CHEMICAL RESISTANCE OF TYPICAL HPLC (HIGH-PRESSURE LIQUID CHROMATOGRAPHY) SOLUTIONS

Bal Seal Engineering UP-40 Polyethylene and GFPA-PTFE Materials

Technical Report
TR-60B (Rev. 5; 05-10-02)
(100-27-8)

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1.0 SUMMARY

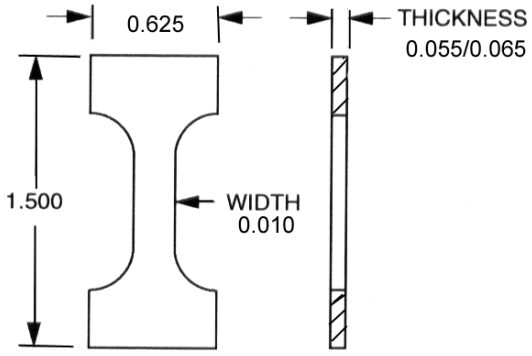
Tests have been conducted at Bal Seal Engineering Company, Inc., to determine the chemical resistance of BAL Seal UP-40 polyethylene and GFPA-PTFE materials. These materials are widely used as the piston seal in HPLC (high-pressure liquid chromatography) pumps.

The data has been condensed to indicate the changes in material properties after material samples were immersed in various chemicals for 168 hours. Changes in dimension, weight, tensile strength, and elongation are reported.

In general, distinct changes in material properties tend to affect the performance of seals made from the same material. For example, significant dimensional changes occurring when a material is immersed in a chemical are likely to affect the frictional properties of the seal. Significant tensile and elongation property changes are likely to affect the seal wear properties.

2.0 TEST PROCEDURES

The tests were conducted per Bal Seal Engineering specification MT-12. A test specimen was immersed in various chemicals at ambient temperature for 168 hours (Figure 1).



Typical Test Specimen

Figure 1

Three seal material samples were tested in each chemical. These samples were measured, weighed and soaked in the chemicals for 168 hours. The samples were then removed from the media. Immediately thereafter, each sample was tested to determine the tensile and elongation properties. The tested samples were dried and the weight and weight variation recorded. (Request Bal Seal Engineering Research Report #58-45-1)

3.0 RESULTS

The results of the three samples were averaged to obtain the final values. The tensile strength and elongation values were compared with the three control samples taken from the same bar of material. The data presented in the following tables is based on retention of tensile and elongation properties retention and dimension and weight changes after exposing the material to the chemical at ambient temperature for 168 hours. The charts display the chemical resistance of BAL Seal materials UP-40 polyethylene and GFPA-PTFE to various representative media. In actual use, other factors, such as pressure, temperature and velocity, also affect the performance of BAL Seals.

3.1 Chemical resistance of BAL™ Seal UP-40 polyethylene material

BAL Seal UP-40, an FDA compatible* polyethylene composition, provides very good wear resistance in aqueous solutions; however, it has specific chemical resistance limitations. The results of the UP-40 material testing are shown below in Table 1.

* For a description, request Bal Seal Engineering Research Report #607-50-17.

Chemical Resistance of UP-40 Polyethylene				
Chemical	**Weight Change (%)**	**Dimension Changes (Average of width and thickness %)**	**Tensile Strength Retention (%)**	**Elongation Retention (%)**
Alcohols Ethylene glycol Isopropyl alcohol Methyl alcohol	 + 0.06 + 0.19 + 0.06	 + 1.2 0.0 - 0.8	 89 92 93	 94 97 84
Aqueous Solutions Distilled water	+ 0.07	+ 2.6	95	104
Aromatics Benzene Toluene	 + 5.78 + 7.01	 + 2.5 + 2.5	 113 88	 70 96
Chlorinated Solvents Carbon tetrachloride Dichloromethane Freon TF Trichloroethylene	 + 15.23 + 6.03 + 3.91 + 11.77	 + 3.4 + 1.7 + 1.2 + 2.4	 82 101 92 103	 89 89 101 89
Ethers Tetrahydrofuran	+ 5.93	+ 3.3	86	87
Hydrocarbons Hexane Mineral oil	 + 5.21 + 0.23	 + 0.8 - 2.3	 104 79	 100 101
Nitriles Acetonitrile	+ 0.09	+ 1.6	97	96
Miscellaneous Alconox detergent Triethylene glycol	 0.00 - 0.06	 + 0.8 + 2.5	 110 95	 92 104

Table 1
Property changes of BAL™ Seal UP-40 material when immersed in various chemicals for 168 hours per Bal Seal Engineering Specification MT-12

3.2 Chemical resistance of BAL™ SEAL GFPA-PTFE material

BAL Seal GFPA-PTFE, a graphite fiber-filled PTFE-based material, has excellent wear resistance in high-pressure, high-temperature and high-speed applications. This material is particularly suited for applications where high chemical resistance and good wear resistance are needed. BAL Seal GFPA-PTFE material requires that the piston be made from sapphire, TZP or other ceramic-type materials. Results of GFPA-PTFE material testing are shown below in Table 2.

Chemical Resistance of GFPA-PTFE				
Chemical	**Weight Change (%)**	**Dimension Changes (Average of width and thickness %)**	**Tensile Strength Retention (%)**	**Elongation Retention (%)**
Alcohols				
Ethylene glycol	+ 0.03	0.0	87	128
Isopropyl alcohol	+ 0.28	0.0	87	92
Methyl alcohol (58-45-1)	+ 0.29	+ 0.8	96	84
Aqueous Solutions				
Distilled water	+ 0.03	0.0	113	98
Aromatics				
Benzene	+ 0.60	+ 1.3	98	114
Toluene	+ 0.85	+ 0.8	93	82
Chlorinated Solvents				
Carbon tetrachloride	+ 1.33	0.0	99	118
Dichloromethane	+ 2.17	+ 1.6	110	89
Freon TF	+ 4.03	+ 2.4	82	177
Trichloroethylene	+ 2.87	+ 0.7	116	78
Ethers				
Tetrahydrofuran	+ 1.05	+ 0.0	89	85
Hydrocarbons				
Hexane	+ 0.68	+ 0.9	122	94
Mineral oil	+ 0.48	0.0	80	155
Nitriles				
Acetonitrile (58-45-1)	+ 0.35	- 0.8	96	87
Miscellaneous				
Alconox detergent	+ 0.07	0.0	95	78
Triethylene glycol	- 0.01	0.0	85	92

Table 2: Property changes of BAL™ Seal GFPA-PTFE material when immersed in various chemicals for 168 hours per Bal Seal Engineering Specification MT-12.