

COMPATIBILITY OF REFRIGERANTS AND LUBRICANTS WITH ENGINEERING PLASTICS

Final Report

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ABSTRACT

Twenty-three engineering plastics have been subjected to immersion studies using seven different lubricants at 60°C (140°F) and 100°C (212°F) and ten different refrigerants (HCFC-22, 123, 124, and 142b; HFC-32, 125, 134, 134a, 143a, and 152a) at ambient and at 60°C (140°F). All of the engineering thermoplastics and one phenolic resin compound were molded into modified ASTM Type 5 test bars using the manufacturers' specifications. The test bars were used as molded. Prior to the study, the bars were inspected for physical consistency and integrity.

In the first part of the study, twenty-two hermetic stress crack-creep rupture test chambers were constructed to determine the dynamic effects of a constant dead weight load on similar plastic test bars which were immersed at 20°C (68°F) in a 40% refrigerant 32 ISO VG branched acid polyolester lubricant. The creep modulus data of the ten different refrigerants, using a dead weight load of 25% of ultimate tensile, are compared to values for air and HCFC-22.

In the second part of the study, the plastic test bars were aged for fourteen days at constant refrigerant pressure exposure (300 psia) with seventeen refrigerant lubricant combinations at 150°C (≈300°F). The physical data are presented as percent change of tensile retention, dimensional change, and percent elongation.

Additional evaluations were implemented after the second part of this study in order to elucidate the separate actions of temperature, refrigerant and lubricant upon the plastics. At the elevated temperatures of 150°C (≈300°F) the high acid formation (high TAN) was further examined with dehydrated plastics. These evaluations indicate that dehydrating the plastics reduced, but did not eliminate, observed high TAN values and that heat alone appears to be the principal cause of lost physicals. The alternative HFC refrigerants have little impact on the plastics; some polyolester lubricants caused identifiable changes.

The data presented here will assist engineers in identifying, within the next one to two years, the materials suitable for the design of reliable compressors.

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1. INTRODUCTION

1.1 Overview

Compressor design requires engineering plastics that are durable, reliable over a long period of time, moldable into complex shapes, and compatible with refrigerants and lubricants. In compressors using traditional refrigerants, engineering plastics have become essential to efficiency and cost-effectiveness. The role of these plastics in compressors using HFC refrigerants, however, is still uncertain; the introduction of these new refrigerants has challenged hermetic chemists to identify compatible materials and to assess their value in compressor design.

While almost all engineering plastics have been designed to fill specific needs and requirements, these requirements rarely include compatibility with HFCs. From the broad range of available engineering plastics, the design engineer and the hermetic chemist must select for compatibility testing those materials potentially suitable in other respects for inclusion in compressor design. The process of identifying such materials is complicated and difficult; unlike metals, whose properties are generally constant, plastics are sensitive to changes in environmental conditions such as temperature, lubricants, and refrigerants. In addition, engineers must consider the strengths and limitations of each of the two broad groups of engineering plastics: thermoplastics and thermosetting plastics. Thermoplastics have medium to high operational temperatures and can be injection molded; thermosetting plastics are stronger and more rigid, with better operational temperatures, but may be brittle. The selection of individual materials for individual applications assumes primary importance. The factors that influence materials selection -- creep and relaxation, and stress -- must also be considered when studying the interaction of a material with environmental conditions.

Almost all molded parts have residual stresses from the molding process, and many may have additional stresses due to part geometry and wall design. Parts with long thin walls are subjected to undue molding pressures which create polymer shear and reduce the molecular weight of the material. These effects, in turn, reduce the strength of the part. Recognizing such stresses is essential to identifying and understanding the effects of the environment.

In order to use plastics appropriately, compressor and refrigeration systems design engineers require information about changes in their physical properties. Plastics under long term load, and subject to various temperatures and chemical environments, undergo measurable changes; understanding these is essential for an understanding of material behavior. The phenomenon of deformation under load is known as creep. At low temperatures, liquid refrigerant can become more concentrated and increase creep under specific load conditions. Many plastics have a molecular structure and physical state specifically designed to reduce creep at higher temperatures. The density of some higher temperature specialty polymers, such as polyamide-imide and polyimide, minimizes refrigerant swell and thereby reduces creep.

While the properties of the engineering plastics tested are obviously extremely important considerations, the properties and structures of the lubricants and refrigerants used are equally important. The polarity of lubricants and refrigerants greatly influences the degree and nature of their effect on plastic materials; when polyglycol and polyolester lubricants are used with various polymers in moderate temperature aging experiments, changes have occurred in both the plastics and the lubricants. Consideration of the role of the lubricants' chemical structure has been crucial to these experiments.

Research into materials compatibility has been necessary before. When R-22 became a standard refrigerant, Mylar and phenolic epoxy varnishes were introduced because the varnished fabric insulation and rubber fittings used in R-12 compressors swelled in the presence of R-22. The advent of engineering plastics, which replaced metal parts, posed additional problems for those who worked to insure the compatibility of non-metallic compressor materials. These problems, which were solved by understanding the challenge and design value of new materials, are similar to those facing modern hermetic chemists and design engineers.

1.2 Scope

This research is intended to provide information about the compatibility of engineering plastics with alternative refrigerants and a wide variety of suitable lubricants. This report, in part, presents data obtained for the physical changes in dimension and tensile retention of plastics after ambient aging, thermal aging, and stress in the presence of refrigerants and lubricants. It also presents data for these changes when the plastics are exposed to selected refrigerant/lubricant mixtures at constant refrigerant pressures.

1.3 Observed physical changes of engineering plastics with lubricants

The physical and chemical changes of engineering plastics in various chemical environments are generally specific to the plastic's processing, synthesis, and polymer type. Manufacturers have their own patent or proprietary methods of polymer synthesis and these are not always identified by the generic name of the polymer alone. Therefore, a molded polymer produced by one company will not necessarily perform in the same way as that from another company, even though the polymer is nominally the same. Engineering plastics differ in their molecular weights, molecular weight distributions, polymer structures, and chain lengths. This report reflects the observed changes in the properties of engineering plastics obtained from manufacturers of specific specialty plastics and of generic-type plastics.

All of the polyolesters used in this study may be assumed to be pentaerythritol esters. The most effective method of reporting the lubricant quality would be to report the actual type and stoichiometry of carboxylic acids used, as well as the amount of complexing that was used to provide the viscosity and liquid miscibility of the product with the various refrigerants should be reported. Because the lubricants used in this program are proprietary formulations, however, the compatibility must be reported based on the liquid/liquid miscibility and proprietary structural properties. The generic nomenclature used does not specify their chemical makeup.

[Table A.1](#) shows each of the engineering plastics used in this study, giving the trade name, manufacturer, and generic name. The occurrence of trademarks, registered trademarks, or copyrighted names is noted. Each plastic is assigned a number, which is used throughout the Report and Appendices. [Table A.2](#) shows the synthetic lubricants used in the testing

program, with their names, types, manufacturers and registered trademarks, or trademarks. [Table A.3](#) identifies the processing conditions used to mold the engineering plastic test bars according to the manufacturer's specifications. [Table A.3](#) also shows the plastic number, name, manufacturer, and generic name.

2. EXPERIMENTAL METHODS

2.1 Engineering plastics preparation

With three exceptions -- DuPont polytetrafluoroethylene (PTFE), (12, table A.1); DuPont polyimide (19); and DuPont polyimide DF-ISO (20), the test plastics were molded by a specialty injection molder into modified type 5 ASTM test bars (Figure 1a).

2.1.1 Molded test bars

The mold used was a production quality steel thermoplastic/thermoset injection mold (Figure 2) completed in March 1992. Each of the cavities was numbered. The first material tested, Nylon 6/6 (23), performed as expected. The surface finish of the test bar in the gauge area was 6F. The initial run of Nylon 6/6 had only two ejector pins and produced a part with a slight bow. Two extra ejectors were machined and installed in the mold just outside the gauge stress area. The injection ports, sprues, and gates of this mold were larger than usual to improve homogeneity and to reduce physical degradation of the plastic. To minimize possible slippage during testing, 0.005" by 0.032" 00 molded nipples were added on each side of the test bar.

Thermoset phenolic materials, which require longer mold residence time, higher temperature, and higher pressure than thermoplastic materials, were included in this study. As a result the mold was designed to handle both types of materials. It included a large cartridge heater, which was necessary for the phenolic thermoset curing reaction; this allowed the phenolic used in this study to be cured almost completely in the mold before ejection.

2.1.2. Test bars used as received

DuPont polytetrafluoroethylene (PTFE) (12), DuPont polyimide DF (19), and DuPont polyimide DF-ISO (20) required special molding operations and sintering equipment not available to this laboratory. These materials, therefore, were used as received.

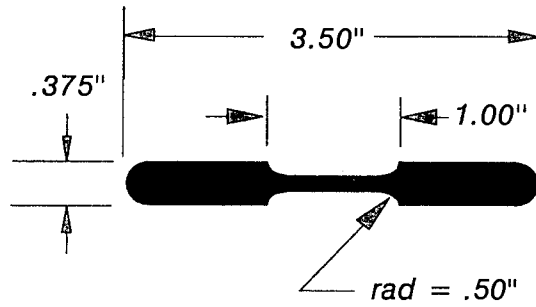
The PTFE (12) test bars (Figure 1b) were rule die cut from sheet grade virgin PTFE as specified in ASTM D 1457-91a, "Standard Specification for Polytetrafluoroethylene (PTFE) Molding and Extrusion Materials."

The polyimide test bars (Figure 1c) were compression molded by DuPont, using the ASTM E8-91 "Standard Test Methods of Tension Testing of Metallic Materials." Polyimide DF test bars were produced from granulated polyimide powder, and formed to near net shapes by a very high-pressure compaction process. Polyimide DF-ISO test bars were compaction molded; these were additionally densified by sintering under pressure in liquid metal.

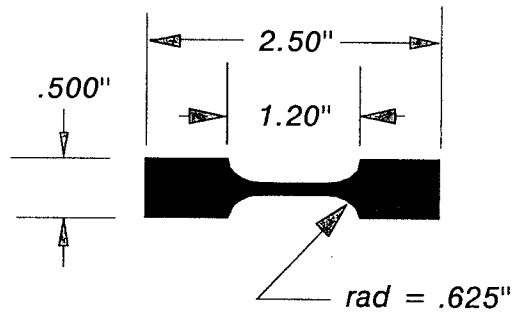
2.1.3 Test bar consistency

Consistency among test specimens was determined by tensile measurements of five individual unaged test bars. These, and all other plastic samples used in this study, were allowed to equilibrate for fourteen days under laboratory conditions of pressure and temperature. All bars met the reported tensile properties of the molded engineering plastic. The unaged data are presented as an average of five test bars. At the beginning of this study, the committee recognized that the produced parts have residual stress. The parts were used as molded and not stress relieved for the duration of the study.

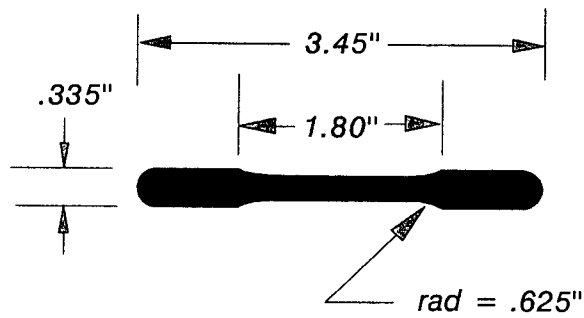
Figure 1. Test Bar Dimensions



1a. Modified Type 5 ASTM Test Bar

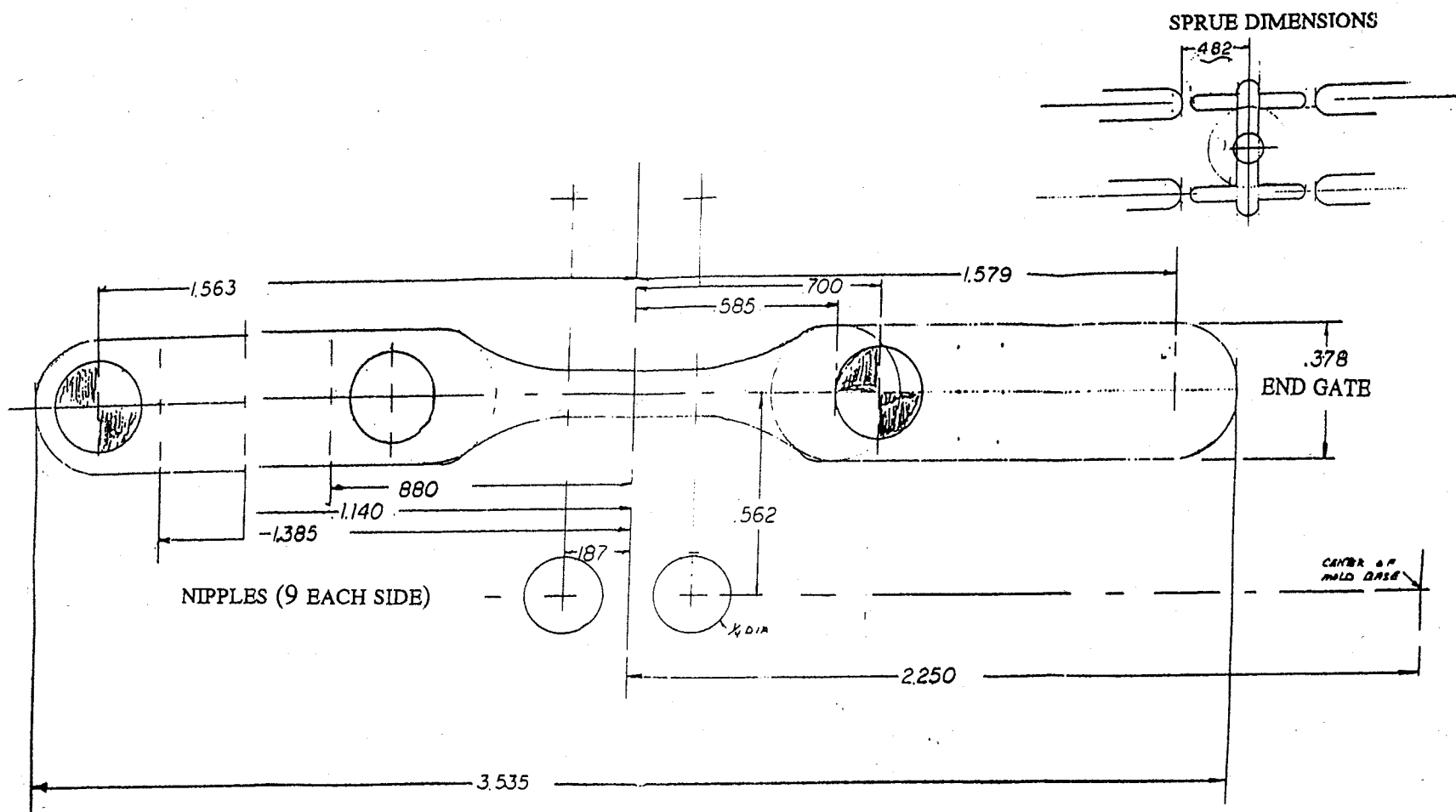


1b. PTFE Test Bar



1c. DuPont Polyimide Test Bar

Figure 2. Thermoplastic and Thermoset Mold Dimensions



2.2 Tensile and percent elongation measurements

The tensile tests were conducted using an Instron Model 1122 with a modified ASTM type 5 tensile bar. The plastics were placed vertically in the test grips attached to the crosshead via a self-aligning universal yoke. The cross head movement was set at the specified ASTM D 678 pull rates and were between 0.2 and 1.2 mm/min. The load cell resolution is 0.5% of the observed force and has a load range of 0 to 120 Kg.

The physical property values of aged test bars reported in [Appendices E](#) and [F](#). were derived from two samples of test bars exposed to the selected lubricant and refrigerant environments. The unaged properties were from five test pieces. Percent elongation and ultimate tensile were calculated from the physical test data provided by the Instron measurements. Percent elongation is the total change in the length divided by the one inch (25.4 mm) necked down length. The change in length is measured by the amount the crosshead moves from the original position until the instant the plastic bar breaks. Ultimate tensile is the maximum recorded load divided by the cross-sectional area of the gauge region of the plastic test piece. The values for plastics thermally aged in different oil and refrigerant environments were then compared to the values for non-treated plastics. Relative percent changes were calculated and examined for significant changes.

2.3 Lubricant immersion studies

The following procedures were used in evaluating the effects of lubricants on two samples of each plastic at the required temperatures, 60°C (140°F) and 100°C (212°F).

2.3.1 Lubricant preparation

All lubricants used for these tests were degassed by stirring and dried by being heated (in bulk quantities) to 60°C (140°F) under vacuum for at least twenty-four hours. Moisture content did not exceed 50 ppm; the total acid number for all of the fluids was below 0.05 mg KOH/gm.

2.3.2 Immersion of plastic samples in lubricant

Each plastic test bar was weighed, measured, and then tested, without drying or annealing. All plastics were immersed in the selected lubricants in screw cap sealed vials under nitrogen cover at the specified aging temperature. After fourteen days of aging, the test bars were rinsed with isopropyl alcohol and set on paper towels to dry. The dry, cleaned plastics were then stored in dry, clean vials in case further measurement was necessary. This was fortuitous, as later in the study measurements of the tensile strength of these materials were necessary.

2.4 Refrigerant immersion studies

The test bars were aged in pure refrigerant for fourteen days at ambient and 60°C (140°F) in pure refrigerant at the refrigerant saturation pressure according to the following procedures.

2.4.1 Refrigerant preparation

Refrigerants received for use in this study were checked by packed-column gas chromatography for contamination by other refrigerant gases. The refrigerants were found to have little, if any, contamination; they were used as received. Moisture content in the refrigerants was not determined.

2.4.2 Immersion of plastic samples in refrigerant

The liquid refrigerant immersion studies were performed in separate stainless steel pressure tubes equipped with a gas space and a metering needle valve (Figure 3). The tubes were filled using a special low-volume, low-loss stainless steel manifold (Figure 4). Prior to filling, the tubes were evacuated to 20-30 millitorr for several minutes and then chilled in ice water. The valves were closed and then sequentially opened for filling with liquid refrigerant. The plastic specimens were exposed to about 20 grams of liquid refrigerant.

Stainless steel tubes, rather than glass tubes, were used in this study because the test bars were used both for swell tests and tensile tests. While large glass sealed tubes would perform adequately, filling them would require liquid nitrogen conditions in order to condense and freeze measured quantities of refrigerant gas. Freezing the plastic specimens with liquid nitrogen might introduce unknown and uncontrolled internal stresses, which would bias the end results of immersion and thermal exposure tests.

At the end of the exposure time, the refrigerants were exhausted from the stainless steel tube as liquid into liquid-N₂ cooled tared test tubes. The residues were concentrated by boiling off the refrigerant.

Figure 3. High Pressure Stainless Steel Tube

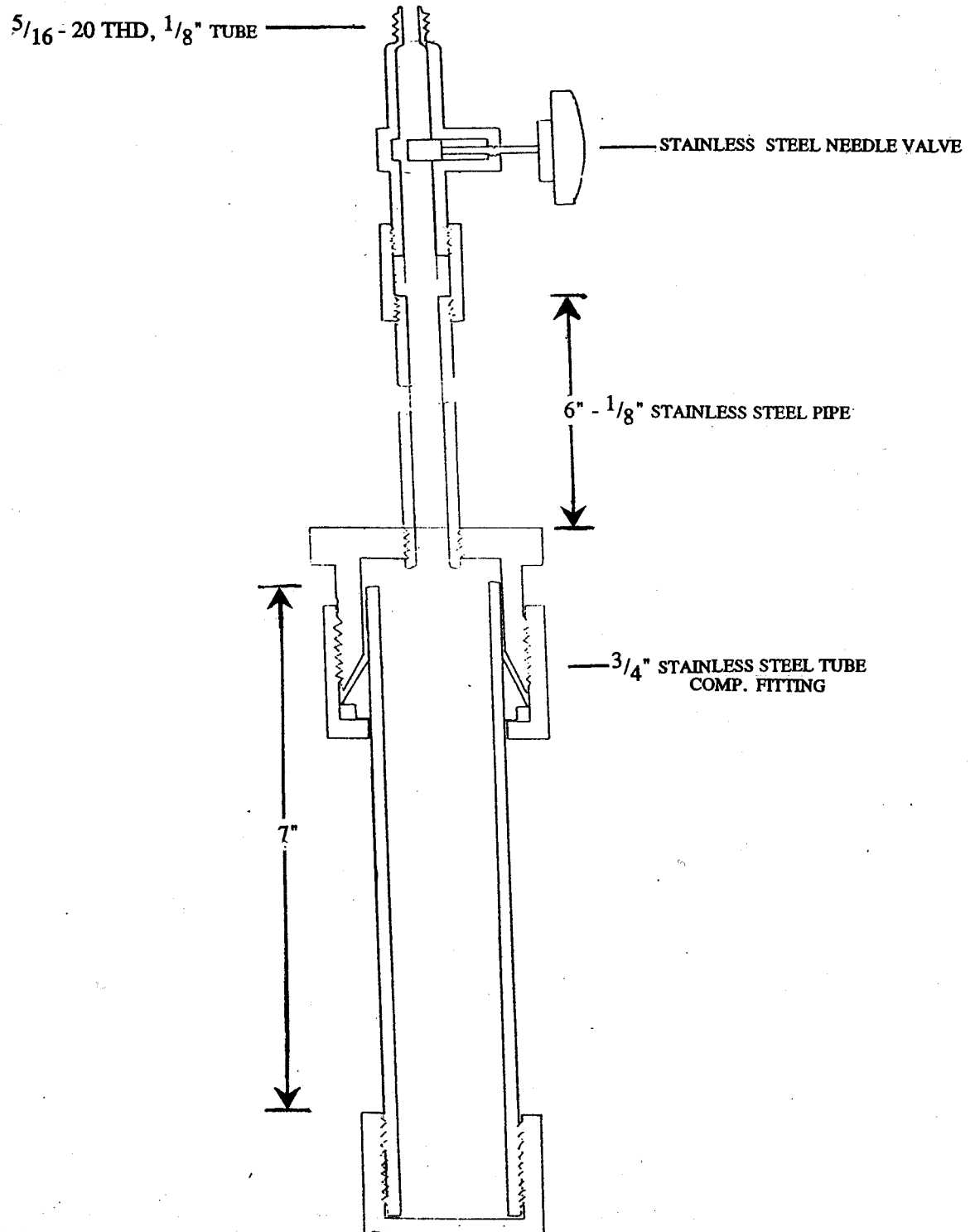
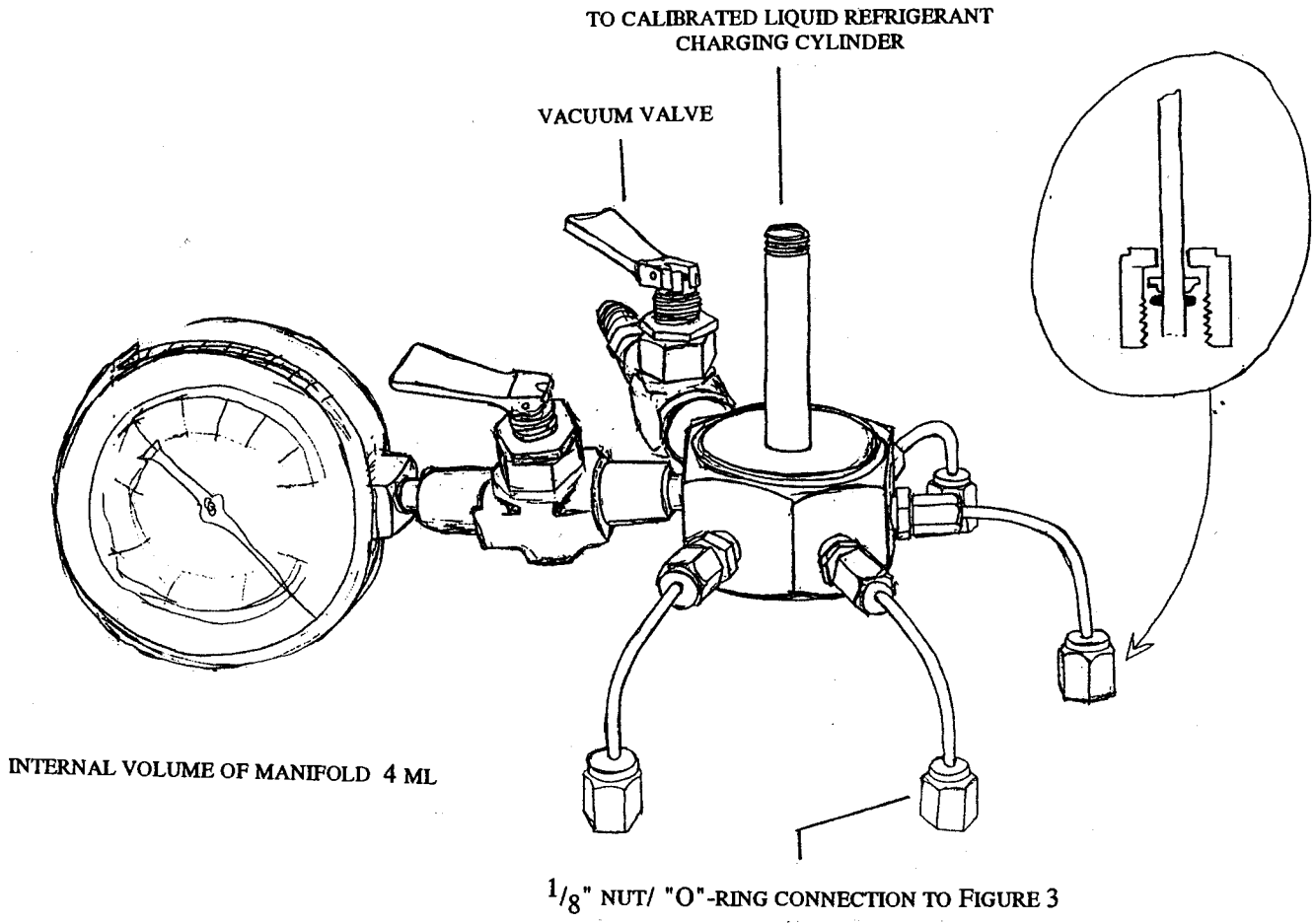


Figure 4. Low Volume, Low Loss Stainless Steel Refrigerant Loading Manifold



2.5 Stress crack creep rupture testing

In this study, creep was measured for plastics submerged in a 32 ISO VG branched acid polyolester with selected refrigerants maintained at 40% concentration by weight at 20°C (68°F). The plastic test bars were held in screw-clamped stainless steel jaws and contained in a movable transformer core insert set assembly. (See [Figure 5](#) which illustrates the creep rig.) The matched stainless steel jaws were formed by coarse sawing a 0.375-inch rod. The saw marks provided the grip surface. Four opposed sets of cup-pointed socket set screws applied clamping action. Clamping was performed by centering the test piece between the jaws and firmly squeezing the plastic tabs. An hour after the initial tightening, the jaws were tightened again to take up any cold flow which may have occurred in the jaw area.

Stress crack-creep rupture test cells were designed and constructed from 4" stainless steel pipe and standard fittings ([Figure 4](#)). The internal dead weight was designed using 4" stainless steel tube (0.062 wall) with 0.186" machined end plates containing bearings and a filler pipe plug. LVDT technology was used to monitor the position and rate of plastic movement; the LVDTs used provided high reliability and linearity.

Prior to loading, the test bars were immersed in the lubricant while a 100 millitorr vacuum was pulled for several hours, removing any air. Liquid refrigerant was added to the bottom of the test cylinder through a needle valve. The cylinders were charged to a previously determined equilibrium gas pressure known to yield 40% refrigerant by weight. The value of equilibrium gas solubility was obtained from separate experiments of each refrigerant over the 32 ISO VG polyolester lubricant.

Once the plastic test bar was fully aligned and clamped in the insert assembly, this assembly was loaded into the LVDT measurement tube. The union nut allowed the removal of the LVDT measurement tube. The vacuum/pressure seal was accomplished with a neoprene O-ring.

The sample was loaded by slowly releasing a predetermined dead weight providing 25% of the sample's ultimate tensile strength. The dead weight was held up until the air was released. The sliding center bearing held the weight plumb. Air pressure was applied to and maintained over the upper pneumatic cylinder area to extend the lower centering

bearing and prevent the internal applied refrigerant gas from causing the cylinder shaft to move upward.

2.5.1 Experimental stress crack-creep rupture test cells

Creep stress analyses were performed at 25% of the ultimate tensile load. Earlier experiments with lighter loads indicated that nylon test bars were insufficiently stressed. At lighter tensile loads, the nylon samples were in a purely elastic region, resulting in spring like behavior. Experiments with 25% load gave the best creep curve function, and provided sufficient load to stress the gauge area of the test bar within the 14 day test period.

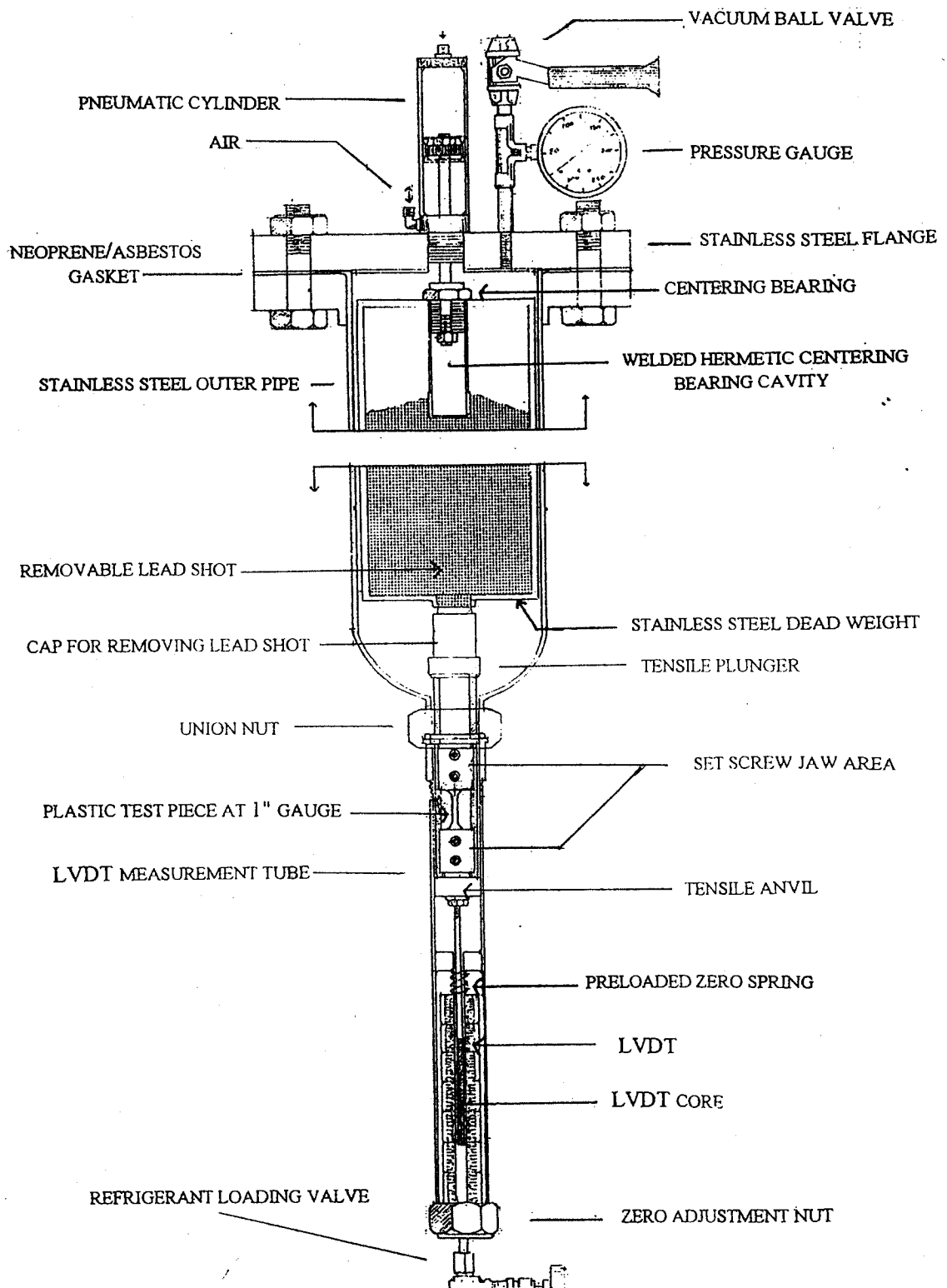
2.5.2 Creep measurement process

The principle of creep rupture measurement required the use of sensitive, long term, noise-free electronics. Initially, a commercial LVDT computer board system was used to measure creep. However, unacceptable oscillatory noise was observed in test specimens using the 25% of dead-weight load. This unwanted noise seemed to originate with the sampling board.

It was determined that powering each LVDT with individual amplifiers and frequency source eliminated all the noise. Unfortunately, the required amplifiers were not immediately available; all boards presently in use were designed, built, and tested by this laboratory. The data are acquired with a commercial A/O board that signals mercury wetted relay boards to acquire store and calculate LVDT electrical signal data.

The use of individual amplifiers allowed each cell to be sampled hourly, using four separate 15-second sample times averaged as a single test point. This increase in sensitivity further improved accuracy by eliminating random noise. Using individual amplifiers also allowed for rapid change-out in the event of channel failure. In the initial stages of the experiment, the sensitivity of the measurement was 1.5×10^{-4} inches. However, as the experiment progressed, this was increased to 7.5×10^{-6} inches, which improved measurements for plastics that showed minimal creep.

Figure 5. Creep Rig



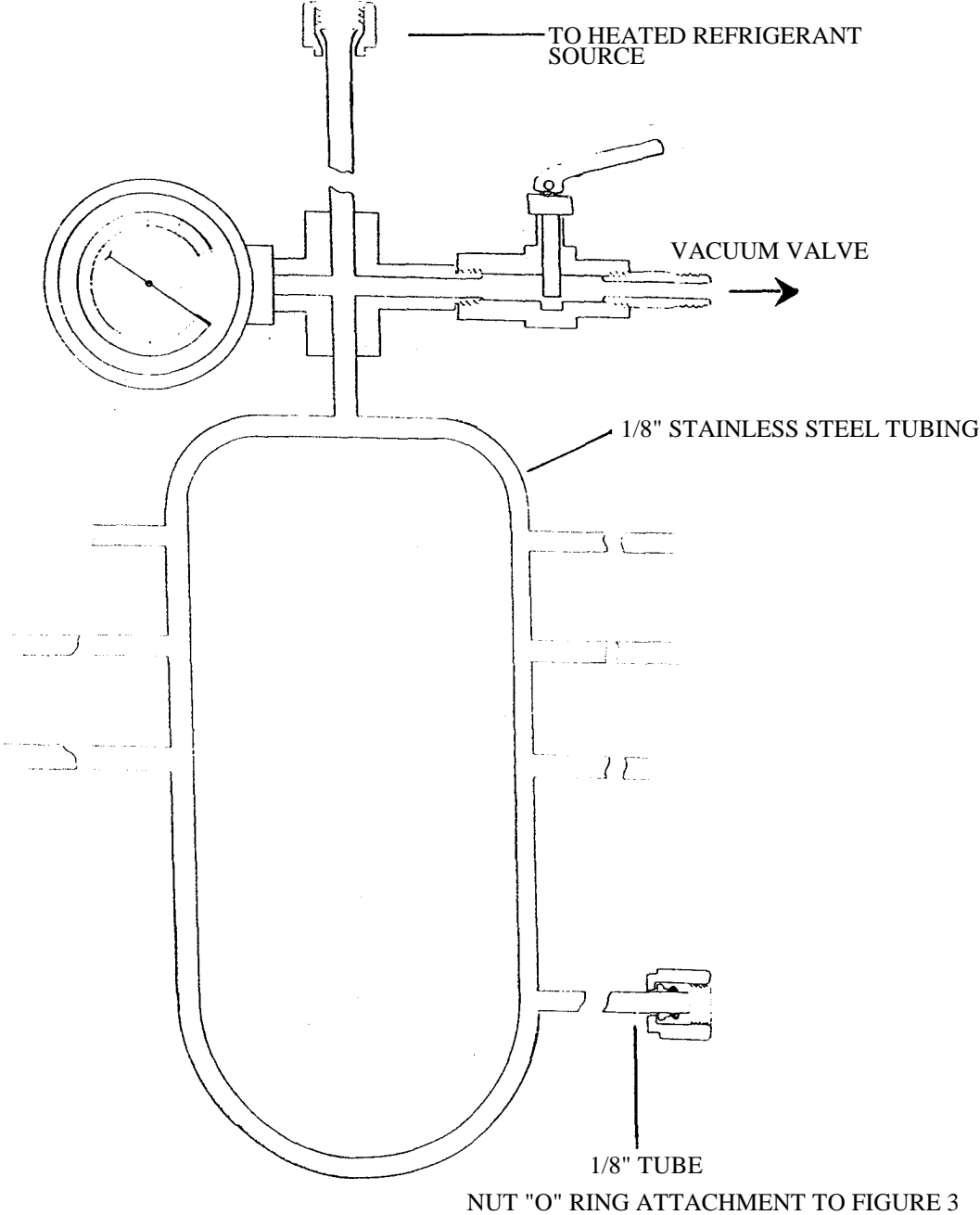
2.6 Thermal aging of plastics with refrigerant and lubricant

Plastic test bars were thermally aged at 150°C (300°F) for fourteen days with selected refrigerant and lubricant combinations in stainless steel pressure tubes with refrigerant pressure not exceeding 275-300 psia. The pressure tubes, shown in [Figure 3](#), were heated in a hot air oven. The stem of the pressure tube was brought out of the oven through insulation seals. Pressure was applied to the heated tubes through a manifold ([Figure 6](#)) by heating steel bottles containing the respective refrigerants to 275-300 psia. The pressure of gas in all of the tubes was checked every day and adjusted if necessary. This may be a laborious way to control pressure, but it guarantees that refrigerant pressures do not exceed this value. If needed in later experiments, the equilibrium gas solubility of each refrigerant/lubricant combination can be determined.

Following fourteen days of thermal and pressure aging, plastic test bars were pulled and measured for elongation and tensile strength retention. Detailed results for each refrigerant and lubricant combination are included in the tables of physical change data appearing in [Appendices E and F](#).

The plastic test bars were aged in HCFC-123 (R-123) at 125°C rather than the specified 150°C, since the lubricant/refrigeration combination is known to become reactive and unstable at the higher temperature. Unfortunately, most of the plastic specimens failed, indicating that this temperature was still too high. After some discussion with the MCLR committee, the experiments were rerun using an aging temperature of 105°C. These data, along with those for the higher temperature, are presented in [Appendices E and F](#).

Figure 6. Pressure Distribution Manifold



2.6.1 Total Acid Number (TAN)

Thermally aging plastics with refrigerant and lubricant for fourteen days produced, in addition to changes in tensile properties, some unexpected results. Hydrocarbon and polyalkylene glycol lubricants removed from the small reaction cylinders had very strong odors of decomposed oil, while very strong acidic odors came from the polyolesters. Whether the strong odor was associated with high TAN values or whether it was one of the principal causes of reduced tensile retention could not be determined. The TANS of the lubricants removed after testing are given in [Tables F.6](#) through [F.17](#).

TAN measurements were made using color titration, ASTM D974-87, in a tightly sealed cell. This method does not specify a nitrogen blanket in the cell. Initially, samples were analyzed both by potentiometric and color titration. A closed reaction cell with a very slow titration rate was used in both procedures. Since both procedures gave nearly identical results (+0.005 mg KOH/gm) the color indicator method was chosen for ease of use. All TAN values represent mg KOH needed to neutralize one gram of lubricant.

3. SIGNIFICANT RESULTS

This section reports the environmental effects of pure lubricants, pure refrigerants, and the combination of selected lubricants and refrigerants at an elevated temperature. All of the plastic test bars used in this section are used as molded; none have been annealed, post-cured, or dried. Polyamide-imide (13 and 14) test bars were post-cured according to the manufacturer's recommendations but were then equilibrated to laboratory conditions as described in Section 2 of this report. Therefore, a variable amount of moisture was assumed present in all test bars.

3.1 Results of lubricant immersion studies

The dimensional property changes observed indicated that all of the plastics tested were affected by the lubricants in some way. However, none of the test bars was changed significantly. Some samples of clear or translucent plastic exhibited a color change.

Tables for each lubricant at 60°C (140°F) and 100°C (212°F) are provided in [Appendix B](#), which summarizes the average percent effect on measured parameters.

Dimensional property changes do not necessarily indicate any changes in tensile properties. However, any change in dimension does suggest that some lubricant absorption has taken place, possibly affecting physical properties of the plastic.

3.2 Results of refrigerant immersion studies

All refrigerants were found to affect the plastic parts in some way. In comparison with pure lubricants, pure refrigerants were more likely to affect the appearance and dimensions of the test bars. Because refrigerants are small molecules, a slight weight gain and some softening of the plastic were usually observed. Clear test plastics took on a silvery appearance. Generally, the HFC refrigerants appear to affect the plastics least. The three plastics most severely affected were acrylonitrile butadiene styrene terpolymer (2), polyphenylene oxide (7), and polycarbonate (6).

Collection of the liquid refrigerant, followed by concentration, left residues of low weight; this suggested that very little (approximately 10-15mg per two test bars) extractable

matter was present. Although this result does not represent extensive extraction studies, it does imply that HFC refrigerants are not necessarily strong solvents.

3.3 Results of stress crack-creep rupture testing

When a plastic test piece was loaded, it rapidly deformed to a strain roughly predicted by its previously determined stress-strain modulus. With time and/or temperature, the plastic part would continue to deform until rupture or yielding caused failure.

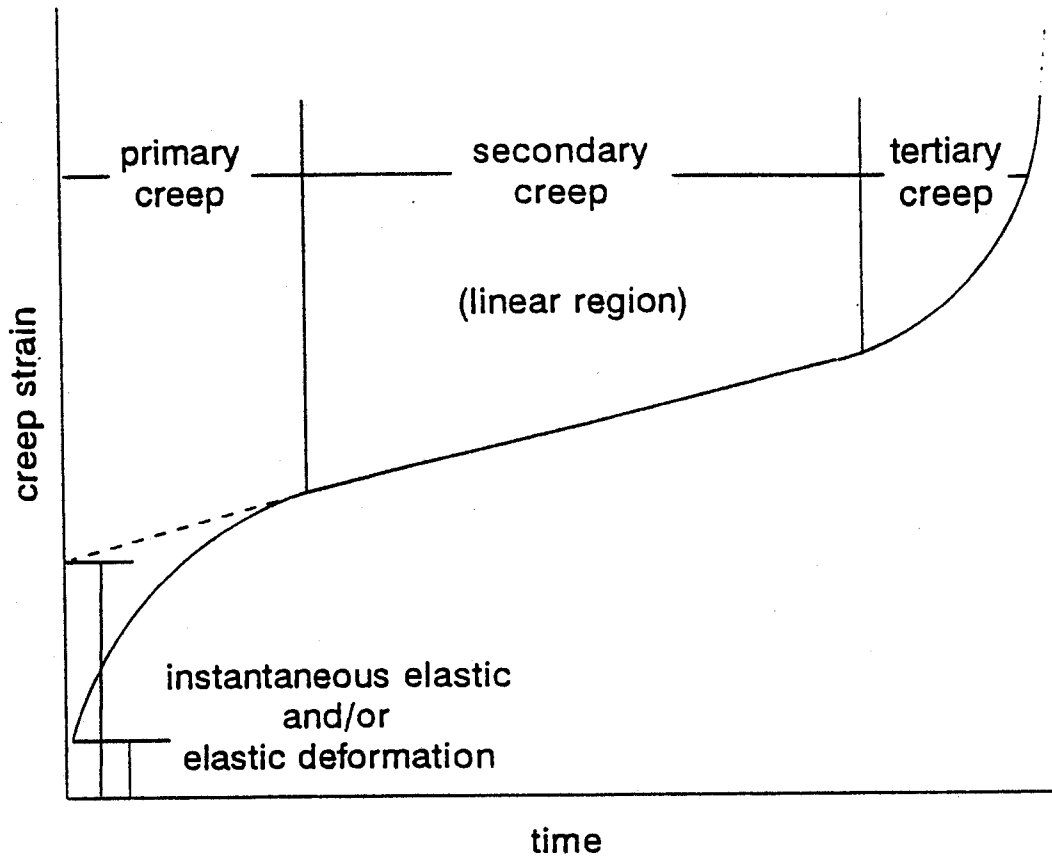
Figure 7 shows a creep curve typical of the test plastics; this curve shows four distinct regions of the creep curve. The first stage represents the near instantaneous elastic deformation of the gauge area. The second stage, called primary creep, is more easily seen; this is strain which occurs much more rapidly but at a decreasing rate. The third stage, sometimes called cold flow, is represented by the linear region of the curve, and is characterized by a constant rate of creep. In almost none of the plastics tested was the fourth stage, failure or rupture, observed. The exceptions were the acrylonitrile-butadiene-styrene terpolymer (2) and the modified polyphenylene oxide (7), which failed within one hour in lubricant and refrigerant mixtures.

Appendix D is devoted to the data analysis of the first three sections on the creep curve as described above. The charts in Appendix D list the creep modulus, $\text{ksi}(\text{Kg}/\text{M}^2)$, at five different times: 10, 50, 100, 200 and 300 hours respectively, with remarks. The remarks column describes the fourth section of the curve, where the failure occurs.

The measurement of creep is usually a long-term experimental process that can take months or years. Over this much time, a much larger dimensional change takes place, and all three phases of the creep curve can be properly defined. This project is intended to be a screen of the environmental effects of refrigerants and lubricants on plastics; therefore, it has identified a creep value, and the environmental effects of synthetic lubricants and differing refrigerants on plastics under stress, within 14 days. Sensitivity to the smallest movements is extremely important, since these movements are related to the effects of long term environmental chemical exposure. The regions currently identified as the second and third regions on the creep curve may possibly be primary creep, rather than long term creep.

Most manufacturers publish plastic creep values for several different temperatures and loads. In this study, we initially considered creep testing at 60°C (140°F) with refrigerant at a specific pressure, thus allowing the refrigerant concentration to be whatever it is at a specified pressure. However in order to expose the plastic to a greater amount of refrigerant a temperature reduction was necessary. Due to equilibrium gas solubility limitations of some of the HFCs, the concentration was limited to 40% by weight; this could be achieved with the 32 ISO VG mixed branched acid pentaerythritol polyolester at 20°C (68°F) and not at 60°C (140°F). The polyolester has been determined to have sufficient gas solubility to meet the 40% refrigerant by weight specifications.

Figure 7. Typical Creep Curve



3.3.1 Discussion of stress crack-creep rupture testing results

Plastic creep appears to be nearly the same for all refrigerants. However, HCFC-22 showed a slightly lower creep rate than the other nine refrigerants. Two of the plastics routinely failed: ABS (2) and modified phenylene oxide (7). Stress crack sensitivity may cause this failure. Refrigerant 123, as expected, showed a pronounced increase in creep modulus, but did not promote rupture of the plastic test specimen. None of the test refrigerants produced creep rupture, indicating that there was no enhanced failure or stress cracking of the plastic surface. However, comparison of [Tables D1](#) and [D2](#) will show that creep values for plastics tested in air are higher than those for plastics tested with HCFC22. The dehydrating effect of both POE and refrigerant enhances the rigidity and stiffness of the test bars.

This creep rupture experimentation was intended to show any gross or exaggerated effects on the plastics in the presence of a polyolester combined with a range of different refrigerants. The experimentation was conducted at the lower temperature in order to examine the environmental effects that the alternative refrigerants might have on plastics. Further experimentation is needed at higher temperatures (60°C). Creep rates at higher temperatures would be greater, and thus more likely to indicate any severe attack on the plastic surface. Higher temperature creep measurements would give the refrigeration and air-conditioning industry a better understanding of the performance of engineering plastics

Teflon PTFE plastic was not tested in the creep rigs, due to its high creep and cold flow properties.

3.4 Results of thermal aging of plastics with refrigerants and lubricants

The second phase of this study entailed evaluating the end result of property changes in plastics at elevated pressure and temperature conditions. Using a test temperature of 150°C (302°F) for all plastics except the polypropylene (8), which was exposed to 100°C (212°F), precluded the assumption that all plastics were stable at these temperatures. Two lower temperatures of 105°C (221°F) and 125°C (257°F) were used with HCFC-123 (R123) because this refrigerant is more reactive and aggressive than other HFCs and HCFCs.

The ratio of plastic weight to lubricant weight was approximately 50:50 in all of the test chambers, which is not a ratio usually found in operating refrigeration systems. Smaller vessels were required, since there were smaller quantities of refrigerants.

With the exception of the hydrocarbon lubricants, mineral oil and alkylbenzene, the polyolesters are found less stable than polyalkylene glycols (PAGs); they reacted with water released from the plastic during the 14 day test. Some polyols seem to have produced varying amounts of carboxylic acids and an assortment of other compounds, some possibly more aggressive toward the plastic than the lubricant. This caused some concern in the absence of prior knowledge of the effects of decomposed lubricants or of the formed products.

Completion of the second part of the study indicated that thermal exposure of the engineering plastics induced severe tensile and elongation changes in the test bars. It could not be known whether the effects were produced by both refrigerant and lubricant at temperature, temperature alone, or some unknown product.

The analysis for part two was therefore extended by determining the effects of temperature alone. Samples of all test plastics were heated in air for fourteen days at 150°C (302°F); their tensile and elongation losses, if any, were then measured. In addition, plastics were dehydrated and exposed to anhydrous branched and mixed acid polyolesters; the TAN of the polyolesters was then determined. The final analysis makes clear that most of the tensile and elongation losses observed were caused by the heat aging of unannealed test bars. The primary cause of high TAN values was wet or undehydrated plastics.

An understanding of tensile retention of the plastic when not in the presence of refrigerant and lubricant is presently needed. This study considered plastics in the presence of refrigerant at elevated temperature and pressure. It is also necessary to find a means of identification of the effects contributed by refrigerant or lubricant alone.

The acetal (3), polybutylene terephthalate (PBT) (18) and polyethylene terephthalate (PET) (10) left a flocculant precipitate when the lubricant cooled for several days. (The PET and extractable are dependent on manufacture and on the retrograding process that occurs with temperature. The extractable of PETs increases with time and temperature; and may be accelerated depending on the polyolester lubricant used.)

The acetal sample evaluated in this study is rated "food-grade." Samples of lubricant used in the acetal exposure were re-examined due to the drastic loss in tensile retention of the plastic bar. The retained lubricant sample had a very strong odor of formaldehyde. The acetal product literature indicated that formaldehyde is released when acetal is heated to 120°C for any length of time. The presence of formaldehyde was confirmed by trapping formaldehyde with benzyl ethanol amine and detecting its presence as the 3-benzyl oxazolidine derivative by gas chromatography. The formaldehyde was removed from the lubricant by purging a portion of the lubricant sample with nitrogen and trapping the effluent gas on chromasorb coated with benzyl ethanol amine, followed by extraction with methylene chloride and confirmed by gas chromatography.

3.4.1 Dimensional and tensile changes after thermal aging

[Appendix E](#) details the physical dimensional changes of the thermal portion of this study and indicates that most of the plastics have shown minimal changes in size. However, [Appendix F](#) details the tensile properties of the test plastics and shows clearly that all of the plastics are affected under these conditions.

3.4.1.1 Tensile changes after aging in pure lubricant

The lubricant immersion studies detailed in [Appendix B](#) indicate there are few significant dimensional changes for most of the test plastics. To achieve a more complete understanding of the thermal effect of lubricants on the plastics' dimensional properties, tensile property measurements were conducted at 60°C (140°F) and 100°C (212°F).

Test bars were stored in a closed screw cap glass container for 4 months before the tensile pulls were performed. At the time of the immersion study, tensile pulls were not required.

The results of the lubricant immersion tensile property data are found in [Appendix H, Tables H.1 through H.14](#). The unfilled polyamide-imide (13) had the greatest initial tensile strength while polytetrafluoroethylene bars (12) were the weakest. Polypropylene homopolymer (8) had the greatest elasticity, while phenolic bars (4) were the most brittle.

When aged for 14 days with temperature in lubricant, significant changes in tensile strength and percent elongation were found for many of the plastics. Most lost elasticity as is indicated by minus percent elongation. The only exception was the 6/6 nylon polyamide (23) which became more elastic. This is surprising because nylon usually becomes brittle when heated at dehydration conditions; 100°C may not be a high enough temperature to cause this. Modified polyetherimide (16), polybutylene terephthalate (18), and liquid crystal polymer (22) show increased tensile strength in all lubricants at both temperatures. Graphite filled polyamide-imide (14) gave a general decrease in tensile strength under the same conditions; the graphite fiber may have become wet or allowed the lubricant to penetrate the polymer structure. The lubricant that causes the greatest change (loss and gain) in tensile strength in all plastics is alkylbenzene; that which has the least effect on tensile strength is branched acid polyolester. Polypropylene glycol diol had the greatest influence on change in the percent elongation of all plastics, while modified polyglycol had the least.

Presently, no study has measured tensile properties ([Appendix F](#)) for plastics exposed to refrigerant/lubricant at 150°C (302°F) for 14 days aging at 300 psia refrigerant pressure. This temperature represents the highest used in the lubricant immersion study. It was decided to conduct a similar 14 day experiment with plastics immersed in only 32 ISO VG branched acid and 22 ISO VG mixed-acid polyolesters at 150°C (302°F). Data at this temperature should correlate with the 60°C (140°F) and 100°C (212°F) immersion temperatures, simplifying comparisons.

[Tables I.1 and I.3](#) compare the tensile retention properties of all plastics after immersion in 32 ISO VG branched acid and 22 ISO VG mixed acid polyolesters at the above three temperatures. Tensile and percent elongation patterns can be noted for each plastic for the three temperatures. Tensile was found to increase, but elasticity of most plastics deteriorates as the temperature rises. Plastic tensile properties in the presence of the two polyolesters do not appear to differ greatly. In conclusion, the tensile properties of plastics immersed in lubricants tell us more about how the plastic test bars were affected than the dimensional measurements do. Large variations in before/after tensile properties were

found. Some variations were unique to particular lubricant/plastic combinations. In general, alkylbenzene and polypropylene glycol diol had the greatest lubricant effects on tensile properties of all plastics. Also, most plastics lost elasticity while submerged in hot lubricant, but this was caused by the heat and not by lubricant interaction with the plastic.

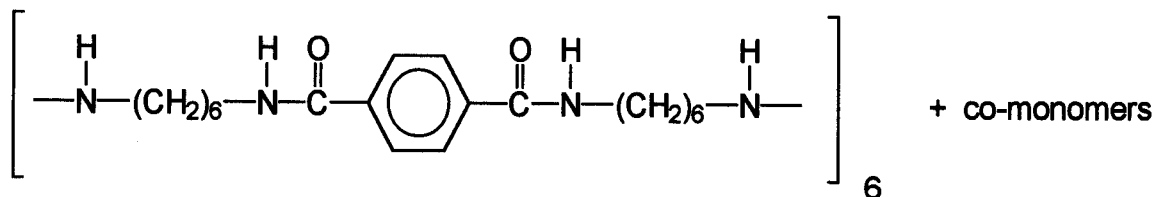
In conclusion, the tensile properties of plastics immersed in lubricants tell us more about how the plastic test bars were affected than the dimensional measurements do. Large variations in before/after tensile properties were found. Some variations were unique to particular lubricant/plastic combinations. In general, pure alkylbenzene and pure polypropylene glycol diol had the greatest lubricant effects on tensile properties of all plastics. Also, most plastics lost elasticity while submerged in hot lubricant, but this has been determined to be caused by the heat and not necessarily by lubricant interaction with the plastic.

All the plastics tested have individual chemistries and different mechanical response values. Therefore, a description of each plastic is provided in this report. These descriptions include chemistry; expected mechanical properties; and heat distortion temperature, which indicates useful service temperature. A small table summarizes the average effect on the plastic of refrigerants in hydrocarbon, polyalkylene glycol, and polyolester lubricants; and the compatibility results are briefly discussed. This table includes the results of tests with R-134a; these were chosen for presentation because R-134a was used in tests with two different lubricants (branched-acid and mixed-acid polyolester) at identical conditions, allowing comparisons of the results. Any anomalies will be indicated; the basis for comparison is the physical losses due to thermal aging.

4. PLASTICS TESTED

#	GENERIC NAME	Trade name	Maker
1	POLYPHTHALAMIDE	Amodel AD-1000 HS	Amoco

Published molecular structure sub-unit:



Introduction and Description

Polyphthalamide, a fully crystalline thermoplastic resin, is a derivative of polyamide 6,T with added co-monomers. This polymer can be glass and/or mineral filled up to 40% for added thermal properties and strength. Pure polyamide 6,T has long been recognized for excellent dimensional stability, low moisture absorption, high strength, and high heat resistance. Its high crystalline melting point (370°C) is above its thermal decomposition temperature; this rules out most conventional injection molding techniques. The introduction of co-monomers lowers the melting point of polyamide 6,T while retaining its fast crystallization rate. The base resin is Amodel AD-1000 HS, which has excellent resistance to chemicals, wear, and friction. The HDT of 120°C (240°F) = 1.8 MPa (264 psi). Polyphthalamide can be annealed in air up to 3 hours at 150°C.

(continued)

POLYPHTHALAMIDE, continued

Compatibility Results

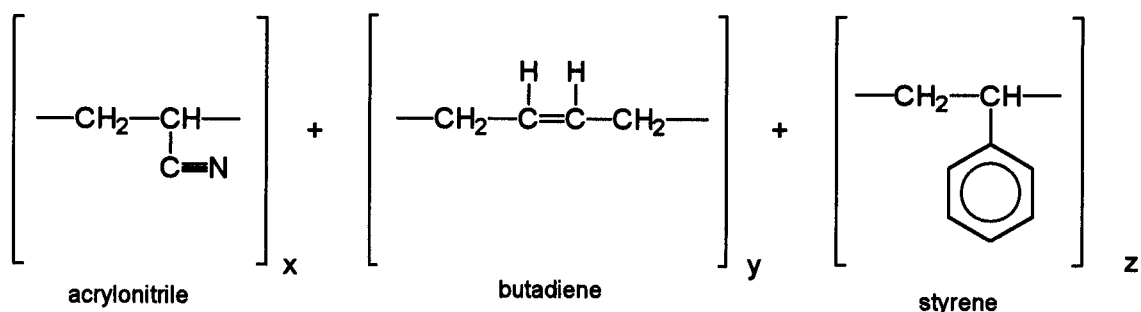
Lubricant	Total Acid Number	% Tensile Change	% Elongation Change
Air		37.4	-66.6
Branched -Acid Polyolester (ambient, no refrigerant)	3.5	37.8	-65.9
Branched Acid Polyolester (dehydrated, no refrigerant)	0.3	-1.7*	11.7*
Mineral Oil (ambient, R-22)		-22.1	-78.5
Branched Acid Polyolester (ambient, R-134a)	1.6	32.0	-62.9
Mixed Acid Polyolester (ambient, R-134a)		30.8	-60.4
Branched Acid Polyolester (ambient, average for all refrigerants)		28.7	-64.8
Polyalkylene Glycols (ambient, average for all refrigerants)		28.6	-62.1†
Mineral Oils/ Alkylbenzenes (ambient, average for all refrigerants)		22.1	-63.0

* These values represent percent change relative to ambient test bars, not to control.

† An anomalous value (337.4%, for polypropylene glycol butyl monoether and HFC-134a) has been excluded from the average.

#	GENERIC NAME	Trade name	Maker
2	ACRYLONITRILE-BUTADIENE-STYRENE TERPOLYMER (ABS)	Cycolac GPM 4700	G.E.

Published molecular structure subunit:



Introduction and description

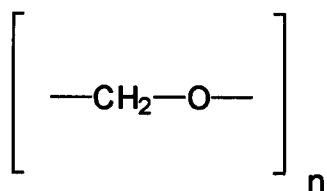
Acrylonitrile-butadiene-styrene (ABS) plastics are thermoplastics of the styrene family that are blended with varying amounts of acrylonitrile and butadiene rubbers to achieve toughness and impact strength. The three individual components incrementally add to the physical properties of the ABS terpolymer. Acrylonitrile provides heat and chemical resistance, tensile strength, and durability; butadiene contributes impact resistance and overall toughness. The HDT at 1.82 MPa (264 psi) = 93°C (200°F). Although ABS has better mechanical properties than polystyrene, the modified polymer is still prone to stress cracking when exposed to certain organic solvents.

Compatibility results

This plastic was not included in the refrigerant/lubricant thermal aging study. It was found to be vulnerable to the action of refrigerant alone, failing at 60°C in R-32 and 152a, and at both tested temperatures (ambient and 60°) in R-22, R-123, R-124, and R-134. Refrigerant dissolved in the plastic and slowly released itself at ambient conditions; this produced foams or rods from the flat test specimens.

#	GENERIC NAME	Trade name	Maker
3	ACETAL	Delrin II 11500	DuPont

Published molecular structure subunit:



Introduction and description

Acetals are crystalline thermoplastic homopolymers made by the polymerization of formaldehyde. They exhibit high stiffness, good tensile strength, and good fatigue endurance. Changes in temperature do not greatly affect their impact resistance. This property of acetals, combined with their strength, creep resistance, and good dimensional stability, allows them to replace many metal parts. Acetals generally exhibit excellent resistance to moisture, solvents, and most neutral chemicals. The Delrin II 11500 used in this study is an unfilled general purpose resin. The three basic compositions of Delrin (100, 500, and 900) differ primarily in melt viscosity. Delrin 100 is the most viscous; Delrin 900, the most fluid. With prolonged heating above 120°C (250°F) acetal gives off formaldehyde as a retrograde product. The HDT 1.8 MPa (264 psi) = 130°C (260°F.)

(continued)

ACETAL, continued.

Compatibility results

Lubricant	Total Acid Number	% Tensile Change	% Elongation Change
Air		-0.7	-35.5
Branched -Acid Polyolester (ambient, no refrigerant)	0.8	5.1	-7.7
Branched Acid Polyolester (dehydrated, no refrigerant)	0.2	-3.2*	1.9*
Mineral Oil (ambient, R-22)		-54.7	-49.5
Branched Acid Polyolester (ambient, R-134a)	0.2	1.3	3.7
Mixed Acid Polyolester (ambient, R-134a)		1.15	13.24
Branched Acid Polyolester (ambient, average for all refrigerants)		2.3†	2.5†
Polyalkylene Glycols (ambient, average for all refrigerants)		-6.8‡	24.8
Mineral Oils/ Alkylbenzenes (ambient, average for all refrigerants)		-36.6	-31.6

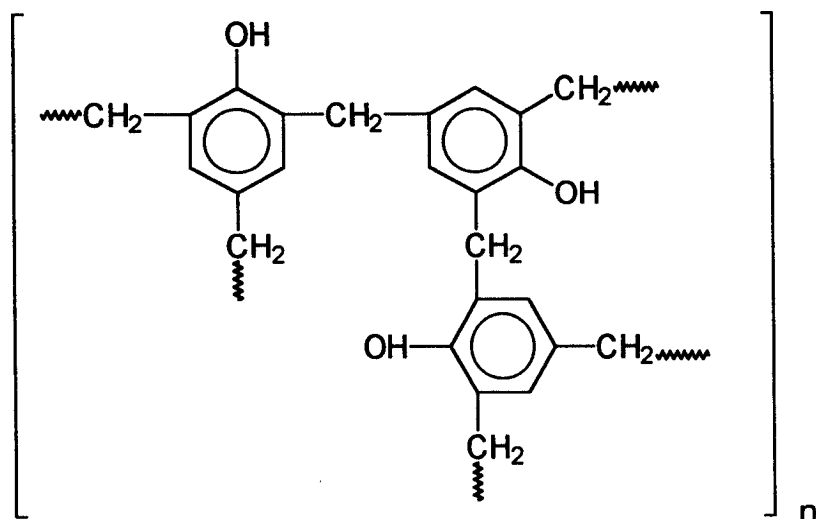
* These values represent percent change relative to ambient test bars, not to control.

† Anomalous values (tensile 15.7%, elongation -25.1% for 32 ISO branched acid polyolester and HFC-143a) have been excluded from the average.

‡ An anomalous value (-53.8% for polypropylene glycol butyl mono ether and HFC-32) has been excluded from the average.

#	GENERIC NAME	Trade name	Maker
4	PHENOLIC	Durez	Hooker

Published molecular structure sub-unit:



Introduction and Description

Phenolic resins, which were discovered in 1909, are one of the oldest types of synthetic plastics. Like other thermoset plastics, phenolic is stiff, resistant to solvents, and retains its physical properties with heat. Phenolic compounds are multi-component materials that are cured in situ at time and temperature. The amount of water that forms during the polymerization reaction depends on the molecular weight of the partially cured (B staged) mass. To soften or liquefy a resin preform (compression mold) or pellet (screw injection mold), preheating is often necessary. The resin preform or pellet is then forced into very hot cavities where it is held for almost a complete cure, or a functional part. Extensive cross-linking may occur, causing the phenolic resin to become stiff or brittle. To prevent this, fillers and reinforcement materials may be added; these include wood flour, asbestos, synthetic fiber, chopped cloth, glass fiber and cotton flock. The finished product may have all of the stated physical properties without being fully cured. Post curing may be necessary for optimum lubricant/refrigerant compatibility. The rate and quantity of moisture absorption depend on the resin density and the filler. The HDT 185°C (365°F) = 1.8 MPa (264 psi).

(continued)

PHENOLIC, continued.

Compatibility Results

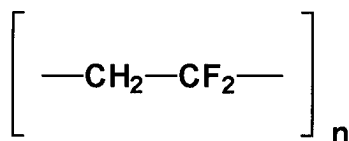
Lubricant	Total Acid Number	% Tensile Change	% Elongation Change
Air		8.4	-24.8
Branched -Acid Polyolester (ambient, no refrigerant)	19.9	5.0	-33.0
Branched Acid Polyolester (dehydrated, no refrigerant)	1.7	2.2*	9.0*
Mineral Oil (ambient, R-22)		-16.8	-5.5
Branched Acid Polyolester (ambient, R-134a)	21.3	23.0	-26.8
Mixed Acid Polyolester (ambient, R-134a)		37.0	12.8
Branched Acid Polyolester (ambient, average for all refrigerants)		10.4	-28.7
Polyalkylene Glycols (ambient, average for all refrigerants)		3.2	-9.8
Mineral Oils/ Alkylbenzenes (ambient, average for all refrigerants)		-6.2	-4.6

* These values represent percent change relative to ambient test bars, not to control.

Appendix I clearly shows that phenolic may require postcuring either to complete the cross-linking reaction or to eliminate water of reaction. The possible presence of water in the test specimens may explain the variance in tensile and elongation.

#	GENERIC NAME	Trade name	Maker
5	POLYVINYLIDENE FLUORIDE	Kynar 720	Atochem

Published molecular structure sub-unit:



Introduction and Description

Polyvinylidene fluoride (PVF₂) is a semi-crystalline, melt-processing, thermoplastic resin that can be injection molded. PVF₂ parts have superior mechanical properties and can be used in load-bearing applications up to 150°C (300°F.) This material, unlike other fluoroplastics, has low moisture absorption. The HDT 115°C (239°F) = 1.8 MPa (264 psi.)

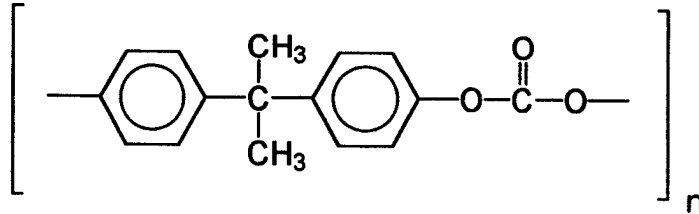
Compatibility Results

Lubricant	Total Acid Number	% Tensile Change	% Elongation Change
Air		9.4	-50.3
Branched -Acid Polyolester (ambient, no refrigerant)	0.1	0.8	-28.1
Branched Acid Polyolester (dehydrated, no refrigerant)	0.2	-1.1*	-2.1*
Mineral Oil (ambient, R-22)		-4.2	-41.7
Branched Acid Polyolester (ambient, R-134a)	0.1	-8.1	-5.9
Mixed Acid Polyolester (ambient, R-134a)		-11.2	-4.7
Branched Acid Polyolester (ambient, average for all refrigerants)		-11.4	14.4
Polyalkylene Glycols (ambient, average for all refrigerants)		-10.5	-0.9
Mineral Oils/ Alkylbenzenes (ambient, average for all refrigerants)		-10.8	6.9

*These values represent percent change relative to ambient test bars, not to control.

#	GENERIC NAME	Trade name	Maker
6	POLYCARBONATE	Lexan 161	G.E.

Published molecular structure subunit:



Introduction and description

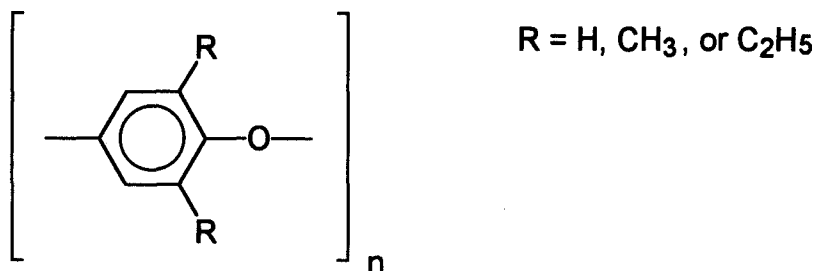
The chemical structure above is typical of the polycarbonate polymer, which is a condensation reaction product of phosgene (COCl_2) and 4,4'-Isopropylidenediphenol and similar derivatives. Polycarbonates are well-known engineering plastics characterized by toughness, high stiffness, very good impact resistance, and creep resistance up to 120°C (250°F) at ambient conditions. However, they can soften when exposed to many aromatic solvents. Polycarbonates are best known for being transparent; however, when they are filled with glass fibers (up to 40% by weight), they are tough enough to be used for gears and other mechanical parts. Polycarbonates are generally stable to water, mineral acids and organic acids, but crazing and/or embrittlement can occur under some conditions, if a polycarbonate part is stressed. Under these conditions the highest recommended operating temperature is 60°C (140°F) whereas the HDT at 1.8 MPa (264 psi) is 132°C (250°F).

Compatibility results

Polycarbonate was not included in refrigerant/lubricant thermal aging studies. It swelled (thickness change 21.2%) in the presence of R-22 and failed completely in the presence of R-123.

#	GENERIC NAME	Trade name	Maker
7	MODIFIED POLYPHENYLENE OXIDE	Noryl 731	G.E.

Published molecular structure sub-unit:



Introduction and Description

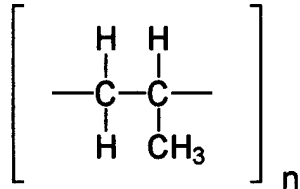
Polyphenylene oxide (PPO) polymer is synthesized by oxidative coupling techniques using various "R" substituted phenols. This amorphous polymer is frequently compounded with polystyrene to become a moderately high temperature engineering plastic. The T_g is raised when the "R" substituent is changed from H to CH₃, phenyl. In ambient conditions, PPO is characterized by a wide temperature range up to 175°C (375°F) for negligible moisture adsorption and tensile above moisture conditioned nylon. Although this resin is a general purpose unfilled resin, PPO is available in glass filled resins and modified high modulus forms. While the modified PPO in this study does possess a higher impact strength, it suffers in tensile strength and lacks temperature resistance. Stress cracking sensitivity due to polystyrene inclusion may also occur. The reported HDT at 1.8 MPa (264 psi) is 127°C (260°F).

Compatibility Results

Modified phenylene oxide was not included in refrigerant/lubricant thermal aging studies. It swelled (thickness change 51.8%) when exposed to R-22 at 60°C and failed completely in R-123 at both temperatures.

#	GENERIC NAME	Trade name	Maker
8	POLYPROPYLENE	Profax 6331 NW	Himont

Published molecular structure subunit:



Introduction and description

The polypropylene homopolymer is a crystalline thermoplastic material, with good chemical resistance but poor thermal properties. The crystalline structure of this material determines its mechanical properties, such as its immunity to stress cracking. The introduction of copolymers, such as polypropylene copolymer, makes polypropylene less brittle at low temperatures. The reported pure resin HDT at 1.8 MPa (264 psi) is 60°C (140°F) whereas that for the 40% glass filled homopolymer is 150°C (300°F).

(continued)

POLYPROPYLENE, continued

Compatibility results

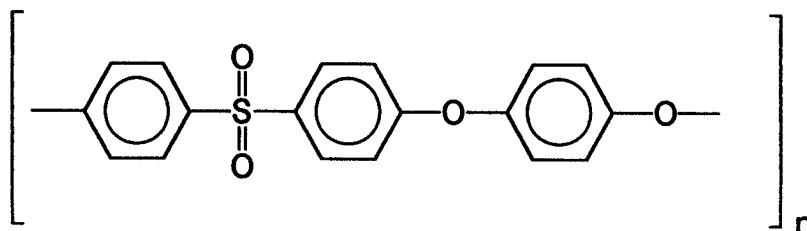
Lubricant	Total Acid Number	% Tensile Change	% Elongation Change
Air		8.0	-83.7
Branched -Acid Polyolester (ambient, no refrigerant)	0.3	-11.7	-84.2
Branched Acid Polyolester (dehydrated, no refrigerant)	0.1	0.3*	-8.0*
Mineral Oil (ambient, R-22)		-9.9	11.1
Branched Acid Polyolester (ambient, R-134a)	0.1	-13.9	-16.2
Mixed Acid Polyolester (ambient, R-134a)		-12.4	-13.2
Branched Acid Polyolester (ambient, average for all refrigerants)		-7.3*	-26.9
Polyalkylene Glycols (ambient, average for all refrigerants)		-10.6	-44.8
Mineral Oils/ Alkylbenzenes (ambient, average for all refrigerants)		-13.4	-10.2

* These values represent percent change relative to ambient test bars, not to control.

† An anomalous value (198% for 32 ISO VG branched acid polyol ester and HFC-32) has been excluded from the average.

#	GENERIC NAME	Trade name	Maker
9	POLYARYL SULFONE	Radel A-200	Amoco

Published molecular structure subunit:



Introduction and Description

Radel A-200 is best described as an amorphous, glassy, polyethersulfone polymer, comprising small amounts of polyetherethersulfone in the resin matrix. These polymers are prepared either by a nucleophilic ether synthesis or by an electrophilic (Friedal Crafts) sulfone coupling method. The resulting material is a transparent, amber plastic characterized by excellent thermo-oxidative stability and impact resistance at low temperatures. Its toughness, elongation, and ductility are high, and it exhibits good resistance to creep-stress cracking. However, it adsorbs water because of its polar matrix nature. The reported HDT is 204°C (400°F) at 1.8 MPa (264 psi). The addition of glass fiber fillers raises the HDT value only slightly.

(continued)

POLYARYL SULFONE, continued

Compatibility Results

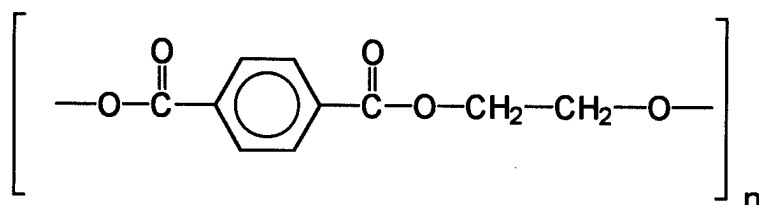
Lubricant	Total Acid Number	% Tensile Change	% Elongation Change
Air		12.1	-45.9
Branched -Acid Polyolester (ambient, no refrigerant)	3.6	19.5	-39.7
Branched Acid Polyolester (dehydrated, no refrigerant)	0.8	3.1*	25.6*
Mineral Oil (ambient, R-22)		15.1	-64.1
Branched Acid Polyolester (ambient, R-134a)	0.7	-29.7	-34.4
Mixed Acid Polyolester (ambient, R-134a)		-39.1	-58.02
Branched Acid Polyolester (ambient, average for all refrigerants)		0.0	-44.2
Polyalkylene Glycols (ambient, average for all refrigerants)		15.1	-66.3
Mineral Oils/ Alkylbenzenes (ambient, average for all refrigerants)		9.6*	-48.7

* These values represent percent change relative to ambient test bars, not to control.

† An anomalous value (101.1 % for 32 ISO VG alkylbenzene and HCFC-142b) has been excluded from the average.

#	GENERIC NAME	Trade name	Maker
10	POLYETHYLENE TEREPHTHALATE	Rynite 530	DuPont

Published molecular structure sub-unit:



Introduction and Description

The oxidation of paraxylene produces terephthalic acid, which is purified with methanol as dimethyl terephthalate (DMT). Therefore, polyethylene terephthalate (PET) is a condensation polymer of DMT, with ethylene glycol in a continuous melt phase polymerization process, which is followed by a solid state polymerization process that yields a highly crystalline pellet. PET, which has a low oligmer content and refrigerant extractables, can be clear or fully crystallized depending on the molecular weight distribution and the process variables. PET adsorbs water, but under carefully controlled conditions it can dry-out so that temperature exposure causes only minimal embrittlement. Highly crystalline PET can have a melting point of 270°C (518°F), but reported HDT of annealed material at 1.8 MPa (264 psi) is 44°C (110°F), and glass filled materials can be as high as 200°C (410°F), which takes advantage of the crystalline nature of the product. PET motor insulation materials injection, therefore, moldable PETs may be chosen due to low oligmer content and refrigerant extractables.

(continued)

POLYETHYLENE TEREPHTHALATE, continued.

Compatibility Results

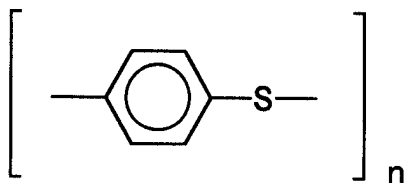
Lubricant	Total Acid Number	% Tensile Change	% Elongation Change
Air		-9.5	-23.2
Branched -Acid Polyolester (ambient, no refrigerant)	0.3	-44.0	-49.5
Branched Acid Polyolester (dehydrated, no refrigerant)	0.3	15.3*	15.6*
Mineral Oil (ambient, R-22)		-66.0	-36.9
Branched Acid Polyolester (ambient, R-134a)	0.2	-33.6	-32.2
Mixed Acid Polyolester (ambient, R-134a)		-15.9	-2.2
Branched Acid Polyolester (ambient, average for all refrigerants)		-14.4	-20.4
Polyalkylene Glycols (ambient, average for all refrigerants)		-45.4	-36.4
Mineral Oils/ Alkylbenzenes (ambient, average for all refrigerant)		-39.9	-36.6

* These values represent percent change relative to ambient test bars, not to control.

Dehydrating this plastic prior to thermal aging with polyols provides obvious benefits. Water present in a PET test bar during the elevated temperature aging process causes brittleness. The PET tested differed in form from PET motor insulation film, a reinforced material which, in its undehydrated state, is affected more severely by lubricants and refrigerants.

#	GENERIC NAME	Trade name	Maker
11	POLYPHENYLENE SULFIDE	Supec G401	G.E.

Published molecular structure sub-unit:



Introduction and description

Polyphenylene sulfide (PPS) is a thio analog of polyphenylene ether (PPO); these two polymers are very similar. PPS is a highly crystalline polymer that is characterized by excellent chemical resistance, high strength with fillers, extreme brittleness without fillers, very low water adsorption, and excellent tensile properties at high temperatures. PPS can cross-link irreversibly at temperatures above 200°C (400°F) and does not show weight loss above 500°C (932°F) in air. Virgin PPS is approximately 65% crystalline, and this amorphous material crystallizes below 120°C. Annealing occurs at about 204°C, although quenching results in approximately 5% crystallinity. Annealing unfilled PPS raises the HDT at 1.8 MPa (264 psi) from 100°C (212°F) to 128°C (264°F), but lowers the tensile strength. PPS has an exceptional ability to wet reinforcing fibers when extruded, and the 40% glass filled versions show an enormous increase in HDT at 1.8 MPa (264 psi) is >260 °C (>500°F)

(continued)

POLYPHENYLENE SULFIDE, continued.

Compatibility Results

Lubricant	Total Acid Number	% Tensile Change	% Elongation Change
Air		9.0	-14.2
Branched -Acid Polyolester (ambient, no refrigerant)	0.1	4.6	-17.6
Branched Acid Polyolester (dehydrated, no refrigerant)	0.3	16.2*	11.7*
Mineral Oil (ambient, R-22)		17.1	26.9
Branched Acid Polyolester (ambient, R-134a)	0.1	14.8	-15.4
Mixed Acid Polyolester (ambient, R-134a)		15.6	1.9
Branched Acid Polyolester (ambient, average for all refrigerants)		15.8	9.6
Polyalkylene Glycols (ambient, average for all refrigerants)		18.5	-3.8
Mineral Oils/ Alkylbenzenes (ambient, average for all refrigerants)		11.8	-2.7†

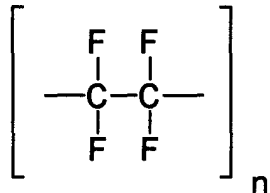
* These values represent percent change relative to ambient test bars, not to control.

† An anomalous value (69.2% for mineral oil and HCFC-123) has been excluded from the average.

Depending on the quality of the cross-linking process, PPS may have free, unreacted sulfide or thio links, which may be extractable by refrigerants and lubricants. Extracted, low molecular weight compounds may react, forming sulfide compounds and tarnishing copper. Lot to lot examination of parts prior to compressor or system service is recommended. The effects of moisture upon these plastics are minimal, and all of the observed changes are within the expected range of this study.

#	GENERIC NAME	Trade name	Maker
12	POLYTETRAFLUOROETHYLENE	Teflon	DuPont

Published molecular structure sub-unit:



Introduction and Description

Free radical initiated polymerization of tetrafluoroethylene produces a finely divided polytetrafluoroethylene (PTFE) powder. This crystalline material is sold as dispersions or as micronized fibers (such as Goretex); it may also be formed into machinable billets or a continuous extruded sheet. PTFE is a non-melting polymer of low tensile, high cold flow, excellent chemical resistance, and high elongation. While the material is soft and self-lubricating, it is generally used with a mineral filler to improve lubrication properties even further. Parts can be cold formed from powder and then sintered.

(continued)

POLYTETRAFLUOROETHYLENE, continued.

Compatibility Results

Lubricant	Total Acid Number	% Tensile Change	% Elongation Change
Air		10.8	-8.8
Branched -Acid Polyolester (ambient, no refrigerant)	2.4	20.7	5.6
Branched Acid Polyolester (dehydrated, no refrigerant)	1.5	10.3*	-13.6*
Mineral Oil (ambient, R-22)		28.9	-3.5
Branched Acid Polyolester (ambient, R-134a)	0.1	83.0	1.8
Mixed Acid Polyolester (ambient, R-134a)		6.2	-8.6
Branched Acid Polyolester (ambient, average for all refrigerants)		5.7	-20.2
Polyalkylene Glycols (ambient, average for all refrigerants)		-5.1†	-3.8‡
Mineral Oils/ Alkylbenzenes (ambient, average for all refrigerants)		-2.7	9.5

* These values represent percent change relative to ambient test bars, not to control.

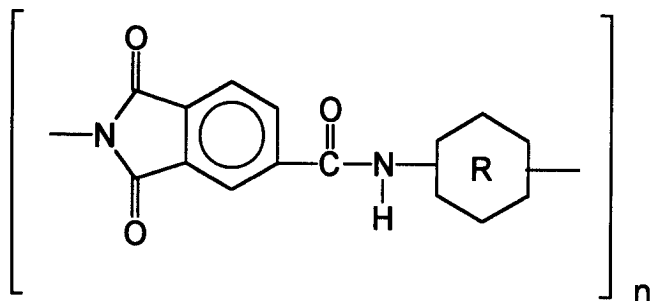
† An anomalous value (133.0 % for polypropylene glycol butyl mono ether and HFC-125) has been excluded from the average.

‡ An anomalous value (8.2 % for polypropylene glycol diol and HCFC-134a) has been excluded from the average.

PTFE absorbed some water, as seen above, but remained very chemically resistant. Although some anomalies are reported here, these values may accurately represent the facts since both test bars reacted in the same fashion.

#	GENERIC NAME	Trade name	Maker
13	POLYAMIDE-IMIDE (HIGH STRENGTH)	Torlon 4203L	Amoco

Published molecular structure sub-unit:



Introduction and Description

This high strength polyamide imide (PAI) is a partially polymerized condensation product of trimellitic anhydride and a proprietary aromatic dianiline mixture (which produces an intermediate resin mix containing 3% Titanium Oxide and 0.5% fluorocarbon). Prior to injection molding, this PAI must be thoroughly dried in a desiccant drier. When the dry PAI is injected into a heated mold at specified temperatures (post curing), the material will achieve its ultimate tensile, chemical and mechanical properties. While post curing is not simple, it is essential, because it continues the imidiation process that releases water of reaction. Post-curing requires a very temperature controlled ramping process over a period of at least 14 to 21 days. The rate of post curing depends on the thickness and on the mass of the green molded part. PAI maintains high tensile at high temperatures, is considered the least brittle of plastics at low temperatures, and reportedly has continuous operational temperatures of 232°C (450°F). This high strength grade has a reported HDT at 1.8 MPa (264 psi) of 277°C (532°F); however, it also has a moisture adsorption of 0.33% over a 24 hour period.

(continued)

POLYAMIDE IMIDE, continued.

Compatibility Results

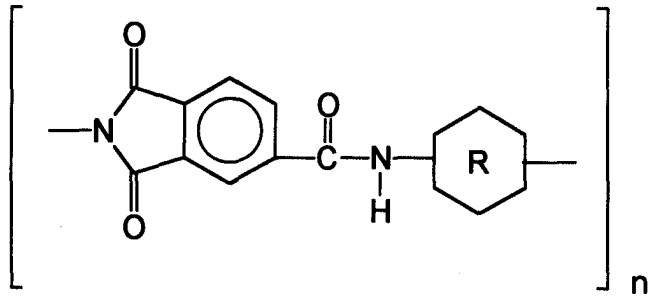
Lubricant	Total Acid Number	% Tensile Change	% Elongation Change
Air		-44.6	13.5
Branched -Acid Polyolester (ambient, no refrigerant)	9.5	1.8	8.3
Branched Acid Polyolester (dehydrated, no refrigerant)	0.3	15.1*	18.7*
Mineral Oil (ambient, R-22)		-41.9	30.1
Branched Acid Polyolester (ambient, R-134a)	0.1	-39.9	22.7
Mixed Acid Polyolester (ambient, R-134a)		-41.9	23.8
Branched Acid Polyolester (ambient, average for all refrigerants)		1.4	0.3
Polyalkylene Glycols (ambient, average for all refrigerants)		-7.6	0.2
Mineral Oils/ Alkylbenzenes (ambient, average for all refrigerants)		-11.8	14.7

* These values represent percent change relative to ambient test bars, not to control.

Very rapid heating of PAI parts causes a rapid release of moisture, which may alter their internal tensile strength. This seems to be evident with test bars that were maintained at ambient conditions and then rapidly heated.

#	GENERIC NAME	Trade name	Maker
14	POLYAMIDE-IMIDE 12% GRAPHITE	Torlon 4301	Amoco

Published molecular structure sub-unit:



Introduction and Description

This polyamide-imide (PAI), which contains 12% graphite and 3% fluorocarbon filler, is considered a wear-resistant grade of engineering plastic. This PAI has the same chemical composition as the number 13 PAI material, as well as the same pre-molding drying requirements. The post curing process, which continues for several days at 260°C (500° F), has a dramatic effect on wear properties. Graphite fillers tend to reduce the tensile strength of the end product 16.3 vs. 27 kpsi), while slightly increasing the HDT at 1.8 MPa (264 psi) to 279°C (534°F). Although fillers increase the density of this polymer, they do not reduce the moisture uptake as they do in many other polymers.

(continued)

POLYAMIDE IMIDE, 12% GRAPHITE, continued.

Compatibility Results

Lubricant	Total Acid Number	% Tensile Change	% Elongation Change
Air		-6.2.	-2.3
Branched -Acid Polyolester (ambient, no refrigerant)	7.5	-14.8	-13.1
Branched Acid Polyolester (dehydrated, no refrigerant)	0.4	14.2*	5.6*
Mineral Oil (ambient, R-22)		-10.7	-8.2
Branched Acid Polyolester (ambient, R-134a)	2.6	-2.6	-9.2
Mixed Acid Polyolester (ambient, R-134a)		-7.5	-7.2
Branched Acid Polyolester (ambient, average for all refrigerants)		-3.5	-7.6
Polyalkylene Glycols (ambient, average for all refrigerants)		-4.0†	-6.8
Mineral Oils/ Alkylbenzenes (ambient, average for all refrigerants)		-3.4	-7.4

* These values represent percent change relative to ambient test bars, not to control.

† An anomalous value (108.8% for polypropylene glycol butyl mono ether and HFC-134a) has been excluded from the average.

#	GENERIC NAME	Trade name	Maker
15	POLYETHERIMIDE	Ultem 1000	G.E.

Published molecular structure sub-unit:

NOT PUBLISHED

Introduction and Description

This polyetherimide (PEI) is an amorphous polymer with an amber, glassy appearance. Because of its high heat resistance, it demonstrates very good strength and modulus at elevated temperatures. The PEI evaluated in this study is unfilled, although filled grades (up to 40% glass) are available. The recognized UL operational temperature is 170°C (338°F), and the reported HDT at 1.8 MPa (264 psi) is 200°C (392°F), which indicates useful temperature ranges. The annealing of parts at 200°C (392°F) for 4 hours is recommended to remove any additional stress.

POLYETHERIMIDE, continued.

Compatibility Results

Lubricant	Total Acid Number	% Tensile Change	% Elongation Change
Air		11.3	-31.3
Branched -Acid Polyolester (ambient, no refrigerant)	2.5	10.8	-75.8
Branched Acid Polyolester (dehydrated, no refrigerant)	0.2	-2.8*	210.2*
Mineral Oil (ambient, R-22)		1.3	7.1
Branched Acid Polyolester (ambient, R-134a)	3.1	3.3	-31.3
Mixed Acid Polyolester (ambient, R-134a)		3.0	-38.2
Branched Acid Polyolester (ambient, average for all refrigerants)		4.4	-32.8
Polyalkylene Glycols (ambient, average for all refrigerants)		4.8	18.2†
Mineral Oils/ Alkylbenzenes (ambient, average for all refrigerants)		2.3	-16.6

* These values represent percent change relative to ambient test bars, not to control.

† An anomalous value (-62.7% for polypropylene glycol butyl mono ether and HFC-125) has been excluded from the average.

The overall impact of refrigerants and lubricants on this polymer is minimal; temperature effects are more evident. The loss of physicals with temperature may simply occur in the annealing process; had annealed test bars been used, the changes might have been less significant.

#	GENERIC NAME	Trade name	Maker
16	MODIFIED POLYETHERIMIDE	Ultem CRS 5001	G.E.

Published molecular structure sub-unit:

NOT PUBLISHED

Introduction and Description

Modified polyetherimide (PEI) is an amorphous polymer with an amber, glassy appearance and the highest chemical resistance of the PEI family. It is characterized by high heat resistance, with excellent strength and modulus at elevated temperatures. The modified PEI evaluated in this study is unfilled. The reported HDT at 1.8 MPa (264 psi) is 209°C (408°F), which indicates the useful temperature ranges. We assume that parts should be annealed at 200°C (392°F) for 4 hours to remove any additional stress. This modified PEI has lower moisture adsorption than the unmodified version.

MODIFIED POLYETHERIMIDE, continued.

Compatibility Results

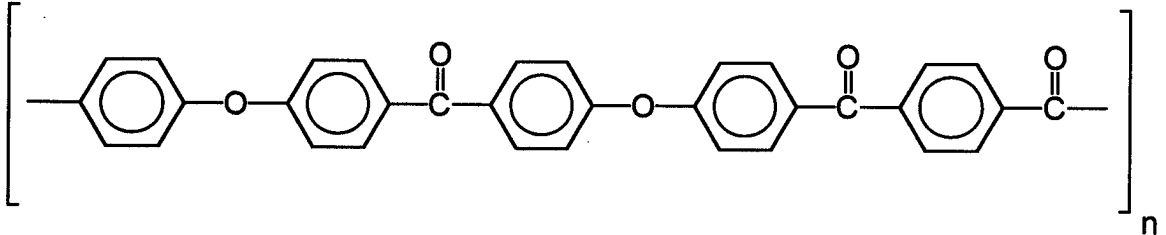
Lubricant	Total Acid Number	% Tensile Change	% Elongation Change
Air		12.2	-11.5
Branched -Acid Polyolester (ambient, no refrigerant)	1.3	13.0	-13.4
Branched Acid Polyolester (dehydrated, no refrigerant)	0.2	-0.4*	-21.1*
Mineral Oil (ambient, R-22)		6.5	2.0
Branched Acid Polyolester (ambient, R-134a)	0.3	-10.3	7.8
Mixed Acid Polyolester (ambient, R-134a)		18.6	43.6
Branched Acid Polyolester (ambient, average for all refrigerants)		3.4	-5.5
Polyalkylene Glycols (ambient, average for all refrigerants)		7.9	13.0
Mineral Oils/ Alkylbenzenes (ambient, average for all refrigerants)		9.2	-3.8

* These values represent percent change relative to ambient test bars, not to control.

The tensile and elongation properties of both PEIs seem to be improved by polyalkylene glycols; these polymers seem to be least affected by PAGs at temperature. However, the modified polyetherimide seems to perform better overall, with the least tensile loss and embrittlement. This may illustrate the beneficial effects of lubricants and refrigerants on some polymers.

#	GENERIC NAME	Trade name	Maker
17	POLYARYLEETHERKETONE	Ultrapek (PAEK)	BASF

Published molecular structure sub-unit:



Introduction and Description

Poly(aryl-ether-ketone) (PAEK) is a semi-crystalline thermoplastic polycondensation resin unsurpassed for molding thin or thick sections. This chemical is characterized by a well-balanced combination of great rigidity and strength at high temperature, by good resistance to heat deformation under load for sliding friction applications, and by very good chemical resistance. Continuous heat applications of 170°C (338°F) are standard for parts made from non-reinforced PAEK, which can be heated momentarily just below the melting point (381°C (717°F)) without any significant change in mechanical properties. PAEK has three viscosity grades: low, medium and high; the last of these has glass or carbon fiber reinforcements. Under standard moisture conditions of 50±6% RH at 23°C, PAEK neat resin will absorb moisture up to 0.25% without loss of any physical properties. The reported HDT at 1.8 MPa (264 psi) is 170°C (338°F) for neat resin with 20% fiber reinforcement. The maximum HDT at 1.8 MP a (265 psi) is about 350°C (662°F).

(continued)

POLY(ARYL ETHER KETONE), continued.

Compatibility Results

Lubricant	Total Acid Number	% Tensile Change	% Elongation Change
Air		8.2.	-48.2
Branched -Acid Polyolester (ambient, no refrigerant)	0.3	10.0	-61.4
Branched Acid Polyolester (dehydrated, no refrigerant)	0.4	9.6*	193.4*
Mineral Oil (ambient, R-22)		8.7	4.3
Branched Acid Polyolester (ambient, R-134a)	0.3	-15.5	-88.0
Mixed Acid Polyolester (ambient, R-134a)		11.8	-0.4
Branched Acid Polyolester (ambient, average for all refrigerants)		9.5†	-34.1
Polyalkylene Glycols (ambient, average for all refrigerants)		8.9	-14.3
Mineral Oils/ Alkylbenzenes (ambient, average for all refrigerants)		7.8	-7.5

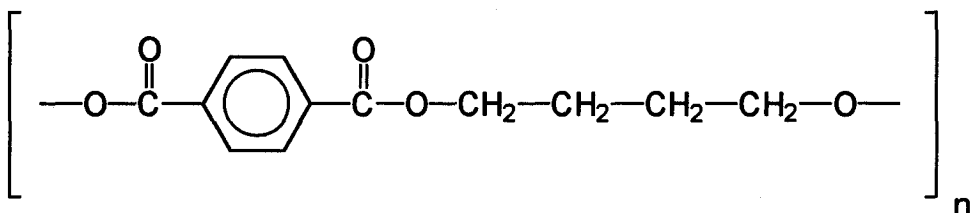
* These values represent percent change relative to ambient test bars, not to control.

† An anomalous value (-15.5% for branched acid polyolester and HFC-134a) has been excluded.

The softening of dehydrated PAEK by branched-acid polyolesters is unexplained. Since PAEK is semicrystalline, the softening may be caused by annealing the part before chemical exposure, rather than by chemical impact.

#	GENERIC NAME	Trade name	Maker
18	POLYBUTYLENE TEREPHTHALATE	Valox 325 PBT	G.E.

Published molecular structure sub-unit:



Introduction and Description

Poly(butylene-terephthalate) (PBT) is a partially crystalline or semicrystalline polycondensation thermoplastic resin, which is obtained from the reaction of 1,4-butanediol with terephthalic acid or dimethyl terephthalate. Because PBT adsorbs moisture and is susceptible to hydrolysis, injection molding of PBT must be done in a very dry environment. PBT is available from different manufacturers in up to nine different viscosity grades, which can be filled with glass fiber, beads, and minerals. Under injection molding conditions, PBT is shear and hydrolytically unstable (chain cleaving); parts molded from PBT can be brittle, but they have good tensile properties. PBT is temperature limited, because its tensile performance is affected by heat. The reported HDT at 1.8 MPa (264 psi) can be 54°C (130°F) for a neat resin with a low inherent viscosity; compared with 121°C (250°F) for one with a higher viscosity. This indicates the importance of resin optimization.

(continued)

POLYBUTYLENE TEREPHTHALATE, continued.

Compatibility Results

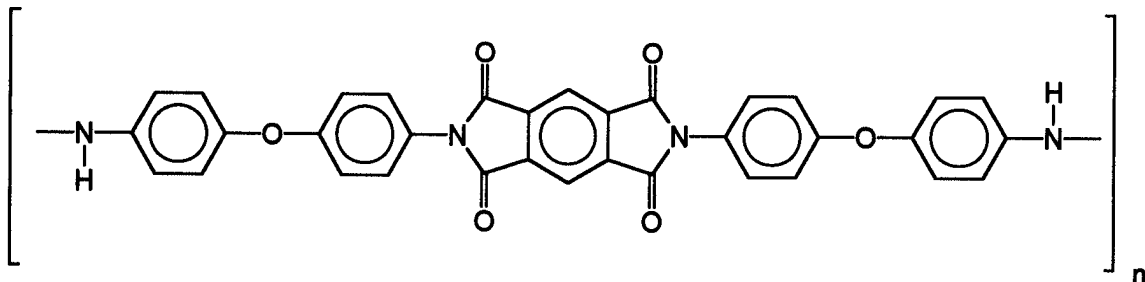
Lubricant	Total Acid Number	% Tensile Change	% Elongation Change
Air		26.9	-90.4
Branched -Acid Polyolester (ambient, no refrigerant)	0.7	-22.4	-96.4
Branched Acid Polyolester (dehydrated, no refrigerant)	0.6	-2.8*	0.0*
Mineral Oil (ambient, R-22)		N/A	N/A
Branched Acid Polyolester (ambient, R-134a)	0.2	-15.0	-88.0
Mixed Acid Polyolester (ambient, R-134a)		-6.8	-93.7
Branched Acid Polyolester (ambient, average for all refrigerants)		16.6	-92.6
Polyalkylene Glycols (ambient, average for all refrigerants)		-2.8	-95.0
Mineral Oils/ Alkylbenzenes (ambient, average for all refrigerants)		-26.6	-75.3

*These values represent change relative to ambient test bars, not to control.

A wide variety of generic grades of PBT are available. This one was chosen as a general example of a wide molecular weight PBT. PBT is sensitive to moisture, heat, and molding conditions. Of all the plastics tested, PBT in particular should have been dried and annealed prior to aging at 150°C (302°F). Dehydrating the part definitely improves its performance. Overall, PBT seems to perform poorly, but this may be attributed to thermal degradation effects, which are clearly documented in the product literature, and the presence of moisture. The quantity of extractables produced in the lubricants is typical for PBT, but can be nearly eliminated by choosing grades with the proper molecular weight and melt index. PBT seems to be softened by mixtures of HFC-134a with 32 ISO VG PAG diol and PAG butyl mono ether with HFC-134a; however, no softening is apparent with HFC-134a and the modified PAG used in this study.

#	GENERIC NAME	Trade name	Maker
19	POLYIMIDE-DF	Vespel-DF	DuPont

Published molecular structure sub-unit:



Introduction and Description

This almost-crystalline polyimide (PI) resin is a condensation polymer of pyromellitic dianhydride and bis-(4-aminophenyl) ether. This non-melting material exhibits continuous use temperatures that exceed 260°C (500°F), with excursions up to 482°C (900°F), as well as excellent lubricated and unlubricated wear. Because PI does not soften completely, thermoplastic molding techniques are not needed. Instead, a small portion of PTFE dispersion is added to the reaction mixture; this becomes an almost fully imidized powder which is filtered from the reaction solvent, washed, dried, densified by compaction, granulated to size and finally compacted under very high pressures. This forms a green part, which is sintered to complete the reaction of imidization cross-linking and part shrinkage. The resulting part is dense (1.34 gm/ml) and has PI's characteristic properties. Directly formed PI parts have several metallic high temperature qualities and very good impact resistance. The typical CFC and HCFC refrigerants and mineral oil lubricants are compatible with PI, although HCFC-22 is known to swell this material minimally. Under standard laboratory conditions of moisture, PI holds moisture only to 0.24% within 24 hours. The reported HDT at 1.8 MPa (264 psi) is 360°C (680°F). PI is available in graphite filled forms, with added Teflon and minimal loss in physical properties, for use in bearing and dynamic seals.

(continued)

POLYIMIDE, continued.

Compatibility Results

Lubricant	Total Acid Number	% Tensile Change	% Elongation Change
Air		0.5	-23.8
Branched -Acid Polyolester (ambient, no refrigerant)	1.9	0.3	-17.7
Branched Acid Polyolester (dehydrated, no refrigerant)	0.7	-1.8*	-8.4*
Mineral Oil (ambient, R-22)		-4.0	-22.0
Branched Acid Polyolester (ambient, R-134a)	0.2	-3.5	-24.6
Mixed Acid Polyolester (ambient, R-134a)		-2.3	-13.3
Branched Acid Polyolester (ambient, average for all refrigerants)		-3.3	-16.2
Polyalkylene Glycols (ambient, average for all refrigerants)		1.1†	-17.2
Mineral Oils/ Alkylbenzenes (ambient, average for all refrigerants)		-4.4	-19.7

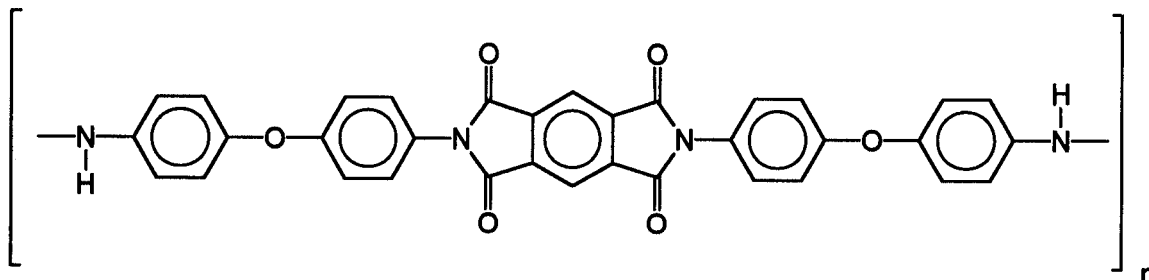
*These values represent change relative to ambient test bars, not to control.

† An anomalous value (-15.4% for modified polyglycol and HFC-143a) has been excluded.

The physicals of this polymer after aging in refrigerant and lubricant are little different from those measured after heating in air. Pure R-22 may have caused some slight swelling, but no dramatic changes occurred. However, the high TAN produced by dehydrated PI, in which water content should be minimal, is of some concern.

#	GENERIC NAME	Trade name	Maker
20	POLYIMIDE-DF-ISO	Vespel-DF -ISO	DuPont

Published molecular structure sub-unit:



Introduction and Description

This polyimide is the same resin as PI (19). The principal differences include a much higher density (1.43 gm/ml), lower reported refrigerant swells, and improved physical characteristics. The formed, green state compact is sintered at nearly identical temperature conditions; the density is improved by under-liquid metal pressurized conditions at sintering temperatures. This material maintains high impact strength, low creep at high temperatures, and very good wear characteristics.

(continued)

POLYIMIDE DF-ISO, continued

Compatibility results

Lubricant	Total Acid Number	% Tensile Change	% Elongation Change
Air		-12.6	-24.1
Branched -Acid Polyolester (ambient, no refrigerant)	1.0	-3.7	-4.8
Branched Acid Polyolester (dehydrated, no refrigerant)	0.3	4.6*	-11.5*
Mineral Oil (ambient, R-22)		-7.1	-14.7
Branched Acid Polyolester (ambient, R-134a)	0.5	-10.9	-26.7
Mixed Acid Polyolester (ambient, R-134a)		-7.0	-8.1
Branched Acid Polyolester (ambient, average for all refrigerants)		-6.4	-21.2
Polyalkylene Glycols (ambient, average for all refrigerants)		-8.0	-17.0
Mineral Oils/ Alkylbenzenes (ambient, average for all refrigerants)		-21.8†	-20.7

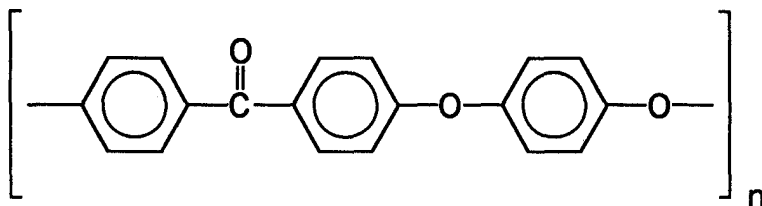
*These values represent change relative to ambient test bars, not to control.

† An anomalous value (67.0% for mineral oil and HCFC-123) has been excluded.

The physicals of this polymer after aging in refrigerant and lubricant are little different from those measured after heating in air. Pure R-22 may have caused some slight swelling but no dramatic changes occurred. However, the high TAN produced by dehydrated PI, in which water content should be minimal, is of some concern.

#	GENERIC NAME	Trade name	Maker
21	POLY(ARYL ETHER ETHER KETONE)	Victrex PEEK 450 G	ICI

Published molecular structure sub-unit



Introduction and Description

Polyaryletheretherketone is a semicrystalline thermoplastic; its chemistry, based on the above repeating unit, is that of a linear aromatic polymer. PEEK is characterized by very good resistance to chemicals, temperature changes, and wear, as well as excellent resistance to hydrolysis. Moisture adsorption is low. Its melting point is 343°C, and its glass transition temperature, T_g is 143°C. Standard unfilled grades of PEEK have a reported HDT of 156°C (315°F) at 1.8 MPa (264 psi), and a UL continuous use temperature of 250°C.

(continued)

POLYARYLETHETHERKETONE , continued.

Compatibility Results

Lubricant	Total Acid Number	% Tensile Change	% Elongation Change
Air		9.5	5.6
Branched -Acid Polyolester (ambient, no refrigerant)	0.2	4.8	-15.0
Branched Acid Polyolester (dehydrated, no refrigerant)	0.2	5.5*	11.1*
Mineral Oil (ambient, R-22)		3.4	-13.7
Branched Acid Polyolester (ambient, R-134a)	0.1	7.0	1.0
Mixed Acid Polyolester (ambient, R-134a)		5.7	-3.2
Branched Acid Polyolester (ambient, average for all refrigerants)		3.5	-14.6
Polyalkylene Glycols (ambient, average for all refrigerants)		3.6	-15.2
Mineral Oils/ Alkylbenzenes (ambient, average for all refrigerants)		0.4	-23.3

* These values represent percent change relative to ambient test bars, not to control.

PEEK shows very good environmental characteristics, but some of the chosen lubricants seem to cause some embrittlement. Annealing and drying the plastic before immersion seems to reduce this effect.

#	GENERIC NAME	Trade name	Maker
22	LIQUID CRYSTAL POLYMER	Xydar MG 450	Amoco

Published molecular structure sub-unit:

NOT PUBLISHED

Introduction and Description

Liquid crystal polymer MG 450 is a mineral-glass filled resin developed for use in complicated and difficult parts; such applications require high density and a balance of flatness, and strength. It is stiff, strong at elevated temperatures, and very resistant to chemicals. LCP-MG 450 has low water adsorption and a reported HDT of 294°C (560°F) at 1.8 MPa (264 psi).

Compatibility Results

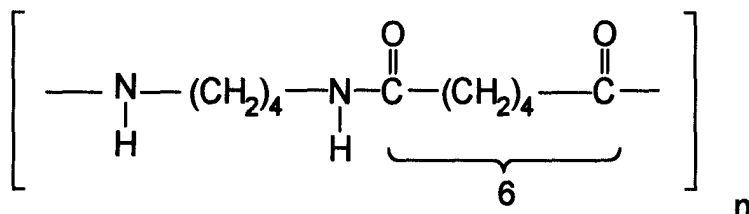
Lubricant	Total Acid Number	% Tensile Change	% Elongation Change
Air		14.6	-13.8
Branched -Acid Polyolester (ambient, no refrigerant)	0.2	21.6	-12.5
Branched Acid Polyolester (dehydrated, no refrigerant)	0.2	-1.2*	6.5*
Mineral Oil (ambient, R-22)		13.7	-1.1
Branched Acid Polyolester (ambient, R-134a)	0.2	15.6	-14.5
Mixed Acid Polyolester (ambient, R-134a)		3.0	0.8
Branched Acid Polyolester (ambient, average for all refrigerants)		13.9	-2.4
Polyalkylene Glycols (ambient, average for all refrigerants)		16.6	-7.5
Mineral Oils/ Alkylbenzenes (ambient, average for all refrigerants)			

* These values represent percent change relative to ambient test bars, not to control.

The differences in TAN between dehydrated and ambient test bars are slight; the differences in tensile and elongation may be caused by annealing. Overall, LCP seems to be one of the polymers most compatible with refrigerants and lubricants, and it appears to be the least affected by heat.

#	GENERIC NAME	Trade name	Maker
23	NYLON 6/6 POLYAMIDE	Zytel 101	DuPont

Published molecular structure sub-unit:



Introduction and Description

Polyamides are condensation polymers designated by the number of carbon atoms in the diamine followed by the number of carbon atoms in the diacid. Nylon 6/6 is the most common nylon and the grade tested here is the general 6/6 grade. It is resistant to non-polar solvents, including aromatic hydrocarbons, esters, and many oils. Nylon can adsorb and be softened by polar materials, such as water, alcohols, glycols, and small polar esters. Nylons can be heat stabilized, hydrolysis stabilized, and alloyed with many different materials that increase impact strength in the dry state. Nylons filled with molybdenum disulfide have improved wear, flexural properties, stiffness, and heat resistance; nylons filled with glass fibers have improved tensile strength and heat distortion temperatures. Dry AS molded, unfilled nylon has an HDT of 75°C (167°F) at 1.8 MPa (264 psia), while glass fiber-filled nylon has an HDT of 251°C (485°F).

NYLON 6/6 POLYAMIDE, continued.

Compatibility Results

Lubricant	Total Acid Number	% Tensile Change	% Elongation Change
Air		-69.3	-96.6
Branched -Acid Polyolester (ambient, no refrigerant)	3.0	30.6	-61.8
Branched Acid Polyolester (dehydrated, no refrigerant)	0.3	-67.2*	-87.3*
Mineral Oil (ambient, R-22)		N/A†	N/A†
Branched Acid Polyolester (ambient, R-134a)	0.9	20.5	-44.1
Mixed Acid Polyolester (ambient, R-134a)		19.6	-55.7
Branched Acid Polyolester (ambient, average for all refrigerants)		18.0	-50.5
Polyalkylene Glycols (ambient, average for all refrigerants)		17.6	-45.1
Mineral Oils/ Alkylbenzenes (ambient, average for all refrigerants)		10.6	-49.7‡

* These values represent percent change relative to ambient test bars, not to control.

† The test bars were destroyed by these conditions.

‡ An anomalous value (177.0% for mineral oil and HCFC-123) has been excluded.

When Nylon 6/6 is heated in air, it becomes brittle due to dehydration and loss of hydrogen bonding. The high moisture adsorption is evident from the high TANs that are reduced with dehydration. Although there is consistent embrittlement, this is always accompanied by an increase in tensile strength. Hydrogen bonding due to refrigerant action may be responsible for this effect.

5. CONCLUSIONS

It seems to be reasonably clear that HFC refrigerants and lubricants have no dramatic effect on the plastic test bars. As expected, most plastics adsorbed some refrigerant and lubricant, which softened the parts slightly. The most prominent observation was the decrease in tensile and elongation due to heating alone. Had this effect not been separately determined, this study would have concluded that the plastics were severely incompatible with lubricants and refrigerants.

The analytical picture presented here would have been clearer and crisper if the tested parts had been annealed and dehydrated before testing, as some of the results seem to be affected either by water present in the test bars or by polar lubricants, which some plastics, such as nylon, absorb.

6. COMPLIANCE WITH AGREEMENT

Imagination Resources, Inc. has complied with all requirements of the agreement.

7. PRINCIPAL INVESTIGATOR EFFORT

The principal investigator has devoted 1980 hours toward the completion of this contract. Technicians and other investigators have worked approximately 2930 hours since the beginning of this project.

APPENDICES

Appendix A: Plastics, Registered Trademarks, and Specifications

**THE ENGINEERING PLASTICS USED IN THIS TESTING PROGRAM ARE
REGISTERED TRADEMARKS, TRADEMARKS, OR ARE NONE OF THE RESPECTIVE MANUFACTURER**

Table A.1

ENGINEERING PLASTIC				REGISTERED TRADEMARK, TRADEMARK, OR NONE
NO.	TRADE NAME	GENERIC NAME	MANUFACTURER	
1	AMODEL AD-1000 HS	POLYPHTHALAMIDE	AMOCO	REGISTERED TRADEMARK
2	CYCOLAC GPM 4700	ACRYLONITRILE-BUTADIENE-STYRENE TERPOLYMER	G.E.	REGISTERED TRADEMARK
3	DELRIN II 11500	ACETAL	DUPONT	REGISTERED TRADEMARK
4	DUREZ	PHENOLIC	HOOKEE	REGISTERED TRADEMARK
5	KYNAR 720	POLYVINYLIDENE FLOURIDE	ATOCHEM	REGISTERED TRADEMARK
6	LEXAN 161	POLYCARBONATE	G.E.	REGISTERED TRADEMARK
7	NORYL 731	MODIFIED POLYPHENYLENE OXIDE	G.E.	REGISTERED TRADEMARK
8	PROFAX 6331 NW	POLYPROPYLENE	HIMONT	TRADEMARK
9	RADEL A-200	POLYARYLSULFONE	AMOCO	REGISTERED TRADEMARK
10	RYNITE 530	POLYETHYLENE TEREPHTHALATE	DUPONT	REGISTERED TRADEMARK
11	SUPEC G401	POLYPHENYLENESULFIDE	G.E.	REGISTERED TRADEMARK
12	TEFLON	POLYTETRAFLUOROETHENE	DUPONT	REGISTERED TRADEMARK
13	TORLON 4203L	POLYAMIDE-IMIDE, HIGH STREHGTH	AMOCO	REGISTERED TRADEMARK
14	TORLON 4301	POLYAMIDE-IMIDE, 12% GRAPHITE	AMOCO	REGISTERED TRADEMARK
15	ULTEM 1000	POLYETHERIMIDE	G.E.	REGISTERED TRADEMARK
16	ULTEM CRS 5001	MODIFIED POLYETHERIMIDE	G.E.	REGISTERED TRADEMARK
17	ULTRAPEK (PAEK)	POLYARYLEETHERKETONE	BASF	REGISTERED TRADEMARK
18	VALOX 325 PBT	POLYBUTYLENE TEREPHTHALATE	G.E.	REGISTERED TRADEMARK
19	VESPEL-DF	POLYIMIDE-DF	DUPONT	REGISTERED TRADEMARK
20	VESPEL-DF-ISO	POLYIMIDE-DF-ISO	DUPONT	REGISTERED TRADEMARK
21	VICTREX PEEK 450G	POLY(ARYLEETHERETHERKETONE)	ICI	TRADEMARK
22	XYDAR MG 450	LIQUID CRYSTAL POLYMER	AMOCO	REGISTERED TRADEMARK
23	ZYTEL 101	66 NYLON, POLYAMIDE	DUPONT	REGISTERED TRADEMARK

**THE SYNTHETIC LUBRICANTS USED IN THIS TESTING PROGRAM ARE
REGISTERED TRADEMARKS, TRADEMARKS, OR ARE NONE OF THE RESPECTIVE MANUFACTURER**

Table A.2

SYNTHETIC LUBRICANT NAME	TYPE	MANUFACTURER	REGISTERED TRADEMARK, TRADEMARK, OR NONE
ALLIED SIGNAL BRL 150	32 ISO VG MODIFIED POLYGLYCOL	ALLIED-SIG.	NONE
B-V RO-15	32 ISO VG MINERAL OIL	BV ASSOC.	NONE
EMERY 2927-A	32 ISO VG BRANCHED ACID POLYOL ESTER	HENKEL	REGISTERED TRADEMARK
EMKARATE RL244	22 ISO VG MIXED-ACID POLYOL ESTER	ICI	TRADEMARK
EMKAROX VG32	32 ISO VG POLYPROPYLENE GLYCOL BUTYL MONO ETHER	ICI	REGISTERED TRADEMARK
POLYGLYCOL P-425	32 ISO VG POLYPROPYLENE GLYCOL DIOL	DOW CHEMICAL	NONE
SHRIEVE ZEROL 150	32 ISO VG ALKYL BENZENE	SHRIEVE CHEM.	REGISTERED TRADEMARK

ENGINEERING PLASTICS MOLDING SPECIFICATIONS AND MOLDING CONDITIONS

Table A.3

Plastic Type/Manufacturer	No.	MANUFACTURER'S SPECIFICATIONS									ACTUAL MOLDING CONDITIONS													
		Drying time (hour)	Drying temp (°F)	Drying temp (°C)	Cylinder temp (°F) Range	Cylinder temp (°C) Range	Injection Pressure (psi)	Injection Pressure (KPa)	Mold temp (°F)	Mold temp (°C)	Drying time (hour)	Drying temp (°F)	Drying temp (°C)	Cylinder temp (°F) Front*	Cylinder temp (°C) Front*	Cylinder temp (°F) Mid*	Cylinder temp (°C) Mid*	Cylinder temp (°F) Rear*	Cylinder temp (°C) Rear*	Cycle time (sec)	Injection Pressure (psi)	Injection Pressure (KPa)	Mold temp (°F)	Mold temp (°C)
Amodel AD - 1000 HS Polyphthalamide/Amoco	1	a	175	79	585-625	307-329	a	a	a	a	14.5	300	149	615	324	600	316	595	313	18	750	5173	180	82
Cyclocac GPM4700 ABS/GE	2	2-4	190-200	88-93	400-475	204-246	8000-20000	55178-137944	120-140	49-60	11	190	88	460	238	455	235	450	232	15	800	5518	120	49
Delrin II -11500 Acetal/DuPont	3	a	a	a	400-440	204-227	10000-16000	68972-110355	180-220	82-104	666	190	88	430	221	425	218	420	216	15	700	4828	180	82
Durez 153 Phenolic/Hooker	4	a	a	a	a	a	a	a	340	171	NR	NR	NR	170	77	170	77	170	77	80	545	3759	355	179
Kynar 720 Polyvinylidene Chloride ATOChem	5	NR	NR	NR	375-450	191-232	MAX	MAX	120-200	49-93	NR	NR	NR	445	229	435	224	435	224	15	700	4828	150	66
Lexan 161 Polycarbonate/GE	6	3-4	250	121	520-570	271-299	12000-20000	82767-137944	a	a	15	300	149	555	291	545	285	535	279	18	1200	8277	110	43
Noryl 731 Polyphenylene ether/GE	7	2-4	230-250	110-121	540-570	282-299	10000-18000	68972-124150	160-210	71-99	11	190	88	560	293	555	291	550	288	15	850	5863	150	66
Plenco 04485 Phenolic/Chem. Eng.	8	a	a	a	a	a	2000-6000	13794-41383	300-360	149-182	NR	NR	NR	170	77	170	77	170	77	80	545	3759	355	179
Profax 6331 NW Polypropylene/Himont	9	a	a	a	a	a	a	a	a	a	NR	NR	NR	415	213	400	204	395	202	15	700	4828	105	41
Radel A-200 Polyaryl Sulfide/Amoco	10	2.5	350	177	650-725	343-385	a	a	280-325	138-163	15	300	149	745	396	735	391	730	388	21	900	6207	305	152
Rynite 530 Polyethylene Terephthalate DuPont	11	2-3	250-275	121-135	555	291	a	a	190-250	88-121	14.5	300	149	550	288	545	285	540	282	20	750	5173	180	82
Supec G401 Polyphenylene Sulfide/GE	12	3-4	285	141	580-630	304-332	a	a	280-320	138-160	14.5	300	149	615	324	600	316	595	313	18	750	5173	180	82
Torlon 4203L Polyamide-imide/Amoco	13	8-24	250-350	121-177	580-650	304-343	MAX	MAX	390-420	199-216	48	350	177	675	357	660	349	650	343	20	1700	11725	425	218
Torlon 4301 Polyamide-imide/Amoco	14	8-24	250-350	121-177	580-650	304-343	MAX	MAX	390-420	199-216	48	350	177	675	357	660	349	650	343	20	1700	11725	450	232
Utem 1000 Polyetherimide/GE	15	4	300	149	660-800	349-427	10000-20000	68972-137944	130-250	54-121	15	300	149	775	427	770	410	765	407	21	1000	6897	255	124
Utem CRS 5001 Polyetherimide/GE	16	4	300	149	660-800	349-427	10000-20000	68972-137944	150-350	66-177	15	300	149	775	413	770	410	765	407	21	1000	6897	255	124
Ultrapak Polyetherketone/BASF	17	a	a	a	716-788	380-420	a	a	a	a	14	250	121	765	407	755	402	745	396	19	800	5518	375	191
Valox 325 PBT Polyethylene Terephthalate General Electric	18	3-4	250	121	455-480	235-249	8000-10000	55178-68972	60-150	16-66	11	190	88	480	249	475	246	470	243	15	900	6207	110	43
Victrax PEEK 450G Polyetheretherketone/ICI	19	3	300	149	698	370-420	10000-20300	68972-140013	356-374	180-190	15	300	149	725	385	715	379	710	377	25	1100	7587	362	183
Xydar MG 450 Liquid crystal polymer/Amoco	20	8	300	149	660-730	349-389	a	a	180-220	82-104	14.5	300	149	715	379	710	377	705	374	15	900	6207	190	88
Zytel 101 Nylon 6/6 DuPont	21	24	175	79	550-590	289-310	5000-20000	34486-137944	210-250	99-121	14.5	300	149	550	288	545	285	540	282	20	650	4483	180	82

NR = not required

a = not specified by manufacturer

* temperature was measured at the three cylinders (barrel) zones indicated, some plastics required slightly higher barrel temperatures for best cavity fill and density

Appendix B: Dimensional Changes from Lubricant Immersions

CHANGES IN PLASTICS IMMERSSED IN 32 ISO VG MINERAL OIL

Table B.1

NO.	TYPE	Temp (°C) ^a	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average % Length Change ^c	Average % Width Change ^c	Average % Thickness Change ^c	Average % Weight Change ^c
1	POLYPHTHALAMIDE	60	0	0	0	0	CREAM/FAINT GREEN	-0.03	-0.14	0.00	-0.11
		100	0	0	0	0	NONE	-0.59	-0.54	0.00	-0.34
2	ABS	60	0	0	0	0	NONE	-0.08	-0.32	0.00	-0.06
		100	0	0	0	0	CREAM/WHITE COAT	-1.91	5.75	10.05	14.40
3	ACETAL	60	0	0	0	0	NONE	-0.13	0.14	0.00	-0.17
		100	0	0	0	0	NONE	-0.28	-0.41	0.79	-0.21
4	PHENOLIC	60	0	0	0	0	NONE	-0.07	0.14	0.38	-0.44
		100	0	0	0	0	NONE	-0.38	-0.81	-0.38	-2.51
5	POLYVINYLIDENE FLUORIDE	60	0	0	0	0	NONE	-0.04	-0.27	0.40	-0.05
		100	0	0	0	0	LUCITE/YELLOW TINT	-0.16	-0.14	0.00	0.00
6	POLYCARBONATE	60	0	0	0	0	NONE	-0.07	-0.11	0.31	0.03
		100	0	0	0	0	NONE	-0.09	-0.68	-0.61	0.03
7	MODIFIED POLYPHENYLENE OXID	60	0	0	0	0	NONE	-0.17	-0.69	-0.62	0.15
		100	0	0	0	0	GREY/WHITE COAT	-0.14	-0.05	1.24	2.38
8	POLYPROPYLENE	60	0	0	0	0	NONE	0.40	-0.14	0.78	1.59
		100	0	0	0	0	NONE	-0.09	2.44	2.34	10.44
9	POLYARYL SULFONE	60	0	0	0	0	NONE	0.01	-0.40	0.00	0.09
		100	0	0	0	0	NONE	-0.01	0.00	-0.38	0.06
10	POLYETHYLENE TEREPHTHALATE	60	0	0	0	0	NONE	0.01	-0.40	-0.78	0.02
		100	0	0	0	0	NONE	-0.01	0.13	-0.39	-0.09
11	POLYPHENYLENESULFIDE	60	0	0	0	0	NONE	-0.03	-0.27	-0.62	0.01
		100	0	0	0	0	CHOCOLATE/LIGHTER	-0.10	-0.53	-0.47	-0.01
12	POLYTETRAFLUOROETHYLENE	60	0	0	0	0	NONE	0.02	-0.40	0.39	0.12
		100	0	0	0	0	NONE	0.02	0.52	-1.49	0.03
13	POLYAMIDE-IMIDE	60	0	0	0	0	NONE	-0.03	0.40	0.39	0.20
		100	0	0	0	0	NONE	0.00	0.00	1.15	0.15
14	POLYAMIDE-IMIDE	60	0	0	0	0	NONE	-0.04	-0.53	-1.51	0.16
		100	0	0	0	0	NONE	-0.14	-0.13	0.00	0.19
15	POLYETHERIMIDE	60	0	0	0	0	NONE	-0.09	-0.32	0.00	0.01
		100	0	0	0	0	NONE	-0.02	-0.16	0.00	0.02
16	MODIFIED POLYETHERIMIDE	60	0	0	0	0	NONE	0.01	-0.43	0.16	0.09
		100	0	0	0	0	NONE	-0.06	-0.69	0.00	0.01
17	POLYARYLEETHERKETONE	60	0	0	0	0	NONE	-0.01	0.00	0.78	0.04
		100	0	0	0	0	NONE	0.00	0.00	-1.15	-0.11
18	POLYBUTYLENE TEREPHTHALATE	60	0	0	0	0	NONE	-0.07	-0.38	0.01	0.06
		100	0	0	0	0	NONE	-0.26	-0.22	0.00	0.05
19	POLYIMIDE-DF	60	0	0	0	0	NONE	0.04	0.00	0.96	0.07
		100	0	0	0	0	NONE	0.00	-0.15	0.96	0.02
20	POLYIMIDE-DF-ISO	60	0	0	0	0	NONE	-0.03	-0.45	0.00	-0.08
		100	1	0	0	0	NONE	-0.03	-0.45	0.00	-0.25
21	POLY(ARYLEETHERETHERKETONE)	60	0	0	0	0	NONE	0.00	-0.40	0.00	0.03
		100	0	0	0	0	NONE	-0.01	-0.40	-0.77	-0.03
22	LIQUID CRYSTAL POLYMER	60	0	0	0	0	NONE	0.01	-0.53	0.00	-0.03
		100	0	0	0	0	NONE	0.00	-0.27	0.00	-0.03
23	66 NYLON, POLYAMIDE	60	0	0	0	0	NONE	0.03	0.14	-0.78	-0.04
		100	0	0	0	0	NONE	-0.20	-0.41	-1.16	0.03

^a Temperature conversions: 60°C = 140°F, 100°C = 212°F

^b Qualitative scale: 0=no change, 1=slight, 2=large, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

CHANGES IN PLASTICS IMMERSSED IN 32 ISO VG MODIFIED POLYGLYCOL

Table B.2

NO.	TYPE	Temp (°C) ^a	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average % Length Change ^c	Average % Width Change ^c	Average % Thickness Change ^c	Average % Weight Change ^c
1	POLYPHTHALAMIDE	60	0	0	0	0	NONE	-0.143	-0.541	0.000	-0.314
		100	0	0	0	0	CREAM/BURNT CREAM	-0.544	-0.540	0.000	-0.779
2	ABS	60	0	0	0	0	NONE	-0.097	0.000	0.468	-0.104
		100	0	0	0	0	NONE	-3.518	0.214	1.249	-0.109
3	ACETAL	60	0	0	0	0	NONE	-0.160	-0.274	0.000	-0.171
		100	0	0	0	0	WHITE/OFF WHITE	-0.335	-0.274	0.000	-0.383
4	PHENOLIC	60	0	0	0	0	NONE	-0.413	-0.538	-0.763	-2.373
		100	0	0	0	0	NONE	-0.370	-0.405	-1.148	-2.279
5	POLYVINYLIDENE FLUORIDE	60	0	0	0	0	NONE	-0.102	-0.541	-0.394	-0.008
		100	0	0	0	0	LUCITE/CREAM	-0.204	-0.407	-0.787	-0.010
6	POLYCARBONATE	60	0	0	0	0	NONE	-0.080	-0.267	0.000	-0.059
		100	0	0	0	0	NONE	-0.074	-0.534	-0.154	-0.076
7	MODIFIED POLYPHENYLENE OXIDE	60	0	0	0	0	NONE	-0.103	-0.268	0.001	0.115
		100	0	0	0	0	NONE	-0.143	-0.589	0.000	0.075
8	POLYPROPYLENE	60	0	0	0	0	NONE	-0.158	-0.542	-0.781	-0.018
		100	0	0	0	0	LUCITE/MORE GRAY	-0.129	-0.406	-0.391	0.120
9	POLYARYL SULFONE	60	0	0	0	0	NONE	-0.085	-0.401	0.000	-0.375
		100	0	0	0	0	NONE	-0.128	-0.267	0.388	-0.414
10	POLYETHYLENE TEREPHTHALATE	60	0	0	0	0	NONE	-0.071	0.134	0.781	-0.051
		100	0	0	0	0	LIGHT TAN/PALE TAN	-0.057	-0.535	0.391	-0.125
11	POLYPHENYLENESULFIDE	60	0	0	0	0	NONE	-0.028	-0.374	-0.624	-0.011
		100	0	0	0	0	NONE	-0.091	-0.321	0.624	-0.025
12	POLYTETRAFLUOROETHYLENE	60	0	0	0	0	NONE	-0.040	0.416	-1.553	0.099
		100	0	0	0	0	NONE	-0.080	-0.312	-1.517	0.311
13	POLYAMIDE-IMIDE	60	0	0	0	0	NONE	0.029	0.000	0.769	0.329
		100	0	0	0	0	NONE	-0.014	0.000	1.154	0.172
14	POLYAMIDE-IMIDE	60	0	0	0	0	NONE	0.014	0.269	0.766	0.213
		100	0	0	0	0	NONE	-0.085	0.268	-1.493	0.080
15	POLYETHERIMIDE	60	0	0	0	0	NONE	-0.028	-0.428	-0.002	-0.165
		100	0	0	0	0	NONE	-0.023	-1.306	1.090	-0.179
16	MODIFIED POLYETHERIMIDE	60	0	0	0	0	NONE	-0.017	-0.268	0.314	-0.144
		100	0	0	0	0	NONE	-0.063	-0.268	0.629	-0.288
17	POLYARYLEETHERKETONE	60	0	0	0	0	NONE	-0.014	0.136	1.157	-0.097
		100	0	0	0	0	NONE	-0.029	0.136	0.388	-0.194
18	POLYBUTYLENE TEREPHTHALATE	60	0	0	0	0	NONE	-0.115	-0.594	0.153	-0.080
		100	0	0	0	0	NONE	-0.271	-0.377	0.157	-0.135
19	POLYIMIDE-DF	60	0	0	0	0	NONE	0.000	-0.149	-0.943	-0.265
		100	0	0	0	0	NONE	-0.015	-0.149	-0.476	-0.325
20	POLYIMIDE-DF-ISO	60	0	0	0	0	NONE	1.443	0.152	-0.472	-0.439
		100	0	0	0	0	NONE	-0.059	-0.151	-0.467	-0.593
21	POLY(ARYLEETHERETHERKETONE)	60	0	0	0	0	NONE	-0.014	-0.135	0.000	-0.078
		100	0	0	0	0	NONE	-0.029	-0.134	0.000	-0.088
22	LIQUID CRYSTAL POLYMER	60	0	0	0	0	NONE	-0.014	-0.668	0.000	-0.001
		100	0	0	0	0	NONE	0.014	-0.535	-0.388	-0.058
23	66 NYLON, POLYAMIDE	60	0	0	0	0	NONE	-0.187	-0.271	-0.391	-0.298
		100	0	0	0	0	YELLOW CREAM/BROWN	-0.245	-0.542	0.000	-0.526

^a Temperature conversions: 60°C = 140°F, 100°C = 212°F

^b Qualitative scale: 0=no change, 1=slight, 2=large, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

CHANGES IN PLASTICS IMMERSSED IN 32 ISO VG POLYPROPYLENE GLYCOL DIOL

Table B.3

NO.	TYPE	Temp (°C) ^a	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average % Length Change ^c	Average % Width Change ^c	Average % Thickness Change ^c	Average % Weight Change ^c
1	POLYPHTHALAMIDE	60	0	0	0	0	CREAM/GREEN TINT	-0.14	-0.41	-0.39	-0.43
		100	0	0	0	0	NONE	-0.49	-0.27	-0.39	-0.66
2	ABS	60	0	0	0	0	NONE	-0.06	-0.11	0.16	-0.12
		100	2	0	0	0	NONE	-1.73	0.05	3.42	3.91
3	ACETAL	60	0	0	0	0	NONE	-0.12	-0.27	0.00	-0.17
		100	0	0	0	0	WHITE/OFF WHITE	0.28	-0.27	0.79	0.47
4	PHENOLIC	60	0	0	0	0	NONE	-0.14	-0.40	-0.77	-1.41
		100	0	0	0	0	NONE	-0.47	-1.07	-1.15	-2.96
5	POLYVINYLIDENE FLUORIDE	60	0	0	0	0	NONE	0.04	0.14	-0.39	-0.01
		100	0	0	0	0	LUCITE/OFF WHITE	0.12	0.27	0.00	0.26
6	POLYCARBONATE	60	0	0	0	0	CLEAR/CLOUDY	-0.03	-0.32	-0.15	-0.07
		100	0	0	0	0	CLEAR/CLOUDY	-0.08	0.16	1.37	1.24
7	MODIFIED POLYPHENYLENE OXIDE	60	0	0	0	0	NONE	-0.04	-0.43	0.63	0.00
		100	0	0	0	0	NONE	-0.14	-0.21	0.94	0.04
8	POLYPROPYLENE	60	0	0	0	0	NONE	-0.01	0.00	-0.39	2.75
		100	0	0	0	0	NONE	-0.01	-0.27	-0.78	0.34
9	POLYARYL SULFONE	60	0	0	0	0	NONE	-0.09	0.13	0.00	-0.48
		100	0	0	0	0	NONE	-0.10	-0.40	0.00	-0.46
10	POLYETHYLENE TEREPHTHALATE	60	0	0	0	0	NONE	-0.01	0.00	0.00	-0.11
		100	0	0	0	0	NONE	-0.04	-0.27	-0.39	-0.06
11	POLYPHENYLENESULFIDE	60	0	0	0	0	NONE	0.00	-0.32	0.31	-0.04
		100	0	0	0	0	NONE	-0.07	-0.16	0.16	-0.06
12	POLYTETRAFLUOROETHYLENE	60	0	0	0	0	NONE	-0.02	-0.10	-1.19	0.02
		100	0	0	0	0	NONE	0.30	0.10	-1.96	0.03
13	POLYAMIDE-IMIDE	60	0	0	0	0	NONE	-0.01	-0.13	1.16	0.10
		100	0	0	0	0	NONE	0.00	0.13	0.01	0.18
14	POLYAMIDE-IMIDE	60	0	0	0	0	NONE	0.01	0.00	-0.01	0.09
		100	0	0	0	0	NONE	-0.03	-0.27	-1.51	0.09
15	POLYETHERIMIDE	60	0	0	0	0	NONE	-0.01	-0.16	0.63	-0.24
		100	0	0	0	0	NONE	-0.01	-0.21	0.31	-0.23
16	MODIFIED POLYETHERIMIDE	60	0	0	0	0	NONE	-0.02	-0.37	0.63	-0.25
		100	0	0	0	0	NONE	-0.04	-0.21	0.16	-0.26
17	POLYARYLEETHERKETONE	60	0	0	0	0	NONE	0.01	0.00	-0.39	-0.14
		100	0	0	0	0	NONE	-0.06	-0.14	1.17	-0.16
18	POLYBUTYLENE TEREPHTHALATE	60	0	0	0	0	NONE	-0.05	-0.22	-0.46	-0.17
		100	0	0	0	0	NONE	-0.14	-0.59	-0.61	0.03
19	POLYIMIDE-DF	60	0	0	0	0	NONE	-0.03	-0.30	-0.93	-0.33
		100	0	0	0	0	NONE	0.00	0.00	0.00	-0.29
20	POLYIMIDE-DF-ISO	60	0	0	0	0	NONE	-0.04	-0.15	-0.47	-0.49
		100	0	0	0	0	NONE	-0.06	-0.15	-1.41	-0.62
21	POLY(ARYLEETHERETHERKETONE)	60	0	0	0	0	NONE	-0.10	-0.14	0.00	-0.08
		100	0	0	0	0	NONE	-0.03	-0.27	-0.78	-0.08
22	LIQUID CRYSTAL POLYMER	60	0	0	0	0	NONE	0.03	-0.27	0.00	-0.01
		100	0	0	0	0	NONE	0.01	-0.13	0.00	-0.05
23	66 NYLON, POLYAMIDE	60	0	0	0	0	YELLOW CREAM/YELLOW	-0.19	-0.54	0.00	-0.45
		100	0	0	0	0	YELLOW CREAM/YELLOW	-0.23	-0.41	-0.39	-0.50

^a Temperature conversions: 60°C = 140°F, 100°C = 212

^b Qualitative scale: 0=no change, 1=slight, 2=large, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

CHANGES IN PLASTICS IMMERSSED IN 32 ISO VG BRANCHED ACID POLYOLESTER

Table B.4

NO.	TYPE	Temp (°C) ^a	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average % Length Change ^c	Average % Width Change ^c	Average % Thickness Change ^c	Average % Weight Change ^c
1	POLYPHTHALAMIDE	60	0	0	0	0	CREAM/GREEN TINT	-0.03	0.135	0.000	0.006
		100	0	0	0	0	CREAM/DULL CREAM	-0.49	-0.135	0.391	-0.263
2	ABS	60	0	0	0	0	NONE	-0.119	-0.053	-0.463	-0.099
		100	0	0	0	0	CREAM/FLESH CREAM	-2.231	0.748	5.451	5.319
3	ACETAL	60	0	0	0	0	NONE	-0.044	0.137	0.787	-0.114
		100	0	0	0	0	NONE	-0.160	0.000	0.394	-0.221
4	PHENOLIC	60	0	0	0	0	NONE	-0.100	-0.402	-0.382	-0.740
		100	0	0	0	0	NONE	-0.527	-0.270	0.003	-3.182
5	POLYVINYLIDENE FLUORIDE	60	0	0	0	0	NONE	0.058	0.272	0.000	0.000
		100	0	0	0	0	NONE	-0.058	-0.135	0.000	0.143
6	POLYCARBONATE	60	0	0	0	0	NONE	-0.028	-0.801	0.000	0.009
		100	0	0	0	0	NONE	-0.057	-1.181	0.000	0.777
7	MODIFIED POLYPHENYLENE OXIDE	60	0	0	0	0	NONE	0.000	0.536	0.394	-0.010
		100	0	0	0	0	GRAY/CLOUDY GRAY	-0.100	0.134	1.169	0.568
8	POLYPROPYLENE	60	0	0	0	0	NONE	0.029	0.410	0.787	0.073
		100	0	0	0	0	NONE	0.705	0.407	0.000	2.625
9	POLYARYL SULFONE	60	0	0	0	0	NONE	0.000	-0.401	-0.388	0.030
		100	0	0	0	0	NONE	-0.014	-0.133	-0.772	-0.122
10	POLYETHYLENE TEREPHTHALATE	60	0	0	0	0	NONE	-0.028	0.404	-0.388	-0.032
		100	0	0	0	0	NONE	-0.028	0.000	-0.778	-0.083
11	POLYPHENYLENESULFIDE	60	0	0	0	0	NONE	0.000	0.268	0.944	-0.023
		100	0	0	0	0	NONE	-0.102	0.214	0.001	-0.009
12	POLYTETRAFLUOROETHYLENE	60	0	0	0	0	NONE	0.140	1.140	0.000	0.004
		100	0	0	0	0	NONE	0.180	0.403	0.442	0.629
13	POLYAMIDE-IMIDE	60	0	0	0	0	NONE	-0.029	0.135	0.000	0.251
		100	0	0	0	0	NONE	0.000	0.135	1.163	0.048
14	POLYAMIDE-IMIDE	60	0	0	0	0	NONE	0.029	0.135	-0.382	0.224
		100	0	0	0	0	NONE	-0.043	0.134	0.382	0.052
15	POLYETHERIMIDE	60	0	0	0	0	NONE	-0.091	-0.641	0.314	-0.045
		100	0	0	0	0	NONE	-0.034	-0.214	0.000	-0.131
16	MODIFIED POLYETHERIMIDE	60	0	0	0	0	NONE	-0.028	-0.428	0.156	0.006
		100	0	0	0	0	NONE	-0.080	-0.106	0.469	-0.040
17	POLYARYLEETHERKETONE	60	0	0	0	0	NONE	-0.014	-0.001	0.794	-0.135
		100	0	0	0	0	NONE	-0.058	-0.001	0.000	-0.199
18	POLYBUTYLENE TEREPHTHALATE	60	0	0	0	0	NONE	0.023	0.054	-0.429	-0.022
		100	0	0	0	0	NONE	-0.184	-0.054	0.308	-0.067
19	POLYIMIDE-DF	60	0	0	0	0	NONE	0.015	0.000	0.000	0.064
		100	0	0	0	0	NONE	0.029	-0.149	0.962	-0.154
20	POLYIMIDE-DF-ISO	60	0	0	0	0	NONE	-0.015	0.000	-0.476	-0.298
		100	0	0	0	0	NONE	-0.074	0.000	0.485	-0.613
21	POLY(ARYLEETHERETHERKETONE)	60	0	0	0	0	NONE	0.000	-0.270	-0.385	0.030
		100	0	0	0	0	NONE	-0.057	0.000	-0.772	0.007
22	LIQUID CRYSTAL POLYMER	60	0	0	0	0	NONE	0.042	0.135	0.391	-0.008
		100	0	0	0	0	NONE	-0.014	0.403	0.000	-0.020
23	66 NYLON, POLYAMIDE	60	0	0	0	0	NONE	0.000	0.000	-1.136	0.027
		100	0	0	0	0	YELLOW CREAM/DARKER	-0.173	-0.135	0.000	-0.147

^a Temperature conversions: 60°C = 140°F, 100°C = 212°F

^b Qualitative scale: 0=no change, 1=slight, 2=large, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

CHANGES IN PLASTICS IMMERSSED IN 22 ISO VG MIXED-ACID POLYOLESTER

Table B.5

NO.	TYPE	Temp (°C) ^a	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average % Length Change ^c	Average % Width Change ^c	Average % Thickness Change ^c	Average % Weight Change ^c
1	POLYPHTHALAMIDE	60	0	0	0	0	CREAM/GREEN TINT	-0.19	-0.27	-0.39	-0.32
		100	0	0	0	0	CREAM/GREEN TINT	-0.07	-0.27	-0.39	-0.79
2	ABS	60	0	0	0	0	CREAM/WHITE FILM	-0.10	-0.16	0.62	-0.03
		100	2	0	0	0	CREAM/OFF WHITE	-2.11	2.51	10.56	13.17
3	ACETAL	60	0	0	0	0	NONE	-0.23	-0.41	0.00	-0.24
		100	0	0	0	0	NONE	-0.23	-0.14	0.39	-0.26
4	PHENOLIC	60	0	0	0	0	NONE	-0.10	-0.13	-0.38	-0.76
		100	0	0	0	0	NONE	-0.51	0.13	-0.77	-2.92
5	POLYVINYLIDENE FLUORIDE	60	0	0	0	0	NONE	-0.10	-0.41	0.79	-0.01
		100	0	0	0	0	NONE	-0.10	-0.54	0.79	0.07
6	POLYCARBONATE	60	0	0	0	0	NONE	-0.09	-0.21	-0.15	-0.02
		100	0	0	0	0	CLEAR/FOGGY	-0.07	-0.42	1.53	0.80
7	MODIFIED POLYPHENYLENE OXID	60	0	0	0	0	NONE	-0.06	-0.32	1.25	0.13
		100	0	0	0	0	NONE	-0.11	0.21	2.34	1.91
8	POLYPROPYLENE	60	0	0	0	0	NONE	-0.06	-0.54	0.39	0.28
		100	0	0	0	0	NONE	0.49	0.14	0.39	1.97
9	POLYARYL SULFONE	60	0	0	0	0	NONE	-0.04	-0.67	-0.38	-0.29
		100	0	0	0	0	NONE	0.04	-0.40	0.00	-0.52
10	POLYETHYLENE TEREPHTHALATE	60	0	0	0	0	NONE	-0.01	-0.40	-0.39	-0.09
		100	0	0	0	0	NONE	-0.01	-0.54	-0.39	-0.15
11	POLYPHENYLENESULFIDE	60	0	0	0	0	NONE	-0.01	-0.27	-0.16	0.00
		100	0	0	0	0	CHOCOLATE/LIGHTER	-0.07	-0.37	0.16	-0.01
12	POLYTETRAFLUOROETHYLENE	60	0	0	0	0	NONE	-0.04	0.00	-1.25	0.22
		100	0	0	0	0	NONE	0.08	0.00	0.00	0.04
13	POLYAMIDE-IMIDE	60	0	0	0	0	NONE	0.00	0.27	1.16	0.25
		100	0	0	0	0	NONE	0.01	0.00	-0.38	0.11
14	POLYAMIDE-IMIDE	60	0	0	0	0	NONE	0.00	0.00	0.38	0.17
		100	0	0	0	0	NONE	0.00	0.00	-0.38	0.08
15	POLYETHERIMIDE	60	0	0	0	0	NONE	-0.03	-0.48	0.63	-0.07
		100	0	0	0	0	NONE	-0.09	-0.43	0.00	-0.12
16	MODIFIED POLYETHERIMIDE	60	0	0	0	0	NONE	-0.05	-0.32	-0.31	-0.12
		100	0	0	0	0	NONE	-0.08	-0.53	0.16	-0.17
17	POLYARYLEETHERKETONE	60	0	0	0	0	NONE	-0.01	-0.14	0.78	-0.23
		100	0	0	0	0	NONE	0.00	0.14	0.39	-0.19
18	POLYBUTYLENE TEREPHTHALATE	60	0	0	0	0	NONE	-0.16	-0.32	0.16	-0.05
		100	0	0	0	0	NONE	-0.30	-0.65	0.00	-0.10
19	POLYIMIDE-DF	60	0	0	0	0	NONE	-0.04	-0.15	-1.43	-0.22
		100	0	0	0	0	NONE	-0.03	0.00	-0.47	-0.32
20	POLYIMIDE-DF-ISO	60	0	0	0	0	NONE	-0.06	-0.15	-0.48	-0.41
		100	0	0	0	0	NONE	-0.07	-0.15	-0.95	-0.56
21	POLY(ARYLEETHERETHERKETONE)	60	0	0	0	0	NONE	0.01	-0.54	-0.39	-0.06
		100	0	0	0	0	NONE	-0.01	-0.40	0.39	-0.09
22	LIQUID CRYSTAL POLYMER	60	0	0	0	0	NONE	0.03	0.00	-0.39	-0.01
		100	0	0	0	0	NONE	0.00	-0.13	0.00	-0.06
23	66 NYLON, POLYAMIDE	60	0	0	0	0	NONE	-0.13	-0.41	-0.39	-0.25
		100	0	0	0	0	NONE	-0.29	-0.27	-0.39	-0.63

^a Temperature conversions: 60°C = 140°F, 100°C = 212°F

^b Qualitative scale: 0=no change, 1=slight, 2=large, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

CHANGES IN PLASTICS IMMERSSED IN 32 ISO VG POLYPROPYLENE GLYCOL BUTYL MONO ETHER

Table B.6

NO.	TYPE	Temp (°C) ^a	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average % Length Change ^c	Average % Width Change ^c	Average % Thickness Change ^c	Average % Weight Change ^c
1	POLYPHTHALAMIDE	60	0	0	0	0	CREAM/GREEN TINT	-0.04	-0.13	0.00	-0.02
		100	0	0	0	0	CREAM/DULL CREAM	-0.40	-0.27	0.00	-0.37
2	ABS	60	0	0	0	0	NONE	-0.13	-0.32	0.16	-0.14
		100	0	0	0	0	CREAM/FLESH	-4.14	0.21	0.46	0.11
3	ACETAL	60	0	0	0	0	NONE	-0.06	-0.06	0.00	-0.12
		100	0	0	0	0	NONE	-0.19	-0.14	0.00	-0.25
4	PHENOLIC	60	0	0	0	0	NONE	-0.31	-0.14	-0.38	-2.01
		100	0	0	0	0	NONE	-0.37	-0.54	-0.76	-2.00
5	POLYVINYLIDENE FLUORIDE	60	0	0	0	0	NONE	0.06	-0.14	0.00	-0.01
		100	0	0	0	0	LUCITE/DULLER	-0.07	-0.14	-0.39	0.02
6	POLYCARBONATE	60	0	0	0	0	NONE	-0.11	-0.27	-0.74	0.18
		100	0	0	0	0	NONE	-0.13	-0.32	0.30	0.20
7	MODIFIED POLYPHENYLENE OXIDE	60	0	0	0	0	NONE	-0.13	0.11	0.63	0.00
		100	0	0	0	0	GRAY/CLOUDY	-0.07	0.43	1.25	0.85
8	POLYPROPYLENE	60	0	0	0	0	NONE	0.98	0.00	0.00	0.02
		100	0	0	0	0	NONE	0.22	0.14	0.00	0.40
9	POLYARYL SULFONE	60	0	0	0	0	NONE	0.01	-0.67	-0.38	-0.08
		100	0	0	0	0	NONE	0.04	-0.40	-0.39	-0.06
10	POLYETHYLENE TEREPHTHALATE	60	0	0	0	0	NONE	-0.01	0.00	0.00	-0.01
		100	0	0	0	0	NONE	-0.06	0.00	0.00	-0.08
11	POLYPHENYLENESULFIDE	60	0	0	0	0	NONE	0.00	0.05	0.31	-0.03
		100	0	0	0	0	CHOCOLATE/LIGHTER	-0.10	0.05	0.31	-0.01
12	POLYTETRAFLUOROETHYLENE	60	0	0	0	0	NONE	0.08	0.51	0.38	0.04
		100	0	0	0	0	NONE	0.30	0.00	1.64	1.19
13	POLYAMIDE-IMIDE	60	0	0	0	0	NONE	0.00	0.14	0.77	0.05
		100	0	0	0	0	NONE	0.03	0.13	0.00	0.07
14	POLYAMIDE-IMIDE	60	0	0	0	0	NONE	0.01	0.13	0.00	0.13
		100	0	0	0	0	NONE	0.01	0.40	-0.76	0.12
15	POLYETHERIMIDE	60	0	0	0	0	NONE	-0.01	-0.27	-0.31	0.43
		100	0	0	0	0	NONE	-0.10	-0.32	-0.15	-0.01
16	MODIFIED POLYETHERIMIDE	60	0	0	0	0	NONE	0.01	-0.16	-0.31	-0.05
		100	0	0	0	0	NONE	-0.03	-0.32	0.16	-0.05
17	POLYARYLEETHERKETONE	60	0	0	0	0	NONE	-0.01	0.00	0.39	-0.15
		100	0	0	0	0	NONE	-0.01	0.00	-1.15	-0.16
18	POLYBUTYLENE TEREPHTHALATE	60	0	0	0	0	NONE	-0.06	0.11	0.00	-0.05
		100	0	0	0	0	NONE	-0.18	-0.05	0.30	-0.05
19	POLYIMIDE-DF	60	0	0	0	0	NONE	0.01	0.30	0.00	-0.04
		100	0	0	0	0	NONE	0.00	-0.15	1.44	-0.11
20	POLYIMIDE-DF-ISO	60	0	0	0	0	NONE	-0.04	-0.15	1.46	-0.56
		100	0	0	0	0	NONE	-0.03	0.00	-1.43	-0.34
21	POLY(ARYLEETHERETHERKETONE)	60	0	0	0	0	NONE	-0.01	-0.13	-0.77	0.00
		100	0	0	0	0	NONE	-0.03	0.00	0.00	0.00
22	LIQUID CRYSTAL POLYMER	60	0	0	0	0	NONE	0.06	0.27	0.00	-0.01
		100	0	0	0	0	NONE	0.00	-0.13	0.39	-0.02
23	66 NYLON, POLYAMIDE	60	0	0	0	0	NONE	-0.03	-0.14	0.00	-0.03
		100	0	0	0	0	NONE	-0.14	-0.14	-0.78	-0.18

^a Temperature conversions: 60°C = 140°F, 100°C = 212

^b Qualitative scale: 0=no change, 1=slight, 2=large, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

CHANGES IN PLASTICS IMMERSSED IN 32 ISO VG ALKYL BENZENE

Table B.7

NO.	TYPE	Temp (°C) ^a	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average % Length Change ^c	Average % Width Change ^c	Average % Thickness Change ^c	Average % Weight Change ^c
1	POLYPHTHALAMIDE	60	0	0	0	0	CREAM/GEEEN TINT	-0.09	-0.27	0.00	-0.08
		100	0	0	0	0	NONE	-0.69	-0.27	-0.39	-0.51
2	ABS	60	0	0	0	0	NONE	-0.09	-0.13	0.78	-0.13
		100	1	0	0	0	CREAM/OFF WHITE ENDS	-2.69	3.07	3.40	5.57
3	ACETAL	60	0	0	0	0	NONE	-0.22	-0.68	0.00	-0.15
		100	0	0	0	0	NONE	-0.57	-0.55	0.39	-0.58
4	PHENOLIC	60	0	0	0	0	NONE	-0.01	-0.27	0.00	-0.15
		100	0	0	0	0	NONE	-0.40	-0.54	0.00	-2.62
5	POLYVINYLIDENE FLUORIDE	60	0	0	0	0	NONE	2.90	1.22	0.40	2.96
		100	0	0	0	0	LUCITE/YELLOW TINT	2.83	1.49	-1.50	2.82
6	POLYCARBONATE	60	0	0	0	0	NONE	-0.09	-0.05	-0.15	0.02
		100	0	0	0	0	NONE	-0.12	0.11	0.16	0.02
7	MODIFIED POLYPHENYLENE OXID	60	0	0	0	0	NONE	-0.08	-0.16	0.00	0.07
		100	0	0	0	0	GREY/WHITE COAT	-0.01	1.23	5.46	5.49
8	POLYPROPYLENE	60	0	0	0	0	NONE	0.40	0.14	-4.44	1.53
		100	0	0	0	0	NONE	2.83	3.12	3.18	8.83
9	POLYARYL SULFONE	60	0	0	0	0	NONE	0.01	-0.53	0.78	0.40
		100	0	0	0	0	NONE	0.03	-0.40	0.78	0.09
10	POLYETHYLENE TEREPHTHALATE	60	0	0	0	0	NONE	-0.01	-0.27	0.00	-0.07
		100	0	0	0	0	NONE	-0.04	-0.40	-0.39	-0.14
11	POLYPHENYLENESULFIDE	60	0	0	0	0	NONE	-2.75	-0.80	-3.82	-2.88
		100	0	0	0	0	CHOCOLATE/LIGHTER	-3.05	-1.60	-5.54	-2.83
12	POLYTETRAFLUOROETHYLENE	60	0	0	0	0	NONE	0.02	-0.20	-0.04	-0.04
		100	0	0	0	0	NONE	0.00	-0.51	-1.96	0.00
13	POLYAMIDE-IMIDE	60	0	0	0	0	NONE	0.03	0.13	1.92	0.24
		100	0	0	0	0	NONE	-0.01	0.13	-0.38	0.13
14	POLYAMIDE-IMIDE	60	0	0	0	0	NONE	0.00	0.00	0.00	0.20
		100	0	0	0	0	NONE	-0.03	0.00	-0.37	0.10
15	POLYETHERIMIDE	60	0	0	0	0	NONE	-0.04	-0.48	0.31	0.12
		100	0	0	0	0	NONE	-0.07	-0.69	0.94	0.07
16	MODIFIED POLYETHERIMIDE	60	0	0	0	0	NONE	-0.06	0.16	0.31	0.01
		100	0	0	0	0	NONE	-0.16	-0.43	-2.28	-0.24
17	POLYARYLEETHERKETONE	60	0	0	0	0	NONE	0.01	0.14	0.00	-0.03
		100	0	0	0	0	NONE	0.01	0.14	1.17	-0.13
18	POLYBUTYLENE TEREPHTHALATE	60	0	0	0	0	NONE	-0.10	-0.13	0.00	-0.02
		100	0	0	0	0	NONE	-0.19	-0.27	-0.76	-0.08
19	POLYIMIDE-DF	60	0	0	0	0	NONE	-0.01	-0.30	-0.48	-0.05
		100	0	0	0	0	NONE	-0.04	-0.15	-0.94	0.01
20	POLYIMIDE-DF-ISO	60	0	0	0	0	NONE	0.01	0.00	1.44	-0.06
		100	0	0	0	0	NONE	-0.06	0.00	-0.96	-0.54
21	POLY(ARYLEETHERETHERKETONE)	60	0	0	0	0	NONE	-0.04	-0.40	0.00	0.04
		100	0	0	0	0	NONE	-0.06	-0.54	-0.39	-0.02
22	LIQUID CRYSTAL POLYMER	60	0	0	0	0	NONE	0.01	0.00	-1.89	0.00
		100	0	0	0	0	NONE	-0.07	0.27	-2.28	-0.05
23	66 NYLON, POLYAMIDE	60	0	0	0	0	NONE	-0.14	-0.27	-0.39	-0.08
		100	0	0	0	0	NONE	-0.22	-0.14	-0.39	-0.12

^a Temperature conversions: 60°C = 140°F, 100°C = 212°F

^b Qualitative scale: 0=no change, 1=slight, 2=large, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

Appendix C: Dimensional Changes from Refrigerant Immersions

CHANGES IN PLASTICS IMMERSSED IN HCFC-22 (R-22)

Table C.1

NO.	TYPE	Temp (°C) ^a	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average % Length Change ^c	Average % Width Change ^c	Average % Thickness Change ^c	Average % Weight Change ^c	Average % 24 hr Weight Change ^c
1	POLYPHTHALAMIDE	RT	0	0	0	0	NONE	0.084	0.135	-0.388	0.841	0.722
		60	1	0	0	0	YELLOW/OFF WHITE	-0.469	0.135	0.781	2.126	2.041
2	ABS	RT	3	3	3	3	NONE	FAILED	FAILED	FAILED	FAILED	FAILED
		60	3	3	3	3	NONE	FAILED	FAILED	FAILED	FAILED	FAILED
3	ACETAL	RT	0	0	0	0	NONE	0.087	0.274	3.165	0.672	0.494
		60	1	0	0	1	NONE	2.626	2.470	0.000	8.085	3.841
4	PHENOLIC	RT	0	0	0	0	NONE	0.171	0.537	3.462	1.236	1.044
		60	2	0	0	0	NONE	0.399	0.941	0.373	2.207	1.980
5	POLYVINYLIDENE FLUORIDE	RT	0	0	0	0	NONE	0.108	0.272	-0.348	0.607	0.522
		60	1	0	0	1	NONE	3.094	2.978	2.390	7.929	5.422
6	POLYCARBONATE	RT	2	0	0	0	CLEAR/CLOUDY	-0.754	2.267	25.185	28.097	18.217
		60	1	2	2	2	CLEAR/CLOUDY	-1.123	3.338	21.240	20.607	13.685
7	MODIFIED POLYPHENYLENE OXIDE	RT	2	0	0	0	NONE	-1.442	3.091	15.955	27.090	17.905
		60	1	0	0	2	NONE	-1.741	0.536	51.759	25.209	16.640
8	POLYPROPYLENE	RT	0	0	0	0	NONE	0.127	0.412	0.400	1.117	0.956
		60	2	0	0	1	LUCITE/CLOUDY	9.133	0.538	-0.388	8.656	3.252
9	POLYARYL SULFONE	RT	0	0	0	0	NONE	0.114	0.937	1.947	1.916	0.626
		60	1	0	0	0	TAN/METALLIC TAN	0.100	0.802	0.769	5.119	4.183
10	POLYETHYLENE TEREPHTHALATE	RT	0	0	0	0	LT.TAN/WHITE EDGES	0.000	0.938	2.359	3.082	2.898
		60	2	0	0	0	LT.TAN/WHITE EDGES	0.255	1.203	6.278	8.456	7.158
11	POLYPHENYLENESULFIDE	RT	0	0	0	0	NONE	0.000	0.134	-0.391	0.143	0.104
		60	1	0	0	0	CHOCOLATE/LIGHTER	0.057	0.000	-0.769	0.254	0.237
12	POLYTETRAFLUOROETHYLENE	RT	0	0	0	0	NONE	1.667	-0.185	0.952	5.709	2.180
		60	0	0	0	0	NONE	1.621	1.219	2.794	4.085	2.355
13	POLYAMIDE-IMIDE	RT	0	0	0	0	NONE	0.099	0.002	1.163	1.126	1.036
		60	1	0	0	0	NONE	0.002	0.267	0.000	0.594	0.630
14	POLYAMIDE-IMIDE	RT	0	0	0	0	NONE	0.071	0.403	-0.388	0.885	0.810
		60	1	0	0	0	NONE	0.014	-0.267	0.385	0.589	0.586
15	POLYETHERIMIDE	RT	0	0	0	0	NONE	0.086	1.477	3.888	6.674	5.202
		60	0	0	0	0	BROWN/METALLIC GOLD	0.612	0.799	1.163	6.207	5.056
16	MODIFIED POLYETHERIMIDE	RT	0	0	0	0	NONE	-0.011	1.072	2.028	7.070	5.248
		60	1	0	0	0	BROWN/METALLIC GOLD	0.008	0.748	2.327	6.092	4.684
17	POLYARYLEETHERKETONE	RT	0	0	0	0	NONE	0.001	0.001	-2.267	0.158	0.128
		60	0	0	0	0	NONE	0.027	0.946	-2.593	0.292	0.281
18	POLYBUTYLENE TEREPHTHALATE	RT	0	0	0	0	NONE	0.849	1.220	-0.732	8.194	6.132
		60	1	0	0	2	NONE	2.880	2.965	5.829	12.664	9.822
19	POLYIMIDE-DF	RT	0	0	0	0	NONE	0.523	0.745	0.481	4.895	3.658
		60	1	0	0	0	NONE	0.450	0.446	-5.788	3.278	2.714
20	POLYIMIDE-DF-ISO	RT	0	0	0	0	NONE	0.147	0.000	-1.433	1.004	0.839
		60	1	0	0	0	NONE	0.059	0.303	-5.786	0.292	0.321
21	POLY(ARYLEETHERETHERKETONE)	RT	0	0	0	0	NONE	0.043	0.406	6.299	0.247	0.141
		60	0	0	0	0	NONE	0.029	0.135	0.784	0.380	0.364
22	LIQUID CRYSTAL POLYMER	RT	0	0	0	0	NONE	-0.028	0.269	2.332	0.299	0.047
		60	1	0	0	0	NONE	0.028	0.000	1.186	0.052	0.057
23	66 NYLON, POLYAMIDE	RT	0	0	0	0	NONE	0.159	0.543	-0.388	1.604	1.338
		60	0	0	0	0	NONE	0.634	1.083	0.787	3.509	3.389

^a Temperature conversions: 60°C = 140°F, RT = ambient

^b Qualitative scale: 0=no change, 1=slight, 2=swelled, 3=dissolved, deformed or melted

^c% Change = change in before/after measurements of plastics

CHANGES IN PLASTICS IMMERSED IN HFC-32 (R-32)

Table C.2

NO.	TYPE	Temp (°C) ^a	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average %	Average %	Average %	Average %	Average % 24 hr
								Length Change ^c	Width Change ^c	Thickness Change ^c	Weight Change ^c	Weight Change ^c
1	POLYPHTHALAMIDE	RT	0	0	0	0	NONE	0.035	0.405	0.794	0.283	0.288
		60	0	0	0	0	YELLOW/OFF WHITE	0.422	0.548	4.694	2.208	1.074
2	ABS	RT	0	0	0	2	CREAM/LIGHT CREAM	11.655	50.535	181.722	18.400	8.141
		60	3	3	3	3	NONE	FAILED	FAILED	FAILED	FAILED	FAILED
3	ACETAL	RT	0	0	0	0	NONE	1.544	1.646	1.587	3.864	2.154
		60	1	0	0	0	NONE	1.325	1.505	2.362	3.951	1.735
4	PHENOLIC	RT	0	0	0	0	NONE	0.028	-0.267	-0.775	0.265	0.223
		60	0	0	0	0	NONE	-0.057	-0.134	-0.758	0.353	0.275
5	POLYVINYLIDENE FLUORIDE	RT	0	0	0	0	NONE	2.542	2.578	1.200	5.945	3.433
		60	0	0	0	2	NONE	1.974	5.827	7.099	9.259	4.118
6	POLYCARBONATE	RT	0	0	0	0	NONE	0.468	2.006	4.261	10.135	7.643
		60	1	0	0	0	CLEAR/PEARL	-1.764	-0.668	13.588	9.007	7.498
7	MODIFIED POLYPHENYLENE OXIDE	RT	0	0	0	0	NONE	1.071	2.145	3.510	7.591	5.078
		60	2	0	0	0	NONE	-1.071	1.740	4.234	7.657	5.238
8	POLYPROPYLENE	RT	0	0	0	0	NONE	0.669	0.271	0.794	1.994	1.386
		60	0	0	0	0	LUCITE/WHITE CENTER	0.395	0.675	0.787	2.307	1.212
9	POLYARYL SULFONE	RT	0	0	0	0	NONE	0.329	0.399	2.353	3.856	2.945
		60	1	2	0	0	NONE	0.598	1.337	3.504	5.301	4.377
10	POLYETHYLENE TEREPHTHALATE	RT	0	0	0	0	NONE	0.043	0.402	1.978	1.810	1.450
		60	0	0	0	0	TAN/OFF WHITE	0.028	0.401	2.734	3.965	3.424
11	POLYPHENYLENESULFIDE	RT	0	0	0	0	NONE	0.014	0.535	0.018	0.319	0.241
		60	0	0	0	0	CHOCOLATE/LIGHTER	-0.085	-0.134	1.154	0.438	0.390
12	POLYTETRAFLUOROETHYLENE	RT	0	0	0	0	NONE	0.622	0.413	3.051	1.451	0.771
		60	0	0	0	0	NONE	0.723	0.725	0.362	1.636	0.735
13	POLYAMIDE-IMIDE	RT	0	0	0	0	NONE	0.014	-0.267	1.550	0.285	0.290
		60	0	0	0	0	NONE	0.083	-0.133	0.382	0.509	0.456
14	POLYAMIDE-IMIDE	RT	0	0	0	0	NONE	-0.029	0.000	0.787	0.289	0.265
		60	0	0	0	0	NONE	0.043	-0.134	1.151	0.558	0.528
15	POLYETHERIMIDE	RT	0	0	0	0	NONE	0.100	0.667	-1.113	2.442	1.890
		60	0	0	0	0	NONE	0.271	0.534	1.163	4.039	3.447
16	MODIFIED POLYETHERIMIDE	RT	0	0	0	0	NONE	0.170	0.803	1.259	2.758	2.095
		60	0	0	0	0	NONE	0.334	0.534	2.503	4.417	3.747
17	POLYARYLEETHERKETONE	RT	0	0	0	0	NONE	0.294	0.541	0.391	0.410	0.315
		60	0	0	0	0	NONE	-0.144	0.270	0.791	1.213	1.055
18	POLYBUTYLENE TEREPHTHALATE	RT	0	0	0	1	NONE	0.302	0.947	2.353	2.206	1.795
		60	0	0	0	1	NONE	1.122	0.672	3.113	2.545	3.877
19	POLYIMIDE-DF	RT	0	0	0	0	NONE	0.537	0.892	1.942	5.553	4.069
		60	0	0	0	0	NONE	1.364	1.488	1.442	6.019	4.619
20	POLYIMIDE-DF-ISO	RT	0	0	0	0	NONE	0.088	0.000	1.475	0.864	0.738
		60	0	0	0	0	NONE	0.280	0.453	0.966	1.467	1.334
21	POLY(ARYLEETHERETHERKETONE)	RT	0	0	0	0	NONE	-0.071	0.404	0.018	0.473	0.382
		60	0	0	0	0	NONE	0.143	0.270	0.784	1.515	1.328
22	LIQUID CRYSTAL POLYMER	RT	0	0	0	0	NONE	-0.014	0.134	-0.379	0.062	0.050
		60	0	0	0	0	NONE	-0.042	-0.402	1.572	0.098	0.079
23	66 NYLON, POLYAMIDE	RT	1	0	0	0	NONE	1.484	0.136	0.794	0.193	0.204
		60	0	0	0	0	NONE	0.288	0.405	1.163	1.479	1.410

^a Temperature conversions: 60°C = 140°F, RT = ambient

^b Qualitative scale: 0=no change, 1=slight, 2=swelled, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

CHANGES IN PLASTICS IMMERSSED IN HCFC-123 (R-123)

Table C.3

NO.	TYPE	Temp (°C) ^a	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average %	Average %	Average %	Average %	Average % 24 hr
								Length Change ^c	Width Change ^c	Thickness Change ^c	Weight Change ^c	Weight Change ^c
1	POLYPHTHALAMIDE	RT	0	0	0	0	NONE	-0.029	0.813	-1.556	-0.069	-0.061
		60	0	0	0	0	NONE	-0.053	0.678	-1.917	2.187	2.045
2	ABS	RT	3	3	3	3	NONE	FAILED	FAILED	FAILED	FAILED	FAILED
		60	3	3	3	3	NONE	FAILED	FAILED	FAILED	FAILED	FAILED
3	ACETAL	RT	0	0	0	0	NONE	0.160	-0.137	-1.181	0.649	0.502
		60	0	0	0	0	NONE	3.194	3.151	0.787	9.294	6.617
4	PHENOLIC	RT	0	0	0	0	NONE	0.329	-0.668	0.000	6.241	6.266
		60	0	0	0	0	NONE	0.028	-0.133	-0.009	0.818	0.716
5	POLYVINYLIDENE FLUORIDE	RT	0	0	0	0	NONE	0.116	0.409	0.797	0.118	-0.167
		60	0	0	0	0	NONE	0.823	0.137	-2.362	1.582	1.421
6	POLYCARBONATE	RT	3	3	3	3	NONE	FAILED	FAILED	FAILED	FAILED	FAILED
		60	3	3	3	3	NONE	FAILED	FAILED	FAILED	FAILED	FAILED
7	MODIFIED POLYPHENYLENE OXIDE	RT	3	3	3	3	NONE	FAILED	FAILED	FAILED	FAILED	FAILED
		60	3	3	3	3	NONE	FAILED	FAILED	FAILED	FAILED	FAILED
8	POLYPROPYLENE	RT	0	0	0	0	NONE	1.166	0.816	1.569	6.854	5.272
		60	0	0	0	0	NONE	1.770	2.988	-0.391	14.309	8.038
9	POLYARYL SULFONE	RT	0	0	0	0	NONE	0.100	0.535	-0.775	-0.270	-0.247
		60	0	0	0	0	NONE	0.114	0.268	-1.163	0.778	0.572
10	POLYETHYLENE TEREPHTHALATE	RT	0	0	0	0	LT. TAN/WHITE EDGES	0.014	0.134	1.563	0.154	-0.463
		60	0	0	0	0	LT. TAN/WHITE EDGES	0.099	1.745	0.781	4.530	3.773
11	POLYPHENYLENESULFIDE	RT	0	0	0	0	NONE	-0.014	0.134	0.784	-0.005	-0.009
		60	0	0	0	0	NONE	-0.057	-0.401	-2.734	0.129	0.109
12	POLYTETRAFLUOROETHYLENE	RT	0	0	0	0	NONE	0.622	0.000	-1.136	2.473	2.078
		60	0	0	0	0	NONE	1.803	1.421	-1.168	4.903	4.063
13	POLYAMIDE-IMIDE	RT	0	0	0	0	NONE	-0.014	-0.401	1.154	-0.019	0.052
		60	0	0	0	0	NONE	-0.591	0.806	-1.938	0.509	0.633
14	POLYAMIDE-IMIDE	RT	0	0	0	0	NONE	-0.028	-0.268	2.713	-0.023	0.047
		60	0	0	0	0	NONE	0.000	-0.402	-1.533	0.375	0.465
15	POLYETHERIMIDE	RT	0	0	0	0	NONE	-0.071	0.001	-0.778	-0.178	-0.118
		60	0	0	0	0	NONE	0.071	0.003	-0.388	0.752	0.575
16	MODIFIED POLYETHERIMIDE	RT	0	0	0	0	NONE	-0.028	0.161	-0.465	-0.150	-0.118
		60	0	0	0	0	NONE	0.040	0.912	-0.780	0.686	0.549
17	POLYARYLEETHERKETONE	RT	0	0	0	0	NONE	0.043	-0.136	-0.781	-0.086	-0.049
		60	0	0	0	0	NONE	1.204	0.813	0.775	0.099	0.060
18	POLYBUTYLENE TEREPHTHALATE	RT	0	0	0	0	NONE	0.014	0.136	1.163	1.510	1.237
		60	0	0	0	0	NONE	0.863	1.081	1.145	7.023	6.281
19	POLYIMIDE-DF	RT	0	0	0	0	NONE	-0.116	-0.298	-1.909	-0.100	-0.091
		60	0	0	0	0	NONE	0.102	-0.149	-0.952	0.663	0.608
20	POLYIMIDE-DF-ISO	RT	0	0	0	0	NONE	0.015	0.000	-0.966	-0.163	-0.125
		60	0	0	0	0	NONE	0.074	-0.302	-1.905	0.265	0.265
21	POLY(ARYLEETHERETHERKETONE)	RT	0	0	0	0	NONE	-0.057	0.000	-1.563	-0.075	-0.050
		60	0	0	0	0	NONE	0.014	-0.134	-1.544	0.020	0.023
22	LIQUID CRYSTAL POLYMER	RT	0	0	0	0	NONE	-0.028	-0.134	-0.388	0.005	0.003
		60	0	0	0	0	NONE	-0.014	-0.669	-0.781	0.048	0.051
23	66 NYLON, POLYAMIDE	RT	0	0	0	0	NONE	-0.058	0.542	-1.929	-0.261	-0.190
		60	0	0	0	0	NONE	0.462	1.085	-1.903	2.305	2.216

^a Temperature conversions: 60°C = 140°F, RT = ambient

^b Qualitative scale: 0=no change, 1=slight, 2=swelled, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

CHANGES IN PLASTICS IMMERSSED IN HCFC-124 (R-124)

Table C.4

NO.	TYPE	Temp (°C) ^a	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average % Length Change ^c	Average % Width Change ^c	Average % Thickness Change ^c	Average % Weight Change ^c	Average % 24 hr Weight Change ^c
1	POLYPHTHALAMIDE	RT	0	0	0	0	NONE	0.008	0.812	3.543	1.921	1.589
		60	0	0	0	0	NONE	-0.348	0.540	1.178	0.176	0.201
2	ABS	RT	3	3	3	3	CREME/WHITE	FAILED	FAILED	FAILED	FAILED	FAILED
		60	3	3	3	3	NONE	FAILED	FAILED	FAILED	FAILED	FAILED
3	ACETAL	RT	0	0	0	0	NONE	0.539	0.962	0.047	1.360	0.960
		60	0	0	0	0	NONE	1.896	1.779	0.000	4.684	4.535
4	PHENOLIC	RT	0	0	0	0	NONE	0.171	0.943	3.587	1.426	1.302
		60	0	0	0	0	NONE	0.043	0.268	-1.142	0.523	0.465
5	POLYVINYLIDENE FLUORIDE	RT	0	0	0	0	NONE	0.056	-0.130	2.013	0.272	0.392
		60	0	0	0	0	NONE	1.404	1.357	2.381	3.779	3.568
6	POLYCARBONATE	RT	0	0	0	0	NONE	-0.014	-0.664	1.944	0.799	0.677
		60	0	0	0	0	CLEAR/CLOUDY	0.085	1.604	3.066	5.867	5.552
7	MODIFIED POLYPHENYLENE OXIDE	RT	0	0	0	0	NONE	0.014	0.673	4.378	0.695	0.514
		60	0	0	0	0	GRAY/WHITE STREAKS	0.014	1.072	3.125	5.936	5.390
8	POLYPROPYLENE	RT	0	0	0	0	NONE	0.545	1.360	2.778	1.492	1.296
		60	0	0	0	0	LUCITE/CLOUDY	1.446	0.841	2.756	7.594	6.363
9	POLYARYL SULFONE	RT	0	0	0	0	NONE	0.142	0.804	2.375	0.999	0.720
		60	0	0	0	0	NONE	0.057	0.134	-2.281	0.240	-0.043
10	POLYETHYLENE TEREPHTHALATE	RT	0	0	0	0	LT. TAN/WHITE EDGES	-0.043	0.674	1.984	0.675	0.616
		60	0	0	0	0	TAN/LIGHTER EDGES	-0.014	0.134	-0.388	1.013	0.983
11	POLYPHENYLENESULFIDE	RT	0	0	0	0	NONE	-0.057	0.268	0.794	0.124	0.234
		60	0	0	0	0	NONE	-0.014	0.134	-2.643	1.265	0.046
12	POLYTETRAFLUOROETHYLENE	RT	0	0	0	0	NONE	1.522	2.491	2.267	4.432	3.176
		60	0	0	0	0	NONE	1.743	1.942	-2.423	5.469	3.715
13	POLYAMIDE-IMIDE	RT	0	0	0	0	NONE	0.178	0.942	2.729	1.172	1.112
		60	0	0	0	0	NONE	0.000	-0.133	-1.504	-0.130	-0.123
14	POLYAMIDE-IMIDE	RT	0	0	0	0	NONE	0.029	0.537	0.394	0.841	0.852
		60	0	0	0	0	NONE	0.000	0.000	-0.382	0.003	0.026
15	POLYETHERIMIDE	RT	0	0	0	0	NONE	0.242	0.671	-1.527	0.584	0.561
		60	0	0	0	0	NONE	0.043	0.000	0.775	0.250	0.127
16	MODIFIED POLYETHERIMIDE	RT	0	0	0	0	NONE	0.209	0.645	2.062	0.584	0.532
		60	0	0	0	0	NONE	-0.062	0.322	0.004	0.110	0.038
17	POLYARYLEETHERKETONE	RT	0	0	0	0	NONE	1.637	0.272	2.368	0.313	0.334
		60	0	0	0	0	NONE	0.078	0.136	-0.385	-0.046	-0.053
18	POLYBUTYLENE TEREPHTHALATE	RT	0	0	0	0	NONE	0.043	0.544	1.178	2.162	2.198
		60	0	0	0	0	NONE	0.130	0.405	1.935	1.902	1.885
19	POLYIMIDE-DF	RT	0	0	0	0	NONE	0.160	0.000	7.921	1.535	1.238
		60	0	0	0	0	NONE	0.029	0.000	-4.571	0.213	0.116
20	POLYIMIDE-DF-ISO	RT	0	0	0	0	NONE	0.044	0.152	4.036	0.704	0.742
		60	0	0	0	0	NONE	0.029	0.151	-4.080	0.020	-0.024
21	POLY(ARYLEETHERETHERKETONE)	RT	0	0	0	0	NONE	-0.086	0.813	1.969	0.238	0.279
		60	0	0	0	0	NONE	-0.014	0.000	0.000	0.059	0.045
22	LIQUID CRYSTAL POLYMER	RT	0	0	0	0	NONE	-0.014	0.404	1.994	0.050	0.163
		60	0	0	0	0	NONE	0.028	-0.268	-0.775	-0.295	0.072
23	66 NYLON, POLYAMIDE	RT	0	0	0	0	NONE	0.475	1.359	3.165	3.460	2.679
		60	0	0	0	0	NONE	-0.072	0.407	-1.539	0.239	0.280

^a Temperature conversions: 60°C = 140°F, RT = ambient

^b Qualitative scale: 0=no change, 1=slight, 2=swelled, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

CHANGES IN PLASTICS IMMERSSED IN HFC-125 (R-125)

Table C.5

NO.	TYPE	Temp (°C) ^a	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average %	Average %	Average %	Average %	Average % 24 hr
								Length Change ^c	Width Change ^c	Thickness Change ^c	Weight Change ^c	Weight Change ^c
1	POLYPHTHALAMIDE	RT	0	0	0	0	NONE	0.167	0.269	-0.769	0.587	0.537
		60	0	0	0	0	CREAM/OFF WHITE	-0.250	1.082	0.781	1.113	1.057
2	ABS	RT	0	0	0	0	NONE	0.271	-0.133	-0.388	0.659	0.380
		60	0	0	0	0	NONE	0.100	0.400	1.559	1.300	1.115
3	ACETAL	RT	0	0	0	0	NONE	0.496	0.409	-2.296	1.145	0.648
		60	0	0	0	0	NONE	0.831	0.822	-1.914	2.058	1.656
4	PHENOLIC	RT	0	0	0	0	NONE	0.171	0.000	-7.606	0.921	0.854
		60	0	0	0	0	NONE	0.228	0.538	0.769	1.557	1.417
5	POLYVINYLIDENE FLUORIDE	RT	0	0	0	0	NONE	0.094	-0.270	-1.538	0.341	0.242
		60	0	0	0	0	NONE	0.707	0.949	0.403	1.725	1.639
6	POLYCARBONATE	RT	0	0	0	0	NONE	-0.692	-0.926	-1.116	0.360	0.220
		60	0	0	0	0	NONE	0.028	0.268	-0.382	0.624	0.470
7	MODIFIED POLYPHENYLENE OXIDE	RT	0	0	0	0	NONE	0.215	-0.268	0.003	0.301	0.132
		60	0	0	0	0	NONE	0.043	0.134	0.000	0.485	0.368
8	POLYPROPYLENE	RT	0	0	0	0	NONE	0.218	-0.267	-2.256	0.355	0.361
		60	0	0	0	0	LUCITE/CLOUDY	0.595	0.272	0.391	2.381	2.223
9	POLYARYL SULFONE	RT	0	0	0	0	NONE	0.014	-0.133	0.394	0.285	0.218
		60	0	0	0	0	NONE	0.100	0.000	0.391	-0.100	-0.005
10	POLYETHYLENE TEREPHTHALATE	RT	0	0	0	0	NONE	0.213	-0.267	-1.157	0.430	0.301
		60	0	0	0	0	NONE	0.043	0.134	0.009	0.993	0.878
11	POLYPHENYLENESULFIDE	RT	0	0	0	0	NONE	1.559	0.268	-0.751	0.173	0.091
		60	0	0	0	0	NONE	0.042	0.268	0.394	0.240	0.221
12	POLYTETRAFLUOROETHYLENE	RT	0	0	0	0	NONE	1.383	-0.589	0.807	4.149	2.645
		60	0	0	0	0	NONE	2.027	1.979	-0.373	3.734	2.760
13	POLYAMIDE-IMIDE	RT	0	0	0	0	NONE	0.023	0.401	-1.148	1.348	1.256
		60	0	0	0	0	NONE	-0.157	0.535	1.550	-0.060	0.014
14	POLYAMIDE-IMIDE	RT	0	0	0	0	NONE	0.171	0.133	0.772	1.028	0.943
		60	0	0	0	0	NONE	0.029	0.000	0.003	0.029	0.079
15	POLYETHERIMIDE	RT	0	0	0	0	NONE	0.071	-0.266	-3.030	0.733	0.681
		60	0	0	0	0	NONE	0.100	0.402	-2.202	0.751	0.613
16	MODIFIED POLYETHERIMIDE	RT	0	0	0	0	NONE	0.167	-0.053	-0.308	0.789	0.642
		60	0	0	0	0	NONE	0.071	0.000	-0.459	0.725	0.606
17	POLYARYLEETHERKETONE	RT	0	0	0	0	NONE	-0.255	0.135	0.394	0.356	0.282
		60	0	0	0	0	NONE	0.056	0.000	-1.527	-0.129	-0.145
18	POLYBUTYLENE TEREPHTHALATE	RT	0	0	0	0	NONE	0.115	0.676	-1.157	0.272	0.256
		60	0	0	0	0	NONE	0.115	0.406	0.000	1.015	0.963
19	POLYIMIDE-DF	RT	0	0	0	0	NONE	0.305	1.813	-3.267	0.162	-0.199
		60	0	0	0	0	NONE	0.305	0.447	-3.670	1.403	1.157
20	POLYIMIDE-DF-ISO	RT	0	0	0	0	NONE	0.206	-1.190	-0.485	0.835	0.711
		60	0	0	0	0	NONE	0.250	0.000	-2.791	0.933	0.833
21	POLY(ARYLEETHERETHERKETONE)	RT	0	0	0	0	NONE	0.000	0.135	0.394	0.242	0.180
		60	0	0	0	0	NONE	-0.129	0.134	-1.151	-0.146	-0.149
22	LIQUID CRYSTAL POLYMER	RT	0	0	0	0	NONE	0.000	-0.134	-0.769	0.068	0.042
		60	0	0	0	0	NONE	0.057	0.402	-0.388	0.085	0.067
23	66 NYLON, POLYAMIDE	RT	0	0	0	0	NONE	0.086	0.407	0.391	1.093	1.012
		60	0	0	0	0	NONE	0.259	0.680	0.000	1.223	1.132

^a Temperature conversions: 60°C = 140°F, RT = ambient

^b Qualitative scale: 0=no change, 1=slight, 2=swelled, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

CHANGES IN PLASTICS IMMERSSED IN HFC-134 (R-134)

Table C.6

NO.	TYPE	Temp (°C) ^a	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average %	Average %	Average %	Average %	Average % 24 hr
								Length Change ^c	Width Change ^c	Thickness Change ^c	Weight Change ^c	Weight Change ^c
1	POLYPHTHALAMIDE	RT	0	0	0	0	NONE	0.043	0.677	-0.769	1.926	1.490
		60	0	0	0	0	NONE	-0.202	0.000	-0.778	0.024	0.060
2	ABS	RT	3	3	3	3	NONE	FAILED	FAILED	FAILED	FAILED	FAILED
		60	3	3	3	3	NONE	FAILED	FAILED	FAILED	FAILED	FAILED
3	ACETAL	RT	0	0	0	0	NONE	1.764	1.646	0.394	3.370	2.355
		60	0	0	0	0	NONE	2.071	2.329	0.406	6.503	4.731
4	PHENOLIC	RT	0	0	0	0	NONE	0.242	0.808	-1.530	1.776	1.371
		60	0	0	0	0	NONE	-0.114	0.000	0.000	-0.301	-0.305
5	POLYVINYLIDENE FLUORIDE	RT	0	0	0	0	NONE	0.100	0.545	-1.184	0.599	0.568
		60	0	0	0	0	NONE	2.745	2.849	1.581	7.772	6.206
6	POLYCARBONATE	RT	0	0	0	0	NONE	0.014	0.401	1.938	1.287	0.895
		60	0	0	0	0	CLEAR/CLOUDY	-0.028	1.203	4.116	6.328	6.055
7	MODIFIED POLYPHENYLENE OXIDE	RT	0	0	0	0	NONE	0.172	0.268	0.781	0.581	0.368
		60	0	0	0	0	NONE	0.029	0.134	-0.388	2.045	1.766
8	POLYPROPYLENE	RT	0	0	0	0	NONE	0.091	-0.269	-1.548	0.473	0.335
		60	0	0	0	0	LUCITE/CLOUDY	0.605	0.543	-3.031	2.990	2.739
9	POLYARYL SULFONE	RT	0	0	0	0	NONE	0.199	0.402	-2.256	1.117	0.729
		60	0	0	0	0	NONE	0.114	0.000	0.000	0.243	0.244
10	POLYETHYLENE TEREPHTHALATE	RT	0	0	0	0	LT TAN/WHITE EDGES	0.099	0.673	-3.369	1.301	1.071
		60	0	0	0	0	LT TAN/WHITE EDGES	0.099	0.402	0.391	2.292	2.170
11	POLYPHENYLENESULFIDE	RT	0	0	0	0	NONE	0.000	0.401	1.932	0.069	0.073
		60	0	0	0	0	NONE	0.042	0.401	-1.154	0.086	0.067
12	POLYTETRAFLUOROETHYLENE	RT	0	0	0	0	NONE	0.783	1.263	-2.980	1.607	1.259
		60	0	0	0	0	NONE	1.104	-0.830	-2.787	2.983	2.428
13	POLYAMIDE-IMIDE	RT	0	0	0	0	NONE	0.152	0.804	-2.276	1.136	0.934
		60	0	0	0	0	NONE	0.000	0.000	-0.391	-0.081	0.012
14	POLYAMIDE-IMIDE	RT	0	0	0	0	NONE	0.085	0.402	-1.136	0.879	0.710
		60	0	0	0	0	NONE	0.128	0.000	1.154	0.060	0.117
15	POLYETHERIMIDE	RT	0	0	0	0	NONE	0.100	0.804	-1.929	0.694	0.489
		60	0	0	0	0	NONE	-0.043	0.134	0.787	0.062	0.098
16	MODIFIED POLYETHERIMIDE	RT	0	0	0	0	NONE	0.114	0.646	-0.779	0.253	0.049
		60	0	0	0	0	NONE	-0.036	0.268	0.314	0.024	0.044
17	POLYARYLEETHERKETONE	RT	0	0	0	0	NONE	0.030	0.813	0.000	0.315	0.236
		60	0	0	0	0	NONE	-0.044	0.000	-1.527	-0.138	-0.125
18	POLYBUTYLENE TEREPHTHALATE	RT	0	0	0	0	NONE	0.259	0.542	-0.769	0.945	0.686
		60	0	0	0	0	NONE	0.389	0.946	1.160	2.810	2.789
19	POLYIMIDE-DF	RT	0	0	0	0	NONE	0.334	0.902	-0.948	1.623	1.170
		60	0	0	0	0	NONE	0.000	0.000	0.485	0.307	0.246
20	POLYIMIDE-DF-ISO	RT	0	0	0	0	NONE	0.132	0.152	-1.896	0.694	0.525
		60	0	0	0	0	NONE	-0.103	0.000	0.000	-0.321	-0.305
21	POLY(ARYLEETHERETHERKETONE)	RT	0	0	0	0	NONE	-0.057	0.270	-2.256	0.242	0.162
		60	0	0	0	0	NONE	-0.501	-0.673	2.362	-0.046	-0.037
22	LIQUID CRYSTAL POLYMER	RT	0	0	0	0	NONE	0.057	0.269	1.953	0.020	0.011
		60	0	0	0	0	NONE	0.014	0.268	-1.166	0.016	0.015
23	66 NYLON, POLYAMIDE	RT	0	0	0	0	NONE	0.461	1.493	1.172	3.408	2.601
		60	0	0	0	0	NONE	0.029	-0.405	-1.157	0.381	0.459

^a Temperature conversions: 60°C = 140°F, RT = ambient

^b Qualitative scale: 0=no change, 1=slight, 2=swelled, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

CHANGES IN PLASTICS IMMERSSED IN HFC-134a (R-134a)

Table C.7

NO.	TYPE	Temp (°C) ^a	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average % Length Change ^c	Average % Width Change ^c	Average % Thickness Change ^c	Average % Weight Change ^c	Average % 24 hr Weight Change ^c
1	POLYPHTHALAMIDE	RT	0	0	0	0	NONE	0.129	2.902	2.950	1.383	1.185
		60	0	0	0	0	NONE	-0.230	-0.270	0.794	-0.339	-0.300
2	ABS	RT	0	0	0	0	NONE	0.157	1.743	1.569	1.774	1.194
		60	0	0	0	0	NONE	-0.199	2.271	3.107	9.463	8.829
3	ACETAL	RT	0	0	0	0	NONE	0.378	2.092	5.833	1.377	0.781
		60	0	0	0	0	NONE	1.441	1.366	-2.296	3.527	2.716
4	PHENOLIC	RT	0	0	0	0	NONE	0.441	0.673	5.039	1.893	1.419
		60	0	0	0	0	NONE	0.242	0.267	-3.344	0.730	1.339
5	POLYVINYLIDENE FLUORIDE	RT	0	0	0	0	NONE	0.263	0.956	0.806	0.728	0.539
		60	0	0	0	0	NONE	2.300	2.301	3.200	0.860	0.145
6	POLYCARBONATE	RT	0	0	0	0	NONE	1.226	3.017	3.587	0.554	0.299
		60	0	0	0	0	NONE	0.299	0.000	0.000	1.409	1.196
7	MODIFIED POLYPHENYLENE OXIDE	RT	0	0	0	0	NONE	0.057	0.404	1.181	0.324	0.175
		60	0	0	0	0	NONE	0.100	0.535	-1.136	1.208	1.003
8	POLYPROPYLENE	RT	0	0	0	0	NONE	0.168	0.822	-0.781	0.530	0.373
		60	0	0	0	0	LUCITE/CLOUDY	0.951	0.407	0.797	2.870	2.529
9	POLYARYL SULFONE	RT	0	0	0	0	NONE	0.485	2.743	6.148	0.752	0.479
		60	0	0	0	0	NONE	0.043	-0.266	0.787	-0.126	-0.064
10	POLYETHYLENE TEREPHTHALATE	RT	0	0	0	0	NONE	0.198	2.339	2.866	0.401	0.245
		60	0	0	0	0	NONE	0.057	0.001	0.787	0.505	0.518
11	POLYPHENYLENESULFIDE	RT	0	0	0	0	NONE	0.014	0.405	0.000	0.096	0.042
		60	0	0	0	0	CHOCOLATE/LIGHTER	0.042	0.134	-3.759	0.473	0.416
12	POLYTETRAFLUOROETHYLENE	RT	0	0	0	0	NONE	1.329	-0.103	9.619	2.305	1.875
		60	0	0	0	0	NONE	1.504	1.151	1.910	2.982	2.231
13	POLYAMIDE-IMIDE	RT	0	0	0	0	NONE	0.136	0.943	0.754	1.152	0.951
		60	0	0	0	0	NONE	0.157	0.134	-2.273	1.082	1.067
14	POLYAMIDE-IMIDE	RT	0	0	0	0	NONE	0.071	0.673	1.160	0.870	0.685
		60	0	0	0	0	NONE	-0.114	0.133	-0.376	1.012	1.000
15	POLYETHERIMIDE	RT	0	0	0	0	NONE	0.584	0.673	0.394	0.776	0.412
		60	0	0	0	0	NONE	0.142	0.267	0.787	1.069	0.919
16	MODIFIED POLYETHERIMIDE	RT	0	0	0	0	NONE	0.096	0.700	0.957	0.656	0.446
		60	0	0	0	0	NONE	-0.003	0.054	-0.292	0.776	0.660
17	POLYARYLEETHERKETONE	RT	0	0	0	0	NONE	0.136	2.072	5.417	0.395	0.243
		60	0	0	0	0	NONE	0.227	0.925	-1.880	0.384	0.337
18	POLYBUTYLENE TEREPHTHALATE	RT	0	0	0	0	NONE	0.274	0.407	0.391	0.308	0.180
		60	0	0	0	0	NONE	0.245	0.270	1.563	1.603	1.530
19	POLYIMIDE-DF	RT	0	0	0	0	NONE	0.524	2.439	6.701	1.513	1.065
		60	0	0	0	0	NONE	0.131	0.149	-0.971	0.794	0.693
20	POLYIMIDE-DF-ISO	RT	0	0	0	0	NONE	0.339	2.477	6.186	0.745	0.553
		60	0	0	0	0	NONE	0.088	-0.151	-0.485	0.418	0.394
21	POLY(ARYLEETHERETHERKETONE)	RT	0	0	0	0	NONE	0.244	1.928	7.058	0.364	0.186
		60	0	0	0	0	NONE	0.186	0.000	1.148	0.277	0.232
22	LIQUID CRYSTAL POLYMER	RT	0	0	0	0	NONE	0.042	0.675	1.587	0.035	0.026
		60	0	0	0	0	NONE	0.071	-0.535	-2.317	0.264	0.233
23	66 NYLON, POLYAMIDE	RT	0	0	0	0	NONE	0.591	3.186	3.690	2.691	2.210
		60	0	0	0	0	NONE	0.101	0.271	-1.133	0.512	0.577

^a Temperature conversions: 60°C = 140°F, RT = ambient

^b Qualitative scale: 0=no change, 1=slight, 2=swelled, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

CHANGES IN PLASTICS IMMERSED IN HCFC-142b (R-142b)

Table C.8

NO.	TYPE	Temp (°C) ^a	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average %	Average %	Average %	Average %	Average % 24 hr
								Length Change ^c	Width Change ^c	Thickness Change ^c	Weight Change ^c	Weight Change ^c
1	POLYPHTHALAMIDE	RT	0	0	0	0	NONE	0.000	0.271	1.563	0.225	0.192
		60	0	0	0	0	NONE	-0.426	0.404	0.000	-0.019	-0.001
2	ABS	RT	2	0	0	2	CREAM/OFF WHITE	0.000	2.410	4.267	13.249	10.998
		60	2	0	0	1	NONE	-5.126	8.968	21.484	29.868	26.306
3	ACETAL	RT	0	0	0	0	NONE	0.000	0.412	-0.722	0.474	0.383
		60	0	0	0	0	NONE	1.311	1.651	0.812	2.668	2.369
4	PHENOLIC	RT	1	0	0	0	NONE	0.114	0.137	-1.550	0.268	0.247
		60	0	0	0	0	NONE	0.043	0.270	0.402	0.370	0.284
5	POLYVINYLIDENE FLUORIDE	RT	0	0	0	0	NONE	-0.058	-0.270	-0.766	0.407	0.367
		60	0	0	0	0	NONE	1.663	1.497	2.381	3.532	3.151
6	POLYCARBONATE	RT	0	0	0	0	NONE	0.000	-0.652	-1.103	0.984	0.718
		60	0	0	0	0	NONE	0.128	2.136	3.818	5.590	5.276
7	MODIFIED POLYPHENYLENE OXIDE	RT	0	0	0	0	NONE	0.000	0.940	2.719	2.944	1.914
		60	1	0	0	1	NONE	-0.400	2.544	10.981	18.661	16.859
8	POLYPROPYLENE	RT	0	0	0	0	NONE	0.924	1.496	-0.388	3.947	3.050
		60	1	0	0	0	NONE	1.990	2.307	1.181	8.829	5.103
9	POLYARYL SULFONE	RT	0	0	0	0	NONE	0.000	-0.263	-0.769	0.063	0.149
		60	0	0	0	0	NONE	0.028	0.536	-4.119	0.000	0.015
10	POLYETHYLENE TEREPHTHALATE	RT	0	0	0	0	NONE	0.000	0.403	-1.489	0.295	0.269
		60	1	0	0	0	NONE	-0.128	0.268	1.181	0.743	0.722
11	POLYPHENYLENESULFIDE	RT	0	0	0	0	NONE	0.000	0.134	0.775	0.135	0.141
		60	0	0	0	0	NONE	0.028	0.134	-1.862	0.026	0.015
12	POLYTETRAFLUOROETHYLENE	RT	0	0	0	0	NONE	0.945	0.003	0.360	2.138	1.787
		60	0	0	0	0	NONE	1.568	1.248	0.803	3.015	1.988
13	POLYAMIDE-IMIDE	RT	0	0	0	0	NONE	-0.021	0.805	0.376	0.149	0.204
		60	0	0	0	0	NONE	0.035	-0.134	-1.493	-0.061	0.031
14	POLYAMIDE-IMIDE	RT	0	0	0	0	NONE	0.000	0.268	-0.373	0.150	0.202
		60	0	0	0	0	NONE	0.043	0.133	0.385	0.024	0.085
15	POLYETHERIMIDE	RT	0	0	0	0	NONE	0.000	-0.264	2.347	0.119	0.147
		60	0	0	0	0	NONE	0.014	0.000	0.000	-0.007	0.025
16	MODIFIED POLYETHERIMIDE	RT	0	0	0	0	NONE	0.000	0.268	0.004	0.129	0.124
		60	0	0	0	0	NONE	0.003	0.267	0.471	0.045	0.039
17	POLYARYLEETHERKETONE	RT	1	0	0	0	NONE	0.029	0.008	-3.393	0.151	0.129
		60	0	0	0	0	NONE	0.014	0.271	-0.746	-0.073	-0.048
18	POLYBUTYLENE TEREPHTHALATE	RT	0	0	0	0	NONE	0.014	0.136	-0.388	0.252	0.231
		60	0	0	0	0	NONE	0.144	0.677	2.747	1.246	1.242
19	POLYIMIDE-DF	RT	0	0	0	0	NONE	0.000	0.000	0.014	0.229	0.217
		60	0	0	0	0	NONE	0.015	0.298	0.971	0.023	0.351
20	POLYIMIDE-DF-ISO	RT	0	0	0	0	NONE	-0.015	0.152	-5.951	0.160	0.160
		60	0	0	0	0	NONE	0.044	0.000	0.980	-0.098	-0.078
21	POLY(ARYLEETHERETHERKETONE)	RT	1	0	0	0	NONE	-0.029	-0.135	-0.778	0.138	0.129
		60	0	0	0	0	NONE	0.043	-0.269	-2.632	-0.003	0.002
22	LIQUID CRYSTAL POLYMER	RT	0	0	0	0	NONE	0.000	0.403	-1.544	0.142	0.146
		60	0	0	0	0	NONE	0.028	0.134	0.787	-0.006	-0.008
23	66 NYLON, POLYAMIDE	RT	0	0	0	0	NONE	0.072	0.407	-0.775	0.132	0.163
		60	0	0	0	0	NONE	-0.058	0.271	-4.150	0.063	0.120

^a Temperature conversions: 60°C = 140°F, RT = ambient

^b Qualitative scale: 0=no change, 1=slight, 2=swelled, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

CHANGES IN PLASTICS IMMERSSED IN HFC-143a (R-143a)

Table C.9

NO.	TYPE	Temp (°C) ^a	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average %	Average %	Average %	Average %	Average % 24 hr
								Length Change ^c	Width Change ^c	Thickness Change ^c	Weight Change ^c	Weight Change ^c
1	POLYPHTHALAMIDE	RT	0	0	0	0	NONE	-0.094	0.134	3.175	1.761	1.393
		60	0	0	0	0	YELLOW/OFF WHITE	-0.229	0.000	0.394	1.498	1.487
2	ABS	RT	0	0	0	0	NONE	0.085	0.402	0.775	0.750	0.461
		60	0	0	0	0	CREAM/OFF WHITE	0.256	0.266	1.944	2.940	2.684
3	ACETAL	RT	0	0	0	0	NONE	-0.215	0.137	1.997	0.690	0.428
		60	0	0	0	0	NONE	1.125	0.548	0.787	1.815	1.487
4	PHENOLIC	RT	0	0	0	0	NONE	0.142	0.268	1.128	1.264	1.075
		60	0	0	0	0	NONE	0.085	0.000	0.388	0.288	0.282
5	POLYVINYLIDENE FLUORIDE	RT	0	0	0	0	NONE	0.203	0.136	0.000	0.378	0.324
		60	0	0	0	0	NONE	1.584	1.355	1.190	3.180	2.961
6	POLYCARBONATE	RT	0	0	0	0	NONE	0.014	0.268	1.932	0.395	0.295
		60	0	0	0	0	NONE	0.128	0.266	1.154	0.968	0.870
7	MODIFIED POLYPHENYLENE OXIDE	RT	0	0	0	0	NONE	0.014	0.541	-0.769	0.371	0.268
		60	0	0	0	0	NONE	0.114	0.402	1.545	1.169	1.031
8	POLYPROPYLENE	RT	0	0	0	0	NONE	0.357	0.137	2.344	0.800	0.676
		60	0	0	0	0	LUCITE/CLOUDY	0.526	-0.131	-0.388	2.835	2.513
9	POLYARYL SULFONE	RT	0	0	0	0	NONE	0.128	-0.266	-3.662	0.857	0.706
		60	0	0	0	0	NONE	0.895	0.134	0.009	0.722	0.623
10	POLYETHYLENE TEREPHTHALATE	RT	0	0	0	0	NONE	-0.028	-0.531	2.344	0.325	0.241
		60	0	0	0	0	NONE	0.057	0.403	-0.760	0.937	0.884
11	POLYPHENYLENESULFIDE	RT	0	0	0	0	NONE	0.028	0.268	0.012	0.081	0.083
		60	0	0	0	0	CHOCOLATE/LIGHTER	0.014	0.000	-1.151	8.412	0.218
12	POLYTETRAFLUOROETHYLENE	RT	0	0	0	0	NONE	1.429	-1.318	4.262	2.553	1.906
		60	0	0	0	0	NONE	1.003	1.447	2.327	2.044	1.654
13	POLYAMIDE-IMIDE	RT	0	0	0	0	NONE	0.148	0.802	0.405	1.084	0.975
		60	0	0	0	0	NONE	0.127	-0.134	0.003	-10.880	0.579
14	POLYAMIDE-IMIDE	RT	0	0	0	0	NONE	0.014	0.002	0.772	0.758	0.667
		60	0	0	0	0	NONE	0.100	-0.401	-0.376	-6.505	0.635
15	POLYETHERIMIDE	RT	0	0	0	0	NONE	0.071	0.000	2.323	0.285	0.216
		60	0	0	0	0	NONE	0.071	-0.267	0.000	0.478	0.433
16	MODIFIED POLYETHERIMIDE	RT	0	0	0	0	NONE	0.555	-0.049	0.013	0.605	0.452
		60	0	0	0	0	NONE	0.123	-0.160	-0.900	0.267	0.248
17	POLYARYLEETHERKETONE	RT	0	0	0	0	NONE	0.110	-1.060	1.190	0.290	0.220
		60	0	0	0	0	NONE	0.147	0.000	-0.716	0.456	0.415
18	POLYBUTYLENE TEREPHTHALATE	RT	0	0	0	0	NONE	0.216	0.406	-0.758	0.288	0.234
		60	0	0	0	0	NONE	0.158	0.271	1.918	0.980	0.941
19	POLYIMIDE-DF	RT	0	0	0	0	NONE	0.290	0.447	0.490	1.369	1.021
		60	0	0	0	0	NONE	0.276	0.298	-4.545	0.954	0.834
20	POLYIMIDE-DF-ISO	RT	0	0	0	0	NONE	0.147	0.455	0.005	0.718	0.569
		60	0	0	0	0	NONE	0.118	0.303	0.966	0.618	0.565
21	POLY(ARYLEETHERETHERKETONE)	RT	0	0	0	0	NONE	0.172	-0.801	1.600	0.139	0.088
		60	0	0	0	0	NONE	0.072	-0.538	0.000	0.346	0.307
22	LIQUID CRYSTAL POLYMER	RT	0	0	0	0	NONE	-0.071	0.403	0.778	0.026	0.029
		60	0	0	0	0	NONE	0.127	-0.402	0.778	-16.450	0.079
23	66 NYLON, POLYAMIDE	RT	0	0	0	0	NONE	0.187	-0.267	-1.100	2.620	2.111
		60	0	0	0	0	NONE	0.404	0.405	-0.385	1.915	1.805

^a Temperature conversions: 60°C = 140°F, RT = ambient

^b Qualitative scale: 0=no change, 1=slight, 2=swelled, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

CHANGES IN PLASTICS IMMERSSED IN HFC-152a (R-152a)

Table C.10

NO.	TYPE	Temp (°C) ^a	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average % Length Change ^c	Average % Width Change ^c	Average % Thickness Change ^c	Average % Weight Change ^c	Average % 24 hr Weight Change ^c
1	POLYPHTHALAMIDE	RT	0	0	0	0	NONE	0.211	-0.775	1.965	1.644	1.287
		60	1	0	0	0	CREAM/OFF WHITE	-0.876	-0.002	0.000	-0.090	-0.115
2	ABS	RT	1	0	0	2	NONE	-5.140	0.000	147.704	19.111	14.809
		60	3	3	3	3	NONE	FAILED	FAILED	FAILED	FAILED	FAILED
3	ACETAL	RT	0	0	0	0	NONE	1.327	1.235	2.390	3.573	2.903
		60	2	0	0	0	NONE	1.327	1.094	0.791	3.817	2.645
4	PHENOLIC	RT	0	0	0	0	NONE	0.299	0.268	-0.758	1.908	1.510
		60	2	0	0	0	NONE	-0.028	0.268	0.000	0.152	0.109
5	POLYVINYLIDENE FLUORIDE	RT	0	0	0	0	NONE	0.826	0.948	1.994	2.021	1.614
		60	2	0	0	0	NONE	1.381	4.336	2.778	8.961	5.325
6	POLYCARBONATE	RT	1	0	0	0	NONE	0.057	0.401	2.713	2.473	1.799
		60	1	0	0	1	CLEAR/CLOUDY	-0.754	0.534	7.692	6.372	5.991
7	MODIFIED POLYPHENYLENE OXIDE	RT	0	0	0	0	NONE	0.257	0.535	2.753	2.241	1.441
		60	2	0	0	0	NONE	0.342	2.406	3.531	9.278	8.265
8	POLYPROPYLENE	RT	0	0	0	0	NONE	0.522	0.271	-1.929	1.513	1.163
		60	3	0	0	0	NONE	0.693	1.355	0.787	4.888	3.214
9	POLYARYL SULFONE	RT	0	0	0	0	NONE	0.591	0.812	2.362	3.264	2.562
		60	0	0	0	0	NONE	0.028	0.000	0.778	0.780	0.640
10	POLYETHYLENE TEREPHTHALATE	RT	0	0	0	0	NONE	-0.014	0.537	-0.373	0.842	0.579
		60	3	0	0	0	NONE	0.099	0.669	1.581	2.272	2.127
11	POLYPHENYLENESULFIDE	RT	0	0	0	0	NONE	1.471	0.000	1.181	0.137	0.088
		60	2	0	0	0	CHOCOLATE/LT. BROWN	-0.099	-0.533	0.000	0.064	0.073
12	POLYTETRAFLUOROETHYLENE	RT	0	0	0	0	NONE	0.702	0.304	3.712	1.129	0.891
		60	1	0	0	0	NONE	0.682	0.317	-0.012	1.964	1.394
13	POLYAMIDE-IMIDE	RT	0	0	0	0	NONE	0.093	0.000	-0.003	0.310	0.326
		60	1	0	0	0	NONE	0.000	-0.662	0.003	-0.150	-0.104
14	POLYAMIDE-IMIDE	RT	0	0	0	0	NONE	0.611	0.267	-0.385	0.251	0.250
		60	0	0	0	0	NONE	0.128	0.134	0.003	0.041	0.061
15	POLYETHERIMIDE	RT	0	0	0	0	NONE	0.171	1.374	-0.385	0.853	0.601
		60	0	0	0	0	NONE	-0.028	-0.266	2.344	0.409	0.319
16	MODIFIED POLYETHERIMIDE	RT	0	0	0	0	NONE	0.108	0.413	0.198	0.831	0.651
		60	1	0	0	0	NONE	0.008	0.381	0.939	0.578	0.472
17	POLYARYLEETHERKETONE	RT	0	0	0	0	NONE	-0.007	0.000	0.800	-0.543	-0.579
		60	0	0	0	0	NONE	0.062	0.000	3.159	-0.080	-0.076
18	POLYBUTYLENE TEREPHTHALATE	RT	0	0	0	0	NONE	0.216	0.135	0.000	0.701	0.508
		60	2	0	0	0	NONE	0.792	0.809	1.166	3.238	3.107
19	POLYIMIDE-DF	RT	0	0	0	0	NONE	0.421	0.447	2.956	2.019	1.569
		60	0	0	0	0	NONE	0.087	0.149	0.481	0.885	0.700
20	POLYIMIDE-DF-ISO	RT	0	0	0	0	NONE	0.147	0.303	1.980	0.770	0.622
		60	1	0	0	0	NONE	0.000	-0.151	0.500	-0.221	-0.228
21	POLY(ARYLEETHERETHERKETONE)	RT	0	0	0	0	NONE	0.043	0.135	1.187	0.055	0.011
		60	0	0	0	0	NONE	-0.014	0.270	1.956	0.046	0.064
22	LIQUID CRYSTAL POLYMER	RT	0	0	0	0	NONE	0.057	0.269	-3.381	-0.024	-0.047
		60	1	0	0	0	NONE	0.014	0.134	0.000	0.013	0.025
23	66 NYLON, POLYAMIDE	RT	0	0	0	0	NONE	0.100	0.267	2.359	1.217	0.823
		60	0	0	0	0	NONE	-0.043	0.270	1.181	0.213	0.222

^a Temperature conversions: 60°C = 140°F, RT = ambient

^b Qualitative scale: 0=no change, 1=slight, 2=swelled, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

Appendix D: Stress Crack - Creep Rupture of Plastics in 32 ISO VG Branched Acid Polyolester with Refrigerant

CREEP OF ENGINEERING PLASTICS AT AMBIENT LABORATORY CONDITIONS

[14 DAY CREEP AT 20°C IN AIR]

Table D.1

		Air equilibrium test pressure = 0 psig										time of break or start of yielding
		Creep Modulus										
NO.	TYPE	10 hours		50 hours		100 hours		200 hours		300 hours		
		ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	
1	POLYPHTHALAMIDE	4103.1	2885.7	3590.2	2525.0	2735.4	1923.8	2297.7	1616.0	2192.5	1542.0	
2	ACRYLONITRILE-BUTADIENE-STYRENE TERPOLYMER	-	-	-	-	-	-	-	-	-	-	broke @ 1 hr
3	ACETAL	937.8	659.6	662.6	466.0	491.6	345.8	484.8	340.9	427.8	300.9	
4	PHENOLIC	8611.7	6056.6	7973.8	5608.0	6624.4	4658.9	5980.3	4206.0	5382.3	3785.4	
5	POLYVINYLIDENE FLUORIDE	564.9	397.3	435.0	305.9	336.3	236.5	333.9	234.8	303.8	213.6	
6	POLYCARBONATE	2315.5	1628.5	2037.7	1433.1	1756.6	1235.4	1643.3	1155.7	1439.0	1012.1	
7	MODIFIED POLYPHENYLENE OXIDE	-	-	-	-	-	-	-	-	-	-	broke @ 7 hr
8	POLYPROPYLENE	465.3	327.2	313.8	220.7	187.4	131.8	158.7	111.6	134.9	94.9	
9	POLYARYL SULFONE	2587.0	1819.5	2525.4	1776.1	2410.6	1695.4	2209.8	1554.1	2079.8	1462.7	
10	POLYETHYLENE TEREPHTHALATE	5877.6	4133.7	5561.6	3911.5	5070.9	3566.3	4537.1	3190.9	4236.1	2979.2	
11	POLYPHENYLENESULFIDE	11073.8	7788.2	11812.1	8307.4	7816.8	5497.6	6728.4	4732.1	6482.2	4558.9	
13	POLYAMIDE-IMIDE	2792.0	1963.6	2181.2	1534.1	1745.0	1227.2	1551.1	1090.9	1454.2	1022.7	
14	POLYAMIDE-IMIDE	4105.4	2887.3	3380.9	2377.8	3380.9	2377.8	2673.3	1880.1	2445.7	1720.1	
15	POLYETHERIMIDE	1968.8	1384.6	1789.8	1258.7	1514.4	1065.1	1357.8	954.9	1270.2	893.3	
16	MODIFIED POLYETHERIMIDE	2415.2	1698.6	2131.0	1498.8	1916.8	1348.1	1595.9	1122.4	1509.5	1061.6	
17	POLYARYLEETHERKETONE	5337.7	3754.0	4981.9	3503.7	4245.9	2986.1	4151.6	2919.8	3812.7	2681.4	
18	POLYBUTYLENE TEREPHTHALATE	3429.0	2411.6	2360.2	1659.9	1489.7	1047.7	1477.5	1039.2	1366.4	961.0	
19	POLYIMIDE-DF	1165.7	819.9	998.6	702.3	867.8	610.3	838.3	589.6	798.9	561.8	
20	POLYIMIDE-DF-ISO	1387.4	975.7	1327.1	933.3	1130.5	795.0	1090.1	766.7	1000.7	703.8	
21	POLY(ARYLEETHERETHERKETONE)	5128.5	3606.9	4851.3	3411.9	3988.8	2805.3	3945.0	2774.5	3590.0	2524.8	
22	LIQUID CRYSTAL POLYMER	10672.4	7505.9	6362.4	4474.7	5950.4	4185.0	3948.0	2776.7	3615.8	2543.0	
23	66 NYLON, POLYAMIDE	819.0	576.0	585.0	411.4	438.8	308.6	402.8	283.3	366.7	257.9	

**CREEP OF ENGINEERING PLASTICS IN SYNTHETIC LUBRICANT / REFRIGERANT ENVIRONMENT
[14 DAY CREEP AT 20°C (68°F) IN 32 ISO VG BRANCHED ACID, POLYOL ESTER WITH 40% HCFC-22 (R-22) BY WEIGHT]**

Table D.2

		HCFC-22 (R-22) equilibrium test pressure = 97 psig										time of break or start of yielding
		Creep Modulus										
NO.	TYPE	10 hours		50 hours		100 hours		200 hours		300 hours		
		ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	
1	POLYPHTHALAMIDE	957.4	673.3	718.0	505.0	675.8	475.3	574.4	404.0	522.2	367.3	
2	ACRYLONITRILE-BUTADIENE-STYRENE TERPOLYMER	-	-	-	-	-	-	-	-	-	-	broke @ 1 hr
3	ACETAL	487.7	343.0	304.8	214.4	143.4	100.9	42.4	29.8	34.8	24.5	yield @ 150 hr
4	PHENOLIC	3075.6	2160.7	2870.6	2016.7	2691.2	1890.6	2691.2	1890.6	2152.9	1512.5	
5	POLYVINYLIDENE FLUORIDE	617.7	434.2	336.9	236.8	185.3	130.3	148.2	104.2	123.5	86.8	
6	POLYCARBONATE	2547.1	1790.0	1273.5	895.0	849.0	596.7	509.4	358.0	424.5	298.3	
7	MODIFIED POLYPHENYLENE OXIDE	-	-	-	-	-	-	-	-	-	-	broke @ 1 hr
8	POLYPROPYLENE	359.8	252.7	134.9	94.8	90.0	63.2	54.0	37.9	28.7	20.2	yield @ 200 hr
9	POLYARYL SULFONE	4242.7	2983.3	2447.7	1721.2	1591.0	1118.8	1060.7	745.8	795.5	559.4	
10	POLYETHYLENE TEREPHTHALATE	2068.9	1455.0	1724.1	1212.5	1477.8	1039.3	1124.4	790.8	1100.5	773.9	
11	POLYPHENYLENESULFIDE	7087.2	4983.3	5315.4	3737.5	4252.3	2990.0	4252.3	2990.0	4252.3	2990.0	
13	POLYAMIDE-IMIDE	3034.8	2133.7	2792.0	1963.0	2326.7	1635.8	1745.0	1226.9	1396.0	981.5	
14	POLYAMIDE-IMIDE	2873.8	2020.0	2498.9	1756.5	2299.0	1616.0	1642.1	1154.3	1277.2	897.8	
15	POLYETHERIMIDE	4921.9	3459.4	2316.2	1627.9	1575.0	1107.0	1193.2	838.6	960.4	675.0	
16	MODIFEID POLYETHERIMIDE	603.8	424.6	381.3	268.2	326.4	229.5	326.4	229.5	322.0	226.4	
17	POLYARYLEETHERKETONE	4670.5	3284.4	3736.4	2627.5	3736.4	2627.5	2335.3	1642.2	2075.8	1459.7	
18	POLYBUTYLENE TEREPHTHALATE	1453.9	1022.0	363.5	255.5	290.8	204.4	207.7	146.0	165.2	116.1	
19	POLYIMIDE-DF	2716.2	1910.0	1086.5	764.0	679.0	477.5	543.2	382.0	452.7	318.3	
20	POLYIMIDE-DF-ISO	3052.2	2145.0	1017.4	715.0	953.8	670.3	872.1	612.9	824.9	579.7	
21	POLY(ARYLEETHERETHERKETONE)	2991.6	2104.2	1436.0	1010.0	1196.7	841.7	1025.7	721.4	897.5	631.3	
22	LIQUID CRYSTAL POLYMER	4135.6	2906.3	3308.5	2325.0	2363.2	1660.7	1654.2	1162.5	1203.1	845.5	
23	66 NYLON, POLYAMIDE	491.4	345.5	245.7	172.8	196.6	138.2	169.4	119.1	163.8	115.2	

CREEP OF ENGINEERING PLASTICS IN SYNTHETIC LUBRICANT / REFRIGERANT ENVIRONMENT
[14 DAY CREEP AT 20°C (68°F) IN 32 ISO VG BRANCHED ACID, POLYOL ESTER WITH 40% HFC-32 (R-32) BY WEIGHT]

Table D.3

NO.	TYPE	HFC-32 (R-32) equilibrium test pressure = 215 psig										time of break or start of yielding
		Creep Modulus										
		10 hours		50 hours		100 hours		200 hours		300 hours		
	ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²		
1	POLYPHTHALAMIDE	9573.9	6733.3	3779.2	2657.9	3590.2	2525.0	2611.1	1836.4	1914.8	1346.7	
2	ACRYLONITRILE-BUTADIENE-STYRENE TERPOLYMER	-	-	-	-	-	-	-	-	-	-	broke @ 1 hr
3	ACETAL	903.1	635.2	277.1	194.9	72.8	51.2	38.5	27.1	30.0	21.1	
4	PHENOLIC	5382.3	3785.4	3363.9	2365.9	3075.6	2163.1	2949.2	2074.2	2796.0	1966.4	
5	POLYVINYLIDENE FLUORIDE	579.1	407.2	171.6	120.7	92.2	64.8	62.6	44.0	48.1	33.8	
6	POLYCARBONATE	1340.6	942.8	446.9	314.3	259.9	182.8	147.9	104.0	115.3	81.1	
7	MODIFIED POLYPHENYLENE OXIDE	-	-	-	-	-	-	-	-	-	-	broke @ 1 hr
8	POLYPROPYLENE	586.6	412.6	337.3	237.2	128.5	90.4	80.8	56.8	45.6	32.1	
9	POLYARYL SULFONE	3182.1	2237.9	1223.9	860.7	723.2	508.6	418.7	294.5	272.0	191.3	
10	POLYETHYLENE TEREPHTHALATE	6465.3	4547.1	3315.6	2331.8	2068.9	1455.1	1567.4	1102.3	1326.2	932.7	
11	POLYPHENYLENESULFIDE	7593.5	5340.5	5906.0	4153.7	4429.5	3115.3	4088.8	2875.6	3543.6	2492.2	
13	POLYAMIDE-IMIDE	9971.4	7012.9	3814.2	2682.5	2684.6	1888.1	1886.5	1326.8	1485.1	1044.5	
14	POLYAMIDE-IMIDE	9579.2	6737.0	4421.2	3109.4	2736.9	1924.9	2210.6	1554.7	1854.0	1303.9	
15	POLYETHERIMIDE	3937.5	2769.2	1875.0	1318.7	1230.5	865.4	757.2	532.5	570.7	401.3	
16	MODIFEID POLYETHERIMIDE	2415.2	1698.6	1097.8	772.1	1035.1	728.0	635.6	447.0	548.9	386.0	
17	POLYARYLEETHERKETONE	5337.7	3754.0	1779.2	1251.3	1437.1	1010.7	1098.9	772.9	889.6	625.7	
18	POLYBUTYLENE TEREPHTHALATE	3634.8	2556.3	1211.6	852.1	626.7	440.7	378.6	266.3	313.3	220.4	
19	POLYIMIDE-DF	2469.2	1736.6	603.6	424.5	352.7	248.1	148.4	104.4	116.6	82.0	
20	POLYIMIDE-DF-ISO	5087.0	3577.7	1453.4	1022.2	635.9	447.2	492.3	346.2	401.6	282.5	
21	POLY(ARYLEETHERETHERKETONE)	7179.9	5049.6	2761.5	1942.2	1994.4	1402.7	1436.0	1009.9	1087.9	765.1	
22	LIQUID CRYSTAL POLYMER	5514.1	3878.1	1946.1	1368.7	1538.8	1082.2	1524.6	1072.3	1457.5	1025.0	
23	66 NYLON, POLYAMIDE	2960.2	2081.9	1228.5	864.0	702.0	493.7	455.0	320.0	336.6	236.7	

CREEP OF ENGINEERING PLASTICS IN SYNTHETIC LUBRICANT / REFRIGERANT ENVIRONMENT
[14 DAY CREEP AT 20°C (68°F) IN 32 ISO VG BRANCHED ACID, POLYOL ESTER WITH 40% HCFC-123 (R-123) BY WEIGHT]

Table D.4

		HCFC-123 (R-123) equilibrium test pressure = 0 psi										time of break or start of yielding
		Creep Modulus										
NO.	TYPE	10 hours		50 hours		100 hours		200 hours		300 hours		
		ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	
1	POLYPHTHALAMIDE	820.6	577.1	776.3	545.9	736.5	517.9	718.0	505.0	683.9	481.0	
2	ACRYLONITRILE-BUTADIENE-STYRENE TERPOLYMER	-	-	-	-	-	-	-	-	-	-	broke @ 1 hr
3	ACETAL	1283.4	902.6	762.0	535.9	594.7	418.3	497.6	350.0	435.4	306.2	
4	PHENOLIC	19572.0	13765.0	14352.8	10094.3	12664.3	8906.8	10764.6	7570.8	9786.0	6882.5	
5	POLYVINYLIDENE FLUORIDE	741.2	521.3	500.8	352.2	421.1	296.2	378.2	266.0	343.1	241.3	
6	POLYCARBONATE	-	-	-	-	-	-	-	-	-	-	broke @ 7 hr
7	MODIFIED POLYPHENYLENE OXIDE	-	-	-	-	-	-	-	-	-	-	broke @ 1 hr
8	POLYPROPYLENE	465.3	327.2	259.5	182.5	207.6	146.0	175.2	123.2	151.6	106.6	
9	POLYARYL SULFONE	7955.1	5594.8	6917.5	4865.1	5303.4	3729.9	5216.5	3668.7	5050.9	3552.3	
10	POLYETHYLENE TEREPHTHALATE	17240.9	12125.5	12930.7	9094.2	6631.1	4663.7	6385.5	4490.9	6085.0	4279.6	
11	POLYPHENYLENESULFIDE	19686.8	13845.7	14765.1	10384.3	11073.8	7788.2	10422.4	7330.1	10029.1	7053.5	
13	POLYAMIDE-IMIDE	3490.0	2454.5	2326.7	1636.3	1994.3	1402.6	1745.0	1227.2	1586.4	1115.7	
14	POLYAMIDE-IMIDE	4789.6	3368.5	3193.1	2245.7	3025.0	2127.5	2736.9	1924.9	2498.9	1757.5	
15	POLYETHERIMIDE	3937.5	2769.2	3281.3	2307.7	2812.5	1978.0	2734.4	1923.1	2678.6	1883.8	
16	MODIFIED POLYETHERIMIDE	3293.4	2316.3	2264.2	1592.4	2012.6	1415.5	1725.1	1213.3	1509.5	1061.6	
17	POLYARYLEETHERKETONE	17792.4	12513.4	12454.7	8759.4	9341.0	6569.5	9113.2	6409.3	8689.3	6111.2	
18	POLYBUTYLENE TEREPHTHALATE	649.1	456.5	432.7	304.3	386.7	271.9	349.5	245.8	330.4	232.4	
19	POLYIMIDE-DF	1597.7	1123.7	1293.4	909.7	1180.9	830.6	1086.5	764.1	1006.0	707.5	
20	POLYIMIDE-DF-ISO	2774.8	1951.5	1849.8	1301.0	1526.1	1073.3	1453.4	1022.2	1327.1	933.3	
21	POLY(ARYLEETHERETHERKETONE)	8974.9	6312.0	8547.5	6011.5	5983.3	4208.0	5790.2	4072.3	5609.3	3945.0	
22	LIQUID CRYSTAL POLYMER	16542.3	11634.2	15754.5	11080.2	15038.4	10576.5	12724.8	8949.4	10672.4	7505.9	
23	66 NYLON, POLYAMIDE	767.8	540.0	546.0	384.0	463.6	326.0	438.8	308.6	416.4	292.9	

CREEP OF ENGINEERING PLASTICS IN SYNTHETIC LUBRICANT / REFRIGERANT ENVIRONMENT
[14 DAY CREEP AT 20°C (68°F) IN 32 ISO VG BRANCHED ACID, POLYOL ESTER WITH 40% HCFC-124 (R-124) BY WEIGHT]

Table D.5

		HCFC-124 (R-124) equilibrium test pressure = 30 psig										time of break or start of yielding
		Creep Modulus										
NO.	TYPE	10 hours		50 hours		100 hours		200 hours		300 hours		
		ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	
1	POLYPHTHALAMIDE	7180.4	5050.0	5744.4	4040.0	495.2	348.3	463.3	325.8	410.3	288.6	
2	ACRYLONITRILE-BUTADIENE-STYRENE TERPOLYMER	-	-	-	-	-	-	-	-	-	-	broke @ 1 hr
3	ACETAL	4876.8	3429.9	1393.4	980.0	937.8	659.6	717.2	504.4	650.2	457.3	
4	PHENOLIC	86117.0	60566.1	43058.5	30283.0	33121.9	23294.6	23921.4	16823.9	19572.0	13765.0	
5	POLYVINYLIDENE FLUORIDE	9264.9	6516.0	2058.9	1448.0	1158.1	814.5	1029.4	724.0	882.4	620.6	
6	POLYCARBONATE	25470.8	17913.6	16980.5	11942.4	1061.3	746.4	727.7	511.8	606.4	426.5	
7	MODIFIED POLYPHENYLENE OXIDE	-	-	-	-	-	-	-	-	-	-	broke @ 1 hr
8	POLYPROPYLENE	2698.5	1897.9	674.6	474.5	449.8	316.3	355.1	249.7	299.8	210.9	
9	POLYARYL SULFONE	63641.0	44758.7	31820.5	22379.4	21213.7	14919.6	15910.3	11189.7	12238.7	8607.4	
10	POLYETHYLENE TEREPHTHALATE	10344.6	7275.3	9404.1	6613.9	8620.5	6062.8	8342.4	5867.2	8081.7	5683.8	
11	POLYPHENYLENESULFIDE	53154.3	37383.4	22147.6	15576.4	16610.7	11682.3	12361.5	8693.8	10222.0	7189.1	
13	POLYAMIDE-IMIDE	8724.9	6136.2	3877.8	2727.2	2803.2	1971.5	2684.6	1888.1	2538.2	1785.1	
14	POLYAMIDE-IMIDE	12772.2	8982.7	5747.5	4042.2	4997.8	3515.0	4421.2	3109.4	4164.9	2929.1	
15	POLYETHERIMIDE	19687.5	13846.2	11580.9	8144.8	9375.0	6593.4	6788.8	4774.6	6057.7	4260.4	
16	MODIFEID POLYETHERIMIDE	4262.1	2997.5	4116.8	2895.3	3659.3	2573.6	3019.0	2123.2	2012.6	1415.5	
17	POLYARYLEETHERKETONE	37364.0	26278.1	24909.3	17518.7	17792.4	12513.4	13344.3	9385.0	11861.6	8342.3	
18	POLYBUTYLENE TEREPHTHALATE	1135.9	798.8	1062.8	747.5	982.4	690.9	956.5	672.7	908.7	639.1	
19	POLYIMIDE-DF	2263.5	1591.9	1697.6	1193.9	1358.1	955.1	1180.9	830.6	1044.7	734.7	
20	POLYIMIDE-DF-ISO	6104.5	4293.3	3633.6	2555.5	3052.2	2146.6	2543.5	1788.9	2260.9	1590.1	
21	POLY(ARYLEETHERETHERKETONE)	13807.5	9710.8	12821.3	9017.2	9447.2	6644.2	8974.9	6312.0	7977.7	5610.7	
22	LIQUID CRYSTAL POLYMER	22056.3	15512.2	13233.8	9307.3	7877.3	5540.1	5514.1	3878.1	3676.1	2585.4	
23	66 NYLON, POLYAMIDE	12285.0	8640.0	3510.0	2468.6	2233.6	1570.9	1965.6	1382.4	1833.6	1289.6	

**CREEP OF ENGINEERING PLASTICS IN SYNTHETIC LUBRICANT / REFRIGERANT ENVIRONMENT
[14 DAY CREEP AT 20°C (68°F) IN 32 ISO VG BRANCHED ACID, POLYOL ESTER WITH 40% HFC-125 (R-125) BY WEIGHT]**

Table D.6

		HFC-125 (R-125) equilibrium test pressure = 125 psig										time of break or start of yielding
		Creep Modulus										
NO.	TYPE	10 hours		50 hours		100 hours		200 hours		300 hours		
		ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	
1	POLYPHTHALAMIDE	8703.6	6121.2	5983.7	4208.3	5222.1	3672.7	4487.8	3156.3	3682.3	2589.7	
2	ACRYLONITRILE-BUTADIENE-STYRENE TERPOLYMER	-	-	-	-	-	-	-	-	-	-	broke @ 1 hr
3	ACETAL	1741.7	1224.9	903.1	635.2	812.8	571.6	762.0	535.9	659.0	463.5	
4	PHENOLIC	17941.0	12617.9	9786.0	6882.5	5818.7	4092.3	5251.0	3693.1	5006.8	3521.3	
5	POLYVINYLIDENE FLUORIDE	1029.4	724.0	441.2	310.3	394.3	277.3	330.9	232.7	308.8	217.2	
6	POLYCARBONATE	6367.7	4478.4	4391.5	3088.5	3396.1	2388.5	3032.2	2132.6	2799.0	1968.5	
7	MODIFIED POLYPHENYLENE OXIDE	-	-	-	-	-	-	-	-	-	-	broke @ 1 hr
8	POLYPROPYLENE	355.1	249.7	329.1	231.4	207.6	146.0	190.0	133.7	164.5	115.7	
9	POLYARYL SULFONE	9091.6	6394.1	5785.5	4069.0	4895.5	3443.0	4545.8	3197.1	3535.6	2486.6	
10	POLYETHYLENE TEREPHTHALATE	7957.3	5596.4	7284.9	5123.5	6896.4	4850.2	6085.0	4279.6	5622.0	3954.0	
11	POLYPHENYLENESULFIDE	11812.1	8307.4	8305.4	5841.2	6814.6	4792.7	5906.0	4153.7	4662.7	3279.2	
13	POLYAMIDE-IMIDE	6345.4	4462.7	3404.9	2394.6	3034.8	2134.3	2792.0	1963.6	2288.5	1609.5	
14	POLYAMIDE-IMIDE	10450.0	7349.5	4997.8	3515.0	4321.4	3039.3	3732.1	2624.8	3175.4	2233.3	
15	POLYETHERIMIDE	3579.5	2517.5	2715.5	1909.8	2187.5	1538.5	2139.9	1505.0	1806.2	1270.3	
16	MODIFIED POLYETHERIMIDE	4528.4	3184.9	2587.7	1819.9	2156.4	1516.6	1968.9	1384.7	1692.9	1190.6	
17	POLYARYLEETHERKETONE	10675.4	7508.0	5189.4	3649.7	4448.1	3128.3	4105.9	2887.7	3558.5	2502.7	
18	POLYBUTYLENE TEREPHTHALATE	7269.5	5112.6	3634.8	2556.3	2271.7	1597.7	2138.1	1503.7	2019.3	1420.2	
19	POLYIMIDE-DF	2469.2	1736.6	1697.6	1193.9	1429.6	1005.4	1293.4	909.7	1131.7	795.9	
20	POLYIMIDE-DF-ISO	4069.6	2862.2	2180.2	1533.3	1849.8	1301.0	1774.5	1248.0	1695.7	1192.6	
21	POLY(ARYLEETHERETHERKETONE)	4786.6	3366.4	3988.8	2805.3	3778.9	2657.7	3590.0	2524.8	2761.5	1942.2	
22	LIQUID CRYSTAL POLYMER	15754.5	11080.2	8706.4	6123.2	7877.3	5540.1	6892.6	4847.6	6362.4	4474.7	
23	66 NYLON, POLYAMIDE	2457.0	1728.0	1293.2	909.5	1023.8	720.0	945.0	664.6	767.8	540.0	

**CREEP OF ENGINEERING PLASTICS IN SYNTHETIC LUBRICANT / REFRIGERANT ENVIRONMENT
[14 DAY CREEP AT 20°C (68°F) IN 32 ISO VG BRANCHED ACID, POLYOL ESTER WITH 40% HFC-134 (R-134) BY WEIGHT]**

Table D.7

		HFC-134 (R-134) equilibrium test pressure = 40 psig										time of break or start of yielding
		Creep Modulus										
NO.	TYPE	10 hours		50 hours		100 hours		200 hours		300 hours		
		ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	
1	POLYPHTHALAMIDE	3590.2	2525.0	3191.3	2244.4	2497.5	1756.5	2243.9	1578.1	2143.4	1507.5	
2	ACRYLONITRILE-BUTADIENE-STYRENE TERPOLYMER	-	-	-	-	-	-	-	-	-	-	broke @ 1 hr
3	ACETAL	1625.6	1143.3	609.6	428.7	375.1	263.8	238.6	167.8	221.7	155.9	
4	PHENOLIC	3588.2	2523.6	3075.6	2163.1	2870.6	2018.9	2796.0	1966.4	2691.2	1892.7	
5	POLYVINYLIDENE FLUORIDE	1029.4	724.0	411.8	289.6	349.6	245.9	226.0	158.9	247.1	173.8	
6	POLYCARBONATE	2830.1	1990.4	1698.1	1194.2	1498.3	1053.7	1340.6	942.8	1184.7	833.2	
7	MODIFIED POLYPHENYLENE OXIDE	-	-	-	-	-	-	-	-	-	-	broke @ 1 hr
8	POLYPROPYLENE	385.5	271.1	107.9	75.9	96.4	67.8	62.8	44.1	54.0	38.0	
9	POLYARYL SULFONE	3182.1	2237.9	2272.9	1598.5	1988.8	1398.7	1767.8	1243.3	1466.4	1031.3	
10	POLYETHYLENE TEREPHTHALATE	6085.0	4279.6	3273.6	2302.3	2873.5	2020.9	2463.0	1732.2	2298.8	1616.7	
11	POLYPHENYLENESULFIDE	9325.3	6558.5	6562.3	4615.2	6253.4	4398.0	5369.1	3776.1	5062.3	3560.3	
13	POLYAMIDE-IMIDE	5816.6	4090.8	2792.0	1963.6	2492.8	1753.2	2052.9	1443.8	1813.0	1275.1	
14	POLYAMIDE-IMIDE	6386.1	4491.4	4134.9	2908.1	3831.7	2694.8	3025.0	2127.5	2612.5	1837.4	
15	POLYETHERIMIDE	7159.1	5035.0	2983.0	2097.9	2715.5	1909.8	2386.4	1678.3	2187.5	1538.5	
16	MODIFEID POLYETHERIMIDE	3622.8	2547.9	3070.1	2159.2	2551.2	1794.3	1820.5	1280.3	1503.2	1057.2	
17	POLYARYLEETHERKETONE	6026.5	4238.4	4981.9	3503.7	4017.6	2825.6	3592.7	2526.7	3396.7	2388.9	
18	POLYBUTYLENE TEREPHTHALATE	908.7	639.1	807.7	568.1	709.9	499.3	466.0	327.7	432.7	304.3	
19	POLYIMIDE-DF	2469.2	1736.6	1429.6	1005.4	1155.8	812.9	1006.0	707.5	927.0	652.0	
20	POLYIMIDE-DF-ISO	4769.1	3354.1	2347.9	1651.3	1861.1	1308.9	1606.4	1129.8	1453.4	1022.2	
21	POLY(ARYLEETHERETHERKETONE)	4487.4	3156.0	4079.5	2869.1	3945.0	2774.5	3739.5	2630.0	34190.0	24045.8	
22	LIQUID CRYSTAL POLYMER	8271.1	5817.1	5514.1	3878.1	4135.6	2908.5	3150.9	2216.0	2605.1	1832.2	
23	66 NYLON, POLYAMIDE	1638.0	1152.0	982.8	691.2	792.6	557.4	704.0	495.1	673.2	473.4	

CREEP OF ENGINEERING PLASTICS IN SYNTHETIC LUBRICANT / REFRIGERANT ENVIRONMENT
[14 DAY CREEP AT 20°C (68°F) IN 32 ISO VG BRANCHED ACID, POLYOL ESTER WITH 40% HFC-134a (R-134a) BY WEIGHT]

Table D.8

		HFC-134a (R-134a) equilibrium test pressure = 65 psig										time of break or start of yielding
		Creep Modulus										
NO.	TYPE	10 hours		50 hours		100 hours		200 hours		300 hours		
		ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	
1	POLYPHTHALAMIDE	4262.1	2997.5	3293.4	2316.3	1685.0	1185.1	1317.4	926.5	1207.6	849.3	
2	ACRYLONITRILE-BUTADIENE-STYRENE TERPOLYMER	-	-	-	-	-	-	-	-	-	-	broke @ 1 hr
3	ACETAL	3968.1	2790.7	496.0	348.8	305.2	214.7	172.5	121.3	147.0	103.4	
4	PHENOLIC	9700.5	6822.4	7760.4	5457.9	7760.4	5457.9	6467.0	4548.3	5543.2	3898.5	
5	POLYVINYLIDENE FLUORIDE	2008.0	1412.3	1362.6	958.3	1173.9	825.6	1105.9	777.8	1045.3	735.1	
6	POLYCARBONATE	22437.2	15780.1	19944.2	14026.7	17949.8	12624.1	11966.5	8416.0	9972.1	7013.4	
7	MODIFIED POLYPHENYLENE OXIDE	-	-	-	-	-	-	-	-	-	-	broke @ 1 hr
8	POLYPROPYLENE	2815.9	1980.4	938.6	660.1	603.4	424.4	412.1	289.8	367.3	258.3	
9	POLYARYL SULFONE	4300.1	3024.2	2272.9	1598.5	1272.8	895.2	521.6	366.9	442.0	310.8	
10	POLYETHYLENE TEREPHTHALATE	7389.0	5196.7	5747.0	4041.8	4310.2	3031.4	3978.7	2798.2	3232.7	2273.5	
11	POLYPHENYLENESULFIDE	6253.4	4398.0	3385.6	2381.1	2920.6	2054.0	2416.1	1699.2	2044.4	1437.8	
13	POLYAMIDE-IMIDE	13959.9	9818.0	4653.3	3272.7	3172.7	2231.4	2684.6	1888.1	2102.4	1478.6	
14	POLYAMIDE-IMIDE	11495.0	8084.4	5225.0	3674.7	3193.1	2245.7	3025.0	2127.5	2498.9	1757.5	
15	POLYETHERIMIDE	7875.0	5538.5	3028.8	2130.2	2460.9	1730.8	1875.0	1318.7	1640.6	1153.9	
16	MODIFEID POLYETHERIMIDE	7245.5	5095.8	1906.7	1341.0	1575.1	1107.8	1449.1	1019.2	1065.5	749.4	
17	POLYARYLEETHERKETONE	7472.8	5255.6	5337.7	3754.0	4670.5	3284.8	4670.5	3284.8	4395.8	3091.5	
18	POLYBUTYLENE TEREPHTHALATE	793.6	558.1	757.2	532.6	586.3	412.3	562.0	395.2	534.5	375.9	
19	POLYIMIDE-DF	3880.2	2729.0	2771.6	1949.3	2716.2	1910.3	1509.0	1061.3	1180.9	830.6	
20	POLYIMIDE-DF-ISO	7630.6	5366.6	3052.2	2146.6	2347.9	1651.3	1907.6	1341.6	1327.1	933.3	
21	POLY(ARYLEETHERETHERKETONE)	17949.8	12624.1	17949.8	12624.1	17095.0	12022.9	10558.7	7425.9	8756.0	6158.1	
22	LIQUID CRYSTAL POLYMER	8271.1	5817.1	4135.6	2908.5	3007.7	2115.3	1946.1	1368.7	1654.2	1163.4	
23	66 NYLON, POLYAMIDE	1689.5	1188.2	1305.5	918.2	667.9	469.8	522.2	367.3	478.7	336.7	

CREEP OF ENGINEERING PLASTICS IN SYNTHETIC LUBRICANT / REFRIGERANT ENVIRONMENT
[14 DAY CREEP AT 20°C (68°F) IN 32 ISO VG BRANCHED ACID, POLYOL ESTER WITH 40% HCFC-142b (R-142b) BY WEIGHT]

Table D.9

		HCFC-142b (R-142b) equilibrium test pressure = 54 psig										time of break or start of yielding
		Creep Modulus										
NO.	TYPE	10 hours		50 hours		100 hours		200 hours		300 hours		
		ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	
1	POLYPHTHALAMIDE	19147.8	13466.7	7180.4	5050.0	4103.1	2885.7	3590.2	2525.0	3191.3	2244.4	
2	ACRYLONITRILE-BUTADIENE-STYRENE TERPOLYMER	-	-	-	-	-	-	-	-	-	-	broke @ 1 hr
3	ACETAL	2438.4	1714.9	2032.0	1429.1	1434.4	1008.8	641.7	451.3	541.9	381.1	
4	PHENOLIC	30756.1	21630.7	10764.6	7570.8	5382.3	3785.4	4893.0	3441.3	4485.3	3154.5	
5	POLYVINYLIDENE FLUORIDE	2470.6	1737.6	1853.0	1303.2	1123.0	789.8	597.7	420.4	500.8	352.2	
6	POLYCARBONATE	-	-	-	-	-	-	-	-	-	-	broke @ 1 hr
7	MODIFIED POLYPHENYLENE OXIDE	-	-	-	-	-	-	-	-	-	-	broke @ 1 hr
8	POLYPROPYLENE	899.5	632.6	562.2	395.4	337.3	237.2	192.8	135.6	122.7	86.3	
9	POLYARYL SULFONE	31820.5	22379.4	7071.2	4973.2	6364.1	4475.9	4611.7	3243.4	4242.7	2983.9	
10	POLYETHYLENE TEREPHTHALATE	20689.1	14550.6	3859.9	2714.7	3642.4	2561.7	3567.1	2508.7	3425.3	2409.0	
11	POLYPHENYLENESULFIDE	13288.6	9345.8	11812.1	8307.4	10222.0	7189.1	8713.8	6128.4	830.5	584.1	
13	POLYAMIDE-IMIDE	5816.6	4090.8	5021.5	3531.7	3793.5	2667.9	2684.6	1888.1	2415.2	1698.6	
14	POLYAMIDE-IMIDE	22990.0	16168.9	10450.0	7349.5	8842.3	6218.8	7184.4	5052.8	6050.0	4255.0	
15	POLYETHERIMIDE	5250.0	3692.3	4632.4	3257.9	4375.0	3076.9	3750.0	2637.4	3336.9	2346.8	
16	MODIFIED POLYETHERIMIDE	5175.4	3639.8	3150.2	2215.5	2786.7	1959.9	2498.4	1757.2	2307.5	1622.9	
17	POLYARYLEETHERKETONE	24909.3	17518.7	18682.0	13139.1	12884.1	9061.4	10989.4	7728.9	911.3	640.9	
18	POLYBUTYLENE TEREPHTHALATE	3029.0	2130.3	1730.8	1217.3	1514.5	1065.1	1398.0	983.2	1279.8	900.1	
19	POLYIMIDE-DF	2586.8	1819.3	2562.4	1802.1	1940.1	1364.5	1822.9	1282.1	1697.6	1193.9	
20	POLYIMIDE-DF-ISO	6104.5	4293.3	3815.3	2683.3	2774.8	1951.5	2543.5	1788.9	2008.0	1412.3	
21	POLY(ARYLEETHERETHERKETONE)	71799.0	50496.2	15608.5	10977.4	13296.1	9351.2	12379.1	8706.2	11580.5	8144.6	
22	LIQUID CRYSTAL POLYMER	330845.0	232683.3	22056.3	15512.2	16542.3	11634.2	11408.4	8023.6	8483.2	5966.2	
23	66 NYLON, POLYAMIDE	3276.0	2304.0	2890.6	2033.0	2586.3	1819.0	2457.0	1728.0	2328.9	1637.9	

CREEP OF ENGINEERING PLASTICS IN SYNTHETIC LUBRICANT / REFRIGERANT ENVIRONMENT
[14 DAY CREEP AT 20°C (68°F) IN 32 ISO VG BRANCHED ACID, POLYOL ESTER WITH 40% HFC-143a (R-143a) BY WEIGHT]

Table D.10

		HFC-143a (R-143a) equilibrium test pressure = 168 psig										time of break or start of yielding
		Creep Modulus										
NO.	TYPE	10 hours		50 hours		100 hours		200 hours		300 hours		
		ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	
1	POLYPHTHALAMIDE	8975.5	6312.5	7558.4	5315.8	7364.6	5179.5	6679.5	4697.7	5983.7	4208.3	
2	ACRYLONITRILE-BUTADIENE-STYRENE TERPOLYMER	-	-	-	-	-	-	-	-	-	-	broke @ 1 hr
3	ACETAL	3251.2	2286.6	1625.6	1143.3	1219.2	857.5	677.3	476.4	580.6	408.3	
4	PHENOLIC	21529.3	15141.5	16561.0	11647.3	13712.9	9644.3	12664.3	8906.8	10764.6	7570.8	
5	POLYVINYLIDENE FLUORIDE	1372.6	965.3	1090.0	766.6	712.7	501.2	421.1	296.2	378.2	266.0	
6	POLYCARBONATE	-	-	-	-	-	-	-	-	-	-	broke @ 1 hr
7	MODIFIED POLYPHENYLENE OXIDE	-	-	-	-	-	-	-	-	-	-	broke @ 1 hr
8	POLYPROPYLENE	586.6	412.6	329.1	231.4	236.7	166.5	164.5	115.7	134.9	94.9	
9	POLYARYL SULFONE	21213.7	14919.6	17678.1	12433.0	13835.0	9730.2	10264.7	7219.1	9359.0	6582.2	
10	POLYETHYLENE TEREPHTHALATE	24629.9	17322.2	11493.9	8083.7	8620.5	6062.8	7957.3	5596.4	7284.9	5123.5	
11	POLYPHENYLENESULFIDE	26577.1	18691.7	21261.7	14953.4	17718.1	12461.1	1398.8	983.8	1084.8	762.9	
13	POLYAMIDE-IMIDE	6345.4	4462.7	3921.3	2757.9	3323.8	2337.6	2492.8	1753.2	2115.1	1487.6	
14	POLYAMIDE-IMIDE	6050.0	4255.0	4997.8	3515.0	4105.4	2887.3	3106.8	2185.0	2394.8	1684.3	
15	POLYETHERIMIDE	6152.3	4326.9	4375.0	3076.9	3937.5	2769.2	3281.3	2307.7	2938.4	2066.6	
16	MODIFEID POLYETHERIMIDE	3813.4	2682.0	3293.4	2316.3	2898.2	2038.3	2498.4	1757.2	23678.1	16652.8	
17	POLYARYLEETHERKETONE	53377.1	37540.1	24909.3	17518.7	18682.0	13139.1	8303.1	5839.6	7185.4	5053.5	
18	POLYBUTYLENE TEREPHTHALATE	18173.8	12781.6	7269.5	5112.6	5679.3	3994.2	2672.6	1879.6	1835.7	1291.1	
19	POLYIMIDE-DF	3395.2	2387.8	2469.2	1736.6	2012.0	1415.0	1719.1	1209.0	1676.6	1179.2	
20	POLYIMIDE-DF-ISO	6358.8	4472.1	4695.7	3302.5	3815.3	2683.3	2774.8	1951.5	2441.8	1717.3	
21	POLY(ARYLEETHERETHERKETONE)	47866.0	33664.2	35899.5	25248.1	27615.0	19421.6	25642.5	18034.4	18894.5	13288.5	
22	LIQUID CRYSTAL POLYMER	13233.8	9307.3	10672.4	7505.9	9730.7	6843.6	7877.3	5540.1	6751.9	4748.6	
23	66 NYLON, POLYAMIDE	1365.0	960.0	1063.6	748.1	859.4	604.4	792.6	557.4	744.5	523.6	

CREEP OF ENGINEERING PLASTICS IN SYNTHETIC LUBRICANT / REFRIGERANT ENVIRONMENT
[14 DAY CREEP AT 20°C (68°F) IN 32 ISO VG BRANCHED ACID, POLYOL ESTER WITH 40% HFC-152a (R-152a) BY WEIGHT]

Table D.11

		HFC-152a (R-152a) equilibrium test pressure = 55 psig										time of break or start of yielding
		Creep Modulus										
NO.	TYPE	10 hours		50 hours		100 hours		200 hours		300 hours		
		ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	ksi	kg/mm ²	
1	POLYPHTHALAMIDE	2051.6	1442.9	1795.1	1262.5	1689.5	1188.2	1305.5	918.2	1025.8	721.4	
2	ACRYLONITRILE-BUTADIENE-STYRENE TERPOLYMER	-	-	-	-	-	-	-	-	-	-	broke @ 1 hr
3	ACETAL	609.6	428.7	406.4	285.8	270.9	190.5	187.6	131.9	135.5	95.3	
4	PHENOLIC	10764.6	7570.8	7176.4	5047.2	4305.9	3028.3	3588.2	2523.6	2870.6	2018.9	
5	POLYVINYLIDENE FLUORIDE	264.7	186.2	154.4	108.6	123.5	86.9	100.2	70.4	82.4	57.9	
6	POLYCARBONATE	1273.5	895.7	849.0	597.1	749.1	526.9	636.8	447.8	599.3	421.5	
7	MODIFIED POLYPHENYLENE OXIDE	-	-	-	-	-	-	-	-	-	-	broke @ 1 hr
8	POLYPROPYLENE	269.9	189.8	112.4	79.1	96.4	67.8	84.3	59.3	75.0	52.7	
9	POLYARYL SULFONE	3182.1	2237.9	1272.8	895.2	1060.7	746.0	795.5	559.5	757.6	532.8	
10	POLYETHYLENE TEREPHTHALATE	5172.3	3637.7	3694.5	2598.3	3448.2	2425.1	2586.1	1818.8	2068.9	1455.1	
11	POLYPHENYLENESULFIDE	13288.6	9345.8	11812.1	8307.4	11812.1	8307.4	9664.4	6797.0	9491.8	6675.6	
13	POLYAMIDE-IMIDE	2326.7	1636.3	1623.2	1141.6	1485.1	1044.5	1269.1	892.5	1183.0	832.0	
14	POLYAMIDE-IMIDE	2873.8	2021.1	1553.4	1092.5	1306.3	918.7	1197.4	842.1	1149.5	808.4	
15	POLYETHERIMIDE	1575.0	1107.7	1230.5	865.4	1093.8	769.2	1036.2	728.7	984.4	692.3	
16	MODIFIED POLYETHERIMIDE	905.7	637.0	584.3	410.9	532.8	374.7	470.5	330.9	431.3	303.3	
17	POLYARYLEETHERKETONE	4670.5	3284.8	3113.7	2189.8	2490.9	1751.9	2335.3	1642.4	2197.9	1545.8	
18	POLYBUTYLENE TEREPHTHALATE	727.0	511.3	466.0	327.7	370.9	260.8	370.9	260.8	363.5	255.6	
19	POLYIMIDE-DF	452.7	318.4	362.2	254.7	352.7	248.1	352.7	248.1	339.5	238.8	
20	POLYIMIDE-DF-ISO	1220.9	858.7	872.1	613.3	847.8	596.3	744.4	523.6	678.3	477.0	
21	POLY(ARYLEETHERETHERKETONE)	5128.5	3606.9	3590.0	2524.8	2991.6	2104.0	2111.7	1485.2	1795.0	1262.4	
22	LIQUID CRYSTAL POLYMER	4726.4	3324.0	3676.1	2585.4	3308.5	2326.8	1654.2	1163.4	1323.4	930.7	
23	66 NYLON, POLYAMIDE	327.6	230.4	213.7	150.3	196.6	138.2	175.5	123.4	49.1	34.6	

Appendix E: Dimensional Changes After Refrigerant/Lubricant Thermal Aging

**PHYSICAL CHANGES IN PLASTICS EXPOSED TO 32 ISO VG MINERAL OIL AND HCFC-22 (R-22)
[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]**

Table E.1

NO.	TYPE	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average %	Average %	Average %	Average %
							Length Change ^c	Width Change ^c	Thickness Change ^c	Weight Change ^c
1	POLYPHTHALAMIDE	0	0	0	0	GREEN-CREAM/ALMOND	-1.24	-0.13	-0.78	-1.12
3	ACETAL	0	3	0	0	WHITE/CREAM	-3.88	-3.41	-0.79	-9.57
4	PHENOLIC	0	0	0	0	NONE	-0.61	-0.54	0.00	-3.29
5	POLYVINYLIDENE FLUORIDE	0	0	0	0	LUCITE-HAZY/CHOC.	-0.19	0.14	0.79	0.25
8	POLYPROPYLENE ^a	0	0	0	0	LUCITE-HAZY/WHITE	3.62	3.80	4.72	14.73
9	POLYARYL SULFONE	0	0	0	0	NONE	0.01	0.13	0.39	0.78
10	POLYETHYLENE TEREPHTHALATE	0	0	0	0	NONE	-0.13	-0.13	-1.56	0.67
11	POLYPHENYLENESULFIDE	0	0	0	0	NONE	-0.08	0.00	0.39	0.09
12	POLYTETRAFLUOROETHYLENE	0	0	0	0	NONE	0.66	-0.31	2.07	1.46
13	POLYAMIDE-IMIDE	0	0	0	0	NONE	-0.11	-0.13	-0.39	-0.99
14	POLYAMIDE-IMIDE	0	0	0	0	NONE	-0.04	-0.13	-0.38	-0.69
15	POLYETHERIMIDE	0	0	0	0	NONE	-0.01	0.00	0.39	0.71
16	MODIFIED POLYETHERIMIDE	0	0	0	0	NONE	-0.05	0.21	0.63	0.58
17	POLYARYLETHETERKETONE	0	0	0	0	GRAY-GREEN/BROWN	-0.06	0.00	0.39	0.17
18	POLYBUTYLENE TEREPHTHALATE	0	3	0	0	NONE	0.12	0.14	0.00	2.68
19	POLYIMIDE-DF	0	0	0	0	NONE	0.10	0.15	-0.48	0.80
20	POLYIMIDE-DF-ISO	0	0	0	0	NONE	-0.06	0.00	-0.96	-0.35
21	POLY(ARYLETHETERETHERKETONE)	0	0	0	0	NONE	0.09	0.00	0.39	0.72
22	LIQUID CRYSTAL POLYMER	0	0	0	0	NONE	0.03	0.00	0.00	0.02
23	66 NYLON, POLYAMIDE	0	0	0	0	CREAM/YELLOW	-0.40	0.00	-0.39	1.54

^a Aging temperature = 100°C (212°F)

^b Qualitative scale: 0=no change, 1=slight, 2=large, 3=dissolved, deformed or melted

^c% Change = change in before/after measurements of plastics

PHYSICAL CHANGES IN PLASTICS EXPOSED TO 32 ISO VG BRANCHED ACID POLYOL ESTER AND HFC-32 (R-32)

[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]

Table E.2

NO.	TYPE	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average %	Average %	Average %	Average %
							Length Change ^c	Width Change ^c	Thickness Change ^c	Weight Change ^c
1	POLYPHTHALAMIDE	0	0	0	0	GREEN-CREAM/ALMOND	-1.10	-0.54	-0.39	-1.29
3	ACETAL	0	0	0	0	WHITE/YELLOW	-0.01	0.14	0.79	0.37
4	PHENOLIC	0	0	0	0	NONE	-0.63	-0.40	0.00	-3.83
5	POLYVINYLIDENE FLUORIDE	0	0	0	1	LUCITE-HAZY/GRAY	1.86	2.17	2.78	3.76
8	POLYPROPYLENE ^a	0	0	0	0	NONE	0.68	0.81	1.57	2.97
9	POLYARYL SULFONE	0	0	0	0	NONE	-0.01	0.00	0.78	-0.26
10	POLYETHYLENE TEREPHTHALATE	0	0	0	0	NONE	-0.17	-0.27	0.39	-0.46
11	POLYPHENYLENESULFIDE	0	0	0	0	NONE	-0.04	-0.13	0.78	0.09
12	POLYTETRAFLUOROETHYLENE	0	0	0	0	NONE	0.08	0.73	0.38	0.23
13	POLYAMIDE-IMIDE	0	0	0	0	NONE	-0.11	-0.13	0.00	-1.41
14	POLYAMIDE-IMIDE	0	0	0	0	NONE	-0.11	-0.13	0.77	-0.80
15	POLYETHERIMIDE	0	0	0	0	NONE	-0.17	0.40	0.78	0.51
16	MODIFIED POLYETHERIMIDE	0	0	0	0	NONE	-0.03	0.00	0.63	0.32
17	POLYARYLEETHERKETONE	0	0	0	0	NONE	-0.17	0.14	0.78	-0.09
18	POLYBUTYLENE TEREPHTHALATE	1	0	0	0	NONE	-0.35	0.27	1.18	0.47
19	POLYIMIDE-DF	0	0	0	0	NONE	0.01	0.15	0.00	0.03
20	POLYIMIDE-DF-ISO	0	0	0	0	NONE	-0.12	-0.30	0.00	-0.94
21	POLY(ARYLEETHERETHERKETONE)	0	0	0	0	NONE	-0.11	0.27	0.79	-0.17
22	LIQUID CRYSTAL POLYMER	0	0	0	0	NONE	-0.03	-0.13	0.00	-0.05
23	66 NYLON, POLYAMIDE	1	0	0	0	NONE	-0.66	-0.67	0.00	-1.32

^a Aging temperature = 100°C (212°F)

^b Qualitative scale: 0=no change, 1=slight, 2=large, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

PHYSICAL CHANGES IN PLASTICS EXPOSED TO 32 ISO VG POLYPROPYLENE GLYCOL BUTYL MONO ETHER AND HFC-32 (R-32)

[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]

Table E.3

NO.	TYPE	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average %	Average %	Average %	Average %
							Length Change ^c	Width Change ^c	Thickness Change ^c	Weight Change ^c
1	POLYPHTHALAMIDE	0	0	0	0	GREEN-CREAM/CREAM	-1.19	-0.81	0.00	-1.45
3	ACETAL	1	0	0	0	WHITE/LIGHT YELLOW	-0.19	0.00	0.40	0.04
4	PHENOLIC	0	0	0	0	NONE	-0.70	-0.67	-0.77	-4.09
5	POLYVINYLIDENE FLUORIDE	0	0	0	0	LUCITE-HAZY/LT. YELLOW	0.01	0.14	1.19	0.91
8	POLYPROPYLENE ^a	0	0	0	0	WHITE/LIGHT FLESH	0.24	0.00	0.00	1.18
9	POLYARYL SULFONE	0	0	0	0	NONE	-0.17	-0.13	0.39	-0.74
10	POLYETHYLENE TEREPHTHALATE	1	0	0	0	NONE	-0.11	-0.27	0.00	-0.32
11	POLYPHENYLENESULFIDE	0	0	0	0	NONE	-0.14	-0.13	0.79	0.13
12	POLYTETRAFLUOROETHYLENE	0	0	0	0	NONE	0.14	0.21	0.00	0.30
13	POLYAMIDE-IMIDE	0	0	0	0	NONE	-0.16	0.00	0.00	-1.09
14	POLYAMIDE-IMIDE	0	0	0	0	NONE	-0.21	-0.13	0.00	-0.84
15	POLYETHERIMIDE	0	0	0	0	NONE	0.04	0.00	0.39	0.42
16	MODIFIED POLYETHERIMIDE	0	0	0	0	NONE	0.01	0.11	0.31	0.45
17	POLYARYLEETHERKETONE	0	0	0	0	NONE	-0.06	-0.14	0.39	0.09
18	POLYBUTYLENE TEREPHTHALATE	2	0	0	0	NONE	-0.65	0.00	0.00	-0.14
19	POLYIMIDE-DF	0	0	0	0	NONE	-0.16	-0.15	0.00	-0.89
20	POLYIMIDE-DF-ISO	0	0	0	0	NONE	-0.15	-0.15	0.00	-0.89
21	POLY(ARYLEETHERETHERKETONE)	0	0	0	0	NONE	0.00	0.00	0.00	0.26
22	LIQUID CRYSTAL POLYMER	0	0	0	0	NONE	-0.07	-0.13	0.01	-0.11
23	66 NYLON, POLYAMIDE	0	0	0	0	NONE	-0.69	-0.27	-0.39	-1.32

^a Aging temperature = 100°C (212°F)

^b Qualitative scale: 0=no change, 1=slight, 2=large, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

PHYSICAL CHANGES IN PLASTICS EXPOSED TO 32 ISO VG MINERAL OIL AND HCFC-123 (R-123)

[14 DAYS AT 105°C (221°F) AT 275-300 PSIA]

Table E.4

NO.	TYPE	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average %	Average %	Average %	Average %
							Length Change ^c	Width Change ^c	Thickness Change ^c	Weight Change ^c
1	POLYPHTHALAMIDE	0	0	0	0	GREEN-CREAM/ALMOND	-0.76	-1.15	0.78	0.08
3	ACETAL	0	3	0	0	WHITE/YELLOW-TAN	0.78	0.40	1.59	5.40
4	PHENOLIC	0	0	0	0	NONE	-0.01	0.00	0.00	0.33
5	POLYVINYLIDENE FLUORIDE	0	0	0	1	LUCITE-HAZY/TAN	1.72	1.57	1.59	5.10
8	POLYPROPYLENE ^a	0	0	0	0	LUCITE-HAZY/WHITE	4.73	4.32	5.56	22.59
9	POLYARYL SULFONE	0	0	0	0	NONE	-0.01	0.78	0.79	0.06
10	POLYETHYLENE TEREPHTHALATE	0	0	0	0	NONE	-0.23	0.39	0.00	4.13
11	POLYPHENYLENESULFIDE	0	0	0	0	CHOC./LIGHT-CHOC.	-0.10	0.00	-0.39	0.10
12	POLYTETRAFLUOROETHYLENE	0	0	0	0	NONE	1.45	0.01	-0.43	4.21
13	POLYAMIDE-IMIDE	0	0	0	0	NONE	0.03	0.00	-0.39	-0.09
14	POLYAMIDE-IMIDE	0	0	0	0	NONE	0.00	0.38	-0.38	0.08
15	POLYETHERIMIDE	0	0	0	0	NONE	-0.07	0.39	0.00	0.08
16	MODIFIED POLYETHERIMIDE	0	0	0	0	NONE	0.00	0.00	0.31	0.26
17	POLYARYLEETHERKETONE	0	0	0	0	NONE	-0.10	-0.38	0.00	-0.36
18	POLYBUTYLENE TEREPHTHALATE	0	0	0	0	WHITE/FLESH	1.51	1.92	2.36	8.33
19	POLYIMIDE-DF	0	0	0	0	NONE	0.01	0.00	0.00	0.02
20	POLYIMIDE-DF-ISO	0	0	0	0	NONE	-0.04	0.23	0.00	-0.62
21	POLY(ARYLEETHERETHERKETONE)	0	0	0	0	NONE	0.10	0.00	0.00	-0.02
22	LIQUID CRYSTAL POLYMER	0	0	0	0	NONE	0.20	0.79	0.79	-0.02
23	66 NYLON, POLYAMIDE	0	0	0	0	CREAM/LIGHT-BROWN	0.26	0.00	0.00	2.56

^a Aging temperature = 100°C (212°F)

^b Qualitative scale: 0=no change, 1=slight, 2=large, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

PHYSICAL CHANGES IN PLASTICS EXPOSED TO 32 ISO VG MINERAL OIL AND HCFC-123 (R-123)

[14 DAYS AT 125°C (257°F) AT 275-300 PSIA]

Table E.5

NO.	TYPE	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average % Length Change ^c	Average % Width Change ^c	Average % Thickness Change ^c	Average % Weight Change ^c
1	POLYPHTHALAMIDE	0	0	0	0	GREEN-CREAM/ALMOND	-0.86	-0.13	0.00	0.34
3	ACETAL	3	3	3	3	NONE	FAILED	FAILED	FAILED	FAILED
4	PHENOLIC	0	0	0	0	NONE	-0.06	0.27	0.77	-0.29
5	POLYVINYLIDENE FLUORIDE	0	0	0	0	LUCITE-HAZY/TAN	1.11	0.95	1.19	3.47
8	POLYPROPYLENE ^a	0	0	0	3	LUCITE-HAZY/WHITE	6.41	13.50	35.97	50.53
9	POLYARYL SULFONE	0	0	0	0	NONE	-0.09	0.13	-0.78	-0.19
10	POLYETHYLENE TEREPHTHALATE	0	0	0	0	LT.TAN/LT.BROWN	-0.18	0.54	0.79	3.19
11	POLYPHENYLENESULFIDE	0	0	0	0	CHOCOLATE/BROWN	-0.21	-0.13	0.78	0.14
12	POLYTETRAFLUOROETHYLENE	0	0	0	0	NONE	0.86	0.32	-0.41	2.14
13	POLYAMIDE-IMIDE	0	0	0	0	NONE	0.03	0.13	0.00	-0.38
14	POLYAMIDE-IMIDE	0	0	0	0	NONE	-0.06	0.27	0.00	-0.26
15	POLYETHERIMIDE	0	0	0	0	NONE	-0.30	0.00	0.00	-0.17
16	MODIFIED POLYETHERIMIDE	0	0	0	0	NONE	-0.50	-0.16	0.31	-0.47
17	POLYARYLEETHERKETONE	0	0	0	0	NONE	-0.09	-0.13	0.78	-0.19
18	POLYBUTYLENE TEREPHTHALATE	0	3	0	0	NONE	1.76	1.86	2.31	8.38
19	POLYIMIDE-DF	0	0	0	0	NONE	-0.03	0.00	-1.43	-0.18
20	POLYIMIDE-DF-ISO	0	0	0	0	NONE	-0.07	0.00	-1.43	-0.55
21	POLY(ARYLEETHERETHERKETONE)	0	0	0	0	NONE	-0.06	0.00	0.39	0.01
22	LIQUID CRYSTAL POLYMER	0	0	0	0	NONE	0.00	-0.27	0.39	-0.20
23	66 NYLON, POLYAMIDE	0	0	0	0	CREAM/LT.BROWN	0.24	0.41	0.39	2.72

^a Aging temperature = 100°C (212°F)

^b Qualitative scale: 0=no change, 1=slight, 2=large, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

PHYSICAL CHANGES IN PLASTICS EXPOSED TO 32 ISO VG ALKYL BENZENE AND HCFC-124 (R-124)

[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]

Table E.6

NO.	TYPE	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average % Length Change ^c	Average % Width Change ^c	Average % Thickness Change ^c	Average % Weight Change ^c
1	POLYPHTHALAMIDE	0	0	0	0	GREEN-CREAM/CREAM	-1.23	-1.07	-1.56	-1.93
3	ACETAL	0	0	0	0	WHITE/LIGHT YELLOW	-1.18	-0.14	-0.39	-1.24
4	PHENOLIC	0	0	0	0	NONE	-0.68	-0.94	-1.54	-4.38
5	POLYVINYLIDENE FLUORIDE	0	0	0	0	LUCITE-HAZY/LT.BROWN	0.76	1.08	0.39	2.80
8	POLYPROPYLENE ^a	0	0	0	1	NONE	3.13	3.39	3.11	14.39
9	POLYARYL SULFONE	0	0	0	0	NONE	-0.04	-0.26	0.39	-0.54
10	POLYETHYLENE TEREPHTHALATE	1	0	0	0	NONE	-0.14	-0.26	-1.56	-0.41
11	POLYPHENYLENESULFIDE	0	0	0	0	CHOCOLATE/BROWN	-0.24	-1.06	0.00	-0.03
12	POLYTETRAFLUOROETHYLENE	0	0	0	0	NONE	0.04	0.30	0.38	0.21
13	POLYAMIDE-IMIDE	0	0	0	0	NONE	-0.33	-0.26	-0.77	-1.67
14	POLYAMIDE-IMIDE	0	0	0	0	NONE	-0.38	-1.58	-0.76	-1.32
15	POLYETHERIMIDE	0	0	0	0	NONE	0.00	0.00	0.00	-0.57
16	MODIFIED POLYETHERIMIDE	0	0	0	0	NONE	-0.17	-0.74	0.16	-0.47
17	POLYARYLETHETERKETONE	0	0	0	0	GREY-GREEN/DARKER	-0.09	0.00	0.00	-0.38
18	POLYBUTYLENE TEREPHTHALATE	1	0	0	0	WHITE/LIGHT PEACH	-0.04	0.00	0.00	1.64
19	POLYIMIDE-DF	0	0	0	0	NONE	-0.09	0.00	0.00	-0.96
20	POLYIMIDE-DF-ISO	0	0	0	0	NONE	-0.09	0.00	-0.49	-0.90
21	POLY(ARYLETHETERETHERKETONE)	0	0	0	0	NONE	-0.43	-0.94	0.00	0.02
22	LIQUID CRYSTAL POLYMER	0	0	0	0	NONE	0.04	0.00	0.00	-0.08
23	66 NYLON, POLYAMIDE	1	0	0	0	CREAM/GREY	-0.22	0.40	0.00	-0.07

^a Aging temperature = 100°C (212°F)

^b Qualitative scale: 0=no change, 1=slight, 2=large, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

PHYSICAL CHANGES IN PLASTICS EXPOSED TO 32 ISO VG MODIFIED POLYGLYCOL AND HFC-125 (R-125)

[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]

Table E.7

NO.	TYPE	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average %	Average %	Average %	Average %
							Length Change ^c	Width Change ^c	Thickness Change ^c	Weight Change ^c
1	POLYPHTHALAMIDE	0	0	0	0	GREEN-CREAM/CREAM	-1.30	-1.74	-4.87	-1.75
3	ACETAL	0	0	0	0	WHITE/YELLOW	-2.72	-2.59	-1.59	-5.48
4	PHENOLIC	0	0	0	0	NONE	-0.81	-2.64	-0.38	-4.48
5	POLYVINYLIDENE FLUORIDE	0	0	0	0	LUCITE-HAZY/BROWN	-0.07	-0.41	0.79	1.12
8	POLYPROPYLENE ^a	0	0	0	0	NONE	0.12	-1.34	0.00	1.33
9	POLYARYL SULFONE	0	0	0	0	NONE	-0.20	-1.46	-0.39	-0.86
10	POLYETHYLENE TEREPHTHALATE	0	0	0	0	LT. TAN/TAN	-0.31	-0.53	-0.78	-0.39
11	POLYPHENYLENESULFIDE	0	0	0	0	CHOCOLATE/BROWN	-0.24	-1.19	0.00	-0.03
12	POLYTETRAFLUOROETHYLENE	0	0	0	0	NONE	0.38	-3.03	0.00	0.86
13	POLYAMIDE-IMIDE	0	0	0	0	NONE	-0.19	-1.06	0.00	-1.57
14	POLYAMIDE-IMIDE	0	0	0	0	NONE	-0.14	-1.19	-0.77	-1.16
15	POLYETHERIMIDE	0	0	0	0	NONE	-0.19	-1.33	0.00	-0.58
16	MODIFIED POLYETHERIMIDE	0	0	0	0	NONE	-0.18	-0.90	-0.47	-0.62
17	POLYARYLEETHERKETONE	0	0	0	0	NONE	-0.17	-0.80	-0.39	-0.38
18	POLYBUTYLENE TEREPHTHALATE	2	0	0	0	WHITE/CREAM	-0.56	-0.40	-0.38	0.06
19	POLYIMIDE-DF	0	0	0	0	NONE	-0.12	-0.15	0.00	-0.93
20	POLYIMIDE-DF-ISO	0	0	0	0	NONE	-0.18	-1.81	0.00	-0.97
21	POLY(ARYLEETHERETHERKETONE)	0	0	0	0	NONE	-0.09	-1.98	0.39	-0.21
22	LIQUID CRYSTAL POLYMER	0	0	0	0	LT. TAN/TAN	-0.10	-0.27	0.00	-0.07
23	66 NYLON, POLYAMIDE	0	0	0	1	CREAM/DARKER	-0.60	-1.87	-3.79	-1.34

^a Aging temperature = 100°C (212°F)

^b Qualitative scale: 0=no change, 1=slight, 2=large, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

**PHYSICAL CHANGES IN PLASTICS EXPOSED TO 32 ISO VG BRANCHED ACID POLYOL ESTER AND HFC-125
[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]**

Table E.8

NO.	TYPE	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average % Length Change ^c	Average % Width Change ^c	Average % Thickness Change ^c	Average % Weight Change ^c
1	POLYPHTHALAMIDE	0	0	0	0	GREEN-CREAM/CREAM	-1.20	-1.33	-0.39	-1.77
3	ACETAL	0	0	0	0	WHITE/LT. YELLOW	0.10	-0.27	0.79	0.56
4	PHENOLIC	0	0	0	0	NONE	-0.71	-2.12	-0.77	-4.56
5	POLYVINYLIDENE FLUORIDE	0	0	0	1	LUCITE-HAZY/DARKER	-2.02	-1.19	0.78	2.76
8	POLYPROPYLENE ^a	0	0	0	0	NONE	0.91	0.68	1.58	3.61
9	POLYARYL SULFONE	0	0	0	0	NONE	-0.11	-0.93	0.00	-0.83
10	POLYETHYLENE TEREPHTHALATE	0	0	0	0	NONE	-0.24	-0.53	0.00	-0.60
11	POLYPHENYLENESULFIDE	0	0	0	0	CHOCOLATE/BROWN	2.83	1.35	0.79	-0.05
12	POLYTETRAFLUOROETHYLENE	0	0	0	0	NONE	-0.18	-0.10	0.00	0.72
13	POLYAMIDE-IMIDE	0	0	0	0	NONE	-0.26	-0.80	0.00	-1.64
14	POLYAMIDE-IMIDE	0	0	0	0	NONE	-0.11	-1.06	-0.38	-1.29
15	POLYETHERIMIDE	0	0	0	0	NONE	-0.09	-0.66	0.39	-0.66
16	MODIFIED POLYETHERIMIDE	0	0	0	0	NONE	-0.14	-0.64	0.47	-0.55
17	POLYARYLEETHERKETONE	0	0	0	0	NONE	-0.24	-0.81	0.00	-0.41
18	POLYBUTYLENE TEREPHTHALATE	1	0	0	0	NONE	-0.37	-0.67	0.00	0.16
19	POLYIMIDE-DF	0	0	0	0	NONE	-0.10	0.15	0.49	-0.96
20	POLYIMIDE-DF-ISO	0	0	0	0	NONE	-0.10	0.00	0.00	-0.96
21	POLY(ARYLEETHERETHERKETONE)	0	0	0	0	NONE	-0.06	-0.54	0.00	-0.25
22	LIQUID CRYSTAL POLYMER	0	0	0	0	NONE	-0.04	-0.80	0.00	-0.09
23	66 NYLON, POLYAMIDE	0	0	0	0	NONE	-0.66	-1.20	0.00	-1.79

^a Aging temperature = 100°C (212°F)

^b Qualitative scale: 0=no change, 1=slight, 2=large, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

PHYSICAL CHANGES IN PLASTICS EXPOSED TO 32 ISO VG POLYPROPYLENE GLYCOL BUTYL MONO ETHER AND HFC-125 (R-125)

[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]

Table E.9

NO.	TYPE	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average % Length Change ^c	Average % Width Change ^c	Average % Thickness Change ^c	Average % Weight Change ^c
1	POLYPHTHALAMIDE	0	0	0	0	GREEN-CREAM/CREAM	-1.30	-0.81	-1.17	-1.77
3	ACETAL	0	0	0	0	WHITE/YELLOW	-0.85	-0.27	0.00	-0.05
4	PHENOLIC	0	0	0	0	NONE	-0.92	-1.21	-0.77	-3.82
5	POLYVINYLIDENE FLUORIDE	0	0	0	0	LUCITE-HAZY/YELLOW	-0.01	0.00	0.79	1.25
8	POLYPROPYLENE ^a	0	0	0	0	NONE	0.19	-0.14	0.40	1.40
9	POLYARYL SULFONE	0	0	0	0	NONE	-0.20	-0.40	0.00	-0.84
10	POLYETHYLENE TEREPHTHALATE	0	0	0	0	NONE	0.04	-0.27	0.00	-0.57
11	POLYPHENYLENESULFIDE	0	0	0	0	CHOCOLATE/BROWN	-0.16	-0.79	0.00	-0.06
12	POLYTETRAFLUOROETHYLENE	0	0	0	0	NONE	0.30	0.22	0.00	0.92
13	POLYAMIDE-IMIDE	0	0	0	0	NONE	-0.19	-0.27	0.00	-1.40
14	POLYAMIDE-IMIDE	0	0	0	0	NONE	-0.16	-0.27	0.00	-1.06
15	POLYETHERIMIDE	0	0	0	0	NONE	-0.31	-0.53	0.01	-0.54
16	MODIFIED POLYETHERIMIDE	0	0	0	0	NONE	-0.09	-0.11	0.16	-0.50
17	POLYARYLEETHERKETONE	0	0	0	0	NONE	-0.09	0.00	0.00	-0.42
18	POLYBUTYLENE TEREPHTHALATE	1	0	0	0	WHITE/LT.PINK	-0.53	-0.40	0.00	0.12
19	POLYIMIDE-DF	0	0	0	0	NONE	-0.12	0.15	0.00	-0.83
20	POLYIMIDE-DF-ISO	0	0	0	0	NONE	-0.09	-0.30	0.00	-0.77
21	POLY(ARYLEETHERETHERKETONE)	0	0	0	0	NONE	-0.14	-0.54	0.39	-0.21
22	LIQUID CRYSTAL POLYMER	0	0	0	0	NONE	-0.01	0.00	0.00	-0.08
23	66 NYLON, POLYAMIDE	0	0	0	0	NONE	-0.75	-0.67	0.00	-1.45

^a Aging temperature = 100°C (212°F)

^b Qualitative scale: 0=no change, 1=slight, 2=large, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

PHYSICAL CHANGES IN PLASTICS EXPOSED TO 32 ISO VG BRANCHED ACID POLYOL ESTER AND HFC-134 (R-134)

[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]

Table E.10

NO.	TYPE	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average %	Average %	Average %	Average %
							Length Change ^c	Width Change ^c	Thickness Change ^c	Weight Change ^c
1	POLYPHTHALAMIDE	0	0	0	0	GREEN-CREAM/CREAM	-1.20	-1.99	-0.39	-1.50
3	ACETAL	1	0	0	0	WHITE/YELLOW	0.45	-0.14	0.79	1.93
4	PHENOLIC	0	0	0	0	NONE	-0.65	-3.27	-0.38	-4.06
5	POLYVINYLIDENE FLUORIDE	0	0	0	1	LUCITE-HAZY/GREY	1.47	1.22	4.37	3.53
8	POLYPROPYLENE ^a	0	0	0	1	LUCITE-HAZY/WHITE	0.78	0.13	0.79	3.95
9	POLYARYL SULFONE	0	0	0	0	NONE	-0.20	0.00	0.00	-0.55
10	POLYETHYLENE TEREPHTHALATE	0	0	0	0	LT. TAN/LIGHTER	-0.16	-1.98	-0.39	0.50
11	POLYPHENYLENESULFIDE	0	0	0	0	CHOCOLATE/BROWN	-0.21	-1.19	0.00	-0.06
12	POLYTETRAFLUOROETHYLENE	0	0	0	0	NONE	0.33	-0.40	0.84	0.95
13	POLYAMIDE-IMIDE	0	0	0	0	NONE	-0.31	-0.40	0.39	-1.52
14	POLYAMIDE-IMIDE	0	0	0	0	NONE	-0.18	-1.06	-0.38	-1.05
15	POLYETHERIMIDE	0	0	0	0	NONE	-0.09	-0.80	0.00	-0.23
16	MODIFIED POLYETHERIMIDE	0	0	0	0	NONE	-0.07	-0.32	1.58	-0.28
17	POLYETHERKETONE	0	0	0	0	NONE	-0.19	-1.99	0.00	-0.29
18	POLYBUTYLENE TEREPHTHALATE	2	0	0	0	NONE	0.00	-1.85	0.39	1.64
19	POLYIMIDE-DF	0	0	0	0	NONE	-0.07	0.15	0.00	-0.50
20	POLYIMIDE-DF-ISO	0	0	0	0	NONE	-0.09	0.15	-0.48	-0.79
21	POLY(ARYLETHETHERETHERKETONE)	0	0	0	0	NONE	-0.24	-0.13	-0.39	-0.23
22	LIQUID CRYSTAL POLYMER	0	0	0	0	NONE	0.01	-1.19	0.39	-0.07
23	66 NYLON, POLYAMIDE	1	0	0	0	NONE	-0.66	-2.12	0.00	-0.89

^a Aging temperature = 100°C (212°F)

^b Qualitative scale: 0=no change, 1=slight, 2=large, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

PHYSICAL CHANGES IN PLASTICS EXPOSED TO 32 ISO VG MODIFIED POLYGLYCOL AND HFC-134a (R-134a)

[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]

Table E.11

NO.	TYPE	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average %	Average %	Average %	Average %
							Length Change ^c	Width Change ^c	Thickness Change ^c	Weight Change ^c
1	POLYPHTHALAMIDE	0	0	0	0	GREEN-CREAM/ALMOND	-1.10	-0.67	0.00	-1.40
3	ACETAL	0	0	0	1	WHITE/YELLOW	-4.07	-2.88	-0.40	-9.22
4	PHENOLIC	0	0	0	0	NONE	-0.61	-1.07	-0.38	-3.94
5	POLYVINYLIDENE FLUORIDE	0	0	0	1	LUCITE-HAZY/BROWN	0.12	0.82	1.20	1.49
8	POLYPROPYLENE ^a	0	0	0	0	NONE	0.27	0.14	0.79	1.78
9	POLYARYL SULFONE	0	0	0	0	NONE	-0.28	1.07	0.00	-0.54
10	POLYETHYLENE TEREPHTHALATE	0	0	0	0	NONE	-0.11	-0.67	0.00	-0.07
11	POLYPHENYLENESULFIDE	0	0	0	0	NONE	-0.14	-0.40	0.00	0.09
12	POLYTETRAFLUOROETHYLENE	0	0	0	0	NONE	0.28	-0.10	0.81	1.61
13	POLYAMIDE-IMIDE	0	0	0	0	NONE	-0.17	-0.40	0.00	-1.35
14	POLYAMIDE-IMIDE	0	0	0	0	NONE	-0.01	-0.13	0.00	-1.24
15	POLYETHERIMIDE	0	0	0	0	NONE	-0.13	-0.27	0.78	-0.37
16	MODIFIED POLYETHERIMIDE	0	0	0	0	NONE	-0.17	0.16	0.63	-0.44
17	POLYARYLEETHERKETONE	0	0	0	0	DARKER EDGES	-0.07	0.00	0.00	-0.29
18	POLYBUTYLENE TEREPHTHALATE	0	0	0	0	WHITE/ALMOND	-0.56	-0.14	0.00	0.16
19	POLYIMIDE-DF	0	0	0	0	NONE	-0.10	-0.89	0.00	-0.70
20	POLYIMIDE-DF-ISO	0	0	0	0	NONE	-0.10	0.00	-0.48	-0.91
21	POLY(ARYLEETHERETHERKETONE)	0	0	0	0	NONE	-0.21	-0.27	0.00	-0.17
22	LIQUID CRYSTAL POLYMER	0	0	0	0	NONE	-0.04	0.00	0.00	-0.01
23	66 NYLON, POLYAMIDE	0	0	0	0	CREAM/LIGHT TAN	-0.01	-0.67	0.00	-0.82

^a Aging temperature = 100°C (212°F)

^b Qualitative scale: 0=no change, 1=slight, 2=large, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

PHYSICAL CHANGES IN PLASTICS EXPOSED TO 32 ISO VG POLYPROPYLENE GLYCOL DIOL AND HFC-134a (R-134a)

[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]

Table E.12

NO.	TYPE	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average %	Average %	Average %	Average %
							Length Change ^c	Width Change ^c	Thickness Change ^c	Weight Change ^c
1	POLYPHTHALAMIDE	0	0	0	0	GREEN-CREAM/ALMOND	-1.04	-0.40	-1.92	-1.39
3	ACETAL	0	0	0	1	WHITE/LT. YELLOW	0.53	0.68	-3.03	0.50
4	PHENOLIC	0	0	0	0	NONE	-0.64	-0.80	-1.90	-3.96
5	POLYVINYLIDENE FLUORIDE	0	0	0	0	LUCITE/TAN	1.56	1.63	0.41	3.62
8	POLYPROPYLENE ^a	0	0	0	0	NONE	0.70	0.54	0.00	3.84
9	POLYARYL SULFONE	0	0	0	0	NONE	0.03	0.00	-1.52	-0.46
10	POLYETHYLENE TEREPHTHALATE	0	0	0	0	NONE	-0.01	0.54	-0.78	0.83
11	POLYPHENYLENESULFIDE	0	0	0	0	CHOCOLATE/LIGHTER	-0.08	0.13	-1.88	0.09
12	POLYTETRAFLUOROETHYLENE	0	0	0	0	NONE	0.38	0.00	-1.48	2.10
13	POLYAMIDE-IMIDE	0	0	0	0	NONE	0.04	-0.53	-0.38	-1.41
14	POLYAMIDE-IMIDE	0	0	0	0	NONE	0.11	-0.13	-1.90	-0.84
15	POLYETHERIMIDE	0	1	0	0	NONE	0.27	0.00	-1.90	-0.34
16	MODIFIED POLYETHERIMIDE	0	1	0	0	NONE	-0.07	-0.21	-0.46	-0.29
17	POLYARYLEETHERKETONE	0	0	0	0	NONE	0.04	-0.13	-1.92	-0.33
18	POLYBUTYLENE TEREPHTHALATE	0	3	0	0	WHITE/FLESH	0.84	0.81	-1.52	3.52
19	POLYIMIDE-DF	0	0	0	0	NONE	-0.03	-0.15	-3.28	-0.64
20	POLYIMIDE-DF-ISO	0	0	0	0	NONE	-0.10	-0.15	-2.37	-0.88
21	POLY(ARYLEETHERETHERKETONE)	0	0	0	0	NONE	-0.01	0.13	-3.77	-0.08
22	LIQUID CRYSTAL POLYMER	0	0	0	0	NONE	0.06	-0.27	-0.78	-0.17
23	66 NYLON, POLYAMIDE	0	0	0	0	NONE	-0.37	0.14	-1.54	-0.59

^a Aging temperature = 100°C (212°F)

^b Qualitative scale: 0=no change, 1=slight, 2=large, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

PHYSICAL CHANGES IN PLASTICS EXPOSED TO 32 ISO VG BRANCHED ACID POLYOL ESTER AND HFC-134a (R-134a)

[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]

Table E.13

NO.	TYPE	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average %	Average %	Average %	Average %
							Length Change ^c	Width Change ^c	Thickness Change ^c	Weight Change ^c
1	POLYPHTHALAMIDE	0	0	0	0	GREEN-CREAM/ALMOND	-1.21	-0.81	-0.78	-1.85
3	ACETAL	0	0	0	0	WHITE/CREAM	0.16	0.21	0.79	0.82
4	PHENOLIC	0	0	0	0	NONE	-0.64	-0.80	-0.38	-4.12
5	POLYVINYLIDENE FLUORIDE	0	0	0	0	LUCITE-HAZY/GRAY	0.98	1.22	1.59	2.26
8	POLYPROPYLENE ^a	0	0	0	0	NONE	0.99	0.81	0.79	4.15
9	POLYARYL SULFONE	0	0	0	0	NONE	-0.23	0.00	0.00	-0.79
10	POLYETHYLENE TEREPHTHALATE	0	0	0	0	NONE	-0.06	-0.27	0.00	0.06
11	POLYPHENYLENESULFIDE	0	0	0	0	NONE	-0.11	-0.13	0.79	0.02
12	POLYTETRAFLUOROETHYLENE	0	0	0	0	NONE	0.40	-0.10	0.42	1.04
13	POLYAMIDE-IMIDE	0	0	0	0	NONE	-0.10	-0.13	0.00	-1.43
14	POLYAMIDE-IMIDE	0	0	0	0	NONE	-0.10	0.00	0.00	-0.96
15	POLYETHERIMIDE	0	0	0	0	NONE	-0.13	-0.40	0.00	-0.36
16	MODIFIED POLYETHERIMIDE	0	0	0	0	NONE	-0.08	-0.11	0.47	-0.34
17	POLYARYLEETHERKETONE	0	0	0	0	NONE	-0.24	0.00	0.00	-0.28
18	POLYBUTYLENE TEREPHTHALATE	0	0	0	0	NONE	-0.27	0.00	0.38	0.84
19	POLYIMIDE-DF	0	0	0	0	NONE	-0.07	0.00	0.00	-0.55
20	POLYIMIDE-DF-ISO	0	0	0	0	NONE	-0.15	0.00	0.00	-0.82
21	POLY(ARYLEETHERETHERKETONE)	0	0	0	0	NONE	-0.20	-0.27	0.78	-0.15
22	LIQUID CRYSTAL POLYMER	0	0	0	0	NONE	-0.01	-0.13	0.39	-0.05
23	66 NYLON, POLYAMIDE	0	0	0	0	NONE	-0.78	-0.67	0.00	-1.71

^a Aging temperature = 100°C (212°F)

^b Qualitative scale: 0=no change, 1=slight, 2=large, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

PHYSICAL CHANGES IN PLASTICS EXPOSED TO 22 ISO VG MIXED-ACID POLYOL ESTER AND HFC-134a (R-134a)

[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]

Table E.14

NO.	TYPE	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average %	Average %	Average %	Average %
							Length Change ^c	Width Change ^c	Thickness Change ^c	Weight Change ^c
1	POLYPHTHALAMIDE	0	0	0	0	GREEN-CREAM/ALMOND	-1.17	-0.54	0.00	-1.61
3	ACETAL	0	0	0	0	WHITE/YELLOW	-0.19	0.41	0.80	-0.08
4	PHENOLIC	0	0	0	0	NONE	-0.74	-0.67	0.00	-4.33
5	POLYVINYLIDENE FLUORIDE	0	0	0	0	LUCITE-HAZY/YELLOWED	0.95	1.09	2.00	2.32
8	POLYPROPYLENE ^a	0	0	0	0	NONE	1.01	1.22	1.59	4.37
9	POLYARYL SULFONE	0	0	0	0	NONE	-0.17	-0.13	0.79	-0.77
10	POLYETHYLENE TEREPHTHALATE	0	0	0	0	NONE	-0.09	0.14	0.40	-0.04
11	POLYPHENYLENESULFIDE	0	0	0	0	NONE	-0.21	0.27	0.79	0.11
12	POLYTETRAFLUOROETHYLENE	0	0	0	0	NONE	0.22	0.41	1.63	0.75
13	POLYAMIDE-IMIDE	0	0	0	0	NONE	0.10	0.00	0.00	-1.49
14	POLYAMIDE-IMIDE	0	0	0	0	NONE	-0.11	0.00	0.00	-1.03
15	POLYETHERIMIDE	0	0	0	0	NONE	0.01	0.00	1.18	-0.43
16	MODIFIED POLYETHERIMIDE	0	0	0	0	NONE	-0.25	0.00	1.10	-0.40
17	POLYARYLEETHERKETONE	0	0	0	0	NONE	-0.10	0.14	1.18	-0.26
18	POLYBUTYLENE TEREPHTHALATE	0	0	0	0	NONE	-0.33	0.00	1.56	0.66
19	POLYIMIDE-DF	0	0	0	0	NONE	-0.15	-0.30	-0.48	-0.89
20	POLYIMIDE-DF-ISO	0	0	0	0	NONE	-0.12	0.00	0.00	-0.81
21	POLY(ARYLEETHERETHERKETONE)	0	0	0	0	NONE	-0.07	0.41	1.19	-0.07
22	LIQUID CRYSTAL POLYMER	0	0	0	0	NONE	0.00	-0.13	0.39	-0.01
23	66 NYLON, POLYAMIDE	0	0	0	0	NONE	-0.59	-0.27	0.39	-1.04

^a Aging temperature = 100°C (212°F)

^b Qualitative scale: 0=no change, 1=slight, 2=large, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

PHYSICAL CHANGES IN PLASTICS EXPOSED TO 32 ISO VG POLYPROPYLENE GLYCOL BUTYL MONO ETHER AND HFC-134a (R-134a)

[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]

Table E.15

NO.	TYPE	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average %	Average %	Average %	Average %
							Length Change ^c	Width Change ^c	Thickness Change ^c	Weight Change ^c
1	POLYPHTHALAMIDE	0	0	0	0	GREEN-CREAM/ALMOND	-1.07	-0.67	-1.17	-1.26
3	ACETAL	0	0	0	0	WHITE/LIGHT YELLOW	-0.70	-0.27	-0.39	-1.13
4	PHENOLIC	0	0	0	0	NONE	-0.57	-0.94	-1.16	-4.60
5	POLYVINYLIDENE FLUORIDE	0	0	0	0	LUCITE/TAN	0.61	1.09	-0.78	2.05
8	POLYPROPYLENE ^a	0	0	0	0	NONE	0.58	0.54	-1.54	3.00
9	POLYARYL SULFONE	0	0	0	0	NONE	-0.20	-0.13	0.78	-0.66
10	POLYETHYLENE TEREPHTHALATE	0	0	0	0	NONE	0.06	0.40	-0.78	0.54
11	POLYPHENYLENESULFIDE	0	0	0	0	CHOCOLATE/LIGHTER	-0.08	0.27	-1.53	0.00
12	POLYTETRAFLUOROETHYLENE	0	0	0	0	NONE	0.32	0.61	0.00	0.86
13	POLYAMIDE-IMIDE	0	0	0	0	NONE	0.27	-0.13	-4.07	-1.45
14	POLYAMIDE-IMIDE	0	0	0	0	NONE	0.03	-0.13	0.00	-0.88
15	POLYETHERIMIDE	0	0	0	0	NONE	0.26	0.27	-0.77	-0.67
16	MODIFIED POLYETHERIMIDE	0	0	0	0	NONE	0.00	0.11	-0.61	-0.27
17	POLYARYLEETHERKETONE	0	0	0	0	NONE	-0.07	-0.27	0.00	-0.31
18	POLYBUTYLENE TEREPHTHALATE	0	0	0	0	WHITE/FLESH	-0.56	-0.54	-1.53	0.56
19	POLYIMIDE-DF	0	0	0	0	NONE	-0.03	0.00	-0.96	-0.59
20	POLYIMIDE-DF-ISO	0	0	0	0	NONE	-0.10	0.00	-0.48	-0.84
21	POLY(ARYLEETHERETHERKETONE)	0	0	0	0	NONE	0.01	0.13	-0.78	-0.01
22	LIQUID CRYSTAL POLYMER	0	0	0	0	NONE	0.07	-0.27	-1.17	-0.03
23	66 NYLON, POLYAMIDE	0	0	0	0	NONE	-0.24	-0.27	-1.16	-0.94

^a Aging temperature = 100°C (212°F)

^b Qualitative scale: 0=no change, 1=slight, 2=large, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

**PHYSICAL CHANGES IN PLASTICS EXPOSED TO 32 ISO VG ALKYL BENZENE AND HCFC-142b (R-142b)
[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]**

Table E.16

NO.	TYPE	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average % Length Change ^c	Average % Width Change ^c	Average % Thickness Change ^c	Average % Weight Change ^c
1	POLYPHTHALAMIDE	0	0	0	0	GREEN-CREAM/CREAM	-1.26	-0.67	-0.39	-1.55
3	ACETAL	0	0	0	0	WHITE/LT. YELLOW	-0.60	-0.41	0.00	-0.69
4	PHENOLIC	0	0	0	0	NONE	-0.48	-1.46	-0.38	-2.65
5	POLYVINYLIDENE FLUORIDE	0	0	0	0	LUCITE-HAZY/YEL-BR'N	0.90	1.63	1.19	2.54
8	POLYPROPYLENE ^a	0	0	0	0	LUCITE-HAZY/WHITE	3.59	3.78	4.33	15.13
9	POLYARYL SULFONE	0	0	0	0	NONE	-0.13	0.00	0.78	-0.58
10	POLYETHYLENE TEREPHTHALATE	2	0	0	0	LIGHT TAN/LIGHTER	0.31	-0.26	0.00	0.62
11	POLYPHENYLENESULFIDE	0	0	0	0	CHOCOLATE/BROWN	-0.20	-0.53	0.39	0.30
12	POLYTETRAFLUOROETHYLENE	0	0	0	0	NONE	0.32	-0.91	2.09	1.22
13	POLYAMIDE-IMIDE	0	0	0	0	NONE	-0.16	0.00	-0.39	-1.53
14	POLYAMIDE-IMIDE	0	0	0	0	NONE	-0.11	-0.26	0.00	-1.20
15	POLYETHERIMIDE	0	0	0	0	NONE	-0.20	0.00	0.00	-0.37
16	MODIFIED POLYETHERIMIDE	0	0	0	0	NONE	-0.11	-0.48	0.94	-0.29
17	POLYARYLEETHERKETONE	0	0	0	0	NONE	-0.07	0.53	0.39	-0.29
18	POLYBUTYLENE TEREPHTHALATE	1	0	0	0	WHITE/LIGHT FLESH	0.06	0.27	0.00	1.73
19	POLYIMIDE-DF	0	0	0	0	NONE	0.06	0.30	0.00	-0.31
20	POLYIMIDE-DF-ISO	0	0	0	0	NONE	-0.13	0.00	0.00	-0.86
21	POLY(ARYLEETHERETHERKETONE)	0	0	0	0	NONE	-0.21	-0.67	0.78	0.10
22	LIQUID CRYSTAL POLYMER	0	0	0	0	NONE	0.06	-0.13	-0.39	-0.06
23	66 NYLON, POLYAMIDE	1	0	0	0	NONE	-0.80	-1.73	0.01	-1.73

^a Aging temperature = 100°C (212°F)

^b Qualitative scale: 0=no change, 1=slight, 2=large, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

PHYSICAL CHANGES IN PLASTICS EXPOSED TO 32 ISO VG BRANCHED ACID POLYOL ESTER AND HFC-143a (R-143a)

[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]

Table E.17

NO.	TYPE	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average % Length Change ^c	Average % Width Change ^c	Average % Thickness Change ^c	Average % Weight Change ^c
1	POLYPHTHALAMIDE	0	0	0	0	GREEN-CREAM/CREAM	-1.23	-1.34	0.00	-1.63
3	ACETAL	1	0	0	0	WHITE/LT. YELLOW	0.10	-0.40	1.19	0.73
4	PHENOLIC	0	0	0	0	NONE	-0.97	-2.24	-0.77	-4.18
5	POLYVINYLIDENE FLUORIDE	0	0	0	0	LUCITE-HAZY/GREY	1.21	1.08	2.38	2.64
8	POLYPROPYLENE ^a	0	0	0	1	NONE	0.75	0.68	0.39	4.00
9	POLYARYL SULFONE	0	0	0	0	NONE	-0.18	-0.53	0.00	-0.81
10	POLYETHYLENE TEREPHTHALATE	0	0	0	0	LT. TAN/LIGHTER	-0.17	-0.66	0.40	-0.12
11	POLYPHENYLENESULFIDE	0	0	0	0	CHOCOLATE/BROWN	-0.42	-0.53	0.78	-0.10
12	POLYTETRAFLUOROETHYLENE	0	0	0	0	NONE	0.30	-1.72	1.24	1.12
13	POLYAMIDE-IMIDE	0	0	0	0	NONE	-0.24	-0.93	0.00	-1.59
14	POLYAMIDE-IMIDE	0	0	0	0	NONE	-0.20	-0.53	0.00	-1.15
15	POLYETHERIMIDE	0	0	0	0	NONE	-0.23	-0.53	0.00	-0.41
16	MODIFIED POLYETHERIMIDE	0	0	0	0	NONE	-0.16	-1.01	0.31	-0.34
17	POLYARYLEETHERKETONE	0	0	0	0	NONE	-0.13	-2.12	0.00	0.12
18	POLYBUTYLENE TEREPHTHALATE	2	0	0	0	NONE	-0.55	-0.40	0.00	0.47
19	POLYIMIDE-DF	0	0	0	0	NONE	-0.10	0.00	0.00	-0.64
20	POLYIMIDE-DF-ISO	0	0	0	0	NONE	-0.10	0.15	0.49	1.07
21	POLY(ARYLEETHERETHERKETONE)	0	0	0	0	NONE	-0.19	-1.33	0.00	-0.22
22	LIQUID CRYSTAL POLYMER	0	0	0	0	NONE	-0.07	-0.27	0.00	-0.06
23	66 NYLON, POLYAMIDE	1	0	0	0	NONE	-0.88	-0.54	0.00	-1.77

^a Aging temperature = 100°C (212°F)

^b Qualitative scale: 0=no change, 1=slight, 2=large, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

PHYSICAL CHANGES IN PLASTICS EXPOSED TO 32 ISO VG ALKYL BENZENE AND HFC-152a (R-152a)

[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]

Table E.18

NO.	TYPE	Particulates ^b	Cracking ^b	Crazing ^b	Softening ^b	Color Change after Aging	Average %	Average %	Average %	Average %
							Length Change ^c	Width Change ^c	Thickness Change ^c	Weight Change ^c
1	POLYPHTHALAMIDE	0	0	0	0	GREEN-CREAM/CREAM	-1.14	-0.81	-0.78	-1.10
3	ACETAL	2	0	0	1	WHITE/CREAM	-1.50	-0.68	3.97	-4.79
4	PHENOLIC	0	0	0	0	NONE	-0.55	-1.07	0.00	-4.30
5	POLYVINYLIDENE FLUORIDE	0	0	0	0	LUCITE-HAZY/LT.TAN	-0.19	0.14	1.19	0.41
8	POLYPROPYLENE ^a	0	0	0	1	NONE	3.06	3.67	4.35	11.09
9	POLYARYL SULFONE	0	0	0	0	NONE	-0.17	0.27	0.78	-0.11
10	POLYETHYLENE TEREPHTHALATE	0	0	0	0	NONE	-0.17	0.00	0.39	0.08
11	POLYPHENYLENESULFIDE	0	0	0	0	NONE	0.11	0.00	0.00	0.25
12	POLYTETRAFLUOROETHYLENE	0	0	0	0	NONE	0.12	0.31	0.83	0.58
13	POLYAMIDE-IMIDE	0	0	0	0	NONE	-0.16	-0.27	0.39	-1.44
14	POLYAMIDE-IMIDE	0	0	0	0	NONE	-0.18	-0.27	0.00	-1.08
15	POLYETHERIMIDE	0	0	0	0	NONE	0.13	0.13	0.39	-0.14
16	MODIFIED POLYETHERIMIDE	0	0	0	0	NONE	-0.07	0.27	0.94	0.14
17	POLYARYLEETHERKETONE	0	0	0	0	NONE	-0.19	-0.27	0.39	-0.12
18	POLYBUTYLENE TEREPHTHALATE	0	0	0	0	WHITE/FLESH	-0.33	-0.54	0.00	0.62
19	POLYIMIDE-DF	0	0	0	0	NONE	-0.04	-0.15	0.49	-0.48
20	POLYIMIDE-DF-ISO	0	0	0	0	NONE	-1.52	-0.15	0.00	-0.52
21	POLY(ARYLEETHERETHERKETONE)	0	0	0	0	NONE	-0.11	0.14	0.78	0.25
22	LIQUID CRYSTAL POLYMER	0	0	0	0	NONE	-0.01	0.27	0.00	-0.04
23	66 NYLON, POLYAMIDE	0	0	0	0	NONE	-0.70	-0.40	0.00	-1.71

^a Aging temperature = 100°C (212°F)

^b Qualitative scale: 0=no change, 1=slight, 2=large, 3=dissolved, deformed or melted

^c % Change = change in before/after measurements of plastics

Appendix F: Tensile and Elongation Changes after Refrigerant/Lubricant Thermal Aging

TENSILE PROPERTIES OF PLASTICS EXPOSED TO 32 ISO VG MINERAL OIL AND HCFC-22 (R-22)
[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]

Table F.1

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING			% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile		% Elongation	Tensile		% Elongation	Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²		lb/in ²	kg/mm ²			
1	POLYPHTHALAMIDE	0.017	10.65	11489	8.08	39.29	8953	6.29	8.46	-22.07	-78.46
3	ACETAL	0.016	10.57	9754	6.86	22.60	4415	3.10	11.42	-54.74	-49.48
4	PHENOLIC	0.017	10.76	8617	6.06	6.46	7171	5.04	6.10	-16.78	-5.49
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7412	5.21	105.39	7102	4.99	61.42	-4.18	-41.73
8	POLYPROPYLENE	0.016	10.62	5397	3.79	372.76	4865	3.42	413.98	-9.86	11.06
9	POLYARYL SULFONE	0.017	10.77	12728	8.95	70.16	14646	10.30	25.20	15.07	-64.09
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689	14.55	12.48	7039	4.95	7.87	-65.98	-36.91
11	POLYPHENYLENESULFIDE	0.017	10.76	21262	14.95	10.24	24908	17.51	12.99	17.15	26.92
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3879	2.73	262.68	4998	3.51	253.54	28.86	-3.48
13	POLYAMIDE-IMIDE	0.017	10.69	23510	16.53	17.17	13668	9.61	22.44	-41.86	30.73
14	POLYAMIDE-IMIDE	0.017	10.67	22990	16.16	20.16	20539	14.44	18.50	-10.66	-8.20
15	POLYETHERIMIDE	0.017	10.73	15750	11.07	64.33	15957	11.22	68.90	1.31	7.10
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082	9.90	46.38	14998	10.54	47.32	6.50	2.04
17	POLYARYLETHETHERKETONE	0.016	10.63	14946	10.51	62.28	16249	11.42	64.96	8.72	4.30
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7240	5.09	162.40	N/A	N/A	N/A	N/A	N/A
19	POLYIMIDE-DF	0.023	14.76	10865	7.64	22.72	10433	7.34	17.72	-3.97	-22.01
20	POLYIMIDE-DF-ISO	0.022	14.42	12209	8.58	17.99	11346	7.98	15.35	-7.07	-14.66
21	POLY(ARYLETHETHERETHERKETONE)	0.017	10.90	14360	10.10	75.04	14848	10.44	64.76	3.40	-13.69
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488	8.78	10.35	14192	9.98	10.24	13.65	-1.14
23	66 NYLON, POLYAMIDE	0.016	10.64	10093	7.10	81.30	N/A	N/A	N/A	N/A	N/A

All calculations based on an average of two tensile tests, except #16, which was an average of five.

All tensile pulls were at ambient condition and within 24hrs after aging conditions.

N/A = a stress-relieving set caused bending in the gauge area and prohibited tensile testing

**TENSILE PROPERTIES OF PLASTICS EXPOSED TO 32 ISO VG BRANCHED ACID POLYOL ESTER AND HFC-32 (R-32)
[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]**

Table F.2

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING			% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile		% Elongation	Tensile		% Elongation	Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²		lb/in ²	kg/mm ²			
1	POLYPHTHALAMIDE	0.017	10.65	11489	8.08	39.29	14312	10.06	11.61	24.58	-70.44
3	ACETAL	0.016	10.57	9754	6.86	22.60	9485	6.67	22.44	-2.77	-0.70
4	PHENOLIC	0.017	10.76	8617	6.06	6.46	8051	5.66	4.53	-6.57	-29.88
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7412	5.21	105.39	6198	4.36	115.94	-16.37	10.01
8	POLYPROPYLENE	0.016	10.62	5397	3.79	372.76	16098	11.32	207.48	198.29	-44.34
9	POLYARYL SULFONE	0.017	10.77	12728	8.95	70.16	14308	10.06	29.92	12.41	-57.35
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689	14.55	12.48	18614	13.09	9.65	-10.03	-22.71
11	POLYPHENYLENESULFIDE	0.017	10.76	21262	14.95	10.24	25238	17.74	9.06	18.70	-11.54
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3879	2.73	262.68	3953	2.78	95.08	1.91	-63.80
13	POLYAMIDE-IMIDE	0.017	10.69	23510	16.53	17.17	28082	19.74	19.88	19.45	15.83
14	POLYAMIDE-IMIDE	0.017	10.67	22990	16.16	20.16	22575	15.87	18.90	-1.80	-6.25
15	POLYETHERIMIDE	0.017	10.73	15750	11.07	64.33	16150	11.35	62.80	2.54	-2.39
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082	9.90	46.38	14780	10.39	38.68	4.96	-16.60
17	POLYARYLETHETHERKETONE	0.016	10.63	14946	10.51	62.28	16098	11.32	56.10	7.71	-9.92
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7240	5.09	162.40	7748	5.45	12.99	7.01	-92.00
19	POLYIMIDE-DF	0.023	14.76	10865	7.64	22.72	11071	7.78	18.31	1.90	-19.41
20	POLYIMIDE-DF-ISO	0.022	14.42	12209	8.58	17.99	11451	8.05	13.78	-6.21	-23.41
21	POLY(ARYLETHETHERETHERKETONE)	0.017	10.90	14360	10.10	75.04	14737	10.36	64.96	2.63	-13.43
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488	8.78	10.35	14503	10.20	11.02	16.13	6.46
23	66 NYLON, POLYAMIDE	0.016	10.64	10093	7.10	81.30	11129	7.82	28.35	10.27	-65.13

All calculations based on an average of two tensile tests, except #16, which was an average of five.

All tensile pulls were at ambient condition and within 24hrs after aging conditions.

**TENSILE PROPERTIES OF PLASTICS EXPOSED TO 32 ISO VG POLYPROPYLENE GLYCOL BUTYL MONO ETHER AND HFC-32 (R-32)
[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]**

Table F.3

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING			% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile		% Elongation	Tensile		% Elongation	Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²		lb/in ²	kg/mm ²			
1	POLYPHTHALAMIDE	0.017	10.65	11489	8.08	39.29	14879	10.46	12.01	29.51	-69.44
3	ACETAL	0.016	10.57	9754	6.86	22.60	4505	3.17	22.83	-53.81	1.05
4	PHENOLIC	0.017	10.76	8617	6.06	6.46	5993	4.21	4.13	-30.45	-35.98
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7412	5.21	105.39	6844	4.81	84.84	-7.66	-19.50
8	POLYPROPYLENE	0.016	10.62	5397	3.79	372.76	5193	3.65	188.58	-3.78	-49.41
9	POLYARYL SULFONE	0.017	10.77	12728	8.95	70.16	14389	10.12	20.87	13.05	-70.26
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689	14.55	12.48	10693	7.52	6.89	-48.32	-44.79
11	POLYPHENYLENESULFIDE	0.017	10.76	21262	14.95	10.24	25765	18.11	9.06	21.18	-11.54
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3879	2.73	262.68	4263	3.00	257.48	9.92	-1.98
13	POLYAMIDE-IMIDE	0.017	10.69	23510	16.53	17.17	28580	20.09	19.69	21.56	14.68
14	POLYAMIDE-IMIDE	0.017	10.67	22990	16.16	20.16	22135	15.56	18.50	-3.72	-8.20
15	POLYETHERIMIDE	0.017	10.73	15750	11.07	64.33	16385	11.52	45.47	4.03	-29.31
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082	9.90	46.38	15184	10.68	37.95	7.82	-18.17
17	POLYARYLETHETHERKETONE	0.016	10.63	14946	10.51	62.28	16550	11.64	54.33	10.74	-12.77
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7240	5.09	162.40	7152	5.03	7.87	-1.21	-95.15
19	POLYIMIDE-DF	0.023	14.76	10865	7.64	22.72	11107	7.81	17.52	2.23	-22.88
20	POLYIMIDE-DF-ISO	0.022	14.42	12209	8.58	17.99	10835	7.62	13.19	-11.25	-26.70
21	POLY(ARYLETHETHERETHERKETONE)	0.017	10.90	14360	10.10	75.04	14005	9.85	42.32	-2.47	-43.60
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488	8.78	10.35	14406	10.13	9.06	15.35	-12.55
23	66 NYLON, POLYAMIDE	0.016	10.64	10093	7.10	81.30	11734	8.25	67.13	16.26	-17.43

All calculations based on an average of two tensile tests, except #16, which was an average of five.

All tensile pulls were at ambient condition and within 24hrs after aging conditions.

TENSILE PROPERTIES OF PLASTICS EXPOSED TO 32 ISO VG MINERAL OIL AND HCFC-123 (R-123)
[14 DAYS AT 105°C (221°F) AT 275-300 PSIA]

Table F.4

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING			% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile		% Elongation	Tensile		% Elongation	Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²		lb/in ²	kg/mm ²			
1	POLYPHTHALAMIDE	0.017	10.65	11489	8.08	39.29	13028	9.16	19.69	13.39	-49.90
3	ACETAL	0.016	10.57	9754	6.86	22.60	N/A	N/A	N/A	N/A	N/A
4	PHENOLIC	0.017	10.76	8617	6.06	6.46	10902	7.66	7.48	26.51	15.85
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7412	5.21	105.39	6462	4.54	138.98	-12.82	31.86
8	POLYPROPYLENE	0.016	10.62	5397	3.79	372.76	3709	2.61	166.34	-31.28	-55.38
9	POLYARYL SULFONE	0.017	10.77	12728	8.95	70.16	13050	9.17	36.02	2.52	-48.65
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689	14.55	12.48	15809	11.11	11.42	-23.59	-8.52
11	POLYPHENYLENESULFIDE	0.017	10.76	21262	14.95	10.24	24225	17.03	10.04	13.94	-1.92
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3879	2.73	262.68	3328	2.34	312.99	-14.21	19.15
13	POLYAMIDE-IMIDE	0.017	10.69	23510	16.53	17.17	21587	15.18	16.93	-8.18	-1.38
14	POLYAMIDE-IMIDE	0.017	10.67	22990	16.16	20.16	21700	15.26	19.49	-5.61	-3.32
15	POLYETHERIMIDE	0.017	10.73	15750	11.07	64.33	15227	10.71	36.61	-3.32	-43.08
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082	9.90	46.38	14809	10.41	50.08	5.16	7.98
17	POLYARYLETHETHERKETONE	0.016	10.63	14946	10.51	62.28	15546	10.93	64.96	4.02	4.30
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7240	5.09	162.40	5425	3.81	34.84	-25.06	-78.55
19	POLYIMIDE-DF	0.023	14.76	10865	7.64	22.72	10263	7.22	17.72	-5.53	-22.01
20	POLYIMIDE-DF-ISO	0.022	14.42	12209	8.58	17.99	11216	7.89	15.55	-8.14	-13.57
21	POLY(ARYLETHETHERETHERKETONE)	0.017	10.90	14360	10.10	75.04	13742	9.66	47.44	-4.30	-36.78
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488	8.78	10.35	14564	10.24	10.24	16.62	-1.14
23	66 NYLON, POLYAMIDE	0.016	10.64	10093	7.10	81.30	10965	7.71	225.20	8.64	177.00

All calculations based on an average of two tensile tests, except #16, which was an average of five.

All tensile pulls were at ambient condition and within 24hrs after aging conditions.

N/A = a stress-relieving set caused bending in the gauge area and prohibited tensile testing

TENSILE PROPERTIES OF PLASTICS EXPOSED TO 32 ISO VG MINERAL OIL AND HCFC-123 (R-123)
[14 DAYS AT 125°C (257°F) AT 275-300 PSIA.]

Table F.5

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING			% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile		% Elongation	Tensile		% Elongation	Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²		lb/in ²	kg/mm ²			
1	POLYPHTHALAMIDE	0.017	10.65	11489	8.08	39.29	12703	8.93	16.73	10.57	-57.41
3	ACETAL	0.016	10.57	9754	6.86	22.60	N/A	N/A	N/A	N/A	N/A
4	PHENOLIC	0.017	10.76	8617	6.06	6.46	8129	5.72	11.02	-5.66	70.73
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7412	5.21	105.39	6379	4.48	114.17	-13.94	8.33
8	POLYPROPYLENE	0.016	10.62	5397	3.79	372.76	N/A	N/A	N/A	N/A	N/A
9	POLYARYL SULFONE	0.017	10.77	12728	8.95	70.16	13337	9.38	34.65	4.78	-50.62
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689	14.55	12.48	4985	3.51	4.53	-75.90	-63.72
11	POLYPHENYLENESULFIDE	0.017	10.76	21262	14.95	10.24	23454	16.49	17.32	10.31	69.23
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3879	2.73	262.68	3485	2.45	299.80	-10.14	14.13
13	POLYAMIDE-IMIDE	0.017	10.69	23510	16.53	17.17	25421	17.87	25.00	8.13	45.64
14	POLYAMIDE-IMIDE	0.017	10.67	22990	16.16	20.16	21770	15.31	24.41	-5.31	21.09
15	POLYETHERIMIDE	0.017	10.73	15750	11.07	64.33	15826	11.13	58.46	0.48	-9.12
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082	9.90	46.38	14856	10.45	52.60	5.50	13.41
17	POLYARYLETHETHERKETONE	0.016	10.63	14946	10.51	62.28	15667	11.02	75.39	4.83	21.05
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7240	5.09	162.40	N/A	N/A	N/A	N/A	N/A
19	POLYIMIDE-DF	0.023	14.76	10865	7.64	22.72	9948	6.99	22.24	-8.44	-2.08
20	POLYIMIDE-DF-ISO	0.022	14.42	12209	8.58	17.99	3912	2.75	16.14	-67.96	-10.28
21	POLY(ARYLETHETHERETHERKETONE)	0.017	10.90	14360	10.10	75.04	14969	10.52	66.54	4.24	-11.33
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488	8.78	10.35	14478	10.18	9.25	15.93	-10.65
23	66 NYLON, POLYAMIDE	0.016	10.64	10093	7.10	81.30	8832	6.21	45.47	-12.50	-44.07

All calculations based on an average of two tensile tests, except #16, which was an average of five.

All tensile pulls were at ambient condition and within 24hrs after aging conditions.

N/A = a stress-relieving set caused bending in the gauge area and prohibited tensile testing

**TENSILE PROPERTIES OF PLASTICS EXPOSED TO 32 ISO VG ALKYL BENZENE AND HCFC-124 (R-124)
[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]**

Table F.6

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING			% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile		% Elongation	Tensile		% Elongation	Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²		lb/in ²	kg/mm ²			
1	POLYPHTHALAMIDE	0.017	10.65	11489	8.08	39.29	14982	10.53	13.58	30.41	-65.43
3	ACETAL	0.016	10.57	9754	6.86	22.60	9364	6.58	19.09	-3.99	-15.51
4	PHENOLIC	0.017	10.76	8617	6.06	6.46	6834	4.80	3.74	-20.69	-42.07
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7412	5.21	105.39	6241	4.39	69.29	-15.80	-34.25
8	POLYPROPYLENE	0.016	10.62	5397	3.79	372.76	4847	3.41	394.09	-10.20	5.72
9	POLYARYL SULFONE	0.017	10.77	12728	8.95	70.16	14452	10.16	42.32	13.54	-39.67
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689	14.55	12.48	18997	13.36	9.45	-8.18	-24.29
11	POLYPHENYLENESULFIDE	0.017	10.76	21262	14.95	10.24	24263	17.06	8.86	14.12	-13.46
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3879	2.73	262.68	4123	2.90	303.15	6.31	15.41
13	POLYAMIDE-IMIDE	0.017	10.69	23510	16.53	17.17	24473	17.21	14.96	4.10	-12.84
14	POLYAMIDE-IMIDE	0.017	10.67	22990	16.16	20.16	23180	16.30	20.08	0.83	-0.39
15	POLYETHERIMIDE	0.017	10.73	15750	11.07	64.33	16282	11.45	52.76	3.38	-17.99
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082	9.90	46.38	15841	11.14	39.37	12.49	-15.11
17	POLYARYLETHETHERKETONE	0.016	10.63	14946	10.51	62.28	16170	11.37	55.91	8.19	-10.24
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7240	5.09	162.40	3552	2.50	4.72	-50.94	-97.09
19	POLYIMIDE-DF	0.023	14.76	10865	7.64	22.72	10603	7.45	17.13	-2.41	-24.61
20	POLYIMIDE-DF-ISO	0.022	14.42	12209	8.58	17.99	7523	5.29	10.04	-38.38	-44.20
21	POLY(ARYLETHETHERETHERKETONE)	0.017	10.90	14360	10.10	75.04	14463	10.17	60.24	0.72	-19.73
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488	8.78	10.35	15033	10.57	9.45	20.38	-8.75
23	66 NYLON, POLYAMIDE	0.016	10.64	10093	7.10	81.30	11310	7.95	38.19	12.06	-53.03

All calculations based on an average of two tensile tests, except #16, which was an average of five.

All tensile pulls were at ambient condition and within 24hrs after aging conditions.

TENSILE PROPERTIES OF PLASTICS EXPOSED TO 32 ISO VG MODIFIED POLYGLYCOL AND HFC-125 (R-125)

[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]

Table F.7

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING			% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile		% Elongation	Tensile		% Elongation	Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²		lb/in ²	kg/mm ²			
1	POLYPHTHALAMIDE	0.017	10.65	11489	8.08	39.29	14539	10.22	14.76	26.55	-62.42
3	ACETAL	0.016	10.57	9754	6.86	22.60	8972	6.31	24.02	-8.01	6.27
4	PHENOLIC	0.017	10.76	8617	6.06	6.46	9798	6.89	24.02	13.71	271.95
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7412	5.21	105.39	6869	4.83	90.75	-7.32	-13.90
8	POLYPROPYLENE	0.016	10.62	5397	3.79	372.76	4824	3.39	227.56	-10.61	-38.95
9	POLYARYL SULFONE	0.017	10.77	12728	8.95	70.16	14321	10.07	35.24	12.52	-49.78
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689	14.55	12.48	20673	14.53	10.63	-0.08	-14.83
11	POLYPHENYLENESULFIDE	0.017	10.76	21262	14.95	10.24	26219	18.43	9.45	23.32	-7.69
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3879	2.73	262.68	3385	2.38	238.58	-12.73	-9.17
13	POLYAMIDE-IMIDE	0.017	10.69	23510	16.53	17.17	22822	16.05	14.37	-2.92	-16.28
14	POLYAMIDE-IMIDE	0.017	10.67	22990	16.16	20.16	21945	15.43	17.72	-4.54	-12.11
15	POLYETHERIMIDE	0.017	10.73	15750	11.07	64.33	16147	11.35	54.53	2.52	-15.24
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082	9.90	46.38	15287	10.75	37.80	8.56	-18.51
17	POLYARYLETHETHERKETONE	0.016	10.63	14946	10.51	62.28	16254	11.43	45.08	8.75	-27.62
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7240	5.09	162.40	7969	5.60	9.65	10.07	-94.06
19	POLYIMIDE-DF	0.023	14.76	10865	7.64	22.72	11126	7.82	18.50	2.41	-18.54
20	POLYIMIDE-DF-ISO	0.022	14.42	12209	8.58	17.99	11152	7.84	13.58	-8.65	-24.51
21	POLY(ARYLETHETHERETHERKETONE)	0.017	10.90	14360	10.10	75.04	14807	10.41	68.90	3.11	-8.18
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488	8.78	10.35	14067	9.89	8.86	12.64	-14.45
23	66 NYLON, POLYAMIDE	0.016	10.64	10093	7.10	81.30	12067	8.48	36.42	19.56	-55.21

All calculations based on an average of two tensile tests, except #16, which was an average of five.

All tensile pulls were at ambient condition and within 24hrs after aging conditions.

**TENSILE PROPERTIES OF PLASTICS EXPOSED TO 32 ISO VG BRANCHED ACID POLYOL ESTER AND HFC-125 (R-125)
[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]**

Table F.8

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING			% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile		% Elongation	Tensile		% Elongation	Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²		lb/in ²	kg/mm ²			
1	POLYPHTHALAMIDE	0.017	10.65	11489	8.08	39.29	14988	10.54	13.78	30.46	-64.93
3	ACETAL	0.016	10.57	9754	6.86	22.60	10165	7.15	22.64	4.22	0.17
4	PHENOLIC	0.017	10.76	8617	6.06	6.46	7281	5.12	3.54	-15.51	-45.12
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7412	5.21	105.39	6736	4.74	83.07	-9.11	-21.18
8	POLYPROPYLENE	0.016	10.62	5397	3.79	372.76	4945	3.48	183.07	-8.37	-50.89
9	POLYARYL SULFONE	0.017	10.77	12728	8.95	70.16	14375	10.11	31.10	12.93	-55.67
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689	14.55	12.48	20560	14.46	10.24	-0.62	-17.98
11	POLYPHENYLENESULFIDE	0.017	10.76	21262	14.95	10.24	23816	16.74	9.45	12.01	-7.69
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3879	2.73	262.68	3521	2.48	175.20	-9.23	-33.30
13	POLYAMIDE-IMIDE	0.017	10.69	23510	16.53	17.17	26187	18.41	16.34	11.39	-4.82
14	POLYAMIDE-IMIDE	0.017	10.67	22990	16.16	20.16	21785	15.32	17.91	-5.24	-11.13
15	POLYETHERIMIDE	0.017	10.73	15750	11.07	64.33	16891	11.88	40.94	7.24	-36.35
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082	9.90	46.38	15350	10.79	38.19	9.00	-17.66
17	POLYARYLETHETHERKETONE	0.016	10.63	14946	10.51	62.28	16673	11.72	56.89	11.55	-8.66
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7240	5.09	162.40	12814	9.01	11.81	76.99	-92.73
19	POLYIMIDE-DF	0.023	14.76	10865	7.64	22.72	10372	7.29	18.70	-4.53	-17.68
20	POLYIMIDE-DF-ISO	0.022	14.42	12209	8.58	17.99	10987	7.72	13.58	-10.01	-24.51
21	POLY(ARYLETHETHERETHERKETONE)	0.017	10.90	14360	10.10	75.04	14663	10.31	39.57	2.11	-47.27
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488	8.78	10.35	14647	10.30	9.25	17.29	-10.65
23	66 NYLON, POLYAMIDE	0.016	10.64	10093	7.10	81.30	12389	8.71	46.26	22.75	-43.10

All calculations based on an average of two tensile tests, except #16, which was an average of five.

All tensile pulls were at ambient condition and within 24hrs after aging conditions.

**TENSILE PROPERTIES OF PLASTICS EXPOSED TO 32 ISO VG POLYPROPYLENE GLYCOL BUTYL MONO ETHER AND HFC-125 (R-125)
[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]**

Table F.9

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING				% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile			Tensile			Tensile	% Elongation	
		in ²	mm ²	lb/in ²	kg/mm ²	% Elongation	lb/in ²	kg/mm ²	% Elongation			
1	POLYPHTHALAMIDE	0.017	10.65	11489	8.08	39.29	15198	10.69	13.58	32.29	-65.43	
3	ACETAL	0.016	10.57	9754	6.86	22.60	9819	6.90	27.76	0.67	22.83	
4	PHENOLIC	0.017	10.76	8617	6.06	6.46	9805	6.89	4.33	13.78	-32.97	
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7412	5.21	105.39	6850	4.82	106.30	-7.58	0.86	
8	POLYPROPYLENE	0.016	10.62	5397	3.79	372.76	4686	3.29	193.90	-13.17	-47.98	
9	POLYARYL SULFONE	0.017	10.77	12728	8.95	70.16	14508	10.20	18.11	13.98	-74.19	
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689	14.55	12.48	16916	11.89	8.46	-18.24	-32.18	
11	POLYPHENYLENESULFIDE	0.017	10.76	21262	14.95	10.24	24859	17.48	8.86	16.92	-13.46	
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3879	2.73	262.68	9036	6.35	249.61	132.97	-4.98	
13	POLYAMIDE-IMIDE	0.017	10.69	23510	16.53	17.17	28466	20.01	18.31	21.08	6.65	
14	POLYAMIDE-IMIDE	0.017	10.67	22990	16.16	20.16	21723	15.27	18.31	-5.51	-9.18	
15	POLYETHERIMIDE	0.017	10.73	15750	11.07	64.33	16432	11.55	24.02	4.33	-62.67	
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082	9.90	46.38	15495	10.89	26.97	10.04	-41.85	
17	POLYARYLEETHERKETONE	0.016	10.63	14946	10.51	62.28	16147	11.35	54.92	8.04	-11.82	
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7240	5.09	162.40	6651	4.68	7.09	-8.13	-95.64	
19	POLYIMIDE-DF	0.023	14.76	10865	7.64	22.72	10982	7.72	17.32	1.08	-23.74	
20	POLYIMIDE-DF-ISO	0.022	14.42	12209	8.58	17.99	10279	7.23	11.81	-15.80	-34.35	
21	POLY(ARYLEETHERETHERKETONE)	0.017	10.90	14360	10.10	75.04	15154	10.65	72.83	5.53	-2.94	
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488	8.78	10.35	14825	10.42	9.65	18.71	-6.84	
23	66 NYLON, POLYAMIDE	0.016	10.64	10093	7.10	81.30	12013	8.45	34.45	19.02	-57.63	

All calculations based on an average of two tensile tests, except #16, which was an average of five.

All tensile pulls were at ambient condition and within 24hrs after aging conditions.

**TENSILE PROPERTIES OF PLASTICS EXPOSED TO 32 ISO VG BRANCHED ACID POLYOL ESTER AND HFC-134 (R-134)
[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]**

Table F.10

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING			% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile		% Elongation	Tensile		% Elongation	Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²		lb/in ²	kg/mm ²			
1	POLYPHTHALAMIDE	0.017	10.65	11489	8.08	39.29	14603	10.27	14.37	27.11	-63.43
3	ACETAL	0.016	10.57	9754	6.86	22.60	9409	6.61	23.82	-3.54	5.40
4	PHENOLIC	0.017	10.76	8617	6.06	6.46	11261	7.92	5.51	30.68	-14.63
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7412	5.21	105.39	6342	4.46	118.90	-14.43	12.81
8	POLYPROPYLENE	0.016	10.62	5397	3.79	372.76	5213	3.67	342.52	-3.41	-8.11
9	POLYARYL SULFONE	0.017	10.77	12728	8.95	70.16	14231	10.01	25.00	11.81	-64.37
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689	14.55	12.48	19406	13.64	11.02	-6.20	-11.67
11	POLYPHENYLENESULFIDE	0.017	10.76	21262	14.95	10.24	24898	17.51	9.45	17.10	-7.69
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3879	2.73	262.68	4358	3.06	282.68	12.35	7.61
13	POLYAMIDE-IMIDE	0.017	10.69	23510	16.53	17.17	27994	19.68	19.49	19.07	13.53
14	POLYAMIDE-IMIDE	0.017	10.67	22990	16.16	20.16	22654	15.93	18.50	-1.46	-8.20
15	POLYETHERIMIDE	0.017	10.73	15750	11.07	64.33	16200	11.39	31.10	2.86	-51.65
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082	9.90	46.38	14991	10.54	35.98	6.46	-22.41
17	POLYARYLETHETHERKETONE	0.016	10.63	14946	10.51	62.28	16435	11.55	26.18	9.96	-57.96
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7240	5.09	162.40	7414	5.21	15.16	2.40	-90.67
19	POLYIMIDE-DF	0.023	14.76	10865	7.64	22.72	9810	6.90	17.52	-9.71	-22.88
20	POLYIMIDE-DF-ISO	0.022	14.42	12209	8.58	17.99	11496	8.08	14.57	-5.84	-19.04
21	POLY(ARYLETHETHERETHERKETONE)	0.017	10.90	14360	10.10	75.04	14586	10.26	67.32	1.58	-10.28
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488	8.78	10.35	14968	10.52	10.04	19.86	-3.04
23	66 NYLON, POLYAMIDE	0.016	10.64	10093	7.10	81.30	11615	8.17	47.24	15.08	-41.89

All calculations based on an average of two tensile tests, except #16, which was an average of five.

TENSILE PROPERTIES OF PLASTICS EXPOSED TO 32 ISO VG MODIFIED POLYGLYCOL AND HFC-134a (R-134a)

[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]

Table F.11

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING			% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile			Tensile			Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²	% Elongation	lb/in ²	kg/mm ²	% Elongation		
1	POLYPHTHALAMIDE	0.017	10.65	11489	8.08	39.29	14728	10.36	15.16	28.20	-61.42
3	ACETAL	0.016	10.57	9754	6.86	22.60	8122	5.71	23.23	-16.72	2.79
4	PHENOLIC	0.017	10.76	8617	6.06	6.46	10731	7.54	7.09	24.53	9.76
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7412	5.21	105.39	6177	4.34	106.30	-16.66	0.86
8	POLYPROPYLENE	0.016	10.62	5397	3.79	372.76	4692	3.30	288.58	-13.07	-22.58
9	POLYARYL SULFONE	0.017	10.77	12728	8.95	70.16	14899	10.47	21.46	17.05	-69.42
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689	14.55	12.48	6324	4.45	6.69	-69.44	-46.37
11	POLYPHENYLENESULFIDE	0.017	10.76	21262	14.95	10.24	24483	17.21	10.43	15.15	1.92
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3879	2.73	262.68	3365	2.37	237.99	-13.23	-9.40
13	POLYAMIDE-IMIDE	0.017	10.69	23510	16.53	17.17	14044	9.87	22.83	-40.26	33.03
14	POLYAMIDE-IMIDE	0.017	10.67	22990	16.16	20.16	22411	15.76	19.29	-2.52	-4.30
15	POLYETHERIMIDE	0.017	10.73	15750	11.07	64.33	17031	11.97	58.07	8.13	-9.73
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082	9.90	46.38	15243	11.62	70.94	17.33	52.97
17	POLYARYLETHETHERKETONE	0.016	10.63	14946	10.51	62.28	16523	11.62	45.67	10.56	-26.68
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7240	5.09	162.40	5182	3.64	8.27	-28.42	-94.91
19	POLYIMIDE-DF	0.023	14.76	10865	7.64	22.72	9188	6.46	19.69	-15.43	-13.34
20	POLYIMIDE-DF-ISO	0.022	14.42	12209	8.58	17.99	11468	8.06	17.32	-6.07	-3.72
21	POLY(ARYLETHETHERETHERKETONE)	0.017	10.90	14360	10.10	75.04	14278	10.04	42.13	-0.57	-43.86
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488	8.78	10.35	14307	10.06	11.02	14.56	6.46
23	66 NYLON, POLYAMIDE	0.016	10.64	10093	7.10	81.30	11942	8.40	39.17	18.31	-51.82

All calculations based on an average of two tensile tests, except #16, which was an average of five.

All tensile pulls were at ambient condition and within 24hrs after aging conditions.

TENSILE PROPERTIES OF PLASTICS EXPOSED TO 32 ISO VG POLYPROPYLENE GLYCOL DIOL AND HFC-134a (R-134a)
[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]

Table F.12

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING				% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile			Tensile			% Elongation	Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²	% Elongation	lb/in ²	kg/mm ²				
1	POLYPHTHALAMIDE	0.017	10.65	11489	8.08	39.29	14404	10.13	18.90	25.37	-51.90	
3	ACETAL	0.016	10.57	9754	6.86	22.60	9380	6.59	30.71	-3.83	35.89	
4	PHENOLIC	0.017	10.76	8617	6.06	6.46	10252	7.21	7.48	18.98	15.85	
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7412	5.21	105.39	6483	4.56	123.23	-12.53	16.92	
8	POLYPROPYLENE	0.016	10.62	5397	3.79	372.76	5091	3.58	138.19	-5.54	-62.93	
9	POLYARYL SULFONE	0.017	10.77	12728	8.95	70.16	14128	9.93	17.72	11.00	-74.75	
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689	14.55	12.48	6994	4.92	9.06	-66.20	-27.44	
11	POLYPHENYLENESULFIDE	0.017	10.76	21262	14.95	10.24	24519	17.24	11.02	15.32	7.69	
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3879	2.73	262.68	3698	2.60	284.25	-4.65	8.21	
13	POLYAMIDE-IMIDE	0.017	10.69	23510	16.53	17.17	15384	10.82	12.60	-34.56	-26.61	
14	POLYAMIDE-IMIDE	0.017	10.67	22990	16.16	20.16	22081	15.52	20.08	-3.95	-0.39	
15	POLYETHERIMIDE	0.017	10.73	15750	11.07	64.33	16375	11.51	54.33	3.97	-15.54	
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082	9.90	46.38	14863	10.45	25.98	5.55	-43.97	
17	POLYARYLETHETHERKETONE	0.016	10.63	14946	10.51	62.28	16224	11.41	66.93	8.55	7.46	
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7240	5.09	162.40	N/A	N/A	N/A	N/A	N/A	
19	POLYIMIDE-DF	0.023	14.76	10865	7.64	22.72	11051	7.77	21.26	1.72	-6.41	
20	POLYIMIDE-DF-ISO	0.022	14.42	12209	8.58	17.99	12524	8.81	17.72	2.58	-1.53	
21	POLY(ARYLETHETHERETHERKETONE)	0.017	10.90	14360	10.10	75.04	15552	10.93	80.71	8.30	7.56	
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488	8.78	10.35	14414	10.13	11.42	15.42	10.27	
23	66 NYLON, POLYAMIDE	0.016	10.64	10093	7.10	81.30	11273	7.93	41.34	11.69	-49.15	

All calculations based on an average of two tensile tests, except #16, which was an average of five.

All tensile pulls were at ambient condition and within 24hrs after aging conditions.

N/A = a stress-relieving set caused bending in the gauge area and prohibited tensile testing

TENSILE PROPERTIES OF PLASTICS EXPOSED TO 32 ISO VG BRANCHED ACID POLYOL ESTER AND HFC-134a (R-134a)
[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]

Table F.13

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING			% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile		% Elongation	Tensile		% Elongation	Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²		lb/in ²	kg/mm ²			
1	POLYPHTHALAMIDE	0.017	10.65	11489	8.08	39.29	15161	10.66	14.57	31.96	-62.93
3	ACETAL	0.016	10.57	9754	6.86	22.60	9882	6.95	23.43	1.32	3.66
4	PHENOLIC	0.017	10.76	8617	6.06	6.46	10597	7.45	4.72	22.97	-26.83
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7412	5.21	105.39	6811	4.79	99.21	-8.06	-5.86
8	POLYPROPYLENE	0.016	10.62	5397	3.79	372.76	4650	3.27	312.20	-13.84	-16.24
9	POLYARYL SULFONE	0.017	10.77	12728	8.95	70.16	8948	6.29	46.06	-29.70	-34.34
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689	14.55	12.48	13739	9.66	8.46	-33.59	-32.18
11	POLYPHENYLENESULFIDE	0.017	10.76	21262	14.95	10.24	24397	17.15	8.66	14.75	-15.38
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3879	2.73	262.68	7099	4.99	267.32	83.04	1.77
13	POLYAMIDE-IMIDE	0.017	10.69	23510	16.53	17.17	14139	9.94	21.06	-39.86	22.71
14	POLYAMIDE-IMIDE	0.017	10.67	22990	16.16	20.16	22385	15.74	18.31	-2.63	-9.18
15	POLYETHERIMIDE	0.017	10.73	15750	11.07	64.33	16271	11.44	44.29	3.31	-31.15
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082	9.90	46.38	15146	8.88	50.00	-10.26	7.81
17	POLYARYLETHETHERKETONE	0.016	10.63	14946	10.51	62.28	12637	8.88	7.48	-15.45	-87.99
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7240	5.09	162.40	6156	4.33	7.48	-14.97	-95.39
19	POLYIMIDE-DF	0.023	14.76	10865	7.64	22.72	10482	7.37	17.13	-3.52	-24.61
20	POLYIMIDE-DF-ISO	0.022	14.42	12209	8.58	17.99	10875	7.65	13.19	-10.92	-26.70
21	POLY(ARYLETHETHERETHERKETONE)	0.017	10.90	14360	10.10	75.04	15365	10.80	75.79	7.00	1.00
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488	8.78	10.35	14430	10.15	8.86	15.55	-14.45
23	66 NYLON, POLYAMIDE	0.016	10.64	10093	7.10	81.30	12163	8.55	45.47	20.51	-44.07

All calculations based on an average of two tensile tests, except #16, which was an average of five.

All tensile pulls were at ambient condition and within 24hrs after aging conditions.

TENSILE PROPERTIES OF PLASTICS EXPOSED TO 22 ISO VG MIXED-ACID POLYOL ESTER AND HFC-134a (R-134a)

[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]

Table F.14

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING			% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile		% Elongation	Tensile		% Elongation	Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²		lb/in ²	kg/mm ²			
1	POLYPHTHALAMIDE	0.017	10.65	11489	8.08	39.29	15028	10.57	15.55	30.81	-60.42
3	ACETAL	0.016	10.57	9754	6.86	22.60	9866	6.94	25.59	1.15	13.24
4	PHENOLIC	0.017	10.76	8617	6.06	6.46	11809	8.30	7.28	37.04	12.80
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7412	5.21	105.39	6582	4.63	100.39	-11.19	-4.74
8	POLYPROPYLENE	0.016	10.62	5397	3.79	372.76	4729	3.33	256.30	-12.37	-31.24
9	POLYARYL SULFONE	0.017	10.77	12728	8.95	70.16	7758	5.45	29.33	-39.05	-58.19
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689	14.55	12.48	17410	12.24	12.20	-15.85	-2.21
11	POLYPHENYLENESULFIDE	0.017	10.76	21262	14.95	10.24	24582	17.28	10.43	15.61	1.92
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3879	2.73	262.68	4118	2.90	240.16	6.18	-8.57
13	POLYAMIDE-IMIDE	0.017	10.69	23510	16.53	17.17	13667	9.61	21.26	-41.87	23.85
14	POLYAMIDE-IMIDE	0.017	10.67	22990	16.16	20.16	21275	14.96	18.70	-7.46	-7.23
15	POLYETHERIMIDE	0.017	10.73	15750	11.07	64.33	16222	11.40	39.76	2.99	-38.19
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082	9.90	46.38	15230	11.75	26.14	18.63	-43.63
17	POLYARYLETHETHERKETONE	0.016	10.63	14946	10.51	62.28	16706	11.75	62.01	11.78	-0.44
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7240	5.09	162.40	6744	4.74	10.24	-6.84	-93.70
19	POLYIMIDE-DF	0.023	14.76	10865	7.64	22.72	10613	7.46	19.69	-2.32	-13.34
20	POLYIMIDE-DF-ISO	0.022	14.42	12209	8.58	17.99	11350	7.98	16.54	-7.03	-8.10
21	POLY(ARYLETHETHERETHERKETONE)	0.017	10.90	14360	10.10	75.04	15173	10.67	72.64	5.67	-3.20
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488	8.78	10.35	12863	9.04	10.43	3.00	0.76
23	66 NYLON, POLYAMIDE	0.016	10.64	10093	7.10	81.30	12073	8.49	36.02	19.61	-55.69

All calculations based on an average of two tensile tests, except #16, which was an average of five.

All tensile pulls were at ambient condition and within 24hrs after aging conditions.

**TENSILE PROPERTIES OF PLASTICS EXPOSED TO 32 ISO VG POLYPROPYLENE GLYCOL BUTYL MONO ETHER AND HFC-134a (R-134a)
[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]**

Table F.15

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING			% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile		% Elongation	Tensile		% Elongation	Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²		lb/in ²	kg/mm ²			
1	POLYPHTHALAMIDE	0.017	10.65	11489	8.08	39.29	14893	10.47	170.28	29.64	333.37
3	ACETAL	0.016	10.57	9754	6.86	22.60	9983	7.02	35.04	2.35	55.05
4	PHENOLIC	0.017	10.76	8617	6.06	6.46	6741	4.74	6.69	-21.77	3.66
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7412	5.21	105.39	6561	4.61	114.96	-11.48	9.08
8	POLYPROPYLENE	0.016	10.62	5397	3.79	372.76	4883	3.43	148.03	-9.53	-60.29
9	POLYARYL SULFONE	0.017	10.77	12728	8.95	70.16	15628	10.99	28.43	22.78	-59.48
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689	14.55	12.48	6190	4.35	5.91	-70.08	-52.68
11	POLYPHENYLENESULFIDE	0.017	10.76	21262	14.95	10.24	25318	17.80	10.24	19.08	0.00
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3879	2.73	262.68	3684	2.59	230.91	-5.01	-12.10
13	POLYAMIDE-IMIDE	0.017	10.69	23510	16.53	17.17	21058	14.80	15.35	-10.43	-10.55
14	POLYAMIDE-IMIDE	0.017	10.67	22990	16.16	20.16	47991	33.74	22.44	108.75	11.33
15	POLYETHERIMIDE	0.017	10.73	15750	11.07	64.33	16697	11.74	50.79	6.02	-21.05
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082	9.90	46.38	13995	9.84	29.13	-0.62	-37.18
17	POLYARYLEETHERKETONE	0.016	10.63	14946	10.51	62.28	15963	11.22	20.47	6.80	-67.13
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7240	5.09	162.40	N/A	N/A	0.00	N/A	N/A
19	POLYIMIDE-DF	0.023	14.76	10865	7.64	22.72	10653	7.49	18.50	-1.95	-18.54
20	POLYIMIDE-DF-ISO	0.022	14.42	12209	8.58	17.99	11121	7.82	15.94	-8.91	-11.38
21	POLY(ARYLEETHERETHERKETONE)	0.017	10.90	14360	10.10	75.04	15439	10.85	74.80	7.51	-0.31
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488	8.78	10.35	13293	9.35	10.63	6.45	2.66
23	66 NYLON, POLYAMIDE	0.016	10.64	10093	7.10	81.30	12178	8.56	49.21	20.66	-39.47

All calculations based on an average of two tensile tests, except #16, which was an average of five.

All tensile pulls were at ambient condition and within 24hrs after aging conditions.

N/A = a stress-relieving set caused bending in the guage area and prohibited tensile testing

TENSILE PROPERTIES OF PLASTICS EXPOSED TO 32 ISO VG ALKYL BENZENE AND HCFC-142b (142b)
[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]

Table F.16

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING			% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile		% Elongation	Tensile		% Elongation	Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²		lb/in ²	kg/mm ²			
1	POLYPHTHALAMIDE	0.017	10.65	11489	8.08	39.29	15164	10.66	15.75	31.99	-59.92
3	ACETAL	0.016	10.57	9754	6.86	22.60	7992	5.62	24.21	-18.06	7.14
4	PHENOLIC	0.017	10.76	8617	6.06	6.46	8497	5.97	3.94	-1.39	-39.02
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7412	5.21	105.39	6371	4.48	87.40	-14.04	-17.07
8	POLYPROPYLENE	0.016	10.62	5397	3.79	372.76	4669	3.28	386.22	-13.48	3.61
9	POLYARYL SULFONE	0.017	10.77	12728	8.95	70.16	25600	18.00	38.78	101.13	-44.73
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689	14.55	12.48	13952	9.81	6.10	-32.56	-51.10
11	POLYPHENYLENESULFIDE	0.017	10.76	21262	14.95	10.24	24547	17.26	8.66	15.45	-15.38
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3879	2.73	262.68	3833	2.70	256.02	-1.17	-2.53
13	POLYAMIDE-IMIDE	0.017	10.69	23510	16.53	17.17	20485	14.40	15.75	-12.86	-8.26
14	POLYAMIDE-IMIDE	0.017	10.67	22990	16.16	20.16	23518	16.53	19.29	2.30	-4.30
15	POLYETHERIMIDE	0.017	10.73	15750	11.07	64.33	16740	11.77	56.50	6.28	-12.18
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082	9.90	46.38	15347	11.70	30.79	18.13	-33.62
17	POLYARYLETHETHERKETONE	0.016	10.63	14946	10.51	62.28	16636	11.70	43.11	11.31	-30.78
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7240	5.09	162.40	3211	2.26	4.72	-55.65	-97.09
19	POLYIMIDE-DF	0.023	14.76	10865	7.64	22.72	10766	7.57	16.14	-0.91	-28.94
20	POLYIMIDE-DF-ISO	0.022	14.42	12209	8.58	17.99	10780	7.58	12.80	-11.70	-28.88
21	POLY(ARYLETHETHERETHERKETONE)	0.017	10.90	14360	10.10	75.04	15004	10.55	40.75	4.49	-45.70
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488	8.78	10.35	14814	10.42	9.25	18.62	-10.65
23	66 NYLON, POLYAMIDE	0.016	10.64	10093	7.10	81.30	12429	8.74	32.48	23.15	-60.05

All calculations based on an average of two tensile tests, except #16, which was an average of five.

All tensile pulls were at ambient condition and within 24hrs after aging conditions.

**TENSILE PROPERTIES OF PLASTICS EXPOSED TO 32 ISO VG BRANCHED ACID POLYOL ESTER AND HFC-143a (R-143a)
[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]**

Table F.17

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING			% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile		% Elongation	Tensile		% Elongation	Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²		lb/in ²	kg/mm ²			
1	POLYPHTHALAMIDE	0.017	10.65	11489	8.08	39.29	14882	10.46	14.76	29.53	-62.42
3	ACETAL	0.016	10.57	9754	6.86	22.60	8227	5.78	16.93	-15.65	-25.09
4	PHENOLIC	0.017	10.76	8617	6.06	6.46	10356	7.28	4.72	20.18	-26.83
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7412	5.21	105.39	6753	4.75	141.34	-8.89	34.11
8	POLYPROPYLENE	0.016	10.62	5397	3.79	372.76	4811	3.38	317.52	-10.86	-14.82
9	POLYARYL SULFONE	0.017	10.77	12728	8.95	70.16	14490	10.19	60.24	13.84	-14.14
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689	14.55	12.48	16181	11.38	9.06	-21.79	-27.44
11	POLYPHENYLENESULFIDE	0.017	10.76	21262	14.95	10.24	24749	17.40	9.65	16.40	-5.77
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3879	2.73	262.68	3856	2.71	227.36	-0.58	-13.44
13	POLYAMIDE-IMIDE	0.017	10.69	23510	16.53	17.17	22737	15.99	13.98	-3.29	-18.58
14	POLYAMIDE-IMIDE	0.017	10.67	22990	16.16	20.16	21570	15.17	19.49	-6.17	-3.32
15	POLYETHERIMIDE	0.017	10.73	15750	11.07	64.33	16666	11.72	37.20	5.81	-42.17
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082	9.90	46.38	15042	10.58	36.54	6.81	-21.22
17	POLYARYLETHETHERKETONE	0.016	10.63	14946	10.51	62.28	16256	11.43	54.92	8.77	-11.82
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7240	5.09	162.40	8072	5.68	12.60	11.49	-92.24
19	POLYIMIDE-DF	0.023	14.76	10865	7.64	22.72	10563	7.43	17.32	-2.78	-23.74
20	POLYIMIDE-DF-ISO	0.022	14.42	12209	8.58	17.99	12109	8.51	15.75	-0.81	-12.47
21	POLY(ARYLETHETHERETHERKETONE)	0.017	10.90	14360	10.10	75.04	14932	10.50	72.64	3.98	-3.20
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488	8.78	10.35	14469	10.17	9.84	15.86	-4.94
23	66 NYLON, POLYAMIDE	0.016	10.64	10093	7.10	81.30	12268	8.63	34.06	21.55	-58.11

All calculations based on an average of two tensile tests, except #16, which was an average of five.

All tensile pulls were at ambient condition and within 24hrs after aging conditions.

TENSILE PROPERTIES OF PLASTICS EXPOSED TO 32 ISO VG ALKYL BENZENE AND HFC-152a (R-152a)

[14 DAYS AT 150°C (300°F) AT 275-300 PSIA]

Table F.18

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING			% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile		% Elongation	Tensile		% Elongation	Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²		lb/in ²	kg/mm ²			
1	POLYPHTHALAMIDE	0.017	10.65	11489	8.08	39.29	14199	9.98	12.99	23.59	-66.93
3	ACETAL	0.016	10.57	9754	6.86	22.60	2965	2.08	7.09	-69.60	-68.64
4	PHENOLIC	0.017	10.76	8617	6.06	6.46	10275	7.22	4.72	19.24	-26.83
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7412	5.21	105.39	7102	4.99	117.32	-4.18	11.32
8	POLYPROPYLENE	0.016	10.62	5397	3.79	372.76	4567	3.21	312.60	-15.38	-16.14
9	POLYARYL SULFONE	0.017	10.77	12728	8.95	70.16	14299	10.05	39.17	12.34	-44.16
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689	14.55	12.48	13800	9.70	8.07	-33.30	-35.33
11	POLYPHENYLENESULFIDE	0.017	10.76	21262	14.95	10.24	24569	17.27	9.25	15.55	-9.62
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3879	2.73	262.68	4090	2.88	299.61	5.46	14.06
13	POLYAMIDE-IMIDE	0.017	10.69	23510	16.53	17.17	14187	9.97	19.49	-39.66	13.53
14	POLYAMIDE-IMIDE	0.017	10.67	22990	16.16	20.16	22537	15.84	18.70	-1.97	-7.23
15	POLYETHERIMIDE	0.017	10.73	15750	11.07	64.33	16622	11.69	48.62	5.54	-24.42
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082	9.90	46.38	15085	10.61	47.64	7.13	2.72
17	POLYARYLETHETHERKETONE	0.016	10.63	14946	10.51	62.28	16458	11.57	41.34	10.12	-33.63
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7240	5.09	162.40	4994	3.51	5.51	-31.02	-96.61
19	POLYIMIDE-DF	0.023	14.76	10865	7.64	22.72	11407	8.02	18.50	4.99	-18.54
20	POLYIMIDE-DF-ISO	0.022	14.42	12209	8.58	17.99	12391	8.71	15.75	1.49	-12.47
21	POLY(ARYLETHETHERETHERKETONE)	0.017	10.90	14360	10.10	75.04	14898	10.47	65.55	3.75	-12.64
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488	8.78	10.35	14251	10.02	9.06	14.12	-12.55
23	66 NYLON, POLYAMIDE	0.016	10.64	10093	7.10	81.30	12238	8.60	47.64	21.26	-41.40

All calculations based on an average of two tensile tests, except #16, which was an average of five.

All tensile pulls were at ambient condition and within 24hrs after aging conditions.

Appendix G: Total Acid Numbers of Thermally Aged Lubricants With and Without Plastics

TOTAL ACID NUMBERS OF LUBRICANTS EXPOSED TO PLASTICS AND REFRIGERANTS
[14 DAYS AT 150°C (300°F)]
Table G.1

NO.	TYPE	BRANCHED-ACID POLYOLESTER				POLYPROPYLENE GLYCOL MONOBUTYLETER		ALKYLBENZENE		MODIFIED POLYGLYCOL
		HFC-32	HFC-143a	HFC-125	HFC-134	HFC-32	HFC-125	HFC-124	HFC-142b	HFC-125
1	POLYPHTHALAMIDE	1.741	1.823	1.227	1.603	0.020	0.046	0.016	0.035	0.009
3	ACETAL	0.481	0.011	0.099	0.151	0.137	0.171	0.050	0.091	0.352
4	PHENOLIC	28.676*	25.178*	21.862*	21.346*	0.123	0.054	0.042	0.058	0.161
5	POLYVINYLIDENE FLUORIDE	0.099	0.118	0.187	0.074	0.089	0.109	0.041	0.042	0.174
8	POLYPROPYLENE	0.195	1.589	0.132	0.068	0.095	0.041	0.081	0.045	0.045
9	POLYARYL SULFONE	3.592	1.491	1.366	0.709	0.125	0.071	0.037	0.050	0.133
10	POLYETHYLENE TEREPHTHALATE	0.280	0.241	0.176	0.182	0.141	0.067	0.056	0.052	0.086
11	POLYPHENYLENESULFIDE	0.344	0.168	0.115	0.072	0.054	0.030	0.036	0.040	0.132
12	POLYTETRAFLUOROETHENE	0.033	0.101	0.075	0.088	0.085	0.044	0.054	0.032	0.064
13	POLYAMIDE-IMIDE	2.068	2.239	1.453	2.591	0.033	0.078	0.031	0.037	0.246
14	POLYAMIDE-IMIDE	2.018	2.522	2.499	3.099	0.050	0.067	0.038	0.031	0.058
15	POLYETHERIMIDE	0.581	0.368	0.434	0.307	0.057	0.056	0.042	0.036	0.065
16	MODIFIED POLYETHERIMIDE	0.680	0.805	0.669	0.316	0.056	0.065	0.030	0.106	0.040
17	POLYARYLEETHERKETONE	0.493	0.388	0.312	0.245	0.095	0.045	0.101	0.039	0.298
18	POLYBUTYLENE TEREPHTHALATE	0.412	0.441	0.258	0.327	0.312	0.207	0.049	0.057	0.137
19	POLYIMIDE-DF	0.966	0.491	0.189	0.170	0.062	0.033	0.027	0.012	0.097
20	POLYIMIDE-DF-ISO	0.404	0.665	0.976	0.527	0.095	0.080	0.049	0.030	0.109
21	POLY(ARYLEETHERETHERKETONE)	0.147	0.072	0.257	0.109	0.048	0.158	0.089	0.042	0.114
22	LIQUID CRYSTAL POLYMER	0.135	0.129	0.236	0.166	0.062	0.068	0.041	0.037	0.178
23	66 NYLON, POLYAMIDE	0.604	0.581	0.952	0.930	0.029	0.028	0.021	0.080	0.045

* phenolic test bars were not post cured or dehydrated, the high tan may be due to trapped moisture and/or unreacted phenolic materials

Total Acid Number = mg KOH / g lubricant

Plastics aged in glass jars

Plastics used without dehydration and as used throughout study

**EFFECTS OF DEHYDRATING PLASTICS ON TOTAL ACID NUMBER
WHEN EXPOSED TO BRANCHED-ACID POLYOLESTER
[14 DAYS AT 150°C (300°F)]**

Table G.2

NO.	TYPE	TOTAL ACID NUMBER		
		WITHOUT DEHYDRATION	AFTER DEHYDRATION	PERCENT CHANGE
1	POLYPHTHALAMIDE	3.479	0.309	-91.1
3	ACETAL	0.75	0.194	-74.1
4	PHENOLIC	19.88	1.725	-91.3
5	POLYVINYLIDENE FLUORIDE	0.119	0.185	55.5
8	POLYPROPYLENE	0.261	0.139	-46.7
9	POLYARYL SULFONE	3.57	0.831	-76.7
10	POLYETHYLENE TEREPHTHALATE	0.294	0.274	-6.8
11	POLYPHENYLENE SULFIDE	0.108	0.33	205.6
12	POLYTETRAFLUOROETHYLENE	2.387	1.458	-38.9
13	POLYAMIDE-IMIDE	9.47	0.301	-96.8
14	POLYAMIDE-IMIDE	7.526	0.408	-94.6
15	POLYETHERIMIDE	2.458	0.175	-92.9
16	MODIFIED POLYETHERIMIDE	1.335	0.225	-83.1
17	POLYARYLEETHERKETONE	0.307	0.354	15.3
18	POLYBUTYLENE TEREPHTHALATE	0.746	0.564	-24.4
19	POLYIMIDE-DF	1.82	0.708	-61.6
20	POLYIMIDE-DF-ISO	1.03	0.322	-68.7
21	POLY(ARYLEETHERETHERKETONE)	0.218	0.165	-24.3
22	LIQUID CRYSTAL POLYMER	0.207	0.231	11.6
23	66 NYLON,POLYAMIDE	3.019	0.293	-90.3

**TOTAL ACID NUMBER OF LUBRICANTS EXPOSED TO PREBAKED PHENOLIC
[14 DAYS EXPOSURE AT 150°C (300°F)]**

Table G.2a

NO.	TYPE	HOURS PREBAKE	BRANCHED-ACID POLYOLESTER	MIXED-ACID POLYOLESTER
4	PHENOLIC	0	2.26	10.89
4	PHENOLIC	24	1.39	0.57
4	PHENOLIC	48	0.91	0.45
4	PHENOLIC	72	0.63	0.49

Total Acid Number = mg KOH /g lubricant

Plastics aged in glass jars

**TOTAL ACID NUMBERS OF LUBRICANTS EXPOSED TO PLASTICS AT VARIOUS TEMPERATURES
(14 DAYS EXPOSURE)**

Table G.3

NO.	TYPE	BRANCHED-ACID POLYOLESTER					MIXED-ACID POLYOLESTER				
		22°C (72°F)	60°C (140°F)	100°C (212°F)	150°C (302°F)		22°C (72°F)	60°C (140°F)	100°C (212°F)	150°C (302°F)	
			30ml	30ml	30ml	120ml		30ml	30ml	30ml	120ml
	NONE	0.024	0.040	0.050	2.06		0.024	0.036	0.061	0.313	
1	POLYPHTHALAMIDE				3.479	0.294				0.705	0.067
3	ACETAL		0.020	0.099	0.750	0.177		0.093	0.089	0.578	0.245
4	PHENOLIC		0.154	0.583	19.880	3.115		0.232	0.487	24.910	7.748
5	POLYVINYLIDENE FLUORIDE				0.119	0.800				0.572	0.075
8	POLYPROPYLENE				0.261	0.123				0.314	0.078
9	POLYARYL SULFONE				3.570	0.874				3.560	0.124
10	POLYETHYLENE TEREPHTHALATE				0.294	0.117				0.412	0.078
11	POLYPHENYLENESULFIDE				0.108	0.125				0.096	0.082
12	POLYTETRAFLUOROETHENE				2.387	0.108				0.156	0.046
13	POLYAMIDE-IMIDE				9.470	0.683				9.831	0.134
14	POLYAMIDE-IMIDE				7.526	1.568				8.077	0.091
15	POLYETHERIMIDE				2.458	0.165				0.231	0.122
16	MODIFIED POLYETHERIMIDE				1.335	0.138				0.184	0.129
17	POLYARYLEETHERKETONE				0.307	1.278				0.529	0.096
18	POLYBUTYLENE TEREPHTHALATE		0.054	0.265	0.746	0.145		0.053	0.058	0.508	0.136
19	POLYIMIDE-DF				1.820	1.154				0.949	0.114
20	POLYIMIDE-DF-ISO				1.030	0.877				0.444	0.181
21	POLY(ARYLEETHERETHERKETONE)				0.218	0.399				0.220	0.056
22	LIQUID CRYSTAL POLYMER				0.207	0.096				0.208	0.139
23	66 NYLON, POLYAMIDE				3.019	0.729				1.645	0.142

Total Acid Number = mg KOH / g lubricant

Plastics aged in glass jars

Plastics used without dehydration and as used throughout study

H. Tensile Properties of Plastics after Lubricant Immersion

TENSILE PROPERTIES OF PLASTICS EXPOSED TO 32 ISO VG BRANCHED ACID POLYOLESTER
[14 DAYS AT 60°C (140°F)]
Table H.1

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING			% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile		% Elongation	Tensile		% Elongation	Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²		lb/in ²	kg/mm ²			
1	POLYPHTHALAMIDE	0.017	10.65	11488.70	8.08	39.29	11145.86	7.84	74.61	-2.98	89.89
2	ABS	0.017	10.69	5528.90	3.89	40.47	5349.01	3.76	29.92	-3.25	-26.07
3	ACETAL	0.016	10.57	9753.56	6.86	22.60	10252.56	7.21	17.91	5.12	-20.74
4	PHENOLIC	0.017	10.76	8617.06	6.06	6.46	9529.05	6.70	4.72	10.58	-26.87
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7411.88	5.21	105.39	8055.16	5.66	58.86	8.68	-44.15
6	POLYCARBONATE	0.017	11.00	10188.30	7.16	87.40	9007.46	6.33	81.25	-11.59	-7.04
7	MODIFIED POLYPHENYLENE OXIDE	0.017	10.74	7778.90	5.47	46.85	7697.79	5.41	24.65	-1.04	-47.39
8	POLYPROPYLENE	0.016	10.62	5396.97	3.79	372.76	5767.41	4.05	104.72	6.86	-71.91
9	POLYARYL SULFONE	0.017	10.77	12728.23	8.95	70.16	12368.95	8.70	23.62	-2.82	-66.33
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689.05	14.55	12.48	21722.73	15.27	12.40	5.00	-0.63
11	POLYPHENYLENESULFIDE	0.017	10.76	21261.70	14.95	10.24	20939.46	14.72	9.13	-1.52	-10.84
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3878.52	2.73	262.68	4132.32	2.91	298.23	6.54	13.53
13	POLYAMIDE-IMIDE	0.017	10.69	23509.83	16.53	17.17	18278.86	12.85	15.94	-22.25	-7.14
14	POLYAMIDE-IMIDE	0.017	10.67	22989.70	16.16	20.16	20477.85	14.40	19.09	-10.93	-5.29
15	POLYETHERIMIDE	0.017	10.73	15750.01	11.07	64.33	15604.16	10.97	52.99	-0.93	-17.62
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082.09	9.90	46.38	14310.00	10.06	47.40	1.62	2.20
17	POLYARYLEETHERKETONE	0.016	10.63	14945.59	10.51	62.28	14694.52	10.33	39.96	-1.68	-35.84
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7239.88	5.09	162.40	7459.83	5.24	158.19	3.04	-2.59
19	POLYIMIDE-DF	0.023	14.76	10864.58	7.64	22.72	10737.90	7.55	19.09	-1.17	-15.96
20	POLYIMIDE-DF-ISO	0.022	14.42	12208.91	8.58	17.99	11707.86	8.23	15.55	-4.10	-13.56
21	POLY(ARYLEETHERETHERKETONE)	0.017	10.90	14359.79	10.10	75.04	14894.79	10.47	82.28	3.73	9.65
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488.22	8.78	10.35	14157.28	9.95	10.04	13.37	-3.00
23	66 NYLON, POLYAMIDE	0.016	10.64	10093.02	7.10	81.30	9733.06	6.84	103.35	-3.57	27.12

All calculations based on an average of two tensile tests, except numbers 2, 6, 7, 11, 15, 16, and 18, which were an average of five.

All tensile pulls were at ambient condition.

TENSILE PROPERTIES OF PLASTICS EXPOSED TO 32 ISO VG BRANCHED ACID POLYOLESTER
[14 DAYS AT 100°C (212°F)]
Table H.2

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING			% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile		% Elongation	Tensile		% Elongation	Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²		lb/in ²	kg/mm ²			
1	POLYPHTHALAMIDE	0.017	10.65	11488.70	8.08	39.29	11493.58	8.08	61.02	0.04	55.32
2	ABS	0.017	10.69	5528.90	3.89	40.47	4344.87	3.05	10.24	-21.42	-74.71
3	ACETAL	0.016	10.57	9753.56	6.86	22.60	10327.31	7.26	15.35	5.88	-32.06
4	PHENOLIC	0.017	10.76	8617.06	6.06	6.46	7635.26	5.37	3.94	-11.39	-39.06
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7411.88	5.21	105.39	7820.42	5.50	81.69	5.51	-22.49
6	POLYCARBONATE	0.017	11.00	10188.30	7.16	87.40	9815.28	6.90	16.06	-3.66	-81.62
7	MODIFIED POLYPHENYLENE OXIDE	0.017	10.74	7778.90	5.47	46.85	7834.09	5.51	19.13	0.71	-59.17
8	POLYPROPYLENE	0.016	10.62	5396.97	3.79	372.76	5412.42	3.81	146.46	0.29	-60.71
9	POLYARYL SULFONE	0.017	10.77	12728.23	8.95	70.16	12477.52	8.77	67.32	-1.97	-4.04
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689.05	14.55	12.48	22362.59	15.72	11.61	8.09	-6.94
11	POLYPHENYLENESULFIDE	0.017	10.76	21261.70	14.95	10.24	23160.96	16.28	9.29	8.93	-9.26
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3878.52	2.73	262.68	4305.10	3.03	323.23	11.00	23.05
13	POLYAMIDE-IMIDE	0.017	10.69	23509.83	16.53	17.17	20653.02	14.52	14.57	-12.15	-15.16
14	POLYAMIDE-IMIDE	0.017	10.67	22989.70	16.16	20.16	21130.72	14.86	21.26	-8.09	5.46
15	POLYETHERIMIDE	0.017	10.73	15750.01	11.07	64.33	15193.43	10.68	52.44	-3.53	-18.48
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082.09	9.90	46.38	14663.57	10.31	37.70	4.13	-18.71
17	POLYARYLEETHERKETONE	0.016	10.63	14945.59	10.51	62.28	14797.88	10.40	63.58	-0.99	2.09
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7239.88	5.09	162.40	7970.78	5.60	49.13	10.10	-69.75
19	POLYIMIDE-DF	0.023	14.76	10864.58	7.64	22.72	10751.57	7.56	18.50	-1.04	-18.56
20	POLYIMIDE-DF-ISO	0.022	14.42	12208.91	8.58	17.99	11140.49	7.83	15.35	-8.75	-14.65
21	POLY(ARYLEETHERETHERKETONE)	0.017	10.90	14359.79	10.10	75.04	14454.86	10.16	75.98	0.66	1.26
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488.22	8.78	10.35	13887.26	9.76	9.84	11.20	-4.90
23	66 NYLON, POLYAMIDE	0.016	10.64	10093.02	7.10	81.30	9624.25	6.77	147.05	-4.64	80.87

All calculations based on an average of two tensile tests, except numbers 2, 6, 7, 11, 15, 16, and 18, which were an average of one test.

All tensile pulls were at ambient condition.

TENSILE PROPERTIES OF PLASTICS EXPOSED TO 32 ISO VG POLYPROPYLENE GLYCOL BUTYL MONO ETHER
[14 DAYS AT 60°C (140°F)]
Table H.3

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING			% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile		% Elongation	Tensile		% Elongation	Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²		lb/in ²	kg/mm ²			
1	POLYPHTHALAMIDE	0.017	10.65	11488.70	8.08	39.29	11225.77	7.89	65.94	-2.29	67.84
2	ABS	0.017	10.69	5528.90	3.89	40.47	5018.83	3.53	6.93	-9.23	-82.88
3	ACETAL	0.016	10.57	9753.56	6.86	22.60	10309.87	7.25	18.50	5.70	-18.12
4	PHENOLIC	0.017	10.76	8617.06	6.06	6.46	6970.86	4.90	3.74	-19.10	-42.10
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7411.88	5.21	105.39	8094.10	5.69	88.39	9.20	-16.13
6	POLYCARBONATE	0.017	11.00	10188.30	7.16	87.40	9662.33	6.79	70.79	-5.16	-19.00
7	MODIFIED POLYPHENYLENE OXIDE	0.017	10.74	7778.90	5.47	46.85	7559.98	5.32	24.09	-2.81	-48.58
8	POLYPROPYLENE	0.016	10.62	5396.97	3.79	372.76	5984.56	4.21	17.32	10.89	-95.35
9	POLYARYL SULFONE	0.017	10.77	12728.23	8.95	70.16	12398.97	8.72	46.06	-2.59	-34.35
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689.05	14.55	12.48	21598.79	15.19	11.61	4.40	-6.94
11	POLYPHENYLENESULFIDE	0.017	10.76	21261.70	14.95	10.24	22269.42	15.66	10.08	4.74	-1.56
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3878.52	2.73	262.68	3732.65	2.62	247.44	-3.76	-5.80
13	POLYAMIDE-IMIDE	0.017	10.69	23509.83	16.53	17.17	22438.68	15.78	16.73	-4.56	-2.55
14	POLYAMIDE-IMIDE	0.017	10.67	22989.70	16.16	20.16	20267.55	14.25	16.93	-11.84	-16.03
15	POLYETHERIMIDE	0.017	10.73	15750.01	11.07	64.33	15539.24	10.93	57.80	-1.34	-10.16
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082.09	9.90	46.38	14366.92	10.10	41.42	2.02	-10.69
17	POLYARYLEETHERKETONE	0.016	10.63	14945.59	10.51	62.28	15138.60	10.64	66.73	1.29	7.15
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7239.88	5.09	162.40	7646.58	5.38	144.33	5.62	-11.13
19	POLYIMIDE-DF	0.023	14.76	10864.58	7.64	22.72	11025.83	7.75	20.08	1.48	-11.63
20	POLYIMIDE-DF-ISO	0.022	14.42	12208.91	8.58	17.99	11633.04	8.18	14.37	-4.72	-20.12
21	POLY(ARYLEETHERETHERKETONE)	0.017	10.90	14359.79	10.10	75.04	14721.33	10.35	78.94	2.52	5.19
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488.22	8.78	10.35	14073.28	9.89	10.04	12.69	-3.00
23	66 NYLON, POLYAMIDE	0.016	10.64	10093.02	7.10	81.30	10946.30	7.70	224.21	8.45	175.78

All calculations based on an average of two tensile tests, except numbers 2, 6, 7, 11, 15, 16, and 18, which were an average of three tests.

All tensile pulls were at ambient condition.

**TENSILE PROPERTIES OF PLASTICS EXPOSED TO 32 ISO VG POLYPROPYLENE GLYCOL BUTYL MONO ETHER
[14 DAYS AT 100°C (212°F)]**

Table H.4

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING			% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile		% Elongation	Tensile		% Elongation	Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²		lb/in ²	kg/mm ²			
1	POLYPHTHALAMIDE	0.017	10.65	11488.70	8.08	39.29	11960.35	8.41	21.46	4.11	-45.39
2	ABS	0.017	10.69	5528.90	3.89	40.47	5098.68	3.58	24.41	-7.78	-39.69
3	ACETAL	0.016	10.57	9753.56	6.86	22.60	10495.96	7.38	16.73	7.61	-25.96
4	PHENOLIC	0.017	10.76	8617.06	6.06	6.46	8389.98	5.90	4.72	-2.64	-26.87
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7411.88	5.21	105.39	8189.93	5.76	74.61	10.50	-29.21
6	POLYCARBONATE	0.017	11.00	10188.30	7.16	87.40	10079.32	7.09	19.06	-1.07	-78.19
7	MODIFIED POLYPHENYLENE OXIDE	0.017	10.74	7778.90	5.47	46.85	7591.05	5.34	18.11	-2.41	-61.34
8	POLYPROPYLENE	0.016	10.62	5396.97	3.79	372.76	5758.47	4.05	54.53	6.70	-85.37
9	POLYARYL SULFONE	0.017	10.77	12728.23	8.95	70.16	12685.88	8.92	28.15	-0.33	-59.88
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689.05	14.55	12.48	22116.74	15.55	11.42	6.90	-8.52
11	POLYPHENYLENESULFIDE	0.017	10.76	21261.70	14.95	10.24	24709.98	17.37	9.61	16.22	-6.19
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3878.52	2.73	262.68	2544.86	1.79	153.54	-34.39	-41.55
13	POLYAMIDE-IMIDE	0.017	10.69	23509.83	16.53	17.17	17162.87	12.07	15.94	-27.00	-7.14
14	POLYAMIDE-IMIDE	0.017	10.67	22989.70	16.16	20.16	20955.05	14.73	20.08	-8.85	-0.40
15	POLYETHERIMIDE	0.017	10.73	15750.01	11.07	64.33	15888.23	11.17	59.45	0.88	-7.59
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082.09	9.90	46.38	14765.84	10.38	45.66	4.86	-1.55
17	POLYARYLEETHERKETONE	0.016	10.63	14945.59	10.51	62.28	10272.66	7.22	75.39	-31.27	21.06
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7239.88	5.09	162.40	7682.64	5.40	30.24	6.12	-81.38
19	POLYIMIDE-DF	0.023	14.76	10864.58	7.64	22.72	10379.78	7.30	18.31	-4.46	-19.42
20	POLYIMIDE-DF-ISO	0.022	14.42	12208.91	8.58	17.99	11903.06	8.37	15.55	-2.51	-13.56
21	POLY(ARYLEETHERETHERKETONE)	0.017	10.90	14359.79	10.10	75.04	14017.60	9.86	60.63	-2.38	-19.20
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488.22	8.78	10.35	14873.48	10.46	9.84	19.10	-4.90
23	66 NYLON, POLYAMIDE	0.016	10.64	10093.02	7.10	81.30	9899.88	6.96	178.74	-1.91	119.85

All calculations based on an average of two tensile tests, except numbers 2, 6, 7, 11, 15, 16, and 18, which were an average of three tests.

All tensile pulls were at ambient condition.

TENSILE PROPERTIES OF PLASTICS EXPOSED TO 32 ISO VG MINERAL OIL
[14 DAYS AT 60°C (140°F)]
Table H.5

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING				% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile		% Elongation	Tensile		% Elongation	Tensile	% Elongation	
		in ²	mm ²	lb/in ²	kg/mm ²		lb/in ²	kg/mm ²				
1	POLYPHTHALAMIDE	0.017	10.65	11488.70	8.08	39.29	11419.12	8.03	58.66	-0.61	49.30	
2	ABS	0.017	10.69	5528.90	3.89	40.47	5191.08	3.65	29.84	-6.11	-26.26	
3	ACETAL	0.016	10.57	9753.56	6.86	22.60	10169.47	7.15	13.98	4.26	-38.16	
4	PHENOLIC	0.017	10.76	8617.06	6.06	6.46	7060.91	4.96	3.74	-18.06	-42.10	
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7411.88	5.21	105.39	8223.65	5.78	73.03	10.95	-30.70	
6	POLYCARBONATE	0.017	11.00	10188.30	7.16	87.40	9656.78	6.79	73.86	-5.22	-15.49	
7	MODIFIED POLYPHENYLENE OXIDE	0.017	10.74	7778.90	5.47	46.85	7400.32	5.20	23.78	-4.87	-49.24	
8	POLYPROPYLENE	0.016	10.62	5396.97	3.79	372.76	4075.24	2.87	13.58	-24.49	-96.36	
9	POLYARYL SULFONE	0.017	10.77	12728.23	8.95	70.16	12486.61	8.78	37.99	-1.90	-45.85	
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689.05	14.55	12.48	22723.71	15.98	12.01	9.83	-3.78	
11	POLYPHENYLENESULFIDE	0.017	10.76	21261.70	14.95	10.24	22629.36	15.91	9.21	6.43	-10.03	
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3878.52	2.73	262.68	3639.36	2.56	187.80	-6.17	-28.51	
13	POLYAMIDE-IMIDE	0.017	10.69	23509.83	16.53	17.17	8874.45	6.24	14.57	-62.25	-15.16	
14	POLYAMIDE-IMIDE	0.017	10.67	22989.70	16.16	20.16	21172.85	14.89	17.32	-7.90	-14.07	
15	POLYETHERIMIDE	0.017	10.73	15750.01	11.07	64.33	48594.11	34.17	55.75	208.53	-13.34	
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082.09	9.90	46.38	14564.75	10.24	42.83	3.43	-7.65	
17	POLYARYLEETHERKETONE	0.016	10.63	14945.59	10.51	62.28	15053.50	10.58	64.57	0.72	3.67	
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7239.88	5.09	162.40	8094.49	5.69	74.65	11.80	-54.03	
19	POLYIMIDE-DF	0.023	14.76	10864.58	7.64	22.72	11105.20	7.81	19.69	2.21	-13.36	
20	POLYIMIDE-DF-ISO	0.022	14.42	12208.91	8.58	17.99	10448.89	7.35	12.60	-14.42	-29.97	
21	POLY(ARYLEETHERETHERKETONE)	0.017	10.90	14359.79	10.10	75.04	14957.53	10.52	81.30	4.16	8.34	
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488.22	8.78	10.35	14930.88	10.50	9.65	19.56	-6.81	
23	66 NYLON, POLYAMIDE	0.016	10.64	10093.02	7.10	81.30	10695.30	7.52	218.31	5.97	168.52	

All calculations based on an average of two tensile tests, except numbers 2, 6, 7, 11, 15, 16, and 18, which were an average of three tests.

All tensile pulls were at ambient condition.

TENSILE PROPERTIES OF PLASTICS EXPOSED TO 32 ISO VG MINERAL OIL
[14 DAYS AT 100°C (212°F)]
Table H.6

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING			% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile		% Elongation	Tensile		% Elongation	Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²		lb/in ²	kg/mm ²			
1	POLYPHTHALAMIDE	0.017	10.65	11488.70	8.08	39.29	13876.75	9.76	15.75	20.79	-59.92
2	ABS	0.017	10.69	5528.90	3.89	40.47	3311.66	2.33	20.47	-40.10	-49.41
3	ACETAL	0.016	10.57	9753.56	6.86	22.60	10401.77	7.31	15.16	6.65	-32.93
4	PHENOLIC	0.017	10.76	8617.06	6.06	6.46	10055.10	7.07	4.72	16.69	-26.87
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7411.88	5.21	105.39	8617.19	6.06	89.57	16.26	-15.01
6	POLYCARBONATE	0.017	11.00	10188.30	7.16	87.40	10172.58	7.15	58.11	-0.15	-33.51
7	MODIFIED POLYPHENYLENE OXIDE	0.017	10.74	7778.90	5.47	46.85	7210.89	5.07	16.93	-7.30	-63.86
8	POLYPROPYLENE	0.016	10.62	5396.97	3.79	372.76	4643.76	3.26	175.39	-13.96	-52.95
9	POLYARYL SULFONE	0.017	10.77	12728.23	8.95	70.16	12962.29	9.11	29.53	1.84	-57.91
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689.05	14.55	12.48	23140.05	16.27	11.42	11.85	-8.52
11	POLYPHENYLENESULFIDE	0.017	10.76	21261.70	14.95	10.24	24202.36	17.02	9.45	13.83	-7.73
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3878.52	2.73	262.68	4052.41	2.85	252.76	4.48	-3.78
13	POLYAMIDE-IMIDE	0.017	10.69	23509.83	16.53	17.17	14119.29	9.93	14.17	-39.94	-17.45
14	POLYAMIDE-IMIDE	0.017	10.67	22989.70	16.16	20.16	20598.86	14.48	18.31	-10.40	-9.19
15	POLYETHERIMIDE	0.017	10.73	15750.01	11.07	64.33	16204.53	11.39	52.52	2.89	-18.36
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082.09	9.90	46.38	14669.45	10.31	37.32	4.17	-19.53
17	POLYARYLEETHERKETONE	0.016	10.63	14945.59	10.51	62.28	14756.01	10.37	55.51	-1.27	-10.87
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7239.88	5.09	162.40	8388.03	5.90	34.41	15.86	-78.81
19	POLYIMIDE-DF	0.023	14.76	10864.58	7.64	22.72	10650.22	7.49	18.31	-1.97	-19.42
20	POLYIMIDE-DF-ISO	0.022	14.42	12208.91	8.58	17.99	10768.33	7.57	13.58	-11.80	-24.50
21	POLY(ARYLEETHERETHERKETONE)	0.017	10.90	14359.79	10.10	75.04	14367.37	10.10	70.67	0.05	-5.82
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488.22	8.78	10.35	15167.91	10.66	9.45	21.46	-8.71
23	66 NYLON, POLYAMIDE	0.016	10.64	10093.02	7.10	81.30	10576.38	7.44	215.35	4.79	164.89

All calculations based on an average of two tensile tests, except numbers 2, 6, 7, 11, 15, 16, and 18, which were an average of three tests.

All tensile pulls were at ambient condition.

TENSILE PROPERTIES OF PLASTICS EXPOSED TO 32 ISO VG ALKYL BENZENE
[14 DAYS AT 60°C (140°F)]
Table H.7

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING			% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile		% Elongation	Tensile		% Elongation	Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²		lb/in ²	kg/mm ²			
1	POLYPHTHALAMIDE	0.017	10.65	11488.70	8.08	39.29	11252.57	7.91	49.21	-2.06	25.25
2	ABS	0.017	10.69	5528.90	3.89	40.47	5686.62	4.00	20.47	2.85	-49.41
3	ACETAL	0.016	10.57	9753.56	6.86	22.60	10414.90	7.32	15.16	6.78	-32.93
4	PHENOLIC	0.017	10.76	8617.06	6.06	6.46	7816.28	5.50	4.72	-9.29	-26.87
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7411.88	5.21	105.39	23034.55	16.19	68.11	210.78	-35.37
6	POLYCARBONATE	0.017	11.00	10188.30	7.16	87.40	10236.27	7.20	89.84	0.47	2.79
7	MODIFIED POLYPHENYLENE OXIDE	0.017	10.74	7778.90	5.47	46.85	7375.41	5.19	24.57	-5.19	-47.56
8	POLYPROPYLENE	0.016	10.62	5396.97	3.79	372.76	5520.04	3.88	63.78	2.28	-82.89
9	POLYARYL SULFONE	0.017	10.77	12728.23	8.95	70.16	12568.43	8.84	43.11	-1.26	-38.55
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689.05	14.55	12.48	22032.18	15.49	11.22	6.49	-10.09
11	POLYPHENYLENESULFIDE	0.017	10.76	21261.70	14.95	10.24	23034.55	16.19	9.65	8.34	-5.80
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3878.52	2.73	262.68	4128.41	2.90	250.00	6.44	-4.83
13	POLYAMIDE-IMIDE	0.017	10.69	23509.83	16.53	17.17	14053.24	9.88	21.65	-40.22	26.11
14	POLYAMIDE-IMIDE	0.017	10.67	22989.70	16.16	20.16	21241.15	14.93	17.91	-7.61	-11.14
15	POLYETHERIMIDE	0.017	10.73	15750.01	11.07	64.33	15470.06	10.88	55.20	-1.78	-14.20
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082.09	9.90	46.38	14357.58	10.09	40.94	1.96	-11.72
17	POLYARYLEETHERKETONE	0.016	10.63	14945.59	10.51	62.28	14432.00	10.15	52.36	-3.44	-15.92
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7239.88	5.09	162.40	8105.41	5.70	100.59	11.95	-38.06
19	POLYIMIDE-DF	0.023	14.76	10864.58	7.64	22.72	10654.97	7.49	17.91	-1.93	-21.16
20	POLYIMIDE-DF-ISO	0.022	14.42	12208.91	8.58	17.99	11410.91	8.02	14.17	-6.54	-21.22
21	POLY(ARYLEETHERETHERKETONE)	0.017	10.90	14359.79	10.10	75.04	15135.57	10.64	82.68	5.40	10.18
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488.22	8.78	10.35	15576.36	10.95	9.45	24.73	-8.71
23	66 NYLON, POLYAMIDE	0.016	10.64	10093.02	7.10	81.30	10020.26	7.04	201.38	-0.72	147.70

All calculations based on an average of two tensile tests, except numbers 2, 6, 7, 11, 15, 16, and 18, which were an average of three tests.

All tensile pulls were at ambient condition.

TENSILE PROPERTIES OF PLASTICS EXPOSED TO 32 ISO VG ALKYL BENZENE
[14 DAYS AT 100°C (212°F)]
Table H.8

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING			% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile		% Elongation	Tensile		% Elongation	Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²		lb/in ²	kg/mm ²			
1	POLYPHTHALAMIDE	0.017	10.65	11488.70	8.08	39.29	12909.28	9.08	18.11	12.36	-53.91
2	ABS	0.017	10.69	5528.90	3.89	40.47	4715.33	3.32	23.23	-14.71	-42.60
3	ACETAL	0.016	10.57	9753.56	6.86	22.60	10290.08	7.23	14.57	5.50	-35.54
4	PHENOLIC	0.017	10.76	8617.06	6.06	6.46	9107.48	6.40	4.33	5.69	-32.96
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7411.88	5.21	105.39	24804.61	17.44	9.45	234.66	-91.03
6	POLYCARBONATE	0.017	11.00	10188.30	7.16	87.40	9824.30	6.91	29.76	-3.57	-65.95
7	MODIFIED POLYPHENYLENE OXIDE	0.017	10.74	7778.90	5.47	46.85	6397.66	4.50	24.02	-17.76	-48.73
8	POLYPROPYLENE	0.016	10.62	5396.97	3.79	372.76	3232.75	2.27	137.80	-40.10	-63.03
9	POLYARYL SULFONE	0.017	10.77	12728.23	8.95	70.16	12667.47	8.91	59.65	-0.48	-14.99
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689.05	14.55	12.48	22753.91	16.00	11.81	9.98	-5.36
11	POLYPHENYLENESULFIDE	0.017	10.76	21261.70	14.95	10.24	8430.32	5.93	20.08	-60.35	96.08
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3878.52	2.73	262.68	4127.20	2.90	238.78	6.41	-9.10
13	POLYAMIDE-IMIDE	0.017	10.69	23509.83	16.53	17.17	13846.50	9.74	14.37	-41.10	-16.31
14	POLYAMIDE-IMIDE	0.017	10.67	22989.70	16.16	20.16	19736.12	13.88	16.54	-14.15	-17.98
15	POLYETHERIMIDE	0.017	10.73	15750.01	11.07	64.33	10227.29	7.19	59.69	-35.06	-7.22
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082.09	9.90	46.38	14721.57	10.35	45.43	4.54	-2.04
17	POLYARYLEETHERKETONE	0.016	10.63	14945.59	10.51	62.28	14904.78	10.48	62.60	-0.27	0.51
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7239.88	5.09	162.40	9106.57	6.40	28.74	25.78	-82.30
19	POLYIMIDE-DF	0.023	14.76	10864.58	7.64	22.72	10201.73	7.17	17.13	-6.10	-24.62
20	POLYIMIDE-DF-ISO	0.022	14.42	12208.91	8.58	17.99	11038.72	7.76	13.78	-9.58	-23.40
21	POLY(ARYLEETHERETHERKETONE)	0.017	10.90	14359.79	10.10	75.04	14897.33	10.47	76.57	3.74	2.05
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488.22	8.78	10.35	14521.33	10.21	9.06	16.28	-12.51
23	66 NYLON, POLYAMIDE	0.016	10.64	10093.02	7.10	81.30	9818.50	6.90	142.91	-2.72	75.79

All calculations based on an average of two tensile tests, except numbers 2, 6, 7, 11, 15, 16, and 18, which were an average of three tests.

All tensile pulls were at ambient condition.

TENSILE PROPERTIES OF PLASTICS EXPOSED TO 22 ISO VG MIXED-ACID POLYOLESTER
[14 DAYS AT 60°C (140°F)]
Table H.9

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING			% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile		% Elongation	Tensile		% Elongation	Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²		lb/in ²	kg/mm ²			
1	POLYPHTHALAMIDE	0.017	10.65	11488.70	8.08	39.29	11204.59	7.88	72.64	-2.47	84.88
2	ABS	0.017	10.69	5528.90	3.89	40.47	5589.16	3.93	27.56	1.09	-31.90
3	ACETAL	0.016	10.57	9753.56	6.86	22.60	10547.47	7.42	16.73	8.14	-25.96
4	PHENOLIC	0.017	10.76	8617.06	6.06	6.46	7809.91	5.49	4.13	-9.37	-36.01
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7411.88	5.21	105.39	8012.95	5.63	100.39	8.11	-4.74
6	POLYCARBONATE	0.017	11.00	10188.30	7.16	87.40	9116.70	6.41	33.70	-10.52	-61.44
7	MODIFIED POLYPHENYLENE OXIDE	0.017	10.74	7778.90	5.47	46.85	7621.62	5.36	16.06	-2.02	-65.71
8	POLYPROPYLENE	0.016	10.62	5396.97	3.79	372.76	5831.20	4.10	39.57	8.05	-89.39
9	POLYARYL SULFONE	0.017	10.77	12728.23	8.95	70.16	12731.61	8.95	78.15	0.03	11.39
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689.05	14.55	12.48	22437.22	15.77	11.22	8.45	-10.09
11	POLYPHENYLENESULFIDE	0.017	10.76	21261.70	14.95	10.24	22429.20	15.77	9.06	5.49	-11.57
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3878.52	2.73	262.68	3591.25	2.52	230.31	-7.41	-12.32
13	POLYAMIDE-IMIDE	0.017	10.69	23509.83	16.53	17.17	21166.82	14.88	15.16	-9.97	-11.72
14	POLYAMIDE-IMIDE	0.017	10.67	22989.70	16.16	20.16	20395.18	14.34	17.72	-11.29	-12.12
15	POLYETHERIMIDE	0.017	10.73	15750.01	11.07	64.33	15490.50	10.89	58.19	-1.65	-9.55
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082.09	9.90	46.38	14639.92	10.29	41.34	3.96	-10.87
17	POLYARYLEETHERKETONE	0.016	10.63	14945.59	10.51	62.28	14668.82	10.31	60.63	-1.85	-2.65
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7239.88	5.09	162.40	7818.65	5.50	68.50	7.99	-57.82
19	POLYIMIDE-DF	0.023	14.76	10864.58	7.64	22.72	7784.17	5.47	13.58	-28.35	-40.22
20	POLYIMIDE-DF-ISO	0.022	14.42	12208.91	8.58	17.99	5466.20	3.84	13.58	-55.23	-24.50
21	POLY(ARYLEETHERETHERKETONE)	0.017	10.90	14359.79	10.10	75.04	14950.34	10.51	80.71	4.11	7.55
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488.22	8.78	10.35	14027.08	9.86	8.86	12.32	-14.41
23	66 NYLON, POLYAMIDE	0.016	10.64	10093.02	7.10	81.30	9579.46	6.74	142.32	-5.09	75.06

All calculations based on an average of two tensile tests, except numbers 2, 6, 7, 11, 15, 16, and 18, which were an average of three tests.

All tensile pulls were at ambient condition.

**TENSILE PROPERTIES OF PLASTICS EXPOSED TO 22 ISO VG MIXED-ACID POLYOLESTER
[14 DAYS AT 100°C (212°F)]
Table H.10**

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING			% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile		% Elongation	Tensile		% Elongation	Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²		lb/in ²	kg/mm ²			
1	POLYPHTHALAMIDE	0.017	10.65	11488.70	8.08	39.29	12304.47	8.65	22.05	7.10	-43.89
2	ABS	0.017	10.69	5528.90	3.89	40.47	3444.01	2.42	11.65	-37.71	-71.20
3	ACETAL	0.016	10.57	9753.56	6.86	22.60	7751.10	5.45	13.39	-20.53	-40.77
4	PHENOLIC	0.017	10.76	8617.06	6.06	6.46	10159.88	7.14	5.31	17.90	-17.73
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7411.88	5.21	105.39	6097.68	4.29	94.49	-17.73	-10.34
6	POLYCARBONATE	0.017	11.00	10188.30	7.16	87.40	9393.31	6.60	12.44	-7.80	-85.77
7	MODIFIED POLYPHENYLENE OXIDE	0.017	10.74	7778.90	5.47	46.85	7314.00	5.14	12.44	-5.98	-73.45
8	POLYPROPYLENE	0.016	10.62	5396.97	3.79	372.76	8363.47	5.88	90.94	54.97	-75.60
9	POLYARYL SULFONE	0.017	10.77	12728.23	8.95	70.16	13061.97	9.18	57.09	2.62	-18.63
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689.05	14.55	12.48	22511.93	15.83	11.42	8.81	-8.52
11	POLYPHENYLENESULFIDE	0.017	10.76	21261.70	14.95	10.24	24554.79	17.26	9.45	15.49	-7.73
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3878.52	2.73	262.68	4115.25	2.89	261.02	6.10	-0.63
13	POLYAMIDE-IMIDE	0.017	10.69	23509.83	16.53	17.17	19473.61	13.69	21.65	-17.17	26.11
14	POLYAMIDE-IMIDE	0.017	10.67	22989.70	16.16	20.16	18981.04	13.35	18.70	-17.44	-7.24
15	POLYETHERIMIDE	0.017	10.73	15750.01	11.07	64.33	15705.42	11.04	38.50	-0.28	-40.15
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082.09	9.90	46.38	14657.97	10.31	31.97	4.09	-31.07
17	POLYARYLEETHERKETONE	0.016	10.63	14945.59	10.51	62.28	14615.38	10.28	62.40	-2.21	0.20
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7239.88	5.09	162.40	7971.09	5.60	51.89	10.10	-68.05
19	POLYIMIDE-DF	0.023	14.76	10864.58	7.64	22.72	7993.71	5.62	18.11	-26.42	-20.29
20	POLYIMIDE-DF-ISO	0.022	14.42	12208.91	8.58	17.99	15362.38	10.80	15.16	25.83	-15.74
21	POLY(ARYLEETHERETHERKETONE)	0.017	10.90	14359.79	10.10	75.04	15223.84	10.70	82.87	6.02	10.44
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488.22	8.78	10.35	14648.33	10.30	10.43	17.30	0.80
23	66 NYLON, POLYAMIDE	0.016	10.64	10093.02	7.10	81.30	17534.75	12.33	195.08	73.73	139.95

All calculations based on an average of two tensile tests, except numbers 2, 6, 7, 11, 15, 16, and 18, which were an average of three tests.

All tensile pulls were at ambient condition.

TENSILE PROPERTIES OF PLASTICS EXPOSED TO 32 ISO VG POLYPROPYLENE GLYCOL DIOL
[14 DAYS AT 60°C (140°F)]
Table H.11

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING			% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile		% Elongation	Tensile		% Elongation	Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²		lb/in ²	kg/mm ²			
1	POLYPHTHALAMIDE	0.017	10.65	11488.70	8.08	39.29	11626.62	8.17	68.50	1.20	74.35
2	ABS	0.017	10.69	5528.90	3.89	40.47	5729.61	4.03	23.86	3.63	-41.05
3	ACETAL	0.016	10.57	9753.56	6.86	22.60	10234.71	7.20	18.70	4.93	-17.25
4	PHENOLIC	0.017	10.76	8617.06	6.06	6.46	7472.16	5.25	3.74	-13.29	-42.10
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7411.88	5.21	105.39	8013.52	5.63	55.51	8.12	-47.33
6	POLYCARBONATE	0.017	11.00	10188.30	7.16	87.40	9165.91	6.44	53.54	-10.03	-38.74
7	MODIFIED POLYPHENYLENE OXIDE	0.017	10.74	7778.90	5.47	46.85	7711.57	5.42	25.98	-0.87	-44.54
8	POLYPROPYLENE	0.016	10.62	5396.97	3.79	372.76	5983.92	4.21	21.06	10.88	-94.35
9	POLYARYL SULFONE	0.017	10.77	12728.23	8.95	70.16	12776.91	8.98	77.56	0.38	10.55
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689.05	14.55	12.48	17932.11	12.61	11.22	-13.33	-10.09
11	POLYPHENYLENESULFIDE	0.017	10.76	21261.70	14.95	10.24	22464.98	15.79	8.90	5.66	-13.11
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3878.52	2.73	262.68	3953.16	2.78	220.28	1.92	-16.14
13	POLYAMIDE-IMIDE	0.017	10.69	23509.83	16.53	17.17	25965.36	18.26	19.88	10.44	15.79
14	POLYAMIDE-IMIDE	0.017	10.67	22989.70	16.16	20.16	20113.71	14.14	16.54	-12.51	-17.98
15	POLYETHERIMIDE	0.017	10.73	15750.01	11.07	64.33	16086.44	11.31	49.13	2.14	-23.62
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082.09	9.90	46.38	14309.18	10.06	48.03	1.61	3.56
17	POLYARYLEETHERKETONE	0.016	10.63	14945.59	10.51	62.28	15125.77	10.63	83.46	1.21	34.02
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7239.88	5.09	162.40	8060.45	5.67	77.87	11.33	-52.05
19	POLYIMIDE-DF	0.023	14.76	10864.58	7.64	22.72	8077.57	5.68	15.16	-25.65	-33.29
20	POLYIMIDE-DF-ISO	0.022	14.42	12208.91	8.58	17.99	11974.28	8.42	15.16	-1.92	-15.74
21	POLY(ARYLEETHERETHERKETONE)	0.017	10.90	14359.79	10.10	75.04	13567.33	9.54	49.21	-5.52	-34.42
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488.22	8.78	10.35	14847.62	10.44	9.45	18.89	-8.71
23	66 NYLON, POLYAMIDE	0.016	10.64	10093.02	7.10	81.30	10767.57	7.57	86.61	6.68	6.54

All calculations based on an average of two tensile tests, except numbers 2, 6, 7, 11, 15, 16, and 18, which were an average of three tests.

All tensile pulls were at ambient condition.

TENSILE PROPERTIES OF PLASTICS EXPOSED TO 32 ISO VG POLYPROPYLENE GLYCOL DIOL
[14 DAYS AT 100°C (212°F)]
Table H.12

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING			% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile		% Elongation	Tensile		% Elongation	Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²		lb/in ²	kg/mm ²			
1	POLYPHTHALAMIDE	0.017	10.65	11488.70	8.08	39.29	11889.45	8.36	18.31	3.49	-53.41
2	ABS	0.017	10.69	5528.90	3.89	40.47	4414.30	3.10	11.57	-20.16	-71.40
3	ACETAL	0.016	10.57	9753.56	6.86	22.60	10301.79	7.24	15.55	5.62	-31.19
4	PHENOLIC	0.017	10.76	8617.06	6.06	6.46	7864.68	5.53	4.13	-8.73	-36.01
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7411.88	5.21	105.39	8095.48	5.69	85.04	9.22	-19.31
6	POLYCARBONATE	0.017	11.00	10188.30	7.16	87.40	9878.32	6.95	11.26	-3.04	-87.12
7	MODIFIED POLYPHENYLENE OXIDE	0.017	10.74	7778.90	5.47	46.85	8350.23	5.87	23.78	7.34	-49.24
8	POLYPROPYLENE	0.016	10.62	5396.97	3.79	372.76	5931.93	4.17	35.04	9.91	-90.60
9	POLYARYL SULFONE	0.017	10.77	12728.23	8.95	70.16	13062.76	9.18	19.69	2.63	-71.94
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689.05	14.55	12.48	20771.34	14.60	9.25	0.40	-25.87
11	POLYPHENYLENESULFIDE	0.017	10.76	21261.70	14.95	10.24	21298.48	14.97	8.82	0.17	-13.88
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3878.52	2.73	262.68	4213.65	2.96	253.94	8.64	-3.33
13	POLYAMIDE-IMIDE	0.017	10.69	23509.83	16.53	17.17	25900.50	18.21	20.28	10.17	18.09
14	POLYAMIDE-IMIDE	0.017	10.67	22989.70	16.16	20.16	19769.54	13.90	15.35	-14.01	-23.84
15	POLYETHERIMIDE	0.017	10.73	15750.01	11.07	64.33	15696.89	11.04	41.10	-0.34	-36.11
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082.09	9.90	46.38	14610.26	10.27	43.31	3.75	-6.62
17	POLYARYLEETHERKETONE	0.016	10.63	14945.59	10.51	62.28	15437.20	10.85	57.09	3.29	-8.34
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7239.88	5.09	162.40	8209.45	5.77	75.43	13.39	-53.55
19	POLYIMIDE-DF	0.023	14.76	10864.58	7.64	22.72	8265.06	5.81	17.91	-23.93	-21.16
20	POLYIMIDE-DF-ISO	0.022	14.42	12208.91	8.58	17.99	9621.81	6.76	11.61	-21.19	-35.44
21	POLY(ARYLEETHERETHERKETONE)	0.017	10.90	14359.79	10.10	75.04	14593.41	10.26	69.49	1.63	-7.40
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488.22	8.78	10.35	13750.55	9.67	8.07	10.11	-22.02
23	66 NYLON, POLYAMIDE	0.016	10.64	10093.02	7.10	81.30	9552.99	6.72	136.42	-5.35	67.79

All calculations based on an average of two tensile tests, except numbers 2, 6, 7, 11, 15, 16, and 18, which were an average of three tests.

All tensile pulls were at ambient condition.

TENSILE PROPERTIES OF PLASTICS EXPOSED TO 32 ISO VG MODIFIED POLYGLYCOL
[14 DAYS AT 60°C (140°F)]
Table H.13

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING			% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile		% Elongation	Tensile		% Elongation	Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²		lb/in ²	kg/mm ²			
1	POLYPHTHALAMIDE	0.017	10.65	11488.70	8.08	39.29	12360.02	8.69	43.50	7.58	10.73
2	ABS	0.017	10.69	5528.90	3.89	40.47	5687.36	4.00	23.23	2.87	-42.60
3	ACETAL	0.016	10.57	9753.56	6.86	22.60	10618.33	7.47	20.28	8.87	-10.28
4	PHENOLIC	0.017	10.76	8617.06	6.06	6.46	9701.03	6.82	4.72	12.58	-26.87
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7411.88	5.21	105.39	8316.62	5.85	59.84	12.21	-43.22
6	POLYCARBONATE	0.017	11.00	10188.30	7.16	87.40	9797.40	6.89	73.39	-3.84	-16.03
7	MODIFIED POLYPHENYLENE OXIDE	0.017	10.74	7778.90	5.47	46.85	7710.10	5.42	22.05	-0.88	-52.94
8	POLYPROPYLENE	0.016	10.62	5396.97	3.79	372.76	5934.54	4.17	34.65	9.96	-90.71
9	POLYARYL SULFONE	0.017	10.77	12728.23	8.95	70.16	12653.54	8.90	60.04	-0.59	-14.43
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689.05	14.55	12.48	23013.70	16.18	11.22	11.24	-10.09
11	POLYPHENYLENESULFIDE	0.017	10.76	21261.70	14.95	10.24	22891.15	16.09	9.13	7.66	-10.80
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3878.52	2.73	262.68	4463.90	3.14	236.02	15.09	-10.15
13	POLYAMIDE-IMIDE	0.017	10.69	23509.83	16.53	17.17	21434.24	15.07	14.96	-8.83	-12.87
14	POLYAMIDE-IMIDE	0.017	10.67	22989.70	16.16	20.16	20163.79	14.18	17.52	-12.29	-13.10
15	POLYETHERIMIDE	0.017	10.73	15750.01	11.07	64.33	16102.33	11.32	49.21	2.24	-23.50
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082.09	9.90	46.38	14454.08	10.16	40.79	2.64	-12.05
17	POLYARYLEETHERKETONE	0.016	10.63	14945.59	10.51	62.28	14852.61	10.44	64.76	-0.62	3.99
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7239.88	5.09	162.40	8032.66	5.65	63.54	10.95	-60.87
19	POLYIMIDE-DF	0.023	14.76	10864.58	7.64	22.72	7992.34	5.62	15.35	-26.44	-32.42
20	POLYIMIDE-DF-ISO	0.022	14.42	12208.91	8.58	17.99	11577.30	8.14	13.98	-5.17	-22.31
21	POLY(ARYLEETHERETHERKETONE)	0.017	10.90	14359.79	10.10	75.04	14737.84	10.36	77.76	2.63	3.62
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488.22	8.78	10.35	15352.47	10.79	10.04	22.94	-3.00
23	66 NYLON, POLYAMIDE	0.016	10.64	10093.02	7.10	81.30	10323.20	7.26	190.94	2.28	134.86

All calculations based on an average of two tensile tests, except numbers 2, 6, 7, 11, 15, 16, and 18, which were an average of three tests.

All tensile pulls were at ambient condition.

TENSILE PROPERTIES OF PLASTICS EXPOSED TO 32 ISO VG MODIFIED POLYGLYCOL
[14 DAYS AT 100°C (212°F)]
Table H.14

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING			% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile		% Elongation	Tensile		% Elongation	Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²		lb/in ²	kg/mm ²			
1	POLYPHTHALAMIDE	0.017	10.65	11488.70	8.08	39.29	13528.58	9.51	18.90	17.76	-51.90
2	ABS	0.017	10.69	5528.90	3.89	40.47	5173.98	3.64	23.86	-6.42	-41.05
3	ACETAL	0.016	10.57	9753.56	6.86	22.60	10519.68	7.40	15.35	7.85	-32.06
4	PHENOLIC	0.017	10.76	8617.06	6.06	6.46	8727.73	6.14	3.94	1.28	-39.06
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7411.88	5.21	105.39	8401.22	5.91	55.71	13.35	-47.14
6	POLYCARBONATE	0.017	11.00	10188.30	7.16	87.40	10158.52	7.14	14.88	-0.29	-82.97
7	MODIFIED POLYPHENYLENE OXIDE	0.017	10.74	7778.90	5.47	46.85	8211.84	5.77	20.00	5.57	-57.31
8	POLYPROPYLENE	0.016	10.62	5396.97	3.79	372.76	5942.44	4.18	32.87	10.11	-91.18
9	POLYARYL SULFONE	0.017	10.77	12728.23	8.95	70.16	12956.68	9.11	77.95	1.79	11.11
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689.05	14.55	12.48	20967.05	14.74	11.02	1.34	-11.67
11	POLYPHENYLENESULFIDE	0.017	10.76	21261.70	14.95	10.24	23266.53	16.36	9.06	9.43	-11.57
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3878.52	2.73	262.68	4169.40	2.93	239.76	7.50	-8.72
13	POLYAMIDE-IMIDE	0.017	10.69	23509.83	16.53	17.17	19605.08	13.78	13.78	-16.61	-19.75
14	POLYAMIDE-IMIDE	0.017	10.67	22989.70	16.16	20.16	21854.28	15.37	19.29	-4.94	-4.31
15	POLYETHERIMIDE	0.017	10.73	15750.01	11.07	64.33	15153.32	10.65	50.00	-3.79	-22.28
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082.09	9.90	46.38	14341.83	10.08	43.78	1.84	-5.61
17	POLYARYLEETHERKETONE	0.016	10.63	14945.59	10.51	62.28	15034.41	10.57	71.46	0.59	14.73
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7239.88	5.09	162.40	8113.20	5.70	72.68	12.06	-55.25
19	POLYIMIDE-DF	0.023	14.76	10864.58	7.64	22.72	7990.96	5.62	14.96	-26.45	-34.15
20	POLYIMIDE-DF-ISO	0.022	14.42	12208.91	8.58	17.99	11663.72	8.20	16.14	-4.47	-10.27
21	POLY(ARYLEETHERETHERKETONE)	0.017	10.90	14359.79	10.10	75.04	14070.74	9.89	45.08	-2.01	-39.93
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488.22	8.78	10.35	13414.29	9.43	8.46	7.42	-18.22
23	66 NYLON, POLYAMIDE	0.016	10.64	10093.02	7.10	81.30	10452.97	7.35	85.43	3.57	5.08

All calculations based on an average of two tensile tests, except numbers 2, 6, 7, 11, 15, 16, and 18, which were an average of three tests.

All tensile pulls were at ambient condition.

I. Physical Changes of Plastics after Temperature and Dehydrating Conditions

TEMPERATURE EFFECTS OF TENSILE PROPERTIES ON PLASTICS EXPOSED TO HEAT IN AIR
[14 DAYS AT 150°C (300°F)]

Table I.1

NO.	TYPE	INITIAL TESTING					AFTER AGING TESTING			% CHANGE AFTER AGING	
		Cross-Sectional Area		Tensile		% Elongation at Break	Tensile		% Elongation	Tensile	% Elongation
		in ²	mm ²	lb/in ²	kg/mm ²		lb/in ²	kg/mm ²			
1	POLYPHTHALAMIDE	0.017	10.65	11489	8.08	39.29	15475	10.88	13.12	34.70	-66.61
2	ABS TERPOLYMER	0.017	10.69	5517	3.88	40.47	NA	NA	NA	NA	NA
3	ACETAL	0.016	10.57	9754	6.86	22.60	9686	6.81	14.57	-0.69	-35.53
4	PHENOLIC	0.017	10.76	8617	6.06	6.46	9345	6.57	4.86	8.44	-24.77
5	POLYVINYLIDENE FLUORIDE	0.016	10.30	7412	5.21	105.39	8107	5.70	52.36	9.38	-50.32
6	POLYCARBONATE	0.017	11.00	10182	7.16	87.40	10483	7.37	33.86	2.93	-61.26
7	MODIFIED POLYPHENYLENE OXIDE	0.017	10.70	7864	5.53	46.85	5647	3.97	5.12	-28.21	-89.07
8	POLYPROPYLENE	0.016	10.62	5397	3.79	372.76	5832	4.10	60.89	8.05	-83.67
9	POLYARYL SULFONE	0.017	10.77	12728	8.95	70.16	14266	10.03	37.95	12.08	-45.91
10	POLYETHYLENE TEREPHTHALATE	0.017	10.85	20689	14.55	12.48	18732	13.17	9.58	-9.46	-23.24
11	POLYPHENYLENE SULFIDE	0.017	10.76	21262	14.95	10.24	23184	16.30	8.79	9.04	-14.16
12	POLYTETRAFLUOROETHYLENE	0.013	8.63	3879	2.73	262.68	4295	3.02	239.50	10.75	-8.82
13	POLYAMIDE-IMIDE	0.017	10.69	23510	16.53	17.17	13029	9.16	19.49	-44.58	13.51
14	POLYAMIDE-IMIDE	0.017	10.67	22990	16.16	20.16	21577	15.17	19.69	-6.15	-2.33
15	POLYETHERIMIDE	0.017	10.73	15750	11.07	64.33	17523	12.32	44.22	11.26	-31.26
16	MODIFIED POLYETHERIMIDE	0.016	10.57	14082	9.90	46.38	15802	11.11	41.07	12.21	-11.45
17	POLYARYLEETHERKETONE	0.016	10.63	14946	10.51	62.28	16172	11.37	32.28	8.21	-48.17
18	POLYBUTYLENE TEREPHTHALATE	0.017	10.95	7240	5.09	162.40	9188	6.46	15.62	26.91	-90.38
19	POLYIMIDE-DF	0.023	14.76	10865	7.64	22.72	10924	7.68	17.32	0.54	-23.77
20	POLYIMIDE-DF-ISO	0.022	14.42	12209	8.58	17.99	10667	7.50	13.65	-12.63	-24.12
21	POLY(ARYLEETHERETHERKETONE)	0.017	10.90	14360	10.10	75.04	15717	11.05	79.27	9.45	5.64
22	LIQUID CRYSTAL POLYMER	0.017	10.69	12488	8.78	10.35	14309	10.06	8.92	14.58	-13.82
23	66 NYLON,POLYAMIDE	0.016	10.64	10093	7.10	81.30	3101	2.18	2.76	-69.28	-96.61

All calculations based on an average of three tensile tests.

All tensile pulls were at ambient condition and within 24hrs after aging conditions.

N/A = test bars not evaluated at these conditions

**TEMPERATURE EFFECTS OF TENSILE PROPERTIES ON PLASTICS EXPOSED TO
32 ISO VG MIXED-ACID POLYOLESTER
[14 DAYS EXPOSURE]**

Table I.2

NO.	TYPE	PERCENT CHANGE AFTER AGING					
		60°C (140°F)		100°C (212°F)		150°C (302°F)	
		Tensile	% Elongation	Tensile	% Elongation	Tensile	% Elongation
1	POLYPHTHALAMIDE	-2.47	84.88	7.10	-43.89	34.45	-67.93
2	ABS	1.09	-31.90	-37.71	-71.20	N/A	N/A
3	ACETEL	8.14	-25.96	-20.53	-40.77	-3.61	-18.14
4	PHENOLIC	-9.37	-36.01	17.90	-17.73	23.79	-20.74
5	POLYVINYLIDENE FLUORIDE	8.11	-4.74	-17.73	-10.34	0.55	-18.75
6	POLYCARBONATEPOLYCARBONATE	-10.52	-61.44	-7.80	-85.77	N/A	N/A
7	MODIFIED POLYPHENYLENE OXIDE	-2.02	-65.71	-5.98	-73.45	N/A	N/A
8	POLYPROPYLENE	8.05	-89.39	54.97	-75.60	-0.64	-59.07
9	POLYARYL SULFONE	0.03	11.39	2.62	-18.63	19.46	-51.18
10	POLYETHYLENE TEREPHTHALATE	8.45	-10.09	8.81	-8.52	-41.08	-46.39
11	POLYPHENYLENESULFIDE	5.49	-11.57	15.49	-7.73	22.49	-7.71
12	POLYTETRAFLUOROETHYLENE	-7.41	-12.32	6.10	-0.63	17.72	-4.90
13	POLYAMIDE-IMIDE	-9.97	-11.72	-17.17	26.11	21.24	18.11
14	POLYAMIDE-IMIDE	-11.29	-12.12	-17.44	-7.24	-9.73	-11.16
15	POLYETHERIMIDE	-1.65	-9.55	-0.27	-40.15	9.09	-69.39
16	MODIFIED POLYETHERIMIDE	3.96	-10.87	4.09	-31.07	11.81	-36.33
17	POLYARYLEETHERKETONE	-1.85	-2.65	-2.21	0.20	13.92	-13.09
18	POLYBUTYLENE TEREPHTHALATE	7.99	-57.82	10.10	-68.05	-36.74	-96.85
19	POLYIMIDE-DF	-28.35	-40.22	-26.42	-20.29	3.03	-18.57
20	POLYIMIDE-DF-ISO	-55.23	-24.50	25.83	-15.74	0.07	-10.28
21	POLY(ARYLEETHERETHERKETONE)	4.11	7.55	6.02	10.44	2.42	-48.59
22	LIQUID CRYSTAL POLYMER	12.32	-14.41	17.30	0.80	16.63	-6.76
23	66 NYLON, POLYAMIDE	-5.09	75.06	73.73	139.95	-67.31	-96.13

All calculations were based on an average of two tensile tests.

All tensile pulls were at ambient conditions.

N/A = test bar not evaluated at these conditions

**TEMPERATURE EFFECTS OF TENSILE PROPERTIES ON PLASTICS EXPOSED TO
32 ISO VG BRANCHED-ACID POLYOLESTER
[14 DAYS EXPOSURE]**

Table I.3

NO.	TYPE	PERCENT CHANGE AFTER AGING					
		60°C (140°F)		100°C (212°F)		150°C (302°F)	
		Tensile	% Elongation	Tensile	% Elongation	Tensile	% Elongation
1	POLYPHTHALAMIDE	-2.98	89.89	0.04	55.32	37.79	-65.92
2	ABS	-3.25	-26.07	-21.42	-74.71	N/A	N/A
3	ACETEL	5.12	-20.74	5.88	-32.06	5.14	-7.65
4	PHENOLIC	10.58	-26.87	-11.39	-39.06	4.98	-32.97
5	POLYVINYLIDENE FLUORIDE	8.68	-44.15	5.51	-22.49	0.75	-28.09
6	POLYCARBONATEPOLYCARBONATE	-11.59	-7.04	-3.66	-81.62	N/A	N/A
7	MODIFIED POLYPHENYLENE OXIDE	-1.04	-47.39	0.71	-59.17	N/A	N/A
8	POLYPROPYLENE	6.86	71.91	0.29	-60.71	-11.71	-84.21
9	POLYARYL SULFONE	-2.82	-66.33	-1.97	-4.04	19.49	-39.68
10	POLYETHYLENE TEREPHTHALATE	5.00	-0.63	8.09	-6.94	-43.97	-49.52
11	POLYPHENYLENESULFIDE	-1.52	-10.84	8.93	-9.26	4.63	-17.38
12	POLYTETRAFLUOROETHYLENE	6.54	13.53	11.00	23.05	20.65	5.59
13	POLYAMIDE-IMIDE	-22.25	-7.14	-12.15	-15.16	1.82	-8.27
14	POLYAMIDE-IMIDE	-10.93	-5.29	-8.09	5.46	-14.81	-13.10
15	POLYETHERIMIDE	-0.93	-17.62	-3.53	-18.48	10.81	-75.83
16	MODIFIED POLYETHERIMIDE	1.62	2.20	4.13	-18.71	13.03	-13.40
17	POLYARYLEETHERKETONE	-1.68	-35.84	-0.99	2.09	10.01	-61.43
18	POLYBUTYLENE TEREPHTHALATE	3.04	-2.59	10.1	-69.75	-22.40	-96.36
19	POLYIMIDE-DF	-1.17	-15.96	-1.04	-18.56	0.28	-17.69
20	POLYIMIDE-DF-ISO	-4.10	-13.56	-8.75	-14.65	-3.65	-4.78
21	POLY(ARYLEETHERETHERKETONE)	3.73	9.65	0.66	1.26	4.79	-15.01
22	LIQUID CRYSTAL POLYMER	13.37	-3.00	11.2	-4.90	21.64	-12.46
23	66 NYLON, POLYAMIDE	-3.57	27.12	-4.64	80.87	30.63	-61.75

All calculations were based on an average of two tensile tests.

All tensile pulls were at ambient conditions.

N/A = test bar not evaluated at these conditions

**EFFECTS OF DEHYDRATING PLASTICS ON TENSILE PROPERTIES
WHEN EXPOSED TO BRANCHED-ACID POLYOLESTER¹
[14 DAYS AT 150°C (300°F)]
Table I.4**

NO.	TYPE	TENSILE (kg/mm ²)			% ELONGATION		
		WITHOUT DEHYDRATION	AFTER DEHYDRATION	PERCENT CHANGE	WITHOUT DEHYDRATION	AFTER DEHYDRATION	PERCENT CHANGE
1	POLYPHTHALAMIDE	11.13	10.94	-1.7	13.39	14.96	11.7
3	ACETAL	7.21	6.98	-3.2	20.87	21.26	1.9
4	PHENOLIC	6.36	6.50	2.2	4.33	4.72	9.0
5	POLYVINYLIDENE FLUORIDE	5.25	5.19	-1.1	75.79	74.21	-2.1
8	POLYPROPYLENE	3.35	3.36	0.3	58.86	54.13	-8.0
9	POLYARYL SULFONE	10.69	11.02	3.1	42.32	53.15	25.6
10	POLYETHYLENE TEREPHTHALATE	8.15	9.40	15.3	6.30	7.28	15.6
11	POLYPHENYLENE SULFIDE	15.64	18.18	16.2	8.46	9.45	11.7
12	POLYTETRAFLUOROETHYLENE	3.29	3.63	10.3	277.36	239.57	-13.6
13	POLYAMIDE-IMIDE	16.83	19.37	15.1	15.75	18.70	18.7
14	POLYAMIDE-IMIDE	13.77	15.73	14.2	17.52	18.50	5.6
15	POLYETHERIMIDE	12.27	11.93	-2.8	15.55	48.23	210.2
16	MODIFIED POLYETHERIMIDE	11.19	11.15	-0.4	40.16	31.69	-21.1
17	POLYARYLEETHERKETONE	11.56	12.67	9.6	24.02	70.47	193.4
18	POLYBUTYLENE TEREPHTHALATE	3.95	3.84	-2.8	5.91	5.91	0.0
19	POLYIMIDE-DF	7.66	7.52	-1.8	18.70	17.13	-8.4
20	POLYIMIDE-DF-ISO	8.27	8.65	4.6	17.13	15.16	-11.5
21	POLY(ARYLEETHERETHERKETONE)	10.58	11.16	5.5	63.78	70.87	11.1
22	LIQUID CRYSTAL POLYMER	10.68	10.55	-1.2	9.06	9.65	6.5
23	66 NYLON,POLYAMIDE	9.27	3.04	-67.2	31.10	3.94	-87.3

¹Dehydration of plastics accomplished by heating at 150°C (302°F) for 24hrs prior to lubricant exposure

All calculations based on an average of two tensile tests.

All tensile pulls were at ambient conditions.