SECTION 11408 - DIGESTER GAS HANDLING EQUIPMENT

City of San Diego, CWP Guidelines

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing the gas handling equipment for the anaerobic sludge digesters and all appurtenant work, complete and operable, including gas compressors, gas mixer assemblies, sediment traps, drip traps, pressure relief assemblies, vacuum breakers, and flame arrester assemblies.

1.2 RELATED SECTIONS

A. The WORK of the following Sections applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.

1. Section 09800 Protective Coating
2. Section 11000 Equipment General Provisions
3. Section 13300 Instrumentation and Control
4. Section 15000 Piping Components
4. Section 16040 Electric Motors
5. Section 16050 Basic Electrical Materials and Methods

1.3 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1.	ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
2.	ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys.

1.4 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted in compliance with Section 01300:

1. Specifications, detail drawings and information on compressor and drive assembly input and output speeds and capacities, exact drive ratios, and service factor.

2. Information on at least one successfully performing installation of comparable size and complexity constructed in the recent past including contact name, address, and telephone number.

1.5 OWNER'S MANUAL

A. The following shall be included in the OWNER'S MANUAL in compliance with Section 01300:

1. Compressor lubricating instructions.

1.6 SERVICES OF MANUFACTURER

A. An authorized representative of the manufacturer shall visit the site for not less than [ ] days to provide the services indicated in Section 11000.

1.7 QUALIFICATIONS

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NTS: In the paragraph below, define the terms "comparable size and complexity" for the equipment or system specified. Requiring experience of more than one successful project requires sound justification and prior written approval from the City Project Manager.

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A. **Manufacturer:** Company specializing in manufacturing of gas compressors with minimum one successfully performing installation of comparable size and complexity constructed in the recent past. Equipment of comparable size and complexity shall have the following characteristics: [ ].

PART 2 -- PRODUCTS

2.1 GENERAL

A. **General:** Only products certified as complying with the indicated requirements shall be provided.

2.1 EQUIPMENT SCHEDULE

A. The following equipment shall be provided:

Quantity	Equipment	I.D. No.
[ ]	Gas Compressors	[ ]
[ ]	Gas Mixing Assemblies	[ ]
[ ]	Flame traps	[ ]
[ ]	[Multi-port Rotary Valve]	[ ]
[ ]	Sediment traps	[ ]
[ ]	Drip traps	[ ]
[ ]	Temperature sensing assemblies	[ ]
[ ]	Relief and vacuum valves	[ ]

2.2 GAS COMPRESSORS [ ]

A. **General:** Gas compressors shall conform to the following requirements:

Number of compressors - [ ]

Type - rotary, positive displacement

Location	-	[ ]
Operation (hours per day)	-	24 hrs. continuous
Drive	-	heavy duty, TEFC, constant speed electric motor, belt driven, with replaceable sheaves and belts

B. **Operating Conditions:**

Service	-	digester gas with the following approximate composition:

Methane	[ ] percent
Carbon Dioxide	[ ] percent
Nitrogen	[ ] percent
Hydrogen Sulfide	[ ] ppm
Moisture Content	Saturated
Specific Gravity	0.8
Density	0.074

Capacity, (inlet cfm)	-	[[ ], [ ], or [ ]] (3 sheaves and sets of belts provided with drive to accommodate three-speed operation.
Pressure differential (psig)	-	[ ]
Inlet pressure (psia)	-	[ ]
Specific gravity of gas	-	0.8
Inlet gas temperature (degrees F)	-	90
Max pump speed (rpm)	-	[ ]
Max motor speed (rpm)	-	[ ]
Min motor size (hp)	-	[ ]
Noise level	-	Less than 80 db @ 20 feet
Environment	-	Class I, Division 2 Hazardous Area

C. **Pump Size:**

Suction flange size (inches)	-	[ ]
Discharge flange size (inches)	-	[ ]
Flange rating (psi)	-	125

D. **Compressor Construction**:

Impeller case	-	heavily ribbed cast iron or ductile iron
Head plates	-	machined cast iron or ductile iron
Impeller, (lobe-type)	-	machine cast iron or ductile iron, balanced.
Anti-friction bearings	-	min [60,000] hours L-10 life
Timing gears	-	accurately cut steel, oil-splash lubricated
Drive end bearing lubrication	-	grease or oil lubricated (continuous forced lubrication will not be acceptable)
Shaft	-	carbon steel
Seal to prevent oil leakage	-	special packing glands
Common base plate	-	cast iron or steel
Drive	-	V-belt drive with guard
Connections	-	flexible, flanged connectors

A. **Compressor Instrumentation:** The unit shall be equipped with pressure gage and safety switches to shut off in case of high oil temperature or low oil pressure. Other control features shall be as indicated in the wiring diagrams on the electrical drawings. All equipment including the safety switches shall be explosion-proof.

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NTS: Specifier should select the Draft Tube Gas Mixer Assemblies or Lance Type Gas Mixing Assemblies, based on system design. The assembly not selected should be deleted from the Specifications.

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[2.4 DRAFT TUBE GAS MIXING ASSEMBLIES

A. **General**: The CONTRACTOR shall furnish and install [ ] gas mixer assemblies as indicated. Each gas mixer assembly shall consist of stainless steel gas injection piping, valves and couplings, a cover plate, seal pipes, a baffle plate assembly, a draft tube, all anchor bolts and fasteners and other appurtenances. Each injector shall have a minimum of [6] stainless steel injector lances.

The gas mixing assembly shall be removable and replaceable without taking the digester out of service, dewatering the digester, or entering the digester.

B. **Draft Tubes**: Each draft tube shall be [42 inches] in outside diameter and of the appropriate length for complete mixing of the digesters with the sidewater depth as indicated. Draft tube shall be fabricated of 1/4-inch minimum steel plate. The protecting coating system shall be in accordance with Section 09800. The draft tube shall be anchored to the digester floor as indicated.

C. **Gas Mixing Assembly**: Each gas mixing assembly shall consist of a mounting cover plate, [six] gas seal tubes, [six] gas injectors, steel baffle plate, [six] gas diffusers and all pipe, valves, cuttings, anchor bolts and fasteners and all other appurtenances for complete assembly.

The cover plate shall be fabricated of minimum 1/4-inch steel plate in a flanged arrangement for bolting to the roof of the digester as indicated. The plate shall be supplied with a neoprene gasket, anchor bolts and other necessary hardware for bolting to the digester dome for a gas tight seal at 60 inches water column.

Gas injectors shall consist of [six] 2-inch minimum diameter Type 304 stainless steel pipes connected to a cast iron diffusion head. Each diffusion head shall include high velocity gas injection orifices with polypropylene inserts and a self-cleaning, open end blow off leg extending 18 inches below the orifices to prevent any chance of gas line plugging during periods of shut down.

Each gas supply line shall have a lifting device and seal flange terminating in a safety chamber to allow complete removal of the gas supply line without removing the gas dome seal plate or permitting the release of gas stored in the digester. Each safety chamber shall consist of a cast iron fitting with a sealing flange on the bottom and a gasketed mechanical joint fitting at the top to receive the gas supply line. Below each safety chamber there shall be provided a 6-inch diameter seal pipe to extend from below the sludge level to above the gas dome seal plate.]

[2.4 LANCE TYPE GAS MIXING ASSEMBLY

A. **General**: The CONTRACTOR shall furnish and install the lance type gas mixing assemblies as indicated. Each lance type gas mixing assembly shall consist of multi-port rotary valve, gas discharge assembly and appurtenances.

B. **Multi-port Rotary Valve**:

1. General: The rotary valve shall direct the sequential discharge of gas to the various discharge diffuser assemblies or allow for all diffuser assemblies to discharge simultaneously. The rotary valve shall have a multi-port cast iron body with connections for the supply lines to the discharge diffuser assemblies. The rotary valve shall have ports, and a line routed to the diffuser nearest the center of the digester shall remain open at all times.

   The valve shall have a vertically mounted sequencing sleeve to prevent moisture accumulations on horizontal surfaces. The sleeve shall be spring compressed against the body to seal nondischarging ports. The sleeve shall compress during sequencing to prevent binding due to normal accumulation of gas borne particles.

   The rotary valve shall also be capable of discharging to any individual gas diffuser by manual selection.

2. Materials:

Component	Material
Gas circulation rotary valve body	Cast iron

Valve housing	Steel

3. Motor: Rotary valve shall be driven by a [1/4]-horsepower, 120-volt, single phase, explosion proof motor suitable for installation in an NEC Class 1, Division 1, Group D environment.

4. Valve Housing: The rotary valve and rotary valve bypass valve shall be provided with a housing fabricated of minimum 3/16-inch steel and shall be insulated internally with minimum 1-inch thick insulation. Hinged doors with latch door handle on both housing sides, located along the long dimensions, shall be provided to allow access to all equipment from the digester cover. Suitable mounting for all equipment shall be provided within the housing. The housing shall be provided with a removable gabled roof and a gravity ventilator adequate for the service, heating, and environment indicated. The gravity ventilator shall be aluminum with at least a 6-inch diameter. All connections to the digester cover for mounting equipment and housing shall be gas tight. The housing, including the interior space, shall be coated in accordance with Section 09800.

5. Valve Housing Heater: The housing shall have a 3-kW, 460-volt, single-phase, explosion proof heater provided by the manufacturer, designed to prevent moisture condensation in the gas apparatus. Controls shall include unit heater, NEMA 7 thermostat, and disconnect switch mounted in a NEMA 7 box.

6. Controls: All the controls, motor, timers, switches and any other electrical items required for the operation of the rotary valve shall meet the electrical area classification Class 1, Division 1 and comply with the applicable requirements of Division 16. The rotary valve shall be motor-operated and shall have positioning controls that automatically allow recirculated gas to be discharged through the individual gas diffusers in a predetermined sequence or for all rotary valve ports to discharge simultaneously. The arrangement shall not require field adjustment. Controls shall allow time of discharge to be varied from a few minutes to a few hours, and also shall allow manual setting for continuous discharge at any port.

   Controls shall also indicate the position of the opening by activating micro switches tied to indicator lights. A control switch shall provide for the selection of either sequential or simultaneous operation. Indicator lights shall reflect the mode of operation. Control arrangements that do not directly indicate the opening location are not acceptable.

   Controls shall include, but not be limited to, the following:

   Rotary valve control relay.

   15-minutes to 3-hour repeat cycle.

   "Select-Hold-Auto" selector switch.

   Valve port indicating lights.

   Housing heater controls consisting of a contactor, 120-volt AC control transformer, and "Off-Auto" selector switch.

C. **Gas Discharge Assembly**: Gas discharge assemblies utilizing circulated digester gas shall be provided for each digester cover as indicated.

Each gas discharge assembly shall consist of a 4-inch diameter steel pipe well shell, a 2-1/2-inch diameter, Schedule 80, black steel, gas discharge pipe, internal seal rings and gaskets, and other appurtenances.

Each pipe well shall be provided as indicated, terminating at 10 feet minimum below the liquid level to provide a positive gas seal and added rigidity for the gas discharge piping. The upper end of each pipe well shell shall be extended above the cover roof and provided with a gastight, bolted cover plate with lifting handle. Removable assemblies shall be provided for each 2-1/2-inch gas discharge pipe. Each gas discharge pipe shall be arranged to screw into the well shell cover plate as indicated. Assemblies shall be removable for replacement or change in depth of discharge without interrupting digester operation. Each gas discharge pipe shall extend below the liquid surface as indicated and shall be provided with openings at both ends as indicated for entrance and exit of incoming circulated digester gas.

A compression ring to receive a rubber O-ring gasket shall be welded to each gas discharge pipe below the gas entrance section. When the cover plate of well shell is bolted down, the O-ring gasket shall compress against the seat ring as a gas seal.

The gas discharge assemblies shall be furnished complete with necessary supports, cross bracing, and anchorage as required and shall be rigidly attached to the digester cover.]

2.5 TRAPS, ARRESTERS, AND VALVES

A. **Flame Traps/Arresters:** Each flame trap/arrester shall be of the horizontal type with [ ]-inch, 125-lb ANSI flanged connections and a flow capacity of [ ] scfh sludge gas at 0.25 inches water column pressure drop. Housing construction shall be cast-aluminum ends and cast-iron side and cover plates. The bank assembly shall be all aluminum and shall be arranged for easy removal from the housing to facilitate cleaning and inspection. Net free area through the bank shall not be less than 4 times the corresponding pipe cross-sectional area. All grids of the bank shall be individually stamped rectangular shaped sheets and shall be arranged for individual removal. All flame traps shall be approved by the Associated Factory Mutuals' Laboratories and listed by Underwriters' Laboratories.

B. **Sediment Traps:** Sediment traps shall be designed specifically for sediment and condensate removal from sludge gas lines. Each sediment trap shall have [ ]-inch, 125-lb, ANSI standard flanged end connections and a flow capacity of not less than [ ] scfh at 0.3-inch water column pressure drop for 0.8 specific gravity gas. Storage capacity shall be not less than 6 gals of sediment and 6 gals of condensate. The operating principle for removing the sediment from the gas shall be centrifugal force, developed by a circular motion of gas passing through at high velocities, and gravity at low gas velocities. A 1-inch NPT blowout connection, a 1-inch NPT drip trap connection, a drip trap, and two 1/2-inch NPT connections for a sight glass shall be provided. A removable top cover for interior access and an inspection pipe for content level measurements shall be provided. Construction shall be all welded steel. The sight glass shall be provided for each sediment trap and shall be 1/2-inch proprietary glass tube size. It shall include 2 valves for isolating the tube from the sediment trap to facilitate cleaning or replacement. Guard rods for protection of the glass tube and drain cock on the lower valve for draining the tube shall be provided.

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NTS: The drip traps below may not be required if a centralized condensate removal system is provided.

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C. **Drip Traps:** The drip traps shall have 1-inch size NPT inlet and outlet connections and shall be of the ball float operated needle valve type. A plug shall be provided to permit manual draining of the bowl. Construction shall be cast iron or aluminum cover, bowl and operating lever and stainless steel float, needle valve and seat.

D. **Pressure Relief and Vacuum Breaker Valve with Flame Arrester:** The unit shall be a [3]-inch size 125-lb ANSI flanged mounting connection, a pressure relief capacity of not less than [4000] scfh sludge gas at 12 inches water column accumulation and a vacuum relief capacity of not less than [4000] scfh air at 2 inches water column accumulation. Vent valve and flame arrester shall be 2 independent items of equipment; however, the valve shall be mounted on the flame arrester by means of a bolted and gasketed flange connection. The valve portion shall be light weight aluminum construction throughout consisting of cast aluminum body, seat rings, pallets, and hood over pressure pallet. Protective wire mesh screens shall be provided at the intake and exhaust ports and shall be located external to pallets. Seat rings and pallets shall be anodized and removable. Pressure and vacuum pallets shall be the same diameter and the effective diameter shall not exceed the port diameter by more than 14 percent. Pallets shall be center and side-guided and shall incorporate replaceable synthetic rubber seats inserts. Pressure pallet shall include removable lead weights for adjusting setting from 2 inches to 10 inches water column in 1-inch water column increments. Vacuum pallet shall be weighted for 2 inches water column setting. Flame arrester portion shall have a housing constructed of cast aluminum ends and cast-iron side and cover plates. The bank assembly shall be all aluminum and shall be arranged for easy removal from the housing to facilitate inspection and cleaning. Net free area through the bank assembly shall be not less than 4 times that of the corresponding size standard pipe. All grids of bank shall be individual corrugate stamped and rectangular shaped sheets and shall be arranged for individual removal. It shall be approved by Associated Factory Mutuals' Laboratories and be listed by Underwriters' Laboratories.

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NTS: A gas scrubbing system shall be added if the gas must be scrubbed.

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2.6 NAMEPLATES, TOOLS AND SPARE PARTS

A. The WORK includes the following spare parts for each gas compressor unit:

1. 3 filter elements
2. 2 drive belts
3. 2 sets of seals and gaskets

2.7 MANUFACTURERS

A. Products of the type or model indicated shall be manufactured by one of the following (or equal):

1. Gas compressors:

Dresser Industries, Roots, model [ ]
Fuller Company (GATX), Sutorbilt model [ ]
Schwitzer Industrial Products, model [ ]

2. Multi-port rotary valves:

   Envirex, PFT Pearth Type

3. Flame arresters, sediment traps, drip traps, and pressure relief and vacuum breaker valves:

   Enardo Products
   Groth Equipment Corp.
   Kemp Manufacturing Co.
   Protectoseal Company
   Shand and Jurs

PART 3 -- EXECUTION

3.1 INSTALLATION

A. **General:** All gas handling equipment shall be installed in strict accordance with the manufacturer's written installation instructions.

B. **Tests:** Upon completion of the installation, each piece of equipment and each system shall be tested for satisfactory operation without leakage, excessive noise, vibration, overheating, etc. All equipment must be adjusted and checked for misalignment, clearances, supports, and adherence to safety standards.

** END OF SECTION **