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(U) MEMORANDUM OF UNDERSTANDING  
BETWEEN THE  
NATIONAL RECONNAISSANCE OFFICE  
MISSION OPERATIONS DIRECTORATE  
AND  
COMMUNICATIONS SYSTEMS DIRECTORATE  
AND  
MANAGEMENT SERVICES AND OPERATIONS DIRECTORATE  
AND  
OFFICE OF THE UNDERSECRETARY OF DEFENSE ACQUISITION,  
TECHNOLOGIES AND LOGISTICS (OUSAD/AT&L) FOR SPACE & INTELLIGENCE  
ON  
INFORMATION TECHNOLOGY SERVICES

**A. (U) PURPOSE**

(U//FOUO) The purpose of this MEMORANDUM OF UNDERSTANDING (MOU) is to formally document the roles and responsibilities between the National Reconnaissance Office (NRO) Mission Operations Directorate (MOD); Communications Systems Directorate (COMM); Management Services and Operations Directorate (MS&O) and OUSAD (AT&L) Director for Space and Intelligence regarding NRO provided Information Technology (IT) services. This Memorandum of Understanding is needed in order to comply with the Economy Act (31 USC 1535 et seq). This is the umbrella MOU for all existing IT communications services provided by the NRO to the OUSAD (AT&L) Director for Space and Intelligence and establishes the relationship between the organizations to allow the OUSAD (AT&L) Director for Space and Intelligence to request future IT Services from MOD/NOG. Specific details to include funding, equipment responsibilities, supported projects and locations will be defined in separate NRO Communication Support Agreements between MOD/NOG, the OUSAD (AT&L) Director for Space and Intelligence and Management Services and Operations Directorate (MS&O).

**B. (U) REFERENCES**

1. (U) National Reconnaissance Office Corporate Business Process Instruction (CBPI) 20-14: Funds From Others (FFO) Policy
2. (U) NRO 60-1a: Approval Procedures - Information Technology Services Provided by the Communications Systems Directorate.
3. (U) National Reconnaissance Office Directive (NROD) 61-5: NRO Government Wide Area Network Access Policy.

SUBJECT: (U//FOUO) MOU BETWEEN NRO/MOD, COMM, MS&O and OUSAD (AT&I)

4. (U) NRO Security Manual.
5. (U) CBP 100, Appendix A-A-1-1: NRO Polygraph Program.
6. (S) NROI 50-1b: DCI Directive 6/3 Implementation Pertaining to Media, Media Access Devices, Passwords, Screen Savers, and Log-Off Requirements for NRO Sensitive Compartmented Information (SCI) Systems.
7. (U) NAM N17.5 Interagency Acquisitions Under the Economy Act Paragraph 4-1 (i-v).
8. (U) CBPI 20-7 - Documenting External Agreements,
9. (U) Economy Act (31 USC 1535 et seq)

C. (U) BACKGROUND

(U//FOUO) The NRO and OUSAD (AT&I) Director for Space and Intelligence have many common interests in support of both the NRO and OUSAD activities. Currently OUSAD (AT&I) Director for Space and Intelligence has been moved to the Pentagon Suite 3C636. They have requested NRO communications support in order to reach members of the IC. This MOU addresses specific communications services support and identifies that the internal NRO sponsor for this effort is the Management Services and Operations Directorate (MS&O). MS&O will act as the focal point for handling of all future requests as well as O&M funding and work with the Communications Systems Directorate.

D. (U) SCOPE

1. (U//FOUO) MOD provides the following communications services to external customers when approved and validated in accordance with NRO Directives and Instructions and NRO COMM Configuration Management processes. Services provided to external customers in each of these areas are further defined in documentation managed by the COMM Directorate. NRO provided Communications Services available include:

- a. (U//FOUO) Video service - video teleconferencing.
- b. (U//FOUO) Voice services - i.e. NRO Secure Voice Network (NSVN) telephones, Secure Telephone Equipment (STE), Secure Data Device (SDD).

SUBJECT: (U//FOUO) MOU BETWEEN NRO/MOL, COMM, MS&O and OUSAD (AT&L)

- c. (U//FOUO) Network access and connectivity services.

**E. (U) RESPONSIBILITIES**

1. (U) The OUSAD (AT&L) Director for Space and Intelligence agrees to:

- a. (U//FOUO) Submit all requests for IT Services to the Management Services and Operations Directorate (MS&O) in accordance with Reference Documents.

- b. (U//FOUO) Fund services including nonrecurring and O&M costs as outlined in CBPI 20-14 and specified in the individual NRO Communications Support agreements. NRO external customers are expected to budget for and fund the total life cycle costs associated with all communications and communications support services provided by COMM, unless this requirement is completely or partially waived by the Director of COMM based upon guidance from the NRO Board of Directors or an internal NRO activity agrees to fund the effort and/or O&M costs. Out year funding is based on congressionally approved availability of funds.

- c. (U//FOUO) Maintain and update, as required, an approved System Security Plan and accredited Sensitive Compartmented Facility in accordance with Reference Documents and individual NRO Communications Support Agreements.

2. (U) The Management Services and Operations Directorate (MS&O) agrees to:

- a. (U//FOUO) Validate IT Services requested by the OUSAD (AT&L) Director for Space and Intelligence or by internal NRO Communications Support Agreement sponsors, with regard to benefits to the NRO or to the U.S. Government and consistency with the NRO mission.

- b. (U//FOUO) Coordinate with the OUSAD (AT&L) Director for Space and Intelligence or internal NRO Communications Support Agreement Sponsor to ensure that providing the requested IT services is consistent with applicable regulations or statutes regarding interagency acquisitions.

- c. (U//FOUO) Provide funding arrangements between the NRO, the OUSAD (AT&L) Director for Space and Intelligence and

SUBJECT: (U//FOUO) MOU BETWEEN NRO/MOD, COMM, MS&O and OUSAD (AT&L) internal NRO Communications Support Agreements Sponsors, as needed.

3. (U) NRO COMM agrees to:

a. (U//FOUO) Process requests for the IT Services in accordance with existing policies and directives regarding the provision of services to external customers. An authorized Management Services and Operations Directorate (MS&O) validator must approve all requests.

b. (U//FOUO) Procure all COMM equipment associated with the approved IT service requests (further identified in the individual NRO Communications Support Agreements).

4. (U) NRO Mission Operations Directorate agrees to:

a. (U//FOUO) Install, upgrade, maintain and process requests for IT services in accordance with existing services

b. (U//FOUO) Provide point of contact (POC) and telephone numbers for requirements and engineering personnel for specific issues

c. (U//FOUO) Notify the OUSAD (AT&L) Director for Space and Intelligence of outages/impairments to NRO Circuits or systems that may impact OUSAD (AT&L) Director for Space and Intelligence operations

d. (U//FOUO) Process request for the IT Services in accordance with existing policies

e. (U//FOUO) Maintain configuration control over NRO communications systems and equipment and coordinate any changes that may affect external interfaces

**F. (U) IMPLEMENTATION**

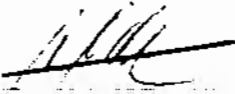
1. (U//FOUO) This MOU shall take effect upon signature of the authorized representatives from the OUSAD (AT&L) Director for Space and Intelligence, Mission Operations Directorate, NRO Communications Systems Acquisition and Operations Directorate and Management Services and Operations Directorate (MS&O).

SUBJECT: (U//FOUO) MOU BETWEEN NRO/MOD, COMM, MS&O and OUSAD (AT&L)

2. (U//FOUO) All activities under or pursuant to this agreement are subject to the availability of appropriate funds, and no provision herein shall be interpreted to require obligation or payment of funds in violation of the Anti-Deficiency Act, 31 U.S.C. 1341. This agreement is not a funding document, and does not represent the obligation or transfer of funds.

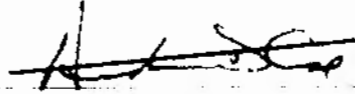
3. (U//FOUO) As agreed to by all parties, or their designees, the MOU shall be reviewed every year to determine its continued applicability. The MOU may be amended upon mutual agreement of the parties. Any of the parties may terminate the MOU by written notification to the other party.

SUBJECT: ~~CONFIDENTIAL~~ MOU BETWEEN NRO/MOD, COMM, MS&D and OUSAF (AT&L)



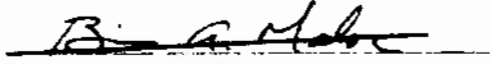
GARY RUBIN, Brig Gen, USAF  
Director, Mission Operations  
Directorate, NRO

31 July 10  
Date



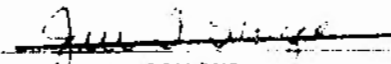
ANDREW D. COX  
Director, Communications  
Systems Directorate, NRO

7-26-10  
Date



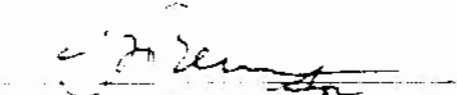
BRIAN A. MALONE  
Director, Management Services  
and Operations Directorate,  
NRO

July 12, 2010  
Date



WILL T. SINGER  
Chief Information Officer,  
NRO

17 July 2010  
Date



GIL KLINGER  
Director, OUSAF (AT&L) for  
Space and Intelligence

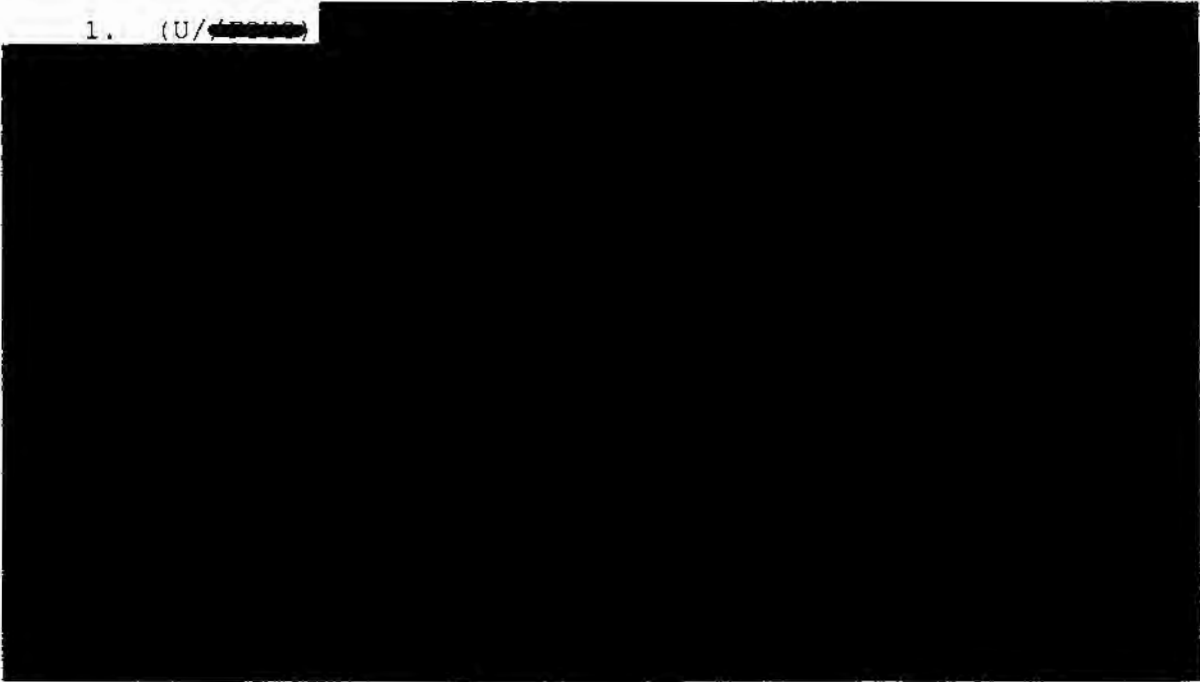
22 July 10  
Date

MEMORANDUM OF UNDERSTANDING  
BETWEEN  
NATIONAL RECONNAISSANCE OFFICE  
ADVANCED SYSTEMS AND TECHNOLOGY DIRECTORATE  
AND  
DEPUTY ASSISTANT SECRETARY OF DEFENSE FOR  
MANUFACTURING AND INDUSTRIAL BASE POLICY  
ON  
CARBON NANOTUBE DEVELOPMENT AND PRODUCTION ENHANCEMENT

**A. (U) PURPOSE.** This Memorandum of Understanding (MOU) between the National Reconnaissance Office (NRO) Advanced Systems and Technology Directorate (AS&T) and the Deputy Assistant Secretary of Defense for Manufacturing and Industrial Base Policy, DASD(MIBP) establishes a joint program to further carbon nanotubes (CNT) development, increase supply, improve quality, reduce cost, and rapidly transition carbon nanotube materials, wires, and structures into survivable spacecraft. CNTs are an essential revolutionary technology that enables great reductions in size, weight, and power consumption for future spacecraft that cannot be achieved with conventional technologies. NRO program execution will be conducted by AS&T. DASD(MIBP) participation will be conducted by the Defense Production Act (DPA) Title III Office (DPA Title III).

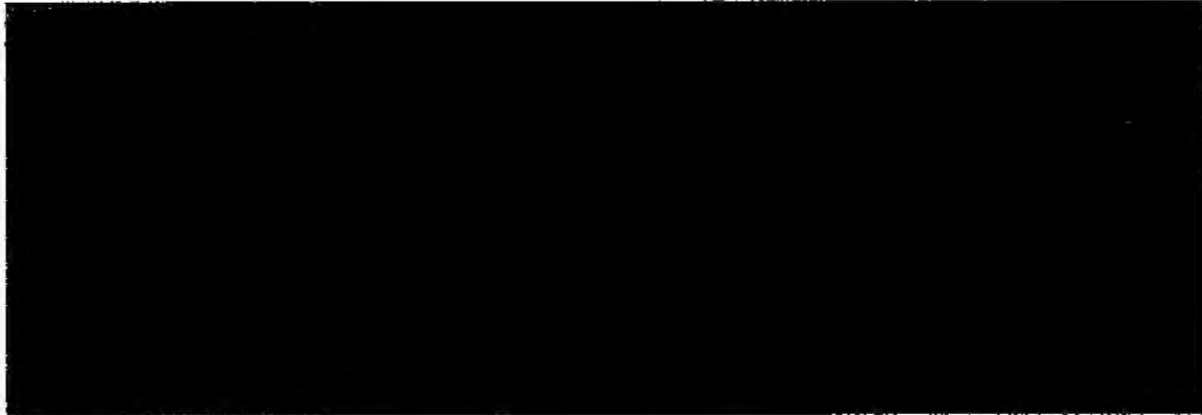
**B (U) BACKGROUND.**

1. (U//~~FOUO~~)





SUBJECT: (U) MOU BETWEEN NRO/AS&T AND DASD(M&IBP) ON CARBON NANOTUBE DEVELOPMENT AND PRODUCTION ENHANCEMENT



2. (U//~~FOUO~~)



SUBJECT: (U) MOU BETWEEN NRO/AS&T AND DASD(M&IBP) ON CARBON NANOTUBE DEVELOPMENT AND PRODUCTION ENHANCEMENT

3. (U//~~FOUO~~) [REDACTED]

a. (U//~~FOUO~~) [REDACTED]

b. (U//~~FOUO~~) [REDACTED]

c. (U//~~FOUO~~) [REDACTED]

d. (U//~~FOUO~~) [REDACTED]

4. (U//~~FOUO~~) [REDACTED]

SUBJECT: (U) MOU BETWEEN NRO/AS&T AND DASD(M&IBP) ON CARBON NANOTUBE DEVELOPMENT AND PRODUCTION ENHANCEMENT

[REDACTED]

a. (U//~~FOUO~~) [REDACTED]

b. (U//~~FOUO~~) [REDACTED]

c. (U//~~FOUO~~) [REDACTED]

**C. (U) RESPONSIBILITIES.**

1. (U) AS&T will:

a. (U) Jointly develop roadmaps, execution, and transition plans and production capability expansion/capital investment contract initiations with DPA Title III;

b. (U) Fund, initiate, and manage material property performance improvement contracts, using AS&T contracting officer and AS&T contracting officer's technical representative (COTR);

c. (U) Provide an AS&T technical advisor(s) to assist the DPA Title III COTR for DPA Title III initiated production capability expansion/capital investment contracts. The technical advisor participates in: development of objectives and statements of work, evaluation of proposals, source selection activities, and program reviews;

d. (U) As funding allows: fund, initiate, and manage technology development, space-qualification, and transition contracts, using AS&T contracting officer and AS&T COTR; and

e. (U) Conduct joint quarterly reviews.

2. (U) DPA Title III will:

a. (U) Jointly develop road maps, execution and transition plans, and capital investment contract initiations with AS&T;

SUBJECT: (U) MOU BETWEEN NRO/AS&T AND DASD(M&IBP) ON CARBON NANOTUBE DEVELOPMENT AND PRODUCTION ENHANCEMENT

b. (U) Fund and initiate capital investment contracts that enable high-volume bulk CNT manufacturing, using DPA Title III contracting vehicles; and

c. (U) [REDACTED]

D. (U//~~FOUO~~) TECHNOLOGY PROTECTION. [REDACTED]

1. (U//~~FOUO~~) [REDACTED]

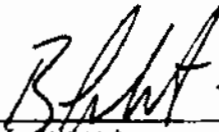
2. (U//~~FOUO~~) [REDACTED]

3. (U//~~FOUO~~) [REDACTED]

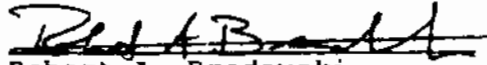
4. (U//~~FOUO~~) [REDACTED]

SUBJECT: (U) MOU BETWEEN NRO/AS&T AND DASD(M&IBP) ON CARBON NANOTUBE DEVELOPMENT AND PRODUCTION ENHANCEMENT

**E. (U) IMPLEMENTATION.** This MOU shall take effect upon signature of the authorized representatives from NRO/AS&T and DASD(M&IBP) and remain active through 30 September 2014. As agreed to by all parties, or their designees, the MOU shall be reviewed every two years to determine its continued applicability. Either party may terminate the MOU by written notification to the other party. The MOU will terminate after such written notification.



\_\_\_\_\_  
Brett Lambert  
Deputy Assistant Secretary of  
Defense for Manufacturing and  
Industrial Base Policy



\_\_\_\_\_  
Robert A. Brodowski  
Director, Advanced Systems  
and Technology

5/3/11

\_\_\_\_\_  
Date

4/8/11

\_\_\_\_\_  
Date

SUBJECT: (U) MOU BETWEEN NRO/AS&T AND DASD(M&IBP) ON CARBON NANOTUBE DEVELOPMENT AND PRODUCTION ENHANCEMENT

(U) APPENDIX A

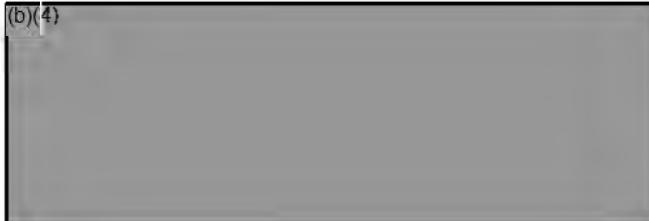
(U) Products Available as a Result of This Investment and Product Specifications

### (U) Specifications for Conductive Space Applications



<b>Temperature Rating (°C)</b>	
Ambient: 70F ± 20	-273 to 250
Geosynchronous orbit: -190F to 300F	
<b>Thermal endurance</b>	TBD
<b>Flexing endurance (cycles)</b>	>1,500,000
<b>Linear Resistivity (Ohm-cm)</b>	
Post-processed	$< 1 \times 10^{-4}$
Raw yarn	$3 \times 10^{-4}$
<b>Max weight (g/m)</b>	0.002
	Tex - 2g/km

(b)(4)



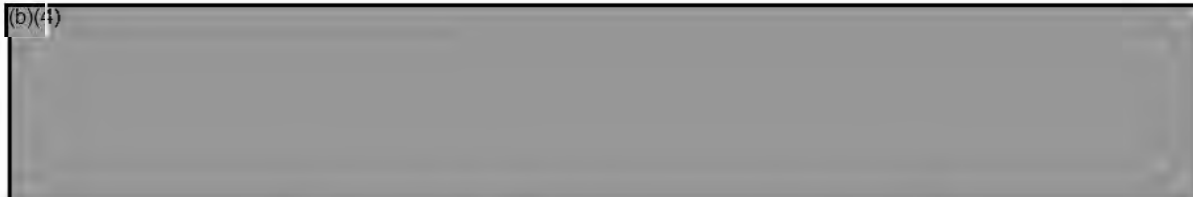
<b>Breaking Strength (N/Tex)</b>	
Stretched & coated	1.25-1.75
Raw yarn	0.55-0.60

**Platability** Plated with Ni & Cu

**Solderability** Solderable when plated

This table is unclassified

(b)(4)



SUBJECT: (U) MOU BETWEEN NRO/AS&T AND DASD(M&IBP) ON CARBON NANOTUBE DEVELOPMENT AND PRODUCTION ENHANCEMENT

**(U) Specifications for Structural Space Applications**



<b>Tex (g/km)</b>	1-2
<b>Filament Diameter – after wet out (microns)</b>	50-75
<b>Density (g/cc)</b>	0.75 ± 0.25
<b>% Iron</b>	5.4% ± 1.2%
<b>Key attribute is lot-to-lot consistency</b>	



<b>Stiffness</b>	TBD
<b>Flexing endurance (cycles)</b>	>1,500,000
<b>Temperature Rating (°C)</b>	-273 to 250

This table is unclassified

SUBJECT: (U) MOU BETWEEN NRO/AS&T AND DASD(M&IBP) ON CARBON NANOTUBE DEVELOPMENT AND PRODUCTION ENHANCEMENT

**(U) Cables**


**TYCO Electronics  
Boeing**

**(U) EMSHIELD™ CNT EMI Shielding  
(replaces braided copper):**

Base Material: CNT sheet stock  
Density: 15 grams per square meter  
Thickness: 65 microns ± 5 microns  
Material cut to tape-widths  
Dimensions: 2cm wide ± .1%  
1km long packaged in spools  
Mechanical Strength: 500 mpa capable of processing on Tyco extrusion systems  
Electrical Resistivity: ~0.3 ohms-sq  
Temperature Rating (°C): -200 to +250  
50dB Insertion Loss according to IEE-STD-299 Modified Test

**(U) CTEX™ CNT Wire  
(replaces copper core conductor)**

Base Material CNT CTEX yarn 1-2 tex  
Average diameter 15 micron ± 1%  
Gauge Required 24 & 26 AWG  
Continuous 1Km Lengths Equivalent plied CNT yarns  
Mechanical Strength: 700 MPa ± 10%  
Electrical Resistivity: ~4x10<sup>-4</sup> ohms-cm  
Fatigue Cycles to Failure: >1.5 x 10<sup>6</sup>  
Temperature Rating (°C): -200 to +250

(b)(4) 



SUBJECT: (U) MOU BETWEEN NRO/AS&T AND DASD(M&IBP) ON CARBON NANOTUBE DEVELOPMENT AND PRODUCTION ENHANCEMENT

### (U) EMSHIELD™ CNT Rollstock Specifications For EMI Shielding

<b>Density (g/cm<sup>3</sup>) (acid treated / acetone condensed)</b>		0.70 +/-0.10
<b>After condensation (microns)</b>		thickness: 70μ ±5%
<b>Engineering Resistivity (Ω*cm)</b>	<b>Treated (DC)</b>	2.6 x 10 <sup>-4</sup> – 4.4 x 10 <sup>-4</sup>
<b>Based on measured cross section</b>		
<b>Specific Conductivity (S*cm<sup>2</sup>/g)</b>	<b>DC</b>	0.32 x 10 <sup>4</sup> – 0.55 x 10 <sup>4</sup>
(b)(4)		
<b>Strain to Failure (%)</b>		10%
<b>Sheet Resistance (Ω/□) 15 gsm</b>		0.2 Ω/□
<b>Thermal Conductivity (W/m*K)</b>		Tunable: 10 – 100 W/m*K
<b>Coefficient of Thermal Expansion (K<sup>-1</sup>)</b>		-3 x 10 <sup>-6</sup>
<b>Temperature Coefficient of Resistivity</b>	<b>Untreated</b>	1.2 x 10 <sup>-3</sup>
	<b>Treated</b>	1.6 x 10 <sup>-3</sup>
<b>Temperature Rating (°C)</b>		-200 to -250

This table is unclassified

<sup>(1)</sup> Reported value will vary depending on the density used in the calculation. NCTI measures density prior to testing knowing that the density will increase during actual testing.

<sup>(2)</sup> Calculated using a density of 0.75 g/cm<sup>3</sup>

(U) The information contained herein is, to the best of our knowledge and belief accurate. However, since the conditions of handling and of use are beyond our control, we make no guarantee of results and assume no liability for damages incurred by following these suggestions. Nothing contained herein is to be construed as a recommendation for use in violation of any patents or of applicable laws or regulations. Nanocomp Technologies, Inc., may, as needed modify or change our test procedures in order to improve on the consistency and accuracy of the data. 09/07/2010