1. Mixers

1.1 Scope

This Clause presents the specifications for the submersible, electric motor driven propeller mixers to be supplied by the Contractor as follows:

Sludge Tank Mixers
One (1) Mixer will be supplied to ensure mixing, aerating and preventing sedimentation of the sludge in the 250 cubic meter Sludge (WAS) Storage Tank.

Description	Units	Value
Motor Tag No		M-12.0-00
Water level	m	5
Diameter	m	8
Volume	m^3	250
Solids (range)	%	0.4-1
Viscosity (range)	mPa-s	10-160
SVI (range)	ml/gr	80-300
Required velocity at each point in the tank	m/s	0.3-0.5
Required thrust	N	1540
Number of Mixers		1
Required thrust per mixer	N	770
Maximum RPM		340

The Mixed Sludge Tank is shown in Drawings 04044_13.51_ARCH-GEN

The civil engineering works associated with the construction of the tank, are within the scope of this contract. The erection of the above equipment is also within the scope of this contract.

1.2 General Requirements

The supply of each mixer shall include a complete mounting and lifting system to enable easy and convenient adjustment and removal of the mixer.

Vibrations that may have detrimental effects on the performance or strength of the equipment shall be avoided. A short description of the dynamic balancing procedures used by the manufacturer shall be provided.

The propellers shall be two-bladed, backward curved to prevent clogging, and shall be made of stainless steel and fiber reinforced polyurethane. The propeller shaft shall be stainless steel 1.4401, DIN 17440, designed to be completely sealed off and not in contact with the liquid. The mixer shall have one mechanical seal (tungsten carbide - tungsten carbide) and two lip seals.

The mixer housing shall be made of stainless steel 1.4401, DIN 17440. Inside the housing, an oil casing shall serve to lubricate and cool the seals, bearings and gears and act as an additional barrier against penetrating liquid.

The motor shaft, countershaft and propeller shaft shall be carried in bearings with a B-10 life of at least 100,000 hours.

The reduction gear shall be a two-stage shaft-mounted gear with helical teeth, AGMA-rated for more than 100,000 hours of continuous duty operation.

The motor shall be a squirrel-cage, 3-phase induction motor, in accordance with Clause 3.13, class F insulation, designed to run continuously.

The mixer shall include a built-in leak detector (for detection of water in the oil casing) and a high-temperature sensor for stopping the mixer in either fault event (fault signals to be relayed to the plant's Central Control Panel).

Each mixer shall be equipped with its own mounting system and manual hoist, which shall permit adjustment of the angle of the mixer (vertically and horizontally) and allow the mixer to be easily removed from the tank for servicing. The mounting equipment shall include (but not be limited to): bottom holder; guide bar; bar studs and holders; support arms and appurtenances; locking plate; handle; lifting davit; suspension chain hook; cable holder; 316 SS lifting chain. All mounting system equipment shall be stainless steel. The hoist and the mounting systems shall be so designed as to make it possible to remove mixer for maintenance.

Each mixer shall be supplied with an integral 15-meter-long electrical cable.

1.3 Operation and Control

The mixers shall be operated and controlled from the plant's Central Control Panel. It is intended that the mixers run continuously to provide the needed minimum tank velocity (and the complete mixing in the Selector) on a constant basis.

2. Central Heat Exchanger

2.1 Scope of Supply

This specification covers the design, manufacture, supply, and delivery of one (1) Decoupling Cylinder (hydraulic separator) for the hot water heating system serving the anaerobic sludge digesters at Ashdod Wastewater Treatment Plant. The decoupling cylinder hydraulically separates the primary boiler circuit from the secondary heat-exchanger circuits.

2.2 General Design Basis

The heating system comprises two (2) De Dietrich GT530-12 hot-water boilers, each with a nominal output of 696 kW (598,600 kcal/hr), serving three (3) shell-and-tube sludge heat exchangers via a decoupling cylinder. Key design parameters are summarized below.

SYSTEM DESIGN PARAMETERS	
Number of boilers	2 × De Dietrich GT530-12
Nominal output per boiler	696 kW (598,600 kcal/hr)
Total system heat output (2 boilers)	1,337 kWh (1,150,000 kcal/hr)
Number of secondary circuits (heat exchangers)	3
Primary circuit pump type	Pump Type A
Secondary circuit pump type	Pump Type B
Primary collector pipe diameter (ØD)	12" (323.9 mm OD / 312.8 mm ID)
Primary flow rate – both boilers in service	220 m³/hr
Primary flow rate – one boiler in service	110 m³/hr
Secondary flow rate per circuit – Mode B (2 boilers)	64 m³/hr
Secondary flow rate per circuit – Mode A (1 boiler)	30 m³/hr
Hot water supply temperature (boiler outlet)	72 °C
Hot water return temperature (boiler inlet)	67 °C
Maximum water temperature at heat exchanger inlet	70 °C

Minimum return water temperature	55 °C
Digester operating temperature	35–37 °C

2.3 Technical Requirements

The decoupling cylinder shall be sized in strict accordance with the De Dietrich manufacturer guidelines for average water velocities. The following velocity limits shall be met:

- Internal water velocity within the decoupling cylinder: ≤ 0.1 m/s (absolute maximum, not to be exceeded under any operating condition)
- Velocity in the primary collector (manifold): 0.7 – 0.9 m/s target; 0.9 m/s maximum
- Cylinder internal diameter: not less than 3 × ØD (three times the primary collector internal diameter)

DECOUPLING CYLINDER SIZING CALCULATION	
Maximum primary flow (two boilers)	220 m^3/hr = 0.061 m^3/s
Maximum allowable velocity in collector	0.9 m/s
Required collector cross-sectional area	0.068 m^2
Calculated collector internal diameter	≥ 294 mm
Selected primary collector pipe (ØD)	12" – OD 323.9 mm, ID 312.8 mm
Actual velocity in collector (@ 220 m^3/hr)	0.795 m/s ✓ (< 0.9 m/s)
Minimum decoupling cylinder internal diameter (3×ØD)	3 × 312.8 = ≥ 938 mm
Selected cylinder internal diameter	938 mm (0.938 m)
Cross-sectional area of cylinder	0.660 m^2
Actual water velocity inside cylinder (@ 220 m^3/hr)	0.093 m/s ✓ (< 0.1 m/s)

CYLINDER PHYSICAL DIMENSIONS	
Internal diameter of decoupling cylinder	938 mm (≈ 3 × 312.8 mm ID collector)
Internal diameter of primary collector / manifold pipe	312.8 mm (12" pipe, schedule 3/16")
Overall cylinder length (L = 9 × 3D spacing)	L = 9 × 930 mm = 8,370 mm
Connection spacing (centr-to-centr, each tier)	3D = 930 mm
Number of outlet connections (to heat exchangers)	3 (one per secondary circuit)
Number of return connections (from heat exchangers)	3 (one per secondary circuit)
Secondary connection pipe size	4" (DN100)
Vent connection (top)	Automatic air vent – size per manufacturer standard
Blowdown / drain nozzle (bottom)	Ø 2" (DN50)
Boiler output manifold connection	Ø 12" (matching primary collector – ØD)
Boiler return manifold connection	Ø 12" (matching primary collector – ØD)

2.4 Connection Geometry (Nozzle Layout)

The nozzle layout shall follow the De Dietrich standard decoupling cylinder arrangement. From top to bottom, the cylinder shall incorporate the following connections at the specified spacing:

	Connection	Left Side (Supply)	Right Side (Return)
Top	Vent (auto air vent)	—	—
1	Boiler output manifold	12" inlet (from boilers)	—
2	HEX circuit #1 outlet	—	4" supply to HEX #1
3	HEX circuit #2 outlet	—	4" supply to HEX #2
4	HEX circuit #3 outlet	—	4" supply to HEX #3
5	HEX circuit #1 return	4" return from HEX #1	—
6	HEX circuit #2 return	4" return from HEX #2	—

7	HEX circuit #3 return	4" return from HEX #3	—
8	Boiler return manifold	12" outlet (to boilers)	—
Bottom	Blowdown nozzle	Ø 2"	—

2.5 Design Pressure and Temperature

PRESSURE & TEMPERATURE RATINGS	
Maximum operating pressure	6 bar (matching boiler GT530-12 maximum)
Design pressure (test pressure)	1.5 × operating = 9 bar minimum
Maximum operating temperature	100 °C
Normal operating temperature (supply)	72 °C
Normal operating temperature (return)	67 °C

2.6 Materials and Construction

MATERIALS	
Cylinder shell material	Carbon steel – minimum 5 mm wall thickness
Manifold / collector pipe material	Carbon steel, schedule 3/16" for 12" pipe
Secondary connection nozzles (4")	Carbon steel, schedule 3/16"
Internal surface treatment	Shot-blasted to Sa 2.5 minimum prior to coating or passivation
External surface treatment	Two-coat epoxy primer + finish coat, RAL 5015 (sky blue) or as agreed
Flanges	PN10 flat-face flanges; drilled to EN 1092-1 or ANSI 150# as specified
Supports / legs	Adjustable steel legs with base plates for floor mounting

2.7 Accessories and Ancillaries

The following accessories shall be supplied as an integral part of the decoupling cylinder assembly:

- Automatic air vent (float type) at the top of the cylinder – DN15 minimum
- Manual drain / blowdown nozzle DN50 (Ø 2") at the bottom

- Temperature gauge pocket (thermowell) on main body
- Pressure gauge connection (1/2" BSP) on main body
- Thermal insulation: 80 mm mineral wool or equivalent, faced with aluminium cladding, complete with jacket
- Identification plate: stainless steel, engraved with tag number, year of manufacture, design pressure, design temperature, and volume
- All flange gaskets and bolting for the supply connections

2.8 Operating Modes

The decoupling cylinder shall function correctly and maintain water velocity ≤ 0.1 m/s under all of the following operating scenarios:

OPERATING MODE SUMMARY	
Mode A – One boiler in service	Primary flow: 110 m³/hr; Secondary flow per circuit: 30 m³/hr; Velocity in cylinder: ~0.046 m/s ✓
Mode B – Two boilers in service	Primary flow: 220 m³/hr; Secondary flow per circuit: 64 m³/hr; Velocity in cylinder: ~0.093 m/s ✓
Stand-by / emergency (1 boiler fault)	System shall maintain digester temperature at 35–37 °C on one boiler alone. The decoupling cylinder shall not restrict this capability.

3. Hot water recirculation pumps

3.1 Scope of Supply

The Contractor shall supply two (2) inline single-stage centrifugal hot-water circulating pumps (tag numbers M-14-4-10 and M-14-4-11) for the primary heating circuit of the Anaerobic Digestion System at Ashdod WWTP and also three (3) inline single stage centrifugal hot water to recirculate water between the heat exchanger and water column.
Each unit shall be complete with motor, baseplate, coupling, and all ancillary items required for a fully operational installation.

3.2 Performance Requirements

HYDRAULIC DUTY POINT	
Pump Type A – Primary water recirculation Pump	
No of units	2
Tags No	M-14.4-10 / M-14.4-11
Minimum flow rate (duty)	110 m³/hr
Minimum total head (duty)	10 m
Operating temperature range	70 °C – 85 °C
Maximum fluid temperature (transient)	100 °C
Maximum operating pressure	6 bar
Speed control	Fixed speed (50 Hz) acceptable; VFD compatible preferred
Pump Type B – Secondary water recirculation Pump	
No of units	3
Tags No	M-14.4-26 / M-14.4-46 / M-14.4-66
Minimum flow rate (duty)	65 m³/hr
Minimum total head (duty)	10 m
Operating temperature range	70 °C – 85 °C
Maximum fluid temperature (transient)	100 °C
Maximum operating pressure	6 bar

Speed control	Fixed speed (50 Hz) acceptable; VFD compatible preferred

The pump curve shall demonstrate a stable, non-overloading characteristic across the full operating range. The Best Efficiency Point (BEP) shall be within 20% of the specified duty flow. The pump shall not cavitate at the specified operating conditions.

3.3 Technical Specifications

PUMP CONSTRUCTION	
Type	Inline single-stage centrifugal, close-coupled or long-coupled
Casing material	Cast iron (GG25) or ductile iron minimum
Impeller material	Bronze (CuSn) or AISI 316 stainless steel
Shaft material	AISI 316 stainless steel or equivalent
Shaft seal	Mechanical seal rated for 100 °C continuous service
Coupling	Flexible jaw or disc coupling – rated for 100 °C continuous, hot-water duty
Connections	Flanged – PN16 flat-face or raised-face to EN 1092-1
Connection size	DN150 (6") inlet and outlet – to match primary circuit piping
Mounting	Inline (pipe-mounted) with floor support bracket
Rotation	Clockwise viewed from drive end (unless otherwise stated)
Balancing	Impeller dynamically balanced to ISO 1940 Grade G2.5 or better

MOTOR AND ELECTRICAL	
Motor type	TEFC (Totally Enclosed Fan Cooled), IE3 efficiency class minimum
Power supply	400 V / 3-phase / 50 Hz
Insulation class	Class F (temperature rise limited to Class B)
Protection class	IP55 minimum
Motor speed	1,450 rpm required to meet duty point
Starting method	Direct-on-line (DOL) or soft-starter – as per electrical design
Motor frame size	IEC standard
Terminal box position	Top or right-hand side – suitable for conduit entry

3.4 Accessories and Ancillaries

Each pumping unit shall be supplied complete with:

- Baseplate – fabricated steel, drilled for grouting, with drip rim
- Flexible coupling with guard – suitable for continuous 100 °C service
- Suction and discharge isolation valves – gate or butterfly, PN16, DN150
- Discharge check valve – swing or dual-plate type, PN16, DN150
- Pressure gauges – one on suction, one on discharge (glycerine-filled, 0–10 bar)
- Drain plug on pump casing
- Lifting eyes or lifting lug on motor
- Nameplate: stainless steel, engraved with tag number, duty point, serial number, and year of manufacture
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Motor supply	400 V / 3-ph / 50 Hz
Motor efficiency class	IE3 minimum
Motor enclosure / protection	TEFC / IP55 minimum
Performance standard	ISO 9906 Grade 2

4. Sludge Recirculation Pumping Units

4.1 Scope of Supply

The Contractor shall supply sludge recirculation centrifugal pumping units, complete with integrated macerator, for the external sludge recirculation loop of the Anaerobic Digesters at Ashdod WWTP. Each unit pumps digested sludge from the digester recirculation suction pipe, through the sludge heat exchanger, and back to the digester. Raw feed sludge is injected into the recirculated sludge flow stream downstream of the pump.

The pumping units shall be of the centrifugal type with an integrated macerator (grinder), installed dry (above-grade), horizontally, in accordance with the P&ID (tag references M-14-52).

4.2 Process Design Basis

PROCESS CONDITIONS	
Fluid	Digested sludge (anaerobically digested biosolids)
Sludge concentration (TS)	Up to 5% total solids
Fluid temperature (normal)	35–37 °C
Fluid temperature (maximum)	40 °C
pH range	6.5 – 8.0 (typical anaerobic digester range
Fluid density (design)	Approx. 1,010 – 1,050 kg/m³
Presence of fibrous/abrasive material	Yes – screened raw sludge, rags, grit traces possible
Suction source	Digester recirculation suction pipe (from bottom of digester)
Discharge destination	Shell side of sludge heat exchanger, then back to digester
Raw sludge injection point	Downstream of pump – injected into recirculation flow stream

4.3 Hydraulic Duty Requirements

DUTY POINT	
Nominal flow rate	70 m³/hr
Total dynamic head (TDH)	10 m
Duty configuration	One duty
Minimum TDH (contractual)	10 m
Suction pipe size (P&ID)	DN150 reducing to DN125 at pump inlet
Discharge pipe size (P&ID)	DN125 expanding to DN150 at pump outlet
Operating mode	Continuous – 24 hr/day, 7 days/week

The Contractor shall submit detailed hydraulic calculations with the bid, demonstrating that the selected pump meets the duty point including all pipe friction losses, fittings, heat exchanger shell-side pressure drop, and static head. The pump curve shall show stable operation at the duty point with no risk of surging or cavitation.

4.4 Pump Technical Specification

PUMP CONSTRUCTION	
Type	Single-stage centrifugal, with integrated macerator/grinder at suction
Installation	Dry-installed (above grade), horizontal shaft, direct-coupled to motor
Macerator / grinder	Integrated at pump suction – capable of reducing solids and fibrous material to pass freely through the impeller without blockage. Grinder blades shall be of hardened stainless steel or equivalent wear-resistant material.
Casing material	Cast iron GG25 or ductile iron GGG50; suitable for sludge service
Impeller type	Open or semi-open vortex/channel type – non-clog design for sludge
Impeller material	Cast iron, ductile iron, or chrome iron – wear resistant; minimum Brinell hardness 280 HB
Casing wear plate / liner	Replaceable hardened wear plate, chrome iron or equivalent
Shaft material	AISI 316 stainless steel
Shaft seal	Mechanical seal – single, internal, flushed (flush water from discharge or clean water supply). Seal faces: silicon carbide / silicon carbide or tungsten carbide / carbon. Seal elastomers: EPDM or NBR suitable for sludge at 40°C.
Bearings	Heavy-duty grease-lubricated or oil-lubricated anti-friction bearings; L10 bearing life ≥ 50,000 hours at duty conditions
Connections	Flanged DN125 suction inlet and DN125 discharge outlet, PN10 flat-face to EN 1092-1

MOTOR AND DRIVE	
Drive type	Direct-coupled (flexible coupling); no V-belt drives
Motor type	TEFC (IP55), IE3 efficiency class minimum
Power supply	400 V / 3-phase / 50 Hz
Insulation class	Class F (temperature rise limited to Class B)

Starting method	Soft-starter or DOL – as per electrical design
Motor frame	IEC standard B3 (foot-mounted) or B3/B5
Motor power sizing	Non-overloading across the full pump curve – motor shall not be overloaded at any point from shut-off to maximum flow
Coupling	Flexible jaw or disc coupling with spacer to allow seal removal without disturbing motor or pipe connections; coupling guard to EN 953

BASEPLATE AND MOUNTING	
Baseplate	Common fabricated steel baseplate for pump and motor; drip-rim design to capture seal leakage
Mounting	Baseplate drilled and tapped for anchor bolts; grout holes provided
Alignment	Laser-aligned at factory; alignment certificate to be provided
Levelling	Adjustable levelling feet on baseplate

4.5 Accessories

Each pumping unit shall be supplied complete with the following:

- Common fabricated steel baseplate with drip rim – for pump and motor
- Flexible coupling with spacer element and removable coupling guard (EN 953 compliant)
- Suction and discharge flange connections – DN125, PN10, flat-face
- Suction and discharge pressure gauge tappings (1/2" BSP) – gauges by piping contractor
- Drain plug on casing
- Motor terminal box – positioned for conduit entry from below or side
- Identification nameplate: stainless steel, engraved with tag number, duty point (m^3/hr and m head), serial number, year of manufacture
- Commissioning spares: one set of mechanical seal, one set of coupling insert/element, one set of macerator blades

4.6 Inspection and Testing

- Performance test: each pump to be factory-tested per ISO 9906 Grade 2 (or equivalent) with clean water. Test report to show flow, head, power, and efficiency at the duty point and at minimum three points on the pump curve including shut-off head.
- Macerator function test: grinder/macerator to be demonstrated in operation prior to despatch.

- Hydrostatic pressure test: pump casing to be tested to 1.5 × maximum allowable working pressure for not less than 30 minutes with no leakage.
- Mechanical running test: minimum 30 minutes at duty flow with vibration and temperature readings recorded.
- Material certificates: EN 10204 Type 2.2 minimum for wetted parts; Type 3.1 for casing and impeller if specifically requested.
- All test certificates to be supplied before despatch.