Grantham Waste Water Treatment Plant

Operations and Maintenance Manual

INDEX

Glossary of Terms

Term	Definition
Anoxic	A system devoid of oxygen.
Aerobic	A system that requires oxygen.
Anaerobic	A system that does not require oxygen.
Backwash	A reverse flow of liquid to remove solids from the filter.
Chlorination	The adding of chlorine to water for the purpose of disinfection.
Denitrification	The process where nitrogen is removed from the liquor in the anoxic tank and converted to nitrogen gas.
Disinfection	The process used to kill micro-organisms in the water stream, including all pathogenic (disease causing) bacteria.
Filtration	The process by which solid particles are separated from a liquid by passing the liquid through a permeable material.
Filtration Rate	The volume of liquid that passes through a given area in a specified time.
Membrane	Media through which a liquid is passed associated with filtration.
Nitrification	The process where ammonia (NH_3) is converted (oxidised) into nitrites (NO_2) and nitrates (NO_3) by bacteria within the aeration tank.
Pathogen	Disease causing bacteria particles.
pH	pH the expression intensity of the basic of acidic condition of a liquid.
Sludge	Solid constituents of sewage that precipitate during treatment and are removed.
Supernatant	Liquid floating on the surface over sludge.
Turbidity	The amount of suspended matter in wastewater, obtained by measuring its light scattering ability.

List of Abbreviations

AS	— Activated Sludge
BOD	— Biological Oxygen Demand
DO	— Dissolved Oxygen
EPA	— Environmental Protection Agency
HMI	— Human Machine Interface
MCB	— Miniature Circuit Breaker
MLSS	— Mixed Liquor Suspended Solids
MSDS	— Material Safety Data Sheet
NTU	— Nephelometric Turbidity Unit
P&ID	— Process and Instrumentation Diagram
PLC	— Programmable Logic Computer
RAS	— Return Activated Sludge
SSV	— Settled Sludge Volume
SVI	— Sludge Volume Index
TSS	— Total Suspended Solids
UV	— Ultraviolet
VSD	— Variable Speed Drive
WAS	— Waste Activated Sludge
WWTP	— Waste Water Treatment Plant

Section 1 — Process and General Maintenance

Hazard and Safety Warnings

Prompts have been used throughout the manual to highlight safety, environmental and process concerns. The following information describes the prompts used in the manual and their meanings:

DANGER!

Indicates a hazard or situation where failure to use the correct procedures WILL cause either severe personal injury or death.

WARNING!

Indicates a hazard or situation where failure to use the correct procedures COULD result in severe personal injury or death.

CAUTION!

Indicates a hazard or situation where failure to use the correct procedures COULD result in severe personal injury or equipment damage.

IMPORTANT!

Indicates information within the text which is of particular importance to the procedure or operation being described.

REMEMBER!

Indicates information within the text which is of sufficient importance to warrant highlighting.

NOTE!

Indicates information which has been covered in an earlier section of the text but which warrants reinforcement.

Contents

1.1 Background

The Grantham Township was devastated by floods in 2011. The Lockyer Valley Regional Council has undertaken to rebuild Grantham in a flood free zone adjacent to the original township.

Grantham residents will be able to relocate their homes or construct new homes on sites within the new development.

This is a three stage project appropriately named as the “Strengthening Grantham” project with stage one now complete.

Housing lots in stage one have been connected to a sewage reticulation system that supplies effluent to the Grantham wastewater treatment plant.

The Grantham wastewater treatment plant has been designed to treat a maximum of 50,000L of effluent per day with treated effluent being discharged to a fenced irrigation field adjacent to the treatment plant.

Figure 1 View of Grantham AS Wastewater Treatment Plant under construction

1.2 Introduction

This section provides reference information for the operation and maintenance of the Grantham Activated Sludge (AS) Waste Water Treatment Plant (WWTP).

The AS wastewater treatment system produces a high standard of recycled water, suitable for controlled reuse including above surface irrigation in fenced off areas.

In a technical sense, it is a suspended growth activated sludge system that utilises a clarifier for solid/liquid separation, followed by tertiary treatment through filtration and disinfection.

The system incorporates a proprietary biological treatment process using extended aeration. The treatment process provides flexibility in flow demands, in addition to a high standard of effluent quality with virtually no odours. The clarifier further removes suspended solids from the liquid and the clarifier sludge forms an integral part of the biological process.

Flow balancing is incorporated into the design of the plant to enable the daily peaks to be absorbed, while the normal treatment processes are undertaken. This enables the plant to spread the load over the day resulting in a higher quality final effluent being produced.

Aeration is undertaken in the aeration tank using fine bubble membrane diffusers. Dissolved oxygen monitoring and variable speed control of the aeration equipment is used to maximise plant power efficiency while providing the ideal conditions for optimum wastewater treatment.

Media filtration (Sand Filter) and Ultra Violet (UV) lamps provides the disinfection stage in the plant to destroy liquid bound virus and bacteria.

The UV disinfection removes the E Coli present in the fluid to achieve the required standard of effluent continuously.

The entire treatment plant is automatically controlled by a control system that also allows for manual process intervention.

1.3 AS Waste Water Treatment Plant Process Flow

The composition and volume of wastewater entering the plant varies depending on the number of people using the system. This variability alters the strength and volume of the raw sewage that enters the treatment plant, therefore, impacting the effluent quality leaving the sewage treatment plant after effluent treatment processes have been complete.

The principal producers of wastewater that forms the sewage that is fed into the treatment plant, typically includes that of laundry and shower facilities, kitchen wastewater, and toilet amenities.

Table 1 details the expected Grantham influent characteristics

Parameter	Value	Range
pH		6.5-8.5
Suspended Solids	mg/L	200-450
BOD_5	mg/L	220-450
COD	mg/L	400-800
Ammonia Nitrogen	mg/L	30-75
Total Phosphorous	mg/L	Oct-16
Sulphate	mg/L	20-75
Alkalinity	mg/L	150-250
Total Dissolved Solids	mg/L	250-750

Table 1 Influent Characteristics

The Grantham wastewater treatment plant has been designed to treat the influent to meet the following effluent characteristics and meet the DERM discharge license requirements.

Parameter	Required	Release limit
pH	6.5-8.5	range
Turbidity	<5NTU	80th percentile
Suspended Solids	<15mg/L	80th percentile
BOD_5	<10mg/L	80th percentile
Total Nitrogen	<5mg/L	50th percentile
Total Phosphorous	<2mg/L	50th percentile
Residual Chlorine	0.7mg/L free chlorine	Minimum
Faecal Coliform	<10cfu/100ml	95th percentile

Table 2 Effluent Requirements

The treatment plant can be broadly separated into key equipment items and processes that include:

- the influent screen
- the screened influent sump
- the balance tank
- the aeration system
- the anoxic and aeration tanks
- the clarifier
- the Clarified tank
- Media filtration
- U.V. disinfection
- the solids digester tank
- the final effluent tank
- The irrigation scheme.

Each of the key equipment items and processes require auxiliary equipment to transfer process liquids and control operation of the treatment plant. These auxiliary equipment items include:

- pumps
- gauges
- meters
- sensors
- valves

NOTE!

The treatment plant is controlled by a PLC control unit that operates the key and auxiliary equipment items. The interface for controlling and operating the treatment plant is located in the control room.

1.3.1 Inlet Screen

Raw sewage is pumped to the wastewater treatment plant via the Grantham effluent reticulation scheme.

The raw sewage enters the plant though a bar screen which separates the sewage solids and liquid.

The bar screen uses a one millimetre screen to separate the solids and the liquid, whereby the solids are scraped from the surface and discarded in a bin and the screened sewage liquid gravity feeds via a sump into the balance tank.

Figure 2 ShinMaywa Inlet Screen

1.3.2 Inlet Screen - General Maintenance

WARNING!

INLET SCREEN CAN START AUTOMATICALLY
ALWAYS ISOLATE BEFORE CONDUCTING MAINTENANCE

.

	Activity	Frequency
1	• Visually inspect Screen and record observations on log-sheets	Daily
2	• Check screen bars are clear of debris and that there are no large gaps	Daily
3	• Clean screen and sump (Washdown)	Daily
4	• Service screen chain drive	Annually

Table 3 Inlet Screen-General Maintenance

	Activity	Frequency
1	• Check and record sump level	Daily
2	• Check and clean sump sensor.	Monthly

Table 4 Inlet Screen-Sensor Maintenance

	Activity	Frequency
1	• Visually inspect pipe-work	Daily
2	• Check all valves for signs of corrosion. • Clean valve bodies and apply corrosion protection as required	Weekly
3	• Check operation of all valves by opening and closing through range of motion.	Weekly

Table 5 Inlet Screen - Valve Maintenance

1.3.3 Balance Tank

The screened sewage is transferred to the balance tank where it is stored, before being pumped to the anoxic and aeration tanks.

The balance tank has an operating volume of 45,000L (45m³)

The balance tank allows the treatment plant to capture and control inflow when it is greater than the production capacity of the plant.

Screened raw sewage is fed from the bar screen sump into the aerated flow balance tank.

Aeration is supplied via the air blower's reticulation system.

This tank is critical to protect the plant from hydraulic surges, and provides smoothing of peak loads onto downstream processes

The raw sewage is pumped to the Anoxic tank at a controlled rate by way of the balance pumps.

Entrained suspended solids from the media filters are fed to the Balance tank during media filtration backwash cycle.

Figure 3 Balance Tank

The excess flows during peak periods is stored in the balance tank and gradually introduced to the treatment plant via the balance pumps during off peak periods.

1.3.4 Balance Tank & Balance Pumps - General Maintenance

WARNING!

BALANCE TANK PUMPS START AUTOMATICALLY.

ALWAYS ISOLATE BEFORE CONDUCTING MAINTENANCE

WARNING!

BALANCE TANK IS A CONFINED SPACE.

DO NOT ENTER WITHOUT APPROPRIATE PERMITS, EQUIPMENT, TRAINING AND PERSONNEL

	Activity	Frequency
1	• Visually inspect tank and record observations on log-sheets	Daily
2	• Check and confirm operation of balance tank pumps P-102A and P-102B	Daily
3	• Clean pump P-101 and P-102 casing and check for signs of corrosion	Daily
4	• Service Balance Pumps P-101 and P-102	Annually

Table 6 Balance Tank - General Maintenance

	Activity	Frequency
1	• Check and record tank level	Daily
2	• Check and clean level sensor.	Monthly

Table 7 Balance Tank - Sensor Maintenance

	Activity	Frequency
1	• Visually inspect pipe-work	Daily
2	• Check all valves for signs of corrosion. Clean valve bodies and apply corrosion protection as required	Weekly
3	• Check operation of all valves by opening and closing through range of motion.	Weekly

Table 8 Balance Tank - Valve Maintenance

1.3.5 Biological (Aeration-Anoxic) System

The biological treatment system is based upon the Modified Ludzak-Ettinger (MLE) treatment process. The process is a compartmentalised process consisting of separate reaction volumes for the Anoxic and Aerobic processes.

A basic process flow is presented in the following Figure.

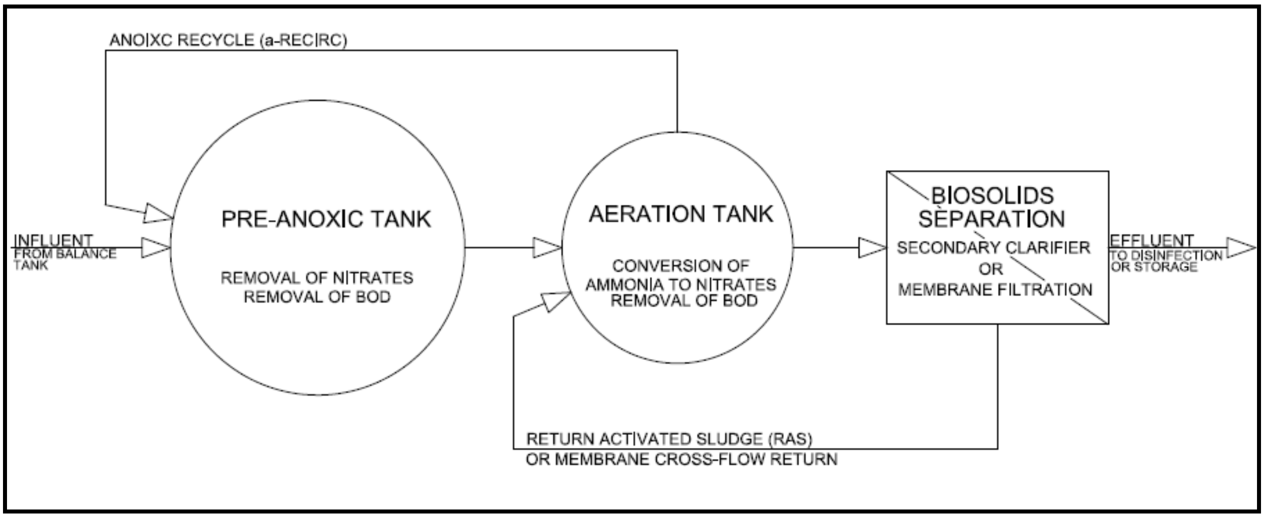


Figure 4 Biological Process Train

The system utilises ‘a’ recycle in order to provide nitrates to the pre-anoxic zone, where contact with fresh influent BOD and the lack of an active aeration system results in the formation of anoxic conditions, resulting in the conversion of Nitrates into nitrogen gas (with the subsequent release to atmosphere).

Nitrates are created in the aeration zone once the available BOD has been utilised by the bacteria present by bacteria able to metabolise Ammonia (this process requires the presence of oxygen).

The balance of the anoxic recycle rate, the aeration rate, the volume of air entrained in the recycle, and the availability of BOD/COD are all critical in achieving satisfactory results with this process.

1.3.6 Aeration System

The aeration system is comprised of two air blowers and the associated valves and piping that deliver process air to the:

- aeration tank;
- balance tank; and
- Digester tank.

The aeration levels are closely controlled in the aeration tank as they determine the amount of dissolved oxygen in that tank, which in turn affects how the sewage is broken down by the oxygen dependent micro-organisms.

Figure 5 Aeration System Blowers

NOTE!

Aeration minimises the amount of odour the treatment plant emits.

1.3.7 Anoxic Tank

Screened raw sewage is pumped from the balance tank to the anoxic tank by the duty balance pump with standby operation managed by the standby balance pump (P101 and P102). Balance flow rate is at a pre-set rate from the balance tank to the anoxic tank.

The screened influent enters the anoxic tank through a de-aeration chamber which is essentially a vertical pipe of circa 300mm diameter that by way of the vertical column of liquid formed applies pressure on entrained air to allow continuous de-gassifying of this air out of the chamber.

The anoxic tank has an operating volume of 36,000L (36m³) which is continuously mixed by the anoxic mixer (MX101).

The anoxic mixer turns over the anoxic tank continuously to promote a healthy anoxic zone and prevent settling. The mixer operates continuously when there is sufficient fluid in the anoxic tank.

Returned mixed liquor from the aeration tank is also fed into the anoxic tank, this is known as the ‘a’ Recycle.

The ‘a’ Recycle system returns biomass rich in nitrates from the aeration tank to the anoxic tank for denitrification.

The ‘a’ recycle pump (P103) operates on a time run and time stop sequence. The run time and rest time can be set in the SCADA. The ‘a’ Recycle pump is controlled by a PID loop to achieve the desired flow rate.

Within the anoxic tank the liquor is maintained in an anoxic state where the dissolved oxygen level is below 0.5mg/l. This level is needed to maintain a consistent level of denitrification which breaks down the sewage.

Denitrification

Denitrification is the process where nitrate is removed from the liquor in the anoxic tank and converted to nitrogen gas.

For denitrification to occur four key elements are required;

- Bacteria;
- Food for the bacteria to consume (BOD);
- Nitrates; and
- Anoxic conditions i.e. Free of dissolved oxygen (DO)

In technical terms the biological reduction of nitrate (NO3) to nitrogen gas (N2) by *facultative heterotrophic* bacteria is called Denitrification.

“*Heterotrophic*” bacteria need a carbon source as food to live. (In the form of raw sewage (BOD) and/or supplemental carbon dosing; molasses, dog food etc)

“*Facultative*” bacteria can get their oxygen by taking dissolved oxygen out of the water or by taking it off of nitrate molecules. In this case, nitrates supplied by the returned biomass, rich in nitrates, from the aeration tank via the ‘a’ recycle system.

Denitrification occurs when oxygen levels are depleted and nitrate becomes the primary oxygen source for microorganisms.

The process is performed under anoxic conditions, when the dissolved oxygen concentration is less than 0.5 mg/L, ideally less than 0.2mg/L.

When bacteria break apart nitrate (NO3-) to gain the oxygen (O2), the nitrate is reduced to nitrous oxide (N2O), and, in turn, nitrogen gas (N2). Since nitrogen gas has low water solubility, it escapes into the atmosphere as gas bubbles.

Free nitrogen is the major component of air, thus its release does not cause any environmental concern.

Therefore for denitrification to occur the anoxic tank must be free of dissolved oxygen and there must be a source of nitrate, (supplied by the ‘a’ recycle from the aeration tank.)

IMPORTANT!

Effluent rich in nitrogen is very harmful to the environment and can cause algal blooms in waterways which causes fish kills and can damage the entire ecosystem.

1.3.8 Anoxic Tank & 'a' Recycle pump - General Maintenance

WARNING!

ANOXIC MIXER STARTS AUTOMATICALLY
ALWAYS ISOLATE BEFORE CONDUCTING MAINTENANCE

WARNING!

ANOXIC RECYCLE PUMPS START AUTOMATICALLY
ALWAYS ISOLATE BEFORE CONDUCTING MAINTENANCE

WARNING!

ANOXIC TANK IS A CONFINED SPACE
DO NOT ENTER WITHOUT APPROPRIATE PERMITS, EQUIPMENT, TRAINING AND PERSONNEL

	Activity	Frequency
1	• Visually observe mixing pattern within anoxic tank. • Record any deviations on the log-sheet	Daily
2	• Check tank Dissolved Oxygen and pH levels using a handheld probe. • Ensure that measurement is being taken outside the inlet baffle. • Record observations on the log-sheet	Daily
3	• Hose down any accumulated scum or foam	Daily
4	• Check operation of Anoxic Recycle Pump (P103)	Daily
5	• Check and record total flow and instant flow of Anoxic Recycle Pump (P103). • Compare to set-point.	Daily

6	• Conduct a 30min Settled Sludge Volume (SSV) Test. Record results on results sheet	Daily
7	• Once per week, take a sample and test for Nitrate + Nitrite, Ammonia and Alkalinity using the field test kit. Sample may require settling or filtration. • Record results on results sheet.	Weekly
8	• Lift and check mixer for signs of wear or damage	Quarterly
9	• Lift and Service Anoxic Mixer	Annually

Table 9 Anoxic Tank General Equipment Maintenance Summary

	Activity	Frequency
1	• Check operation of ‘a’ Recycle Pump flowmeter. • Record total flow and instant flow and compare with SCADA set-point	Daily
2	• Check calibration of ‘a’ recycle flowmeter using draw-down test or calibrated hand-held flowmeter	Annually or as Required
3	• Check operation of MLSS Meter. Record readings	Daily
	• Perform basic cross-check using SSV or SVI test (conversion factor from MLSS Testing)	Weekly (MLSS Test Monthly)
4	• Take MLSS Samples. Perform calibration and store as per instruction Manual. • Send samples to lab for suspended solids analysis. • Enter calibration points upon receipt of results.	Annually or as Required

Table 10 Anoxic Tank Sensor Summary

	Activity	Frequency
1	• Check each valve for signs of corrosion or damage. • Dust valves and apply corrosion protection as necessary	Weekly
2	• Open and close valves through full range of movement. • Ensure pumps are Off during this. • Note any problems on the log-sheets	Weekly

Table 11 Anoxic Tank-Valve Maintenance Summary

1.3.9 Aeration Tank

Mixed liquor from the anoxic tank flows into the aeration tank via a mid level gravity feed system. This hydraulically links the two tanks, such that the levels in both tanks increase and decrease at the same time.

The aeration tank has an operating volume of 46,000L (46m³)

The aeration tank uses fine bubble aeration from the aeration system to maintain the dissolved oxygen levels in the tank. (The air is forced through Rehau diffusers)

Air for the diffuser system is supplied by a set of 2 blowers, running in a duty/duty assist/standby arrangement, with the air injection rate being controlled by a Dissolved Oxygen Probe and variable speed drives on the blowers.

The dissolved oxygen content is critical to the nitrification process which is used to breakdown ammonia (NH3) present in the sewage.

The aeration tank provides oxidation of the BOD and Ammonia present.

BOD is oxidised to Carbon Dioxide with the creation of new cellular biomass (or the maintenance of existing cellular biomass), whereas Ammonia is oxidised to Nitrates via the Nitrification process (producing Nitrates and new cellular biomass).

Nitrification occurs once all the available BOD is removed from the sewage.

Nitrification

The biological conversion of ammonium to nitrate nitrogen is called Nitrification.

Nitrification is a two-step process.

1. Bacteria known as *Nitrosomonas* convert ammonia and ammonium to nitrite.
2. Bacteria called *Nitrobacter* finish the conversion of nitrite to nitrate.

The reactions are generally coupled and proceed rapidly to the nitrate form; therefore, nitrite levels at any given time are usually low.

These bacteria known as “nitrifiers” are strict “aerobes,” meaning they must have free dissolved Oxygen (DO) to perform their work.

Nitrification occurs only under aerobic conditions at dissolved oxygen levels of 1.0 mg/L or more (typically around 1.6mg/L).

At dissolved oxygen (DO) concentrations less than 0.5 mg/L, the growth rate is minimal.

Nitrification requires:

- a long retention time,
- a low food to microorganism ratio (F:M),

- a high mean residence time (Sludge Age), and
- pH control

The nitrates and nitrites are then pumped into the anoxic tank via the ‘a’ recycle system.

IMPORTANT!

The growth of Nitrosomonas and Nitrobacteria is also dependent on ambient temperature and sludge age, (the average lifespan of bacteria in the system). A 6°C drop temperature can halve the growth rate of the organisms. For this reason, longer sludge ages are required during winter to ensure nitrification occurs, however, 20-30 days sludge age is sufficient for winter temperatures in Australian conditions. The design sludge age of the STP is 20-30 days, which is sufficient to ensure consistent nitrification all year round.

IMPORTANT!

Nitrification is very dependent on pH and is inhibited if the pH is outside the 7 to 8.5 range. The pH can fall during the nitrifying stage, however, this can be rectified by running the treatment plant in a denitrifying mode. .

NOTE!

The dissolved oxygen meter (DO101) in the aeration tank regulates the rate of air that is being transferred to the tank from the aeration system.

Figure 6 Aeration Tank

The net result of the nitrification denitrification process is a very low total nitrogen concentration in the final effluent.

NOTE!

Total Nitrogen (TN) consists of Ammonia (NH_3), organic nitrogen (Org-N), Nitrate (NO_3) and Nitrite (NO_2); therefore $TN=NH_3+NO_3+NO_2+Org\text{-}N$

1.3.10 Aeration Tank - General Maintenance

WARNING!

AERATION BLOWERS START AUTOMATICALLY
ALWAYS ISOLATE BEFORE CONDUCTING MAINTENANCE

WARNING!

AERATION TANK IS A CONFINED SPACE
DO NOT ENTER WITHOUT APPROPRIATE PERMITS, EQUIPMENT, TRAINING AND PERSONNEL

	Activity	Frequency
1	• From the access platform, visually inspect tank for colour, foaming and the shape and formation of the bubble plume. • Record observations on log-sheet	Daily

	Activity	Frequency
	• From the access platform, hose down any excessive foam or scum	Daily
2	• From the access platform hose down walls and equipment to remove any built up sludge scum or gunge	Daily
3	• From the access platform, lift DO sensor and clean end using damp cloth or lens wipe	Daily
4	• Check and confirm operation of aeration blowers. • Start and stop manually via SCADA	Daily
5	• Check DO trend on SCADA. Record observations on log-sheet	Daily
6	• Take DO and pH readings using hand-held meter. Record on log-sheet	Daily
7	• Conduct 30min SSV Test. • Record on log-sheet	Daily
8	• Once per week collect a sample and test for Ammonia, Nitrate + Nitrite, Alkalinity and Phosphorous. • Record on log-sheet	Weekly
9	• Isolate blowers.(P203 & P204) . • Open side panel and check drive belt tension (±10mm), tighten as necessary. • Check Filter, replace or service as necessary or after 6 months (whichever is sooner).	Weekly
10	• Isolate blowers. • Open side panel and grease bearings using grease gun. • Check oil level	Monthly
11	• Isolate blowers. • Open side panel and grease and replace blower Oil. • Replace filter.	6-Monthly
12	• Service Blowers	Annually

Table 12 Aeration Tank - General Maintenance

	Activity	Frequency
1	• From the access platform, lift DO sensor and clean end using damp cloth or lens wipe	Daily
2	• Check accuracy of DO sensor against handheld DO Probe. Ensure Probe is calibrated	Daily
3	• Check and record level in Aeration Tank	Daily
4	• Lift DO Sensor from tank and perform air-saturation calibration	Monthly
5	• Service DO sensor and replace sensor head	Quarterly

Table 13 Aeration Tank - Sensors Maintenance

	Activity	Frequency
1	• Check all valves for signs of damage or corrosion. • Dust valves and apply corrosion protection as required	Daily
2	• Operate valves through range of motion. • Ensure any pumps or equipment are not operating while doing so. • Note any difficulty in operation	Weekly

Table 14 Aeration Tank - Valves Maintenance

1.3.11 Phosphorous Removal

Phosphorous is removed using chemical coagulation by dosing the sewage with sodium Aluminate solution. Sodium Aluminate precipitates dissolved phosphorous, which is removed though sludge wasting.

The Sodium Aluminate is pumped from the 500L bunded tank by P104 into the aeration tank

The dose of chemical can be increased or decreased to adjust the concentration of phosphorus in the effluent, and some operator intervention will be required to keep the system running optimally.

The sodium Aluminate store is located in the chemical storage area in the control room container.

The precipitated phosphorous settles out in the aeration tank and is wasted from the system with the Waste Activated Sludge (WAS).

In addition to precipitation of phosphorous, Sodium Aluminate aids in alkalinity maintenance, both through the production of Hydroxide ions in the reaction itself, and the fact that the solution is provided on a caustic basis (i.e. contains a part caustic soda).

It should be noted, however, that Sodium Aluminate alone may not provide sufficient alkalinity to maintain the Nitrification process, and as such, alkalinity testing and balancing is an important part of overall process monitoring.

Figure 7 Sodium Aluminate Dosing pump

1.3.12 Phosphorous System General Maintenance

WARNING!

DOSING PUMP STARTS AUTOMATICALLY.

ALWAYS ISOLATE BEFORE CONDUCTING MAINTENANCE

(OTHER THAN PUMP BLEEDING)

WARNING!

SODIUM ALUMINATE IS A CAUSTIC CHEMICAL

CONSULT MATERIAL SAFETY DATA SHEETS. ALWAYS WEAR CHEMICAL RESISTANT SAFETY GLOVES AND SAFETY GLASSES WHEN HANDLING

	Activity	Frequency
1	• Check pump (P104) for gas-locking, bleed pump as necessary	Daily
2	• Check and confirm operation of dosing pump	Daily
3	• Check dosing head for signs of chemical or precipitate build up	Weekly
4	• Clean dosing pump casing and dosing head using warm water and detergent	Monthly
5	• Dismantle and clean dosing head, check diaphragm and seals for signs of wear or damage	Quarterly
6	• Service dosing pump	Annually

Table 15 Sodium Aluminate Dosing - General Maintenance

	Activity	Frequency
1	• There are no sensors associated with this process	N/A

Table 16 Sodium Aluminate Dosing - Sensors Maintenance

	Activity	Frequency
1	• Check all valves for signs of damage or corrosion. • Dust valves and apply corrosion protection as required	Daily
2	• Operate valves through range of motion. • Ensure any pumps or equipment are not operating while doing so. • Note any difficulty in operation	Weekly
3	• From the Aeration Tank access way, check loading valve for signs of precipitation or clogging. • Clean as required	Daily

Table 17 Sodium Aluminate Dosing - Valve Maintenance

The sodium Aluminate pumps should be inspected daily to ensure that they are operational.

Care should be taken to check for gassed liquid gas-locking the pump lines, which will cause the metering pump to lose its prime.

The chemical dosing pumps should also be cleaned on a weekly basis.

The sodium Aluminate supply will need to be inspected on a daily basis to ensure levels are adequate for dosing requirements. If the level is below half full a new drum will need to be ordered.

1.3.13 Clarifier

Liquor is gravity fed from the aeration tank to the inlet of the clarifier.

The Grantham clarifier is a 4 hopper clarifier (constructed from grade 316 stainless steel) with an operating volume of 7,800L (7.8m^3)

The clarifier forms a key part in the treatment process to reduce the suspended solids in the final effluent.

The clarifier is designed to provide sufficient retention time in the clarifier to allow larger solids to settle out into the hoppers located at the base of the clarifier.

Typically, conventional activated sludge, settles at 1.35 m/hr.

An energy dissipating inlet (EDI) is used to reduce the velocity and control the direction of the liquid entering the clarifier. The EDI avoids fluid short circuiting across the clarifier by directing the flow downwards to ensure the desired retention time is achieved.

The outlet launder uses a V notch weir design to control the velocity surrounding the launder. The upflow velocity in the clarifier is kept below 3.5m/hr under normal operating conditions.

A return activated sludge (RAS) system is used to return sludge from the base of the clarifier to the bioreactor, to maintain the desired mixed liquor suspended solids (MLSS) concentration.

A surface skimmer is used to remove floating sludge and containments from the surface of the clarifier. Without a surface skimmer the lighter sludge and other containments would pass through the outlet weir to the final effluent tank.

1.3.14 Clarifier - General Maintenance

WARNING!

RAS PUMPS START AUTOMATICALLY

ALWAYS ISOLATE BEFORE CONDUCTING MAINTENANCE

	Activity	Frequency
1	• From access way visually observe performance of clarifier (colour, presence or loss of solids, foaming or scumming, etc). • Note any changes on log-sheet	Daily
2	• From access way, visually observe condition	Daily
3	• From access way, gently skim any floating sludge towards the scum Skimmer (Check air skimmer operational)	Daily
4	• Drain and clean clarifier.	Annually
5	• Check RAS pump operation. • Record timer settings on log-sheet. Note any changes to timers	Daily
6	• Observe operation of RAS pumps. • Note any peculiarities or changes on log-sheet	Daily
7	• Service RAS pump	Annually

Table 18 Clarifier General Maintenance

	Activity	Frequency
1	• There are no sensors associated with this process	N/A

Table 19 Clarifier -Sensor Maintenance

	Activity	Frequency
1	• Open RAS pump trim valve fully to flush any accumulated detritus. • Return valve to operating position	Daily
2	• Check all valves for signs of damage or corrosion. • Dust valves and apply corrosion protection as required	Daily
3	• Operate valves through range of motion. • Ensure any pumps or equipment are not operating while doing so. Note any difficulty in operation	Weekly

Table 20 Clarifier Valve Maintenance

NOTE!

The clarifier removes suspended solids from the liquid to produce the required effluent standard.

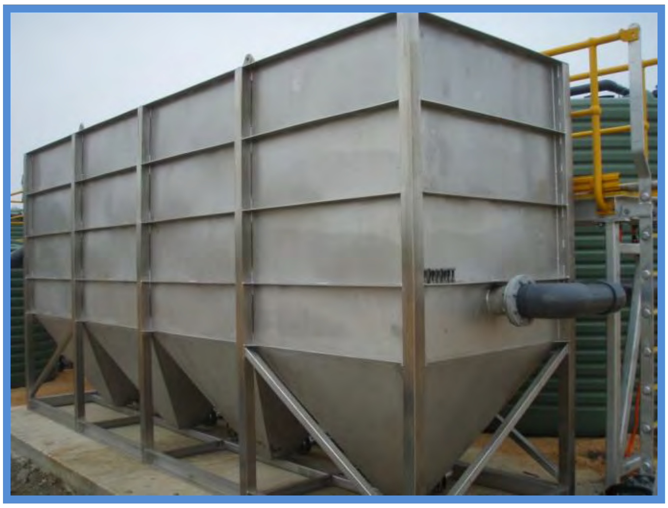


Figure 8 Clarifier – External View

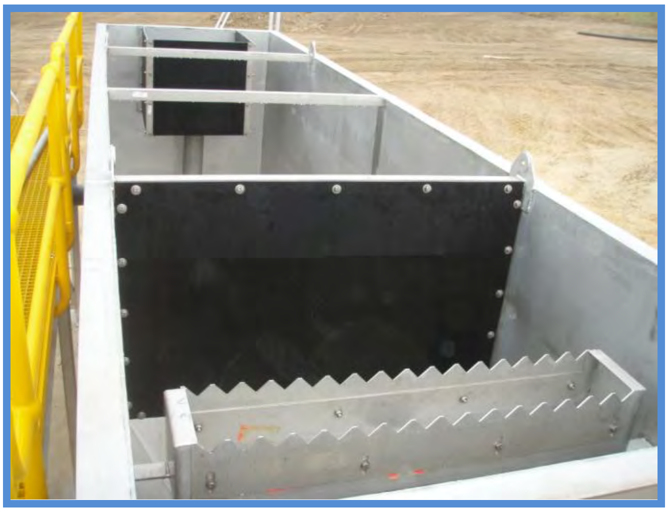


Figure 9 Clarifier – Internal View

1.3.15 Clarifier Tank

The Clarified tank stores liquor laundered from the clarifier for supply to the tertiary treatment requirements of the wastewater treatment process. The clarifier tank has an operating volume of 10,000L (10m³).

Figure 10 Clarified tank

1.3.16 Clarified Tank - General Maintenance

WARNING!

CLARIFIED TANK IS A CONFINED SPACE.

DO NOT ENTER WITHOUT APPROPRIATE PERMITS, EQUIPMENT, TRAINING AND PERSONNEL

	Activity	Frequency
1	• Visually inspect tank and record observations on log-sheets	Daily

Table 21 Clarified Tank - General Maintenance

	Activity	Frequency
1	• Check and record tank level	Daily
2	• Check and clean level sensor.	Monthly

Table 22 Clarified Tank – Sensor Maintenance

	Activity	Frequency
1	• Visually inspect pipe-work	Daily
2	• Check all valves for signs of corrosion. Clean valve bodies and apply corrosion protection as required	Weekly
3	• Check operation of all valves by opening and closing through range of motion.	Weekly

Table 23 Clarified Tank - Valve Maintenance

1.3.17 Media Filtration

There are two media filters installed in parallel to assist in the removal of suspended solids from liquor (crossflow) supplied from the clarified tank.

The media used is sand and consists of the following graded material:

- Sand – sized nominally 0.8mm – 1.8mm
- Sand – sized nominally 1.5mm – 3.0m
- Gravel – sized nominally 6.0mm to 12.0mm

The crossflow is pumped down through the media via the Crossflow pumps P301 and P302.

Laterals installed within the filter allow water to be discharged but retain the media within the filter.

A filter backwash cycle is installed where treated effluent is supplied from the final effluent tank via the backwash pump P303.

The backwash from the filters is returned to the balance tank for re-treatment.

The backwash cycle is triggered by a pre-determined differential pressure between filter inlet and outlet.

Figure 11 Media filters

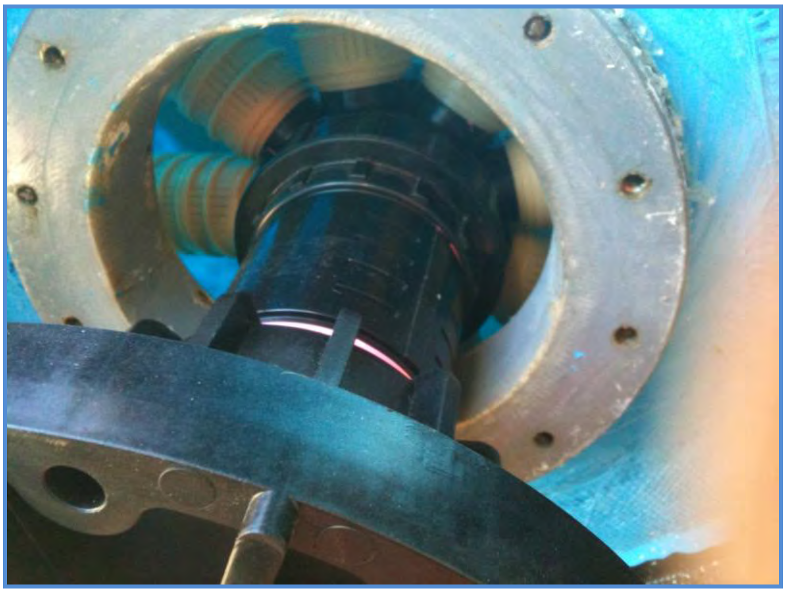


Figure 12 Media filter laterals

1.3.18 Media Filters - General Maintenance

WARNING!

MEDIA FILTER IS A CONFINED SPACE.

DO NOT ENTER WITHOUT APPROPRIATE PERMITS, EQUIPMENT, TRAINING AND PERSONNEL

ENSURE CROSSFLOW AND BACKWASH PUMPS ARE ISOLATED BEFORE UNDERTAKING ANY MAINTENANCE

	Activity	Frequency
1	• Ensure media filters are clean, washdown if required	Daily
2	• Drain and clean filters.	Annually
3	• Check Crossflow pump (P301, P302) operation.	Daily
4	• Check Crossflow pumps for damage & corrosion	Daily
5	• Check Backwash pump (P303) operation.	Daily
6	• Check Backwash pump for damage & corrosion	Daily
7	• Service Crossflow and Backwash Pumps	Annually
8	• Observe operation of Crossflow and Backwash pumps. Note any peculiarities or changes on log-sheet	Daily

Table 24 Media Filters General Maintenance

	Activity	Frequency
1	• Check all valves for signs of damage or corrosion. • Dust valves and apply corrosion protection as required	• Daily
2	• Operate valves through range of motion. • Ensure any pumps or equipment are not operating while doing so. Note any difficulty in operation	• Weekly

Table 25 Media filter Valve Maintenance

1.3.19 UV Disinfection

Ultraviolet (UV) disinfection is a physical process that instantaneously neutralises microorganisms as they pass by ultraviolet lamps submerged in the effluent.

The process adds nothing to the water but UV light, and therefore, has no impact on the chemical composition or the dissolved oxygen content of the water. In that respect, it ensures compliance with ever-tightening wastewater effluent discharge regulations.

UV is the only cost-effective disinfection alternative that does not have the potential to create or release carcinogenic by-products into the environment and effectively removed Ecoli from the filtered effluent. In addition, UV is an effective disinfectant for chlorine-resistant protozoa like Cryptosporidium and Giardia.

The Grantham WWTP UV system uses two lamps in parallel.

Filtered effluent is passed through the UV system and into the final effluent tank an insertion meter post UV measures the filtered and disinfected effluent turbidity.

Figure 13 UV System

1.3.20 UV System-General Maintenance

WARNING!

ENSURE EQUIPMENT IS ISOLATED BEFORE UNDERTAKING ANY MAINTENANCE

FOLLOW MANUFACTURER'S INSTRUCTIONS!

1.3.21 Final Effluent Tank

The treated effluent is stored in the final effluent tank where it can be transferred via the treated effluent pumps (P404 and P405) to irrigation as required by compliance discharge conditions.

A final effluent tank recirculation pump (P401) circulates treated effluent and allows monitoring and control of disinfection by way of a CONEX unit and Sodium Hypochlorite (NaOCl) dosing system (P402)

The Sodium Hypochlorite (NaOCl) is stored in a bunded 200l tank

The CONEX unit is a chlorine analyser that measures Chlorine residue in the treated effluent as well as measuring temperature and pH.

A Reticulation pump (P403) provides treated effluent for general washdown purposes.

Figure 14 CONEX Unit

Figure 15 Sodium Hypochlorite dosing pump

1.3.22 Final Effluent - General Maintenance

WARNING!

SODIUM HYPOCHCLORITE DOSING PUMP STARTS AUTOMATICALLY.
ALWAYS ISOLATE BEFORE CONDUCTING MAINTENANCE

WARNING!

RECIRCULATION LOOP PUMP STARTS AUTOMATICALLY.
ALWAYS ISOLATE BEFORE CONDUCTING MAINTENANCE

WARNING!

SODIUM HYPOCHLORITE IS A CAUSTIC CHEMICAL
CONSULT MSDS. ALWAYS WEAR CHEMICAL RESISTANT SAFETY GLOVES (LATEX OR SIMILAR) AND SAFETY GLASSES WHEN HANDLING

WARNING!

FINAL EFFLUENT TANK IS A CONFINED SPACE

DO NOT ENTER WITHOUT APPROPRIATE PERMITS, EQUIPMENT, TRAINING AND PERSONNEL

	Activity	Frequency
1	• Check and observe operation of Chlorine Recirculation pump	Daily
2	• Check and observe operation of Sodium Hypochlorite dosing pump	Daily
3	• Check dosing fittings for leaks. Tighten as necessary	Daily
4	• Check hypochlorite pump for gas locking. Bleed as necessary	Daily
5	• Check and record level of chlorine storage. Replace as necessary	Daily
6	• Check pH and DO of effluent	Daily
7	• Collect sample of Effluent and perform field test for Ammonia, Nitrate + Nitrite, Phosphorous and Alkalinity	Weekly
8	• Clean pump casings	Weekly
9	• Clean dosing head and dosing pump casing	Weekly
10	• Dismantle dosing head and check condition of Diaphragm and Seals	6-Monthly or as required
11	• Service Dosing pump	Annually
12	• Service Recirculation Pump	Annually
13	• Visually inspect tank and record observations on log-sheets	Daily

Table 26 Final Effluent - General Maintenance

	Activity	Frequency
1	• Check and record free chlorine residual reading from HMI.	Daily
2	• Conduct Free Chlorine analysis using field kit.	Daily
3	• Cross-Check result with chlorine meter. Recalibrate as necessary.	Daily
4	• Check Chlorine Analyser pH Probe reading using Buffer. Recalibrate as necessary	Monthly or as required
5	• Check and record level of Final Effluent Tank.	Daily
6	• Service Chlorine Analyser.	Annually

Table 27 Final Effluent - Sensor maintenance

	Activity	Frequency
1	• Check all valves for operation. Record observations on log-sheet	Daily
2	• Dust valve casings and apply corrosion protection as required	Weekly

Table 28 Final Effluent - Valve Maintenance

The level of Sodium Hypochlorite in the dosing tank should be checked daily, and the difference in level from the day before calculated, and used to calculate the volume used.

The dosing pumps should be visually observed daily, and cleaned on a monthly basis. Cleaning should consist of warm water and a phosphorous free detergent.

Every 6 months or when performance degrades, the pump head should be dismantled and the diaphragm checked.

A sample of the final effluent should be taken and checked for Chlorine, Ammonia, Nitrate + Nitrite, Phosphorous and Turbidity once per week, with results being recorded.

The chlorine result from the test should be checked to the reading of the on-line chlorine analyser.

The level of the final effluent tank should be checked and recorded. The Recirculation Pump should be inspected and cleaned on a daily basis, and serviced annually.

The composition of the effluent stored in the final effluent tank should include:

Parameter	Unit	50%ile	80%ile	95%ile	Range
Biochemical Oxygen Demand (BOD)	mg/L		<10		
Total Nitrogen (TN)	mg/L	<5			
Total Phosphorous (TP)	mg/L	<2			
Total Suspended Solids (TSS)	mg/L		<15		
pH Value					6.5 — 8.5
E Coli	cfu/100ml			<10	
Turbidity	NTU		<5		
Residual Chlorine	mg/L				0.7)min)

Table 29 Discharge License Requirements

Discharge license requirements for the Grantham wastewater Treatment Plant

These required effluent quality characteristics from the treatment plant are the emission limits to meet Class A requirements for re-use.

1.3.23 Solids Digester Tank

The organic solids that accumulate in the sewage treatment plant are pumped to the solids digester tank during the digestion operation that occurs once daily or as required.

During this process organic solids or sludge is pumped by the WAS pump

The Digester tank has an operating volume of 46,000L (46m³)

The Grantham WWTP operates at a lower sludge age of approximately 25 days or less, in order to keep the solids loading at a level compatible with the secondary clarifier. This requires frequent sludge wasting.

Sludge is pumped from the aeration tank as fully mixed liquor, either based upon mixed liquor concentration or based upon an on/off time clock setting.

Sequenced aeration within the digester allows for the settling out of the sludge component, allowing displacement of clear supernatant from the digester during sludge wasting.

The clear supernatant gravity feeds back into the Balance tank.

This increases the sludge residence time in the digester, producing a thicker, more stable sludge and increasing the time between pump-out of the digester.

Over time the solids concentrate in the digester tank and break down through aerobic digestion. Aerobic digestion is a bacterial process occurring in the presence of oxygen, whereby bacteria rapidly breakdown the organic matter and convert it to carbon dioxide (CO_2).

Air is supplied via the aeration system and forced through a set of Rehau diffusers.

The solids digester tank is fitted with an isolation valve and camlock fitting to allow removal of sludge via tanker removal.

NOTE!

The treatment plant's aeration system supplies the digester tank with air which aids in the aerobic digestion process, along with suppressing unpleasant odours.

Figure 16 Digester Tank

1.3.24 Sludge Management - General Maintenance

WARNING!

WASTE ACTIVATED SLUDGE PUMP STARTS AUTOMATICALLY.
ALWAYS ISOLATE BEFORE CONDUCTING MAINTENANCE

WARNING!

DIGESTER AIR SUPPLY VALVE OPERATES AUTOMATICALLY.
ALWAYS ISOLATE BEFORE CONDUCTING MAINTENANCE

WARNING!

THE SOLIDS DIGESTER TANK IS A CONFINED SPACE
DO NOT ENTER WITHOUT APPROPRIATE PERMITS, EQUPMENT, TRAINING AND PERSONNEL

WARNING!

ANAEROBIC CONDITIONS MAY RESULT IN HYDROGEN SULPHIDE GENERATION OR AN OXYGEN DEFICIENT ATMOSPHERE

The WAS sludge digester should be checked on a daily basis.

Operators should check the level of sludge within the digester, and the aeration plume pattern.

The digester air supply should be shut down and the sludge be allowed to settle, with operators observing the colouring the supernatant after settling.

The run time for the WAS pump should be checked and recorded.

The operation of the WAS air supply control valve should be checked by opening and closing the valve manually from the HMI.

	Activity	Frequency
1	• Check and Observe operation of WAS pump	Daily
2	• Check and Observe operation of WAS aeration control solenoid	Daily
3	• Check and Observe Sludge management aeration operation	Daily

4	• Check and Observe contents of digester tank. Record observations	Daily
5	• Service WAS Pump	Daily
6	• Check supernatant flow for entrained sludge. Record observations	Daily
7	• Arrange for Vacuum Tanker for removal of Sludge	As Required by wasting schedule

Table 30 Sludge Management - General Maintenance

	Activity	Frequency
1	• Operate all valves through range.	Weekly
2	• Clean valve casing and apply corrosion protection as necessary	Weekly
3	• Check and observe operation of air control solenoid valve	Daily

Table 31 Sludge Management-Valve Maintenance

1.3.25 Chemical Storage Room

The chemicals used in the process are stored in liquid form in a bunded area in the chemical store. All chemicals are pumped via metering pumps from the chemical store to the dosing point. An eyewash and chemical shower is situated outside the chemical storage area.

WARNING!

SODIUM HYPOCHLORITE IS A CAUSTIC CHEMICAL

CONSULT MSDS. ALWAYS WEAR CHEMICAL RESISTANT SAFETY GLOVES (LATEX OR SIMILAR) AND SAFETY GLASSES WHEN HANDLING

WARNING!

SODIUM ALUMINATE IS A CAUSTIC CHEMICAL

CONSULT MSDS. ALWAYS WEAR CHEMICAL RESISTANT SAFETY GLOVES (LATEX OR SIMILAR) AND SAFETY GLASSES WHEN HANDLING

	Activity	Frequency
1	• Check bunds for signs of spillage. • Arrange removal if spillage has occurred	Daily
2	• Check, prime and clean dosing pumps as per specific sections	Daily
3	• Check level of chemical in all chemical storage drums. • Refill or replace as necessary	Daily
4	• Organise replacement chemicals if storage levels are low. • Allow for lead and delivery time when ordering	As Required
5	• Sweep room floor	Daily
6	• Check and observe operation of safety shower. • Ensure wash-water is cool	Daily
7	• Check and observe operation of eyewash. • Ensure wash-water is cool	Daily

Table 32 Chemical Storage - Maintenance

The storage bunds within the chemical store need to be visually inspected daily for signs of leaks. Cleaning and removal of spilt chemicals needs to be conducted using spill absorbent kits. Once used the absorbent needs to be disposed of to a registered land fill and a new spill kit ordered.

Daily chemical usage should be noted on the log sheets, and the chemical stores should be inspected weekly to ensure that adequate chemical is available for dosing. If the stores are low they will need to be refilled or replaced.

The chemical dosing pumps should be inspected daily for loss of prime, and re-primed if the prime has been lost. The dosing pumps should also be cleaned on a weekly basis.

1.3.26 Automatic Control Systems

The treatment plant is equipped with an automated control system, allowing for automatic control of electrical equipment (pumps, motors, etc). In order to optimise the operation of the treatment plant operators will need to be familiar with the use of the control system.

The MCC controls both VSD and DOL pumps with VSDs externally mounted adjacent to the MCC

Pumps, blowers, and other process equipment are controlled by PLC's (Programmable Logic Controllers), which are fed information by various sensors installed into the process, and timers, which can be set by the operator.

This is used to control the overall process. In this manual a 'control element' is any mechanical device which is controlled by the switchboard, generally the motor for a pump or a blower.

The information collected by the plant PLC's is organised and presented using a Supervisory Control and Data Acquisition (SCADA) system.

This information is presented via an interface (HMI or Human Machine Interface, a PC computer), and is centrally organised for ease of reference.

The HMI also contains controls allowing for adjustment of process set-points, manual operation of equipment, trend logging and alarm logging. It's possible to control the plant completely from the HMI, however manual checking and cleaning of equipment is still required.

The following section gives an overview of the electrical control system, the switchboard, HMI, control loops and an overview of the HMI system and how to control system elements remotely.

1.3.27 Switchboard

DANGER!

ONLY LICENSED ELECTRICIANS TO ENTER SWITCHBOARD ENCLOSURE

The switchboard is located in the plant control room, next to the pump room.

The control panel contains a number of elements, including indicator lights, mode selector switches, and various information readouts.

While it is possible to perform basic element control from the switchboard, the majority of process control is conducted using the SCADA system.

The following sections explain the various switchboard elements in more detail.

Mode Selector switches

All control elements installed are capable of running in 2 modes: manual and automatic.

When in automatic mode the PLC controls the equipment.

In manual mode the operator is able to select whether the element is on, or off. When manually controlled from the switchboard PLC control of the piece of equipment is completely bypassed.

Changing modes is achieved by using a selector switch. The switches installed at this plant generally have 3 positions.

Manual or 'Man'

When in manual the motor connected runs constantly, unless it is isolated (turned off at its local power point) or an interlock device, or sensor (emergency low level stop, interlocked pump, etc), locks the piece of equipment out (prevents it from starting, generally to avoid damage to pumps or pipe-work).

Off

When in the 'off' position the element (motor, drive, light, etc) is 'off', and will not be allowed to start.

Auto

When in the 'auto' position the element is placed under the control of the PLC, which will start, stop, open or close the control element depending on its programming and process sensor input.

Figure 17 Form 1 MCC

Figure 18 Externally Mounted VSDs

1.3.28 Supervisory Control and Data Acquisition (SCADA)

The treatment plant is equipped with a Supervisory Control and Data Acquisition (SCADA) system that collects data from the process for control over various elements via Programmable Logic Controllers (PLC's).

Data is presented to the operators via a Human Machine Interface (HMI).

The HMI consists of a Personal Computer, running the SCADA program.

The SCADA program interfaces with the plants PLC (Programmable Logic Controller), and displays a large range of process data in an easy-to-follow graphical format.

From the HMI it is possible for operators to monitor various process parameters (tank level, pump speed, Dissolved Oxygen concentration, the run status of various pieces of equipment, etc), to make adjustments to the treatment plant controls set points (pump start levels, dissolved oxygen concentration set-points, timer setpoints, etc), and to initiate various process activities.

1.3.29 Human Machine Interface (HMI)

General Use of the HMI

Various aspects of the HMI are available through 'clicking' with the mouse.

Equipment is represented by various icons on the screen, which are connected via arrows showing basic process arrangements. This is roughly analogous to the P&ID, but is not as complicated.

The HMI consists of 4 primary screens:

- Pre-Treatment, which covers the inlet screens, Aerated Balance Tank and the Balance pumps.
- Biological Process, which covers the Anoxic and Aeration tanks, Aeration blowers and WAS digester
- Secondary Treatment, which covers clarifier, RAS pumps & clarified tank
- Post-Treatment, which covers Media filtration, UV and final effluent tank Pumps

Equipment (Actuated Valves, Blowers, Pumps and Mixers) may be directly controlled by clicking the equipment tag below the icon. This will bring up a small control screen allowing the equipment in question to be operated manually or placed in automatic. Automatic and Manual control will be further detailed below.

System variables and set-points may be accessed by clicking on the 'Settings' option at the bottom of the screen. This will request a password that will need to be entered to access the menu (this ensures that the general populace is unable to change settings). From the settings menu various set-points may be adjusted, including start times, pump start and stop levels for tanks, VSD or Flow set-points and ETC. A functional description explaining these set-points is provided in the 'Grantham WWTP Control Philosophy Document'.

Alarms may be accessed by clicking the 'Alarm' button at the bottom of the page. Alarms remain on the alarm page until acknowledged and re-set.

A summary of the information on the page can be accessed by clicking the 'Summary' button at the bottom of the page. This shows information such as flowmeter totalised values, and process steps and timers.

Finally, Plant Start-up and Effluent class may be selected using the buttons at the bottom left of the HMI. 'Biological' will start the biological process, It should also be noted that if the plant is stopped and started again all equipment will be re-set to automatic and will run to the set-points set in the 'settings' menus.

Automatic Control

The automated control system is governed by a number of ‘set-points’. These set-points generally define target sensor readings (such as DO concentration in the aeration tank), and the plant PLC alters equipment settings to achieve these set-points. Set-points themselves may be a variety of sensor inputs, such as tank level, Dissolved Oxygen, flow-rate, pH, Turbidity, or may be timer settings, such as time on or time off, filtration time, number-of-cycles or other similar information.

Operators may input process set-points simply by clicking on the set-point indicator and typing in a new set-point. Limits are hard-coded into the system to prevent operators from making detrimental changes to the system

Manual Control

Automated equipment may be set from manual to automatic operation via the HMI by clicking on the equipment icon and selecting the operation. Manual control both allows equipment to be turned on and off (or open and closed in the case of actuated valves) or allow for manual control over other parameters, such as the VSD speed of pumps or blowers. Care must be taken when using manual control, as safety lockouts within the control system may be bypassed, allowing operators to overflow tanks or damage pumps, or blowers.

HMI Overview

As stated previously, the HMI is organised into a number of ‘screens’ which logically gather process units for ease of browsing. Information about these units (such as tank level) may be read from the HMI. The operational status of equipment (i.e. is it stopped, operating, is it running in automatic or manual, is there a fault, etc) is also displayed graphically.

The following section gives an overview of some the HMI screens available.

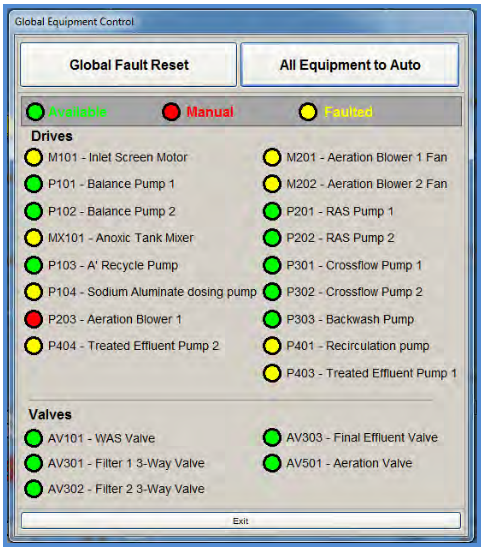


Figure 19 – General status screen

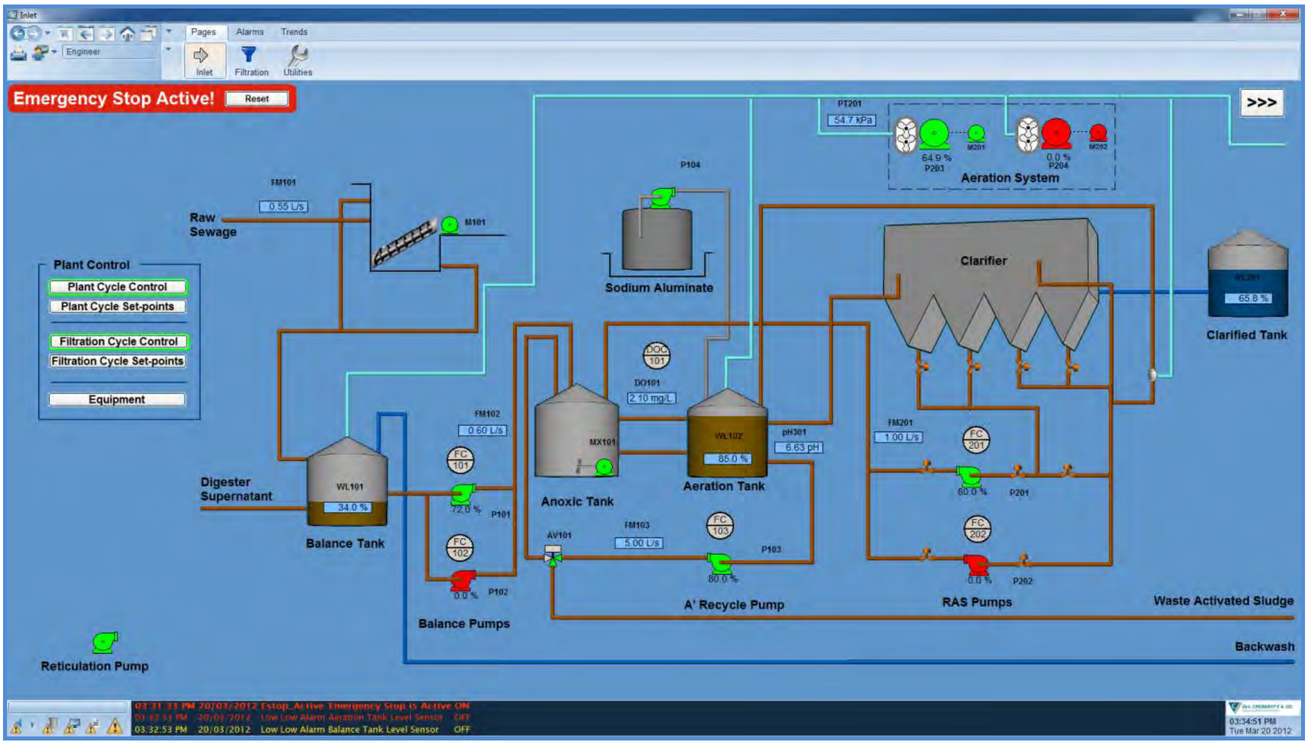


Figure 20 - Inlet Works Screen

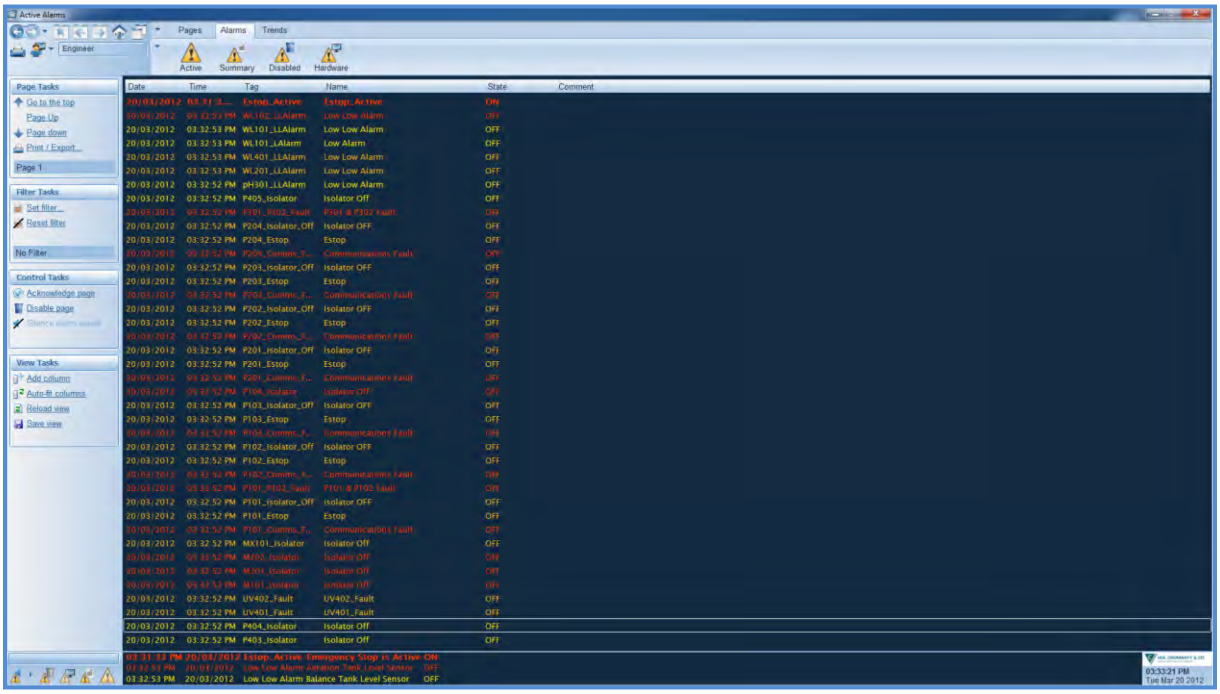


Figure 21 – Alarms Page

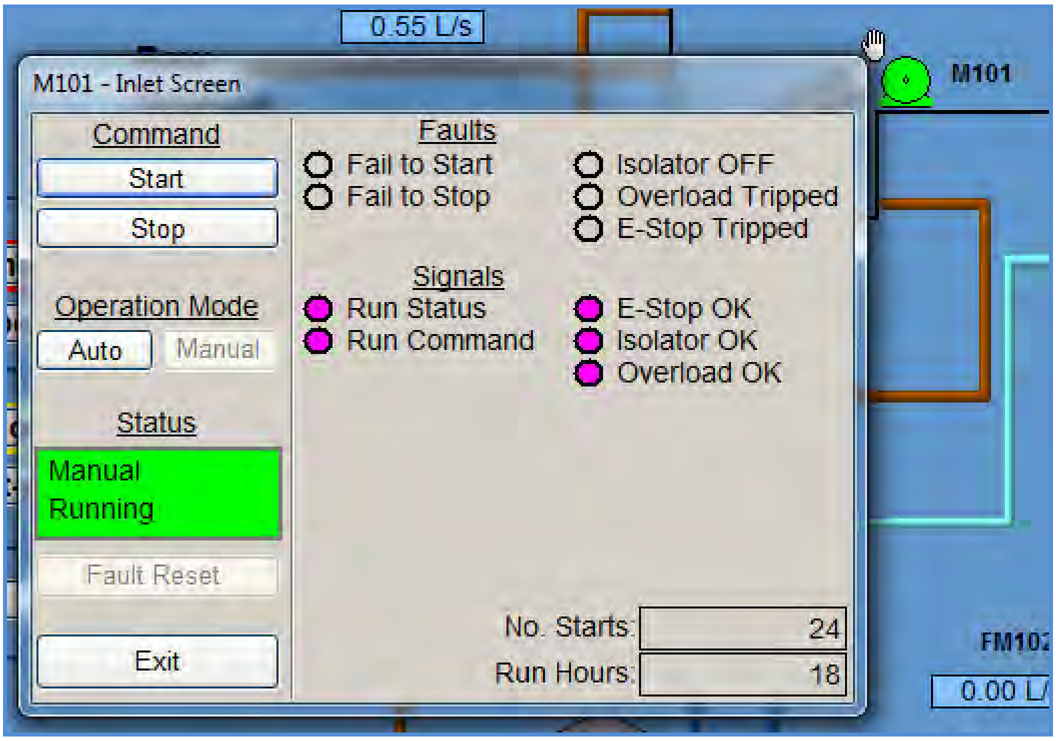


Figure 22 – DOL Running

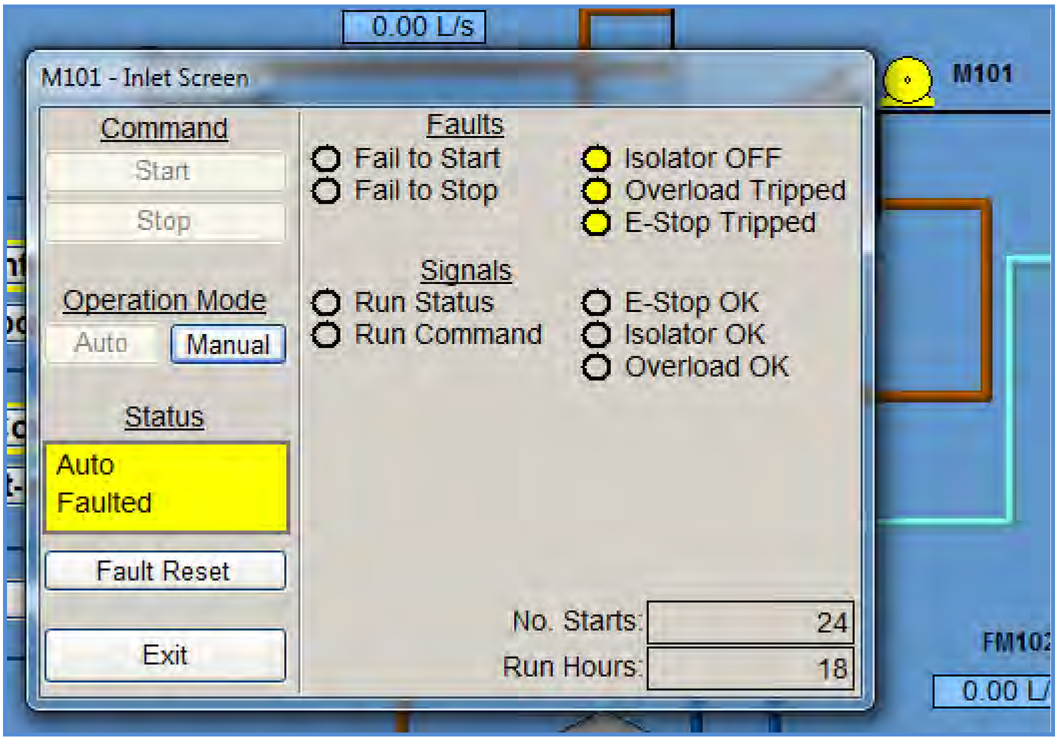


Figure 23 – DOL Fault

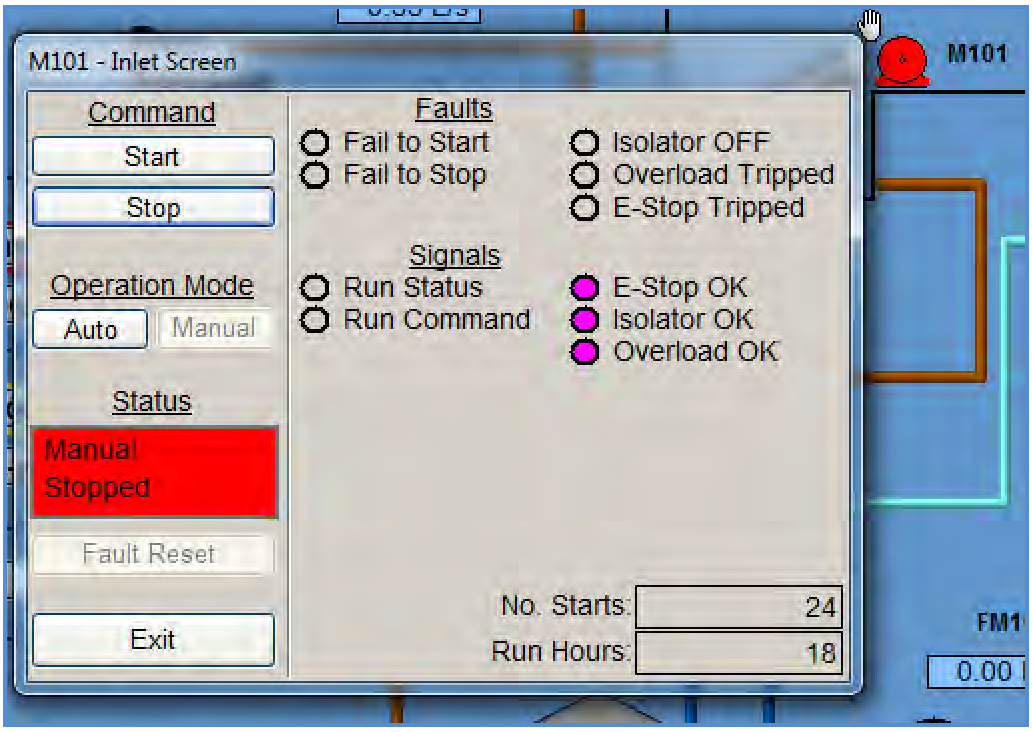


Figure 24 – DOL Stopped

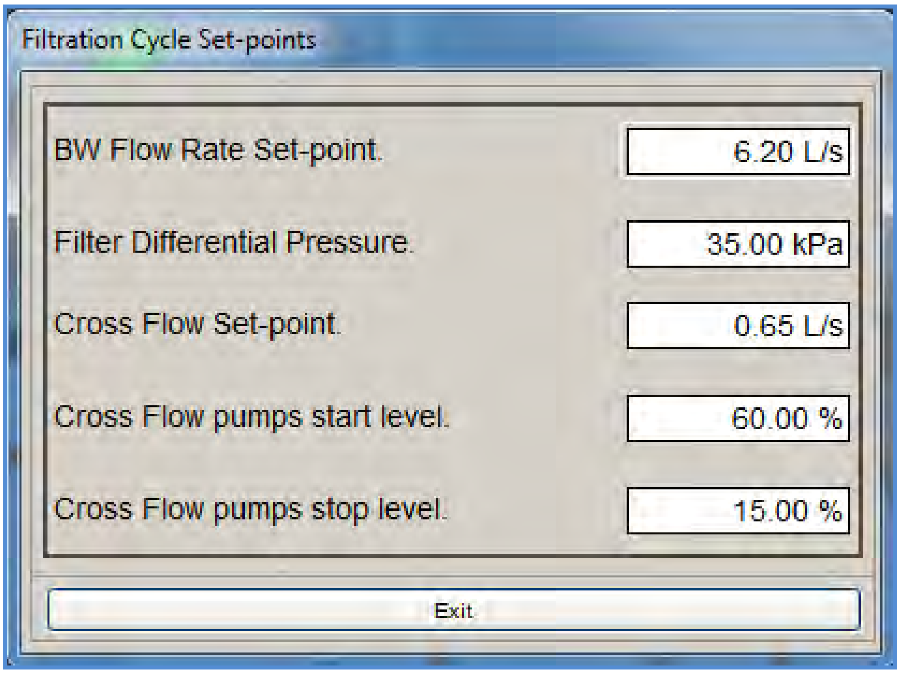


Figure 25 – Filtration Cycle Set Points

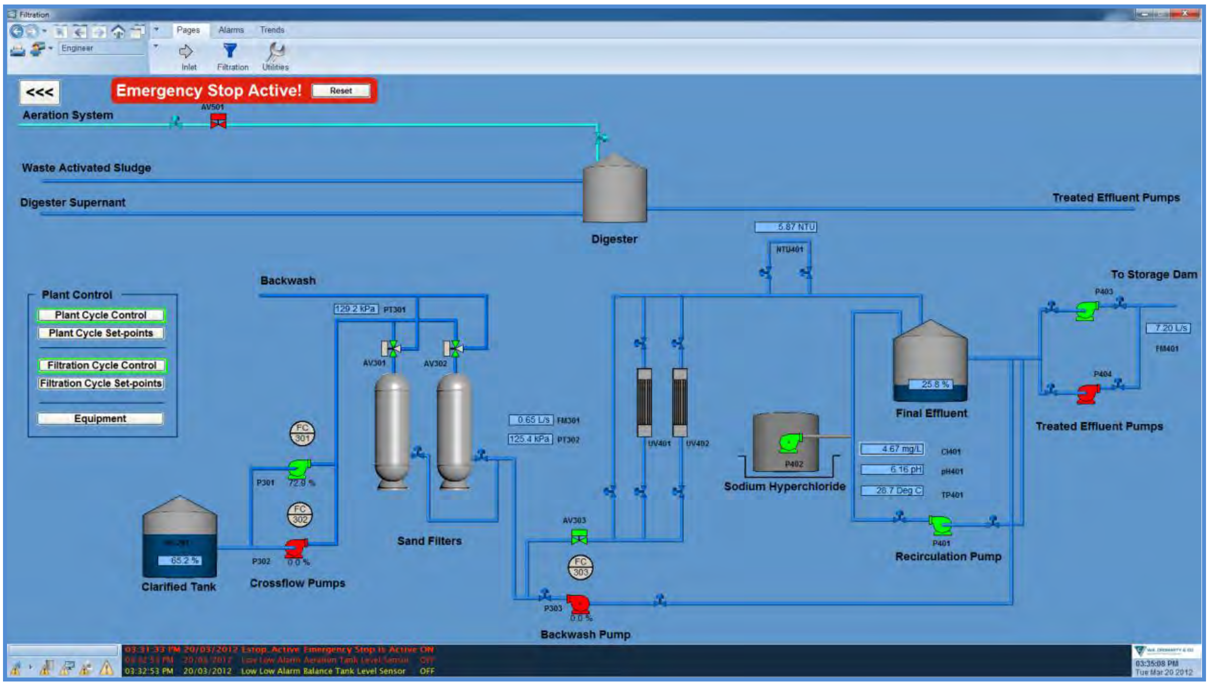


Figure 26 – Filtration Page

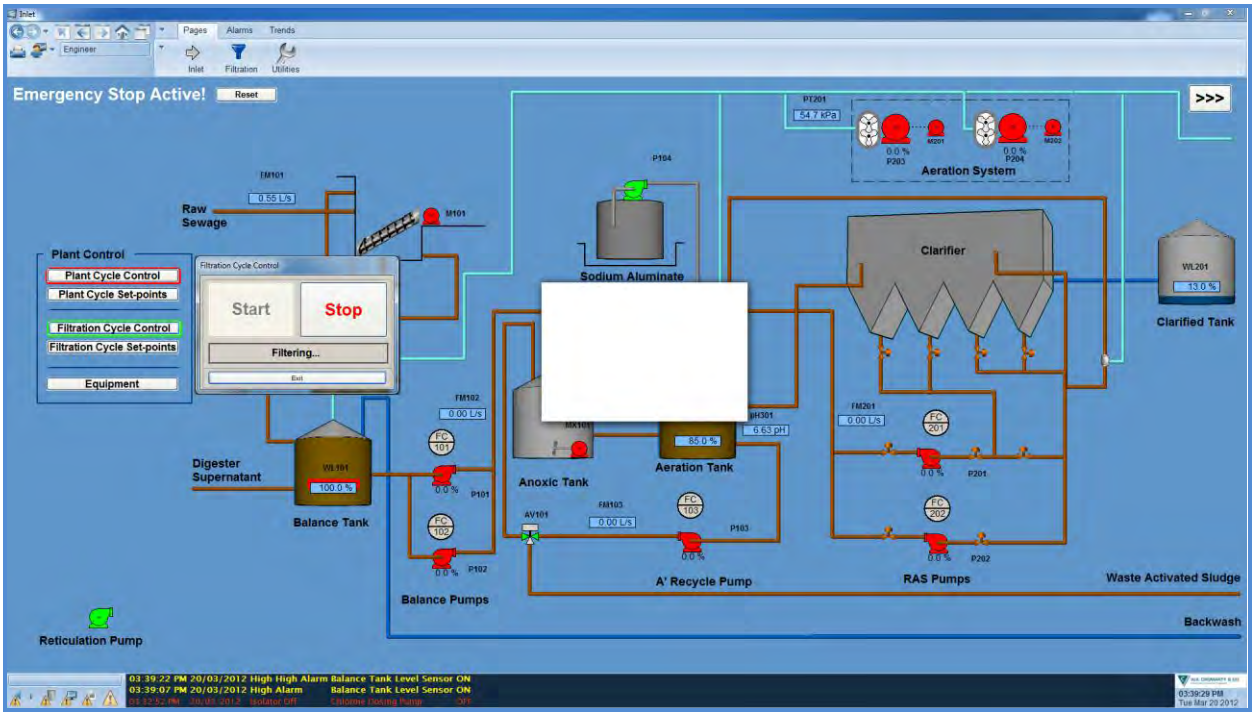


Figure 27 – Filtration Page Pop up running

SECTION 2 – SAFETY INFORMATION

Hazard and Safety Warnings

Prompts have been used throughout the manual to highlight safety, environmental and process concerns. The following information describes the prompts used in the manual and their meanings:

DANGER!

Indicates a hazard or situation where failure to use the correct procedures WILL cause either severe personal injury or death.

WARNING!

Indicates a hazard or situation where failure to use the correct procedures COULD result in severe personal injury or death.

CAUTION!

Indicates a hazard or situation where failure to use the correct procedures COULD result in severe personal injury or equipment damage.

IMPORTANT!

Indicates information within the text which is of particular importance to the procedure or operation being described.

REMEMBER!

Indicates information within the text which is of sufficient importance to warrant highlighting.

NOTE!

Indicates information which has been covered in an earlier section of the text but which warrants reinforcement.

Contents

1.1 Introduction

The treatment plant has been designed with safety in mind. It is a fully enclosed structure which eliminates the risk of operators coming into contact with hazardous substances.

However, there are other hazards associated with working on or around the waste water treatment facility.

This section describes the safety regulations, procedures and considerations that must be taken into account and followed during the operation and maintenance of the treatment plant.

WARNING!

Prior to conducting certain operational or maintenance tasks around the Wastewater treatment plant, conduct a risk assessment in accordance with work site procedures to assess the risk posed by any identified hazards that may be present when conducting the task.

1.2 Hazard Identification

Hazard identification is the ability to identify an item, action or process that has the potential to cause harm, damage or injury to personnel or equipment. In the treatment plant, hazard identification means being able to identify any hazards that may affect the water quality for example, pollutions sources, as well as any hazards that may causes incidents and injury, for example, slips and trips.

Hazards associated with the operation, maintenance and equipment items in the treatment plant include:

- water quality
- hazardous substances
- pressurised systems
- electrical energy
- slips and trips
- confined spaces.

IMPORTANT!

Operators are responsible to identify all hazards and hazardous events that may affect final effluent quality and safety (what can happen and how) should be identified.

1.2.1 Treated Final Effluent Quality

The table below lists some examples of hazardous events/areas and the potential sources of hazards that may impact treated final effluent quality.

Hazardous Event	Potential Source of Hazard
Storage Tanks and Intakes	• Uncovered storages • Human access • Depletion of reservoir storage • Unsuitable intake location • Bushfires and natural disasters
Treatment Systems	• Significant flow variations through treatment system • Incapable equipment or unit processes • Process control incapability • Use of unapproved or contaminated water treatment, chemicals and materials • Chemical dosing failures • Inadequate mixing • Failure of dosing equipment • Inadequate clarification • Equipment malfunctions • Poor reliability of processes • Power failures • Failure of alarms and monitoring equipment • Sabotage and natural disaster
Storage Tanks and Distribution Systems	• Open reservoirs, uncovered storage areas • Animal access including birds and vermin • Build-up of sediments and slime • Pipe burst or leaks • Flow variability and inadequate pressures • Failure of alarms and monitoring equipment • Sabotage and natural disasters • Treatment dosing failure

Table 1 Possible Hazards

1.2.2 Hazardous Substances

Hazardous substances are substances that have an adverse effect on a person's health after exposure through inhalation, ingestion or direct skin contact.

Hazardous substances within the treatment plant include:

- biological waste,
- chlorine, and
- acids.

Follow the correct storage, handling and disposal procedures when working around chemicals and biological waste in the treatment plant to minimise the risk posed operators.

The correct storage, handling and disposal procedures for chemicals and biological waste are found on Material Safety Data Sheets (MSDS) located within the wastewater treatment control room. Read and follow the instructions on each Material Safety Data Sheet before handling any chemical or biological waste.

IMPORTANT!

Store chemicals in the correct storage place and in accordance to the instructions on the MSDS when not in use.

1.2.3 Pressurised Systems

Pressurised systems include pipes, pumps and hoses containing pressurised fluids. Loss of control over pressurised fluids can cause equipment damage, severe personal injuries or even death.

The treatment plant contains a number of high pressure pumps and pipes used to transport liquids. Always endeavour to know what type of fluid is being pumped or transported and work in accordance with the correct procedures for the specific type of fluid.

Figure 1 Pressurised System

When conducting operational or maintenance work around pressurised systems relieve any pressures before proceeding.

WARNING!

Never open a pipeline or valve unless the proper isolation and/or bleed down procedure has been implemented.

1.2.4 Electrical

All electrical equipment within the wastewater treatment facility has been designed and installed in accordance with the specified workplace standards.

When working around electrical equipment, it is always to be considered 'live' and therefore considered dangerous.

DANGER!

Uncontrolled electrical energy can cause electrocution, explosion and fires.

Persons carrying out work on electrical equipment within the treatment plant must hold a recognised competency.

Before work is carried out any exposed electrical conductor, it must be positively isolated from the source of electricity, tested for dead and if it is a high voltage conductor earthed.

1.2.5 Slips and Trips

Spilled fluids around the treatment plant increase the risk of slips and trips occurring. Use caution when walking around sewage treatment tanks and pumps to avoid slipping and tripping on any spilled fluids.

1.2.6 Confined Spaces

The process and storage tanks in the treatment plant and some of the piping instrumentation are designated confined spaces. A confined space is an enclosed or partially enclosed space which is:

- at atmospheric pressure during occupancy
- not intended or designed primarily as a place of work
- restricted in means of entry and exit
- a space which may have at atmosphere containing harmful levels of contaminant, an unsafe oxygen level and could potentially cause engulfment.

Figure 2 Confined space signage

Hazards associated with working within confined spaces include:

- oxygen deficiency
- oxygen excess
- presence of contaminants on surfaces or in the atmosphere
- uncontrolled introduction of liquid into the space

All confined spaces in the treatment plant are signposted and secured and should only be entered if:

1. Personnel are trained and deemed competent.
2. Signed onto a confined space permit. Refer to Section 4. 6. 1 Confined Space Entry Permit.

1.3 Safety Equipment

Using safety equipment is essential to the safe operation and maintenance of the sewage treatment plant. All safety equipment is to be in a good condition and approved for usage by the site workplace. The safety equipment required to operate and maintain the treatment plant includes:

- personal protective equipment
- safety harness and rope
- emergency spill kit
- safety showers / eyewash stations
- fire extinguishers
- first aid kits.

1.3.1 Personal Protective Equipment

The following items of personal protective equipment (PPE) are to be worn when working on or around the WWTP:

- steel capped boots
- high visibility clothing
- safety glasses
- safety gloves
- hearing protection
- breathing protection when working inside tanks.

Figure 3 Typical Safety Equipment

Additional PPE may be required when performing specific operational and/or maintenance tasks, for example, wear rubber knee high boots when working in pump wells and half empty tanks. Refer to site work instructions for specific PPE requirements.

1.3.2 Safety Harness and Rope

Personnel working in confined space tanks must be provided with and wear safety harnesses and rope.

When working inside the tanks, there is a risk of personnel collapsing due to lingering odours.

Attaching a safety harness and rope to the operator inside the tank and connecting it to a tripod mounted outside the tank or anchor point ensures the operator can be easily lifted out in the event of a collapse.

All safety harnesses and safety lifting equipment must be certified compliant and hold current date.

1.3.3 Emergency Response Spill Kit

An emergency response spill kit should be located in the treatment plant to enable personnel to immediately respond to and deal with hazardous substance spills.

Each spill kit contains absorbent material, waste recovery containers, shovel, PPE and approved containers for the use of repackaging any contents of leaking packages.

Figure 4 Typical Emergency Spill Kit

1.3.4 Safety Shower / Eyewash Stations

A Safety showers and eyewash station is located next to the control room/MCC for immediate first-aid treatment of chemical splashes and extinguishing clothing fires.

Any person who comes into contact with hazardous substances is to wash the affected part of his/her body under running water.

Figure 5 Safety Shower and eye wash station

To activate the safety shower, pull down on the triangular grab handle. To activate the eyewash station, step on the foot activation bar located under the hand basin at ground level or push down on the lever located on the right hand side of the basin.

WARNING!

Personnel who come into contact with hazardous substances must immediately seek medical attention.

1.4 Isolation

Isolation is the disconnection from all possible sources of energy that have the potential for harm. Disconnection includes making mechanical disconnections by opening switches, closing valves and/or switching the main isolation switches to the off position.

Isolation is required whenever:

- a risk assessment identifies potential exposure to hazardous energy or substances
- required as set out in work procedures and/or instructions for repairs and maintenance.

The distribution box in the control room houses the main isolator switch used to isolate the entire wastewater treatment plant.

Figure 6 Isolation switch above pump

Individual field isolators are located in the control room above each pump. Refer to relevant workplace isolation procedures for the location of nominated isolation points where appointed persons place isolation locks as directed by the procedure.

WARNING!

Failure to isolate equipment in accordance with workplace isolation procedures may result in severe injury and/or death.

Perform isolation tasks in accordance with workplace standards. On occasion, electrical isolation of equipment or conductors is required. Electrical isolations are to be carried out by an authorised electrician. In some cases, a permit is required to perform electrical isolations.

Figure 7 Typical field isolations

1.5 Emergency Stop

An emergency stop button is located on the control board in the control room. Press the button to stop the operation of the sewage treatment plant in the event of an emergency.

Figure 8 Emergency Stop

1.6 Safety Permits

In addition to isolation procedures, permits are required when performing hazardous actions or processes on site. Recommended safety permits to obtain for performing certain operational and maintenance tasks on or around the wastewater treatment plant include confined space entry and hot work permits.

1.6.1 Confined Space Entry Permit

Before any work can be undertaken in a confined space, site management must provide written approval in the form of a Confined Space Entry Permit.

The confined space entry permit includes:

- precautions and instructions for safe entry and work into confined spaces such as applicable isolations
- hot work requirements
- hazards specific to the task
- atmospheric testing requirements
- stand-by personnel
- PPE requirements.

IMPORTANT!

Only persons trained and certified holding current certification may undertake confined space activities

1.6.2 Hot Work Permit

A Hot Work Permit is required when performing welding, oxy/acetylene cutting or other hot work on or around the WWTP where there is a risk of personal injury or damage to the WWTP facilities from a fire. The Hot Work Permit controls hot work tasks such as:

- time and place of work
- availability of fire fighting equipment
- post work inspections
- fire watch requirements
- other requirements specific to the hot work task.

A Hot Work Permit must be completed and signed by a competent and authorised person before commencing any hot work at the WWTP.

1.7 Housekeeping

All operators are responsible for maintaining high standards of housekeeping within the wastewater treatment facility. Poor housekeeping increases the risk of slips and trips and can result in incidents.

General housekeeping tasks involve:

- cleaning-up your work area as you go by removing any spillages other materials off floors, walls and machine walkways to eliminate slip and trip hazards
- returning equipment and materials you may be using to their correct storage place when you finish using them
- ensure all containers are labelled in accordance with the contents they contain
- keeping entrances, aisles and stairways clear of obstructions at all times
- discarding rubbish and packaging correctly.

1.8 Contamination

Contamination of treated final effluent water in the treatment plant is a major safety issue as the treated water will be used on site and could enter local waterways. To prevent contamination:

- perform adequate checks to ensure the treated final effluent is a class B standard
- check final effluent storage tanks are securely roofed at all times
- follow workplace maintenance procedures/instructions when repairing faults exactly as directed to ensure work is carried out in such a way contamination is prevented
- ensure appropriate security and regulations are in place to prevent unauthorised access to, or interference with, final effluent storages
- confirm adequate training of operational and maintenance personnel responsible for the system takes place.

SECTION 3 – TROUBLESHOOTING

Hazard and Safety Warnings

Prompts have been used throughout the manual to highlight safety, environmental and process concerns. The following information describes the prompts used in the manual and their meanings:

DANGER!

Indicates a hazard or situation where failure to use the correct procedures WILL cause either severe personal injury or death.

WARNING!

Indicates a hazard or situation where failure to use the correct procedures COULD result in severe personal injury or death.

CAUTION!

Indicates a hazard or situation where failure to use the correct procedures COULD result in severe personal injury or equipment damage.

IMPORTANT!

Indicates information within the text which is of particular importance to the procedure or operation being described.

REMEMBER!

Indicates information within the text which is of sufficient importance to warrant highlighting.

NOTE!

Indicates information which has been covered in an earlier section of the text but which warrants reinforcement.

Contents

1.1 Operational Challenges

1.1.1 Scum Growth

Scum growth can accumulate on the surface of the anoxic mixing and aeration tanks. The scum is not harmful to the wastewater treatment process, however, it does create dangerous and unpleasant operating conditions including pungent odours and slippery surfaces.

Scum growth in most instances is attributed to over aeration for prolonged periods of time. Maintaining 1.6 mg/L of dissolved oxygen within the aeration tank greatly reduces the chances of scum growth.

In the event that scum growth does occur the issue is best resolved by reducing the oxygen level throughout the treatment plant.

This is done by reducing the flow of the aeration system by reducing the flow rate of the blowers. The result will be an increase in odour from the treatment plant; however, the problem will be rapidly solved.

In addition to a reduction in oxygen levels rapid de-sludging of the treatment plant by an authorised contractor is also required so that the mixed liquor suspended solids (MLSS) drops to approximately 4000 mg/L.

CAUTION!

Do not use chemicals such as chlorine to remove scum growth as this will kill the good bacteria used to breakdown and treat the effluent.

CAUTION!

Do not allow any scum that has been removed from the reactor tanks to be recycled back into the system. This will result in the scum 'reseeding' and the problem returning.

Low oxygen and MLSS levels must be maintained until the problem is resolved, followed by a gradual increase of both oxygen and sludge volume until normal operating conditions are achieved.

1.1.2 Filamentous Bacteria Growth

Filamentous bacteria, as the name suggests, are filament shaped bacteria that are often branched.

Large quantities of filamentous bacteria can cause poor settling and promote denitrification in the aerobic tank. This problem can be avoided by maintaining the dissolved oxygen concentration in the aeration tank between 1.5 and 2.5 mg/l.

If the dissolved oxygen concentration in the aerobic tank falls below 0.5 mg/l filamentous bacteria growth will be encouraged.

1.1.3 Aeration System Failure

Anaerobic conditions within the treatment plant, especially the aeration tank, will result if the aeration system fails for approximately four to six hours in a 24 hour period, resulting in rapid deterioration of the effluent quality.

Sludge wasting will decrease the mixed liquor suspended solids (MLSS) and help minimise the problems resulting from the aeration system failure, however, other problems may need to be rectified once the aeration system is working again.

CAUTION!

If the treatment plant's aeration system fails for over six hour in any 24 hour period a portable air compressor must be commissioned to provide aeration

1.1.4 Maintaining Treated Water Specification – Suspended Solids and Turbidity

The critical aspect of control for an Activated Sludge Process utilising Media Filtration as the means of sustaining treated water quality is the operation of the Clarifier.

The Clarifier is the unit operation that dictates the load on the Media (Sand) Filter and its associated performance. As the Activated Sludge Process is integrally linked with the Clarifier operation, then it follows on that to control the Clarifier means controlling the whole process adequately.

The key impacts on Clarifier control are the hydraulic rate and settling characteristics of the sludge.

One important control is to not allow the Clarifier to go anoxic where it produces sludge blankets, which will immediately cause failure to meet treated water specifications and over-loading of the Media Filter.

Another key aspect in regards to settling and clarity of overflow from the Clarifier is to maintain the feed to biomass ratio (FM Ratio) within the acceptable range.

Maintaining the correct balance is important as it impacts sludge settling rates and density, and the formation of a higher quality supernatant (clear liquid above settled sludge).

It should be noted that the system being controlled is biological and has the associated sensitivities in control. While the following operational controls will minimise turbidity and suspended solids loading of the treated water, the list of controls is by no means exhaustive. The specific ranges specified will vary marginally depending on the design of the site specific treatment system and specific operating characteristics.

The following table lists the key control parameters required to maintain plant operation, optimise Clarifier operation and minimise Suspended Solids and Turbidity of treated water.

Parameter	Objective Range / Control	Corrective Action	Analysis / Task Frequency (While within specification)	Analysis / Task Frequency (While outside specification)
Feed Flow	Feed Flow must be maintained constant over day with flow maintained below design peak rate	Manage flow from Balance Tank	Weekly	Daily
Return Activated Sludge Rate (RAS) rate	0.8 to 1.5 times the feed rate	Determine why sludge rate exceeds 1.5 feed rate, refer to settling characteristics	Weekly	Daily
Settled Solids Volume test	400 to 800 ml/L	Check sludge wasting regime	Weekly	Three times per week
Suspended Solids Test and Settled Solids Volume Index	SVI of 50 to 100	Check F/M ratios and corrective actions, obtain advice	Monthly	Twice per week
Clarifier DO at depth	>0.5 mg/l	Adjust sludge return rates and concentration of biomass	Monthly	Daily
Feed to Biomass Ration	0.2 to 0.7 gBOD/gVSS.d	Adjust Biomass concentration and review feed aspects against design	Monthly	Weekly
Feed Nitrogen Loading	< 75 mg/l, high nitrogen of influent can result in high nitrate in clarifier and denitrification within clarifier	Identify cause of high nitrogen in sewage and mitigate	Monthly	Twice per Month
Feed Temperature	< 30C	Determine cause of high temperature	Monthly	Daily
Feed Fat Oil and Grease	< 50 mg/l. Oil and grease will accumulate on clarifier surface and add to turbidity issues.	Determine source and control	Monthly	Weekly

Parameter	Objective Range / Control	Corrective Action	Analysis / Task Frequency (While within specification)	Analysis / Task Frequency (While outside specification)
Contamination of Feed	No Contamination	Ensure no biocide, paints, oils, insecticides, formaldehyde, and non-sewage based materials in influent.	Quarterly	Weekly
Detergents and Surfactants in Sewage	No foaming on aeration. Detergents cause suspension of solids in Clarifier	Determine source and control	Quarterly	Daily
Feed pH	6.5 to 8.5	Adjust feed pH	Monthly	Daily
Clarifier Overflow Turbidity	< 30 NTU	Check above parameters	Weekly	Daily
Clarifier Suspended Solids	< 30 mg/l	Check above parameters	Weekly	Daily
Filtered Water Turbidity	< specification	Ensure Clarifier Turbidity on specification	Weekly	Daily
Filtered Water Suspended Solids	< specification	Ensure Suspended Solids on specification	Weekly	Daily
Filter Back Flush Control	Not too excessive and performed at a sufficient frequency	Too frequent reduces filter performance, not frequent enough causes process problems	Weekly	Daily

Table 1 Key control parameters - SS & NTU

1.2 Troubleshooting

The Grantham Waste Water Treatment Plant runs automatically and trouble free, however situations may arise that are beyond the operator's control.

The table displayed in the following pages describes various operational issues that may be encountered with the treatment plant and the best method for quickly resolving the issues.

Item	Problem	Possible Causes	Solution
Inlet Screen	Water running down spiral screen	Rundown mesh clogged	Dispose of garbage bag.
	Wheelie bin full of water solids	High solid content in influent	Clean mesh with supplied hose daily, check operation of automatic screen washing.
	Sump full of water	Blockage	Shut down power to screen and inspect blockage in discharge pipe work.
Balance System	Balance Tank overflowing	Balance Pumps Not Running	Isolator Switch off – Turn on isolator switches for Balance Pumps (P101 and P102) Check the water level in the Balance Tank (WL201) is reading on the Overview page of operator interface screen. If not replace probe. Overload – Check Balance Pump (P101, P102) for blockages, clean out pump as necessary and reset the isolator in the control board.

Item	Problem	Possible Causes	Solution
Balance System	Balance Tank overflowing	Water Level Sensor Failure (WL101)	Check overview screen on the operator interface to confirm probe failure (0%). Visually inspect the probe located on the side of the Balance Tank to see if the probe is connected to the wiring. Check Aeration Tank level on the Overview screen (WL102) of the operator interface. If the reading is less than 90% the balance pumps can be activated manually via "Pump Control" on operator interface. Activate P101 and P102 to transfer from the balance tank to the anoxic tank. Monitor the level with the main process tank and manually turn P101 and P102 OFF when the level in the tanks reaches 100%. The liquid in the Balance tank will have to be manually transferred until a replacement probe is installed
Aeration Tank	Water Level High	Water Level Probe Failure (WL102)	Check level on Overview page of operator interface. If WL101 reads 0% then there has been a failure of WL102. Visually inspect WL102 and check that cabling is connected and has not been damaged. If it does not appear damaged, remove the connector cap and inspect terminals for corrosion. To stop water being transferred from the Balance Tanks the Balance pumps need to be manually stopped. Stop P101 and P102 by switching off their isolators located above the pumps. To enable the plant to operate while a replacement probe is sourced, it is recommended to remove the water

Item	Problem	Possible Causes	Solution
			level probe from the Balance Tank (WL101) and place it in the location of WL102. If the probe is not installed the plant will not run in filtration mode and will trigger relaxation mode.
		Balance Pumps P101 and P102 left in "Manual ON" on operator interface.	Go to "Pump Control" on operator interface. Select OFF button for P101 and P102.
Clarifier	Carry over floc	Air skimmer blocked or not operating at correct depth	Check the operation of the air skimmer and ensure valve for the air supply to the skimmer is fully opened. Back flush the air skimmer return line if a blockage is found in the line. Adjust air skimmer stilling tube height by either tighten or loosening the thread to lower and extend the tube respectively.
	Build up on	Excessive sludge in bioreactor	Remove and clean with hose and broom. Reinstall cleaned plates. Check SSV reading and refer to correct levels for digestion.

Table 2 Troubleshooting guide

Indicators/Observations	Probable Cause	Check or Monitor	Solutions
Very stable Dark tan foam on aeration basin which hosing cannot break up	1. Sludge age is too old 2. Plant loading <25% of Plant capacity		Increase sludge wasting in order to reduce sludge age
Thick billows of white sudsy foam on the aeration tank	1. MLSS, too low 2. Hydraulic washout of biomass (solids) 3. Sludge wasting too high 4. Plant Start-up	1. Confirm MLSS with Lab	1. Reduce hydraulic inflow if possible. 2. Shorten pump station loading times to 1% of aeration volume 3. Decrease sludge wasting rate. 4. Start up supplementary feeding if required, otherwise do nothing.
Aeration basin contents turn grey to black	1. Inadequate aeration	1. Aeration basin dissolved oxygen	1. Increase aeration by increasing run times 2. Decrease mixed liquor suspended solids if SSV is above 400ml/l 3. Clean any plugged diffusers. 4. Check aeration system for efficient operation.
Pipe blockages	1. High solids loading 2. Inadequate pumping	1. Screens solids or rats in the treatment plant	1. Rake screens more frequently. 2. Lessen rubbish in-take to the plant.

Indicators/Observations	Probable Cause	Check or Monitor	Solutions
Aeration tank smells	1. Low aeration 2. Low pH	1. Dissolved oxygen 2. SSV 3. pH	1. Increase aeration until D.O. is between 1.5 - 2.5mg/L 2. Increase sludge wasting if SSV is above 600mL/L 3. If pH is below 7.2 add lime.
pH of mixed liquor decreases to 6.7 or lower. Sludge becomes less dense	Nitrification occurring without denitrification and wastewater alkalinity is too low.	Effluent NH_3. Influent and effluent alkalinity. Nitrification/denitrification cycles Influent pH	Alter aeration times to give minimum 30 minutes off to allow denitrification. Add source of alkalinity - lime or sodium bicarbonate. Determine source of acid wastewater and stop flow into the system.
Sludge concentration in return sludge is too low	Sludge return rate too low. WAS too high. Actinomycetes (floating sludge) predominates.	Return sludge rate Check rate of concentration Microscopic examination (if available) dissolved from content	Increase sludge return rate Lower WAS rate Reduce aeration and increase WAS to lower concentration.
Dead spots in aeration tank	Diffusers malfunctioning Under-aeration resulting in low D.O.	Visual inspection Check D.O.	Clean or repair diffusers - check blower belts Increase rate of aeration to bring D.O. concentration up to 2 to 3mg/L

Indicators/Observations	Probable Cause	Check or Monitor	Solutions
Sludge blanket over-flowing aeration tank weir	MLSS (SSV) too high due to inadequate wasting Inadequate sludge return.	Check SSV to see if it is above 600ml/l	Increase wasting if SSV > 600ml/l
Sludge floating to surface of aeration tank	Filamentous organisms pre-dominating in mixed liquor (bulking sludge). Actinomycetes organisms pre-dominating in mixed liquor. Denitrification occurring in tank; nitrogen gas bubbles attaching to sludge particles; sludge rises in clumps. Sludge collectors operating too slowly (septic sludge producing H_2S gas) Over-aerated sludge.	SSV - if less than 800mL/L is not likely the cause. If surface sludge is oily, actinomycetes bacteria likely. Nitrate concentration in aeration tank influx too high Frequency and speed of sludge collection (sludge black with septic odour) Mixed liquor dissolved oxygen should be 2-4mg/L Effluent nitrogen concentration	Increase D.O. if < 1mg/L Increase pH above 7.2 If SSV is > 600mL/L increase sludge waste by 10% per day until SSV 400ml/l or less, but no less than 250ml/l. Keep sludge age at 20 to 25 days Increase the sludge return rate. Decrease sludge return rate. Increase D.O. - if < 1.0mg/l during aeration make sure denitrification off time > 30 minutes. Reduce sludge age. Increase frequency of sludge waste. Reduce aeration if D.O. > 4 mg/l. Increase denitrification time but do not exceed 1.0 hr/cycle.

Indicators/Observations	Probable Cause	Check or Monitor	Solutions
Pin floc in effluent overflow - SSV (400 to 600) is good but effluent is turbid (cloudy)	Excessive aeration in aeration tanks. Sludge age > 40 days. Anaerobic conditions in aeration tanks. Toxic shock load. Short - circuiting of flow allowing solids to pass into effluent.	D.O. in aeration chamber. Sludge appearance very dark and dense. Microscopically examine sludge for inactive protozoa. Inlet baffles for leaks.	Reduce air input to Plant. Increase sludge wasting to decrease sludge age. Increase D.O. in aeration tanks. Enforce toxics exclusion rules. If toxic loads still likely, neutralise as fast as possible. Repair leaks/fractures to inlet baffles. Identify and correct sources of anaerobic conditions.
Plugging of sludge suction	High content of rubbish and debris. Low velocity in withdrawal lines.	Visual inspection Sludge withdrawal rate and resulting velocity	Clean rubbish and debris from sludge pipe-work. Back-flush clogged line. Check and keep inlet screens clear to reduce input of rubbish into the plant. Increase sludge return rate.
Short-circuiting of flow through aeration tank	Excessive hydraulic loading. Equipment malfunction. Reduced detention time due to large solids and grit accumulation. Damaged inlet baffles.	Visual inspection Visual inspection Visual inspection	Reduce raw sewage pump loading to plant to 1% of aeration volume if loading exceeds 120% of plant capacity, augmentation required.

Indicators/Observations	Probable Cause	Check or Monitor	Solutions
De-flocculation in aeration tank	Toxic or acid wastes. Anaerobic condition in aeration tanks. Aeration basin overloaded. Inadequate nitrogen or phosphorus supply. Excessive shear caused by turbulence.	Supernatant above settled sludge is uniform in turbidity	Remove source of toxic discharge or ensure adequate dilution when toxic spillages occur. Increase D.O. in aeration tanks. Ensure loading of pump stations 1% of aeration volume. If plant loaded 120% above design, plant augmentation needed. Supplement deficiency in nutrients by chemical addition. Reduce agitation, i.e. aeration if D.O allows, otherwise step down aeration headers inlet to outlet.
Billowing sludge	Hydraulic surges. Density currents, e.g. hot sun on one side of Plant.	Visual inspection of sludge conditions	Ensure loading of pump stations 1% of aeration volume. If plant loaded 120% above design, plant augmentation needed. Keep sludge depth as low as possible.
Dissolved oxygen low in aeration tanks	Under-aeration	Aeration times Shorten anoxic period	Maintain D.O. between 1.5 and 2.5mg/L during aeration period by increasing aeration rate. Shorten anoxic period to maximum of 30 minutes. Intersperse anoxic and anaerobic periods.

Indicators/Observations	Probable Cause	Check or Monitor	Solutions
Dissolved oxygen concentration low in final effluent	Anoxic conditions in aeration tank	Sludge return rate D.O. in aeration tanks - increase if <1.0mg/L	Ensure sludge return ratio 0.5 to 1.0. Aeration decreased to 2 to 4 mg/l.
Dissolved oxygen concentration high in aeration tanks	Over-aeration	Aeration times	Decrease aeration to achieve between 1.0 and 2.5mg/l per minute.
Final effluent chlorine concentration low	Under-chlorination Effluent quality poor Sludge in base of chlorine detention tank	Free and total chlorine residuals Visual inspection	Adjust chlorine dose so as to provide free chlorine residual of between 0.3 and 0.7mg/L after 30 minutes detention If final effluent is of poor quality, particularly with respect to suspended solids, chlorine concentration will be low due to high Cl_2 demand. Recheck Cl_2 concentrations once effluent quality improves. Empty and clean out chlorine detention tank. This should be done monthly as preventative maintenance
Final effluent chlorine concentration high	Over-chlorination	Free and total chlorine residual	Adjust chlorine dose so as to provide free chlorine residual of between 0.3 and 0.7mg/l after 30 minutes detention.

Indicators/Observations	Probable Cause	Check or Monitor	Solutions
Mixed liquor pH < 7	Low pH influent (< 7)	Influent pH. Nitrification occurring without denitrification.	Neutralise all inflows to sewer with soda ash or lime Dose soda ash or lime to balance tanks to increase pH to between 7 and 8. Set aeration 1 hr off, and adjust for D.O. levels of 30 minutes to allow denitrification.
Mixed liquor pH > 8.5	High pH influent > 8.5	Influent pH	Neutralise all inflow to sewer with diluted hydrochloric acid. Allow longer nitrification periods of up to 2 hrs with only 30 minutes denitrification.
Sludge dark in colour (grey or black)	Septic sludge - inadequate aeration	Oxygen input	Increase aeration while maintaining D.O. between 1.5 and 2.5 mg/L during aeration period Increase by 10% WAS. Clean any plugged diffusers. Check aeration system piping for leaks.
Large free-floc percentage (> 15%) - turbid effluent	Over agitation of mixed liquor. Over-aeration.	Visual inspection Oxygen input Effluent nitrogen concentration	Reduce turbulence in aeration tanks (if possible). Maintain D.O. between 1.5 and 2.5mg/L during aeration. Create anoxic periods to reduce air input and turbulence; set plant 1hour on and 1 hour off, with minimum off time = 30 minutes (then readjust for D.O.).

Indicators/Observations	Probable Cause	Check or Monitor	Solutions
Dominance of filamentous bacteria (poor settleability)	Plant operating outside optimal performance criteria	D.O. concentration in mixed liquor. 30 minute SSV.	Reduce length of anoxic periods (no < 30 minutes). Maintain high recycle ratio (up to 1.5 ADWF). Maintain D.O. in aeration tanks between 1.5 & 2.5. Increase pH to at least 7.2. Increase WAS gradually until SSV 250mL/L (maintain for at least 14 days).
Large quantities of actinomycetes bacteria (scum forming)	Infection from area	Microscopic identification	Reduce D.O. in Plant to 1.0mg/L and hold for up to 21 days. There will be some odour on start of each cycle. Alter sludge age drastically by WAS.
Floc weak and poorly formed	Numerous	Microscopic identification. Check pH to see if low.	Maintain sludge age at 25 days. Reduce turbulence in aeration tanks. Maintain D.O. between 1.5 and 2.5 mg/L in aeration tanks. Add lime if pH < 7.

Indicators/Observations	Probable Cause	Check or Monitor	Solutions
Dominance of amoeba and flagellates	Plant in recovery stage	Microscopic identification. Plant performance parameters.	Maintain sludge age between 20 and 25 days. Maintain D.O. in aeration tanks between 1.0 and 2.5. Stabilise Plant operation with respect to influent and aeration. Prevent entry to sewer system of toxic compounds. Limit anoxic periods to 30 minutes. Maintain high recycle ratio.
SSV test above 700ml/l. Effluent dirty, full of sludge	Too much sludge Sludge bulking	Check WAS rate Check SSV again Check D.O. Check WAS	Waste sludge at twice daily requirement for 2 days, then leave for 3 days. Repeat until SSV below 400ml/l. Maintain D.O. in range 1.5-2.5mg/l.
SSV test below 300ml/l	Too high waste rate. Too little sludge	Check WAS Check SSV Check D.O.	Reduce WAS until SSV above 300ml/l. Maintain D.O. between 1.5 and 2.5.

Table 3 Process Indicators (1)

INDICATORS/OBSERVATIONS	PROBABLE CAUSE	CHECK OR MONITOR	SOLUTIONS
Secondary clarifier effluent looks muddy brown, and effluent suspended solids have been increasing	1. Dentrification in clarifier	1. Floating sludge and Nitrate in the effluent. If Nitrate >5mg/L this is most likely the cause	1. Increase clarifier sludge recycle rate (RAS); increase anoxic recycle rate. 2. Skim floating sludge from entire surface of clarifier or use water sprays to release nitrogen gas from sludge so sludge will resettle.
	2. Sludge off take lines fouled or running too slow	2. Sludge collection equipment	3. Repair or adjust valves in sludge off take manifold if failed or running slow
	3. RAS recycle pump failure	3. RAS recycle pumps	4. Rectify fault as per Manufacturer's specifications 5. Maintain routine maintenance schedule
	4. Short circuiting of flow through secondary clarifier	4. Inlet and outlet baffles	6. Ensure inlet and outlet baffles working correctly, in place and operating without blockage. Reposition or repair baffle as necessary
Increase in secondary clarifier effluent Ammonia	1. Poor Oxidation of the Sewage.		1.
	1a. Blower Mechanical Fault	1a. Check blowers for operation, as per maintenance guide (Filters, belts, pullies, etc	1a. Rectify any mechanical faults as per manufactures recommendations
	1b. Aeration Diffusers Ruptured will generally require multiple	1b. Check aeration plume for signs of ruptured or	1b. If significant numbers of diffuser are ruptured the diffusers will need to be replaced

INDICATORS/OBSERVATIONS	PROBABLE CAUSE	CHECK OR MONITOR	SOLUTIONS
		damaged diffusers ('Mushrooming')	
	1c. Air Supply pipework ruptured or leaking	1c. Check aeration pipework for signs of leaks or other damage	1c. Repair pipework breakages, tighten bolts or change flange seals where required
	1d. Closed valve or sticking reflux	1d. Check all valves are open, all reflux valves are operational (i.e. not sticking closed)	1d. Open isolation valves on blowers, diffuser headers and droppers. Replace faulty reflux valves
	1e. WAS digester harvesting too much air	1e. Check WAS digester valve settings to ensure that the WAS digester isn't taking too much air	1e. Reduce volume of air directed to WAS digester using WAS digester trim valve
	1f. DO Probe Calibration drift	1f. Check DO probe calibration against calibrated hand-held meter	1f. Recalibrate probe.
	1g. DO Probe giving faulty reading or probe itself is	1g. Ensure DO probe is giving a true	1g. Recalibrate if possible, otherwise remove for repair and run blowers in

INDICATORS/OBSERVATIONS	PROBABLE CAUSE	CHECK OR MONITOR	SOLUTIONS
	faulty	reading of the DO concentration.	manual to achieve a DO of 1.5 – 2.0 mg/L in the aeration tank
	2. Insufficient alkalinity available to support Nitrification reaction	2.	2.
	2a. Insufficient Alkalinity In Raw Sewage	2a. Alkalinity in Raw Sewage, Final Effluent and Aeration Tank	2a. Increase (or commence) alkalinity dosing in the form of Soda Ash or Quicklime into BOD Fortification solution
	2b. Poor De-Nitrification resulting in sufficient alkalinity to maintain pH	2b. Check anoxic tank performance as per next section of troubleshooting guide	2b. Rectify anoxic performance as per the next section of the troubleshooting guide
	2c. Insufficient alkalinity addition	2c. Check alkalinity dosing	2c. Increase alkalinity dosing
Increase in secondary clarifier effluent nitrate >5mg/L	1. Inadequate Anoxic recycle rate		3.
	1a. Anoxic Recycle Pumps Mechanical Fault	1a. Check operation of a-recycle pumps as per maintenance guide.	1a. Rectify any faults as per manufacturer's documentation
	1b. Anoxic Recycle Pumps Stopped	1b. Check for root cause of stoppage	1b. Restart pumps if safe to do so. If not, identify fault and rectify
	1c. Inadequate Anoxic Recycle Rate	1c. Check anoxic recycle flowmeter and calculate daily	1c. Increase recycle ratio of below 18x the influent flow

INDICATORS/OBSERVATIONS	PROBABLE CAUSE	CHECK OR MONITOR	SOLUTIONS
		anoxic recycle flow and daily influent flow	
	1d. Flowmeter reading faulty/VSD Reading faulty	1d. Check flowmeter reading against VSD setting	1d. Calibrate flowmeter as per manufacturer's documentation. May require qualified technician
	2. Oxygen Inhibition of the Anoxic Tank	2.	2.
	2a. Excessive Recycle of Oxygen from Aeration Tank	2a. Check recycle rate	2a. If recycle ratio is above 20x influent flow rate, reduce recycle to 18-20x inflow
	2b. Excessive DO concentration in aeration tank	2b. Check DO in Anoxic Tank, ensure DO is below 0.5mg/L	2b. Reduce DO setpoint for Aeration Tank or reduce blower VSD to achieve a DO of 1.3 – 2.0 mg/L
	2c. Anoxic conditions not achieved even though DO concentration reads as 0mg/L (i.e. dissolved oxygen not present, but sufficient oxygen is recycled to inhibit process)	2c. Check ORP (Oxidation Reduction Potential) in Anoxic tank is below 0mV	2c. Restart mixer if safe to do so
	2d. Anoxic Mixer Stopped	2d. Check mixer for mechanical faults as per maintenance guide	2d. Restart mixer if safe to do so

INDICATORS/OBSERVATIONS	PROBABLE CAUSE	CHECK OR MONITOR	SOLUTIONS
	3. Insufficient BOD dosing to balance raw sewage requirements	3.	3.
	3a. Dosing Pumps Stopped	3a. Check for root cause of stoppage and rectify as per maintenance guide	3a. Restart pumps if safe to do so
	3b. Insufficient BOD Dose rate	3b. Check dosage rate, check raw sewage BOD (preferable by lab test, or through turbidity)	3b. Increase dose rate if required
	3c. Insufficient BOD fortificant added to mixing tank	3c. Check mass of BOD fortification vector added. Calculate approximate BOD mass required	3c. Increase mass of fortificant added
	3d. Mixer failure resulting ineffective solution dissolution	3d. Check operation of Anoxic Mixer	3d. Rectify any faults and restart mixer if safe to do so
	3e. Clogged dosing lines, injection quill, non-return valves or loading valve	3e. Check dosing lines, valves, injection quills and non-return valves for signs of blockage	3e. Dose through warm water solution. Remove and clean valves or injection quills. Replace damaged dosing lines.

INDICATORS/OBSERVATIONS	PROBABLE CAUSE	CHECK OR MONITOR	SOLUTIONS
	3f. Airlocking or clogging of dosing pump	3f. Listen to dosing pump. If actuation noise is abnormally loud it is likely to be airlocked or clogged	3f. Bleed any air from dosing pumps. Remove pump head and clean diaphragm
	3g. Crystalisation of sugar in valves or dosing head	3g. Check dosing head if safe to do so	3g. Dose warm water and detergent solution or similar to dissolve crystal deposits. Alternatively, remove and dismantle dosing and check valves and clean manually using warm water and detergent
Objectionable odours from Plant	1. Excessive organic load causing anaerobic decomposition in anoxic tank and/or aeration tank	1. Colour and condition mixed liquor. Dissolved oxygen trend in Balance Tank. Low (negative) ORP in Anoxic Tank.	1a. If running on timer control, increase aeration time
			1b. Increase DO setpoint
			1c. Increase anoxic recycle rate
			1d. Reduce BOD fortification dose if dose is in excess of requirements 2.
	2. Insufficient dissolved oxygen in balance tank	2.	
	2a. Insufficient Aeration Time	2a. Check dissolved oxygen concentration	2a. Increase aeration time if dissolved oxygen is below 1.0mg/L during aeration
	2b. Aerator Fault	2b. If aerator fails to start, check aerator as per	2b. Rectify any faults according to manufacturer's documentation. Restart aerator if safe to do so

INDICATORS/OBSERVATIONS	PROBABLE CAUSE	CHECK OR MONITOR	SOLUTIONS
		maintenance guide	
	2c. Aerator ejector pipe clogged or damaged	2c. If aerator starts but fails to deliver water, check aerator as per maintenance guide	2c. Life aerator and remove blockage. Replace discharge piping. Replace and restart aerator if safe to do so.
	2d. Dissolved Oxygen Meter Calibration Drift High	2d. Cross-check DO meter reading with calibrated handheld meter	2d. Repair or service DO probe as per manufacturer's instructions
	3. Sludge acidic	3.	3.
	3a. Insufficient alkalinity to maintain pH	3a. pH of sludge Aeration tank and final effluent alkalinity	3a. If sludge pH,6.0, increase (or commence) alkalinity dosing to increase pH to 7.0, or until residual alkalinity in the effluent is at least 50mg/L as CaC03
Short Circuiting through Anoxic Tank	1. Anoxic Mixer failure	1.	
	1a. Anoxic tank miser mechanical fault	1a. Check mixer as per maintenance guide.	1a. Rectify any mechanical faults as per manufacturer's documentation. Restart if safe
	1b. Anoxic tank mixer stopped	1b. Check for root cause of mixer stoppage. Check level sensors against PLC outputs	1b. Rectify any faulty level sensor readings as per manufacturer's documentation. Restart mixer if safe to do so.

INDICATORS/OBSERVATIONS	PROBABLE CAUSE	CHECK OR MONITOR	SOLUTIONS
	1c. Baffle leak or break	1c. Visually inspect baffle integrity	1c. Repair any breaks or damage to the anoxic baffle as required if safe to do so
	2. Sludge viscosity too great for anoxic mixer	2. Check Mixed Liquor Suspended Solids	2. Initiate sludge waste if suspended solids are greater than 11,000mg/L, to a target range of 8,000-10,000mg/L
Balance Tank overflows	1. Excessive inflow from pumping network	1. Investigate cause of excessive inflows (infiltration, leak into pumping station, illegal dumping into pumping station, etc)	1. Rectify problem at source if able to do so. Otherwise organize temporary pump-out of ABT
	2. Balance tank transfer pumps operating at insufficient rate	2. Trim valve settings	2. Increase opening of forward trim valve, close backflow valve if open
	3. Standby pump fails to start	3. Pump indicator lights/HMI Alarm Page	3. 3a. Heck pump as per routing maintenance schedule. Identify fault according to manufacturer's recommendations and rectify if safe to do so.
			3b. If pump fails to start, check screen, as screenings may be clogging pump if screen has blinded/failed
			3c. If no fault can be found, check level sensor output.

INDICATORS/OBSERVATIONS	PROBABLE CAUSE	CHECK OR MONITOR	SOLUTIONS
Pipe blockages	1. Ineffective Screening	1a. Bar screen rake drive failures	1a. Check bar screen rake drive and identify root cause of fault as per manufacturer's documentation. Rectify fault if safe to do so
		1b. Drum screen cleaning jet failure	1b. Check solenoids, RPZDs and isolation valves for failure or inappropriate settings (closed isolation valves, etc). Rectify faults if safe to do so.
		1c. Drum screen drive failure	1c. Check drum screen drive. Identify faults as per manufacturer's documentation and rectify if safe to do so.
		1d. Drum screen blinded	1d. Check bar screen and grit settler and clean as necessary. Clean drum screen.
		1e. Insufficient water pressure from booster pump to operate cleaning jets effectively	1e. Check output pressure from pressure pump. Check valves and fittings for signs of clogging. Identify faults according to manufacturer's documentation. Rectify faults if safe to do so.
		1f. If very large solids being passed in from raw sewage catchment	1f. Check condition of macerator pumps and impellers in raw sewage pumping stations for signs of damage. Rectify or replace damaged macerator blades or pump impellers if safe to do so
		1g. Ingres of foreign	1g. Remove any detritus found floating

INDICATORS/OBSERVATIONS	PROBABLE CAUSE	CHECK OR MONITOR	SOLUTIONS
		matter from environment (i.e. falling or blowing into open topped tanks)	in tanks during routine operations. Isolate affected equipment and remove blockages. Recommission equipment.
Foaming in Aeration or Balance Tank	1. Surfactant (Detergent) Foaming	1. Colour of Foam. Frothy white foam is generally associated with surfactant foaming	1. Check with cleaners about cleaning solutions used in toilets and crib rooms around site. Cleaners should use biodegradable phosphorous free detergents. High foaming detergents or cleaners should be avoided
	2. Bacterial Stress Reaction	2. Check colour of Foam. Brown coloured foam indicates bacterial reactions	2. Temporary control may be attained by hosing down foam. If long-term problems persist a sprinkler system may need to be considered.
	2a. Very low F:M ratio (i.e. not enough BOD) causing stress	2a. Influent BOD and BOD fortification rates	2a. Increase BOD fortification rate
	2b. Inhibitor or Toxin entering system	2b. Take samples for Laboratory testing. Check local catchment for any obvious signs of toxins or toxic substances (Oils, hydrocarbons, heavy metals such	2b. If able, remove source of toxin or inhibitor. Process may need to be re-started with fresh biological seed.

INDICATORS/OBSERVATIONS	PROBABLE CAUSE	CHECK OR MONITOR	SOLUTIONS
		as Copper, Nickel, biocides such as chlorine, etc)	
	2c. Excessively low temperatures	2c. Unlikely to occur in Western Australia. Check Mixed Liquor temperature	2c. Unlikely to occur in Western Australia. Hose down foam temporarily.
Formation of surface Scum	1. Generally associated with Anoxic processes. Scum is generally thicker than foaming. Anaerobic conditions in Anoxic tank	1. Anoxic system performance. pH of sludge, general odour around plant	1. If foam is light brown, hose down scum. If septic odours are present, increase oxygen input into aeration tank, increase dissolved oxygen concentration in aeration tank to between 1.0 and 2.0mg/L

Table 4 Process Indicators (2)

SECTION 4 – PLANT OPERATION

Hazard and Safety Warnings

Prompts have been used throughout the manual to highlight safety, environmental and process concerns. The following information describes the prompts used in the manual and their meanings:

DANGER!

Indicates a hazard or situation where failure to use the correct procedures WILL cause either severe personal injury or death.

WARNING!

Indicates a hazard or situation where failure to use the correct procedures COULD result in severe personal injury or death.

CAUTION!

Indicates a hazard or situation where failure to use the correct procedures COULD result in severe personal injury or equipment damage.

IMPORTANT!

Indicates information within the text which is of particular importance to the procedure or operation being described.

REMEMBER!

Indicates information within the text which is of sufficient importance to warrant highlighting.

NOTE!

Indicates information which has been covered in an earlier section of the text but which warrants reinforcement.

Contents

1.1 Introduction

The Grantham Waste Water Treatment Plant (WWTP) is an automated plant that requires minimal operator intervention.

The following processes are explained in this section:

- Plant Operation
- Filtration Operation
- Digester Operation
- Sludge Management
- Plant Checks
- Process Sampling

NOTE!

Each of the automated processes can be manually initiated through the operator interface screen (HMI)

IMPORTANT!

The following chemicals are not permitted to enter the treatment plant during operation or any other time:

- ***Pesticides/ herbicides/ insecticides***
- ***Petrol/ oil/any hydrocarbons***
- ***Organic Solvents***
- ***Large quantities of chlorine***
- ***Large quantities of acids or caustic material***
- ***Heavy metals***
- ***Detergents with high concentrators of nitrogen phosphorus.***

1.2 Plant Operation

The plant operation can be controlled on the main screen of the operator interface (HMI). Once the plant cycle has been initiated, the vital equipment required to maintain a healthy bioreactor is operated in auto mode. This equipment includes;

- Balance pumps (P101 & P102)
- Inlet Screen (SC101)
- Aeration blowers (P203 or P204)
- a' Recycle pump (P103)
- RAS pumps (P201 & P202)
- Sodium Aluminate Dosing pump (P104)

Testing and operator observations will provide the indicators on whether adjustments are required to optimise performance.

Key pumps have variable speed drives (VSDs) where adjustments can be made to flow rates

Key pumps are:

- Balance pumps (P101 & P102)
- Aeration blowers (P203 or P204)
- a' Recycle pump (P103)
- RAS pumps (P201 & P202)

For full explanation, please refer to W536 Grantham WWTP Control Methodology in the Appendix

1.3 Filtration Operation

The filtration cycle can be controlled on the main screen of the operator interface.

Once the filtration cycle has been initiated, the equipment required to filtrate and produce final effluent at the desired flow rate is operated in auto mode.

Filtration mode cannot be initiated without the plant cycle also running.

The crossflow pumps (P301 & P302) transfer clarified influent from the clarified tank through the sand filter and the UV disinfection system to the final effluent tank. The crossflow pumps are VSD driven. A PID loop is used to adjust the speed of the pumps to achieve a desired flow rate.

The backwash pump (P303) transfers final effluent from the final effluent tank through the sand filter in the reversed direction.

The flow of the backwash removes contaminants that have built up in the sand during filtration. The backwash pump is VSD driven.

A PID loop is used to adjust the speed of the pump to achieve a desired flow rate.

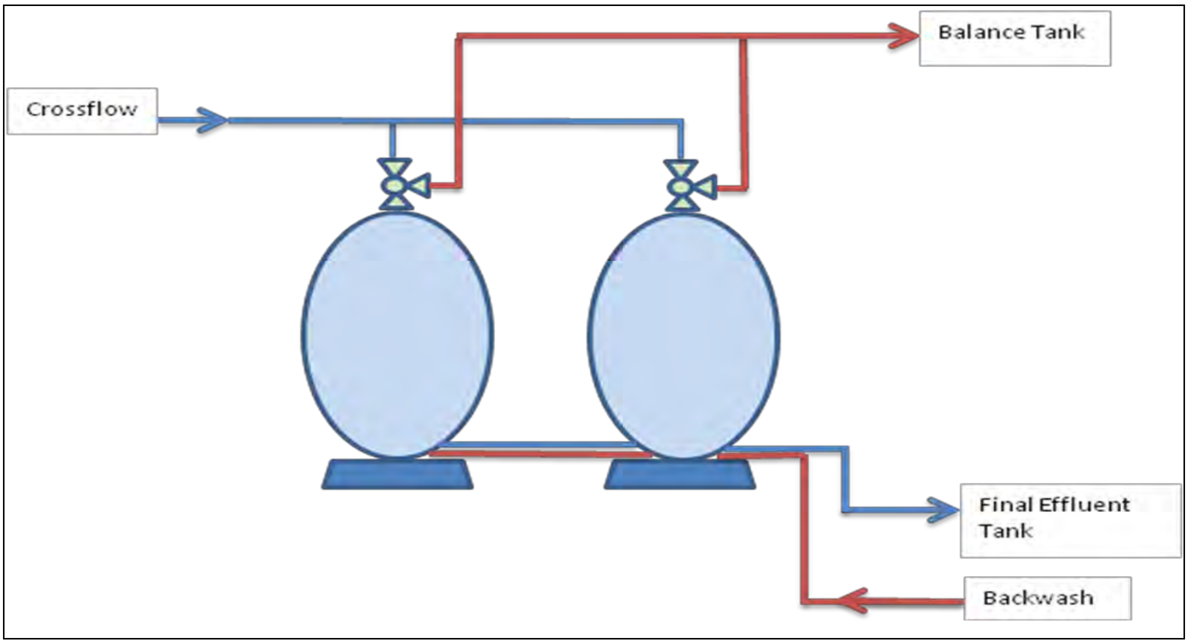


Figure 1 Basic Media Filter Operation

Step	Next Step	Description	Delay (secs)	Crossflow (P301 or P302)	Backwash Pump (P303)	Filter 1 Divert Valve (AV301)	Filter 2 Divert Valve (AV302)	Backwash Valve (AV303)	P301/P302 VSD Speed Setpoint	P303 VSD Speed Setpoint	Filtration Cycle	BW Cycle
1	2	Filtration Cycle	-	R	S	O	O	O	Filtration Flow	-	ON	OFF
2	3	Backwash Triggered (Filter 1)	4	S	S	O	O	O	-	-	OFF	ON
3	4	Set Valves (Filter 1)	Valve Time	S	S	C	O	C	-	-	OFF	ON
4	5	Start Backwash Pump (Filter 1)	BW Run Time	S	R	C	O	C	-	BW Flow	OFF	ON
5	6	Stop Backwash Pump (Filter 1)	4	S	S	C	O	C	-	-	OFF	ON
6	7	Set Valves (Filter 2)	Valve Time	S	S	O	C	C	-	-	OFF	ON
7	8	Start Backwash Pump (Filter 2)	BW Run Time	S	R	O	C	C	-	BW Flow	OFF	ON
8	9	Stop Backwash Pump (Filter 2)	4	S	S	O	C	C	-	-	OFF	ON
9	10	Reset Valves	Valve Time	S	S	O	O	O	-	-	OFF	ON
10	1	Return to Filtration	-	R	S	O	O	O	Filtration Flow	-	ON	OFF

Figure 2 Filtration Cycle

O = Valve Open (Divert valves = Filtration)
C = Valve Closed (Divert valves = Waste)
R = Pump Running
S = Pump Stopped

1.4 Digester Operation

During the sewage treatment process, solids build up and must be purged from the system and stored.

The digester tank acts as a storage and concentrating location for solids within the treatment plant. The micro-organisms in the solid organic matter in the digester tank break down over time reducing the amount of solid waste the treatment plant produces. The supernatant or digester liquid is returned to the balance tanks via gravity discharge.

In order to remove solids from treatment process the automatic digester operation must occur once or twice daily. The process is automatic and the frequency is selected through the operator interface. The digester process sequence is displayed below.

The waste activated sludge cycle transfers aged sludge from the aeration tank to the digester tank for further aerobic digestion. The digester tank, with the addition of air, breaks down the remaining sludge and releases carbon dioxide gas.

The digestion cycle first turns the air off to the tank to allow the sludge to settle and supernatant to form. The WAS is then introduced to the tank and the supernatant overflows back to the balance tank. The air remains off for an additional settling period. (See Figure 4 WAS cycle).

Figure 3 Grantham Digester Tank

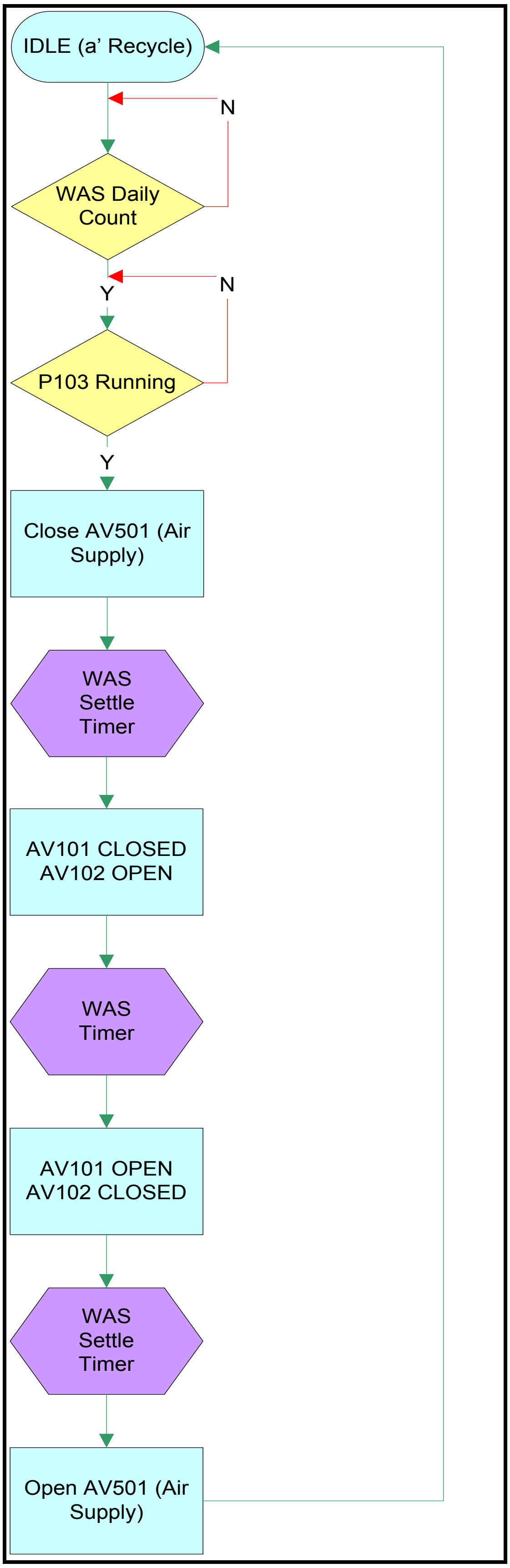


Figure 4 WAS Cycle

1.5 Sludge Management

In order to maintain the correct sludge or suspended solids concentrations, mixed liquor samples must be taken monthly and the settled sludge volume determined. This is required to ensure the mixed liquor suspended solids concentration is in the correct range (3500 to 4500 mg/l) and that the sludge is settling at the required rate.

NOTE!

Mixed liquor sampling is explained in section 1.6.5

1.5.1 Sludge Volume Index (SVI)

The sludge volume index provides a further measure of the settling characteristics of the sludge. It is defined as the volume in millilitres occupied by one gram of sludge, dry weight, after settling for 30 minutes in a 1000 millilitre graduated flask. It may be calculated from the following expression:

$$SVI = \frac{30\,\text{min}\ SSV\ (ml) \times 1000}{Suspended\ Solids\ Concentration\ (^{mg}/_{l})}$$

Values of the SVI less than 100 are generally regarded as good, while values greater than 200 often indicate a bulking sludge.

IMPORTANT!

The SVI can only be calculated when the mixed liquor suspended solids concentration has been performed by a laboratory.

1.5.2 Sludge Removal

When the mixed liquor suspended solids within the solids digester tank reaches a point where settling has little or no effect, the digester requires a pump out and sludge disposal by a licensed contractor.

Typically this point occurs when the MLSS within the solids digester tank reaches in excess of 20,000 mg/l.

NOTE!

Observation of digester supernatant return to the balance tank gives a good indication of settling performance.

1.6 Treatment Plant Monitoring

Key elements of the treatment plant must be monitored daily, weekly and monthly to ensure efficient operation.

The information must be recorded on a form and retained to ensure the treatment is always operating within specification. The operator interface allows easy access to the majority of the required information.

NOTE!

A sample of a weekly checklist form is displayed in the appendix.

1.6.1 Daily Monitoring Checks and Tasks

Required daily monitoring checks include:

- checking the treatment plant for operational alarms
- checking the Inlet flow meter (FM101) and recording the value
- visually inspecting the inlet screen (SC01) and hosing the screenings off the top of the screen as required
- visually inspecting tanks to ensure they are in good working order
- checking the pump station control board for alarms
- checking the balance pumps (P101 and P102), that feed the bioreactor, for priming
- checking and recording the values of the treatment plant's flow meters.

1.6.2 Weekly Monitoring Checks

Required weekly monitoring checks include:

- recording the result of the settled sludge volume testing of the aeration tank
- checking the chlorine in the chlorine dosing tank and replacing when the levels are low
- observing the operation of the digestion cycle
- recording chemical levels.

1.6.3 Monthly Monitoring Checks

Monthly checks require samples to be taken from the final effluent tank, the solids digester tank and the aerobic tank, with the samples to be analysed by a laboratory. The method for correctly sampling is discussed in section 1.6.5 — 'Sampling'.

The final effluent must comply with DERM requirements which include:

Parameter	Required	Release limit
pH	6.5-8.5	range
Turbidity	<5NTU	80th percentile
Suspended Solids	<15mg/L	80th percentile
BOD_5	<10mg/L	80th percentile
Total Nitrogen	<5mg/L	50th percentile
Total Phosphorous	<2mg/L	50th percentile
Residual Chlorine	0.7mg/L free chlorine	Minimum
Faecal Coliform	<10cfu/100ml	95th percentile

Table 1 Discharge requirements

The check of the final effluent ensures the treatment plant is operating efficiently and within specification. Additional samples from the aeration and solids digester tanks are also required to ensure the mixed liquor suspended solids (MLSS) is within specification.

1.6.4 Three Monthly Checks

Required three monthly monitoring checks include:

- checking the air blowers (P203 & P204) for undue noise and checking for pressure loss, if any, by observing bubbling in the aeration tank
- cleaning the air blowers air filter.
- checking the correct operation of all pumps
- checking all air lines for leaks
- checking for adequate chlorine levels in the storage vessel
- checking the clarifier unit for correct operation
- checking air skimmer in clarifier and clean any build up
- checking for correct operation of the chemical dosing pumps (P304, P305)
- checking for aeration in the solids digester tank, screened influent
- checking the sludge level in the solids digester tank is below one metre, (sludge needs to be removed from the tank if it is above this level).

1.6.5 Sampling Procedure

Collection of samples for on site and laboratory testing is extremely important to ensure the treatment plant is operating normally. Samples must be collected in the correct manner to ensure that the results are accurate and not misleading. The instructions for taking the required samples are displayed in the following sections.

1.6.6 Sampling from the Final Effluent Tank

Bacteriological Samples

Douse the treated waste water storage tank tap with 10% Sodium Hypochlorite solution.

After adequate sterilization of the tap, allow the water to run to waste for approximately 1 minute.

Remove the lid of the sample bottle and fill the bottle almost full. *Leave an air gap of approximately 1cm in the top of the bottle.* Replace the lid and screw down firmly. Do no over tighten. Place the bottle in the esky, and chill with either ice or freezer bricks for the return trip.

Collect and despatch so that the laboratory will receive the sample within 24 hours from collection.

Chemical Samples

Attach a clean piece of pipe to the tap.

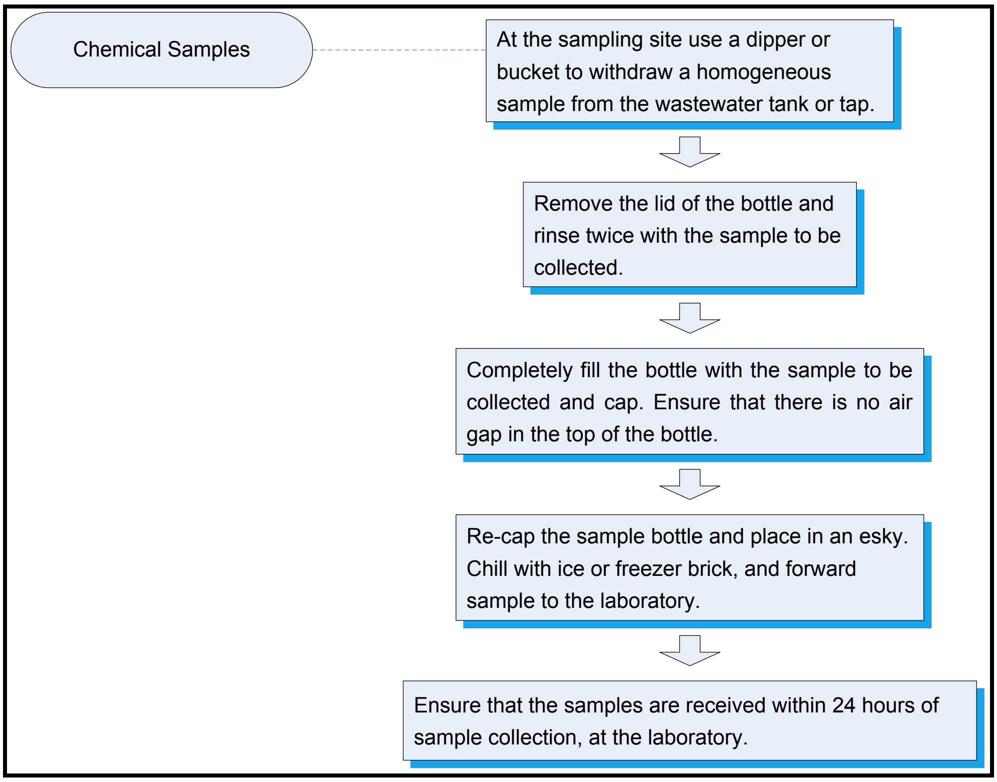
Allow a tap to run for at least two minutes.

Place the end of the pipe in the sample bottle and the bottle inside a 10L bucket. Allow the bottle to fill then overflow and fill the bucket.

Remove the pipe from the bottle and cap under water. *Ensure that there is no air space in the bottle when it is capped.*

Place the bottle in an esky and chill with either ice or freezer blocks for the return journey. *Ensure that the samples are delivered to the laboratory within 24 hours of sample collection.*

1.6.7 Sampling from Process Tanks

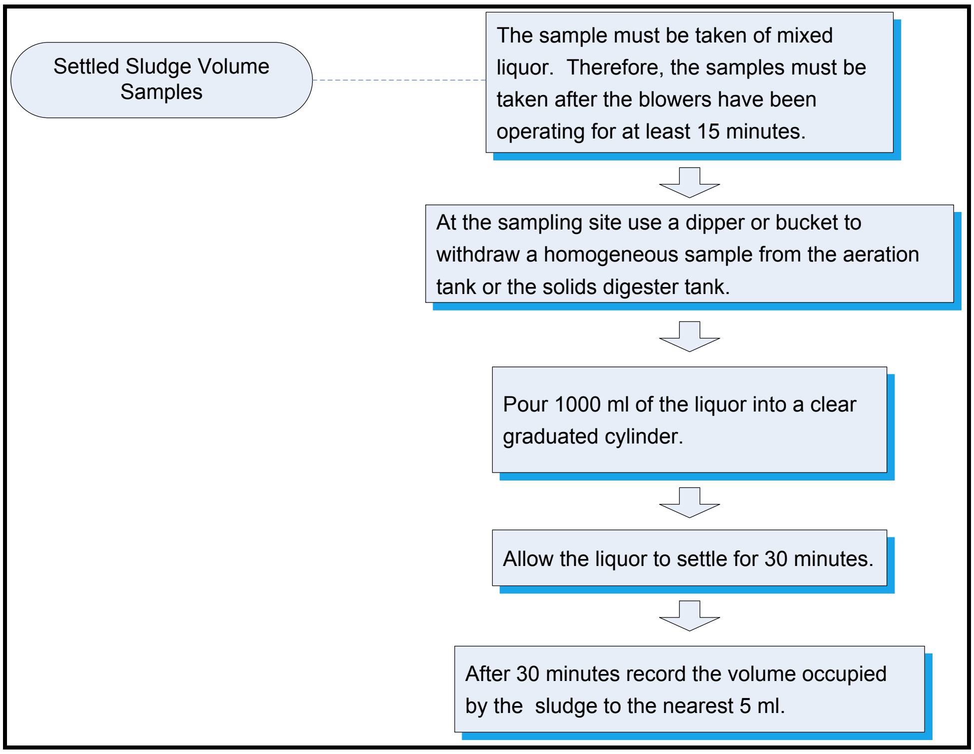


1.6.8 SSV Sampling

SSV Sampling from the Solids Digester Tank and the Aeration Tank

Settled Sludge Volume (SSV) samples are taken to determine the suspended solids concentration and sludge settleability.

SSV = ml of sludge in 1000 ml cylinder after 30 minutes of settling.



Settled Sludge Volume (SSV) Sampling Procedure

1.7 APPENDIX

1.7.1 W536 Grantham WWTP Control Methodology

Project Ref W536

GRANTHAM SEWAGE TREATMENT PLANT

Control Methodology

April 2012

Document Status

Rev	Status	Author	Reviewer		Approved for Issue		
			Name	Signature	Name	Signature	Date
A	First Issue	D Cokley	A Mythen				
B	Additional Specs	J Styles			A Mythen	On File	19/04/12

TABLE OF CONTENTS

1. INTRODUCTION

This document summarises the control methodology for the Grantham Development Wastewater Treatment Plant to be commissioned in April, 2012 at Grantham, Queensland.

2. CONTROL REQUIREMENTS

Treatment plant control requirements are summarised in Appendix A. General system control requirements are outlined in the sections below.

2.1. Pumps

2.1.1. General

All pump and all control valves to have manual start, manual stop and auto modes.

The minimum run speed for all VSD driven motors shall be 60% of the maximum run speed.

2.1.2. Duty Standby Pumps

Duty/Standby configuration ensures the critical process pumps will continue to operate if one pump fails. The duty pump is to alternate between pumps on each activation (ie. P105 runs, then system stops, next time the duty pump is called P106 runs). If an MCB or contactor failure is registered for the duty pump, the standby pump is automatically started. If the duty pump registers a VSD fault, the standby pump is activated.

2.2. Alarms

Treatment plant alarm list is summarised in Appendix B. The alarm list includes low, medium and high priority alarms.

High Level Alarm – Critical to the operation of the plant. This fault must be attended to within 4 hours.

Medium Level Alarm – Standby equipment has been activated or is non-critical to the plants operation. This fault must be attended to within 12 hours.

Low Level Alarm – Non-critical alarm. This fault must be attended to at the next scheduled daily visit.

Low Flow Alarms are activated if the pump is running but the flow meter is reading no flow. (Possible causes are fault with pump or fault with flow meter)

2.3. Treatment System

The STP has two main modes of operation, the plant cycle and the filtration mode.

The plant cycle runs the vital equipment to maintain the biological system in the STP. When only the plant cycle is operating the STP will not treat and discharge effluent.

The filtration mode runs the filtration system including the final discharge system. The STP is to be running in filtration mode when required to treat and release effluent.

The purpose of the two modes is to allow operators to stop the filtration cycle for maintenance whilst the vital plant equipment is still able to operate.

Manual backwash of sand filters is to be available from SCADA.

2.4. SCADA Security

Three levels of security will be provided with users able to be assigned the following roles:

- Operator
  - Change device modes (auto/manual)
  - Start and stop equipment
- Supervisor
  - Change set-points
- Engineer
  - Change PI controller tuning parameters
  - Change administrative settings

Automatic logon of the operator user will be provided and, in addition, higher level users will be logged off and replaced automatically by the operator user after a predetermined amount of time.

2.5. Response to power failure

In the event of a power failure when power is restored the plant will restart in automatic operation as if it has been started from scratch. In addition, the SCADA computer will automatically power up and logon as an operator user.

Historical Trending

All recorded data will be retained on the SCADA computer for a period of 12 months and can be accessed through the SCADA computer using Process Analyst.

2.6. SCADA device colour standards

The following specifies colours that will indicate device states on the SCADA screen:

- Any Fault – Flashing Yellow
- Any Interlock – Blue
- Analogue
    - High-High alarm – Red bar above displayed value
    - High alarm – Orange above displayed value
    - Low alarm – Orange below displayed value
    - Low-Low alarm – Red below displayed value
- On/Off Valve
    - Closed – Red
    - Open – Green
- 3-way Valve – Green highlight indicates current path
- Drive
    - Stopped – Red
    - Running – Green
    - Starting/Ramping – Flashing Green

2.7. Alarm Paging

TBA

2.8. Materials and Equipment

2.8.1. SCADA

The Citect SCADA system provides operators with control over, and feedback from the WWTP. The Citect system will also provide alarming and diagnostic reporting functionality.

2.8.2. PLC

A Schneider Modicon system will be used. The PLC processor is located in the WWTP MCC.

2.8.3. Equipment – Instruments

Instrument ID	Description	Range
FM101	Inlet Flow meter	?
FM102	Balance Delivery Flow meter	?
WL101	Balance Tank Level Sensor	0 – 0.4bar
DO101	Aeration Tank Dissolved Oxygen	?
WL102	Aeration Tank Level Sensor	0 – 0.4bar
FM103	a' Recycle Flow meter	?
FM201	RAS Flow meter	?
WL201	Clarified Tank Level Sensor	0 – 0.25bar
PT201	Aeration Pressure Sensor	0 – 1bar
FM301	Filtration Flow meter	?
pH301	Aeration pH	?
PT301	Pre-filter Pressure	0 – 4bar
PT302	Post-filter Pressure	0 – 4bar
WL401	Final Effluent Tank Level Sensor	0 – 0.4bar
FM401	Discharge Flow meter	?
NTU401	Turbidity Meter	?
UV401	UV disinfection system	On..Off
UV402	UV disinfection system	On..Off
CL401	Chlorine Residual Analyser	?
pH401	pH probe	?
TP401	Temperature sensor	?

2.8.4. Equipment – Drives

Equipment ID	Description	Type
MX101	Anoxic Mixer	DOL
M101	Screen Motor	DOL
M201	Blower Fan 1	DOL
M202	Blower Fan 2	DOL
P101	Balance Pump 1	VSD
P102	Balance Pump 2	VSD
P103	a' Recycle Pump	VSD
P104	Sodium Aluminate Dosing Pump	DOL
P201	RAS Pump 1	VSD
P202	RAS Pump 2	VSD
P203	Aeration Blower 1	VSD
P204	Aeration Blower 2	VSD
P301	Cross flow Pump 1	VSD
P302	Cross flow Pump 2	VSD
P303	Backwash Pump	VSD
P401	Recirculation Pump	DOL
P402	Chlorine Dosing Pump	DOL

2.8.5. Equipment – Solenoid Valves

Equipment ID	Description
AV101	Three way Electronic Actuated Ball Valve
AV301	Three way Electronic Actuated Ball Valve
AV302	Three way Electronic Actuated Ball Valve
AV303	Electronic Actuated Ball Valve
AV501	Brass Solenoid Valve

2.8.6. Equipment – PID Loops

Equipment ID	Description
FC101	Balance flow controller 1
FC102	Balance flow controller 2
DOC101	Dissolved oxygen controller
FC103	Recycle flow controller
FC201	RAS pump 1 flow controller
FC202	RAS pump 2 flow controller
FC301	Cross flow pump 1 flow controller
FC302	Cross flow pump 2 flow controller
FC303	Back wash pump flow controller
FC403	Treated effluent pump 1 flow controller
FC404	Treated effluent pump 2 flow controller

2.9. Device Code Blocks

Equipment will be divided into specific types to allow common blocks of code to be reused for the same types of equipment both inside the PLC program and within the Citect SCADA environment. All devices will have an associated symbol on the SCADA screen, for example, a drive will have a motor symbol colour coded to indicate the status of the drive. When the symbol is clicked a popup will appear giving the operator details and controls for the device. The following device types will be created…

2.9.1. Analogue input

The analogue input device allows the raw 4-20mA signal from the field to be scaled to engineering units and displayed on the Citect SCADA screen. Other features include:

- Raw signal 1st order filter
- Trending of the engineering value displayed on the SCADA pop-up
- Low, Low-Low, High, High-High alarms dead-band all configurable from the SCADA pop-up

2.9.2. Digital input

This device provides an interface for contact based feedback signals, for example, a high level switch or fault signal. It includes:

- Signal inversion
- On and Off delays configurable from the SCADA pop-up
- Trending of the inverted and delayed value displayed on the SCADA pop-up
- Associated alarm

2.9.3. DOL drive

This device provides code for a standard contactor based DOL drive and the associated feedback and alarms. It includes:

- Safety interlocks, displayed on the SCADA pop-up
- Fail to start and stop faults with delays
- Run feedback indication on the SCADA pop-up
- Overload fault displayed on the SCADA pop-up
- Auto and Manual start/stop modes selectable via the SCADA pop-up
- Number of starts recorded and displayed via the SCADA pop-up
- Run hours recorded and displayed via the SCADA pop-up

2.9.4. VSD drive

The VSD drive device is essentially the same as the DOL but with the following additions:

- Speed reference and current displayed and trended on the SCADA pop-up
- VSD Fault displayed on the SCADA pop-up
- Manual speed reference is possible in manual mode

2.9.5. *Actuated valve*

The Actuated valve device is capable of driving both a normal single action on/off valve and a dual destination 3-way valve. Both valves are controlled by a single digital output and can have up to two digital feedbacks for position. It also includes:

- Safety interlocks, displayed on the SCADA pop-up
- Fail to move faults with delays
- Position feedback indication on the SCADA pop-up
- Number of actuations recorded and displayed via the SCADA pop-up
- Auto and Manual modes selectable via the SCADA pop-up

2.9.6. *PI loop controller*

This device implements a standard proportional-integral loop controller. Derivative action is deemed unessicary because all plant control loops are not unstable enough to warrant derivative action. The PI loop controller includes:

- Auto and manual modes selectable via the SCADA pop-up
- Bump-less transfer between auto and manual modes
- Trending of set-point, measurement and output variables displayed on the SCADA pop-up
- Proportional and integral gain configurable on the SCADA pop-up
- High and low output limits and alarms
- High and low set-point limits
- Deviation alarm with dead-band configurable on the SCADA pop-up

Appendix A. Control Requirements

A.1 Details

Treatment plant control requirements are summarised in Table 1. Table 1 details the control requirements for the STP.

Table 1 STP Control Summary

Process	Control Methodology	Related Instruments	Control Logic
Balance Pumps P101 & P102	The balance pumps transfer screened influent from the balance tank to the anoxic tank. The balance pumps control the flow across the clarifier as the system gravity feeds from anoxic to aeration to clarifier. The balance pumps are VSD driven. A PID loop is used to adjust the speed of the pumps to achieve a desired flow rate.	• WL101 • FM102 • WL102 • WL201	DUTY/STANDBY SYSTEM MANUAL START/ STOP/ AUTO/ RUNNING STATUS Duty pump starts IF: • Plant cycle = ON AND; • WL101 ≥ balance duty start AND; • WL102 < aeration high level AND; • WL201 < clarified high level Duty pump stops IF: • Plant cycle = OFF OR; • WL101 < balance duty stop OR; • WL102 > aeration high level, with 30s delay OR; • WL201 > clarified high level with 30s delay Balance Flow rate: • Balance flow rate set point on SCADA screen (Range 0 – 1 L/s) • Feedback for PID loop = FM102
Inlet Screen M101	The inlet screen removes solids greater than 1mm from the sewage entering the system. The inlet screen motor operates when there is flow entering the screen. The screen motor operates the chain driven teeth that remove the trapped solids from the bar screen.	• FM101	MANUAL START/ STOP/ AUTO/ RUNNING STATUS Motor starts IF: • FM101 > screen run flow rate AND; • Plant cycle = ON

Process	Control Methodology	Related Instruments	Control Logic
			Motor stops IF: • FM101 < screen run flow with 1 min delay OR; • Plant cycle = OFF
Anoxic Mixer (MX101)	The anoxic mixer turns over the anoxic tank continuously to promote a healthy anoxic zone and prevent settling. The mixer operates continuously when there is sufficient fluid in the anoxic tank.	• WL102	MANUAL START/ STOP/ AUTO/ RUNNING STATUS Mixer starts IF: • WL102 > aeration low level AND; • Plant cycle = ON Mixer stops IF: • WL102 < aeration low level with 30 sec delay OR; • Plant cycle = OFF
a’ Recycle Pump (P103)	The a’ Recycle pump returns biomass rich in nitrates from the aeration tank to the anoxic tank for denitrification. The a’ recycle pump operates on a time run and time stop sequence. The run time and rest time can be set in the SCADA. The a’ Recycle pump is also controlled by a PID loop to achieve the desired flow rate.	• WL102 • FM103	MANUAL START/ STOP/ AUTO/ RUNNING STATUS Pump starts IF: • WL102 > aeration low level AND; • a’ Recycle run timer = ON AND; • Plant cycle = ON Pump stops IF: • WL102 < aeration low level after 30 sec delay OR; • a’ Recycle run timer = OFF OR; • Plant cycle = OFF a’ Recycle flow rate: • A’ Recycle flow rate set point on SCADA screen (0 – 5L/s) • Feedback for PID loop = FM103

Process	Control Methodology	Related Instruments	Control Logic
			Rest timer starts when run timer is complete. The run timer restarts when the rest timer is complete.
Alum Dosing Pump (P104)	The alum dosing pump doses Sodium Aluminate into the aeration tank to assist with phosphorus removal from the influent. The dosage rate can be manually adjusted on the screen of the pump.		MANUAL START/ STOP/ AUTO/ RUNNING STATUS Pump starts IF: • Filtration mode = ON Pump stops IF: • Filtration mode = OFF
RAS pumps (P201 & P202)	The RAS pumps transfers activated sludge from the hoppers of the clarifier back to the anoxic zone. This process helps maintain the desired MLSS level in the bioreactor. The RAS pumps operates on a time run and time stop sequence. The run time and rest time can be set in the SCADA. P201 draws sludge from the first two hoppers of the clarifier to form RAS A. P202 draws sludge from the last two hoppers of the clarifier to form RAS B. The run and rest times for RAS A & B are independent as A is typically 4 x greater than B. The RAS pumps are VSD driven and a PID loop controlled the flow rate according to FM201.		MANUAL START/ STOP/ AUTO/ RUNNING STATUS **RAS A (Hoppers 1 & 2)** Pump starts IF: • Plant cycle = ON AND; • RAS A run timer = ON Pump stop IF: • RAS A run timer = OFF OR; • Plant cycle = OFF **RAS B (Hoppers 3 & 4)** Pump starts IF: • Plant cycle = ON AND; • RAS B run timer = ON Pump stop IF: • RAS B run timer = OFF OR;

Process	Control Methodology	Related Instruments	Control Logic
			• Plant cycle = OFF RAS A flow rate: • IF P201 = ON THEN; • PID set point for P201 = RAS A flow rate • FM201 = Feedback for PID loop RAS B flow rate: • IF P202 = ON THEN; • PID set point for P202 = RAS B flow rate • FM201 = Feedback for PID loop Combined flow rate: • IF P201 = ON AND; • P202 = ON THEN; • PID set point for P201 = (RAS A flow rate + RAS B flow rate) • PID set point for P202 = (RAS A flow rate + RAS B flow rate) • FM201 = Feedback for PID loop • RAS A flow rate set point on SCADA (Range 0 – 5 L/s) • RAS B flow rate set point on SCADA (Range 0 – 5L/s) *Rest timer starts when run timer is complete. The run timer restarts when the rest timer is complete.*
Aeration blowers (P203 & P204)	The aeration blowers supply air to the aeration, balance and digester tank. A dissolved oxygen sensor located in the aeration tank continuously monitors the DO level. The aeration blowers are VSD	• DO101	DUTY/STANDBY SYSTEM MANUAL START/ STOP/ AUTO/ RUNNING STATUS Duty blower starts IF:

Process	Control Methodology	Related Instruments	Control Logic
	driven. A PID loop is used to adjust the speed of the blowers to achieve a desired dissolved oxygen level in the aeration tank.		• Plant cycle = ON AND; • DO101 < DO low level Duty blower stop IF: • Plant cycle = OFF OR; • DO101 ≥ DO high level Blower run speed: • DO level set point on SCADA (0-3mg/L) • Reset PID loop when blower starts
Aeration blower fans (M201 & M202)	The aeration blower fans provide circulation of fresh air into the acoustic housing to cool the motor and the roots pump. The associated fan is to run continuously when the duty blower is in operation.		M201 starts IF: • P203 = ON M202 starts IF: • P204 = ON M201 stop IF: • P203 = OFF M202 stop IF: • P204 = OFF
Filtration cycle	The filtration cycle transfers clarified influent from the clarified tank through the sand filters and UV disinfection unit to the final effluent tank.		Refer to Table 2 Filtration Sequence for detailed control logic. Filtration Start IF: • Filtration mode = ON AND;

Process	Control Methodology	Related Instruments	Control Logic
			• Filtration timer = ON AND; • Turbidity filtration stop = OFF Filtration Stop IF: • Filtration mode = OFF OR; • BW cycle = ON OR; • Turbidity filtration stop = ON
Filter backwash cycle	The sand filter backwash is initiated by either the filtration timer elapsed or a high pressure differential across the filters	PT301; PT302;	Refer to Table 2 Filtration Sequence for further details. Backwash Start IF: • BW cycle = ON OR; • Sand Filter Differential (PT301 – PT302) > filter diff pressure Backwash Stop IF: • BW cycle = OFF IF BW cycle = ON THEN Filtration cycle = OFF IF BW CYCLE COUNT > 2, within < 1 day THEN FILTER BW ALARM = ON
Crossflow pumps (P301 & P302)	The crossflow pumps transfer clarified influent from the clarified tank through the sand filter and the UV disinfection system to the final effluent tank. The crossflow pumps are VSD driven. A PID loop is used to adjust the speed of the pumps to achieve	• WL201 • PT301 • PT302 • FM301 • WL401	DUTY/STANDBY SYSTEM MANUAL START/ STOP/ AUTO/ RUNNING STATUS Duty Pump Starts IF: • Filtration mode = ON AND;

Process	Control Methodology	Related Instruments	Control Logic
	a desired flow rate.		• WL201 ≥ crossflow duty start AND; • WL401 < final effluent high level AND; • Turbidity filtration stop = OFF Duty Pump Stop IF: • Filtration mode = OFF OR; • WL202 < crossflow duty stop OR; • WL401 ≥ final effluent high level after 30 sec delay OR; • Turbidity filtration stop = ON Crossflow Flow rate: • Crossflow flow rate set point on SCADA (0 – 3L/s) • Feedback for PID loop = FM301
Backwash pump (P303)	The backwash pump transfers final effluent from the final effluent tank through the sand filter in the reversed direction. The flow of the backwash removes contaminants that have built up in the sand during filtration. The backwash pump is VSD driven. A PID loop is used to adjust the speed of the pump to achieve a desired flow rate.	• FM301 • WL401	MANUAL START/ STOP/ AUTO/ RUNNING STATUS Duty Pump Starts IF: • BW cycle = ON AND; • WL401 > final effluent low level Duty Pump Stop IF: • BW cycle = OFF OR; • WL401 < final effluent low level after 30 sec delay

Process	Control Methodology	Related Instruments	Control Logic
UV disinfection system UV401, UV402	The UV disinfection system is self-controlling with UV intensity and lamp hour life control logic. The UV units are self alarming.		
WAS Digestion Cycle	The waste activated sludge cycle transfers aged sludge from the aeration tank to the digester tank for further aerobic digestion. The digester tank with the addition of air, breaks down the remaining sludge to a carbon and releases carbon dioxide gas. The digestion cycle first turns the air off to the tank to allow the sludge to settle and supernatant to form. The WAS is then introduced to the tank and the supernatant overflows back to the balance tank. The air remains off for an additional settling period.		WAS cycle start IF: • Plant cycle = ON AND; • WAS rest timer = OFF WAS cycle stop IF: • Plant cycle = OFF OR; • WAS rest timer = ON Refer to Table 3 Waste activated sludge cycle, for further details
Recirculation Pump (P401)	The recirculation pump turns over the final effluent tank to reduce the likelihood of bacteria regrowth. The recirculation system operates continuously when the running in plant auto mode. The recirculation pump provides a sample for the chlorine analyser. Chlorine is then dosed into the recirculation line down stream of the	• WL401	MANUAL START/ STOP/ AUTO/ RUNNING STATUS Pump Start IF: • Plant cycle = ON AND; • WL401 > final effluent low level Pump Stop IF: • Plant cycle = OFF OR;

Process	Control Methodology	Related Instruments	Control Logic
	analyser to maintain constant free chlorine residual in the final effluent tank.		• WL401 < final effluent low level after 30 sec delay
Chlorine dosing pump (P402)	The chlorine dosing pump doses sodium hypochlorite into the recirculation line to maintain constant free chlorine residual in the final effluent tank. The chlorine dosing pump is independently controlled by the chlorine analyser. The chlorine analyser has three analogue outputs to the PLC for chlorine, pH and Temperature.		
Reticulation pressure pump (P403)	The reticulation pressure pump supplies final effluent to a hose reel and tap for screen wash, anoxic/aeration wash down and general wash down for the STP. The pressure pump is self controlling to maintain a set pressure in the discharge line.		MANUAL START/ STOP/ AUTO/ RUNNING STATUS • ALWAYS ON regardless of plant/filtration mode
Turbidity Off Specification	The turbidity meter (NTU401) measures the turbidity of the final effluent post sand filtration. If the turbidity is greater than the given set point the plant is not able to release to the irrigation field. A warning alarm is to signal when the turbidity is greater than the set point. If the warning alarm remains true for a given period of time the filtration cycle will stop, to avoid	• NTU401	Turbidity warning alarm ON, IF: • NTU401 > Turbidity set point Turbidity warning alarm OFF, IF: • NTU401 < Turbidity set point Turbidity filtration stop IF: • Turbidity warning = ON for filtration stop time

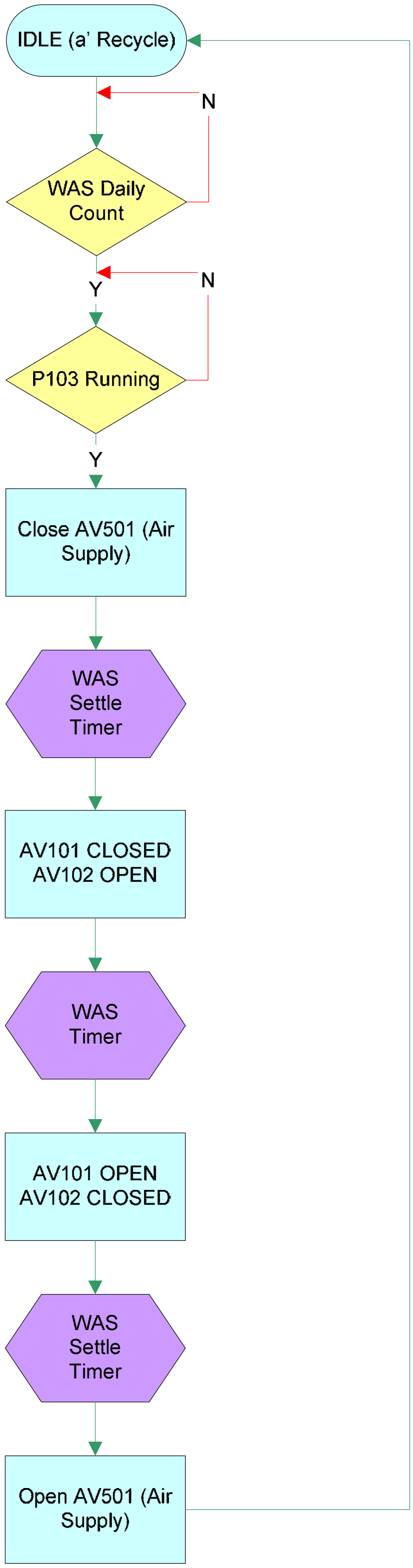
Process	Control Methodology	Related Instruments	Control Logic
	contaminating the final effluent tank.		

Table 2 Filtration Sequence

Step	Next Step	Description	Delay (secs)	Crossflow (P301 or P302)	Backwash Pump (P303)	Filter 1 Divert Valve (AV301)	Filter 2 Divert Valve (AV302)	Backwash Valve (AV303)	P301/P302 VSD Speed Setpoint	P303 VSD Speed Setpoint	Filtration Cycle	BW Cycle
1	2	Filtration Cycle	-	R	S	O	O	O	Filtration Flow	-	ON	OFF
2	3	Backwash Triggered (Filter 1)	4	S	S	O	O	O	-	-	OFF	ON
3	4	Set Valves (Filter 1)	Valve Time	S	S	C	O	C	-	-	OFF	ON
4	5	Start Backwash Pump (Filter 1)	BW Run Time	S	R	C	O	C	-	BW Flow	OFF	ON
5	6	Stop Backwash Pump (Filter 1)	4	S	S	C	O	C	-	-	OFF	ON
6	7	Set Valves (Filter 2)	Valve Time	S	S	O	C	C	-	-	OFF	ON
7	8	Start Backwash Pump (Filter 2)	BW Run Time	S	R	O	C	C	-	BW Flow	OFF	ON
8	9	Stop Backwash Pump (Filter 2)	4	S	S	O	C	C	-	-	OFF	ON
9	10	Reset Valves	Valve Time	S	S	O	O	O	-	-	OFF	ON
10	1	Return to Filtration	-	R	S	O	O	O	Filtration Flow	-	ON	OFF

O = Valve Open (Divert valves = Filtration)
C = Valve Closed (Divert valves = Waste)
R = Pump Running
S = Pump Stopped

Table 3 Waste activated sludge cycle



Appendix B. Alarm Listing

B.1 General

The table below summarises the treatment system alarm requirements.

Alarm Description	ALARM	PRIORITY		
		HIGH	MED	LOW
Emergency Stop	Emergency stop	X		
Phase Failure	Phase failure	X		
Crossflow pump 1 VSD	P301 VSD FAULT		X	
Crossflow pump 2 VSD	P302 VSD FAULT		X	
Crossflow pump 1 & 2 VSD	P301 & P302 VSD FAULT	X		
Balance Pump 1 VSD	P101 VSD FAULT		X	
Balance Pump 2 VSD	P102 VSD FAULT		X	
Balance Pump 1 & 2 VSD	P101 & P102 VSD FAULT	X		
RAS Pump 1 VSD	P201 VSD FAULT		X	
RAS Pump 2 VSD	P202 VSD FAULT		X	
RAS Pump 1 & 2 VSD	P201 & P202 VSD FAULT	X		
a' Recycle VSD	P103 VSD FAULT		X	
Aeration Blower 1 VSD	P203 VSD FAULT		X	
Aeration Blower 2 VSD	P204 VSD FAULT		X	
Aeration Blower 1 & 2 VSD	P203 & 204 VSD FAULT	X		
Backwash Pump VSD	P303 VSD FAULT		X	
Screen Motor	M101 MCB & CONTACTOR	X		
Anoxic Mixer	MX101 MCB & CONTACTOR		X	
Balance Pump 1 D/S	P105 MCB		X	
Balance Pump 2 D/S	P106 MCB		X	
Balance Pump 1 & 2	P105 & P106 MCB	X		
a' Recycle Pump	P103 MCB		X	
RAS Pump 1	P201 MCB		X	

Alarm Description	ALARM	PRIORITY		
		HIGH	MED	LOW
RAS Pump 2	P202 MCB		X	
Aeration Blower 1 D/S	P203 MCB		X	
Aeration Blower 2 D/S	P204 MCB		X	
Aeration Blower 1 & 2	P203 & P204 MCB	X		
Crossflow pump 1 D/S	P301 MCB		X	
Crossflow pump 2 D/S	P302 MCB		X	
Crossflow pump 1 & 2 D/S	P301 & P302 MCB	X		
Backwash Pump	P303 MCB		X	
Recirculation Pump	P401 MCB & CONTACTOR		X	
Reticulation Pressure Pump	P403 MCB			X
Balance Tank Low Level	WL101 LOW LEVEL			X
Balance Tank High Level	WL101 HIGH LEVEL		X	
Balance Tank High High Level	WL101 HIGH HIGH LEVEL	X		
Aeration Tank Low Level	WL201 LOW LEVEL	X		
Aeration Tank High Level	WL201 HIGH LEVEL	X		
Clarified Tank Low Level	WL202 LOW LEVEL		X	
Clarified Tank High Level	WL202 HIGH LEVEL	X		
Final Effluent Tank Low Level	WL401 LOW LEVEL		X	
Final Effluent Tank High Level	WL401 HIGH LEVEL	X		
Sand Filter Pressure Differential	High sand filter pressure			X
BW alarm	Sand Filter BW alarm		X	
Dissolved Oxygen Low Level	DO LOW LEVEL			X
Turbidity Off spec warning	NTU401 OFF SPEC		X	
Turbidity Off spec filtration stop	NTU401 FILTRATION STOP	X		
Balance Low Flow	P101/102 LOW FLOW	X		
a' Recycle Low Flow	P103 LOW FLOW		X	
RAS A Low Flow	P201 LOW FLOW		X	
RAS B Low Flow	P202 LOW FLOW		X	
Crossflow Low Flow	P301/302 LOW FLOW		X	

Alarm Description	ALARM	PRIORITY		
		HIGH	MED	LOW
Low Chlorine Residual	CL401 LOW LEVEL		X	
Aeration Pressure High	PT201 HIGH PRESSURE		X	

Appendix C. Process Set points

C.1 General

The table below summarises the process set points values for the treatment plant.

PLC Address	Set point Name	Units	Preliminary Setpoint	Commissioning Setpoint
	SCREEN RUN FLOW	L/s	0.5	
	BALANCE DUTY START	%	30	
	BALANCE DUTY STOP	%	20	
	BALANCE STANDBY START	%	80	
	BALANCE FLOW RATE	L/s	0.6	
	BALANCE HIGH LEVEL	%	90	
	BALANCE HIGH HIGH LEVEL	%	100	
	AERATION LOW LEVEL	%	30	
	AERATION HIGH LEVEL	%	98	
	CLARIFIED LOW LEVEL	%	30	
	CLARIFIED HIGH LEVEL	%	95	
	CROSSFLOW DUTY START	%	60	
	CROSSFLOW DUTY STOP	%	15	
	FINAL EFFLUENT LOW LEVEL	%	10	
	FINAL EFFLUENT HIGH LEVEL	%	95	
	FINAL EFFLUENT DUTY START	%	30	
	FINAL EFFLUENT DUTY STOP	%	15	
	WAS RUN TIMER	MINS	5	
	WAS REST TIMER	HRS	23	
	WAS SETTLE TIMER	MINS	30	

	RAS A RUN TIMER	MINS	3	
	RAS A REST TIMER	MINS	2	
	RAS B RUN TIMER	MINS	1	
	RAS B REST TIMER	MINS	10	
	RAS A FLOW RATE	L/S	1	
	RAS B FLOW RATE	L/S	1	
	a’ REC FLOW RATE	L/S	6	
	A' REC RUN TIMER	MINS	50	
	A' REC REST TIMER	MINS	10	
	FILTER DIFF PRESSURE	kPa	35	
	BW CYCLE TIME	0:00	11:00 AM	
	BW RUN TIMER (PER FILTER)	MINS	12	
	CROSSFLOW FLOW RATE	L/s	0.6	
	BW FLOW RATE	L/s	6.2	
	VALVE ACTUATION TIME	SECS	20	
	BALANCE LOW FLOW	L/s	0.1	
	RAS A LOW FLOW	L/s	0.2	
	RAS B LOW FLOW	L/s	0.2	
	a’ REC LOW FLOW	L/s	0.2	
	CROSSFLOW LOW FLOW	L/s	0.2	
	LOW DISSOLVED OXYGEN	mg/L	1	
	TURBIDITY WARNING	NTU	10	
	TURBIDITY FILTRATION STOP	HRS	1	
	LOW CHLORINE RESIDUAL	mg/L	0.3	
	HIGH AERATION PRESSURE	kPa	100	
	BW CYCLE ALARM	COUNT	2	

SECTION 5 – PLANT START UP AND SHUT DOWN

Hazard and Safety Warnings

Prompts have been used throughout the manual to highlight safety, environmental and process concerns. The following information describes the prompts used in the manual and their meanings:

DANGER!

Indicates a hazard or situation where failure to use the correct procedures WILL cause either severe personal injury or death.

WARNING!

Indicates a hazard or situation where failure to use the correct procedures COULD result in severe personal injury or death.

CAUTION!

Indicates a hazard or situation where failure to use the correct procedures COULD result in severe personal injury or equipment damage.

IMPORTANT!

Indicates information within the text which is of particular importance to the procedure or operation being described.

REMEMBER!

Indicates information within the text which is of sufficient importance to warrant highlighting.

NOTE!

Indicates information which has been covered in an earlier section of the text but which warrants reinforcement.

Contents

1.1 Plant Start-Up

The Grantham wastewater treatment system is able to treat raw sewage and deliver a class A final effluent.

In order to achieve this result the start-up of the treatment plant must take into account the type of sewage, (also called the plant load) that the plant is treating.

The treatment plant has process variables that can be altered to accommodate sewage with different properties. These process variables include:

- flow rate of the a' recycle pump
- flow rate of the aeration system
- flow rate of the RAS pumps
- running times
- the amount of chemical dosing
- the amount of sludge wasted per day
- the amount of effluent being pumped through recycle streams.

Plant loads are unique, therefore it is impossible to pre-install the treatment plant with the optimum settings.

The optimum process settings are generated after making adjustments based on daily observations of key process parameters. The following pre-start and start-up process must be conducted before the sewage treatment plant will achieve peak operating efficiency.

1.1.1 Pre-Start Checks

Task Step	Explanation	Critical Comment
Section One: Electrical Control Board		
1. Confirm correct power supply to the electrical control board.	This will have been verified during Site Acceptance Testing (SAT)	**WARNING!** **Do not touch any electrical connections or wires.** **WARNING!** **A qualified electrician must perform this task step.**
2. Check that all components are wired and plugged in to the correct field isolators	This will have been verified during Site Acceptance Testing (SAT)	**WARNING!** **Do not touch any electrical connections or wires.** **WARNING!** **A qualified electrician must perform this task step.**
Section Two: Anoxic and Aeration Tanks		
3. Check the tanks are clear of any rags or debris.	Perform a visual check.	**CAUTION!** **Tanks are confined spaces. Ensure precautions are taken to prevent personnel from falling into the tanks.**
4. Inspect the condition of the diffusers.	Ensure the diffusers are clear of any blockages and they are level.	
5. Check the tanks for any external or internal leaks.		**IMPORTANT!** **All tank leaks must be repaired before start-up.**
6. Confirm valves are in their 'normal' position	Perform a visual check	

Task Step	Explanation	Critical Comment
Section Three: Chemical Dosing and General Checks		
7. Ensure there are sufficient chemicals in the chemical storage tank.		**CAUTION!** **Chemicals in the dosing unit are corrosive. Ensure correct PPE is used at all times.**
8. Remove all inspection covers throughout the treatment plant and check fluid levels in all chambers are correct.		
9. Tested emergency stop switches throughout the plant	This function will be tested during SAT.	

1.1.2 Initial Start-Up

Task Step	Explanation	Critical Comment
Section One: General Checks		
1. Confirm that all valves, level switches and operation levels are correct.		
2. Fill the balance chamber to not less than one metre in depth.		
3. Fill the anoxic tank to one metre in depth.		
4. Fill the aeration tank and clarifier to remain at same level as anoxic tank due to equalisation.		

Task Step	Explanation	Critical Comment
Section Two: Electrical Start-Up		
5. Ensure that all main switches, Miniature Circuit Breakers (MCB), field isolation switches and equipment switches are in the off position.		
6. Switch on the main control breaker and the MCB for the PLC and interface screen.		
7. Turn on the PC and place all equipment in the 'manual off' position.		
8. Turn on all field isolation, equipment and MCBs.		
9. Turn on each piece of equipment and test.	Using the PC turn on the treatment plant equipment, test each piece of equipment before selecting the AUTO function.	
Section Three: Influent Screen		
10. Ensure the influent is received into the screen by the influent rising main.	The influent wash down is manual in operation	
Section Four: Balance System		
11. Adjust the level sensor in the balance tank to preset levels.	Use the operator interface to adjust the level sensor and turn the isolation switches for balance pump one and two to ON.	

Task Step	Explanation	Critical Comment
12. Adjust the aeration system.	Adjust the aeration system to the balance tank to 25% open. Open as a start-up position and adjust as needed to maintain <1.0 mg/l Dissolved Oxygen (DO) content.	
Section Five: Aeration System		
13. Turn the field isolation switches to the aeration unit to ON	Adjust the DO sensor and Variable Speed Drive (VSD) blowers using the operator interface.	
Section Six: Recycle and Return Pumps		
14. Turn all field isolation switches to on and adjust run times for suit ADWF.	The recycle pumps are VSD driven and maintain a set flow rate based on the operator input parameters.	
Section Seven: Inflow		
15. Allow the raw sewage to flow into the inlet screen.		
16. Adjust the a' recycle flow rate.	Adjust the a' recycle flow rate once the liquid levels have equalised and normal flow through the plant has been established.	**NOTE!** **When the plant operates under normal conditions activated sludge will gradually build up in the aeration tank which is returned to the anoxic tank. The activated sludge should be brownish in colour.**
17. Check the sludge digester operation for adequate aeration.		

Task Step	Explanation	Critical Comment
18. Determine the rate at which sludge is wasted into the sludge digester during the operational sequence.	Ensure the supernatant return time is long enough to remove all supernatant that the plumbing allows.	**IMPORTANT!** **It is critical that the sludge wasted into the digester is not greater than the transfer capacity of the supernatant return in its allotted time period.**
Section Eight: Air, Mixing and Cycle Adjustments		
19. Adjust the aeration rate of the air flow rate through the aeration diffusers to achieve even mixing.	Minor adjustments — Regulate the individual valves for each diffuser bar assembly within the operator interface screen. Large adjustments — Regulate the dissolved oxygen probe that controls the blower, using the operator interface screen.	**IMPORTANT!** **The level of dissolved oxygen and the degree of mixing within the aeration tank is determined by the flow rate of air inputted by the diffusers.** **IMPORTANT!** **The valves should never be 'throttled down'.** **NOTE!** **Even mixing means the air from the diffusers should move the tank contents so it is rolling evenly along the tank wall.** **NOTE!** **It is possible to maintain high mixing velocities in the aeration tank and still control and maintain the desired level of dissolved oxygen.**

1.1.3 Inflow Troubleshooting at Start -Up

INFLUENT COLOUR	AERATION COLOUR	RETURN SLUDGE COLOUR	ODOUR	CONDITION	ADJUSTMENT
Grey	Chocolate Brown	Chocolate Brown	Earthy	Good Operation	None
Grey	Chocolate Brown	Chocolate Brown	Earthy	Excessive Foaming	Foaming is Normal During Start-Up
Grey	Chocolate Brown	Light	Musty	Solids in Effluent	Reduce Sludge Return Rate
Grey	Light Brown	Light	Slightly Septic	No Sludge return	Back Wash Sludge Return
Grey	Red	Light Brown	None	Over Mixing	Reduce Aeration
Grey	Brown	Black	Septic	Insufficient Aeration	Increase Aeration

1.2 Shutdown Procedures

IMPORTANT!

The Grantham wastewater treatment system is designed to run automatically and continuously, therefore, a complete shutdown is generally not required.

1.3 Failure and Emergency Procedures

Always leave the power to the treatment plant turned on. In the event of a complete power outage, upon the return of power the treatment plant will reset and start up automatically.

IMPORTANT!

In the event of an emergency situation, the emergency stop button located in the control room must be pressed to stop all treatment plant equipment.

SECTION 6 – PLANT EQUIPMENT FUNCTION

Hazard and Safety Warnings

Prompts have been used throughout the manual to highlight safety, environmental and process concerns. The following information describes the prompts used in the manual and their meanings:

DANGER!

Indicates a hazard or situation where failure to use the correct procedures WILL cause either severe personal injury or death.

WARNING!

Indicates a hazard or situation where failure to use the correct procedures COULD result in severe personal injury or death.

CAUTION!

Indicates a hazard or situation where failure to use the correct procedures COULD result in severe personal injury or equipment damage.

IMPORTANT!

Indicates information within the text which is of particular importance to the procedure or operation being described.

REMEMBER!

Indicates information within the text which is of sufficient importance to warrant highlighting.

NOTE!

Indicates information which has been covered in an earlier section of the text but which warrants reinforcement.

Contents

Equipment Function

Equipment

The specific equipment items and their function are described in this section.

IMPORTANT!

All equipment functions are automatically controlled by the treatment plant's control system. Manual intervention is possible through the operator interface that is described in *Error! Reference source not found.* ***'Software'.***

Equipment Name	Equipment Number	Equipment Function
Balance Tank	N/A	The holding tank where screened influent is transferred and held for further treatment. The holding tank ensures the treatment plant can manage high inflows during peak periods by storing the influent and treating it during off peak periods.
Anoxic Tank	N/A	The denitrification process occurs in the anoxic tank under anaerobic conditions, removing and releasing nitrogen (N) from the effluent.
Aeration Tank	N/A	The nitrification process occurs in the aeration tank under aerobic conditions, where ammonia (NH_3) is converted (oxidised) into nitrites (NO_2^-) and nitrates (NO_3) by bacteria within the aeration tank.
Clarified Tank	N/A	The clarified tank is a holding tank for effluent that has been clarified prior to being pumped to tertiary treatment via the crossflow pumps (P301 & 302)
Solids Digester Tank	N/A	The organic solids that accumulate in the sewage treatment plant are pumped to the solids digester tank during the digestion operation that occurs once or twice daily. Over time the solids concentrate in the digester tank and break down through aerobic digestion. Aerobic digestion is a bacterial process occurring in the presence of oxygen, whereby bacteria rapidly breakdown the organic matter and convert in to carbon dioxide (CO_2).

Final Effluent Tank	N/A	The treated effluent is stored in the final effluent tank where it is transferred to the irrigation storage tanks.
Pump Room	N/A	All pumps except blowers & dosing pumps are installed in the pump room. 
Balance Pump 1	P101	Pump screened influent from the balance tank to the anoxic tank in tandem with balance pump 2.
Balance Pump 2	P102	Pump screened influent from the balance tank to the anoxic tank in tandem with balance pump 1.
Air Blowers	P203 & P204	Delivers process air to the aeration tank, balance tank and solids digester tank.
a' Recycle Pump	P103	Recirculates liquor from the aeration tank to the anoxic tank to ensure sufficient denitrification.
RAS Pumps	P201 & P202	Returns activated sludge to the anoxic tank to maintain sufficient MLSS level in the bioreactor.
Backwash pump	P303	Pumps treated effluent to backwash media filters.
Crossflow Pumps	P301 & P302	Pumps clarified effluent through media filters and UV lamps to final effluent tank
Recirculation Pump	P401	Pump recirculates final treated effluent to maintain a chlorine residue via CL401 and P402
Sodium Hypochlorite Dosing Pump	P402	Chlorine addition 

Sodium Aluminate Dosing Pump	P205	Phosphorous removal 
Digital Flow Meter – Full Bore	FM101	Measures the flow rate of raw sewage entering the treatment plant and feeds the information into the treatment plant control system.
Insertion Flow Meter	FM102	Balance tank delivery flow meter
Insertion Flow Meter	FM103	'a' recycle flow meter 
Diaphragm Pressure Sensor 0-0.4 Bar	WL101	Measures the liquid level by sensing pressure in the balance tank and feeds the information into the treatment plant control system.
Dissolved Oxygen Sensor & Transmitter	DO101	Measures dissolved Oxygen level in aeration tank

		
Diaphragm Pressure Sensor 0-0.4 Bar	WL102	Aeration tank level sensor
Diaphragm Pressure Sensor 0-0.25 Bar	WL201	Clarified tank level sensor
Diaphragm Pressure Sensor 0-1 Bar	PT201	Aeration pressure sensor.
Insertion Flow Meter	FM301	Filtration flow meter 
pH transmitter	pH301	Aeration pH
Diaphragm Pressure Sensor 0-4Bar	PT301	Pre-filter pressure sensor 

Diaphragm Pressure Sensor 0-4 Bar	PT302	Post filter pressure sensor
Diaphragm Pressure Sensor 0-0.4 Bar	WL401	Final effluent tank level sensor
Insertion Flow Meter	FM401	Discharge flow meter
CONEX 314	CL401	Chlorine residual monitor & controller 
CONEX 314	pH401	pH probe
CONEX 314	TP401	Temperature probe
	NTU401	Turbidity sensor and transmitter

Manual Valves		Many types of manual shut off valves have been installed within the treatment plant and are used to isolate equipment items or perform other manual tasks like draining a process tank. 
UV System	UV401 & UV402	Disinfects filtered effluent 
Digester Air Supply Solenoid Valve	AV101	Controls the air supply to the digester. Turns off during the WAS cycle to allow the digester to settle and the supernatant overflow back to the anoxic tank.

Equipment Description and Specifications

The following tables display a complete parts list of the equipment used in the Grantham Waste Water Treatment Plant, including:

- the part number as displayed in Stornoway's Process and Instrumentation Diagrams (P&IDs)
- the power requirements and size of the equipment
- the electric power phase
- a description of the equipment
- where the equipment is located on Stornoway P&IDs
- the manufacturer of the equipment
- the model of the equipment
- the type of treatment process flow the equipment works with, for example, raw sewage.

Parts List

NOTE!

Refer to the Process & Instrumentation Drawings.

Tank	Description	Drawing #	Volume	Material	Liquid
Balance Tank	Screened sewage holding tank	P&ID-01	46 m^3	Polyethylene	Screened Influent
Anoxic Tank	Denitrification — very low dissolved oxygen	P&ID-01	36m^3	Polyethylene	Process Liquor
Aeration Tank	Nitrification — aerated liquor and high dissolved oxygen	P&ID-01	46m^3	Polyethylene	Process Liquor
Clarified Tank	Storage of clarified liquor, holding tank for tertiary treatment (filtration/UV)	P&ID-02	10m^3	Polyethylene	Process Liquor
Solids Digester Tank	Aerobic digestion — breaks down organic solids	P&ID-05	46m^3	Polyethylene	Activated Sludge
Final Effluent Tank	Stores final effluent	P&ID-04	46m^3	Polyethylene	Treated Effluent

Table 1 Tank Register

Motor Number	kW	Phase	Drive	Description	Drawing #	Manufacturer	Model	Liquid	Plant Location	Control Location
MX101	0.75	3	DOL	Anoxic Mixer	W536 - P001	GRUNDFOS	AMD.07.18.1410	Screened Influer	Anoxic Tank	STP MCC
M101	0.5	3	DOL	Screen Motor	W536 - P001			Raw Sewage	Screen	STP MCC
M201	0.14	3	DOL	Blower Fan 1	W536 - P002	ROBUSCHI		Air	Blower	STP MCC
M202	0.14	3	DOL	Blower Fan 2	W536 - P002	ROBUSCHI		Air	Blower	STP MCC

Pump Number	kW	Phase		Description	Drawing #	Manufacturer	Model	Liquid	Plant Location	Control Location
P101	0.75	3	VSD	Balance Pump 1	W536 - P001	GRUNDFOS	NBG 50-32-160/177	Screened Influer	Control Room	STP MCC
P102	0.75	3	VSD	Balance Pump 2	W536 - P001	GRUNDFOS	NBG 50-32-160/177	Screened Influer	Control Room	STP MCC
P103	0.55	3	VSD	a' Recycle Pump	W536 - P001	GRUNDFOS	NBG 50-32-160/172	Screened Influer	Control Room	STP MCC
P104	0.02	1	DOL	Sodium Aluminate Dosing Pump	W536 - P001	GRUNDFOS		NaAlO2	Chemical Room	STP MCC
P201	0.75	3	VSD	RAS Pump 1	W536 - P002	GRUNDFOS	NBG 50-32-160/177	Screened Influer	Control Room	STP MCC
P202	0.75	3	VSD	RAS Pump 2	W536 - P002	GRUNDFOS	NBG 50-32-160/177	Screened Influer	Control Room	STP MCC
P203	4	3	VSD	Aeration Blower 1	W536 - P002	ROBUSCHI	ES15/1P	Air	Outside control roo	STP MCC
P204	4	3	VSD	Aeration Blower 2	W536 - P002	ROBUSCHI	ES15/1P	Air	Outside control roo	STP MCC
P301	0.75	3	VSD	Crossflow Pump 1	W536 - P003	GRUNDFOS	NBG 50-32-160/177	Screened Influer	Control Room	STP MCC
P302	0.75	3	VSD	Crossflow Pump 2	W536 - P003	GRUNDFOS	NBG 50-32-160/177	Screened Influer	Control Room	STP MCC
P303	2.2	3	VSD	Backwash Pump	W536 - P003	GRUNDFOS	NBG 65-40-200/217	Final Effluent	Control Room	STP MCC
P401	1.5	3	DOL	Recirc Pump	W535 - P004	GRUNDFOS	NBG 50-32-160/172	Final Effluent	Control Room	STP MCC
P402	0.02	1	DOL	Chlorine Dosing Pump	W536 - P004	GRUNDFOS		NAOCl	Chemical Room	Via Conex Unit
P403	0.55	3	VSD	Reticultation Pump	W536 - P004	GRUNDFOS		Final Effluent		
P404	<4 kW	3	DOL	Discharge Pump 1	W536 - P004	GRUNDFOS		Final Effluent	Control Room	STP MCC
P405	<4 kW	3	DOL	Discharge Pump 2	W536 - P004	GRUNDFOS		Final Effluent	Control Room	STP MCC

Table 2 Motors and pumps register

Equipment Number	Size	Power Supply	Phase	Output	Application	Description	Drawing #	Manufacturer	Model	Liquid
FM101	3"	24v	DC	4-20mA	Inlet Flowmeter	Digital flow meter - Mag Flow	W536 - P001	Burkert	Series SO55 & SE56	Raw Sewage
FM102	1 1/2"	24v	DC	4-20mA	Balance Delivery Flowmeter	Digital flow meter - Insertion	W536 - P001	Burkert	Series 8045 & SO20	Screened Influent
WL101	1" BSP	24v	DC	4-20mA	Balance Tank Level Sensor	Diaphragm Pressure Sensor; 0-0.4 Bar	W536 - P001	Burkert	Series 8323	Screened Influent
DO101	24v	240v	1 ph	4-20mA	Aeration Tank Dissolved Oxygen	Dissolved Oxygen Sensor and Transmitter	W536 - P001	Endress & Hauser	Liquisys M COM253 & Oxymax W COS61	Screened Influent
WL102	1" BSP	24v	DC	4-20mA	Aeration Tank Level Sensor	Diaphragm Pressure Sensor; 0-0.4Bar	W536 - P001	Burkert	Series 8323	Screened Influent
FM103	3"	24v	DC	4-20mA	a' Recycle Flowmeter	Digital flow meter - Insertion	W536 - P001	Burkert	Series 8045 & SO20	Screened Influent
WL201	1" BSP	24v	DC	4-20mA	Clarified Tank Level Sensor	Diaphragm Pressure Sensor; 0-0.25Bar	W536 - P002	Burkert	Series 8323	Screened Influent
PT201	1/2"	24v	DC	4-20mA	Aeration Pressure Sensor	Diaphragm Pressure Sensor; 0-1 Bar	W536 - P002	Burkert	Series 8323	Air
FM301	2"	24v	DC	4-20mA	Filtration Flowmeter	Digital flow meter - Insertion	W536 - P003	Burkert	Series 8045 & SO20	Clarified Sewage
pH301	2"	24v	DC	4-20mA	Aeration pH	pH Transmitter	W536 - P003	Burkert	Series 8202	Clarified Sewage
PT301	1/2"	24v	DC	4-20mA	Pre-filter Pressure	Diaphragm Pressure Sensor; 0-4Bar	W536 - P003	Burkert	Series 8323	Clarified Sewage
PT302	1/2"	24v	DC	4-20mA	Post-filter Pressure	Diaphragm Pressure Sensor; 0-4Bar	W536 - P003	Burkert	Series 8323	Filtered Sewage
WL401	1"BSP	24v	DC	4-20mA	Final Effluent Tank Level Sensor	Diaphragm Pressure Sensor; 0-0.4Bar	W536 - P004	Burkert	Series 8323	Final Effluent
FM401	2"	24v	DC	4-20mA	Discharge Flowmeter	Digital flow meter - Insertion	W536 - P004	Burkert	Series 8045 & SO20	Final Effluent
UV401	N/A	240v	1 ph	Contact	UV disinfection system	UV Disinfection Unit	W536 - P004	UV Safewater	Upstream 10-50	Filtered Sewage
UV402	N/A	240v	1 ph	Contact	UV disinfection system	UV Disinfection Unit	W536 - P004	UV Safewater	Upstream 10-50	Filtered Sewage
CL401	N/A	240v	1 ph	4-20mA	Chlorine Residual Analyser	Chlorine Residual Monitor and Controller	W536 - P004	Grundfos	Conex 314	Final Effluent
pH401	N/A	240v	1 ph	4-20mA	pH probe	pH Transmitter	W536 - P004	Grundfos	Conex 314	Final Effluent
TP401	N/A	240v	1 ph	4-20mA	Temperature sensor	Temperature Transmitter	W536 - P004	Grundfos	Conex 314	Final Effluent
NTU401	N/A	240v	1 ph	4-20mA	Turbidity meter	NTU Sensor and Transmitter	W536 - P004	Endress & Hauser	Turnimax WCUS31	Final Effluent

Table 3 Instrumentation Register

Auomatic Valve List	SIZE	Voltage	Status	Description	Drawing #	Manufacturer	Model	Liquid
AV101	3"	24V AC/DC	N/O	Electronic Actuated Ball Valve	W536 - P001	AVFI		Mixed Liqour
AV102	2"	24V AC/DC	N/O	Electronic Actuated Ball Valve	W536 - P001	AVFI		Mixed Liqour
AV301	2"	24V AC/DC	N/O	Three way Electronic Actuated Ball Valve	W536 - P003	AVFI	OM-1	Clarified Sewage
AV302	2"	24V AC/DC	N/O	Three way Electronic Actuated Ball Valve	W536 - P003	AVFI	OM-1	Clarified Sewage
AV303	2"	24V AC/DC	N/O	Electronic Actuated Ball Valve	W536 - P003	AVFI	OM-1	Filtered Sewage
AV501	2"	24V DC	N/O	Brass Solenoid Valve	W536 - P005	AVFI	Series 5281	Air

Table 4 Automatic Valve Register

Valve List	SIZE		Status	Description	Drawing #	Manufacturer	Model	Liquid
V101	2"		N/O	Cast Iron Butterfly Valve	W536 - P001	Tony Powell		Screened Influent
V102	2"		N/O	uPVC True Union Ball Valve	W536 - P001	Georg Fischer		Air
V103	2"		N/O	Cast Iron Butterfly Valve	W536 - P001	Tony Powell		Screened Influent
V104	2"		N/O	uPVC True Union Ball Valve	W536 - P001	Georg Fischer		Screened Influent
V105	2"		N/O	uPVC True Union Ball Valve	W536 - P001	Georg Fischer		Screened Influent
V106	1¼"		N/O	uPVC True Union Ball Valve	W536 - P001	Georg Fischer		Screened Influent
V107	1¼"		N/O	uPVC True Union Ball Valve	W536 - P001	Georg Fischer		Screened Influent
V108	1¼"		N/O	Brass Swing Check Valve	W536 - P001	Tony Powell		Screened Influent
V109	1¼"		N/O	Brass Swing Check Valve	W536 - P001	Tony Powell		Screened Influent
V110	6"		N/O	Cast Iron Butterfly Valve	W536 - P001	Tony Powell		Mixed Liquor
V111	6"		N/O	Cast Iron Butterfly Valve	W536 - P001	Tony Powell		Mixed Liquor
V112	6"		N/O	Cast Iron Butterfly Valve	W536 - P001	Tony Powell		Mixed Liquor
V113	2"		N/O	Cast Iron Butterfly Valve	W536 - P001	Tony Powell		Mixed Liquor
V114	2"		N/O	Cast Iron Butterfly Valve	W536 - P001	Tony Powell		Mixed Liquor
V115	2"		N/O	uPVC True Union Ball Valve	W536 - P001	Georg Fischer		Mixed Liquor
V116	1¼"		N/O	uPVC True Union Ball Valve	W536 - P001	Georg Fischer		Mixed Liquor
V117	1¼"		N/O	Brass Swing Check Valve	W536 - P001	Tony Powell		Mixed Liquor
V118	2"		N/O	uPVC True Union Ball Valve	W536 - P001	Georg Fischer		Air
V119	2"		%	uPVC True Union Ball Valve	W536 - P001	Georg Fischer		Air
V120	2"		%	uPVC True Union Ball Valve	W536 - P001	Georg Fischer		Air
V121	2"		%	uPVC True Union Ball Valve	W536 - P001	Georg Fischer		Air
V122	2"		%	uPVC True Union Ball Valve	W536 - P001	Georg Fischer		Air
V123	4mm		%	Pressure Regulating Valve	W536 - P001	Grundfos		NaAlO2
V124	4mm		%	Pressure Relief Valve	W536 - P001	Grundfos		NaAlO2
V125	4mm		N/O	Internal PE Ball Check Valve	W536 - P001	Grundfos		NaAlO2
V126	1"		N/C	uPVC Glued Socket Ball Valve	W536 - P001	Georg Fischer		Screened Influent
V127	1"		N/C	uPVC Glued Socket Ball Valve	W536 - P001	Georg Fischer		Mixed Liquor
V128	1"		N/C	uPVC Glued Socket Ball Valve	W536 - P001	Georg Fischer		Mixed Liquor
V128	1"		N/C	uPVC Glued Socket Ball Valve	W536 - P001	Georg Fischer		
V201	3"		N/O	Cast Iron Butterfly Valve	W536 - P002	Tony Powell		Mixed Liquor
V202	3"		N/O	Cast Iron Butterfly Valve	W536 - P002	Tony Powell		Mixed Liquor
V203	3"		N/O	Cast Iron Butterfly Valve	W536 - P002	Tony Powell		Mixed Liquor
V204	3"		N/O	Cast Iron Butterfly Valve	W536 - P002	Tony Powell		Mixed Liquor
Valve List	SIZE		Status	Description	Drawing #	Manufacturer	Model	Liquid

V205	3"		N/O	Cast Iron Butterfly Valve	W536 - P002	Tony Powell		Mixed Liquor
V206	2"		N/O	uPVC True Union Ball Valve	W536 - P002	Georg Fischer		Mixed Liquor
V207	2"		N/O	uPVC True Union Ball Valve	W536 - P002	Georg Fischer		Mixed Liquor
V208	1¼"		N/O	uPVC True Union Ball Valve	W536 - P002	Georg Fischer		Mixed Liquor
V208	1¼"		N/O	uPVC True Union Ball Valve	W536 - P002	Georg Fischer		Mixed Liquor
V210	1¼"		N/O	Brass Swing Check Valve	W536 - P002	Tony Powell		Mixed Liquor
V211	1¼"		N/O	Brass Swing Check Valve	W536 - P002	Tony Powell		Mixed Liquor
V212	1/4"		%	SS Quarter Turn Ball Valve	W536 - P002	Tony Powell		Air
V213	2"		N/O	Cast Iron Butterfly Valve	W536 - P002	Tony Powell		Clarified Influent
V214	2"		N/O	Cast Iron Butterfly Valve	W536 - P002	Tony Powell		
V215	3"		N/O	Brass Swing Check Valve	W536 - P002	Tony Powell		Air
V216	3"		N/O	Brass Swing Check Valve	W536 - P002	Tony Powell		Air
V217	3"		N/O	Brass Gate Valve	W536 - P002	Tony Powell		Air
V218	3"		N/O	Brass Gate Valve	W536 - P002	Tony Powell		Air
V219	1"		N/C	uPVC Glued Socket Ball Valve	W536 - P002	Georg Fischer		Mixed Liquor
V220	1"		N/C	uPVC Glued Socket Ball Valve	W536 - P002	Georg Fischer		Mixed Liquor
V301	2"		N/O	uPVC True Union Ball Valve	W536 - P003	Georg Fischer		Clarified Influent
V302	2"		N/O	uPVC True Union Ball Valve	W536 - P003	Georg Fischer		Clarified Influent
V303	2"		N/O	uPVC True Union Ball Valve	W536 - P003	Georg Fischer		Clarified Influent
V304	2"		N/O	uPVC True Union Ball Valve	W536 - P003	Georg Fischer		Clarified Influent
V305	2"		N/O	Brass Swing Check Valve	W536 - P003	Tony Powell		Clarified Influent
V306	2"		N/O	Brass Swing Check Valve	W536 - P003	Tony Powell		Clarified Influent
V307	2"		N/C	PVC Air Release Valve	W536 - P003	Georg Fischer		Clarified Influent
V308	2"		N/O	uPVC True Union Ball Valve	W536 - P003	Georg Fischer		Filtered Influent
V309	2"		N/O	uPVC True Union Ball Valve	W536 - P003	Georg Fischer		Filtered Influent
V310	2"		N/O	uPVC True Union Ball Valve	W536 - P003	Georg Fischer		Final Effluent
V311	2"		N/O	uPVC True Union Ball Valve	W536 - P003	Georg Fischer		Final Effluent
V312	2"		N/O	Brass Swing Check Valve	W536 - P003	Tony Powell		Final Effluent
V313	1"		N/C	uPVC Glued Socket Ball Valve	W536 - P003	Georg Fischer		Mixed Liquor
V401	2"		N/C	uPVC Glued Socket Ball Valve	W536 - P004	Georg Fischer		Filtered Influent
V402	1"		N/O	uPVC Glued Socket Ball Valve	W536 - P004	Georg Fischer		Filtered Influent
V403	1"		N/O	uPVC Glued Socket Ball Valve	W536 - P004	Georg Fischer		Filtered Influent
V404	1"		N/O	uPVC Glued Socket Ball Valve	W536 - P004	Georg Fischer		Final Effluent
V405	1"		N/O	uPVC Glued Socket Ball Valve	W536 - P004	Georg Fischer		Final Effluent
V406	1"		N/C	uPVC Glued Socket Ball Valve	W536 - P004	Georg Fischer		Final Effluent
V407	1"		N/C	uPVC Glued Socket Ball Valve	W536 - P004	Georg Fischer		Final Effluent
V408	2"		N/C	PVC Air Release Valve	W536 - P004	Georg Fischer		Filtered Influent
V409	4mm		N/O	Internal PE Ball Check Valve	W536 - P004	Grundfos		NaOCl
V410	2"		N/O	Cast Iron Butterfly Valve	W536 - P004	Tony Powell		Final Effluent
V411	2"		N/O	uPVC True Union Ball Valve	W536 - P004	Georg Fischer		Final Effluent
V412	2"		N/O	uPVC True Union Ball Valve	W536 - P004	Georg Fischer		Final Effluent
V413	2"		N/O	Brass Swing Check Valve	W536 - P004	Tony Powell		Final Effluent
V414	6"		N/O	Cast Iron Butterfly Valve	W536 - P004	Tony Powell		Final Effluent
V415	2"		N/O	uPVC True Union Ball Valve	W536 - P004	Georg Fischer		Final Effluent
V416	1¼"		N/O	uPVC True Union Ball Valve	W536 - P004	Georg Fischer		Final Effluent
V417	1"		N/O	uPVC True Union Ball Valve	W536 - P004	Georg Fischer		Final Effluent
V418	1"		N/O	Brass Swing Check Valve	W536 - P004	Tony Powell		Final Effluent
V419	63mm		N/O	uPVC True Union Ball Valve	W536 - P004	Georg Fischer		Final Effluent
V420	63mm		N/O	uPVC True Union Ball Valve	W536 - P004	Georg Fischer		Final Effluent
V421	63mm		N/O	uPVC True Union Ball Valve	W536 - P004	Georg Fischer		Final Effluent
V422	63mm		N/O	uPVC True Union Ball Valve	W536 - P004	Georg Fischer		Final Effluent
V423	63mm		N/O	Brass Swing Check Valve	W536 - P004	Tony Powell		Final Effluent
V424	63mm		N/O	Brass Swing Check Valve	W536 - P004	Tony Powell		Final Effluent
V501	2"		%	Brass Gate Valve	W536 - P005	Tony Powell		Air
V502	2"		%	uPVC Glued Socket Ball Valve	W536 - P005	Georg Fischer		Air
V503	3"		N/O	Cast Iron Butterfly Valve	W536 - P005	Tony Powell		Mixed Liquor
V504	1"		N/C	uPVC Glued Socket Ball Valve	W536 – P005	Georg Fischer		Mixed Liquor

Table 5 Valve Register

Updates issued 12/12/2013. Manual supplied as well as corrections issued were PDF format only. Proper updated manual or Word versions to enable in-house updating were not supplied. Updated pages/inserts appended following this page.

INSTALLATION & OPERATING INSTRUCTIONS FOR
INFRALIGHT ULTRA V
ULTRAVIOLET DISINFECTION SYSTEM

OPERATING PRESSURE

Maximum operating pressure for stainless steel UV chambers is 850kPa (125 psi). If this pressure can be exceeded or if operating close to this pressure fit a suitable pressure-limiting valve in the supply to the UV chamber

WARNING:

The UV Chamber operates under pressure. Under no circumstances should the UV Chamber be disassembled unless the internal pressure of the unit has been relieved. Failure to observe this warning will expose persons to the possibility of personal injury and may result in damage to the UV system or other property.

DO NOT LOOK AT UV LAMP WHILE UV LAMP IS OPERATING

DO NOT DISASSEMBLE ANY COMPONENTS UNTIL YOU HAVE FULLY READ THESE INSTRUCTIONS!

This unit is designed to operate between 5C and 75C

Switch off UV system before removing covers. If working within line of sight of UV light, ensure that a suitable full-face plastic facemask is worn.

SKIN

It is recommended that exposed skin is covered to prevent sunburn, possibly severe, if working within line of sight of operating UV system. Note: exposure to UV light results in symptoms that develop slowly, the exposure cannot be felt at the time.

WARNING: ULTRAVIOLET LIGHT IS HARMFUL TO SKIN AND EYES

SYMPTOMS

EYES: Mild exposure - irritation developing several hours later.
Severe exposure - sore, red eyes, sensitive to light, painful to keep eyes open.
SKIN: Mild exposure - slight reddening, tenderness, mild sunburn symptoms.
Severe exposure - skin sloughing (peeling), weeping area, sever sunburn symptoms.

FIRST AID

EYES: In mild cases, if in doubt seek medical attention.
Severe cases cover eyes with gauze or clean cloth, seek medical attention.
SKIN: In mild cases removal from exposure may be sufficient. If in doubt seek medical attention.
In severe cases, cover affected area loosely with a clean bandage or cloth. Seek medical attention. Do not apply fat, butter or oil to skin.

The above notes are intended to highlight the dangers of exposure to UV radiation. With sensible precautions any hazard can be eliminated. Germicidal UV cannot pass through clothing or other opaque materials or clear materials such as plastics or even window glass.

During service DO NOT use lubricants or sealants of any type on the o-rings. Keep the inside of the quartz sleeve dry and clean

WARNING - Do not use hydrocarbon based or hydrocarbon propelled sprays around the electrical components of this unit

After Sales Service

For professional after sales service or repair, contact Infralight (02) 4294 2779

ULTRA V DISINFECTION UNIT

Congratulations on your purchase of a high quality, Ultraviolet water treatment system from Infralight Pty Ltd. All components have been designed and manufactured to give trouble free, reliable operation.

Your new Infralight UV system incorporates a lamp failure system design feature that enables you to be warned of a lamp failure by:

1. A pilot light for lamp on/off
2. Remote alarm contacts, voltage free

Before installing your new Infralight UV system, please read all instructions carefully, as failures caused by incorrect installation or operation are not covered by the guarantee. Your Ultraviolet water treatment system is designed to handle clean water. The system should not be used for any other purpose without specific referral to Infralight. The use of the system with flammable, corrosive and other materials of a hazardous nature is specifically excluded.

Preparing Your Unit

On removing your Infralight UV system from its carton you should check all components, especially the lamp, to ensure all are present and have not been damaged in transportation.

You should have:

1. Power supply control box with indicator lights and electrical flex and mounit brackets.
2. UV lamps
3. Quartz Sleeves
4. O-rings.
1. Treatment chamber with mounting brackets

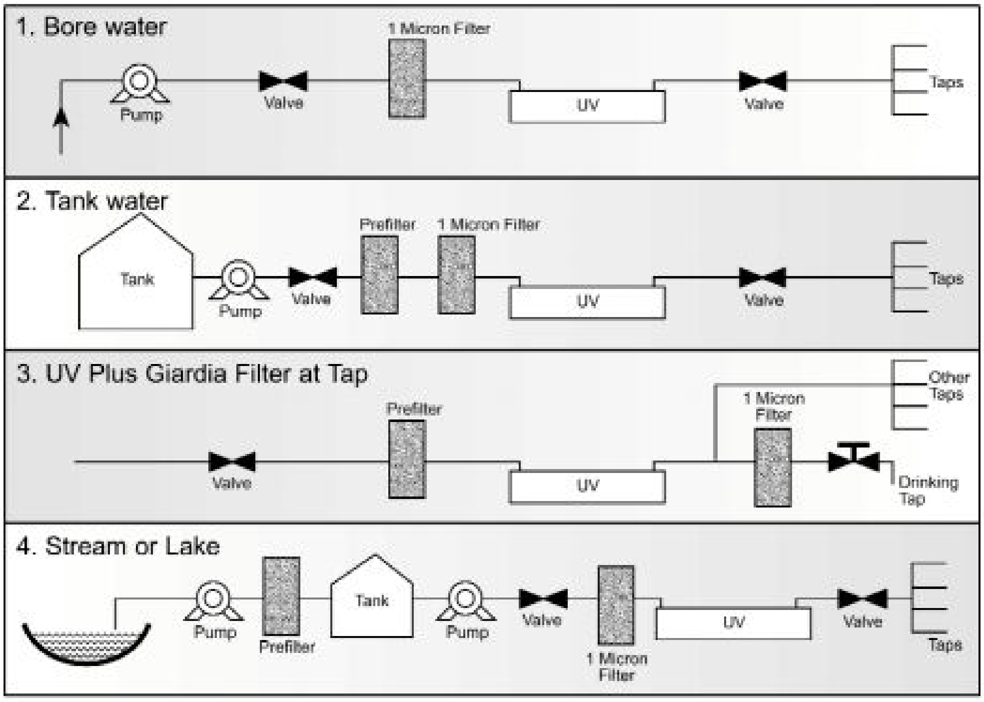
Choosing a Site

Choose a site with a firm mounting position. Allow room for removal of the lamp and sleeve during servicing. Leave chamber lengths space at the lamp connector end for lamp removal, with 100mm free at the other end for access to the end nut. The 'open' end nut and the blank end nut are interchangeable, so lamp removal can be from either end.

Housing Your Infralight UV System

To protect your Infralight UV system® from the weather, make sure the site is both waterproof, frost-free and has adequate ventilation. The unit should be either horizontally mounted with the inlet and outlet facing upwards or vertically mounted with the inlet at the bottom. Allow for drainage, to avoid damage to flooring etc., that over time may occur from leaking pipe joints or seals.

WARNING: Some insects, such as small ants, find electrical devices attractive for various reasons. If your site or enclosure is susceptible to insect infestation you should implement a suitable pest control plan

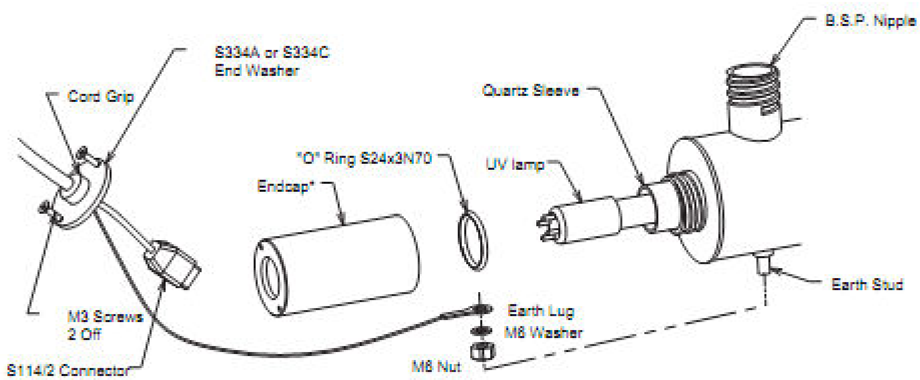


Power Connection

WARNING: When servicing or attending your Infralight UV system always ensure power is switched off and lead unplugged. Only qualified persons should service electrical connections. If the electrical supply lead of this system is damaged, it must be replaced

Electrical Power Surge Protection

If the installation is subject to electrical power surges or lightning, we strongly recommend the use of suitable additional surge protection devices on ALL electrical equipment.
Connect lead to power supply designated on control box label. Do not use long extension leads as they cause substantial voltage drop and/or poor lamp performance. Earth stainless steel chambers where possible.



Open Endcap and Lamp Details

Install the power supply enclosure **above** the treatment chamber so that in the event of a leak, water cannot drip down the lamp lead into the enclosure.

CAUTION: The supply cord is necessary for lamp changing. The three pin supply plug must remain accessible after installation. If installed to fixed wiring without the plug a two pole switch must be fitted and its ON and OFF positions shall be marked. An electrical power surge or spike can travel on the supply lines and cause serious damage to your electrical equipment. The Infralight UV control box has a 6 AMP circuit breaker to protect the circuit. The circuit breaker is not a lightning arrestor and may not protect the system if lightning or a very powerful surge hits the unit. If the installation is subject to electrical power surges or lightening, we strongly recommend the use of suitable additional surge protection devices on **ALL** electrical equipment.

A RCD breaker is highly recommended on the power supply

Pipe Connections

For best performance use copper, stainless steel, galvanised or polythene pipes at least the same diameter as the inlet and outlet connections. Never use PVC pipe directly connected to unit. PVC pipe and fittings can be used after 90^{o} bends of a suitable material are connected to the inlet and outlet of the chamber. Larger diameter pipe may be used to minimise resistance to flow, but maximum flow rates should not be exceeded, as correct water treatment cannot be assured at higher flows. If flows may exceed the design maximum, install a flow restriction device

Do not use pipe thread sealing compounds (especially hemp) on any part of this unit. ONLY use Teflon sealing tape.

Use unions at pipe connections to enable easy removal and servicing. Use sufficient tape to ensure airtight seal and do not over tighten. To prevent strain on unit threads always support heavy inlet and outlet pipes. If there is a likelihood the water supply may contain sediment or solid particles such as pieces of plant or vegetable matter, a filter should be installed before the UV system.

Pre-Treatment (drinking water)

Prefiltration is usually required to ensure that particulate matter does not shield microorganisms from the UV light. Sand filtration or 20 micron cartridge filtration
is the usual minimum. In some cases, particularly with surface water, finer filtration may be necessary, or if cysts like Giardia or Cryptosporidium may be present. In this case 1-micron filtration is required, not necessarily for the whole supply, filtration for the drinking tap only may be practical.

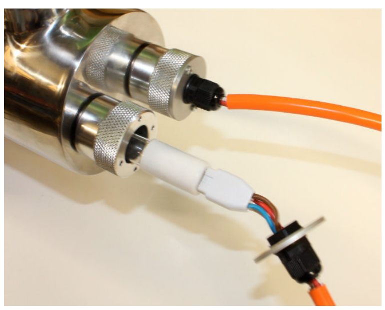
Lamp Installation

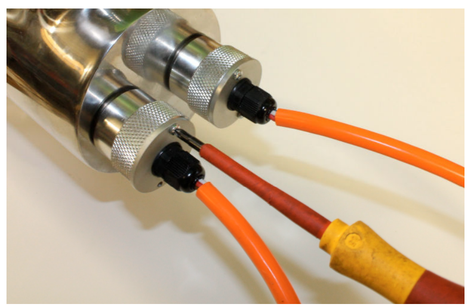
Once the Treatment Chamber has been connected to the pipework, the installation should be checked for water leaks.

If the chamber test is successful, it is now time to insert the UV lamp. **DO NOT INSERT THREE PIN POWER PLUG TO POWER OUTLET YET!**

Expose the connection end of the lamp from its transport tube and protective wrapping. The lamp connection socket is "keyed" to ensure correct alignment. Carefully remove the tube fully from its transport tube, touching the lamp as little as possible. Handle the lamp by the ends where possible. Wipe with clean cloth and methylated spirits if fingerprints or dirt need removing.

Slide the lamp into the chamber, fit lamp connection socket and then fasten the end washer into the endcap, with the screws provided.





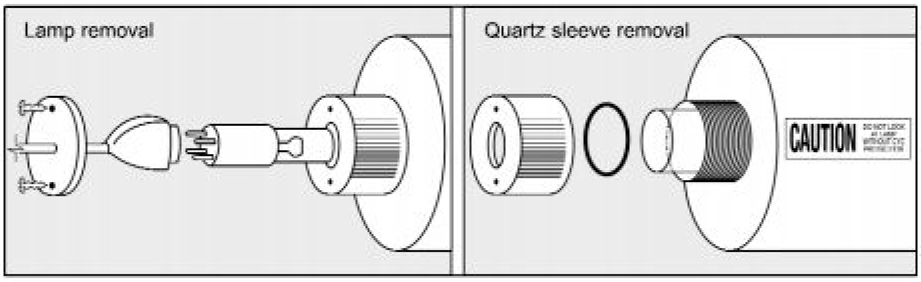
Operation

Once all leak testing and lamp fitment has been completed, open valves and allow water to fill the chamber. Connect three-pin plug to outlet and switch on. The pilot lights for each lamp will be illuminated.

Allow two minutes for the UV lamp to reach full intensity before starting water flow. Full lamp performance for a new installation will be achieved in 24 hours. On a new installation where no other form of sterilisation has been in constant usage we recommend chemically dosing your rainwater tank for the first month. Alternatively you can use a Chlorine flush of the plumbing downstream of the UV system. Use a 20mg per litre dose and leave the chlorine dose in the plumbing at least for an hour, and preferably overnight.

Abrasive Materials - The passage of abrasive materials will cause damage to the UV system and affect the integrity of the water treatment which will then not be covered by the guarantee.

Maintenance



Lamp changing (every year of operation):

1. Shut valve(s) so that water cannot flow through steriliser.
2. Switch off steriliser by unplugging mains.
3. Unplug lamp connector.
4. Remove lamp.

Reverse procedure when replacing lamp, ensuring that lamp is centrally located in the chamber. Handle only by the ends.

Quartz Sleeve Cleaning (three monthly):

If dirt is allowed to build up on the quartz sleeve it will impair the UV output. The quartz sleeve should be removed after one month and inspected for deposits. Clean with methylated spirits (5% hydrochloric acid or phosphoric acid if heavily fouled) and carefully dry. Handle the sleeve with tissue to keep it clean. The sleeve should be cleaned every three months or as required.

CAUTION: Handling lamp and quartz sleeve. Keep the quartz components free of finger marks to avoid loss of output through dirt or grease shadows - handle the lamps by their ends where possible. Wipe lamp and sleeve with clean cloth or tissue if needed. The o-rings should be replaced annually or if damaged – do not grease the o-rings

Quartz Sleeve Removal

1. Remove lamp as described.
2. Remove drain port cap and empty water from chamber.
2. Undo nut at one end of the chamber and remove o-ring, repeat with nut at other end and remove oring, withdraw sleeve carefully
3. Inspect o-rings for damage, replace annually

NOTE: When withdrawing sleeve take care not to let the end drop into the chamber as it could break - a clean dowel inserted right through the sleeve to support it is useful.

Reverse procedure when replacing sleeve.

When replacing quartz sleeve after cleaning, the sleeve should stick out about 1cm at each end. Place o-ring over closed nut end and fit closed nut, fastening it hand tight. Hold the other end of the sleeve in position during the tightening with the other hand, then fit open end o-ring and cap.

A tiny amount of silicon spray or CRC in the end of aluminium endcap threads will aid easy tightening. Do not use excessive force when tightening nuts. Do not re-use quartz sleeve if damaged.

Water Quality

Where the water being pumped contains unusually high levels of dissolved solids (hard water), iron, manganese or biological organisms, a deposit build up on the quartz sleeve may occur over time. This will compromise the effectiveness of the UV system and the sleeve should be cleaned as required to maintain it in a clean condition. Discoloured water will reduce the effectiveness of the UV system and filtration should be installed.

UV Lamp Failure

The UV2500 is available with either , red pilot lights, lamp failure alarm or voltage free alarm contacts. In the event of a lamp failure, the green lamp pilot light will be off, the red pilot light will be on, or the corresponding contact will be in the closed position. If the pilot light has failed but the UV lamp is still operating, open the enclosure door. The ballast will show either a green or red light on the ballast to indicate lamp failure.

Trouble Shooting

The basic electrical circuit is like a fluorescent light. Electronic ballast provides the correct voltage and current for the lamps.

a) UV LAMP OUT, NO pilot "ON" LIGHT,

1. No mains voltage.
2. Internal circuit breaker failed
3. Check mains power connections inside power supply

.

b) UV LAMP FLICKERING, Light off, contacts closed

1. Failed lamp.
2. Incorrect lamp or ballast fitted.

c) UV LAMP OUT, ALARM CONTACTS CLOSED

1. Lamp failed.
2. Poor connection to lamp (check/clean connector/lamp pins).
3. Ballast failed. Check LED on Ballast. No LEDs active and 240VAC is on, Ballast has failed.

e) LAMP OUT, ALARM CONTACTS OPEN

4. Loose connection, faulty ballast or possibly faulty lamp

Care should also be taken when servicing or disassembling the unit and associated pipework to avoid possible injury from pressurised water. Unplug power, relieve pressure by opening a tap on the discharge side of the unit and allow any water in the unit to cool before attempting to dismantle

PARTS LIST	QUANTITY	INFRALIGHT PART NUMBER
UV lamp	2	GPH843T5L/4P 80W 4 Pin or GIA843T5L/4P
Quartz Sleeve	2	Q2320/890, 890x23x20
O-ring	2	O2320
UV Chamber	1	UV2500/SS
Viewing Port	1	UV117
Drain Plug	1	UV118
4 Pin Plug and Cable	2	UV114, 4 Pin and Cable, 1.5m, 4 Core. 1mm2
Endcap Al Open	2	UV139, Aluminium
Endcap AL Closed	2	UV140, Aluminium
Ballast	2	RH7-900-75, 80W at 0.8amps
Main Switch	1	AESS2, 2 Pole
Pilot Light	2	SEL22LED240
Circuit Breaker	1	C6 Hager, 6 Amp
Enclosure	1	TEAG2939

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UV PURE

UPSTREAM™

ULTRAVIOLET WATER PURIFICATION SYSTEMS

INSTRUCTION MANUAL

MODEL:
VOLTAGE:
SERIAL #:

CROSS FIRE TECHNOLOGY

C ETL US INTERTEK LISTED

INSTRUCTION MANUAL

Publication Number: R800001E1
Fifth Edition, June 2007

NOTICE

THANK YOU

By purchasing the Upstream UV system with Crossfire Technology, you can now be certain that microbiologically safe drinking water is provided to every tap in the house.

The Upstream outperforms conventional systems by delivering highly effective UV dosage rates for the inactivation of pathogens, including:

- viruses
- bacteria
- cryptosporidium
- giardia
- legionella
- E. coli
- Total coliforms

The Upstream units are laboratory tested to achieve a minimum dose of $40 mJ/cm^2$.

Please read the complete instruction manual before installing or operating the Upstream. Retain these instructions and the purchase receipt for the unit.

IMPORTANT
Fill out and send in the product warranty registration card.

1. About the Upstream

The Upstream and the Hallett systems, manufactured by UV Pure Technologies, are the world's only ultraviolet water purification device with patented Crossfire Technology.

US Patent 6,707,048
Patent Pending in Canada, Australasia, Mexico, Japan, UK, Europe, & Eurasia

UV Pure's Upstream UV systems employ revolutionary Crossfire Technology that is self-cleaning, self-monitoring, and fail-safe. The Upstream™ system design with Crossfire Technology™ eliminates the potential risks associated with conventional single lamp UV systems to provide Pure Safe Water. Always.™

Committed to exceeding drinking water purification standards, UV Pure has turned conventional technology inside-out by running the water inside the quartz sleeve and including two lamps mounted in air, dual smart sensors, elliptical reflectors and an optional fail-safe solenoid valve.

Crossfire Technology is complete UV disinfection: Crossfire Technology incorporates *two* proprietary high-output UV lamps, with elliptical reflectors, that target pathogens with radiation from 360º, to deactivate pathogens and provide microbiologically safe drinking water.

Crossfire Technology is risk-free and fail-safe: Crossfire Technology uses dual smart UV sensors mounted in air, which cannot foul and are more reliable indicators of system performance than ordinary systems. The lamps are fan-cooled and maintain consistent levels of UV output for maximum pathogen deactivation. Computerized alarms, and an optional auto shut-off fail-safe valve are on board so you know only safe water can enter your water system.

Crossfire Technology is self-cleaning: Crossfire Technology uses a stainless steel wiper to clean the inside of the quartz sleeve eliminating quartz fouling and the need for a water softener making abrasive quartz cleaning a thing of the past – saving money and the environment.

Crossfire Technology is virtually maintenance-free: Crossfire technology utilizes two lamps mounted in air, outside the quartz sleeve so maintaining an Upstream is as easy as changing a light bulb with no system draining required. The UV lamps require replacement after 12 months of operation and notification of lamp replacement is given via a warning one month in advance.

Crossfire Technology is easy to install: Crossfire technology employs flexible stainless steel hoses with Female Iron Pipe (FIP) connections for quick and simple installation.

The Upstream has a smart display: The operator interface allows for unprecedented access to information such as lamp lifetime, message history and UV intensity display.

The Upstream can show remote status: Be alerted to any change in system status immediately in any room with the optional Remote Monitor. The monitor is a handheld wireless device can be placed in a convenient location to provide operational information about the Upstream.

The Upstream has a built-in purge valve: The purge valve eliminates the need to shutdown the unit in the event of no water flow for days (as long as water supply is present). It is designed to prevent build up metals and minerals on internal components. The purge valve also eliminates nuisance alarms from changing water transmittance conditions.

The Upstream offers remote start up: The Upstream can be started or stopped via external device.

2. Installation Instructions

Before Beginning Installation

Water Conditions - Pre-treatment Parameters

Note this section is designed to ensure the optimal performance of your Upstream system. Please review the following pre-treatment parameters prior to installation.
If any specifications are of concern or unclear please contact your water treatment dealer or specialist. Note some of the information below is technical in nature and you may want to contact your water treatment specialist to review the parameters.

IMPORTANT - Should any of the following water parameters exceed the recommended limits; the system will not be serviceable under warranty.

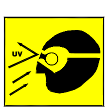
Water Parameters for Treating Drinking Water:
The minimum water requirements for operating the Upstream system are:

- **UV Transmittance** – see Product Specification Table. It is recommended for the water to be tested for UV transmittance in any applications using cisterns, surface water or ground water under the influence of surface water.
- **Total Dissolved solids (TDS)** - must be less than or equal to 1000 mg/L (mg/L=ppm)
- **Level of turbidity** - or cloudiness - of less than or equal to 1 NTU (nephelometric turbidity unit). A 5 micron sediment filter is recommended before the unit to reduce turbidity (the presence of a filter will also simplify disinfection of plumbing – see Disinfecting the Plumbing). For surface waters, a dual gradient pre-filter (75x25 or 50x5) is recommended. For temperature and pressure ranges and other specifications, please see Product Specification Table.

The Upstream units include a flow regulating device that will limit the flow rate. **Warning:** Removal of this device may allow the water flow to exceed the validated performance of the system which therefore may not provide the necessary UV dose to inactivate all pathogens.

Safety Information

WARNING: Potential Shock Hazard
Use only a grounded electrical outlet when connecting the unit to a power source. If you do not know whether the outlet is grounded, check with a qualified electrician. Do not plug in unit if water is present on the unit.



WARNING: Ultraviolet Light Hazard
The lamps in the unit emit ultraviolet (UV) light that can cause permanent damage to the skin & eyes. **Never look at the lamp when it is operating.** Do not plug the unit in unless it is properly secured to a wall (see Installation Instructions) and the front panel and ballast enclosure door are secure. Do not open the front panel or perform any service unless the unit has been unplugged. Never look into the unit or place any exposed skin into the illuminated areas when it is operating. Do not operate a unit that has been damaged or missing any components or safety devices.

Note that service to the unit does not require the removal of the side aluminum panels or aluminum endplates and they must remain assembled. The Upstream unit is not intended for use by young children or infirm persons without supervision. Young children should be supervised to ensure that they do not play with the Upstream unit.

Product Specifications Table

Models	NC10-75	NC10-50	NC15-75	NC15-50	†NC30-75, 1"	††NC30-75, 1.5"
Water Capacity	10 USgpm 38 L/min 2.3 m^3/hr	10 USgpm 38 L/min 2.3 m^3/hr	15 Usgpm 57 L/min 3.4 m^3/hr	15 Usgpm 57 L/min 3.4 m^3/hr	28.5 Usgpm 108 L/min 6.47 m^3/hr	28.5 USgpm 108 L/min 6.47 m^3/hr
min. UV Transmittance	75%	50%	75%	50%	75%	75%
Operating Pressure[1]	0-100 psig 0-690 kPa	0-100 psig 0-690 kPa	0-100 psig 0-690 kPa	0-100 psig 0-690 kPa	0-100 psig 0-690 kPa	0-100 psig 0-690 kPa
Water Temperature range	34-104° F 1-40° C	34-104° F 1-40° C	34-104° F 1-40° C	34-104° F 1-40° C	34-104° F 1-40° C	34-104° F 1-40° C
Air Temperature range	34-104° F 1-40° C	34-104° F 1-40° C	34-104° F 1-40° C	34-104° F 1-40° C	34-104° F 1-40° C	34-104° F 1-40° C
Voltage[2]	115Vac	115Vac	115Vac	115Vac	115Vac	115Vac
Power Consumption	135W	175W	175W	200W	200W	200W
Dry Contact	Yes	Yes	Yes	Yes	Yes	Yes
Remote Monitor	Optional	Optional	Optional	Optional	Optional	Optional
Remote Start/Stop	Yes	Yes	Yes	Yes	Yes	Yes
Flow Restrictor	Yes	Yes	Yes	Yes	Yes	No
Pressure Drop at 75% rated capacity	7 psig (48 kPa)	7 psig (48 kPa)	7 psig (48 kPa)	7 psig (48 kPa)	7 psig (48 kPa)	2 psig (13 kPa)
Inlet & Outlet Port size	1" MNPT	1" MNPT	1" MNPT	1" MNPT	1" MNPT	1.5" MNPT
Dimensions (L x W x D)	32"x7.5"x9.3" (813x190x 236mm)	35.8"x7.5"x9.3" (908x190x 236mm)	35.8"x7.5"x9.3" (908x190x 236mm)	39.8"x7.5"x9.3" (1010x190x 236mm)	39.8"x7.5"x9.3" (1010x190x 236mm)	39.8"x7.5"x9.3" (1010x190x 236mm)

¹ The optional shutoff valve requires min. 10psig to operate.
² 100-240Vac versions available with same operating specifications.

†The Upstream™ model NC 30-75 with 1" manifolds achieves a dose of 40 mJ per cm2 at a maximum restricted flow rate of 28.5 US GPM.

††The Upstream™ model NC 30 with 1 ½" manifolds achieves a dose of 40 mJ per cm2 at a maximum unrestricted flow rate of 28.5 US GPM. There is no flow restrictor installed as standard on this model of Upstream, therefore, a flow rate below 28.5 GPM will result in a dose greater than 40 mJ per cm2, and conversely, a flow rate greater than 28.5 US GPM will result in a lower dose. This model is designed to allow for low pressure drop applications and can be programmed to achieve target deactivation levels in a broad range of applications and pre-treatment water quality, in combination with external flow restriction.

Parts Included

- Upstream UV system complete with integral wall brackets (1)
- Remote Monitor, 9V battery included (1) (in bundled systems only)
- Instruction manual (1)
- Product & warranty registration card (1)
- Power cord (1) (located within packaging)
- Stainless flexible hoses (2) per system (hoses located within packaging)
- Ultraviolet lamps (2) – installed within the unit
- External dry contact for remote monitoring or optional autodialer.
- 20' of Flexible hose for connection of purge valve to drain

Optional - Pre-treatment sediment and or carbon filter to remove water particles, odor or trace chemicals for improved taste.
Automatic shutoff solenoid valve.

Other Materials Needed

The Upstream requires four # 12 to 1/4" diameter fasteners (not provided) to mount to a wall.
It also requires male NPT fittings for the hose connections and also for the optional solenoid valve (1"or 1.5"). The Upstream unit requires a drain for purge valve discharge line. These fittings, pipe insulation, and any piping compatible with the plumbing should be on hand before you begin installation. See Figure 1B and make a list of all necessary components including solder, paste and thread sealant. Bypass piping and valves that isolate the unit are optional, (but recommended) as is a drain valve for draining the unit.

Pipe insulation is to be wrapped around the top hose and any other piping overhead to prevent condensation from dripping back onto the unit.

Note: Teflon tape and thread sealant are not required to connect the Stainless flexible hoses to the Upstream or to the plumbing system – the FIP connectors mate with male NPT (National Pipe-Taper) fittings. The rubber washer in each end of the hose provides the seal. Ensure that the washer is in place before making the connection.

Tools Needed

- pipe cutter, torch and other typical plumbing tools for modifying piping
- Wrench for tightening hose connections
- Phillips screwdriver
- Slotted screwdriver

Do not operate a unit that has been damaged or that is missing any components. If a part is missing from your Upstream, contact your dealer.

The installation of the Upstream (see Figures 1A through 1E) should be done in compliance with all applicable federal, state/provincial, and local regulations. We recommend that the unit be installed by a qualified service technician. Failure to install the system properly may result in property damage (leaks/flooding) or personal injury (electrical shock) and will void warranty.

The Upstream is intended only for indoor use in a dry location. Should these minimum installation recommendations not be met, the system will not operate effectively.

Location (on a wall)

The unit must be positioned vertically on a wall **(the performance of the system will be adversely affected if mounted horizontally)** See Figure 1A for clearances.

The Upstream should be installed downstream of (after) any pre-treatment devices such as filters, water softeners etc and also any pressure tanks. However, it must be installed **upstream of (before) any branches** in the piping so that **all** the water is disinfected before splitting and distributing throughout the home or facility. If the plumbing system has a grounding lug or strap, this should also be upstream from the unit, optional shutoff valve or filters. If grounding of the Upstream or plumbing system is in question, please consult your local electrical inspector.

Time Required

Please note that full installation of the Upstream requires shutting off the main water supply for a number of hours. If disinfection is necessary, all pipes must be treated and flushed. Once the unit is plugged in, the new UV lamps may take from a few moments to several hours to reach full power. Having a Lamp Alarm is normal with a new system (or with newly installed lamps) until the lamps have reached full power.

Summary of Installation:
Unpack and install Upstream on wall
Install top & bottom hose to unit and to plumbing
Install optional Shutoff solenoid valve
Install optional bypass & drain plumbing
Install purge valve discharge line to a suitable drain line

Assembling the Unit

Step 1: Unpack the unit, being careful to remove all packaging material. Inspect the unit for damage particularly the quartz sleeve – See Figure 4A for disassembly. **Ensure back reflector is completely down** – sometimes movement in shipping cause the back reflector to slide up. Push down on it until it rests on the bottom plate of the unit.

Step 2: The Upstream has four keyhole slots for convenient mounting – all four should be used. **The unit should be secured vertically to a solid wall large enough to cover the complete backside of the unit – See Figure 1E. Do not** install the unit horizontally. Remove the top and bottom covers of the unit to make the mounting holes accessible.

Step 3: Connect the Stainless flexible hoses to both the top and bottom of the Upstream. Make sure that the sealing washer is inside the hose end before making the connection. Tighten securely. Wrap the top hose with pipe insulation. (Not provided)

Connecting the Pipes

We recommend that a qualified plumber or certified technician perform the water connections for your Upstream. **Water must flow into the inlet at the bottom of the unit. The outlet is located at the top of the unit.** Install the optional shutoff valve before the unit.

Step 1: Shut off the water supply. **Caution:** Always turn off the water supply before modifying or disconnecting any piping. Always open a faucet after shutting off the water supply to relieve water pressure and ensure that the water has been completely shut off.

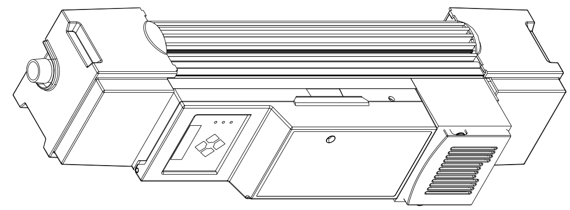
Step 2: If you have decided to install an optional bypass line and drain, you may begin to install these fittings at this point. See Figure 1B or 1C for more information on how to connect optional bypass piping and drain.

Step 3: Connect the optional solenoid valve to the plumbing just upstream (before) the unit. Note the solenoid valve ensures that should the system fail, due to power loss, color in the water or low UV lamp output, the system will fail in safe mode and shut down the flow of water to your tap.

The direction of flow through the valve is important – **verify flow direction with label on the valve**. **Caution: over tightening a metal fitting into the valve will cause it to crack. Do not over tighten.** Keep the coil of the valve pointing upward (to prevent water from dripping on it). Water will not flow backwards through the valve. See Figure 1D

If you did not purchase the optional solenoid valve please move to Step 4 (b)

UNIT (MODEL)	Ø NPT MALE	A inches [mm]	B inches [mm]	C inches [mm]
NC10-75 NCi10-75 DS10 DSi10	1"	32.00" [813]	21.71" [551]	20.00" [508]
NC15-75 NC10-50 NCi15-75 NCi10-50 DS15 DSi15	1"	35.75" [908]	24.34" [618]	23.75" [603]
NC30-75_1" NCi30-75_1" NC15-50 NCi15-50 DS30_1" DSi30_1"	1"	39.75" [1010]	27.04" [687]	27.75" [705]
NC30-75_1½" NCi30-75_1½" DS30_1½" DSi30_1½"	1½"	39.75" [1010]	27.04" [687]	27.75" [705]



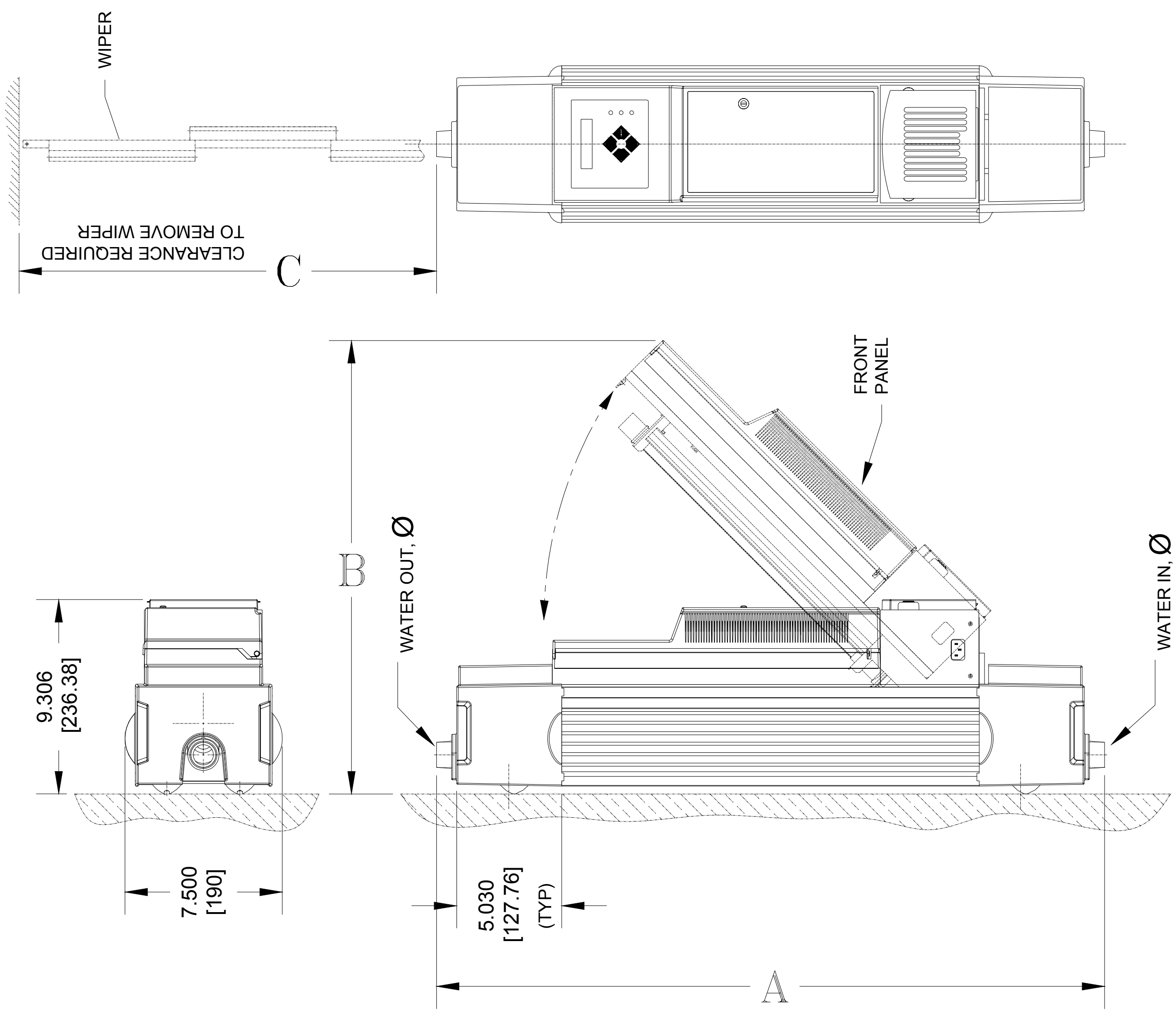


Figure 1A

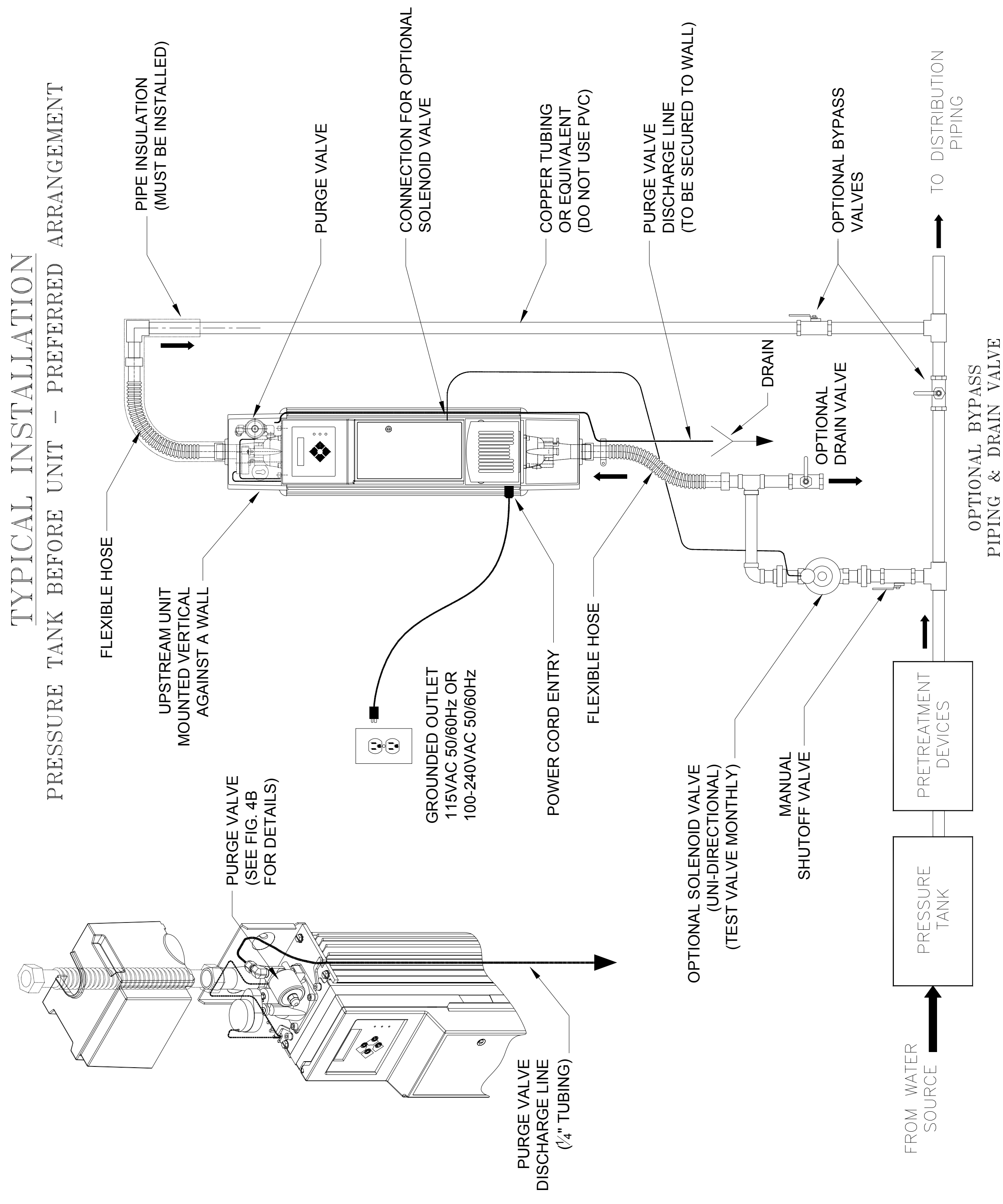

TYPICAL INSTALLATION
PRESSURE TANK BEFORE UNIT – PREFERRED ARRANGEMENT
PIPE INSULATION (MUST BE INSTALLED)
PURGE VALVE
CONNECTION FOR OPTIONAL SOLENOID VALVE
COPPER TUBING OR EQUIVALENT (DO NOT USE PVC)
PURGE VALVE DISCHARGE LINE (TO BE SECURED TO WALL)
OPTIONAL BYPASS VALVES
TO DISTRIBUTION PIPING
DRAIN
OPTIONAL DRAIN VALVE
OPTIONAL BYPASS PIPING & DRAIN VALVE
FLEXIBLE HOSE
UPSTREAM UNIT MOUNTED VERTICAL AGAINST A WALL
GROUNDED OUTLET 115VAC 50/60Hz OR 100-240VAC 50/60Hz
POWER CORD ENTRY
FLEXIBLE HOSE
OPTIONAL SOLENOID VALVE (UNI-DIRECTIONAL) (TEST VALVE MONTHLY)
MANUAL SHUTOFF VALVE
PRETREATMENT DEVICES
PRESSURE TANK
FROM WATER SOURCE
PURGE VALVE (SEE FIG. 4B FOR DETAILS)
PURGE VALVE DISCHARGE LINE (¼" TUBING)

Figure 1B

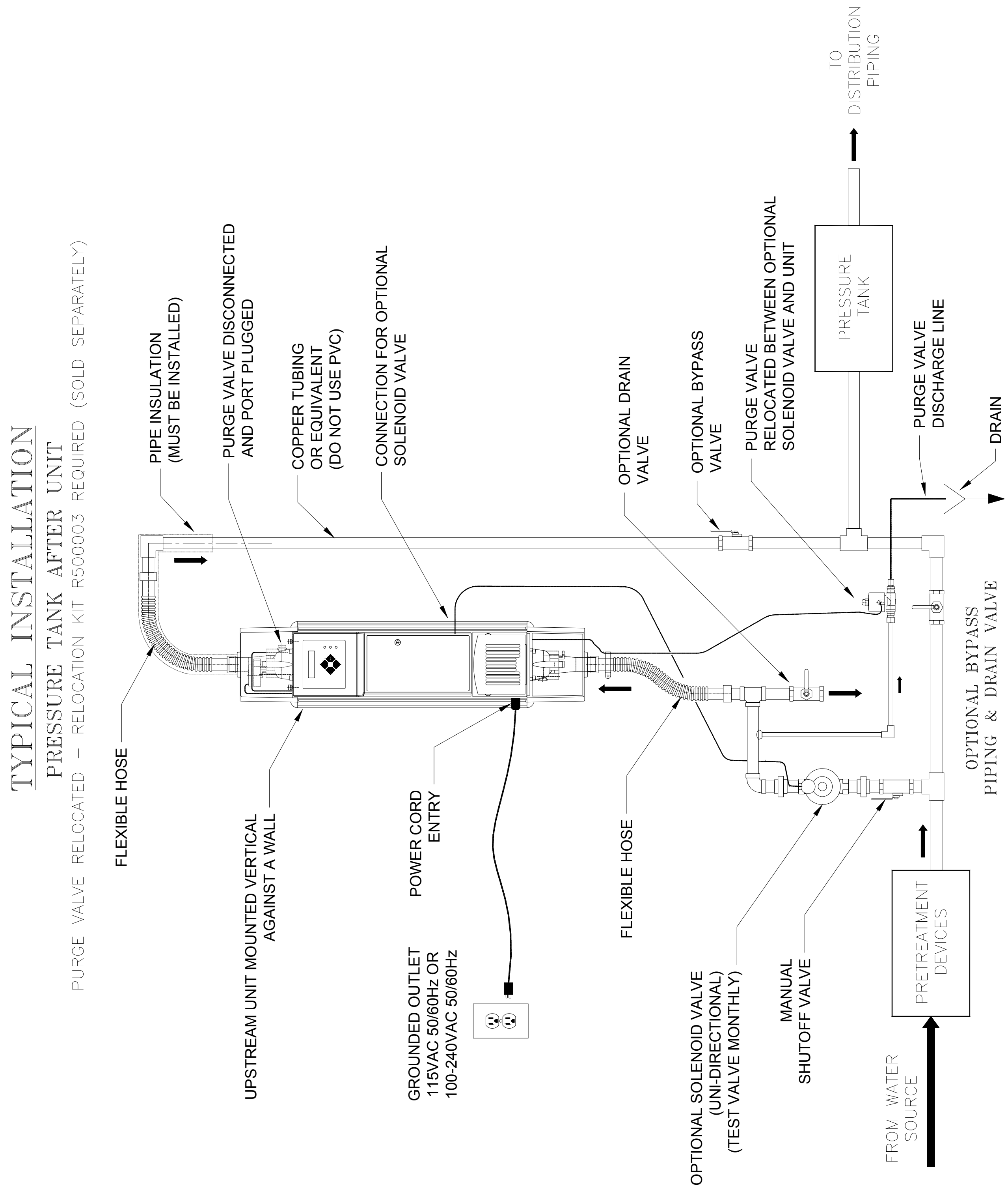

TYPICAL INSTALLATION
PRESSURE TANK AFTER UNIT
PURGE VALVE RELOCATED – RELOCATION KIT R500003 REQUIRED (SOLD SEPARATELY)
FLEXIBLE HOSE
PIPE INSULATION (MUST BE INSTALLED)
PURGE VALVE DISCONNECTED AND PORT PLUGGED
COPPER TUBING OR EQUIVALENT (DO NOT USE PVC)
CONNECTION FOR OPTIONAL SOLENOID VALVE
UPSTREAM UNIT MOUNTED VERTICAL AGAINST A WALL
POWER CORD ENTRY
GROUNDED OUTLET 115VAC 50/60Hz OR 100-240VAC 50/60Hz
OPTIONAL DRAIN VALVE
FLEXIBLE HOSE
OPTIONAL BYPASS VALVE
PURGE VALVE RELOCATED BETWEEN OPTIONAL SOLENOID VALVE AND UNIT
OPTIONAL SOLENOID VALVE (UNI-DIRECTIONAL) (TEST VALVE MONTHLY)
MANUAL SHUTOFF VALVE
PRESSURE TANK
TO DISTRIBUTION PIPING
PURGE VALVE DISCHARGE LINE
DRAIN
OPTIONAL BYPASS PIPING & DRAIN VALVE
PRETREATMENT DEVICES
FROM WATER SOURCE

Figure 1C

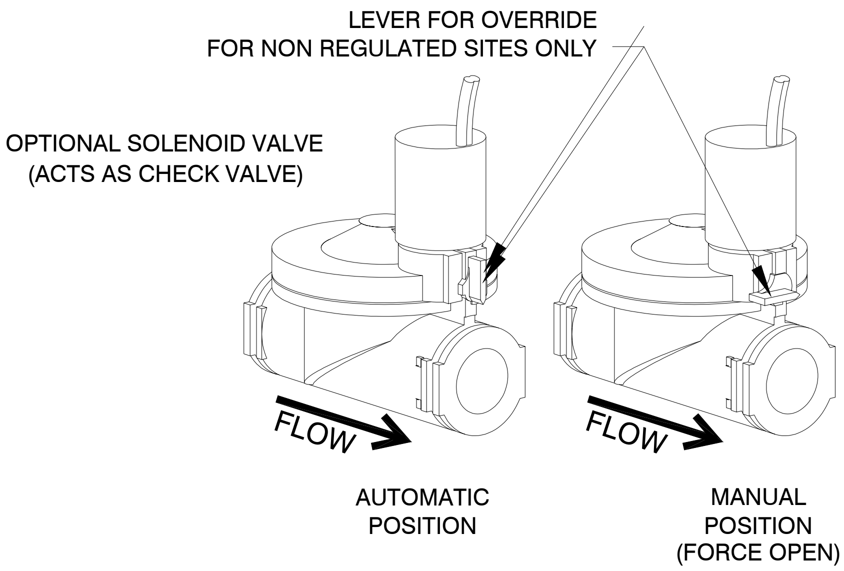


Figure 1D

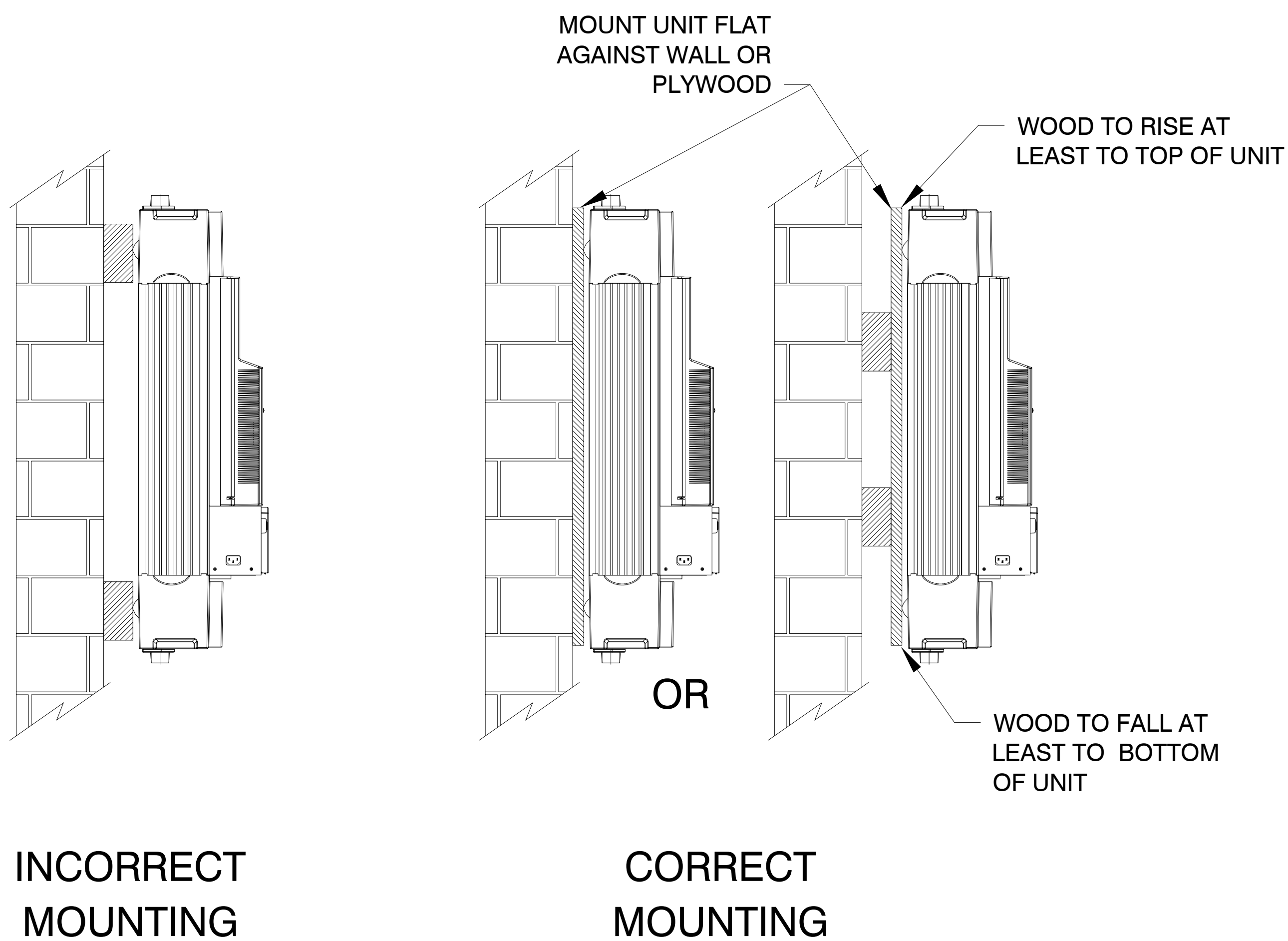


Figure 1E

Step 4: a) Connect the optional solenoid valve to the Stainless flexible hose attached to the bottom of the Upstream. Do not bend the hose excessively. Make sure the sealing washer is inside the end of the hose before making the connection. The optional solenoid valve plugs into the right hand side of the unit where a port is provided. **The valve is a non-serviceable component and nothing else should be plugged into this port.** Secure the cable from the valve to the wall. The optional solenoid valve is normally closed and must be powered to open. The valve has a manual override (white lever) that can be used to force the valve open should you require water for service/emergency purposes (note in the event of alarm and shut down it is recommended you boil your water). **In any regulated sites such as municipal applications, the manual override should not be used.** For normal operation, always leave valve in automatic position. In the Setup menu of the Upstream, toggle the valve to be "Installed" and a monthly reminder will appear to test valve.

b) If you did not purchase the optional solenoid valve simply attach the Stainless flex hose to the bottom of the Upstream and to the plumbing fitting.

Caution: Do not allow solder or solder flux to fall in or on the unit.

Step 5: Connect the remaining piping to the top Stainless flexible hose at the top of the unit – **do not use PVC pipe or braided hose**. Make sure the sealing washer is inside the end of the hose before making the connection. Do not bend the flexible hose excessively. Tighten securely.

Step 6: Connect the purge valve to a drain using the flexible tubing provided. Ensure the brass adapter is inserted into the tubing before tightening the compression fitting. If a Push-In fitting is supplied for connecting the flexible tubing, a brass adapter in *not* provided. The tubing can be run down the right hand side of the unit within the recess provided – the plastic cover may be removed to insert tube. The tubing should be secured to the wall or floor to prevent it from moving during purging cycle. If the pressure tank (water reservoir) is located downstream of the unit, the purge valve must be relocated. A Purge Valve Relocation Kit R500003 is required (sold separately).

Step 7: Caution: do not allow the inside of the unit to get wet. Before opening the water supply, double check all connections and cover the top of the unit with a rag or some plastic to prevent water entry. Ensure front panel is closed. Close any faucets you opened in Step 1 and then slowly turn on the water supply to check for leaks. If leaks exist, investigate the cause and repair. **Caution:** Do not connect the unit to electrical power until the piping and unit are free of water leaks. The optional solenoid valve can be placed into manual mode to allow water to enter the unit. Switch back to automatic mode when done.

Step 8: Once the system is checked for leaks, install pipe insulation on the outlet hose and piping to prevent condensation from falling onto or into the unit.

Parallel Installation

When more than one unit is installed in parallel (flow split between units), the units must be installed with manual shutoff valves both upstream and downstream of each unit. This allows one unit to be serviced without interrupting the flow to the other units. Another requirement is the installation of a check valve downstream of the unit (after the unit). This will prevent the backflow of water to a unit. See Figure 1F.

Remote Monitor Setup procedure (for optional handheld remote)

Step 1: Using the Setup Menu on the Upstream select "Bind Remote Device" and choose a bind number (This is a number from 0 to 40 to differentiate each unit in parallel or series.) Each Upstream within an approximate 500 feet, line of sight, range should have a different bind number. Once you have chosen a bind number press Enter. Leave menu display at "Remote Device Bind #"

Step 2: Pick up the remote monitor and then connect the battery. The remote will display "Init…, Version

# of program and then "UNBOUND" (if never initially bound). Press and hold the button and the display on the remote monitor will then show "BINDING". The button can be released at this point. When the display on the remote shows "BOUND", the process is complete. If the unit does not display "Bound", repeat the process with a different Bind # on the main unit (even if a message suddenly appears, repeat the process). It must say "BOUND" on the remote monitor.

Note: Pressing and holding the button of the remote monitor at any time will initiate another binding process.

Step 3: Syncronization is now complete, return to the main UV Pure unit. You must return the screen from Bind # to "Bound" by pressing Enter and then the Down Arrow button. This will cycle the bind numbers down until you get the "Bound" screen. Once at "Bound", press Enter and then press Left Arrow several times to return to main page.

Step 4: Disconnect the battery on the remote monitor and then reconnect. It will then sync up with main unit within a few moments.

TYPICAL INSTALLATION
OF PARALLEL UNITS

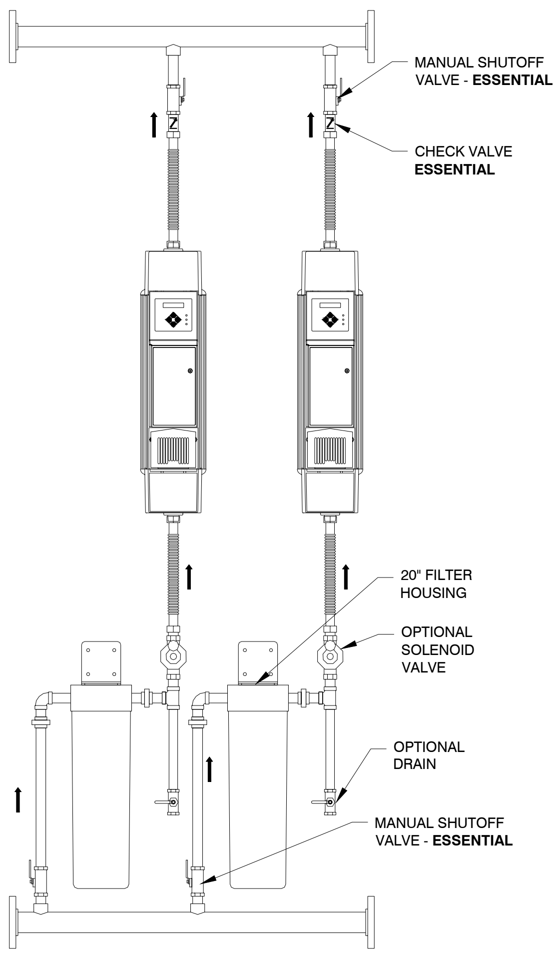


Figure 1F

Plugging in the Upstream

Step 1: Ensure that the front panel of the unit is closed and the unit is securely fastened to the wall. (**Note:** You should not open the front panel unless the unit has been unplugged).

Caution: Do not operate unit dry. There must be water in the treatment chamber to prevent damage to internal components.

Step 2: Plug the female end of the power cord into the power entry module located on the left side of the front panel. The power cord must be removed before front panel can be opened. See Figure 1B or 1C.

Caution: Use only a grounded electrical outlet when connecting the unit to a power source. If you do not know whether the outlet is grounded, check with a qualified electrician. If an extension cord is necessary, the cord should contain a ground and be rated for the same amperage as the unit. If there is a possibility of voltage spikes in the supply line, a voltage suppressor (surge protector) should be used.

Installation is now complete.

Important: after the unit has been operating for a few hours, unplug the unit and check all hose connections for leaks (the top hose in particular). Repeat this procedure periodically.

Proceed to system operation for further instruction to ensure optimal performance.

Flushing Instructions

Flushing the system is required after installation or after any disassembly and cleaning. Flushing may also be required to remove colored water from the unit. Most filters (if installed) also require flushing prior to use – follow the manufacturer's recommendations.

The system may be flushed in two ways. It can be done manually by disassembling the unit and filling and draining the unit by hand (see Cleaning the Unit). Flushing may also be done while the unit is operating. Plug in the unit and open a faucet closest to the unit and run the water for a minimum of 15 minutes.

Control Interfaces

Remote Monitor (optional)

The Upstream system is available with a remote monitor that monitors the system operation and alerts you to any change in status. If the unit did not come with a Remote Monitor, the main unit will display "Radio Initialize Problem" or "Radio Device Not Installed" upon start up – please ignore this message. If the unit is equipped with a Remote monitor, install the 9v battery (included) in the remote monitor and place the monitor in a location of your choice. The remote will operate up to 164 feet (50m) from the Upstream system location, (Please note that masonry walls decrease the distance the remote can communicate with the Upstream system). The remote will run through a diagnostic and then sync with your Upstream system and display a message indicating unit status. If a warning or alarm is displayed, detailed information will be available at main unit. If the remote loses communication with the Upstream, it will display "No Sync". Move the monitor to a different location until communication has been reestablished.

The radio frequency used by the remote is 2.4GHz and has FCC modular approval grant to meet FCC Part15, EN300 328-1, EN301 489-1, Industry Canada RSS-211.

External Alarm Contacts

The Upstream system provides an external "dry" contact for remote alarms or autodialers – the word "dry" indicates no voltage present at the contact. It can be wired normally open or normally closed. The contact is referred to as a “System Run” condition. The status of the contact changes when the Upstream unit changes from a normal condition (energized relay) to alarm condition (de-energized relay). The contact is meant for control purposes only, not to drive devices. The maximum rating of the contact is 24 Vdc. When the unit is awaiting a remote start, the relay is energized. See Figure 1G

REMOTE START/STOP

The Upstream has remote start/stop capability which allows it to remain idle without operating the UV lamps. When a signal is given (voltage applied), UV lamps are energized. This is convenient for locations requiring periodic disinfection such as pump houses. **It is recommended to limit starts and stops of the UV lamps to two per day**. Any more may jeopardize lamp life and is not covered under warranty. The maximum rating of the contact is 22-36 Vdc, 0.5W max or 16-28 Vac, 0.5W max. The remote start/stop is disabled by default and can be enabled in the Setup section of the menu.

There is a knockout provided at the base of the front panel for cable entry. See Figure 1G & 1H.

Caution: Unplug the unit before gaining access to do any wiring or accessing ballast enclosure.

The door to the ballast enclosure must be opened to gain access to external alarm and remote start/stop contacts. As well, the blower and blower housing must be removed for cable entry. See Figure 1G & 1H.

Step 1: Loosen screw that secures door – no need to remove.

Step 2: Unplug blower from circuit board – connector J6.

Step 3: Open blower housing panel and remove screw that secures it.

Step 4: Gently pull out blower housing and blower allowing connector and wire to follow.

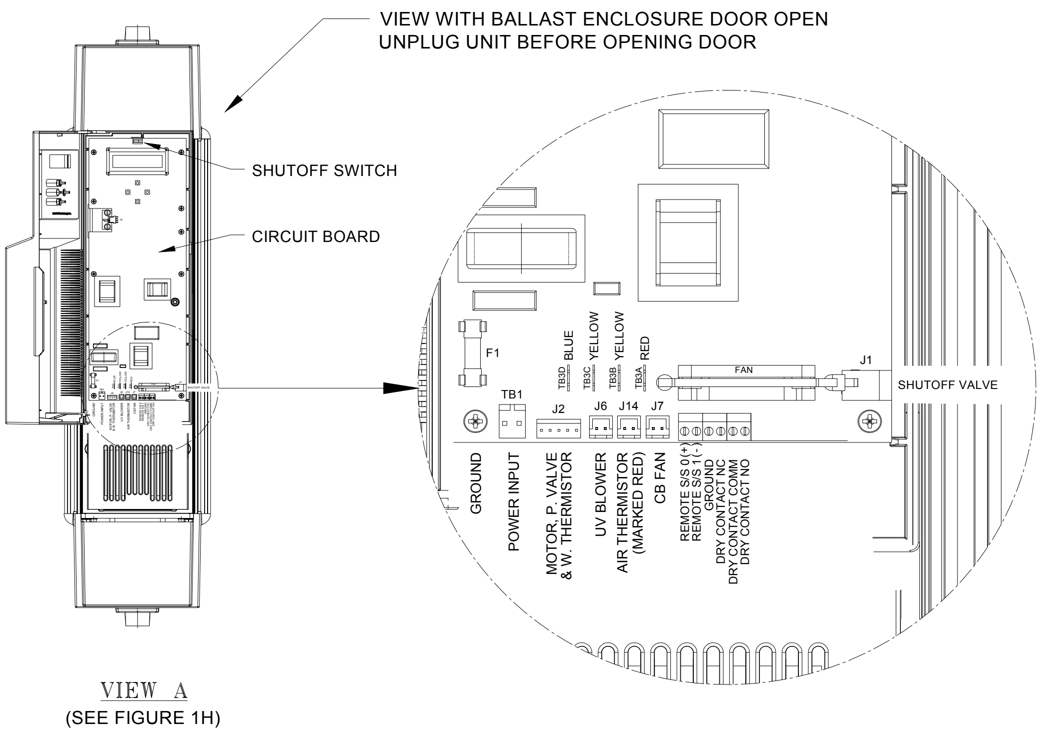
Step 5: Remove knockout & install conduit / external wiring up to circuit board and terminate. Wiring may be secured internally to standoffs but allow enough slack to allow front panel to open.

Step 6: Test opening of front panel to ensure newly installed wires do not restrict movement.

Step 7: Replace blower and blower housing and allow connector & wire back to the circuit board. Secure with screw. Ensure wires do not obstruct blower.

Step 8: Plug in blower connector to J6.

Step 9: Close ballast enclosure door and secure with screw.



VIEW WITH BALLAST ENCLOSURE DOOR OPEN
UNPLUG UNIT BEFORE OPENING DOOR
SHUTOFF SWITCH
CIRCUIT BOARD
F1
TB1
J2
J6
J14
J7
J1
FAN
SHUTOFF VALVE
TB3D BLUE
TB3C YELLOW
TB3B YELLOW
TB3A RED
GROUND
POWER INPUT
MOTOR, P. VALVE & W. THERMISTOR
UV BLOWER
AIR THERMISTOR (MARKED RED)
CB FAN
REMOTE S/S 0 (+)
REMOTE S/S 1 (-)
GROUND
DRY CONTACT NC
DRY CONTACT COMM
DRY CONTACT NO
VIEW A
(SEE FIGURE 1H)

Figure 1G

TYPICAL UPSTREAM UNIT

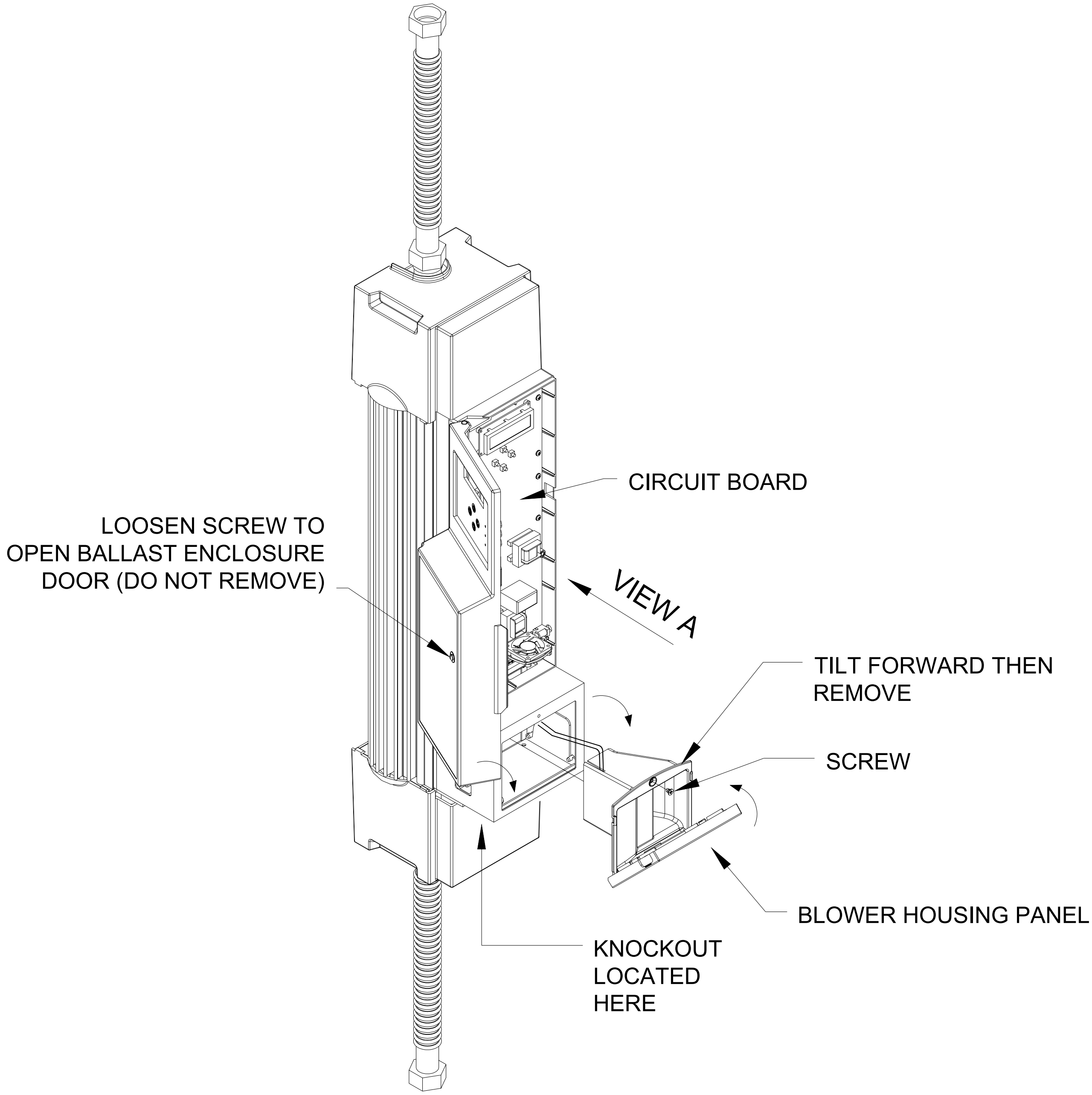
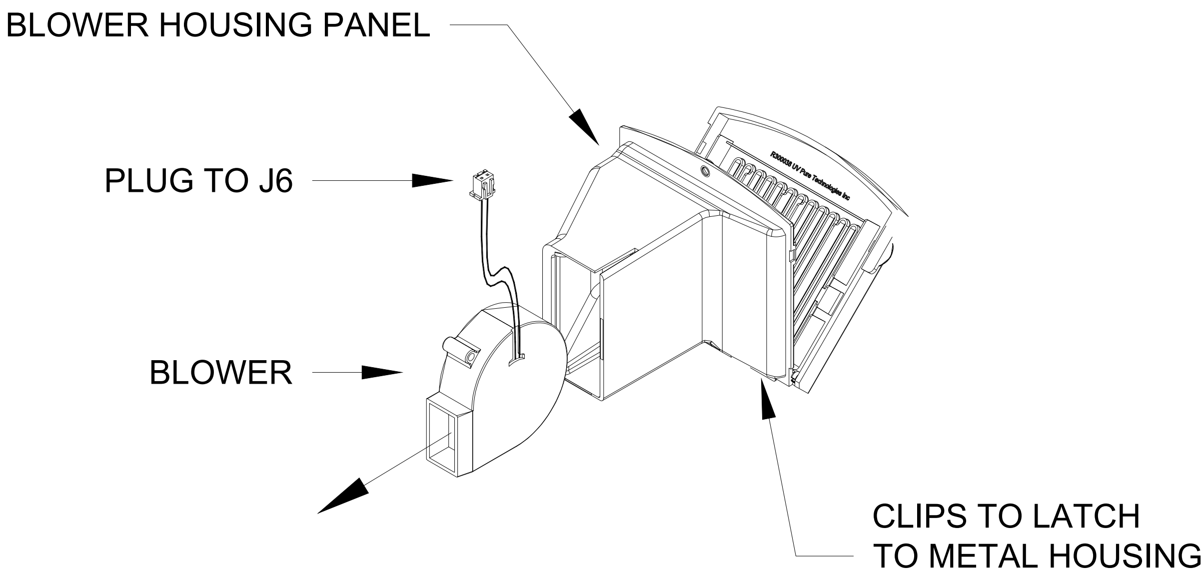


Figure 1H



EXPLODED VIEW OF BLOWER
AND BLOWER HOUSING PANEL

Figure 1I

3. Operating Instructions

The Upstream applies advanced Crossfire Technology, yet is simple to operate. With automatic quartz cleaning, periodic shutdowns are not necessary to inspect the cleanliness of the quartz. The only required maintenance is the replacement of the two UV lamps every 12 months (note - if you shut your system down for seasonal use - the lamp life will be extended)

Unit Functions

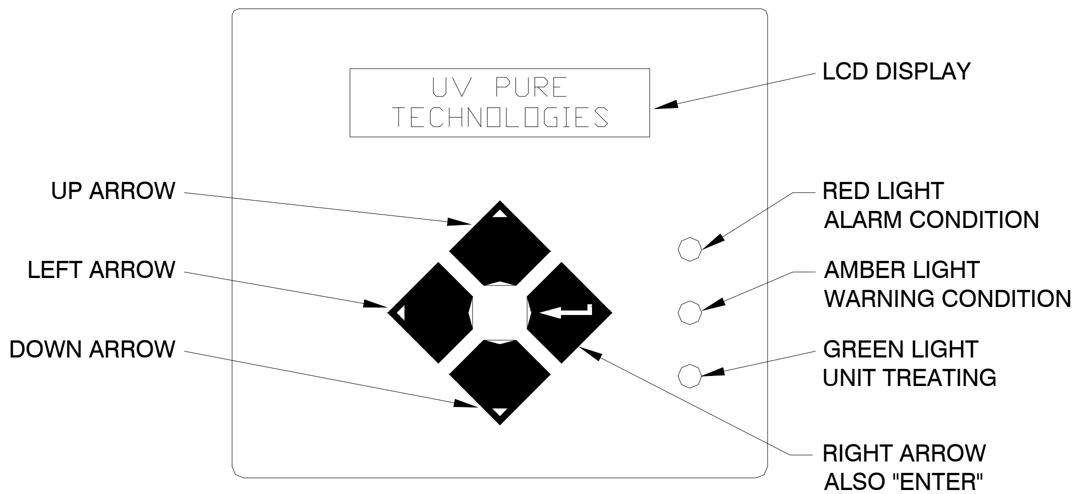


Figure 2

There is an LCD display, four pushbuttons, and three indicating lights on the front panel. See Figure 2. The pushbuttons allow you to navigate the menu screens on the LCD display. See Menu section

LCD Display
The 2 line backlit display provides status information including lifetime remaining on lamps, message history and setup options. See Menu Section.

Pushbuttons
Left Arrow – press to move back to a previous menu and or to escape from a menu choice.

Up Arrow – press to move up a menu in a section and also select data whether it is menu choices or numerical values.

Down Arrow – press to move down a menu in a section and also select data whether it is menu choices or numerical values.

Right Arrow – press to Enter selection or save value.

Indicating Lights
Green Light – situated at the bottom, an illuminated green light indicates the Upstream is treating normally. A flashing green light means the lamps are not yet at full power or the unit is in standby mode awaiting a remote start.

Amber Light – situated in the middle, an illuminated amber light indicates a warning of some condition that, if not addressed, could impact the Upstream's performance. Warnings should be addressed as soon as possible. Warnings are accompanied with a single beep, messages and troubleshooting tips on the LCD display.

Red Light – situated at the top, an illuminated red light indicates an alarm which has significantly impacted the Upstream's performance and it must be addressed immediately. Alarms are accompanied with continuous beeping, messages and troubleshooting tips on the LCD display.

Starting the Unit

Caution: Do not operate unit with the front panel or ballast enclosure door open. Do not try to open the front panel or ballast enclosure door when the unit is operating – Shutdown and unplug the unit first before trying to gain access. The Upstream contains a safety switch that will disable the lamp power supply (ballast) if the front panel is not completely closed.

Caution: Do not operate unit dry. There must be water in the treatment chamber to prevent damage to internal components. In the event of a lack of water or water supply being turned off, shutdown the unit until the water supply can be restored. In the event of a power failure, the unit will shut down and the solenoid valve (optional) will close, preventing water from flowing. When the power returns, the unit will automatically restart and perform a self-test. If no faults are detected, the unit will return to normal operation and the solenoid valve (optional) will open. Note that even during a brownout, the supply voltage may drop low enough to cause the unit to shut down. If the unit does not automatically restart as described above, shutdown and unplug the unit and plug it in again.

Step 1: Plug the unit into a grounded outlet to start the lamps. **Caution:** Never look into or place any exposed skin into the illuminated areas when the unit is operating.

Step 2: Once the unit is plugged in, all three lights will illuminate an audible alarm will sound and the display will become active. This verifies that the lights and the audible alarm are functioning. The unit then performs a self-test. During this test, the green light flashes and the solenoid valve (optional) remains closed. A solid green light appears when the UV lamps have reached full power and there are no system faults. **New lamps may take from a few moments to several hours to reach full power. Continue to run the unit until the lamps reach full power.** The solenoid valve (optional) will then open and allow water to flow through the unit. This is the normal operating mode of the unit. If the UV lamps fail to ignite, the unit will try several more times before issuing an alarm.

Remote Monitor (optional)

The Upstream unit is available with a wireless alarm that can be positioned up to 164 feet (50m) from the unit. The remote device has a LCD display to provide status messages and an audible alarm that sounds in the event of a system fault – detailed information about the fault would be available at main unit. The remote device is battery powered (9V) and can be conveniently located near the kitchen tap for a home or in the office for a school. Pressing the button on the remote will silence the beeping when an alarm occurs and it will cause any message to be redisplayed. If several warnings or alarms conditions exist at one time, pressing the button repeatedly will cycle through all messages.

Automatic Quartz Cleaning Device

The self-cleaning feature of the Upstream system involves a wiper turning inside the quartz sleeve. The wiper operates soon after power up of the lamps and then every 4 hours it will cycle for 5 minutes. The wiper can be enabled anytime in the Service section of the manual.

Built in Purge Valve

The Upstream contains a flushing or purge valve that cycles water through the unit during long periods of no water usage. The Upstream monitors water usage by measuring the rise in water temperature within the treatment chamber. During periods of no water flow, the purge valve will expel up to 1 gallon (4 liters) of water every 60-90 minutes depending on inlet water temperature and pressure.

Shutting Down of Unit and Seasonal Use

To power down the Upstream, press Enter when the screen displays “Unit Treating”. Select *Shutdown Unit* from the main menu and after the message *You may safely unplug your unit* appears, unplug the unit. If an alarm condition exists, the Upstream is to be simply unplugged to power down.

The Upstream can operate for extended periods of time without water usage **as long as the water supply is present.** The unit may be shutdown in the case of seasonal residences or during a vacation. If the possibility of freezing exists, the unit and any filters must be drained. (See Draining the Unit.) Upon returning, reconnect all fittings, close all valves and turn on water supply. Plug in the Upstream and when operational, flush the water through the unit for at least 5 minutes.

Caution: When the unit is not operating, the solenoid valve (optional) remains closed. If the solenoid valve is forced open or if the optional bypass piping is used, untreated water may enter the plumbing system. Emergency use of untreated water is the only situation where the bypass piping should be used. Any water used for drinking should be boiled. Unplug the unit if the bypass is used. **Do not run the unit dry. This will cause potential damage and scratching of the quartz sleeve.**

Disinfecting the Plumbing

Disinfection of the household or facility plumbing should be performed after the Upstream has been installed and is operating. This procedure should also be done if the unit is not functioning normally, if the bypass has been used, or if there has been a high background bacteria count in a water sample. Disinfecting the plumbing will ensure that any potential bacteria or contaminants in the distribution system are treated prior to system use.

Please note that this procedure is ineffective against protozoa that can be found in surface water or shallow wells under the influence of surface water. Under these circumstances, it is important to perform the disinfecting procedure and then operate the Upstream.
This procedure does not work with sediments or heavy biofilm and encrustations, which must be removed mechanically.

The accepted practice for sanitizing the household or facility plumbing involves adding 50 ppm chlorine from bleach for 12 hours and then flushing. This can be achieved by doing the following:

Step 1: Turn off the unit by unplugging it.

Step 2: Shut off the water supply and relieve the water pressure by opening a faucet.

Step 3: Remove the filter from its housing and fill the housing with bleach.

Step 4: Re-mount the housing (but not the filter) and plug in the Upstream to turn it on.

Step 5: Once the Upstream is operating, turn on the water supply and run water to all faucets (hot and cold), toilets, the washing machine and other water-using appliances – the bleach must fill every inch of plumbing. The UVT alarm may arise after the introduction of bleach. If this occurs, use the manual override on the solenoid valve (optional) to keep valve open during procedure. **Return override to auto position afterward.**

Step 6: When you detect the odor of chlorine at each spot, stop running the water and let the bleach remain in the lines for at least 12 hours – **turn off the Upstream unit**.

Step 7: After the waiting period is over, flush every line for at least five minutes or until the odor of chlorine is gone. If you have a septic tank, the water should be flushed to a safe waste disposal site or de-chlorinated, not directed into the septic tank.

Step 8: Now that the disinfection procedure is complete you will need to return the filter to its housing. Shut off the water supply, relieve water pressure by opening a faucet, and return the filter to the housing. Allow a few days after a disinfection procedure before getting a sample since residual chlorine may affect the results.

Have the water tested by a local recognized testing agency prior to any water consumption. UV Pure partners with water testing organizations in select locations throughout North America. Contact UV Pure for potential water testing partners: 1-888-407-9997. The testing should be performed on a regular basis as required by local regulations.

Caution: Do not allow corrosive chemicals to remain in the unit for more than 12 hours – Do not operate unit during this time period as heating the water will increase corrosive nature of chemicals.

4. Menu and Troubleshooting

The Upstream will run unattended until an alarm, or fault, arises. If an alarm does occur, the solenoid valve (optional) will close, preventing water from flowing. The green light will go out, the red light will illuminate, the audio alarm will beep, the remote will beep and an alarm message is displayed on the Upstream. The fault should be corrected to return the unit to normal operation and have the water flow again. Note that the audible alarm can be silenced for 24 hrs, 48 hrs or 1 week in the Service Section of the menu.

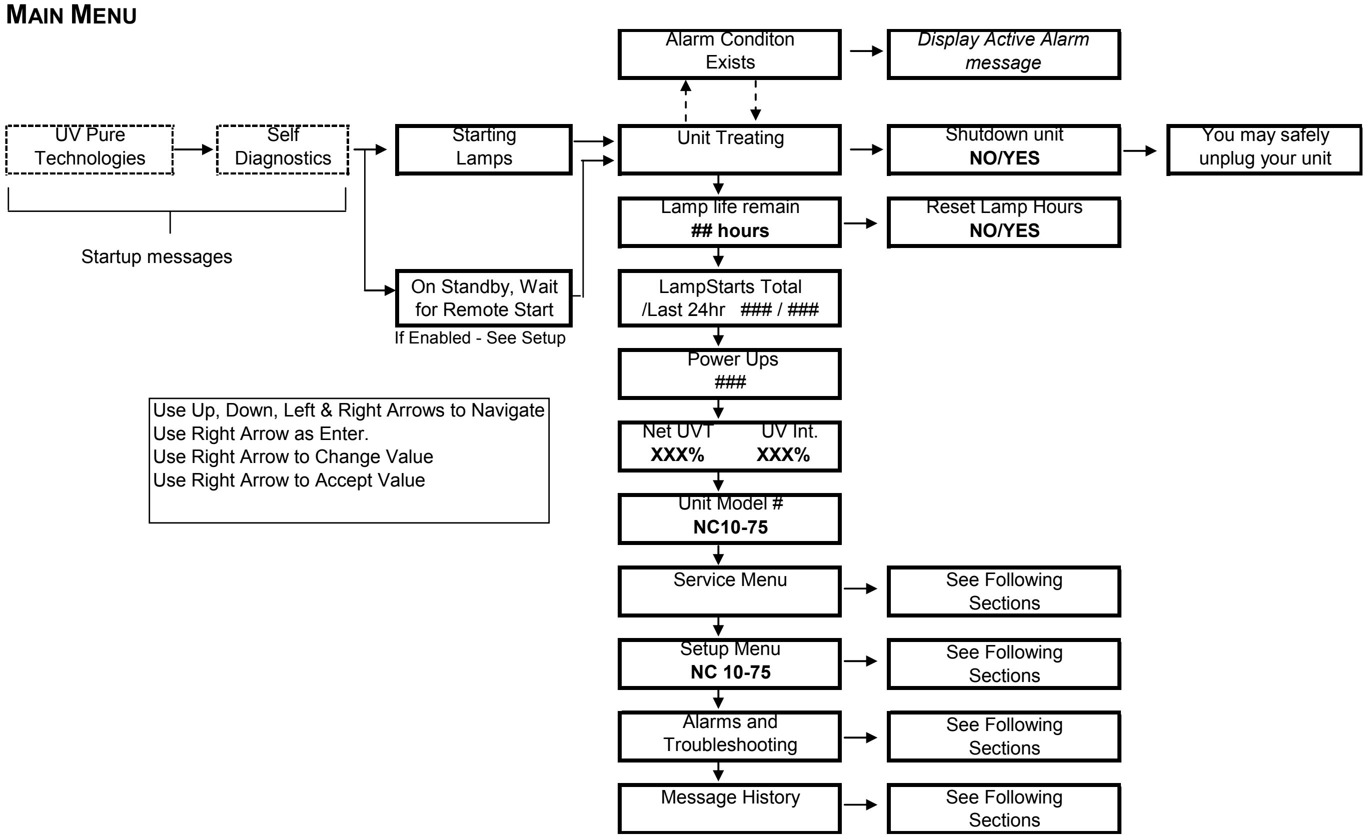
In addition to system alarms, there are system warnings. System warnings do not close the optional solenoid valve. A warning allows the problem to be addressed before the solenoid valve closes. If the warnings are left unattended, a system fault may occur. For a warning, the audio alarm will sound once, the amber light will illuminate, the remote will beep once, and a warning message is displayed on the Upstream.

The disinfection of water will occur as long as the unit is properly maintained in accordance with the instructions set out in this manual. Operating a malfunctioning unit or defeating any system sensors may jeopardize the safety of the water. If any system failure occurs and water enters the plumbing system without being disinfected, if the optional shutoff valve has been placed into manual mode, or if the optional bypass is used, any water used for drinking should be boiled. Under these circumstances, the water supply should be disinfected after returning the unit to normal operation.

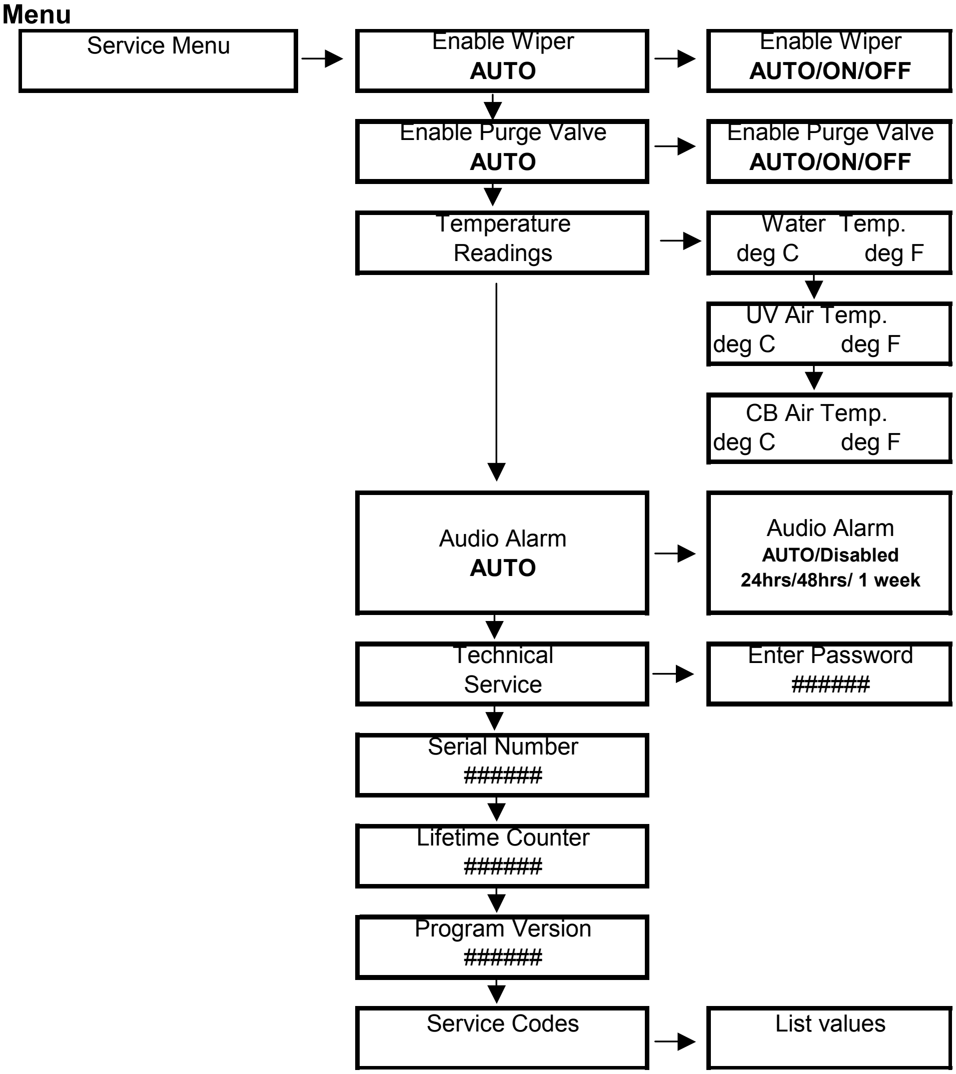
If water should fall on the unit, unplug the unit and repair leak (or add pipe insulation to prevent condensation runoff). Dry up all remaining water and inspect lamps and reflectors for water spots and clean if necessary– see section on Replacing and Cleaning UV Lamps. Inspect reflectors for water damage. The reflectors are the shiny curved panels in front and behind the lamps. The reflectors may be wiped with a clean soft cloth. If the panels do not come clean or are damaged, they must be replaced.
In the event of an alarm, a physical inspection of the unit with the power off should be done to try to identify a cause. A troubleshooting guide is provided with each alarm or warning message and presented in the Menu Section of the Instruction Manual.

Navigating the Menu

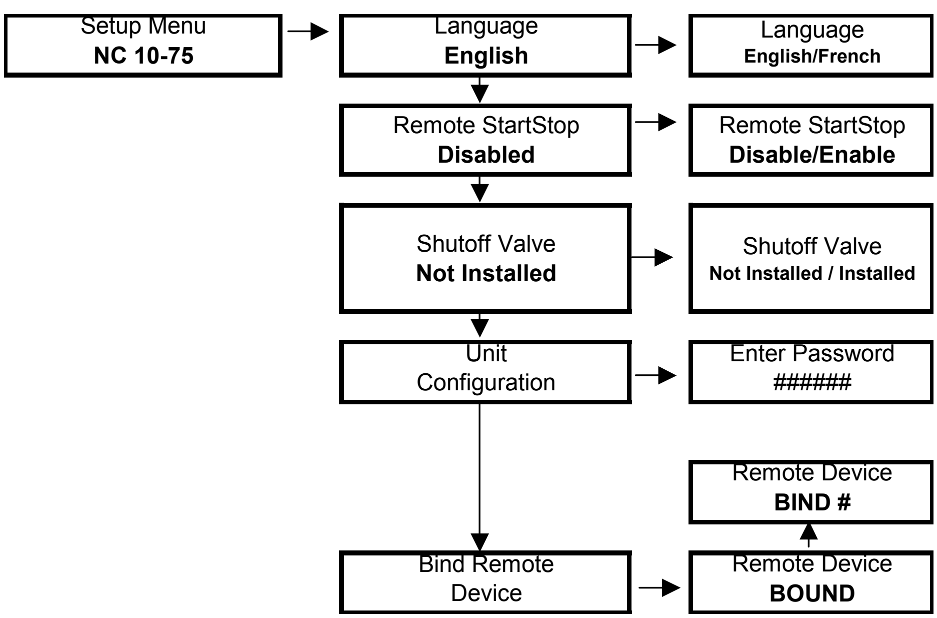
MAIN MENU



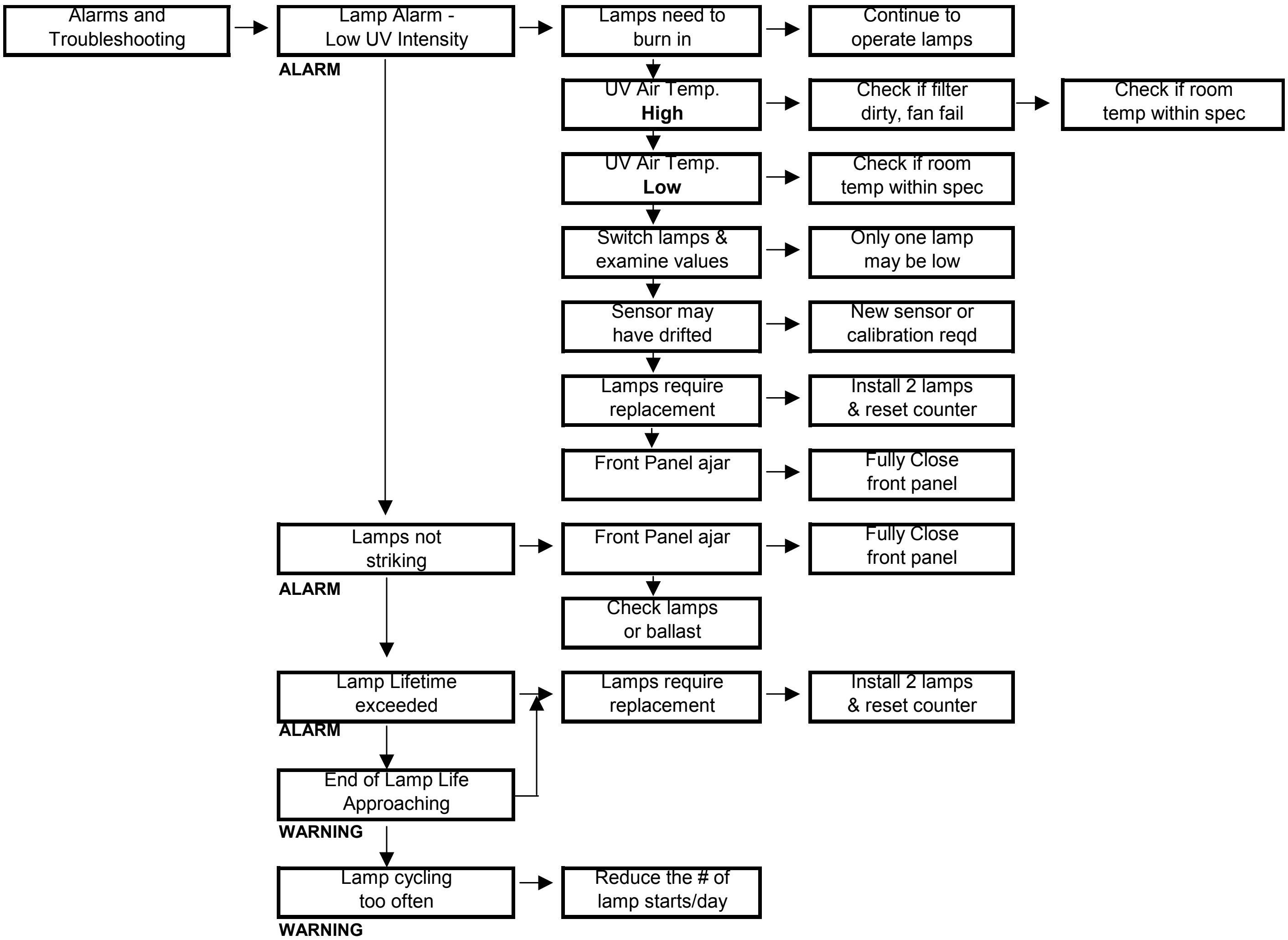
Service Menu



Setup Menu

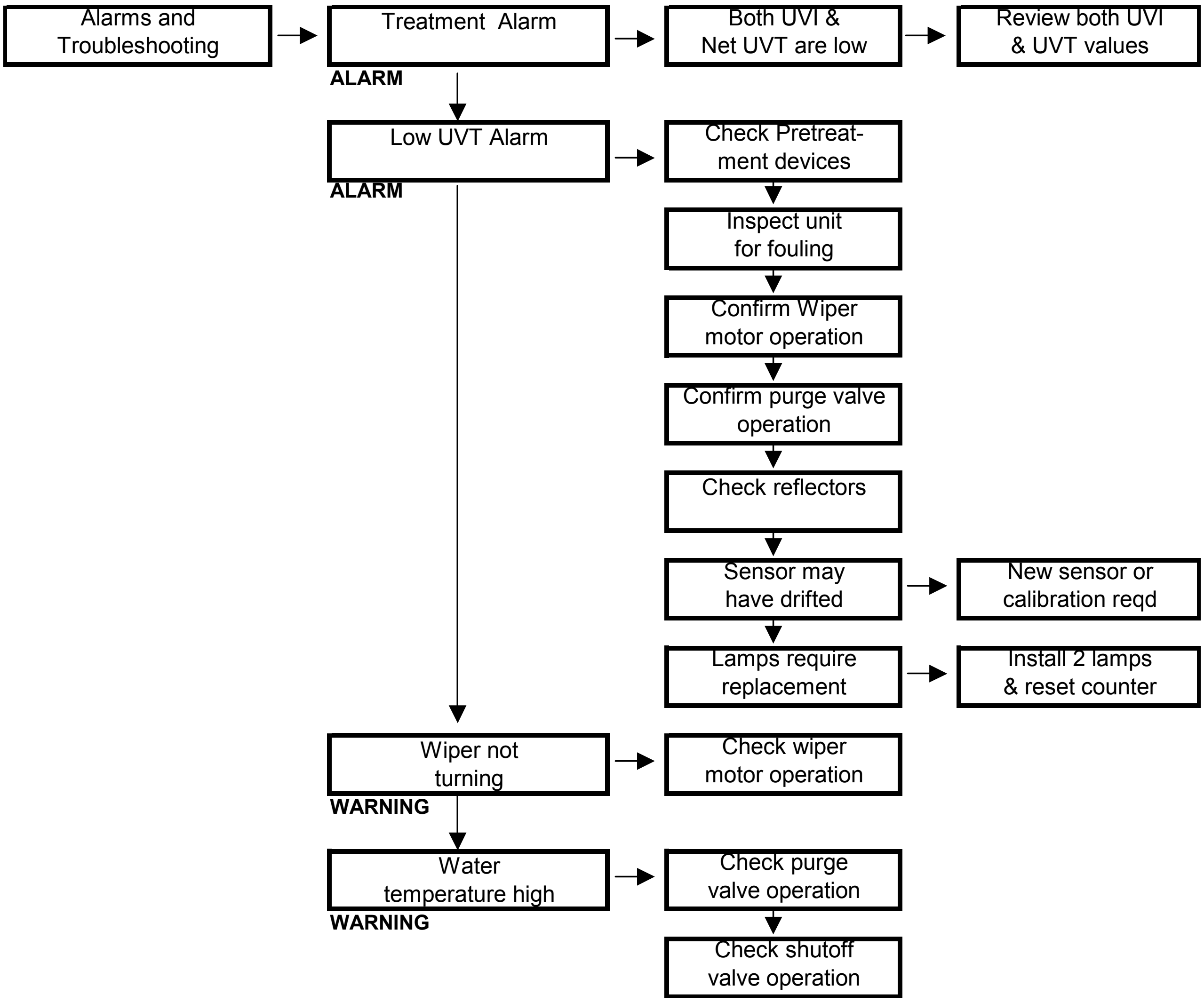


ALARMS & TROUBLESHOOTING MENU

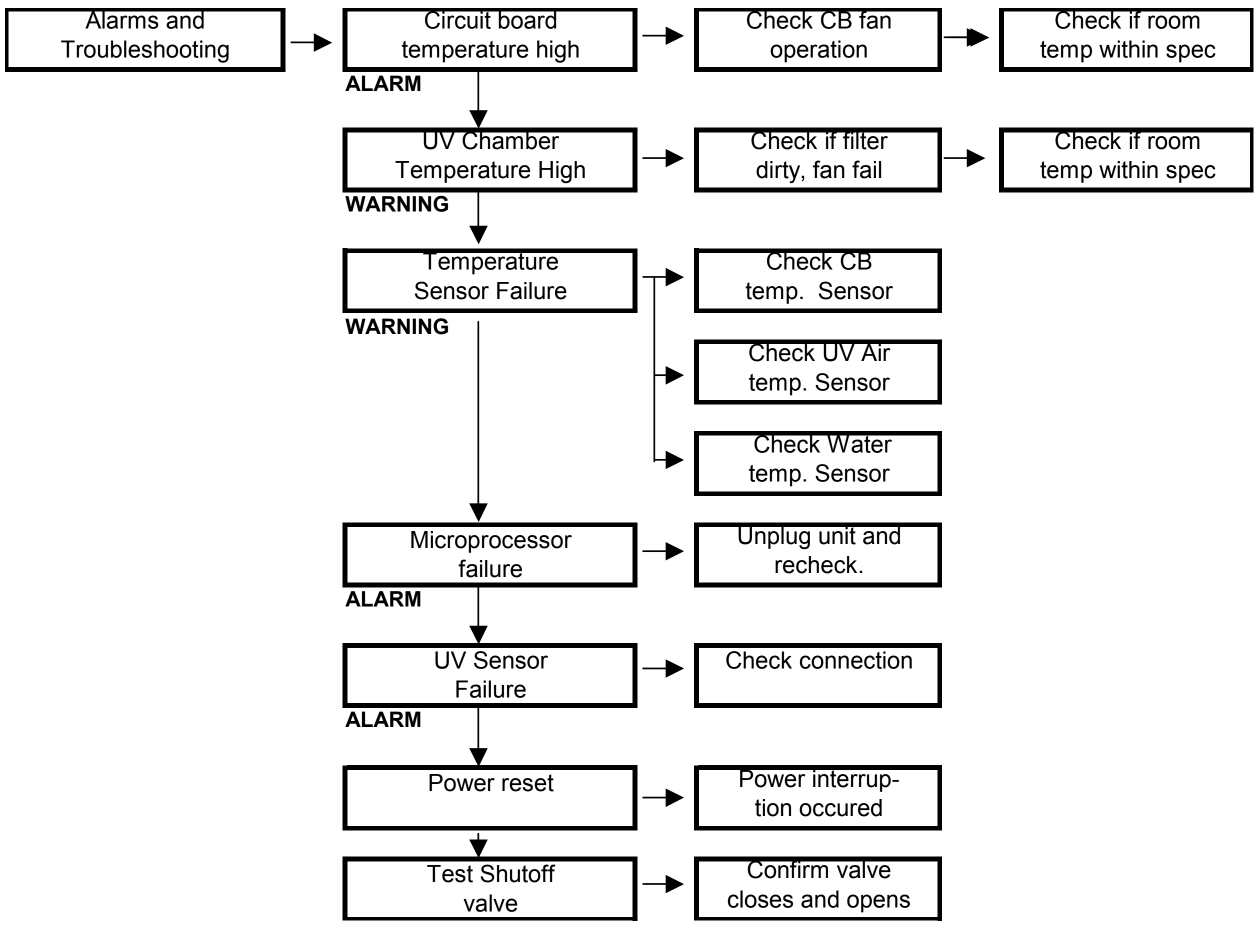


For additional info call 1-888-407-9997 or email info@uvpure.com or visit www.uvpure.com

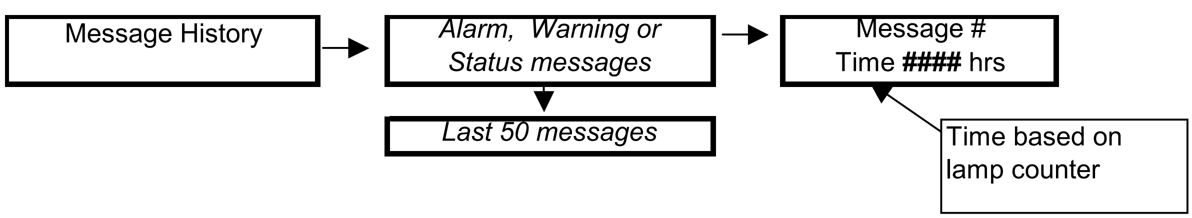
ALARMS & TROUBLESHOOTING MENU (CONT'D)



ALARMS & TROUBLESHOOTING MENU (CONT'D)



Message History Menu



5. MAINTENANCE

Test Shutoff Valve Monthly
The Optional Solenoid Shutoff valve should be tested monthly to confirm it opens and closes. Unplug valve from unit to confirm water stops flowing. Plug the valve in again to confirm water continues to flow.

Clean Air Filter Periodically
The Upstream contains a washable air filter in the blower housing panel (See Figure 1H). Periodically check and clean the filter to ensure blower operation is not impeded.

Replacing and Cleaning UV Lamps

The Upstream contains two ultraviolet (UV) lamps that emit high-intensity UV light in the germicidal range, providing effective disinfection of the water flowing through the unit. The lamps in your unit will decay over time and should be replaced every 12 months for optimum performance. Avoid continuously starting and stopping the unit within a 24 hr period, as this will accelerate the aging of the UV lamps (note: however shutting down the system for seasonal use will extend lamp life)

Your unit has an internal timer to keep track of the lifetime of the lamps. It will issue a warning when the end of their lifetime approaches (see Troubleshooting Guide). The amount of life remaining on the lamps is measured in hours and can be seen in the main section of the menu.

The lamps can be replaced in a few minutes. Draining the unit is not required.
See Figure 3.

Caution: The lamps in the unit emit ultraviolet (UV) light that can cause permanent damage to the skin and eyes. **Never look at a lamp when it is operating. Always unplug the unit before replacing lamps.**

Caution: Never touch the bulb (quartz portion) of a lamp with your fingers. Handle the lamp by its ends only. If the surface of the lamp becomes dusty or dirty, use a clean lint-free cloth and some rubbing alcohol to remove the dirt. For more difficult stains such as water spots, use a scale remover to remove the stain and then rubbing alcohol afterwards. The lamps are fragile and must be handled with care.

Tools Needed
- Slotted screwdriver
- 3/16” hex wrench (Allen wrench)

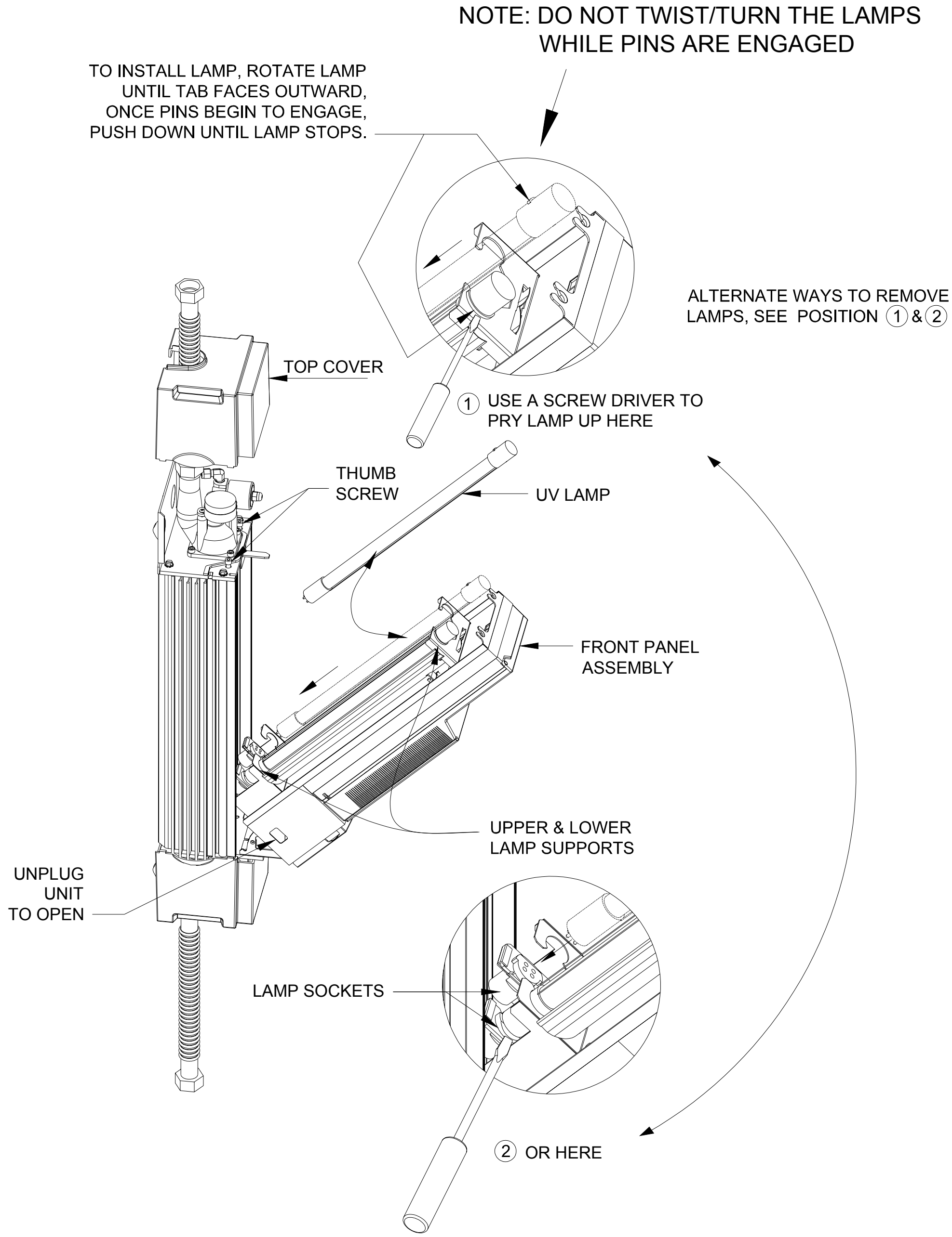


Figure 3

Step 1: Always shutdown and unplug the unit before attempting to install or replace the lamps. This will close the solenoid valve (optional) and temporarily shut off the water supply. **Caution:** The lamps heat up after continuous use and can burn your skin if touched. Allow lamps to cool for five minutes before removing them.

Step 2: Remove the top cover by pulling each side of the plastic top cover outward from the unit. This will reveal the two thumb screws that secure the front panel in place. Loosen the thumb screws (hex wrench may be required) so that the front panel may be tilted forward to reveal the lamps. **Hold the front panel**

until it comes to rest at a 45° position.

Step 3: Slowly lift the old lamps out of the unit. **Do not twist the lamps when they are installed.** For assistance in this task, use a flat screwdriver and pry the lamps up either below tabs at the top of the lamp or between lamp base and socket (see Figure 3). Dispose of the old lamps in the same way as you would dispose of ordinary fluorescent tubes. Note that old lamps should be disposed of at a household waste management depot or transfer station; contact your local recycling and waste management authority for proper disposal procedures in your area.

Step 4: Install the new lamps into the unit, being careful not to touch the bulb. Align the tab of the lamp to face the outside of the unit, as shown in Figure 3. Once the pins of the lamp begin to engage into the lamp socket, push firmly down on the top of the lamp. **Do not twist the lamps when they are installed.** The lamp will come to rest when the lamp pins are fully inserted into the socket. When pressing down, be sure to position the lamp ceramic end in the centre of the hole in the lamp holders. Repeat for the other side.

Step 5: Return the front panel to the upright position and secure it by tightening the thumbscrews. Replace the top cover

Step 6: Record the date of the lamp replacement in your Service Record Sheet.

Step 7: Plug in the unit.

Step 8: Wait for the start-up sequence to end, then select the *Lamp life remaining* screen. Press Enter move to next screen to reset counter. Push Up or Down key to select YES and then press Enter. The lamp hours will reset to 9000. **New lamps may take from a few moments to several hours to reach full power. Continue to run the unit until the lamps reach full power.** The solenoid valve (optional) will remain closed until the lamps have reached full power.

Draining the Unit

The Upstream does not normally require draining for routine operation or lamp replacement. Draining is necessary to disassemble the system, to protect against freezing, or to remove poor-quality water.

Step 1: Shut off the water supply.

Step 2: Shutdown and unplug the unit from the electrical outlet.

Step 3: Place a bucket under the unit to collect the water.

Step 4: Open a faucet downstream of the unit.

Step 5: If you have installed the optional drain valve, open the drain valve. If you do not have an optional drain valve, disconnect the Stainless flexible hose below the unit and allow the system to drain for a few minutes.

Step 6: When draining is complete, close the drain valve or reconnect the flexible hose.

Step 7: Close any faucets that were previously opened.

Cleaning the Unit

The Upstream has automatic quartz cleaning and does not normally require disassembly and cleaning of the quartz - the quartz will remain clear and transparent as glass. If a component of the cleaning device fails, such as the wiper motor, or in extreme water cases the quartz may become fouled and require manual cleaning. In this situation the UVT alarm will arise and alert you to the unsatisfactory conditions.

Follow the steps below to inspect the quartz and disassemble the unit for quartz cleaning.

Caution: Always shutdown and unplug the unit before performing any maintenance. Never operate a unit unless the front panel is completely secured.

Tools Needed

- slotted screwdriver
- 3/16" Hex wrench (Allen wrench)

Determining the Need for Cleaning

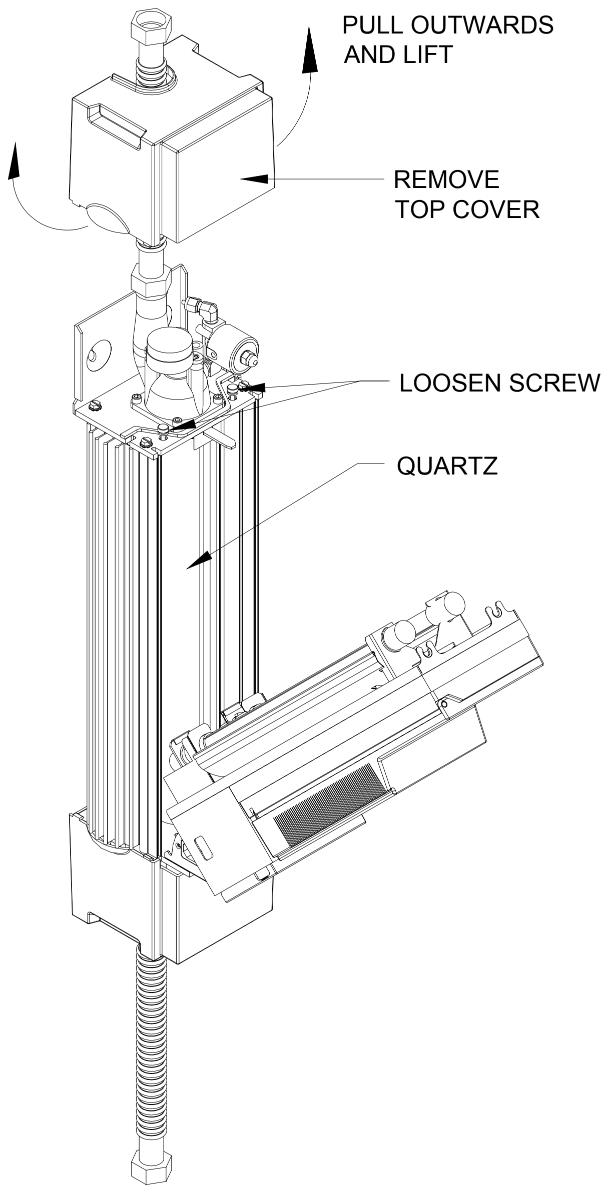


Figure 4A

Step 1: Shutdown and unplug the unit.

Step 2: Remove the top cover by pulling each side of the plastic top cover outward from the unit, and loosen the thumb screws.

Step 3: Tilt and hold the front panel until it comes to rest at a 45° position.

Step 4: Examine the quartz sleeve both inside and out. If it is clean, no disassembly is required. Return the front panel to the upright position and tighten thumb screws. Plug in the unit and operate as normal.

If the quartz sleeve is dirty on the outside, proceed to wipe it down with a clean lint-free cloth and rubbing alcohol to remove the dirt. If the quartz sleeve is dirty on the inside, proceed with in-place cleaning or disassembly.

Caution: The quartz sleeve can break or chip if mishandled. Always handle it with care and keep it in a safe place if it is removed from the unit. Do not strike the quartz sleeve with any tool, since even the smallest chip can cause it to break under pressure.

In-place cleaning

Your Upstream is equipped with a self cleaning wiper that (in normal operating circumstances) maintains the quartz, ensuring years of full disinfection. However, there are rare instances where water chemistry requires some manual quartz cleaning as well. This procedure will clean the quartz without its removal from the unit. This is a quick and easy procedure that works well in most cases.

Step 1: Fill a bucket or container with water before shutting off the water supply since you will need the water later to clean the quartz sleeve. A squeeze bottle is useful for applying water or cleaning solution to the inside of the quartz sleeve.

Step 2: Shutdown the unit, unplug and open the front panel by pulling each side of the plastic top cover outward from the unit. This will reveal the two thumb screws that secure the front panel in place. Loosen the thumb screws (hex wrench may be required) so that the front panel may be tilted forward to reveal the lamps. **Hold the front panel** until it comes to rest at a 45° position.

Step 3: Place another bucket under the unit and drain the unit until there is about 1" (3cm) of water left in the quartz sleeve (see Draining the Unit).

Step 4: Disconnect the **top** hose from the plumbing side (not the unit side but other end).

Step 5: Add about 2 oz. (60cc) of cleaning solution to the top hose. The cleaning solution can be a citric acid, vinegar or other non-hazardous solutions. **Any solution used should be thoroughly rinsed out afterwards.** Fill the rest of the quartz with water.

Step 6: Let the cleaning solution remain in the quartz for at least 10-20 minutes.

Step 7: Manually turning the wiper may greatly assist the cleaning process. To do this, remove the motor assembly and turn the wiper shaft with a flat-bladed screwdriver (counterclockwise while looking at the shaft).

Step 8: Drain the unit and inspect the quartz sleeve. If clean, flush the unit with clean water. If fouling remains, repeat procedure.

Step 9: Once the unit is clean, reassemble the unit including the motor and top hose connection.

Step 10: Slowly open the water supply and check for leaks.

Step 11: Replace all covers and plug in the Upstream unit.

Disassembling the Unit

NOTE: This procedure is not recommended for individual household users please contact your certified water specialist to assist should disassembly be required.

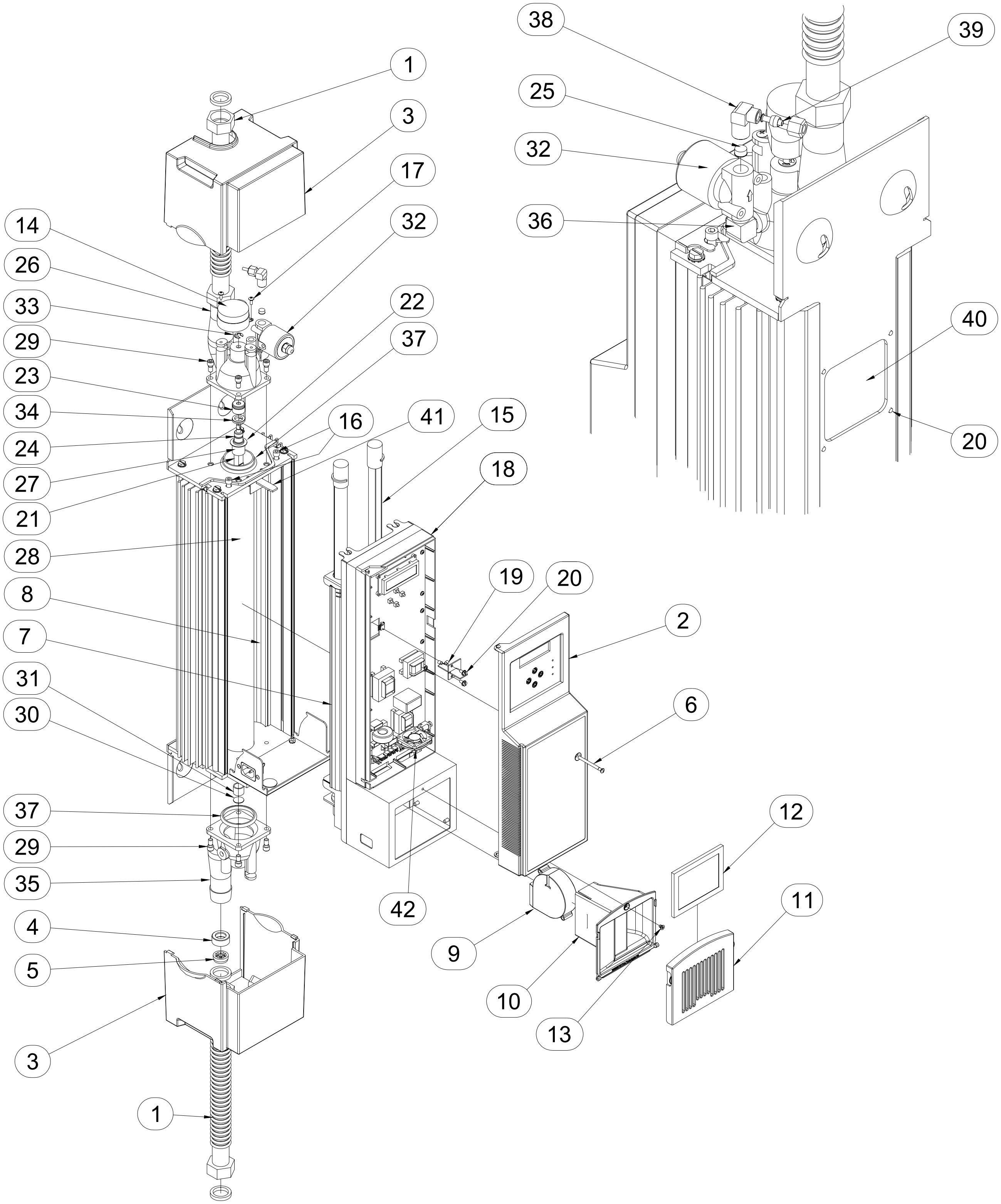


Figure 4B – Upstream

Parts List							
Item	Part No. & QTY.						Description
	NC10	Qty.	NC15	Qty.	NC30	Qty.	
1	550115	2	550115	2	550115	2	HOSE, SS, 1" FIP x FIP, 12" LONG
2	R300005A	1	R300005A	1	R300005A	1	ENCLOSURE DOOR, PLASTIC FOR ELECTRONICS
3	R300007A	2	R300007A	2	R300007A	2	COVER, TOP & BOTTOM, PLASTIC
4	C300075C	1	C300075C	1			INSERT ADAPTER FOR FLOW REGULATOR
5	550108	1	550113	1	550114	1	FLOW RESTRICTOR, 10gpm / 15gpm / 30gpm
6	650113	1	650113	1	650113	1	SLOTTED RAISED COUNTERSUNK HD SCW #8-32x2"LG.
7	R300012C	1	R300049B	1	R300069B	1	REFLECTOR - FRONT
8	R300011A	1	R300048A	1	R300068	1	REFLECTOR - REAR
9	150174A	1	150174A	1	150174A	1	BLOWER, 12VDC FOR UV CHAMBER
10	R300037A	1	R300037A	1	R300037A	1	FAN HOUSING
11	R300038A	1	R300038A	1	R300038A	1	FAN HOUSING DOOR
12	R300026A	1	R300026A	1	R300026A	1	AIR FILTER - INLET TO UV CHAMBER
13	650116	1	650116	1	650116	1	FSTN, ZINC, SCW, FLATHEAD, PHILIPS, #8-32 X 1/4"
14	X100034B	1	X100034B	1	X100034B	1	MOTOR, 24VAC FOR WIPER, 1rpm
15	E300151C	2	E300209	2	C300064	2	LAMP 40W (NC10) / 50W (NC15) / 60W (NC30)
16	650095	2	650095	2	650095	2	FASTENER, SS, SCW, SHCS, 1/4-20X5/8"LG
17	650117	2	650117	2	650117	2	FSTN, SS, SCW, PAN, PHILIPS, 6-32 X 3/8"
18	R100000	1	R100020	1	R100021	1	ELECTRICAL ASSEMBLY 120V
19	R100007	1	R100007	1	R100007	1	UV SENSOR ASSEMBLY
20	650075	6	650075	6	650075	6	FSTN, ZINC, MTL SLOT, HEX., WSH, #8-32x5/16"
21	R300019A	1	R300055	1	R300065	1	WIPER WELDED ASSEMBLY
22	E300108	1	E300108	1	E300108	1	WASHER, TEFLON, 5/8" ID X 1" OD X 1/32"
23	E300177	1	E300177	1	E300177	1	BEARING ASSY C/W O RING
24	350009	1	350009	1	350009	1	WIPER O RING SEAL
25	550085	1	550085	1	550085	1	FLOW CONTROLLER, 1 LPM
26	E300206D	1	E300206D	1	E300206D	1	TOP END CAP 1" CASTED & MACHINED
27	E300208A	1	E300208A	1	E300208A	1	SHAFT ADAPTER CASTED & MACHINED
28	R300023C	1	R300028C	1	R300029C	1	QUARTZ SLEEVE
29	650119	8	650119	8	650119	8	FSTN, SS, SCW, SHCS, 1/4-20X1/2"LG
30	R300072	1	R300072	1	R300072	1	WASHER, TEFLON, 5/8" ID X 1" OD X 1/32"
31	R500004	1	R500004	1	R500004	1	WIPER CENTERING PIECE
32	550101B	1	550101B	1	550101B	1	VALVE, 1/4" BRASS 24 Vac, N/C, WIRE LEADS
33	650066	1	650066	1	650066	1	FSTN, ZINC, E-RING, 1/4" SHAFT
34	350007	1	350007	1	350007	1	SEAL, U-CUP, FOR WIPER
35	E300207F	1	E300207F	1	E300207F	1	BOTTOM END CAP 1" CASTED & MACHINED
36	550111	1	550111	1	550111	1	PIPING, BRASS, ELBOW, 1/4" X 1/4" MALE, NPT
37	350005	2	350005	2	350005	2	QUARTZ O RING SEAL
38	550112A	1	550112A	1	550112A	1	PIPING, BRASS, 90 DEG ELB 1/4" MNPT X 1/4" TUBE
39	550117	1	550117	1	550117	1	PIPING, BRASS, INSERT FOR 1/4 COMP. FITTING
40	150185	1	150185	1	150185	1	WIRE MESH SCREEN, FOR BACKPLATE
41	R300089	1	R300089	1	R300089	1	SAFETY SWITCH ACTIVATION ARM
42	150186	1	150186	1	150186	1	FAN.MUFFIN, 12VDC

Figure 4B – Upstream Parts List

Step 1: Fill a bucket or container with water before shutting off the water supply since you will need the water later to clean the quartz sleeve (28). A squeeze bottle is useful for applying water or cleaning solution to the inside of the quartz sleeve.

Step 2: Place another bucket under the unit and drain the unit (see Draining the Unit).

Step 3: Open the front panel. The lamps may be removed to prevent them from getting dirty or damaged.

Step 4: Disconnect the Stainless flexible hose (1) from the top of the unit and remove the top quartz seal assembly.

Caution: Do not damage the sealing surfaces of the end caps (26 and 35) or the shaft of the wiper assembly (21). Handle these parts with care to prevent water leaks.

Use the 3/16” Hex wrench to remove the four fasteners in an alternating pattern (top left, bottom right, bottom left, then top right). The bottom quartz seal assembly does not require removal to clean the quartz, so leave it in place. This will support the quartz sleeve during cleaning and simplify the overall process.

Step 5: Remove the top quartz seal assembly (Figure 4C) by lifting it straight up. The wires are bundled together using a tie wrap. If you require more room to lift the top quartz seal assembly, cut the tie wrap to give you more freedom to lift the assembly over the wiper shaft.

Step 6: Remove the wiper assembly (21) by carefully lifting it up and out of the quartz sleeve. Rotating it as you lift will help. **Caution: the wiper blades are sharp, handle them with care.**

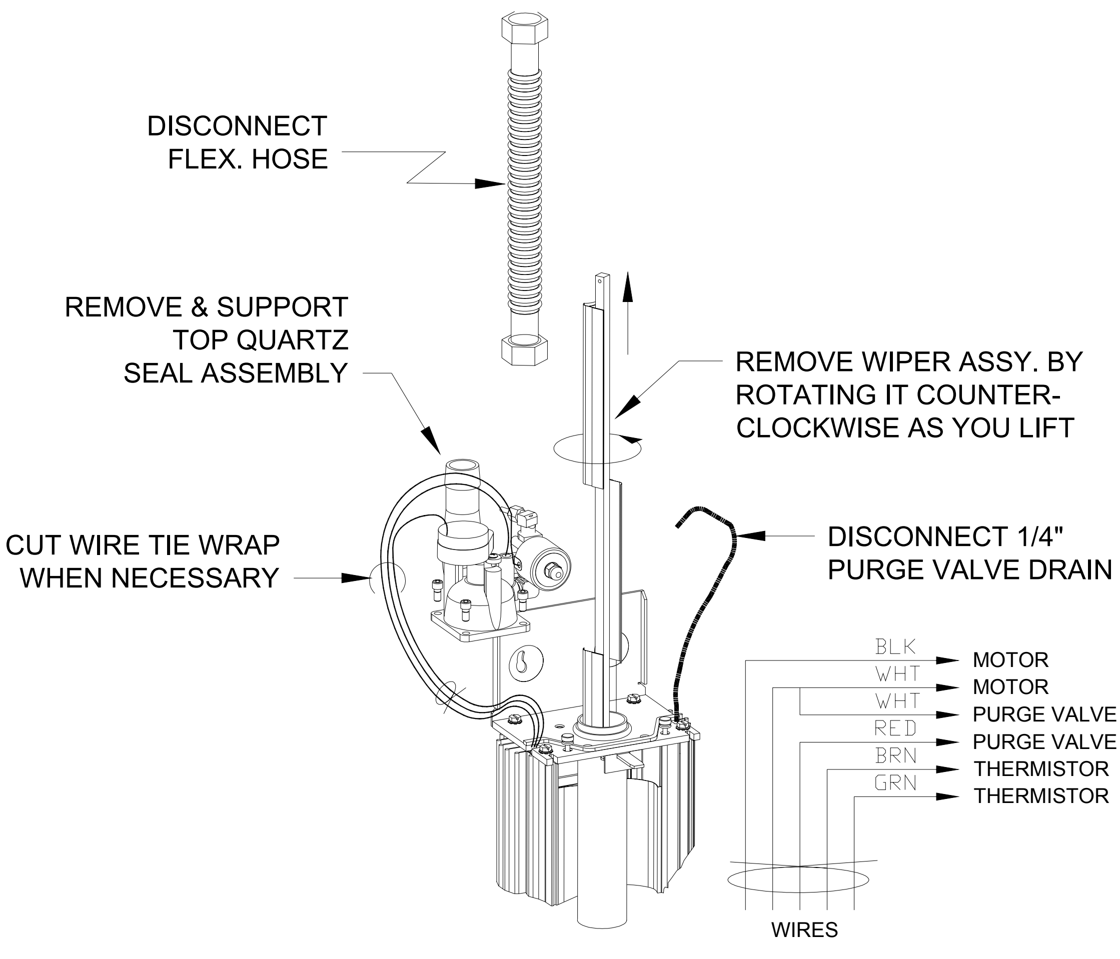


Figure 4C

Cleaning/Removing the Quartz Sleeve

Note that numbers in parentheses refer to Figure 4B.

Step 1: Use a bottle cleaning brush with a long handle to scrub the inside of the quartz sleeve. Scrub and flush it with water repeatedly to clean the quartz. Use a squeeze bottle to apply water or solution to the quartz sleeve to keep the area tidy. **Note: Keep the rest of the unit free from moisture.** Examine the quartz.

Step 2: If the quartz is still dirty, use a scale remover such as CLR or Lime Away and apply it to the inside of the quartz sleeve. Citric acid, available at a drug store, can also be used. **Always flush with clean water afterwards.**

Step 3: Once the quartz is clean, reassemble the unit (see Figure 4E). Replace any seals that appear to have been damaged.

Step 4: If the quartz is still not clean, it requires replacement. This is done by removing the bottom quartz seal assembly (see Figure 4D).

Step 5: Remove the bottom cover and then the bottom quartz seal assembly by pulling the plastic tabs of the cover out and down and then undoing the four fasteners in an alternating pattern (top left, bottom right, bottom left, then top right). Support the quartz sleeve as you remove this item.

Step 6: Remove the quartz sleeve by removing the top and bottom O rings (37). Lift the quartz sleeve out of the unit.

Step 7: Install the new quartz sleeve into the unit and center it vertically. **Be careful not to chip the ends.** You may open the front of the unit to assist you in aligning the quartz sleeve if necessary. Support the quartz for the next two actions.

Step 8: Replace the top and bottom O rings (37), keeping the quartz centered vertically in the unit.

Step 9: Replace the bottom quartz seal assembly (Figure 4D) by installing the four fasteners in an alternating pattern (top left, bottom right, bottom left, then top right) Ensure that the connection port is at the backside of the unit.

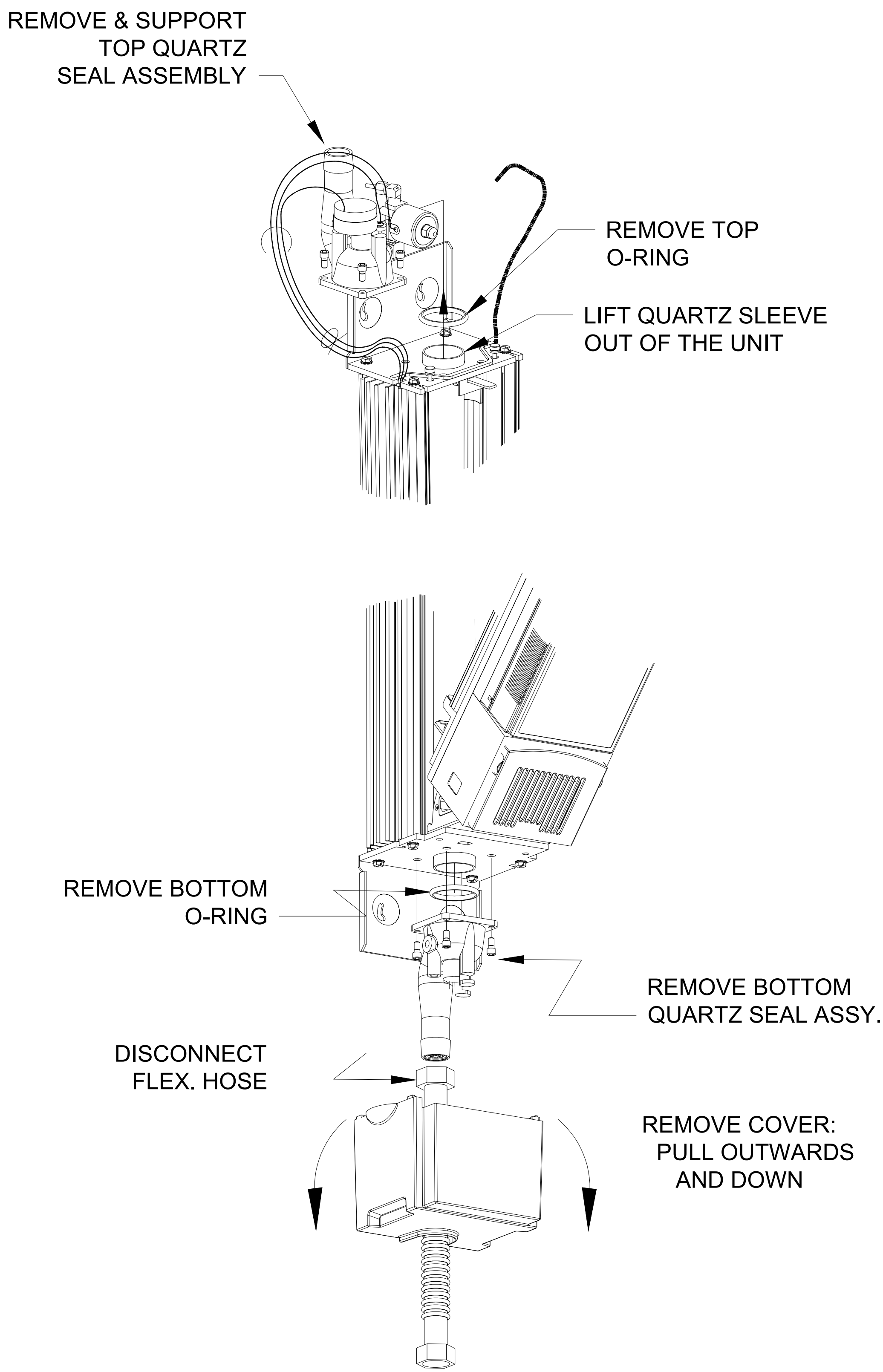

REMOVE & SUPPORT
TOP QUARTZ
SEAL ASSEMBLY
REMOVE TOP
O-RING
LIFT QUARTZ SLEEVE
OUT OF THE UNIT
REMOVE BOTTOM
O-RING
REMOVE BOTTOM
QUARTZ SEAL ASSY.
DISCONNECT
FLEX. HOSE
REMOVE COVER:
PULL OUTWARDS
AND DOWN

Figure 4D

Reassembling the Unit

Note that numbers in parentheses refer to Figure 4B.

Step 1: Replace the wiper assembly (21) carefully in the quartz sleeve. The hole on the end of the shaft must be up. Turn the wiper assembly counter-clockwise (looking from the top) as it is being inserted into the quartz – this will make the task easier and align the wiper blades properly. Wetting the inside of the quartz with water will also make the task easier.

Step 2: Ensure the quartz O-ring seal (37) is in place around the quartz sleeve and then replace the top quartz seal assembly by aligning the shaft adapter with the wiper shaft (see Figure 4E). Rotate wiper shaft to suit.

Step 3: Tighten the fasteners (29) in an alternating pattern. Bundle the wires if necessary.

Step 4: Reconnect the flexible hoses (1), both top and bottom. Close the front panel.

Step 5: Close any faucets and open the water supply. Inspect for leaks. The solenoid valve (optional) can be placed into manual mode to allow water to enter the unit. Switch back to automatic mode when done. Repair any leaks if necessary. **Caution:** Do not operate the unit if there are any leaks at the piping connections or within the unit.

Step 6: Replace the lamps.

Step 7: Reinstall the top and bottom covers.

Step 8: Plug in the unit.

Step 9: Make an entry in the service record to establish a cleaning schedule.

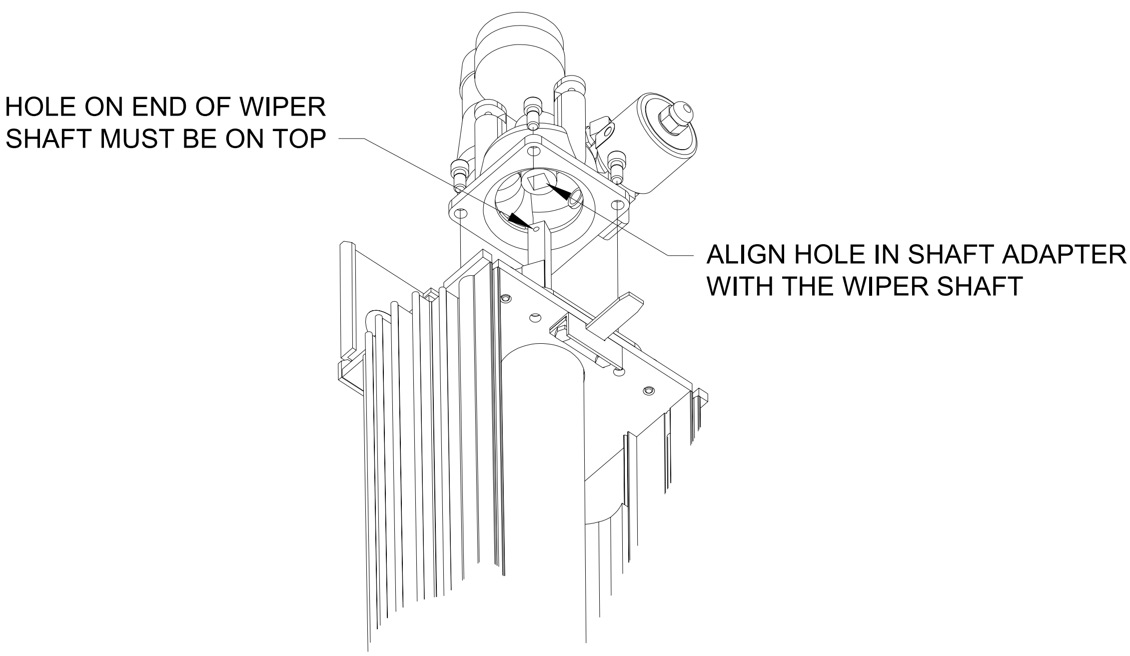


Figure 4E

Replacement Parts

Use only genuine UV Pure parts when servicing your Upstream.

Upstream Spare Parts

<table>
<tr><th>Part Name</th><th>NC10-75</th><th>NC10-50</th><th>NC15-75</th><th>NC15-50</th><th>NC30-75-1</th><th>NC30-75-1.5</th></tr>
<tr><td rowspan="3">Lamps (shipped in pairs)</td><td>E300165</td><td colspan="5"></td></tr>
<tr><td></td><td colspan="2">E300210</td><td colspan="3"></td></tr>
<tr><td colspan="3"></td><td colspan="3">C300065</td></tr>
<tr><td rowspan="2">Optional Solenoid shut-off Valve For 120V models</td><td colspan="5">E500021</td><td></td></tr>
<tr><td colspan="5"></td><td>C500017</td></tr>
<tr><td rowspan="2">Optional Solenoid shut-off Valve For 100-240V models</td><td colspan="5">E500021U</td><td></td></tr>
<tr><td colspan="5"></td><td>C500017U</td></tr>
<tr><td>Quartz sleeve Replacement Kit (including seals)</td><td>R400001</td><td colspan="2">R400010</td><td colspan="3">R400012</td></tr>
<tr><td>Purge Valve Repair Kit</td><td colspan="6">R400046</td></tr>
<tr><td>Wiper Motor Kit</td><td colspan="6">R400005</td></tr>
<tr><td>UV Sensor Array Replacement Kit</td><td colspan="6">R400002</td></tr>
<tr><td>Circuit Board / Ballast 120V</td><td>R400055</td><td>R400056</td><td>R400057</td><td>R400058</td><td>R400059</td><td>R400060</td></tr>
<tr><td>Circuit Board / Ballast 100-240V</td><td>R400061</td><td>R400062</td><td>R400063</td><td>R400064</td><td>R400065</td><td>R400066</td></tr>
<tr><td>Fuse Pack (6 in pack)</td><td colspan="6">R400042</td></tr>
<tr><td>Remote Monitor Kit - (Contains handheld & Transmitter)</td><td colspan="6">R400054</td></tr>
<tr><td>Remote Monitor (Handheld unit only)</td><td colspan="6">R400030</td></tr>
<tr><td>Reflector Kit (shipped & sold in pairs)</td><td>R400024</td><td colspan="2">R400026</td><td colspan="3">R400028</td></tr>
<tr><td>Wiper Assembly Kit</td><td>R400006</td><td colspan="2">R400011</td><td colspan="3">R400013</td></tr>
<tr><td>1" Flexible SS Hose</td><td colspan="5">R400007</td><td></td></tr>
<tr><td>1 1/2" Flexible SS Hose</td><td colspan="5"></td><td>R400015</td></tr>
<tr><td>Reactor Cooling Blower Kit (including filter)</td><td colspan="6">R400008</td></tr>
<tr><td>Fan Filter</td><td colspan="6">R400009</td></tr>
<tr><td>Top SS Manifold/Thermistor/Purge Valve Replacement, 1”</td><td colspan="6">R400016</td></tr>
<tr><td>Bottom SS Manifold, 1”</td><td colspan="6">R400047</td></tr>
<tr><td>Air Thermistor Replacement Kit</td><td colspan="6">R400018</td></tr>
<tr><td>Circuit Board Cooling Fan Replacement Kit</td><td colspan="6">R400019</td></tr>
<tr><td>Seal Kit (complete)</td><td colspan="6">R400031</td></tr>
<tr><td>Lamp Socket Wire Harness</td><td colspan="6">R400033</td></tr>
<tr><td>Top or Bottom Cap</td><td colspan="6">R400017</td></tr>
<tr><td>Cabinet Door</td><td>R400022</td><td>R400067</td><td>R400068</td><td>R400069</td><td>R400070</td><td>R400071</td></tr>
</table>

Replacement parts and Service are available from your dealer or:

UV Pure Technologies Inc.
60 Venture Drive, Unit 19
Toronto, Ontario, Canada
M1B 3S4
416-208-9884, 1-888-407-9997
FAX 416-208-5808

Manufactured by: UV Pure Technologies Inc.
60 Venture Drive, Unit 19
Toronto, Ontario, Canada
M1B 3S4
Phone: 416-208-9884
Toll Free (USA & CDA) 1-888-407-9997
Fax: 416-208-5808
e-mail inquiries: info@uvpure.com
www.uvpure.com

Date of Purchase:
Dealer Name:
Model:
Serial Number (located on the side of the front panel):

6. SERVICE RECORD SHEET

Record lamp replacement dates and events in the space provided below.

Date (MMM/DD/YYYY)	**Action**
	System Installed

7. UV Pure Technologies Limited Warranty

UV Pure Technologies Inc. (UV Pure) warrants the body of the Upstream to be free from defects in material and workmanship for a period of five (5) years from the date of purchase. Any defective components will be repaired or replaced (at UV Pure's option) during this time.

Lamps

UV Pure warrants the ultraviolet lamps within the Upstream to be free from defects in material and workmanship for a period of twelve (12) months from the date of purchase. Any defective components will be repaired or replaced (at UV Pure's option) during this time.

Electrical

UV Pure warrants the electrical components, quartz sleeve, wiper and shaft assembly, and flexible hoses within the Upstream to be free from defects in material and workmanship for a period of three (3) years from the date of purchase. Any defective components will be repaired or replaced (at UV Pure's option) during this time.

The warranty applies to the original purchaser and to the original installation location. Date of purchase can be verified by the purchase receipt or filled-out warranty card that has been registered with UV Pure. The warranty for any component does not include the shipping and handling charges. The warranty does not include the cost of labour to remove a defective component or to install a replacement component.

Damage

The above warranties do not apply to damage caused by misuse, improper maintenance (including repairs or alterations performed by anyone not authorized by UV Pure) or improper installation as outlined in this manual. Nor does it apply to accidents, acts of God, scratches or other minor imperfections caused by shipping and handling that do not impair the operation of the unit. This limited warranty is in lieu of all other warranties, whether expressed or implied. No warranty of fitness for a particular purpose or of merchantability shall apply to any of the UV Pure products.

Liability

UV Pure does not assume liability for personal injury or property damage caused by the use or misuse of the Upstream or any product mentioned above. UV Pure shall not in any event be liable for special, incidental, indirect, or consequential damages in connection with the use of UV Pure's products. UV Pure's liability shall, in all instances, be limited to repair or replacement of defective components and this liability shall be limited in duration to the duration of the applicable warranty period.

I N F R A L i G H T Ultraviolet Solutions

UltravIolet Disinfection: Ultra-V 2500/A

Specification UV2500

- Nominal Flow Rate 0-250 L/min
- Design Flow 250L/min
- Minimum flow Nil
- Maximum Pressure 850Kpa
- Polished AS316 Stainless Steel
- Dimensions 906mm x 90mm
- 40mm BSP Inlet/Outlet Ports
- Total UV Power 240W
- 2x120W High Output Lamps
- 2 x Fused Quartz Sleeves
- O-rings
- Power Supply and Cabling
- Enclosure Material: ABS
- Enclosure: 400x300x150mm
- Lamp On Indicator Green
- Lamp Failure Indicator Red
- 240VAC Cable, 2m, 3 Pin Plug
- Frequency 50Hz at 240VAC
- Circuit breaker 6 amps
- 2 x Mounting Brackets Inclusive
- Viewing port
- Drain Plug
- 12 Months warranty
- UV Irradiance 9000 Hours: 30mJ/cm2 at 95% UVT
- Design Lamp Life: 9000 Hours
- Optional Volt free alarm contacts
- Optional IP65 Rating

Infralight Pty Ltd
Phone: +61 2 4294 2779
E-mail: iruv@infralight.com.au
Web: www.infralight.com.au

The Infralight range of ultraviolet UV sterilizes are an economical means to eliminate harmful bacteria and other microbes. All Infralight UV systems are designed and built in Australia. The design of the Ultra-V sterilizing system is intended to provide many years of reliable operation. UV Chambers are AS304 or polished AS316. A range of options is available, with the basic version suitable for all domestic, farms and light commercial use.

The Infralight Ultra-V disinfection system is designed for continuos operation treating cold or hot water at any flow from zero up to the design limit. The Ultra-V range of disinfection systems is suitable for potable water, food industry, pharmaceutical, brewing and soft drinks manufacture.

All Infralight uv systems feature single-ended lamps for simple connection and user friendly servicing.

The high output ultraviolet lamp generates UV Light at a wavelength of 254nm wavelength, which is lethal to organisms.

Effective

Inexpensive

No Moving Parts

No Chemicals

No Waste

No Taste

No Residue

Low Maintenance

Made in Australia

12 Month Warranty

Pressure measurement

Process pressure

VEGABAR 14
VEGABAR 17

Product Information

Contents

Take note of safety instructions for Ex areas

Please note the Ex specific safety information for installation and operation in Ex areas which you will find on our homepage www.vega.com\services\downloads and which come with the appropriate instrument. In hazardous areas you should take note of the appropriate regulations, conformity and type approval certificates of the sensors and power supply units. The sensors must only be operated in intrinsically safe circuits. The permissible electrical values are stated in the certificate.

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1 Description of the measuring principle

Measuring principle

VEGABAR 14

The sensor element of VEGABAR 14 is the dry, ceramic-capacitive CERTEC® measuring cell. Base element and diaphragm are made of high purity sapphire-ceramic®.

The process pressure causes a change in theelectrical characteristics of the measuring cell via the diaphragm. This change is converted into an appropriate output signal.

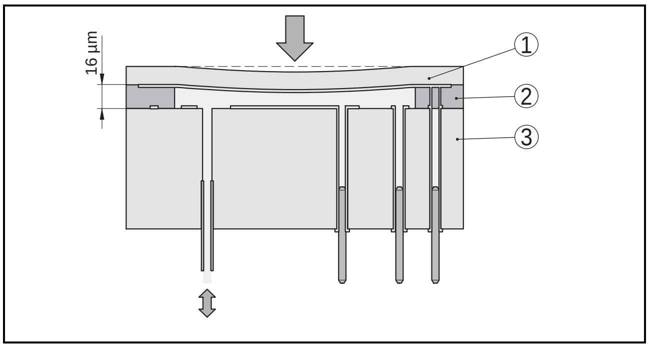

Fig. 1: Configuration of the CERTEC® measuring cell with VEGABAR 14

1 *Diaphragm*
2 *Glass solder connection*
3 *Base element*

The advantages of the CERTEC® measuring cell are:
- very high overload resistance
- no hysteresis
- excellent long-term stability
- completely flush installation
- good corrosion resistance
- very good abrasion resistance.

VEGABAR 17

In VEGABAR 17, a measuring cell with a piezoresistive sensor element containing an internal transmisson liquid is used for measuring ranges up to 16 bar. The process diaphragm is made of stainless steel.

For measuring ranges from 25 bar, a dry strain gauge (DMS) element is implemented on the rear of the stainless steel process diaphragm.

The process pressure causes a change of an electrical characteristics in the measuring cell via the diaphragm. This change is converted into an appropriate output signal.

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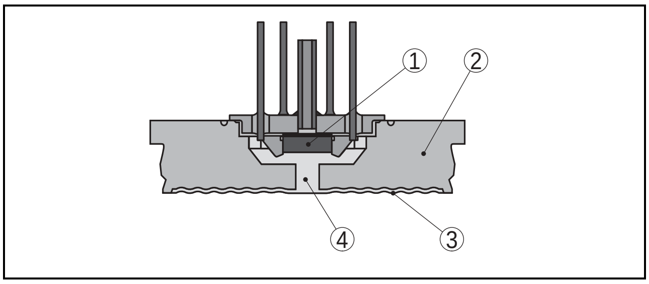

Fig. 2: Configuration of a piezoresistive measuring cell with VEGABAR 17

1 Sensor element
2 Base element
3 Diaphragm
4 Silicone oil

The advantages of the piezoresistive measuring cell are:
- elastomere-free
- wetted parts of stainless steel
- small diameter, therefore small process fittings possible
- small hysteresis.

Wide application range

VEGABAR 14 and 17 are suitable for process pressure measurement of gases, vapours and liquids. Suitable versions are also available for viscous liquids and corrosive or aggressive products. The main area of applications is mechanical engineering and plant construction.

VEGABAR 14 and 17 are economic instruments with small dimensions for standard applications with 4 ... 20 mA signal output. They offer sufficient accuracy as well as flush process fittings, but have limited adjustment options.

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2 Type overview

	VEGABAR 14	VEGABAR 17
		
Measuring cell:	CERTEC®	piezoresistive/DMS
Diaphragm:	ceramic	metal
Products:	gases, vapours and liquids	gases, vapours and liquids, also viscous products and foodstuffs
Process fitting:	G½A or M20x1.5 acc. to EN837, G½A inner G¼A, ½ NPT inner ¼ NPT	G1B or G½B flush, G½B or G¼B manometer connection, ½ NPT or ¼ NPT manometer connection
Material:	316 Ti (1.4571)	316 Ti (1.4571)
Oil and grease-free/for oxygen applications	--/--	yes/yes
Measuring range:	-1 … 0.6 bar up to 0 … 60 bar (-14.5 … 8.7 bar up to 0 … 870 psi)	-1 … 0 bar up to 0 … 600 bar (-14.5 … 0 bar up to 0 … 8702 psi)
Process temperature:	-40 … +100°C (-40 … +212°F)	-40 … +150°C (-40 … +312°F)
Deviation in characteristics:	<0.5 %	<0.5 %
Signal output:	4 … 20 mA	4 … 20 mA
Connection:	plug acc. to DIN 43650, cable outlet, plug M12x1	plug acc. to DIN 43650, cable outlet, plug M12x1, terminal housing 316 L
Adjustment:	zero/--	zero-span/--

3 Mounting information

Installation location

VEGABAR functions in any installation position. Depending on the measuring system, the installation position can influence the measurement. This can be compensated by a position correction.

The instruments with manometer connection acc. to EN 837 are mounted acc. to the regulations for manometers (DIN EN 839-2).

Information:
We recommend using lock fittings, measuring instrument holders and siphons from the line of VEGA accessories.

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4 Electrical connection

4.1 General requirements

The power supply range can differ depending on the instrument version. You will find detailed information in the Technical data.

Take note of country-specific installation standards (e.g. the VDE regulations in Germany) as well as all prevailing safety regulations and accident prevention rules.

In hazardous areas you should take note of the appropriate regulations, conformity and type approval certificates of the sensors and power supply units.

4.2 Power supply

Power supply and current signal are carried over the same two-wire connection cable. The requirements on the power supply are stated in the Technical data of this Product Information manual.

The VEGA power supply units VEGATRENN 149AEx, VEGASTAB 690, VEGADIS 371 as well as the VEGAMET signal conditioning instruments are suitable for power supply. When one of these instruments is used, a reliable separation of the supply circuit from the mains circuits acc. to DIN VDE 0106 part 101 and protection class is ensured.

4.3 Connection cable

General

An outer cable diameter of 5 ... 9 mm ensures the seal effect of the cable entry. If electromagnetic interference is expected, we recommend the use of screened cable for the signal lines.

The sensors are connected with standard two-wire cable without screen.

Ex applications

In Ex applications, the corresponding installation regulations must be noted for the connection cable.

4.4 Cable screening and grounding

The cable screen must be connected on both ends to ground potential.

If potential equalisation currents are expected, the connection on the evaluation side must be made via a ceramic capacitor (e.g. 1 nF, 1500 V).

4.5 Wiring plans

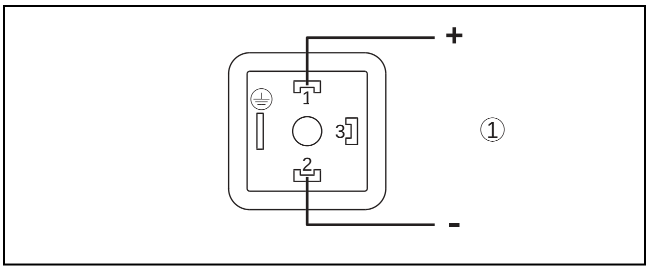

Fig. 3: Connection VEGABAR 14 and 17

1 Power supply and signal output

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5 Adjustment

5.1 Overview

VEGABAR 14 enables zero point adjustment +/- 1 mA via an integrated potentiometer.

VEGABAR 17 offers a zero/span adjustment +/- 10 % via two integrated potentiometers.

5.2 Zero point adjustment with VEGABAR 14

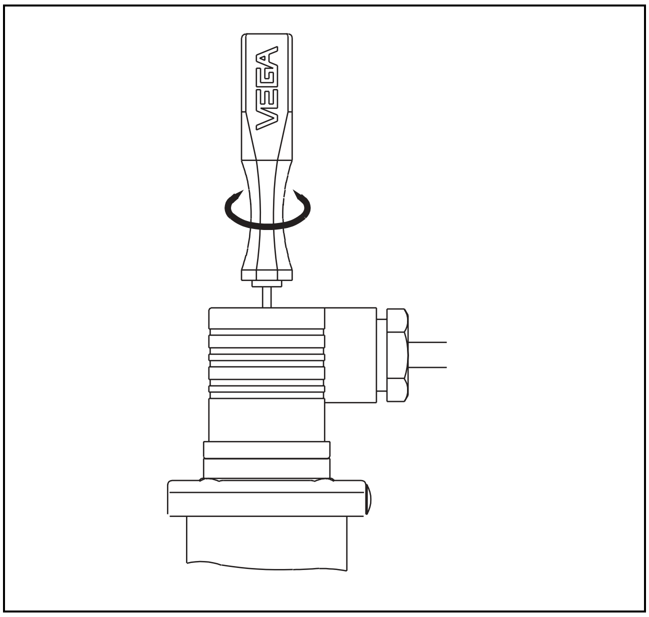

Fig. 4: Adjustment of the zero point

5.3 Zero/span adjustment with VEGABAR 17

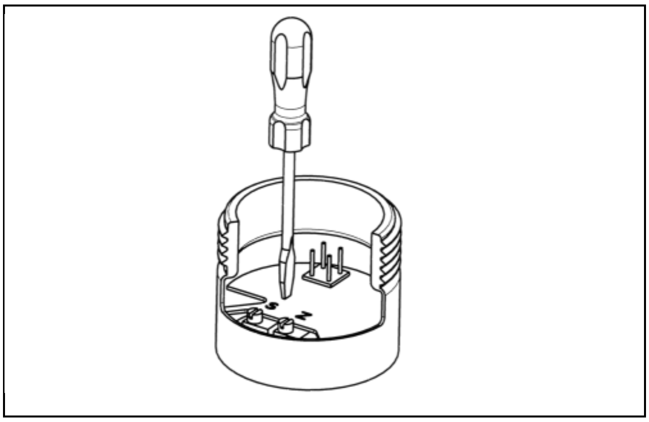

Fig. 5: Adjustment of zero and span

S span
Z zero

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6 Technical data

General data

VEGABAR 14

Materials, wetted parts	
– process fitting	316Ti (stainless steel 1.4571)
– diaphragm	sapphire-ceramic® (99.9 % oxideceramic Al_2O_3)
– process seal	Viton, EPDM
Materials, non-wetted parts	
– housing	nickle-plated brass
– connection plug, cable outlet	PA
– plug seal	NBR
– connection cable	PUR
Weight	approx. 0.5 kg (1.1 lbs)

VEGABAR 17

Materials, wetted parts	
– process fitting	316Ti (stainless steel 1.4571)
– diaphragm with measuring ranges < 16 bar	316Ti (stainless steel 1.4571)
– diaphragm with measuring ranges > 16 bar	stainless steel 1.4542
– diaphragm with measuring ranges > 16 bar front-flush	Elgiloy (2.4711)
– seal ring, O-ring	Viton, EPDM, NBR
Materials, non-wetted parts	
– internal transmission liquid	synthetic oil[1)], halocarbon oil[2)]
– housing	316Ti (stainless steel 1.4571)
– terminal housing	316 L (stainless steel 1.4435)
– connection plug, cable outlet	PA
– plug seal	silicone
– connection cable	PUR
Weight	approx. 0.5 kg (1.1 lbs)

Output variable

VEGABAR 14

Output signal	4 ... 20 mA
Adjustable zero point[3)]	4 m A ± 1 mA
Range	3 ... 23 mA
Current limitation	23 mA
Rise time (0 ... 63 %)	5 ms

1) With meas. ranges up to 16 bar, FDA-listed for the food processing industry. With measuring ranges up to 16 bar dry measuring cell.
2) Generally with oxygen applications not with vacuum meas. ranges, not with absolute meas. ranges < 1 bar_{abs}.
3) Only with the version with plug.

VEGABAR 17	Output signal	4 ... 20 mA/HART
	Zero adjustable	± 10 %
	Span adjustable	± 10 %
	Resolution	I_{max} typ. < 30 mA
	Rise – standard – product temperature <-30°C (-22°F), measuring ranges > 16 bar (232 psi), flush diaphragm	 <= 1 ms <= 10 ms
	Permissible load – at 10 V – at 30 V	 0 Ohm 1000 Ohm

Input variable

Parameter	Pressure
Measuring ranges	see product code

Accuracy (similar to DIN EN 60770-1)

Reference conditions acc. to DIN EN 61298-1 – temperature – relative humidity – pressure	 18 … 30°C (64.4 … 86°F) 45 … 75 % 860 … 1060 mbar (86 … 106 kPa/ 12.5 … 15.4 psi)
Determination of characteristics	limit point adjustment acc. to DIN 16086
Characteristics	linear

Deviation in characteristics

VEGABAR 14	Deviation in characteristics[4]	<0.5 %
VEGABAR 17	Deviation in characteristics[5]	<0.5 %
	Hysteresis	<= 0.1 %
	Repeatability	<= 0.05 %

[4] Relating to the nominal range, incl. hysteresis and repeatability, determined acc. to the limit point method.
[5] Without hysteresis and repeatability.

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Influence of the ambient temperature

VEGABAR 14	Average temperature coefficient of the zero signal[6] [7]	<0.15 %/10 K
VEGABAR 17	Average temperature coefficient of the zero signal[8]	
	– standard	< 0.2 %/10 K
	– measuring range > 100 bar (1450 psi)	< 0.4 %/10 K
	– flush version with measuring ranges < 100 bar (1450 psi)	< -0.2 % ... +0.3 %/10 K
	Average temperature coefficient of the span	< 0.2 %/10 K

Long-term stability

Long-term drift of the zero signal[9] [10]	
– VEGABAR 14	< 0.1 %/2 years
– VEGABAR 17	< 0.2 %/1 year

Ambient conditions

Ambient, storage and transport temperature	
– standard	-40 … +80°C (-40 … 176°F)
– VEGABAR 17 in flush version up to 150°C (302°F)	-10 … +80°C (14 … 176°F)

Process conditions

VEGABAR 14	Product temperature with measuring cell seal	
	– Viton	-20 … +100°C (-40 … 212°F)
	– EPDM	-40 … +100°C (-40 … 212°F)
VEGABAR 17	Product temperature[11]	
	– standard	-30 … +100°C (-22 … 212°F)
	– extended	-40 … +125°C (-40 … 257°F)
	– with integrated cooling section	-10 … +150°C (-40 … 302°F)
VEGABAR 14	Vibration resistance	mechanical vibrations with 4 g and 5 ... 100 Hz [12]
VEGABAR 17	Shock resistance	1000 g acc. to IEC 770 (mechanical shock)
	Vibration resistance	20 g acc. to IEC 770 (vibration at resonance)

6) In the compensated temperature range of 0 … 80°C (32 … 176°F), reference temperature 20°C (68°F).
7) Acc. to IEC 60770-1, relating to the nominal range.
8) In the compensated temperature range of 0 … 80°C (176°F), reference temperature 20°C (68°F).
9) Similar to DIN 16086, DINV 19259-1 and IEC 60770-1.
10) Acc. to IEC 60770-1, relating to the nominal range.
11) Version for oxygen applications max. +60°C (+140°F).
12) Tested acc. to the regulations of German Lloyd, GL directive 2.

Electromechanical data

	Angle plug connector	4-pole acc. to DIN 43560A
	Round plug connector[13]	4-pole with screwed connection M12x1
	Cable outlet[14]	1.5 m; 3 m; 5 m; 10 m; cable ventilated inside
	Terminals[15]	for wire cross sections up to 2.5 mm^2

Power supply

VEGABAR 14	Supply voltage – permissible residual ripple	12 … 30 V DC $U_{ss} < 1$ V
VEGABAR 17	Supply voltage	10 … 30 V DC

Electrical protective measures

VEGABAR 14	Protection[16] – with plug acc. to DIN 43650A – with direct cable outlet	 IP 65 IP 67
	Protection class	III
	Overvoltage category	III
VEGABAR 17	Protection[17] – with plug acc. to DIN 43650A – with cable outlet	 IP 65 IP 67, IP 68
	Other protective measures	interpolation, overvoltage and short-circuit protection

Approvals[18] [19]

VEGABAR 14	Ex Zone 2	manufacturer declaration
VEGABAR 17	ATEX	ATEX II 1/2G, 2G EEx ia IIC T6; ATEX II 1/2G, 2G EEx ia IIC T6+ ATEX II 1/2D IP6XT+M1; ATEX II 1/2G, EEx ia IIC T6
	Ship approvals	GL, LRS, ABS, CCS, RINA

13) Only VEGABAR 17.
14) VEGABAR 14 only 5 m.
15) Only VEGABAR 17.
16) Acc. to EN 60529/IEC 529.
17) Acc. to EN 60529/IEC 529.
18) Deviating data with Ex applications: see separate safety instructions.
19) You will find detailed information under www.vega.com.

CE conformity

VEGABAR 14	EMC (89/336/EWG)	Emission EN 500081-1: 1992, Susceptibility EN 580082-2: 1995
	NSR (73/23/EWG)	EN 61010-1: 1993
VEGABAR 17	EMC (89/336/EWG)	EN 61326: 2002

Environmental instructions

VEGA environment management system[20]	certified acc. to DIN EN ISO 14001

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[20] You will find detailed information under www.vega.com.

7 Dimensions

VEGABAR 14

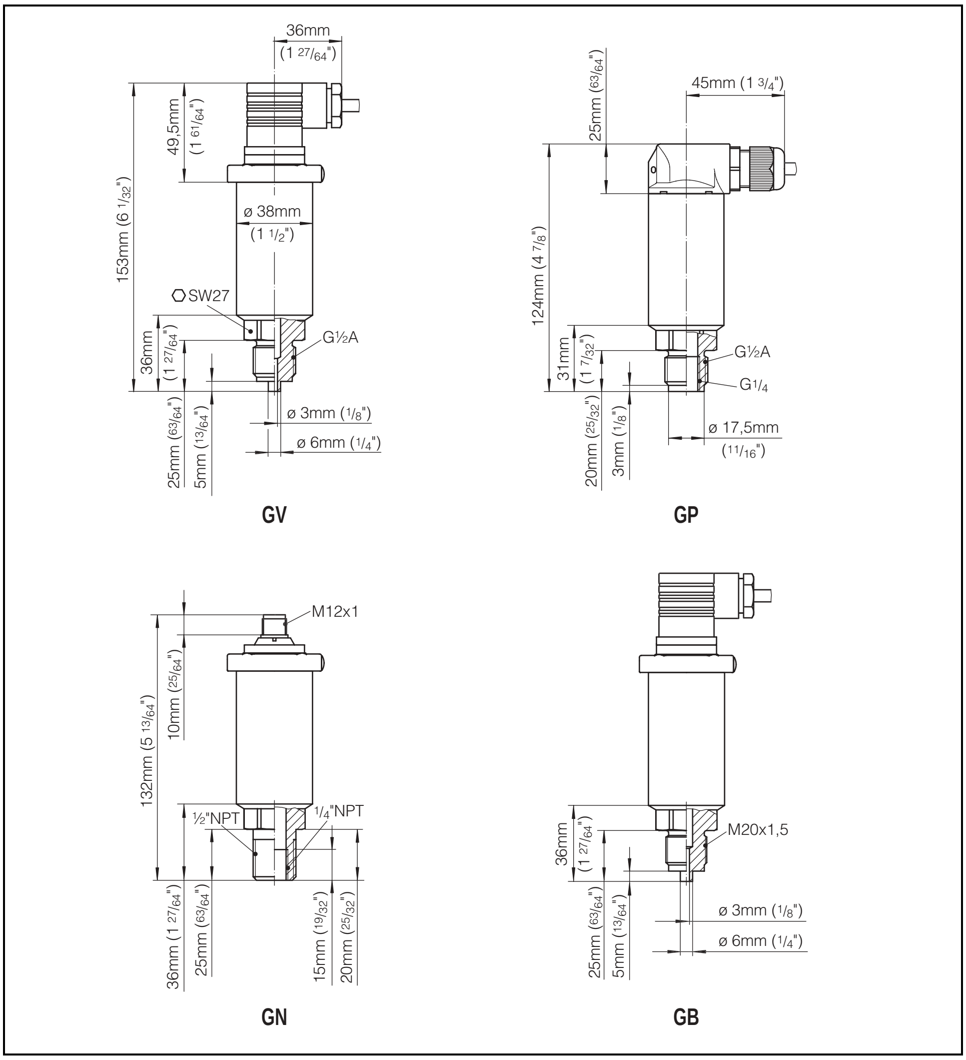

Fig. 6: VEGABAR 14

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VEGABAR 17

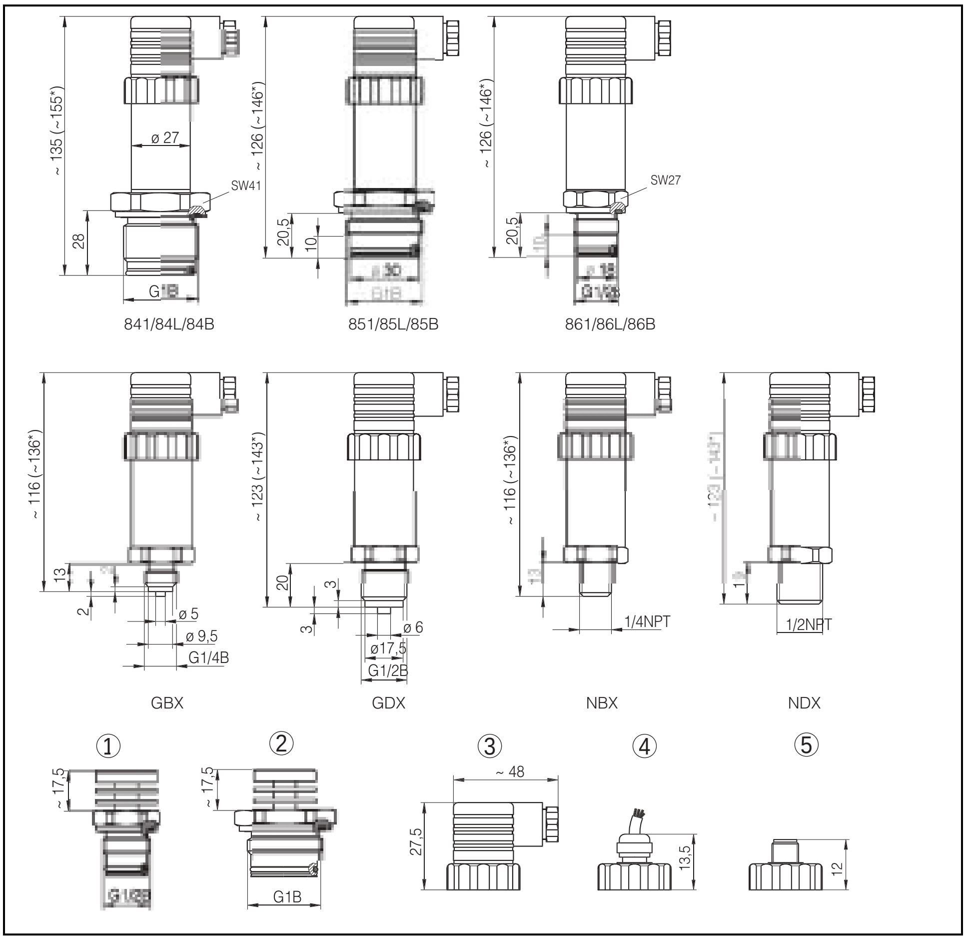

Fig. 7: VEGABAR 17

1. *Cooling element G½B*
2. *Cooling element G1B*
3. *Plug acc. to DIN 43650A*
4. *Cable outlet*
5. *Plug M12x1*

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8 Product code

Information:
The product codes shown here are only an excerpt from the list of all possible product versions. You will find detailed information in the VEGA product catalogue or under **www.vega.com**.

VEGABAR 14

Approval
.X without
.Z Ex Zone2

Pressure/Measuring range
1S Gauge pressure/0...0.1 bar(0...10 kPa)
1T Gauge pressure/0...0.25 bar(0...25 kPa)
1U Gauge pressure/0...0.4 bar(0...40 kPa)
1V Gauge pressure/0...0.6 bar(0...60 kPa)
1A Gauge pressure/0...1 bar(0...100 kPa)
1B Gauge pressure/0...1.6 bar(0...160 kPa)
1C Gauge pressure/0...2.5 bar(0...250 kPa)
1D Gauge pressure/0...4 bar(0...400 kPa)
1E Gauge pressure/0...6 bar(0...600 kPa)
1F Gauge pressure/0...10 bar(0...1000 kPa)
1G Gauge pressure/0...16 bar(0...1600 kPa)
1H Gauge pressure/0...25 bar(0...2500 kPa)
1I Gauge pressure/0...40 bar(0...4000 kPa)
1J Gauge pressure/0...60 bar(0...6000 kPa)
3T Gauge pressure/-0.1...+0.1 bar(-10...+10 kPa)
3U Gauge pressure/-0.2...+0.2 bar(-20...+20 kPa)
3A Gauge pressure/-0.5...+0.5 bar(-50...+50 kPa)
3B Gauge pressure/-1...+0.6 bar(-100...+60 kPa)
3W Gauge pressure/-1...+1 bar(-100...+100 kPa)
3C Gauge pressure/-1...+1.5 bar(-100...+150 kPa)
3D Gauge pressure/-1...+3 bar(-100...+300 kPa)
3E Gauge pressure/-1...+5 bar(-100...+500 kPa)
3F Gauge pressure/-1...+9 bar(-100...+900 kPa)
3G Gauge pressure/-1...+15 bar(-100...+1500 kPa)
2A Abs.pressure/0...1 bar(0..100kPa)
2B Abs.pressure/0...1.6 bar(0...160kPa)
2C Abs.pressure/0...2.5 bar(0...250kPa)
2D Abs.pressure/0...4 bar(0...400kPa)
2E Abs.pressure/0...6 bar(0...600kPa)
2F Abs.pressure/0...10 bar(0...1000kPa)
2G Abs.pressure/0...16 bar(0...1600kPa)

Electrical connection/Protection
A1 4-pole plug connection DIN43650-A PG9/IP65
C1 Direct cable outlet with 5 m cable/IP67
M1 Circular plug conn.,4-pole w.screwed plug M12x1/IP65

Process connection/Material
GV G½A,manometer connec. EN837 PN60 /316Ti
GP G½A inner G¼A PN60/316Ti
GN ½NPT inner ¼NPT PN60/316Ti
GB M20x1,5 manometer connection EN837 PN60/316Ti

Seal measuring cell
1 Viton
3 EPDM

BAR14					

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VEGABAR 17

Approval
- **Z** without
- **G** Ship approval
- **A** ATEX II 1/2G, 2G EEx ia IIC T6
- **D** ATEX II 1/2G, 2G EEx ia IIC T6+ATEX II 1/2D IP6X T+M1 [1)]
- **S** ATEX II 1/2G, EEx ia IIC T6 + Ship approval

Process connection
- **84L** Thread G1B, hygienic/316Ti, max.25 bar/Viton [2)]
- **84B** Thread G1B, hygienic/316Ti, max.25 bar/EPDM [2)]
- **851** Thread G1B,flush/316Ti w.o-ring, up to 1.6bar/NBR

Pressure
- **B** Gauge pressure
- **S** Absolute pressure [3)]

Measuring range
- **LA** -0.1...0 bar(-10...0 kPa)
- **XX**

Electrical connection/Protection
- **A4** Angle plug connector DIN43650/IP65
- **M4** Circular plug connector, 4-pole w. screwed plug M12x1
- **DL** Cable outlet/IP67
- **DM** Cable outlet/IP68
- **FW** Terminal housing 316L, plastic cable cland/IP67
- **FV** Terminal housing 316L, stainless steel cable cland/IP67

Cable length
- **Z** without
- **C** 1.5 m
- **E** 3 m
- **G** 5 m
- **I** 10 m

Features/Cleaning procedure
- **Z** without
- **E** oil and grease-free
- **A** oil and grease free for oxygen applications [4)]
- **G** Fill fluid and materials suitable for foodstuffs

Temperature range
- **A** -30...100˚C (standard product temperature)
- **B** -40...125˚C (product temperature)
- **C** -20...150˚C (product temperature, with cooling element)
- **U** -20...80˚C (ambient temperature with EEx ia) [5)]

Test certificate
- **Z** no
- **1** yes [6)]

BR17.									

1) only with Electrical Connection/Protection "DM"
2) Only with temperature range "C "
3) Only for measuring ranges 0...0.25 bar up to 0...16 bar
4) Medium temperature max. 60˚C
5) See EC type approval certificate
6) Price and delivery time on request

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E-Mail: info@de.vega.com
www.vega.com

You can find at **www.vega.com**
downloads of the following
- operating instructions manuals
- menu schematics
- software
- certificates
- approvals

and much, much more

29730-EN-041110

Operating Instructions

VEGABAR 14

Document ID:
22441

Process pressure

Contents

22441-EN-111006

Supplementary documentation

Information:
Supplementary documents appropriate to the ordered version come with the delivery. You can find them listed in chapter "*Product description*".

Instructions manuals for accessories and replacement parts

Tip:
To ensure reliable setup and operation of your VEGABAR 14, we offer accessories and replacement parts. The corresponding documentations are:

- 32036 - Welded socket and seals

Editing status: 2011-09-23

22441-EN-111006

1 About this document

1.1 Function

This operating instructions manual provides all the information you need for mounting, connection and setup as well as important instructions for maintenance and fault rectification. Please read this information before putting the instrument into operation and keep this manual accessible in the immediate vicinity of the device.

1.2 Target group

This operating instructions manual is directed to trained qualified personnel. The contents of this manual should be made available to these personnel and put into practice by them.

1.3 Symbolism used

Information, tip, note
This symbol indicates helpful additional information.

Caution: If this warning is ignored, faults or malfunctions can result.
Warning: If this warning is ignored, injury to persons and/or serious damage to the instrument can result.
Danger: If this warning is ignored, serious injury to persons and/or destruction of the instrument can result.

Ex applications
This symbol indicates special instructions for Ex applications.

•

List
The dot set in front indicates a list with no implied sequence.

→

Action
This arrow indicates a single action.

1

Sequence
Numbers set in front indicate successive steps in a procedure.

2244I-EN-111006

2 For your safety

2.1 Authorised personnel

All operations described in this operating instructions manual must be carried out only by trained specialist personnel authorised by the plant operator.

During work on and with the device the required personal protective equipment must always be worn.

2.2 Appropriate use

VEGABAR 14 is a pressure transmitter for measurement of gauge pressure, absolute pressure and vacuum.

You can find detailed information on the application range in chapter "*Product description*".

Operational reliability is ensured only if the instrument is properly used according to the specifications in the operating instructions manual as well as possible supplementary instructions.

For safety and warranty reasons, any invasive work on the device beyond that described in the operating instructions manual may be carried out only by personnel authorised by the manufacturer. Arbitrary conversions or modifications are explicitly forbidden.

2.3 Warning about misuse

Inappropriate or incorrect use of the instrument can give rise to application-specific hazards, e.g. vessel overfill or damage to system components through incorrect mounting or adjustment.

2.4 General safety instructions

This is a high-tech instrument requiring the strict observance of standard regulations and guidelines. The user must take note of the safety instructions in this operating instructions manual, the country-specific installation standards as well as all prevailing safety regulations and accident prevention rules.

The instrument must only be operated in a technically flawless and reliable condition. The operator is responsible for trouble-free operation of the instrument.

During the entire duration of use, the user is obliged to determine the compliance of the necessary occupational safety measures with the current valid rules and regulations and also take note of new regulations.

2.5 Safety label on the instrument

The safety approval markings and safety tips on the device must be observed.

2.6 CE conformity

This device fulfills the legal requirements of the applicable EC guidelines. By attaching the CE mark, VEGA provides a confirmation of successful testing. You can find the CE conformity declaration in the download area of www.vega.com.

2.7 Measuring range - permissible process pressure

Due to the application, a measuring cell with a measuring range higher than the permissible pressure range of the process fitting may have been integrated. The permissible process pressure is stated with "Process pressure" on the type label, see chapter 3.1 "*Configuration*". For safety reasons, this range must not be exceeded.

2.8 Fulfillment of NAMUR recommendations

With respect to interference resistance and emitted interference, the NAMUR recommendation NE 21 is fulfilled.

2.9 Safety instructions for Ex areas

Please note the Ex-specific safety information for installation and operation in Ex areas. These safety instructions are part of the operating instructions manual and come with the Ex-approved instruments.

2.10 Environmental instructions

Protection of the environment is one of our most important duties. That is why we have introduced an environment management system with the goal of continuously improving company environmental protection. The environment management system is certified according to DIN EN ISO 14001.

Please help us fulfil this obligation by observing the environmental instructions in this manual:

- Chapter "*Packaging, transport and storage*"
- Chapter "*Disposal*"

3 Product description

3.1 Structure

Scope of delivery

The scope of delivery encompasses:

- VEGABAR 14 process pressure transmitter
- depending on the version, with plug connector, direct cable outlet or plug connector with connection cable
- Documentation
  - this operating instructions manual
  - Ex-specific "*Safety instructions*" (with Ex versions)
  - if necessary, further certificates

Structure

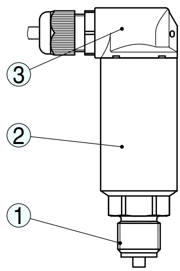

Fig. 1: VEGABAR 14 with cable outlet

1 Process fitting
2 Housing with electronics
3 Cable outlet

Type label

The type label contains the most important data for identification and use of the instrument:

- Article number
- Serial number
- Technical data
- Article numbers, documentation

With the serial number, you can access the delivery data of the instrument via www.vega.com, "*VEGA Tools*" and "*serial number search*". In addition to the type label outside, you can also find the serial number on the inside of the instrument.

3.2 Principle of operation

Application area

VEGABAR 14 is a pressure transmitter for measurement of gauge pressure, absolute pressure or vacuum. Measured products are gases, vapours and liquids.

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Functional principle

The sensor element is the CERTEC® measuring cell with rugged ceramic diaphragm. The process pressure causes a capacitance change in the measuring cell via the ceramic diaphragm. This change is converted into an appropriate output signal and outputted as measured value.

Voltage supply

Two-wire electronics 4 … 20 mA for power supply and measured value transmission over the same cable.

3.3 Operation

The instrument offers no adjustment options.

3.4 Packaging, transport and storage

Packaging

The device was protected by packaging during transport. Its capacity to handle normal loads during transport is assured by a test according to DIN EN 24180.

The packaging of standard instruments consists of environment-friendly, recyclable cardboard. For special versions, PE foam or PE foil is also used. Dispose of the packaging material via specialised recycling companies.

Transport

Transport must be carried out under consideration of the notes on the transport packaging. Nonobservance of these instructions can cause damage to the device.

Transport inspection

The delivery must be checked for completeness and possible transit damage immediately at receipt. Ascertained transit damage or concealed defects must be appropriately dealt with.

Storage

Up to the time of installation, the packages must be left closed and stored according to the orientation and storage markings on the outside.

Unless otherwise indicated, the packages must be stored only under the following conditions:

- Not in the open
- Dry and dust free
- Not exposed to corrosive media
- Protected against solar radiation
- Avoiding mechanical shock and vibration

Storage and transport temperature

- Storage and transport temperature see chapter "*Supplement - Technical data - Ambient conditions*"
- Relative humidity 20 … 85 %

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4 Mounting

4.1 General instructions

Suitability for the process conditions

Make sure that all parts of the instrument exposed to the process, in particular the sensor element, process seal and process fitting, are suitable for the existing process conditions. These include above all the process pressure, process temperature as well as the chemical properties of the medium.

You can find the specifications in chapter "*Technical data*" or on the type label.

4.2 Instructions for installation

Mounting position

VEGABAR 14 functions in any installation position. It is mounted according to the same directives as a manometer (DIN EN 839-2).

Information:
We recommend using lock fittings, measuring instrument holders and siphons from our line of accessories.

4.3 Mounting steps

Welding the socket

For mounting VEGABAR 14, a welded socket is required. You can find these components in the supplementary instructions manual "*Welded socket and seals*".

Sealing/Screwing in

Use the attached seal:

- Process fitting GV, GB and GP

- or -

Seal the thread with teflon, hemp or a similar resistant seal material:

- Process fitting GN

→ Screw VEGABAR 14 into the welded socket. Tighten the hexagon screw on the process fitting. Wrench size, see chapter "*Dimensions*", torque see chapter "*Technical data*".

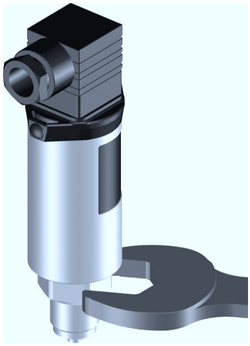

Fig. 2: Installation of VEGABAR 14

5 Connecting to power supply

5.1 Preparing the connection

Note safety instructions

Always keep in mind the following safety instructions:

- Connect only in the complete absence of line voltage
- If voltage surges are expected, install overvoltage arresters

Tip:
We recommend VEGA overvoltage arrester ÜSB 62-36G.X.

Take note of safety instructions for Ex applications

In hazardous areas you must take note of the respective regulations, conformity and type approval certificates of the sensors and power supply units.

Select power supply

The supply voltage and the current signal are carried on the same two-wire connection cable.

Provide a reliable separation between the supply circuit and the mains circuits according to DIN VDE 0106 part 101.

VEGA power supply units VEGATRENN 149AEx, VEGASTAB 690, VEGADIS 371 as well as all VEGAMETs meet this requirement. When using one of these instruments, protection class III is ensured for VEGABAR 14.

Keep in mind the following additional factors that influence the operating voltage:

- Output voltage of the power supply unit can be lower under nominal load (with a sensor current of 20.5 mA or 22 mA in case of fault message)
- Influence of additional instruments in the circuit (see load values in chapter "*Technical data*")

Select connection cable

The instrument is connected with standard two-wire cable without screen. If electromagnetic interference is expected which is above the test values of EN 61326 for industrial areas, screened cable should be used.

Use cable with round cross-section. A cable outer diameter of 5 … 9 mm (0.2 … 0.35 in) ensures the seal effect of the cable gland. If you are using cable with a different diameter or cross-section, exchange the seal or use a suitable cable gland.

Cable screening and grounding

Connect the cable screen on both ends to ground potential.

If potential equalisation currents are expected, the connection on the processing side must be made via a ceramic capacitor (e. g. 1 nF, 1500 V). The low frequency potential equalisation currents are thus suppressed, but the protective effect against high frequency interference signals remains.

Warning:
Within galvanic plants as well as vessels with cathodic corrosion protection there are considerable potential differences. Considerably equalisation currents can be caused via the cable scrren when the screen is earthed on both ends. To avoid this, the cable screen must only connected to ground potential on one side of the switching cabinet in such applications. The cable screen must **not** be connected to the internal ground terminal in the sensor and the outer ground terminal on the housing **not** to the potential equalisation!

Information:
The metal parts of the instrument (antenna, transmitter, concentric tube, etc.) are conductive connected with the inner and outer ground terminal on the housing. This connection exists either directly metallic or with instruments with external electronics via the screen of the special connection cable. You can find specifications to the potential connections within the instrument in chapter "*Technical data*".

Select connection cable for Ex applications

Take note of the corresponding installation regulations for Ex applications.

5.2 Connection procedure

Connection via angle plug connector

Proceed as follows:

1 Loosen the screw on the rear of the plug connector
2 Remove the plug connector and seal from VEGABAR 14
3 Remove the plug insert out of the plug housing

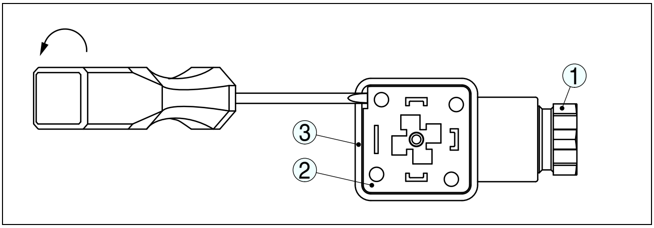

Fig. 3: Loosen the plug insert

1 Cable gland
2 Plug insert
3 Plug housing

4 Remove approx. 5 cm of the cable mantle, strip approx. 1 cm insulation from the individual wires
5 Lead the cable through the cable gland into the plug housing
6 Connect the wire ends to the screw terminals according to the wiring plan

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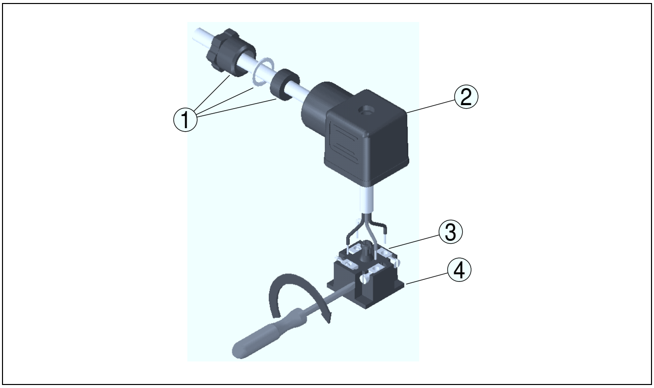

Fig. 4: Connection to the screw terminals

1 Cable gland
2 Plug housing
3 Plug insert
4 Plug seal

7 Snap the plug insert into the plug housing and insert the sensor seal
8 Plug the plug insert with seal to VEGABAR 14 and tighten the screw

The electrical connection is finished.

Connection via angle plug connector with hinged cover

Proceed as follows:

1 Loosen the screw in the cover of the plug connector
2 Open the cover and remove it
3 Press the plug insert downwards
4 Loosen the screws of the strain relief and cable entry

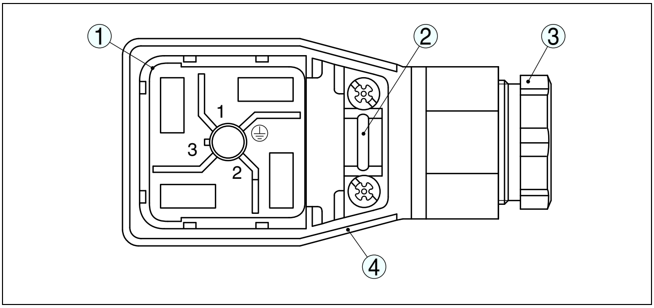

Fig. 5: Loosen the plug insert

1 Plug insert
2 Strain relief
3 Cable gland
4 Plug housing

5 Remove approx. 5 cm of the cable mantle, strip approx. 1 cm insulation from the individual wires

6 Lead the cable through the cable gland into the plug housing

7 Connect the wire ends to the screw terminals according to the wiring plan

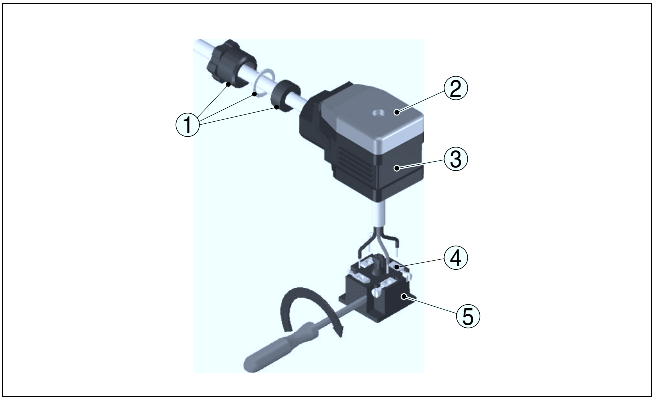

Fig. 6: Connection to the screw terminals

1 Cable gland
2 Cover
3 Plug housing
4 Plug insert
5 Plug seal

8 Snap the plug insert into the plug housing and insert the sensor seal

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Information:
Note the correct arrangement, see illustration

9 Tighten the screws on the strain relief and cable entry
10 Hook in the cover and push onto the plug connection, tighten cover screw
11 Plug the plug insert with seal to VEGABAR 14 and tighten the screw

The electrical connection is finished.

5.3 Wiring plan

Angled plug connector according to ISO 4400

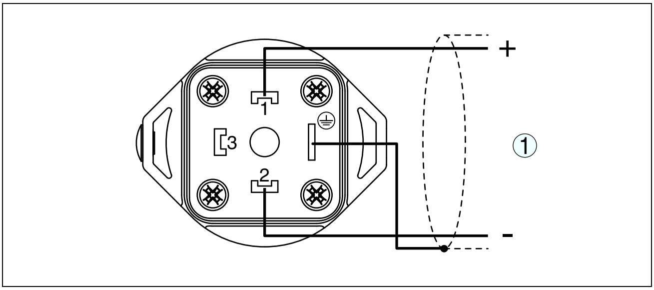

Fig. 7: Wiring plan plug connector according to ISO 4400, view to the connection on the instrument side

1 Voltage supply and signal output

Round plug connector M12 x 1

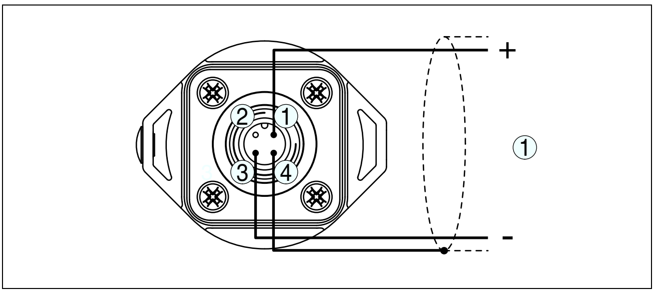

Fig. 8: Wiring plan round plug connector M12 x 1, view to the connection on the instrument side

1 Voltage supply and signal output

Connection via confectioned cable with 4-pin socket M12 x 1
As an option, the instrument is supplied with a confectioned cable with 4-pin socket M12 x 1. The following table shows the wire assignment of the socket.

Wire colour	Connector
Brown	1
White	2
Blue	3
Black	4

Direct cable outlet

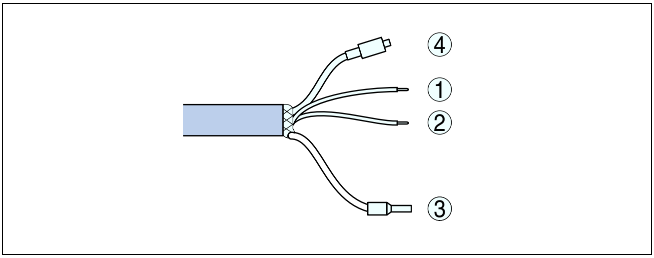

Fig. 9: Wiring plan cable outlet[1)]

1 *brown (+) power supply and signal output*
2 *blue (-) power supply and signal output*
3 *Cable screening*
4 *Breather capillaries*

5.4 Switch-on phase

After connecting VEGABAR 14 to power supply or after a voltage recurrence, the instrument carries out a self-check:

- Internal check of the electronics
- 4 … 20 mA output jumps to the fault signal 22 mA

Then VEGABAR 14 delivers a current of 4 … 20 mA to the cable. The value corresponds to the actual level as well as to settings already carried out, e.g. the factory setting.

1) The other cables are not connected.

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6 Set up

6.1 Setup steps

After mounting and electrical connection, VEGABAR 14 is ready for operation.

VEGABAR 14 delivers a current of 4 … 20 mA corresponding to the actual process pressure.

Further settings are not necessary.

7 Maintenance and fault rectification

7.1 Maintenance

If the instrument is used properly, no special maintenance is required in normal operation.

7.2 Remove interferences

Reaction when malfunctions occur

The operator of the system is responsible for taking suitable measures to rectify faults.

Failure reasons

VEGABAR 14 offers maximum reliability. Nevertheless, faults can occur during operation. These may be caused by the following, e.g.:

- Sensor
- Process
- Voltage supply
- Signal processing

Fault rectification

The first measure to be taken is to check the output signal. In many cases, the causes can be determined this way and the faults rectified.

24 hour service hotline

Should these measures not be successful, please call in urgent cases the VEGA service hotline under the phone no. **+49 1805 858550**.

The hotline is available to you 7 days a week round-the-clock. Since we offer this service world-wide, the support is only available in the English language. The service is free of charge, only the standard telephone costs will be charged.

Checking the 4 … 20 mA signal

? 4 … 20 mA signal not stable

- no atmospheric pressure compensation

→ Check the pressure compensation in the plug or via the capillaries

? No 4 … 20 mA signal

- Connection to voltage supply wrong

→ Check connection according to chapter "*Connection steps*" and if necessary, correct according to chapter "*Wiring plan*"

- No voltage supply

→ Check cables for breaks; repair if necessary

- Operating voltage too low or load resistance too high

→ Check, adapt if necessary

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? Current signal 22 mA

- electronics module or measuring cell defective
- → Exchange the instrument or send it in for repair

In Ex applications, the regulations for the wiring of intrinsically safe circuits must be observed.

Reaction after fault rectification

Depending on the reason for the fault and the measures taken, the steps described in chapter "*Set up*" may have to be carried out again.

7.3 Instrument repair

If a repair is necessary, please proceed as follows:

You can download a return form (23 KB) from our Internet homepage www.vega.com under: "*Downloads - Forms and certificates - Repair form*".

By doing this you help us carry out the repair quickly and without having to call back for needed information.

- Print and fill out one form per instrument
- Clean the instrument and pack it damage-proof
- Attach the completed form and, if need be, also a safety data sheet outside on the packaging
- Please ask the agency serving you for the address of your return shipment. You can find the respective agency on our website www.vega.com under: "*Company - VEGA worldwide*"

8 Dismounting

8.1 Dismounting steps

Warning:
Before dismounting, be aware of dangerous process conditions such as e.g. pressure in the vessel, high temperatures, corrosive or toxic products etc.

Take note of chapters "*Mounting*" and "*Connecting to power supply*" and carry out the listed steps in reverse order.

8.2 Disposal

The instrument consists of materials which can be recycled by specialised recycling companies. We use recyclable materials and have designed the electronics to be easily separable.

WEEE directive 2002/96/EG
This instrument is not subject to the WEEE directive 2002/96/EG and the respective national laws. Pass the instrument directly on to a specialised recycling company and do not use the municipal collecting points. These may be used only for privately used products according to the WEEE directive.

Correct disposal avoids negative effects on humans and the environment and ensures recycling of useful raw materials.

Materials: see chapter "*Technical data*"

If you have no way to dispose of the old instrument properly, please contact us concerning return and disposal.

9 Supplement

9.1 Technical data

General data

Parameter, pressure	Gauge pressure, absolute pressure, vacuum
Measuring principle	Ceramic-capacitive, dry measuring cell
Communication interface	None

Materials and weights

Materials, wetted parts	
– Process fitting	316L, PVDF
– Diaphragm	sapphire ceramic® (99.9 % oxide ceramic)
– Measuring cell seal	FKM (VP2/A), EPDM (A+P 75.5/KW75F)
Materials, non-wetted parts	
– Electronics housing	brass, nickel-plated
Materials, non-wetted parts, version with plug connector ISO 4400	
– Contact, housing plug	PA
– Cover screw	StSt
– Contact surface	Sn
– Plug seal	Silicone
Materials, non-wetted parts, version with plug connector M12 x 1	
– Contact support	PA
– Contacts	CuZn, nickel layer and 0.8 µm gold-plated
– Plug seal	FKM
Materials, non-wetted parts, connection cable with plug connector M12 x 1 (optional)	
– Grip body, plug connector	PA
– Compression nut	Zinc die casting
– Cable/wire insulation	PVC
Materials, non-wetted parts, verson with cable outlet	
– Cable gland	PA
– Cable	PE
Ohmic contact	Between ground terminal, housing and process fitting
Torque max.[2]	50 Nm (36.88 lbf ft)
Weight approx.	0.25 kg (0.55 lbs)

Output variable

Output signal	4 … 20 mA

2) With material process fitting 316L.

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Range	3.8 … 20.5 mA
Fault signal	22 mA
Signal resolution	5 µA
Max. output current	22 mA
Run-up time	approx. 2 s
Dead time	≤ 10 ms
Step response time	≤ 20 ms (0 … 63 %)

Input variable

The overload specifications are only an overview and refer to the measuring cell. Limitations due to material and process fitting version are possible. The specifications on the type label are applicable.

Nominal range	Overload capacity, max. pressure	Overload capacity, min. pressure
Gauge pressure		
0 … 0.05 bar/0 … 5 kPa	15 bar/1500 kPa	-0.2 bar/-20 kPa
0 … 0.1 bar/0 … 10 kPa	15 bar/1500 kPa	-0.2 bar/-20 kPa
0 … 0.25 bar/0 … 25 kPa	30 bar/3000 kPa	-0.8 bar/-80 kPa
0 … 0.4 bar/0 … 40 kPa	30 bar/3000 kPa	-0.8 bar/-80 kPa
0 … 0.6 bar/0 … 60 kPa	35 bar/3500 kPa	-1 bar/-100 kPa
0 … 1 bar/0 … 100 kPa	35 bar/3500 kPa	-1 bar/-100 kPa
0 … 1.6 bar/0 … 160 kPa	50 bar/5000 kPa	-1 bar/-100 kPa
0 … 2.5 bar/0 … 250 kPa	50 bar/5000 kPa	-1 bar/-100 kPa
0 … 4 bar/0 … 40 kPa	65 bar/6500 kPa	-1 bar/-100 kPa
0 … 6 bar/0 … 600 kPa	90 bar/9000 kPa	-1 bar/-100 kPa
0 … 10 bar/0 … 1000 kPa	90 bar/9000 kPa	-1 bar/-100 kPa
0 … 16 bar/0 … 1.6 MPa	130 bar/13 MPa	-1 bar/-100 kPa
0 … 25 bar/0 … 2.5 MPa	130 bar/13 MPa	-1 bar/-100 kPa
0 … 40 bar/0 … 4 MPa	200 bar/20 MPa	-1 bar/-100 kPa
0 … 60 bar/0 … 6 MPa	200 bar/20 MPa	-1 bar/-100 kPa
-0.1 … 0.1 bar/-10 … 10 kPa	20 bar/2000 kPa	-0.4 bar/-40 kPa
-0.2 … 0.2 bar/-20 … 20 kPa	30 bar/3000 kPa	-0.8 bar/-80 kPa
-0.5 … 0.5 bar/-50 … 50 kPa	35 bar/3500 kPa	-1 bar/-100 kPa
-1 … 0.6 bar/-100 … 60 kPa	50 bar/5000 kPa	-1 bar/-100 kPa
-1 … 1 bar/-100 … 100 kPa	50 bar/5000 kPa	-1 bar/-100 kPa
-1 … 1.5 bar/-100 … 150 kPa	50 bar/5000 kPa	-1 bar/-100 kPa
-1 … 3 bar/-100 … 300 kPa	65 bar/6500 kPa	-1 bar/-100 kPa
-1 … 5 bar/-100 … 500 kPa	90 bar/9000 kPa	-1 bar/-100 kPa
-1 … 9 bar/-100 … 900 kPa	90 bar/9000 kPa	-1 bar/-100 kPa
-1 … 15 bar/-100 … 1500 kPa	130 bar/13000 kPa	-1 bar/-100 kPa

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Nominal range	Overload capacity, max. pressure	Overload capacity, min. pressure
-1 … 25 bar/-1 … 2.5 MPa	130 bar/13 MPa	-1 bar/-100 kPa
-1 … 40 bar/-1 … 4 MPa	200 bar/20 MPa	-1 bar/-100 kPa
-1 … 60 bar/-1 … 6 MPa	200 bar/20 MPa	-1 bar/-100 kPa
Absolute pressure		
0 … 1 bar/0 … 100 kPa	35 bar/3500 kPa	
0 … 1.6 bar/0 … 160 kPa	50 bar/5000 kPa	
0 … 2.5 bar/0 … 250 kPa	50 bar/5000 kPa	
0 … 4 bar/0 … 400 kPa	65 bar/6500 kPa	
0 … 6 bar/0 … 600 kPa	90 bar/9000 kPa	
0 … 10 bar/0 … 1 MPa	90 bar/9 MPa	
0 … 16 bar/0 … 1.6 MPa	130 bar/13 MPa	
0 … 25 bar/0 … 2.5 MPa	200 bar/20 MPa	
0 … 40 bar/0 … 4 MPa	200 bar/20 MPa	
0 … 60 bar/0 … 6 MPa	200 bar/20 MPa	

Reference conditions and actuating variables (similar to DIN EN 60770-1)

Reference conditions according to DIN EN 61298-1

- Temperature +15 … +25 °C (+59 … +77 °F)
- Relative humidity 45 … 75 %
- Air pressure 860 … 1060 mbar/86 … 106 kPa (12.5 … 15.4 psi)

Determination of characteristics Limit point adjustment according to IEC 61298-2

Characterstic curve Linear

Reference installation position upright, diaphragm points downward

Influence of the installation position < 0.2 mbar/20 Pa (0.003 psig)

Deviation determined according to the limit point method according to IEC 60770[3]

Deviation < 0.3 %

Influence of the ambient temperature[4]

Average temperature coefficient of the zero signal[5] < 0.15 %/10 K

Long-term stability (similar to DIN 16086, DINV 19259-1 and IEC 60770-1)

Long-term drift of the zero signal[6] < 0.1 %/2 years

3) Relating to the nominal measuring range, incl. non-linearity, hysteresis and non-reproducibility.
4) Relating to the nominal measuring range.
5) In the compensated temperature range of 0 … +80 °C (+32 … +176 °F), reference temperature 20 °C (68 °F).
6) Relating to the nominal measuring range.

Ambient conditions

Ambient temperature	
– Version with plug connector	-20 … +85 °C (-4 … +185 °F)
– Version with cable outlet	-20 … +60 °C (-4 … +140 °F)
Storage and transport temperature	
– Version with plug connector	-40 … +100 °C (-40 … +212 °F)
– Version with cable outlet	-40 … +60 °C (-40 … +140 °F)

Process conditions

The specifications of the pressure stage and the product temperature are used as an overview. The specifications of the type label are applicable.

Pressure stage, process fitting	
– Thread 316L	PN 60
– Thread PVDF	PN 10
Product temperature depending on the measuring cell seal	
– FKM (VP2/A)	-20 … +100 °C (-4 … +212 °F)
– EPDM (A+P 75.5/KW75F)	-40 … +100 °C (-40 … +212 °F)
Vibration resistance	mechanical vibrations with 4 g and 5 … 100 Hz[7)]

Electromechanical data

Angled plug connector	
– Version	4-pin according to ISO 4400
– Screw terminals for cable cross-section up to	2.5 mm^2 (AWG 14)
– Cable gland	M16 (for cable: ø 4.5 … 10 mm)
Circular plug connector	4-pin with screwed connection M12 x 1
Cable outlet	
– Length	5 m (16.4 ft)
– Min. bending radius	25 mm (with 25 °C/77 °F)
– Diameter approx.	6 mm

Voltage supply

Operating voltage	8 … 30 V DC
Permissible residual ripple	$U_{ss} < 1$ V
Load	see diagram

7) Tested according to the guidelines of German Lloyd, GL directive 2.

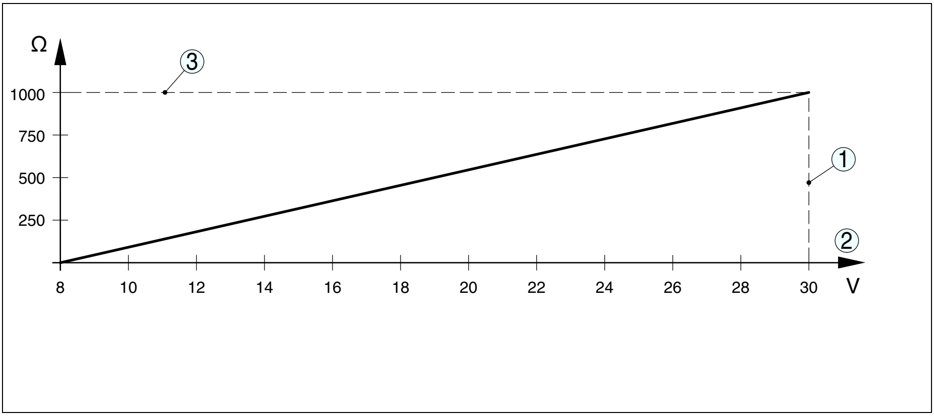

Fig. 10: Voltage diagram

1 Voltage limit
2 Operating voltage
3 Max. load

Electrical protective measures

Protection rating[8]	
– With plug M12 x 1 or according to ISO 4400	IP 65
– with direct cable outlet	IP 67
Protection class	III
Overvoltage category	III

Approvals

Instruments with approvals can have different technical data depending on the version.

That's why the associated approval documents have to be noted with these instruments. They are part of the delivery or can be downloaded under www.vega.com via "*VEGA Tools*" and "*serial number search*" as well as via "*Downloads*" and "*Approvals*".

8) According to EN 60529/IEC 529.

9.2 Dimensions

VEGABAR 14

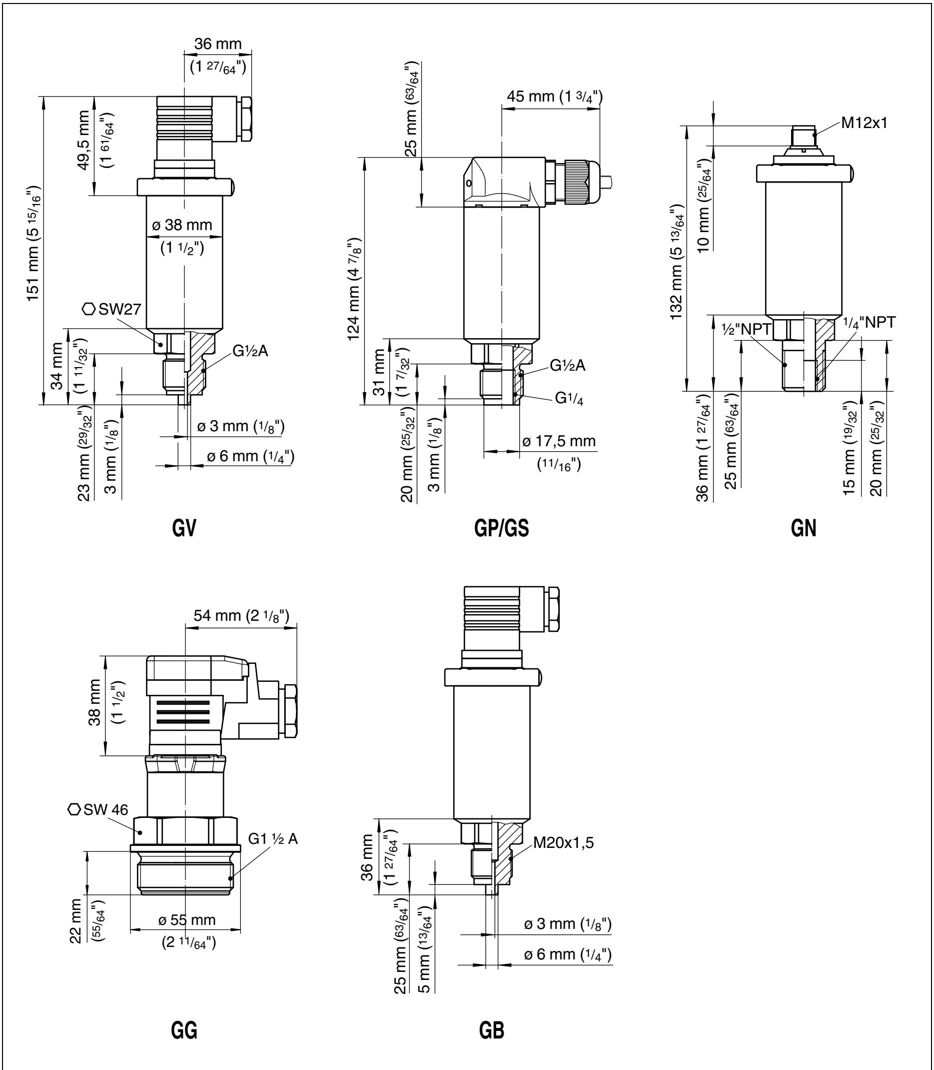

Fig. 11: VEGABAR 14 GV = G½ A manometer connection EN 837, version with angled plug connector, GP/GS = G½ A inner G¼ A, version with cable outlet, GN = ½ NPT, version with round plug connector, GG = G1½ A, version with angled plug connector with hinged cover, GB = M20 x 1.5 manometer connection EN 837, version with angled plug connector

9.3 Industrial property rights

VEGA product lines are global protected by industrial property rights. Further information see http://www.vega.com.

Only in U.S.A.: Further information see patent label at the sensor housing.

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9.4 Trademark

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All statements concerning scope of delivery, application, practical use and operating conditions of the sensors and processing systems correspond to the information available at the time of printing.

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TABLE OF CONTENTS

1. INSTALLATION

1.1 GENERAL

The aerators are to be stored in their original packaging, in a dry, ventilated room, in compliance with DIN 7716. Do not store them in the open!

1.1.1 INSPECTION

Every aerator, especially the membrane, must be checked for damage. For pipe aerators, a check on the stainless steel clips should also be carried out to ensure that they are firmly seated.

1.1.2 INSTALLATION PREPARATION

Care should be taken when opening the carton boxes using box cutter so that the aerators will not be accidentally damaged. When the carton box is opened, aerators should not be poured onto the concrete tank base. This could cause damage to the membrane.

1.1.3 CLEANING OF PIPE WORK

Once the air distribution pipes are connected to the main air distribution pipe, the pipe work is to be flushed for at least 10 minutes using compressed air in order to remove residues and dirt trapped in the pipe work.

Open all down pipe valves prior to start-up of the blowers and ensure that there is no obstruction in the pipe work. Provide an opening at the end of the air distribution pipes to allow air and foreign materials to be discharged from the system. The opening may be made at the end of the air distribution pipe by leaving the end cap off.

In order to increase the velocity of air through the header and air distribution pipes, it may be desirable to operate at maximum blower capacity. In addition, it may be necessary to close some of the isolation valves at the down pipes to achieve a high velocity through the balance of the air distribution pipes that are open to the atmosphere. A high velocity is required in order to blow out any accumulated foreign matter.

As air distribution pipes are consecutively cleaned, the isolation valves are operated in a manner that allows the remaining air distribution pipes to be cleaned by an air purge. Upon completion of the air purge, the blowers are shut down and the air distribution pipes are capped and purge lines shut off. RAUBIOXON Plus or RAUBIOFLEX aerators are then installed on air distribution pipes. All isolation valves are opened prior to filling the aeration tank with water.

Objects such as stones, pieces of wood, etc. are to be removed from the treatment tank. Also, no welding, painting, concrete sealing should be carried out after the aerators have been connected to the air distribution pipes. If such work cannot be avoided, all aerators have to be protected by a thick plastic sheet while the work is being carried out.

1.2 INSTALLATION OF AERATORS

1.2.1 STANDARD PIPE AERATOR

An installation adaptor (Figure 1) with a ½" square opening is required for installing the standard pipe aerator. A screwdriver with a shaft diameter of between 5 to 6 mm can be placed in the slot in the opposite pipe aerator so that it does not rotate during tightening of the pipe aerator. The tightening of

Figure 1: Installation adaptor

the pipe aerator is carried out using a ratchet wrench with ½" square bit.

1.2.1.1 CONNECTOR FOR THE INSTALLATION OF STANDARD PIPE AERATOR

Depending on the size of the air distribution pipes, the threaded stainless steel rods (M10) as shown in Table 1 are to be used.

Article number	Thread rod length (mm)	Air distribution pipes
279888	210	80 x 80
279898	230	100 x 100
279908	250	120 x 120

Table 1: Threaded rod lengths and corresponding size of square distribution pipes

A pair of standard pipe aerators is to be installed as follows:

1. The threaded rod M10 is screwed into the female threaded insert of the pipe aerator until it is hand tight (about 1 cm deep) (Figure 2).
   Do not apply lubricant to the EPDM seals!
2. Once inserted into the female insert, the pipe aerator is tightened using a ratchet wrench equipped with the installation adaptor and a screwdriver as a counter-brace on the other end.
   The pipe aerator cannot be tightened by hand because the membrane will be twisted. This is not permissible.
3. One pipe aerator is fixed in position by using a screwdriver (Figure 3). The screwdriver should be held in upright position.
4. The other pipe aerator is to be tightened to a maximum torque of 35 Nm (Figure 4). This can be checked using a torque wrench.

Figure 2: Threaded rod screwed into the pipe aerator distribution pipes

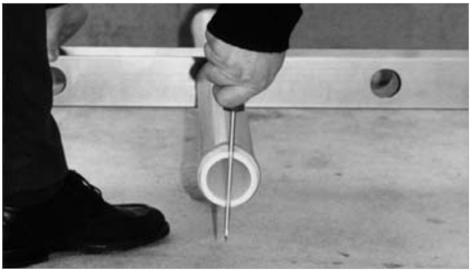

Figure 3: Align with screwdriver

Figure 4: Tighten with torque wrench

5. Depending on the position of the membrane groove when the torque wrench is engaged, the pipe aerator should only be rotated by a maximum of half a turn in order to bring the membrane groove in an upright position.
   Please note: The membrane groove may deviate from the vertical position by maximum ±10° (Figure 5).
6. If the seal is not compressed evenly, the tightening process has to be repeated with a new seal.

1.2.1.2 CONNECTION TO EXISTING SQUARE AIR DISTRIBUTION PIPE

If the diameter of the opening in the square air distribution pipe is not 45 mm, a PP adaptor ring with EPDM seal is to be added onto the pipe aerator to ensure that the connection to the air distribution pipe is tight.

With the addition of such adaptor on each side of the air distribution pipe, the length of the threaded rod has to be increased by about 20 mm

1.2.1.3 CONNECTION TO ROUND AIR DISTRIBUTION PIPE

To connect the pipe aerator to round air distribution pipe, a PP adaptor with EPDM seal is required. (Figure 6 and Table 2) As a result of using the adaptor, the length of the threaded rod has to be increased as shown in Table 3.

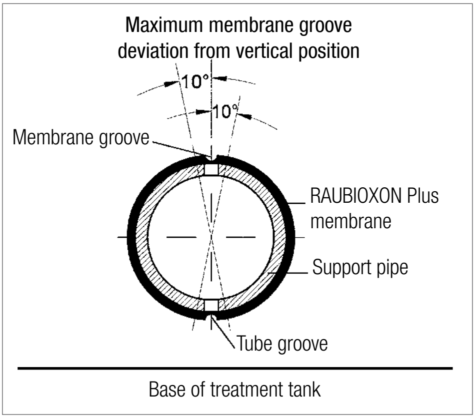

Figure 5: Positioning of pipe aerator

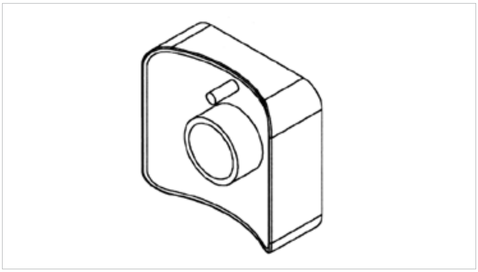

Figure 6: Adaptor for round pipe

Article number	Pipe DN
233511	80
233521	100
235936	125
235946	150

Table 2: Article numbers of adaptors for various pipe sizes

Article number	Thread rod length	Pipe DN
236684	255 mm	80
236694	275 mm	100
On request	305 mm	125
On request	325 mm	150

Table 3: Threaded rod lengths and corresponding size of round distribution pipes

1.2.2 INSTALLATION OF DUO PIPE AERATORS

Assembling the DUO pipe aerator onto a round distribution pipe is generally more straight forward as compared to the standard pipe aerator assembly. Note: DUO pipe aerators can only be installed on DN80 and DN100 round air distribution pipes.

Prior to the assembly of DUO pipe aerator, openings 30 -0/+1 mm are to be made on both sides of the air distribution pipe. The center of both openings must be in line with each other (max deviation: ± 0.5mm). Thereafter, the air distribution pipes are to be laid horizontal and adjusted to the same height. An even air bubble distribution depends on good leveling of the air distribution pipes.

Remove the DUO pipe aerator from the carton box, unfold and place it over the openings of the air distribution pipe (Figure 7). O-rings which are provided separately are to be inserted into the allocated slots of the connection saddle.

Straighten the DUO pipe aerator such that the centering rings of the saddle lock into the openings of the air distribution pipe (Figure 8).

Place the free ends of the fastener in the recess of the saddle and press it down till it spans into position (Figure 9). Figure 10 shows the photograph of the locked saddle.

Figure 7: DUO pipe aerator in opened configuration

Figure 8: DUO pipe aerator in closed configuration

Figure 9: Locking the saddle with a fastener

Figure 10: Bottom view of locked saddle

1.2.3 INSTALLATION OF DISC AERATORS

Standard PVC pipes of pressure rating PN10 or PN16 have to be used as air lateral pipes. Grommet has to be used as connectors between the disc aerator and the air distribution pipe (Figure 11). Their size has to match the pressure rating (wall thickness) of the air lateral pipes. All air lateral pipes must be leveled within ±5 mm for proper function of the diffusers. In order to assemble the grommet holes in air lateral pipes, openings with diameter of 32 ±0.15 mm must be pre-drilled. Vertical alignment of the holes has to be within ±3°. All holes must be deburred. Remove all internal debris from within the laterals with a water flush through the laterals. The grommets should be installed before the air lateral pipes are mounted to the tank base.

To ease installation the grommet may be wetted with lubricant. Recommended lubricants are commercial-grade, water-based soap or regular household detergents. Do not use lubricants containing mineral oils or other hydrocarbons. The lubricant is applied onto the outer surface of the grommet from the bottom up to the rim. Other surfaces must not be in contact with lubricants. Press the grommet into the hole and it snaps into the opening. To ease installation, we recommend a rubber mallet. (Figure 12) Press the disc slightly with its NPT thread into the grommet until it reaches the thread of the grommet. Attention should be paid to a horizontal alignment of the disc aerator. Then turn the disc clockwise until the lower rim of the disc aerator touches the top of the grommet. (Figure 13 & 14) In case of rotation of the grommet, use the special retaining clip.

Figure 11: Grommet

Figure 12: Grommet Installation into a 32mm hole

Figure 13: Disc aerator Installation

Figure 14: Bottom view of installed disc aerator

1.3 ADJUSTMENT OF AERATORS AND AIR DISTRIBUTION PIPE

1.3.1 ADJUSTMENT OF AERATORS

Pipe aerator

Air distribution through the pipe aerators is a function of the individual pipe aerator elevation. For proper system operation, REHAU recommends a leveling tolerance of ± 20 mm between the two ends of each pipe aerator 1 meter long. If the pipe aerators are mounted with excessive elevation deviation, the airflow distribution in the system will be adversely impacted.

Disc aerator

Ensure that the grommet is firmly installed on the air distribution pipe and the disc aerator is firmly seated onto the installed grommet. The membrane surface of the installed disc aerator should be parallel to the tank base.

1.3.2 ADJUSTMENT OF AIR DISTRIBUTION PIPE

Due to possible unevenness of the tank base, each individual air distribution pipe has to be adjusted vertically through adjusting the stainless steel pipe clamp so that as far as possible the air distribution pipe should be horizontal. REHAU recommends a leveling tolerance of ± 10 mm between both ends of each air distribution pipe.

2. COMMISSIONING

2.1 GENERAL

These instructions cover the general commissioning requirements for the aeration system. Special commissioning requirements outlined in the Engineer's specifications and contract documents shall be supplementary to or take precedent over these general instructions.

2.2 TRIAL

A trial of the aeration system should be carried out as soon as possible after installation of the aerators. Start filling the aeration tank with clean water up to the level of the aerators. Confirm that all aerators are level with the water level. Should height difference between air distribution pipe and water level be greater than 10 mm, adjust height of air distribution pipe in order to correct height difference.

Continue filling the aeration tank with water until the water level is about 20 cm above the aerators. Activate the blower and introduce air to the aeration system, starting with low airflow rate of around the lower airflow limit of the aerator. Check pipe work and aerator joints for leaks. If there is a major leak in the pipe work or connection between air distribution pipe and aerator, drain water to a level, which allows the leak to be exposed and carry out repair. Thereafter, repeat the checking procedure by increasing the water level back to 20 cm above the aerator. When no major leak is detected, cut off the air supply to each individual air distribution pipe by closing the isolation valve at the down pipe one at a time and look out for rising of air bubble from the pipe aerator joints.

2.3 OXYGEN TRANSFER MEASUREMENT

Prior to taking oxygen transfer measurement, the aeration process is to be continued for a period of at least 48 hours at a specific airflow rate of at least 8 $Nm^3/h{*}m_{\text{pipe aerator}}$ in order to ensure that the aerators function properly. Otherwise, the latest version of the wastewater purification regulations, ATV M209 shall apply.

2.4 IDLE TIME, PRIOR TO CONTINUOUS OPERATION

If the aerators are not taken into operation immediately following the commissioning of the aeration system, then the depth of water above the pipe aerators is to be increased to 1 m. This depth of water must be maintained until the equipment is finally put into operation. Ensure that the water level does not drop significantly as a result of evaporation.

If there is frost, the depth of water above the pipe aerators must be at least 10% of the minus temperature of the water.

Example:
At -20°C, water height above the pipe aerators = 2m.

OPERATION 3.

3.1 GENERAL

The aeration system is normally designed to provide uniform distribution of air without requiring adjustment of the isolation/throttling valves on the down pipes with the exception in situations where water level variation exists. These valves are typically provided for direct control of airflow distribution on large aeration systems or for process control.

The aerators have no moving parts and require very little maintenance for long-term operation. REHAU recommends that the air supply to the aerators be maintained at all times for optimum performance. The airflow to the aerators must be kept within the ranges to maintain the mechanical and operating characteristics of the aerator. Continuous application at high airflow rate, greater than that allowed for normal operation may result in physical damage to the membrane. Under no circumstances should the airflow indicated as maximum be exceeded unless approval is given by the REHAU Competence Team.

NOTE: Exercise caution when adjusting several lateral throttling valves in the same piping system. This procedure can result in elevated airflows in sections of the aeration system, which may exceed the maximum allowable airflow to each pipe aerator.

The recommended operating airflow ranges for RAUBIOXON Plus and RAUBIOFLEX pipe aerators are as follows:

500 mm : 1 to 6 Nm^3/h

750 mm : 1.5 to 9 Nm^3/h

1,000 mm : 2 to 12 Nm^3/h

The recommended operating airflow ranges for RAUBIOXON Plus and RAUBIOFLEX disc aerators are as follows:

Dia. 200mm : 0.5 to 4 Nm^3/h

Dia. 300mm : 1.5 to 8 Nm^3/h

3.2 AIR SUPPLY

The air supply system has to be free of oil, dust and solvent and must include a filtration system. Dust filters for ambient dust are to be designed to achieve 90% filtration in conformity with EN 779, filter class G4. Air temperature at inlets may not exceed 80°C. Higher temperatures may be permitted in consultation with REHAU Competence Team.

3.3 NORMAL OPERATION OF THE AERATION SYSTEM

The following procedures should be followed on a regular basis to assure consistent and satisfactory performance of the aeration system. The airflow rate to the system may be adjusted to maintain the desired dissolved oxygen levels in the aeration tank. When adjusting the airflow rate, the aerators should be operated within the normal operating range. Excessive airflow rates will result in high-pressure loss across the aerators and reduced oxygen transfer performance. Airflow rates lower than the recommended minimum operation airflow may result in incomplete utilization of the aerators and uneven air distribution.

Positive dissolved oxygen concentrations should be present throughout the entire system during normal operation. A dissolved oxygen profile analysis may be used to confirm the performance of the aeration system. Typically, the dissolved oxygen levels are measured at the inlet, the outlet, and the midpoint locations of each aeration tank to determine the aeration system performance. In regulating the system airflow to control dissolved oxygen levels, the aerators should be operated within their minimum and maximum airflow limits.

3.4 VARYING WATER LEVEL OPERATIONS

In applications where water level variations may exist between aeration tanks supplied by a single blower, the isolation valves may need to be adjusted to maintain adequate airflow distribution. This normally requires throttling back the air to the aeration tank with the reduced water level. It is important to confirm the operating airflow range of the aerators before throttling back any isolation valve. Damage could result to the aerator if airflow is supplied for a long period of time above the recommendations enclosed herein. Please consult REHAU Competence Team to confirm operating at airflow rate higher than the maximum recommended value.

3.5 TROUBLE SHOOTING

Periodic visual inspection of the system should allow the operator to determine if the system is performing at optimum levels. For example, aerator elevation variations greater than the design tolerance, typically ± 20 mm, will reduce the uniformity of air distribution in the system. In addition, operating airflows below the design condition will also reduce the uniformity of air distribution.

Below are symptoms and actions to remedy situations if inspection of the aeration system reveals abnormal operating characteristics:

a. **Large volume of air in localized area**
   Possible causes:
   - Connection between aerator and air distribution pipe is loosened
   - Pipe aerator membrane is damaged

   Actions:
   - Drain tank to access area in question
   - Inspect pipe joint and membrane for loose connection and damage respectively. Repair as required. See Section 4.

b. **Decreased air bubble distribution and increased pressure loss noted at blower**
   Possible causes:
   - Membranes have fouled
   - Reduced blower discharge air volume
   - Restriction in air distribution pipe

   Actions:
   - Drain tank to access pipe aerators
   - Inspect for external fouling. Clean or replace membrane when required
   - Check blower operating point and speed
   - Check isolation valve position on down pipe

c. **Dissolved oxygen profile not satisfactory through out basin**
   Possible causes:
   - Increased loading to system
   - Reduced blower discharge air volume
   - Improper distribution of air in system
   - Air leak in system

   Actions
   - Check loading to system
   - Check blower operations
   - Refer to sections 3.5 a. and b.

3.6 SHUTDOWN OF AERATION SYSTEM

If an interruption in air service is experienced at any time, restoration of air service should be instituted as soon as possible. When restarting positive displacement blower units, follow blower suppliers recommended procedures. If the PRV releases air for an extended period of time, the relief setting should be checked.

If the aeration tank is to be idle for a prolonged time period, the aeration tank should be drained and cleaned. If the draining of the aeration tank takes more than a day, the minimum airflow to the system should be maintained during the draining of the aeration tank.

Once the tank is drained, the aerators should be quickly cleaned using high pressure hosing in order to remove sludge deposit from the membrane surface.

Leaving the sludge deposit on the membrane surface will cause it to dry up quickly, especially under hot weather condition. Such dried sludge will adversely affect the performance of the membrane when it is put into operation again.

Care should be exercised when removing sludge from the tank base in order to prevent damage to the aerators. Stubborn sludge close to the aerator should be dislodged using high pressure hosing and removed using suction pump. Avoid using shovel or other mechanical tool to remove sludge near the pipe aerators that can cause accidental damage to the aerators.

When the aerators and aeration tank base is cleaned, fill the tank to a depth of 1 m with water so as to prevent accidental damage to the aerator.

If the aerators are left idle for a long period, then maximum air flow rate is to be applied for a period of approximately 20 minutes, once per week.

4. MAINTENANCE

4.1 GENERAL

The aerator is a fine bubble aeration device that offers maximum benefits for oxygen transfer and mixing. Proper operation and maintenance of the aerator can provide years of long-term performance with minimum energy cost and minimum maintenance cost. For all fine bubble aerators, it is necessary to follow preventive maintenance procedures to sustain peak or optimum performance, prolong equipment life, and avoid emergency situations or a system failure. Proper maintenance procedures will also minimize the frequency of system interruptions. The following guidelines should be referenced in maintaining the aerator system.

The membrane should be protected from organic solvents, such as aromatic hydrocarbons. Contact with such substances will cause the membrane to swell.

Good air filtration is required with all fine bubble aerators including RAUBIOXON Plus and RAUBIOFLEX aerators. The blower system should be equipped with inlet dust filters to achieve 90% filtration in conformity with EN779, filter class G4 in order to prevent clogging of the rubber membrane.

Some evidence of increased head loss through the aerators may be experienced over a long period of operation. This increase in pressure loss is often the result of biological and/or inorganic materials build-up on the membrane surface. The rate at which the pressure loss increases depends on the type of wastewater and the specific operating conditions of the treatment process. To restore membrane performance and decrease the operating head loss, refer to the following sections.

4.2 MAINTENANCE OF THE AERATORS

REHAU recommends that the pressure loss of the aerators be monitored and documented in plant records on a regular basis once the aeration system is put into operation so that an appropriate cleaning cycle can be established. The pressure loss should always be measured at a constant airflow rate as it is directly proportional to airflow rate. It is advisable to clean the aerators regularly and whenever the increase in pressure loss reaches 30 mbar.

Depending on the design of the aeration system, the aerators can be accessed by draining the aeration tank or lifting the aeration grid out of the aeration tank. If draining of the aeration tank takes more than a day, the minimum airflow to the system should be maintained during the draining of the aeration tank.

The following items may be helpful in servicing the aerators during maintenance:
- High-pressure hosing equipment.
- Ladder to access the aeration tank.
- Protective gloves and clothing.
- Long-handled bristle brush for cleaning pipe aerators.
- Special REHAU pliers and single-ear clips (for pipe aerators).
- Spare membranes.

4.2.1 IN SITU CLEANING OF MEMBRANES

Depending on the wastewater characteristics and specific operating conditions of the treatment process, the frequency of cleaning the membranes will vary from plant to plant. Silicone and EPDM rubber membranes require cleaning because of two common types of surface build-up; sludge deposit with biological fouling and inorganic scaling. The recommended cleaning procedure for both types of build-up is detailed below.

4.2.1.1 SLUDGE DEPOSIT/BIOLOGICAL FOULING

The recommended cleaning procedure is to physically remove the sludge deposit/fouling by using industrial high pressure hosing equipment, which can deliver variable water pressure up to 140 bar. The pressure required for hosing depends on the amount of sludge/fouling and how long they are left on the membrane in the open. During hosing operation, maintain airflow rate of 4 to 5 $Nm^3/h\text{-}m_{pipe\ aerator}$ for the pipe aerators, 1.5-2 Nm^3/h-disc aerator for diameter 200 disc aerator and 3-4 Nm^3/h-disc aerator for diameter 300 disc aerator. The water pressure should be gradually increased to suit the actual condition. The length of time required to remove sludge deposit/fouling is dependent on the type of problem, water pressure and distance from aerator, etc. Typically, 10 to 15 seconds and 5 to 10 seconds are required per pipe aerator and disc aerator respectively.

4.2.1.2 INORGANIC DEPOSITS

Inorganic deposits are characterized by a granular mineral like precipitate that can form on the membrane surface as a result of process-related deposit such as calcium or ferrous deposits. If brushing of membrane surface or hosing the membrane does not remove the scaling, 85% formic acid can be used since it is sufficiently strong to dissolve most of the inorganic deposit. It is biodegradable and does not interfere with the biological process. Also, it does not damage air distribution pipes made of PVC, PP or stainless steel. Large quantities of acid combined with prolonged exposure may, however, attack galvanized air distribution pipes.

As 85% formic acid is a potent and easily volatile acid, it burns the skin. Its vapour can irritate the eyes and mucous membranes and is also dangerous when inhaled. Therefore, it must always be handled in a well-ventilated space. If necessary, a respirator should be worn. To protect one-self from splashes, use protective goggles and gloves made of natural rubber. Formic acid may not be kept near an open flame or other sources of heat. Ignited formic acid can be put out with a powder or carbon dioxide extinguisher. Workers should be briefed on the safety aspects before proceeding with handling of formic acid. Safety instruction and first aid must be available at the work site.

During cleaning the airflow rate should be as close to the maximum as possible so that the mixture of air and formic acid effectively penetrates through the membranes.

The recommended dispensing rates for various types of clogging are as follows:

	g $HCOOH/m^3$ of air	Duration (min)
Calcium deposits	20	5 to 10
Ferrous deposits	50	30 to 60

The cleaning process should be divided into several short dosing duration of about 2 minutes for each aeration grid. If each aeration grid is thoroughly cleaned at one go, air will escape via the aerators that have already been cleaned. This may cause the cleaning of the aerators in the last aeration grid not to be effective as the amount of air supplied is too low. The supply of formic acid should be carried out using a dosing pump, which regulates the flow rate.

Before cleaning the aerators, drain any condensed water from the air distribution pipes by opening the drain valve. Clean the nozzle on the down pipe before connecting the acid feeding hose to it with care. Ensure that air enters the acid container during the dosing of acid into the down pipe so that it does not vaporise.

4.2.2 REPLACEMENT OF DUO / PIPE AERATOR MEMBRANE

If inspection reveals the need to replace the rubber membrane, the following guidelines should be followed:

1. Remove the stainless steel single-ear clips. This is easily accomplished by bending back the small tab on the clip with a crimping tool or screwdriver. The operator should not attempt to snip or cut the single-ear of the clip. The stainless steel material is very strong and excessive force is required to shear the material.
2. Pull the rubber membrane off the PP support pipe.
3. Clean the PP support pipe. Insert a new membrane onto the PP support pipe and align it in such a way that only non-perforated membrane section is positioned over the air outlet openings. To secure the membrane firmly on the PP support pipe, use only stainless steel single-ear clips that are smooth on the inside. Worm-drive clips must not be used. The single-ear clips must be aligned in such a way that the clip ear is positioned exactly over the membrane groove. One single-ear clip should be located between the small protrusion at the edge of the support pipe and the rib on PP support pipe, next to the air outlet and the other single-ear clip about 2 to 4 mm away from the slots found at the open end of the support pipe. Ensure that the clip does not cover the slots or the perforated section of the membrane. See Figure 15.
4. The positioned one ear clip should be fully compressed using special REHAU pliers. The crimping force applied must be high enough to ensure that the clip is firmly seated and the connection is unable to leak. In the crimped state, dimension "x" must be less than 2.0 mm. See Figure 16.
5. Contact REHAU for the special pliers because the use of a general-purpose crimping tool may result in a rounded ear on the clip. The ear should have a flat top.

Note: The non-perforated portion of the membrane should be installed on the top/bottom of the support pipe and centered over the air outlet holes to provide check valve action.

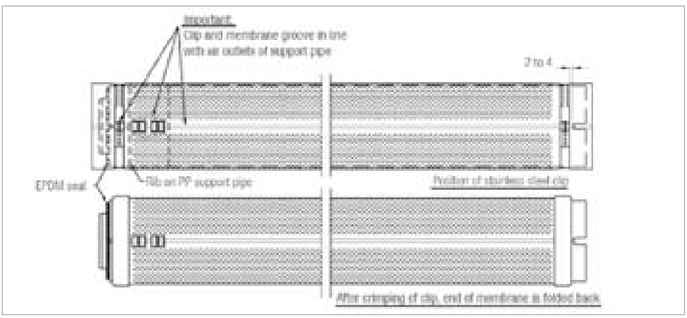

Figure 15: Positioning of stainless steel single ear clip on pipe aerator

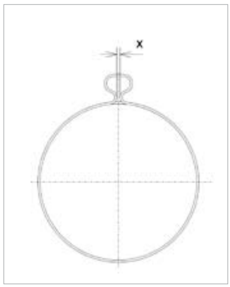

Figure 16: Diagram of an installed single ear clip

4.2.3 REPLACEMENT OF STANDARD PIPE AERATOR

If it becomes necessary to remove standard pipe aerator from the air distribution pipe, the general procedures outlined below should be followed:

1. Shut off air supply to the particular air distribution pipe.
2. Remove threaded rod from pipe aerator using recommended tools such as screwdriver, installation adaptors and ratchet wrench.
3. Re-install the pipe aerator following installation details.

When properly operated and maintained, the RAUBIOXON Plus aeration system will provide years of high efficiency treatment with minimum attention from the operator. Questions regarding RAUBIOXON Plus system operation, maintenance, etc. should be forwarded to your local REHAU sales office.

4.2.4 REPLACEMENT OF DUO PIPE AERATOR

If it becomes necessary to remove DUO pipe aerator from the air distribution pipe, the general procedures outlined below should be followed:

1. Shut off air supply to the particular air distribution pipe.
2. Release the fastener.
3. Unfold the saddle.
4. Reinstall the saddle following installation details.

4.2.5 REPLACEMENT OF DISC AERATOR MEMBRANE

Please consult your nearest REHAU sales office or REHAU's official distributor.

4.2.6 REPLACEMENT OF DISC AERATOR

If it becomes necessary to remove disc aerator from the air distribution pipe, the general procedures outlined below should be followed:

1. Shut off air supply to the particular air distribution grid.
2. Remove the existing disc aerator by turning it anti-clockwise.
3. Re-install the disc aerator by placing it on the grommet and turning it in the clockwise direction.

NOTES

Construction Automotive Industry

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ShinMaywa

Screen series
BS·VS/VSK/VSP·SB/S

Automatic bar screen

Automatic bar screen

Wedge wire screen

Supply records

Original mechanism and durable structure!
ShinMaywa Screen series!

Original mechanism and durable structure! ShinMaywa Screen series!

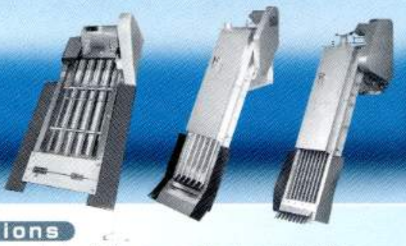
BS series Automatic bar screen

BS series is an automatic bar screen that applies to Japanese standard of human-waste treatment tank. It has high durability for hard usage conditions such as 24 hours continuous operation, submergence, etc. and available for industrial waste also.

Applications

*Removing suspended solid in sewage treatment facilities.
*Removing suspended solid in industrial waste water treatment facilities.

VS/VSK/VSP series Automatic bar screen (coarse spacing, belt moving type)



Automatic belt moving type screen VS series is designed as inflow screen for a human-waste treatment tank. The feature of this product is not only scrape-up solids, but also can separate a variety of solid mechanically. It is available to install not only for new plant, but also existing plant.

Applications

*Removing suspended solid in sewage treatment faxilities.
*Removing suspended solid in industrial waste water treatment facilities. water treatment facilities.

S/SB series Wedge wire screen

SB/S-series are wedge wire screen for removing a solid contained in waste water. SB series: Non-clogging operation by built-in rotation brush.S series: Easy and economical operation by simple structure.

Applications

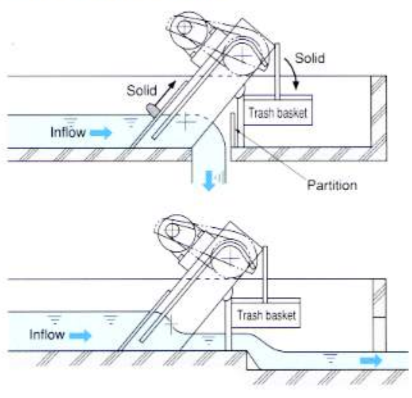
*Suspended solids objects removal in sewage treatment plant.
*Material recovery and waste water treatment process in the paper factory.
*Waste water treatment process in the food, fiber, and chemical industry.
*Separation and selection in mining water treatment facilities. water treatment facilities.

ShinMaywa Screen series

Type	Automatic bar screen				Wedge wire screen	
Model	BS	VS	VSK	VSP	SB	S
Slit (unit : mm)	1.0 2.0 2.5 5.0 10 20 30 50	20 30 50			0.25 0.5 0.75 1.0 2.0	
Output	BS-H: 25W, BS-N:100W	100W VSK-H:25W			100W 220SB:200W	—
Applications	Removing suspended solid in waste water treatment facilities					

Installation example

This type is to be installed in channel



This type is to be installed in the piping arrangement

* Details : Refer to instruction manual.

BS Series

Automatic bar screen (fine spacing)

Stainless steel body

Main parts such as frame, screen bars, rakes and drive chain are made of stainless steel that has high strength and corrosion resistance.

Inner chain structure

The carriage chain and sprockets are put in side frame. Therefore garbage hardly twines around the chain and sprocket.

Newly developed link type bar support mechanism

This mechanism prevents a slack of screen bar caused by bar's own weight. Also, this mechanism is less frictional wear and high durability compared with conventional rake type bar support mechanism.

One-way clutch mechanism

In case of reverse the motor due to power supply condition or faulty wiring at site, one-way clutch mechanism cut drive train and protects the raking system.

Water proof motor with reducer

BS series employs a water proof motor enjoying high reputation as before. Even if the screen was submerged due to unexpected freshet, it can be used again if you take early detection and treatment.

Standard specification

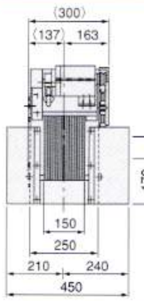
	Slit (mm)	Model							
		BS1H	BS2H	BS3H	BS1N	BS2N	BS3N	BS4N	BS5N
Capacity (m^3/h)	1	18	25	43	18	25	43	86	99
	2	23	45	65	23	45	65	106	145
	2.5	27	50	75	27	50	75	130	179
	5	38	70	105	38	70	105	182	240
	10	43	75	112	43	75	112	206	251
	20	47	88	130	47	88	130	226	260
	30	50	92	138	50	92	138	240	276
	50	—	—	—	—	—	—	252	290
Rake-up speed	(m/min)	1.9/2.3 (50/60Hz)							
Motor		25W, Three-phase (Water-proof type)			0.1kW, Three-phase (Water-proof type)				
Weight	(kg)	21~24	28~33	29~37	21~24	28~33	29~37	32~50	43~68
Applicable Channel Width (mm)		300~400						500~600	
Standard Accessories		Power cable (VCT 1.25mm² 4 Cores Dia.φ11.5) ×6m Trash basket (SUS304) 1 V-belt (Spare) 1							

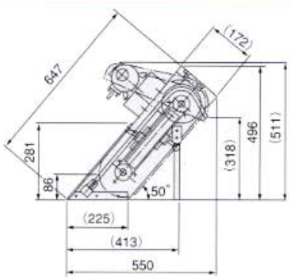
* Special specification: manual type (Available for BS1H,1N,2H,2N only)
Special specification:BS1H~3H,1N~3N bar spacing 50mm
* Treated water capacity is the value measured in clear water.

Dimension

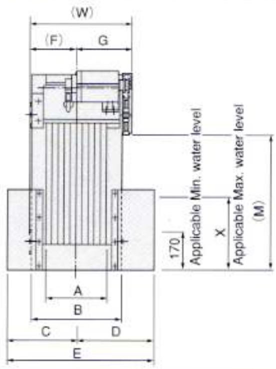
(unit : mm)

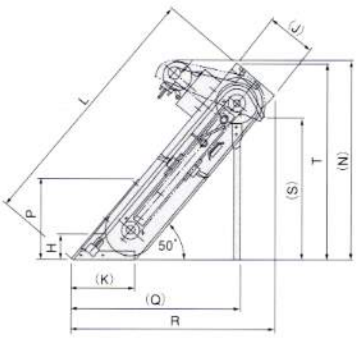
BS1N,BS1H





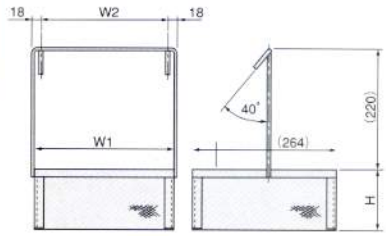
BS2N,BS3N,BS4N,BS5N,BS2H,BS3H





Model	BS2N BS2H	BS3N BS3H	BS4N	BS5N
A	150	150	350	350
B	250	250	450	450
C	210	210	335	335
D	240	240	365	365
E	450	450	700	700
F	137	137	237	237
G	163	163	263	263
H	86	86	86	86
J	172	172	172	172
K	225	225	225	225
L	981	1,140	1,140	1,568
M	531	653	653	982
N	766	894	894	1,216
P	370	570	570	650
Q	629	731	734	1,010
R	765	868	868	1,143
S	573	701	701	1,023
T	751	879	879	1,201
W	300	300	500	500
X	330	510	510	580

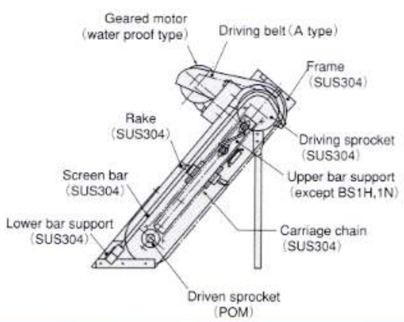
Dimension of trash basket

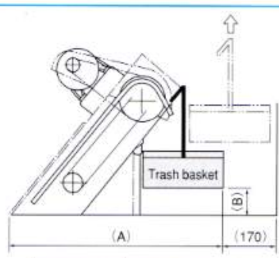


H	W1	W2	Model
110	254	230	BS1N・BS1H
180	254	230	BS2N・3N・2H・3H
200	454	430	BS4N・5N

Structure and material

(unit : mm)





A	B	Model
677	69	BS1N・1H
893	254	BS2N・2H
995	382	BS3N・3H
998	362	BS4N
1,274	684	BS5N

Notice

* In case of the following applications, please contact us in advance. Special specifications may be required.
・For oily solid in a food processing or spherical solid
・For industrial waste water
・Install in outdoor

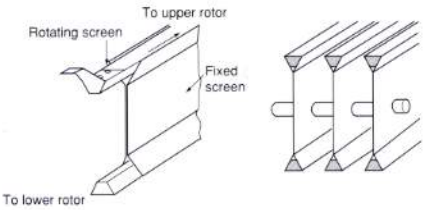
VS・VSK・VSP Series

Automatic bar screen (coarse spacing)

The automatic bar screen <Model VSK・VSP・VS series> is developed and designed as a inflow screen in the sewage treatment plant. It has such a structure that scrapes up and separates paper, cloth, vinyl, etc., contained in the inflow and does not scrape up feces. Also high-durability structure against hard conditions such as 24 hours continuous operation, lower bearing in submergence, etc., makes it long-term operation.

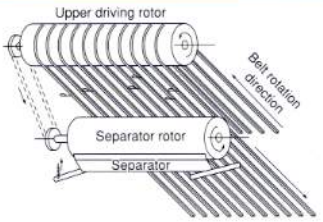
Fixed bar and rotating belt scraper

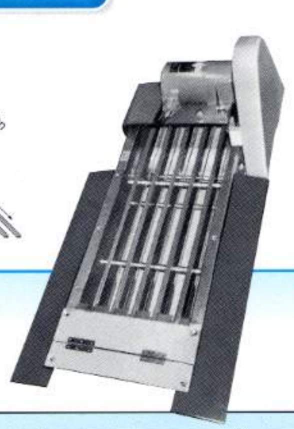
Rotating belt with hooks moves along V-shape groove on fixed bar and scrape up paper, cloth, vinyl, etc., contained in the inflow and does not scrape up feces.



Separating device

Paper, cloth, vinyl, etc., scraped up by rotating belt are separated forcibly by separating device which is consist of separator-rotor and separator. Therefore, the surface of rotation screen is always kept clean.



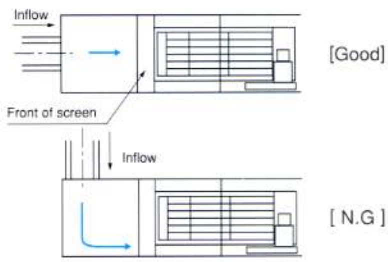


Notice

・Selection for bar spacing
In general wastewater treatment plant, the bar spacing of coarse screen shall be 50mm. Feces may be scraped up, in case the bar spacing of it is 20mm and/or 30mm.
・This equipment is designed for indoor use. If this will be used at outdoor, please contact us in advance as special spec. may be required.
・This equipment cannot be applied to industrial wastewater containing oil in plenty. If this will be used such conditions, please contact us in advance as special spec. may be required.

Caution

Make sure that the waste water flows into the screen squarely against the front face of the screen. If the inflow direction becomes diagonal or sideways to the face of the screen, feces can be easily stuck on the midway of the channel.



VS Coarse spacing automatic bar screen

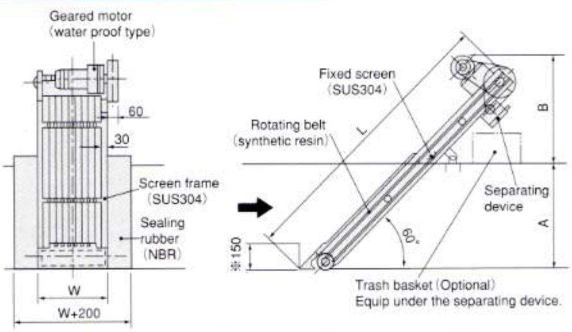
Standard specification

	Slit (mm)	Model							
		VS-1H	VS-2H	VS-1	VS-2	VS-3	VS-4	VS-5	VS-6
Capacity (m^3/h)	20	40	70	40	70	120	70	120	150
	30	50	80	50	80	150	80	150	180
	50	70	100	70	100	180	100	190	220
Scrape-up speed	(m/min)	3.0/3.6 (50/60Hz)							
Weight	(kg)	55	65	55	65	70	65	75	85
Motor		25W, Three-phase (Water proof type)		0.1kW, Three-phase (Water proof type)					
Applicable channel width	(mm)	400~500	400~500	400~500	400~500	400~ 500	600~700	600~700	600~ 700
Applicable water depth	(mm)	150~300	150~400	150~300	150~400	150~ 600	150~300	150~400	150~ 600
Applicable channel height	(mm)	420~490	610~820	420~490	610~820	930~1,140	420~490	610~820	930~1,140

* Treated water capacity is the value measured in clear water.

Dimension and materials

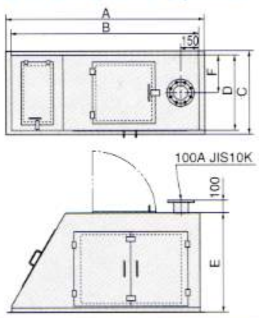
(unit : mm)



Model	Bar spacing			Length	Width	A	B
VS-1・1H	20	30	50	1,000	380	490	440
VS-2・2H	20	30	50	1,500	380	820	580
VS-3	20	30	50	1,950	380	1,140	660
VS-4	20	30	50	1,000	580	490	440
VS-5	20	30	50	1,500	580	820	580
VS-6	20	30	50	1,950	580	1,140	660

* Caution : The minimum water depth for the screen is 150 mm.

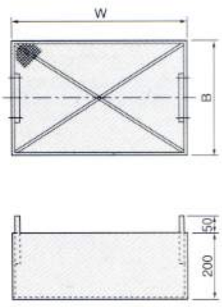
Dimensions for screen cover (optional)



Model	A	B	C	D	E	F	Applicable channel width	Applicable channel depth
VS-1・1H	1,280	1,200	680	600	700	300	400~500	420~ 490
VS-2・2H	1,380	1,300	680	600	1,000	300	400~500	610~ 820
VS-3	1,480	1,400	680	600	1,100	300	400~500	930~1,140
VS-4	1,380	1,300	880	800	700	300	600~700	420~ 490
VS-5	1,480	1,400	880	800	1,000	300	600~700	610~ 820
VS-6	1,580	1,500	880	800	1,100	300	600~700	930~1,140

Material : PVC (Stainless is available as optional.)

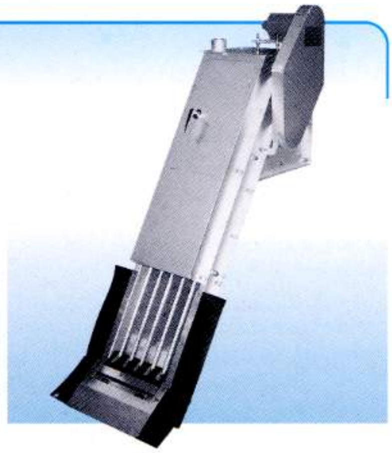
Dimension of trash basket



W	B	Applicable model
400	350	VS-1・1H・2・2H・3
600	400	VS-4・5・6

Material : SUS304

VSK Coarse spacing automatic bar screen with deodorant cover



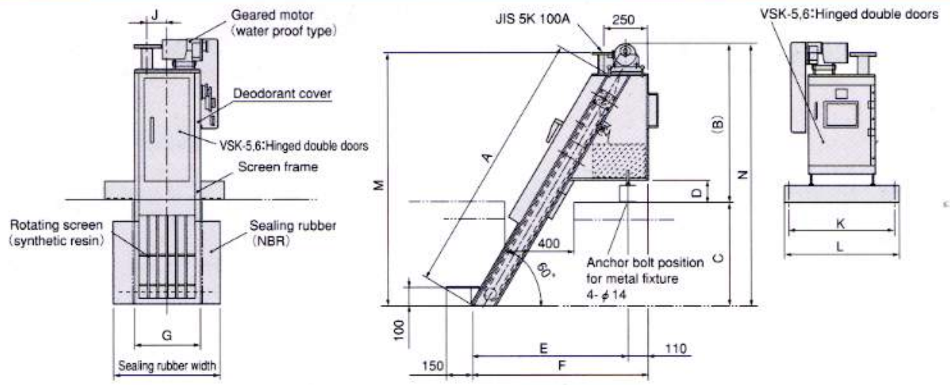
Standard specification

	Slit (mm)	Model					
		VSK-2	VSK-3	VSK-5	VSK-6	VSK-2H	VSK-3H
Capacity (m^3/h)	20	70	120	120	150	70	120
	30	80	150	150	180	80	150
	50	100	180	190	220	100	180
Scrape-up speed	(m/min)	3.0/3.6 (50/60Hz)					
Weight	(kg)	93~103	103~118	120~135	135~145	93~103	103~118
Motor		0.1kW, Three-phase (Water proof type)				25W, Three-phase (Water proof type)	
Applicable channel width	(mm)	400~550	400~ 550	600~750	600~ 750	400~550	400~ 550
Applicable water depth	(mm)	500~600	650~1,000	500~600	650~1,000	500~600	650~1,000
Applicable channel height	(mm)	150~400	150~ 600	150~400	150~ 600	150~400	150~ 600

* Treated water capacity is the value measured in clear water.

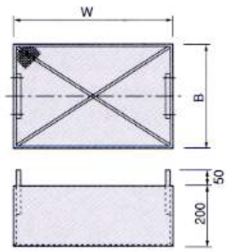
Dimension

(unit : mm)



Model	A	B	C	D	E	F	G	H	J	K	L	M	N
VSK-2・2H	1,540	1,040~940	500~ 600	240~140	890	1,000	380	680	120	600	660	1,480	1,540
VSK-3・3H	2,000	1,290~940	650~1,000	490~140	1,120	1,230	380	680	120	600	660	1,880	1,940
VSK-5	1,540	1,040~940	500~ 600	240~140	890	1,000	580	880	120	800	860	1,480	1,540
VSK-6	2,000	1,290~940	650~1,000	490~140	1,120	1,230	580	880	120	800	860	1,880	1,940

Dimension of trash basket



W	B	Applicable model
300	260	VSK-2・2H・3・3H
500	260	VSK-5・6

Material : SUS304

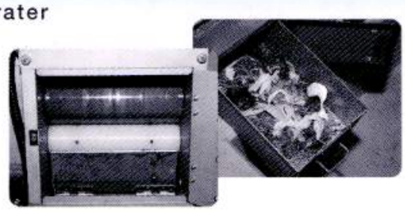
VS/VSK/VSP Series

VSP Coarse spacing auomatic bar screen with deodorant cover built-in dehydrater

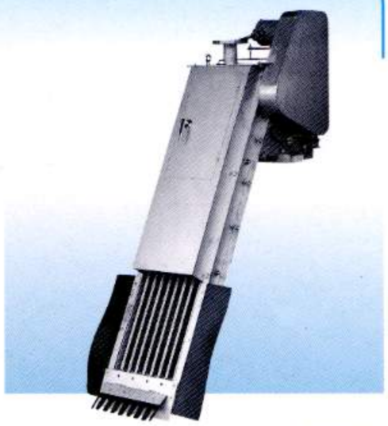
Standard specification

	Slit (mm)	Model			
		VSP-2	VSP-3	VSP-5	VSP-6
Capacity (m^3/h)	20	70	120	120	150
	30	80	150	150	180
	50	100	180	190	220
Scrape-up speed (m/min)		3.0/3.6 (50/60Hz)			
Weight	(kg)	105~115	115~130	145~160	160~170
Motor		0.1kW, Three-phase (Water proof type)			
Applicable channel width (mm)		400~550	400~ 550	600~750	600~ 750
Applicable water depth (mm)		500~650	700~1,000	500~600	700~1,000
Applicable channel height (mm)		150~400	150~ 600	150~400	150~ 600

* Treated water capacity is the value measured in clear water.

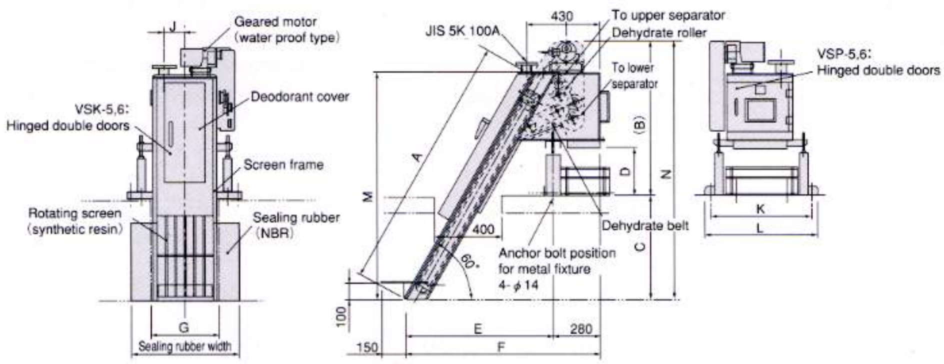


Automatic operation of screening, dehydration and packing in one unit enables easy operation and maintenance.



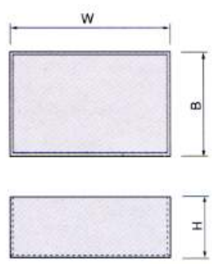
Dimension

(unit : mm)



Model	A	B	C	D	E	F	G	H	J	K	L	M	N
VSP-2	1,540	1,040~890	500~ 650	380~230	890	1,170	380	680	120	600	660	1,480	1,540
VSP-3	2,000	1,240~940	700~1,000	580~280	1,120	1,400	380	680	120	600	660	1,880	1,940
VSP-5	1,540	1,040~890	500~ 650	380~230	890	1,170	580	880	120	800	860	1,480	1,540
VSP-6	2,000	1,240~940	700~1,000	580~280	1,120	1,400	580	880	120	800	860	1,880	1,940

Dimension of trash basket



W	B	H	Applicable model
365	270	166	VSP-2・3
592	384	208	VSP-5・6

Material : synthetic resin

SB Series

SS Screen (built-in a rotating brush)

Always clean

The rotating brush equipped behind the screen automatically washes and always keeps the screen clean.

Low running cost

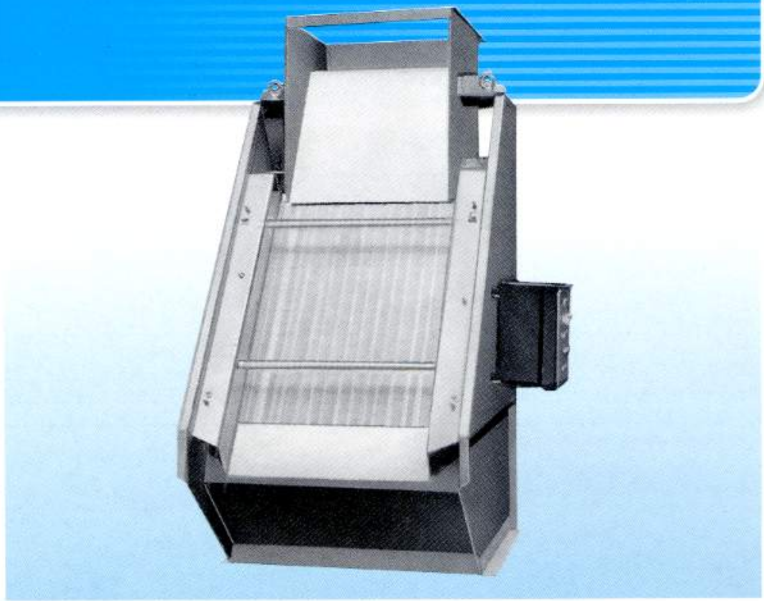
The driving power of the rotating brush is 100W. Moreover, the intermittent operation keeps power consumption lower.

High screening effect

Clean slit kept by rotating brush maintain the higher screening effect.

Easy washing

While a brush rotates, the slit of a screen is met and it moves horizontally, and the water divided into the solid and the liquid on the screen is emitted from the screen back with centrifugal force in a brush.



Treatment capacity

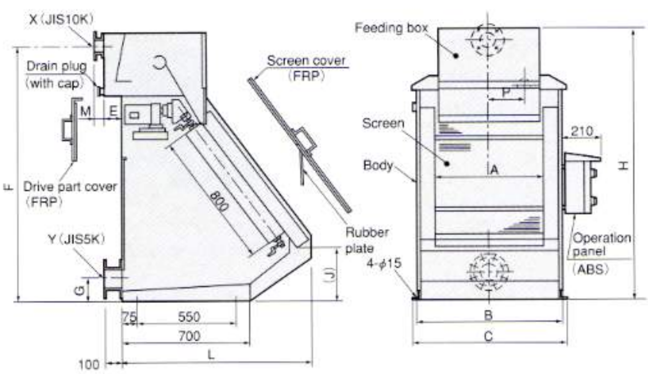
(unit : m^3/h)

Kinds of waste water	Slit (mm)	Model 32SB	62SB	92SB	122SB	152SB	182SB	220SB
Clear water	0.25	16	32	48	85	106	127	154
	0.5	18	36	54	95	118	141	171
	0.75	20	40	60	106	132	158	192
	1.0	22	44	66	117	146	175	212
	1.5	24	48	72	127	158	189	229
	2.0	27	54	81	143	178	213	259
From Pulp bleaching process	0.25	6	11	17	22	28	33	39
From Dyeing process	0.5	8	15	23	31	39	47	57
From Livestock farm	0.5	10	20	30	40	50	60	70
From Garbage incinerator	0.5	15	31	47	62	78	93	113
From Fish process/Leather process	0.5	11	22	33	44	55	66	80
Waste paper in empty bottles recycling process	0.5	12	24	36	49	61	73	88
From Old newspaper concentration	0.5	10	20	30	40	50	60	70
From Beer brewery	0.5	16	32	48	64	80	96	116
Vegitable debris from food processing factory	0.75	16	32	48	64	80	96	116
From Tofu process	0.9	13	26	39	52	65	78	94
From Kitchen (Restaurant)	1.0	16	32	48	64	80	96	116
Sewage	1.0	20	40	60	80	100	120	140

*This table shall be used only for reference. Please select a suitable model after checking actual liquid, because the treatment capacity depends on not only the kinds of wastewater, but also the condition of liquid.

Dimension

(unit : mm)



*Deodorization cover, screen-washing shower is available as optional.

Standard specification

〈32SB~182SB〉

Frequency	Output (W)	Phase	Brush speed (mm/s)	Rotation (min^{-1})
50Hz	100	Three-phase	116	55
60Hz	100	Three-phase	139	66

〈220SB〉

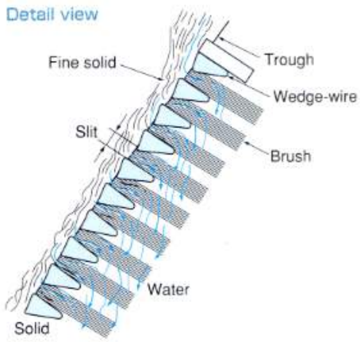
Frequency	Output (W)	Phase	Brush speed (mm/s)	Rotation (min^{-1})
50Hz	200	Three-phase	116	55
60Hz	200	Three-phase	139	66

Model	Effective size of screen Length×Width (mm)	A	B	C	E	F	G	H	J	L	M	P	Q	X	Y	Weight (kg)
32SB	800× 295	295	503	538	95	1,450	120	1,525	300	1,040	50	75	25A	50A	100A	150
62SB	800× 600	600	808	843			132					200		65A	125A	200
92SB	800× 905	905	1,113	1,148			145					350		80A	150A	250
122SB	800×1,190	1,190	1,429	1,474	120	1,650	180	1,750	390	1,070	75	500	50A	100A	200A	350
152SB	800×1,495	1,495	1,734	1,779			205					650		125A	250A	400
182SB	800×1,800	1,800	2,039	2,084			230					800		150A	300A	450
220SB	800×2,190	2,190	2,446	2,506		1,800	255	1,950	500	1,140		1,000		200A	350A	550

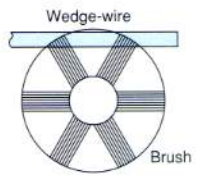
Structure

* SS screen consists of feeding box, body and screen. Screen is composed of wedge wires and support rods which are welded together. Main parts of SS screen is made of stainless steel and has corrosion-resistance.

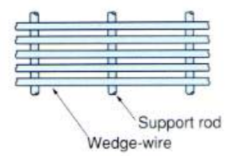
Detail view



- Wedge wire and support rod are one structures by special welding, there is no deviation of a slit.
- Welded downward (slanting) to wedge wire and support rod, a solid and water are effectively separable.



- Rotating brush is installed behind the screen, and timer controlled.
- The controller is built into water-proof operation panel.



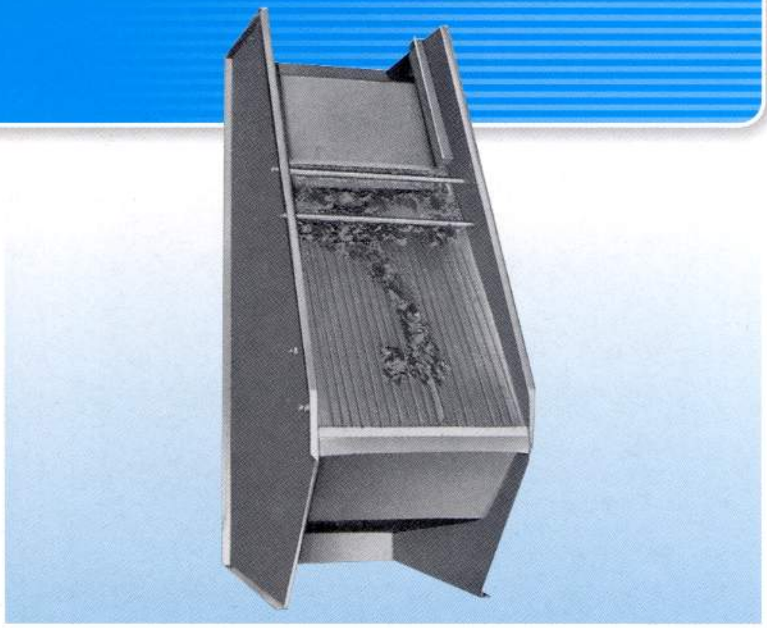
Slit size (unit : mm)

0.25	0.5	0.75	1.0	1.5	2.0

*Size for 0.2, 0.3, 0.4, 0.6, 0.9,can also be manufactured.

S Series

SS Screen



Economical

Since power is not used, a running cost is unnecessary. Simple structure enabled easy and economical operation.

Easy installation

Small installation area and light-weigth enable us to installation easily even in existing plant.

High screening capability

Wedge wire having an angle against wastewater flow shows us high screening capability.

Treatment capacity

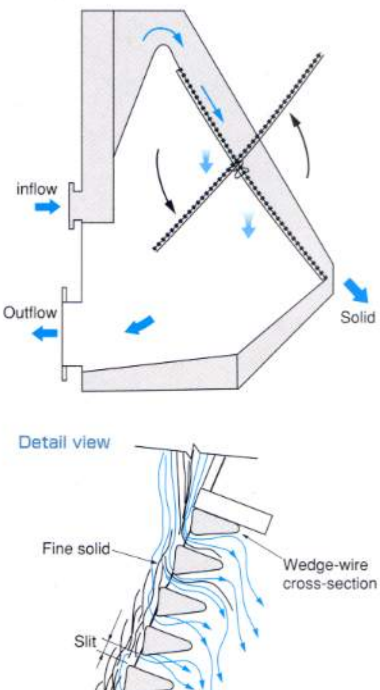
(unit : m³/h)

Kinds of waste water	Slit (mm)	30S	60S	90S	130S	170S	200S	230S
Clear water	0.25	16	32	48	85	106	127	160
	0.5	18	36	54	95	118	141	178
	0.75	20	40	60	106	132	158	199
	1.0	22	44	66	117	146	175	221
	1.5	24	48	72	127	158	189	238
	2.0	27	54	81	143	178	213	269
From Pulp bleaching process	0.25	5	10	15	26	32	38	48
From Dyeing process	0.5	7	14	21	38	47	56	70
From Livestock farm	0.5	9	18	27	47	59	70	88
From Garbage incinerator	0.5	14	28	43	76	94	113	142
From Fish process/Leather process	0.5	10	21	32	55	67	80	101
Waste paper in empty bottles recycling process	0.5	11	22	33	57	71	85	107
From Old newspaper concentration	0.5	9	18	27	45	56	67	84
From Beer brewery	0.5	16	32	48	86	106	127	160
Vegitable debris from food processing factory	0.75	15	30	45	80	99	119	150
From Tofu process	0.9	13	26	39	70	88	105	132
From Kitchen (Restaurant)	0.5	14	28	43	76	94	113	142
Sewage	1.0	18	35	53	94	117	140	176

*This table shall be used only for reference. Please select a suitable model after checking actual liquid, because the treatment capacity depends on not only the kinds of wastewater, but also the condition of liquid.

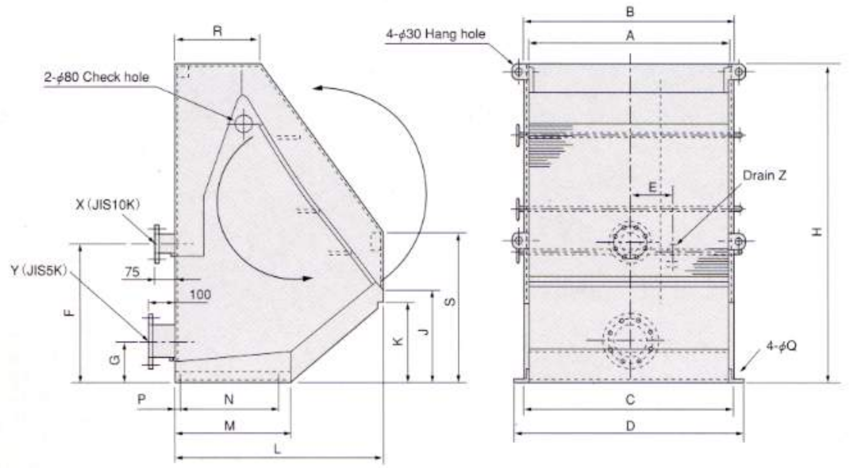
One structure by special welding

* Screen is composed of wedge wires made of stainless steel and support rods which are welded together. There is no deviations of a slit. Since a screen part can be rotated, maintenace is also easy.



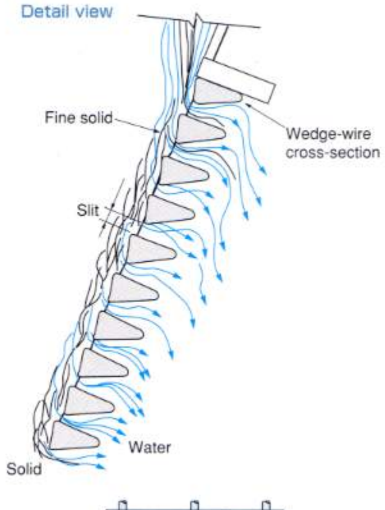
Dimension

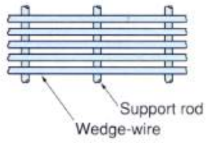
(unit : mm)



Model	Effective size of screen Length×Width (mm)	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	X	Y	Z	Weight (kg)
30S	900× 285	285	333	339	389	115	632	160											50A	100A	25A	70
60S	900× 600	600	648	654	704	150	640	172	1,500	430	363	960	555	450	50	15	390	686	65A	125A	40A	105
90S	900× 905	905	953	959	1,009	200	646	185											80A	150A		135
130S	1,200×1,220	1,222	1,270	1,276	1,326		859	211											100A	200A		215
170S	1,200×1,500	1,502	1,550	1,556	1,606	300	872	236	1,800	477	460	1,180	720	600	60	19	470	786	125A	250A	50A	250
200S	1,200×1,805	1,807	1,855	1,861	1,911		885	262											150A	300A		300
230S	1,300×2,280	2,280	2,350	2,366	2,436	600	920	290	2,000	558	483	1,469	893	700	100		703	673	200A	350A		630

Detail view





Slit size

(unit : mm)

0.25	0.5	0.75	1.0	1.5	2.0

*Size for 0.2, 0.3, 0.4, 0.6, 0.9,can also be manufactured.

S Series

Supply records

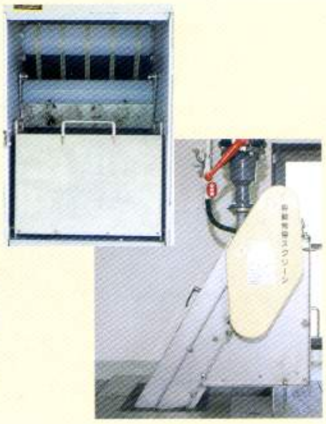
BS1H

Site : Agricultural community waste water treatment plant

BS5N

Site : Confectionery plant

VSK-2



(With deodorant cover)
Site : Agricultural community waste water treatment plant

VSP-2

(With deodorant cover built-in dehydrater)
Site : Agricultural community waste water treatment plant

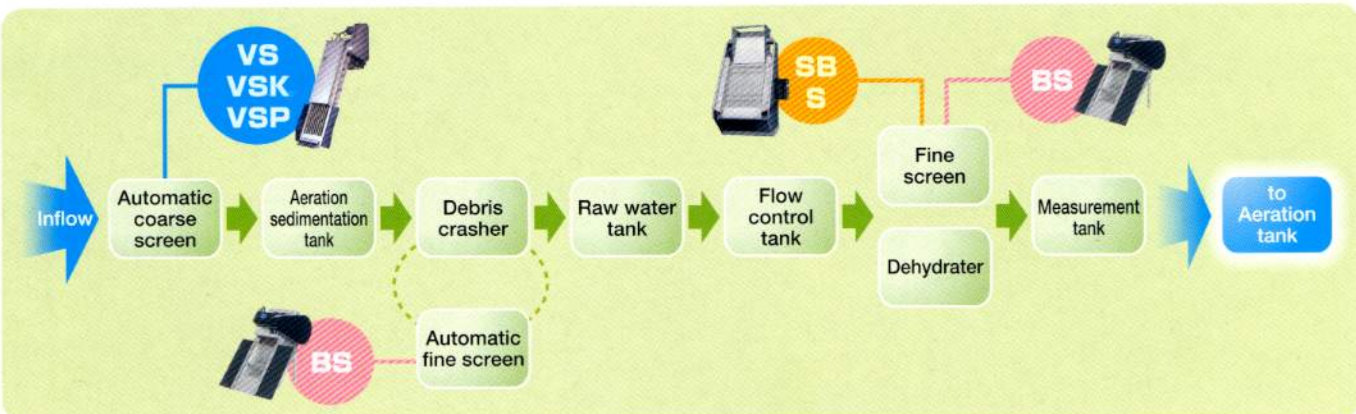
SB Screen

Site : Dairy products plant

SB Screen

Site : Fish processing plant

Flow chart of pre-treatment



Specifications and dimensions are subject to change without notice.

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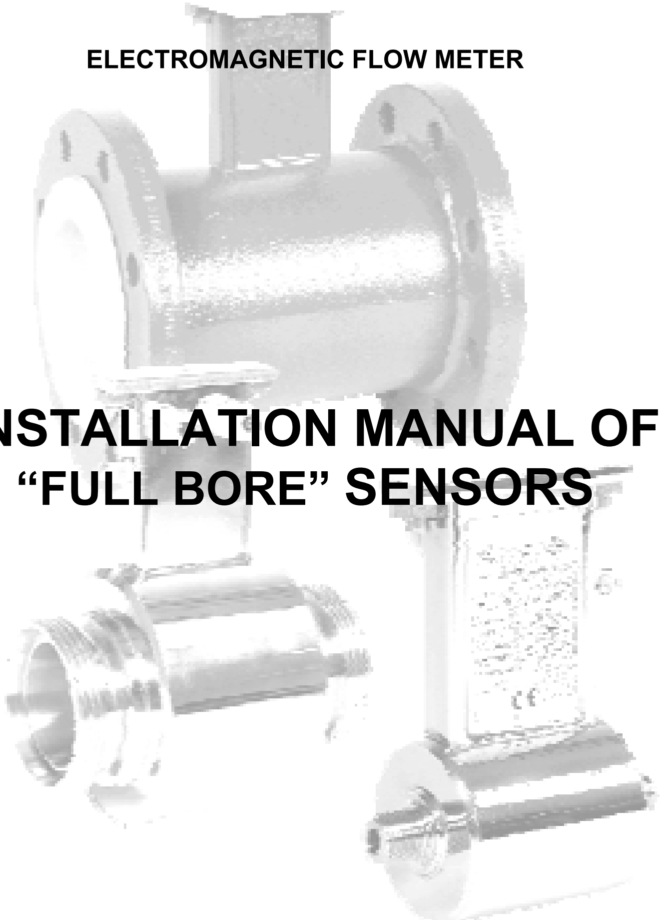
ShinMaywa ONO PLANT
ISO 9001 (No.956445) / ISO 14001 (No.771888)

http://www.shinmaywa.co.jp

'06.2. Z-E148

Printed on recycled paper.
Printed in Japan 2.1

ELECTROMAGNETIC FLOW METER



INSTALLATION MANUAL OF “FULL BORE” SENSORS

MAN 1000102634 EN Version: B printed: 17.02.2011 Status: RL (released | freigegeben)

INDEX

INTRODUCTION

- **This manual is integral part of the product. Read carefully the instructions contained since it contains important indications for the safety of use and of maintenance.**
- **The technical information and the relative products of this manual could be modified without any previous notice.**
- **The flow meter must be used for the use it has been built for. The improper use, possible tampering of the instrument or parts of it and substitutions of any components not original, makes the warranty to decay automatically.**
- **The manufacturer is considered responsible only if the instrument in used in its original configuration and setting.**
- **The flowmeter makes measures of liquids with conductivity greater than 5 µS; it consists of a sensor (described in this manual) and a converter, for it see the manual provided.**
- **If the sensor is supplied in compact version to the converter, consider the operating temperatures more restrictive, otherwise refer to the respective manuals (page 5).**
- **When transporting, unpacking and handling the flowmeter, be careful and care.**
- **In the case of prolonged storage and of transport, use and store in the original container in a dry place, do not place more than 3 packs one above the other. It is possible pallets storage and transport (in case of wooden crates do not place one above the other).**
- **For the cleaning of the device use only a damp cloth, and for the maintenance/repairs, contact the customer service.**
- **For the disposal of the device and of the packaging make strict reference to the regulations.**
- **It's forbidden the reproduction of the present manual and of possible software supplied with the instrument.**

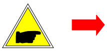
START UP AND MAINTENANCE OF THE INSTRUMENTS

- **Before starting up the instrument, always make a sure connection to ground as suitable to page 6.**
- **Verify periodically: the integrity of the cables, the tightening of the sealing elements (cable glands, covers, etc.), the mechanical fixing of the instrument on the pipe or on the wall stand.**

Before using the instrument, always make a sure connection to ground

Avoid any attempt to repair the instrument. If the instrument is not functioning properly, please call the nearest assistance service

Pay maximum attention during the operations



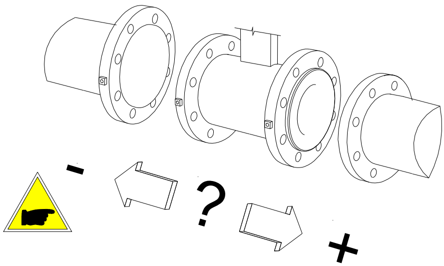
ATTENTION !!!

DANGER !!!

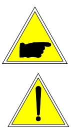
GENERAL INFORMATION ON THE SENSORS INSTALLATION

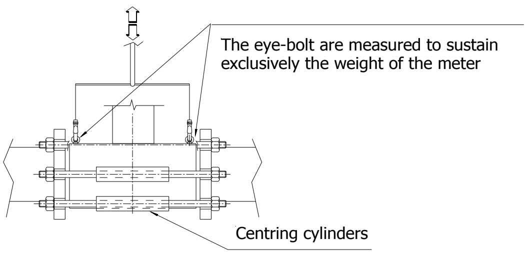
- **Flow direction**

Before install the sensor locate the direction of the liquid in the piping
The sign of the flow rate **is positive**, when the flow direction it's from **– to +** as printed on the tag plate.
If after the installation, for plant request becomes necessary reverse the sign of the flow, it's enough reverse the sign of the coefficient KA



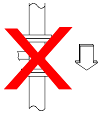
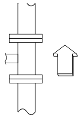
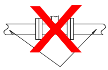
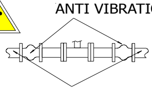
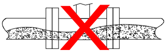
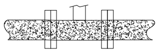
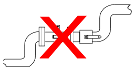
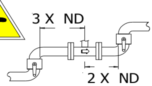
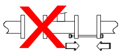
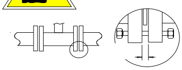
- **Installation** (Method recommended for ALL THE SENSOR WITH EYEBOLT)





N.B.: For sensor MS 1000 we recommend the use of centring cylinders

○ **Shrewdness and precautions**

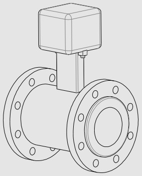
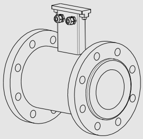
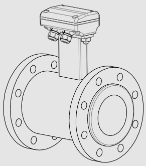
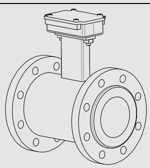
NO		YES	
	For vertical installations with descending flow direction contact the manufacturer		For vertical installations is preferable an ascending flow
 LONG PIPE	 Avoid the installation of the sensor in a long pipe line, without anysupport of the same	 ANTI VIBRATION JOINTS  LONG PIPE	For installations on long pipe line, please use the anti vibration joints
	 Avoid the functioning with the pipe partially empty	 	During the functioning the pipe must be completely full of liquid, or completely empty
	 Avoid the installation near curves or hydraulic accessories	 	Install the sensor away from curves and hydraulic accessories
	 Avoid the approach of the flange and counter flange using the closing force of the nuts	  GASKET THICKNESS + 4mm	Before tightening the nuts approach as more possible the flange of the piping to the flange of the sensor

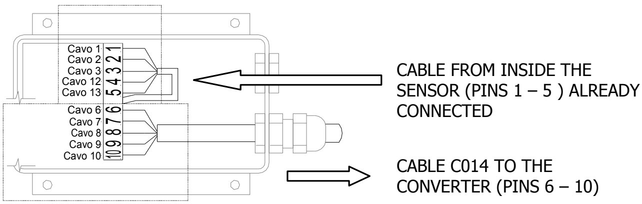
OPERATING TEMPERATURES

	EBONITE LINING				PP LINING				PTFE LINING			
	Liquid Temp.		Ambient Temp.		Liquid Temp.		Ambient Temp.		Liquid Temp.		Ambient Temp.	
	Min.	Max	Min.	Max	Min.	Max	Min.	Max	Min.	Max	Min.	Max
° C	0	80	-5	60	0	60	0	60	-20	130	-10	60
° F	30	176	23	140	32	140	32	140	-4	266	14	140

ELECTRICAL CONNECTIONS OF SENSOR TO CONVERTER

(CONNECTIONS TO CONVERTER: SEE PROPER MANUAL)

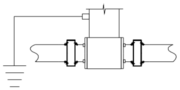
	VERSION	SUITABLE FOR	SENSOR'S CONNECTION
	COMPACT	ALL SENSORS MODEL	NO CONNECTIONS
	SEPARATE WITHOUT JUNCTIONS-BOX	STAINLESS STEEL MODEL	NO CONNECTIONS REQUIRED (CABLE ALREADY CONNECTED AND POTTED)
	SEPARATE WITH JUNCTIONS-BOX	ALL CARBON STEEL MODELS	NO CONNECTIONS REQUIRED (CABLE ALREADY CONNECTED AND POTTED)
	SEPARATE WITH PREAMPLIFIER	ALL SENSORS MODEL	SEE BELOW



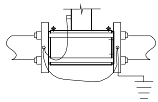
GROUNDING INSTRUCTIONS

For correct operation of the meter is NECESSARY that the sensor and the liquid are equipotential, so ALWAY connect the sensor and converter to ground:

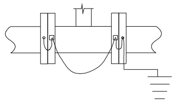
- ### Grounding with metallic pipe



sensors with ground socket on the connection box

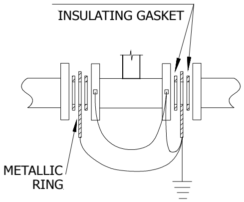


Wafer sensors



Flanged sensors

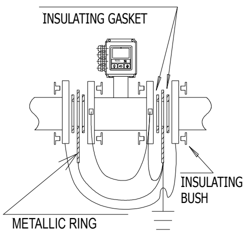
- ### Grounding with insulating pipe



If the sensor has to be mounted on a pipe made of an insulating material is necessary:

- Install two metallic ring between the sensor flanges and the counter flanges of the pipe line or:
- Use a sensor with the additional grounding electrode

- ### Grounding when there is a cathodic protection over the pipe



If the sensor must be install in the piping with a chatode protection, is necessary:

- using insulating bushes to isolate the bolts
- Grounding metallic rings should be provided to ground the liquid using insulating gasket between the rings

- IMPORTANT :
  The ripple of DC power source used for cathodic protection shall be = 0

TORQUES (Nm) FOR SENSOR'S BOLTS (FLANGED & WAFER)

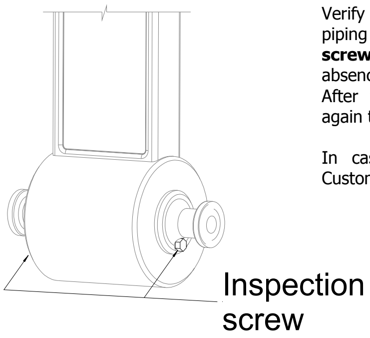
OPERATIVE PRESSURE										
Kpa	**1000**		**1600**			**2500**		**4000**		**6400**
psi	**140**		**260**			**350**		**600**		**1000**
DN	**PTFE**	**EBON.**	**PTFE**	**EBON.**	**PP**	**PTFE**	**EBON.**	**PTFE**	**EBON.**	**EBON.**
25			25 (21)		19	25		25 [32]		39 [32]
32			43 (26)		28	43		43 [40]		53 [40]
40			53 (32)		36	53		53 [63]		72 [63]
50			68 (60)		52	68		68 [35]		81 [35]
65			90 (78)		75	45		45 [53]		58 [53]
80			53 (89)		41	53		53 [68]		62 [68]
100			59 (70)		56	83		83 [94]		87 [94]
125			77 (94)		71	112		112 [130]		148 [130]
150			108 (106)		106	135		135 [113]		217 [113]
200	148	432	99 (148)	288 (433)		134	391	178 [178]	520 [519]	816 [519]
250	123	359	140 (156)	408 (455)		204	595	267 [185]	780 [540]	1124 [540]
300	142	415	175 (234)	510 (683)		201	588	278 [275]	812 [803]	1108 [803]
350	172	502	205 (325)	598 (946)		324	945	422 [318]	1231 [927]	1684 [927]
400	217	632	282 (312)	821 (911)		426	1243	619 [411]	1805 [1198]	2180 [1198]
450	194	564	281 (336)	981 (926)				[398]	[1161]	
500	224	652	382 (317)	1113 (924)				[465]	[1356]	
550			(379)	(1105)				[608]	[1772]	
600	323	942	568 (463)	1658 (1350)				[774]	[2258]	
650			(429)	(1251)				[753]	[2195]	
700	356	1040	421 (503)	1230 (1468)				[947]	[2761]	
750			(451)	(1315)				[1105]	[3223]	
800	476	1388	549	1603						
850			(563)	(1642)				[1373]	[4006]	
900	450	1312	519 (618)	1515 (1803)				[1408]	[4106]	
1000	582	1699	721 (736)	2105 (2146)				[1598]	[4662]	

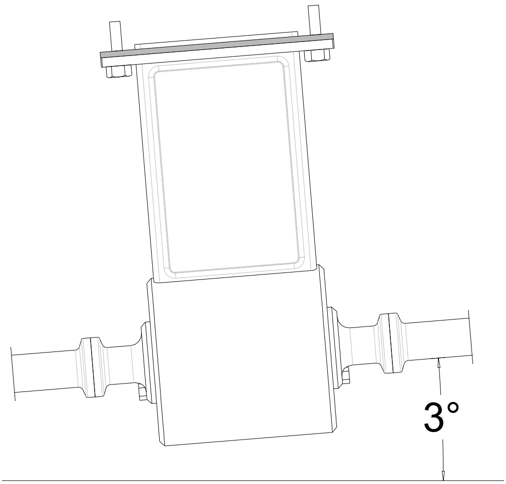
- Tighten uniformly in diagonally opposite sequence
- The torque listed in tab are applicable to flanges:
  EN1092-1, DIN 2501, BS 4504, ANSI B16.5 , JIS
- Is recommended the use of gaskets DIN 2690
- For DN > 1000 contact the manufacturer
- (***)= ANSI 150
- [***]= ANSI 300

NOTE FOR 3A APPROVED SENSORS

Verify periodically the sensor’s seals integrity: with piping full of liquid, unscrew the **Inspection screws** (see drawing aside) and verify the total absence of liquid from inspection hole!
After the above operation, REMEMBER to close again the holes.

In case of leakage contact immediately our Customer Service.





When flow meter it’s installed horizontally, ensure minimum angle of 3° for self draining purposes

ERRATA

Page 7 - Section 1- Table 1 – Replace Oct-16 with 10-16

Page 11 – Section 1.3.2 – Insert following photographs and table

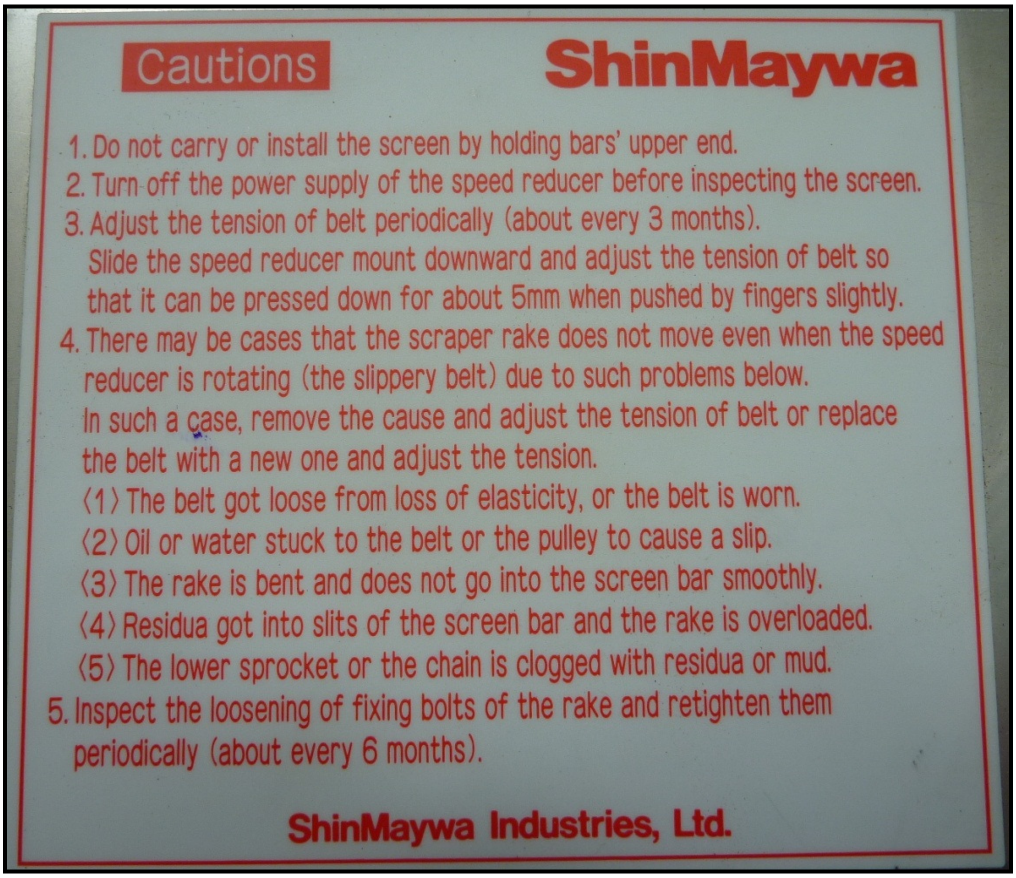


Figure 1 Inlet Screen - Belt Maintenance

	Activity	Frequency
1	Lubricate chain drive using approved silicone based lubricant or grease	Monthly
2	Remove chain by loosen the 12mm bolt head on the bottom right hand side of the screen to remove the bottom support shaft. Once the bottom shaft is removed the top shaft can be loosened. The chains can be removed once both shafts have been removed.	Annually
3	Degrease the chains if necessary. If large amount of grit and other build up is present on the surface of the chain, it is recommended that the chains are degreased. A kerosene or citric acid based degreaser can be used, or approved equivalent.	Annually
4	Using Vernier callipers, measure the distance between 5 links, record this value and calculate the current link length by dividing the total length by 5 to produce the length between each link. Refer Figure 2 for more details.	Annually
5	If the link length has increase by 10% of the original value the chain is to be replaced.	Annually

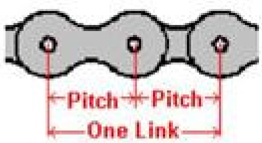


Figure 2 Inlet Screen – Chain pitch

Figure 3 Inlet Screen – Chain drive

Page 20 –Section 1.3.8 Insert table

	Activity
1	Isolate the anoxic mixer via the SCADA screen, MCB lock out in the MCC and finally at the field isolator on the mixer stand.
2	Loosen the nuts on the pipe clamp supporting the mixer pole in the tank. A second person is necessary to support the weight of the mixer pole.
3	Remove the nuts and the front face of the pipe clamp. Together take the weight of the mixer pole and slowly raise the pole out of the tank.
4	Rotate the mixer up onto the side of the manhole and hose off any residual activated sludge back into the tank.
5	Once the mixer is clean, lift the mixer pole up onto the access way.
6	Inspect the propeller on the mixer for ragging or other contaminants. Remove as necessary.
7	If there are signs to indicate water has entered the mixer, do not attempt to repair. Remove the mixer and send back to the supplier for a replacement.
8	Reinstall the mixer by placing the mixer pole back into the man hole and reinstalling the pipe clamps.
9	Un-isolate the mixer by reversing Step 1.
10	Ensure sufficient mixing pattern and no surging is present in the anoxic tank. If surging occurs, loosen the pipe clamp and slightly rotate the direction of the mixer to provide a clockwise rotation around the tank.

Table 1 Anoxic Mixer maintenance procedure

Page 25 Section 1.3.9 Insert table

	Activity
1	Turn the air OFF to the diffuser to be serviced by closing the ball valve on top of the aeration tank off the main header where the pipe enters the tank.
2	Once the air is off, remove the manhole cover to access the diffuser pipe work.
3	Unscrew the barrel union located on the inside of the tank which is accessed via the man hole.
4	Once the barrel union is undone, the pipe work can be rotated toward the man hole and the base will lift out of the support ring.
5	As the aeration dropper is removed attempt to wash as much activated sludge back into the tank as possible.
6	Once the diffusers become visible above the water line, loosen the backing nut of the back of each diffusers. Care must be taken during this step to avoid dropping any of the diffuser parts into the aeration tank
7	Remove the diffuser, backing nut and the two pipe connectors.
8	The diffuser can now be cleaned using a mild detergent and water. Avoid pressure cleaning the diffusers as the silicone membrane can be damaged.
9	Reinstall the diffusers by reversing Steps 1 – 7. Tip: Diffusers must be installed inside the tank as they will not fit through the man hole if they are fitted to the dropper outside of the tank.

Table 2 Aeration Tank –Diffuser maintenance

Page 29 – Section 1.3.13 Replace containments with contaminants

Page 36-Section 1.3.18 Insert Table

	Activity
1	Isolate Crossflow and Backwash pumps on the SCADA screen and at the field isolators
2	Isolate the manual valves upstream and downstream of the filters.
3	Undo the barrel union located at the top of the filter. Remove the pipe work to provide access to the 4" flange on top of the filters.
4	Undo the bolts on the flange and remove the flange with the inlet diffuser still installed.
5	Using either a vacuum truck or a wet/dry vacuum, remove the media from the filter. Once the majority of the media has been removed the pipe work on the bottom of the filter can be disconnected and the filter can be rotated onto its side to assist in removing the remaining media.
6	The inside of the filter can be cleaned using a diluted chlorine solution and a pressure cleaner.
7	Install media as per the following schedule: • **First** - Product Number 4 (6-12mm) Gravel = Total 26 bags • **Second** - Product Number 6 (1.5-3.0mm) Sand = Total 8 bags • **Third** - Product Number 6.5 (0.8-1.8mm) Sand = Total 44 bags Care must be taken when installing the first load of bags not to damage the laterals at the base of the filter. Once the laterals are covered the bags can be installed faster.
8	Once the media is installed, fill the filter will water and allow to soak for 4 hrs.
9	Reinstall the pipe work, un-isolate the valves and pumps.
10	Manually run a backwash cycle on the SCADA screen to remove any contaminates from the filters before filtrating.

Table 3 Filter media replacement procedure

ERRATA

Page 5 - Table 1 – Replace Feed to Mass Ration to Feed to Mass Ratio

Page 9 – Table 2 –Insert Floating Sludge - Denitrification in clarifier- Increase a recycle rate

Page 12 – Table 3 – Delete reference to sludge collectors stornoway

Project Ref W536

GRANTHAM SEWAGE TREATMENT PLANT

Control Methodology

June 2012

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Document Status

Rev	Status	Author	Reviewer		Approved for Issue		
			Name	Signature	Name	Signature	Date
A	First Issue	D Cokley	A Mythen				
B	Additional Specs	J Styles					

TABLE OF CONTENTS

1. INTRODUCTION

This document summarises the control methodology for the Grantham Development Wastewater Treatment Plant to be commissioned in April, 2012 at Grantham, Queensland.

2. CONTROL REQUIREMENTS

Treatment plant control requirements are summarised in Appendix A. General system control requirements are outlined in the sections below.

2.1. Pumps

2.1.1. General

All pump and all control valves to have manual start, manual stop and auto modes.

The minimum run speed for all VSD driven motors shall be 60% of the maximum run speed.

2.1.2. Duty Standby Pumps

Duty/Standby configuration ensures the critical process pumps will continue to operate if one pump fails. The duty pump is to alternate between pumps on each activation (ie. P105 runs, then system stops, next time the duty pump is called P106 runs). If an MCB or contactor failure is registered for the duty pump, the standby pump is automatically started. If the duty pump registers a VSD fault, the standby pump is activated.

2.2. Alarms

Treatment plant alarm list is summarised in Appendix B. The alarm list includes low, medium and high priority alarms.

High Level Alarm – Critical to the operation of the plant. This fault must be attended to within 4 hours.

Medium Level Alarm – Standby equipment has been activated or is non-critical to the plants operation. This fault must be attended to within 12 hours.

Low Level Alarm – Non-critical alarm. This fault must be attended to at the next scheduled daily visit.

Low Flow Alarms are activated if the pump is running but the flow meter is reading no flow. (Possible causes are fault with pump or fault with flow meter)

2.3. Treatment System

The STP has two main modes of operation, the plant cycle and the filtration mode.

The plant cycle runs the vital equipment to maintain the biological system in the STP. When only the plant cycle is operating the STP will not treat and discharge effluent.

The filtration mode runs the filtration system including the final discharge system. The STP is to be running in filtration mode when required to treat and release effluent.

The purpose of the two modes is to allow operators to stop the filtration cycle for maintenance whilst the vital plant equipment is still able to operate.

Manual backwash of sand filters is to be available from SCADA.

2.4. SCADA Security

Three levels of security will be provided with users able to be assigned the following roles:

- Operator
    - Change device modes (auto/manual)
    - Start and stop equipment
- Supervisor
    - Change set-points
- Engineer
    - Change PI controller tuning parameters
    - Change administrative settings

Automatic logon of the operator user will be provided and, in addition, higher level users will be logged off and replaced automatically by the operator user after a predetermined amount of time.

2.5. Response to power failure

In the event of a power failure when power is restored the plant will restart in automatic operation as if it has been started from scratch. In addition, the SCADA computer will automatically power up and logon as an operator user. Historical Trending

All recorded data will be retained on the SCADA computer for a period of 12 months and can be accessed through the SCADA computer using Process Analyst.

2.6. SCADA device colour standards

The following specifies colours that will indicate device states on the SCADA screen:

- Any Fault – Flashing Yellow
- Any Interlock – Blue
- Analogue
  - High-High alarm – Red bar above displayed value
  - High alarm – Orange above displayed value
  - Low alarm – Orange below displayed value
  - Low-Low alarm – Red below displayed value
- On/Off Valve
  - Closed – Red
  - Open – Green
- 3-way Valve – Green highlight indicates current path
- Drive
  - Stopped – Red
  - Running – Green
  - Starting/Ramping – Flashing Green

2.7. Alarm Paging

TBA

2.8. Materials and Equipment

2.8.1. SCADA

The Citect SCADA system provides operators with control over, and feedback from the WWTP. The Citect system will also provide alarming and diagnostic reporting functionality.

2.8.2. PLC

A Schneider Modicon system will be used. The PLC processor is located in the WWTP MCC.

2.8.3. *Equipment – Instruments*

Instrument ID	Description	Range
FM101	Inlet Flow meter	0 – 50L/s
FM102	Balance Delivery Flow meter	0 – 5L/s
WL101	Balance Tank Level Sensor	0 – 0.4bar
DO101	Aeration Tank Dissolved Oxygen	0 – 10mg/L
WL102	Aeration Tank Level Sensor	0 – 0.4bar
FM103	a' Recycle Flow meter	0 – 5L/s
FM201	RAS Flow meter	0 – 5L/s
WL201	Clarified Tank Level Sensor	0 – 0.25bar
PT201	Aeration Pressure Sensor	0 – 1bar
FM301	Filtration Flow meter	0 – 5L/s
pH301	Aeration pH	0-14
PT301	Pre-filter Pressure	0 – 4bar
PT302	Post-filter Pressure	0 – 4bar
WL401	Final Effluent Tank Level Sensor	0 – 0.4bar
NTU401	Turbidity Meter	0 – 1000 NTU
UV401	UV disinfection system	On..Off
UV402	UV disinfection system	On..Off
CL401	Chlorine Residual Analyser	0 – 10mg/L
pH401	pH probe	0 - 14
TP401	Temperature sensor	0 - 50°C

2.8.4. *Equipment – Drives*

Equipment ID	Description	Type
MX101	Anoxic Mixer	DOL
M101	Screen Motor	DOL
M201	Blower Fan 1	DOL
M202	Blower Fan 2	DOL
P101	Balance Pump 1	VSD
P102	Balance Pump 2	VSD
P103	a' Recycle Pump	VSD
P104	Sodium Aluminate Dosing Pump	DOL
P201	RAS Pump 1	VSD
P202	RAS Pump 2	VSD
P203	Aeration Blower 1	VSD
P204	Aeration Blower 2	VSD
P301	Cross flow Pump 1	VSD
P302	Cross flow Pump 2	VSD
P303	Backwash Pump	VSD
P401	Recirculation Pump	DOL
P402	Chlorine Dosing Pump	DOL

2.8.5. *Equipment – Solenoid Valves*

Equipment ID	Description

AV101	Three way Electronic Actuated Ball Valve
AV301	Three way Electronic Actuated Ball Valve
AV302	Three way Electronic Actuated Ball Valve
AV303	Electronic Actuated Ball Valve
AV501	Brass Solenoid Valve

2.8.6. Equipment – PID Loops

Equipment ID	Description
FC101	Balance flow controller 1
FC102	Balance flow controller 2
DOC101	Dissolved oxygen controller
FC103	Recycle flow controller
FC201	RAS pump 1 flow controller
FC202	RAS pump 2 flow controller
FC301	Cross flow pump 1 flow controller
FC302	Cross flow pump 2 flow controller
FC303	Back wash pump flow controller
FC403	Treated effluent pump 1 flow controller
FC404	Treated effluent pump 2 flow controller

2.9. Device Code Blocks

Equipment will be divided into specific types to allow common blocks of code to be reused for the same types of equipment both inside the PLC program and within the Citect SCADA environment. All devices will have an associated symbol on the SCADA screen, for example, a drive will have a motor symbol colour coded to indicate the status of the drive. When the symbol is clicked a popup will appear giving the operator details and controls for the device. The following device types will be created…

2.9.1. Analogue input

The analogue input device allows the raw 4-20mA signal from the field to be scaled to engineering units and displayed on the Citect SCADA screen. Other features include:

- Raw signal 1st order filter
- Trending of the engineering value displayed on the SCADA pop-up
- Low, Low-Low, High, High-High alarms dead-band all configurable from the SCADA pop-up

2.9.2. *Digital input*

This device provides an interface for contact based feedback signals, for example, a high level switch or fault signal. It includes:

- Signal inversion
- On and Off delays configurable from the SCADA pop-up
- Trending of the inverted and delayed value displayed on the SCADA pop-up
- Associated alarm

2.9.3. *DOL drive*

This device provides code for a standard contactor based DOL drive and the associated feedback and alarms. It includes:

- Safety interlocks, displayed on the SCADA pop-up
- Fail to start and stop faults with delays
- Run feedback indication on the SCADA pop-up
- Overload fault displayed on the SCADA pop-up
- Auto and Manual start/stop modes selectable via the SCADA pop-up
- Number of starts recorded and displayed via the SCADA pop-up
- Run hours recorded and displayed via the SCADA pop-up

2.9.4. *VSD drive*

The VSD drive device is essentially the same as the DOL but with the following additions:

- Speed reference and current displayed and trended on the SCADA pop-up
- VSD Fault displayed on the SCADA pop-up
- Manual speed reference is possible in manual mode

2.9.5. *Actuated valve*

The Actuated valve device is capable of driving both a normal single action on/off valve and a dual destination 3-way valve. Both valves are controlled by a single digital output and can have up to two digital feedbacks for position. It also includes:

- Safety interlocks, displayed on the SCADA pop-up
- Fail to move faults with delays
- Position feedback indication on the SCADA pop-up
- Number of actuations recorded and displayed via the SCADA pop-up
- Auto and Manual modes selectable via the SCADA pop-up

2.9.6. *PI loop controller*

This device implements a standard proportional-integral loop controller. Derivative action is deemed unnecessary because all plant control loops are not unstable enough to warrant derivative action. The PI loop controller includes:

- Auto and manual modes selectable via the SCADA pop-up
- Bump-less transfer between auto and manual modes
- Trending of set-point, measurement and output variables displayed on the SCADA pop-up
- Proportional and integral gain configurable on the SCADA pop-up
- High and low output limits and alarms
- High and low set-point limits
- Deviation alarm with dead-band configurable on the SCADA pop-up

Appendix A. Control Requirements

A.1 Details

Treatment plant control requirements are summarised in Table 1. Table 1 details the control requirements for the STP.

Table 1 STP Control Summary

Process	Control Methodology	Related Instruments	Control Logic
Balance Pumps P101 & P102	The balance pumps transfer screened influent from the balance tank to the anoxic tank. The balance pumps control the flow across the clarifier as the system gravity feeds from anoxic to aeration to clarifier. The balance pumps are VSD driven. A PID loop is used to adjust the speed of the pumps to achieve a desired flow rate.	• WL101 • FM102 • WL102 • WL201	DUTY/STANDBY SYSTEM MANUAL START/ STOP/ AUTO/ RUNNING STATUS Duty pump starts IF: • Plant cycle = ON AND; • WL101 ≥ balance duty start AND; • WL102 < aeration high level AND; • WL201 < clarified high level Duty pump stops IF: • Plant cycle = OFF OR; • WL101 < balance duty stop OR; • WL102 > aeration high level, with 30s delay OR; • WL201 > clarified high level with 30s delay Balance Flow rate: • Balance flow rate set point on SCADA screen (Range 0 – 1 L/s) • Feedback for PID loop = FM102
Inlet Screen M101	The inlet screen removes solids greater than 1mm from the sewage entering the system. The inlet screen motor operates when there is flow entering the screen. The screen motor operates the chain driven teeth that remove the trapped solids from the bar screen.	• FM101	MANUAL START/ STOP/ AUTO/ RUNNING STATUS Motor starts IF: • FM101 > screen run flow rate AND; • Plant cycle = ON

Process	Control Methodology	Related Instruments	Control Logic
			Motor stops IF: • FM101 < screen run flow with 1 min delay OR; • Plant cycle = OFF
Anoxic Mixer (MX101)	The anoxic mixer turns over the anoxic tank continuously to promote a healthy anoxic zone and prevent settling. The mixer operates continuously when there is sufficient fluid in the anoxic tank.	• WL102	MANUAL START/ STOP/ AUTO/ RUNNING STATUS Mixer starts IF: • WL102 > aeration low level AND; • Plant cycle = ON Mixer stops IF: • WL102 < aeration low level with 30 sec delay OR; • Plant cycle = OFF
a' Recycle Pump (P103)	The a' Recycle pump returns biomass rich in nitrates from the aeration tank to the anoxic tank for denitrification. The a' recycle pump operates on a time run and time stop sequence. The run time and rest time can be set in the SCADA. The a' Recycle pump is also controlled by a PID loop to achieve the desired flow rate.	• WL102 • FM103	MANUAL START/ STOP/ AUTO/ RUNNING STATUS Pump starts IF: • WL102 > aeration low level AND; • a' Recycle run timer = ON AND; • Plant cycle = ON Pump stops IF: • WL102 < aeration low level after 30 sec delay OR; • a' Recycle run timer = OFF OR; • Plant cycle = OFF a' Recycle flow rate: • A' Recycle flow rate set point on SCADA screen (0 – 5L/s) • Feedback for PID loop = FM103

Process	Control Methodology	Related Instruments	Control Logic
			Rest timer starts when run timer is complete. The run timer restarts when the rest timer is complete.
Alum Dosing Pump (P104)	The alum dosing pump doses Sodium Aluminate into the aeration tank to assist with phosphorus removal from the influent. The dosage rate can be manually adjusted on the screen of the pump.		MANUAL START/ STOP/ AUTO/ RUNNING STATUS Pump starts IF: • Filtration mode = ON Pump stops IF: • Filtration mode = OFF
RAS pumps (P201 & P202)	The RAS pumps transfers activated sludge from the hoppers of the clarifier back to the anoxic zone. This process helps maintain the desired MLSS level in the bioreactor. The RAS pumps operates on a time run and time stop sequence. The run time and rest time can be set in the SCADA. P201 draws sludge from the first two hoppers of the clarifier to form RAS A. P202 draws sludge from the last two hoppers of the clarifier to form RAS B. The run and rest times for RAS A & B are independent as A is typically 4 x greater than B. The RAS pumps are VSD driven and a PID loop controlled the flow rate according to FM201.		MANUAL START/ STOP/ AUTO/ RUNNING STATUS **RAS A (Hoppers 1 & 2)** Pump starts IF: • Plant cycle = ON AND; • RAS A run timer = ON Pump stop IF: • RAS A run timer = OFF OR; • Plant cycle = OFF **RAS B (Hoppers 3 & 4)** Pump starts IF: • Plant cycle = ON AND; • RAS B run timer = ON Pump stop IF: • RAS B run timer = OFF OR;

Process	Control Methodology	Related Instruments	Control Logic
			• Plant cycle = OFF RAS A flow rate: • IF P201 = ON THEN; • PID set point for P201 = RAS A flow rate • FM201 = Feedback for PID loop RAS B flow rate: • IF P202 = ON THEN; • PID set point for P202 = RAS B flow rate • FM201 = Feedback for PID loop Combined flow rate: • IF P201 = ON AND; • P202 = ON THEN; • PID set point for P201 = (RAS A flow rate + RAS B flow rate) • PID set point for P202 = (RAS A flow rate + RAS B flow rate) • FM201 = Feedback for PID loop • RAS A flow rate set point on SCADA (Range 0 – 5 L/s) • RAS B flow rate set point on SCADA (Range 0 – 5L/s) *Rest timer starts when run timer is complete. The run timer restarts when the rest timer is complete.*
Aeration blowers (P203 & P204)	The aeration blowers supply air to the aeration, balance and digester tank. A dissolved oxygen sensor located in the aeration tank continuously monitors the DO level. The aeration blowers are VSD	• DO101	DUTY/STANDBY SYSTEM MANUAL START/ STOP/ AUTO/ RUNNING STATUS Duty blower starts IF:

Process	Control Methodology	Related Instruments	Control Logic
	driven. A PID loop is used to adjust the speed of the blowers to achieve a desired dissolved oxygen level in the aeration tank.		• Plant cycle = ON AND; • DO101 < DO low level Duty blower stop IF: • Plant cycle = OFF OR; • DO101 ≥ DO high level Blower run speed: • DO level set point on SCADA (0-3mg/L) • Reset PID loop when blower starts
Aeration blower fans (M201 & M202)	The aeration blower fans provide circulation of fresh air into the acoustic housing to cool the motor and the roots pump. The associated fan is to run continuously when the duty blower is in operation.		M201 starts IF: • P203 = ON M202 starts IF: • P204 = ON M201 stop IF: • P203 = OFF M202 stop IF: • P204 = OFF
Filtration cycle	The filtration cycle transfers clarified influent from the clarified tank through the sand filters and UV disinfection unit to the final effluent tank.		Refer to Table 2 Filtration Sequence for detailed control logic. Filtration Start IF: • Filtration mode = ON AND;

Process	Control Methodology	Related Instruments	Control Logic
			• Filtration timer = ON AND; • Turbidity filtration stop = OFF Filtration Stop IF: • Filtration mode = OFF OR; • BW cycle = ON OR; • Turbidity filtration stop = ON
Filter backwash cycle	The sand filter backwash is initiated by either the filtration timer elapsed or a high pressure differential across the filters	PT301; PT302;	Refer to Table 2 Filtration Sequence for further details. Backwash Start IF: • BW cycle = ON OR; • Sand Filter Differential (PT301 – PT302) > filter diff pressure Backwash Stop IF: • BW cycle = OFF IF BW cycle = ON THEN Filtration cycle = OFF IF BW CYCLE COUNT > 2, within < 1 day THEN FILTER BW ALARM = ON
Crossflow pumps (P301 & P302)	The crossflow pumps transfer clarified influent from the clarified tank through the sand filter and the UV disinfection system to the final effluent tank. The crossflow pumps are VSD driven. A PID loop is used to adjust the speed of the pumps to achieve	• WL201 • PT301 • PT302 • FM301 • WL401	DUTY/STANDBY SYSTEM MANUAL START/ STOP/ AUTO/ RUNNING STATUS Duty Pump Starts IF: • Filtration mode = ON AND;

Process	Control Methodology	Related Instruments	Control Logic
	a desired flow rate.		• WL201 ≥ crossflow duty start AND; • WL401 < final effluent high level AND; • Turbidity filtration stop = OFF Duty Pump Stop IF: • Filtration mode = OFF OR; • WL202 < crossflow duty stop OR; • WL401 ≥ final effluent high level after 30 sec delay OR; • Turbidity filtration stop = ON Crossflow Flow rate: • Crossflow flow rate set point on SCADA (0 – 3L/s) • Feedback for PID loop = FM301
Backwash pump (P303)	The backwash pump transfers final effluent from the final effluent tank through the sand filter in the reversed direction. The flow of the backwash removes contaminants that have built up in the sand during filtration. The backwash pump is VSD driven. A PID loop is used to adjust the speed of the pump to achieve a desired flow rate.	• FM301 • WL401	MANUAL START/ STOP/ AUTO/ RUNNING STATUS Duty Pump Starts IF: • BW cycle = ON AND; • WL401 > final effluent low level Duty Pump Stop IF: • BW cycle = OFF OR; • WL401 < final effluent low level after 30 sec delay

Process	Control Methodology	Related Instruments	Control Logic
UV disinfection system UV401, UV402	The UV disinfection system is self-controlling with UV intensity and lamp hour life control logic. The UV units are self alarming.		
WAS Digestion Cycle	The waste activated sludge cycle transfers aged sludge from the aeration tank to the digester tank for further aerobic digestion. The digester tank with the addition of air, breaks down the remaining sludge to a carbon and releases carbon dioxide gas. The digestion cycle first turns the air off to the tank to allow the sludge to settle and supernatant to form. The WAS is then introduced to the tank and the supernatant overflows back to the balance tank. The air remains off for an additional settling period.		WAS cycle start IF: • Plant cycle = ON AND; • WAS rest timer = OFF WAS cycle stop IF: • Plant cycle = OFF OR; • WAS rest timer = ON Refer to Table 3 Waste activated sludge cycle, for further details
Recirculation Pump (P401)	The recirculation pump turns over the final effluent tank to reduce the likelihood of bacteria regrowth. The recirculation system operates continuously when the running in plant auto mode. The recirculation pump provides a sample for the chlorine analyser. Chlorine is then dosed into the recirculation line down stream of the	• WL401	MANUAL START/ STOP/ AUTO/ RUNNING STATUS Pump Start IF: • Plant cycle = ON AND; • WL401 > final effluent low level Pump Stop IF: • Plant cycle = OFF OR;

Process	Control Methodology	Related Instruments	Control Logic
	analyser to maintain constant free chlorine residual in the final effluent tank.		• WL401 < final effluent low level after 30 sec delay
Chlorine dosing pump (P402)	The chlorine dosing pump doses sodium hypochlorite into the recirculation line to maintain constant free chlorine residual in the final effluent tank. The chlorine dosing pump is independently controlled by the chlorine analyser. The chlorine analyser has three analogue outputs to the PLC for chlorine, pH and Temperature.		
Reticulation pressure pump (P403)	The reticulation pressure pump supplies final effluent to a hose reel and tap for screen wash, anoxic/aeration wash down and general wash down for the STP. The pressure pump is self controlling to maintain a set pressure in the discharge line.		MANUAL START/ STOP/ AUTO/ RUNNING STATUS • ALWAYS ON regardless of plant/filtration mode
Turbidity Off Specification	The turbidity meter (NTU401) measures the turbidity of the final effluent post sand filtration. If the turbidity is greater than the given set point the plant is not able to release to the irrigation field. A warning alarm is to signal when the turbidity is greater than the set point. If the warning alarm remains true for a given period of time the filtration cycle will stop, to avoid	• NTU401	Turbidity warning alarm ON, IF: • NTU401 > Turbidity set point Turbidity warning alarm OFF, IF: • NTU401 < Turbidity set point Turbidity filtration stop IF: • Turbidity warning = ON for filtration stop time

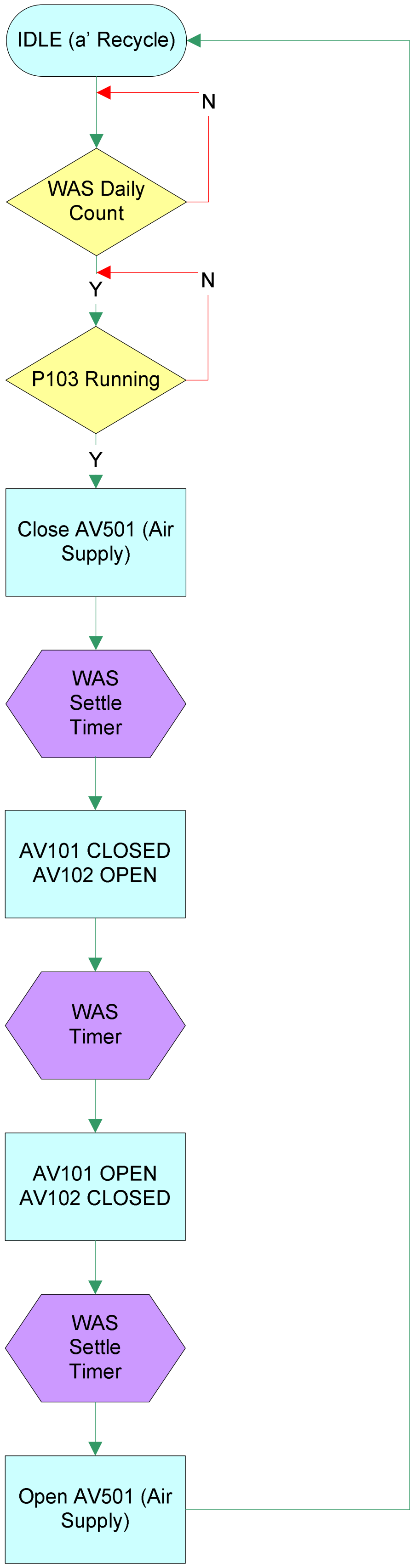
Process	Control Methodology	Related Instruments	Control Logic
	contaminating the final effluent tank.		

Table 2 Filtration Sequence

Step	Next Step	Description	Delay (secs)	Crossflow (P301 or P302)	Backwash Pump (P303)	Filter 1 Divert Valve (AV301)	Filter 2 Divert Valve (AV302)	Backwash Valve (AV303)	P301/P302 VSD Speed Setpoint	P303 VSD Speed Setpoint	Filtration Cycle	BW Cycle
1	2	Filtration Cycle	-	R	S	O	O	O	Filtration Flow	-	ON	OFF
2	3	Backwash Triggered (Filter 1)	4	S	S	O	O	O	-	-	OFF	ON
3	4	Set Valves (Filter 1)	Valve Time	S	S	C	O	C	-	-	OFF	ON
4	5	Start Backwash Pump (Filter 1)	BW Run Time	S	R	C	O	C	-	BW Flow	OFF	ON
5	6	Stop Backwash Pump (Filter 1)	4	S	S	C	O	C	-	-	OFF	ON
6	7	Set Valves (Filter 2)	Valve Time	S	S	O	C	C	-	-	OFF	ON
7	8	Start Backwash Pump (Filter 2)	BW Run Time	S	R	O	C	C	-	BW Flow	OFF	ON
8	9	Stop Backwash Pump (Filter 2)	4	S	S	O	C	C	-	-	OFF	ON
9	10	Reset Valves	Valve Time	S	S	O	O	O	-	-	OFF	ON
10	1	Return to Filtration	-	R	S	O	O	O	Filtration Flow	-	ON	OFF

O = Valve Open (Divert valves = Filtration)
C = Valve Closed (Divert valves = Waste)
R = Pump Running
S = Pump Stopped

Table 3 Waste activated sludge cycle



Appendix B. Alarm Listing

B.1 General

The table below summarises the treatment system alarm requirements.

Alarm Description	ALARM	PRIORITY		
		HIGH	MED	LOW
Emergency Stop	Emergency stop	X		
Phase Failure	Phase failure	X		
Crossflow pump 1 VSD	P301 VSD FAULT		X	
Crossflow pump 2 VSD	P302 VSD FAULT		X	
Crossflow pump 1 & 2 VSD	P301 & P302 VSD FAULT	X		
Balance Pump 1 VSD	P101 VSD FAULT		X	
Balance Pump 2 VSD	P102 VSD FAULT		X	
Balance Pump 1 & 2 VSD	P101 & P102 VSD FAULT	X		
RAS Pump 1 VSD	P201 VSD FAULT		X	
RAS Pump 2 VSD	P202 VSD FAULT		X	
RAS Pump 1 & 2 VSD	P201 & P202 VSD FAULT	X		
a' Recycle VSD	P103 VSD FAULT		X	
Aeration Blower 1 VSD	P203 VSD FAULT		X	
Aeration Blower 2 VSD	P204 VSD FAULT		X	
Aeration Blower 1 & 2 VSD	P203 & 204 VSD FAULT	X		
Backwash Pump VSD	P303 VSD FAULT		X	
Screen Motor	M101 MCB & CONTACTOR	X		
Anoxic Mixer	MX101 MCB & CONTACTOR		X	
Balance Pump 1 D/S	P105 MCB		X	
Balance Pump 2 D/S	P106 MCB		X	
Balance Pump 1 & 2	P105 & P106 MCB	X		
a' Recycle Pump	P103 MCB		X	
RAS Pump 1	P201 MCB		X	

Alarm Description	ALARM	PRIORITY		
		HIGH	MED	LOW
RAS Pump 2	P202 MCB		X	
Aeration Blower 1 D/S	P203 MCB		X	
Aeration Blower 2 D/S	P204 MCB		X	
Aeration Blower 1 & 2	P203 & P204 MCB	X		
Crossflow pump 1 D/S	P301 MCB		X	
Crossflow pump 2 D/S	P302 MCB		X	
Crossflow pump 1 & 2 D/S	P301 & P302 MCB	X		
Backwash Pump	P303 MCB		X	
Recirculation Pump	P401 MCB & CONTACTOR		X	
Reticulation Pressure Pump	P403 MCB			X
Balance Tank Low Level	WL101 LOW LEVEL			X
Balance Tank High Level	WL101 HIGH LEVEL		X	
Balance Tank High High Level	WL101 HIGH HIGH LEVEL	X		
Aeration Tank Low Level	WL201 LOW LEVEL	X		
Aeration Tank High Level	WL201 HIGH LEVEL	X		
Clarified Tank Low Level	WL202 LOW LEVEL		X	
Clarified Tank High Level	WL202 HIGH LEVEL	X		
Final Effluent Tank Low Level	WL401 LOW LEVEL		X	
Final Effluent Tank High Level	WL401 HIGH LEVEL	X		
Sand Filter Pressure Differential	High sand filter pressure			X
BW alarm	Sand Filter BW alarm		X	
Dissolved Oxygen Low Level	DO LOW LEVEL			X
Turbidity Off spec warning	NTU401 OFF SPEC		X	
Turbidity Off spec filtration stop	NTU401 FILTRATION STOP	X		
Balance Low Flow	P101/102 LOW FLOW	X		
a' Recycle Low Flow	P103 LOW FLOW		X	
RAS A Low Flow	P201 LOW FLOW		X	
RAS B Low Flow	P202 LOW FLOW		X	
Crossflow Low Flow	P301/302 LOW FLOW		X	

Alarm Description	ALARM	PRIORITY		
		HIGH	MED	LOW
Low Chlorine Residual	CL401 LOW LEVEL		X	
Aeration Pressure High	PT201 HIGH PRESSURE		X	

Appendix C. Process Set points

C.1 General

The table below summarises the process set points values for the treatment plant.

PLC Address	Set point Name	Units	Preliminary Setpoint	Commissioning Setpoint
	SCREEN RUN FLOW	L/s	0.5	
	BALANCE DUTY START	%	30	
	BALANCE DUTY STOP	%	20	
	BALANCE STANDBY START	%	80	
	BALANCE FLOW RATE	L/s	0.6	
	BALANCE HIGH LEVEL	%	90	
	BALANCE HIGH HIGH LEVEL	%	100	
	AERATION LOW LEVEL	%	30	
	AERATION HIGH LEVEL	%	98	
	CLARIFIED LOW LEVEL	%	30	
	CLARIFIED HIGH LEVEL	%	95	
	CROSSFLOW DUTY START	%	60	
	CROSSFLOW DUTY STOP	%	15	
	FINAL EFFLUENT LOW LEVEL	%	10	
	FINAL EFFLUENT HIGH LEVEL	%	95	
	FINAL EFFLUENT DUTY START	%	30	
	FINAL EFFLUENT DUTY STOP	%	15	
	WAS RUN TIMER	MINS	5	
	WAS REST TIMER	HRS	23	
	WAS SETTLE TIMER	MINS	30	

PLC Address	Set point Name	Units	Preliminary Setpoint	Commissioning Setpoint
	RAS A RUN TIMER	MINS	3	
	RAS A REST TIMER	MINS	2	
	RAS B RUN TIMER	MINS	1	
	RAS B REST TIMER	MINS	10	
	RAS A FLOW RATE	L/S	1	
	RAS B FLOW RATE	L/S	1	
	a' REC FLOW RATE	L/S	6	
	A' REC RUN TIMER	MINS	50	
	A' REC REST TIMER	MINS	10	
	FILTER DIFF PRESSURE	kPa	35	
	BW CYCLE TIME	0:00	11:00 AM	
	BW RUN TIMER (PER FILTER)	MINS	12	
	CROSSFLOW FLOW RATE	L/s	0.6	
	BW FLOW RATE	L/s	6.2	
	VALVE ACTUATION TIME	SECS	20	
	BALANCE LOW FLOW	L/s	0.1	
	RAS A LOW FLOW	L/s	0.2	
	RAS B LOW FLOW	L/s	0.2	
	a' REC LOW FLOW	L/s	0.2	
	CROSSFLOW LOW FLOW	L/s	0.2	
	LOW DISSOLVED OXYGEN	mg/L	1	
	TURBIDITY WARNING	NTU	10	
	TURBIDITY FILTRATION STOP	HRS	1	
	LOW CHLORINE RESIDUAL	mg/L	0.3	
	HIGH AERATION PRESSURE	kPa	100	

PLC Address	Set point Name	Units	Preliminary Setpoint	Commissioning Setpoint
	BW CYCLE ALARM	COUNT	2	