

## Hall Flow Testing for Metal Powders

### Why test metal powder flow for Additive Manufacturing applications?

The flowability of a metal powder affects its behaviour in Additive Manufacturing (AM) production. Moisture content, morphology, and Particle Size Distribution, among other parameters, can all influence flow. Once a powder has been characterised and optimal parameters designed for a component, any change in the powder's behaviour can have an impact on the mechanical properties of the final built part. If a build fails, testing flowability will give an early indication of whether the issue lies with the powder or the AM machine.

### Why use the Hall Flow test?

The Hall Flow test is conducted to ASTM B213 standard, which includes rigorous requirements for the accuracy of the equipment and its calibration. Metal powder is timed as it flows through the orifice of a Hall Flowmeter funnel. The test can be used to confirm consistency between batches, and to assist investigation of failed builds. If powder flow problems are indicated, the cause can be further examined and costly down time investigating the machine avoided. However, if the expected flow is achieved, analysis of the machine process can be undertaken.

Not all AM machines or applications require a powder to flow through as small an aperture as the Hall Flow funnel, and some fine powders may not flow through the Hall Flowmeter funnel at all. If a larger orifice is required, the Carney Flow test method (ASTM B964) may be used to determine a meaningful flow rate (see Carney Flow datasheet).



### Hall Flow methodology

The test is undertaken in a laboratory environment using specialised equipment which is calibrated every six months. 50 g of powder is taken from the sample provided and measured into a clean weighing dish. The discharge of powder from the orifice at the bottom of the funnel is blocked with a dry finger, and the powder is poured into the funnel without any tapping, vibration, or movement of the funnel. The emptied dish is placed under the funnel, and as the stopwatch is started the finger is simultaneously removed from the funnel orifice.

If the powder fails to start flowing, one light tap on the funnel rim is permitted. The timing device is stopped the instant the last of the powder exits the orifice, and the elapsed time is recorded to the nearest 0.1 s. Three repeat measurements are taken, and the times averaged to give the result.

Typically, end users request a flow/no-flow result, however, the timing data generated can provide a comparison against the powder's historic parameters and previous powder batches to confirm condition.

The analysis reports are returned electronically via LPW's secure, encrypted system and treated in the strictest of confidence.

#### LPW PowderFlow kit

To conduct powder flow testing in your own laboratory or production environment, LPW offers PowderFlow. The PowderFlow kit contains a complete suite of powder flow measurement techniques, allowing the measurement of Apparent Density, Angle of Repose, Hall Flow and Carney Flow to relevant ASTM standards.



#### Additional metal powder and Additive Manufacturing testing services

LPW's PowderLab offers a complete suite of tests for enhanced characterisation of powders, fully optimised for specific applications. With our metal 3D printing industry expertise, we can test AM components in validation studies and root cause analysis of failed builds.

#### Chemical analysis

- Oxygen, nitrogen, and hydrogen analysis by Inert Gas Fusion
- Elemental analysis/Contamination screening (EDX)
- Moisture analysis by Karl Fischer titration

Full Chemical Analysis is available including residual elements and interstitials using various techniques as appropriate, undertaken by ISO17025/Nadcap Approved Lab

#### Physical analysis

A range of physical tests is available including:

- Apparent/Bulk Density (measurement according to ASTM B212)
- Tap Density (ASTM B527)
- Hall Flow (ASTM B213)
- Carney Flow (ASTM B964)
- Angle of Repose (LPW standardised internal procedure)
- Sieve Analysis (ASTM B214)
- Particle Size Distribution by Laser Size Diffraction (ASTM B822)
- Powder Imaging (SEM)
- Powder Cross-Section/Porosity Imaging (SEM)
- Metallographic sample preparation & examination (SEM)
- Rheometry and Shear Cell Analysis
- True Density by Helium Gas Pycnometry (ASTM B923)
- Quantitative Shape Analysis (Optical & SEM)

All testing is undertaken to relevant ASTM as standard with ISO available on request, adding consistency and confidence to your process.

For further information on any of our analytical testing services, please contact your local LPW office at [www.lpwtechnology.com/contact-us/](http://www.lpwtechnology.com/contact-us/) or email [sales@lpwtechnology.com](mailto:sales@lpwtechnology.com)