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Committee D02 on Petroleum Products and Lubricants

Research Report D02-1170

Supporting Data for ASTM D4308 - Test Method for Electrical Conductivity of Liquid Hydrocarbons by Precision Meter

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Derivation of Precision Statement for
ASTM D-----83, "Electrical Conductivity
of Liquid Hydrocarbons by Precision Meter"
Background

A precision program for D3314, "D-C Electrical Conductivity of Hydrocarbon Fuels", using the Balsbough 100T2 Cell and the Keithley 60 Electrometer was conducted in 1971 and the resulting precision statement was published in D3314-72.

In 1980 Emcee Corporation proposed another apparatus based on the KSLA cell and in June 1980 a cooperative program was run at Mobil Research and Development Corporation to compare the relative precision of the two pieces of apparatus. A summary of the round-robin, including a listing of the program results and the participants is contained in Appendix A. The statistical analysis of these data will be found in Appendix B.

A comparison of the relative precision of the two instruments indicated the Emcee instrument to be more precise than the Balsbough - Keithley unit, but neither device showed precision as good as that published in 1971. The 1971 Balsbough data were therefore reanalyzed by the latest ASTM statistical techniques and were found to be equivalent to the 1980 precision. This analysis is shown in Appendix C.

However, before these results could be published it was learned in December 1981 that the Balsbough 100T2 cell was no longer commercially available. A program was therefore conducted at Exxon Research and Engineering Company on June 15-25, 1982 to investigate a replacement cell and to compare the Emcee KSLA and the Balsbough - Keithley DC methods against an AC method. This program and its results are described in Appendix D. Briefly the program showed the DC methods to be unsuitable for conductivities below 0.1 pS/m and very thorough cleaning to be required below 1 pS/m. Below 0.1 pS/m an AC method such as D1169 is suggested. It was also found that above 1 pS/m the Emcee, KSLA unit have results closer to the AC method than did the Balsbough - Keithley method.

Under these circumstances Technical Committee J voted in June 1982 to publish the Emcee KSLA procedure as a standard test method. D3114 was renewed unchanged for one year to 1983. Further renewal of D3114 is not anticipated. The remainder of this report will therefore discuss the precision of the Emcee KSLA method in more detail.

Discussion of Emcee KSLA Precision

The examination of Appendix B highlights several problems with the data. True ASTM reproducibility could not be calculated because there were only half as many pieces of apparatus as there were operators and "reproducibility" as calculated by this analysis could therefore be somewhat better than reproducibility where each operator would have his own equipment. Secondly, due to blending problems there were no test fuels with conductivities in the 1-50 picoSiemens/meter range.

The resultant precisions are tabulated in Table I and are plotted in Figure 1. This figure is the published precision for D---- and the dashed portion of the curves reflects the lack of fuel data in this precision range. It can also be seen that precision is significantly poorer at very low conductivity levels. This is probably due to the cleaning difficulties mentioned in Appendix D.