



September 17, 2019

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Subject: **Final Report of ASTM C331  
Carolina Stalite Fine Lightweight Aggregate (D-Tank)  
TEC Services Project No: 04-0574  
TEC Services Sample ID: 19-456**

Dear Mr. Wall:

Testing, Engineering & Consulting Services, Inc. (TEC Services) is an AASHTO R18, ANS/ISO/IEC Standard 17025:2005 and is an Army Corps of Engineers accredited laboratory. TEC Services is pleased to present this report of our testing on the fine lightweight aggregate submitted to our laboratory in April of 2019. The results of this testing pertain only to the samples tested. The aggregate was tested in accordance to ASTM C331-14 *Standard Specification for Lightweight Aggregates for Concrete Masonry Units* as authorized by the service agreement (TEC-PRO-04-0574) dated March 2005.

This specification covers lightweight aggregates intended for use in concrete masonry units when a prime consideration is to reduce the density of the units. The maximum and minimum requirements for this specification are presented in Section 4 *Chemical Composition* and Section 5 *Physical Properties* of ASTM C331 and are listed in Table 1. Based on the results, the D-Tank Fine lightweight aggregate (Gold Hill, NC) from Carolina Stalite submitted to our laboratory meet and/or exceeds the requirements of ASTM C331-17.



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**Table 1: Summary of Test Results**

<b>Section 5 - Chemical Composition</b>	<b>Test Results</b>	<b>ASTM C331 Requirements</b>
Organic Impurities (Color change)	<1	3 max
Staining (Stain index)	0	60 max
Loss on Ignition	0.26	5% max
<b>Section 6 – Physical Properties</b>		
Clay Lumps and Friable Particles (Dry mass)	0.2	2% max
Bulk Density (Loose) lbs/ft <sup>3</sup>	64	70
Relative Density (Specific Gravity – Wetted Surface Dry)	1.888	----
72-Hour Absorption	10.2%	----
Drying Shrinkage at 100 Days	-0.062	-0.10% max
Popouts	0	0 max
Grading	See Table 3	

## Test Results

### Organic Impurities

Organic impurities were determined in accordance with ASTM C40-19 *Standard Test Method for Organic Impurities in Fine Aggregates for Concrete*. The presence of organic impurities were evaluated by comparing the color of the supernatant liquid of the test sample to the Organic Plate Glass Color Standard; if the color of the supernatant liquid is darker than Organic Plate No. 3 the fine aggregate shall be considered to possibly contain injurious organic impurities. The D-Tank fine lightweight aggregate produced a supernatant liquid lighter in color than Organic Plate No. 1 indicating that the aggregate does not contain injurious organic impurities.

### Iron Staining

Potential of staining from iron compounds was determined in accordance with ASTM C641-17. The visual classification method was used, and we determined that the filter paper after test most resembled the staining index of 0 which is the lowest staining reference. The maximum allowed visual staining index allowed by C331 is 60.

### Loss on Ignition

Loss on ignition is determined in accordance with ASTM C114-15. Loss on ignition of the D-Tank Fine Lightweight aggregate is 0.26

**Clay Lumps and Friable Particles**

Testing for clay lumps and friable particles were determined in accordance with ASTM C142-17. Test results are reported in Table 2.

**Table 2: Clay Lumps and Friable Particles**

Size of Particles Making Up Sample	Grading of Original Sample (% Retained)	Mass of Test Fractions Before Test (g)	% Passing Designated Sieve After Test	Weighted Percent Loss
No.16 to No.4 (1.18mm to 4.75 mm)	57.5	26.1	0.3	0.2
<b>Total Weighted % Loss</b>				<b>0.2</b>

**Grading**

The grading shall be by mutual agreement between interested parties. The Grading and the suggested range are reported in Table 3.

**Table 3: Grading and Suggested Range**

Sieve Size	% Retained Each Sieve	ASTM C331 Suggested Range
3/8 in	0	0-2
No. 4	3.8	0-10
No. 8	27.2	15-35
No. 16	26.5	15-35
No. 30	14.7	5-20
No. 50	10.2	5-15
No. 100	6.5	5-15
Pan	14.7	8-20

**Bulk Density (dry-loose)**

The dry, loose bulk density of the aggregate was tested in accordance with ASTM C29 – 17a *Standard Test Method for Bulk Density (Unit Weight) & Voids in Aggregate*. The bulk density was determined to be 64 lbs/ft<sup>3</sup>. The maximum bulk density for fine aggregate allowed in ASTM C331 is 70 lbs/ft<sup>3</sup>.

**Specific Gravity & Absorption**

The density factor was tested in accordance with ASTM C128 - 15 *Standard Test Method for Density, Relative Density (Specific Gravity) & Absorption of Fine Aggregate*. The sample was dried to a constant mass and soaked for 72 hours. The specific gravity and absorption is reported in Table 4.

**Table 4: Specific Gravity & Absorption**

Absorption after 72-hour Soak (percent)	Relative Density (Specific Gravity) (OD)	Relative Density (Specific Gravity) (SSD)
10.2	1.712	1.888

A concrete mixture containing the D-Tank Fine lightweight aggregate was batched in order to make test samples for drying shrinkage and popouts per ASTM C331. The material sources and amount of material used in the concrete mix are presented in Table 5.

### Concrete Mix Proportions

**Table 5: Mix Proportions**

Material	Source	Batch Weights lbs.
Cement	Lehigh, Leeds	6.96
Fine Lightweight Aggregate	D-Tank, Carolina Stalite	26.53
Water	Lawrenceville City Water	7.85
Total		41.34

*NOTE: Concrete had a slump of 2.25 inches*

### Drying Shrinkage

Three length change beams (2" x 2" x 11¼") were moist cured for seven days. Upon the completion of the moist curing, an initial reading was obtained, and was used as the base length for the drying shrinkage calculations. The samples were then placed in a curing cabinet maintained at 73.5 ± 3.5°F with a relative humidity of 50 ± 5%. Drying shrinkage shall not exceed 0.10 % at 100 days. The results are reported in Table 6.

**Table 6: Drying Shrinkage at 28 days and 100 days.**

Concrete Age	28 Days	100 Days
Curing Method	Air Cured	Air cured
Date	07-02-2019	09-12-2019
Sample ID	Length Change (%)	Length Change (%)
1	-0.050	-0.063
2	-0.052	-0.060
3	-0.050	-0.062
<b>Average</b>	-0.051	-0.062

**Popouts**

Requirement – There shall be no popouts observed after test concrete made with the tested lightweight aggregate is subjected to an autoclave in accordance with ASTM C151-18 *Standard Test Method for Autoclave Expansion of Hydraulic Cement*. No popouts were observed.

We appreciate the opportunity to provide our services to you on this project. Should you have any questions or comments regarding this report, please feel free to contact us at your convenience

Sincerely,

**SGS TEC Services**



Steven Maloof  
Laboratory Principal/Sr. Project Manager



Brian Smith  
Project Manager