SECTION 11234 - RECTANGULAR, CHAIN AND FLIGHT CLARIFIER

City of San Diego, CWP Guidelines

PART 1 -- GENERAL

- 1.1 WORK OF THIS SECTION
 - A. The WORK of this Section includes providing rectangular longitudinal flight-type sludge collection for [primary] [secondary] clarification basins, and scum removal equipment for [primary] [secondary] clarification basins, complete and operable as indicated. The sludge and scum collectors shall be specifically designed for collection of concentrated [primary] [secondary] sludge and scum in a municipal wastewater treatment plant.
 - B. The WORK also requires that one manufacturer accept responsibility for furnishing the WORK as indicated but without altering or modifying the CONTRACTOR'S responsibilities under the Contract Documents.
 - C. The WORK additionally requires that the one manufacturer who accepts the indicated responsibilities shall manufacture the principal elements and components including, as a minimum, the driven equipment.
- 1.2 RELATED SECTIONS
 - A. The WORK of the following Sections applies to the WORK of this Section. Other Sections of the specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.
 - 1. Section 06610 Glass Fiber and Resin Fabrications, General
 - 2. Section 11000 Equipment General Provisions

1.3 SPECIFICATIONS AND STANDARDS

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

| 1. | ASTM D 570 | Test Methods for Water Absorption of Plastics |
|----|-------------|--|
| 2. | ASTM D 638 | Test Methods for Tensile Properties of Plastic |
| 3. | ASTM D 785 | Test Methods for Rockwell Hardness of Plastics and Electrical Insulating Materials |
| 4. | ASTM D 2240 | Test Method for Rubber Property-Durometer Hardness (PVC) |
| 5. | ASTM E 18 | Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials |

| 6. | AGMA 908-B | Geometry Factors for Determining the Pitting Resistance and Bending Strength of Spur, Helical, and Herringbone Gear Teeth |
|-----|---------------|---|
| 7. | AGMA 6010-E | Standard for Spur, Helical, Herringbone, and Bevel Enclosed Drives |
| 8. | AGMA 6019-E | Gear Motors Using Spur, Helical, Herringbone, Straight Bevel, or Spiral Bevel Gears |
| 9. | NEMA 250 | Enclosures for Electrical Equipment |
| 10. | NEMA ICS 2 | Industrial Control Devices, Controllers and Assemblies 3 |
| 11. | ANSI B 39.21M | 700 Class Welded and Cast Chains, Attachments and Sprockets for Water and Sewage Treatment Plants |

1.4 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted in compliance with Section 01300:
 - 1. Manufacturer's product data including catalogue cuts.
 - 2. Complete certified equipment drawings, showing all dimensions, weights, materials of construction, structural members, sludge collection members, welds, torque ratings, and gears.
 - 3. Foundation, installation, and grouting plans.
 - 4. Anchor bolt placement measured from construction joints in the concrete structure. Anchor bolt details shall include projections from concrete.
 - 5. Skimming device details.
 - 6. Chain size, weight, and fabrication details.
 - 7. Sprocket types and size details.
 - 8. Shaft material and sizes.
 - 9. Bearing types and details.
 - 10 Type, specifications, details, input and output speeds, exact gear ratios, service factor (24-hour continuous service), capacity, and efficiency of gear reducer units and drive assembly.
 - 11. Equipment drive and drive guard details.

- 12. Size, make, and type designation of electric motor, including mounting details.
- 13. Details and description of the overload protection assembly. Details submitted shall clearly demonstrate the adequacy of the overload protection provided by the assembly proposed. Overload alarm contact shall be provided as shown on the control diagram.
- 14. List of spare parts to be furnished.
- 15. List of special tools to be furnished.
- 16. Information on at least one successfully performing installation of comparable size and complexity constructed in the recent past. including contact name, telephone number, and address.
- 17. Names of independent testing laboratories.
- 1.5 SERVICES OF MANUFACTURER
 - A. **Inspection, Startup, and Field Adjustment:** An authorized service representative of the manufacturer shall visit the site for not less than [] days to furnish the indicated services.
 - B. **Instruction of OWNER'S Personnel**: The authorized service representative shall also furnish the indicated services for instruction of the OWNER'S personnel in the operation and maintenance of the equipment including step-by-step troubleshooting procedures with necessary test equipment for not less than [one] day.
- 1.6 OWNER'S MANUAL
 - A. In addition to the requirements of Section 11000, the following shall be included in the ONWER'S MANUAL in compliance with Section 01300:
 - 1. A certificate of design, signed by a Registered Professional Engineer, shall be submitted to the CONSTRUCTION MANAGER, prior to the manufacture of the equipment. The certificate shall include the following information:
 - a. Codes and Specifications followed in the design.
 - b. Type and strength of materials for members.
 - c. Loading conditions used for the design.
 - d. Certification that equipment is designed to withstand maximum continuous running torque and loads.
- 1.7 FACTORY TESTING

- A. **Product Testing:** Products shall be tested at the factory for compliance with the indicated requirements. Copies of the records from the manufacturer's tests shall be furnished to the OWNER as product data.
 - 1. Sludge Collector Chains: Six sample strands of not less than six pitches from each day's production shall be tested to ultimate strength. Minimum ultimate strength shall be 6,000 pounds. Should any one sample fail, an additional six samples shall be selected and tested to ultimate strength. Should any one sample of the second test fail, it shall be cause to reject the lot.

Each assembled strand (20 pitches, 10 feet in length) shall be proof loaded to 5000 pounds prior to shipment. Proof loads shall not cause damage or distortion to the chain.

Copies of the records from the manufacturer's tests as specified shall be furnished to the OWNER as product data.

- 2. All Sprockets, Flights and Wearing Shoes: The manufacturer shall supply certification that these items meet or exceed the requirements for water absorption and hardness as indicated.
- B. **Witnesses:** The OWNER and the CONSTRUCTION MANAGER (at the option of either) reserves the right to witness factory tests. The CONTRACTOR shall give 2 weeks advance notice to the CONSTRUCTION MANAGER for any factory tests.

1.8 LABORATORY TESTING

- A. **General**: The CONTRACTOR shall propose the names and qualifications of at least three independent testing laboratories who shall be fully qualified to conduct the tests described below. The OWNER shall select one from this group for the purpose of performing the indicated tests. All costs of testing shall be borne by the CONTRACTOR. All sampling shall be random sampling performed by the testing laboratory.
- B. **Material**: At least five samples of sludge collector chain and links and one collector flight per day shall be tested for hardness and water absorption as indicated. Failure of any sample shall be cause for retesting. Failure of the subsequent test shall be cause for rejection of the batch.

C. Chain Tests:

1. General: Not less than three 10-foot long strands of sludge collector chain per each 1000 feet of assembled chain shall be tested in accordance with the following paragraphs. If any one strand fails, three more strands shall be tested. Failure of the second test group shall be cause for rejection of the entire batch.

At least one 5-foot section of each drive chain shall be tested. Rejection criteria shall be as set forth above for collector chain.

- 2. Load Tests: Each strand of chain shall be set up in a calibrated load testing machine so that the end links are gripped such that the resulting force is directed along the centerline of the chain strand. Test shall be in accordance with chain manufacturer's instructions to fixture the test strand in the load testing machine. Applied load shall be 5000 pounds for sludge collector chain and 3000 pounds for sludge collection drive chain. The applied load shall be maintained on each strand for not less than 10 seconds. The chain elongation shall not exceed 4 percent at the applied load. The skimming blade drive chains shall be tested for an average ultimate strength of 75,000 pounds.
- 3. Dimensional Tests: Dimensional tests for sludge collector chain only shall include tests for length, camber, twist and match. Failure of samples to pass the following tests shall be cause to resample and retest. Failure of the second set of samples shall be cause for rejection of the lot.

Length: Ten-foot long strands shall be 120 inches long, minus 0.000 inch, plus 0.750 inch, measured at a pull of 200 pounds.

Camber: Ten-foot long strands, when tested in accordance with procedures described in ANSI B29.21M, Section 4 shall camber 1 inch minimum in each direction and shall be equal to each other within 3 inches.

Twist: Ten-foot long strands, when tested in accordance with procedures described in ANSI B29.21M, Section 5, shall twist a minimum of 8 degrees in each direction and shall be equal to each other within 15 degrees.

Match: The length of matched pairs of 10-foot long strands shall be within 0.19 inch of each other.

Flights: A minimum of five out of each fifty sludge collector flights shall be selected at random by representatives of the testing laboratory. Each flight shall be tested to determine the flight straightness. While simply supported on the wearing shoes, the front bottom edge of the flight shall not deviate more than 1 inch above nor 1/8 inch below a straight line between the bottom edge of the flight at the wearing shoes (sag). The horizontal displacement of the front bottom edge from the straight line (bow) shall not exceed 1-1/4 inch. If any of the test group fails this test, a second set of samples shall be selected. Failure of the second set of samples shall be considered cause for rejection of the entire lot.

- D. **Reports**: Copies of all test reports shall be furnished directly to the OWNER as product data. All reports shall be specific as to lot number, batch number, type of test, test results and action taken.
- 1.9 FIELD TESTING
 - A. **Testing:** Products shall be field-tested for compliance with the indicated requirements. Inspection, testing and certification shall be provided, and testing procedures and forms shall be submitted and used. Torque tests shall be performed on all sludge collector mechanisms in the presence of the OWNER. Each driver sprocket overload shear pin shall be tested to demonstrate the shear pins will fail at the load value determined by the

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manufacturer with a tolerance range of plus or minus 10 percent. The manufacturer shall furnish all equipment necessary to conduct the test. Manufacturer shall also furnish as product data design calculations to substantiate wet tank torque calculations.

For the torque tests, two hydraulic cylinders with dial gauges shall be provided. Each cylinder shall be attached to the influent corner shaft, each adjacent to one of the two collector chain sprockets. The other end of each cylinder shall be attached to a link of the corresponding collector chain located between the influent corner shaft and the collector head shaft. The dial gauge shall continuously record the load on the collector under power so the collector chain pull at the time of pin failure is known. The manufacturer shall provide the necessary data to convert gauge pounds pressure to pin shear value expressed in pounds.

During initial operation testing, each sedimentation tank shall be filled with water to its operating level and the mechanism operated at its design speed for a period not less than 24 hours. At no time during the operating tests shall the equipment exhibit indications of binding or uneven operation. The manufacturer's representative shall be present and direct this testing.

If the mechanism should, in the opinion of the OWNER, exhibit indications of binding or improper adjustment, the manufacturer's representative shall immediately halt the tests and the CONTRACTOR shall remedy the problem. After completion of necessary repairs or adjustments, the tests shall be repeated. Failure to successfully complete the test in six attempts shall be considered sufficient cause for rejection.

- B. **Witnesses:** The OWNER and the CONSTRUCTION MANAGER (at the option of either) reserves the right to witness field tests.
- 1.10 QUALIFICATIONS
- \$#
 - NTS: In the paragraph below, define the terms "comparable size and complexity" for the equipment or system specified. Requiring experience of more than one successful project requires sound justification and prior written approval from the City Project Manager.

_____ #\$

A. **Manufacturer:** Company specializing in rectangular, chain and flight clarifiers comparable to the complexity and size indicated with at least one successful installation constructed in the recent past. Equipment of comparable size and complexity shall have the following characteristics: [].

PART 2 -- PRODUCTS

- 2.1 GENERAL
 - A. **General**: The CONTRACTOR shall furnish and install the equipment specified herein in the proposed [primary] [and] [secondary] rectangular clarifiers. The equipment shall be fabricated, erected, assembled and placed in proper operating condition in full conformity

with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer.

The collectors shall be suitable for continuous duty and exposure to wastewater, scum and sludges containing organic and inorganic solids, including vegetable parts, grit, paper and rubber products, rags, petroleum products, animal fats and greases, industrial solvents, ammonia, and detergents. Wastewater temperatures may be expected to vary between 50 degrees F and 85 degrees F. It is anticipated that sludge concentrations up to [15] percent may be encountered during the normal operation of this equipment.

Each item of equipment shall be furnished and installed complete with all supports, electric drive units, chains, flights, rails, shafts, sprockets, mechanical equipment, electrical work and all other appurtenances which are specified or required for proper operation.

All mechanisms or parts shall be amply proportioned for the stresses which may occur during long, continuous and uninterrupted service, fabrication, transportation, erection, and startup. All equipment shall be designed with consideration for proper operation when the tanks are dewatered. Individual parts furnished which are alike in all units shall be alike in workmanship, design, and materials, and shall be interchangeable. Provision shall be made for easy access for service or replacement of parts.

2.2 OPERATING CONDITIONS

A. The collectors in each sedimentation tank shall be suitable for operation under the following conditions:

| Number of bays per tank | [|] | |
|-------------------------------------|---|---------------|---|
| Dimensions, feet: | | | |
| Width, per bay | [|] | |
| Length | [|] | |
| Side water depth (average) | [|] Freeboard [|] |
| Tank floor slope, feet per 100 feet | [|] | |
| Maximum flow, mgd | [|] | |
| Average flow, mgd | [|] | |
| Sludge Collector Drive: | | | |
| Minimum motor horsepower, hp | [|] | |
| Motor speed, rpm | [|] | |
| Sludge Collector Drive: | | | |
| Minimum motor horsepower, hp | [|] | |
| Maximum motor speed, rpm | [|] | |
| | | | |

At the highest operating point the collector flights shall be 1.0 feet or more below the minimum water surface specified.

2.3 MATERIALS

[CONTRACT NO.]-[CONTRACT TITLE]

A. Materials for components of the sludge collection equipment shall be as follows:

| <u>Component</u> | <u>Material</u> |
|------------------------------|---|
| Collector Chains | |
| Links and flight attachments | Unfilled acetal resin, or glass reinforced polyester. |
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| Pins | Glass reinforced nylon or polyester, acetal resin, or stainless steel. | | |
|-----------------------------------|--|--|--|
| Drive Chains | | | |
| Links | Unfilled acetal resin injected with Teflon, reinforced polyester thermoplastic or glass reinforced nylon. | | |
| Pins | Stainless steel. | | |
| Collector Flights | Fiberglass reinforced plastic pultrusion; nonfilled; minimum average glass content (isothalic polyester polymer), 45 percent (± 2 percent). | | |
| Flight Top & Bottom Wearing Sh | oes Cast Nylon-6, molded polyurethane or UHMW-PEtwo wearing surfaces | | |
| Flight Filler Block or Bracket | Molded polypropylene or acetyl resin thermoplastic. | | |
| Shafts | Cold rolled steel, AISI C1045. Cast nylon stub shafts, biaxially wrapped fiberglass telescopic headshafts. | | |
| Sprockets: | | | |
| Drive | Polyurethane toothed rim bolted to a metallic hub, UHMW-PE toothed rim bolted to a split cast iron hub, or cast Nylon-6. | | |
| Driven | Polyurethane or UHMW-PE toothed rim bolted to a split cast iron or polyurethane body, or cast Nylon-6. | | |
| Collector | Molded totally of polyurethane or UHMW-PE, or UHMW-PE toothed bolted to a split cast iron hub, or cast Nylon-6. | | |
| Underwater Bearings | Babbitted cast iron or cast Nylon-6. | | |
| Fasteners, including anchor bolts | Type 316 stainless steel. | | |

2.4 SLUDGE COLLECTION EQUIPMENT

A. Flights:

1. The flights shall be mounted at 10-ft intervals on the collector chain, and they shall be 3-inch by 8-inch nominal size, fabricated from fiber glass reinforced

plastic with continuous filaments running the full length of the flight, in the shape of open channel or angle sections without return bends or other moldings which could trap the sludge, and they shall not be bowed or twisted. The flight shall have a minimum minor axis moment of inertia of 1.75 inches. Water absorption rate not to exceed 0.5 percent at saturation in accordance with ASTM D 570.

- 2. Each flight shall include a scraper lip on the leading edge to optimize cleaning of the tank floor. Polypropylene filler blocks shall be furnished to allow the flight to be securely bolted to the chain attachment. The blocks shall provide an interference fit with the flight to maintain proper positioning during assembly. Flights shall be accurately drilled and notched at the factory and banded together for safe shipment.
- 3. Fiberglass flights shall be guaranteed by the manufacturer to provide a minimum service life of five years under normal usage.
- B. Wearing Shoes: Each flight shall be provided with 1/2-inch thick wearing shoes to run on the floor rails and on the angle tracks on the return run. The shoes shall be cast of heat cured Methylene Bis/Phenyl Isocyanate polyester polyurethane with a minimum Shore D hardness of 80 (ASTM D2240), ultra high molecular weight (UHMW) polyethylene with minimum R56 Rockwell hardness (ASTM D785), or cast Nylon-6 with minimum R116 Rockwell hardness. Water absorption rate not to exceed 1.3 percent at saturation in accordance with ASTM D570. Wearing shoes running on the floor rails shall be located central to the chain attachment to avoid drilling additional holes which would weaken the flight. The return run wearing shoes shall include a guide lug to ensure proper tracking of the flight with the return track where required. All wearing shoes shall be reversible providing two usable wearing surfaces.
- C. Wearing Rails and Return Guides: Wearing rails set in the bottom of the tank shall be as indicated, located as required by the equipment manufacturer, 3 inches wide with polyethylene wear strip protruding 3/8 inch above the tank floor. Return guides shall be 3-inch by 2-inch by 3/8-inch steel or fiberglass reinforced plastic angles supported on wall mounted brackets spaced a maximum of 10 feet apart.

UHMW-polyethylene wear strips, 2 5/8-inch wide, minimum, by 3/8-inch thick, shall be provided and attached to the steel floor rails and to the return tracks. Each strip shall include one anchoring hole and not less than two slotted holes to accommodate the 316 stainless steel weld washers used to secure the wear strips to the steel rails and tracks. Provisions shall be included to allow for anticipated thermal expansion of the wear strips and allow unimpeded transition of the wear shoes from one strip to another.

D. Collector Chain: Collector chain shall have 6-inch pitch links with an average weight of 1.3 pounds per foot. The material shall have a Rockwell hardness (ASTM D785) of not less than R-120 and a water absorption rate not to exceed 0.9 percent at saturation (ASTM D570). The chain shall have a catalog working load of not less than 2400 pounds based upon strength, fatigue and wear considerations. The chain shall be molded with the barrel and side bars as an integral assembly.

The chain shall be assembled with either nonmetallic or stainless steel pins designed to provide full dead load bearing capacity throughout the full length of the link side bar hubs. Nonmetallic pins shall be not less than 7/8-inch diameter. Stainless steel pins shall be not less than 3/4-inch diameter. The pins shall have a T-head to engage retainer lugs molded integrally with one link side bar hub as a positive means to prevent pin rotation. The pins shall be locked in position by a retainer ring molded integrally with the opposite side bar hub, by a retainer clip or by self-locking snap tabs integrally molded on the pin, and shall provide a positive locking contact around the full periphery of the pin. The pins shall be pressed into the link side bar hubs to exclude abrasives using, if necessary, a tool supplied by the manufacturer.

The attachment links shall be of similar construction with the flight pusher plate or attachment, extending the full depth of the flight, molded integrally with or bolted to the link side bars and designed to minimize loading on the flight attachment bolts. Longitudinal collector flight attachments shall be spaced at intervals of 10 feet. The attachment mounting hole spacing shall conform to ANSI B29.21M and shall accommodate four 3/8-inch diameter, 316 stainless steel hexagon head attachment bolts, hexagon nuts and cut washers.

E. Sprockets:

1. Collector Headshaft and Corner Shaft: Sprockets for the collector chains shall be molded totally of cast Nylon-6 with minimum R116 Rockwell hardness, polyurethane with a minimum Shore D hardness of 80 (ASTM D2240), UHMW polyethylene with minimum R56 Rockwell hardness (ASTM D785), or UHMW polyethylene toothed rim on split cast iron hub. Water absorption rate shall not exceed 1.3 percent at saturation in accordance with ASTM D570. Unless otherwise indicated, the sprockets shall be of split construction and shall have a tooth profile compatible with nonmetallic chain and shall have chain saver rims and hunting tooth design. Sprockets shall be supplied by the chain manufacturer.

Driving sprockets shall be keyed firmly to the headshaft. The corner shafts shall have both sprockets clamped firmly to the shaft with the sprocket teeth properly aligned or have one sprocket running free between two set collars to maintain alignment as recommended by manufacturer. Sprocket sizes and number of teeth shall be as indicated.

2. Driver and Driven: The drive chain driven sprocket materials for sprockets shall be as indicated. Each segment shall be bolted to the cast iron hub with 316 stainless steel bolts. The mounting rim of the body shall be machined concentric and perpendicular to the bore with the mounting bolt holes accurately located to ensure concentricity of the sprocket assembly. The split body shall be keyed with set screw for attachment to the gear output shaft or clamped to the shaft with two 316 stainless steel hub bolts and two 316 stainless steel rim stud assemblies.

The drive chain driver sprocket assembly materials shall be as indicated. A shear pin device shall be provided for full protection of the equipment in the event excessive loading is encountered. Aluminum shear pins shall be

provided to transmit torque from the driving hub to the sprocket shear plate with a polymeric gasket located between the shear faces to prevent seizing. Each breaking pin device shall be arranged to actuate a limit switch rated 460V in accordance with NEMA Standard ICS. The switch shall have a NEMA 4 enclosure.

3. Sprocket sizes and number of teeth shall be as follows:

| | Min. pitch <u>diameter, inches</u> | Min. number <u>of teeth</u> |
|-----------------------|---------------------------------------|--------------------------------|
| Headshaft sprocket | 22.21 | 23 |
| Corner shaft sprocket | 16.59 | 7 |
| Driver sprocket | 9.26 | 11 |
| Driven sprocket | 33.25 | 40 |

F. **Shafts**: Shafts shall be cold rolled steel or telescopic fiberglass torque tube, straight and true, continuous between bearings, of ample size to transmit required power and shall have minimum diameters as follows:

| <u>Shaft</u> | <u>Diameter, inches</u> |
|--------------|-------------------------|
| Headshaft | 4-15/16 |
| Corner shaft | 4-7/16 |

Cast nylon stub shafts with non-metallic bearings are acceptable for corner shaft locations.

G. Bearings:

- 1. Submerged Bearings: All submerged bearings shall be of the split type or cast Nylon-6, equipped with Babbitt linings. Self-aligning feature is mandatory. The bearing housing bracket shall be either of the split type or shall be open on one side to permit easy removal of the shaft without removing the housing bracket from the wall. The submerged bearings shall be grease lubricated to exclude grit and shall be equipped with brass lubrication tubing which extends above the water surface for lubrication when the tanks are full. All necessary supports for attachment of the lubrication system to concrete surfaces shall be furnished and shall be of a size and strength as recommended by the manufacturer.
- 2. Bearings Above Water: All bearings for use above water shall be self-aligning, split-pillow-block type, equipped with Babbitt linings and provided with Alemite industrial-type lubrication fittings.

H. Drive Assemblies:

1. General: Each drive assembly shall be arranged to operate [one] [2] parallel longitudinal collector[s] [as a pair or] independently. Each assembly shall consist of a motor, flexible coupling, speed reducer, and [2] driving sprocket[s

with jaw clutches]. The drive shall be equipped with an overload protection system.

- 2. Motors: Each collector drive assembly motor shall be of the squirrel cage induction type, totally enclosed, suitable for continuous outdoor operation. The motor shall be mounted on a common base with the speed reducer or parallel scoop mounted. Motors shall be 1800-rpm synchronous speed and shall not be less than [1.0] hp. Drive motor shall be of the heavy duty type, suitable for 24 hours continuous operation, as specified in Section 16040.
- 3. Speed Reducers: The speed reducer shall be of the horizontal, in- line, helical reduction gear type, with mechanical efficiency of not less than 92 percent and shall be amply-sized to drive the sludge collection mechanism. It shall run in oil and be fully housed in a heavy cast iron or steel moisture-proof case, complete with easily accessible oil fill and drain plugs. It shall be geared to drive the collector at a speed of approximately [2] fpm.
- 4. [Jaw Clutches: [For double drives, only]. Each drive sprocket shall be provided with a cast iron spiral jaw clutch to permit individual operation of either sludge collection mechanism. Grease fittings shall be provided for lubrication between shafts and clutches. A shifting lever shall extend approximately 6 inches above the jaw clutch and be suitably sized and shaped to receive an extension arm fabricated from a standard size steel pipe. The steel pipe extension shall be supplied by the CONTRACTOR. The shifting lever shall be oriented on the jaw clutch in such a manner that it can be operated, by means of the pipe extension, from the outside of the collector drive assembly cover. The jaw clutch assembly shall be located outside the collector drive assembly cover.]
- 5. Drive Chain: A drive chain shall extend from each driving sprocket to the corresponding collector head shaft drive sprocket. Drive chain shall be nonmetallic having 2.609-inch pitch length with an average weight of 1.4 pounds per foot. The chain shall have a catalog working load of not less than 1350 pounds based upon strength and wear considerations. The chain links shall be connected with stainless steel pins not less than 3/8-inch diameter. The pins shall be constructed to prevent rotation and shall be held in place without the use of pins or cotters. Provision shall be made on each collector drive assembly for adjusting the tension of the drive chain.

2.5 PRIMARY BASIN SCUM REMOVAL EQUIPMENT

A. **General**: Each mechanism shall skim the full width between the two side baffle plates set out from the tank side walls. The mechanism shall consist essentially of two endless strands of chain, one of each of the tank side walls to which shall be attached one steel cross member spanning the width between chains and having the skimming blade suspended from the cross member.

All mechanisms or parts shall be proportioned for the stresses which may occur during operation or for any other stresses which may occur during fabrication and erection. Individual parts furnished which are alike in all units shall be alike in workmanship, design and materials, and shall be interchangeable.

B. Fasteners: All fasteners, including anchor bolts, used in the installation and assembly of the equipment shall be stainless steel, Type 316. Stainless steel, Type 316, split lockwashers shall be used on all bolted connections. Stainless steel, Type 316, locknuts will be acceptable in lieu of the nut and split lockwasher assembly. All bolt heads and nuts shall be hex-head construction. Anchor bolts shall be cast in place in new concrete.

C. Skimming Blade Assemblies:

1. Blades: The blades shall be properly fabricated, installed and adjusted, as indicated, to effectively remove scum without appreciable flow back and without leaving accumulations on the trough beach. Pressure of the lip against the beach shall be provided by the chain bearing against the upper portion of the lower chain guide which is parallel to the beach. Care shall be taken to properly fabricate the chain guide such that it performs this important function.

Each skimming blade shall have a 3/8-inch thick lip fabricated of neoprene, which bears against the scum trough beach, and is bolted to the blade with a bolt spacing not to exceed 6 inches on center. The edge of the lip which bears against the beach shall conform to the surface of the beach with water tightness across its full length. Cutting of the neoprene shall be done by shearing using a sheet metal shear or paper guillotine knife. Not more than one length shall be used for a single blade. The ends of the lip shall bear against the side baffle plates such that no bypass of liquid occurs around the ends of the blades.

- 2. Cross Members: Cross members shall consist of aluminum plate as indicated. An aluminum skimming blade shall be welded to the 6-inch aluminum plate in a position perpendicular to the length of the chain sidebar.
- D. **Scum Trough**: A steel scum trough of welded steel plate construction shall be provided for each mechanism. The steel shall not be less than 3/8-inch thick. The design shall provide a steel beach that is smooth, straight and true, that extends the full width of the tank and that functions properly with the skimming mechanism and conforms to certain critical dimensions as indicated. The beach in place shall not deviate from a true flat plane by more than 1/16-inch plus or minus over its entire flat surface.
- E. **Bottom Baffle**: The design shall also include a bottom baffle construction from steel plate not less than 3/8-inch thick. The bottom baffle plate shall fit within 1/8-inch at each tank sidewall. The bottom baffle plate shall be attached to the tank sidewalls independently of the beach and shall be so installed as to abut the beach support.
- F. **Side Frames**: Side frames shall be of unit construction, incorporating the upper chain guide, skimming blade chain takeup, stub shaft and head shaft bearing support and shall be fabricated of adequately reinforced, welded steel plate construction.

G. **Skimming Blade Chain**: The skimming blade chain shall be fabricated of corrosion resisting processed metal and shall consist of 4.04-inch pitch malleable iron block links alternated with galvanized steel side bars and shall be assembled using stainless steel cotters or T-head copper plated steel pinlocks. The chain shall have a minimum weight of 9.2 pounds per foot, an average ultimate strength of 75,000 pounds per square inch, a Brinell hardness of 170 to 190 and a minimum ultimate strength of 36,000 pounds. Special steel side bars, galvanized after fabrication, shall be furnished for attachment of skimming blades as indicated.

The skimming blade chain takeup shall be of the adjustable screw type, providing for 6 inches of travel.

- H. **Sprockets**: All sprockets shall be made of chilled alloy cast iron, the rims and teeth having a Brinell hardness of not less than 375. Depth of hardness chill in the rims and teeth shall be not less than 3/16-inch. Sprockets shall be smooth and shall fit the type of chain used and shall be keyed where necessary. The head shaft drive sprocket shall be 18 inches in diameter. The skimmer chain sprockets shall have a pitch diameter of 13 inches.
- I. Shafts: All shafting shall be continuous between bearings and of ample size to transmit the power required. Keyways shall be accurately cut in line and phase with the sprocket teeth. Shaftings shall not be turned down at the ends to accommodate bearings or sprockets whose bore is less than the diameter of the shaft. All shafts shall turn in the end bearings. Shafting material shall be cold rolled, turned and polished solid steel, straight and true, and inspected for roughness and tolerances prior to mounting of sprockets and bearings.
- J. **Bearings**: Bearings shall be of the split, pillow type, equipped with babbitt linings, grease-lubricated, and provided with Alemite industrial type lubrication fittings.

K. Drive Assembly:

1. General: The drive assembly shall be reversible and arranged to drive the scum removal units as a pair or independently. The assembly shall consist of a motor, adjustable torque coupling, dual-output, right-angle speed reducer, two driving sprockets and two jaw clutches placed on a slow speed shaft extending from the speed reducer designed to drive the scum removal units.

A drive chain shall extend from the driving sprocket to the corresponding collector head shaft drive sprocket. The drive assembly shall be so geared that each skimming blade shall be approximately [2] feet per minute.

- 2. Motor: Each collector drive assembly motor shall be a TEFC machine rated at 460 V, 60 Hz, 3 phase, [1/2] horsepower, [1800] rpm. The motors shall be mounted on a common base with the speed reducer, or in combination arrangement where the reducer unit supports a bracket on which the motor is mounted.
- 3. Speed Reducers: The speed reducers shall be of the helical reduction gear type with mechanical efficiency of not less than 92 percent. They shall be constructed with dual right angle output shafts, shall run in oil and be fully

housed in a heavy cast iron or steel moistureproof case. The speed reducers shall be made to AGMA standards and bear an AGMA nameplate.

- 4. Drive Sprockets: Two driving sprockets shall be placed on the slow speed shaft extending from the speed reducer. The drive sprocket shall be fitted with a bronze bushing. Grease fittings shall be provided for lubrication between shafts and sprockets.
- 5. Jaw Clutches: Each drive sprocket shall be provided with a cast iron spiral jaw clutch to permit individual operation of either scum removal mechanism. Grease fittings shall provide for lubrication between shafts and clutches. The drive unit shall be controlled by a reversing starter. Upon initiation of the reverse direction, the spiral jaw clutches shall disengage.
- 6. Overload Protection: Each drive sprocket shall be furnished with a shear pin coupling to prevent damage to the motor and gear reducer in the event of an overload. Shear pins shall be straight aluminum rod with no neck-down. Hardened stainless steel bushings shall be press fit into the shear hubs to hold the shear pins. The mating faces of the shear hubs shall be separated by a Teflon washer approximately 1/32-inch thick.
- 7. Drive Chain: A drive chain shall extend from the driving sprocket to the corresponding shaft drive sprocket. The drive chain shall be Type H Mill chain made of process malleable iron. The metal shall be corrosion resistant material, shall have an average ultimate strength of 75,000 psi, and the Brinell hardness shall be in the range of 180-210. The chain shall have a 2.609-inch pitch, a pin diameter of 1/2-inch, a barrel diameter of 7/8-inch, a minimum weight of 4.2 lbs/ft, and an average ultimate strength of 16,000 pounds. Each length shall be connected by heat treated manganese steel pins fastened with a stainless steel cotter or a T-head copper plated steel pin lock.
- 8. Drive Chain Tension Adjustment: Provision shall be made on each collector drive assembly for adjusting the tension of each drive chain.

2.6 WEIRS

- A. The weirs shall consist of 1/4-inch thick by []-inch deep fiberglass plate complying with Section 06610. Plate sections shall have []-inch deep 90 degree V-notches at []-inch intervals. The weir sections shall be fastened to the tank with washers, clamps, stainless steel anchor bolts and hex nuts to allow vertical adjustment.
- [2.7 SECONDARY BASIN SCUM REMOVAL
 - A. **General**: Scum removal shall be by a motor operated scum pipe assembly complete with a variable time operator. It shall also be capable of manual operation by means of an independent manual lever operator. All mechanisms and parts shall be proportioned for the stresses which may occur during operation.
 - B. **Scum Pipe**: The skimmer shall be a(n) []-inch diameter slotted steel pipe. The slotted steel pipe shall have a full length, 60E opening except at locations of stiffeners and wall connections.

C. **Motor Operators**: The motor operator shall be a variable speed drive unit connected to an intermediate linkage system. The degree of pipe rotation shall be controlled by manual adjustments in the intermediate linkage, capable of accurate adjustment for control of skimming. The motor operator shall be complete with variable timing device which is capable of being manually set for constant to intermittent skimming operation. Worm gear operators are not acceptable. Each scum trough in multiple tank operations shall operate independently of each other.]

2.8 NAMEPLATES, TOOLS AND SPARE PARTS

- A. **Nameplates**: Nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in accessible locations. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the machine performance ratings.
- B. **Tools**: The WORK includes special tools necessary for maintenance and repair; tools shall be stored in tool boxes, and identified with the equipment number by means of stainless steel or solid plastic name tags attached to the box.
- C. **Spare Parts:** Spare parts shall be stored in accordance with the provisions of this paragraph. Spare parts shall be tagged by project equipment number and identified as to part number, equipment manufacturer, and subassembly component (if appropriate). Spare parts subject to deterioration such as ferrous metal items and electrical components shall be properly protected by lubricants or desiccants and encapsulated in hermetically sealed plastic wrapping. Spare parts with individual weights less than 50 pounds and dimensions less than 2 feet wide, or 18 inches high, or 3 feet in length shall be stored in a wooden box with a hinged wooden cover and locking hasp. Hinges shall be strap type. The box shall be painted and identified with stenciled lettering stating the name of the equipment, equipment numbers, and the words "spare parts." A neatly typed inventory of spare parts shall be taged to the underside of the cover.

The following spare parts shall be provided for each sludge collector bay installed in this project:

- 2 10-foot lengths of collector chain
- 4 collector flights of each size furnished complete with wearing shoes and filler blocks or brackets
- 1 dozen, link pins
- 2 attachment links

The following spare parts shall be provided for each drive unit installed in this project:

- 1 strand of drive chain (each system)
- 1 2 dozen, shear pins (each size)
- 1 driven sprocket (each system)
- 1 drive sprocket (each system)
- 1 headshaft sprocket (each system)
- 1 corner shaft sprocket
- 1 set of all oil seals and bearings for each reduction gear unit

3 - pin removal tools

2.9 MANUFACTURER

- A. Sludge collectors shall be as manufactured by the following (or equal):
 - 1. Budd Co. Poly Chem Division;
 - 2. Envirex;
 - 3. FMC Link-Belt;
 - 4. Jeffrey-Dresser.
- B. Drive units shall be manufactured by the following (or equal):
 - 1. Dresser Foot Jones Division;
 - 2. Falk Corp.

PART 3 -- EXECUTION

- 3.1 FLIGHT STORAGE AND PROTECTION
 - A. The flights shall be stacked, until used, in such a manner as to protect them from rain and excessive heat and to prevent warpage. All stacks shall be level and supported at frequent intervals to prevent sagging.
- 3.2 INSTALLATION
 - A. Clarifier assemblies and equipment shall be installed in accordance with approved procedures submitted with the shop drawings and as indicated, and in strict compliance with the manufacturer's recommendations, unless otherwise approved.
 - B. Inspection, testing, startup and field adjustment shall be as indicated.

** END OF SECTION **