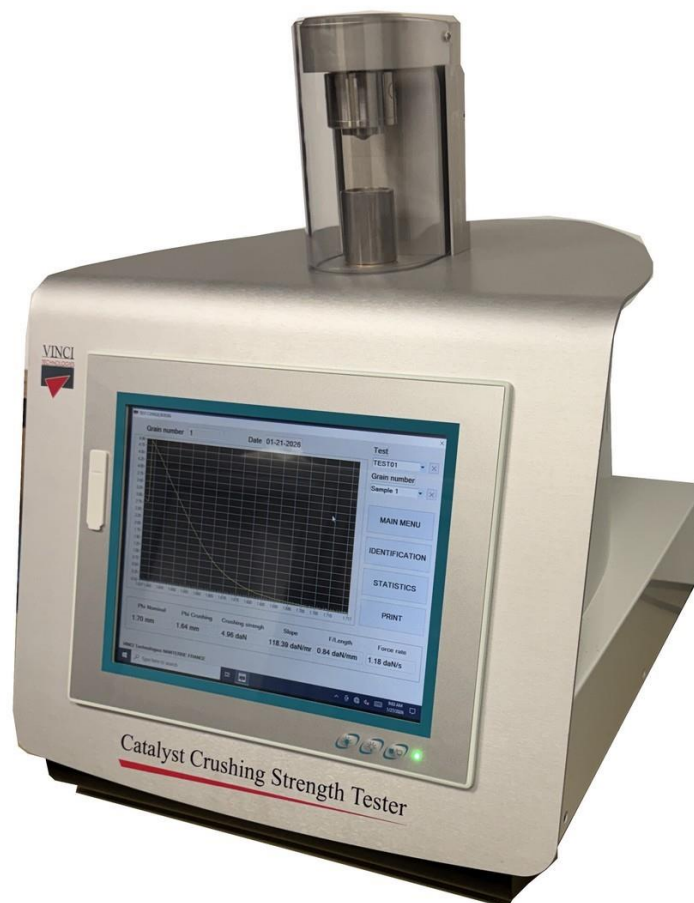


## VCS- Versatile Catalyst Crushing Strength Tester

**Determination of the mechanical resistance of catalysts and catalyst carriers under compressive load**

**In Full Compliance with ASTM D4179, D6175, D7084 & SMS1471**



The VCS – Versatile Catalyst Crushing Strength Tester – is an advanced laboratory instrument designed for the precise determination of the mechanical resistance of catalysts and catalyst carriers under compressive load. The system is compliant with ASTM D4179 for single pellet crushing strength, ASTM D6175 for radial crushing strength of extrudates, ASTM D7084 for bulk crushing strength, and the industry method SMS-1471 for bulk crushing strength using a reduced-volume holding cell. This versatility allows the same equipment to evaluate individual particles as well as bulk catalyst beds, covering spherical beads, pellets, tablets, irregular grains, and cylindrical extrudates.

The instrument is equipped with a high-precision force sensor coupled to an automated motor-driven press that applies a progressively increasing load under controlled conditions. Interchangeable hammer-anvil and holding assemblies, manufactured in stainless steel and standardized in accordance with ASTM dimensional requirements, ensure repeatable and reproducible testing conditions. The integrated Human Machine Interface enables the operator to monitor and record critical parameters such as catalyst nominal diameter, crushing diameter, applied force in decanewtons, crushing slope expressed in daN/mm, loading rate in daN/s, and statistical indicators including minimum, maximum, and standard deviation values for defined sample batches.

Under ASTM D4179, which addresses single catalyst pellet crushing strength, a representative sample consisting typically of 50 to 200 individual particles is first dried at elevated temperature to eliminate moisture and volatile components, then cooled in a desiccator to avoid humidity reabsorption. Each individual grain is subsequently subjected to a gradually increasing compressive load until fracture occurs. The breaking force is recorded in decanewtons and represents the crushing strength of the particle. This method is particularly relevant for spherical or near-spherical catalyst bodies where axial compression defines the dominant failure mechanism.

In accordance with ASTM D6175, which applies to radial crushing strength of extrudates, dried cylindrical extrudates are positioned so that the load is applied along a generating line of the cylinder. The compressive force is progressively increased until rupture occurs. Because geometry influences stress distribution, results are typically expressed in daN per millimeter, allowing normalization relative to extrudate length and ensuring comparability between samples of different dimensions.

ASTM D7084 evaluates bulk crushing strength by subjecting a confined bed of catalyst particles to progressively increasing pressure. A representative dried and sieved sample is introduced into a standardized cylindrical cell of defined volume, after which compressive force is applied at a controlled rate. After each pressure stage, the material is sieved and the fraction of particles passing through the specified mesh is classified as fines. Multiple tests are performed at different pressure levels in order to determine the pressure required to generate 1.0 percent by weight of fines. The bulk crushing strength is calculated as the ratio of the applied force to the cross-sectional area of the sample holder, thereby expressing the result in terms of pressure corresponding to the defined fines threshold.

The SMS-1471 method follows a similar bulk approach but uses a smaller holding cell and introduces calibrated steel balls above the catalyst bed to ensure uniform load transmission. After controlled staged loading, the sample is sieved through a 420-micron mesh, and the pressure required to produce 0.5 percent fines is determined. As with ASTM D7084, the crushing strength is calculated from the applied force divided by the cross-sectional area of the test cell, providing a pressure-based mechanical resistance value.

The VCS tester is compact, with approximate dimensions of 440 × 470 × 555 mm and a weight of about 28 kg, making it suitable for research laboratories, pilot plants, and quality control environments. By integrating single-particle and bulk mechanical resistance measurements within one automated platform, the VCS provides comprehensive characterization of catalyst robustness. This is critical for predicting resistance to breakage during transport, reactor loading, thermal cycling, and operational stress, thereby reducing the risk of fines formation, pressure drop increase, and unplanned shutdowns in industrial units.

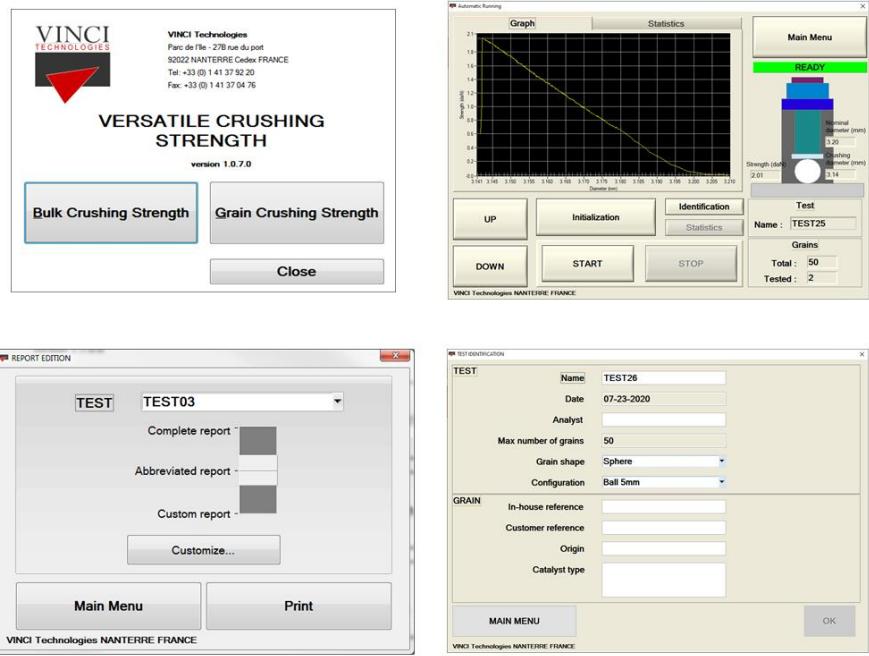


Figure 1: User Interface of the VCS Tester