From the President

Over the years, we’ve watched AEI grow and have had the privilege to work with so many valued clients. We have great plans for the next 10 years and want to thank all of you who have helped make AEI’s success possible.

We would like to thank everyone who attended our 4th Annual Charity Casino Night and Silent Auction. We also can’t say thank you enough to those businesses and individuals who so generously donated items to the Silent Auction. The event was held on Friday, September 18, 2015 at our Littleton, CO facility. The Charity receiving 100% or the proceeds from the evening is The Adoption Exchange. The event raised a total of $6,050. You can find details and photographs from the event in this newsletter.

In other news, we want to be sure you all know about the AEI On Tour training and presentation program we offer. Our engineers and investigators are excellent presenters, and we have many presentations already approved for CO, WY and TX insurance continuing education credits, as well as some that are also approved for Colorado Legal Continuing Education Credits. We can present on topics such as, Fire and Explosion Investigations, Oil and Gas Industry Related Accident Investigations, Commercial Cooking Line Fires, Carbon Monoxide Related Incidents, and much more. We come to your chosen location and present for groups of 10 or more, all for no cost to you. If you’re interested in this offering, just give our Business and Marketing Manager, Carol Chavez, a call or send an email. (303) 709-0706, carol@AEIengineers.com.

We hope you all enjoy the coming holiday season and have a fabulous Fall. Remember, The Right Intel Solves the Problem. Visit our webpage at AEIengineers.com to learn more.

Best Regards,

Jay Freeman
Jay Freeman, President

Greetings from all of us here at AEI Corporation.

August 1st marked the 10 year anniversary of AEI Corporation. John Schumacher, Dennis Shelp and I formed AEI in 2005 with a vision of providing high-quality expert services to our clients. It has always been important to us that our clients know they can rely on our experience, professionalism and integrity.

Out and About

October 2, 2015 – John L. Schumacher, MChE, PE, CFI, CFPS, will be presenting at the annual Colorado Claims Association conference at The Inverness Hotel in Denver, CO on the topic of butane hash oil explosions.

October 6 – 9, 2015 – Carol L. Chavez, Business & Marketing Manager, will be representing AEI at the Annual Nebraska State Bar Conference in Omaha, NE.

October 20, 2015 – Charles B. Sullivan, Senior Consultant, will be presenting at the monthly Colorado Property and Casualty Underwriters meeting on commercial cooking line fires.

November 5, 2015 – Jeffery Berino, BS, AAS, CFEI, CFPI, will be presenting at the annual Colorado Property and Casualty Underwriters All Industry Day conference at The Sheraton DTC in Greenwood Village, CO on the wildland fire investigations. Carol Chavez will also be attending.

February 3 – 5, 2016 – AEI will be attending the Annual DRI Product Liability Conference in New Orleans, LA.
Commercial Cooking Operations

By Charlie Sullivan, Senior Consultant

Fires that occur in restaurant kitchens typically involve electric, gas, or solid fuel cooking appliances. Determining where the fire started on the cooking line is only one part of the investigation. Equally important is the evaluation of the restaurant hood, fire extinguishing system, and exhaust duct as they relate to the growth and spread of the fire.

Although other types of suppression systems are permissible, this article addresses properly functioning wet chemical extinguishing systems. A properly designed, installed, and maintained wet chemical extinguishing system should extinguish an incipient fire very quickly, resulting in minimal damage from smoke and the extinguishing agent. A kitchen that experiences a fire under a hood with a wet chemical extinguishing system should be operational in as little time as it takes to recharge the system, replace fusible links, and clean the appliances and floors.

If a fire spreads beyond the hood, the functionality of the entire system should be questioned. A typical commercial cooking operation consists of the cooking appliances, a Type I hood, an exhaust duct, an exhaust fan, and an extinguishing system installed in the hood over the appliance line. The hood, duct, fan, and extinguishing system operate as one entity. If one of the components is impaired the entire operation may be compromised. It is important to have an understanding of the design objective, overall operation, and applicable codes and standards relating to the restaurant fire suppression system, the hood and duct, the exhaust/ventilation system, and various other components of the operation.

Ultimately the responsibility for the care of the systems is that of the owner or the owner's designated representative. It is the owner or owner's representative's responsibility to place the various systems and components into the care of qualified individuals. This will ensure that the systems and components are inspected, tested, and maintained in accordance with prescribed schedules, which are outlined in applicable codes and manufacturer's manuals.

General housekeeping plays a big role in the proper function of systems. Although the exhaust/ventilation and extinguishing systems are being maintained, often the appliance line is unkempt. In many cases the appliance line isn't being cleaned, appliances have large grease deposits on them, and weekly inspections aren't being performed by the kitchen staff. This can contribute to the ignition of a fire and growth of the fire.

A lack of prescribed maintenance is often a contributing factor in the failure of a hood system to extinguish a fire allowing it to extend beyond the hood and exhaust/ventilation system into other parts of a structure. Some insurance companies have language in their policies requiring that the owner or owner's representative must maintain the commercial cooking operation in accordance with the applicable codes or face the possibility of a claim being denied. Just as the contractors and manufacturers who maintain systems and provide system components are held to industry standards, so too are the commercial cooking operation operators.

The extinguishing system is required to be inspected by a qualified contractor at six month intervals. The hood and exhaust/ventilation system is cleaned and inspected based on the type of operation and volume of cooking. The cleaning company should be advising the kitchen operator on how often the hood and duct should be cleaned. The cleaning company should also be evaluating the condition of the hood, exhaust duct, and exhaust fan. The appliances and other cooking line components are also required to be maintained in accordance with the manufacturer's installation and service manuals. When a service company determines that a system is impaired, the system should: code quote be tagged as non-compliant. When notified of an impairment or deficiency it is the responsibility of the owner or owner's representative to promptly have the problem corrected.

In the event of a fire that is not contained to the appliance line it is important to get the right personnel involved as early as possible opportunity to assess the loss. All too often experts are retained long after the loss, after repairs have been completed, damaged components have been thrown out, potential parties haven't been interviewed and/or notified, and no information has been collected. Identifying the potential parties is important on both the subrogation and defense side of any claim. Determine the cause of the loss may be almost impossible months or years after the fact if proper steps to acquire information and preserve evidence are not taken.
Fractography 102 – The Hidden Beauty of Brittle Fractures
By Shawn Sapp, Ph.D.

In our first introduction to Fractography, published in the July 2015 edition of ADVANCED Thinking!, we learned that a great deal of meaningful forensic information can be derived by careful examination of fracture surfaces in metals. The fractures often can reveal details of the forces that were applied that led to the failure as well as the mechanism by which the part failed: material defect, cyclic fatigue, monotonic overload, etc. We also discussed the concept of how different materials can range from the soft-end of the spectrum where they are deformable like clay, which we call ductile, to material on the hard-end of the spectrum, which can be brittle like glass or ceramics. It turns out that metals (and some plastics) are a special class of material that can exhibit both ductile and brittle behavior depending on the circumstances, and much of the fractographic information that we can identify in metals derives from this mixed-mode behavior. In some ways, purely brittle materials behave in a more ideal way than many metals; when they break... they break all the way and they break rapidly. Think of the last time you dropped a glass, a plate or a piece of chalk onto a hard surface, it likely broke in what would be called a catastrophic failure (all those sharp little pieces, everywhere). In the section that follows, we are going to delve a little deeper into the world of fractography and introduce a number of more technical terms or names for certain meaningful features. It is not all that important for you to remember these names, so long as you can 1) begin to see the beauty of these, complicated and detailed features the next time you look at a broken window, and 2) appreciate that these intricate features allow us at AEI Corporation to better understand how and why a brittle material or part failed. brittle materials like hardened metals, ceramics, glass, and some plastics have their own set of fracture features, some of which can be easier to identify than the fracture features in ductile metals or plastics, but again, lighting conditions and camera or artifact positioning are critical for feature identification. Figure 2 shows four different examples of brittle fracture features, all revealed in the reflected light from the fractured surface. The image in Figure 2A shows the fracture surface of float glass (used in home windows and picture frames), and a number of very telling features can be seen. First, we can determine that this piece of glass was broken in bending because the overall fracture surface is relatively flat (and ~90° to either surface) except for the surface towards the blue arrow where the crack wanders out of the focal plane of the image; this feature is call the compression curl or cantilever curl and is distinctive of specimens broken in bending—try bending and breaking a carrot and you will notice a distinct lip or curl on the side of the carrot in compression. This places the opposite side of the glass (Figure 2A, red arrow) as the tension side, and this is the side where brittle materials fail first—in tension—so the origin of this fracture is just outside of this image, above the base of the topmost yellow arrow. The soft, circular or hook-shaped lines that look like ripples on the surface of a pond are called Wallner Lines (primary and secondary, in this case) and are the result of acoustic reflections within the material intersecting the propagating crack-front as the fracture grows and are most indicative of the direction of crack formation (designated by the yellow arrows) [3]. Wallner lines are like ripples on the surface of the pond when you throw a stone in, but these ripples are frozen in place by the fracture surface as it progresses through these ripples. Just adjacent to the Wallner Lines (to the left in Figure 2A, under the yellow arrows) is an area that appears foggy or misty and this is called the Mist Hackle and results from the acceleration of the fracture front as it approaches terminal velocity where Mist Hackle transitions to Velocity Hackle [2]. These features also help the Fractographer identify the point of failure origin(s) and the mode in which failure occurred [3, 2].

Figure 2B shows an artifact that was also broken in bending like the glass in Figure 2A; however, some features like the Wallner Lines are less distinct for this sample because it is semi-crystalline polystyrene, a rigid plastic used in many household goods (Recycle #7). Like many rigid plastics, semi-crystalline polystyrene is not a purely brittle material (unlike glass and ceramics), so it appears to break in a brittle fashion at large scales (macro-scale), but at the micro-scale, this fracture appears more ductile. This hybrid fracture is...
mode fracture" can complicate the interpretation of the plastic part failures compared to metals, glasses, and ceramics, but fortunately a great body of experience and knowledge exists for Fractographers to reference, and replication of plastic fracture features in exemplar artifacts can further solidify the analysis and interpretation of features [4].

Having discussed some of the prominent brittle fracture features of sheet glass in bending failure (from Figure 2A), it can also be helpful to see how thermally strengthened glass (tempered/safety glass, like in automobile windows) shows related fracture features. Tempered glass is strengthened through careful temperature control of its interior and exterior surfaces upon cooling. This leads to outer surfaces that are under compressive stress and an interior that is under and equal and opposite tensile stress. This built-in surface compression leads to incredibly strong glass, but when it does break—as anyone who has shattered a glass baking dish knows—it does so rapidly and with a great energy release that leads to tiny fracture pieces, minimizing the danger of the razor-sharp edges in an accident. The small fractured pieces of tempered glass, like the one imaged in Figure 2C, are readily identified by their surface compression zones (blue arrows), central or internal mist and velocity hackle (yellow arrows, also fracture propagation direction), and nearly symmetrical pattern of secondary Wallner lines (red arrows).

One of the more common questions asked during a failure analysis investigation is, “is there any evidence of surface impact?” Another similar question is, “did this break from the outside-in or inside-out?” Both questions can be similar in nature from a physics point-of-view; what the Fractographer looks for is distinguishing surface features that are unique to impact events or surface abrasions. This can be likened to the rock that strikes your car’s windshield in the spring, and then suddenly one day in the summer you find a large running crack that crosses your field of view. You might not have even noticed the initial impact defect, but if you look carefully and closely enough, you will eventually find a part of the fracture that looks like the image in Figure 2D. These fracture patterns are quite recognizable and are sometimes called conchoidal fractures, but to the Fractographer, these patterns are known as tertiary Wallner lines and are characteristic of surface defects, typically originating from surface impacts or abrasions [3, 2]. As in the example of the rock striking the car windshield, a surface impact does not always lead to immediate failure or large scale fractures, but eventually through the application of some form of stress (thermal, mechanical, or chemical), fatigue will begin to expand the original defect(s) until a critical crack size is reached, leading to final failure of the part.

ACKNOWLEDGMENTS
Dr. Sapp would like to thank his generous instructors at ASM International, Alfred University and Colorado State University for having graciously passed the torch of their Fractography, Surface Characterization, and Scientific Imaging knowledge and experience on to the next generations of scientists and engineers; theirs’ are the shoulders on which we stand.

REFERENCES

About The Author
Dr. Sapp received his Ph.D. in analytical chemistry from Colorado State University in 2002. For almost 13 years he has been a practicing materials scientist with emphasis on polymer chemistry, metallurgy, novel composite materials, surface characterization, and hazmat safety. He is ASM Certified in Fracture Mechanics, Fractography, and Failure Analysis to determine the origin and cause of failures in metals, ceramics, plastics, and composites. He is a highly experienced electrochemist and metallurgist with over twelve years of experience in industrial, aerospace, marine, and electronics corrosion testing and surface analysis. His knowledge of process chemistry spans from pilot-scale pharmaceutical synthesis and bio-conversion, to full-scale petro-chemical production. He has expertise in investigating accidents in the chemical process and oil & gas industries; analyzing flammable and combustible liquid-related accidents; and investigating chemical release or exposure-related incidents.
Fun and Successful 4th Annual Charity Casino Night & Silent Auction

AEI Corporation would like to extend our thanks to everyone who joined us, or otherwise supported, our 4th Annual Charity Casino Night & Silent Auction on Friday September 18, 2015. The Adoption Exchange received 100% of the proceeds from the purchase of gaming vouchers, prize drawing tickets, silent auction items and donations. Dan Lawrence, Senior Vice President, Development and Marketing, for the organization attended the event and shared with everyone a bit about The Adoption Exchange and the great work and support services they provide.

The Adoption Exchange believes every child deserves a family. They are the connection between children who wait in foster care and the families who adopt. They provide expertise and support before, during, and after the adoption process. The generosity of those who supported this event was touching. At the end of the night we had collected over $6,000 in donations for The Adoption Exchange. Special thanks to all who joined us and made donations, to Colorado Event Productions, who handled the gaming, green screen photo booth, and DJ, and to El Jardin Mexican Restaurant who catered the event with some fantastic food.

We want to mention all the wonderful companies who were so generous in donating items for the Silent Auction. We absolutely couldn’t have these great results without their support. Be sure to keep in mind when you are shopping in Colorado.

Aspen Falls Custom Design & Landscaping - $500 certificate for landscape design services
Colorado Rockies Organization – Autographed Nolan Arenado baseball
Hunter Douglas and Leslie Lim from Broomfield – 50 sq ft of Hunter Douglas blinds valued at $1,500
Lucky Strike Lanes – 2 hours of bowling for up to 8 people, including shoe rental and select menu items
Grist Brewing Company – Growler, gift card for growler fill, coasters, hat and bottle opener
The Coleman Company – 2 Denver Broncos, Performance Wheeled Coolers
Elitch Gardens – 2 day passes to their theme and water park
Historic Denver – 4 tickets to the Historic Denver Walking Tours for both LoDo and Capitol Hill, as well as 4 tickets to the Molly Brown House Museum
Rio Grande Mexican Restaurant – $25 gift card
Colorado Fire Fighter Calendar Organization – Two fully autographed 2016 calendars
American Girl – Award winning collectable doll of the year, “Grace”

Below are a few photos from the event. This year, AEI had a Mexican Fiesta theme and incorporated that in the decorations, food and green screen photo booth backgrounds and props. We had a blast!

AEI Corporation and Jennifer Poynter of Poynter Law, LLC, Provide a Full Day of Training in Colorado Springs

AEI Corporation would like to thank the Colorado Springs Fire Department for attending the Thursday, September 10, 2015, full day training seminar put on by AEI Corporation and Jennifer Poynter, Esq. We also would like to thank the Department for opening their training facility so others from the area could join us.

With 35 in attendance, AEI’s Charles Sullivan, Senior Consultant and Fire Investigator Jeffery Berino, and Jennifer Poynter, Esq. of the Poynter Law Firm, LLC, presented a full day of information on the subjects of Commercial Cooking Line Fires, Pyrotechnic (Fireworks)Related Accidents, and Wildfire Investigations. There were great questions and participation from the attendees, and some fun demonstrations during presentations.

If you have an interest in hosting a training event in your geographical area that offers insurance continuing education and continuing legal education credits, get in touch with Carol Chavez at carol@AEIengineers.com, or at (303) 339.3223.

Lucky Strike Lanes – 2 hours of bowling for up to 8 people, including shoe rental and select menu items
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AEI Corporation Featured on 7News Denver

On September 7, 2015, AEI Corporation was featured on 7News in a segment by Anchor, Theresa Marchetta. The story focused on how grills can spark dangerous, destructive fires. Having investigated multiple grill fires, AEI hosted a live burn at its Littleton, CO facility that recreated a common grill fire often seen. In addition to using footage of the burn, 7News also interviewed Dennis Shelp, MS, PE, CFI, CFEI and principal engineer at AEI. Dennis explained that the burn cell was constructed to replicate the inside corner of a house exterior with a section of deck, and an eave overhang for the roof. This setup duplicates the construction of many homes. Theresa shared that the National Fire Incident Reporting System reports 8,800 house fires caused by grills every year. 80% of which involve gas grills.

Dennis explained that if people are using the grill close to their house and a fire occurs, flames can work their way up and into the house through the eave overhang. From there, it will spread to the roof. Ideally, keep grills at least 10 feet away from your home. You should also perform the manufacturer recommended leak tests to confirm your grill is leak free.

AEI Corporation’s Materials Scientist, Also an Artist

Shawn Sapp, Ph.D. and Materials Scientist at AEI Corporation and his wife Jami, recently participated in the 2015 Centennial, CO Chalk Art Festival on September 19th and 20th. Several talented artists participate in this event every year. Shawn and Jami’s vision for this year’s piece was to inspire the younger generation to take an interest in engineering and learn more about the field. They did this by depicting characters from Walt Disney’s Big Hero 6. The movie is about a robotics prodigy who ends up assembling a band of high-tech heroes. The photos below show the progression of their very creative work.

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