Development of a New Instrument and Test Technique to Study Low Temperature Mobility of Lubricating Greases

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Overview

Currently, a few experimental techniques, such as the US Steel Grease Mobility, the Lincoln Ventmeter, and the Apparent Viscosity of Lubricating Greases (ASTM D1092) Methods are used to study low temperature properties of greases.

The Kesternich Method (DIN 51805), has been used in Europe to gain a better understanding of low temperature properties of greases.

Our Instrument

The Low Temperature Flow Tester (K95300) has a variety of advantages over competitive instruments that also operate according to the Kesternich method.

	Koehler	Others
Temperature Range	<-50˚C without external cooling device	-30˚C without external cooling device
User Interface	Guided Touch Interface	Cursor-based Text Interface
Precool time to -30˚C	< 10 minutes	< 60 minutes
Data Storage	Standard USB	Not available
Support Function	Embedded Support and Handbook	Handbook
Remote Monitoring	Mobile App available	Not Available

Alternative Methods

The current low temperature grease testing standards all require at least 220 g of sample to conduct the test (Table 1), while the Kesternich test only requires a sample size of approximately 1.6485 mL, the equivalent of less than 2 g of water.

	ASTM D1092	Lincoln Ventmeter	US Steel Mobility	Kesternich
Minimum Temperature	-54˚C	-29˚C	-34.4˚C	-50˚C
Method to move grease sample	Piston	Air Pressure	Piston	Air Pressure
Sample Size	223 g	400 g	220 g	2 g †

What is the Kesternich Method?

The Kesternich Method (DIN 51805) is a test method that tests the flow of greases at low temperatures. To perform the Kesternich test, the test nozzle is filled with the grease sample, typically by repeatedly pressing the nozzle against the sample until a sufficient amount is inside. After the device has been cooled to the selected temperature, pressure is applied to the grease sample and increases every 30 seconds until the grease sample has been forced out of the nozzle.

How The K95300 Works

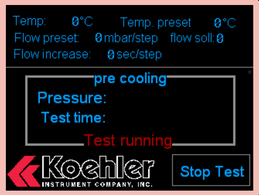
1

The instrument will cool down the test sleeve to the desired test temperature. This is done using a cascaded Peltier system.

2

After the test temperature is reached, the system will start the stabilization time.

(range from 15-500 minutes)



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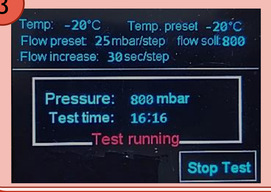
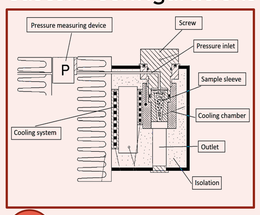
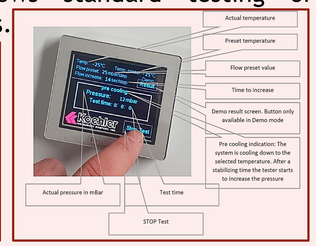


Once the test begins, the instrument will increase the pressure on the grease in the test sleeve in the predefined steps for the test.

The K95300 is a fully automatic test system that can achieve temperatures of -50°C without external cooling devices. The Kesternich Test Method is currently programmed into the instrument and allows standard testing or custom configurations.





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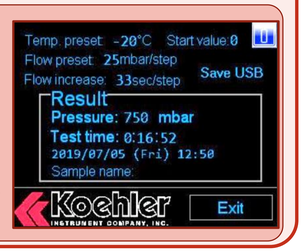
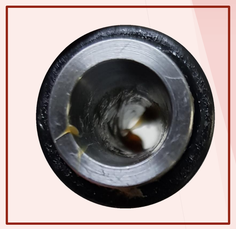
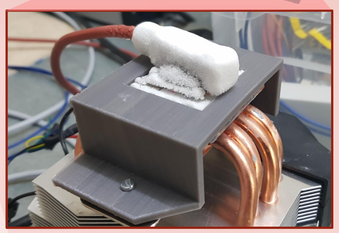
If the system recognizes a rapid pressure decrease, the system will store the maximum pressure value as the test result.



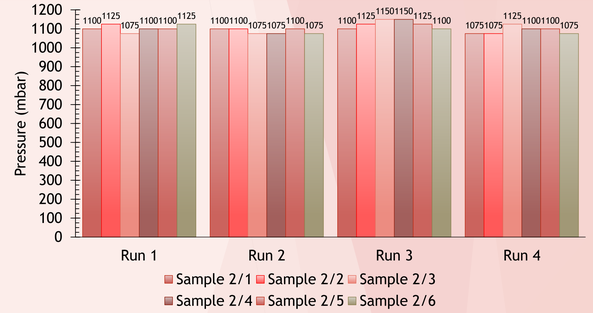
Preparation for Testing

Grease is loaded into the nozzle by using a spatula to pack it inside. The nozzle is then inserted into the instrument and cooled before the test begins.



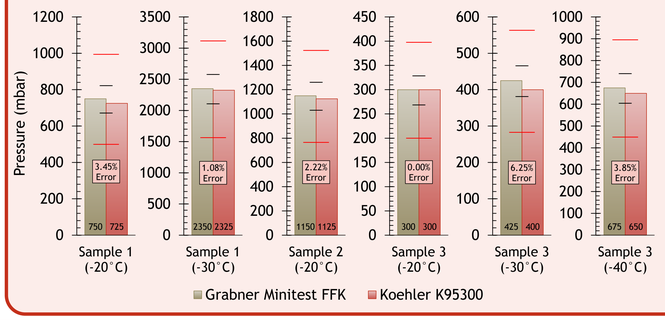


Repeatability



This instrument produces highly repeatable results, with a range of no more than 50 mbar and a maximum standard deviation of 2%. The 25 measurements for each run were collected at -20˚C, 25 mbar steps and 30 second increase time. Results are in *mbar*.

Data Comparison with Grabner Low Temperature Flow Tester



The K95300 produces highly accurate results. This analysis assumes the Grabner Minitest FFK results are accurate and compares the results of identical tests on the Koehler K95300. The black lines represent the 10% tolerance of different tests on the same machine and the red lines represent the 30% tolerance of different tests in different laboratories. In our tests, the highest percent of error was Sample 3 run at -30°C (6.25%). The average variation between the K95300 and Grabner Minitest was 3%. These results are well-within both thresholds.

Conclusion

The K95300 shows highly repeatable results and is well-within the requirements outlined by the Kesternich Method. The instrument also features newer technology than competitive instruments available, such as lower cooling temperatures and more configuration options, making the K95300 a suitable choice for low temperature mobility testing.

References

ASTM D1092 “Standard Test Method for Measuring Apparent Viscosity of Lubricating Greases” (ASTM International)
US Steel Grease Mobility Method “United States Steel Method Using SOD Cylinder and Capillary” (United States Steel Corporation)
Lincoln Ventmeter Test “Standard Test Method for Determining Grease Ventability by Lincoln Ventmeter” (ASTM International)
DIN 51805 “Determination of flow pressure of lubricating greases according to Kesternich method” (DIN Germany)

† All test methods except Kesternich provide a minimum sample size in grams. DIN 51805 requires a specific volume which converts to approximately 1.6 g of water, rounded up to 2 g.

Acknowledgements

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