Notice!

I've found that this book project has been showing up on more and more search engines lately and is also being directly linked to for the information it contains[1]. I therefore find it necessary to warn all persons viewing this document that it is a work in progress, and as such it contains errors of all kinds, be them in experimental procedures that may cause harm, or in faulty reasoning that would get you slapped by nearly any chemistry instructor. Please for now take the information here with a grain of salt.

Most Importantly!

By reading further you agree not to hold the authors of this document responsible for any injuries/fatalities that may occur from attempting to make any of the products or following any of the procedures that are outlined within. Chemistry inherently possesses a degree of danger and you must understand this, wear gloves and more if the situation calls for it, your safety is in your own hands, not mine!

Also note that this project is open for contribution by any party on the internet. Simply submit a section to Rob.Vincent@gmail.com and it will be added into the text pending editing and such within a few weeks. Any person contributing will have their name mentioned in the credits. Thank you for reading this, and enjoy!

1 Although this document may be directly linked to, it will not work in that manner as I have hotlink protection f documents, however directly linking to the html document is possible, still though I would prefer links be to the ma project page.

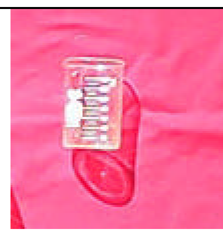
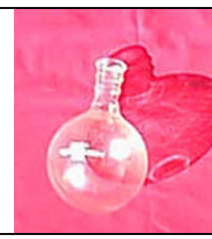
2.0 Reaction vessels

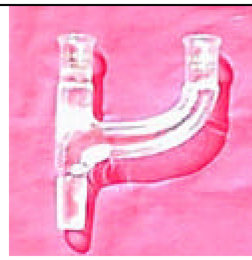
It all starts, sometimes even before the chemicals, with choosing what you will be doing your reactions in. In the beginning it is common to improvise your glassware, just re-using old jars and bottles to store reagents that you procure or produce or to run reactions in. However as time goes on you start to realize you might not be able to heat your bottles without them shattering, and those plastic pop bottles that at one time seemed like a stroke of genius to store things in, are now melting like candles from the corrosive fumes. Well, we all have to start somewhere, and even soda glass has its place, so take the time to read through these varied reaction vessels. Remember glass is the old standby but there are different kinds of glass and there are some reactions that, either though intense heat or specific reagents, are unsuitable to be run in glass.

2.1 Glassware

Most laboratory work is safe to conduct in some sort of glass apparatus. And that's great news, glass is resistant to most chemical attack; notable exceptions being strong hot bases, and most definitely hydrofluoric acid/some fluorides. Glass also has a high melting point. Glass will deform at high temperature but some types of glass will shatter along the way as you will see from the following descriptions. Another plus is that it is amorphous, and by lacking a crystal structure it is clear, allowing you to see reactions taking place inside the vessel and to allow measuring of liquids using graduation marks found on many pieces of glassware. Glassware is also convenient for storing regents for long periods of time; carrying out complex refluxing; distillation under high heat or pressure/vacuum, glass is the containment choice for nearly every chemist under most situations.

There are many forms of common glassware including beakers, flasks, tubes, test tubes, funnels, pipettes, graduated cylinders and watch glasses. There are also more exotic (and more expensive) glassware products including separatory funnels, ground glass jointed distillation flasks and jacketed condensers. I am only going to explain the purpose of some of the more common glassware that a new home chemist would have.

		
Standard funnel	Beaker	Round Bottom (RB) Flask
		
Graduated Cylinder	Volumetric Flask	Sepretory Funnel

		
Erlenmeyer Flask	Claisen Adapter	90 Deg Vacuum Adapter
		
Still Head with Thermometer	Vigreux Column	2-Neck Flat Bottom (FB) Flask
		
	Liebig Condenser	

Beakers: These are simple cylinders with a pour spout on the lib and a flat bottom. Many times beakers have graduations on the side but be warned that these are not as accurate as from a graduated cylinders. Beakers are used to mix or dissolve substances, as simple heating vessels and sometimes as heating or cooling bath containers.

Flasks: There are two types of flasks; Florence flasks (sometimes called boiling flasks) and Erlenmeyer flasks. Florence flasks have a round body with one or more necks going into them. Some have round bottoms and some have flat bottoms. Round bottomed flasks need stands to hold them up but are stronger so you can use a vacuum with them without fear of an implosion. Erlenmeyer flasks have a cone-like body and are used for simple heating and, with a side nipple, for vacuum filtration. Volumetric flasks are simply Florence flasks with a flat bottom and a very long neck with a mark at the 500ml or 1 liter line. They are used to prepare a solution of known molarity.

Tubes: Tubes are simply glass cylinders. Some are made of Pyrex but most are made of soda glass. By melting and blowing with the help of a burner the home chemist can make simple equipment to help with an experiment. For example he could wrap a cooking thermometer made of metal in glass to increase its chemical resistance or make a simple gas drying tube. Pyrex tubing must be melted with an oxygen rich flame. Tubes can be bent once heated to carry liquids or gas to different glassware.

Test Tubes: Test tubes are simply tubes with a rounded end and a lip made of Pyrex or soda glass. Small reactions can be run in them and small amounts of substances can be stored in them. For example a small bit of potassium metal could be stored in oil in a test tube properly sealed at the top. Because the bottoms are rounded they are susceptible though to being dropped. The bottom can easily crack out in these instances and spill liquids everywhere and care should be taken when using stirring rods and they can also puncture holes in the bottoms of test tubes.

Funnels: Funnels can be used to filter things when you use filter paper or to add liquids or powders into a small area like the mouth of a test tube.

Pipits: Pipits are glass tubes with a small hole in one end and a larger hole in the other. They have very accurate volume measurements on the side of the glass. Pipits are used to suck up liquids, measure small amounts of liquids and place small amounts of liquids somewhere. Never pipit by mouth; always use a rubber pipit bulb.

Graduated Cylinders: These are simply large tubes with a stand on the bottom and a pouring spout. They are used to measure volume and come in sizes from 10ml to 500ml. 100ml cylinders are the most common.

Watch Glasses: These are curved dome-like pieces of glass that can be used to hold powders, cover beakers or make "cold fingers" for sublimation purification of things like iodine crystals.

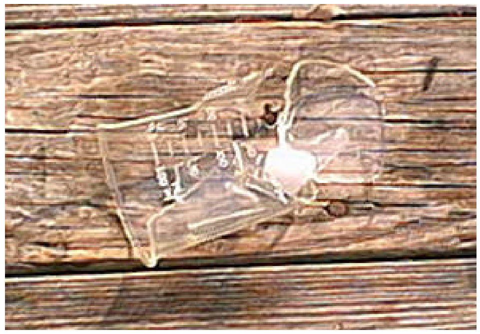
2.1a Pyrex/Borosilicate Glassware

(From left to right …..)

"Pyrex" is a brand of high quality borosilicate glass but the name is used to refer to all sorts of heat resistant glass. Borosilicate glass is simply the type of glass that most high quality labware is made out of, it's most notable difference between normal soda lime glass being a high percentage of boric oxide in the mix which reduces its expansion as it heats. Some of the cheaper glasswares made by companies like Bomex can show lessened resistance to heating and usage, this should be taken into consideration when purchasing glassware of unknown origin. Pyrex and Kimax are good mid priced glassware while Duran is top quality. Although technically any piece of glassware can have ground connections they appear almost exclusively with borosilicate glassware. Ground glassware is simply a larger diameter opening called the female end and a smaller diameter which is frosted on the outside called the male, the male fitting into the female and the area of their connection actually ground to give an even connection. There are many different sizes of joints with which glassware can connect and most countries have their own sizes that are most commonly available.

Other then the glassware intended strictly for purposes of chemistry some glassware available readily from your grocery store is likely Pyrex® these types of glassware include measuring cups and baking dishes, heating these is not recommended by the manufacturer on an open flame but it can be done, there are also glass pans made from these heat resistant glasses, these are great for reducing the volume of aqueous solutions and such to a manageable level though their availability is sometimes limited.

Never assume that your glassware is Pyrex or other another heat resistant type, back in my early days I was planning to boil down about 400ml of $CuCO_3$ in water. At that time I did not have a nice hotplate like I do now so I tried to use the stove. I grabbed a cooking bowl made of glass and poured the greenish mess into it. I then placed it on the stove and started stirring it when after a few minutes it cracked into about four parts. The nasty stuff got all over the oven and dripped onto the floor and the range area. A thousand thoughts started to rush through my head. "CuCO3 + HCl in stomach --> Death?" I cleaned like a cheap animation on a laserdisk stuck in fast forward. Don't assume all glass is Pyrex without looking.

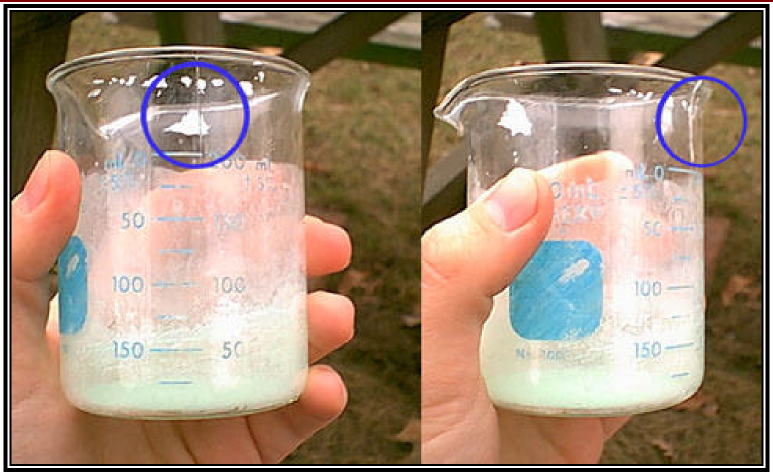


Your glassware will break, how often that happens of course depends on what kind of reactions you do, where you work, and most of all how careful you are when you experiment. But this will happen. Broken Pyrex though is still useful. It can be kept and broken further in order to fill fractioning columns, normally these are filled with Pyrex beads, but broken glassware works as well and the beads used, being Pyrex, are expensive and it can cost over $100 to fill one of these columns with beads but you can just use your broken glassware. Another use is for boiling stones, broken glassware can help to form nucleation points in boiling and keep things boiling smoothly, especially in test tubes. Shards can be used to scrape out beakers, and for filler in reaction vessels, for example shards of glassware can be used to fill a container and keep a powder or chunky solid separate so it doesn't clump together in one mass, or they can also be used in catalyst tubes. The possibilities for broken glassware are unlimited and Pyrex is not something a chemist should throw away lightly.

Ground glassware joints are occasionally subject to a process called freezing. In this, usually, some foreign substance has made its way between the ground joint (Could also be something like vacuum grease or something else you put there) and for some reason or another the glassware becomes fused at the joint and undoing it seems nearly impossible. Storing strong bases in glassware can also freeze the joints from hydroxide getting into the ground joint and somewhat dissolving some of the glass. In any case there are a number of steps you can take to attempt to free your glassware joint so that you can use it once again.

1. Soaking the joint for several hours or even days might help, water is a good first choice, base and acid solutions can be helpful for specific culprits, and organics such as ethanol or stronger non-polars could also free the joint.
2. Next try gentle heating with a blow dryer. Attempt the twist back and fourth while heating.

From there though the processes begins to give a greater possibility of damaging the glassware, such as tapping the glassware, heating with a Ni-Cr wire, or using a torch. Hopefully you will succeed in getting the glassware unfroze, and if you manage that you should take some fine steel wool and gently go over the joint again to free it from any clinging particulates and be sure to clean it well before using again.



Cracks may be difficult to see when looking straight on at an object.

Before heating any borosilicate glassware it is good to check it carefully for defects. Cracks and pits known as stars can lead to catastrophic failure at high temperature due to the expansion of the glass causing tension along the fractures created. Although it is not something to worry about compulsively, if you are using your glassware over high heat containing any corrosives, oxidizing materials, or anything that presents a high hazard situation then beforehand do yourself a favor and give your glassware a quick check over for defects.

2.1b Soda-Lime

In all likelihood this is the type of glassware with which you have had the most contact throughout your life. If it is made out of glass, and there is no need to heat it, it is probably some composition of soda-lime. The number one advantage of soda-lime, over all other types of glassware from an industrial point of view, is the cost of production. For what you get, i.e., a fairly inert transparent material, it has a good cost to usage ratio. So jars are made from it, drinking glasses, vases, light bulbs, and more.

So, it's cheap to produce and therefore you have lots of it laying around, so by that same virtue it is cheap for you to use since it is so widely available. Many people will use soda-lime glass somewhere, sometime, for some reason or another, some people only own soda-lime, while others shun it. Well, it's easy to see where its use can come into play, first, lets look at the advantages of soda-lime:

- Resistant to most chemicals (Exceptions are hydrofluoric acid, fluosilicic acid, concentrated phosphoric acid, or hot/concentrated bases)
- Cheap, and widely available
- Electrical insulator (Can be a good thing or a bad thing.)
- Has a continuous high use temperature of almost 125 C

Now many people will say, wow, soda-lime doesn't look like a bad choice for glassware at all. As a matter of fact, its properties closely match those of the preferred type of glassware for chemical reactions, borosilicate glass. However there is one major exception.

Soda-Lime glass is not meant for heating!

There are people that would argue over this point. Not many though. Aside from gradual heating, in a water bath or just for very short periods this rule will catch up with you. Soda-lime has a terrible time of trying to be conductive toward heat, and as such one part of the glass will try to expand while the other parts do not and you get hairline cracks, usually not even noticing them until it is too late. The average scenario plays out like this.

A chemist is working at home and they have constructed a distillation apparatus consisting of a jam jar into which a tube has been secured into the lid to lead away the vapors. This jar is heated on a hot plate and the liquid begins to boil and distil across the tube. The procedure continues without interruption until the chemist notices some precipitate in the reaction container. Out of curiosity they go to pick up the container to swirl it and better ascertain the identity of the unknown precipitate. But when they go to pick it up the whole top comes away. The bottom has broken off cleanly from the uneven expansion of the glass as it heated, and the liquid filling the flask, hot and boiling, goes everywhere. This is actually a common situation.

For example the picture at left shows a setup for washing gasses, note that the glass components are regular jars over the counter, and the are well suited for this purpose as temperatures and pressures involved are not that great. Also to note is the glass tubes used. Glass tubing is widely available and you have a choice of soda-lime or borosilicate, but in this case the differences between the two are less noticeable. Both can be heated over an open flame to get them to their softening point where they can be bent into a number of shapes suiting your purpose. Although soda-lime is sensitive to heat as long as it is dry the area that is being heated is so small that it can be done safely.

Heating soda-lime is its major weak point and should be undertaken with caution and only where the contents of the container do not pose a significant hazard. However it is good for any of a number of reactions where there is no heating involved, gas generation apparatuses, storage of liquid or solid reagents, or for many other things. Notice that water or aqueous solutions should not be stored in soda lime or any other glass container if there is the possibility of freezing, the expansion of the liquid as it freezes can and often will crack and destroy the containers you have chosen. Nevertheless, soda-lime does have it's place in the home lab, just be sure to consider the fault in heating it.

2.1c Lead Glass, Vycor, Misc.

Vycor™, also known as fused silica or vitreous silica is the holy grail of glassware. Composed entirely of SiO_2 fused together at high temperature, it is very resistant to thermal shock, even more chemically resistant then glass, able to be heated to nearly 1200 °C in use, and does not soften until nearly 1500 °C! This would be the preferred way to go for many chemical vessels. Problem is, owing to its high melting point and exacting standards of preparation fused silica is quite expensive and hard to acquire. Often when you encounter fused silica it will be in the form of a crucible for use in a furnace. Not clear and usually white these crucibles are great for ashing samples for analysis. The absolute cheapest source of fused silica for the home chemist is from online jewelry supply stores. They sell small fused silica crucibles for the explicit purpose of melting precious metals such as gold within the average jewelers shop. These are also often shaped in such a way as to allow direct intense heating of the contents and are thus suitable for direct intense heating of pretty much anything and are considerably cheaper then fused silica crucibles intended for laboratory use.

There are a number of specialty glasses to be found on the free market not listed here. Lead glass is known for being dense and having a high refractive color on cut surfaces. Its use is mainly ornamental, if used in a chemistry lab however there is a high probability that any liquid contained without would leech out a portion of the lead contained and ruin most stored reagents this way. The same holds true for Vaseline glass. This light green glass is also used for ornamental purposes and is quite old usually. The pigment in the glass is uranium oxide and as such this could be leeched with acids leading to ruined reagents. The point of this being that unknown glasses should not be used for the storage of reagents because although they may look aesthetically pleasing they may cause harm to the chemicals contained within.

2.1d Cleaning Glassware

It should be your goal every day, at the end of your experiments to make sure you keep your glassware clean. Dirty glassware can catalyze decompositions, destroy glassware, result in inaccurate measurements, or simply result in you having a solution left in a beaker, unlabeled, of which you have no idea of the contents. Plus if you need to use a piece of glassware that is dirty you usually have to stop what you're doing and wander off to clean the glassware, and you better hope water won't hurt the reaction otherwise you have to dry it too. And things tend to stick in glassware over time, best just to clean it when you use it.

Oft times cleaning glassware is as easy as rinsing out the contents with water, then maybe distilled water and allowing to drip dry. However cleaning organics is another story. Most times in laboratory settings organic compounds are initially rinsed out with acetone, and then water. This combination works well as the acetone removes and dilutes the concentrations of insoluble organics but is itself soluble in water. It's a nice in between solvent for this. Of course you could use a strictly organic solvent like toluene or xylene or even something like methanol too but the first two of these will pose their own problems in terms of their ability to be washed out with simple water.

What about the other times though, how about if something gets stuck inside your glassware. The best advice is to use your brute strength and rub it out. Let it dry and get a cloth and just try and wipe the spot out. This can save a whole world of pain in trying to find the perfect solvent. Even for rings and such inside flasks where they are impossible to get to, improvise, use a pen and bend it in the middle and use that to wipe a piece of paper towel around on the inside. If this does not work, usually it will make it smear or it just might not rub off. Then you have to start to analyze the situation. Is the stain organic? If it is try and use some acetone or ethanol. Next give some acids a try, hydrochloric is a good starter in case it is acid reactive. If you want to step up from here try sodium hydroxide in ethanol and let that soak about an hour (no longer, this mixture can attack glass joints and ruin volumetric flasks). If that doesn't work, boiling nitric will oxidize even carbon to CO_2 which should clear up nearly any mess you can make.

There are other mixtures too though. A mixture of acidified potassium dichromate (usually with sulfuric acid) is a tried and tested method to clean glassware. But remember the carcinogenity of chromium in the +6 oxidation state such as it is here(1), also this is a strong oxidizing agent it can set fire to some organics, cotton in contact with it will develop burn holes quickly if it is fairly concentrated. Another powerful method uses a mixture of concentrated sulfuric acid with strong hydrogen peroxide solution. This solution known as Caro's Acid or "Piranha Solution" is a very strong oxidizing solution and it is the authors recommendation to avoid this as it can explode from contact with easily oxidizeable organics. Another safer alternative might be Fenton's Reagent(2) which is utilized by add a soluble iron salt to a solution of peroxide and acidifying mildly. This can take some time but it will remove most stains. There are many other solutions available including pre-packaged alternatives, many of which involving hydrogen peroxide or solid peroxides such as sodium perborate.

At the very least these methods should loosen stains which will allow you to fall back on physical methods to remove crusted on staining material. Some things however are irremovable such as pitting or etching of the glass and chipping and removal of layers, these may look like stains at first glance but upon close inspection it becomes apparent that the glass is indeed damaged physically. In these cases the glassware should take up a reduced work load and be retired from continuous use.

(1) It is this carcinogenic property of this solution of potassium dichromate in sulfuric acid that has caused it to fall out in many labs. Prepared solutions of this in the home lab may have solid CrO_3 precipitated at the bottom as a brick red this is a very strong oxidizing agent capable of igniting ethanol vapors, take care.
(2) For more information on Fenton's Reagent try http://www.h2o2.com/applications/industrialwastewater/fentonsreagent.l

2.2 Plastics

Plastics are good for storage of some chemical reagents. Nearly all plastics can store non-oxidizing/non-dehydrating/non-reducing aqueous solutions. Such as water, hydrochloric acid, dilute sulfuric acid, sodium hydroxide or other basic solutions (This is the preferred storage medium for many bases), and solutions of inorganic salts. There are however many different kind of plastic, often differentiable by the designation somewhere on containers as to their recycling preference. Once you know exactly what kind of plastic you are dealing with you open up new possibilities as to what you can store in it, for example, some plastics become soft and dissolve in acetone, whereas acetone may be purchased in containers made from a different type of plastic, here are the common types seen on the bottom of most containers, at least in America:

Polymer Name and Abbreviations	Generalized Properties
Polyethylene Terephthalate PETE or PET	
High-density Polyethylene HDPE	
Polyvinyl Chloride V or PVC	
Low-density Polyethylene LDPE	
Polypropylene PP	
Polystyrene PS	

2.3 Ceramic

The best use of ceramics often comes in the form of their heat resistance, especially in light of their price. They are somewhat resistant to acids and less so to concentrated bases. They also find use in laboratory equipment, one common item found made of a ceramic composition is the Buckner funnel. In terms of over the counter ceramic items with a use in the lab, one common item available that is suitable for at least limited high temperature use is the flower pot. Some flower pots are high in magnesium oxide or simply known as high magnesia, these are capable of withstanding high temperatures for short periods of time. For example, such pots, with the drainage hole in the bottom are used with a piece of paper over it, and contained within the pot is a charge of thermite powder. Upon ignition the liquid metal drips out of the bottom of the pot where it can fall into molds to cast simple objects.

Flower pots are the cheaper end of the ceramics front. Things can and do get significantly more expensive, ceramic plates are used in high end bullet proof vests and there are innumerable membranes derived from ceramics that find use in electrolysis and reverse osmosis. Ceramic pots though are quite useful and available. Not only is the thermite trick a use for such a vessel, but arc furnaces and high temperature reductions along with exotherms can be done in these cheap available vessels.

1) Nomenclature:

Before discussing various aspects of high temperature furnaces and other equipment, it is helpful to understand how ceramics actually work. Simply put, ceramics are mostly metal oxides, such as aluminum oxide (Al_2O_3), silicon dioxide (SiO_2), calcium oxide (CaO), etc. To specify an oxide of a metal, commonly the –um, –ium, or -on at the end of the element's name is dropped, and replaced with –a. eg; alumina, zirconia, silica, calcia, etc. Ceramics can also be composed of more complex mixtures, such as kaolin, a type of large grained clay, $Al_2O_3{*}2SiO_2{*}2H_2O$. A list of commonly used ceramic materials and their properties will follow soon enough.

2) Acid, Neutral, and Basic compounds:

Ceramic compounds fall into these three broad categories. Where R represents a metal and O represents oxygen, chemicals with the formula R_2O and RO are bases or fluxes (eg calcia), chemicals with the formula R_2O_3 are neutral compounds (eg alumina), and chemicals with the formula RO_2 are acids or glass formers (eg silica). At high temperatures, which depend on the compound in question, fluxes attack acids or glass formers, lower their melting point, and together form a glass. Soda lime glass, for instance, is easily melted in a furnace because of the large amounts of soda and lime, while pure silica is much harder to melt. Neutral compounds do not flux other compounds and are not easily dissolved by fluxes, with some exceptions such as boria (B_2O_3). While glass is great for making household glass items, pyrex, and pottery glazes, in the furnace itself glass is undesirable.

3)Green strength:

Clay particles will adhere to one another when wet and dried, but most particles will not. If clay is used, the ceramic will probably not need another binder, but if pure alumina, for example is used, some sort of binder will also be needed to keep the powder together until it has heated enough to form a ceramic bond.

4)Firing:

Ceramic objects and ceramic bonds are created by high temperature firing of powders. The powders are usually slip cast, pressed, or extruded into the shape needed, and then dried and heated. At high temperatures the mobility of molecules and ions within ceramic objects increases, and eventually gain enough mobility to diffuse across various grains of the ceramic powder, fusing the separate grains into one monolithic object. This is a ceramic bond created by what I will call solid state sintering. As the grains fuse together, they shrink towards one another, decreasing the porosity of the ceramic object, causing it to shrink. Another type of bond that occurs is called liquid state sintering (by me at least). Here, some of the components of the mixture melt into a glass, which envelops the non-melted particles, and begins to dissolve them. Eventually the solution saturates, and sometimes higher melting point crystals form within the solution, also knitting the ceramic together.

2.4 Teflon ®

Teflon®, is the brand name of a polymer produced by Dupont named PolyTetraFluorEthylene or PTFE for short. A Dupont researcher accidentally discovered this compound when he noticed there was no more pressure on his vessel, which contained tetrafluorethylene gas. He found a snow-white condensation product, which proved to have exceptional chemical resistance.

Teflon is the compound of choice for the amateur chemist when he needs a very resistant and yet not extremely expensive material. The only problem with teflon is that it is a thermoplast and thus it weakens and eventually melts/decomposes when heated too much. Compared to usual plastics its heat resistance is far higher, it can be safely employed between -200°C and +250°C. Another noteworthy fact is that Teflon is insoluble in every solvent below 300°C. Teflon should never be exposed to temperatures above 400°C because it will decompose into several fluorocarbon nasties, which can severely damage your health.

Because of the exceptionally strong fluorine-carbon bond, Teflon resists the most aggressive chemicals, including fluorine gas or ozone. The only applications where it can't be employed are those where it comes into contact with very strong reducing agents and molten hydroxides, because of the fluorine content Teflon can act as an oxidizer in special circumstances. These reductants are mainly alkali and to a lesser degree alkali earth metals. The Air Force uses Teflon + Mg flares (although hard to ignite) to distract heat seeking missiles because they burn hotter than an aircraft exhaust, so be warned.

Teflon is OTC available mainly as tape, for sealing pipe joints in plumbing, and as sheet, for baking without the use of grease. Teflon tape (if it's pure, it should be white) is a very good substitute for joint grease because it won't contaminate your distillate, yet it provides good sealing. Teflon tubing is available on the internet and in other places and is a great choice for leading around halogens in their vapor forum. Many baking sheets are also coated in Teflon but are Most teflon black, so it probably is not pure, but it is the material of choice for applications where elevated temperatures are needed. Note that some baking sheets are made out of ICFLON, an unknown propriety compound.

2.5 Refractory Compositions

Refractory compositions possess an even higher degree of heat resistance then any compound mentioned thus far, except some ceramics into which they overlap. For examples of refractory compositions please see the section 8.4 on working with refectories.

2.6 Metals

As with all these other reaction vessels, metals have their own notch were they work the best. The actual value of a metal vessel is of course directly related to what metal it is made out of:

Metal	Working Temperature	Chemical Resistance	Additional Properties	Obtained From
Nickel (Ni)	900 C	Very highly resistant to alkali conditions, resistant to non-oxidizing acids	Can be used to handle fluorine or other halogens.	Nickel can be bought in the form of crucibles from chemistry suppliers
Iron (Fe)	1200 C	Iron will dissolve in acids readily, however is it somewhat more resistant to alkalis, it oxidizes easily.	Iron oxide that forms on the surface of objects adheres loosely flaking off and leading to further oxidation.	Iron end caps for plumbing are cheap and readily available. The shiny end caps are galvanized and have a thin layer of zinc plated on them.
Stainless Steel	1000 C	More resistant to acids and bases then iron alone. Less easily oxidized in general.	Can cause hard to determine contamination to reactions due to varying compositions.	Mixing bowls, measuring cups, and other kitchen containers can often be found to be made of stainless steel.
Copper (Cu)	775 C	Somewhat resistant to acids, equally resistant to bases, better then iron, on par if not slightly better then stainless.	Forms soluble highly colored contaminates. Clean before every use due to oxidation by air. Can be used with fluorine or other halogens.	Copper end caps are available for plumbing; they are perfect for amateur experimenting.
Tin (Sn)	250 C	Weak against acids and bases.	Tin forms an oxide coating when exposed to concentrated oxidizing agents that can prevent it from reacting further.	Unknown, tin cans actually only have a insignificant tin coating, therefore they do not convey the properties of tin entirely.
Aluminum (Al)	550 C	Very weak against acids and bases.	Forms a tenacious oxide coating that prevents further	Aluminum end caps and pipes are available in larger home

			oxidation in strong oxidizing conditions such as HNO3 >75%	improvement stores.
Silver (Ag)	700 C	Strong against acids and bases.	-NA-	Expensive, hard to find vessels made of silver, used for work with hydrazine.
Platinum (Pt)	1200 C	Very resistant to most anything	-NA-	Very, very, expensive, platinum vessels for chemistry are hard to come by as well due to these price constraints.

So what's the consensus? If you cannot perform a reaction in glass for one reason or another then you need another choice. Examples of extreme circumstances being, high temperature, reaction mixture attacks glass, or thermal shock might be a problem, metals can be a cheap alternative.