TACKINESS ADHESION ANALYZER

Quantifiable tackiness properties with the Falex Tackiness Adhesion Analyzer (TAA).

Falex introduces the first commercial instrument to accurately measure both the tackiness and adhesion of greases and other viscous or viscoelastic fluids and semi-solids. TAA replaces the subjective finger test and other empirical methods by **measuring adhesion force, and thread length (tackiness)** between a probe and the grease. **separation energy** can be calculated from force-indentation curves.

The Falex TAA will give the user consistent data for quality control of greases and other materials for applications where tackiness or adhesion is critical to the functioning of the equipment. The instrument also supports development of tacky products.

In the scientific publications by D. Drees, E. Georgiou et al[1], the test method, based on indentation-retraction curves, is presented. The Falex TAA automatically executes and records these curves under variable and well controlled conditions of temperature and retraction speed. This allows for a complete mapping of tackiness under different conditions.

The instrument is designed for ease of use with automatic operation. A wide range of retraction speeds, temperatures and probe materials allow for flexibility and customization in identifying adhesion and tackiness properties under a wide range of test conditions. While a 3mm ball stylus is used for standardization work, other materials and geometric shapes are possible.

[1] *Can we put a Value on the Adhesion and Tackiness of Greases?, E.P. Georgiou, D.Drees, M. De Bilde, M. Anderson, in : Tribology Letters (2018) 66:60*

FALEX 200 Features

- Only instrument that measures the complete approach-retraction curve with high precision and repeatability
- Algorithm computes the thread length, adhesion and separation energy for easy ranking of greases
- Very small amount of grease required per test (5 ml)
- Fully automated test sequences, programmed from user interface with touchscreen
- Programmable indexing table for automation of the tackiness curve measurements
- Variable retraction speeds
- Removable 3-piece sample holder for easy cleaning
- Easily exchangeable sensor stylus
- Temperature testing range from ambient to 100°C
- Hierarchical USER management (operator - superuser)
- Sleek, modern design
- 'Industry 4.0 ready' design for integration of data analysis in cloud or network databases
- DMA (Dynamic Measurement Analysis) expansion

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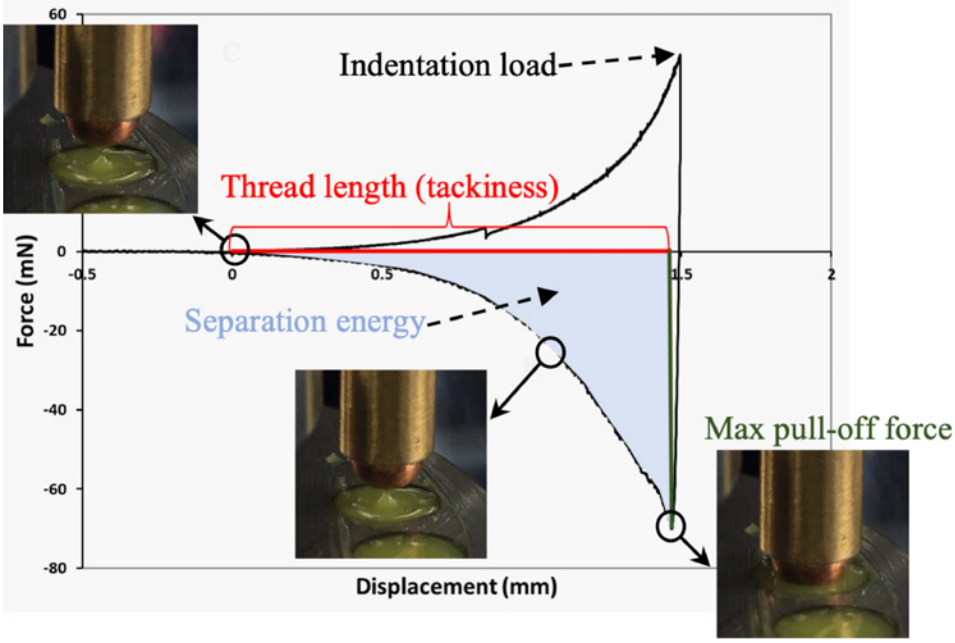
Falex TAA Working Principle

Sensor approach and retraction

A probe, connected to a high precision force sensor, is pushed into a defined grease sample with controlled force. This is followed by retraction of the probe from the grease sample. The motion is done with a precisely controlled acceleration and speed. During operation, both force and position of the probe are measured simultaneously. The system has to be accurate enough to distinguish the small changes in displacement-force curves, dependent on the conditions and on the grease sample. Grease samples can be heated from ambient to 100°C.

Schematic of retraction curve and calculation of tackiness parameters*



Tackiness test parameters are :

Distance from the max pull-off force until zero force = 'thread length' (in red in the graph). It is a direct measurement of the length of a thread of grease, being pulled out of the grease volume and thus a measure for grease tackiness, as defined by the finger tests shown in the photo below.

It is calculated as the distance between the maximum pull off force and zero force, during the retraction part.

The max pull-off force in the retraction curve is the adhesion to overcome, and can be interpreted as a measure for the 'stickiness' of a grease covered surface. This parameter can also be used to measure stickiness (adhesion) between two bodies in general. It generally does not correlate well with the thread formation of a grease*

It is calculated as the maximum force in negative direction, during the retraction part.

The Grease 'B' forms long threads in the finger test, indicating a tacky grease. This finger test is not very repeatable because neither speed, nor grease amount are well controlled. It risks being subjective to the operator.

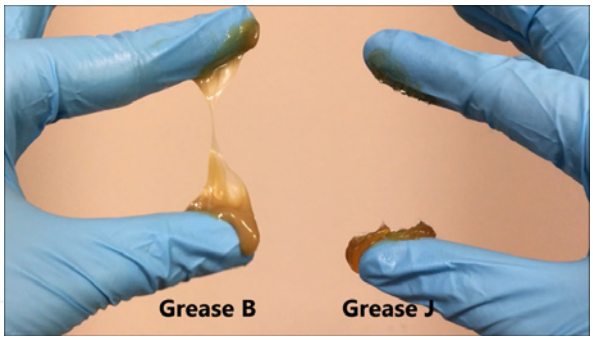
Differences between greases can objectively be measured by the tackiness adhesion analyser TAA, as illustrated in the results of the Draft ASTM Method below.

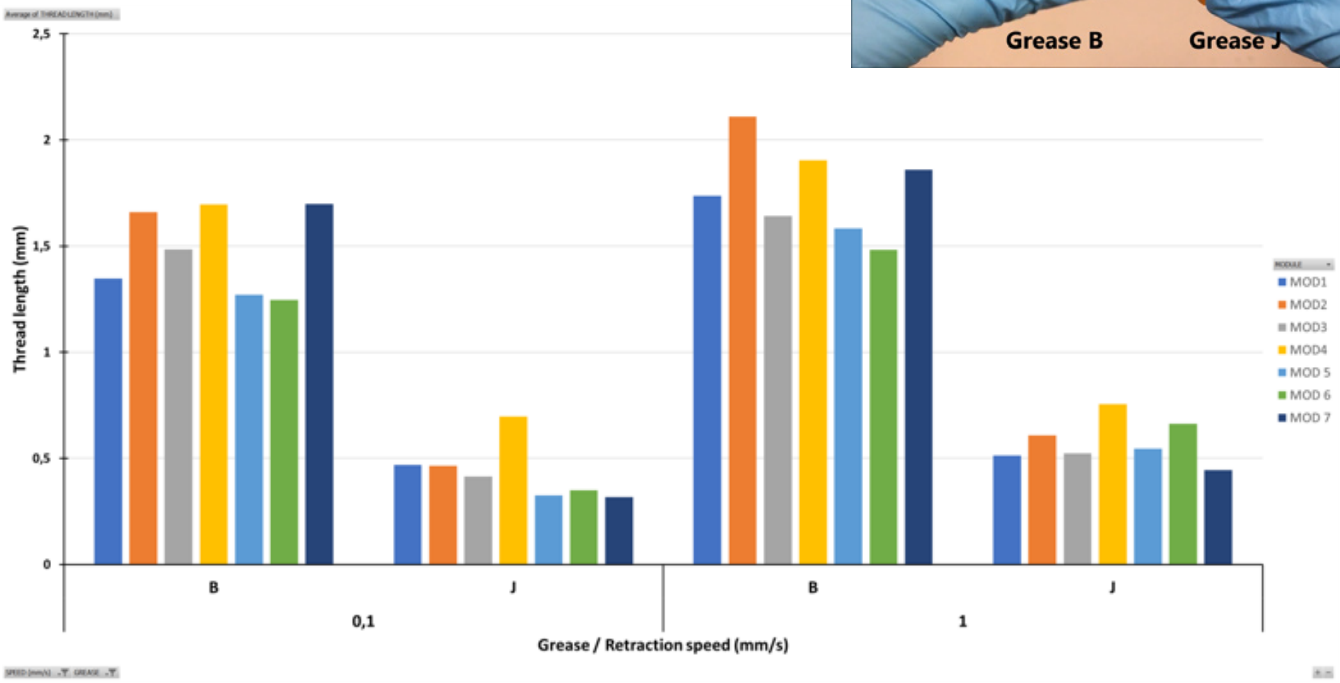
ASTM Draft Method Significance and Reproducibility

A standardized protocol is used to compare the tackiness of different grease compositions as measured by the thread length of greases at different retraction speeds from 0,1 to 5 mm/s. Test Reproducibility is indicated by 7 measurements on different test modules and by different operators. A typical variation of less than 15% is generally found and is sufficient to measure the tackiness difference between Grease B and Grease J.

These tests are done at ambient temperature, but the method can be extended to elevated temperatures

A significant difference in tackiness is proven between Grease B and Grease J





Summary of the ASTM Draft method

- Temperature: 25 ± 2 °C
- Indentation load: 50 mN
- Dwell time at load: 3 sec
- Retraction speeds: 0.1, 0.5, 1.0, 2.0 and 5.0 mm/s
- Test positions: 15 individual test positions to be filled with the same grease
- Grease working: With a grease micro-worker with 8x3.17 mm holes and ¼ cone. Perform 60 strokes* for 1 minute, with a speed of 1 stroke* per sec (according to ASTM D1403)
- Repeats: 5 cycles per position and 3 different positions per retraction speed
  - (P1: 0.1 mm/s, P2: 0.5 mm/s, P3: 1 mm/s, P4: 2 mm/s, P5: 5 mm/s, P6: 0.1 mm/s, P7: 0.5 mm/s, P8: 1 mm/s, P9: 2 mm/s, P10: 5 mm/s, P11: 0.1 mm/s, P12: 0.5 mm/s, P13: 1 mm/s, P14: 2 mm/s, P15: 5 mm/s)
- Report
  - Thread length (tackiness) per position (average of 5 cycles with STDEV)
  - Max pull-off force (adhesion) per position (average of 5 cycles with STDEV)

** 1 stroke = 1 push and 1 pull in either direction*

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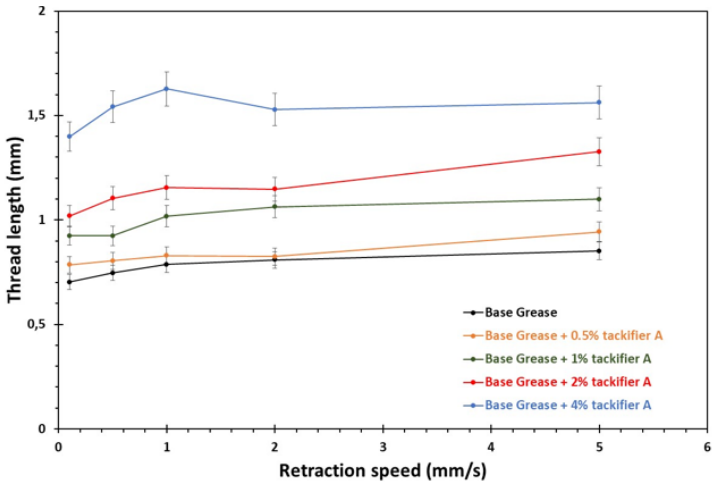
Falex 200 Typical Results

Effect of tackifier additive

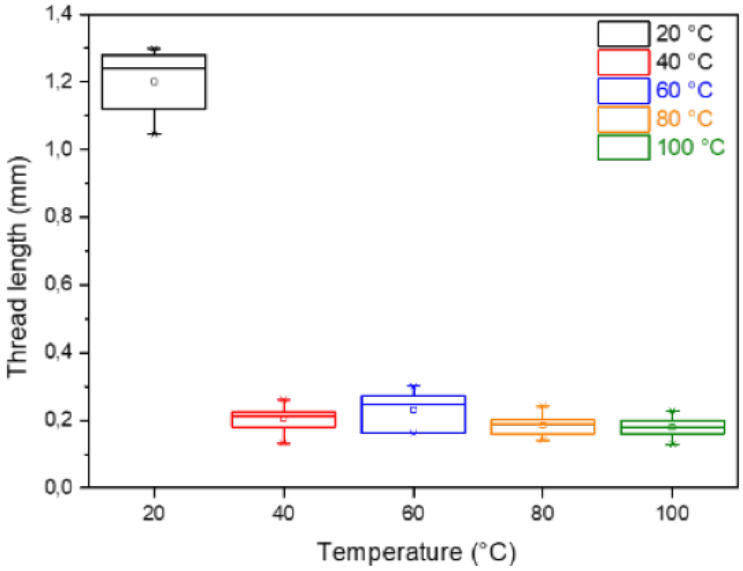
This graph clearly illustrates the sensitivity of the thread length measurement method to tackifier concentration. With an increase of the tackifier from 0.5 to 4%, the thread lengths in retraction increase significantly at every retraction speed.

Studies like this can show the relative efficiency of tackifier additives in increasing thread length, but can also show if there are any compatibility issues with the grease, or the effect of base grease composition

The repeatability of tests is indicated by the vertical marks and show less than 10% variation between tests. This repeatability is enough to distinguish between these 5 tackifier concentrations.



Likewise, the effect of temperature on the thread formation can be studied. In this example, heating the grease even from 20°C to 40°C completely breaks down the thread formation property, reducing thread lengths from 1.2 mm to 0.2 mm.



Falex 200 Technical Data

Temperature	Ambient to 100°C
Data Acquisition	1000Hz
Initial Acceleration	Up to 80m/s2
Retraction Speed	0.1-5mm/s
Overall Dimensions	45L x 35W x 45H cm
Weight	25 Kg
Power Requirements	110V or 220V, 50/60Hz, 10 AMP

Falex Corporation follows a policy of continuous product improvement. Specifications are subject to change without notice.

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