TracPipe® CounterStrike®
Flexible Gas Piping by OmegaFlex®

CASE STUDY

CounterStrike® in Earthquake Hazard Zones

- Saves Time
- Saves Money
- Saves Lives

Product:
CounterStrike® CSST Versus Black Iron Pipe in Simulated Hospital Structure

Location:
San Diego, CA

What happens when you build a fully equipped five-story hospital, including an intensive care unit, a surgery suite, piping and air conditioning, fire barriers and the first-time-ever seismic test of a working elevator, through a series of high-intensity earthquakes on the world's largest outdoor shake table?

Structural engineers at the University of California, San Diego's Englekirk Structural Engineering Center conducted one month of seismic testing beginning in April 2012 in an effort to determine this.

The engineers used scaled versions of motions recorded during some of the largest earthquakes, including the 1994 earthquake in Northridge, CA, and monitored the building's performance with more than 500 sensors and more than 87 cameras that recorded the movement of non-structural components inside the building.

The $5 million project was supported by the National Science Foundation and industry partners including OmegaFlex Inc. The project's goal was to determine what needs to be done to make sure that high-value buildings, such as hospitals and data centers, remain operational when an earthquake hits. UC engineers also evaluated whether the building's fire barriers were affected by the trembling.

To date, only a handful of full-scale seismic building experiments have been conducted. Of these, none have evaluated the post-earthquake fire performance of the complete building system and only a select few (in Japan) have emphasized evaluating nonstructural component's and system's (NCS) response during earthquake shaking. This contradicts the fact that NCSs encompass more than 80 percent of the total investment in building construction. Over the past three decades, the majority of earthquake-induced direct losses in buildings are directly attributed to NCS damage.

The 1994 earthquake in Northridge, California, reported that there were at least 50 gas-related fires in structures above ground, where rigid pipe had been the predominant gas piping material for decades.

"We hope plumbers, electricians, ceiling contractors, and wall contractors can learn and benefit from this testing program," said UC-San Diego project leader Tara Hutchinson. "During earthquakes, it is critical that our hospitals and other vital structures remain functional to serve the needs of those in distress."

This landmark project of a 14 million pound structure built at full-scale and completely furnished with NCSs, including a functioning passenger elevator, partition walls, cladding and glazing systems, piping, HVAC, ceiling, sprinklers, building contents, as well as passive and active fire systems. Post-earthquake fire and life safety performance of both the structure and NCSs will be evaluated by conducting non-thermal and live fire testing. In addition, this project investigated the potential for protecting critical NCS systems using, for example, damping and/or isolation methods. Finally, data from this unique experiment was used to compare with earthquake performance predictions using available commercial and research computational modeling platforms.

Omega Flex viewed this program as an opportunity to continue its ongoing efforts to advance gas piping safety.

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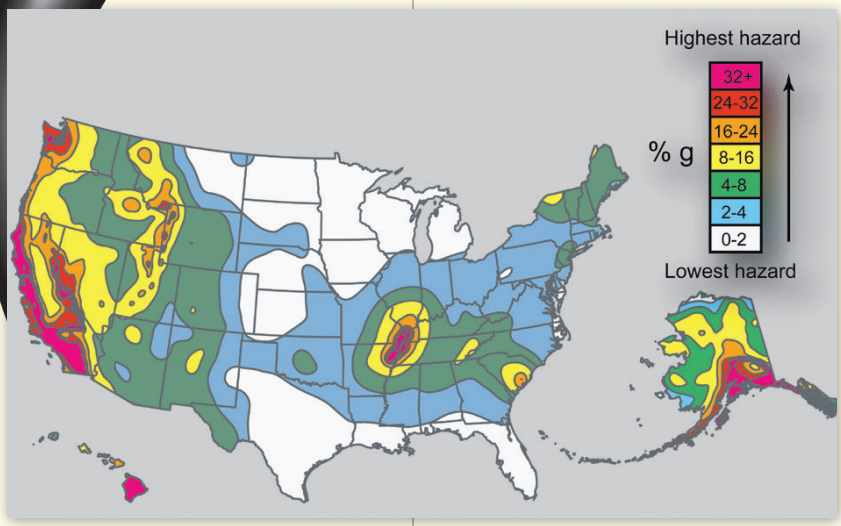
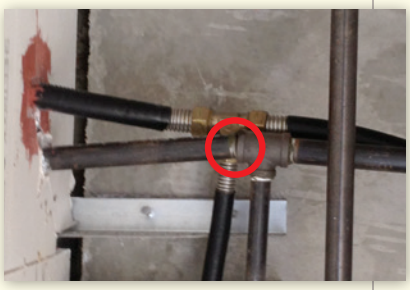


Earthquake hazard map.



The black iron pipe, which was installed next to CounterStrike, fractured in the same test. It took 96 man hours to install the black iron pipe versus just 32 man hours to install CounterStrike.

CounterStrike is the only approved CSST in the industry that does not require heat-treating to meet the rigorous ANSI LC-1 Standard providing for a robust, damage-resistant product with high crush strength.

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CSST was developed in Japan to solve the dangers of broken rigid gas piping in an earthquake, and then brought to the United States by the American Gas Association (AGA) and the Gas Research Institute (GRI) as an alternative gas piping solution.

Given the flexibility of the tubing, CounterStrike® withstood the worst seismic activity simulated without any failures, leaks or damage. Meanwhile black iron pipe, which was installed next to CounterStrike®, fractured in the same test.

According the National Fire Protection Association Guide (NFPA 921) "Leakage from piping and equipment is the main cause of gas fueled fires and explosions. Commonly, leaks occur at pipe junctions, at unlit pilot lights or burners, at uncapped pipes and outlets, at areas of corrosion in pipes or from physical damage to the gas lines."

The simulated hospital in the UC San Diego test building required *103 junctions* to run black iron pipe up the five stories of the simulated hospital versus a total of only *22 junctions* for CounterStrike® CSST – 79 percent fewer.

Given the NFPA 921 research on leaks occurring at pipe junctions, it is easy to see why CounterStrike® CSST is a vastly superior solution to schedule 40 black iron pipe.

In a 2007 study by Victoria University of Wellington New Zealand on wood framed houses (in a country that experiences a 7.0 plus earthquake every ten years) stated "limiting the number of dwellings collapsing due to weak foundations, fitting flexible gas connections (including CSST) and seismic shutoff valves will mitigate the burden on the fire services during the post-earthquake period." This same report concluded "if gas remedial measures (like the above) are adopted, the number of ignitions due to gas leakage decreases by about two-thirds."

According to U.S. Geological Survey, "Thousands of earthquakes occur around the world every day, although most are so small they can only be detected by sensitive seismographs. The number of large earthquakes (M = 6.0 and greater) has stayed relatively constant, based on observations since 1900. For example, an average of 120 earthquakes per year worldwide in the magnitude range of 6.0 - 6.9 (like the Northridge and Kobe events) have occurred since 1900. These numbers tell us that events like those affecting Northridge and Kobe are not unusual, and that we should be prepared for such shocks wherever our cities and towns are located in seismically active areas."

So whether it is a hospital or a home, CounterStrike® CSST can provide improved safety versus black iron pipe during or after an earthquake.

CounterStrike® is listed to Underwriters Laboratories (UL) for 1, 2 and 4 hour through penetration fire stop systems and meets ASTM E84 with respect to flame spread and smoke density. This permits installation in return air plenums.