

SPECIFICATIONS - DETAILED PROVISIONS
Section 11021 - Natural Gas Engines

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ATTACHMENT

[MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION](#)

**SECTION 11021
NATURAL GAS ENGINES**

PART 1 - GENERAL

GENERAL. The work under this section includes the furnishing and installation of mechanical equipment, appurtenant equipment, and accessories necessary for complete and operable systems as shown on the Plans and specified herein.

All mechanical equipment and accessories furnished by the Contractor shall be new and of current manufacture. A certificate from the manufacturer stating that the equipment furnished is new and of current manufacture shall be furnished to the District. The Contractor shall furnish and replace, without cost to the District, any equipment part that is defective or shows undue wear within three (3) years after it has been put into operation.

Should the mechanical equipment selected by the Contractor require revisions to the structures, piping, electrical, or other work shown on the Drawings, the Contractor shall include the cost of such revisions in his bid for the equipment, and no extra payment shall be made for such revisions. All such revisions shall be subject to the approval of the Engineer.

The Contractor shall submit shop drawings for all Contractor-furnished equipment for approval prior to fabrication and installation. It shall be the Contractor's responsibility to place orders for equipment and materials at the earliest possible time to provide ample time for the preparation, submittal, and approval of shop drawings.

All equipment furnished under these Specifications shall comply with the safety orders of local, state, and federal governing bodies. All sprockets, V-belts, drive chains, gearing, and couplings on the drive assemblies shall be enclosed in expanded metal safety enclosures in compliance with said safety orders.

1.01 DESCRIPTION - NATURAL GAS ENGINES FOR PUMPS

The work covered by this section includes the furnishing, installation and testing of natural gas engines for driving pumps.

Engine Description or Location: Pump Station

Quantity and Type: 1 Natural Gas Engine

Operating Conditions

Maximum Design Operating Speed (rpm)	1600
Estimated Brake Horsepower Range	150-178
Minimum Displacement (cubic inches)	855
Maximum Compression Ratio	12:1

Engines shall be suitable for installation indoors under the following environmental operating conditions:

Elevation (ft)	1600
Temperature (°F)	30-120
Relative Humidity (%)	10-80
Air Supply - filtered air from engine room	

1.02 QUALITY ASSURANCE

Engines shall be a product of an engine manufacturer regularly engaged in the building of gas engines. The engine manufacturer shall have service personnel and stocked service parts available within a radius of 150 miles from the Project.

Where materials are specified on the Drawings, but not specifically covered herein by Detailed Specifications, the Contractor shall use first-class, commercial grades of materials or articles having physical and chemical properties best suited to the purpose for which the part is to be used.

1.03 SUBMITTALS

- A. Shop Drawings. The Contractor shall submit shop drawings for all engines covered in this section for approval prior to shipping and installation. Shop drawings shall show the dimensions, ratings, materials of construction and other relevant details of the engines to be furnished.
- B. Torsion Analysis. To ensure that no harmful critical torsion exists in the operating range, a mathematical analysis shall be made in the complete rotating system of the engine and pump throughout the operating speed ranges of all pump engines. The engine manufacturer shall perform the torsion analysis through the RPM speed range, and it shall not exceed 5000 psi.

Copies of the torsion analysis showing no harmful critical torsion in the operating range shall be submitted for approval prior to the complete assembly layout of the unit.

- C. Performance Curve. The Contractor shall submit to the Owner's Representative performance curves for all engines showing the engine efficiencies at 1/4, 1/2, 3/4 and full load.

PART 2 - PRODUCTS

2.01 NATURAL GAS ENGINES FOR PUMPS - EQUIPMENT AND MATERIALS

- A. Engine. The engine shall be a four (4) cycle, six (6) cylinder, naturally aspirated, water-cooled, air-started, spark-ignited type engine. It shall have seven (7) main bearings, interchangeable cylinder heads, single exhaust outlet, high compression aluminum alloy pistons, flywheel with housing, and with other features common to heavy-duty engines. The engines shall be capable of operating at the maximum design operating speed on a continuous 24 hours per day basis.

The engine shall deliver sufficient net brake horsepower to drive its load including power absorbing accessories, when operating under the conditions set forth in these Specifications.

- B. Engine Cooling System. The Contractor shall furnish and install engine cooler units suitable for use with natural gas engines as shown on the Plans. The cooling system shall consist of a single pass shell and tube heat exchanger with admiralty bronze tubes and tube sheets, free-standing surge tank with gauge glass, and the engine-driven water circulating pump adequately sized for all the full operating range of the engine. The heat exchangers shall be in in-line type suitable for the maximum horsepower rating of the engines and maximum flow rate of the pumps.

A 1000 watt engine jacket heater and water filter shall be installed in the cooling system of each range.

- C. Engine Fuel System. The engine shall be equipped with a natural gas carburetor, air cleaner, single fuel gas piping inlet connection with two gas regulators, one regulator set for 3 to 5 psi and the other regulator set for inches, on the inlet gas pressure, and a 24 volt direct current normally closed gas solenoid valve mounted on the engine. Gas valve shall close on power failure. The controls shall have provisions for starting the engine with the throttle closed. Controls shall provide an adjustable time for engine warm-up and cool-down purpose. A flexible fuel connection between the engine and the fuel supply line shall be installed. The Contractor shall furnish and install all piping, fittings and valves necessary to complete the fuel system.

- D. Engine Lubrication. The engine shall be equipped with a gear-type lubricating oil pump which will supply oil under pressure to all bearings, crankpin bearings, camshaft bearings, and valve rocker arm mechanisms. The lubricating system shall have a full flow lubricating oil filter equipped with spring loaded bypass valve. A lubricating oil cooler shall be connected into each engine cooling system to maintain favorable oil temperature when engine is in operation. Each engine shall be equipped with a high/low oil level safety switch, Ren, Murphy or equal.

The oil level regulator shall be installed with a bypass valve around the regulator for filling the engine. An oil drain shall be provided for the engine as shown on the Plans. Oil inlet lines, oil level regulator bypass valves, and oil drain valves shall be sized in accordance with the Plans and shall be connected to the engines with flexible oil feed lines.

- E. Engine Exhaust Silencing System. Each engine shall be provided with a "hospital zone" exhaust silencer. The muffler shall be suitable for horizontal installation with baseplate and supplied with flanges on the end inlet and end outlet of the muffler and with mounting brackets which will support the silencer so as to clear the roof by 12-inches minimum as shown on the Plans. Each silencer shall be equipped with a raincap on the exhaust outlet sized the same diameter as the outlet. Each silencer shall be fitted with a heat shield as shown on the plans.

Each engine shall be supplied with a single exhaust outlet and exhaust stainless steel flexible connector flange type to be installed in the exhaust line system. The entire exhaust system inside the building, including the stainless steel flexible connector shall be installed with 5 inch minimum air space. Exhaust stack shall be as shown on the Plans.

- F. Engine Ignition System. Each engine shall be equipped with a low tension capacitance discharge heavy duty magneto ignition system.
- G. Engine Starting System. The starting system for each engine shall be equipped with an air starter. System shall be mounted on the engine and shall include a motor, automatic lubricator with clear reservoir and valved bypass line, manual drain filter, air starter relay valve, a 24 volt D.C. normally closed solenoid valve, intake pressure regulator set, shutoff cock, exhaust silencer, and a stainless steel braided flex connection. Provisions must be made to start engine manually in the event starter solenoid valve fails to open. Air will be supplied at a maximum pressure of 150 psig and a minimum of 90 psig. The air exhaust silencer shall be mounted on the engine and shall comply with CALOSHA standards.

- H. Combustion Air system. The engine shall obtain the necessary volume of combustion air from the pump station room. Engine inlet air filters shall be of the dry type with replaceable filter cartridges.
- I. Shaft Couplings. A flywheel type shaft coupling shall be furnished and installed suitable for connecting the engine and pump. Couplings shall accommodate shaft misalignment to one (1) degree angular, to 1/16 inch parallel connected shafts, and to 3/32 inch shaft end-float. Couplings shall be rated for the maximum continuous speed and horsepower of the engines and shall accommodate the maximum bore of the shafts to be coupled. Couplings shall be made of high strength steel and neoprene flexible element with bolted construction.
- J. Engine Junction Box. Each engine shall be equipped with a terminal waterproof junction box, with all automatic engine contacts shop wired to it. All wiring shall be clearly identified and be wired exactly the same for all units.
- K. Flexible Metal Hose. Flexible metal hose connectors for jacket water, lube oil, fuel, starting air and exhaust shall be provided. The flexible metal hose for starting air shall be doubled braided, stainless steel, suitable for 1000 psig working pressure. Water, oil and fuel connectors shall be single braided, stainless steel, 150 psig working pressure. Fuel connectors shall bear the Underwriters' Laboratories label. The exhaust connector shall be unbraided, stainless steel, suitable for temperatures up to 1300 degrees Fahrenheit. All connectors shall be selected for a design of not less than 10,000 full displacement cycles.
- All piping and electrical connections to the engine shall be through flexible connections that are in length at least three times the diameter of the pipe. Pipe connectors shall be stainless steel.
- L. Engine Automatic Controls. The Contractor shall coordinate this subsection with the other sections of the Specifications to ensure that a complete and operable control and instrumentation system exists.

The engines shall be supplied with individual automatic starting control panel housed in a NEMA 12 enclosure for separate mounting as shown on the Plans. All switching and logic functions of the automatic controls to be of solid state, printed circuit design, using relays only for passing out signals to main control panel terminals. Voltage between control enclosure and engine wiring termination not to exceed 24 volts. Controls shall be manufactured by Frank W. Murphy, MFR, Inc., or approved equal. The batteries and chargers to be supplied by the District.

The control shall have a test run-off-automatic switch and perform the following functions. Automatic control shall be via future telemetry.

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With the Control switch in the run position, a cranking cycle shall be initiated and repeated five times or until a start up signal is received from the engine, thus terminating cranking. If the cranking cycle is repeated six times and the engine does not start, an overcrank condition exists. This condition shall be indicated and cranking shall terminate. The speed of the engine shall be set manually and a speed controller shall automatically maintain this speed. The ramp up and down speed shall be manually set. The maximum and minimum speed shall be manually set to stop the engine if it overspeeds or cannot maintain minimum speed. When the engine is turned to off position, the engine speed shall decrease to the appropriate minimum rpm level and after a pre-selected time delay it shall stop. All safety shutdowns shall be in effect in the manual and automatic modes. When the engine is stopped, the 24-volt solenoid valve on the fuel supply line shall be closed.

The control panel shall include the following indicators which will stop the engine:

1. Low engine oil pressure
 2. High engine water jacket temperature
 3. Low engine water jacket level
 4. Low engine oil level
 5. Overload – Underload
 6. Overcrank
 7. Master shutdown
 8. Vibration
 9. Overspeed
 10. High Oil Temperature
- M. Instrument Panel. Each engine shall be equipped with an instrument panel which shall be located as shown on the Plans. The panel shall contain the following instruments:
1. Engine jacket water temperature gauges on the inlet and outlet lines
 2. Engine oil pressure gauge
 3. Engine oil temperature gauge

4. Engine vacuum gauge
 5. Tachometer
 6. 120-volt A.C. totalizing type hour meter capable of reading up to 99,999.99 to be installed in Micro Processor Panel furnished by others.
 7. Exhaust gas temperature
- N. Engine Speed Control. Each engine shall be equipped with a centrifugal-type governor for engine overspeed. The governor shall be manually adjustable and shall limit the speed of the engine to the maximum design operating speed.

2.02 APPROVED MANUFACTURERS

- A. Approved Engine Manufacturers include Caterpillar, Cummins and Waukesha.
- B. Engine Coolers shall be as manufactured by Yardney Electric Corporation or approved equal.
- C. Engine Exhaust Silencing System shall be manufactured by Donaldson, Kittel, or approved equal.
- D. Magnetos for engine ignition system shall be American Bosch, Altronic, or approved equal.
- E. Air Starters for engine starting system shall be Start Master Ingersoll Rand, or approved equal.
- F. Engine Shaft Couplings shall be Dodge Para-Flex, or approved equal.

PART 3 - EXECUTION

3.01 INSPECTION

The Contractor shall submit the attached "Manufacturer's Certificate of Proper Installation" to the District confirming that all pumping equipment was inspected, operation checked, and installation approved in writing by the respective pumping equipment representative.

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3.02 PREPARATION

As required by the General Conditions, instructions for field procedures for erection, adjustments, inspection, and testing shall be provided prior to installation of the engines.

3.03 INSTALLATION

The Contractor shall install all engine equipment in strict accordance with the manufacturer's instructions. Care shall be used in handling to avoid bumping, twisting, dropping or otherwise damaging the equipment.

In accordance with the requirements of the General Conditions, all equipment manufacturers shall furnish the services of factory-trained personnel as required during installation and through the warranty period to inspect the installation, supervise startup of equipment installed, and repair the equipment when required. Service requests shall be answered and acted upon promptly.

3.04 FIELD QUALITY

- A. Maintenance Instructions and Field Procedures. As required by the General Conditions, printed instructions relating to proper maintenance, including lubrication, and parts lists indicating the various parts by name, number, and diagram where necessary shall be furnished with each unit or set of identical units. Recommended spare parts list shall be included and local supplier's name where spare parts are available.

END OF SECTION 11021

MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

OWNER: _____ EQPT SERIAL NO: _____
EQPT TAG NO: _____ EQPT/SYSTEM: _____
PROJECT NO: _____ SPEC. SECTION: _____

I hereby certify that the above-referenced equipment/system has been:

(Check Applicable)

- Installed in accordance with Manufacturer's recommendations.
- Inspected, checked, and adjusted.
- Serviced with proper initial lubricants.
- Electrical and mechanical connections meet quality and safety standards.
- All applicable safety equipment has been properly installed.
- System has been performance tested, and meets or exceeds specified performance requirements. (When complete system of one manufacturer)

Comments: _____

I, the undersigned Manufacturer's Representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate his equipment and (iii) authorized to make recommendations required to assure that the equipment furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____

Manufacturer: _____

By Manufacturer's Authorized Representative: _____
(Authorized Signature)

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