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IEST leads ISO 14644 Experts in Focus on Nanotechnology in Cleanrooms

By Anne Marie Dixon, David Ensor, and Roberta Burrows

IEST has again taken a leadership role in ISO Technical Committee 209 *Cleanrooms and associated controlled environments* as the committee begins developing standards for the nanoscale.

Keywords

Nanotechnology, ISO, TC 209, 14644, cleanroom

During its recent September meeting in Ireland, ISO Technical Committee 209 (ISO/TC 209) established a new Working Group (WG) convened under IEST's leadership for the United States with IEST experts Anne Marie Dixon and David Ensor as Co-Convenors. Cleanrooms and associated controlled environments, WG 10: Nanotechnology will begin work in 2009 under a preliminary scope that would specify the minimum requirements for design, operations, monitoring, and testing of nanotechnology facilities in those respects that they differ from cleanrooms as described in ISO 14644-4 (*Design, construction and start-up*) and 14644-5 (*Operations*).

The field of nanotechnology is not new to IEST. Currently, several IEST Recommended Practices are in production with meetings scheduled during the IEST Fall Conference in Arlington Heights, Illinois, November 10-13, 2008. IEST's expertise in cleanrooms and controlled environments, experience in ISO standards (ISO/TC 209 has published 10 standards under IEST's support as Secretariat), and leadership will be invaluable in this new international endeavor. IEST has served as the Secretariat for ISO/TC 209 for the past 15 years and has established its role as the global leader in cleanrooms and controlled environments with more than 50 years of expertise in this area. Secretariat support for ISO/TC 209 WG 10 will be provided by the United Kingdom through the British Standards Institute (BSI).

The new standards under discussion from WG 10: Nanotechnology are proposed to include:

- Guidance for applying established physical, biological, and chemical contamination control principles to nanotechnology facilities.
- Cleanliness requirements covering nanoparticles for future contamination control in nanotechnology research and manufacturing.
- Requirements for controlled environments including vibration and electromagnetics.

New "divide and conquer" nanotechnology standards process

Until last month, ISO/TC 229 Nanotechnologies had taken center stage in international standards activities related to the nanoscale. However, the committee recognized that the crosscutting nature of nanotechnology requires the supporting knowledge found in other committees. For this reason,

earlier this year ISO/TC 229 created the Nanotechnologies Liaison Coordination Group (NLCG) as a forum to provide communication between standards developing organizations to harmonize standards. ISO/TC 209 is a member of the NLCG. During the first meeting of the liaison group, Ensor articulated ISO/TC 209's interest in a cooperative effort. Based on informal feedback, it was suggested that ISO/TC 209 form a WG in this area and define the extent of collaboration.

In tandem with this action, ISO/TC 209 had established an ad hoc committee to undertake its own review of the potential for a nanotechnology focus within ISO/TC 209. The ad hoc committee examined the relationship with the ISO/TC 229 group and reported that an effective coordination should be established to ensure the development of harmonized standards in nanotechnology.

Aligning scopes and efforts of ISO/TC 229 and ISO/TC 209

In reviewing the potential for a nanotechnology focus within ISO/TC 209, the first step for the ad hoc committee was to ensure that the scopes of ISO/TC 209 and ISO/TC 229 would have limited overlap and no interference.

Nanoscale is defined as between approximately 1 and 100 nm. When ISO/TC 209 launched its efforts in the area of contamination control, it limited the scope of the hallmark contamination control standard, *ISO 14644-1: Cleanrooms and associated controlled environments–Part 1: Classification of air cleanliness*, to particle sizes greater than 100 nm. This served the accepted industry practices in the early 1990s and predated current nanotechnology activities. The scope of ISO/TC 209 focuses tightly on contamination control and does not mention size of the product or the physical size of contaminants.

ISO/TC 229, on the other hand, has a broad scope including terminology, metrology, and environmental heath and safety (EHS). The ISO/TC 209 scope does not include the development of EHS requirements and the ISO/TC 229 scope does not include facilities and controlled environments, which are main components of the ISO/TC 209 scope. Together, these complementary scopes provide broad coverage in the overall nanotechnology standards development program.

The liaison relationship established with ISO/TC 229 will allow ISO/TC 209 to develop nanotechnology standards in harmony and support with ISO/TC 229. In particular, the ability to discuss terminology, metrology, EHS, and other aspects outside the scope of the ISO/TC 209 documents will enable WG 10 to reference ISO/TC 229 documents and thus avoid duplication or contradiction. Also, ISO/TC 209 may request review by ISO/TC 229 of its draft documents at the appropriate stages. These practices will increase the value of the ISO/TC 209 documents.

New standards-writing process for nanotechnology documents

Team approach

Historically, ISO/TC 209 has commissioned its WGs to write and maintain one document. While this approach has served development of standards in a well-defined field, it may not be adequate for a rapidly changing area such as nanotechnology. Instead, the ad hoc committee recommended and ISO/TC 209 agreed to establish a single WG with the mandate to write a series of standards, if needed. Each document would have a specific group of drafting experts, organized to write either a specific document or section(s) of documents.

As proposed, the first document written by the new WG 10: Nanotechnology would comprise a single source to help those in the field of nanotechnology apply the existing series of ISO/TC 209 documents. It is believed that timely publication of the document would benefit both the nanotechnology and contamination control communities. The committee may consider publishing the document as a technical specification or technical guide to shorten the time required for public availability.

The WG 10 documents would probably be based on the existing documents listed in the proposed outline (see sidebar) and others to be determined. Therefore, WG 10 could be comprised of those experts or expert bodies that have had experience writing the various parts of the current ISO/TC 209 standards.

Proposed Outline

The following is the proposed outline for the ISO/TC 209 WG 10: Nanotechnology standards including reference documents that may be incorporated as they apply to nanotechnology. The outline is preliminary and highly dependent on the course of action determined by WG 10. Note: ISO 14644 and 14698 documents are part of the *Cleanrooms and associated controlled environments* series of standards.

Terminology

Definitions will be drawn from available sources, if possible.

- ISO 14644-6:2007 *Vocabulary*
- ISO/TS 27687:2008 *Nanotechnologies—Terminology and definition for nanoparticles*

Design

- ISO 14644-4:2001 *Design, construction and start-up*
- ISO 14644-1:1999 *Classification of air cleanliness*
- ISO 14644-7:2004 *Separative devices (clean air hoods, gloveboxes, isolators and minienvironments*
- IEST-RP-CC200 Nanotechnology series
- IEST-RP-CC024 *Measuring and Reporting Vibration in Microelectronic Facilities*
- Others as essential

Operations

- ISO 14644-4:2001 *Design, construction and start-up*
- ISO 14698-1:2003 *Biocontamination control—Part 1: General principles and methods*
- ISO 14698-2:2003 *Biocontamination control—Part 2: Evaluation and interpretation of biocontamination data*
- Create a list of items to consider related to contamination from surroundings and potential sensitivity of the product and process
- Create a list of items to consider related to risks from the processing of nano products to the environment, clean space, controlled environment, personnel, etc.

Monitoring

- ISO 14644-2 *Specifications for testing and monitoring to prove continued compliance with ISO 14644-1*
- ISO 14698-1:2003 *Biocontamination control—Part 1: General principles and methods*
- ISO 14698-2:2003 *Biocontamination control—Part 2: Evaluation and interpretation of biocontamination data*
- ISO 14644-3:2005 *Test methods*
- ISO 14644-8:2006 *Classification of airborne molecular contamination*
- ISO/DIS 14644-9 *Classification of surface particle cleanliness*
- ISO/TR 27628:2007 *Workplace atmospherics—Ultrafine, nanoparticle and nano-structured aerosols—Inhalation exposure characterization and assessment*
- ISO/TR (in development) *Nanotechnologies—Safe handling of nanomaterials*
- *Normative information on monitoring for nanoparticles in controlled environments*
- *FED-STD-209E, Appendix D: Method for Measuring the Concentration of Ultrafine Particles*

Initial structure of the WG

The intent is that WG 10: Nanotechnology will consist of three teams, each assigned to one of the three main, interrelated areas—design, operations, and maintenance. The group could hold a multi-day meeting during which teams would meet individually followed by a daily meeting of all teams to discuss progress. The other details for the document process would be handled by the Convenor. This approach will allow for extensive work without duplication of efforts.

Timeline

IEST will begin requesting the nominations of experts this fall for WG 10: Nanotechnology and will recruit ISO/TC 229 members, industry leaders, technical professionals, and scientists. Nominations will close January 1, 2009, and IEST will report to the Co-Convenors by January 31, 2009. The first meeting of WG 10 is scheduled to take place in May 2009 in Seattle in conjunction with the ISO/TC 229 meetings. WG 10 will prepare text for a New Work Item Proposal for presentation to ISO/TC 209 at or before the next meeting in fall 2009 in the United States.

IEST thanks the ISO/TC 209 ad hoc committee on nanotechnology for its work in establishing WG 10: Nanotechnology and in assisting ISO/TC 209 to reach unanimous consensus to undertake this exciting new area. Information provided to ISO/TC 209 by the ad hoc committee serves as the reference basis for this article.

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David Ensor is Co-Convenor of ISO/TC 209 WG 10: Nanotechnology, IEST Representative to the US TAG to ISO/TC 229, Member of the US Delegation to ISO/TC 229, Liaison ISO/TC 229 to ISO/TC 209, and IEST Senior Fellow.

Roberta Burrows is ISO/TC 209 Secretariat and IEST Executive Director.

To express interest in joining WG 10: Nanotechnology or in sponsoring events related to the group's meetings, please contact Linda Gajda, ISO/TC 209 Secretariat Coordinator, through IEST at lgajda@iest.org.