PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The extent of the vacuum sewer work is shown on the drawings. The work includes installation, testing, and flushing of the vacuum sewers, vacuum valves pits, buffer tanks, and division valves, including all equipment, fittings, accessories, and specialty items associated with the vacuum sewer system, as shown on the Construction Plans, as specified herein, and as directed by the Engineer, all as required to produce a fully operational vacuum sewer system.

B. The Contractor shall comply with the requirements of other applicable Technical Specifications sections required in connection with vacuum sewer work.

1.02 METHOD OF MEASUREMENT & PAYMENT

A. VACUUM MAIN: Vacuum main shall be paid for at the contract bid price per lineal foot for each size and type of material specified which shall include the cost of furnishing all pipe, fittings, pipe bend sections, jointing material, reducers, tie-ins to existing mains, restraints, stainless steel stiffeners, marker tape, bedding material and all other appurtenances, and of delivering, handling, laying, dewatering, trenching, sheeting and backfilling, furnishing and installing flowable fill used for tunneling/defecting pipe under and adjacent to existing storm piping/structures, testing, restoring the surface (unless separate bid item is provided), necessary permits, and all material or work necessary to install the pipe complete in place at the depth specified on the plans and/or as directed by CCU. Measurement of the pipe shall be rounded to the nearest foot along the horizontal centerline of the installed pipe, including the lengths of valves and fittings.

B. DIVISION GATE VALVE: Division gate valve shall be paid for at the contract unit price per each size installed including the valve, valve stem, bedding material, concrete pad, valve box, valve box extensions, excavation, dewatering, backfill, compaction, clean-up, testing, and all necessary labor, equipment, and materials for installation of a valve as shown and described in the drawings and specifications.

C. VACUUM VALVE PIT ASSEMBLY: Vacuum valve pit assembly shall be paid for at the contract unit price per each installed including a valve pit assembly, complete and in service. The valve pit assembly, including the flex hose connector, will be supplied by the Owner. This item also includes the assembly of Owner provided equipment, fittings, excavation, dewatering, pipe, bedding, backfill, compaction, flex hose connector, clean-up, testing, and all labor, equipment and materials necessary for the installation as shown and described in the drawings and specifications.

D. SINGLE/DUAL BUFFER TANK: Single/dual buffer tank shall include a buffer tank supplied and installed by the Contractor. Valve mounting bracket kits for buffer tanks will be supplied by Owner and installed by the Contractor. This item also includes assembly of Owner provided equipment, fittings, excavation, dewatering, pipe, bedding, backfill, compaction, flex hose connector, clean-up, testing, and all labor, equipment and materials necessary for the installation as shown and described in the drawings and specifications. Payment will be made at the unit price for each SINGLE/DUAL BUFFER TANK installed.

E. VALVE PIT CONCRETE COLLAR: Valve pit concrete collar shall include construction of a concrete collar as shown and described in the drawings and specifications for valve pits constructed in traffic areas and valve pits as determined by the Engineer to be in
areas where there is potential for vehicular damage to occur. Payment will be made at the unit price for each VALVE PIT CONCRETE COLLAR constructed.

F. PROTECTIVE CONCRETE CAP: If required, protective concrete cap shall include dewatering, excavation, form work, concrete, compaction and all necessary labor and equipment as required to construct a protective cap as shown and described in the drawings and specifications. Payment will be made at the Contract unit price per square yard of concrete.

1.03 EQUIPMENT AND WORK PROVIDED BY OWNER AND CONTRACTOR

A. The Owner shall purchase all valve pits and associated equipment and accessories directly from the vacuum system manufacturer with the exception of the gravity line stub-outs. The Owner, coordinating with the Contractor, shall have such equipment delivered to the Project Site. The Contractor shall be responsible for off-loading and storage of all items furnished by the Owner to be installed under this Contract.

B. The Contractor shall furnish and install the vacuum sewer pipe, fittings, division valves, buffer tanks, sewer service laterals (gravity line stub-outs), and related appurtenances as described in this section.

C. The Contractor shall install all materials and equipment furnished by the Owner as described in this section.

D. The Owner shall purchase all vacuum valves and spare parts for the vacuum sewers directly from the vacuum system manufacturer.

E. The Owner shall provide a Trailer Mounted Vacuum Test Pump (TMVP) from the vacuum system manufacturer, which will be used for testing the vacuum sewers under this contract. All required maintenance and repairs to the unit shall be made by the Contractor at the Contractor's expense.

F. The Contractor shall record all pertinent data relating to the valve pit installation on the vacuum system manufacturer's Valve Pit Installation Form and submit the completed forms to the Owner at the completion of the project.

G. The Owner shall install vacuum valves in the valve pits when customer connects to the system.

1.04 QUALITY ASSURANCE

A. Manufacturer's Experience: The vacuum system manufacturer shall have a minimum of five (5) years of experience in the manufacture of vacuum systems and shall have at least ten (10) installations in service within the United States of America. A "system" is defined as a vacuum sewer system collecting domestic waste water that has been in operation for at least five (5) years which has at least 150 vacuum interface valves, and valve pits. Provide verification at the request of the Engineer.

B. Sole source Vacuum system manufacturer: AIRVAC, INC., P.O. Box 528, 4217 N. Old U.S. 31, Rochester, Indiana, 46975.

1.05 SUBMITTALS

A. Shop Drawings: Submit shop drawings and product data under provisions specified elsewhere. Indicate materials of construction, physical properties, controls, operational requirements and details.

B. Flushing procedures: Submit manufacturer's recommended line flushing procedure for Engineer's approval.

C. Manufacturer's installation instructions: Submit manufacturer's installation instructions under provisions specified elsewhere.

D. Manufacturer's Valve Pit Installation Forms: Submit manufacturer's Valve Pit Installation Form for Engineer's approval.

E. Manufacturer's Final Inspection Form: Submit manufacturer's Final Inspection Form for Engineer's approval.

SECTION 02730 UNDERGROUND VACUUM SEWER PIPING

Page 2 of 16
F. Manufacturer’s Vacuum Valve Installation Forms: Submit manufacturer’s Vacuum Valve Installation Form for Engineer’s approval.

1.06 CERTIFICATES AND FORMS

A. Pipe and pipe gasket: Provide a certificate from the pipe manufacturer by the manufacturer stating the pipe and the pipe gasket has been tested at 22 in. hg. vacuum with no leakage in accordance with ASTM 3139, and is guaranteed for such use.

B. Division valve: Submit division valve manufacturer’s certificate that valve will not leak when subject to a vacuum of 22 inches mercury for one (1) hour in both open and closed position.

C. Plan & profile: Provide a letter from the vacuum manufacturer indicating their acceptance of the plan and profiles as designed.

D. Valve Pit Installation Forms: Provide the Owner with a complete set of Valve Pit Installation Forms. One form is required for each valve pit installed. Each form must be signed by the Contractor certifying that all required pressure tests have been successfully completed and that all sump cut-outs (coupons) have been removed from the sump.

E. Final Inspection Form: Provide the Owner with a signed copy of the Final Inspection Form.

1.07 OPERATION AND MAINTENANCE MANUALS

A. Operation and Maintenance Manuals: Submit four (4) copies of the manufacturer’s operation and maintenance data. Include manufacturer’s spare part list, start-up, and operation and maintenance procedures.

1.08 WARRANTY

A. Contractor to provide a one (1) year installation warranty. Warranty shall commence on date of Substantial Completion.

1.09 DELIVERY, STORAGE and HANDLING

A. Valve pit cones, collection sumps, valve pit bottoms, cast iron rings and covers and fiberglass flotation collars may be stored outside. If any fiberglass sump or valve pit is to be stored in excess of 2 years (such as spares for future work), temporary shading is required. Simple covering of these products, which allows temperature buildup or exposure to direct or indirect sunlight, is not permitted.

B. Suction pipes, sensor pipes and flexible service laterals shall be stored in a manner that will keep them at ambient outdoor temperatures and out of the sunlight. Temporary shading as required to meet this requirement shall be provided. Simple covering of the pipe and fittings, which allows temperature buildup or exposure to direct or indirect sunlight, is not permitted.

C. Boxes of nuts, bolts, washers, grommets, valve pit o-ring seals, and butyl shall be kept in a dry area.

D. 3” Vacuum valves with controllers, sump breathers, and installation parts bags shall be kept in a dry area. For safe storage, the individual cartons are to remain intact while in storage. Temperature surrounding the boxes while in storage shall not exceed 110 degrees.

E. Valve pit cones: Valve pit cones may be stacked or laid on their sides. Stack shall be limited to a maximum of eight (8) valve pit cones.

F. Collection sumps: Collection sumps shall be stacked upside-down and on pallets. Stack shall be limited to a maximum of five (5) sumps.

G. Valve pit bottoms: Pit bottoms shall be stacked upside-down on pallets.

H. Cast iron rings and covers shall be stacked on pallets. Rings and covers shall be on separate pallets.

SECTION 02730 UNDERGROUND VACUUM SEWER PIPING

Page 3 of 16
PART 2 - PRODUCTS

2.01 VACUUM SEWER PIPE

A. All buried vacuum mainlines and branch lines shall be SDR21 pressure rated PVC pipe.
B. Pipe: ASTM D-2241.
C. Pipe Color: Pipe color shall be White.
D. Joint: ASTM D-3139 Using elastomeric seals. Manufacturer is required to submit a certification that the pipe seal will operate at 22 inches of mercury vacuum and withstand a vacuum test at 22 inches of mercury vacuum with no leakage after 1 hour with joints deflected as per ASTM D3139.6.1.1. Elastomeric joints to be “Rieber Style” or equal.
E. Fittings: All PVC Schedule 40 pipe fittings (for solvent cement joints) shall be pressure rated as produced by Spears Manufacturing Company (or equal) from a PVC compound having a cell classification of 12454 conforming to ASTM D-1784. All PVC Schedule 40 fittings shall be injection molded in accordance with ASTM D-2466 with the exception of wye fittings. The wye fittings may be fabricated provided that fitting dimensions do not deviate significantly from those shown on the standard details. Wye fitting sockets shall be made in accordance with ASTM D-2466. Manufacturer shall submit a certification that the fittings will operate at and withstand a vacuum test at 22 inches of mercury vacuum.
F. Primer: ASTM F-656
G. Solvent Cement: ASTM 2564; cement shall not be same color as primer.
H. Wye fittings: 45° Els shall be used throughout. A 3” - 90° El may be used at the entering side of 3” vacuum valve and at the wye connection to the vacuum main. Tee fittings and vent type ells are prohibited.

2.02 GRAVITY SEWER PIPE (Stub-out pipes and Sewer Service laterals)

A. All valve pit stub-out pipes and gravity laterals installed in the public right-of-way shall be pressure rated pipe: SDR21. Non-pressure rated pipe and foam core pipe are not acceptable.
B. Pipe: SDR 21: ASTM D2241
C. Pipe Color: Pipe color shall be Green.
D. Stub outs: Stub-outs shall be either 4” or 6” in diameter as indicated on the Construction Plans, and shall be a minimum of 72” long, and fully extended to the property line.
2.03 VACUUM LINE DIVISION VALVES (Supersedes CCU Specification 002340 relative to valve specification)

A. Valves shall conform to AWWA C509 latest revision, Standard for Resilient Seated Gate Valves, as manufactured by Waterous Company or equal.
B. Wedge shall be constructed of ductile iron, fully encapsulated in synthetic rubber except for guide and wedge nut areas.
C. Wedge rubber shall be molded in place and bonded to the ductile iron portion, and shall not be mechanically attached with screws, rivets, or similar fasteners.
D. Wedge shall seat against seating surfaces arranged symmetrically about the centerline of the operating stem, so that seating is equally effective regardless of direction of pressure unbalance across the wedge.
E. All seating surfaces in body shall be inclined to the vertical at a minimum angle of 32° (when stem is in a vertical position) to eliminate abrasive wear of rubber sealing surfaces.
F. Stem shall be sealed by at least two (2) O-Rings; all stem seals shall be replaceable with valve wide open and while subjected to full rated pressure.
G. Waterway shall be smooth and shall have no depressions or cavities in seat area where foreign material can lodge and prevent closure or sealing.
H. Valve body and bonnet shall be coated, inside and out, with fusion-bonded epoxy. Coating shall conform to AWWA C550-81, Standard for Protective Interior Coating for Valves and Hydrants.
I. Mechanical joint connections with transition to PVC gaskets shall be provided.
J. Two (2) tee keys shall be provided for each valve size required.
K. Buried valves shall be provided with valve boxes and covers conforming to CCU Specification 02340, with the operating nut extended to within 9", plus or minus 6", of the finished grade. The valve box cover shall have the words “SEWER” and “OPEN” with a directional arrow cast on it. The valve cover shall be painted green.
L. Manufacturer shall provide a full ten (10) year money back warranty.

2.04 TRAILER MOUNTED VACUUM PUMP (TMVP) (Owner Supplied)

A. Unit shall be assembled on a two wheel trailer, equipped with a Class II ball hitch coupler, tongue jack, lights for road use pre-wired to a round 6 contact trailer receptacle (NAPA-ECHLIN TC-6207), and 5.70 x 8", load range B, 2 ply nylon tires.
B. Vacuum pump: Masport belt driven, sliding vane vacuum pump with a capacity of 200 cfm, at 27" hg vacuum. The belt drive shall be enclosed by OSHA style belt guard. Unit shall include an air inlet filter, lubricant recovery units with integral exhaust smoke/mist elimination system, a fan cooled liquid to air heat exchanger, and a 3" diameter temperature gauge.
C. Engine: 18 Hp Kohler, two (2) cylinder, four (4) stroke gasoline engine. Engine shall have a 1/2" ball valve to facilitate draining engine oil and an oil pressure monitoring system to de-energize engine when oil pressure drops below acceptable level.
D. Electrical: Engine shall have a 12-volt electric starter, 25 amp Alternator and a 12-volt battery mounted in lockable battery case.
E. Control panel: Panel shall be weather-tight with Key start ignition switch, On-off switch to control the vacuum pump clutch, Over-current protection, Push button to shut down engine when depressed, Amp gauge, Hour Meter, red pilot light to indicate high liquid level in 30-gallon inlet tank, and a green pilot light to indicate vacuum pump clutch is engaged.
F. Fuel tank: Fuel tank shall be steel with a shut-off valve.
G. Collection tank: Tank shall have a capacity of 30 gallons and be fitted with a liquid level sight glass, a vacuum gauge with polycarbonate lens, a vacuum relief valve set for 27"Hg, a proximity switch to disengage vacuum pump drive clutch in response to excessive fluid level in the tank, a ball valve to drain collected liquid from the collection tank, an outlet check valve and a Cam-lock adapter on the tank inlet.

SECTION 02730 UNDERGROUND VACUUM SEWER PIPING
H. Hoses & connectors: 25 feet of 2" low temperature EPDM flexible suction hose equipped with cam-lock connectors and an inlet strainer.

I. Accessories: Unit shall include a (1) -8" portable chart recorder, 100 charts, 5 pens, (1) - 0-50 magnehelic gauge kit, tubing and a valve pit test connection with shutoff valve and Cam-lock adaptor.

J. Finish: TMVP shall be finished in enamel finish equal to Rust-Oleum #925 SAFETY BLUE.

K. Manufacturer: TMVP as manufactured by AIRVAC.

2.05 VALVE PITS -GENERAL

2-PIECE TYPE

A. Valve pit types: Valve pits shall be provided in the following types and depths as shown in the ENGINEER's plans. Depth to invert of the gravity inlet is based on the use of 6" stub-outs.

<table>
<thead>
<tr>
<th>AIRVAC Model No.</th>
<th>Overall Depth</th>
<th>Depth to invert of gravity inlet 6&quot; stub-out</th>
<th>Sump capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>VP3042H</td>
<td>6 ft</td>
<td>4.74 ft</td>
<td>85 gal</td>
</tr>
<tr>
<td>VP5442H</td>
<td>8 ft</td>
<td>6.74 ft</td>
<td>158 gal</td>
</tr>
</tbody>
</table>

B. Separating barrier: All valve pits shall incorporate a physical barrier that separates the valve chamber from the collection sump.

C. Traffic rated: All valve pits shall be H20 traffic rated. An independent laboratory certification shall be provided that the entire valve pit assembly is rated for H20 traffic wheel loads. Calculated data is not acceptable.

D. In-sump breather: All valve pits shall include an internal "in-sump" breather. No external breather piping or tubing will be acceptable. The sump breather is to be as described in paragraph 2.8.

E. Manufacturer: Valve pits and accessories as manufactured by AIRVAC.

2.1 VALVE PITS (2-PIECE TYPE)

Described below is the Model VP3042H valve pit. The other 2-piece model (VP5442H) differs only by dimensions relating to depth.

A. Type: Valve pit shall have two (2) major components: 1) the valve pit cone; and (2) the collection sump as well as associated pipes, connectors, seals and grommets. Overall depth of the unit shall be 72" nominal.

B. Valve pit cone: The valve pit cone shall be manufactured by filament winding fiberglass process with a 36" inside diameter at bottom and conically shaped to allow fitting a 26 ¾" frame with a 23 ½" inch diameter clear opening cast iron cover. The valve pit cone shall have a depth of 42" and a wall thickness of 3/16".

C. Collection sump: The collection sump and integral pit bottom shall be manufactured by the rotational molding process using polyethylene (PE). It shall be tapered with the upper rim designed to accept the valve pit cone as described in paragraph B above. The collection sump shall have an overall height of 30" nominal with a capacity of 85 gallons. The collection sump shall be designed to allow up to (4) homes to be connected with either 6" PVC pipe (see Part 2 Products for approved materials).
D. Suction and Sensor Pipes: Suction and sensor pipes shall be Sch 40 PVC. Lubricant shall be as specified in Part 2.5.E.

E. Anti-buoyancy collar: Anti-buoyancy collars shall be manufactured from reinforced fiberglass and shall be designed to prevent floatation of the valve pit assembly when ground water is present at grade. Anti-buoyancy collar shall be a minimum of 53” square with rounded corners and a minimum ¾” thick.

F. Grommets: Holes for the house gravity line connections into the collection sump shall be field located and cut. EPDM Rubber grommets as manufactured by AIRVAC shall be used to make a watertight seal.

G. Connectors and seals: A roll of butyl shall be provided for use between the valve pit cone and collection sump.

H. Manufacturer: Valve pit model VP3042H as manufactured by AIRVAC.

2.2 FLEXIBLE CONNECTOR

A. Flexible connector: Flexible connector shall be 3” in diameter with an overall length of 7’10 ¼" (+/-3/4”). The flexible connector shall incorporate a 4’ 2” long piece of flexible pipe that is specially manufactured for AIRVAC. The flexible pipe shall have the proper outside diameter for solvent welding into PVC fittings. One end of the flexible pipe shall be joined to a piece of 3” Sch. 40 PVC pipe with a 3” Sch. 40 PVC coupling. The opposite end of the flexible pipe shall be fitted with a 3” Sch. 40 PVC coupling.

B. Manufacturer: Flexible connectors as manufactured by AIRVAC.

2.06 VALVE PIT COVERS

A. Valve pit covers: Valve pit covers shall be designed for H-20 loading. Castings shall meet ASTM A-48, Class 30 gray cast iron.

B. Identification markings: The words "AIRVAC SEWER" shall appear on top of cover in 1” tall raised lettering.

C. Pick holes: Covers for the two-piece valve pit shall have an open pick hole and no elastomer seal. Manufacturer: USF BL Cover US FOUNDRY & MFG CORP.

D. Concrete collars: Concrete collars are required for all AIRVAC valve pits located in traffic areas or as directed by the Engineer. See Construction Plans for details.

E. Manufacturer: US FOUNDRY & MFG CORP.

2.07 CONCRETE BUFFER TANKS.

A. Tank: A 48” diameter, reinforced pre-cast concrete manhole conforming to CCU Specification 002320, with integral base shall be provided, containing a bottom sump as shown on the standard details.

B. Manhole Joints: Joints shall be tongue and groove in pre-cast wall; pre-formed flexible plastic gaskets, Type 1, rope form, which meet or exceed FS-SS-S-00210.

C. Collections sumps: The sump shall be 1’-6” in diameter and 1’-0” deep. The bottom of the tank shall be sloped from the gravity inlets toward the sump as shown on the standard details. Dual valve buffer tanks shall include provisions to divide flow between the two collection sump basins.

D. Pipe penetrations: All pipe penetrations through the buffer tank walls shall be watertight. Contractor shall submit material to be used for sealing to the Engineer for approval.

E. Cover: Manhole casting and frame, with concealed pick holes and gasket. Cover to be clear, even grain, tough, gray cast iron, smooth, true to pattern and free of projections, sand holes, warp and other defect; designed for H2O traffic loading; Class 30 Gray Iron; ASTM A48. Model R5900 Neenah Foundry or equal. The words "AIRVAC SEWER" shall appear on top of the cover in 1” tall raised lettering.
G. Related items: Buffer tanks shall contain provisions to accept the installation of one or two AIRVAC vacuum interface valves as indicated on the Construction Plans. The vacuum valves are to be as described in paragraphs 2.11 and 2.12 below, with the exception that they are to be Type “D”, intended for use with external breathers.

H. Each Buffer Tank shall be constructed with a dedicated 6” Air Intake. See Construction Plans for details.

I. Accessories: Buffer Tank Kits are to be supplied by AIRVAC and shall include the flexible breather and all fittings except the underground piping or tubing. The kit shall also include the internal piping supports, tubing, tubing clamps, no-hub clamps and sensor cap(s). Refer to the standard details for specific parts assembly.

2.08 VACUUM VALVE AND VALVE PIT INTERDEPENDENCE

A. Interdependence: The vacuum valve and valve pit shall be designed to function together as a complete system. Valve, valve pits and accessories shall be by the same manufacturer.

B. Manufacturer: Vacuum valves, valve pits and accessories as manufactured by AIRVAC.

2.09 VACUUM VALVE

A. Design conformance: Vacuum valves shall be designed such that head loss through the valve is at minimum. The “Cv” factor for these valves shall be 268 or higher. An Independent laboratory certificate shall be supplied upon request.

B. Type: Internal breather; Type F as manufactured by AIRVAC.

C. Valve Construction: Full-port 3-inch diameter valve capable of passing a 3” diameter solid while matching the outside diameter of 3” SDR 21 PVC pipe. Valve to be vacuum operated on opening and spring assisted on closing; valve configuration arranged so that the sewer vacuum ensures positive valve seating. Valve plunger and shaft arranged to be completely out of the flow path when valve is in open position.

D. Vacuum Operator: Self lubricating, rolling diaphragm type; diameter sufficient to open valve fully using line vacuum to overcome sealing force; equipped with elastomer seal where shaft enters housing; vacuum drain connected to housing to return seal leakage to sewer when valve cycles.

E. Operation: Valve and sensor / controller require no outside power service.

F. The valve shall be manufactured such that small objects may be removed from the valve seat area by means other than complete valve removal and disassembly.

G. The valve and sensor/controller shall be capable of operation when submerged in water to a depth of 2 feet above the upper most component.

H. Materials: Valves shall be chemically resistant to sewage and sewage gases. The valves shall be constructed from materials described in the following table.
COMPONENT | MATERIAL
--- | ---
Valve Body | Glass Filled Polypropylene
Valve Shaft | 316 Stainless Steel
Valve Shaft Seal | Buna N Rubber
Valve O-Rings | Buna N Rubber
Valve Spring | 304 Stainless Steel
Valve Plunger | Polypropylene
Valve Seat | EPDM Rubber
Valve Piston Cup | Polypropylene
Valve Bearing | Acetal

I. Furnished: Vacuum valves shall be furnished by the Owner.
J. Installed: Vacuum valves shall be installed by others (see paragraph 1.02 above for exception).
K. Manufacturer: Vacuum valve and accessories as manufactured by AIRVAC.

2.10 VACUUM VALVE SENSOR / CONTROLLER

A. The vacuum valve shall be equipped with a sensor-controller which shall rely on atmospheric air and vacuum pressure from the downstream side of the valve for its operation, thereby requiring no other power source. Rising liquid within the holding sump shall initiate the opening of the valve when sufficient head pressure is reached in the holding sump. The activation point shall equate to approximately 10 gallons of liquid. The controller shall apply line vacuum from the downstream side of the vacuum valve and apply it to the actuator chamber and fully open the valve.

B. The controller shall be capable of maintaining the valve fully open for a fixed period of time. This shall be field adjustable over a range of 3 to 10 seconds. After this time period has elapsed, the controller shall apply atmospheric air to the actuator chamber permitting spring assisted closure of the valve.

C. The controller shall be serviceable by factory-trained personnel and shall be removable from the valve by means of a sliding key device. There shall be no tools required to remove and replace the controller from the vacuum valve with the exception of tubing clamp nut drivers.

D. The entire body shall be constructed to allow visual inspection of the internal mechanism without disassembly. The controller shall be equipped with external test ports for bench testing of various chambers during re-build.

E. Each vacuum valve controller shall be equipped with a port for connecting a portable, self-contained valve cycle counter.

F. The controllers shall be chemically resistant to sewage and sewage gases. Controllers shall be constructed from materials described in the following table.

COMPONENT | MATERIAL
--- | ---
Controller Body | Clear Nylon 11
Controller Shaft | Acetal
Controller Springs | Stainless Steel
Controller O-Rings | Buna N Rubber
Controller Tubing | Polyurethane
All Fasteners | 304 Stainless Steel

G. Manufacturer: Vacuum valve controller as manufactured by AIRVAC.
2.11 IN-SUMP BREATHER

A. With the exception of the individual house 4" gravity line air intake (or the 6" dedicated air-terminal, if used), there shall be no other external sources of air necessary or permitted as a part of this assembly.

B. A factory provided internal sump breather unit arrangement shall connect the controller to its air source and provide a means of assuring no liquid can enter the controller during system shut downs and re-starts.

C. The internal sump breather shall be arranged to prevent sump pressure from forcing the valve to open during low vacuum conditions and provide positive sump venting regardless of traps in the home gravity service line.

D. Manufacturer: In-sump breather as manufactured by AIRVAC.

2.12 6" DEDICATED AIR-TERMINAL-MOLDED VERSION (AIRVAC Standard)

A. Valve Pits: When specified and detailed on the Construction Plans, this item is to be used in-lieu of individual 4" air-intakes that are normally provided by the home Owner's plumber.

B. Buffer Tanks: All locations.

C. Complete Dedicated air-terminal: One 6" dedicated air-terminal assembly as shown on the Construction Plans shall be connected to each buffer tank and, where called for, each valve pit sump through one of the four sump openings provided.

D. Height: The air-terminal's slotted door shall be above the highest expected water level as shown on the standard details. The molded air-terminal is intended to be installed flush with the ground, but may be partially buried up to a maximum of 12 inches. (See standard details).

E. Piping: 6" pressure rated SDR 21 PVC pipe and Sch 40 pressure rated fittings shall be used.

F. Molded Air-Terminal: Molded polyethylene construction with approximately 3/16" wall thickness, and equipped with pipe grommet for sealing against ground water intrusion. Standard color Simulated Brown Stone.

G. Support: This product is intended to be self supporting but may also be attached to a permanent structure if so desired.

H. Options (only if specified by the Engineer): Other colors may be available upon request. The air-terminal may also be equipped with an optional cycle counter and/or other AIRVAC devices. The air terminal is also available without an access door (AIRVAC Model AT1000-4).

I. Manufacturer: 6" Dedicated Air-Terminal as manufactured by AIRVAC (Model AT1000-1).

2.13 SPARE PARTS – VALVE RELATED (1 SET PER 100 VALVE PITS) – SUPPLIED AND STORED BY OWNER

A. The vacuum valve manufacturer shall provide one (1) set of spare parts for every 100 valve pits (rounded to nearest 100).

B. One (1) set of spare parts consists of the following:
### VALVE PIT

<table>
<thead>
<tr>
<th>Qty</th>
<th>Description</th>
<th>Qty</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 ea</td>
<td>3&quot; Model F Vacuum valves</td>
<td>6 ea</td>
<td>3&quot; Valve rebuild kits</td>
</tr>
<tr>
<td>3 ea</td>
<td>Sump breathers</td>
<td>6 ea</td>
<td>Controller mounting O-rings</td>
</tr>
<tr>
<td>3 ea</td>
<td>Installation part bags</td>
<td>1 ea</td>
<td>Tube of controller grease</td>
</tr>
<tr>
<td>6 ea</td>
<td>Controllers</td>
<td>1 ea</td>
<td>Tube of valve shaft grease</td>
</tr>
<tr>
<td>3 ea</td>
<td>Controller rebuild kits</td>
<td>3 ea</td>
<td>Surge suppressors</td>
</tr>
<tr>
<td>6 ea</td>
<td>3&quot; No-hub couplings</td>
<td>12 ea</td>
<td>Tubing clamps</td>
</tr>
<tr>
<td>25 ft</td>
<td>3/8&quot; clear tubing</td>
<td>3 ea</td>
<td>Controller mounting keys</td>
</tr>
<tr>
<td>50 ft</td>
<td>5/8&quot; clear tubing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 ea</td>
<td>3&quot; grommet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 ea</td>
<td>6&quot; grommet</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 2.14 SPECIAL TOOLS – SUPPLIED AND STORED BY OWNER

A. The vacuum valve manufacturer shall provide one (1) set of special tools.

B. One (1) set of special tools consists of the following:

### VALVE PIT

<table>
<thead>
<tr>
<th>Qty</th>
<th>Description</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1 ea</td>
<td>Sensor pipe puller</td>
<td>1 ea</td>
<td>24 hr. portable chart recorder</td>
</tr>
<tr>
<td>2 ea</td>
<td>No-hub torque wrenches</td>
<td>1 ea</td>
<td>AIRVAC portable Test Box</td>
</tr>
<tr>
<td>1 ea</td>
<td>0-50&quot; Magnehelic gauge</td>
<td>1 ea</td>
<td>AIRVAC Valve repair stand</td>
</tr>
<tr>
<td>1 ea</td>
<td>2 ½&quot; vacuum gauge</td>
<td>3 ea</td>
<td>AIRVAC cycle counters</td>
</tr>
</tbody>
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#### PART 3 - EXECUTION

3.01 TRENCHING (See CCU Standard Detail)

3.02 DEWATERING (See CCU Specification 002240, Dewatering)

3.03 VACUUM SEWER LINE INSTALLATION

A. All vacuum sewers shall be laid to the line and grade shown on the Construction Plans, with the use of construction laser beam equipment. All pipe which has been designed to slope downward shall be installed to slope continuously downward. There shall be no abrupt sags or bellies in the line. The maximum deviation from planned elevations shall not exceed 0.05 feet in any 100 feet of length. This plus or minus tolerance applies to all pipe sizes.

B. Installation by the horizontal directional drilling (HDD) method is not acceptable, unless prior, written approval is obtained from the Engineer. Approval would be on a case-by-case basis. Request to use HDD is a major deviation requiring different pipe materials, joints, etc. Should Engineer approve the use of HDD, the same installation tolerances specified above for open-cut would apply, no abrupt sags or bellies would be allowed and the Contractor would be required to verify such through electronic means while the pipe is being installed.

C. Use proper tools and equipment for handling and laying of pipe and fittings.

D. Prevent entrance of dirt or foreign matter or damage to pipe lining or coating. Plug the pipe any time that work is stopped.

SECTION 02730 UNDERGROUND VACUUM SEWER PIPING

Page 11 of 16
E. Do not allow trench water to enter the pipe at any time.
F. No defective pieces are permitted. Defective pieces discovered after installation will be removed and replaced with a sound piece.
G. Fully bare pipe along its entire length.
H. Lay and join pipe in accordance with manufacturer’s instructions to insure pipe thermal expansion and contraction. Lay pipe with spigot end downstream.
I. Assemble Lifts as shown on the Construction Plans using either solvent welded or “Reiber” gasketed joints, assembled under controlled environmental conditions.
J. All fittings on vacuum mains, pit connection to vacuum main and change of directions shall be field assembled by the Contractor using either solvent welds or “Reiber” type gasketed joints in accordance with the Construction Plans and as directed.
K. Install marker balls, and metallic marker tape along the entire length of the vacuum sewer system as indicated in contract documents.
L. Place compacted fill in entire space between the pipe/fittings and the trench walls.
M. Use temporary manufactured plugs in end of pipes when work is not in progress.
N. Provide pipe through casing with support skids to hold pipe to center of casing as shown on the Construction Plans. Alternate support methods may be acceptable, contingent upon Engineer’s review and approval.
O. Bed pipe as specified in section describing trenching.
P. Verify pipe grade, location, and elevation at each change in grade and change in direction, and record on the plans and in a notebook in a manner acceptable to the Engineer.

3.04 DIVISION VALVE AND GAGE TAP INSTALLATION

A. Division valves shall be resilient wedge gate valves. See paragraph 2.03 above.
B. Furnish and install valves under provisions of paragraph 2.03 above.
C. Where called for and required on the Construction Plans, install gage tap adjacent to division valve as shown on the standard detail.
D. Provide concrete collar around each division valve and gage tap, where installed.

3.05 VALVE PIT INSTALLATION - GENERAL

A. The end of the stub-out pipe that passes through the valve pit grommet shall be beveled. A stop ring shall be used to ensure the pipe does not protrude more than 4" inside the collection sump with an allowable tolerance of ±1/8".
B. All pipes that penetrate the valve pit through grommets shall be Sch 40 or SDR 21 pressure rated PVC pipe. No other pipe is acceptable.
C. Water-soluble soap or silicone spray shall be used when installing PVC pipes through AIRVAC grommets. Use of petroleum lubricant or pipe lube is prohibited.

3.06 VALVE PIT INSTALLATION (2-PIECE PITS)

A. Valve pits shall be assembled in accordance with manufacturer’s instructions.
B. Valve pits shall be installed using the following procedures:
   1. Install the suction and sensor pipes.
   2. Determine proper location and alignment with vacuum main and wye connection.
   3. Determine grade elevation for the top of the pit package.
   4. Determine the gravity line depth from the home to the pit package and verify that adequate slope exists between the house and the sump inlet. If sufficient fall does not exist, consult the ENGINEER or inspector prior to completing the valve pit installation.
   5. Determine which raised flat area of the sump will require a gravity line stub out. Mark and cut the holes in the raised flat area as required. Each coupon shall be removed from the hole saw and hung inside the upper chamber as proof of its removal.
3.07 AIRVAC SUMP TESTING - 2-PIECE PITS

A. One sump test shall be performed. This test is performed after all holes have been field cut, grommets and stub-out pipes installed and the entire valve pit assembly is ready for installation. This test is done to test the grommets and the overall sump assembly.

B. Sump testing shall be done as follows:
   1. Attach provided sump test assembly onto the end of the 3” suction pipe inside the valve pit with a 3” No-hub or Fernco coupling and PVC test cap.
   2. Secure 1/8” tubing to the HIGH port on a 0-50” magnehelic gauge, and then connect the other end to the tubing port on the PVC test cap.
   3. Install a test plug in the sump breather hole using the rubber seal provided. Apply water soluble soap to the rubber seal before installation. Turn 90 degrees to make a tight seal.
   4. Pressurize the collection sump though the air chuck on the PVC test cap.

SECTION 02730 UNDERGROUND VACUUM SEWER PIPING
5. Test at 40" water gauge pressure. Leakage must be under 5" water gauge in one (1) minute.
6. If leak test fails the CONTRACTOR must locate the leak, repair it and retest.

3.08 CONCRETE BUFFER TANK INSTALLATION

A. Install buffer tank as shown on the Construction Plans, and applicable portions of the Technical Specification.
B. Fabricate and install the suction and sensor pipes as shown on the standard details. Attach these lines to the buffer tank sidewalls using the hardware included in the AIRVAC Buffer Tank Kit. Secure to wall using Stainless Steel anchor bolts.
C. The 3" service lateral is to be stubbed into the buffer tank and capped or otherwise sealed until the vacuum valve is installed.
D. The following describes a typical installation procedure for external breathers as utilized with AIRVAC valves and may duplicate portions of AIRVAC's installation instructions described elsewhere:
   1. Mark and cut the buffer tank wall as required for the underground portion of the breather assembly. The hole is to be located at least 2" above the 5/8" breather port on the AIRVAC controller. For best results, avoid placing the opening directly behind the AIRVAC valve. The preferred location is 45° either side of the valve.
   2. Contractor shall consult with AIRVAC regarding flexible breather assembly materials, and jointing and construction methods. Contractor shall follow manufacturer's instructions and recommendations.
   3. Install breather unit as shown on the Construction Plans and as directed. It is important that the breather line connecting the valve pit to the flexible breather assembly be laid at a uniform slope towards the valve pit and that no sags be allowed in this line. Insure all buffer tanks wall penetrations are sealed.
   4. Install exposed portion of the flexible breather assembly away from vehicular and foot traffic areas.
   5. Provide temporary manufactured plugs for any portion of the breather assembly not otherwise sealed for the entire construction period.

3.09 BUFFER TANK TESTS

A. Buffer tanks shall be tested after assembly. Two tests are required: a tightness test of the tank itself and a Breather test.
B. Stub-ins and pipe plugs shall be secured to prevent movement while tests are conducted.
C. Tank Tightness Testing: Test the buffer tank as follows:
   1. Contractor shall fill the entire buffer tank with water to a point even with the top frame of the man-way. If any water level in the buffer tank falls ½" or more during a 24 hour period, the cause of the leakage shall be determined and appropriate repairs made. The assembly shall be retested in this manner until no leakage in excess of ½" in 24 hours is achieved.
   2. Any visible leak must be repaired even though the water tightness test may be successful.
   3. After final testing, the buffer tank is to be de-watered by means other than by the vacuum system.
D. AIRVAC Breather Testing: After installation is complete, test the breather as follows:
1. Fabricate a test air pressure connection by drilling and tapping a 3/4' pipe plug to accept a vehicle tire pressurization fitting or other air connection shut off device.
2. Remove breather dome and insert this fitting into adaptor on top of breather. It may be necessary to install a temporary pipe clamp around the flexible pipe at the adapter for test purposes. This clamp can be removed after testing since this joint need not be watertight.
3. Install the breather tee inside the valve pit and cap the 5/8' end.
4. Using the 3/8' end of the breather tee, connect a 0-50' Magnehelic water gauge.
5. Pressurize the breather assembly and test at 40' water gauge pressure for 15 minutes. The breather is acceptable if no loss of pressure is observed for this period.
6. Installation may proceed per manufacturer's instructions and recommendations.

E. Installation and operation of vacuum equipment and indicating devices shall be in accordance with manufacturer's recommendations.

3.10 VALVE INSTALLATION

A. Vacuum interface valve installers shall be required to attend an Airvac facilitated training course prior to the installation of the vacuum valves. Course will be provided by Airvac on-site.

3.11 VACUUM LINE TESTING – DAILY TESTING

A. A two (2) hour vacuum tightness test of all sewer mains and lateral connections shall be conducted daily as follows:
1. Plug all open connection with manufactured rubber stoppers or manufactured temporary caps, fitted to the pipe by "no-hub" couplings.
2. Apply a vacuum to 22 inches Hg to the pipes and allow the pressure to stabilize for 15 minutes.
3. There shall be no loss of vacuum in excess of 1% per hour for a two-hour test period.
4. There shall be absolutely no water allowed to be admitted into the piping network during this test.
5. As pipe is laid the new section shall be tested in addition to the previously laid pipe on that main.
6. The Contractor should leave uncovered the sewer main pipe joints until after the daily vacuum test is complete so that any leaks can be easily located and repaired.

B. If the Contractor successfully passes the daily 2-hour test for seven (7) consecutive working days or two thousand (2,000) feet of pipe, a request to modify the test procedures may be made to the Engineer. If so approved by the Engineer, the daily two (2) hour vacuum test procedure may by modified as follows:
1. The procedure may be altered to allow the trench to be covered as work progresses rather than being kept open all day as is the norm with the daily 2-hour test.
2. Should a line fail the vacuum test while utilizing this test modification, the Contractor shall take whatever action necessary at his own expense to successfully pass the test including the re-excavation of the trench, leak detection, line repair, and additional cleanup as required by the Engineer.
3. After a failure, the Contractor must return to the standard testing procedures in order to "re-qualify" for the modified testing again.
4. This test modification is optional, and as such, the Contractor assumes all liability in its use, even if approved by the Engineer.
3.12 VACUUM LINE TESTING – FINAL ACCEPTANCE TEST

A. A four (4) hour vacuum tightness test of the complete vacuum piping network, including all sewer mains and lateral connections shall be conducted as follows:
   1. Subject the entire sewerage system to a vacuum of 22 inches Hg, and allow it to stabilize for 15 minutes.
   2. There shall be no loss greater than 1% per hour over a four (4) hour test period.
   3. There shall be absolutely no water allowed to enter the piping system or the vacuum station during this test.
B. Contractor to provide 48 hours notice to Engineer prior to test.
C. Contractor to assure all division valves are open prior to beginning of Final Acceptance Test.
D. Final Acceptance Test shall be recorded on approved vacuum chart recorder. This chart will not be considered valid unless witnessed by Engineer on test equipment at the beginning and the end of the vacuum test period.
E. Engineer will sign and date chart to verify witness of test. This signature does not indicate acceptance of the system.

3.13 LINE FLUSHING

A. After successful final four (4) hour acceptance testing, flush lines to remove debris and foreign materials that accumulated during construction.
B. Suggested procedure (In the absence of special test apparatus, this procedure will require the use of vacuum valves, which must be installed by the Owner. Coordination is therefore required.):
   1. Place system under vacuum.
   2. Add water and air in controlled amounts to valve pits at extreme ends of system.
   3. Utilize system vacuum to transport water and debris to collection point.
   4. Continue procedure until water entering at collection point is free of contamination or debris.
   5. If the vacuum collection tank is used as the collection point, monitor volume of liquid in tank and pump out as necessary.
   6. Use system sewage pumps only after verifying that no debris is present in collection tank.
   7. If debris is present, use other methods to empty collection tank.
   8. At completion of flushing, clean collection tank of all collected debris.
   9. Seal system and make ready to place into operation.
C. Alternate flushing procedure subject to Engineer's review and approval.

END OF SECTION