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## 11 SCREENING EQUIPMENT

### 11.1 GENERAL

#### 11.1.1 Scope

1 This part specifies the requirement for the design, manufacture, construction, installation, testing and commissioning of screening equipment.

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

#### 11.1.2 References

BS 970 (ISO 683) 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)

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)

BS 6739..... Code of practice for instrumentation in process control systems: installation design and practice

List of 'Approved Suppliers' prepared by the Public Works Authority

#### 11.1.3 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.

## 11.2 PRODUCTS

### 11.2.1 General

- 1 Screens shall be complete with all the necessary ancillary equipment and with screenings washing and compacting facilities.
- 2 The screens shall be fitted with an automatic cleaning mechanism, which shall remove the screenings adequately and positively into a screenings transfer system to the screenings washing equipment without risk of spillage. The transfer system shall be totally enclosed and be fitted with bolted removable access cover sections.
- 3 Unless otherwise stated in the Contract Documents the Contractor shall make his own assessment of the amount of screenings that will be produced by his equipment and the design of the screenings handling system shall be sized accordingly.
- 4 In all cases the screens shall be protected by a torque limiting device in addition to the motor overload protection. Rake parking switches shall also be provided and in each case the electrical circuit information for each device shall be provided with drawings for approval. The screening equipment shall not immediately restart on removal of the obstruction but shall be manually reset at the control panel.
- 5 The screen aperture shall be as stated in the Contract Documents.
- 6 All moving parts of the screen shall have oil impregnated, sintered bronze or grease lubricated bearings. In the case of the latter, individual stainless steel feed pipes and flexible polyurethane tubes to the bearings shall be fed from a manifold that shall be located in a convenient position outside any guards on the screen. A manual grease feed pumping system shall be incorporated.
- 7 The screen framework and components shall be designed to resist both hydraulic and drive mechanism loads during normal running and all modes of failure. Screen rake mechanism shall be arranged such that the minimum number of moving parts will remain immersed when the screen is in the parked position.
- 8 The complete headgear shall be enclosed within a removable glass reinforced plastic splash hood and a hinged door shall be provided to give visual inspection of the screens. The hood shall incorporate air admittance valves.
- 9 The plant shall be controlled by PLC suitable for SCADA and telemetry connection and shall incorporate a Human Machine Interface (HMI) within a dedicated Motor Control Centre (MCC).
- 10 Control system and Instruments such as level sensors, limit switches, etc. shall conform to the requirements of Section 10. The automatic control of the screen shall be achieved through differential level measurements of upstream and downstream levels in addition to timer control.
- 11 The screen shall be manufactured from stainless steel Grade 316 S31 to BS 970-1 (partially replaced by EN 10084), unless otherwise stated.
- 12 Limit of position indication shall be incorporated into the drive mechanism by means of proximity switches protected to IP68.

### 11.2.2 Brush Screen

- 1 The screen shall comprise perforated stainless steel Grade 316 S31 to BS 970-1 (partially replaced by EN 10084), or moulded polyurethane panels with 6mm apertures. .

- 2 The rotating brush shall incorporate adjustment arrangements to optimise brush effectiveness and reduce brush wear. Brush adjusters shall be fitted with either locknuts, stiff nuts or stop retainers to prevent disengagement of the brush resulting in consequent damage of the screen plates.
- 3 The screening panels shall be bolted to the framework using stainless countersunk bolts. Edge clearances shall not be capable of trapping screenings and in any event shall not exceed 5mm.
- 4 The screen shall be provided with a brush wiper mechanism to ensure the complete removal of screenings from the brush.

### 11.2.3 Band / Escalator Screen

- 1 Travelling Band / Escalator Screens shall not be permanently secured to the screen chamber walls. Location fixings shall be positioned at coping level for ease of access.
- 2 Screens to be housed in enclosed structures shall be manufactured in sections to facilitate removal from the chamber making due allowance for the maximum height available.
- 3 Where the size of the screen permits, the screen may be hinged such that it can be tilted out of the chamber for maintenance purposes.
- 4 The screen shall consist of a moving band of screening panels supported above coping level on two cast iron sprockets mounted on a horizontal headshaft supported in self aligning roller bearings. The headshaft shall be mounted on machined guides to allow for adjustment to compensate for chain wear. Tension screws shall be provided and shall be manufactured from stainless steel.
- 5 The main chain shall comprise links, bushes, pins and rollers and shall be self-lubricating by immersion in the flow. The links shall carry the mesh panel support frame and shall be fixed with stainless steel set screws. The chain shall run in curved guides at the bottom of the channel. Sprockets shall not be used to return the chain at the bottom of the channel.
- 6 The mesh panels shall be constructed of perforated stainless steel Grade 316 S31 to BS 970-1 (partially replaced by EN 10084), or moulded polyurethane, and provided with elevators to raise the screened material to the cleaning point. Woven panels shall not be used for screening sewage. The panels shall be designed to withstand full differential head across a fully blinded panel.
- 7 A sealing plate shall be provided between the outer edge of the mesh panels and a sealing angle bolted to the walls of the screening chamber. The plate shall enclose the chain guide on the upstream side of the screen to prevent debris fouling the chain. Sealing strips shall be provided between adjacent mesh panels to maintain the screening aperture when panels articulate around the bottom curve of the chain guide.
- 8 Spray jets shall be provided within the head section to remove the screenings from the mesh into a debris collecting trough. The spray pipe feeding the jets shall be provided with a washout valve fitted with a hose connection to facilitate flushing of the system. A rotating brush shall be provided immediately after the spray jets to remove fibrous material that has interwoven between the mesh apertures. The brush shall be easily renewable and fixed by stainless steel set screws.
- 9 The spray jet water shall be applied at the correct quality and pressure to efficiently remove all screenings during one pass of the panels.
- 10 Chain driven screens shall be provided with chain tensioners and have provision for manual adjustment in the event of chain stretching.

- 11 Tracked carriages shall also be provided with wheel adjustment so that engagement in the channels of the track can be optimised.

#### 11.2.4 Rotary Raked Bar Screen

- 1 Rotary curved bar screens shall be raked by a shaft mounted rake mechanism revolving continuously through 360°. The rotation of the cleaning rake shall clean the radius of the stationary bar rack and elevate screenings to a discharge point at the top of the rack. At this point a wiper mechanism shall ensure that the rake is cleared of all screenings before continuing its cycle.

#### 11.2.5 Semi Rotary Raked Bar Screen

- 1 Semi rotary curved raked bar screens shall comprise a single cleaning rake which by means of a pivoting linkage describes a rotary path along the stationary curved rack, disengages at the top of the screen rake and re-engages at the bottom of the rack.
- 2 At the top of the rack a wiper mechanism shall ensure that the rake is positively cleared of all screenings before continuing its cycle.
- 3 This type of screen may also be hydraulically operated.

#### 11.2.6 Step Screen

- 1 Step screens shall not be permanently secured to the screen chamber walls. Location fixings shall be positioned at coping level for ease of access.
- 2 Screens to be housed in enclosed structures shall be manufactured in sections to facilitate removal from the chamber making due allowance for the maximum height available.
- 3 Where the size of the screen permits, the screen may be hinged such that it can be tilted out of the chamber for maintenance purposes.
- 4 The screen shall consist of a series of self cleaning screening bars in a staircase configuration. Every other bar shall be fixed in a rigid structure and the remaining bars shall form a robust moveable framework that shall revolve in a reciprocating motion to lift the screenings step by step to the top for discharge.
- 5 A sealing plate shall be provided between the outer edge of the screen and the walls of the screening chamber. The plate shall enclose the drive mechanism on the upstream side of the screen to prevent fouling by debris. Chain drives, if used, shall incorporate means of adjustment to compensate for chain wear. Tension screws shall be provided and shall be manufactured from stainless steel.
- 6 The screen shall be designed to prevent blockage at the base by grit or stones and shall be constructed of stainless steel Grade 316 S31 to BS 970-1 (partially replaced by EN 10084).

#### 11.2.7 Straight Bar Screen

- 1 The straight bar screen may be vertical or inclined and shall comprise a stationary bar rack or grid which is automatically cleaned by one or more power operated rakes.
- 2 The screen bars shall be at the centres as specified in the Contract and fabricated from stainless steel to BS 970, Grade 316 S31 (partially replaced by EN 10084).
- 3 The screen may be front or back raked. In the case of reciprocating rake machines, the rakes shall clear the bars on the down stroke and engage positively with screen bars prior to the upward stroke. A wiper mechanism shall ensure that the rake is cleared of all screenings before continuing its cycle.

- 4 The cleaning rake shall be jam proof type, chain driven, suitable for either front or back cleaning, and shall be formed of stainless steel with teeth of adequate length and section bolted on for easy replacement.
- 5 Chain driven screens shall be provided with chain tensioners and have provision for manual adjustment in the event of chain stretching.
- 6 Tracked rake carriages shall also be provided with wheel adjustment so that engagement in the channels of the track can be optimised.
- 7 Manual screens are to be provided with channel sections to support/guide the screen enabling easy raising/lowering of the screen. The channel sections shall be made of SS316 or better material.
- 8 All pumping stations with a capacity of more than 500 l/s and a screen chamber depth of more than 8m shall be provided with automatically operated grab type screen(s).

#### 11.2.8 Covered Skip Containers

- 1 Covered skips shall be suitably sized and fabricated from steel sheets of sufficient thickness to withstand full volume of screenings or grit loading and the stresses of movement and dumping of the screenings and grit.
- 2 The shape and dimensions of the skip containers shall be compatible with the configuration of the screenings and grit dewaterers so that discharge to the skip containers occurs without spillage. The skips shall have nominal liquids capacity of 7m<sup>3</sup> and shall be suitable for use with Government of Qatar standard skip transporting vehicles.
- 3 Skip containers shall have rubberised castor wheels, with a minimum wheel diameter 150mm.
- 4 Skip containers shall be epoxy coated in accordance with Section 8, with a minimum of at least 3 epoxy coats.
- 5 Covered skips shall be interchangeable between the screens and grit removal applications.
- 6 Skips shall be subject to a 5 year replacement guarantee under regular use by the Client, provided that the skips are not subjected to misuse.

### 11.3 SCREENINGS TRANSFER SYSTEMS

#### 11.3.1 Screening Trough

- 1 Screenings shall be discharged from the screens into a screening trough for water borne transfer to the washer/compactors. The trough shall be made of minimum 6 mm thickness stainless steel Grade 316 S31 to BS 970-1 (partially replaced by EN 10084) plate with bolted removable access cover sections.
- 2 Water for flushing the screenings from the screen discharge collection point to the washer/compactor shall be 6mm screened sewage, treated sewage effluent or potable water as specified in the Contract. Screened sewage shall only be used with the approval of the Engineer and the Contractor shall take all necessary measures to eliminate odour release and to treat any odours that are released.
- 3 The trough shall be supplied with two inspection ports having dimensions of approximately 100 mm by 500mm. A 25 mm pipe flushing connections shall be provided at each end of the drainage collecting trough to allow washing/cleaning of the trough.

### 11.3.2 Conveyor Belt

- 1 Conveyor belts shall be of 3-ply standard endless conveyor belting (joints to be vulcanised), reinforced with fabric between plies of width 800mm and a thickness of 20mm (upper ply-contact surface 7mm, middle ply 8mm and bottom ply 5mm thickness). This conveyor shall be incorporated with SS side plates, doctor blades, troughing and stainless steel return idlers, adjustable tail pulley and a motorized head pulley permitting rotation in both directions. The conveyor shall be mounted on stainless steel frame work.

## 11.4 SCREENING WASHER/COMPACTORS

### 11.4.1 Screening Washer/Compactor

- 1 Screenings compactors shall consist of an inlet hopper, high energy washing zone, screw compactor, electric motors and reduction gear drive unit, discharge pipe, drain connections and water spray system. The whole unit shall be factory assembled and tested prior to shipment. The unit shall be designed to wash faecal and organic matter from the screenings before compaction and discharge through a chute suitable for use with a standard skip.
- 2 The washing impeller and its drive unit shall be hinged from the tank for ease of maintenance.
- 3 A drain shall be installed at the lowest point of the wash tank, be fitted with a knife valve and shall be piped, together with the wash water overflow, to a local drain point.
- 4 The dewatering compartment shall be a screw compactor operating in a trough with maximum 6mm diameter perforations for drainage. The compactor screw shall be fitted with a hard wearing brush on the periphery of the screw blades to ensure free drainage is maintained. The brush shall be arranged to allow adjustment for wear.
- 5 The compactor will have a minimum capacity as required by the volume of screenings expected to be produced by the contractors proposed screens and will be designed to provide compacted screenings with a maximum moisture content of 50% and a maximum faecal content of 5%.
- 6 The compactor screw shall be constructed of stainless steel flights welded to a stainless steel solid shaft. The screw shall extend a minimum of 600mm beyond the end of the dewatering zone. The pressing zone shall be a cylindrical stainless steel pipe rising towards the discharge chute. Stainless steel shall be Grade 316 S31 to BS 970-1 (partially replaced by EN 10084).
- 7 The discharge pipe shall be made of stainless steel and shall use long-radius fittings designed to avoid any jamming of the partially dewatered/compacted screenings. The discharge pipe shall be easily disassembled to clear blockages and shall terminate in a position or manner such that a standard skip can be easily removed from below it.

### 11.4.2 Washer/Dewaterer

- 1 Washer/dewaterers shall be of the two stage brush and perforated plate type and fabricated from stainless steel with removable GRP access covers.
- 2 The first stage, (washing stage) shall contain the rotating brush assembly fitted with four polypropylene brushes, and the second stage, (dewatering stage) shall contain a rotating rubber roller assembly fitted with four tensioned rollers.
- 3 The screening panels shall be manufactured from stainless steel with 3mm perforations.



- 4 The machine shall be complete with integral inspection walkway, access ladder and handrailing, the walkway width being 900mm minimum. Where duty and standby machines are specified a common walkway may be sited between the machines, however the machines must be of sufficient height to allow discharge of the screenings into a common skip.
- 5 The filtrate shall collect in the bottom of the machine and discharge through a NP16 flanged outlet of 100mm n.b. A 100mm n.b. overflow outlet, flanged to NP16 shall also be provided above the centre line of the machine. Pipework shall be of stainless steel.

### 11.5 GEAR REDUCER

- 1 The screens and washer/compactors shall be powered by an electric motor and gear reducer.
- 2 The gear reducer shall include anti-friction bearings with high overhung load properties and oil-seal, double-lip, high temperature synthetic riding on precision ground shaft, to minimise leakage possibilities. The speed reducer shall be enclosed in a cast iron weatherproof casing. Gears shall be made of hardened and heat treated forged steel. The gear reducer shall not be overloaded under any normal operating conditions and shall be designed for heavy-duty service. The gearing shall be oil lubricated.

### 11.6 MOTORS

- 1 Motors shall have Class F insulation and be rated for continuous duty operation. They shall conform to the requirements of Section 21 of the specification and the recommendations of the manufacturer.
- 2 Motors shall be sized so that under maximum continuous loading the motor rated power is a minimum of 50 % greater than the driven load.

### 11.7 CONTROLS

- 1 All necessary controls shall be incorporated in an FBA as described in Section 21.
- 2 The controls shall include all the necessary relays, starters, timers, indicators, breakers, switches and fuses and all other electrical accessories required to make the system complete and perfect in every way.

### 11.8 INSTALLATION AND COMMISSIONING

#### 11.8.1 Installation and Commissioning

- 1 The equipment delivered to Site shall be examined by the Engineer to determine that it is in good condition and in conformance with the approved working drawings and certification. All equipment shall be installed in strict accordance with Part 1 of this Section 9.

#### 11.8.2 Testing

- 1 Test Procedures shall be in accordance with Part 1 of this Section 9 and the particulars of the Contract.

END OF PART