21 MISCELLANEOUS EQUIPMENT

21.1 GENERAL

21.1.1 Scope

1 This part specifies the requirement for the design, manufacture, testing and commissioning of miscellaneous items of 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

21.1.2 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)

BS 970-1 ..... Specification for wrought steels for mechanical and allied engineering purposes - General inspection and testing procedures and specific requirements for carbon, carbon manganese, alloy and stainless steels; (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; BSI PD 970 Wrought steels for mechanical and allied engineering purposes. Requirements for carbon, carbon manganese and alloy hot worked or cold finished steels)

BS 3170,..... Specification for flexible couplings for power transmission

DIN 1.4517 ... Cast Stainless Steel (duplex stainless steel formulated for casting: EN 10213 Steel castings for pressure purposes; EN 10283 Corrosion resistant steel castings)

EN 1092 ..... Flanges and their joints - Circular flanges for pipes, valves, fittings and accessories, PN designated

EN 1561 ..... Founding - Grey cast irons; (ISO 185 - Grey cast irons — Classification)

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)

ISO 281 ..... Rolling bearings — Dynamic load ratings and rating life

ISO 10816 ... Mechanical vibration — Evaluation of machine vibration by measurements on non-rotating parts

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

21.1.3 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.

21.1.4 General

1 The plant shall be complete with electric motors, starters and switchboards, cabling, accessories, valves, piping, holding down bolts, lubricators, appendages and connections to make the plant complete and perfect in every part and detail.

2 There shall be included all necessary stairs, ladders, platforms etc. to provide permanent, fixed safe and easy access for the maintenance of every item of plant.

21.2 PROGRESSIVE CAVITY PUMPS

21.2.1 General

1 Each pump shall be capable of pumping sludge with a dry solids content 50% greater than the design percentage of solids.

2 It should be noted that macerators/munchers might be required in certain applications.

3 The design of the installation shall allow the pump rotor to be removed from the installed pump body without the need to remove the pump casing from its installation.

21.2.2 Pump Design

1 The pumps shall be of the horizontal rotary type, for abrasive service provide hard chrome plated tool steel, for corrosive service provide hard chrome plated SS316 S31 having an abrasion resistant helical rotor operating in a resilient, synthetic rubber stator, suitable for the handling of the sludge.

2 The pumps shall be of robust construction throughout suitable for the arduous conditions involved when pumping sludge, and shall be capable of working for long periods without requiring maintenance attention.

3 The rotor speed shall not exceed 400 rpm and provision shall be made for easy inspection of the rotor.

4 The pumps may be direct driven or belt driven and the motors shall be mounted beside the pumps.

5 The pumps and motor shall be mounted on a robustly constructed baseplate which shall incorporate, if belt driven, a positive belt tensioning device and shall be arranged such that access for inspection and maintenance is not unduly restricted or hindered by pipework connections etc.

6 For belt driven pumps, the drive between the pump and motor shall be by Vee Belts and shall be rated such that with half the number of belts broken the remaining belts can transmit the full driving power required by the pump at maximum duty.

7 The belt drive and pulleys shall be completely protected by suitable guards easily removable for inspection.

8 Each pump shall be supplied with a spring loaded pressure relief valve, the discharge of which shall be separately piped back to the suction pipework. To allow an increased head for main clearing purposes the valves shall be arranged to relieve at 45 metres head or at the maximum head under which the pumps may operate, whichever is the lower.

9 The pumps shall be arranged with “suction on gland” and the suction body shall be fitted with a flushing connection from the wash water system.

10 The Contractor shall provide and install all necessary pipework and valves from wash water system to the pumps.

11 Calculations for sizing the pumps shall be supplied with the offer and when tested at the maker’s works, the pumps shall give results that conform to the said calculations.

21.2.3 Macerator/Muncher

1 Macerators if required shall be installed upstream of each pump and shall be able to handle an equivalent flow.

2 The macerator/muncher shall comprise a slow speed, high torque, parallel shaft grinder.

3 The macerator/muncher shall ensure that the progressing cavity pumps are protected from and can adequately cope with the diverse materials likely to be encountered in the sludge.

21.3 END SUCTION PUMPS

21.3.1 General

1 End suction pumps may be close horizontally coupled to the motor as a single compact unit or independent of the motor.

2 The pumps shall be continuously rated and designed for an operating life of 20 years without major overhaul. Components likely to wear in the course of normal operation shall be capable of replacement with readily exchangeable components.

3 The pump casing and other parts in contact with the liquid shall be suitable for the duties involved.

4 Close coupled pumps shall be directly coupled to the drive motor through a rigid coupling and end thrusts accommodated in the motor bearings. The motor shall be flanged and spigotted for correct alignment, it shall be fitted with jacking bolts to ease removal.

5 Independent pumps shall be coupled to the drive motor through a flexible coupling which shall not be capable of transmitting end thrust to the motor.

6 The rotating unit must be removable type from the pump casing without disturbing the suction and delivery piping and the motor. A spacer type flexible coupling shall be used for power transmission.

7 Vibration level, procedures and guideline shall be in accordance with ISO 10816 for the measurement and classification of mechanical vibration.

21.3.2 Casing

1 The pump casing shall be of cast iron to EN 1561, Grade 250 and be abrasion resistant, capable of taking shock loads and incorporate lifting eyes for removal of the pump. It shall be designed and correctly formed to provide the highest efficiency and absence of turbulence and shall be flanged and spigotted for correct location and jointing.

2 Readily replaceable back and front casing wear rings shall be provided, unless otherwise specified the casing wear rings shall be stainless steel Grade 316 S31 to BS 970 Part 1 and the wear rings shall be locked to prevent rotation by dowels or other similar approved method.

3 The pump casing shall be complete with integrally cast feet and lifting points.

21.3.3 Shaft and Impeller

1 The shaft shall be of stainless steel of minimum Grade 316 –S31 to BS 970-1 and of ample diameter to withstand all stresses imposed.

2 Where shafts are exposed to the process fluid and where they pass through the sealing gland they shall be fitted with positively driven stainless steel sleeves Grade 316-S31 to BS 970-1, which shall extend through the stuffing box.

3 The impeller shall be made of duplex stainless steel DIN 1.4517 and be of robust construction and be machined where possible with the water passages and blades filed and scraped, to produce smooth surfaces so that rags and stringy matter will not adhere. It shall be provided with auxiliary back blades to reduce the pressure at the mechanical seal and prevent the ingress of solids and abrasive matter. Hydraulic balance holes shall not be provided and the impeller shall be tested and adjusted for static and dynamic balance. The impeller shall be fitted to the drive shaft by a fitted impeller key and secured by a contoured nut, provided with a positive locking arrangement. Impellers are to be provided with renewable wear rings. Impeller wear rings shall be stainless steel Grade 316 S31 to BS 970 Part 1. The shaft shall be fully protected from contact with the pumped liquid.

4 The pump shall rotate in a clockwise direction when viewed from the suction end. The rotating element shall be in balance and designed so that the maximum operating speed is not less than 30 per cent below the first critical speed and there is no tendency for any part to unlock due to possible reversal of rotation.

21.3.4 Gland Plate

1 The gland plate shall be flanged and spigotted for correct alignment, it shall be fitted with jacking bolts to ease removal from the pump casing.

2 The gland plate shall be fitted with a cartridge type mechanical seal. The gland stuffing box shall be designed for soft gland packing as an alternative.

3 The mechanical seal selected shall be suitable for the pump duty and the media being pumped, the seal shall be water lubricated and shall not in normal use permit any controlled leakage from the pump.

21.3.5 Bearings

1 Independent pumps shall be fitted with an external shaft bearing assembly. It shall positively locate the shaft so that on reassembly the shaft and impeller are in true alignment within the rotating unit and it shall be provided with locating dowels and jacking bolts to ease removal.

2 Bearings shall be generously rated and sized to take all thrust and radial loads and to ensure satisfactory and stable running under all conditions of operation, they shall be to ISO standard with SI unit dimensions. Bearings shall be of anti-friction type designed for an L10 life of at least 100,000 hours in accordance with ISO 281. The bearings shall be arranged for oil or grease lubrication.

21.3.6 Pump Performance

1 The pump head/flow characteristic curve shall be stable, rising steadily to closed valve head and non-overloading. The closed valve head shall be a minimum of 110% of the maximum duty head

2 Where the maximum duty is met by parallel pump operation, a single pump shall be capable of operation without run-out or overloading.

3 The Contractor shall make his own assessment of the friction losses under all operating conditions.

4 The pump quantity/power characteristics shall be stable and non-overloading such that the maximum power absorbed under any condition remains at least 10% less than the rating of the motor.

5 Characteristic curves for the pump shall be supplied with the Tender to a large scale which shall show the capacity of the pumps when pumping singly at minimum and maximum head. Where two or more pumps are installed discharging through the same pumping main, the characteristic curves shall include the system curves for all combinations of pumps. Curves showing pump efficiency and kW loading shall also be included. Where pumps are supplied with variable speed drives provide pump curves for minimum and maximum speed with pump efficiency and kW loading at intersections of the system curve.

6 When tested through their complete range of workable heads at the maker's works, the pumps shall give results which conform to the curves submitted with the Tender

21.4 PRESSURE FILTERS AND STRAINERS

21.4.1 Pressure Filters

1 Automatic self cleaning filters shall be specifically suitable for use with organic contaminants. Cleaning shall be by a hydraulically powered suction scanner, automatically activated when the differential pressure across the filter reaches an adjustable level, nominally 3.5m.

2 The filter body and all internal parts, including flanges, shall be stainless steel Grade 316S31 to BS 970-1 (partially replaced by EN 10084). The screen shall be 150 micron mesh size. The flushing line shall be connected to the works drainage system.

3 The control system shall feature a fail-safe timer to prevent continuous flushing due to malfunction. The filter shall not flush when the system or pumps are not working.

4 All the filters shall have isolation valves in the suction and delivery side for easy maintenance. The controller for the filters shall be equipped with a timer and pressure differential control unit.

5 Pressure gauges shall be connected to suction and delivery side of each filter, pressure switches shall be mounted in the electric control panel in an isolated compartment.

6 Input and output flanges dimensions shall be in accordance with EN 1092 PN 16.

21.4.2 Basket Strainers

1 The strainer shall be of the duplex in-line basket flanged type, of compact design and shall incorporate large filtration areas giving low pressure drops.

2 The body and cover will be of cast iron to EN 1561 grade 250 or equivalent, and shall be fusion bonded epoxy coated internally and externally with a minimum thickness of 300 microns. Flanges shall be PN16 to EN 1092.

3 Internal parts shall be of stainless steel Grade 316S31 to BS 970-1 (partially replaced by EN 10084) or equivalent.

4 The filter shall be 920 microns mesh inserted into a perforated plate basket.

5 Strainers shall be suitably rated for all working and test delivery pressures.

6 A differential pressure switch shall be connected between the inlet and outlet of the filter, and if the pressure drop across the filter is exceeded by 50% (or other value recommended by the Manufacturer and agreed with the Engineer) a lamp on the panel shall indicate “filter blocked” and operation of the system shall be disabled.

21.5 POLYMER PREPARATION AND DOSING SYSTEMS

21.5.1 General

1 A polyelectrolyte make-up, storage and dosing system shall be provided. The system shall be sized to provide the polyelectrolyte requirements of the sludge thickening system as designed by the Contractor and provide an adequate storage period of the necessary raw materials

2 The Contractor shall provide a facility for dosing by direct injection into the pipework, of pre-prepared polyelectrolyte, upstream of the conditioning tanks. The facility shall be manually selected via a gate valve and capable of being isolated from the dosing system.

3 The dry granule storage hopper shall be fabricated of stainless steel and shall have a 25kg minimum capacity. The hopper shall be mounted on the polyelectrolyte feeder and shall be provided with supports. The hopper shall be provided with a low-level alarm.

4 The hopper shall be enclosed by a stainless steel cabinet with a tubular heater fitted inside to prevent condensation and maintain polyelectrolyte in a dry condition.

5 The transfer of granules into the hopper shall use a vacuum system designed to operate with 1 tonne bulk bags.

6 The dry granule transfer equipment for the transfer of dry polymer from hopper to wetting device shall include the following: -

(a) A granule feeder with single screw discharge. The granule feeder outlet shall be fitted with a heater to prevent condensation.

(b) A stainless steel funnel to direct the granules from the screw discharge into an air lift venturi. The funnel shall be fitted with a sieve.

(c) A centrifugal air blower to provide a high velocity air stream. The motor shall be totally enclosed with a degree of enclosure protection appropriate to the equipment. The level of protection shall not be less than IP55.

(d) An air dehumidifier.

(e) A venturi granule injector to feed the granules into the air stream.

(f) An anti-static connecting hose.

7 All stainless steel parts shall be Grade 316 S31 to BS 970-1 (partially replaced by EN 10084)

21.5.2 Wetting and Dispersing Device

1 Wetting and dispersing devices shall ensure that every granule of polyelectrolyte delivered by the air stream is wetted and dispersed into the make-up tank. No conglomerates of polyelectrolyte shall be produced. The spray heads shall be of stainless steel Grade 316 S31 to BS 970-1 (partially replaced by EN 10084) and shall be fitted with a water pressure gauge and a control pressure switch. Potable water shall be used

2 The Contractor shall provide the Engineer with design calculations to demonstrate that he has made all reasonable endeavours to optimise the use of water on works processes.

3 For the polyelectrolyte system, the Contractor must install a break tank of sufficient water capacity to allow batch polymer to be mixed for one day's use.

4 The Contractor shall design the polyelectrolyte break tank with optimal spare capacity and shall impose a strict regime of control to suppress any peaks and troughs of the water demand pattern.

21.5.3 Flocculent Storage Tanks

1 Flocculent storage tanks shall be fabricated from glass-reinforced plastic or steel reinforced glass fibre and shall include the following: -

(a) Slow speed propeller or turbine mixer.

(b) Level electrodes to control solenoid valves, air blower, mixer, screw feeder and dosing pumps.

(c) Mounting for wetting and dispersing device.

(d) Flanged inlet, outlet, drain and overflow connections.

(e) Removable covers.

(f) Sight glass.

(g) Tank contents gauge with analogue output to SCADA system.

21.5.4 Dosing Pumps

1 Duty and standby chemical metering pumps shall be provided complete with all pipework, valves and any necessary metering arrangements. The output of the pumps shall be variable by means of hydraulic variator or adjustable speed drive depending on pump type selected, so as to get accuracy in the dosing rate.

2 Flow meter (analogue-mechanical type) shall be installed in the delivery line of the pump to get the chemical flow rate.

21.6 INSTALLATION AND COMMISSIONING

1 Installation and commissioning shall be in accordance with Part 1 of this Section 9.

END OF PART