

July 27, 2023

Director
Environmental Compliance and Enforcement
Manitoba Environment and Climate
Box 35, 14 Fultz Blvd
Winnipeg, Manitoba R3Y 0L6

Client File: 5791.00

Notice of Alteration – Price Industries Ltd. – EAL No. 3169

Dear Director,

Price Industries Ltd. (PIL) is submitting a Notice of Alteration (NoA) request to Environment Act Licence No. 3169 for the 638 Raleigh Campus location. The submission includes three alteration requests to the current Licence as described below.

Solvent Recycling

As part of our routine inspection on August 29, 2022, a proposed solvent recycling process was identified as requiring a Notice of Alteration. PIL initiated the installation of a solvent recycling system in Q4 2022 for recycling of methyl ethyl ketone. The unit has been in operation starting Q1 2023. PIL requests the solvent recycling process be added to the scope of Client File 5791.00, EAL No. 3169.

Dangerous Goods and Transportation Act 8 HW

As part of a routine inspection on August 29, 2022, it was identified Dangerous Goods and Transportation Act Licence No.8 HW was issued for a burn-off oven that has been decommissioned. The original oven was moved to an alternate location within the 638 Raleigh Street Facility and a second oven was added. The original oven was decommissioned in-situ. The second oven is operational. PIL requests Client File 2722.00, DGHTAL No. 8 HW be rescinded, and the operational burn-off oven be added to the scope of Client File 5791.00, EAL No. 3169.

Wax Melting Pot Exhaust

The scope of the proposed project is to modify the ducting of an existing fume extractor to remove the fumes generated by the operation of a bench top wax melting pot, cap un-used extraction points, and install ducting to draw hot air out of the area. The wax melting pot operation is not hazardous to humans or the environment. The operation is creating an indoor odor nuisance for our operators. PIL requests the alteration to the ducting and discharge to the outdoor environment be approved and added to the scope of Client File 5791.00, EAL No. 3169.

Please find enclosed the following:

1. Notice of Alteration Form
2. Notice of Alteration Detailed Report
3. Appendix A – Uni-Ram User Manual URS900 CE Series
4. Appendix B – Appendix B – GUSPRO INC. Heat Cleaning Ovens Operations & Maintenance Manual Ovens with E Burners
5. Appendix C – Safety Data Sheet – Evans Coatings LLC – Type II: B-52
6. Appendix D – Technical Data Sheet – Evans Coatings LLC – Type II: B-52

Yours truly,

Sheena Porco C.E.T, EPt
EHS Specialist

Price Industries Limited
638 Raleigh Street | Winnipeg, MB | R2K 3Z9
Phone: 204-669-4220 | Mobile: 204-295-8139
SheenaP@priceindustries.com

Notice of Alteration Form



File No. : 5791.00	Environment Act Licence No. : 3169
Legal name of the Licencee: Price Industries Ltd.	
Name of the development: Price Industries Ltd.	
Category and Type of development per Classes of Development Regulation: Manufacturing <input type="button" value="v"/> <SELECT>	
Licencee Contact Person: Sheena Porco Mailing address of the Licencee: 638 Raleigh Street City: Winnipeg Province: Manitoba Postal Code: R2K 2V2 Phone Number:(204) 295-8139 Fax: Email: sheenap@priceindustries.com	
Name of proponent contact person for purposes of the environmental assessment (e.g. consultant): Sheena Porco	
Phone: (204) 295-8139 Fax:	Mailing address: 638 Raleigh Street WPG, MB R2K 3Z9
Email address: sheenap@priceindustries.com	
Short Description of Alteration (max 90 characters): Add solvent recycler, rescind DGHTAL No. 8 HW/add to EAL 3169, and exhaust wax melt fume.	
Alteration fee attached: Yes: <input type="checkbox"/> No: <input checked="" type="checkbox"/>	
If No, please explain: Alterations proposed to be minor in nature.	
Date: 2023-07-28	Signature: Printed name: Sheena Porco
<p>A complete Notice of Alteration (NoA) consists of the following components:</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Cover letter <input checked="" type="checkbox"/> Notice of Alteration Form <input checked="" type="checkbox"/> 1 hard copy and 1 electronic copy of the NoA detailed report (see "Information Bulletin - Alteration to Developments with Environment Act Licences") <input type="checkbox"/> \$500 Application fee, if applicable (Cheque, payable to the Minister of Finance) 	
<p>Submit the complete NoA to: Director, Environmental Approvals Branch Manitoba Environment, Climate and Parks 1007 Century Street Winnipeg, Manitoba R3H 0W4 EABDirector@gov.mb.ca</p> <p>For more information: Phone: (204) 945-8321 Fax: (204) 945-5229 https://www.gov.mb.ca/sd/permits_licenses_approvals/eal/licence/index.html</p>	
<p>Note: Per Section 14(3) of the Environment Act, Major Notices of Alteration must be filed through submission of an Environment Act Proposal Form (see "Information Bulletin – Environment Act Proposal Report Guidelines")</p>	

Reset

Print

Notice of Alteration Environment Act Licence No. 3169 – Solvent Recycling

Solvent Use – Liquid Paint Processes

Price Industries Ltd. (PIL) utilizes toluene, methyl ethyl ketone (MEK), and xylene in liquid paint process. The solvents are consumed in process, emitted as volatile organic compounds (VOCs), or sent off-site as hazardous waste.

Data collected during annual VOC reporting demonstrates the highest average annual release of VOCs results from the usage of MEK with an average annual mass balance release of 4,396 kg (Figures 1 and 2). To demonstrate commitment to environmental stewardship through the reduction of VOCs and comply with Clause 10 (e) of Environment Act Licence No. 3169, PIL initiated the installation of a solvent recycling system for MEK in Q4-2022 and implemented the equipment in Q1-2023.

Solvent	CAS	Average Annual Release (KG)
Methyl Ethyl Ketone	78-93-3	4,396
Toluene	108-88-3	3,394
Xylene	1330-20-7	3,796
Total Solvents	-	11,585

Figure 1: Average Mass Balance Annual VOC Release – Liquid Paint Solvents (2016-2022)

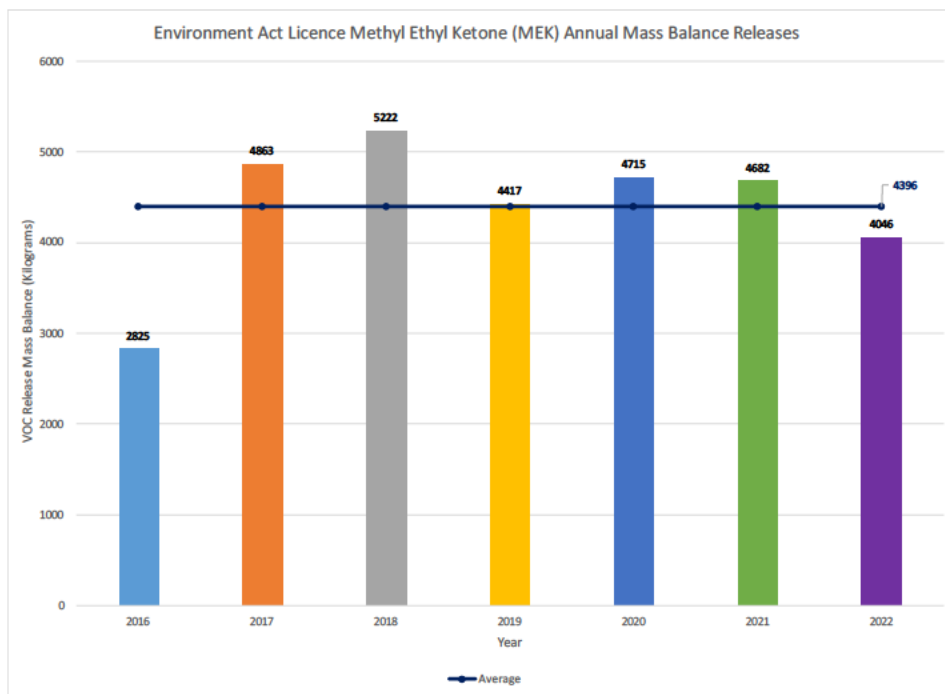


Figure 2: Average Annual Mass Balance Release of Methyl Ethyl Ketone

Solvent Recycling System – Uni-Ram URS900EP2

To reduce solvent use and VOC emissions Price implemented the Uni-Ram URS900EP2 Solvent Recycling System (Uni-Ram). The 20 L tank capacity Uni-Ram effectively reclaims solvent through distillation (vaporization and condensation); producing reclaimed solvent and paint/solvent sludge mixture. The reclaimed solvent is re-used in liquid paint processes and the sludge is transferred off-site as hazardous waste.



Photo 1: Uni-Ram Solvent Recycling System

Installation and Equipment Location

The Uni-Ram complies with CSA C22.2 No. 88 and UL2208 and was installed in compliance with all applicable Codes. The equipment is located in the northwest portion of the 638 Raleigh Street Facility in the extraction booth of the liquid paint area (Figure 3).

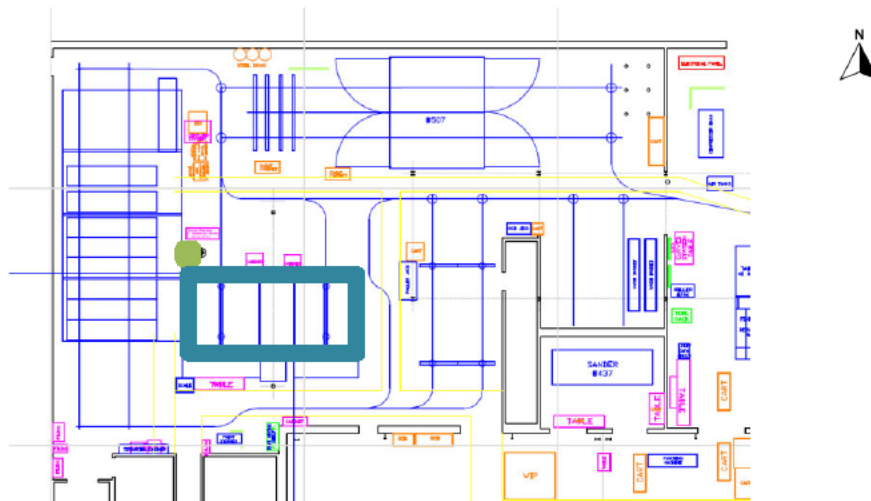


Figure 3: Uni-Ram Solvent Recycling System Location

- Uni-Ram URS900EP2 Solvent Recycling System
- Liquid Paint Extraction Booths

Operation

MEK is recycled daily from Monday to Friday during day shift operations. Approximately 1 to 1 ½ pails (20 L/pail) of paint/solvent mix are recycled each shift. The recycling process produces approximately ¾ of a pail of recycled solvent and 3 inches of sludge.

Trained operators pneumatically transfer the solvent/paint mix from a grounded pail into the bag-lined distillation tank. The operator closes the unit and sets the controls. The recycler operates as a sealed unit using electricity to heat the paint/solvent mix to a pre-set temperature specific to MEK. The solvent evaporates from the mixture and enters the condensing coil through a vapor outlet. The cooling vapors return to liquid form and are collected in a sealed container inside the equipment. The remaining paint sludge in the unit is disposed as hazardous waste. The recycled solvent is recaptured and re-used in paint processes. The equipment comes with a standard automatic shut-off and is not left unattended while in operation. The Uni-Ram is equipped with an emergency shut off. A stocked spill kit is located in the immediate area.

Request to Include Solvent Recycling to Licence No. 3169

PIL the solvent recycling process be added to the scope of Client File 5791.00, EAL No. 3169.

Dangerous Goods and Transportation Act 8 HW

Decommissioned Bayco Burn Off Oven

As part of a routine inspection on August 29, 2022, it was identified the oven referenced in Dangerous Goods and Transportation Act Licence No.8 HW has been decommissioned. Historical document review indicates the Licence was issued in the early 1990s for Bayco Model No. BB 0150 Burnout Oven (Bayco). The Bayco oven was located in the southwestern portion of the 638 Raleigh Street facility. In the early 2000's the oven was relocated to the north portion of the facility (Figure 4). The Bayco remained operational until the early 2010's when it was decommissioned in-situ (Photos 2 & 3).

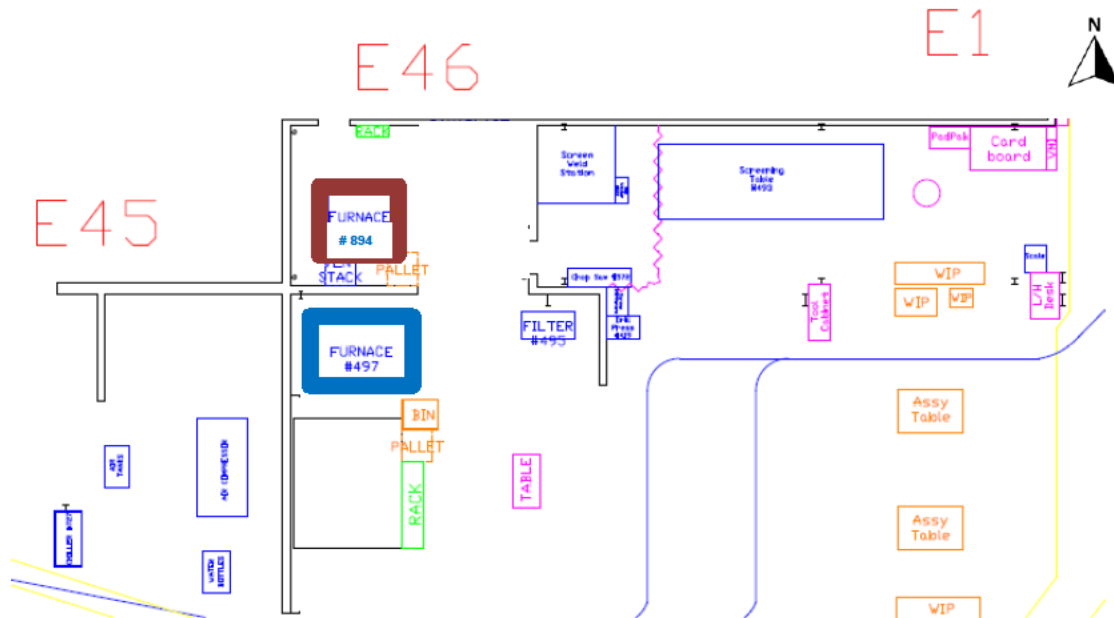


Figure 4: Current Oven Locations

- Decommissioned Bayco Model No. BB 0150 Burnout Oven
- Guspro Inc. Oven with E burners



Photo 2: for Bayco Model No. BB 0150 Burnout Oven



Photo 3: Disconnected Electrical Connection

Guspro Inc. Oven with E Burners



Photo 4: Guspro Inc. Oven with E Burners



Photo 5: Hooks to be Processed

In the early 2010s, the Bayco was replaced with the Guspro Inc. Oven (Guspro) with E Burners (Model: GO-729672) (Photo 4). PIL utilizes the Guspro to remove (burn-off) powder paint residue from metal handling equipment (load bars, hooks and jigs) and parts (diffusers, panels, etc.) from the powder paint processes (Photo 5).

Operation

A trained operator weighs, documents and loads the equipment to be processed into the Guspro. The operator uses the equipment controls to set and cycle the equipment. The Guspro uses two natural gas burners equipped with approved ignition and flame safety systems. Heat passes from underneath the cart rack to heat the parts. This enhances temperature uniformity in the process chamber while reducing energy consumption and cycle times. Typical cycle time is 1.5 - 4.0 hours. The Guspro volatilizes the waste material gradually and at a controlled rate to avoid overloading, which could result in incomplete combustion.

A temperature control system oversees the operation of both burners. Flue gases are vented to the atmosphere by a self-supporting refractory lined stack (Photo 6 and Figure 5). The stack is designed to provide natural draft operation and does not require either an exhaust blower or induced draft fan. The hot stack gases discharged to the atmosphere consist primarily of excess oxygen/nitrogen, water vapour and carbon dioxide, which are invisible, odorless, and harmless.



Photo 6: Guspro Stack

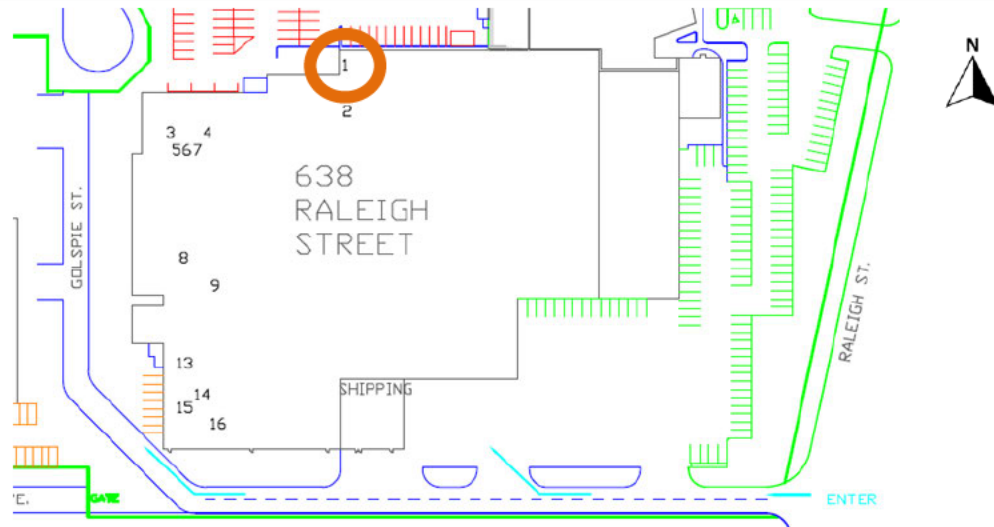


Figure 5: Guspro Stack Location

The Guspro is equipped with an ETC-S high limit system. The ETC-S system shuts down the oven when the stack temperature exceeds a pre-set value (1850 °F). Once the ETC-S system trips open, the system cannot be re-started unless it is manually reset. The controller cannot be reset until the temperature has dropped below the high limit set point. The Guspro has an automatic over-temperature suppression system. The system automatically injects water mist in case of a sudden temperature.

Following completion of the burn-off cycle the oven is cooled to a minimum of 200 °F. The operator removes the parts from the oven and collects the dry dust generated by the heat cleaning process. The equipment and parts are weighed and documented. The dry dust generated by the heat cleaning process is disposed to landfill.

Monitoring

PIL submits monthly reports documenting the weights of the parts and equipment before, after and the calculated difference following burn-off.

Request to Rescind DGHTAL No. 8 HW

PIL requests Client File 2722.00, DGHTAL No. 8 HW be rescinded. We request the operational Guspro Inc. Oven with E Burners be added to the scope of Client File 5791.00, EAL No. 3169.

Notice of Alteration Environment Act Licence No. 3169 – Strip Coating Exhaust

Type II: B-52 Strip Coat

Type II: B-52 is a non-toxic strippable coating. The coating is composed mostly of a material called cellulose acetate butyrate. Cellulose acetate butyrate (CAS 9004-36-8) is listed as not meeting the criteria under Section 64 of CEPA¹. B-52 is heated between 275 °F and 360 °F and has a flash point over 410 °F. It contains no solvents. The low operating temperature creates very little odor and very few fumes. Appendix C – Safety Data Sheet – Evans Coatings LLC – Type II: B-52 and Appendix D – Evans Coatings LLC Technical Data Sheet are attached for additional information.

Type II: B-52 Strip Coating Process

PIL utilizes Evans Coatings LLC – Type II: B-52 Strip Coating (B-52) to coat and protect dies and other small parts during storage and transportation. The process is carried out in the southeast portion of the 638 Raleigh Street Facility in the Tool & Die Department. B-52 is heated and melted in a bench-top WAAGE Electric Inc round dip coating pot (model: WP2A-19). Components are dipped in B-52 and allowed to cool. The process is completed on average two to three times per week for a maximum of fifteen minutes per day. When the coating is no longer required it is easily peeled from the components and disposed in general waste.



Photo 7: WAAGE Electric Inc Round Dip Coating Pot



Photo 8: Melted Type II: B-52

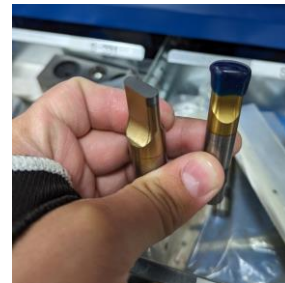


Photo 9: Uncoated and Coated Part

Type II: B-52 Discharge Proposal

The current process is completed on the bench top with general ventilation. The process is not hazardous to human health but produces a nuisance odor. PIL proposes fume extraction with discharge to the outdoor environment. Discharge would be achieved by modifying the ducting of an existing fume extractor that is currently not serving any processes. One branch would be added to serve the coating process (Figure 6). Several unused extraction points in the system will be capped. Additional ducting will be added westward to aid in reducing ambient temperatures.

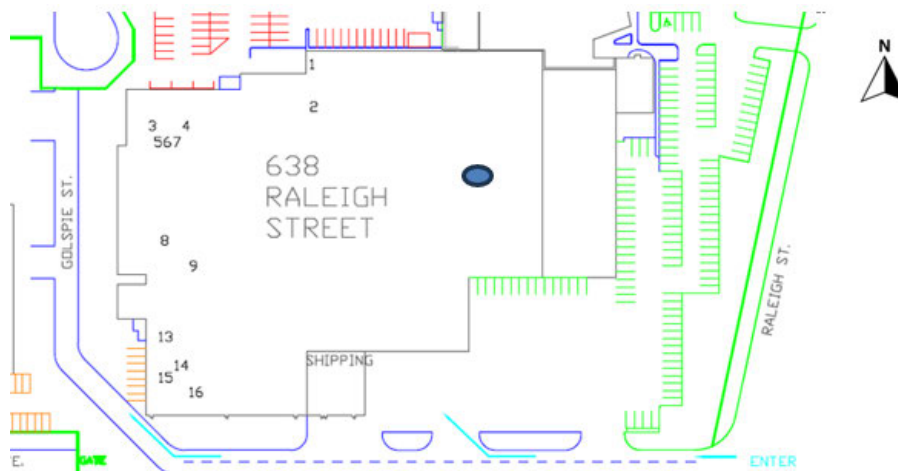


Figure 6: Proposed Exhaust Location

¹ Environment and Climate Change Canada. (2018). Second phase of polymer rapid screening. Government of Canada.



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Appendix A – Uni-Ram User Manual URS900 CE Series



USER MANUAL

URS900 CE SERIES



URS900-CE



URS900EP2-CE

UNI-RAM CORPORATION • ONTARIO • CANADA

Revision 2015-03

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INTRODUCTION

Uni-ram holds many patents on designs used in its innovative products. Every machine is tested for compliance with Quality Assurance standards. Follow the instructions on preparation, use and operation to operate this machine safely and effectively. Ensure that this manual is readily available to the operator at all times. If you have any questions about the operation of this machine, contact your distributor.



CE APPROVAL

MANUAL TRANSFER

 TYPE URSxxx SOLVENT RECYCLER Uni-ram	
URS500	VOLTAGE AC 100-120 CURRENT 15.00 -12.5 AMP.
URS600	VOLTAGE AC 200-240 CURRENT 7.50 -6.25 AMP.
URS900	VOLTAGE AC 200-240 CURRENT 11.20 -8.75 AMP.
PHASE	SINGLE HZ 50/60
 II 2 G IECEX BAS11.0057 Baseefa11ATEX0118 CE1180 Ex d ib IIA T2 Gb	
MANUFACTURED BY UNI-RAM CORPORATION 381 Bentley Street, Markham, Ontario, Canada, Tel # 1-800-417-9133 600-9914CE	

Ex	EU Explosion atmosphere symbol
b	Protection by control of ignition source
c	Protection by constructional safety
d	Protection by Flame Proof enclosure
ib	Zone / Measurement Control
IIA	Gas Group
T2	Temperature Class 2
Gb	Equipment Protection Level, G=Gas, b=Zone 1

PUMP TRANSFER

 TYPE URSxxxEP2 SOLVENT RECYCLER Uni-ram	
URS500	VOLTAGE AC 100-120 CURRENT 15,00 -12.5 AMP.
URS600	VOLTAGE AC 200-240 CURRENT 7.50 -6.25 AMP.
URS900	VOLTAGE AC 200-240 CURRENT 11.20 -8.75 AMP.
PHASE	SINGLE HZ 50/60
IECEX BAS11.0057 Ex d ib IIA T2 Gb	
 II 2 G Baseefa 11 ATEX0118 CE1180 Ex b c d ib IIA T2 Gb	
MANUFACTURED BY UNI-RAM CORPORATION 381 Bentley Street, Markham, Ontario, Canada, Tel # 1-800-417-9133 600-9916	

CAUTIONS AND WARNINGS

- Wear protective clothing according to local safety and environmental regulations, with a minimum of face goggles, gloves and mask.
- Disconnect from the power source before performing maintenance.
- DO NOT SMOKE OR USE THIS EQUIPMENT NEAR A POTENTIAL SOURCE OF IGNITION SUCH AS SPARKS OR AN OPEN FLAME. This unit must be located at least 6 feet (1.8 m) from all potential sources of ignition including electrical receptacles, switches, pilot lights, fixtures and contacts when installed in non - hazardous locations.

- The ambient temperature must be between 5°C (41°F) and 35°C (95°F).
- Do not distill solvents which may contain Nitrocellulose or any other unstable components.
- Do not distill solvents with an Ignition Temperature lower than 250°C (482°F).
- Do not install, operate or maintain this unit in a location where the Ignition Temperature of the hazardous atmosphere(s) is lower than 250°C (482°F).
- Solvents that are recycled can be flammable. Establish and follow safe practices to store and handle solvents. Such safety procedures will result in safely contained solvents free from spillage.
- Units must be installed by a qualified electrician.
- Install on a dedicated circuit with sufficient current capacity (see specifications section).

FEATURES AND SPECIFICATIONS

All Uni-ram Solvent Recyclers feature **rapid-start** direct electric heating of solvent (so there is no diathermic oil to change) as well as high-efficiency condensers, air cooled with a motor driven fan. All of the Recyclers can be used with any Uni-ram Automatic Apray Gun Cleaner. The "E" models are designed to be linked directly to a Uni-ram "E" series Automatic Spray Gun Cleaner or to an external container. The direct connection creates a self-contained Recycling System allowing Timer-controlled Transfer In and Out between the Solvent Recycler and the other component.

MODEL	URS900	URS900EP2
VOLTAGE (V)	220/240	220/240
RECOMMENDED CIRCUIT AMPS	15	15
TANK CAPACITY	19 LITRES)	19 LITRES
LID GASKET	NEOPRENE	NEOPRENE
SOLVENT TRANSFER SYSTEM	NO	YES
SHIPPING DIMENSIONS (WDH")	31 X 30 X 45	31 X 30 X 45
WEIGHT (LB/KG)	175/80	175/80

Safety Features:

- **Certified** to IECx and BAS11.0057, Baseefa11ATEX0118, Ex d ib IIA T2 Gb. See the section, Introduction, for certifications.
- **Explosion proof construction** and intrinsically safe electric circuitry.
- **Computer controlled** with many built-in safety programs including temperature control of all critical points including tank, condenser and fan motor. Power is cut when the temperature at any of these points rises above a pre-set level. Operation also terminates when other abnormal conditions exist (eg: boiling does not start on time or the distillation process takes too long).
- **Automatic pressure relief** lid system prevents pressure in the Distillation Tank from exceeding 0.5 to 1.0 psi. (0.035 to 0.070 kg/cm²).
- **Self Diagnostic** error messages are displayed on the Display Panel.
- **Dual lid** cover system.
- **Compact, enclosed cabinet** for safe storage of the Solvent Receiving Container inside the cabinet.

Operating Features:

- **Rapid-start** due to direct electric heating of solvent, no diathermic oil to change.
- **Short cool-down time.** High efficiency condenser, air cooled with motor driven fan.

PREPARATION AND SETUP:

- Carefully inspect the shipping carton for any sign of transport damage.
- Carefully remove the unit from the shipping carton.
- Check the unit for damage. **Report any transport damage immediately to the carrier and your vendor. Initiate a freight claim with the carrier.** The manufacturer is not responsible for freight damage.
- A Liner Bag and Retainer Ring are already installed inside the distillation tank.
- Check the Accessory Kit for the parts listed below. If any parts are missing, contact your supplier. Additional consumables and accessories are also listed.
- Level the unit using the adjustable feet and install the Door Handle.
- For models with the Solvent Transfer System (EP2 Models), install the Solvent Transfer Hoses and the Air Supply Kit. (See instructions on Pages 7-8).

ACCESSORY KIT (Included Parts)

All Models	Replacement Part Number
Manual	NA
Lid Gasket, Standard (Neoprene)*	770-2150N
Liner Bag, 2 Spares	See below for re-order numbers
Door Handle & 2 Screws	120-318 & 909-404S
Solvent Outlet Tube	770-8131
EP2 Models Only	
Transfer Hoses and Fittings (EP2 Series)	KIT-TRANSHOSES-A
Air supply Kit (EP2 Series)	KIT-AIRSUPPLY-E

CAUTION:

USE ONLY GENUINE UNI-RAM LINER BAGS. THESE WOULD HAVE BEEN RECEIVED BEARING THE UNI-RAM NAME AND LOGO.

THEY ARE SPECIALLY MANUFACTURED TO BE STRONG, HEAT RESISTANT AND CHEMICAL RESISTANT.

USE OF A NON-UNI-RAM LINER BAG WILL VOID THE WARRANTY.

This unit is certified for use in non-hazardous locations and hazardous locations, zone one for gas group IIA. Ex d ib IIA T2 Gb.

LOCATION AND CONNECTION:

- **Non-hazardous Location:**
If using a non-hazardous plug, the unit must be located outside of a hazardous location. In a non-hazardous location, we recommend that you use a receptacle located a minimum of 6 feet (185 cm) from the unit and a minimum of 30" (80 cm) from the floor. We also recommend that the unit be located at least 6 feet from any potential source of ignition such as electrical receptacles, switches, pilot lights, fixtures, contacts and similar equipment. To clarify the definition of an appropriate location, contact your local authority. This unit must be connected to the power supply only by a qualified electrician in accordance with the National Electrical Code.
- **Hazardous Location:**
In hazardous locations, the power cord must be connected to the main power supply by a qualified electrician, in accordance with the National Electrical Code. An explosion proof outlet (receptacle or hard wired) must also be used.

Select a Location That Meets EACH AND EVERY Requirement, Described Below.

- 1) Comply with the instructions in the section: CAUTIONS AND WARNINGS.
- 2) Position the solvent recycler in a location so that there is at least 6 inches (15 cm) of space all around the unit. Ensure that the safety lid and door freely opens fully and a container for receiving the distilled solvent can freely move in and out of the cabinet. The unit must be in a location where people or equipment cannot disturb the power cord or connection. The cord must be connected directly to the main power supply; an extension cord cannot be used.
- 3) Connect the unit to a dedicated 20A, 200/240V branch circuit.

On first power up and when the unit is ready to begin a new cycle, the Display Panel shows "READY S.P. = XXX°C".

SOLVENT REQUIREMENTS

This unit recycles flammable solvents and combustible solvents. Flammable solvents include lacquer thinner, paint thinner, acetone and other paint diluents. Flammable Solvents have a flash point below 38.7°C (100°F). These solvents are commonly used in the industry as cleaning solvents or paint diluents.

Dirty solvent to be distilled must meet **each requirement** described below. The Material Safety Data Sheet (MSDS) provides data on the properties of the virgin solvent.

- 1) The BP (Boiling Point) of the dirty solvent must be less than 200°C (392°F). BP increases with greater contamination.
- 2) The auto-ignition temperature of the solvent to be distilled must be higher than 250°C (482°F) for safe operation. Do not recycle Nitrocellulose. The auto ignition temperature is 135°C (275°F).

Notes:

- Recycle recently contaminated solvent only. Standing solvent can become acidic over time.
- To avoid "FISH EYE" problems, do not recycle both paint diluents and parts washer solvent in the same unit.

Waste Residue

The waste residue of some paints will remain moist after recycling due to the composition of the paint itself. A dry waste residue is not guaranteed.

Definitions**Flash Point:**

The lowest temperature at which the vapor of a solvent can be made to ignite momentarily in air.

Auto-ignition Temperature (often referred to as "ignition Temperature" or "Ignition Point"):

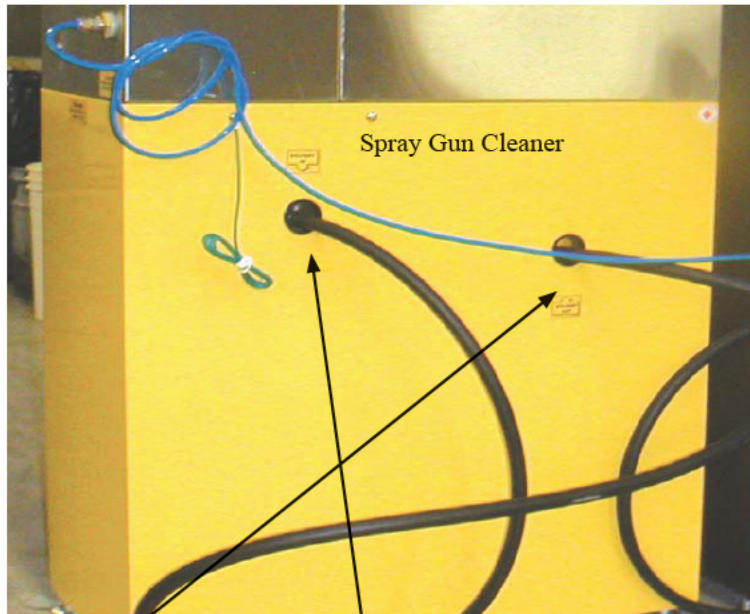
The temperature at which solvent ignites by itself.

INSTALLATION OF SOLVENT TRANSFER HOSES AND THE AIR SUPPLY KIT (EP2 MODELS ONLY)

- 1) Transferring Solvent To and From a Spray Gun Cleaner
- 2) Transferring Solvent To and From a Drum / Container
- 3) Stand-alone Operation

For the URS900 (Non-EP2) Models, use 3) Stand-alone Operation

1) Transferring Solvent To and From a Spray Gun Cleaner



Attach Moisture Filter (optional) to Air Input and the Tee to the Filter (if used) and the Blue Airline to Tee and Gun Cleaner. The Air Supply fitting is also not supplied.

Dirty Solvent Out Clean Solvent In

Dirty Solvent Out

Clean Solvent In



SOLVENT PAILS
Inside Gun Cleaner Cabinet

Hoses:

Connect the end of the hose with the "Solvent In" label to the "Solvent In" port on the recycler. Hand tighten. Pass the other end of this hose through the hole in the back of the gun cleaner that is marked "Solvent Out" and hand tighten onto the lid of the "WASH SOLVENT" pail. Connect the hose with the "Solvent Out" label to the "Solvent Out" port at the back of the recycler and pass the other end of this hose through the hole in the gun cleaner that is marked "Solvent In" and hand tighten onto the lid of the "CLEAN SOLVENT" pail. Make sure there is no leakage.

Air Supply:

The blue airline and Tee are for use with an "E" series spray gun cleaner to allow one air supply to feed both the spray gun cleaner and the solvent recycler. **Ensure the air supply is not connected to the spray gun cleaner or solvent recycler before installation.**

Remove the 2 airline connectors from the "T". Connect the male port of the "T" to Air Inlet of the recycler. Connect the Moisture Filter (optional). Connect one end of the blue airline to the "T". Connect the other end of the blue airline to the Air Input of the spray gun cleaner.

2) Connecting Hoses for Transferring Solvent To and From a Drum / Container



Attach Air Supply fitting (not supplied) and/or Moisture Filter (not supplied)

Dirty Solvent Out

Clean Solvent In

Connect the end of the hose with the “Solvent In” label to the “Solvent In” port on the recycler. Hand tighten. Connect the other end of the hose to the 3 ft suction pipe using the hose clamp. Insert the 3 ft suction pipe into the drum / container of dirty solvent. Connect the other hose with the 4 3/8” suction pipe to the “Solvent Out” port on the recycler and place the suction pipe into a clean drum / container large enough to receive the clean, recycled solvent.

Air Supply:

The blue airline and Tee are for use with an “E” series spray gun cleaner to allow one air supply to feed both the spray gun cleaner and the solvent recycler. It is not used in this situation. If necessary, connect a Moisture Filter (not supplied) directly to the Air Input port of the Solvent Recycler and attach a suitable Air Supply Fitting (not supplied).

3) Stand-alone Operation

For the URS900, stand-alone operation is standard and this model does not have the ports shown above.

OPERATING PROCEDURES

Wear protective clothing in accordance with local safety and environmental regulations. Use face goggles and gloves as a minimum. Use an apron and respirator if required.

Summary of Operating Steps:

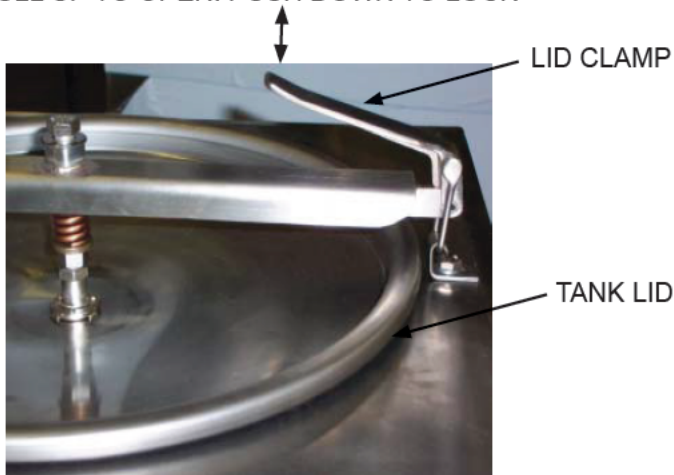
- 1) Open the Safety Cover and Tank Lid
- 2) Transfer Solvent to the Recycler Tank
- 3) Position Solvent Receiving Pail
- 4) Check distillation conditions and change, if necessary, using SETUP MODE.
- 5) Recycling
- 6) Finish Recycling
- 7) Transfer clean solvent
- 8) Remove debris
- 9) Clean Distillation Tank and Lid Surface
- 10) Install new liner bag
- 11) Inspect Lid Gasket, Remove and Replace if necessary

Each Step is described in detail below.

1) Open the Tank Lid and Safety Cover

- Open the safety cover.
- Open the inner lid by releasing the Lid Clamp.
- Make sure that Tank is empty and that a Liner Bag is properly installed in the Tank.

PULL UP TO OPEN. PUSH DOWN TO LOCK



2) Transfer Solvent To the Recycler Tank

Verify that the solvent to be recycled complies with the requirements described in the section, Solvent Requirements. Solvent can be put into the Distillation Tank by hand or by using the Transfer Hoses and built-in Transfer System (EP2 Models only).

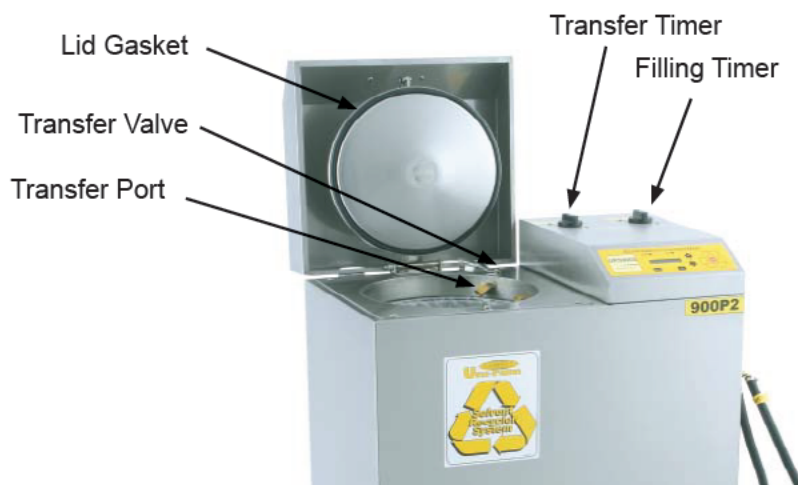
a) For models without the Solvent Transfer System

Pour the solvent into the Distillation Tank. Fill to 1.5 inches below the Retainer Ring.

Maximum volume is 6.6 gal (25 L) and minimum volume is 1.5 gal (6 L). Do not let the container of dirty solvent touch the top of the recycler. When pouring the contaminated solvent, make sure all solvent goes into the Liner Bag, not between the Liner Bag and the wall of the Distillation Tank. Clean Lid Gasket and top of distillation tank. Close inner lid, engage lid clamp and close safety lid. **Caution:** Do not overfill Distillation Tank because contaminated solvent could flow into Condenser and block the condenser passage way. Close the Tank Lid, lock down the Lid Clamp and close the safety Cover.

b) For models with the Solvent Transfer System (EP2 Models):

- Open the Transfer Valve by turning the handle counter-clockwise 90°.
- Turn the Filling Timer knob clockwise fully. Dirty solvent will flow from the Transfer Port into the Liner Bag and stop when the timer runs out.
- Close the Transfer Valve by turning the handle clockwise 90°.
- Close the tank Lid, lock down the Lid Clamp and close the safety Cover.

**3) Position Solvent Receiving Pail****a) For models without the Solvent Transfer System**

Open the Door and position a Solvent Receiving Pail (not provided) with a minimum size of 5 US Gal (20 L) inside the cabinet. Insert the Solvent Outlet Tube (short and curved) into the top opening of the pail. The Solvent Outlet Tube must extend below the rim of the pail to prevent solvent spillage. If the pail is metal, connect the alligator clamp of the Ground wire to the rim of the pail. Close the door.

b) For models with the Solvent Transfer System (EP2 Models):

Open the Door. A special, connected, plastic Solvent Receiving Pail is provided. Check to make sure that the Solvent Outlet Tube (short and curved) is inserted into the hole in the top of the pail and that the Pick Up Tube (long and straight) is tightly attached to the Quick Connect fitting.

4) Check distillation conditions and change, if necessary, using SETUP MODE.**Estimate Boiling Point**

Add 40°C (100°F) to the boiling point of the pure solvent as shown on the MSDS (Material Safety Data Sheet) or another reliable source.

Recycle more often

The boiling point of the waste solvent mixture increases as it gets dirtier. To reduce the boiling point, recycle more often.

Minimize Temperature Set Point

After recycling there will be a small amount of solvent, about 1/8 US gal (500 ml), remaining in the distillation tank due to condensation. Select the lowest Temperature Set Point that recycles the solvent to this level.

To change the temperature units from °C to °F, press and hold the + and - keys together until a tone sounds (about 2 seconds). To change other settings use **SETUP MODE**.

If all the settings are acceptable, press **START** to begin distillation.

SETUP MODE

To change settings, enter Setup Mode by holding down the SETUP key and pressing START, then pressing SET-UP again. "SET-UP MODE" is displayed.

STEP	SETTING	ADJUST	ACCEPT	DESCRIPTION
1	SET-PT = XXX°C (°F)	+ OR -	OK	To choose a SET POINT, look up the solvent's BP (boiling point (MSDS, online etc) and add about 40°C (100°F).
2	POWER = XXX%	+ OR -	OK	If boiling is too vigorous due to one or more of the following conditions, decrease POWER by one increment or more. <ul style="list-style-type: none"> • vapour leaks at the Lid Gasket • recycled solvent comes out too hot • waste material is carried into the recycled solvent Otherwise, use 100%.
3	SHUT-OFF = AUTO**	+ OR -	OK	If too much solvent remains in the Distillation Tank after recycling and the problems in the Troubleshooting Guide have been ruled out, over-ride the AUTO SHUT-OFF and manually select a heating time (eg: 4 hours). The heater will stay on for this amount of time and then cooling will begin.
4	BAKE TIME = XXM	+ OR -	OK	Only available when SHUT-OFF = AUTO. Increase if residue (puck) is too wet.
**WARNING: SHUT-OFF TIME MUST NOT BE SET TO MORE THAN 8 HOURS MAXIMUM				

5) Recycling

On first power up and when the unit is ready to begin a new cycle, the Display Panel shows "READY S.P. = XXX°C" (S.P. = SET POINT). When Setup is complete and START has been pressed, the "HEAT" light comes on and the recycling process begins. During the boiling phase, 3 temperatures will alternate on the Display: "SET-PT", "TANK" and "VAPOR EX." When the boiling phase is complete, "COOLING" will be displayed. Note: the fan may still be running; this is normal as it continues to run until the temperature drops below 50°C. To cancel the cycle, press the "START/STOP" key.

6) Finish Recycling CAUTION: DO NOT OPEN LID UNTIL COOLING IS COMPLETE

The clean, recycled solvent is available for use when the display shows "READY S.P. = XXX°C". After the clean solvent is transferred, the unit will be ready for another cycle.

Note: during the cooling phase, the display will show "COOLING T = XXX°C" (T = TEMPERATURE) and the fan may still be running; this is normal as it continues to run until the temperature drops below 50°C.

7) Transfer Clean Solvent

- a) For models without the Solvent Transfer System: remove the pail and replace with an empty one.
- b) For models with the Solvent Transfer System: turn the Transfer Timer knob clockwise fully. The clean solvent will flow out of the Solvent Receiving Pail into either a free-standing, external container or the Clean Solvent Pail of a Spray Gun Cleaner. The transfer will stop when the timer runs out.

8) Remove Debris:

Remove the Retainer Ring and slowly pull the Liner Bag containing the debris out of the distillation tank in a way that the Liner Bag does not break. Dispose of the debris in accordance with local regulations.

NOTE: If the bag sticks to the bottom of the tank, turn the recycler on for 5 minutes to loosen the bag from the bottom of the tank, then lift the bag out while the bag is warm.

9) Clean Distillation Tank and Lid Surface

Distillation Tank:

Wipe inside the Tank with a cloth.

Remove any remaining debris from the Distillation Tank using if necessary, plastic or wooden tools (not supplied). Do not clean with abrasive or hard metal instruments that can damage the tank. The warranty does not cover such damage.

Note: There will be about 1/8 Gal (500 ml) of solvent remaining in the Distillation Tank after recycling due to condensation. This solvent, if left in the tank, can cause corrosion. Dirt and debris left in the tank can prevent full heat from reaching the dirty solvent during recycling.

Caution: Acidic or chlorinated solvents typically cause corrosion on an aluminum tank. It appears as black pitting spots on the tank. Excessive pitting leads to an unsafe condition of holes in the walls of the tank and solvent leakage. Inspect your tank after each batch. If there is excessive pitting, call a Service Technician and replace the tank with a corrosive resistant, stainless steel one.

Lid Surface:

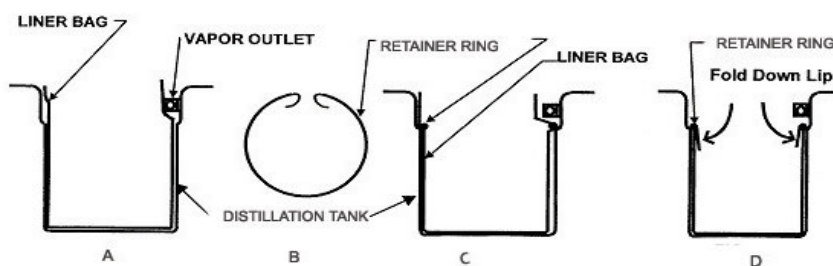
Use a cloth. Dry and clean the lid and the top of tank where the Lid Gasket sits to extend the life of the Lid Gasket and prevent leakage. Avoid rotating the lid during cleaning. The lid gasket is a wear item.

10) Install a new Liner Bag

Lift Recycler Safety Cover and Tank Lid fully; lids will stay in the open position.

- Install the Liner Bag so that the bottom of the Bag sits flat on the bottom of the Distillation Tank as shown.
- With thumb and index finger, squeeze the Retainer Ring and insert into inside of the Liner Bag. Let go and make sure it fits securely in the groove.
- Fold the flap of the liner bag over the retainer ring.

Caution: Ensure that the bag material does not block the Vapor Outlet.



NOTE: This is a schematic drawing only; not all components are exactly as shown.

11) Inspect Lid Gasket, Remove and Replace if necessary as required

Inspect the Lid Gasket for shrinking, hardness and cuts. The Lid Gasket is a wear item as it is exposed to high temperature and solvent vapor during distillation. Damage to the lid gasket will cause solvent to leak.

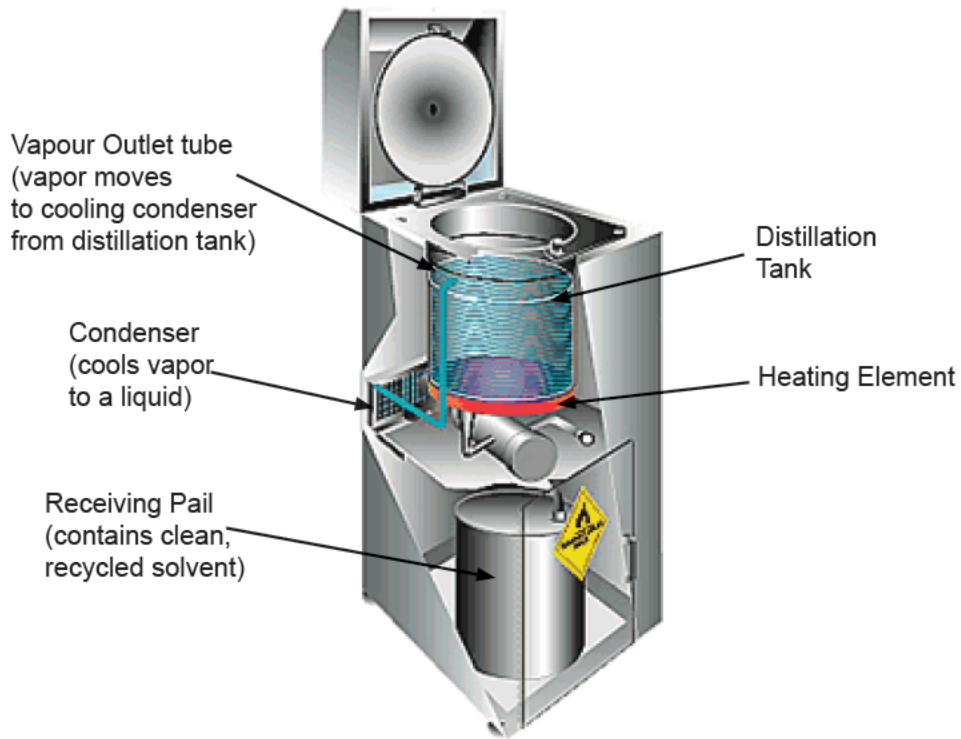
To remove, open the Safety Cover and Tank Lid. Lift out the old gasket by hand and clean the cavity with a cloth. To Install, place the new gasket in the cavity, rub solvent or soapy water on the gasket to make insertion easier. Press the gasket firmly into the cavity all around.

Note: Keep a spare in stock. One extra is included with the unit.

THEORY OF OPERATION - DISTILLATION PROCESS

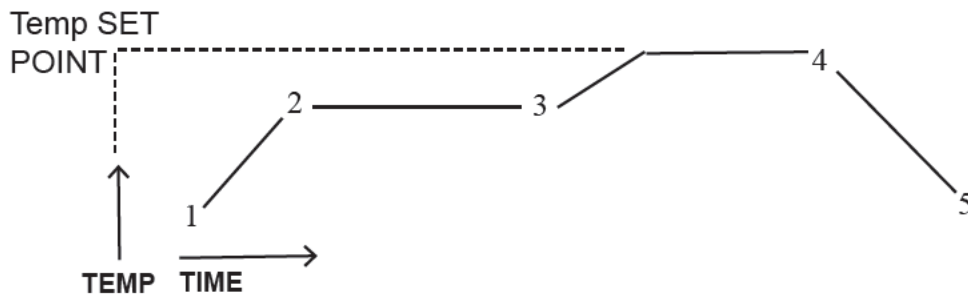
Waste solvent consists of the original solvent plus liquid and solid materials picked up during use of the solvent. Recycling separates the original solvent from the waste materials. During the recycling process, the distillation tank fills with dirty solvent and the heating element heats the mixture. The solvent mixture boils and the vapour passes through a cooling condenser where purified, clean solvent, ready for use condenses out. Waste materials in the dirty solvent boil at a temperature substantially above the Temperature Set Point so they remain in the distillation tank for disposal.

Solvent Recycling



Distillation Cycle

1. Heating starts, temperature rises
2. Vapourization starts
3. Vapourization ends, AUTO SHUT-OFF / BAKE TIME starts (see SETUP)
4. Baking finishes, cooling begins
5. Cooling is complete



TROUBLE SHOOTING GUIDE

Carry out each action step until a solution is found. If the recommended actions do not solve the problem call Uni-ram Service in North America or contact a qualified Service Technician.

Caution: Disconnect the power supply before conducting maintenance or service.

PROBLEM	CAUSE	ACTION STEPS
Unit is plugged in, power light is off, Display Panel is not working.	Power is not getting to the unit.	Reset breaker or replace fuse. If power is still not getting to the unit, call a Qualified Service Technician. Ensure that the unit is the only device on a circuit with sufficient capacity.
Unit is plugged in, power light is on, Display Panel is not working.	Power board or computer board not functioning.	Call Uni-ram Service
Recycled solvent is not clear	1) The solvent is reacting chemically.	1) Run SETUP and lower the Temperature Set Point.
	2) The solvent flow path is dirty. One cause is overfilling the distillation tank.	2) To clean the path, follow Service Procedure 2 and then recycle 3 gal of clean solvent.
	3) Orange colour due to rust in receiving pail.	3) Place a jar under outlet tube and capture some solvent. If the solvent is clear, replace the pail with a non-corrosive one.
	4) Milky colour due to presence of water.	4) Eliminate source of water in solvent.
Dirty solvent remains in Distillation Tank after recycling Note: 1/8 Gal (500 ml) of recycled solvent is expected due to condensation.	1) Poor heat transfer due to dirt and debris left in the tank.	1) Clean the tank, replace the Liner Bag, recycle with pure solvent to test. If successful, the problem is due to a dirty tank, debris left in the tank or the solvent is too contaminated. Adjust accordingly. Follow Operating Procedures closely. If the level of contamination is too high, recycle more often.
	2) Boiling point of solvent is above Temperature Set Point.	2) Run SETUP, raise the Temperature Set Point and repeat the recycling operation. The Temperature Set Point should be the BP of pure solvent (as determined from the MSDS or other source) plus 45°C (113°F) to allow for contamination. If the boiling point is above the maximum Temperature Set Point for your model (either 200°C or 240°C), dirty solvent cannot be recycled in this unit.
	3) The Auto Shut Off system is shutting the unit off too soon.	3) Run SETUP and over-ride the auto SHUT-OFF. Select a time period long enough to recycle the solvent. The heater will stay on for this duration. Repeat the recycling operation.
Liner Bag sticks		Turn unit on for 5 minutes and lift out bag while it is still warm.

PROBLEM	CAUSE	ACTION STEPS
Solvent vapor leaks from the Lid Gasket	1) The Lid Gasket has excessive wear as indicated by cracks, shrinkage, hardness etc	1) Replace the Lid Gasket (See Operating Procedure 11).
	2) The Solvent flow path is blocked.	2) Follow Service Procedure 2.
	3) Lid Tension is not adequate	3) Follow Service Procedure 4.
	3) The Lid is not seated correctly.	3) Follow Service Procedure 5.
	4) The temperature SET-PT is too high, resulting in excessively high solvent vapour pressure	4) Run SETUP, reduce the Temperature Set Point and repeat the recycling operation. If successful, continue to recycle using the lower Temperature Set Point. If not, reduce the POWER %.
Sections on Bag are brown and thin due to High Temperature	1) Use of inferior low temperature bag.	1) Use new genuine Uni-ram high temperature Liner Bag and recycle.
	2) The temperature SET-PT is too high.	2) Run SETUP, reduce the Temperature Set Point and repeat the recycling operation. If successful, continue to recycle using the lower Temperature Set Point.
The computer appears to be operating erratically.	The computer may require re-booting.	Disconnect the power supply for 30 seconds. Restore power and operate unit.
Residue (puck) in Tank is too wet.	1) BAKE TIME is not long enough.	1) Run SETUP and increase the BAKE TIME.
	2) Residue cannot be dried completely due to its composition.	2) None.

TEST MODE

Use this mode as part of your troubleshooting procedures.

1. Make sure Display Panel shows "READY SP = XXX °C".
2. Press and hold the OK key while pressing the "-" key for about 3 seconds or until the display shows the Model No. and software version followed by "TEST MODE". The testing cycle will begin.

TESTING CYCLE

- The Display shows "TC#1 = XXX °C, TC#2 = XXX°C".
 - Press "OK" to proceed to the next step.
 - The Display shows "FAN ON" for 5 seconds while the Cooling Fan runs.
 - The Display changes to "DO NOT TOUCH KEYS" for 5 seconds while a key check is performed.
 - If the keys are ok, the Display shows "NO KEYS STUCK" for 5 seconds.
 - The Display changes to "HEATER TEST ON" for 10 minutes or until the computer detects a 3°C increase in temperature at TC#1, then the Display should change to "HEATER TEST OK".
3. If the display does not show "HEATER TEST OK", there is a problem in the heater circuit such as a defective Heater TRIAC, Heater Element or Fuse.
 4. Press "STOP" to end the test. The Display will return to "READY SP = XXX °C".

ERROR MESSAGES

If an abnormal condition is detected by the unit's Self-diagnostic System, the Display Panel shows one of the following error messages:

MESSAGE	POSSIBLE CAUSE	ACTION
BOILING TIME OUT (No change in vapour temperature was detected within the set time limit, usually 45 minutes)	<ul style="list-style-type: none"> Boiling did not occur within the set time limit because the dirty solvent mixture is too contaminated Blockage in the solvent flow path, most likely with leakage of solvent at the lid 	<ul style="list-style-type: none"> Run SETUP, raise the Temperature Set Point and repeat the recycling operation. See Troubleshooting Guide ("Dirty solvent remains in Distillation Tank after recycling"). Follow Service Procedure 2
READY TIME OUT	Recycling was not completed within 9 hours and/or dirty solvent remains in the Tank.	If dirty solvent remains in the Tank, see the Troubleshooting Guide.
RESET OCCURRED	The computer has been reset due to a power interruption or drop in voltage during the recycling operation.	Press the "SET-UP" key twice to restore the message: "READY-SP = XXX° C".
CONDSR OVER-HEAT	Over-heating occurred at the Condenser.	The Condenser is dirty or the Fan stopped for another reason (see below). Clean the Condenser. When the Fan Motor has recovered (4-5 min), this message will disappear and normal operation will resume.
CHECK FAN	Appears 10 min after the message above if the problem is a loose fan blade, blown fuse (F3 or F4) or other fan-related problem. Also appears if the condenser is dirty.	Clean the Condenser. Run TEST MODE to check for defective fan motor. If necessary, check for a loose fan blade or blown fuse (see next section).
CHK HEATER FUSES	Appears if the computer does not detect a rise in tank temperature after 15 minutes.	There may be a short circuit in the Heater circuit causing fuse F3 and/or F4 to blow or poor electrical contact in the Heater circuit. Check circuit condition with a tester. Correct as required.
WARNING! VERY IMPORTANT! IF TRIAC IS FAULTY, DISCONTINUE USE IMMEDIATELY!		
CHK HEATER TRIAC	Short circuit in the TRIAC (a switching transistor that controls heater power, located on the Power Control Board).	To confirm, first disconnect and re-connect the power supply. If the Distillation Tank becomes hot to the touch and both the Heat Light and the Fan Light are off, the TRIAC is defective. Disconnect the power supply immediately and do not use again until the Power Control Board has been replaced.

SERVICE PROCEDURES

1) CLEAN CONDENSER

Remove the screen at the back of the unit that covers the condenser and vacuum the condenser using a brush attachment. Re-install the screen.

2) CLEAR BLOCKED SOLVENT FLOW PATH

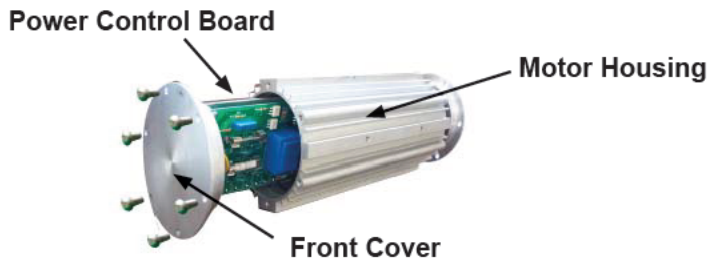
CAUTION: WEAR SAFETY GOGGLES.

A blockage in the solvent flow path (Vapour Outlet - Condenser - Solvent Outlet Tube) can cause solvent to leak. To determine the location of the blockage, first check the Solvent Outlet Tube and the Vapour Outlet Fitting for visible signs of blockage or damage. If the problem is not in either of these locations, the Condenser is probably blocked. To clear the condenser, pour some clean solvent into the Vapour Outlet and check if it comes out of the Solvent Outlet Tube. If the blockage persists, blow air at about 30 PSI (2 kg/cm²) into the Vapour Outlet. If the air comes out of the Solvent Outlet Tube, the blockage has been cleared. If not, call for service.

3) REPLACE FUSES

Fuses are located on the Power Control Board inside the Motor Housing.

- Disconnect power supply.
- Remove the Guard Screen by unscrewing two metal screws to get access to the Motor Housing



- Unscrew the 6 screws from the Front Cover and pull it gently from the motor housing to expose the fuses. **Note: Care should be taken not to pull the Front Cover too far as some wires may disconnect.**

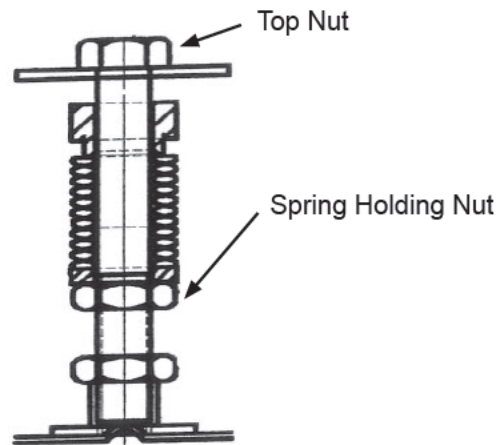
Fuses F1 & F2: 240 VAC, 20.0 A, 3AG, fast action, for Heater
Fuses F3 & F4: 25 VDC, 2.0 A, 3AG, slow action, for Fan Motor
Fuse F5: 240 VAC, 0.0625 A, 3AG, fast action, for Computer Board

- Remove the fuses from the board and, using a meter, test each one and replace as needed.
- Carefully push the Power Control Board back into the Motor Housing.
- Ensure that the wire to the computer board is secure.
- Re-install the Front Cover using all 6 screws..
- Install the Guard Screen using two metal screws.
- Close the Door and re-connect the power supply.

4) INCREASE LID TENSION (BY ADJUSTING THE SPRING BOLT)

CAUTION:

SHOULD BE DONE ONLY AS A LAST RESORT - FIRST CHECK FOR A WORN LID GASKET, A BLOCKAGE IN THE SOLVENT FLOW PATH, LOOSE HINGE BOLTS OR A SET POINT THAT IS TOO HIGH FOR THE SOLVENT BEING RECYCLED.



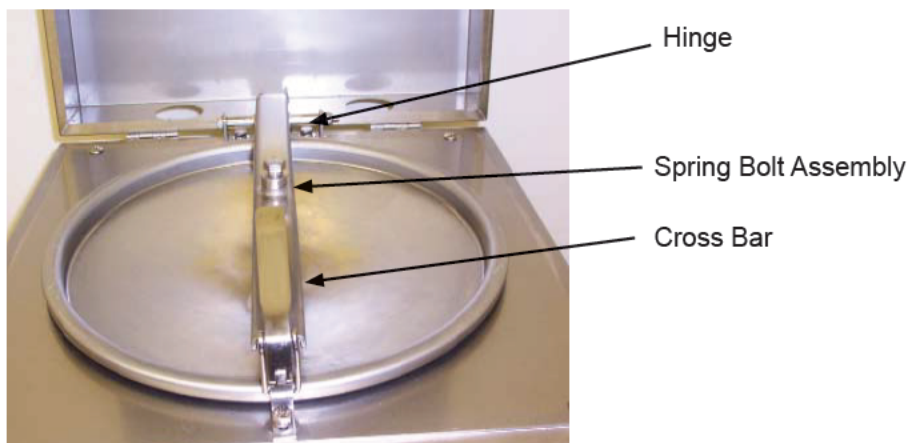
Spring Bolt Assembly

This procedure tightens the Lid by increasing the tension on the spring attached to the Lid Bar Spring Bolt Assembly. The Lid and Bolt Assembly is carefully designed as a Safety Pressure Relief system to prevent a dangerous build up of pressure inside the closed tank. **Do not adjust the Spring Holding Nut by more than 2 full turns maximum.** If 2 full turns do not solve the problem, call for service.

- While holding the top nut with a wrench, turn the Spring Holding Nut no more than a 1/2 turn at a time. Turn in a counter-clockwise direction (as you look down on it).
- After each 1/2 turn, operate the unit normally and check for leaks.

5) REPOSITION LID and TIGHTEN HINGE BOLTS

The Hinge bolts can loosen over time, causing the lid to shift off center. This can lead to an inadequate seal and leaking around the Gasket. Loosen the bolts, reposition the lid and re-tighten the bolts.



6) RECOMMENDED 6-MONTH MAINTENANCE

- Vacuum the condenser (see Service Procedure 1).
- Clean the solvent flow path by recycling 3 Gal of clean solvent.
- Inspect Distillation Tank for debris, pitting and/or other damage.
- Inspect Lid Gasket for wear or damage (see Operating Procedure 11).

REPLACEMENT PARTS

DESCRIPTION	PART NO.
SAFETY COVER	770-3311
KEYPAD	900-3461
DIAPHRAGM PUMP	UDP4TA
DOOR HANDLE & 2 SCREWS	120-318F & 99-404S
TRANSFER HOSE KIT (E MODELS ONLY)	KIT-TRANSHOSES-A
AIR SUPPLY KIT (E MODELS ONLY)	KIT-AIRSUPPLY-E
LID GASKET, NEOPRENE	770-2150N
SOLVENT RECEIVING PAIL	750-710C
TIMER WITH KNOB	115-200/K
LINER BAG. PKG OF 10	LB900C-10
RETAINER RING	770-9110

Declaration of Conformity in accordance with European Directive 94/9/EC

Manufacturer: Uni-ram Corporation

Address: 381 Bentley St, Markham ON L3R 9T2 Canada

Equipment Type: Solvent Recyclers: URS500, URS600 and URS900

Directive 94/9/EC ATEX

Provisions of the Directive fulfilled by the Equipment:

Group II Category 2G Ex d ib 11A T2 Gb

Notified Body for EC-Type Examination:

Baseefa 1180 Buxton UK

EC-Type Examination Certificate:

Baseefa 11ATEX0118

Notified Body for production:

Baseefa 1180 Buxton UK

Harmonized standards used:

EN60079-0;2009 EN60079-1;2007 EN60079-11;2012

On behalf of Uni-ram Corporation, I declare that, on the date the equipment accompanied by this declaration is placed on the market, the equipment conforms with all regulatory requirements of the above listed directives.



Sam Yamamoto
President

1.10

Appendix B – GUSPRO INC. Heat Cleaning Ovens Operations & Maintenance Manual Ovens with E Burners



GUSPRO INC.
CHATHAM, ONTARIO
CANADA

HEAT CLEANING OVENS

OPERATIONS & MAINTENANCE MANUAL

OVENS WITH E BURNERS

MODEL NUMBER: _____

SERIAL #: _____

MANUFACTURED BY GUSPRO INC.

280 GRAND AVENUE EAST

CHATHAM, ONTARIO

N7M 5L5

CANADA

TELEPHONE: (519) 352-4550

FAX: (519) 352-7676

Website: www.guspro.com

Email: Guspro@guspro.com

NOTICE

Both the main gas valve and the electric supply should be clearly marked or tagged.

INSTALLATION

This unit shall be installed in accordance with the National Fuel Gas Code ANSI Z223.1, The National Gas Installation Code CAN/CGA B149.1 or the Propane Installation Code CAN/CGA-B 149.2, as applicable.

If applicable, the vent line from the gas appliance pressure regulator shall be installed to the outdoors in accordance with local codes or, in the absence of local codes, with the National Fuel Gas Code, ANSI Z223.1, Natural gas Installation Code, CAN/CGA-B149.1, or the Propane Installation Code, CAN/CGA-B149.2, as applicable.

The unit and its individual shut off valves must be disconnected from the gas supply piping system during any pressure testing of that system at test pressures in excess of 1/2 PSI (3.45 Kpa).

The unit when installed shall be electrically connected and grounded in accordance with local codes, or in the absence of local codes, with the National Electrical Code, ANSI/NFPA70, or the Canadian Electrical Code, CSAC22.2, as applicable.

AFTER INSTALLATION

After installation, be sure to maintain adequate combustion and ventilation air. Do not allow materials or articles to be stacked or piled near or against the oven or burners so as to block or inhibit air flow. In the case of a through the wall installation, do not allow snow or ice to build up around the burner covers or the oven relief lid.

NOTICE

The oven manual should be retained for future use. A “C” sized electrical diagram is contained in the manual. An electrical diagram is placed in the electrical panel.

- The Process Chamber referred to in this manual is also known as the *Primary Chamber*.
- The Oxidizer Chamber referred to in this manual is also known as the *Afterburner* or *Secondary Chamber*.

It is recommended that the operator reads Sections 4.2-4.4 prior to powering up the unit!!

NOTICE - The purchaser shall post in a prominent location, instructions to be followed in the event the user smells gas.

- 1) Turn **OFF** the main fuel supply valve. This will lockout the burners.
- 2) If the oven is in use, **do not** shut the electrical power off. This will allow the OTS to function and prevent any runaway situations.
- 3) Ventilate area by opening windows and doors (if possible).
- 4) Contact your local supplier or licensed installer.
- 5) Notify Guspro Inc.

FOR YOUR SAFETY

Do not store or use gasoline or other flammable vapours or liquids in the vicinity of this or any other appliance.

WARNING: Improper installation, adjustment, alterations, service or maintenance can cause property damage, injury or death. Read the installation, operating and maintenance instructions thoroughly before installing or servicing this equipment.

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1.0 - GUSPRO HEAT CLEANING OVEN

1.1 Introduction

The Guspro heat-cleaning oven is state-of-the-art technology that enables heat cleaning of parts coated with grease, oil, paint, carbon, plastics and water scale. Materials that can be heat cleaned include steel, aluminum, and cast iron.

Applications include:

- Paint or powder coating line fixtures such as hooks, trees, trays and baskets.
- Paint, grease and combustion contaminated automotive engine blocks, heads, cranks, camshafts, brake parts, transmissions, power boosters and water pumps.
- Epoxy and varnish coated components such as electrical motor armatures, stators and transformer cores.
- Reclamation of manufactured parts with reject or service damaged coatings.
- Precious metal recovery in photographic film processing, transistors, printed circuit boards and personal computer board salvage.
- Polymer coated tooling screws, breaker plates, dies and screens.

Parts are protected from distortion by precise temperature controls and backup control and safety systems. Further, the heat cleaning process has the following advantages:

- Controlled heat cleaning cycles coupled with an absence of direct flame on the parts prevents distortion and warpage.
- Operations are improved with safe, fast and efficient cleaning.
- Automatic operation ensures minimal operator supervision.
- Automatic over-temperature suppression system automatically injects water mist in case of a sudden temperature rise, ensuring that high tolerance steel parts, and even most aluminum parts are safely heat cleaned.
- The typical cycle time is 1.5 - 4.0 hours. Short cleaning cycles limit the exposure time of parts to temperature, cut down fuel cost and provide fast turn around.
- Models are designed for at least two or three heat cleaning cycles per day, which is the key to high efficiency and productivity.
- A platform cart is supplied. This ensures both a fast manual or optional lift truck loading operation.

- Low labour cost associated with automatic operation plus low fuel usage per cycle ensures significant annual savings.
- Eliminates use of expensive cleaning chemicals, waste slurry disposal costs and associated liability.

The burners on the Guspro heat cleaning ovens are sized to ensure that heavy loads are brought to processing temperature fast. Depending on the oven model and site-specific loads, the powerful standard refractory-lined oxidizer can process up to 70 pounds of combustibles per hour once operating temperatures are reached. This amount may vary depending on the BTU value of the combustible product being processed.

Note: *The combustible load and cycle times are limited to the capacity of a given model's thermal oxidizer capacity. Extra heavy-duty or 100 pound afterburners are also available as an option.*

Heat passes from underneath the cart rack to heat the parts. This enhances temperature uniformity in the process chamber while reducing energy consumption and cycle times.

The dry dust generated by the heat cleaning process meets stringent **EPA** solid waste disposal standards (**RCRA/SARA**) and is easy to dispose of. A simple ash analysis on the dust residue will determine if the dust requires *special* handling.

Tables 1.1 and 1.2 offer a summary of the type of automotive or industrial parts that can and cannot be processed in the Oven.

Table 1.1

Summary of Loads that CAN be processed in the Oven

<u>Parts made of:</u>
<ul style="list-style-type: none"> • Aluminum <p><u>Note:</u> It may be necessary to use slower heat up and cool down rates on some parts to prevent thermal distortion.</p>
<ul style="list-style-type: none"> • Iron
<ul style="list-style-type: none"> • Steel
<u>Coatings made of:</u>
<ul style="list-style-type: none"> • Straight chain hydrocarbons (glues, adhesives, polymers).
<ul style="list-style-type: none"> • Epoxy, polyester, powder and wet paints and coatings.

Table 1.2

Summary of Loads that CAN NOT be processed in the Oven

<u>Parts Made of:</u>
• Metals that melt under 900 °F (e.g. Zinc and its alloys)
• Magnesium which burns violently when ignited
• Alloy aluminum with a low melting point.
<u>Coatings Made of:</u>
Chlorinated compounds (PVC's) - (Depends on concentration)
Fluorinated compounds (Teflon)

Note: *Guspro Inc. should be consulted before processing loads*

1.2 Design

1.2.1 Introduction

Guspro heat cleaning ovens are of the two stage controlled air design. The first stage is called the ***Process Chamber***, while the second stage is called the ***Oxidizer Chamber***.

A separate burner(s) heats each chamber. The process chamber burner(s) is fires into an internal or external firebox. The oxidizer burner(s) fire directly into a chamber located on top of the oven. A temperature control system oversees the operation of both burners. Flue gases are vented to the atmosphere by a self-supporting refractory lined stack.

1.2.2 Specifications

Table 1.3 lists the usable dimensions, burner models and ratings on standard Guspro ovens. Guspro heat cleaning ovens are designed with larger oxidizer capacities to quickly and efficiently burn off volatile particles from the process chamber, while complying with environmental regulations. A summary of Oxidizer combustible ratings for standard Guspro oven models is listed in **Table 1.4**.

Table 1.3
Oven Design Information

<u>Model</u>	<u>Actual Inside Dim.</u> <u>(Inches)</u>			<u>Design</u> <u>Load</u>	<u>Burner Rating</u> <u>(BTU/hr)</u>		<u>Burner Model</u>	
	<u>W</u>	<u>D</u>	<u>H</u>	<u>LBS</u>	<u>PROCESS</u>	<u>OXIDIZER</u>	<u>PROCESS</u>	<u>OXIDIZER</u>
GO-484072	54	48	99	3,000	500,000	750,000	E3	E4
GO-484084	54	48	111	3,000	500,000	750,000	E3	E4
GO-606060	66	68	87	4,000	750,000	750,000	E4	E4
GO-607272	66	80	99	4,000	750,000	750,000	E4	E4
GO-607284	66	80	111	4,000	750,000	750,000	E4	E4
GO-727272	78	80	99	5,000	1,000,000	1,000,000	E5	E5
GO-727284	78	80	111	5,000	1,000,000	1,000,000	E5	E5
GO-729672	78	104	99	6,000	1,000,000	1,000,000	E5	E5
GO-7212072	78	128	99	6,000	1,000,000	1,000,000	E5	E5
GO-7212096	78	128	123	6,000	1,000,000	1,000,000	E5	E5
GO-9612096	102	128	123	6,000	1,000,000	1,000,000	E5	E5

Table 1.4
Summary of Oxidizer Combustible Ratings

<u>Oven Model</u>	<u>Oxidizer Rating</u> <u>(lbs/hr)</u>
GO-484072 to GO-484084	40
GO-606060 to GO-607284	50
GO-727272 to GO-7212096	55
GO-9612096	70
<i>Special</i> models and standard models (GO-484072 and up) are available with larger capacity oxidizers.	100

Note: *Certain site specific applications may need special custom designed ovens or larger capacity oxidizer chambers.*

1.3 Burners

Gas burners are equipped with approved ignition and flame safety systems. The burners may be used with Liquefied Propane Gas (LPG) by a modification to the orifice. Fuel oil fired ovens are available upon request.

1.4 Materials of Construction

All Guspro ovens are fabricated with hot rolled 7-gauge steel floors and 12-gauge steel wall and roof backed by a framework of 3" channel, tube and flat iron. All steel work is finished with two coats of 400 °F heat resistant paint on the outside, while the insides of the steel walls are coated with chemical resistant *Mastic*.

The inside of oven walls and doors are insulated with three layers of insulation. The innermost layer consists of 2" mineral fiber rock board, which is rated at 1200 °F. The next two layers are made of 1/2" ceramic fiber board, which is rated at 2300 °F.

The wall insulation is anchored to the steel skin with stainless steel pins and clips.

The process chamber doors are equipped with a high temperature ceramic tadpole gasket, hinges and cam type safety locking latches.

The floors are poured with 3" thick castable refractory. Cart tracks are embedded in the refractory floor. Removable external cart track extensions are included.

Note: The cart track extensions may be left in place at all times. They do not have to be removed to close the oven door.

The self-supporting stack is fully lined with a 2300 °F castable refractory. It is designed to provide natural draft operation, and does not require either an exhaust blower or induced draft fan.

1.5 Instrumentation and Control

A microprocessor - controlled operating system coordinates the functions of the process burner, the oxidizer, and the Over Temperature Suppression (*OTS*) System during a heat cleaning cycle. After the heat cleaning cycle, the system shuts down to cool.

All oven models have an OTS system included. The ovens come with a separate process chamber excess temperature backup sensor. This will activate the OTS system by water mist

injection in case the oven operational temperatures exceed set parameters.

The **process** burner is controlled by a programmable digital temperature controller, which can store up to four programs patterns with 16 steps of ramp and soaks. The process burner uses of a High/Low gas valve which will cycle between high and low fire to maintain set point. This enables heat cleaning temperature control and fuel efficiency.

An independent digital temperature controller controls the **oxidizer** system. The oxidizer temperature controller senses the stack temperature and controls oxidizer temperatures through the use of a High/Low gas valve control system.

The use of a High/Low gas valve allows for a fast response oxidizer system (FRS). This system gets the oxidizer to set point temperature quickly and then cycles to low fire to maintain set point.

The oxidizer chamber also includes an excess airport for excess air combustion of combustibles. The oxidizer chamber is designed to operate at a set-point temperature of between 1400 °F (760 °C) to 1600 °F (870 °C).

Note: The oxidizer set-point temperature is dependent on regulations set forth by the local air pollution control authority. This value typically varies between 1400 °F and 1600 °F over North America.

The oxidizer chamber is designed for a total *residence* time of 0.50 to 1.00 second through the refractory lined mixing chamber and stack volume up to the thermocouple port.

Guspro ovens are equipped with a manual reset Excess Temperature Controller (**ETC-S**) located in the panel. The ETC-S is used for safety shutdown if the flue gas temperature exceeds a pre-set limit (1850 °F).

Operating and safety controls required by most provinces, states and local codes are standard equipment. Special requirements such as Factory Mutual (**FM**) standards and Industrial Risk Insurers (**IRI**) standards are available at **extra cost** where required by the purchaser or the insurance underwriter.

1.6 Installation

The Guspro heat-cleaning oven is completely piped, wired and tested at the factory to reduce installation costs to a minimum.

1.7 Air Permits

The Guspro heat-cleaning oven is state-of-the-art technology that enables safe and economical cleaning of automotive and industrial parts, fixtures, paint hooks and racks. However, operation of the oven will require an air permit from the local Air Pollution Control Authority.

The process of securing a permit to construct or install process equipment like the Guspro oven usually requires that the purchaser fill out the applicable local forms and provide information about the process, the equipment and the location where the equipment is to be used.

Upon request, Guspro Inc. will furnish an appropriate Air Permit support package that can be used as an application package for submittal to the local authorities. The package generally requires completion of the Air Quality portions of local forms. Guspro Inc. will supply supporting technical documentation such as:

- Expected stack emissions.
- Combustion gas flow rates.
- Operating temperatures.
- Heat and mass balances.
- Residence time calculations.

The purchaser must supply the following information:

- Local application forms.
- Owner of the equipment.
- Persons responsible.
- Physical locations (including plot plans where required)
- Any other information required

The purchaser is ultimately responsible for fully completing, signing and submitting the completed forms along with any necessary filing fees.

1.8 Local Codes

The Guspro Heat Cleaning Oven is designed to comply with most building and safety codes. If any modifications are requested for compliance with other codes or regulations, Guspro Inc. will review the requirements. Guspro Inc will then provide a cost estimate for additional work required to meet these standards.

1.9 Safety Standards

OSHA standards have not yet been released for this class of equipment. The installed flame safety systems have a 4.0 second proof of ignition and a 0.8 second flameout response time.

The Guspro safety systems meet current industry standards. The comprehensive features of the Guspro safety system also ensure compliance with potential future standards.

1.10 Warranty

Guspro Inc. guarantees its equipment against defects in materials and workmanship, when operated in accordance with standard operating instructions. The warranty is good for a period of one year from date of shipment.

During this time period, defective parts will be replaced free of charge. Parts subject to normal deterioration in use, such as spark electrodes, electric relays, panel light bulbs, gaskets, fire-box tiles, etc. are not covered by this warranty.

Guspro Inc. makes no guarantee with respect to motors, controls, or other apparatus of third party manufacture. The respective manufacturers usually guarantee these separately. Guspro Inc. handles warranty exchange of such parts on behalf of the customer.

Guspro Inc. cannot accept responsibility for damage or injury resulting from oven operation.

When operated in accordance with manufacturer's instructions, all Guspro ovens are guaranteed to comply with the EPA particulate emission standard of 11 mg/Rm³ (15 mg/dscm @ 7% O₂). Costs of source tests that may be required by local air pollution agencies are not included in the base price of the unit.

2.0 - CONTROL AND SAFETY CONFIGURATION

2.1 Introduction

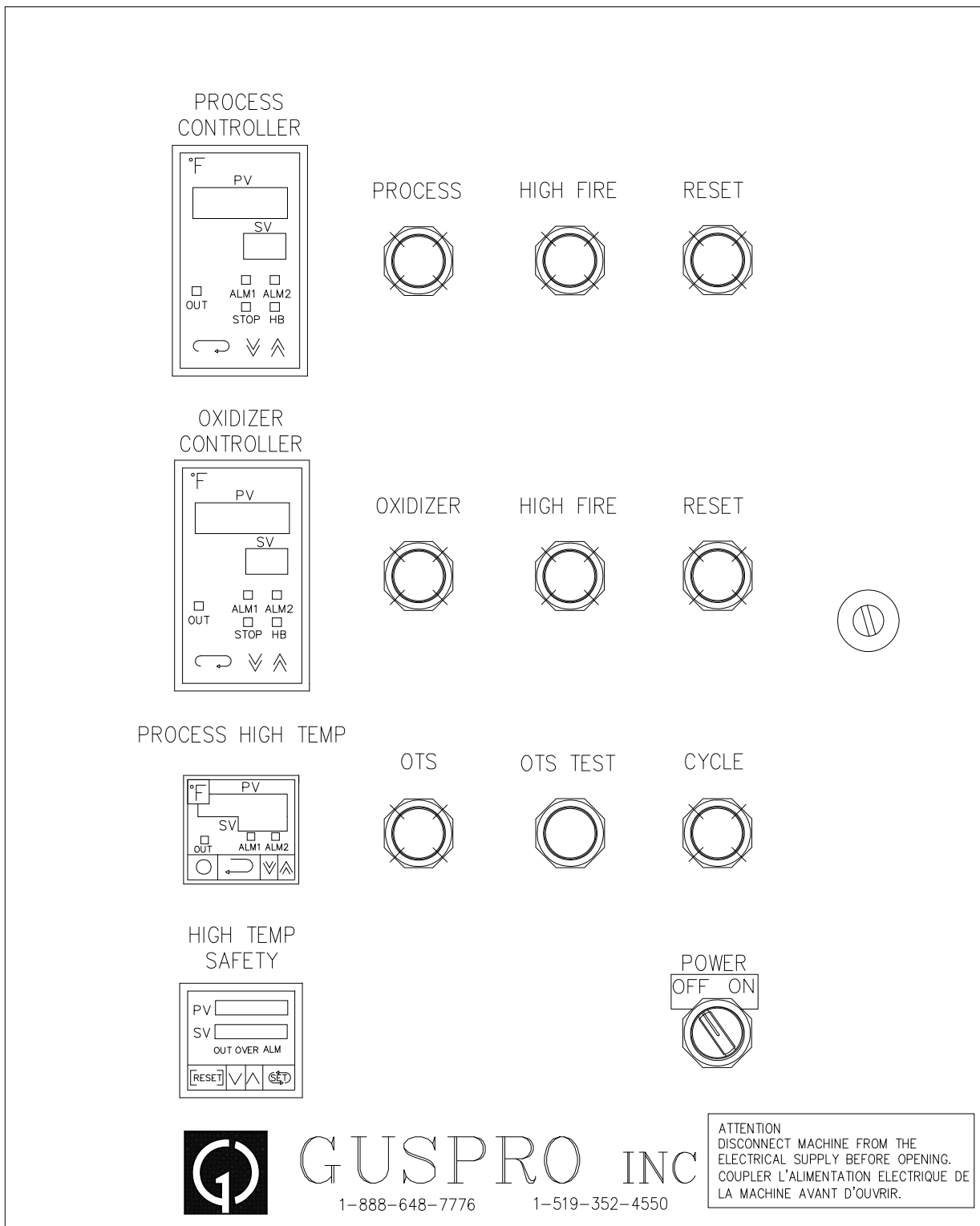
Figure 2.1 displays a schematic of the main control panel.

2.2 Main Control Panel

The central control panel includes the following features:

- Two 1/8 DIN digital temperature controllers. One controller controls the burner(s) and the temperature in the process chamber. The other controller controls the burner(s) and the temperature in the oxidizer chamber via a High/Low fire - modulating actuator.
- A 1/16 DIN controller, which serves as an OTS High Temp controller.
- System-on and burner-on indicating lights.
- Relays and interconnects.
- ETC-S High Temperature. All ovens have a second 1/16 DIN digital temperature controller. This Factory Mutual (**FM**) approved controller and is used for system lockout if the temperature exceeds safety limits. This controller is also used in FM and Industrial Risk Insurers (**IRI**) approved ovens.

Figure 2.1 Schematic of Main Control Panel.



A brief description of the functionality of each of these elements is presented in the following sections.

2.2.1 Temperature Controllers

All ovens include digital temperature controllers actuated by a Type K thermocouple(s) located in the process and oxidizer chambers. Instructions for setting up these controllers are listed in the Appendix.

The controllers have an adjustable hysteresis for better control. This is set at the factory and should not be adjusted unless Guspro has been consulted.

The oxidizer burner is fired automatically and remains on high fire until the microprocessor set point is achieved. It will then cycle high/low fire to maintain the chamber temperature. The process chamber burner fires until the set point on the temperature controller is reached. The burner will then cycle high/low fire to maintain the process chamber temperature.

Note: All ovens include an Over Temperature Suppression misting system in the process chamber. The OTS system is activated by the process and oxidizer chamber temperature controllers on the main panel.

2.2.2 Cycle Timer

All Guspro ovens are supplied with programmable ramp and soak microprocessor controllers and may not have a separate cycle timer. The microprocessor controls the cycle time.

2.2.3 Fault Light

Red Fault lights located on the panel will indicate if either the process or oxidizer chamber burners has faulted out and gone into **Reset** mode.

2.2.4 Oxidizer or Process Chamber Faults

If the oxidizer chamber faults out on start-up the process chamber burner will not ignite. If the oxidizer chamber burner faults out during operation, the process chamber burner will shut down. If the process chamber burner faults out, the oxidizer chamber burner will continue to run. This ensures maximum environmental protection.

2.2.5 Reset Faults

The ***Reset Faults*** push buttons are located on the flame safety modules. It is used to resume normal operation after either a ***Process*** or ***Oxidizer fault*** has been corrected.

2.2.6 OTS Test

The ***OTS (Over Temperature Suppression) Test*** push-button is used to verify that the OTS spray misting system is functioning properly. The OTS system is an integral and highly important safety feature that ensures that a runaway combustion event that drives up either the process chamber, the oxidizer chamber or the stack gas temperatures above acceptable limits does not occur.

Before starting the processing cycle, the operator should open the process chamber doors and push the OTS Test push-button. The operator should observe and ensure that the misting nozzles are misting properly.

The OTS misting nozzle must mist to be effective. If the water is injected directly without misting, it will not have any effect in suppressing over-temperature conditions in the process chamber. This visual inspection will verify that the misting pin is not broken and that the nozzles are not plugged. This inspection is very important and should be performed prior to each start-up.

2.2.7 Stack High Limit Controller [ETC-S]

Some older model ovens include an Excess Temperature Control-System (ETC-S) switch located in the stack base. If the temperature of the flue gas from the oxidizer chamber exceeds a preset temperature, the ETC-S opens up the circuit to the system and shuts it down. However, in 1996 the system was changed and is now controlled from the panel with a manual reset temperature controller. This controller is labeled ETC-S HIGH TEMP.

Note: *The power supply to the water solenoid valve is not affected when the oven high limit control system is tripped. The OTS water mist spray system can continue to operate to lower the chamber temperature.*

Effective June 15, 1996 all oven models, irrespective of size, are equipped with an ETC-S high limit system. The ETC-S system shuts down the oven when the stack temperature exceeds a pre-set value (1850 °F) depending on local codes.

Once the ETC-S system trips open, the system cannot be re-started unless it is manually reset. The controller cannot be reset until the temperature has dropped below the high limit set point.

The ETC-S protects the entire oven from operating at excessive temperatures. The following are two examples that could cause excessive temperatures in the oxidizer chamber:

- Improper oxidizer chamber burner settings.
- Improper or overloading of parts or material in the process chamber. This can result in combustion overload in the oxidizer chamber, thus causing the temperature to increase beyond normal limits.

2.3 Gas Burners

The heat-cleaning oven is equipped with two natural gas burners as discussed in Section 1.0. A technical description of the burner and the process chamber/oxidizer chamber burner configurations is presented below.

Note: *Special oven models may have more than one burner per chamber.*

2.3.1 Technical Description

The gas burners on the oven are packaged burners. Burner types and model numbers for different oven models are listed in **Table 1.3**.

Gas supply pressure to the oven should be 7" W.C. and must be maintained with all burners operating at the maximum BTU rating (supply valves wide open).

The manifold gas pressure required for each burner to operate at its maximum BTU rating is listed on the burner identification plates. Technical specifications for each burner are listed in the Appendix.

Table 1.3 lists the maximum BTU rating required for each standard oven model. Each burner valve train is supplied with an in-line regulator to ensure proper supply to the individual burners. Gas flow is controlled through a slow opening, fast closing valve.

Combustion air is supplied at the burner by a manually set damper. Damper settings are calibrated at the factory and should *not* be adjusted unless Guspro Inc. has been consulted.

Gas flow modulation is accomplished through a High-Low fire actuator valve which is cycled by the temperature controller to maintain set point.

The high/low fire valve train lines are equipped with adjustable valve which are set to control the high fire. The low fire adjustment is factory set in the High-Low fire actuator and should not be adjusted unless Guspro has been consulted.

These valves control gas flow and are set at initial start-up only.

2.3.2 Process Chamber Burner Configuration

The Process Chamber burner supplies heat input to raise the chamber to the operating set-point temperature (normally between 550 °F - 800 °F).

The burner fires through the back wall into a firebox or combustion chamber. The firebox is typically located under the cart.

The firebox fulfils the following functions:

- Prevents any *direct* contact between the flame and the material to be heat-cleaned. The flame does *not* protrude outside this chamber.
- Heats the material to be heat-cleaned gradually and evenly to prevent thermal damage to the components to be heat cleaned.
- Volatilizes the waste material gradually and at a controlled rate to avoid overloading of the oxidizer chamber, which could result in incomplete combustion.

Gases and fumes resulting from the heat cleaning process flow through an inlet port from the process chamber into the oxidizer chamber. When the process chamber reaches the set point, the burner cycles to low fire.

2.3.3 Oxidizer Chamber Burner Configuration

The Oxidizer Chamber burner fires through the wall into a combustion chamber. The oxidizer chamber is located on top of the process chamber.

Note: *The oxidizer set-point temperature is dependent on regulations set forth by the local air pollution district. This value typically varies between 1400 °F and 1600 °F over North America.*

2.4 Flame Safety Controls

The process chamber and oxidizer chamber gas burners utilize electronic flame safety controls based on the flame scanner principle. When the gas burner pilot ignites, the flame safety scanner detects the ultra-violet rays.

The scanner then allows the burner's main gas valve to open. The flame failure response in this safety system is 0.8 seconds. The safety system should generate 5V DC. Voltage test points are located in the flame safety module.

Note: If the pilot flame is not established within 4.0 seconds (trial for ignition period), the flame safety lockout will be activated.

2.5 Optional Controls

Guspro ovens are built to **CGA & AGA** specifications. Operating and safety controls meet or exceed Federal and local codes.

The purchaser should check with the insurance broker and the on-site policy regarding the installation of fuel fired equipment. Additional controls for compliance with Factory Mutual (**FM**) and Industrial Risk Insurers (**IRI**) standards are available at an additional cost.

2.6 Chart Recorder

A single or dual pen circular chart recorder may be ordered with the oven. The chart recorder can be used to log the process chamber and oxidizer chamber temperature profiles during the daily cycle.

Note: Single pen chart recorders are also available. They are normally used to record oxidizer chamber temperatures.

2.7 Core Temperature Controller

A core temperature controller is available as an option with all ovens. This is an additional safety feature that is mostly utilized in the electric motor rewind business.

The core temperature controller is connected to the part via a thermocouple. It senses the part temperature and also concurrently records the part temperature on a chart recorder.

If the part temperature exceeds a critical limit, the process chamber burner is shut off and will activate the OTS system if required. The core temperature controller serves to further protect valuable parts.

3.0 - INSTALLATION

3.1 Permits

In all areas, a permit to install is required from the local Air Pollution Control Authorities. The purchaser is required to obtain the necessary forms and complete the application process.

Guspro Inc. will furnish technical support material for submittal with the application forms (see *Section 1.7*). Guspro will also complete a technical inspection of the forms and supply independent test report data upon request.

In some localities, building permits are required for installation of process equipment such as the Guspro heat-cleaning oven. The purchaser is advised to contact their Building Department for clarification.

3.2 Purchaser's Requirements Prior to Installation

Prior to oven delivery, the purchaser will need to provide the following:

1. An adequately reinforced concrete pad for setting the Oven. The proposed location must be checked for stack clearance from walls and stack height over the roof or adjacent roofs.
2. Recommended stack clearances are listed in Table 3.1. Some of these values may vary from region to region. It is the purchaser's responsibility to confirm these requirements with local authorities.

Table 3.1
Minimum Suggested Stack Clearances

<u>Location</u>	<u>Position</u>	<u>Required Height</u>
Stack Extends	Over roof line	10 ft.
	25 ft from any obstruction	10 ft.
Side & Back	Clearance to wall (non-combustible)	2 ft.
Front	Clearance	8 ft. ^[1]
Top	Relief Lid (when fully opened) <i>Recommended Minimum</i>	4 ft.

[1] Depending on oven model, adequate clearance should be maintained for safe loading and unloading of parts.

3. Make-up air vent sizing should be checked with local authorities if required. Combustion air requirements in ft³/min for Guspro ovens are available on request.
4. The oven should **NOT** be operated in a completely closed room, or one under negative pressure from exhaust blower systems or any other operation that depletes normal air levels (e.g. spray paint booths, cleaning booths, etc.).

Negative pressure in a building will overcome the natural draft mechanism provided by the stack and may cause raw combustion smoke, heat or odour from the oven into the building. Excessive negative pressure may cause the burners to be starved for air.
5. Through the wall installations require special precautions:
 - The OTS water line needs to be wrapped with heat trace wire (supplied by the purchaser) to prevent the water line from freezing.
 - The relief lid mounted on top must be kept free of snow and ice.
 - Units equipped with a circulating blower must have a covering roof.
 - Weather covers are required to prevent damage to the burners by the elements.
6. A stack rain cap must **NOT** be installed. A rain cap will reduce stack induced natural draft.
7. The purchaser is required to:
 - Pay freight charges for delivery from the factory.
 - Provide fork truck or crane service to facilitate the installation of the oven and stack.
 - Arrange for utility connections for start-up and operation of the oven.
8. ***Guspro factory service representatives are available to supervise installation and start up at a daily rate, including per diem and travel expenses.***

3.3 Electrical Service

3.3.1 Standard Ovens

These require 120V-15A-1 phase-60 Hz power supply.

3.3.2 Ovens With Multi-Burner Chambers

These require 110/220V-15A-1 phase-60 Hz power supply.

3.3.3 Ovens With Circulating Blowers

These require 208/220V-25A-3 phase/4 wire-60 Hz power supply.

Other supply voltages are available on request (e.g. 240V, 460V)

Note: *Required amperages in 3.3.2 and 3.3.3 could vary.*

Wiring to the oven should be a dedicated line. Low supply voltages will affect control system performance and may damage the controls.

3.4 Fuel Supply

Guspro ovens include complete manifold on the oven for single point fuel connection with either Natural Gas or Liquefied Propane Gas (LPG). Oil fired units are also available. Individual requirements for ovens burning these fuels are discussed below.

3.4.1 Natural Gas Service

Standard natural gas service is 0.25 psi or 7" water column pressure (WC) at the pressure gauge. This gas pressure must be maintained with all burners operating at maximum BTU output.

The oven is designed for this service with a normal pressure drop in the line to the oven of up to 1/2" WC. The rated capacity on the burners is at the manifold pressure indicated on the burner information plates.

If service is over 0.50 PSI or 14" water column, the purchaser must install a separate supply regulator at the oven. The purchaser's gas service should include a manual shut off valve and a pressure regulator at utility connection point to the oven. The shut-off valve should be installed close to the connection point.

The local gas company should be contacted to check the installation plan, piping size and the regulator capacity to provide the correct gas supply. Dirt and scale must be blown out of gas line before the final connection is established. Once the gas supply is connected, the system should be checked for leaks.

Pipeline sizing should be obtained through the local natural gas supplier. Licensed gas installers are another reliable source. Pipe sizing is important as an undersized pipe results in a pressure drop. This in turn reduces the gas flow across the regulators and impedes burner BTU values.

Note: The local gas company should be contacted for confirmation of facility requirements and verification of meter size.

3.4.2 Liquefied Propane Gas Service

Guspro standard gas burners will operate on Liquefied Propane Gas (**LPG**). The propane supply should be determined in consultation with the local propane supplier.

The total BTU requirements for the unit are available on the oven specification plate. The individual burner ratings are listed on the burner plates.

The natural gas burners supplied as standard equipment can be modified to work with LPG by changing the orifice size on each burner head. The purchaser may perform at the factory or in the field this orifice change.

Note: If the orifices on the burners are changed in the field, the oven main line and pilot regulators may need adjusting. Guspro should be contacted before the change is made.

3.4.3 Oil Service

Guspro Ovens may also be operated with diesel, #1 fuel oil or #2 fuel oil. When oil burners are supplied, the purchaser must supply an oil supply tank, with supply and return lines and proper oil filtration.

Note:

- ***Local oil suppliers should be contacted regarding tank sizing, placement and line protection in cold weather. Burner sizing and approximate oil requirements are available from Guspro Inc.***

3.5 Water Supply

A galvanized, copper or other rust resistant pipe should supply water supply to the oven. Clean city water is normally acceptable. Effluents from other plant processes should **NOT** be used.

The water mist nozzles on the OTS spray system have orifices that may get plugged by debris in the water supply. **Hard** water may also cause spray nozzles to be clogged due to mineral deposits. It may be necessary to use a water softener with the water supply if the local water is very **hard**.

The water pipe should be protected against freezing including suitable valves to drain water from any exposed pipes when freezing is expected. Provisions for insulation and heat tracing of water pipes should be made if the oven will be exposed to below freezing conditions.

The water connection for the Over Temperature Suppression System (OTS) system is typically on the right side of the oven at the inlet solenoid valve. The diameter of the connecting pipe on the OTS system is 3/4". If the inlet water line is 1/2", a reducing fitting should be connected to the OTS pipe.

The OTS nozzles are sized for 30-50 PSI pressure when operating. This may be verified by depressing the OTS Test button after connection and reading the attached gauge. The minimum water pressure is 20 PSI. If at any time the water pressure drops below the minimum 20 PSI the low water pressure switch located on the OTS valve block will shut down the process burner.

If the observed operating pressure is over tagged value, the manual valve on the manifold should be adjusted to ensure proper operating pressure.

If the observed operating pressure is under 30 PSI, the supply line should be checked for restrictions. The water pressure required is supplied on a tag on the OTS valve block. This should be noted at start-up.

3.6 Receiving

The Oven is shipped completely assembled and only requires stack installation and utility connections. Due to shipping regulations, oxidizer chambers on larger units are often shipped separately. An installation diagram is included with the oven.

Under the terms of the sale, shipment becomes the purchaser's property when released by Guspro to the carrier. While Guspro is not responsible for loss or damage in transit, Guspro will assist in processing claims against the carrier when necessary.

It is the purchaser's responsibility to make a thorough inspection of the shipment immediately upon delivery.

If damage is found or if all the items listed on the bill of lading have not been received, the local agent of the delivering carrier should be notified and requested to inspect the shipment. Failure to give such notification could result in the carrier's refusal to process a loss or damage claim.

Any and all damage must be noted on delivery receipt. The name of the carrier's representative, and the date and time of contact, must be noted on the delivery receipt.

Should the carrier's representative fail to make an inspection of the short or damaged equipment after being notified, details of inspection by the consignee should be furnished immediately in writing to the delivering carrier.

Concealed damage must be reported to the local agent of the delivering carrier immediately upon discovery and in any event within 48 hours after receipt.

Guspro must always be notified when lost, short-shipments, or damages occur so that a record can be made. This will aid supply of replacement parts and preparation of repair or replacement cost estimates.

Purchaser must file the final claim promptly with the carrier.

3.7 Storage

Refractory should be dried out and cured as soon as possible. If the Oven cannot be placed in immediate service, it must be protected during storage from freezing and rain. The internal refractory surfaces, including the stack interior, must be protected from excessive moisture until cured.

3.8 Installation

3.8.1 Introduction

Each oven is shipped with burners, gas manifolds and all electrical manifolds completely assembled. The refractory-lined stack is shipped separately.

Installation involves setting the oven in position on a level concrete pad or floor.

Note: The pad on the floor should be as level as possible. If the area is not level, this will be reflected in the stack vertical plane when installed.

Some large units are shipped with the oxidizer chamber separate from the oven. Oxidizer chamber installation is a ***bolt on*** assembly. Assembly instructions are included.

3.8.2 Stack Installation

The recommended method of venting flue gases from combustion inside the Oven is straight up the refractory lined stack to the outside atmosphere. Ovens are supplied with three six-foot sections of insulated stacking.

The stack sections normally bolt together and are bolted in place on top of the unit. In case this is not feasible, breech stacking and fittings are available for through the wall installation or other special requirements.

Note:

- a. Gaskets are not required between the stack flanges. However, if sealant is available, it is recommended that a bead be placed on a flange face before each section is bolted together.***
- b. A barometric damper is required if the stack height exceeds 27' (or 1.5 times the standard stack height).***
- c. Standard stack installation is through the roof. A through the wall installation may be ordered as a special option.***

3.8.3 Procedure

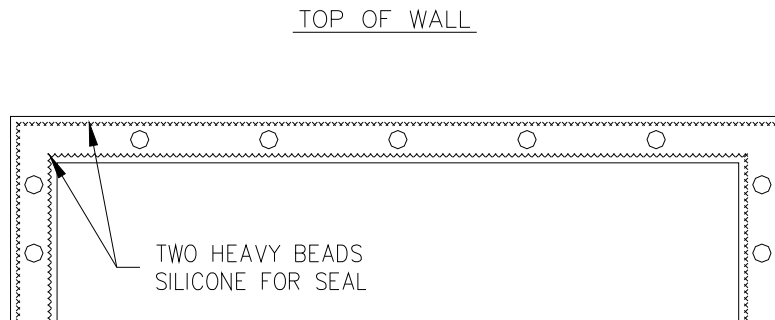
1. Unload the oven shipment. Remove the protective packaging and unpack the components.
2. The oxidizer chamber on some larger ovens is shipped separately. Oxidizer chamber installation is via a bolt on assembly as depicted in Figure 3.1.

3. Set the oven in assigned location. Use the stack lifting lugs provided and set the stack in the marked stack base location. Special stack installation instructions for ovens with heavy-duty oxidizers are depicted in Figure 3.2.

Note: *When locating the base stack, locate the thermocouple ports to the rear.*

4. Connect water, fuel and electrical supplies.
5. The cart extensions should be hooked on the oven and care should be taken to ensure that they sit on a level plane.

Figure 3.1 Assembly Instructions for Bolting Oxidizers.



FOR ALL MODELS STANDARD
OR HEAVY DUTY, IF OXIDIZER
CHAMBER IS SHIPPED
SEPARATELY.

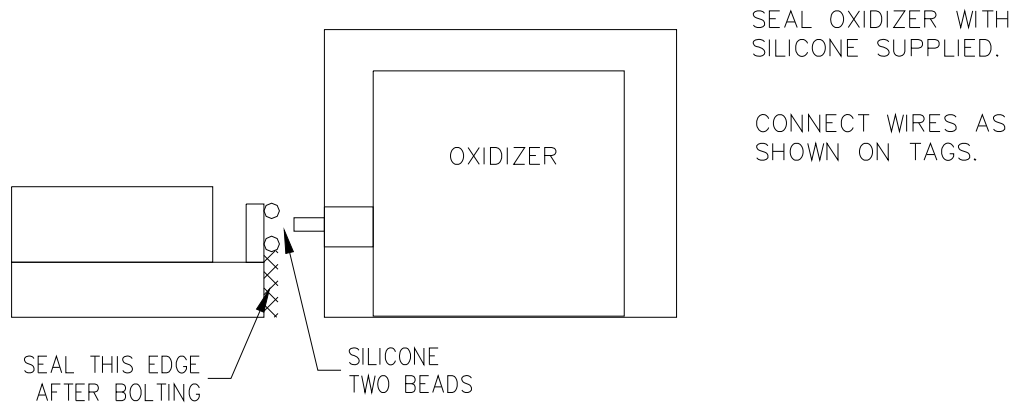
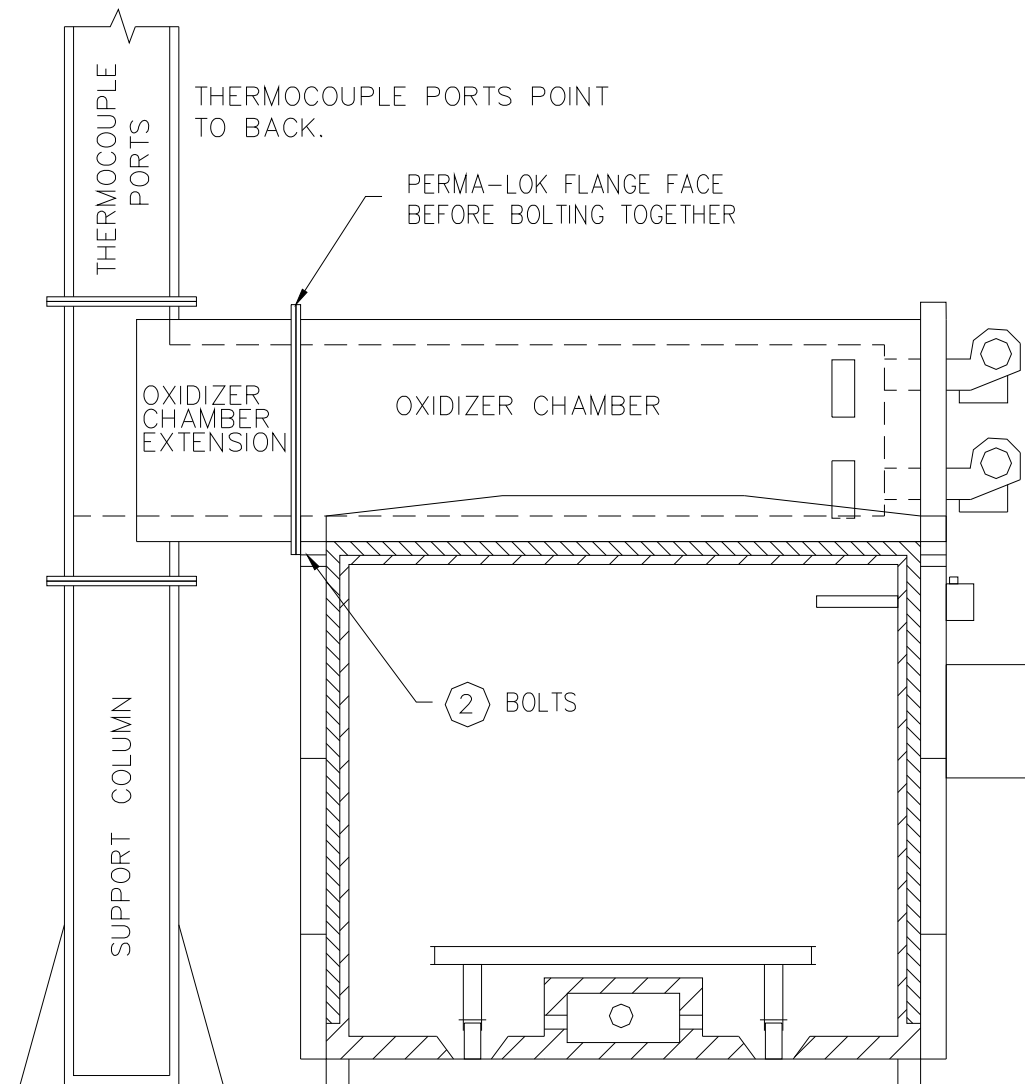


Figure 3.2 Stack Assembly for Ovens With Heavy Duty Oxidizers.



- | | | |
|--|---|---|
| <p>1. RUN SILICON BEADS ON TOP EDGE (FLANGE) OF OVEN AS SHOWN. (SEPARATE DRAWING)</p> <p>2. INSTALL OXIDIZER CHAMBER. (BOLTS SUPPLIED)
#NOTE: BE SURE TO INSTALL BOLTS ON UNDERSIDE OF WALL AS INDICATED ON THE DRAWING.</p> | <p>3. PLACE BEAD OF PERMA-LOK ON FLANGE INDICATED ON DRAWING</p> <p>4. PLACE SUPPORT COLUMN IN POSITION.</p> <p>5. INSTALL OXIDIZER CHAMBER EXTENSION ON SUPPORT COLUMN AND BOLT TOGETHER (COLUMN, OXIDIZER EXTENSION AND OXIDIZER CHAMBER)</p> | <p>6. LAG SUPPORT COLUMN TO FLOOR.</p> <p>7. BOLT STACK SECTIONS ON OVEN.</p> |
|--|---|---|

4.0 - OPERATION

4.1 Introduction

As explained in previous sections, the Guspro Heat Cleaning Oven includes a process chamber, an integral thermal oxidizer, temperature controls for burners and air supply, and a water mist injection system. Both the process and oxidizer temperature controllers control the water mist injection system.

During operation, the oven is first purged with air corresponding to *four times* the total volume of the process chamber, oxidizer chamber and the stack. The oxidizer burner is then fired and the chamber is preheated up to 15 minutes before the process chamber burner fires.

The oxidizer burner switches between high and low fire to maintain the chamber temperature at the set point. The process burner cycles on and off while maintaining the process chamber at the set-point temperature.

4.1.1 Process Chamber

The process chamber is designed to strip coatings/contaminants from metal parts. This is accomplished by volatilizing the load gradually. As temperature in the process chamber reaches the flash point, volatilization of the load increases.

As the volatile particles ignite, a rapid rise in process chamber temperature occurs. Thus, the process chamber controller automatically shuts down the process chamber burner. If the process chamber continues to rise, the OTS misting system is activated.

When temperatures in the process chamber begin to drop, the burner is then fired again to maintain a uniform processing temperature. The OTS is activated only when temperatures continue to rise after burner chamber and excess temperature set points are reached. This allows for minimal fuel and water consumption while offering complete load and temperature control.

As airflow in the process chamber is very low, velocities across the load are very low and little ash, if any, is entrained and carried to the stack.

4.1.2 High Combustible Loads

Some coatings contain bound oxygen atoms as part of their chemical structure. As these coatings are decomposed by heat, the released oxygen ignites rapidly causing a rampant temperature rise in the process and oxidizer chambers if not regulated.

On loads that have a high combustible content, it may be necessary to program a ramp and soak temperature profile in the process chamber controller. Special temperature controllers are available to automatically implement these control strategies.

4.1.3 Oxidizer Chamber

Hydrocarbon vapour, water vapour and hot gases generated in the process chamber are directed into the thermal oxidizer chamber, which is designed for a total *residence* time of between 0.75 - 1 second. The temperature in the oxidizer chamber is maintained between 1400 °F (760 °C) - 1600 °F (870 °C) by an independent second burner.

Note: *As discussed in Section 2.0, the oxidizer chamber temperature is dependent on regulations set forth by the local air pollution control authority.*

Ambient air is drawn via stack induced natural draft through a fresh airport designed to provide up to 50% excess air into the oxidizer chamber. This mixes with the incoming stream from the process chamber and oxidation is completed in the oxidizer chamber prior to entering the stack.

The hot stack gases discharged to the atmosphere consist primarily of excess oxygen/nitrogen, water vapour and carbon dioxide, which are invisible, odourless and harmless. This assures compliance with the most stringent North American, U.S. (EPA), European and regional air pollution standards.

4.2 System Checks Prior To Start-Up

Vibrations from shipping and installation can sometimes cause wires and relays to come loose. It is recommended that the following steps be performed prior to initial start-up.

1. Before turning on electrical power visually check for loose wires. It is good practice to snug the wire terminal screws with a screwdriver.
2. Push on all relays to ensure they are plugged into bases properly.
3. Activate the electrical power to the unit.
4. Turn on the power switch located on the panel. Do ***not*** turn on the timer on standard units. If the unit is supplied with a programmable controller do ***not*** activate it.

5. Push all reset buttons. The High Temperature Safety controller located on all panels has a reset button.

Note:

- a) *The U.V. scanner flame safeties have a reset button located on the module and one located on the motor of each burner.*
- b) *Older models have a High Temperature Safety (Burling Switch) located in the stack. The Burling switch has a reset button located behind the aluminum nut just below the probe. In newer models (post 1996) the Burling switch has been replaced by manual reset controller at the oven control panel.*

4.3 Initial Start-Up

This section describes the steps involved during the initial start-up procedure for a Guspro Heat Cleaning Oven after it has been connected to gas, electricity, water and the stack has been installed.

A summary of factory gas and airflow settings is presented in Table 9.1. These are initial settings. Final adjustments to these settings may be necessary on-site during the first or second processing run. From this point onwards, the operator only needs to load and run the unit.

1. Familiarize the operator with the location of all the controls and the normal operating sequence based on Section 2.1 and Section 4.4.
2. Turn the water on and purge the water lines to remove accumulated dirt and scale in the newly installed piping.
3. Check the gas or fuel supply line for leaks. New fuel supply lines must be pressure tested. Care should be taken to ensure that the pressure has been released.

Note: *Natural gas joints should be checked for leaks with soap and water. Care must be taken to ensure that air from the pressure test is bled off and not evacuated through the valve train components. If high-pressure air is accidentally evacuated through the valve train, it will damage the regulator and pressure switch diaphragms.*

Certified personnel should complete both of these checks!

4. Remove the cart.

5. Turn on the gas supply followed by the electrical supply. Bleed air from the gas supply pipe by loosening the pilot lines on both burners. The oven doors should be left open to vent any remaining gas from the purge lines. Tighten the pilot lines.
6. Close the firing valves on all burners. The firing valves are located directly in front of the burner. This allows the operator to visually check the pilot flame through the peep-site glass located on the burner.
7. Ensure that all other gas valves are open.
8. Inspect the electrodes for cracks. Check and make sure they are gapped for 1/8".
9. The manual gas flow valve on the process burner should be set between 3/16" to 1/4" open.
10. The manual gas flow valve on the oxidizer low fire valve train should be set at 3/8" open.
11. The manual gas flow valve on the oxidizer (afterburner) high fire valve train should be set at 5/8" open.
12. The oxidizer chamber airport should be set at 1/2" open.
13. Open the panel door and turn the oxidizer preheat timer down to 0-9 seconds. Close the panel door.
14. Turn on the electrical power.
15. Check the set-points parameters on the panel temperature controllers to ensure the proper settings. The process chamber set point should be set at 250 °F, which corresponds to the first curing level. The process alarm (water mist) should be set at 50 °F. The oxidizer chamber set point should be set at the temperature specified by the local air pollution control authority (generally between 1400 °F - 1600 °F). The oxidizer alarm (OTS mist) should be set at 100 °F.

Note: *The process chamber's 50 °F alarm setting and the oxidizer chamber's 100 °F alarm setting will activate the OTS mist system. These settings remain constant and will activate above set-point values.*

Example: *Process chamber - 200 °F set point-----OTS activates at 250 °F*
400 °F set point-----OTS activates at 450 °F
800 °F set point-----OTS activates at 850 °F
Oxidizer chamber - 1600 °F set point-----OTS activates at 1700 °F

16. Open the oven doors. Press the OTS test button located on the panel to ensure that the water nozzles mist properly. Hold the OTS button on and adjust the OTS valve block water valve to the pressure indicated on the tag. Turn off the water supply. Water is not required during the cure cycle.
17. Turn on the cycle timer (or in case of ovens with programmable controllers, run the processing program) with the oven doors open. The burner firing sequence will start. The oven has a purge cycle and an oxidizer preheat cycle. The oven will be purged with air equal to four times the system volume. The oxidizer and primary burner pilots will then ignite. Check the pilots to ensure a nice flame. The flame should fill most of the burner cup. If the flame is blowing away or dancing, it may require adjustment. Flame adjustment can be accomplished by adjusting the pilot regulator. Remove the cap on the regulator. Turn it with a screwdriver as required (a clockwise turn enhances the flame, while a counter clockwise turn diminishes the flame).
The air supply to the burner should be gradually adjusted by setting the burner air damper. A 1/4 turn will greatly affect the pilot flame. Turning the damper counter-clockwise will increase the airflow, while turning the damper clockwise decreases the airflow.

Note: Normally the factory air damper setting is proper. The gas supply may be adjusted if required. Care should be taken to ensure that a strong pilot flame exists at all times.

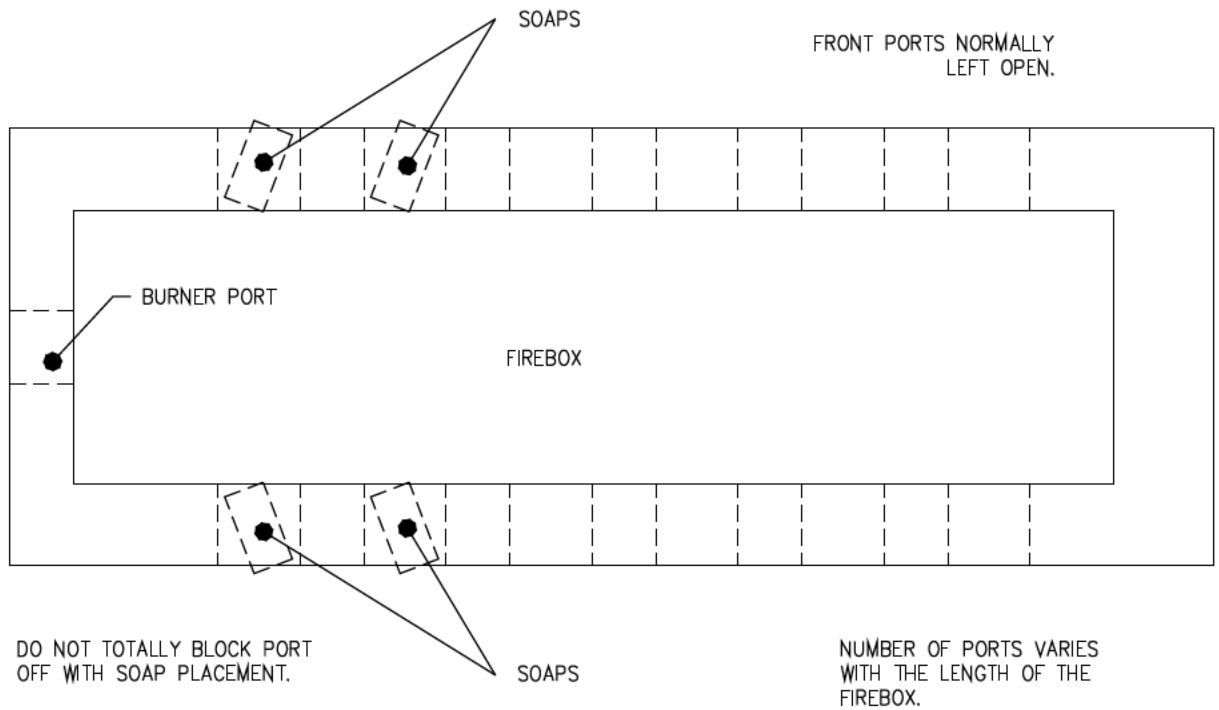
18. Turn off the oven. Place the firebox tiles on the top of the process chamber firebox. Install the soaps (small pieces of firebrick). Starting at the back of the oven place the soaps in the heat ports as shown in Figure 4.1. Work your way forward and fill at least 3/4 of the heat ports on each side under the cart.
19. Open the firing valve on the process burner.
20. Start the oven with the doors open. After the purge, the process burner will ignite. Look at the flame to ensure that it is either contained in the firebox or flickering slightly from the heat ports.

21. If the flame is excessive, decrease the gas flow by the manual flow valve (eclipse valve). Mark the setting on the valve with a pencil. Hold the adjusting ring with one hand and loosen the screw with an Allen Wrench. Adjust the valve by turning the ring (a clockwise turn increases the gas flow, while a counter clockwise turn decreases the gas flow). Move the ring a maximum of 1/32" and tighten the screw while holding the ring.
 22. If the flame is a dirty yellow colour or is sooty, open the air damper slightly, a 1/4 turn at a time.
 23. Close the doors and cure the oven as per Section 4.4.
- Caution: Do not proceed further without curing the unit!***
24. After the cure cycle, shut off the power and open the panel door to reset the oxidizer preheat timer to the factory setting of 900 seconds. Close the panel door.
 25. Open the firing valve on the oxidizer burner.
 26. Turn on the water supply.
 27. Replace the cart.
 28. The oven is now ready to run.

Note: The oxidizer flame may need to be adjusted to ensure proper heat-up to processing temperature. This may be accomplished while the burner is operational as described in Section 4.3 - Step #21.

Figure 4.1 Placements of Firebrick Soaps.

A NUMBER OF SOAPS ARE SUPPLIED WITH EACH OVEN UNIT. PLACE THE SOAPS AS SHOWN AND AS REQUIRED. SOAPS ARE USED TO CONTAIN THE FLAME FLICKER AND TO MOVE THE FLAME AND THEREFORE THE HEAT EVENLY TO THE FRONT OF THE FIREBOX. INSTRUCTIONS FOR THEIR PLACEMENT IS CONTAINED IN THE STARTUP DESCRIPTION.



4.4 Curing Procedure

After installation, the oven must be cured. The curing procedure is described below.

Note: *Ovens with special requirements are tagged. Further, wood forms are left in the oxidizer for all ovens. These forms burn out during curing and may emit some smoke temporarily. However, this is not a cause for alarm.*

1. Check all connections and passages.
2. Turn off OTS (Over Temperature Suppression) valve and turn on electrical power to unit.
3. Turn down the manually adjustable gas valve on the process burner to a very low setting (no flame protrusion from ports).

Note: *The oven has a yellow jumper wire installed to allow the oxidizer to be bypassed during the cure cycle.*

4. Turn off the oxidizer firing gas valve. The oven is cured with the process burner and the oxidizer on pilot.
5. Tap the scroll key on the process controller to confirm pattern #0 and the curing procedure. Press the RUN/REST button on the programmable process controller to start the cure cycle.
6. Program #0 will raise the oven temperature from ambient to 250 °F using a 3 hour ramp and hold for 6 hours. This should be accomplished with only the process burner on.
7. Then it will raise the temperature to 600 °F using a 7 hour ramp rate. The refractory should be allowed to soak for 6 hours at this temperature.
8. Finally the temperature will be raised to 800 °F using a 2 hour ramp rate. The refractory should be allowed to soak for 6 hours at this temperature.

Note: *During the cure, if you can see steam at any temp, do not ramp up until steam is gone. If the process chamber temperature does not increase as required, increase the gas flow slightly by adjusting the manual flow valve.*

9. The cure cycle is now complete.
10. The oven is now ready for normal operation.
11. Turn on OTS (Over Temperature Suppression) valve.
12. Turn on the firing valve to the oxidizer.
13. Reset both the process and oxidizer controller set points to normal operating temperatures.
14. Review the firing instructions (Sections 4.5, 4.6) carefully before processing a load.

4.5 Operating Sequence

The sequence of events that occur during normal operation of the oven is explained below. Further, the electrical component firing sequence is listed in Table 4.1 The wiring ladder diagram is included in the Appendix.

The process chamber must be heated slowly and evenly without direct exposure to the flame. This prevents any distortion of material to be heat cleaned. The average time required to heat the process chamber to operating temperature is 45-75 minutes, depending on the mass of the material to be heat cleaned and the material being processed. The oxidizer chamber burner preheats up to 15 minutes before the process chamber burner activates. This ensures that the oxidizer chamber is at temperature before any heat induced off gassing or waste combustion occurs. During the first hour, most of the heat is used to heat the process chamber and the parts being processed.

A specially designed platform cart is loaded with the material to be heat-cleaned. The loaded cart is then pushed into the oven and the doors are closed.

Table 4.1**Firing Sequence**

System on	TE1 (process controller) TE2 (oxidizer controller) TE3 (process high temp controller) TE4 (high temp safety controller) BC 1 (7800 module processor) BC 2 (7800 module oxidizer) CR7 (cycle start)	Indicates PV (process value) - SUB1 closes Indicates temperature and SV (set value) CR9 energizes (process high temp relay) CR8 energizes (high temp safety relay) Electronic circuits energized Electronic circuits energized CR7-1 closes
	PPC (proof of closure) proves	PL1 illuminates (system light) CR2 energizes (process blower relay) CR3 Energizes if WPS1 is proven (SEE NOTE 2) B1 blower motor starts (optional)
	CR2-1 closes CR2-2 closes	Holding coil for CR2 PM1 starts (1 st process blower)
TR1 (purge timer) allows process blower to blow 4 volumes of air into oven.	PAS1 closes (process air switch)	CR11 energizes TR1 (purge timer)
When timer is complete	TR1-1 closes TR1-2 opens OPC (proof of closure) proves	Keeps process burner from firing CR1 energizes (oxidizer burner relay)
	CR1-1 closes CR1-2 closes	Holding coil for CR1 OM1 starts (oxidizer blower)
	OAS1 closes (oxidizer air switch)	OBC1 energizes (oxidizer burner) OPV1 (oxidizer pilot flame) opens and allows 4 seconds of gas OIT1 (oxidizer ignition) sparks for 4 seconds
	OUV1 (oxidizer scanner proves flame in .8 seconds) OR1-1, OR1-2 closes	OR1 (oxidizer main gas valve relay) energizes OMV (oxidizer main gas valve) opens TE2 operates Hi Lo contact on OMV oxidizer main gas valve (SEE NOTE 1) PL2 illuminates (oxidizer Hi Lo light) OPL1 illuminates (oxidizer gas on light)
CR6 (Proof of temp) ensures that the oxidizer chamber is at 1400 degrees F before energizing the process burners PBC1	CR6-1 closes CR6-2 closes CR6-3 closes, CR3-1 closed, CR-11-2 closed	Holding coil for TR1-2 Holding coil for CR6 PBC1 energizes (1 st process burner) (SEE NOTE 3) PPV1 (process pilot flame) opens and allows 4 seconds of gas PIT1 (1 st process ignition) sparks for 4 sec
	PUV1 (1 st process scanner proves flame in .8 seconds) PR1 closes	PR1-1 energizes TE1 - OUT1 process Hi/Lo contact on PMV process main gas valve (SEE NOTE 2) PPV1 solenoid valves open PPL4illuminates (1 st process gas on light)
	TE1 program completes	SUB1 opens CR7 de-energies ALL devices open (end of cycle)

Firing Sequence [Contd.]

NOTE 1: When the temperature in the oxidizer chamber reaches the set point indicated on the oxidizer controller TE2, the control output OUT1 will open, modulate the oxidizer Hi/Lo actuator gas valve OMV. OUT1 will open and close continuously until the TE1 program has finished in order to keep the oxidizer temperature at the set point value. If temperature exceeds 100°F above set point the water-misting valve WV1 will activate.

NOTE 2: WPS1 Water pressure switch must prove before CR3 relay is activated. If at any time WPS1 water pressure drops below acceptable water pressure CR3 will open and shut down the process burner.

NOTE 3: When the temperature in the process chamber reaches the set point indicated on process chamber controller TE1, control output OUT1 will modulate the process burners Hi/Lo actuator PMV to maintain temperature at the set point value through to the end of the program. If temperature exceeds 50°F above set point the process high temp OUT2 closes activating the water-misting valve WV1.

If the 1st processor burner flame sensor PUV1 fails to prove, the Honeywell module will close processor main gas valve PMV putting burner into lockout.

If the oxidizer flame sensor OUV1 fails to prove, the Honeywell module will close the oxidizer main gas valve OM1, putting burner into lockout.

Note: Reset buttons are located on the face of the flame safety modules.

If the oxidizer goes into lockout anytime during the operation, the process burner will not fire until the oxidizer is reset.

If the temperature in the oxidizer reaches 1850 °F, the high temperature safety CR8 energizes, opening the CR-8 relay, causing the oven to go into lockout. Press the reset on the high temperature safety controller TE4. The oven firing sequence will repeat.

Note: Burner ignition is one try at 4 seconds. If flame is not detected in 4.0 seconds, the burner will go into lockout. Flame failure response time 0.8 seconds.

Note: *Some units are loaded with fork trucks and do not require cart track extensions.*

The following sequence of events occurs after the oven is turned on:

- The process chamber is purged with air equal to four times the combined volume of the process chamber, oxidizer chamber and the stack.
- The oxidizer burner fires upon completion of the process chamber purge cycle.
- Once oxidizer chamber reaches set point the process burner fires.
- The process burner will remain “on” during the entire heat cleaning cycle. Once set point has been reached the process burner cycles between high fire and low fire to maintain that temperature. The set-point temperature can be varied easily depending the material being processed. Normal processing temperatures are between 550 °F and 800 °F.
- The oxidizer burner remains “on” during the entire heat cleaning cycle. Once set point has been reached the process burner cycles between high fire and low fire to maintain that temperature.
- If the oxidizer flame fails to establish at start-up, the process burner will not fire.
- If the oxidizer burner fails during operation, the process burner will shut down.
- If the process burner fails, the oxidizer burner will continue operating.

4.6 Operating Procedure

A step-by-step description of the normal operating procedure is presented below.

1. Load the platform cart or rack with the doors fully open and ensure that:
 - The load is placed so as to allow for good heat flow from underneath the cart. If a cart is totally blocked off it will cause cart warpage and improper cleaning of the load. Parts are stacked carefully to prevent wall damage.
 - The recommended minimum clearance between the load and the hanging misting nozzles is 6". This will assure proper misting on the load when required.
2. Turn on the panel power.
3. Press the ***OTS Test*** button located on the panel door and visually checks the misting nozzles. The nozzles must mist to be effective. If the load blocks the nozzles or if a steady stream of water is flowing, they are totally ineffective. Damaged nozzles should be replaced immediately.
4. Close the doors.

5. **Standard controls** -Verify the set points for both chambers. Ensure that the AL-1 setting in the process controller is 50 °F, while the AL-1 setting in the oxidizer controller is 100 °F. The AL-1 alarm activates the OTS water mist.
Programmable controls - Check the temperature profile that has been entered.
6. Verify that the OTS high temperature process controller is properly set.
7. Start the unit by either activating the programmable microprocessor.
8. After the cycle is complete, allow the oven to cool down before opening the doors. The oven temperature can be read on either controller after the cycle is complete.

NOTICE - IN THE CASE OF POWER FAILURE

*OVENS WITH MANUAL CYCLE TIMERS - If possible, turn the timer to zero. **Do not** turn off the power switch. When the power re-energizes, the OTS misting system will activate should a load ignition happen. If the timer is not turned to zero, the oven will restart with a full purge and maintain its regular firing sequence.*

*PROGRAMMABLE CONTROLLERS - **Do not** need to turn off the power switch. When the power re-energizes the controller will shutdown and go into reset. A full purge is ensured on start up.*

OTS (Over Temperature Suppression) valve block is equipped with a manual by-pass valve should a load ignition happen during power failure.

5.0 - PRECAUTIONS

This section briefly discusses basic precautions that should be taken during oven operation. A comprehensive treatment of maintenance and trouble shooting procedures is presented in Sections 6-9.

5.1 Loading

1. ***Plugs or caps should be removed from jackets. Parts that have sealed water or liquids must not be processed.***

Note: Do not process sealed containers or tanks.

2. After the oven has been loaded, the oven doors should be closed and the processing cycle started. The oven should not be kept loaded with parts and let stand.

Note: Doors should not be opened until the processing cycle is complete.

3. The oven is designed for heat cleaning parts as discussed in Section 1. It should not be used for reclamation of heavy insulated wire or parts not listed in Table 1.1.
4. The oven should not be overloaded. An overloaded oven is a safety hazard. Oil or other fluids should be drained from jackets or containers prior to starting the processing cycle.

5.2 Operation

1. The OTS system should be checked prior to processing a load.
2. A log of normally used settings should be maintained.
3. Experience gained through daily usage on different type loads should be logged and used to determine shop procedures. Faster cycle times can thus be safely determined.
4. The process burner should be initially adjusted to a low fire setting. Opening the burner manual gas flow valve gradually can increase the load heat up rate.
5. The top tiles should be set together. They may be removed while cleaning the oven.

Note: Do not walk on the tiles.

6. High stack or high wind conditions can cause more heat on one side than the other. This can be balanced by partially blocking the side ports with firebrick soaps. These can also be used to partially block the flame ports in the firebox for heat adjustment.
7. Natural gas supply should be maintained at 7" W.C. with all burners operating at maximum BTU output. The corresponding setting for Liquefied Propane Gas is 11" W.C. This is required to ensure that the heat-cleaning oven operates as designed.

8. A slow cool down rate can be achieved by keeping doors shut. Keeping the doors slightly open will accelerate cooling. The system switch should be left **ON** to monitor temperature during cooling.

5.3 Parts

1. Aluminum parts should always be processed below 600 °F. The recommended operating temperature range is 500 - 525 °F. For automotive heads made of aluminum, the processing temperature should not exceed 600 °F.
2. Parts coated with *Epoxy* paint should be processed with a reduced process burner setting for slower heat up. In some cases, it may be necessary to use a ramp and soak profile.
3. Special parts such as water-jacketed stators or other components with internal enclosures must be processed with care. All enclosures *must be opened* before processing in the oven.
4. Electric motors with aluminum housings should not be stacked.

5.4 Emissions Control

Stack emissions should be checked regularly to ensure that the oven is operating properly. A plume emission indicates that the oxidizer chamber air supply or oxidizer chamber burner setting should be adjusted. A flame emission from the stack is abnormal and should be corrected immediately by properly adjusting the oxidizer gas valve.

There should be no visible smoke. If stack emissions are dense and black due to incomplete combustion, the oxidizer gas flow setting may be adjusted.

Oxidizer gas flow adjustments may be made while processing a load as follows:

1. Mark and maintain gas flow valve adjustments used on both burners.
2. The oxidizer airport should be locked in position for the full burning cycle.

6.0 - GENERAL MAINTENANCE

WARNING - Disconnect the Power Supply Before Cleaning and Servicing.

6.1 Introduction

This section presents an overview of maintenance procedures for various components of a Guspro Heat Cleaning Oven. It is recommended that maintenance inspections of the oven be carried out on a regular basis and that defective parts should be immediately replaced.

6.2 Gas Burners

This section deals with cleaning and servicing of the gas burner assembly for Guspro *E* burners. Maintenance tips for the following components are included: Spark Electrode, Blower Mechanism, Air Flow Switch, Automatic Gas Valve/Actuator and Air Damper.

6.2.1 Electrode Assembly

The most common cause of the burner failing to light is due to an electrode malfunction. This can normally be attributed to the following:

- Incorrect electrode sparking gap.
- Cracked insulation on electrode.
- Surface rust or dirt on the burner nozzle at the point where the electrode sparks.

6.2.2 Electrode Gap

Warning: Be sure to turn off electrical power to the burner before proceeding. The electrode transformer generates a minimum of 6000 V and 20 mA.

Remove the electrode. Grind or file the electrode tip on a 45° angle. Check the porcelain for cracks.

Inspect the position of the burner cup nozzle inside the housing by looking into the mounting hole of the electrode. Check to ensure that the burner cup and nozzle is centred in the housing and scrape off any surface rust, dust, soot etc. with a screwdriver.

Before installing the electrode back in the burner housing, inspect the connector of the ignition cable to ensure that it fits properly.

To set the electrode gap, drop the electrode to the bottom and mark the ceramic with a pencil. Move the electrode up 1/8" and tighten the screw.

Note: Over tightening will crack the electrode porcelain.

Test for ignition by either restarting the oven or pushing the Reset button.

6.2.3 U.V. Flame Scanner

Check that the glass on the U.V. scanner is clean. This is a threaded connection and is easily removed if dirty. A “Kleenex tissue” is recommended for cleaning.

In addition, check for the following:

- Damage to the burner housing or component parts.
- Build up soot, dirt or rust.

6.2.4 Blower

The blower motor has permanently lubricated bearings and requires no routine oiling maintenance.

Cleaning of the squirrel cage blower wheels should be done when they show a visible accumulation of dust or dirt. The motor air vents should also be cleaned at the same time.

Prior to cleaning, power supply to the oven should be turned off. Record the air damper setting so that it can be reset to the proper position after cleaning.

Using low-pressure compressed air to blow off the accumulated dirt is the simplest method. Aim the compressed air inside the squirrel cage blower. If the fan is not removed from the motor, care must be taken to prevent any dirt from being blown into the motor bearings.

6.2.5 Blower Motor

If the motor needs to be replaced, shut off power supply to the oven. Disconnect the electric wires and remove the motor by unscrewing the two bolts.

Remove the squirrel cage by loosening the setscrew. To install the squirrel cage on the new motor, push it down 7/8" on the shaft and tighten the setscrew.

After installing the motor, the squirrel cage should be spun with the index finger to ensure that the cage is not rubbing against the burner housing.

6.2.6 Air Flow Switch

The airflow switch is located on top of the burner. An aluminum tube runs from the airflow switch to the inside of the damper. Ensure that the aluminum tube is clear of restrictions. Disconnect the airflow tube and blow out clogged debris with compressed air if required.

6.2.8 Automatic Gas Valve

The automatic gas valve (On-Off Fluid Power Actuator and Valve Body) is rated at 120V and is supplied as part of the *E* burner gas train.

Note: *These gas valves are not field repairable and have to be replaced if they leak or fail.*

6.2.9 Air Damper

The air damper controls the amount of airflow through the burner and ensures proper combustion at the burner tip. If the damper loosens it should be re-adjusted to factory settings [Table 9.1] or normal operating position and fastened in place.

6.3 Door Gaskets and Seals

The function of the door gasket is to serve as a tight seal to minimize air leakage into the heat-cleaning oven. The door gasket may wear over a period of time. This could cause a substantial volume of cold air leakage into the oven, which could in turn cause cold spots in the unit.

Thus, the heat-up time in the process chamber would increase significantly. Further, excess air causes longer cycles and poor processing cycles. The door gasket should be checked periodically to ensure that it has not been damaged.

If any section of the gasket is damaged, the whole gasket must be replaced. Refer to the following guidelines:

1. Pull off and remove old gasket entirely.
2. Scrape away the residual door sealant.
3. Coat one side of the tail of the gasket with sealant. Let the gasket sit for approximately 10 minutes until the sealant becomes “tacky”.
4. Snugly fit and install new gasket.

6.4 Wall Insulation

The oven wall insulation ensures that the outer skin temperature is within acceptable limits. It is important to maintain the oven wall insulation in good condition; otherwise the operating temperature will cause the following problems:

- Heat leakage would increase the oven heat up time and the ambient temperature.
- Increase fuel consumption, thus increasing operating costs.
- Reduce the life of the 12-gauge hot rolled steel oven wall.

If a section of the wall insulation is so damaged, a patch of insulation should be installed to repair the wall. Insulation is available in 24" board and 36" board sections.

6.5 Firebrick Soaps

The function of the firebrick soaps is to confine the process chamber heat input within the firebox. This helps to spread the flame evenly (thus the heat) from the rear of the firebox to the front, thus eliminating cold spots.

Missing or damaged firebrick soaps would cause the process burner flame to flicker from the rear ports in the process chamber firebox. This can cause uneven heating from under the cart. Excess flame "licking" on the cart may cause distortion, warpage and damage to parts.

A supply of firebrick soaps is sent with each oven. If they deteriorate over time, a supply of soaps should be obtained from the factory and placed in the vacant flame ports.

The normal practice is to install firebrick soaps into all the flame ports starting from the back of the oven. The last two flame ports in the firebox closest to the door are left open. Figure 4.1 depicts placement of firebrick soaps on ovens with centre-fired fireboxes.

6.6 Lubrication of Loading Cart Wheels

Most models have a cart that can be pulled in and out of the oven for loading and unloading. The wheels on the loading cart assembly should be lubricated from time to time. This ensures that:

- The cartwheels function smoothly.
- Wear and tear on the wheels is minimized.

A special high temperature lubricant is recommended for the sleeves in the cartwheels. Supplies can be ordered from the factory.

Note: *When an oven is used on a continuous basis, the cart wheels should be greased daily. When used occasionally, the cartwheels should be greased once a week.*

6.7 Ash Handling and Disposal

Ash, pigments, dirt or other residual inorganic material from the heat cleaning process should be removed periodically using an industrial strength vacuum. Ash accumulation will:

- Cause an increase in heat up times in the process chamber, due to absorption of a portion of the chamber natural gas heat input by the ash.
- Block the firebox heat ports.
- Compact in the cart tracks and restrict movement of the loading cart.

Personnel handling the dust or ash should wear suitable masks as protection from inhaling the dust when unloading the cleaned parts, or when periodically removing any ash from the oven floor.

The chemical composition of the ash will depend on whatever inorganic constituents are present in the organic materials being removed. For example, if the oven is being used for the removal of cured paint residues, the Material Safety Data Sheets supplied by the paint manufacturer will list the fillers, pigments, or other inorganic components.

A simple ash analysis on the dust residue would enable determination if the dust requires *special* handling. If the ash is deemed to be hazardous, then it must be disposed of by the proper methods. The local environmental authority must be consulted for the appropriate regulations governing the disposal of hazardous ash.

6.8 Maintenance Tips

1. It is best to cool any oven slowly. When the process cycle ends, leave the doors closed until the process chamber cools down to the unloading temperature.
2. Cart wheels should be greased weekly with high temperature lubricant. *NS 2000* is recommended.
3. Clean the unit thoroughly on a regular basis. Be careful not to strike refractory with cleaning tools. Do not stand on fire-box tiles.

Note: *Steel rake or tools should not be used for cleaning. These will cause severe wear in the floor refractory. A soft broom or vacuum cleaner is recommended for cleaning.*

4. On outside installations, clean top drain holes regularly to prevent rainwater accumulation. Check the sealant in the joints and reseal as required.
5. Any refractory will crack during usage due to thermal expansion. Minor cracks should not be a cause for concern. If the top tiles of the firebox start to collapse after a period of time, they must be replaced immediately.
6. New castable tiles must be slowly cured - see Curing Procedure (Sec. 4.4).
Note: Cured tiles are available.
7. Check the door gaskets regularly. Leakage is usually readily apparent. If the gasket is not frayed or torn in places, leakage may be due to flattening of the gasket, necessitating a door adjustment (see Item #10 below).
8. A summary of maintenance tips for checking the electrical, safety, and control systems is listed in Table 6.1.
9. The 2300 °F ceramic board used on the walls and doors is anchored by 304 stainless steel studs and washers. Damaged sections may be easily replaced. The two 1/2" thick boards with 2" overlapped joints are backed by 2" of 1200 °F insulation.
10. All Guspro ovens with either standard or safety doors are equipped with complete adjustment features. Safety doors have a door lock screw adjustment to compensate for pin wear on the lock. Both doors compensate for gasket compression with cam lock adjustments. These are located at the top and bottom door lock cams.
11. Check latch adjustments on safety doors regularly.
12. Guspro maintains a complete stock of oven replacement parts.

Table 6.1

Summary of Maintenance Tips

<u>Frequency</u>	<u>Procedures</u>
EACH RUN	<ul style="list-style-type: none">• Perform OTS test and rectify problems if required (Section 7.0).• Verify controller settings.• Check burner operation and firing sequences.
MONTHLY	<ul style="list-style-type: none">• Clean spark electrodes• Clean scanners• Check Gaskets• Synchronize Controls• Inspect Safeties• Clean Thermocouple & OTS/ETC-P with steel wool (where applicable).

7.0 - OVER TEMPERATURE SUPPRESSION SYSTEM

7.1 Introduction

The OTS (Over Temperature Suppression) system injects a fine, cone-shaped water mist spray to handle virtually any over-temperature condition or ignition inside the heat-cleaning oven. Since the spray nozzles are made of stainless steel, they tend to gall and bind from the high temperature inside the oven. This can make it difficult to unscrew the nozzle cap so the assembly can be cleaned.

The oven should not be operated if the nozzles do not spray properly. It is recommended that a new, complete, spare set of water spray nozzles be kept in inventory at all times.

7.2 Operation

The Over Temperature Suppression System is a backup safety system. Its purpose is fast suppression of excess temperature caused by excessive volatilisation of the product being processed in the oven. This may occur if the oven has been overloaded with parts coated with an extremely volatile coating.

The OTS is operated full open at 40-45 PSI, as this provides the fast suppression desired. On extreme loads, such as heavily coated stators and heavy paint loads, the OTS control should be set a maximum of 25 °F over the set point. It is important to set the OTS properly as excess water could pressurize the oven process chamber. This may cause:

- Incomplete heat cleaning of parts
- Smoke emissions from the chamber.

Should either of the above conditions occur, adjustments must be made. The OTS system should be checked for defective nozzles. In some cases, the oven processing control sequence may need to be modified.

When the OTS system is activated, the OTS sprays water until the process temperature drops to the OTS set point. In turn, the burner activates when the temperature drops to the process chamber set point.

The oxidizer chamber water spray control system is normally set to activate at 100 °F above the oxidizer set point temperature. This corresponds to the Alarm 1 setting of the Oxidizer temperature controller. When this limit is reached, a relay is activated.

This causes the normally closed solenoid valve on the water line to be energized, spraying water through the misting nozzles to cool the process chamber and oxidizer flue gases. This water spray action continues until the oxidizer temperature is reduced below the alarm setting.

If the water spray control system stays on for more than 30 seconds, several conditions may exist:

1. The nozzles of the OTS system are either partially or completely clogged, thus preventing a proper water spray from occurring.
2. The deflector pins on the nozzles are bent or broken off which causes a straight stream of water to be injected into the process chamber. This is not proper, as the OTS spray must *mist* to be effective
3. The oven was overloaded with combustible material, which produces combustible fumes more rapidly than the OTS system can handle.
4. The loading procedures and/or parts processed have been changed or the alarm settings have been altered on the oven controllers.
5. In case events #3 or #4 occur frequently, a programmable ramp and soak controller may be installed to control the temperature in the process chamber. This controller will raise the chamber temperature via a special customized profile or temperature set-point sequence.

7.3 Testing

Test the process chamber water spray nozzles with the door open so that you can observe the water spray from the nozzles. Check the system before each cleaning cycle

Activate the OTS spray system by pressing the ***OTS Test*** button. This should start the process chamber water spray mist, which can be confirmed by visual inspection.

7.4 Instrument Synchronization

[For Ovens With Adjustable Burling Switches]

The process indicating control, OTS control, and ETC-P (Excess Temperature Control-Process) should be synchronized for:

ETC-P and OTS closes 50⁰F above process chamber set point.

Note: Programmable controllers - Set OTS and ETC-P 50⁰F above the highest set point

Steps for normal 750 °F set point operation:

- 1) Turn both ETC-P and OTS Burling controls to full scale.
- 2) Set instrument at 900 °F. Bring empty oven to 900 °F. Allow stabilizing in 15-20 minutes.
- 3) Bring the ETC-P down scale until process burner shuts off. This establishes 900 °F ETC-P synchronized safety shutoff.
- 4) Reset instrument to 825 °F and allow oven to stabilize. Bring the OTS control down scale until pump engages. This establishes 825 °F OTS synchronized start.
- 5) Reset instrument to 750 °F. With instruments synchronized, other desired instrument settings may be used.

7.5 Adjustments

7.5.1 For Normal Loads

Almost all loads normally encountered can be processed with full on OTS operation and a slow heat up rate to temperature. This is advisable as this allows more time for de-volatilization. Oven heat up times typically varies from 45 to 75 minutes. Heat up times in ovens processing automotive products is usually shorter in duration.

8.0 - GENERAL TROUBLE-SHOOTING

Guspro Inc. or its factory representative should be contacted in regards to maintenance and repairs. The customer can perform the greater majority of repairs. In a few isolated instances, it may be necessary to retain the services of Guspro personnel or a local service company.

8.1 Oven Will Not Start

- a) Is the fuel supply on?

The oven manifold fuel pressure gauge should read:

7" W.C. - Natural Gas

11" W.C. - Propane

If the gauge does not indicate any pressure, open the main line supply valve.

If the supply valve is open, check the supply regulator setting.

- b) Are all the manual gas valves on the oven manifold and valve trains open?

8.2 Electrical System Check

- a) Turn on the electrical power on to the oven.
- b) Turn on the power switch located on the electrical panel.
- c) Do the microprocessor controls light up? If not:
- Ensure that the electrical power to the oven is turned on.
 - Check the fuse(s) in the oven panel.
 - Check the electrical power at the temperature controllers.
- d) Do the temperature controllers indicate the room temperature? If not:
- Check for a loose thermocouple wire at the microprocessor
 - Check for a loose thermocouple wire at the thermocouple
- e) Do the temperature controllers indicate the correct set points?
- f) Press following reset buttons:
- Manual reset high limit control on the panel
 - Reset button on the motors and the U.V. flame safeties.

8.3 Start Oven

- Standard panels - Turn on the timer.
- Programmable Temperature controllers - Start program.

8.4 Process Burner Fails To Purge

The process chamber burner motor should start to purge. If not:

- Press the processor flame safety reset.
- Press the oxidizer flame safety reset.
- Press the high temp safety reset.
- Check the electrical power to the process burner motor.
- Check the proof of closure switch on the main gas valve actuator.
- Check the OTS settings on the process and oxidizer temperature controllers.

Note:

- 1. Large units also have a backup process chamber OTS controller.***
- 2. The process chamber burner motor will run long enough to purge four times the system volume before the oxidizer burner will fire. This will take between 1-15 minutes depending on the unit size.***

8.5 Oxidizer Burner Motor Fails To Start

The oxidizer burner motor should start. If not:

- Press the high temp safety reset
- Check the electrical power to the oxidizer burner motor.
- Check the proof of closure switch on the main gas valve.
- Did you wait for the purge delay?
- Check the purge delay relay in the electrical panel.

8.6 Oxidizer Burner Motor Starts But Flame Does Not Ignite

- Is the air proving switch-making contact? There is an On/Off indicator on the side of the switch.
- The air proving switch is a positive/negative pressure actuated switch. Are the 1/4" aluminum tubes installed properly?

Note: The air-proving switch supplies 120 V of electrical power to the ignition system.

Warning: The electrode and ignition transformer generate 6000 V, 20 mA of electrical power!

- Is the electrode gapped properly at 1/8" gap? A wider or narrower gap generates a weak spark.
- Is the electrode arcing? The electrode will only arc for 4 seconds before lockout and is normally audible when it occurs.

8.7 Electrode Arcs But Pilot Does Not Ignite

- Is the main valve train manual valve open?
- Is the manual pilot line valve on?
- Is the pilot pipe valve on?
- Is the pilot regulator adjusting screw turned at least 3/4 of the way down. A clockwise turn increases gas flow, while a counter-clockwise turn decreases the gas flow.
- Is the pilot solenoid valve opening? It can usually be heard or felt as it opens.
- Is the pilot pipe opening (orifice) plugged with dirt or corrosion? This is easily checked visually by loosening a single screw. Be sure to replace it after checking.

Note: The trial for ignition period before lockout is only 4 seconds.

8.8 Pilot Fires But Will Not Stay Lit

- U.V. scanner lens may be dirty. Wipe it clean with a tissue.
- Excessive combustion air supplied is blowing the pilot flame away from the end of the burner cup. Adjust the air damper.
- Excessive gas pressure. Adjust the pilot regulator
- The scanner is defective. Replace it.

8.9 Pilot Lights But Main Burner Will Not Fire

- Is the firing or test valve open?
- Is the manual eclipse flow valve adjusted?
- Is the burner regulator adjusted properly?
- Is the main gas valve opening? There is a window at the side of the gas valve actuator that enables the operator to visually verify whether the valve is opening.

If the main gas valve is not opening, check the electrical power to the actuator.

Note: *The 120 V electrical power supply to the actuator will be activated only after the pilot flame has proven.*

Caution: *A 120 V potential difference is developed between the terminals of the proof of closure switch located in the actuator housing!*

8.10 Process Burner Motor Runs But The Flame Does Not Ignite

- Check the process flame delay timer in the electrical panel.
- Perform the checks listed in Steps 8.6 through 8.9.

8.11 Burner Cycles

The Oxidizer will run continuously during the processing cycle. However, the process burner will cycle On/Off at set point until the cycle time ends.

9.0 - E-BURNER

9.1 Introduction

The E-Burner is a package type burner. The burner is manufactured by Guspro Inc. and has been CGA & AGA approved for use on Guspro Heat Cleaning Ovens. The burner is complete with motor and blower, ultraviolet flame safeguard controls, ignition transformer, spark electrode, pilot and firing valves. The main gas valves are not included as they are supplied separately on the equipment.

The E-Burner is fully adaptable to FM and IRI approved burner and valve train systems. With regulator adjustments and orifice changes it can be fired by either natural gas or liquefied propane gas (LPG).

9.2 Design

The E-burner is easy to install and service. The burner is mounted on two studs attached to the external surface of the oxidizer or process chamber. The burner may be removed by loosening two nuts and one union on the fuel line. The electrical lines are disconnected at numbered terminals.

The burner is of the nozzle mix design. A schematic of the E-burner is depicted in Figure 9.1. This design allows the motor and fan attachment, electrode, air proving switch, flame safety system, UV scanner and the pilot solenoid valve to be externally mounted.

Since these parts are external mounted, access to individual components for troubleshooting or component parts exchange is easy. Electrode service (checking for cracked porcelain and “re-gapping”) can be accomplished in less than a minute.

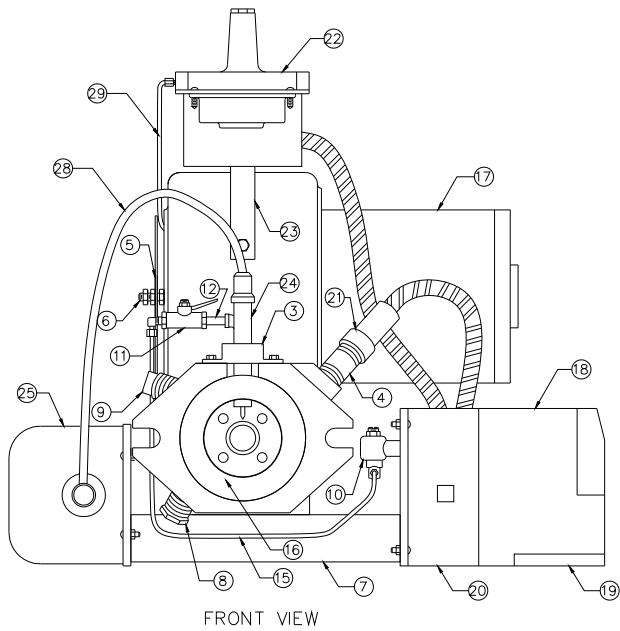
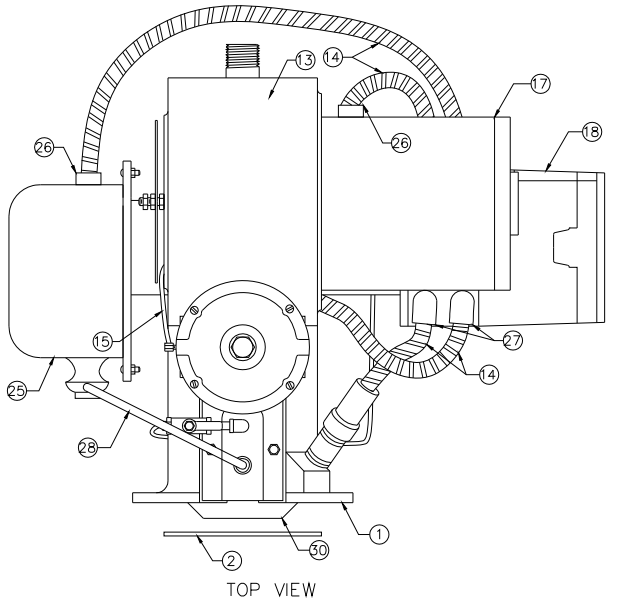
The flame safeties allow for an ignition trial of 4 seconds and a 0.8 second lockout on flameout. The proof of ignition trial allows for one attempt before lockout.

The air damper is a circular (5" dia) metal plate located on the side of the burner. The plate has been designed and located for easy air adjustment.

9.3 Ignition Sequence

1. Blower on-air switch closes.
2. Pilot ignition on (spark cuts off after pilot flame proves).
3. Pilot solenoid open - pilot flame proves - runs continuously while the burner is on.
4. UV scanner proves pilot in 4 seconds. If the flame does not prove, the burner will lockout.

Figure 9.1 Schematic of E-Burner.



ITEM	PART #	DESCRIPTION
1	BB-1	ALUMINUM BURNER HOUSING
2	BB-1A	GASKET 5"OD x 4"ID x 1/8"
3	BB-3	ELECTRODE HOLDER (E-TYPE)
4	BB-350	NIPPLE (1/2" x 2"L.)
5	BB-6	DAMPER ASSEMBLY (DWG C-254)
6	BB-6-2	STUD 2" LONG
7	BB-7	BURNER BRACKET ASSEMBLY
8	BB-813	PEEP SIGHT 1/2"
9	BB-814	1/2" PIPE PUG-BLACK
10	BB-820	PILOT GAS VALVE I.T.I.
11	BS-880	1/4" NEO 525 BALL VALVE
12	BB-833	NIPPLE, BLACK 1/4 x 1-1/2
13	BB-9	BLOWER ROTOR (TORIN)
14	BBM-18375	7/16" BX FLEX CABLE
15	BBM-64025	1/4" PILOT LINE TUBE
16	BH-17	BURNER HEAD ASSEMBLY (E-TYPE)
17	BH-840	GE 1/4HP MOTOR
18	BH-852-2	HONEYWELL FLAME SAFETY CONTROL
19	BH-852-3	U V AMPLIFIER
20	BH-852-4	SUB BASE
21	BH-853	HONEYWELL FLAME DETECT
22	BH-870	AIR FLOW SAFETY SWITCH
23	BH-872L	AIR SWITCH BRACKET
24	BS-810	IGNITION ELECTRODE
25	BS-835	IGNITION TRANSFORMER
26	BS-860	3/8" BX CONNECTOR
27	BS-865	3/8" BX CONNECTOR-90°
28	BS-844A	IGNITION WIRE ASSEMBLY
29	BBM-64025	1/4" AIR FLOW SAFETY SWITCH TUBE
30	BH-17-BC	BURNER CONE

THE LOCATION OF #'s 8 & 9 WILL BE REVERSED FOR
PROCESS (PRIMARY) BURNERS AND OXIDIZER
(SECONDARY) BURNERS.

5. Main gas valve (slow opening) activates and allows for a full processing flame.

Note: Flameout response time is 0.8 seconds. Safety lockout requires manual reset.

The ignition sequence is depicted in Figure 9.2.

9.4 Maintenance

The burner should be visually inspected periodically as follows:

1. Check that flow of combustion air to the burner is not blocked or obstructed in any way.
2. Ensure that the blower wheel is not dirty or plugged with foreign matter (clean the wheel if needed - a dirty wheel can reduce airflow up to 35%).
3. Check the air damper to ensure that it has not loosened.
4. Clean, inspect, and reset the spark electrode regularly. The electrode ignition end should be ground on a 45-degree angle to a point. This ensures a direct hot spark. To adjust the spark electrode insert it until the ground tip bottoms out, back it off 1/8 inch and snug the screw.

Note: Make sure the electrode tip is *not* touching the bottom and that the porcelain is *not* catching on the burner cup. Do not over tighten the screw, as it will crack the porcelain.

5. If the electrode porcelain is cracked, replace the electrode. Cracked porcelain may cause shorts and weak sparks.
6. Keep the burner clean and free of dirt and debris.

9.5 Adjustments

Refer to Table 9.1 for preliminary gas valve and air shutter adjustments.

9.6 Trouble Shooting

Malfunctions can usually be pinpointed visually or audibly. The following steps should be performed if the burner does not fire.

- Clean and reset the spark electrode and clean the scanner lens.
- Reset the burner and perform the checks listed in the Table 9.2.

Figure 9.2 E-Burner Sequence of Operation.

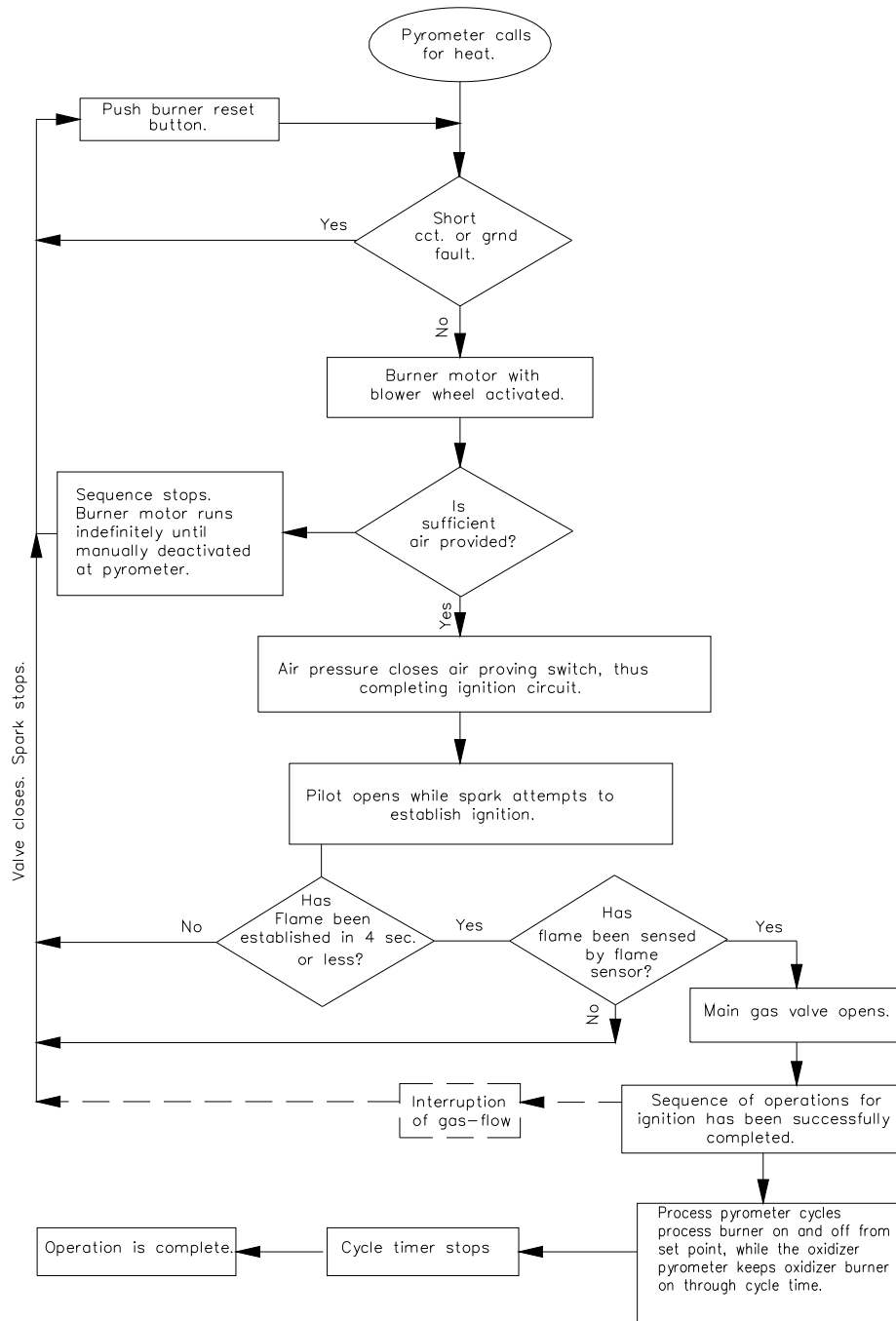


Table 9.1

E-Burner Factory Air and Gas Flow Settings

<u>Process Variable</u>	<u>Setting</u>
Process burner air	Adjust air damper to open approximately 1/4" - 3/8".
Process burner flame protrusion	Maximum 1" flicker from firebox ports.
Oxidizer burner air	Adjust air damper to open approximately 1/4" - 3/8".
Oxidizer air port	1/3" – 1/2"open
Gas adjustment	<u>Oxidizer Valves</u> High Fire: 1/2 - 3/4 open Low Fire: 1/4 – 1/2 open <u>Process Valves</u> 3/16 - 1/4 open

Table 9.2

E-Burner Trouble Shooting Tips

<u>Sequence</u>	<u>Check</u>
1) Blower on	<ul style="list-style-type: none">• Power supply from oven.• Motor thermal reset.• Flame safety reset (red-button) motor functions.• Airflow switch closed.
2) Adequate spark	<ul style="list-style-type: none">• Transformer output spark to external ground.• Electrode for cracks.• Electrode setting.
3) Adequate pilot	<ul style="list-style-type: none">• Pilot adjusts valve full open.• Pilot solenoid opens (clicks).• Remove scanner and observe visible pilot (will lock out in 4 seconds).
4) Control	<ul style="list-style-type: none">• Check electrical voltage or exchange parts for the scanner.• Check electrical voltage or exchange parts for the control module.
5) Main valve	<ul style="list-style-type: none">• Burner light on valve is energized.• Valve is functioning.

APPENDIX

OMRON TEMPERATURE CONTROLLER SETTINGS - PROCESS

The procedure shown below describes the standard controller settings utilized during the assembling and testing of the Guspro heat cleaning ovens. A Guspro technician should be contacted if there is any deviation from the following procedure.

To run a set program:

1. Press the *scroll* key until *Ptrn* is in the upper display.
2. Press the *up and down* arrow keys until the pattern required shows in the lower right hand display. Wait until the left hand lower display changes to the same number.
3. Press the *scroll* key repeatedly until the display is back to indicating the chamber temperature and set point (regular display).
4. Push and hold the *RUN/RST* button until the cycle starts.

Omron Temperature Controller - Factory Settings

<u>Chamber</u>	<u>Temperature Setting (°F)</u>	<u>Controller LED (light)</u>
Process Chamber Output	Set By Operator	OUT 1
Process Alarm 1	Burner Relay	OUT 2
Process Alarm 2 (OTS Mist)	50°F (deviation from set point)	SUB1
Process Alarm 3	Cycle Start	SUB2

OMRON TEMPERATURE CONTROLLER SETTINGS - OXIDIZER

The procedure shown below describes the standard controller settings utilized during the assembling and testing of the Guspro heat cleaning ovens. A Guspro technician should be contacted if there is any deviation from the following procedure.

1. To change the **Set Point** value press the **up or down** arrow keys until the desired temperature is achieved.
2. To check/change values of Alarm points:
Depress the **scroll** key for 2 seconds until **Lu-0** appears in the lower display.

Press the **UP arrow** key until the display changes to **Lu-1**.

Press and hold the **scroll** key for 2 seconds until the upper display shows **At** and the lower display shows **off**.

Press the **scroll** key quickly until **AL-1** appears in the upper display.

Use the **UP or DOWN arrow** keys until the desired temperature is achieved.

By pressing the **scroll** key repeatedly the other alarm values can be changed.

When changes are finished hold down the **scroll** key for 2 seconds until **Lu-1** appears again in the lower display.

Press the **DOWN** arrow key until **Lu-0** appears. Press the **scroll** key for 2 seconds to return to the regular display.

3. This completes the **OMRON E5EK** temperature controller set up.

Omron Temperature Controller - Factory Settings

<u>Chamber</u>	<u>Temperature Setting (°F)</u>	<u>Controller LED (light)</u>
Oxidizer Chamber	T_R	OUT1
Oxidizer Alarm 1 (OTS mist)	100°F (deviation from set point)	OUT 2
Oxidizer Alarm 2	Proof of temp (1,400°F)	SUB1
Oxidizer Alarm 3	Not Used	SUB2

Note: T_R = Oxidizer Temperature Required By Local Air Pollution Regulation.
E.g. T_R = 1450 °F in Ontario and T_R = 1500 °F in New Jersey.

PROGRAMMING RAMPS & SOAKS

Below are complete instructions to configure and run a program which contains three ramps and soaks. The first ramp and soak is for 500⁰F and 3 hours. The second and third are at 600⁰F and 700⁰F for 1 hour each.

- 1.1 Push and hold the scroll key until **nEnU & Lu-0** appear in the upper and lower display.
- 1.2 Press the **Down arrow** key until the **PrGn** appears in the lower display.
- 1.3 Push and hold the **Scroll** key, the word **Ptrn** should appear in the upper display. Program “0” contains the cure cycle and can be overwritten when cure is complete.
- 1.4 Press the **Up or Down arrow** key to select Program you wish to configure. If you’re overwriting the cure select “0”.
- 1.5 Press the **Scroll** key once and **S-no** appears. This is the number of segments required for the program. Using the **UP arrow** key, enter **6**. (One segment for each ramp and soak.)
- 1.6 Press the **Scroll** key and **SP0** appears in the upper display. This is the 1st set point. Enter **500** in the lower display.
- 1.7 Press the **Scroll** key and **ti0** appears. This is the ramp time. Enter **0.02** in the lower display.
- 1.8 **The above setting is for the first ramp section.**
- 1.9 Press the **Scroll** key and **SP1** appears. Press the **UP arrow** key until **500** is entered in the lower display.
- 1.10 Press the **Scroll key** and **ti1** appears. Enter **3.00** in the lower display.
- 1.11 The above setting represents a **3 hour soak at 500 F**.
- 1.12 Press the **Scroll key** and **SP2** appears. Enter **600** in the lower display.
- 1.13 Press the **Scroll key** and **ti2** appears. Enter **0.02** in the lower display.
- 1.14 Press the **Scroll key** and **SP3** appears. Enter **600** in the lower display.
- 1.15 Press the **Down key** until **1.00** appears in the lower display.
- 1.16 **The above settings represent the second ramp and soak.**
- 1.17 Press the **Scroll key** and **SP4** appears. Enter **700** in the lower display.
- 1.18 Press the **Scroll key** and **ti4** appears. Enter **0.02** in the lower display.
- 1.19 Press the **Scroll key** and **SP5** appears. Enter **700** in the lower display.

- 1.20 Press the *Scroll key* and *ti5* appears. Enter *1.00* in the lower display.
- 1.21 **The above represents the 3rd ramp and soak.**
- 1.22 Press the *Scroll key* and *rPt & 1* appear. This represents one cycle. **Leave as Is.**
- 1.23 Press the *Scroll key* and *AL-1 & 50* appear. This represents the *OTS misting system*, which controls over temperature conditions. **This is factory set at 50 degrees.** Press the *Scroll key* and *AL-2* and *AL-3* will appear. **These are not used.**
- 1.24 **The following steps are the Oxidizer burner permissive and are factory set as follows and should not be changed. Note: These values may have to be entered on program that were not originally configured at the factory.**
- 1.25 Press the *Scroll key* UNTIL *tSIS & 0* appear.
- 1.26 Press the *Scroll key* and *on1 & 0:00* should appear.
- 1.27 Press the *Scroll key* and *oF1 & 99:59* should appear. **On unconfigured programs this value must be enter (99:59). The previous 2 values (steps 1.25 and 1.26) arrive defaulted at 0 and 0.00.**
- 1.28 Press the *Scroll key* to return to *Ptrn*. If another program is needed to be configured use the *arrow key* to select what program you wish to enter and them proceed back to *step 1.4*
- 1.29 Push and hold the *Scroll key* until *nEnU & PrGn* appear.
- 1.30 Press the *Down key* until the display shows *Lu-0*.
- 1.31 Push and hold the *Scroll key* until the display changes back to the original temperature indicatio

You are now finished entering the program. To run the program shown in the program box push the **Run** button.

To select another program to run, push and hold the *Scroll key* until *Lu-0* appears. Use the **UP arrow** to change to *PrGn*. Push and hold the *Scroll key* until *Ptrn* appears. Use the **arrow keys** to select which pattern you would like to run. After selection push and hold the *Scroll key* until *Prgn* appears. Use the **down arrow key** to go to *Lu-0*. Push and hold the *Scroll key* until display reverts back to temperature indication. Push the **Run** button to run the selected program.

Partlow 1161+ Series

Changing Set point Instructions

Power up the controller

Push and hold the **scroll** key and tap the **up** arrow key, **OPTr SLCT** will display

Tap the **up** arrow key, **SETP SLCT** will display

Tap the **scroll** key, **ULOC** will display

Tap the **up** arrow key to **10**

Tap the **scroll** key, **SP** value (1850) will display

Tap the **up** or **down** arrows to the desired set point

Hold the **scroll** key and tap the **up** key, **SETP SLCT** will display

Tap the **down** arrow once, **OPTr SLCT** will display

Tap the **scroll** key and the new set point and oven temp will display

1/16 - 1/8 - 1/4 DIN PROCESS CONTROLLERS CONCISE PRODUCT MANUAL (59300-4)



CAUTION: Installation should be only performed by technically competent personnel. Local Regulations regarding electrical installation & safety must be observed.

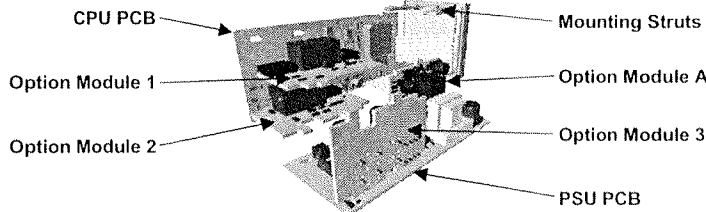
1. INSTALLATION

The models covered by this manual have three different DIN case sizes (refer to section 10). Some installation details vary between models. These differences have been clearly shown.

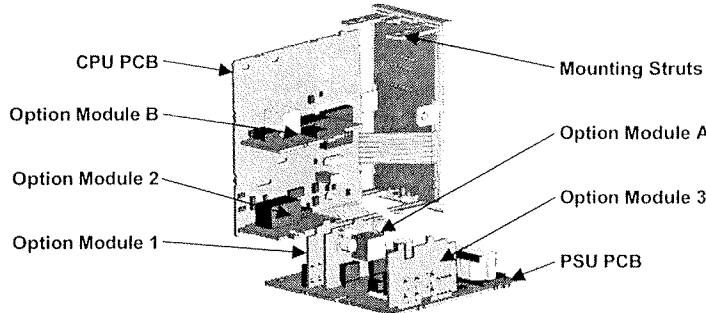
Note: The functions described in sections 2 thru 9 are common to all models.

Installing Option Modules

1/16 Din Size Instruments



1/8 & 1/4 Din Size Instruments



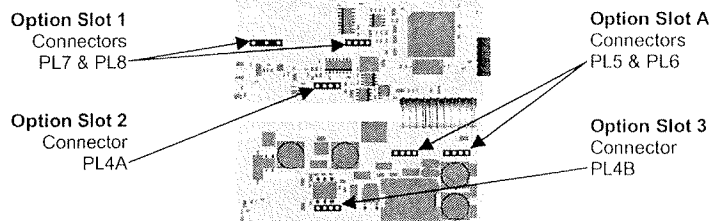
To access modules 1, A or B, first detach the PSU and CPU boards from the front by lifting first the upper, and then lower mounting struts. Gently separate the boards.

- Plug the required option modules into the correct connectors, as shown below.
- Locate the module tongues in the corresponding slot on the opposite board.
- Hold the main boards together while relocating back on the mounting struts.
- Replace the instrument by aligning the CPU and PSU boards with their guides in the housing, then slowly push the instrument back into position.

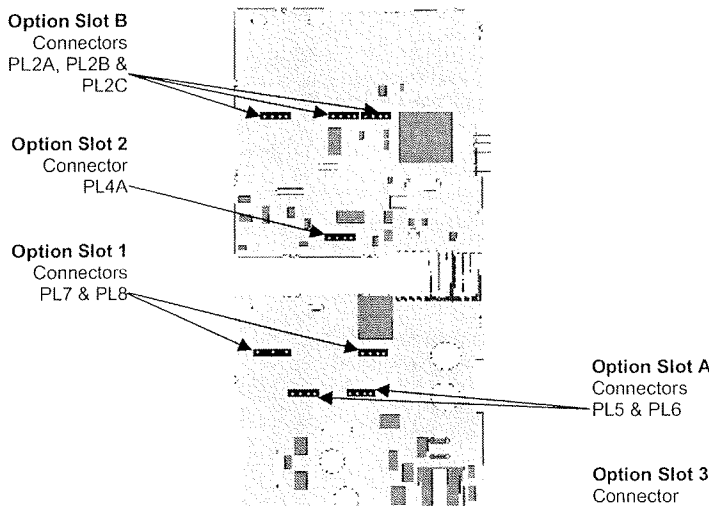
Note: Option modules are automatically detected at power up.

Option Module Connectors

1/16 Din Size Instruments



1/8 & 1/4 Din Size Instruments

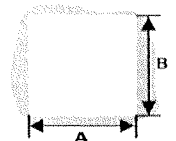


Panel-Mounting

The mounting panel must be rigid, and may be up to 6.0mm (0.25inch) thick. Cut-out sizes are:

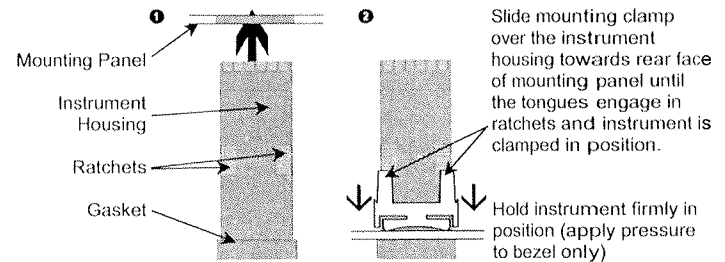
Cut-Out Dim A
1/16 & 1/8 Din = 45mm
1/4 Din = 92mm

Cut-Out Dim B
1/16 Din = 45mm
1/8 & 1/4 Din = 92mm



For n multiple instruments mounted side-by-side, cut-out A is $48n-4$ mm (1/16 & 1/8 Din) or $96n-4$ mm (1/4 Din)

Tolerance +0.5, -0.0mm

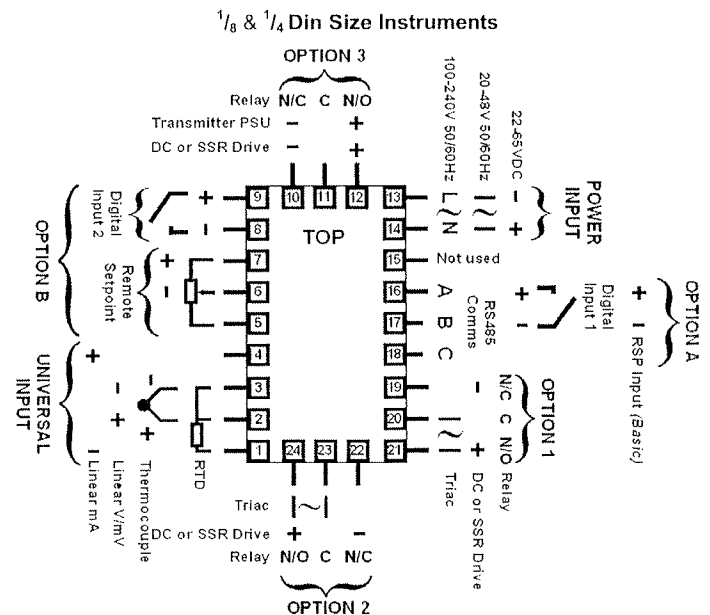
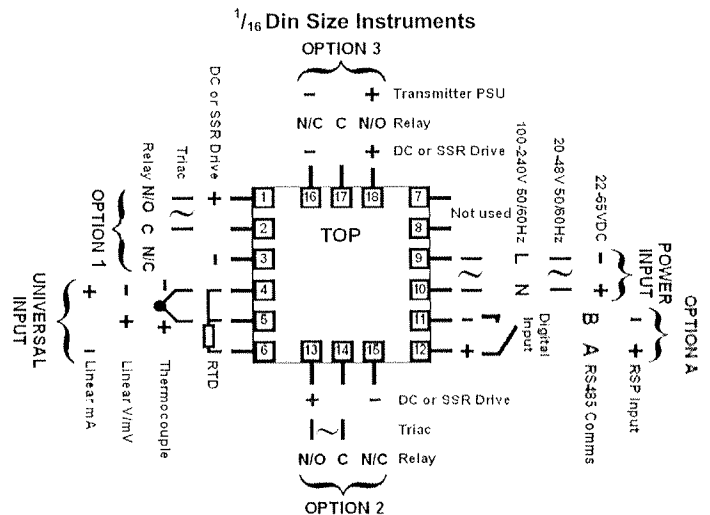


CAUTION: Do not remove the panel gasket; it is a seal against dust and moisture.

Rear Terminal Wiring

USE COPPER CONDUCTORS (EXCEPT FOR T/C INPUT)

Single Strand wire gauge: Max 1.2mm (18SWG)



These diagrams show all possible option combinations. The actual connections required depends on the exact model and options fitted.



CAUTION: Check information label on housing for correct operating voltage before connecting supply to Power Input
Fuse: 100 - 240V ac - 1amp anti-surge
24/48V ac/dc - 315mA anti-surge

Note: At first power-up the message `Go to Conf` is displayed, as described in section 7 of this manual. Access to other menus is denied until configuration mode is completed

2. SELECT MODE

Select mode is used to access the configuration and operation menu functions. It can be accessed at any time by holding down **[ON]** and pressing **[A]**. In select mode, press **[A]** or **[V]** to choose the required mode, press **[ON]** to enter. An unlock code is required to prevent unauthorised entry to Configuration, & Setup modes. Press **[A]** or **[V]** to enter the unlock code, then press **[ON]** to proceed.

Mode	Upper Display	Lower Display	Description	Default Unlock Codes
Operator	OPtr	SLCt	Normal operation	None
Set Up	SEtP	SLCt	Tailor settings to the application	10
Configuration	ConF	SLCt	Configure the instrument for use	20
Product Info	InfO	SLCt	Check manufacturing information	None
Auto-Tuning	Autun	SLCt	Invoke Pre-Tune or Self-Tune	0

Note: The instrument will always return automatically to Operator mode if there is no key activity for 2 minutes.

3. CONFIGURATION MODE

First select Configuration mode from Select mode (refer to section 2). Press **[ON]** to scroll through the parameters, then press **[A]** or **[V]** to set the required value. Press **[ON]** to accept the change, otherwise parameter will revert to previous value. To exit from Configuration mode, hold down **[ON]** and press **[A]**, to return to Select mode.

Note: Parameters displayed depends on how instrument has been configured. Refer to user guide (available from your supplier) for further details. Parameters marked * are repeated in Setup Mode.

Parameter	Lower Display	Upper Display	Adjustment range & Description	Default Value	
Input Range/Type	inPt	See following table for possible codes		JL	
Code	Input Type & Range	Code	Input Type & Range	Code	Input Type & Range
bC	B: 100 - 1824 °C	Lc	L: 0.0 - 537.7 °C	P24F	PIRh20% vs 40%: 32 - 3362 °F
bF	B: 211 - 3315 °F	Lf	L: 32.0 - 999.9 °F	P24C	PI100: -199 - 800 °C
cC	C: 0 - 2320 °C	Nc	N: 0 - 1399 °C	P24F	PI100: -328 - 1472 °F
cF	C: 32 - 4208 °F	Nf	N: 32 - 2551 °F	P24C	PI100: -128.8 - 537.7 °C
Jc	J: -200 - 1200 °C	Rc	R: 0 - 1759 °C	P24F	PI100: -199.9 - 999.9 °F
Jf	J: -328 - 2192 °F	Rf	R: 32 - 3198 °F	P24C	PI100: -199.9 - 999.9 °F
Jc	J: -128.8 - 537.7 °C	S	S: 0 - 1762 °C	0.20	0 - 20 mA DC
Jf	J: -199.9 - 999.9 °F	S	S: 32 - 3204 °F	4.20	4 - 20 mA DC
Kc	K: -240 - 1373 °C	T	T: -240 - 400 °C	0.50	0 - 50 mV DC
Kf	K: -400 - 2503 °F	T	T: -400 - 752 °F	10.50	10 - 50 mV DC
Kc	K: -128.8 - 537.7 °C	D	D: -128.8 - 400.0 °C	0.5	0 - 5 V DC
Kf	K: -199.9 - 999.9 °F	D	D: -199.9 - 752.0 °F	1.5	1 - 5 V DC
Lc	L: 0 - 762 °C	P24C	PIRh20% vs. 40%: 0 - 1850 °C	0.10	0 - 10 V DC
Lf	L: 32 - 1403 °F	P24F		2.10	2 - 10 V DC

Note: Decimal point shown in table indicates temperature resolution of 0.1°

Parameter	Lower Display	Upper Display	Adjustment range & Description	Default Value
Scale Range Upper Limit	rUL	Scale Range Lower Limit +100 to Range Maximum		Range max (Lin=1000)
Scale Range Lower Limit	rLL	Range Minimum to Scale Range Upper Limit -100		Range min (Linear=0)
Decimal point position	dPoS	0=XXXX, 1=XXX.X, 2=XX.XX, 3=X.XXX (non-temperature ranges only)		1
Control Type	CLYP	SnGL	Primary only	SnGL
		duAL	Primary & Secondary (e.g. heat & cool)	
Primary Output Control Action	CLrL	rEv	Reverse Acting	rEv
		d.r	Direct Acting	
Alarm 1Type	ALr1	P_H1	Process High Alarm	P_H1
		P_Lo	Process Low Alarm	
		dE	Deviation Alarm	
		bAnd	Band Alarm	
		nonE	No alarm	
High Alarm 1 value*	P_Hr1	Range Minimum to Range Maximum in display units		Range Max
Low Alarm 1 value*	P_Lr1			Range Min
Band Alarm 1 value*	bAr1	1 LSD to span from setpoint in display units		5
Dev. Alarm 1 value*	dAL1	+/- Span from setpoint in display units		5
Alarm 1 Hysteresis*	AHr1	1 LSD to full span in display units		1
Alarm 2 Type*	ALr2			P_Lo
High Alarm 2 value*	P_Hr2			Range Max
Low Alarm 2 value*	P_Lr2	Options as for alarm 1		Range Min

Parameter	Lower Display	Upper Display	Adjustment range & Description	Default Value
Dev. Alarm 2 Value*	dAL2	Options as for alarm 1		5
Alarm 2 Hysteresis*	AHr2			1
Loop Alarm	LAEn	d.rSA (disabled) or EnrAb (enabled)		d.rSA
Loop Alarm Time*	LAtr	1 sec to 99 mins. 59secs		99.59
Alarm Inhibit	Inh1	nonE	No alarms Inhibited	nonE
		ALr1	Alarm 1 inhibited	
		ALr2	Alarm 2 inhibited	
		both	Alarm 1 and alarm 2 inhibited	
Output 1 Usage	USE1	Pr1	Primary Power	Pr1
		SEt	Secondary Power	
		ALd	Alarm 1, Direct	
		ALr	Alarm 1, Reverse	
		ALd	Alarm 2, Direct	
		ALr	Alarm 2, Reverse	
		LPd	Loop Alarm, Direct	
		LPr	Loop Alarm, Reverse	
		DLd	Logical Alarm 1 OR 2, Direct	
		DLr	Logical Alarm 1 OR 2, Reverse	
		Ad_d	Logical Alarm 1 AND 2, Direct	
		Ad_r	Logical Alarm 1 AND 2, Reverse	
Linear Output 1 Range	LrP1	rEL5	Retransmit SP Output	0.10
		rELP	Retransmit PV Output	
		0.5	0 to 5 V DC output	
		0.10	0 to 10 V DC output	
Retransmit Output 1 Scale maximum	ro1H	0.20	0 to 20 mA DC output	Range max
		4.20	4 to 20 mA DC output	
Retransmit Output 1 Scale minimum	ro1L	(display value at which output will be minimum)		Range min
Output 2 Usage	USE2	As for output 1		Sec or AI2
Linear Output 2 Range	LrP2	As for output 1		0.10
Retransmit Output 2 Scale maximum	ro2H	(display value at which output will be maximum)		Range max
Retransmit Output 2 Scale minimum	ro2L	(display value at which output will be minimum)		Range min
Output 3 Usage	USE3	As for output 1		ALd
Linear Output 3 Range	LrP3	As for output 1		0.10
Retransmit Output 3 Scale maximum	ro3H	(display value at which output will be maximum)		Range max
Retransmit Output 3 Scale minimum	ro3L	(display value at which output will be minimum)		Range min
Display Strategy	d.rSP	1, 2, 3, 4, 5 or 6 (refer to section 8)		1
Serial Communications Protocol	Prot	ASC1	ASCII	r7bN
		r7bN	Modbus with no parity	
		r7bE	Modbus with Even Parity	
Serial Communications Bit Rate	bArud	r7bO	Modbus with Odd Parity	4.8
		1.2	1.2 kbps	
		2.4	2.4 kbps	
		4.8	4.8 kbps	
		9.6	9.6 kbps	
		19.2	19.2 kbps	
Comms Address	Addr	1	1 to 255 (Modbus), 1 to 99 (ASCII)	1
Comms Write	EoEn	r.rW	Read/Write	r.rW
		r.rO	Read only	
Digital Input 1 Usage	d.rIG1	d.rS1	Setpoint 1 / Setpoint 2 select*	d.rS1
		d.rAS	Automatic / Manual select	
Digital Input 2 Usage	d.rIG2	d.rS1	Setpoint 1 / Setpoint 2 select*	d.rS1
		d.rAS	Automatic / Manual select	
		d.rR5	Remote / Local setpoint select	

Note: d.rIG2 has priority over d.rIG1 if both are configured for the same usage. If d.rIG1 or d.rIG2 = d.rS1 the remote setpoint input is disabled.

Continued on next page...

Parameter	Lower Display	Upper Display	Adjustment range & Description	Default Value
Remote Setpoint Input Range	r _{inp}	0_20	0 to 20 mA DC input	0_10
		4_20	4 to 20 mA DC input	
		0_10	0 to 10 V DC input	
		2_10	2 to 10 V DC input	
		0_5	0 to 5 V DC input	
		1_5	1 to 5 V DC input	
		100	0 to 100mV DC input	
	Potentiometer (2KΩ minimum)			
RSP Upper Limit	r _{SPu}		-1999 to 9999	Range max
RSP Lower Limit	r _{SPl}		-1999 to 9999	Range min
RSP Offset	r _{SPo}		Constrained within Scale Range Upper & Scale Range Lower limits	0
Configuration Lock Code	CLoc		0 to 9999	20

4. SETUP MODE

Note: Configuration must be completed before adjusting Setup parameters.

First select Setup mode from Select mode (refer to section 2). The MAN LED will light while in Setup mode. Press **↔** to scroll through the parameters, then press **▲** or **▼** to set the required value.

To exit from Setup mode, hold down **↔** and press **▲** to return to Select mode.

Note: Parameters displayed depends on how instrument has been configured.

Parameter	Lower Display	Upper Display	Adjustment Range & Description	Default Value
Input Filter Time Constant	F _{ILT}		OFF or 0.5 to 100.0 secs	2.0
Process Variable Offset	OFFS		±Span of controller	0
Primary Power	PP _U		Current power levels (read only)	N/A
Secondary Power	SP _U			
Primary Proportional Band	P _{b_P}		0.0% (ON/OFF) and 0.5% to 999.9% of input span	10.0
Secondary Proportional Band	P _{b_S}			
Automatic Reset (Integral Time)	A _R SE		1 sec to 99 mins 59 secs and OFF	5.00
Rate (Derivative Time)	r _{ATE}		00 secs to 99 mins 59 secs	1.15
Overlap/Deadband	OL		-20 to +20% of Primary and Secondary Proportional Band	0
Manual Reset (Bias)	b _{AS}		0%(-100% if dual control) to 100%	25
Primary ON/OFF Differential	d _{IFP}		0.1% to 10.0% of input span centered about the setpoint. (Entered as a percentage of span)	0.5
Secondary ON/OFF Diff.	d _{IFS}			
Prim. & Sec. ON/OFF Differential	d _{IFF}			
Setpoint Upper Limit	SP _{UL}		Current Setpoint to Range max	R/max
Setpoint Lower limit	SP _{LL}		Range min to Current Setpoint	R/min
Primary Output Power Limit	OP _{UL}		0% to 100% of full power	100
Output 1 Cycle Time	CT ₁		0.5, 1, 2, 4, 8, 16, 32, 64, 128, 256 or 512 secs.	32
Output 2 Cycle Time	CT ₂			
Output 3 Cycle Time	CT ₃			
High Alarm 1 value	PHA ₁		Range Minimum to Range Maximum	R/max
Low Alarm 1 value	PLA ₁			R/min
Deviation Alarm 1 Value	d _{AL1}		±Span from SP in display units	5
Band Alarm 1 value	b _{AL1}		1 LSD to span from setpoint	5
Alarm 1 Hysteresis	AHY ₁		1 LSD to full span in display units	1
High Alarm 2 value	PHA ₂		Range Minimum to Range Maximum	R/max
Low Alarm 2 value	PLA ₂			R/min
Deviation Alarm 2 Value	d _{AL2}		±Span from SP in display units	5
Band Alarm 2 value	b _{AL2}		1 LSD to span from setpoint	5
Alarm 2 Hysteresis	AHY ₂		1 LSD to full span in display units	1
Loop Alarm Time	LAT ₁		1 LSD to full span in display units	99.59
Auto Pre-tune	APTE			
Auto/manual Control selection	P _{oEn}		d _{ISA} (disabled) or EnAb (enabled)	d _{ISA}
Setpoint Select shown in Operator Mode	SSEn			
Setpoint ramp adjustment shown in Operator Mode	SP _r			
SP Ramp Rate Value	r _P		1 to 9999 units/hour or Off (blank)	Off
Setpoint Value	SP		Scale range upper to lower limits. (when dual or remote setpoint options are used, SP is replaced by SP1 & SP2 or LSP - or = before the legend indicates the currently active SP)	Scale Range Minimum
Local Setpoint Value	_LSP			
Setpoint 1 Value	_SP1			
Setpoint 2 Value	_SP2			

5. AUTOMATIC TUNING MODE

First select Automatic tuning mode from Select mode (refer to section 2).

Press **↔** to scroll through the modes, then press **▲** or **▼** to set the required value.

To exit from Automatic tuning mode, hold down **↔** and press **▲**, to return to Select mode.

Pre-tune is a single-shot routine and is thus self-disengaging when complete.

If APTE in Setup mode = EnAb, Pre-tune will attempt to run at every power up*.

Refer to the full user guide (available from your supplier) for details on controller tuning.

Parameter	Lower Display	Upper Display	Default Value
Pre-Tune	P _{tun}	On or OFF. Indication remains OFF if automatic tuning cannot be used at this time*	OFF
Self-Tune	S _{tun}		0
Tune Lock	t _{Loc}	0 to 9999	0

* Note: Automatic tuning will not engage if either proportional band = 0.

Also, Pre-tune will not engage if setpoint is ramping, or the PV is less than 5% of input span from the setpoint.

6. PRODUCT INFORMATION MODE

First select Product information mode from Select mode (refer to section 2).

Press **↔** to view each parameter. To exit from Product Information mode,

hold down **↔** and press **▲** to return to Select mode.

Note: These parameters are all read only.

Parameter	Lower Display	Upper Display	Description
Input type	In ₁	Un ₁	Universal input
Option 1 module type fitted	OP _{n1}	nonE	No option fitted
		rLY	Relay output
		SSr	SSR drive output
		tr ₁	Triac output
Option 2 module type fitted	OP _{n2}	L _{in}	Linear DC voltage / current output
			As Option 1
Option 3 module type fitted	OP _{n3}	nonE	No option fitted
		rLY	Relay output
		SSr	SSR drive output
		L _{in}	Linear DC voltage / current output
Auxiliary Option A module type fitted	OP _{nA}	dc24	Transmitter power supply
		nonE	No option fitted
		r485	RS485 communications
Auxiliary Option B module type fitted	OP _{nB}	d _{IO}	Digital Input*
		r _{SP}	Remote Setpoint Input (basic)*
Firmware type	F _U	nonE	No option fitted
		r _{SP}	Remote Setpoint Input (full) and Digital Input 2*
Firmware issue	ISS		Value displayed is firmware issue number
Product Revision Level	P _{rL}		Value displayed is Product Revision level
Date of manufacture	d _{OR}		Manufacturing date code (mmyy)
Serial number 1	S _{n1}		First four digits of serial number
Serial number 2	S _{n2}		Middle four digits of serial number
Serial number 3	S _{n3}		Last four digits of serial number

7. MESSAGES & ERROR INDICATIONS

These messages indicate that an error has occurred or there is a problem with the process variable input signal or its wiring.

Caution: Do not continue with the process until the issue is resolved.

Parameter	Upper Display	Lower Display	Description
Instrument parameters are in default conditions	Goto	Conf	Configuration & Setup required. This screen is seen at first turn on, or if hardware configuration has been changed. Press ↔ to enter the Configuration Mode, next press ▲ or ▼ to enter the unlock code number, then press ↔ to proceed
Input Over Range	[HH]	Normal	Process variable input > 5% over-range
Input Under Range	[LL]	Normal	Process variable input > 5% under-range
Input Sensor Break	OPEN	Normal	Break detected in process variable input sensor or wiring
RSP Over Range	[HH]**		RSP input over-range
RSP Under Range	[LL]**		RSP input under-range
RSP Break	OPEN**		Break detected in RSP input signal
Option 1 Error	OP _{n1}		Option 1 module fault
Option 2 Error	OP _{n2}		Option 2 module fault
Option 3 Error	OP _{n3}		Option 3 module fault

** also seen wherever RSP value would be displayed

8. OPERATOR MODE

This mode is entered at power on, or accessed from Select mode (see section 2).

Note: All Configuration mode and Setup mode parameters must be set as required before starting normal operations.

Press to scroll through the parameters, then press or to set the required value.

Note: All Operator Mode parameters in Display strategy 6 are read only (see d iSP in configuration mode), they can only be adjusted via Setup mode.

Upper Display	Lower Display	Display Strategy and When Visible	Description
PV Value	Active SP Value	1 & 2 (initial screen)	PV and target value of selected SP <i>Local Setpoints are adjustable in Strategy 2</i>
PV Value	Actual SP Value	3 & 6 (initial screen)	PV and actual value of selected SP (e.g. ramping SP value). <i>Read only</i>
PV Value	(Blank)	4 (initial screen)	Process variable only <i>Read only</i>
Active SP Value	(Blank)	5 (initial screen)	Target value of selected setpoint only. <i>Read only</i>
SP Value	SP	1, 3, 4, 5 & 6 if digital input is not d iS I and RSP not fitted	Target value of SP <i>Adjustable except in Strategy 6</i>
SP1 Value	SP1	Digital input = d iS I. lit if active SP = SP1	Target value of SP1 <i>Adjustable except in Strategy 6</i>
SP2 Value	SP2	Digital input = d iS I. lit if active SP = SP2	Target value of SP2 <i>Adjustable except in Strategy 6</i>
Local SP Value	LSP	RSP fitted. - or lit if the active SP = LSP	Target value of local setpoint <i>Adjustable except in Strategy 6</i>
Remote SP Value	rSP	RSP fitted. - or lit if the active SP = rSP	Target value of remote setpoint <i>Read only</i>
d iG i, LSP or rSP	SPS	RSP is fitted, digital input is not d iS I and SSEN is enabled in Setup mode	Selects local/remote active setpoint LSP = local SP, rSP = remote SP d iG i = selection via digital input (if configured). <i>Note: selecting LSP or rSP will override digital input, active SP indication changes to lit</i> <i>Adjustable except in Strategy 6</i>
Actual SP Value	SPrP	rP is not blank	Actual (ramping) value of selected SP. <i>Read only</i>
Ramp Rate	rP	SPrP enabled in Setup mode	SP ramping rate, in units per hour <i>Adjustable except in Strategy 6</i>
Active Alarm Status	ALSt	When one or more alarms are active. ALM indicator will also flash	Alarm 2 active Alarm 1 active Loop Alarm active

Manual Control

If P_{oEn} is set to E_{nRb} in Setup mode, manual control can be selected/de-selected by pressing the key in Operator mode, or by changing the status of a digital input if d iG i or d iG 2 have been configured for d iRS in Configuration mode.

While in Manual Control mode, the indicator will flash and the lower display will show P_{xxx} (where xxx is the current manual power level). Switching to/from manual mode is via Bumpless Transfer. Press or to set the required output power.

Caution: Manual power level is not restricted by the OP_{UL} power limit.

9. SERIAL COMMUNICATIONS

Refer to the full user guide (available from your supplier) for details.

10. SPECIFICATIONS

UNIVERSAL INPUT

Thermocouple Calibration:	±0.1% of full range, ±1LSD (±1°C for Thermocouple CJC). BS4937, NBS125 & IEC584.
PT100 Calibration:	±0.1% of full range, ±1LSD. BS1904 & DIN43760 (0.00385Ω/Ω°C).
DC Calibration:	±0.1% of full range, ±1LSD.
Sampling Rate:	4 per second.
Impedance:	>10MΩ resistive, except DC mA (5Ω) and V (47kΩ).
Sensor Break Detection:	Thermocouple, RTD, 4 to 20 mA, 2 to 10V and 1 to 5V ranges only. <i>Control outputs turn off.</i>
Isolation:	Isolated from all outputs (except SSR driver). Universal input must not be connected to operator accessible circuits if relay outputs are connected to a hazardous voltage source. Supplementary insulation or input grounding would then be required.

REMOTE SETPOINT INPUT

Accuracy:	±0.25% of input range ±1 LSD.
Sampling Rate:	4 per second.
Sensor Break Detection:	4 to 20 mA, 2 to 10V and 1 to 5V ranges only. <i>Control outputs turn off if RSP is the active SP.</i>
Isolation:	Slot A - Basic isolation, Slot B - Reinforced safety isolation from other inputs and outputs.

DIGITAL INPUTS

Volt-free(or TTL):	Open(2 to 24VDC) = SP1, Local SP or Auto Mode, Closed(<0.8VDC) = SP2, Remote SP or Manual Mode.
Isolation:	Reinforced safety isolation from inputs and other outputs.

OUTPUTS

Relay	
Contact Type & Rating:	Single pole double throw (SPDT); 2A resistive at 120/240VAC.
Lifetime:	>500,000 operations at rated voltage/current.
Isolation:	Basic Isolation from universal input and SSR outputs.
SSR Driver	
Drive Capability:	SSR drive voltage >10V into 500Ω min.
Isolation:	Not isolated from universal input or other SSR driver outputs.
Triac	
Operating Voltage:	20 to 280Vrms (47 to 63Hz).
Current Rating:	0.01 to 1A (full cycle rms on-state @ 25°C); derates linearly above 40°C to 0.5A @ 80°C.
Isolation:	Reinforced safety isolation from inputs and other outputs.

DC

Resolution:	8 bits in 250mS (10 bits in 1s typical, >10 bits in >1s typical).
Isolation:	Reinforced safety isolation from inputs and other outputs.

Transmitter PSU

Power Rating:	20 to 28V DC (24V nominal) into 910Ω minimum resistance.
Isolation:	Reinforced safety isolation from inputs and other outputs.

SERIAL COMMUNICATIONS

Physical:	RS485, at 1200, 2400, 4800, 9600 or 19200 bps.
Protocols:	Selectable between Modbus and West ASCII.
Isolation:	Reinforced safety isolation from all inputs and outputs.

OPERATING CONDITIONS (FOR INDOOR USE)

Ambient Temperature:	0°C to 55°C (Operating), -20°C to 80°C (Storage).
Relative Humidity:	20% to 95% non-condensing.
Supply Voltage and Power:	100 to 240VAC ±10%, 50/60Hz, 7.5VA (for mains powered versions), or 20 to 48VAC 50/60Hz 7.5VA or 22 to 65VDC 5W (for low voltage versions).

ENVIRONMENTAL

Standards:	CE, UL, ULC.
EMI:	Complies with EN61326 (Susceptibility & Emissions).
Safety Considerations:	Complies with EN61010-1 & UL3121. Pollution Degree 2, Installation Category II.
Front Panel Sealing:	To IP66 (IP20 behind the panel).

PHYSICAL

Front Bezel Size:	$\frac{1}{16}$ Din = 48 x 48mm, $\frac{1}{8}$ Din = 96 x 48mm, $\frac{1}{4}$ Din = 96 x 96mm.
Depth Behind Panel:	$\frac{1}{16}$ Din = 110mm, $\frac{1}{8}$ & $\frac{1}{4}$ Din = 100mm.
Weight:	0.21kg maximum.

Advanced Process Digital Controllers with Fuzzy Logic

- Field configurable outputs, options
- 100 ms sampling (for analog input)
- Advanced PID, or fuzzy self-tuning
- Conforms to UL, CSA and CE standards
- Water-resistant front panel meets IP66/NEMA 4X
- Remote set point with optional event input board
- Set point ramp
- Serial communications available
- Front panel programming
- Heat only or heat/cool control
- Auxiliary outputs (SPST) standard; two for E5AK/E5EK, one for E5CK
- 3-year warranty



Ordering Information

Order Control Output Boards and Option Boards separately below.

Description	DIN size	Supply voltage	Part number
Standard model	1/4 DIN (96 x 96 mm)	100 to 240 VAC	E5AK-AA2-500
Position-proportional model (See Note 3)		100 to 240 VAC	E5AK-PRR2-500
Standard model		24 VAC/VDC	E5AK-AA2-500 AC/DC24
Position-proportional model (See Note 3)		24 VAC/VDC	E5AK-PRR2-500 AC/DC24
Standard model	1/8 DIN (48 x 96 mm)	100 to 240 VAC	E5EK-AA2-500
Position-proportional model (See Note 3)		100 to 240 VAC	E5EK-PRR2-500
Standard model		24 VAC/VDC	E5EK-AA2-500 AC/DC24
Position-proportional model (See Note 3)		24 VAC/VDC	E5EK-PRR2-500 AC/DC24
Standard model	1/16 DIN (48 x 48 mm)	100 to 240 VAC	E5CK-AA1-500
Standard model		24 VAC/VDC	E5CK-AA1-500 AC/DC24
Non-standard model with built-in quick auto-tune button (See <i>Nomenclature</i> section for details)		100 to 240 VAC	E5CK-AA1-302

- Note: 1. When using the heater burnout alarm function with a standard model, the Linear Output Module cannot be used for the control outputs (heat). The Digital Controller provides transfer outputs at 4 to 20 mA for the PV and other values and control outputs at 4 to 20 mA for the current outputs.
2. E5EK-PRR2/E5AK-PRR2 controllers are supplied with relay output. The relay output is not compatible with any other module.
3. Position-proportional models are intended for motorized valves (not 4-20 mA modulating valves). These use two relays ("open" and "close") which will turn a motor clockwise or counter-clockwise, thus opening or closing the valve.

■ OPTIONAL OUTPUT BOARDS

Description	Specifications	Compatible controller	Max. quantity	Part number
Relay	SPST, 5 A, 250 VAC	E5AK/E5EK	2	E53-R
SSR (solid state relay)	1 A, 75 to 250 VAC	E5AK/E5EK	2	E53-S
Voltage pulse	NPN, 12 VDC	E5AK/E5EK	2	E53-Q
	NPN, 24 VDC	E5AK/E5EK	2	E53-Q3
	PNP, 24 VDC	E5AK/E5EK	2	E53-Q4
Linear current	4 to 20 mA	E5AK/E5EK	2	E53-C3
	0 to 20 mA	E5AK/E5EK	2	E53-C3D
Linear voltage	0 to 10 VDC	E5AK/E5EK	2	E53-V34
	0 to 5 VDC	E5AK/E5EK	2	E53-V35
Relay/Relay	SPST/SPST, 5 A, 250 VAC	E5CK	1	E53-R4R4
Relay/Pulse	SPST, 5 A/NPN, 24 VDC	E5CK	1	E53-Q4R4
	SPST, 5 A/PNP, 24 VDC	E5CK	1	E53-Q4HR4
Relay/Linear current	SPST, 5 A/4 to 20 mA	E5CK	1	E53-C4R4
	SPST, 5 A/0 to 20 mA	E5CK	1	E53-C4DR4
Relay/Linear voltage	SPST, 5 A/0 to 10 VDC	E5CK	1	E53-V44R4
Pulse/Pulse	NPN/NPN, 24 VDC	E5CK	1	E53-Q4Q4
	PNP/PNP, 24 VDC	E5CK	1	E53-Q4HQ4H
Computer communications	RS-232C	E5AK/E5EK	3/1	E53-AK01
	RS-232C	E5CK	1	E53-CK01
	RS-422	E5AK/E5EK	3/1	E53-AK02
Computer communications	RS-485	E5AK/E5EK	3/1	E53-AK03
		E5CK	1	E53-CK03
Event input	For remote set point	E5AK/E5EK	3/1	E53-AKB
	For remote set point	E5CK	1	E53-CKB
Transfer output	4 to 20 mA	E5AK/E5EK	3/1	E53-AKF
	4 to 20 mA	E5CK	1	E53-CKF

Note: If the control period is less than 5 seconds, use an SSR (solid state relay) or pulse voltage output.

■ ACCESSORIES (ORDER SEPARATELY)

Description	Specifications	Compatible controller	Max. quantity	Part number
Current transformer; order only if using heater burnout alarm function	50 A load, 5.8 mm hole dia.	E5AK/E5EK	1	E54-CT1
	120 A load, 12 mm hole dia.	E5AK/E5EK	1	E54-CT3
Terminal cover (supplied with Standard models)	Provides finger protection from terminals (VDE0106 part 100)	E5AK	1	E53-COV0809
		E5CK	1	E53-COV07
		E5EK	1	E53-COV08
Software	For setup and monitoring; requires optional computer communications board	All	1	SYS-CONFIG V2.0

Input Types (selectable with input jumper connector)**Thermocouple**

Input (field selectable) (See Notes)		K1	K2	J1	J2	T	E	L1	L2	U	N	R	S	B	W	PLII
Range	°C	-200 to 1,300	0.0 to 500.0	-100 to 850	0.0 to 400.0	-199.9 to 400.0	0 to 600	-100 to 850	0.0 to 400.0	-199.9 to 400.0	-200 to 1,300	0 to 1,700	0 to 1,700	100 to 1,800	0 to 2,300	0 to 1,300
	°F	-300 to 2,300	0.0 to 900.0	-100 to 1,500	0.0 to 750.0	-199.9 to 700.0	0 to 1,100	-100 to 1,500	0.0 to 750.0	-199.9 to 700.0	-300 to 2,300	0 to 3,000	0 to 3,000	300 to 3,200	0 to 4,100	0 to 2,300

- Note: 1. Setting number is factory-set to 2 (K1).
 2. Thermocouple W is W/Re5-26 (tungsten rhenium 5, tungsten rhenium 26).

Platinum Resistance Thermometer (RTD's)

Input (field selectable)		JPt100	Pt100
Range	°C	-199.9 to 650.0	-199.9 to 650.0
	°F	-199.9 to 999.9	-199.9 to 999.9

Current/Voltage

Input (field selectable)	Current input		Voltage input		
	4 to 20 mA	0 to 20 mA	1 to 5 V	0 to 5 V	0 to 10 V

Note: When a current/voltage input is selected, the decimal point is fully adjustable.

Specifications

■ RATINGS

Model number		E5□K Standard		E5□K 24V AC/DC
Supply voltage		100–240 VAC, 50/60 Hz		24 VAC/VDC, 50/60 Hz
Operating voltage range		85% to 110% of rated supply voltage		85% to 110% of rated supply voltage
Power consumption		E5AK	16 VA	9 VA, 6 W
		E5EK	15 VA	9 VA, 6 W
		E5CK	10 VA (at 100 VAC) 14 VA (at 240 VAC)	6 VA, 3.5 W
Input	Thermocouple	K, J, T, E, L, U, N, R, S, B, W, PLII		
	Platinum resistance thermometer (RTD)	JPt100, Pt100		
	Current input	4 to 20 mA, 0 to 20 mA		
	Voltage input	1 to 5 V, 0 to 5 V, 0 to 10 V		
Mean Time Between Failure		15.4 years (135,000 hours)		
Control output (See Note 1)	Relay	SPST, 250 VAC, 3 A (resistive load) Mechanical life expectancy: 10,000,000 operations min. Electrical life expectancy: 100,000 operations min.		
	Voltage (pulse)	NPN	20 mA at 12/24 VDC (with short-circuit protection)	
		PNP	20 mA at 24 VDC (with short-circuit protection)	
	Linear voltage	0 to 10 VDC	Permissible load impedance: 1 kΩ min. Resolution: Approximately 2600 steps	
	Linear current	4 to 20 mA	Permissible load impedance: 500 Ω max. Resolution: Approximately 2600 steps	
0 to 20 mA		Permissible load impedance: 500 Ω max. Resolution: Approximately 2600 steps		
Auxiliary output	SPST-NO	E5AK	3 A at 250 VAC (resistive load)	
		E5EK	3 A at 250 VAC (resistive load)	
		E5CK	1A at 250 VAC (resistive load)	
Control method (See Note 2)		ON/OFF, Advanced PID Control (with auto-tuning) or Self-tuning		
Setting method		Digital setting using front panel keys or communications features		
Indication method – 7-seg. digital display and LEDs		E5AK: PV = 15 mm, SP = 10.5 mm E5EK: PV = 14 mm, SP = 9.5 mm E5CK: PV = 12 mm, SP = 8 mm		
Potentiometer for valve positioning (for E5AK-PRR and E5EK-PRR only)		100 Ω to 2.5 kΩ		
Event input	Contact input	ON	1 kΩ max.	
		OFF	100 kΩ min.	
	No-contact input	ON	residual voltage: 1.5 V max.	
		OFF	leakage current: 0.1 mA max.	
Transmission output		4 to 20 mA, permissible load impedance: 600 Ω max., resolution: Approximately 2600 steps		
Remote SP input (for E5AK and E5EK only)	Current input	4 to 20 mA (Input impedance: 150 Ω)		
Current Transformer input (for E5AK and E5EK only)		Connect only an Omron Current Transformer (E54-CT1 or E54-CT3)		
Other functions	Standard	Manual output, heating/cooling control, SP limiter, loop burnout alarm, SP ramp, MV limiter, MV change rate limiter, input digital filter, input shift, run/stop, protect functions		
	Option	Multiple SP, run/stop selection, transfer output functions, auto/manual Communications (RS-232C, RS-422, or RS-485), Loop Break Alarm, and Transfer Output.		
Standards	UL	File No.: E68481		
	CSA	File No.: LR59623		
	CE	File No.: EN50081-2; EN50082-2; IEC 1010-1		

Note: 1. All control outputs are insulated from the input circuit.

2. Fuzzy self-tuning is available only when using the Digital Controller in standard control operation with temperature input.

■ OPTION BOARD RATINGS AND CHARACTERISTICS

Event inputs		Contact input: ON: 1 k Ω max., OFF: 100 k Ω min. No-contact input: ON: residual voltage 1.5 V max., OFF: leakage current 0.1 mA max.
Communications	Interface	RS-232C and RS-485; RS-422 for E5AK and E5EK only
	Transmission method	Half-duplex
	Synchronization method	Start-stop synchronization (asynchronous method)
	Baud rate	1.2/2.4/4.8/9.6/19.2 kbps
Transfer output		4 to 20 mA: Permissible load impedance: E5AK and E5EK = 600 Ω max. E5CK = 500 Ω max. Resolution: E5AK and E5EK = approx. 2,600 steps E5CK = approx. 2,600 steps
		RS-232C Peer-to-peer only; maximum cable length = 15 m (49.2 feet) RS-422 and RS-485 32 controller maximum to host computer; maximum cable length = 500 m (1640 feet)

■ CURRENT TRANSFORMER RATINGS

Part number	E54-CT1	E54-CT3
Max. continuous heater current	50 amps	120 amps
Dielectric strength	1,000 VAC (for 1 min)	
Vibration resistance	50 Hz, 98 m/s ² (10G)	
Weight	Approx. 11.5 g	Approx. 50 g
Accessories	—	Armature: 2; Plug: 2

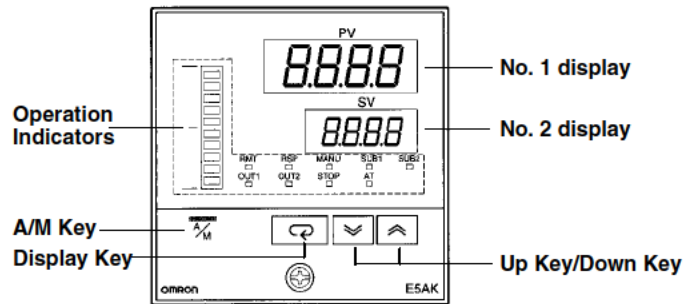
■ HEATER BURNOUT ALARM

Max. heater current	Single-phase 50 A VAC (See Note 1.)
Heater current value display accuracy	$\pm 5\%$ FS ± 1 digit max.
Heater burnout alarm setting range	0.1 to 49.9 A (in units of 0.1 A) (See Note 2.)
Min. detection ON time	190 ms (See Note 3.)

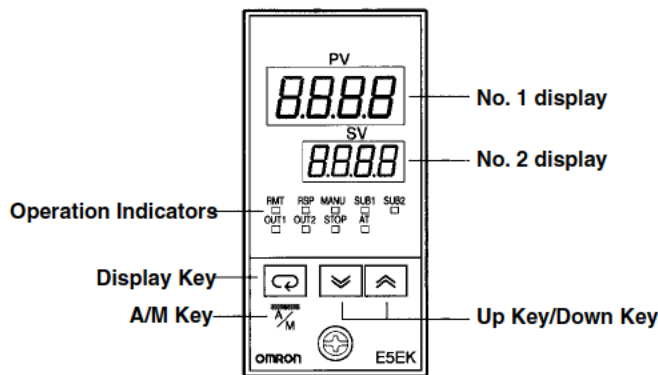
- Note: 1. Use the K2CU-F□□A-□GS (with gate input terminals) for the detection of three-phase heater burnout.
 2. The heater burnout alarm is always OFF if the alarm is set to 0.0 A and always ON if the alarm is set to 50.0 A.
 3. No heater burnout detection or heater current value measurement is possible if the control output (heat) is ON for less than 190 ms.

Nomenclature

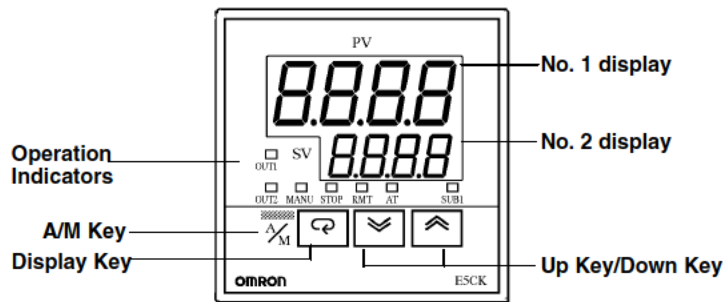
■ E5AK



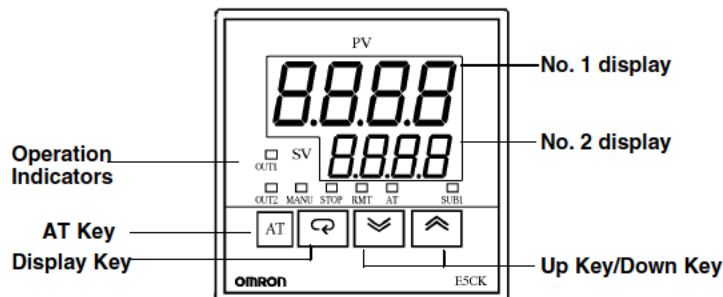
■ E5EK



■ E5CK



■ E5CK-302 (Non-standard)



Operation Indicators

- **OUT1**
Lit when control output 1 turns ON.
- **OUT2**
Lit when control output 2 turns ON.
- **SUB1**
Lit when the output function assigned to auxiliary output 1 turns ON.
- **SUB2** (for E5AK and E5EK only)
Lit when the output function assigned to auxiliary output 2 turns ON.
- **MANU**
Lit when the manual operation mode is being used.
- **STOP**
Lit when control operation has been stopped.
- **RMT**
Lit during remote communications operation.
- **AT**
Flashes during auto-tuning. Auto-tuning is completed when this LED stops flashing.
- **RSP** (for E5AK and E5EK only)
Lit during remote SP operation.
- **Bar Graph** (for E5AK only)
On a standard model (E5AK-AA2), this bar graph indicates the manipulated variable (heat) in 10% increments per single segment. On a position-proportional model (E5AK-PRR2), this bar graph indicates the valve opening in 10% increments per single segment.

No. 1 Display

Displays the process value or parameter symbols.

No. 2 Display

Displays the set point, set point during SP ramp, manipulated variable, or parameter settings.

A/M Key

Press to select the auto operation or manual operation.

Up Key/Down Key

Press to increase or decrease the value on the No.2 display.

Display Key

Press quickly (for less than 1 s) to shift the display to the next parameter. When this key is pressed for 1 s or more, the menu screen will be displayed in any case.

- **AT**
Press key for automatic tuning.
- **A/M**
This feature is located in level one. (Replaced AT feature in level one).

Operation

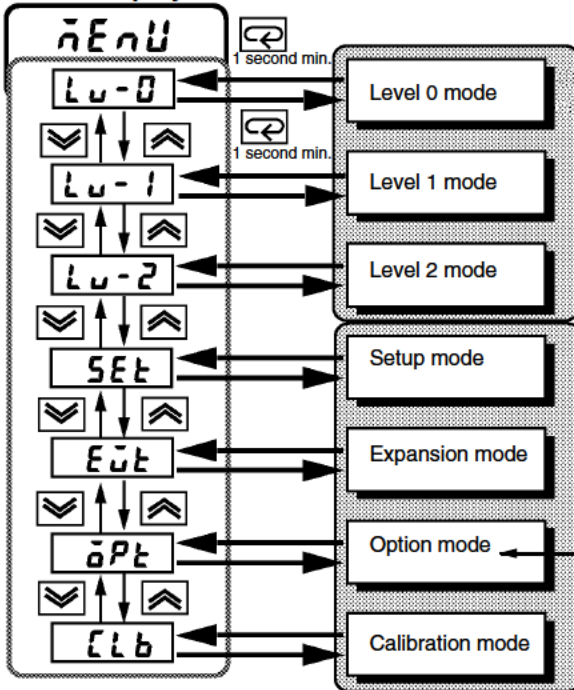
OPERATING PARAMETERS

Mode Selection

Press the Display Key for 1 sec. min. to switch to modes other than the manual or protect mode.

The figure below (Menu Display) shows all modes in the order that they are displayed. Some parameters are not displayed, depending on the protect mode setting and the option boards used.

Menu Display



To Access *Protect Mode*

Press and hold the A/M Key and the Display Key for more than 1 second.

To Return to the Main PV/SP Display from the *Protect Mode*

Press and hold the A/M Key and the Display Key for more than 1 second.

To Access *Manual Mode*

Press and hold the A/M Key for more than 1 second.

To switch parameters **within** a mode, use the Display Key. Press the display key for **less** than one second to move between parameters.

Note: 1. In Level 0 mode, Level 1 mode, and Level 2 mode: The controller will maintain control of the process.

2. In Setup mode, Expansion mode, Option mode, and Calibration mode: Control of the process is not maintained. The outputs are inactive.

3. Option Mode will be accessible only when an option board is installed in the controller.

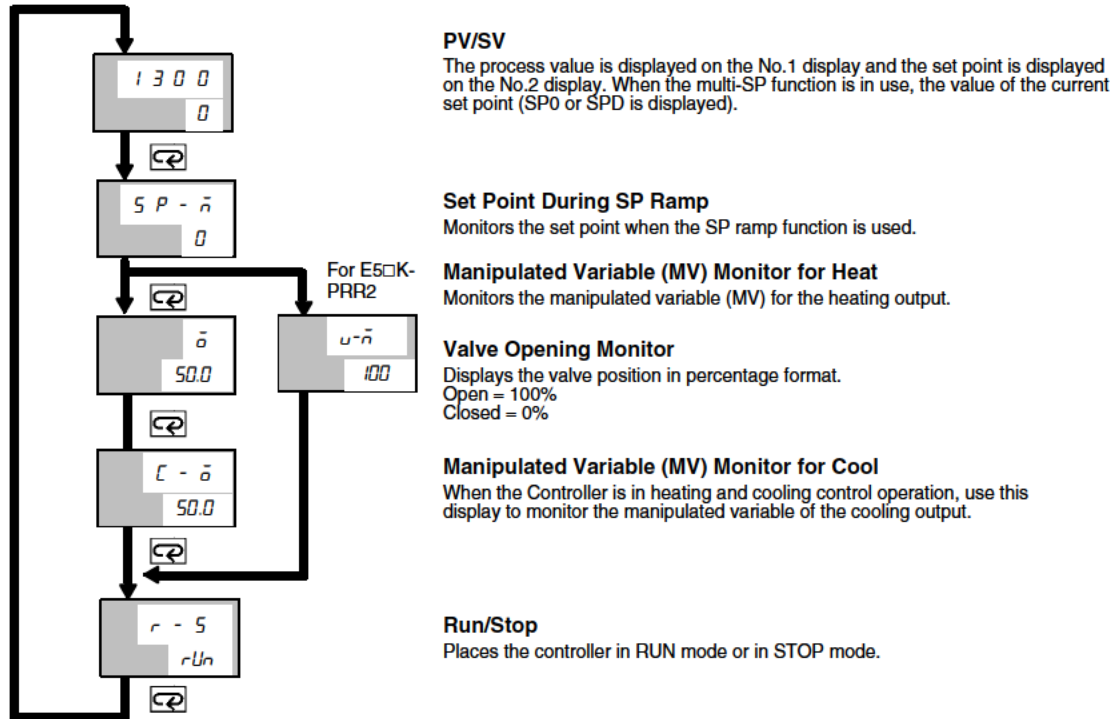
PARAMETERS AND MENUS – FOR SETTING THE CONTROLLER

Protect Mode	Limits use of the menu and A/M Keys. The protect function prevents unwanted modification of parameters and can also be used to prevent switching between the auto and manual operation.
Manual Mode	Sets the controller to manual operation mode. You can only manually adjust the manipulated variable (MV) in this mode.
Level 0 Mode	For normal operation. Change: the set point during operation, and start or stop Controller operation; and, (only in this mode) monitor the process value, ramp SP, and manipulated variable.
Level 1 Mode	For adjusting primary control parameters. Execute: AT (auto-tuning); set alarm values; set the control period; and, set PID parameters.
Level 2 Mode	For adjusting secondary control parameters. Set parameters for: limiting the manipulated variable and set point; switch between the remote and local modes; set the loop break alarm (LBA), alarm hysteresis, and the digital filter value of inputs.
Setup Mode	For setting the basic specifications. Set parameters for: input type, scaling, output assignments and direct/reverse operation.
Expansion Mode	For setting expanded functions. Set: ST (self-tuning), SP setting limiter. Select: advanced PID or ON/OFF control. Specify the standby sequence resetting method. Initialize parameters; and, set the time for automatic return to the monitoring display.
Option Mode	For setting option functions. Set: the communications conditions; transfer: output and event input parameters to match the type of Option Board installed in the Controller. <i>This mode will be accessible <u>only</u> when an option board is installed in the controller.</i>
Calibration Mode	For calibrating inputs and transfer output. Calibrate the selected input type. <i>Transfer output can be calibrated only when the Communications Unit (E53-CKF) has been installed in the Controller.</i>

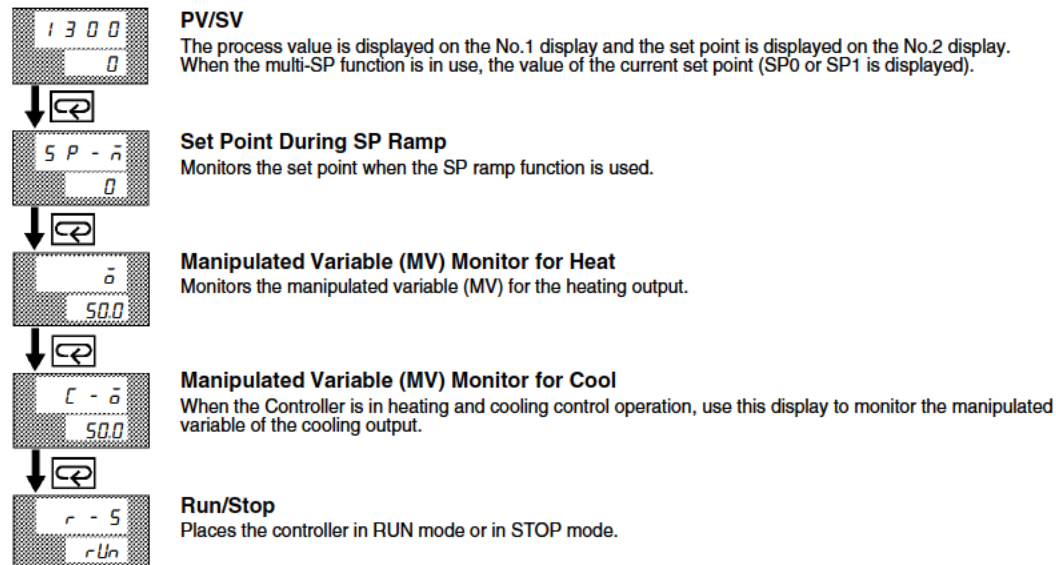
PARAMETERS DEFINITIONS

Refer to your *User's Manual* for each parameter and the calibration mode in detail.

Level 0 Mode for E5AK and E5EK



Level 0 Mode for E5CK



Security

Using the Security Level Table:

Any mode marked with an X is displayed in the Security Level indicated.



Example: Selecting Security Level 2:
 Displays these modes: Level 0, Level 1 and Level 2 only.
 Does NOT display these modes: Setup, Expansion, Option, Calibration

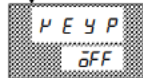
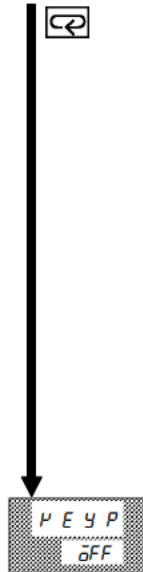
Mode	Set value						
	0	1	2	3	4	5	6
Calibration	x						
Option	x	x					
Expansion	x	x					
Setup	x	x					
Level 2	x	x	x				
Level 1	x	x	x	x			
Level 0	x	x	x	x	x	x	

← Security Level

↑ Lowest Security Level (first column) ↑ Highest Security Level (last column)

When the set value is 5:
 Only the **PV/SP monitor** and **set point** parameter can be used.

When the set value is 6:
 Only the **PV/SP monitor** parameter can be used.

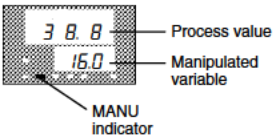


A/M Key Protect

This invalidates the function of the A/M Key.

- To Access *Protect Mode*
 Press and hold the A/M Key and the Display Key for more than 1 second.
- To Return to the Main PV/SP Display from the *Protect Mode*
 Press and hold the A/M Key and the Display Key for more than 1 second.

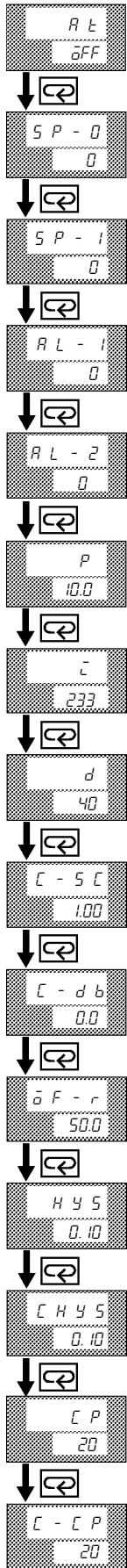
Note: For E5CK-302 models, this is done the same way, using the AT button.



MV Manual

- To Access *Manual Mode*
 Press and hold the A/M Key for more than 1 second.
- Range = -105% to 105%

Level 1 Mode

**AT Execute/Cancel**

Starts the Auto-tune function or cancels an active auto-tune. When an active auto-tune is cancelled, the original PID constants will be used again.

AT-1 = Limited MV change during Autotuning ($\pm 40\%$ max.)

AT-2 = Full MV change during Autotuning ($\pm 100\%$ max.)

Note: E5AK and E5EK can have up to 4 set points or 4 alarms

Set Point 0

Default set point when used with multi-SP function. This set point is active when the Event input is OFF.

Note: E5AK and E5EK can have up to 4 set points or 4 alarms

Set Point 1

Used only with multi-SP function. This set point is active when the Event input is ON. This parameter is available only if an Event Input Option Board is installed.

Alarm Value 1

Available only when Control Output 2 is not used as a control output. This setting determines what the Alarm 1 set point will be.

Alarm Value 2

Available only when the alarm output function of the Controller is selected. This setting determines what the Alarm 2 set point will be. This alarm can be programmed to work on Control Output 2 or the SUB-1 output (user-selectable). Factory Default = Control Output 2.

Note: Alarm Value 3 is available only when SUB-1 or Control Output No. 1 is selected as AL-3.

Proportional Band

Range = 0.1% to 999.9%

Integral Time

Range = 0 to 3999 seconds

Derivative Time

Range = 0 to 3999 seconds
See Note at right.

Note: For Valve Positioning Models E5□K-PRR2, all subsequent parameters (those after Derivative Time) listed in Level 1 Mode are **not** available. See Level 1 Valve Positioning model (provided on the following page).

Cooling Coefficient

Used when the Controller is in heat/cool control. This setting describes the ratio between the heating proportional band and the cooling proportional band.

$C - S C = \frac{\text{cooling P band}}{\text{heating P band}}$

Dead Band

Used when the Controller is in heating and cooling control. This setting determines the amount of overlap or dead band present in a heat/cool configuration. Range = -19.99 → 99.99.

Negative values = overlap band. Positive values = Dead band.

Manual Reset Value

Available **ONLY** when the integral time parameter of the Controller in standard control is set to **0**. The Controller must be in Standard or Advanced PID control and self-tune must be set to off.

Hysteresis (Heat)

Available when the Controller is in ON/OFF control.

If PID control selected, this value will not appear on the menu.

Range = 0.01 to 99.99 FS. Default = 0.10.

Hysteresis (Cool)

Available when the Controller is in ON/OFF control in heating and cooling control.

Range = 0.01 to 99.99 FS. Default = 0.10.

Control Period (Heat)

Available only when the Controller has a relay or voltage output, or is in advanced PID control.

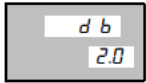
Range = 1 to 99 s. Default = 20 s.

Control Period (Cool)

Available when the Controller has a relay or voltage output, or is in advanced PID control in heating and cooling control.

Range = 1 to 99 s. Default = 20 s.

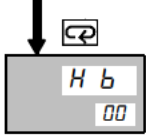
Note: This level 1 Mode ends here for the E5CK models only. For all other E5□K models in this data sheet, continue with the next page.

Level 1 Valve Positioning Model (for E5AK and E5EK only)**Position Proportional Dead Band**

For valve positioning units only.
Used to adjust the dead band for a valve; displayed in percentage format.
Range = 0.1–10
Default = 2.0

**Heater Current Monitor**

Available when the heater burnout alarm is assigned.

**Heater Burnout Detection**

Available when the heater burnout alarm is assigned.
Activates the Heater Burnout Alarm when the heater current falls below the set value.
Range = 0.0–50.0A
Default = 0.0

Level 2 Mode

**Remote/Local**

Used for the communications function. Only accessible when communication option boards are installed. Determines whether the user will program the unit by the key pads on the face plate (local), by a computer, or PLC (remote).
Default = local.

SP Ramp Time Unit

Determines what unit of time to use on a set point ramp: minutes or hours. Self-tune must be set to OFF.
Default = minutes.

SP Ramp Set Value

Determines the maximum allowable degrees of change per Time Unit.
Example: SP Ramp Time Unit = minute SP0 = 100°F
 SP Ramp Set Value = 10° SP1 = 150°F
It will take 5 minutes to ramp up to 150°F from 100°F.

Default = 0.

LBA Detection Time

Available only when the LBA (loop break alarm) function of the Controller is selected. This parameter is automatically set by Auto-tuning. Determines how long it will take the controller to detect a loop break.
Range = 0 – 9999 sec.
Default = 0

Manipulated Variable (MV) at Stop

Determines what percentage of Manipulated Variable (MV) will be when control has been stopped.
Default = 0%
Range = -5 to 105% for standard control; -105 to 105% for heat/cool control.

MV at PV Error

Determines what percentage of Manipulated Variable (MV) will be when an input error has been detected.
Default = 0%
Range = -5 to 105% for standard control; -105 to 105% for heat/cool control.

MV Upper Limit

Stops the MV from going higher than the set value. Default = 105%

MV Lower Limit

Stops the MV from going lower than the set value.
Default (heat only) = -5%
Default (heat/cool) = -105%
Default (cool only) = -105%

MV Change Rate Limit

Limits how fast the MV can change in % of FS per second.
Default = 0%
Range = 0 – 100%

Input Digital Filter

Sets the time constant for the digital filter.
Range = 0 to 9999 sec.
Default = 0

Alarm 1 Hysteresis

Available only when the Controller has an alarm output.
Range = 0 to 9999 sec.
Default = 0.2

Alarm 2 Hysteresis

Available only when the Controller has an alarm output.
Range = 0 to 9999 sec.
Default = 0.2

Alarm 3 Hysteresis (Note: An example of this display is not shown here.)

Available only when the Controller has an alarm output.
Range = 0 to 9999 sec.
Default = 0.2

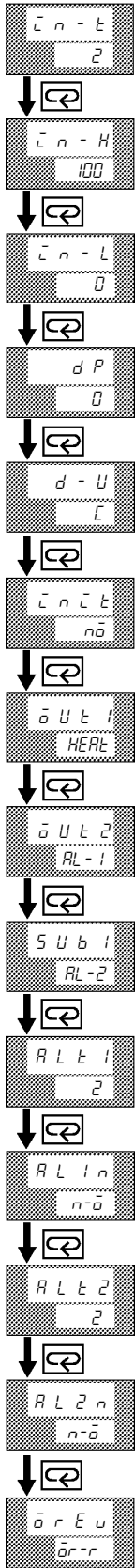
Input Shift Upper Limit

Available if the input type connected to the Controller is a thermocouple or platinum RTD.
Range = -199.9 to 999.9 °C/°F; default = 0 to 0 °C/°F

Input Shift Lower Limit

Available if the input type connected to the Controller is a thermocouple or platinum resistance thermometer.
Range = -199.9 to 999.9 °C/°F; default = 0 to 0 °C/°F

Setup Mode

**Input Type**

Sets the input type connected to terminals 6 through 8.
 Note: Set input jumper to current, voltage, or temperature setting before changing input type.
 Default = 2 (K1 type thermocouple)

Scaling Upper Limit

Used if the input type connected to the Controller is an analog input (voltage or current input).
 Range = 1 to 9999
 Default = 100

Scaling Lower Limit

Used if the input type connected to the Controller is an analog input (voltage or current input).
 Range = -1999 to -1
 Default = 0

Decimal Point

Used only if the input type connected to the Controller is an analog input (voltage or current input).
 Range = 0 to 3
 Default = 0

°C/°F Selection

Used if the input type connected to the Controller is a temperature input (thermocouple or platinum resistance thermometer).
 Default = °C

Parameter Initialize

Returns the controller to Factory Default Settings.

Control Output 1 Assignment

Assigns the Controller to have one of the following output functions: heating control, cooling control, alarm 1, alarm 2, alarm 3, and LBA (loop break alarm).
 Default = heat

Control Output 2 Assignment

Assigns the Controller to have one of the following output functions: heating control, cooling control, alarm 1, alarm 2, alarm 3, and LBA (loop break alarm).
 Default = Alarm 1

Auxiliary Output 1 Assignment

Enables the Controller to have one of the following outputs: alarm 1, alarm 2, alarm 3, LBA (loop break alarm)
 Default = Alarm 2
 Note: The following parameters are available only when the controller has an alarm output. (See the table on the Expansion Mode table.)

Alarm 1 Type

Provides a choice of 11 different alarm operations.
 Default = 2 (See Alarm Summary Table for Alarm types available.)

Alarm 1 Open in Alarm

Synchronizes the alarm LED with the operation of the alarm. If the alarm is operating as a normally closed relay (open in alarm condition), this parameter should be set to 'Open in Alarm'. If the alarm is operating as a normally open relay (close in alarm condition), this parameter should be set to 'Close in Alarm'.

Alarm 2 Type

Provides a choice of 11 different alarm operations.
 Default = 2 (See Alarm Summary Table for Alarm types available.)

Alarm 3 Type Note: An example of this display is not shown here.
 OPEN W/Alarm

Alarm 2 Open in Alarm

Synchronizes the alarm LED with the operation of the alarm. If the alarm is operating as a normally closed relay (open in alarm condition), this parameter should be set to 'Open in Alarm'. If the alarm is operating as a normally open relay (close in alarm condition), this parameter should be set to 'Close in Alarm'.

Direct/Reverse Operation

Choose between direct (cooling) or reverse (heating) control action.
 Default = reverse (heating).
 Direct (cooling) = MV increases with decreasing PV.
 Reverse (heating) = MV increases with increasing PV.

Selecting a Control Method

When selecting a control method, refer to the following table for correct parameter setting.

Control method	Control output 1 assignment	Control output 2 assignment	Operation
Heat	Control output (heat)	---	Reverse
Cool	Control output (heat)	---	Direct
Heat/Cool	Control output (heat)	Control output (cool)	Reverse
Heat/Cool	Control output (cool)	Control output (heat)	Direct

Selecting Input Type

Platinum Resistance Thermometer (RTD's)

Input (field selectable)		JPt100	Pt100
Range	°C	-199.9 to 650.0	-199.9 to 650.0
	°F	-199.9 to 999.9	-199.9 to 999.9
Input setting		0	1

Thermocouple

Input (field selectable) (See Notes)		K1	K2	J1	J2	T	E	L1	L2	U	N	R	S	B	W	PLII
Range	°C	-200 to 1,300	0.0 to 500.0	-100 to 850	0.0 to 400.0	-199.9 to 400.0	0 to 600	-100 to 850	0.0 to 400.0	-199.9 to 400.0	-200 to 1,300	0 to 1,700	0 to 1,700	100 to 1,800	0 to 2,300	0 to 1,300
	°F	-300 to 2,300	0.0 to 900.0	-100 to 1,500	0.0 to 750.0	-199.9 to 700.0	0 to 1,100	-100 to 1,500	0.0 to 750.0	-199.9 to 700.0	-300 to 2,300	0 to 3,000	0 to 3,000	300 to 3,200	0 to 4,100	0 to 2,300
Input setting		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Note: 1. Setting number is factory-set to 2 (K1).
2. Thermocouple W is W/Re5-26 (tungsten rhenium 5, tungsten rhenium 26).

Current/Voltage

Input (field selectable)	Current input		Voltage input		
	4 to 20 mA	0 to 20 mA	1 to 5 V	0 to 5 V	0 to 10 V
Input setting	17	18	19	20	21

Note: When a current/voltage input is selected, the decimal point is fully adjustable.

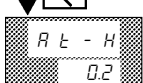
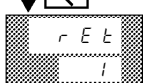
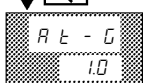
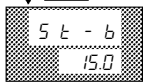
■ CLOSE IN ALARM/OPEN IN ALARM

If the alarm is operating as a normally closed relay (open in alarm condition), this parameter should be set to 'Open in Alarm'. If the alarm is operating as a normally open relay (close in alarm condition), this parameter should be set to 'Close in Alarm'.

Condition	Alarm	Output LED
Close in alarm (N.O.)	ON	Lit
	OFF	Not lit
Open in alarm (N.C.)	ON	Lit
	OFF	Not lit

Factory setting is "close in alarm" [$\bar{0}$].

Expansion Mode

**SP Setting Upper Limit**

Stops the set point from going higher than the SP setting upper limit.
Default = 1300

This setting has no effect on the input scaling values.

SP Setting Lower Limit

Stops the set point from going any lower than the SP setting lower limit
Default = -200

This setting has no effect on the input scaling values.

PID/ON/OFF

Selects the type of control method for the controller to use.
Default = PID

Adaptive Tuning (Self Tuning)

Only available if the Controller in standard control or advanced PID control has a temperature input.
Default = OFF. If ON is selected, the controller will use fuzzy logic to self tune the PID values for optimum control.
PID values will not be seen when ST (Self Tune) is on.

ST Stable Range

Only available if the Controller is in standard control or advanced PID control with the Self Tune (ST) set to ON.

 α

Only available if the Controller is in advanced PID control with the ST set to OFF.
This setting allows tailoring of the PID algorithm to emphasize control or fast response.
Default = 0.65
Fast Response = 0.0 → 0.65
Stability Emphasis = 0.65 → 1

AT Calculated Gain

Allows the controller to focus the auto-tune on increased response or more stability.
Range = 0.1 (fast response) to 10 (increase stability).
Available if the Controller is in advanced PID control with the ST set to OFF.
Default = 1.0

Alarm Standby Sequence Reset Method

Used with alarm settings to have a stand-by sequence applied to the alarm.
Default = 0

Automatic Return of Display Mode

Automatically returns the display of the controller to Level 0 PV/SP display after the set amount of time has elapsed if no buttons on the face plate have been used.
Applies only in Levels 0 through 2. Default = 0. Range = 0 to 99 sec.

AT Hysteresis

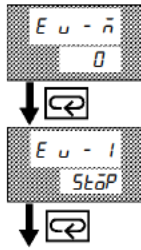
Only available if the Controller is in advanced PID control with the ST set to OFF.
Default = 0.2% FS; Range = 0.1 to 9.9% FS

LBA Detection Width

Only available only when the LBA (Loop Break Alarm) function of the Controller is selected.
Range 0.0 → 999.9% FS
Default = 0.2

Option Mode – ONLY Visible if an Option Board is Installed

E5□K

**Multi-SP Function**

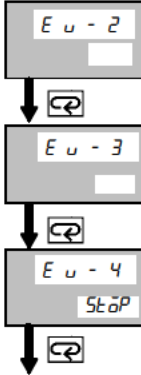
Specifies the number of set points that will be used. Must be set to one to use SP Ramp feature.

Available for the event input function. Default = 0

Event Input Assignment 1

Available for the event input function. If multi-SP is set to 0, this parameter assigns event input function as: Run/Stop, Auto/Manual, or Protect Function. Default = Stop.

E5AK and E5EK only

**Event Input Assignment 2**

Available for the event input function.

Event Input Assignment 3

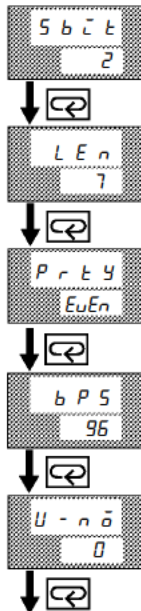
Available for the event input function.

Event Input Assignment 4

Available for the event input function.

COMMUNICATIONS FUNCTION

Communications selections are ONLY available if a communications board is installed.



(continued on next page)

Communication Stop Bit

Displayed when the communications function is in use.

Range = 1 to 2

Default = 2

Communication Data Length

Displayed when the communications function is in use.

Range = 7 to 8

Default = 7

Communication Parity

Displayed when the communications function is in use.

Range = None, Even, Odd

Default = Even

Communication Baud Rate

Displayed when the communications function is in use.

Range = 1.2, 2.4, 4.8, 9.6, 19.2 k baud

Default = 9.6

Communication Unit No.

Displayed when the communications function is in use.

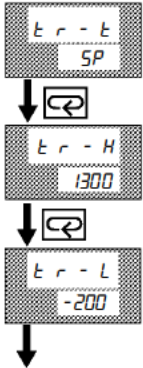
Range = 0 — 99

Default = 0

Option Mode – ONLY Visible if an Option Board is Installed, continued

TRANSFER OUTPUT SECTION

Transfer output selections are ONLY available if a transfer board is installed.



Transfer Output Type

Set when the transfer output function is in use. Determines which function the transfer output will re-transmit as a 4-20mA signal: SP, PV, SP Ramp, MV

Transfer Output Upper Limit

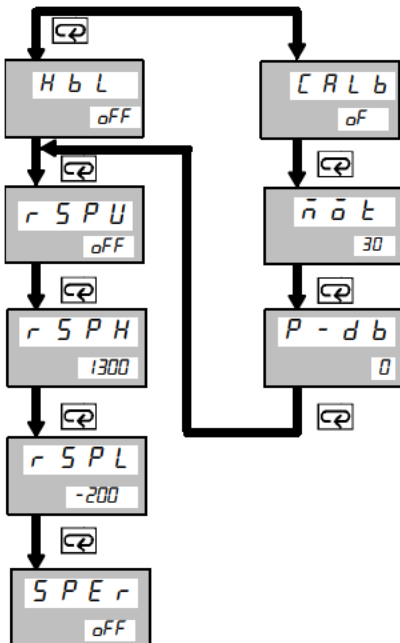
Set when the transfer output function is in use. Stops the transfer output from going higher than the Set Value.

Transfer Output Lower Limit

Set when the transfer output function is in use. Stops the transfer output from going lower than the Set Value.

REMOTE SET POINT FUNCTION

Remote set point function is available on all E5AK/E5EK models, with or without an option board installed.



HBA Latch

Makes the heater burnout alarm remain activated when triggered. It must be reset manually.

Motor Calibration

Determines how long it takes a fully closed proportional valve to fully open.

Travel time

The amount of time it takes to determine the motor calibration parameter. Range = 1–999 sec. Default = 30 sec.

PV Dead Band

Determines the size of the dead band around the process variable in which the valve will take no control action. Range = 0–9999. Default = 0

Remote SP Enable

Enables the controller to use a remote set point. Default = off

Remote SP Upper Limit (Available when the remote SP is enable)

Stops the RSP from going any higher than the set value. Default = 1300

Remote SP Lower Limit (Available when the remote SP is enable)

Stops the RSP from going any lower than the set valve. Default = –200

SP tracking (Available when the remote SP is enable)

Allows a smooth transition between a RSP and a local SP when enabled. When on, the LSP will become the RSP that was being used immediately before switching.

■ ALARM MODE SELECTORS

Alarm outputs are available if they are allocated as outputs. Factory setting is "2: Upper-limit alarm (deviation)."

Setting number	Alarm types	Alarm output	
		When X is positive	When X is negative
1	Upper- and lower-limit alarm (deviation)		Always ON
2	Upper-limit alarm (deviation)		
3	Lower-limit alarm (deviation)		
4	Upper- and lower-limit range alarm (deviation)		Always OFF
5	Upper- and lower-limit alarm with standby sequence (deviation)		Always OFF
6	Upper-limit alarm with standby sequence (deviation)		
7	Lower-limit alarm with standby sequence (deviation)		
8	Absolute-value upper-limit alarm		
9	Absolute-value lower-limit alarm		
10	Absolute-value upper-limit alarm with standby sequence		
11	Absolute-value lower-limit alarm with standby sequence		

Note: 1. A deviation is defined as deviation from SP.

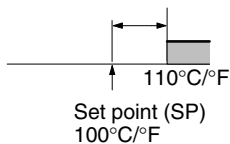
2. An absolute alarm is defined as a fixed value X with reference to 0.

3. Standby sequence is defined as having the alarm outputs inactive until SP is reached on the initial power up of the Controller. After SP has been reached, alarms will function normally.

Deviation Alarm

If the alarm mode selector is set to a number between 1 to 7, alarm values are set to the width deviated from the set point as shown in the following illustration.

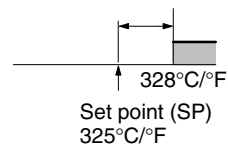
Alarm value = 10°C/°F



Absolute Alarm

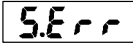
If the alarm mode selector is set to 8 or 9, alarm values are set to the absolute value based on 0°C/°F as shown in the following illustration.

Alarm value = 328°C/°F



■ HOW TO USE THE ERROR DISPLAY

When an error has occurred, the No.1 display alternately indicates error codes together with the current display item. This section describes how to check error codes on the display, and the actions that must be taken to remedy the problem.

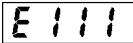


Input Error

Meaning Input is in error.

Action Check the wiring of inputs, disconnections, and shorts, and check the input type and the input type jumper connector.

Operation at Error For control output functions, output the manipulated variable matched to the setting of the "MV at PV error" parameter (level 2 mode). Alarm output functions are activated when the upper limit is exceeded.

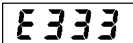


Memory Error

Meaning Internal memory operation is in error

Action First, turn the power OFF then back ON again. If the display remains the same, the E5AK/E5EK Controller must be repaired. If the display is restored to normal, the probable cause may be external noise affecting the control system. Check for external noise.

Operation at Error Control output functions turn OFF (2 mA max. at 4 to 20 mA output, and output equivalent to 0% in case of other outputs). Alarm output functions turn OFF.

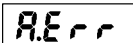


A/D Converter Error

Meaning Internal circuits are in error.

Action First, turn the power OFF then back ON again. If the display remains the same, the E5AK/E5EK Controller must be repaired. If the display is restored to normal, the probable cause may be external noise affecting the control system. Check for external noise.

Operation at Error Control output functions turn OFF (2 mA max. at 4 to 20 mA output, and output equivalent to 0% in case of other outputs). Alarm output functions turn OFF.



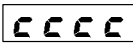
Calibration Data Error

This error is output only during temperature input and is displayed for two seconds when the power is turned ON.

Meaning Calibration data is in error.

Action Must repair.



Operation at Error Both control output functions and alarm output functions are active. However, note that the readout accuracy is not assured.



Display Range Over



Meaning Though not an error, this is displayed when the process value exceeds the display range when the control range (setting range $\pm 10\%$) is larger than the display range (-1999 to 9999).

- When less than "-1999" 
- When greater than "9999" 

Operation Control continues, allowing normal operation.

■ FUZZY SELF-TUNING

Fuzzy self-tuning is a function that enables the E5□K to calculate the most suitable PID constants for the control output.

Features

- The E5□K determines by itself when to perform fuzzy self-tuning.
- During fuzzy self-tuning, the E5□K does not output any signal that disturbs the temperature or output value.

Fuzzy Self-tuning Function

The fuzzy self-tuning function has three modes.

- In SRT (step response tuning) mode, the PID constants are tuned using a step response method at the time the set point is changed.
- In DT (disturbance tuning) mode, the PID constants are amended so that the controlled temperature will be within the target range set in advance when there is external disturbance.
- In HT (hunting tuning) mode, when hunting occurs, the PID constants are amended to suppress the hunting.

Note: You must turn ON the power supply to the LOAD either before or simultaneously with the start of Temperature Controller operation.

Dead time will be measured from the time the Temperature Controller starts operating. If a load, such as a heater, is turned on after the Temperature Controller is turned on, dead time longer than the actual value will be measured, and inappropriate PID constants will be obtained.

If an extremely large amount of dead time is measured, the control amount will be set to 0% for a short period of time before being returned to 100%, and the constants will then be re-tuned. Re-tuning is performed only for large amounts of dead time, so be sure to follow the precaution given above when starting operation.

Startup Conditions of SRT

SRT will start if conditions 1 to 5 are satisfied when the set point is changed, or the E5□K is turned on.

1. The new set point is different from the set point used at the time SRT was last executed.
2. The difference between the new set point and the last set point is larger than the value obtained from the calculation: present proportional band value (P) x approximately 1.27+4.

Note: When the E5□K is turned on, the difference between the process value and set point is regarded as *Deviation*.

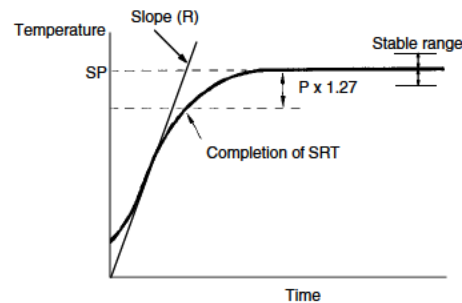
3. The temperature is stable before changing the set point, or the temperature is balanced while the E5□K is turned on before any output is obtained.
4. The set point is changed in the direction that the controlled amount increases (i.e., the control amount is in the upper direction at the time of reverse operation and in the lower direction at the time of normal operation).
5. No SRT has been executed with the current set point.

In the following cases, SRT will not be executed accurately. Therefore the E5□K must be tuned in DT or HT mode.

1. The maximum temperature slope (R) is not obtained before the process value reaches the value obtained from the calculation: present proportional band value (P) x approximately 1.27 (i.e., the maximum temperature slope (R) is not obtained before the SRT is finished). If the proportional band, obtained before SRT is finished, is larger than the previous proportional band, however, the PID constants will be renewed, so their values will be more accurate.
2. The set point is changed during SRT, and the SRT completion conditions are satisfied; and, no PID constant will be renewed.

Stable Temperature Status

If the temperature is within the stable range for a specified period, the temperature is considered *stable*.

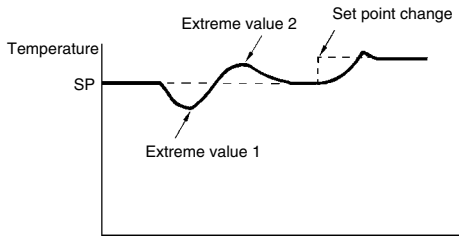


Balanced Status

If the process value is within the stable range for 60 s when there is no output, the the temperature is considered *balanced*.

Startup Conditions of DT

- DT will start if the temperature that has been stable varies due to external disturbance and the deflection of the temperature exceeds the stable range, and then the temperature becomes stable, provided that the number of maximum temperature values is less than four.
- DT will start if the set point is changed under the condition that SRT does not start and the temperature becomes stable, provided that the number of maximum temperature values is less than four.
If there are four or more maximum temperature values, HT will start.

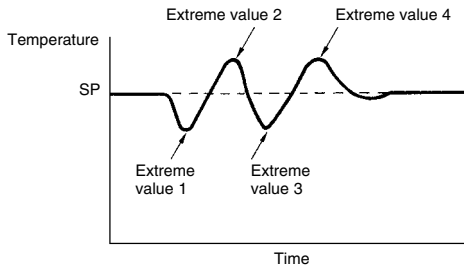


Balanced Status

If the process value is within the stable range for 60 s when there is no output, it is deemed that the the temperature is balanced.

Startup Conditions of HT

HT will be ON when there is hunting with four or more maximum temperature values (extreme values) while SRT is not being executed.

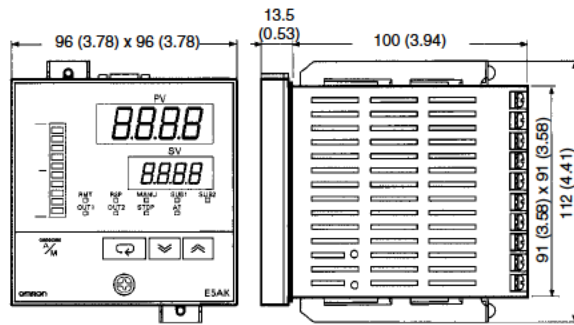


Note: In specific applications where temperature varies periodically due to disturbance, internal parameters need to be adjusted. For details, refer to your User's Manual.

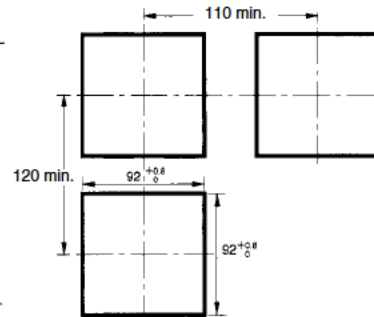
Dimensions

Unit: mm (inch)

E5AK

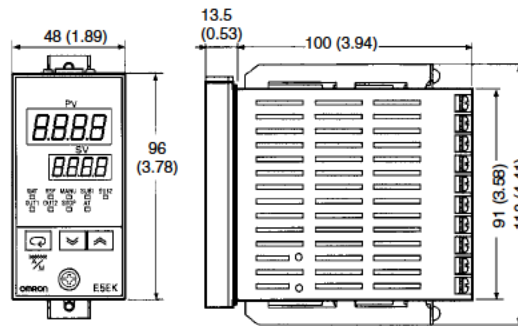


Panel Cutouts

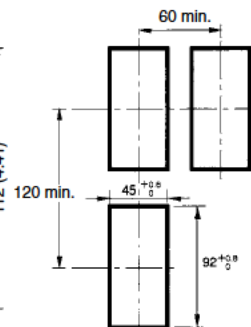


- Note: 1. Recommended panel thickness is 1 to 8 mm.
 2. Maintain the specified vertical and horizontal mounting space between each Unit. Units must not be closely mounted vertically or horizontally.

E5EK

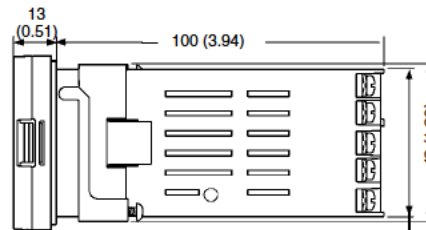
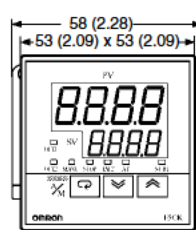


Panel Cutouts



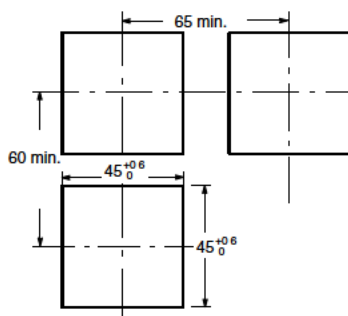
- Note: 1. Recommended panel thickness is 1 to 8 mm.
 2. Maintain the specified vertical and horizontal mounting space between each Unit. Units must not be closely mounted vertically or horizontally.

E5CK



44.8 (1.76) x 44.8 (1.76)

Panel Cutouts



- Note: 1. Recommended panel thickness is 1 to 5 mm.
 2. Maintain the specified vertical and horizontal mounting space between each Unit. Units must not be closely mounted, either vertically or horizontally.

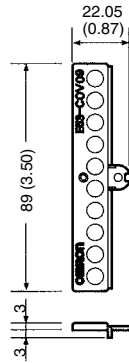
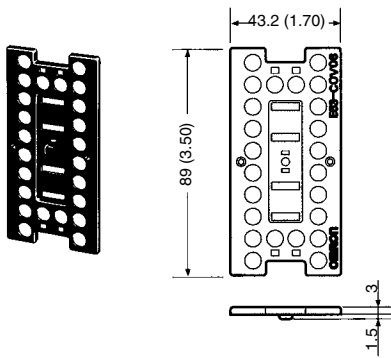
■ E5CK-302

The E5CK-302 model has the same dimension and cutouts as the E5CK.

■ ACCESSORIES (Order Separately)

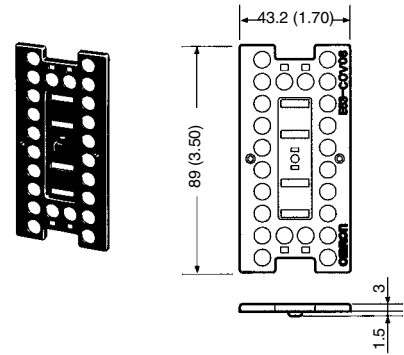
Terminal Cover for E5AK

E53-COV0809



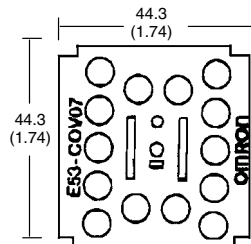
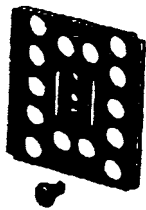
Terminal Cover for E5EK

E53-COV08



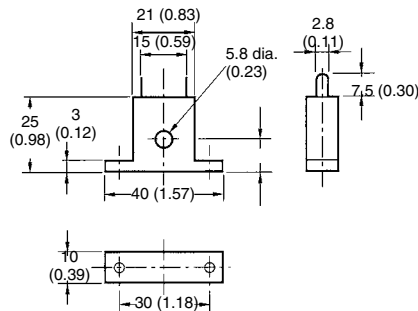
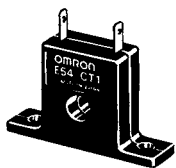
Terminal Cover for E5CK

E53-COV07

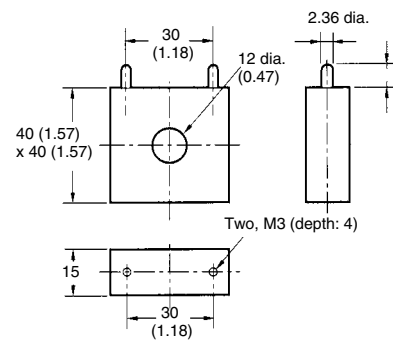


Current Transformer (E5AK and E5EK only for Heater Burnout Alarm)

E54-CT1



E54-CT3



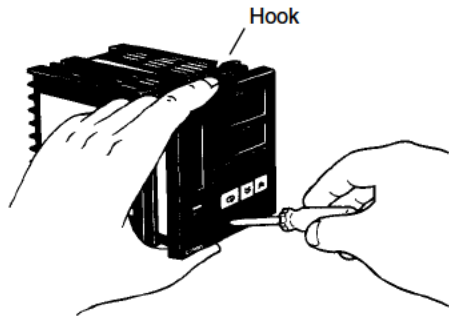
Installation

■ REMOVE CONTROLLER FROM REAR HOUSING

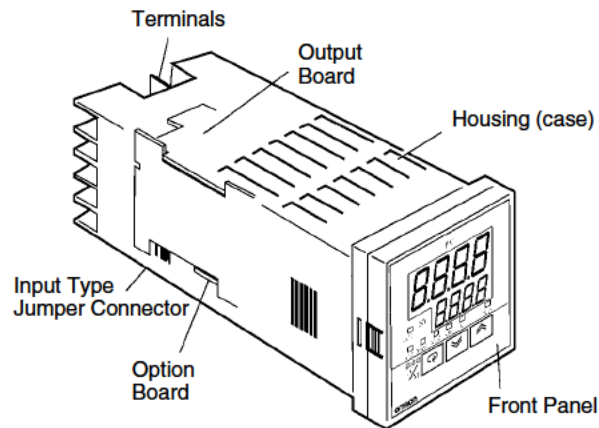
E5AK and E5EK

To pull out the internal mechanism from the housing, use a Phillips screwdriver matching the screw on the lower part of the front panel.

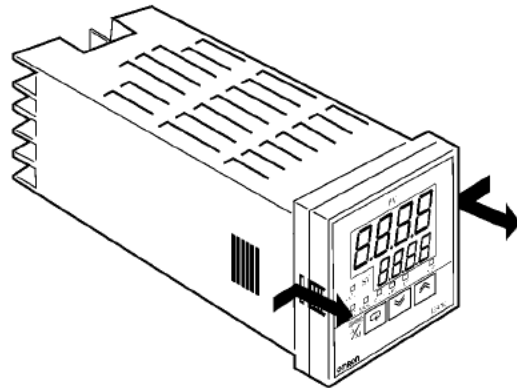
1. Turn the screw counterclockwise while pressing the hook on the upper part of the front panel.
2. Carefully pull out the internal mechanism while holding the left and right sides of the front panel.



E5CK



First, while pressing the hooks on the left and right sides of the front panel, pull the internal mechanism from the housing.



■ SETTINGS

Note: Always turn off the power supply to the Digital Controller before changing any switch settings.

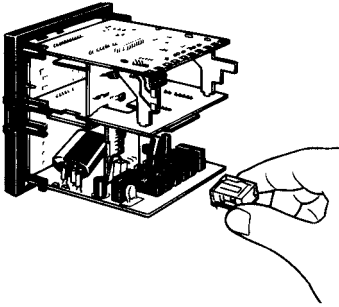
On a standard model, set up the Output Modules for control outputs 1 and 2 before mounting the Controller.

On a position-proportional model, the Relay Output Module is already set. Do not change that set-up parameter. Do not replace with other Output Modules.

Setting Up and Removing the Output Module

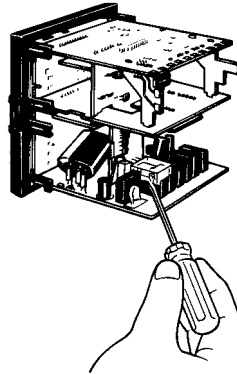
Setting Up the Output Module

When setting up the Output Modules, pull out the internal mechanism from the housing and insert the Output Modules into the sockets for control outputs 1 and 2.



Removing the Output Module

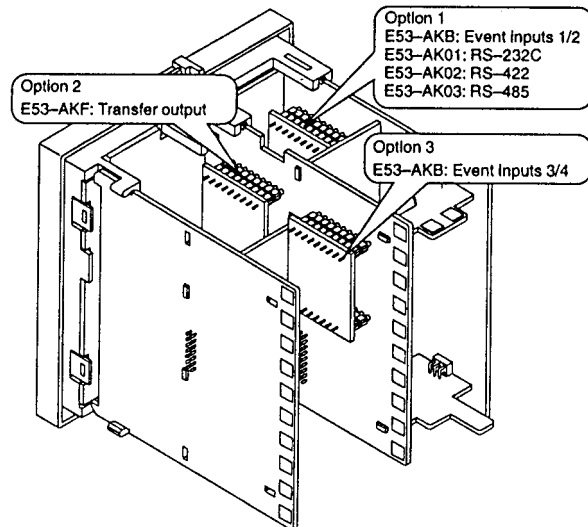
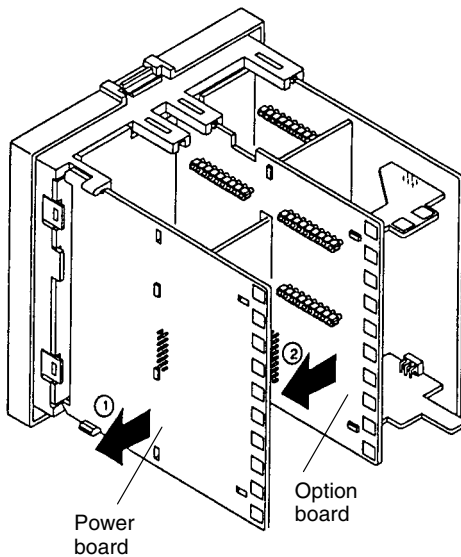
To replace the Output Module, use a flat-blade screwdriver to push up the Output Module.



Setting Up the Option/Output Board

E5AK

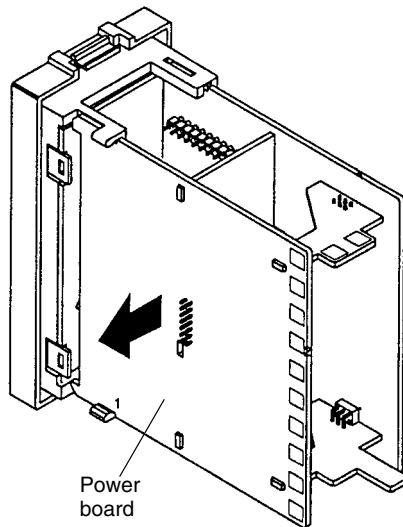
1. Remove the Power Board and Option Boards in the order shown in the following diagram.
2. Insert the Option Boards into the sockets for options 1 to 3. The following diagram shows the relationship between the Option Boards and mounting positions.



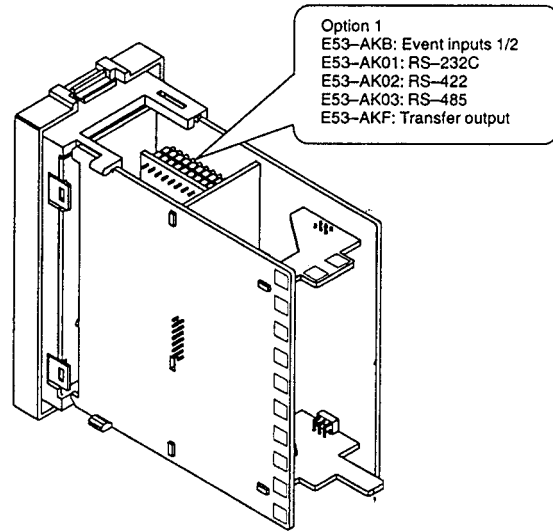
3. Mount the option boards and the power board in the order shown.

E5EK

1. Remove the Power Board in the order shown in the following diagram.



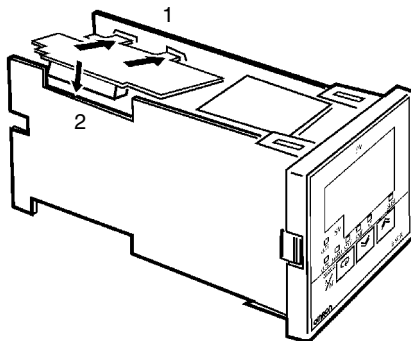
2. Insert the Option Board into the socket for option 1. The following diagram shows the relationship between the Option Board and mounting position.



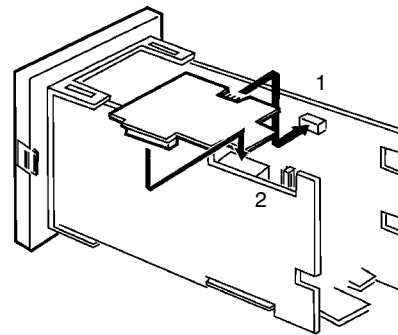
3. Mount the option boards and the power board in the order shown.

E5CK

1. Two rectangular holes are provided on the Power Board (right side of Controller). Fit the two protrusions of the output board into these two holes.
2. With the output board fitted into the Power Board, fit the output board into the connector on the control board (left side of Controller).

**Set up the Option Board**

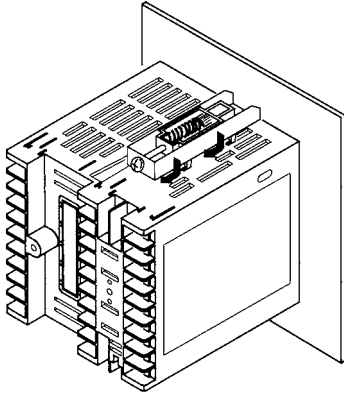
1. Place the bottom of the Controller facing up, fit the board horizontally into the connector on the power board (right side of controller).
2. With the Power Board connected, fit the board vertically into the connector on the control board (left side of Controller).



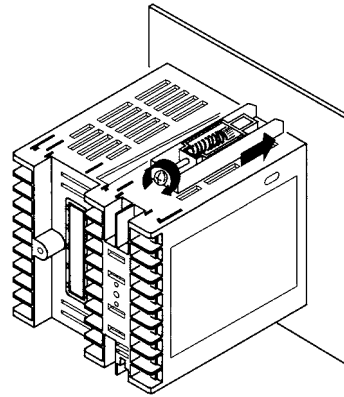
■ MOUNTING CONTROLLER

E5AK and E5EK

1. Insert the controller into the panel's mounting hole at the position shown in the figure below.
2. Fit the mounting bracket (accessory) into the mounting slots on the top and bottom of the rear case.

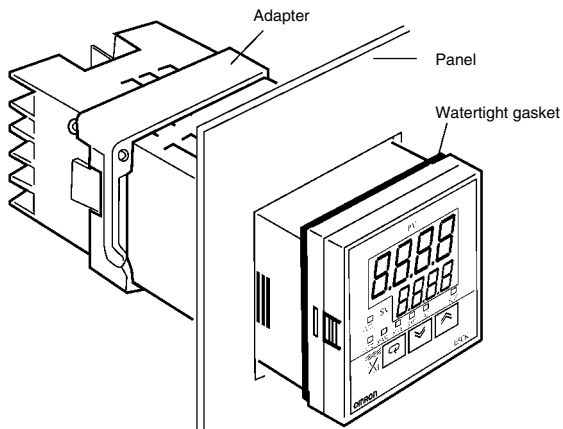


3. Tighten the mounting bracket screws on the upper and lower parts in small increments alternately and equally until the ratchet start to slide.



E5CK

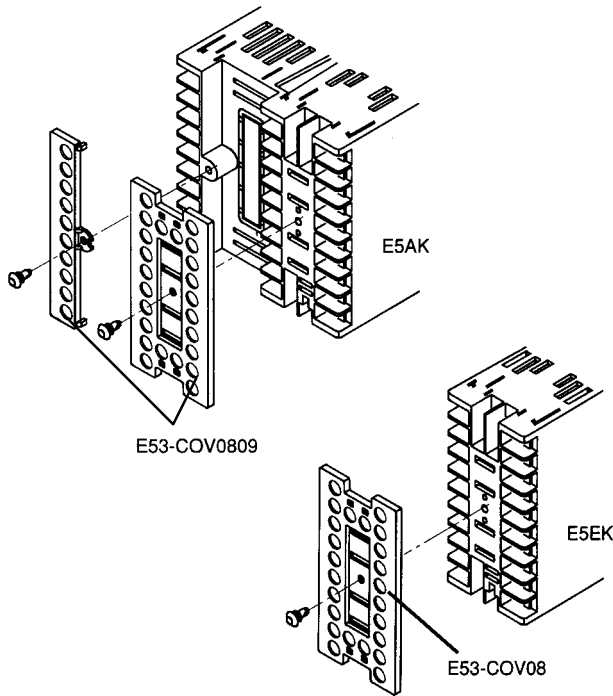
1. Insert the E5CK Controller into the cutout on the panel, as shown in the figure here.
2. Push the adapter along the Controller body from the terminals up to the panel, and fasten temporarily.
3. Tighten the two mounting screws on the adapter. When tightening screws, tighten the two screws alternately keeping the torque to approximately 0.29 to 0.39 N • m, or 3 to 4 kgf • cm.



■ MOUNTING TERMINAL COVER

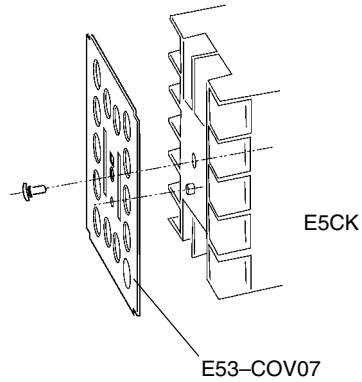
E5AK and E5EK

1. Fasten the terminals covers as follows by using the plastic pins. Plastic pins are provided with the terminal covers.



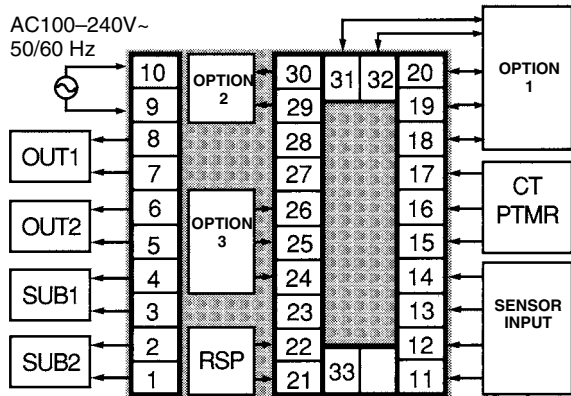
E5CK

1. The E5CK-AA1-500 Controller is provided with a Terminal Cover (E53-COV07). Fasten the Terminal Cover as follows by using the plastic pin.



■ WIRING TERMINALS FOR E5AK

E5AK Terminal Arrangement



TRSF: Transfer output
 EV1 to 4: Event input
 PTMR: Potentiometer
 RSP: Remote SP input

Wiring

In the following wiring diagrams, the left side of the terminal numbers indicate the inside of the Controller.

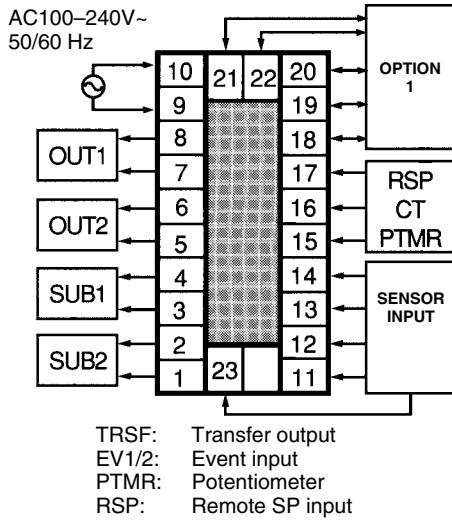
Power Supply

Input power to terminal numbers 9 and 10. Power specifications are as follows: 100 to 240 VAC, 50/60 Hz, approx. 16 VA

10		30	31	32	20
9		29			19
8		28			18
7		27			17
6		26			16
5		25			15
4		24			14
3		23			13
2		22			12
1		21	33		11

■ WIRING TERMINALS FOR E5EK

E5EK Terminal Arrangement



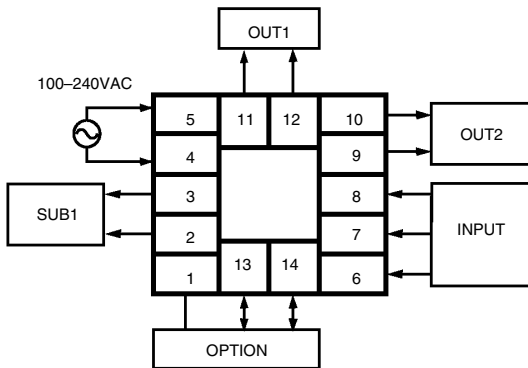
Power supply

Input power to terminal numbers 9 and 10. Power specifications are as follows: 100 to 240 VAC, 50/60 Hz, approx. 15 VA

10	21	22	20
9			19
8			18
7			17
6			16
5			15
4			14
3			13
2			12
1	23		11

■ WIRING TERMINALS FOR E5CK

E5CK Terminal Arrangement



Wiring Precautions

- To protect the Controller and its lines from external noise, use the wire ducts to separate input leads and power lines.
- Use solderless terminals when wiring the Controller.
- Tighten the terminal screws using a torque no greater than 0.78 N • m, or 8 kgf • cm max. DO NOT tighten the terminal screws too tightly.

Power Supply

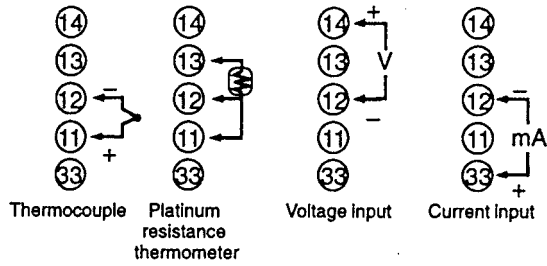
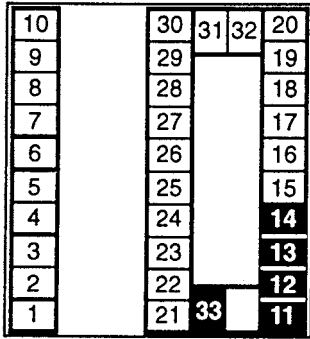
Input 100 to 240 VAC to terminal numbers 4 and 5.

5	11	12	10
4			9
3			8
2			7
1	13	14	6

■ SENSOR INPUT WIRING

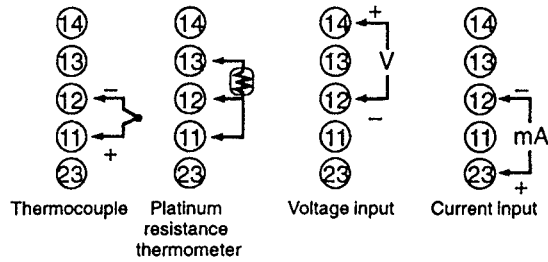
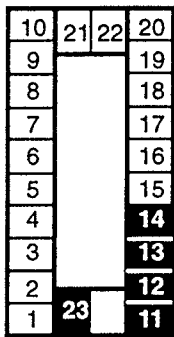
E5AK

Connect the sensor input to terminal numbers 11 to 14 and 33 as follows according to the input type.



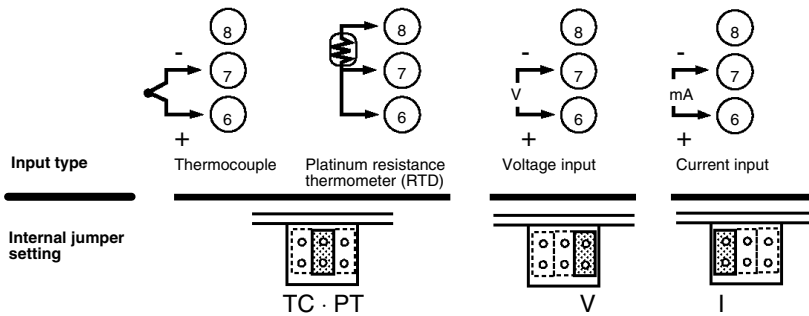
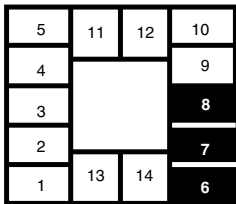
E5EK

Connect the sensor input to terminal numbers 11 to 14 and 23 as follows according to the input type.



E5CK

Connect the sensor input to terminal numbers 6 to 8 as indicated here, according to the input type.



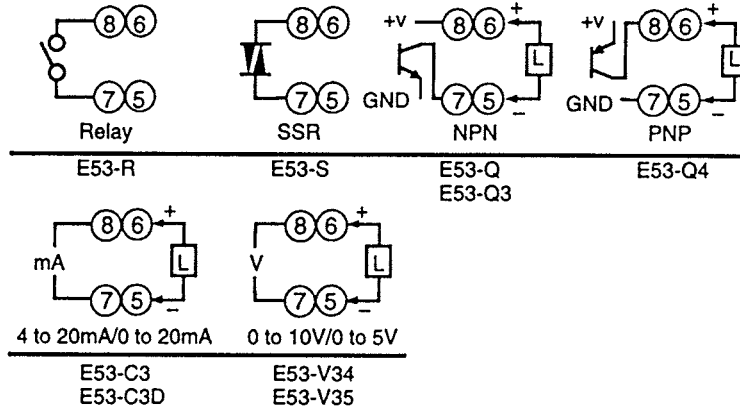
Match the inputs with the internal jumper settings for each input type. For thermocouple or platinum resistance thermometer inputs, set the internal jumper to a common position (TC/PT) as the temperature input.

CONTROL OUTPUT

E5AK Control Output

Terminal numbers 7 and 8 are for control output 1 (OUT1), and terminal numbers 5 and 6 are for control output 2 (OUT2). The following diagrams show the available Output Modules and their internal circuits.

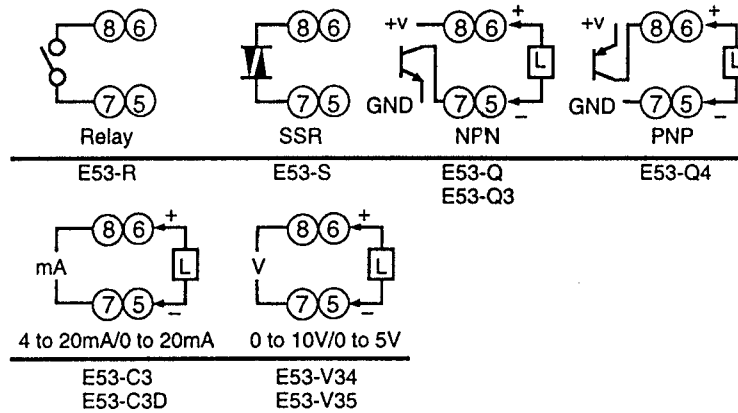
10		30	31	32	20
9		29			19
8		28			18
7		27			17
6		26			16
5		25			15
4		24			14
3		23			13
2		22			12
1		21	33		11



E5EK Control Output

Terminal numbers 7 and 8 are for control output 1 (OUT1), and terminal numbers 5 and 6 are for control output 2 (OUT2). The following diagrams show the available Output Modules and their internal circuits.

10	21	22	20
9			19
8			18
7			17
6			16
5			15
4			14
3			13
2			12
1	23		11

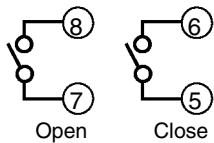


With E53-V□□ Output Modules, approx. 2 V is output for one second after the power is interrupted.

E5AK-PRR2/E5EK-PRR2 Controllers

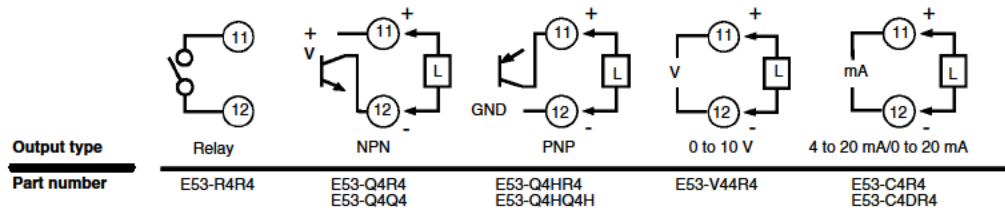
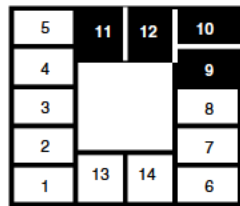
The E5AK-PRR2 and E5EK-PRR2 Controllers are supplied with relay output. This relay output is not compatible with any other module.

When replacing the Output Module, use the E53-R. The following diagrams show the relationship between terminals and open/close relay settings.

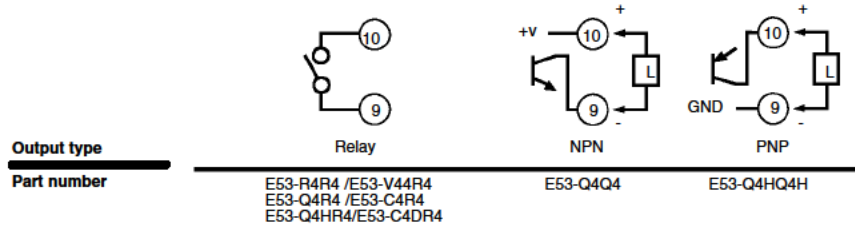


E5CK Control Output

Terminal numbers 11 and 12 are for control output 1 (OUT1). The five output types and internal circuits are available according to the Output Board.



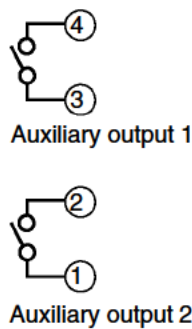
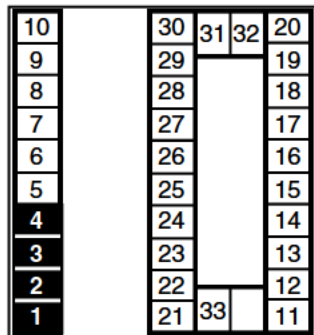
Terminal numbers 9 and 10 are for control output 2 (OUT2). The three output types and internal circuits are available according to the Output Board.



AUXILIARY OUTPUT

E5AK

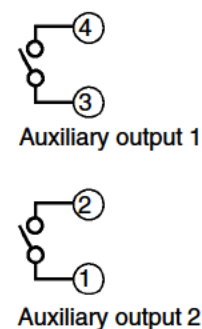
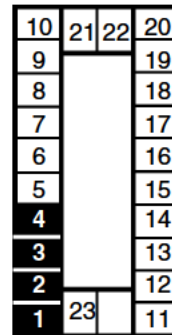
Terminal numbers 3 and 4 are for auxiliary output 1 (SUB1) and terminal numbers 1 and 2 are for auxiliary output 2 (SUB2). The following diagrams show the internal equalizing circuits for the auxiliary outputs:



Output specifications are as follows: SPST-NO, 3 A at 250 VAC

E5EK

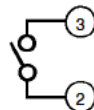
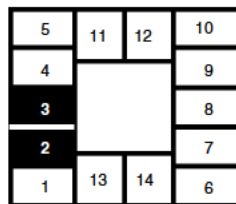
Terminal numbers 3 and 4 are for auxiliary output 1 (SUB1) and terminal numbers 1 and 2 are for auxiliary output 2 (SUB2). The following diagrams show the internal equalizing circuits for the auxiliary outputs:



Output specifications are as follows: SPST-NO, 3A at 250 VAC

E5CK

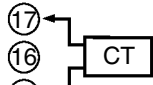
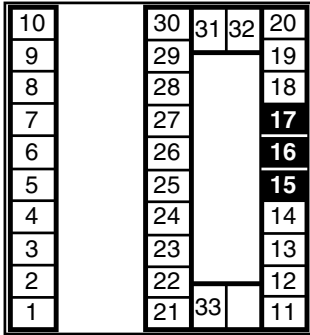
Terminal numbers 2 and 3 are for auxiliary output 1 (SUB1). The internal equalizing circuit for auxiliary output 1 is as follows:



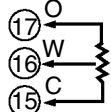
■ CT INPUT/POTENTIOMETER (FOR E5AK AND E5EK ONLY)

E5AK CT Input/Potentiometer

When using the HBA function on the E5AK-AA2 Controller, connect Current Transformer input (CT) to terminal numbers 15 to 17. When monitoring the valve opening on the E5AK-PRR2 Controller, connect the potentiometer (PTMR) to terminal numbers 15 to 17. Connect each of these inputs as follows:



CT input

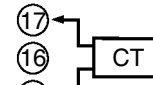
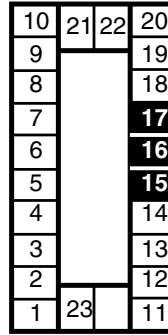


Potentiometer

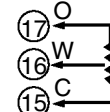
For details on CT inputs, refer to *Appendix, About Current Transformer* in your *User's Manual*. For details on the potentiometer, refer to the *Instruction Manual* for the valve connected to the Controller. The variable resistance range is 100 Ω to 2.5 kΩ.

E5EK CT Input/Potentiometer

When using the HBA function on the E5EK-AA2 Controller, connect Current Transformer input (CT) to terminal numbers 15 to 17. When monitoring the valve opening on the E5EK-PRR2 Controller, connect the potentiometer (PTMR) to terminal numbers 15 to 17. Connect each of these inputs as follows:



CT input



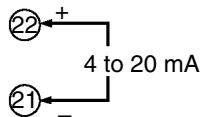
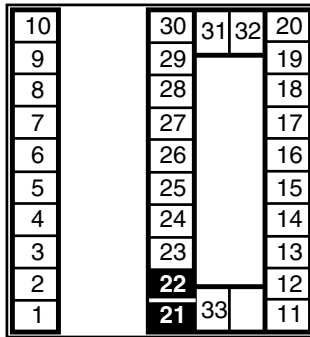
Potentiometer

For details on CT inputs, refer to *Appendix, About Current Transformer* in your *User's Manual*. The potentiometer cannot be used simultaneously with remote SP input. For details on the potentiometer, refer to the *Instruction Manual* for the valve connected to the Controller. The variable resistance range is 100 Ω to 2.5 kΩ.

■ REMOTE SET POINT INPUT (FOR E5AK AND E5EK ONLY)

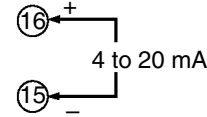
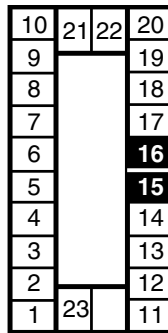
E5AK Remote SP Input

Connect the input (RSP) to be used as the remote SP to terminal numbers 21 and 22. Only 4 to 20 mA inputs can be connected. Connect the input as follows:



E5EK Remote SP Input

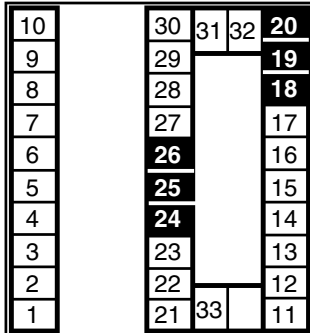
Connect the input (RSP) to be used as the remote SP to terminal numbers 15 and 16. However, note that the potentiometer cannot be used simultaneously with remote SP input. Only 4 to 20 mA inputs can be connected. Connect the input as follows:



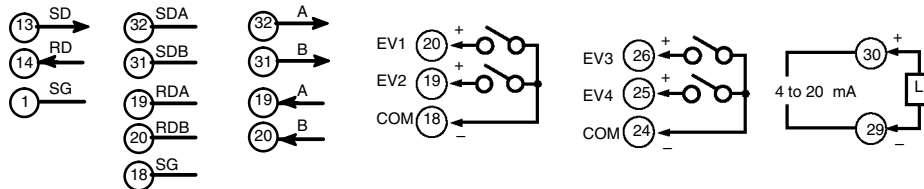
OPTION BOARD WIRING

E5AK

Connect event inputs 1 and 2 (EV1/2) to terminal numbers 18 to 20, and event events 3 and 4 (EV3/4) to terminal numbers 24 to 26. However, note that terminal numbers 18 to 20 cannot be used on Controllers with a communications function. Connect the event inputs as follows:



Terminals 18 and 24 (COM) are connected internally.



Option type	RS-232C	RS-422	RS-485	Event input 1 and 2 (no contact)	Event input 3 and 4 (no contact)	Transfer output
Part number	E53-AK01	E53-AK02	E53-AK03			

Use event inputs under the following conditions:

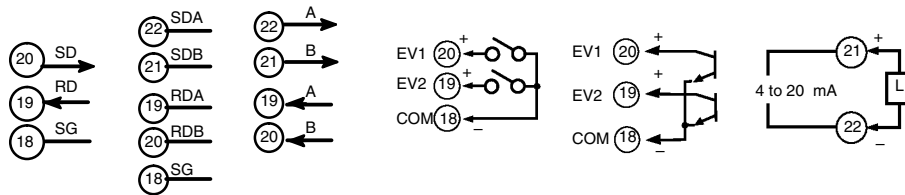
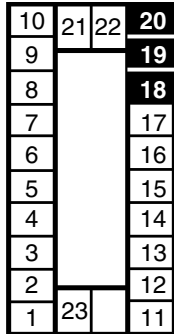
Contact input	ON: 1 k Ω max. OFF: 100 k Ω min.
No-contact input	ON: Residual voltage 1.5 V max., OFF: Leakage current 0.1 mA max.

Communications

Terminal numbers 18 to 20, 31 and 32 can be used only on Controllers with Communications Units (E53-AK01/02/03). For details on wiring, refer to *Chapter 6, Using the Communications Function* in your *User's Manual*.

E5EK

Connect event inputs 1 and 2 (EV1/2) to terminal numbers 18 to 20. However, note that terminal numbers 18 to 20 cannot be used on Controllers with a communications function. Connect the event inputs as follows:



Option type	RS-232C	RS-422	RS-485	Event input 1 and 2	Event input 1 and 2 (no contact)	Transfer output
Part number	E53-AK01	E53-AK02	E53-AK03			

Use event inputs under the following conditions:

Contact input	ON: 1 kΩ max., OFF: 100 kΩ min.
No-contact input	ON: Residual voltage 1.5 V max., OFF: Leakage current 0.1 mA max.

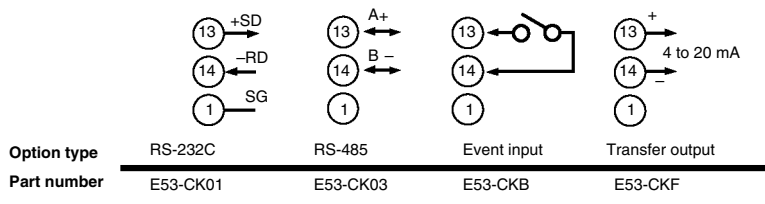
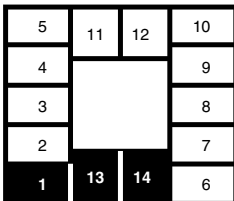
Communications

Terminal numbers 18 to 20, 31 and 32 can be used only on Controllers with Communications Units (E53-AK01/02/03). For details on wiring, refer to *Chapter 6, Using the Communications Function* in your *User's Manual*.

E5CK

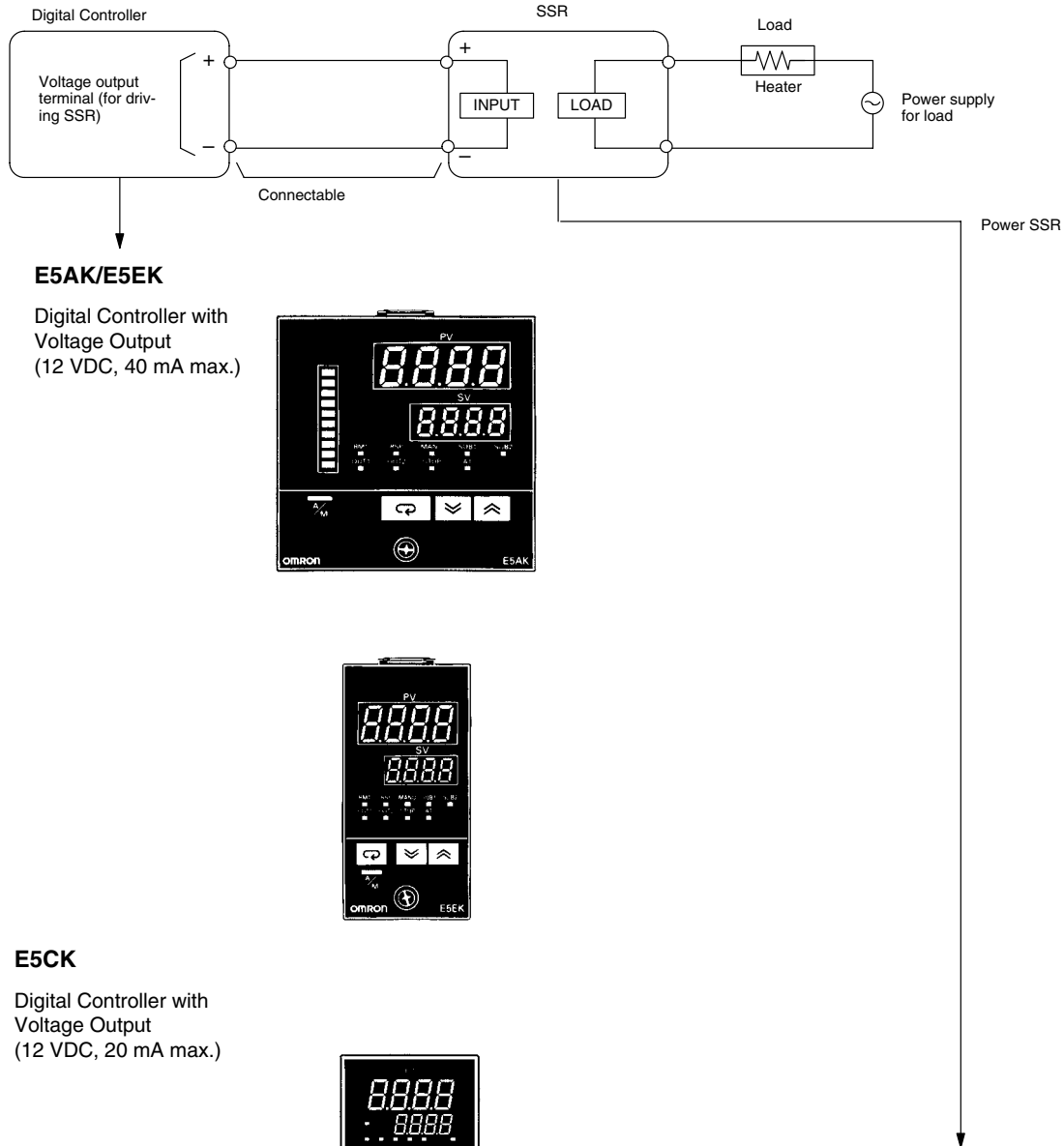
Terminal numbers 1, 13, and 14 are valid only when the Option Board is set in the Controller

The following four connections are possible depending on the model of the Option Board.



Option type	RS-232C	RS-485	Event input	Transfer output
Part number	E53-CK01	E53-CK03	E53-CKB	E53-CKF

■ CONNECTION EXAMPLE OF DIGITAL CONTROLLER AND SSR



See the Process and Temperature Controller Catalog GCTC11 for further information on External SSR.

Precautions

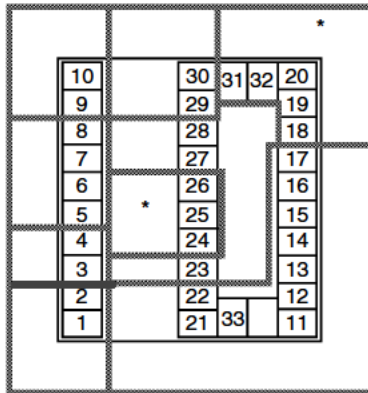
■ PRECAUTIONS WHEN WIRING

- Use wire ducts to separate input leads and power lines in order to protect the Controller and its lines from external noise.
- Solderless terminals are recommended when wiring the Controller.
- Tighten the terminal screws using a torque no greater than $0.78 \text{ N} \cdot \text{m}$, or $8 \text{ kgf} \cdot \text{cm}$ max. Take care not to tighten the terminal screws too tightly.

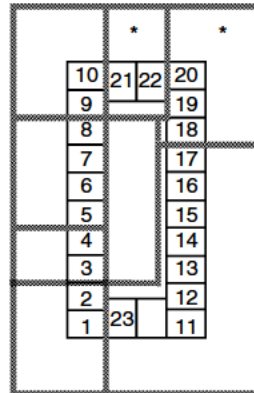
Power Blocks

The E5AK/E5EK has independent power supplies for each of the terminal blocks shown below.

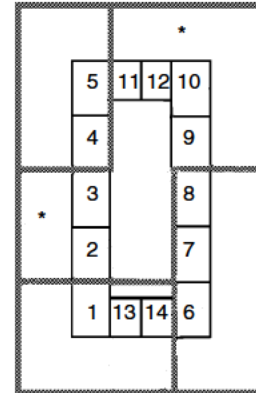
E5AK



E5EK



E5CK



* Uses same internal power supply

Note: Terminals 21 and 22 of the E5EK belong to the B block when a transfer output is set to option 1 and to the C block for other Option Boards.

■ OPERATING ENVIRONMENT

- Keep within the rated ambient operating temperature, ambient operating humidity, and storage temperature ranges.
- Use the Unit according to the vibration resistance, shock resistance, and enclosure ratings.
- Do not use the Unit in places with corrosive gas or excessive dust.
- Do not use the Unit near machines generating high-frequency noise.

■ CORRECT USE

Mounting

- The dimensions of the Digital Controller conform to DIN 43700.
- Recommended panel thickness is 1 to 8 mm.
- Mount the Unit horizontally.

Connection

- To reduce inductive noise influence, the lead wires connecting the input type to the Digital Controller must be separated from the power lines and load lines.
- Use the specified compensating conductors for thermocouples. Use lead wires having a small resistance for platinum resistance thermometers.

Connection Example

- Wire the terminals of the Unit using solderless terminals.
- The tightening torque applied to the terminal screws of the Unit must be approximately $0.78 \text{ N} \cdot \text{m}$ or $8 \text{ kgf} \cdot \text{cm}$.

Use the following type of solderless terminals for M3.5 screws.



■ OPERATION

- For models with alarm functions: The alarm outputs of a model with an alarm function may not turn ON properly when the model malfunctions. The use of alarm equipment with the model is recommended.
- The parameters and internal switch are set before shipping so that the Unit will function normally. Change the settings of the parameters and internal switch according to the application, if necessary.
- Several seconds are required until the relay is turned ON after power has been supplied to the Digital Controller. you must take this time delay into consideration when designing sequenced circuits which incorporate a Digital Controller.
- Do not use excessive force when pulling out the internal mechanism from the housing. Protect the internal connector or electronic parts of the Unit from shock. Protect against static discharge when changing the settings of the internal switch. Changing the settings on a grounded conductive mat is recommended.
- When connecting the Control Output Unit to the Temperature Controller or Digital Controller, make sure that the Control Output Unit is a suitable type. The use of an improper type of Control Output Unit may cause the system to malfunction.
- The heater burnout alarm will not be available if the Linear Output Unit is used.

Intelligent 1/16 DIN Temperature Controller

- Accepts thermocouple, platinum RTD, non-contact temperature sensor, and analog temperature inputs
- Auto-tuning and self-tuning available; functions can be used simultaneously
- Heating or heating/cooling control
- Event input option allows multiple set point selection and Run/Stop function
- Water-resistant construction (NEMA 4X, equivalent to IP66)
- Conforms to UL, CSA, and IEC safety standards as well as CE marking
- 3-year warranty



Ordering Information

■ TEMPERATURE CONTROLLERS

Optional communications and event input boards are shown on the following page.

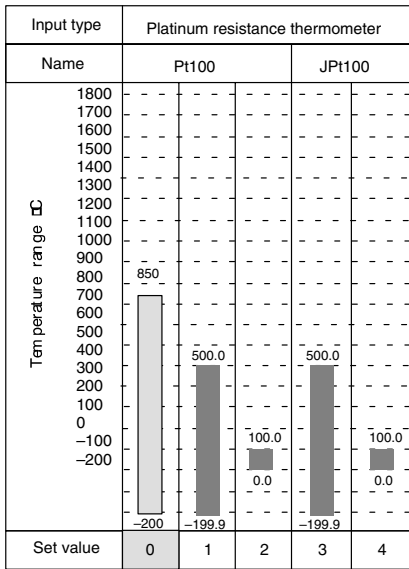
Size	Power supply voltage	Alarm points	Output	Part number	
				Thermocouple input	Platinum RTD input
1/16 DIN 48(W) x 48(H) x 78(D) mm	100 to 240 VAC	—	Relay	E5CN-RMTC-500 AC100-240	E5CN-RMP-500 AC100-240
			Voltage (for driving SSR)	E5CN-QMTC-500 AC100-240	E5CN-QMP-500 AC100-240
			Current	E5CN-CMTC-500 AC100-240	E5CN-CMP-500 AC100-240
		2	Relay	E5CN-R2MTC-500 AC100-240	E5CN-R2MP-500 AC100-240
			Voltage (for driving SSR)	E5CN-Q2MTC-500 AC100-240	E5CN-Q2MP-500 AC100-240
			Current	E5CN-C2MTC-500 AC100-240	E5CN-C2MP-500 AC100-240
	24 V AC/DC	—	Relay	E5CN-RMTC-500 AC/DC24	E5CN-RMP-500 AC/DC24
			Voltage (for driving SSR)	E5CN-QMTC-500 AC/DC24	E5CN-QMP-500 AC/DC24
			Current	E5CN-CMTC-500 AC/DC24	E5CN-CMP-500 AC/DC24
		2	Relay	E5CN-R2MTC-500 AC/DC24	E5CN-R2MP-500 AC/DC24
			Voltage (for driving SSR)	E5CN-Q2MTC-500 AC/DC24	E5CN-Q2MP-500 AC/DC24
			Current	E5CN-C2MTC-500 AC/DC24	E5CN-C2MP-500 AC/DC24

Note: When the heating and cooling function is available on models with two alarm points.

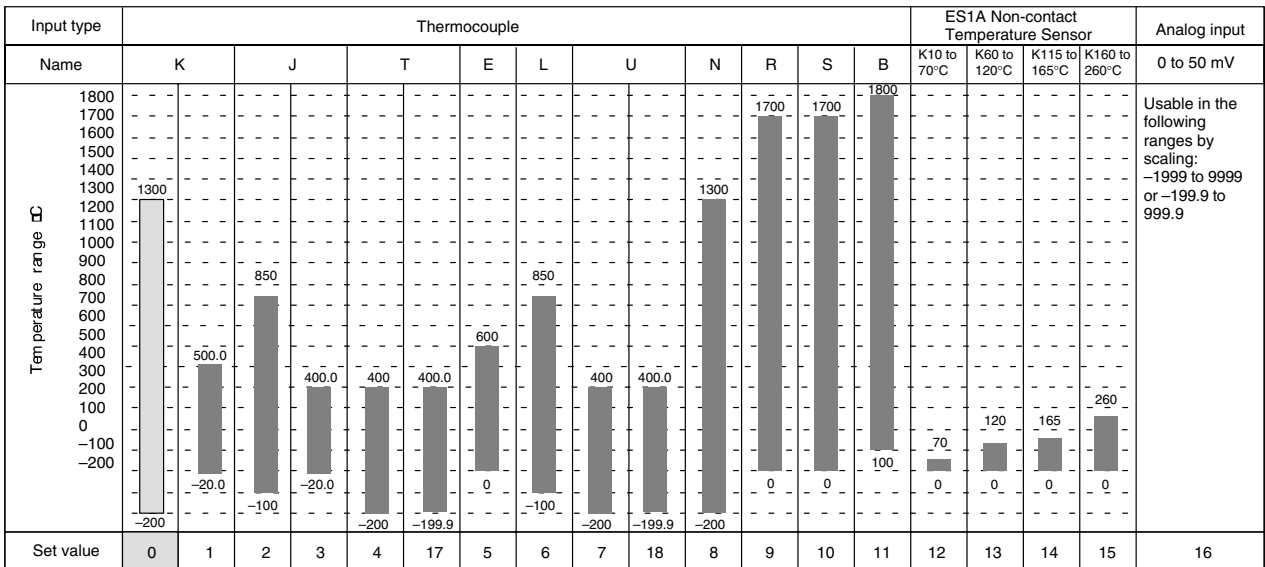
■ ACCESSORIES (ORDER SEPARATELY)

Description	Specifications	Part number
Computer communications boards	RS-485 and heater burnout alarm (for relay and voltage output models)	E53-CNH03
	RS-485 (for current output models)	E53-CN03
Event input board (for remote set point and run/stop functionality)	Event input and heater burnout alarm (for relay and voltage output models)	E53-CNHB
	Event input (for current output models)	E53-CNB
Current transformer; order only if using heater burnout alarm output	50 A load, 5.8 mm hole dia.	E54-CT1
	120 A load, 12 mm hole dia.	E54-CT3
Terminal cover (supplied with controller)	Provides finger protection from terminals (VDE0106 part 100)	E53-COV10
Software	For setup and monitoring; requires computer communications board	SYS-CONFIG V2.0

■ INPUT RANGES



Note: Lightly shaded ranges indicate default settings.



Applicable standards by input type are as follows:

- K, J, T, E, N, R, S, B: JIS C1602-1995
- L: Fe-CuNi, DIN 43710-1985
- U: Cu-CuNi, DIN 43710-1985
- JPt100: JIS C1604-1989, JIS C1606-1989
- Pt100: JIS C1604-1997, IEC751

Specifications

■ RATINGS

Supply voltage	100 to 240 VAC, 50/60 Hz	24 VAC, 50/60 Hz/24 VDC
Operating voltage range	85% to 110% of rated supply voltage	
Power consumption	7 VA	4 VA/3 W
Sensor input	Thermocouple: K, J, T, E, L, U, N, R, S, B Platinum resistance thermometer: Pt100, JPt100 Non-contact temperature sensor: 10 to 70°C, 60 to 120°C, 115 to 165°C, 160 to 260°C Voltage input: 0 to 50 mV	
Control output	Relay output	SPST-NO, 250 VAC, 3 A (resistive load), electrical life: 100,000 operations
	Voltage output	12 VDC $+15\%/-20\%$ (PNP), max. load current: 21 mA, with short-circuit protection circuit
	Current output	4 to 20 mA DC, load: 600 Ω max., resolution: approx. 2,600
Alarm output	SPST-NO, 250 VAC, 1 A (resistive load), electrical life: 100,000 operations	
Control method	PID or ON/OFF control	
Setting method	Digital setting using front panel keys	
Indication method	7-segment digital display and single-lighting indicator Character height: PV: 9.9 mm; SV: 6.4 mm	
Ambient operating temperature	-10°C to 55°C (14°F to 131°F) with no condensation or icing	
Storage temperature	-25°C to 65°C (-13°F to 149°F) with no condensation or icing	
Ambient humidity	25% to 85% RH	

■ CHARACTERISTICS

Indication accuracy	Thermocouple: $\pm 0.5\%$ of indicated value or $\pm 1^\circ\text{C}$, whichever greater, ± 1 digit max. (See Note) Platinum resistance thermometer: $\pm 0.5\%$ of indicated value or $\pm 1^\circ\text{C}$, whichever greater, ± 1 digit max. Analog input: $\pm 0.5\%$ FS ± 1 digit max. CT input: $\pm 5\%$ FS ± 1 digit max.
Hysteresis	0.1 to 999.9 EU (in units of 0.1 EU)
Proportional band (P)	0.1 to 999.9 EU (in units of 0.1 EU)
Integral time (I)	0 to 3999 s (in units of 1 s)
Derivative time (D)	0 to 3999 s (in units of 1 s)
Control period	1 to 99 s (in units of 1 s)
Manual reset value	0.0% to 100.0% (in units of 0.1%)
Alarm setting range	-1999 to 9999 (decimal point position depends on input type)
Sampling period	500 ms
Insulation resistance	20 M Ω min. at 500 VDC
Dielectric strength	2000 VAC, 50 or 60 Hz for 1 min between different charging terminals
Vibration resistance	10 to 55 Hz, 10 m/s ² for 2 hours each in X, Y and Z directions
Shock resistance	300 m/s ² , 3 times each in 3 axes, 6 directions (relay: 100 m/s ²)
Weight	Approx. 150 g; mounting bracket: Approx. 10 g
Protective structure	Front panel: NEMA 4X for indoor use (equivalent to IP66), rear case: IP20, terminals: IP00
Memory protection	EEPROM non-volatile memory (number of writes: 100,000)

Note: The indication of K thermocouples in the -200 to 1300°C range, and T and N thermocouples at a temperature of -100°C or less, and U and L thermocouples at any temperature is $\pm 2^\circ\text{C} \pm 1$ digit maximum. The indication of B thermocouples at a temperature of 400°C or less is unrestricted.

The indication of R and S thermocouples at a temperature of 200°C or less is $\pm 3^\circ\text{C} \pm 1$ digit maximum.

(This table continues on the next page.)

Specifications Table – continued from previous page

EMC	Emission Enclosure:	EN55011 Group 1 class A
	Emission AC Mains:	EN55011 Group 1 class A
	Immunity ESD:	EN61000-4-2: 4 kV contact discharge (level 2) 8 kV air discharge (level 3)
	Immunity RF-interference:	ENV50140: 10 V/m (amplitude modulated, 80 MHz to 1 GHz) (level 3) 10 V/m (pulse modulated, 900 MHz)
	Immunity Conducted Disturbance:	ENV50141: 10 V (0.15 to 80 MHz) (level 3)
	Immunity Burst:	EN61000-4-4: 2 kV power-line (level 3) 2 kV I/O signal-line (level 4)
Approved standards	UL3121-1, CSA22.2 No. 14, E.B.1402C Conforms to EN50081-2, EN50082-2, EN61010-1 (IEC61010-1) Conforms to VDE0106/part 100 (Finger Protection) when the terminal cover is mounted.	

■ COMMUNICATIONS SPECIFICATIONS

Transmission path connection	Multiple points
Communications method (See Note)	RS-485 (two-wire, half duplex)
Synchronization method	Start-stop synchronization
Baud rate	1,200/2,400/4,800/9,600/19,200 bps
Transmission code	ASCII
Data bit length (See Note)	7 or 8 bits
Stop bit length (See Note)	1 or 2 bits
Error detection	Vertical parity (none, even, odd) Frame check sequence (FCS): with SYSMAC WAY Block check character (BCC): with CompoWay/F
Flow control	Not available
Interface (See Note 1)	RS-485
Retry function	Not available
Communications buffer	40 bytes

Note: The baud rate, data bit length, stop bit length, or vertical parity can be individually set using the communications setting level.

■ CURRENT TRANSFORMER RATINGS

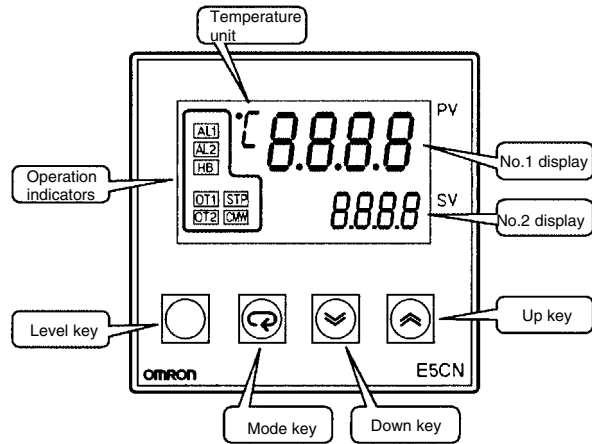
Part number	E54-CT1	E54-CT3
Max. continuous heater current	50 amps	120 amps
Dielectric strength	1,000 VAC (for 1 min)	
Vibration resistance	50 Hz, 98 m/s ² (10G)	
Weight	Approx. 11.5 g	Approx. 50 g
Accessories	—	Armature: 2; Plug: 2

■ HEATER BURNOUT ALARM

Max. heater current	Single-phase 50 A VAC (See Note 1)
Heater current value display accuracy	±5% FS±1 digit max.
Heater burnout alarm setting range	0.1 to 49.9 A (in units of 0.1 A) (See Note 2)
Min. detection ON time	190 ms (See Note 3)

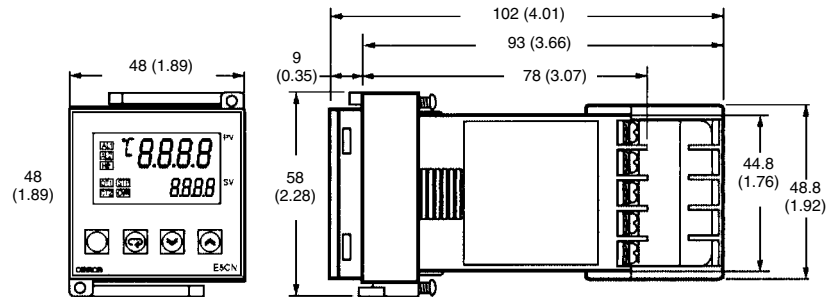
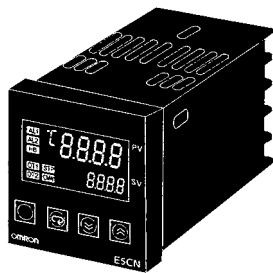
- Note: 1. Use the K2CU-F□□A-□GS (with gate input terminals) for the detection of three-phase heater burnout.
 2. The heater burnout alarm is always OFF if the alarm is set to 0.0 A and always ON if the alarm is set to 50.0 A.
 3. No heater burnout detection or heater current value measurement is possible if the control output (heat) is ON for less than 190 ms.

Nomenclature

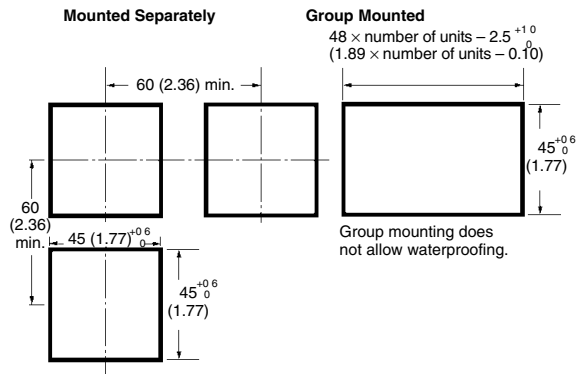


Dimensions

Unit: mm (inch)



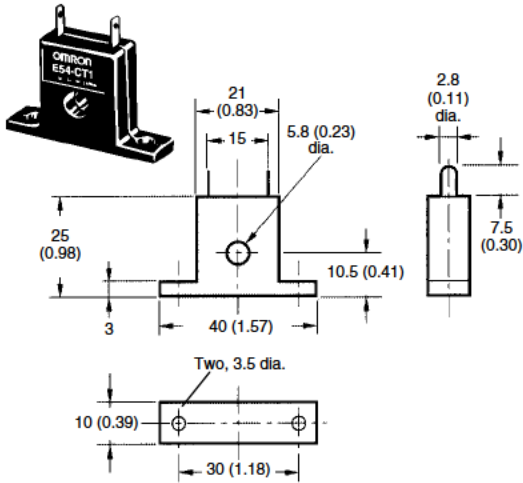
Panel Cutouts



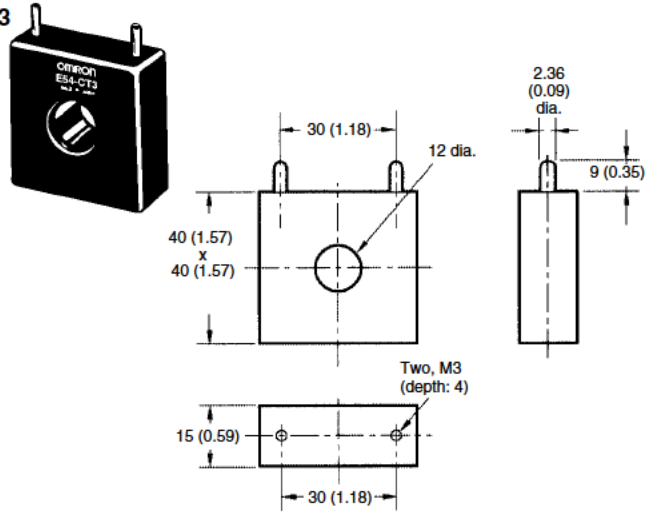
- Recommended panel thickness is 1 to 5 mm (0.04 to 0.20 inch).
- Group mounting is not possible in the vertical direction. (Maintain the specified mounting space between Controllers when they are group mounted.)
- To mount the E5CN so that it is waterproof, apply the waterproof packing to the E5CN.
- When two or more E5CNs are mounted, make sure that the surrounding temperature does not exceed the allowable operating temperature range in the specifications.

■ CURRENT TRANSFORMER (SOLD SEPARATELY)

E54-CT1

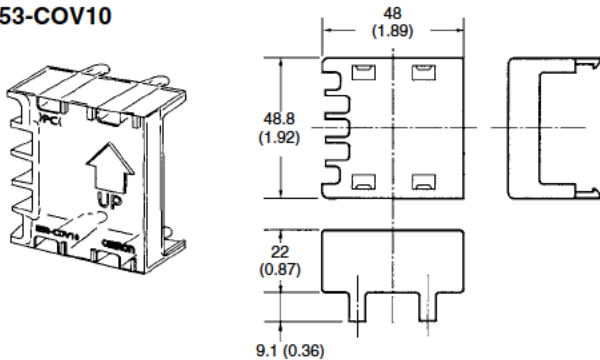


E54-CT3



■ TERMINAL COVER

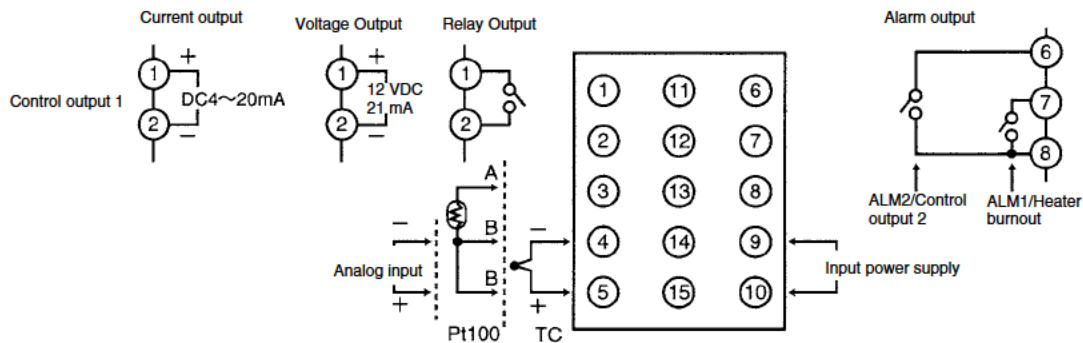
E53-COV10



Wiring Terminals

The voltage output (control output) is not electrically isolated from the internal circuits. When using a grounded thermocouple, do not connect the control output terminals to ground. If the control output terminals are connected to the ground, errors will occur in the measured temperature values as a result of leakage current.

Standard insulation is applied to the power supply I/O sections. If reinforced insulation is required, connect the input and output terminals to a device without any exposed current-carrying parts or to a device with standard insulation suitable for the maximum operating voltage of the power supply I/O section.

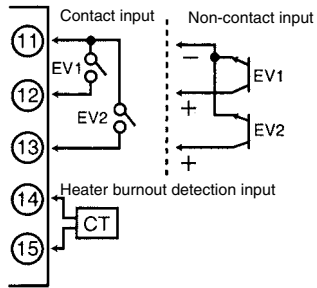


Two input power supplies are available: 100 to 240 VAC or 24 VDC.

■ E5CN ACCESSORY BOARDS

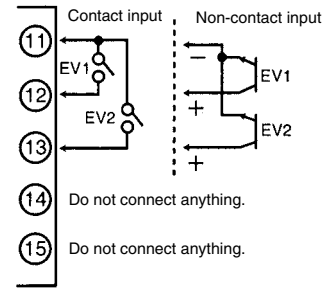
E53-CNHB Event Input/Heater Burnout Alarm Unit

Event Input/Heater Burnout Detection



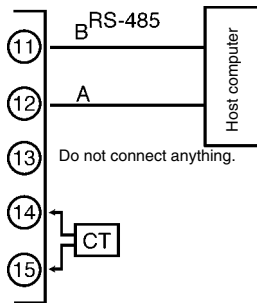
E53-CNB Event Input

Event Input



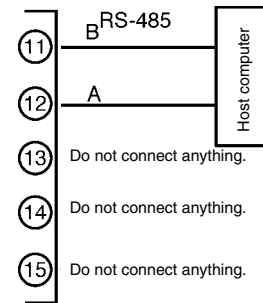
E53-CNH03 Communications/Heater Burnout Alarm Unit

Communications Specification/Heater Burnout Specification



E53-CN03 Communications Unit

Communications Specification



RM7895A,B,C,D/EC7895A,C; RM7896A,B,C,D 7800 SERIES Relay Modules

INSTALLATION INSTRUCTIONS

APPLICATION

The RM7895A,B,C,D/EC7895A,C; RM7896A,B,C,D are microprocessor-based integrated burner controls for automatically fired gas, oil, or combination fuel single burner applications. They are intended to replace the R4795 and R7795 Primary Controls. The RM7895A,B,C,D/EC7895A; RM7896A,B,C,D systems consist of a relay module, subbase, amplifier, and purge card. Options include keyboard display module (KDM), Personal Computer Interface, Data ControlBus Module™, remote display mounting, expanded annunciator and Combustion System Manager® Software.

Functions provided by the RM7895A,B,C,D/EC7895A,C; RM7896A,B,C,D include automatic burner sequencing, flame supervision, system status indication, system or self-diagnostics and troubleshooting. The RM7896 provides a postpurge function.

This document provides installation and static checkout instructions. Other applicable publications are:

Publication No.	Product
63-2278	Q7700 Network Interface Unit Product Data
65-0084	Q7800A,B 22-Terminal Wiring Subbase Product Data
65-0090	S7800A Keyboard Display Module Product Data
65-0091	S7810A Data ControlBus Module™ Product Data
65-0095	S7820 Remote Reset Module Product Data
65-0097	221729C Dust Cover Packing Instructions
65-0101	S7830 Expanded Annunciator Product Data
65-0102	ZM7850A Combustion System Manager™ Operating Instructions
65-0109	R7824, R7847, R7848, R7849, R7851, R7861, R7886 Flame Amplifiers for the 7800 Series Product Data
65-0131	221818A Extension Cable Assembly Product Data
65-0229	7800 SERIES Relay Modules Checkout and Troubleshooting Product Data.
65-0092	QS7800A ControlBus™ Module, Standard
65-0227	QS7800B ControlBus™ Module, Multidrop

SPECIFICATIONS

Electrical Ratings (See Table 3):

Voltage and Frequency:
 RM7895/RM7896: 120 Vac (+10/-15%), 50/60 Hz (± 10%).
 EC7895A,C: 220/240 Vac (+10%/-15%), 50/60 Hz (±10%)
 Power Dissipation: 10W maximum.
 Maximum Total Connected Load: 2000 VA.
 Fusing Total Connected Load: 20A maximum, type FRN or equivalent.

Environmental Ratings:

Ambient Temperature:
 Operating: -40°F to 140°F (-40°C to +60°C).
 Storage: -40°F to 150°F (-40°C to +66°C).
 Humidity: 85% relative humidity continuous, noncondensing.
 Vibration: 0.5G environment.

Approvals:

RM7895/RM7896:
 Underwriters Laboratories Inc. Listed: File No. MP268, Guide No. MCCZ.
 Canadian Standards Association Certified: LR9S329-3.
 Factory Mutual Approved: Report No. J.I.1V9A0.AF.
 IRI Acceptable.
 Federal Communications Commission: Part 15, Class B, Emissions.
 EC7895A,C:
 Factory Mutual Approved.

INSTALLATION

When Installing this Product...

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and marked on the product to make sure the product is suitable for the application.
3. Installer must be a trained, experienced, flame safe-guard service technician.
4. After installation is complete, check out the product operation as provided in these instructions.



WARNING

Fire or Explosion Hazard.

Can cause property damage, severe injury, or death.

Follow applicable safety requirements when installing a control on a burner to prevent death or severe injury.

WARNING

Electrical Shock Hazard.

Can cause serious injury, death or equipment damage .

Disconnect power supply before beginning installation.

IMPORTANT

1. *Wiring connections for the relay modules are unique; refer to Fig. 2 and 3 or the appropriate Specifications for proper subbase wiring.*
2. *Wiring must comply with all applicable codes, ordinances and regulations.*
3. *Wiring must comply with NEC Class 1 (Line Voltage) wiring.*
4. *Loads connected to the RM7895A,B,C,D/EC7895A,C; RM7896A,B,C,D must not exceed those listed on the RM7895A,B,C,D/EC7895A,C; RM7896A,B,C,D label or the Specifications; see Table 1.*
5. *Limits and interlocks must be rated to simultaneously carry and break current to the ignition transformer, pilot valve, and main fuel valve(s).*
6. *All external timers must be listed or component-recognized by authorities who have proper jurisdiction.*
7. *For on-off gas-fired systems, some authorities who have jurisdiction prohibit the wiring of any limit or operating contacts in series between the flame safeguard control and the main fuel valve(s).*
8. *Two flame detectors can be connected in parallel with the exception of Infrared Flame Detectors (C7015).*
9. *This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, can cause interference with radio communications. It has been tested and found to comply with the limits for a Class B computing device of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area may cause interference, in which case, the users, at their own expense, may be required to take whatever measures are required to correct this interference.*
10. *This digital apparatus does not exceed the Class B limits for radio noise for digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.*

Location

Humidity

Install the relay module where the relative humidity never reaches the saturation point. The relay module is designed to operate in a maximum 85% relative humidity continuous, noncondensing, moisture environment. Condensing moisture can cause a safety shutdown.

Vibration

Do not install the relay module where it can be subjected to vibration in excess of 0.5G continuous maximum vibration.

Weather

The relay module is not designed to be weather tight. When installed outdoors, protect the relay module in an approved weather-tight enclosure.

Mounting Wiring Subbase

1. Mount the subbase in any position except horizontally with the bifurcated contacts pointing down. The standard vertical position is recommended. Any other position decreases the maximum ambient temperature rating.
2. Select a location on a wall, burner or electrical panel. The Q7800 can be mounted directly in the control cabinet. Be sure to allow adequate clearance for service, installation, access or removal of the RM7895A,B,C,D/EC7895A,C; RM7896A,B,C,D, expanded annunciator, keyboard display module, flame amplifier, flame amplifier signal voltage probes, run/test switch, electrical signal voltage probes and electrical field connections.
3. For surface mounting, use the back of the subbase as a template to mark the four screw locations. Then drill the pilot holes.
4. Securely mount the subbase using four no. 6 screws (not provided).

Wiring Subbase

⚠ WARNING

Electrical Shock Hazard.
 Can cause serious injury, death or equipment damage.
 Disconnect the power supply before beginning installation.

The internal block diagram of the RM7895A,B,C,D/EC7895A,C;RM7896A,B,C,D is shown in Fig. 1.

1. For proper subbase wiring and sequence chart, refer to Fig. 2 and 3.
2. For remote wiring of the Keyboard Display Module, refer to the Specifications for the Keyboard Display Module (65-0090), Network Interface Unit (63-2278), Data ControlBus Module™ (65-0091) or Extension Cable Assembly (65-0131).
3. Disconnect the power supply from the main disconnect before beginning installation to prevent electrical shock and equipment damage. More than one disconnect can be required.
4. All wiring must comply with all applicable electrical codes, ordinances and regulations. Wiring, where required, must comply with NEC, Class 1 (Line Voltage) wiring.
5. For recommended wire size and type, see Table 1.
6. For recommended grounding practices, see Table 2.

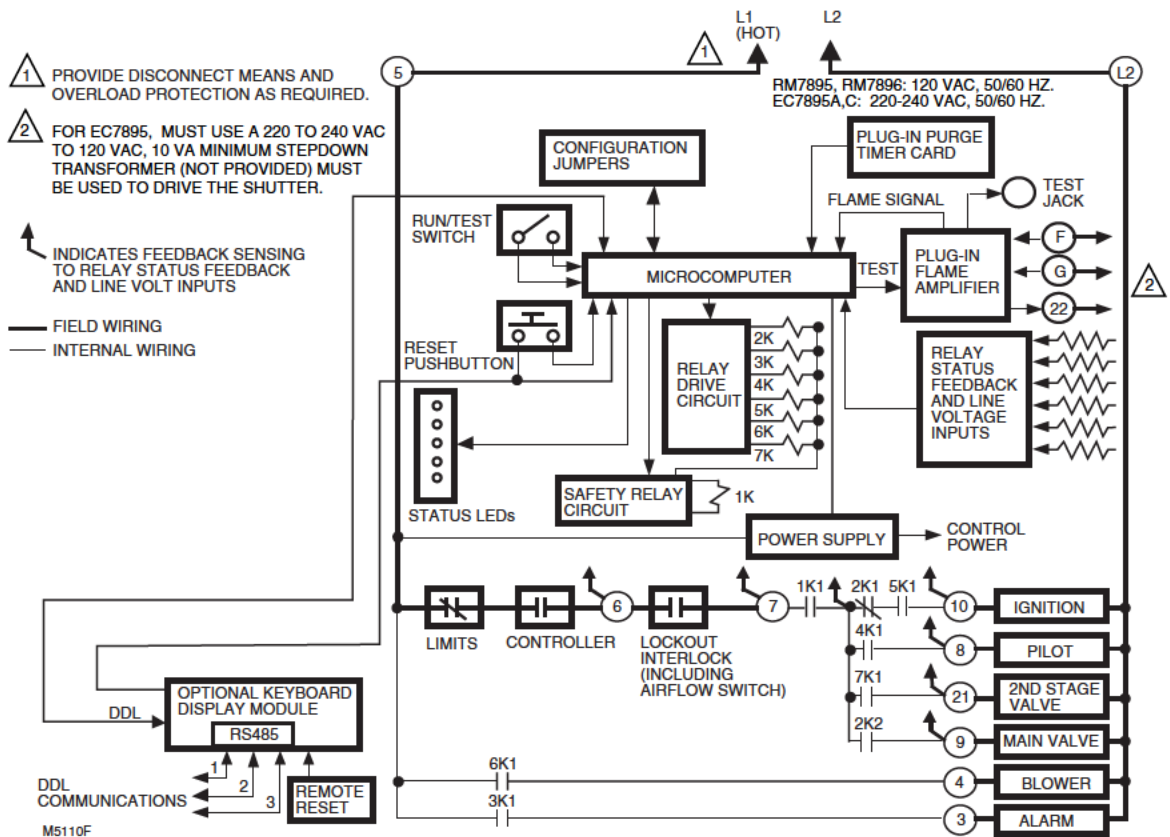
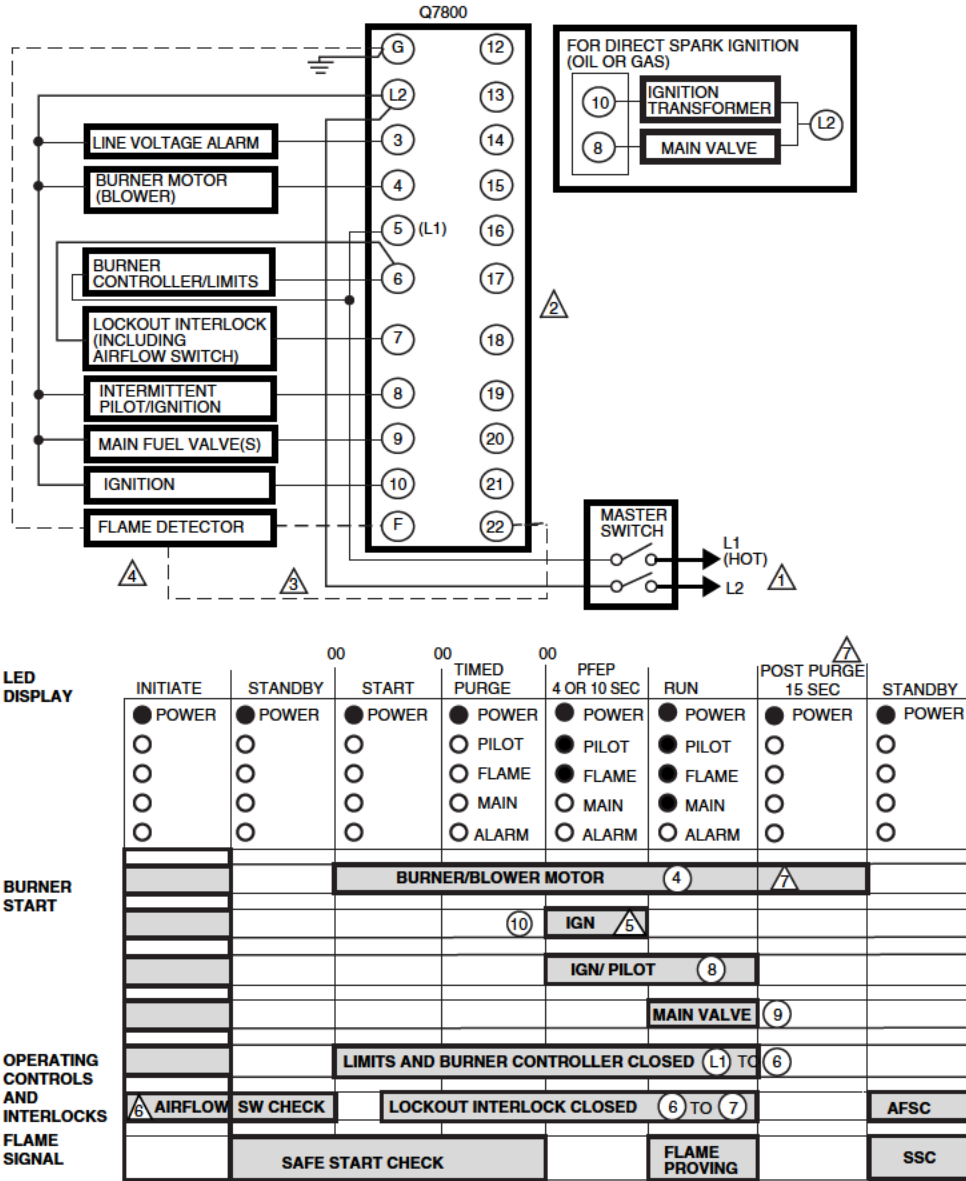


Fig. 1. Internal block diagram of RM7895A,B,C,D/EC7895A,C; RM7896A,B,C,D (see Fig. 2 and 3 for detailed wiring instructions).



△ RM7895, RM7896: 120 VAC, 50/60 HZ; EC7895: 220-240 VAC, 50/60 HZ POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

△ DO NOT CONNECT ANY WIRES TO UNUSED TERMINALS.

△ FOR EC7895, A 220 TO 240 VAC TO 120 VAC, 10 VA MINIMUM STEPDOWN TRANSFORMER (NOT PROVIDED) MUST BE USED TO DRIVE THE SHUTTER.

△ SEE FLAME DETECTOR SPECIFICATIONS FOR CORRECT WIRING.

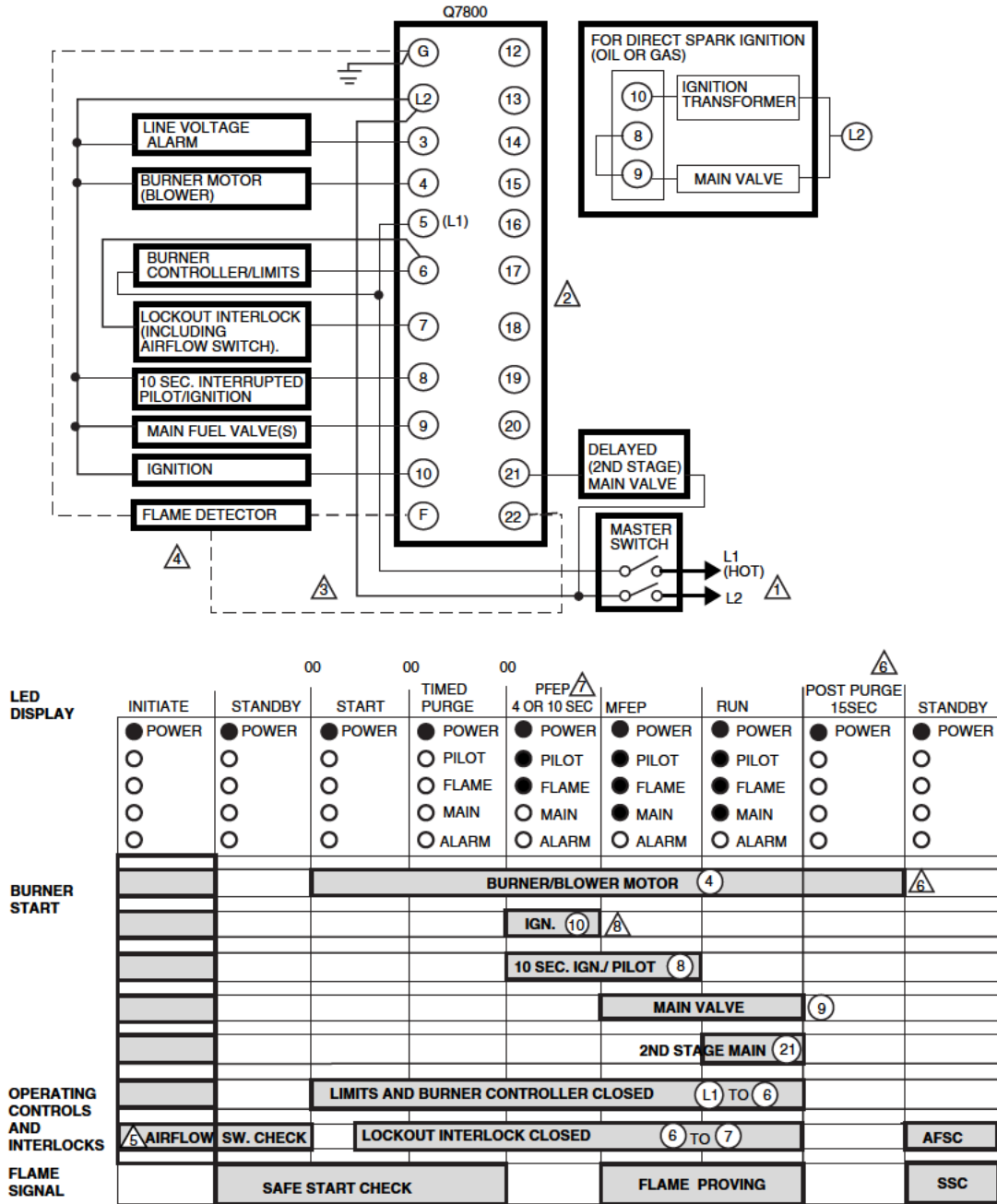
△ FOR RM7895A1048 (ONLY), IGNITION TERMINAL 10 IS DE-ENERGIZED WHEN FLAME IS PROVEN.

△ AIRFLOW SWITCH CHECK FEATURE IS FOR THE RM7895B, RM7896B.

△ RM7896A, B ONLY.

M15123A

Fig. 2. Wiring subbase and sequence chart for RM7895A,B/EC7895A; RM7896A,B.



△1 RM7895, RM7896: 120 VAC, 50/60 HZ; EC7895: 220-240 VAC, 50/60 HZ POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

△2 DO NOT CONNECT ANY WIRES TO UNUSED TERMINALS.

△3 FOR EC7895, A 220 TO 240 VAC TO 120 VAC, 10 VA MINIMUM STEPDOWN TRANSFORMER (NOT PROVIDED) MUST BE USED TO DRIVE THE SHUTTER.

△4 SEE FLAME DETECTOR SPECIFICATIONS FOR CORRECT WIRING.

△5 AIRFLOW SWITCH CHECK FEATURE IS FOR THE RM7895D, RM7896D.

△6 RM7896C,D ONLY.

△7 RM7895C1020, RM7896C1036 PFEP 10 SECONDS ONLY.

△8 RM7895C1020, RM7896C1036: DURING FIRST 8 SECONDS OF PFEP, WHEN A FLAME SIGNAL IS DETECTED, TERMINAL 10 IS DE-ENERGIZED. IF FLAME SIGNAL IS LOST, TERMINAL 10 WILL RE-ENERGIZE.

M15124GR

Fig. 3. Wiring subbase and sequence chart for RM7895C,D/EC7895C,D; RM7896C,D.

Table 1. Recommended Wire Sizes and Part Numbers.

Application	Recommended Wire Size	Recommended Part Numbers
Line voltage terminals.	14, 16 or 18 AWG copper conductor, 600 volt insulation, moisture-resistant wire.	TTW60C, THW75C, THHN90C.
Keyboard Display Module	22 AWG two-wire twisted pair with ground, or five-wire.	Belden 8723 shielded cable or equivalent.
Data ControlBus™ Module ^a	22 AWG two-wire twisted pair with ground, or five-wire.	Belden 8723 shielded cable or equivalent.
Remote Reset Module	22 AWG two-wire twisted pair, insulated for low voltage.	—
Communications Interface ControlBus™ Module ^a	22 AWG two-wire twisted pair with ground.	Belden 8723 shielded cable or equivalent.
13 Vdc full-wave rectified transformer power input.	18 AWG wire insulated for voltages and temperatures for given application.	TTW60C, THW75C, THHN90C.

^a The KDM, Data ControlBus™ Module (for remote mounting or communications) or Communication Interface ControlBus™ Module must be wired in daisy chain configuration, 1(a)-1(a), 2(b)-2(b), 3(c)-3(c). The order of interconnection of all the devices listed above is not important. Be aware that modules on the closest and farthest end of the daisy chain configuration string require a 120 ohm (1/4 watt minimum) resistor termination across terminals 1 and 2 of the electrical connectors for connections over 100 feet (31 meters).

Table 2. Recommended Grounding Practices.

Ground Type	Recommended Practice
Earth ground (subbase and relay module).	<ol style="list-style-type: none"> 1. Use to provide a connection between the subbase and the control panel of the equipment. Earth ground must be capable of conducting enough current to blow the 20A fuse (or breaker) in the event of an internal short circuit. 2. Use wide straps or brackets to provide minimum length, maximum surface area ground conductors. If a leadwire is required, use 14 AWG copper wire. 3. Make sure that mechanically tightened joints along the ground path are free of nonconductive coatings and protected against corrosion on mating surfaces.
Signal ground (Keyboard Display Module, Data ControlBus™ Module, Communications Interface ControlBus™ Module).	Use the shield of the signal wire to ground the device to the signal ground terminal 3(c) of each device. Connect the shield at both ends of the daisy chain to earth ground.

7. Recommended wire routing of leadwires:
 - a. Do not run high voltage ignition transformer wires in the same conduit with the flame detector, Data ControlBus Module™, or Remote Reset Module wiring.
 - b. Do not route flame detector, Data ControlBus Module™, or Remote Reset Module leadwires in conduit with line voltage circuits.
 - c. Enclose flame detector leadwires without armor cable in metal cable or conduit.
 - d. Follow directions in flame detector, Data ControlBus Module™, or Remote Reset Module Instructions.
8. The KDM is powered from a low voltage, energy limited source. It can be mounted outside of a control panel if it is protected from mechanical damage.
 - a. Remote Reset leadwires: The maximum length of wire is 1000 feet (305 meters) to a Remote Reset pushbutton.
 - b. Data ControlBus Module™: The maximum Data ControlBus Module™ cable length depends on the number of system modules connected, the noise conditions and the cable used. The maximum length of all Data ControlBus Module™ interconnecting wire is 4000 feet (1219 meters).
10. Be sure loads do not exceed the terminal ratings. Refer to the label on the RM7895A,B,C,D/EC7895A,C; RM7896A,B,C,D or to the terminal ratings in Table 3.

Final Wiring Check

1. Check the power supply circuit. The voltage and frequency tolerance must match those of the RM7895A,B,C,D/EC7895A,C; RM7896A,B,C,D. A separate power supply circuit can be required for the RM7895A,B,C,D/EC7895A,C; RM7896A,B,C,D. Add the required disconnect means and overload protection.
2. Check all wiring circuits and complete Static Checkout in Table 4 before installing the RM7895A,B,C,D/EC7895A,C; RM7896A,B,C,D on the subbase.
3. Install all electrical connectors.
4. Restore power to the panel.

NOTE: A 13 Vdc power supply must be used any time more than one KDM is used.

9. Maximum wire lengths:
 - a. RM7895A,B,C,D/EC7895A,C; RM7896A,B,C,D leadwires: The maximum leadwire length is 300 feet to terminal inputs (Control, Running/Lockout Interlock).
 - b. Flame Detector leadwires: The maximum flame sensor leadwire length is limited by the flame signal strength.

Table 3. Terminal Ratings.

Terminal Number	Description	Ratings	
		RM7895/RM7896	EC7895
G	Flame Sensor Ground	—	—
Earth G	Earth Ground ^a	—	—
L2(N)	Line Voltage Common	—	—
3	Alarm	120 Vac, 1A pilot duty.	220-240 Vac, 1A pilot duty.
4	Burner Motor	120 Vac, 9.8A AFL, 58.8 ALR (inrush).	220-240 Vac, 4A at PF = 0.5, 20A inrush.
5	Line Voltage Supply (L1)	120 Vac (+10/-15%), 50 or 60 Hz (±10%). ^b	220-240 Vac (+10/-15%), 50 or 60 Hz (±10%).
6	Burner Controller and Limits	120 Vac, 1 mA.	220-240 Vac, 1 mA.
7	Lockout Interlock	120 Vac, 8A run, 43A inrush.	8A at PF = 0.5, 40A inrush, 2A at PF = 0.2.
8	Pilot Valve/Ignition	120 Vac ^c	220-240 Vac, 4A at PF = 0.5, 20A inrush.
9	Main Fuel Valve	120 Vac ^c	220-240 Vac, 4A at PF = 0.5, 20A inrush.
10	Ignition	120 Vac ^c	220-240 Vac, 2A at PF = 0.2
F(11)	Flame Sensor	60 to 220 Vac, current limited.	60 to 220 Vac, current limited.
12 to 20	Unused	—	—
21	2nd Stage Main Valve (EC7895C, RM7895C,D; RM7896C,D)	120 Vac ^c	220-240 Vac, 4A at PF = 0.5, 20A inrush.
22	Shutter	120 Vac, 0.5A	220-240 Vac ^d

^a See Table 2.

^b 2000 VA maximum load connected to RM7895A,B,C,D/EC7895A,C/RM7896A,B,C,D Assembly.

^c See Tables 4 and 5.

^d Requires 220-240 Vac, 10 VA minimum, stepdown transformer to operate the shutter.

Table 4. Combinations for Terminals 8, 9, 10 and 21.

Combination Number	Pilot Fuel 8	Main 9	Ignition 10	Delayed Main Valve 21
1	C	F	No Load	No Load
2	B	F	No Load	No Load
3	F ^a	No Load	A	No Load
4	F	F	A	No Load
5	F ^a	No Load	A	F
6	D	F	A	No Load
7	D ^a	No Load	A	D
8	D	D	A	No Load
9	D ^a	No Load	A	D

^a RM7895C,D: EC7895C only, jumper terminals 8 to 9.

Table 5. Composition of each Combination.

A	B	C	D	F
4.5A ignition	50 VA Pilot Duty plus 4.5A ignition.	180 VA Ignition plus motor valves with: 660 VA inrush, 360 VA open, 240 VA hold.	2A Pilot Duty	65 VA Pilot Duty plus motor valves with: 3850 VA inrush, 700 VA open, 250 VA hold.

STATIC CHECKOUT

After checking all wiring, perform this checkout before installing the EC7895A,C/RM7895A,B,C,D/RM7896A,B,C,D on the subbase. These tests verify the Q7800 Wiring Subbase is wired correctly, and the external controllers, limits, interlocks, actuators, valves, transformers, motors and other devices are operating properly.

WARNING

Fire or Explosion Hazard.
Can cause property damage, severe injury or death.
 Close all manual fuel shutoff valve(s) before starting these tests.

Use extreme care while testing the system. Line voltage is present on most terminal connections when power is on.

Ensure proper selection of configuration jumpers before starting the burner operation.

CAUTION

Electrical Hazard.
Can cause equipment damage or failure.
 Do not perform a dielectric test with the relay module installed. Internal surge protectors can break down, allowing relay module to fail the dielectric test and destroy the internal lightning and high current protection.

1. Open the master switch before installing or removing a jumper on the subbase.
2. Before continuing to the next test, be sure to remove the test jumper(s) used in the previous test.
3. Replace all limits and interlocks that are not operating properly. Do not bypass limits and interlocks.

Equipment Recommended

1. Voltmeter (1M ohm/volt minimum sensitivity) set on the 0 to 300 Vac scale.
2. Two jumper wires, no. 14 wire, insulated, 12 in. (304.8 mm) long with insulated alligator clips at both ends.

General Instructions

1. Perform all applicable tests listed in Static Checkout, Table 6, in the order listed.
2. Make sure all manual fuel shutoff valve(s) are closed.
3. For each test, open the master switch and install the jumper wire(s) between the subbase wiring terminals listed in the Test Jumpers column.
4. Close the master switch before observing operation.
5. Read the voltage between the subbase wiring terminals listed in the Voltmeter column.
6. If there is no voltage or the operation is abnormal, check the circuits and external devices as described in the last column.
7. Check all wiring for correct connections, tight terminal screws, correct wire, and proper wiring techniques. Replace all damaged or incorrectly sized wires.
8. Replace faulty controllers, limits, interlocks, actuators, valves, transformers, motors and other devices, as required.
9. Make sure normal operation is obtained for each required test before continuing the checkout.
10. After completing each test, be sure to open the master power switch and remove the test jumper(s) before proceeding to the next test.


WARNING

Explosion hazard.
Can cause serious injury or death.
 Be sure all manual fuel shutoff valves are closed.

Table 6. Static Checkout.

Test Number	Relay Module Model	Test Jumpers	Voltmeter	Normal Operation	If Operation is Abnormal, Check Items Listed Below
1	All	None	5-L2	Line voltage at terminal 5.	1. Master switch. 2. Power connected to master switch. 3. Overload protection (fuse, circuit breaker, etc.) has not opened power line.
2	All	None	6-L2	Line voltage at terminal 6.	1. Limits. 2. Burner controller.
3	All	4-5	7-L2	1. Burner motor (fan or blower) starts. 2. Line voltage at terminal 7 within 10 seconds.	1. Burner motor circuit. a. Manual switch of burner motor. b. Burner motor power supply, overload protection and starter. c. Burner motor.
4	All	5-10	—	1. Ignition spark (if ignition transformer is connected to terminal 10).	1. Watch for spark or listen for buzz. a. Ignition electrodes are clean. b. Ignition transformer is okay.

Table 6. Static Checkout.

Test Number	Relay Module Model	Test Jumpers	Voltmeter	Normal Operation	If Operation is Abnormal, Check Items Listed Below
5	All	5-8	—	1. Ignition spark (if ignition transformer is connected to terminal 8). 2. Automatic pilot valve opens (if connected to terminal 8). NOTE: Refer to wiring diagram of system being tested.	1. Watch for spark or listen for buzz. 2. Listen for click or feel head of valve for activation. a. Actuator if used. b. Pilot valve.
6	All	5-9	—	Automatic fuel valve(s) open(s). If using direct spark ignition, check first stage fuel valve(s) instead of pilot valve.	Same as test 5. If using direct spark ignition, check first stage fuel valve(s) instead of pilot valve.
7	EC785C; RM7895C,D; RM7896C,D	5-21	—	Automatic second stage main fuel valve(s) open(s).	1. Listen for and observe operation of second stage main fuel valve(s) and actuator(s). 2. Valve(s) and actuator(s).
8	All	5-3	—	Alarm (if used) turns on.	1. Alarm.
Final	All	 CAUTION Equipment Damage Hazard. Can cause equipment damage. After completing these tests, open master switch and remove all test jumpers from subbase terminals. Also remove bypass jumpers, if used, from low fuel pressure limits.			

Mounting RM7895A,B,C,D/EC7895A,C; RM7896A,B,C,D Relay Module

1. Mount the RM7895A,B,C,D/EC7895A,C; RM7896A,B,C,D vertically on the Q7800 Subbase or mount horizontally with the knife blade terminals pointing down. When mounted on the Q7800A, the RM7895A,B,C,D/EC7895A,C; RM7896A,B,C,D must be in an electrical enclosure.
2. When mounting in an electrical enclosure, provide adequate clearance for servicing, installation and removal of the RM7895A,B,C,D/EC7895A,C; RM7896A,B,C,D, KDM, flame amplifier, flame amplifier signal voltage probes, electrical signal voltage probes and electrical connections.
 - a. Allow an additional two inches (51 mm) below the RM7895A,B,C,D/EC7895A,C; RM7896A,B,C,D for the flame amplifier mounting.
 - b. Allow an optional three-inch (76 mm) minimum on both sides of the RM7895A,B,C,D/EC7895A,C; RM7896A,B,C,D for electrical signal voltage probes.
3. Make sure no subbase wiring is projecting beyond the terminal blocks. Tuck in wiring against the back of the subbase so it does not interfere with the knife blade terminals or bifurcated contacts.

IMPORTANT

The RM7895A,B,C,D/EC7895A,C; RM7896A,B,C,D must be installed with a plug-in motion rather than a hinge action.

4. Mount the RM7895A,B,C,D/EC7895A,C; RM7896A,B,C,D by aligning the four L-shaped corner guides and knife blade terminals with the bifurcated contacts on the wiring subbase and securely tightening the two screws without deforming the plastic.

Mounting Other System Components (Fig. 4)

Refer to the applicable specifications for mounting other system components.

PRINCIPAL TECHNICAL FEATURES

The RM7895 provides all customary flame safeguard functions as well as significant advancements in safety, annunciation, and system diagnostics.

Safety Shutdown (Lockout) Occurs if:

1. INITIATE PERIOD
 - a. Purge card is not installed or removed.
 - b. Purge card is bad.
 - c. Configuration jumpers have been changed (after 200 hours)—Fault Code 110.
 - d. AC line power errors occurred, see Operation.
 - e. Four minute INITIATE period has been exceeded.

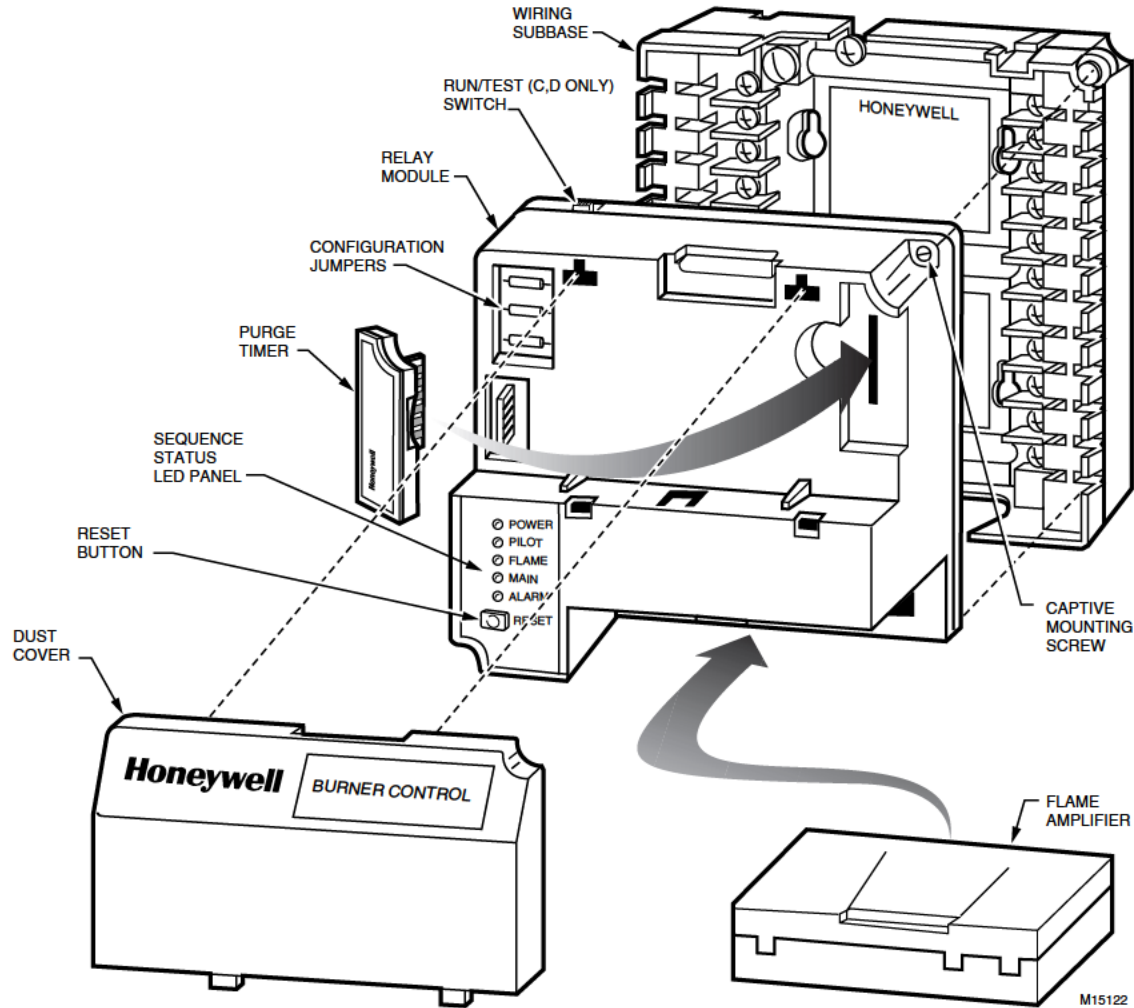


Fig. 4. RM7895A,B,C,D/EC7895A,C; RM7896A,B,C,D Relay Module, exploded view.

2. STANDBY PERIOD

- a. Airflow lockout feature is enabled and the airflow switch does not close after ten seconds or within the specified purge card timing.
- b. Flame signal is detected after 30 seconds.
- c. Ignition/pilot valve/intermittent pilot valve terminal is energized.
- d. Main valve terminal is energized.
- e. Delayed main valve terminal is energized (RM7895C,D).
- f. Internal system fault occurred.
- g. Purge card is removed.
- h. Purge card is bad.

3. PREPURGE PERIOD

- a. Airflow lockout feature is enabled and the airflow switch opens.
- b. Ignition/pilot valve terminal is energized.
- c. Main valve terminal is energized.
- d. Delayed main valve terminal is energized (RM7895C,D).
- e. Internal system fault occurred.
- f. Purge card is removed.
- g. Purge card is bad.
- h. Flame signal is detected.

4. PILOT FLAME ESTABLISHING PERIOD (PFEP)

- a. Airflow lockout feature is enabled and the airflow switch opens.
- b. No flame signal at end of PFEP.
- c. Ignition/pilot valve/intermittent pilot valve terminal is not energized.

NOTE: For the RM7895C1020 and RM7896C1036, during the first 8 seconds of PFEP, when a flame signal is detected, terminal 10 is de-energized. If the flame signal is lost, terminal 10 will re-energize.

- d. Main valve terminal is energized.
- e. Delayed (second stage) main valve terminal is energized (RM7895C,D/EC7895C; RM7896C,D).
- f. Internal system fault occurred.
- g. Purge card is removed.
- h. Purge card is bad.

5. MAIN FLAME ESTABLISHING PERIOD (MFEP) (RM7895C,D)
 - a. Airflow lockout feature is enabled and the airflow switch opens.
 - b. Ignition terminal is energized.
 - c. Ignition/pilot valve terminal is not energized.
 - d. Main valve terminal is not energized.
 - e. Delayed main valve terminal is energized.
 - f. No flame signal at end of Flame Failure Response Time.
 - g. Internal system fault occurred.
 - h. Purge card is removed.
 - i. Purge card is bad.
6. RUN PERIOD
 - a. No flame present.
 - b. Airflow lockout feature is enabled and the airflow switch opens.
 - c. Interrupted pilot valve terminal is energized (RM7895C,D).
 - d. Main valve terminal is not energized.
 - e. Delayed main valve terminal is not energized (RM7895C,D).
 - f. Internal system fault occurred.
 - g. Purge card is removed.
 - h. Purge card is bad.
 - i. Ignition terminal is energized.

OPERATION

Sequence of Operation

The RM7895A,B,C,D/EC7895A,C; RM7896A,B,C,D has the operating sequences listed below; see Fig. 2 and 3. The RM7895A,B,C,D/EC7895A,C; RM7896A,B,C,D LED provide positive visual indication of the program sequence: POWER, PILOT, FLAME, MAIN and ALARM.

Initiate

The EC7895A,C/RM7895A,B,C,D;RM7896A,B,C,D Relay Module enters the INITIATE sequence when the relay module is powered. The EC7895A,C/RM7895A,B,C,D; RM7896A,B,C,D can also enter the INITIATE sequence if the relay module verifies voltage fluctuations of +10/-15% or frequency fluctuations of $\pm 10\%$ during any part of the operating sequence. The INITIATE sequence lasts for ten seconds unless the voltage or frequency tolerances are not met. When not met, a hold condition is initiated and displayed on the optional KDM for at least five seconds; when met, the INITIATE sequence restarts. If the condition is not corrected and the hold condition exists for four minutes, the EC7895A,C/RM7895A,B,C,D; RM7896A,B,C,D locks out. Causes for hold conditions in the INITIATE sequence:

1. AC line dropout detection.
2. AC line noise that can prevent a sufficient reading of the line voltage inputs.
3. Low line voltage brownouts.

The INITIATE sequence also delays the burner motor starter from being energized and de-energized from an intermittent AC line input or control input.

Standby

The EC7895A,C/RM7895A,B,C,D;RM7896A,B,C,D is ready to start an operating sequence when the operating control input determines a call for heat is present. The burner switch, limits, operating limit control and all microcomputer-monitored circuits must be in the correct state for the relay module to continue into the PREPURGE sequence.

Normal Start-Up Prepurge

The EC7895A,C/RM7895A,B,C,D/RM7896A,B,C,D Relay Module provides PREPURGE timing selectable from two seconds to thirty minutes with power applied and the operating control indicating a call for heat.

1. The Airflow Interlock, burner switch, Run/Test switch and all microcomputer-monitored circuits must also be in the correct operating state.
2. The motor output, terminal 4, is powered to start the PREPURGE sequence.
3. The Airflow Interlock input closes ten seconds into PREPURGE or within the specified purge card timing; otherwise, a recycle to the beginning of PREPURGE or lockout occurs, depending on how the Airflow Switch selectable jumper (JR3) is configured.

Ignition Trials

1. Pilot Flame Establishing Period (PFEP):
 - a. When the PFEP begins:
 - (1) The pilot valve and ignition transformer, terminals 8 and 10, are energized. The EC7895A, RM7895A,B, and RM7896A,B have an intermittent pilot valve, terminal 8. The EC7895C, RM7895C,D, and RM7896C,D have an interrupted pilot valve, terminal 8.
 - (2) Flame must be proven by the end of the ten second PFEP (four seconds if Configuration Jumper JR1 is clipped) to allow the sequence to continue. If a flame is not proven by the end of PFEP, a safety shutdown occurs.
 - b. With flame proven, the ignition, terminal 10, is de-energized.

NOTE: For the RM7895C1020 and RM7896C1036, during the first 8 seconds of PFEP, when a flame signal is detected, terminal 10 is de-energized. If the flame signal is lost, terminal 10 will re-energize.

2. Main Flame Establishing Period (MFEP):
 - a. After PFEP, and with the presence of flame, the main fuel valve, terminal 9, is powered. If a flameout occurs, the relay module locks out or recycles (depending on status of jumper JR2) within 0.8 or 3 seconds, depending on the Flame Failure Response Time (FFRT) of the amplifier.
 - b. The EC7895C, RM7895C,D and RM7896C,D have a ten second MFEP. After the Ignition Trials, the pilot valve, terminal 8, is de-energized. If a flameout occurs, the relay module locks out or recycles (depending on status of jumper JR2) within 0.8 or 3 seconds, depending on the Flame Failure Response Time (FFRT) of the amplifier.

Run

1. The EC7895C, RM7895C,D, RM7896C,D has a delayed main valve that is energized once the RUN period is entered.
2. The relay module is now in RUN and remains in RUN until the controller input, terminal 6, opens, indicating that the demand is satisfied or a limit has opened.

Post Purge (RM7896A,B,C,D Only)

After demand is satisfied or a limit opens, de-energizing terminal 6, the Ignition/Pilot valve, main valve and delayed main valve, terminals 8, 9 and 21, are de-energized. The blower motor, terminal 4, remains powered for 15 seconds.

Run/Test Switch (RM/EC7895C,D; RM7896C,D only)

The Run/Test Switch is located on the top side of the relay module, see Fig. 5. The Run/Test Switch allows the burner sequence to be altered as follows:

1. In the measured PREPURGE sequence, the Run/Test Switch, placed in the TEST position, causes the PREPURGE timing to stop.
2. In the Pilot Flame Establishing Period, the Run/Test Switch, placed in the TEST position, stops the timer during the first eight seconds of a ten-second PFEP selection or during the first three seconds of a four-second PFEP selection. It also allows for pilot turn-down test and other burner adjustments. This activates a fifteen-second flameout timer that permits pilot flame adjustment without nuisance safety shutdowns. The Run/Test Switch is ignored during PFEP for the C and D relay modules if terminals 8 and 9 or 9 and 21 are jumpered.

IMPORTANT

When the relay module is switched to the TEST mode, it stops and holds at the next Run/Test Switch point in the operating sequence. Make sure that the Run/Test Switch is in the RUN position before leaving the installation.

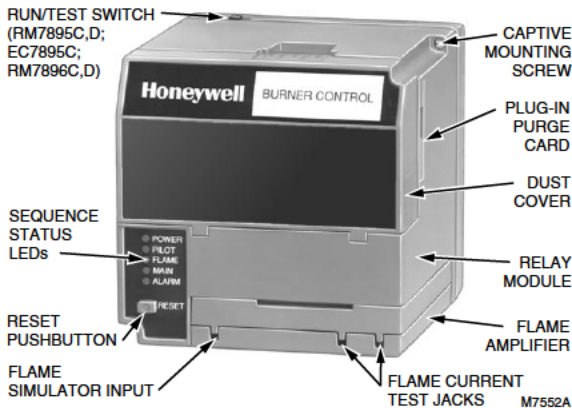


Fig. 5. Sequence Status LEDs.

SETTINGS AND ADJUSTMENTS

Selectable Site-Configurable Jumpers

The relay module has three site-configurable jumper options, see Fig. 6 and Table 6. If necessary, clip the site-configurable jumpers with side cutters and remove the resistors from the relay module.

SERVICE NOTE: Clipping and removing a site-configurable jumper enhances the level of safety.

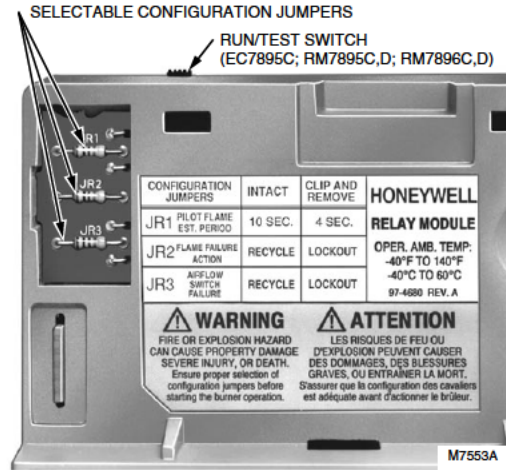


Fig. 6. Selectable site-configurable jumpers.

Table 7. Site-configurable jumper options.

Jumper Number	Description	Intact	Clipped
JR1 ^a	Pilot Flame Establishing Period (PFEP)	10 seconds	4 seconds
JR2	Flame Failure Action	Recycle	Lockout
JR3	Airflow Switch (ILK) Failure	Recycle	Lockout

^a The RM7895C1020 and RM7896C1036 have fixed PFEP of ten seconds and do not have jumper JR1.

IMPORTANT

Clipping and removing a jumper after 200 hours of operation causes a nonresettable Fault 110. The relay module must then be replaced.



Home and Building Control
Honeywell
1985 Douglas Drive North
Golden Valley, MN 55422

Home and Building Control
Honeywell Limited-Honeywell Limitée
35 Dynamic Drive
Scarborough, Ontario
M1V 4Z9

General Purpose Relays and Timing Relays



Bulletin 700-HR

- Dial Timing Relay
- 5 A Contact Rating
- 16 Programmable Timing Ranges
- 100...240V AC Multi-Voltage Input
- 24V AC/DC Dual Voltage Input
- Tube Base Pin Style Terminals
- Timed Contacts and Instantaneous Contacts
- Single Function
- Multi-Function
- Multi-Range
- 4 Different Operating Modes
- 0.05 s...60 h

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Description	Page	Description	Page
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Accessories	9-94	Approximate Dimensions	9-99
Specifications	9-96		

Description

The Bulletin 700-HR Multi-Function, Multi-Range Timing Relays are available with 16 programmable timing ranges with calibrated scales. They have four programmable timing modes: On-Delay, Off-Delay, Repeat Cycle, and One Shot. They are tube based relays with pin style terminations and 2 Form C timed DPDT contacts.

The Bulletin 700-HRC Multi-Range Timing Relays are On-Delay only, and are available with 16 programmable timing ranges with calibrated scales. They are tube based relays with pin style terminations and 1 Form C timed SPDT and 1 Form C instantaneous SPDT contact.

The Bulletin 700-HRM Multi-Range Timing Relays are On-Delay only, and are available with 16 programmable timing ranges with calibrated scales. They are tube based relays with pin style terminations with 2 Form C DPDT timed contact.

Conformity to Standards:

- EN 60947-5-1
- EN 50081-2
- EN 50082-2
- IEC 947
- VDE 0435
- CSA 22.2
- UL 508




Approvals:

- CSA Certified, File LR60859
- UL Recognized, File E14840 Guide NKCR 2
- CE Marked (per EU Low Voltage Directive 73/23 EEC 93/68 EEC: per Electromagnetic Compatibility Directive 89/336 EEC 92/31 EEC 93/681 EEC)

Your order must include:

- Cat. No. of the plug-in relay plus suffixes of selection options.
- Cat. No. of socket required.
- If required, Cat. No. of any accessories.

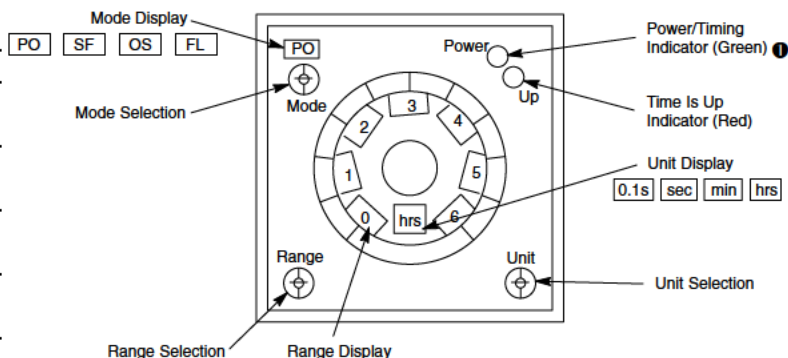
Bulletin 700-HR, -HRM, -HRC Multi-Function Multi-Range Dial Timing Relay with Pin Style Terminations ❶

	Timing Mode	Timing Range	Input Voltage	Cat. No.
<p>11-Pin Terminations</p>  <p><i>Cat. No. 700-HR... DPDT 2-Pole — 2 Form C Contacts Sockets — 700-HN101, -HN126, -HN129</i></p>	ON-Delay <input type="checkbox"/> PO	0.05 s...60 h	24V AC/DC	700-HR52TU24 ❷
	OFF-Delay <input type="checkbox"/> SF			
	One Shot (Interval) <input type="checkbox"/> OS			
	Repeat Cycle <input type="checkbox"/> FL		100...240V AC	700-HR52TA17 ❷
<p>8-Pin Terminations</p>  <p><i>Cat. No. 700-HRM... DPDT 2-Pole — 2 Form C Contacts Sockets — 700-HN100, -HN108, -HN125</i></p>	ON-Delay	0.05 s...60 h	24V AC/DC	700-HRM12TU24 ❷
			100...240V AC	700-HRM12TA17 ❷
<p>7-Pin Terminations</p>  <p><i>Cat. No. 700-HRC... Timed: SPDT 1-Pole — 1 Form C Contact Instantaneous: SPDT 1-Pole — 1 Form C Contact Sockets — 700-HN100, -HN108, -HN125</i></p>	ON-Delay	0.05 s...60 h	24V AC/DC	700-HRC12TU24 ❸
			100...240V AC	700-HRC12TA17 ❸

- ❶ For wiring diagrams, see Specifications page 9-97.
- ❷ This timer has 2 DPDT timed contacts.
- ❸ This timer has 1 SPDT timed contact and 1 SPDT instantaneous contact.

Bulletin 700-HR, -HRM, -HRC Timing Ranges










Unit	Range			
0.1s	0.05... 0.06 s	0.1...1.2 s	0.25... 3.0 s	0.5...6 s
sec	0.5...6 s	1...12 s	2.5...30 s	5...60 s
min	0.5...6 m	1...12 m	2.5...30 m	5...60 m
hrs	0.5...6 h	1...12 h	2.5...30 h	5...60 h



❶ Steady light is for power on, flashing light is for timing.

General Purpose Relays and Timing Relays



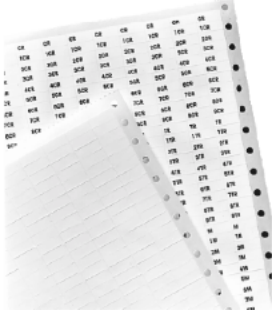
Accessories

	Description	Pkg. Qty.	Cat. No.
 <p>Cat. No. 700-HN100</p>	Screw Terminal Tube Base Sockets — Panel or DIN Rail Mounting Guarded Terminal Construction 8-pin for use with DPDT Bulletin 700-HA relays, -HX digital timing relays, -HT (ON-Delay) and -HRM, -HRC and -HV (Repeat Cycle) timing relays. Order must be for 10 sockets or multiples of 10.	10	700-HN100
 <p>Cat. No. 700-HN125</p>	Screw Terminal Tube Base Sockets — Panel or DIN Rail Mounting Open Style Construction 8-pin for use with DPDT Bulletin 700-HA relays, -HT (ON-Delay) and -HRM, -HRC and -HV (Repeat Cycle) timing relays. Order must be for 10 sockets or multiples of 10. No retainer clip required.	10	700-HN125
 <p>Cat. No. 700-HN101</p>	Screw Terminal Tube Base Sockets — Panel or DIN Rail Mounting Guarded Terminal Construction 11-pin for use with 3PDT Bulletin 700-HA relays, -HR and -HT (OFF-Delay) timing relays. Order must be for 10 sockets or multiples of 10.	10	700-HN101
 <p>Cat. No. 700-HN126</p>	Screw Terminal Tube Base Sockets — Panel or DIN Rail Mounting Guarded Terminal Construction 11-pin for use with 3PDT Bulletin 700-HA relays, -HR and -HT (OFF-Delay) timing relays. Order must be for 10 sockets or multiples of 10.	10	700-HN126
 <p>Cat. No. 199-DR1</p>	DIN Rail Mounting Pack Standard 35 x 7.5 mm DIN Rail, 1 meter long, 10 rails per package. Order must be for 10 rails or multiples of 10.	10	199-DR1
 <p>Cat. No. 700-HN108</p>	Specialty Socket 8-pin backwired socket with solder terminals for use with Bulletin 700-HRM, -HRC and -HX timing relays. Order must be for 10 sockets or multiples of 10.	10	700-HN108
 <p>Cat. No. 700-HN129</p>	Specialty Socket 11-pin backwired socket with solder terminals for use with Bulletin 700-HR timing relays. Order must be for 10 sockets or multiples of 10.	10	700-HN129
 <p>Sample Retainer Clips</p>	Retainer Clip for Cat. Nos. 700-HN100 and -HN101 Sockets with 700-HR Timing Relay or Cat. No. 700-HN Sockets with Bulletin 700-HRM and -HRC Timing Relays Secures relay in socket. Order must be for 10 clips or multiples of 10.	10	700-HN131
 <p>Cat. No. 700-HN120</p>	Type 1 Enclosure For use with any of the listed relays. Knockouts for 1/2" and 3/4" conduit connections. The enclosure exceeds the minimum clearances required by U.S. Standards, resulting in generous wiring space.	1	700-HN120

① Bulletin 700-HR, -HRM, -HRC Multi-Function Multi-Range Dial Timing Relay, Socket, Retainer Clip Reference Chart

Relay Type	Socket	Retainer Clip
700-HR	700-HN101	700-HN131
	700-HN126	Not Required *
	700-HN129	700-HN130 Frame Adapter
700-HRM/HRC	700-HN100	700-HN131
	700-HN108	700-HN130 Frame Adapter
	700-HN125	Not Required ②

② Design of these sockets holds the relays securely and does not require retainer clips

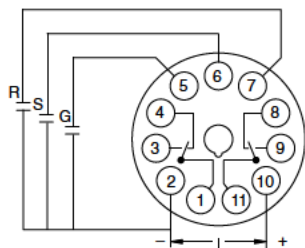
	Description	Pkg. Qty.	Cat. No.
 <p>Cat. No. 700-HN130</p>	<p>Frame Adapter For flush or door mounting of Bulletin 700-HR, -HRM and -HRC timing relays.</p>	1	700-HN130
 <p>Cat. No. 700-HN132</p>	<p>Protective Cover Helps prevent tampering of timing and mode settings. Provides a degree of protection against water and dirt from entering the front of the relay. For use with Bulletin 700-HR, -HRM, -HRC, and -HX timing relays.</p>	1	700-HN132
	<p>Pre-printed identification tags — contains 10 sheets of pre-printed and blank tags. Each sheet contains 13 sets of the markings CR...9CR, TR...9TR, M...9M, F, R, 1S, and 117 blank tags. Tags are peel-off with sticky backing for easy placement on relays.</p>	10	700-N40
	<p>Blank identification tags — contains 10 sheets of blank identification tags for customer specialized printing. Each sheet contains 546 blank tags. Tags are peel-off with sticky backing for easy placement on relays.</p>	10	700-N41

Bulletin 700-HR
General Purpose Relays and Timing Relays
Specifications ❶

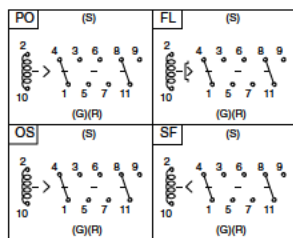
		Bulletin 700-HR, -HRM/-HRC		
Electrical Ratings				
Pilot Duty Rating ❷		NEMA C300		
Rated Thermal Current (I_{th})		5 A		
Rated Insulation Voltage (Ui)		250V IEC, 300V UL/CSA		
Contacts	Inductive	Make	Break	HP
	120V AC 240V AC	▶ ◀ 15 A 7.5 A	◀ ▶ 1.5 A 0.75 A	1/6 1/4
	Make, Break, and Continuous V DC	30V, 5 A		
Permissible Coil Voltage Variation		80...110% of Nominal Voltage at 50 Hz 85...110% of Nominal Voltage at 60 Hz 80...110% of Nominal Voltage at DC		
Power Consumption ±10%	24V AC	1.0 VA		
	120V AC	5.0 VA		
AC	240V AC	10.0 VA		
DC		1 W		
Design Specification/Test Requirements				
Dielectric Withstand Voltage	Pole to Pole (VRMS)	1500V AC		
	Contact to Coil (VRMS)	1500V AC		
Mechanical				
Degree of Protection		Open Type (Guarded Terminal Sockets)		
Mechanical Life Operations		10 x 10 ⁶		
Switching Frequency Operations		1800/HR		
Timing	Duty Cycle	Continuous		
Repeat Accuracy ❸ Adjustable Fixed Time Setting		±0.3% ±10 ms		
Timing Change		±0.5% of full scale		
Scale Tolerance	High End of Range Low End of Range	±5% of full scale		
Reset Time		100 ms		
Timing Range		0.05 s...60 hours		
Coil Voltages		See Product Selection		
Environmental				
Temperature	Operating	-30...+55°C (-22...+131°F)		
	Storage	-55...+85°C (-67...+185°F)		
Altitude		2000 m (6560 ft)		
Construction				
Insulating Material		Molded High Dielectric Material		
Enclosure		Impact Resistant Dust Cover		
Contact Material		Silver Cad. Ox.		
Terminal Markings on Socket		In accordance with EN50 0005		
Sockets	8-Pin	700-HN100, -HN125		
	11-Pin	700-HN101, -HN126		
	Specialty	700-HN108, -HN129		

- ❶ Performance Data — See page Important-2.
- ❷ NEMA Rating Chart is on page 9-12.
- ❸ At constant voltage and temperature.

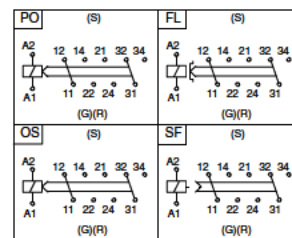
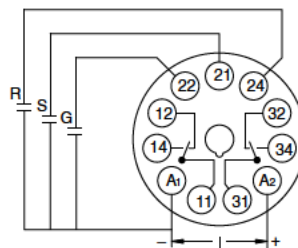
Bulletin 700-HR, -HRM, -HRC



USA/Canada



International



(I) Input Power (terminals ② and ⑩)

- Power to terminals ② and ⑩ must be applied continuously. The time delay and output contacts reset immediately upon removal of power.
- For a DC power supply the positive (+) must be connected to terminal ⑩.

(S) Start Signal (terminals ② and ⑥)

- A signal must be applied across terminals ② and ⑥ to start the timing interval. This signal can be either momentary or maintained.

(R) Reset Signal (terminals ② and ⑦)

- The reset signal is not required for normal operation. Reset can be accomplished by removing power from terminals ② and ⑩.

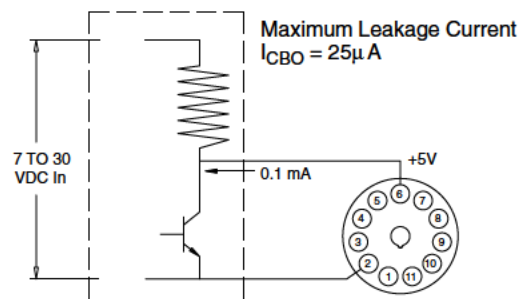
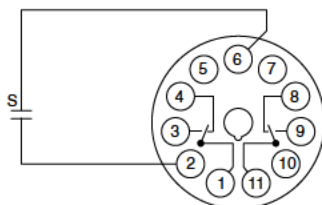
- To reset the timer without removing power, a signal must be applied across terminals ② and ⑦ which resets the timing cycle and returns the output contacts to their shelf state.
- The reset signal will override both the start signal and gate signal.
- The reset signal can be either momentary or maintained.

(G) Gate Signal (terminals ② and ⑤)

- The gate signal is not required for normal operation.
- The gate signal provides a pause or retentive timing function. When a signal is applied across terminals ② and ⑤ the timing cycle is momentarily interrupted. When a signal is removed the timing cycle resumes timing at the point the cycle was interrupted and will continue timing until the time delay is completed or the gate signal is re-applied.

ATTENTION: The internal circuitry of the timer can be damaged if the input signal terminals ⑤, ⑥ or ⑦ are connected to other loads.

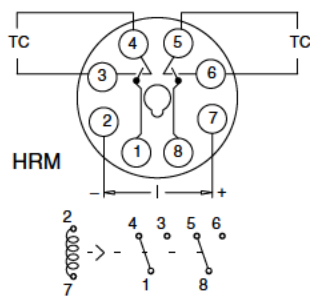
Input Description (Typical)



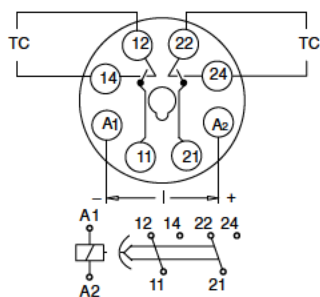
Contact Inputs (R, S, G): For optimum reliability use external switches that are designed for low level switching (Cat. No. 700-HC54__, -HAX__, or -HKX__).

Solid State Signal Inputs (R, S, G): Proximity switch, photoelectric switch, etc.

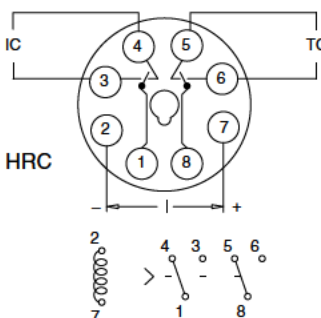
U.S./Canada



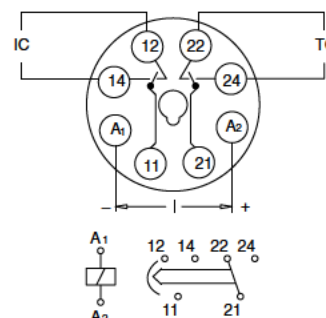
International



U.S./Canada



International



(I) Input Power (terminals ② and ⑦)

- Power to terminals ② and ⑦ must be applied continuously. The time delay and output contacts reset immediately upon removal of power.

- For a DC power supply the positive (+) must be connected to terminal ⑩.

IC = Instantaneous Contacts
 TC = Timed Contacts

General Purpose Relays and Timing Relays

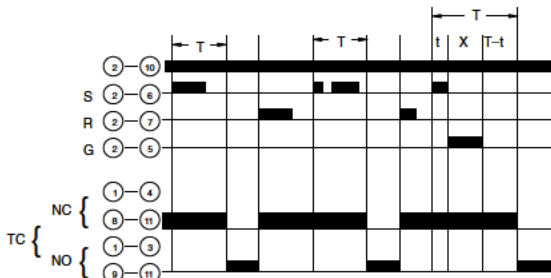
Timing Charts

Bulletin 700-HR, -HRC, and -HRM Dial Timing Relay (T = Time Range 0.05 s...60 h)

Bulletin 700-HR

On-Delay (PO): Input power must be applied continuously. When a start signal is applied the timing cycle begins. The output contacts change state after the time delay is completed. The contacts will return to their shelf state when a reset signal is applied or power is removed.

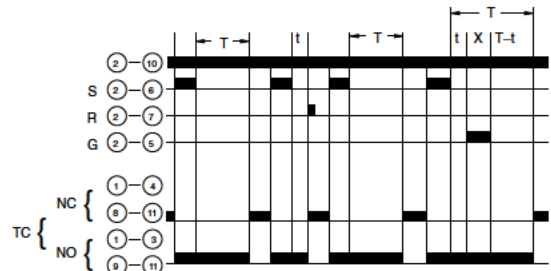
- The start signal can be either momentary or maintained.
- Reapplying a start signal during the timing cycle will have no effect on the time delay.
- The start signal can be eliminated by jumpering terminals ② and ⑥. The timing cycle will now begin upon application of power to terminals ② and ⑩.



Off-Delay (SF): Input power must be applied continuously. When a start signal is applied the output contacts change state immediately. When the start signal is removed the timing cycle begins. The output contacts will return to their shelf state once the time delay is completed. Reset will occur when a reset signal is applied or power is removed.

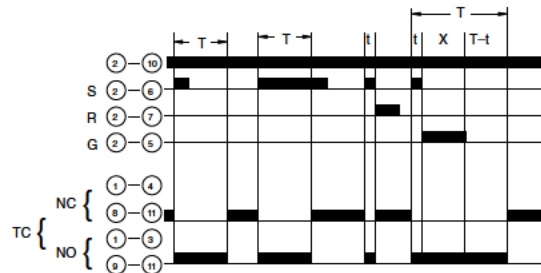
- The start signal must be maintained until the timing cycle is to begin.
- If the start signal is reapplied after the timing cycle has begun, the time delay resets and will not begin again until the start signal is removed.

ATTENTION: If the start signal is a maintained signal the timer will initiate a new off delay immediately upon removal of the reset signal.



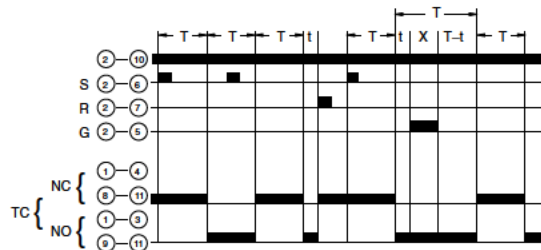
One Shot (OS): Input power must be applied continuously. When a start signal is applied the output contacts change state immediately and the timing cycle begins. The output contacts return to their shelf state once the time delay is completed. Reset will occur when a reset signal is applied or power is removed.

- The start signal can be either momentary or maintained.
- Reapplying a start signal during the timing cycle will have no effect on the time delay.
- Reapplying a start signal after the time delay is completed will start a new timing cycle (no reset is required).
- The start signal can be eliminated by jumpering terminals ② and ⑥. The time delay will now begin when power is applied to terminals ② and ⑩, similar to an "interval on" timing mode.



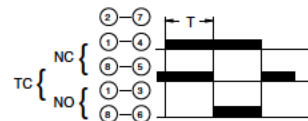
Repeat Cycle (FL): Input power must be applied continuously. When a start signal is applied the "off timing cycle" begins, but the output contacts remain in the shelf state. When the time delay is completed the output contacts change state and the next "on timing cycle" begins. When this time delay is completed the output contacts return to their shelf state. This sequence will repeat until a reset signal is applied or power is removed.

- The start signal can be either momentary or maintained.
- Reapplying a start signal during the timing cycle will have no effect on the time delay.
- The start signal can be eliminated by jumpering terminals ② and ⑥. The time delay will now begin when power is applied to terminals ② and ⑩.
- This is a symmetrical timing relay where the "off cycle" and "on cycle" are of equal value.



Bulletin 700-HRM

On-Delay: When power is applied to terminals ② and ⑦ the timing cycle begins. The output contacts change state after the time delay is completed. The contacts will return to their shelf state when power is removed.



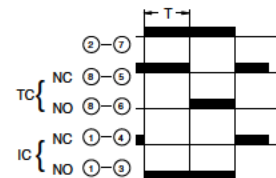
Bulletin 700-HRC

On-Delay: When power is applied to terminals ② and ⑦ the instantaneous output contacts (IC) change state and the timing cycle begins. The timed output contacts (TC) change state after the time delay is completed. All contacts will return to their shelf state when power is removed.

(T) is the set time delay.

(t) is a timing cycle less than the set time delay. (t) can reflect that a reset signal has been applied or power has been removed prior to completion of the time delay. (t) can also indicate that prior to completion of the time delay a gate signal has been applied which momentarily interrupts the timing cycle.

(T-t) is the completion of the time delay after the gate signal is removed. (X) is the duration of the gate signal.

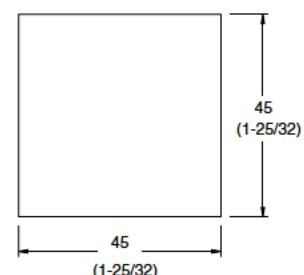
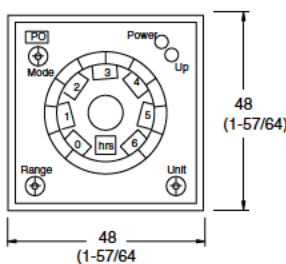
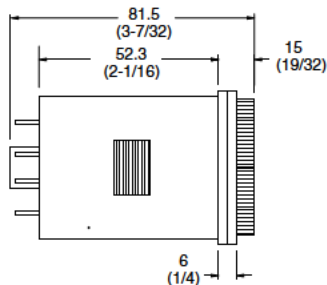


Bulletin 700-HR

General Purpose Relays and Timing Relays

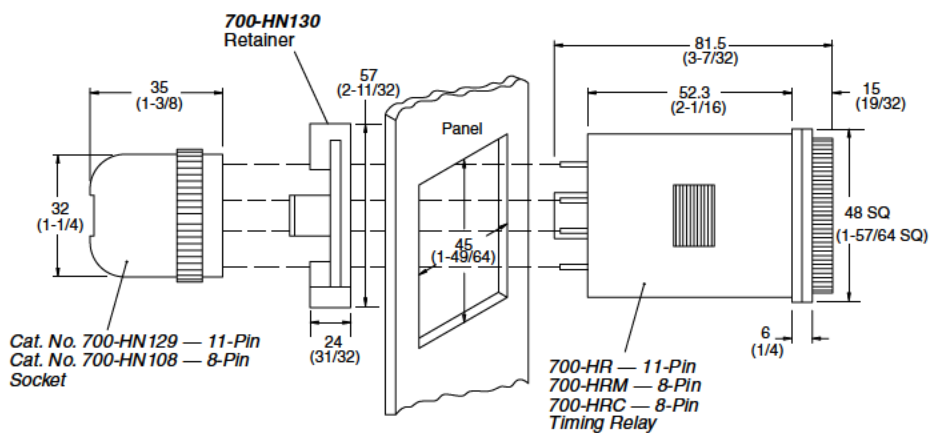
Approximate Dimensions

Dimensions are shown in millimeters (inches). Dimensions are not intended for manufacturing purposes.



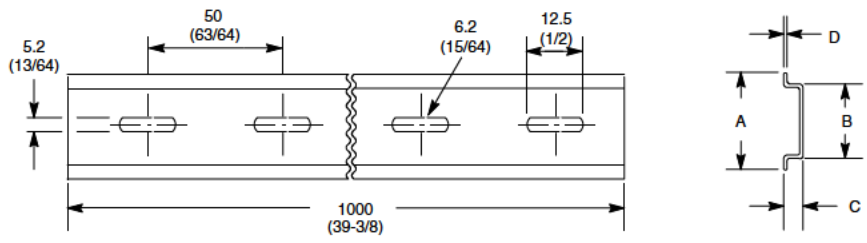
Cat. No. 700-HR.../HRM.../HRC... Timing Relays

Cat. No. 700-HR.../HRM.../HRC... Panel Cutout



Cat. No. 700-HN129 — 11-Pin
Cat. No. 700-HN108 — 8-Pin
Socket

700-HR — 11-Pin
700-HRM — 8-Pin
700-HRC — 8-Pin
Timing Relay



Cat. No. 199-DR1 DIN Mounting Rail Series B
Cat. No. 199-DR4 DIN Mounting Rail Series B Has No Mounting Holes

Cat. No.	A	B	C	D	Approx. Shipping Wt.
199-DR1	35 (1-3/8)	27 (1-1/16)	7.5 (19/64)	1.02 (1/64)	1.85 kg (4.07 lbs.) (10/pkg)
199-DR4	35 (1-3/8)	27 (1-1/16)	15 (19/32)	2.3 (3/32)	3.68 kg (8 lbs.) (5/pkg)

General Description

The AH4E Hydramotors are three-position push-type, self-contained, electrohydraulic linear actuators featuring dual internal control valves for repeatable positioning. The low-fire position is factory set at the stroke midpoint, but can be field adjustable to any position between 15% and 100% of stroke.

When power is applied, the actuator shaft travels to the low-fire position. After an external switch completes the low-fire controller circuit, the shaft continues on to the high-fire setting. Opening the external switch returns the shaft to the low-fire setting, and power interruption fully closes the valve in one second or less from any position.

The AH4E Hydramotor/V710(B) gas valve combination provides reliable main line gas control for a wide range of applications, including boilers, furnaces, ovens and all types of industrial and commercial burners.

Specifications

Power Requirement: 220 VA max.

Closing Time: One second max.

Opening Time:

Fast Opening: 14 seconds max.

Slow Opening: 26 seconds max.

Note: Opening time is double between -30°F and -40°F ambient.

Opening time increases 20% when operating on 50Hz.

Enclosure

Standard: General Purpose Type 1

Optional: Watertight Type 4

(Also meets General Purpose Type 1 and Raintight Type 3)

Ambient Temperature

-40°F to 150°F (-40°C to 66°C)

Electrical

Standard voltages: 120V/60Hz, 110V/50Hz

Non-standard voltages: 240V/60Hz, 220V/50Hz

Proof of Closure Switch (POC): (optional)

A factory set, non-field adjustable SPDT switch. 1800VA max. connected load (e.g. 15A max. load @ 120V; 7.5A max. load at 240V).

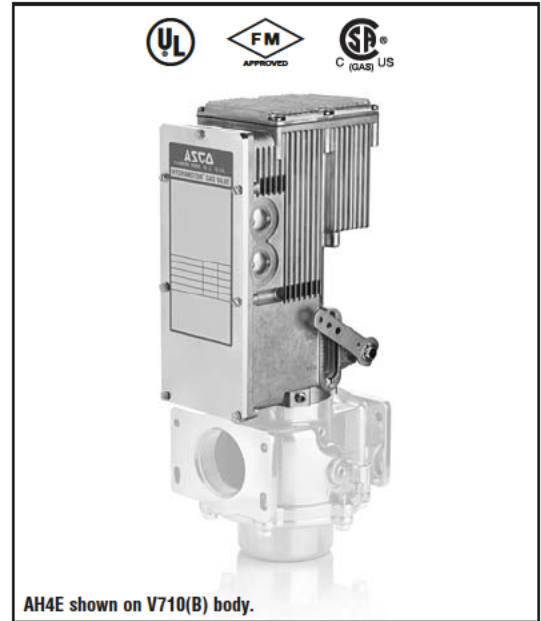
Auxiliary Switch: (optional)

One integral SPDT switch; field adjustable to actuate at any position of stroke. 1800 VA max. connected load (e.g. 15A max. load @ 120V; 7.5A max. load at 240V). (Note: Not available if optional POC switch is ordered)

Electrical Characteristics

Voltage/Hz*	Amperes		
	Inrush	Opening	Holding
120V/60, 110/50	5.6	2.1	0.09
240V/60, 220/50	2.8	1.1	0.04

*Current increases by 20% for 50 Hz operation.



Installation

AH4E Hydramotor mounts in any position directly to a V710 valve with 3 set screws.



Damper Arm Rating

Drives damper in one direction only. 20 lb. max. at 2.85" radius at 20°F to 150°F and 10 lb. max. at -40°F to 20°F. Travel 2" max.

Approvals

AH4E Hydramotor with V710 valve

UL listed to standard 429 "Electrically Operated Valves," Guide Y10Z, File MP932 Safety Valves

FM Approved to Class 7400 "liquid and gas safety shutoff valves."

CSA Certified to:

1. Automatic Gas Valves ANSI Z21.21 CSA 6.5, C/I, File 109157 and 113070.
2. Automatic Gas Safety Shutoff Valves (CGA 3.9), File 113070
3. Standard C22.2 No. 139, File 109157 and 113070

Ordering Information

Important: Order by Catalog Number and add suffix number for desired optional feature. e.g. AH4E112A1

Specifications

Applications	Catalog Number	
	120V/60Hz, 110V/50Hz	240V/60Hz, 220V/50Hz
On-Off Slow Opening (26 seconds Max) (Watertight)		
Standard	AH4E102A	AH4E104A
Proof of closure	AH4E102S	AH4E104S
On-Off Slow Opening (26 seconds Max) (General Purpose)		
Standard	AH4E202A	AH4E204A
Proof of closure	AH4E202S	AH4E204S
On-Off Fast Opening (14 seconds Max) (Watertight)		
Standard	AH4E112A	AH4E114A
Proof of closure	AH4E112S	AH4E114S
On-Off Fast Opening (14 seconds Max) (General Purpose)		
Standard	AH4E212A	AH4E214A
Proof of closure	AH4E212S	AH4E214S

Optional Features

Add appropriate suffix number to catalog number

Damper shaft (add Suffix 1)

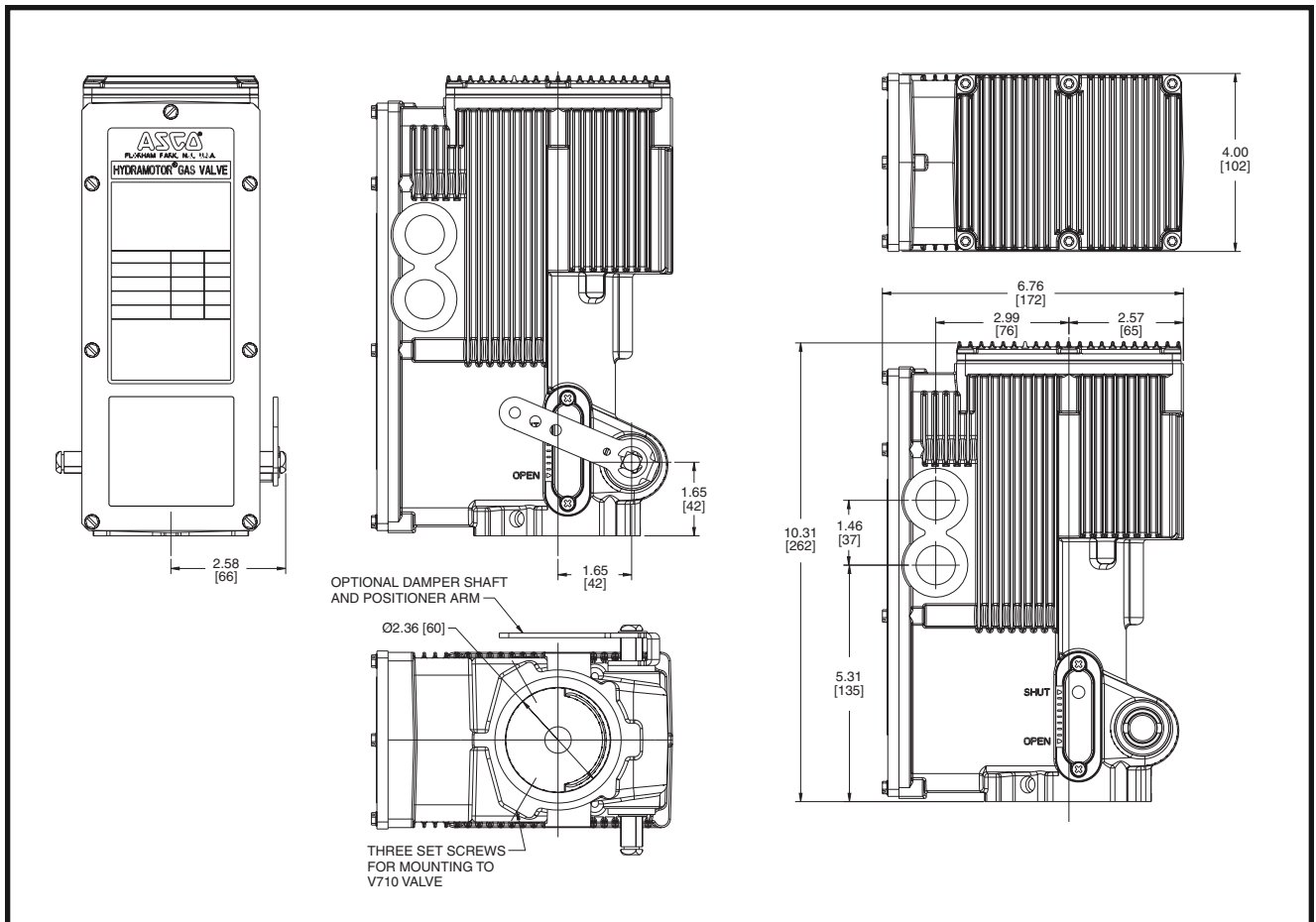
Damper shaft & arm (add Suffix 4)

One auxiliary switch (add Suffix 2)*

Damper shaft, arm & one auxiliary switch (add Suffix 5)*

*Not available with proof of closure constructions

Dimensions inches (mm)



Installation & Maintenance Instructions

HYDRAMOTOR® PUSH-TYPE LINEAR ACTUATOR
WITH USER SETTABLE LOW FIRE SETTING AND
GENERAL PURPOSE OR WATERTIGHT ENCLOSURE

AH4E
SERIES

I&M No. V9611R2

WARNING

- To prevent the possibility of death, serious injury or property damage, the Hydramotor® Actuator must be installed and serviced only by a qualified service technician avoiding the following hazards:
- Electrical hazard. Turn off all electrical power to Hydramotor® Actuator.
- Risk of electric shock – More than one disconnect switch may be required to de-energize the device for servicing.
- Pressure hazard. Depressurize valve and vent hazardous or combustible fluid to a safe area before inspection or removal of the actuator or valve from service.
- Explosion, fire or toxic gas hazards. Extinguish all open flames and avoid any type of sparking or ignition during leakage testing.

Service Notices

See separate V710 Gas Valve Installation and Maintenance Instructions for information on: Operation, Positioning, Mounting, Piping, Strainer or Filter Requirements, Flow Controls, Preventive Maintenance, and Cause of Improper Operation.

Do not install an actuator with General Purpose Enclosure in a location subject to weather, wash down, or other sources for water ingress. Use AH actuators with watertight enclosure for these locations.

DESCRIPTION

AH4E Hydramotors® are self-contained linear, push-type actuators which extend when powered and retract by spring force upon power interruption.

The AH actuator is typically used for control of gas-fired heating equipment, commonly to open and close a valve or both a valve and damper. AH4E actuators position V710 Series gas valve assemblies.

OPERATION

Application of electrical power simultaneously drives an electric pump and closes a normally-open dump valve and control valve, resulting in up to 250 pounds of force on the actuator stem. This extends the actuator stem and attached valve poppet, to open the valve and/or damper.

On reaching the low fire setpoint, a low fire switch interrupts power to the motor while maintaining power to the dump and control valves, thus stabilizing hydraulic pressure to hold shaft position.

Closing the external high fire switch causes the actuator to extend beyond the low fire point.

Upon reaching the fully extended position, a travel limit switch interrupts power to the electric motor while maintaining power to the dump valve and control valves, thus stabilizing hydraulic pressure to hold shaft position.

Opening the high fire switch de-energizes the control valve allowing the gas valve to return smoothly to the low fire position.

Position indicators on both sides of the actuator show the actual position of the valve stem.

Upon power interruption, the dump valve opens, releasing hydraulic pressure, and allowing the return spring to retract the stem and close the valve fully. Closing time is one second or less.

ACTUATOR / VALVE COMPATIBILITY

The AH4E series actuator is designed for use only with ASCO V710 valves having V15 or V25 suffix in catalog number.

OPTIONAL FEATURES

- Damper Shaft Arm** is factory-mounted on RH side. The arm is field-adjustable to 8 positions and can be switched to the LH side.
- Auxiliary Switch** One integral SPDT switch, field adjustable to actuate at any position of stroke. This is not a safety switch.
- Overtravel Proof-of-Closure Switch** A single factory set non-field adjustable SPDT switch to be used in conjunction with V710 Series Gas Valves with overtravel seal (V25 suffix in catalog number).

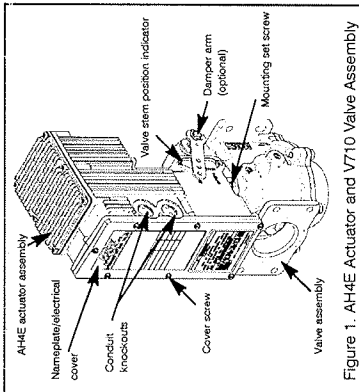


Figure 1. AH4E Actuator and V710 Valve Assembly

Force Output: 250 lbs

Stroke: 1 1/8" maximum

Electrical Characteristics:

Operating Voltage / Frequency	Current in Amperes		Holding
	Inrush	Opening	
120/60	3.6	2.2	0.18
240/60	1.9	1.2	0.09

Opening Time: Fast Opening: 14 seconds max.
Slow Opening: 26 seconds max.

Note:

- Opening time doubles below -30°F (-34°C).
- 50Hz operation increases opening time by 20%.
- Opening time is not field adjustable.
- Maximum Closing Time: One second

Ambient Temperature and Duty Cycle Limitations

The actuator may be operated in ambient temperature conditions from -40°F to 150°F (-40°C to 65°C). Actuator can be cycled open / close continuously below 108°F (42°C) for 60Hz and below 90°F (32°C) for 50 Hz. See chart below for limitations (open / close cycles) at elevated temperatures.

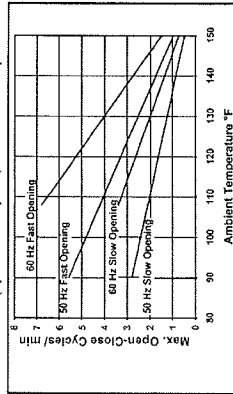


Figure 2. Wiring

Wiring must comply with local codes and the National Electrical Code. Limit controls must conform with actuator rating (volts, amperage, hertz). Wiring to meet NEC Class I, suitable for 90°C. Wire limit controls to the hot side of power supply.

- Check the nameplate and confirm that the appropriate power is being supplied to the unit. Remove the front cover (with nameplate) and set aside to access electrical connections taking care not to damage the cover gasket if supplied. A diagram is located on the inside of the cover to aid in making electrical connections.
- Remove the desired electrical knock out and install appropriate electrical fittings. Type4 fittings must be used with watertight units. Route wiring through the fitting. Take care not to scratch or otherwise damage the cover sealing surface when working on watertight enclosure.
- Connect the power to terminals 1 and 2. The neutral wire, if applicable, should be connected to terminal 1. Connect the ground wire to the grounding screw provided on the housing next to the terminal strip.
- Torque terminal screws: 8 to 12 in.-lbs [0.9 to 1.3 Nm]. Torque ground screw: 20 to 25 in.-lbs (2.3 to 2.8 Nm)
- Connect wiring from an external high-fire switch (not supplied) to the 2-way terminal block. The switch must be rated at 240V minimum and 2.5A minimum. Torque terminal screws to 8 to 12 in.-lbs [0.9 to 1.3 Nm].
- If a proof of closure or auxiliary switch is being used make those electrical connections. Disregard markings on the switch and use the markings located on the insulator to determine normally open and normally closed terminals. Torque electrical connection screws 8 to 12 in.-lbs (0.9 to 1.3 Nm). Refer to auxiliary switch on adjustment section on page 3 for instructions on adjusting switch. Proof of closure switches are set at the factory. Do not adjust proof of closure switches.

NOTICE

The AH4E actuator is fitted with a self-resetting thermal cutout device. If the recommended temperatures and duty cycles above are exceeded, the thermal cutout may trip causing the actuator to stop in its current position during valve opening. The valve closing time remains one second or less regardless of thermal cutout trip. Once the actuator cools, the cutout will self-reset and the actuator will resume operation. If the cutout trips repeatedly, verify that the application is within the ambient temperature and the duty cycle limits of the actuator. If the application is within the specified operating limits and the cutout continues to trip, replace actuator.

Damper Arm Rating: Drives damper in one direction only: 20 lb maximum at 2.85 in. radius at 20°F to 150°F (-7°C to 65°C) and 10 lb maximum at -40°F to 20°F (-40°C to -7°C).

Damper Arm Travel: 2"

INSTALLATION

Positioning/Mounting

Follow the V710 Series Gas valve and/or damper manufacturer's instructions when installing the Hydramotor®.

- AH4E actuators can be installed to operate in any position.
- Check to ensure that the mounting gasket, if applicable, is in the proper position, clean and without damage. Position the actuator to operate the valve (and damper if appropriate). Secure actuator with the three mounting set screws. Tighten set screws to 80 ± 5 in.-lbs [9.0 ± 0.5 Nm] using a 5/32" hex key wrench. (See Figure 1)

Wiring (Refer to Figure 2)

WARNING: Electrical hazard. To prevent the possibility of death, serious injury or property damage, open all circuits before inspection, service or disassembly.

- Install the cover. Be certain that the gasket (if applicable) and sealing surfaces are clean and there is no damage to the surfaces or gasket. Snug down all screws before tightening. Torque screws 20 to 25 in.-lbs (2.3 to 2.8 Nm) evenly using a crisscross pattern starting in the middle and not in the corner.
- Operate actuator (with valve) through five cycles to verify proper operation prior to use.

Auxiliary and Overtravel Proof-of-Closure Switch Ratings

120 VAC, 15 Amps, 1/3 HP
240 VAC, 7.5 Amps, 1/2 HP
Total connected load of auxiliary and overtravel proof-of-closure switches not to exceed 1800 VA.

CAUTION: Overtravel Proof-of-closure switch must only be used with V710 Series Gas Valves having an overtravel seal (V22 or V25 Suffix in catalog number).

Overtravel Proof-of-Closure Switch

The optional valve overtravel proof-of-closure switch is set at the factory to provide both a mechanical and electrical means of proving valve closed position interlock to the primary control. This switch is not to be field adjusted.

Optional Auxiliary or Overtravel Proof-of-Closure Switch (Partial Views)

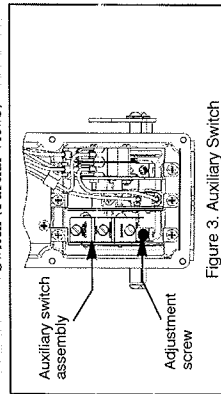


Figure 3. Auxiliary Switch

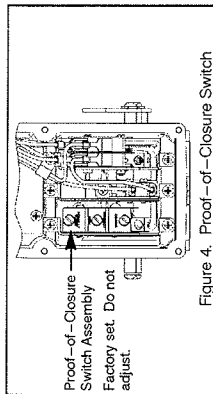


Figure 4. Proof-of-Closure Switch

Auxiliary Switch Adjustment (Refer to Figure 5)

Note: The Auxiliary switch is not a safety switch.

- Before removing the cover, review WARNING statements on page 1. Remove cover screws and nameplate/electrical cover (with gasket if fitted). Take care not to damage the sealing surfaces and cover gasket if supplied.

- Insert 1/16" Allen key into adjusting screw on auxiliary switch assembly.
- Turn screw clockwise to move setpoint towards beginning of actuator stroke. Turn screw counterclockwise to move setpoint toward the end of the actuator stroke. (approximately 8.5 turns from 0 to 100% travel)
- Cycle the actuator to verify the switch setting and readjust as required.
- Install the cover. Be certain that the gasket (if applicable) and sealing surfaces are clean and without damage. Snug down all screws before tightening. Torque screws 20 to 25 in.-lbs (2.3 to 2.8 Nm) evenly using a crisscross pattern starting in the middle.

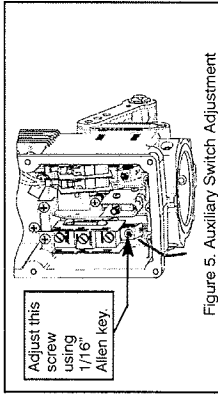


Figure 5. Auxiliary Switch Adjustment

Low Fire Switch Adjustment (Refer to Figure 6)

- Before removing the cover, review WARNING statements on page 1. Remove cover screws and nameplate/electrical cover (with gasket if fitted). Take care not to damage the sealing surfaces and cover gasket if supplied.
 - Insert a 7/64" Allen key into the adjusting screw on low fire switch assembly.
 - The AH4E actuator is supplied with the low fire switch set at approximately 50% of the valve stroke. Turn screw clockwise to move setpoint towards the beginning of actuator stroke. Turn screw counterclockwise to move setpoint towards the end of the actuator stroke. (One turn = approximately 20% of valve stroke). Note: Do not apply excessive force to the low fire adjustment screw while setting.
- Attention: Under some operating conditions, when the low fire set screw is adjusted to less than 15% of the valve stroke, the AH4E unit may not open when energized from the closed position. Please unscrew the low fire set screw in 1/8th turn counterclockwise increments until the unit opens when energized. Then further apply 1/2 turn counterclockwise.
- Cycle the actuator several times to verify the switch setting and readjust as required.
 - Install the cover. Be certain that the gasket (if applicable) and sealing surfaces are clean and without damage. Snug down all screws before tightening. Torque screws 20 to 25 in.-lbs (2.3 to 2.8 Nm) evenly using a crisscross pattern starting in the middle.

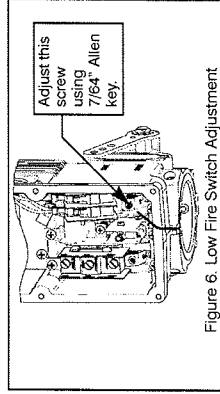


Figure 6. Low Fire Switch Adjustment

Damper Arm Adjustment

To reposition the damper arm, remove the c-ring retainer and reposition damper arm and reinstall c-ring. When repositioning arm onto the opposite side, remove c-rings on both sides and reposition and install on opposite sides. DO NOT remove the square damper shaft.

MAINTENANCE

Before inspection, maintenance or rebuild, review WARNING statements on page 1. Maintenance should include annual inspection and cleaning. Use a mild cleaning fluid, not aggressive solvents to remove dirt and oil. Organize a maintenance schedule based on environment and frequency of use. Check for loose electrical and mechanical connections and replace damaged parts. Do not remove the top cover for maintenance. There are no serviceable parts contained inside the actuator housing.

Field Service Notice

Field service replacement kits are limited to the following:

- Auxiliary Switch Replacement Kit 296804
- Proof of Closure Switch Replacement Kit 296806
- Travel Limit Switch Replacement Kit 296807
- Gasket and Screw Replacement Kit 296808
Kit contains:
 - Front cover gasket and screws
 - Window o-ring and screws
 - Mounting gasket and set screws
- Low Fire Switch Replacement Kit 425981
To order, specify the kit or part number, as well as the actuator model number.

Auxiliary Switch Replacement (Refer to Figure 7)

Note: The Auxiliary switch is not a safety switch.

- Before removing the cover, review WARNING statements on page 1. Remove the front cover (with nameplate) and set aside. Take care not to damage the cover gasket if supplied or sealing surfaces. A diagram is located on the inside of the cover to aid in making electrical connections.
- Disconnect auxiliary switch wiring.
- Remove two mounting screws and the auxiliary switch.
- Install new auxiliary switch in the actuator making sure that the fork of the switch actuation lever engages the indicator arm as shown in Figure 7.
- Torque mounting screws 20 to 25 in.-lbs (2.3 to 2.8 Nm).
- Reconnect switch wiring and torque terminal screws 8 to 12 in.-lbs (0.9 to 1.3 Nm).

- See instructions on page 3 for auxiliary switch adjustment, starting at Step 2.

Proof of Closure Switch Replacement (Refer to Figure 7)

Same as auxiliary switch replacement except switch must NOT be adjusted.

Low Fire Switch Replacement (Refer to Figure 7)

Same as auxiliary switch replacement. Make a note of terminal connections before disassembly. Ensure terminals are replaced in the same positions.

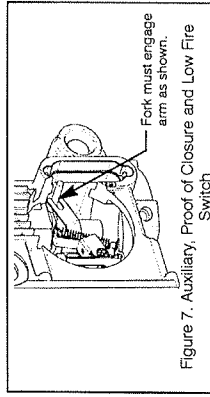


Figure 7. Auxiliary, Proof of Closure and Low Fire Switch

Travel Limit Switch Replacement (Refer to Figure 8)

- Before removing the cover, review WARNING statements on page 1. Remove the front cover (with nameplate) and set aside. Take care not to damage the cover gasket if supplied or sealing surfaces. A diagram is located on the inside of the cover to aid in making electrical connections.
- Remove the two mounting screws.
- Disconnect wiring from the travel limit switch taking care not to strain the wire connection at the terminal.
- Install new travel limit switch. Torque mounting screws 20 to 25 in.-lbs (2.3 to 2.8 Nm). Travel limit switches are set at the factory. DO NOT adjust.
- Plug terminal connections to travel limit switch.
- Install the cover. Be certain that the gasket (if applicable) and sealing surfaces are clean and without damage. Snug down all screws before tightening. Torque screws 20 to 25 in.-lbs (2.3 to 2.8 Nm) evenly using a crisscross pattern starting at the middle.
- Operate actuator (with valve) through five cycles to verify proper operation prior to use.

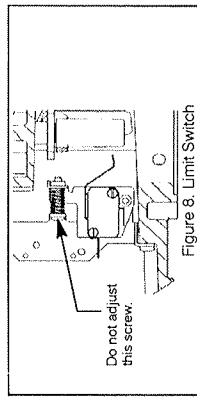


Figure 8. Limit Switch

Gasket replacement

The gaskets have an adhesive attachment. Use a nonmarrying tool to peel off the old gasket. Remove backing from new gasket and stick on in the same location as the old gasket.

General Description

These 2-way normally closed valve bodies are designed for on/off control of commercial or industrial gas burners. The V710(B) is designed exclusively for use with the AH(E) Hydramotor® actuator. The AH(E) Hydramotor valve consists of two assemblies; the V710(B) valve body and the AH(E) Hydramotor actuator.

The V710(B) is a push-to-open valve which opens when the valve stem is depressed by an AH(E) Hydramotor. An internal return spring closes the valve when the Hydramotor actuator is de-energized. Optional flange adapters are available for ease of installation and service.

Construction

Valve Parts in Contact with Fluids	
Body	Die-cast aluminum
Bonnet	Die-cast aluminum
Seals	Nitrile
Springs	Zinc-plated steel
Stem Bushing	Delrin
Valve Stem	303 stainless steel
Discs	NBR
Retaining Ring	303 stainless steel
Pipe Plugs	Zinc-plated steel
Seal Ring	PTFE (models with overtravel)
Stem Connector	303 stainless steel

Model Types

Quick Opening Trim: (Standard)

For applications where metered flow control is not required.

Quick Opening w/Valve Seal Overtravel Trim: (Suffix V22)

For any "on-off" application where the user, code or approval agency requires a valve seal overtravel arrangement.

Specifications

Closeoff Pressure: 50 psi (3.5 bar) maximum

Pressure Taps: Two 1/8" NPT downstream, two 1/8" NPT upstream.

Fluid: Fuel Gas



Series V710(B) valve body with AH(E) Hydramotor

Installation

V710(B) valve body mounts in any position directly to AH2(E) Hydromotor Actuator.



Approvals

V710(B) valve with AH2E Hydramotor

UL listed to standard 429 "Electrically Operated Valves," Guide Y10Z, File MP932 Safety Valves

FM Approved to Class 7400 "liquid and gas safety shutoff valves."

CSA Certified to:

1. Automatic Gas Valves ANSI Z21.21 CSA 6.5, C/I, File 109157 and 113070.
2. Automatic Gas Safety Shutoff Valves (CGA 3.9), File 113070
3. Standard C22.2 No. 139, File 109157 and 113070

Specifications (English units)

Pipe Size (ins.)	Orifice Size (ins.)	Cv Flow Factor	Flow Capacity ft ³ /hr Ⓞ	Gas Capacity Btu/hr. Ⓞ	Operating Pressure Differential (psi)		Fluid Temp. °F		Catalog Numbers		Const. Ref.	Approx. Shipping Weight (lbs)
					Min.	Max.	Min.	Max.	Quick Opening Trim	Quick Opening w/Valve Seal Overtravel Trim		
COMBUSTION (Fuel Gas) - Normally Closed												
3/4	1 5/8	14	754	754,900	0	15	-40	150	V710EBS	V710EBSV22	1	4.3
1	1 5/8	20	1,078	1,078,400	0	15	-40	150	V710FBS	V710FBSV22	1	4.2
1 1/4	2 3/32	44	2,353	2,353,000	0	15	-40	150	V710GBS	V710GBSV22	2	6.3
1 1/2	2 3/32	57	3,048	3,048,000	0	15	-40	150	V710HBS	V710HBSV22	2	6.1
2	2 3/32	74	3,956	3,956,500	0	15	-40	150	V710JBS	V710JBSV22	2	5.8
2 (High Flow)	3	91	4,906	4,906,800	0	15	-40	150	V710MBS	V710MBSV22	3	13.2
2 1/2	3	120	6,470	6,470,500	0	15	-40	150	V710KBS	V710KBSV22	3	12.7
3	3	160	8,627	8,627,300	0	15	-40	150	V710LBS	V710LBSV22	3	11.7

Ⓞ 1' W.C. Drop @ 2' W.C. Inlet Pressure, 1,000 Btu/cu.ft. or more, 0.64 Specific Gravity Gas.

Specifications (Metric units)

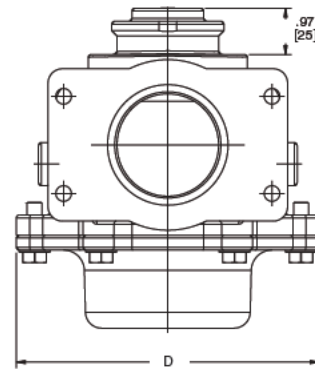
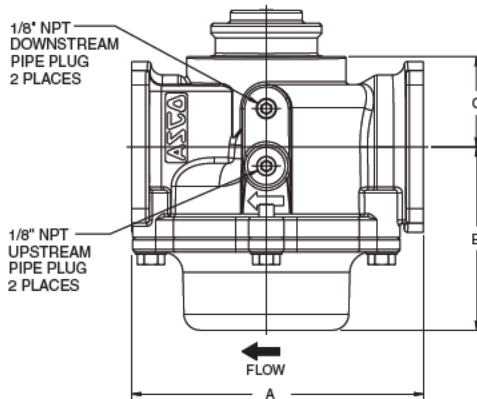
Pipe Size (ins.)	Orifice Size (mm)	Kv Flow Factor	Flow Capacity m ³ /hr Ⓞ	Gas Capacity Btu/hr. Ⓞ	Operating Pressure Differential (bar)		Fluid Temp. °C		Catalog Numbers		Const. Ref.	Approx. Shipping Weight (kgs)
					Min.	Max.	Min.	Max.	Quick Opening Trim	Quick Opening w/Valve Seal Overtravel Trim		
COMBUSTION (Fuel Gas) - Normally Closed												
3/4	41	11.9	21	754,900	0	1	-40	66	V710EBS	V710EBSV22	1	2.0
1	41	17.1	31	1,078,400	0	1	-40	66	V710FBS	V710FBSV22	1	1.9
1 1/4	53	37.5	67	2,353,000	0	1	-40	66	V710GBS	V710GBSV22	2	2.9
1 1/2	53	48.6	86	3,048,000	0	1	-40	66	V710HBS	V710HBSV22	2	2.8
2	53	63.1	112	3,956,500	0	1	-40	66	V710JBS	V710JBSV22	2	2.6
2 (High Flow)	76	77.6	139	4,906,800	0	1	-40	66	V710MBS	V710MBSV22	3	6.0
2 1/2	76	102.4	183	6,470,500	0	1	-40	66	V710KBS	V710KBSV22	3	5.8
3	76	136.5	244	8,627,300	0	1	-40	66	V710LBS	V710LBSV22	3	5.3

Ⓞ 1' W.C. Drop @ 2' W.C. Inlet Pressure, 1,000 Btu/cu.ft. or more, 0.64 Specific Gravity Gas.

Dimensions inches (mm)

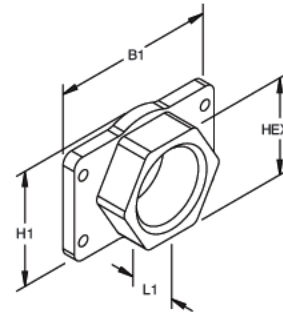
Const. Ref.		A	B	C	D
1	ins.	5.3	3.48	1.46	5.39
	mm	135	88	37	137
2	ins.	6.09	3.83	1.89	6.32
	mm	155	97	48	161
3	ins.	7.80	5.28	2.38	7.94
	mm	198	134	60	202
4	ins.	13.88	5	7.40	9
	mm	353	127	188	229

Const. Ref. 1-3

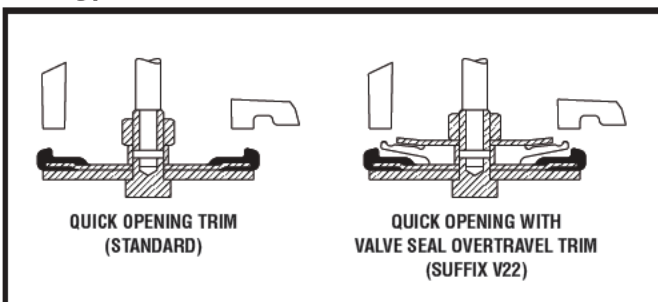


Flange Adapters

Flange Adapters		B1	H1	L1	HEX
3/4" - 1"	ins.	4.8	2.5	1.27	2.5
	mm	122	76	32	64
1 1/4" - 2"	ins.	5	3.56	1.38	3
	mm	127	90	35	76
2" (High Flow) - 3"	ins.	7	4.5	2.015	4.5
	mm	178	114	51	114



Trim Types



Flange Adapter Kits (Optional)*

Pipe Size (ins.)	Inlet & Outlet Adapter/Hardware Kit
3/4	296659-001
1	296659-002
1 1/4	296659-005
1 1/2	296659-006
2	296659-007
2 (High Flow)	296659-008
2 1/2	296659-009
3	296659-010

* Please refer to the Double Gas Shutoff Valves catalog pages for more kit information.

TWO WAY - NORMALLY CLOSED

V710 Valve Body

Pipe Sizes 3/4" to 3" NPT, 4" Flange

ASCO General Controls

**V710
SERIES**

General Description

These 2 way normally closed globe type valve bodies are designed for on/off or proportional control of commercial or industrial gas burners. The V710 is designed exclusively for use with the AH Hydramotor actuator. The AH Hydramotor valve consists of two assemblies; the valve body and the AH Hydramotor actuator.

The V710 is a Push-to-Open valve which opens when the valve stem is depressed by an AH Hydramotor actuator. An internal return spring closes the valve when the Hydramotor actuator is de-energized.

Model Types:

Quick Opening Trim: (Standard)

For applications where metered flow control is not required.

Quick Opening w/Valve Seal Overtravel Trim: (Suffix V22)

For any "on-off" application where the user, code or approval agency requires a valve seal overtravel arrangement.

Linear Trim: (Suffix V15)

For applications that require flow control, such as slow opening, low fire turn down, or proportional control.

Linear w/Valve Seal

Overtravel Trim: (Suffix V25)

For applications where both valve seal overtravel and flow control are required. (Not available in 4" pipe sizes.)

Specifications:

Pressure Taps: two 1/4" NPT downstream, two 1/4" NPT upstream.

Fluid: Fuel Gas

Valve Parts in Contact with Fluid:

Body - 3/4" to 3" NPT -

Die-cast aluminum

4" Flange - cast iron

Bonnet - Die-cast aluminum

Seals - Nitrile

Springs - Zinc-plated music wire

Stem Bushing - Delrin

Valve Stem - 303 s.s.

Retaining Pin - 303 s.s.

Retaining Ring - 17-7 s.s.

Pipe Plugs - Zinc-plated steel

Seal Ring - Teflon (models with overtravel)

Closeoff Pressure: 25 psi maximum

Installation:

V710 valve body mounts in any position directly to the AH2 Hydramotor actuator.



Series V710 Valve Body with AH Hydramotor

Approvals:

V710 Valve with AH hydramotor.

File # MP932, Vol.17, Sec. 3; Safety Valves

Report # L2105011; Automatic Safety Shut-off Valves

Report # L2105011; Automatic Valves

JI 3000606 Gas Safety Shut-off Valves

Ordering Information:

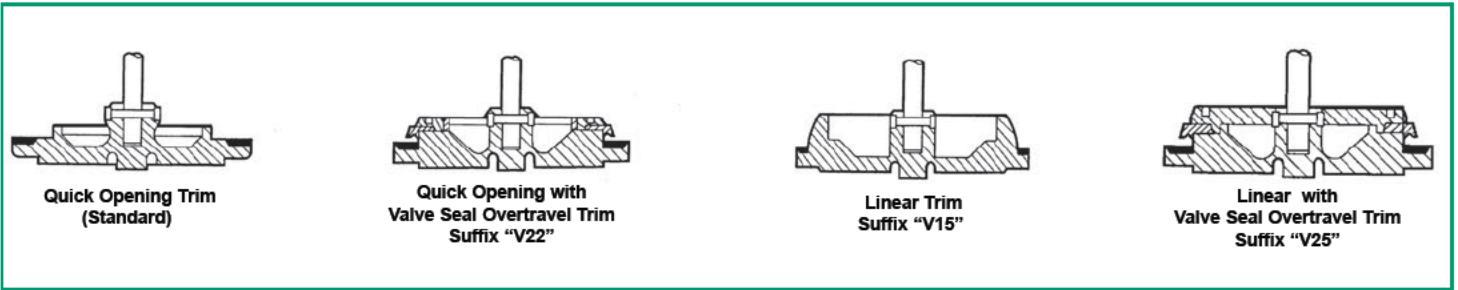
Important: Order by Catalog Number .
e.g. V710EASV22

Specifications

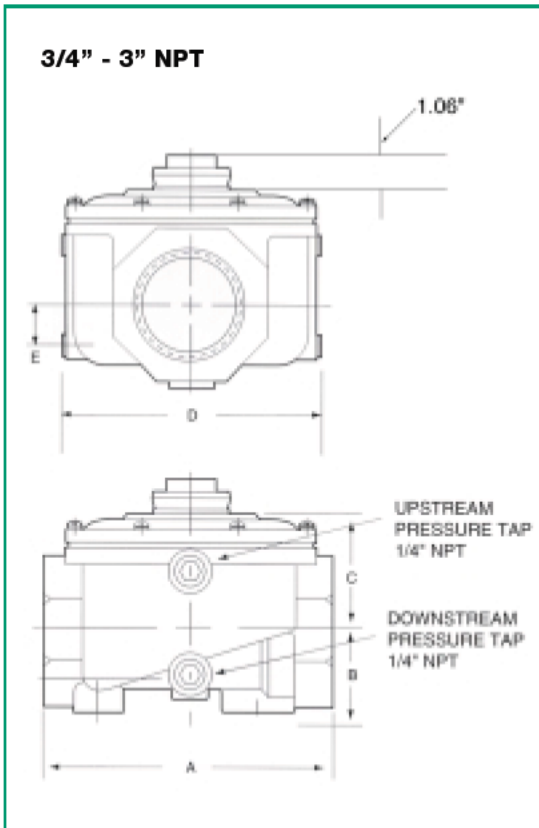
Pipe Size (ins.)	Minimum Cv Flow Factor	Minimum Gas Capacity* Btu/hr	Operating Pressure Differential (psi)		Fluid & Ambient Temperature °F		Catalog Numbers			
			Min.	Max.	Min.	Max.	Quick Opening Trim	Quick Opening w/Valve Seal Overtravel Trim	Linear Trim	Linear w/Valve Seal Overtravel Trim
NORMALLY CLOSED (Closed when released)										
3/4	12	665,000	0	15	-40	150	V710EAS	V710EASV22	V710EASV15	V710EASV25
1	17	960,000	0	15	-40	150	V710FAS	V710FASV22	V710FASV15	V710FASV25
1 1/4	25	1,406,000	0	15	-40	150	V710GAS	V710GASV22	V710GASV15	V710GASV25
1 1/2	30	1,717,000	0	15	-40	150	V710HAS	V710HASV22	V710HASV15	V710HASV25
2	64	3,620,000	0	10	-40	150	V710JAS	V710JASV22	V710JASV15	V710JASV25
2 1/2	75	4,250,000	0	10	-40	150	V710KAS	V710KASV22	V710KASV15	V710KASV25
3	92	5,230,000	0	10	-40	150	V710LAS	V710LASV22	V710LASV15	V710LASV25
4	180	10,200,000	0	15	-40	150	V710NCF	V710NCFV22	V710NCFV15	N/A

* 1" W. C. Drop @ 2" W. C. Inlet Pressure, 1,000 Btu/Cu. Ft or more, 0.64 Spec. Grav. Gas

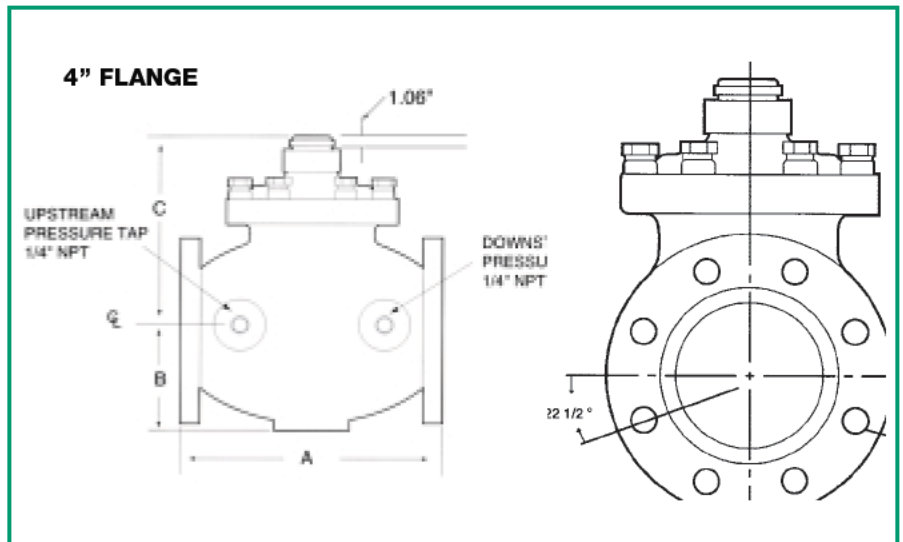
Trim Types



Dimensions - inches



Pipe	Dimensions (inches)					Shipping Weight (lbs)
	A	B	C	D	E	
3/4	5.78	1.95	2.64	5.19	1.16	4.0
1	5.78	1.95	2.64	5.19	1.16	4.0
1 1/4	5.78	2.01	2.94	5.19	0.70	4.2
1 1/2	5.78	2.01	2.94	5.19	0.70	4.2
2	8.12	2.66	3.05	8.01	0.96	9.5
2 1/2	9.00	2.96	3.87	8.01	0.70	13
3	9.00	2.96	3.87	8.01	0.70	12
4	13.88	5.00	7.40	9.00	0.00	100



ASCO Valve - Americas

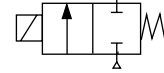
Automatic Switch Co.
Hanover Rd. , Florham Park, NJ 07932
Tel: (973) 966-2000 Fax: (973) 966-2628
website: www.ascovalve.com

ASCO / General Controls
Valencia, CA 91355
Tel: (805) 294-1770
Fax: (805) 294-1766

ASCOELECTRIC limited
Brantford, Ontario N3T 5M8
Tel: (519) 758-2700
Fax: (519) 758 5540

ASCOMATICA, S. A. de C.V.
Mexico City, D. F. CP11700
Tel: (52) 5-596-77-41
Fax: (52) 5-596-77-19

ASCOVAL, Ind E Com Ltda.
06465-030 Barueri, São Paulo, Brazil
Tel: (55) 11-421-5333
Fax: (55) 11-421-5185



Features

- 2 way Normally Closed operation.
- Die-cast aluminum bodies.
- For positive shutoff on pilot or main gas lines of commercial and industrial gas burners.
- Valves provided with 1/8" NPT up stream and down stream pipe tap with plug for routine testing.
- Suitable for ambient temperatures up to 175°F.

Specifications

Fluid Handled: Fuel Gas

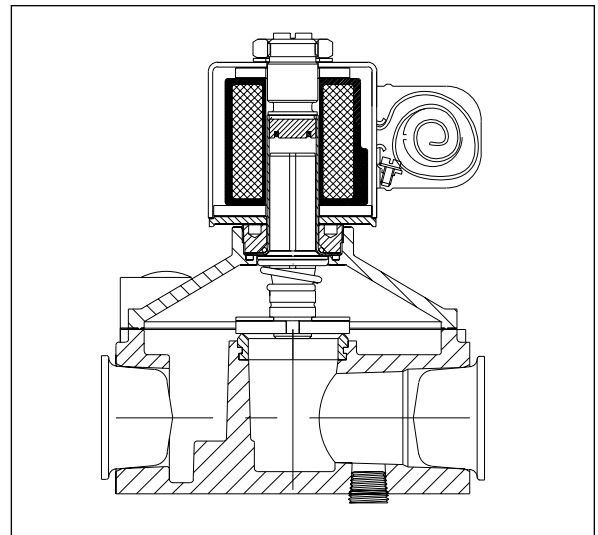
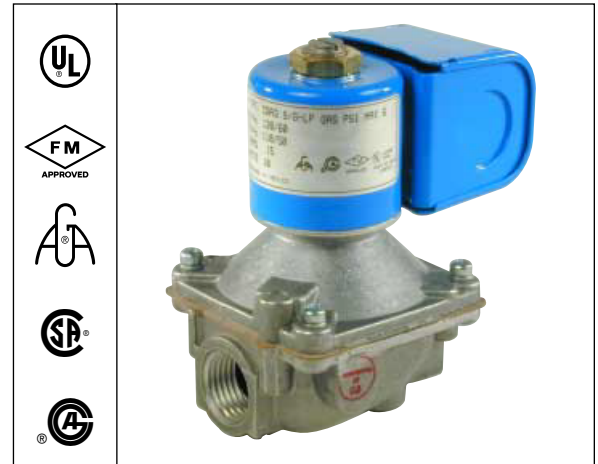
Fluid Temperature: 77°F (25°C) Nominal

Ambient Temperature: -40°F to 175°F (-40° to 80°C)

Installation: Mount with coil housing upright or horizontal.

Construction

Valve Parts in Contact with Fluids	
Body	Aluminum
Seals and Disc	NBR
Washer	302 Stainless Steel
Core Tube	304L Stainless Steel
Core and Plugnut	430F Stainless Steel
Core Guide	PTFE
Springs	302F Stainless Steel
Shading Coil	Copper
Body Gasket	Cork
Pipe Plug	Zinc Plated Steel



Electrical

Standard Coil and Class of Insulation	Watt Rating and Power Consumption				Spare Coil Part No.		
	DC Watts	AC			General Purpose		
		Watts	VA Holding	VA Inrush	24/60	120/60 110/50	240/60 220/50
F	--	10	18	77	CS4AF01A18	CS4AF02A18	CS4AF04A18
Standard lead length 18"							

Solenoid Enclosures

Standard: Junction Box Housing with two 7/8" knock-outs.

Approvals:

UL listed Shutoff Valve; Guide No.Y10Z (File MP-932) to standard UL 429; "Electrically Operated Valves".

FM approved to Class No. 7400 "Liquid and Gas Safety Shutoff Valves" J.I.2X2A8.AF Class 7411 (3/8" thru 3/4" only)

AGA - ANSI Z21.21-CGA 6.5 Class 3371 83 "Automatic Valves for Gas Appliances" Certificate 109157-0000-000014.

CGA - ANSI Z21.21-CGA 6.5 Class 3371 03 "Automatic Valves for Gas Appliances" Certificate 109157-0000-000014.

CGA - C/I (3.9) Class 3371 04 "Automatic Safety Shutoff Gas Valves" Certificate 109157-0000-000014.

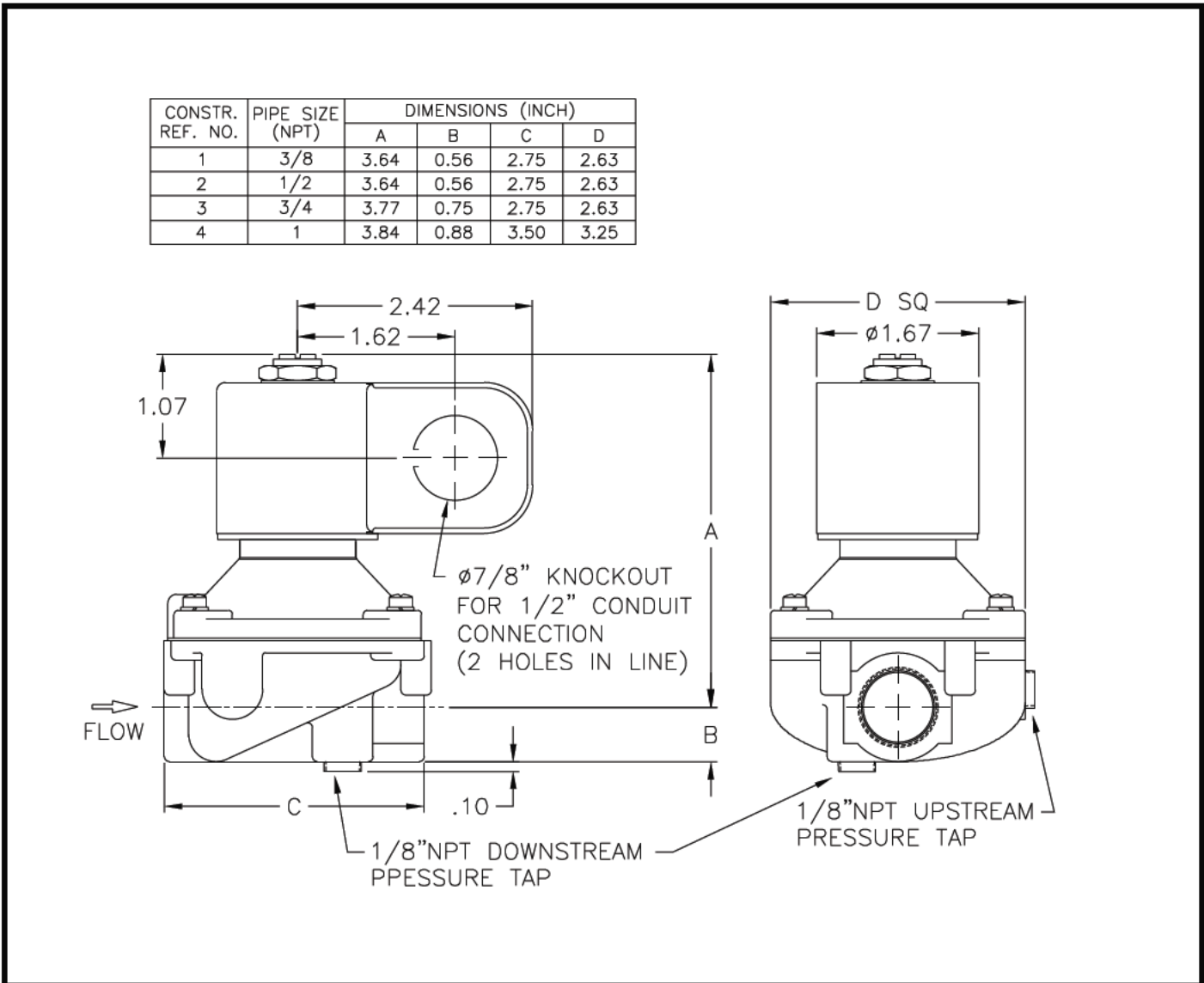
CSA Standard C22.2 No. 139, "Electrically Operated Valves" Certificate 109157-0000-000014.

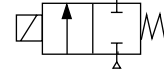
Specifications

Pipe Size (ins.)	Orifice Size (ins.)	CV Flow Factor	Gas Capacity ① Btu/hr	Operating Pressure Differential (psi)		Catalog Number ②			Constr. Ref. No.	Watt Rating/ Class of Coil Insulation ②
				Min.	Max.	24 V 60 Hz.	110-120 V 50-60 Hz.	220-240 V 50-60 Hz.		
NORMALLY CLOSED (Closed when de-energized)										
3/8	0.456	4	215,000	0	0.5	K3A431T	K3A432T	K3A434T	1	10/F
1/2	0.687	6	350,000	0	0.5	K3A441T	K3A442T	K3A444T	2	10/F
3/4	0.812	9	520,000	0	0.5	K3A451T	K3A452T	K3A454T	3	10/F
1	1.000	14	755,000	0	0.5	K3A461T	K3A462T	K3A464T	4	10/F

Notes: ① 1" W.C. Drop @ 2" W.C. Inlet Pressure, 1, 000 Btu/Cu.Ft. or more, 0.64 Specific Gravity Gas
② Standard lead length 18"

Dimensions: inches





Features

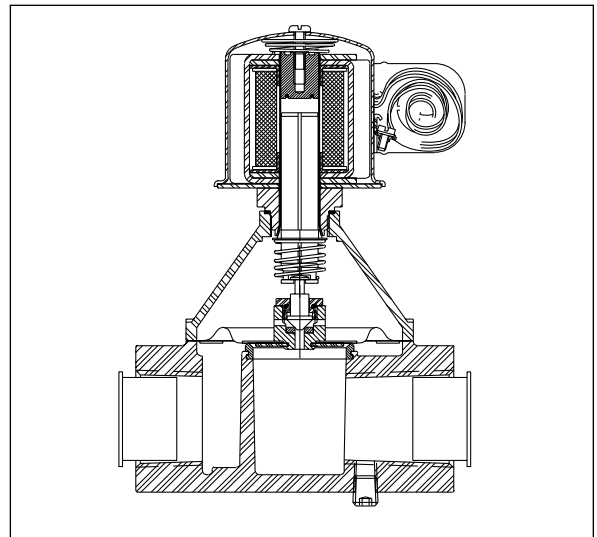
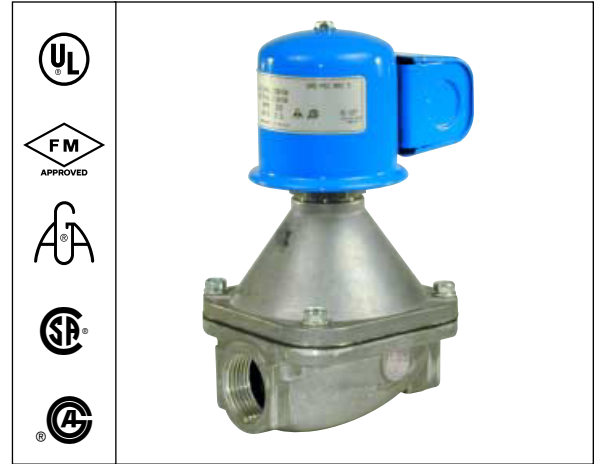
- 2 way Normally Closed operation.
- Die-cast aluminum bodies.
- For positive shutoff on pilot or main gas lines of commercial and industrial gas burners.
- Valves provided with 1/8" NPT upstream and downstream pipe tap with plug for routine testing.
- Suitable for ambient temperatures up to 175°F.

Specifications

Fluid Handled: Fuel Gas
 Fluid Temperature: 77°F (25°C) Nominal
 Ambient Temperature: -40°F to 175°F (-40° to 80°C)
 Installation: Mount with coil housing upright or horizontal.

Construction

Valve Parts in Contact with Fluids	
Body	Aluminum
Seals and Disc	NBR
Washer	302 Stainless Steel
Core Tube	304L Stainless Steel
Core and Plugnut	430F Stainless Steel
Core Guide	PTFE
Springs	302F Stainless Steel
Shading Coil	Copper
Pipe Plug	Zinc Plated Steel



Electrical

Standard Coil and Class of Insulation	Watt Rating and Power Consumption				Spare Coil Part No.		
	DC Watts	AC			General Purpose		
		Watts	VA Holding	VA Inrush	24/60	120/60 110/50	240/60 220/50
F	-	17.5	30	168	CS5AF01A18	CS5AF02A18	CS5AF04A18
Standard lead length 18"							

Solenoid Enclosures

Standard: Junction Box Housing with two 7/8" knock-outs.

Approvals:

- UL listed Shutoff Valve; Guide No.Y10Z (File MP-932) to standard UL 429; "Electrically Operated Valves".
- FM approved to Class No. 7400 "Liquid and Gas Safety Shutoff Valves" J.I.2X2A8.AF Class 7411 (3/8" thru 3/4" only)
- AGA - ANSI Z21.21-CGA 6.5 Class 3371 83 "Automatic Valves for Gas Appliances" Certificate 109157-0000-000014.
- CGA - ANSI Z21.21-CGA 6.5 Class 3371 03 "Automatic Valves for Gas Appliances" Certificate 109157-0000-000014.
- CGA - C/I (3.9) Class 3371 04 "Automatic Safety Shutoff Gas Valves" Certificate 109157-0000-000014.
- CSA Standard C22.2 No. 139, "Electrically Operated Valves" Certificate 109157-0000-000014.

Specifications

Pipe Size (ins.)	Orifice Size (ins.)	CV Flow Factor	Gas Capacity ① Btu/hr	Operating Pressure Differential (psi)		Fluid & Ambient Temperature °F		Catalog Number			Constr. Ref. No.	Watt Rating/Class of Coil Insulation ②
				Min.	Max.	Min.	Max.	24 V 60 Hz.	110-120 V 50-60 Hz.	220-240 V 50-60 Hz.		
NORMALLY CLOSED (Closed when de-energized)												
3/4	1.250	12	667,000	0	5	-40	175	K3A651T	K3A652T	K3A654T	1	17.5/F
1	1.250	17	960,000	0	5	-40	175	K3A661T	K3A662T	K3A664T	1	17.5/F
1 1/4	1.750	23	1,290,000	0	5	-40	175	K3A671T	K3A672T	K3A674T	2	17.5/F
1 1/2	1.750	27	1,509,000	0	5	-40	175	K3A681T	K3A682T	K3A684T	2	17.5/F

Notes: ① 1" W.C. Drop @ 2" W.C. Inlet Pressure, 1, 000 Btu/Cu.Ft. or more, 0.64 Specific Gravity Gas
② Standard lead length 18"

Dimensions: inches

Constr. Refs. 1 and 2

Constr. Ref. No.	Dimensions		
	A	B	C
1	6.50 (165.1)	0.88 (22.35)	4.00 (101.60)
2	6.83 (173.48)	1.25 (31.75)	5.25 (133.35)

Features

- 2 way normally closed operation.
- For gas pilot control of commercial and industrial gas burners.
- Direct lift with resilient soft seating for tight shut-off.
- Valves provided with 1/8" NPT down stream pipe tap with plug for routine testing.
- Suitable for ambient temperatures up to 175°F.

Specifications

Fluid Handled: Fuel Gas
 Fluid Temperature: -40°F to 175°F (-40° to 80°C)
 Ambient Temperature: -40°F to 175°F (-40° to 80°C)
 Installation: Mountable in any position

Construction

Valve Parts in Contact with Fluids	
Body	Aluminum
Seals and Disc	NBR
Core Tube	305 Stainless Steel
Core and Plugnut	430F Stainless Steel
Springs	302 Stainless Steel
Shading Coil	Copper
Pipe Plug	Zinc Plated Steel

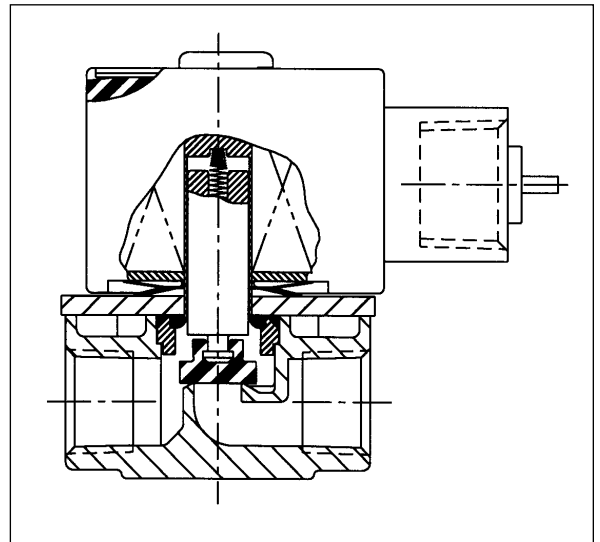
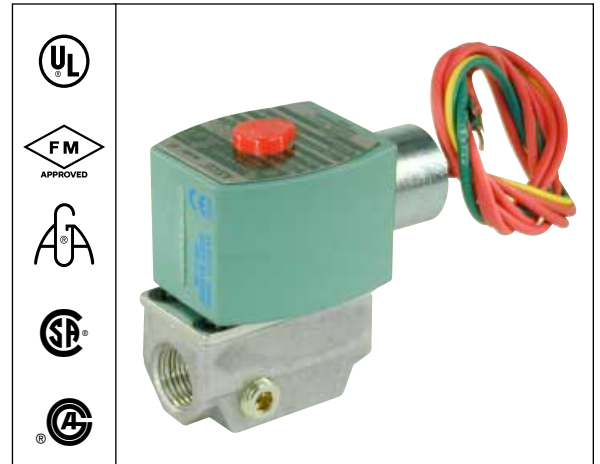
Electrical

Standard Coil and Class of Insulation	Watt Rating and Power Consumption				Spare Coil Part No.		
	DC Watts	AC			General Purpose		
		Watts	VA Holding	VA Inrush	24/60	120/60 110/50	240/60 220/50
F	--	6.1	16	40	238210-005-D	238210-032-D	238210-058-D

Standard lead length 18" (72" leads optional - change suffix "D" to "K")

Solenoid Enclosures

Standard: Watertight, Types 1, 2, 3, 3S, 4, and 4X with 1/2" conduit hub.



Approvals:

UL listed Shutoff Valve; Guide No.Y10Z (File MP-932) to standard UL 429; "Electrically Operated Valves".

FM approved to Class No. 7400 "Liquid and Gas Safety Shutoff Valves".

AGA - ANSI Z21.21-CGA 6.5 Class 3371 83 "Automatic Valves for Gas Appliances" Certificate 150281 (LM112872-2)

CGA - ANSI Z21.21-CGA 6.5 Class 3371 03 "Automatic Valves for Gas Appliances" Certificate 150281 (LM112872-2)

CGA - C/I (3.9) Class 3371 04 "Automatic Safety Shutoff Gas Valves" Certificate 150281 (LM112872-2)

CSA Standard C22.2 No. 139, "Electrically Operated Valves" Class 3221 01, File LR 702258

CE - EMC (Electromagnetic Compatibility) 89/336/EEC, Low Voltage 72/23/EEC

Specifications

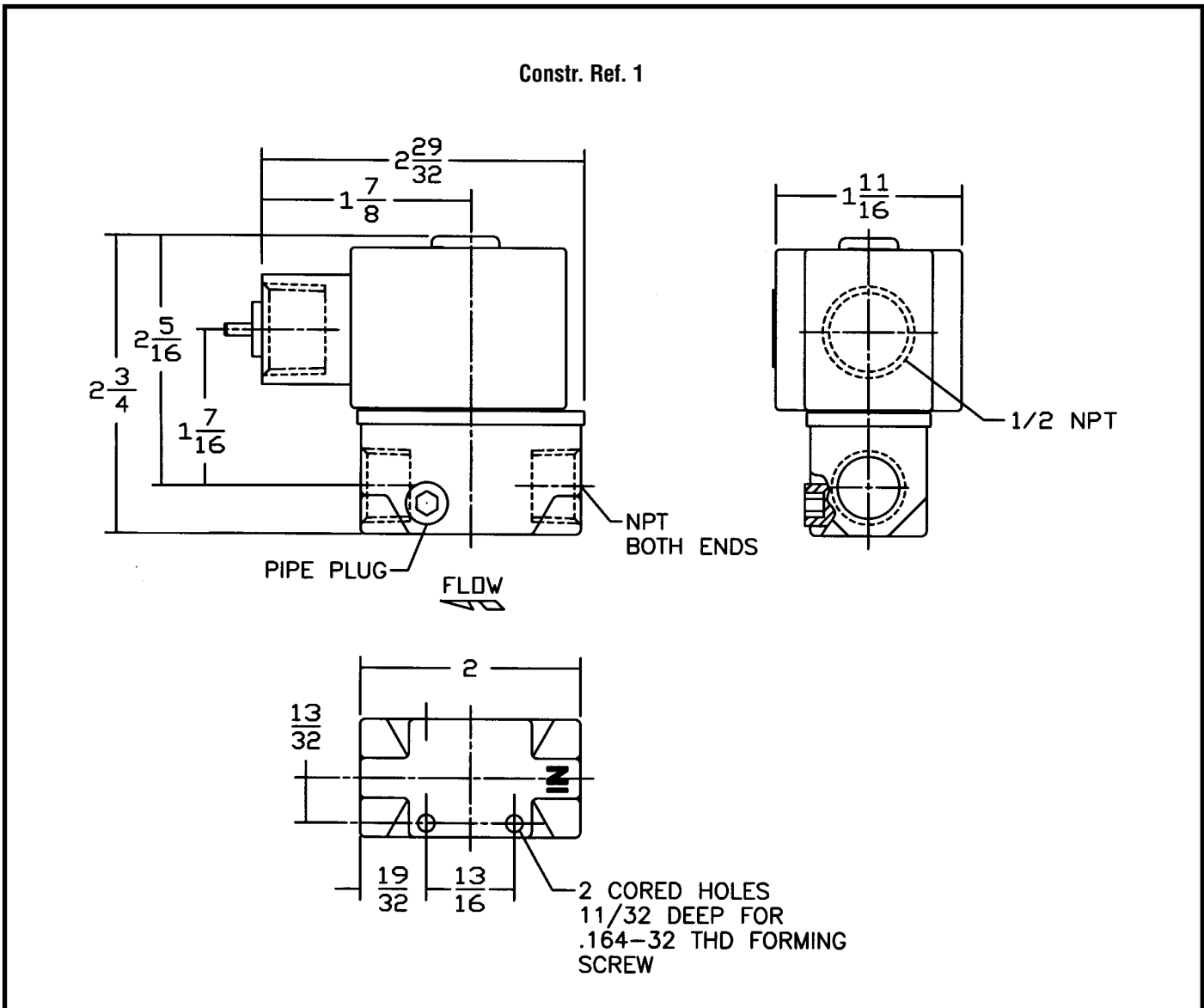
Pipe Size (ins.)	Orifice Size (ins.)	CV Flow Factor	Gas Capacity ① Btu/hr	Operating Pressure Differential (psi)		Catalog Number ③			Constr. Ref. No.	Watt Rating/ Class of Coil Insulation ②
				Min.	Max.	24 V 60 Hz.	110-120 V 50-60 Hz.	220-240 V 50-60 Hz.		
NORMALLY CLOSED (Closed when de-energized)										
1/8	5/16	1.0	53,700	0	15	SV311A01N6AF5	SV311A02N6AF5	SV311A04N6AF5	1	6.1/F
1/4	5/16	1.1	59,000	0	15	SV311A01N6BF5	SV311A02N6BF5	SV311A04N6BF5	1	6.1/F
3/8	5/16	1.2	64,400	0	15	SV311A01N6CF5	SV311A02N6CF5	SV311A04N6CF5	1	6.1/F

Notes: ① 1" W.C. Drop @ 2" W.C. Inlet Pressure, 1, 000 Btu/Cu.Ft. or more, 0.64 Specific Gravity Gas

② On 50 hertz service, the watt rating for the 6.1/F solenoid is 8.1 watts.

③ Standard lead length 18" (72" leads optional, add suffix "K")

Dimensions: inches



8210 General Service Solenoid Valves Pilot Operated • Brass or Stainless Steel Bodies

Features

- Wide range of sizes
- High Flow Valves for liquid, and air/inert gas service.
- Industrial applications include:
 - Car wash
 - Laundry equipment
 - Air compressors
 - Industrial water control
 - Pumps

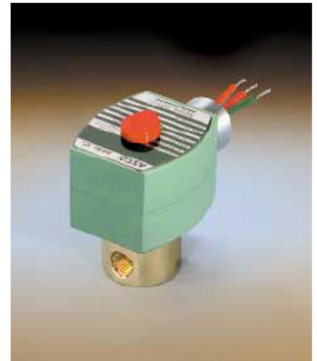


Pipe Size (ins.)	Orifice Size (ins.)	Cv Flow Factor	Operating Pressure Differential (psi)						Max. Fluid Temp. °F		Brass Body		Stainless Steel Body		Watt Rating/ Class of Coil Insulation ϕ		Voltage	MSA #	
			Max. AC			Max. DC			AC	DC	Catalog Number	UL ϕ Listing	Catalog Number	UL ϕ Listing	AC	DC			
			Air-Inert Gas	Water	Light Oil @ 300 SSU	Air-Inert Gas	Water	Light Oil @ 300 SSU											
NORMALLY CLOSED (Closed when de-energized), NBR or PTFE ϕ Seating																			
3/8	3/8	1.5	ϕ	150	125	-	-	-	-	180	-	8210G73 ϕ	●	-	-	6.1/F	-	120/60, 110/50	20194
3/8	5/8	3	0	150	150	-	-	-	-	180	-	8210G93	○	-	-	10.1/F	-	120/60, 110/50	20221
3/8	5/8	3	5	200	150	135	-	-	-	180	-	8210G1	○	-	-	6.1/F	-	120/60, 110/50	20032
3/8	5/8	3	5	200	150	135	-	-	-	180	-	SC8210G1	○	-	-	6.1/F	-	120/60, 110/50	21037
1/2	7/16	2.2	ϕ	150	125	-	-	-	-	180	-	8210G15 ϕ	●	-	-	6.1/F	-	120/60, 110/50	20126
1/2	5/8	4	0	150	150	-	-	-	-	180	-	8210G94	○	-	-	10.1/F	-	120/60, 110/50	20229
1/2	5/8	4	0	150	150	-	-	-	-	180	-	SC8210G94	○	-	-	10.1/F	-	120/60, 110/50	21031
1/2	5/8	4	0	150	150	-	-	-	-	180	-	EF8210G94	○	-	-	10.1/F	-	120/60, 110/50	20236
1/2	5/8	4	0	150	150	-	-	-	-	180	-	JKF8210G94	○	-	-	10.1/F	-	120/60, 110/50	20242
1/2	5/8	4	0	150	150	125	-	-	-	175	-	-	-	8210G87	●	17.1/F	-	120/60, 110/50	20201
1/2	5/8	4	5	-	-	-	125	100	100	-	150	8210G2	○	-	-	-	11.6/F	12/DC	20061
1/2	5/8	4	5	200	150	135	-	-	-	180	-	8210G2	○	-	-	6.1/F	-	120/60, 110/50	20043
1/2	5/8	4	5	200	100	135	-	-	-	180	-	8210G2	○	-	-	6.1/F	-	24/60	20058
1/2	5/8	4	5	-	-	-	125	100	100	-	150	8210G2	○	-	-	-	11.6/F	24/DC	20062
1/2	5/8	4	5	200	150	135	-	-	-	180	-	8210G2HW	○	-	-	6.1/F	-	120/60, 110/50	20045
1/2	5/8	4	5	200	150	135	-	-	-	180	-	EF8210G2	○	-	-	6.1/F	-	120/60, 110/50	20049
1/2	5/8	4	5	200	150	135	-	-	-	180	-	SC8210G2	○	-	-	6.1/F	-	120/60, 110/50	20095
1/2	5/8	4	5	-	-	-	125	100	100	-	150	SC8210G2	○	-	-	-	11.6/F	24/DC	21134
1/2	5/8	4	5	-	-	-	125	100	100	-	150	JKF8210G2	○	-	-	-	11.6/F	24/DC	20051
1/2	5/8	4	5	300	300	300	-	-	-	175	-	8210G7	○	-	-	17.1/F	-	120/60, 110/50	20095
3/4	5/8	4.5	0	150	150	125	-	-	-	175	-	-	-	8210G88	●	17.1/F	-	120/60, 110/50	20210
3/4	3/4	5	5	125	125	125	-	-	-	180	-	8210G9	○	-	-	6.1/F	-	120/60, 110/50	20107
3/4	3/4	5	5	-	-	-	100	90	75	-	150	8210G9	○	-	-	-	11.6/F	24/DC	20121
3/4	3/4	5	5	125	125	125	-	-	-	180	-	8210G9HW	○	-	-	6.1/F	-	120/60, 110/50	20108
3/4	3/4	5	0	150	150	-	-	-	-	180	-	8210G95	○	-	-	10.1/F	-	120/60, 110/50	20250
3/4	3/4	5	0	150	150	-	-	-	-	180	-	8210G95	○	-	-	10.1/F	-	24/60	20265
3/4	3/4	5	0	150	150	-	-	-	-	180	-	EF8210G95	○	-	-	10.1/F	-	120/60, 110/50	20257
3/4	3/4	6	0	350	300	200	-	-	-	200	-	8210G26 ϕ ‡	●	-	-	16.1/F	-	120/60	21412
1	1	13	0	150	125	125	-	-	-	180	-	8210G54 ‡	●	-	-	16.1/F	-	120/60	21414
1	1	13	5	150	150	100	-	-	-	180	-	8210G4	○	-	-	6.1/F	-	120/60, 110/50	20077
1	1	13	5	-	-	-	125	125	125	-	150	EF8210G4	○	-	-	-	11.6/F	24/DC	20091
1 1/4	1 1/8	15	5	150	150	100	-	-	-	180	-	8210G8	○	-	-	6.1/F	-	120/60, 110/50	20102
1 1/2	1 1/4	22.5	0	150	125	125	-	-	-	180	-	8210G56 ‡	-	-	-	16.1/F	-	120/60	21417
1 1/2	1 1/4	22.5	5	150	150	100	-	-	-	180	-	8210G22	●	-	-	6.1/F	-	120/60, 110/50	20132
2	1 3/4	43	5	150	125	90	-	-	-	180	-	8210G100	●	-	-	6.1/F	-	120/60, 110/50	20268
NORMALLY OPEN (Open when de-energized), NBR Seating (PA Disc-Holder, except as noted)																			
3/8	5/8	3	0	150	150	125	-	-	-	180	-	8210G33	●	-	-	10.1/F	-	120/60, 110/50	20146
1/2	5/8	4	0	150	150	125	-	-	-	180	-	8210G34	●	-	-	10.1/F	-	120/60, 110/50	20154
3/4	3/4	5.5	0	150	150	125	-	-	-	180	-	8210G35	●	-	-	10.1/F	-	120/60, 110/50	20166
Notes: ϕ 5 psi on Air; 1 psi on Water. ϕ 2 Valve provided with PTFE main disc. ϕ 3 Valve includes Ultem (G.E. trademark) piston.										ϕ ○ Safety Shutoff Valve; ● General Purpose Valve. ϕ 2 On 50 hertz service, the watt rating for the 6.1/F solenoid is 8.1 watts. ϕ 3 ‡ Must have solenoid mounted vertical and upright.									
EF = Explosionproof, SC = Type F - High temperature DIN-type connector, JKF = Elongated splice box, Class F - High temperature - Screw terminals, HW = Hot water construction																			

8262 General Service Solenoid Valves Direct Acting • Brass or Stainless Steel Bodies

Features

- Reliable, proven design.
- Small poppet valves for tight shutoff.
- Mountable in any position.
- Brass body construction for general atmospheres;
Stainless Steel for corrosive atmospheres.



Pipe Size (ins.)	Orifice Size (ins.)	Cv Flow Factor	Operating Pressure Differential (psi)						Max. Fluid Temp. °F		Brass Body		Stainless Steel Body		Watt Rating/ Class of Coil Insulation ②		Voltage	MSA #	
			Max. AC			Max. DC			AC	DC	Catalog Number	UL ③ Listing	Catalog Number	UL ③ Listing	AC	DC			
			Air-Inert Gas	Water	Lt. Oil @ 300 SSU	Air-Inert Gas	Water	Lt. Oil @ 300 SSU											
NORMALLY CLOSED (Closed when de-energized), NBR Disc																			
1/8	3/32	.20	-	-	-	150	140	145	-	120	8262G14	○	-	○	-	10.6/F	12/DC	20411	
1/8	1/8	.34	155	180	140	-	-	-	180	-	8262G2	○	-	○	6.1/F	-	120/60, 110/50	20389	
1/8	1/8	.34	155	180	140	-	-	-	180	-	EF8262G2	○	-	○	6.1/F	-	120/60, 110/50	20391	
1/8	1/8	.34	100	-	-	-	-	-	180	-	X8262C2-TPL 13200	○	-	○	15.3/F	-	120/60, 110/50	00951	
1/8	1/8	.34	155	180	140	-	-	-	180	-	P8262C2	○	-	○	6.1/F	-	120/60, 110/50	00954	
1/8	1/8	.34	155	180	140	-	-	-	180	-	PSF8262C2	○	-	○	6.1/F	-	120/60, 110/50	00955	
1/4	3/64	.06	750	750	500	-	-	-	180	-	-	○	8262G80	○	6.1/F	-	120/60, 110/50	20441	
1/4	3/32	.17	360	340	160	-	-	-	180	-	8262G20	○	-	○	6.1/F	-	120/60, 110/50	20417	
1/4	1/8	.35	140	165	90	-	-	-	180	-	8262G22	○	-	○	6.1/F	-	120/60, 110/50	20422	
1/4	1/8	.35	300	300	200	-	-	-	180	-	8262G232	○	-	-	10.1/F	-	120/60, 110/50	20497	
1/4	5/32	.50	180	200	145	-	-	-	180	-	8262G202	○	-	○	10.1/F	-	120/60, 110/50	20461	
1/4	7/32	.72	90	100	100	-	-	-	180	-	8262G208V	○	-	○	10.1/F	-	120/60, 110/50	20474	
1/4	7/32	.85	40	50	40	-	-	-	180	-	8262G13	○	-	○	6.1/F	-	120/60, 110/50	20404	
1/4	9/32	.88	90	100	90	-	-	-	180	-	8262G212	○	-	○	17.1/F	-	120/60, 110/50	20484	
1/4	9/32	.96	-	-	-	15	16	16	-	120	8262G90	○	-	○	-	10.6/F	12/DC	20451	
1/4	9/32	.96	27	36	28	-	-	-	180	-	8262G90	○	-	○	6.1/F	-	120/60, 110/50	20445	
1/4	9/32	.96	-	-	-	15	16	16	-	120	8262G90	○	-	○	-	10.6/F	24/DC	20452	
NORMALLY OPEN (Open when de-energized), NBR Disc																			
1/8	1/16	.09	500	300	225	-	-	-	180	-	8262G91	●	-	●	6.1/F	-	120/60, 110/50	20453	
1/4	1/8	.35	130	110	100	-	-	-	180	-	8262G262	-	-	-	10.1/F	-	120/60, 110/50	20501	
Notes: ② On 50 hertz service, the rating for the 6.1/F solenoid is 8.1 watts. ③ ○ Safety Shutoff Valve; ● General Purpose Valve. Refer to Engineering Section (Approvals) for details.																			
EF = Explosionproof, X with TPL 13200 = Special gasketed panel mount, P = Panel mounted, SF = Class F - High temperature - Spade terminals, V = Viton																			

Installation & Maintenance Instructions

2-WAY PILOT-OPERATED OR DIRECT – ACTING SOLENOID VALVES
NORMALLY CLOSED OPERATION — 3/4", 1", OR 1 1/2" NPT
FUEL GAS SERVICE

SERIES

K3A6

K3A7

Form No.V8501

Service Notice

Except for coil replacement, the Series K3A6 and K3A7 are not repairable. When any performance problems are detected during routine inspection, replace valve immediately.

DESCRIPTION

Series K3A6 and K3A7 valves are 2-way normally closed solenoid valves designed for fuel gas service. Series K3A6 is a pilot-operated solenoid valve, while Series K3A7 is direct-acting. Valve bodies are made of rugged aluminum with trim and internal parts made of steel and stainless steel. These valves are provided with a general purpose junction box solenoid enclosure.

Provisions for Pressure and Seat Leakage Testing

Series K3A6 and K3A7 valves are provided with two 1/8" NPT tapped and plugged holes (pressure taps). The upstream tapped and plugged hole is on the side of the valve body; downstream on the bottom of the valve body. One upstream for pressure testing; one downstream for seat leakage testing. Leakage testing frequency shall be at least annually in accordance with NFPA-86 or original equipment manufacturer recommendations. For instructions, refer to section on *Testing for Internal (Seat) Leakage* and Figure 3.

Partial view of valve body showing location of tapped and plugged holes for pressure and seat leakage testing

Pipe plugs are 1/8" NPT
(use 3/16" Hex Key Wrench)

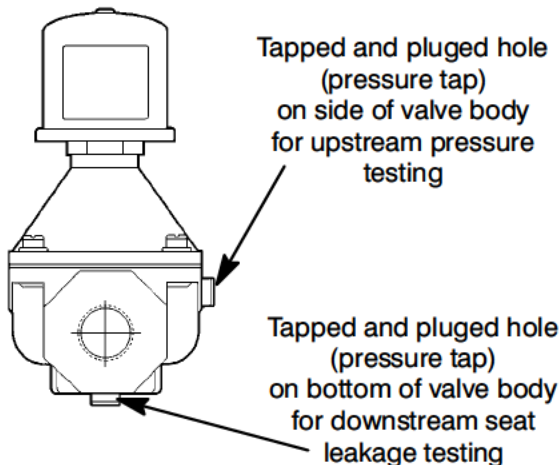


Figure 1. Provisions for pressure and seat leakage testing.

OPERATION

Normally Closed: Valve is closed when solenoid is de-energized; open when energized.

Note: No minimum operating pressure differential required.

INSTALLATION

Check nameplate for correct catalog number, pressure, voltage, frequency, and service. Never apply incompatible fluids or exceed pressure rating of the valve. Installation and valve maintenance to be performed by qualified personnel.

Temperature Limitations

Coil Class Temperature Rating	Nominal Fluid Temperature	Ambient Temperature Range
F 311°F (155°C)	77°F (25°C)	-40°F (-40°C) to 175°F (80°C)

Positioning

Valve must be mounted with solenoid vertical and upright or in a horizontal position only. Valves equipped with rainproof housings (W in the 3rd character position of the valve catalog number) must be mounted in a vertical and upright position only.

Piping

CAUTION: Piping must comply with applicable local and national codes and ordinances, including the National Fuel Gas Code ANSI Z223.1/NFPA No. 54.

Connect piping to valve according to flow arrow on bottom of valve body. Apply pipe compound sparingly to male pipe threads only. If applied to valve threads, the compound may enter the valve and cause operational difficulty. Avoid pipe strain by properly supporting and aligning piping. When tightening the pipe, do not use valve or solenoid as a lever. Locate wrenches applied to valve body or piping as close as possible to connection point. Valve should be checked for external leakage at piping connections after installation, see *Testing for External Leakage* section.

CAUTION: To avoid damage to the valve body, DO NOT OVERTIGHTEN PIPE CONNECTIONS. If Teflon* tape, paste, spray, or similar lubricant is used, use extra care when tightening due to reduced friction.

*DuPont's Registered Trademark

▲ CAUTION: To protect the solenoid valve, install a strainer or filter, suitable for the service involved, in the inlet side as close to the valve as possible. Clean periodically depending on service conditions. See ASCO Series 8600, 8601 and 8602 for strainers.

Wiring

Wiring must comply with local codes and the National Electrical Code. To facilitate wiring, the solenoid enclosure may be rotated 360° by loosening the screw on the top of the enclosure. Rotate enclosure to desired position, then torque screw to 10 – 13 in–lbs [1,1 – 1,5 Nm]. The junction box housing has two 7/8" diameter knockouts to accommodate 1/2" conduit. Drive out appropriate knockout with junction box completely assembled (with cover) for support. Remove "J" box cover, by spreading cover and disengaging nibs (lift up and pull down simultaneously). The coil jacket is provided with a grounding screw (green) and a tab for the grounding connection. Within the junction box solenoid enclosure use field wire that is rated 90° C or greater for connections. Replace "J" box cover before operating.

Testing for External Leakage

▲ WARNING: To prevent the possibility of severe personal injury or property damage, extinguish all open flames and avoid any type of sparking or ignition.

1. Block gas flow on downstream side of valve.
2. Apply pressure to valve within nameplate rating and energize solenoid.
3. Apply a soapy solution or a commercially available leak detecting solution to the pipe connections and check for bubbles. If the valve has been tested for seat leakage, apply the solution around the pipe plugs.
4. If leakage exists, depressurize valve and turn off electrical power supply. Tighten connections as required and retest following the above steps.

Solenoid Temperature

Series K3A6 and K3A7 valves are supplied with coils designed for continuous duty service. When the solenoid is energized for a long period, the solenoid enclosure becomes hot and can be touched with the hand for an instant. This is a safe operating temperature. Any excessive heating will be indicated by the smoke and odor of burning coil insulation.

MAINTENANCE

▲ WARNING: To prevent the possibility of severe personal injury or property damage, turn off electrical power, depressurize valve, extinguish all open flames and avoid any type of sparking or ignition. Vent hazardous or combustible fluid to a safe area before inspection or removing the valve from service.

Preventive Maintenance

- Prepare and follow a routine inspection schedule based on the media, environment, and frequency of use. This should include periodic internal and external leakage checks.
- Keep the medium flowing through the valve as free from dirt and foreign material as possible.
- While in service, the valve should be operated at least once a month to ensure proper opening and closing.

NOTE: For performance problems, refer to *Troubleshooting Chart* on page 4 of 4.

Coil Replacement (Refer to Figure 2)

NOTE: It is not necessary to remove the valve from the pipeline for *Coil Replacement*.

▲ CAUTION: Exercise care to prevent damage to the plunger tube. Do not grasp plunger tube with wrench or pliers.

1. Remove cover and disconnect supply wires to coil, grounding wire, and rigid conduit from coil jacket.
2. Remove screw and lockwasher, then carefully lift coil jacket assembly off plunger tube.
3. Remove the spring, coil, coil frames and washers from the coil jacket.
4. Reassemble in reverse order of disassembly, using a new replacement coil.
5. Place inner washers, then coil frames onto coil as originally configured. Coil voltage markings on coil must face toward valve body.
6. Place the spring inside the coil jacket.
7. Insert coil lead wires through hole in coil jacket. Pull wires all the way through, and seat coil in jacket.
8. Place bottom washer inside coil jacket.
9. Place coil/jacket assembly on plunger tube.
10. Install lockwasher, and screw onto coil jacket. Torque screw to 10–13 in–lbs [1,1–1,5 Nm].
11. Make electrical connections to solenoid, see *Wiring* section.
12. Replace "J" box cover on coil jacket.

▲ CAUTION: Solenoid must be fully reassembled as the coil jacket and internal parts are part of and complete the magnetic circuit.

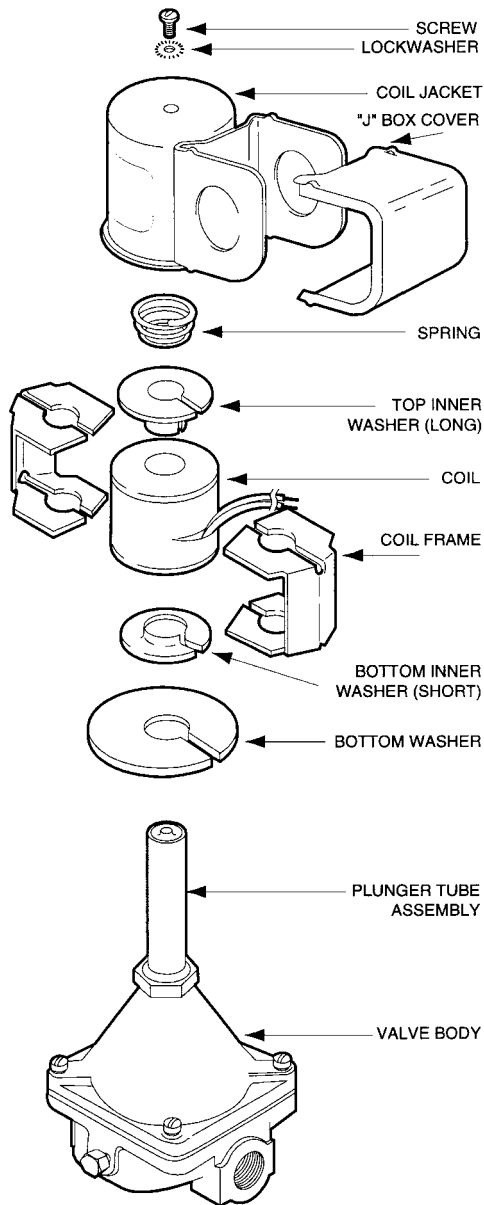


Figure 2. Exploded view, typical K3A valve.

Testing for Internal (Seat) Leakage (Refer to Figure 3)

CAUTION: Be sure valve can be tested without affecting other equipment.

1. Shut off both the upstream and downstream manual gas cocks. The downstream manual gas cock should remain closed throughout the entire test procedure.
2. Program the control system to operate the valve through five cycles. Listen carefully for the solenoid coil to *click* indicating proper operation.
3. Open the upstream manual gas cock. Program the control system to energize and maintain the valve in the open (energized) position. Check all valve and piping connections for external leaks with rich soap and water solution or a commercially available leak detecting solution.

4. Shut off the upstream manual gas cock and de-energize valve. Remove the plug from the leak test tap or downstream pressure tap in the valve body. Connect leak test equipment with the test petcock in the closed position (Figure 3).
5. Open the upstream manual gas cock. Program the control system to energize the valve to the full open position, then immediately de-energize it to seat the valve operationally.
6. Immerse the 1/4" leak test tube vertically into a jar of water to a depth of about 1/2". Slowly open the test petcock. Bubbles may appear in the water as the pressure equalizes.
7. After the rate of bubbles coming through the water stabilizes, count the number of bubbles appearing in a 10 second period. The allowable leakage in 10 seconds for an orifice diameter of 1 inch (25.4 mm) or less is 6 bubbles (3 cc/min). For valves with an orifice diameter over 1 inch (25.4 mm) the allowable leakage rate is 6 bubbles (3 cc/min.) per inch (25.4 mm) of orifice diameter. If leakage exceeds this rate, replace valve.

NOTE: The leakage rate above recognizes that some wear and contamination from use can result in a slight amount of leakage. The allowable leakage rate is well within the leakage limits as recognized by applicable approval agencies.

8. Close the upstream manual gas cock and the test petcock. Then remove the test equipment. Apply a small amount of Loctite Corporation's PST® Pipe Sealant 567 (or equivalent) to the pipe plug threads. Reinstall the pipe plug and tighten securely.
9. Turn on the gas supply at the upstream manual gas cock and energize the valve.
10. Open the upstream manual gas cock. Program the control system to energize and maintain the valve in the open (energized) position. Check all valve and piping connections for external leaks with rich soap and water solution or a commercially available leak detecting solution.
11. De-energize the valve. Open the downstream manual gas cock.
12. Restore the system to normal operation.

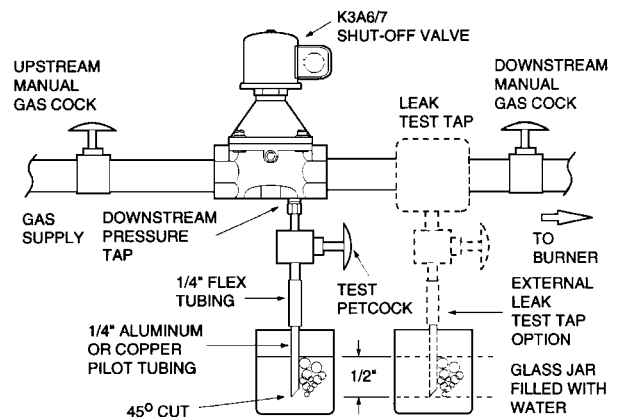


Figure 3. Testing for internal seat leakage.

**ORDERING INFORMATION
FOR COIL REPLACEMENT**

When ordering coils, specify valve catalog number, voltage and coil number, if possible.

Troubleshooting Chart

Trouble	Possible Cause	Remedy
Valve operation is sluggish	<p>Solenoid coil short, or wrong voltage.</p> <p>Damaged plunger assembly.</p> <p>Dirt or other foreign matter restricting operation of valve.</p>	<p>Check coil voltage. Replace solenoid coil.</p> <p>Replace valve.</p> <p>Replace valve and install strainer upstream of valve.</p>
Valve fails to open	<p>Timer, limit controls or other devices not energizing circuit.</p> <p>Damaged plunger assembly preventing plunger operation.</p> <p>Solenoid coil short, burned—out or wrong voltage.</p> <p>Dirt, pipe compound or other foreign matter restricting operation of valve.</p>	<p>Check circuit for limit control operation, blown fuse, short circuit and loose wiring.</p> <p>Replace valve.</p> <p>Replace with solenoid coil of correct voltage</p> <p>Replace valve and install strainer upstream valve.</p>
Valve fails to close	<p>Damaged plunger assembly preventing plunger operation.</p> <p>Dirt, pipe compound or other foreign matter restricting operation of valve.</p> <p>Limit controls improperly installed to grounded side.</p>	<p>Replace valve.</p> <p>Replace valve and install strainer upstream of valve.</p> <p>Wire controls in hot side of circuit.</p>
Valve “chatters”	<p>Valve supply voltage is improper (too low)</p> <p>Dirt or chips between top of plunger assembly and plunger tube.</p>	<p>Apply correct voltage to valve.</p> <p>Replace valve and install strainer upstream of valve.</p>



Gas Appliance Pressure Regulators

Straight-Thru-Flow Design

RV52, RV53, RV61, RV81, RV91, RV111, and RV131
1/2", 3/4", 1", 1 1/4", 1 1/2", 2", 2 1/2", 3" & 4"



design certified

Maximum Pressure

A.G.A. Rated (except RV131) 1/2 psi (35 mbar)

Maxitrol Tested*

RV52 & RV53 1/2 psi (35 mbar)

RV61, RV81, RV91, & RV111 1 psi (70 mbar)

RV131 2 psi (140 mbar)

* Do not use if inlet pressure is more than 10 times
desired outlet pressure

EMERGENCY EXPOSURE LIMITS (Maxitrol Tested)

RV52 & RV53 3 psi (210 mbar)

RV61, RV81, RV91 & RV111 5 psi (350 mbar)

RV131 15 psi (1050 mbar)

GAS CONTAINMENT EXPOSURE LIMITS*

RV 52 & RV53 15 psi (1050 mbar)

RV61, RV81, RV91, RV111,

& RV131 25 psi (1750 mbar)

* Please note that internal damage may occur when
exposed to these pressures.

AMBIENT TEMPERATURE LIMITS

RV52, RV53, RV61, RV81,

RV91 & RV111 -40° to 205° F (-40° to 96° C)

RV131 -40 to 125° F (-40 to 52° C)

GASES: Natural, manufactured, mixed, liquefied
petroleum, or LP gas-air mixture.

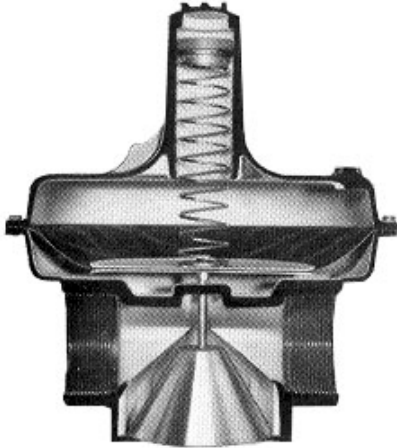


S-T-F Series



Straight-Thru-Flow Design

RV series



All models except RV131 are A.G.A. design certified for 1/2 psi rated pressure under the ANSI standard for gas pressure regulators; and CGA listed to certify compliance with nationally published safety, construction, and performance standards.

They are main burner only, non-lockup type. They should not be used as a line gas pressure regulator ahead of low pressure controls. Use only where downstream controls can operate at line pressure. Refer to other Maxitrol sales bulletins for proper types.

The RV52, RV53, & RV61 are suitable for multipoise mounting. The RV81, RV91, RV111, & RV131 are recommended for normal horizontal position only.

Maxitrol's original Straight-Thru-Flow design meets your needs for high capacities at low inlet pressures. The basic difference between S-T-F design and other type regulators lies in the conical valve. The cone principal permits gas to flow straight through the regulator without changing directions. Frictional flow resistance is reduced, resulting in greater capacity.

The improved flow pattern provides accurate sensitive regulation at extremely low pressure differentials. The ability of the regulator to handle large capacity appliances with limited supply pressure offers a definite advantage to designers of commercial and industrial gas-fired equipment. Models up to the three inch pipe size have high strength pressure cast aluminum housings. The

RV52, RV53, RV61, RV81, RV91, RV111, and RV131

FEATURES

- Greater accuracy—higher pressure drop capacity
- Outlet pressures available to 42" w.c.
- Available in full range of pipe sizes from 1/2" to 4"
- All models tapped with NPT vent bosses
- A.G.A./CGA Design Certified (except RV131)

BENEFITS

- Unique conical valve design fills need of combining good regulation with high capacity in low to intermediate pressure range
- Allows more pressure drop to be assigned to piping and valves—permits reduction in manifold size
- Provides accurate, sensitive regulation at inlet pressures as low as 3" w.c.
- Also provides bonus benefits of high capacity and good performance at pressures of 1 psi or higher
- Ease of installation and replacement

RV131 four inch model is of cast iron and steel construction. RV61, RV81, RV91, RV111, & RV131 internal conical valves are coated with Teflon® for long life. Diaphragm material is cut from the finest synthetic coated fabrics available. All other parts are carefully specified corrosion-resistant or plated material.

Pipe sizes of 1/2", 3/4", 1", 1-1/4", 1-1/2", 2", 2-1/2", 3", and 4" are available. Models through the 3" size are threaded, the 4" RV131 is flanged.

At the emergency exposure limits, there may be no regulation, but all models will contain gas. They will suffer no internal damage and will resume regulation when normal pressure is restored.

Straight-Thru-Flow appliance regulators are intended for use with all fuel gases, and may also be used with air or other noncorrosive gases within their pressure limits.

Typical applications include all types of residential, commercial and industrial gas-fired appliances and equipment used on low pressure gas supply. See Maxitrol's "Spring Selection Chart" for part numbers, color and size of springs.

Teflon is a registered trademark of DuPont Corporation.

NOTE: All Maxitrol appliance regulators should be installed in accordance with Maxitrol's "Safety Warning" bulletin.

Capacities and Pressure Drop

CAPACITIES—expressed in CFH (m³/h)—0.64 sp gr gas

Model Number and Pipe Size		A.G.A. MAX	Pressure Drop (Inches w.c. (mbar))												
			0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	2	3	4
RV52	1/2 x 1/2 3/4 x 3/4	450 (12.7)	151 (4.2)	214 (6.1)	262 (7.4)	302 (8.5)	338 (9.5)	370 (10.5)	400 (11.3)	427 (12.1)	453 (12.8)	478 (13.5)	676 (19.1)	828 (23.4)	956 (27.1)
RV53	3/4 x 3/4 1 x 1	710 (20.1)	217 (6.1)	306 (8.6)	375 (10.6)	433 (12.2)	484 (13.7)	530 (15)	573 (16.2)	612 (17.3)	650 (18.4)	684 (19.3)	968 (27.4)	1185 (33.5)	1369 (38.7)
RV61	1 x 1 1-1/4 x 1-1/4	1100 (31.1)	379 (10.7)	536 (15.1)	675 (19.1)	759 (21.5)	848 (24)	929 (26.3)	1004 (28.4)	1073 (30.4)	1138 (32.2)	1200 (34.0)	1742 (49.3)	2134 (60.4)	2464 (69.8)
RV81	1-1/4 x 1-1/4 1-1/2 x 1-1/2	2500 (70.8)	780 (22.1)	1102 (31.2)	1350 (38.2)	1559 (44.1)	1743 (49.5)	1909 (54)	2062 (58.4)	2204 (62.4)	2339 (66.2)	2465 (69.8)	3485 (98.7)	4269 (120)	4929 (139)
RV91	2 x 2 2-1/2 x 2-1/2	3275 (92.7)	1212 (34.3)	1714 (48.5)	2100 (59.4)	2424 (68.6)	2711 (76.7)	2969 (84.1)	3208 (90.8)	3429 (97.1)	3637 (103)	3834 (108)	5422 (153)	6640 (188)	7668 (217)
RV111	2-1/2 x 2-1/2 3 x 3	7500 (212)	2742 (78)	3878 (110)	4750 (134)	5485 (155)	6132 (175)	6718 (190)	7256 (205)	7757 (219)	8227 (233)	8572 (243)	12134 (343)	14862 (420)	17161 (486)
RV131	4 x 4	--	4734 (134)	6695 (190)	8200 (232)	9468 (268)	10586 (300)	11596 (328)	12525 (354)	13390 (380)	14202 (402)	14971 (424)	21172 (600)	25930 (734)	29942 (848)

Sizing Instructions

In order to select the proper size regulator, you must know the available inlet pressure, desired outlet pressure, and the required maximum flow rate.

Example No. 1—To select a regulator of ample capacity to handle flow.

KNOWN:

Pipe size 2-1/2", flow rate 8,000 CFH (0.64 sp gr), inlet pressure 9" w.c., desired outlet pressure 5" w.c.

SOLUTION:

- Determine differential pressure available:
 Inlet pressure 9" w.c.
 Subtract outlet pressure - 5" w.c.
 Available differential pressure 4" w.c.
- When determining capacity Maxitrol recommends that the pressure drop not exceed 1/2 of available differential pressure (1/2 of 4" w.c. = 2" w.c.).
- Check Capacity Chart to determine which regulator has a pressure drop of 2" w.c. or less at a flow rate of 8,000 CFH.
- The RV111 meets these standards with a flow rate of 12,134 CFH for the 2-1/2" pipe size at 2" w.c. pressure drop. The 2-1/2" RV91 flows 5422 CFH at 2" w.c. pressure drop. Therefore, the RV111—2-1/2" is the correct regulator to use.

Example No. 2—To determine maximum recommended operating outlet pressure.

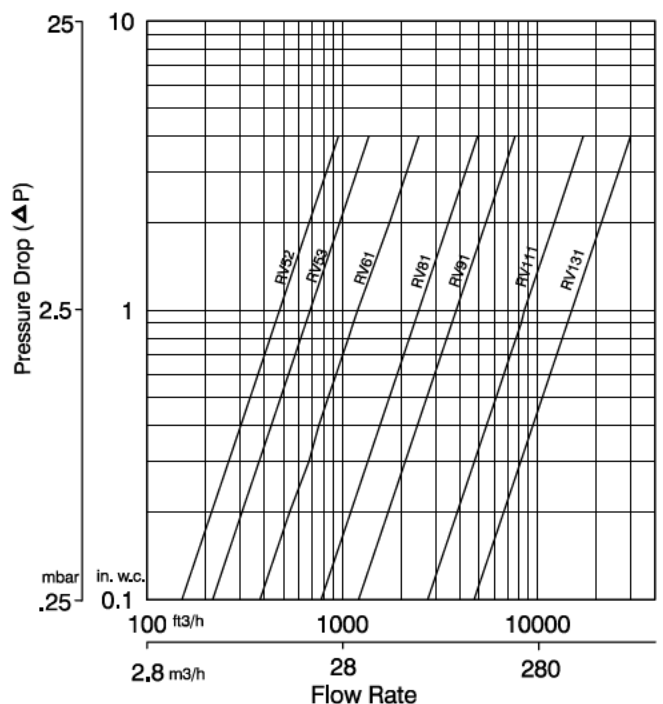
KNOWN:

Pipe size 4", flow rate 21,000 CFH, inlet pressure 10" w.c.

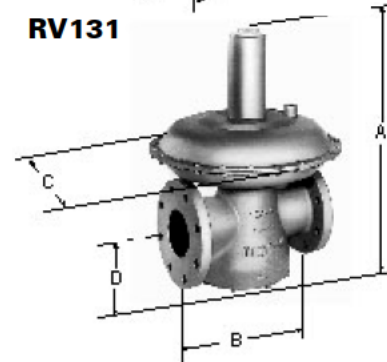
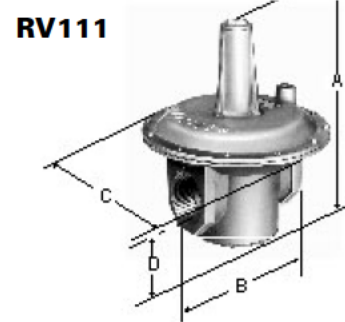
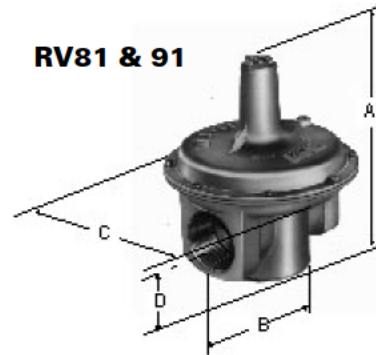
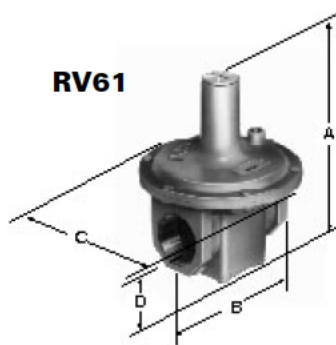
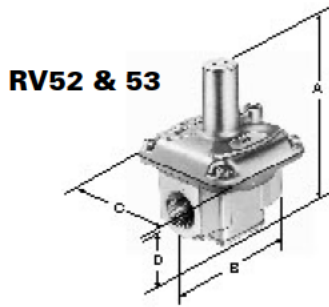
SOLUTION:

- Check capacity Chart above for 4" regulator, RV131.
- Note that at a flow rate of 21,172 CFH the pressure drop is 2" w.c.
- Multiply this by two to obtain recommended differential pressure (4" w.c.).
- Subtract 4" differential pressure from 10" w.c. inlet pressure to obtain maximum recommended outlet pressure setting of 6" w.c.

Pressure Drop Chart



Dimensions and Spring Ranges



DIMENSIONS* — inches (millimeters)

Model & Illustration Number	Vent Tap	Swing Radius	Call-Outs			
			A	B	C	D
RV52	1/8" NPT	3.6 (91)	4.9 (124)	3.2 (81)	3.25 (83)	1.25 (32)
RV53	1/8" NPT	3.9 (99)	5.2 (132)	3.75 (95)	3.9 (99)	1.3 (33)
RV61	1/8" NPT	4.8 (122)	6.4 (164)	4.4 (111)	5.4 (138)	1.6 (41)
RV81	3/8" NPT	6.4 (162)	8.4 (213)	6 (153)	7 (178)	2 (51)
RV91 2" pipe	1/2" NPT	8.5 (216)	10.8 (275)	6.5 (165)	9.1 (232)	2.3 (60)
RV91 2.5" pipe	1/4" NPT	8.3 (212)	10.5 (267)	7.1 (181)	9.1 (232)	2.4 (62)
RV111	3/4" NPT	11.5 (284)	15.1 (373)	9 (229)	13.4 (324)	3.5 (89)
RV131	3/4" NPT	18.2 (462)	23.25 (590)	13.9 (353)	18 (458)	5.1 (129)

* Dimensions are to be used only as an aid in designing clearance for the valve. Actual production dimensions may vary somewhat from those shown.

SPRING SELECTION CHART — inches w.c. (mbar)

Model Number	A.G.A. Certified Springs			Other Springs Available							
	3 to 6 (7.5-15)	4-8 (10-20)	5-12 (12.5-30)	1-3.5 (2.5-9)	2-5 (5-12.5)	3-8 (7.5-20)	4-12 (10-30)	5-15 (12.5-38)	10-22 (25-55)	15-30 (38-75)	20-42 (50-105)
RV52	3 to 6 (7.5-15)	4-8 (10-20)	5-12 (12.5-30)	1-3.5 (2.5-9)	2-5 (5-12.5)	3-8 (7.5-20)	4-12 (10-30)	--	--	--	--
RV53	3 to 6 (7.5-15)	4-8 (10-20)	5-12 (12.5-30)	1-3.5 (2.5-9)	2-5 (5-12.5)	3-8 (7.5-20)	4-12 (10-30)	--	--	--	--
RV61	3 to 6 (7.5-15)	4-8 (10-20)	5-12 (12.5-30)	1-3.5 (2.5-9)	2-5 (5-12.5)	3-8 (7.5-20)	--	--	10-22 (25-55)	--	--
RV81	3 to 6 (7.5-15)	4-8 (10-20)	5-12 (12.5-30)	1-3.5 (2.5-9)	2-5 (5-12.5)	3-8 (7.5-20)	4-12 (10-30)	5-15 (12.5-38)	10-22 (25-55)	--	--
RV91	3 to 6 (7.5-15)	4-8 (10-20)	5-12 (12.5-30)	1-3.5 (2.5-9)	2-5 (5-12.5)	3-8 (7.5-20)	4-12 (10-30)	5-15 (12.5-38)	10-22 (25-55)	--	--
RV111	3 to 6 (7.5-15)	4-8 (10-20)	5-12 (12.5-30)	1-3.5 (2.5-9)	2-5 (5-12.5)	3-8 (7.5-20)	4-12 (10-30)	5-15 (12.5-38)	10-22 (25-55)	--	--
RV131	3 to 6 (7.5-15)	--	5-12 (12.5-30)	--	2-5 (5-12.5)	3-8 (7.5-20)	4-12 (10-30)	--	10-22 (25-55)	15-30 (38-75)	20-42 (50-105)

NOTE: The area within the heavy line indicates A.G.A. certified springs.

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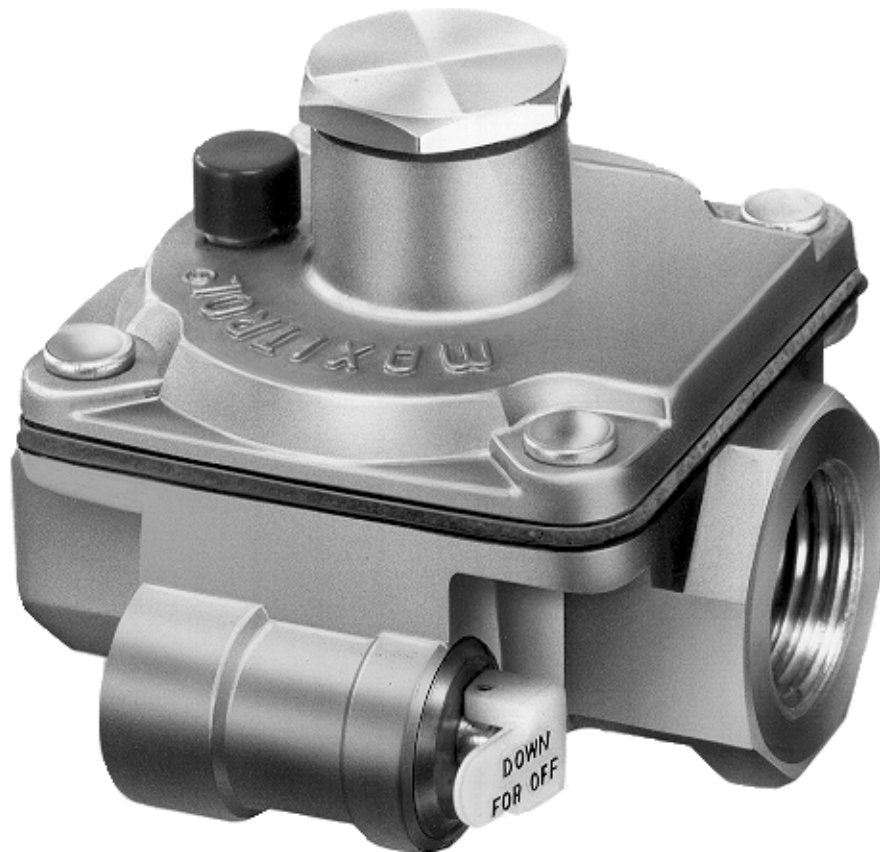


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Gas Appliance Pressure Regulators

Rubber Seat Poppet Models



MAXITROL  **company**®

RV/CV Series— RV12, RV20, RV47, RV48, and CV47



These rubber seat poppet type regulators are designed primarily for main burner and pilot load applications where precise control of tiny flows is an essential operating requirement. ® certified (.15 CFH).

Housings are of high strength aluminum die castings. All models have been tested for multi-poise mounting and may be installed in any plane or angle without restriction. Other than normal upright position will result in slight difference of outlet pressure. They may be used with natural, manufactured, mixed, LP, or LP gas-air mixture.

Models having the letters A, C, D, E, F, L, M, MK, N, R, SR, S, T, or a combination of any of these suffix letters, indicates the design modifications described below:

- A** — short stack – limited spring adjustment (RV47 & CV47).
- C** — convertible regulators – preset to deliver outlet pressures for either NAT or LP gases (RV20, RV47, RV48, and CV47)
- D** — integral ball check limiting device that permits normal opening and restricts closing cycle (RV47 and CV47)
- E** — excessive pressure rated
- F** — factory-set, fixed/non-adjustable regulator
- F6**— 3/8" tube inverted flare
- I** — left side integral manual valve – outlet faces main inlet (CV47)
- L** — an integral vent limiting orifice as the breather hole
- L3**— 1/8" outlet tube loxit (RV12)
- L4**— 1/2" outlet tube loxit (RV 47)
- L6**— 3/8" outlet tube loxit (RV20)

MAXIMUM INLET PRESSURE:

RV12, RV20, RV47, RV47A,
RV48 & CV47, CV47A 1/2 psi (34 mbar)
RV20L 2 psi (140 mbar)

EMERGENCY EXPOSURE LIMITS:

RV12, RV20, RV47, RV47A, RV48
& CV47, CV47A 2.5 psi (172 mbar)

AMBIENT TEMPERATURE LIMITS:

RV12LT & RV20LT -40° to 275°F (-40° to 135°C)
RV48T 32° to 275°F (0° to 135°C)
RV20L -40° to 225°F (-40° to 107°C)
RV20C, RV47, RV47A, RV47C, RV48, RV48C &
CV47, CV47A, CV47C. 32° to 225°F (0° to 107°C)

GASES: Natural, manufactured, mixed, liquified petroleum or LP gas-air mixture.

MOUNTING: Other than normal upright position will result in slight difference of outlet pressure — mount with flow direction as marked on bottom casting.

NOTE: All Maxitrol gas appliances pressure regulators should be installed and operated in accordance with Maxitrol's "Safety Warning" Bulletin. Different models have American Gas Association, German D.V.G.W., European EN-88, Canadian Gas Association, and Australian Gas Association certifications.

- M** — B.S.P. - PL parallel thread – conforms to ISO 7-1, where pressure tight joints are made on the threads.
- MK**— B.S.P. - TR taper thread – conforms to ISO 7-1, where pressure tight joints are made on the threads.
- N** — main burner only – includes internal by-pass orifice to prevent lockup (RV20, RV47, RV48 & CV47).
- R** — right side integral manual valve – outlet faces main outlet (CV47).
- SR**— side tap – right side 1/8" N.P.T. (RV20 & RV47).
- S** — side tap – left side 1/8" N.P.T. (RV20, RV47 & CV47).
- T** — model variation for operating at higher ambient temperatures to 275°F (135°C), (RV48, RV20, & RV12).

The CV47 can best be described as an RV47 with an extra regulated outlet. This outlet contains an integral manual valve, and is located on the valve body's side.

The short stack models have an adjustment range of less than 2" w.c. (5 mbar). These models are advantageous where installation must be made in limited space.

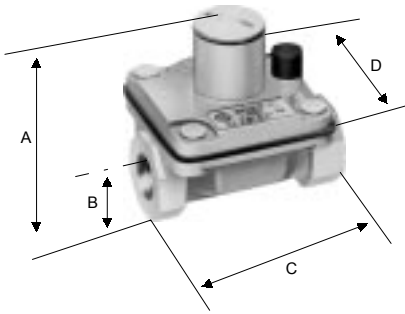
Convertible regulators are designed to deliver either of two fixed outlet pressures, for natural or LP gases. RV 20C 4" to 10" w.c. RV47C & CV47C 4", 5" or 6" to 10" or 11" w.c. RV48C 5" to 10" w.c.

The RV48 model may be used with either a 12A04 ball check device, or a 12A06 fixed orifice vent limiting device.

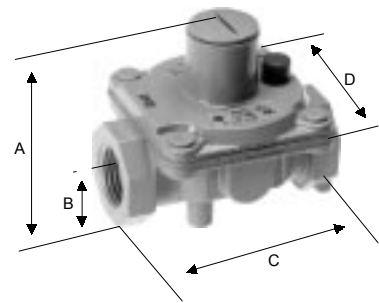
Maxitrol rubber seat poppet models offer the ultimate in design features and performance capabilities to meet specific appliance or utility requirements.

Specifications

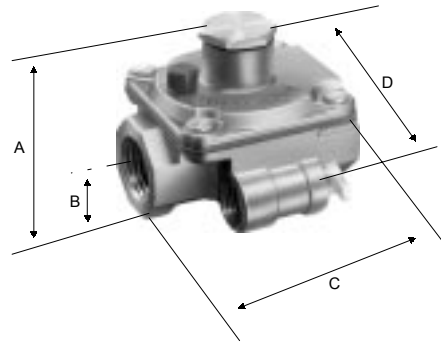
RV12



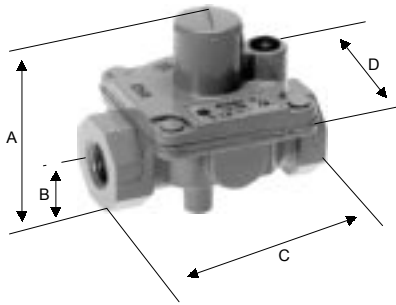
RV47, 47A



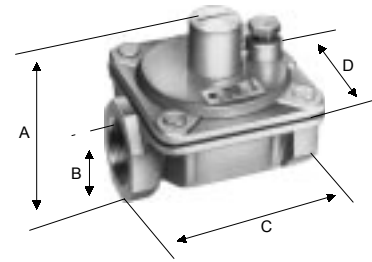
CV47, 47A



RV20



RV48



*Dimensions are maximums and are to be used only as an aid in designing clearance for the valve. Actual production dimensions may vary somewhat from those shown.

DIMENSIONS*: inches (millimeters)

Model	Vent Tap	Swing Radius	Call-Outs			
			A	B	C	D
RV12	None (Integral)	1-3/8 (35)	1-11/16 (43)	3/8 (10)	1-11/16 (43)	1-3/8 (35)
RV20	A 5/16-24	1-5/8 (41)	2-1/8 (54)	1/2 (13)	2-3/8 (61)	1-3/4 (45)
RV47 CV47	B None (Integral)	1-7/8 (48)	2-1/2 (64)	5/8 (16)	2-15/16 (75)	2-1/4 (57)
RV47A CV47A	B None (Integral)	1-5/8 (41)	2-1/4 (57)	5/8 (16)	2-15/16 (75)	2-1/4 (57)
RV48	c 1/8" NPT	2 (51)	2-3/4 (70)	3/4 (19)	3-3/8 (86)	3 (76)

A For 1/8" tube connector

B Order with "D" or "L" suffix

C Can be supplied with 12A04 or 12A06 vent limiting device

SPRING SELECTION CHART — inches water column (millibars)

Model	Standard Spring	Other Springs Available										
		1.0-3.5 (2.5-8.8)	—	—	—	4.0-8.0 (10-20)	—	—	—	6.0-10 (15-25)	8.0-12 (20-30)	—
RV12	2.8" to 5.2" (6.9 to 13)	1.0-3.5 (2.5-8.8)	—	—	—	4.0-8.0 (10-20)	—	—	—	6.0-10 (15-25)	8.0-12 (20-30)	—
RV20	2.8" to 5.2" (6.9 to 13)	1.0-3.5 (2.5-8.8)	—	—	—	4.0-8.0 (10-20)	—	—	—	6.0-10 (15-25)	8.0-12 (20-30)	9-12 (22.5-30)
CV47 RV47	2.8" to 5.2" (6.9 to 13)	1.0-3.5 (2.5-8.8)	—	—	3.8-4.3 (9.5-10.8)	4.0-8.0 (10-20)	4.7-5.3 (11.8-13.3)	—	5.6-6.4 (14-16)	6.0-10 (15-25)	8.0-12 (20-30)	9.7-11.3 (24.2-28.3)
RV48	3.0" to 6.0" (7.5 to 15)	1.0-3.5 (2.5-8.8)	—	—	—	4.0-8.0 (10-20)	—	5.0-12 (12.5-30)	—	6.0-10 (15-25)	—	—

CAPACITY CHART — expressed in Btu/h (cubic meters/h) — 0.64 sp gr gas

Model	Pipe Size	Pressure Drop @ 0.3" w.c. or (.7mb)	Range of Regulations		Individual Load	
			Main Burner	M.B. and Pilot	Fixed Orifice	Ball Check Devices
RV12	1/8" x 1/8"* 3/16"Lox x 3/16"Lox	14,800 (.42) 8,800 (.25)	30,000 (.85)	25,000 (.71) 15,000 (.43)	20,000 (.56) 15,000 (.43)	—
RV20	1/4" x 1/4" 3/8" x 3/8"*	30,000 (.85)	65,000 (1.84)	50,000 (1.4)	30,000 (.85)	—
RV20C	1/4" x 1/4" 3/8" x 3/8"	30,000 (.85)	75,000 (2.11)	50,000 (1.4)	15,000 (.42)	—
CV47 RV47	3/8" x 3/8" 1/2 x 1/2"*	55,000 (1.5) 60,000 (1.7)	125,000 (3.5)	90,000 (2.5)	40,000 (1.1)	90,000 (2.5)
CV47A & C RV47A & C	3/8" x 3/8" 1/2" x 1/2"	55,000 (1.5) 60,000 (1.7)	125,000 (3.5)	125,000 (3.5)	40,000 (1.1)	125,000 (3.5)
RV48	1/2" x 1/2" 3/4" x 3/4"	130,000 (3.7) 150,000 (4.2)	230,000 (6.5) 250,000 (7.1)	230,000 (6.5) 250,000 (7.1)	40,000 (1.1)	160,000 (4.5)
RV48C	1/2" x 1/2" 3/4" x 3/4"	130,000 (3.7) 150,000 (4.2)	400,000 (11.3)	275,000 Nat (7.0) 250,000 LP (2.8)	40,000 (1.1)	160,000 (4.5)

NOTE: Minimum main burner regulation capacity for all models (except "N") is 150 Btu/h (.0042 m³/h).

* Available as loxit connection.

HOW TO CALCULATE PRESSURE DROP AT VARIOUS FLOW RATES FROM CAPACITY CHART:

$$\text{FORMULA: } P_2 = P_1 \times (Q_2/Q_1)^2$$

P₂ = Pressure drop at desired flow rate.

Q₂ = Desired flow rate.

P₁ = Known pressure drop (in this case 0.3" w.c.).

Q₁ = Known flow rate at 0.3" w.c. (see chart).

SELECTING A REGULATOR WITH SUFFICIENT CAPACITY:

A. Check Capacity Chart insuring regulator has ample range of regulation and individual load capacities (for use with pilot) for the application.

B. Know minimum encountered inlet pressure.

MINIMUM INLET PRESSURE MINUS "P₂" MUST BE GREATER THAN DESIRED OUTLET PRESSURE.

Solve for "P₂" using above formula.

EXAMPLE: 1/2"NPT regulator required for main burner and pilot.

Desired maximum flow rate = 150,000 Btu/h.

Maximum individual load = 150,000 Btu/h.

Minimum inlet pressure = 7.0" w.c.

Required outlet pressure = 5.0" w.c.

Using the Capacity Chart shows the RV48 is the only regulator satisfying the requirements in "A".

$P_2 = 0.3" \text{ w.c.} \times (150,000/130,000)^2 = 0.4" \text{ w.c.}$

7.0" w.c. — 0.4" w.c. = 6.6" w.c.

6.6" w.c. is greater than the required P_o of 5.0" w.c.

THE RV48 (non "L" fixed orifice), VENTED OR W/12A04 BALL CHECK DEVICE, IS THE CORRECT REGULATOR FOR THIS APPLICATION.

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Appendix C – Safety Data Sheet – Evans Coatings LLC – Type II: B-52

Safety Data Sheet

May be used to comply with
OSHA's Hazard Communication Standard
29 CFR 1910.1200 Standard must be
Consulted for specific requirements

U.S. Dep. of Labor
Occupational Safety and Health Admin.
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072

Product Identity (as used on label & list)

Type II: B-52

HMIS/NFPA HAZARD
ID SYSTEM

Section I: Identification

Manufacturers Name:	Emergency Telephone Number	Health:	1
Evans Coatings LLC	248-583-9890		
Address:	Tel/Fax Numbers for Information	Flammability:	1
1330 Souter Drive, Troy, MI 48083	Tel: 248-583-9890 Fax: 248-583-2050		
	Date Prepared:	Reactivity:	1
	January 2, 2018		
	Signature of Preparer (optional):	Personal Protection:	B

Section II: Hazards Identification

Emergency overview

Color	Clear or Colored
Physical State	Solid
Odor	Slight Hydrocarbon when warm
OSHA/HCS Status	This product is not considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).
Hazard Statement	This product can cause burns when exposed to skin at elevated temperatures.
Routes of Entry	Eyes, Skin, Ingestion, Inhalation

Potential acute health effects

Inhalation	None expected
Ingestion	None at room temperature
Skin	Molten component can cause burns
Eyes	Hot fumes may cause irritation

Section III: Composition/Information on Ingredients

Chemical Name	CAS #	% Weight	% Volume	Listed Carcinogen
Cellulose Acetate Butyrate	9004-36-8	see note	see note	No
Epoxidized Soybean Oil	8013-07-8	see note	see note	No
Diisononyl Phthalate Linear	28553-12-0	see note	see note	No

Note: percentages not provided in order to protect trade secret formula under HCS 2012 (i)(1)

Section IV: First Aid Measures

Eye Contact	If exposed to fumes or smoke, flush eyes immediately with water followed by removing contact lenses if applicable and repeating rinse. Get medical attention if irritation persists.
Skin Contact	Not hazardous other than when hot and molten. If molten liquid contacts skin then treat as an oil burn.
Inhalation	Respiratory irritation not expected unless the product is heated to a point of fuming. If fumes are inhaled removed immediately to fresh air and get prompt medical attention.
Ingestion	Non-hazardous but rinse mouth and do not induce vomiting if swallowed. Get prompt medical attention if swallowed.
Protection of Responders	No unusual precautions are necessary.

Section V: Fire Fighting Measures

Appropriate Extinguishing media	Dry chemical, CO ₂ , alcohol-resistant foam, H ₂ O fog
Fire Fighting Precautions	Keep untrained personnel away from the fire. Soak thoroughly with appropriate extinguishing media and keep cool to prevent reigniting.
Special Protective Equipment for Fire Fighters	Wear positive pressure self-contained breathing apparatus and protective fire fighting clothing.
Hazardous Thermal Decomposition Products	Smoke and fumes generated from fire or combustion may contain but not necessarily limited to NO _x , CO ₂ and CO.

Section VI: Accidental Release Measures

Spills or Leaks	Handle as a thermoplastic. With molten spills, allow the material to solidify and cool. Keep material out of sewers and watercourses by diking or impounding. Recover and place into appropriate containers for recycling or disposal according to local, state and federal laws.
-----------------	---

Section VII: Handling and Storage

As a solid, avoid contamination by keeping in closed containers. Keep away from incompatible materials.

Section VIII: Exposure Controls/Personal Protection

This material will be utilized in a molten form. Proper protective splash resistant clothing, thermal gloves, splash resistant shoes and eye shields must be worn to prevent injury. Use molten material in well-ventilated area. When working in confined areas or areas without adequate ventilation use appropriate respiratory equipment.

Section IX: Physical and Chemical Properties

Softening Point	258 F	Boiling Point	> 700 F
Flash Point	>410 F	Specific Gravity (H ₂ O = 1)	1.0702
Vapor Pressure	< 0.1 mmHg	Evaporation Rate	Negligible
Solubility in Water	< 1 ppm	Appearance and Odor	100% solid, wax odor

Section X: Stability and Reactivity

Stability	Unstable	Conditions to avoid: Dipping in excess of flash point	
	Stable	X	
Incompatibility (materials to avoid): Strong acids and alkalis			
Hazardous decomposition or byproducts: None known			
Hazardous	May Occur	Conditions to avoid: Dipping in excess of F.P.	
Polymerization	Will Not Occur	X	

Section XI: Toxicological Information of ingredients

Ingredient	ROE	Carc	LD50	LC50	TLV/TWA	Mutagen	Repr	Neuro	Tera
Cellulose Acetate	S,E,I	No	>3200	N/A	N/A	N/A	No	No	No
Butyrate			mg/kg						
Soya Oil	S,E,I	No	N/A	N/A	N/A	No	No	No	No
Diisononyl Phthalate	S,E,I	No	>10 g/kg	N/A	N/A	No	No	N/A	No
Linear									

Section XII: Ecological Information

Bio-Toxicity (plants/animals)	Not expected
Aquatic Toxicity	Not expected
Soil Mobility	Product is solid at temperatures below 100 F
Degradability	Product is completely biodegradable

Section XII: Ecological Information (cont.)

Bioaccumulation potential	Not determined
Other adverse effects	Not determined

Section XIII: Disposal Considerations

This product in its pure solid form at room temperature is not considered hazardous and can normally be disposed of by incineration or by landfill according to federal, state and local regulations for this type of product. Dispose of surplus and non-recyclable product via a licensed waste disposal contractor.

Refer to Section 7: Handling and Storage and Section 8: Exposure Controls/Personal Protection for additional handling information and protection of employees.

Section XIV: Transport Information

DOT Proper Shipping Name	Not regulated
DOT Hazardous Classification	Not applicable
DOT Hazardous Material 172.101	Not listed
DOT Appendix to Section 172.101	Not listed
DOT Labels Required	None
DOT Placards Required	None for solid products None for molten products shipped at below 212 F Hot molten product shipped over 212 F requires a class 9 "HOT" placard. Bill of lading must carry the statement: Elevated temperature material, liquid, N.O.S. 9, UN3257, III (Wax).
TDG classification	Not controlled under TDG (Canada)

Section XV: Regulatory Information

Section XV: Regulatory Information cont:

Superfund Amendments and Reauthorization Act (SARA) of 1986 Title III (Emergency Planning and Community Right-to-Know Act of 1986) Section 313: This material contains no known products restricted under SARA Title III, Section 313.
U.S. Toxic Substances Control Act (TSCA): All components of this product are on the TSCA Inventory or are exempt from TSCA Inventory requirements under 40 CFR 720.30.
California Safe Drinking Water & Toxic Enforcement Act (Proposition 65): This product contains including Diisononyl Phthalate (DINP) which is [are] known to the State of California to cause Cancer.
CEPA - Domestic Substances List (DSL): All substances contained in the product are listed on the Canadian Domestic Substances List (DSL) or are not required to be listed.
RCRA: This material is not a RCRA hazardous waste.

Section XVI: Other

Legend of Abbreviations

Designation	Meaning
OSHA	Occupational Safety and Health Administration
HCS	Hazard Communication Standard
CFR	Code of Federal Regulations
CAS	Chemical Abstract Service
DOT	Department of Transportation
HMIS	Hazardous Materials Identification System
NFPA	National Fire Protection Association
RCRA	Resource Conservation and Recovery Act
PPM	Parts per Million
F.P.	Flash Point
ROE	Routes of Entry
S, E, I	Skin, Eyes, Inhalation
N/A	Not Available
N.O.S.	Not Otherwise Specified
>	Greater Than

Hazard Ratings: Health: 1 Flammability: 1 Reactivity: 1 Specific Hazard: 0

Evans Coatings LLC urges each customer or recipient of the MSDS to study it carefully and consult appropriate expertise, as necessary, to become aware of and to understand the content herein and any hazards associated with the product. This information is provided in good faith and is believed to be

OSHA Hazard Communication Standard: This product is not a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200
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accurate as of the effective date shown above. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ between various locations. It is the buyer/user(s) responsibility to ensure that his activities comply with all federal , state, provincial or local laws and regulations. The information presented herein pertains only to the product as shipped. Since conditions for use of the product are not under the control of the manufacturer, it is the buyer/user(s) duty to determine the conditions necessary for the safe use of this product.



Price Industries Limited
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Appendix D – Evans Coatings LLC Technical Data Sheet



EVANS COATINGS LLC

1330 Souter - Troy, Michigan 48083
(248) 583-9890 - FAX (248) 583-2050
(800) 343-8267

Website: www.evanscoatings.com
E-mail: info@evanscoatings.com

B-52

EXPLANATION: This material is a Type II, Cellulose Acetate Butyrate based plastic. It is composed of Cellulose Acetate Butyrate and various plasticizers. It contains no solvents or harmful ingredients.

COLOR	Clear	
DENSITY:	8.21 lbs/gal	(.984 gm/ml)
VISCOSITY AT 350 °F Brookfield RVF Spindle 4-20 RPM	1350 CPS	(177 °C)
OPERATING TEMPERATURE:	310 °F	(155 °C)
COATING THICKNESS:	.050 in	(1.27 mm)
FLASH POINT COC °F (°C)	395 °F	(206 °C)
FIRE POINT COC °F (°C)	445 °F	(229 °C)
SOFTENING POINT °F (°C) Ring & Ball	218 °F	(102 °C)
COOLING TIME:	60 SEC	
HARDNESS SHORE A:	51	
TENSILE STRENGTH: Instron 1130	435.9 PSI	(30.6 kg/sq cm)
ELONGATION: Instron 1130	148.2%	
ELECTRICAL RESISTANCE Meg Check	EXCELLENT	
MOISTURE RESISTANCE	EXCELLENT	
CHEMICAL RESISTANCE	Attacked by solvents and long immersion in strong acids and bases	
AVAILABLE COLORS:	Clear, Red, Blue and green	
USES:	Used where materials must be very flexible and have some stretch	