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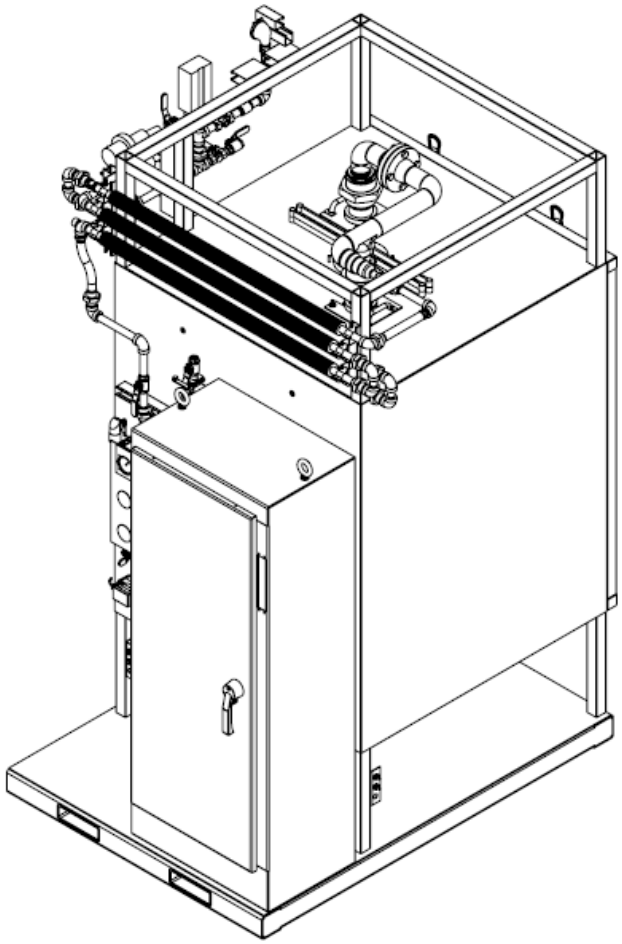
D.A.GEN™
AMMONIA DISSOCIATOR
WITH REACTIONCORE™ TECHNOLOGY

INSTALLATION AND OPERATION MANUAL



Phone: 414-331-2457
Fax: 414-332-2457

419 West Boden Street
Milwaukee, Wisconsin 53207

E-Mail: support@atmoseng.com
Web: www.atmoseng.com

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Phone: 414-331-2457
Fax: 414-332-2457
419 West Boden Street
Milwaukee, Wisconsin 53221
E-Mail: sales@atmoseng.com
Web: www.atmoseng.com

1.1 NOTICE, CAUTIONS, AND WARNINGS

NOTICE

This Bulletin contains important safety information and should be read and understood by all individuals who install, operate, or service this equipment.

Failure to follow the precautions and recommendations of this manual may subject personnel and property to dangerous conditions.

TECHNICAL ASSISTANCE

Contact Atmosphere Engineering with all questions or concerns regarding the installation, operation, and setup of the D.A.Gen™ generator or the EndoInjector™ mixing system.

Atmosphere Engineering Company
419 West Boden Street
Milwaukee, Wisconsin 53207
United States of America

Phone: 414-331-2457
Fax: 414-332-2457
E-Mail: support@atmoseng.com

1.2 EXPRESS WARRANTY ON ATMOSPHERE ENGINEERING EQUIPMENT

ATMOSPHERE ENGINEERING COMPANY (AEC) warrants products for a period of one (1) year from the date of shipment from AEC to the original purchaser to be free from defects in material and workmanship under normal recommended use, service, inspection, and maintenance. Normal recommended use, service, inspection, and maintenance, mean:

1. Not to be used in excess of nor below the rated capacity, pressure, and temperature ranges specified in the applicable quotation, purchase order, acknowledgment, marketing literature, nameplate, specification sheet, or the Installation, Operation, Inspection, and Maintenance Manual (THE MANUAL); and

2. Using only clean gases free of solids and other contaminants not considered constituents of the gas; and

3. Installation, operation, inspection, and maintenance in compliance with THE MANUAL; and

4. The AEC products being used only in:

    a. Ambient environments lower than 132 °Fahrenheit (54 °Celsius) unless specifically designed and so labeled by AEC for higher temperatures; and
    b. Non-corrosive environments; and
    c. Completely protected from moisture, rain, snow, or other outside environments; and
    d. Not to be used below 32 °Fahrenheit (0 °Celsius) unless precautions are taken for low temperature conditions as shown in THE MANUAL.

5. Being used only for applications permitted by THE MANUAL or other AEC literature or special applications approved in a separate written authorization by AEC.

WARRANTY EXCEPTIONS

This Warranty does not apply to damage caused by any or all of the following circumstances or conditions:

1. Freight damage;

2. Parts, accessories, materials, or components not obtained from nor approved in writing by AEC;

3. Any consequential or incidental damages including but not limited to loss of use, loss of profits, loss of sales, increased costs, arising from the use of any product system or other goods or services manufactured, sold, or provided by AEC;

4. Misapplication, misuse, and failure to follow THE MANUAL or other literature, instructions, or bulletins (including drawings) published or distributed prior to THE MANUAL.

The exclusive remedy under this Warranty or any other express warranty is the repair or replacement without charge for labor and materials of any AEC parts found upon examination by AEC to have been defective. Since certain AEC equipment is heavy, bulky and not deliverable by U.S. mail or other parcel service, AEC equipment may be returned only upon written consent of AEC and then only to the location designated by AEC. Generally such consent will be given only upon the condition that the customer assume and prepay all carrier charges and responsibility for damage in transit.

Purchasers of AEC products, equipment, goods, or services waive subrogation on all items covered under their own or any other insurance.

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Phone: 414-331-2457
Fax: 414-332-2457
419 West Boden Street
Milwaukee, Wisconsin 53221
E-Mail: sales@atmoseng.com
Web: www.atmoseng.com

EXPRESS WARRANTY ON ATMOSPHERE ENGINEERING EQUIPMENT

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DISCLAIMER

THIS WARRANTY IS EXCLUSIVE. AEC EXPRESSLY DISCLAIMS ANY AND ALL OTHER WARRANTIES WHETHER EXPRESS OR IMPLIED INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY PURPOSE.

No person, including dealer, seller, or other representative of AEC is authorized to make, on behalf of AEC, any representations beyond those contained in AEC literature and documents or to assume for AEC any obligations or duties not contained in this Warranty and Warranty Policy.

AEC reserves the right to make design and other changes, modifications or improvements to products, services, literature, or systems, without any obligation, to furnish or install same on any previously sold or delivered products or systems.

LIMITATION OF LIABILITY

It is expressly agreed that the liability of AEC is limited and AEC does not function as an insurer. The purchaser and/or user agree that AEC is not liable for loss, harm, or damage due directly or indirectly to any occurrence or consequences there from. If AEC should be found liable to anyone on any theory (except any express warranty where the remedy is set forth in Section 2 of this Warranty and Warranty Policy) for loss harm or damage, the liability of AEC shall be limited to the lesser of the actual loss, harm or damage or the purchase price of the involved AEC equipment or service when sold (or when service performed) by AEC to customer. This liability is exclusive and regardless of cause or origin resulting directly or indirectly to any person or property from:

1. The performance or nonperformance of any obligations set forth in this Warranty and Warranty Policy;
2. Any agreement including specifications between AEC and the customer;
3. Negligence, active, passive or otherwise of AEC or any of agents or employees;
4. Breach of any judicially imposed warranty or covenant of workmanship, durability or performance; and
5. Misrepresentation (under the Restatement, common law or otherwise) and/or strict liability involvement;
6. Liability for fraud-in-the-inducement.

WARRANTY FIELD SERVICE

If Warranty Field Service is rendered at the request of the purchaser or user and the difficulty is found not to be with AEC's product, the purchaser shall pay the time and expense (at the prevailing rate at the time of the service) of AEC's field representative(s). Charges for service, labor, and other expenses that have been incurred by the purchaser, customer, or agent without written approval of AEC will not be accepted. The OEM or other reseller is responsible for transmitting installation and operating instructions, THE MANUAL or other service literature supplied by AEC with the equipment.

(END OF WARRANTY TEXT)

Phone: 414-331-2457
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1.3 GENERATOR DESCRIPTION

D.A.Gen™ Ammonia Dissociator
The D.A.Gen™ is designed to produce dissociated ammonia $(N_2 + 3H_2)$ by cracking anhydrous ammonia $(2NH_3)$ in the presence of a catalyst at elevated temperatures for use in atmosphere heat treatment furnaces. The system uses ReactionCore™ technology which is designed to greatly improve the efficiency of the reaction and significantly reduce the amount of heating energy required. The heating chambers employ silicon carbide heating elements which are controlled by an SCR controller. In addition they are insulated with ceramic fiber modules to minimize heat loss and speed up heating time.

Temperature Control
The integrated temperature control logic of the D.A.Gen™ will monitor a single temperature zone or multiple temperature zones and provide an output (relay or signal) that can be used to accurately control the temperature of the generator. The thermocouples required to monitor and control the temperature have already been installed on the system.

Pressure Control
The outlet pressure of the generator is controlled by a regulator located at the inlet of incoming ammonia gas. This device monitors the pressure of the dissociated ammonia after it has cooled and has been set to maintain a constant pressure based on this point of sense.

Paperless Chart Recorder
The D.A.Gen™ integrates a full-color touch-screen paperless chart recorder to monitor all critical process variables of an ammonia dissociator. The data and backup files are stored and maintained on the touch-screen in an encrypted format for a period of 5+ years. The data can be exported to CSV format for easy review within a spreadsheet application (i.e. MS Excel or similar).

Custom Designed System
The D.A.Gen™ is a precision gas generation system that is assembled, calibrated, and fully tested to perform to the exact requirements of the consumer. The system is not designed to be interchangeable with any other generator without written approval of the new generator application from Atmosphere Engineering.

Ammonia Dissociation Quality Control Monitoring
The D.A.Gen™ generator has been equipped with an additional Hydrogen sensor with appropriate alarming to ensure the dissociation quality at all times.

Phone: 414-331-2457
Fax: 414-332-2457
419 West Boden Street
Milwaukee, Wisconsin 53221
E-Mail: sales@atmoseng.com
Web: www.atmoseng.com

1.4 SYSTEM SPECIFICATIONS

Gas Supply
Required Gas Supply ..... 175CFH of Anhydrous Ammonia @ 10PSIG
Maximum Gas Supply Pressure Limit ..... 10 psig maximum

Electrical Power
Voltage 440VAC/50Hz
Amperage 50A

Dissociated Ammonia Production
Maximum Capability ..... 350CFH of Dissociated Ammonia @ 20"wcg
(Minimum Gas Production) ..... 70CFH of Dissociated Ammonia

Ambient Condition Limits
Ambient Temperature Limits ..... 50°F to 130°F
Humidity ..... Non-Water Condensing Conditions
System is designed to be installed inside a controlled industrial environment. The system is not designed to be used outside.

Ventilation Requirements
Dissociated Ammonia Burnoff Vent ..... 200,000 btu/hr (maximum)
Ventilation systems shall be designed to meet facility, local, state, and federal codes regarding the safe ventilation of combustion products including CO2, CO, Water Vapor.

1.5 MODBUS COMMUNICATION

Standard communication between the HMI and the control system is handled via ModbusTCP/IP (Ethernet) as required. Additional communications ports are available but can vary by type depending on the control system specified when ordering and provided with the system. A modbus register address list and other communication details are provided as an attachment to this manual. Contact Atmosphere Engineering support team with any questions regarding communication setup of this device.

CAUTION: REMOTE CONNECTION CONSIDERATIONS
Connection of industrial equipment to a remote network opens the system to security and safety vulnerabilities. Access to any industrial equipment over a network must be strictly controlled so that only those trained in the operation of the equipment can modify parameter values within the system. Further, precautions should be integrated to prevent parameters from being modified accidentally and set to values outside of safe ranges.

1.6 DATA STORAGE

The HMI touchscreen includes a minimum of 7GB of unused internal hard drive space. The daily encrypted log files are contained within the AEC log directory and a backup file is located in a backup directory. The combined daily file size will consume approximately 300KB per day. Therefore, the actual capacity of the hard drive will be able to maintain over 60 years of log data. However, due to memory life considerations the process log data integrity should be considered maintained locally at the machine for a period of 5+ years. Of course, the actual data may last longer and can be backed up remotely for an indefinite period.

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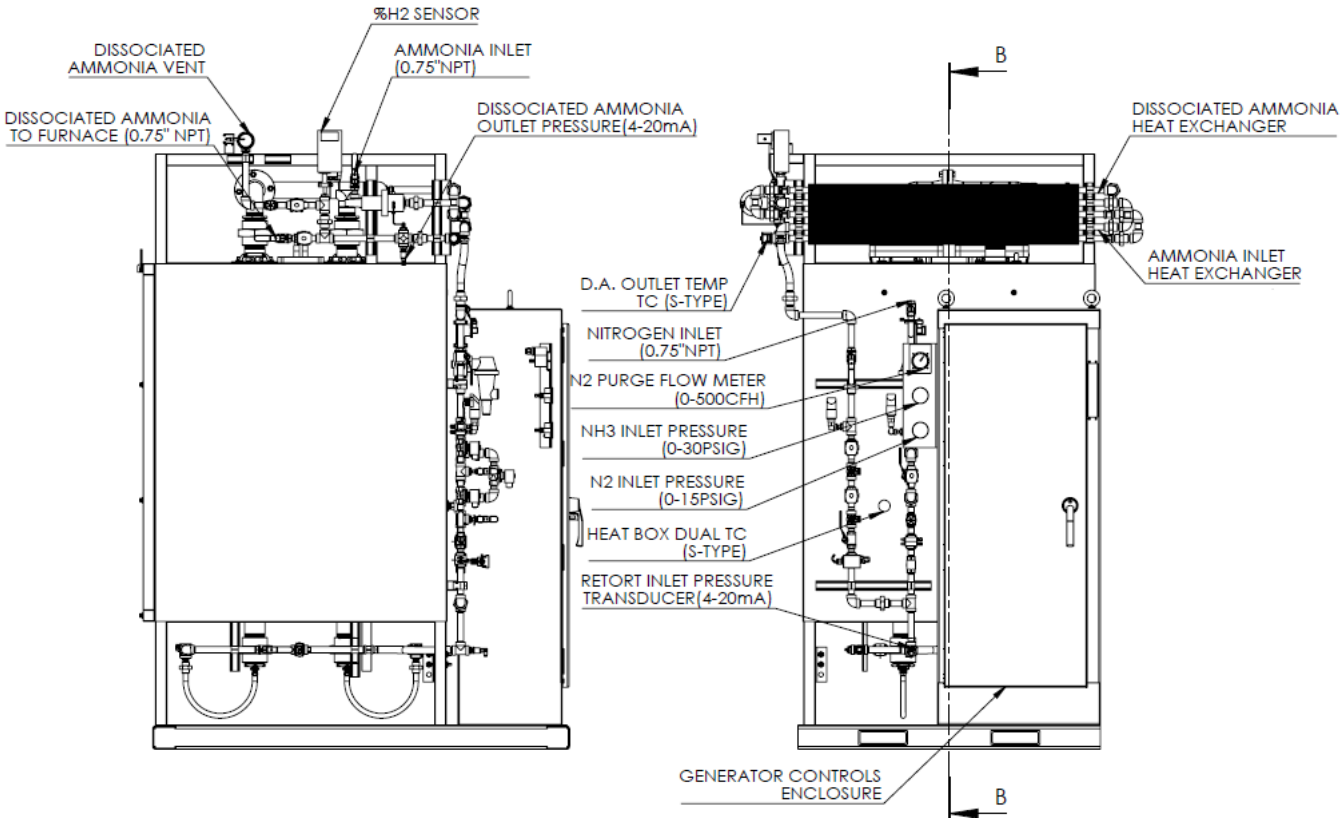
1.7 CRITICAL COMPONENT OVERVIEW

The following is a schematic detailing critical components. Refer to the electrical and mechanical assembly diagrams and material list attached to this manual and ensure that each item detailed in the attached drawing is accounted for and has not experienced physical damage during shipment prior to proceeding with the installation.



Phone: 414-331-2457
Fax: 414-332-2457
419 West Boden Street
Milwaukee, Wisconsin 53221
E-Mail: sales@atmoseng.com
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2.0 GENERATOR INSTALLATION

2.1 INSTALLATION NOTICE

Only qualified personnel experienced with ammonia dissociator operation and safety requirements shall perform installation. It should be noted that additional mechanical components and interlocks may be required within the facility other than those supplied with the unit to ensure it is safe and meets NFPA 86 (or similar) guidelines.

The D.A.Gen™ is a robust industrial device. However, some precision measurement components may be susceptible to damage from severe shock, and care should be taken to handle the generator during the installation process. The system was not designed to safely support personnel and should not be used as a step or a support as this could damage components on the system and may cause injury.

2.2 MECHANICAL INSTALLATION

Installation Procedure (Refer to mechanical assembly and pipeline diagram attached to manual for proper installation)

1. Inspect the generator for any damaged or missing components and confirm each component detailed in the "Critical Component Review" section of this manual is accounted for based on the configuration provided.

2. Select a location where the generator will be located in the facility. The generator should be mounted level and should be reasonably insulated from shock, vibration, and any direct radiant heat sources. Make note of the following locations on the generator and consider the best location for the generator to accommodate access to proper piping and ventilation of the following locations:
    a. NH3/N2 Supply Inlets
    b. Dissociated Ammonia Outlet Valve
    c. Dissociated Ammonia Vent Burn-off (Exhaust Requirement)
    d. ReactionCore™ Door Access (Maintenance Access)

3. Attach the ammonia gas supply pipeline to the generator main gas supply inlet valve. The gas supply must be pressure regulated to a **minimum of 10 psig** and a **maximum of 20 psig**. Refer to the generator pipeline diagram (D-6249) for more detailed information on system pressure requirements.

4. Attach the dissociated ammonia outlet valve to an appropriately sized pipeline header supplying atmosphere heat treatment furnaces.

5. Install properly sized and temperature rated ventilation hoods over dissociated ammonia vent burn-off locations.

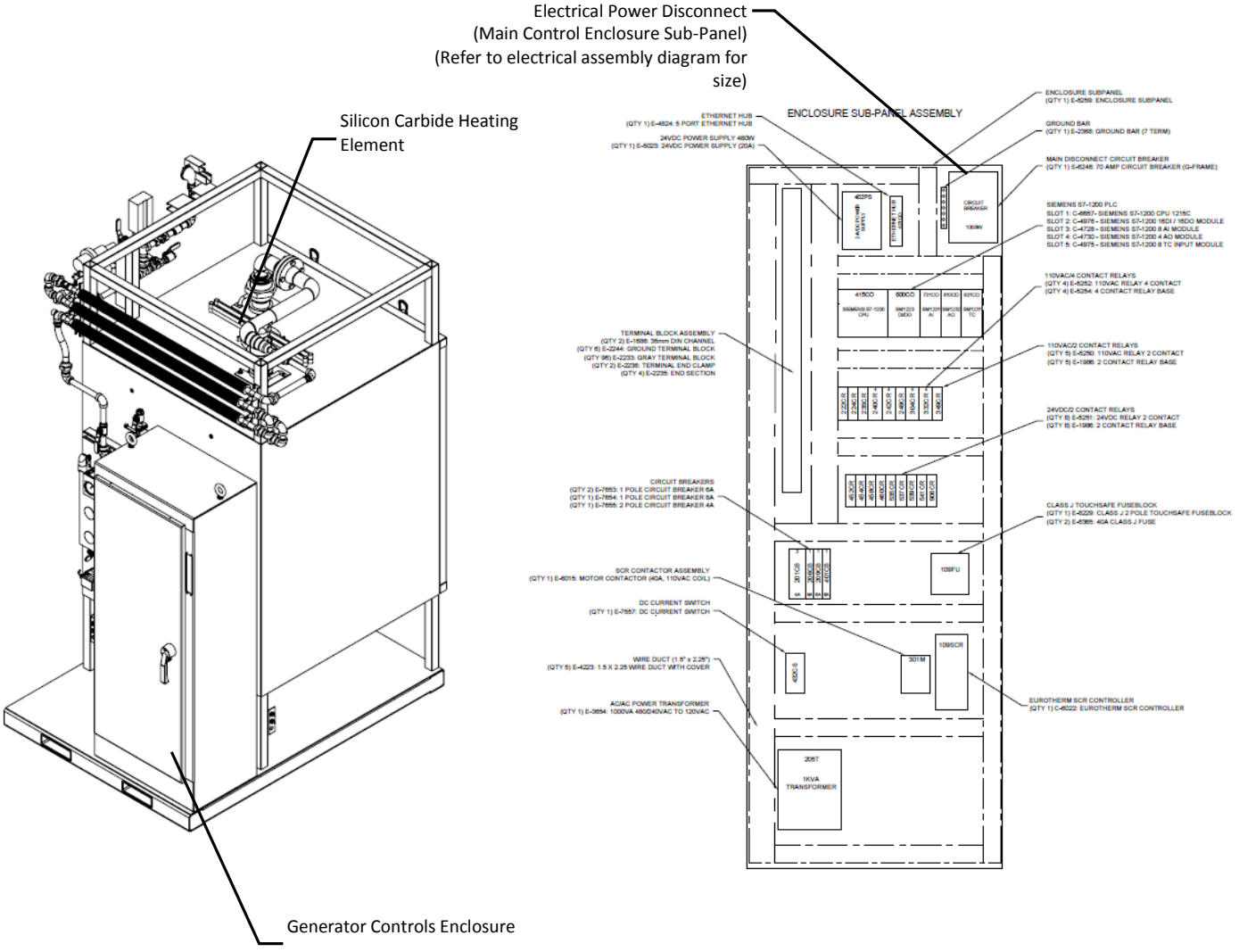
Phone: 414-331-2457
Fax: 414-332-2457
419 West Boden Street
Milwaukee, Wisconsin 53221
E-Mail: sales@atmoseng.com
Web: www.atmoseng.com

2.3 ELECTRICAL INSTALLATION

Only a qualified electrician experienced with ammonia dissociator operation and current safety requirements shall perform a D.A.Gen™ generator installation. Proper safe electrical interlocks must be designed to meet safe generator operation based on NFPA86 guidelines. If necessary, installation supervision and direction of turnkey installation services are available from Atmosphere Engineering or an AEC certified installation professional. Installation Procedure (Refer to electrical assembly and pipeline diagram attached to manual for additional information):

1. Thoroughly review the system wiring. The D.A.Gen™ should arrive with most wires self-contained and tested from AEC, however due to shipping limitations, the generator may be shipped as separate pieces. Any loose wires will be labeled according to the wiring diagram. Verify all wiring connections before continuing installation.

2. Connect main power from a facility supplied lockable disconnect to the main disconnect located in the generator control enclosure. The facility disconnect should be clearly labeled and located reasonably close to the generator. Care should be taken to avoid heat sources and exhaust ventilation locations when mounting electrical conduit. It is important to review the electrical assembly diagram and ensure properly sized electrical wire and disconnect is provided to the generator.



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3.0 HMI OPERATION

This generator is equipped with AEC's ACTIVE proprietary controls package. The ACTIVE PLC and ACTIVE HMI give the user easy access to the unit's primary functions by allowing important process parameters to be changed at the push of a button.

COMMUNICATION STATUS

The tip of the logo at the top right of the screen will blink green when communication is established between the HMI and the controller. If the tip is blinking RED then this is an indication that there is no communication link between the HMI and the controller. During startup it may take 5-10 seconds to establish communications however, a prolonged disconnect may be the sign of a communications setup problem or a wiring problem.

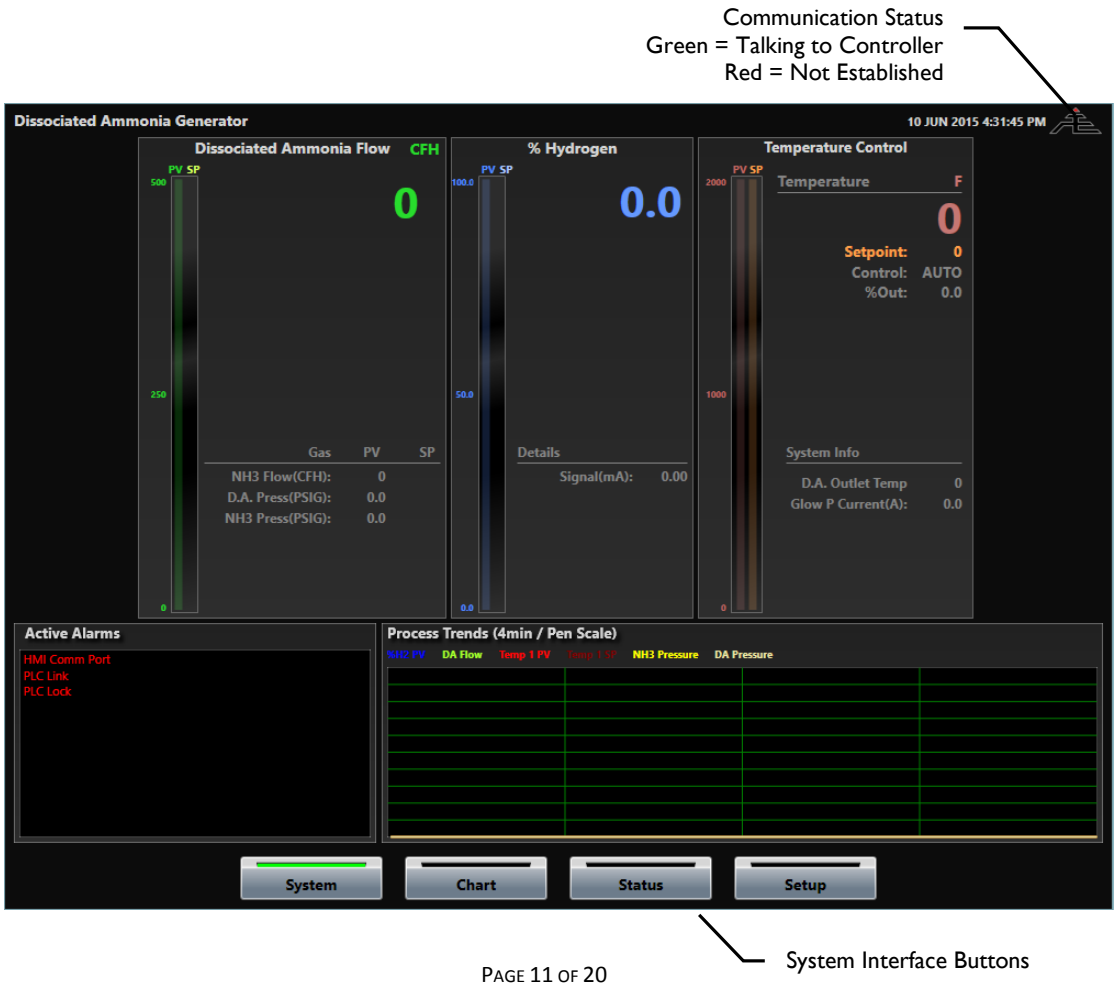
SYSTEM NAVIGATION BUTTONS

System Button
The "System" button is used to display the main generator process control values screen.

Chart Button
The "Chart" button is used to access the paperless chart recorder.

Status Button
The "Status" button is used to view active system alarms and communications status.

Setup Button
The "Setup" button is used to access the system setup screen. It should be noted that all system parameters are password protected with 3 levels of security to ensure accidental parameter changes cannot occur unless the user is logged in.



Phone: 414-331-2457
Fax: 414-332-2457
419 West Boden Street
Milwaukee, Wisconsin 53221
E-Mail: sales@atmoseng.com
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3.1 PROCESS SCREEN OVERVIEW

FLOW CONTROL PANEL

The flow control panel provides detailed information regarding the system flow operation. Note: The bar graph scales are dependent on the pen scales defined within the paperless chart recorder and can be changed using the "edit pen" button on the history screen.

Dissociated Ammonia Flow is the current volumetric flow rate (in CFH) of Dissociated Ammonia at the outlet of the generator. This value is calculated based on the inlet Ammonia flow determined by the flow sensor located on the incoming ammonia line and is not able to be directly changed by the user.

NH3 Flow is the amount of Ammonia flow in the system before dissociation. This value is determined by the flow sensor located on the incoming Ammonia line and is not able to be directly changes by the user. NH3 Flow is used to calculate Dissociated Ammonia Flow.

D.A. Pressure (PSIG) is a scaled value from an analog input (4-20mA) coming from a pressure transducer located at the outlet of the generator. This value is not able to be directly changed by the user and is displayed only to allow easy verification of the outlet pressure of the generator.

NH3 Pressure (PSIG) is a scaled value from an analog input (4-20mA) coming from a pressure transducer located at the inlet of the retort header. This value is not able to be directly changed by the user and is displayed only to allow easy verification of the retort inlet pressure of the generator.

% HYDROGEN PANEL

This panel allows the user to easily view the reaction quality of the dissociated ammonia. Hydrogen percentage will be displayed in a simple 0-100% scale both numerically and on the bar graph. Note: The bar graph scales are dependent on the pen scales defined within the paperless chart recorder and can be changed using the "edit pen" button on the history screen. The signal (4-20mA) can also be viewed on this panel to ensure the proper operation of the hydrogen sensor located on the outlet side of the generator.

REACTIONCORE™ CONTROL PANEL(S)

The ReactionCore™ control panel provides detailed information regarding the various system temperatures. Note: The bar graph scales are dependent on the pen scales defined within the paperless chart recorder and can be changed using the "edit pen" button on the history screen.

Temperature is the actual temperature within the hot zone of the Ammonia Dissociator. This value is measured by an industrial thermocouple. Note: a value of >3000 means that there is an open loop on the thermocouple input and the thermocouple is either not wired correctly or has failed.

Temperature Setpoint is the desired temperature within the hot zone of an endothermic gas generator. This value is typically set by the generator operator to a value of 1700degF or 1750degF for normal generator operation.

%Output value represents the PID control output signal used to control the temperature of the generator. The actual output can be either a time proportional (relay type) control or a 4-20mA control signal. If the temperature is lower than the temperature setpoint then the %output will increase. The increase in %output will result in the temperature control relay being energized "more often" and also result in the 4-20mA signal to increase in current.

D.A. Outlet Temp is the actual temperature of the dissociated ammonia after the gas has passed through the heat exchanger. This value is measured by an industrial thermocouple. Note: a value of >3000 means that there is an open loop on the thermocouple input and the thermocouple is either not wired correctly or has failed.

Glow P(lug) Current is the current draw (A) of the glow plug measured by the current transducer located in the electrical cabinet.

Phone: 414-331-2457
Fax: 414-332-2457
419 West Boden Street
Milwaukee, Wisconsin 53221
E-Mail: sales@atmoseng.com
Web: www.atmoseng.com

PROCESS SCREEN OVERVIEW *(CONTINUED)*

PROCESS CONTROL TREND PANEL

The process control trend panel is updated every second to display actual control characteristics of the generator that might not be seen on the one minute storage interval of the historical log found in the paperless chart recorder. The trend panel is not the same as the paperless chart recorder in that all the data is updated much more quickly (1 second intervals) and the trend data is not stored longer than 4 minutes. The primary function of the trend panel is to provide real time feedback of system operation to better tune and confirm minimal control oscillations during system operation.

> **Trend Panel Setup**: Double tapping on the trend title will display the trend pen selection menu. Select a value to display for each pen and close the setup screen. Changes are immediate. Note: The trend pen scaling and color is dependent on the setup for those values within the paperless chart recorder and can be changed using the "edit pen" button on the chart screen.

ACTIVE ALARM PANEL

The active alarm panel displays all currently active alarms in RED. Detailed alarm status and alarm history can be found in the "Status" screen that will be displayed by pressing the "Status" button at the bottom of the screen.

3.2 Setup Screen Overview

The setup panel organizes all setup parameters into specific groups. These groups are accessed using the "Parameter Group" buttons located at the top of the setup screen. It should be noted that all parameters are password protected to provide "READ ONLY" access to control parameters. It is not possible to change system parameter setting if not logged into the system.

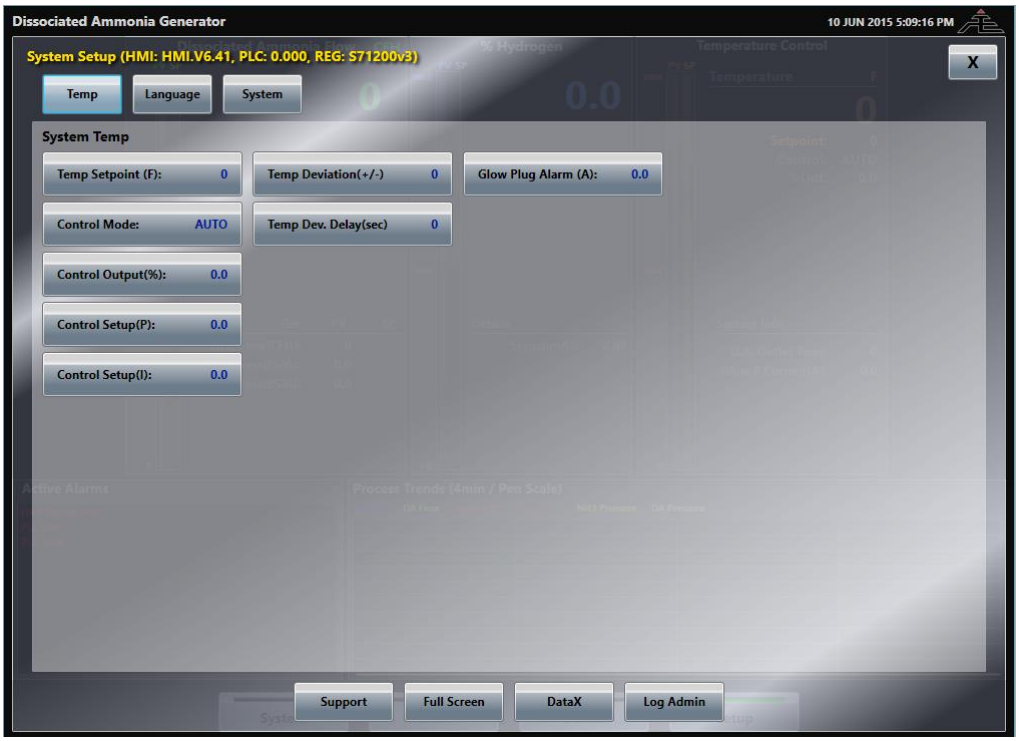
Login Permissions

The HMI V6 software provides 3 levels of access to the system configuration setup screen.

USER LEVEL (Default = 2): Provides access to standard system set points and tuning variables.

ADMINISTRATION LEVEL (Default = 22): Provides access to critical control parameters and alarm setpoint variables.

ENGINEER LEVEL (Contact AEC): Provides access to Modbus mapping and controller setup functions.



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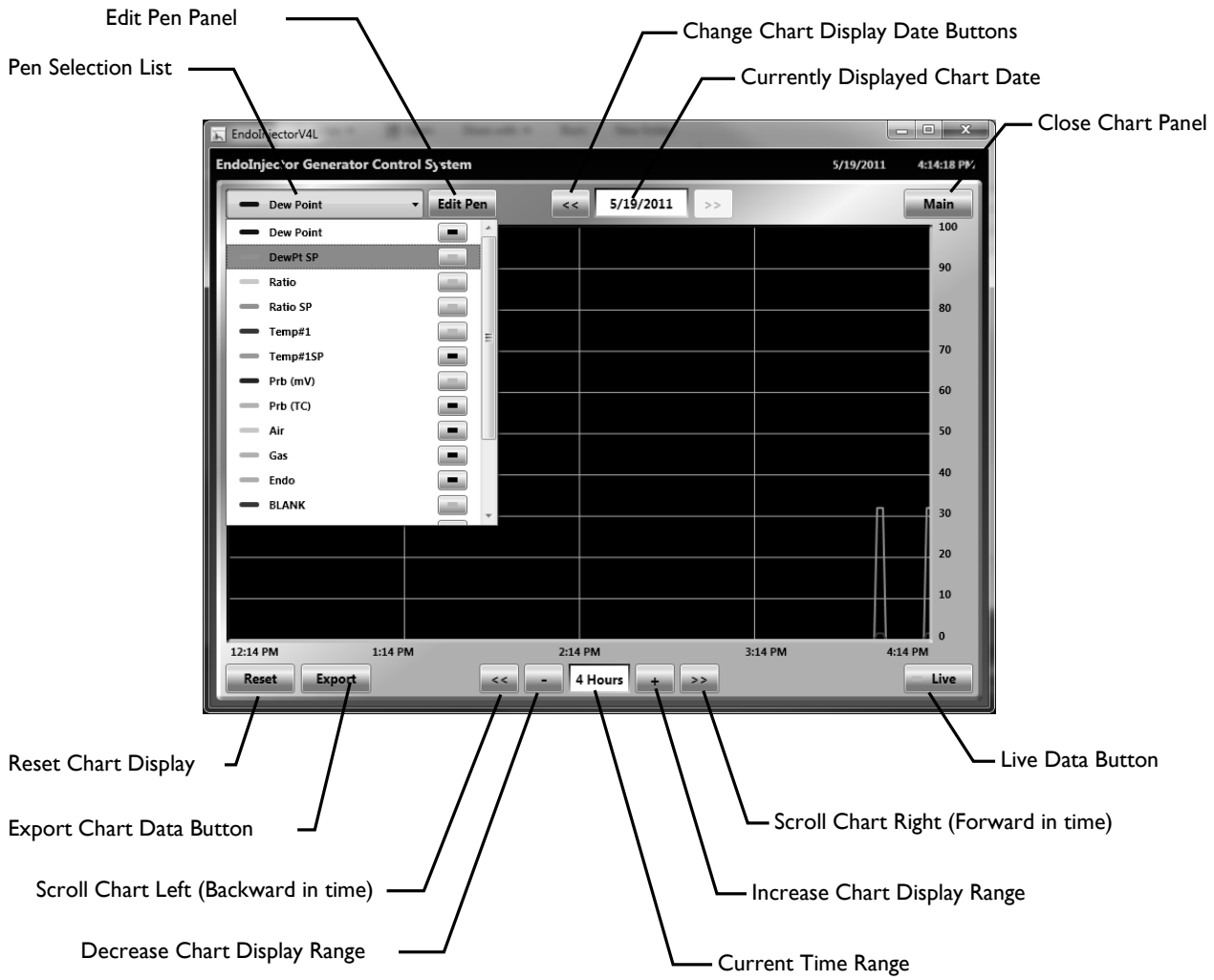
3.3 PAPERLESS CHART RECORDER

Pressing the "History" button on the main screen opens the generator paperless chart recorder. The paperless chart recorder displays the long term historical data for all generator process variables. Data is stored once every minute on the touch-screen hard drive in daily encrypted log files that can be exported to CSV files that can be opened in any spreadsheet program (i.e. MS Excel) for detailed investigation and reporting if required. The generator performance data will never overwrite old data since the hard drive space provides 50+ years worth of daily storage space. However, for tacking purposes, the data should only be considered archived for 5+ years on the touch screen unless backed up to a remotely maintained data storage center.

PAPERLESS CHART RECORDER OVERVIEW



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Fax: 414-332-2457
419 West Boden Street
Milwaukee, Wisconsin 53221
E-Mail: sales@atmoseng.com
Web: www.atmoseng.com

3.3 PAPERLESS CHART RECORDER

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PEN SELECTION LIST

The pen selection list provides a list of all pens available to display, the current pen color for each variable, and a button to display or hide the pen on the chart. Also, selecting a pen will update the scale values on the right of the chart to display the selected pen's scale settings. Each pen is drawn based on their own minimum and maximum scale range. The scale range for each pen can be changed by first selecting that pen in the Pen Selection List and then pressing the "Edit Pen" button. Note: The actual data values are stored regardless of pen scale or display settings.

Edit Pen Button

The edit pen button opens a panel that provides a way to edit the minimum display scale range, maximum display scale range, and pen color selection. Note that each pen is drawn based to it's own scale however, actual data stored is not affected by these settings.

Currently Displayed Chart Date

The log data is separated into daily log files. The log file that is currently being displayed is shown in the currently displayed chart date at the top of the chart.

Change Chart Display Date Buttons

The change chart display date buttons are located on either side of the current chart date at the top of the chart screen. Pressing these buttons will increase or decrease the current display date by one day.

Current Time Range

The current time range is found at the bottom of the chart display and represents the amount of time currently displayed from the left to the right on the chart. The default is to display 4 hours of data at a time but this can be increased to an entire day or decreased to just 15 minutes.

Increase / Decrease Chart Display Range Buttons (+ / -)

The increase and decrease chart display buttons will change the time range of data to display on the chart. Basically, these buttons provide a way to zoom in and out of the data in time. The limit is to increase the range to view an entire day of data or decrease the range to view just 15minutes of data.

Scroll Chart Right / Left (<< / >>)

The scroll chart buttons provide the means to pan the chart through time. Each press of either of these buttons will scroll the chart by 2 vertical gridlines (1/2 of the time range displayed).

Live Data Button

The live data button indicates and provides a way to turn the chart display on or off so that it automatically updates while viewing the data. When the live button is "on" then the chart will update and scroll automatically from right to left as new data is written to the log file.

Reset Chart Display

The reset chart display will reset the current display date to "today" and the current time range to 4 hours.

Export Data Button

The export data button opens a save dialog window to export the currently displayed daily data to a csv file. Attach a USB storage device to one of the USB ports on the back of the touch-screen then navigate and save the csv file to the storage device so that it can be transferred to another computer for review.

Phone: 414-331-2457
Fax: 414-332-2457
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3.4 ALARM STATUS SCREEN

Pressing the "Status" button on the main screen opens the alarm status screen that indicates current system alarm status. The visibility of some alarms depends on what alarms are enabled on the system and available on the controller installed. The lists of alarms will turn green, yellow, or red depending on status of the alarm being described.

Red = Active alarm that has not been acknowledged
Yellow = Active alarm that has been acknowledged
Green = Alarm is OK
Black = Alarm status is Unknown due to communication failure

Communication Alarm Status

Communication alarms occur when any failure of the Modbus communication is detected. All other alarms will remain "Black" until all communication alarms are resolved as OK.

HMI Comm Port

An HMI Comm Port alarm occurs when the com port selected in the setup screen is not actually found on the HMI touch screen. Also, if the communication port of Ethernet is selected then a port alarm will occur when the IP address the HMI is trying to reach to communicate with the ratio controller is not found.

PLC Link

A PLC Link Alarm will occur when communication between the HMI and the PLC cannot be established or has an error.

PLC Lock

A PLC Lock Alarm will occur when a valid PLC Unlock is not detected. Contact AEC for further assistance.

Process Gas Alarm Status

NH3 Flow Sensor Signal

Indication that the signal from the flow sensor, located on the main NH3 line, is OK.

Glow Plug

Indication that the current to the glow plug, located at the vent outlet of the generator, is OK.

Phone: 414-331-2457
Fax: 414-332-2457
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NH3 Low Pressure
Indication that the gas pressure in the main NH3 line is above the low setpoint.

NH3 High Pressure
Indication that the gas pressure in the main NH3 line is below the high setpoint.

N2 Gas Low Pressure
Indication that the gas pressure in the main N2 line is above the low setpoint.

N2 Gas High Pressure
Indication that the gas pressure in the main N2 line is below the high setpoint.

N2 Gas Inlet Valve
Indication of the N2 Inlet Valve positon. (Green = OPEN, RED = CLOSED)

Process Alarm Status

Over Temperature
Indication that the generator hot zone temperature is above the 2000F high limit setpoint.

Process Low Temp
Indication that the generator hot zone temperature is below the 1400F low limit setpoint.

Process Temp Deviation
Indication that the generator hot zone temperature is greater or less than the temperature deviation setpoint.

H2 Sensor Signal
Indication that the H2 Sensor signal, located at the outlet of the generator, is OK.

4.0 Generator Operating Procedures

The D.A.Gen™ Dissociated Ammonia Generator is fitted with the latest technology to provide feedback to the operator regarding all critical system variables. Review the HMI Software Overview section of this manual and navigate through the different screens to become familiar with where critical information and alarm history will be located prior to operating the generator. Refer to the pipeline diagram for additional help locating any components detailed in the procedures below.

4.1 Generator Startup Procedure

1. Heat Up the Generator to Operating Temperature (1700 - 1800degF)
   a. Turn on the main power disconnect.
   b. Silence and acknowledge any alarm horn that has occurred during the power up sequence.
   c. Press the “Reset” button on the Temperature Limit Controller(s)
   d. Turn Heat Enable switch on front of enclosure to Enable.
   e. Using the HMI, set the desired temperature set point for each module.
      [Note: if this is from a “cold” state, it is recommended to set the initial temperature set point to 1000degF and allow to reach and soak at this temperature for 30 minutes before raising to the desired operating temperature (1700degF)]
   f. Wait for the temperature to reach the desired operating temperature (1700-1800degF).

2. Start Dissociated Ammonia Gas
   a. Correct any active critical alarms on the status screen.
   b. Ensure the temperature of the ReactionCore™ module is at operating temperature (1700-1800degF) and that the “System Ready” light on the front of the panel is lit.
   c. Make sure that the “Generator Control” switch is in the “Vent” position. The system will allow the user to start the generator in “Furnace” position, however it is highly recommended that start-up always be done in the “Vent” positon.
   d. Hit the green “Process Start” button located on the front of the panel to begin introducing Ammonia into the generator.
   e. Monitor the %H2 from the HMI Screen until a value of ~75% is reached. This is an indication that all of the Ammonia has cracked.
   f. When the furnaces are ready for Dissociated Ammonia, turn the Generator Control switch to the Furnace position to open the solenoid to the furnaces. The vent position solenoid should close automatically.

Phone: 414-331-2457 | 419 West Boden Street | E-Mail: sales@atmoseng.com
Fax: 414-332-2457 | Milwaukee, Wisconsin 53221 | Web: www.atmoseng.com

4.2 Generator Shutdown Procedure

1. Stop Making Endothermic Gas
    a. Turn the Generator Control switch to the Vent positon.
    b. Press the "Process Stop" button to stop producing Dissociated Ammonia Gas

2. Turn off the Heat
    a. Turn the Heat Enable switch to the Off position. This will immediately cut power from the SCR and heating elements. [Note: The temperature can be gradually turned down to extend the life of the silicon carbide heating elements before cutting power off entirely.]
    b. It is now safe to turn off the main power disconnect for the generator.

5.0 Maintenance

The D.A.Gen™ Dissociated Ammonia Generator is fitted with many sensors and alarm messages to help troubleshoot most generator issues and is designed to be as easy to maintain as possible.

5.1 Catalyst Change (Frequency: Annually)

Each ReactionCore™ is comprised of four (2) 70" long retort tubes.
Each retort tube contains 11.5" of allumdum balls for pre-heating at the bottom of the retort
On top of the alumdum balls, is 46" of 11/16" cube nickel/alumina catalyst.

IMPORTANT: The generator must be cold (ambient) temperature before attempting to remove or change the catalyst. Changing the catalyst while the generator is hot can result in personnel injury and/or property damage. It should also be noted that inside of the heat box should be inspected after changing a retort tube to ensure that no insulation has fallen out of place during the following procedure. Any insulation that has shifted or moved should be replaced before the generator is brought back online.

1. Removal of Spent Catalyst
    a. Place large container or box under retort to be emptied
    b. Loosen Union at bottom of retort using pipe wrench
    c. When union is separated, the catalyst and alumdum balls will fall out of the retort.
    (If the catalyst is stuck it may be necessary to tap on the retort with a rubber mallet, however, care should be taken not to damage the retort using excessive force. In addition, it is possible to remove the header at the top of the retort and force a steel bar down the retort to loosen any debris stuck in the retort.)

2. Filling Retort with New Catalyst (Charging the Catalyst)
    a. Replace and tighten the union located at the bottom of the retort that has been emptied
    b. Remove the header above the retort that has been emptied of catalyst.
    c. Pour 11.5" of alumdum balls into the retort. Use a tape measure to confirm fill level.
    d. Pour 46" of high quality nickel/alumina catalyst into the retort. Use a tape measure to confirm fill level.
    e. Replace and tighten the header above the retort and secure header to endo "ring" using flange bolts and high temperature gasket.

5.2 Retort Replacement

1. Removal of a damaged retort
    a. Empty all catalyst from the retort to be changed (refer to "removal of spent catalyst" section)
    b. Disconnect the outlet header from the heat exchanger by cracking the union located on the braided hose.
    c. Remove the header above the retort to be changed by disassembling the flange between retort 1 and 2 and cracking the union above the retort that is to be removed.
    d. Remove the pipe collar that is holding the retort and remove the metal plate that it was resting on.
    e. Lift the retort out the top of the generator. (Each retort weighs approximately 80 lbs)

2. Installing Replacement Retort
    a. Drop the new retort down through the empty retort location
    b. Replace the metal plate around the retort and tighten the pipe collar.
    c. Tighten the Union located at the bottom of the retort.
    d. Fill the retort with alumdum balls and catalyst (refer to "Filling Retort with New Catalyst" section)
    e. Replace and tighten the header above the retort and secure using flange bolts and high temperature gasket.
    f. Reconnect the heat exchanger to the outlet of the header and ensure that all unions and connecting points are sufficiently tightened.

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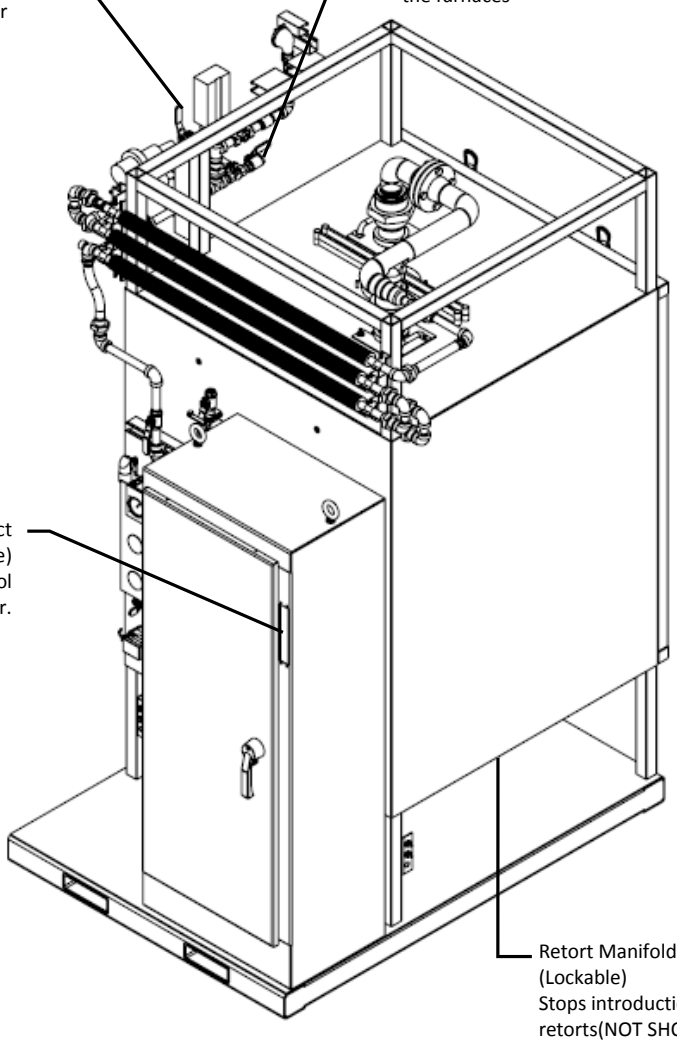
Fax: 414-332-2457 | Milwaukee, Wisconsin 53221 | Web: www.atmoseng.com

5.3 Critical Safety Lockout Locations

The D.A.Gen™ is designed with lock out valves and power disconnects to provide safe "lockout / tagout" procedures. The following are some critical lockout components and their locations on the generator.



Phone: 414-331-2457
Fax: 414-332-2457
419 West Boden Street
Milwaukee, Wisconsin 53221
E-Mail: sales@atmoseng.com
Web: www.atmoseng.com

6.0 Additional Documentation

The following important documents have been included with your system. It is recommended that each one of these be stored in a folder and placed in the pocket located in the electrical enclosure for easy access and reference.

6.1 Mechanical Documents

- A-6249-R1 (GEN-2015-4222-6) Ammonia Dissociator – 350CFH
- D-6249-R3 350 CFH D.A. Generator Pipeline Diagram(SO#4222)

6.2 Electrical Documents

- A-8227-R1 Lindberg DA Generator (350CFH) Electrical Assemby

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Milwaukee, Wisconsin 53221
E-Mail: sales@atmoseng.com
Web: www.atmoseng.com