Test Report

NanoShine Group Corp.

Product Description: Non-coating Cylinder and Coating Cylinder
Product Submitted By: NanoShine Group Corp
Date of Sample Received: February 16th , 2016
Date of Testing: April 14th , 2016

Test Required: Surface coating on the drag for a PVC cylinder
Reference Method: ASCE Standard ASCE/SEI 7-10 Minimum Design Loads for Buildings and Other Structures
Test Equipment: Atmospheric Boundary Layer Wind Tunnel
Anemometer
Force-moment sensor
Experimental Setup: The experimental setup is shown in Figure 1. The leading edge of the test models was located at 2.8 m from the inlet of test section. The testing models were installed on the force-moment censor. Two side acrylic boards were installed. The distance between the edge of the cylinder and acrylic was 2.5 diameter of the PVC cylinder.

Figure 1. Experiment setup

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NCKU ASTRC Wind Tunnel Lab 國立成功大學 航太科學研究中心 風洞實驗室
No.2500, Sec. 1, Zhongzheng S. Rd., Guiren Dist., Tainan City 711, Taiwan (R.O.C.) 台南市歸仁區中正南路一段 2500 號
Tel: (886-6) 2392811 Fax: (886-6) 2391915

Test Report

Test Result:

The result is shown in Table 1.

Table 1 Drag for a PVC cylinder with and without surface coating

Wind speed (m/s)	Drag (N)		Drag reduction (%)
	Non-coating cylinder	Coating cylinder	
8.1	5.87	5.69	3.0
10.4	9.68	9.47	2.1
14	17.68	17.35	1.8
16	23.11	22.79	1.4
18.1	29.16	28.76	1.4

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Appendix 1

1. Summary

This wind tunnel tests addressed the surface coating on the drag for a PVC cylinder, provided by NanoShine Group Corp. The test was conducted at the Atmospheric Boundary Layer Wind Tunnel (ABLWT), Architecture and Building Research Institute. The PVC cylinders were installed on the force-moment sensor in order to acquire the wind load at five constant wind speeds, namely 8.1 m/s, 10.4 m/s, 14 m/s, 16 m/s, and 18.1 m/s. Five repeated runs were conducted for a given wind speed. The results indicate that there is a 3.0% reduction for the drag of a PVC cylinder with surface coating at the speed of 8.1 m/s, in comparison with that of a non surface coating PVC cylinder.

2. Testing Model

The diameter and height of the PVC cylinder were 0.232 m and 0.8 m, respectively. In order to prevent the wind from flowing into the cylinder, the top cross-section of the cylinder was tightly covered by acrylic.

3. Facility and Instrumentation

3.1 Wind tunnel

The tests were conducted at Atmospheric Boundary Layer Wind Tunnel (ABLWT), Architecture and Building Research Institute. There are a honeycomb and three screens, and the contraction ratio is 4.71. The constant-area test section is 2.6 m in height, 4 m in width and 36.5 m long. Turbulence intensity is approximately 0.3%.

3.2 Anemometer

The wind speed was measured by rotating vane anemometer (OMEGA HHF 141). The calibration certificate is shown in Appendix 2.

3.3 Force-moment sensor

The wind load was measure by force-moment sensor (JR3-75E20). The calibration certificate is shown in Appendix 3.

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Appendix 1

4. Experimental Setup

The experimental setup is shown in Figure 1. The leading edge of the test models was located at 2.8 m from the inlet of test section. In Figure 2, the testing models were installed on the force-moment censor. Two side acrylic boards were installed. The distance between the edge of the cylinder and acrylic was 2.5 diameter of the PVC cylinder.

Figure A1 Installation of PVC cylinder

5. Results

The results are summarized in Table A1. It can be seen that the drag for a PVC cylinder with surface coating is lower than that for a PVC cylinder without surface coating. The most drag reduction is 3.0% at the wind speed of 8.1 m/s.

Table A1 Drag for a PVC cylinder with and without surface coating

Wind speed (m/s)	Drag (N)		Drag reduction (%)
	Non-coating cylinder	Coating cylinder	
8.1	5.87	5.69	3.0
10.4	9.68	9.47	2.1
14	17.68	17.35	1.9
16	23.11	22.79	1.4
18.1	29.16	28.76	1.4

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Appendix 2

CERTIFICATE OF CALIBRATION (NIST TRACEABLE)

OMEGA®

Model Number: HHF141

Instrument S/N#: 1015613

Program Version: 3.20

Air Velocity (FPM): 13-2-852

Standard		As Sent
300		296
1000		995
3000		3017

Temperature: °C or °F

Standard		As Sent
0		
50		
100		

Rel. Humidity (%RH): ________

Standard		As Sent

CERTIFICATE PRESENTED TO:

CALIBRATION EQUIPMENT:

Pacer Inst. Digital Anemometer:
Model: DA400
Serial Number: 1014068
NIST Traceable Cert. #2008120214714
Due: 05/25/2013

Airflow Technical Products:
Open Jet Wind Tunnel
Calibrated to Doc# 405-7-0154
Due: 06/11/2013

Fluke RTD Calibrator:
Model: 712 SN: 1196144
Cert. #620069-1196144:1339409057
Due: 06/11/2013

Edgetech Hygrometer:
Model: Dewprime II
SN: 31122/1H1298MCR
Cert. #2013.410012
Due: 01/14/2014

AS SENT ACCURACY:
on units original design standards.

Air Velocity:
AP275/APT275:
+/-(1.0% of reading + 1 digit)
AP100/APT100:
+/-(0.25% FS + 0.75% reading + 1 digit)

Temperature:
+/-(0.3°C +0.2% reading °C)

Relative Humidity: +/- 2.0 %RH

[illegible]

Calibrated by:
Tech: (3) Date: 2-26-13
Due Date: Feb 26, 2014

Omega Engineering, Inc.
PO Box 4047
One Omega Drive, Stamford, CT 06907 USA
Email: info@omega.com
Phone: 203-359-1660

19274

Figure A2 Calibration certificates of anemometer

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Appendix 3

JR3
Multi-Axis Load Cell Technologies

FORCE-MOMENT SENSOR SPECIFICATION SHEET

JR3, Inc.
22 Harter Avenue
Woodland, CA 95776
(530) 661-3677
Fax (530) 661-3701
e-mail: jr3@jr3.com

75E20A4-I125-EF mFS 334N
Serial Number 3572

Analog calibration.

	Electrical Load Settings	Sensor Load Ratings	Calibration Loads used
Fx	315 N	334 N	70.0 lbs
Fy	315 N	334 N	70.0 lbs
Fz	630 N	667 N	120.0 lbs
Mx	63 Nm	63.6 Nm	455.0 in-lbs
My	63 Nm	63.6 Nm	455.0 in-lbs
Mz	63 Nm	63.6 Nm	455.0 in-lbs

Calibration Matrix: Multiply the calibration matrix and the sensor Voltage vector to determine the loads. (N and Nm)

36.5929	0.2069	-0.1376	-1.9833	-0.1037	0.0795	Fx Volts
0.1724	36.6431	-0.0938	0.0099	-2.0348	0.6183	Fy Volts
1.5202	1.1847	73.8182	-0.5367	-0.1993	-4.8031	Fz Volts
0.0690	0.0299	0.0111	7.4566	0.0073	-0.1531	Mx Volts
0.0093	0.1860	-0.0269	-0.0051	7.0215	-0.0923	My Volts
0.0073	0.0364	0.1006	0.0465	0.0152	7.1161	Mz Volts

Sensor Excitation +/-3.0V
Shunt Voltages:

Fx	Fy	Fz	Mx	My	Mz
3.9569	3.8796	6.2123	5.7022	5.9657	5.2076

Pin	Signal
Pin 1	Fx
Pin 2	Fy
Pin 3	Fz
Pin 4	Mx
Pin 5	My
Pin 6	Mz
Pin 7	+12V (12 to 15)
Pin 8	-12V (12 to 15)
Pin 9	COMMON

Connector
5 4 3 2 1
9 8 7 6
DE9S

Final Inspection:

Calibration Date	22 OCT 2013
Calibration Matrix	24 OCT 2013
Axis Orientation	✓
Units (N and Nm)	✓
Hardware Correct	✓
Label Correct	✓
Functional Test	✓
Inspection Date	2013-10-24
Inspector Initial	ERA

Figure A3 Calibration certificates of force-moment sensor

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