

## SECTION 14555

### SHAFTLESS SCREW CONVEYORS

#### PART 1 – GENERAL

##### 1.1 DESCRIPTION

###### A. Scope

1. Furnish and install shaftless screw conveyor system
  - a. Conveyor CV-1: Convey compacted raw wastewater screenings from the screenings compactors to multiple discharge points over the screenings container inside the Headworks Building
2. Conveyor to be furnished complete with troughs, liners, covers, spiral flighting, electric drive motor and gear reducer, chutes and connections, manually operated slide gates, supports, control panel and all other appurtenances and accessories as specified herein and as required for proper installation and operation, including manufacturer's field services

###### B. Additional Required Specified Elsewhere

1. Section 01010: Summary of Work
2. Section 01340: Shop Drawings, Product Data and Samples
3. Section 01600: Materials and Equipment
4. Section 01730: Operating and Maintenance Data

###### C. Related Requirements Specified Elsewhere

1. Section 03600: Grout
2. Division 5: Metals
3. Section 09900: Painting
4. Division 11: Equipment
5. Section 13300: Utility Control System
6. Division 16: Electrical

##### 1.2 QUALITY ASSURANCE

###### A. Manufacturer's Qualifications

1. All equipment and accessories to be furnished by or through a single manufacturer experienced in the design and manufacture of equipment for conveying the specified wastewater related materials
  - a. Equipment to be the standard product of the manufacturer with specified optional equipment and components
  - b. Manufacturer to certify to a minimum of ten (10) years experience in the application, design and manufacture of wastewater related conveying equipment including shaftless screw conveyors
  - c. Provide list of installations where shaftless screw conveyors are in operation conveying the specified materials

2. Acceptable manufacturers
  - a. Custom Conveyor Corporation
  - b. Jim Myers and Sons, Inc.
  - c. KWS Environmental, Inc.
  - d. Spirac, Inc.
  - e. Equivalent products of other manufacturers may be accepted subject to compliance with design, function, materials and performance of the specified items and subject to the acceptance of the Owner and Engineer

### 1.3 REFERENCE SPECIFICATIONS CODES AND STANDARDS

- A. American Gear Manufacturers Association (AGMA)
- B. Anti-Friction Bearing Manufacturers Association (AFBMA)
- C. Conveyor Equipment Manufacturers Association (CEMA)
- D. American Iron and Steel Institute (AISI)
- E. National Electrical Code (NEC)

### 1.4 SUBMITTALS

- A. In Accordance with Section 01340
- B. Manufacturer's Specifications and Illustrations
  1. Sufficient data to verify compliance with specifications and to illustrate construction and assembly of products
    - a. Conveyors
      - 1) Manufacturer
      - 2) Type, model and size
      - 3) Design speed
      - 4) Bearing type and life calculations
      - 5) Horizontal and vertical loadings for structural supports
      - 6) Dimensions
      - 7) Weight
    - b. Motors
      - 1) Manufacturer
      - 2) Type and model including class
      - 3) Rated horsepower
      - 4) Temperature rating and service factor
      - 5) Rating for maximum number of starts per hour
      - 6) Design rotative speed
      - 7) Voltage, phase and frequency
      - 8) Full load and locked rotor currents
      - 9) Dimensions
      - 10) Weight
    - c. Drive
      - 1) Manufacturer
      - 2) Type and model

- 3) Input and output speeds
- 4) Gear ratios
- 5) Service factor (24 hour continuous service)
- 6) Torque and horsepower requirement calculations
- d. Trough, chute and gates
  - 1) Materials of construction
  - 2) Dimensions
  - 3) Connections
  - 4) Supports
- 2. General
  - a. Materials
  - b. Parts
  - c. Devices
  - d. Accessories
  - e. Dimensions
  - f. Controls and control devices
  - g. Written description of system controls
  - h. Electrical and control wiring diagrams
  - i. Panel layout diagrams
  - j. Data on shop coating
  - k. Spare parts list

#### C. Shop Drawings

- 1. Fabrication
- 2. Assembly
- 3. Foundation and structural components
- 4. Installation
- 5. Anchor bolt setting template

#### D. Certification of Compliance

- 1. Manufacturer's affidavit of compliance certifying
  - a. All equipment and materials comply with these specifications with any exceptions noted
  - b. Equipment has been properly installed and is operating within specification tolerances
  - c. All tests have been performed with satisfactory results

#### E. Operating and Maintenance Manuals in Accordance with Section 01730

### 1.5 JOB CONDITIONS

#### A. Conveyor CV-1

- 1. Application
  - a. Accept compacted screenings from the screenings compactors
  - b. Distribute compacted screenings through multiple discharge points to the screenings container in the Preliminary Treatment Area of the Headworks Building

2. Installation conditions
  - a. Install in Preliminary Treatment Area of the Headworks Building suspended from equipment beams over the screenings container
  - b. Provide supports connected to and suspended from equipment beams
    - 1) Two (2) supports required, one (1) from each equipment beam
    - 2) Provide all bracing and stiffeners to properly secure unit during motor starts and stops and during continuous operation
    - 3) Horizontal distance between equipment beam centerlines: 12'-0"
    - 4) Midpoint of conveyor trough approximately centered horizontally between centerline of equipment beams
    - 5) Bottom of beam elevation (both equipment beams): 5432.00
    - 6) Equipment beam sizes
      - a) South beam: S15 x 42.9
      - b) North beam: S12 x 31.8
  - c. Interior, heated location
  - d. Site elevation: 5425.00 feet above mean sea level
  - e. Physical characteristics
    - 1) Screenings container slab elevation: 5418.00
    - 2) Maximum elevation of conveyor trough: 5426.00
    - 3) Minimum elevation of conveyor and gate components: 5424.25
    - 4) Minimum length of conveyor trough: 16'-0"
    - 5) Number of discharge chutes: 3
      - a) Size
        - (1) Width equal to at least full width of conveyor trough
        - (2) Length in direction of travel shall provide a minimum of 1.5 spiral flight pitch rotations be exposed in the opening
      - b) Manual slide gates
        - (1) Required on two discharge chutes
        - (2) No gate required on discharge chute closest to the north drive end
  - f. Orientation
    - 1) Receive compacted screenings discharge near south end of conveyor trough before first gate opening
    - 2) Compacted screenings discharge pipe
      - a) Two pipes total, one from each compactor
      - b) Both pipes to discharge into south receiving end of trough
      - c) Both pipes discharge within the southern 4'-0" of the south receiving end
    - 3) Drive end is located at north end of conveyor trough to facilitate ease of access for maintenance activities
3. All electrical equipment, components and work in the Preliminary Treatment Area of the Headworks Building shall conform to NEC Class 1, Division 2, Groups C and D

## PART 2 – PRODUCTS

### 2.1 PERFORMANCE AND DESIGN REQUIREMENTS

#### A. Conveyor CV-1

1. Conveyor shall be designed and manufactured to handle compacted raw wastewater screenings from the screenings compactors and distribute them into the screenings container without spillage, jamming or clogging
2. Conveyors shall be designed to handle continuous or intermittent loading of compacted screenings
  - a. Compacted screenings typically in a moist, plug-shaped mass discharged from screenings compactor approximately 8" to 10" in diameter, and length varying from a few inches to 12" to 18"
  - b. Compacted screenings density: 65 to 75 pounds per cubic foot
3. Capacity
  - a. Design loading: 25 cubic feet per hour
  - b. Maximum trough filling at design loading: 30%
4. Maximum rotative speed of conveyor flight: 20 rpm
  - a. Unless availability of reducer ratios require adjustment
  - b. Unless manufacturer's calculations require faster speeds to meet design loading requirements
5. Total conveying capacity of the conveyor shall not be less than 2 times the design loading of 25 cubic feet per hour
6. Torque capacity of the drive unit shall be sufficient to start the conveyor with 100% trough loading
7. Torsional rating of flight shall exceed torque rating of drive motor at 150% of motor nameplate horsepower
8. Spring effect of the spiral shall not exceed 0.08 inches per foot of length at design load conditions
  - a. Submit calculations
9. At 100% trough loading and operating, the stress in the auger shall not exceed 30% of the shear strength rating in the extreme outer fibers of the spiral
  - a. Submit calculations

### 2.2 MATERIALS

#### A. Conform to CEMA 350 dimensional tolerance standards

#### B. Conveyor Assemblies

1. Trough: Type 304 stainless steel, 1/8" minimum
2. Inlet chutes and skirt boards: Type 304 stainless steel, 3/16" minimum thickness
3. Drive and end plates: Type 304 stainless steel, 1/2" minimum drive, 3/8" non-drive
4. Spiral flights: Cold formed, carbon micro-alloy, Brinell 220 minimum, minimum 80,000 psi yield
5. Wear liner: Plastomeric UHMW 1/2" thick minimum
6. Drive shaft: AISI 1045

7. Slide gates: Type 304 stainless steel, 3/16" minimum thickness
8. Covers: Type 304 stainless steel, 12 gauge minimum
9. Cover fasteners: Type 304 stainless steel, 24" maximum spacing
10. Supports: Type 304 stainless steel
11. Hardware: Type 316 stainless steel
12. All new material

## 2.3 FABRICATION AND MANUFACTURE

### A. Spiral Flight

1. Shaftless spiral fighting consisting of two spirals with minimum dimensions as follows
  - a. Outer spiral thickness: 25 mm, minimum
  - b. Inner spiral thickness: 20 mm, minimum
2. Rigid and stable, to operate without distortion or jumping in trough
3. Spiral fighting cold formed in sections from continuous flat hot rolled bar
  - a. Concentric to within 1/16 of an inch
  - b. Sectional fighting formed from plate shall not be permitted
4. Fabricate to limit neck down and outside edge micro-cracking
  - a. Maximum allowable outside edge neck down of 10% of inside edge thickness
  - b. Spiral edges to be smooth in the as-rolled condition
  - c. Dye-penetrate test to show no cracks or grinding marks
5. Spiral fighting to be connected to the drive shaft by welding the spirals to a circular torque plate properly reinforced with a curve gusset plate
6. Separate connection plate shall be bored with a hole equal to the shaft size
  - a. Drive shaft shall be concentrically welded to the connection plate to effectively transmit torque
  - b. Connection plate to be bolted to the torque plate
7. Welded according to AISC B-U3-GF and be full penetration, continuous welds
  - a. Flights shall be welded in a jig to assure true alignment

### B. Trough and Liner

1. U-trough with neoprene gasketing at each trough flange
2. Trough lined with wear resistant, plastomeric type UHMWPE (ultra high molecular weight polyethylene)
  - a. Liner formed by bonding two layers of the same material, each layer being a different color
  - b. Liners shall be field replaceable
3. Non-penetrating 304 stainless steel retainer bars welded to the trough at 180° along the trough
  - a. Fasteners that penetrate trough shall not be permitted
4. Conveyor shall have trough end plates with split gland seal at the drive end
5. All components including saddles and supports shall be Type 304 stainless steel except the drive unit and spiral
6. Provide bolted cover panels over top of trough
  - a. Conveyor CV-1

- 1) The south 4'-0" of the south end of trough will not require covers; this area to have open top with skirt boards for receiving compacted screenings discharge
- 2) Maximum cover panel length: 5'-0"
7. Provide stainless steel inlet chute and skirt boards for directing all material into trough without spillage or leakage
  - a. Conveyor CV-1
    - 1) Skirt boards required at south receiving end of trough only
    - 2) Extend minimum 2'-6" above top of trough
    - 3) At south receiving end of trough, place skirt boards on south and east sides of trough
      - a) Across active width of trough at south end
      - b) On the east side of the trough, along southern 4'-0" of south receiving end

#### C. Drive Unit

1. Constant speed, gear reducer motor drive
  - a. Single or double reduction, helical gear unit
  - b. Equipped with high capacity roller bearings with AFBMA B-10 life of 30,000 hours, minimum
  - c. Mounted to adaptor flange configured to prevent leakage from conveyor entering gear reducer/motor unit
  - d. Direct coupling of gear reducer/motor drive unit to end flange of conveyor will not be acceptable
2. Minimum AGMA Class 2
3. Enclosure: TEFC
4. Motor to be sized for the site elevation previously stated
  - a. Sized so that under maximum, continuous design load imposed by driven equipment, motor nameplate horsepower will not be exceeded
5. Motor size:
  - a. Conveyor CV-1: 3 hp, maximum
6. Power supply: 480V, 60 Hz, 3-phase
7. Motors to be rated "energy efficient" per NEMA MG1
8. Motors to have Class B insulation or better and Class B or better speed/torque characteristics
9. Motor service factor: 1.15, minimum
10. Gear reducer torque service factor: 1.5 times absorbed power or 1.1 times motor nameplate, at driven shaft speed, whichever is greater
11. Shaft to pass through a sealed housing at end plate
12. Connect shaft to the spiral for transmitting torque effectively to flight

#### D. Supports

1. Conveyor trough saddles shall be provided for support
  - a. Fabricated from 304 stainless steel structural shapes and plates, minimum ¼" thickness
2. Structural members for support or suspension to be designed such that the ratio of the unbraced length to the least radius of gyration does not exceed 120 for compression and 240 for tension

3. Stresses in supports not to exceed AISC allowable stress by more than one-third when subject to two times the running torque of the drive motor
4. Provide bolted connections between conveyor supports and structural support system
  - a. Provide suitable electrical insulation between dissimilar metals

#### E. Slide Gates

1. Manually operated slide gates to be provided on required discharge chutes
  - a. Trimline design to minimize frame depth
  - b. Stainless steel construction with UHMWPE gate seals
  - c. Roller gates will not be acceptable
2. Gate seals to be fabricated from UHMWPE with machined groove to accept gate blade
  - a. Provide a positive seal
  - b. Non-jamming design that allows no buildup of material in gate track
3. Gate blade provided with handle for manual operation
  - a. Handle to extend a minimum of 3'-0" from the longitudinal centerline of the conveyor trough

#### F. Accessories

1. Provide the following control devices
  - a. Emergency stop system with cables on both sides of conveyor
    - 1) Provide safety stop switch and safety pull chords with high visibility orange protective coating for each side
  - b. Zero speed switch with time delay
  - c. Overtorque switch
2. See Section 13300 for additional control requirements
3. Provide stainless steel inlet chutes and/or skirt boards per Drawings and as specified

### 2.4 PAINTING AND COATINGS

#### A. All surfaces to be painted or coated except

1. Stainless steel
2. Aluminum
3. Galvanized
4. Nickel or chromium
5. Rubber and plastic

#### B. All surfaces to receive prime, intermediate and/or finish painting or coating at the factory

#### C. Surface Preparation

1. Based on service exposure to wastewater materials
2. Non-immersion and non-contact service: Steel Structures Painting Council (SSPC) - SP6 Commercial Blast Cleaning



3. Immersion and contact service: Steel Structures Painting Council (SSPC) - SP10 Near White Blast Cleaning

D. Painting or Coating System

1. Manufacturer's standard coating system
  - a. Provide manufacturer's standard color
  - b. Owner to select color from manufacturer's standard color chart
2. Use only mercury-free, lead-free, fume-proof paint or coatings
3. Paint or coatings must be suitable for atmosphere containing hydrogen sulfide

E. Refer to Section 01600 for additional requirements

## 2.5 ANCHOR BOLTS

A. Manufacturer to specify type, size, number required, etc.

1. Refer to Section 05501 for general requirements

B. Manufacturer to provide anchor bolt setting template, drawings and/or setting instructions

C. Anchor bolts will be furnished by installation contractor

## 2.6 CONTROLS

A. Conveyor CV-1

1. Provide one control panel for the shaftless screw conveyor
2. Shaftless screw conveyor shall be operated through its own control panel
3. Control panel to be wall-mounted in the Electrical and Control Room of the Headworks Building
4. The Preliminary Treatment Area of the Headworks Building will include hazardous environment monitoring devices. Should a hazardous environment condition occur, it will be indicated in the SCADA system which will in turn send a shut down signal to the equipment in the area. The shaftless screw conveyor control panel must be able to accept this signal and upon its activation immediately de-energize all equipment in the Preliminary Treatment Area
5. Provide separate local emergency stop pushbutton in a NEMA 7 enclosure to be installed at the shaftless screw conveyor in the Preliminary Treatment Area as indicated on the Drawings. Switch must be capable of being locked in the Off position
6. Provide a local emergency stop pull chord system as specified at the shaftless screw conveyor utilizing NEMA 7 rated equipment and enclosures
7. Operation of the shaftless screw conveyor shall be controlled through timers
8. Control panel
  - a. Number required: 1
  - b. Panel tag designation: LCP CV-1
  - c. Enclosure rating: NEMA 4
  - d. Control panel component rating: NEMA 4X

- e. Completely prewired and factory tested prior to shipment
- f. Main disconnect switch capable of being locked in the Off position
- g. Accept input power of 480 VAC, 3-phase, 60 hertz
- h. Include all logic devices, programmable relays, timers and appurtenances for proper equipment operation
- i. Include the following minimum electrical devices
  - 1) FVNR motor starter and motor overload protection
  - 2) Transformer for 120 VAC control system power
  - 3) Main circuit breaker
- j. Include the following minimum pilot and control devices
  - 1) Hand/Off/Auto selector switch for drive motor
    - a) When in Hand, equipment to operate continuously
    - b) When in Auto, equipment to operate as follows
      - (1) Conveyor operation will be initialized and an adjustable run time timer will be energized
      - (2) Conveyor operation will continue until the run time timer times out
      - (3) When the run time timer times out, the conveyor will be de-energized, an adjustable off time timer will be energized and the run time timer will reset
      - (4) When the off time timer times out it shall reset, the run time timer shall energize and the conveyor shall be energized for operation
  - 2) Emergency stop pushbutton
  - 3) System reset pushbutton
  - 4) Run indicating light: Green
  - 5) General fault indicating light: Red
  - 6) Zero speed fault indicating light: Red
  - 7) Overtorque fault indicating light: Red
  - 8) Hour meter/run time meter
    - a) Nonresettable
  - 9) Solid state run time timer with a minimum adjustable range of 0 to 30 minutes at one (1) minute increments
  - 10) Solid state off time timer with a minimum adjustable range of 0 to 120 minutes at ten (10) minute increments
  - 11) Run output contact to SCADA system
  - 12) General fault output contact to SCADA system
  - 13) Input contact for equipment shutdown signal from SCADA system
- k. Provide circuitry and devices to shutdown the equipment upon the following conditions
  - 1) Motor overload/fault
  - 2) Control panel emergency stop pushbutton activation
  - 3) Local emergency stop pushbutton activation
  - 4) Local emergency stop pull chord activation
  - 5) Receipt of SCADA system shutdown signal
  - 6) Zero speed condition
  - 7) Overtorque condition
- l. General fault indicator light and output contact to SCADA system shall be energized under any and all fault conditions
- m. Clearly label all front panel mounted items and devices on the outside front of the panel

- n. Clearly label all wires and terminal points inside the control panel
- o. All power and control wiring shall be 600 Volt insulated copper and sized for the required load, 14 AWG minimum
- p. All circuit breakers shall be thermal magnetic molded case units
- q. All selector switches, pushbuttons and pilot lights shall be heavy-duty, water/oil tight, corrosion resistant units rated for NEMA 4X service
- r. All terminal blocks shall be pressure connector type with marking strips and covers suitable for copper connectors sized for the application
- s. All control relays shall be industrial plug in type rated for the appropriate application load

## 2.7 SPARE PARTS

- A. Manufacturer to furnish all recommended spare parts
- B. The following spare parts shall be furnished, as a minimum
  - 1. One complete set of all seals and gaskets
  - 2. One complete set of trough liners

## PART 3 – EXECUTION

### 3.1. FACTORY TESTING

- A. All conveyor equipment and components shall be factory tested to ensure satisfactory assembly and operation

### 3.2. PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 01600 for requirements

### 3.3. INSTALLATION

- A. Inspection
  - 1. Inspect materials and equipment for signs of damage, pitting, rust, decay or other deleterious effects of storage, transportation, handling, etc.
    - a. Replace or repair any materials or equipment showing such effects to the satisfaction of the Engineer and Owner
    - b. Replace damaged materials or equipment with identical new materials or equipment
- B. Equipment Installation
  - 1. Handle, install, connect, clean, condition, level, plumb, align and adjust products and equipment in strict accordance with manufacturer's instructions and in conformity with specification requirements and all OSHA, local, State and Federal codes and regulations
    - a. Maintain one complete set of manufacturer's installation instructions at the jobsite during installation and until installation is accepted by the Engineer and Owner

- b. Perform all work in accordance with manufacturer's instructions
      - 1) Do not omit any preparatory step or installation procedure unless specifically modified or exempted by contract documents
      - 2) Should job conditions or specification requirements conflict with manufacturer's instructions, consult with Engineer prior to proceeding
    - c. Shimming between machined surfaces is not permitted
  - 2. Provide lubricants as recommended by the manufacturer
    - a. Provide sufficient quantity to
      - 1) Fill all lubricant reservoirs
      - 2) Replace all lubricant consumed during testing, startup and operation prior to acceptance of equipment by Owner
- C. Take special care to maintain proper alignment of all components
  - 1. Provide minor adjustments to accommodate associated equipment and field conditions
  - 2. Correct any misalignment, noisy operation or other indications of improper setting
- D. Provide flexible electrical field connections to drive motors conforming to NEC requirements
- E. Paint and Coatings
  - 1. Recoat all shop coated surfaces damaged prior to product acceptance to the satisfaction of the Engineer and Owner
    - a. Use paint and/or coating materials identical to those used by manufacturer for shop priming and painting
    - b. Utilize surface preparation procedures as specified herein or as may be appropriate for repairs needed
- F. Adjustment and Cleaning
  - 1. Perform all required adjustments, tests, operational checks, cleaning and other startup activities required
  - 2. Remove all grease, dirt, excess paint, etc., from equipment surfaces prior to final acceptance

### 3.4. FIELD TESTING

- A. Ensure all bearings, gear reducers and other rotating parts are properly lubricated in accordance with the manufacturer's recommendations
- B. Ensure drive system is properly installed and aligned
- C. Make all necessary initial alignments and adjustments to put equipment into operation
- D. Operate equipment for 24 hours

- E. Verify operational compatibility with screenings compactors and associated equipment
- F. Log drive motor amperages
- G. Perform all other manufacturer's standard battery of tests
- H. Equipment: No indication of binding, unusual loads, intermittent operation, or other problems

### 3.5. FIELD QUALITY CONTROL

- A. Provide Manufacturer's Field Service
  - 1. Minimum two trips to project site at one-half (1/2) day each
  - 2. Qualifications of manufacturer's representative
    - a. Authorized representative of the manufacturer
    - b. Experienced in the application, installation, operation and maintenance of the subject work, materials and equipment
  - 3. Services provided by representative
    - a. Provide guidance regarding proper installation
    - b. Supervise installation of equipment furnished under this section
    - c. Inspect, check, adjust and test equipment installed, as required, and approve final installation
    - d. Be present when equipment is placed in operation
    - e. Revisit site as often as required to correct all problems and until equipment installation and operation are acceptable to Engineer and Owner
  - 4. Manufacturer's representative to instruct Owner's personnel in the operation and maintenance of the equipment furnished. Minimum one-half day including classroom and field training. May be combined with startup services
- B. Furnish three (3) copies of written report to Engineer certifying that
  - 1. Equipment is properly installed and lubricated
  - 2. Equipment is in accurate alignment and balance
  - 3. Equipment is free from any undue stress imposed by connecting piping, anchor bolts, etc.
  - 4. Equipment has operated satisfactorily under full load conditions and as specified through full operating range
- C. Provide telephone support to Owner up to a maximum of 10 hours for operation, adjustment and troubleshooting during the warranty period
  - 1. No limit on support to Owner on issues subject to equipment warranty

END OF SECTION