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ARTI REFRIGERANT DATABASE

DATA SUMMARIES - VOLUME 3:

TOXICITY AND COMPATIBILITY

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prepared by

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Introduction

This report provides data summaries from the *ARTI Refrigerant Database.* Volumes 1 and 2 present refrigerant profiles for single-compound refrigerants and refrigerant profiles, respectively. Volume 3 presents data summaries for compatibility and toxicity. They are part of a series to provide a record of the database entries in printed form.

Purpose

The Refrigerant Database is an information system on alternative refrigerants, associated lubricants, and their use in air conditioning and refrigeration. It consolidates and facilitates access to property, compatibility, environmental, safety, application, and other information. It provides corresponding information on older refrigerants, to assist manufacturers and those using alternative refrigerants to make comparisons and determine differences. The underlying purpose is to accelerate phase out of chemical compounds of environmental concern.

Contents

The database identifies sources of specific information on R-22, R-23, R-32, R-41, R-116, R-123, R-124, R-125, R-134, R-134a, R-141b, R-142b, R-143a, R-152a, R-218, R-227ea, R-236fa, R-245ca, R-245fa, R-290 (propane), R-C318, R-717 (ammonia), R-718 (water), R-744 (carbon dioxide), R-1270 (propylene), ethers, and others as well as azeotropic and zeotropic blends of these fluids. These blends include R-400, R-401A, R-401B, R-401C, R-402A, R-402B, R-403A, R-403B, R-404A, R-405A, R-406A, R-407A, R-407B, R-407C, R-407D, R-408A, R-409A, R-409B, R-410A, R-410B, R-411A, R-411B, R-412A, R-413A, R-414A, R-414B, R-415A, R-416A, R-500, R-501, R-502, R-503, R-504, R-505, R-506, R-507A, R-508A, R-508B, R-509A, and others for which information is available even though standard designations may not have been assigned yet. It addresses lubricants including alkylbenzene, polyalkylene glycol, polyolester, and other synthetics as well as mineral oils. It also references documents addressing compatibility of refrigerants and lubricants with metals, plastics, elastomers, motor insulation, and other materials used in refrigerant circuits.

The database provides bibliographic citations and abstracts for publications that may be useful in research and design of air-conditioning and refrigeration equipment. The complete docu-

ments are not included, though some may be added at a later date. Incomplete citations or abstracts are provided for some documents. They are included to accelerate availability of the information and will be completed or replaced in future updates.

Limitations

The Refrigerant Database is intended as a means to assist users in locating sources of information on alternative refrigerants. But, the database is:

- neither a comprehensive nor authoritative reference source,
- not a substitute for independent data collection by users,
- not a substitute for examination of the data, information on how they were arrived at, assumptions, and caveats in the cited documents, and
- not an endorsement of suitability or accuracy of the referenced publications.

The information in the database was obtained from published and unpublished sources, or calculated from them, without verification. Some of the data may be imprecise or incorrect, as manifested - in some cases - by inclusion of conflicting data based on disagreement among identified sources. Similarly, errors may have occurred in assembling and processing the database. Users are cautioned to check the data and associated limitations and caveats in the referenced documents and other sources before use, particularly if such use might risk harm to life or property. Newer or more complete data may be available from refrigerant suppliers or elsewhere.

Materials compatibility, properties, safety considerations, and other characteristics affecting suitability or desirability may be influenced by a number of factors. Among them are specific application conditions, preparation such as drying before use, additives including fillers, impurities, catalytic interactions with other materials used, and changes in compounding between one source or batch and another. Similarly, new findings or corrections may supersede previously published data. The database is an aid in locating data that may be pertinent; it is not and should not be viewed as the source of data for research, design, analysis, or other purposes.

Database Form

The database is available in both computerized ("electronic") and report ("manual" or "listing") versions.

Computerized Version

The computerized version includes both data summaries and bibliographic citations organized into a number of segments ("files"). These segments can be searched individually or together, in any combination.

The computerized database provides 606 specially-prepared data summaries, including refrigerant (single compound and blend) profiles, tabular compatibility summaries for plastics and

Distribution of the Refrigerant Database

	computerized (diskette)	report (listing)	documents (copies)
data summaries			
• refrigerant profiles	yes	no	[a]
• compatibility	yes	no	[a]
• toxicity	yes	no	[a]
bibliographic citations and synopses (detailed abstracts)			
• recently added and key	yes	yes	[a]
• copper supplement [b]	yes	[b]	[a]
• archival and historical	yes	no	[a]
search and retrieval software	yes [c]	no	no
additions and changes flagged	no	yes	no
distributed on cost-recovery basis			
• subscription (periodic updates)	yes	yes	no
• as ordered	no	yes	yes [d]

[a] Data summaries, citations, and synopses may be printed with the computerized version.

[b] The Copper Development Association (CDA) sponsored supplement provides additional citations and synopses, most of which address compatibility with or use of copper in air-conditioning and refrigeration systems. The supplement is included and searchable with the computerized version, but published as a separate report.

[c] Use of the search and retrieval software is subject to acceptance of the license agreement for it; both accompany the computerized version.

[d] Distribution is limited to documents in the public domain or for which authorization has been obtained. Others may be ordered from their publishers, which are identified in the bibliographic citations.

elastomers, and toxicity reviews for refrigerants. The refrigerant profiles cover designations, common uses, chemical and trade names, other identifiers, molecular mass, critical properties (pressure, temperature, specific volume, and density at the critical point), physical and thermophysical properties for selected conditions, safety classifications, toxicity and flammability data, exposure limits, atmospheric lifetime, ozone depletion potential, global warming potential, halogen global warming potential, commercialization, phaseout, and other data.

The computerized version also provides more than 6,100 citations. They are organized into a primary file that includes recently added and key references, a supplement on copper in air conditioning and refrigeration, and an archival group covering historical and superseded documents.

The search and retrieval software provided with the computerized version enables very fast searches for user-selected terms or combinations of terms. The search program offers several automated features to simplify use. They include optional prompting by search category, an automated "thesaurus" of synonyms and related terms, chain searches to broaden or narrow prior searches, a "wildcard" capability to allow entry of word segments, and a configuration capability to customize a number of options. The program also allows printing of selected portions of the database. Printing the entire database would yield more than 8,000 pages, so a printed version is available for those who prefer to use the database manually.

Report Version

A listing of the recent and key citations is provided in report form. The citations are grouped under the primary or first subject addressed; they are not cross-referenced under other topics. The computerized version, therefore, is better suited to search for information by subject.

Citations and summaries from the supplement on copper in air conditioning and refrigeration are published separately. They also are arranged by subject.

Archival and historic citations are included in a third report. They are presented in reverse chronological order, beginning with the most recent. These citations remain accessible through the computerized version.

Documents

The database also includes a collection of published and unpublished documents, copies of which can be ordered individually. Approximately one third of the documents cited in the database are included in this collection. They include documents that are not protected by copyright or proprietary restrictions. They also include documents for which the authors or copyright owners granted permission for reproduction and distribution. Documents that are not dis-

tributed through the database can be obtained from their publishers, libraries, and other sources (please refer to the database User's Manual for suggestions).

Ordering Information

The computerized version of the database and the report version for recently added and key references can be ordered along with a subscription for updates. The report versions of the copper supplement, archival citations, and data summaries are available as separate documents distributed through the database.

An order form for the Refrigerant Database, which indicates the pricing, accepted methods of payment, and applicable terms and conditions, may be downloaded from the Internet from *http://www.arti-21cr.org/db.* Alternatively, a copy may be obtained by mail or fax by calling +1-703/524-8800 or faxing +1-703/522-2349. Questions should be sent by e-mail to *database@spectrum-internet.com.* Please note that the same form may be used to obtain the computerized database and remaining scheduled updates, the report version and remaining scheduled updates for primary and key references, and database documents by completing the corresponding portions of the form.

Additions

Future updates and expansions to the database are planned. Please help in making it more useful, and facilitating use of alternative refrigerants, by submitting the following:

- corrections to errors identified in the database,
- copies of helpful papers - whether your own or written by others - for citation, and
- suggestions for improving the database.

Authors or those holding rights to published or unpublished works pertinent to the database are invited - and encouraged - to authorize their reproduction and unrestricted distribution through the database. Product literature normally is not included, but technical bulletins and papers providing relevant information, whether on proprietary or generic substances, will be considered.

Please send your inputs to:

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Thank you for your help with and use of the database. Its objective is to accelerate phase out of chemical compounds of environmental concern by sharing the information needed to do so.

ARTI Refrigerant Database - Data Summaries

Toxicity

(Editor's Note: Paper DOE/CE/23810-110 contains the toxicity summaries for these refrigerants. Click on the refrigerant of interest to view the toxicity summary.)

Compatibility - Elastomers

G. R. Hammed, R. H. Seiple, and O. Taikum (University of Akron), **Compatibility of Refrigerants and Lubricants with Elastomers**, report DOE/CE/23810-14, Air-Conditioning and Refrigeration Technology Institute (ARTI), Arlington, VA, January 1994 (538 pages with 519 figures and 117 tables, available from JMC as RDB4501)

This report provides extensive data on the swell behavior of 95 elastomeric gasket and seal materials in 10 refrigerants and 7 lubricants. It also details tensile strength, hardness, weight, and dimensional changes for 25 selected elastomers after thermal aging in refrigerant-lubricant mixtures. The report describes the selections as well as sample verifications for the elastomers, refrigerants, and lubricant. It then discusses resistance to solvent uptake - and resultant swell - based on the degree of crosslinking, the degree of interaction with a solvent (based on the Flory-Rehner equation), the roles of cure level and filler content, and tradeoffs with hardness and brittleness. R-123 generally resulted in the greatest swelling, but EPDM/PP/TPE, butyl rubber/PP TPE, and several vendor-supplied compositions swelled little in this refrigerant. The HFCs generally gave much less swelling than the HCFCs, though the fluoroelastomers and fluorosilicones exhibit high swelling in them. Some vendor compositions are identified that resisted swelling in all refrigerants and lubricants tested. The refrigerants tested included both hydrochlorofluorocarbons (HCFCs R-22, R-123, R-124, and R-142b) and hydrofluorocarbons (HFCs R-32, R-125, R-134, R-134a, R-143a, and R-152a). The lubricants included a naphthenic mineral oil (MO, Witco Suniso® 3GS), alkylbenzene (AB, Shrieve Zerol® 150), and three polyalkylene glycols (PAGs), namely a polypropylene glycol butyl monoether (ICI Emkarox®), a polypropylene glycol diol (Dow P425), and a modified polyglycol (AlliedSignal BRL-150). Two polyolester (POE) lubricants also were included, namely a pentaerythritol ester branched acid (Henkel Emery® 2927-A) and a pentaerythritol ester mixed acid (ICI Emkarate™ RL 22H, formerly RL 244). Appendices describe the test methodology and identify the elastomer formulations. They include polyisoprene (Natsyn™ 2200), polychloroprene (Neoprene™ W), isobutyl isoprene (Polysar Butyl), bromobutyl (Polysar X2), chlorobutyl 1068, styrene butadiene rubber (SBR 1502 and Stereon 730A and 840A), nitrile (Chemigum™ N206, N300, N615B, and N917), hydrogenated nitrile (Polysar Tomac™ A3850 and A4555), fluoroelastomers (DuPont Viton® A, B, and GF), fluorinated/chlorinated rubber (KEL-F™ 3700), epichlorohydrin homopolymer (Hydrin™ H-65), epichlorohydrin copolymer (Hydrin™ C-65 and T-75), methyl vinyl silicone (SE-33™), dimethyl silicone (SE-436U™), methyl vinyl phenyl silicone (SE-565U™) silicone (SE-3808U™), fluorinated silicone (LS-63U™), EPDM/polypropylene thermoplastic elastomer (TPE, Advanced Elastomer Systems Santoprene® 201-73, 201-87, 203-40, and 203-50), nitrile/polypropylene TPE (Geolast™ 701-87, 701-80, and 701-40), copolyester TPE (Hytrel™ 4056, 5526, G6356, and 7246), polysulfide rubber (FA™ and ST™), polyurethane (Airthane™ PET-95A and PET-60D, Cyanaprene™ A-8 and D-55, Millathane™ 76 and E-34), chlorosulfonated polyethylene (Hypalon™ 20, 40, and 4085), ethylene propylene (EPM, Vistalon™ 404 and 707), ethylene acrylic (Vamac™ G and B-124MB), chlorinated polyethylenes (Dow CM0136™ and 4211P™), ethylene propylene diene (EPDM, Royalene™ 552, 525, and 359), and EPDM/butyl TPE (Trefsin™). Another appendix identifies ten gasket materials supplied by ARTI including filled chloroprene (Precision Rubber 2167), acrylonitrile (Precision Rubber 7507), neoprene (Garlock 2930), non-asbestos (Armstrong N-8092, Specialty Paperboard NI-2085G, Victopac 69, and Klinger C-4401), nitrile-aramid (Specialty Paperboard 2099), fluorocarbon (Parker V747-75), and neoprene (Greene, Tweed and Company 956). 95 tables present data on swell after immersions of 1, 3, and 14 days, weight change after 14 days, diameter and weight after removal, and shore hardness after 1 day of drying. 18 figures for each refrigerant and lubricant illustrate di-

ameter changes for the exposed elastomers. Oscillating disk rheometer (ODR) curves are provided for 68 curable elastomers and thermogravimetric analysis (TGA) plots for 94 elastomers. Physical property data before exposures also are given, including modulus, tensile strength elongation at break, and hardness. Infrared (IR) and gas chromatographic (GC) analyses are summarized for the refrigerants and lubricants. A set of tables then identifies the specific refrigerant-lubricant combinations tested and changes in weight, width, thickness, tensile strength, and hardness after aging; the changes in tensile strength also are plotted.

polyisoprene with sulfur cure

COMPATIBILITY SUMMARY			
elastomer	polyisoprene with sulfur cure Natsyn(TM) 2200		see RDB#
composition	(in parts per hundred parts of elastomer)		
	polyisoprene	100	
	zinc oxide	5	
	sulfur	2.25	
	stearic acid	2	
	N-t-butyl-2-benzothiazl sulfenamide	0.7	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness	
R-22						
neat (at ambient)	10.2	43.9	-0.8	-1.8	---	4501
R-32						
neat (at ambient)	2.7	8.8	-0.2	1.8	46.5	4501
R-123						
neat (at ambient)	48.0	328.	0.1	1.3	---	4501
R-124						
neat (at ambient)	5.8	30.0	0.2	0.0	---	4501
R-125						
neat (at ambient)	4.2	14.6	2.5	8.9	---	4501
R-134						
neat (at ambient)	1.5	7.7	-1.2	-0.1	45.5	4501
R-134a						
neat (at ambient)	1.2	4.9	-0.3	-0.9	---	4501
R-142b						
neat (at ambient)	10.2	29.4	0.6	-1.2	---	4501
R-143a						
neat (at ambient)	1.9	5.2	0.6	-0.7	---	4501
R-152a						
neat (at ambient)	4.2	12.7	-0.1	1.9	---	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	53.2	247.	---	237.	---	4501
AB (60°C,140°F)	56.5	263.	54.4	251.	---	4501
PAG PPG butyl monoether (60°C)	8.1	28.0	6.4	19.6	---	4501
PPG diol (60°C,140°F)	2.2	7.8	---	7.3	---	4501
modified polyol (60C,140F)	2.6	8.6	1.8	7.6	39.5	4501
POE branched acid (60°C,140°F)	26.1	105.	---	96.9	---	4501
mixed acid (60°C,140°F)	28.6	115.	25.1	104.	---	4501

* mineral oil (MO)

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naphthenic (Witco Suniso(R) 3GS)
alkylbenzene (AB)
(Shrieve Zerol(R) 150)
polyalkylene glycol (PAG)
modified polyol (AlliedSignal BRL-150)
polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
polypropylene glycol (PPG) diol (Dow P425)
polyolester (POE)
pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

polyisoprene with sulfur cure and carbon fill

COMPATIBILITY SUMMARY			
elastomer	polyisoprene with sulfur cure and carbon fill Natsyn(TM) 2200		see RDB#
composition	(in parts per hundred parts of elastomer)		
	polyisoprene	100	
	zinc oxide	5	
	sulfur	2.25	
	stearic acid	2	
	N-t-butyl-2-benzothiazl sulfenamide	0.7	
	N330 carbon black	35	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness change (%)	
R-22						
neat (at ambient)	9.0	32.1	-0.4	-1.1	---	4501
R-32						
neat (at ambient)	1.4	4.9	-0.7	-0.2	63.5	4501
R-123						
neat (at ambient)	37.6	221.	0.6	1.6	---	4501
R-124						
neat (at ambient)	5.6	22.5	-0.2	0.5	---	4501
R-125						
neat (at ambient)	3.1	9.1	1.3	5.1	---	4501
R-134						
neat (at ambient)	1.1	5.7	-0.4	-0.2	63.5	4501
R-134a						
neat (at ambient)	1.0	3.8	0.2	-0.5	---	4501
R-142b						
neat (at ambient)	7.8	30.5	-0.3	-0.8	---	4501
R-143a						
neat (at ambient)	2.2	3.6	0.8	-0.5	--- #	4501
R-152a						
neat (at ambient)	2.5	8.2	-0.5	-0.3	---	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	40.7	165.	---	159.	---	4501
AB (60°C,140°F)	46.1	184.	44.7	176.	---	4501
PAG PPG butyl monoether (60°C)	6.6	20.8	5.3	15.2	---	4501
PPG diol (60°C,140°F)	2.2	6.6	---	5.9	---	4501
modified polyol (60C,140F)	2.2	7.0	1.3	6.3	---	4501
POE branched acid (60°C,140°F)	18.2	64.4	---	59.7	---	4501
mixed acid (60°C,140°F)	21.7	77.6	20.4	70.5	---	4501

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* mineral oil (MO)
  naphthenic (Witco Suniso(R) 3GS)
  alkylbenzene (AB)
  (Shrieve Zerol(R) 150)
  polyalkylene glycol (PAG)
  modified polyol (AlliedSignal BRL-150)
  polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
  polypropylene glycol (PPG) diol (Dow P425)
  polyolester (POE)
  pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
  pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)
Specimen showed deterioration after removal from the test fluid.

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

polyisoprene with vulcanization cure

---------- COMPATIBILITY SUMMARY ----------

			see RDB#
elastomer	polyisoprene with vulcanization cure Natsyn(TM) 2200		
composition	(in parts per hundred parts of elastomer)		
	polyisoprene	100	
	zinc oxide	5	
	stearic acid	2	
	N-oxydiethylene-2-benzothiazl sulfenamide	1.0	
	tetramethylthiuram disulfide	1.0	
	di-morpholino disulfide	1.0	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness change (%)	
R-22						
neat (at ambient)	8.9	43.5	-0.5	-3.6	---	4501
R-32						
neat (at ambient)	1.5	4.6	0.1	-1.8	43.5	4501
R-123						
neat (at ambient)	51.8	388.	-0.9	-0.6	40.5	4501
R-124						
neat (at ambient)	6.1	28.3	-0.7	-2.4	---	4501
R-125						
neat (at ambient)	2.7	10.2	1.1	4.7	---	4501
R-134						
neat (at ambient)	1.0	6.1	-1.5	-1.5	41.5	4501
R-134a						
neat (at ambient)	1.2	3.6	-0.1	-2.2	---	4501
R-142b						
neat (at ambient)	9.5	39.6	-1.1	-2.7	---	4501
R-143a						
neat (at ambient)	2.7	4.4	0.6	-1.9	---	4501
R-152a						
neat (at ambient)	3.1	8.9	-1.1	-2.1	---	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	56.9	271.	---	262.	---	4501
AB (60°C,140°F)	55.9	257.	65.7	247.	---	4501
PAG PPG butyl monoether (60°C)	5.8	17.9	3.5	9.4	---	4501
PPG diol (60°C,140°F)	0.7	1.6	---	1.1	---	4501
modified polyol (60C,140F)	2.0	6.1	0.1	4.9	32.5	4501
POE branched acid (60°C,140°F)	20.3	76.1	---	66.3	---	4501
mixed acid (60°C,140°F)	22.0	83.2	18.7	71.0	---	4501

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

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mineral oil (MO)
  naphthenic (Witco Suniso(R) 3GS)
alkylbenzene (AB)
  (Shrieve Zerol(R) 150)
polyalkylene glycol (PAG)
  modified polyol (AlliedSignal BRL-150)
  polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
  polypropylene glycol (PPG) diol (Dow P425)
polyolester (POE)
  pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
  pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

polychloroprene

COMPATIBILITY SUMMARY			
elastomer	polychloroprene Neoprene(TM) W		see RDB#
composition	(in parts per hundred parts of elastomer)		
	poly(chlorobutadiene)	100	
	zinc oxide	5	
	magnesium oxide	4	
	stearic acid	0.5	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness change (%)	
R-22						
neat (at ambient)	6.1	2.19	26.4	-0.3	---	4501
R-32						
neat (at ambient)	1.0	4.4	0.3	0.5	68.5	4501
R-123						
neat (at ambient)	15.3	65.1	1.4	8.7	---	4501
R-124						
neat (at ambient)	2.8	10.2	1.5	5.1	---	4501
R-125						
neat (at ambient)	2.7	5.3	2.5	4.3	---	4501
R-134						
neat (at ambient)	0.6	3.4	1.5	1.9	73.5	4501
R-134a						
neat (at ambient)	1.2	3.4	0.7	1.8	---	4501
R-142b						
neat (at ambient)	6.5	18.5	1.8	3.1	---	4501
R-143a						
neat (at ambient)	1.2	3.5	3.3	1.5	---	4501
R-152a						
neat (at ambient)	3.0	7.6	0.4	1.3	---	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	26.3	73.3	---	68.5	---	4501
AB (60°C,140°F)	19.9	52.2	20.3	47.9	---	4501
PAG PPG butyl monoether (60°C)	11.9	30.4	10.6	30.0	---	4501
PPG diol (60°C,140°F)	7.6	19.3	---	18.4	---	4501
modified polyol (60C,140F)	4.0	11.9	3.7	11.6	35.5	4501
POE branched acid (60°C,140°F)	30.7	103.	---	98.7	---	4501
mixed acid (60°C,140°F)	53.5	206.	52.5	193.	---	4501

* mineral oil (MO)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

naphthenic (Witco Suniso(R) 3GS)
alkylbenzene (AB)
(Shrieve Zerol(R) 150)
polyalkylene glycol (PAG)
modified polyol (AlliedSignal BRL-150)
polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
polypropylene glycol (PPG) diol (Dow P425)
polyolester (POE)
pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

polychloroprene with carbon fill

COMPATIBILITY SUMMARY			see RDB#
elastomer	polychloroprene with carbon fill Neoprene(TM) W		
composition	(in parts per hundred parts of elastomer)		
	poly(chlorobutadiene)	100	
	zinc oxide	5	
	magnesium oxide	4	
	stearic acid	0.5	
	N330 carbon black	30	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness change (%)	
R-22						
neat (at ambient)	4.9	17.0	-0.9	0.8	---	4501
R-32						
neat (at ambient)	1.4	3.7	-0.2	0.3	81.5	4501
R-123						
neat (at ambient)	11.4	49.2	1.2	7.1	---	4501
R-124						
neat (at ambient)	1.6	7.7	0.9	4.1	---	4501
R-125						
neat (at ambient)	2.1	4.6	1.2	3.8	---	4501
R-134						
neat (at ambient)	0.9	2.7	0.3	1.4	82.5	4501
R-134a						
neat (at ambient)	1.0	2.7	0.4	1.3	---	4501
R-142b						
neat (at ambient)	4.8	14.5	1.2	3.7	---	4501
R-143a						
neat (at ambient)	0.8	2.3	0.4	1.1	---	4501
R-152a						
neat (at ambient)	2.9	5.8	0.3	1.4	---	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	18.6	48.7	---	45.8	---	4501
AB (60°C,140°F)	15.7	31.0	14.6	35.4	---	4501
PAG PPG butyl monoether (60°C)	9.4	23.0	8.9	22.1	---	4501
PPG diol (60°C,140°F)	4.9	13.6	---	13.5	---	4501
modified polyol (60C,140F)	2.9	7.5	2.2	7.3	57.5	4501
POE branched acid (60°C,140°F)	22.1	64.9	---	63.5	---	4501
mixed acid (60°C,140°F)	29.6	92.4	27.3	89.4	---	4501

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

* mineral oil (MO)
  naphthenic (Witco Suniso(R) 3GS)
alkylbenzene (AB)
  (Shrieve Zerol(R) 150)
polyalkylene glycol (PAG)
  modified polyol (AlliedSignal BRL-150)
  polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
  polypropylene glycol (PPG) diol (Dow P425)
polyolester (POE)
  pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
  pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

butyl rubber, 0.7% unsaturated with sulfur cure

---------- COMPATIBILITY SUMMARY ----------

			see RDB#
elastomer	butyl rubber, 0.7% unsaturated with sulfur cure		
composition	(in parts per hundred parts of elastomer)		
	isobutyl isoprene (0.7% unsaturated)	100	
	zinc oxide	3	
	sulfur	1.65	
	stearic acid	1	
	tetramethylthiuram disulfide	1	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness change (%)	
R-22						
neat (at ambient)	3.9	22.1	57.9	2.3	--- #	4501
R-32						
neat (at ambient)	1.0	4.0	33.5	1.7	25.5	4501
R-123						
neat (at ambient)	16.3	90.2	5.5	27.2	---	4501
R-124						
neat (at ambient)	3.2	16.4	2.7	13.1	---	4501
R-125						
neat (at ambient)	2.6	7.7	8.5	6.7	---	4501
R-134						
neat (at ambient)	0.5	2.9	0.1	1.8	33.5	4501
R-134a						
neat (at ambient)	0.6	2.9	0.3	1.9	---	4501
R-142b						
neat (at ambient)	6.2	25.7	3.7	13.3	---	4501
R-143a						
neat (at ambient)	1.3	3.8	28.1	2.9	---	4501
R-152a						
neat (at ambient)	1.7	7.0	2.6	4.0	---	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	68.9	361.	---	350.	---	4501
AB (60°C,140°F)	67.6	339.	67.0	328.	---	4501
PAG PPG butyl monoether (60°C)	0.2	0.4	0.3	0.0	---	4501
PPG diol (60°C,140°F)	0.1	-0.1	---	-0.3	---	4501
modified polyol (60C,140F)	-1.2	-0.1	-0.5	-0.5	27.5	4501
POE branched acid (60°C,140°F)	2.2	7.2	---	6.5	---	4501
mixed acid (60°C,140°F)	3.0	10.0	2.6	8.8	---	4501

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

```
* mineral oil (MO)
    naphthenic (Witco Suniso(R) 3GS)
  alkylbenzene (AB)
    (Shrieve Zerol(R) 150)
  polyalkylene glycol (PAG)
    modified polyol (AlliedSignal BRL-150)
    polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
    polypropylene glycol (PPG) diol (Dow P425)
  polyolester (POE)
    pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
    pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)
# Specimen showed deterioration after removal from the test fluid.
```

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

butyl rubber, 2.2% unsaturated with sulfur cure

COMPATIBILITY SUMMARY			
elastomer	butyl rubber, 2.2% unsaturated with sulfur cure		see RDB#
composition	(in parts per hundred parts of elastomer)		
	isobutyl isoprene (2.2% unsaturated)	100	
	zinc oxide	3	
	sulfur	1.75	
	stearic acid	1	
	tetramethylthiuram disulfide	1	4501

The following table presents data after thermal aging in refrigerant-lubricant mixtures for 14 days at the temperatures indicated. The data include changes in weight, width, thickness, tensile strength, and hardness. Details of the tests are identified in the referenced source(s).

refrigerant (aging Temp) lubricant, % by weight	weight change (%)	width swell (%)	thick-ness swell (%)	tensile strength change (%)	Shore A hardness change (%)	
R-22 at 100 °C (212 °F)						
MO naphthenic, 33%	389.5	87.6	44.6	# -90.5	-87.6	4501
R-32 at 100 °C (212 °F)						
POE branched acid, 22%	20.1	35.0	38.5	# -58.8	-58.4	4501
POE mixed acid, 23%	23.5	2.5	3.8	# -30.2	-51.7	4501
R-123 at 100 °C (212 °F)						
MO naphthenic, 50%	514.5	69.2	52.2	-84.9	-76.4	4501
R-124 at 100 °C (212 °F)						
AB, 50%	161.5	29.0	28.4	# -82.4	-51.7	4501
R-125 at 100 °C (212 °F)						
PAG PPG diol, 37%	3.5	1.6	0.0	# -26.8	-24.7	4501
POE branched acid, 38%	19.7	21.1	16.4	# -29.8	-47.2	4501
POE mixed acid, 36%	17.0	19.4	15.9	# -39.9	-51.7	4501
R-134 at 100 °C (212 °F)						
POE branched acid, 67%	8.1	0.0	0.0	-26.9	-31.5	4501
R-134a at 100 °C (212 °F)						
PAG modified, 35%	3.9	5.4	1.9	-22.4	-4.5	4501
PAG PPG diol, 39%	5.5	-0.9	1.3	-24.2	-9.0	4501
POE branched acid, 47%	15.2	1.3	0.7	-35.0	-18.0	4501
POE mixed acid, 41%	17.2	4.1	4.4	# -33.3	-22.5	4501
R-142b at 100 °C (212 °F)						
AB, 50%	202.5	38.1	30.0	# -83.9	-65.2	4501
R-143a at 100 °C (212 °F)						
POE branched acid, 28%	22.6	5.1	2.4	# -23.3	-13.5	4501
R-152a at 100 °C (212 °F)						
AB, 34%	172.0	44.5	33.4	# -95.3	-67.4	4501
POE branched acid, 46%	15.4	3.2	1.3	# -46.1	-22.5	4501

* The lubricants tested were:
MO: naphthenic mineral oil (Witco Suniso(R) 3GS)
AB: alkylbenzene (Shrieve Zerol(R) 150)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

PAG: polyalkylene glycol, modified polyol (AlliedSignal BRL-150)
polykylene glycol, polypropylene glycol diol (Dow P425)
POE: polyolester, pentaerythritol ester branched acid
(Henkel Emery(R) 2927-A)
polyolester, pentaerythritol ester mixed acid
(ICI Emkarate(TM) RL 22H)

Tensile strength data not significant; specimen was highly swollen or deteriorated.

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

filled butyl rubber, 2.2% unsaturated with sulfur cure

---------- COMPATIBILITY SUMMARY ----------

			see RDB#
elastomer	filled butyl rubber, 2.2% unsaturated with sulfur cure		
composition	(in parts per hundred parts of elastomer)		
	isobutyl isoprene (2.2% unsaturated)	100	
	zinc oxide	3	
	sulfur	1.75	
	stearic acid	1	
	tetramethylthiuram disulfide	1	
	N330 carbon black	50	4501

The following table presents data after thermal aging in refrigerant-lubricant mixtures for 14 days at the temperatures indicated. The data include changes in weight, width, thickness, tensile strength, and hardness. Details of the tests are identified in the referenced source(s).

refrigerant (aging Temp) lubricant, % by weight	weight change (%)	width swell (%)	thick-ness swell (%)	tensile strength change (%)	Shore A hardness change (%)	
R-22 at 100 °C (212 °F)						
MO naphthenic, 33%	242	46.8	32.3	# -97.3	-63.4	4501
R-32 at 100 °C (212 °F)						
POE branched acid, 22%	12.1	3.1	1.8	-19.1	-17.9	4501
POE mixed acid, 23%	13.1	4.1	5.2	-15.5	-17.9	4501
R-123 at 100 °C (212 °F)						
MO naphthenic, 50%	330.5	51.5	50.1	-89.9	-65.0	4501
R-124 at 100 °C (212 °F)						
AB, 50%	133.5	23.2	29.4	-81.8	-39.0	4501
R-125 at 100 °C (212 °F)						
PAG PPG diol, 37%	2.7	0.4	0.6	-14.6	-1.6	4501
POE branched acid, 38%	13.4	3.2	3.6	-7.2	-17.9	4501
POE mixed acid, 36%	13.9	4.9	3.5	-14.7	-16.3	4501
R-134 at 100 °C (212 °F)						
POE branched acid, 67%	5.5	1.0	0.6	-32.1	-1.6	4501
R-134a at 100 °C (212 °F)						
PAG modified, 35%	3.1	6.9	1.9	-16.9	-14.6	4501
PAG PPG diol, 39%	4.4	0.0	0.9	-21.1	---	4501
POE branched acid, 47%	9.9	4.5	3.1	-13.5	-8.1	4501
POE mixed acid, 41%	11.3	4.5	3.1	-10.0	-11.4	4501
R-142b at 100 °C (212 °F)						
AB, 50%	137.5	31.9	33.6	# -83.4	-53.7	4501
R-143a at 100 °C (212 °F)						
POE branched acid, 28%	15.5	4.5	3.8	-11.9	-16.3	4501
R-152a at 100 °C (212 °F)						
AB, 34%	127.5	33.2	32.1	# -96.3	-3.3	4501
POE branched acid, 46%	10.7	4.9	2.4	-21.9	-14.6	4501

* The lubricants tested were:
MO: naphthenic mineral oil (Witco Suniso(R) 3GS)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

AB: alkylbenzene (Shrieve Zerol(R) 150)
PAG: polyalkylene glycol, modified polyol (AlliedSignal BRL-150)
polyalkylene glycol, polypropylene glycol diol (Dow P425)
POE: polyolester, pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
polyolester, pentaerythritol ester mixed acid (ICI Emkarate(TM) RL 22H)

Tensile strength data not significant; specimen was highly swollen or deteriorated.

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

bromobutyl rubber

---------- COMPATIBILITY SUMMARY ----------

			see RDB#
elastomer	bromobutyl rubber		
composition	(in parts per hundred parts of elastomer)		
	bromobutyl	100	
	zinc oxide	5	
	stearic acid	1	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness change (%)	
R-22						
neat (at ambient)	5.3	23.5	84.4	4.4	---	4501
R-32						
neat (at ambient)	1.1	4.1	38.1	1.4	23.5	4501
R-123						
neat (at ambient)	18.8	102.	5.6	27.7	---	4501
R-124						
neat (at ambient)	4.1	17.9	3.0	13.3	---	4501
R-125						
neat (at ambient)	2.9	8.1	16.4	7.1	---	4501
R-134						
neat (at ambient)	0.2	2.8	-0.1	2.1	32.5	4501
R-134a						
neat (at ambient)	0.6	3.0	0.5	2.1	---	4501
R-142b						
neat (at ambient)	6.5	26.6	3.0	13.4	---	4501
R-143a						
neat (at ambient)	1.1	4.4	40.2	3.4	---	4501
R-152a						
neat (at ambient)	1.9	6.5	3.9	4.0	---	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	86.2	515.	---	491.	---	4501
AB (60°C,140°F)	81.6	485.	80.7	444.	---	4501
PAG PPG butyl monoether (60°C)	0.9	4.1	0.7	3.8	---	4501
PPG diol (60°C,140°F)	1.2	5.2	---	5.1	---	4501
modified polyol (60C,140F)	0.1	1.1	-0.4	0.8	28.5	4501
POE branched acid (60°C,140°F)	3.7	11.9	---	11.5	---	4501
mixed acid (60°C,140°F)	6.0	21.4	5.2	21.0	---	4501

* mineral oil (MO)
naphthenic (Witco Suniso(R) 3GS)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

alkylbenzene (AB)
  (Shrieve Zerol(R) 150)
polyalkylene glycol (PAG)
  modified polyol (AlliedSignal BRL-150)
  polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
  polypropylene glycol (PPG) diol (Dow P425)
polyolester (POE)
  pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
  pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

bromobutyl rubber with carbon fill

---------- COMPATIBILITY SUMMARY ----------

			see RDB#
elastomer	bromobutyl rubber with carbon fill		
composition	(in parts per hundred parts of elastomer)		
	bromobutyl	100	
	zinc oxide	5	
	stearic acid	1	
	N330 carbon black	40	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness change (%)	
R-22						
neat (at ambient)	3.8	16.9	0.8	6.3	---	4501
R-32						
neat (at ambient)	0.5	3.4	0.6	1.6	57.5	4501
R-123						
neat (at ambient)	14.4	71.7	4.0	21.2	---	4501
R-124						
neat (at ambient)	2.5	12.6	1.7	10.2	---	4501
R-125						
neat (at ambient)	2.7	7.5	2.1	6.6	---	4501
R-134						
neat (at ambient)	-0.2	2.3	0.4	1.6	55.5	4501
R-134a						
neat (at ambient)	0.4	1.8	0.1	1.3	---	4501
R-142b						
neat (at ambient)	5.6	19.2	2.8	10.5	---	4501
R-143a						
neat (at ambient)	0.9	2.9	0.8	2.4	---	4501
R-152a						
neat (at ambient)	1.2	4.8	0.9	3.1	---	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	51.6	227.	---	221.	---	4501
AB (60°C,140°F)	47.4	188.	44.6	179.	---	4501
PAG PPG butyl monoether (60°C)	0.8	2.9	0.6	2.4	---	4501
PPG diol (60°C,140°F)	1.3	3.2	---	3.3	---	4501
modified polyol (60C,140F)	0.3	0.8	-0.2	0.5	56.5	4501
POE branched acid (60°C,140°F)	2.1	7.1	---	6.8	---	4501
mixed acid (60°C,140°F)	4.0	12.5	4.1	12.1	---	4501

* mineral oil (MO)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

naphthenic (Witco Suniso(R) 3GS)
alkylbenzene (AB)
(Shrieve Zerol(R) 150)
polyalkylene glycol (PAG)
modified polyol (AlliedSignal BRL-150)
polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
polypropylene glycol (PPG) diol (Dow P425)
polyolester (POE)
pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)

SEE DATA LIMITATIONS AND NOTES ON

chlorobutyl rubber

---------- COMPATIBILITY SUMMARY ----------

			see RDB#
elastomer	chlorobutyl rubber		
composition	(in parts per hundred parts of elastomer)		
	chlorobutyl	100	
	zinc oxide	5	
	stearic acid	1	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness change (%)	
R-22						
neat (at ambient)	5.7	25.9	40.0	4.2	--- #	4501
R-32						
neat (at ambient)	1.2	4.6	27.4	1.6	27.5	4501
R-123						
neat (at ambient)	18.5	33.5	5.5	27.1	32.5	4501
R-124						
neat (at ambient)	3.6	18.7	2.3	12.9	---	4501
R-125						
neat (at ambient)	2.5	7.7	7.7	6.4	---	4501
R-134						
neat (at ambient)	-0.1	2.9	0.2	2.1	34.5	4501
R-134a						
neat (at ambient)	0.5	2.7	0.0	2.1	---	4501
R-142b						
neat (at ambient)	7.0	28.1	3.4	15.1	---	4501
R-143a						
neat (at ambient)	1.3	3.9	23.1	3.1	---	4501
R-152a						
neat (at ambient)	1.9	6.7	1.1	4.3	33.5	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	68.9	378.	67.5	369.	8.5	4501
AB (60°C,140°F)	61.9	298.	60.9	294.	5.5	4501
PAG PPG butyl monoether (60°C)	0.7	3.2	0.1	2.9	29.5	4501
PPG diol (60°C,140°F)	1.3	4.4	0.1	4.3	27.5	4501
modified polyol (60C,140F)	0.1	1.1	-0.3	1.0	30.5	4501
POE branched acid (60°C,140°F)	3.6	13.1	2.9	12.5	25.5	4501
mixed acid (60°C,140°F)	4.2	14.7	3.2	14.4	24.5	4501

* mineral oil (MO)
naphthenic (Witco Suniso(R) 3GS)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

alkylbenzene (AB)
(Shrieve Zerol(R) 150)
polyalkylene glycol (PAG)
modified polyol (AlliedSignal BRL-150)
polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
polypropylene glycol (PPG) diol (Dow P425)
polyolester (POE)
pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)
Specimen showed deterioration after removal from the test fluid.

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

chlorobutyl rubber with carbon fill

---------- COMPATIBILITY SUMMARY ----------

elastomer	chlorobutyl rubber with carbon fill		see RDB#
composition	(in parts per hundred parts of elastomer)		
	chlorobutyl	100	
	zinc oxide	5	
	stearic acid	1	
	N330 carbon black	40	4501

The following table presents data after thermal aging in refrigerant-lubricant mixtures for 14 days at the temperatures indicated. The data include changes in weight, width, thickness, tensile strength, and hardness. Details of the tests are identified in the referenced source(s).

refrigerant (aging Temp) lubricant, % by weight	weight change (%)	width swell (%)	thick-ness swell (%)	tensile strength change (%)	Shore A hardness change (%)	
R-22 at 100 °C (212 °F)						
MO naphthenic, 33%	166.5	29.3	51.7	# -94.9	-12.6	4501
R-32 at 100 °C (212 °F)						
POE branched acid, 22%	15.7	2.9	4.6	-30.8	-21.6	4501
POE mixed acid, 23%	37.8	1.6	8.3	-29.8	-18.0	4501
R-123 at 100 °C (212 °F)						
MO naphthenic, 50%	229.0	33.1	56.5	-80.8	-39.6	4501
R-124 at 100 °C (212 °F)						
AB, 50%	133.0	21.5	37.4	-72.2	-14.4	4501
R-125 at 100 °C (212 °F)						
PAG PPG diol, 37%	17.2	3.9	6.0	-25.9	-18.0	4501
POE branched acid, 38%	15.7	6.8	5.2	-25.4	0.0	4501
POE mixed acid, 36%	19.1	4.9	7.1	-30.9	-18.0	4501
R-134 at 100 °C (212 °F)						
POE branched acid, 67%	11.9	0.0	3.8	-26.6	-1.8	4501
R-134a at 100 °C (212 °F)						
PAG modified, 35%	4.8	5.8	3.0	-17.1	-7.2	4501
PAG PPG diol, 39%	20.2	3.1	6.4	-28.2	-23.4	4501
POE branched acid, 47%	13.2	6.8	4.8	-21.0	-1.8	4501
POE mixed acid, 41%	16.4	3.2	4.8	-31.5	-9.0	4501
R-142b at 100 °C (212 °F)						
AB, 50%	145.0	29.0	35.7	-71.2	-37.8	4501
R-143a at 100 °C (212 °F)						
POE branched acid, 28%	20.3	3.8	6.5	-26.1	-10.8	4501
R-152a at 100 °C (212 °F)						
AB, 34%	123.0	25.8	36.6	-75.6	-25.2	4501
POE branched acid, 46%	14.5	5.2	3.8	-31.4	-7.2	4501

* The lubricants tested were:
MO: naphthenic mineral oil (Witco Suniso(R) 3GS)
AB: alkylbenzene (Shrieve Zerol(R) 150)
PAG: polyalkylene glycol, modified polyol (AlliedSignal BRL-150)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

polyalkylene glycol, polypropylene glycol diol (Dow P425)
POE: polyolester, pentaerythritol ester branched acid
(Henkel Emery(R) 2927-A)
polyolester, pentaerythritol ester mixed acid
(ICI Emkarate(TM) RL 22H)
Tensile strength data not significant; specimen was highly swollen or deteriorated.

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

styrene butadiene rubber with 23.5% styrene

COMPATIBILITY SUMMARY			
elastomer	styrene butadiene rubber with 23.5% styrene		see RDB#
SBR	SBR 1502		
composition	(in parts per hundred parts of elastomer)		
	SBR 1502 (23.5% styrene)	100	
	zinc oxide	3	
	sulfur	1.75	
	stearic acid	1	
	N-t-butyl-2-benzothiazyl sulfenamide	1	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness change (%)	
R-22						
neat (at ambient)	9.8	40.3	-1.0	-2.6	---	4501
R-32						
neat (at ambient)	2.0	6.8	-1.0	-1.0	49.5	4501
R-123						
neat (at ambient)	40.8	271	-1.1	-0.7	---	4501
R-124						
neat (at ambient)	4.1	22.5	0.5	1.9	---	4501
R-125						
neat (at ambient)	3.6	10.4	2.2	6.2	---	4501
R-134						
neat (at ambient)	1.4	7.4	-0.2	0.7	47.5	4501
R-134a						
neat (at ambient)	1.0	5.0	-0.5	-0.4	---	4501
R-142b						
neat (at ambient)	7.3	30.7	-1.4	-2.6	---	4501
R-143a						
neat (at ambient)	1.5	5.2	-0.6	0.2	---	4501
R-152a						
neat (at ambient)	2.8	10.9	-1.4	-1.6	---	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	44.3	186	---	175	---	4501
AB (60°C,140°F)	43.0	173	41.9	158	---	4501
PAG PPG butyl monoether (60°C)	9.6	29.5	8.1	21.6	---	4501
PPG diol (60°C,140°F)	1.5	5.7	---	4.5	---	4501
modified polyol (60C,140F)	2.6	8.2	1.6	7.5	39.5	4501
POE branched acid (60°C,140°F)	16.1	56.8	---	51.2	---	4501
mixed acid (60°C,140°F)	22.8	85.2	21.1	78.7	---	4501

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

* mineral oil (MO)
  naphthenic (Witco Suniso(R) 3GS)
  alkylbenzene (AB)
  (Shrieve Zerol(R) 150)
  polyalkylene glycol (PAG)
  modified polyol (AlliedSignal BRL-150)
  polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
  polypropylene glycol (PPG) diol (Dow P425)
  polyolester (POE)
  pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
  pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

styrene butadiene rubber with 23.5% styrene, carbon fill

COMPATIBILITY SUMMARY			
elastomer	styrene butadiene rubber with 23.5% styrene, carbon fill		see RDB#
SBR	SBR 1502 with carbon fill		
composition	(in parts per hundred parts of elastomer)		
	SBR 1502 (23.5% styrene)	100	
	zinc oxide	3	
	sulfur	1.75	
	stearic acid	1	
	N-t-butyl-2-benzothiazyl sulfenamide	1	
	N330 carbon black	50	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness change (%)	
R-22						
neat (at ambient)	7.1	27.0	-1.1	-2.7	---	4501
R-32						
neat (at ambient)	1.1	4.5	-0.7	-0.7	72.5	4501
R-123						
neat (at ambient)	24.9	138	-0.1	1.7	---	4501
R-124						
neat (at ambient)	3.1	15.2	-0.7	2.0	---	4501
R-125						
neat (at ambient)	2.1	6.8	1.0	4.3	---	4501
R-134						
neat (at ambient)	1.1	4.7	-0.4	0.6	70.5	4501
R-134a						
neat (at ambient)	0.6	3.5	-0.1	0.3	---	4501
R-142b						
neat (at ambient)	5.9	20.1	0.3	-1.1	---	4501
R-143a						
neat (at ambient)	0.9	3.7	-0.1	0.3	---	4501
R-152a						
neat (at ambient)	2.0	6.5	-0.7	-0.8	---	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	24.0	88.7	---	84.3	---	4501
AB (60°C,140°F)	24.1	81.6	23.0	75.6	---	4501
PAG PPG butyl monoether (60°C)	5.5	18.9	5.2	15.2	---	4501
PPG diol (60°C,140°F)	1.8	4.9	---	4.3	---	4501
modified polyol (60C,140F)	1.8	5.6	1.4	5.4	67.5	4501
POE branched acid (60°C,140°F)	9.2	31.1	---	29.4	---	4501
mixed acid (60°C,140°F)	13.2	45.3	13.1	42.8	---	4501

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

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* mineral oil (MO)
naphthenic (Witco Suniso(R) 3GS)
alkylbenzene (AB)
(Shrieve Zerol(R) 150)
polyalkylene glycol (PAG)
modified polyol (AlliedSignal BRL-150)
polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
polypropylene glycol (PPG) diol (Dow P425)
polyolester (POE)
pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)
\# Specimen showed deterioration after removal from the test fluid.

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

styrene butadiene rubber (medium styrene content)

---------- COMPATIBILITY SUMMARY ----------

elastomer	styrene butadiene rubber (medium styrene content)		see
SBR			RDB#
			----
composition	(in parts per hundred parts of elastomer)		
	SBR (29% styrene)	100	
	zinc oxide	3	
	sulfur	1.75	
	stearic acid	1	
	N-t-butyl-2-benzothiazyl sulfenamide	1	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness change (%)	
R-22						
neat (at ambient)	11.4	42.9	1.3	-1.5	63.5	4501
R-32						
neat (at ambient)	1.2	7.6	-1.5	-0.3	67.5	4501
R-123						
neat (at ambient)	45.7	315	4.3	34.6	64.5	4501
R-124						
neat (at ambient)	3.7	23.6	0.2	0.0	66.5	4501
R-125						
neat (at ambient)	1.9	10.0	0.3	6.0	67.5	4501
R-134						
neat (at ambient)	1.2	8.3	-0.7	0.5	68.5	4501
R-134a						
neat (at ambient)	1.7	7.5	1.5	1.4	---	4501
R-142b						
neat (at ambient)	7.6	31.1	-0.8	-0.4	67.5	4501
R-143a						
neat (at ambient)	1.6	7.0	1.1	1.0	67.5	4501
R-152a						
neat (at ambient)	3.0	10.1	0.5	-0.4	66.5	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	41.6	178	37.7	172	---	4501
AB (60°C,140°F)	52.4	236	47.0	232	19.5	4501
PAG PPG butyl monoether (60°C)	8.1	28.3	7.2	26.1	51.5	4501
PPG diol (60°C,140°F)	3.3	12.4	2.0	10.7	62.5	4501
modified polyol (60C,140F)	2.7	10.1	3.3	9.4	60.5	4501
POE branched acid (60°C,140°F)	32.0	63.4	15.4	62.4	35.5	4501
mixed acid (60°C,140°F)	20.3	78.0	19.4	76.1	31.5	4501

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

```
* mineral oil (MO)
    naphthenic (Witco Suniso(R) 3GS)
  alkylbenzene (AB)
    (Shrieve Zerol(R) 150)
  polyalkylene glycol (PAG)
    modified polyol (AlliedSignal BRL-150)
    polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
    polypropylene glycol (PPG) diol (Dow P425)
  polyolester (POE)
    pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
    pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)
```

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

styrene butadiene rubber (high styrene content)

---------- COMPATIBILITY SUMMARY ----------

elastomer SBR	styrene butadiene rubber (high styrene content)		see RDB#
composition	(in parts per hundred parts of elastomer)		
	SBR (40% styrene)	100	
	zinc oxide	3	
	sulfur	1.75	
	stearic acid	1	
	N-t-butyl-2-benzothiazyl sulfenamide	1	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness change (%)	
R-22						
neat (at ambient)	1.2	43.6	64.8	-1.9	24.5 #	4501
R-32						
neat (at ambient)	2.3	7.2	-0.2	-0.5	82.5	4501
R-123						
neat (at ambient)	52.6	386	2.0	-4.7	79.5	4501
R-124						
neat (at ambient)	5.1	22.4	-0.5	0.4	83.5	4501
R-125						
neat (at ambient)	2.8	9.0	1.7	5.2	82.5	4501
R-134						
neat (at ambient)	1.7	7.6	-0.6	0.2	83.5	4501
R-134a						
neat (at ambient)	1.7	7.2	0.1	1.0	---	4501
R-142b						
neat (at ambient)	7.8	30.6	0.6	-0.5	81.5	4501
R-143a						
neat (at ambient)	1.4	6.0	-0.4	0.2	84.5	4501
R-152a						
neat (at ambient)	3.5	10.2	-0.8	-0.7	83.5	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	53.0	261	47.0	253	---	4501
AB (60°C,140°F)	59.2	273	55.4	267	10.5	4501
PAG PPG butyl monoether (60°C)	11.1	37.2	9.2	35.4	37.5	4501
PPG diol (60°C,140°F)	3.4	11.4	2.7	10.8	73.5	4501
modified polyol (60C,140F)	3.4	11.0	3.0	10.3	70.5	4501
POE branched acid (60°C,140°F)	21.5	83.1	18.4	82.5	15.5	4501
mixed acid (60°C,140°F)	30.1	127	27.9	124	15.5	4501

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

```
* mineral oil (MO)
    naphthenic (Witco Suniso(R) 3GS)
  alkylbenzene (AB)
    (Shrieve Zerol(R) 150)
  polyalkylene glycol (PAG)
    modified polyol (AlliedSignal BRL-150)
    polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
    polypropylene glycol (PPG) diol (Dow P425)
  polyolester (POE)
    pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
    pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)
# Specimen showed deterioration after removal from the test fluid.
```

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

nitrile rubber, very high ACN content

COMPATIBILITY SUMMARY			
elastomer NBR	nitrile rubber, very high ACN content Chemigum(TM) N206		see RDB#
composition	(in parts per hundred parts of elastomer)		
	nitrile (very high ACN)	100	
	zinc oxide	3	
	sulfur (magnesium carbonate coated)	1.5	
	stearic acid	1	
	N-t-butyl-2-benzothiazyl sulfenamide	0.7	4501

The following table presents data after thermal aging in refrigerant-lubricant mixtures for 14 days at the temperatures indicated. The data include changes in weight, width, thickness, tensile strength, and hardness. Details of the tests are identified in the referenced source(s).

refrigerant (aging Temp) lubricant, % by weight	weight change (%)	width swell (%)	thick-ness swell (%)	tensile strength change (%)	Shore A hardness change (%)	
R-22 at 100 °C (212 °F)						
MO naphthenic, 33%	22.4	3.1	4.0	-55.7	-28.6	4501
R-32 at 100 °C (212 °F)						
POE branched acid, 22%	14.8	3.9	5.9	-76.5	8.4	4501
POE mixed acid, 23%	15.5	5.1	5.0	# -80.7	-16.8	4501
R-123 at 100 °C (212 °F)						
MO naphthenic, 50%	76.0	14.2	12.1	-79.9	-23.5	4501
R-124 at 100 °C (212 °F)						
AB, 50%	40.0	2.8	9.0	-76.5	-10.1	4501
R-125 at 100 °C (212 °F)						
PAG PPG diol, 37%	13.7	2.3	2.5	-66.1	-6.7	4501
POE branched acid, 38%	9.6	0.1	3.1	-76.4	25.2	4501
POE mixed acid, 36%	10.3	2.6	3.6	-70.7	18.5	4501
R-134 at 100 °C (212 °F)						
POE branched acid, 67%	50.4	8.7	10.2	-85.9	-23.5	4501
R-134a at 100 °C (212 °F)						
PAG modified, 35%	8.8	3.0	2.5	-64.1	-25.2	4501
PAG PPG diol, 39%	22.1	3.8	4.0	-53.9	-23.5	4501
POE branched acid, 47%	18.3	6.1	4.9	-78.6	-11.8	4501
POE mixed acid, 41%	19.8	-0.3	4.4	-76.4	-18.5	4501
R-142b at 100 °C (212 °F)						
AB, 50%	21.8	5.1	6.8	-74.6	-10.1	4501
R-143a at 100 °C (212 °F)						
POE branched acid, 28%	19.3	1.9	4.6	-54.0	-23.5	4501
R-152a at 100 °C (212 °F)						
AB, 34%	20.4	1.8	6.5	-82.5	-5.0	4501
POE branched acid, 46%	24.4	7.3	6.2	-81.9	-8.4	4501

* The lubricants tested were:
MO: naphthenic mineral oil (Witco Suniso(R) 3GS)
AB: alkylbenzene (Shrieve Zerol(R) 150)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

PAG: polyalkylene glycol, modified polyol (AlliedSignal BRL-150)
polyalkylene glycol, polypropylene glycol diol (Dow P425)
POE: polyolester, pentaerythritol ester branched acid
(Henkel Emery(R) 2927-A)
polyolester, pentaerythritol ester mixed acid
(ICI Emkarate(TM) RL 22H)

Tensile strength data not significant; specimen was highly swollen or deteriorated.

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

nitrile rubber, high ACN content

COMPATIBILITY SUMMARY			
elastomer	nitrile rubber, high ACN content		see
NBR	Chemigum(TM) N300		RDB#
composition	(in parts per hundred parts of elastomer)		
	nitrile (high ACN)	100	
	zinc oxide	3	
	sulfur (magnesium carbonate coated)	1.5	
	stearic acid	1	
	N-t-butyl-2-benzothiazyl sulfenamide	0.7	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness change (%)	
R-22						
neat (at ambient)	51.4	268	0.6	3.5	--- #	4501
R-32						
neat (at ambient)	8.3	29.7	2.2	-0.4	38.5 #	4501
R-123						
neat (at ambient)	83.7	716	7.1	35.5	53.5	4501
R-124						
neat (at ambient)	45.9	282	5.2	24.9	---	4501
R-125						
neat (at ambient)	3.9	16.1	6.8	12.5	--- #	4501
R-134						
neat (at ambient)	20.6	103	4.3	20.2	53.5	4501
R-134a						
neat (at ambient)	5.1	21.9	3.5	14.6	---	4501
R-142b						
neat (at ambient)	8.7	34.3	4.3	17.1	---	4501
R-143a						
neat (at ambient)	2.0	5.8	1.3	4.8	---	4501
R-152a						
neat (at ambient)	8.8	27.4	2.5	7.6	53.5	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	0.8	2.6	0.8	2.5	51.5	4501
AB (60°C,140°F)	0.2	0.8	0.2	0.9	51.5	4501
PAG PPG butyl monoether (60°C)	0.3	1.1	0.3	1.2	52.5	4501
PPG diol (60°C,140°F)	2.9	9.0	2.7	9.3	48.5	4501
modified polyol (60C,140F)	-0.2	0.1	0.1	0.1	54.5	4501
POE branched acid (60°C,140°F)	2.4	6.7	2.4	6.6	52.5	4501
mixed acid (60°C,140°F)	3.5	10.7	3.6	10.7	49.5	4501

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

```
* mineral oil (MO)
    naphthenic (Witco Suniso(R) 3GS)
  alkylbenzene (AB)
    (Shrieve Zerol(R) 150)
  polyalkylene glycol (PAG)
    modified polyol (AlliedSignal BRL-150)
    polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
    polypropylene glycol (PPG) diol (Dow P425)
  polyolester (POE)
    pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
    pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)
# Specimen showed deterioration after removal from the test fluid.
```

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

nitrile rubber, medium ACN content

COMPATIBILITY SUMMARY			see RDB#
elastomer	nitrile rubber, medium ACN content		
NBR	Chemigum(TM) N615B		
composition	(in parts per hundred parts of elastomer)		
	nitrile (medium ACN)	100	
	zinc oxide	3	
	sulfur (magnesium carbonate coated)	1.5	
	stearic acid	1	
	N-t-butyl-2-benzothiazyl sulfenamide	0.7	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness change (%)	
R-22						
neat (at ambient)	50.4	253	-0.9	-1.8	--- #	4501
R-32						
neat (at ambient)	7.8	26.4	6.3	-0.5	41.5 #	4501
R-123						
neat (at ambient)	94.4	879	4.5	22.7	50.5	4501
R-124						
neat (at ambient)	45.8	298	2.0	9.4	---	4501
R-125						
neat (at ambient)	6.2	23.3	12.6	11.9	--- #	4501
R-134						
neat (at ambient)	14.6	75.2	1.7	11.7	48.5	4501
R-134a						
neat (at ambient)	5.7	24.4	2.3	11.0	--- #	4501
R-142b						
neat (at ambient)	11.6	47.0	2.5	10.3	---	4501
R-143a						
neat (at ambient)	2.7	9.0	1.3	4.8	---	4501
R-152a						
neat (at ambient)	8.7	28.1	0.5	3.6	51.5	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	2.7	8.5	1.8	8.2	44.5	4501
AB (60°C,140°F)	1.8	5.0	1.6	4.9	45.5	4501
PAG PPG butyl monoether (60°C)	1.9	5.9	1.4	5.9	46.5	4501
PPG diol (60°C,140°F)	7.9	25.5	7.4	25.4	37.5	4501
modified polyol (60C,140F)	0.7	2.8	0.3	2.8	47.5	4501
POE branched acid (60°C,140°F)	7.7	25.5	7.6	25.1	39.5	4501
mixed acid (60°C,140°F)	9.8	33.2	10.1	32.8	38.5	4501

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

mineral oil (MO)
  naphthenic (Witco Suniso(R) 3GS)
alkylbenzene (AB)
  (Shrieve Zerol(R) 150)
polyalkylene glycol (PAG)
  modified polyol (AlliedSignal BRL-150)
  polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
  polypropylene glycol (PPG) diol (Dow P425)
polyolester (POE)
  pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
  pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)
Specimen showed deterioration after removal from the test fluid.

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

nitrile rubber, low ACN content

COMPATIBILITY SUMMARY			see RDB#
elastomer	nitrile rubber, low ACN content		
NBR	Chemigum(TM) N917		
composition	(in parts per hundred parts of elastomer)		
	nitrile (low ACN)	100	
	zinc oxide	3	
	sulfur (magnesium carbonate coated)	1.5	
	stearic acid	1	
	N-t-butyl-2-benzothiazyl sulfenamide	0.7	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness change (%)	
R-22						
neat (at ambient)	35.4	177	-2.0	-3.5	--- #	4501
R-32						
neat (at ambient)	6.1	21.3	0.5	-0.2	49.5 #	4501
R-123						
neat (at ambient)	73.2	747	1.3	10.9	52.5	4501
R-124						
neat (at ambient)	29.9	193	0.6	6.1	---	4501
R-125						
neat (at ambient)	5.2	21.7	3.7	6.1	--- #	4501
R-134						
neat (at ambient)	8.9	44.8	0.3	5.6	50.5	4501
R-134a						
neat (at ambient)	4.3	19.0	1.3	3.5	---	4501
R-142b						
neat (at ambient)	14.0	59.4	0.7	5.0	---	4501
R-143a						
neat (at ambient)	3.4	11.5	0.5	3.5	---	4501
R-152a						
neat (at ambient)	7.4	27.2	-0.7	1.1	47.5	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	7.7	26.9	7.4	26.3	42.5	4501
AB (60°C,140°F)	7.0	21.5	6.1	20.5	41.5	4501
PAG PPG butyl monoether (60°C)	7.4	23.7	7.1	23.5	38.5	4501
PPG diol (60°C,140°F)	11.3	39.9	9.6	37.9	37.5	4501
modified polyol (60C,140F)	4.1	14.1	3.8	14.0	42.5	4501
POE branched acid (60°C,140°F)	19.0	72.1	17.8	70.7	33.5	4501
mixed acid (60°C,140°F)	24.1	98.6	22.8	97.0	31.5	4501

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

```
* mineral oil (MO)
    naphthenic (Witco Suniso(R) 3GS)
  alkylbenzene (AB)
    (Shrieve Zerol(R) 150)
  polyalkylene glycol (PAG)
    modified polyol (AlliedSignal BRL-150)
    polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
    polypropylene glycol (PPG) diol (Dow P425)
  polyolester (POE)
    pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
    pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)
# Specimen showed deterioration after removal from the test fluid.
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SEE DATA LIMITATIONS AND NOTES ON PAGE 2

nitrile rubber, low ACN content with carbon fill

COMPATIBILITY SUMMARY			
elastomer	nitrile rubber, low ACN content with carbon fill		see
NBR	Chemigum(TM) N917 with carbon fill		RDB#
composition	(in parts per hundred parts of elastomer)		
	nitrile (low ACN)	100	
	zinc oxide	3	
	sulfur (magnesium carbonate coated)	1.5	
	stearic acid	1	
	N-t-butyl-2-benzothiazyl sulfenamide	0.7	
	N330 carbon black	35	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness change (%)	
R-22						
neat (at ambient)	22.0	118	-1.7	-0.8	65.5	4501
R-32						
neat (at ambient)	4.2	15.8	-0.1	0.2	67.5	4501
R-123						
neat (at ambient)	40.9	357	0.7	-18.4	68.5	4501
R-124						
neat (at ambient)	23.5	108	1.2	8.1	65.5	4501
R-125						
neat (at ambient)	3.4	15.7	1.4	8.1	68.5	4501
R-134						
neat (at ambient)	7.0	33.6	1.0	6.4	67.5	4501
R-134a						
neat (at ambient)	3.5	15.5	0.8	2.3	---	4501
R-142b						
neat (at ambient)	9.1	40.9	0.8	4.3	67.5	4501
R-143a						
neat (at ambient)	1.4	8.0	0.3	2.7	67.5	4501
R-152a						
neat (at ambient)	5.2	19.3	-0.6	1.5	65.5	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	5.2	18.4	4.3	18.0	63.5	4501
AB (60°C,140°F)	4.6	13.9	4.3	14.4	60.5	4501
PAG PPG butyl monoether (60°C)	4.5	15.8	4.0	15.5	63.5	4501
PPG diol (60°C,140°F)	6.6	26.9	5.3	26.4	60.5	4501
modified polyol (60C,140F)	2.7	9.8	1.7	9.7	64.5	4501
POE branched acid (60°C,140°F)	11.9	46.5	11.9	46.7	53.5	4501
mixed acid (60°C,140°F)	14.5	57.0	13.7	56.9	53.5	4501

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

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* mineral oil (MO)
  naphthenic (Witco Suniso(R) 3GS)
  alkylbenzene (AB)
  (Shrieve Zerol(R) 150)
  polyalkylene glycol (PAG)
  modified polyol (AlliedSignal BRL-150)
  polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
  polypropylene glycol (PPG) diol (Dow P425)
  polyolester (POE)
  pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
  pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

nitrile rubber, very high ACN content with carbon fill

COMPATIBILITY SUMMARY			
elastomer	nitrile rubber, very high ACN content with carbon fill		see
NBR	Chemigum(TM) N206 with carbon fill		RDB#
composition	(in parts per hundred parts of elastomer)		
	nitrile (very high ACN)	100	
	zinc oxide	3	
	sulfur (magnesium carbonate coated)	1.5	
	stearic acid	1	
	N-t-butyl-2-benzothiazyl sulfenamide	0.7	
	N330 carbon black	35	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness change (%)	
R-22						
neat (at ambient)	31.7	161	1.3	7.2	63.5	4501
R-32						
neat (at ambient)	6.2	22.3	0.7	4.4	66.5	4501
R-123						
neat (at ambient)	49.7	390.	5.6	31.4	61.5	4501
R-124						
neat (at ambient)	28.7	137	4.0	21.7	62.5	4501
R-125						
neat (at ambient)	1.6	6.9	1.6	6.2	68.5	4501
R-134						
neat (at ambient)	16.5	79.5	3.2	18.1	62.5	4501
R-134a						
neat (at ambient)	4.2	15.8	2.8	10.0	---	4501
R-142b						
neat (at ambient)	5.5	21.2	3.1	13.7	---	4501
R-143a						
neat (at ambient)	0.8	2.6	0.4	2.1	71.5	4501
R-152a						
neat (at ambient)	5.6	18.4	1.4	7.2	63.5	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	0.5	1.2	0.1	0.9	75.5	4501
AB (60°C,140°F)	0.1	0.3	-0.3	0.8	74.5	4501
PAG PPG butyl monoether (60°C)	0.1	0.3	-0.1	0.3	75.5	4501
PPG diol (60°C,140°F)	2.1	6.5	1.7	6.6	69.5	4501
modified polyol (60C,140F)	-0.1	-0.3	-0.7	-0.4	75.5	4501
POE branched acid (60°C,140°F)	3.1	2.5	-0.2	3.2	74.5	4501
mixed acid (60°C,140°F)	0.8	2.8	0.7	2.6	73.5	4501

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

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* mineral oil (MO)
  naphthenic (Witco Suniso(R) 3GS)
  alkylbenzene (AB)
  (Shrieve Zerol(R) 150)
  polyalkylene glycol (PAG)
  modified polyol (AlliedSignal BRL-150)
  polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
  polypropylene glycol (PPG) diol (Dow P425)
  polyolester (POE)
  pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
  pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

hydrogenated nitrile rubber, 38% ACN

COMPATIBILITY SUMMARY			see RDB#
elastomer	hydrogenated nitrile rubber, 38% ACN		
HNBR	Tomac(TM) A3850		
composition	(in parts per hundred parts of elastomer)		
	hydrogenated nitrile (38% ACN)	100	
	magnesium oxide	10	
	2,5-dimethyl-2,5-di(t-butylperoxy)hexane (50%)	10	
	Ricon 153-D (1,2-polybutadiene liquid coagent)	6.5	
	zinc oxide	5	
	stearic acid	1	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness change (%)	
R-22						
neat (at ambient)	34.2	165	-0.3	4.8	67.5	4501
R-32						
neat (at ambient)	5.1	19.9	1.0	-0.5	61.5	4501
R-123						
neat (at ambient)	45.2	316	3.6	23.9	68.5	4501
R-124						
neat (at ambient)	31.8	185	2.1	16.8	69.5	4501
R-125						
neat (at ambient)	7.1	29.6	2.6	15.1	68.5	4501
R-134						
neat (at ambient)	14.3	69.3	2.3	13.2	69.5	4501
R-134a						
neat (at ambient)	5.0	23.3	1.0	9.1	68.5	4501
R-142b						
neat (at ambient)	10.8	44.1	1.3	9.4	69.5	4501
R-143a						
neat (at ambient)	1.3	3.6	-0.5	0.6	70.5	4501
R-152a						
neat (at ambient)	6.8	23.0	0.4	3.0	69.5	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	2.7	10.1	2.3	8.6	66.5	4501
AB (60°C,140°F)	1.7	5.8	0.7	5.2	64.5	4501
PAG PPG butyl monoether (60°C)	0.4	3.3	0.3	2.3	65.5	4501
PPG diol (60°C,140°F)	2.6	8.6	2.1	8.4	65.5	4501
modified polyol (60C,140F)	0.0	1.7	-0.4	0.9	65.5	4501
POE branched acid (60°C,140°F)	4.7	14.2	4.2	14.2	63.5	4501
mixed acid (60°C,140°F)	4.8	17.8	4.5	17.8	66.5	4501

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

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* mineral oil (MO)
  naphthenic (Witco Suniso(R) 3GS)
  alkylbenzene (AB)
  (Shrieve Zerol(R) 150)
  polyalkylene glycol (PAG)
  modified polyol (AlliedSignal BRL-150)
  polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
  polypropylene glycol (PPG) diol (Dow P425)
  polyolester (POE)
  pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
  pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

hydrogenated nitrile rubber, 38% ACN with carbon black

---------- COMPATIBILITY SUMMARY ----------

elastomer HNBR	hydrogenated nitrile rubber, 38% ACN with carbon black filled Tomac(TM) A3850		see RDB#
composition	(in parts per hundred parts of elastomer)		
	hydrogenated nitrile (38% ACN)	100	
	N774 carbon black	40	
	zinc oxide	5	
	benzothiazyl disulfide (MBTS)	1.5	
	magnesium coated sulfur	1.5	
	stearic acid	1	
	tetramethylthiuram monosulfide (TMTM)	0.3	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness change (%)	
R-22						
neat (at ambient)	66.0	264	92.7	-11.1	--- #	4501
R-32						
neat (at ambient)	6.0	20.5	24.1	0.0	37.5	4501
R-123						
neat (at ambient)	115	1297	5.7	-8.2	51.5 #	4501
R-124						
neat (at ambient)	68.0	333	136	-3.3	--- #	4501
R-125						
neat (at ambient)	6.7	26.1	65.3	11.1	35.5 #	4501
R-134						
neat (at ambient)	15.4	70.4	1.3	10.6	55.5	4501
R-134a						
neat (at ambient)	5.5	21.2	0.8	4.4	---	4501
R-142b						
neat (at ambient)	11.0	41.5	1.3	8.0	56.5	4501
R-143a						
neat (at ambient)	2.4	11.6	1.0	4.5	59.5	4501
R-152a						
neat (at ambient)	7.0	22.0	0.6	3.4	59.5	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	3.2	8.8	2.6	8.3	56.5	4501
AB (60°C,140°F)	1.9	4.9	1.7	5.5	59.5	4501
PAG PPG butyl monoether (60°C)	-0.4	1.7	-0.3	1.4	63.5	4501
PPG diol (60°C,140°F)	1.4	8.6	1.5	8.4	57.5	4501
modified polyol (60C,140F)	-0.4	0.3	-0.9	0.1	65.5	4501
POE branched acid (60°C,140°F)	6.7	18.4	4.8	18.9	52.5	4501

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

mixed acid (60°C,140°F)	6.9	22.1	6.6	21.7	48.5	4501

* mineral oil (MO)
  naphthenic (Witco Suniso(R) 3GS)
  alkylbenzene (AB)
  (Shrieve Zerol(R) 150)
  polyalkylene glycol (PAG)
  modified polyol (AlliedSignal BRL-150)
  polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
  polypropylene glycol (PPG) diol (Dow P425)
  polyolester (POE)
  pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
  pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)
Specimen showed deterioration after removal from the test fluid.

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

hydrogenated nitrile rubber, 45% ACN

COMPATIBILITY SUMMARY

			see RDB#
elastomer	hydrogenated nitrile rubber, 45% ACN		
HNBR	Tomac(TM) A4555		
composition	(in parts per hundred parts of elastomer)		
	hydrogenated nitrile (45% ACN)	100	
	2,5-dimethyl-2,5-di(t-butylperoxyl) hexane (50%)	10	
	Ricon 153-D (1,2-polybutadiene liquid coagent)	6.5	
	zinc oxide	5	
	stearic acid	1	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness change (%)	
R-22						
neat (at ambient)	42.0	209	0.3	6.0	63.5	4501
R-32						
neat (at ambient)	5.6	24.5	-0.7	0.5	62.5 #	4501
R-123						
neat (at ambient)	57.2	446	3.7	30.0	62.5	4501
R-124						
neat (at ambient)	39.1	253	2.4	20.6	62.5	4501
R-125						
neat (at ambient)	6.2	29.5	2.5	16.5	61.5	4501
R-134						
neat (at ambient)	20.0	104	2.5	17.2	61.5	4501
R-134a						
neat (at ambient)	5.2	25.6	1.5	10.8	64.5	4501
R-142b						
neat (at ambient)	10.1	42.6	1.5	12.4	62.5	4501
R-143a						
neat (at ambient)	2.1	7.8	0.4	4.9	61.5	4501
R-152a						
neat (at ambient)	7.8	26.1	0.4	4.5	64.5	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	1.8	7.7	1.6	6.4	59.5	4501
AB (60°C,140°F)	0.6	3.0	-0.1	2.5	60.5	4501
PAG PPG butyl monoether (60°C)	-0.3	2.4	0.1	1.0	61.5	4501
PPG diol (60°C,140°F)	2.4	7.2	1.4	7.2	60.5	4501
modified polyol (60C,140F)	-0.4	0.5	-0.8	-0.2	59.5	4501
POE branched acid (60°C,140°F)	3.0	10.4	2.8	10.4	57.5	4501
mixed acid (60°C,140°F)	4.0	12.6	3.9	12.5	61.5	4501

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

* mineral oil (MO)
    naphthenic (Witco Suniso(R) 3GS)
  alkylbenzene (AB)
    (Shrieve Zerol(R) 150)
  polyalkylene glycol (PAG)
    modified polyol (AlliedSignal BRL-150)
    polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
    polypropylene glycol (PPG) diol (Dow P425)
  polyolester (POE)
    pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
    pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)

Specimen showed deterioration after removal from the test fluid.

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

hydrogenated nitrile rubber, 45% ACN with carbon black

---------- COMPATIBILITY SUMMARY ----------

			see RDB#
elastomer HNBR	hydrogenated nitrile rubber, 45% ACN with carbon black filled Tomac(TM) A4555		
composition	(in parts per hundred parts of elastomer)		
	hydrogenated nitrile (45% ACN)	100	
	N774 carbon black	40	
	2,5-dimethyl-2,5-di(t-butylperoxyl) hexane (50%)	10	
	Ricon 153-D (1,2-polybutadiene liquid coagent)	6.5	
	zinc oxide	5	
	stearic acid	1	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness change (%)	
R-22						
neat (at ambient)	25.8	127	-0.1	2.3	79.5	4501
R-32						
neat (at ambient)	5.1	18.0	-0.3	0.5	83.5	4501
R-123						
neat (at ambient)	35.2	213	2.6	18.8	80.5	4501
R-124						
neat (at ambient)	23.7	137	1.5	12.1	80.5	4501
R-125						
neat (at ambient)	4.8	23.0	2.2	11.3	79.5	4501
R-134						
neat (at ambient)	13.4	67.2	1.5	8.2	81.5	4501
R-134a						
neat (at ambient)	3.1	16.3	3.7	4.5	80.5	4501
R-142b						
neat (at ambient)	6.6	27.4	0.9	5.9	80.5	4501
R-143a						
neat (at ambient)	0.6	3.5	0.3	0.5	81.5	4501
R-152a						
neat (at ambient)	5.3	16.3	-0.4	0.8	81.5	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	0.8	3.5	0.6	3.6	80.5	4501
AB (60°C,140°F)	0.4	1.0	0.3	0.8	79.5	4501
PAG PPG butyl monoether (60°C)	-0.7	-0.6	0.1	-0.7	80.5	4501
PPG diol (60°C,140°F)	1.1	4.2	1.2	4.3	78.5	4501
modified polyol (60C,140F)	-0.7	-1.8	-0.5	-1.8	82.5	4501
POE branched acid (60°C,140°F)	2.5	7.2	2.5	7.3	78.5	4501
mixed acid (60°C,140°F)	2.5	8.7	2.7	8.6	78.5	4501

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

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* mineral oil (MO)
  - naphthenic (Witco Suniso(R) 3GS)
- alkylbenzene (AB)
  - (Shrieve Zerol(R) 150)
- polyalkylene glycol (PAG)
  - modified polyol (AlliedSignal BRL-150)
  - polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
  - polypropylene glycol (PPG) diol (Dow P425)
- polyolester (POE)
  - pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
  - pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

fluoroelastomer

---------- COMPATIBILITY SUMMARY ----------

			see RDB#
elastomer	fluoroelastomer DuPont Viton(R) A		
composition	(in parts per hundred parts of elastomer)		
	fluorinated rubber	100	
	magnesium oxide (fluoroelastomer grade)	15	
	N,N'-dicinnamylidene-1,6-hexanediamine	3	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness change (%)	
R-22						
neat (at ambient)	33.2	83.0	0.4	2.3	58.5 #	4501
R-32						
neat (at ambient)	23.2	41.4	0.1	0.2	65.5 #	4501
R-123						
neat (at ambient)	31.6	104	4.0	13.7	56.5	4501
R-124						
neat (at ambient)	28.98	89.5	2.4	9.8	57.5	4501
R-125						
neat (at ambient)	11.7	31.4	2.7	8.8	54.5	4501
R-134						
neat (at ambient)	37.8	118	2.1	4.7	61.5	4501
R-134a						
neat (at ambient)	25.6	67.8	2.4	6.7	57.5	4501
R-142b						
neat (at ambient)	31.8	80.1	2.4	7.0	52.5	4501
R-143a						
neat (at ambient)	13.6	28.3	2.1	6.2	56.5 #	4501
R-152a						
neat (at ambient)	39.1	81.6	1.8	2.1	59.5	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	-0.6	0.6	-0.7	0.2	61.5	4501
AB (60°C,140°F)	0.1	0.5	-0.3	0.2	63.5	4501
PAG PPG butyl monoether (60°C)	0.2	0.8	-0.2	0.3	64.5	4501
PPG diol (60°C,140°F)	1.0	1.6	0.3	1.5	62.5	4501
modified polyol (60C,140F)	0.1	0.7	-0.3	0.4	61.5	4501
POE branched acid (60°C,140°F)	8.5	16.6	7.1	16.8	50.5	4501
mixed acid (60°C,140°F)	3.3	6.3	2.7	6.2	57.5	4501

* mineral oil (MO)
naphthenic (Witco Suniso(R) 3GS)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

```
  alkylbenzene (AB)
    (Shrieve Zerol(R) 150)
  polyalkylene glycol (PAG)
    modified polyol (AlliedSignal BRL-150)
    polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
    polypropylene glycol (PPG) diol (Dow P425)
  polyolester (POE)
    pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
    pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)
# Specimen showed deterioration after removal from the test fluid.
```

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

fluoroelastomer

---------- COMPATIBILITY SUMMARY ----------

			see RDB#
elastomer	fluoroelastomer		
	DuPont Viton(R) B		
composition	(in parts per hundred parts of elastomer)		
	fluorinated rubber	100	
	magnesium oxide (fluoroelastomer grade)	15	
	N,N'-dicinnamylidene-1,6-hexanediamine	3	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness change (%)	
R-22						
neat (at ambient)	35.6	96.8	0.7	-0.6	57.5 #	4501
R-32						
neat (at ambient)	22.2	40.9	5.4	0.1	62.5 #	4501
R-123						
neat (at ambient)	37.4	133	3.7	10.9	60.5	4501
R-124						
neat (at ambient)	37.8	123	2.7	7.9	58.5	4501
R-125						
neat (at ambient)	15.2	41.8	3.7	4.9	53.5 #	4501
R-134						
neat (at ambient)	37.7	115	1.6	2.7	59.5	4501
R-134a						
neat (at ambient)	29.4	82.8	2.2	3.9	57.5	4501
R-142b						
neat (at ambient)	38.7	99.1	2.3	5.2	57.5	4501
R-143a						
neat (at ambient)	17.1	26.4	3.8	3.2	53.5 #	4501
R-152a						
neat (at ambient)	40.1	87.9	1.0	-0.5	61.5 #	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	0.1	0.5	-0.5	0.2	63.5	4501
AB (60°C,140°F)	0.2	0.4	-0.4	0.2	61.5	4501
PAG PPG butyl monoether (60°C)	-0.5	1.1	-0.9	0.2	63.5	4501
PPG diol (60°C,140°F)	1.0	1.2	0.5	1.0	62.5	4501
modified polyol (60C,140F)	0.2	0.7	0.1	0.3	65.5	4501
POE branched acid (60°C,140°F)	2.0	3.7	1.5	3.8	59.5	4501
mixed acid (60°C,140°F)	1.0	2.3	0.6	1.9	61.5	4501

* mineral oil (MO)
naphthenic (Witco Suniso(R) 3GS)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

```
  alkylbenzene (AB)
    (Shrieve Zerol(R) 150)
  polyalkylene glycol (PAG)
    modified polyol (AlliedSignal BRL-150)
    polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
    polypropylene glycol (PPG) diol (Dow P425)
  polyolester (POE)
    pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
    pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)
# Specimen showed deterioration after removal from the test fluid.
```

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

fluoroelastomer

---------- COMPATIBILITY SUMMARY ----------

			see RDB#
elastomer	fluoroelastomer DuPont Viton(R) GF		
composition	(in parts per hundred parts of elastomer)		
	fluorinated rubber	100	
	litharge (sublimed) (lead oxide)	3	
	triallylisocyanurate	3	
	2,5-dimethyl-2,5-di(t-butylperoxyl) hexane (50%)	3	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness change (%)	
R-22						
neat (at ambient)	35.5	87.5	0.3	1.7	---	4501
R-32						
neat (at ambient)	19.6	34.1	0.4	0.5	55.5 #	4501
R-123						
neat (at ambient)	37.8	121	5.1	12.6	56.5	4501
R-124						
neat (at ambient)	39.9	123	3.2	8.5	---	4501
R-125						
neat (at ambient)	19.6	49.3	2.5	6.1	--- #	4501
R-134						
neat (at ambient)	32.3	85.0	2.7	6.4	54.5	4501
R-134a						
neat (at ambient)	30.2	78.0	2.5	6.8	---	4501
R-142b						
neat (at ambient)	37.6	93.2	2.9	6.6	---	4501
R-143a						
neat (at ambient)	20.8	38.1	1.3	3.9	---	4501
R-152a						
neat (at ambient)	34.4	60.8	1.9	2.4	56.5	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	0.3	0.2	0.5	0.1	59.5	4501
AB (60°C,140°F)	0.1	0.2	-0.3	0.1	56.5	4501
PAG PPG butyl monoether (60°C)	0.1	0.3	-0.2	0.2	58.5	4501
PPG diol (60°C,140°F)	0.7	0.8	-0.2	0.8	58.5	4501
modified polyol (60C,140F)	-0.1	0.2	-0.3	0.2	60.5	4501
POE branched acid (60°C,140°F)	1.1	1.6	0.8	1.4	57.5	4501
mixed acid (60°C,140°F)	0.7	1.1	0.2	1.1	59.5	4501

* mineral oil (MO)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

```
    naphthenic (Witco Suniso(R) 3GS)
  alkylbenzene (AB)
    (Shrieve Zerol(R) 150)
  polyalkylene glycol (PAG)
    modified polyol (AlliedSignal BRL-150)
    polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
    polypropylene glycol (PPG) diol (Dow P425)
  polyolester (POE)
    pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
    pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)
# Specimen showed deterioration after removal from the test fluid.
```

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

fluoroelastomer with carbon black

---------- COMPATIBILITY SUMMARY ----------

			see RDB#
elastomer	fluoroelastomer with carbon black filled DuPont Viton(R) GF		
composition	(in parts per hundred parts of elastomer)		
	fluorinated rubber	100	
	N330 carbon black	30	
	litharge (sublimed) (lead oxide)	3	
	triallylisocyanurate	3	
	2,5-dimethyl-2,5-di(t-butylperoxyl) hexane (50%)	3	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness change (%)	
R-22						
neat (at ambient)	22.5	57.1	1.6	3.0	---	4501
R-32						
neat (at ambient)	13.7	26.3	1.0	1.9	83.5	4501
R-123						
neat (at ambient)	24.3	64.6	4.3	11.0	82.5	4501
R-124						
neat (at ambient)	24.0	71.1	2.9	7.3	---	4501
R-125						
neat (at ambient)	13.3	36.2	3.5	7.7	--- #	4501
R-134						
neat (at ambient)	21.1	53.5	2.5	5.0	78.5	4501
R-134a						
neat (at ambient)	18.2	48.6	1.5	5.6	---	4501
R-142b						
neat (at ambient)	23.0	54.4	4.0	6.6	---	4501
R-143a						
neat (at ambient)	14.0	27.4	2.4	4.6	60.5	4501
R-152a						
neat (at ambient)	21.5	41.0	1.9	2.3	86.5	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	0.4	0.3	0.1	0.2	89.5	4501
AB (60°C,140°F)	0.1	0.3	0.2	0.2	90.5	4501
PAG PPG butyl monoether (60°C)	0.2	0.4	0.0	0.3	89.5	4501
PPG diol (60°C,140°F)	0.5	0.9	0.6	0.9	89.5	4501
modified polyol (60C,140F)	0.3	0.2	-0.3	0.2	88.5	4501
POE branched acid (60°C,140°F)	0.8	1.6	0.6	1.3	88.5	4501
mixed acid (60°C,140°F)	0.7	1.0	0.9	0.9	88.5	4501

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

```
* mineral oil (MO)
    naphthenic (Witco Suniso(R) 3GS)
  alkylbenzene (AB)
    (Shrieve Zerol(R) 150)
  polyalkylene glycol (PAG)
    modified polyol (AlliedSignal BRL-150)
    polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
    polypropylene glycol (PPG) diol (Dow P425)
  polyolester (POE)
    pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
    pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)
# Specimen showed deterioration after removal from the test fluid.
```

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

fluorinated-chlorinated rubber

COMPATIBILITY SUMMARY			see RDB#
elastomer	fluorinated-chlorinated rubber Kel-F(TM) 3700		
composition	(in parts per hundred parts of elastomer)		
	fluorinated-chlorinated rubber	100	
	litharge (sublimed) (lead oxide)	1.8	
	triallylisocyanurate	1.8	
	2,5-dimethyl-2,5-di(t-butylperoxyl) hexane (50%)	1.8	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness change (%)	
R-22						
neat (at ambient)	25.9	70.4	2.1	7.1	58.5	4501
R-32						
neat (at ambient)	16.7	34.1	0.7	2.9	60.5 #	4501
R-123						
neat (at ambient)	29.1	107	5.9	20.0	58.5	4501
R-124						
neat (at ambient)	21.5	63.8	4.8	15.2	60.5	4501
R-125						
neat (at ambient)	8.6	22.0	4.9	13.1	60.5	4501
R-134						
neat (at ambient)	22.3	66.6	3.9	11.4	58.5	4501
R-134a						
neat (at ambient)	16.2	42.7	2.6	7.9	---	4501
R-142b						
neat (at ambient)	25.1	67.0	3.4	11.4	59.5	4501
R-143a						
neat (at ambient)	10.2	22.6	3.2	8.9	---	4501
R-152a						
neat (at ambient)	27.0	58.2	2.7	6.4	59.5	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	0.5	0.4	-0.1	0.2	59.5	4501
AB (60°C,140°F)	0.2	0.3	-1.0	0.5	59.5	4501
PAG PPG butyl monoether (60°C)	0.3	1.1	1.6	0.9	59.5	4501
PPG diol (60°C,140°F)	4.7	9.2	4.2	9.1	59.5	4501
modified polyol (60C,140F)	0.5	0.9	-0.2	0.8	61.5	4501
POE branched acid (60°C,140°F)	32.2	76.4	29.9	76.6	49.5	4501
mixed acid (60°C,140°F)	31.5	77.4	30.3	77.3	57.5	4501

* mineral oil (MO)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

```
    naphthenic (Witco Suniso(R) 3GS)
  alkylbenzene (AB)
    (Shrieve Zerol(R) 150)
  polyalkylene glycol (PAG)
    modified polyol (AlliedSignal BRL-150)
    polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
    polypropylene glycol (PPG) diol (Dow P425)
  polyolester (POE)
    pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
    pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)
# Specimen showed deterioration after removal from the test fluid.
```

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

fluorinated-chlorinated rubber

---------- COMPATIBILITY SUMMARY ----------

			see RDB#
elastomer	fluorinated-chlorinated rubber Kel-F(TM) 3700		
composition	(in parts per hundred parts of elastomer)		
	fluorinated-chlorinated rubber	100	
	magnesium oxide (fluoroelastomer grade)	15	
	N,N'-dicinnamylidene-1,6-hexanediamine	3	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness change (%)	
R-22						
neat (at ambient)	23.5	84.0	3.3	3.2	56.5 #	4501
R-32						
neat (at ambient)	13.1	32.5	4.9	2.7	66.5 #	4501
R-123						
neat (at ambient)	36.0	168	4.6	10.9	64.5	4501
R-124						
neat (at ambient)	19.7	79.5	3.1	12.7	60.5	4501
R-125						
neat (at ambient)	6.5	22.5	8.0	7.8	53.5 #	4501
R-134						
neat (at ambient)	20.0	71.0	5.0	11.1	65.5	4501
R-134a						
neat (at ambient)	13.0	44.8	2.9	9.7	65.5 #	4501
R-142b						
neat (at ambient)	28.9	85.6	3.4	7.4	58.5	4501
R-143a						
neat (at ambient)	8.1	22.1	5.2	6.0	53.5 #	4501
R-152a						
neat (at ambient)	25.4	68.3	1.9	2.6	57.5	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	0.9	1.9	1.1	1.4	65.5	4501
AB (60°C,140°F)	0.4	1.4	-0.5	1.0	74.5	4501
PAG PPG butyl monoether (60°C)	0.8	3.2	0.3	2.2	71.5	4501
PPG diol (60°C,140°F)	3.3	9.3	3.5	9.6	65.5	4501
modified polyol (60C,140F)	0.8	2.9	-0.1	2.0	74.5	4501
POE branched acid (60°C,140°F)	47.3	157	47.0	157	28.5	4501
mixed acid (60°C,140°F)	47.1	182	48.1	183	26.5	4501

* mineral oil (MO)
naphthenic (Witco Suniso(R) 3GS)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

alkylbenzene (AB)
(Shrieve Zerol(R) 150)
polyalkylene glycol (PAG)
modified polyol (AlliedSignal BRL-150)
polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
polypropylene glycol (PPG) diol (Dow P425)
polyolester (POE)
pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)
Specimen showed deterioration after removal from the test fluid.

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

fluorinated-chlorinated rubber with carbon black

---------- COMPATIBILITY SUMMARY ----------

			see RDB#
elastomer	fluorinated-chlorinated rubber with carbon black filled Kel-F(TM) 3700		
composition	(in parts per hundred parts of elastomer)		
	fluorinated-chlorinated rubber	100	
	N330 / IRB6 carbon black	30	
	magnesium oxide (fluoroelastomer grade)	15	
	N,N'-dicinnamylidene-1,6-hexanediamine	3	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore D hardness change (%)	
R-22						
neat (at ambient)	6.5	21.8	1.4	5.8	67.5	4501
R-32						
neat (at ambient)	6.5	18.0	0.9	2.6	95.5 55.5 □	4501
R-123						
neat (at ambient)	6.5	26.2	2.1	12.1	67.5	4501
R-124						
neat (at ambient)	5.0	26.7	2.7	9.7	65.5	4501
R-125						
neat (at ambient)	4.8	14.0	1.6	8.5	62.5	4501
R-134						
neat (at ambient)	7.4	28.0	2.1	6.9	52.5	4501
R-134a						
neat (at ambient)	4.1	17.8	1.9	7.8	66.5	4501
R-142b						
neat (at ambient)	5.7	19.7	2.1	7.7	65.5	4501
R-143a						
neat (at ambient)	3.0	12.4	2.2	6.8	65.5	4501
R-152a						
neat (at ambient)	6.2	16.7	1.5	4.5	69.5	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	-0.1	0.7	0.3	0.7	71.5	4501
AB (60°C,140°F)	0.2	1.0	0.6	0.8	70.5	4501
PAG PPG butyl monoether (60°C)	0.9	1.3	1.3	1.4	69.5	4501
PPG diol (60°C,140°F)	1.9	5.5	1.7	5.9	64.5	4501
modified polyol (60C,140F)	0.9	1.6	0.6	1.6	67.5	4501
POE branched acid (60°C,140°F)	6.0	-4.9	5.8	19.2	52.5	4501
mixed acid (60°C,140°F)	6.1	17.2	5.5	17.6	51.5	4501

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

□ Shore A hardness change; other data in this column are Shore D.
* mineral oil (MO)
  naphthenic (Witco Suniso(R) 3GS)
  alkylbenzene (AB)
  (Shrieve Zerol(R) 150)
  polyalkylene glycol (PAG)
  modified polyol (AlliedSignal BRL-150)
  polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
  polypropylene glycol (PPG) diol (Dow P425)
  polyolester (POE)
  pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
  pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

epichlorohydrin based rubber

---------- COMPATIBILITY SUMMARY ----------

elastomer	epichlorohydrin based rubber		see
CO	Goodrich Hydrin(TM) H-65		RDB#
			----
composition	(in parts per hundred parts of elastomer)		
	epichlorohydrin homopolymer (Hydrin(TM) H-65)	100	
	red lead	5	
	ethylene thiourea	1.85	
	nickel dibutyldithiocarbamate	1	
	stearic acid	1	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness change (%)	
R-22						
neat (at ambient)	12.3	38.7	-0.1	-1.8	37.5 #	4501
R-32						
neat (at ambient)	4.2	11.9	0.0	-0.6	37.5 #	4501
R-123						
neat (at ambient)	17.1	68.0	5.7	24.8	39.5	4501
R-124						
neat (at ambient)	3.4	11.5	2.3	9.0	41.5	4501
R-125						
neat (at ambient)	0.1	1.4	0.7	1.4	38.5	4501
R-134						
neat (at ambient)	3.5	12.4	2.2	8.7	40.5	4501
R-134a						
neat (at ambient)	1.3	4.3	0.5	2.8	---	4501
R-142b						
neat (at ambient)	5.0	14.4	2.8	8.9	37.5	4501
R-143a						
neat (at ambient)	0.9	2.7	2.0	2.0	40.5	4501
R-152a						
neat (at ambient)	4.8	11.9	1.8	4.8	41.5	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	1.0	2.6	0.6	2.4	38.5	4501
AB (60°C,140°F)	0.3	0.5	-0.4	1.0	40.5	4501
PAG PPG butyl monoether (60°C)	2.0	4.0	1.0	3.8	38.5	4501
PPG diol (60°C,140°F)	18.1	46.5	16.8	46.4	33.5	4501
modified polyol (60C,140F)	0.4	0.6	-0.8	0.5	40.5	4501
POE branched acid (60°C,140°F)	17.4	44.5	15.8	44.9	32.5	4501
mixed acid (60°C,140°F)	26.8	72.9	25.8	72.1	31.5	4501

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

* mineral oil (MO)
  naphthenic (Witco Suniso(R) 3GS)
  alkylbenzene (AB)
  (Shrieve Zerol(R) 150)
  polyalkylene glycol (PAG)
  modified polyol (AlliedSignal BRL-150)
  polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
  polypropylene glycol (PPG) diol (Dow P425)
  polyolester (POE)
  pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
  pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)
Specimen showed deterioration after removal from the test fluid.

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

epichlorohydrin based rubber with carbon black

---------- COMPATIBILITY SUMMARY ----------

			see RDB#
elastomer CO	epichlorohydrin based rubber with carbon black filled Goodrich Hydrin(TM) H-65		
composition	(in parts per hundred parts of elastomer)		
	epichlorohydrin homopolymer (Hydrin(TM) H-65)	100	
	N330 carbon black	40	
	red lead	5	
	ethylene thiourea	1.85	
	nickel dibutyldithiocarbamate	1	
	stearic acid	1	4501

The following table presents data after thermal aging in refrigerant-lubricant mixtures for 14 days at the temperatures indicated. The data include changes in weight, width, thickness, tensile strength, and hardness. Details of the tests are identified in the referenced source(s).

refrigerant (aging Temp) lubricant, % by weight	weight change (%)	width swell (%)	thick-ness swell (%)	tensile strength change (%)	Shore A hardness change (%)	
R-22 at 100 °C (212 °F)						
MO naphthenic, 33%	11.1	-0.1	4.7	-18.6	-15.3	4501
R-32 at 100 °C (212 °F)						
POE branched acid, 22%	29.2	13.6	13.7	-22.8	-7.6	4501
POE mixed acid, 23%	37.7	12.5	15.5	-49.9	-19.8	4501
R-123 at 100 °C (212 °F)						
MO naphthenic, 50%	18.0	3.2	7.0	-20.2	-4.6	4501
R-124 at 100 °C (212 °F)						
AB, 50%	7.3	4.9	2.7	-10.3	-4.6	4501
R-125 at 100 °C (212 °F)						
PAG PPG diol, 37%	17.9	6.8	7.9	-9.4	-3.1	4501
POE branched acid, 38%	14.2	4.2	7.9	-17.8	0.0	4501
POE mixed acid, 36%	20.7	6.2	10.5	-26.9	-3.1	4501
R-134 at 100 °C (212 °F)						
POE branched acid, 67%	11.0	5.5	4.3	-11.2	0.0	4501
R-134a at 100 °C (212 °F)						
PAG modified, 35%	3.3	2.6	1.3	-25.7	-19.8	4501
PAG PPG diol, 39%	15.5	4.5	6.5	-19.7	-7.6	4501
POE branched acid, 47%	12.9	5.2	6.0	-19.7	-1.5	4501
POE mixed acid, 41%	19.5	9.0	8.3	-13.0	-16.8	4501
R-142b at 100 °C (212 °F)						
AB, 50%	9.5	8.5	4.7	-21.6	1.5	4501
R-143a at 100 °C (212 °F)						
POE branched acid, 28%	24.4	9.5	11.1	-20.7	-16.8	4501
R-152a at 100 °C (212 °F)						
AB, 34%	9.4	2.5	4.7	-37.8	4.6	4501
POE branched acid, 46%	22.5	6.8	10.4	-34.7	-7.6	4501

* The lubricants tested were:
  MO: naphthenic mineral oil (Witco Suniso(R) 3GS)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

AB: alkylbenzene (Shrieve Zerol(R) 150)
PAG: polyalkylene glycol, modified polyol (AlliedSignal BRL-150)
polyalkylene glycol, polypropylene glycol diol (Dow P425)
POE: polyolester, pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
polyolester, pentaerythritol ester mixed acid (ICI Emkarate(TM) RL 22H)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

epichlorohydrin based rubber

---------- COMPATIBILITY SUMMARY ----------

			see RDB#
elastomer	epichlorohydrin based rubber		
CO	Goodrich Hydrin(TM) C-65		
composition	(in parts per hundred parts of elastomer)		
	epichlorohydrin comopolymer (Hydrin(TM) C-65)	100	
	red lead (report indicates both 1 and 5 pph)	5	
	ethylene thiourea	1.85	
	nickel dibutyldithiocarbamate	1	
	stearic acid	1	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness change (%)	
R-22						
neat (at ambient)	36.0	126	-2.2	-5.6	43.5 #	4501
R-32						
neat (at ambient)	6.3	20.6	0.4	-1.2	44.5 #	4501
R-123						
neat (at ambient)	68.0	418	0.3	6.4	44.5	4501
R-124						
neat (at ambient)	22.0	82.7	-1.0	3.3	43.5	4501
R-125						
neat (at ambient)	3.1	10.6	1.2	28	38.5 #	4501
R-134						
neat (at ambient)	12.7	50.8	-1.2	2.2	46.5	4501
R-134a						
neat (at ambient)	3.7	12.1	-0.3	-0.7	---	4501
R-142b						
neat (at ambient)	5.8	20.7	0.1	2.0	46.5	4501
R-143a						
neat (at ambient)	1.6	4.8	-0.1	1.1	42.5	4501
R-152a						
neat (at ambient)	5.0	16.2	-1.3	-0.7	45.5	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	1.0	2.3	-0.4	2.5	43.5	4501
AB (60°C,140°F)	0.3	0.4	-0.1	1.3	41.5	4501
PAG PPG butyl monoether (60°C)	1.0	1.5	-0.1	1.7	41.5	4501
PPG diol (60°C,140°F)	12.5	33.4	10.5	33.7	34.5	4501
modified polyol (60C,140F)	-0.3	-0.7	-1.2	-0.3	42.5	4501
POE branched acid (60°C,140°F)	4.9	12.4	3.8	13.2	37.5	4501
mixed acid (60°C,140°F)	6.9	17.4	5.4	17.1	38.5	4501

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

```
* mineral oil (MO)
    naphthenic (Witco Suniso(R) 3GS)
  alkylbenzene (AB)
    (Shrieve Zerol(R) 150)
  polyalkylene glycol (PAG)
    modified polyol (AlliedSignal BRL-150)
    polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
    polypropylene glycol (PPG) diol (Dow P425)
  polyolester (POE)
    pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
    pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)
# Specimen showed deterioration after removal from the test fluid.
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SEE DATA LIMITATIONS AND NOTES ON PAGE 2

epichlorohydrin based rubber with carbon black

---------- COMPATIBILITY SUMMARY ----------

			see RDB#
elastomer CO	epichlorohydrin based rubber with carbon black filled Goodrich Hydrin(TM) C-65		
composition	(in parts per hundred parts of elastomer)		
	epichlorohydrin comopolymer (Hydrin(TM) C-65)	100	
	N330 carbon black	40	
	red lead	5	
	ethylene thiourea	1.85	
	nickel dibutyldithiocarbamate	1	
	stearic acid	1	4501

The following table presents dimensional, weight, and hardness change data after thermal aging of specimens in refrigerants and lubricants for the intervals and temperatures indicated. Details of the tests are identified in the referenced source(s).

	14 day in-situ		aged 1 day, then in air			
refrigerant/lubricant* (aging temperature)	swell (%)	weight change (%)	swell (%)	weight change (%)	Shore A hardness change (%)	
R-22						
neat (at ambient)	23.8	86.7	-0.8	-1.8	67.5	4501
R-32						
neat (at ambient)	5.4	14.7	-0.3	-0.5	69.5	4501
R-123						
neat (at ambient)	43.2	211	0.7	6.1	67.5	4501
R-124						
neat (at ambient)	15.6	53.7	0.3	3.2	68.5	4501
R-125						
neat (at ambient)	2.4	7.3	0.9	3.4	67.5	4501
R-134						
neat (at ambient)	9.0	34.9	-0.2	2.9	69.5	4501
R-134a						
neat (at ambient)	2.7	8.6	0.3	-0.07 □	---	4501
R-142b						
neat (at ambient)	2.4	7.3	0.9	3.4	67.5	4501
R-143a						
neat (at ambient)	1.2	3.9	0.5	1.3	67.5	4501
R-152a						
neat (at ambient)	2.0	11.6	-0.6	0.0	71.5	4501
neat lubricants*						
MO naphthenic (60°C,140°F)	0.7	1.9	0.8	2.0	68.5	4501
AB (60°C,140°F)	0.1	0.2	0.1	0.9	69.5	4501
PAG PPG butyl monoether (60°C)	0.6	1.3	-0.1	1.4	69.5	4501
PPG diol (60°C,140°F)	8.4	20.9	7.0	23.7	60.5	4501
modified polyol (60C,140F)	-0.2	-0.2	-0.5	0.1	70.5	4501
POE branched acid (60°C,140°F)	3.8	8.6	3.2	9.2	64.5	4501

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

mixed acid (60°C,140°F)	5.1	11.6	3.7	11.5	63.5	4501

□ The source document indicates the formulation as both 1 and 5 pph on pages C-8 and E-40, respectively. Verification is recommended.
□ The weight change indicated for R-134a may be a typographical error in the source document. The measured data are shown to be -0.04 and 0.1 with a mean of -0.07; the intended data may have been -1.4 and 0.1 with a mean of -0.7. Verification is recommended.

* mineral oil (MO)
  naphthenic (Witco Suniso(R) 3GS)
alkylbenzene (AB)
  (Shrieve Zerol(R) 150)
polyalkylene glycol (PAG)
  modified polyol (AlliedSignal BRL-150)
  polypropylene glycol (PPG) butyl monoether (ICI Emkarox(R) RL 32)
  polypropylene glycol (PPG) diol (Dow P425)
polyolester (POE)
  pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)
  pentaerythritol ester mixed acid (ICI Emkarate(R) RL 22H)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

EPDM / polypropylene thermoplastic elastomer (TPE)

COMPATIBILITY SUMMARY		
elastomer	EPDM / polypropylene thermoplastic elastomer (TPE) Santoprene(TM) 201-87	see RDB#
composition	(in parts per hundred parts of elastomer) ethylene propylene diene terpolymer (EPDM) / polypropylene TPE (Shore A hardness 87) 100	4501

The following table presents data after thermal aging in refrigerant-lubricant mixtures for 14 days at the temperatures indicated. The data include changes in weight, width, thickness, tensile strength, and hardness. Details of the tests are identified in the referenced source(s).

refrigerant (aging Temp) lubricant, % by weight	weight change (%)	width swell (%)	thick-ness swell (%)	tensile strength change (%)	Shore A hardness change (%)	
R-22 at 100 °C (212 °F)						
MO naphthenic, 33%	40.8	9.5	12.1	-27.5	-15.0	4501
R-32 at 100 °C (212 °F)						
POE branched acid, 22%	-5.9	-3.2	-3.9	-2.4	2.1	4501
POE mixed acid, 23%	-4.9	-4.2	-4.0	0.1	---	4501
R-123 at 100 °C (212 °F)						
MO naphthenic, 50%	47.6	12.5	11.9	-27.5	-15.0	4501
R-124 at 100 °C (212 °F)						
AB, 50%	17.8	3.1	7.1	-18.8	-13.9	4501
R-125 at 100 °C (212 °F)						
PAG PPG diol, 37%	-11.5	-4.5	-8.0	-1.9	4.3	4501
POE branched acid, 38%	-3.6	-3.8	-3.9	4.2	2.1	4501
POE mixed acid, 36%	-3.0	-1.3	-3.2	-9.2	1.1	4501
R-134 at 100 °C (212 °F)						
POE branched acid, 67%	-8.8	-1.7	-4.2	5.3	0.0	4501
R-134a at 100 °C (212 °F)						
PAG modified, 35%	-8.1	-3.6	-6.2	4.5	-12.8	4501
PAG PPG diol, 39%	-11.7	-5.4	-7.8	5.3	-18.2	4501
POE branched acid, 47%	-5.5	-1.9	-5.1	-2.3	1.1	4501
POE mixed acid, 41%	-5.2	-3.2	-4.9	-17.5	0.0	4501
R-142b at 100 °C (212 °F)						
AB, 50%	21.6	1.9	6.3	-19.2	-8.6	4501
R-143a at 100 °C (212 °F)						
POE branched acid, 28%	-3.0	-2.5	-3.3	-8.4	0.0	4501
R-152a at 100 °C (212 °F)						
AB, 34%	17.8	3.5	8.5	-19.3	-12.8	4501
POE branched acid, 46%	-7.7	-4.7	-5.6	-4.7	-1.1	4501

* The lubricants tested were:
- MO: naphthenic mineral oil (Witco Suniso(R) 3GS)
- AB: alkylbenzene (Shrieve Zerol(R) 150)
- PAG: polyalkylene glycol, modified polyol (AlliedSignal BRL-150)
  polyalkylene glycol, polypropylene glycol diol (Dow P425)
- POE: polyolester, pentaerythritol ester branched acid

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

(Henkel Emery(R) 2927-A)
polyolester, pentaerythritol ester mixed acid
(ICI Emkarate(TM) RL 22H)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

EPDM / polypropylene thermoplastic elastomer (TPE)

COMPATIBILITY SUMMARY			
elastomer	EPDM / polypropylene thermoplastic elastomer (TPE) Santoprene(TM) 201-73		see RDB#
composition	(in parts per hundred parts of elastomer) ethylene propylene diene terpolymer (EPDM) / polypropylene TPE (Shore A hardness 73)	100	4501

The following table presents data after thermal aging in refrigerant-lubricant mixtures for 14 days at the temperatures indicated. The data include changes in weight, width, thickness, tensile strength, and hardness. Details of the tests are identified in the referenced source(s).

refrigerant (aging Temp) lubricant, % by weight	weight change (%)	width swell (%)	thick-ness swell (%)	tensile strength change (%)	Shore A hardness change (%)	
R-22 at 100 °C (212 °F)						
MO naphthenic, 33%	39.4	16.2	17.7	-28.6	-20.4	4501
R-32 at 100 °C (212 °F)						
POE branched acid, 22%	-15.4	-5.2	-8.6	14.1	2.5	4501
POE mixed acid, 23%	-14.6	-6.5	-6.9	1.8	-1.3	4501
R-123 at 100 °C (212 °F)						
MO naphthenic, 50%	76.8	19.7	18.0	-29.8	-24.2	4501
R-124 at 100 °C (212 °F)						
AB, 50%	35.5	5.1	10.8	-29.1	-28.0	4501
R-125 at 100 °C (212 °F)						
PAG PPG diol, 37%	-23.8	-10.3	-14.7	32.5	11.5	4501
POE branched acid, 38%	-14.5	-3.3	-9.8	-43.6	0.0	4501
POE mixed acid, 36%	-13.8	-6.4	-8.7	17.0	5.1	4501
R-134 at 100 °C (212 °F)						
POE branched acid, 67%	-20.7	-9.5	-12.8	31.1	5.1	4501
R-134a at 100 °C (212 °F)						
PAG modified, 35%	-23.7	-6.5	-13.5	35.9	-1.3	4501
PAG PPG diol, 39%	-23.1	-11.4	-10.7	-22.2	---	4501
POE branched acid, 47%	-16.8	-4.8	-9.8	18.6	1.3	4501
POE mixed acid, 41%	-16.5	-7.0	-10.7	8.7	5.1	4501
R-142b at 100 °C (212 °F)						
AB, 50%	30.0	7.0	8.4	-25.5	-20.4	4501
R-143a at 100 °C (212 °F)						
POE branched acid, 28%	-14.1	-6.0	-9.1	2.3	2.5	4501
R-152a at 100 °C (212 °F)						
AB, 34%	38.0	8.5	13.9	-23.3	-21.7	4501
POE branched acid, 46%	-17.8	-7.9	-11.0	11.6	2.5	4501

* The lubricants tested were:
- MO: naphthenic mineral oil (Witco Suniso(R) 3GS)
- AB: alkylbenzene (Shrieve Zerol(R) 150)
- PAG: polyalkylene glycol, modified polyol (AlliedSignal BRL-150)
  polyalkylene glycol, polypropylene glycol diol (Dow P425)
- POE: polyolester, pentaerythritol ester branched acid

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

(Henkel Emery(R) 2927-A)
polyolester, pentaerythritol ester mixed acid
(ICI Emkarate(TM) RL 22H)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

EPDM / polypropylene thermoplastic elastomer (TPE)

COMPATIBILITY SUMMARY			
elastomer	EPDM / polypropylene thermoplastic elastomer (TPE) Santoprene(TM) 203-40		see RDB#
composition	(in parts per hundred parts of elastomer) ethylene propylene diene terpolymer (EPDM) / polypropylene TPE (Shore D hardness 40)	100	4501

The following table presents data after thermal aging in refrigerant-lubricant mixtures for 14 days at the temperatures indicated. The data include changes in weight, width, thickness, tensile strength, and hardness. Details of the tests are identified in the referenced source(s).

refrigerant (aging Temp) lubricant, % by weight	weight change (%)	width swell (%)	thick-ness swell (%)	tensile strength change (%)	Shore D hardness change (%)	
R-22 at 100 °C (212 °F)						
MO naphthenic, 33%	31.0	9.9	11.5	-19.9	-35.3	4501
R-32 at 100 °C (212 °F)						
POE branched acid, 22%	-0.5	-1.6	-1.8	-26.5	-2.4	4501
POE mixed acid, 23%	-0.9	-1.0	-2.2	-8.8	-9.4	4501
R-123 at 100 °C (212 °F)						
MO naphthenic, 50%	41.0	8.9	11.4	-20.3	-42.4	4501
R-124 at 100 °C (212 °F)						
AB, 50%	14.9	4.5	6.0	-9.2	94.1	4501
R-125 at 100 °C (212 °F)						
PAG PPG diol, 37%	-4.4	-1.9	-3.5	-11.3	11.8	4501
POE branched acid, 38%	-1.6	-2.5	-1.8	-15.0	-2.4	4501
POE mixed acid, 36%	0.6	0.3	-1.7	-10.1	0.0	4501
R-134 at 100 °C (212 °F)						
POE branched acid, 67%	-4.0	-2.2	-4.5	-13.3	4.7	4501
R-134a at 100 °C (212 °F)						
PAG modified, 35%	-3.5	0.0	-4.9	-4.9	-47.1	4501
PAG PPG diol, 39%	-3.5	-2.5	-3.5	-9.7	-18.8	4501
POE branched acid, 47%	-1.3	-1.6	-2.7	-11.7	-9.4	4501
POE mixed acid, 41%	-0.8	-1.9	-2.3	-10.5	-21.2	4501
R-142b at 100 °C (212 °F)						
AB, 50%	16.1	2.8	5.4	-11.4	-44.7	4501
R-143a at 100 °C (212 °F)						
POE branched acid, 28%	-3.3	-1.3	-3.5	-9.0	-7.1	4501
R-152a at 100 °C (212 °F)						
AB, 34%	13.8	2.2	6.1	-16.5	-32.9	4501
POE branched acid, 46%	-2.6	-0.6	-3.6	-15.1	-9.4	4501

* The lubricants tested were:
- MO: naphthenic mineral oil (Witco Suniso(R) 3GS)
- AB: alkylbenzene (Shrieve Zerol(R) 150)
- PAG: polyalkylene glycol, modified polyol (AlliedSignal BRL-150)
  polyalkylene glycol, polypropylene glycol diol (Dow P425)
- POE: polyolester, pentaerythritol ester branched acid

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

(Henkel Emery(R) 2927-A)
polyolester, pentaerythritol ester mixed acid
(ICI Emkarate(TM) RL 22H)

nitrile / polypropylene thermoplastic elastomer (TPE)

COMPATIBILITY SUMMARY			
elastomer	nitrile / polypropylene thermoplastic elastomer (TPE) Geolast(TM) 701-87		see RDB#
composition	(in parts per hundred parts of elastomer) nitrile / polypropylene TPE (Shore A hardness 87)	100	4501

The following table presents data after thermal aging in refrigerant-lubricant mixtures for 14 days at the temperatures indicated. The data include changes in weight, width, thickness, tensile strength, and hardness. Details of the tests are identified in the referenced source(s).

refrigerant (aging Temp) lubricant, % by weight	weight change (%)	width swell (%)	thick-ness swell (%)	tensile strength change (%)	Shore A hardness change (%)	
R-22 at 100 °C (212 °F)						
MO naphthenic, 33%	11.8	2.9	5.4	-17.4	-12.4	4501
R-32 at 100 °C (212 °F)						
POE branched acid, 22%	4.8	2.3	2.5	-12.9	-2.1	4501
POE mixed acid, 23%	5.4	5.6	2.5	-15.9	-7.3	4501
R-123 at 100 °C (212 °F)						
MO naphthenic, 50%	44.1	9.7	10.0	-32.9	-14.5	4501
R-124 at 100 °C (212 °F)						
AB, 50%	3.5	5.0	1.3	-18.3	-13.5	4501
R-125 at 100 °C (212 °F)						
PAG PPG diol, 37%	3.0	1.7	0.4	-12.7	0.0	4501
POE branched acid, 38%	2.9	1.3	0.9	0.8	-1.0	4501
POE mixed acid, 36%	4.7	1.6	0.4	-13.8	0.0	4501
R-134 at 100 °C (212 °F)						
POE branched acid, 67%	7.5	1.3	0.9	-20.6	---	4501
R-134a at 100 °C (212 °F)						
PAG modified, 35%	0.1	1.7	-0.4	-15.1	-1.0	4501
PAG PPG diol, 39%	6.3	2.6	1.7	-15.0	-3.1	4501
POE branched acid, 47%	4.2	1.0	1.3	-21.6	---	4501
POE mixed acid, 41%	7.1	2.6	1.7	-19.5	-6.2	4501
R-142b at 100 °C (212 °F)						
AB, 50%	13.0	4.9	4.2	-43.8	-5.2	4501
R-143a at 100 °C (212 °F)						
POE branched acid, 28%	3.4	2.6	1.7	-10.4	-1.0	4501
R-152a at 100 °C (212 °F)						
AB, 34%	8.3	3.6	3.8	-25.8	-5.2	4501
POE branched acid, 46%	5.1	2.9	0.9	-22.6	-2.1	4501

* The lubricants tested were:
- MO: naphthenic mineral oil (Witco Suniso(R) 3GS)
- AB: alkylbenzene (Shrieve Zerol(R) 150)
- PAG: polyalkylene glycol, modified polyol (AlliedSignal BRL-150)
  polyalkylene glycol, polypropylene glycol diol (Dow P425)
- POE: polyolester, pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

polyolester, pentaerythritol ester mixed acid
(ICI Emkarate(TM) RL 22H)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

nitrile / polypropylene thermoplastic elastomer (TPE)

---------- COMPATIBILITY SUMMARY ----------

			see RDB#
elastomer	nitrile / polypropylene thermoplastic elastomer (TPE) Geolast(TM) 701-80		
composition	(in parts per hundred parts of elastomer)		
	nitrile / polypropylene TPE (Shore A hardness 80)	100	4501

The following table presents data after thermal aging in refrigerant-lubricant mixtures for 14 days at the temperatures indicated. The data include changes in weight, width, thickness, tensile strength, and hardness. Details of the tests are identified in the referenced source(s).

refrigerant (aging Temp) lubricant, % by weight	weight change (%)	width swell (%)	thick-ness swell (%)	tensile strength change (%)	Shore A hardness change (%)	
R-22 at 100 °C (212 °F)						
MO naphthenic, 33%	12.8	0.3	2.4	-27.9	-11.8	4501
R-32 at 100 °C (212 °F)						
POE branched acid, 22%	4.2	0.3	0.8	-14.9	0.0	4501
POE mixed acid, 23%	8.5	2.3	3.2	-17.8	-4.7	4501
R-123 at 100 °C (212 °F)						
MO naphthenic, 50%	49.6	10.1	11.3	-32.3	-15.4	4501
R-124 at 100 °C (212 °F)						
AB, 50%	13.6	2.3	3.2	-19.6	-22.5	4501
R-125 at 100 °C (212 °F)						
PAG PPG diol, 37%	5.5	0.0	1.6	-12.9	-1.2	4501
POE branched acid, 38%	2.5	-0.3	0.0	3.1	-2.4	4501
POE mixed acid, 36%	7.0	0.7	1.6	-5.0	0.0	4501
R-134 at 100 °C (212 °F)						
POE branched acid, 67%	9.6	2.0	1.6	-9.4	-2.4	4501
R-134a at 100 °C (212 °F)						
PAG modified, 35%	-4.9	1.0	-3.2	-0.1	0.0	4501
PAG PPG diol, 39%	5.6	-0.4	2.0	-25.8	-9.5	4501
POE branched acid, 47%	4.6	0.7	0.4	-9.0	-3.6	4501
POE mixed acid, 41%	8.3	1.3	19.0	-12.1	-2.4	4501
R-142b at 100 °C (212 °F)						
AB, 50%	9.6	2.3	2.4	-20.9	-8.3	4501
R-143a at 100 °C (212 °F)						
POE branched acid, 28%	3.3	2.0	0.0	-14.8	0.0	4501
R-152a at 100 °C (212 °F)						
AB, 34%	8.3	1.3	3.2	-23.7	-8.3	4501
POE branched acid, 46%	3.6	0.3	0.8	-18.9	-3.6	4501

* The lubricants tested were:
- MO: naphthenic mineral oil (Witco Suniso(R) 3GS)
- AB: alkylbenzene (Shrieve Zerol(R) 150)
- PAG: polyalkylene glycol, modified polyol (AlliedSignal BRL-150)
  polyalkylene glycol, polypropylene glycol diol (Dow P425)
- POE: polyolester, pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

polyolester, pentaerythritol ester mixed acid
(ICI Emkarate(TM) RL 22H)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

copolyester thermoplastic elastomer (TPE)

---------- COMPATIBILITY SUMMARY ----------

			see RDB#
elastomer	copolyester thermoplastic elastomer (TPE) DuPont Hytrel(R) G6356		
composition	(in parts per hundred parts of elastomer) polyester TPE (Shore D hardness 72)	100	4501

The following table presents data after thermal aging in refrigerant-lubricant mixtures for 14 days at the temperatures indicated. The data include changes in weight, width, thickness, tensile strength, and hardness. Details of the tests are identified in the referenced source(s).

refrigerant (aging Temp) lubricant, % by weight	weight change (%)	width swell (%)	thick-ness swell (%)	tensile strength change (%)	Shore D hardness change (%)	
R-22 at 100 °C (212 °F)						
MO naphthenic, 33%	12.7	9.0	3.3	-6.2	-11.4	4501
R-32 at 100 °C (212 °F)						
POE branched acid, 22%	5.6	2.9	2.4	-4.6	-1.9	4501
POE mixed acid, 23%	6.1	1.7	2.4	4.4	-3.8	4501
R-123 at 100 °C (212 °F)						
MO naphthenic, 50%	27.4	9.7	6.8	-0.3	-21.0	4501
R-124 at 100 °C (212 °F)						
AB, 50%	14.2	3.5	4.8	-6.4	-22.9	4501
R-125 at 100 °C (212 °F)						
PAG PPG diol, 37%	6.9	1.3	1.7	2.6	0.0	4501
POE branched acid, 38%	5.2	0.4	2.5	3.8	-13.3	4501
POE mixed acid, 36%	5.9	1.7	1.7	-3.4	1.9	4501
R-134 at 100 °C (212 °F)						
POE branched acid, 67%	9.0	0.6	4.1	6.1	-5.7	4501
R-134a at 100 °C (212 °F)						
PAG modified, 35%	4.7	8.4	1.2	3.3	-22.9	4501
PAG PPG diol, 39%	8.3	5.3	1.7	-6.4	-36.2	4501
POE branched acid, 47%	8.0	4.0	1.7	-0.9	-5.7	4501
POE mixed acid, 41%	7.6	3.2	1.7	-3.3	---	4501
R-142b at 100 °C (212 °F)						
AB, 50%	11.1	4.1	3.8	7.0	-13.3	4501
R-143a at 100 °C (212 °F)						
POE branched acid, 28%	5.4	0.8	0.8	-1.8	-3.8	4501
R-152a at 100 °C (212 °F)						
AB, 34%	8.4	383	3.4	-16.1	-13.3	4501
POE branched acid, 46%	7.7	2.5	2.4	-5.7	-3.8	4501

* The lubricants tested were:
- MO: naphthenic mineral oil (Witco Suniso(R) 3GS)
- AB: alkylbenzene (Shrieve Zerol(R) 150)
- PAG: polyalkylene glycol, modified polyol (AlliedSignal BRL-150)
  polykylene glycol, polypropylene glycol diol (Dow P425)
- POE: polyolester, pentaerythritol ester branched acid
  (Henkel Emery(R) 2927-A)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

polyolester, pentaerythritol ester mixed acid
(ICI Emkarate(TM) RL 22H)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

copolyester thermoplastic elastomer (TPE)

COMPATIBILITY SUMMARY			
elastomer	copolyester thermoplastic elastomer (TPE) DuPont Hytrel(R) 7246		see RDB#
composition	(in parts per hundred parts of elastomer) polyester TPE (Shore D hardness 55)	100	4501

The following table presents data after thermal aging in refrigerant-lubricant mixtures for 14 days at the temperatures indicated. The data include changes in weight, width, thickness, tensile strength, and hardness. Details of the tests are identified in the referenced source(s).

refrigerant (aging Temp) lubricant, % by weight	weight change (%)	width swell (%)	thick-ness swell (%)	tensile strength change (%)	Shore D hardness change (%)	
R-22 at 100 °C (212 °F)						
MO naphthenic, 33%	9.3	4.6	2.9	-4.5	-14.6	4501
R-32 at 100 °C (212 °F)						
POE branched acid, 22%	3.4	0.8	1.6	2.0	-3.3	4501
POE mixed acid, 23%	4.5	1.7	1.7	5.6	-3.3	4501
R-123 at 100 °C (212 °F)						
MO naphthenic, 50%	18.6	5.8	4.4	-3.3	---	4501
R-124 at 100 °C (212 °F)						
AB, 50%	10.5	3.3	2.6	-9.9	-11.4	4501
R-125 at 100 °C (212 °F)						
PAG PPG diol, 37%	4.6	1.3	1.6	10.7	0.0	4501
POE branched acid, 38%	2.8	-0.8	0.9	20.3	-9.8	4501
POE mixed acid, 36%	3.6	0.0	0.0	1.3	0.0	4501
R-134 at 100 °C (212 °F)						
POE branched acid, 67%	9.1	0.8	2.5	-5.8	-8.1	4501
R-134a at 100 °C (212 °F)						
PAG modified, 35%	2.9	4.7	1.3	-0.1	55.3	4501
PAG PPG diol, 39%	7.4	1.7	1.7	7.1	-6.5	4501
POE branched acid, 47%	5.3	1.1	1.7	7.0	-11.4	4501
POE mixed acid, 41%	5.0	3.9	1.7	-4.3	-17.9	4501
R-142b at 100 °C (212 °F)						
AB, 50%	7.1	4.5	2.6	3.2	-17.9	4501
R-143a at 100 °C (212 °F)						
POE branched acid, 28%	3.0	-0.4	0.9	3.7	-4.9	4501
R-152a at 100 °C (212 °F)						
AB, 34%	4.9	4.9	2.5	1.0	-6.5	4501
POE branched acid, 46%	5.4	-0.4	0.9	-5.1	-9.8	4501

* The lubricants tested were:
- MO: naphthenic mineral oil (Witco Suniso(R) 3GS)
- AB: alkylbenzene (Shrieve Zerol(R) 150)
- PAG: polyalkylene glycol, modified polyol (AlliedSignal BRL-150)
  polykylene glycol, polypropylene glycol diol (Dow P425)
- POE: polyolester, pentaerythritol ester branched acid
  (Henkel Emery(R) 2927-A)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

polyolester, pentaerythritol ester mixed acid
(ICI Emkarate(TM) RL 22H)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

polysulfide rubber

---------- COMPATIBILITY SUMMARY ----------

			see RDB#
elastomer	polysulfide rubber FA(TM)		
composition	(in parts per hundred parts of elastomer)		
	FA polysulfide rubber	100	
	zinc oxide	10	
	stearic acid	0.5	
	2,2'-benzothiazyl disulfide	0.4	
	diphenyl guanidine	0.1	
	2-mercapto imidazoline	0.1	4501

The following table presents data after thermal aging in refrigerant-lubricant mixtures for 14 days at the temperatures indicated. The data include changes in weight, width, thickness, tensile strength, and hardness. Details of the tests are identified in the referenced source(s).

refrigerant (aging Temp) lubricant, % by weight	weight change (%)	width swell (%)	thick-ness swell (%)	tensile strength change (%)	Shore A hardness change (%)	
R-22 at 100 °C (212 °F)						
MO naphthenic, 33%	-35.0	-13.4	-8.6	# -44.6	-8.9	4501
R-32 at 100 °C (212 °F)						
POE branched acid, 22%	-60.3	-31.9	-20.0	-99.0	36.0	4501
POE mixed acid, 23%	-67.7	---	---	-99.0	---	4501
R-123 at 100 °C (212 °F)						
MO naphthenic, 50%	-36.3	-18.5	-12.1	-45.9	22.5	4501
R-124 at 100 °C (212 °F)						
AB, 50%	-30.9	-9.9	-13.8	-29.4	22.5	4501
R-125 at 100 °C (212 °F)						
PAG PPG diol, 37%	-57.4	-24.3	-10.4	-99.0	33.7	4501
POE branched acid, 38%	-35.9	-16.6	-18.4	# -61.9	15.7	4501
POE mixed acid, 36%	-50.3	-17.9	-25.9	# -99.0	56.2	4501
R-134 at 100 °C (212 °F)						
POE branched acid, 67%	-25.3	-9.0	-5.8	# -54.5	31.5	4501
R-134a at 100 °C (212 °F)						
PAG modified, 35%	-52.5	-33.9	-29.6	# -99.0	2.2	4501
PAG PPG diol, 39%	-52.0	-39.1	-4.5	# -99.0	-9.0	4501
POE branched acid, 47%	-47.7	-27.7	-21.5	# -53.0	-9.0	4501
POE mixed acid, 41%	-43.9	-13.8	-23.3	-47.2	-31.5	4501
R-142b at 100 °C (212 °F)						
AB, 50%	-31.3	-15.4	-8.9	-50.9	11.2	4501
R-143a at 100 °C (212 °F)						
POE branched acid, 28%	-45.6	-26.0	-26.4	# -47.7	17.9	4501
R-152a at 100 °C (212 °F)						
AB, 34%	-17.1	-6.3	8.1	# -58.4	17.9	4501
POE branched acid, 46%	-46.1	-15.8	-21.5	# -64.3	44.9	4501

* The lubricants tested were:
  MO: naphthenic mineral oil (Witco Suniso(R) 3GS)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

AB: alkylbenzene (Shrieve Zerol(R) 150)
PAG: polyalkylene glycol, modified polyol (AlliedSignal BRL-150)
polykylene glycol, polypropylene glycol diol (Dow P425)
POE: polyolester, pentaerythritol ester branched acid
(Henkel Emery(R) 2927-A)
polyolester, pentaerythritol ester mixed acid
(ICI Emkarate(TM) RL 22H)

Tensile strength data not significant; specimen was highly swollen or deteriorated.

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

polysulfide rubber with carbon fill

---------- COMPATIBILITY SUMMARY ----------

			see RDB#
elastomer	polysulfide rubber with carbon fill		
	FA(TM)		
composition	(in parts per hundred parts of elastomer)		
	FA polysulfide rubber	100	
	zinc oxide	10	
	stearic acid	0.5	
	2,2'-benzothiazyl disulfide	0.4	
	diphenyl guanidine	0.1	
	2-mercapto imidazoline	0.1	
	N330 (IR B6) carbon black	60	4501

The following table presents data after thermal aging in refrigerant-lubricant mixtures for 14 days at the temperatures indicated. The data include changes in weight, width, thickness, tensile strength, and hardness. Details of the tests are identified in the referenced source(s).

refrigerant (aging Temp) lubricant, % by weight	weight change (%)	width swell (%)	thick-ness swell (%)	tensile strength change (%)	Shore A hardness change (%)	
R-22 at 100 °C (212 °F)						
MO naphthenic, 33%	-20.4	-6.0	-8.9	-77.6	14.4	4501
R-32 at 100 °C (212 °F)						
POE branched acid, 22%	-24.0	-8.8	-4.4	-59.8	---	4501
POE mixed acid, 23%	-23.9	-9.2	-6.0	-74.1	---	4501
R-123 at 100 °C (212 °F)						
MO naphthenic, 50%	-21.6	-6.2	-7.4	-87.0	19.6	4501
R-124 at 100 °C (212 °F)						
AB, 50%	-7.5	2.7	-4.4	-54.6	0.0	4501
R-125 at 100 °C (212 °F)						
PAG PPG diol, 37%	-15.9	-5.5	-2.9	-48.3	10.5	4501
POE branched acid, 38%	-19.0	-6.5	-9.5	-58.7	6.5	4501
POE mixed acid, 36%	-12.0	-4.6	-2.8	-47.9	14.4	4501
R-134 at 100 °C (212 °F)						
POE branched acid, 67%	-11.8	-3.3	-3.1	-42.6	0.1	4501
R-134a at 100 °C (212 °F)						
PAG modified, 35%	-15.2	-5.3	-5.3	-56.8	11.8	4501
PAG PPG diol, 39%	-18.7	-4.9	-4.4	-67.5	10.5	4501
POE branched acid, 47%	-21.9	-6.2	-9.5	-66.2	24.8	4501
POE mixed acid, 41%	-22.4	-6.8	-9.5	-81.1	19.6	4501
R-142b at 100 °C (212 °F)						
AB, 50%	-17.4	-6.2	-7.6	-60.9	18.3	4501
R-143a at 100 °C (212 °F)						
POE branched acid, 28%	-20.4	-6.5	-10.6	-60.4	---	4501
R-152a at 100 °C (212 °F)						
AB, 34%	-15.3	-4.3	-6.2	-54.1	15.7	4501
POE branched acid, 46%	-18.7	-5.3	-9.7	-57.5	19.6	4501

* The lubricants tested were:

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

MO: naphthenic mineral oil (Witco Suniso(R) 3GS)
AB: alkylbenzene (Shrieve Zerol(R) 150)
PAG: polyalkylene glycol, modified polyol (AlliedSignal BRL-150)
polykylene glycol, polypropylene glycol diol (Dow P425)
POE: polyolester, pentaerythritol ester branched acid
(Henkel Emery(R) 2927-A)
polyolester, pentaerythritol ester mixed acid
(ICI Emkarate(TM) RL 22H)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

polysulfide rubber

---------- COMPATIBILITY SUMMARY ----------

			see RDB#
elastomer	polysulfide rubber		
	ST(TM)		
composition	(in parts per hundred parts of elastomer)		
	ST polysulfide rubber	100	
	zinc peroxide	5	
	stearic acid	1	
	calcium hydroxide	1	4501

The following table presents data after thermal aging in refrigerant-lubricant mixtures for 14 days at the temperatures indicated. The data include changes in weight, width, thickness, tensile strength, and hardness. Details of the tests are identified in the referenced source(s).

refrigerant (aging Temp) lubricant, % by weight	weight change (%)	width swell (%)	thick-ness swell (%)	tensile strength change (%)	Shore A hardness change (%)	
R-22 at 100 °C (212 °F)						
MO naphthenic, 33%	-8.5	0.6	-6.8	# -78.2	-33.8	4501
R-32 at 100 °C (212 °F)						
POE branched acid, 22%	-69.1	-34.6	-33.0	-60.9	101.5	4501
POE mixed acid, 23%	-71.5	-35.0	-28.9	-63.9	---	4501
R-123 at 100 °C (212 °F)						
MO naphthenic, 50%	-32.1	-14.1	-17.6	# -99.0	3.1	4501
R-124 at 100 °C (212 °F)						
AB, 50%	-34.8	-13.1	-14.8	-33.2	21.5	4501
R-125 at 100 °C (212 °F)						
PAG PPG diol, 37%	-36.6	-8.9	-5.5	# -63.7	30.8	4501
POE branched acid, 38%	-21.7	-10.3	-9.7	# -24.2	30.8	4501
POE mixed acid, 36%	-63.1	-30.0	-30.0	-35.6	117.0	4501
R-134 at 100 °C (212 °F)						
POE branched acid, 67%	-45.7	-19.9	-21.1	-21.6	40.0	4501
R-134a at 100 °C (212 °F)						
PAG modified, 35%	-27.3	-11.6	-11.0	# -26.0	40.0	4501
PAG PPG diol, 39%	-62.2	-30.7	-33.8	-49.5	83.1	4501
POE branched acid, 47%	-31.0	-11.9	-10.5	# -12.9	55.4	4501
POE mixed acid, 41%	-24.4	-12.5	-9.0	-4.6	24.6	4501
R-142b at 100 °C (212 °F)						
AB, 50%	-31.8	-12.6	-15.0	# -51.6	18.5	4501
R-143a at 100 °C (212 °F)						
POE branched acid, 28%	-57.2	-28.1	-28.5	-27.0	64.6	4501
R-152a at 100 °C (212 °F)						
AB, 34%	-38.0	-13.1	-14.3	-28.6	30.8	4501
POE branched acid, 46%	-22.8	-6.6	-5.9	-10.3	24.6	4501

* The lubricants tested were:
  MO: naphthenic mineral oil (Witco Suniso(R) 3GS)
  AB: alkylbenzene (Shrieve Zerol(R) 150)
  PAG: polyalkylene glycol, modified polyol (AlliedSignal BRL-150)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

polykylene glycol, polypropylene glycol diol (Dow P425)
POE: polyolester, pentaerythritol ester branched acid
(Henkel Emery(R) 2927-A)
polyolester, pentaerythritol ester mixed acid
(ICI Emkarate(TM) RL 22H)
Tensile strength data not significant; specimen was highly swollen or deteriorated.

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

polyurethane

COMPATIBILITY SUMMARY

elastomer	polyurethane		see
PUR	Airthane(TM) PET-60D		RDB#
composition	(in parts per hundred parts of elastomer)		
	ether based polyurethane (Shore D 50)	100	
	moca, 95% stoichiometry	25.9	4501

The following table presents data after thermal aging in refrigerant-lubricant mixtures for 14 days at the temperatures indicated. The data include changes in weight, width, thickness, tensile strength, and hardness. Details of the tests are identified in the referenced source(s).

refrigerant (aging Temp) lubricant, % by weight	weight change (%)	width swell (%)	thick-ness swell (%)	tensile strength change (%)	Shore D hardness change (%)	
R-22 at 100 °C (212 °F)						
MO naphthenic, 33%	28.4	8.4	10.6	-55.7	-45.2	4501
R-32 at 100 °C (212 °F)						
POE branched acid, 22%	12.8	7.4	5.3	-46.5	-15.1	4501
POE mixed acid, 23%	14.2	6.8	5.5	-38.7	-34.4	4501
R-123 at 100 °C (212 °F)						
MO naphthenic, 50%	62.3	16.7	17.0	-66.5	-45.2	4501
R-124 at 100 °C (212 °F)						
AB, 50%	32.9	12.1	10.4	-57.1	-40.9	4501
R-125 at 100 °C (212 °F)						
PAG PPG diol, 37%	---	---	---	# ---	---	4501
POE branched acid, 38%	10.7	2.6	4.0	-26.6	-12.9	4501
POE mixed acid, 36%	12.7	3.0	5.4	-25.7	-10.8	4501
R-134 at 100 °C (212 °F)						
POE branched acid, 67%	19.1	6.6	6.6	-42.9	-32.3	4501
R-134a at 100 °C (212 °F)						
PAG modified, 35%	7.7	6.5	1.8	-8.9	6.5	4501
PAG PPG diol, 39%	40.0	12.9	13.5	-90.8	-68.8	4501
POE branched acid, 47%	14.0	5.2	5.0	-34.4	-28.0	4501
POE mixed acid, 41%	14.8	6.6	4.7	-34.9	-45.2	4501
R-142b at 100 °C (212 °F)						
AB, 50%	21.2	6.5	7.7	-36.1	-43.0	4501
R-143a at 100 °C (212 °F)						
POE branched acid, 28%	12.3	3.3	5.0	-27.3	-19.4	4501
R-152a at 100 °C (212 °F)						
AB, 34%	16.6	4.9	8.1	-53.8	-40.9	4501
POE branched acid, 46%	14.7	3.0	5.8	-43.0	-34.4	4501

* The lubricants tested were:
  MO: naphthenic mineral oil (Witco Suniso(R) 3GS)
  AB: alkylbenzene (Shrieve Zerol(R) 150)
  PAG: polyalkylene glycol, modified polyol (AlliedSignal BRL-150)
  polykylene glycol, polypropylene glycol diol (Dow P425)
  POE: polyolester, pentaerythritol ester branched acid

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

(Henkel Emery(R) 2927-A)
polyolester, pentaerythritol ester mixed acid
(ICI Emkarate(TM) RL 22H)
Tensile strength data not significant; specimen was highly swollen or deteriorated.

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

polyurethane

---------- COMPATIBILITY SUMMARY ----------

			see RDB#
elastomer	polyurethane		
PUR	Cyanaprene(TM) D-55		
composition	(in parts per hundred parts of elastomer)		
	ester based polyurethane (Shore D 50)	100	
	moca, 95% stoichiometry	19.8	4501

The following table presents data after thermal aging in refrigerant-lubricant mixtures for 14 days at the temperatures indicated. The data include changes in weight, width, thickness, tensile strength, and hardness. Details of the tests are identified in the referenced source(s).

refrigerant (aging Temp) lubricant, % by weight	weight change (%)	width swell (%)	thick-ness swell (%)	tensile strength change (%)	Shore D hardness change (%)	
R-22 at 100 °C (212 °F)						
MO naphthenic, 33%	13.7	2.0	4.2	-84.4	-42.9	4501
R-32 at 100 °C (212 °F)						
POE branched acid, 22%	1.6	0.7	0.0	-82.9	-16.8	4501
POE mixed acid, 23%	1.3	-0.4	0.0	-78.8	-14.9	4501
R-123 at 100 °C (212 °F)						
MO naphthenic, 50%	26.9	10.0	8.5	-14.9	-28.0	4501
R-124 at 100 °C (212 °F)						
AB, 50%	15.2	6.7	5.4	-51.2	-20.6	4501
R-125 at 100 °C (212 °F)						
PAG PPG diol, 37%	10.4	4.3	4.3	-84.7	-28.0	4501
POE branched acid, 38%	1.9	1.4	0.6	-49.3	-5.6	4501
POE mixed acid, 36%	2.1	0.7	0.6	-43.3	1.9	4501
R-134 at 100 °C (212 °F)						
POE branched acid, 67%	17.8	4.9	6.8	-70.8	-16.8	4501
R-134a at 100 °C (212 °F)						
PAG modified, 35%	7.1	3.7	2.1	10.6	-16.8	4501
PAG PPG diol, 39%	13.4	8.0	5.8	-74.0	-33.6	4501
POE branched acid, 47%	8.0	3.0	3.1	-23.8	-14.9	4501
POE mixed acid, 41%	4.1	1.7	1.9	-65.3	-29.9	4501
R-142b at 100 °C (212 °F)						
AB, 50%	8.3	3.0	4.3	-32.2	-23.0	4501
R-143a at 100 °C (212 °F)						
POE branched acid, 28%	1.0	0.4	0.0	-65.6	-1.9	4501
R-152a at 100 °C (212 °F)						
AB, 34%	7.4	4.3	2.7	-39.4	-24.3	4501
POE branched acid, 46%	7.4	2.3	3.1	-51.9	-22.4	4501

* The lubricants tested were:
  MO: naphthenic mineral oil (Witco Suniso(R) 3GS)
  AB: alkylbenzene (Shrieve Zerol(R) 150)
  PAG: polyalkylene glycol, modified polyol (AlliedSignal BRL-150)
  polykylene glycol, polypropylene glycol diol (Dow P425)
  POE: polyolester, pentaerythritol ester branched acid

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

(Henkel Emery(R) 2927-A)
polyolester, pentaerythritol ester mixed acid
(ICI Emkarate(TM) RL 22H)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

polyurethane with carbon fill

COMPATIBILITY SUMMARY			
elastomer	polyurethane with carbon fill		see
PUR	Millathane(TM) 76		RDB#
composition	(in parts per hundred parts of elastomer)		
	millable-ester based polyurethane	100	
	benzothiazyl disulfide	1.0	
	2-mercaptobenzothiazole	0.5	
	zinc chloride / benzothiazyl disulfide complex	1.0	
	sulfur	1.5	
	N330 carbon black	40	4501

The following table presents data after thermal aging in refrigerant-lubricant mixtures for 14 days at the temperatures indicated. The data include changes in weight, width, thickness, tensile strength, and hardness. Details of the tests are identified in the referenced source(s).

refrigerant (aging Temp) lubricant, % by weight	weight change (%)	width swell (%)	thick-ness swell (%)	tensile strength change (%)	Shore A hardness change (%)	
R-22 at 100 °C (212 °F)						
MO naphthenic, 33%	9.8	6.0	3.4	-14.3	1.3	4501
R-32 at 100 °C (212 °F)						
POE branched acid, 22%	5.1	1.3	2.5	-34.6	0.0	4501
POE mixed acid, 23%	8.1	3.6	2.3	-29.4	-9.4	4501
R-123 at 100 °C (212 °F)						
MO naphthenic, 50%	41.6	9.3	10.2	-57.1	-21.5	4501
R-124 at 100 °C (212 °F)						
AB, 50%	62.9	24.0	17.2	-37.5	-18.8	4501
R-125 at 100 °C (212 °F)						
PAG PPG diol, 37%	18.2	6.2	5.0	-64.5	-32.2	4501
POE branched acid, 38%	2.9	3.3	-0.6	-17.2	8.1	4501
POE mixed acid, 36%	3.1	2.3	1.9	-26.9	6.7	4501
R-134 at 100 °C (212 °F)						
POE branched acid, 67%	24.1	5.9	6.2	-26.9	-6.7	4501
R-134a at 100 °C (212 °F)						
PAG modified, 35%	2.6	3.6	0.7	-14.9	-9.4	4501
PAG PPG diol, 39%	14.9	2.0	1.6	-90.3	-36.2	4501
POE branched acid, 47%	6.9	3.6	2.6	-27.2	0.0	4501
POE mixed acid, 41%	7.8	4.9	2.0	-29.0	0.0	4501
R-142b at 100 °C (212 °F)						
AB, 50%	8.2	1.9	2.6	-16.6	-10.7	4501
R-143a at 100 °C (212 °F)						
POE branched acid, 28%	2.6	0.0	1.3	-26.0	6.7	4501
R-152a at 100 °C (212 °F)						
AB, 34%	---	---	---	# -99.0	-85.9	4501
POE branched acid, 46%	9.3	4.0	2.6	-21.3	-5.4	4501

* The lubricants tested were:
MO: naphthenic mineral oil (Witco Suniso(R) 3GS)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

AB: alkylbenzene (Shrieve Zerol(R) 150)
PAG: polyalkylene glycol, modified polyol (AlliedSignal BRL-150)
polykylene glycol, polypropylene glycol diol (Dow P425)
POE: polyolester, pentaerythritol ester branched acid
(Henkel Emery(R) 2927-A)
polyolester, pentaerythritol ester mixed acid
(ICI Emkarate(TM) RL 22H)

Tensile strength data not significant; specimen was highly swollen or deteriorated.

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

ethylene propylene rubber with carbon fill

COMPATIBILITY SUMMARY

			see RDB#
elastomer	ethylene propylene rubber with carbon fill		
EPM	Vistalon(TM) 707		
composition	(in parts per hundred parts of elastomer)		
	ethylene propylene monomer	100	
	dicumyl peroxide	3.0	
	N330 carbon black	40	4501

The following table presents data after thermal aging in refrigerant-lubricant mixtures for 14 days at the temperatures indicated. The data include changes in weight, width, thickness, tensile strength, and hardness. Details of the tests are identified in the referenced source(s).

refrigerant (aging Temp) lubricant, % by weight	weight change (%)	width swell (%)	thick-ness swell (%)	tensile strength change (%)	Shore A hardness change (%)	
R-22 at 100 °C (212 °F)						
MO naphthenic, 33%	184	43.3	47.3	# -68.1	-61.8	4501
R-32 at 100 °C (212 °F)						
POE branched acid, 22%	8.3	1.4	3.9	14.3	-7.3	4501
POE mixed acid, 23%	8.6	3.0	3.8	12.3	-13.3	4501
R-123 at 100 °C (212 °F)						
MO naphthenic, 50%	257	26.2	52.9	-60.1	-55.8	4501
R-124 at 100 °C (212 °F)						
AB, 50%	118	26.5	36.6	-36.1	-50.9	4501
R-125 at 100 °C (212 °F)						
PAG PPG diol, 37%	2.8	0.4	1.2	-11.8	-2.4	4501
POE branched acid, 38%	11.1	-0.3	5.6	-7.2	-6.1	4501
POE mixed acid, 36%	10.3	1.4	5.4	-12.5	-8.5	4501
R-134 at 100 °C (212 °F)						
POE branched acid, 67%	5.2	0.0	8.5	-3.8	-6.1	4501
R-134a at 100 °C (212 °F)						
PAG modified, 35%	2.1	-1.0	1.1	-3.8	-33.9	4501
PAG PPG diol, 39%	5.1	0.3	2.0	8.8	-2.4	4501
POE branched acid, 47%	7.8	1.0	4.6	-6.8	-12.1	4501
POE mixed acid, 41%	9.4	-0.4	17.5	-0.9	-9.7	4501
R-142b at 100 °C (212 °F)						
AB, 50%	132	19.7	36.0	# -49.8	-46.1	4501
R-143a at 100 °C (212 °F)						
POE branched acid, 28%	11.8	1.1	5.8	-13.7	-8.5	4501
R-152a at 100 °C (212 °F)						
AB, 34%	122	16.9	36.7	-50.9	-48.5	4501
POE branched acid, 46%	8.8	-0.4	5.3	-17.7	-8.5	4501

* The lubricants tested were:
MO: naphthenic mineral oil (Witco Suniso(R) 3GS)
AB: alkylbenzene (Shrieve Zerol(R) 150)
PAG: polyalkylene glycol, modified polyol (AlliedSignal BRL-150)
polykylene glycol, polypropylene glycol diol (Dow P425)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

POE: polyolester, pentaerythritol ester branched acid
(Henkel Emery(R) 2927-A)
polyolester, pentaerythritol ester mixed acid
(ICI Emkarate(TM) RL 22H)

Tensile strength data not significant; specimen was highly swollen or deteriorated.

EE DATA LIMITATIONS AND NOTES ON PAGE 2

chlorinated polyethylene with carbon fill

COMPATIBILITY SUMMARY			see RDB#
elastomer	chlorinated polyethylene with carbon fill		
CPE	Dow CM0136(TM)		
composition	(in parts per hundred parts of elastomer)		
	chlorinated polyethylene, 35% chlorine	100	
	magnesium dioxide	10	
	triallyl isocyanurate	2	
	dicumyl peroxide on clay	4.0	
	N330 carbon black	40	4501

The following table presents data after thermal aging in refrigerant-lubricant mixtures for 14 days at the temperatures indicated. The data include changes in weight, width, thickness, tensile strength, and hardness. Details of the tests are identified in the referenced source(s).

refrigerant (aging Temp) lubricant, % by weight	weight change (%)	width swell (%)	thick-ness swell (%)	tensile strength change (%)	Shore A hardness change (%)	
R-22 at 100 °C (212 °F)						
MO naphthenic, 33%	35.2	14.1	17.1	-34.5	-20.1	4501
R-32 at 100 °C (212 °F)						
POE branched acid, 22%	25.7	7.4	12.3	-32.4	-14.2	4501
POE mixed acid, 23%	31.7	11.7	15.1	-33.1	-16.6	4501
R-123 at 100 °C (212 °F)						
MO naphthenic, 50%	50.8	13.2	18.5	-41.8	-29.6	4501
R-124 at 100 °C (212 °F)						
AB, 50%	22.7	8.1	10.2	-27.1	-16.6	4501
R-125 at 100 °C (212 °F)						
PAG PPG diol, 37%	7.4	1.9	3.8	-11.8	-29.6	4501
POE branched acid, 38%	18.8	4.8	8.3	-32.4	-14.2	4501
POE mixed acid, 36%	23.0	7.2	11.6	-30.3	-9.5	4501
R-134 at 100 °C (212 °F)						
POE branched acid, 67%	11.3	2.0	4.5	-15.2	-16.6	4501
R-134a at 100 °C (212 °F)						
PAG modified, 35%	3.8	0.0	1.4	-17.1	-11.8	4501
PAG PPG diol, 39%	6.5	0.4	4.4	-11.5	-10.7	4501
POE branched acid, 47%	13.8	3.2	5.9	-18.8	-23.7	4501
POE mixed acid, 41%	20.2	7.5	8.8	-21.7	-23.7	4501
R-142b at 100 °C (212 °F)						
AB, 50%	24.9	8.1	10.8	-33.7	-16.6	4501
R-143a at 100 °C (212 °F)						
POE branched acid, 28%	19.5	7.1	10.4	-24.2	-10.7	4501
R-152a at 100 °C (212 °F)						
AB, 34%	24.6	9.7	13.2	-29.3	-17.8	4501
POE branched acid, 46%	18.5	4.5	9.9	-29.0	-23.7	4501

* The lubricants tested were:
MO: naphthenic mineral oil (Witco Suniso(R) 3GS)
AB: alkylbenzene (Shrieve Zerol(R) 150)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

PAG: polyalkylene glycol, modified polyol (AlliedSignal BRL-150)
polykylene glycol, polypropylene glycol diol (Dow P425)
POE: polyolester, pentaerythritol ester branched acid
(Henkel Emery(R) 2927-A)
polyolester, pentaerythritol ester mixed acid
(ICI Emkarate(TM) RL 22H)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

ethylene propylene diene rubber with carbon fill

---------- COMPATIBILITY SUMMARY ----------

			see RDB#
elastomer	ethylene propylene diene rubber with carbon fill		
EPDM	Royalene(TM) 552		
composition	(in parts per hundred parts of elastomer)		
	ethylene propylene diene monomer	100	
	zinc oxide	5	
	sulfur	1.5	
	stearic acid	1	
	tetramethylthiuram disulfide	1	
	2-mercaptobenzothiazole	0.5	
	N330 carbon black	40	4501

The following table presents data after thermal aging in refrigerant-lubricant mixtures for 14 days at the temperatures indicated. The data include changes in weight, width, thickness, tensile strength, and hardness. Details of the tests are identified in the referenced source(s).

refrigerant (aging Temp) lubricant, % by weight	weight change (%)	width swell (%)	thick-ness swell (%)	tensile strength change (%)	Shore A hardness change (%)	
R-22 at 100 °C (212 °F)						
MO naphthenic, 33%	101	29.8	34.4	-81.7	-46.1	4501
R-32 at 100 °C (212 °F)						
POE branched acid, 22%	8.9	0.0	3.2	0.1	-2.4	4501
POE mixed acid, 23%	8.6	1.0	2.8	-2.7	-3.6	4501
R-123 at 100 °C (212 °F)						
MO naphthenic, 50%	175	31.4	38.8	-81.5	-40.0	4501
R-124 at 100 °C (212 °F)						
AB, 50%	76.5	23.6	22.1	-61.5	-32.7	4501
R-125 at 100 °C (212 °F)						
PAG PPG diol, 37%	3.0	-4.4	0.6	-27.2	2.4	4501
POE branched acid, 38%	7.9	0.0	2.4	-10.3	-4.8	4501
POE mixed acid, 36%	14.8	0.3	2.8	-11.4	-3.6	4501
R-134 at 100 °C (212 °F)						
POE branched acid, 67%	5.1	1.0	1.4	-18.0	-2.4	4501
R-134a at 100 °C (212 °F)						
PAG modified, 35%	2.0	-4.7	0.0	-23.6	-2.4	4501
PAG PPG diol, 39%	5.3	-1.6	1.6	-15.6	-8.5	4501
POE branched acid, 47%	5.8	-1.0	1.9	-5.8	-4.8	4501
POE mixed acid, 41%	7.6	-1.9	2.1	-18.6	-8.5	4501
R-142b at 100 °C (212 °F)						
AB, 50%	85.5	18.3	25.0	-65.6	-32.7	4501
R-143a at 100 °C (212 °F)						
POE branched acid, 28%	8.9	0.4	2.8	-7.8	-21.8	4501
R-152a at 100 °C (212 °F)						
AB, 34%	87.6	21.4	27.1	-69.2	-32.7	4501
POE branched acid, 46%	7.8	-0.3	0.6	-29.2	-4.8	4501

* The lubricants tested were:

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

MO: naphthenic mineral oil (Witco Suniso(R) 3GS)
AB: alkylbenzene (Shrieve Zerol(R) 150)
PAG: polyalkylene glycol, modified polyol (AlliedSignal BRL-150)
polykylene glycol, polypropylene glycol diol (Dow P425)
POE: polyolester, pentaerythritol ester branched acid
(Henkel Emery(R) 2927-A)
polyolester, pentaerythritol ester mixed acid
(ICI Emkarate(TM) RL 22H)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

ethylene propylene diene monomer/ butyl thermoplastic elastomer

---------- COMPATIBILITY SUMMARY ----------

			see RDB#
elastomer	ethylene propylene diene monomer / butyl thermoplastic elastomer Trefsin(TM)		
composition	(in parts per hundred parts of elastomer) EPDM/butyl TPE	100	4501

The following table presents data after thermal aging in refrigerant-lubricant mixtures for 14 days at the temperatures indicated. The data include changes in weight, width, thickness, tensile strength, and hardness. Details of the tests are identified in the referenced source(s).

refrigerant (aging Temp) lubricant, % by weight	weight change (%)	width swell (%)	thick-ness swell (%)	tensile strength change (%)	Shore A hardness change (%)	
R-22 at 100 °C (212 °F)						
MO naphthenic, 33%	135	24.0	32.7	# -79.0	-62.0	4501
R-32 at 100 °C (212 °F)						
POE branched acid, 22%	-6.5	-4.4	-5.9	-10.2	0.0	4501
POE mixed acid, 23%	-6.3	-6.9	-5.4	1.7	-6.2	4501
R-123 at 100 °C (212 °F)						
MO naphthenic, 50%	162	26.7	37.5	-67.8	-51.2	4501
R-124 at 100 °C (212 °F)						
AB, 50%	75.4	25.4	22.7	-57.2	-49.6	4501
R-125 at 100 °C (212 °F)						
PAG PPG diol, 37%	-15.0	-7.5	-9.7	13.3	12.4	4501
POE branched acid, 38%	-5.5	-8.0	-4.7	16.2	1.6	4501
POE mixed acid, 36%	-5.4	-4.4	-4.2	-15.9	-1.6	4501
R-134 at 100 °C (212 °F)						
POE branched acid, 67%	-15.1	-9.2	-11.1	4.6	7.8	4501
R-134a at 100 °C (212 °F)						
PAG modified, 35%	-17.7	-7.1	-10.9	27.3	12.4	4501
PAG PPG diol, 39%	-14.9	-3.9	-8.1	17.8	4.7	4501
POE branched acid, 47%	-12.2	-6.0	-9.0	2.8	-3.1	4501
POE mixed acid, 41%	-7.1	-3.8	-7.1	-12.0	-9.3	4501
R-142b at 100 °C (212 °F)						
AB, 50%	77.3	12.5	16.7	-74.3	-46.5	4501
R-143a at 100 °C (212 °F)						
POE branched acid, 28%	-5.1	-5.2	97.0	-3.5	1.6	4501
R-152a at 100 °C (212 °F)						
AB, 34%	74.7	23.7	22.8	-67.8	-43.4	4501
POE branched acid, 46%	-10.2	-6.0	-7.5	2.9	0.0	4501

* The lubricants tested were:
MO: naphthenic mineral oil (Witco Suniso(R) 3GS)
AB: alkylbenzene (Shrieve Zerol(R) 150)
PAG: polyalkylene glycol, modified polyol (AlliedSignal BRL-150)
polykylene glycol, polypropylene glycol diol (Dow P425)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

POE: polyolester, pentaerythritol ester branched acid
(Henkel Emery(R) 2927-A)
polyolester, pentaerythritol ester mixed acid
(ICI Emkarate(TM) RL 22H)

Tensile strength data not significant; specimen was highly swollen or deteriorated.

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

filled chloroprene

COMPATIBILITY SUMMARY			see RDB#
elastomer	filled chloroprene		
CR	Precision Rubber Products #2167		
composition	(in parts per hundred parts of elastomer)		
	chloroprene compound (35% by weight)	100	
	carbon black (45% by weight)	128.6	
	mineral (5% by weight)	14.3	
	extractables (15% by weight)	42.9	4501

The following table presents data after thermal aging in refrigerant-lubricant mixtures for 14 days at the temperatures indicated. The data include changes in weight, width, thickness, tensile strength, and hardness. Details of the tests are identified in the referenced source(s).

refrigerant (aging Temp) lubricant, % by weight	weight change (%)	width swell (%)	thick-ness swell (%)	tensile strength change (%)	Shore A hardness change (%)	
R-22 at 100 °C (212 °F)						
MO naphthenic, 33%	21.0	9.5	8.7	-16.2	-25.5	4501
R-32 at 100 °C (212 °F)						
POE branched acid, 22%	9.6	3.4	3.9	10.8	-6.7	4501
POE mixed acid, 23%	16.7	9.7	4.5	-2.5	-20.1	4501
R-123 at 100 °C (212 °F)						
MO naphthenic, 50%	30.9	16.4	11.1	-19.2	-25.5	4501
R-124 at 100 °C (212 °F)						
AB, 50%	7.2	9.6	3.6	6.6	-28.2	4501
R-125 at 100 °C (212 °F)						
PAG PPG diol, 37%	-1.6	-1.3	-1.3	-15.6	8.1	4501
POE branched acid, 38%	1.7	0.7	-5.1	-6.4	2.7	4501
POE mixed acid, 36%	7.1	2.3	3.9	0.8	-5.4	4501
R-134 at 100 °C (212 °F)						
POE branched acid, 67%	-4.5	-3.6	-3.5	1.5	13.4	4501
R-134a at 100 °C (212 °F)						
PAG modified, 35%	-5.8	-0.7	-4.0	-12.9	8.1	4501
PAG PPG diol, 39%	-2.6	-1.0	0.0	3.8	1.3	4501
POE branched acid, 47%	-2.6	-2.0	-2.6	-1.8	8.1	4501
POE mixed acid, 41%	2.6	1.0	1.3	-9.9	-1.3	4501
R-142b at 100 °C (212 °F)						
AB, 50%	7.7	2.0	2.6	-1.7	-5.4	4501
R-143a at 100 °C (212 °F)						
POE branched acid, 28%	6.1	1.3	2.5	-7.7	-4.0	4501
R-152a at 100 °C (212 °F)						
AB, 34%	9.9	4.0	4.6	-18.2	-12.1	4501
POE branched acid, 46%	0.5	0.0	0.0	3.1	1.3	4501

* The lubricants tested were:
MO: naphthenic mineral oil (Witco Suniso(R) 3GS)
AB: alkylbenzene (Shrieve Zerol(R) 150)
PAG: polyalkylene glycol, modified polyol (AlliedSignal BRL-150)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

polykylene glycol, polypropylene glycol diol (Dow P425)
POE: polyolester, pentaerythritol ester branched acid
(Henkel Emery(R) 2927-A)
polyolester, pentaerythritol ester mixed acid
(ICI Emkarate(TM) RL 22H)

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nitrile encapsulated nonasbestos material

COMPATIBILITY SUMMARY		see RDB#
elastomer	nitrile encapsulated nonasbestos material Specialty Paperboard NI-2085G	
composition	nitrile rubber nonasbestos inorganic filler blend cellulosic fiber (small proportion)	4501

The following table presents data after thermal aging in refrigerant-lubricant mixtures for 14 days at the temperatures indicated. The data include changes in weight, width, thickness, tensile strength, and hardness. Details of the tests are identified in the referenced source(s).

refrigerant (aging Temp) lubricant, % by weight	weight change (%)	width swell (%)	thick-ness swell (%)	tensile strength change (%)	Shore D hardness change (%)	
R-22 at 100 °C (212 °F)						
MO naphthenic, 33%	16.1	2.3	2.8	-22.9	2.2	4501
R-32 at 100 °C (212 °F)						
POE branched acid, 22%	23.2	1.0	8.3	-30.8	8.8	4501
POE mixed acid, 23%	23.0	0.0	6.7	-34.9	-2.2	4501
R-123 at 100 °C (212 °F)						
MO naphthenic, 50%	28.2	3.0	11.7	-32.6	-2.2	4501
R-124 at 100 °C (212 °F)						
AB, 50%	25.8	3.8	8.0	-45.2	0.0	4501
R-125 at 100 °C (212 °F)						
PAG PPG diol, 37%	25.9	0.4	5.7	-69.8	8.8	4501
POE branched acid, 38%	30.1	1.0	3.1	-32.6	0.0	4501
POE mixed acid, 36%	22.5	-1.3	4.1	-46.6	-6.6	4501
R-134 at 100 °C (212 °F)						
POE branched acid, 67%	26.9	0.0	4.8	-38.0	8.8	4501
R-134a at 100 °C (212 °F)						
PAG modified, 35%	28.4	-0.4	2.3	-57.6	-2.2	4501
PAG PPG diol, 39%	22.7	0.7	6.8	-59.7	0.0	4501
POE branched acid, 47%	24.8	0.4	5.6	-51.8	11.0	4501
POE mixed acid, 41%	32.9	1.7	5.5	-51.4	-8.8	4501
R-142b at 100 °C (212 °F)						
AB, 50%	24.4	0.0	1.5	-49.8	6.6	4501
R-143a at 100 °C (212 °F)						
POE branched acid, 28%	25.1	0.4	4.0	-39.2	6.6	4501
R-152a at 100 °C (212 °F)						
AB, 34%	15.7	-0.4	0.9	-11.2	13.2	4501
POE branched acid, 46%	30.2	1.3	5.5	-45.7	0.0	4501

* The lubricants tested were:
- MO: naphthenic mineral oil (Witco Suniso(R) 3GS)
- AB: alkylbenzene (Shrieve Zerol(R) 150)
- PAG: polyalkylene glycol, modified polyol (AlliedSignal BRL-150)
  polykylene glycol, polypropylene glycol diol (Dow P425)
- POE: polyolester, pentaerythritol ester branched acid

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(Henkel Emery(R) 2927-A)
polyolester, pentaerythritol ester mixed acid
(ICI Emkarate(TM) RL 22H)

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neoprene

---------- COMPATIBILITY SUMMARY ----------

			see RDB#
elastomer	neoprene		
	Greene, Tweed and Company 956		
composition	(in parts per hundred parts of elastomer)		
	neoprene	100	4501

The following table presents data after thermal aging in refrigerant-lubricant mixtures for 14 days at the temperatures indicated. The data include changes in weight, width, thickness, tensile strength, and hardness. Details of the tests are identified in the referenced source(s).

refrigerant (aging Temp) lubricant, % by weight	weight change (%)	width swell (%)	thick-ness swell (%)	tensile strength change (%)	Shore A hardness change (%)	
R-22 at 100 °C (212 °F)						
MO naphthenic, 33%	4.1	4.2	1.1	2.0	-8.4	4501
R-32 at 100 °C (212 °F)						
POE branched acid, 22%	17.3	8.5	7.5	3.0	-9.6	4501
POE mixed acid, 23%	27.4	11.6	10.2	-14.4	-22.8	4501
R-123 at 100 °C (212 °F)						
MO naphthenic, 50%	9.5	1.9	2.1	0.8	-6.0	4501
R-124 at 100 °C (212 °F)						
AB, 50%	2.5	-1.0	0.8	8.2	-16.8	4501
R-125 at 100 °C (212 °F)						
PAG PPG diol, 37%	8.0	2.6	2.1	-0.6	-9.6	4501
POE branched acid, 38%	9.7	6.2	2.7	14.3	-9.6	4501
POE mixed acid, 36%	12.0	5.2	4.8	0.7	-10.8	4501
R-134 at 100 °C (212 °F)						
POE branched acid, 67%	4.6	1.3	1.4	-6.4	-3.6	4501
R-134a at 100 °C (212 °F)						
PAG modified, 35%	1.4	2.0	0.0	-0.0	1.2	4501
PAG PPG diol, 39%	9.1	3.6	2.7	6.4	-12.0	4501
POE branched acid, 47%	5.5	4.0	2.3	-1.5	-10.8	4501
POE mixed acid, 41%	11.7	6.5	3.4	-2.4	-12.0	4501
R-142b at 100 °C (212 °F)						
AB, 50%	3.7	0.4	-37.7	-10.6	-6.0	4501
R-143a at 100 °C (212 °F)						
POE branched acid, 28%	13.7	4.9	4.1	-5.1	---	4501
R-152a at 100 °C (212 °F)						
AB, 34%	1.5	-1.6	0.4	-1.5	-2.4	4501
POE branched acid, 46%	14.0	0.7	5.4	-15.5	-15.6	4501

* The lubricants tested were:
- MO: naphthenic mineral oil (Witco Suniso(R) 3GS)
- AB: alkylbenzene (Shrieve Zerol(R) 150)
- PAG: polyalkylene glycol, modified polyol (AlliedSignal BRL-150)
  polykylene glycol, polypropylene glycol diol (Dow P425)
- POE: polyolester, pentaerythritol ester branched acid (Henkel Emery(R) 2927-A)

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polyolester, pentaerythritol ester mixed acid
(ICI Emkarate(TM) RL 22H)

SEE DATA LIMITATIONS AND NOTES ON PAGE 2

Compatibility - Plastics

R. C. Cavestri (Imagination Resources, Incorporated, IRI), **Compatibility of Refrigerants and Lubricants with Engineering Plastics,** report DOE/CE/23810-15, Air-Conditioning and Refrigeration Technology Institute (ARTI), Arlington, VA, September 1993 with December 1993 revisions (182 pages with 7 figures and 106 tables, available from JMC as RDB4103; type on page 74 is small and may be difficult to read)

This report provides extensive compatibility information on 23 engineering plastics with 10 refrigerants, 7 lubricants, and 17 refrigerant-lubricant combinations. An introduction notes the complexities of both materials selection and application-specific influences, such as changes in environmental conditions and residual molding stresses. A narrative outlines the experimental methods used, including modifications to standard test procedures. Six figures depict the apparatus used in the different tests. The report then presents significant findings. 23 summaries provide generic and trade names for the plastics, the molecular structure if published, a description, and tabular findings for total acid number (TAN), tensile change, and elongation change. The report concludes that the refrigerants and lubricants seemed to have no dramatic effects on most of the plastics tested. Most absorbed some refrigerant and lubricant, which softened the plastics slightly. The most prominent observation was a decrease in tensile strength and elongation due to heating alone. Had this effect not been observed by control tests with air, the study would have concluded that all of the plastics tested were incompatible. In fact, only three (acrylonitrile-butadiene-styrene terpolymer, polyphenylene oxide, and polycarbonate) were affected severely enough to be considered incompatible with HFC refrigerants and lubricants. The report also notes that the analyses would have been clearer with prior annealing and dehydration; special attention is suggested for PET and PBT. Finally, the report notes that some form of extractable component can be obtained whenever any plastic is used with polar refrigerants and lubricants. The plastics included polyphthalamide (Amoco Amodel® AD-1000 HS), acrylonitrile-butadiene-styrene terpolymer (ABS, GE Cycolac® GPM 4700), acetal (DuPont Delrin® II 11500), phenolic (Hooker Durez®), polyvinylidene fluoride (Atochem Kynar® 720), polycarbonate (GE Lexan® 161), modified polyphenylene oxide (PPO, GE Noryl® 731), polypropylene (Himont Profax™ 6331 NW), polyarylsulfone (Amoco Radel®) A-200), polyethylene terephthalate (PET, DuPont Rynite® 530), polyphenylene sulfide (PPS, GE Supec™ G401), polytetrafluoroethylene (PTFE, DuPont Teflon®), high strength polyamide-imide (PAI, Amoco Torlon® 4203L), 12% graphite polyamide-imide (PAI, Amoco Torlon® 4301), polyetherimide (PEI, GE Ultem® 1000), modified polyetherimide (PEI, GE Ultem® CRS 5001), polyaryletherketone (PAEK, BASF Ultrapek®), polybutylene terephthalate (PBT, GE Valox® 325 PBT), polyimide-DF (PI-DF, DuPont Vespel® DF), polyimide-DF-ISO (PI-DF-ISO, DuPont Vespel® DF-ISO), poly(aryl ether ether ketone) (PEEK, ICI Victrex™ PEEK 450 G), liquid crystal polymer (LCP, Amoco Xydar® MG450), and polyamide nylon 6/6 (DuPont Zytel® 101). The refrigerants tested included R-22, R-32, R-123, R-124, R-125, R-134, R-134a, R-142b, R-143a, and R-152a. The lubricants included a mineral oil (MO, BV Associates R0-15); an alkylbenzene (AB, Shrieve Zerol® 150); three polyalkylene glycols (PAGs), namely polypropylene glycol butyl monoether (ICI Emkarox® VG32), polypropylene glycol diol (Dow P-425), and a modified polyglycol (AlliedSignal BRL-150); and two polyolesters (POEs), namely pentaerythritol ester mixed acid (ICI Emkarate™ RL 22H, formerly RL 244), and pentaerythritol ester branched acid (Henkel Emery® 2927-A). Appendices provide further details. The first two list the commercial names of the products tested and summarize the molding specifications and conditions for the plastics. The next comprises seven tables that summarize the changes for immersions in the individual lubricants at 60 and 100 °C (140 and 212 °F). Observations of particulates, cracking, craz-

ing, softening, and color change are presented. Quantitative data are provided for dimensional (length, width, and thickness) and weight changes. Ten tables then summarize corresponding changes following exposures to the refrigerants at room temperature and 60 °C (140 °F) for 14 days. 11 tables summarize the creep modulus of the plastics at 10-300 hours for immersions in air and the 10 refrigerants with POE branched acid. 36 tables summarize physical, tensile, and elongation changes following exposures to refrigerant-lubricant mixtures. The last three appendices document the TANs of thermally aged lubricants with and without plastics, tensile properties of plastics after lubricant immersions, and temperature and dehydrating effects on the plastics.

polyphthalamide (PPA)

---------- COMPATIBILITY SUMMARY ----------

plastic	polyphthalamide	see RDB#
PPA	Amoco Amodel(TM) AD-1000 HS	

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 (698 °F), is above its thermal decomposition temperature; this rules out most conventional injection molding techniques. Introduction of co-monomers lowers the melting point of polyamine 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 heat deflection temperature (HDT) at 1.8 MPa (264 psi) is 120 °C (240 °F). Polyphthalamide can be annealed in air up to 3 hours at 150 °C (302 °F). 4103

The following table presents the total acid number and changes in tensile strength and elongation, after thermal aging of specimens in refrigerants and/or lubricants. Details of the tests are identified in the referenced source(s).

refrigerant (aging temperature) lubricant, condition	total acid number (TAN)	tensile strength change (%)	elongation change (%)	
no refrigerant at 150 °C (302 °F)				
air (no lubricant)		37.4	-66.6	4103
polyolester branched-acid, ambient *	3.5	37.8	-65.9	4103
polyolester branched-acid, dehydrated +	0.3	-1.7	11.7	4103
R-22 at 150 °C (302 °F)				
mineral oil, ambient *		-22.1	-78.5	4103
R-32 at 150 °C (302 °F)				
polyolester branched-acid, ambient *		24.6	-70.4	4103
polyalkylene glycol, ambient *		29.5	-69.4	4103
R-123 at 125 °C (257 °F)				
mineral oil, ambient *		10.6	-57.4	4103
R-124 at 150 °C (302 °F)				
alkylbenzene, ambient *		30.4	-65.4	4103
R-125 at 150 °C (302 °F)				
polyalkylene glycol, ambient *		32.3	-65.4	4103
polyolester branched-acid, ambient *		30.5	-64.9	4103
R-134 at 150 °C (302 °F)				
polyolester branched-acid, ambient *		27.1	-63.4	4103
R-134a at 150 °C (302 °F)				
polyolester branched-acid, ambient *	1.6	32.0	-62.9	4103
polyolester mixed acid, ambient *		30.8	-60.4	4103
R-143a at 150 °C (302 °F)				
polyolester branched-acid, ambient *		29.5	-62.4	4103
average of tested refrigerants at 150 °C (302 °F)				

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mineral oil / alkylbenzene, ambient *	22.1	-63.0	4103
polyalkylene glycol, ambient *	28.6	-62.1	4103
polyolester branched-acid, ambient *	28.7	-64.8	4103

* The refrigerants tested were R-22, R-32, R-123, R-124, R-125, R-134, R-134a, R-142b, R-143a, and R-152a. The mineral oil (MO) and alkylbenzene (AB) were BV Associates R0-15 and Shrieve Zerol(R) 150, respectively. The polyalkylene glycol (PAG) was a polypropylene glycol butyl monoether (ICI Emkarox(R) VG32). The polyolesters (POEs) tested included two pentaerythritol esters, a branched acid (Henkel Emery(R) 2927-A) and a mixed acid (ICI Emkarate(TM) RL 22H). Tabular summary excludes anomalous values.

+ Changes are relative to ambient test bars.

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acrylonitrile-butadiene-styrene terpolymer (ABS)

---------- COMPATIBILITY SUMMARY ----------

plastic	acrylonitrile-butadiene-styrene terpolymer	see RDB#
ABS	General Electric Cycolac(TM) GPM 4700	

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 heat deflection temperature (HDT) at 1.8 MPa (264 psi) is 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. 4103

This plastic was not tested in refrigerant-lubricant combinations since it was found to be vulnerable to the action of refrigerants alone. It failed at 60 °C (140 °F) in R-32 and R-152a, and at both ambient temperature and 60 °C (140 °F) in R-22, R-123, R-124, and R-134. Refrigerant dissolved in the plastic and slowly released itself at ambient conditions, producing foams or rods from flat test specimens. 4103

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acetal [polyacetal] (POM)

---------- COMPATIBILITY SUMMARY ----------

plastic: acetal [polyacetal]
POM: DuPont Delrin(TM) II 11500

see RDB#

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 tested 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 heat deflection temperature (HDT) at 1.8 MPa (264 psi) is 130 °C (260 °F). 4103

The following table presents the total acid number and changes in tensile strength and elongation, after thermal aging of specimens in refrigerants and/or lubricants at 150 °C (302 °F). Details of the tests are identified in the referenced source(s).

refrigerant lubricant, condition	total acid number (TAN)	tensile strength change (%)	elongation change (%)	
no refrigerant ·····				
air (no lubricant)		-0.7	-35.5	4103
polyolester branched-acid, ambient *	0.8	5.1	-7.7	4103
polyolester branched-acid, dehydrated +	0.2	-3.2	1.9	4103
R-22 ·····				
mineral oil, ambient *		-54.7	-49.5	4103
R-134a ·····				
polyolester branched-acid, ambient *	0.2	1.3	3.7	4103
polyolester mixed acid, ambient *		1.15	13.24	4103
average of all tested refrigerants * ·····				
mineral oil / alkylbenzene, ambient *		-36.6	-31.6	4103
polyalkylene glycol, ambient *		-6.8	24.8	4103
polyolester branched-acid, ambient *		2.3	2.5	4103

* The refrigerants tested were R-22, R-32, R-123, R-124, R-125, R-134, R-134a, R-142b, R-143a, and R-152a. The mineral oil (MO) and alkylbenzene (AB) were BV Associates R0-15 and Shrieve Zerol(R) 150, respectively. The polyalkylene glycol (PAG) was a polypropylene glycol butyl monoether (ICI Emkarox(R) VG32). The polyolesters (POEs) tested included two pentaerythritol esters, a branched acid (Henkel Emery(R) 2927-A) and a mixed acid (ICI Emkarate(TM) RL 22H). Tabular summary excludes anomalous values.

+ Changes are relative to ambient test bars.

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phenolic

---------- COMPATIBILITY SUMMARY ----------

plastic: phenolic
Hooker Durez(TM)

see RDB#

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 multicomponent 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. Preheating is often necessary to soften or liquefy a resin preform (compression mold) or pellet (screw injection mold). The resin preform or pellet then is 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. Fillers and reinforcement materials may be added to prevent this; they 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, but post curing may be necessary for optimum refrigerant-lubricant compatibility. The rate and quantity of moisture absorption depend on the resin density and the filler. The heat deflection temperature (HDT) at 1.8 MPa (264 psi) is 185 °C (365 °F). 4103

The following table presents the total acid number and changes in tensile strength and elongation, after thermal aging of specimens in refrigerants and/or lubricants at 150 °C (302 °F). Details of the tests are identified in the referenced source(s).

refrigerant lubricant, condition	total acid number (TAN)	tensile strength change (%)	elongation change (%)	
no refrigerant				
air (no lubricant)		8.4	-24.8	4103
polyolester branched-acid, ambient *	19.9	5.0	-33.0	4103
polyolester branched-acid, dehydrated +	1.7	2.2	9.0	4103
R-22				
mineral oil, ambient *		-16.8	-5.5	4103
R-134a				
polyolester branched-acid, ambient *	21.3	23.0	-26.8	4103
polyolester mixed acid, ambient *		37.0	12.8	4103
average of all tested refrigerants *				
mineral oil / alkylbenzene, ambient *		-6.2	-4.6	4103
polyalkylene glycol, ambient *		3.2	-9.8	4103
polyolester branched-acid, ambient *		10.4	-28.7	4103

* The refrigerants tested were R-22, R-32, R-123, R-124, R-125, R-134, R-134a, R-142b, R-143a, and R-152a. The mineral oil (MO) and alkylbenzene (AB) were BV Associates R0-15 and Shrieve Zerol(R) 150, respectively. The polyalkylene glycol (PAG) was a polypropylene

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glycol butyl monoether (ICI Emkarox(R) VG32). The polyolesters (POEs) tested included two pentaerythritol esters, a branched acid (Henkel Emery(R) 2927-A) and a mixed acid (ICI Emkarate(TM) RL 22H). Tabular summary excludes anomalous values.
+ Changes are relative to ambient test bars, not to control.

Phenolic may require postcuring either to complete the cross linking reaction or to eliminate water of reaction. Variance found in tensile strength and elongation may be due to the possible presence of water in the test specimens used. 4103

polyvinylidene fluoride (PVDF)

---------- COMPATIBILITY SUMMARY ----------

plastic PVDF — polyvinylidene fluoride; Atochem Kynar(R) 720 — see RDB#

Polyvinylidene fluoride is a semi-crystalline, melt-processing, thermoplastic resin that can be injection molded. Polyvinylidene fluoride parts have superior mechanical properties can be used in load-bearing applications up to 150 °C (300 °F). Unlike other fluoroplastics, this material has a low affinity for moisture absorption. Its heat deflection temperature (HDT) at 1.8 MPa (264 psi) is 115 °C (239 °F). 4103

The following table presents the total acid number and changes in tensile strength and elongation, after thermal aging of specimens in refrigerants and/or lubricants at 150 °C (302 °F). Details of the tests are identified in the referenced source(s).

refrigerant lubricant, condition	total acid number (TAN)	tensile strength change (%)	elongation change (%)	
no refrigerant				
air (no lubricant)		9.4	-50.3	4103
polyolester branched-acid, ambient *	0.1	0.8	-28.1	4103
polyolester branched-acid, dehydrated +	0.2	-1.1	-2.1	4103
R-22				
mineral oil, ambient *		-4.2	-41.7	4103
R-134a				
polyolester branched-acid, ambient *	0.1	-8.1	-5.9	4103
polyolester mixed acid, ambient *		-11.2	-4.7	4103
average of all tested refrigerants *				
mineral oil / alkylbenzene, ambient *		-10.8	6.9	4103
polyalkylene glycol, ambient *		-10.5	-0.9	4103
polyolester branched-acid, ambient *		-11.4	14.4	4103

* The refrigerants tested were R-22, R-32, R-123, R-124, R-125, R-134, R-134a, R-142b, R-143a, and R-152a. The mineral oil (MO) and alkylbenzene (AB) were BV Associates R0-15 and Shrieve Zerol(R) 150, respectively. The polyalkylene glycol (PAG) was a polypropylene glycol butyl monoether (ICI Emkarox(R) VG32). The polyolesters (POEs) tested included two pentaerythritol esters, a branched acid (Henkel Emery(R) 2927-A) and a mixed acid (ICI Emkarate(TM) RL 22H). Tabular summary excludes anomalous values.

+ Changes are relative to ambient test bars, not to control.

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polycarbonate (PC)

---------- COMPATIBILITY SUMMARY ----------

plastic	polycarbonate	see RDB#
PC	General Electric Lexan(R) 161	

Polycarbonate polymer 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. They are tough enough to be used for gears and other mechanical parts when filled with glass fibers, up to 40% by weight. Polycarbonates are generally stable to water, mineral acids, and organic acids, but crazing and/or embrittlement can occur, under some conditions if a part is stressed. Under these conditions, the highest recommended operating temperature is 60 °C (140 °F). The heat deflection temperature (HDT) at 1.8 MPa (264 psi) is 132 °C (250 °F). 4103

Polycarbonate was not tested in refrigerant-lubricant combinations since it was found to be vulnerable to the action of refrigerants alone. It swelled (thickness change 21.2%) in the presence of R-22 and failed completely in the presence of R-123. 4103

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modified polyphenylene oxide (PPO)

---------- COMPATIBILITY SUMMARY ----------

plastic	modified polyphenylene oxide	see RDB#
PPO	General Electric Noryl(R) 731	

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 Tg 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 plastic is a general purpose unfilled resin, PPO is available in glass filled resins and modified high modulus forms. While the modified PPO tested does possess a higher impact strength, it suffers in tensile strength and lacks temperature resistance. Stress cracking sensitivity due to polystyrene inclusion also may occur. The heat deflection temperature (HDT) at 1.8 MPa (264 psi) is 127 °C (260 °F). 4103

Modified PPO was not tested in refrigerant-lubricant combinations since it was found to be vulnerable to the action of refrigerants alone. It swelled (thickness change 51.8%) when exposed to R-22 at 60 °C (140 °F) and failed completely in R-123 at both ambient temperature and 60 °C (140 °F). 4103

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polypropylene (PP)

---------- COMPATIBILITY SUMMARY ----------

plastic	polypropylene	see
PP	Himont Profax(TM) [Pro-Fax] 6331 NW	RDB#

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 heat deflection temperature (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). 4103

The following table presents the total acid number and changes in tensile strength and elongation, after thermal aging of specimens in refrigerants and/or lubricants at 150 °C (302 °F). Details of the tests are identified in the referenced source(s).

refrigerant lubricant, condition	total acid number (TAN)	tensile strength change (%)	elongation change (%)	
no refrigerant				
air (no lubricant)		8.0	-83.7	4103
polyolester branched-acid, ambient *	0.3	-11.7	-84.2	4103
polyolester branched-acid, dehydrated +	0.1	0.3	-8.0	4103
R-22				
mineral oil, ambient *		-9.9	11.1	4103
R-134a				
polyolester branched-acid, ambient *	0.1	-13.9	-16.2	4103
polyolester mixed acid, ambient *		-12.4	-13.2	4103
average of all tested refrigerants *				
mineral oil / alkylbenzene, ambient *		-13.4	-10.2	4103
polyalkylene glycol, ambient *		-10.6	-44.8	4103
polyolester branched-acid, ambient *		-7.3	-26.9	4103

* The refrigerants tested were R-22, R-32, R-123, R-124, R-125, R-134, R-134a, R-142b, R-143a, and R-152a. The mineral oil (MO) and alkylbenzene (AB) were BV Associates R0-15 and Shrieve Zerol(R) 150, respectively. The polyalkylene glycol (PAG) was a polypropylene glycol butyl monoether (ICI Emkarox(R) VG32). The polyolesters (POEs) tested included two pentaerythritol esters, a branched acid (Henkel Emery(R) 2927-A) and a mixed acid (ICI Emkarate(TM) RL 22H). Tabular summary excludes anomalous values.

\+ Changes are relative to ambient test bars, not to control.

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polyaryl sulfone [polyethersulphone] (PES)

---------- COMPATIBILITY SUMMARY ----------

plastic: PES — polyaryl sulfone [polyethersulphone]; Amoco Radel(R) A-200 — see RDB# 4103

Radel A-200 is 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 as a result of its polar matrix nature. The heat deflection temperature (HDT) at 1.8 MPa (264 psi) is 204 °C (400 °F). The addition of glass fiber fillers raises the heat deflection temperature (HDT) value only slightly. 4103

The following table presents the total acid number and changes in tensile strength and elongation, after thermal aging of specimens in refrigerants and/or lubricants at 150 °C (302 °F). Details of the tests are identified in the referenced source(s).

refrigerant lubricant, condition	total acid number (TAN)	tensile strength change (%)	elongation change (%)	
no refrigerant				
air (no lubricant)		12.1	-45.9	4103
polyolester branched-acid, ambient *	3.6	19.5	-39.7	4103
polyolester branched-acid, dehydrated +	0.8	3.1	25.6	4103
R-22				
mineral oil, ambient *		15.1	-64.1	4103
R-134a				
polyolester branched-acid, ambient *	0.7	-29.7	-34.4	4103
polyolester mixed acid, ambient *		-39.1	-58.2	4103
average of all tested refrigerants *				
mineral oil / alkylbenzene, ambient *		9.6	-48.7	4103
polyalkylene glycol, ambient *		15.1	-66.3	4103
polyolester branched-acid, ambient *		0.0	-44.2	4103

* The refrigerants tested were R-22, R-32, R-123, R-124, R-125, R-134, R-134a, R-142b, R-143a, and R-152a. The mineral oil (MO) and alkylbenzene (AB) were BV Associates R0-15 and Shrieve Zerol(R) 150, respectively. The polyalkylene glycol (PAG) was a polypropylene glycol butyl monoether (ICI Emkarox(R) VG32). The polyolesters (POEs) tested included two pentaerythritol esters, a branched acid (Henkel Emery(R) 2927-A) and a mixed acid (ICI Emkarate(TM) RL 22H). Tabular summary excludes anomalous values.

+ Changes are relative to ambient test bars, not to control.

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polyethylene terephthalate (PET)

---------- COMPATIBILITY SUMMARY ----------

plastic	polyethylene terephthalate	see RDB#
PET	DuPont Rynite(R) 530	

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 the reported heat deflection temperature (HDT) of annealed material at 1.8 MPa (264 psi) is 44 °C (110 °F), and can be as high as 200 °C (410 °F) for glass-filled materials, which take advantage of the crystalline nature of the product. Moldable PET's may be chosen due to low oligmer content and refrigerant extractables. 4103

The following table presents the total acid number and changes in tensile strength and elongation, after thermal aging of specimens in refrigerants and/or lubricants at 150 °C (302 °F). Details of the tests are identified in the referenced source(s).

refrigerant lubricant, condition	total acid number (TAN)	tensile strength change (%)	elongation change (%)	
no refrigerant				
air (no lubricant)		-9.5	-23.2	4103
polyolester branched-acid, ambient *	0.3	-44.0	-49.5	4103
polyolester branched-acid, dehydrated +	0.3	15.3	15.6	4103
R-22				
mineral oil, ambient *		-66.0	-36.9	4103
R-134a				
polyolester branched-acid, ambient *	0.2	-33.6	-32.2	4103
polyolester mixed acid, ambient *		-15.9	-2.2	4103
average of all tested refrigerants *				
mineral oil / alkylbenzene, ambient *		-39.9	-36.6	4103
polyalkylene glycol, ambient *		-45.4	-36.4	4103
polyolester branched-acid, ambient *		-14.4	-20.4	4103

* The refrigerants tested were R-22, R-32, R-123, R-124, R-125, R-134, R-134a, R-142b, R-143a, and R-152a. The mineral oil (MO) and alkylbenzene (AB) were BV Associates R0-15 and Shrieve Zerol(R) 150, respectively. The polyalkylene glycol (PAG) was a polypropylene glycol butyl monoether (ICI Emkarox(R) VG32). The polyolesters (POEs) tested included two pentaerythritol esters, a branched acid (Henkel Emery(R) 2927-A) and a mixed acid (ICI Emkarate(TM) RL 22H).

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Tabular summary excludes anomalous values.
+ Changes are 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 aging at elevated temperatures 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. Dehydrating PET before using it with polar lubricants may minimize the amount of extractables. In addition, using dehydrated PET in hermetic motors dries the motors, keeping the PET pliable and reducing the amount of water in the motor stacks. 4103

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polyphenylene sulfide (PPS)

---------- COMPATIBILITY SUMMARY ----------

plastic	polyphenylene sulfide	see RDB#
PPS	GE Supec(TM) G401	

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 (248 °F). Annealing occurs at about 204 °C (399 °F), although quenching results in approximately 5% crystallinity. Annealing unfilled PPS raises the heat deflection temperature (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 heat deflection temperature (HDT) at 1.8 MPa (264 psi) exceeds 260 °C (500 °F) 4103

The following table presents the total acid number and changes in tensile strength and elongation, after thermal aging of specimens in refrigerants and/or lubricants at 150 °C (302 °F). Details of the tests are identified in the referenced source(s).

refrigerant lubricant, condition	total acid number (TAN)	tensile strength change (%)	elongation change (%)	
no refrigerant				
air (no lubricant)		9.0	-14.2	4103
polyolester branched-acid, ambient *	0.1	4.6	-17.6	4103
polyolester branched-acid, dehydrated +	0.3	16.2	11.7	4103
R-22				
mineral oil, ambient *		17.1	26.9	4103
R-134a				
polyolester branched-acid, ambient *	0.1	14.8	-15.4	4103
polyolester mixed acid, ambient *		15.6	1.9	4103
average of all tested refrigerants *				
mineral oil / alkylbenzene, ambient *		11.8	-2.7	4103
polyalkylene glycol, ambient *		18.5	-3.8	4103
polyolester branched-acid, ambient *		15.8	9.6	4103

* The refrigerants tested were R-22, R-32, R-123, R-124, R-125, R-134, R-134a, R-142b, R-143a, and R-152a. The mineral oil (MO) and alkylbenzene (AB) were BV Associates R0-15 and Shrieve Zerol(R) 150, respectively. The polyalkylene glycol (PAG) was a polypropylene glycol butyl monoether (ICI Emkarox(R) VG32). The polyolesters (POEs) tested included two pentaerythritol esters, a branched acid (Henkel Emery(R) 2927-A) and a mixed acid (ICI Emkarate(TM) RL 22H).

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Tabular summary excludes anomalous values.
+ Changes are relative to ambient test bars, not to control.

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.

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polytetrafluoroethylene (PTFE)

---------- COMPATIBILITY SUMMARY ----------

plastic: polytetrafluoroethylene
PTFE: DuPont Teflon(R)

see RDB# ----

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 also may be formed into machinable billets or continuous extruded sheets. PTFE is a nonmelting polymer of low tensile strength, high cold flow, excellent chemical resistance, and high elongation. While the material is soft and self-lubricating, it generally is used with a mineral filler to improve lubrication properties even further. Parts can be cold formed from powder and then sintered. 4103

The following table presents the total acid number and changes in tensile strength and elongation, after thermal aging of specimens in refrigerants and/or lubricants at 150 °C (302 °F). Details of the tests are identified in the referenced source(s).

refrigerant lubricant, condition	total acid number (TAN)	tensile strength change (%)	elongation change (%)	
no refrigerant				
air (no lubricant)		10.8	-8.8	4103
polyolester branched-acid, ambient *	2.4	20.7	5.6	4103
polyolester branched-acid, dehydrated +	1.5	10.3	-13.6	4103
R-22				
mineral oil, ambient *		28.9	-3.5	4103
R-134a				
polyolester branched-acid, ambient *	0.1	83.0	1.8	4103
polyolester mixed acid, ambient *		6.2	-8.6	4103
average of all tested refrigerants *				
mineral oil / alkylbenzene, ambient *		-2.7	9.5	4103
polyalkylene glycol, ambient *		-5.1	-3.8	4103
polyolester branched-acid, ambient *		5.7	-20.2	4103

* The refrigerants tested were R-22, R-32, R-123, R-124, R-125, R-134, R-134a, R-142b, R-143a, and R-152a. The mineral oil (MO) and alkylbenzene (AB) were BV Associates R0-15 and Shrieve Zerol(R) 150, respectively. The polyalkylene glycol (PAG) was a polypropylene glycol butyl monoether (ICI Emkarox(R) VG32). The polyolesters (POEs) tested included two pentaerythritol esters, a branched acid (Henkel Emery(R) 2927-A) and a mixed acid (ICI Emkarate(TM) RL 22H). Tabular summary excludes anomalous values.

\+ Changes are relative to ambient test bars, not to control.

PTFE absorbs some water, as seen above, but remains very chemically resistant. Although some measurements appeared anomalous, the values may be accurate, since duplicate test bars reacted similarly. 4103

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polyamide-imide, high strength (PAI)

---------- COMPATIBILITY SUMMARY ----------

plastic PAI — polyamide-imide, high strength; Amoco Torlon(R) 4203L — see RDB#

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. This PAI must be thoroughly dried in a desiccant drier prior to injection molding. 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 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 strength 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 heat deflection temperature (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. 4103

The following table presents the total acid number and changes in tensile strength and elongation, after thermal aging of specimens in refrigerants and/or lubricants at 150 °C (302 °F). Details of the tests are identified in the referenced source(s).

refrigerant lubricant, condition	total acid number (TAN)	tensile strength change (%)	elongation change (%)	
no refrigerant				
air (no lubricant)		-44.6	13.5	4103
polyolester branched-acid, ambient *	9.5	1.8	8.3	4103
polyolester branched-acid, dehydrated +	0.3	15.1	18.7	4103
R-22				
mineral oil, ambient *		-41.9	30.1	4103
R-134a				
polyolester branched-acid, ambient *	0.1	-39.9	22.7	4103
polyolester mixed acid, ambient *		-41.9	23.8	4103
average of all tested refrigerants *				
mineral oil / alkylbenzene, ambient *		-11.8	14.7	4103
polyalkylene glycol, ambient *		-7.6	0.2	4103
polyolester branched-acid, ambient *		1.4	0.3	4103

* The refrigerants tested were R-22, R-32, R-123, R-124, R-125, R-134, R-134a, R-142b, R-143a, and R-152a. The mineral oil (MO) and alkylbenzene (AB) were BV Associates R0-15 and Shrieve Zerol(R) 150, respectively. The polyalkylene glycol (PAG) was a polypropylene glycol butyl monoether (ICI Emkarox(R) VG32). The polyolesters

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(POEs) tested included two pentaerythritol esters, a branched acid (Henkel Emery(R) 2927-A) and a mixed acid (ICI Emkarate(TM) RL 22H). Tabular summary excludes anomalous values.
+ Changes are 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. 4103

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polyamide-imide, 12% graphite (PAI)

---------- COMPATIBILITY SUMMARY ----------

plastic PAI — polyamide-imide, 12% graphite; Amoco Torlon(R) 4301 — see RDB# ----

This polyamide-imide (PAI), which contains 12% graphite and 3% fluorocarbon filler, is considered a wear-resistant grade of engineering plastic. It 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. This PAI must be thoroughly dried in a desiccant drier prior to injection molding. 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, while slightly increasing the heat deflection temperature (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. 4103

The following table presents the total acid number and changes in tensile strength and elongation, after thermal aging of specimens in refrigerants and/or lubricants at 150 °C (302 °F). Details of the tests are identified in the referenced source(s).

refrigerant lubricant, condition	total acid number (TAN)	tensile strength change (%)	elongation change (%)	
no refrigerant				
air (no lubricant)		-6.2.	-2.3	4103
polyolester branched-acid, ambient *	7.5	-14.8	-13.1	4103
polyolester branched-acid, dehydrated +	0.4	14.2	5.6	4103
R-22				
mineral oil, ambient *		-10.7	-8.2	4103
R-134a				
polyolester branched-acid, ambient *	2.6	-2.6	-9.2	4103
polyolester mixed acid, ambient *		-7.5	-7.2	4103
average of all tested refrigerants *				
mineral oil / alkylbenzene, ambient *		-3.4	-7.4	4103
polyalkylene glycol, ambient *		-4.0	-6.8	4103
polyolester branched-acid, ambient *		-3.5	-7.6	4103

* The refrigerants tested were R-22, R-32, R-123, R-124, R-125, R-134, R-134a, R-142b, R-143a, and R-152a. The mineral oil (MO) and alkylbenzene (AB) were BV Associates R0-15 and Shrieve Zerol(R) 150, respectively. The polyalkylene glycol (PAG) was a polypropylene glycol butyl monoether (ICI Emkarox(R) VG32). The polyolesters (POEs) tested included two pentaerythritol esters, a branched acid (Henkel Emery(R) 2927-A) and a mixed acid (ICI Emkarate(TM) RL 22H). Tabular summary excludes anomalous values.

+ Changes are relative to ambient test bars, not to control.

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polyetherimide (PEI)

---------- COMPATIBILITY SUMMARY ----------

plastic PEI — polyetherimide
General Electric Ultem(R) 1000 — see RDB# ----

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 specific PEI evaluated was unfilled, although filled grades (up to 40% glass) are available. The recognized Underwriter's Laboratories (UL) operational temperature is 170 °C (338 °F), and the reported heat deflection temperature (HDT) at 1.8 MPa (264 psi) is 200 °C (392 °F). Annealing at 200 °C (392 °F) for 4 hours is recommended to remove any residual stress — 4103

The following table presents the total acid number and changes in tensile strength and elongation, after thermal aging of specimens in refrigerants and/or lubricants at 150 °C (302 °F). Details of the tests are identified in the referenced source(s).

refrigerant lubricant, condition	total acid number (TAN)	tensile strength change (%)	elongation change (%)	
no refrigerant				
air (no lubricant)		11.3	-31.3	4103
polyolester branched-acid, ambient *	2.5	10.8	-75.8	4103
polyolester branched-acid, dehydrated +	0.2	-2.8	210.2	4103
R-22				
mineral oil, ambient *		1.3	7.1	4103
R-134a				
polyolester branched-acid, ambient *	3.1	3.3	-31.3	4103
polyolester mixed acid, ambient *		3.0	-38.2	4103
average of all tested refrigerants *				
mineral oil / alkylbenzene, ambient *		2.3	-16.6	4103
polyalkylene glycol, ambient *		4.8	18.2	4103
polyolester branched-acid, ambient *		4.4	-32.8	4103

* The refrigerants tested were R-22, R-32, R-123, R-124, R-125, R-134, R-134a, R-142b, R-143a, and R-152a. The mineral oil (MO) and alkylbenzene (AB) were BV Associates R0-15 and Shrieve Zerol(R) 150, respectively. The polyalkylene glycol (PAG) was a polypropylene glycol butyl monoether (ICI Emkarox(R) VG32). The polyolesters (POEs) tested included two pentaerythritol esters, a branched acid (Henkel Emery(R) 2927-A) and a mixed acid (ICI Emkarate(TM) RL 22H). Tabular summary excludes anomalous values.

+ Changes are relative to ambient test bars, not to control.

The overall impact of refrigerants and lubricants on this poylmer is minimal; temperature effects are more evident. The degradation of physical properties with temperature may simply occur in the annealing process. Had annealed test bars been used, the changes might have

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been less significant. 4103

modified polyetherimide (PEI)

---------- COMPATIBILITY SUMMARY ----------

plastic: PEI
modified polyetherimide
General Electric Ultem(R) CRS 5001
see RDB# ----

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 was unfilled. The reported heat deflection temperature (HDT) at 1.8 MPa (264 psi) is 209 °C (408 °F). Parts should be annealed at 200 °C (392 °F) for 4 hours to remove any residual stress. This modified PEI has lower moisture adsorption than the unmodified version. 4103

The following table presents the total acid number and changes in tensile strength and elongation, after thermal aging of specimens in refrigerants and/or lubricants at 150 °C (302 °F). Details of the tests are identified in the referenced source(s).

refrigerant lubricant, condition	total acid number (TAN)	tensile strength change (%)	elongation change (%)	
no refrigerant ·····				
air (no lubricant)		12.2	-11.5	4103
polyolester branched-acid, ambient *	1.3	13.0	-13.4	4103
polyolester branched-acid, dehydrated +	0.2	-0.4	-21.1	4103
R-22 ·····				
mineral oil, ambient *		6.5	2.0	4103
R-134a ·····				
polyolester branched-acid, ambient *	0.3	-10.3	7.8	4103
polyolester mixed acid, ambient *		18.6	43.6	4103
average of all tested refrigerants * ·····				
mineral oil / alkylbenzene, ambient *		9.2	-3.8	4103
polyalkylene glycol, ambient *		7.9	13.0	4103
polyolester branched-acid, ambient *		3.4	-5.5	4103

* The refrigerants tested were R-22, R-32, R-123, R-124, R-125, R-134, R-134a, R-142b, R-143a, and R-152a. The mineral oil (MO) and alkylbenzene (AB) were BV Associates R0-15 and Shrieve Zerol(R) 150, respectively. The polyalkylene glycol (PAG) was a polypropylene glycol butyl monoether (ICI Emkarox(R) VG32). The polyolesters (POEs) tested included two pentaerythritol esters, a branched acid (Henkel Emery(R) 2927-A) and a mixed acid (ICI Emkarate(TM) RL 22H). Tabular summary excludes anomalous values.

+ Changes are relative to ambient test bars, not to control.

The tensile and elongation properties of PEIs seem to be improved by polyalkylene glycols (PAGs); these polymers seem to be least affected by PAGs at elevated temperature. Modified polyetherimide seems to perform better overall, with the least loss in tensile strength and least embrittlement. This improvement illustrates the beneficial

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effects of lubricants and refrigerants on some polymers. 4103

polyaryletherketone (PAEK)

---------- COMPATIBILITY SUMMARY ----------

plastic	polyaryletherketone	see RDB#
PAEK	BASF Ultrapek(R)	

Poly(aryletherketone) (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 nonreinforced PAEK, which can be heated momentarily to just below the melting point, 381 °C (717 °F), without any significant change in mechanical properties. PAEK is available in three viscosity grades: low, medium, and high; the last of these has glass or carbon fiber reinforcements. Under standard moisture conditions of 50±6% relative humidity at 23 °C (73 °F), PAEK neat resin will absorb moisture up to 0.25% without degradation of physical properties. The reported heat deflection temperature (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 MPa (265 psi) is approximately 350 °C (662 °F). 4103

The following table presents the total acid number and changes in tensile strength and elongation, after thermal aging of specimens in refrigerants and/or lubricants at 150 °C (302 °F). Details of the tests are identified in the referenced source(s).

refrigerant lubricant, condition	total acid number (TAN)	tensile strength change (%)	elongation change (%)	
no refrigerant ·····				
air (no lubricant)		8.2	-48.2	4103
polyolester branched-acid, ambient *	0.3	10.0	-61.4	4103
polyolester branched-acid, dehydrated +	0.4	9.6	193.4	4103
R-22 ·····				
mineral oil, ambient *		8.7	4.3	4103
R-134a ·····				
polyolester branched-acid, ambient *	0.3	-15.5	-88.0	4103
polyolester mixed acid, ambient *		11.8	-0.4	4103
average of all tested refrigerants * ·····				
mineral oil / alkylbenzene, ambient *		7.8	-7.5	4103
polyalkylene glycol, ambient *		8.9	-14.3	4103
polyolester branched-acid, ambient *		9.5	-34.1	4103

* The refrigerants tested were R-22, R-32, R-123, R-124, R-125, R-134, R-134a, R-142b, R-143a, and R-152a. The mineral oil (MO) and alkylbenzene (AB) were BV Associates R0-15 and Shrieve Zerol(R) 150, respectively. The polyalkylene glycol (PAG) was a polypropylene glycol butyl monoether (ICI Emkarox(R) VG32). The polyolesters (POEs) tested included two pentaerythritol esters, a branched acid (Henkel Emery(R) 2927-A) and a mixed acid (ICI Emkarate(TM) RL 22H).

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Tabular summary excludes anomalous values.
+ Changes are relative to ambient test bars, not to control.

The softening of dehydrated PAEK by branched-acid polyol esters is unexplained. Since PAEK is semicrystalline, the softening may be caused by annealing the part before chemical exposure, rather than by chemical impact. 4103

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polybutylene terephthalate (PBT)

---------- COMPATIBILITY SUMMARY ----------

plastic	polybutylene terephthalate	see RDB#
PBT	General Electric Valox(R) 325 PBT	

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 terephthlate. 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. PBT is shear and hydrolytically unstable (chain cleaving) under injection molding conditions. 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 heat deflection temperature (HDT) at 1.8 MPa (264 psi) can be 54 °C (130 °F) for a neat resin with a low inherent viscosity and 121 °C (250 °F) for one with a higher viscosity. This indicates the importance of resin optimization. 4103

The following table presents the total acid number and changes in tensile strength and elongation, after thermal aging of specimens in refrigerants and/or lubricants at 150 °C (302 °F). Details of the tests are identified in the referenced source(s).

refrigerant lubricant, condition	total acid number (TAN)	tensile strength change (%)	elongation change (%)	
no refrigerant				
air (no lubricant)		26.9	-90.4	4103
polyolester branched-acid, ambient *	0.7	-22.4	-96.4	4103
polyolester branched-acid, dehydrated +	0.6	-2.8	0.0	4103
R-134a				
polyolester branched-acid, ambient *	0.2	-15.0	-88.0	4103
polyolester mixed acid, ambient *		-6.8	-93.7	4103
average of all tested refrigerants *				
mineral oil / alkylbenzene, ambient *		-26.6	-75.3	4103
polyalkylene glycol, ambient *		-2.8	-95.0	4103
polyolester branched-acid, ambient *		16.6	-92.6	4103

* The refrigerants tested were R-22, R-32, R-123, R-124, R-125, R-134, R-134a, R-142b, R-143a, and R-152a. The mineral oil (MO) and alkylbenzene (AB) were BV Associates R0-15 and Shrieve Zerol(R) 150, respectively. The polyalkylene glycol (PAG) was a polypropylene glycol butyl monoether (ICI Emkarox(R) VG32). The polyolesters (POEs) tested included two pentaerythritol esters, a branched acid (Henkel Emery(R) 2927-A) and a mixed acid (ICI Emkarate(TM) RL 22H). Tabular summary excludes anomalous values.

\+ Changes are relative to ambient test bars, not to control.

A wide variety of generic grades of PBT are available. The one tested

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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 definitely improves performance. Overall, PBT seems to perform poorly, but this may be attibuted to thermal degradation effects, which are clearly documented in the product literature, and the presence of moisture. The quantity of extractables producd 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 R-134a with 32 ISO VG PAG diol and PAG butyl mono ether with R-134a; however, no softening is apparent with R-134a and the modified PAG used in tests. The amounts of extractables produced when PBT is used with polar polyolesters vary, depending on the end use temperature and on the type of PBT chosen. Because of this variation, no generalization can be drawn from the two polyolesters tested. Any use of PBT with polar polyolesters requires individual examination. 4103

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polyimide-DF (PI)

---------- COMPATIBILITY SUMMARY ----------

plastic	polyimide-DF	see RDB#
PI	DuPont Vespel(R) DF	

This almost-crystalline polyimide (PI) resin is a condensation polymer of pyromellitic dianhydride and bis-(4-aminophenyl) ether. This nonmelting 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 sequence 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 kg/l (84 lb/cf), 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 R-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 heat deflection temperature (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. 4103

The following table presents the total acid number and changes in tensile strength and elongation, after thermal aging of specimens in refrigerants and/or lubricants at 150 °C (302 °F). Details of the tests are identified in the referenced source(s).

refrigerant lubricant, condition	total acid number (TAN)	tensile strength change (%)	elongation change (%)	
no refrigerant				
air (no lubricant)		0.5	-23.8	4103
polyolester branched-acid, ambient *	1.9	0.3	-17.7	4103
polyolester branched-acid, dehydrated +	0.7	-1.8	-8.4	4103
R-22				
mineral oil, ambient *		-4.0	-22.0	4103
R-134a				
polyolester branched-acid, ambient *	0.2	-3.5	-24.6	4103
polyolester mixed acid, ambient *		-2.3	-13.3	4103
average of all tested refrigerants *				
mineral oil / alkylbenzene, ambient *		-4.4	-19.7	4103
polyalkylene glycol, ambient *		1.1	-17.2	4103
polyolester branched-acid, ambient *		-3.3	-16.2	4103

* The refrigerants tested were R-22, R-32, R-123, R-124, R-125, R-134, R-134a, R-142b, R-143a, and R-152a. The mineral oil (MO) and

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alkylbenzene (AB) were BV Associates R0-15 and Shrieve Zerol(R) 150, respectively. The polyalkylene glycol (PAG) was a polypropylene glycol butyl monoether (ICI Emkarox(R) VG32). The polyolesters (POEs) tested included two pentaerythritol esters, a branched acid (Henkel Emery(R) 2927-A) and a mixed acid (ICI Emkarate(TM) RL 22H). Tabular summary excludes anomalous values.

+ Changes are relative to ambient test bars, not to control.

The physical properties of this polymer after aging in refrigerant and lubricant are little different from those measured after heating in air. Pure R-22 may cause slight swelling, but no dramatic changes occur. However, the high TAN produced by dehydrated PI, in which water content should be minimal, is of some concern. 4103

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polyimide-DF-ISO (PI)

---------- COMPATIBILITY SUMMARY ----------

plastic PI: polyimide-DF-ISO; DuPont Vespel(R) DF-ISO

see RDB#

This polyimide is the same resin as Vespel(R) DF. The principal differences include a much higher density (1.43 kg/l, 89 lb/cf), 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. 4103

The following table presents the total acid number and changes in tensile strength and elongation, after thermal aging of specimens in refrigerants and/or lubricants at 150 °C (302 °F). Details of the tests are identified in the referenced source(s).

refrigerant lubricant, condition	total acid number (TAN)	tensile strength change (%)	elongation change (%)	
no refrigerant				
air (no lubricant)		-12.6	-24.1	4103
polyolester branched-acid, ambient *	1.0	-3.7	-4.8	4103
polyolester branched-acid, dehydrated +	0.3	4.6	-11.5	4103
R-22				
mineral oil, ambient *		-7.1	-14.7	4103
R-134a				
polyolester branched-acid, ambient *	0.5	-10.9	-26.7	4103
polyolester mixed acid, ambient *		-7.0	-8.1	4103
average of all tested refrigerants *				
mineral oil / alkylbenzene, ambient *		-21.8	-20.7	4103
polyalkylene glycol, ambient *		-8.0	-17.0	4103
polyolester branched-acid, ambient *		-6.4	-21.2	4103

* The refrigerants tested were R-22, R-32, R-123, R-124, R-125, R-134, R-134a, R-142b, R-143a, and R-152a. The mineral oil (MO) and alkylbenzene (AB) were BV Associates R0-15 and Shrieve Zerol(R) 150, respectively. The polyalkylene glycol (PAG) was a polypropylene glycol butyl monoether (ICI Emkarox(R) VG32). The polyolesters (POEs) tested included two pentaerythritol esters, a branched acid (Henkel Emery(R) 2927-A) and a mixed acid (ICI Emkarate(TM) RL 22H). Tabular summary excludes anomalous values.

+ Changes are relative to ambient test bars, not to control.

The physical properties of this polymer are similar after aging in refrigerant and lubricant to those measured after heating in air. Pure R-22 may cause slight swelling, but no dramatic changes occur. However, the high TAN produced by dehydrated PI, in which water content should be minimal, is of some concern. 4103

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poly(aryl ether ether ketone) (PEEK)

---------- COMPATIBILITY SUMMARY ----------

plastic	poly(aryl ether ether ketone)	see RDB#
PEEK	ICI Victrex(TM) PEEK 450 G	

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 (649 °F), and its glass transition temperature, Tg is 143 °C (289 °F). Standard unfilled grades of PEEK have a reported heat deflection temperature (HDT) of 156 °C (315° °F) at 1.8 MPa (264 psi), and a Underwriter's Laboratories (UL) continuous-use temperature of 250 °C (482 °F). 4103

The following table presents the total acid number and changes in tensile strength and elongation, after thermal aging of specimens in refrigerants and/or lubricants at 150 °C (302 °F). Details of the tests are identified in the referenced source(s).

refrigerant lubricant, condition	total acid number (TAN)	tensile strength change (%)	elongation change (%)	
no refrigerant ·····				
air (no lubricant)		9.5	5.6	4103
polyolester branched-acid, ambient *	0.2	4.8	-15.0	4103
polyolester branched-acid, dehydrated +	0.2	5.5	11.1	4103
R-22 ·····				
mineral oil, ambient *		3.4	-13.7	4103
R-134a ·····				
polyolester branched-acid, ambient *	0.1	7.0	1.0	4103
polyolester mixed acid, ambient *		5.7	-3.2	4103
average of all tested refrigerants * ·····				
mineral oil / alkylbenzene, ambient *		0.4	-23.3	4103
polyalkylene glycol, ambient *		3.6	-15.2	4103
polyolester branched-acid, ambient *		3.5	-14.6	4103

* The refrigerants tested were R-22, R-32, R-123, R-124, R-125, R-134, R-134a, R-142b, R-143a, and R-152a. The mineral oil (MO) and alkylbenzene (AB) were BV Associates R0-15 and Shrieve Zerol(R) 150, respectively. The polyalkylene glycol (PAG) was a polypropylene glycol butyl monoether (ICI Emkarox(R) VG32). The polyolesters (POEs) tested included two pentaerythritol esters, a branched acid (Henkel Emery(R) 2927-A) and a mixed acid (ICI Emkarate(TM) RL 22H). Tabular summary excludes anomalous values.

\+ Changes are relative to ambient test bars, not to control.

PEEK shows very good environmental characteristics, but some lubricants seem to cause embrittlement. Annealing and drying the plastic before immersion seems to reduce this effect. 4103

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liquid crystal polymer (LCP)

---------- COMPATIBILITY SUMMARY ----------

plastic	liquid crystal polymer	see RDB#
LCP	Amoco Xydar(R) MG 450	

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. LCP MG 450 is stiff, strong at elevated temperatures, and very resistant to chemicals. It has low water adsorption and a reported heat deflection temperature (HDT) of 294 °C (560°F) at 1.8 MPa (264 psi). 4103

The following table presents the total acid number and changes in tensile strength and elongation, after thermal aging of specimens in refrigerants and/or lubricants at 150 °C (302 °F). Details of the tests are identified in the referenced source(s).

refrigerant lubricant, condition	total acid number (TAN)	tensile strength change (%)	elongation change (%)	
no refrigerant				
air (no lubricant)		14.6	-13.8	4103
polyolester branched-acid, ambient *	0.2	21.6	-12.5	4103
polyolester branched-acid, dehydrated +	0.2	-1.2	6.5	4103
R-22				
mineral oil, ambient *		13.7	-1.1	4103
R-134a				
polyolester branched-acid, ambient *	0.2	15.6	-14.5	4103
polyolester mixed acid, ambient *		3.0	0.8	4103
average of all tested refrigerants *				
polyalkylene glycol, ambient *		16.6	-7.5	4103
polyolester branched-acid, ambient *		13.9	-2.4	4103

* The refrigerants tested were R-22, R-32, R-123, R-124, R-125, R-134, R-134a, R-142b, R-143a, and R-152a. The mineral oil (MO) and alkylbenzene (AB) were BV Associates R0-15 and Shrieve Zerol(R) 150, respectively. The polyalkylene glycol (PAG) was a polypropylene glycol butyl monoether (ICI Emkarox(R) VG32). The polyolesters (POEs) tested included two pentaerythritol esters, a branched acid (Henkel Emery(R) 2927-A) and a mixed acid (ICI Emkarate(TM) RL 22H). Tabular summary excludes anomalous values.

\+ Changes are relative to ambient test bars, not to control.

The differences in TAN between dehydrated and ambient test bars are slight; the differences in tensile strength 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. 4103

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polyamide nylon 6/6 (PA)

---------- COMPATIBILITY SUMMARY ----------

plastic	polyamide nylon 6/6	see RDB#
PA	DuPont Zytel(R) 101	

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 was the general 6/6 grade. It is resistant to nonpolar 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 heat deflection temperature (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) at 1.8 MPa (264 psia). 4103

The following table presents the total acid number and changes in tensile strength and elongation, after thermal aging of specimens in refrigerants and/or lubricants at 150 °C (302 °F). Details of the tests are identified in the referenced source(s).

refrigerant lubricant, condition	total acid number (TAN)	tensile strength change (%)	elongation change (%)	
no refrigerant ·····				
air (no lubricant)		-69.3	-96.6	4103
polyolester branched-acid, ambient *	3.0	30.6	-61.8	4103
polyolester branched-acid, dehydrated +	0.3	-67.2	-87.3	4103
R-22 ·····				
mineral oil, ambient *		#	#	4103
R-134a ·····				
polyolester branched-acid, ambient *	0.9	20.5	-44.1	4103
polyolester mixed acid, ambient *		19.6	-55.7	4103
average of all tested refrigerants * ·····				
mineral oil / alkylbenzene, ambient *		10.6	-49.7	4103
polyalkylene glycol, ambient *		17.6	-45.1	4103
polyolester branched-acid, ambient *		18.0	-50.5	4103

* The refrigerants tested were R-22, R-32, R-123, R-124, R-125, R-134, R-134a, R-142b, R-143a, and R-152a. The mineral oil (MO) and alkylbenzene (AB) were BV Associates R0-15 and Shrieve Zerol(R) 150, respectively. The polyalkylene glycol (PAG) was a polypropylene glycol butyl monoether (ICI Emkarox(R) VG32). The polyolesters (POEs) tested included two pentaerythritol esters, a branched acid (Henkel Emery(R) 2927-A) and a mixed acid (ICI Emkarate(TM) RL 22H). Tabular summary excludes anomalous values.

\+ Changes are relative to ambient test bars, not to control.

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The test specimens were destroyed by these conditions.

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. 4103

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