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**SIEVE ANALYSIS, BULK DENSITY,
SPHERICITY AND ROUNDNESS
& CRUSH RESISTANCE**

SAMPLE: A12

JAN DE NUL NV

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SUMMARY

The following proppant sample was provided for testing by the client, Jan De Nul: A12, which was received on the 2nd February 2017. The sample was sieved to 30/50 and 40/70 from the provided wider range sample.

Testing was carried out in accordance with the ISO 13503-2 suite of tests, covering crush resistance, bulk density, sphericity and roundness and sieve analysis.

A summary of results obtained from the ISO 13503-2 suite of tests is tabulated overleaf and the full results are presented in the main report.

Photomicrographs are given in Appendix A.

Parameters		A12	
		30/50	40/70
Crush Test (psi)	5000	7.3	
	6000	9.2	
	7000	14.0	7.1
	8000		9.3
	9000		12.2
K Value		6000psi	8000psi
Sphericity		0.7 ± 0.1	0.7 ± 0.2
Roundness		0.6 ± 0.1	0.7 ± 0.1
Sieve Analysis (20/40)		30.7 ± 0.4	
Sieve Analysis (30/50)		69.2 ± 0.4	
Sieve Analysis (40/70)		61.6 ± 0.1	
Sieve Analysis (70/100)		3.3 ± 0.0	
Mean Size (mm)		0.226 ± 0.001	
Bulk Density (g/cm ³)		1.55 ± 0.00	

Table i: Summary of API RP 60 & ISO 13503-2 Test Suite on Proppant Samples

1. EXPERIMENTAL PROCEDURES

1.1 ISO 13503-2 Methods

The following tests were performed in exact accordance with the ISO 13503-2 procedures. The relevant sections are as follows:

Section	Test/Procedure
5.2	Sample Splitting
6	Sieve Analysis
7	Sphericity and Roundness
10.3	Bulk Density
11	Crush Resistance (2" cell used with pluviator)*

Table 1: ISO Procedures

*Crush testing was carried out at pressures 5000, 6000, 7000psi for the 30/50 and 7000, 8000 and 9000psi for the 40/70.

2. RESULTS

2.1 Sieve Analysis Results

The result of the sieve analysis is tabulated below:

ASTM Mesh	A12			
	% Proppant (A) by weight	% Proppant (B) by weight	% Average by weight	Standard Deviation
+16	2.51	1.76	2.1	0.5
-16 +20	1.65	1.93	1.8	0.2
-20 +25	2.31	2.46	2.4	0.1
-25 +30	4.13	4.11	4.1	0.0
-30 +35	7.98	8.06	8.0	0.1
-35 +40	15.96	16.37	16.2	0.3
-40 +45	25.93	26.03	26.0	0.1
-45 +50	19.04	19.00	19.0	0.0
-50 +60	11.23	11.06	11.1	0.1
-60 +70	5.41	5.40	5.4	0.0
-70 +100	3.36	3.33	3.3	0.0
-100	0.48	0.48	0.5	0.0
Total	100.0	100.0	100.0	
%20/40	30.4	31.0	30.7	0.4
%30/50	68.9	69.5	69.2	0.4
%40/70	61.6	61.5	61.6	0.1
%70/100	3.4	3.3	3.3	0.0
Mean Size(mm)	0.227	0.225	0.226	0.001

Table 2: Sand A12 Sieve Analysis Results

2.2 Bulk Density Results

The results of the bulk density are tabulated as follows:

Sample Name	Bulk Density (g/cm ³)	Standard Deviation (g/cm ³)
A12	1.55	0.00

Table 3: Bulk Density Results

2.3 Sphericity & Roundness Results

A12 (30/50)		
Sample Reference	Sphericity	Roundness
1	0.7	0.7
2	0.7	0.5
3	0.7	0.5
4	0.7	0.5
5	0.7	0.7
6	0.7	0.7
7	0.7	0.7
8	0.9	0.5
9	0.9	0.5
10	0.7	0.7
11	0.7	0.5
12	0.9	0.5
13	0.7	0.7
14	0.9	0.7
15	0.9	0.7
16	0.7	0.7
17	0.5	0.7
18	0.7	0.5
19	0.7	0.7
20	0.7	0.5
	Mean = 0.7	Mean = 0.6
	Standard Deviation = 0.1	Standard Deviation = 0.1

Table 4: Sand A12 (30/50) Sphericity & Roundness Results

A 12 (40/70)		
Sample Reference	Sphericity	Roundness
1	0.7	0.7
2	0.9	0.7
3	0.7	0.7
4	0.9	0.5
5	0.5	0.7
6	0.7	0.5
7	0.9	0.7
8	0.9	0.7
9	0.7	0.7
10	0.5	0.7
11	0.7	0.5
12	0.9	0.7
13	0.7	0.5
14	0.9	0.7
15	0.9	0.7
16	0.7	0.5
17	0.7	0.7
18	0.5	0.7
19	0.5	0.7
20	0.9	0.7
	Mean = 0.7	Mean = 0.7
	Standard Deviation = 0.2	Standard Deviation = 0.1

Table 5: Sand A12 (40/70) Sphericity & Roundness Results

2.4 Crush Resistance Results

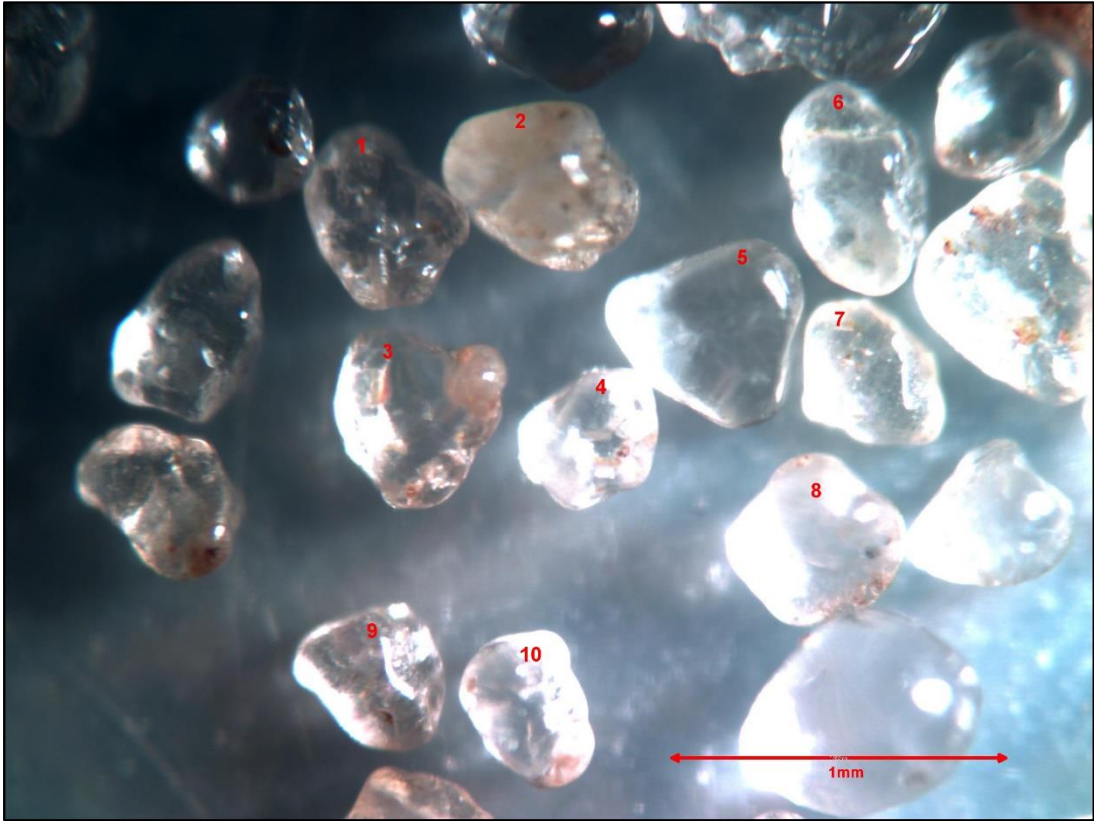
The results of the Crush Resistance tests are tabulated below:

Crush Test (% fines, by mass)			
Parameters		A12 (30/50)	A12 (40/70)
Stress (psi)	5000	7.3	
	6000	9.2	
	7000	14.0	7.1
	8000		9.3
	9000		12.2
K Value		6000psi	8000psi

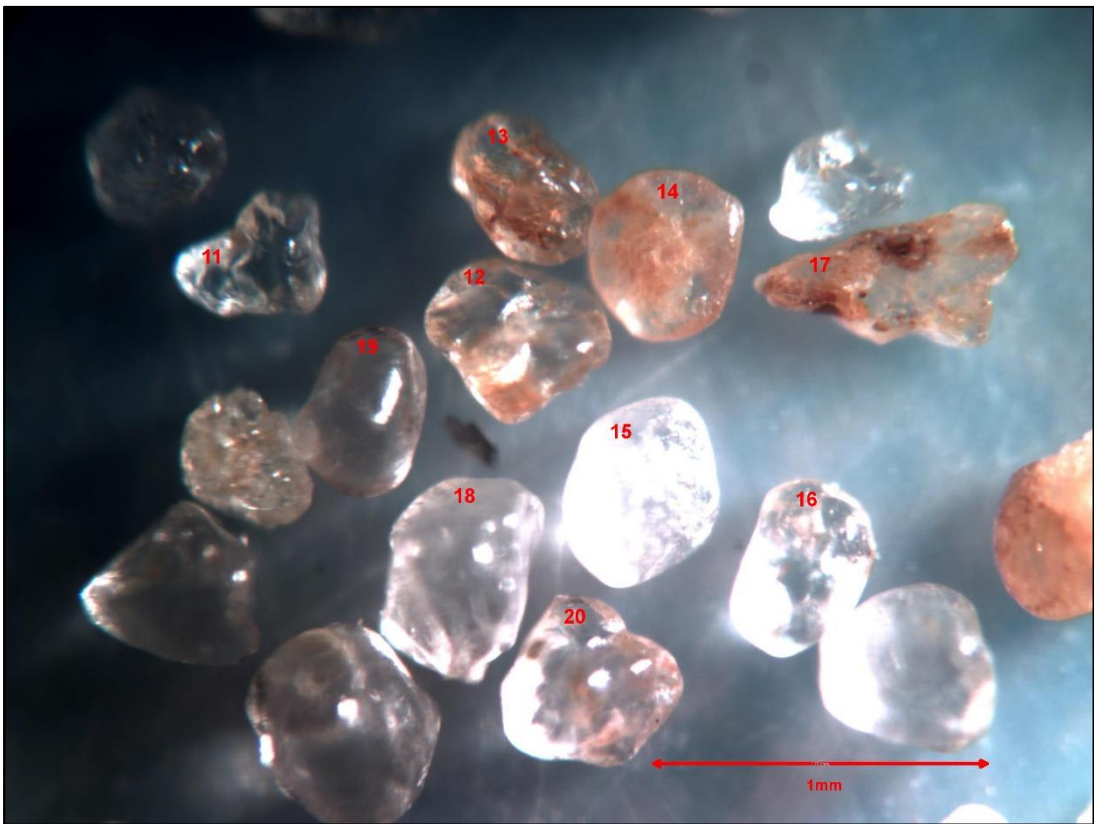
Table 6: Crush Resistance Results Sand A12 (30/50), (40/70)

APPENDIX A

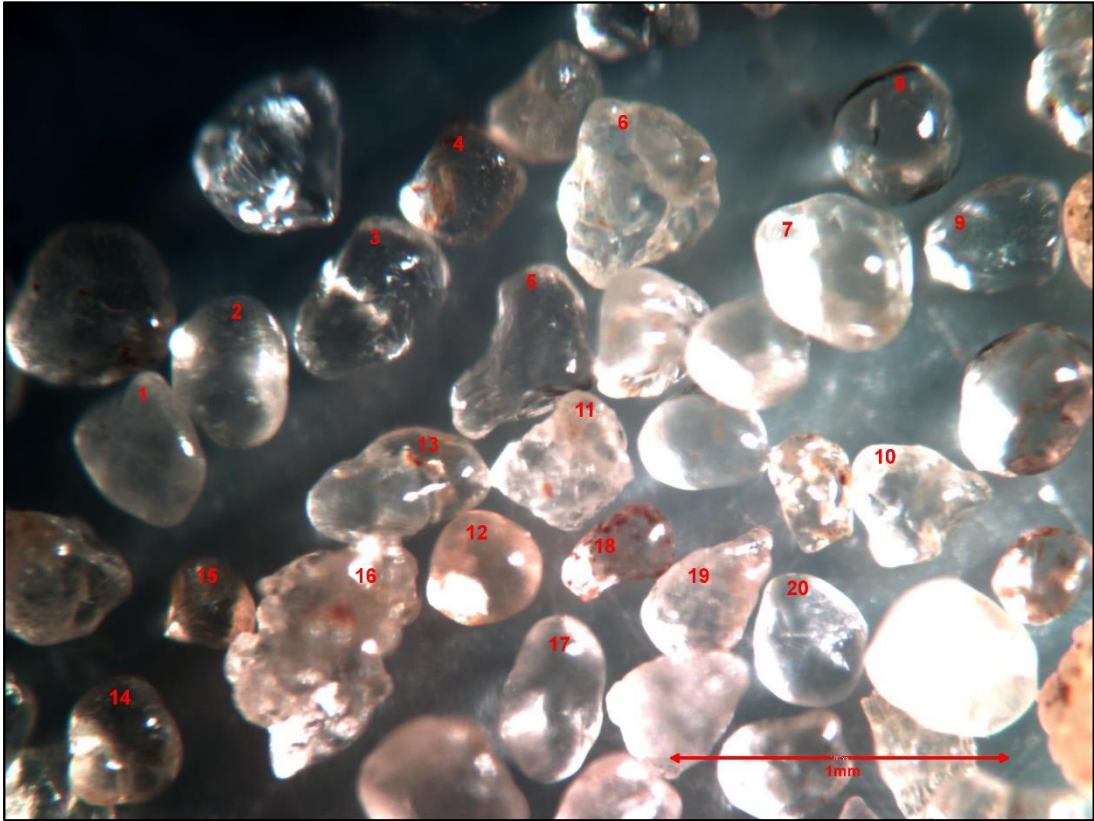
Photomicrographs of Test Samples



Sample A12 (30/50)



Sample A12 (30/50)



Sample A12 (40/70)