

THERMTRONIX®

QUALITY ALUMINUM MELTING SYSTEMS

AUTOCLEAN ELECTRIC SHUTTLE DEGASSING SYSTEM

INSTRUCTION AND SERVICE MANUAL
MODEL NO. 3603

ES'

THERMTRONIX® CORPORATION 17129 MUSKRAT AVENUE • ADELANTO, CA, U.S.A. 92301

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SAFETY FIRST

CAUTION – EXPLOSION HAZARD

THE PLACEMENT OF WET, DAMP, OR
MOISTURE BEARING MATERIALS
INTO MOLTEN METAL WILL CAUSE
AN EXPLOSION WHICH MAY RESULT
IN DEATH AND/OR SERIOUS INJURY
AND PROPERTY DAMAGE.
BE CERTAIN ALL MATERIALS ENTERING
MOLTEN METAL ARE COMPLETELY DRY
AND FREE OF ALL MOISTURE.
PRE-HEAT IF NECESSARY.

DO NOT REMOVE THIS SIGN

PLEASE NOTE THE ABOVE WARNING PLATE IS ATTACHED
TO EVERY AUTOCLEAN ROTARY DEGASSING SYSTEM.

BE CERTAIN THAT ALL EMPLOYEES WHO OPERATE THIS
EQUIPMENT HAVE READ AND UNDERSTAND THIS
IMPORTANT SAFETY INFORMATION.

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INTRODUCTION

The "Autoclean Electric Shuttle" Rotary Degassing System for aluminum alloys was designed by Thermtronix® specifically as a durable, continuous duty, cost effective cleaning system for degassing aluminum alloys in aluminum melting and holding furnaces with precise, repeatable quality results. Autoclean Electric Shuttle is designed for use with inert gases (nitrogen or argon) to assure environmentally safe working conditions while providing consistently high-quality aluminum.

Autoclean utilizes a foundry proven method of spin degassing in which either a "dry" argon or nitrogen gas is passed through a heavy wall machined graphite shaft, factory protected with a non-wetting coating to assure long life. A unique edge-cut rotor shears the gas and evenly disperses it at the bottom of the molten aluminum bath. These miniature gas bubbles present an increased surface area through which dissolved hydrogen in the molten aluminum is absorbed as they slowly rise to the surface.

You will find that this instruction and service manual goes into much greater detail than is required for routine operation and maintenance. Experience has shown that plant operating and maintenance personnel can obtain a good working knowledge of an Autoclean System in just a few hours, and your Thermtronix® representative will be able to assist you by telephone, or in person, if required, to answer any questions you may have and assure that you have a thorough understanding of the Autoclean Electric Shuttle Rotary Degassing System.

SECTION I - INSPECTION AND SET-UP

- A. Carefully inspect all parts of shipment for any possible damage which may have occurred in transit. Any visible signs of damage to the outside of shipment should be noted on the bill of lading and acknowledged by the carriers driver or representative. Any concealed damage discovered during unpacking should be reported immediately to the freight carrier.

- B. Move the crate to an area near the installation site and carefully remove all packing material. It is suggested that the crate and packing materials be retained until after installation is complete and your Autoclean System is operating to assure that no parts have been accidentally discarded with these materials.

- C. Every Autoclean Electric Shuttle Rotary Degassing System is held to the highest quality standards throughout each step of the manufacturing process and system tested after final assembly prior to shipment. However, we suggest the following steps not only as a "double check" of our own high quality standards but also as an aid to familiarize you with the system operating characteristics and maintenance procedures.

- D. Remove the right side access panel (Ref. Item #2 Dwg #ES3603-1) and inspect the following items:
- I. Check for proper tension on drive belt.
 - II. Confirm that both drive shaft pillow block bearings have been properly greased.
 - III. Check that the Anti-Vortex board (Item # 10 Dwg #ES3603-2) is securely clamped in place but is not over tightened.
 - IV. Check that all internal lines and mounting brackets are tight and secure. The access panel should be left off and reinstalled after the graphite degassing shaft has been installed prior to operation.
- E. Remove the shuttle access panel (Item #5 Dwg #ES3603-1) and inspect the interior for any foreign object damage.
- F. Check that all internal lines and mounting brackets are tight and secure.

SECTION II - TESTING PRIOR TO OPERATION

- A. The Autoclean Electric Shuttle is electrically operated and comes equipped with a grounded three pronged service cord. The service cord is short to prevent damage from cuts, abrasions, and tangling. The Autoclean Electric Shuttle should only be used with a three (3) wire power extension cord having a minimum wire size of 14 gauge. Long extension cords should be constructed with a heavier wire gauge size. All switches should be in the "Off" position before applying power.
- B. The standard Autoclean Electric Shuttle comes with two (2) inert gas connection points (Item 4A & 4B Dwg #ES 3603-1). The two (2) inert gas connection points are internally connected. Extreme caution should be exercised when operating the shut-off valves without a hose or pipe plug attached to the valve.

Note: Valve handles are lockable to prevent accidental opening or closure of valve.

The Autoclean Electric Shuttle is capable of carrying two (2) compressed-gas cylinders of varying sizes. Although the unit was designed to carry two (2) compressed-gas cylinders at once, it will safely carry one (1) cylinder.

! C A U T I O N !

A customer supplied regulator is required. DO NOT connect any compressed-gas cylinder directly to the inert gas inlet.

Serious damage and/or personal injury may result.

Inert gas needs to be plumbed to the inert gas inlet at a working pressure of 35 to 45 PSI. (241 to 310 kPa)

- C. Two flow meters are factory installed and connected in parallel for regulation of the inert gas flow. The upper meter is the idle adjustment, calibrated from 0 to 10 SCFH, (0 to 280 l/hr) and the lower meter the flow adjustment, which is calibrated from 0 to 60 SCFH. (0-1700 l/hr)

Verify that all switches are in the "Off" position. Connect the Autoclean Electric Shuttle to the appropriate power source. Verify the inert gas supply is on and regulated to the correct pressure.

- D. The degassing assembly is raised and lowered electro-hydraulically. Raising and lowering of the assembly is performed with the push buttons on the control panel. Check the cable carrier on the side of the shuttle for any obstructions or damage before raising or lowering the degassing assembly.

NOTE:

Both the "Up" and the "Down" button are functional if the Autoclean Electric Shuttle cart is plugged in. Both of the buttons will also terminate a degassing session should the degasser be on when the "Up" or "Down" buttons are pressed. The degassing system is reset by turning the Degassing Timer to the full off position and then back to the desired time setting.

Check for obstructions above and below the degassing assembly and test both the "Up" and "Down" buttons.

- E. Disconnect the power from the Autoclean Electric Shuttle. Inspect the drive in the Degassing Assembly. Make certain it is free to rotate and is clear of any foreign objects. Re-connect the power source to the Autoclean Electric Shuttle and inspect the Degassing Timer on the control panel.

The Degassing Timer is a durable industrial timer. As with all industrial-mechanical timers, the timer knob should not be forced beyond it's mechanical stops. The timer is capable of up to 1 hour of run time if the knob is turned clockwise to the desired time setting. The timer may be placed into a non-timed mode by turning the knob counter-clockwise where it will stay indefinitely. To turn the degassing system off, turn the timer knob to the off position.

The degassing system drive line incorporates a solid-state control system that allows for an infinitely variable speed select-able by the user within a range of 200 to 500 rpm. The rotor speed of the degassing system is adjusted by turning the "Rotor Speed" knob on the control console to the desired rpm.

Test the degassing system by first turning the "Rotor Speed" knob fully counter-clockwise to the lowest available rotor speed. Start the drive line by turning the timer knob past the 10 minute mark and then back to a position halfway between "Off" and 10 minutes. The drive line should stop rotating after about five (5) minutes. After the rotation stops, remove power from the shuttle.

- F. Attach the edge-cut graphite rotor to the graphite degassing shaft with the power disconnected from Autoclean Electric Shuttle. Hold the drive shaft in one hand while threading degassing shaft fully onto drive shaft. Reinstall access cover plate on the degassing assembly.
- G. Do not operate the degassing assembly while the edge-cut graphite rotor is in free air. Equipment damage or personal injury may result from contact with the spinning elements of the degassing assembly.

- H. Measure the overall length of the degassing shaft from the bottom of the Autoclean Degassing frame to the end of the edge-cut rotor. Be certain that when the Autoclean Degassing Assembly is placed in the normal operating position above the top of the furnace that the edge-cut rotor does not contact the bottom of the crucible or cast refractory furnace floor whichever applies to your application. For best results the bottom of the rotor should be no closer than three (3) inches (8 cm) and no further away than twelve (12) inches (30 cm) from the bottom of the crucible or cast refractory furnace floor whichever applies to your application.
- I. You are now ready to begin normal degassing operations.

SECTION III - NORMAL DEGASSING OPERATION

- A. The degassing time required for a particular aluminum melt will vary greatly depending on many factors such as type of alloy, temperature, size of melt, type and quality of inert gas, volume of gas, speed of rotor, level of degassing required, etc. The settings suggested in this manual are based on tests conducted with a 1000 Lb (450 kg) melt of alloy A356, a dry nitrogen gas, a pouring temperature of 1400 F (760 C), a rotor speed of 300 rpm, and a degassing time of twelve minutes.
- B. As noted on the Autoclean warning plate, "CAUTION - EXPLOSION HAZARD", care must be taken that the graphite degassing shaft and rotor are completely dry and free of any moisture bearing substance. It is suggested that the shaft and rotor be "preheated" by simply positioning the Autoclean System over the furnace with the rotor 2 inches (5 cm) above the molten aluminum bath for ten to fifteen minutes. This action not only reduces the chance of accidental metal splatter, but also increases the useful life of the degassing shaft and rotor by eliminating sudden thermal shock.
- C. Verify the position of the dry and preheated degassing shaft and rotor. Engage the foot lock to prevent unintentional movement of the Autoclean Electric Shuttle System.

- D. Connect and turn on the inert gas source. Check for a regulated pressure of 35 to 45 PSI (241-310 kPa). Make sure electrical power is properly applied to the service cord. If the access panel to the shuttle is not off then remove it at this time. Turn on the "Inert Gas" switch. Adjust the upper flow meter to a setting between 6 and 8 SCFH (170 and 225 l/hr). Adjust the lower flow meter to 30 SCFH (850 l/hr), or as required. Shut off the "Inert Gas" switch. The flow meters are now set. They only require periodic inspection for verification of flow rates.
- E. With the Inert Gas switch in the "On" position, lower the Degassing Assembly making certain the shaft is in the center of the melt. A slight bubbling action should be observed due to the idle adjustment of the inert gas.

When the Degassing frame is positioned above the melt and the edge-cut graphite rotor is in its desired location; set the "Degassing Timer" knob to the desired degassing time on the timer. With proper eye protection the action on the surface of the aluminum melt can be observed. Adjust the lower flow meter as required.

- F. It is suggested that samples of each aluminum melt be taken before and after degassing until firm procedures are established for your particular melting operation inspection.

- G. Reliable and relatively simple gas level testing can be easily accomplished with the integral "RATS" System (Reduced Atmosphere Testing System) by Thermtronix. A 4 to 5 ounce (110 to 140 grams) aluminum sample is taken from the melt and immediately placed in the "RATS" test chamber. The system quickly obtains a predetermined reduced atmosphere of 26 to 28 inches of mercury (660 to 710 mmHg). The sample can be viewed through the acrylic sight port during solidification to observe the "bubbling" or "shrinkage" of the sample, giving the first indication of gas content.

A more thorough evaluation can now be made by taking the solidified sample, cutting it in half and polishing the cut surface. Hydrogen gas levels and the resulting porosity, under reduced atmosphere solidification, can normally be seen by the naked eye on the polished surface and reliable, consistent, comparative checks can be easily made.

- H. When degassing action is complete make certain the inert gas switch is in the "On" position. Raise the degassing assembly by pressing the "Up" button until the bottom of the edge-cut rotor will clear all obstacles. Switch off the inert gas switch. Disengage foot-lock to allow shuttle to move freely.
- I. When the Autoclean Electric Shuttle System has been removed from the work area and the Degassing Assembly lowered to a safe height then power can be removed from the service cord. Place the Autoclean Electric Shuttle in a safe area where it can not be damaged and where personnel will not come in contact with the hot shaft and rotor.

SECTION IV - MAINTENANCE AND TROUBLE SHOOTING

- A. Daily inspections should be made of all external hoses and wires. The service cord should be checked for frayed or cracked insulation. The hose and wire in the cable carrier should be inspected for wear. The cable carrier should be inspected for damage. The hoses supplying inert gas to the cart should also be inspected.
- B. The hydraulics should be inspected for proper operation and leaks. The mast should be inspected for its mechanical condition and for foreign objects.
- C. The general condition of the Autoclean System, degassing shaft and rotor should be inspected prior to each use.
- D. Every 30 days or 100 operations, whichever event occurs first, remove the right side Degassing Assembly access panel and inspect the condition and adjustment of the drive belt, rotating gas union, and gear motor. Grease both drive shaft pillow block bearings. Check all mechanical connections and replace access panel.

REPLACEMENT PARTS LIST

<u>DESCRIPTION</u>	<u>PART NUMBER</u>	<u>QTY</u>
Gear Motor	310-0003	1
Rotating Gas Union	310-0021	1
Steel Drive Shaft	310-0013	1
Drive Shaft Pulley	310-0035	1
Motor Drive Pulley	310-0041	1
V-Belt	310-8600	1
Pillow Block Bearing	805-0001	2
Flow Meter (0-10)	310-0051	1
Flow Meter (0-60)	310-0052	1
Graphite Degassing Shaft	022-(length in inches)	1
Edge-Cut Rotor	021-0007	1

AUTOCLEAN ELECTRIC SHUTTLE DEGASSING SYSTEM

INTEGRAL RATS

**REDUCED ATMOSPHERE
TESTING SYSTEM**

INSTRUCTION & SERVICE MANUAL

SAFETY FIRST

CAUTION – EXPLOSION HAZARD

THE PLACEMENT OF WET, DAMP, OR
MOISTURE BEARING MATERIALS
INTO MOLTEN METAL WILL CAUSE
AN EXPLOSION WHICH MAY RESULT
IN DEATH AND/OR SERIOUS INJURY
AND PROPERTY DAMAGE.

BE CERTAIN ALL MATERIALS ENTERING
MOLTEN METAL ARE COMPLETELY DRY
AND FREE OF ALL MOISTURE.
PRE-HEAT IF NECESSARY.

DO NOT REMOVE THIS SIGN

PLEASE NOTE THE ABOVE WARNING PLATE IS ATTACHED
TO EVERY REDUCED ATMOSPHERE TESTING SYSTEM.

BE CERTAIN THAT ALL EMPLOYEES WHO OPERATE THIS
EQUIPMENT HAVE READ AND UNDERSTAND THIS
IMPORTANT SAFETY INFORMATION.

SECTION VI - INTRODUCTION

The "RATS" Reduced Atmosphere Testing System for aluminum alloys was designed by Thermtronix specifically as a compact, portable, low cost quality control system for testing hydrogen gas levels in aluminum alloys. With the RATS unit integral with the Autoclean Degassing System, you have the best available quality control system available for the aluminum casting industry.

The RATS porosity tester allows for a simple, consistent, highly accurate, automatically timed seven minute test that can be performed AT THE FURNACE by shop personnel BEFORE THE METAL IS CAST assuring consistent quality levels.

You will find that this instruction and service manual goes into much greater detail than is required for routine operation and maintenance. Experience has shown that plant operating and maintenance personnel can obtain a good working knowledge of a RATS System with just a few operations and your Thermtronix representative will be able to assist you by telephone, or in person if required, to answer any questions you may have and insure that you have a thorough understanding of the RATS Reduced Atmosphere Testing System.

SECTION VII - INSPECTION AND SET-UP

- A. Carefully inspect all parts of shipment for any possible damage which may have occurred in transit. Any visible signs of damage to the outside of shipment should be noted and acknowledged by the carriers driver or representative. Any concealed damage discovered during unpacking should be reported immediately to the freight carrier.
- B. Move the shipping carton to an area where you can carefully remove all packing material. It is suggested that the carton and packing materials be retained until after your Autoclean Electric Shuttle Degassing System complete with integral RATS is operating to assure that no parts have been accidentally discarded with these materials.
- C. The following parts are packaged and shipped with each RATS Reduced Atmosphere Testing System as part of the Autoclean Shuttle System:
 - a. One (1) factory assembled and tested RATS unit integral with the Autoclean Electric Shuttle Degassing System.
 - b. One (1) aluminum vacuum test chamber with acrylic view port and o-ring.
 - c. Two (2) steel crucibles.
 - d. Two (2) high temperature insulating disks.
 - e. One (1) instruction & service manual.
- D. Every RATS Reduced Atmosphere Testing System is held to the highest quality standards throughout each step of the manufacturing process and system tested after final assembly prior to shipment. However, we suggest you follow the steps Section II "Testing Prior to Operation" not only as a double check of our own high quality standards but also as an aid to familiarize you with the system operating characteristics and maintenance procedures.

SECTION VIII - TESTING PRIOR TO OPERATION

- A. Make certain that both the aluminum base plate, on top of the Autoclean Electric Shuttle cart console, and the o-ring at the bottom of the vacuum test chamber are clean and free of any foreign matter. This is necessary to assure a good chamber seal and proper vacuum for consistent test results.
- B. Your RATS unit was supplied with two (2) high temperature insulating disks. Place one (1) of these disks in the 3" diameter recess of the aluminum base plate. The second insulating disk is a spare.
- C. Two (2) steel crucibles were supplied with your RATS unit. Place one (1) steel crucible on top of the aluminum base plate in the center of the insulating disk.
- D. Remove the shuttle access panel. Make sure the adjusting valve (inside the Autoclean Electric Shuttle cart on the side of the RATS vacuum motor) is fully clockwise (completely shut off) and place the vacuum test chamber on the aluminum base plate making certain the chamber is centered on the base plate.
- E. Plug your Autoclean Electric Shuttle Degassing System unit into a single phase 50/60Hz 120 volt* electrical outlet. While placing a slight pressure on the acrylic view port on top of the vacuum test chamber to form a seal, turn the mechanical timer to approximately seven (7) minutes.

* **NOTE:** Autoclean Electric Shuttle Degassing Systems are available in 120 and 240 volt configurations. Check the electrical specification plate on the side of the Electric Shuttle Cart to verify the proper operation voltage.

F Observe the vacuum gauge. Your RATS unit should pull approximately 28.5 inches of mercury in less than 15 seconds.

NOTE: This is a "sea level" measurement and will be slightly lower at higher altitudes.

G. The adjusting valve may now be set for the desired vacuum level, typical is 28" for sand castings and 26" for permanent molds, and locked in place. Whatever vacuum level you choose, locking the valve in place is an important step to assure consistent and repeatable test results.

SECTION IX - NORMAL OPERATION

- A. First, as noted on the Autoclean Electric Shuttle control console warning plate, "CAUTION - EXPLOSION HAZARD", care must be taken that the steel crucible is completely dry and free of any moisture bearing substance. It is suggested that the steel crucible be carefully preheated before entering the molten aluminum bath. Many customers prefer to coat the steel crucible with a ladle wash to aid in the release of the sample.
- B. Move your Autoclean Electric Shuttle cart to an uncluttered location as close as practical to the furnace from which samples are to be taken. This is necessary to assure the molten aluminum sample is tested before it begins to solidify.
- C. After preheating, dip the steel crucible into the molten aluminum bath filling to approximately 1/8 inch below the lip. While exercising general foundry safety practices not to spill the molten metal immediately place the steel crucible with molten aluminum on the center of the high temperature insulating disk.
- D. Place the vacuum test chamber over the sample and set the RATS timer for seven (7) minutes, while holding a slight pressure on top of the chamber to assure a good seal .

- E. If desired you may observe the sample solidifying through the acrylic view port. If gas levels are extremely high the sample will be seen "bubbling" as gas escapes to the surface. A slight shrink on top of the sample is an indication of a lower and more acceptable gas level.
- F. When the timer runs out in seven (7) minutes press the vacuum release button, above the degassing rotor speed control knob to release the vacuum test chamber. Carefully remove the hot sample from the steel crucible. The sample may be chilled in water to facilitate cooling if desired.

CAUTION: The sample may cause hot water to "spit". Due caution must be exercised to prevent scalding drops of water from contact with skin.

- G. When the sample can be safely handled have it cut in half, observing good safety practices, and sand one half on a belt sander to observe the hydrogen porosity levels as shown on bulletin number 403 (copy attached).

SECTION X - MAINTENANCE AND TROUBLE SHOOTING

- A. **DO NOT** attempt to restart motor under a partial vacuum.
This action may cause permanent motor damage. Always be certain to completely release vacuum before starting motor.
- B. Daily inspections should be made of the vacuum test chamber o-ring as well as all exposed fittings and filters to assure a good seal and proper vacuum.
- C. Observe that the acrylic site port is properly sealed to the vacuum test chamber and has not been damaged by overheating.
- D. Inspect the electrical cord, confirm that it is in good condition and not frayed or burnt.
- E. See parts list in rear of this manual for a complete listing of factory authorized replacement parts.

SECTION XI - REPLACEMENT PARTS LIST

<u>DESCRIPTION</u>	<u>PART NUMBER</u>	<u>QTY</u>
Steel Crucible	400-0001	2
High Temperature Insulating Disk	400-0002	2
Vacuum Test Chamber O-Ring	400-0003	1
Acrylic Site Port	400-0004	1
Vacuum Test Chamber	400-0021	1
Vacuum Base Plate	400-0022	1
Vacuum Gauge	400-0005	1
Vacuum Adjusting Valve	400-0006	1
Vacuum Quick Release Valve	400-0007	2
Vacuum Inlet Filter Port	400-0008	1
Mechanical Timer Assembly	400-0009	1
Vacuum Pump / Motor Assembly	400-0012	1
Exhaust Muffler	400-0013	1
Vacuum Tubing	400-0015	N/A

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
NC	ENGINEERING RELEASE	05/15/00	JD
A	REVISE PER ECO #188	11/17/00	JD

CAUTION

A CUSTOMER SUPPLIED REGULATOR IS REQUIRED. DO NOT CONNECT ANY COMPRESSED-GAS CYLINDER DIRECTLY TO THE INLET GAS INLET. SERIOUS DAMAGE AND/OR PERSONNAL INJURY MAY RESULT.

THERMTRONIX®

34" [863mm] LONG SHAFT

NITROGEN/ARGON
SUPPLIED BY CUSTOMER

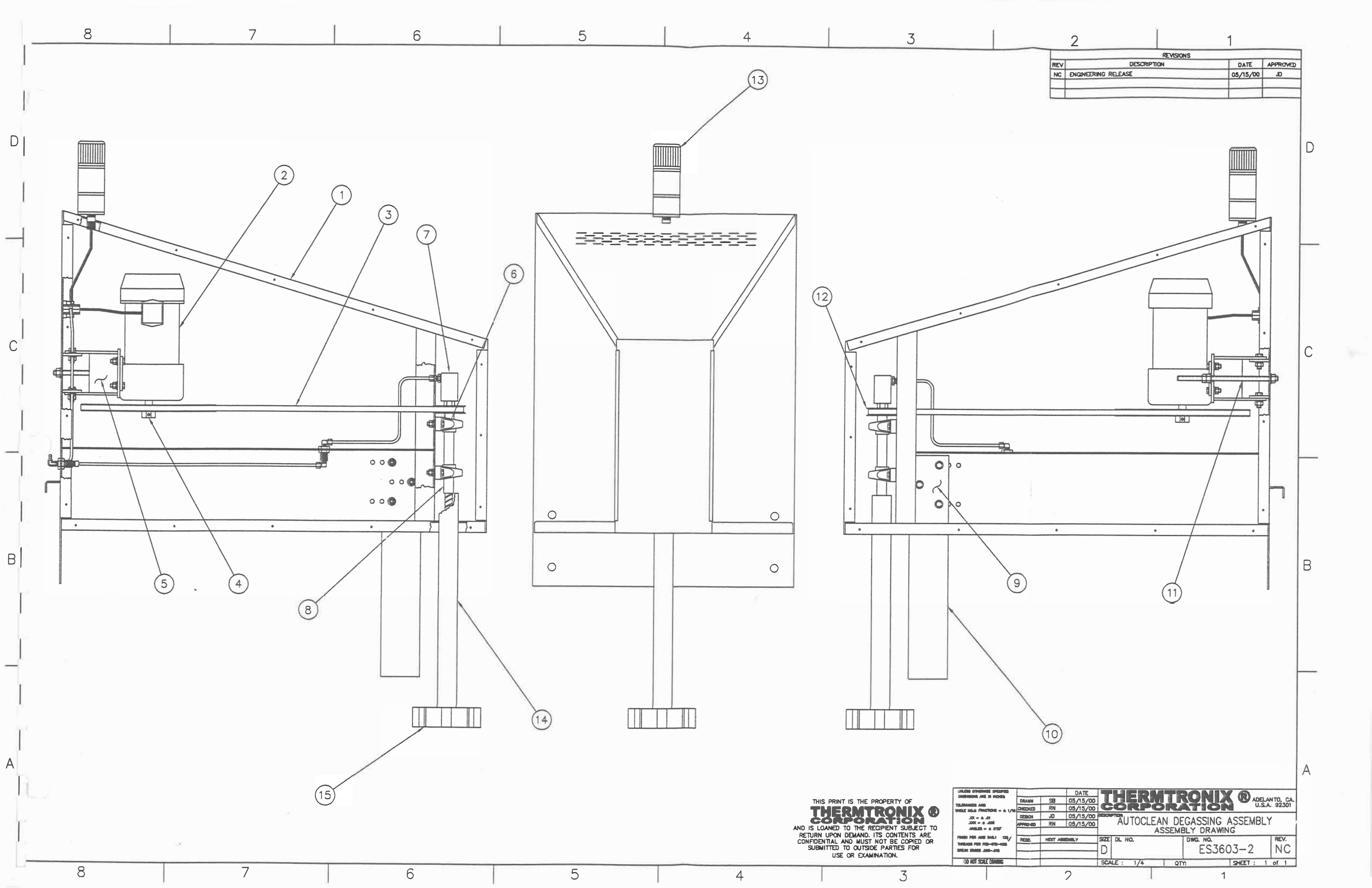
REGULATOR SUPPLIED
BY CUSTOMER

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AUTOCLEAN™
ELECTRIC SHUTTLE

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TOLERANCES AND HOLE SIZE FRACTIONS = ± 1/16	DRAWN SB	05/15/00	CHECKED RN	05/15/00	DESCRIPTION
XX = ± .01	DESIGN JD	05/15/00	APPROVED RN	05/15/00	AUTOCLEAN ELECTRIC SHUTTLE
.XXX = ± .005	REV. NEXT ASSEMBLY	SIZE	DL NO.	DWG. NO.	REV.
FINISH PER ANSI B46.1 125/ BREAK PER FED-STD-45B BREAK EDGES .005-.015		D		ES3603-1	A
DO NOT SCALE DIMENSIONS	SCALE : 5/32	QTY:	SHEET 1	of 1	



REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
NC	ENGINEERING RELEASE	05/15/00	JD

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