

SECTION 13221 - PLASTIC BLOCK AIR SCOURING FILTER UNDERDRAINS

City of San Diego, CWP Guidelines

PART 1 -- GENERAL

1.1 CONTRACTOR'S OPTION FOR THE TYPE OF SYSTEM

- A. An alternative system for plastic block air scouring filter underdrains indicated in this Section are the strainer nozzle air scouring filter underdrains, indicated in Section 13222. The CONTRACTOR has the option to select either type of system.

1.2 WORK OF THIS SECTION

- A. The WORK of this Section includes designing, furnishing and installing the filter underdrain system and media-retaining gravel system as indicated including all items and materials within the filter cell, for collecting filtered water; for uniformly distributing backwash air and water; for retaining filter media; and for retaining, supporting, and sealing the filter underdrain system; as required for a complete and operable filter underdrain system.
- B. The WORK also requires that a single manufacturer accept responsibility for design of and furnishing the filter underdrain system as indicated but without altering or modifying the CONTRACTOR'S responsibilities under the Contract Documents.

1.3 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 03315 Grout
 - 2. Section 05500 Miscellaneous Metalwork
 - 3. Section 13226 Anthracite Media
 - 4. Section 13229 Gravel Filter Bed

1.4 CODES

- A. The WORK of this Section shall comply with the current editions, with revisions, of the following codes as adopted by the City of San Diego. Municipal Code:
 - 1. Uniform Building Code

1.5 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted in compliance with Section 01300.
 - 1. Documentation that the manufacturer meets the qualification criteria.

2. Manufacturer's catalog of the proposed filter underdrain system, identifying all components of the system intended to be used.
3. Complete and explicit details of the design, construction, and operating characteristics of the proposed filter underdrain system. Submittal data shall include applicable structural design calculations, materials of construction, complete head loss data for air, water, and combined air/water flows, installation details and leveling requirements, the maximum percentage of flow maldistribution within a filter cell, certification of compatibility of the underdrain system with the filter media furnished, and all other data necessary to demonstrate conformance with requirements of the Contract Documents.
4. Complete test reports and design calculations showing conformity with all flow design requirements. Submittal data shall include the full range of flow conditions indicated and pertinent physical relationships between air and water metering orifices; cross-sectional flow areas for water and air during transport to the flow metering elements; relative magnitudes of entrance, transport, metering, and discharge losses; and such other data necessary to demonstrate conformance with requirements of Contract Documents.
5. Design calculations referred to above shall be stamped and signed by a California registered structural engineer (for structural calculations) and a California registered civil engineer (for hydraulic calculations).

1.6 OWNER'S MANUAL

- A. The following shall be included in the OWNER'S MANUAL in compliance with Section 01300:
 1. Manufacturer's instructions for installation of all system components.
 2. Manufacturer's maintenance procedures.
 3. Manufacturer's certificate of compliance with this Section of the Specifications.
 4. Complete test reports for all field tests, describing the units tested, the type of test, test setups, procedures, and instrumentation, and test flow rates, pressures, levels, and all other data and test results as required to demonstrate that all items tested meet the requirements of the Contract Documents.

1.7 SERVICES OF MANUFACTURER

A. Installation

The CONTRACTOR shall provide the services of the manufacturer's technical representative for not less than [] working days to inspect and supervise the installation of the filter underdrain system.

B. Field Testing

The CONTRACTOR shall also provide the services of the manufacturer's technical representative for not less than [] working day to inspect and supervise the field testing of the system.

1.8 QUALIFICATIONS

- A. **Manufacturer:** Company specializing in design and manufacture of filter underdrain systems, with a minimum of one successfully performing installation of comparable size and complexity constructed in the recent past.

PART 2 -- PRODUCTS

2.1 SYSTEM REQUIREMENTS

- A. **System Description:** The filter underdrain system shall be of the dual-parallel lateral type, whereby feeder and compensatory laterals are provided within a single block. The blocks shall be self-contained as regards pressure loadings, and shall require only nominal anchorage in the filter cell to resist buoyant and dynamic forces during operation. The feeder laterals shall have a generous cross-sectional area as required to assure low wash water and air transport velocities. The flow metering elements shall consist of an arrangement of orifices properly sized and located between the feeder and compensatory laterals and between the compensatory laterals and top of the blocks. The entrance, transport, and orifice losses, and the location of the orifices shall be coordinated to produce uniform air and water flows throughout the filter cell at all indicated flow conditions. The number and size of the orifices shall be uniform throughout the filter cell. The orifices shall be sized as required to introduce necessary metering head losses, but shall be sufficiently large to prevent clogging.
- B. **Arrangement:** The filter underdrain system shall be arranged for: (1) end entry/exit of water into a collection and distribution chamber at one end of the filter cell, which provides bottom exit/entry of water for the dual lateral system, and (2) for parallel end entry of backwash air to a primary air distribution "T" shape manifold in the distribution chamber.
- C. **Materials and Construction:** The individual blocks used in the system shall be of a suitable, impervious, high strength, completely corrosion-resistant, high density polyethylene material, having uniform smooth surfaces and all orifices properly deburred. The blocks shall have ridges and pockets for structural rigidity and to key into grout. The block dimensions and weight shall permit ease of handling and installation. The blocks shall be mechanically joined to form a continuous lateral run equivalent to the length of the filter cell. The joints shall be double-gasketed, bell and spigot type, restrained with stainless spring clips.
- D. **Support Gravel:** The gravel filter bed is indicated in Section 13229. If, in the opinion of the CONTRACTOR or the underdrain manufacturer, the gradations or

number and sequence of layers of gravel do not meet the backwash design and test criteria indicated herein the gradation or layers may be changed as long as the total depth of gravel bed and the elevation of the top of the anthracite medium is not changed.

E. Performance Criteria

1. **Flow Rates:** The filter underdrain systems shall be designed, furnished and installed to perform satisfactorily and as indicated when operated under the following flow conditions:
 - a. Downflow of filtered water at [] to [] gpm/ft².
 - b. Upflow of backwash air at [] to [] scfm/ft².
 - c. Upflow of backwash air at [] to [] scfm/ft², together with backwash water at [] gpm/ft².
 - d. Upflow of backwash water at [] to [] gpm/ft².
2. **Air Temperature:** During backwash with air, the air temperature at the backwash air trough will be a maximum of 200 degrees F.

2.2 DESIGN REQUIREMENTS

- A. The filter underdrain system shall be designed to insure long-term stability in its operating characteristics. It shall be resistant to changes in head loss, flow uniformity, corrosion, and any other effects which would in time cause loss of efficiency or effectiveness of its operation. The underdrain system shall be a plastic dual-parallel lateral filter underdrain system.
- B. The filter underdrain system shall be designed to produce near-uniform air and water flows throughout the filter cell. Flow uniformity per square foot of filter area shall be as required to permit efficient and effective operation and backwashing, and there shall be no localized areas with flow rates which would cause mounding, lateral displacement, or other deleterious disturbances in the gravel bed or anthracite medium.

The filter underdrain system, as installed, shall satisfy the following criteria for acceptable flow uniformity. Maldistribution of air and water flows during backwash, for all indicated flow conditions, shall not exceed:

1. Water: Plus or minus 5 percent of average gpm/square foot of filter.
2. Air: Plus or minus 10 percent of average cfm/square foot of filter.

C. STRUCTURAL

1. **General:** The filter underdrain system, including anchorage, and supports, shall be designed to safely withstand loadings as indicated.

2. **Internal Loading:** The filter underdrain system, when installed, shall be designed for a net internal loading during backwash of the greater of either [600] psf or [200 percent] of maximum pressure at maximum backwash rates. No credit shall be taken for the weight of gravel or filter media in the design calculations.
3. **Downward Load:** The filter underdrain system shall also be designed to withstand a net downward loading of not less than [1,400] psf, plus its own dead weight.
4. **Safety Factor:** A minimum safety factor of 2.0 shall be included in the design to account for dynamic loadings which may occur during the initiation and termination of air backwash.
5. **Handling Loads:** The design shall adequately provide for all loads incurred during shipment, handling, and installation.

2.3 MATERIALS

- A. **General:** Materials used in the filter underdrain system shall conform to the requirements indicated herein.
- B. **Grout:** Grout shall conform to the applicable requirements of Section 03600. Grout shall be a mixture of one part of portland cement and two parts of sand, with nonshrink admixture and strictly in accordance with the written recommendations of the underdrain manufacturer/supplier.
- C. **Metals:** Metals shall conform to the applicable requirements of Section 05500. All exposed metals, including but not limited to anchor bolts and anchorage, fasteners, washers, spring clips, etc., shall be Type 304 or 316 stainless steel.
- D. **Grout Retaining Strips:** Grout retaining strips shall be of redwood, cypress, or PVC properly keyed to prevent the strips from working loose in time, in accordance with the underdrain manufacturer's instructions.

2.4 MANUFACTURER

- A. The underdrain system shall be a plastic dual-parallel lateral filter underdrain system as manufactured by F.B. Leopold Company, Inc., or equal.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. **General:** The CONTRACTOR shall install the filter underdrain system in strict accordance with the manufacturer's installation drawings and printed recommendations, and as indicated herein. The CONTRACTOR shall obtain from the underdrain manufacturer such written installation details and recommendations as are necessary to acceptably interface the filter underdrain system with all surrounding structures, including requirements for grouting keys and pockets, dowels, and anchorages. The CONTRACTOR is cautioned that such installation details are not indicated on the Contract Drawings, as they will vary according to the individual manufacturer requirements.

- B. **Placement and Cleaning:** The CONTRACTOR shall take all necessary precautions recommended by the underdrain manufacturer in writing and as indicated to insure that the underdrain system and piping connected thereto is completely clean and free of any debris, dirt, or other foreign materials which could clog the underdrain system or interfere with flow. Backwash air and water piping shall be thoroughly flushed clean. Air piping shall be flushed with air only. All loose debris and dirt within the filter cell and flume shall be removed by brooming down and vacuuming. Care shall be taken to prevent grout from extruding into any flow passages or ports, and any extruded grout shall be removed. As installation progresses, underdrain sections partially completed shall be protected with heavy building paper, masking tape, or other acceptable means to maintain cleanliness. Cleanliness shall be maintained until final placement of filter media. The media retaining gravel system shall be placed after the preliminary distribution test indicated under "Field Testing."

- C. **Underdrain Installation:** The filter underdrain sections shall be set in place and grouted to position the air metering orifices in a true and level plane within the lesser of $\pm 1/8$ inch or the tolerance specified by the manufacturer/supplier of the filter underdrain. The filter base slab shall be prepared as necessary to enable installation within the required level tolerance. The CONTRACTOR shall flood the underdrain with water to ascertain that this level tolerance is met. Failure of the filter underdrain sections to meet the level tolerance shall require removal of the failed sections and replacement with new filter underdrain sections to within the tolerances.

- D. **Grouting:** As the underdrain sections are set in place, all grouting spaces shall be completely filled and finished smooth.

3.2 FIELD TESTING

- A. **General:** The CONTRACTOR shall conduct all indicated testing and shall furnish all material, instrumentation, suitable portable blower if necessary, personnel, etc., for the tests indicated. All costs for such testing shall be borne by the CONTRACTOR, as well as the costs for all work and materials to correct deficiencies revealed during testing and retesting shall be borne by the CONTRACTOR. The CONTRACTOR shall give the CONSTRUCTION MANAGER sufficient advance notice of the testing to enable witnessing the tests.

- B. **Data Accuracy:** All test setups, procedures, and instrumentation shall be capable of providing data accuracy of ± 2 percent.
- C. **Underdrain Flow Distribution Test:** The filter underdrain system in each filter cell shall be given a visual water flow distribution test to verify that orifices are not clogged with debris and flow distribution is uniform. This test shall be performed before filter media and gravel bed is placed. The filter underdrain system shall be partially filled with clean water to approximately half the height of the underdrain system at the beginning of the test. The test flow rate shall be at the normal design backwash rate of [] gpm/ft² and the flow rate shall be sustained for approximately 2 minutes while visual observations are made. The test shall be repeated 3 times.
- D. **Visual Flow Test:** During each test, flow from each orifice as well as any sign of dead spots or boils shall be visually observed. The CONTRACTOR shall take such measures as are necessary to correct any deficiencies revealed by these tests, and shall repeat the specified tests until such deficiencies are corrected.
- E. **Gravel Disturbance Test:** The gravel disturbance test shall be performed following placement of the gravel and before the filter media is placed. The gravel bed in 2 filter cells selected by the CONSTRUCTION MANAGER shall be tested. This test shall determine stability of the gravel bed to displacement by backwash sequence. The gravel bed-tests shall consist of 10 backwash cycles of normal filter wash with air scouring applied as follows:
1. Start with initial water level at 3 inches above the top of gravel bed.
 2. Air backwash at 4 cfm/ft² for 4 minutes.
 3. Simultaneous air and water backwash at 4 cfm/ft² and 8 gpm/ft², respectively, for 4 minutes.
 4. Water backwash at 22.5 gpm/ft² for 3 minutes.
 5. Drain down to initial level and repeat.
- F. **Acceptance Criteria:** At the conclusion of 10 backwash cycles, the water surface shall be lowered to the top of the gravel surface. The gravel surface shall be inspected, and there shall be no areas deviating more than $\pm 1/2$ inch from the average level surface, nor shall particles originally below the surface be apparent at the surface in any significant number. If one gravel system in one filter cell fails to meet the test requirements, one more filter cell shall be tested. If the gravel systems in 2 filter cells fail to meet these test requirements, then the gravel systems in all filter cells shall be tested. The CONTRACTOR shall replace and retest the gravel systems in each filter cell which fails to meet test requirements.
- G. **Retesting:** Should it be determined that flow maldistribution is responsible for gravel disturbance, the CONTRACTOR shall correct the maldistribution problem and retest the gravel system.

** END OF SECTION **

[FEBRUARY 1992]
[CONTRACT NO.] [CONTRACT TITLE]

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13221-8