

SECTION 11486

DIGESTER GAS SAFETY AND CONTROL EQUIPMENT

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install gas safety and control equipment as specified herein and shown on the Drawings.
- B. Equipment shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions.
- C. The Contractor shall be responsible for coordinating work in this Section with related work specified elsewhere in this Contract so as to provide all assemblies, hardware, appurtenances, transition pieces and accessories for a complete and fully functional installation.

1.02 DESIGN AND OPERATING CONDITIONS

- A. Digester gas safety and control equipment shall be designed for digester gas service with saturated gas composed of approximately 65% methane and 35% carbon dioxide having a heating value between 550 and 650 Btu per cubic foot, temperature between 90°F and 100°F, and a specific gravity of approximately 0.80-0.90.
- B. Free air capacity, where specified herein, shall be based on atmosphere air at a pressure of 14.7 psia (1 atmosphere) and a temperature of 60° F (15.6°C).
- C. Gas control systems shall include all safety devices specified, indicated on the Drawings, or otherwise required to ensure continuous protection against fire, explosion and gas hazard.

1.03 SUBMITTALS

- A. The following items shall be submitted with the Shop Drawings in accordance with, or in addition to the submittal requirements specified in Section 01300, Submittals; and Section 11000, Equipment General Provisions:
 - 1. Complete design data and pressure drop information for each size and type of gas safety and control accessory provided.
 - 2. Design and manufacturing certification documentation, to substantiate compliance with the specifications

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. Gas safety and control equipment shall be as manufactured by Varec Biogas of Cypress, California.
- B. The Equipment Manufacturer shall certify to not less than ten (10) years of experience in the application, design, and manufacture of sludge digester gas safety and control equipment for use in wastewater treatment plants and shall submit a list of not less than twenty-five (25) operating installations as evidence of meeting the experience requirement.
- C. All materials and equipment covered in this section, except insulation and field paint shall be furnished by, or through, a single manufacturer who shall be responsible for the design, coordination, and satisfactory performance of all components.
- D. The materials covered by these Specifications are intended to be standard equipment of proven reliability and as manufactured by reputable manufacturers having experience in the production of such equipment.

2.02 GENERAL

- A. All gas safety and control devices shall be constructed of first quality materials which have strength, wearing, and corrosion resistance characteristics entirely suitable for the types of service for which the individual devices are designated. All gas safety and control equipment provided under this Contract shall be designed and manufactured in accordance with ISO 9001.
- B. All body castings shall be clean, sound, and without defects of any kind. No plugging, welding, or repairing of defects will be allowed.
- C. All bolt heads and nuts shall be hexagonal of American Standard size. The Contractor shall be responsible for coordinating connecting piping. Gas safety and control devices with screwed ends shall be made tight with Teflon tape. Unions are required at all screwed joint valves within a run of pipe.
- D. Unless otherwise specified, all equipment to be installed in piping less than 4 inches shall have NPT connections and equipment installed in piping 4" and larger shall have flanged connections. Unless otherwise specified, flanges shall be flat faced with ANSI B16.1, Class 125 diameter and drilling.

2.03 FLAME ARRESTERS

- A. The Contractor shall provide flame arresters in the gas piping as shown on the Drawings to prevent the passage of flame by means of a removable flame-arresting bank arranged for easy removal for cleaning, inspection and replacement.
- B. Flame arresters shall be Varec Biogas 5000/5010 Series.

- C. Flame arresters shall be provided with Underwriters Laboratory (UL) and/or Factory Mutual (FM) approved elements, or elements of similar design and configuration as elements approved by UL and/or FM for similar service conditions.
- D. Net free area through the bank assembly shall be not less than three times the corresponding size standard pipe. The entire bank assembly shall slide out of the arrester housing to facilitate inspection and cleaning.
- E. The bank assembly shall be filled with corrugated rectangular shaped or spiral wound crimped ribbon flame sheets. The flame sheets shall be arranged to facilitate removal for inspection and cleaning.
- F. Flame arresters for vertical installation shall be self-draining. Flame arresters for horizontal service shall include an offset housing with a 1/2" NPT drip trap connection at the low point.
- G. Housing construction shall be 356-T6 low copper cast aluminum. Bank assembly shall include a low copper aluminum frame and low copper aluminum bank sheets.
- H. Flame arrester shall be leakproof to 10 psig.
- I. Drain piping with drip traps shall be provided from the inverts of all horizontally installed flame arresters which do not completely drain to adjacent piping.
- J. Flame arresters shall be provided in accordance with the following minimum free air capacity (FAC = 60°F at 14.7 psia) and maximum pressure drop requirements.

Size (inches)	Minimum FAC (CFH)	Maximum ΔP (inches w.c.)
4	15,000	2.0
6	30,000	2.0
8	50,000	2.0
10	90,000	2.0
12	120,000	2.0

2.04 CONDENSATE AND SEDIMENT TRAPS

- A. The Contractor shall provide condensate and sediment traps in the gas piping as shown on the Drawings.
- B. Condensate and sediment traps shall be Varec Biogas 233 Series.
- C. Storage capacity shall be a minimum of six gallons sediment and six gallons condensate.
- D. The operating principal for removing sediment from gas shall be centrifugal force developed by a circular motion of gas passing through at high velocities and gravity at low velocities. The inlet elbow shall be specifically designed to swirl the gas inside the reservoir. An internal baffle shall be located at the base of the reservoir to provide efficient separation of entrained droplets.

- E. A 2" NPT blowout connection, a 1" NPT drain connection and two 1/2" NPT connections for sight glass shall be provided. Sight glass (See Paragraph 2.04) shall be provided as part of the condensate and sediment trap assembly and field installed by the Contractor. Removable top cover for interior access with integral 3/4" NPT inspection pipe for sediment level measurement shall be provided.
- F. Construction shall be heavy welded steel. Condensate and sediment traps shall withstand working pressure of 25 psig without leaking.
- G. Condensate and sediment traps shall be provided in accordance with the following minimum free air capacity (FAC = 60°F at 14.7 psia) and maximum pressure drop requirements.

Size (inches)	Minimum FAC (CFH)	Maximum ΔP (inches w.c.)
4	5,000	0.25
6	10,000	0.25
8	20,000	0.25
10	32,000	0.25
12	48,000	0.25

2.05 SIGHT GLASSES

- A. A sight glass assembly shall be provided for each condensate and sediment trap.
- B. The sight glass assembly shall have 1/2" NPT connections and shall be of the correct length to fit the sight glass connections on condensate and sediment traps. Sight tubes shall be 5/8" O.D., with guard rods provided to protect the sight tube. Sight tubes shall be Pyrex. Guard rods shall be brass.
- C. Two isolation valves shall be provided to facilitate removal and cleaning of the sight tube. The lower isolation valve shall include a drain cock for dewatering the sight tube. Isolation valves shall be bronze.
- D. Sight glasses shall be Varec Biogas Series 218.

2.06 LOW PRESSURE DRIP TRAPS

- A. The Contractor shall provide low pressure drip traps at all low points in the gas piping and at all locations in the gas piping as shown on the Drawings.
- B. All drip traps shall be of the manually operated rotating disc type and shall be by Varec Biogas 246 Series. Where noted specifically on the Drawings electrically actuated drip traps shall be installed. The electrically actuated drip trap shall be Varec Biogas 246AT Series.
- C. Escape of gas shall not be possible regardless of the disc position. An air inlet port shall be provided to permit free flow of condensate from the reservoir when draining. All ports shall be O-ring sealed.

- D. The electrically actuated drip trap shall be provided with a NEMA 7 timer controlled electric actuator to allow operation of the drip trap at adjustable time intervals up to 10-hours with adjustable draining cycle times from 1 to 10 minutes. The electrically actuated drip trap shall be provided with a dual switch local control station. The local control station shall be provided in a NEMA 7 or NEMA 4X stainless steel enclosure depending on the electrical classification of the area of installation. The local control station shall include a HAND-AUTO switch and an OPEN/CLOSE switch. When in AUTO mode the actuator shall operate based on the adjustable timer settings. When in the HAND mode the actuator shall respond to the OPEN/CLOSE switch. Indicating lights shall be provided to show drip trap position while in AUTO or HAND mode.
- E. Drip trap storage capacity shall be 2.5 quarts, minimum, except where noted otherwise on the Drawings.
- F. Housing construction shall be 356-T6 low copper cast aluminum body, cover plate, disc and handle. Cover plate and disc shall be anodized. All internal working parts and fasteners shall be Type 304 stainless steel. O-rings shall be neoprene.
- G. Drip traps shall be designed to withstand a working pressure of 5 psig without leaking.

2.07 THERMAL SHUTOFF VALVE

- A. The Contractor shall provide thermal shutoff valves in the gas piping as shown on the Drawings.
- B. Thermal shutoff valves shall be Varec Biogas 430 Series.
- C. Thermal shutoff valves shall include a fusible element designed to close the valve within 15 seconds upon reaching a temperature of 260°F (minimum). The fusible element shall control a spring-loaded pallet. An isolated sight glass shall be provided so that pallet position can be determined without having to remove the valve from service. The fuse plug shall be gas tight and shall be removable for replacement of the fusible element.
- D. Construction shall be 356-T6 low copper cast aluminum body and cover. The inner valve shall include a low copper aluminum pallet assembly with 304 stainless steel compression spring. Sight glass shall be acrylic with neoprene gaskets.
- E. Thermal shutoff valves shall be designed to withstand a working pressure of 5 psig without leaking.
- F. Thermal shutoff valves shall be provided in accordance with the following minimum free air capacity (FAC = 60°F at 14.7 psia) and maximum pressure drop requirements.

Size (inches)	Minimum FAC (CFH)	Maximum ΔP (inches w.c.)
4	7,500	2.0
6	20,000	2.0
8	35,000	2.0
10	60,000	2.0
12	85,000	2.0

2.08 FLAME TRAP ASSEMBLY

- A. The Contractor shall provide a flame trap assembly, consisting of a flame arrester and thermal shutoff valve, in the gas piping as shown on the Drawings.
- B. The flame trap assembly shall be Varec Biogas 450 Series. The thermal shutoff valve and flame arrester components of the flame trap assembly shall be as previously specified.
- C. The flame trap assembly shall be provided in accordance with the following minimum free air capacity (FAC = 60°F at 14.7 psia) and maximum pressure drop requirements.

Size (inches)	Minimum FAC (CFH)	Maximum ΔP (inches w.c.)
4	9,000	3.0
6	20,000	3.0
8	35,000	3.0
10	60,000	3.0
12	90,000	3.0

2.09 FLAME CHECKS

- A. The Contractor shall provide flame checks in the gas piping where required and/or as shown on the Contract Drawings.
- B. Flame checks shall be Varec Biogas 5200 Series.
- C. Housing shall be of pipe union design to permit easy disassembly for cleaning and inspection.
- D. The element shall be replaceable and made of compressed 316 stainless steel woven wire. Housing construction shall be 356-T6 low copper cast aluminum.
- E. Flame checks shall be designed to withstand a working pressure of 25 psig without leaking.

2.10 PRESSURE RELIEF AND FLAME TRAP ASSEMBLIES

- A. The Contractor shall provide pressure relief valve and flame trap assemblies, consisting of a back pressure relief valve and a flame arrester, in the waste gas burner piping as shown on the Drawings. The flame arrester shall be as previously specified.
- B. Pressure relief and flame trap assemblies shall be Varec Biogas 440 Series.
- C. The pressure relief valves shall be controlled by a large spring-loaded diaphragm and shall provide tight shut-off. The pressure relief valves shall maintain a maximum operating pressure within 10% of its process setting. Pressure relief valves requiring disassembly of the diaphragm housing for pressure adjustment shall not be acceptable.

- D. The spring barrel shall include a glass enclosed pointer and scale to indicate setting. A spring adjusting screw shall permit setting adjustments without disassembling the diaphragm housing. Setting range shall be from 2 to 10 inches w.c.
- E. Construction shall be 356-T6 low copper cast aluminum body, diaphragm and spring housings, and diaphragm inner plate. The inner valve shall include a low copper aluminum pallet with 304 stainless steel stems and bushings. The diaphragm shall be molded Buna-N rubber with Nylon reinforcement. Setting spring shall be zinc-plated steel.
- F. The valves shall be designed to withstand a working pressure of 5 psig without leaking.
- G. Pressure relief valves with pressure control and atmospheric vent tubes, per the manufacturer's recommendations, shall be provided by the Contractor. Tubing shall be 1/2" NPT for the pressure control line, and 1/4" for the atmospheric vent line. NPT taps shall be provided in upstream piping for pressure control tubes.
- H. Atmospheric vent tubes shall be terminated with suitable weather caps to prevent precipitation entry. Flame checks shall be provided on all atmospheric vent lines.
- I. The unit shall be provided with a fusible element that will close the valve and interrupt gas supply if the temperature at the element exceeds 260°F.
- J. The pressure relief and flame trap assembly shall be provided in accordance with the following minimum free air capacity (FAC = 60°F at 14.7 psia) and maximum pressure drop requirements.

Size (inches)	Minimum FAC (CFH)	Maximum ΔP (inches w.c.)
4	9,000	3.0
6	20,000	3.0
8	35,000	3.0
10	55,000	3.0
12	85,000	3.0

2.11 LOW PRESSURE CHECK VALVES

- A. The Contractor shall provide check valves in the gas piping as shown on the Drawings.
- B. Check valves shall be Varec Biogas 211 Series.
- C. Check valves shall include a free swing (pendulum) pallet which shall swing closed against the valve seat upon reversal of gas flow. Positive pressure shall force the pallet away from the seat to permit gas flow. The seat ring shall be threaded into the body for easy removal for maintenance and replacement. A removable cover shall be provided for inspection of valve internals.
- D. Construction shall be 356-HT cast aluminum body and cover. The pallet, pallet arm and seat rings shall also be made of low copper aluminum.
- E. The valves shall be designed to withstand a working pressure of 5 psig without leaking.

- F. The low-pressure check valves shall be provided in accordance with the following minimum free air capacity (FAC = 60°F at 14.7 psia) and maximum pressure drop requirements.

Size (inches)	Minimum FAC (CFH)	Maximum ΔP (inches w.c.)
4	8,000	0.75
6	13,000	0.75
8	25,000	0.75
10	50,000	0.75
12	75,000	0.75

2.12 PRESSURE RELIEF VENT

- A. Pressure relief vents shall be provided on the waste gas burner inlet piping as shown on the Drawings and shall relieve explosion flashback in the piping.
- B. The valve shall have a 356-T6 low copper cast aluminum body and Type 316 stainless steel pallet assembly and seating ring, replaceable gastight, PTFE (Teflon®) seat and shall be adjustable up to 12 inches w.c. The pressure relief vent valve shall be of the all-weather type, suitable for installation in an exterior location, with a weather-hood protecting the pallet assembly.
- C. The explosion pressure relief valve shall be Varec Biogas Model 7101B.

2.13 MANOMETERS

- A. Pressure indicating manometers shall be provided at the locations shown on the Drawings.
- B. Manometers shall be of the single tube, well type, with a direct reading scale having a minimum range of 0 to 20 inches w.c.
- C. Each tube and scale shall be enclosed in a metal housing having a glass front cover plate and shall be suitable for wall mounting. Manometers shall be Varec Biogas Model 217.

2.14 PRESSURE RELIEF AND VACUUM BREAKER VALVE

- A. Pressure relief and vacuum breaker valves shall be provided at the locations shown on the Drawings.
- B. The pressure relief and vacuum breaker valves shall be Varec Biogas Model 2011B.
- C. The pressure relief and vacuum breaker valves shall provide both over-pressure and over-vacuum protection for the anaerobic digester. The valve shall be suitable for installation in an exterior location and operation in all-weather conditions.

- D. The pressure relief and vacuum breaker valve shall have a 356-T6 low copper cast aluminum body with Type 316 stainless steel pallet assembly and seating ring. Pallet seats shall be PTFE (Teflon®).
- E. The pressure relief and vacuum breaker valve shall be weight loaded with removable lead weights to allow adjustment of the pressure relief pallet. Pallet weights shall be lead. The pressure pallet shall be adjustable from +2" to +15" water column. The vacuum pallet shall be set at -2" water column.
- F. The pressure and vacuum breaker valve provided shall have the following minimum free air capacity (FAC = 60°F at 14.7 psia) at the indicated over-pressure and over-vacuum operating conditions.

Size (inches)	Minimum FAC (CFH)	Set Pressure (inches w.c.)	Over-Pressure (of Set Pressure)
4	60,000	+10.0	50%
6	140,000	+10.0	50%
8	180,000	+10.0	50%
10	300,000	+10.0	50%
12	500,000	+10.0	50%

Size (inches)	Minimum FAC (CFH)	Set Pressure (inches w.c.)	Over-Vacuum (of Set Pressure)
4	20,000	-2.0	100%
6	40,000	-2.0	100%
8	80,000	-2.0	100%
10	120,000	-2.0	100%
12	180,000	-2.0	100%

2.15 PRESSURE RELIEF AND VACUUM BREAKER WITH FLAME ARRESTER

- A. Pressure relief and vacuum breaker valves with flame arresters shall be provided at the locations shown on the Drawings.
- B. The pressure and vacuum breaker valves with flame arrester shall be Varec Biogas Model 5811B. The pressure and vacuum breaker valves shall meet the materials of construction requirements specified in Paragraph 2.13. The flame arrester shall meet the materials of construction requirements specified in Paragraph 2.02.
- C. The pressure and vacuum breaker valve with flame arrester provided shall have the following minimum free air capacity (FAC = 60°F at 14.7 psia) at the indicated over-pressure and over-vacuum operating conditions.

Size (inches)	Minimum FAC (CFH)	Set Pressure (inches w.c.)	Over-Pressure (of Set Pressure)
4	35,000	+10.0	50%
6	60,000	+10.0	50%
8	80,000	+10.0	50%
10	120,000	+10.0	50%
12	180,000	+10.0	50%

Size (inches)	Minimum FAC (CFH)	Set Pressure (inches w.c.)	Over-Vacuum (of Set Pressure)
4	14,000	-2.0	100%
6	30,000	-2.0	100%
8	45,000	-2.0	100%
10	65,000	-2.0	100%
12	90,000	-2.0	100%

2.16 WASTE GAS BURNER – ENCLOSED DESIGN

- A. This Section includes one waste gas burner with automatic ignition systems to be furnished by the Owner as listed in Section 01010 – Summary of Work, and in Section 11070 – Contractor Installation of Owner Furnished Equipment and shall be installed as shown on the Drawings.

2.17 INSULATING COVERS

- A. Removable insulation covers shall be furnished for the plug valve, pressure relief and flame arrester assembly, and flow meter in the waste gas flare line.
1. The covers shall consist of a glass fabric with 2-inch fiberglass or teflon coated fiberglass insulation.
 2. The covers shall be of one or two piece sewn construction with end closures and securing belts of Velcro or fiberglass straps with nylon buckles.
 3. Each cover shall have a permanent embossed identification tag.
 4. The covers shall be suitable for installation over heat tape wires and shall be easily removed and replaced.
 5. The cover shall allow operation of the plug valve with the cover in place.
 6. The removable insulation covers shall be Insulation Innovations, Inc. “Cal Save Buckler” or O’Brien Corporation “Flexpack”.

2.18 SPARE PARTS

- A. The Contractor shall furnish one rebuild kit for each size and type of gas safety and control device provided under this Section.

PART 3 -- EXECUTION

3.01 MANUFACTURER’S FIELD SERVICES

- A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 11000, Equipment General Provisions and shall include the following site visits:

Service	Number of Trips	Number of Days/Trip
Digester Gas Safety and Control Equipment (Excluding WGB)		
Installation and Testing	3	1
Startup and Training	3	1
Services after Startup	1	1
Waste Gas Burner & Accessories		
Installation, Inspection, Commissioning, and Start-Up Assistance	1	1
Operator Training and Follow-Up after Start Up	1	1

3.02 INSTALLATION

- A. Before installation, all gas safety and control equipment shall be lubricated where applicable, manually operated to check operation and the interior of the gas safety and control devices shall be thoroughly cleaned.
- B. The gas safety and control devices shall be so located that they are easily accessible for operating purposes, and shall bear no stresses due to loads from the adjacent pipe. The Contractor shall be responsible for coordinating connecting piping.
- C. Any leakage or "sweating" of joints shall be stopped, and all joints shall be tight.

3.03 SHOP AND FIELD TESTING

- A. Shop and field testing of gas safety and control devices shall be as follows:
 - 1. Certified factory testing shall be provided for all gas safety and control devices. Gas safety and control devices shall be shop tested, including performance tests, leakage test, and proof-of-design tests. The manufacturer through the Contractor shall submit certified copies of the reports covering the test for acceptance by the Engineer.
 - 2. The Contractor shall conduct field tests to check and adjust system components, and to test and adjust operation of the overall system.
 - a. Preliminary field tests shall be conducted prior to start-up with final field tests conducted during start-up.
 - b. The factory service representative shall assist the Contractor during all field testing and prepare a written report describing test methods, and changes made during the testing, and summarizing test results.
 - c. The service representative shall certify proper operation of the valve operator system upon successful completion of the final acceptance field testing.

3. Tests shall be conducted at a time approved by the Engineer. The Engineer shall witness all field testing.
4. All waste gas burners and pressure and vacuum relief valves shall be tested for control operation.
5. Preliminary field tests shall be conducted prior to start-up and shall include a functional check of all gas safety and control devices and all system components.
 - a. Preliminary field tests shall demonstrate that the gas safety and control devices perform according to specifications and that all equipment, valves, controls, alarms, interlocks, etc., function properly.
 - b. The preliminary field tests shall include all leakage testing.
 - c. The preliminary field test report must be approved by the Engineer prior to conducting final field acceptance tests.
 - d. Based on results of preliminary field tests, the Contractor shall make any adjustments required to settings, etc., to achieve the required operation specified or otherwise directed by the Engineer.
6. Final field acceptance tests shall be conducted simultaneously with the start-up and field testing of the digesters, gas holders, gas compressors, gas drying and conditioning system, engines, boilers, etc. Field tests shall be conducted for the full range of operating modes and conditions specified and as directed by the Engineer. Each of the gas safety and control devices shall be tested at minimum, maximum, and normal head/flow conditions, and under all specified conditions of opening and closing.
7. Field testing shall include optimization of opening and closing times of the applicable gas safety and control devices. The Contractor shall provide the means for accurate measurement of pipeline pressures. Valve and vent opening and closing times shall be adjusted based on process requirements to optimize their operation. Final valve and vent opening and closing times as determined by field tests shall be approved by the Engineer prior to final acceptance of the system.

- END OF SECTION -