1992

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1992 International Refrigeration Congress
Purdue University, West Lafayette, Indiana
July 17, 1992

COMPATIBILITY OF REFRIGERANTS AND LUBRICANTS WITH MOTOR MATERIALS

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The electric motor sealed in the hermetic refrigeration system has a reputation for trouble-free operation over a 30-60 year lifetime. Cooling of the motor is accomplished through direct contact with the refrigerant and lubricant. As new refrigerant and synthetic lubricants are developed, testing must be done to insure that these replacements for the CFC's, HCFC-22 and mineral oil will be compatible with the electric motor materials. These materials must resist long term deterioration as well as maintaining their dielectric strength saturated with the refrigerant.

The goal of this project is to test 24 representative motor materials with 11 pure refrigerant and 17 refrigerant-lubricant combinations. Exposure will be in pressure vessels for 500 hours. Exposure testing will begin April 1992 and be completed by April 1993.

MOTOR MATERIALS

The motor materials to be evaluated are as follows:

Magnet Wire
- Modified polyester overcoated with polyamide imide, as described in Section MW 73 of NEMA Standard MW 1000.
- Modified polyester overcoated with polyamide imide and epoxy saturated glass as described in Section MW 73 and MW 46 of NEMA Standard MW 1000.
- Polyester imide overcoated with polyamide imide.

Varnishes
- U-475-EH solvent epoxy
- Y-390-PG solvent epoxy-phenolic
- ER-610 93% solids epoxy
- Y-833 100% solids VPI epoxy
- 923 solvent epoxy
- Isopoxy 800 water-borne epoxy

Sheet Insulation, Slot Liners and Phase Separators
- Nomex-Mylar-Nomex
- Dacron-Mylar-Dacron
- Mylar MO
- Nomex 410
- Nomex Mica 418
- Melinex 228

Spiral Wrapped Sleeving Insulation
- Nomex
- Mylar
- Nomex-Mylar

Lead Wire Insulation
- Dacron-Mylar-Dacron
- Dacron-Teflon-Mylar-Dacron

Tapes
- Heat Cleaned Glass
- Heat Shrinkable Braided Polyester
- Permacel P247 glass-acrylic

Tie Cords
- Polyester

REFRIGERANTS AND LUBRICANTS

The 11 pure refrigerants and 17 refrigerant-lubricant combinations are listed below. Exposure will be for 500 hours in four Parr bombs for each pure refrigerant or refrigerant-lubricant combination.

Pure Refrigerants

500 hours at 60°C (140°F)

R-32, R-125, R-143a

500 hours at 90°C (194°F)

R-134a, R-22, R-152a, R-142b, R-124, R-123, R-11 alternative, E134 alternative

Refrigerant-Lubricant Combination

500 hours at 127°C (260°F)

R-32 with pentaerythritol branched acid ester
R-32 with polypropylene glycol butyl monoether
R-125 with pentaerythritol branched acid ester
R-125 with polypropylene glycol butyl monoether
R-125 with polyalkylene glycol fluorinated alkyl ether
R-143a with pentaerythritol branched acid ester
R-134a with polypropylene glycol butyl monoether
R-134a with polypropylene glycol diol
R-134a with polyalkylene glycol fluorinated alkyl ether
R-134a with pentaerythritol branched acid ester
R-134a with pentaerythritol mixed acid ester
R-22 with naphthenic mineral oil
R-152a with alkylbenzene lubricant
R-142b with alkylbenzene lubricant
R-124 with alkylbenzene lubricant
R-11 alt. with pentaerythritol branched acid ester
E134 alt. with ?

COMPATIBILITY EVALUATIONS

After the 500 hour exposure materials will be evaluated in regard to changes in weight, visual appearances, flexibility, dielectric strength, and for some materials tensile strengths. In addition, the three magnet wires will be fabricated into single strands, twisted pairs, and helical coils. These fabricated samples will be dipped and baked with one of each of the six varnishes. After exposure the appropriate coated magnet wire samples will be measured for changes in weight, appearance, flexibility, dielectric breakdown voltage, burnout voltage, and bond strength.

Results after the 500 hour exposure to refrigerant or refrigerant-lubricant combination will be compared to measurements taken on unexposed samples and samples exposed to nitrogen for 500 hours at the test temperature. This will discern the effect of heat as compared with refrigerant or lubricant. In addition to measurements taken immediately after exposure to the refrigerant, exposed samples will be evaluated after baking at 150°C. This will ascertain the effect of refrigerant desorption on the measured properties.

This is a comprehensive compatibility study of motor materials and refrigerants. There will be over 600 motor material samples for each of the 11 refrigerants and 17 refrigerant-lubricant combinations, resulting in over 18,000 samples for the project.

RESULTS

Preliminary results from the compatibility testing of electric motor materials with the first refrigerants and refrigerant-lubricants will be presented at the 1992 International Refrigeration Congress at Purdue University on July 17. Additional information will be presented in January 1993 at the Chicago ASHRAE Meeting. The final report will be submitted to ARTI by April 30, 1993, and will be in the public domain.