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15 SETTLEMENT TANK EQUIPMENT

15.1 GENERAL

15.1.1 Scope

- 1 This part specifies the requirement for the design, manufacture, construction, testing and commissioning of equipment for primary and secondary settlement tanks.
- 2 Related Sections and Parts are as follows:

Section 1	General
Section 8	Drainage Works
Section 10	Instrumentation, Control and Automation
Section 13	Building Electrical Works
Section 21	Electrical Works

15.1.2 References

- 1 The following standards or revised/updated versions are referred to in this part:

BS 4-1	Structural steel sections - Specification for hot-rolled sections; (EN 10034 Structural steel I and H sections - Tolerances on shape and dimensions; EN 10025- Hot rolled products of structural steels- ; EN 10056- Structural steel equal and unequal leg angles-)
BS 449-2	Specification for the use of structural steel in building - Metric units; (EN 1993- Eurocode 3: Design of steel structures)
BS 970.....	Specification for wrought steels for mechanical and allied engineering purposes; (ISO 683-1 Heat-treatable steels, alloy steels and free-cutting steels — Part 1: Non-alloy steels for quenching and tempering; ISO 683-2 Heat-treatable steels, alloy steels and free-cutting steels — Part 2: Alloy steels for quenching and tempering; ISO 683-3 Heat-treatable steels, alloy steels and free-cutting steels — Part 3: Case-hardening steels; ISO 683-4 Heat-treatable steels, alloy steels and free-cutting steels — Part 4: Free-cutting steels; ISO 683-5 Heat treatable steels, alloy steels and free-cutting steels — Part 5: Nitriding steels; EN 10250-4: Open die steel forgings for general engineering purposes - Stainless steels; EN 10095 Heat resisting steels and nickel alloys; BS PD 970 Wrought steels for mechanical and allied engineering purposes. Requirements for carbon, carbon manganese and alloy hot worked or cold finished steels; EN 10089 Hot rolled steels for quenched and tempered springs. Technical delivery conditions; EN 10277 Bright steel products. Technical delivery conditions; EN 10278 Dimensions and tolerances of bright steel products; EN 10088-1 Stainless steels - List of stainless steels; EN 10088-3 Stainless steels - Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes)
BS 7671,	Requirements for Electrical Installations. IET Wiring Regulations
EN 10029	Hot-rolled steel plates 3 mm thick or above - Tolerances on dimensions and shape
EN 10084	Case hardening steels - Technical delivery conditions; (ISO 683-3 Heat-treatable steels, alloy steels and free-cutting steels — Part 3: Case-hardening steels)

- EN 10113Hot-rolled products in weldable fine grain structural steels; (EN 10025-1 Hot rolled products of structural steels - Part 1: General technical delivery conditions; EN 10025-3 Hot rolled products of structural steels - Part 3: Technical delivery conditions for normalized/normalized rolled weldable fine grain structural steels; EN 10025-4 Hot rolled products of structural steels - Part 4: Technical delivery conditions for thermomechanical rolled weldable fine grain structural steels)
- EN 10155Structural steels with improved atmospheric corrosion resistance - Technical delivery conditions; (EN 10025-1 Hot rolled products of structural steels - Part 1: General technical delivery conditions; EN 10025-5 Hot rolled products of structural steels - Part 5: Technical delivery conditions for structural steels with improved atmospheric corrosion resistance)
- EN 10210Hot finished steel structural hollow sections; (EN 10210-1 Hot finished structural hollow sections of non-alloy and fine grain steels - Part 1: Technical delivery conditions; EN 10210-2 Hot finished steel structural hollow sections - Part 2: Tolerances, dimensions and sectional properties; EN 10210-3 Hot finished steel structural hollow sections - Part 3: Technical delivery conditions for high strength and weather resistant steels)
- EN 12020Aluminium and aluminium alloys - Extruded precision profiles in alloys EN AW-6060 and EN AW-6063 ; (EN 12020-1 Aluminium and aluminium alloys - Extruded precision profiles in alloys EN AW-6060 and EN AW-6063 - Part 1: Technical conditions for inspection and delivery; EN 12020-2 Aluminium and aluminium alloys - Extruded precision profiles in alloys EN AW-6060 and EN AW-6063 - Part 2: Tolerances on dimensions and form)
- EN 60947-1Low-voltage switchgear and controlgear - Part 1: General rules; (IEC 60947-1 Low-voltage switchgear and controlgear - Part 1: General rules)

15.1.3 Submittals

- 1 In addition to the requirements of Part 1 of this Section, the Contractor shall reconfirm the information provided in the Technical Submission Schedules submitted with his Tender.

15.2 MATERIALS

- 1 All reference to stainless steel shall mean stainless steel to BS 970 Grade 316 S31 (partially replaced by EN 10084) unless otherwise stated.
- 2 All reference to aluminium shall mean marine grade aluminium milled finished 6063TF alloy to EN 12020.
- 3 All materials shall be protected against corrosion in accordance with Section 8 Part 8.

15.3 BRIDGES AND SCRAPERS

15.3.1 Scrapers

- 1 The tank scrapers shall be of the half-bridge rotating type or fixed bridge type as specified in the Contract Documents.

- 2 Non retractable tubular steel arms shall connect the scraper blades to the drive. The stainless steel scraper blades shall be fitted with removable heavy duty neoprene rubber or synthetic material hard wearing strips having a minimum shore hardness of 70. They shall be not less than 20mm thick and shall be fastened to the mechanism in such a way that the blades may be reversed. The minimum blade life shall be 2 years. Blades shall be arranged to form a continuous spiral across the floor and vertically up the side wall of the tank. Either the arms or blades shall be hinged to compensate for minor variations in the tank floor and side wall. Slotted holes shall be provided on the scraper rubber blades for adjustment against wear.
- 3 The two arms of fixed bridge scrapers with any appendages shall be equally balanced statically and be supported for rigidity using stay rods and turn buckles.
- 4 The scraper and its driving mechanisms shall be designed to allow for longitudinal and vertical movements of the bridge.

15.3.2 Bridges

- 1 The bridge shall be fabricated from structural steelwork to BS 4-1; BS 449-2; EN 10029; EN 10113; EN 10155 and EN 10210.
- 2 Primary tanks bridges shall be fabricated from stainless steel or from marine grade aluminium. Secondary bridges may be fabricated from mild steel, galvanised and painted in accordance with Section 8.
- 3 Fixed bridges shall span the full width of the tank.
- 4 Rotating half bridges shall be supported at the centre of the tank using a tripod manufactured from the same material of the bridge. The structure shall be designed to withstand the total loadings induced by the bridge and other forces associated with the bridge and scraper when in operation. The top plate of the support structure shall accommodate the centre bearing assembly and diffuser drum supports.
- 5 The bridge shall be designed to take a uniform distribution load of 250 kg/m² in addition to the weight of the scraper assembly and shall be capable of satisfactory operation under wind loads, acting horizontally and normal to the total area of exposed surfaces.
- 6 The maximum permissible deflection with this superimposed load shall not be greater than 1/360 of the bridge span. On removal of the load the bridge deflection shall fully recover and return to its original mid span position on either side of the bridge.
- 7 The bridge design shall include provisions to adequately cope with all torsional moments that it may reasonably be expected to encounter, with a safety factor of 2.0.
- 8 Fixed bridges shall be constructed with equal mass on both sides of the centre of the tank. At each end provision shall be made in the design of the supports to allow for expansion and contraction resulting from temperature differentials of not less than 10°C beyond the recorded maximum and minimum ambient temperatures in the region.

15.3.3 Walkways

- 1 The bridge structure shall have suitably rated open stainless steel or aluminium walkway the full length of the structure and the width shall be 850mm, between handrailing.
- 2 Handrailing shall be manufactured from stainless steel to BS 970 Grade 316 S31 (partially replaced by EN 10084) or marine grade aluminium tubes with standards 1100mm above the walkway, top rail and an intermediate rail 550mm above the walkway.
- 3 Toeboards 150mm high shall be fitted along both sides of the walkway.
- 4 Insulation shall be provided as necessary to prevent electrolytic action between dissimilar metals.

15.3.4 Bearings

- 1 Fixed Bridges:

Where the feed pipe rises from the centre of the hopper the scrapers shall be supported from the bridge on a frame around the pipe and shall have at least one steady bearing of phosphor bronze or stainless steel at the base of the scraper frame. The inner ring of this bearing shall be bolted to the feed pipe and the outer ring bolted to the scraper frame. All shafts on the drive system shall have at least two bearings whatever the configuration and as many guides as are necessary to retain stability.

2 Rotating Bridges:

The centre bearing assembly shall be designed to permit both horizontal rotation and vertical undulation of the bridge structure. The slewing and trunnion arrangement shall be designed to withstand the total loading of the bridge and other forces associated with the bridge and scraper in operation. Lubrication for the pivot pins, trunnions, etc. shall be provided from a readily accessible grease nipple battery plate.

15.3.5 Drive Units

- 1 For fixed bridges a motor, flange mounted to a reduction gearbox, shall provide the drive. The motor speed shall not exceed 1500rpm. The motor and gearbox shall be easily accessible for maintenance.
- 2 Rotating bridges shall be driven by a double-wheeled drive unit mounted on the end carriage. The end carriage shall be fabricated from mild steel and incorporate the trailing rear-driven wheel and the leading driving wheel and shall incorporate guards covering all wheels to protect from the possibility of wheel nip. The driving wheel shall be driven by a motor and gearbox unit. Both wheels shall be polyurethane tyred.
- 3 Gearboxes and motors shall have an ingress protection rating conforming to EN 60947-1: IP55 classification. Gearboxes shall have a life of 100,000 hours and be selected in accordance with the AGMA recommendations for power calculation and service factor application, shall incorporate filler cap/breather, dipstick or level plug and drain plug, and have a noise level of not greater than 65 dB(A) at 1 metre distant in any direction.
- 4 For fixed bridge drive units the following shall apply:
 - (a) A drip tray, with gunmetal drain tap, shall be located under the motor and gearbox reduction unit(s). The drip tray shall be manufactured from stainless steel not less than 2mm thickness.
 - (b) Any drive required between the reduction gearbox and the scraper shaft shall be by pinions and spur wheels or geared slewing rings as appropriate.
 - (c) The gearbox may be oil or grease lubricated whilst all other bearings shall be grease lubricated. All grease lubrication pipes shall be manufactured from stainless steel tube and be terminated at a common location on the bridge at a point which affords operational access to enable convenient, safe lubrication and be suitably labelled.
 - (d) The speed of the scraper assemblies measured at the tank periphery shall be. as follows:

Primary tanks	0.75 – 1.0m/min
Final tanks	0.3 – 2.5m/min fully variable.
 - (e) The drive system shall incorporate a loss of rotation monitor and an overload protection device comprising a torque limiting coupling set at the appropriate cut out torque. The device shall incorporate a switch and alarm indication system drawing attention to the fact that the torque limiting device has operated.
 - (f) The gearbox output mechanism shall be restrained by a torque arm fitted with a weatherproof, strain gauge type torque indicator and electro mechanical overload contacts.
 - (g) Guards shall be provided fully enclosing the scraper drive mechanisms.

15.4 ELECTRICAL EQUIPMENT

15.4.1 General

- 1 Electrical equipment and installation shall comply with Section 21 together with the following supplementary clauses.

15.4.2 Slip-Ring Current Collectors

- 1 All power supply, controls and signals to rotating bridges shall be fed to/from the bridge via an underfeed slip ring collector assembly fixed to the stationary centre bearing base plate.
- 2 The unit shall comprise phosphor bronze sliprings fitted with spring loaded brush-holders complete with copper graphite brushes, housed in an overall enclosure with an IP55 rating.
- 3 Current rating shall be adequate for starting and running the size of bridge drive motor chosen by the bridge manufacturer. The assembly shall also be suitable for the transmission of control signals.
- 4 The minimum voltage shall be 24v current capability, twelve circuits shall be provided as a minimum.
- 5 Cable boxes shall be suitable for accepting cable from below via 25mm cable entry and exit points.

15.4.3 Emergency Isolator Limit Switch

- 1 Each rotating bridge shall have an emergency isolator switch mounted on the leading edge of the drive carriage.
- 2 The switch shall have an enclosure rating of IP55 and shall be operated by a touch bar located on the leading edge of the drive carriage. The switch/touchbar assembly will constitute an emergency stop.

15.4.4 Motor Decontactor Plug and Socket

- 1 The supply cable to the drive motor shall incorporate a suitably rated weatherproof decontactor plug and socket.
- 2 The male section of the unit shall be connected directly to the drive motor using suitably rated flexible cable. The female socket shall be securely supported in a position to ensure that the latch button is readily accessible from the bridge.

15.4.5 Parking Switch

- 1 Each rotating bridge shall be provided with a magnetic proximity switch protected to at least IP55 standard arranged to ensure that the bridge is parked at a fixed location on the tank.
- 2 On installations with bridge mounted starters, a parking selector switch must be provided which is accessible from off the bridge.

15.4.6 Cabling

- 1 The Contractor shall supply and install all on-bridge cabling from the slipring collector. Cabling shall be stranded copper 600/1000 volts grade and suitable for the application in accordance with BS 7671 and specification Section 21.
- 2 The main cable from the collector shall be a single multi-core which is to be terminated at the motor end of the bridge with an IP55 junction box. From the terminal box individual three or two core cables shall be run to the various items of equipment included in the bridge contract.
- 3 All cables shall be suitably supported along their length with approved cleats. The spacing centres for the cleats shall not exceed that given in BS 7671. Cleats to be of rigid PVC secured to the bridge structure using stainless steel nuts and bolts. The bridge structure must be pre-drilled prior to galvanising to accept the saddle fixings. Crimped terminals shall be used for all connections.

15.5 ANCILLARY EQUIPMENT

15.5.1 Diffusion Drum

- 1 Diffuser drums shall be constructed in glass reinforced plastic suitably strengthened and supported from the bridge so as to be positioned in the centre of the tank.
- 2 The drum shall be sized to be 10% of the total area of the tank and 2m deep. The top of the diffusion drum shall project 150mm above TWL.
- 3 The drum skin and flange thicknesses shall be not less than 4mm and 6mm respectively.
- 4 Two 180° opposed square cut outs with internal baffles above TWL shall be installed in each drum to enable the removal of grease and sludge.

15.5.2 Weir plates and scum boards

- 1 'V' notch weir plates shall be supplied for bolting to the tank walls. The weir plate shall have 90° notches equi-spaced around the periphery of the tank and slotted adjustment holes. The spacing and size of "V" notches should be determined by calculation. The maximum discharge per notch should be 30-40m³/day to enable uniform outlet conditions.
- 2 The weir plate shall be 300mm deep and be fabricated from composite plastic or GRP. The weir plate shall be pre-curved and of minimum thickness 6mm. Sealing strips shall be provided for installation between the weir plates and the tank wall to allow for discrepancies in the structure.
- 3 Scum boards and fixing brackets shall be provided on all tanks. The brackets shall be stainless steel with stainless steel bolts and be so designed that no fixing is required to the tank wall within 250mm of the weir level.
- 4 The brackets shall hold the scum board securely 500mm from the inside face of the weir wall. The scum boards shall be manufactured from GRP, 305mm deep by 6mm thick pre-curved and shall be positioned so that 100mm of the scum board is above water level.

15.5.3 Scum Skimmer

- 1 A scum skimming arm (trailing scum board) shall be attached to the bridge (for rotary bridge) or to the scraper arm (for fixed bridge) which must maintain contact with the scum board in all positions. The scum arm shall sweep the scum to a trumpet at the periphery of the tank which shall automatically discharge the scum via pipework to a scum/grease trap. The blade shall be fabricated from GRP or stainless steel and shall protrude 100mm above top water level.

15.5.4 Scum Collection

- 1 Scum shall be collected in a scum box attached to the tank wall. The scum box shall be fabricated from stainless steel and terminate with a flanged connection. Scum box flush shall be provided suitable for operation from either the bridge or tank periphery. Not less than two scum collection boxes shall be provided at final settlement tanks associated with Activated Sludge Plants.

15.5.5 Effluent Channel Cleaning

- 1 Where called for in the Contract Documents a spray jet system shall be mounted on the travelling bridge (or on an extension to the scraping mechanism in the case of fixed bridges), to clean the outlet channel. The jets shall be fitted with hooded cover plates to prevent aerosols being forced upwards. A submersible sewage pump, fitted to the bridge or scraper extension shall supply tank effluent to the nozzles. A strainer shall be fitted to the pump. To allow cleaning of the filter, the pump discharge shall be a flexible hose, to allow lifting of the pump from the bridge without dismantling the pipework.
- 2 Spring loaded polypropylene bristle brushes shall be supplied and arranged to assist in cleaning of the effluent channel and weir walls without restricting effluent flow. The assembly shall be fabricated from 316L stainless steel. Springs shall be of stainless steel.
- 3 Effluent channel cleaning systems shall not be installed in primary tanks unless they are fully covered and odour controlled.

END OF PART

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