

## Report

### DEM Testing of Spodumene Concentrate Materials

Pilbara Minerals

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14/08/2024	0	Initial release
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The data provided has been certified and reviewed by: \_\_\_\_\_ Talita Meintjes, Lab-Coordinator \_\_\_\_\_

## 1. INTRODUCTION

Pilbara Minerals has contracted Jenike & Johanson Pty Ltd (J&J) to perform dust extinction moisture (DEM) testing on various spodumene concentrate materials as described below:

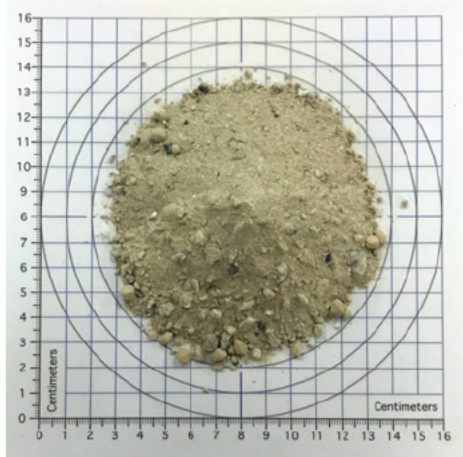
- DEM/SAMP2406/BLEND
- DEM/SAMP2405/COARSE
- DEM/SAMP2404/FINES

## 2. FLOW PROPERTIES TEST PROGRAM

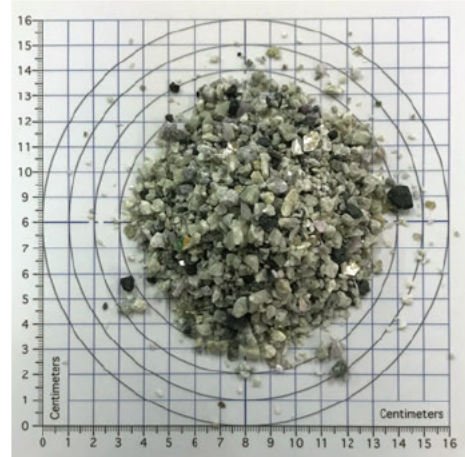
J&J received 3 buckets (one for each sample) of materials for testing. All the samples were received in 25L buckets. The buckets for each material type were split to generate homogenised representative subsamples for DEM tests.

Grid photos of the materials used for the test work are shown below.

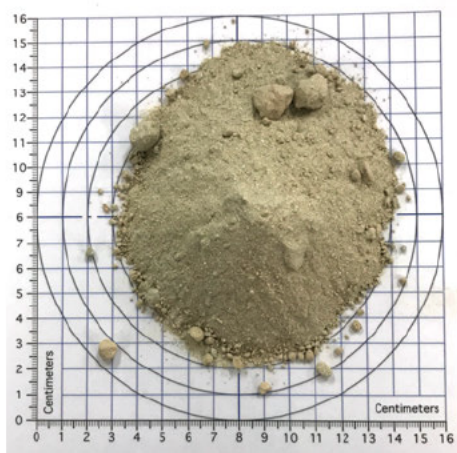
Figure 1: Photos of the as-received materials



DEM/SAMP2406/BLEND



DEM/SAMP2405/COARSE



DEM/SAMP2404/FINES

Tests were performed on the samples at their as received and adjusted moisture contents<sup>1</sup> (mc). The as-received moisture contents of the samples are shown Table 1.

Table 1: Summary of as received moisture contents	
Material	As received moisture content [%]
DEM/SAMP2406/BLEND	0.12
DEM/SAMP2405/COARSE	0.08
DEM/SAMP2404/FINES	0.11

The scope of the test work is:

1. Particle size analysis
2. Dust extinction moisture testing

### 3. SUMMARY OF FLOW PROPERTIES

Highlights of the test results are discussed below for an illustration of the materials' characteristics. The complete test results are contained in the report following the summary section. An Appendix section is included at the end of the report which provides information on the methods used and underlying concepts involved.

#### 3.1. Particle size analysis

A particle size distribution was determined for each as-received material, using a dry sieving method (Ro-Tap, with tapping, 5 minutes total time). The material was dried prior to sieving.

The calculated P20, P50 and P90 sizes are summarized in Table 2:

Table 2: Particle size distribution test results summary			
Material	P20, mm	P50, mm	P90, mm
DEM/SAMP2406/BLEND	0.065	0.200	4.163
DEM/SAMP2405/COARSE	1.730	2.803	5.259
DEM/SAMP2404/FINES	0.048	0.092	0.200

#### 3.2. Dust extinction moisture (DEM) test

A rotating drum dust test was performed on Fines, Coarse and Blend Spodumene to investigate the effects of moisture content on dust generation. This test is conducted using a rotating drum, based on Australian standard AS 4156.6 - 2000.

The test determines a dust number (mass of dust collected divided by original mass of sample multiplied by 100,000) for various moisture contents. The dust numbers are plotted on a log scale against their respective moisture contents on a linear scale to produce a dust/moisture curve.

The standard identifies the dust extinction moisture as the moisture at which a dust number of 10 is attained on the dust/moisture curve. The curve, along with field experience and dust

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<sup>1</sup> Moisture values were determined by drying small samples at 107 °C in a forced convection oven until no change in mass was observed. The loss in weight of each sample, divided by its original weight before drying, is denoted as the moisture.



emission goals, can be used to select a moisture content limit that suits your applications and establish operating and monitoring practices that may be required.

Table 3: Dust extinction moisture test results of railed products	
Material	Dust Extinction Moisture [%]
DEM/SAMP2406/BLEND	3.74
DEM/SAMP2405/COARSE	0.87
DEM/SAMP2404/FINES	9.20

Full results of the test work are provided in the Appendix.

#### 4. TEST REPORT TABLES, PLOTS, AND APPENDIX

Detailed tables and plots of the test results are shown in the pages that follow.

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## Disclaimer

The information contained in this Flow Properties Test Report contains test results only and does not take into account the specific design requirements, needs, and circumstances of any particular storage, handling, and conveying application. The information enclosed must not be used for design purposes without consultation with an appropriately skilled and qualified bulk material handling professional, taking into account specific design requirements, circumstances, and risks.

All Calculated Design Parameters in this report represent limiting conditions for flow.

## Part II

# Test Results

Bulk material 1	DEM/SAMP2406/BLEND
Moisture content	As Rec'd
Particle size	-6.3 mm

Proj #72830A - ID #19252

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**Bulk Material 1**

**DEM/SAMP2406/BLEND**



Bulk material 1 DEM/SAMP2406/BLEND

Moisture content As Rec'd

Particle size -6.3 mm

Proj #72830A - ID #19252

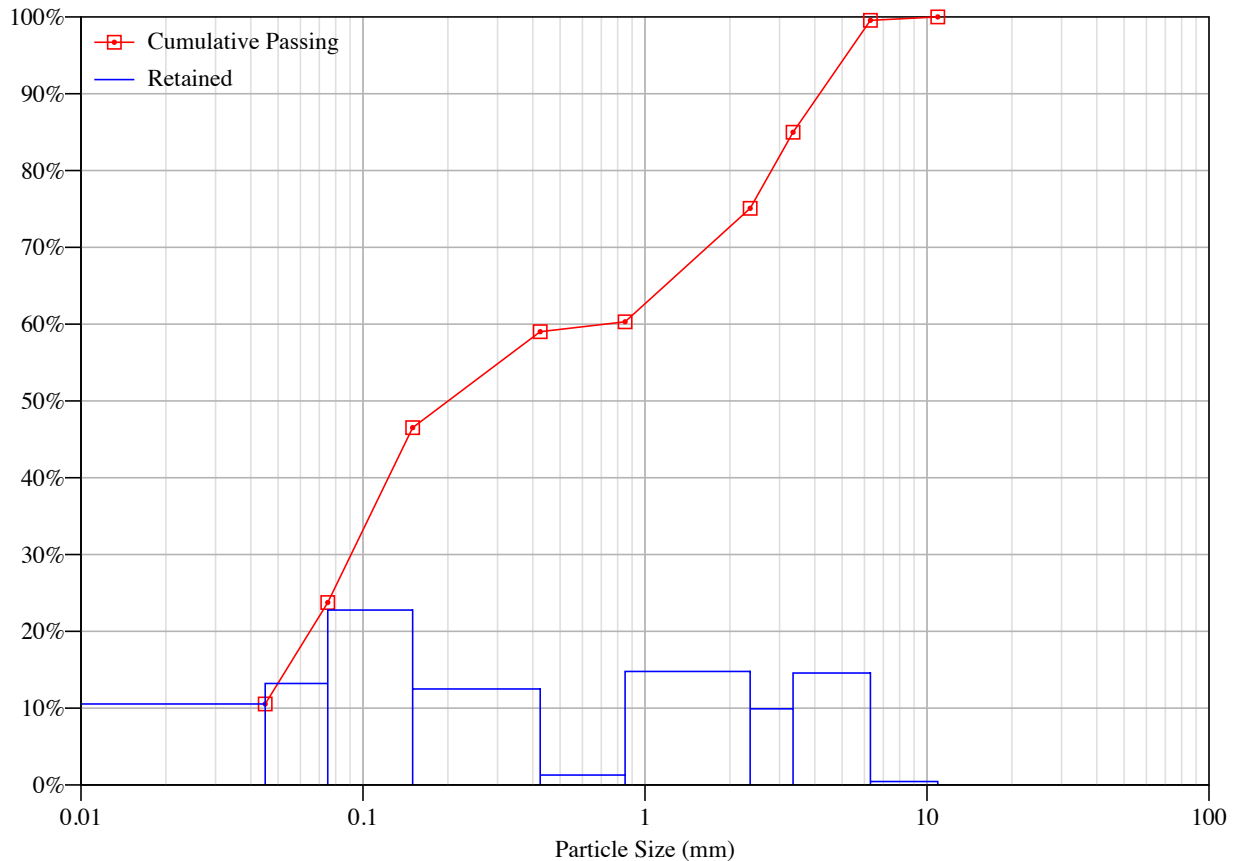
## Particle Size Distribution

### Particle Size Distribution By Sieving

Table 1.1: Reference via Ro-Tap w/ taper

Sieve name	Size	Retained %	Particle	Size
ISO 6.30 mm	6.3 mm	0.44	p <sub>20</sub>	65 $\mu$ m
ISO 3.35 mm	3.35 mm	14.57	p <sub>50</sub>	200 $\mu$ m
ISO 2.36 mm	2.36 mm	9.91	p <sub>80</sub>	2.809 mm
ISO 850 $\mu$ m	850 $\mu$ m	14.78	p <sub>90</sub>	4.163 mm
ISO 425 $\mu$ m	425 $\mu$ m	1.29		
ISO 150 $\mu$ m	150 $\mu$ m	12.49		
ISO 75 $\mu$ m	75 $\mu$ m	22.77		
ISO 45 $\mu$ m	45 $\mu$ m	13.21		
PAN	0 $\mu$ m	10.54		
	Total	100.00		
	Sieving Yield	99.81		
	Initial Total Mass	1.47 kg		

Figure 1.1: Particle size distribution, by mass



**Bulk material 1** DEM/SAMP2406/BLEND  
**Moisture content** As Rec'd  
**Particle size** -6.3 mm      Proj #72830A - ID #19252

## Dust extinction moisture

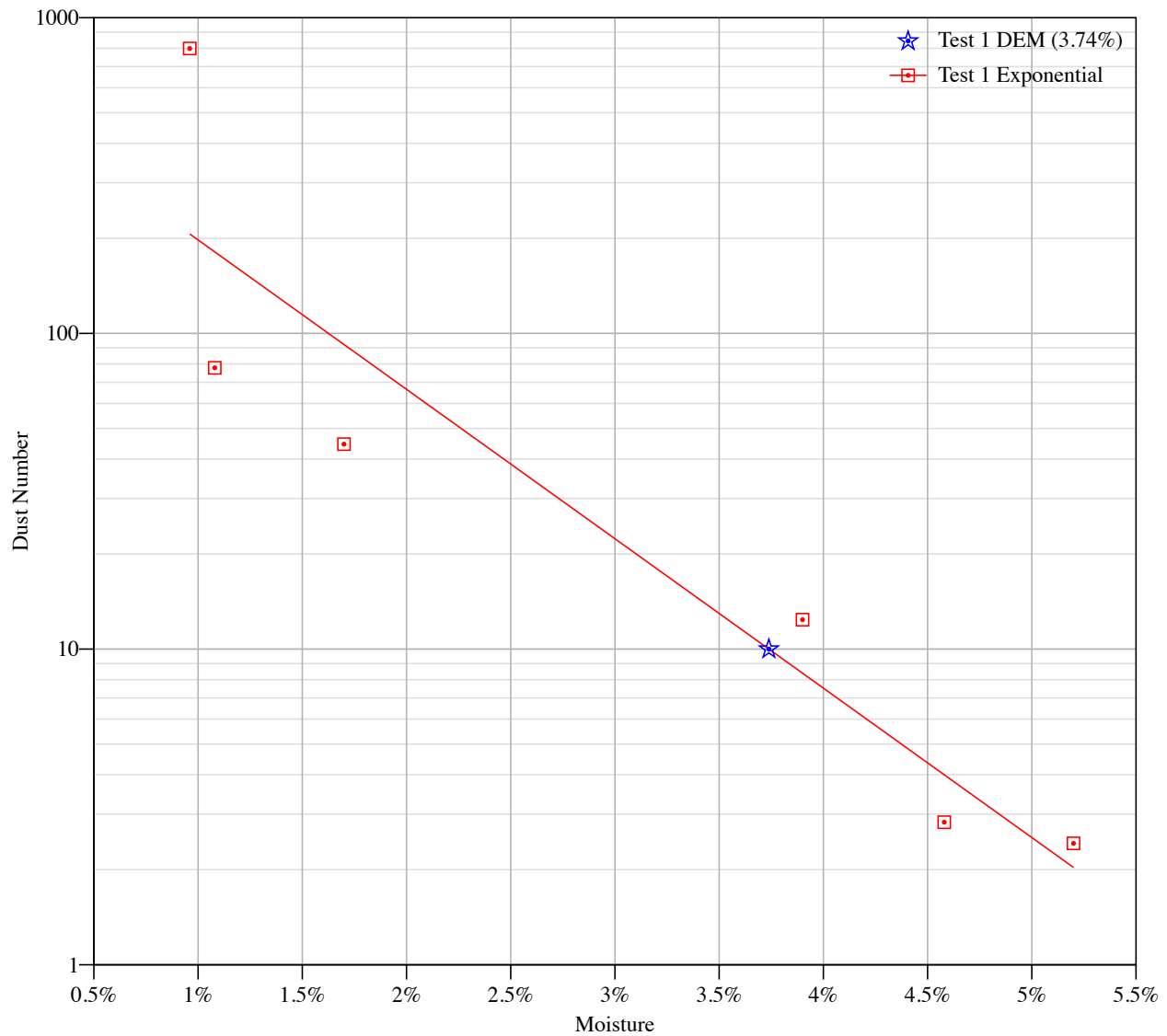
### Test 1

The dust extinction moisture is 3.74%

Table 1.2: Dust Extinction Moisture

Initial Moisture %	Final Dust Number
5.20	2
4.58	3
3.90	12
1.70	45
1.08	78
0.96	799

Figure 1.2: Dust extinction moisture curve



<b>Bulk material 2</b>	DEM/SAMP2405/COARSE
<b>Moisture content</b>	As Rec'd
<b>Particle size</b>	-6.3 mm

Proj #72830A - ID #19253

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## **Bulk Material 2**

# **DEM/SAMP2405/COARSE**

Bulk material 2 DEM/SAMP2405/COARSE

Moisture content As Rec'd

Particle size -6.3 mm

Proj #72830A - ID #19253

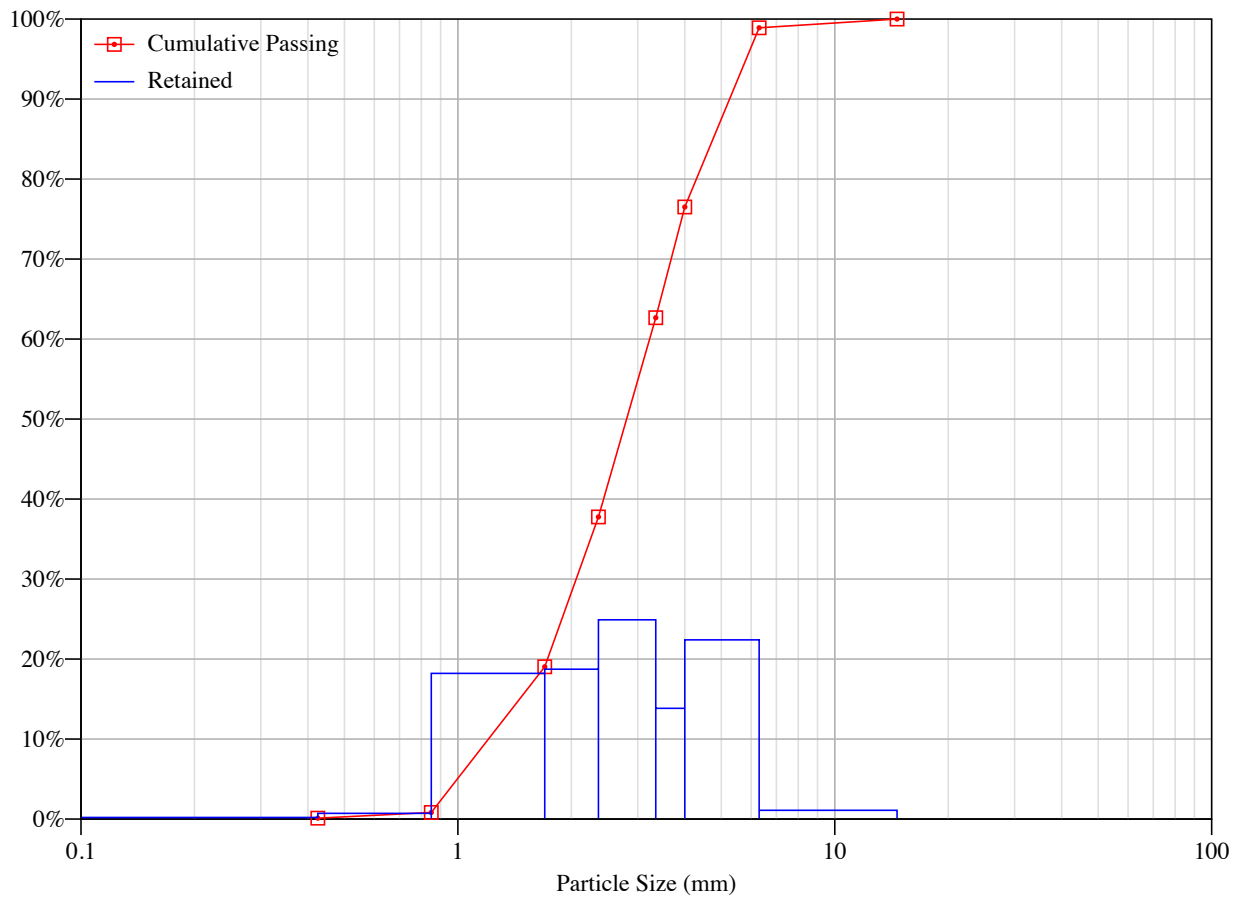
## Particle Size Distribution

### Particle Size Distribution By Sieving

Table 2.1: Reference via Ro-Tap w/ taper

Sieve name	Size	Retained %	Particle	Size
ISO 6.30 mm	6.3 mm	1.09	p10	1.21 mm
ISO 4.00 mm	4 mm	22.40	p20	1.73 mm
ISO 3.35 mm	3.35 mm	13.84	p50	2.803 mm
ISO 2.36 mm	2.36 mm	24.90	p80	4.294 mm
ISO 1.70 mm	1.7 mm	18.73	p90	5.259 mm
ISO 850 $\mu$ m	850 $\mu$ m	18.21		
ISO 425 $\mu$ m	425 $\mu$ m	0.71		
PAN	0 $\mu$ m	0.11		
	Total	100.00		
	Sieving Yield	99.96		
	Initial Total Mass	1.63 kg		

Figure 2.1: Particle size distribution, by mass



**Bulk material 2**    DEM/SAMP2405/COARSE  
**Moisture content**    As Rec'd  
**Particle size**       -6.3 mm       Proj #72830A - ID #19253

## Dust extinction moisture

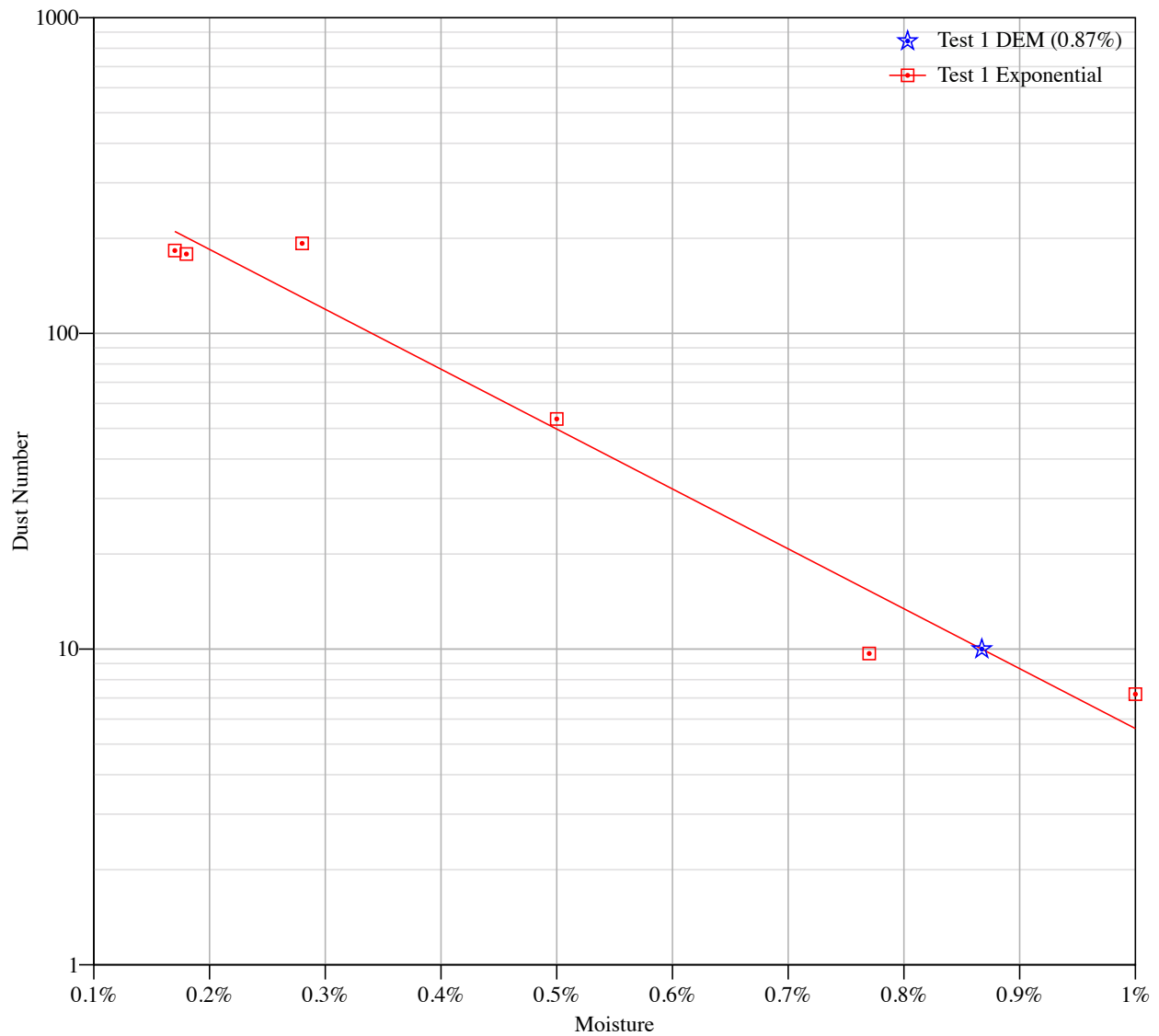
### Test 1

The dust extinction moisture is 0.87%

Table 2.2: Dust Extinction Moisture

Initial Moisture %	Final Dust Number
1.00	7
0.77	10
0.50	54
0.28	193
0.18	178
0.17	183

Figure 2.2: Dust extinction moisture curve



<b>Bulk material 3</b>	DEM/SAMP2404/FINES
<b>Moisture content</b>	As Rec'd
<b>Particle size</b>	-6.3 mm

Proj #72830B - ID #19251

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**Bulk Material 3**

**DEM/SAMP2404/FINES**

Bulk material 3 DEM/SAMP2404/FINES

Moisture content As Rec'd

Particle size -6.3 mm

Proj #72830B - ID #19251

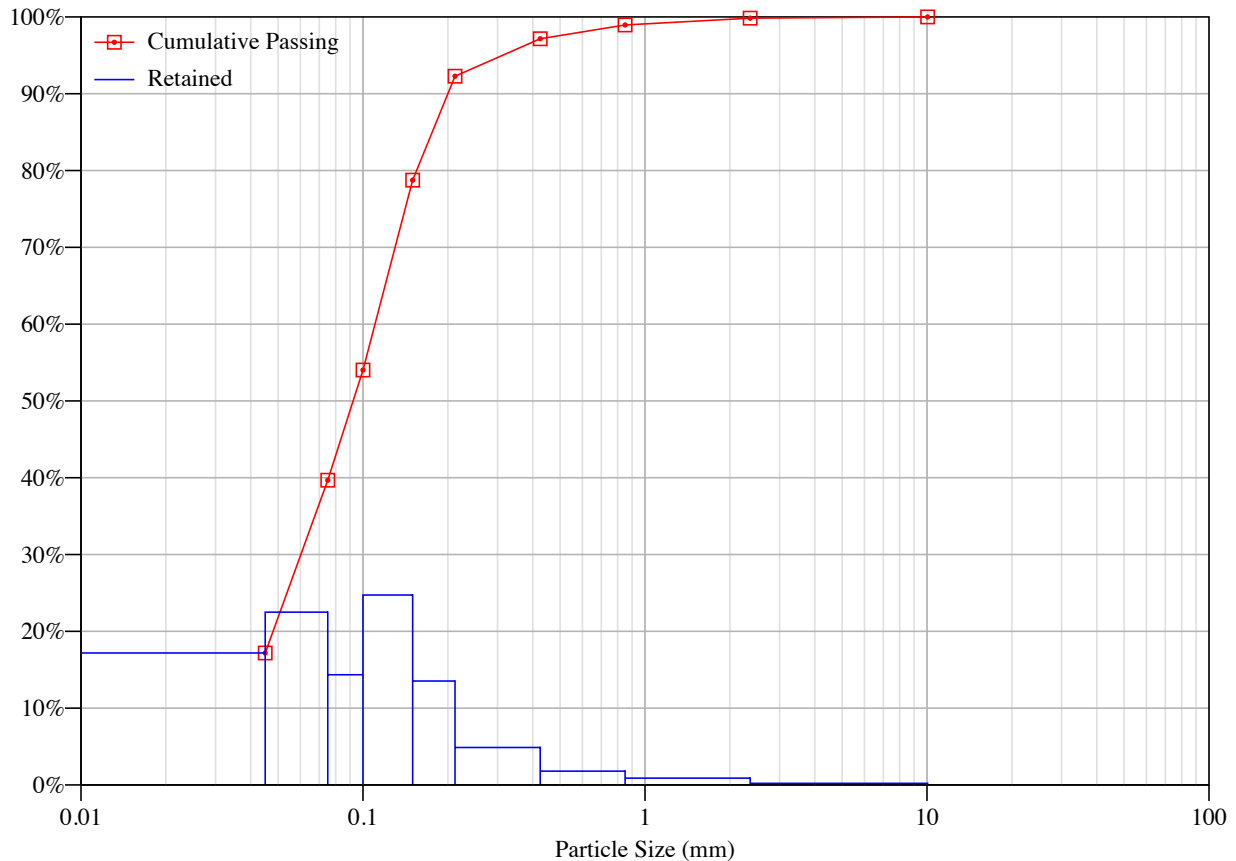
## Particle Size Distribution

### Particle Size Distribution By Sieving

Table 3.1: Reference via Ro-Tap w/ taper

Sieve name	Size	Retained %	Particle	Size
ISO 2.36 mm	2.36 mm	0.16	$p_{20}$	48 $\mu m$
ISO 850 $\mu m$	850 $\mu m$	0.88	$p_{50}$	92 $\mu m$
ISO 425 $\mu m$	425 $\mu m$	1.80	$p_{80}$	150 $\mu m$
ISO 212 $\mu m$	212 $\mu m$	4.88	$p_{90}$	200 $\mu m$
ISO 150 $\mu m$	150 $\mu m$	13.53		
ISO 100 $\mu m$	100 $\mu m$	24.73		
ISO 75 $\mu m$	75 $\mu m$	14.35		
ISO 45 $\mu m$	45 $\mu m$	22.50		
PAN	0 $\mu m$	17.18		
	Total	100.00		
	Sieving Yield	99.85		
	Initial Total Mass	1.18 kg		

Figure 3.1: Particle size distribution, by mass





Bulk material 3 DEM/SAMP2404/FINES

Moisture content As Rec'd

Particle size -6.3 mm

Proj #72830B - ID #19251

## Dust extinction moisture

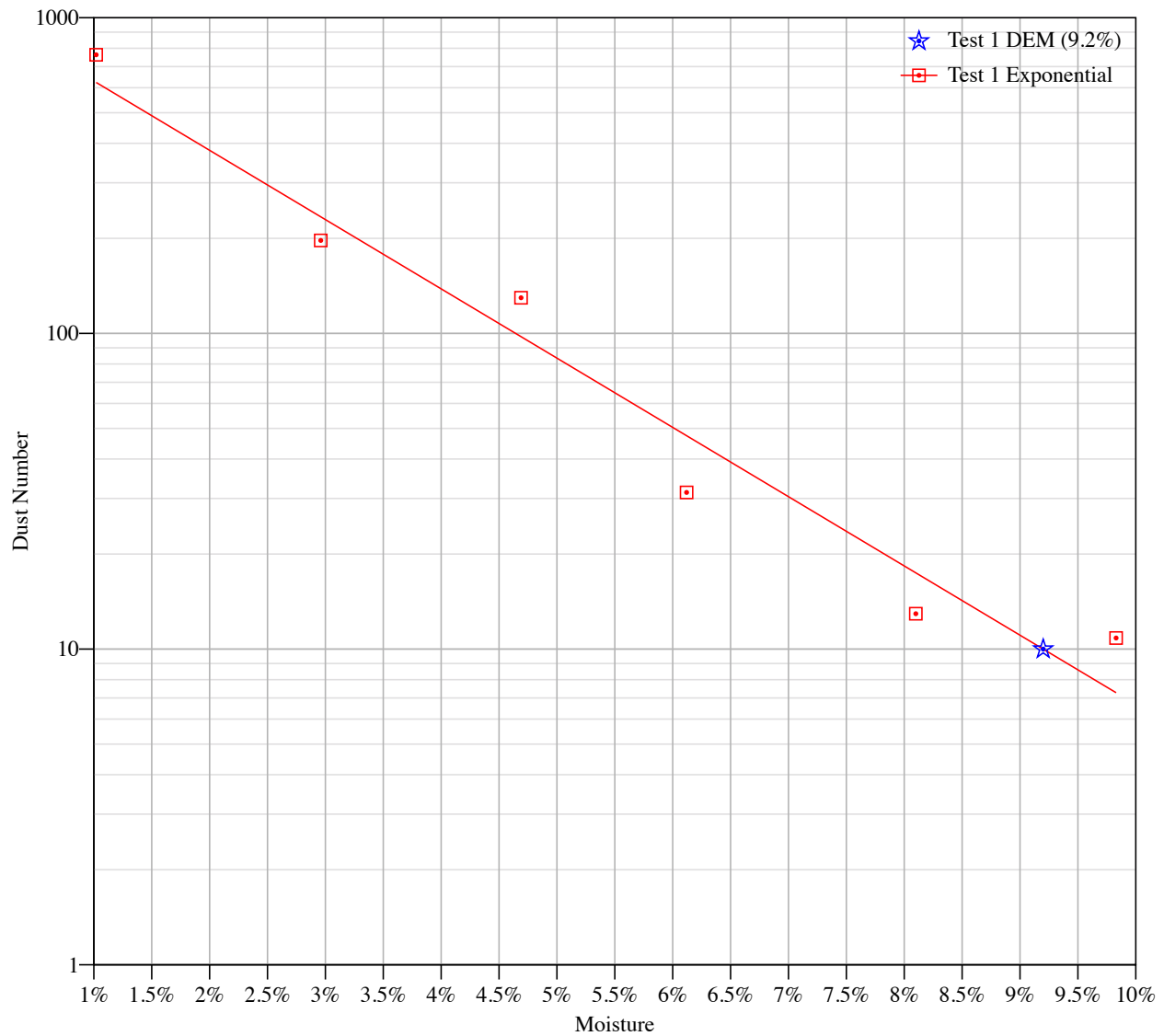
### Test 1

The dust extinction moisture is 9.20%

Table 3.2: Dust Extinction Moisture

Initial Moisture %	Final Dust Number
9.83	11
8.10	13
6.12	31
4.69	130
2.96	197
1.02	763

Figure 3.2: Dust extinction moisture curve



## Part III

# Appendix

## Particle Size Distribution

### Sieving

The particle size distribution was determined using a dry sieving method. Depending on the equipment used, shaking, tapping and/or vibration was used to promote flow through the sieves. This can result in dispersing weak agglomerates and/or breaking weak particles. Materials with significant cohesive strength and/or adhesion to surfaces may not screen well, particularly at finer screen sizes.

Particle size results are dependent on the method, and methods that use different physical principles would be expected to give different results. With all methods, particle shape is an influencing factor that is not well captured by the results alone. A single particle, being a three-dimensional object, has multiple dimensions, and this can only be represented by a single value in the case of a perfect sphere.

The results are given as the percentage retained on a given sieve as well as a cumulative distribution. The terms  $p_{10}$ ,  $p_{50}$ , and  $p_{90}$  refer to the particle sizes at which 10%, 50%, and 90% of the sample is smaller, respectively. This assumes that there is sufficient data on either side of each value to provide proper interpolation; otherwise the values are not given. The sieving yield is the initial mass of material, less the sum of the retained masses after sieving, all divided by the initial mass, expressed as a percentage.

The opening sizes are nominal and are specified in ASTM standard E-11 or ISO 3310, as noted.

## Dust extinction moisture

The dust extinction moisture test is used to investigate the effects of moisture content on dust generation. This test is conducted using a rotating drum, based on Australian standard AS 4156.6 - 2000.

The test determines a dust number (mass of dust collected/original mass of sample multiplied by 100,000) for various moisture contents. The dust numbers are plotted on a log scale against their respective moisture contents on a linear scale to produce a dust/moisture curve.

The standard identifies the dust extinction moisture as the moisture at which a dust number of 10 is attained on the dust/moisture curve. Although the standard was originally developed for higher rank coals, it has been successfully used for years on many coals and other bulk materials. The curve, along with field experience and dust emission goals, can be used in selecting a moisture content limit(s) to suit your application(s), and establishing operating and monitoring practices that may be required.

The standard calls for removal of particles greater than 6.3 mm. The particle size used is reported, which may or may not meet this requirement.

The AS 4156.6 - 2000 standard states the reproducibility of the test to be 10% (relative), and errors in total moisture measurements to be  $\pm 0.2\%$  and in dust number  $\pm 6\%$ .