

	Cylinder Pump(Anyfusion)	Infusion Pump	Syringe Pump
Injection deviation ¹⁾	Small	Large	Large
Accuracy of drug discharge rate	Very high	Low	Low
Accuracy ²⁾	Real-time ±1% range (within 2%) / 72 hrs	±5~20% / 2 hrs	±3% / 2 hrs
Used available range ³⁾	Unlimited when to replace	Frequent replacement of set and container	50, 60, 100cc
Period of Set, Syringe, Cartridge replacement	3days (endurance 30days)	1~2 times /day	Depending on infusion volume / maximum 24 times a day
Using area	High capacity, high precise (Every area)	High capacity, low precise (Use in division)	High capacity, micro-dosage (Use in division)
Pump & drug location ⁴⁾	Irrelevant(solution for pressure of multiple devices)	Keep constant height	Similar height as infusion site
Pole use	Irrelevant & Selectivity	Mandatory	Selectivity
Convenience in move	○	△	△
Use division ⁵⁾	Infusion mode+syringe mode (variety possible combination)	Infusion mode only	Syringe mode only
Forced Injection by unauthorized person	X	○	○
Siphoning phenomenon	X	○	○
Free flow ⁶⁾	X	○	○
Inadvertent bolus ⁷⁾	X	○	○
Accidental bolus	X	○	○

1) Injection deviation of Flow rate

The cylinder pump cartridge set is injected only a certain drug amount according to the internal space, and the flow rate does not change suddenly. Since only cylinder pump cartridge set is not gravity type, it is not affected by real time accuracy, height of drug, viscosity of drug, etc. However, other pumps are affected by height, viscosity, blood pressure, blood vessel, health condition etc so that real-time accuracy is not ensured and there is a large deviation in long-term use.

2) Accuracy

In general, infusion pump injection accuracy is $\pm 5\%$, syringe pump is $\pm 3\%$, fluid flow adjustment set is $\pm 10\%$, but cylinder drug infusion pump with regulation of cylinder cartridge has injection accuracy within $\pm 2\%$.

3) Used available range

Considering that the syringe pump has a maximum syringe capacity of 60 cc, it is necessary to replace the syringe with a new syringe every hour when the drug is injected at a rate of 60 ml / hr or more, resulting in problems such as contamination, infection, and increased workload of medical personnel. However, this product is a cylinder pump that can supply drugs in the form of a liquid bag or a liquid bottle when a large amount of drug is injected, and has durability that can use the cylinder cartridge for up to 3 days (72 hrs) without capacity limitation. Also infection and contamination can be dramatically lowered.

Syringe size and selection

- Ensure syringe sizes and models are compatible with the syringe pump (refer to the manufacturer's instructions for use.) Use of incompatible syringe can cause improper pump operation resulting in inaccurate fluid delivery, insufficient occlusion (blockage) sensing, and other potential problems.
- Use the smallest compatible syringe size necessary to deliver the fluid or medication; this is especially important when infusing high risk or life-sustaining medications at low infusion rates (e.g., less than 5 mL per hour, and especially flow rates less than 0.5 mL per hour). Using a larger syringe when infusing at a low rates can lead to inadequate syringe pump performance including delivery inaccuracies, delay of therapy, and delayed generation of occlusion detection alarms. This is due to the increased friction and variable compliance of the syringe plunger tip with larger syringes.

Source : <http://www.fda.gov/MedicalDevices/Safety/AlertsandNotices/ucm518049.htm>

4) Pump, Drug location

Infusion pumps use gravity to limit the installation site (height), and there is a backflow problem that occurs due to the low drug location. Syringe pumps should also be used at similar heights to infusion sites (syringes), and syringe pumps installed above infusion sites are easy to happen siphoning phenomenon and supply an inappropriate amount. However, since this cylinder pump uses the pressure change mechanism, it is not influenced by the position, and in principle blocks the backflow problem.

2.3.4 Usage considerations

- Syringe pumps have been designed to give optimum performance when placed approximately level with the infusion site. It is not advisable to place the pump well above the infusion site as, even in modern designs, some siphoning can occur in this position.

NB : When the administration set has been connected to the infusion site, the vertical position of the device and giving set in relation to the site should be altered as little as possible. If the pump is raised above the infusion site whilst the liquid is being delivered, it can result in a large bolus being delivered to the patient. (See Section 7 and Appendix 4.)

Source : [UK Medicine and Healthcare Products Regulatory Agency 2013]

Height and Location of the Syringe Pump System

- Ideally, the syringe pump should be level with the distal tip of the catheter (e.g., the site of fluid delivery : if accessing a central line the syringe pump should be at the level of the patient's heart.) If the pump height is raised relative to the distal tip of the catheter (e.g., during patient transport), the increase in height of the syringe pump can result in a temporary increase in fluid delivery or bolus until the flow rate stabilizes. Alternatively, if the pump is lowered relative to the distal tip of the catheter, the decrease in height of the syringe pump may result in a decrease in fluid delivery or under-infusion until the flow rate stabilizes.

Source : <http://www.fda.gov/MedicalDevices/Safety/AlertsandNotices/ucm518049.htm>

5) Use division

Infusion pumps and syringe pumps should be used separately for each purpose and function, but in the case of a cylinder pump, both the infusion pump and the syringe pump can be used in one pump.

6) Free flow

In the case of general pump fluid set, it is possible to prevent free flow only by artificially using roller clamp, etc, and accident due to user mistake may occur. However, due to the internal structure of the cylinder cartridge, the free flow and the forced injection of the patient or the care giver can prevent the accident caused by the user mistake.

FREE_FLOW

Although obvious to all, fully opening the roller clamp on a basic gravity infusion set-up will permit all the fluid and any air in the bag to infuse the patient. we seem to abandon this basic logic when using a pump a pump! If the pump is higher than 12 inches above the patient's heart, and the roller clamp is fully open, free-flow is likely occur if :

- The tubing, syringe or cassette aren't carefully located into the housing.
- The pump door is opened or the syringe is removed from it's clamp.
- There is a break/leak in the upper part of the giving pathway or the syringe.

Source : Conti Edu Anesth Crit 2004;4; 81-5, (<http://www.ebme.co.uk/articles/clinical-engineering/46-infusion-devices-training-tutorial>,UKMedicineandHealthcareProductsRegulatoryAgency2013)

7) Overdosis (Inadvertent bolus)

If the infusion pump door is accidentally opened, the syringe pump may result in an unintentional inadvertent bolus due to syringe detachment, malfunctions during loading, and so on, resulting in a fatal result.

OCCLUSION BOLUS EFFECT

Any blockage/occlusion of the giving pathway causes the downstream line pressure to increase to the pumps occlusion alarm/pressure limit, which causes the tubing to expand/balloon. Clearing the occlusion e.g. opening the tap, roller clamp, kinked tubing will infuse a bolus into the patient. The higher the occlusion alarm/pressure limit is set the larger the bolus.

Source : Conti Edu Anesth Crit 2004;4; 81-5, (<http://www.ebme.co.uk/articles/clinical-engineering/46-infusion-devices-training-tutorial>,UKMedicineandHealthcareProductsRegulatoryAgency2013)