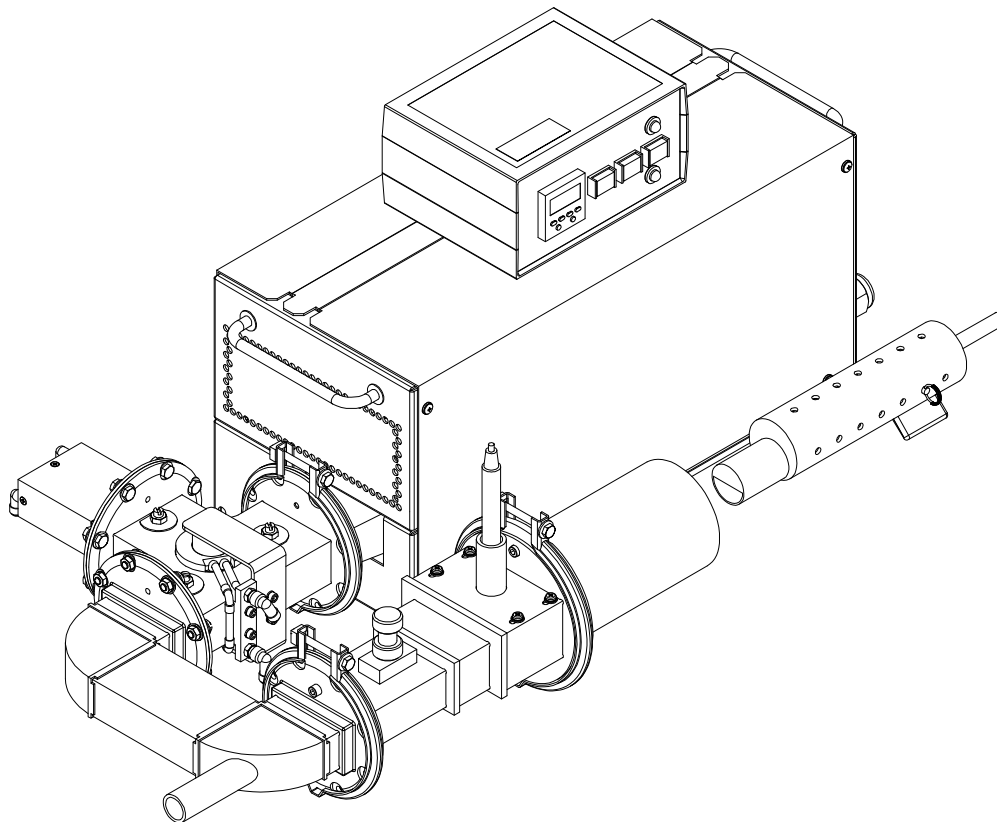

Product User Manual

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Model GA5013

Microwave Animal Fixation System



Document # 930026, Rev. 10



Gerling Applied Engineering, Inc.
P.O. Box 580816 ♦ Modesto, CA 95358
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REVISIONS			
REV.	DESCRIPTION	DATE	APPROVAL
8	MISC. UPDATES	13FEB06	JFG
9	MISC. UPDATES	20DEC06	JFG
10	CUPDATES TO INTERLOCK CONNECTION	03APR08	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.

This warranty supercedes all other warranties, expressed or implied. No warranty is given covering the product for any particular purpose other than as covered by the applicable product specifications. GAE assumes no liability in any event for incidental or consequential damages, financial losses, penalties or other losses incurred in conjunction with the use of GAE products.

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

The microwave system described in this manual is capable of producing a microwave field that is potentially hazardous to operating personnel. The system 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 these units if there is any question or concern about microwave leakage.

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



WARNING

All microwave generators manufactured by GAE, Inc. have internal high voltage circuits that are potentially hazardous or lethal to maintenance personnel. All maintenance must be done ONLY by technical personnel fully trained and qualified for work with high voltage circuits. Access covers must never be removed for any reason other than maintenance by qualified technical personnel. The generator must never be operated in any manner other than as described in this user manual.

TABLE OF CONTENTS

DOCUMENT ATTACHMENTS.....	4
EQUIPMENT DESCRIPTION.....	5
General Specifications	5
Electrical Specifications	5
Mechanical Specifications	5
System Controls	6
Basic System Components	6
Optional Accessories	6
INSTALLATION	7
Preliminary Inspection	7
Mounting Position	7
Waveguide Configuration	7
Flange Connections	8
Animal Chamber Installation	8
Cooling Water Connections	8
Adjustment for Line Voltage	9
Line Power Connection	9
Chassis Ground Connection	10
Control Module and Interlock Connections	10
Timer Programming	11
OPERATION	13
Basic System Operation	13
Animal Loading	13
Cycle Timer Preset	14
System Controls	15
Microwave Power Level Switching	15
MAINTENANCE	16
Cleaning the Animal Chamber and Holder	16
Magnetron Removal and Replacement	16
Filament Voltage Adjustment	18
Equipment Required:	18
Procedure:	18

DOCUMENT ATTACHMENTS

<u>Description</u>	<u>Doc. Number</u>	<u>Rev.</u>
Animal Fixation System Assembly	911020	6
Animal Chamber Assembly, 20-50 gram	911305	5
Animal Chamber Assembly, 50-175 gram	911021	5
Animal Chamber Assembly, 175-450 gram	911022	5
Animal Holder Assembly, 20-50 gram	911306	3
Animal Holder Assembly, 50-100 gram	911023	3
Animal Holder Assembly, 100-175 gram	911024	3
Animal Holder Assembly, 175-325 gram	911025	3
Animal Holder Assembly, 325-450 gram	911026	3
Control Module Schematic Diagram	911095	11
Water Distribution Assembly	911097	8
System Outline Drawing	911368	1

EQUIPMENT DESCRIPTION

This document describes a 4 kW microwave system designed for the fixation of small laboratory animals such as mice and rats. A high power burst of microwave energy is delivered to the brain area of the animal by means of a specially designed waveguide applicator. Fixation occurs by rapid and extreme heating of the brain tissue while minimizing additional trauma caused to the animal.

The system operates at 2.45 GHz at user-selectable microwave output power levels of either 2 kW or 4 kW. Exposure time is also user adjustable via a front panel mounted programmable timer. Standard waveguide components are used to deliver the microwave power to the animal chamber, including a waveguide isolator (circulator and dummy load) to protect the microwave generator from reverse microwave power. Multiple interlock devices protect against hazards caused by incorrect operation.

A wide range of animal sizes can be accommodated using a selection of animal holders and application chambers. One animal holder and chamber set is provided with the system and may be selected by the customer. Additional holders and chambers may be purchased separately.

General Specifications

Electrical Specifications

Output Frequency	2450 MHz +/- 50 MHz
Output Power	4 kW, user-selectable between half and full power
Magnetron	Panasonic 2M265-M12WJ
Input Line Power	
Voltage	60 Hz: 200, 208, 220, 240 VAC, +/- 10% 50 Hz: 200, 230, 240 VAC, +/- 10%
Phase	Single
Current	30 Amps max.
Interlocks	Magnetron temp, Generator access covers, Chamber flanges, Water flow, Connection for external user device

Mechanical Specifications

Cooling Requirement	Water @ 1 gpm (0.5 gpm min.), 95°F max. inlet temp (dew point minimum inlet temp), 70 psig max. inlet pressure
Water Connections	¼" ID rubber hose provided for water connections

Line Power Connection	NEMA style L6-30P locking type plug with 6' power cord
Weight (approx.)	Microwave Generator: 100 lbs Components and accessories: 35 lbs

System Controls

NOTE: Unless otherwise indicated, all controls are located on the control module only.

Microwave Start	Pushbutton
Microwave Stop	Pushbutton (control module and generator)
High/Low Select	Pushbutton
Exposure Timer	Programmable digital timer, .01 sec increments
Indicators	System Ready ("Mw Start" switch) Microwave On ("Mw Stop" switch) High Power Low Power Mw Power (generator only)

Basic System Components

Microwave Generator
System Control Module
3-Port Circulator
Short Dummy Load
Waveguide Bend w/View Tube
Animal Chamber (size specified by customer)
Animal Holder (size specified by customer)
Set of waveguide clamps
Set of connecting cables and hoses
Product User Manual

Optional Accessories

Animal Chamber, 50-175 gram, p/n 911021
Animal Chamber, 175-450 gram, p/n 911022
Animal Holder, 50-100 gram, p/n 911023
Animal Holder, 100-175 gram, p/n 911024
Animal Holder, 175-325 gram, p/n 911025
Animal Holder, 325-450 gram, p/n 911026

INSTALLATION

Preliminary Inspection

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

Mounting Position

The system is supplied as an integral assembly consisting of the microwave generator, control module, waveguide components and animal chamber. The system must be mounted upright on a level surface capable of supporting its weight.

Waveguide Configuration

The system includes three waveguide components used to safely deliver microwave power from the generator to the animal chamber. Figure 1 below illustrates the waveguide configuration.

Included in the configuration are a 3-port circulator and dummy load which together protect the generator (specifically the internal magnetron) from the damaging effects of reverse power. Also included is a waveguide bend section which orients the animal chamber in a position convenient for the system operator. This waveguide section has a viewing tube which allows the operator to observe the animal to ensure proper positioning prior to fixation.

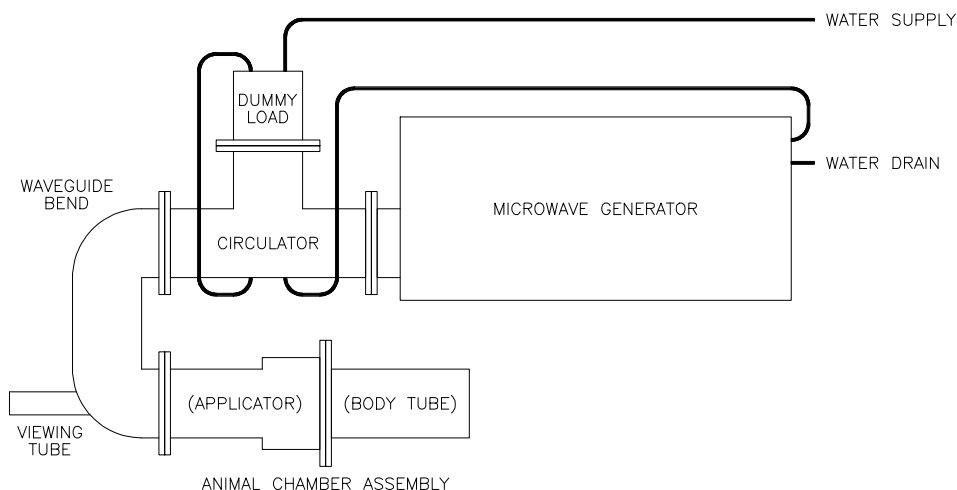


Figure 1, Waveguide configuration and cooling water connections.

Flange Connections

All waveguide components used in the system must be properly connected to each other for safe operation. The three waveguide components described above are connected to each other using standard threaded fastener hardware to form an integral assembly.

This assembly is then connected to the microwave generator using the GA8401 quick-release waveguide clamp. Two alignment pins are supplied with this flange connection, one on each mating waveguide flange, to ensure proper alignment of the waveguide sections. Alignment pins are not required for the waveguide flange connections which use standard hardware.

Animal Chamber Installation

The animal chamber assembly consists of two main sections, the applicator and body tube. These two sections are connected together using a larger size quick-release clamp (similar to the GA8401) to form the animal chamber assembly. This assembly is then connected to the waveguide bend section using another GA8401 quick-release clamp. Flange interlock switches are installed at both ends of the animal applicator section to prevent system operation if either of these flanges is not properly connected.



CAUTION: *Do not loosen the locking nut or attempt to adjust the tuning screw located on the top of the animal applicator. Adjusting the screw setting will alter the calibration of the animal chamber and result in faulty operation.*

Cooling Water Connections

A source of filtered water must be connected to the system that provides a nominal flow rate of 1.0 gpm (0.5 gpm minimum), 70 psig max. inlet pressure and 95°F max. inlet temperature. Figure 1 above illustrates the water connections. The water supply and drain connections can be made to 1/4" ID rubber hoses provided with the system. All other hoses and connection fittings are also provided.



CAUTION: *The minimum inlet temperature of the cooling water must be above the ambient dew point temperature. Allowing the cooling water inlet temperature to drop below the ambient dew point can allow moisture condensation inside the microwave generator and/or waveguide circulator and cause equipment damage.*



CAUTION: *Water should be drained from the unit during extended periods of non-use to prevent freezing. Failure to adequately drain the cooling system can result in damage due to the expansion of freezing water.*



CAUTION: *Inlet water should be filtered to prevent clogging of the internal water lines. The most common failure due to clogging is a malfunction of the water flow interlock switch. Running the cooling water temporarily in the opposite direction can help to unclog the lines.*

Adjustment for Line Voltage

The microwave generator is configured at the factory to operate within a range of line voltages for a specific line frequency (either 60 Hz or 50 Hz). To accomplish this, a series of voltage taps are provided that allow the generator to operate within +/- 10% of the nominal tap voltage. The following is a list of tap voltages and respective operating voltage range.

<u>Tap Voltage (VAC)</u>	<u>Operating Voltage Range</u>
200	180-220
208 (60 Hz only)	187-229
220 (60 Hz only)	198-242
230 (50 Hz only)	207-253
240	216-264

The voltage taps are located on the main (high voltage) transformer inside the microwave generator. Generally, the initial factory set up is according to the line voltage and frequency at the customer's facility. However, the user is advised to measure the facility line voltage and ensure the correct tap is selected prior to operation.



WARNING: *Turn off microwave power and disconnect all electrical connections before adjusting the line voltage taps. Failure to disconnect line power can expose the operator to high voltage and result in severe injury or death.*



CAUTION: *After selecting the proper line voltage tap, the filament voltage should be checked and, if necessary, adjusted according the procedure provide in the Maintenance section of this manual. Improperly adjusted filament voltage can result in premature magnetron failure.*

Line Power Connection

Main line power is connected using a 6-foot type SO power line cord and NEMA L6-30P twist-lock type plug provided with the generator. Wiring is single phase, 2-wire plus ground. The circuit supplying voltage to the receptacle must be rated for at least 30 Amps of continuous current draw. Although a 30 Amp circuit breaker is provided inside the generator, the line power supply circuit should also be fused or circuit breaker protected for the same rating.

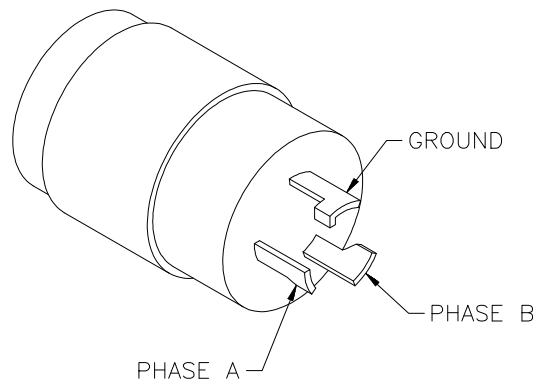


Figure 2, Contact designations for locking style line power plug.

Chassis Ground Connection

Ground connection to the generator is at the ground stud located at the rear of the chassis. The recommended wire is 14 AWG, UL 1007 (or equivalent) with green or green/yellow insulation.



WARNING: Failure to provide an adequate ground connection can expose the operator to high voltage and result in severe injury or death.

Control Module and Interlock Connections

Figure 3 below illustrates the system electrical connections. All cables and mating connectors are supplied with the system. All connections between the microwave generator and control module are provided by the 14-conductor cable and CPC style connector P1.

The animal chamber assembly includes waveguide flange interlock switches which prevent system operation if the animal chamber is not properly installed. The interlock wiring harness has two connectors, a 4-pin circular (“CPC”) connector and a 2-pin header style (“MR”) connector. The 4-pin connector attaches to connector J1 on the rear panel of the control module.

The customer may connect an external interlock device which will prevent the system from operating if the interlock function is not satisfied. The interlock device must be a dry contact switch closure rated for at least 12 VDC. Connection of the external interlock is to the 2-pin connector at the end of a short cable bundled with the animal chamber interlock harness. A mating connector with jumpered contacts is provided, allowing the customer to splice in the external interlock wiring.

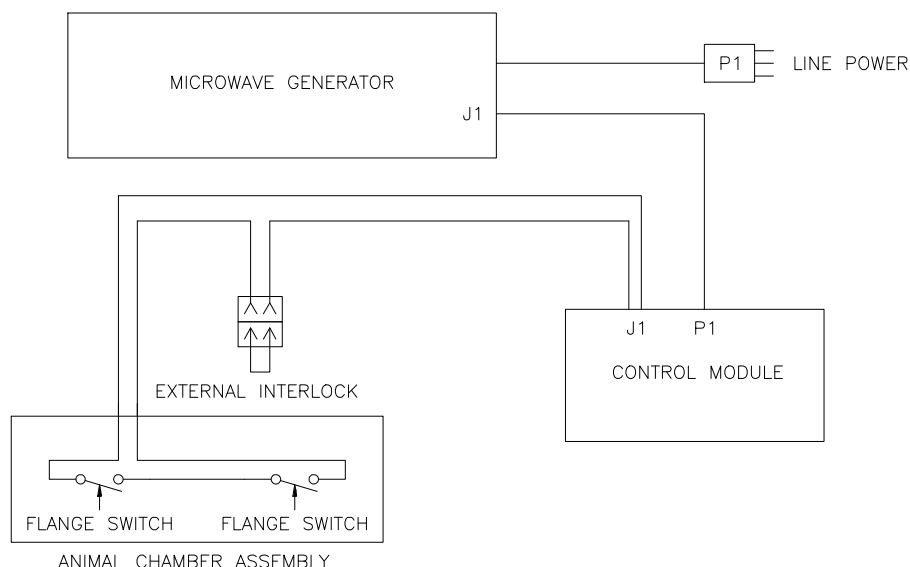


Figure 3, System Electrical Diagram

Timer Programming

The control module includes a multifunction digital timer which can be programmed directly from the front panel. The timer has been preprogrammed for operating functionality best suited for the system. Thus, the user need only enter the preset values for the desired cycle time.

Cycle Time Range – The timer has been preprogrammed at the factory for a cycle range of 0.01 to 99.99 seconds. The operator may adjust the cycle time to any value within this range in 0.01 second increments. However, the practical range for good fixation performance is in the range of 0.5 to 3 seconds depending on animal size and selected microwave power level.



NOTE: *To prevent operation for extended periods, the system has been designed to terminate the cycle automatically after 10 seconds of continuous operation.*

Cycle Time Preset – Use the four numeric keys on the timer front panel to set the cycle time preset. Pressing a numeric key will increment the value of the corresponding digit in a cyclical manner from 0 to 9. The *preset value* is displayed by the *small* set of digits at the bottom of the LCD display. Once set, the value will be retained for each consecutive cycle until readjusted by the operator.

Cycle Time Display – The *large* set of digits on the LCD display represent the *time remaining* in the cycle. These digits count down from the preset value to zero while the system is in “operate” mode (see next section).



WARNING: *The timer has been preprogrammed with a security lock-out which prevents the operator from accessing other timer programming functions. Reprogramming the timer for a different operating function can result in faulty and possibly unsafe system operation. Do not attempt to defeat the security lock-out. Contact GAE for service if timer function reprogramming becomes necessary.*

OPERATION

Basic System Operation

Once the system has been installed according to the previous section, system operation involves the following basic steps (to be explained in more detail later in this section):

1. Load the animal to be fixated.
2. Set the cycle timer to the desired preset.
3. Select the desired microwave power level.
4. Press the “Mw Start” button to operate the system.
5. Press the “Mw Stop” button to stop system operation or after cycle time-out to reset the timer.

Animal Loading

The animal to be fixated is loaded into the animal chamber assembly using a specially design plastic holder. The purpose of this holder is to precisely locate the animal's head inside the applicator to expose it to a highly concentrated field of microwave energy. Approximately 95-99% of the delivered power is absorbed by the animal, while very little is absorbed by the holder. Accurate placement of the animal is critical for proper system performance.

The animal holder consists of three parts: body, retainer and pin. Insert the animal by first removing the retainer and pin from the body. Coax the animal into the body head-first and allow the animal to crawl as far in as it can. Insert the retainer behind the animal with the flat end against the animal's rear and rounded straight edge positioned towards the tail. Applying mild pressure against the animal may be necessary to encourage it to crawl farther into the tube. When the animal is properly situated inside the body, insert the pin through an appropriate set of holes to capture the retainer handle.



NOTE: *Often the animal is quite reluctant to crawl into the holder on its own. A simple trick to facilitate this is to cover the animal holder with a dark opaque cloth while leaving the entry opening exposed. The animal's natural tendency to crawl into dark spaces will make the animal holder an attractive retreat. Quickly insert the retainer and pin once the animal is inside.*

Figure 4 below is a photograph of an animal properly inserted inside the holder. Note that the animal's head should completely inside the small end section beneath the wedge and reasonably level.



Figure 4, Animal properly inserted into holder.

Once the animal is securely inside the holder, carefully insert the holder head-first into the animal chamber. The head section of the animal holder fits into a small diameter hole at the far end of the chamber body tube section. The holder must be inserted all the way in for proper performance.

Alignment of the animal holder within the chamber is also important for proper performance. The holes along the top of the holder body should be in line with a scribe mark on the top and end of the body tube section. The operator may also check alignment by observing the animal inside the chamber through the viewing tube located in the waveguide bend section. A penlight is provided with the system to assist in viewing by inserting it into the vertical tube on top of the animal chamber. Ideally, the holder should be level and animal's eyes symmetrically positioned.



CAUTION: *Avoid system operation without a properly loaded animal. The absence of a suitable load inside the chamber can result in damage to the chamber and/or animal holder.*

Cycle Timer Preset

The preset value of the cycle timer must be determined and set prior to system operation. The optimal preset value may vary depending on microwave power level and animal size. Too high or too low of a value may yield poor results. The following table is provided to assist the operator in determining the optimal preset value.

Table 1 – Recommended cycle timer preset values (sec)		
<i>Animal weight (gm)</i>	<i>Low Power</i>	<i>High Power</i>
20-50		
50-100		
100-175		
175-325		
325-450		

System Controls

Line power is applied to the system by turning on the main circuit breaker located on the rear panel of the microwave generator. There is a brief delay period of approximately 10 seconds for generator warm-up. System operation can begin once the warm-up delay has timed out and all interlocks are satisfied (see previous section).

At this point the system is in “standby” mode as indicated by illumination of the “Mw Start” pushbutton switch located on the control module front panel. Power will also be applied to the cycle timer allowing it to be programmed.

Pressing the “Mw Start” pushbutton will enable the microwave generator and cause microwave power to be generated at a power level corresponding to the power level setting. The system is now in “operate” mode as indicated by illumination of the “Mw Stop” pushbutton switches located on the microwave generator and control module.

The system will remain in “operate” mode until one of the following events occurs:

- a) The cycle timer has timed out. In this case the system and timer must be reset by pressing the “Mw Stop” button on the control module. The system is returned to “standby” mode and will then be ready for the next operation cycle.
- b) Either of the two “Mw Stop” pushbuttons is pressed. In this case the system and timer are automatically reset to “standby” mode and will be ready for the next operation cycle.
- c) An interlock device opens. In this case the microwave generator will immediately stop delivering microwave power, but the cycle timer will continue to operate until it has timed out. Pressing the “Mw Stop” pushbutton either before or after the timer has timed out will reset the timer, but the system will not return to “standby” mode until the all interlock devices are satisfied.



NOTE: *At the end of a normal operating cycle after the cycle timer has timed out, the “Mw Stop” button must be pressed to reset the timer.*

Microwave Power Level Switching

The level of microwave power generated can be switched between low (half) and high (full) power by pressing the “Push to Select” pushbutton switch on the control module front panel. However, the power level setting can not be changed while the generator is in “operate” mode. Upon system power-up, the power level setting is the same as before the previous power-down.

MAINTENANCE

The GA5013 system is designed to be maintenance free with the exception of magnetron replacement and cleaning of the animal chamber and holder. The magnetron is considered a consumable component and has a life expectancy between 1000 to 5000 hours. Refer to the section below for magnetron replacement instructions.

In the event of damage due to improper operation or mishandling, the system should be returned to GAE for repair. Contact GAE for information on repair services.

Cleaning the Animal Chamber and Holder

The animal holder and interior of the animal chamber will require period cleaning to prevent the build-up of residue. The holder is made of acrylic and should be cleaned using soapy water and a non-abrasive sponge or cloth. Surface scratches can allow residue to become permanently lodged in the grooves and may result in excessive heating of the plastic material.

Cleaning the animal chamber requires access to its interior. This involves disconnecting **only** the body tube section by loosening the clamp screw and removing the clamp. Once the two sections are separated, the interior surfaces can be cleaned using soapy water and a non-abrasive sponge. Minor amounts of residue lodged in the interior crevices will not affect performance.



CAUTION: *Do not disassemble the animal chamber components beyond separating the applicator and body tube sections. Loosening and/or moving any of the fastened parts can cause faulty operation and may result in damage.*

Magnetron Removal and Replacement

Microwave power is generated by a vacuum oscillator device inside the generator known as a magnetron. Given its typical life of several thousand hours, it may be many years before magnetron replacement becomes necessary. Magnetron failure can be indicated by any of several symptoms, so we recommend consultation with GAE prior to its replacement. If the magnetron should fail it can be replaced by a qualified technician having a working knowledge of high power and high voltage electrical circuits.

The type of magnetron used in the microwave generator is indicated on the product ID label located on the rear panel. Spare magnetrons can be purchased directly from GAE by ordering part number 010207.



WARNING: *High voltage stored in internal power supply components must be discharged prior to servicing. Failure to allow adequate discharge time can result in sever injury or death. Allow at least 5 minutes following operation of the unit before removing covers for service.*

1. Turn off the microwave generator and disconnect all electrical connections.
2. Turn off the source of cooling water, both supply and drain.
3. Turn the ten captive cover screws $\frac{1}{4}$ turn and remove both covers.
4. Remove the brown filament lead insulator block and disconnect the filament transformer and high voltage leads from the magnetron.
5. Disconnect the two water tubes from the magnetron water fittings by loosening the compression fittings. Some bending of the tubes may be necessary but should be minimized.
6. Disconnect the two leads connected to the thermal switch mounted to the side of the magnetron.
7. Remove the four nuts (below the magnetron) securing the magnetron to the waveguide mounting bracket and carefully lift out the magnetron.
8. Carefully insert the new magnetron into the waveguide, being careful to avoid contact with the ceramic antenna dome.
9. Secure the magnetron in place using the four mounting nuts removed in step 6.
10. Connect the two thermal switch leads onto the thermal switch mounted to the new magnetron.
11. Connect the water tubes to the magnetron water fittings. Be sure to tighten the compression fittings securely.
12. Connect the high voltage and filament transformer leads to the magnetron filament leads using the same hardware as was removed in step 3. Replace the brown insulator block.
13. Turn on the source of cooling water and check for leaks.
14. Replace the chassis side covers.



CAUTION: *Excess or spilled water inside unit can cause damage to the internal high voltage components. All excess and spilled water must be removed from inside the unit before operation.*

Filament Voltage Adjustment

After replacing the magnetron, the voltage delivered to its filament terminals must be adjusted to conform to the magnetron manufacturer's specification and ensure long magnetron life. Improperly adjusted filament voltage can result in premature magnetron failure.

Equipment Required:

1. 0-10 VDC iron-vane (or other **true RMS** type) voltmeter with **full insulation rated for 15 kVDC minimum**. GAE model GA3201 Isolated Filament Voltmeter meets this requirement.
2. #2 Phillips screwdriver

Procedure:

1. Turn off the generator and disconnect all electrical connections.
2. Remove the brown filament lead insulator block at the side of the magnetron.
3. Connect the leads of the isolated filament voltmeter to the magnetron filament lead connectors.
4. Connect a suitable waveguide load to the output flange of the microwave generator (see the *Installation* section of this manual).



WARNING: *High voltage will be present and exposed during the next step. All personnel MUST remain a safe distance away from the exposed high voltage during operation of the microwave generator. Failure to heed this warning can result in sever injury or death.*

5. Turn on the microwave generator to place the system into "stand-by" mode. Do not turn on microwave power yet.
6. The reading on the filament voltmeter should be 4.5 +/- 0.5 Volts. If the reading is not within this range then it may be an indication of a failure of the filament control circuit and must be corrected before proceeding with the next step.
7. Turn on microwave power to place the system into "operate" mode and observe the filament voltmeter reading. If it is 1.5 +/- 0.3 Volts then skip the following step.
8. Turn off the microwave generator and unplug the line power connector. Loosen the tap screw on the high power resistor located on the chassis bottom next to the magnetron. Move the tap as necessary to adjust the filament voltage until it is within the range specified in the previous step. Tighten the resistor tap, plug in the line power connector and turn on the microwave

generator to place it in “stand-by” mode. Repeat the previous step.

9. Turn off the microwave generator, replace the brown filament lead insulator block and replace the side access covers.

REVISIONS			
ZONE	REV	DESCRIPTION	DATE
	6	ADD CUSTOMER REF BOM	03APR08
			BY
			JAS

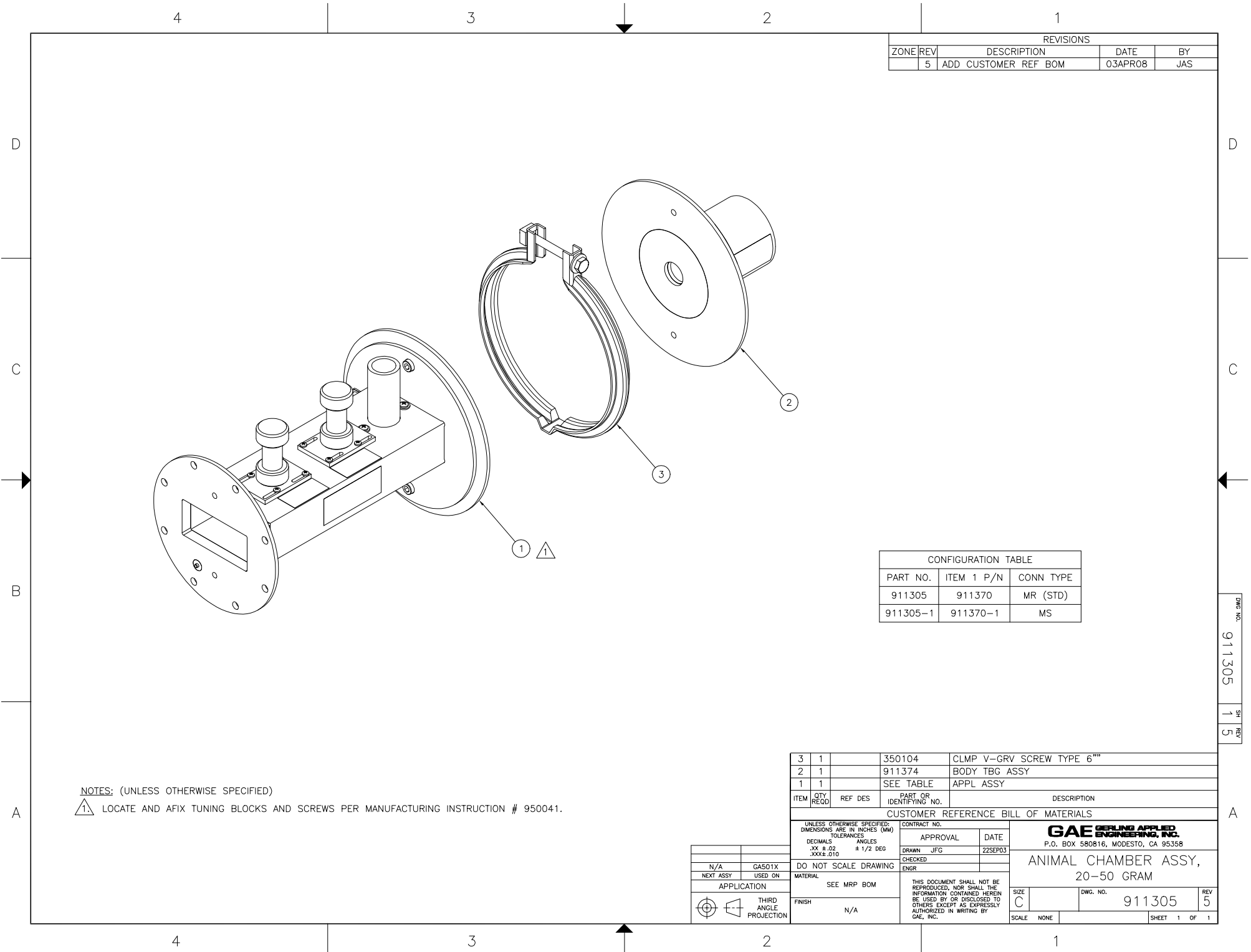
OPTIONS TABLE 			
ANIMAL CHAMBER (ITEM 8)		ANIMAL HOLDER (ITEM 9)	
PART NO.	DESCRIPTION	PART NO.	DESCRIPTION
911305	20-50 GRAM	911306	20-50 GRAM
911021	50-175 GRAM	911023	50-100 GRAM
911022	175-450 GRAM	911024	100-175 GRAM
		911025	175-325 GRAM
		911026	325-450 GRAM

CONFIGURATION TABLE 		
ASSY NO.	ITEM 1 P/N	DESCRIPTION
911020	911197	60 Hz
911020-1	911197-1	50 Hz

16	1	910783	SHPNG CNTNR ASSY
15	1	930026	PROD MNL MW FIXN SYS
14	1	910136	SPRT BLK ASSY WR284
13	32	721051	FL WSHR SAE 1/4" SST
12	16	711501	KEPNUT 1/4-20 SST
11	16	701101-12	HHCS 1/4-20 .75 SST
10	1	060501	PENLIGHT CHR 6" L
9	A/R	SEE TABLE	ANIMAL HOLDER
8	A/R	SEE TABLE	ANIMAL CHAMBER
7	2	350101	FLG CLAMP Q-D
6	1	911097	WTR DISTRIBUTION ASSY
5	1	911094	CONT MDL ASSY
4	1	911079	BEND 180 DEG H-PLANE
3	1	GA1204	SHORT DMY LD WR284
2	1	GA1105A	3-PORT CRCLTR WR284
1	1	SEE TABLE	4KW FXD GEN DUAL PWR

ITEM	QTY REQD	REF DES	PART OR IDENTIFYING NO.	DESCRIPTION
CUSTOMER REFERENCE BILL OF MATERIALS				
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES DECIMALS .XX ±.02 ANGLES ±1/2 DEG XXX±.010		CONTRACT NO.		
DO NOT SCALE DRAWING		APPROVAL		
MATERIAL		DATE		
FINISH		DRAWN JFG		
THIRD ANGLE PROJECTION		CHECKED ENGR		
SEE MRP BOM		THIS DOCUMENT SHALL NOT BE REPRODUCED, NOR SHALL THE INFORMATION CONTAINED HEREIN BE USED BY OR DISCLOSED TO OTHERS EXCEPT AS EXPRESSLY AUTHORIZED IN WRITING BY GAE, INC.		
N/A		GAE BERLING APPLIED ENGINEERING, INC. P.O. BOX 580816, MODESTO, CA 95358		
N/A		ANIMAL FIXATION SYSTEM, 4KW FINAL ASSEMBLY		
N/A		SIZE C		
N/A		DWG. NO. 911020		
N/A		REV 6		
N/A		SCALE NONE		
N/A		SHEET 1 OF 1		

- NOTES: (UNLESS OTHERWISE SPECIFIED)
1. WATER DISTRIBUTION ASSEMBLY (ITEM 6) NOT SHOWN.
 -  ANIMAL CHAMBER (ITEM 8) AND HOLDER (ITEM 9) TO BE SELECTED FROM OPTIONS TABLE BY CUSTOMER.
 -  SEE CONFIGURATION TABLE FOR ITEM 1 PART NUMBER.



REVISIONS			
ZONE	REV	DESCRIPTION	DATE
	5	ADD CUSTOMER REF BOM	03APR08

BY
JAS

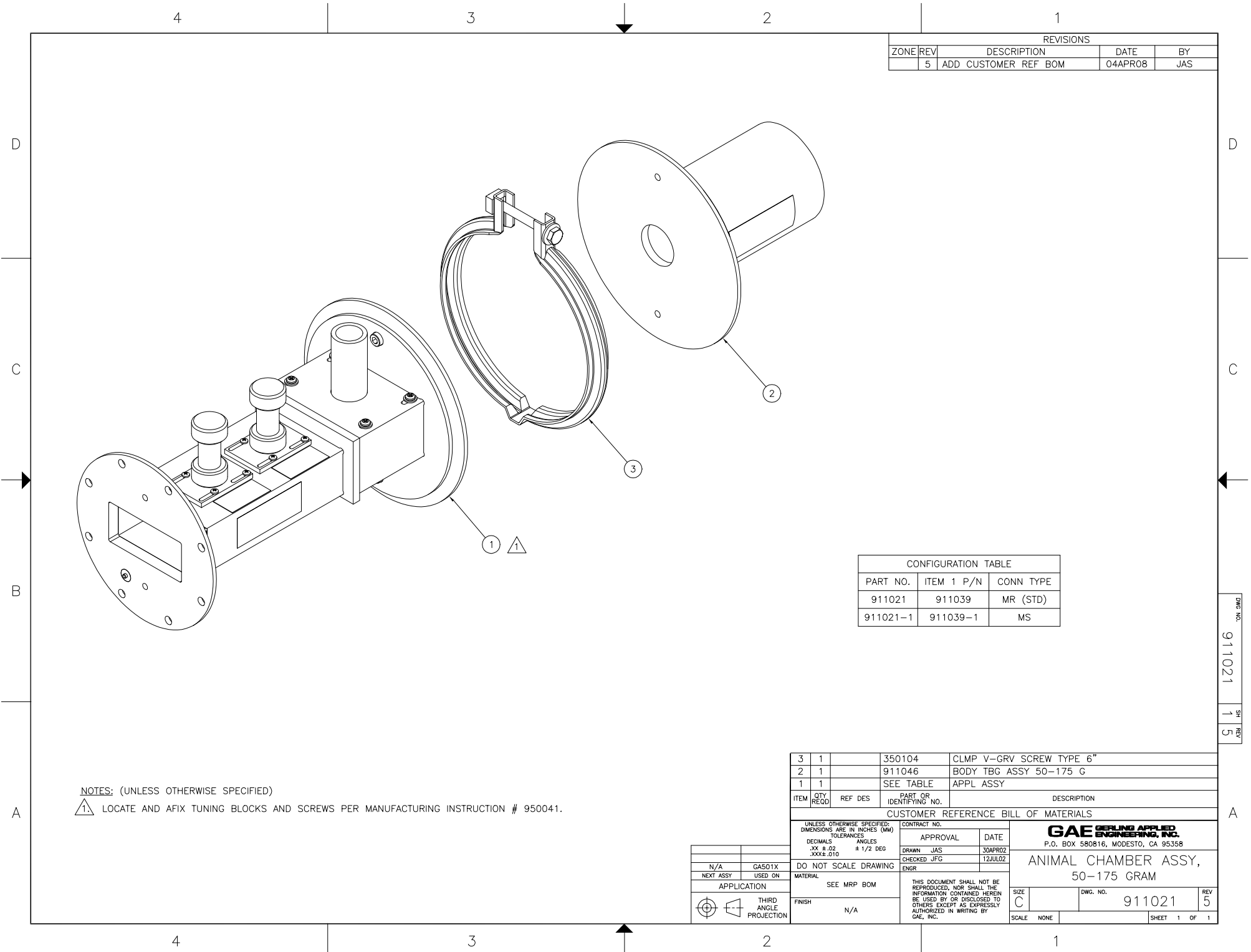
CONFIGURATION TABLE			
PART NO.	ITEM 1	P/N	CONN TYPE
911305		911370	MR (STD)
911305-1		911370-1	MS

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. LOCATE AND AFIX TUNING BLOCKS AND SCREWS PER MANUFACTURING INSTRUCTION # 950041.

3	1		350104	CLMP V-GRV SCREW TYPE 6"
2	1		911374	BODY TBG ASSY
1	1		SEE TABLE	APPL ASSY
ITEM	QTY REQD	REF DES	PART OR IDENTIFYING NO.	DESCRIPTION
CUSTOMER REFERENCE BILL OF MATERIALS				
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES DECIMALS .XX ±.02 ANGLES ± 1/2 DEG XXX±.010			CONTRACT NO.	
			APPROVAL	
			DATE	
			DRAWN JFG ZZSEP03	
DO NOT SCALE DRAWING			CHECKED	
MATERIAL			ENGR	
SEE MRP BOM			GAE GERLING APPLIED ENGINEERING, INC. P.O. BOX 580816, MODESTO, CA 95358 ANIMAL CHAMBER ASSY, 20-50 GRAM	
FINISH N/A				
THIS DOCUMENT SHALL NOT BE REPRODUCED, NOR SHALL THE INFORMATION CONTAINED HEREIN BE USED BY OR DISCLOSED TO OTHERS EXCEPT AS EXPRESSLY AUTHORIZED IN WRITING BY GAE, INC.				
SIZE C			DWG. NO. 911305	
SCALE NONE			REV 5	
SHEET 1			OF 1	

DWG NO. 911305
SH REV 1 5



NOTES: (UNLESS OTHERWISE SPECIFIED)
1. LOCATE AND AFIX TUNING BLOCKS AND SCREWS PER MANUFACTURING INSTRUCTION # 950041.

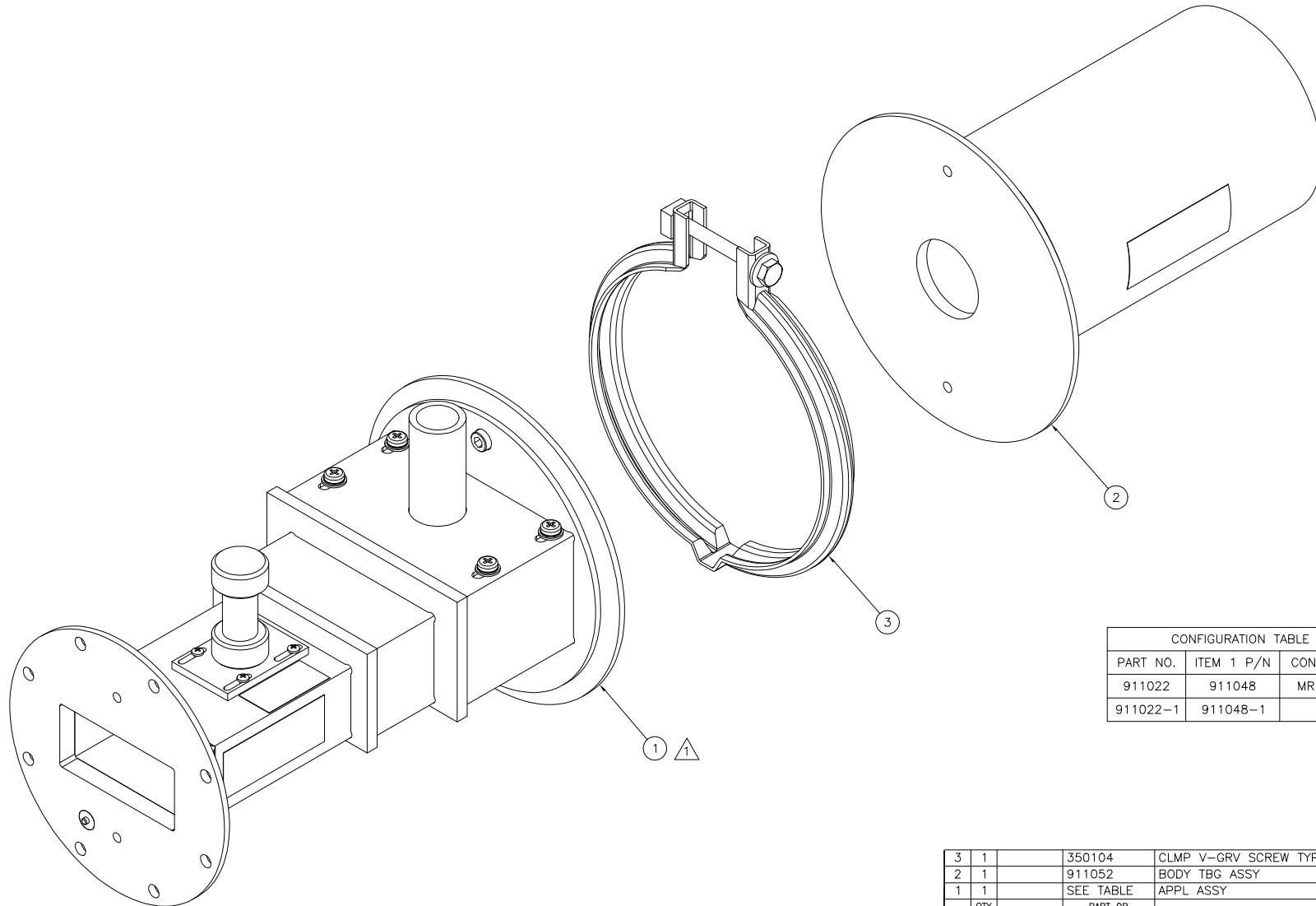
REVISIONS			
ZONE	REV	DESCRIPTION	DATE
	5	ADD CUSTOMER REF BOM	04APR08

CONFIGURATION TABLE		
PART NO.	ITEM 1 P/N	CONN TYPE
911021	911039	MR (STD)
911021-1	911039-1	MS

3	1	350104	CLMP V-GRV SCREW TYPE 6"			
2	1	911046	BODY TBG ASSY 50-175 G			
1	1	SEE TABLE	APPL ASSY			
ITEM	QTY REQD	REF DES	PART OR IDENTIFYING NO.	DESCRIPTION		
CUSTOMER REFERENCE BILL OF MATERIALS						
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES DECIMALS ANGLES .XX ±.02 ± 1/2 DEG .XXX±.010		CONTRACT NO.		GAE GERLING APPLIED ENGINEERING, INC. P.O. BOX 580816, MODESTO, CA 95358		
DO NOT SCALE DRAWING		APPROVAL			DATE	
MATERIAL		DRAWN JAS			30APR02	
SEE MRP BOM		CHECKED JFG			12JUL02	
FINISH		ENGR				
N/A		THIS DOCUMENT SHALL NOT BE REPRODUCED, NOR SHALL THE INFORMATION CONTAINED HEREIN BE USED BY OR DISCLOSED TO OTHERS EXCEPT AS EXPRESSLY AUTHORIZED IN WRITING BY GAE, INC.			ANIMAL CHAMBER ASSY, 50-175 GRAM	
N/A		SIZE C				DWG. NO. 911021
SCALE NONE		SHEET 1 OF 1				

DWG. NO. 911021
SH. REV. 1 5

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	BY
	5	ADD CUSTOMER REF BOM	03APR08	JAS

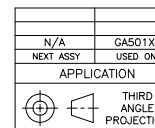


CONFIGURATION TABLE		
PART NO.	ITEM 1 P/N	CONN TYPE
911022	911048	MR (STD)
911022-1	911048-1	MS

3	1	350104	CLMP V-GRV SCREW TYPE "3"	
2	1	911052	BODY TBG ASSY	
1	1	SEE TABLE	APPL ASSY	
ITEM	QTY REQD	REF DES	PART OR IDENTIFYING NO.	DESCRIPTION
CUSTOMER REFERENCE BILL OF MATERIALS				
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM)		CONTRACT NO.		
TOLERANCES		APPROVAL		
DECIMALS ANGLES		DATE		
.XX ± .02 XXX± .010 ± 1/2 DEG		DRAWN JAG 30APR02		
		CHECKED JFG 12JUL02		
DO NOT SCALE DRAWING		ENGR		
MATERIAL		THIS DOCUMENT SHALL NOT BE REPRODUCED, NOR SHALL THE INFORMATION CONTAINED HEREIN BE USED BY OR DISCLOSED TO OTHERS EXCEPT AS EXPRESSLY AUTHORIZED IN WRITING BY GAE, INC.		
SEE MRP BOM		SIZE C DWG. NO. 911022 REV 5		
FINISH N/A		SCALE NONE SHEET 1 OF 1		

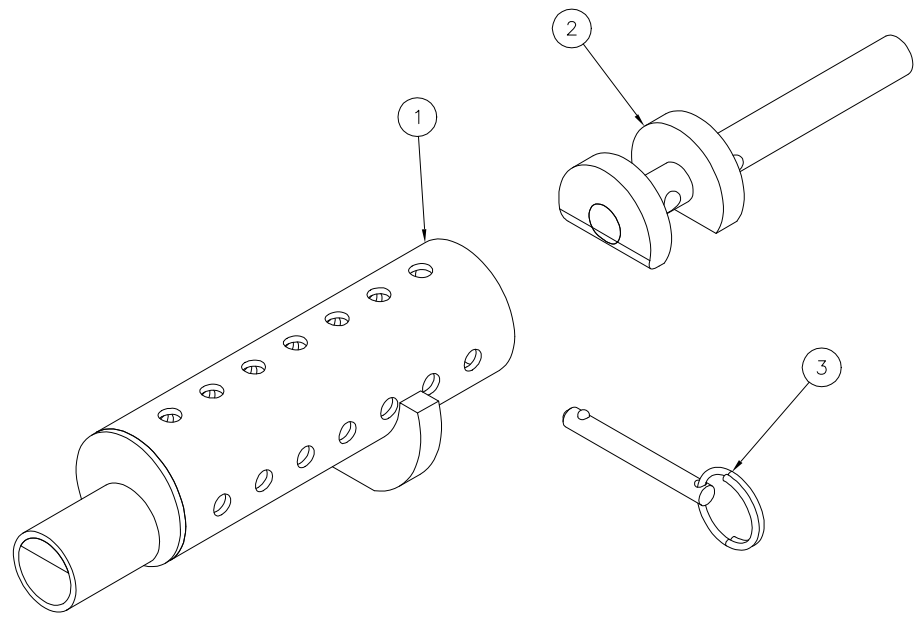
NOTES: (UNLESS OTHERWISE SPECIFIED)

1. LOCATE AND AFIX TUNING BLOCK AND SCREW PER MANUFACTURING INSTRUCTION # 950041.



DWG NO.	911306	SH	1	REV	3
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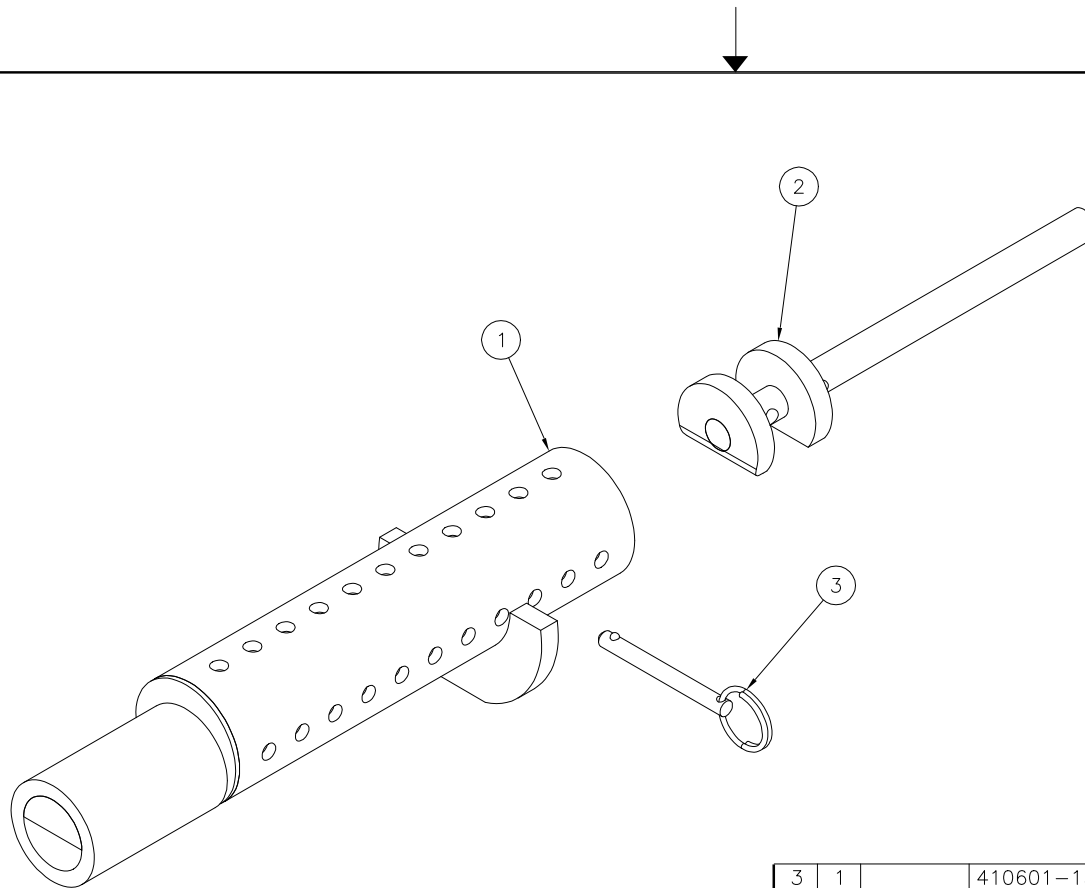
REVISIONS			
REV	DESCRIPTION	DATE	BY
3	UPDATE BOM TO MRP	03APR08	JAS



3	1		410601-13	PIN, QUICK-RELEASE, 3/16" DIA. X 1.3" GRIP
2	1		911382	ANIMAL RETAINER
1	1		911381	ANIMAL HOLDER BODY
ITEM	QTY REQD	REF DES	PART OR IDENTIFYING NO.	DESCRIPTION

CUSTOMER REFERENCE BILL OF MATERIALS			
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES DECIMALS ANGLES .XX ± .02 ± 1/2 DEG .XXX ± .010		CONTRACT NO.	
DO NOT SCALE DRAWING		APPROVAL	DATE
MATERIAL SEE MRP BOM		DRAWN JFG	23SEP03
FINISH NONE		CHECKED	
		ENGR	
		THIS DOCUMENT SHALL NOT BE REPRODUCED, NOR SHALL THE INFORMATION CONTAINED HEREIN BE USED BY OR DISCLOSED TO OTHERS EXCEPT AS EXPRESSLY AUTHORIZED IN WRITING BY GAE, INC.	
		GAE GERLING APPLIED ENGINEERING, INC. P.O. BOX 580816, MODESTO, CA 95358 ANIMAL HOLDER ASSY, 20-50 GRAM	
		SIZE B	DWG. NO. 911306
		SCALE NONE	REV 3
		SHEET 1 OF 1	

N/A	GA501X
NEXT ASSY	USED ON
APPLICATION	
	THIRD ANGLE PROJECTION



DWG NO.	911023	SH	1	REV	3
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REVISIONS			
REV	DESCRIPTION	DATE	BY
3	UPDATE BOM TO MRP	03APR08	JAS

3	1		410601-15	PIN, QUICK-RELEASE, 3/16" DIA. X 1.5" GRIP
2	1		911032	ANIMAL RETAINER
1	1		911031	ANIMAL HOLDER BODY
ITEM	QTY REQD	REF DES	PART OR IDENTIFYING NO.	DESCRIPTION

CUSTOMER REFERENCE BILL OF MATERIALS

N/A	GA501X
NEXT ASSY	USED ON
APPLICATION	
	THIRD ANGLE PROJECTION

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES (MM)
TOLERANCES
DECIMALS ANGLES
.XX ± .02 ± 1/2 DEG
.XXX ± .010

DO NOT SCALE DRAWING

MATERIAL SEE MRP BOM

FINISH NONE

CONTRACT NO.	
APPROVAL	DATE
DRAWN JAS	5APR02
CHECKED JFG	24APR02
ENGR	

THIS DOCUMENT SHALL NOT BE REPRODUCED, NOR SHALL THE INFORMATION CONTAINED HEREIN BE USED BY OR DISCLOSED TO OTHERS EXCEPT AS EXPRESSLY AUTHORIZED IN WRITING BY GAE, INC.

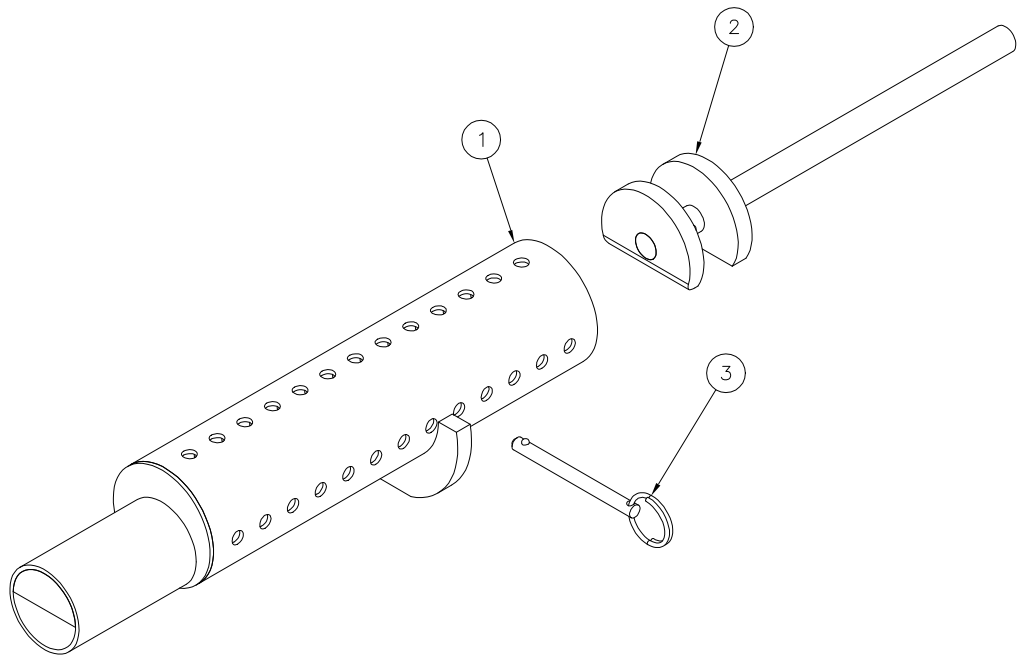
GAE GERLING APPLIED ENGINEERING, INC.
P.O. BOX 580816, MODESTO, CA 95358

ANIMAL HOLDER ASSY,
50-100 GRAM

SIZE	B	DWG. NO.	911023	REV	3
SCALE	NONE			SHEET	1 OF 1

DWG NO.	911024	SH	1	REV	3
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REVISIONS			
REV	DESCRIPTION	DATE	BY
3	UPDATE BOM TO MRP	04APR08	JAS



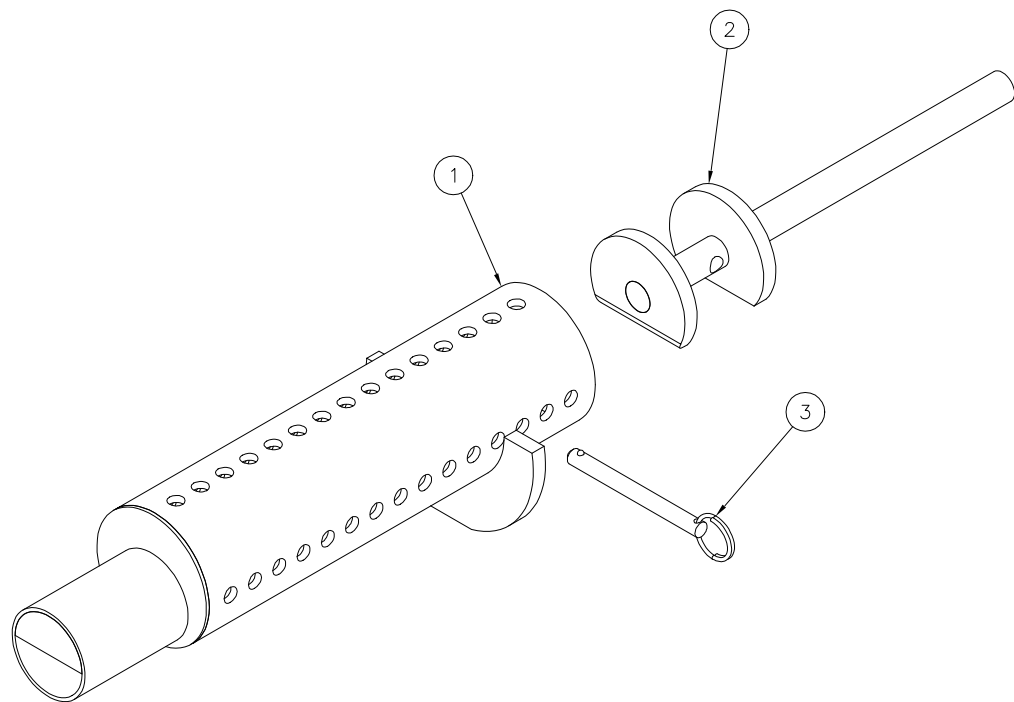
3	1		410601-18	PIN, QUICK-RELEASE, 3/16" DIA. X 1.8" GRIP
2	1		911034	ANIMAL RETAINER
1	1		911033	ANIMAL HOLDER BODY
ITEM	QTY REQD	REF DES	PART OR IDENTIFYING NO.	DESCRIPTION

CUSTOMER REFERENCE BILL OF MATERIALS			
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES DECIMALS ANGLES .XX ± .02 ± 1/2 DEG .XXX ± .010		CONTRACT NO.	
DO NOT SCALE DRAWING		APPROVAL	DATE
MATERIAL		DRAWN JAS	9APR02
FINISH		CHECKED JFG	24APR02
SEE MRP BOM		ENGR	
NONE		THIS DOCUMENT SHALL NOT BE REPRODUCED, NOR SHALL THE INFORMATION CONTAINED HEREIN BE USED BY OR DISCLOSED TO OTHERS EXCEPT AS EXPRESSLY AUTHORIZED IN WRITING BY GAE, INC.	
GAE GERLING APPLIED ENGINEERING, INC. P.O. BOX 580816, MODESTO, CA 95358		ANIMAL HOLDER ASSY, 100-175 GRAM	
SIZE	B	DWG. NO.	911024
SCALE	NONE		REV 3
SHEET 1 OF 1			

N/A	GA501X
NEXT ASSY	USED ON
APPLICATION	
THIRD ANGLE PROJECTION	

DWG NO.	911025	SH	1	REV	3
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REVISIONS			
REV	DESCRIPTION	DATE	BY
3	UPDATE BOM TO MRP	01APR08	JAS

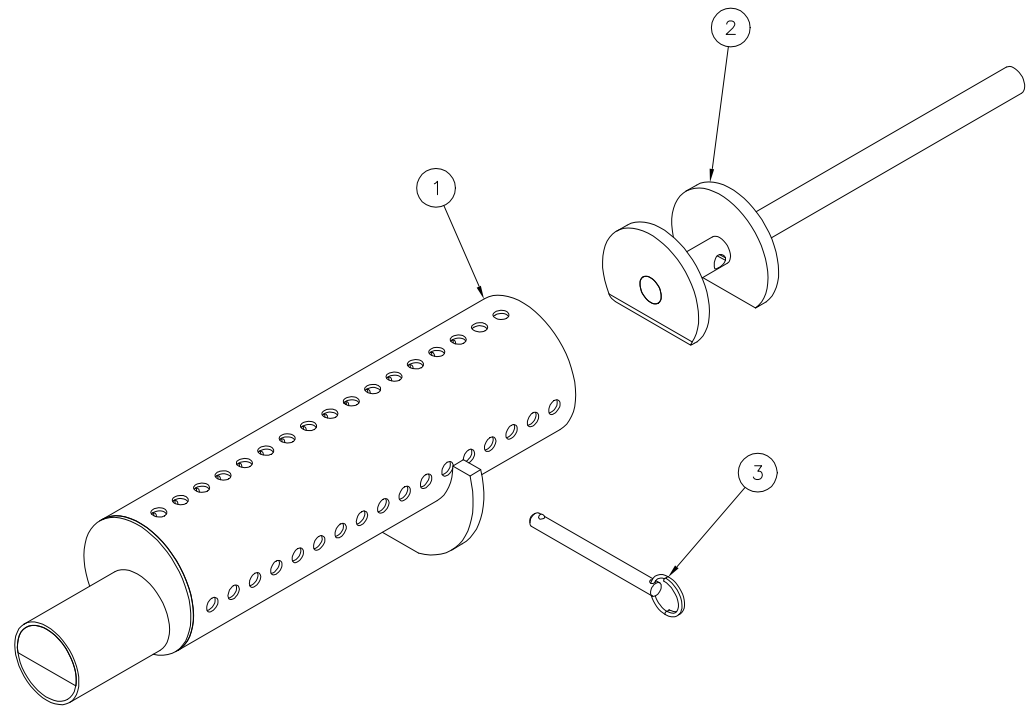


3	1		410602-23	PIN, QUICK-RELEASE, 1/4" DIA. X 2.3" GRIP
2	1		911036	ANIMAL RETAINER
1	1		911035	ANIMAL HOLDER BODY
ITEM	QTY REQD	REF DES	PART OR IDENTIFYING NO.	DESCRIPTION

CUSTOMER REFERENCE BILL OF MATERIALS					
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES DECIMALS ANGLES .XX ±.02 ± 1/2 DEG .XXX±.010		CONTRACT NO.		GAE GERLING APPLIED ENGINEERING, INC. P.O. BOX 580816, MODESTO, CA 95358 ANIMAL HOLDER ASSY, 175-325 GRAM	
		APPROVAL DATE			
		DRAWN JAS	10APR02		
		CHECKED JFG	24APR02		
DO NOT SCALE DRAWING		ENGR		SIZE B SCALE NONE DWG. NO. 911025 SHEET 1 OF 1 REV 3	
MATERIAL		THIS DOCUMENT SHALL NOT BE REPRODUCED, NOR SHALL THE INFORMATION CONTAINED HEREIN BE USED BY OR DISCLOSED TO OTHERS EXCEPT AS EXPRESSLY AUTHORIZED IN WRITING BY GAE, INC.			
SEE MRP BOM					
FINISH NONE					

DWG NO.	911026	SH	1	REV	3
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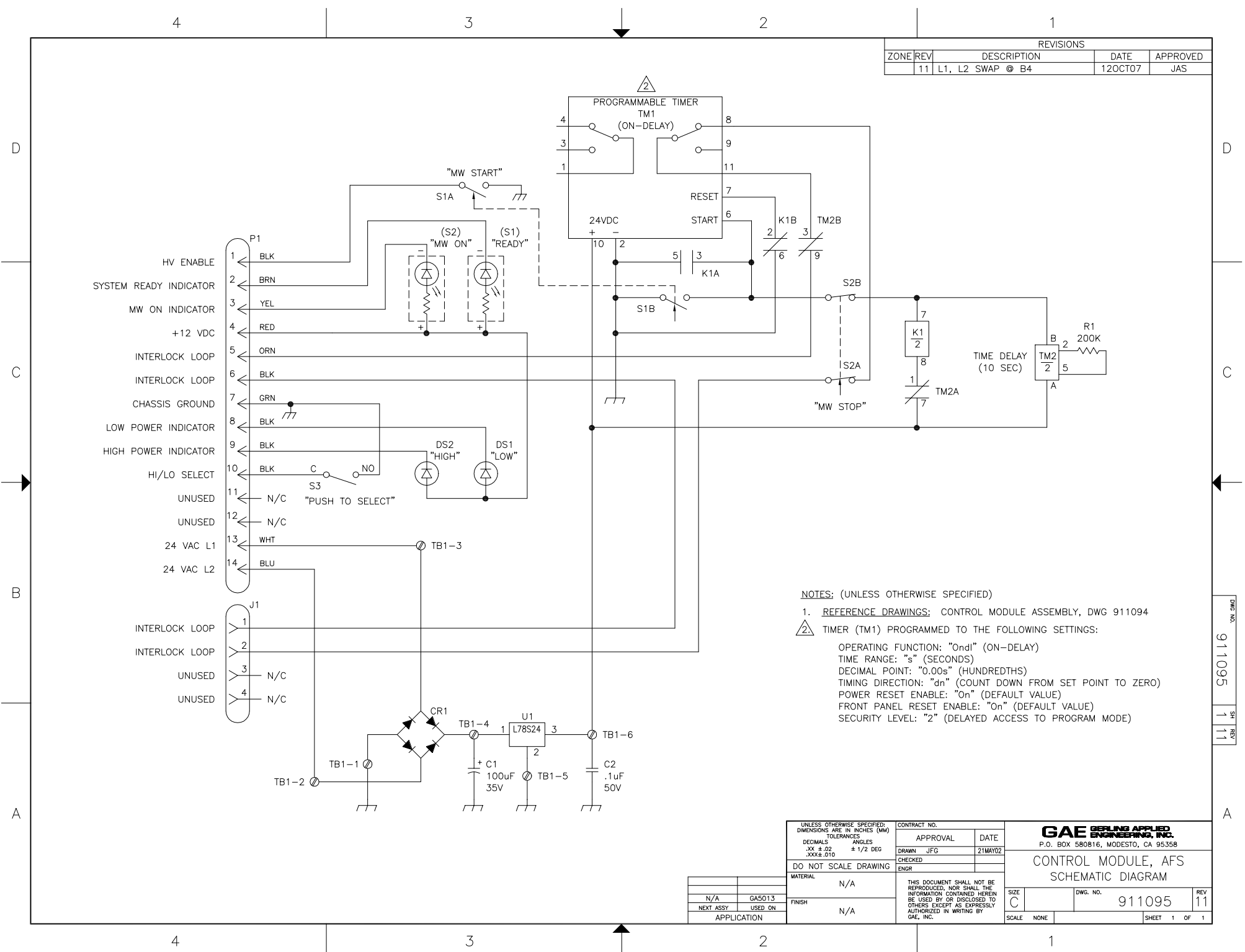
REVISIONS			
REV	DESCRIPTION	DATE	BY
3	UPDATE BOM TO MRP	03APR08	JAS



2	2		410602-25	PIN, QUICK-RELEASE, 1/4" DIA., SST, WITH RING
2	1		911038	ANIMAL RETAINER
1	1		911037	ANIMAL HOLDER BODY
ITEM	QTY REQD	REF DES	PART OR IDENTIFYING NO.	DESCRIPTION

CUSTOMER REFERENCE BILL OF MATERIALS			
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES DECIMALS ANGLES .XX ± .02 ± 1/2 DEG .XXX ± .010		CONTRACT NO.	
DO NOT SCALE DRAWING		APPROVAL	DATE
MATERIAL SEE MRP BOM		DRAWN JAS	8APR02
FINISH NONE		CHECKED JFG	24APR02
		ENGR	
		THIS DOCUMENT SHALL NOT BE REPRODUCED, NOR SHALL THE INFORMATION CONTAINED HEREIN BE USED BY OR DISCLOSED TO OTHERS EXCEPT AS EXPRESSLY AUTHORIZED IN WRITING BY GAE, INC.	
		GAE GERLING APPLIED ENGINEERING, INC. P.O. BOX 580816, MODESTO, CA 95358 ANIMAL HOLDER ASSY, 325-450 GRAM	
		SIZE B	DWG. NO. 911026
		SCALE NONE	REV 3
		SHEET 1 OF 1	

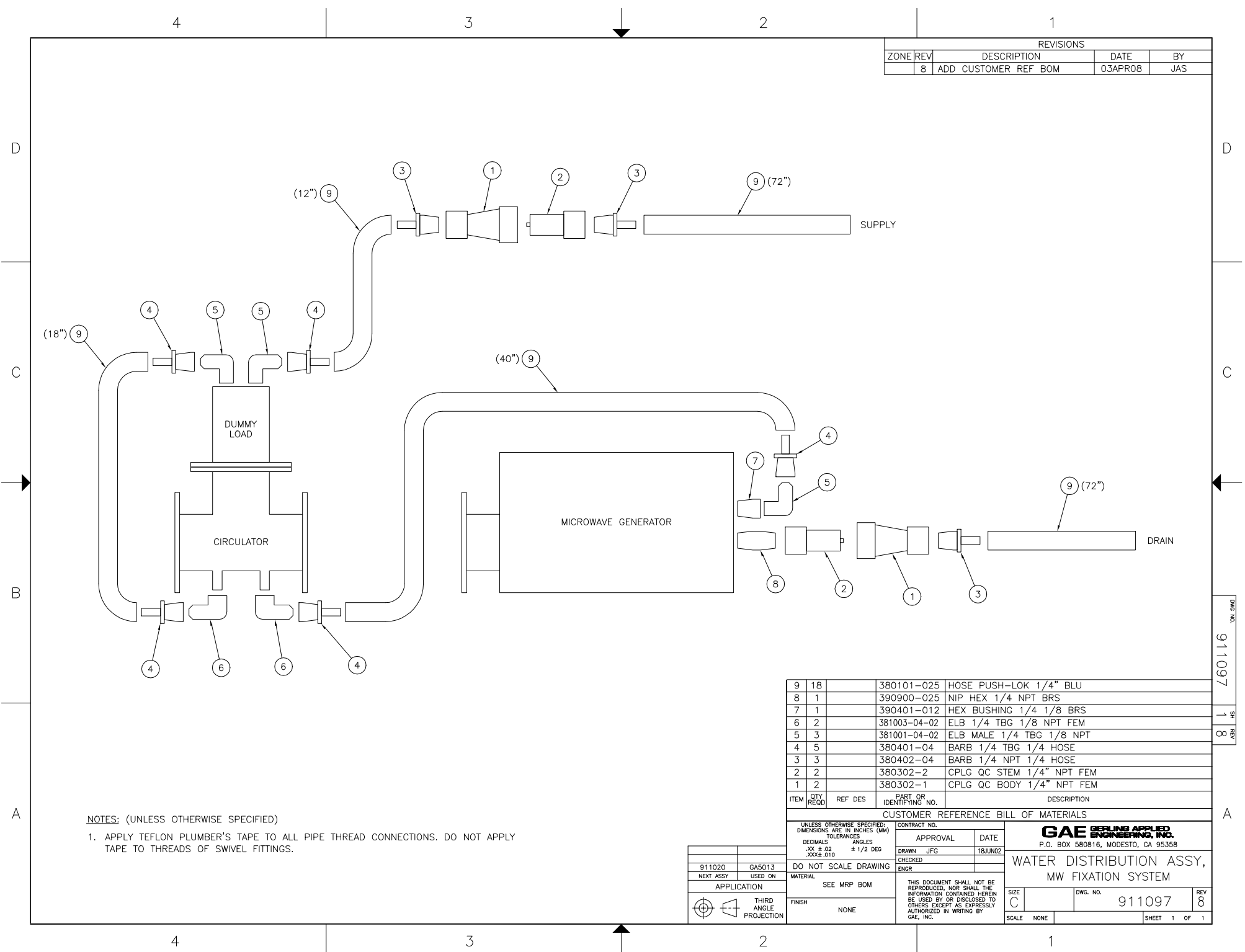
N/A	GA501X
NEXT ASSY	USED ON
APPLICATION	
	THIRD ANGLE PROJECTION



REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	11	L1, L2 SWAP @ B4	12OCT07	JAS

- NOTES: (UNLESS OTHERWISE SPECIFIED)
- REFERENCE DRAWINGS: CONTROL MODULE ASSEMBLY, DWG 911094
 - TIMER (TM1) PROGRAMMED TO THE FOLLOWING SETTINGS:
OPERATING FUNCTION: "On" (ON-DELAY)
TIME RANGE: "s" (SECONDS)
DECIMAL POINT: "0.00s" (HUNDREDTHS)
TIMING DIRECTION: "dn" (COUNT DOWN FROM SET POINT TO ZERO)
POWER RESET ENABLE: "On" (DEFAULT VALUE)
FRONT PANEL RESET ENABLE: "On" (DEFAULT VALUE)
SECURITY LEVEL: "2" (DELAYED ACCESS TO PROGRAM MODE)

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES DECIMALS .XX ±.02 ANGLES ±1/2 DEG DO NOT SCALE DRAWING		CONTRACT NO.		APPROVAL		DATE		GAE GERLING APPLIED ENGINEERING, INC. P.O. BOX 580816, MODESTO, CA 95358	
MATERIAL		DRAWN JFG		CHECKED		21MAY02		CONTROL MODULE, AFS SCHEMATIC DIAGRAM	
FINISH		THIS DOCUMENT SHALL NOT BE REPRODUCED, NOR SHALL THE INFORMATION CONTAINED HEREIN BE USED BY OR DISCLOSED TO OTHERS EXCEPT AS EXPRESSLY AUTHORIZED IN WRITING BY GAE, INC.		SIZE		DWG. NO.		REV	
N/A		N/A		C		911095		11	
NEXT ASSY USED ON		APPLICATION		SCALE		NONE		SHEET 1 OF 1	



REVISIONS				
ZONE	REV	DESCRIPTION	DATE	BY
	8	ADD CUSTOMER REF BOM	03APR08	JAS

9	18		380101-025	HOSE PUSH-LOK 1/4" BLU
8	1		390900-025	NIP HEX 1/4 NPT BRS
7	1		390401-012	HEX BUSHING 1/4 1/8 BRS
6	2		381003-04-02	ELB 1/4 TBG 1/8 NPT FEM
5	3		381001-04-02	ELB MALE 1/4 TBG 1/8 NPT
4	5		380401-04	BARB 1/4 TBG 1/4 HOSE
3	3		380402-04	BARB 1/4 NPT 1/4 HOSE
2	2		380302-2	CPLG QC STEM 1/4" NPT FEM
1	2		380302-1	CPLG QC BODY 1/4" NPT FEM

CUSTOMER REFERENCE BILL OF MATERIALS			
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES DECIMALS ANGLES .XX ±.02 ±1/2 DEG .XXX±.010		CONTRACT NO.	
DO NOT SCALE DRAWING		APPROVAL	DATE
MATERIAL		DRAWN JFG	18JUN02
FINISH		CHECKED	ENGR
NONE		THIS DOCUMENT SHALL NOT BE REPRODUCED, NOR SHALL THE INFORMATION CONTAINED HEREIN BE USED BY OR DISCLOSED TO OTHERS EXCEPT AS EXPRESSLY AUTHORIZED IN WRITING BY GAE, INC.	
SCALE		NONE	SHEET 1 OF 1

GAE GERLING APPLIED
ENGINEERING, INC.
P.O. BOX 580816, MODESTO, CA 95358

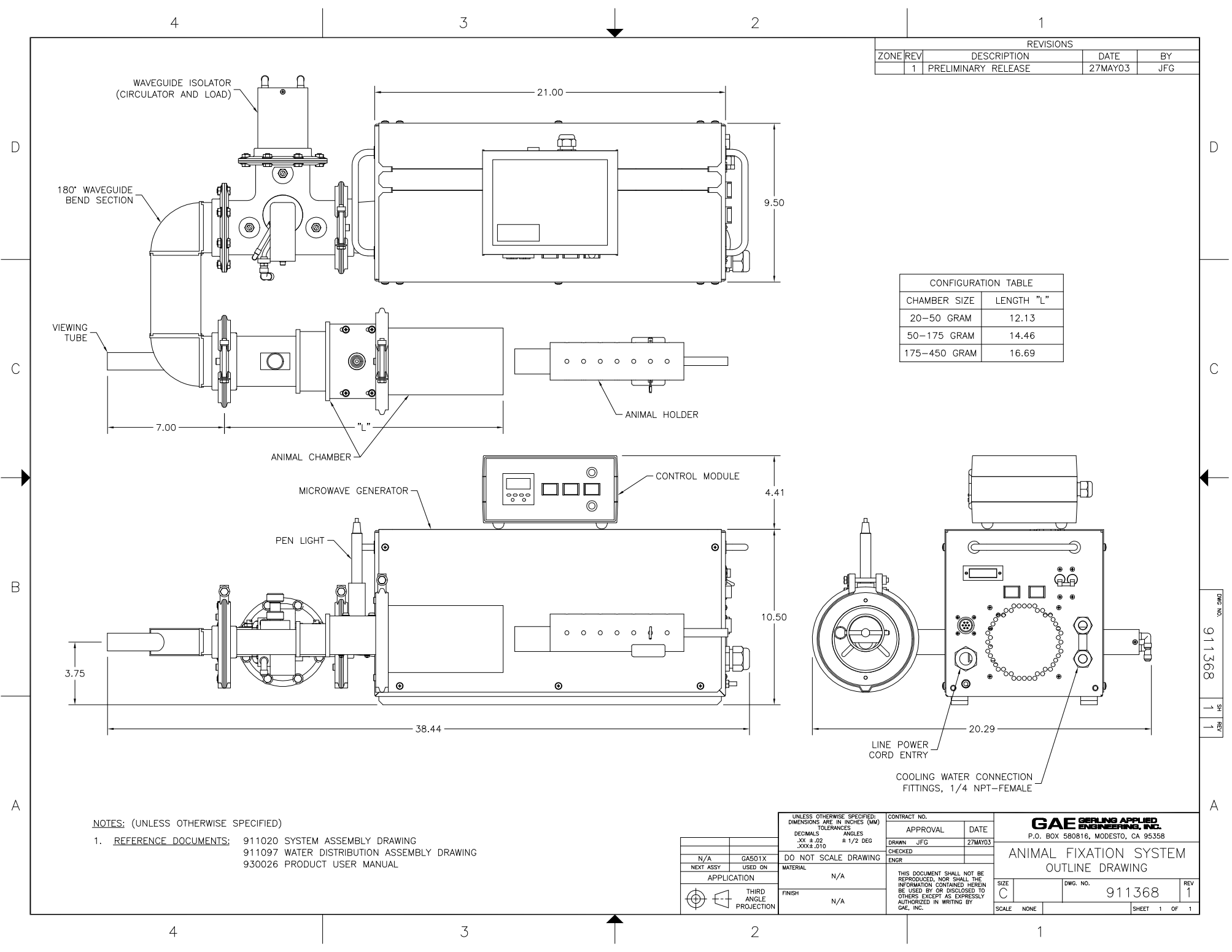
WATER DISTRIBUTION ASSY,
MW FIXATION SYSTEM

DWG. NO. 911097 REV 8

NOTES: (UNLESS OTHERWISE SPECIFIED)
1. APPLY TEFLON PLUMBER'S TAPE TO ALL PIPE THREAD CONNECTIONS. DO NOT APPLY TAPE TO THREADS OF SWIVEL FITTINGS.

911020	GAS013
NEXT ASSY	USED ON
APPLICATION	
SEE MRP BOM	
THIRD ANGLE PROJECTION	

DWG. NO. 911097
SH. REV. 1 8



REVISIONS				
ZONE	REV	DESCRIPTION	DATE	BY
	1	PRELIMINARY RELEASE	27MAY03	JFG

CONFIGURATION TABLE	
CHAMBER SIZE	LENGTH "L"
20-50 GRAM	12.13
50-175 GRAM	14.46
175-450 GRAM	16.69

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. REFERENCE DOCUMENTS: 911020 SYSTEM ASSEMBLY DRAWING
911097 WATER DISTRIBUTION ASSEMBLY DRAWING
930026 PRODUCT USER MANUAL

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES (MM) TOLERANCES DECIMALS ANGLES .XX ±.02 ± 1/2 DEG .XXX ±.010		CONTRACT NO.	
DO NOT SCALE DRAWING		APPROVAL	DATE
MATERIAL N/A		DRAWN JFG	27MAY03
FINISH N/A		CHECKED	ENGR
THIS DOCUMENT SHALL NOT BE REPRODUCED, NOR SHALL THE INFORMATION CONTAINED HEREIN BE USED BY OR DISCLOSED TO OTHERS EXCEPT AS EXPRESSLY AUTHORIZED IN WRITING BY GAE, INC.		GAE GERLING APPLIED ENGINEERING, INC. P.O. BOX 580816, MODESTO, CA 95358	
APPLICATION THIRD ANGLE PROJECTION		ANIMAL FIXATION SYSTEM OUTLINE DRAWING	
SIZE C		DWG. NO. 911368	REV 1
SCALE NONE		SHEET 1 OF 1	

DWG NO. 911368
SH REV 1 1