



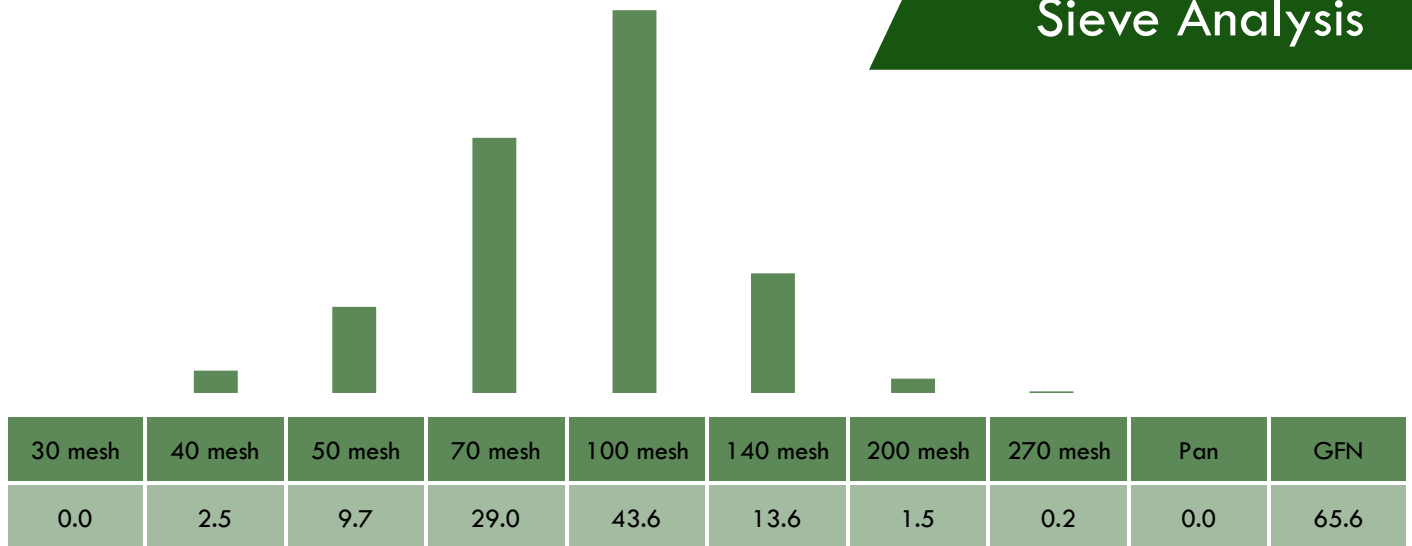
# Badger Printing Sands

*Superior by Nature, Quality by Badger®*

Coming from the highest purity sandstone in North America, Badger Mining's 3D printing sand offers a consistency and quality unmatched in the industry. Our customized mining, washing, drying, and blending processes transform this raw material into the best finished product available in the market.

Our management and manufacturing processes are ISO certified, guaranteeing consistent quality with every load.

## Sieve Analysis



| pH    | Acid Demand Value | Surface Area               | Loss on Ignition | Base Permeability |
|-------|-------------------|----------------------------|------------------|-------------------|
| 7.690 | 0.417             | 107.605 cm <sup>2</sup> /g | 0.089%           | 81.333            |

“The mixing and flowability of the FW65 aggregate performed well in the ExOne S-Max. The material spread consistently and effectively across the print bed. No build up on the recoated swingblade was identified during the limited testing that was completed... the 3D printed Physical Property results indicate that this aggregate is a sufficient and effective option for 3D printing.”

- Characterization of FW65 Aggregate for 3D Printing  
Metal Casting Center, University of Northern Iowa

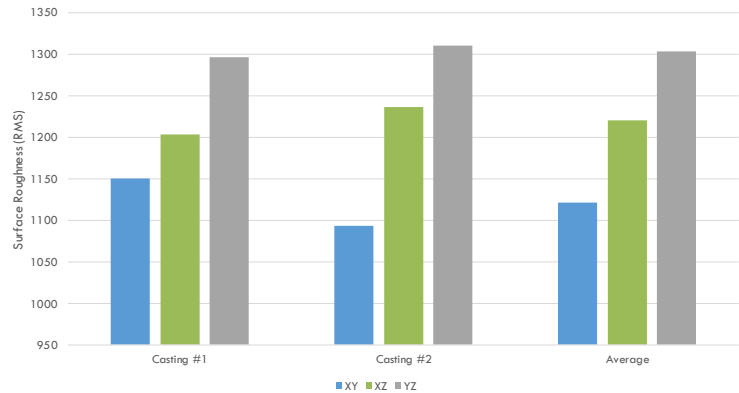
Testing representative of Badger®Sand FW65. Other grades available upon request.

All chemical and physical properties are typical and tested in accordance with AFS Mold and Core Test Handbook using an ExOne S-Max Sand Printer with Furan binder at the University of Northern Iowa. All printing was completed with 100 percent “new” aggregate; no pre-activated “reclaim” aggregate was used.

| Batch Number | 1       | 2       | 3       | 4       | 5       |
|--------------|---------|---------|---------|---------|---------|
| X Res.       | 0.08 mm | 0.10 mm | 0.11 mm | 0.12 mm | 0.14 mm |
| Z Res.       | 0.28 mm | 0.28 mm | 0.28 mm | 0.28 mm | 0.28 mm |
| LOI          | 1.87    | 1.57    | 1.40    | 1.50    | 1.29    |

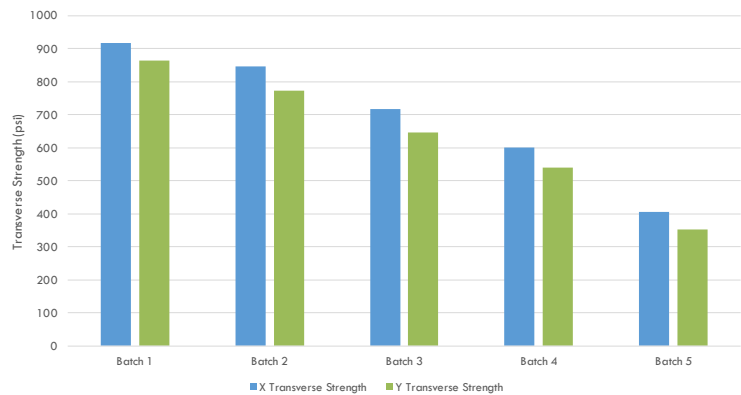
## Surface Roughness

Test molds were designed to measure the surface roughness of cast aluminum against a 3D printed FW65 core. The surface roughness of the test castings was measured using a Taylor-Hobson stylus profilometer. Measurements were repeated seven times for each casting and averaged.



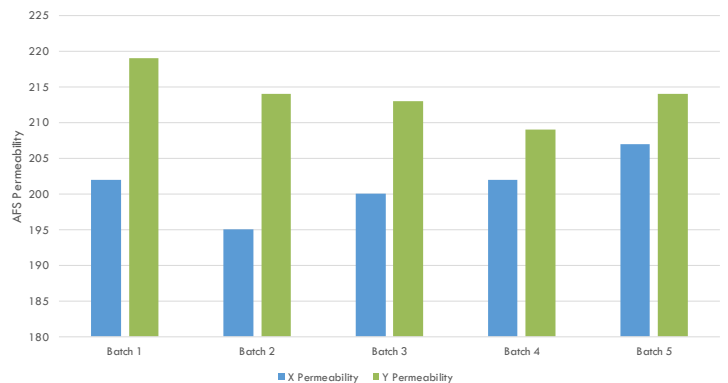
## Transverse Strength

A decrease in the transverse strength mirrors the decrease in binder content. Strength also decreases as X resolution increases. Transverse strengths were measured using a Simpson universal strength tester. Results are an average of 25 samples per batch.



## AFS Permeability

In all five cases, the permeability results were higher than that of the base sand, which is beneficial in reducing gas related defects in castings. Permeability was measured using a Dietert permeability tester. Results are an average of 25 samples per batch.



We give no warranty for our products, either expressed or implied. We recommend that you confirm all properties in the laboratory of your choice.



### Silica Sand and Resin-Coated Silica Sand Products DANGER

These products have been classified, following the Globally Harmonized System (GHS) of Classifying and Labeling Chemicals criteria, as a Category 1A Carcinogen, a Category 1 Specific Target Organ Toxicity (following repeated exposures), and a Category 2B Eye Irritant. For Industrial Use Only. DO NOT USE THIS PRODUCT FOR BLASTING OR AS AN ABRASIVE. DO NOT PNEUMATICALLY UNLOAD THE RESIN-COATED SILICA SAND PRODUCTS AT A PRESSURE EXCEEDING 5 PSI SO AS TO AVOID ABRADING THE PRODUCT. DO NOT BREATHE DUST. Read the specific Safety Data Sheet (SDS) before using and follow applicable local, state and federal health and safety standards. The SDSs for the products are available online at [www.badgerminingcorp.com](http://www.badgerminingcorp.com) or by calling 715-662-2400. October 22, 2016 Revision E