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## EXECUTIVE SUMMARY

### Biodiesel Fuel Effects on Fluorocarbon Formulations

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#### **Background**

Biodiesel fuel is a blend of esterified vegetable oil blended with normal diesel fuel. While the blends can vary in percentage, B20 containing 20% esterified vegetable oil seems to be the most popular ratio.

Beyond this variable, different vegetable oil feed stocks can be utilized. Among these are rapeseed oil, soybean oil, and others. The former is more popular in Europe while the latter is more popular in the U.S.

#### **Test Protocol**

Precix has tested with biodiesel fuels based on both rapeseed oil and soybean oil. We used concentrations of B20, as well as B100 (100% esterified vegetable oil for exaggerated test conditions only). A variety of different fluoroelastomer formulations were exposed to the fuels at room temperature and/or 150°C, for periods up to two weeks.

Copies of the test data are attached.

#### **Summary and Conclusions**

Precix has found that fluorocarbon formulations containing 65 to 66% fluorine and standard incorporated cures work well with biodiesel fuel. This is the technology representative of Precix formulas F75, F90, and others. Higher fluorine levels and peroxide cures offered slight additional advantage in our testing and do not seem necessary.

Test results for the soybean based biodiesel were generally comparable to the results for the rapeseed based biodiesel. While the rubber properties were more affected at 150°C than at room temperature, they are still considered well within acceptable limits for fluorocarbon elastomer compatibility. B20 was slightly more aggressive than B100, and should be the “referee” fluid going forward.

Lastly, Precix has found that zinc oxide must be avoided in fluorocarbon formulations intended for biodiesel applications. Zinc oxide leads to major property degradation, higher volume swells, and sediment formation. It should be noted that zinc oxide is seldom used in incorporated cured fluorocarbons as Precix is recommending. However, if peroxide cured materials were to be used, zinc oxide must be avoided.