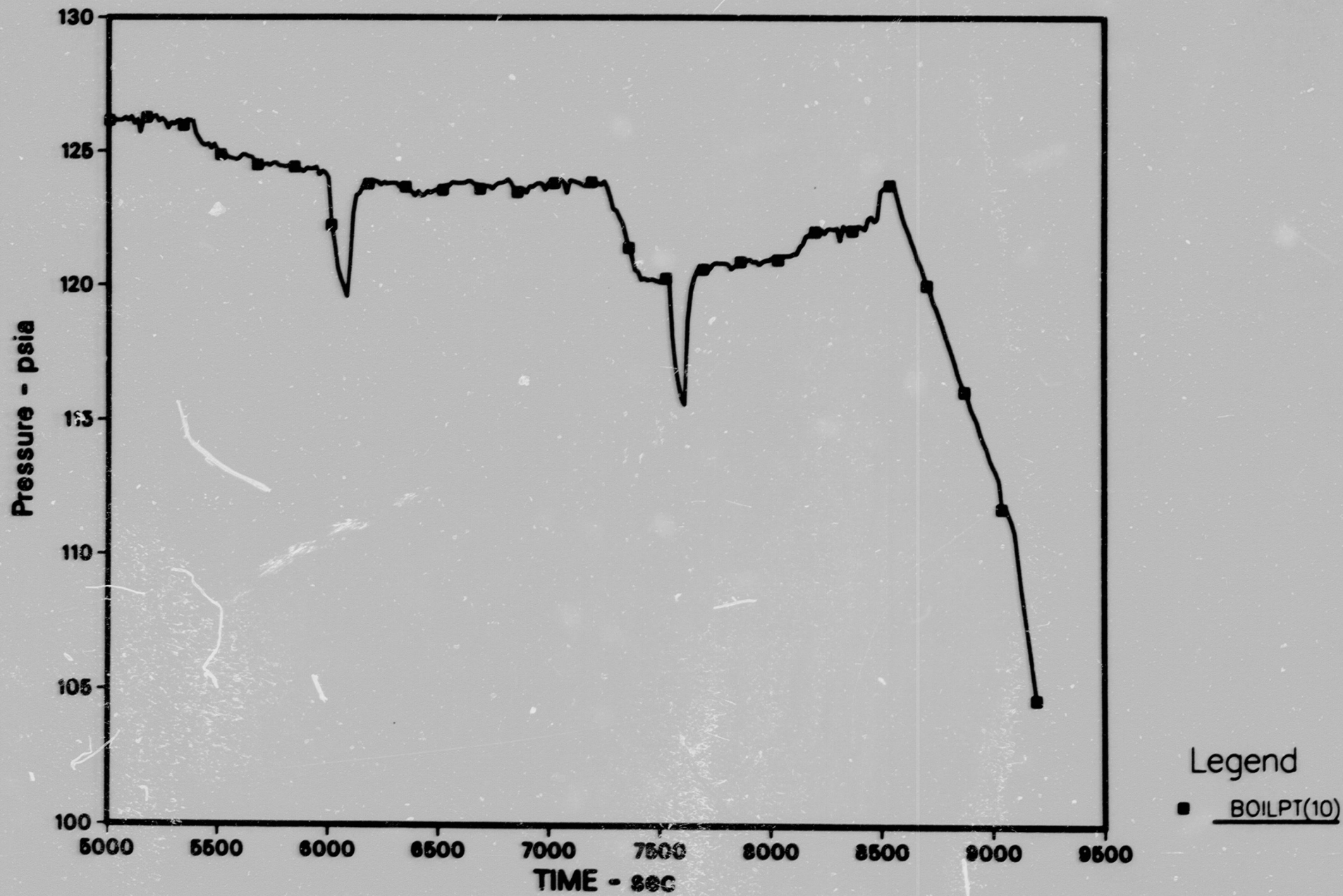
# DF-4 Control Blade (0 Deg) 16.7in Below Fuel Support



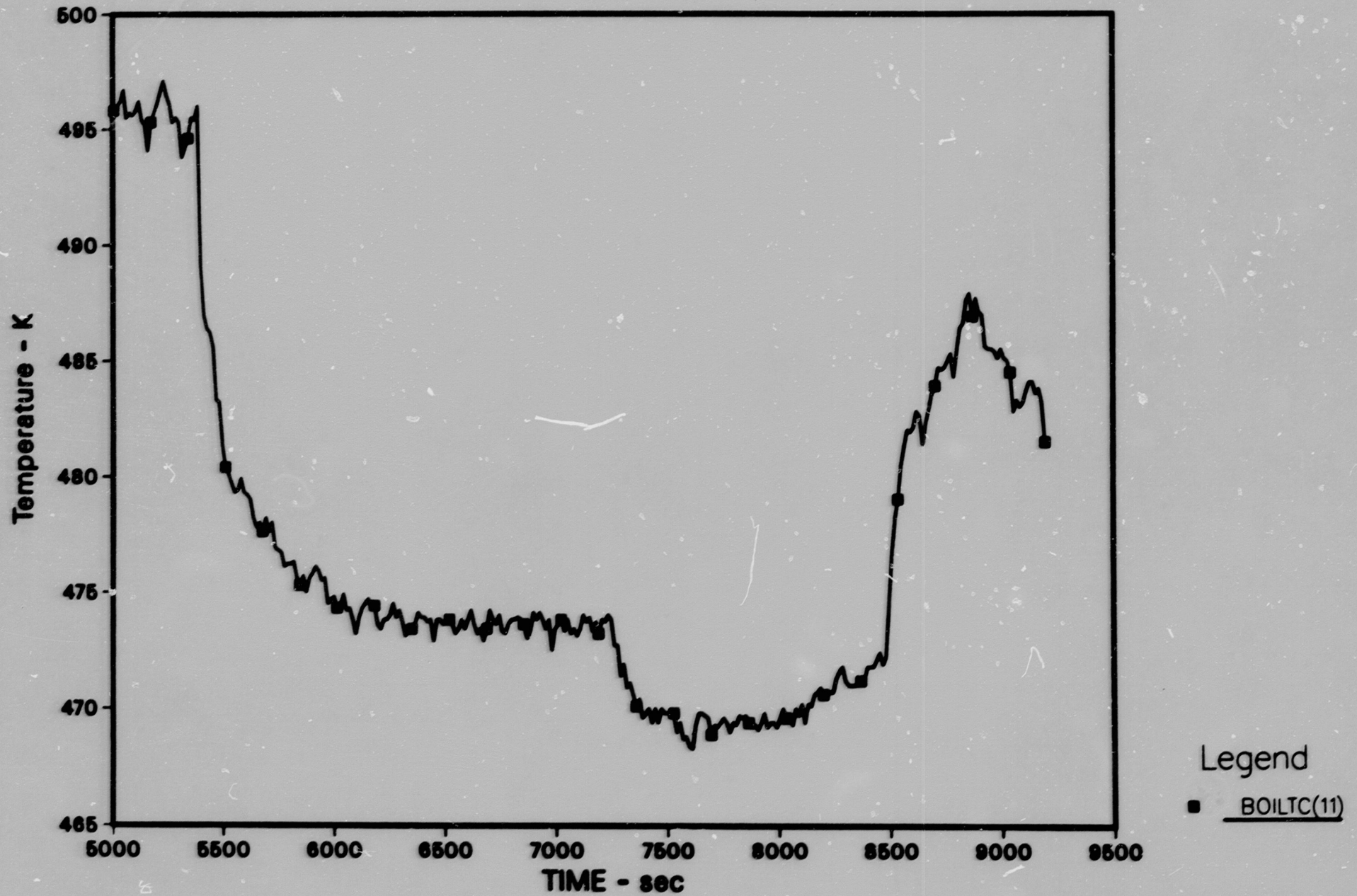
# DF-4 Control Blade (180 Deg) 22.2in Below Fuel Support



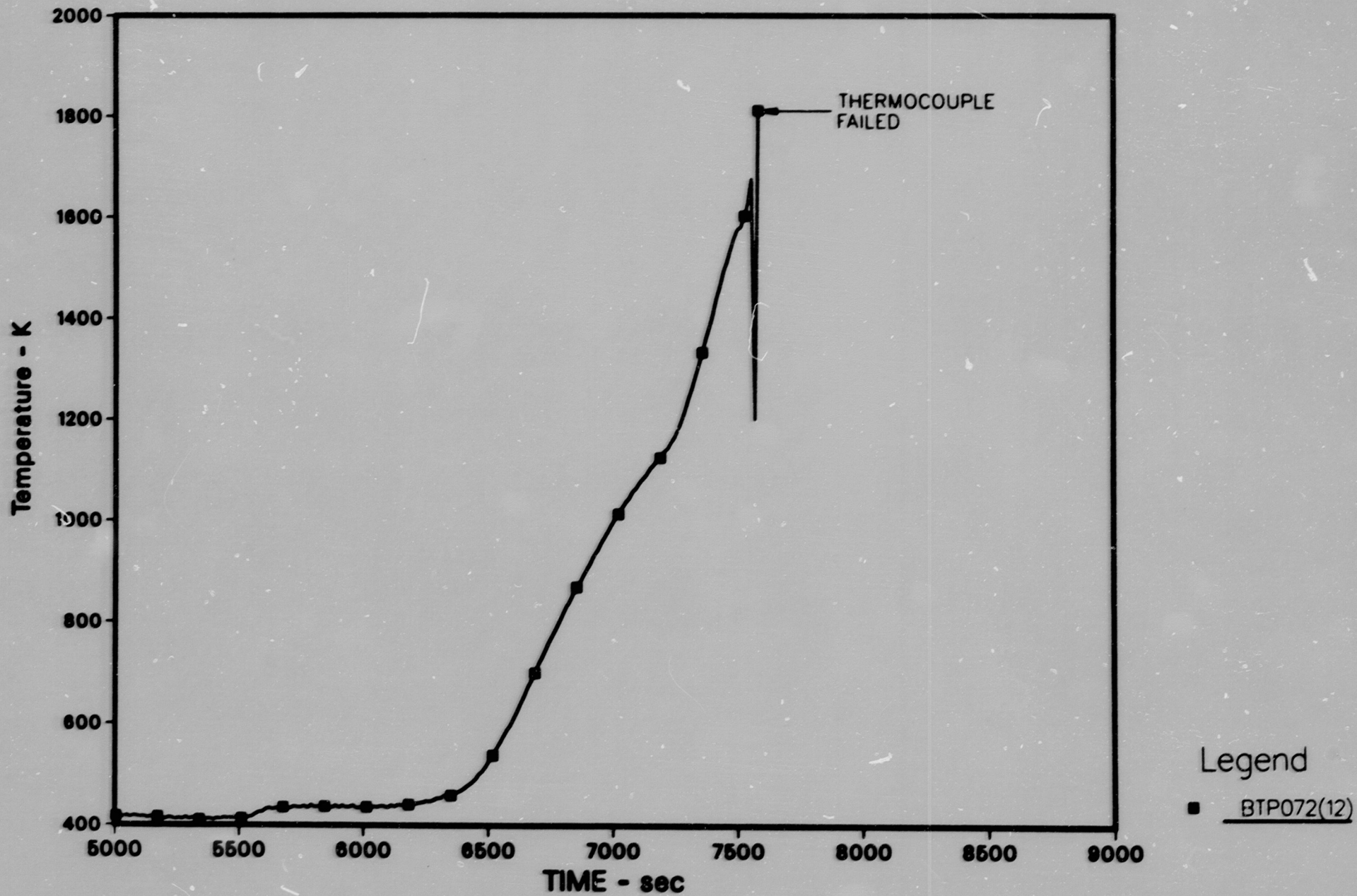
# DF-4 Boiler Pressure



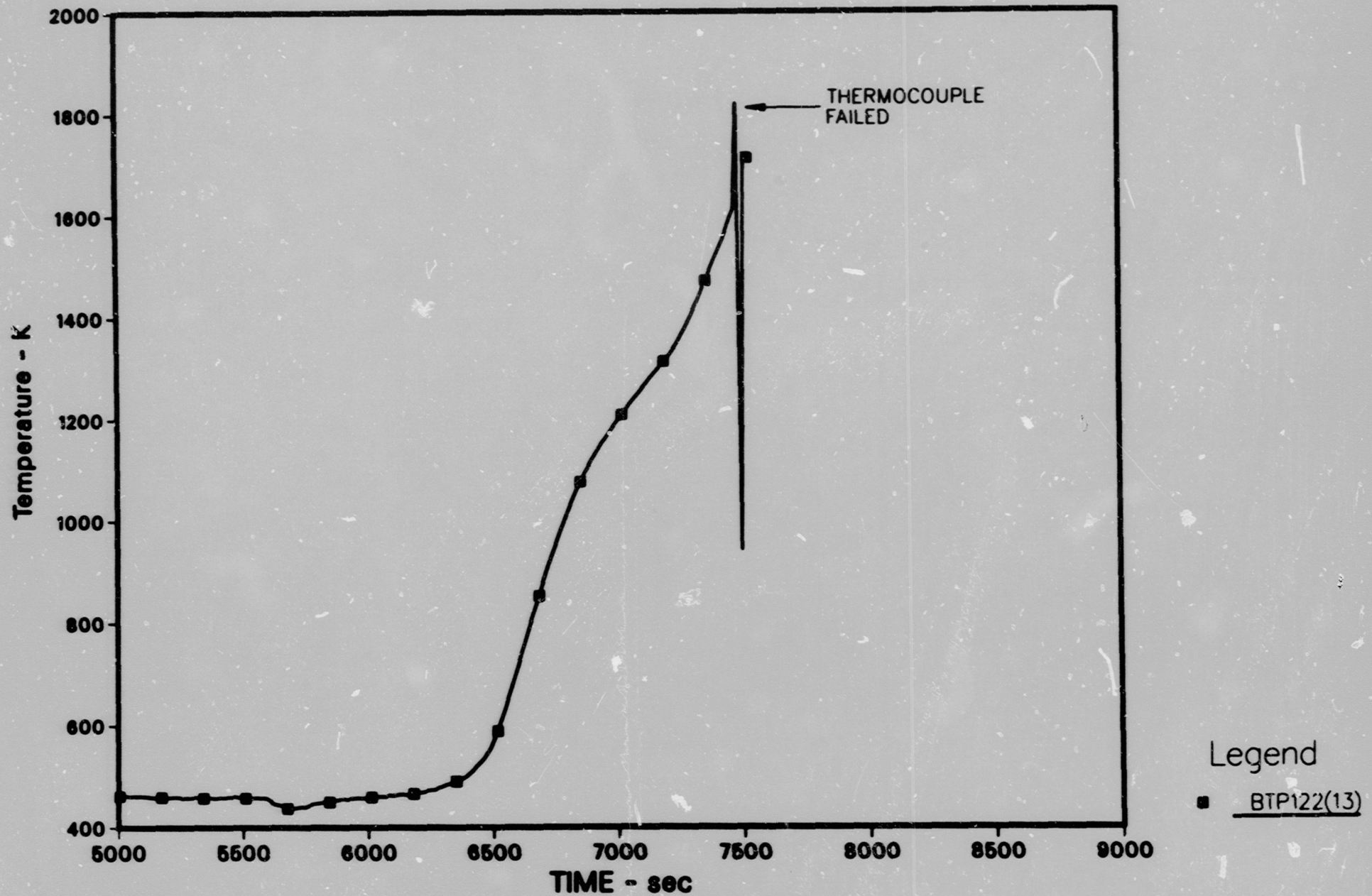
# DF-4 Inside Boiler Exit Steam Line



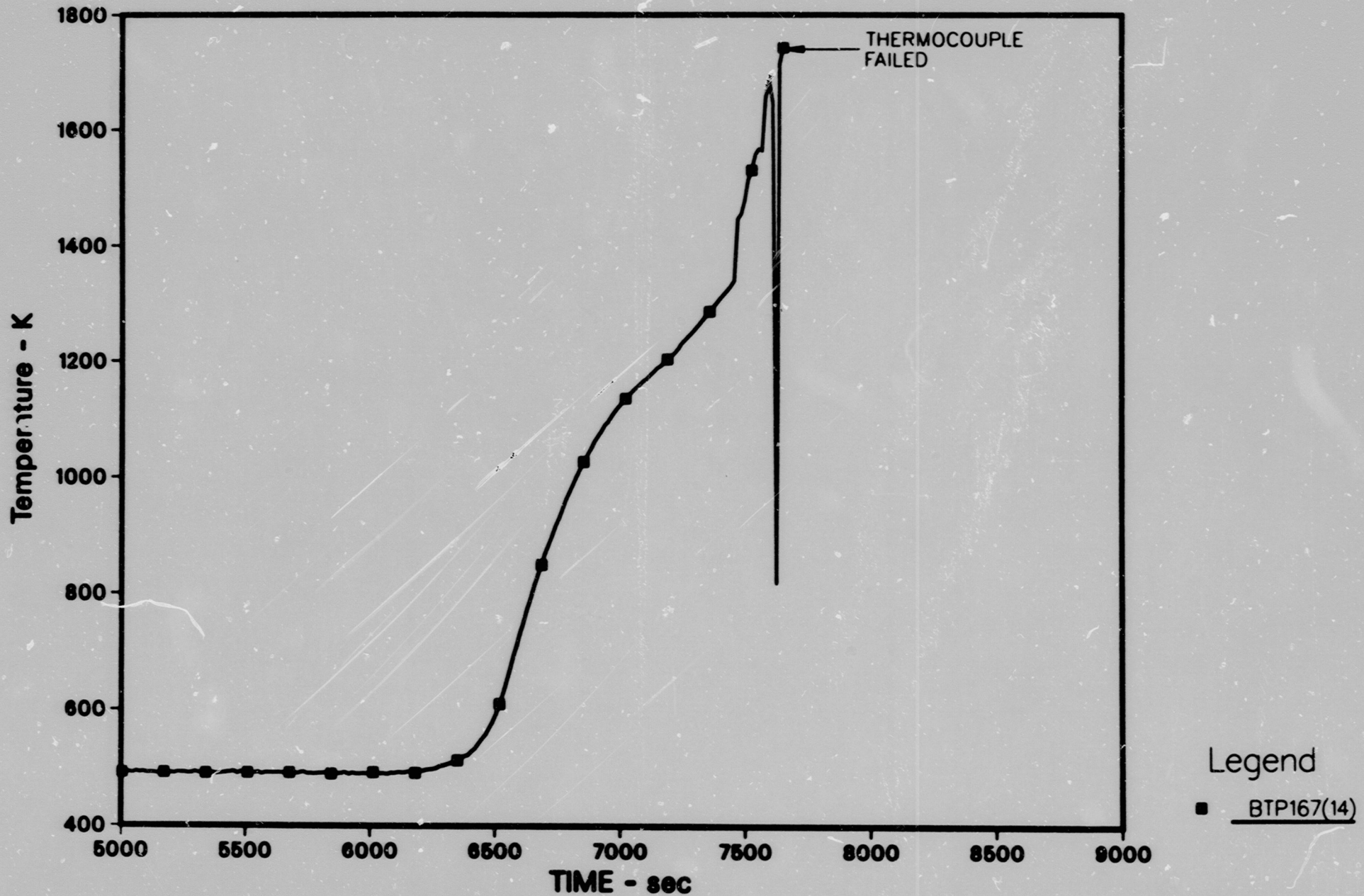
# DF-4 Control Blade Tip (180 Deg) 7.2in Below Fuel Support



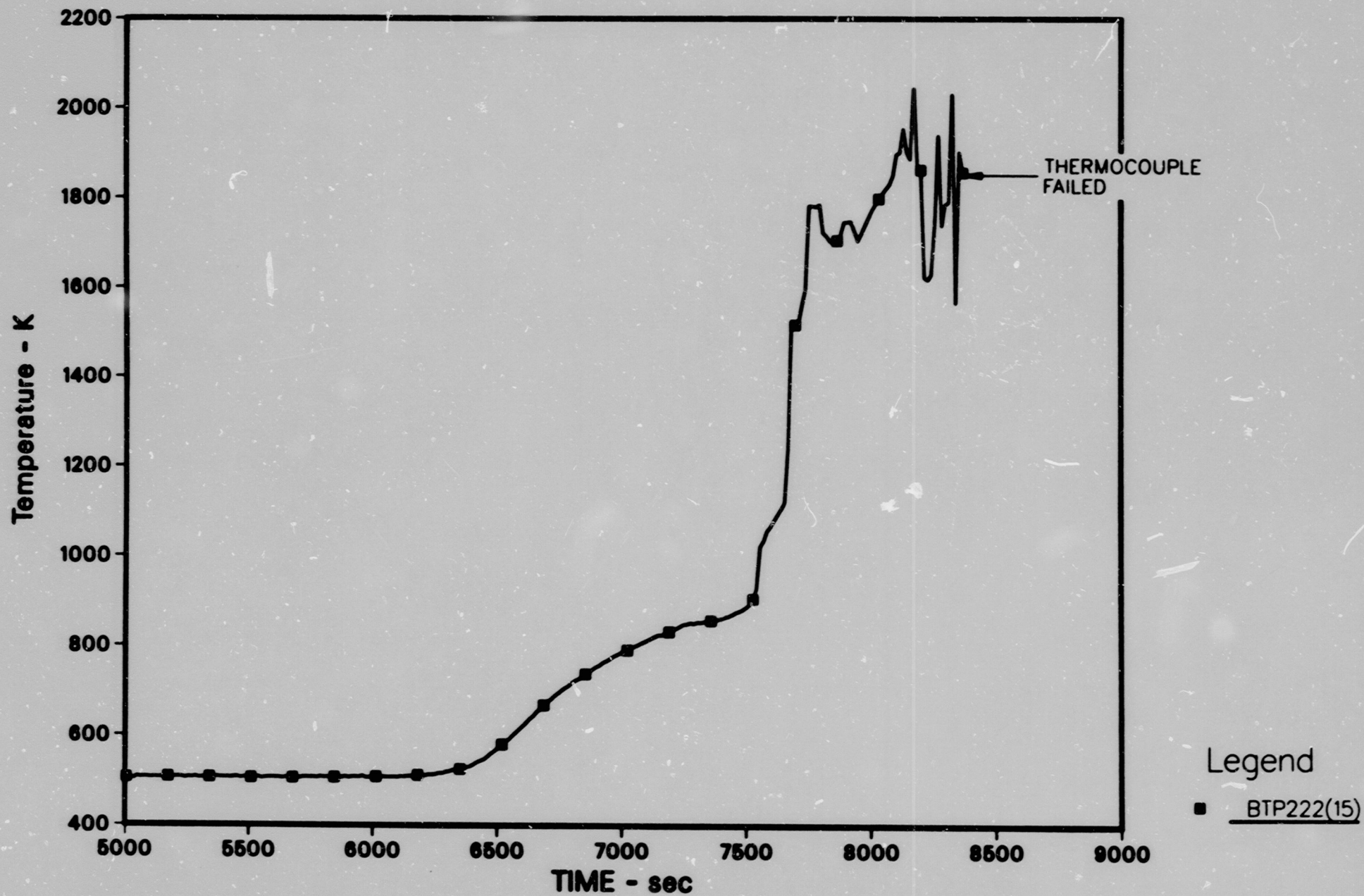
# DF-4 Control Blade Tip (180 Deg) 12.2in Below Fuel Support



# DF-4 Control Blade Tip (0 Deg) 16.7In Below Fuel Support

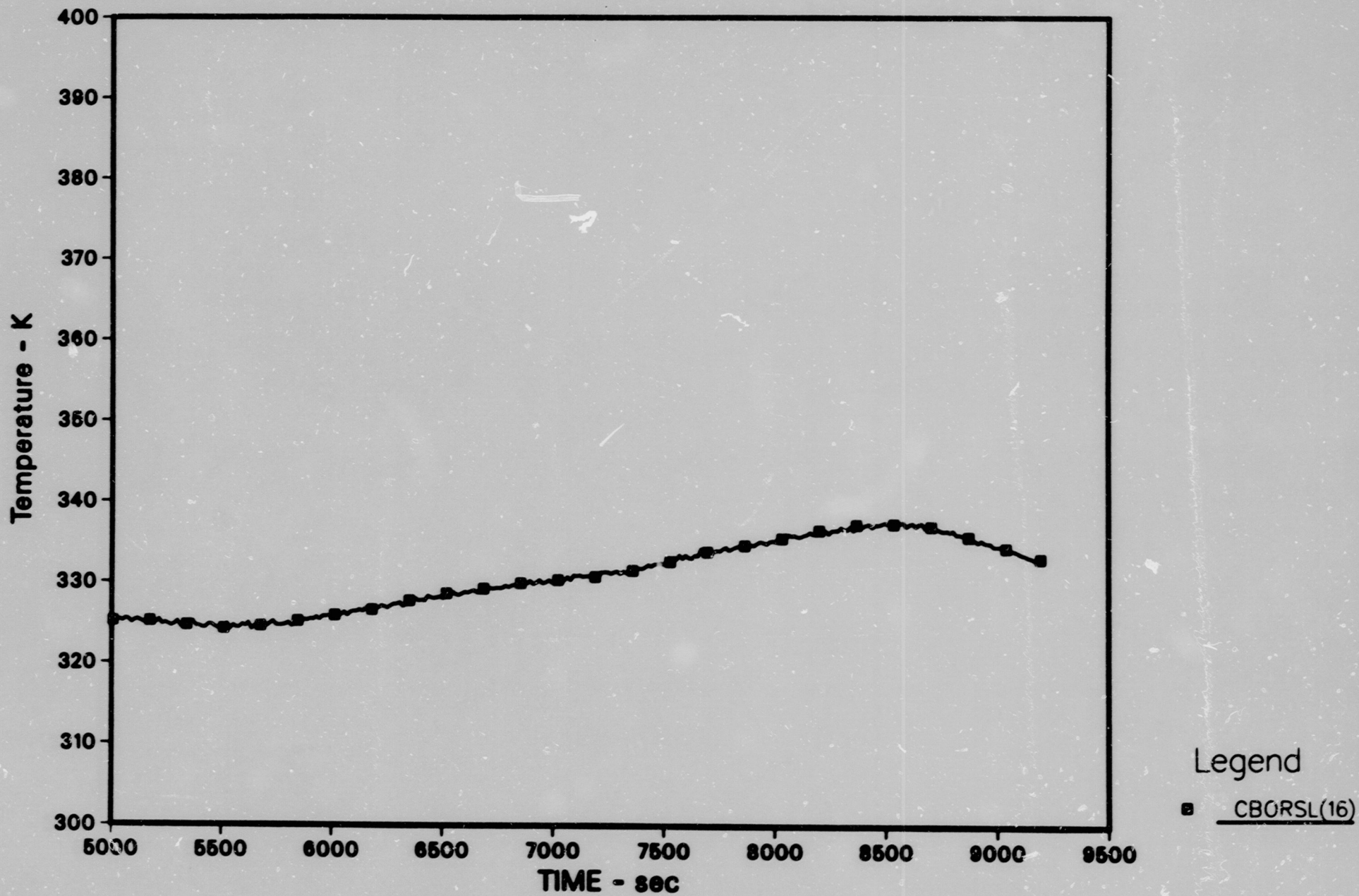


# DF-4 Control Blade Tip (180 Deg) 22.2In Below Fuel Support

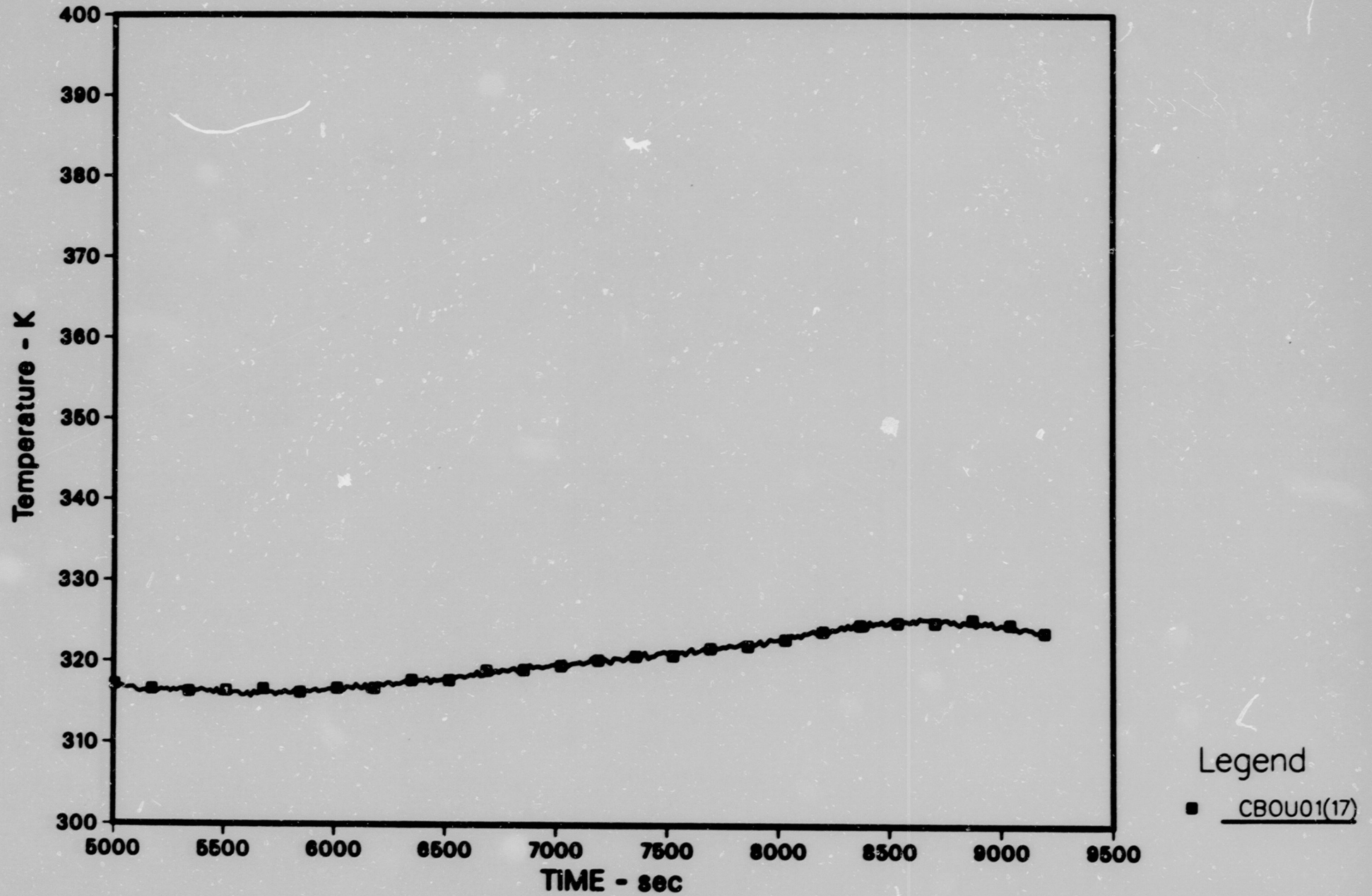




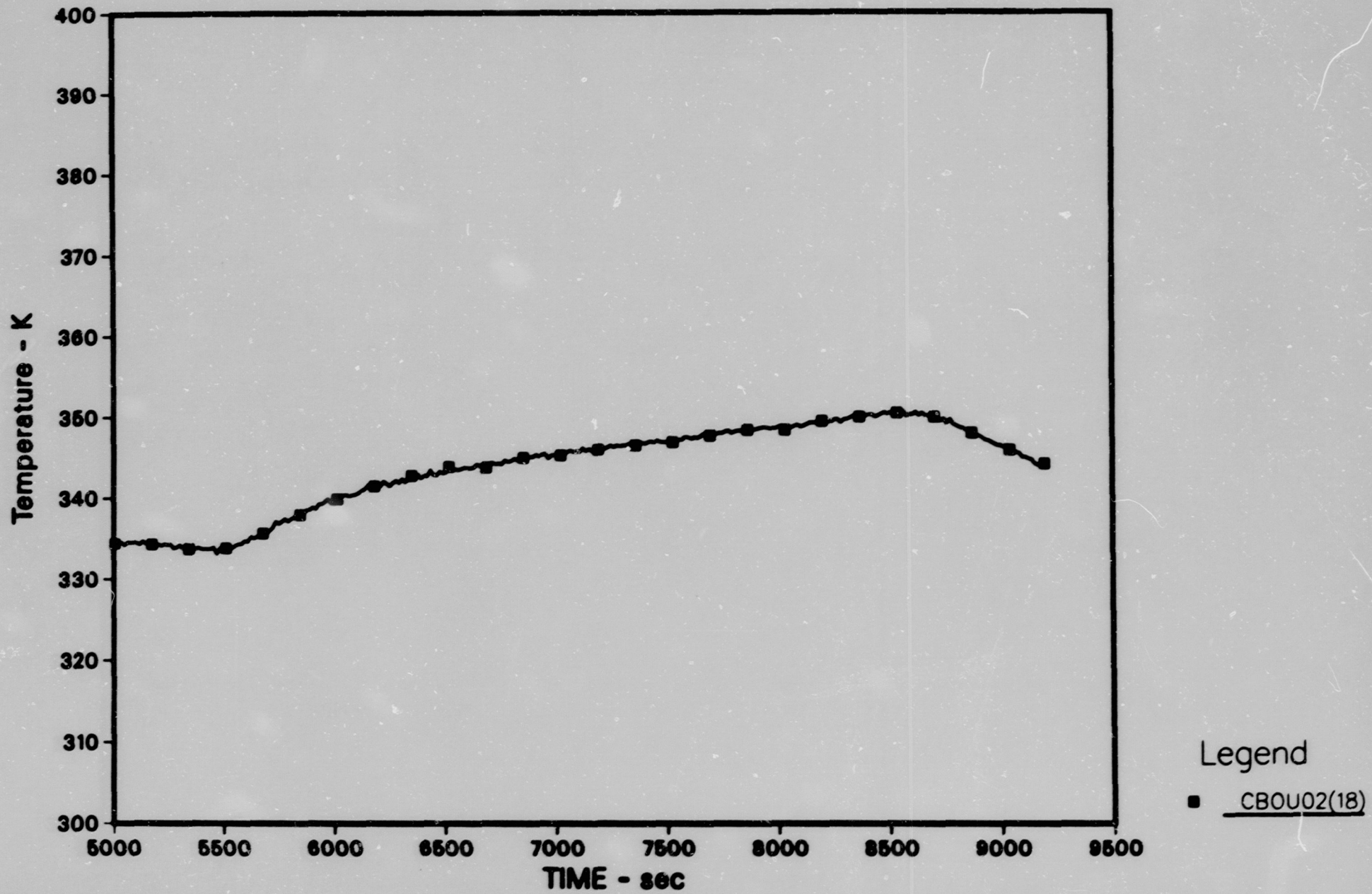
# DF-4 Containment Bulkhead Ring Seal



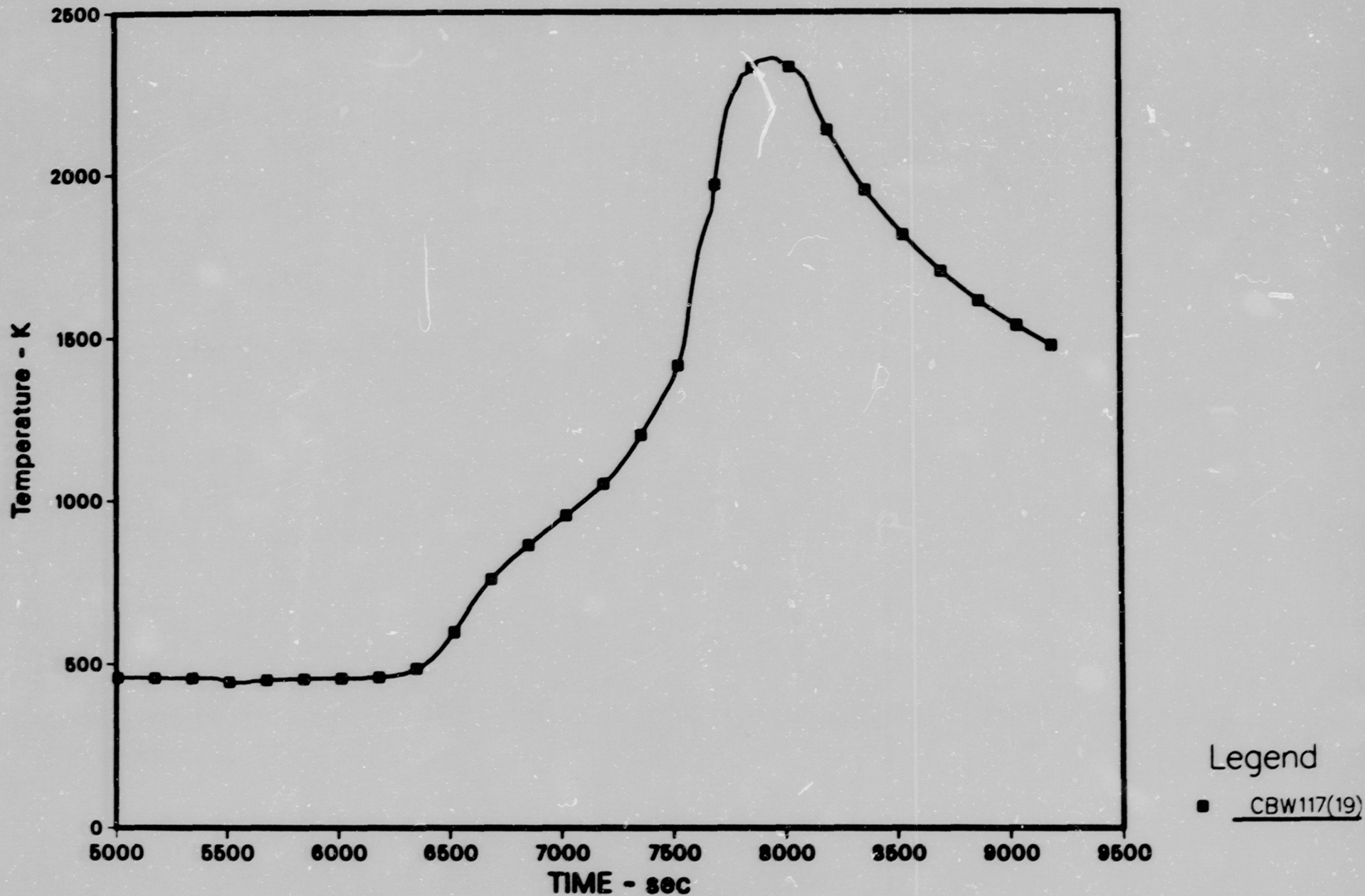
# DF-4 Containment Bulkhead Top



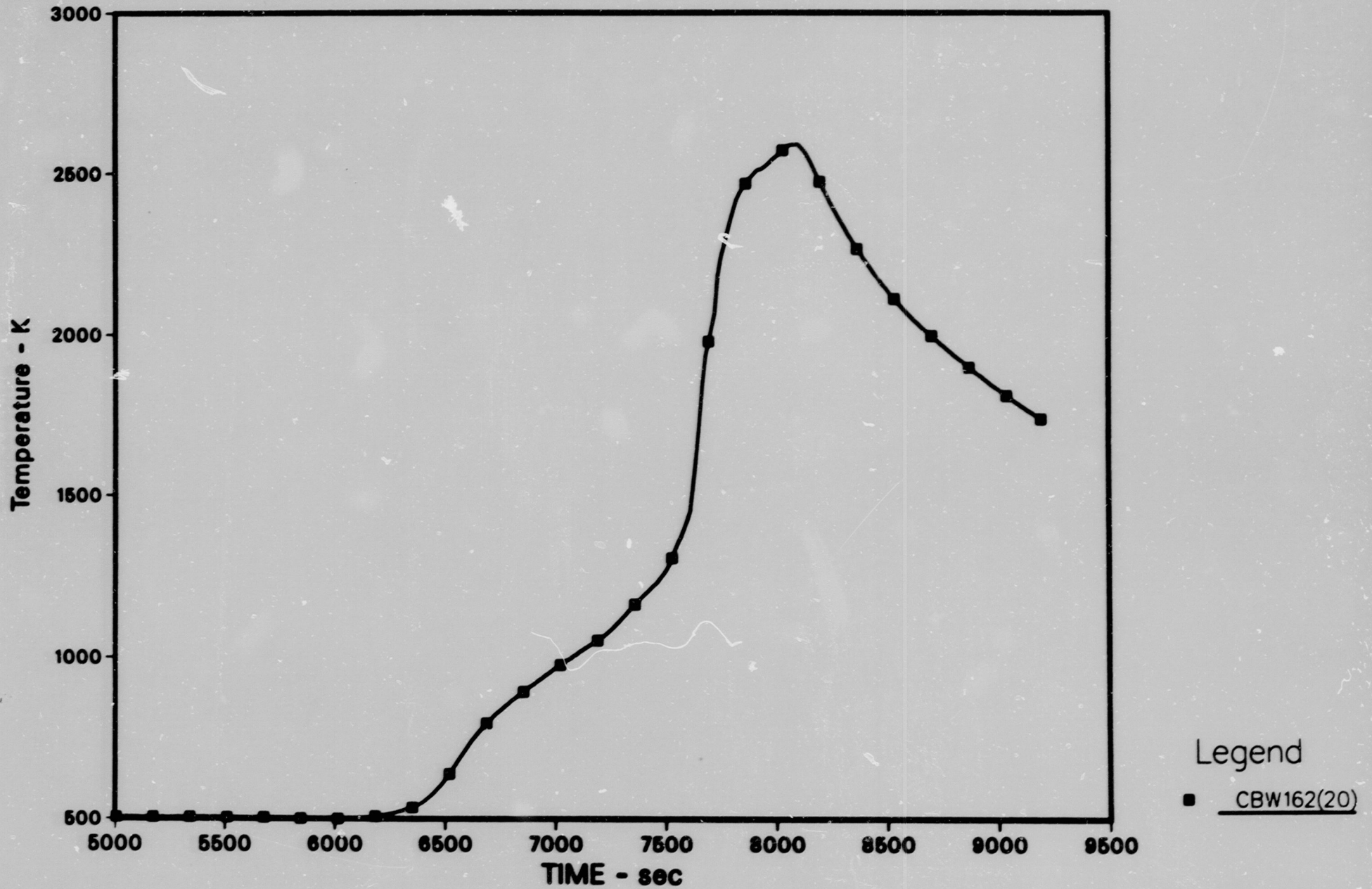
# DF-4 Containment Bulkhead Top (2)



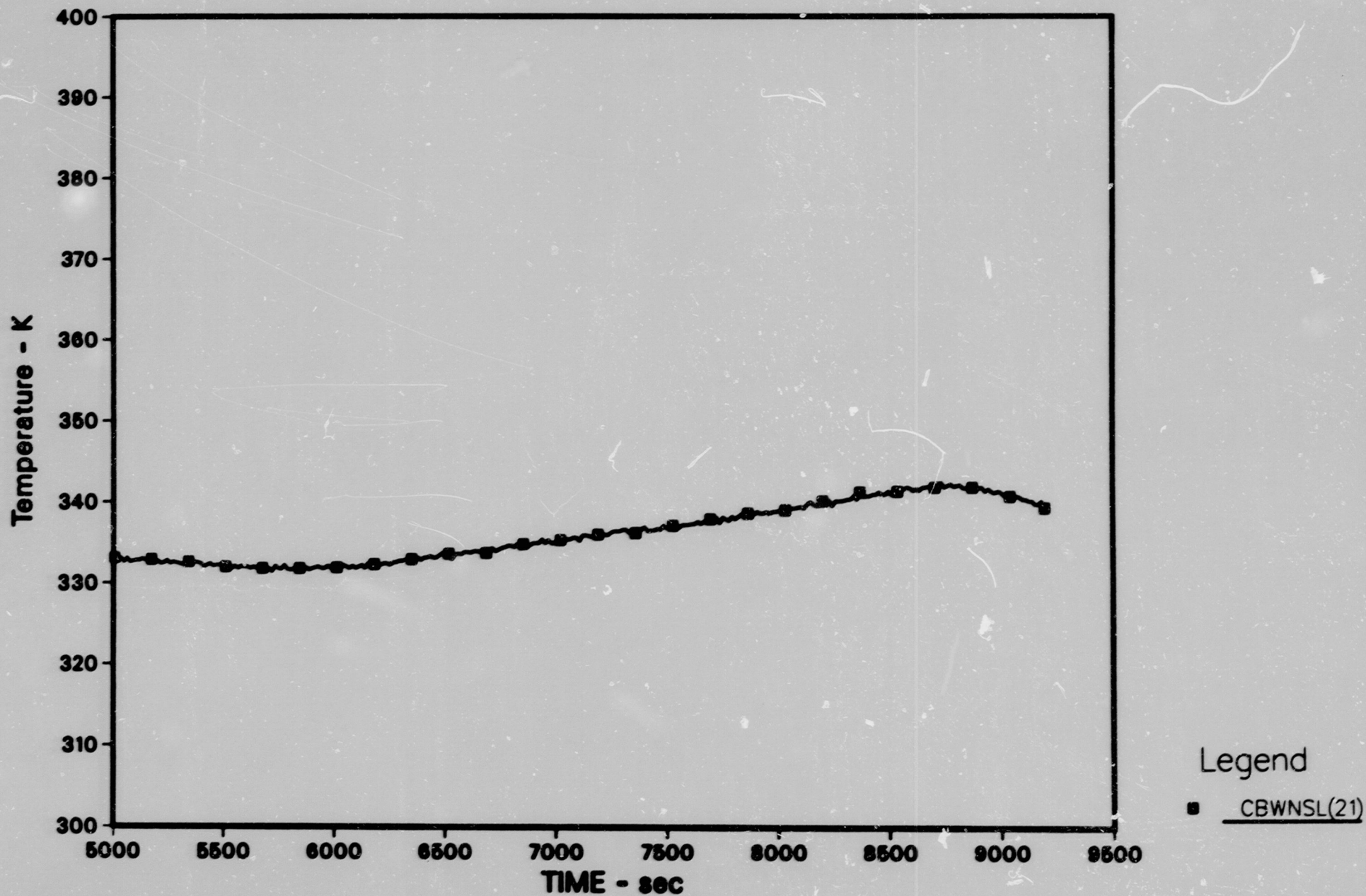
# DF-4 W/Re Outside Channel Box (270 Deg) 11.7in Below Fuel Support



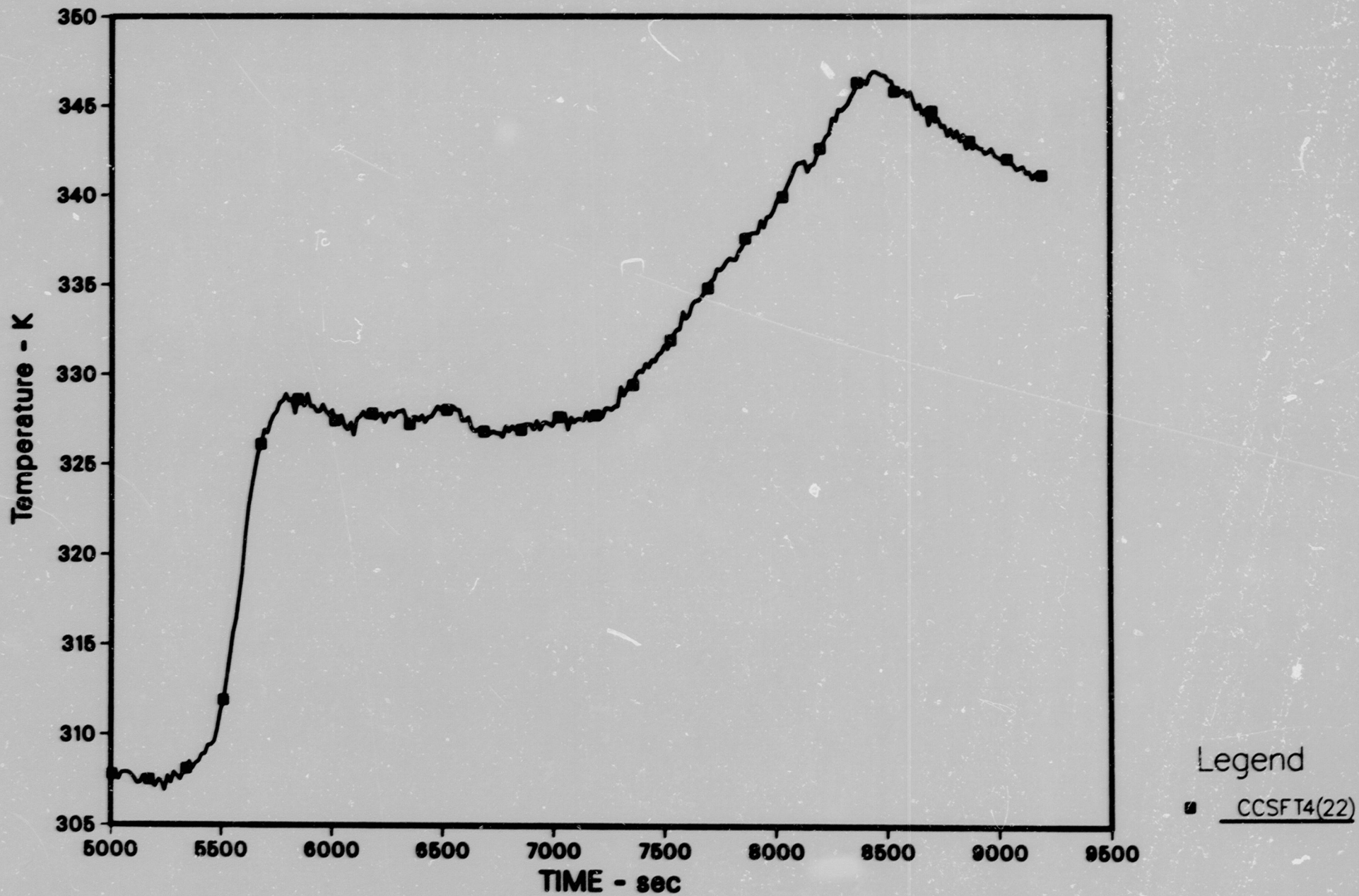
# DF-4 W/Re Outside Channel Box (270 Deg) 16.2In Below Fuel Support



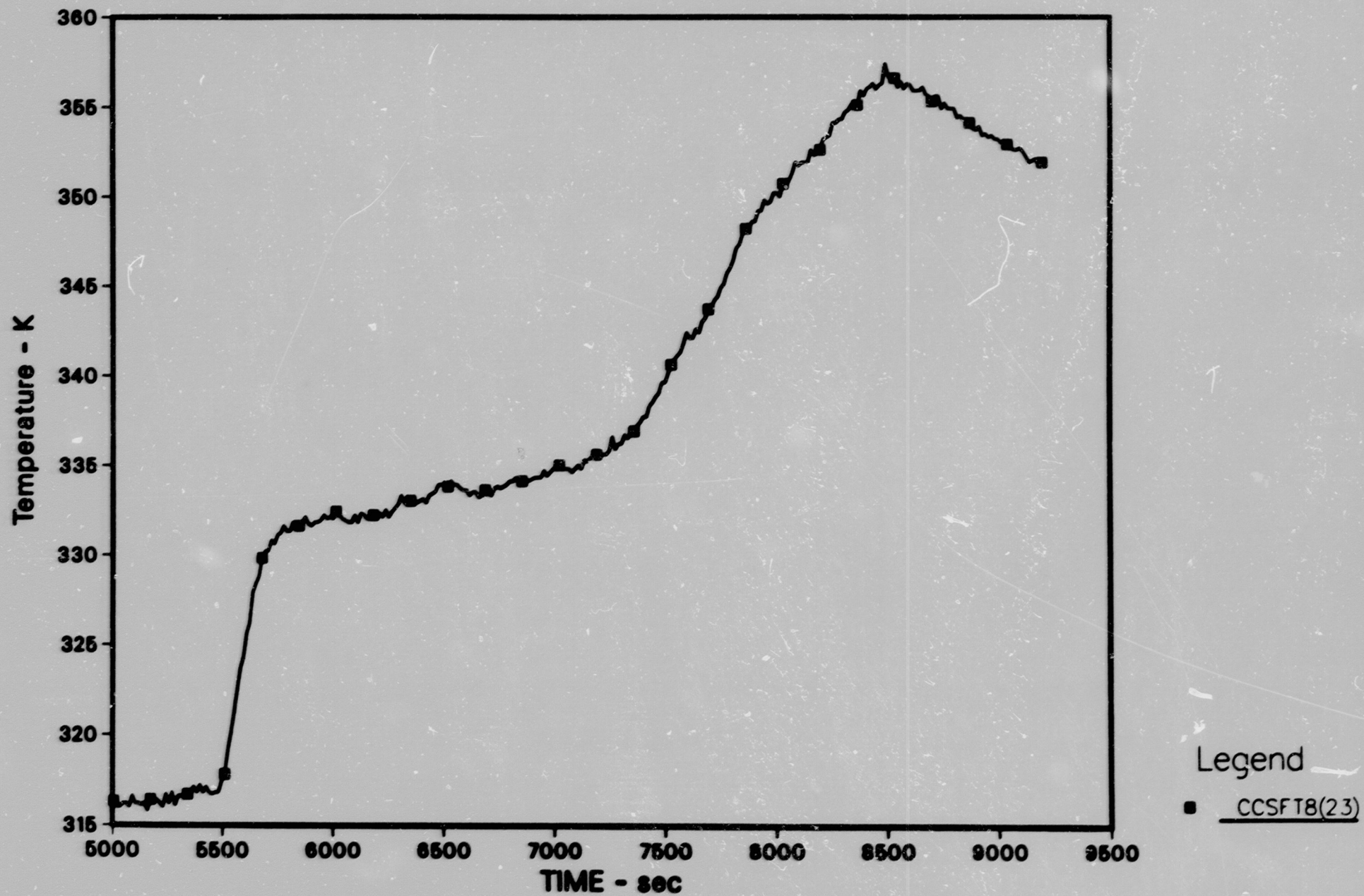
# DF-4 Cont. Bulkhead/Window Extension Tube Seal



# DF-4 Inside Tube 6, 0 Deg Half of Dome

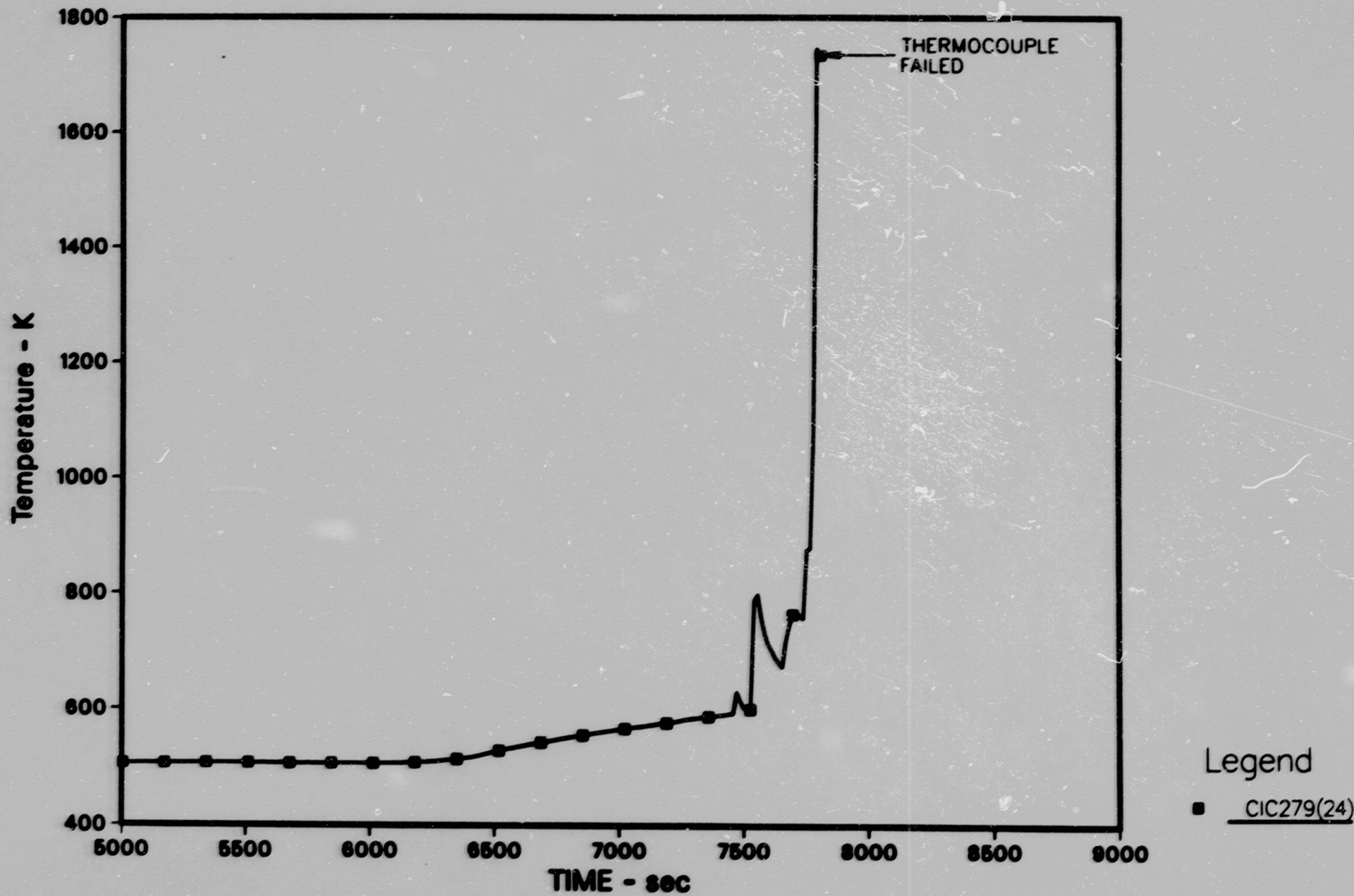


# DF-4 Inside Tube 3, 0 Deg Half of Dome

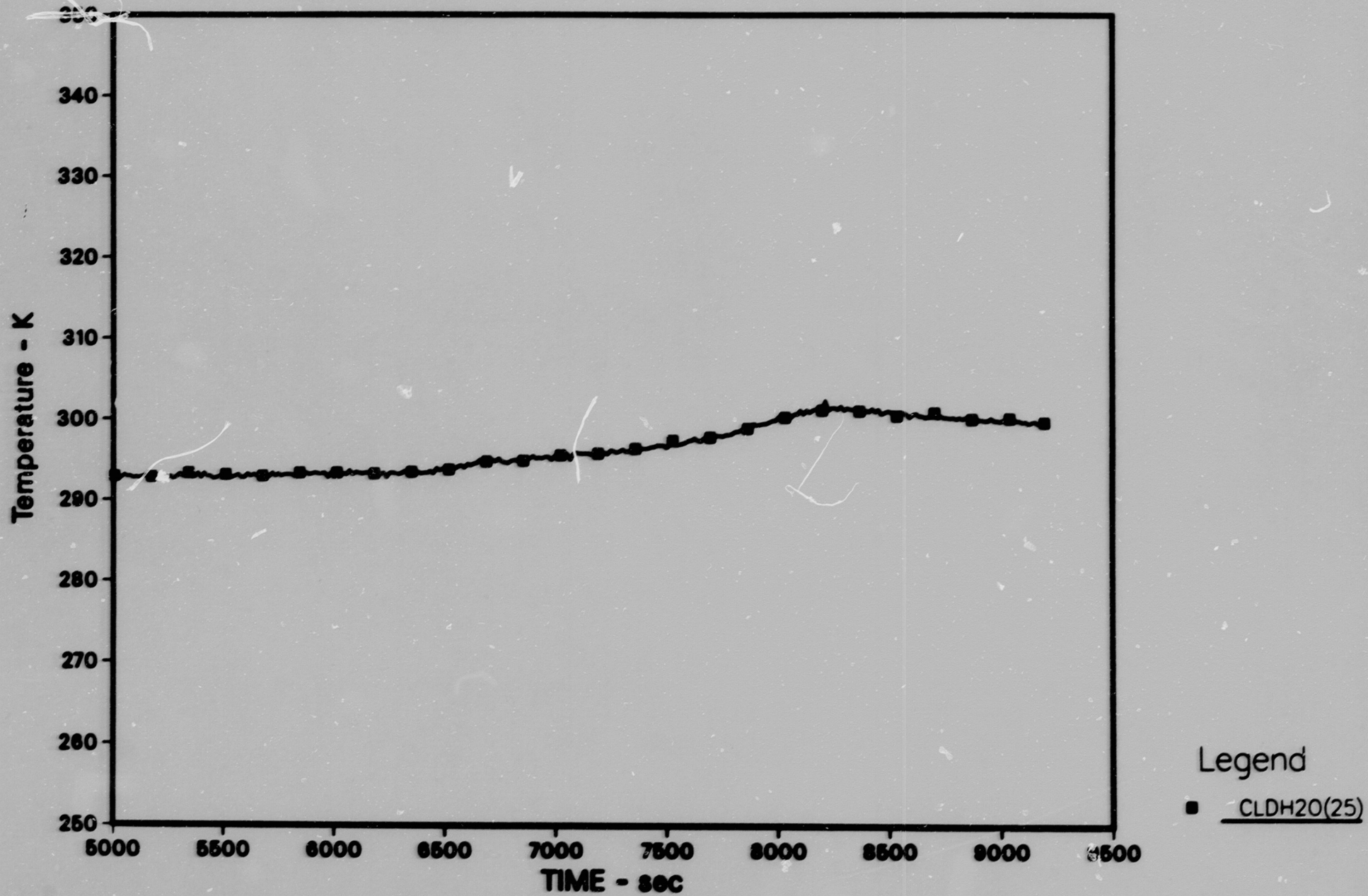




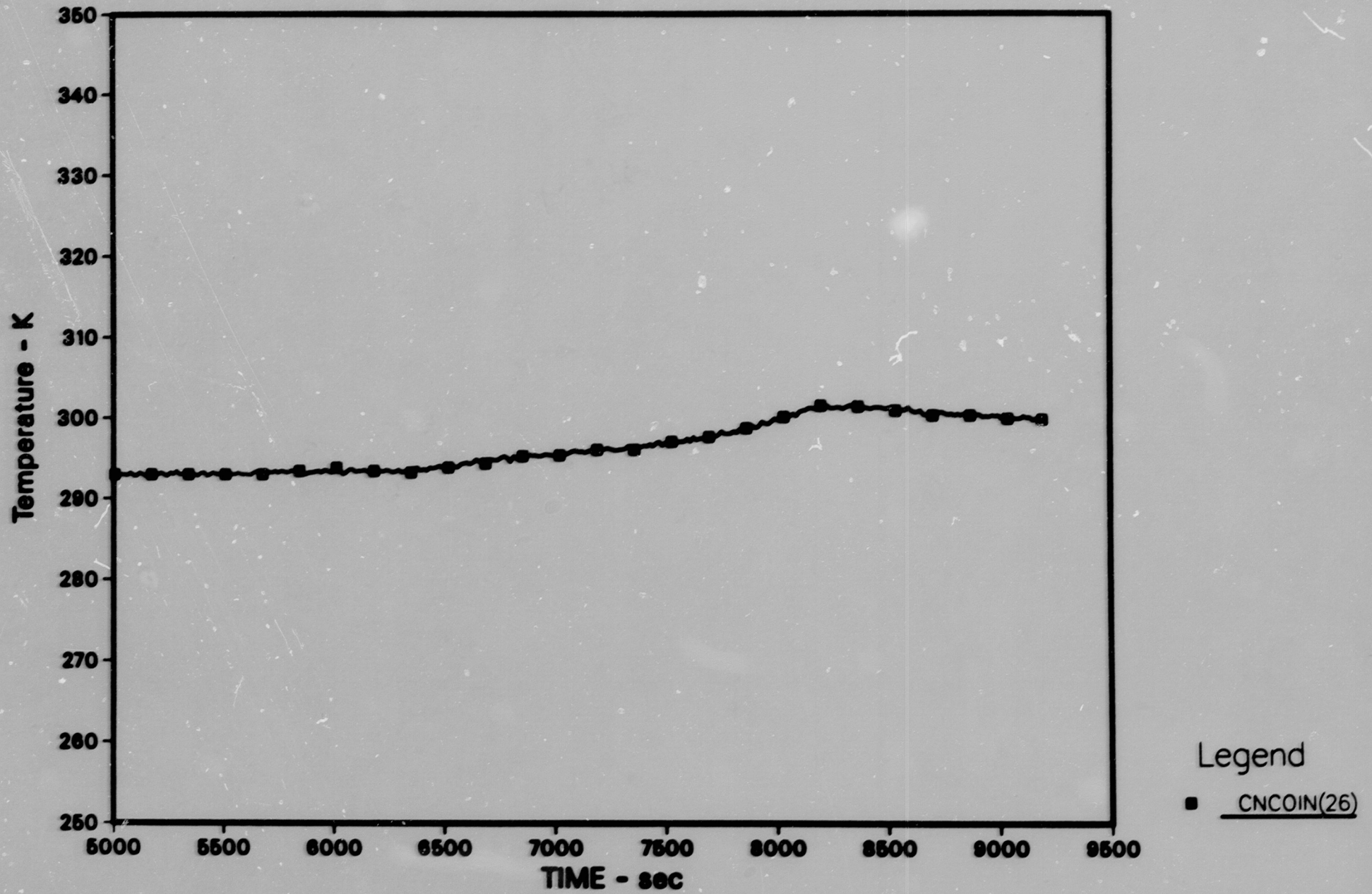
# DF-4 Inside Channel Box, Bottom Surface 27.9In Below Fuel Support



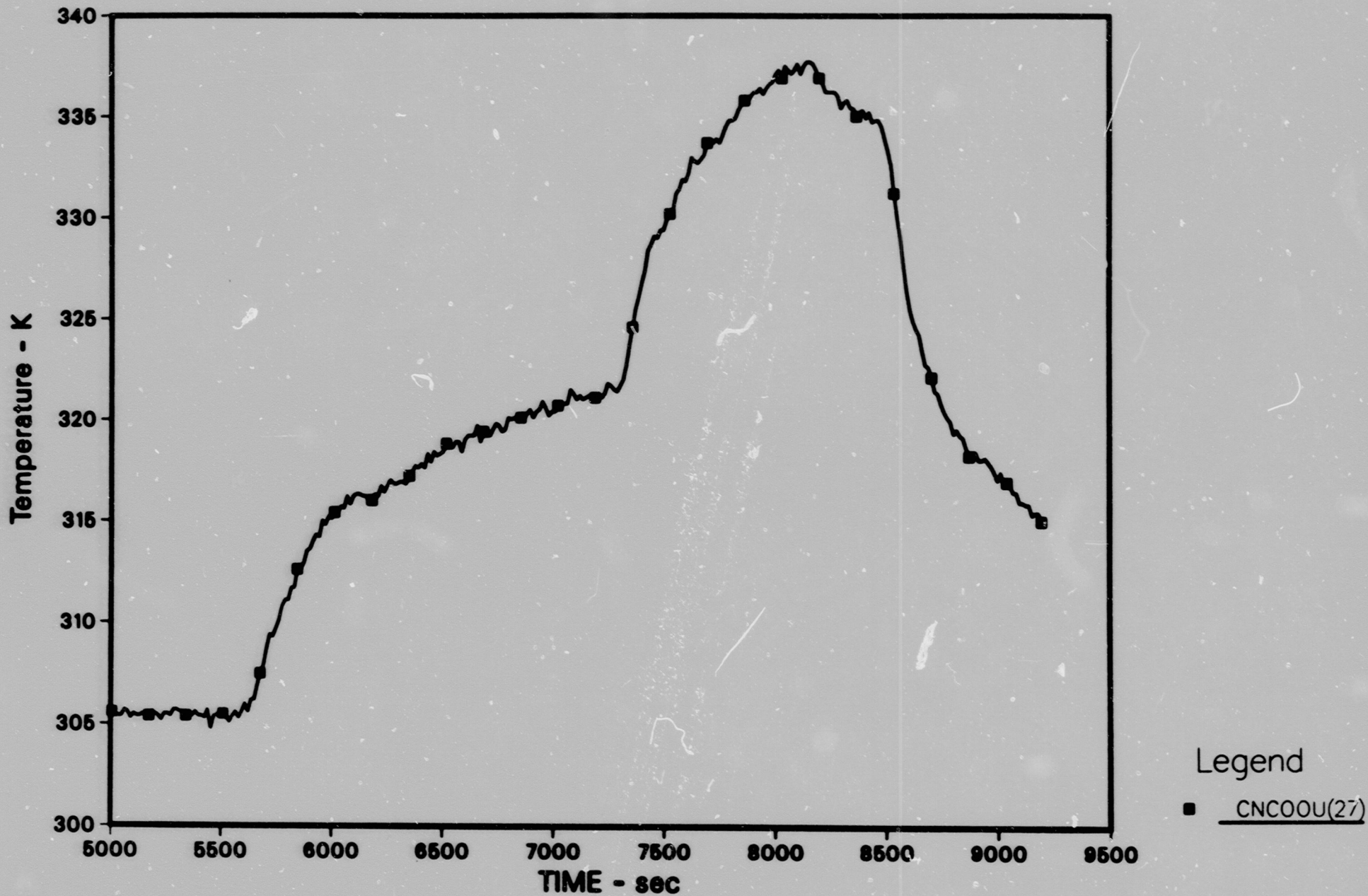
# DF-4 Inside Cool Water Line



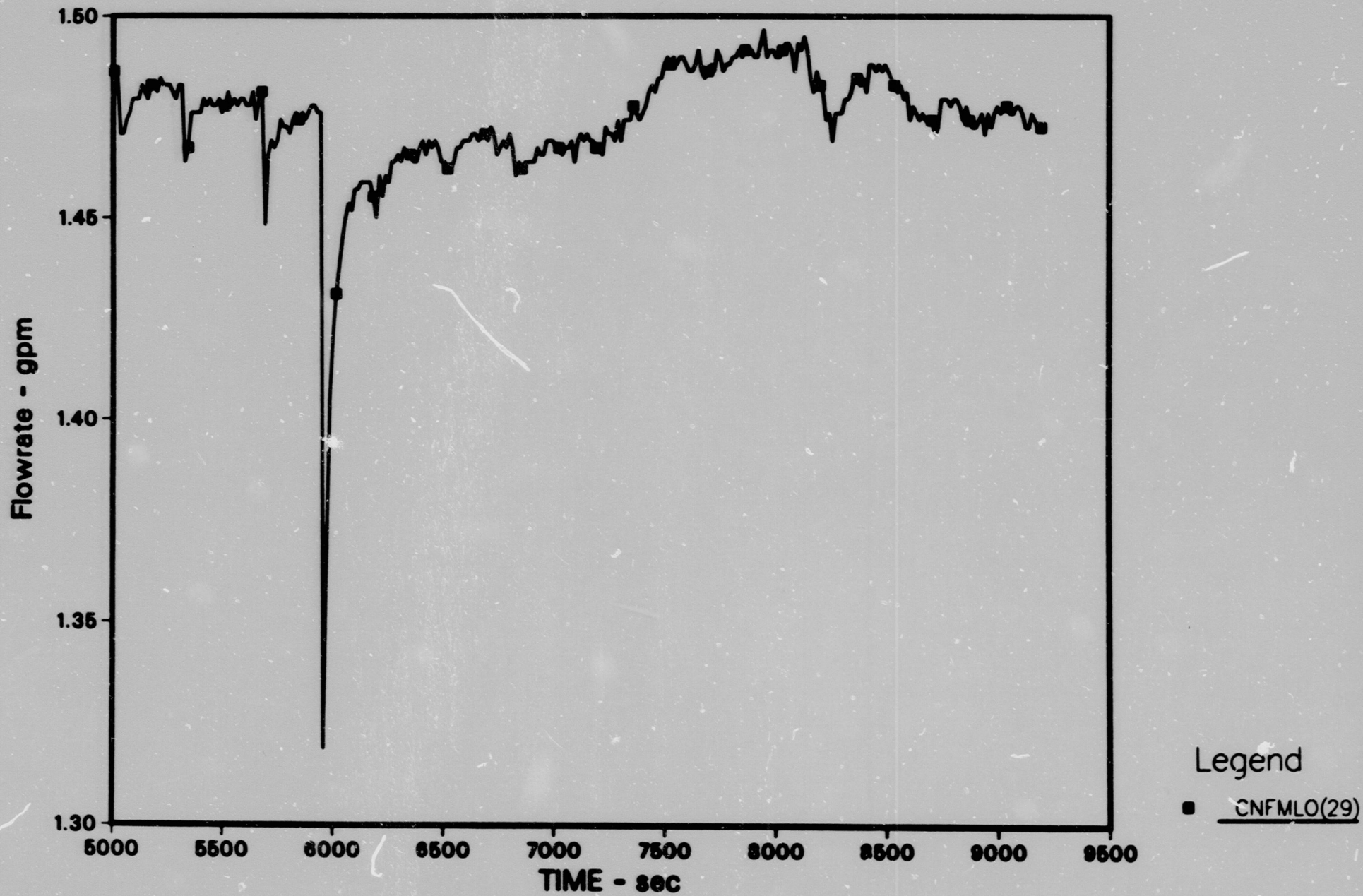
# DF-4 Inside Condenser Coolant Inlet Line



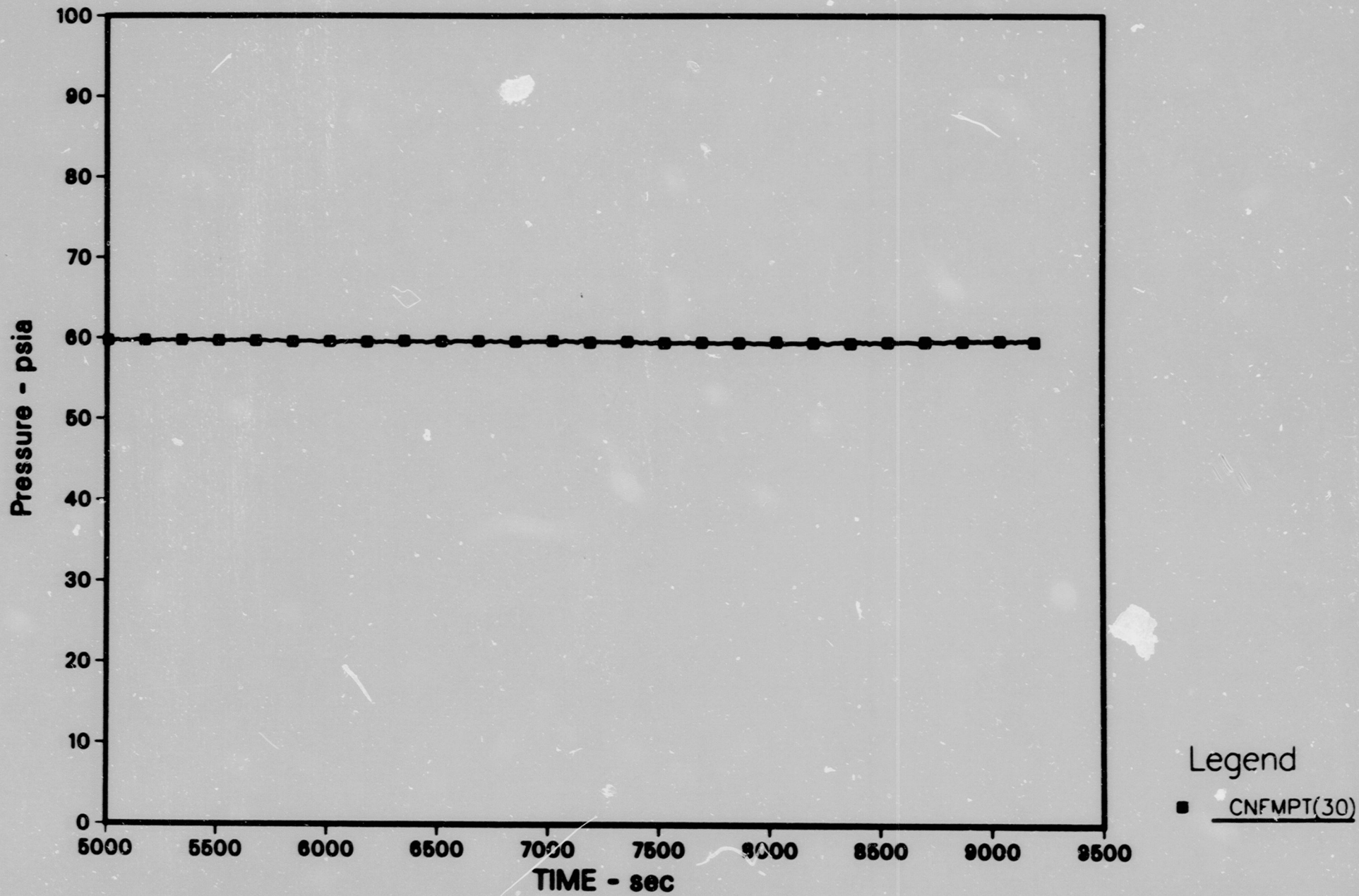
# DF-4 Inside Coolant Water Inlet Line



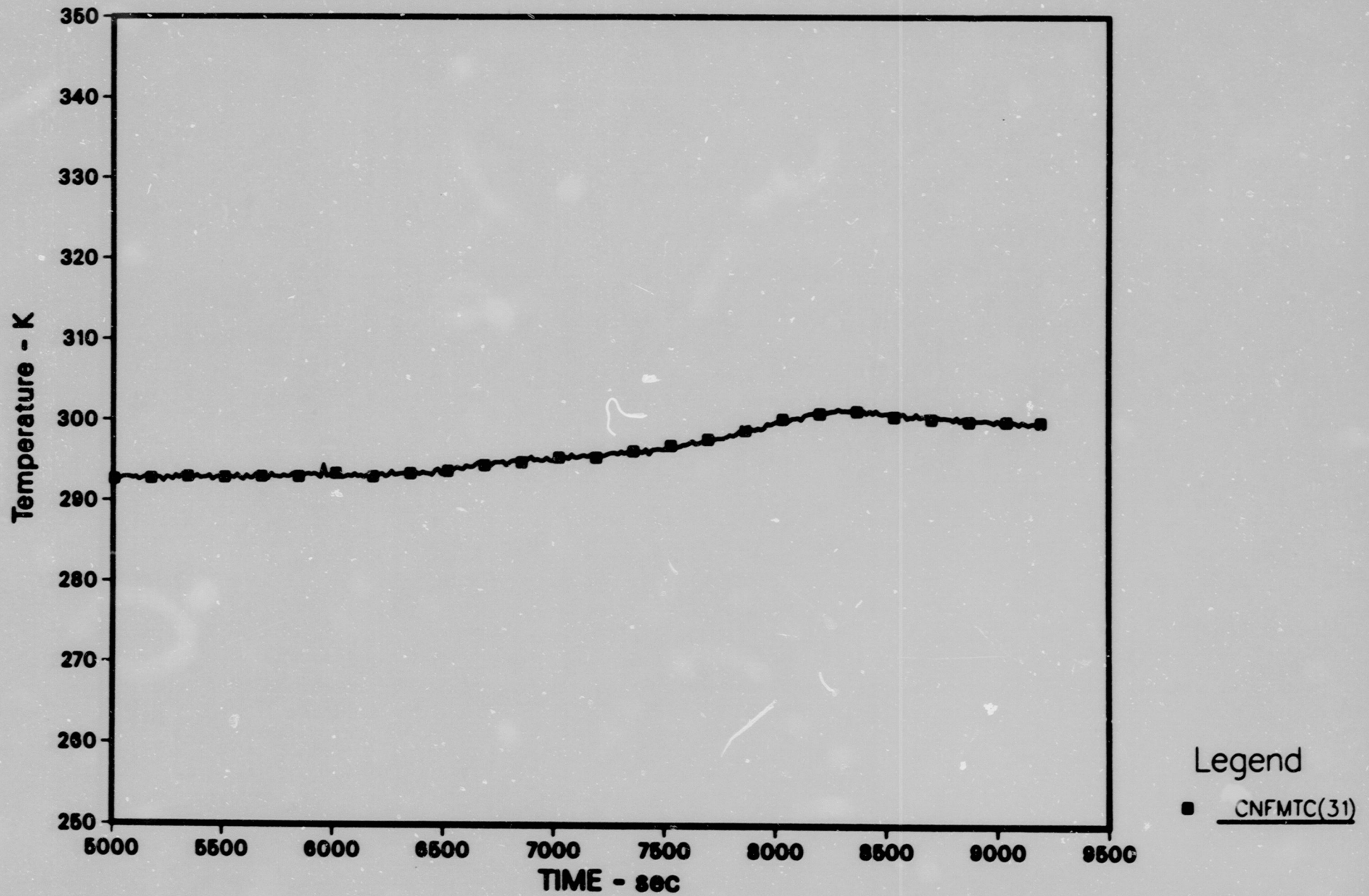
# DF-4 Condenser Coolant Flowmeter



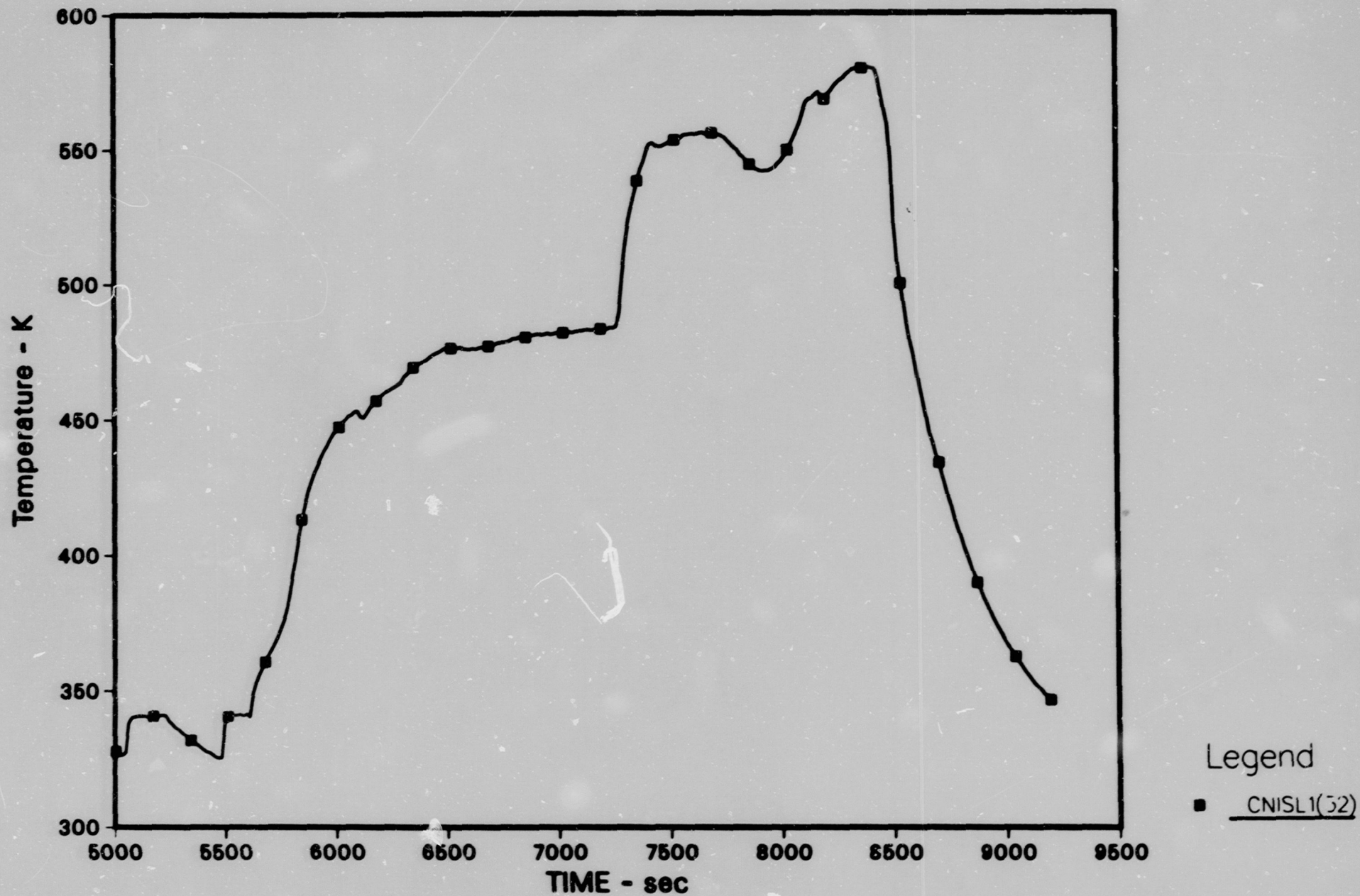
# DF-4 Condenser Cooling Water Pressure



# DF-4 Condenser Cooling Water Temp (for FM)

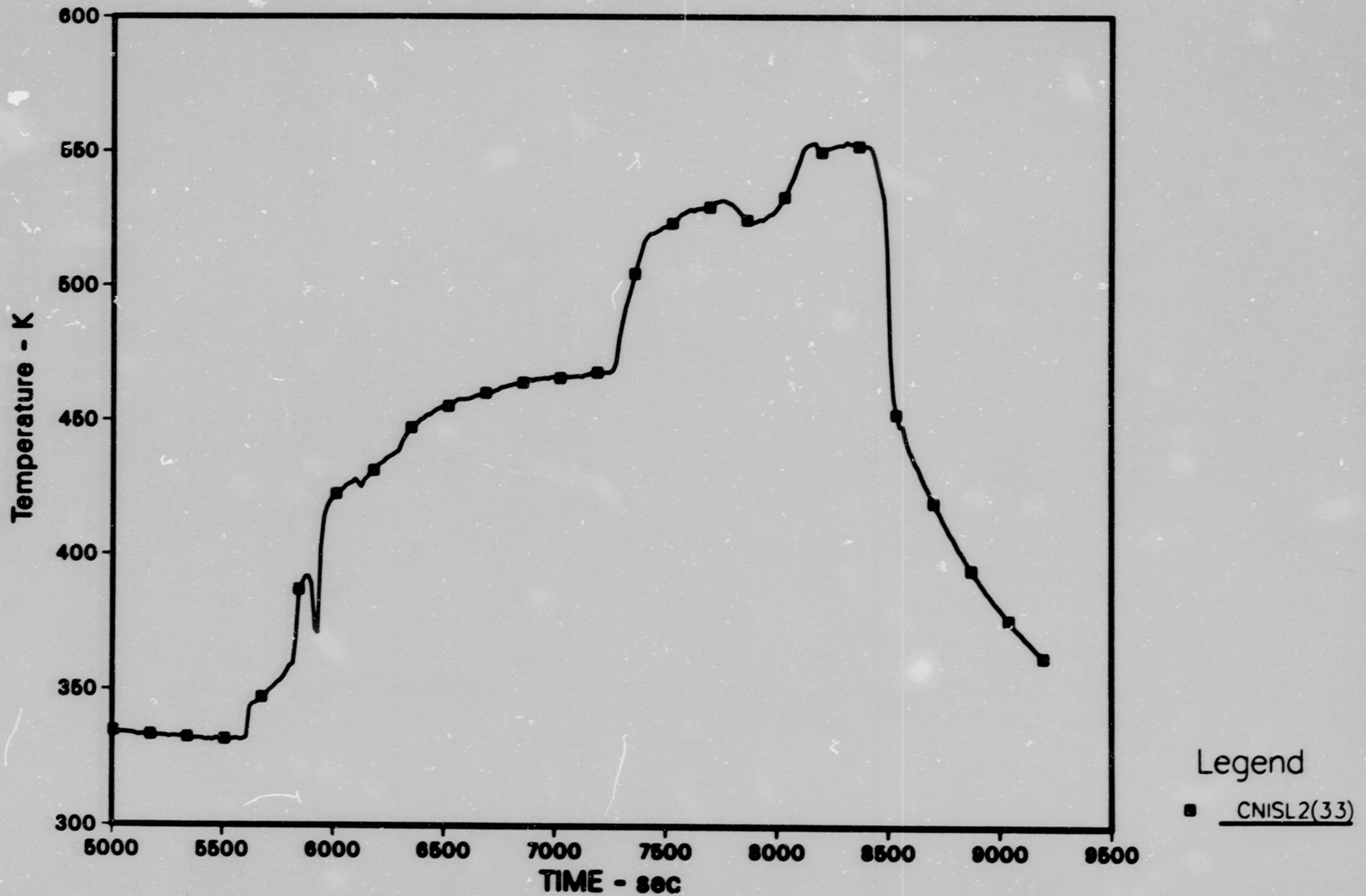


# DF-4 Inside Condenser on Steam Side Wall

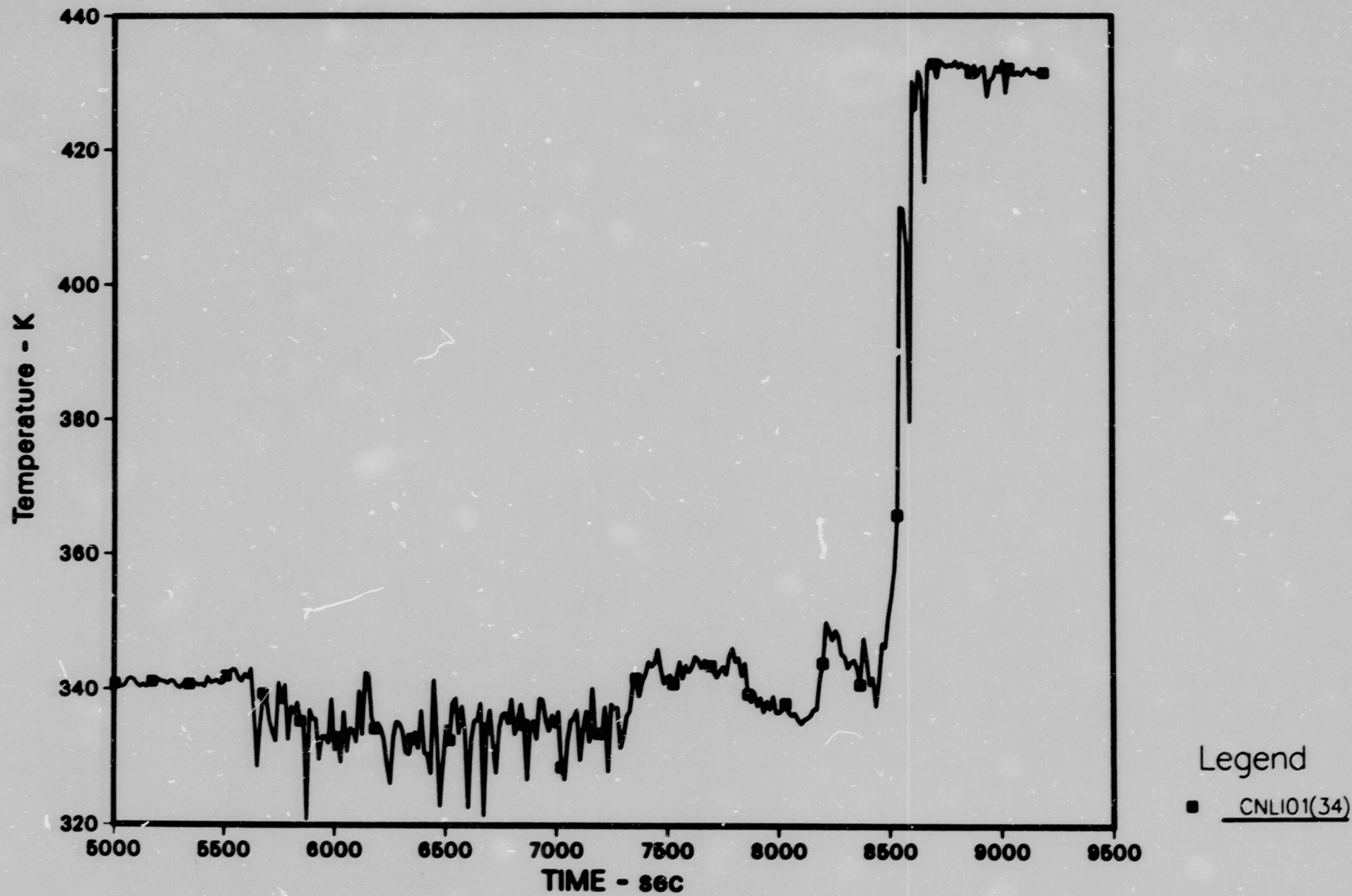




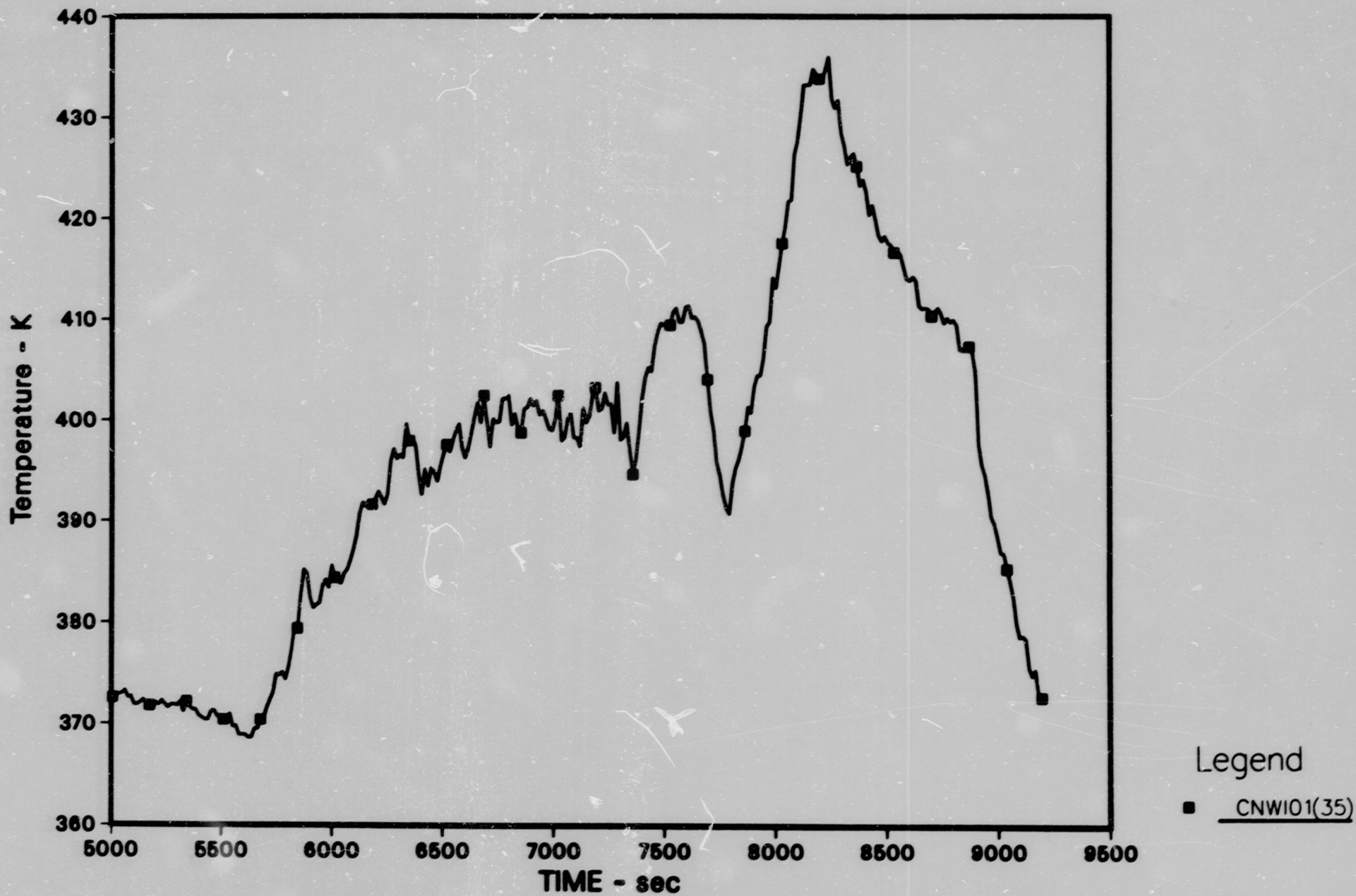
# DF-4 Inside Condenser on Steam Side Wall(2)



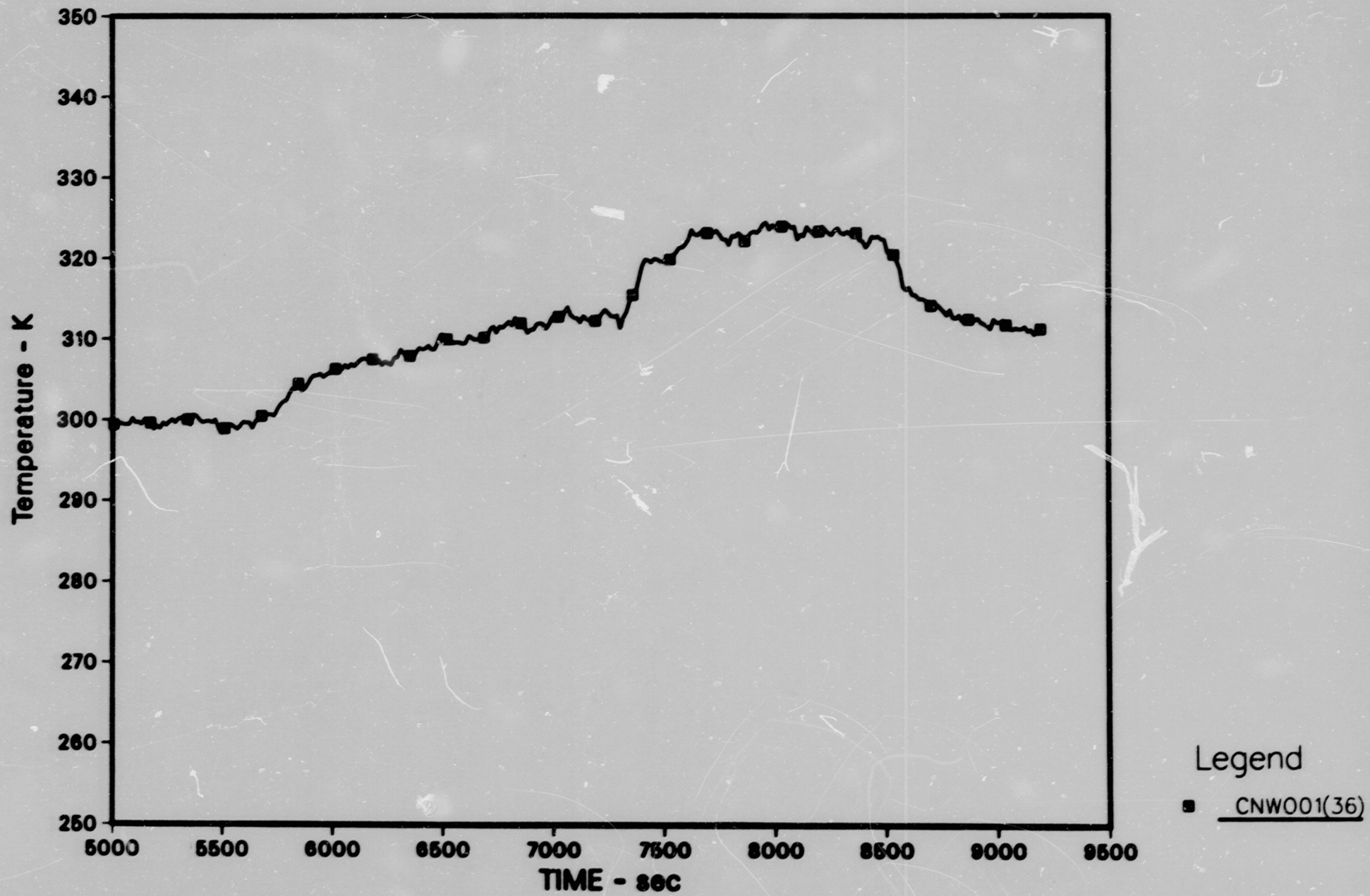
# DF-4 Inside Condensate Line at Condenser Outlet



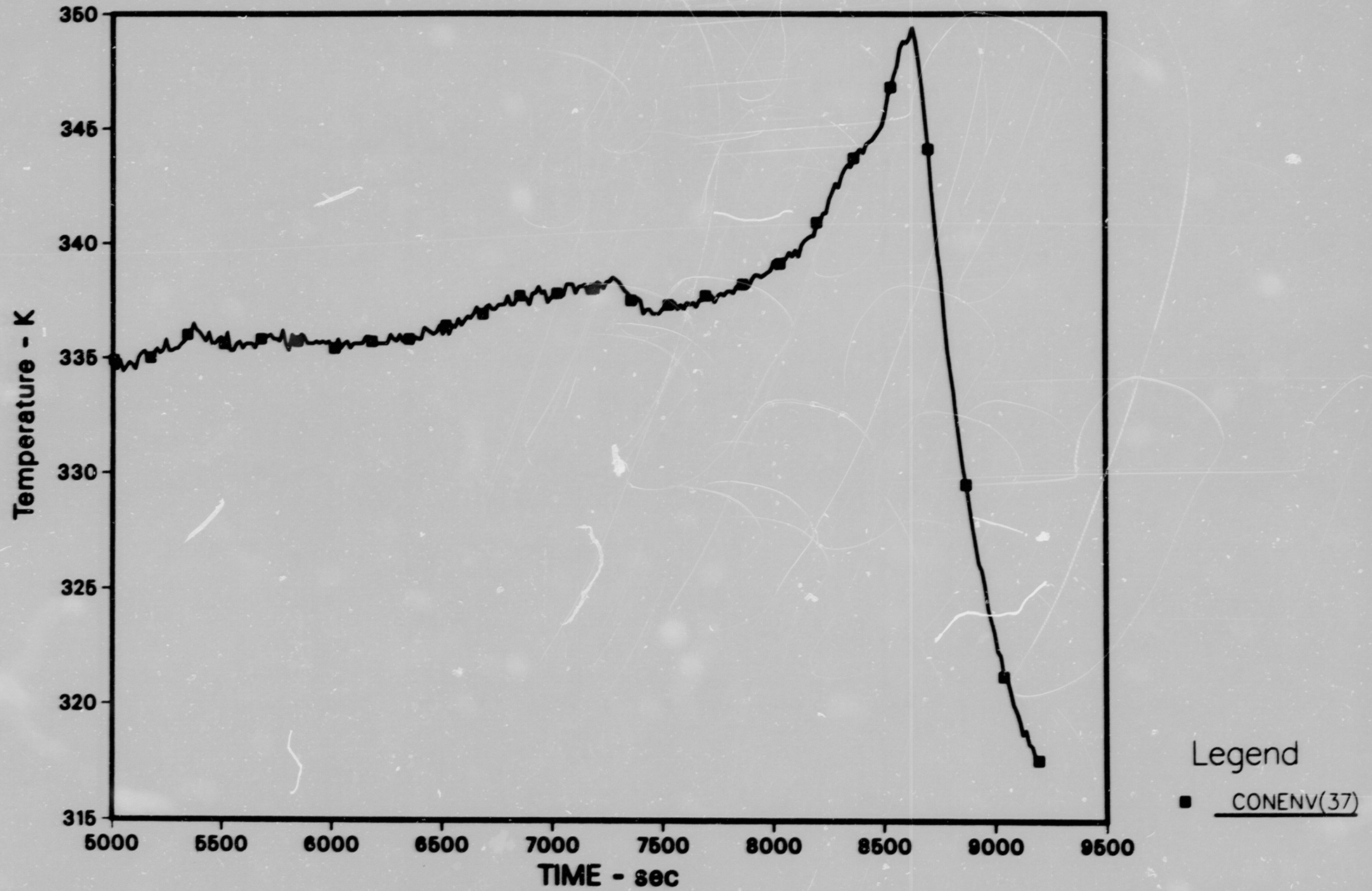
# DF-4 Condenser Inner Wall 6in Below Top



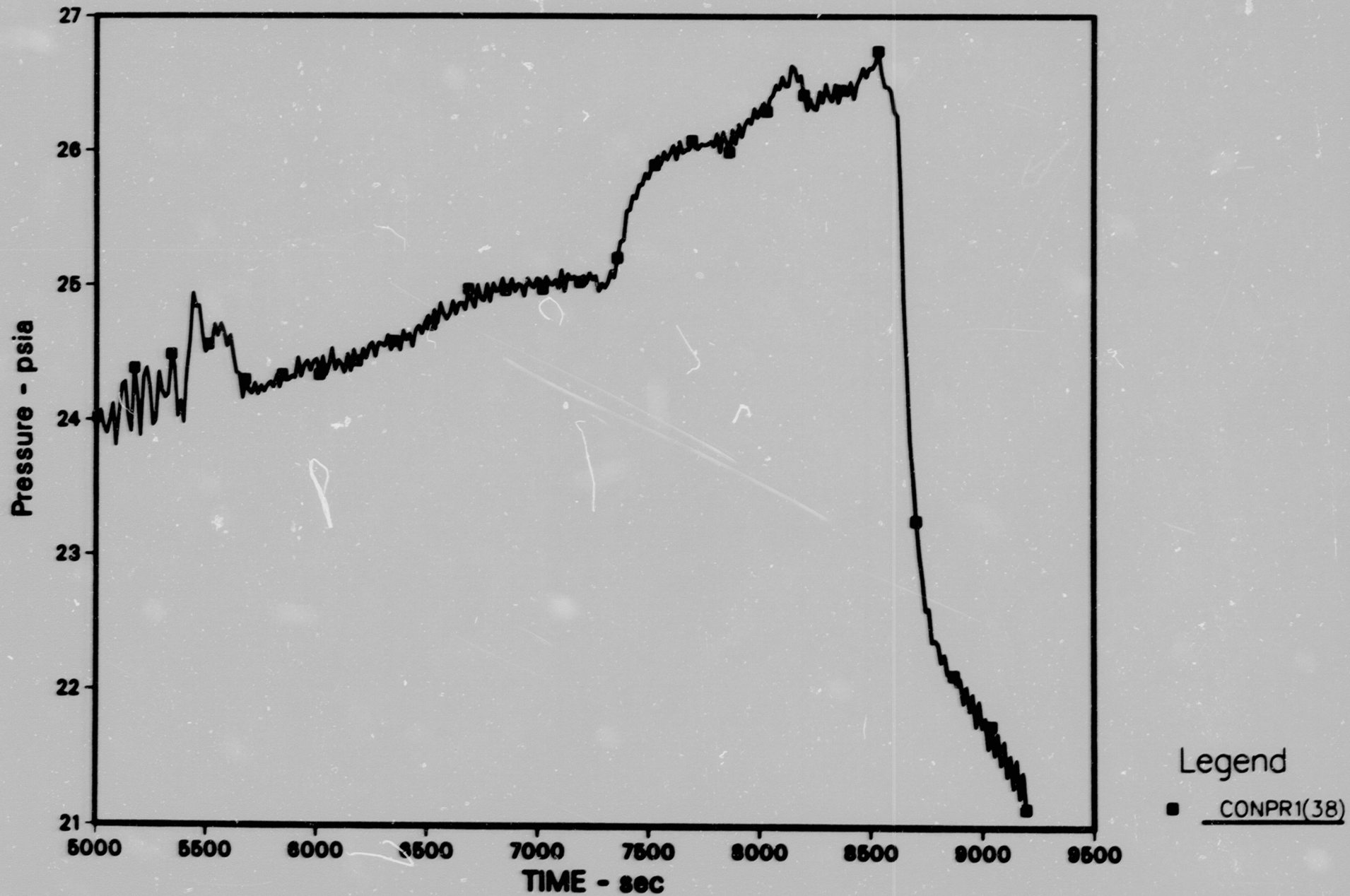
# DF-4 Condenser Outer Wall 6in Above Bottom



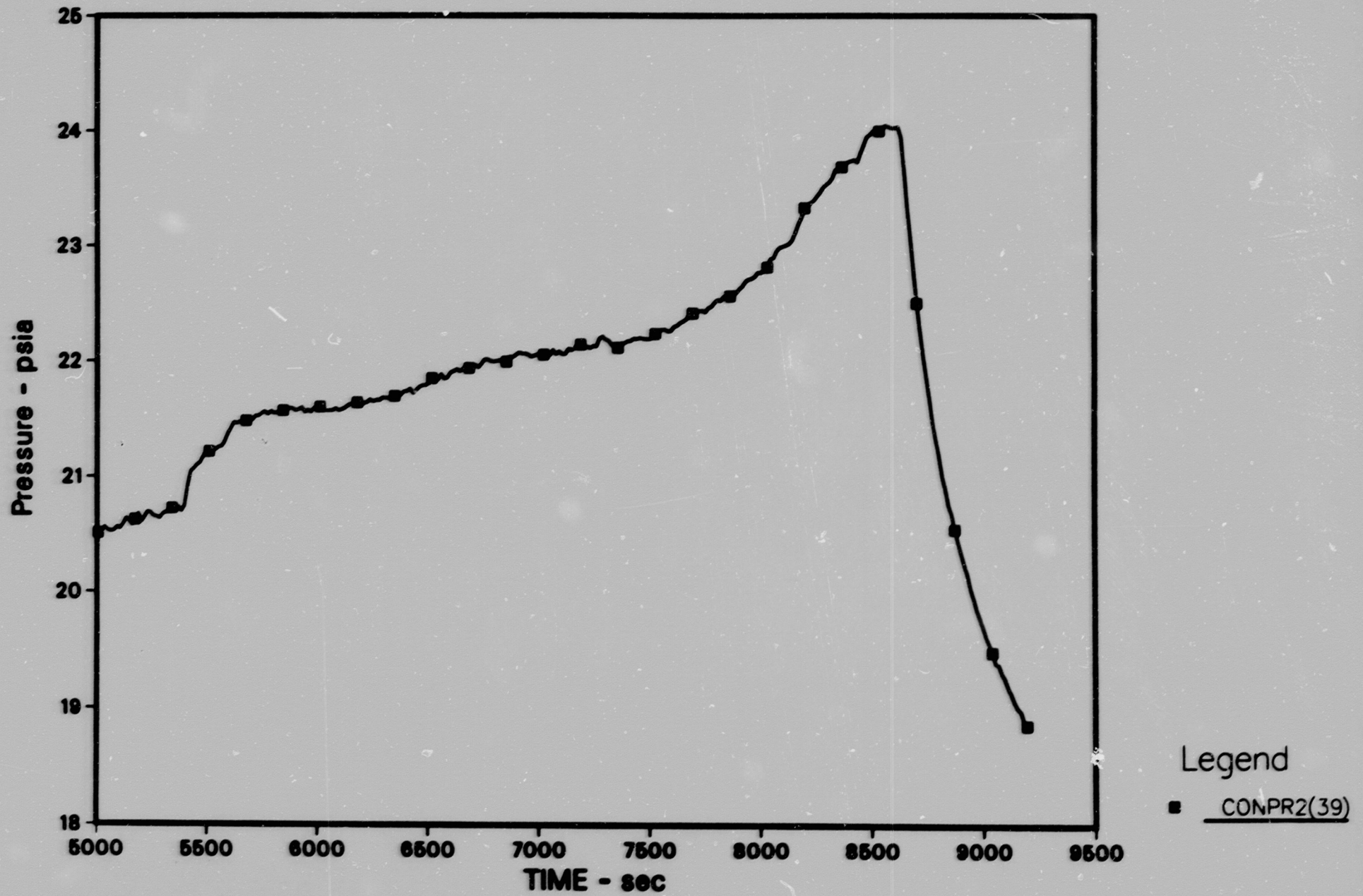
# DF-4 Containment Environment



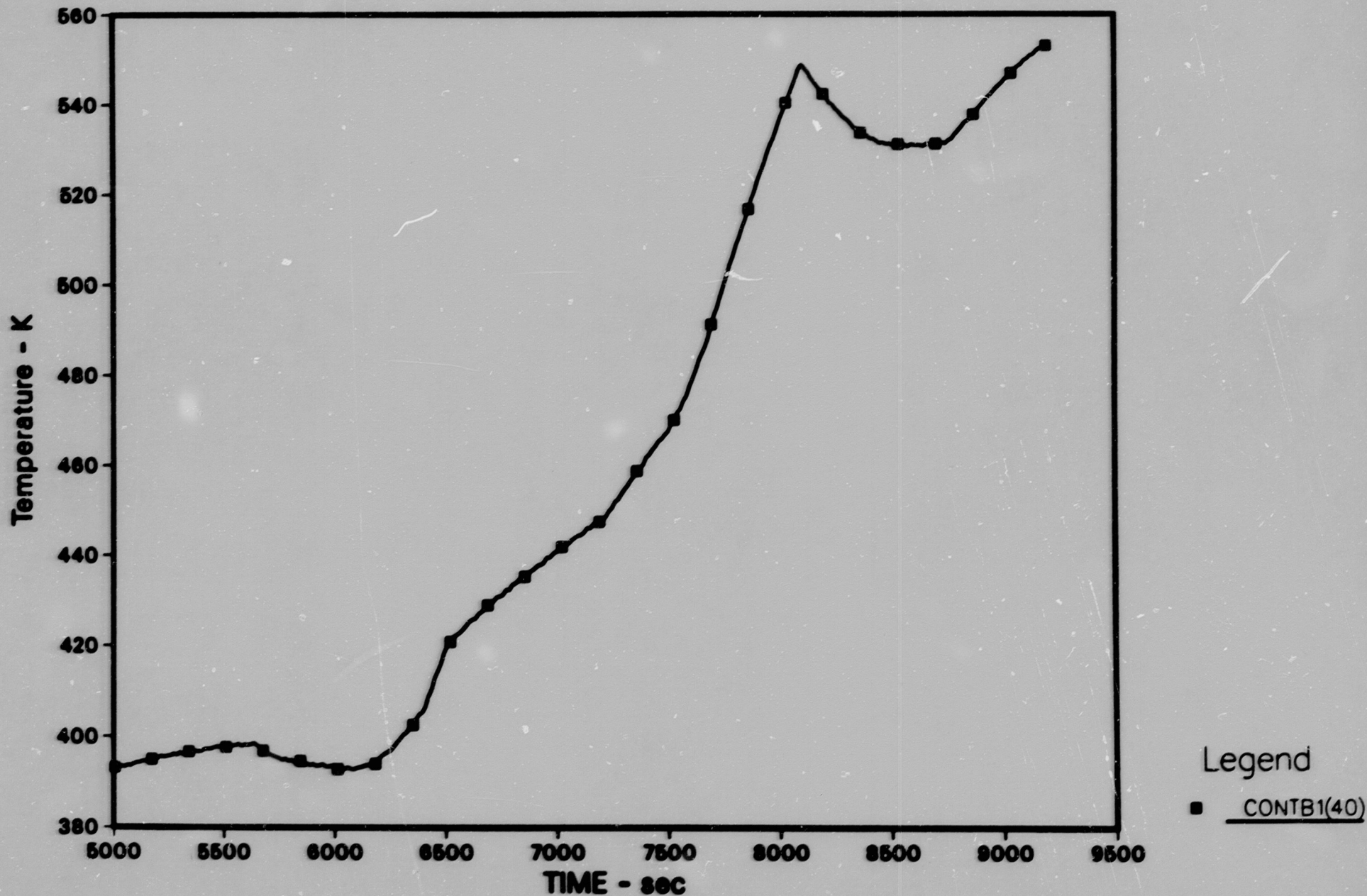
# DF-4 Containment Tube Pressure



# DF-4 Containment Tube Pressure (2)

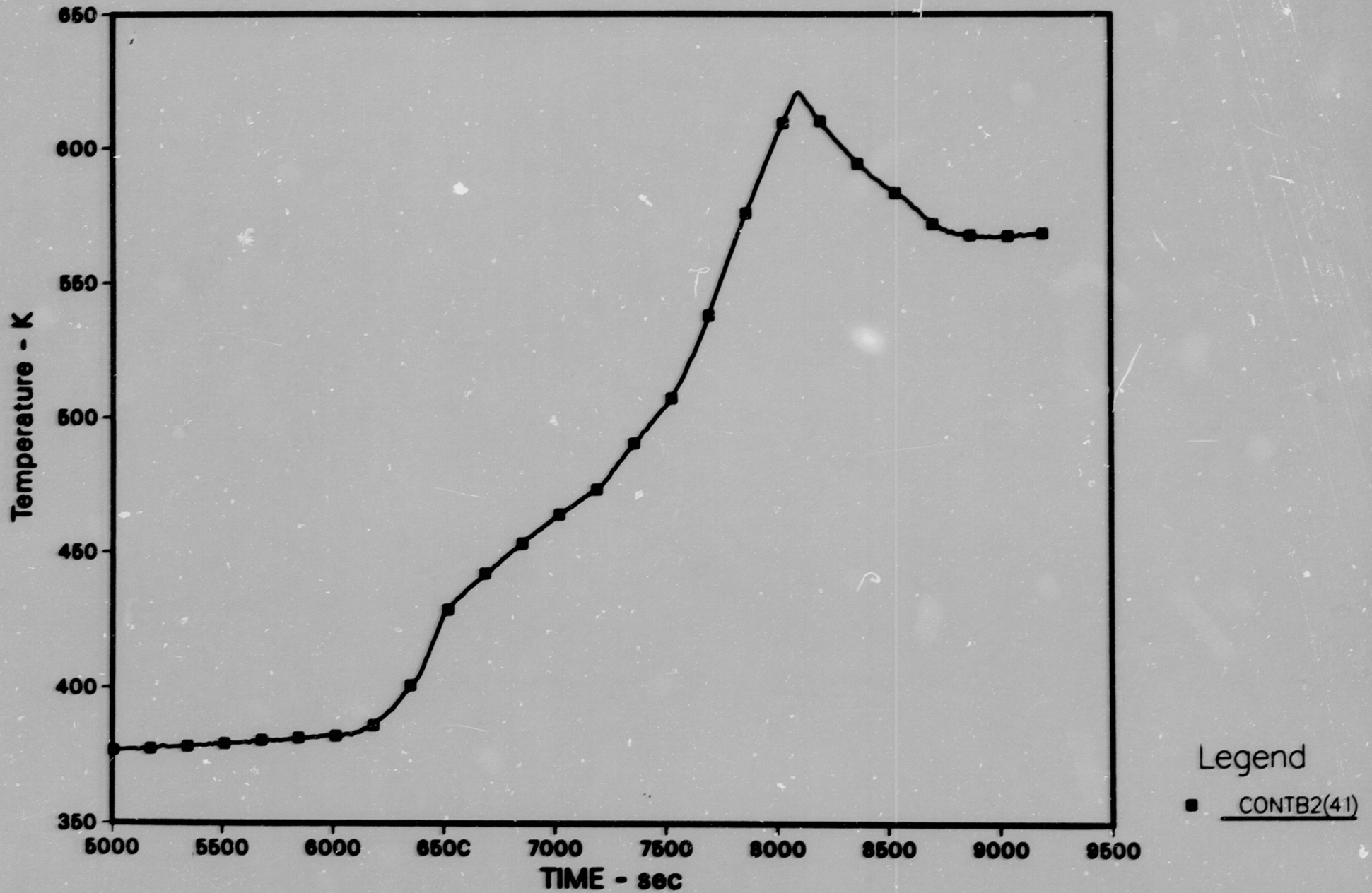


# DF-4 Containment Tube Wall Just Below n-Filter

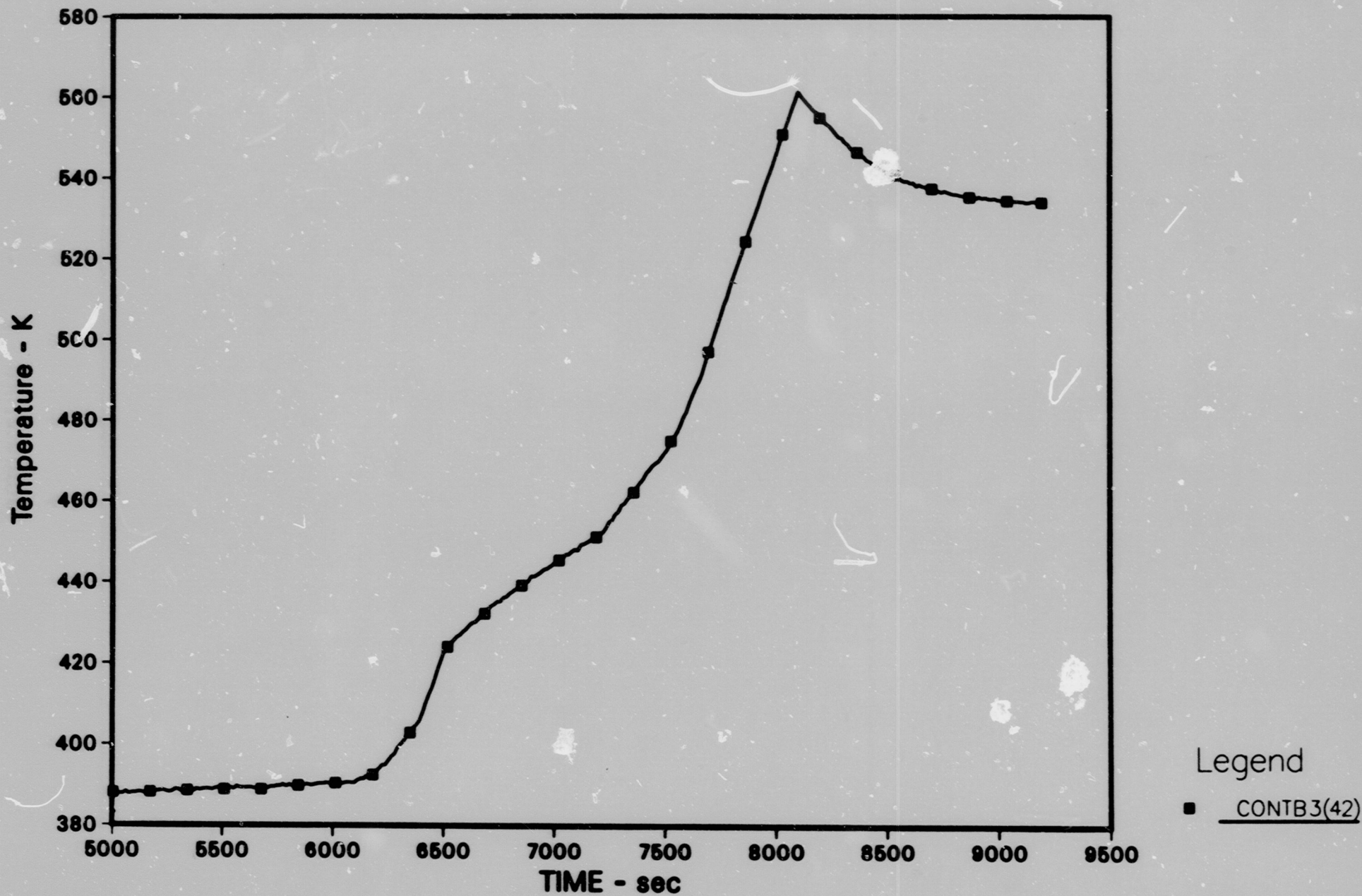




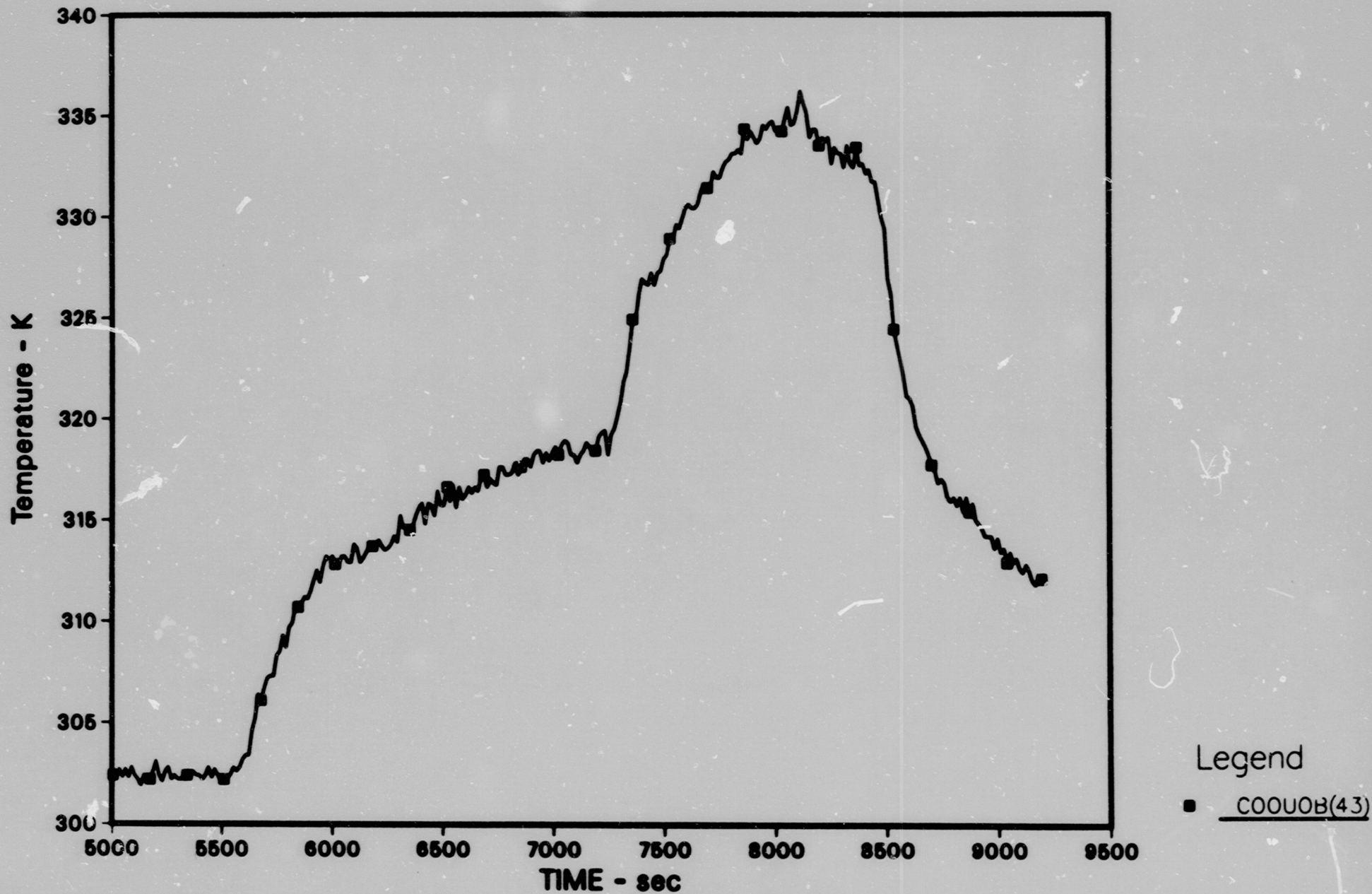
# DF-4 Containment Tube Center of n-Filter



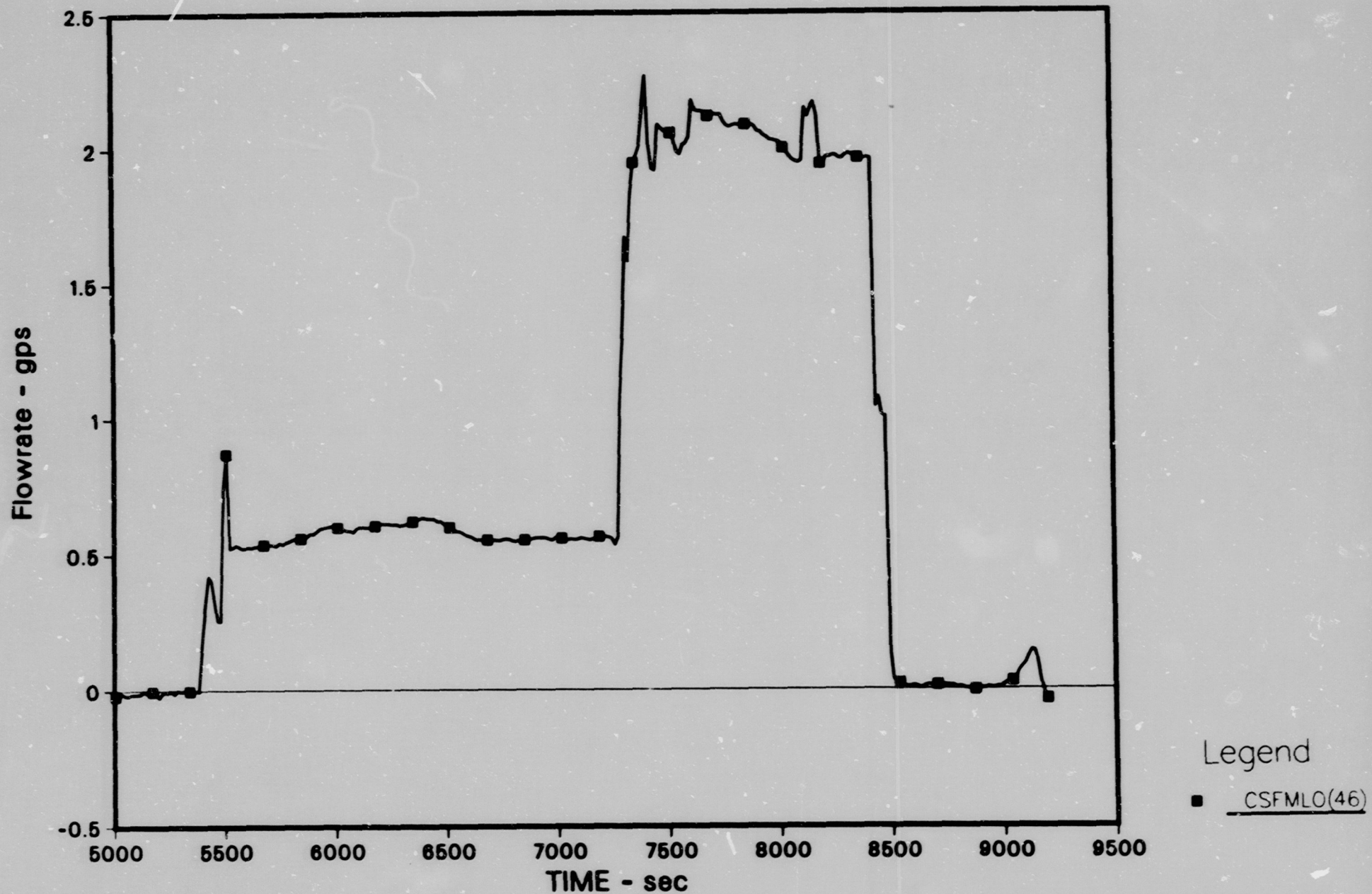
# DF-4 Containment Tube Wall Just Above n-Filter



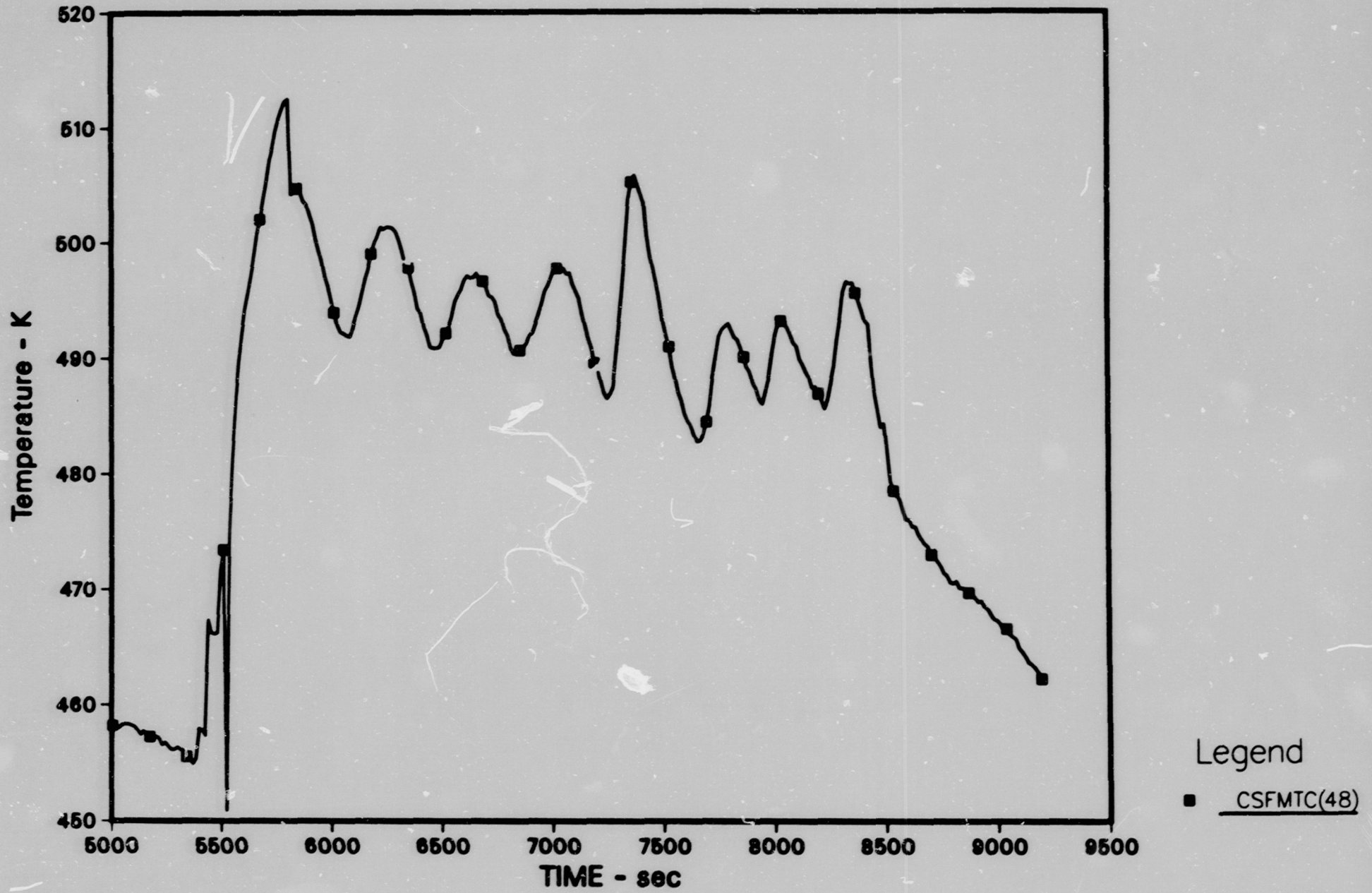
# DF-4 Coolant Outlet Above Bulkhead (inside)



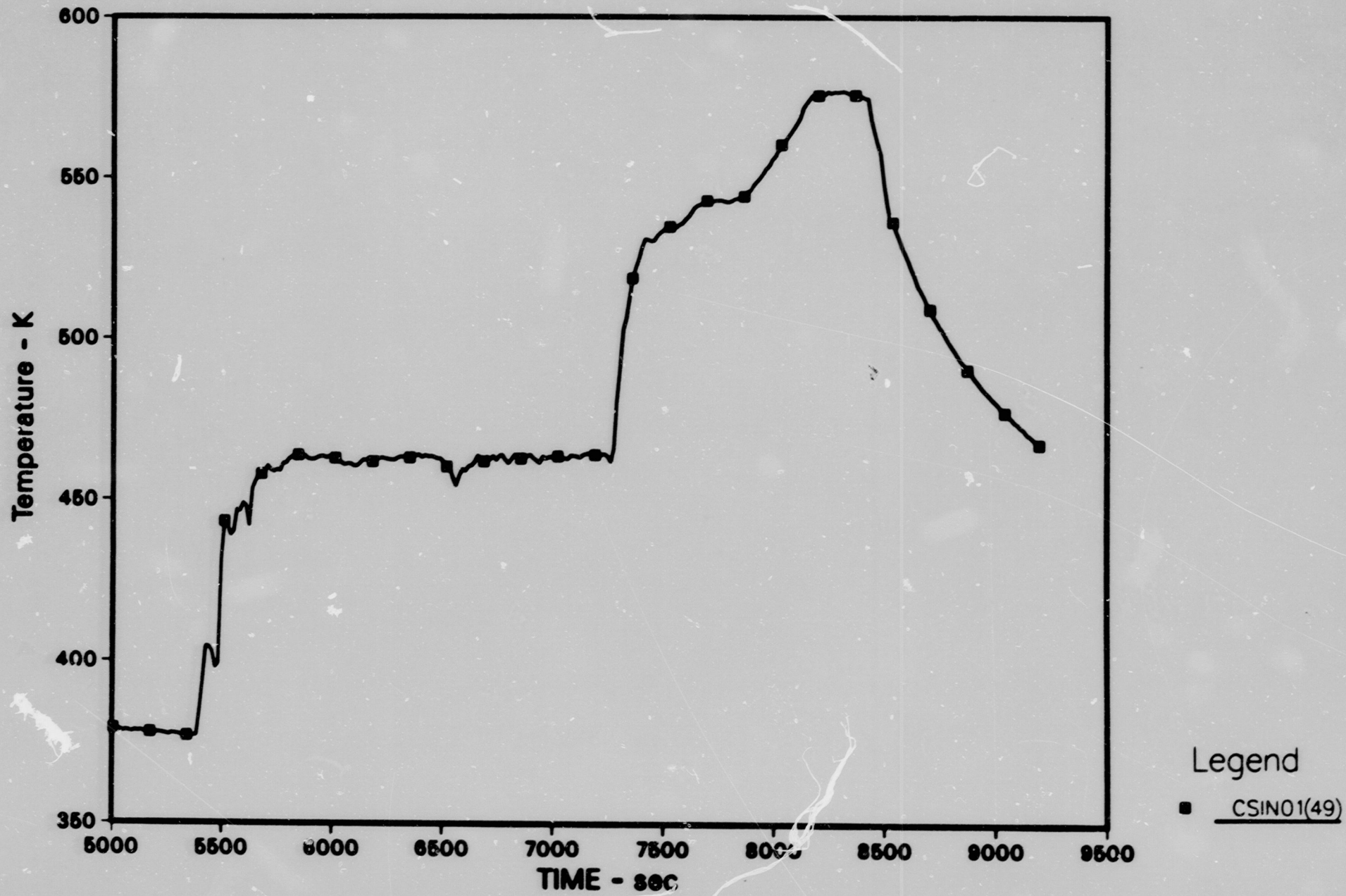
# DF-4 Cool Steam Flow Meter



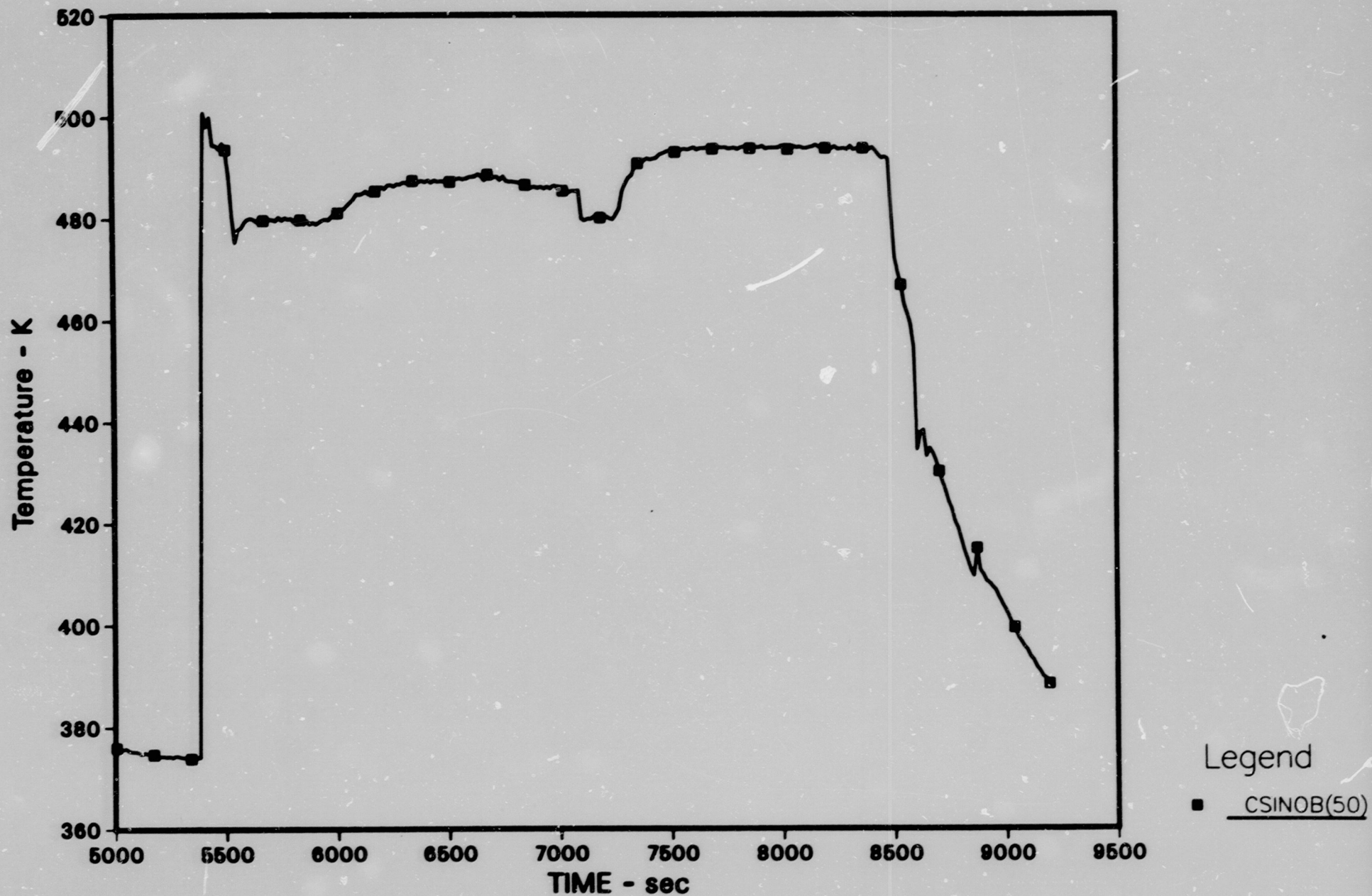
# DF-4 Cool Steam Temp (for FM)



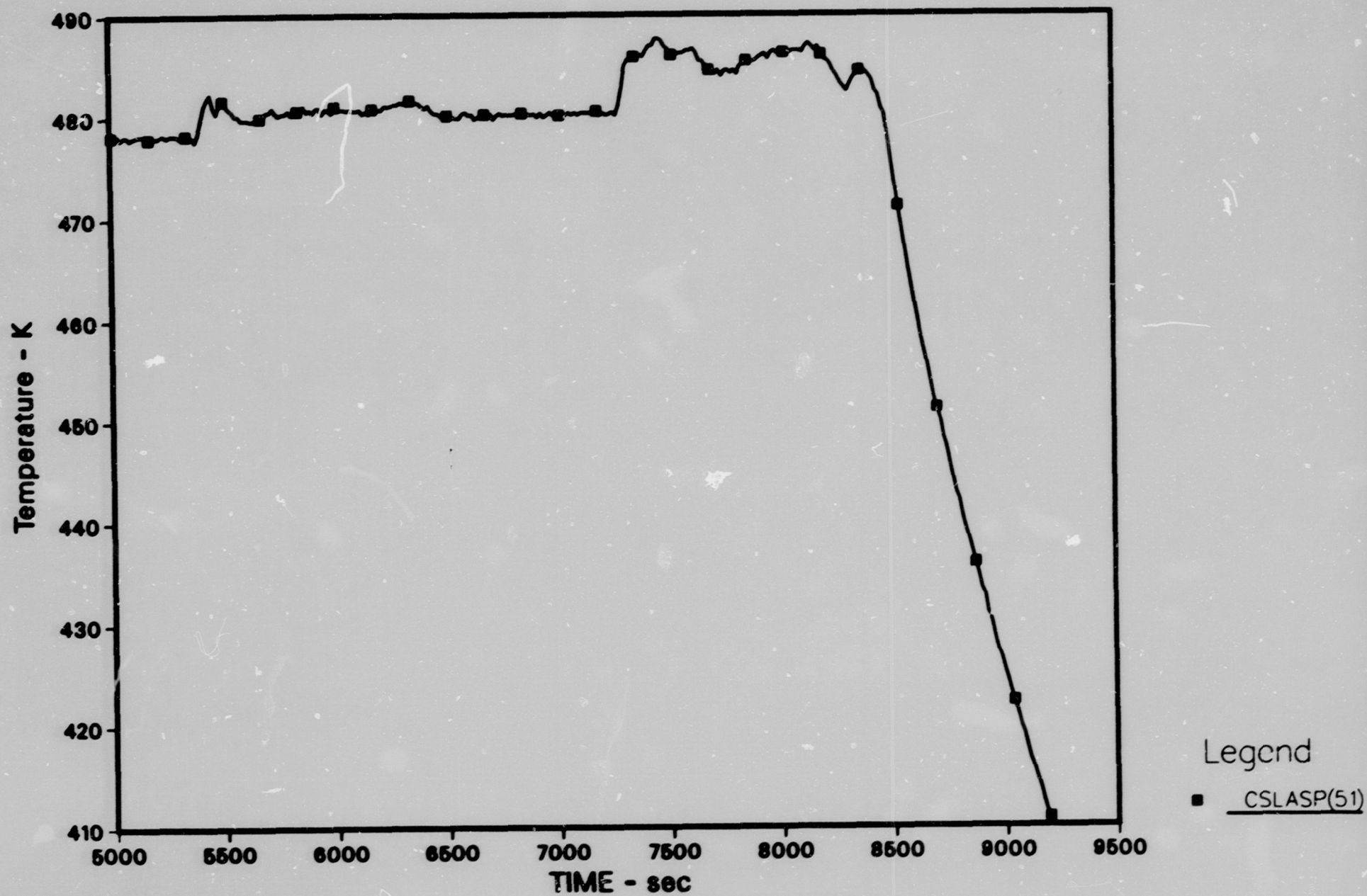
# DF-4 Inside Cool Steam Port @ 90 Deg



# DF-4 inside Cool Steam Line Top of Access Tube

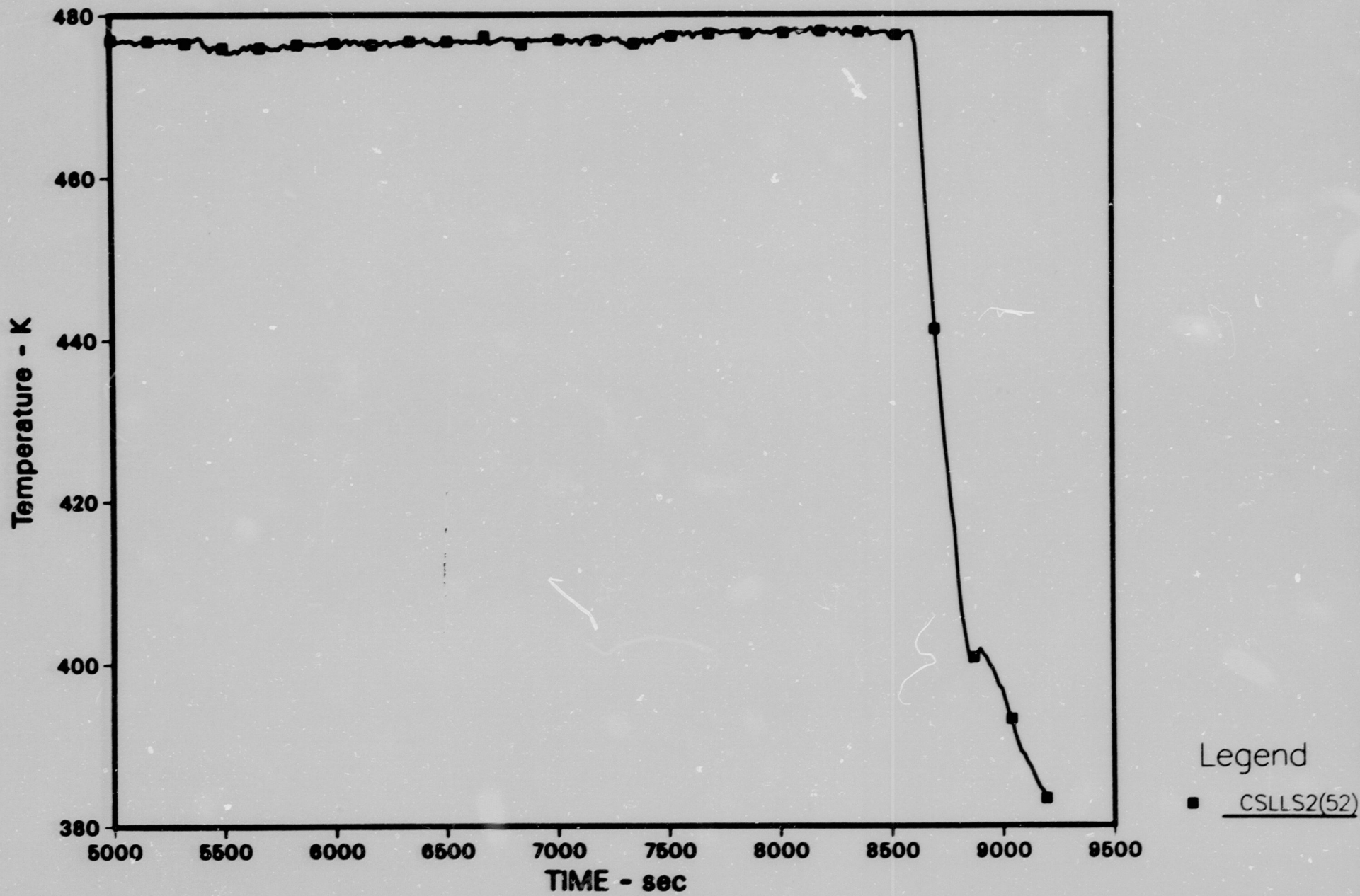


# DF-4 Cool Steam Line Wall Above Shield Plug

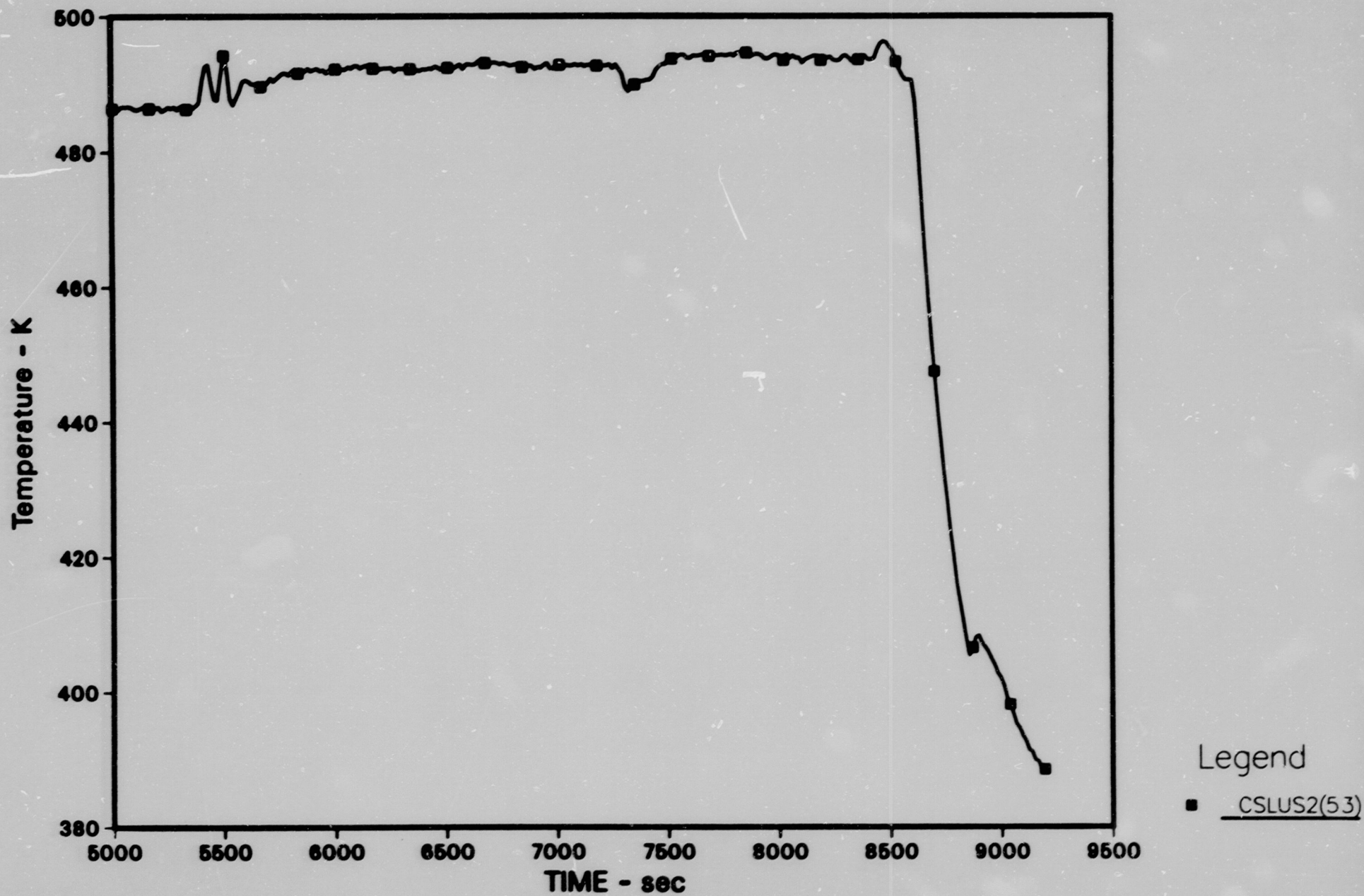




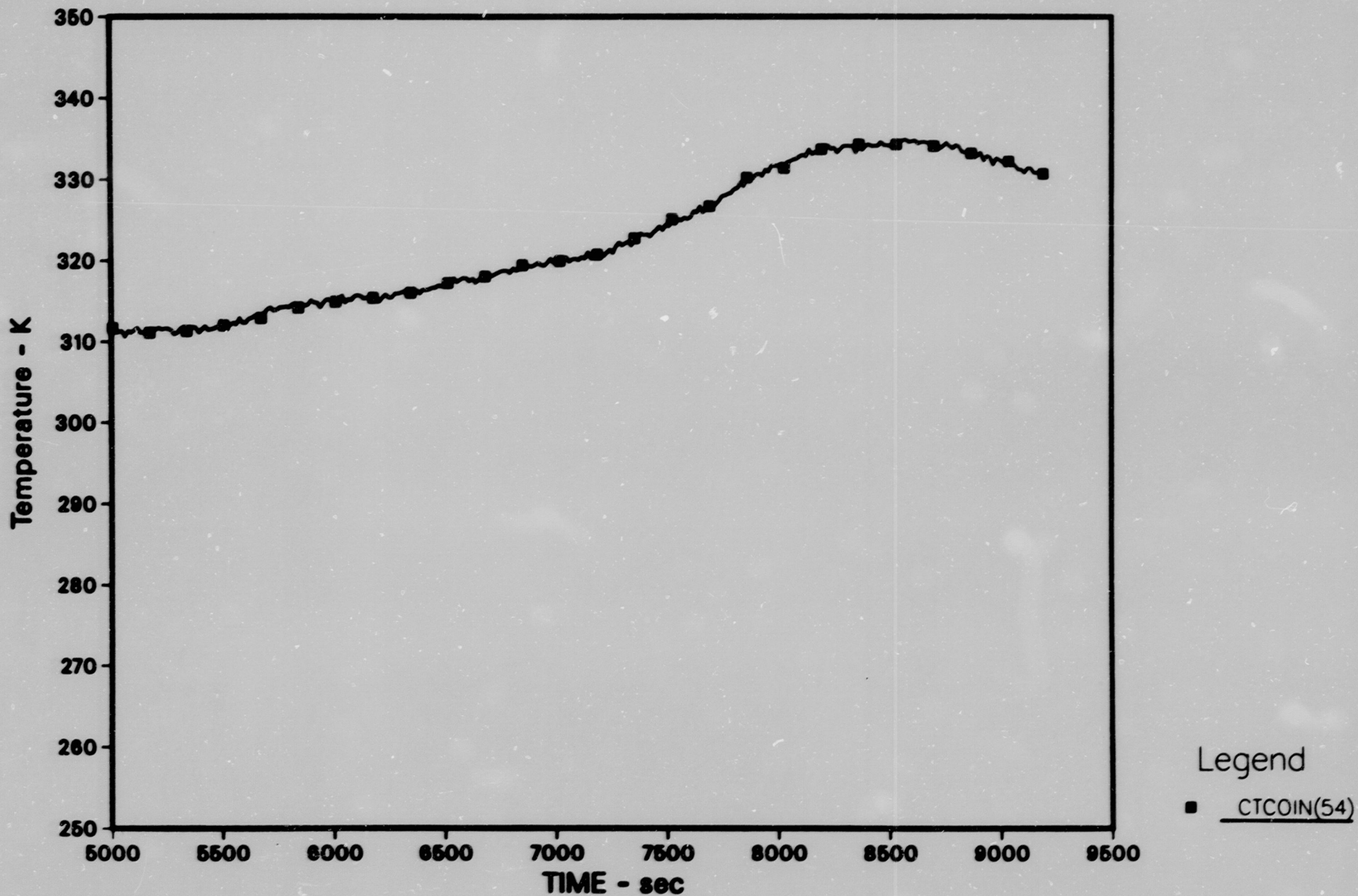
# DF-4 Cool Steam Line Wall, Lower Shield Plug



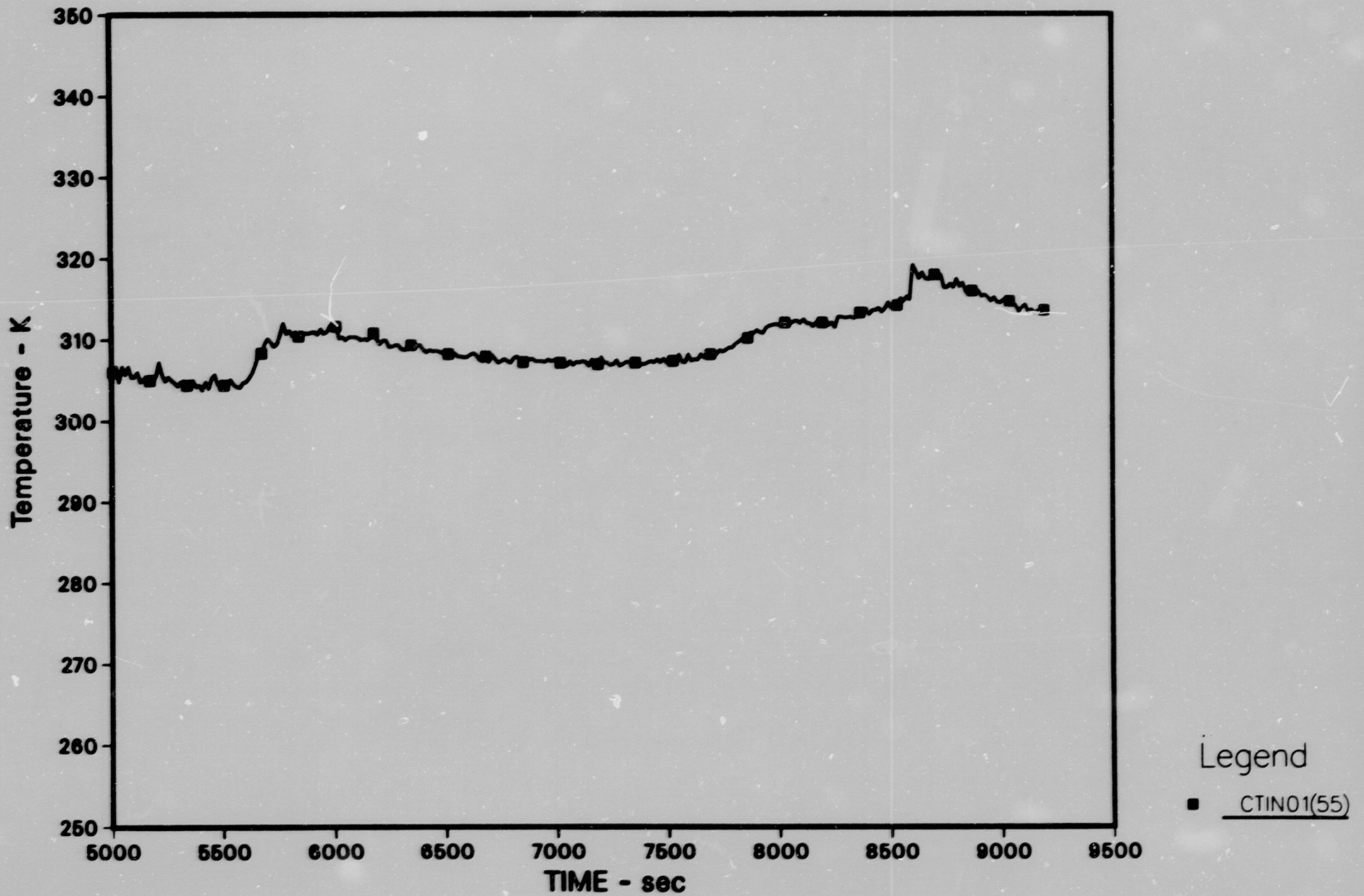
# DF-4 Cool Steam Line Wall, Upper Shield Plug



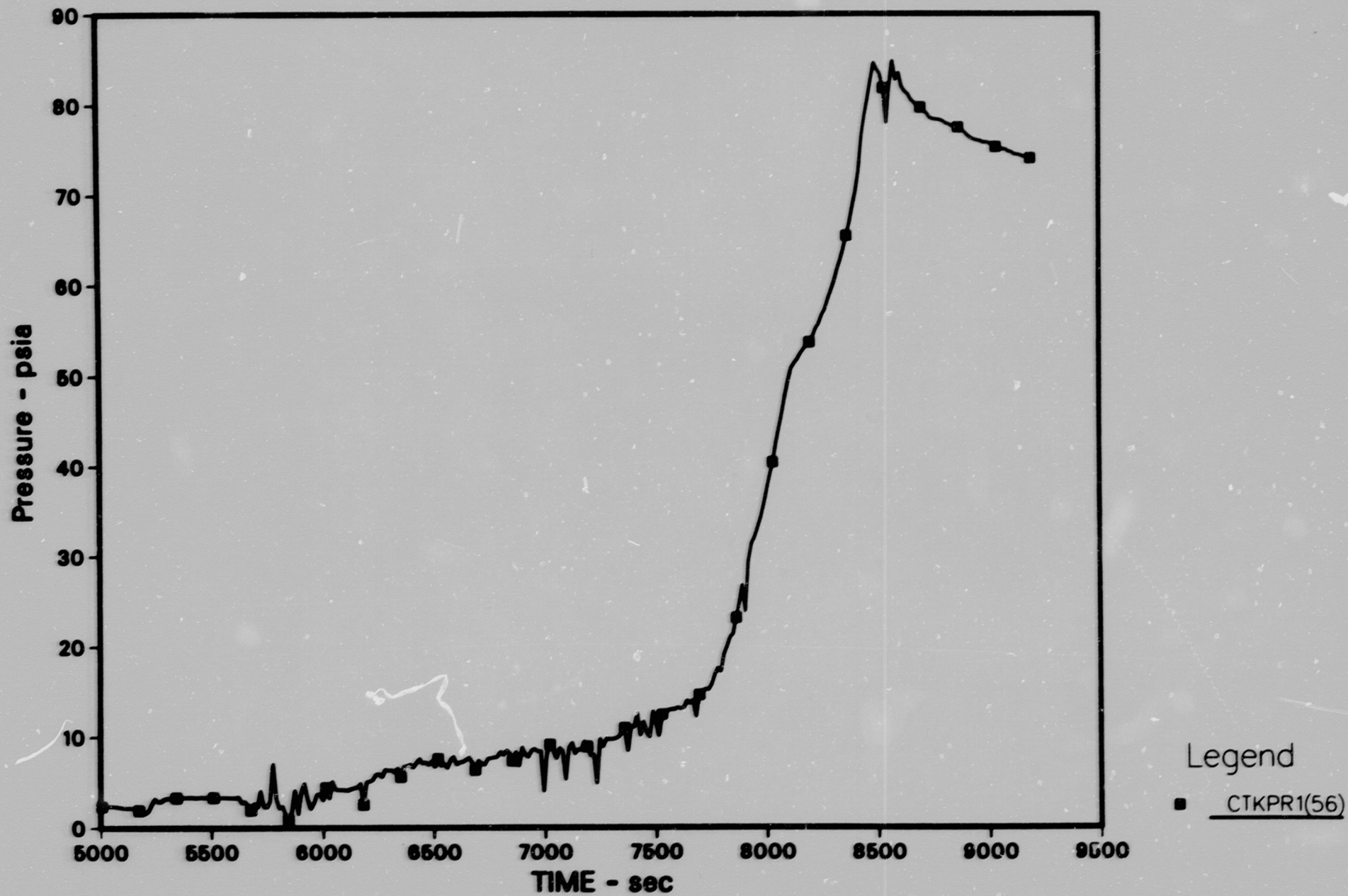
# DF-4 Condensate Tank Coolant Inlet (inside)



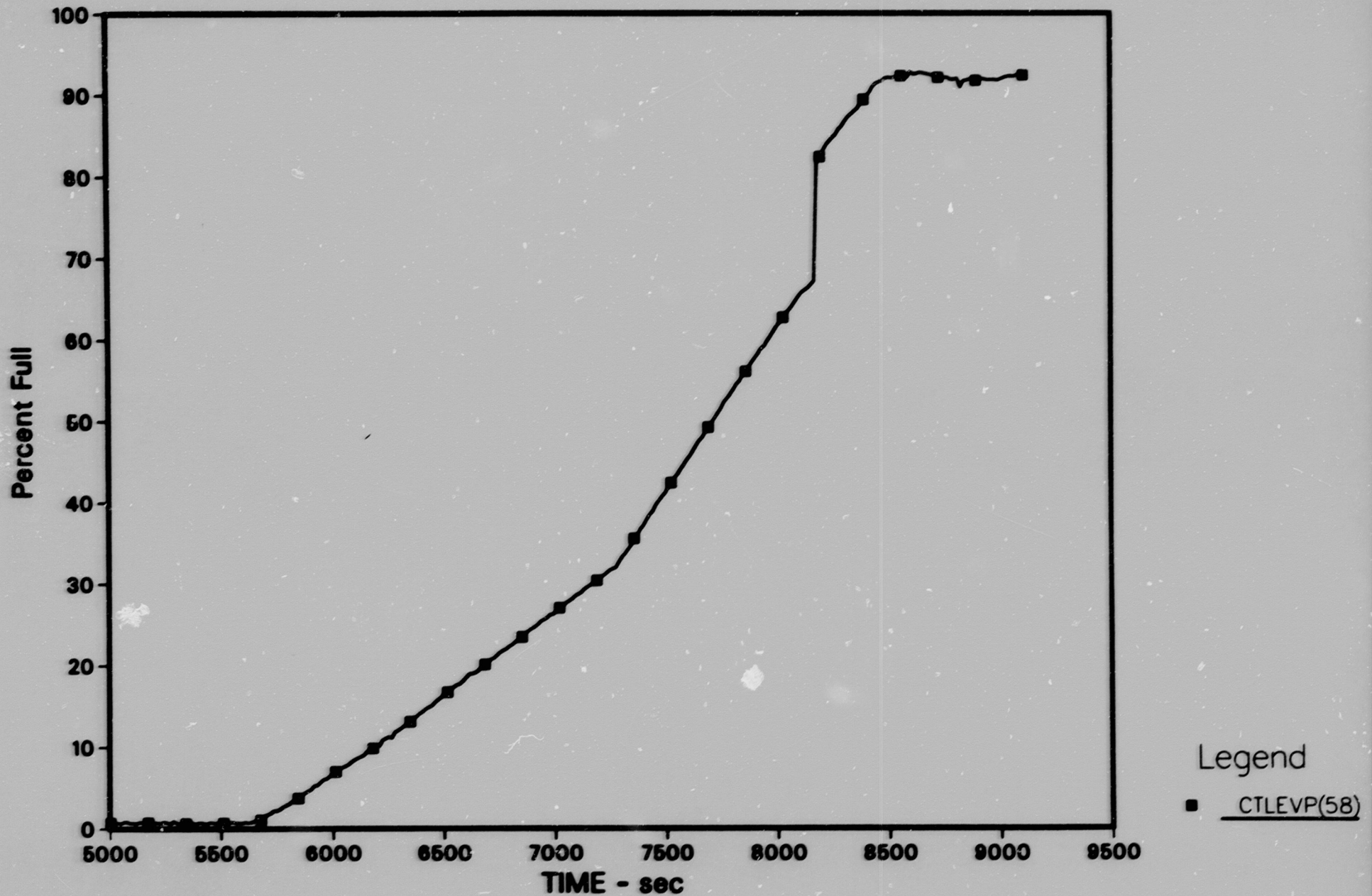
# DF-4 Inside Condensate Tank @ Bottom



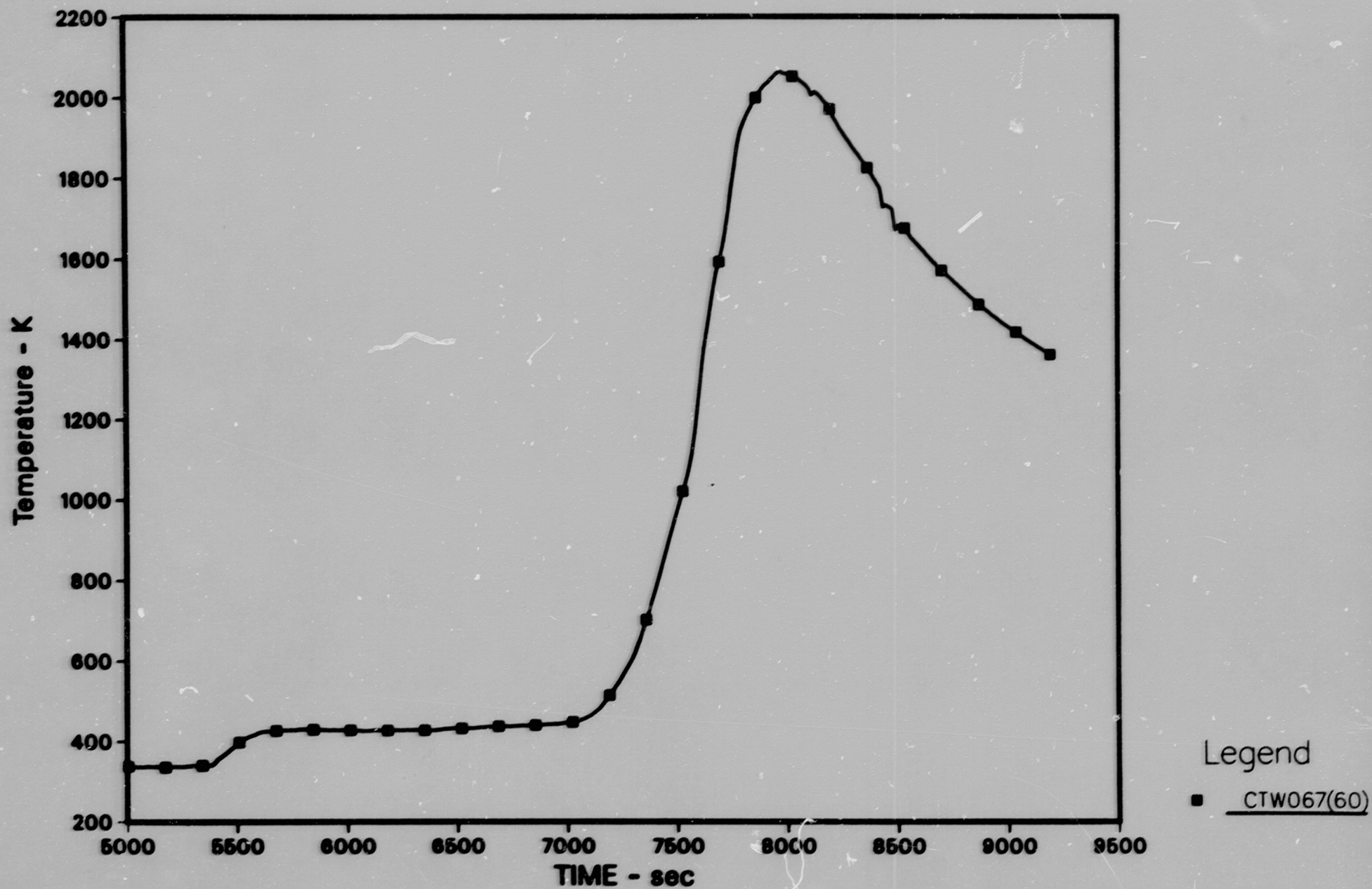
# DF-4 Condensate Tank Pressure



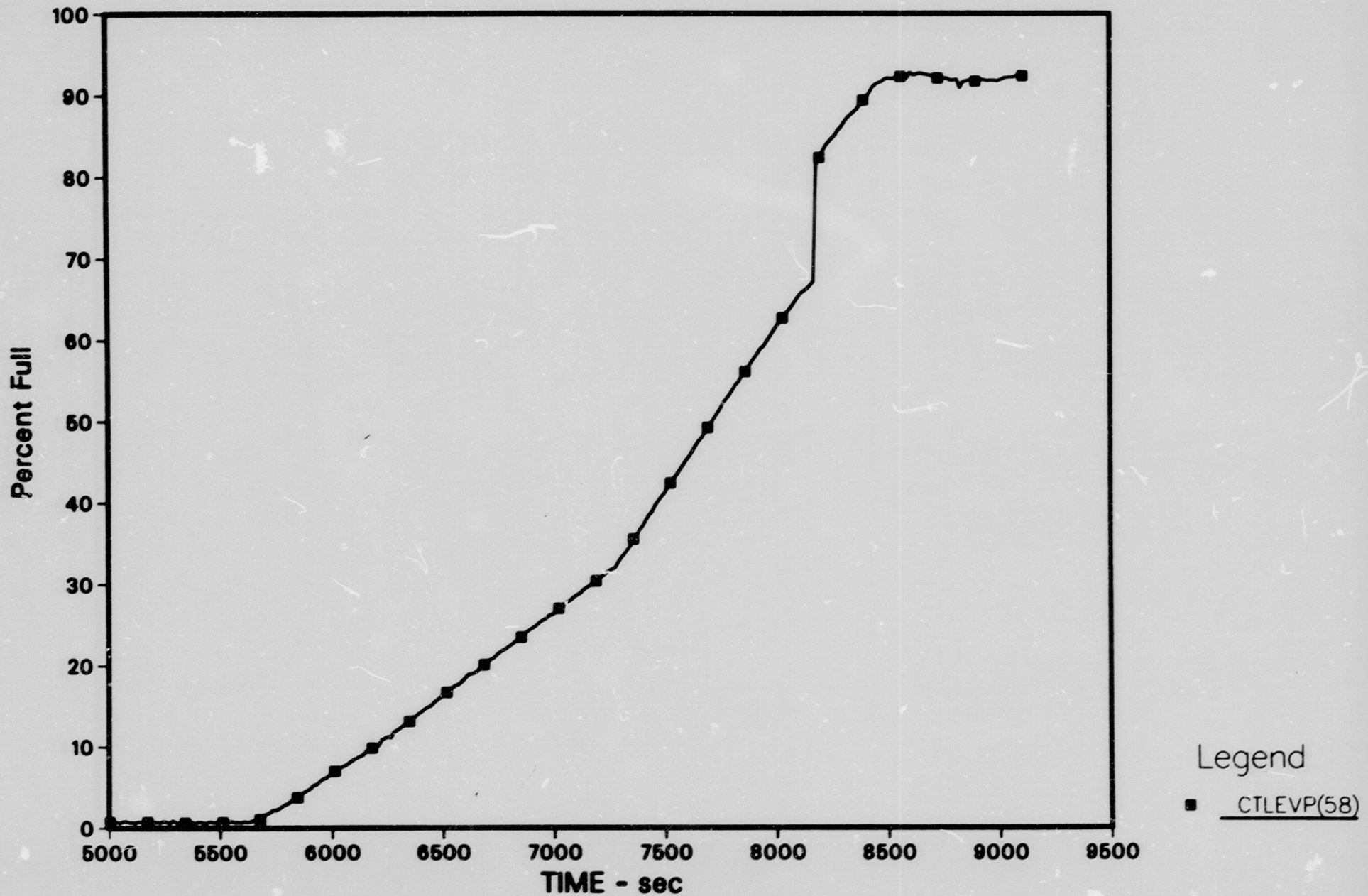
# DF-4 Condensate Tank Level Monitor



# DF-4 W/Re Outside Channel Box (90 Deg) 6.5in Below Fuel Support

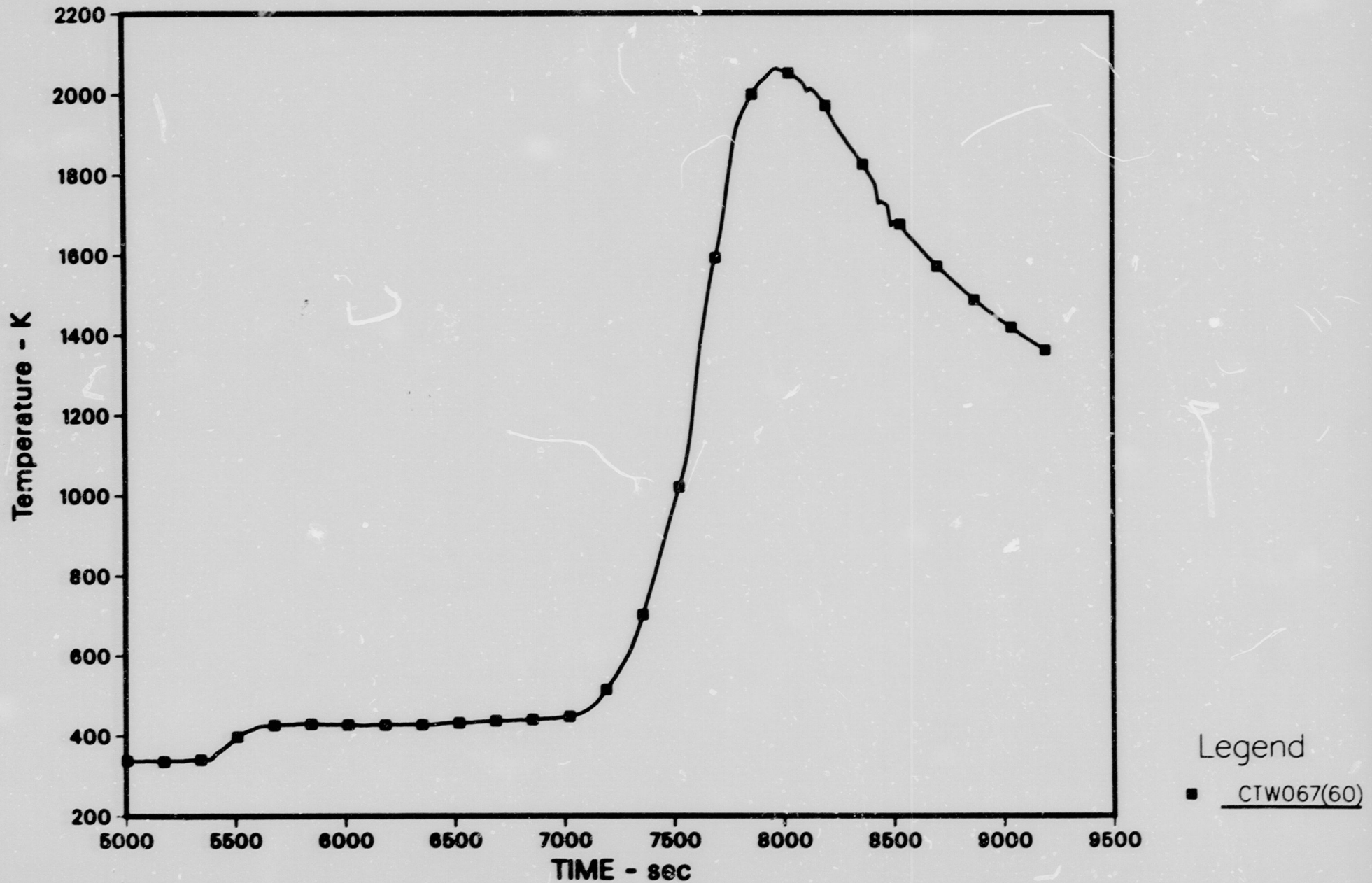


# DF-4 Condensate Tank Level Monitor

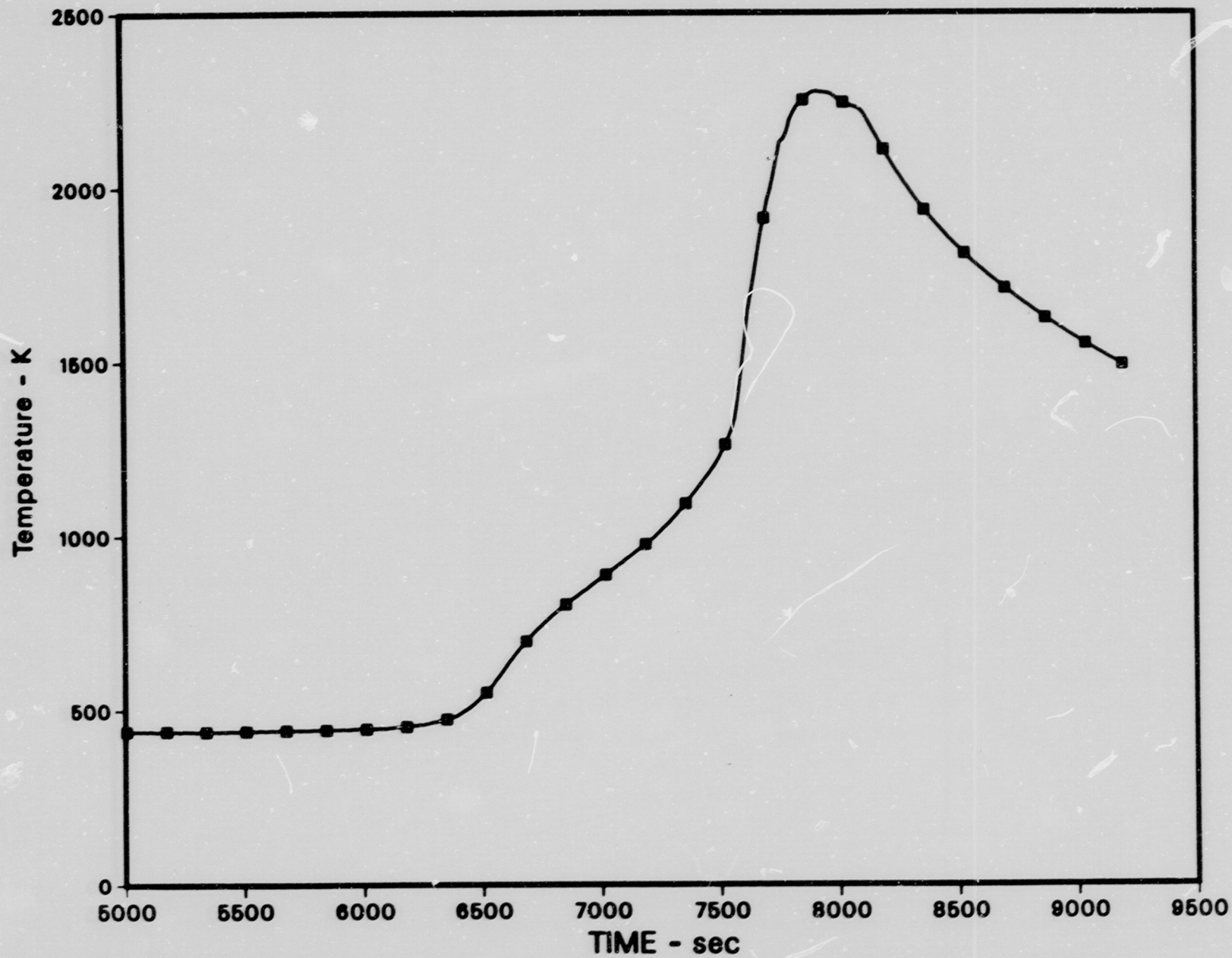




# DF-4 W/Re Outside Channel Box (90 Deg) 6.5In Below Fuel Support



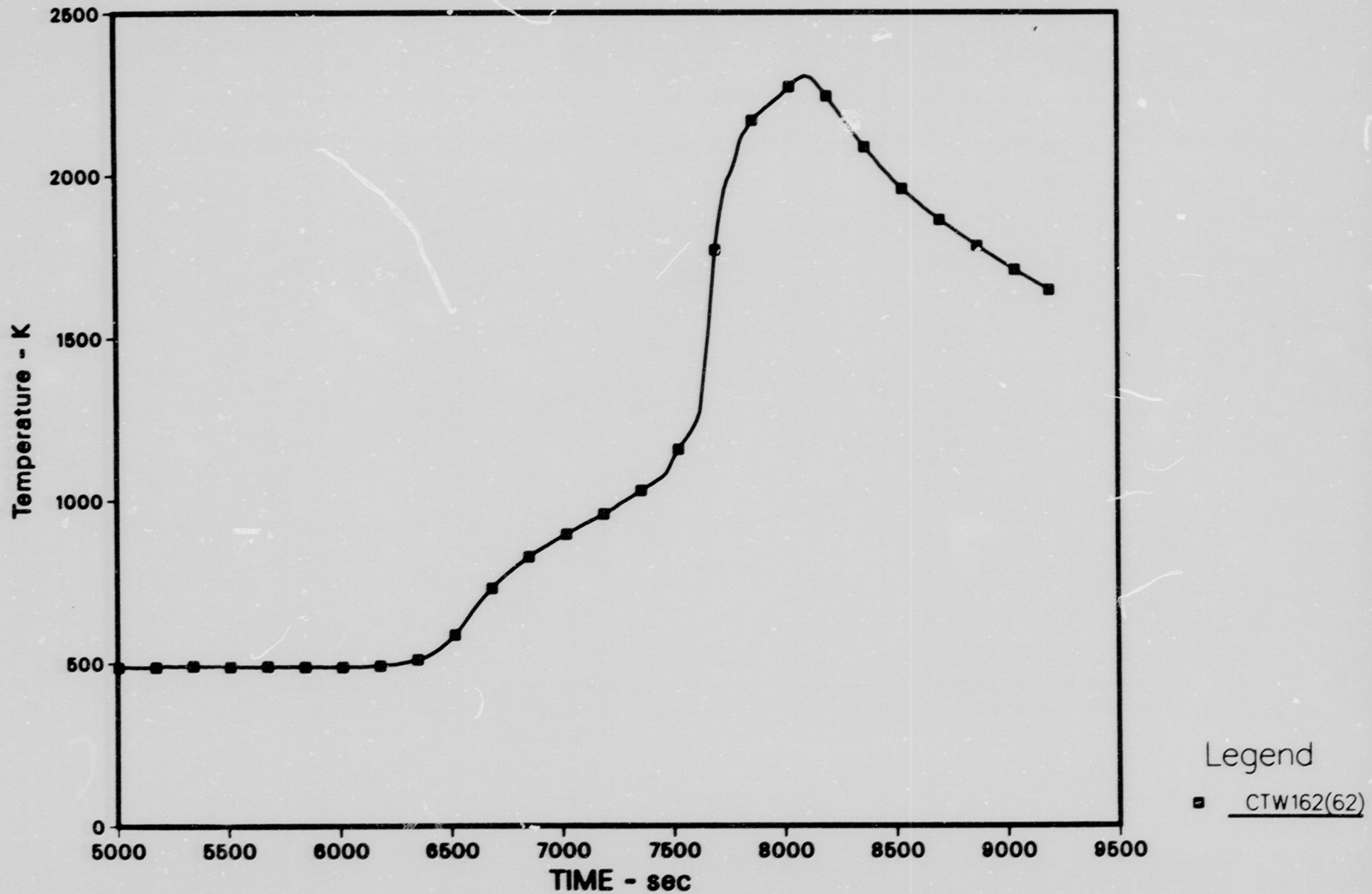
# DF-4 W/Re Outside Channel Box (90 Deg) 11.7in Below Fuel Support



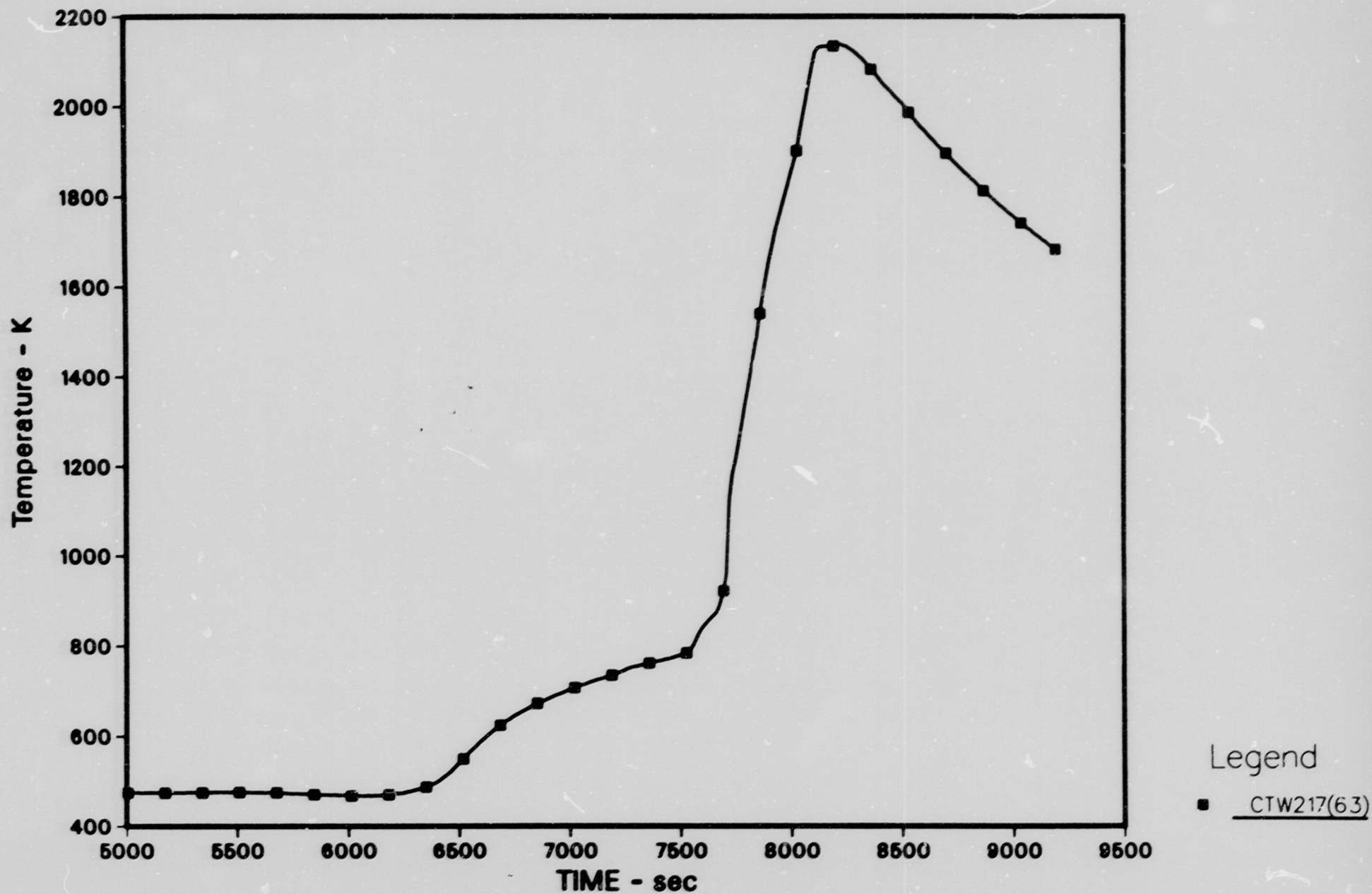
Legend

■ CTW117(61)

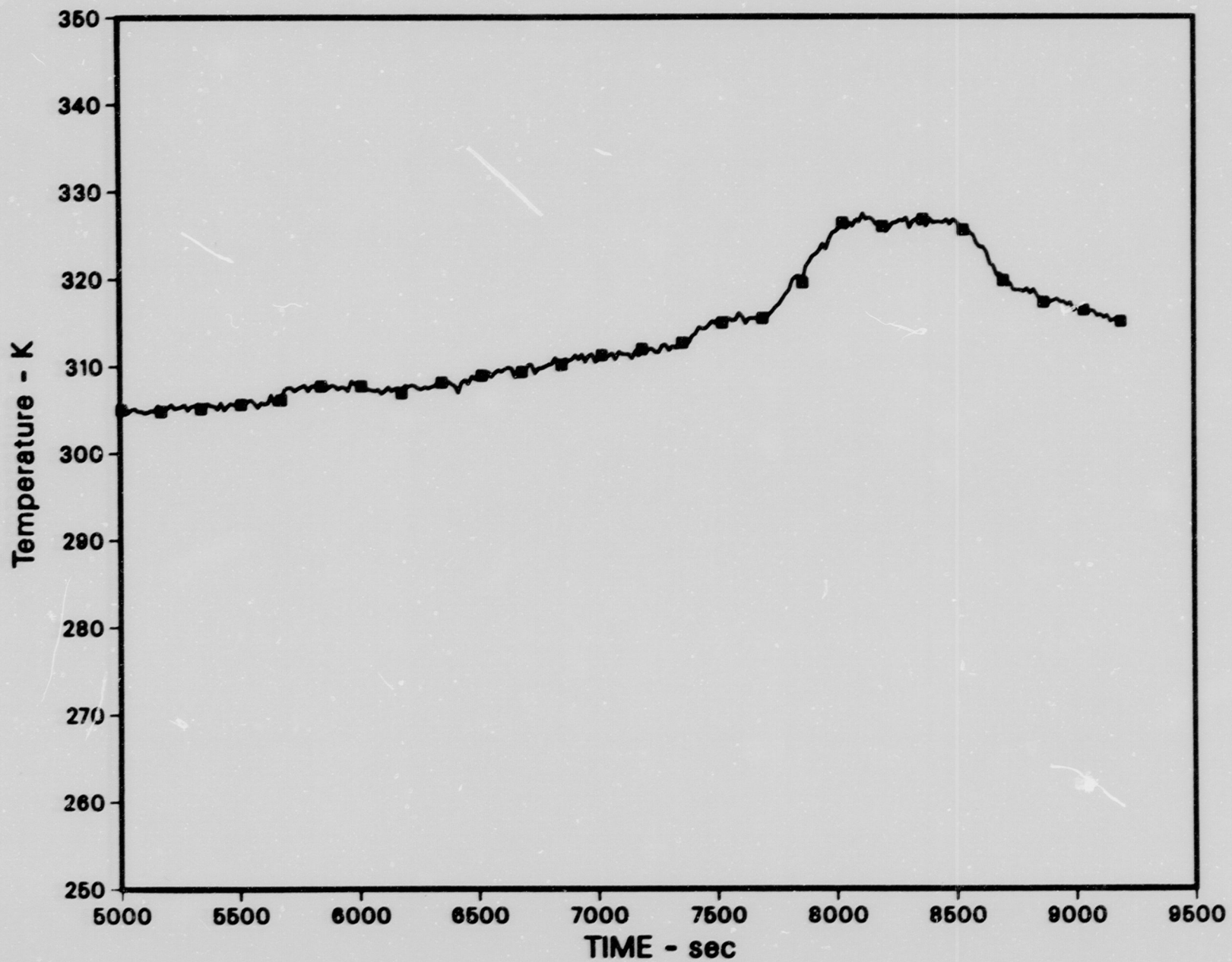
# DF-4 W/Re Outside Channel Box (90 Deg) 16.2in Below Fuel Support



# DF-4 W/Re Outside Channel Box (90 Deg) 21.7In Below Fuel Support



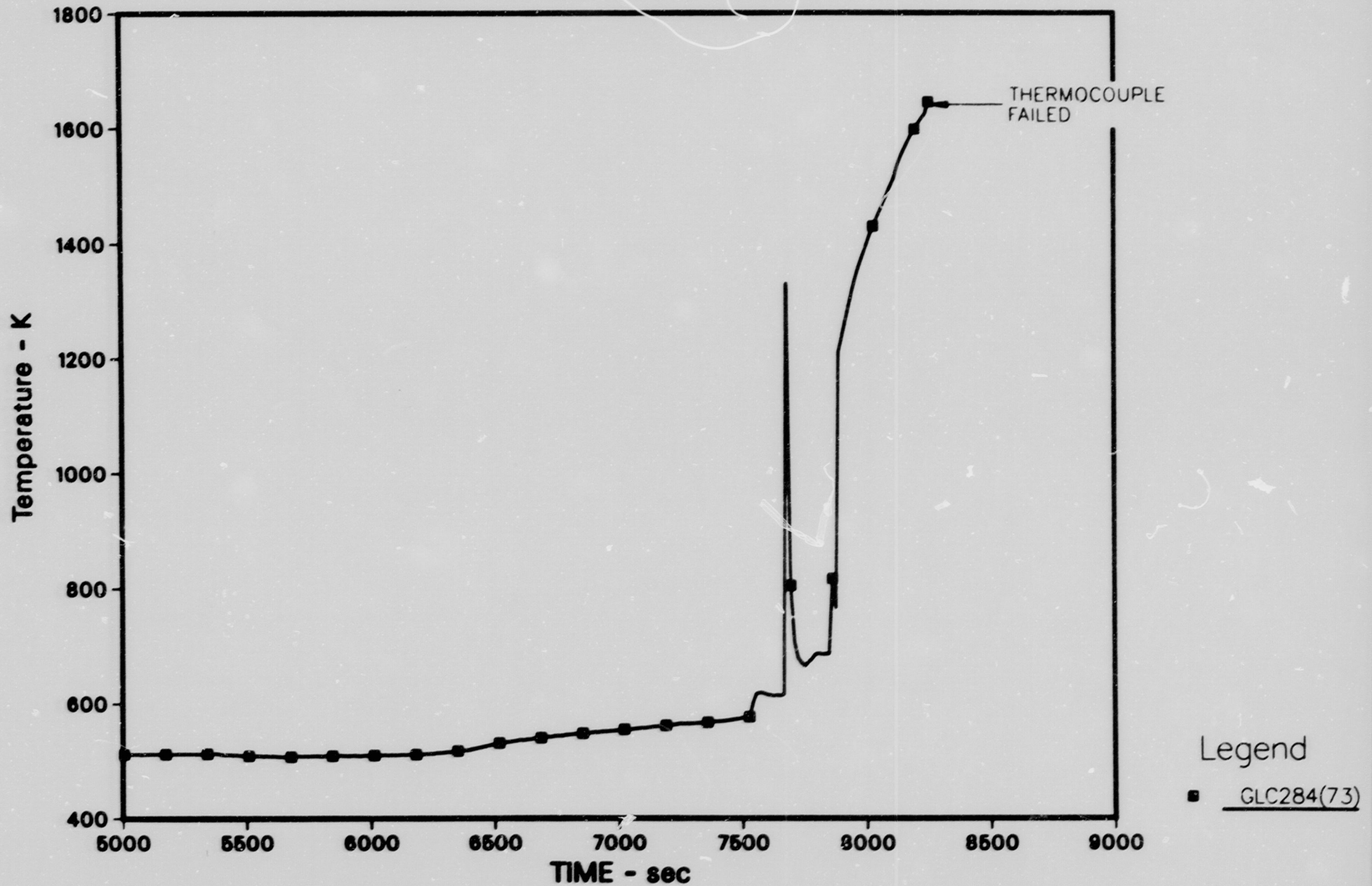
# DF-4 Condensate Tank Outer Wall 8In Below Top



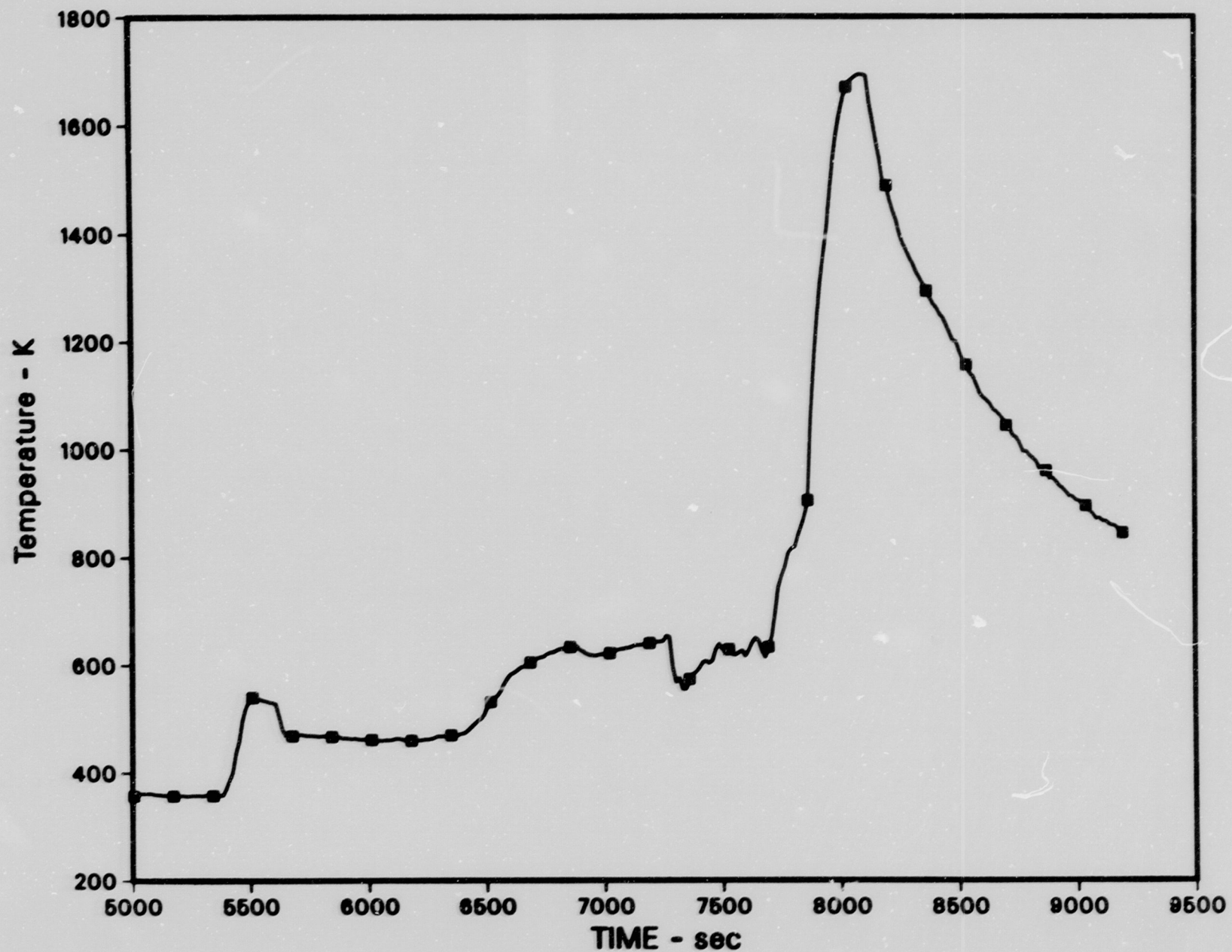
Legend

■ CTWLO1(64)

# DF-4 Steam Cup Manifold Top Pin Support 28.4in Above Fuel Support



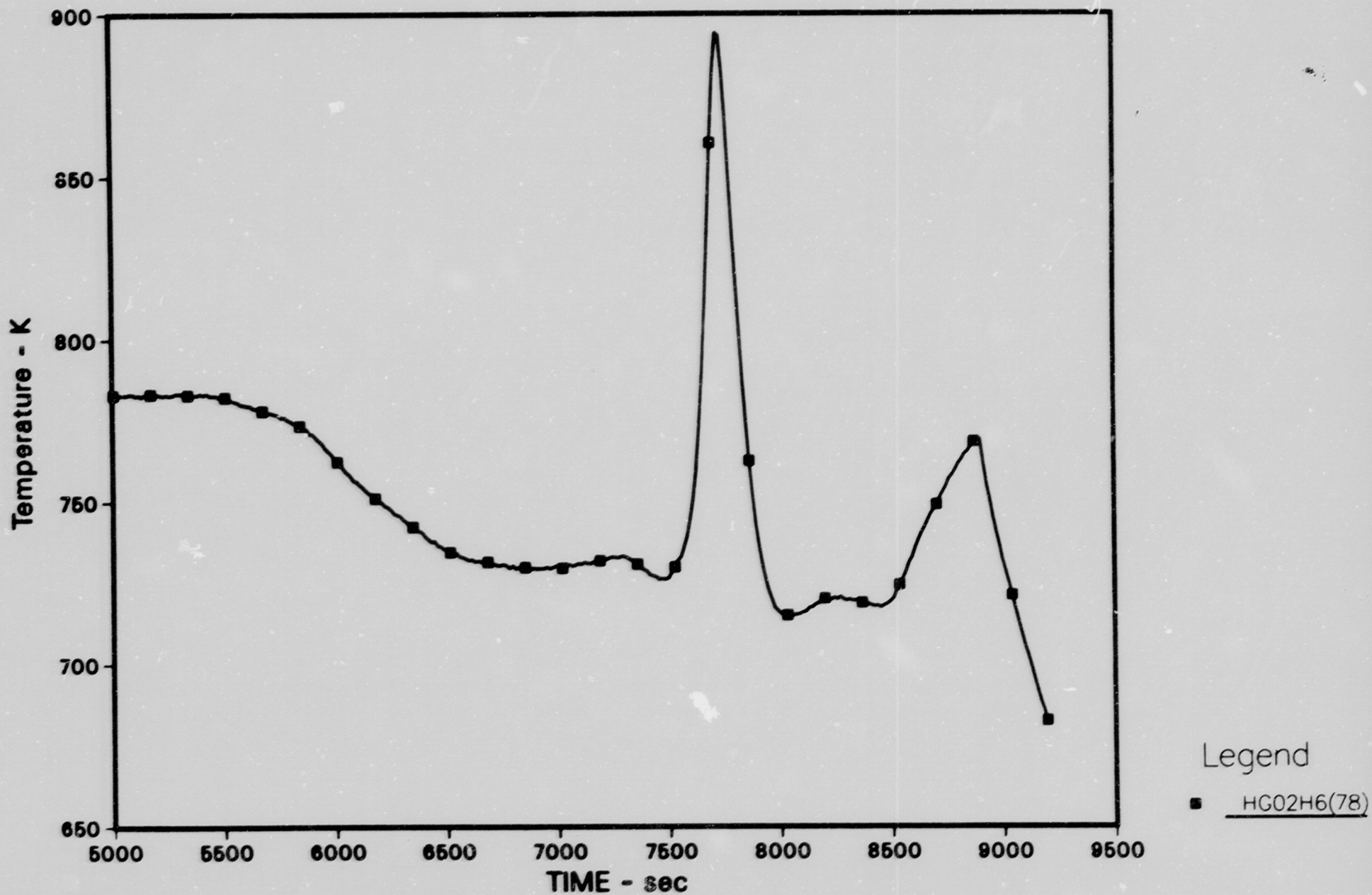
# DF-4 Top Surface Fuel Support Grid @ 270 Deg



Legend

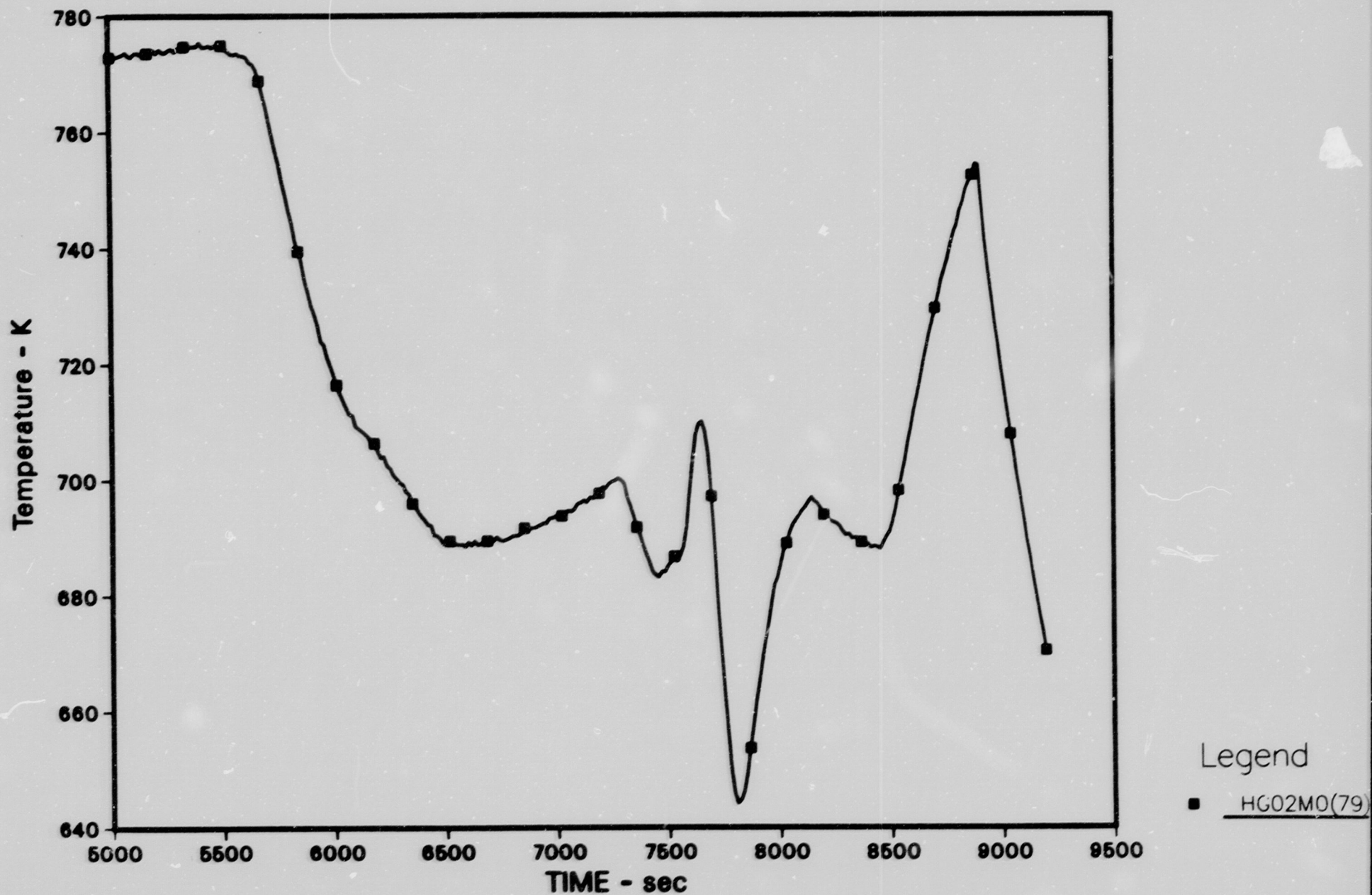
■ GUC004(74)

# DF-4 H2 Getter Tube 2, Heater Location 6in Above Bottom

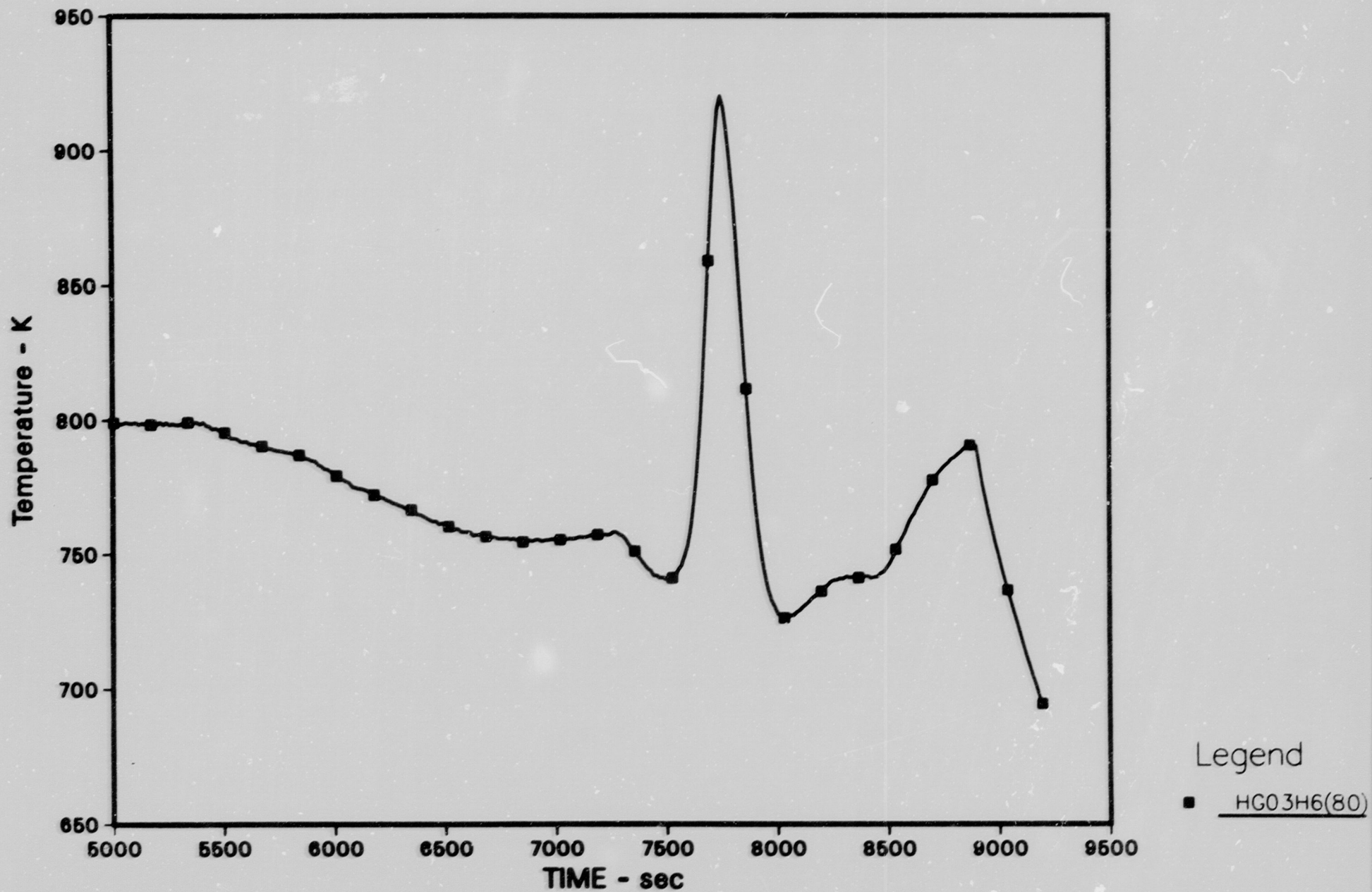




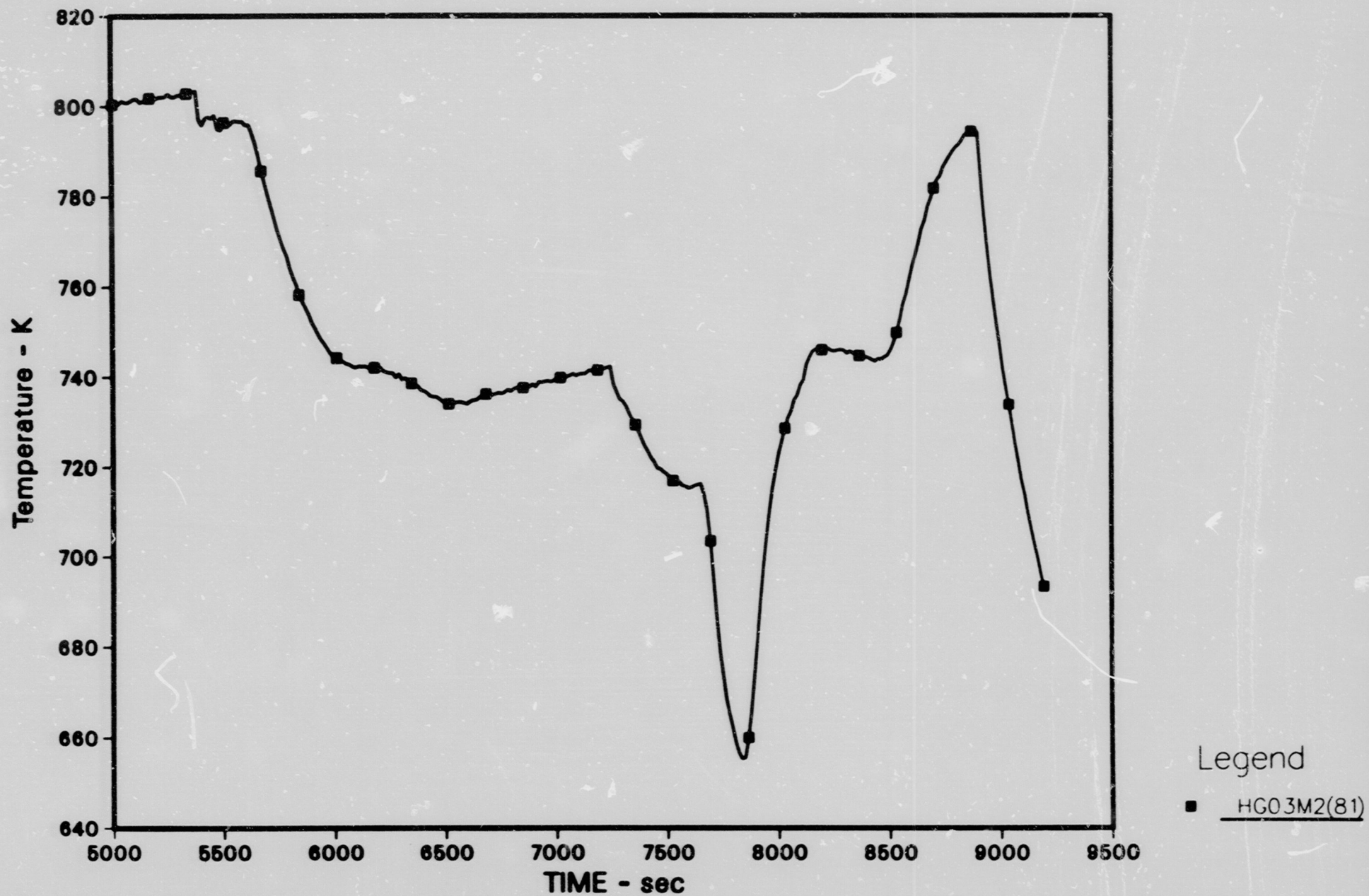
# DF-4 H2 Getter Tube 2, Mixing Tube Side 0in Above Bottom



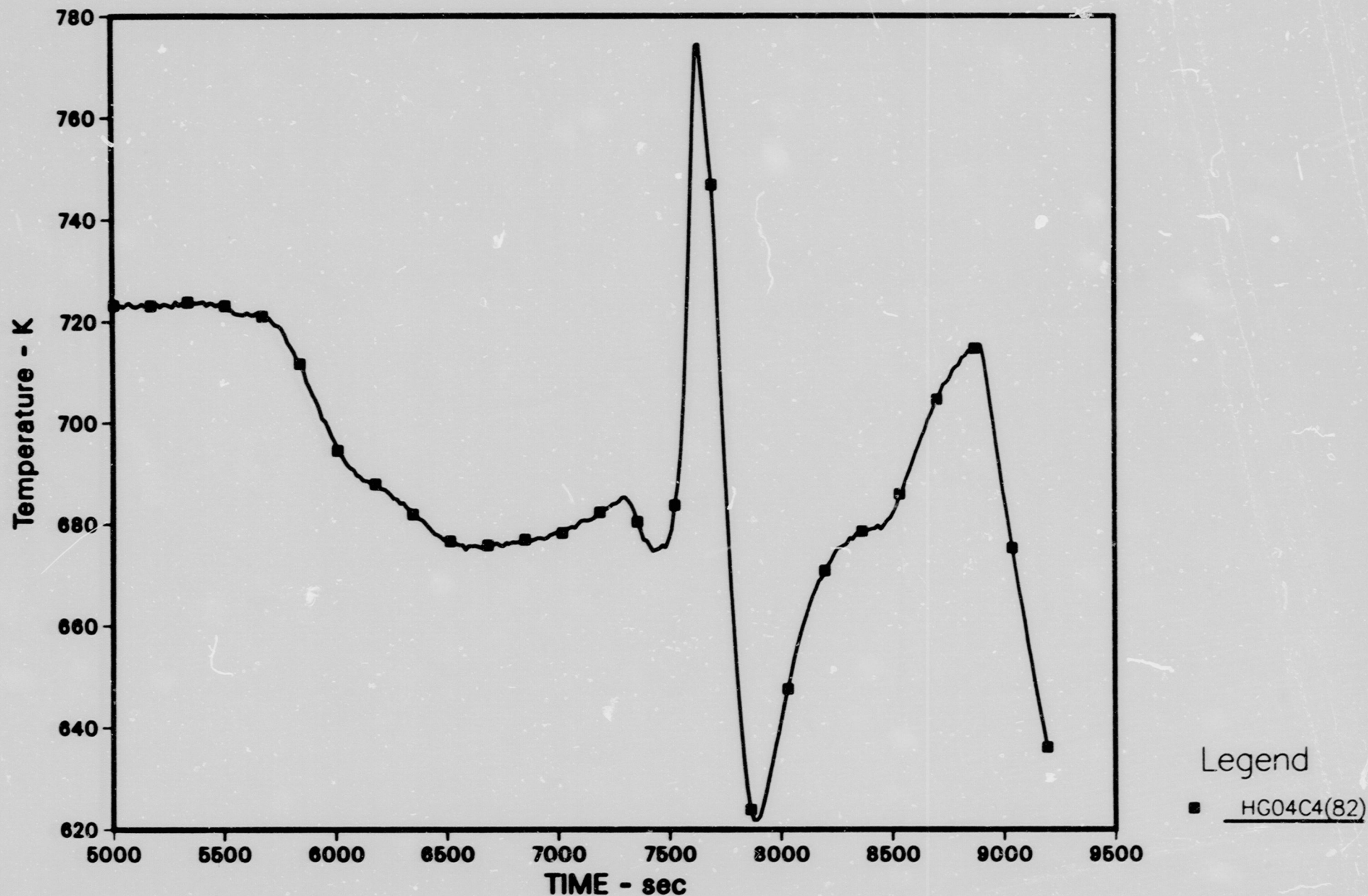
# DF-4 H2 Getter Tube 3, Heater Location 6in Above Bottom



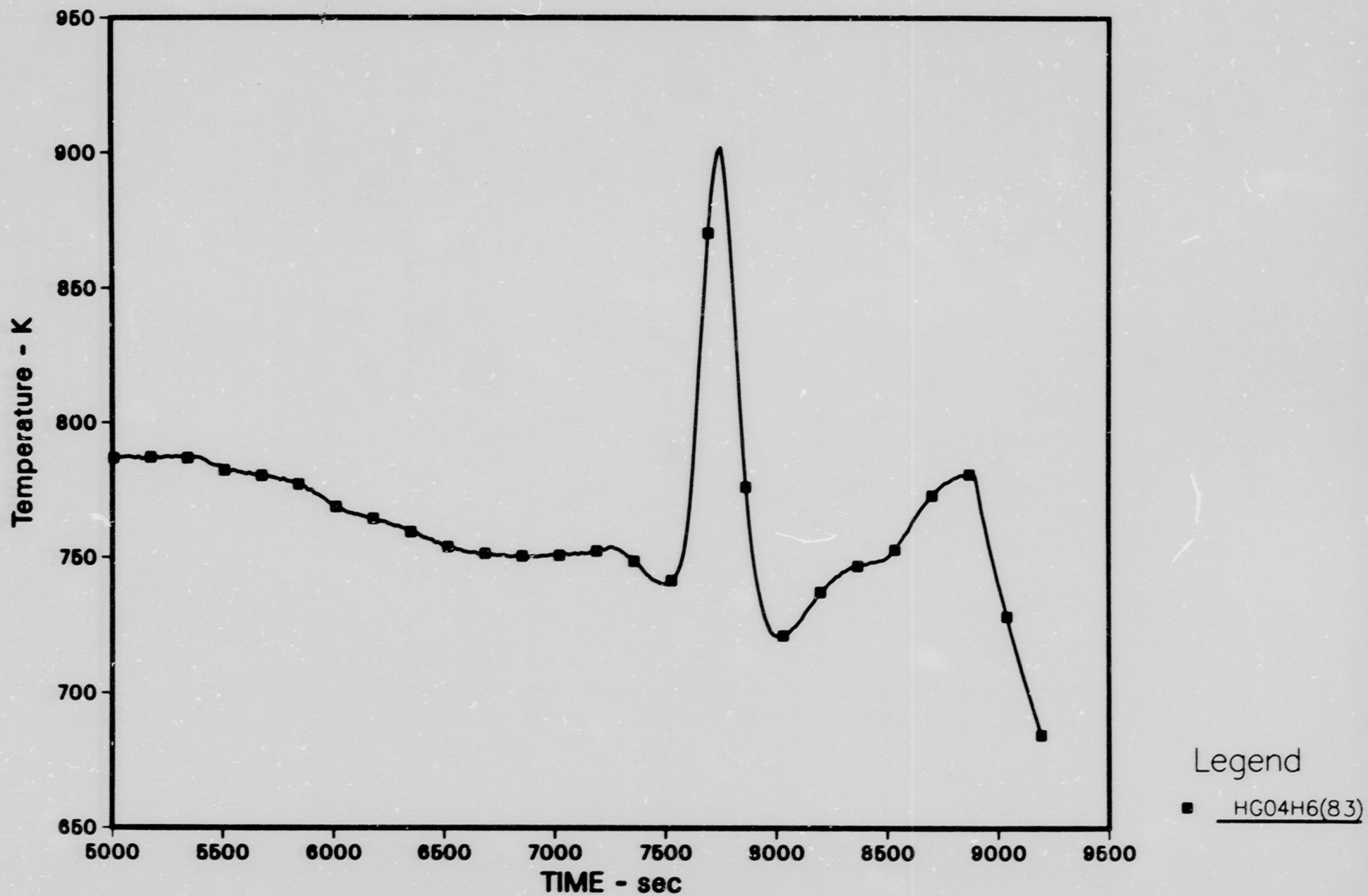
# DF-4 H2 Getter Tube 3, Mixing Tube Side 2in Above Bottom



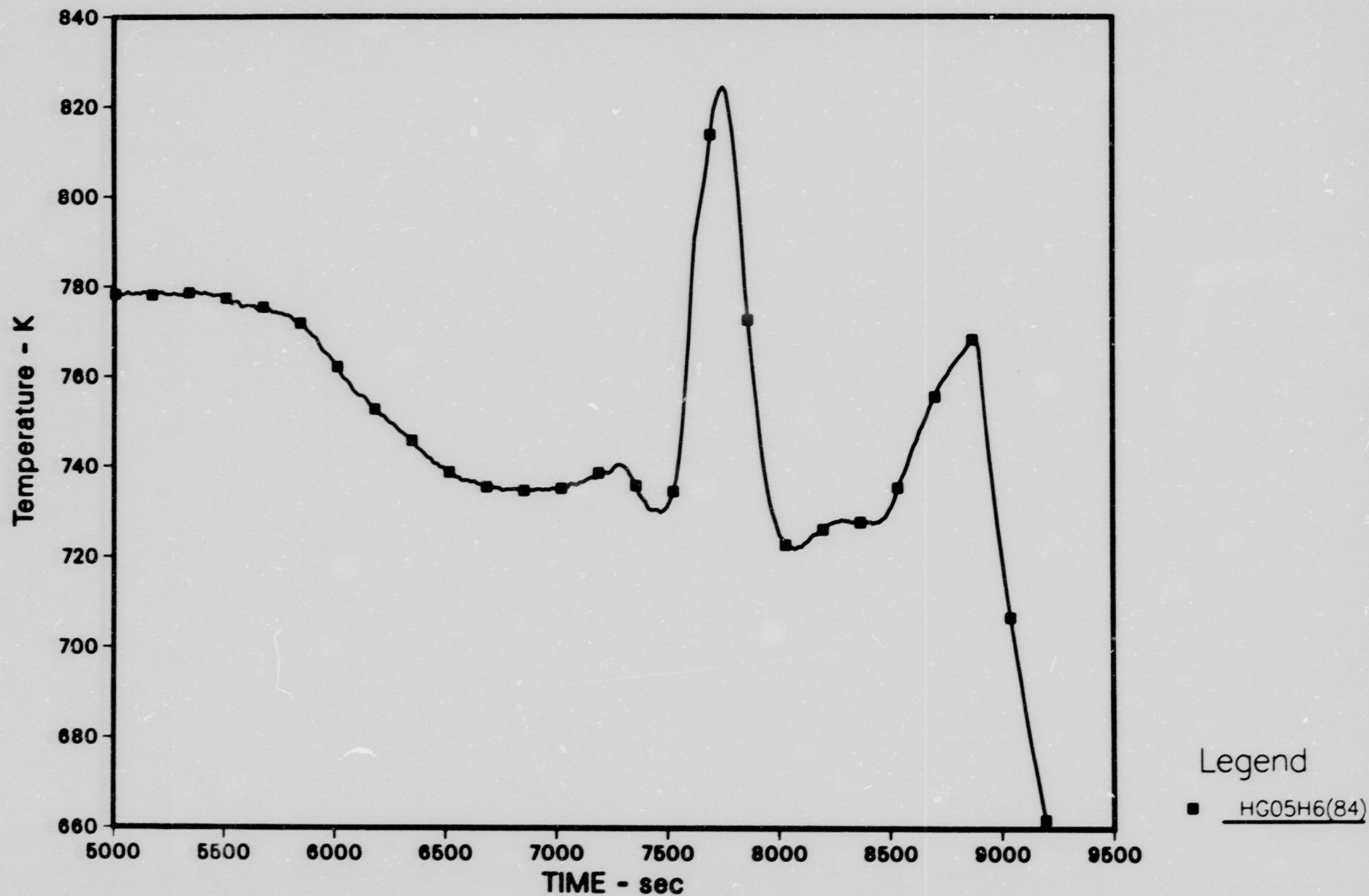
# DF-4 H2 Getter Tube 4, Condenser Side 4in Above Bottom



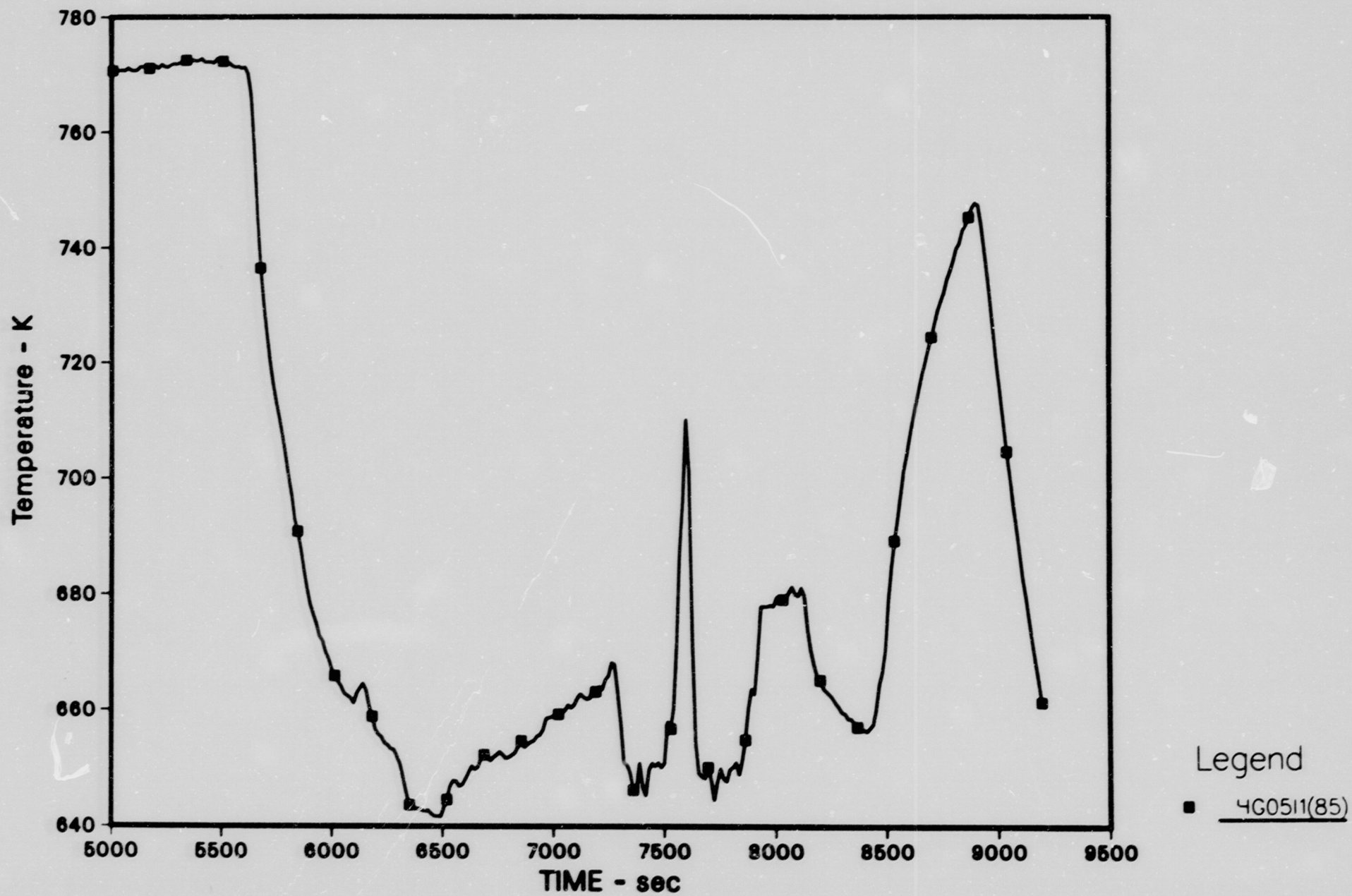
# DF-4 H2 Getter Tube 4, Heater Location 6in Above Bottom



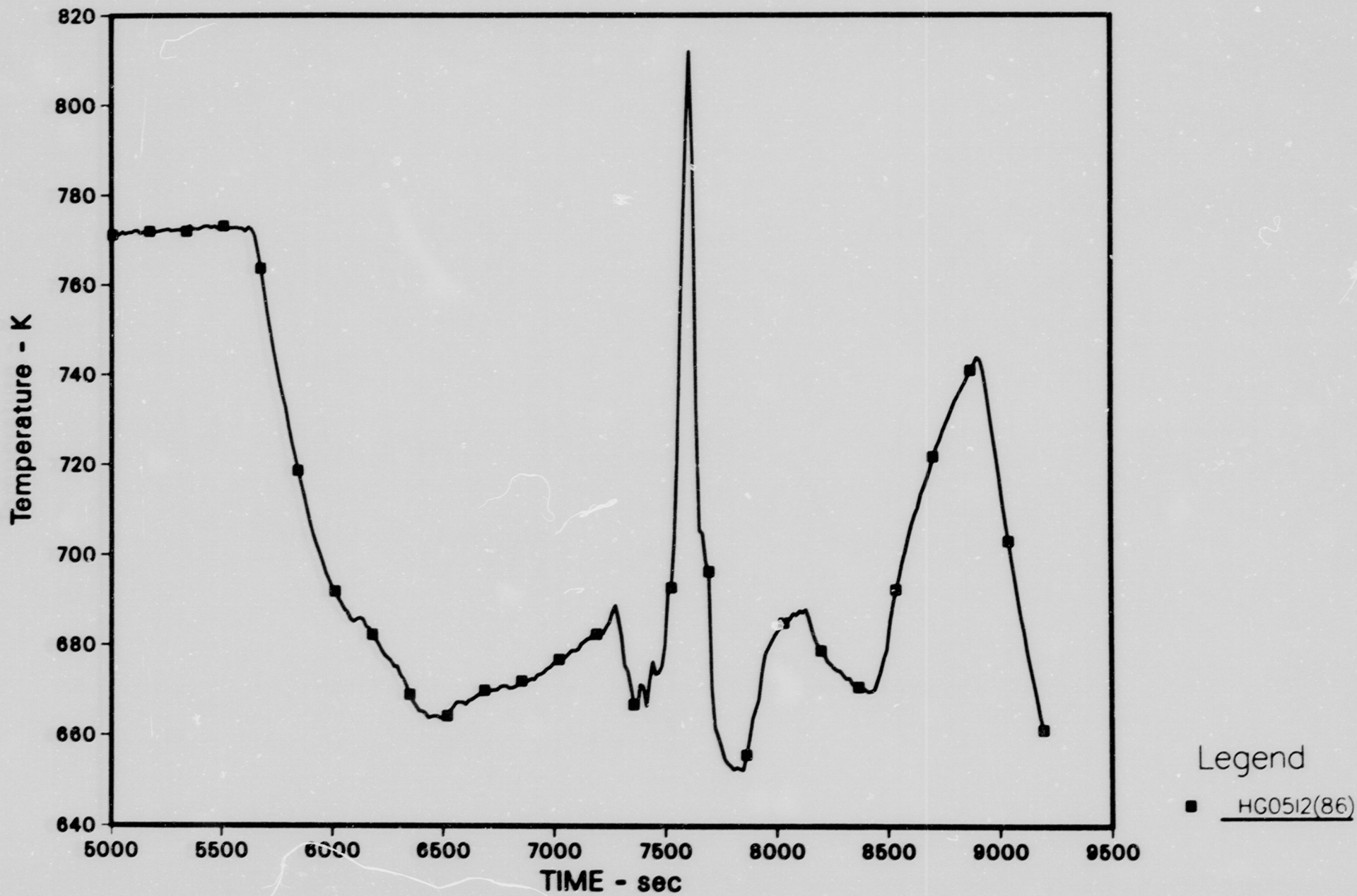
# DF-4 H2 Getter Tube 5, Heater Location 6in Above Bottom



# DF-4 H2 Getter Tube 5, Internal 1in Above Bottom

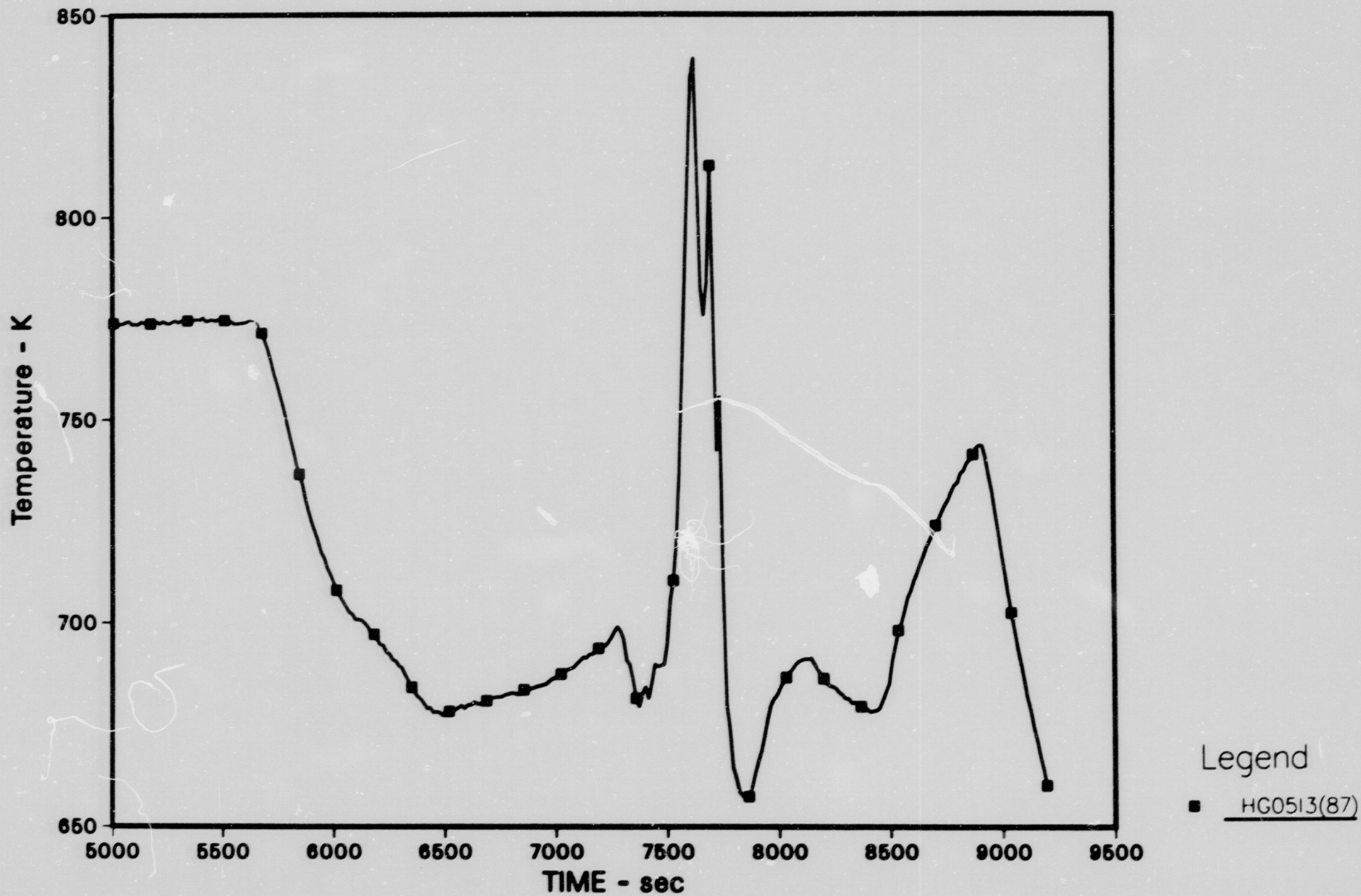


# DF-4 H2 Getter Tube 5, Internal 2In Above Bottom

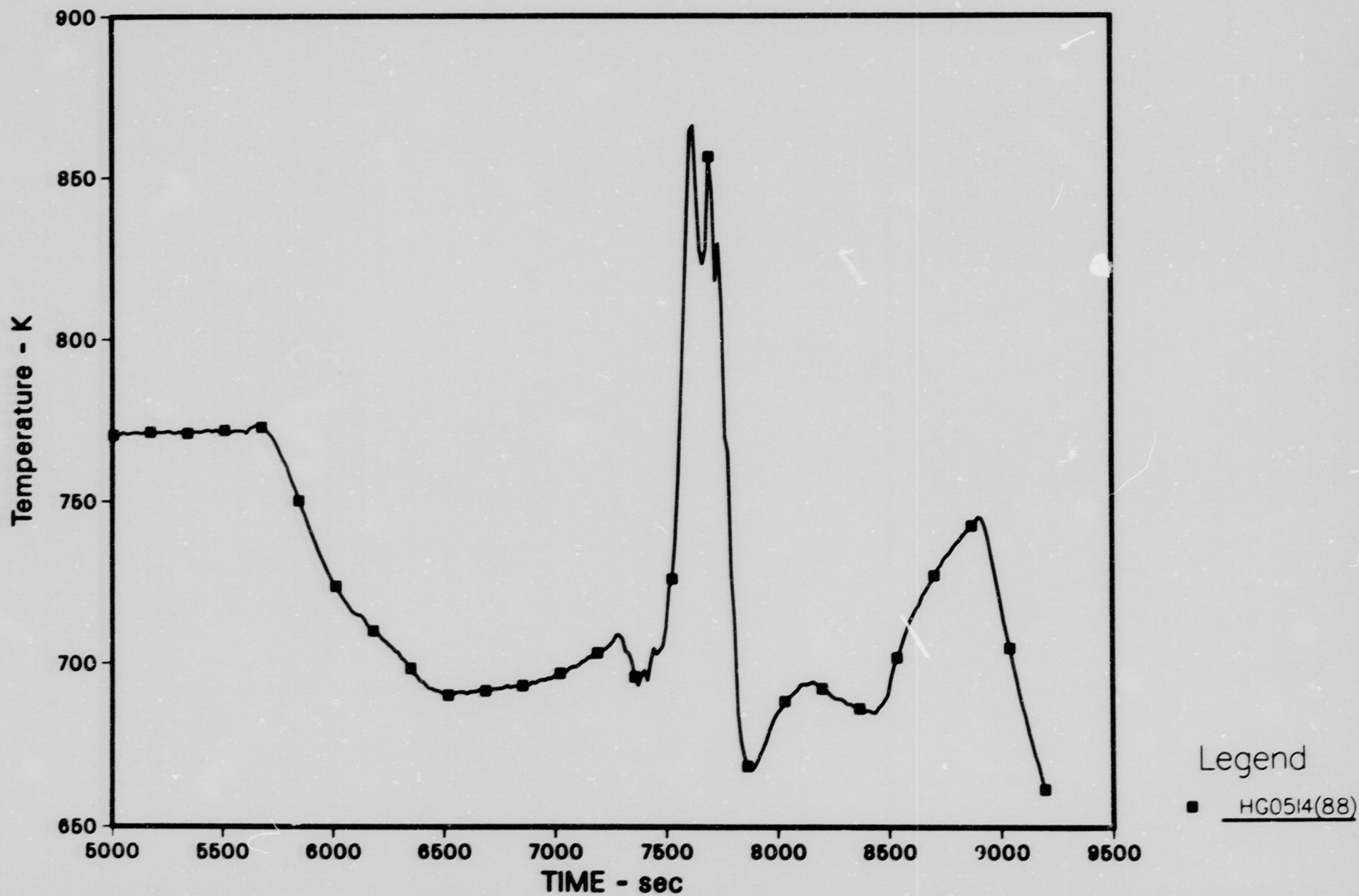




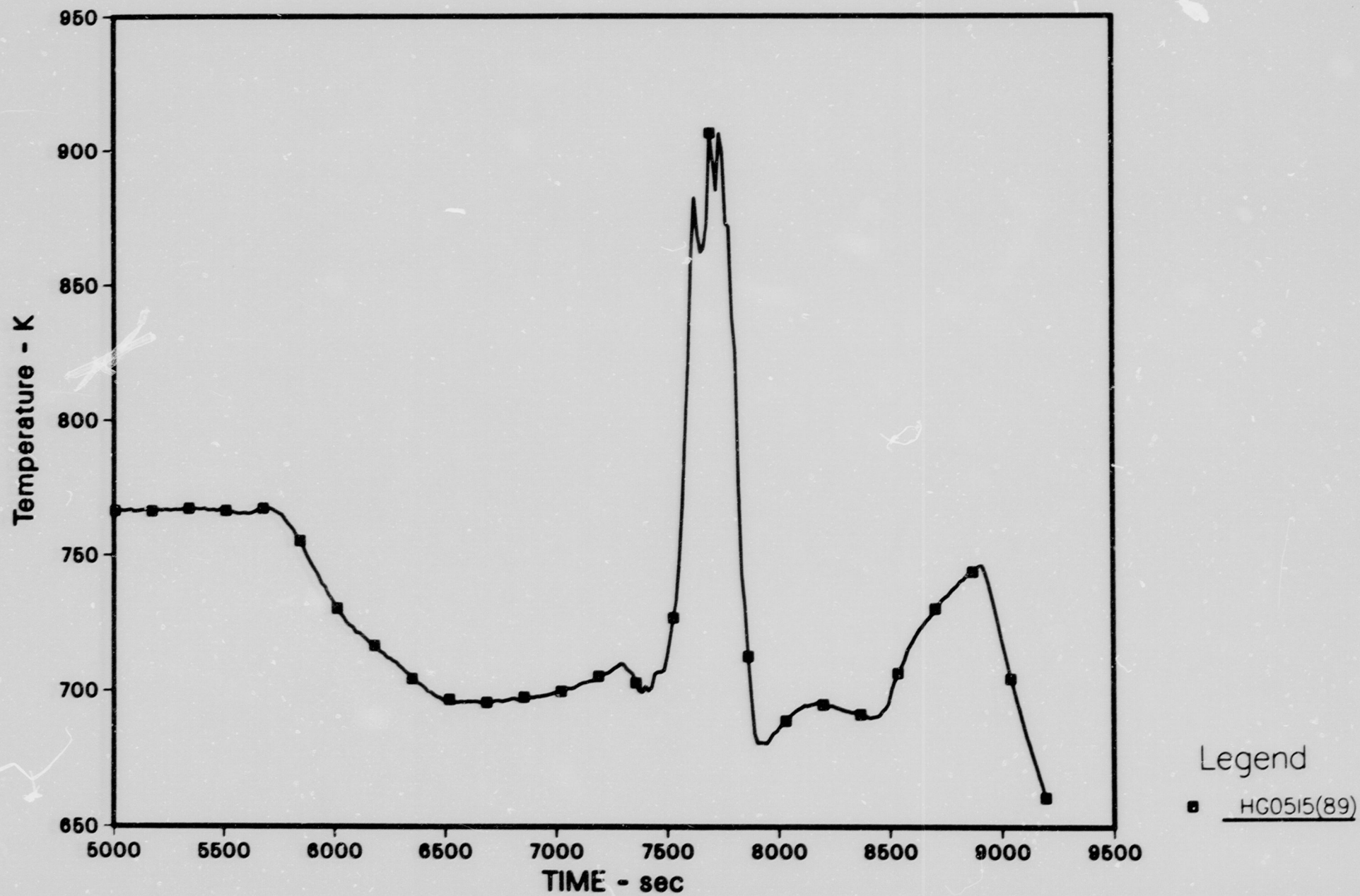
# DF-4 H2 Getter Tube 5, Internal 3in Above Bottom



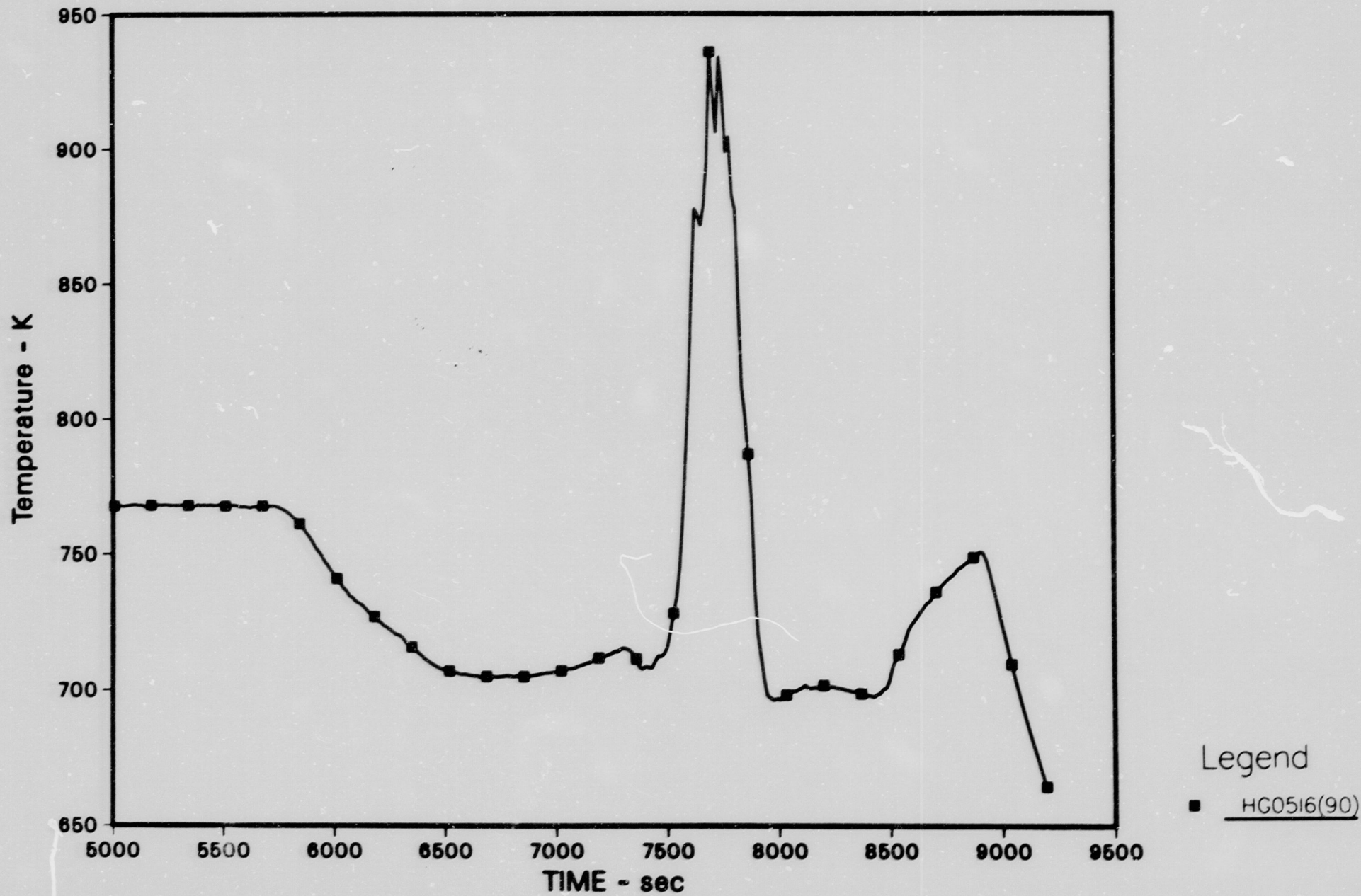
# DF-4 H2 Getter Tube 5, Internal 4in Above Bottom



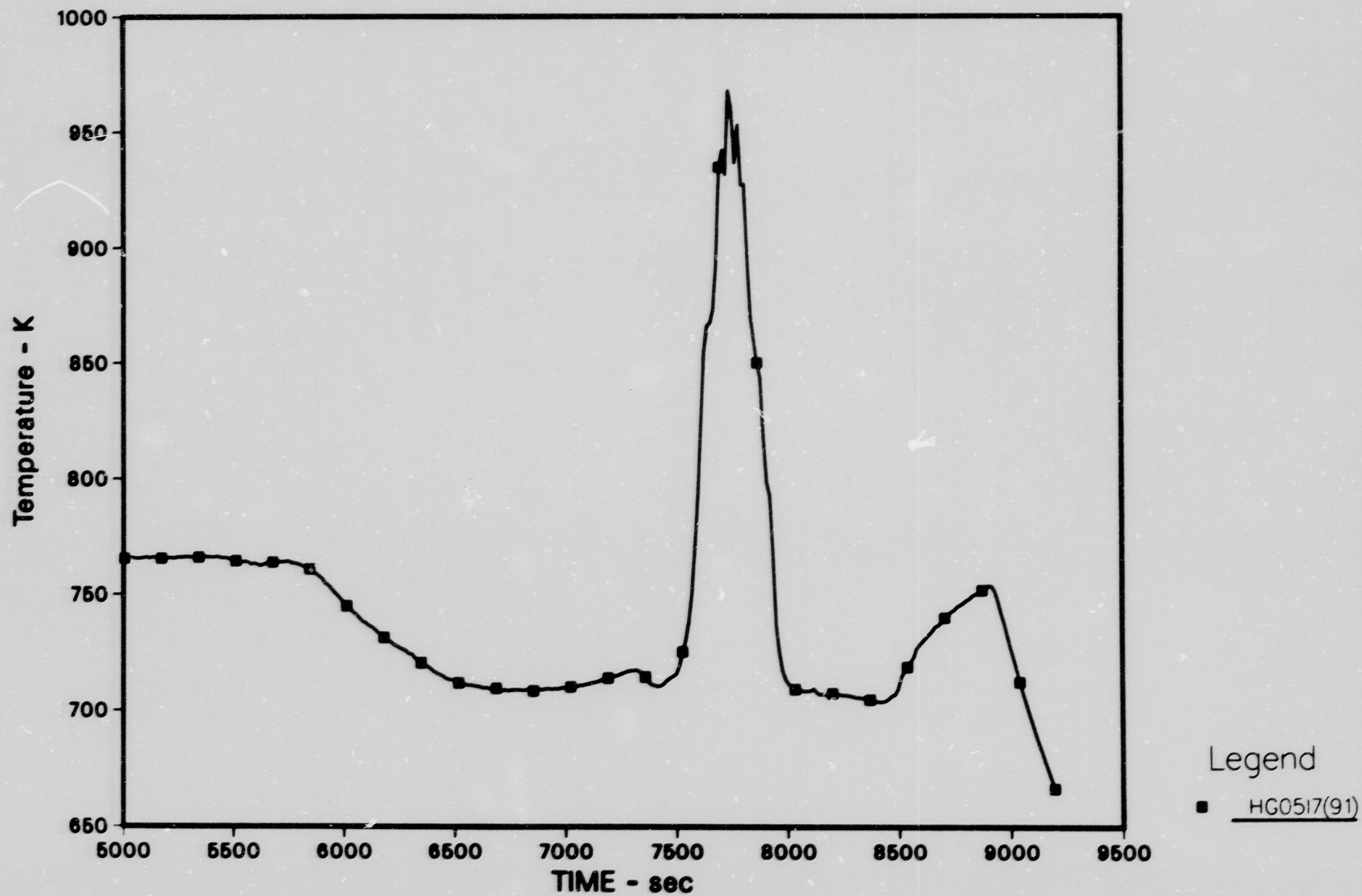
# DF-4 H2 Getter Tube 5, Internal 5in Above Bottom



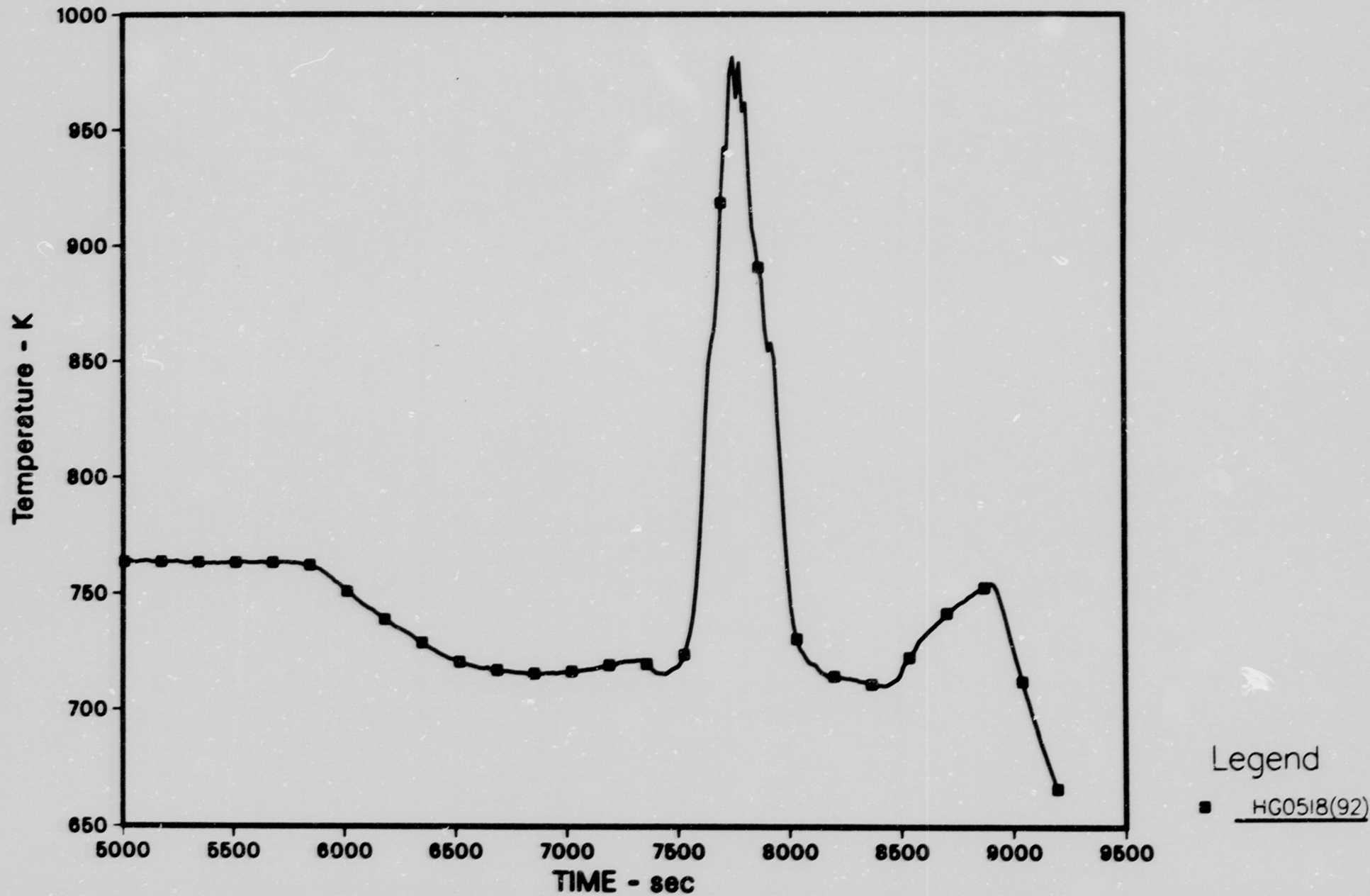
# DF-4 H2 Getter Tube 5, Internal 6in Above Bottom



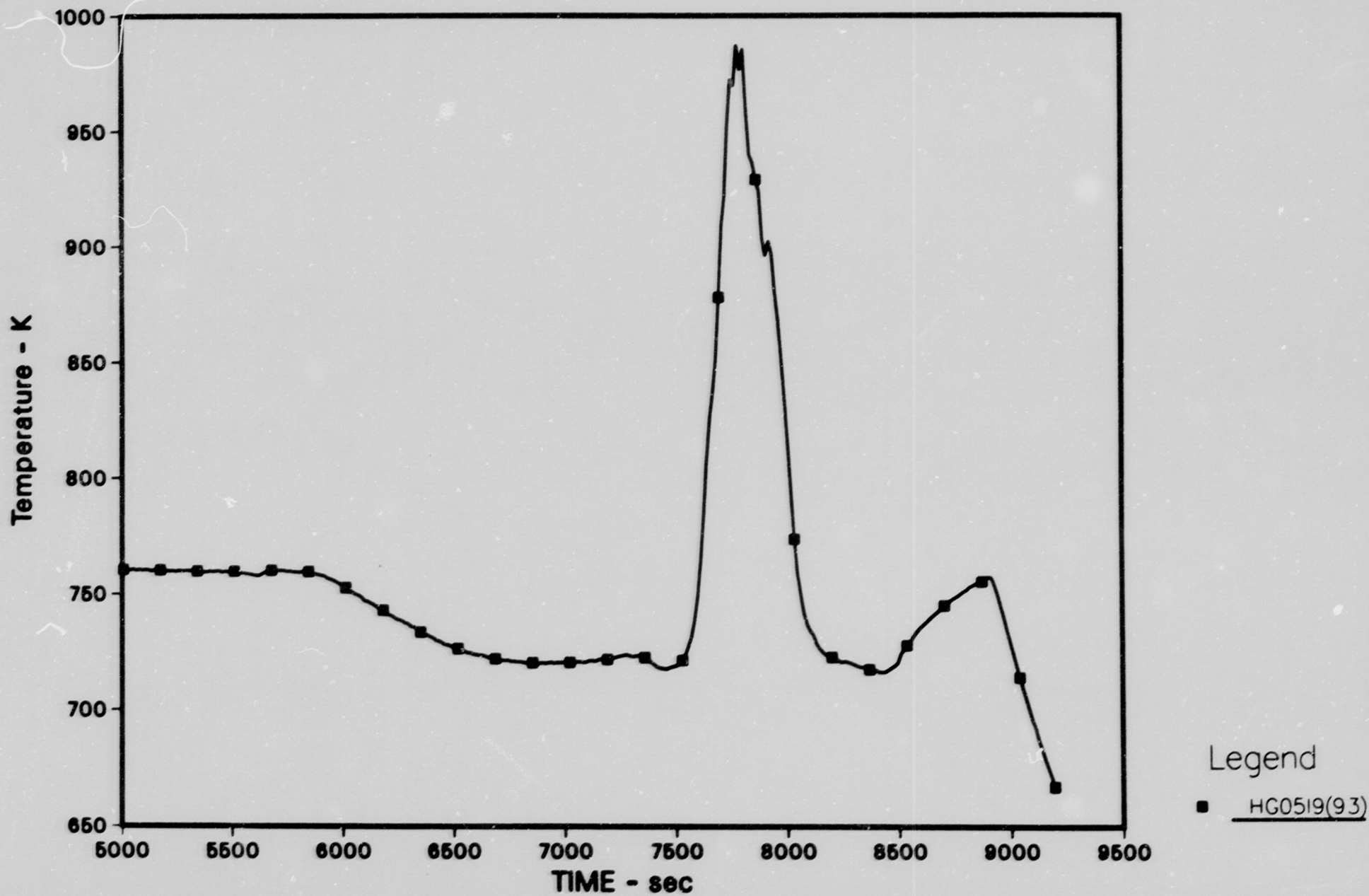
# DF-4 H2 Getter Tube 5, Internal 7in Above Bottom



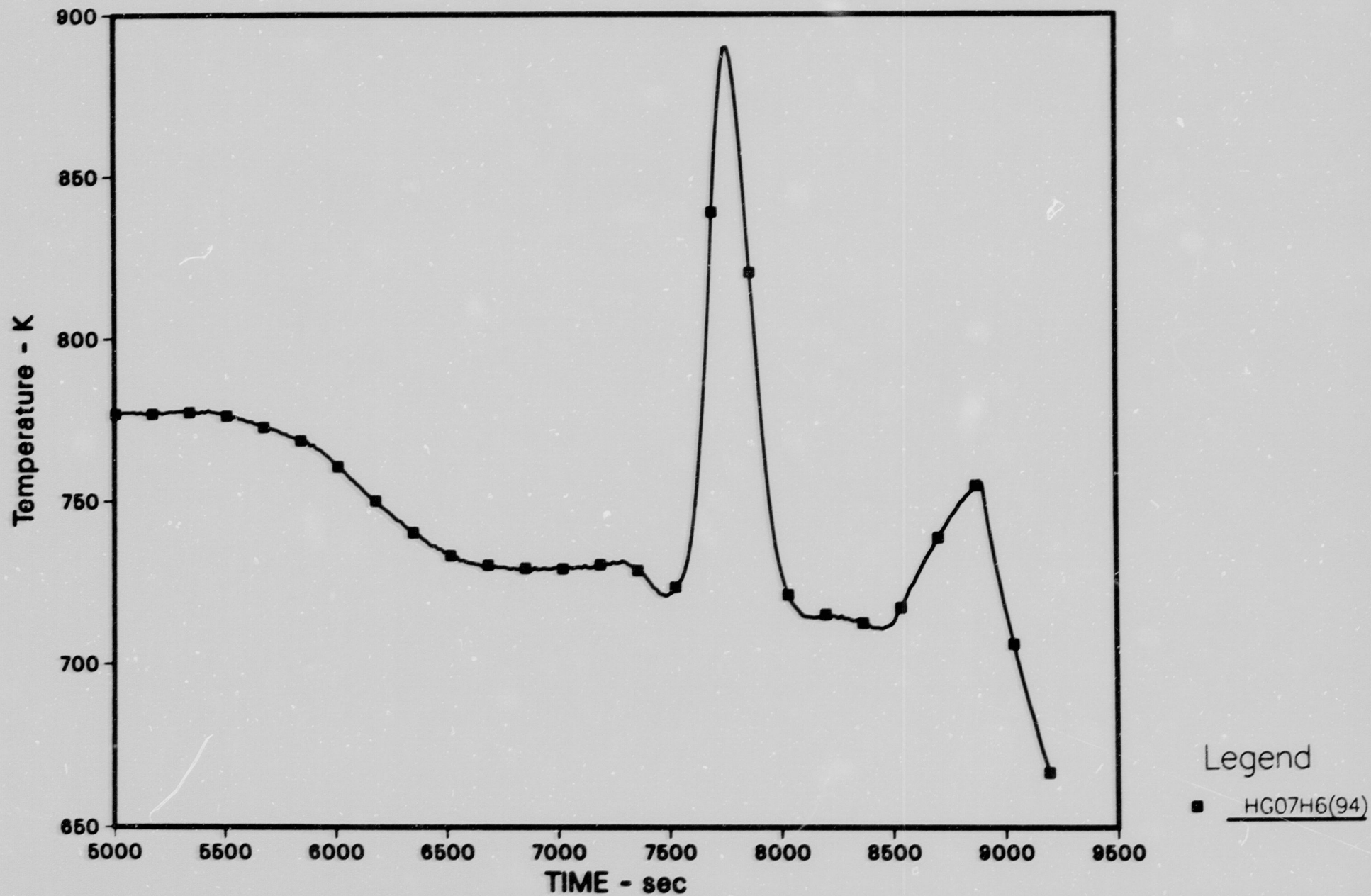
# DF-4 H2 Getter Tube 5, internal 8in Above Bottom



# DF-4 H2 Getter Tube 5, Internal 9in Above Bottom

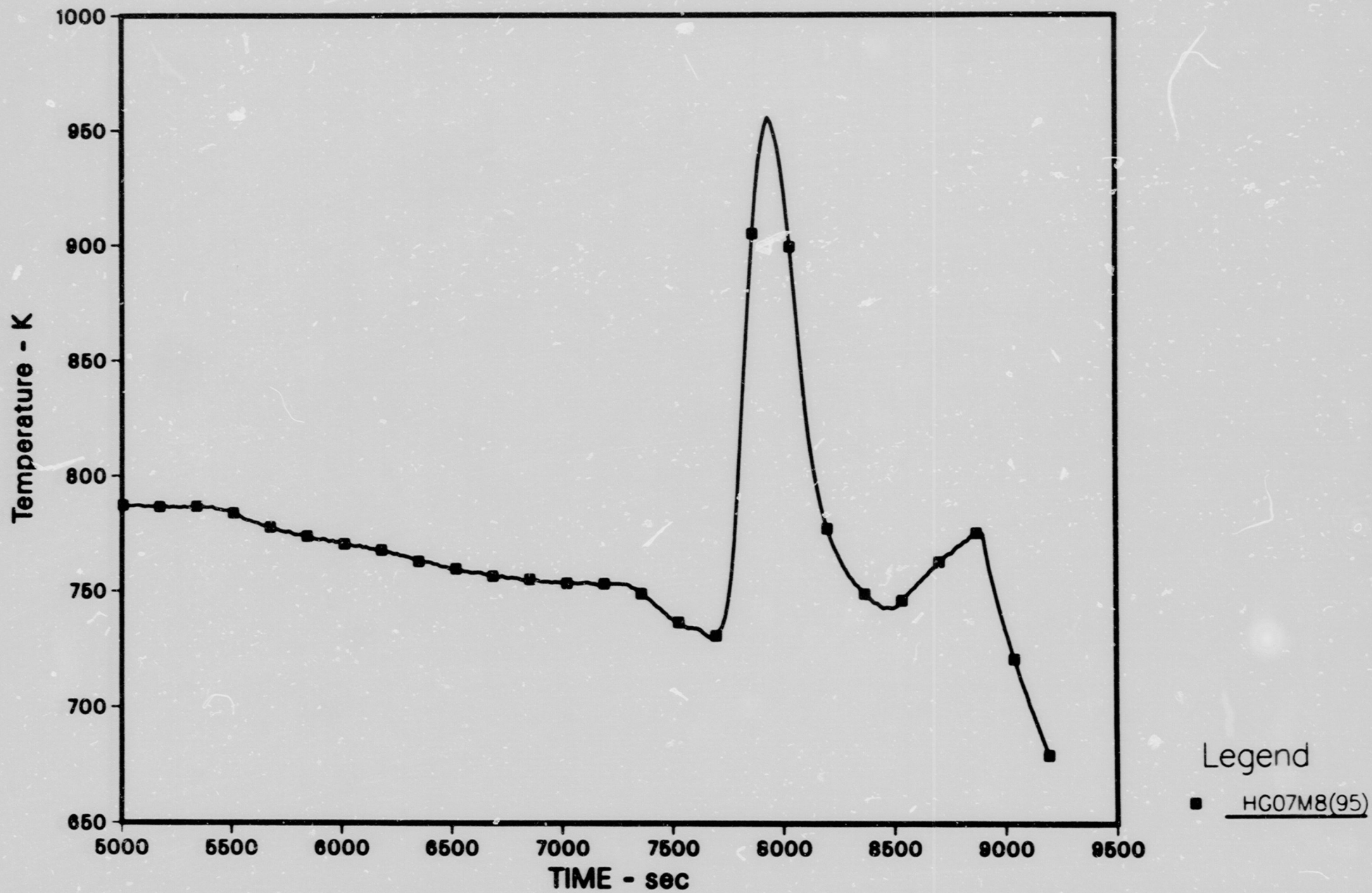


# DF-4 H2 Getter Tube 7, Heater Location 6in Above Bottom

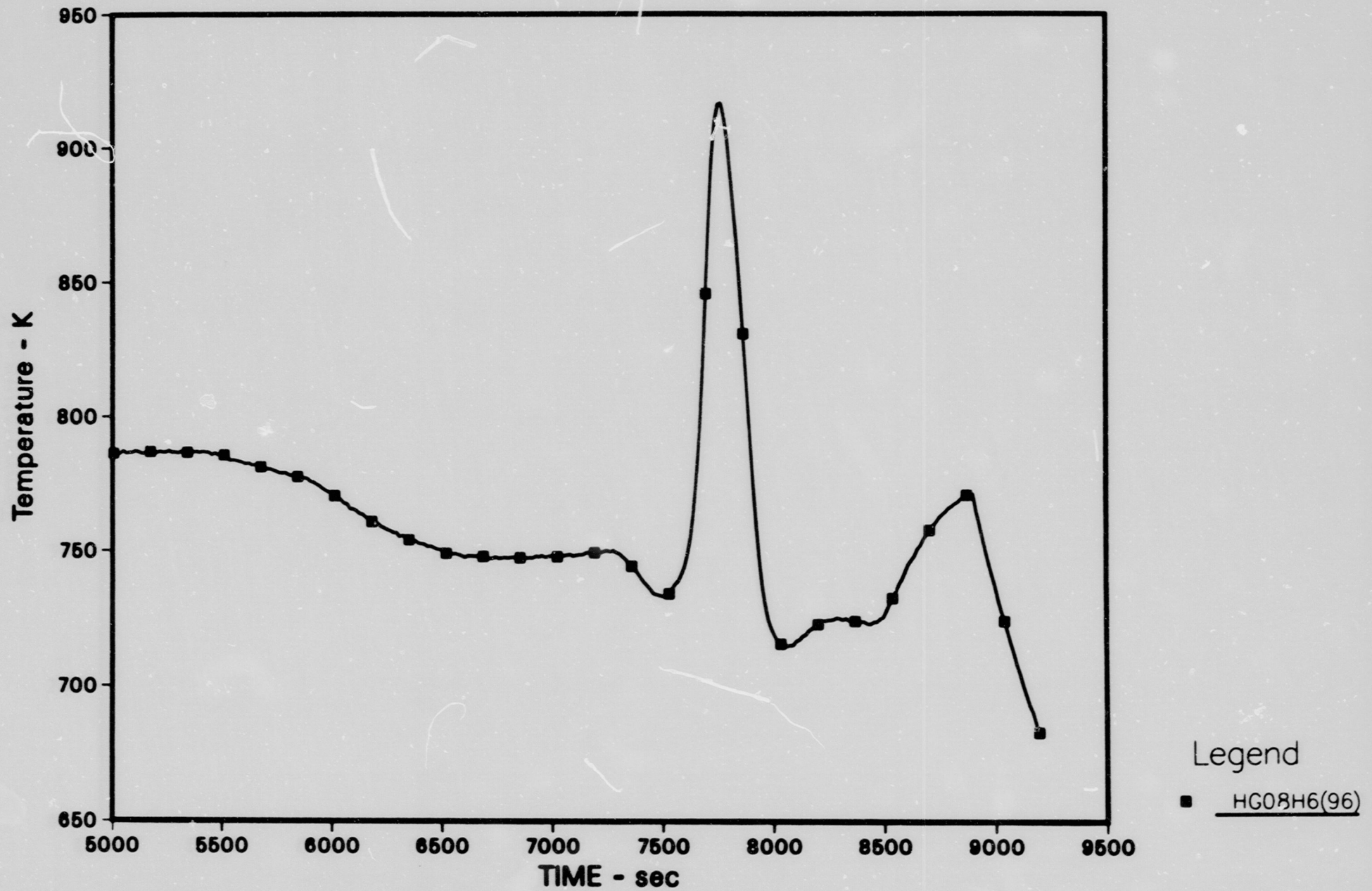




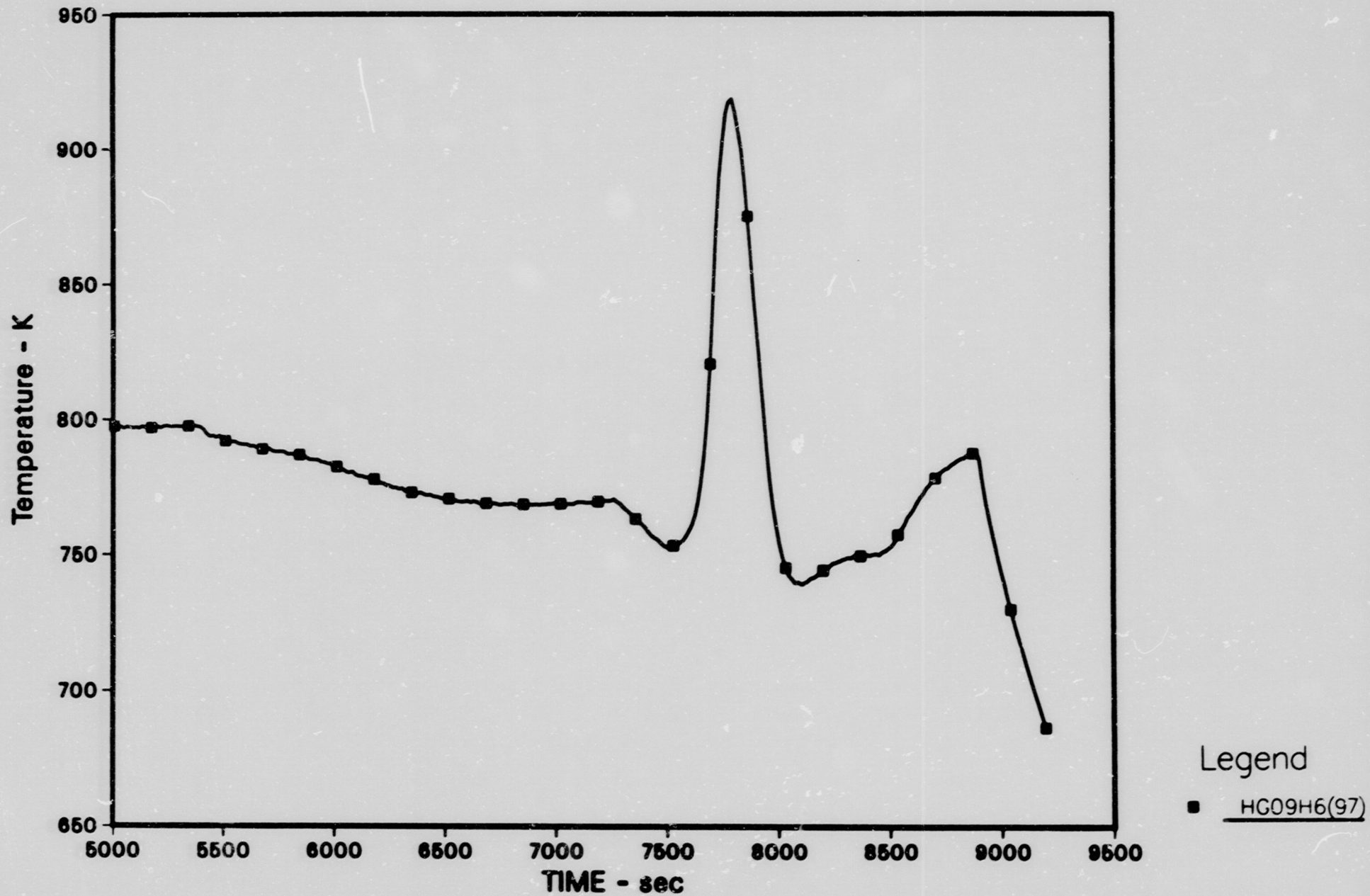
# DF-4 H2 Getter Tube 7, Mixing Tube Side 8in Above Bottom



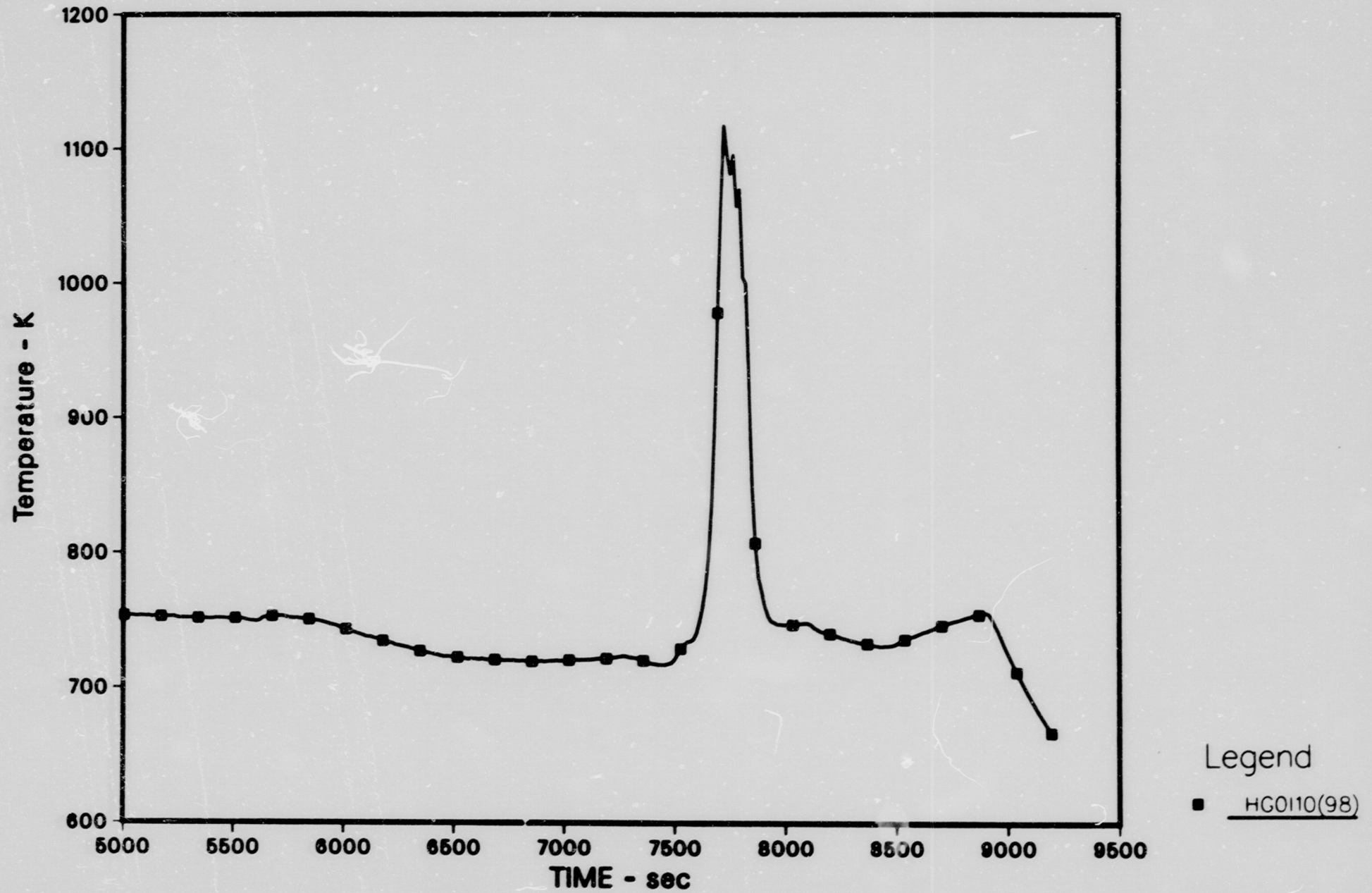
# DF-4 H2 Getter Tube 8, Heater Location 6in Above Bottom



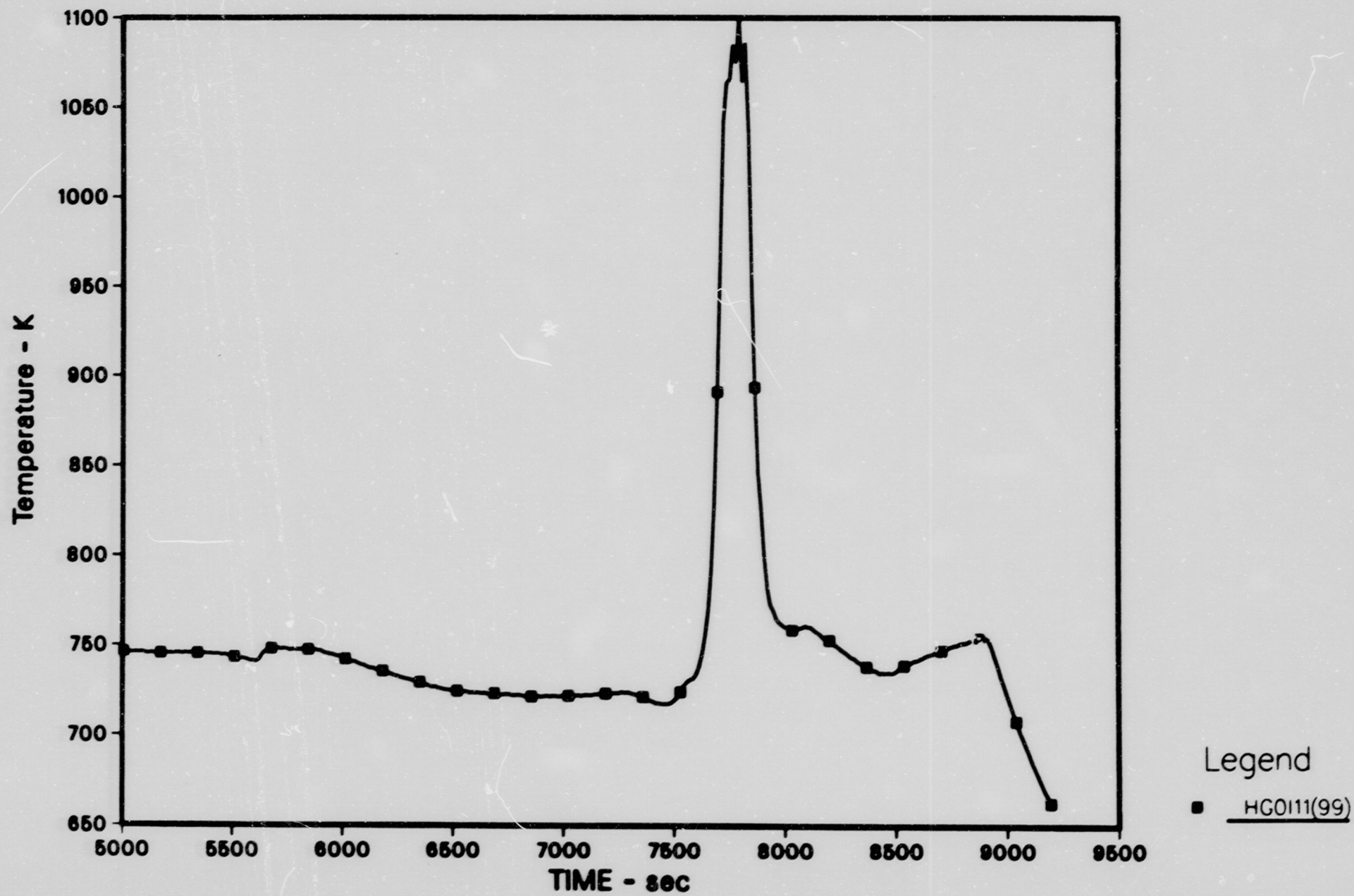
# DF-4 H2 Getter Tube 9, Heater Location 6in Above Bottom



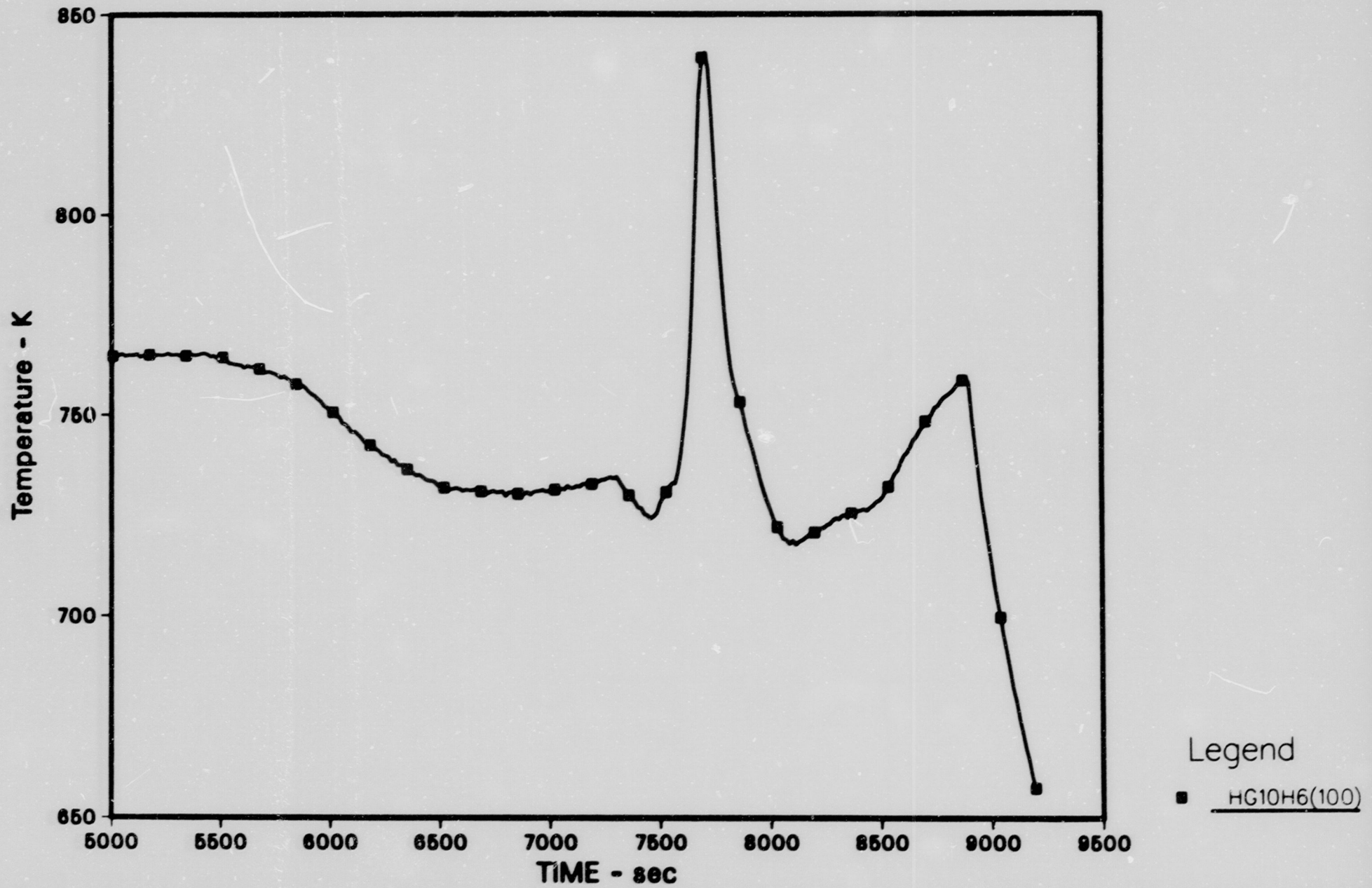
# DF-4 H2 Getter Tube 10, Internal 10in Above Bottom



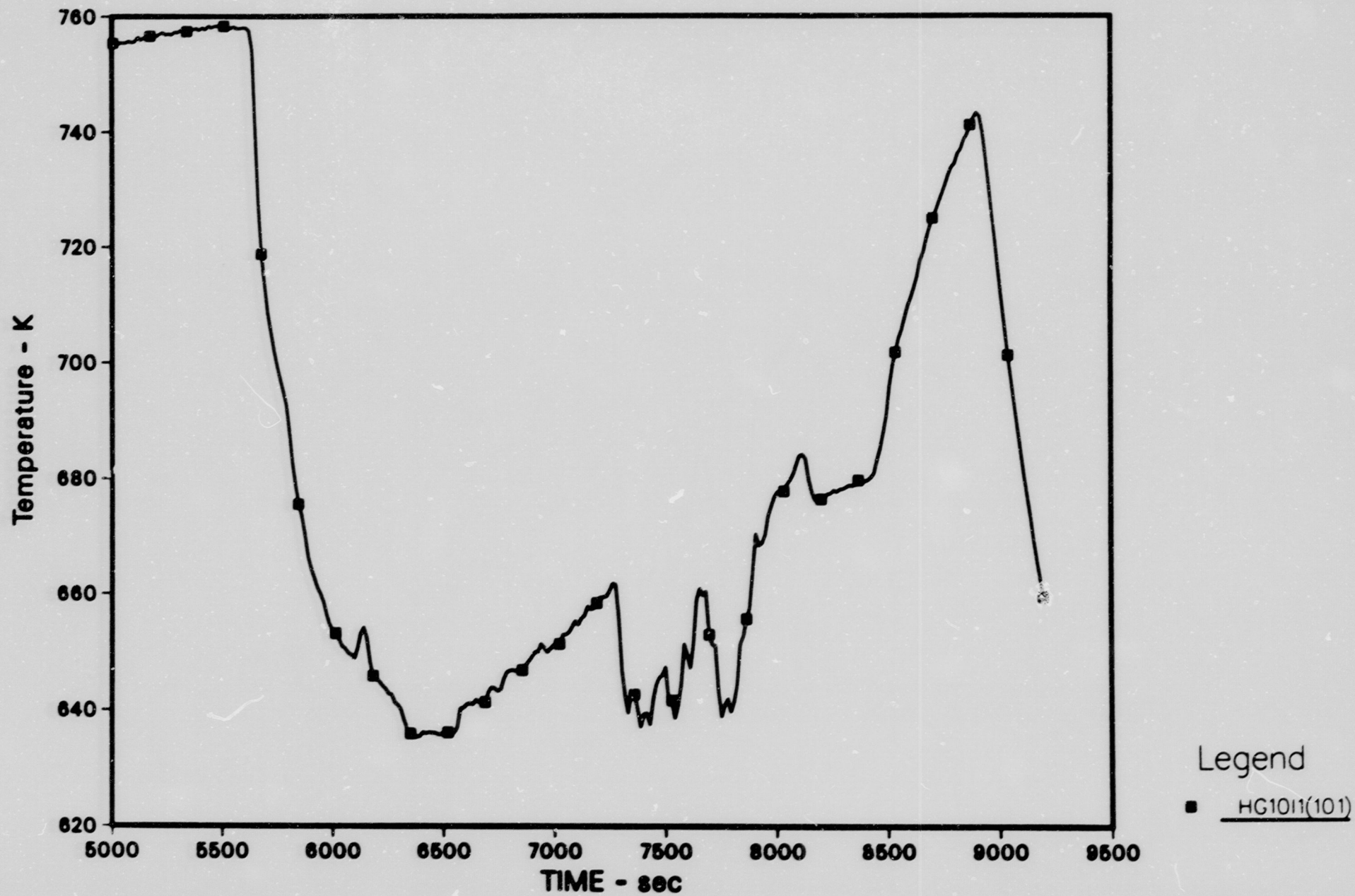
# DF-4 H2 Getter Tube 10, Internal 11in Above Bottom



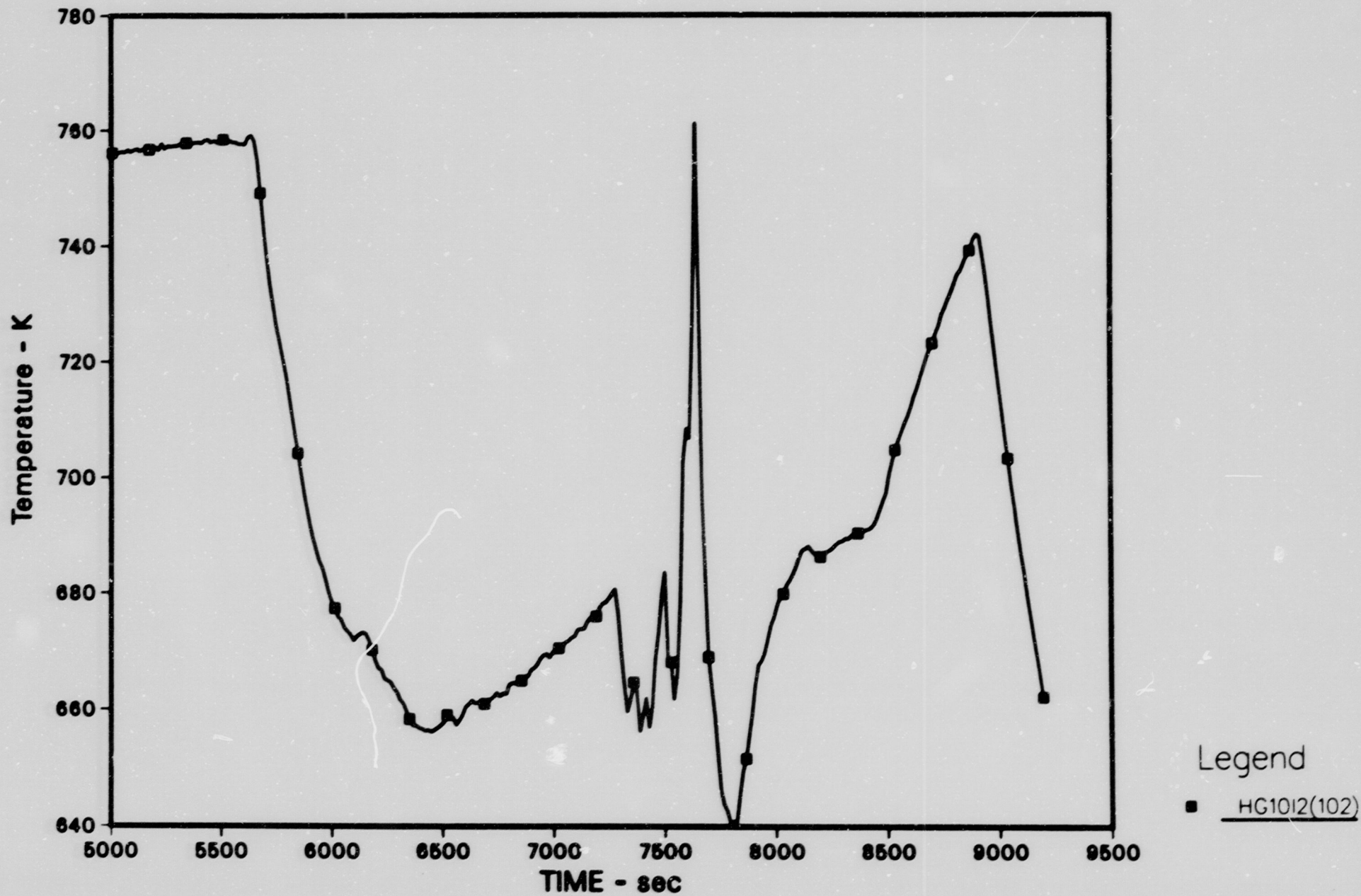
# DF-4 H2 Getter Tube 10, Heater Location 6in Above Bottom



# DF-4 H2 Getter Tube 10, Internal 1in Above Bottom

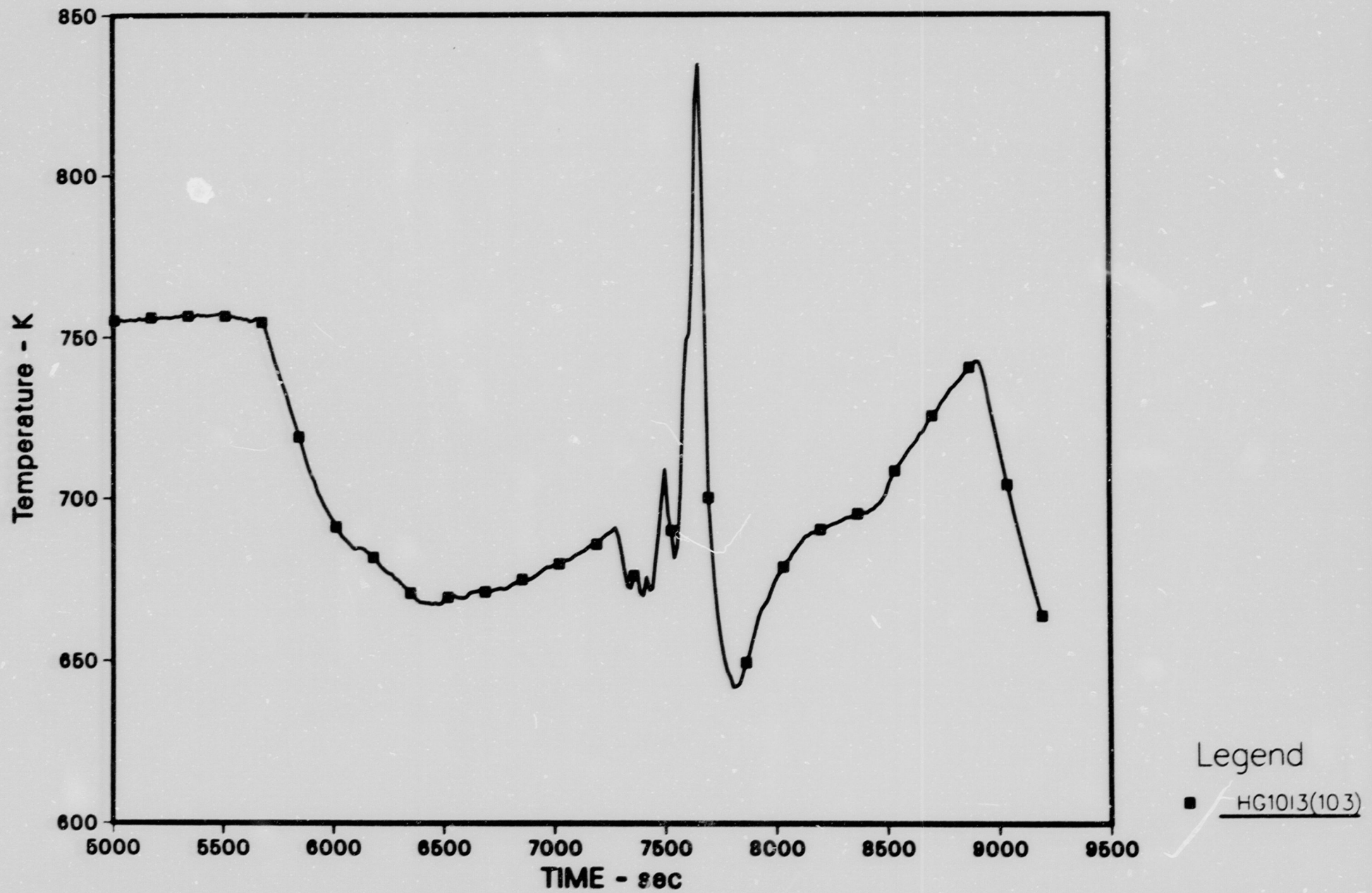


# DF-4 H2 Getter Tube 10, Internal 2in Above Bottom

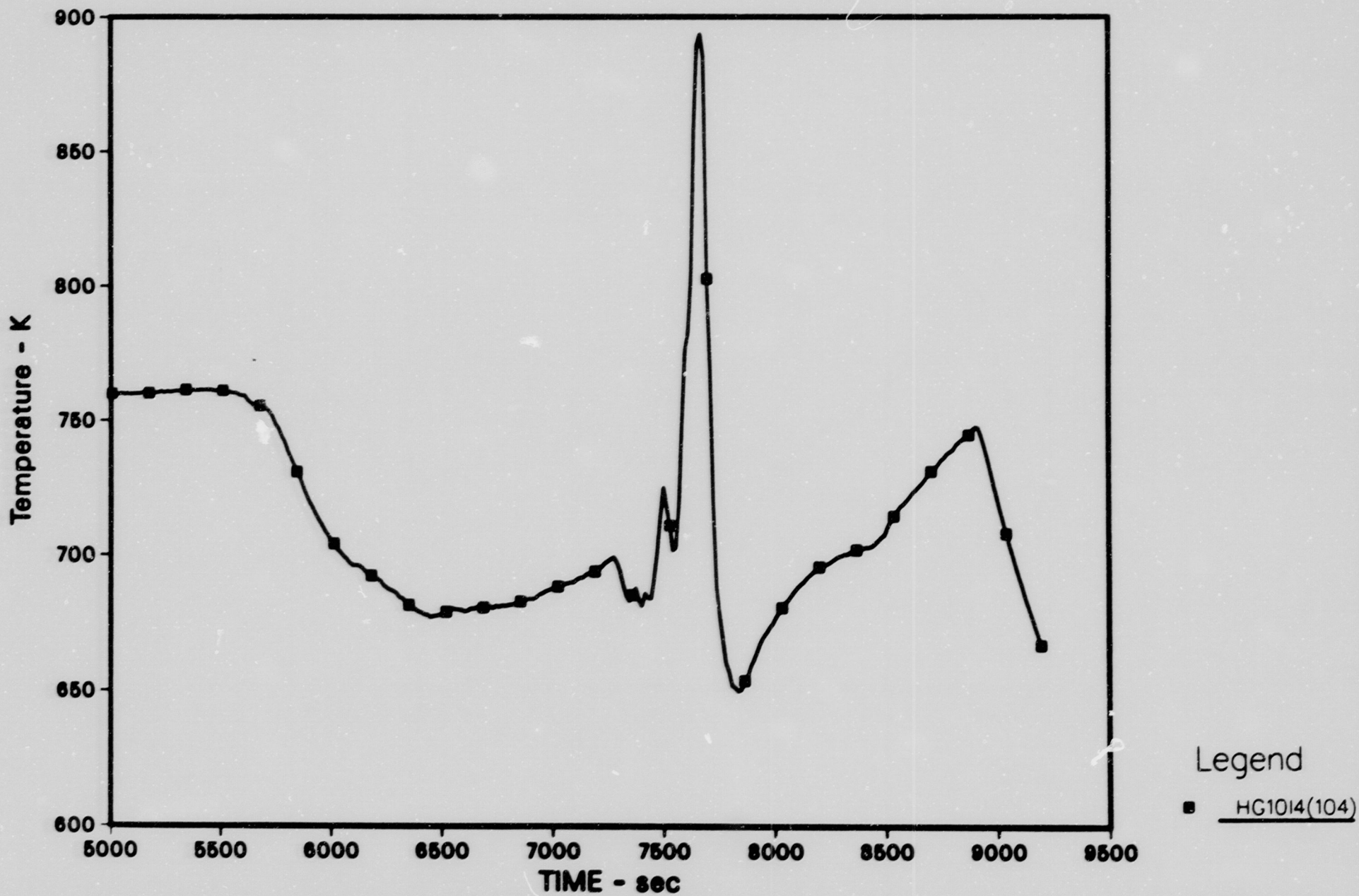




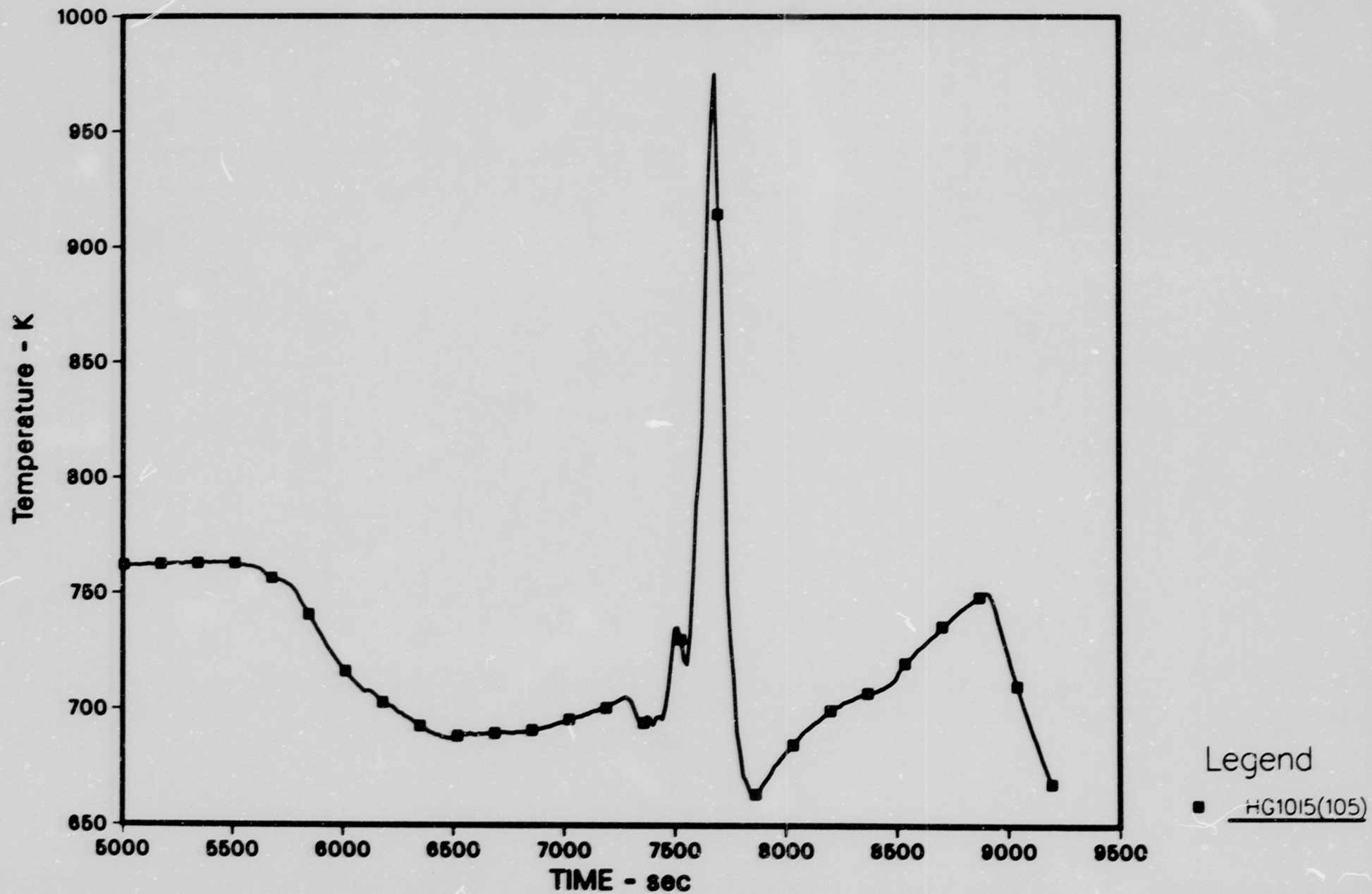
# DF-4 H2 Getter Tube 10, Internal 3in Above Bottom



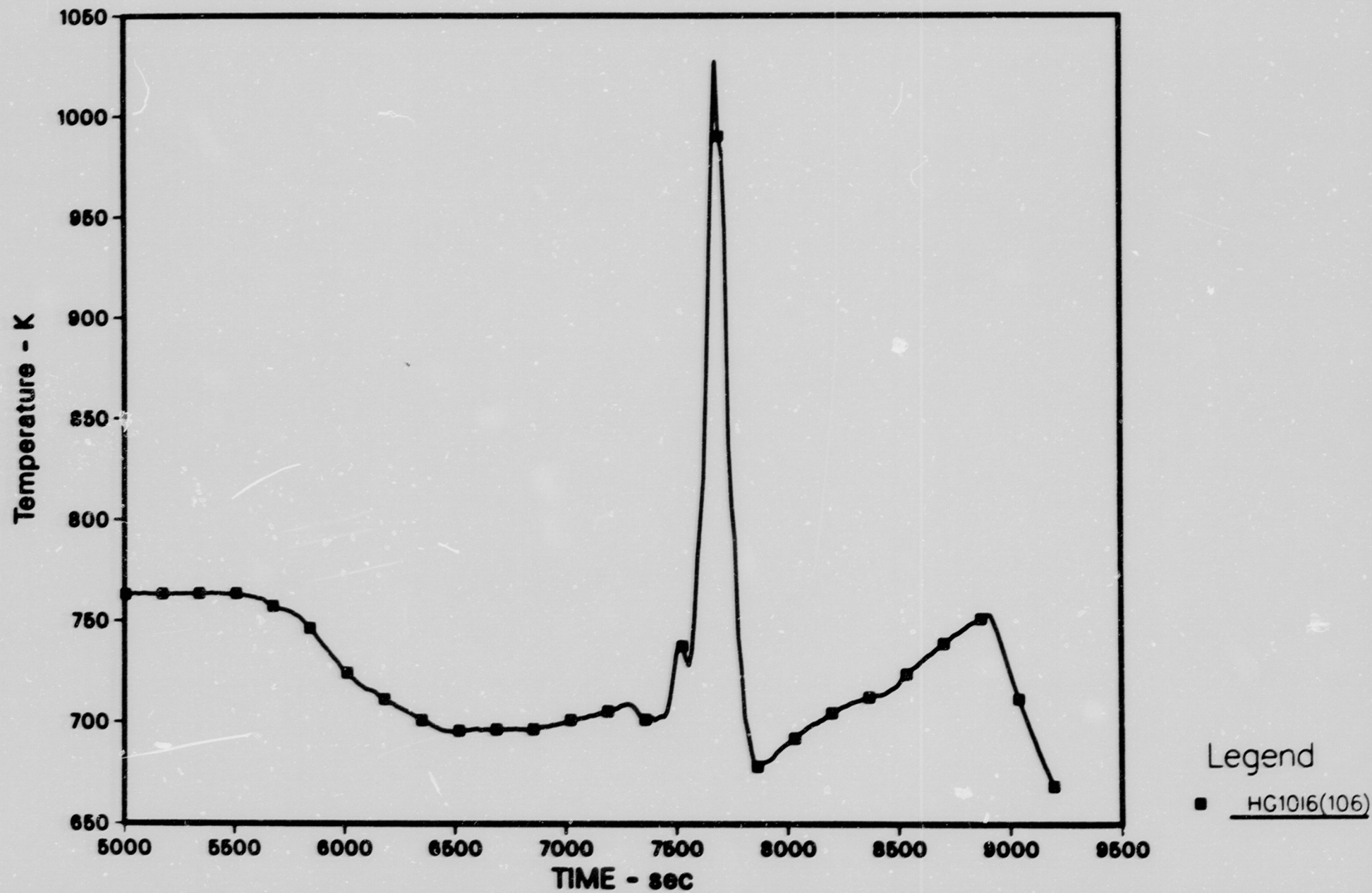
# DF-4 H2 Getter Tube 10, Internal 4In Above Bottom



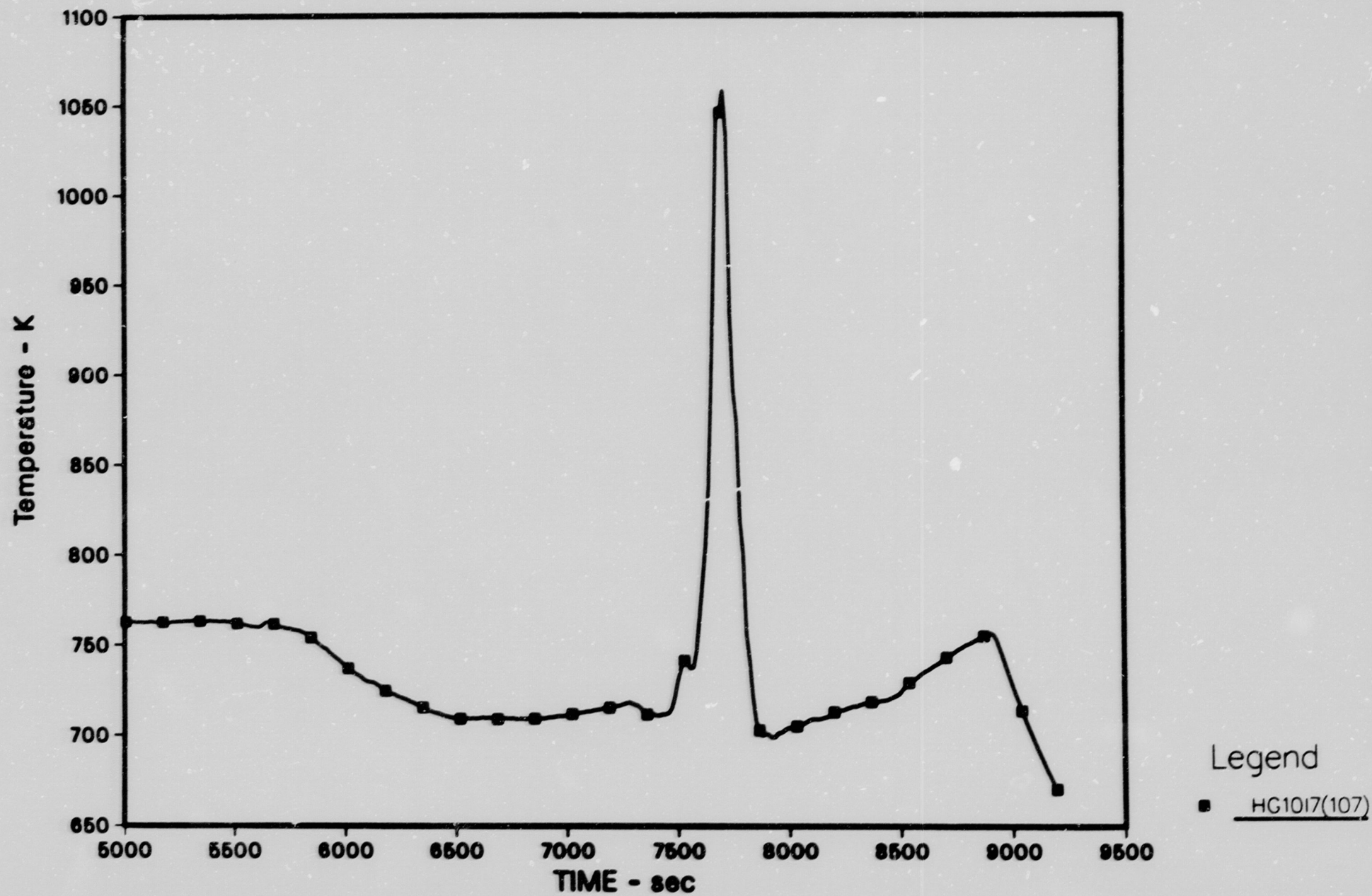
# DF-4 H2 Getter Tube 10, Internal 5in Above Bottom



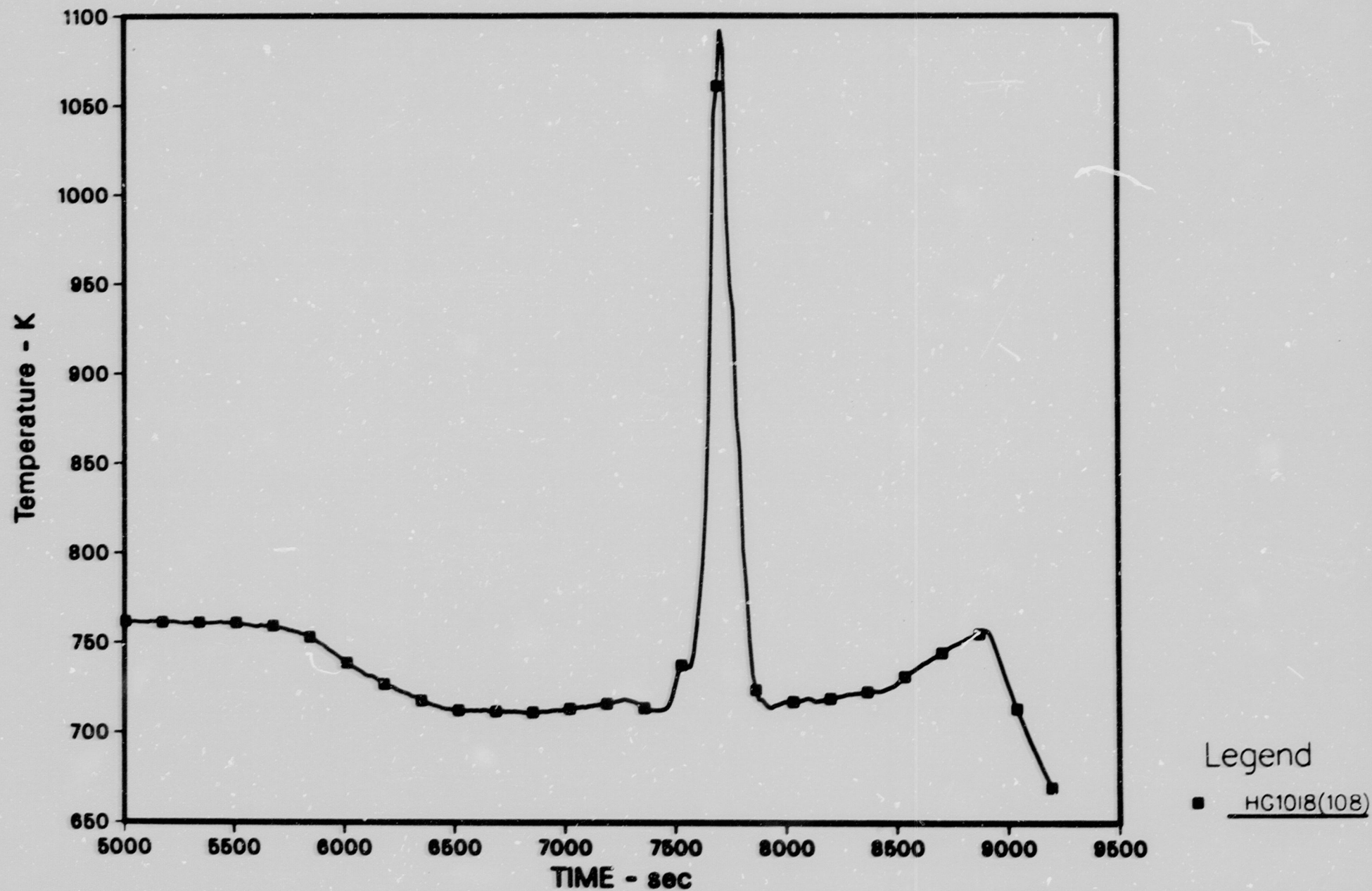
# DF-4 H2 Getter Tube 10, Internal 6In Above Bottom



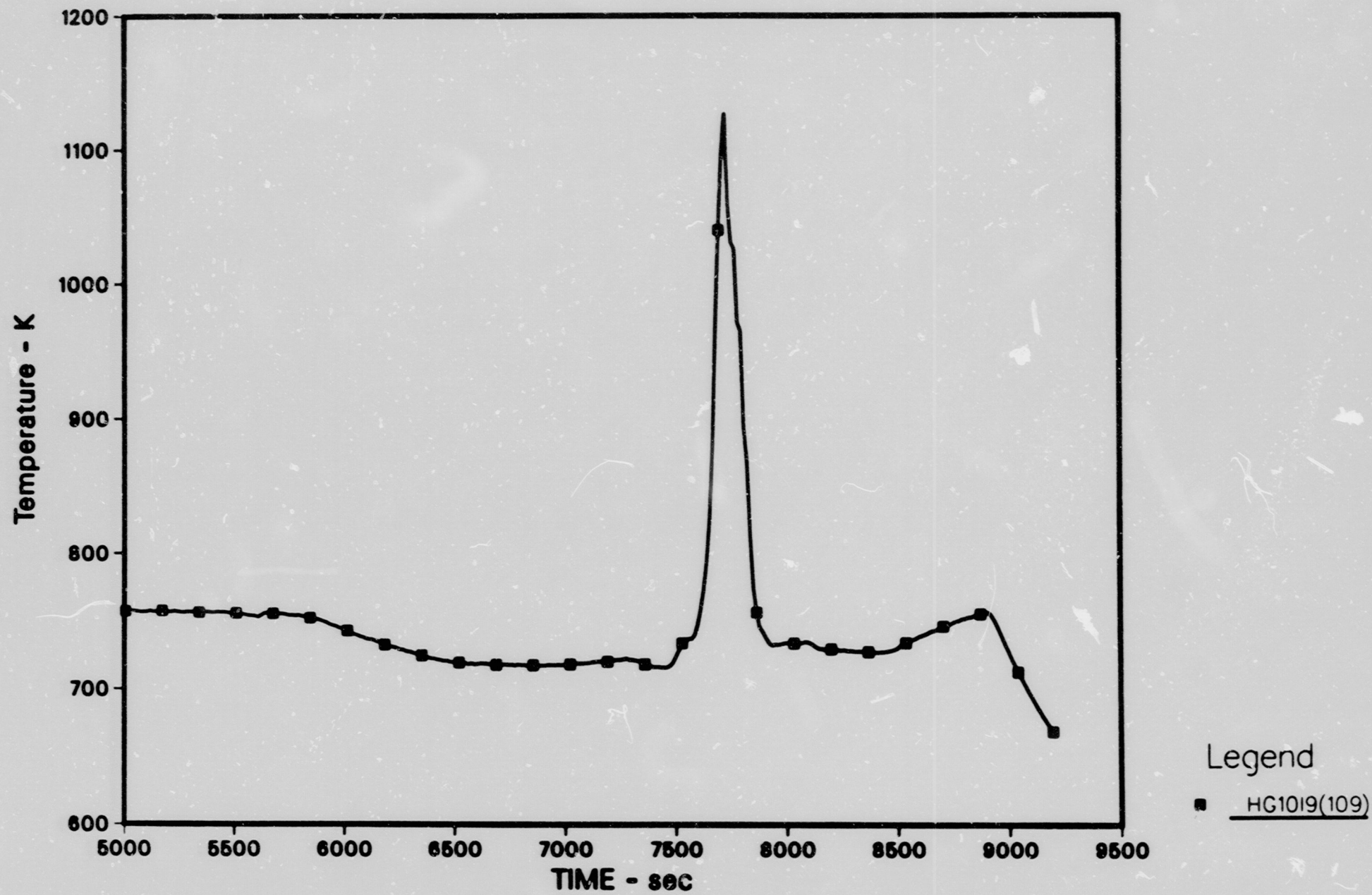
# DF-4 H2 Getter Tube 10, Internal 7in Above Bottom



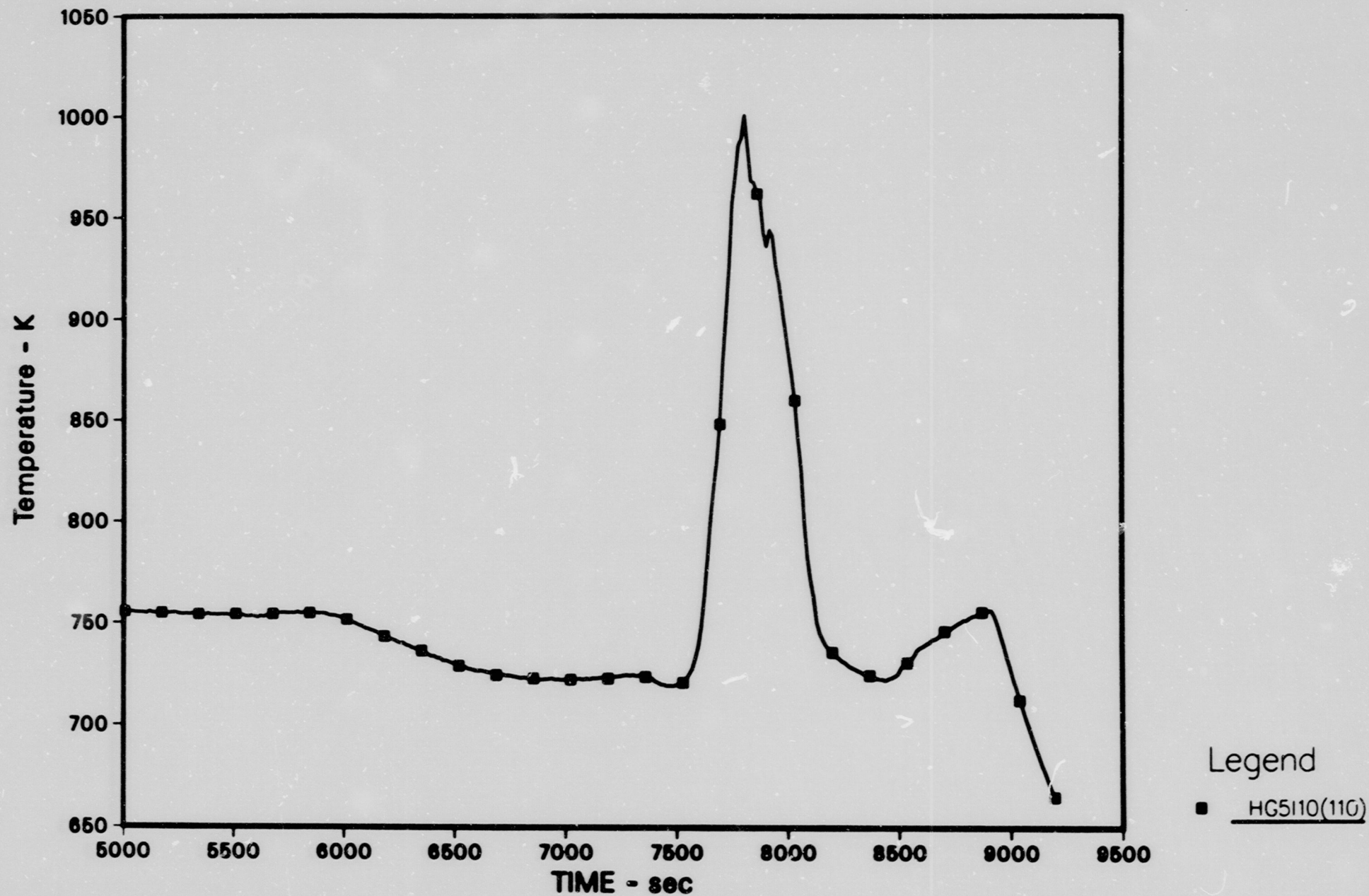
# DF-4 H2 Getter Tube 10, Internal 8in Above Bottom



# DF-4 H2 Getter Tube 10, Internal 9in Above Bottom

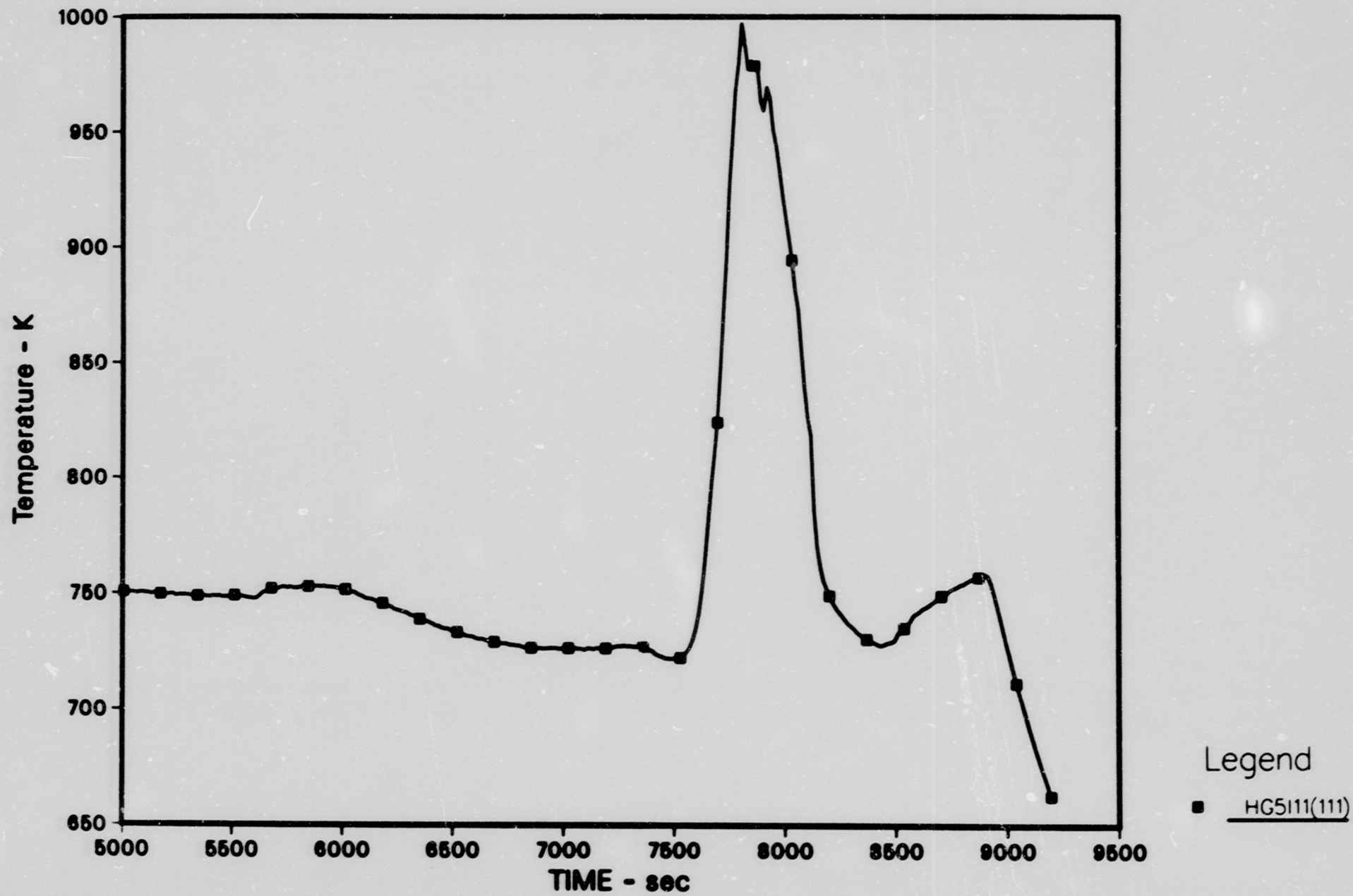


# DF-4 H2 Getter Tube 5, Internal 10in Above Bottom

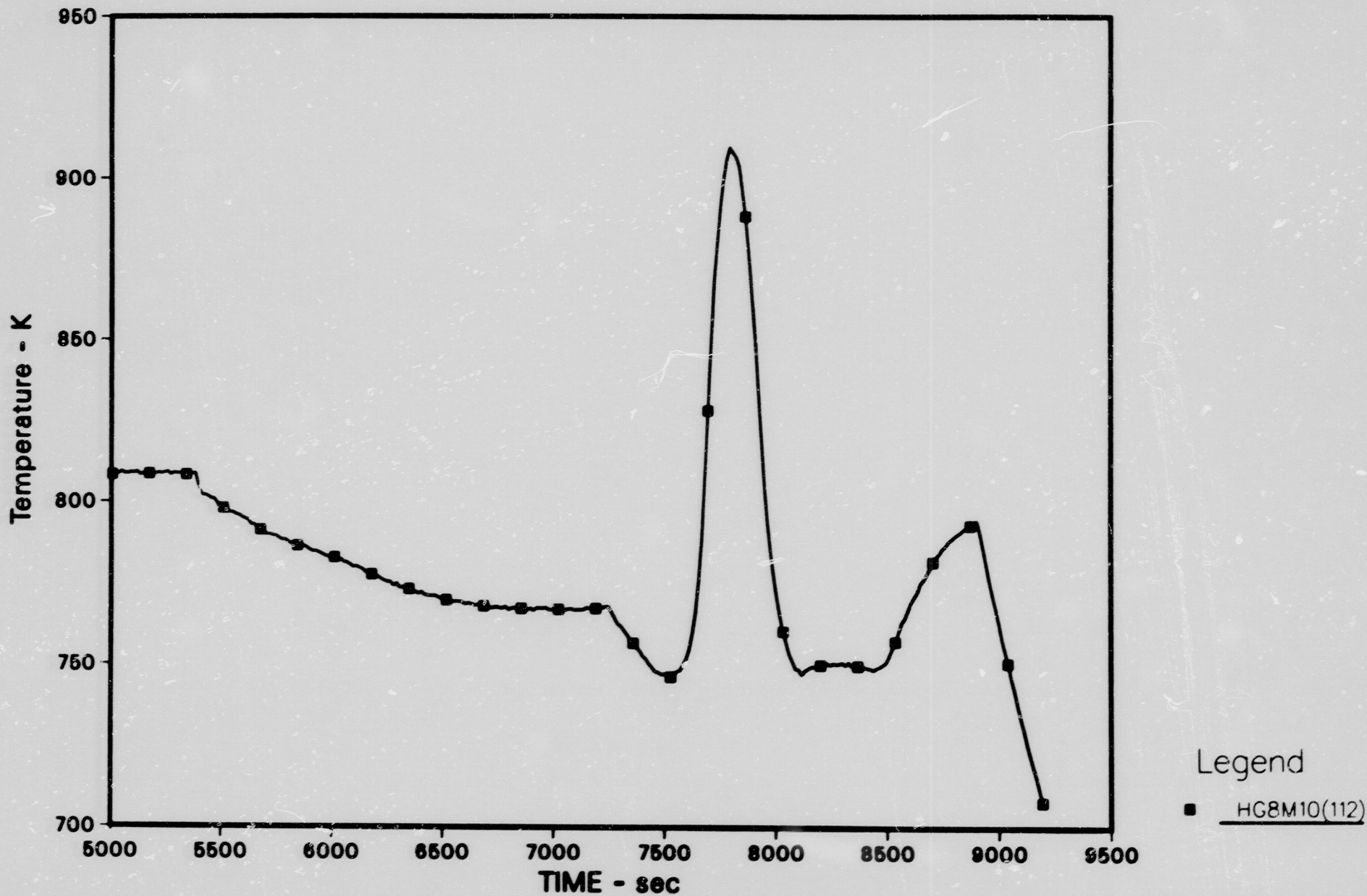




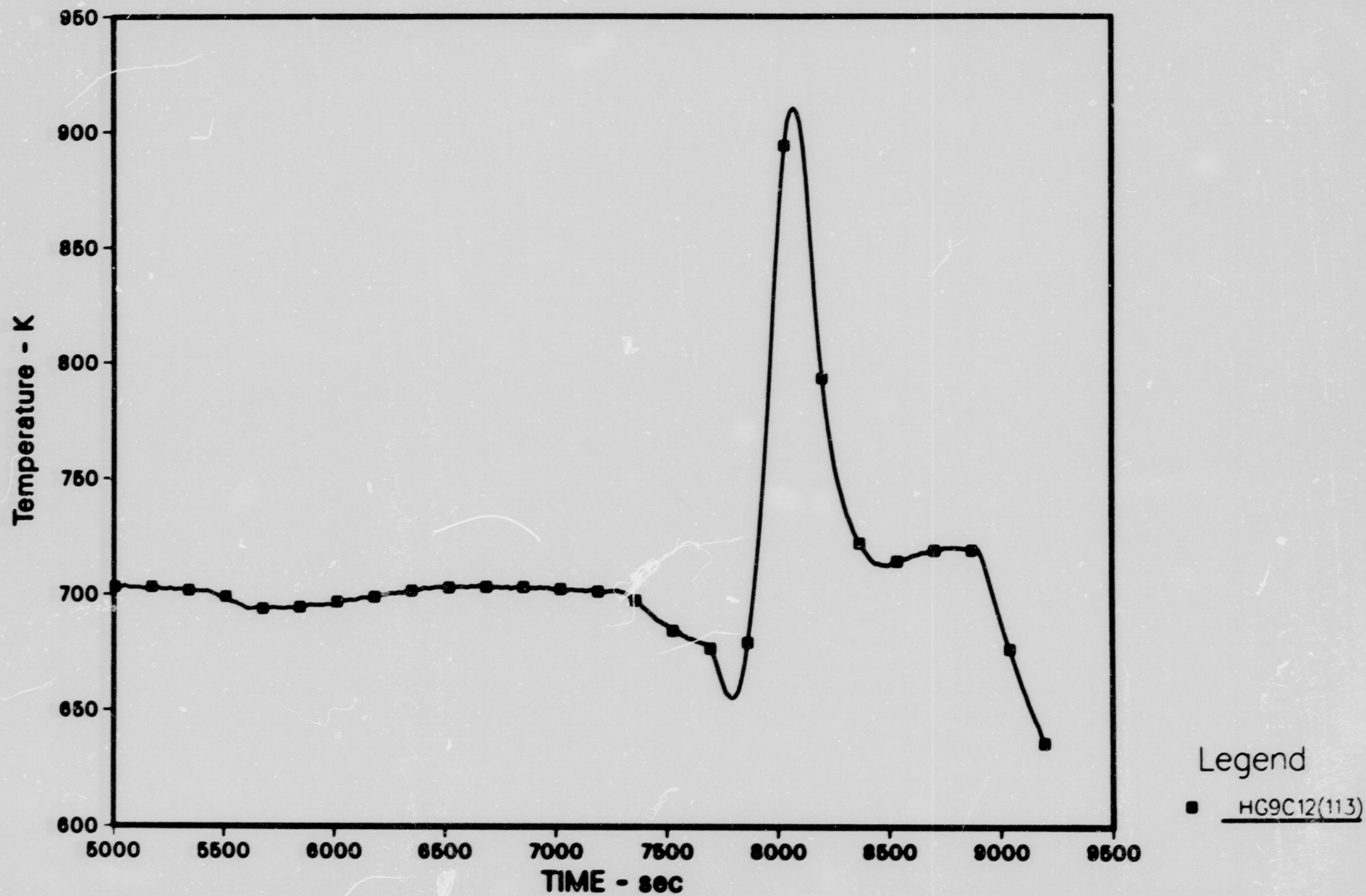
# DF-4 H2 Getter Tube 5, Internal 11in Above Bottom



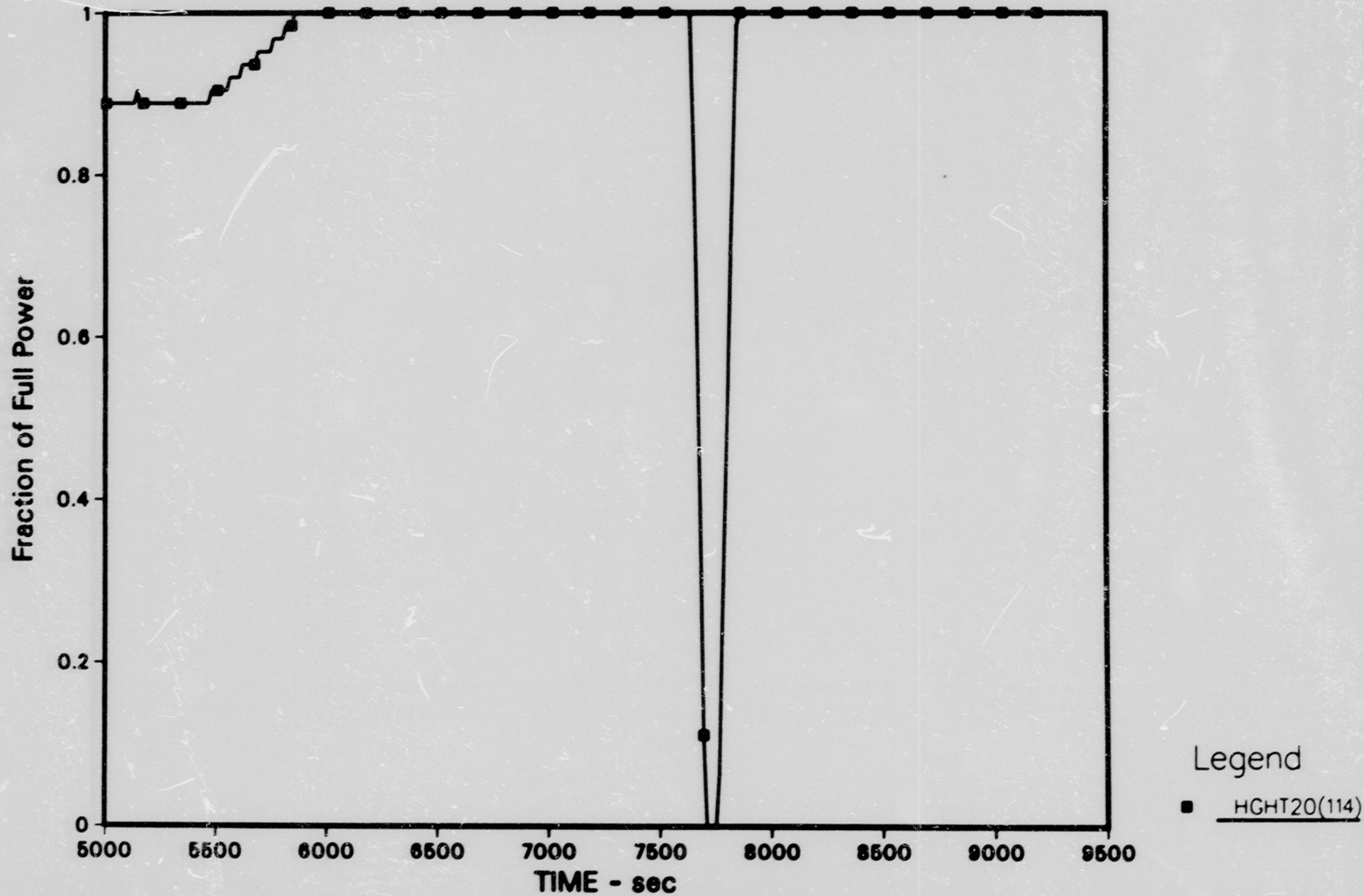
# DF-4 H2 Getter Tube 8, Mixing Tube Side 10in Above Bottom



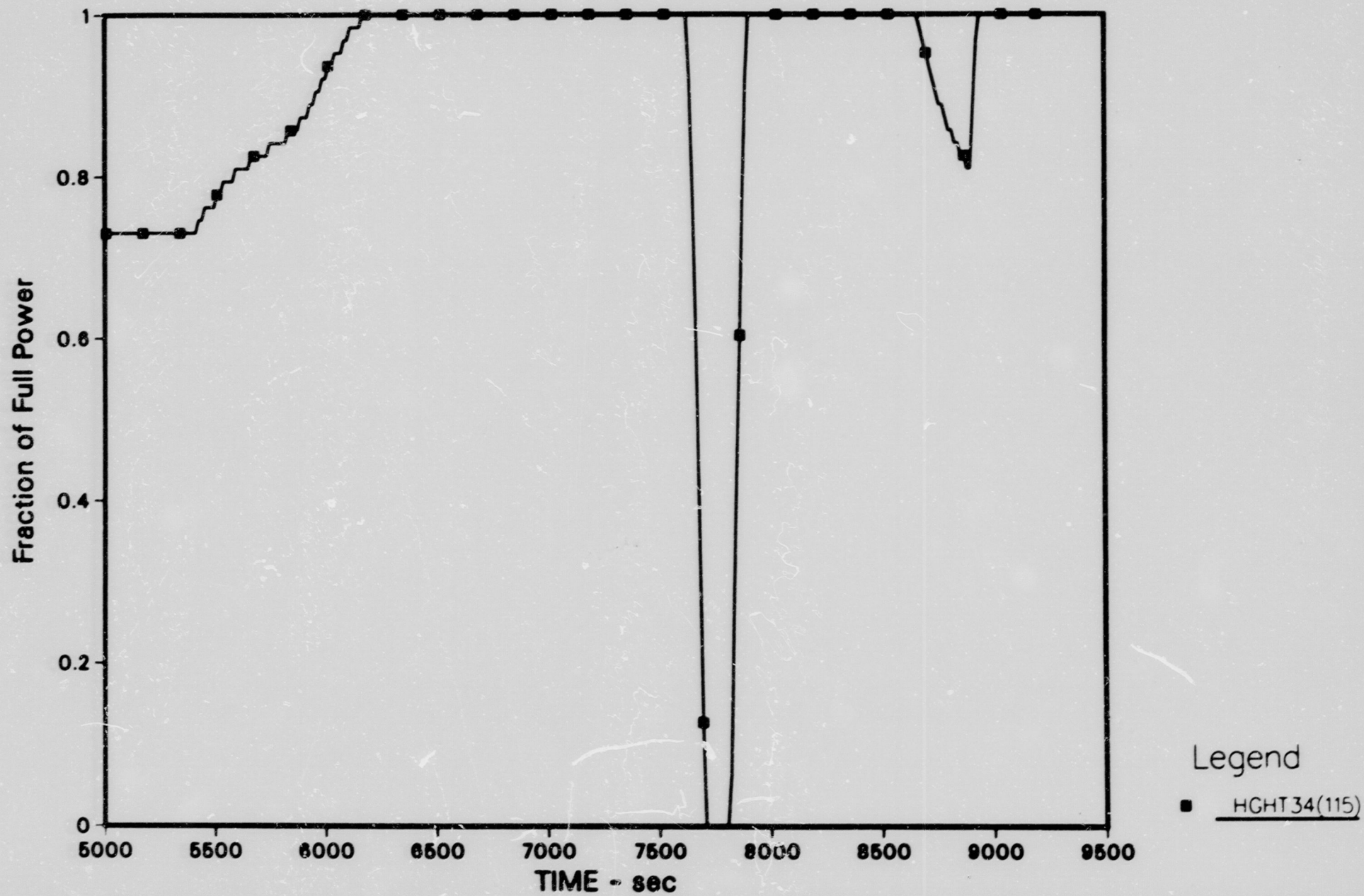
# DF-4 H2 Getter Tube 9, Condenser Side 12in Above Bottom



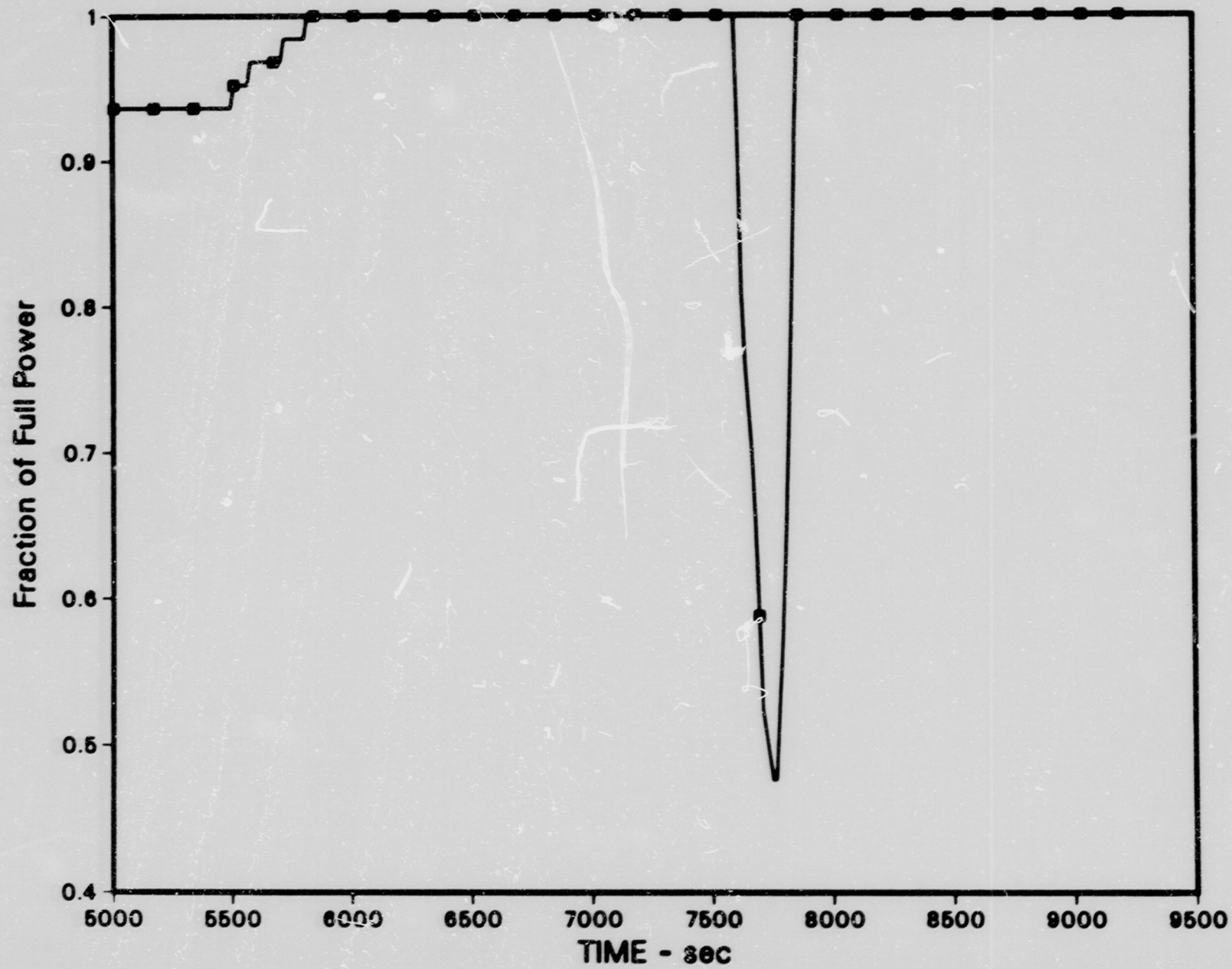
# DF-4 Duty Cycles for Heaters 2&10 CuO Tubes



# DF-4 Duty Cycles for Heaters 3&4 CuO Tubes



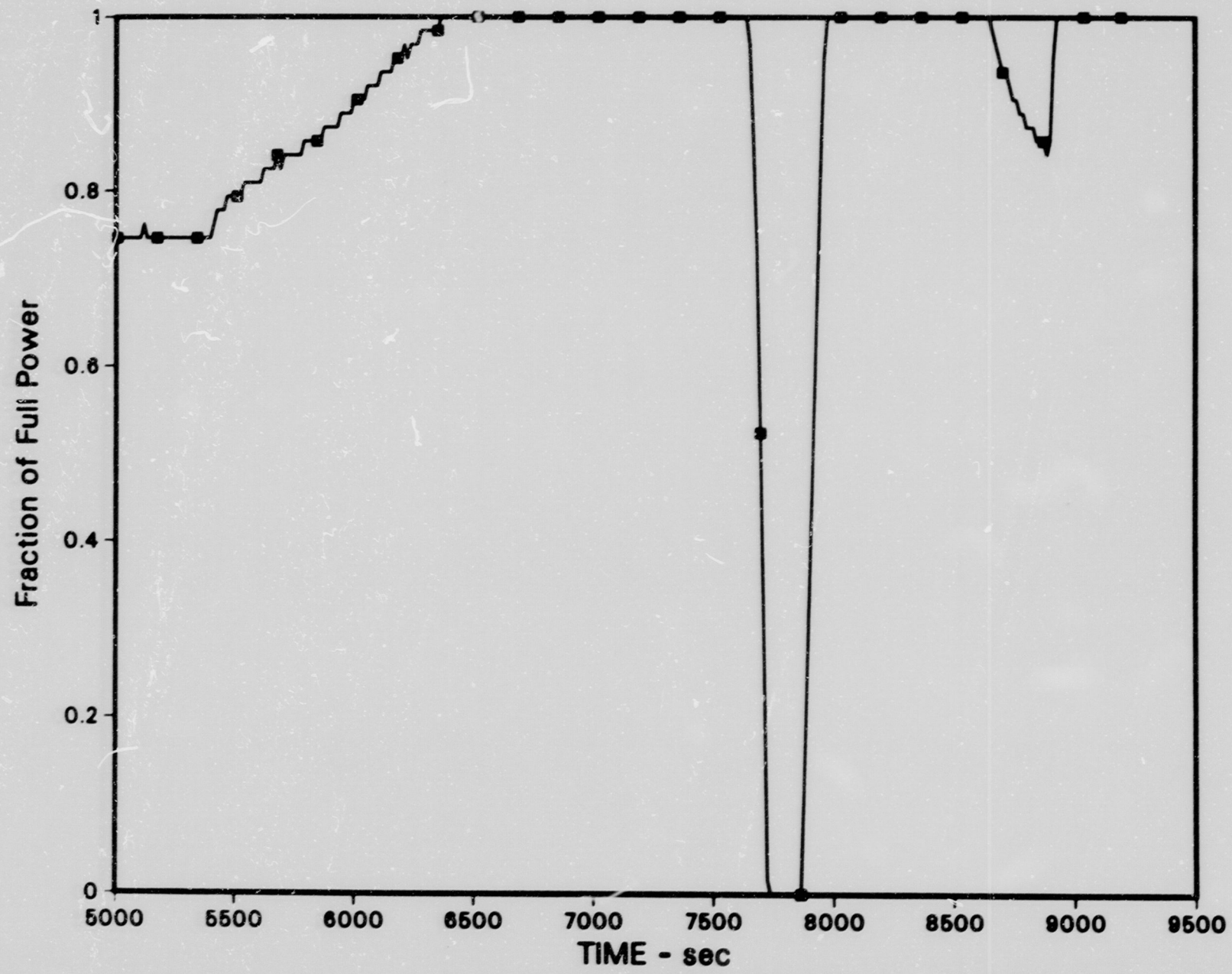
# DF-4 Duty Cycles for Heaters 5&7 CuO Tubes



Legend

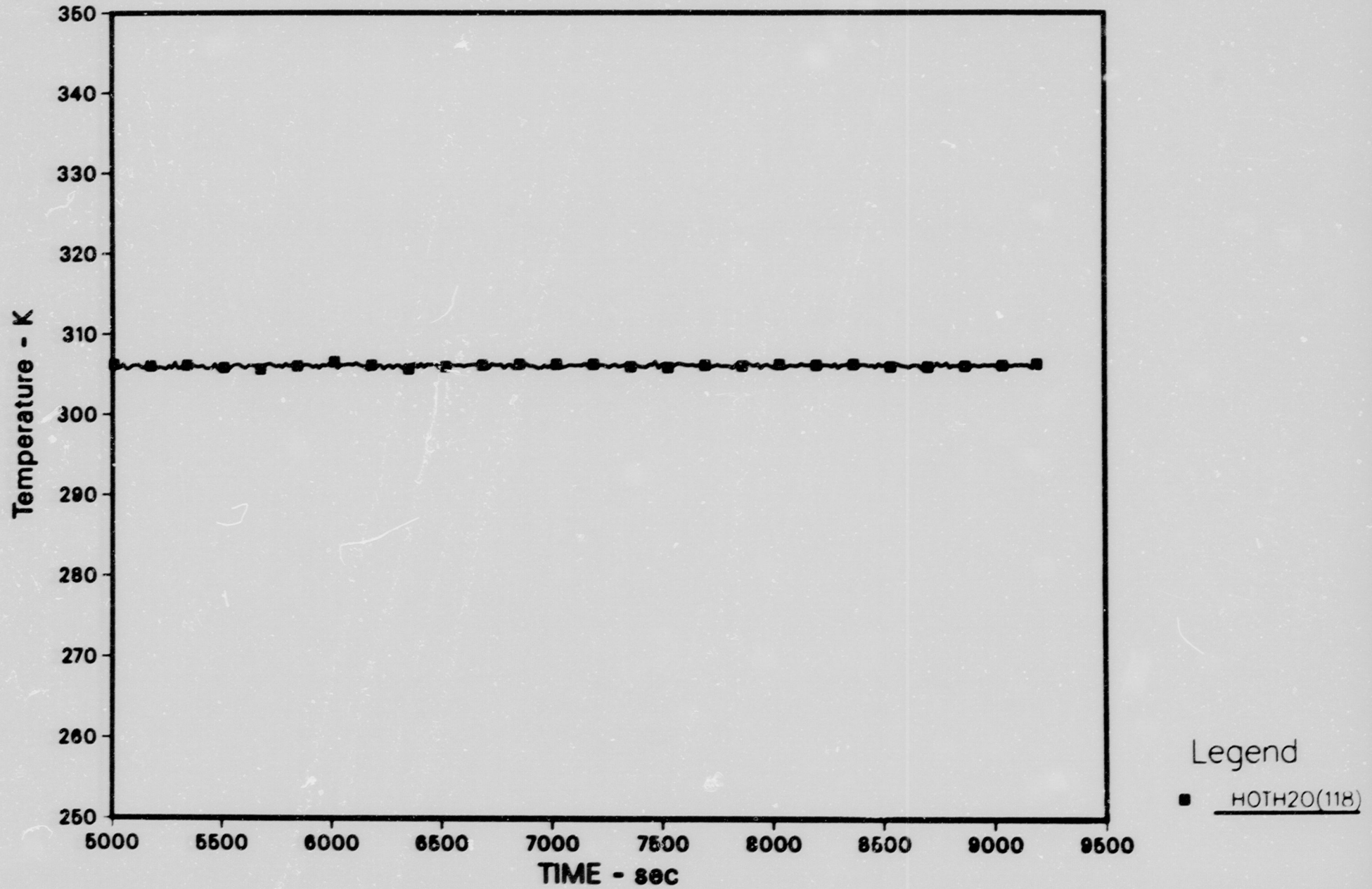
■ HGHT57(116)

# DF-4 Duty Cycles for Heaters 8&9 CuO Tubes



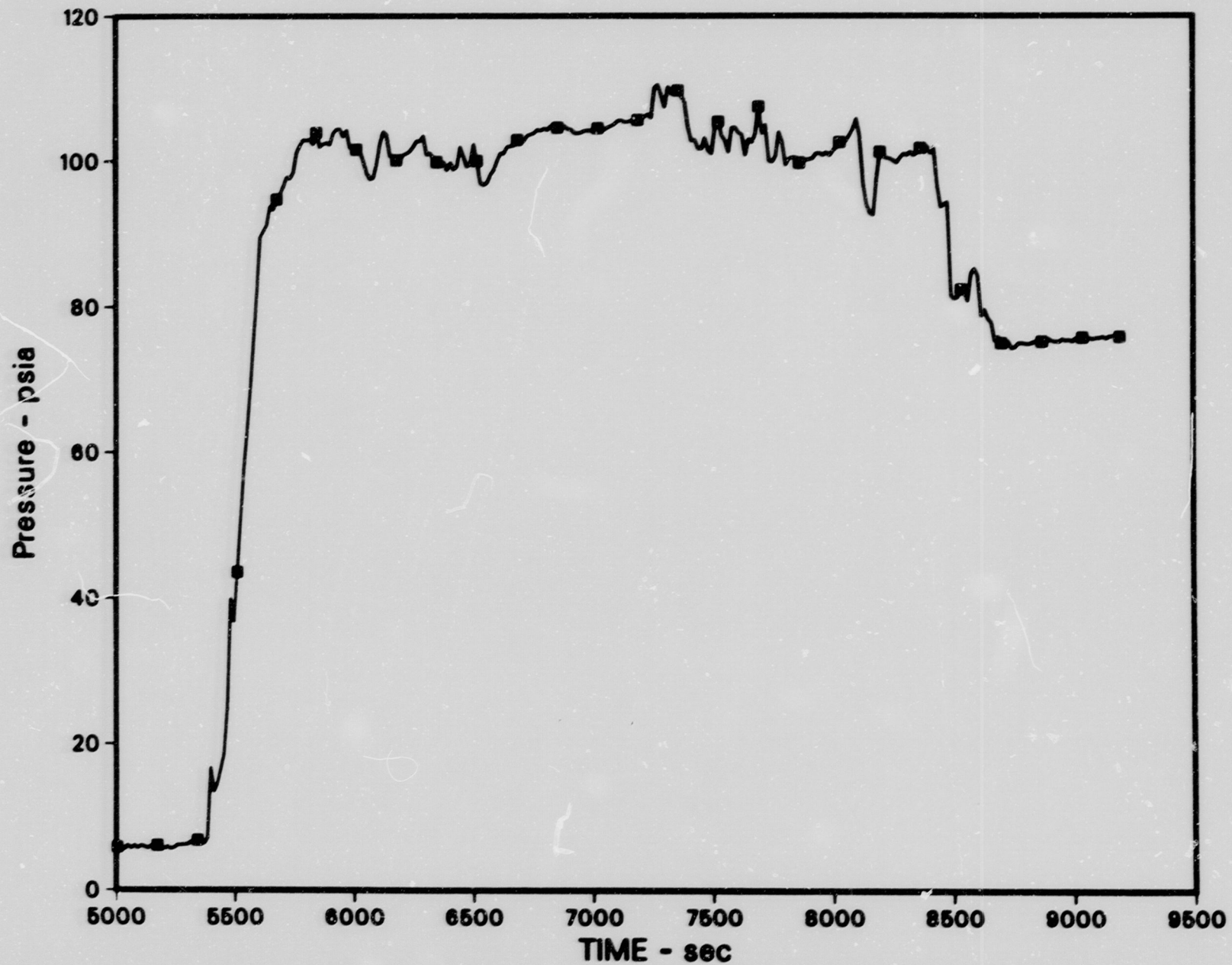
Legend  
■ HGHT89(117)

# DF-4 Inside Hot Water Line





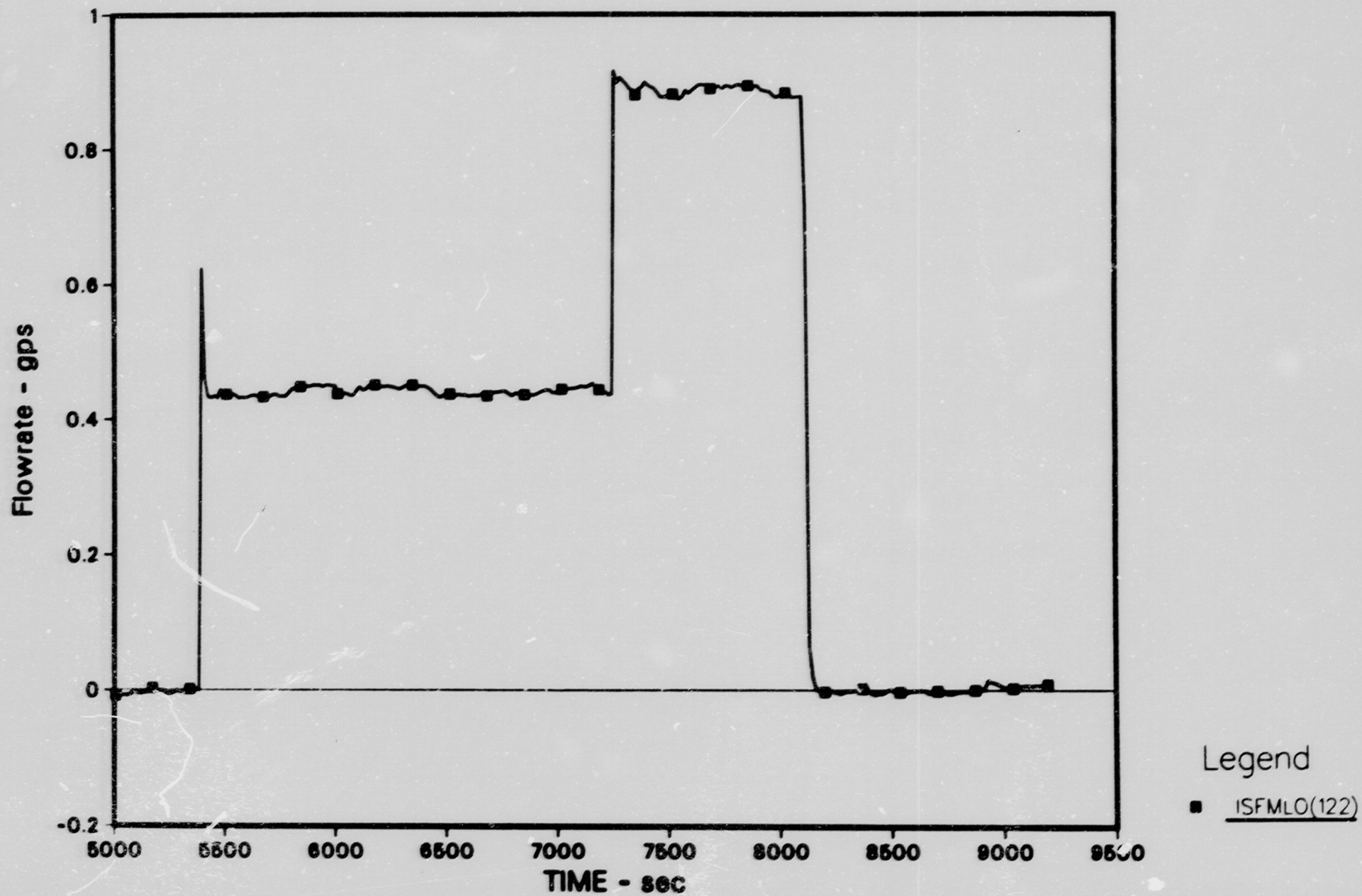
# DF-4 Inlet Steam Pressure (Access Tube Region)



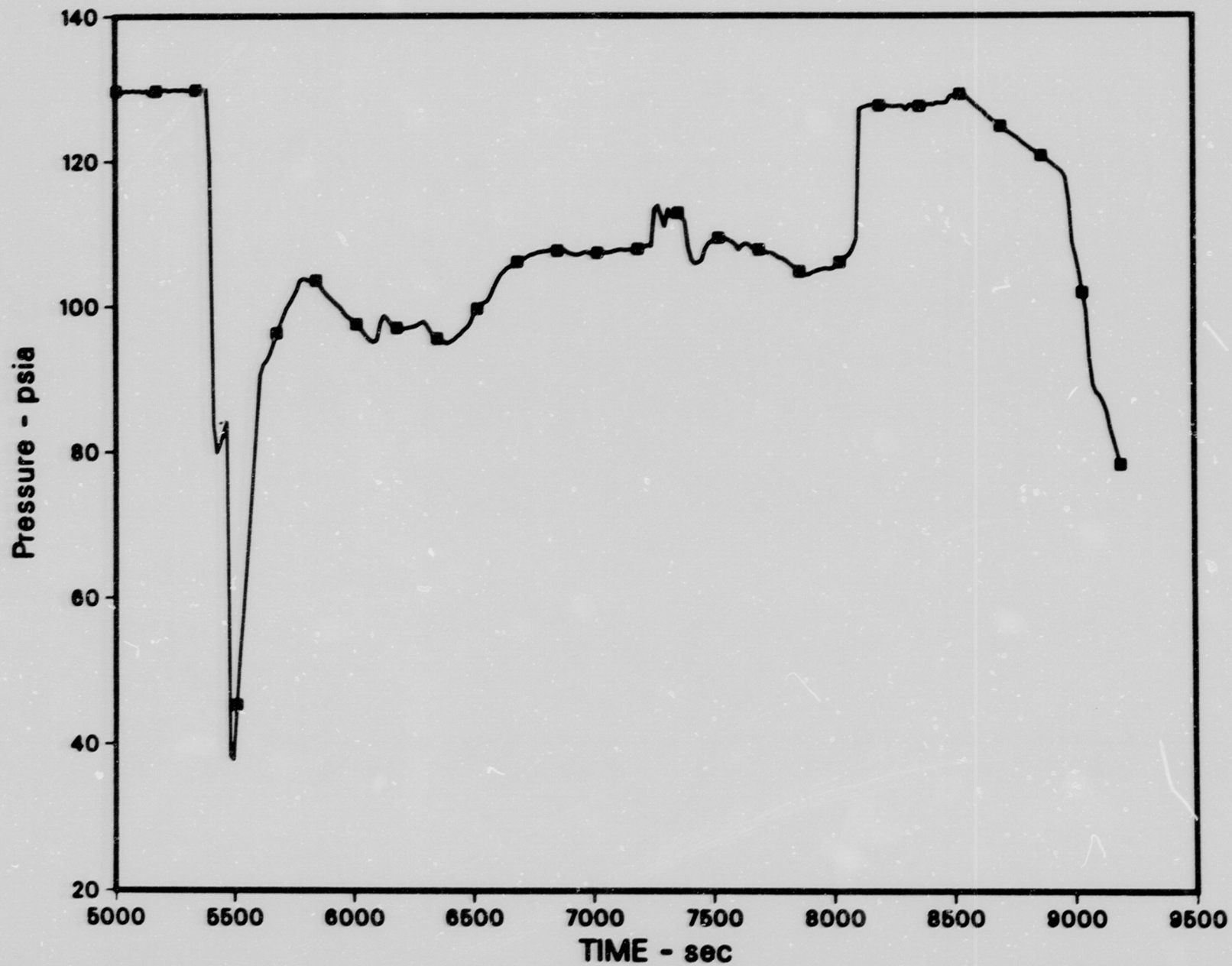
Legend

■ ISABPT(119)

# DF-4 Inlet Steam Flow Meter



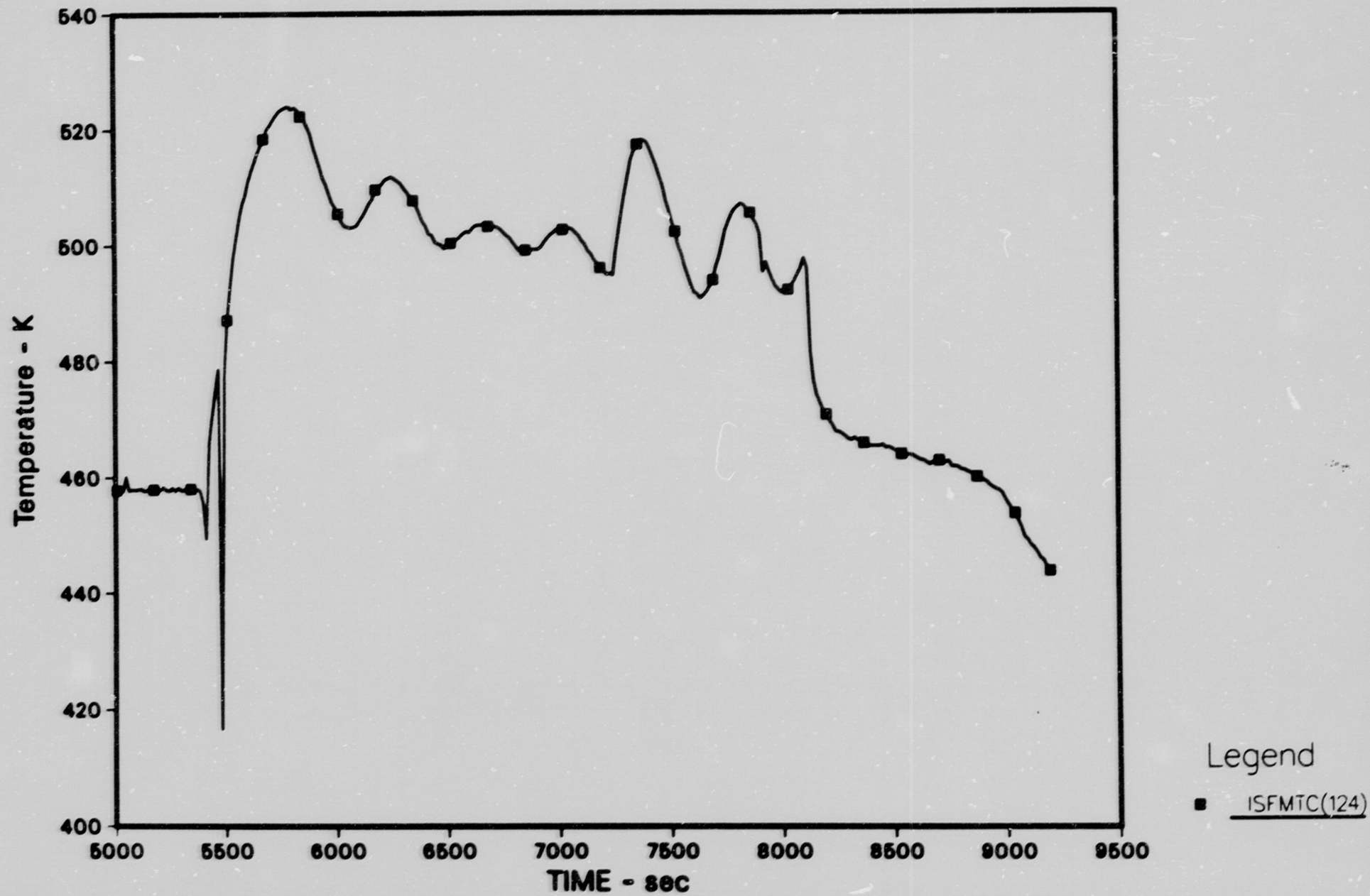
# DF-4 Steam Inlet Pressure (for FM)



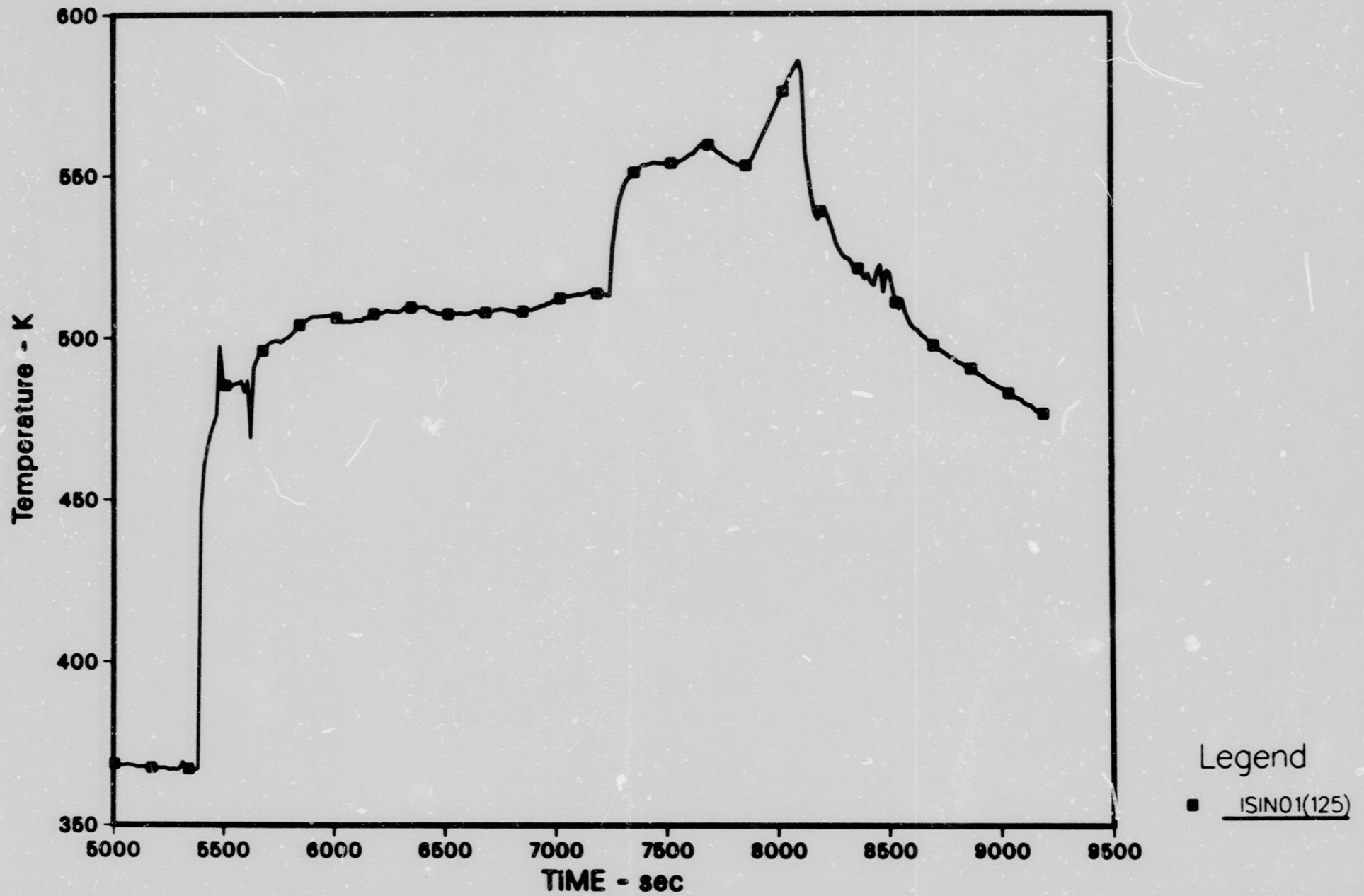
Legend

■ ISFMPT(123)

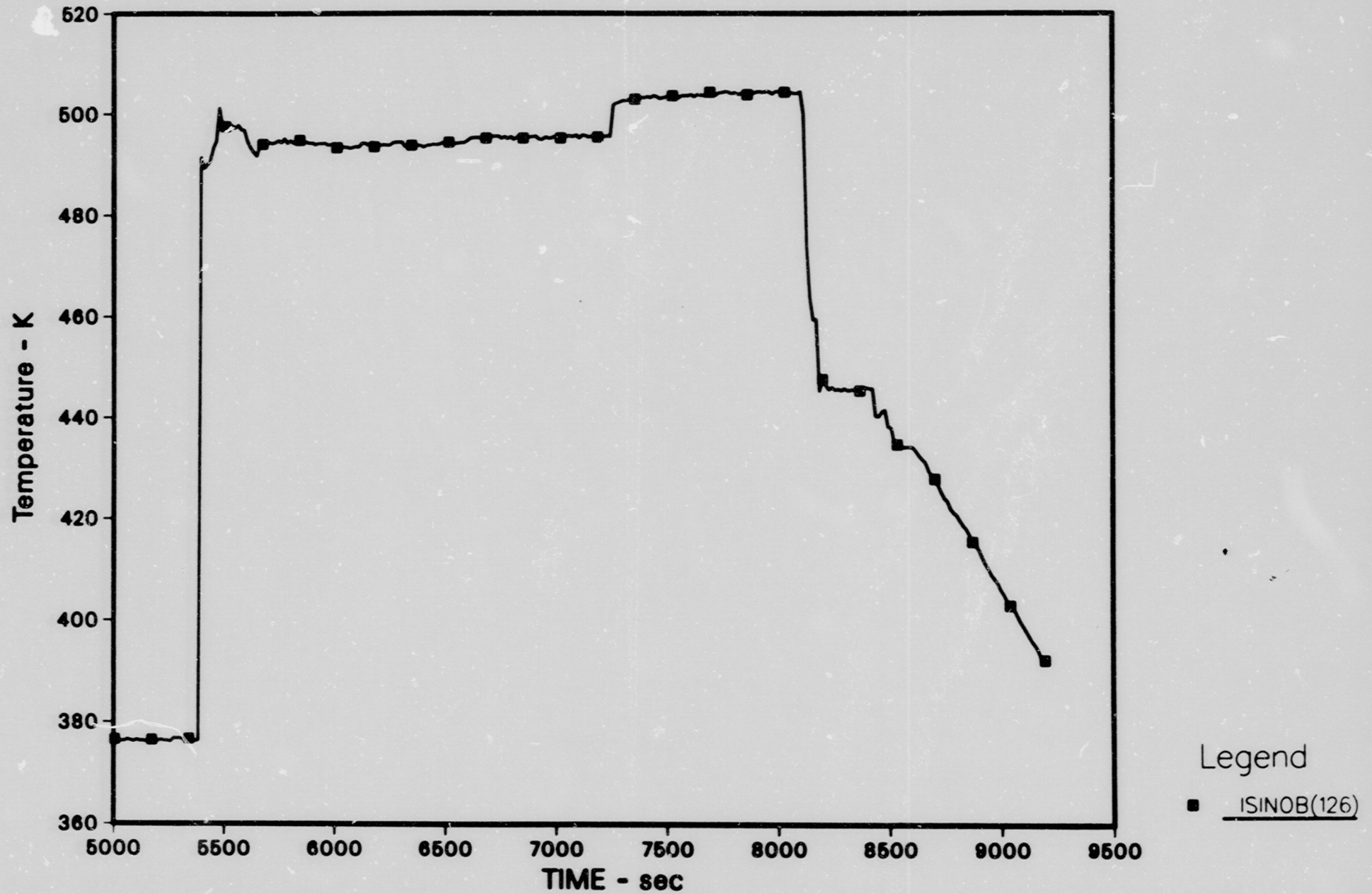
# DF-4 Inlet Steam Temp (for FM)



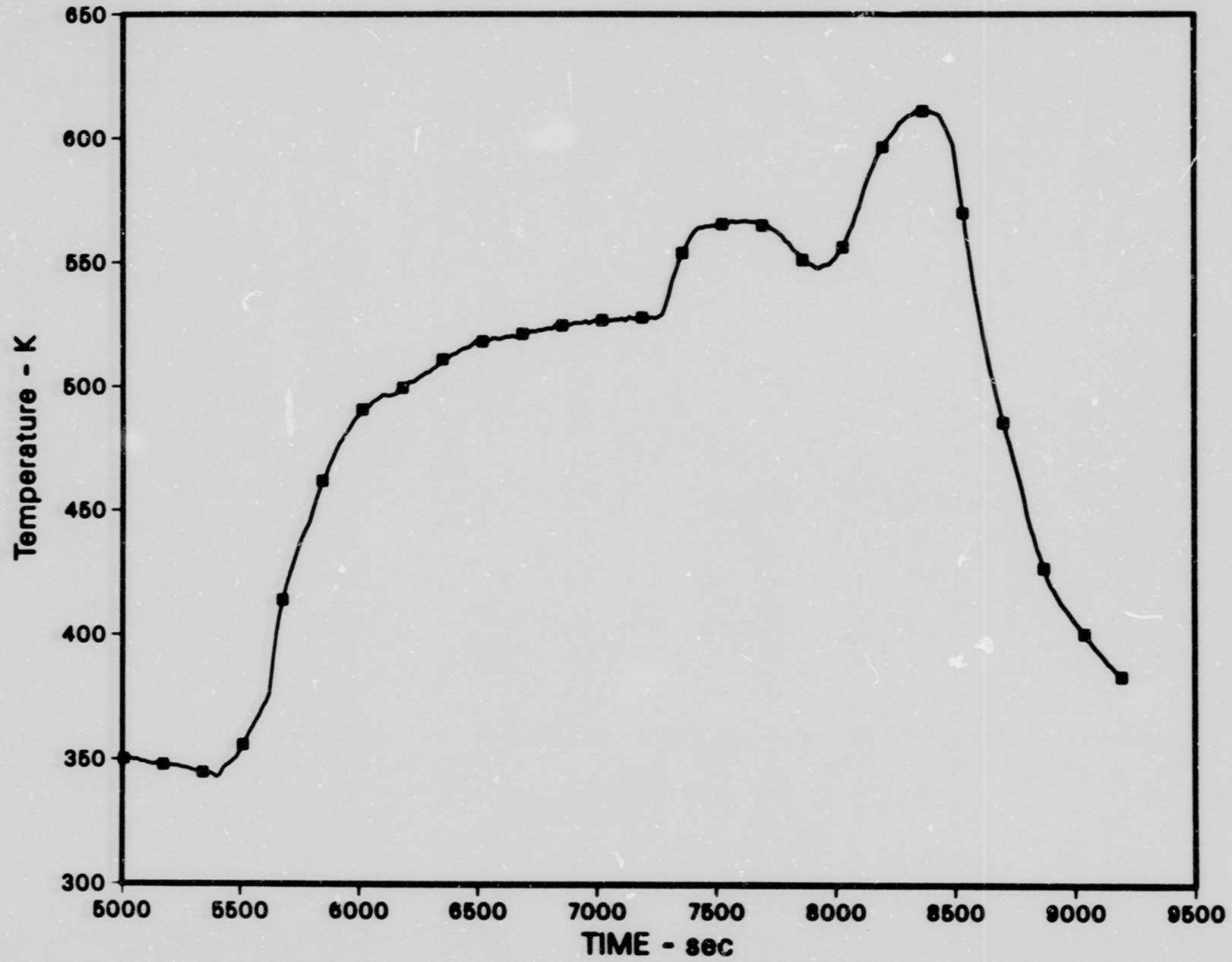
# DF-4 Inside Inlet Steam Line @ Steam Cup Elbow



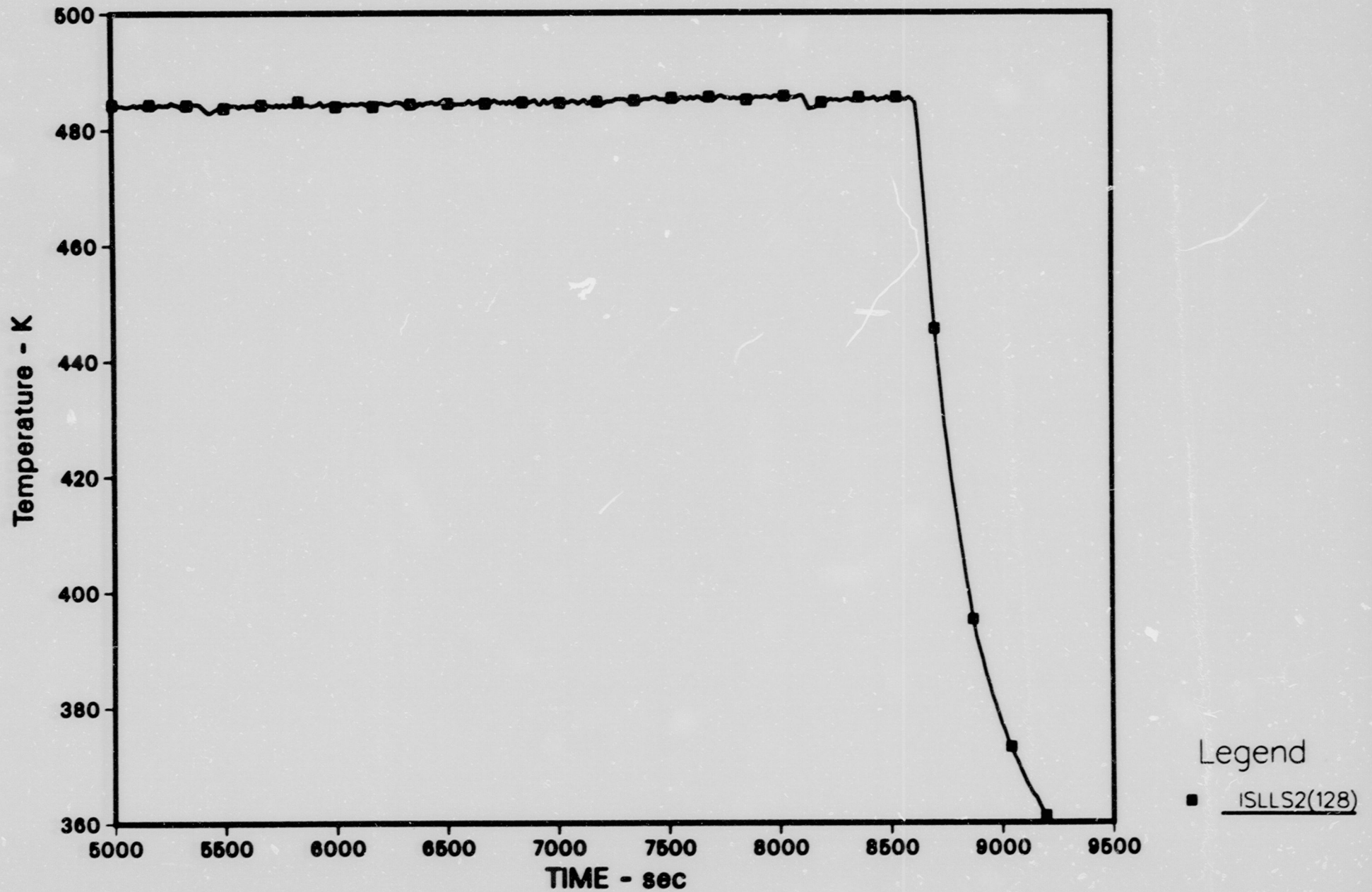
# DF-4 Inside Inlet Steam Line, Top of Access Tube



# DF-4 Motor Valve Body

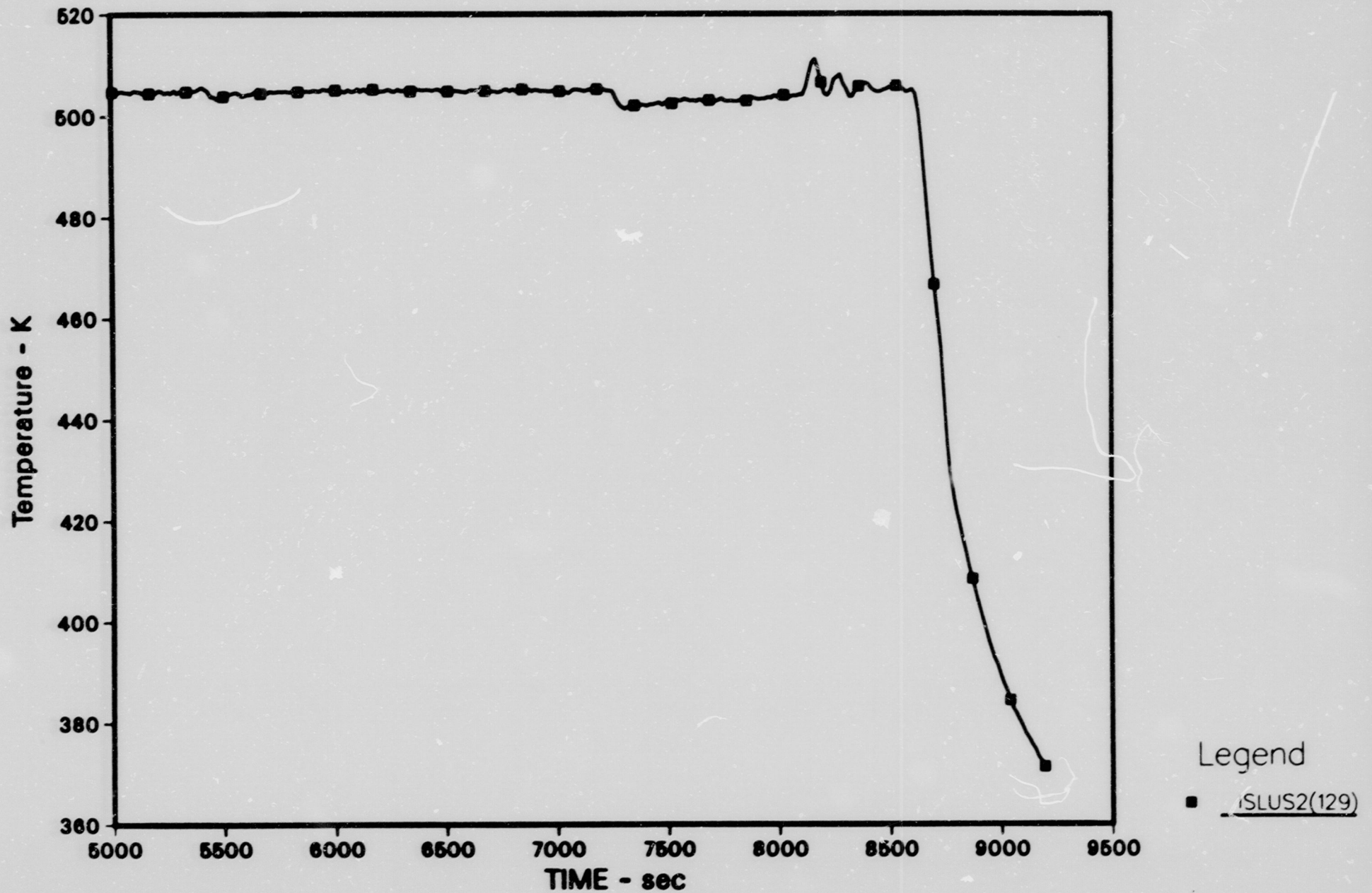


# DF-4 Inlet Steam Line Wall Lower Shield Plug

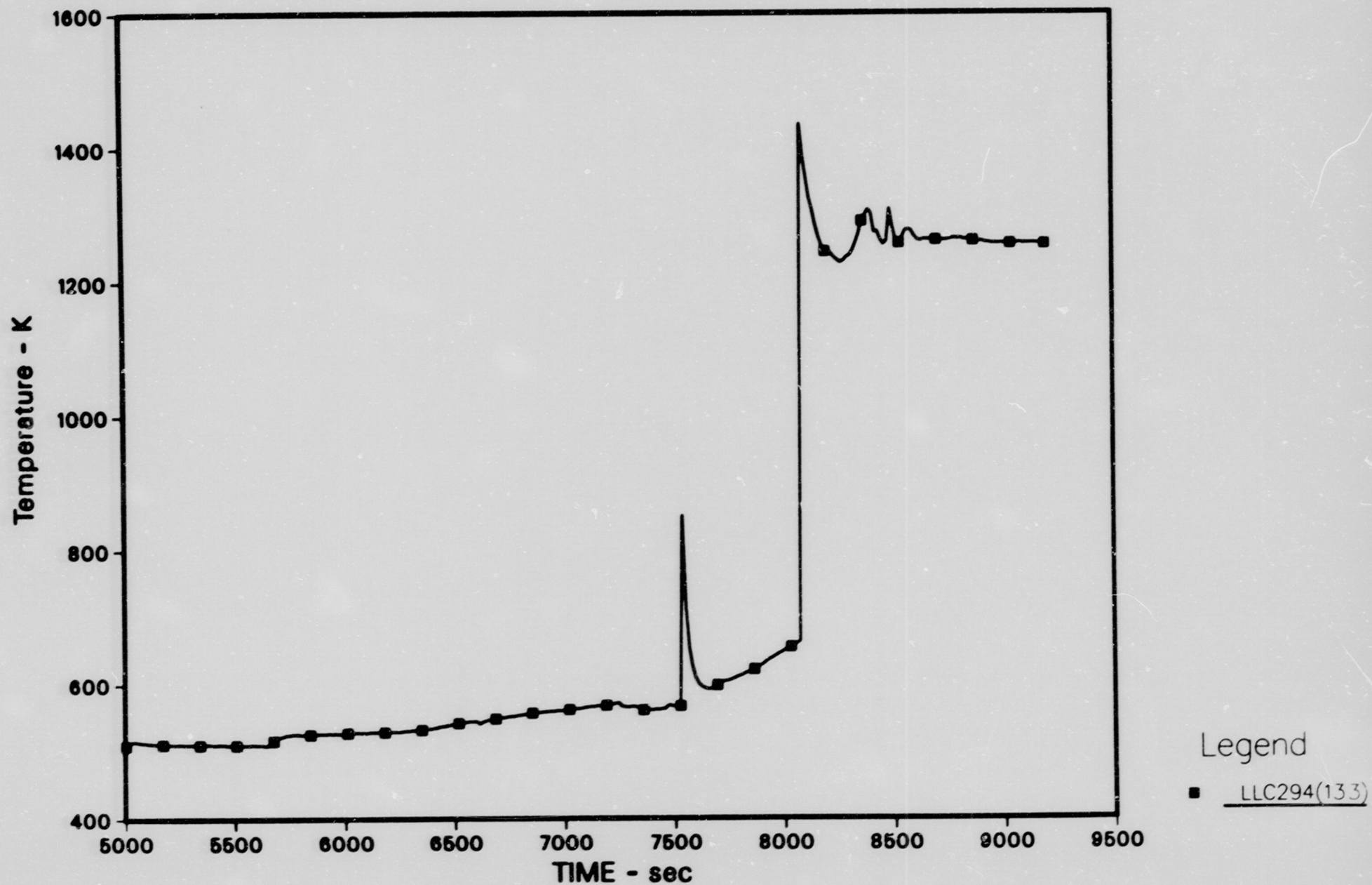




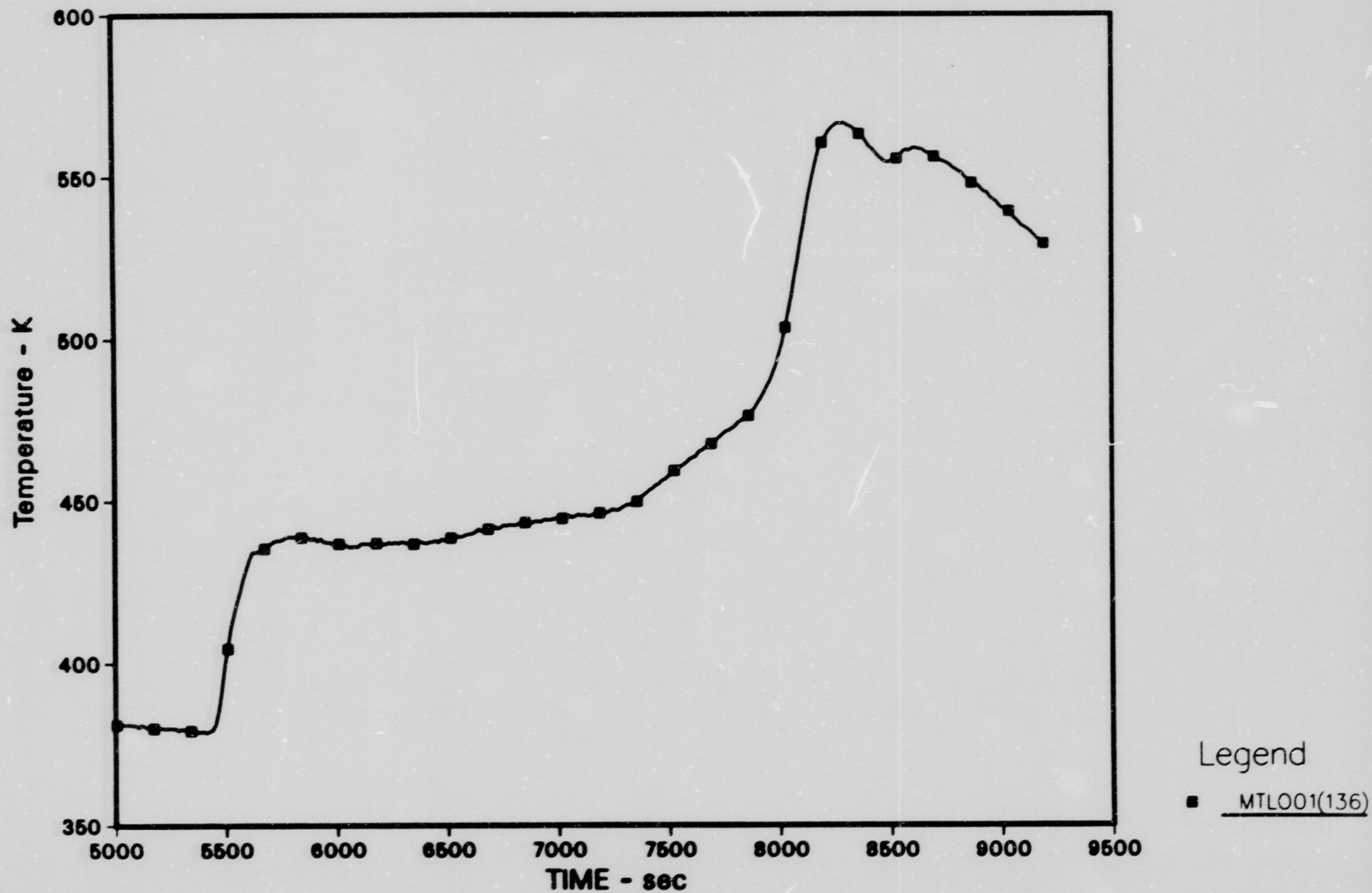
# DF-4 Inlet Steam Line Wall Upper Shield Plug



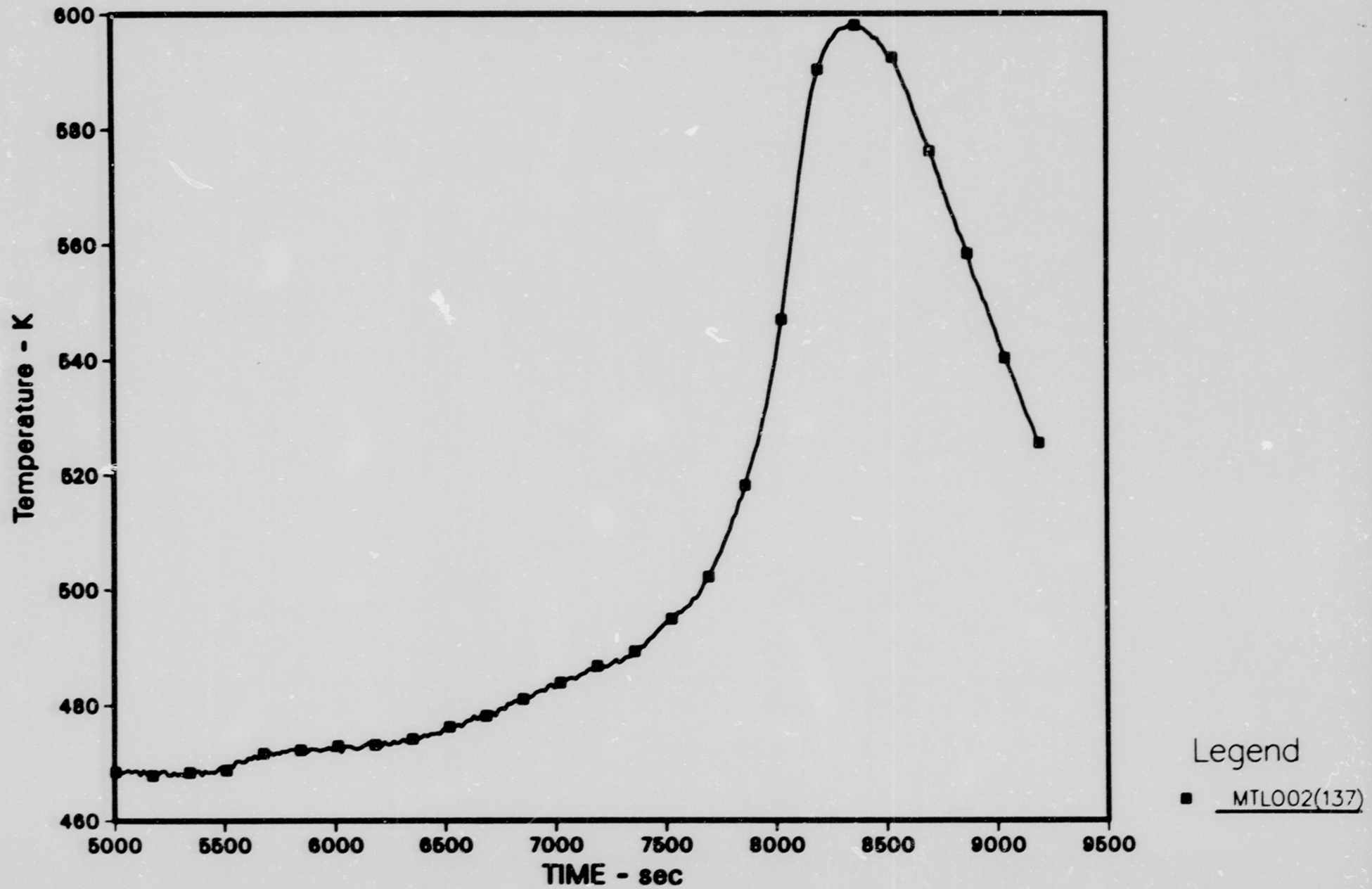
# DF-4 Inside Steam Cup, Below Steam Cup Manifold 29.4In Below Fuel Support Grid



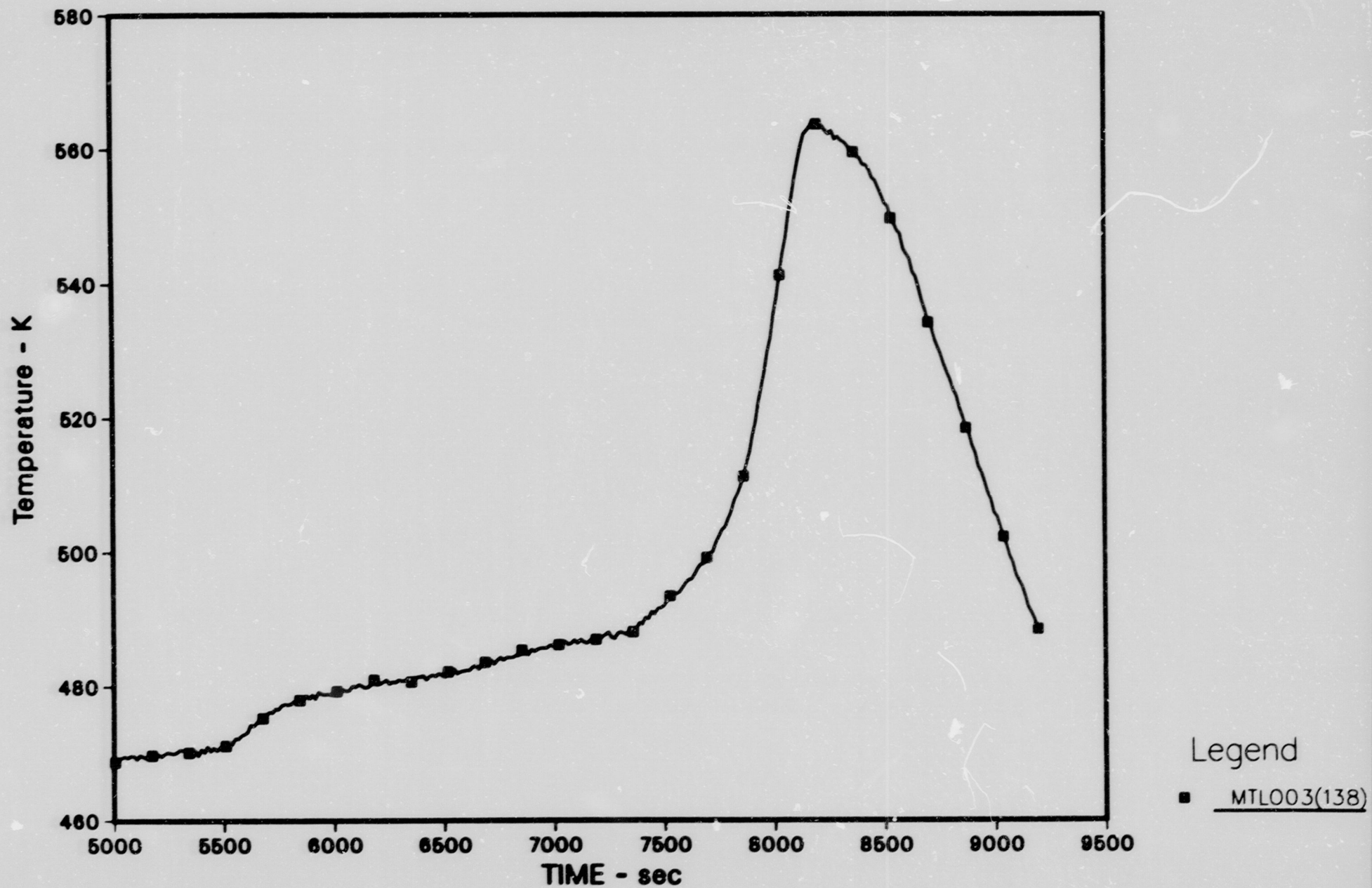
# DF-4 Mixing Tube Lower Outer Wall Near Bulkhead



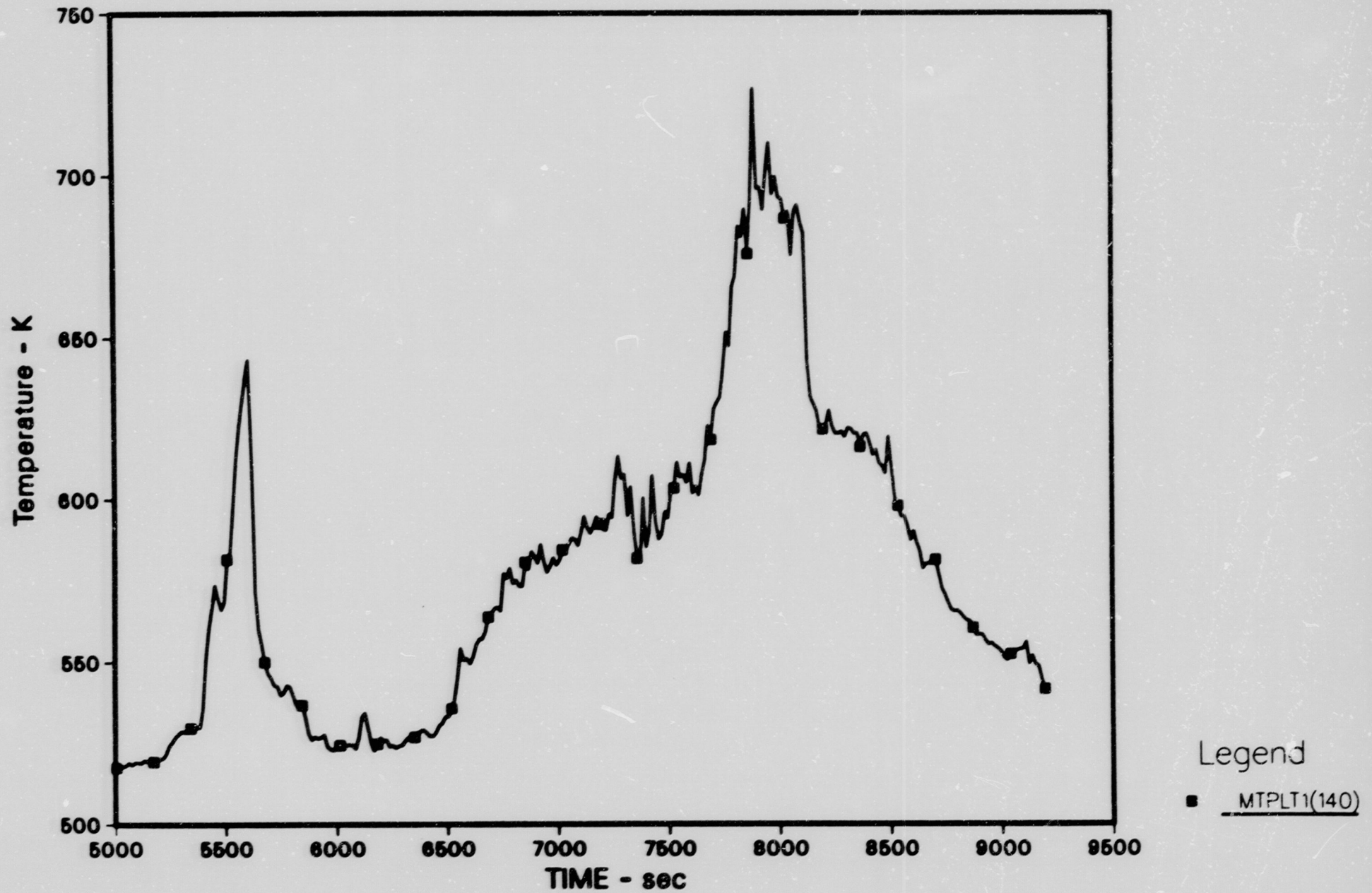
# DF-4 Mixing Tube Lower Outer Wall 9in Above Bulkhead



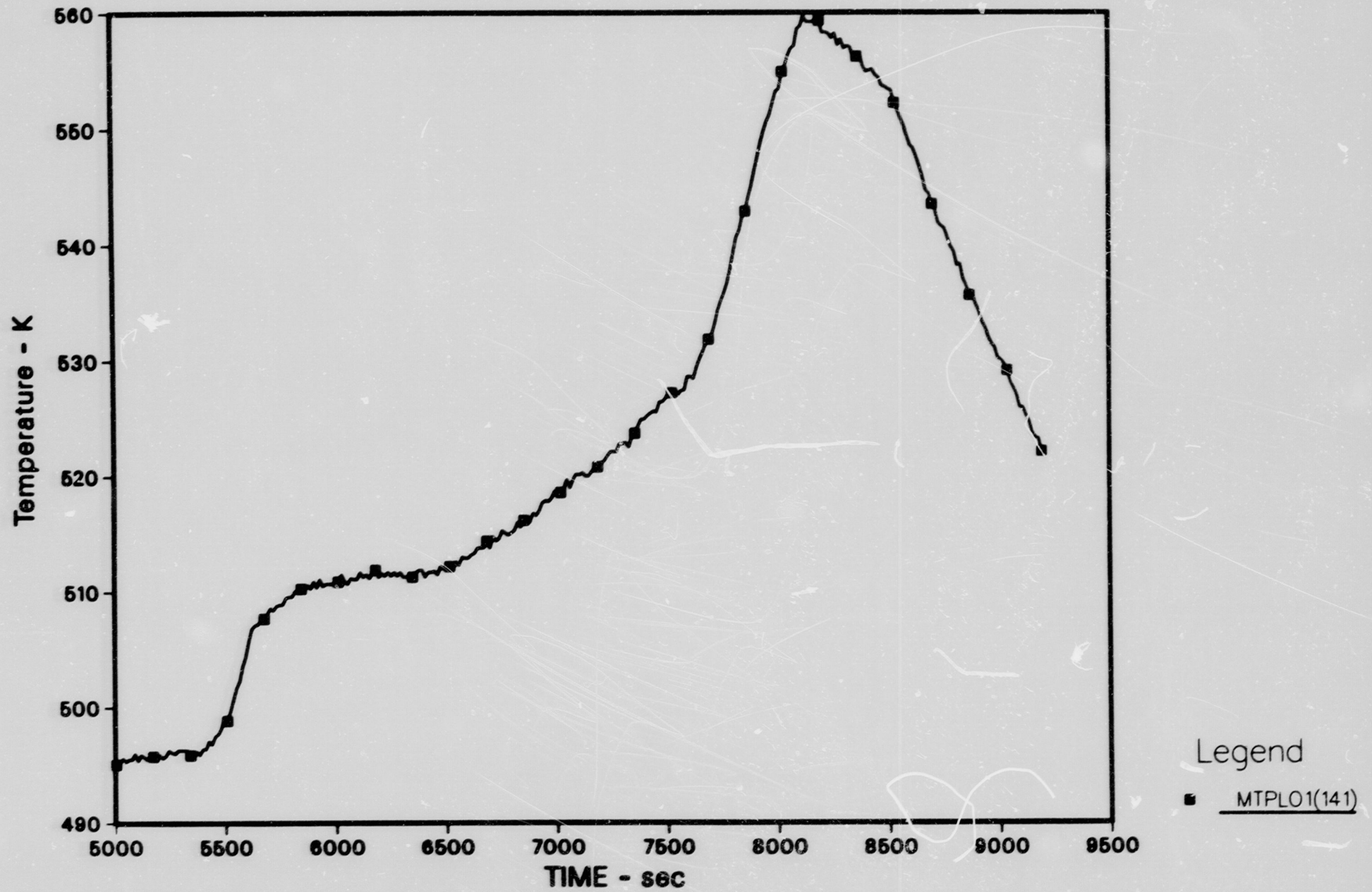
# DF-4 Mixing Tube Lower Outer Wall 6in Below Plenum



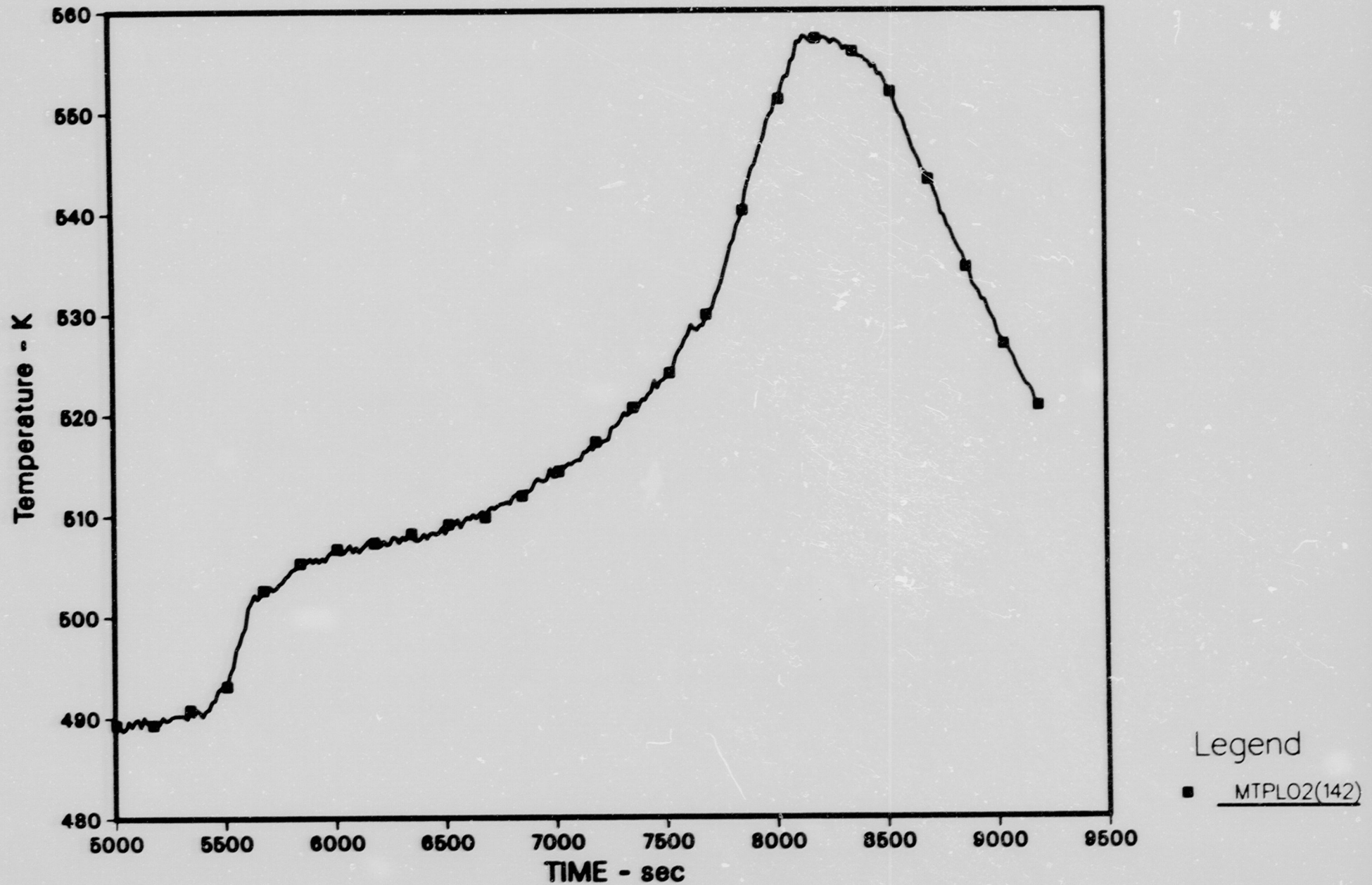
# DF-4 Inside Mixing Tube Plenum



# DF-4 Outside Mixing Tube Plenum

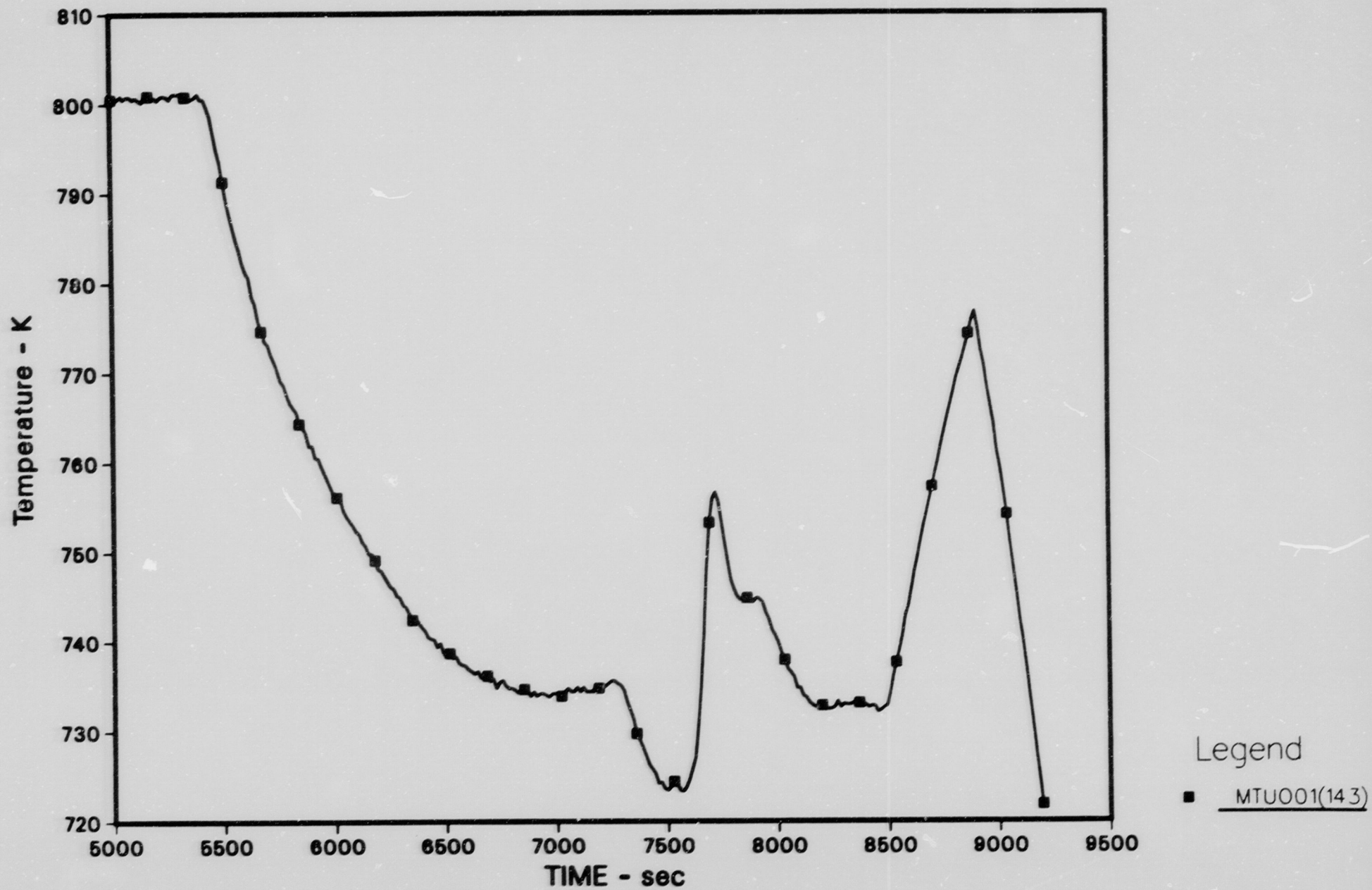


## DF-4 Outside Mixing Tube Plenum (2)

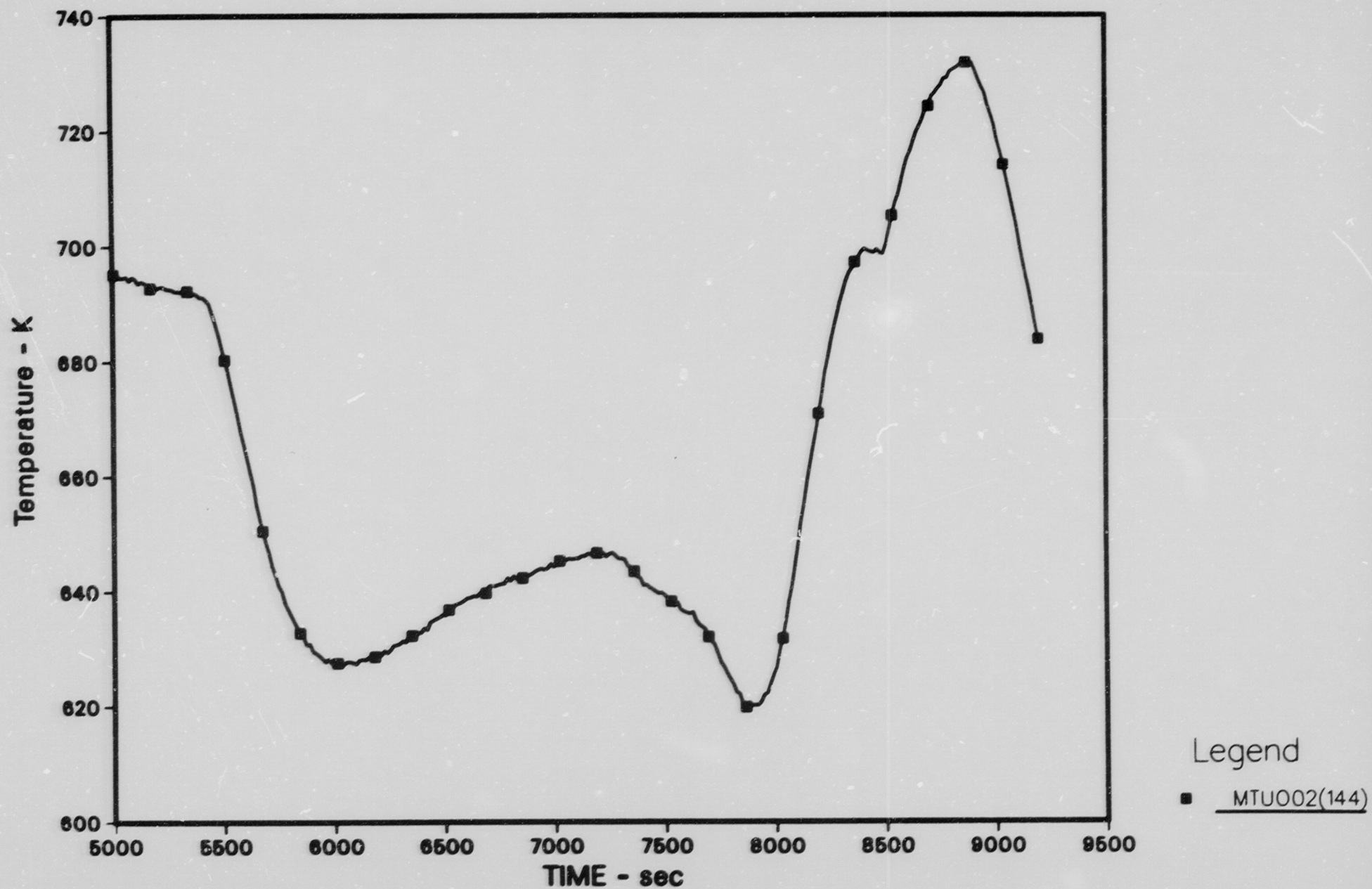




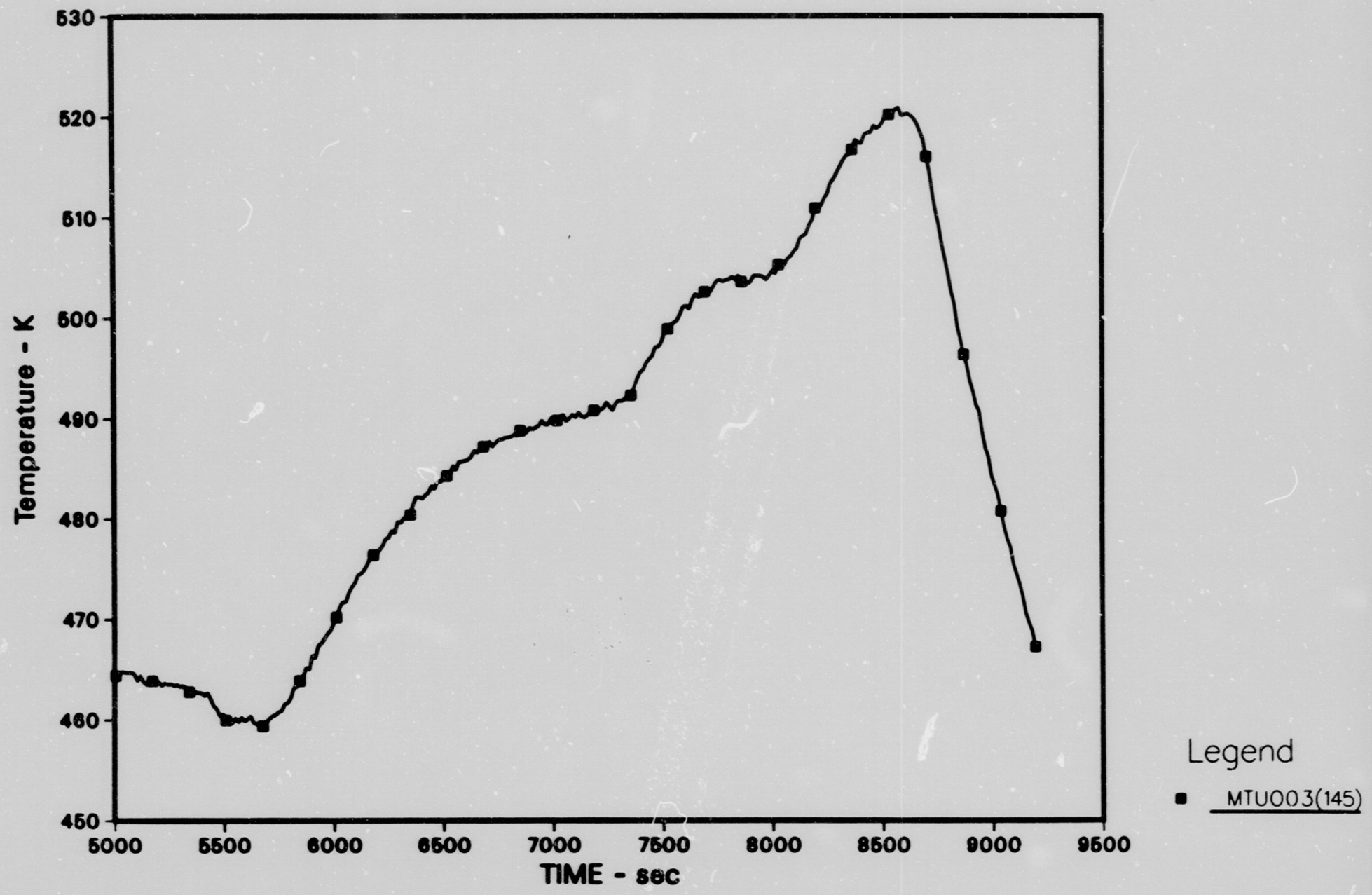
# DF-4 Outside Upper Mixing Tube 12in Above Plenum



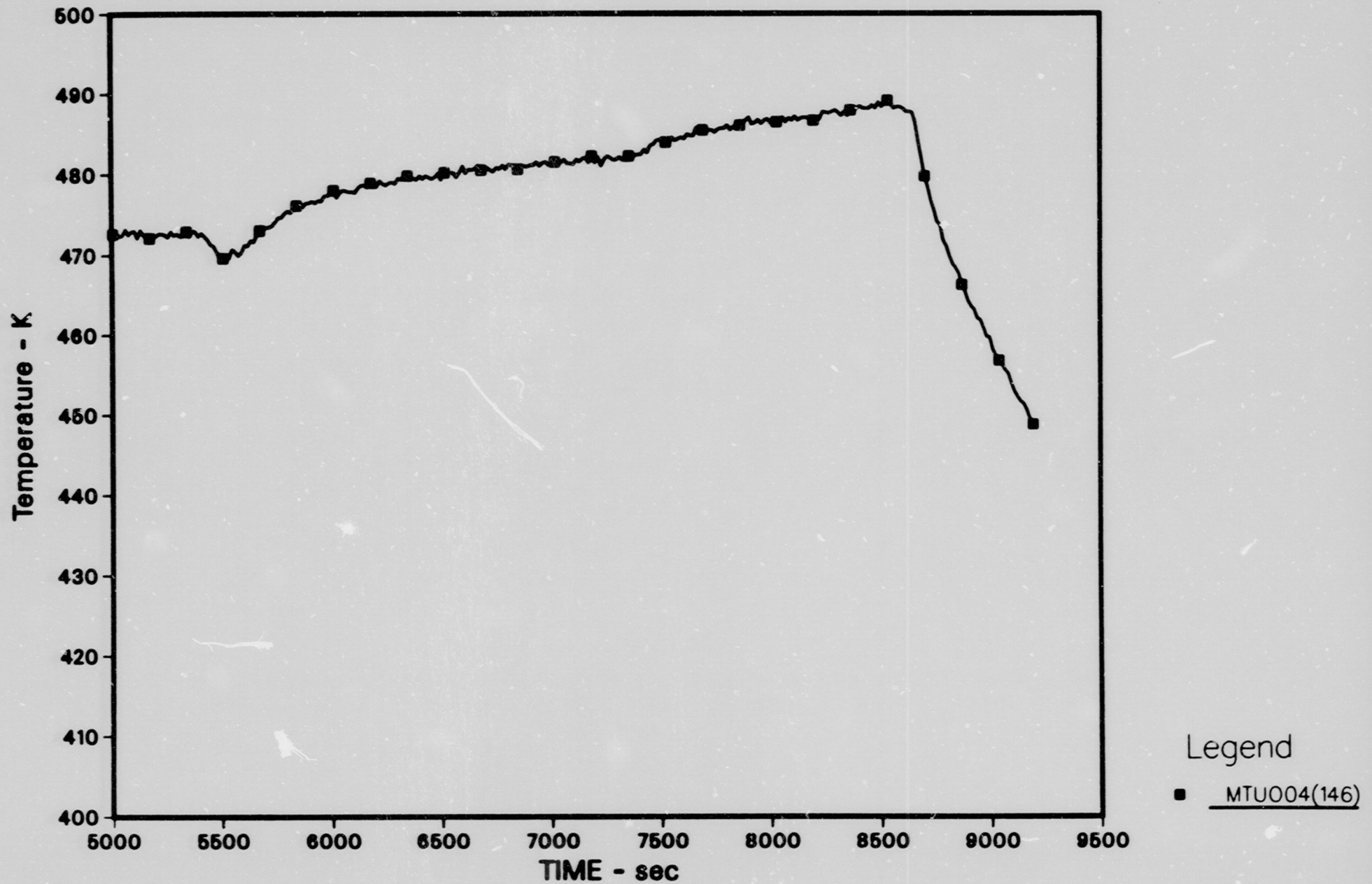
# DF-4 Outside Upper Mixing Tube 24in Above Plenum



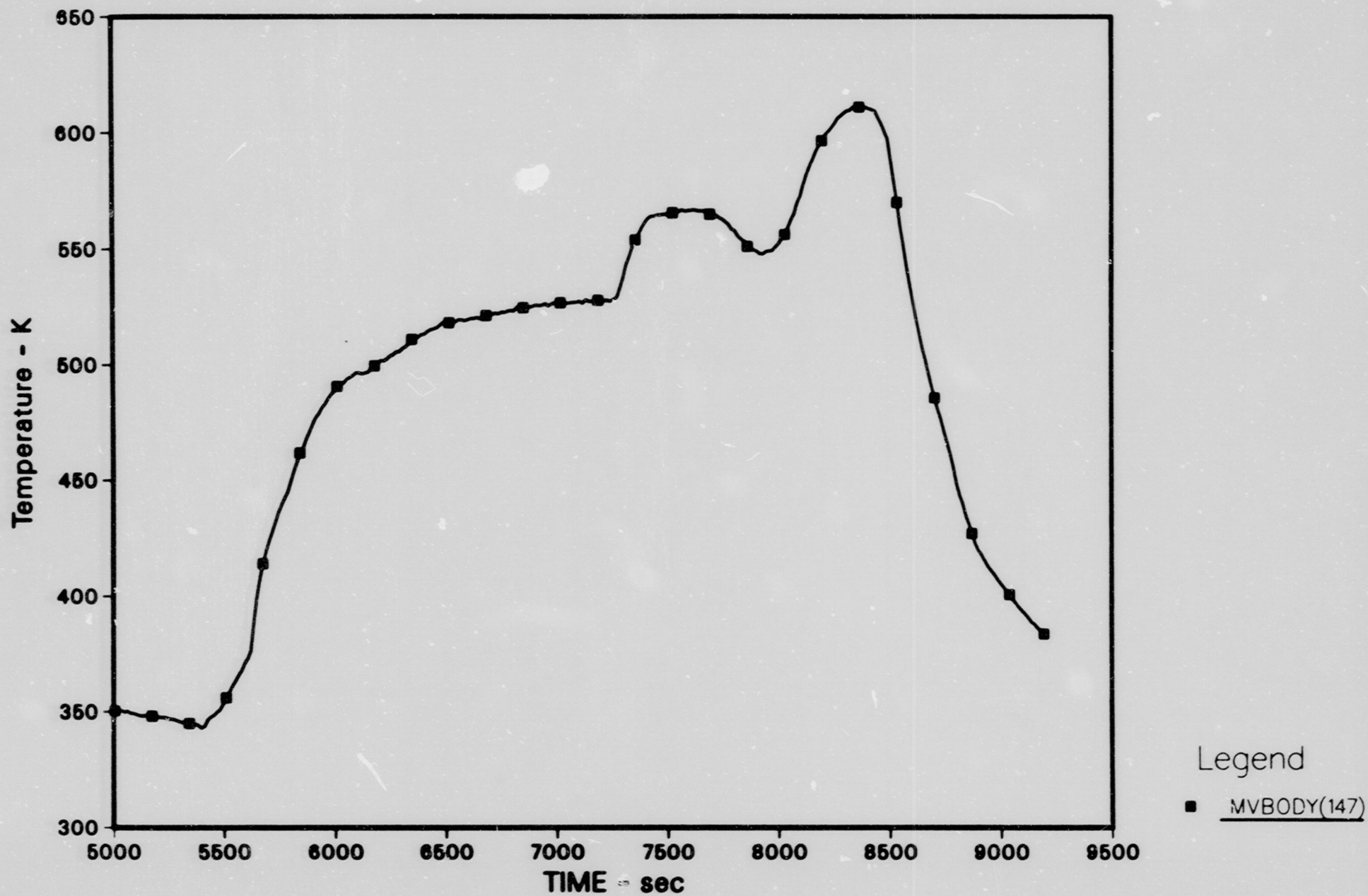
# DF-4 Outside Upper Mixing Tube 36in Above Plenum



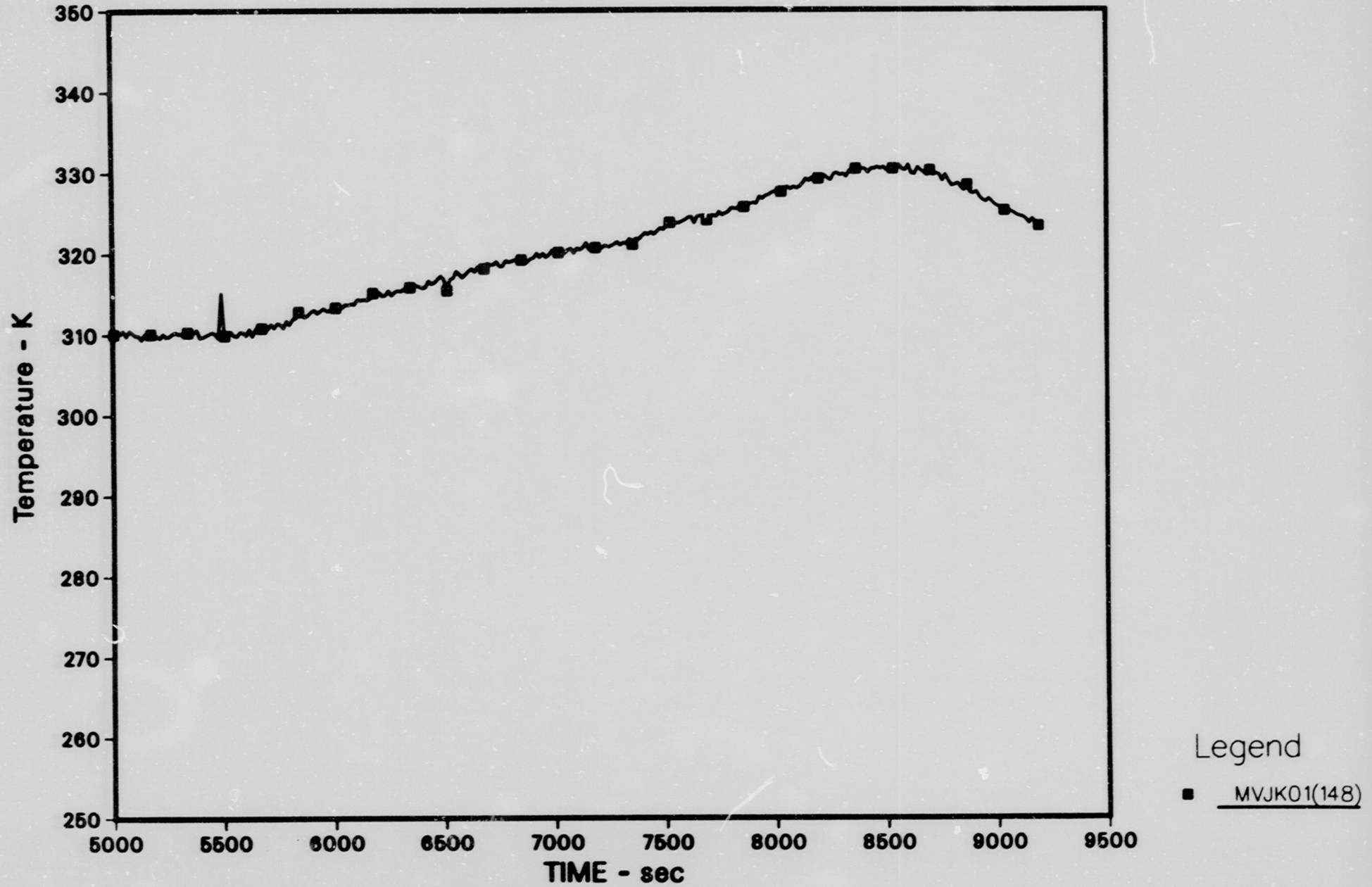
# DF-4 Outside Upper Mixing Tube 1in Above Condenser



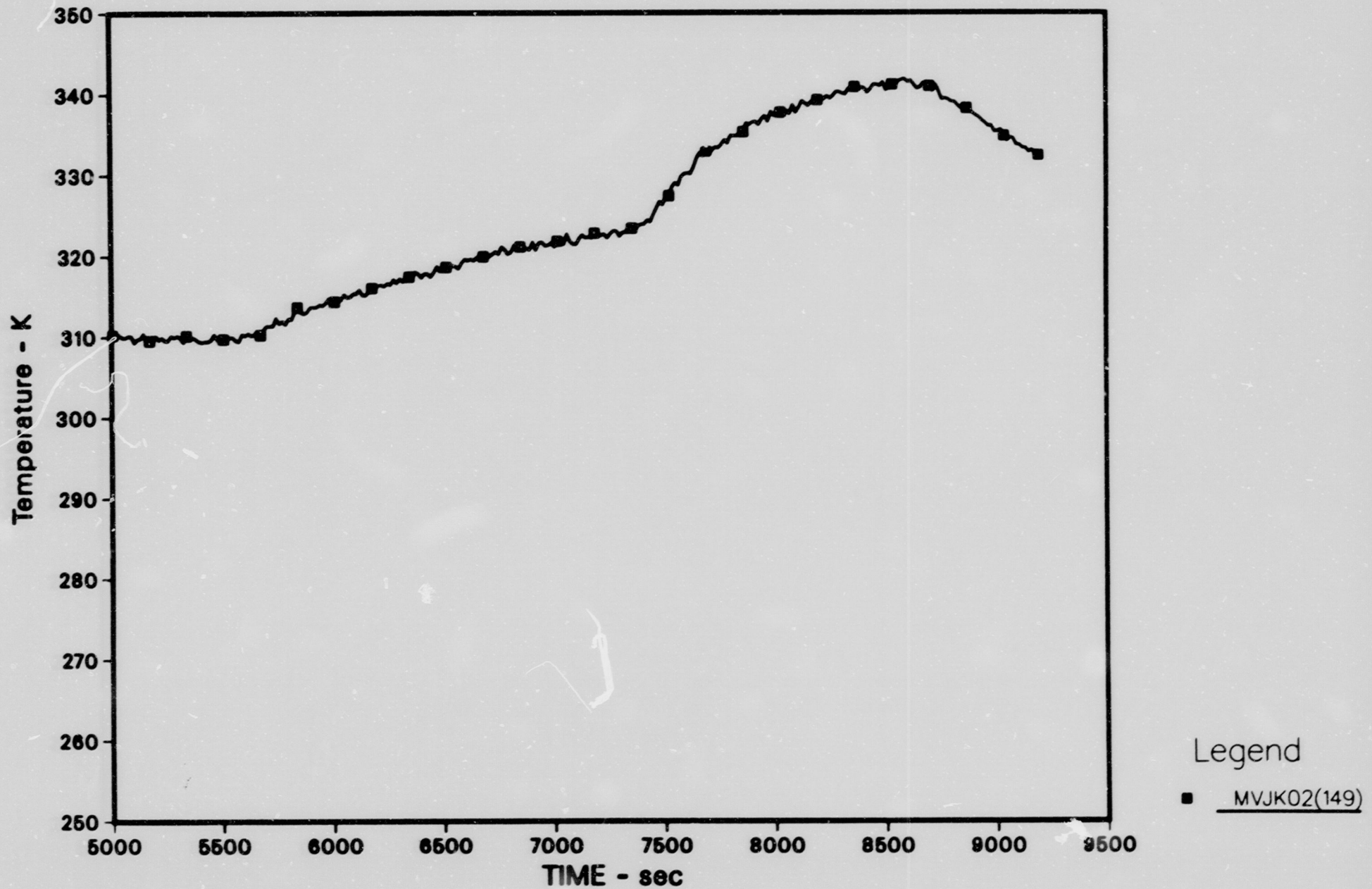
# DF-4 Motor Valve Body



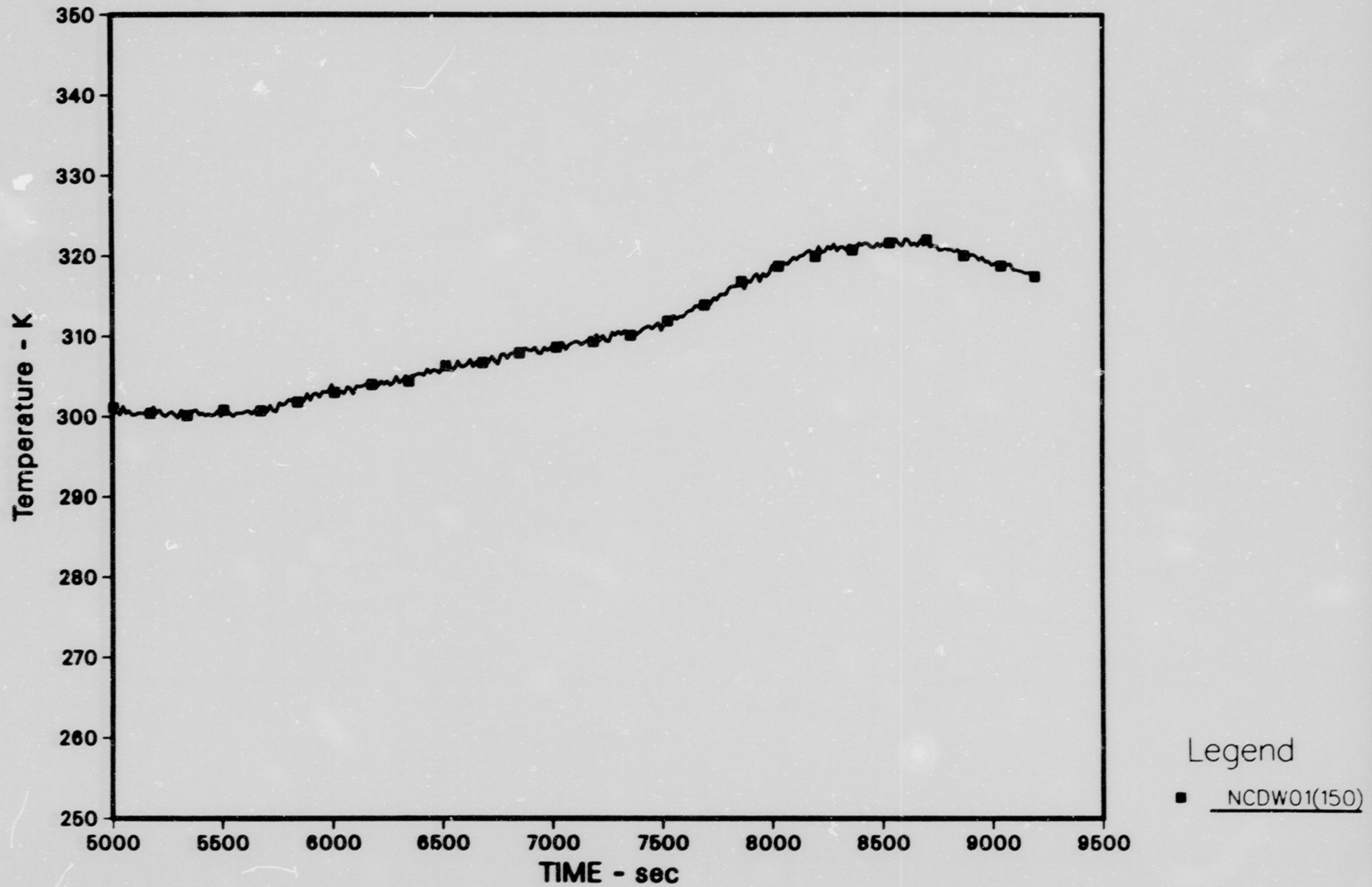
# DF-4 Motor Valve Jacket



# DF-4 Motor Valve Jacket(2)

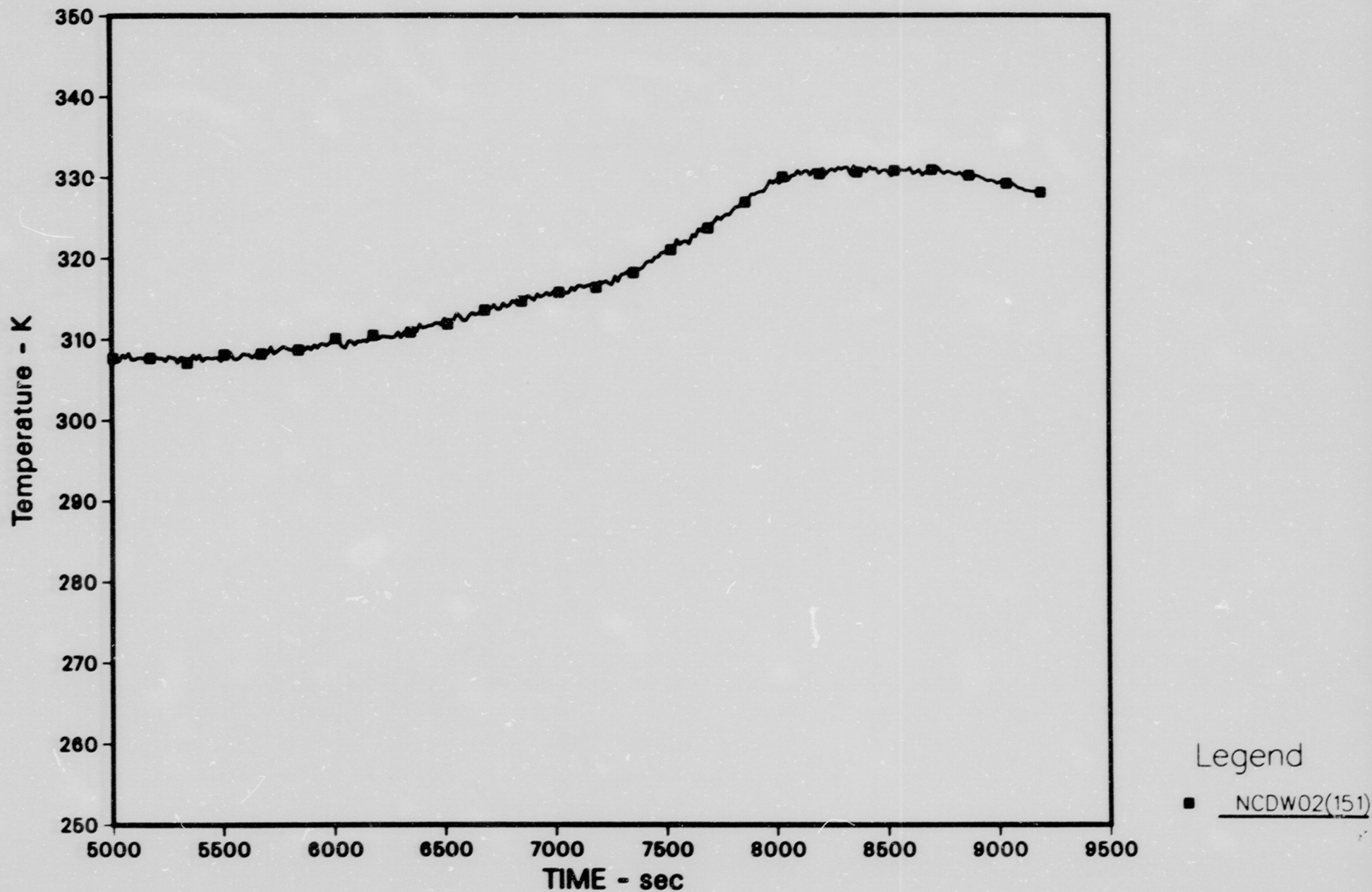


# DF-4 Non-Condensable Dome Outer Wall

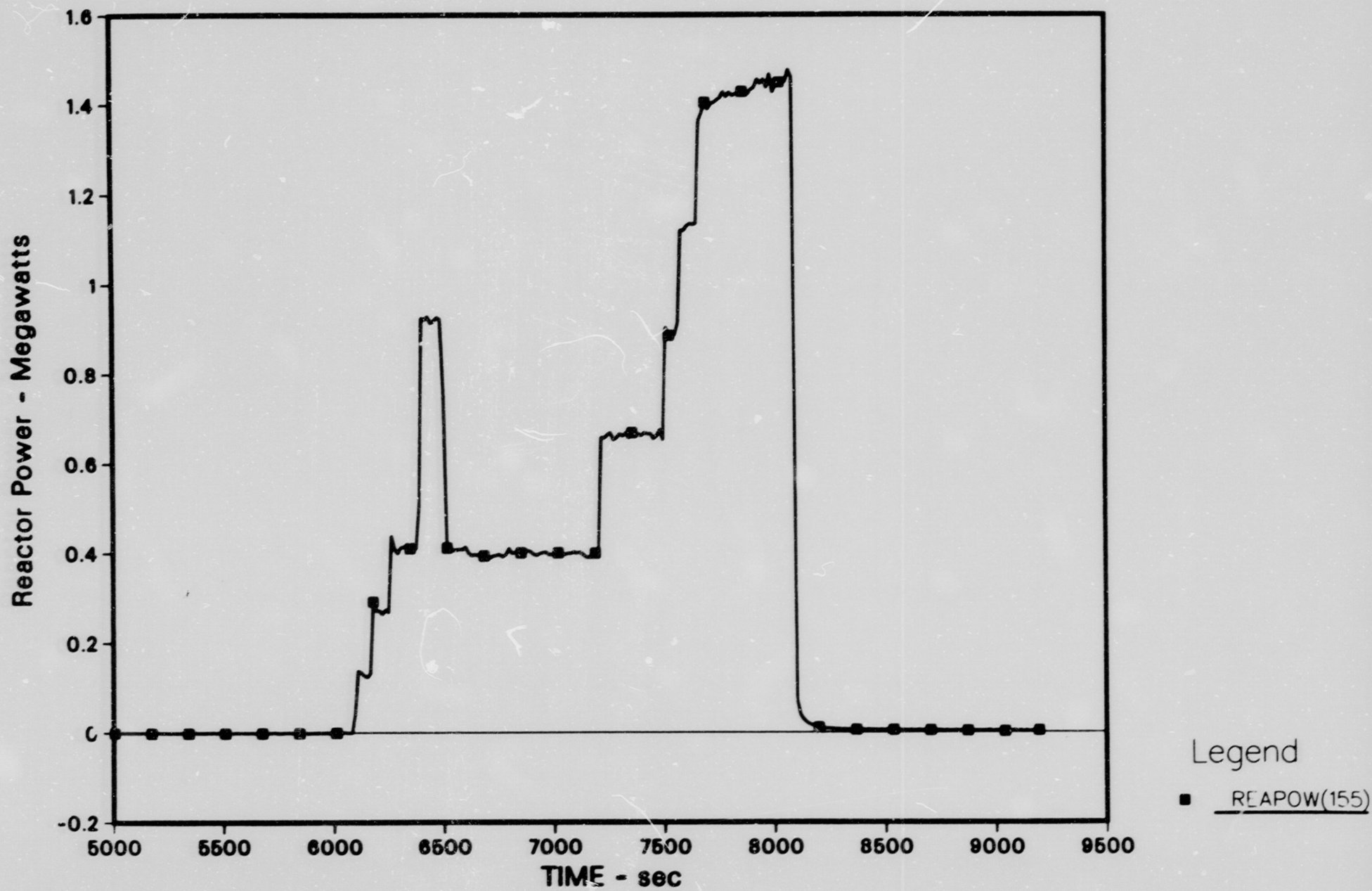




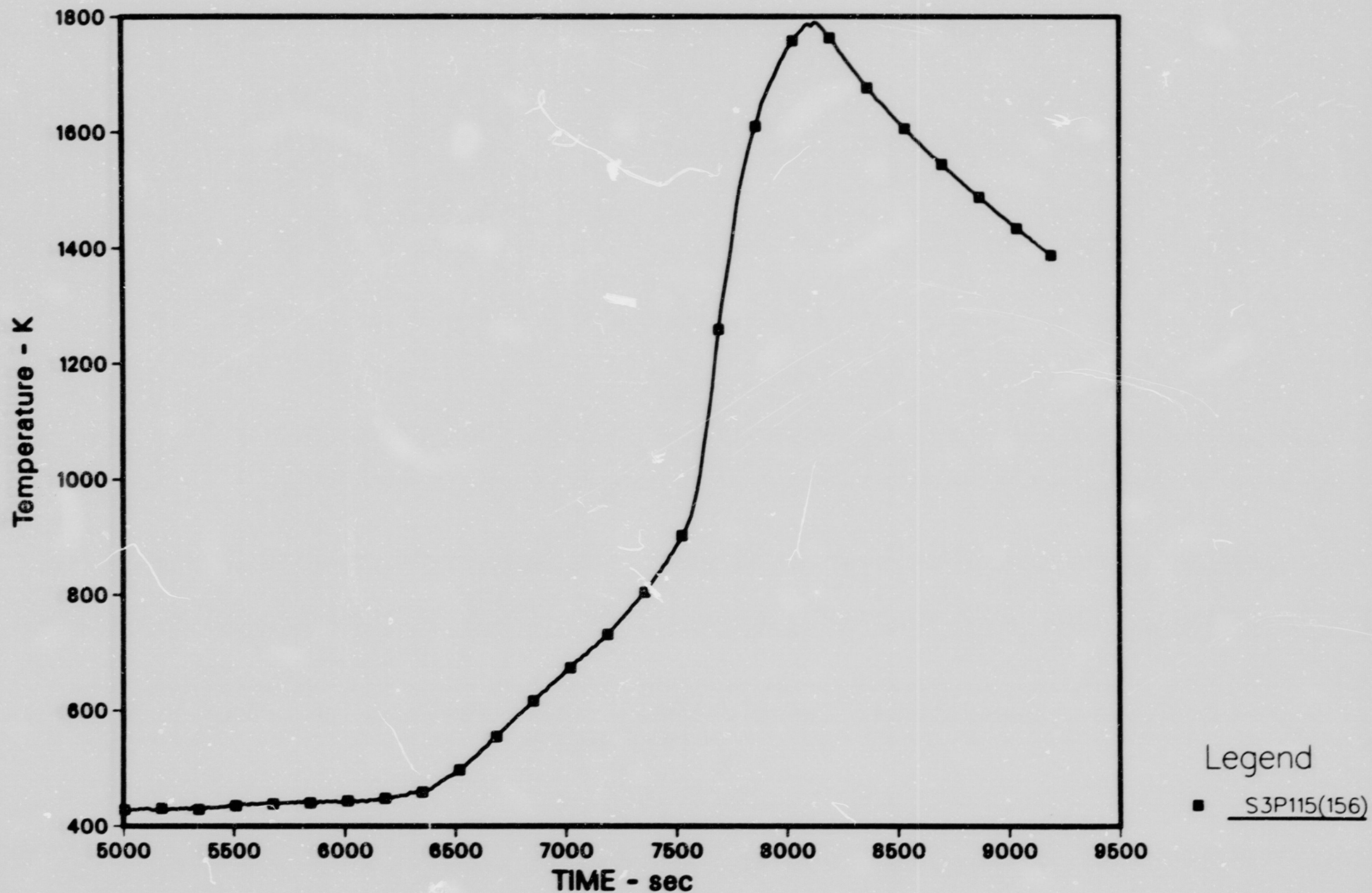
# DF-4 Non-Condensable Dome Outer Wall(2)



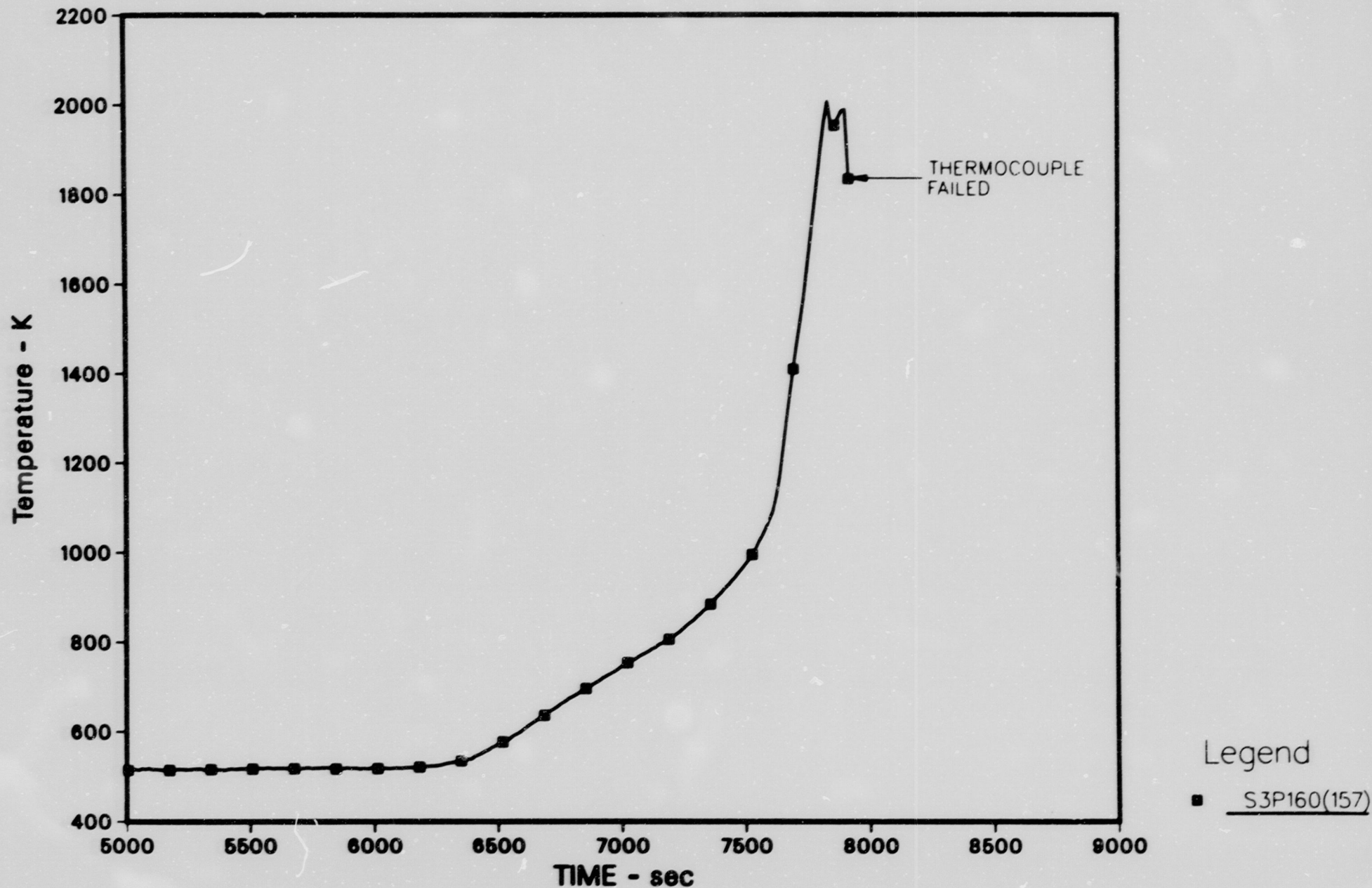
# DF-4 Reactor Power



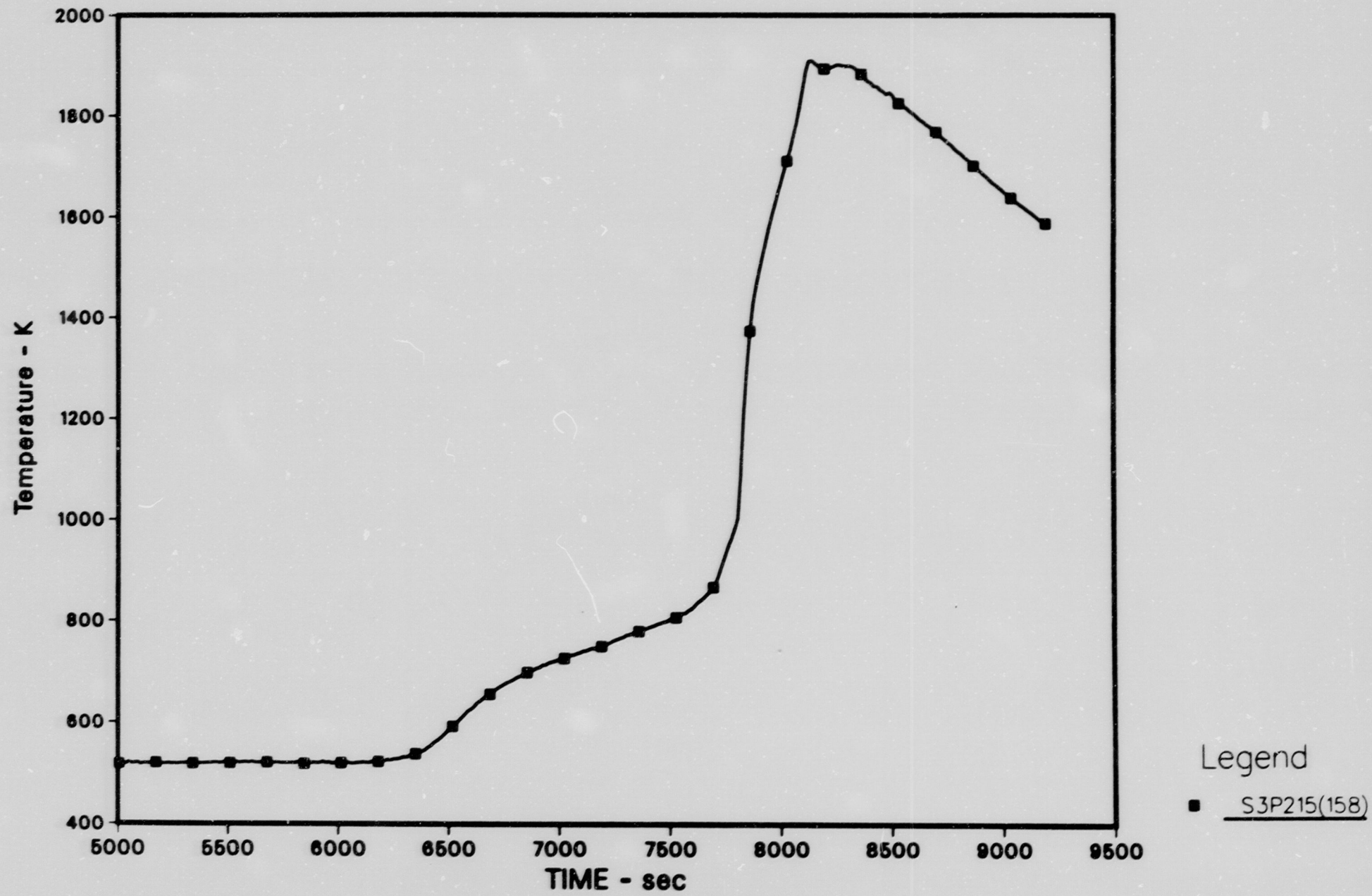
# DF-4 Shroud .3in Inside Wall 11.5in Below Fuel Support



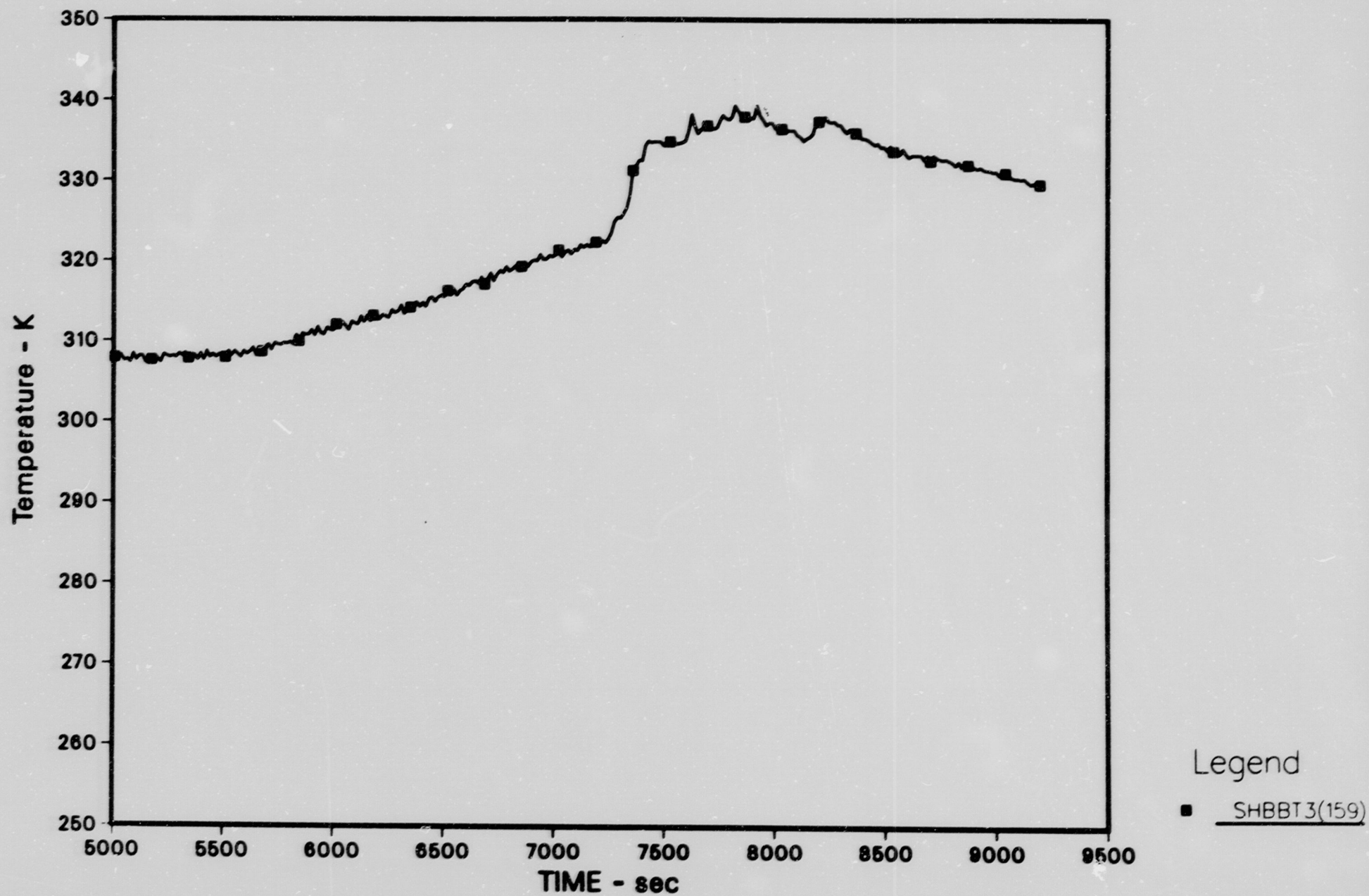
# DF-4 Shroud .3In Inside Wall 16.0In Below Fuel Support



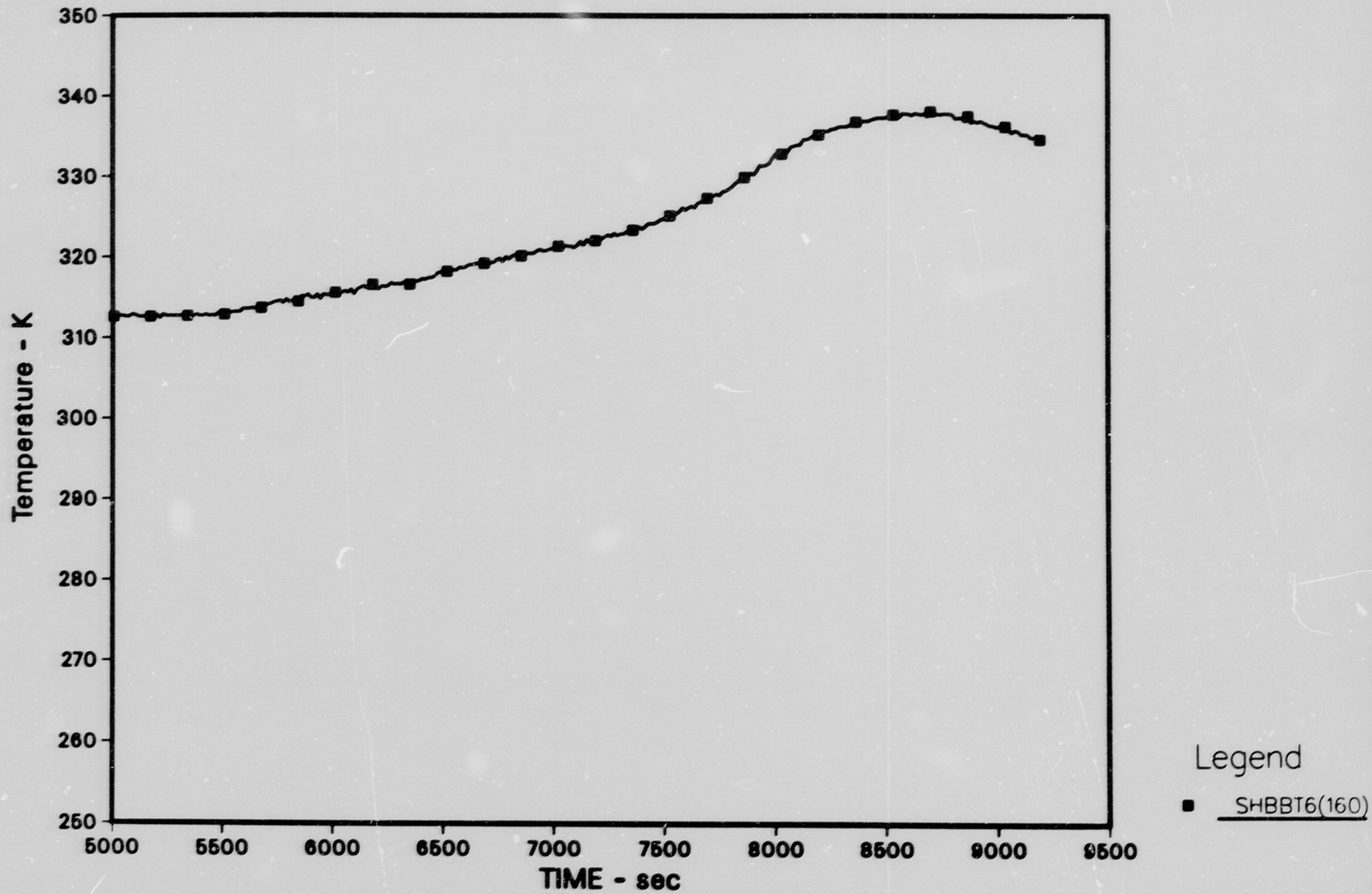
# DF-4 Shroud .3in Inside Wall 21.5in Below Fuel Support



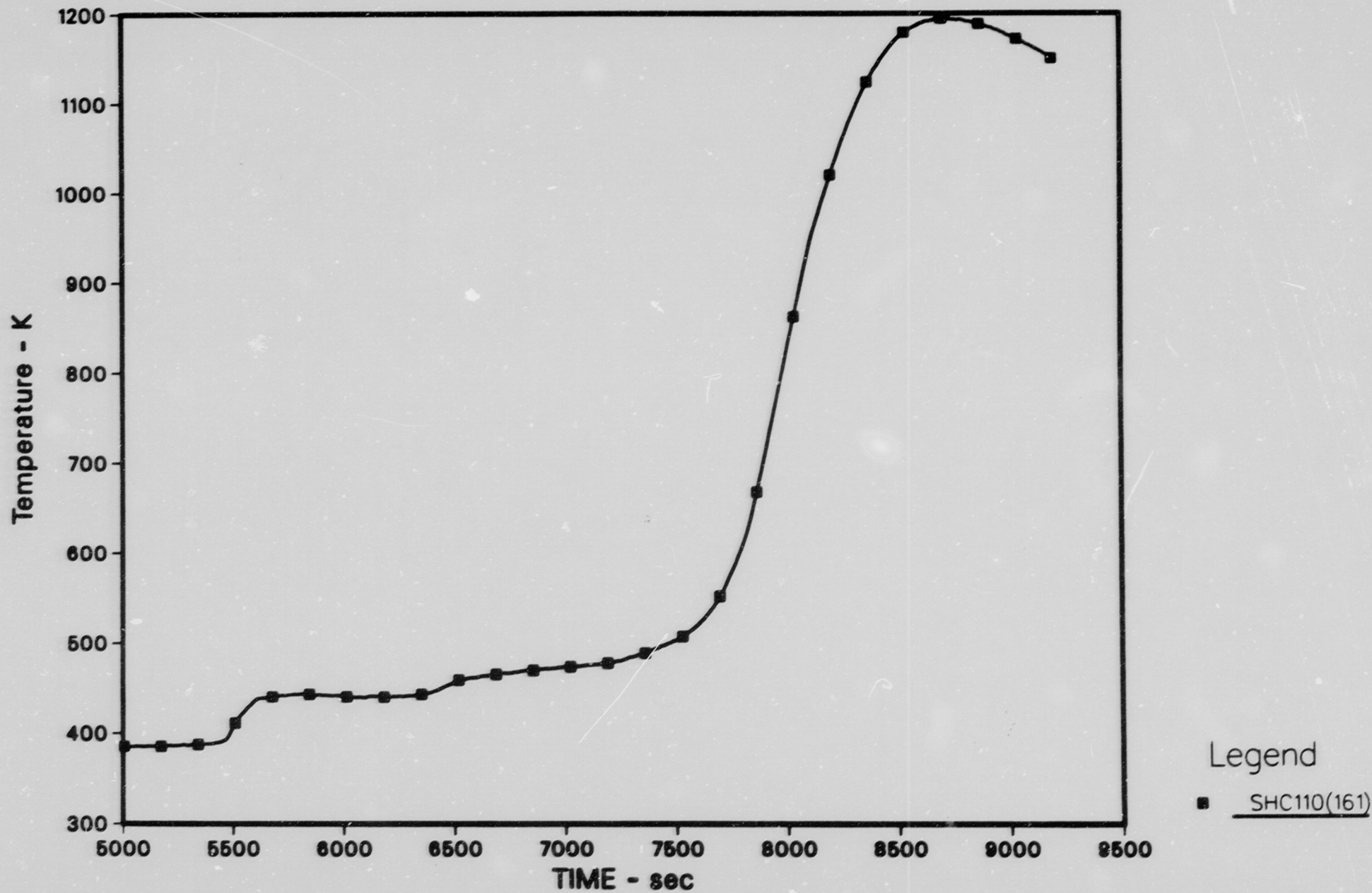
# DF-4 Inside Tube 3, 180 Deg Half of Dome



# DF-4 Inside Tube 6, 180 Deg Half of Dome

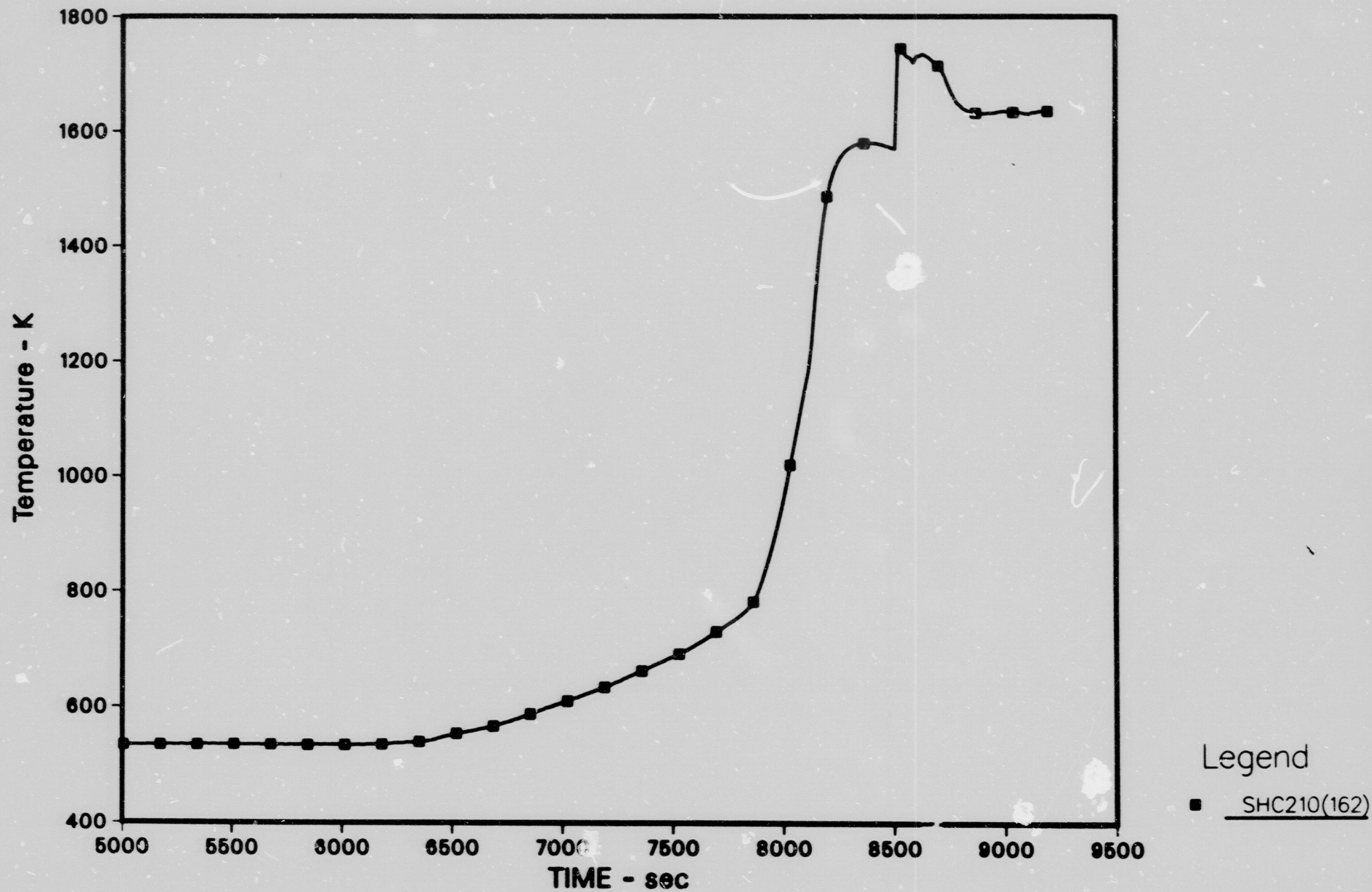


# DF-4 Shroud Heater 90 Deg, 11In Below Fuel Support

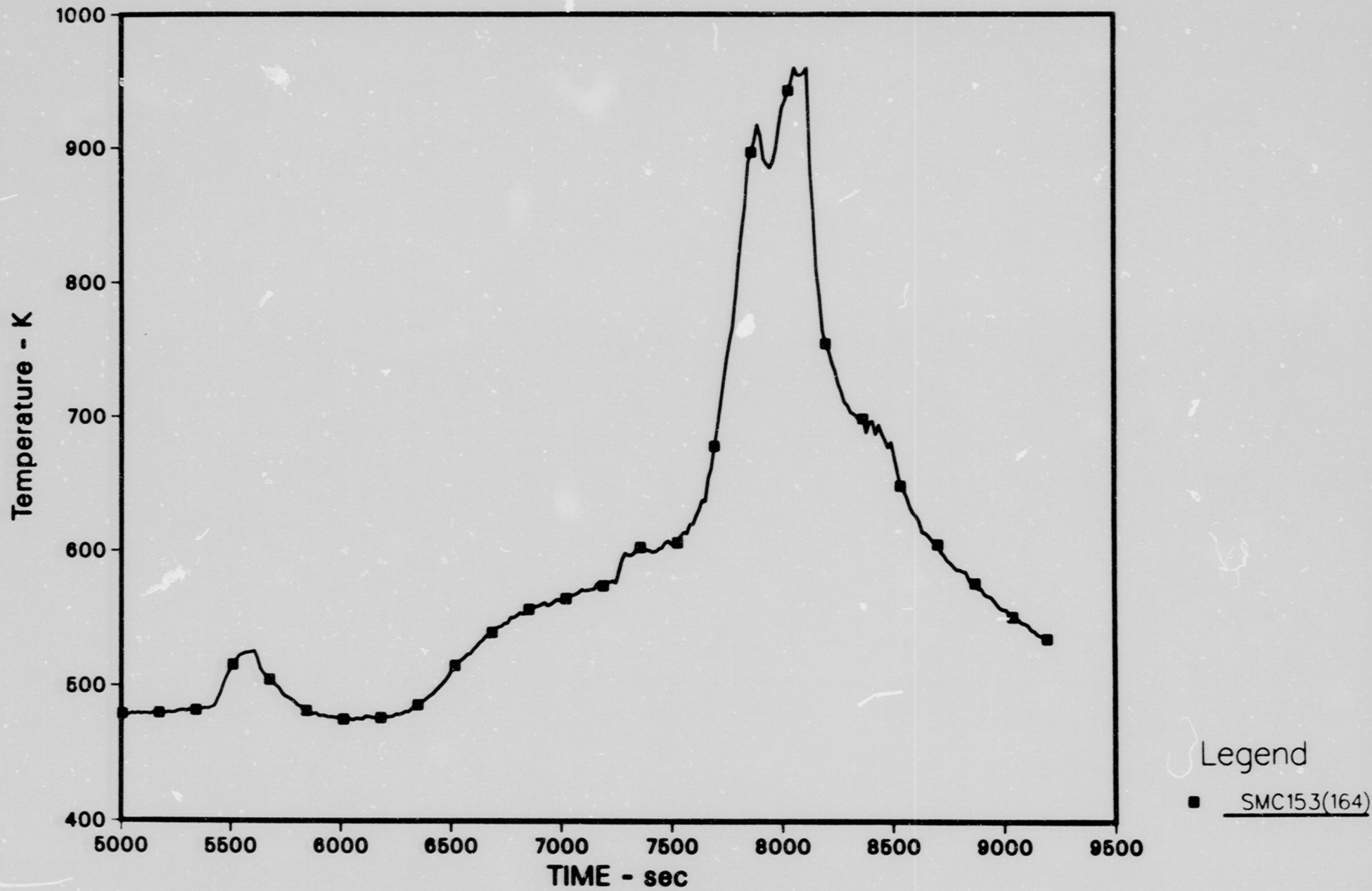




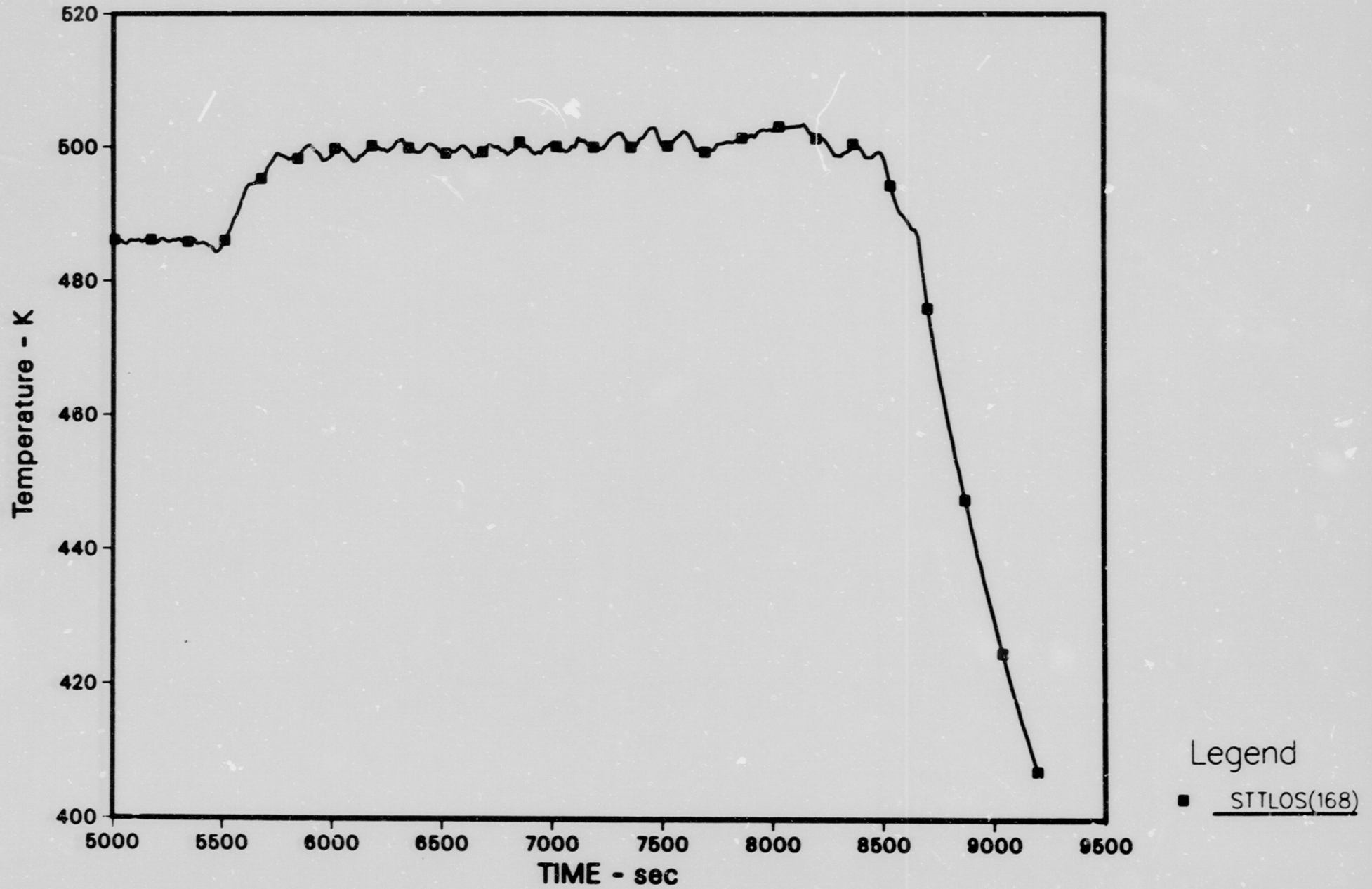
# DF-4 Shroud Heater 180 Deg, 21in Below Fuel Support



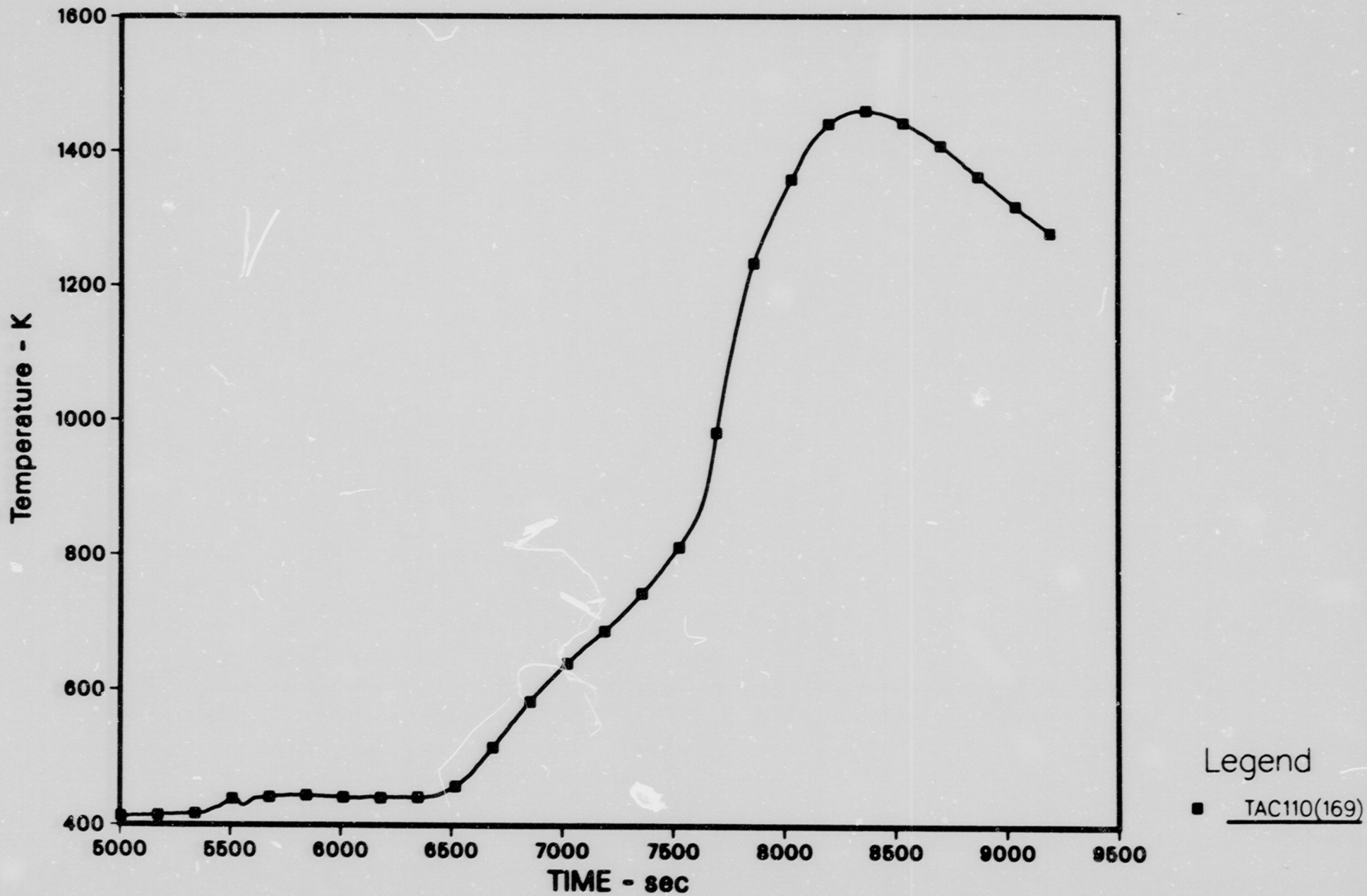
# DF-4 Flow Channel, Inside Mixing Tube 15.3in Above Fuel Support



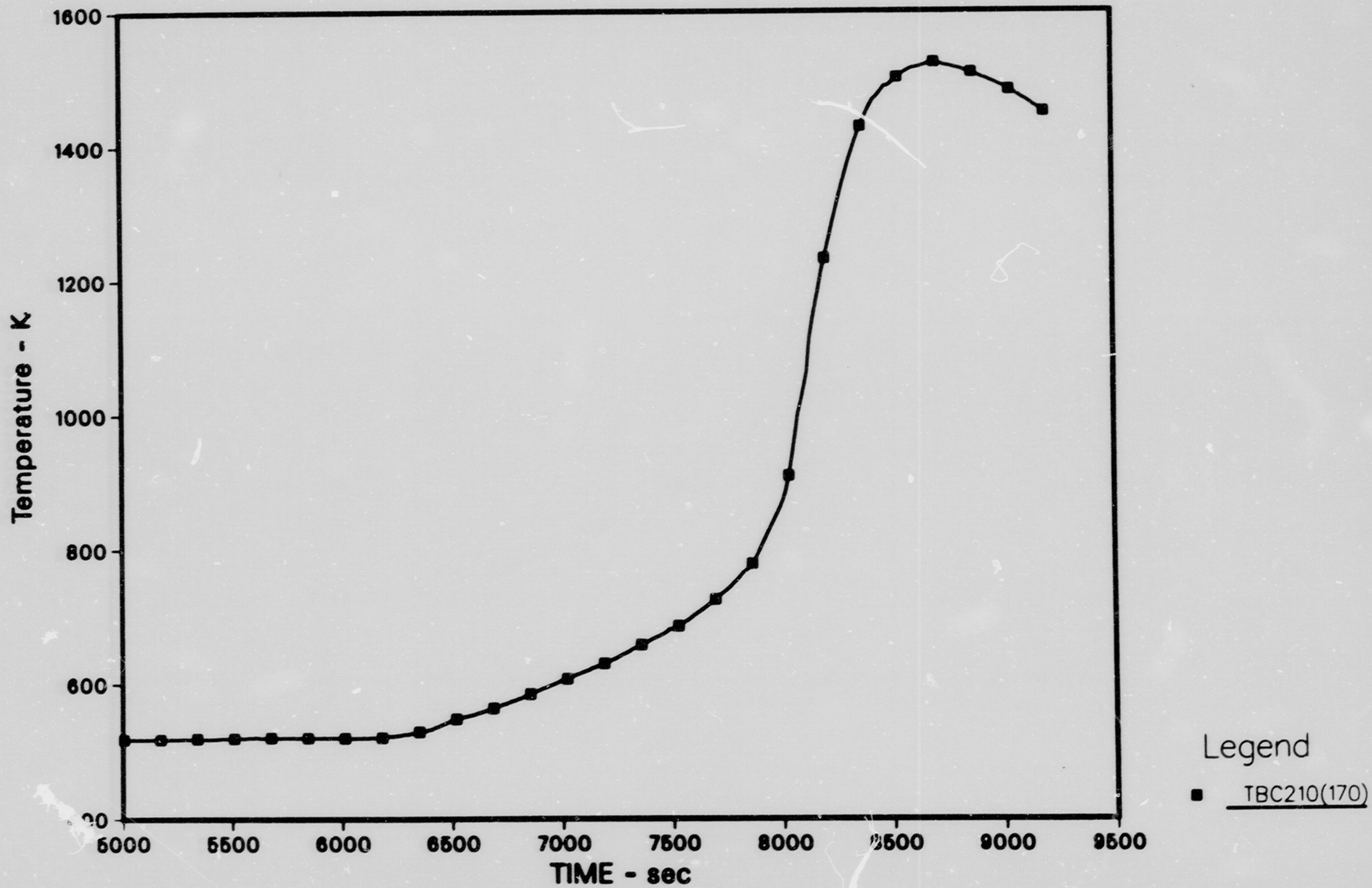
# DF-4 Steam Lines at Top of LOS Tube



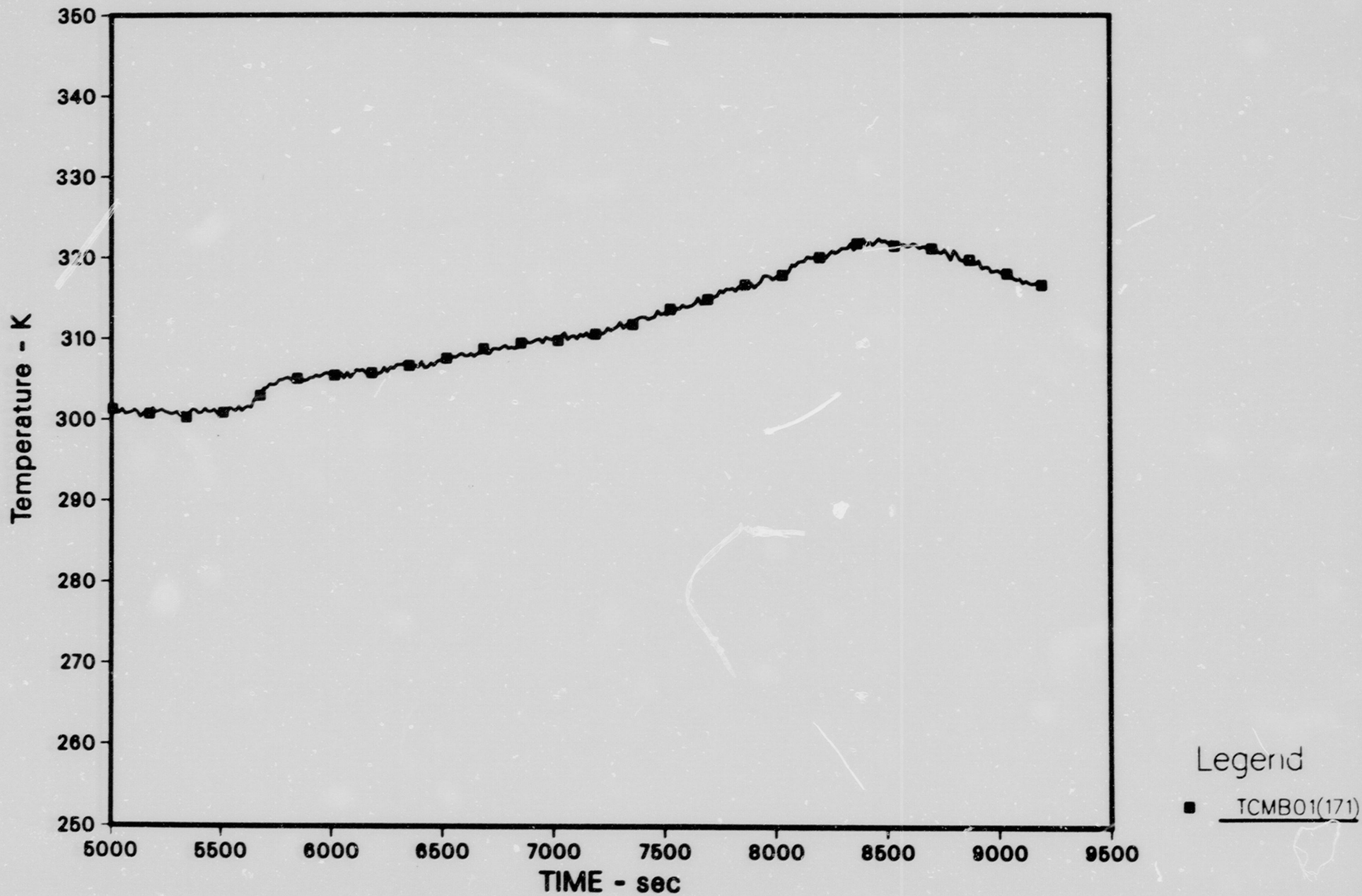
# DF-4 Near TLMA @ 0 Deg, 11in Below Fuel Support



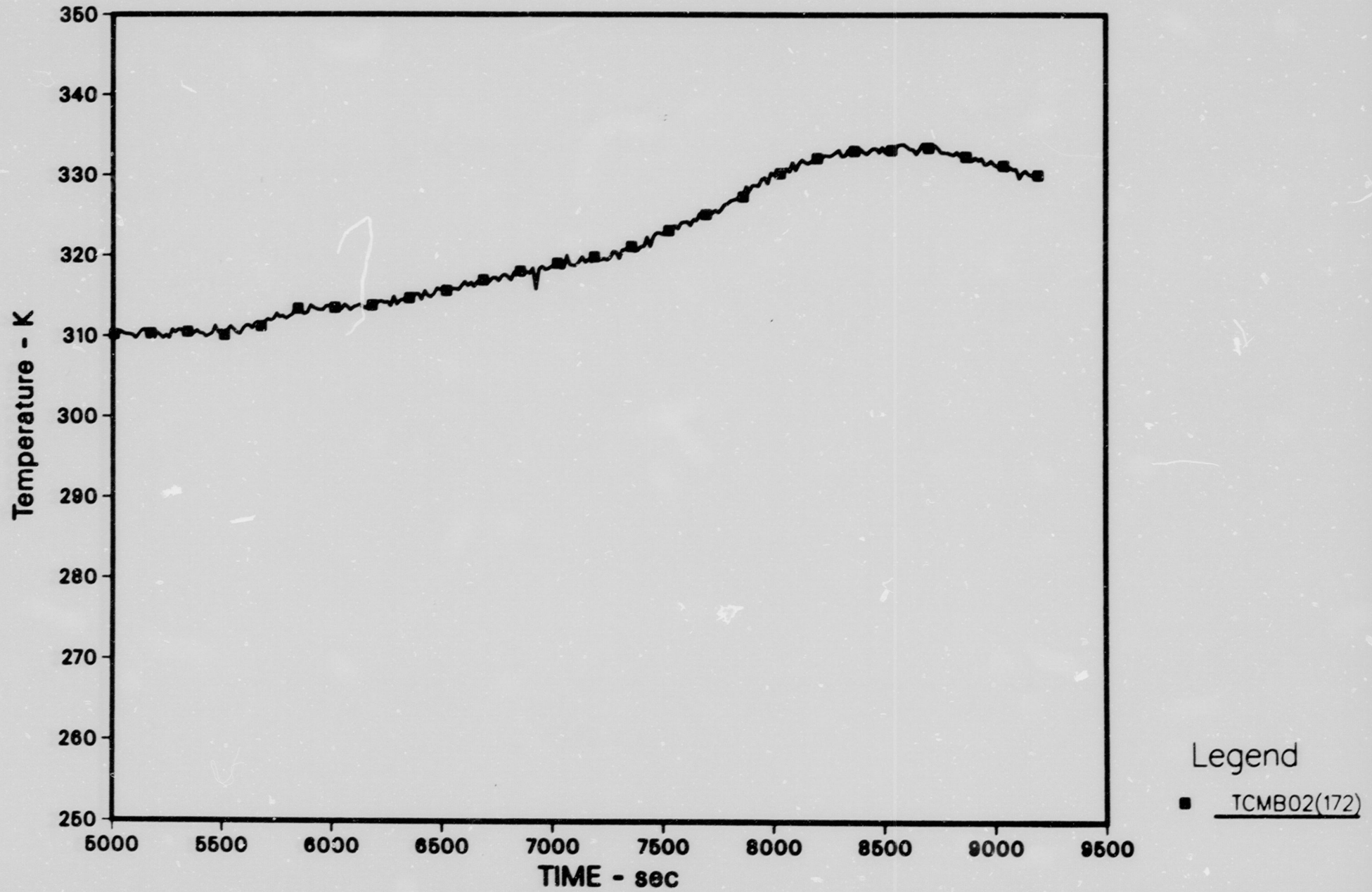
# DF-4 Near TLMB @ 90 Deg, 21in Below Fuel Support



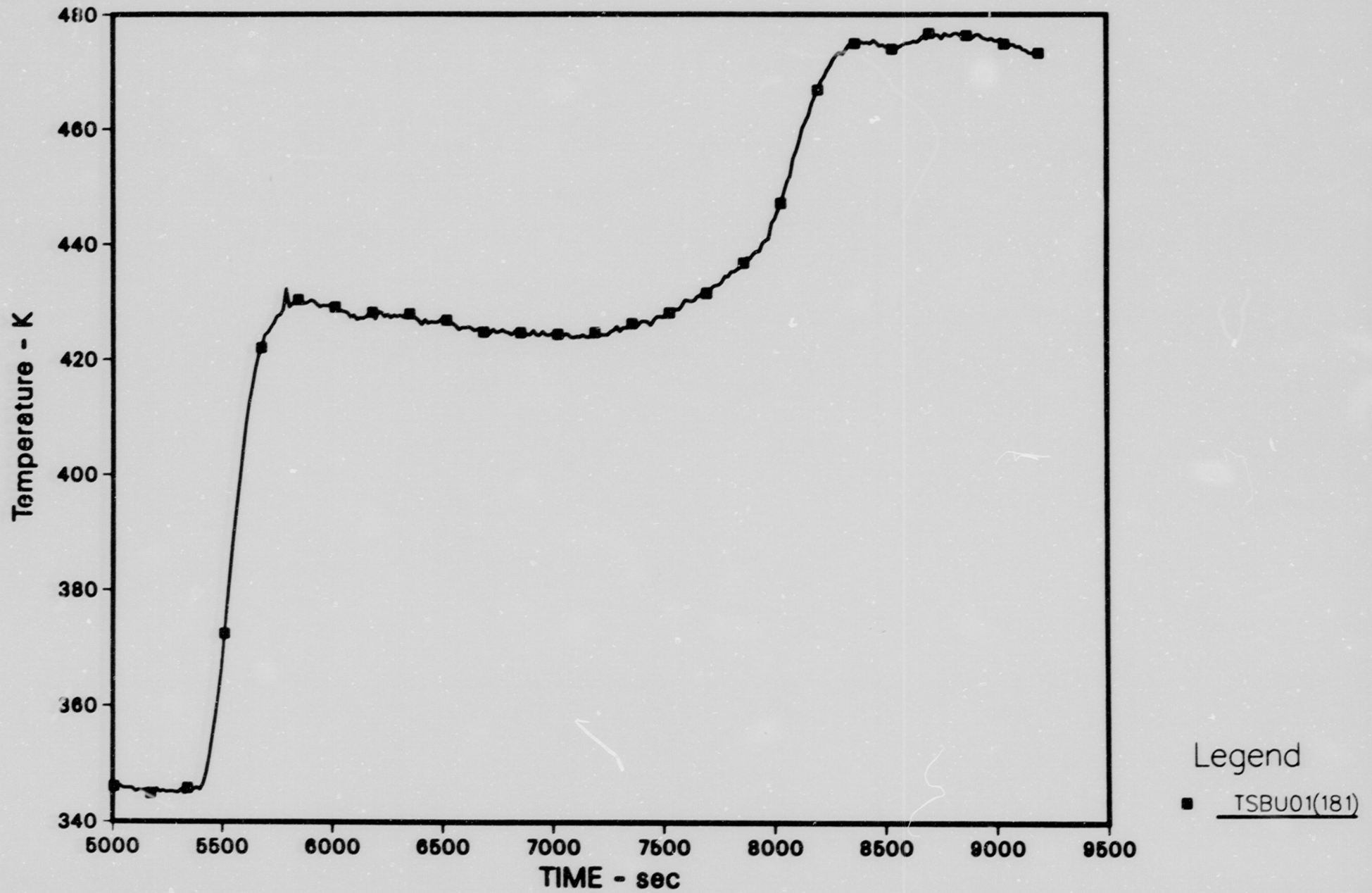
# DF-4 Thermocouple Mounting Block Wall



# DF-4 Thermocouple Mounting Block Wall(2)

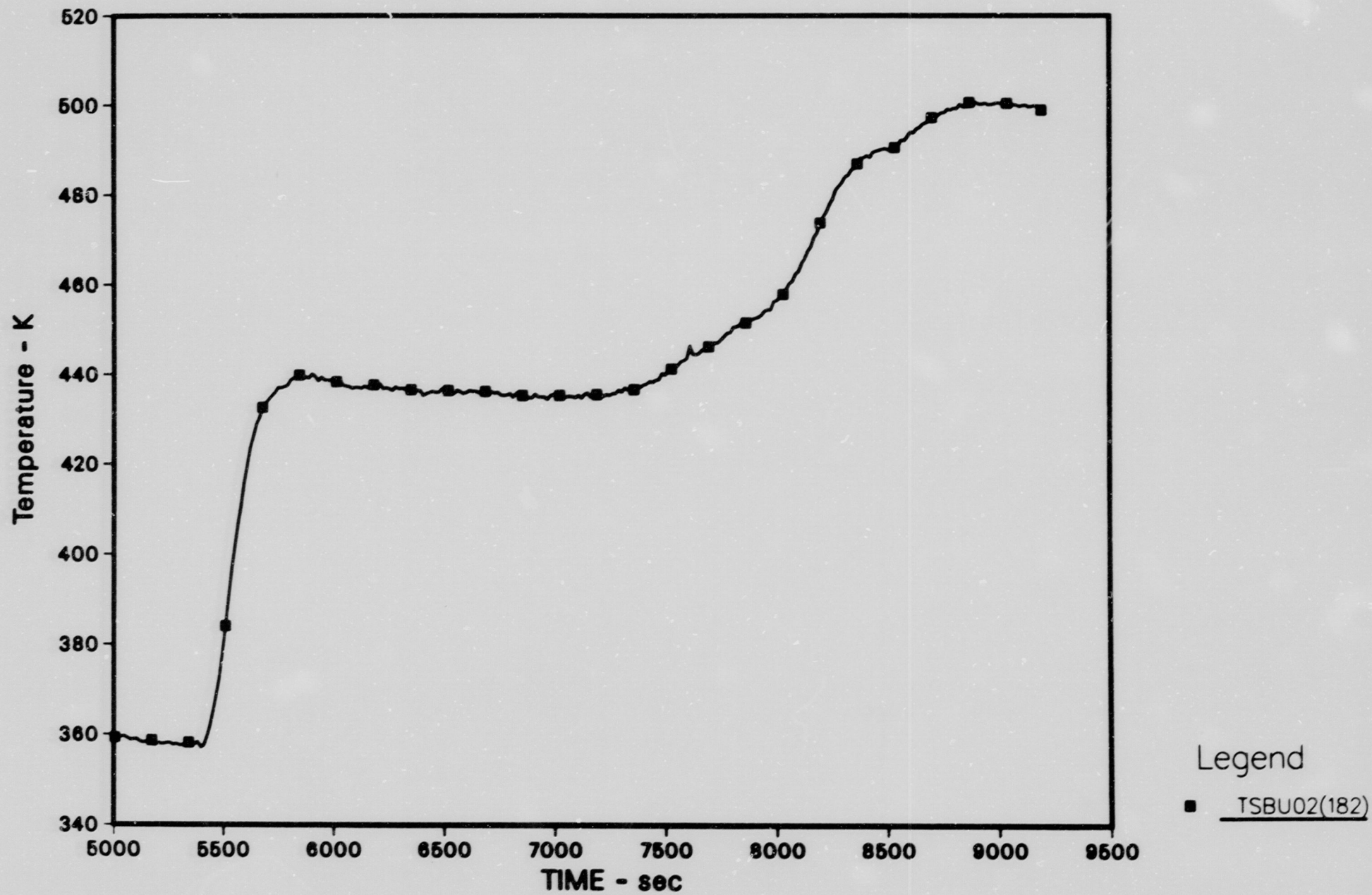


# DF-4 Test Section Bulkhead Between Fittings 1&2

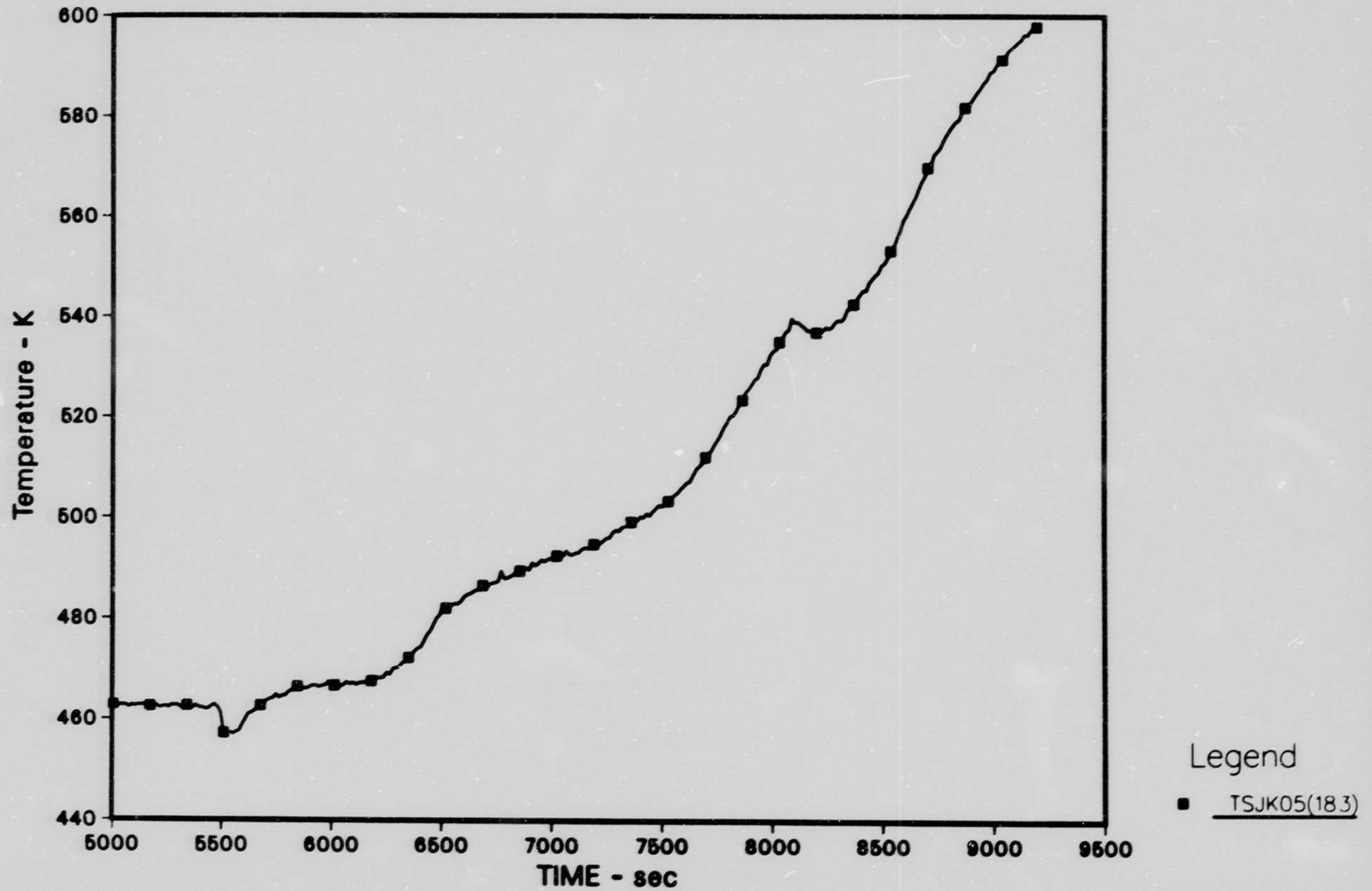




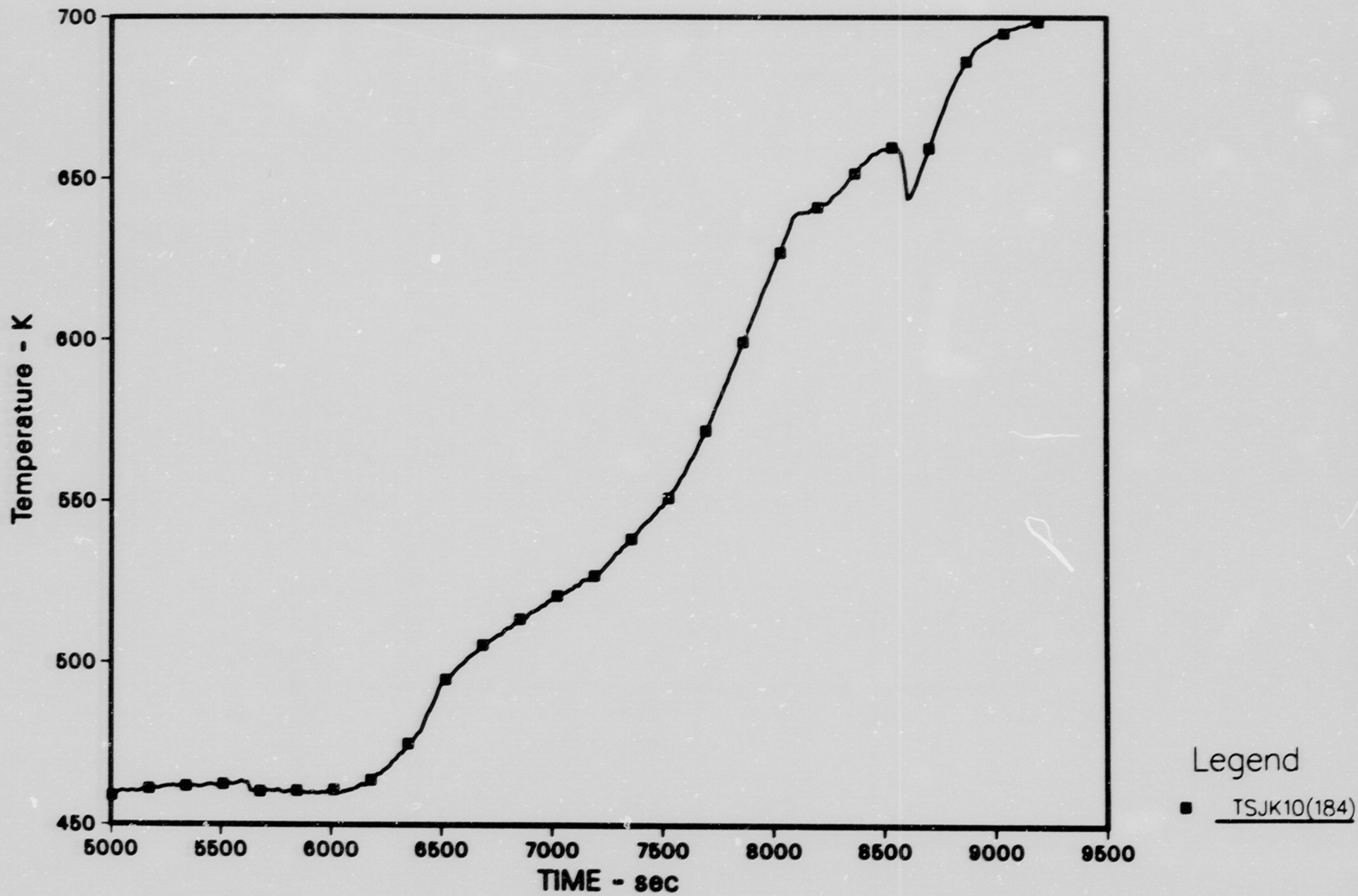
# DF-4 Test Section Bulkhead Between Fittings 8&9



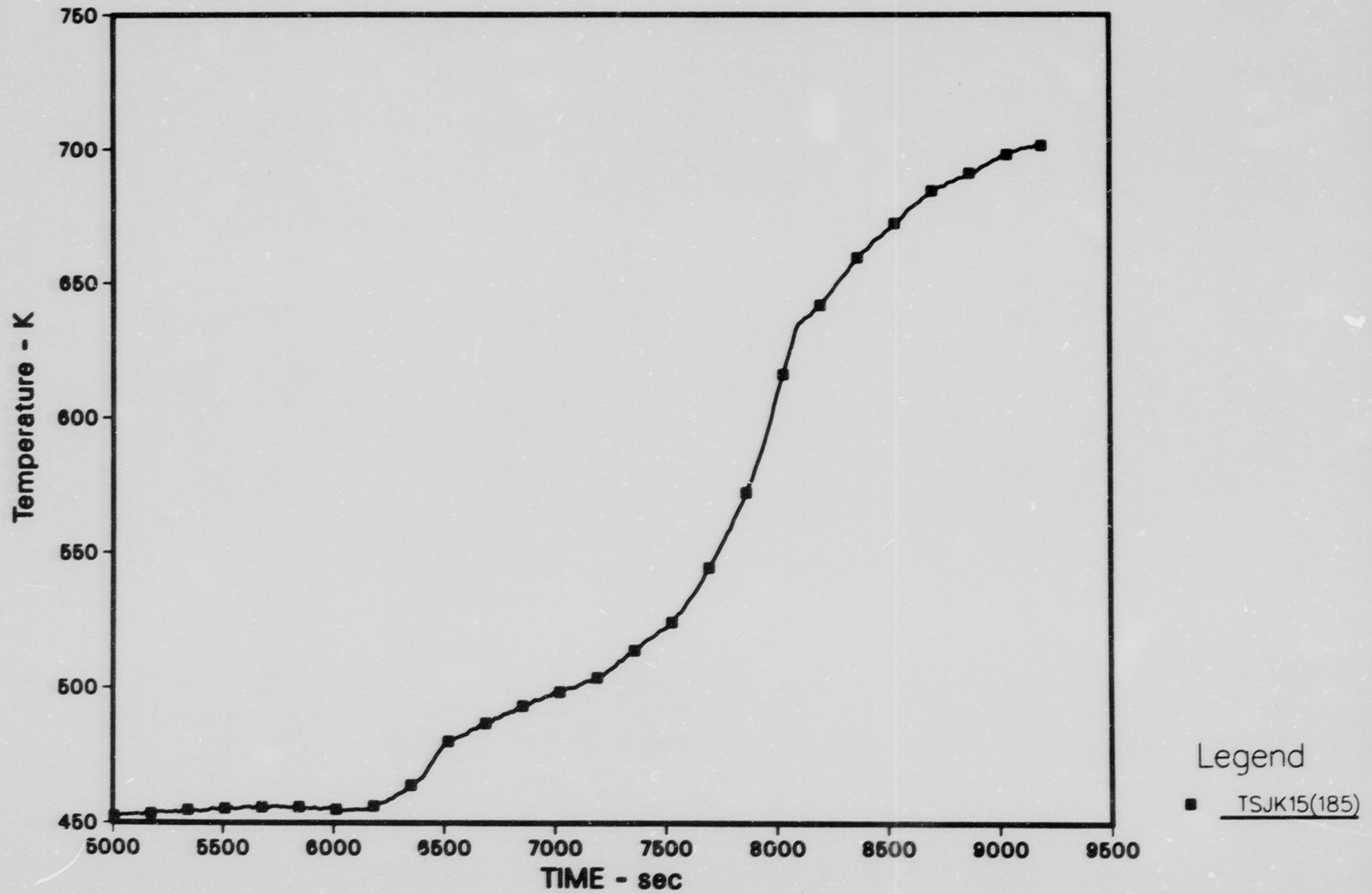
# DF-4 Test Section Jacket 5in Below Top



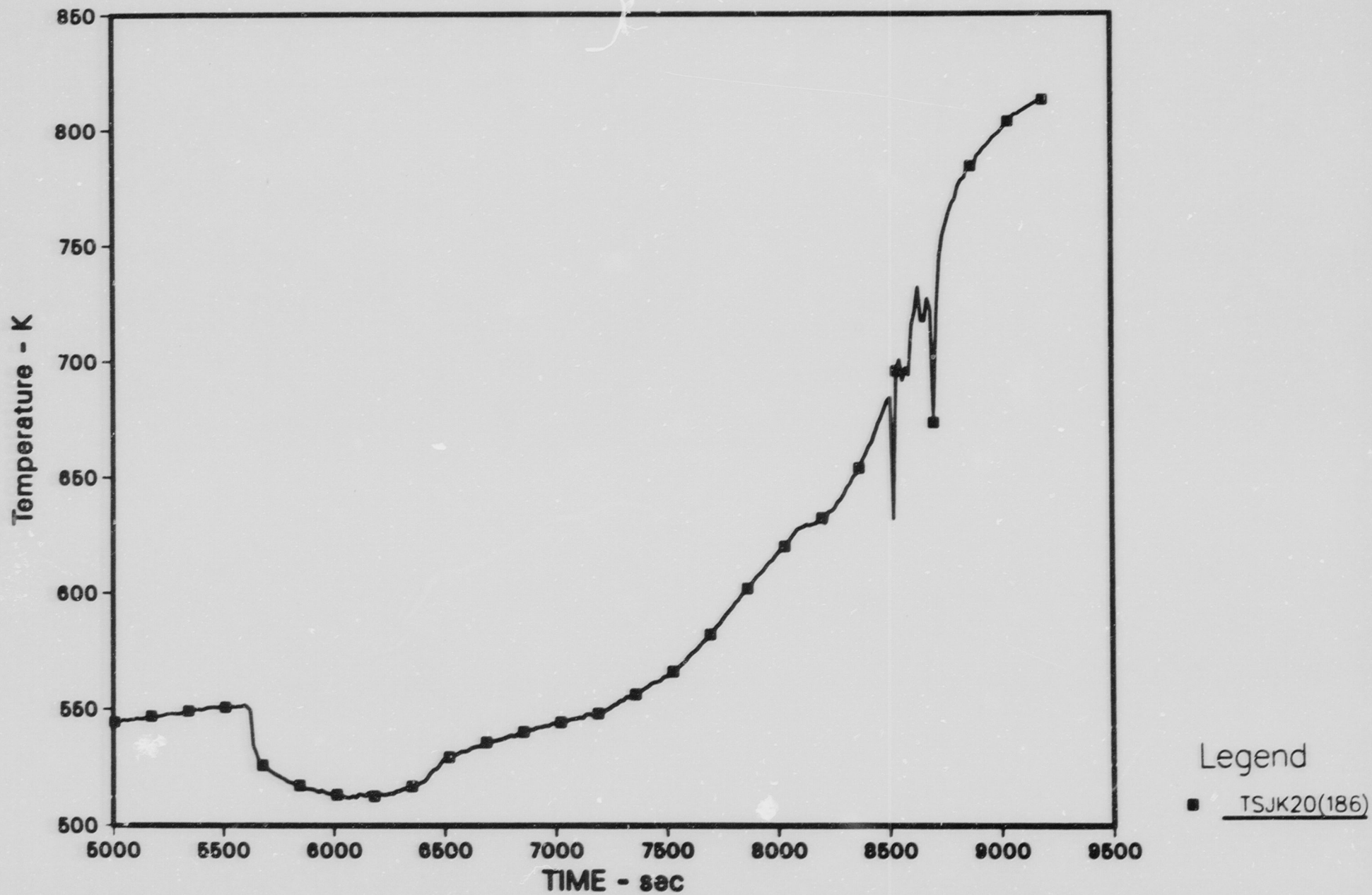
# DF-4 Test Section Jacket 10in Below Top



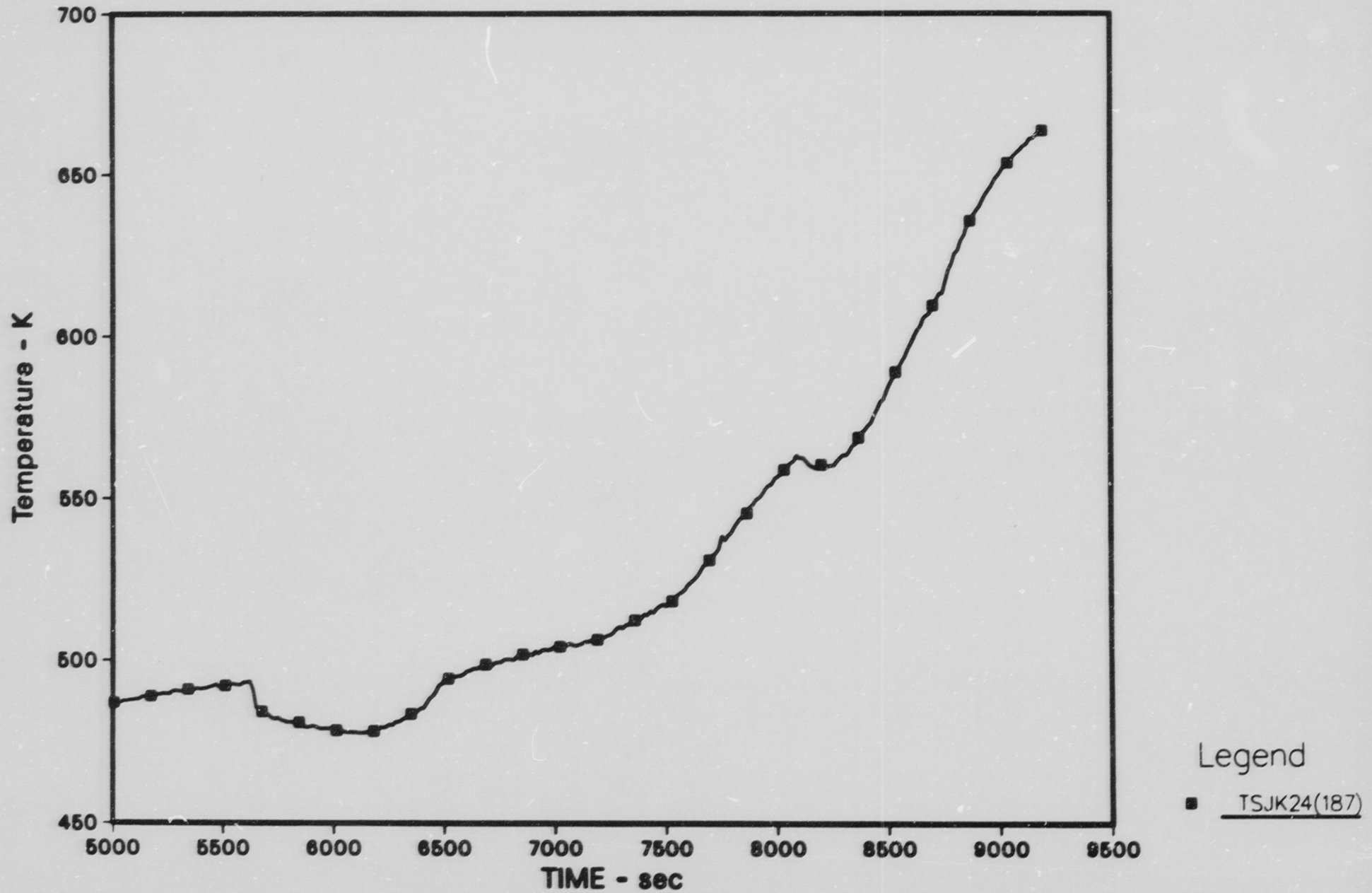
# DF-4 Test Section Jacket 15In Below Top



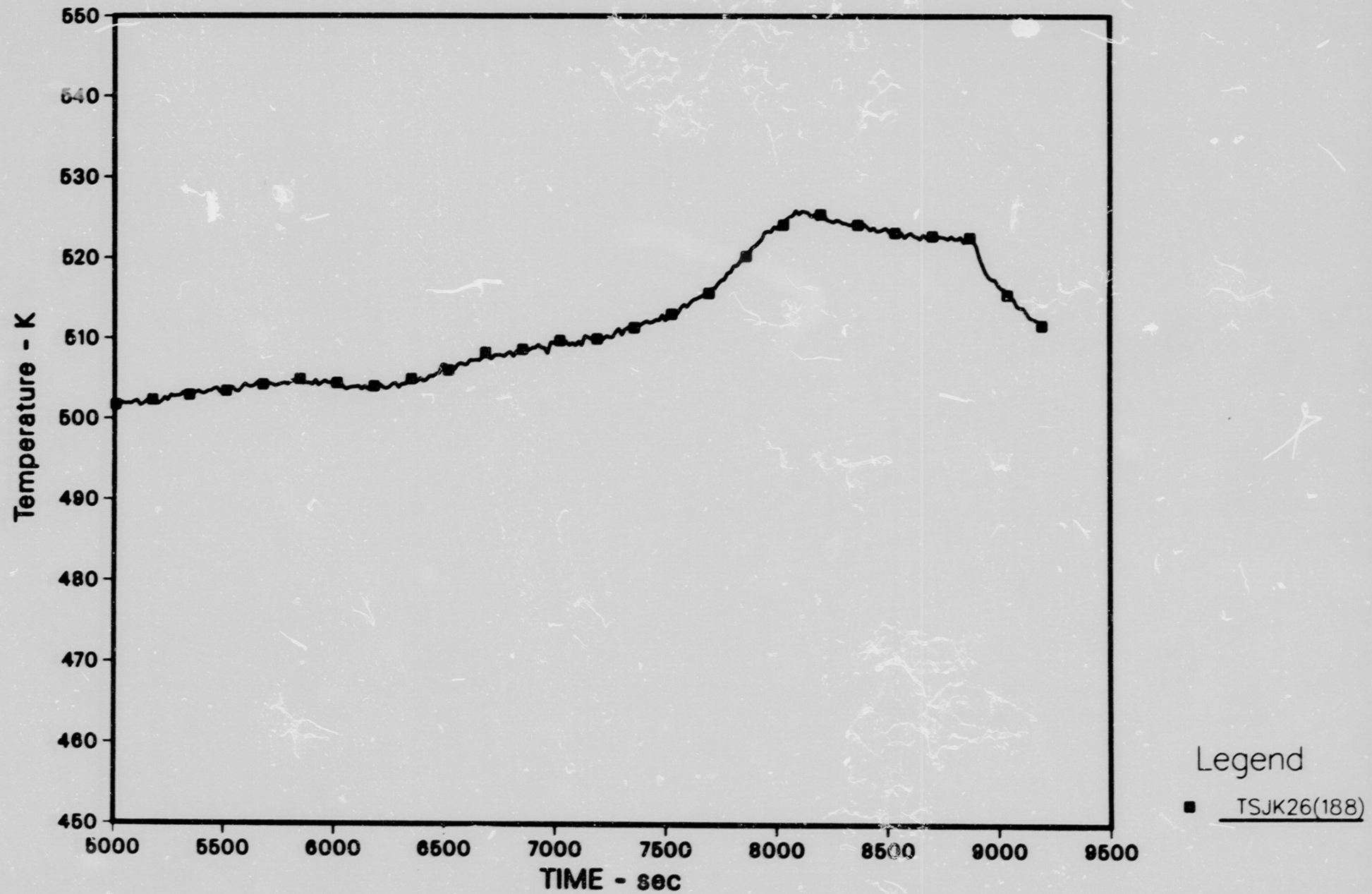
# DF-4 Test Section Jacket 20in Below Top



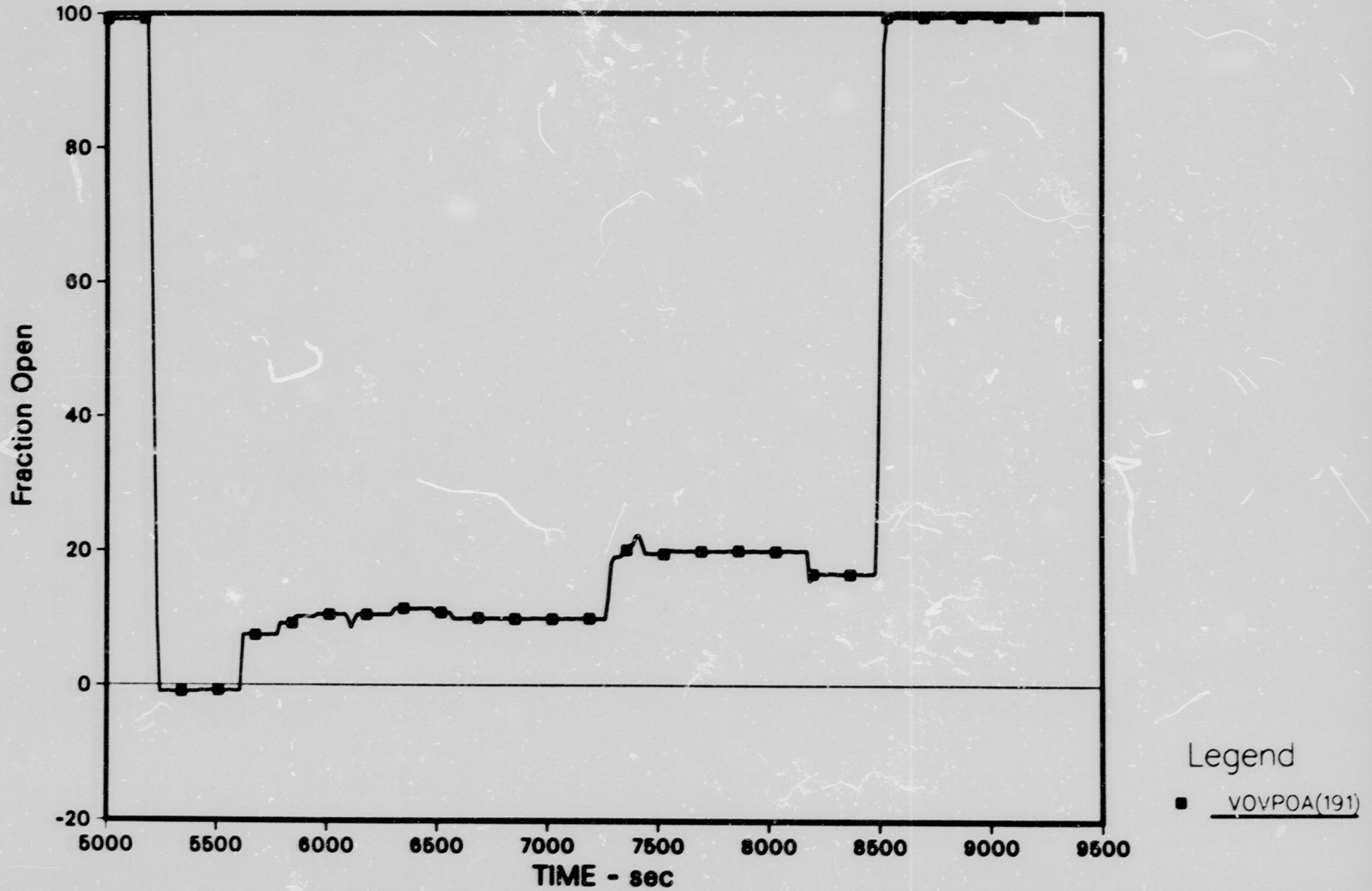
# DF-4 Test Section Jacket 24in Below Top



# DF-4 Test Section Jacket (Bottom) 26in Below Top

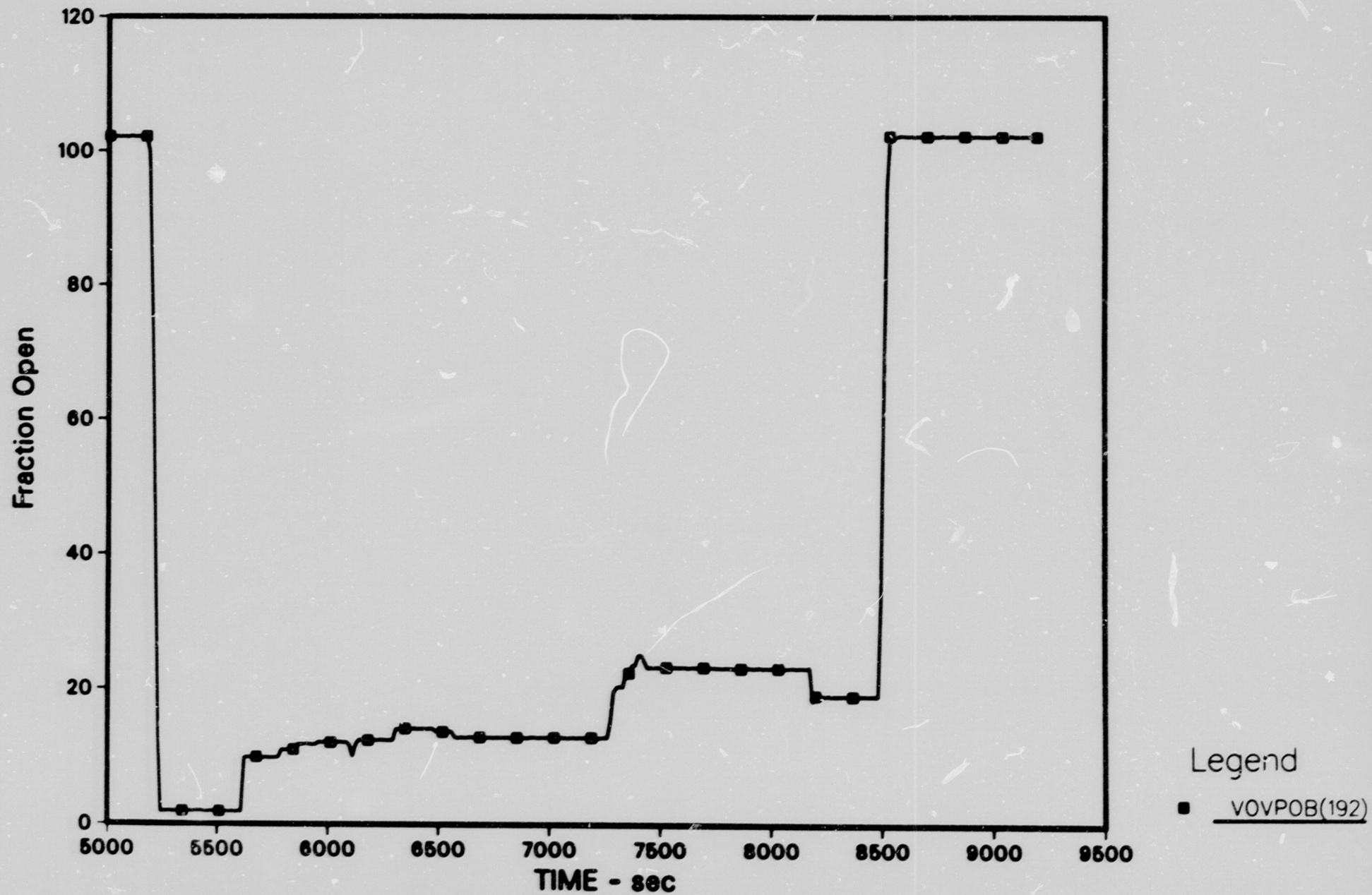


# DF-4 Motor Driven Valve Position

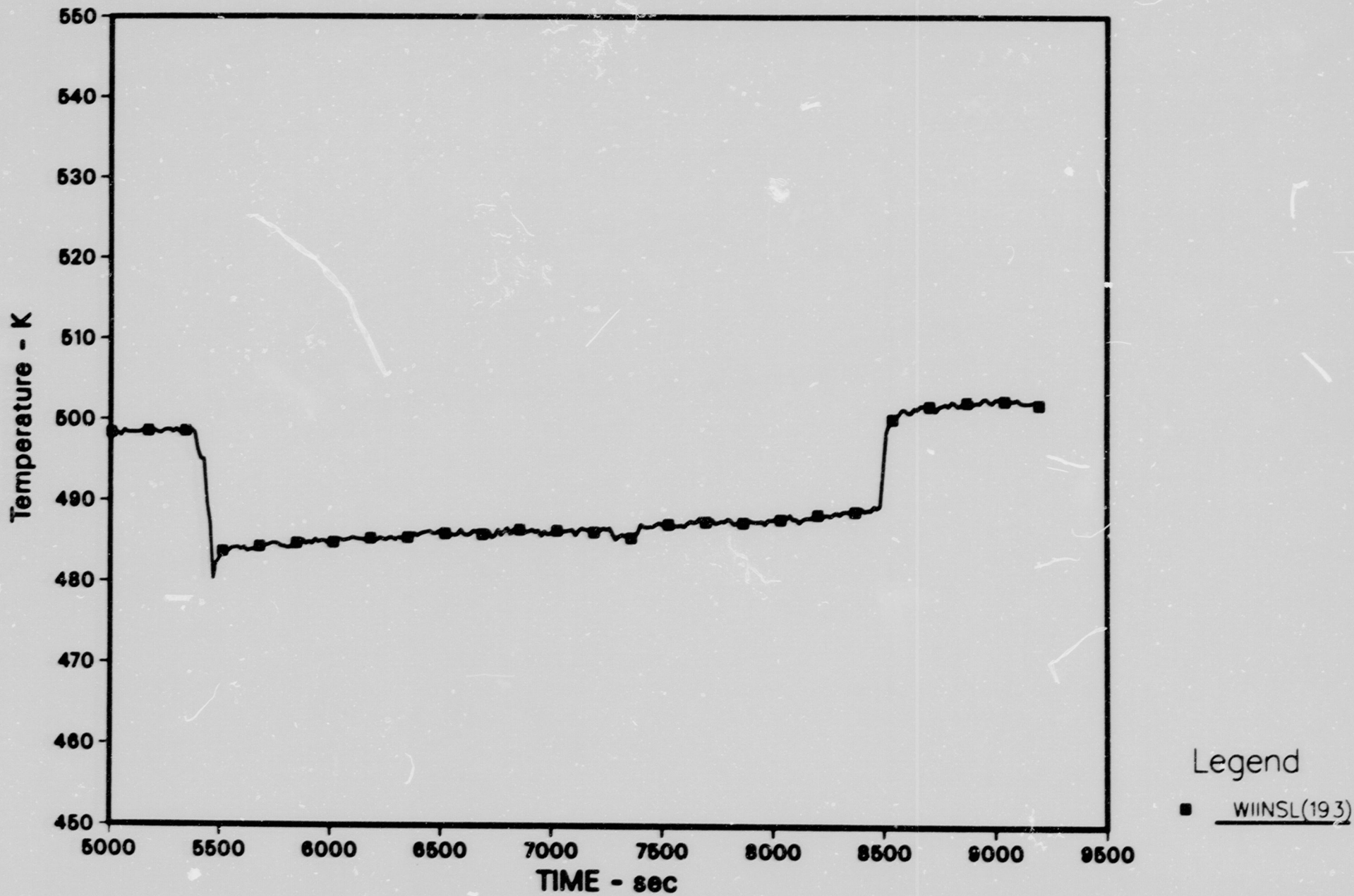




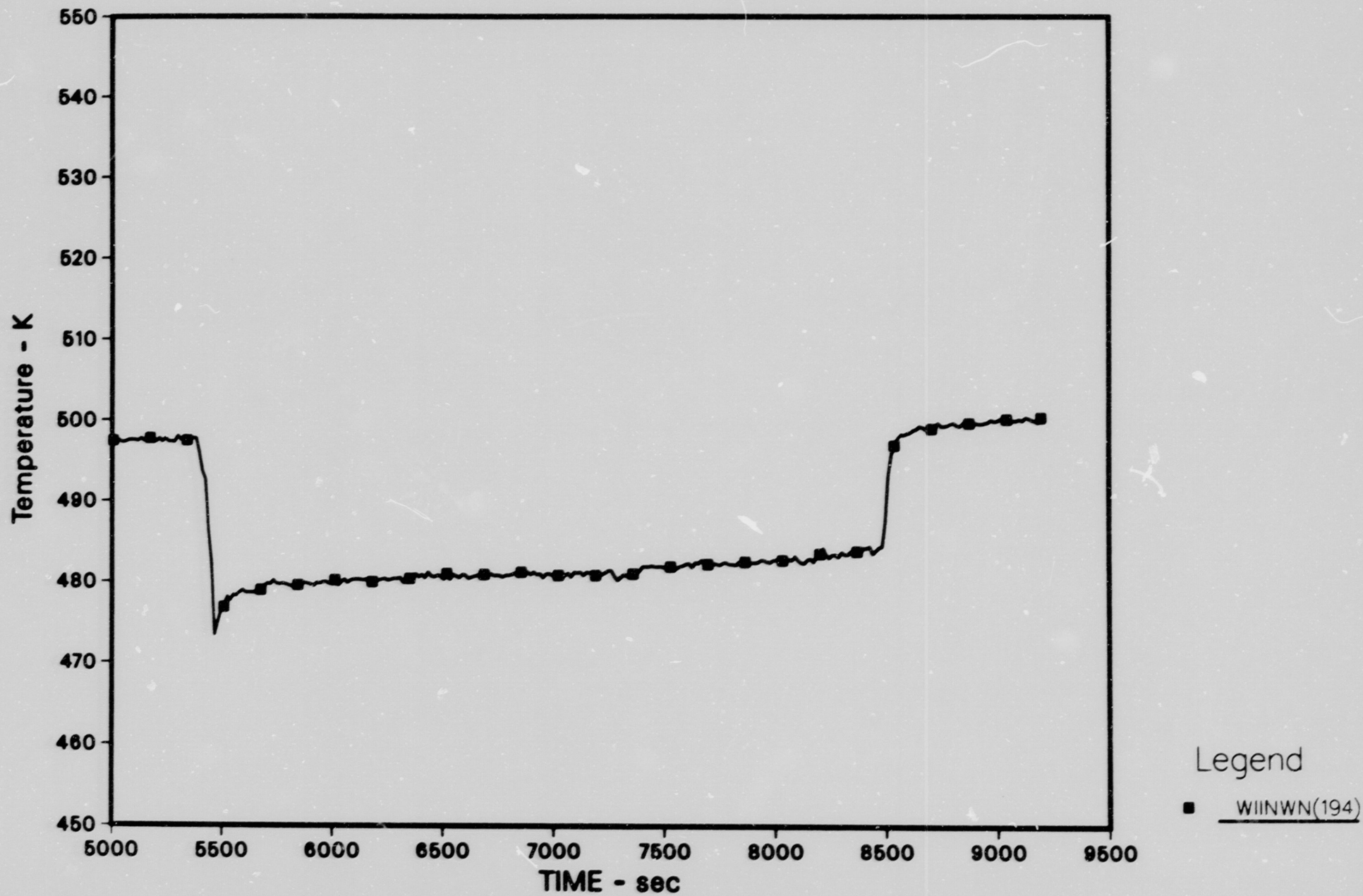
# DF-4 Motor Driven Valve Position (2)



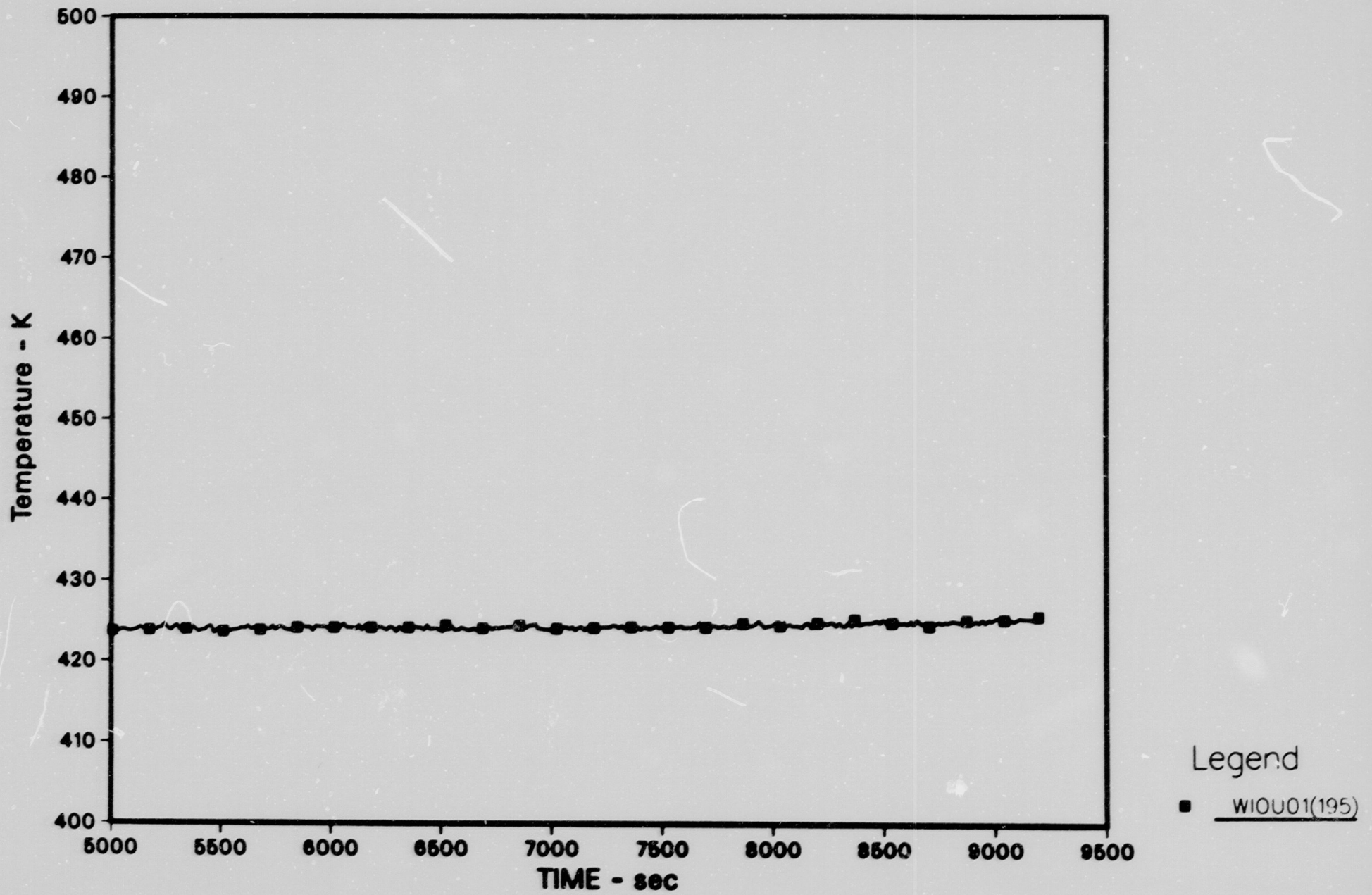
# DF-4 Inner Wall @ Internal Window Seal



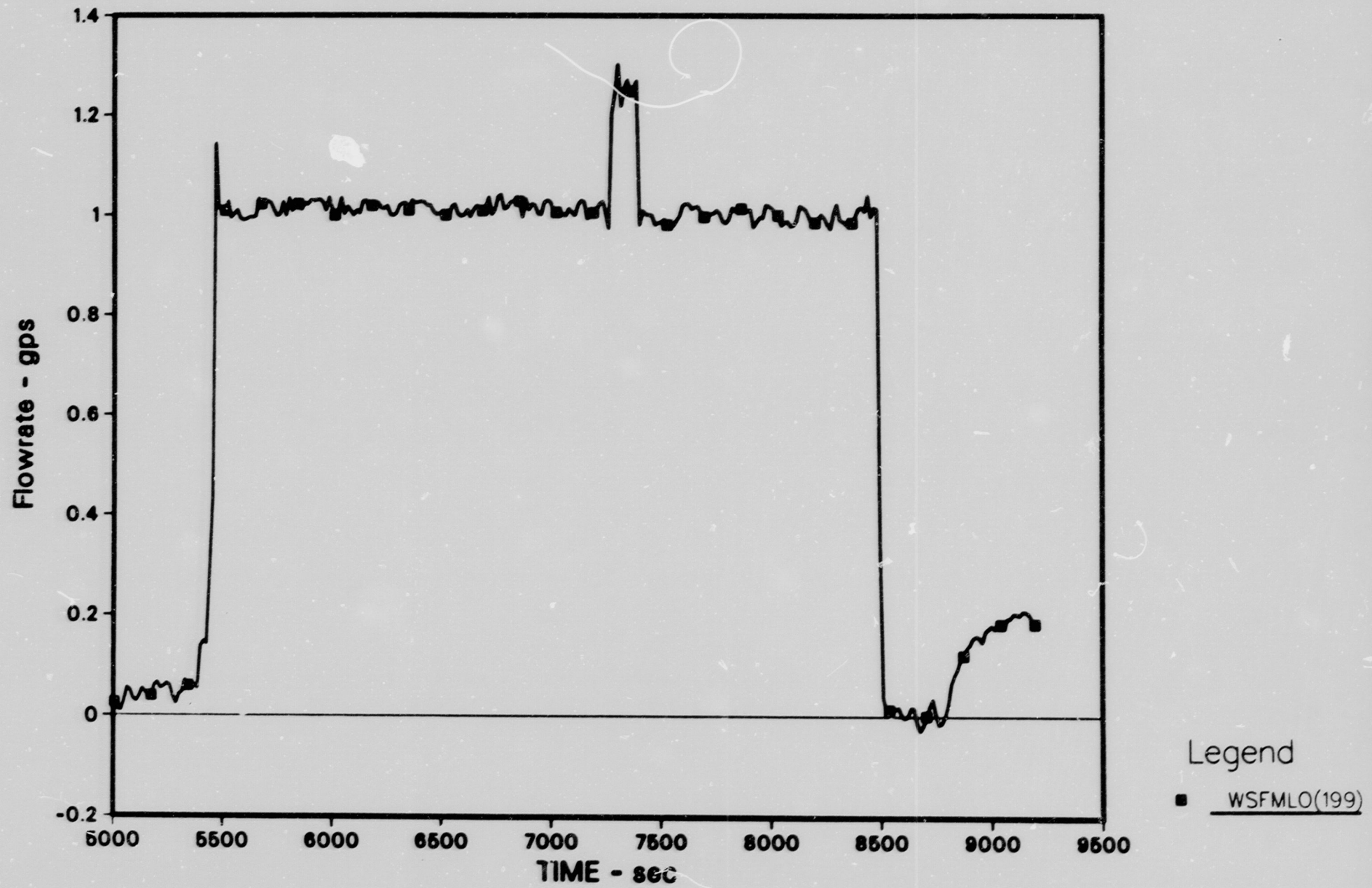
# DF-4 Inner Wall @ Internal Window



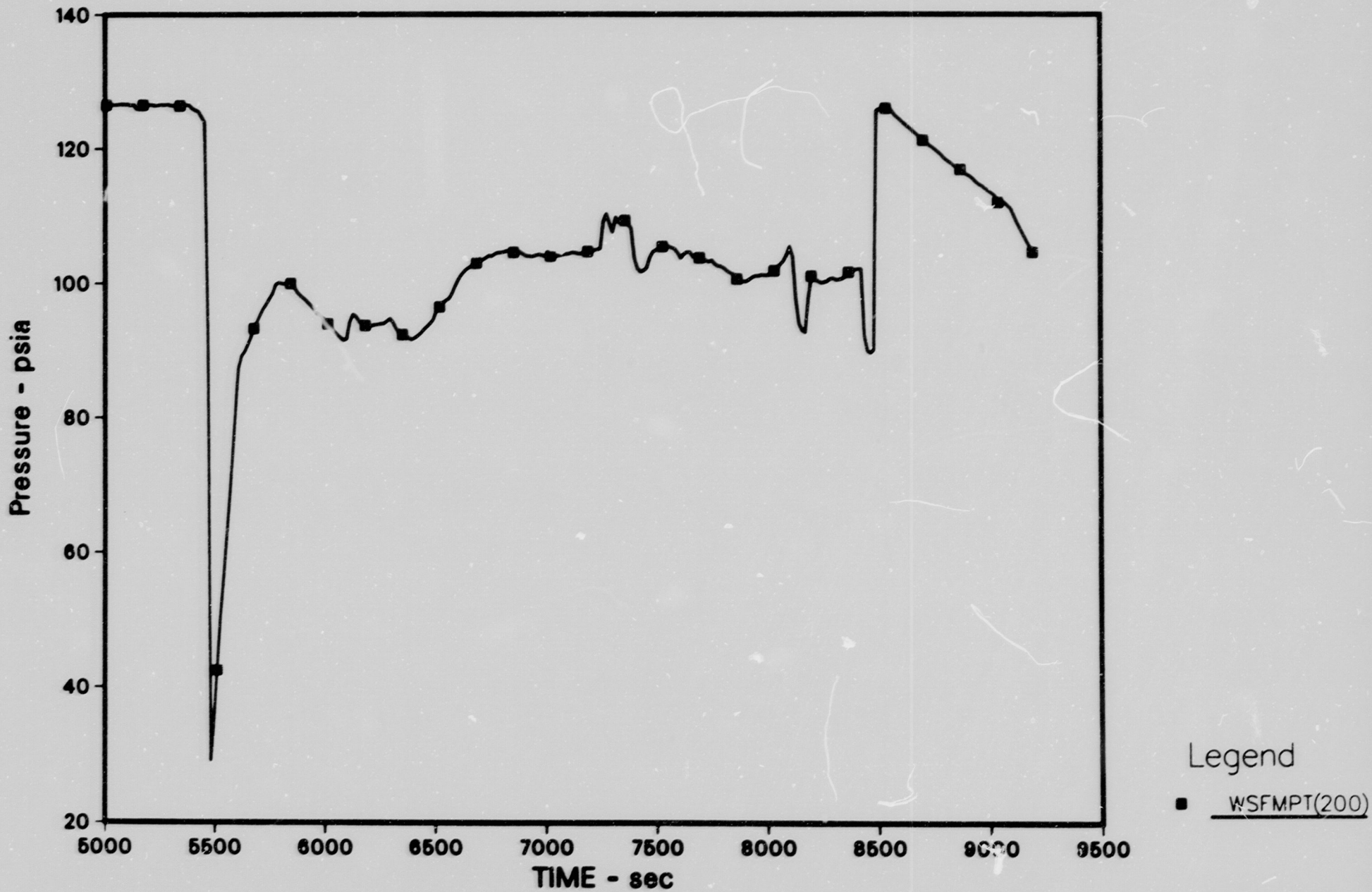
# DF-4 Outer Wall of Window Extension Tube @ Window



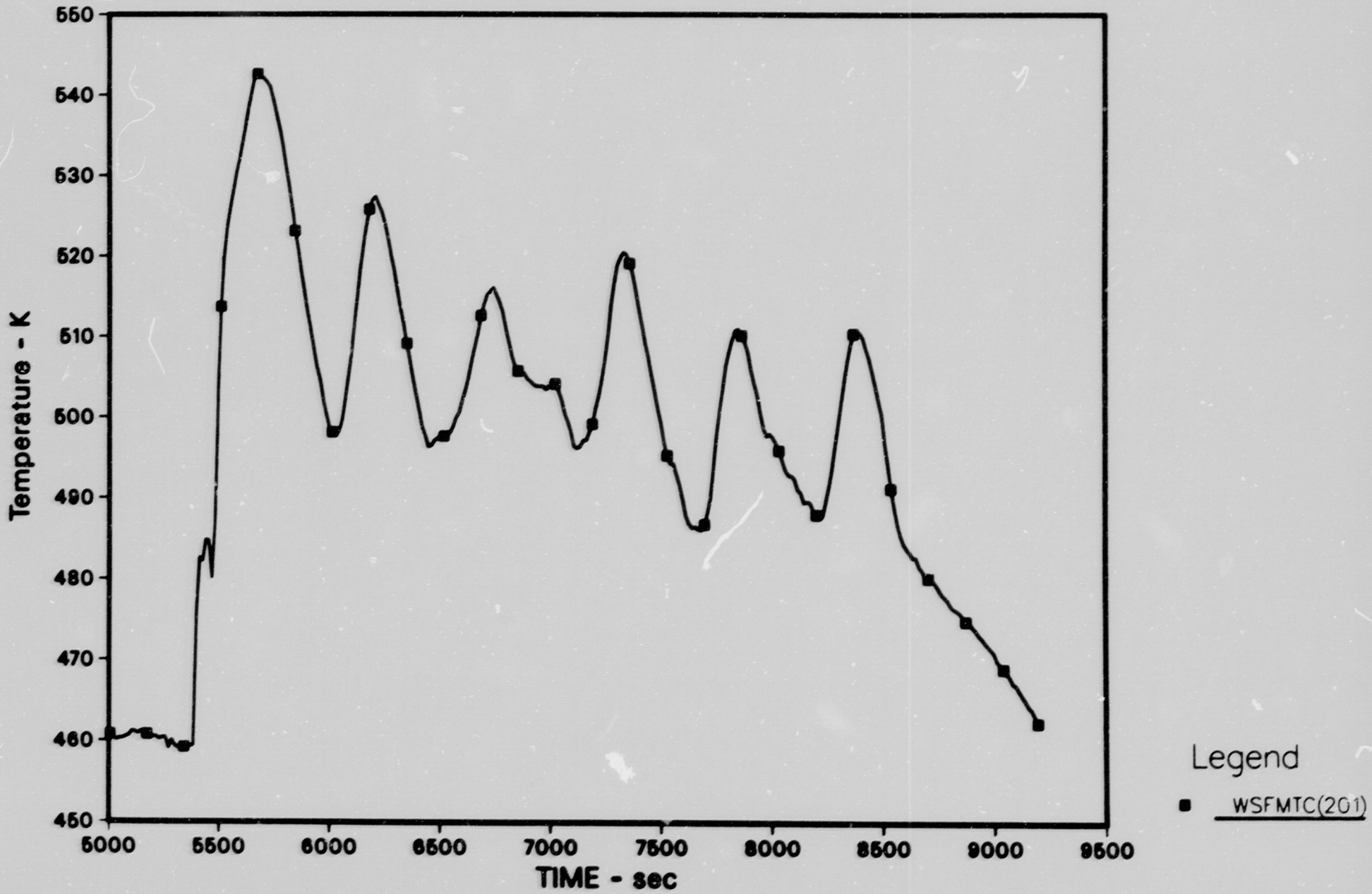
# DF-4 Window Steam Flow Meter



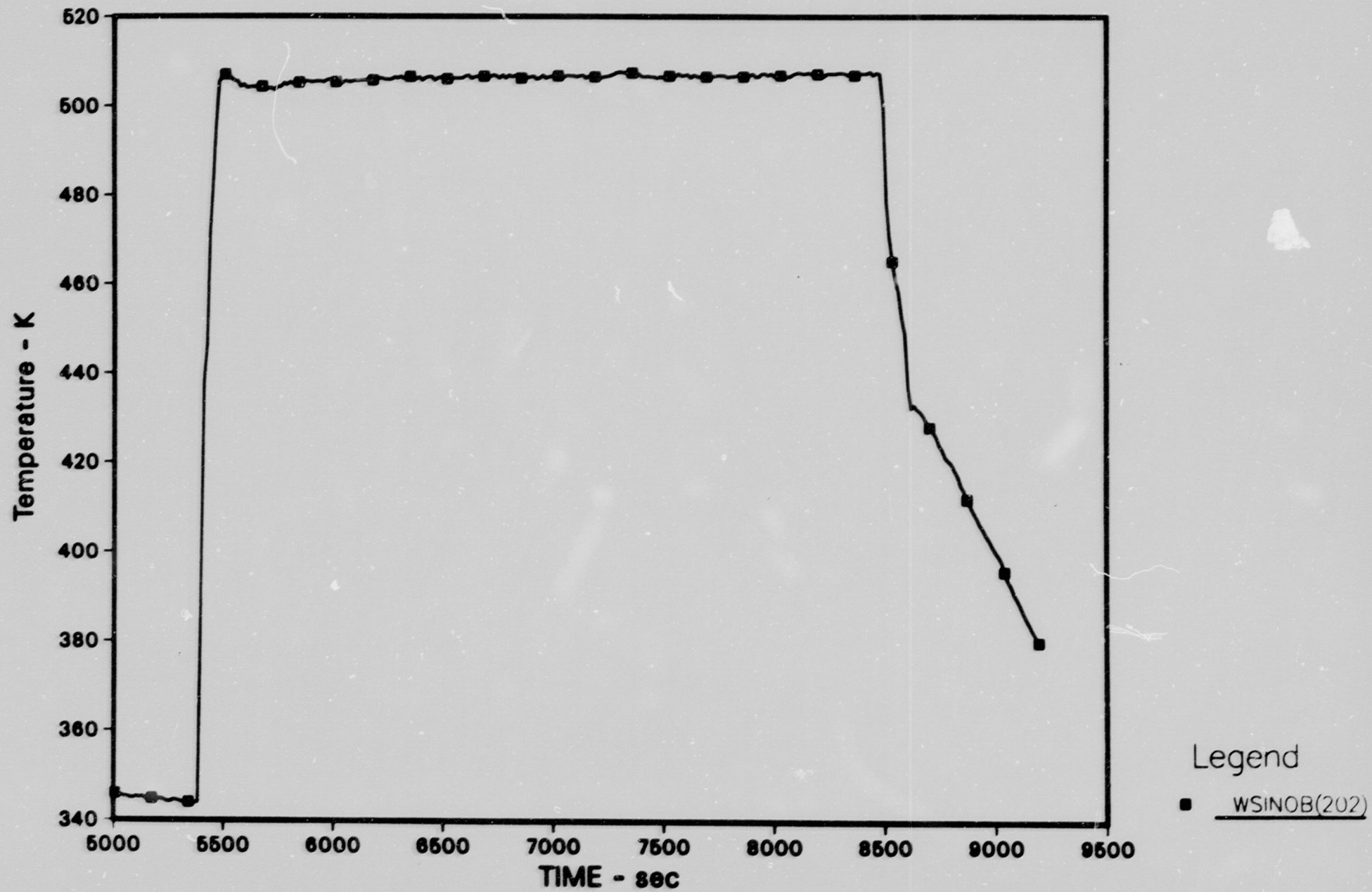
# DF-4 Window Steam Pressure (for FM)



# DF-4 Window Steam Temperature (for FM)

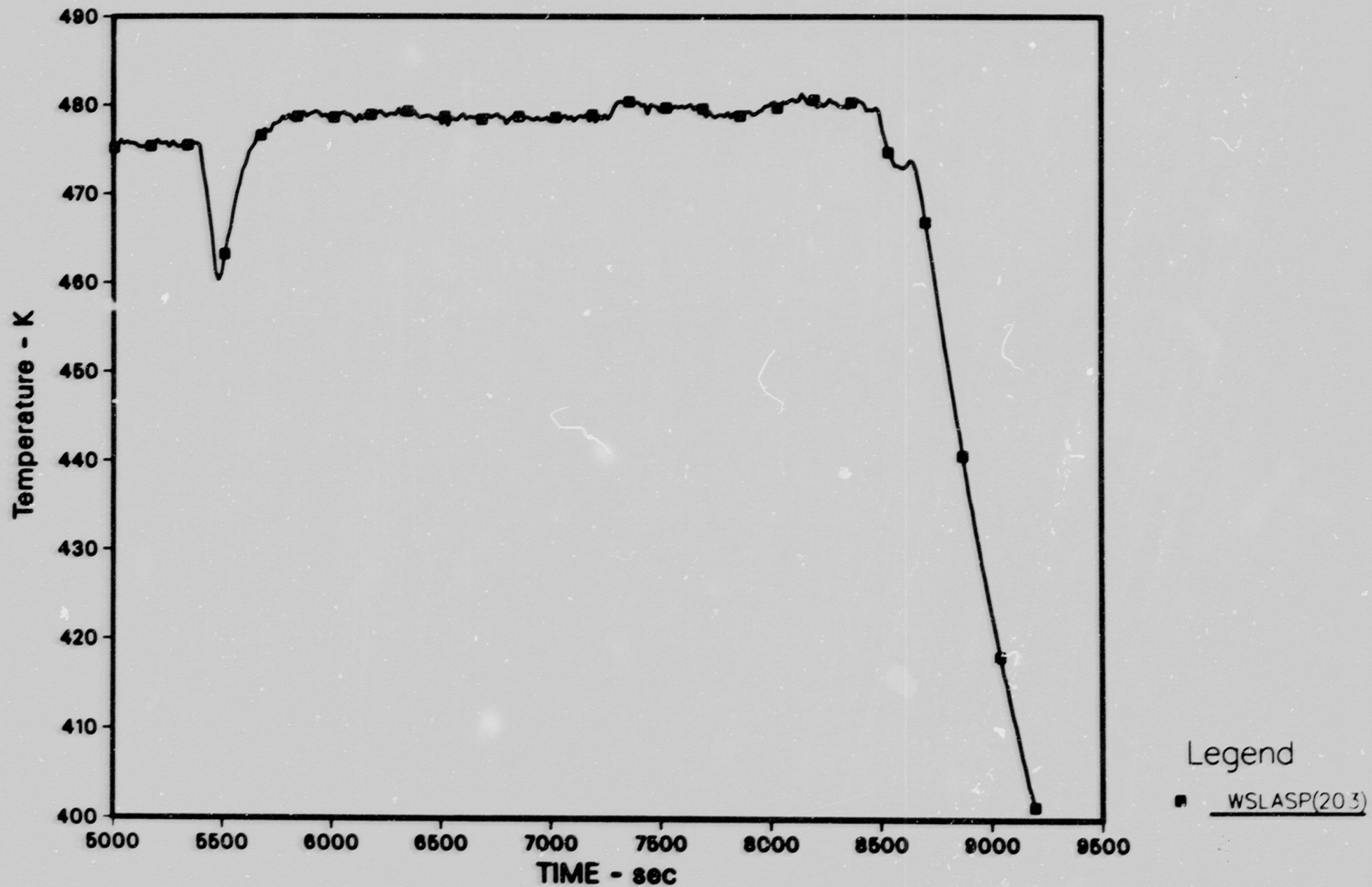


# DF-4 Inside Window Steam Line, Top of Access Tube

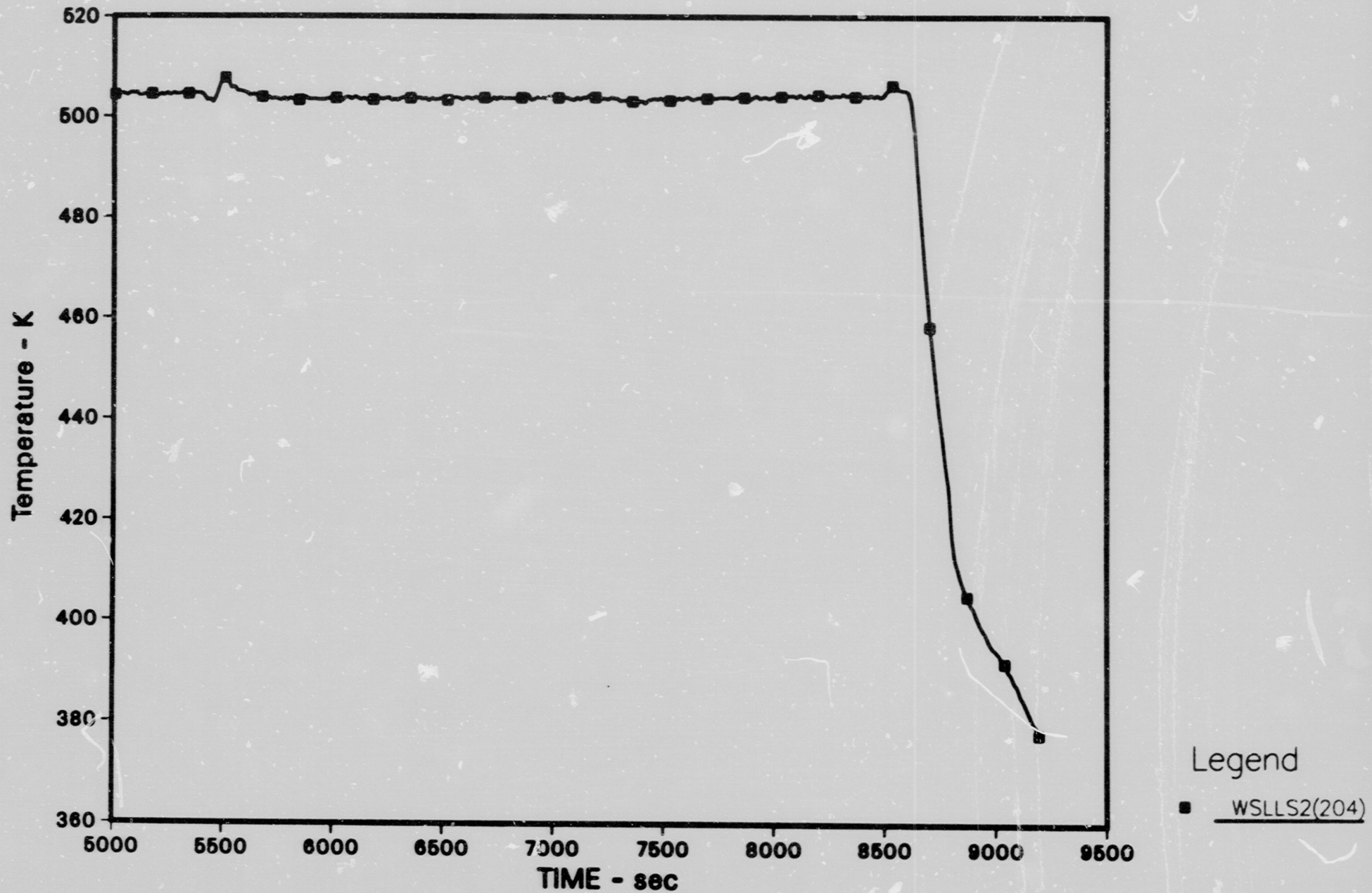




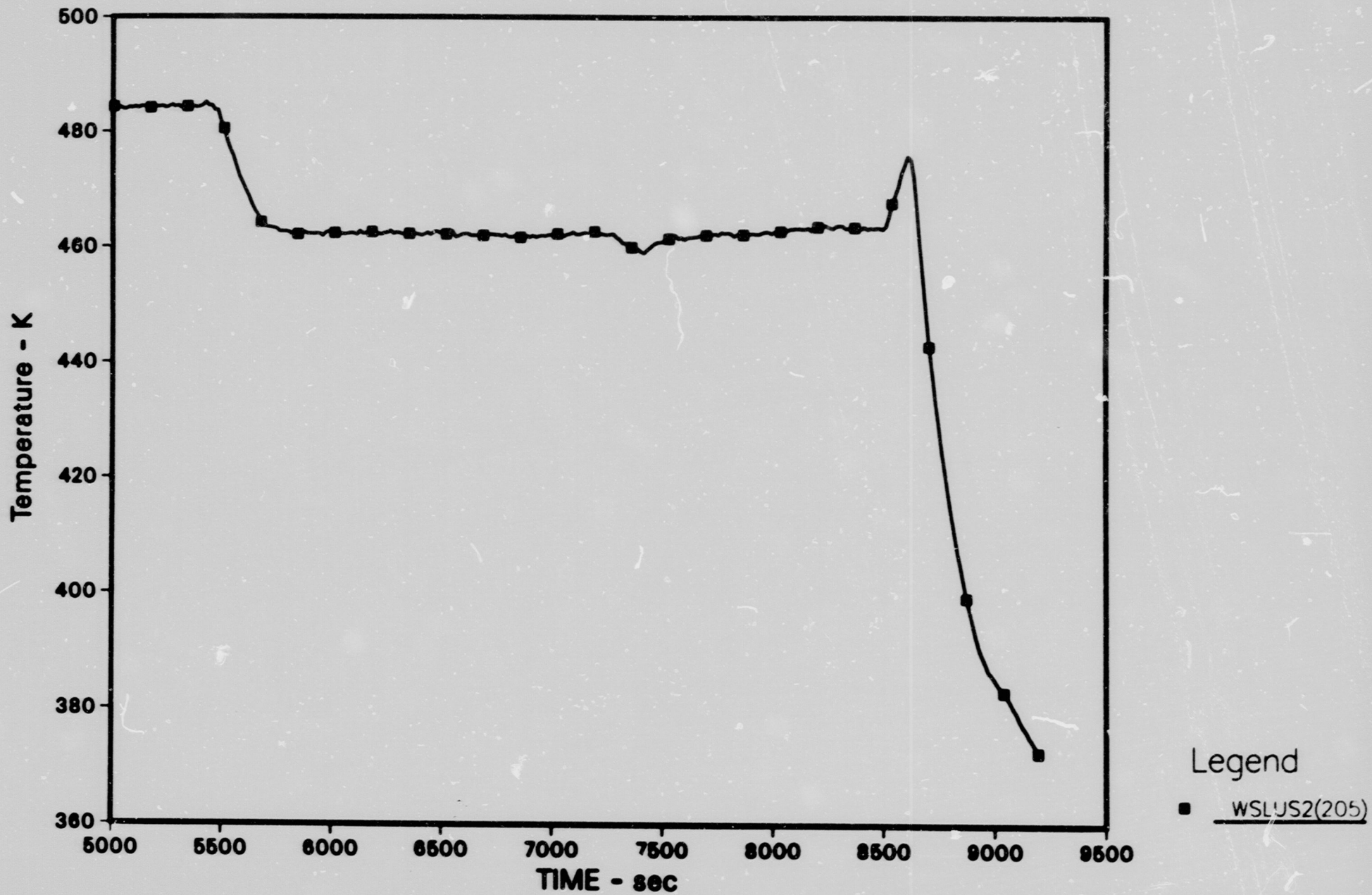
# DF-4 Window Steam Line Wall Above Shield Plug



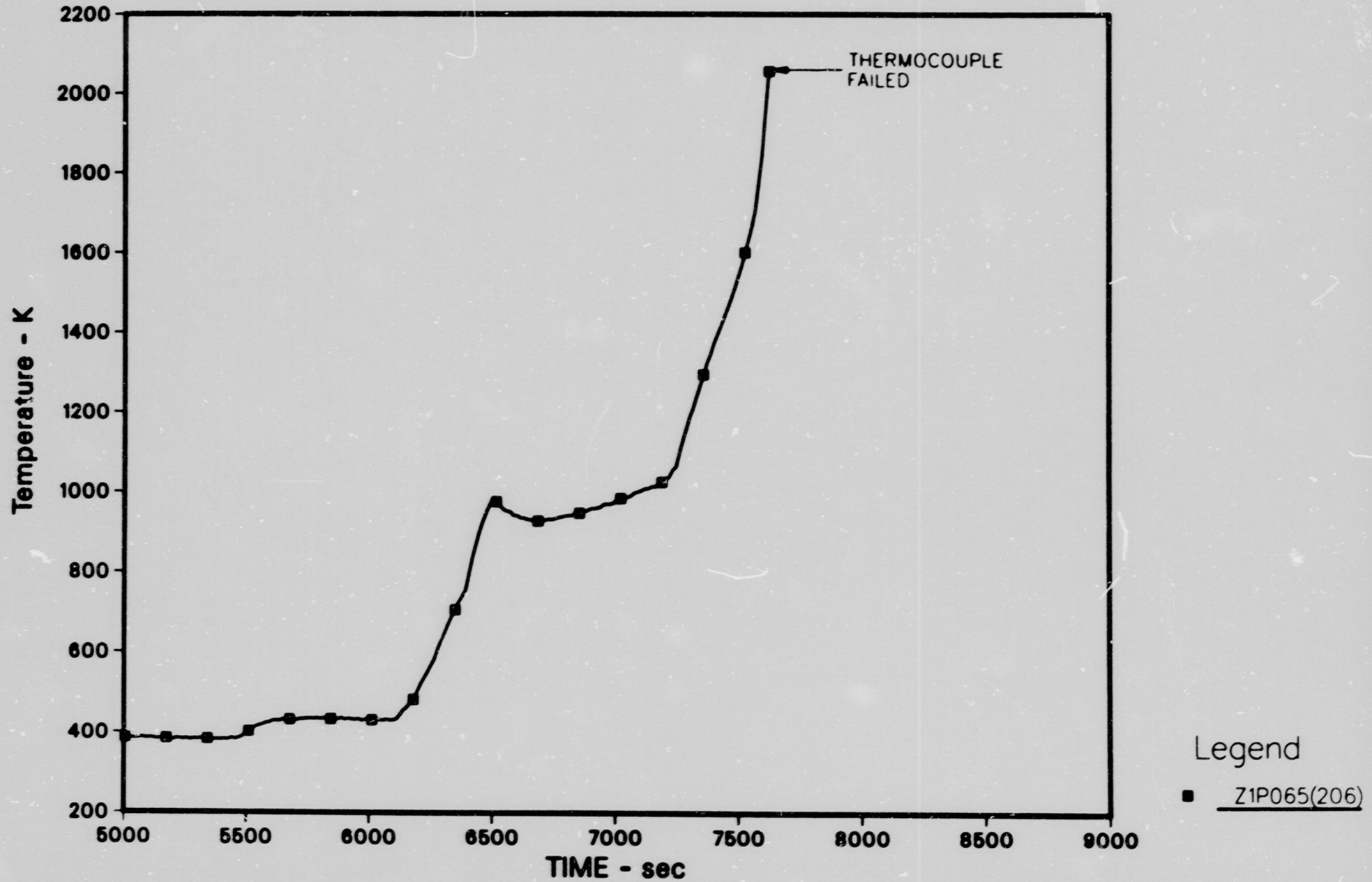
# DF-4 Window Steam Line Wall, Lower Shield Plug



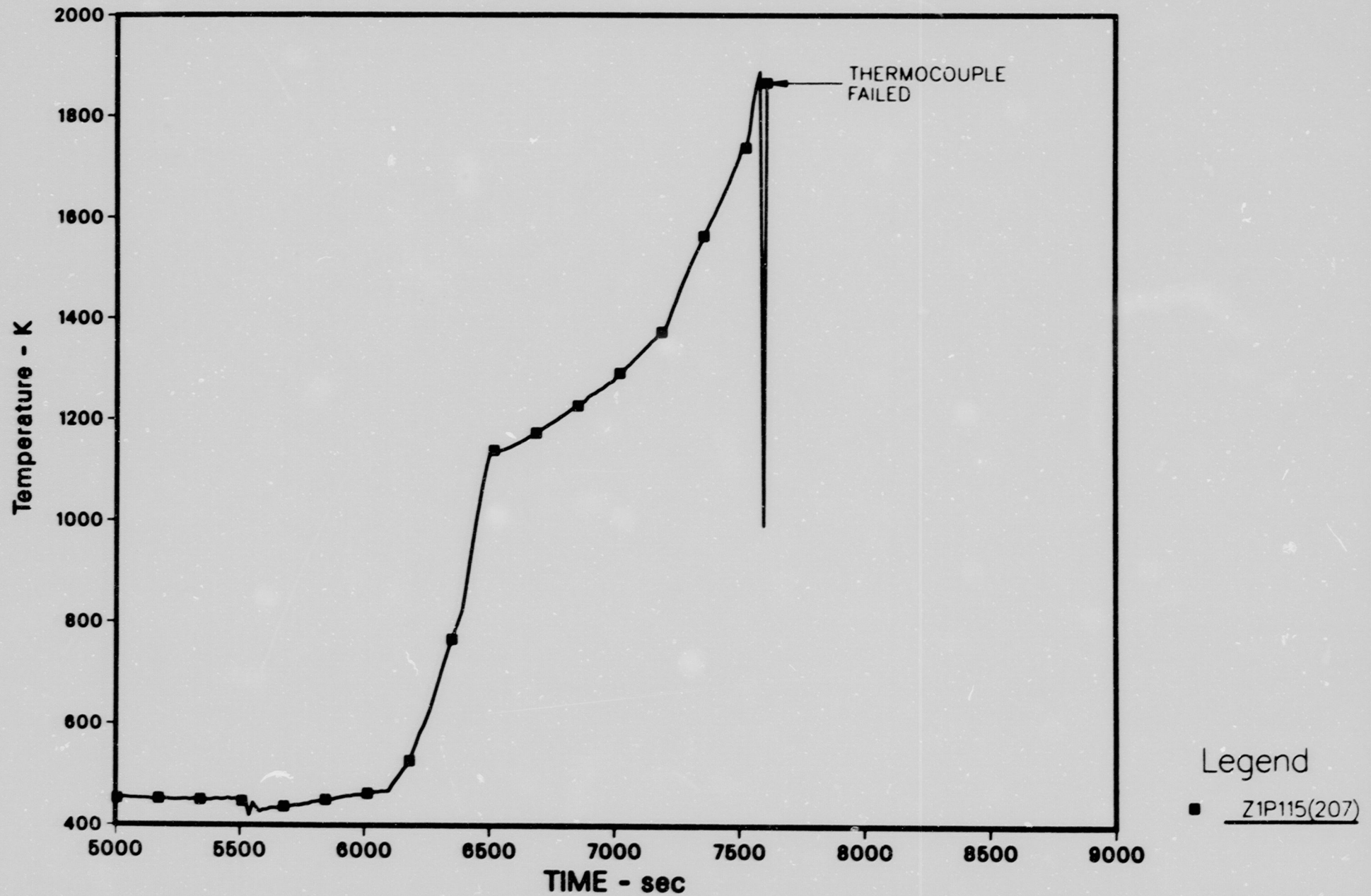
# DF-4 Window Steam Line Wall, Upper Shield Plug



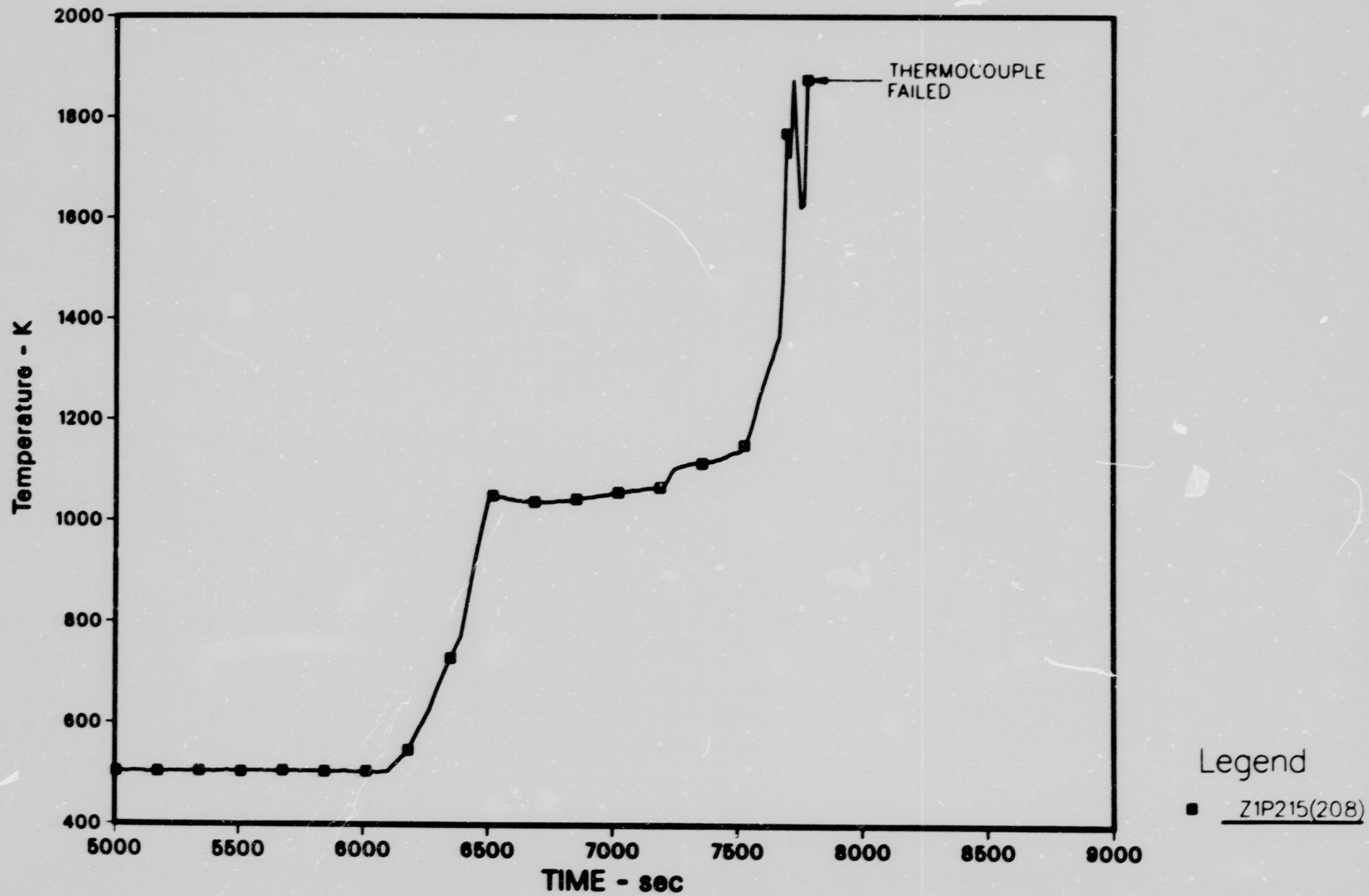
# DF-4 Zr Clad Rod #1, Pt/Rh 6.7in Below Fuel Supp.



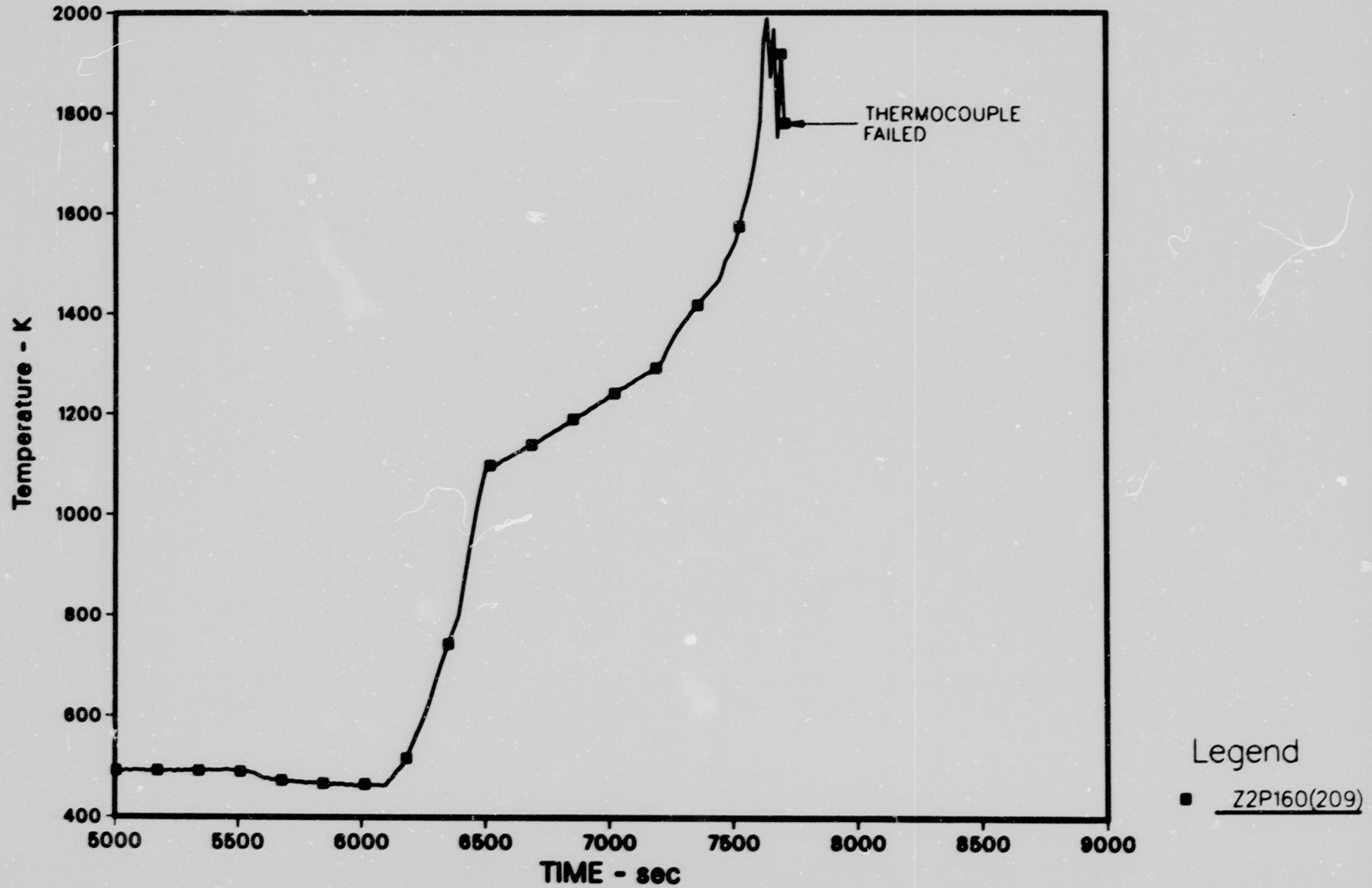
# DF-4 Zr Clad Rod #1, Pt/Rh 11.5in Below Fuel Supp.



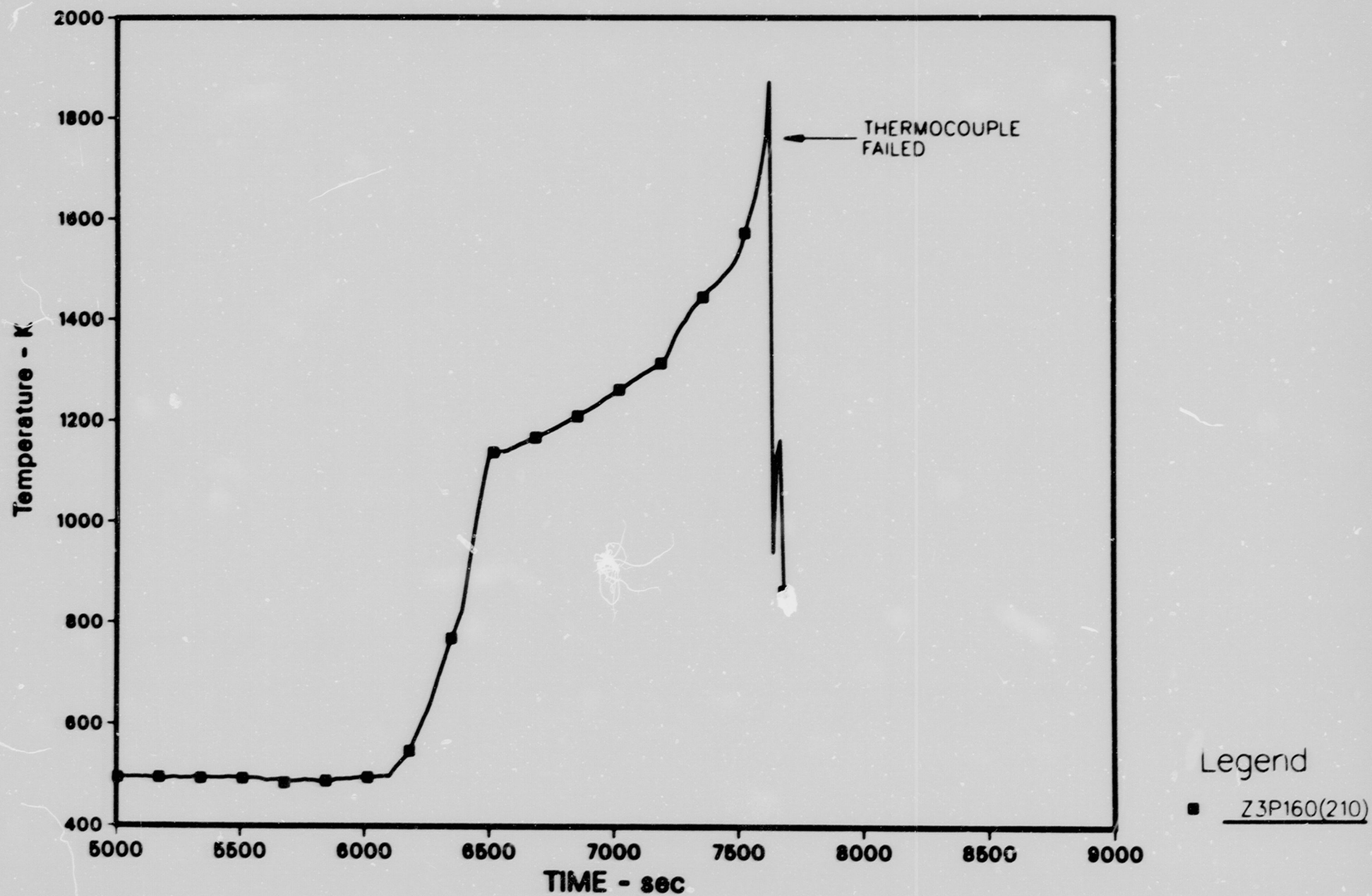
# DF-4 Zr Clad Rod #1, Pt/Rh 21.5in Below Fuel Supp.



# DF-4 Zr Clad Rod #2, Pt/Rh 16.0In Below Fuel Supp.

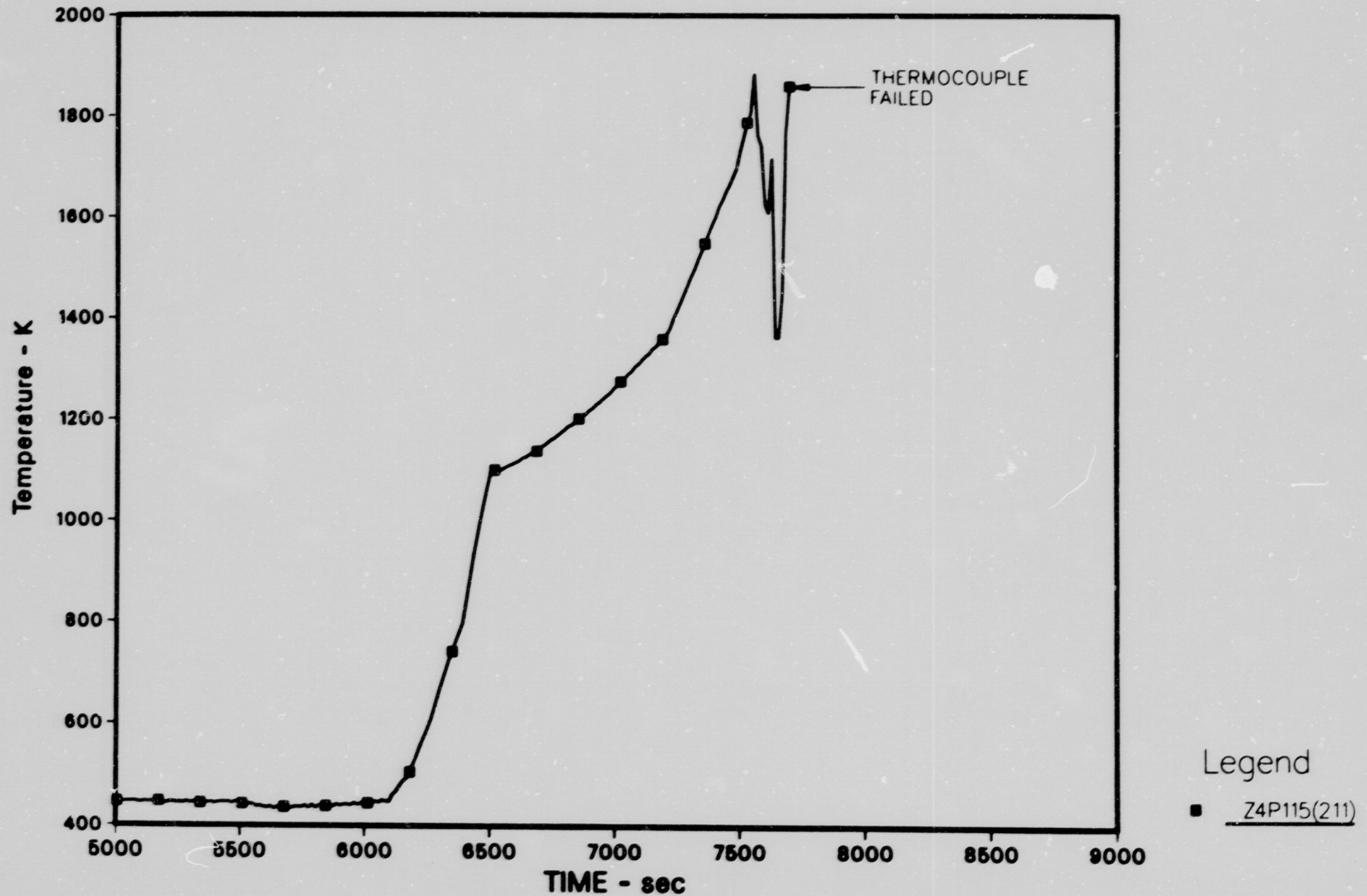


# DF-4 Zr Clad Rod #3, Pt/Rh 16.0In Below Fuel Supp.

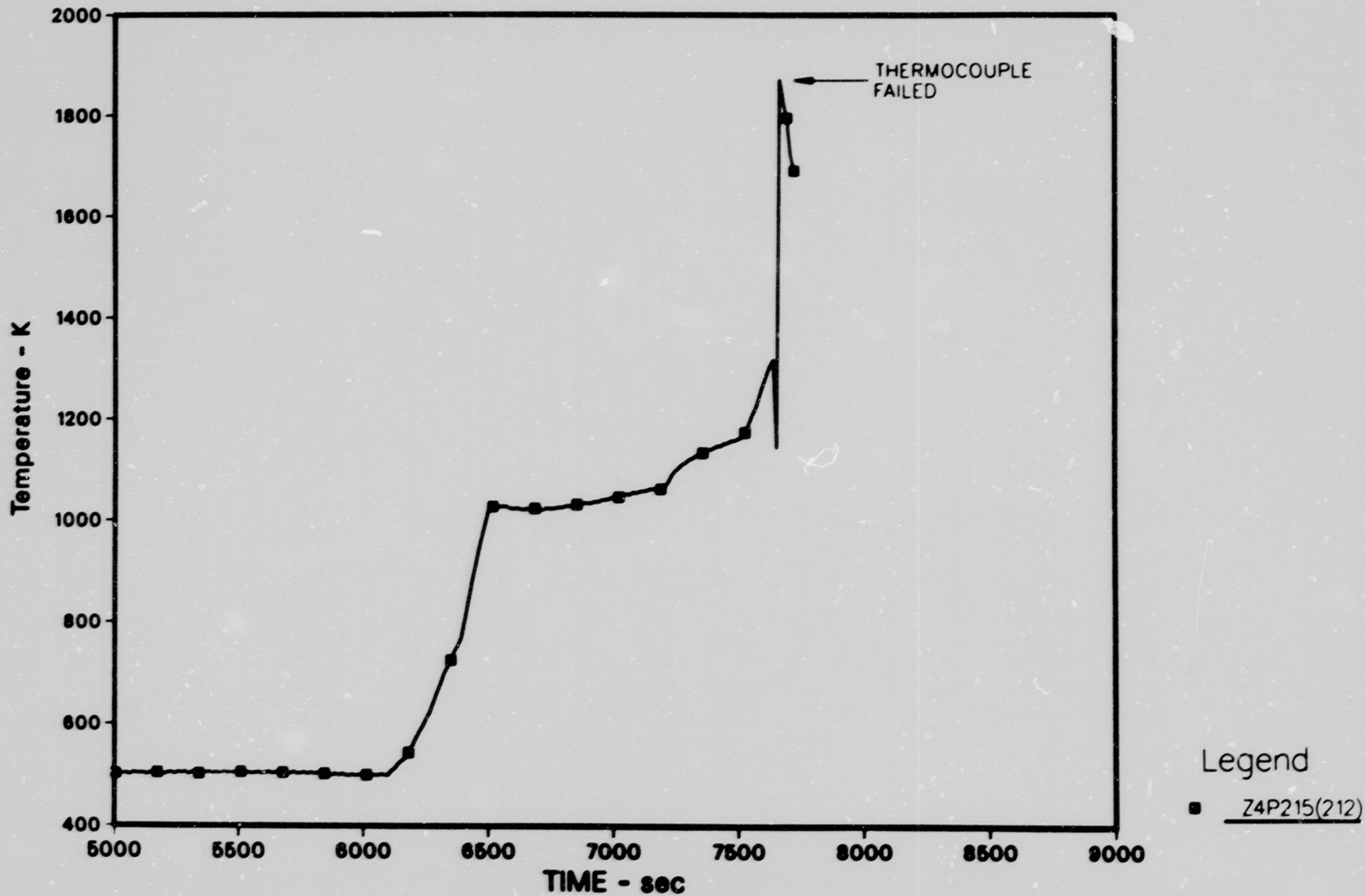




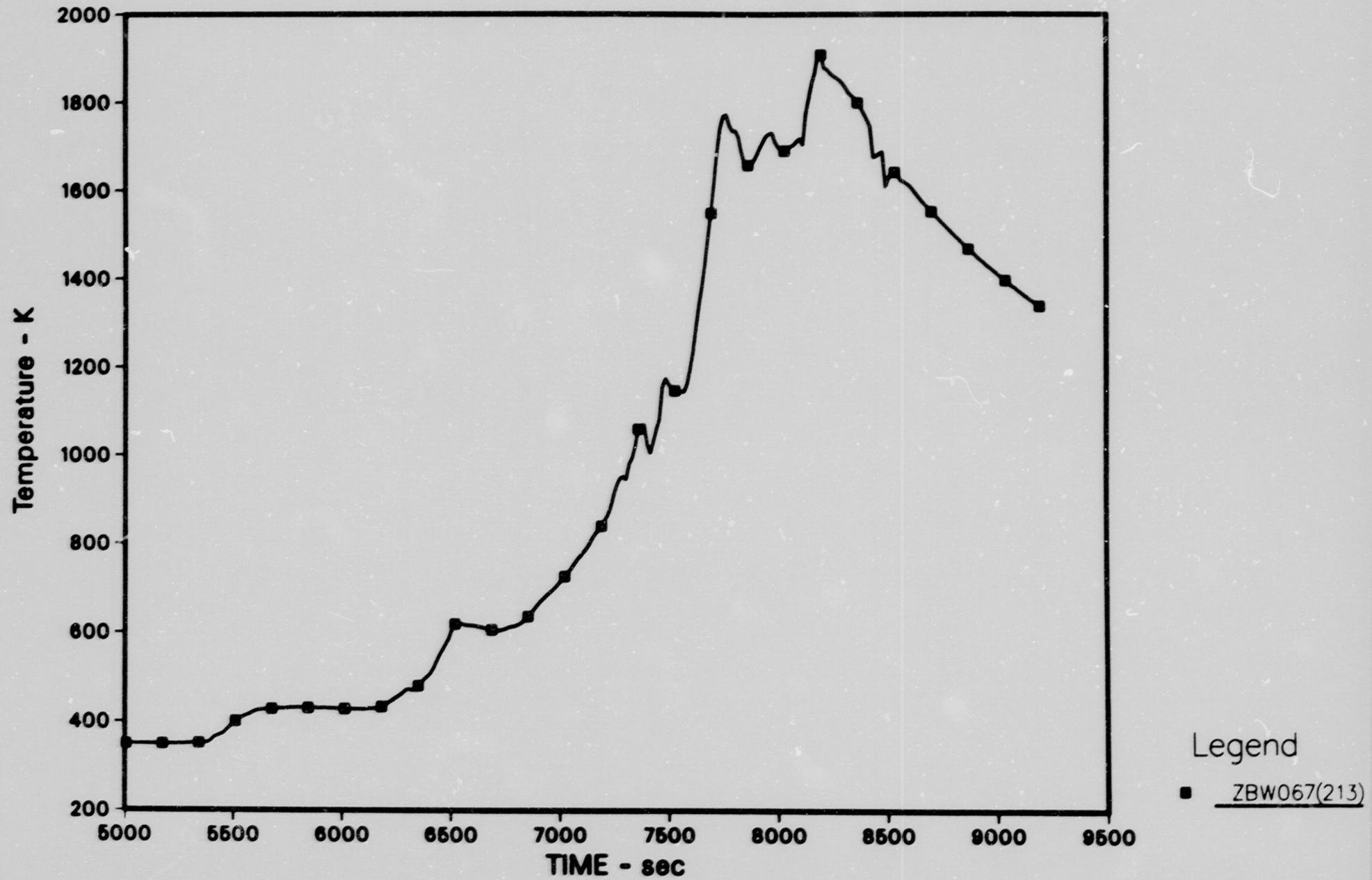
# DF-4 Zr Clad Rod #4, Pt/Rh 11.5in Below Fuel Supp.



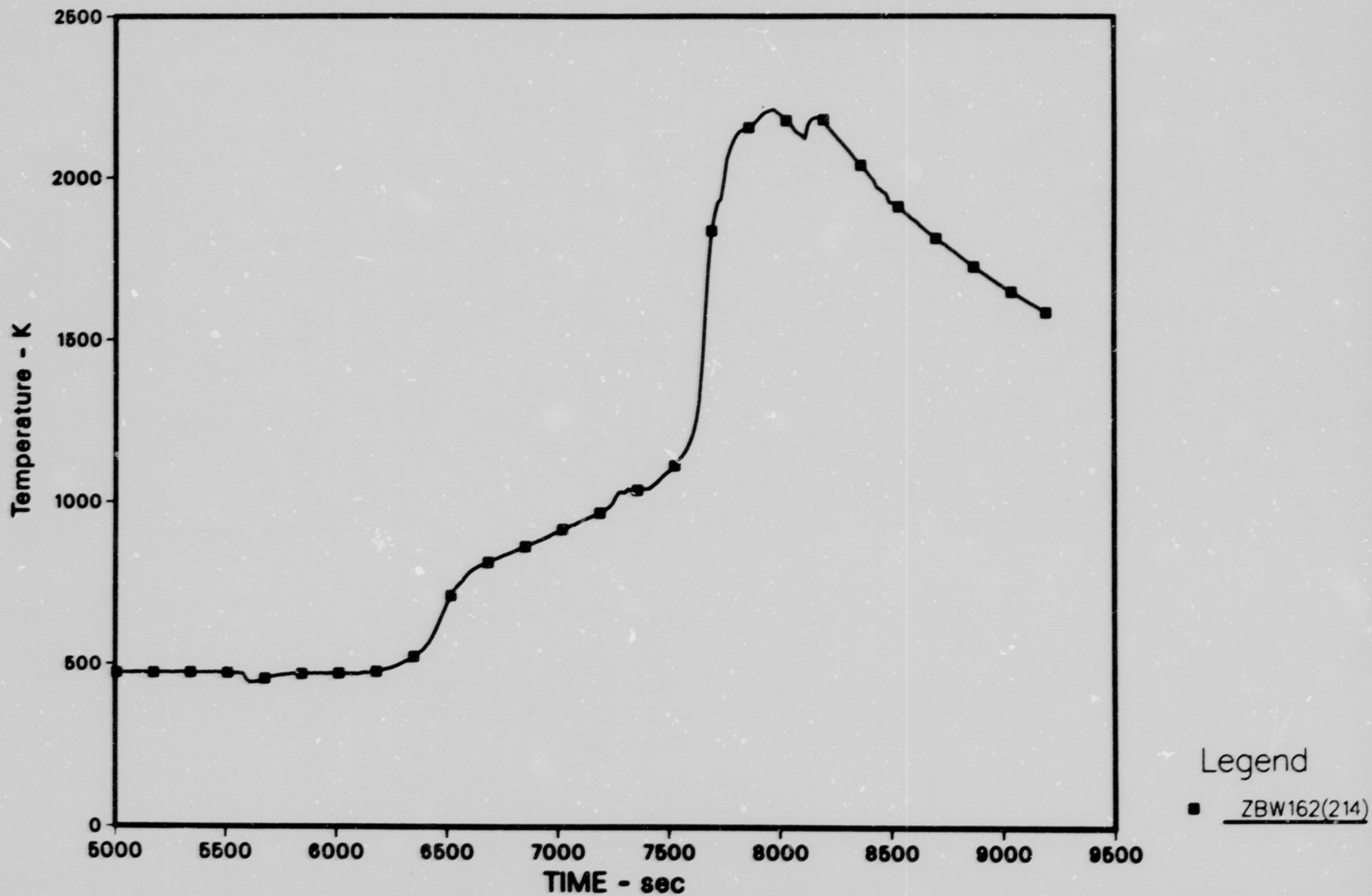
# DF-4 Zr Clad Rod #4, Pt/Rh 21.5in Below Fuel Supp.



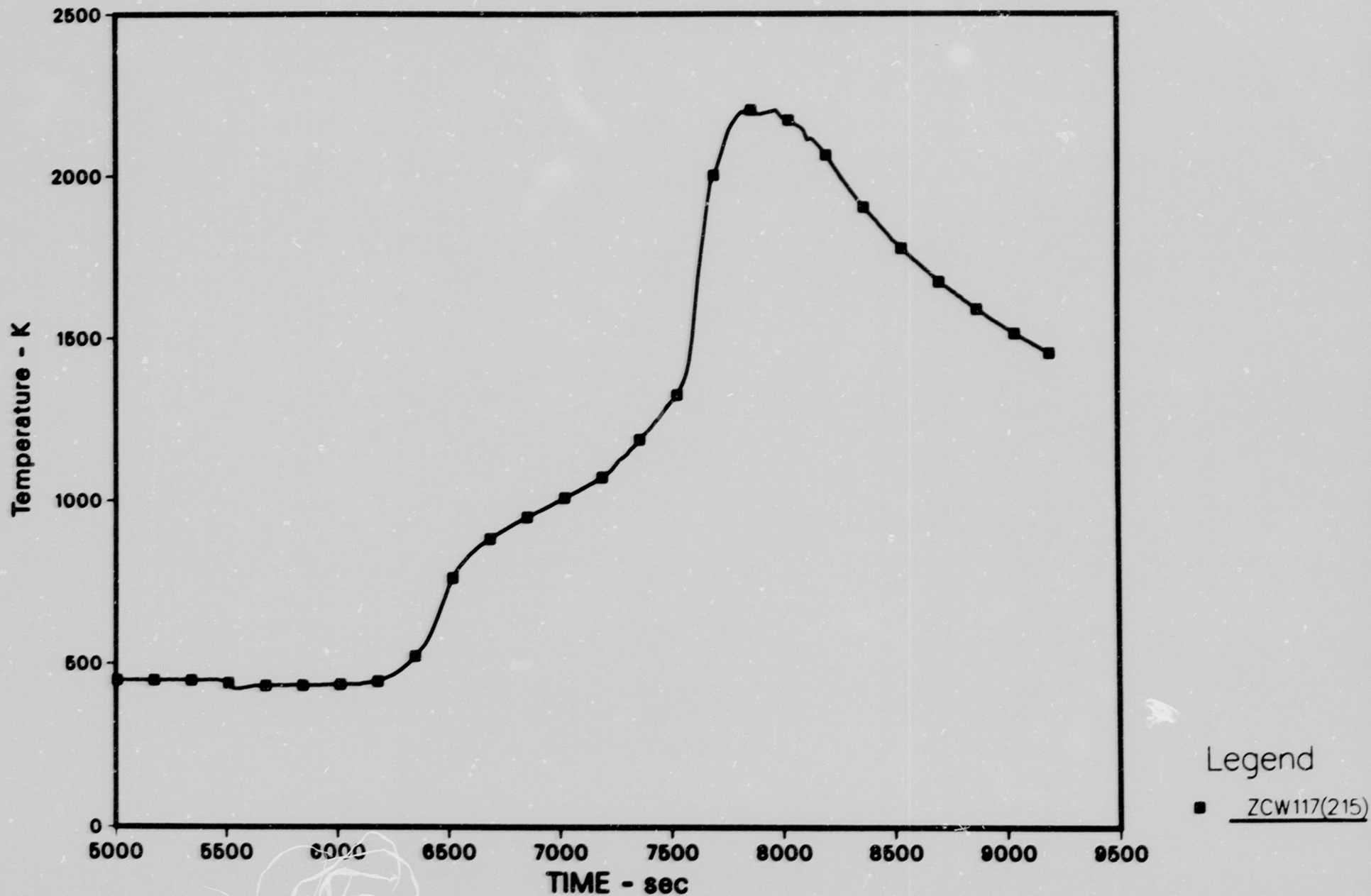
# DF-4 Zr Clad Rod #11, W/Re 6.7In Below Fuel Supp.



# DF-4 Zr Clad Rod #11, W/Re 16.2in Below Fuel Supp.



# DF-4 Zr Clad Rod #12, W/Re 11.7in Below Fuel Supp.



# DF-4 Zr Clad Rod #12, W/Re 21.7in Below Fuel Supp.

