

## **Flexible Magnetic Media**

**Summary:** The tribological properties of flexible magnetic media were studied utilizing the UMT Series Micro-Tribometer. The friction test with rotational speeds from 0.1 to 2000 rpm demonstrated the difference between four types of media. The Zip and the Regular Floppy media had low and the Advanced and the Nomai Super Floppy media had high COF values in the slider/media interface. COF depended on the rotational speed and had maximum value in the speed range from 0.3 to 300 rpm for all the discs. The stiction phenomenon was observed on the Advanced, Regular Floppy and Nomai Super Floppy disks at rotational speeds of less than 1 rpm. The scratch-resistance test with diamond stylus showed that the Advanced and Zip media had a COF value of 0.15, while the Regular Floppy and Nomai Super Floppy media had a COF value of 0.7. In friction test with stainless steel ball the Advanced Floppy had the lowest and the Zip media the highest COF values.

**Instrumentation:** All experiments were conducted with the CETR UMT Series Micro-Tribometer. This precision tribometer provides accurate measurements of the tribological properties of metals, plastics, paper, composites, thin and thick coatings, solid lubricants, oils and greases. The following parameters can be measured:

- 1 - Friction force and coefficient of friction,
- 2 - Adhesion force,
- 3 - Wear and wear rate (including fatigue, abrasive and adhesive wear),
- 4 - Contact resistance or capacitance,
- 5 - Temperature in the friction zone,
- 6 - Acoustic emission.

The UMT can accommodate both upper and lower specimens of wide variety of shapes and dimensions.

The upper specimen can have shape of a

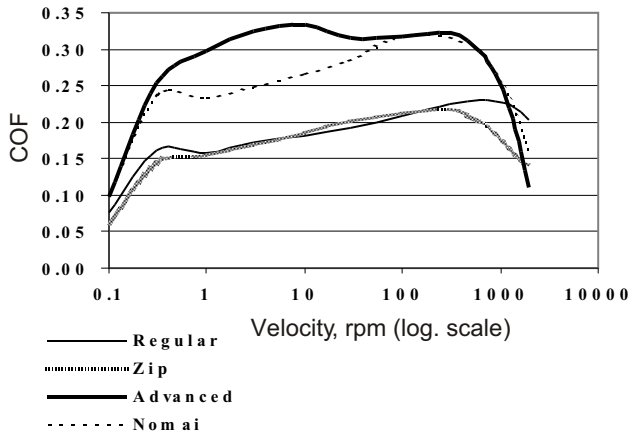
slider, cylindrical or square pin with flat or semi-spherical tip, ball, needle or any other shape that can be affixed to similar pin. The specimen is connected to the vertical linear motion system that has a travel more than 100 mm with resolution of 1  $\mu\text{m}$  (optional 50nm).

The lower specimens can have a shape of a disk with OD up to 6", flat square, rectangular or any other shape and dimensions. The specimen is fixed on the rotating table that has a velocity range from 0.001 rpm up to 5,000 rpm (the rotation is used for positioning and/or tribological measurements). The ultra-accurate strain-gauge sensor performs simultaneous measurements of the normal load and the friction force with very high resolution and repeatability. The normal load sensor provides feedback to the vertical motion controller, actively adjusting the upper specimen position to control the load during testing. The tester has fully automated PC-based motor control and data acquisition, with a user-friendly software interface in a Windows 95 multitasking environment. The test data can be acquired, calculated and displayed in real time, as well as stored for future retrieval.

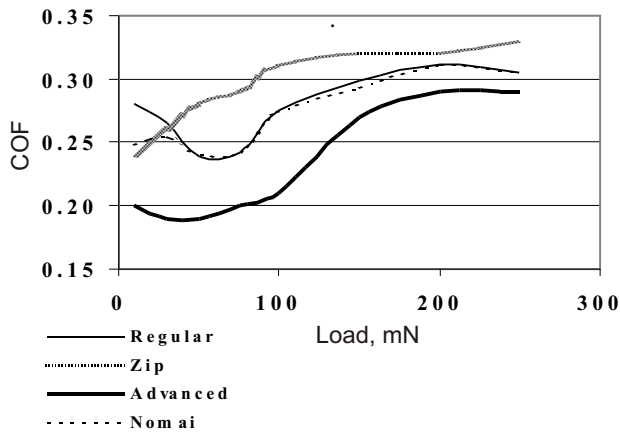
**Sample description:** In this experiment four different flexible media were tested: Regular, Zip, Advanced Very-High-Capacity Floppy, and Nomai Super Floppy.

**Experimental procedure:** All floppy disks underwent two different tests:

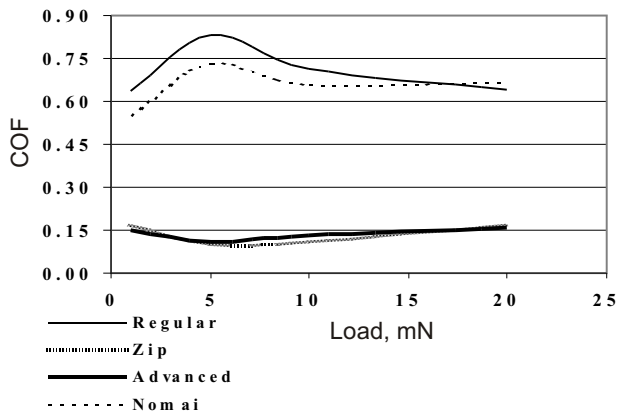
1. The friction test with a 30% slider (HGA) at constant load of 20 mN and a speed range of 0.1-2000 rpm. (This test can be conducted at the gradually and continuously increasing speed).
2. The scratch-resistance test with a stainless steel ball (radius of 254  $\mu\text{m}$ ) and a diamond stylus (radius of 12.5  $\mu\text{m}$ ) at the constant speed of 0.1 mm/second and various loads.



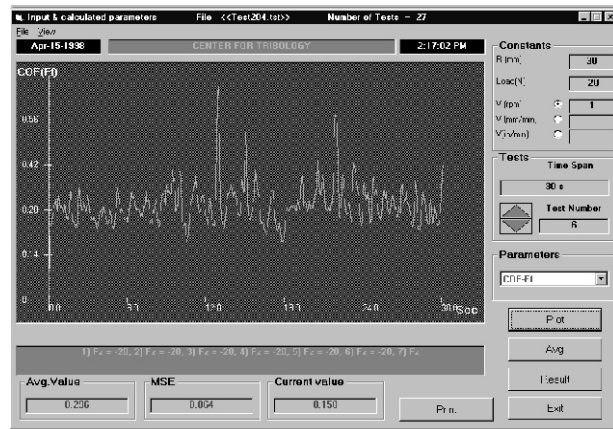
**Figure 1. 30% slider (HGA) on the flexible media**



**Figure 3. Stainless steel ball on the flexible media**



**Figure 4. Diamond stylus on the flexible media**



**Figure 2. Stick-Slip Phenomenon for Advanced Media**

**Results:** Figure 1 demonstrates the dependence of the coefficient of friction (COF) on the gradually increasing rotating speed. The difference between two groups of the disks was obvious: Zip and Regular media demonstrated low COF value, the Advanced and Nomai media had high COF values. The COF had the maximum values in the velocity range from 0.3 to 300 rpm for all tested disks.

The stick-slip phenomenon was discovered on the Advanced, Regular Floppy and Nomai Super Floppy at low speeds (less than 1 rpm). Figure 2 demonstrates this result for the Advanced media.

In the scratch-resistance tests with the stainless steel ball the coefficient of friction depended on the applied load (Figure 3). The Advanced media demonstrated low and the Zip media exhibited high COF value. The Regular Floppy and the Nomai media showed similar results. No visible traces were produced on all disk surfaces. Figure 4 demonstrates the results of scratch-resistance tests on the diamond stylus/flexible media interface. Significant differences were observed between two groups of media. The Regular and Nomai had high COF values of 0.7. The Zip and Advanced had low COF values of 0.15. The visible scratches were discovered on all media at a load of 5-20 mN.

**Conclusion:** The UMT can distinguish between different types of flexible media by tribological testing at different rotational speeds, using diverse shapes of the upper specimen at different loads.

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