

I N S T R U C T I O N B O O K
F O R

8 6 9 0 S E R I E S M O D U L O A D[®]
R F L O A D R E S I S T O R

BIRD
Electronic Corporation

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MODELS COVERED IN THIS INSTRUCTION BOOK

8692-050
8692-060
8692-080
8693-050
8693-060

SAFETY PRECAUTIONS

The following are general safety precautions that are not necessarily related to any specific part or procedure and do not necessarily appear elsewhere in this publication.

Keep away from live circuits.

Operating personnel must at all times observe normal safety regulations. Do not attempt to replace parts or disconnect an RF transmission or any other high voltage line while power is applied. When working with high voltage always have someone present who is capable of rendering aid if necessary. Personnel working with or near high voltage should be familiar with modern methods of resuscitation.

Warning: Warning notes call attention to a procedure which, if not correctly performed, could result in personal injury.

Caution: Caution notes call attention to a procedure which, if not correctly performed, could result in damage to the instrument.

The following will appear in the text of this publication and are shown here for emphasis.

```
*****
*                               C A U T I O N                               *
*                               *                                           *
* Before any RF operation of the load is attempted, the *
* transmitter interlock and ac line attachment to the *
* equipment must be made. First attach the transmitter *
* interlock connections to the two appropriate binding *
* posts on the side panel. *
*                                                                 pg 1 *
*****
```

```
*****
*                               C A U T I O N                               *
*                               *                                           *
* Do not use any sealants, leak-stopping material, or *
* automotive antifreeze in the coolant. Do not use *
* de-ionized water. Use only clear potable water and *
* pure ethylene glycol. *
*                                                                 pg 3 *
*****
```

Continued

* C A U T I O N *
* *
* Do not apply RF power greater than the maximum power *
* rating of the load. *
* pg 6 *

* C A U T I O N *
* *
* Do not block air flow. Air enters housing through *
* perforated grilles on front of the unit and exhausts *
* through grilles at the top. Blocking these grilles *
* could cause unit failure. *
* pg 6 *

* C A U T I O N *
* *
* Do not operate load without connecting the interlock. *
* This is very important. Even momentary application of *
* power to the load while the cooling circulation is off *
* or possibly functioning improperly will cause almost *
* immediate destruction of the resistor element. *
* pg 7 *

* W A R N I N G *
* *
* Never attempt to disconnect RF equipment from a *
* transmission line while RF power is being applied. *
* Leaking RF energy is a potential health hazard. *
* pg 10 *

* W A R N I N G *
* *
* When using dry cleaning solvents, provide adequate *
* ventilation and observe normal safety precautions. *
* Many dry cleaning agents emit toxic fumes that may be *
* harmful to your health, if inhaled. Avoid skin contact *
* with harsh solvents, wear rubber gloves and protective *
* clothing to avoid caustic or acid burns, or other *
* detrimental effects caused by absorption, of some *
* solvents, through the skin. *
* pg 10 *

Continued

* C A U T I O N *
* *
* Handle the load with care. Do not subject it to *
* unnecessary shock or impact. *
* pg 10 *

* C A U T I O N *
* *
* The 4-wire (Super Type) power cord should be *
* disconnected before any access panel is removed or any *
* repair or replacement is attempted. *
* pg 11 *

* W A R N I N G *
* *
* The resistor used in this load consists of a resistive *
* film on a special substrate. If the substrate is *
* broken, there will probably be sharp pieces or *
* splinters inside the load housing. Caution should be *
* exercised to avoid possible injury. *
* pg 15, 16 *

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SERIES 8690 MODULOAD® RF LOAD RESISTOR

INTRODUCTION

PURPOSE AND FUNCTION

The Series 8690 MODULOAD® Coaxial RF Load Resistor is designed as a unique self-cooling, low reflection and non-radiating termination for high power RF transmission up to 80 Kilowatts. Each model is designed for use with a standard connector of the types common to 6 1/8 inch coaxial lines, (see Specifications for individual models) and will maintain a VSWR of less than 1.15 to 1.0 from 1000 Hz up to 800 MHz. These loads are intended for use on CW, AM, FM, SSB and TV modulation envelopes, and within certain limitation on radar or pulse modes. Information on applications involving pulse-type signals should be obtained directly from Bird Electronic Corporation.

The Models 8692/93 consists of three basic systems: The RF Load Assembly, the Control System and the Heat Exchanger Section. The Load Assembly contains the resistor elements with its internal water cooling. The Control System includes the electrical circuitry required to prevent damage to the transmitter in case of malfunction of the load and to protect the RF Load should water flow drop. The Heat Exchanger Components consist essentially of the pump/motor, the cooling blowers, the collector tank, and finned coil cooling unit.

CAPABILITIES

When used in conjunction with the appropriate Bird Model THRULINE® Wattmeter, such as those in the 4902 and 4907 Series, the Model 8692/93 loads may be used for direct RF power measurement within the equipment ratings.

The Models 8792/93 TERMALINE® Load Resistor installed on these units have the feature of field replacement of the resistor, described in the Maintenance Section.

SPECIFICATIONS FOR SERIES 8690 MODULOAD® RF LOAD RESISTOR

Power Rating	80,000 watts
RF Input Impedance	50 ohms
Input Connectors	
Model 8692.....	6-1/8" EIA flanged (50 ohm)
Model 8693.....	6-1/8" unflanged (50 ohm)
Frequency Range	1 kHz to 800 MHz
VSWR	1.15 max. 1000 Hz to 800 MHz
Models	CW, AM, FM, SSB, TV and certain pulse types
Ambient Temperature Range	-20°C to +35°C (-4F to 95F)
AC Power Required	
Models 8692-050 & 8693-050.....	210 - 230 volts @ 50 Hz, 3 phase
Models 8692-060 & 8693-060.....	210 - 230 volts @ 60 Hz, 3 phase
Models 8692-080.....	380 volts @ 50 Hz, 3 phase
Cooling Liquid	2/3 water 1/3 Ethylene Glycol 10 gallons (37.9 liter) approx. (additional coolant required for remote load mounting)
Dimensions (see Outline Drawings)	66" H x 52"W x 27"D (168 x 132 x 686 cm)
Blower Capacity	8000 ft. ³ /min (226.54 m ³ /min)
Weight	830 lbs (376.5 kg) with water 746 lbs (338.4 kg) without water
Finish	Light navy gray enamel

SECTION I - INSTALLATION

1-1. GENERAL

1-2. The Series 8690 must be installed and operated only in its original upright position - as the unit is shipped and as it normally stands on its supporting casters. Operation in any other manner will disable the cooling system and almost certainly result in immediate burnout of the Load Resistor.

1-3. The MODULOAD® may be operated anywhere that adequate ac line power and ventilation are available, and ambient temperatures do not exceed those given, 35°C max. (95F), see Specifications page vi. Note: 80 kW being about equivalent to 273,216 BTU/hr a sufficient quantity of air must be provided. Allow room for unobstructed air intake over the whole surface grille on the front of the equipment and clearance of at least three feet over the top of the unit.

1-4. There are two rectangular exhaust openings at the top of the unit. These openings, 15 x 16 1/8 inch in size (381 x 410 mm), have a 1 1/2 inch lip (38.1 mm) to which outside venting ductwork may be assembled, if desired. If venting ductwork is to be added, caution must be used not to restrict the exhaust air flow. It is advisable to consult with the Company before proceeding.

1-5. LINE ATTACHMENT

```
*****
*                               C A U T I O N                               *
*                               *                                           *
* Before any RF operation of the load is attempted, the *
* transmitter interlock and ac line attachment to the *
* equipment must be made. First attach the transmitter *
* interlock connections to the two appropriate binding *
* posts on the side panel. *
*****
```

1-6. AC line power is supplied to the 4-pole (Super Type) "Twistlock" flanged inlet by means of the 10 foot cable and matching plug that is furnished with the MODULOAD® equipment. The four-wire connection made here includes the "X, Y, Z" (Nema) contacts for the three-phase power, and "G" contact for ground, as included in the outlet receptacle to be used. Do not detach the ac cable - only if necessary and when disconnection of the RF power supply to unit is definitely assured. The 230 V, three-phase ac line may be positioned, but the ac power must not be applied unless coolant is in the system and filled to the correct level. Check per para 1-8 following.

1-7. Operation of the pump-motor (initiating coolant flow) will close the flow switch contacts, the high temperature thermostwitch in series with it being normally closed. This will start operation of the time delay - in approx. two seconds it will close and the transmitter interlock will then permit application of RF power.

1-8. COOLANT AND FILLING OF UNIT

1-9. The coolant is a mixture of 65 percent clear potable water and 35 percent industrial pure ethylene glycol for temperatures from -20°C to +35 °C (-4F to 95F). Use only potable water and industrially pure ethylene glycol. Do not use any automotive antifreeze or stopleak preparations.

1-10. Close the main load supply and return valves. Fill unit with liquid coolant through the 1 1/4 inch fill connection. Open the manual coil vent valve to permit air to escape from the coil, close when necessary. The unit operates with approximately 10 gallons (37.9 liters) of coolant. This amount may vary depending on remote load mounting and length of hose used, not to exceed 40 feet total length.

1-11. When the unit is full, replace the fill plug and vent valve. Apply ac power momentarily and open the manual vent valve slightly until a spurt of coolant is noticed. Close the manual vent valve and turn off ac power.

1-12. Connect the supply and return hoses to the load. Make sure the main supply hose is connected to the coolant input of the load located in the center of the water chamber. Reversed coolant flow will result in load resistor failure. Open the main supply and return valves allowing the coolant to enter the hoses to the load. Note: The 8792/93 load may be remotely mounted from the heat exchanger; however only approximately forty (40) feet total of hosing should be used. This means the load may be mounted about 20 feet from the exchanger. If absolutely necessary, up to 50 feet max. of hose, total, may be used but with extra care as water flow will be restricted. When water flow is restricted to the point where there is an insufficient amount of water flow to cool the load, the flow switch will not actuate, preventing the time delay relay from operating, and the interlock circuit will not close. This safeguard will render the transmitter inoperative until hose length is reduced or sufficient flow rate is again restored.

1-13. The unit should now be started and run for a period of 1 to 1 1/2 minutes - opening the manual vent valve slightly about every 15 seconds to purge the air from the hoses. The liquid level in the view gauge will fall as air is accumulated in the reservoir. If the liquid level falls below the minimum level, the pump should be stopped and additional coolant added to bring the level to near maximum, as shown on the gauge. Note: The pump/motor must not be operated without sufficient coolant in the system as damage to its working parts could result.

1-14. After all air is purged, the system is ready for use. The normal flow and normal temperature lights will indicate that the unit is ready to be used.

1-15. Check the coolant level at regular (daily) intervals when the unit is in prolonged use, or when starting after a period of inaction. The coolant gauge is in the mid right of the right side panel of the MODULOAD® housing. Whether the pump is on or off, when properly filled the red indicator (in the glass tube) should be between the limits marked on the panel. It is important to check this coolant level regularly. Add coolant if necessary to bring to required level.

 * CAUTION *
 *
 * Do not use any sealants, leak-stopping material, or *
 * automotive antifreeze in the coolant. Do not use *
 * de-ionized water. Use only clear potable water and *
 * pure ethylene glycol. *

1-16. DRAINAGE

1-17. Drainage of the unit is performed by following the steps outlined below.

- a. Open the drain valve at the bottom of the unit and let the coolant drain for a few minutes. If the coolant is to be reused, devise a method to catch and save it.
- b. Open the manual vent on the side of the unit to allow the coolant to drain.
- c. Close drain and vent before refilling per para 1-8.

1-18. BLOWER FANS

1-19. The fan motor is wired direct to the ac line input and will always operate along with the pump when ac line power is applied. In addition to the basic function of producing requisite air flow thru the radiator, this ventilation materially assists in cooling the pump/motor unit.

NOTE - Special Precaution

The hoses for the 8792/93 load coolant supply and return, must withstand at least 100 lbf/in². If any other hoses are to be used, other than hoses supplied by Bird Electronic Corporation, be sure this requirement is kept. This is especially true for remote mounting of load.

SECTION II - THEORY OF OPERATION

2-1. GENERAL

2-2. The Model 8792/93 TERMALINE® Coaxial RF Load Resistor mounted on the heat exchanger cabinet is unique in that it utilizes an external water supply for the direct cooling of the resistor element. By using this technique, the need for an intermediate dielectric fluid to transfer the heat generated in the resistor element has been eliminated, reducing the physical size of the load to a virtual minimum. This simplified system allows the use of the loads in more varied environments, and the attachment in any orientation.

2-3. HEAT TRANSFER

2-4. The 50 ohm resistor consists of a high temperature substrate tube with a deposited resistive film. The heat generated by absorption of RF power is transferred from the heated film to the water flowing over it, through a restricted chamber surrounding the resistor body. This water, first diverted to the front of the load resistor by a special inside tube, passes over the entire length of the resistor and is discharged through the sealed water chamber at the rear. The dielectric characteristics and distinctive design of these enclosures provide a very accurate 50 ohm termination over the specified frequency range of this load - 1000 Hz to 800 MHz.

2-5. The absence of intermediate cooling fluids considerably simplifies the construction and sealing of this unit. It can be readily disassembled in the field for resistor element replacement (see Section IV -Maintenance).

2-6. Because there is practically no heat transfer to the outer housing of the load, the housing remains at a cool ambient temperature even under full power conditions. Virtually all of the power input to the load is transformed into heat which is carried away by the cooling water.

2-7. COOLANT QUALITY

2-8. The thermal performance of these loads is also affected by impurities, particularly those impurities that accumulate in the form of scale on the exposed surfaces of the coolant paths of the load assembly. These deposits may result in an increase in the thermal and/or fluid resistance(s) of the load and may in turn cause the load to overheat and fail. It is imperative that only the recommended coolant be used.

2-9. FLOW INTERLOCK CONTROL CIRCUIT

2-10. The interlock control circuit provides instantaneous fail-safe protection of the transmitter and load in the event of even momentary interruption of the cooling water supply. This protection is necessary because dissipation of the heat generated by the RF power is critically dependent upon a required minimum water supply regardless of system water temperature.

2-11. The Water Flow Switch, installed close to the water output to the Load Resistor is "normally open" type i.e. its electrical contact opens when deactivated. Closed during equipment operation, the switch is adjusted to open whenever water flow drops below the safe flow point for the specific unit - about 10 ± 1 (one) gal/min (37.9 l/min). When this occurs, the Timer Relay is instantly deactivated, thereby opening the interlock circuit and causing immediate transmitter shutdown. Also, the centrifugal impeller of the water pump is carefully selected for the current flow. The proper operation of this equipment depends on these conditions being maintained, do not alter the flow switch setting, or disturb the pump.

2-12. After resuming operation of the MODULOAD® heat exchanger and restoring the calibrated water flow, the Time Delay Switch will keep the transmitter interlock "open" for an additional two seconds. This special safeguard assures proper operation of the cooling system before RF power can be applied to the load, preventing damage or burnout of the resistor element.

SECTION III - OPERATING INSTRUCTIONS

3-1. GENERAL

3-2. The MODULOAD® has no operating controls other than the ON/OFF switch, therefore requires no operator present. Install per instructions in Section I. Follow procedure carefully to assure proper operation of equipment.

```
*****
*                               C A U T I O N                               *
*                               *                                           *
* Do not apply RF power greater than the maximum power *
* rating of the load. *
*****
```

```
*****
*                               C A U T I O N                               *
*                               *                                           *
* Do not block air flow. Air enters housing through *
* perforated grilles on front of the unit and exhausts *
* through grilles at the top. Blocking these grilles *
* could cause unit failure. *
*****
```

3-3. CONNECTING RF POWER TO LOAD

3-4. After installation, the coaxial RF transmission line may be attached. For the respective Series 8690 models the connections are as follows:

- a. Model 8692-(000) - 6 1/8 inch EIA, 50 ohms, with swivel flange.
 - 1. Use 6 1/8 inch EIA Coupling Kit Bird P/N 4902-020 which includes (12) 3/8-16 x 1 3/4 inch bolt and nut sets, O-Ring and insulated center bullet.
 - 2. Insert the center bullet, push in to seat insulator in facing and install O-Ring in groove.
 - 3. Connect coaxial input in straight line, push carefully on center contact to close. The swivel flange on the MODULOAD® makes connection independent of a fixed flange on the coaxial input, see figure 3-1.
 - 4. Insert bolt sets, tighten evenly all around.
- b. Model 8693-(000) - 6 1/8 inch unflanged, 50 ohms
 - 1. Use Coupling Kit Bird P/N 5-1322 or RCA MI-561579-4A consisting of outer sleeve with two clamping bands and the center conductor coupling bullet.
 - 2. Insert center bullet and bottom it on the mid-point nibs.
 - 3. Position the outer sleeve (with clamps) over input connector.

4. Introduce transmission line and seat snugly against the coupling stops, see figure 3-2.
5. Position clamp bands evenly about 2 inches apart and tighten.

```

*****
*                               C A U T I O N                               *
*                               *                                           *
* Do not operate load without connecting the interlock. *
* This is very important. Even momentary application of *
* power to the load while the cooling circulation is off *
* or possibly functioning improperly will cause almost *
* immediate destruction of the resistor element. *
*****

```

3-5. OPERATING AS A LOAD RESISTOR

3-6. Before any operation of the load whatsoever, check the interlock circuit for proper operation. Do this by connecting an ohmmeter across the interlock connections and turning the unit on. The ohmmeter should actuate indicating proper operation of the interlock circuit. Follow steps below for load operation.

- a. Check functioning of interlock.
- b. Turn on 210 - 230 V ac power.
- c. After a few seconds apply RF power to Load.

3-7. SHUTDOWN PROCEDURE

- a. Turn RF power to Load off. Always do this first.
- b. Wait 5 minutes, allowing pump and fans to run.
- c. Turn ac power off, stopping the MODULOAD® automatically opens the interlock connection.

3-8. PERFORMANCE NOTES

3-9. The Series 8690 MODULOAD® RF Load Resistor will handle continuous power dissipation up to 80 kW. For other values see Specifications on page vi. The Series 8690 are intended for use on CW, AM, FM, SSB, TV modulation envelopes and within certain limits on radar or pulse modes. For information involving pulse-type signals contact Bird Electronic Corporation.

3-10. When used in conjunction with the appropriate Bird Model THRULINE® Wattmeter, such as those in the 4902 and 4907 Series, the 8690 Series loads may be used for direct RF power measurements within the equipment ratings.

FIGURE 3-1. MODEL 8792, 6 1/8 INCH FLANGED ATTACHMENT

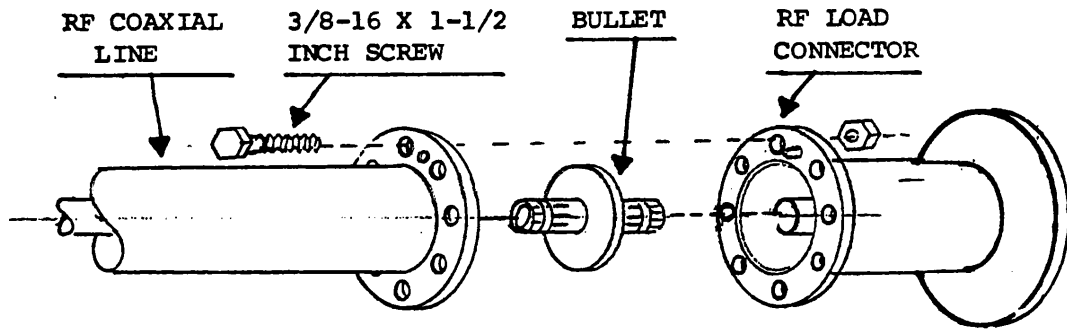
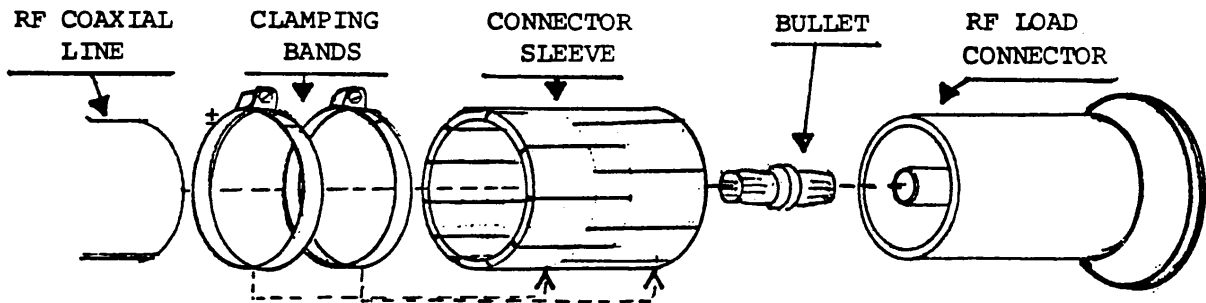


FIGURE 3-2. MODEL 8793, 6 1/8 INCH UNFLANGED ATTACHMENT



3-11. COOLING CHARACTERISTICS

3-12. The electrical performance of the Series 8690 RF MODULOAD® RF Loads is affected by impurities or other chemical additives in the cooling liquid. Therefore, the cooling liquid should be clear water, with industrially pure ethylene glycol and be kept clean at all times.

3-13. Thermal performance is affected by impurities, particularly those which accumulate in the form of scale on the surfaces of the ceramic tube and other water passages. This results in an increase of thermal resistance of the load, and in turn, may cause the load to overheat and fail. Do not use any additives whatsoever in the coolant.

SECTION IV - MAINTENANCE

4-1. GENERAL

```
*****  
*                               W A R N I N G                               *  
*                                                                                   *  
* Never attempt to disconnect RF equipment from a                             *  
* transmission line while RF power is being applied.                           *  
* Leaking RF energy is a potential health hazard.                             *  
*****
```

```
*****  
*                               W A R N I N G                               *  
*                                                                                   *  
* When using dry cleaning solvents, provide adequate                           *  
* ventilation and observe normal safety precautions.                           *  
* Many dry cleaning agents emit toxic fumes that may be                       *  
* harmful to your health if inhaled. Avoid skin contact                       *  
* with harsh solvents, wear rubber gloves and protective                       *  
* clothing to avoid caustic or acid burns, or other                           *  
* detrimental effects caused by absorption, of some                           *  
* solvents, through the skin.                                                   *  
*****
```

4-2. The Coaxial Load Resistor installed on the MODULOAD® heat exchanger is rugged and simple, requiring only nominal and routine attention. The Load is designed to operate for long periods of time if care is taken not to exceed its power handling capabilities.

4-3. The outside surface of the MODULOAD® unit should be wiped free of dust and dirt at regular intervals. Particular attention should be given to the air intake, see para 4-5. Also check condition of RF coaxial connection occasionally. If required, disconnect the instrument from the transmission line and clean the RF connector parts both metallic and insulator surfaces with an acceptable dry cleaning solvent on a cotton swab.

```
*****  
*                               C A U T I O N                               *  
*                                                                                   *  
* Handle the load with care. Do not subject it to                             *  
* unnecessary shock or impact.                                                 *  
*****
```

4-4. RF LOAD RESISTOR

4-5. Accurate measurement of the dc resistance between the inner and outer conductors of the RF input connector will provide a good check of the condition of the load resistor. For this measurement, a resistance bridge or ohmmeter with an accuracy of one percent or better at 50 ohms is recommended. Use low resistance leads, preferably a short piece of 50 ohm coaxial cable fitted with alligator clips. The measured resistance should not deviate more than 2 ohms from the value stamped on the manila tag attached to the load.

Note - It is recommended that this resistance check be performed each time the load is to be used.

4-6. FLOW SWITCH

4-7. This unit is an essentially uncomplicated mechanism, requiring only little care to provide long-term service. Its operation can be checked easily by monitoring the interlock circuit while starting or stopping pump/motor without any RF power on the equipment. This component is non-repairable and must be replaced, see para 4-24.

4-8. ROUTINE SERVICE CHECKS

4-9. When the equipment is being used, watch the coolant level in the system at regular intervals. Check once or twice a week normally, more often if used continuously or under high ambient temperatures. For a safe operation, the coolant level should remain between marks on the coolant gauge - whether the unit is running or not. Add liquid if required, see Installation, Section I. Use only the coolant mixture that is recommended. Do not use any additives and especially no automotive ant-freeze.

4-10. The radiator surface, particularly on the outside, should be inspected thru the grill periodically for possible collection of dust and lint. When the inspection indicates foreign material building up between the fins of the coil, the dirt should be blown with a compressed air nozzle in the reverse direction of the normal cooling air flow. This may be done by removing the large access panel in the rear of the unit and using an air hose directed at the rear side of the coil.

4-11. The fan V-belt drive should be checked after the first 24 to 48 hours of operation. The ideal tension is the lowest tension at which the belts will not slip. Over-tensioning will shorten belt and bearing life; under-tensioning will cause belt slip, heat and premature belt failure. A deflection of 3/8 inch in the belt will be achieved by a force of approximately 1 1/2 pounds exerted perpendicular to the belt midway between the sleeves when properly tensioned. When moving the motor to correct belt tension, care should be exercised to keep the motor shaft parallel to the blower shaft. Misalignment will cause the belt damage.

```
*****  
*                               C A U T I O N                               *  
*                                                                                   *  
* The 4-wire (Super Type) power cord should be                               *  
* disconnected before any access panel is removed or any                       *  
* repair or replacement is attempted.                                         *  
*****
```

4-12. REPAIR AND REPLACEMENT PROCEDURES

4-13. The Series 8690 MODULOAD® is especially designed for independent, long term, trouble free operation without requiring regular procedures other than those described above. The cooling coil and the blowers are not normally field replaceable. It is advisable to return the heat exchanger, minus the load, to the factory should either need replacement.

4-14. Belt Replacement:

- a. Remove back access panel.
- b. Loosen mounting nuts for the blower motor.
- c. Slide blower motor towards front of cabinet to loosen tension on belts. Belts may now easily be removed and replaced.
- d. Slide blower motor back to obtain correct belt tension, as mentioned in para 4-11 of this section and tighten nuts after checking tension.

4-15. Thermoswitch Replacement

4-16. The thermoswitch is a rugged device which is precisely set before leaving the factory. No field adjustments should be attempted. The thermoswitch is located behind the small inspection panel on the right side panel above the supply and return valves. To remove the thermoswitch proceed as follows:

- a. Remove the inspection panel.
- b. Using a 3/32 inch Allen wrench, loosen the socket head set screw located just below the box on the pipe coupling. This will allow the thermoswitch box and housing to be pulled straight up and out of the coupling. When free, pull the switch box through the opening in the panel slightly, i.e. as much as the connecting wires will allow.
- c. With the Thermoswitch removed and freely accessible, remove the four screws securing the cover to the box. Remove the cover, exposing the Terminal Strip.
- d. Loosen the two terminal screws securing the red contact wires. Pull the wires from the thermoswitch box out through the hole on top.
- e. To reinstall the Thermoswitch, reverse the procedure above.

4-17. Switch Replacement

4-18. The ON/OFF Switch on the front panel is removed from within the enclosure. It is situated between the blower units just below the blower drive shaft.

- a. Loosen the two screws holding the three red wires to the switch. Pull the wires up and away from the switch.
- b. Turning the screw, located above the switch body, 1/4 turn counterclockwise loosens the main body of the switch for removal.
- c. When the switch body is removed, a large hex nut is exposed. This large nut retains the switch bezel and latching mechanism. This mechanism will not generally have to be replaced.
- d. To replace switch, reverse above procedure.

4-19. Indicating Lights (Lamp Replacement)

4-20. The indicating lamp fixtures are mounted the same way as the ON/OFF switch. The lamps may be easily replaced from within the enclosure by removing the lamp holder as described in step b above, Switch Body Removal. The lamp may also be replaced from the front panel by;

- a. Squeezing the green cover at the top and bottom and pulling it straight off, exposing the green and opaque lens.
- b. Unscrew this lens counterclockwise, exposing the bayonet type lamp. This lamp pulls straight out.
- c. To replace, reverse above disassembly procedure.

4-21. Pump/Motor Replacement

- a. Disconnect the power wires of the pump/motor from inside the terminal box and remove the BX cable.
- b. Drain the unit entirely. See para 1-16, Drainage.
- c. Disconnect pump input and output pipes at the unions located approximately seven inches from the pump.
- d. Unbolt the pump/motor from its mounting and remove it from the enclosure. Then remove the input and output pipes.
- e. When reinstalling the pump/motor, first reassemble the input and output pipes on the pump, using a thread sealer, such as teflon pipe sealant. Replace the pump/motor in the enclosure and reconnect the pipe unions.
- f. Replace the mounting hardware and partially fill the radiator and check for leaks. When no leaks are observed complete wiring of the motor and refill the unit with coolant.

4-22. Coolant Level Gauge Replacement

4-23. For this replacement procedure the coolant must be drained from the unit until it is below the level of the gauge.

- a. Remove the two 3/4 inch hex head screws holding the gauge in place. The gauge will come right off.
- b. Reverse this procedure to replace. The knurled screws on the ends of the gauge may be removed for inspection and to observe alignment of the holes in the hex head screws.

4-24. Flow Switch

- a. Drain the coolant from the unit until it is below the level of the load resistor coolant return pipe. This may be done by disconnecting the hose from the output of the load on the side of the water chamber. Open vents on top of unit to assist in draining.
- b. Disconnect switch wires from tie points 7 and 8 on the terminal block inside the control and switch box.
- c. Loosen the BX cable clamp nut and pull the BX cable up a little to expose the wires inside. Grasp the wires to retract them from the BX tube. If the wires do not retract freely, make sure they are not caught in the control and switch box. It may be necessary to push the wires from inside the control and switch box to assist in retracting them. The wires will not have to be pulled all the way out, as they are spliced a short distance from the switch. The wires may be separated at this point.
- d. When wires are disconnected, unscrew pipe fitting from switch body. The switch may now be removed by unscrewing it.
- e. The Flow Switch is replaced by reversing the procedure above. Make sure, when re-splicing the wires, to insulate each wire carefully so they will not short together. Also be sure when screwing in the Flow Switch body, that the flow direction arrow points in the direction of the coolant flow.

4-25. Time Delay Relay

4-26. This is an integral component, factory set for the operation of this equipment; i.e., two second delay, isolated circuit relay, see para 2-11. The relay cartridge cannot be disassembled or repaired in the field. A faulty unit should simply be replaced, as follows:

- a. Loosen the 8-32 pan head screw at the top of the relay clamp, releasing the retaining prongs of the clamp. Remove or move clamp to side to free Relay.
- b. Remove the Relay by pulling it straight out of the socket.

- c. To replace Relay, reverse foregoing procedure. The socket is an ordinary octal type. When inserting the relay, rotate cartridge to assure alignment of center post nub in socket.
- d. Prongs of clamp match side slots in the socket holder. Fit clamp in slots and turn head screw down finger tight.

4-27. **REPLACEMENT PROCEDURE FOR RESISTIVE ELEMENT**

4-28. The Model 8792/93 RF Loads used with the Series 8690 MODULOAD® resistors are designed to be quickly and easily repaired in the field. If in performing the dc resistance check described previously in para 4-5, a significant change in resistance is noted, or if for any reason the resistive element should fail, inexpensive replacement resistors are available. They can be installed in the load, using the following procedures:

```

*****
*                               W A R N I N G                               *
*                               *                                           *
* The resistor used in this load consists of a resistive *
* film on a special substrate. If the substrate is *
* broken, there will probably be sharp pieces or *
* splinters inside the load housing. Caution should be *
* exercised to avoid possible injury. *
*****

```

Note: Before removing the Load for any reason, turn supply and return valves off and drain coolant from Load and hoses. This coolant may be saved for replacement, after repairs, if clean. If coolant should become contaminated, due to resistor burnout, etc., it may become necessary to drain entire system, flush out and replace with fresh coolant.

4-29. **RESISTOR REMOVAL**

Note: Item numbers enclosed in brackets [] in the text are so indicated on figures 4-1 and 4-2.

- a. Be sure the water flow has been turned off before any disconnection. If the load is not already removed from the system, disconnect the water hoses at the hose fittings [2] on the load and disconnect the unit from the RF transmission line.
- b. Set the load on end with RF Connector down. The water chamber is removed by unscrewing it in a counterclockwise direction. A strap wrench and a 3/8 to 1/2 inch rod are useful to overcome the initial tension of the water chamber item [1]. The rod is inserted in the water output hose nipple fitting item [2] for leverage.
- c. The water inlet tube [4] will usually come out with the water chamber. If not, it can easily be pulled straight off.

4-30. INSPECTION

4-31. If the load resistor has been successfully removed intact, inspect it carefully to be sure that it is not fractured. In the majority of cases, even in the event of resistor burnout, the resistor substrate will remain intact. If, however, the load resistor had been fractured, rinse all the load internal parts thoroughly under clear running water to remove any remaining pieces or splinters that may be lodged there. Next, examine all other internal parts for any apparent damage.

4-32. REASSEMBLY

4-33. Reassembly is accomplished by simply reversing the procedure of para 4-29. When replacing the resistor [13] in the resistor fitting [22], be sure it is a very snug fit and requires a moderate force to push the resistor into the fitting. This fit must not be loose and yet not excessively tight.

4-34. If the resistor is loose in the fitting [22], press the slotted finger contacts of the fitting together slightly and try the resistor again. Continue closing the ends of the resistor fitting until snug, even fit is obtained. Then bottom the resistor in the fitting. With the resistor in place in the fitting [22], install this assembly upright in the RF outer conductor [28] or [31]. Replace the front housing [19] and continue with reassembly.

4-35. RF CONNECTOR REPLACEMENT

4-36. The RF Coaxial connector consists of the inner conductor [26] or [30] and the outer conductor [28] or [31] respectively. It is disassembled by first removing the six 1/4-20 x 1 inch socket head cap screws [20] from the flange of the front housing assembly [19]. The outer conductor will come off exposing the center conductor and insulator. Grasp the center conductor assembly and gently pull it off the front housing. Usually the resistor [13] and flow tube [21] will remain in place in the housing when the center conductor assembly is removed. There is the occasion, however, when one or both of these parts will come out with the center conductor assembly. This is not a problem and they can be separated from the front center conductor assembly and resealed in the housing without consequence.

4-37. The center conductor assembly can be disassembled further by removing the 3/8-16 x 3/4 inch screw and lockwasher set [27] located inside the center conductor. Use a 5/8 inch socket wrench set with an extension for the screw. Hold the resistor fitting [22] by inserting a 5/32 inch rod, or equivalent, through the holes in the fitting. Do not use any pliers or wrenches on the resistor fitting [22] as damage to its surface may result.

4-38. Reassemble the RF Connector by reversal of the above procedure. When replacing the center conductor assembly, gently manipulate the assembly until it is thoroughly seated in place.

FIGURE 4-1. RESISTOR REMOVAL (EXPLODED VIEW)

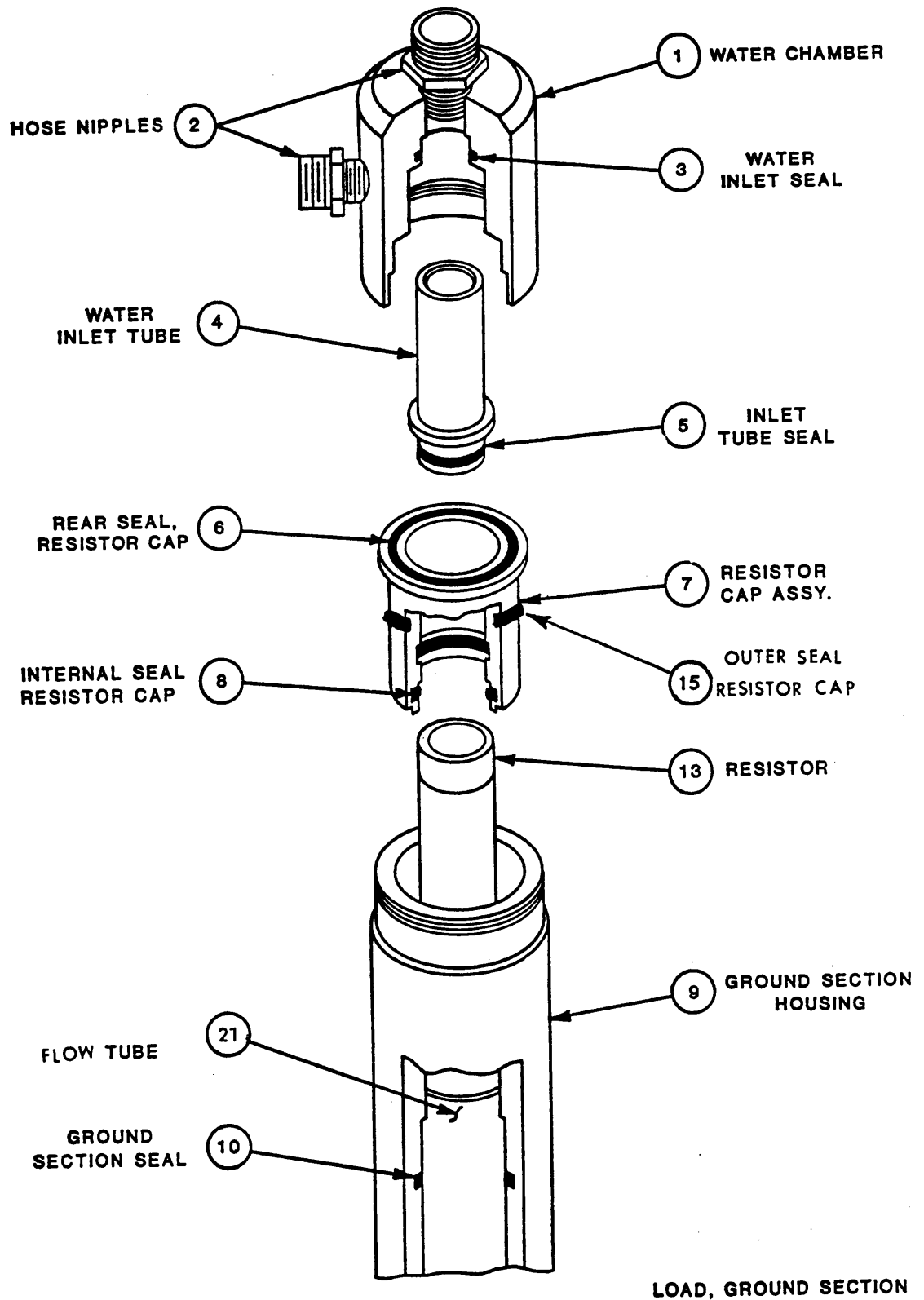
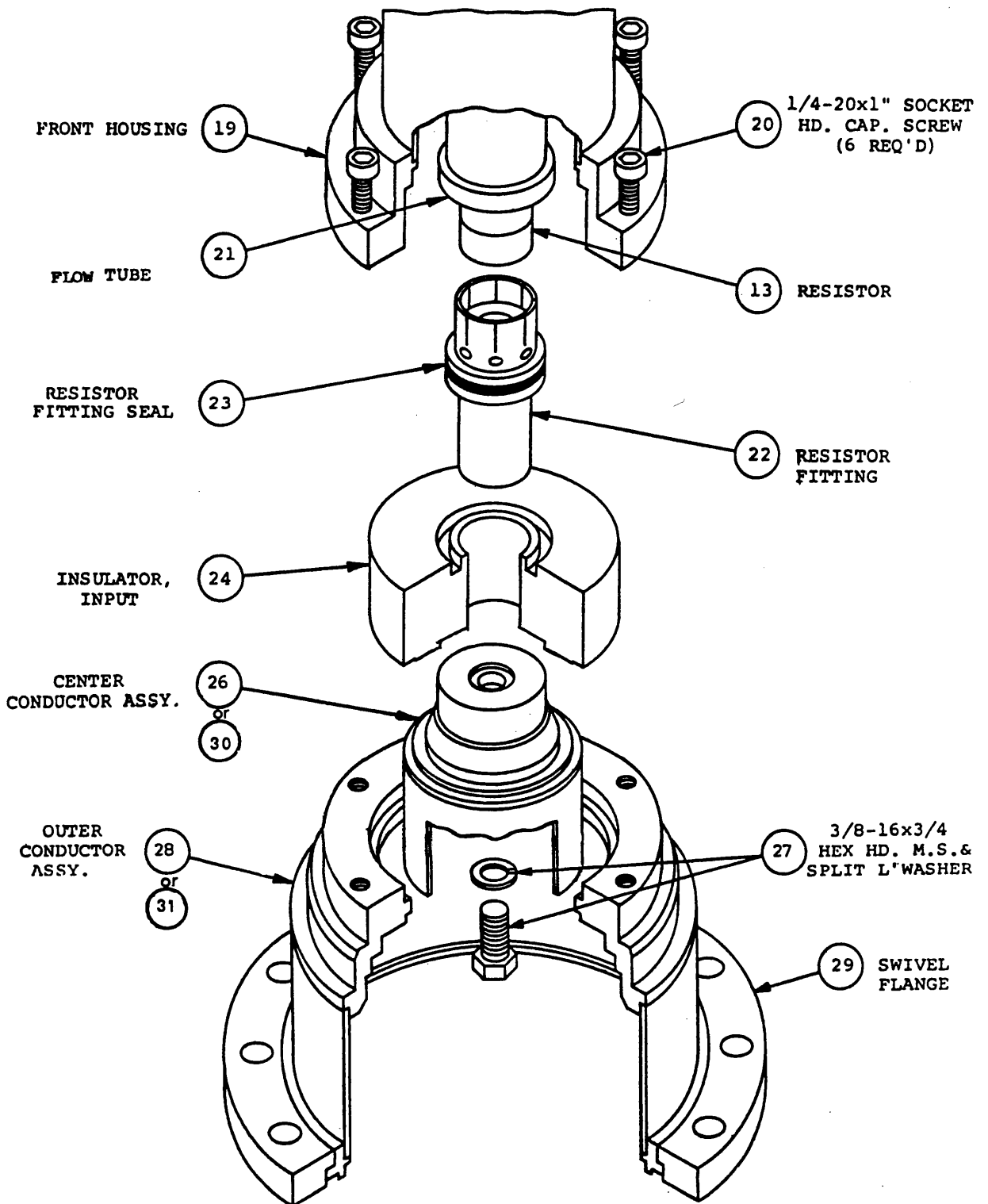


FIGURE 4-2. RF INPUT ASSEMBLY (EXPLODED VIEW)



SECTION V - STORAGE & SHIPPING

5-1. STORAGE

5-2. If the Series 8690 is to be stored for any length of time, be sure it is completely drained of all water and the input and output water ports plugged with plastic caps. Cover the unit to avoid the intrusion of dust and dirt, and store at room ambient temperature. Avoid storing at temperatures below freezing (0 Celsius) or extreme temperatures above 70°C (158F).

5-3. PREPARATION FOR SHIPMENT

5-4. If the unit is to be returned to the factory or shipped to another destination, be sure it has been purged of all coolant and the coolant ports plugged as above for storage. Pad the RF Connector to protect it from damage and if it is a flanged unit, fasten the flange securely to keep it from moving. Put the unit in a sturdy wooden crate, pad and brace it securely. If feasible, it is best to save the original shipping container.

SECTION VI - REPLACEMENT PARTS LIST

6-1. MODELS 8692/93-(050 & 060) MODULOAD® RF LOAD RESISTOR

ITEM	QTY	SYM	DESCRIPTION	PART NUMBER
1	1	A-852	Relay retaining clamp	8630-107
2	1	A-866	Liquid level gauge	8690-058
3	2	A-867	Fixed caster	8690-055
4	2	A-868	Swivel caster	8690-056
5	2	A-869	Blower drive V-belt size 4L610	8690-053
6	1	A-870	Load mounting clamp (large end)	6770-132
7	1	A-871	Load mounting clamp (small end)	6770-133
8	1	A-873	RF load resistor 6 1/8" EIA flanged	8792-000
9	1	A-874	RF load resistor 6 1/8" unflanged	8793-000
10	1	E-820	AC power cable - 10 feet long 4 conductor	8690-070
11	1	E-821	AC power inlet (male recept.)	8690-071
12	3	E-822	Blub, ind. lights C-H No. 28-1029	8692-072
13	3	E-823	Lamp ind. lights C-H E30BM	8692-063
14	1	E-824	Switch, ON/OFF (equip.) C-H E30AD	8692-064
15	3	E-825	Fuse FNQ-8 (pump)	8692-065
16	3	E-826	Fuse FNQ-10 (fan)	8692-066
17	3	E-827	Fuse FNQ-1.6 (control circuits)	8692-067
18	1	E-828	Cable plug male, Hubbell No. 2421	8692-068
19	1	E-829	Cable connector female Hubbell No. 2423	8692-069
20	1	E-830	Transformer, control Hevi-Duty W-150	8692-062
21	1	O-825	Delay relay - interlock	5-1664
22	1	O-835	Pump/motor, Gould No. 3642	8690-051
23	2	O-836	Temp gauge, Weiss No. 20-UB3-4111	8690-052

REPLACEMENT PARTS LIST [CONT.]

6-1. MODELS 8692/93-(050 & 060) MODULOAD® RF LOAD RESISTOR

ITEM	QTY	SYM	DESCRIPTION	PART NUMBER
24	1	O-837	Flow switch, Gems FS600 No. 39973	8690-057
25	1	O-838	Fan motor, Lincoln T3518	8690-054
26	1	O-839	Temperature switch	8690-059
27	1	O-840	Control relay	8690-061
28	2	A-872	Hose (100 lbf/in ² , working pressure)	8690-075
			CAUTION: Hoses must withstand a minimum of 100 lbf/in ²	
29	1	A-873	Pressure vent valve (2-PSI)	5-1350
30	1	A-874	Hex plug	2450-092

REPLACEMENT PARTS LIST

6-2. MODELS 8792 AND 8793 LOAD RESISTOR

ITEM	QTY	DESCRIPTION	PART NUMBER
	(1)	Water chamber assembly	8790-005
1	1	Water chamber	8790-031
2	2	Hose nipple	5-065-2
3	1	Internal O-Ring seal	5-1250
4	1	Water inlet tube	8790-032
5	1	Water inlet seal O-Ring	5-1340
6	1	Resistor cap rear seal O-Ring	5-1128
	(1)	Resistor cap assembly	8792-003
7	1	Resistor cap subassembly	8792-004
8	1	Internal resistor cap seal O-Ring	5-1251
9	1	Housing ground section	8792-007
10	1	Ground section seal O-Ring	5-1128
11	1	Third housing section	8792-002
12	1	Second housing section	8792-006
13	1	Resistor element	8792-010-1
14	1	Cone point socket hd. set screw (front and second section) 10-32 x 1/4 inch	standard
15	1	Outer resistor cap seal O-Ring	5-1128
16	1	Front section housing assembly	8792-005
17	12	1/4-20 x 1 inch sockets head Cap screws	standard
18	1	Flow tube	8792-009
19	1	Resistor fitting	8790-016
20	1	Resistor fitting seal O-Ring	5-1127

REPLACEMENT PARTS LIST [CONT.]

6-2. MODELS 8792 AND 8793 LOAD RESISTOR

<u>ITEM</u>	<u>QTY</u>	<u>DESCRIPTION</u>	<u>PART NUMBER</u>
21	1	Input insulator	8790-015
22	1	Center conductor assembly (MOD 8792/96)	8790-009
23	1	3/8-16 x 3/4 inch hex head s/s	
		Screw and lockwasher set	standard
24	1	Outer conductor assembly (MOD 8792/96)	8790-006
25	1	Swivel flange	4802-014
26	1	Center conductor (8793)	8791-005
27	1	Outer conductor (8793)	8791-004

FIGURE 6-1. OUTLINE, FRONT VIEW

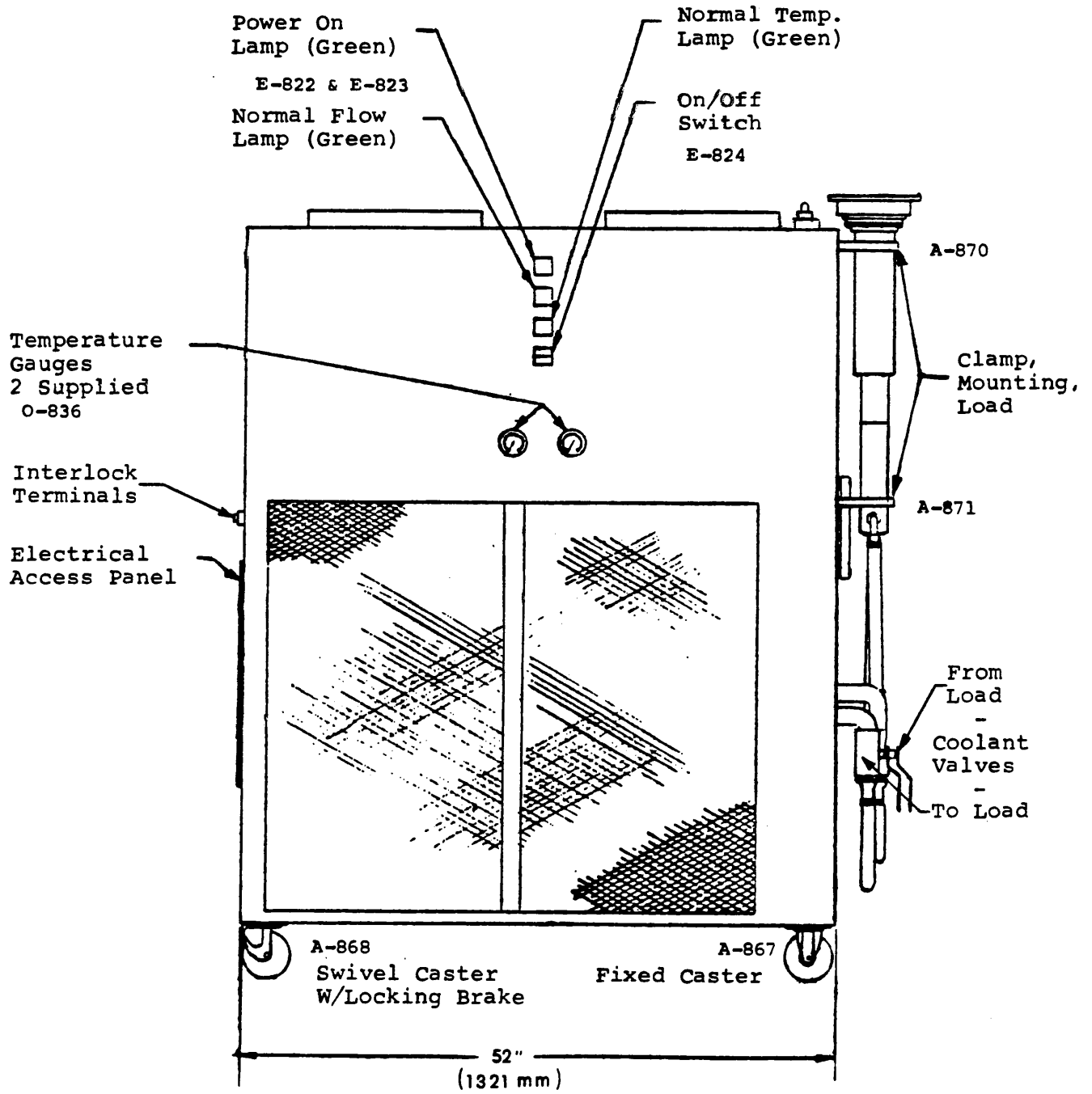


FIGURE 6-2. OUTLINE, SIDE VIEW

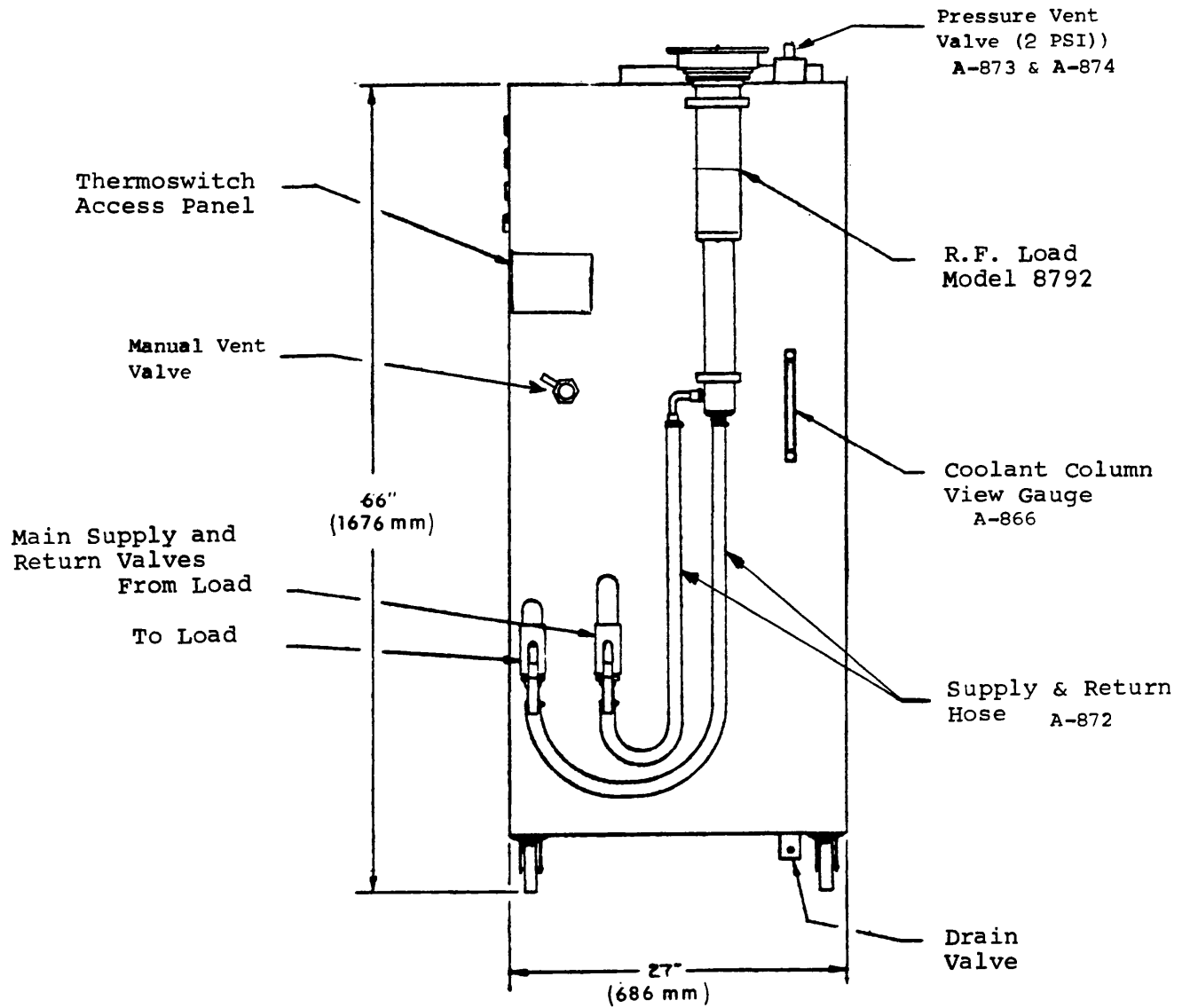


FIGURE 6-3. REAR VIEW (INSIDE)

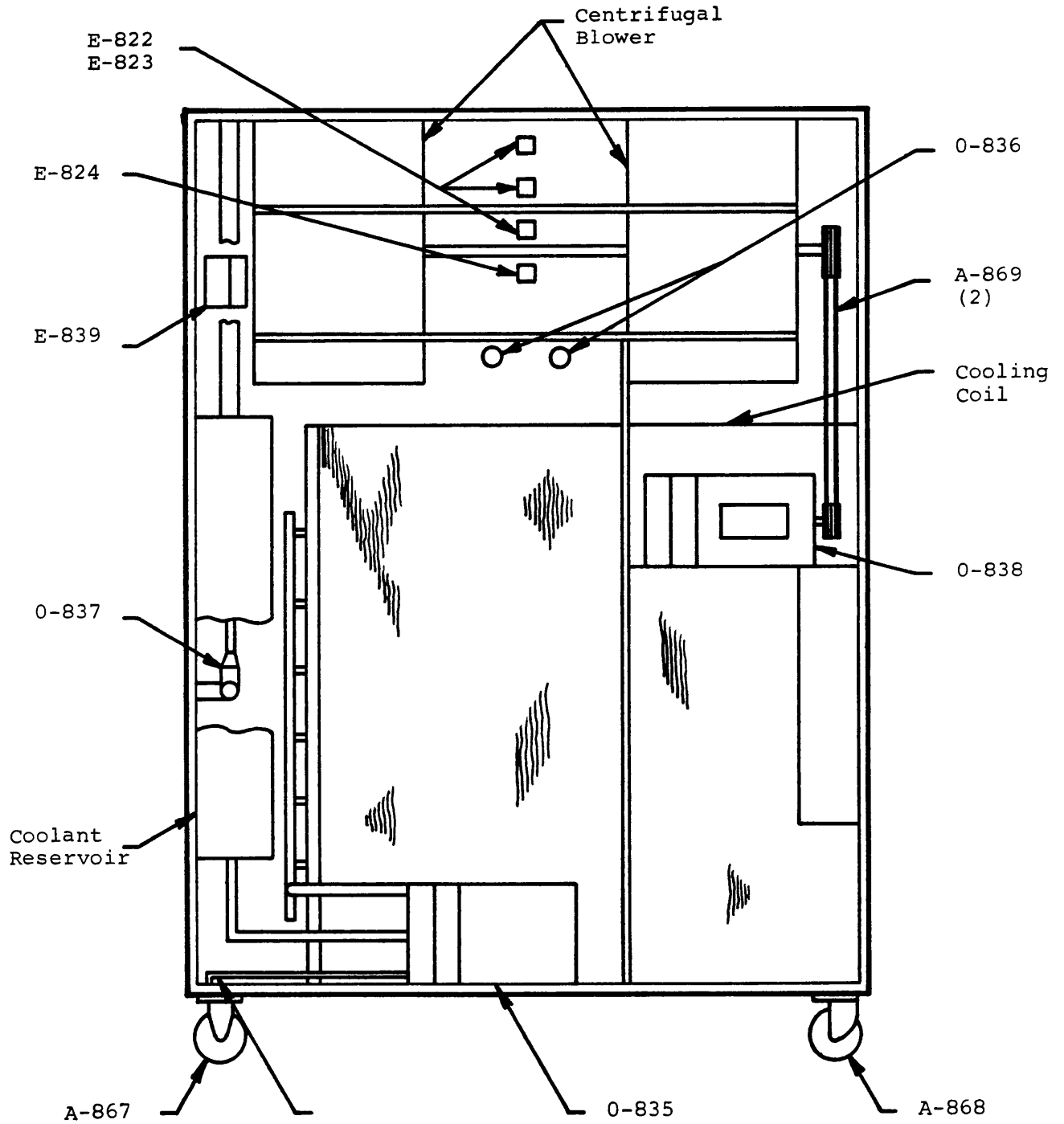


FIGURE 6-4. CONTROL PANEL

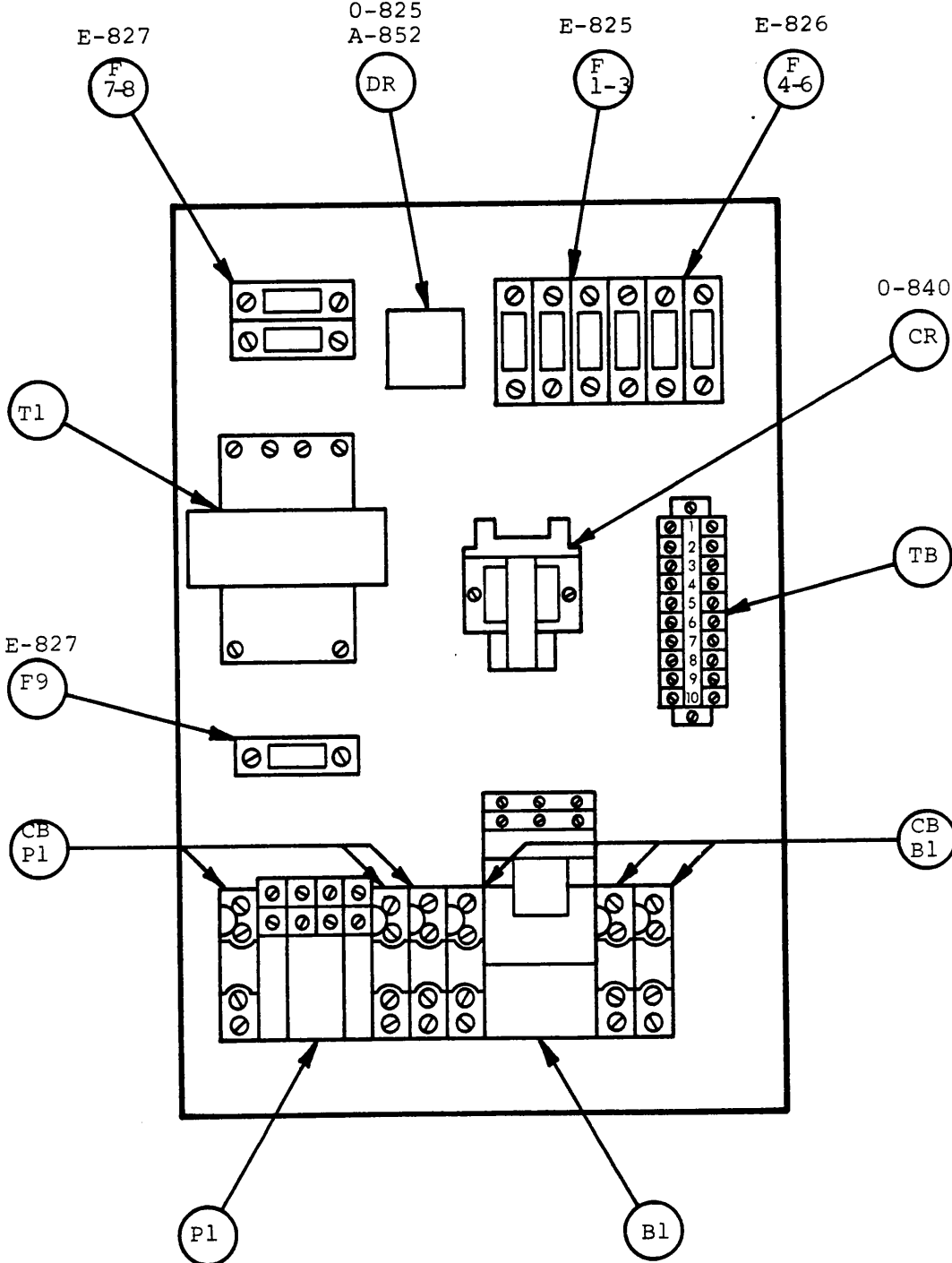


FIGURE 6-4A. CONTROL PANEL (ALTERNATE)

