Product User Manual

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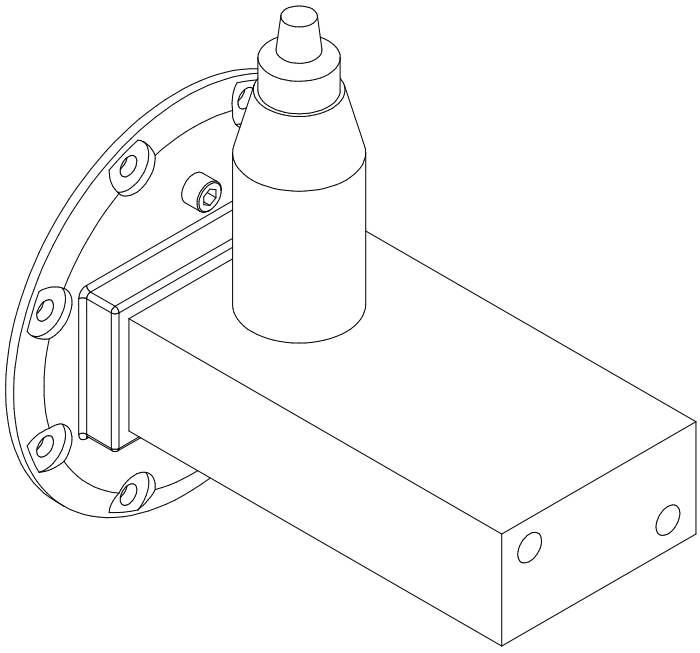
Models GA1213 & GA1214
Dummy Load w/Power Reflector, WR284



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REVISION HISTORY			
REV.	**DESCRIPTION**	**DATE**	**APPROVAL**
2	ADDED FIGURE 3	22JUN06	JFG

WARRANTY

Products manufactured and sold by Gerling Applied Engineering, Inc. ("GAE") are warranted to be free of defects in materials and workmanship under normal use and service for a period of twelve (12) months from the date of original shipment. GAE's obligation under this warranty is limited to repairing or replacing, at GAE's option, all non-consumable component parts. Consumable parts are specifically excluded from this warranty and may include, but are not be limited to, magnetrons, fuses, lamps, seals, o-rings, v-belts, and fluids. All warranty repairs are to be done at GAE's facility or as otherwise authorized by GAE. All shipping charges for warranty repair or replacement are the purchaser's responsibility unless otherwise agreed to by GAE.

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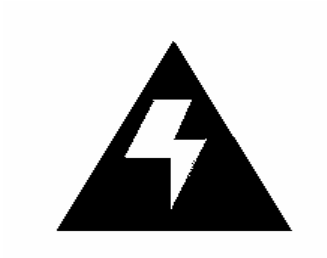
DOCUMENT CONVENTIONS

NOTE: *Means the reader should take note. Notes contain helpful information, suggestions, or references to other sections, chapters, or documents.*

CAUTION: *Means the reader should be careful. You are doing something that might result in equipment damage or loss of data.*

WARNING: *Means danger. A situation exists that could cause bodily injury or death. All personnel must be aware of the hazards involved with high voltage electrical circuitry and high power microwave devices.*



WARNING

All waveguide dummy loads manufactured by GAE are intended for use with other equipment capable of producing a microwave field that is potentially hazardous to operating personnel. It must never be connected or operated in a manner that allows a field in excess of 10 milliwatts per square centimeter to be generated in an area accessible to operating personnel. Contact GAE, Inc. for technical support prior to installation and/or operation of this unit if there is any question or concern about microwave leakage.

All waveguide flange and electrical cable connections throughout the system must be secure prior to operation. Never operate the microwave generator without a properly rated absorbing load attached. To ensure safe operation and prevent microwave leakage, the equipment must be periodically inspected and maintained as required or recommended.

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EQUIPMENT DESCRIPTION

The GA1213 and GA1214 dummy loads with power reflector are designed for use in high power microwave networks requiring a dummy load having variable return loss (variable reflection). These models combine the compact design of GAE's standard short dummy loads (e.g. model GA1201 and GA1204) with the same stub tuning element as its precision waveguide multi-stub tuners. Inserting the stub element into the waveguide causes an impedance mismatch with the dummy load. Thus, varying the amount of stub insertion varies the amount of incident microwave power that is reflected back from the dummy load.

When combined with a 3-port circulator, these devices are useful in applications where it is desirable to vary the level of microwave power delivered to the process without changing the power output from the microwave generator (i.e. variable power at constant frequency). The same configuration also provides a means to vary delivered microwave power at levels much lower than the stable control range of the microwave generator.

Incident microwave power that is not reflected back out is absorbed by water which internally flows through channels in a solid UHMW polyethylene block. Naval brass is used for all water fitting connections to minimize corrosion. The waveguide body is fabricated with dip brazed aluminum. A precision drive mechanism and locking multi-turn dial are provided on the stub enabling highly precise settings. The stub housing is designed with a 1/4-wave reactive choke for high power operation.

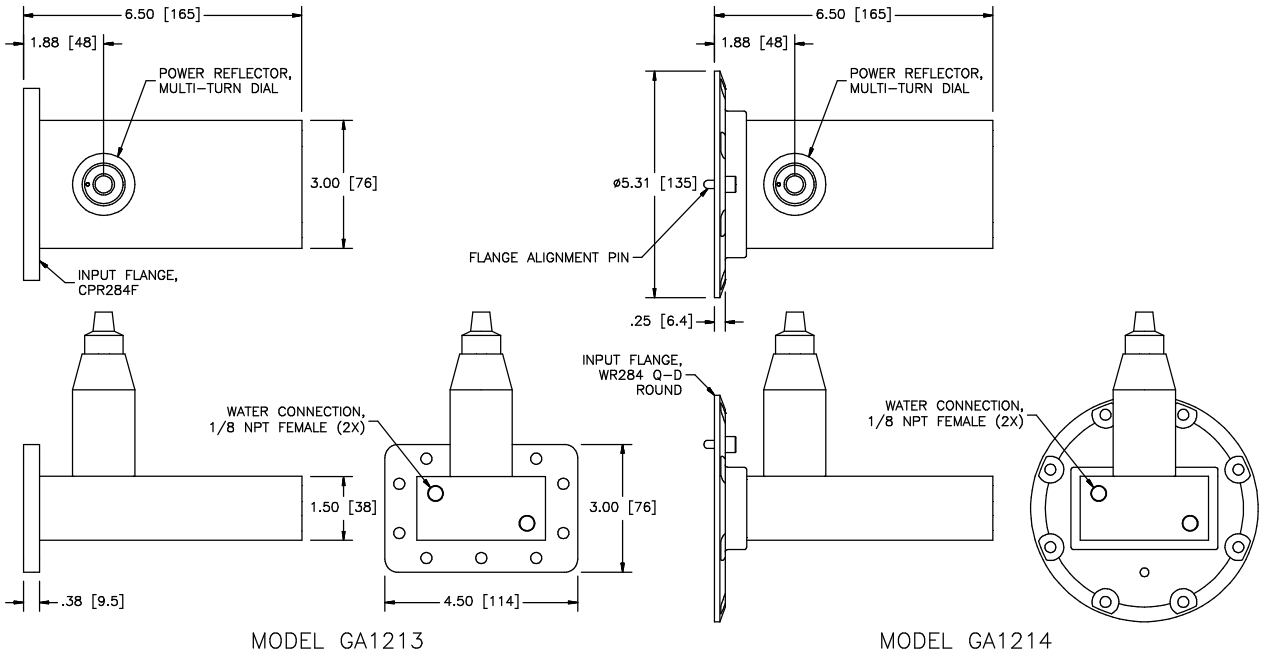
The waveguide flange on the GA1214 is designed to be used with the GA8410 Quick-Release clamp when connected to another similarly designed flange. It can also be connected to any other standard WR284 round flange (UG-584/U) using suitable fastener hardware.

Specifications

Waveguide	WR284
Flange	GA1213: UG-1725/U GA1214: UG-584/U (round) with taper for quick-release clamp
Frequency	2450 MHz nominal
Incident Power	Up to 3kW continuous
Return Loss	6 to 23 dB, continuously variable
Water Connections	1/8 NPT female

Water Flow	1.0 gpm nominal, 2.0 gpm maximum
Water Pressure	70 psi maximum
Water Temp	Inlet: 40 °F (4 °C) minimum Outlet: 150 °F (66 °C) maximum
Overall Length	6.50 inches (16.5 cm)
Net Weight	2 lb. (4.4 kgm)

Outline Drawing



INSTALLATION

Preliminary Inspection

Upon arrival at the installation site the dummy load should be thoroughly inspected for damage or wear caused during shipping. Any visible damage to the packaging material or dummy load should be noted and reported immediately to the shipping company in accordance with standard claims procedures. The following components are included:

a) Dummy Load with Power Reflector

b) Product User Manual

Waveguide Configuration

The dummy load with power reflector can be connected to and used with any common waveguide component having a compatible flange. The mounting position can be in any orientation.

Figure 1 below illustrates a common configuration in which the dummy load with power reflector is used in conjunction with a 3-port circulator to vary the level of microwave power delivered to the process.

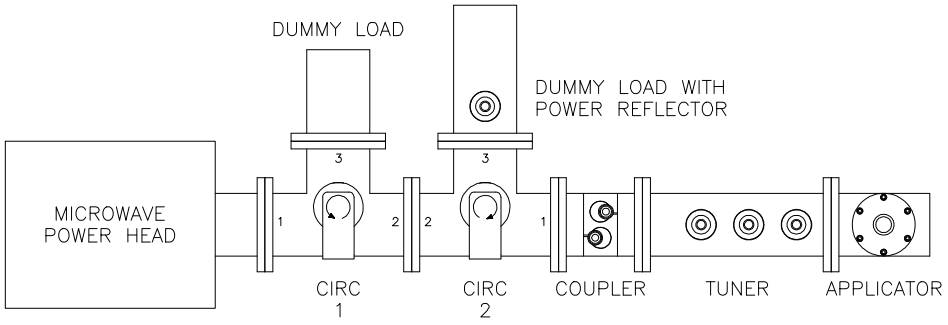


Figure 1, Typical waveguide configuration using the dummy load with power reflector to vary microwave power delivered to the applicator.

Flange Connections

The waveguide flange of the dummy load must be properly connected to another waveguide component having a similar flange style. Model GA1214 is designed to be used with the GA8410 Quick-Release flange clamp when connected to another similarly designed flange. It can also be connected to any other standard WR284 round flange (UG-584/U) using suitable fastener hardware.

Flange Alignment Pins

Each flange connection that uses a quick-release clamp requires two alignment pins for proper alignment of the adjacent waveguide sections. All GAE waveguide components include one alignment pin for each flange designed for use with quick-release clamps. Alignment pins can be installed into either of two threaded holes centered above and below the waveguide broadwalls. For obvious reasons, the pins must not be installed such that they are opposite each other on mating flanges.

Microwave Leakage – Regulatory limits for microwave leakage relate to standards for human safety and interference with other electronic devices. Standards for human safety as adopted by OSHA, the International Electrotechnical Commission (IEC) and other regulatory agencies limit leakage to 5 mW/cm^2 measured at 5 cm from the leakage source under normal operating conditions, and 10 mW/cm^2 at 5 cm from the source under abnormal operating conditions. The U.S. Federal Communications Commission (FCC) has established regulations limiting the emission of energy at frequencies outside the ISM bands. All GAE waveguide components meets these requirements when properly connected to another waveguide component.

Water Flow Requirements

A source of water must be connected to the dummy load that provides an adequate rate of flow. The nominal water flow rate is 1.0 gpm. However, the flow rate must be maintained such that the outlet water temperature does not exceed 150 °F. The minimum allowable flow rate depends on the level of incident microwave power and the inlet water temperature. Figure 2 below shows the minimum flow rate vs. incident microwave power and inlet water temperature.

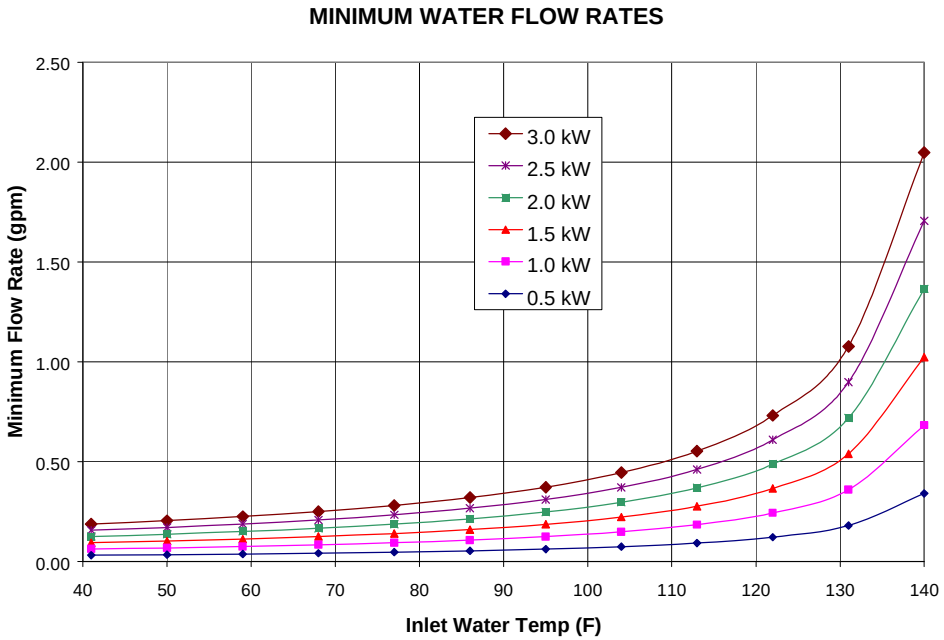


Figure 2, Recommended minimum water flow rates for given inlet water temperature and incident microwave power level.

CAUTION: *Failure to provide an adequate rate of water flow can result in severe damage to the dummy load. It is strongly recommended that an interlock device such as an in-line water flow switch be used to prevent operation of the microwave generator in the event of inadequate or loss of water flow.*

Water Fitting Connections

Standard 1/8 NPT female fittings are provided at the end of the dummy load opposite the waveguide flange. The source of water can be connected to either fitting. It is recommended that a thread sealant such as Teflon pipe thread tape be used to ensure a leak-free connection. Care should be taken to prevent debris from falling into the fitting holes.

Storage and Shipping

Upon removing the dummy load from the set-up it is recommended that all water be drained prior to storage or shipping. This precaution will prevent damage in the event that freezing temperatures are encountered during storage or shipping.

OPERATION

Basic Operation

The GA1213 and GA1214 dummy loads with power reflector utilize water as the medium for absorbing microwave energy that enters through the waveguide flange. The internal UHMW polyethylene block through which the water flows is transparent to microwave energy (referred to as having “low dielectric loss” characteristics) and allows the energy to be absorbed directly into the water. The dielectric loss of water is relatively high and is capable of absorbing over 99% of the incident microwave energy.

When the stub element is fully extracted from the waveguide (fully counterclockwise) the insertion loss will be maximized and reflected power minimized. Turning the stub dial clockwise will drive the stub into the waveguide, causing an impedance mismatch with the dummy load and resulting in some amount of reflected microwave power. Increasing the insert depth causes a greater impedance mismatch and higher reflection. Figure 3 below shows the relationship between the stub position and reflected power.

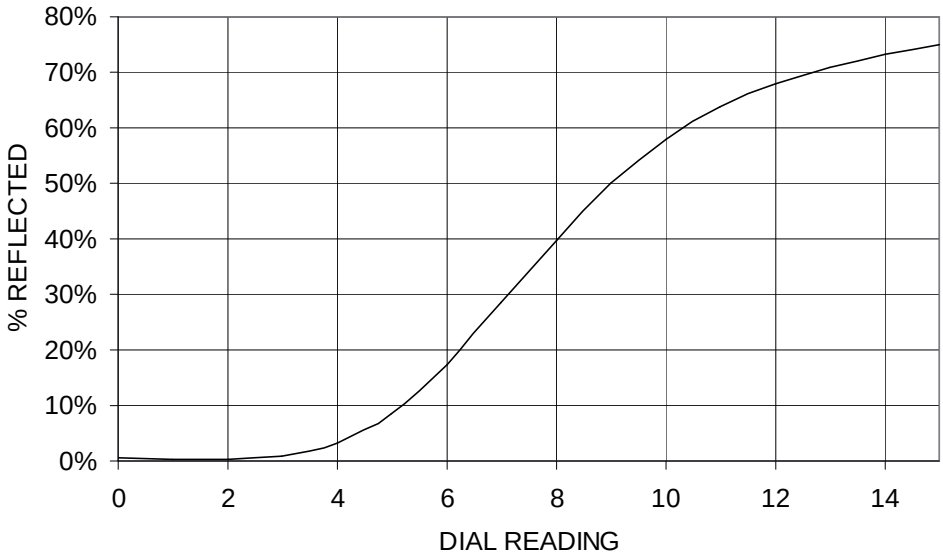


Figure 3, Percent reflected power vs. dial reading.

Typical Application Setup

The following are procedures for setting up common operation schemes.

Variable Power at Constant Frequency

1. Connect the dummy load with power reflector as shown in Figure 1. Adjust the power reflector stub to the fully counterclockwise (fully extracted) position.
2. Turn on the microwave generator and set the output power level to whatever will be the maximum required for the process. NOTE: At this time, the level of microwave power delivered to the process will be extremely low.
3. Turn the power reflector stub on the dummy load clockwise to increase the level of microwave power delivered to the process. Use the power reflecting stub to vary delivered microwave power. Note that output power and thus output frequency from the microwave generator will remain constant.

Low Power Control Range

1. Connect the dummy load with power reflector as shown in Figure 1. Adjust the power reflector stub to the fully counterclockwise (fully extracted) position.
2. Turn on the microwave generator and set the output power level to the maximum. NOTE: At this time, the level of microwave power delivered to the process will be extremely low.
3. Turn the power reflector stub on the dummy load clockwise to increase the level of microwave power delivered to the process. Adjust the stub to the maximum level of delivered power required for the process (presumably somewhat lower than the maximum output from the microwave generator).
4. Varying the power output from the microwave generator will vary the power delivered to the process, and the control range of delivered power is now proportional to generated power according to the power settings in steps 2 and 3.

Performance Considerations

In order to absorb substantially all of the incident microwave energy, the characteristic impedance of the dummy load must be a close match to that of the waveguide to which it is connected. The factors that influence this impedance match include the microwave frequency, the dielectric properties of the insert block and the water, and the physical geometry of the block and the channels through which the water flows.

The dielectric properties of most materials vary with changes in temperature. In the case of water, an increase in temperature

causes a decrease in its dielectric loss and, in general, results in a decrease in microwave energy absorption. However, the geometry of the absorbing load can be optimized, or “tuned”, for the dielectric properties at a desired temperature. In this case, energy absorption is maximized at the design temperature and is reduced at both higher and lower temperatures.

As shown in Figure 4 below, the dummy load is designed for optimal performance at inlet water temperatures between 75 °F (24 °C) and 85 °F (29 °C). For best performance the outlet water temperature should remain as close as possible to the inlet temperature. A low water flow rate and high incident power causes a large increase in temperature which, since the heated water is still inside the load, results in a “detuning” of the load impedance and a decrease in energy absorption.

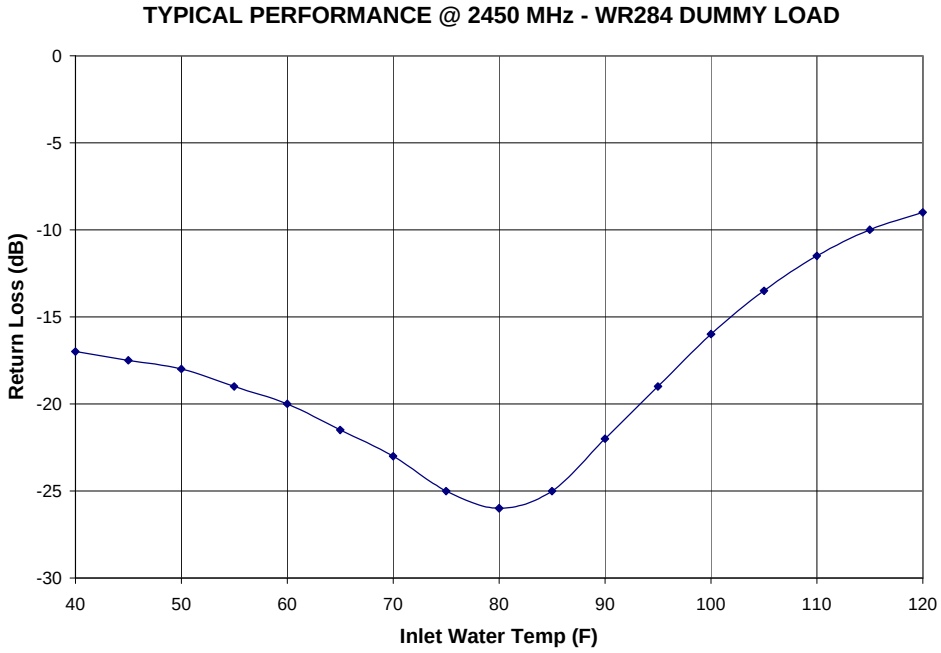


Figure 4, Return loss vs. inlet water temperature

USER MAINTENANCE AND REPAIR

The GA1213 and GA1214 dummy loads are designed to be maintenance free and do not require any user maintenance under normal operating conditions. However, the dummy loads can sustain damage if the water flow rate is insufficient to prevent vaporization (boiling) while operating under conditions of high incident microwave power.

In the event of damage due to insufficient or lack of water flow, the dummy load can be easily repaired by replacing the polyethylene insert block. Repair kit model GA8103 available from GAE includes all necessary components for replacement of the insert block.

Insert Block Replacement Procedure

(refer to Figure 5 below)

1.1 Equipment Requirements

Hex (Allen) driver, 3/16”

1.2 Disassembly

WARNING: Turn off microwave power and disconnect line power from the microwave generator before disconnecting any waveguide components.

1.2.1 Disconnect the water supply and drain from the water fitting connections at the back of the dummy load.

1.2.2 Remove the dummy load from the waveguide set-up and drain the water from inside the load.

1.2.3 Turn the reflector stub dial fully counterclockwise.

1.2.4 Remove the two socket head screws at the back of the dummy load.

1.2.5 Insert the hex driver into one of the two screw holes and gently push the insert block out of the dummy load waveguide.

1.3 Reassembly

1.3.1 Inspect the inside of the waveguide for signs of damage and/or corrosion. In particular, carefully inspect the four o-rings seats on the inside of the back wall. Additional repairs may be required in the event of internal damage or excess corrosion.

CAUTION: Excess corrosion can prevent a water-tight seal or cause premature failure of the seals and result in damage to other equipment. In this case the dummy load may not be repairable.

1.3.2 Remove the four greased o-rings from the polyethylene bag and place them into each of the four seats on the inside back wall of the dummy load.

1.3.3 Carefully slide the insert block assembly into the dummy load waveguide. Ensure that the two plugs (with smaller o-rings) on the sides of the block are fully inserted into the counter-bore holes.
CAUTION: If the plugs have come out (as may happen during shipping), ease them back in while being careful to avoid nicking the o-rings on the edge of the counter-bore.

1.3.4 Insert the two ¼-20 socket head screws into the counter-bored holes at the end of the waveguide and engage the screw threads into the insert block. Carefully tighten the screws with the hex driver just enough to compress the o-rings.
CAUTION: Over-tightening the screws will cause the Helicoil inserts inside the block to become loose and may result in permanent damage to the insert block.

1.3.5 Install water fittings, apply water pressure (70 psi max.) and check for water leaks.

1.3.6 Reinstall dummy load into waveguide set-up.

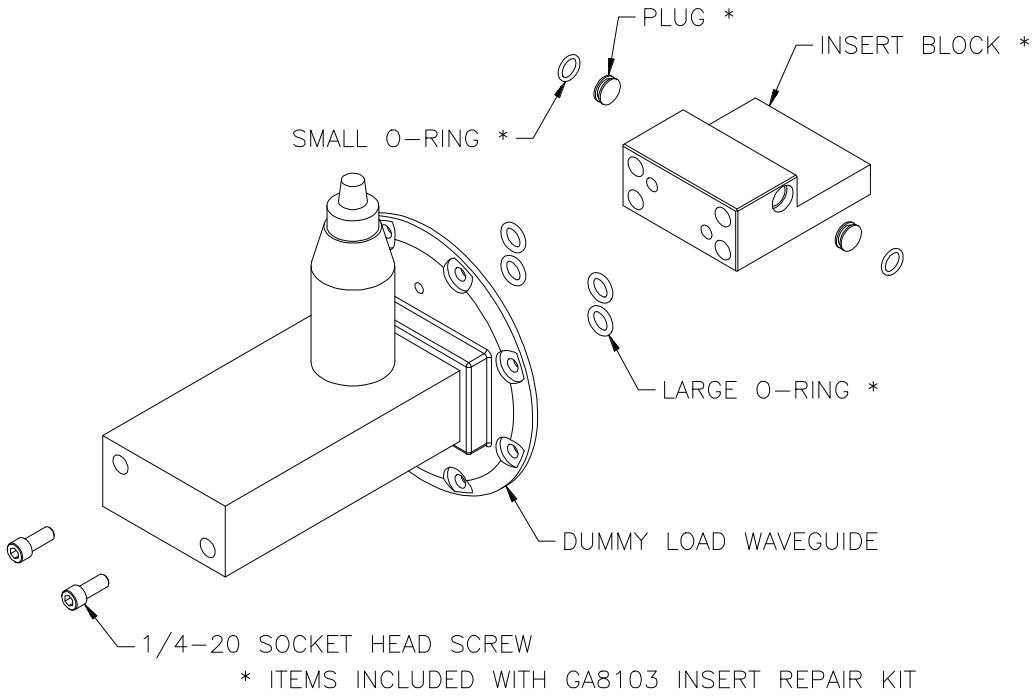


Figure 5, Exploded view of dummy load assembly.