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Title: Wood Burning Insert Issue Paper
Date: April 2, 2012
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Problem:
The Mammoth Lakes Fire Department has responded to several similar fire incidents in the last ten years. In each incident a common factor is an inserted wood burning appliance placed within a previously used zero clearance fireplace box. If you have either a pellet/gas insert installation or a masonry flue/chase, these types of appliances or installations are not an issue. The investigations for each incident found that combustible construction materials (wood, plywood, and/or sheetrock behind the rock, brick, metal and/or wooden material that one can see on the interior surface of the fireplace façade) did not meet the insert manufacturer's required distance for proper installation of the insert. The efficiency and the BTU generation of the insert far exceeds what the original fireplace box was designed for and thus the clearance to combustible materials is insufficient and over time these materials are becoming more susceptible to ignition.

Discussion of Issue:
Mammoth Lakes has seen at least eight structure fires of a similar nature since 2000 as retrieved from the history of our computer generated records. There may have been more, but the records were not discernible to this specific ignition cause and thus have not been included in the above statistics. The issue occurs in all types of residential occupancies, with most occurring in rental multifamily structures (one fire did occur in a single family home). Thus far there have been no injuries from the incidents, though the losses and construction costs have been significant.

Most of the incidents occurred in buildings that were built in the 60's through 80's. All of the fires have occurred in structures where wood burning insert appliances have been installed into pre-existing zero clearance fireplace boxes (fireplaces), which typically are constructed of two to three layers of sheet metal in the form of a box. Also, all of the chimney chases were of wood construction (referred to as factory built fireplace flue assembly), which differ from the typical high mass masonry fireplace and chimney. These fireplace/flue assemblies are connected to the fireplace box by a metallic chimney constructed of concentric metal pipes (either double wall or triple wall pipe), all contained within a wood constructed chase. All of the fireplace boxes appear to have been installed correctly and to code.

In the incidents, all of the flue pipes were of triple wall construction. Some of the installations had a short section of single wall pipe connecting the insert to the collar of the fireplace box and then into the original flue pipe, while others had a steel liner installed inside the flue pipe from the insert all the way, or most of the way, to the cap.

The problem occurs due to the inserts greater efficiency and higher heat output making the clearance to combustibles of the original fireplace installation inadequate. The insert comes with an instruction manual that specifies the manufacturer's tested distance to combustibles to avoid a fire. In each of the incidents the distances to combustibles were not met. When the insert was installed, the walls

surrounding the fireplace would have been opened up and the distances to combustibles measured. In every case, the header above the fireplace is impacted by the heat, becomes subject to **pyrolysis**, and eventually ignites. This process takes several years before it becomes a problem and is aggravated by higher usage and hotter temperatures. See Appendix A.

Pyrolysis *is the chemical decomposition of matter (in this case wood) through the action of heat. When wood pyrolyzes, it releases combustible gases while leaving behind a black, carbonaceous residue called char. The pyrolysis process penetrates deeper into the wood as the heating process continues. As more moisture is removed from the wood, the ignition temperature becomes lowered. From FIRE PROTECTION HANDBOOK, Eighteenth Edition.*

One complex in town had had two fires related to the same problem (one occurred in 2000 and another in 2009). Based upon the two experiences, the Homeowners Association decided to require that all of their owners replace their inserts and remove all combustible materials to the manufacturer's installation requirements. When all of the units were refitted with new appliances, and the walls opened up, 23 of 60 units show some sign of heat damage to combustibles because the proximity to combustible materials was too close.

Background:
There was a resurgence in the construction, installation, and use of wood burning stoves/inserts as a result of the Arab oil embargo of 1974, especially for residential heating. In Mammoth Lakes, wood burning has been a traditional source of heat for a longer time period due to colder temperatures and long winters. With the increase in woodstove/insert use, there has also been a rise in the incident rate of fires associated with woodstoves/inserts, particularly in residential applications.

An insert is one variant of the woodstove industry and was initially solely designed, tested, and listed for insertion into an existing code compliant **masonry fireplace**. Inserts were originally not intended for installation into factory built fireplaces or anything other than a masonry fireplace. However, stove installation shops quickly saw additional profit from sales for installation into factory built fireplaces even though there were technical challenges. These stoves were never Underwriters Laboratory (UL) tested or listed for this application (the zero clearance fireplace box, chimney, and termination cap are all tested and listed as a system). Over time, manufacturers began including basic instructions in their installation manuals for their installation into factory built fireplaces.

The manufacturers of inserts have not had their products tested in zero clearance fireplace assemblies by UL due to the magnitude of different components that exist, but have tested their own products to what is called "UL Standard". The UL testing and listing is important as this serves the basis for the development of the codes. There are three separate cooling systems that are part of the UL tested and listed system. The clearance to combustibles around the fireplace box, the movement of air around the insert and within the fireplace box, and the air movement within the flue pipe assembly are critical to the fire worthiness of the system. Any modification of these components outside the manufacturers listed instructions constitutes a breach of warranty on the part of the person committing the modification, a violation of most model building codes, and voiding the safety listing of the appliance.

Based upon the current level of investigation, the specific challenges and problems of these installations include:

Appears to void the fireplace manufacturer's warranty and listing. Fireplaces are listed to UL 127. The chimney, termination cap, fire stops, and other various components are all tested with the fireplace as a system. Since they all work in conjunction, a liner would have to be tested inside a complete fireplace, chimney, and termination cap. However, the liner is not listed for use inside a factory built chimney,

much less the cap. It appears that this type of testing has never been done by any of the insert manufacturers. Since the heat signature of the fireplace is now drastically altered, all the original test data and predictability of performance is compromised. (Dale Feb, Fireplace Investigation, Research & Education Service, Member of NFPA 211 Committee, Personal Conversation).

Appears to void the stove manufacturer's warrant and listing. Stoves are listed to either UL 1482 or UL 737. These standards rely on testing within a masonry fireplace and chimney only. There are no provisions for testing inside a factory built fireplace. Therefore, a stove may claim to be listed to these standards but only for installation into a masonry fireplace and chimney. (Dale Feb, Fireplace Investigation, Research & Education Service, Member of NFPA 211 Committee, Personal Conversation).

Appears to violate the model building codes where it requires such installations be listed. If the stove's listing involves UL 127, 737, 1482, or 1777, then none of those standards include a test for inserts into factory built fireplaces and chimneys. Even if a stove is listed to one or more of these standards and the manufacturer state they "approve" the installation into a factory built fireplace, the stove is still not listed for this application. (Tom Pierce, Fire Investigator, Fire Cause Analysis, Member of NFPA 211 Committee, Personal Conversation).

Appears to violate the model building codes where they require liners to be listed to UL 1777 and installed to this listing. The 1777 listing involves testing a liner suspended inside a 10 foot tall single brick Wythe chimney. There is no portion of the UL 1777 listing that includes a test in factory built chimney that is listed to UL 103HT or the factory chimney listed with the fireplace to UL 737. (Tom Pierce, Fire Investigator, Fire Cause Analysis, Member of NFPA 211 Committee, Personal Conversation).

Exceeds the 200 pound test requirement in UL 127 for factory built fireplaces. Woodstove inserts can weigh over 500 pounds plus liner, which can easily collapse the base of the firebox. (Dale Feb, Fireplace Investigation, Research & Education Service, Member of NFPA 211 Committee, Personal Conversation).

Blocks the primary cooling systems of the fireplace. The installation of an insert blocks the normal 400-600 cfm flow of cool room air through the wood burning fireplace. The insert installation also blocks the cooling louvers usually located at the sides, bottom, and sometimes top of the opening to the fireplace. Some of these systems discharge heated air into the chimney. The introduction of a chimney liner or connector blocks this air discharge, thus raising temperatures in and around the fireplace. (Dale Feb, Fireplace Investigation, Research & Education Service, Member of NFPA 211 Committee, Personal Conversation).

Additional Items:

Increases the heat and smoke residence time in the fireplace and chimney.
May require removal/modification of several listed components: damper, damper pivot rod, damper linkage, smoke shield, and refractory panels.
Prohibits the installation or may require the removal of the listed fireplace doors, refractory panels, grate, and/or damper.
Woodstove insert can generate more radiant heat than an open hearth fire.
A radiant woodstove insert protruding from the opening of a fireplace will project more heat flux on the hearth extension and mantel.
Use of compressed logs (some UL listed and some not) may be void manufacturer's warranty and an excess number of logs can be used exceeding the log manufacturer's use practices.

APPENDIX "A"
PICTURES AND EXPLANATION

Figure 1- Typical Zero Clearance Fireplace (Fireplace) installation – clearances set by Fireplace Manufacturer.

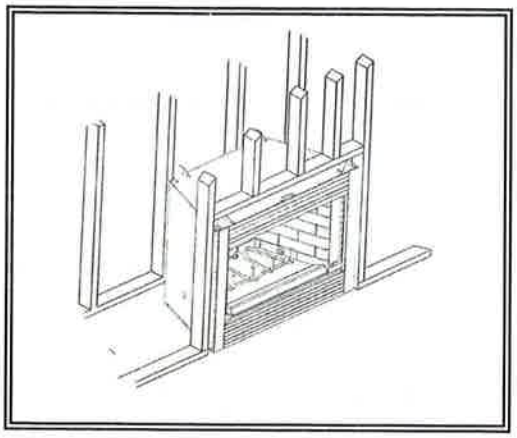

Figure 1

Figure 2-Fireplace with fascia layer added – layer usually includes non-combustible material: rock, brick, metal, or wood.

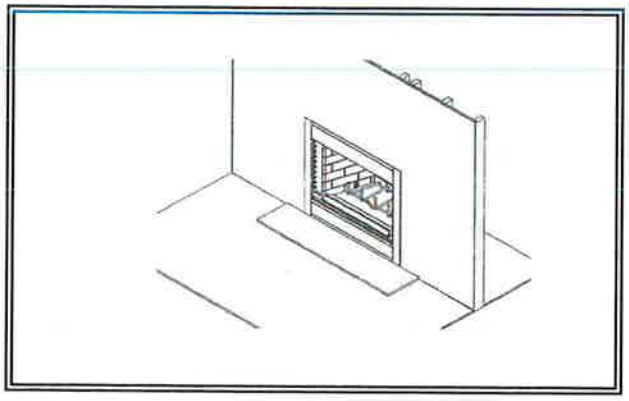

Figure 2

Figure 3-Insert fits inside Fireplace box with connections provided to existing flue piping by installer. Some insert manufacturers require lining of flue pipe with steel liner.

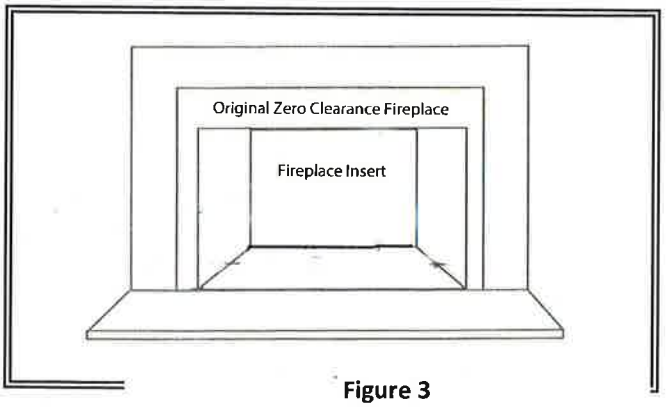

Figure 3

Figure 4- Insert instructions provide distances to combustibles as determined by insert manufacturers. Critical distances are "B" distance to mantel or similar projects of the visible wall. "C" distance to combustibles inside the wall above the insert (behind fascia material). "D" distance to combustibles inside the wall longside the insert (lateral to the insert).

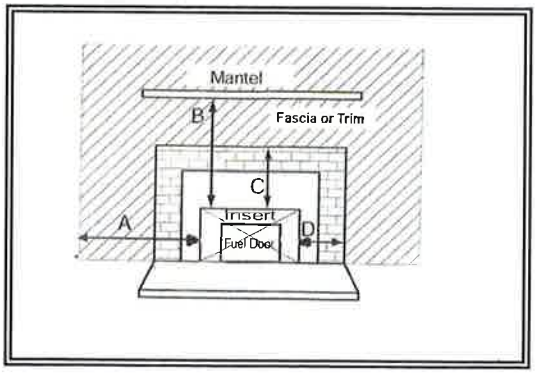

Figure 4

Figure 5 -With fascia in place, it is very difficult to determine the location of combustibles behind the fascia material. The first step in determining if a problem exists will be to determine if there is still a Fireplace box in place. This would involve taking the metal shrouding off from around the insert. If a Fireplace box is found then further investigation is needed. In some situations access to the construction material behind the fascia may be obtained through the exterior of the chimney chase. In most cases, getting to the appropriate location will not be possible and portions of the fascia will need to be removed to determine construction material behind.

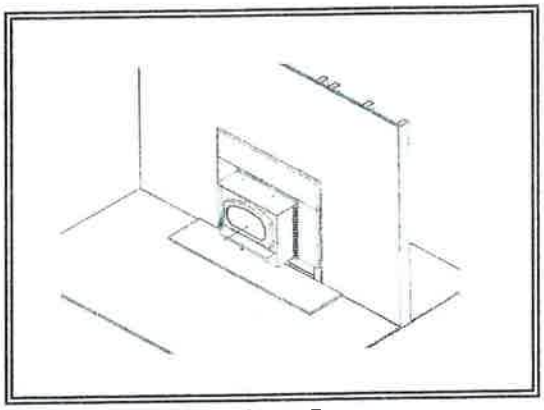

Figure 5

Figure 6/Figure 7- The area of concern is the immediate area around the insert. In these pictures the Fireplace box has been removed, but the area of concern is the distances to combustibles that is required for a proper installation of the insert. Distances vary with insert models, but all insert manufactures have a required distance that must be achieved to protect the combustibles from a structure fire. The shaded area in Figure 7 is the area of concern. Any combustible materials (wood, plywood, sheetrock, etc) could result in an unwanted structure fire.

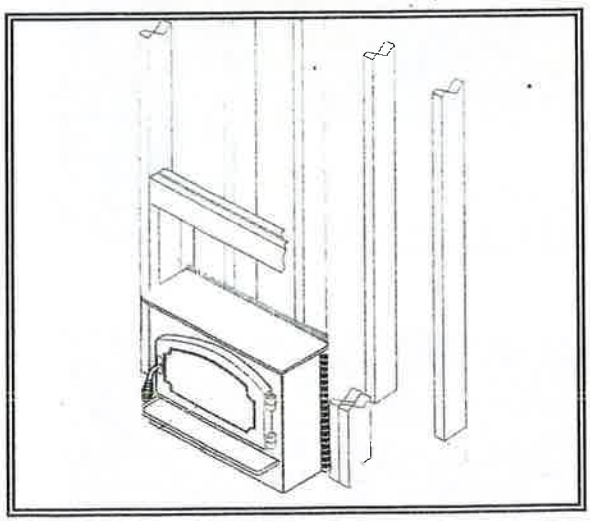

Figure 6

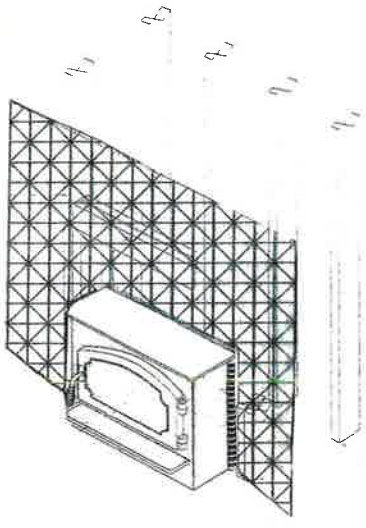

Figure 7

The following pictures come from the wood supports on several condos.

Photo 1 is pyrolysis (the slow baking of wood) that occurred to a header board in a wall of a condo unit that did not catch fire. Pyrolysis caused a charring (blackening) of the wooden material and a lowering of the ignition temperature which makes it more susceptible to ignition. This is an example of well-developed pyrolysis found in a frequently occupied condo unit.

Photo 1

Photo 2 is pyrolysis of a 2x4 header that was removed from condo unit that did not show signs of fire activity. Note paper off the insulation has completely burned away, except for a few small pieces.

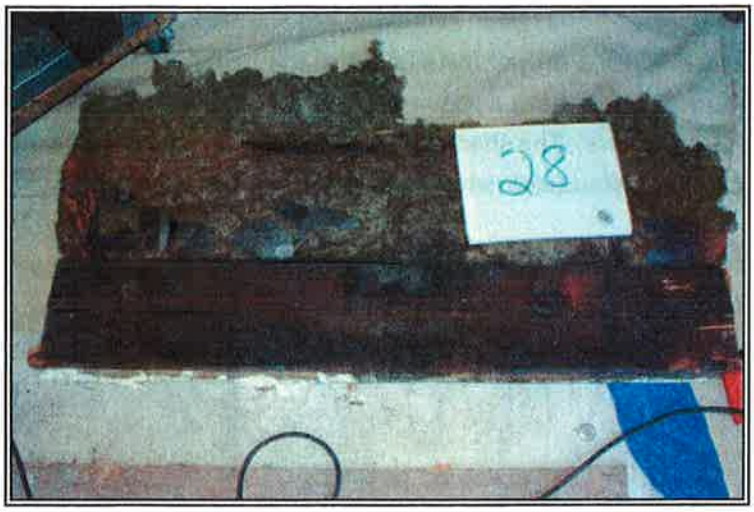

Photo 2

Photo 3 is advanced pyrolysis found in another condo unit. Note the alligator cracking (advanced charring), This also shows the burning away of the paper from the back of the insulation.

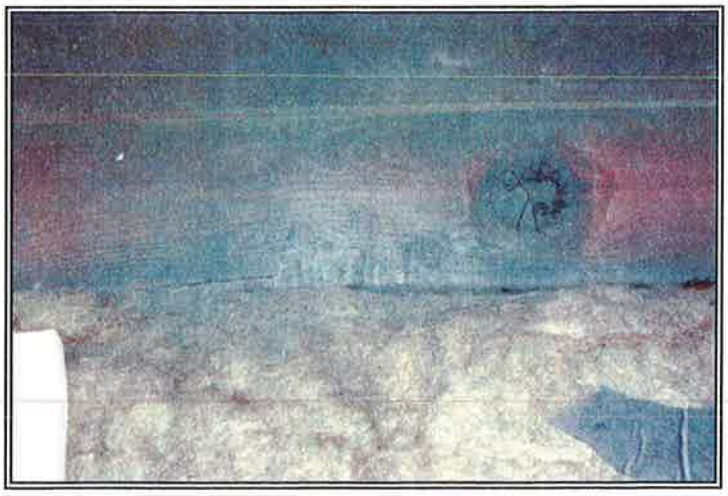

Photo 3

Photo 4 The picture demonstrates the seriousness of the problem. The wall section directly above the center of the insert has been removed (it is upside down). You can see the advanced charring and soot marks on the metal behind the wall section. This section is close to igniting and causing a fire.

Photo 4

Photo 5 is an actual fire caused by pyrolysis around a wood fireplace insert. Fire occurred in March of 2010, fortunately no one was hurt.

Photo 5

Photo 6 Same fire.

Photo 6

Photo 7 shows the whole problem. This is where the fire started (in the last two pictures). You can see the original "zero clearance" fireplace with the wood burning insert. The slow pyrolysis over time finally ignited in the area where the bricks are missing. The fire proceeded further into and up the chase. In many cases in order to find the damage, you need to remove the façade, in this case the bricks, and cut into the wood framing behind the façade.

Photo 7