Designation: C912 – 17

Standard Practice for Designing a Process for Cleaning Technical Glasses[1]

This standard is issued under the fixed designation C912; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers information that will permit design of a rational cleaning procedure that can be used with a glass that is somewhat soluble in many aqueous chemical solutions. Typically, this type of glass is used in applications such as optical ware, glass-to-metal seals, low dielectric loss products, glass fibers, infrared transmitting products, and products resistant to metallic vapors.

1.2 In most cases, this type of glass contains high concentrations of oxides that tend to react with a number of aqueous chemicals. Such oxides include B_2O_3, Al_2O_3, R_2O, RO, La_2O_3, ZnO, PbO, P_2O_5, and Fe_2O_3. The more conventional high-silica glasses are usually more chemically resistant, but the cleaning principles outlined here also apply to them.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* Specific hazard statements are given in Section 4 and Table 1.

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Terminology

2.1 *Definitions of Terms Specific to This Standard:*

2.1.1 *technical glass, n*—glasses designed with some specific property essential for a mechanical, industrial, or scientific device.

3. Significance and Use

3.1 Many of the low-silica technical glasses which contain soluble or reactive oxides require processing or involve applications that require cleaning. Very often these cleaning procedures have evolved over several decades and are considered an art. They usually contain numerous steps, some of questionable validity. It is the premise of this practice that cleaning glass can be more scientific. Design of a cleaning procedure should involve (*1*) a definition of the soil to be removed, (*2*) an awareness of the constraints imposed by the glass composition, and (*3*) a rational selection of alternative methods that will remove the soil and leave the glass in a condition suitable for its intended application. This practice provides information to assist in step (*3*). General references on glass cleaning and on various methods of evaluating cleanliness and associated information has been published.[2]

4. Hazards

4.1 Many of the chemicals that can be used in cleaning glass are hazardous. This is true of most of the aqueous chemicals discussed in Section 5 and shown in Table 1 as well as the organic chemicals discussed in Section 6.

4.2 Special care should be used with hydrofluoric acid (HF), which will react with glass generating heat. HF destroys dermal tissue and exposure of the skin to the liquid or inhalation of the vapors can be fatal.

4.3 Concentrated acids can react violently if water is added into them. When it is necessary to dilute acid, add the acid to the water slowly and with constant stirring so that heat is never allowed to concentrate locally in the solution.

4.4 Organic solvents may be flammable or toxic, or both. Threshold limit values for some common solvents are shown in Table 2. Note that the fluorocarbons are most likely to exhibit toxic effects as a result of inhalation or skin absorption. Benzene is not recommended as a solvent since it is a known carcinogen.

5. Aqueous Solvents

5.1 *Selection*—In using aqueous solvents for cleaning, generally two extreme choices are available. One is to select an aqueous system that dissolves the soil to be removed, but has little effect on the glass. The other is to select a system that dissolves the glass uniformly, thus undercutting the soil and leaving a chemically polished glass surface. It is best to avoid

[1] This practice is under the jurisdiction of ASTM Committee C14 on Glass and Glass Products and is the direct responsibility of Subcommittee C14.02 on Chemical Properties and Analysis.

Current edition approved Nov. 1, 2017. Published November 2017. Originally approved in 1979. Last previous edition approved in 2013 as C912 – 93 (2013). DOI: 10.1520/C912-17.

[2] Campbell, D. E., and Adams, P. B., "Bibliography on Clean Glass: Supplement 1," *Journal of Testing and Evaluation*, Vol 14, No. 5, September 1986, pp. 260–265.

TABLE 1 Relative Solubility of Various Glass Component Oxides in HF, Other Inorganic Acids, and NaOH, in Concentrated Solutions at Room Temperature

NOTE 1—Macro or minor/trace levels will determine degree of precipitation, especially in acids, for example, HNO_3 (Sn, Sb, Mo).

NOTE 2—W is soluble in acid but heat may precipitate it, for example, H_2WO_4.

NOTE 3—Sn^{+4} is soluble in hot H_2SO_4; Sn^{+2} is soluble in other reagents as well.

NOTE 4—Most alkali solutions must be hot to effect solution.

NOTE 5—$PbSO_4$ is soluble in *hot* concentrated H_2SO_4.

NOTE 6—Sb and Bi form insoluble oxychlorides in dilute HCl.

NOTE 7—Ba is insoluble in concentrated HNO_3.

Oxides of	HF 49 %	H_2SO_4 96 %	HNO_3 70 %	HCl 37 %	HBr	HI	H_3PO_4 85 %	NaOH 50 %
Al	s[A]	s	s	s	i	i	i	s
Sb	i[A]	i	i	s	s	s	i	s
As	s	s	s	s	s	s	s	s
Ba	i	i	s	s	s	s	s	s
Be	s	s	s	s	s	s	s	i
Bi	s	s	s	s	s	s	s	i
B	s	s	s	s	s	s	s	s
Cd	s	s	s	s	s	s	s	s
Ca	i	s	s	s	s	s	s	s
Ce	i	s	i	i	i	i	i	i
Cr	i	i	i	i	i	i	i	i
Co	s	s	s	s	s	s	s	i
Cu	s	s	s	s	s	s	s	i
Er	i	s	s	s	s	s	s	i
Eu	i	s	s	s	s	s	s	i
Gd	i	s	s	s	s	s	s	i
Ga	s	s	s	s	s	s	s	i
Ge	s	s	s	s	s	s	s	s
Au	i	i	i	i	i	i	i	i
Hf	s	i	i	i	i	i	i	i
Fe	s	s	s	s	s	s	s	i
La	i	s	s	s	s	s	s	i
Pb	i	i	s	i	i	i	s	s
Li	s	s	s	s	s	s	s	s
Mg	i	s	s	s	s	s	s	i
Mn	s	s	s	s	s	s	s	i
Mo	s	s	i[B]	s	s	s	s	s
Nd	i	s	s	s	s	s	s	i
Ni	s	s	s	s	s	s	s	i
Nb	s	i	i	i	i	i	i	i
Pd	s	s	i	i	i	i	i	i
P	s	s	s	s	s	s	s	s
Pt	i	i	i	i	i	i	i	i
K	s	s	s	s	s	s	s	s
Pr	i	s	s	s	s	s	s	i
Pm	i	s	s	s	s	s	s	i
Rh	i	s	s	s	s	s	s	i
Rb	i	s	s	s	s	s	s	i
Ru	i	s	s	s	s	s	s	i
Sm	i	s	s	s	s	s	s	i
Se	s	s	s	s	s	s	s	s
Si	s	i	i	i	i	i	i	s
Ag	s	s	s	i	i	i	s	i
Na	s	s	s	s	s	s	s	s
Sr	i	i	i	i	i	i	i	i
Ta	s	i	i	i	i	i	i	i
Te	s	s	s	s	s	s	s	s
Tl	s	s	s	s	i	i	s	i
Th	s	s[B]	i	i	i	i	i	i
Sn	s	s	s	s	s	s	s	s
Ti	s	s[B]	i	s	i	i	i	i
W	s	i	i	i	i	i	i	s
U	s	s	s	i	i	i	i	i
V	s	s	s	s	s	s	s	s
Yb	i	s	s	s	s	s	s	i
Y	i	s	s	s	s	s	s	i
Zn	s	s	s	s	s	s	s	s
Zr	s	s[B]	i	i	i	i	i	i

[A] s = relatively soluble, i = relatively insoluble.
[B] hot