Savillex Technical Note

Pressure Ratings of Savillex PFA Vials

Introduction

Savillex PFA vials were designed initially for closed vessel, hotplate digestion of geological samples and are used for that purpose in virtually every geochemistry lab worldwide. In a closed container, internal pressure increases with heating. This technical note provides a guide to the pressure rating of the different sizes of Savillex vials and closures used for hotplate digestion, so that users can determine heating conditions depending on sample size and type (and therefore vial size).

Family of Savillex PFA Vials

Savillex PFA Vials - History and Design

Savillex PFA vials have been used since the 1980s to digest geological rock samples prior to isotopic analysis. Leading researchers in geochemistry collaborated with Savillex over several years in the development of PFA vials suitable for use as closed vessel digestion containers.

Geochemists needed digestion containers which were:

- Ultraclean with respect to metal background
- Inert to mineral acids including HF
- Capable of withstanding elevated temperatures
- Ability to seal and withstand some pressure build up without leaking (which is not possible with fluoropolymers that cold flow like PTFE)

PFA was (and still is) the best choice to meet all the above criteria. Prior to the development of Savillex vials, researchers used PTFE lined Paar bombs which are capable of high temperature and pressure, but expensive and labor intensive to use. What was needed were containers that could simply be sealed with a screw top closure (to prevent contamination and losses due to evaporation) and heated on a hot plate. While PFA was the obvious material of choice, the PFA digestion containers needed to be capable of withstanding some

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level of pressure build up due to heating. Thin walled PFA bottles that were just coming on to the market at that time were not suitable, as the thin side walls and closure design could not handle any pressure build up without leaking or deforming.

The resulting Savillex designs featured thick side walls and thick-walled closures that prevented deformation during pressure build up. The neck/closure design featured more turns of thread engagement and double lipped closure seals to ensure a good seal that could withstand some pressure build up without leaking. The images below show the thick side walls of one of the Savillex PFA Vials most commonly used for rock sample digestion: the 15 mL vial with rounded interior. The rounded interior shape is preferred by geochemists since there are no corners to trap undigested sample.

15 mL Savillex PFA Vial

Cross Section of 15 mL Savillex PFA Vial

33 mm Closure for 15 mL Savillex PFA Vial

Digestion Procedure

There are many variations on digestion methods depending on the sample type, analyte/isotope of interest, and measurement technique. A typical procedure is to weigh powder rock sample into the vial, add HNO_3/HF/DIW, tightly cap the vial and heat on a hot plate at 140°C (surface temperature of hotplate) for several hours. The pressure buildup inside the vial depends on: actual liquid temperature, liquid volume and dead space volume. Rock samples are inorganic and do not generate CO_2 during acid digestion. Acid digestion of any organic matter present, however, would generate CO_2, which would increase pressure rapidy and exceed the pressure rating of the vial.

Important! Savillex vials can not be used to digest organic matter due to rapid pressure increase due to CO_2 production.

Even microwave digestion systems (which use PFA vessels with much thicker side walls and closures, plus outer support sleeves) have to limit the weight of organic matter they can digest without exceeding the pressure rating of the vessel.

Pressure Rating and Influence of Temperature

Unlike metal vessels and containers, PFA vials, even with thicker sidewalls and closures, have limited pressure rating due to the softness of the polymer, specifically at the sealing surfaces. Vials with smaller closures have higher pressure ratings than those with larger closures, because there is less flex with a smaller closure. Temperature plays an important role too. As temperature increases, vial pressure rating rapidly decreases as the polymer at the sealing surfaces starts to soften and flex. The chart on the next page shows the pressure rating of all commonly used Savillex closures with temperature. As can be seen, the smaller closures start out with higher pressure ratings at room temperature (23°C), but all pressure ratings rapidly decline with increasing temperature.

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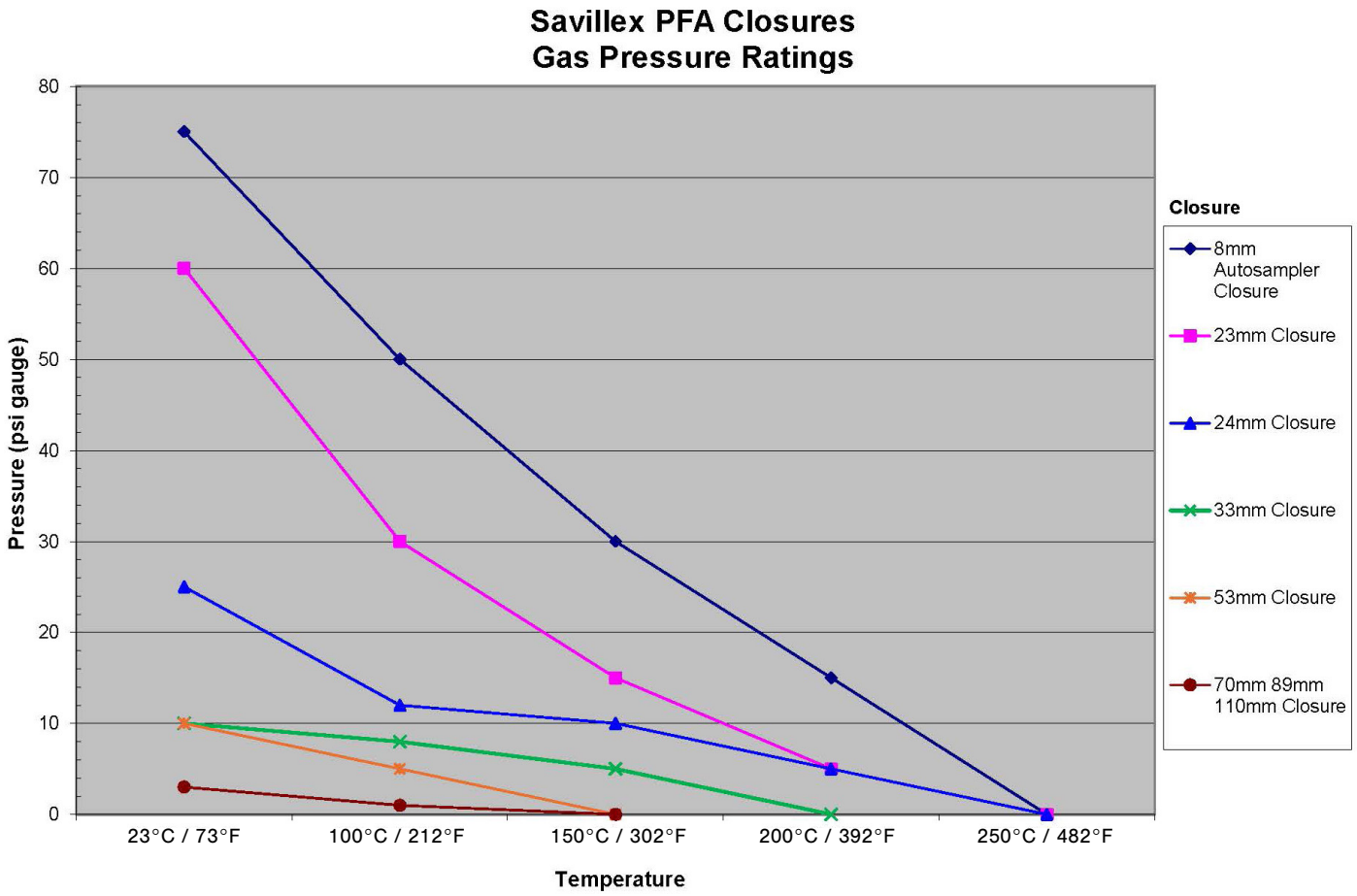

To find the pressure rating of any vial at a given temperature, check the closure size for that vial and refer to the chart. For convenience, this is provided in the table below, which shows which closures are used with Savillex vials commonly used for digestion. Pressure rating depends on closure size and not the vial: the shape of the interior bottom of the vial has no influence on pressure rating, so round, conical and flat bottoms for a given vial all have the same pressure rating. The larger closures are used with Savillex jars which are not typically used for digestion but provided for completeness.

With the pressure rating information, users can decide what digestion temperature to use for a given application and vial size. Generally, use as small a vial as is possible for the digestion method.

Important! Please note that Savillex vials are not pressure vessels and care must be taken to ensure that pressure ratings are not exceeded.

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Vial/Closure Pressure Ratings (all data in psi)

Closure P/N	Closure Description	Vial P/N	Vial Description	23°C/ 73°F	100°C/ 212°F	150°C/ 302°F	200°C/ 392°F	250°C/ 482°F
600-008-01	8 mm Autosampler Closure	200-702-42	200 uL Forensic Vial	75	50	30	15	0
		200-705-42	500 uL Forensic Vial	75	50	30	15	0
600-023-01	23 mm Closure	200-003-12 200-003-20 200-003-30	3 mL Standard Octagonal Body Vial	60	30	15	5	0
		200-006-20	5 mL Standard Octagonal Body Vial	60	30	15	5	0
600-024-01	24 mm Closure	200-007-10 200-007-20 200-007-30	7 mL Standard Vial	25	12	10	5	0
600-033-01	33 mm Closure	200-015-10 200-015-20 200-015-30	15 mL Standard Vial	10	8	5	0	
		200-022-12 200-022-20 200-022-30	22 mL Standard Vial	10	8	5	0	
		200-030-12 200-030-20 200-030-30	30 mL Standard Vial	10	8	5	0	
		200-060-12 200-060-20 200-060-30	60 mL Standard Vial	10	8	5	0	
600-053-01	53 mm Closure	100-0060-01	60 mL Standard Jar	10	5	0		
		100-0090-01	90 mL Standard Jar	10	5	0		
600-070-01	70 mm Closure	100-0120-01	120 mL Standard Jar	3	1	0		
		100-0180-01	180 mL Standard Jar	3	1	0		
		100-0240-01	240 mL Standard Jar	3	1	0		
600-089-01	89 mm Closure	100-0360-01	360 mL Standard Jar	3	1	0		
		100-0500-01	500 mL Standard Jar	3	1	0		
600-110-01	110 mm Closure	100-1000-01	1000 mL Standard Jar	3	1	0		

Notes: For a given vial size, data applies to all interior bottom shapes. For vials not listed in this table, find the closure size used and use the pressure rating for that closure from this table.

Click here to learn more about Savillex PFA Vials and purchase online.

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