Dosage and transfer of liquids

When using syringes & needles: Pay Attention!

Overpressure danger?
Syringe leaking?
Suitable gloves?
Needle disconnection?
Eyes and face protected?

Safety begins with You!

SU-Management D-CHAB | TM-Nov. 2017
What is a plastic single-use syringe?

A syringe is a simple reciprocating pump consisting of a plunger (though in modern syringes it's actually a piston) that fits tightly within a cylindrical tube called a barrel. The plunger can be linearly pulled and pushed along the inside of the tube, allowing the syringe to take in and expel liquid or gas through a discharge orifice at the front (open) end of the tube. The open end of the syringe may be fitted with a hypodermic needle, a nozzle or a tubing to help direct the flow into and out of the barrel. Syringes are frequently used in clinical medicine.

Single-use syringes are mainly produced for medical and not for chemical applications. But they can also be used in the laboratory with care.

Single-use syringes are usually made of polycarbonate, the syringe plunger is usually made of rubber.
In the past, working with plastic disposable syringes repeatedly led to accidents. Especially when using these syringes with dangerous chemicals involves high risks. In this practical module we want to explain the handling of these syringes and the associated risks.
On Jan. 16, Sheharbano (Sheri) Sangji, a 23-year-old chemistry research assistant, died from injuries sustained in a chemical fire on Dec. 29, 2008, in a laboratory at the University of California, Los Angeles.

Sangji was working on a nitrogen manifold in a fume hood in a lab of UCLA’s Molecular Sciences Building. She had titrated the tBuLi twice to determine its concentration—1.69 M—and needed 159.5 mL of the reagent to react with 9.0 mL of vinyl bromide. She was drawing up the tBuLi in roughly 50-mL aliquots in a 60-mL plastic syringe equipped with a 1.5-inch, 20-gauge needle.

For unknown reasons, the syringe plunger came out of the barrel and the tBuLi was exposed to the atmosphere. Although it wasn’t part of her experiment, an open flask of hexane was also in the hood and Sangji knocked it over. The tBuLi ignited and the solvent caught fire, as did Sangji’s clothes. She was wearing nitrile gloves, no lab coat, and no one remembers if she was wearing eye protection.
What is n-Butyllithium (abbreviated n-BuLi)? n-Butyllithium is an organolithium reagent. It is widely used as a polymerization initiator in the production of elastomers. Also, it is broadly employed as a strong base (superbase) in the synthesis of organic compounds as in the pharmaceutical industry.

\[
\text{H}_3\text{C} - \text{Li}
\]

Butyllithium is commercially available as solutions (15%, 25%, 1.5 M, 2 M, 2.5 M, 10 M, etc.) in alkanes such as pentane, hexanes, and heptanes. Solutions in diethylether and THF can be prepared, but are not stable enough for storage.


Source: YouTube
Protect yourself before you work with syringes!

Read the safety data sheet and check the compatibility of materials before transferring liquids with those syringes.

Protect yourself against stitch damages, leakages and splashing liquids.
Types of single use syringes:

- Regular/Slip Tip: The injection needle is impressed onto the central cone of the syringe. This connection is not very stable if viscous or resinous liquids are handled.

- Luer-lock syringe: The cone of the syringe is a screw joint. The injection needle can be attached to the syringe by screwing it onto the cone.

- Eccentric/Slip Tip: The injection needle is impressed onto the eccentric cone of the syringe. This connection is not very stable, if viscous or resinous liquids are handled.

Single-use syringes should be used only once!
Syringes are usually made of several materials. In order to judge the material compatibility of the syringes with a chemical (e.g. solvents, acids, bases, etc.), the nature of the syringe (e.g. polycarbonate, glass), the syringe plunger (e.g. rubber, PTFE, metal) and the injection needle (e.g. metal) needs to be known. When working with hazardous chemicals you should use better syringes qualities than the plastic syringes. For example, syringes made of glass with inside PTFE plunger.

Glass syringe with PTFE plunger
Other points to consider when using single-use syringes: Material compatibility, type, length and thickness of the injection needle.
Septa

Septa are indispensable when working with syringes. There are all kinds of septa available. The figures on the left-hand side show so-called eversion plugs. They are available for all common sizes of joints and additionally for several tube diameters. The conical part is inserted into the joint or tube and the jacket is put over the joint or tube. The figures on the right-hand side show septa with PTFE-coating for screw caps of vials. Also the septa need to be compatible with the chemicals, which are stored in the vessel.

Rubber septa. The material compatibility with the chemicals is not always given. Teflon-coated silicone septa. The Teflon coating is the chemical-compatible side.
The methodology for the transfer, use, and storage of pyrophoric chemicals

Please see the following video from UCLA; Link: https://www.youtube.com/watch?v=21iC4YEgOAs
In addition to the video: Fundamental techniques for the use of syringes and cannulas for the dosage of liquids via septa

Note before you start:

Eye protection: chemical splash goggles or safety glasses must worn whenever handling pyrophoric chemicals. Skin and body protection: gloves should be worn when handling pyrophoric liquids; however, these should not be overly cumbersome because manual dexterity is required to perform the techniques described below. MSDS for specific chemicals to be used should be consulted for direction on which glove type is recommended. A fire resistant fully-buttoned knee-length laboratory coat must be worn to protect the body. In addition, fully enclosed shoes which cover the entire foot (with no holes in the top) must be worn.
Engineering controls and other safety equipment: All manipulation of pyrophoric materials must be conducted inside a well vented fume hood with the sash level at the lowest height possible to perform the required operations. Before starting work, clear the fume hood of any unnecessary equipment or chemicals. An eyewash/safety shower station should be within a ten second travel time of the site of the experiment. Familiarize yourself with the location of this important safety equipment and check that the eye washer is functioning (pass water through it until it runs clear). Also before starting work, know the location of the nearest fire extinguisher and fire alarm pull station.
1) Preparation:

**Important notes**: Small defect, but fatal: The left cannula tip is crooked. This creates large holes in a septum upon puncture. Those holes are not thoroughly closed after retracting the cannula. Therefore only use cannulas with a sharp tip as can be seen on the right side of the figure below.

Adjust the inert gas supply (e.g. nitrogen or argon gas) to a pressure of less than 500 mbar.

Only use clean and dry hoses for the inert gas supply. Connect the end of the gas supply to a cannula as illustrated on the figures below. The hose needs to have a suitable diameter in order for the cannula to fit tightly.
It is even more convenient to prepare a 1-ml syringe the following way:

1. Get a 1-ml single-use syringe.
2. Remove the piston.
3. Cut off the upper part of the syringe.
4. Insert the syringe fragment into the hose.
5. Mount the cannula to the syringe.

It is best to leave the prepared syringe permanently in the hose. Just change the cannula if necessary.

If it is compatible with the experiment or the chemical, grease the cannula with a tiny bit of laboratory grease. It thereby slides easier through a septum and causes less damage. Note: Grease can be an impurity!
If the septum already has holes, try to plunge the cannula through the same holes over and over again. Don’t transform the septum into a sieve! Don’t generate holes, which are not tight anymore.

2) Dosage procedure:

Clamp the storage bottle to prevent it from tipping over. Punch the cannula, which is connected to the inert gas supply, through the bottle’s septum. You can bend the cannula arbitrarily, but not buckle, since this breaks the cannula. The storage bottle is now under a slight overpressure.
Use a single-use syringe of suitable size and a cannula, which is sufficiently long, to reach the liquid in the storage bottle. Attach the cannula firmly to the syringe and prick the syringe deep into the storage bottle! The overpressure in the storage bottle can – and should – push the piston of the syringe slowly out. If the piston doesn't come out on its own, control the gas supply. If the piston still doesn't move, pull (very!) mildly with your hand. But if you actively intake with the syringe, you risk an ingress of air into the syringe and/or the storage bottle. A little bit of gas in the syringe is completely normal, though, and stems from the dead volume of the empty syringe (see figure). However, the little gas bubble should not grow during the pulling!
Carefully bend the syringe, which was plunged into the storage bottle, downwards without breaking the cannula. Not that the cone for mounting the cannula is placed eccentrically (and not centrally in the middle) for good reason. Bend the syringe such that the cone is on the upper edge of the syringe and therefore immediately above the gas bubble - as can be seen in the figure below. Push the gas bubble back into the storage bottle!

The syringe now remains free of gas bubbles if you let the syringe fill by the overpressure in the storage bottle. Wait until the required amount of liquid is in the syringe and then pull it out of the septum (grab the cannula to prevent it from stripping off the syringe). Only then – not before – you can remove the cannula for the inert gas supply from the storage bottle. Thus the storage bottle keeps its overpressure and is protected from air ingestion.
3) In case fast dosage is required or the dosage is not very critical...

Fill a syringe with inert gas by sucking in an inert gas stream and emptying it repeatedly. Plunge the syringe, which is filled with inert gas, into the storage bottle and push the inert gas into the bottle. This sets the vessel under overpressure. **Suck as much liquid as you need into the syringe.** Remove the gas bubble as described before. Pull the syringe out of the storage bottle again. This method only works if the amount of gas, which is pushed in, is in an adequate ratio to the gas volume in the storage bottle. Therefore check the fluid level of the storage bottle!

Quelle:
www.bcp.fu-berlin.de/chemie/chemie/studium/ocpraktikum/ressourcen/laborpraxis/laborpraxis_webinfos/fluessigkeiten/kanuelen/kanue1en1.html
Alternative to single-use syringes:

**Syringe motors** – They offer the best protection for dosage of dangerous liquids. These devices can also be operated with remote control. Even with it accidents can happen. But the risks, that you are directly confronted with the effects of an syringe accident, are minimized.
Disposal Guideline HCI

Waste Disposal