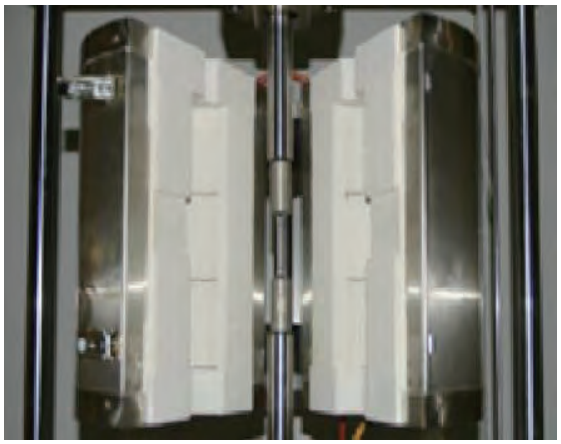
High Temperature Split Tube Furnace



Features:

- Machine Test and Laboratory
- Faster heat up
- Longer element life
- Lower shell temperatures
- Complete line of accessory
- Low watt-density heating elements
- Low K-factor vacuum-cast ceramic fiber i nsulation
- Wide variety of diameters, lengths, sizes, and configurations
- Easy replacement of failed elements
- Precise, Efficient, and Reliable
- Made to Customer Specifications
- Saving you time and money
- Heating elements Nichrome: 1850° F (1000° C)
- Optional elements Kanthal A1: 2200° F (1200° C)

Applications:

- General laboratory
- Machine Test
- Use for testing to ASTM standards
- Universal testing machines
- Creep/stress rupture test
- Stress corrosion cracking test
- High strain rate material test
- Bend fatigue test machines

Description:

Advance Instrument Inc. (AI) Series 4110 Tube and 4210 Split Tube Furnaces have been carefully designed and refined over many years to make them one of the most reliable and efficient laboratory furnaces available on the market today.

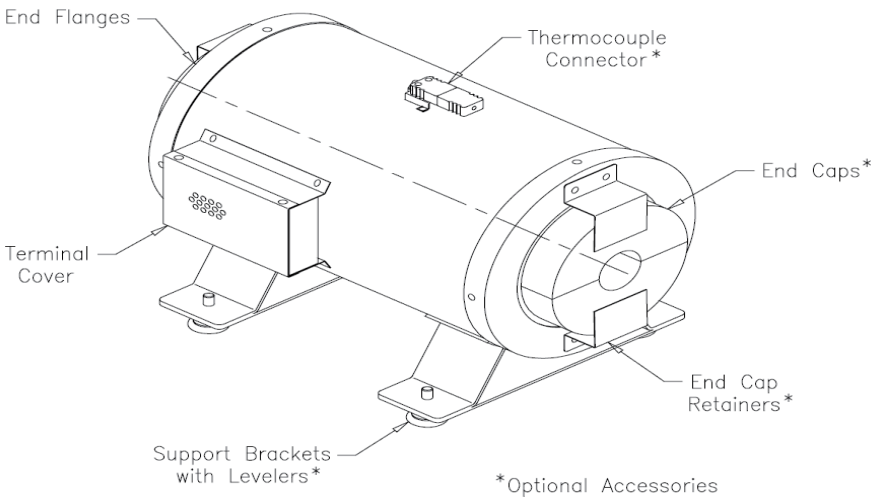
Standard construction features include low K-factor vacuum cast ceramic fiber insulation for superior energy retention and rigid structure, stainless steel shell and end flanges for both durability and appearance, and laboratory-replaceable heating elements manufactured under strict quality-controlled conditions in our own factory.

All Series 4110/4210 furnaces are built-to-order to your specific requirements, with a wide selection of available diameters, lengths, mounting arrangements, and accessory equipment, in a variety of configurations, including isothermal, gradient, adiabatic, and others.

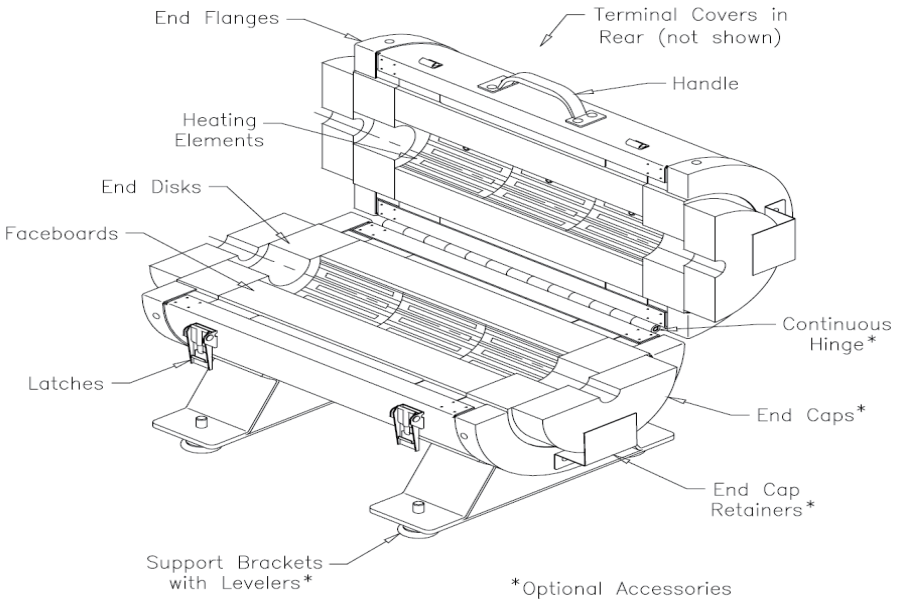
Available options and accessories include heat-equalizing liners, extensometer slots and mounting flats, thermocouples, end caps, view ports, gas ports, cast bronze or brass heating elements, retorts, and more.

High Temperature Split Tube Furnace

Specification: Series 4110/4210 Furnace



Series 4110 Tube Furnace 1100° C Maximum

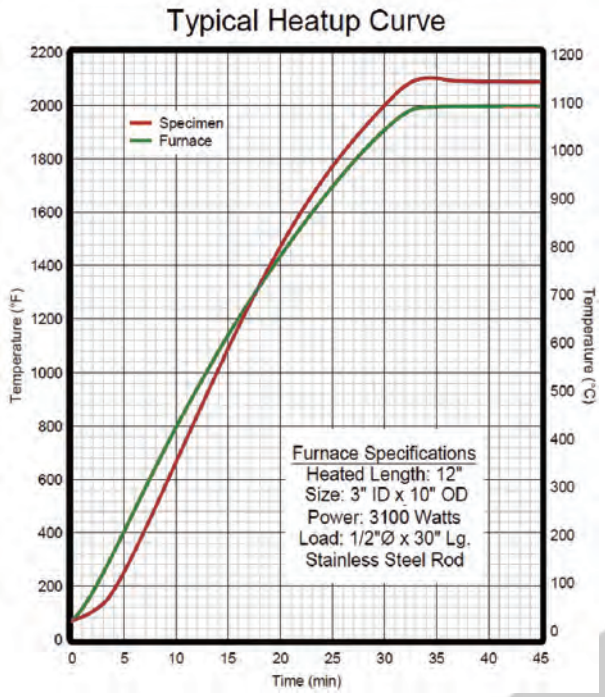


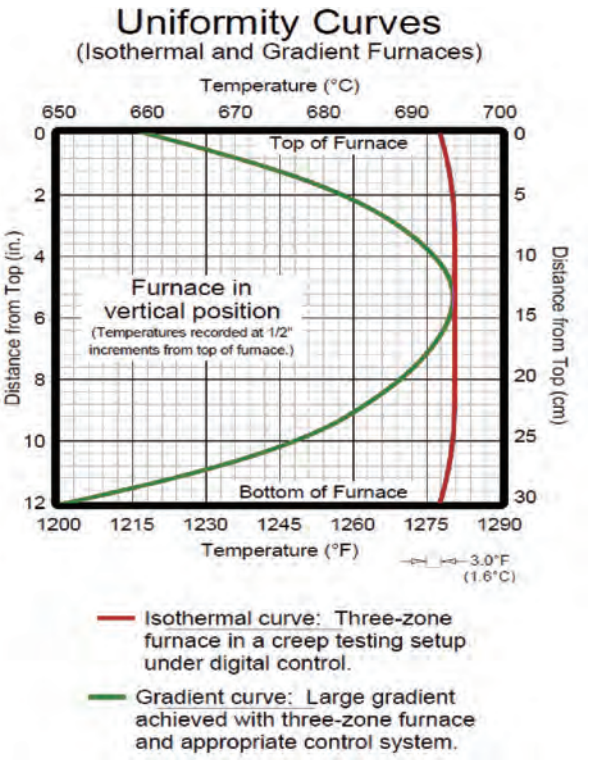
Series 4210 Split Tube Furnace 1200° C Maximum

High Temperature Split Tube Furnace

Specification: Series 4110/4210 Furnace

- Creep Testing Furnaces For the ultimate in precise temperature control and uniformity, AI furnaces can be combined with our exclusive computer creep system.
  This industry-leading hardware/software package automates every aspect of the creep testing process, including control, data acquisition, archiving, analysis, report generation, and much more.





Other sizes supplied on request Length & zone construction made to order Heating elements and temperature range:
Nichrome: 1850° F (1000° C)
Kanthal A1: 2200° F (1200° C)

Typical 4110/4210 Furnace Sizes		
For service to	For service to	For service to
1650° F (900° C)	2000° F (1100° C)	2200° F (1200° C)
"ID" x "OD"	"ID" x "OD"	"ID" x "OD"
19.1mm x 152.4mm	19.1mm x 203.2mm	19.1mm x 254.0mm
25.4mm x 152.4mm	25.4mm x 203.2mm	25.4mm x 254.0mm
31.8mm x 152.4mm	31.8mm x 203.2mm	31.8mm x 254.0mm
41.1mm x 203.2mm	41.1mm x 254.0mm	41.1mm x 304.8mm
50.8mm x 203.2mm	50.8mm x 254.0mm	50.8mm x 304.8mm
60.5mm x 203.2mm	60.5mm x 254.0mm	60.5mm x 304.8mm
76.2mm x 203.2mm	76.2mm x 254.0mm	76.2mm x 304.8mm
95.3mm x 254.0mm	95.3mm x 304.8mm	95.3mm x 355.6mm
127.0mm x 254.0mm	127.0mm x 304.8mm	127.0mm x 355.6mm
139.7mm x 304.8mm	139.7mm x 355.6mm	139.7mm x 406.4mm
152.4mm x 304.8mm	152.4mm x 355.6mm	152.4mm x 406.4mm
177.8mm x 304.8mm	177.8mm x 355.6mm	177.8mm x 406.4mm
209.6mm x 406.4mm	209.6mm x 457.2mm	209.6mm x 508.0mm
304.8mm x 508.0mm	304.8mm x 558.8mm	304.8mm x 609.6mm

High Temperature Split Tube Furnace

Accessories : End Caps & Port Plugs, Temperature Sensors

- End Caps & Port Plugs

AI furnaces are commonly supplied with removable and replaceable ends caps or port plugs.

These relatively inexpensive accessory items extend furnace life by absorbing “wear and tear” caused by the movement of fixtures, reactors, pull rods, etc., thereby preventing damage to the furnace insulation, which is considerably more expensive and time-consuming to replace.

AI end caps and port plugs are also useful in situations where a number of different-sized bore diameters are required.

They can be easily interchanged, allowing a variety of possible configurations for a single furnace.

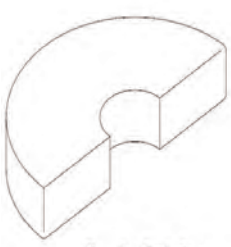


Fig. 1: End Caps

Fig. 2: Port Plugs

- Temperature Sensors

Furnaces from AI can be equipped with a number of different thermocouple types in a variety of mounting configurations.

Thermocouple connectors feature standard ANSI color coding and are available in types J, K, B, R, S, and Platinel-II.

Common mounting configurations include single connector with mounting bracket, duplex connector with mounting bracket, spring loaded for constant contact with a reactor or other vessel, and sealed for use in controlled-atmosphere furnaces, retort

T/C Type	Alloy Combination (+/−)	Max. Temperature	Limits of Error	Comments
ANSI "J"	Fe/Cu−45% Ni	1100°F (590°C)	2.2°C or 0.75%	Reducing, vacuum, inert. Limited use in oxidizing at high temperatures. Not recommended for low temperatures.
ANSI "K"	Ni−10% Cr/ Ni−2% Al−2% Mn−1% Si	2200°F (1200°C)	2.2°C or 0.75%	Clean oxidizing and inert. Limited use in vacuum or reducing. Wide temperature range. Most popular calibration.
ANSI "B"	Pt−30% Rh/Pt−6% Rh	3272°F (1800°C)	0.5% above 800°C	Oxidizing or inert. Do not use in metal tubes. Beware of contamination. High temperature. Common use in glass industry.
ANSI "R"	Pt−13% Rh/Pt	2700°F (1480°C)	1.5°C or 0.25%	Oxidizing or inert. Do not use in metal tubes. Beware of contamination. Precision high temperature.
ANSI "S"	Pt−10% Rh/Pt	2700°F (1480°C)	1.5°C or 0.25%	Oxidizing or inert. Do not use in metal tubes. Beware of contamination. Precision high temperature.
Platinel−II	Platinel−II/Platinel−II	2200°F (1200°C)	1.0%	More stable but more expensive substitute for type "K" thermocouples.

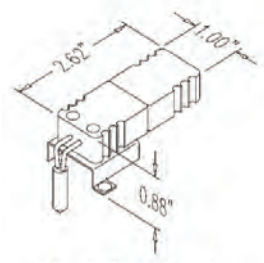


Fig. 3: Single Bracket

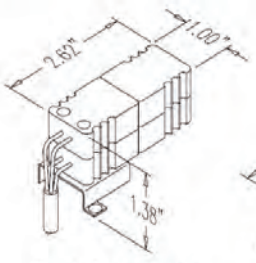


Fig. 4: Duplex Bracket

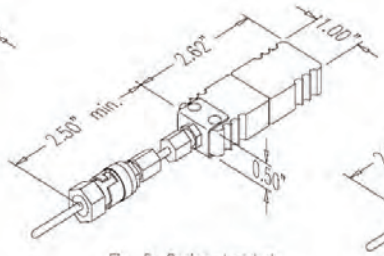


Fig. 5: Spring-Loaded

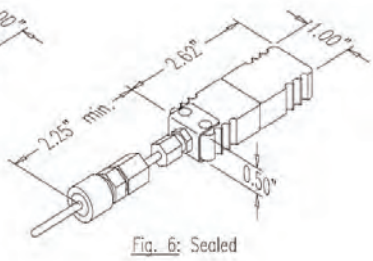


Fig. 6: Sealed

High Temperature Split Tube Furnace

Accessories :

Extensometer Flats & Slots, High Temperature Sample Supports, Zone Dividers

- Extensometer Flats & Slots

When performing creep, stress-rupture, and other tests, it is often necessary to have one or more precision extensometers in place to record dimensional changes that occur in a specimen throughout the process.

While some extensometers are designed to hang vertically from a specimen to take these measurements, many are intended to contact a specimen from one side, requiring a specially-configured furnace to provide clearance for the extensometer and, in some cases, to also provide support for it.

AI has extensive experience in designing such furnaces to suit extensometers from nearly every major supplier. When ordering, please have the information shown in Figure 1 (right) available:

a) distance from surface of fl at to center of furnace;
b) height of fl at;
c) size (width & height) of access slot;
d) sizes & locations (if necessary) of tapped holes for mounting of the extensometer. If available, please also provide the manufacturer and model number of the extensometer being used.

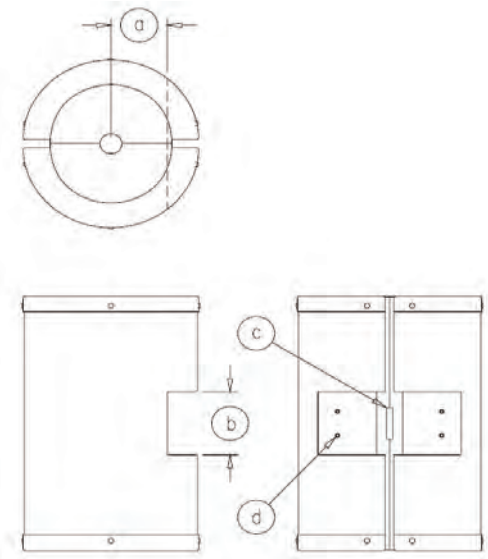


Fig. 1:
Split tube furnace constructed for extensometer mounting

- High Temperature Sample Supports

For laboratory tests or industrial procedures that do not involve test frames, it is often necessary to have some method of providing support for samples or products that must be heated. AI meets this need with custom sample supports, specimen holders, and high-temperature pallets made from stainless steel or Inconel for use with fork trucks.

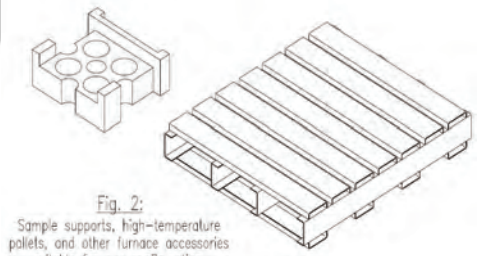


Fig. 2:
Sample supports, high-temperature pallets, and other furnace accessories suitable for any configuration.

- Zone Dividers

Some heating applications involving gasses, liquids, or other substances require a sharp temperature gradient between furnace heating zones.

In such cases, AI furnaces can be constructed with insulating zone dividers to accommodate the required temperature difference

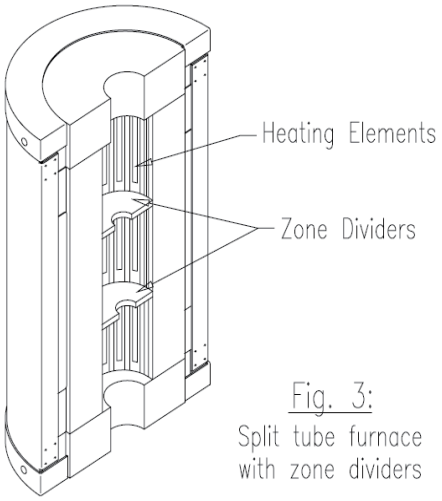


Fig. 3:
Split tube furnace with zone dividers

High Temperature Split Tube Furnace

Accessories : Element Protection Shields, Sealed Terminal Covers, Perforated Heat Shields, Heat Equalizing Blocks, Access Ports

- Element Protection Shields

Upon breakage, some specimens or samples can create flying debris inside a furnace chamber.
Other processes involve reactor vessels with high-pressure liquids or gasses, creating the possibility of pipe rupture.

In such cases, internal element protection shields are recommended to prevent damage to furnace heating elements.

AI tube and split tube furnaces can be supplied with either solid or perforated sheet metal shields, or they can be constructed with embedded ceramic tubes.
Contact AI to discuss the best option for your application.

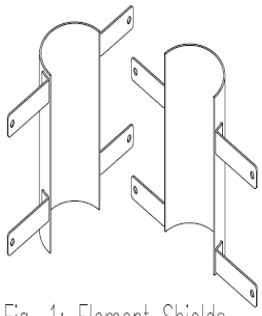


Fig. 1: Element Shields
(for split tube furnaces)

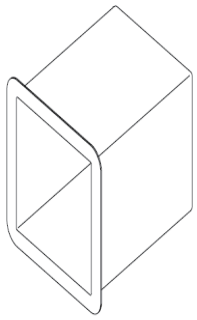


Fig. 2: Protective Liner

- Sealed Terminal Covers

When heating processes are being conducted in hazardous or corrosive environments, or where required by safety codes, AI furnaces can be supplied with sealed terminal covers. Sealed covers feature high-temperature silicone rubber gaskets and are supplied in either cast aluminum or formed stainless steel, depending upon the size, type, and power rating of the furnace.

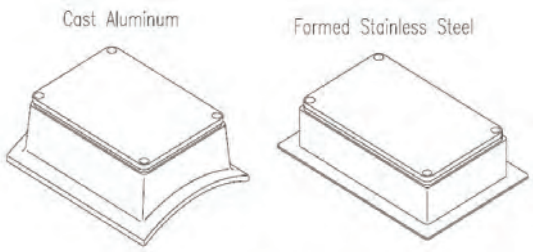


Fig. 3: Sealed Terminal Covers

High Temperature Split Tube Furnace

Accessories : Element Protection Shields, Sealed Terminal Covers, Perforated Heat Shields, Heat Equalizing Blocks, Access Ports

- Perforated Heat Shields

AI furnaces are designed for maximum efficiency and low external shell temperatures.

However, those who have experience working with high-temperature equipment know that any furnace will be relatively hot on the outside during operation and that appropriate safety precautions must be taken.

While this situation is acceptable in most laboratory environments, many manufacturing facilities that use AI equipment must meet stringent safety requirements for the protection of their workers.

To satisfy this need, AI furnaces can be supplied with external perforated sheet metal screens, which significantly reduce an operator's exposure to hot surfaces on the furnace shell.

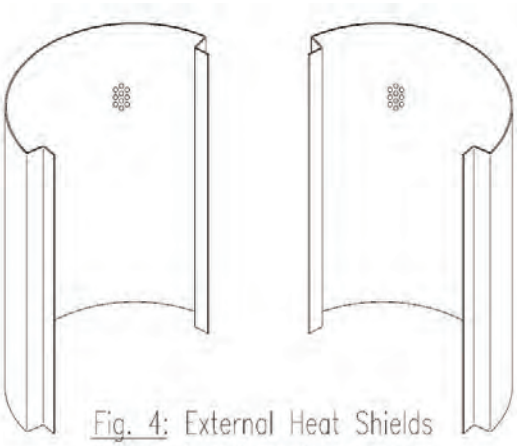


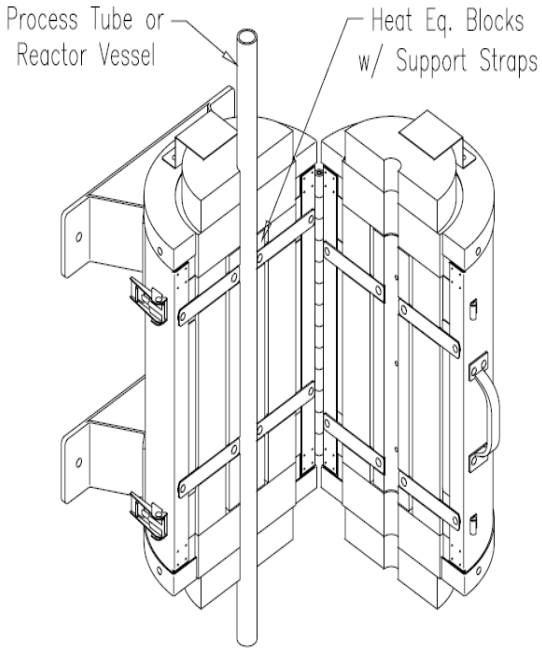
Fig. 4: External Heat Shields
Available for tube or box furnaces, solid or split, in a variety of configurations.

High Temperature Split Tube Furnace

Accessories : Element Protection Shields, Sealed Terminal Covers, Perforated Heat Shields, Heat Equalizing Blocks, Access Ports

- Heat Equalizing Blocks

Some applications require extreme temperature stability. Achieving this goal requires the addition of a stabilizing thermal mass, or core, to the inside of a heat zone.



AI furnaces can meet this need with the addition of heat equalizing blocks to help ensure that maximum temperature uniformity is maintained, either in a single furnace zone or along the entire length of a furnace. Though virtually any metal can serve as a core material, the most common alloy used in AI furnaces is AMPCO-18 cast aluminumbronze, chosen for its relatively high operating temperature (1100 ° F/600 ° C maximum) and its excellent thermal conductivity. Other materials that have been or could be used depending upon the process involved include stainless steel, aluminum, copper, nickel alloys such as Inconel, and others.

Common applications for heat-equalizing blocks include petrochemicals research, pilot plant development, gas and liquid pyrolysis, calibration, viscosity testing, and crystal growth. Custom blocks can be designed for use with any AI furnace and can include such additional features as thermocouple ports, cooling ports, removable blocks with lifting handles, etc.

- Access Ports

Because all AI furnaces are built-to-order, nearly any variety or type of access port can be placed wherever necessary to suit your requirements.

Types of ports include gas inlets and outlets, purging ports, cooling and vent ports, thermocouple ports and thermowells, load train ports, metal-lined ports, or whatever else your specifications demand.

High Temperature Split Tube Furnace

Mounting: Test Frame Mounting Assemblies, Structural Frames, Vertical Support Columns, UTM Baseplate

- Test Frame Mounting Assemblies

AI offers a number of standard test frame mounting assemblies, as shown on the following pages.

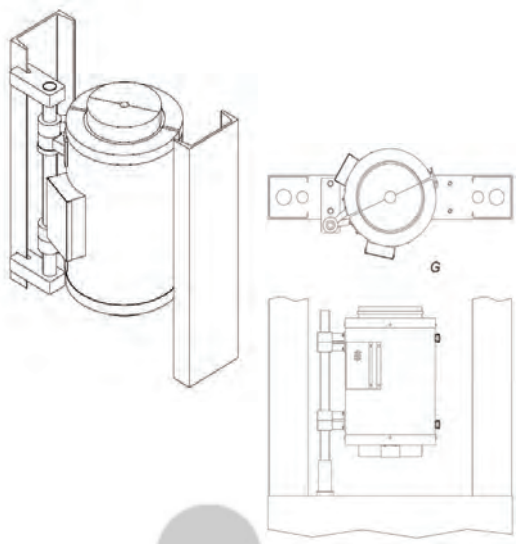
Mounting assemblies are suitable for use with tube, split tube, and split box furnaces and can be reversed for either left-hand or right-hand operation.

The accompanying diagrams demonstrate two-column test machines, but each assembly can easily be adapted to fit four, six, or any number of test frame support beams or columns.

As always, custom mounting inquiries are welcome.

- UTM Baseplate

Many universal testing machines do not provide a suitable means of mounting a furnace.
In such cases, a miniature baseplate with furnace bar can be mounted to the lower crosshead of the machine, as shown in figure G.



G) UTM Baseplate Mounting Assembly:
Shown is a single pivot mounting assembly with a baseplate bracket. Any of the mounting assemblies on this page can be accommodated in this way.

High Temperature Split Tube Furnace

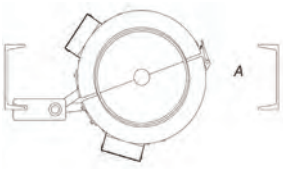
Mounting: Test Frame Mounting Assemblies, Structural Frames, Vertical Support Columns, UTM Baseplate

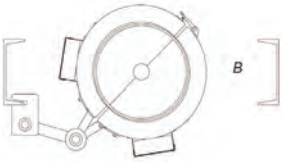
- Structural Frames

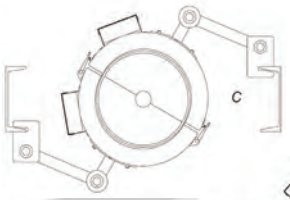
Many systems, including creep testing frames, industrial support structures, and "homemade" laboratory test frames, use structural steel beams in their design.

AI produces a wide array of structural frame clamps, furnace bar brackets, and mounting brackets to fi t such configurations.

These components form the basis for mounting assemblies A, B, and C, shown at left.







A) Single Pivot Mounting Assembly:
This is the simplest and least expensive option for vertical mounting of a furnace on a structural frame.

B) Double Pivot Mounting Assembly:
Offering more versatility than a single pivot mounting assembly, this option allows some adjustment in the location of the furnace centerline, and it allows the furnace to easily swing out of the way when not in use.

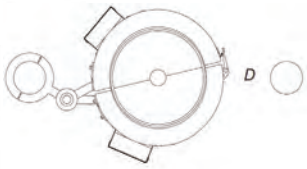
C) Dual Double Pivot Mounting Assembly:
With both furnace halves able to move freely, this mounting assembly offers maximum versatility in setting up load train components and tests.
This configuration is also sometimes the only suitable option in restricted-space situations.

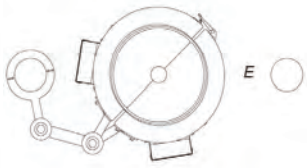
- Vertical Support Columns

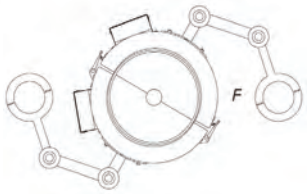
Universal testing machines, fatigue testers, and other systems often feature vertical columns in their design.

AI produces mounting assemblies for these machines which are similar to the structural frame mounting options on the preceding page.

Vertical-column mounting assemblies are shown at left in figures D, E, and F.







D) Single Pivot Mounting Assembly:
Similar to figure A on the previous page.

E) Double Pivot Mounting Assembly:
Similar to figure B on the previous page.

F) Dual Double Pivot Mounting Assembly:
Similar to figure C on the previous page.

High Temperature Split Tube Furnace

Accessories : Temperature Control Systems

- Complete Temperature Control Systems:
  Shown above are examples of complete single and multi-zone furnace temperature control systems. Available features include cabinets with rack-mount panels, transformers, SCR units, gas/cooling supply systems, and other options.

  Whatever your specific application may be, AI has the knowledge and experience to build a control system to suit all of your needs.
  PC software for computerized configuration.

- Temperature Control Systems
  It is obvious that a furnace can only be as precise as its control system.
  Since the beginning, therefore, AI has placed great emphasis on providing complete, accurate temperature control systems using only the highest-quality components.

  AI currently specializes in control systems using the three units shown below, which have been selected for their accuracy, versatility, and reliability.

  Custom control systems are also available using any major-brand temperature controller, including Honeywell, Watlow, SHIMAX, OMRON, and others. Consult an AI sales engineer to discuss your ideal temperature control system.

- SHIMAX MAP6A / MAC6A Series Digital Controller (96 x 96 mm)
  - •High Accuracy 0.1%Fs + 1 digit.
  - •Program MAX 96steps 8patterns. (MAP6A)
  - •MAX 4zone PID control.
  - •Universal input. (Thermo couple RTD, DC voltage, DC current)
  - •Sampling Period 50msec, 166.7msec, 250msec, 500msec.
  - •PV-SV multi points compensation. (MAX11 points)
  - •Space-saving Design : Panel depth 65 mm

High Temperature Split Tube Furnace

Accessories : Temperature Control Systems

- OMRON E5CN-H (48 x 48 mm)
  Advanced Digital Temperature Controller
  A New High-performance Controller: High Resolution, High Speed, andHigh Input Accuracy.
  Logic Operations and Preventive Maintenance Function.
  - High-resolution display with 5 digits/0.01° C display in a compact Controller (48 x 48 mm).
  - High-speed sampling cycle of 60 ms.
  - High Accuracy Thermocouple/Pt input: ± 0.1% of PV, Analog input: ± 0.1% FS
  - Universal inputs on all models (thermocouple, PT, or analog input) to handle various sensors with one Controller.
  - A PV/SV-status display function can be set to automatically alternate between displaying the status of the Temperature Controller (auto/ manual, RUN/ STOP, and alarms) and the PV or SV.
  - Flexible contact outputs with logic operations (AND, OR, and delays) set from the Support Software (CX-Thermo Ver. 4.0)
  - Preventive maintenance for relays in the Temperature Controller using a Control Output ON/OFF Counter.