

1. INTRODUCTION

Mono Pumps Group of Companies

Mono Pumps (NZ) Ltd is a part of the Mono® Group of Companies with facilities in Australia, United Kingdom, United States of America, France and China.

The Mono Group is wholly owned by National Oilwell Varco, a US\$8 billion company located in Houston, Texas, USA.

The Mono Company began the manufacture of the first progressive cavity (PC) pump in 1935 at its manufacturing plant in Manchester, England. Since that time Mono has been a world leader in the development of PC Pumps and other products for the Waste Water industry.

The current product range includes PC Pumps with flows up to 420m³/hr and pressures up to 720bar with a range of various stator elastomers, rotor materials and coatings to suit corrosive and abrasive pumping applications in various industries.

Other products developed by Mono include Power Sections used for directional drilling applications in the oil and gas industries, motor driven and flow powered screens, high speed macerators and low speed grinder units for use in the sewage and waste water markets.

Across all industries and products, Mono is highly committed to delivering comprehensive pumping solutions that are aimed at reducing the costs and risks associated with pump ownership and operation.

Mono Pumps – Australasia

Mono Pumps opened its manufacturing facility in Melbourne Australia in 1952 servicing the industrial and agricultural industries. Since that time Mono Pumps (Australia) Pty Ltd has grown to include a full Research and Development team focused on developing packaged pumping solutions. Mono Pumps (Australia) Pty Ltd has 155 employees and 6 branches throughout Australia.

Mono Pumps (NZ) Ltd. was established in New Zealand in 1976 initially with 7 employees. Currently there are 17 employees including 3 Area Managers, 3 Application/Project personnel, Inventory and Purchasing Controller, Aftermarket Support, and 3 Stores/ Workshop personnel. Mono Pumps (NZ) Ltd. reports directly to Mono Pumps (Australia) Pty. Ltd. and as such has the full back-up and support of the wider Australasian and global organisations.

In addition to promoting Mono company products Mono Pumps (NZ) Ltd has a range of complimentary water and waste-water products from world class manufacturers including, Dresser Roots Blowers, ABS submersible pumps, mixers, aerators, fine bubble diffusers and a range of Scan end suction and split case centrifugal pumps.

2. Technical specifications

This section briefly explains the main beneficial features, with a “FAQ” section.

Grinder Pump

As Mono Pumps core competency for over 60 years was in progressive cavity pump technology, there was significant design capability to produce a product that would exceed the head and flow capability of the other products with a high degree of reliability. By increasing the pump capacity, network designers have significantly greater flexibility in the number of and positioning of larger pump stations within the network. In some instances, the additional head capacity available with the Mono G60 is the difference between a pressure sewer network and a more costly gravity network.

The macerator unit was developed using the proven Grifter technology.

The success of the dry mounted Grifter was instrumental in the final pump design pursued by Mono. The capability of the Mono progressive cavity pump to self prime was proven and for a number of factors, including Health and Safety issues, was considered more desirable than submerging the pump in the sewage.

Level Control

The concept of isolating all components from the liquid being pumped was further utilised with the use of pressure sensors mounted in the dry well compartment of the collection tank. This further eliminated the requirement to submerge a level sensing device in the pumped product where potential interference and blockages could occur.

Electronic Controller and Network Protection

Traditional pressure sewer electrical controllers have been designed around protecting the grinder pump, when designing the Mono controller we took into account the need to protect and control the wider pressure sewer network.

Helical rotor pumps can generate very high discharge pressures and have the capability to exceed the design limits of the rising main, which could lead to mains failure. By developing an extremely accurate pressure cut-out system, via a current sensing device in the main control box, Mono is able to guarantee that the G60 pump will never deliver more than 110% of the pumps rated pressure. As a result of this you can be assured that the risk of rising main failure and accidental environmental discharge is significantly reduced.

Tank & Occupational Health and Safety

To complete the package an LDPE (polyethylene) tank was designed to include a separate waterproof dry well to house the pump and level controls. The current design eliminates the risk of persons accidentally entering the sump when removing the lid of the pump station as there is no direct access via the dry well compartment. Access to the wet well is achievable only through a 110mm inspection and access port.

Design, Manufacture and Testing

The complete Mono Eco PSS package is supplied fully assembled and tested both mechanically and hydraulically to ensure both the integrity of system components and the operational performance of the system.

All product design, development, manufacturing and testing of equipment, with the exception of the LDPE collection tank, is conducted at the Mono Pumps Melbourne manufacturing facility by fully trained Mono Pumps engineering personnel. A number of endurance test regimes are available for inspection on a confidential basis if requested.

Network Design, Partnerships and Risk Mitigation

Mono Pumps is strongly committed to delivering the highest quality pressure sewer networks available and understands many of the concerns, risks and challenges that are faced with their implementation. In order to get the most out of the equipment, Mono is committed to working in partnership with Council engineers, network designers, installers and sub-contractors to ensure that they can have the most effective, low-risk pressure sewer networks that are available.

2.1 Frequently Asked Questions about the Mono PSS Eco 1-60 Package

1. **What happens when solid objects get into the tank?**

All pressure sewer grinder pumps have been designed to grind and transfer a wide variety of items that can be found in domestic sewage. The Mono Eco 1-60 has undergone extensive testing and will efficiently grind and transfer items such as condoms, disposable nappies, plastic bags, tampons and sanitary pads.

As with any sewage system; septic tank, modified gravity or vacuum, users of pressure sewer systems need to be aware that the toilet is not for disposal of general household waste.

The unique elutriation pipe design of the Mono Eco 1-60 system ensures that objects such as cutlery, solid plastics and metal fall to the bottom of the tank and will not be drawn into the grinder and pump mechanism.

2. **What is a brownout?**

A "brownout" is when the supply voltage falls more than 10% below the standard single-phase voltage of 240V.

3. **What will happen to the Mono Eco 1-60 PSS system in a brownout?**

As the voltage to the motor decreases, motor run current will increase and may exceed the maximum rated current and overheat the motor. To protect against this, the motor controller is programmed to shut the motor down if the supply voltage falls to 190V. Once the voltage returns to normal, the motor will start again.

4. **Will the Mono Eco 1-60 PSS system over-pressurise a 600 kPA (60m) pipe?**

No. The controller features over-pressure protection and will shut down the motor before the backpressure reaches 600Kpa.

5. **How does the over-pressure protection work?**

The Controller continually monitors the motor current. As the Mono Eco 1-60 pump is a Progressive Cavity pump, motor current is directly proportional to the backpressure of the system. When the motor run current exceeds 8 amps this indicates a pressure of over 60m, the pump will shut down and then try to start again after 5 minutes.

6. **How big is the Mono Eco 1-60 tank?**

The standard* Eco 1-60 tank is 950mm in diameter and 2m deep. The dry well is sized to accommodate the pump, pressure control box and fittings. This dictates the footprint of its visible component, the tank lid

The 900 litre capacity wet well is sized as follows**:

- 45 litres will always remain in the bottom of the tank.
- The operating level between pump start and pump stop is set at 120 litres or 2 minutes of run time.
- Above the pump on level there is an additional 135 litres capacity before activation of the high level alarm. The remaining 600 litres ensures there is at least a day's emergency storage should there be a power failure.

* Non-standard tanks are available; please contact Mono to discuss requirements

** On / off and alarm levels can be adjusted at time of manufacture if required

7. **How is a Mono Eco 1-60 PSS tank installed?**

A 3 tonne mini-excavator with bucket and teeth is adequate to excavate the hole and lift the tank into position. The small excavator is able to enter and operate in tight, difficult locations with minimal damage to the existing landscape. Mono can arrange installation and commissioning. Alternatively a larger excavator with a suitable auger attachment (Ø1m) can be used.

8. **What depth of hole is required for the install?**

2000mm.

9. **Why the need for a boundary kit? What is in it?**

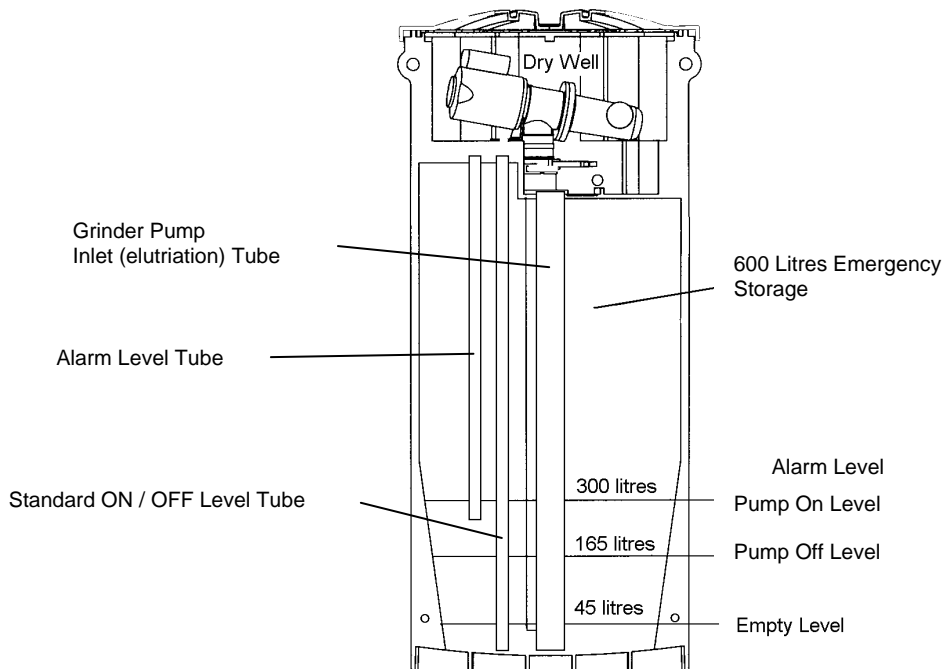
A boundary kit allows isolation of the on-site Mono Eco 1-60 PSS tank and discharge line from a Pressure Sewer System. When the pressure sewer system is in place before the block is built on, a kit is installed on the property's boundary. On development, the Eco 1-60 PSS unit is installed and connected to the boundary kit and the pressure sewer main. (Customized boundary kits are available)

The standard* kit consists of:

- LDPE box and lid
- 1 ¼ inch BSP fittings
- 32mm 316 stainless steel lockable ball valve
- 316 stainless steel check valve and hex nipple

10. How does Mono's system monitor sewage levels in the tank?

As the level of sewage increases in the tank it rises up the level tubes and increases the air pressure within the tube, the increasing or decreasing air pressure acts against pressure switches located in the dry well level control box. The pressure switches turn on or off and signal the Controller to perform the appropriate action.



11. What advantages does the dry well offer over conventional submersibles?

The dry well ensures that the Mono Eco 1-60 pump, pipes and fittings are situated close to the surface and not immersed in sewage. Easy and safe one-man access is achieved and there is minimal sewage contamination of the environment, tools or the service vehicle.

12. Why are there 2 tubes for the level probes?

The longer tube located is the normal operating tube. At the high level (165 litres) it starts the pump and stops it at the low level (45 litres). If the sewage continues to rise it enters a second tube and at the 300 litre level the high level visual and audible alarms will operate. If the pump has failed to start on the low-level tube, it will now start and operate on the alarm tube, thus a level of redundancy has been built into the design.

13. What is the loading of the Eco 1-60 lid?

500kgs.

14. What happens if the operating tube blocks?

If the operating tube is blocked and the pump does not start, the sewage will rise up the second tube and trigger the high-level alarms-warning lamp on front panel, strobe light on top of panel and audible siren alarm. At that point the controller will recognise that the pump is not operating and will start it. It will then stop when the sewage level clears this tube.

If the strobe continues flashing after 30 minutes, the householder should contact the service authority to remove and unblock the two tubes. This is a relatively simple task and does not require removal of the pump from the system.

15. What can be done if the tank fills with product that cannot be pumped out?

There is a 110mm port in the top of the tank external to the dry well that can be quickly accessed via unscrewing a lockable cap to accommodate up to a 100mm hose as would be found on a vacuum sucker truck.

16. What can be done if water pools in the bottom of the dry well during installation?

There is an 80mm drain plug in the bottom of the dry well.

17. What will happen when the pump fails or stops for a period of time such as a power outage?

If the pump stops, the 600 litres of emergency storage in the tank is usually more than sufficient to accommodate inflowing sewage for at least 24 hours.

If the power outage continues and the tank fills up, the sewage will back up and escape through the overflow that we recommend be installed in the gravity feed line and through the breather that is incorporated into the removable 100mm cap. Sewage will spill onto the ground but it is preferable to it backing up the inlet line and entering the premises.

18. How would a network of Mono Eco 1-60 units recover from an extended power outage?

After an extended power outage, pressure sewer networks need to operate at their peak capacity to clear the retained sewage. Upon power being re-established, all units within the network will attempt to start however due to the pressure cut-out system employed by Mono, only the units closest to the network discharge point that see the lowest friction losses will operate.

By utilising the electronic over-pressure protection, you can be assured that the rising main pressure will not exceed the design limits which can lead to rising main failure. All units that failed to start on the first attempt will automatically attempt a second start after a pre-set five minute delay, because some of the first units would have now finished their run cycle, the friction loss in the rising main will be reduced and the second series of pumps will operate. This process will continue until the network fully recovers and the system returns to its normal operating cycle.

If there were specific units that were identified as requiring a higher priority to start on the first attempt - such as nursing homes and hotels due to their relatively smaller storage capacities - the network can be biased to ensure that these units take priority and clear first.

19. What happens in the case of an extended power outage in areas such as rural districts or tropical locations, where the power supply is unstable at the best of times, and there is a potential that a whole lot of these PSS units were to attempt to start up altogether, as the power resumed, how do you prevent a complete power supply network overload?

Due to the fact that the complete PSS Eco 1-60 unit; including the controls and logics; is designed, tested and manufactured at the Mono Melbourne facility, we are able to utilize our R&D department to programme "start delay times" into the controller parameters so that the start up after such an outage can be staggered to avoid a sudden systems power surge.

20. Is there a breather? Why?

There is a Millipore vent breather in the lid of the dry well, this allows air to pass, however it is impervious to water and water vapour. It is necessary to equalize the pressure in the dry well to that outside to ensure better sealing as well as ensuring atmospheric pressure is applied to the level sensors.

21. Is odour an issue? How are odour problems prevented?

Sewage will emit an odour when it becomes septic after about 24 hours. In occupied premises, sewage will not be retained in the tank long enough for this to occur. If the premises are being vacated for longer than about 3 days, a small amount of fresh or grey water should be sent to the tank rather than toilet waste, until the pump starts. When the pump stops at the low level, only 45 litres of fresh or grey water will be retained rather than raw sewage which would go septic and create an odour.

The Mono Eco 1-60 PSS tank is completely sealed so if raw sewage is allowed to go septic in the tank, foul air will be displaced through the breather as fresh sewage enters. However, after one cycle it will be eliminated and no odour will remain.

22. Is there recommended maintenance? What and when?

There is no recommended periodic maintenance schedule.

23. How does the controller work and what does it do?

The Mono pressure sewer system controller has been developed as an integral part of the Eco range of pressure sewer products and has been designed to provide a wide collection of features to protect and control both the grinder pump as well as the wider reticulation network.

Functions performed by the Mono PSS Controller include:

- Monitoring the standard sewage level in the tank via air pressure in level tube and control pump operation
- Monitoring the high level sewage level in the tank via air pressure in level tube and control visual and audible alarms
- Regulate grinder pump operating times to limits within motor manufacturers recommendations
- Regulate the maximum discharge pressure delivered by the pumps via motor current
- Protect the grinder pump from events such as rising-main blockages and 'brown-outs'
- Provide data storage of key events such as total number of starts and hours run
- Provide an interface to enable accurate data to be used for troubleshooting
- Provide a platform for telemetry options

24. What telemetry options are available?

Telemetry allows data on the pump operation to be easily collected for data-logging, detailed analysis or network manipulation. The standard communication options available are low power radio or GSM mobile connection.

All data is transferred according to standard SCADA ASCII protocols. There are further customised telemetry options that can be discussed with Mono.

25. What are the basic principles of network design?

The basic principles involve:

- Determining the path of the sewage
- Determining the length and elevation change within each section.
- Predicting how many units will be operating at any one time.
- Sizing of the pipe diameters in each branch to keep the pressure in the system below the maximum allowable.
- Keeping sewage velocity high enough to enable scouring of the pipes.

26. What are the maximum and minimum operating times of the system per day or per cycle?

The pump motor is rated for maximum continuous running of 20 minutes and 10 starts per hour. The controller will stop the pump after 20 minutes continuous running or after 10 starts in the one hour. The motor will be allowed to cool for 10 minutes and then be started again. Under full loading, the Eco 1-60 can transfer 1200 litres every half hour, however, utilising the 600 litre emergency storage capacity, it could handle a single 1800 litre event without overflow.

27. How far from the house can you install the unit?

The unit should be as close to the house as possible but in an area where there is good drainage away from the lid, the inlet pipe can be laid at a minimum of 1.6:1 grade to enter the tank in the designated area. Identification of a suitable tank location is a process requiring a balance of land owner expectations and hydraulic requirements and as such forms a key step in the detailed design and homeowner consultation process.

28. How is the system electrically connected to the household power supply?

Power to the controller must come from a dedicated circuit from the meter / fuse box with its own 20-amp type D circuit breaker. It is important to consider that in some cases, household electrical audits and circuit upgrades may be necessary prior to commissioning of the pressure sewer equipment.

29. What happens when the householder goes on holidays?

If the householder goes away for a period of the time, they should ensure that the sewage is totally pumped out so it does not go septic and only 45 litres of fresh or grey water is retained in it. Allowing fresh or grey water to enter a basin until the pump turns on will achieve this.

30. What happens when there is a need for a duplex or larger unit?

The Mono Eco 1-60 PSS unit can continuously transfer nominally 2400 litres / hour so compared to competitive units the need for a multiplex system is reduced. For larger flows and head, custom designed Mono pumping stations can be offered using either multiple G60 Grinder pumps in duty / standby configuration, conventional PC pumps and macerators or submersible grinder pumps.

31. What do you recommend to prevent the tank popping out the ground in water charged areas?

The Mono Eco 1-60 PSS O&M specifies that 700kgs of concrete needs to be installed around the base of the tank, assuming the worst ground conditions. Steel reinforcing bar can also be inserted through holes under the tank.

32. Is the Mono Eco 1-60 noisy?

Measurements taken 1 metre above the tank lid during pump operation recorded a noise level of 55 dBA.

33. What sort of installation times and costs are typical, broken down by trade (eg labourer, electrician)?

Typically, using a mini excavator, the hole for the tank can be dug, tank lowered into position and hole filled in less than 2 hours. Allow another hour for plumber to connect external pipe work and 1 hour or less for electrician to position and wire up control box.

34. What is the electrical power consumption per cubic metre of sewage pumped?

The G60 Grifter uses a 0.93kW 240 volt electric motor. The motor has a full load current rating of 6.6 amps. The flow of the pump is 0.833 litres per second at the maximum head of 60 metres. The theoretical maximum power consumption at this duty would be about 0.528kW per cubic metre, this will be proportionally less if the discharge head is reduced.

35. Why doesn't the Mono Eco 1-60 PSS package have an anti-siphon device similar to others?

Due to the high quality of the rotor / stator combination in the Mono G60, the use of an anti-siphon device is not necessary. This feature is not desirable as each time the pump stops air is introduced into the system pipe work, once into the reticulation network, the entrapped air will negatively impact the overall system efficiency. This is often used where pumps are not able to start when subjected to system back-pressure. The Mono pump has been endurance tested starting against full system pressure (6 bar) without any problems.

36. What happens to the liquid in the suction pipe when the pump stops? If it empties how can the pump work when it starts up again?

The liquid stays in the pipe. However, this is not a concern as even if the pipe self-drains, the pump is designed for, and capable of self priming. Tests have been carried out continuously stopping and starting the pumps on the test rigs for an equivalent of 25 years of normal operation without any problems.