August 25, 2005

Mr. Antonio C. Braga
Chairman, NFPA 13 TC on Hanging & Bracing
Of Water-based Fire Protection Systems
1 Batterymarch Park
P.O. Box 9101
Quincy, MA 02169-7471

Reference: Ceiling Systems & FlexHead Flexible Sprinkler Drops

Dear Mr. Braga:

I am writing to address the interaction and compatibility of commercial ceiling systems and FlexHead flexible sprinkler drops. I am currently a member of ASTM E33.04 (responsible for ceiling system suspension systems), Ceilings & Interior Systems Construction Association's Seismic Committee (responsible for installation of ceilings in seismic areas), NFPA's Fire Test Committee, and I am responsible for Product Seismic Performance at Armstrong World Industries.

First, let me provide a little background on commercial ceiling systems' code requirements with particular focus on the structural and seismic requirements. I will be referencing the International Building Code but the conclusions are still valid for all other US building codes.

The main requirements for commercial ceiling systems are detailed in two ASTM documents and two documents developed by Ceilings & Interior Systems Construction Association (CISCA). ASTM C 635, *Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings* and C 636, *Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels* detail the load limitations, connection strength requirements and basic installation requirements for ceiling suspension systems. CISCA's *Recommendations for Direct-hung Acoustical Tile and Lay-in Panel Ceilings, Seismic Zones 0-2* and *Guidelines for Seismic Restraint for Direct Hung Suspended Ceiling Assemblies, Seismic Zones 3 & 4* detail the installation and performance requirements of ceiling suspension systems that are to be used in seismicly active areas. The International Building Code, 2000 (IBC) details additional requirements for ceilings in Section 1621.2.5.1. In the International Building Code, 2003 these requirements have been moved and are included through a reference to ASCE 7-02 Section 9.6.2.6.

The basic assumption of the IBC is that ceiling suspension systems have connection strength of at least 60 pounds in both tension & compression and that main runners & cross runners are capable of carrying the design load without exceeding the maximum allowable deflection. The specifics about grid strength and classification can be found in C 635. The IBC requires that all seismic force calculations be done with a ceiling weight of 4.0 pounds per square foot. The ceiling weight includes the weight of the suspension system, panels, lights, diffusors, sprinklers and anything else clipped to or laterally supported by the grid or ceiling. Actual ceilings today weigh from 1.3 to 2.5 pounds per square foot including all of these components. The grid will easily support the weight of the flexible sprinkler drops. In addition it our opinon that Armstorong standard suspended ceiling systems that are designed and installed in accordance with the CISCA and IBC requirements including the added weigtht of the Flexhead sprinklers and other added fixtures should have adequate capacity to withstand design earthquake motions and still maintain their structural integrity

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In addition to industry standard ceiling system requirements, the IBC and ASCE7 have provisions that allow integral ceiling/sprinkler construction which encourage the sprinkler and ceiling grid to be designed and tied together as an integral unit. Commercial heavy duty ceiling grid which is required by the IBC for seismic design categories D, E & F has more than enough load carrying capacity to fulfill the requirements for integral sprinkler/ceiling construction.

Also, we recently completed two sets of full-scale seismic simulation tests utilizing Armstrong Prelude XL 15/16" Heavy Duty suspension system. These tests were conducted at the State University of New York, University at Buffalo's shake table in their seismic simulation laboratory. The tests followed the procedures outlined in the ICC-ES Acceptance Criteria for Seismic Qualification Testing of Nonstructural Components, AC 156. The seismic simulation was based on the mapped (from the International Building Code, 2000 ed.) spectral accelerations at short periods Ss up to 1.75G. The testing included simultaneous horizontal and vertical earthquake shaking.

Two different ceiling suspension system configurations which satisfied the following two CISCA standards were installed in a test frame mounted on the shake table and tested.

- *CISCA Recommendations for Direct-hung Acoustical Tile and Lay-in Panel Ceilings, Seismic Zones 0-2,* for Seismic Design Category C
- *CISCA Guidelines for Seismic Restraint for Direct Hung Suspended Ceiling Assemblies, Seismic Zones 3 & 4,* for Seismic Design Category D, E & F.

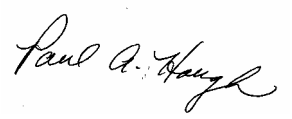
All suspension system components were installed according to the requirements as specified in the IBC & ASCE7.

Both systems were comprised of a 16' X 16' foot ceiling area that had 2' X 2' tile, two 2' X 4' light fixtures, two 2' x 2' air diffusers and 4 FlexHead XYZ flexible sprinkler drops. The systems installed according to Categy C were full floating, unbaced systems and the systems for Category D, E & F had lateral force bracing as prescribed by the IBC.

During the simulated seismic exposure, no panels were dislodged from the suspension system, the suspension system itself did not indicate any signs of distortion or damage and the sprinkler drops remained in place and were not damagedor cause damage after testing at earthquake spectra of 0.25, 0.50, 0.75, 1.00, 1.25, 1.50 and 1.75X. This indicates that the systems as installed should have adequate capacity to withstand design earthquake motions and still maintain their structural integrity.

If you have additional questions, I can be reached at (717) 396-4195. Thank you.

Sincerely,



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