

# Heat Transfer Training Systems

Educational Training Equipment for the 21st Century

Bulletin 689-9E

## H-6899A Thermal Radiation Demonstrator

### Purpose

The Hampden **Model H-6899A** Thermal Radiation Demonstrator is designed to enable the student to investigate fully the fundamental aspects of radiation heat transfer. Radiant energy emitted from various sources is absorbed by media with different characteristics.

### Description

This unit allows the student to verify experimentally the following important laws governing radiant energy heat transfer:

- Planck's Law of Radiation
- Stefan-Boltzmann Law
- Wien's Displacement Law
- Kirchoff's Law of Thermal Radiation
- Prevost's Law of Radiant Intercommunication
- Newton's Law of Cooling
- Lambert's Cosine Law
- Lambert's Law of Absorption

The **Model H-6899A** also enables student study of the following areas of radiation heat transfer:

- Blackbody Radiation
- Non-Blackbody Radiation
- Radiation Shape Factor
- Radiation Shield
- Radiation Heat Transfer Coefficient
- Radiation Effects on Temperature Measurement
- Radiation Absorptivity of Gases and Vapor
- Three-Dimensional Radiation Profile of an Emitter
- Infrared and Optical Absorptivities
- Freezing Point of Elemental Metals
- Melting Point of Elemental Metals
- Optical Energy Intensity (Photometer)
- Radiation Communications Network
- Numerical Solution Methods

**MODEL H-6899A-CDL**  
Thermal Radiation Demonstrator  
w/Computer Data Logging  
Dimensions: 57"H x 72"L x 34"D  
Shipping Weight: 350 lbs



### Optional Accessories

**H-6899A-10**  
Long Pass Filter option

**H-6899A-20**  
Narrow Band Pass Filter option

All Hampden units are available for operation at any voltage or frequency

**Hampden**  
ENGINEERING CORPORATION

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## Description

This unit is furnished with the necessary radiant energy emitter and instrumentation. These items include:

### Electric Muffle Furnace

Can maintain any temperature from 212°F–2012°F (100°C–1100°C) with a regulation of  $\pm 41^\circ\text{F}$  ( $\pm 5^\circ\text{C}$ ). The unit has a heat-up time of 12 minutes and is equipped with a solid state electronic controller for direct digital selection of the temperature. Approximates an ideal blackbody.

### Cylindrical Radiator

Heatable from room temperature to 1202°F (650°C) with near blackbody characteristics.

### Plane Surface Radiator

Heatable from room temperature to 400°F (204°C) with near blackbody characteristics.

### Point Type Optical Radiator

### Point Type Thermal Radiator

### Digital Temperature Display

Accurate to within  $\pm 49^\circ\text{F}$  ( $\pm 0.9^\circ\text{C}$ ) and calibrated for use with type T thermocouples.

### Thermocouple Probes

Supplied are 3 type T thermocouple probes which are rated up to 1832°F (1000°C). Included are a general purpose probe, a surface probe and a probe with a radiation shield.

### Thermocouples

Type T (Chromel-alumel) located on the various test surfaces.

### Photometer (Light Meter)

Photoelectric cell with an integral meter.

### Thermopile

Thermoelectric sensors with two-axis directional sensitivity.

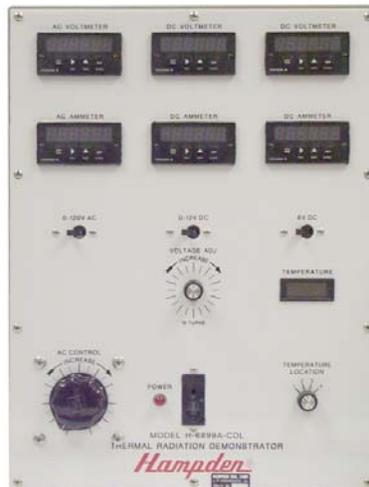
H-6899A Front Control Panel  
Shown with Digital Meters

## Experiment Capability

This unit comes supplied with student and teacher manuals. All of the experimental fixtures necessary to perform any of the experiments listed in the student manual are supplied with the demonstrator. These fixtures include a 48" scaled track for mounting the various radiators, and test geometries.

The test geometries are constructed out of different metals and have emissivities from 0.03 to 0.98. These test geometries also come in different sizes and shapes, namely flat plates, circular disks, coaxial cylinders and cylindrical holes. Radiation shields are also provided which include high temperature glass shields, through low temperature Lexan® shields. Two crucibles are provided to measure the freezing point of different elemental metals and come equipped with thermocouples. Two insulated flasks, capable of handling cryogenic materials and properly thermocoupled, are supplied to conduct experiments in low-temperature radiation. A cylindrical metal container with transparent ends is supplied to conduct experiments in gaseous absorption and emission.

Additionally, all test geometries have temperature labels on them to indicate if the unit is hotter than 104°F (40°C).



## Equipment Accessories

Included with this unit are all of the necessary accessory items needed to make a safe, workable system. These accessory items include the following:

- Instrument case which houses the digital temperature display, thermocouple selection switch, circuit breaker, pilot lights, furnace power switch, and thermocouple panel jacks.
- Heat-resistant gloves rated to 1112°F (600°C).
- Crucible tongs - nickel-plated with a 20 inch reach.
- Power cord - 10 feet long.
- Experiment & Teacher Manuals - includes background theory and list of suggested experiments.

The entire unit is permanently mounted on a mobile table constructed of code gauge furniture stock steel finished in instrument tan texture. It is 36" high by 72" wide by 34" deep. There are 2 swivel and 2 locking swivel 4-inch casters to enable easy movement of the unit. The table includes drawer space for convenient storage of all equipment not permanently attached to the table.

## Input Voltage:

120VAC-1 $\phi$ -30A-60 HZ

## Computer Data Logging

This feature adds three type-T dual thermocouples along with digital meters w/analog outputs to the system. One interface package containing National Instruments I/O modules is provided for interfacing into a PC computer through the USB port.

Computer is not included. Templates for LabVIEW® control software are included. LabVIEW® not included.

Specify **MODEL H-6899A-CDL**

All Hampden units are available for operation at any voltage or frequency

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