



Retsch GmbH
Retsch-Allee 1-5
42781 Haan
Germany

Phone 02104/2333-100
E-Mail info@retsch.com

www.retsch.com

RECOMMENDATIONS FOR THE HIGH PERFORMANCE CYCLONE IN LABORATORY AND PROCESS MILLS

In the grinding and milling of sample materials, the complete and reproducible recovery of the sample is of critical importance. Cyclones are used to minimize sample loss (due to fine particles sticking to the grinding chamber, grinding tools, and connections), thereby ensuring clean and efficient sample recovery. At the same time, the generated airflow provides effective cooling of the sample material and protects the machine bearings from dust exposure.

In addition to the proven standard cyclone, a newly developed high performance cyclone is available, specifically designed for demanding applications in milling or sieving with fine meshes and lightweight sample materials. The aim of the investigations described here was to systematically evaluate the practical benefits of this high performance cyclone in comparison to the standard cyclone and to derive clear recommendations for users.



*Fig. 1:
Set including high performance cyclone
with sample bottles and holder,
FDA-certified connecting hose,
cover with vacuum cleaner connection
and sample outlet*

The tests were conducted using the Ultra Centrifugal Mill ZM 300, the Rotor Beater Mill SR 300, and the Cutting Mill SM 300, and included various sample types, sieve sizes, and operating parameters.



Fig. 2: Ultra Centrifugal Mill ZM 300



Fig. 3: Rotor Beater Mill SR 300



Fig. 4: Cutting Mill SM 300



left: high performance cyclone
right: standard cyclone

Overview of experiments and objectives

The influence of the cyclone type on sample recovery was investigated for:

- | Different mill types
- | Varying sieve sizes (< 0.12 mm to 0.75 mm)
- | Samples with significantly different bulk density and particle morphology

The focus was not on absolute grinding performance, but explicitly on a comparative evaluation of the recovery rates between the standard cyclone and the high performance cyclone under application-oriented, practical conditions.

When is a high performance cyclone useful?

The tests demonstrate that the differences between the standard cyclone and the high performance cyclone depend heavily on the mill used, the sieve size, and the type of sample.

Results on the ZM 300

With the ZM 300, very similar recovery values are achieved for both cyclone types, especially when using a 0.5 mm or coarser sieve. In these applications, the high performance cyclone offers no significant advantage over the standard cyclone.

But there's a clearer difference with finer sieves, for instance when grinding wood with a 0.25 mm sieve. Here, the high performance cyclone tends to deliver better results: while recovery rates of around 90% were achieved with the standard cyclone, the high performance cyclone achieved almost complete recovery (≈100%).

For less lightweight sample types such as chicken feed, the difference between the two cyclones was smaller, although very high recovery rates were achieved with both overall.

Conclusion for the ZM 300:

The high performance cyclone offers added value, especially with fine sieves (<0.5 mm) and lighter samples. The effect is minimal in standard applications with 0.5 mm sieves or coarser.

Results on the SR 300

When using the SR 300, differences between the standard cyclone and the high performance cyclone become already clearly visible with the **0.5 mm sieve**. Across all tests performed, the high performance cyclone consistently delivered **2–5 % higher material recovery rate**, demonstrating its superior separation performance compared to the standard cyclone.

The performance difference became even more pronounced when **using a 0.25 mm sieve**. In this configuration, the **high performance cyclone achieved a 10–13% higher material recovery** than the standard cyclone, clearly emphasizing the efficiency advantage of the high performance design.

Conclusion for the SR 300:

The high performance cyclone represents a **clear functional advantage**, particularly when working with fine sieves and sensitive sample material. Overall, the SR 300 benefits most significantly from the use of the high performance cyclone.

Results on the SM 300

When processing pre-shredded straw with the SM 300, the performance gap between the cyclone types was initially moderate, with the high performance cyclone delivering around 4% higher material recovery.

More significant effects were observed, especially when processing **very light samples**, such as feathers. Here, the high performance cyclone achieved **up to 25% higher recovery rates**. In all tests, the high performance cyclone performed better than the standard cyclone.

The tests were carried out using 0.5 mm and 0.25 mm sieves. The results indicate that the described effects are particularly pronounced at 0.5 mm sieves and smaller, as differences in separation efficiency become especially evident in this fine particle size range.

Conclusion for the SM 300:

For **light, voluminous, or fibrous samples**, the high performance cyclone is **highly recommended**, especially in combination with fine sieves.

KEY TAKEAWAYS

Based on the test results, the following general guidelines can be established:

- | **The lighter the sample material** (e.g., feathers), the more pronounced the performance advantage of the high performance cyclone over the standard cyclone.
- | **The smaller the sieve used, the more significant the differences** between the two cyclones.
- | Compared to the other models, the **SR 300 shows the strongest dependence** on the type of cyclone used and benefits particularly from the high performance cyclone..

Notes:

In coarse size reduction applications - for example with jaw crushers, hammer mills, or the SK 300 cross beater mill - only minimal performance differences are expected, as cyclone influence plays a less significant role in these processes.



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