

# Engineering Report

## Topic: Ceiling Radiation Damper Misconceptions

Today there is a great need for education on how to use or install a ceiling radiation damper. Leader Industries, Inc. tested ceiling radiation dampers back in 1987. Questions consistently arise concerning the proper installation of our ceiling radiation damper into ceilings built. The first question asked of them would be, "Were you wanting a U.L. approved installation?" If the answer to the question were "yes", then the next question would be, "What is the U.L. Design Number of the ceiling you are using?" The U.L. Design Number can be found in the Underwriters Laboratories "Fire Resistance Directory". This number consists of a letter followed by 3 digits.

An example of the numbering system is as follows:

**NUMBERING SYSTEM FOR FIRE RATED ASSEMBLIES**

Groups of Construction	TYPES OF PROTECTION									
	Membrane Protection					Direct Applied Protection				Unprotected
	000-099	100-199	200-299	300-399	400-499	500-699	600-699	700-799	800-899	900-999
Floors-Ceilings A, B*, or C* Concrete and Cellular Steel Floor	Con- cealed Gnd Sys	(Reserved)	Exposed Grid System	(Reserved)	Metal Lath	Gypsum Board	Miscel- laneous	Cemen- tious	Sprayed Fiber	Unprotected
D, E*, or F* Concrete and Steel Floor Units	Con- cealed Grid Sys.	(Reserved)	Exposed Grid System	(Reserved)	Metal Lath	Gypsum Board	Miscel- laneous	Cemen- tious	Sprayed Fiber	Unprotected
G, H*, or I* Concrete and Steel Joists	Con- cealed Grid Sys.	(Reserved)	Exposed Grid System	(Reserved)	Metal Lath	Gypsum Board	Miscel- laneous	Cemen- tious	Sprayed Fiber	Unprotected
J or K Concrete	Con- cealed Grid Sys.	(Reserved)	Exposed Grid System	(Reserved)	Metal Lath	Gypsum Board	Miscel- laneous	Cemen- tious	Sprayed Fiber	Unprotected
L or M* Wood Joist or Combination Wood and Steel Assemblies	Con- cealed Grid Sys.	(Reserved)	Exposed Grid System	(Reserved)	Metal Lath	Gypsum Board	Miscel- laneous	Cemen- tious	Sprayed Fiber	Unprotected
Beams: N or O* for Floor Ceiling	Con- cealed Grid Sys.	(Reserved)	Exposed Grid System	Batts and Blankets or Mineral and Fiber Boards	Metal Lath	Gypsum Board	Miscel- laneous	Cemen- tious	Sprayed Fiber	Unprotected
Roof-Ceiling: P, Q* or R*	Con- cealed Grid Sys	(Reserved)	Exposed Grid System	(Reserved)	Metal Lath	Gypsum Board	Miscel- laneous	Cemen- tious	Sprayed Fiber	Unprotected
Beams: S or T* Roof-Ceiling	Building Units	(Reserved)	Exposed Grid System	(Reserved)	Metal Lath	Gypsum Board	Miscel- laneous	Cemen- tious	Sprayed Fiber	Unprotected
Wall & Partition: U, V or W*	Blgd or Partition Panel Units	(Reserved)	Insulat- ing Concrete	Wood Stud Gypsum Bd Lath &/or Plaster	Metal Stud Gypsum Bd Lath &/or Plaster	Misc	Metal Panels Gypsum Bd Lath &/or Plaster	Metal Panels or Supports Cemen- tious	Metal Panels or Supports Sprayed Fiber	Masonry
Columns: X, Y or Z*	Building Units	Prefab- ricated	(Reserved)	Batts and Blankets or Mineral and Fiber Boards	Metal Lath & Plaster	Gypsum Board	Miscel- laneous	Cemen- tious	Sprayed Fiber	(Reserved)

The prefix numbers with an asterisk (\*) and the design numbers indicated as "Reserved" in the above table are for future expansion and to cater to new types of systems developed in the future.

As defined by UL in their Fire Resistance Directory, Ceiling Dampers are designed to function as a heat barrier in air handling openings penetrating fire resistive membrane ceilings. Ceiling Dampers have been investigated for use in lieu of hinged-door type dampers in floor-ceiling or roof-ceiling designs that contain air ducts and specify hinged-door type dampers over each duct outlet.

Some people consider multiple UL rated components that are assembled, make up a UL approved assembly. For example, a commonly used ceiling would be one or two layers of gypsum wallboard with some form of a wood truss system behind it. Some think that if you need to penetrate the ceiling with lights, ductwork, or grilles, it will be acceptable to put a UL

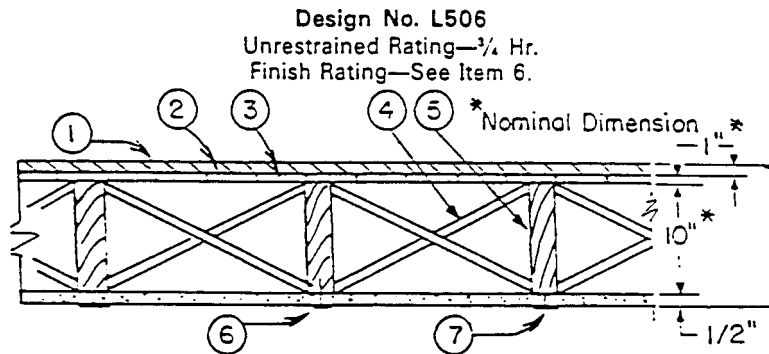


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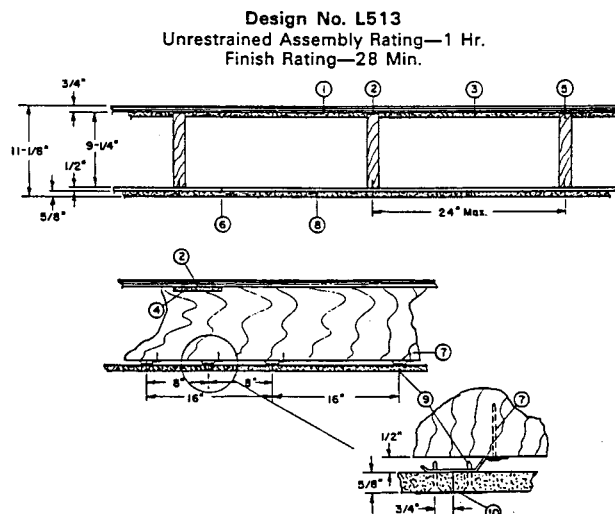
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fire rated product above it to protect it. It does not always carry the UL fire rating for that particular type assembly. In most cases a wood and gypsum ceiling does not allow any penetrations to keep the hourly assembly rating. Some UL fire rated assemblies are rated with penetrations and some without penetrations. Always refer to the UL Fire Resistance Directory before you specify a ceiling design, if you will be putting lights or ductwork through it to make sure you can penetrate it.



Here is an example of design #L506, an assembly showing 2x10's (5), flooring (1), sub-flooring (3), and one layer of gypsum/drywall board (6). This design will not carry the 3/4 hourly rating if it is penetrated. As you can see, it does not show a light, or air duct opening, etc. Its design was tested as you see it. At times these ceilings just reach the hourly rating before they begin to fail. When an opening is produced, some form of sheet metal (light, ceiling damper, grille) is put in its place. This piece of metal carries heat through the opening in the form of conduction. In a lot of cases, the addition of an opening will cause more heat to reach the cavity around the wood trusses thus causing the trusses to weaken at an accelerated rate.



**Design # L 513**

Here is another example of a common ceiling design with a 1 hr rating. It has basically the same materials except for a steel runner that separates the gypsum and the 2x10s. We have witnessed a damper/gypsum ceiling assembly that was subjected to a 1 hr fire test. The ceiling was constructed of a 2x4 frame with fire rated gypsum wallboard on each side. Close



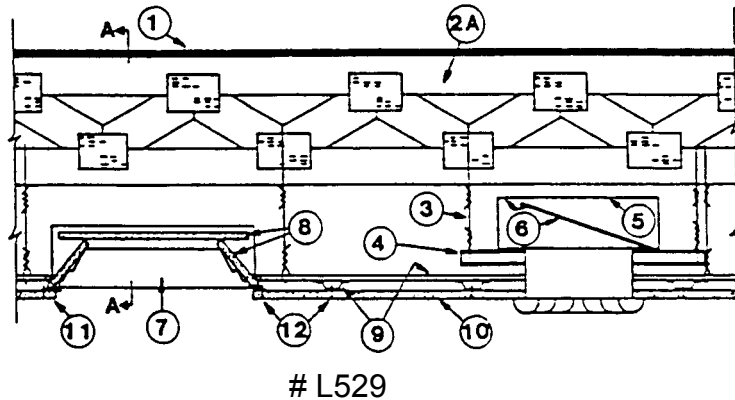
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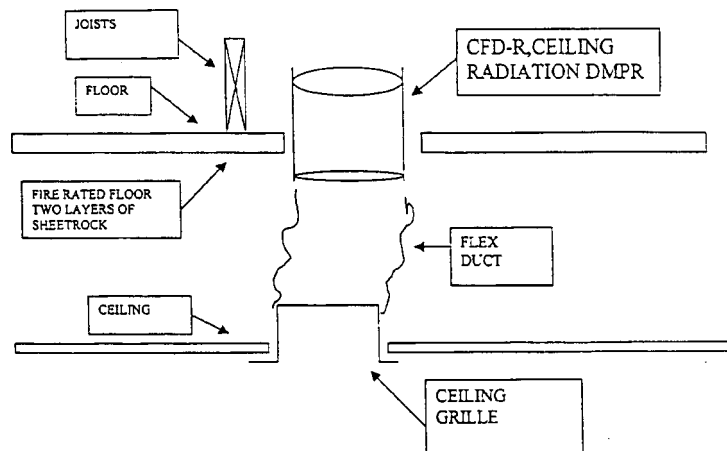
attention was paid where the screws held the gypsum to the wood. It was noticed the wood appeared to have caught on fire. This is partly from the nails being heated up so much that it actually caught the wood on fire inside the structure. This fire test was run in the horizontal mode. As you can see in this design, the hourly rating is greater than the previous one due to the fact that the exposed nails do not directly penetrate the 2x10s. Also, you may notice, there is nothing penetrating the drywall. As in the previous example, it was tested without any penetrations.

**Design No. L529**  
 Unrestrained Assembly Rating - 1 Hr.  
 Finish Rating - 22 Min.



Here is an example of a ceiling design in which you may penetrate with lights, and or, a duct drop. You can see 2x4 wood trusses, drywall, steel runners, damper, and light. This design keeps the screws securing the ceiling, away from the wood. Other examples of penetrable ceiling designs are L005, L006, L201, L202, L206, L209, L210, L211, L212, L525, and L526.

Now that you have been shown a couple of examples of different UL approved ceiling designs, following are some questions/situations we receive fairly often. We receive calls from contractors, fire marshals, inspectors, engineers, and our agents.

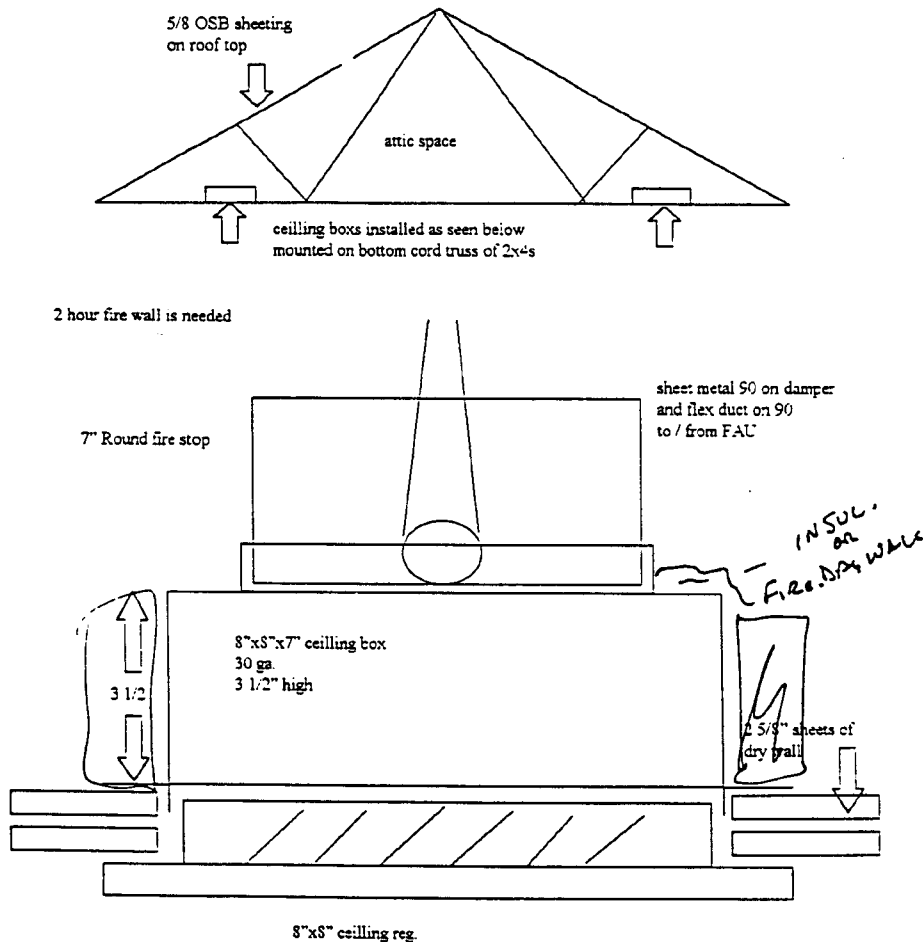


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As you can see there is very little information on this drawing. The enclosed cover letter said "We are ready to order the fire dampers for this job, so we need the "Official" drawing for installation back as soon as possible". The reply back to him was, "We will need the following questions answered before we can tell you anything": 1). What is the U.L. design number for this ceiling design? 2). Do you want this to be a UL approved design? 3). How is, or from what is the damper mounted? 4). Where is it mounted with respect to the 2 layers of sheet rock? 5). What kind of instructions are you looking for? General? Specific? UL approved? Or Leader Dampers & Louvers recommended? In this case the designer did not do the necessary research before submitting the job to be built.



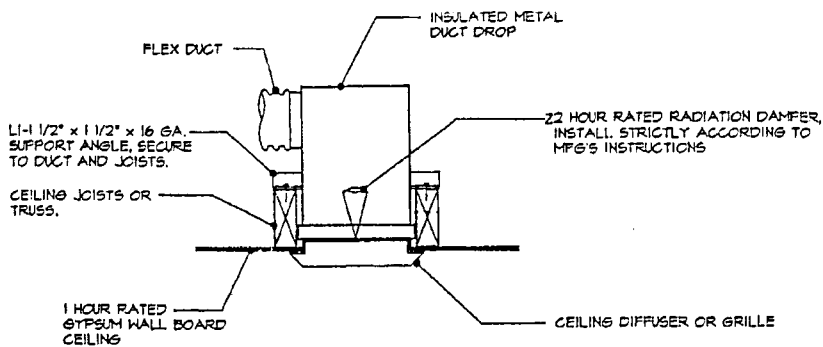
There is slightly more information on this drawing, but not near enough. The enclosed letter says: "Our inspector needs to have, on your company letterhead, (w/signature of responsible party), an OK of this type damper in this application. Please be as helpful as possible." To begin with, when someone makes the notation (w/signature of responsible party) that sets off flags that something may not be right. This is not a UL design. The same questions for him apply from the previous drawing. We are certainly not going to put our company's name on something that has not been proven. But, some people think its no big deal to do that.



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### DETAIL: RADIATION DAMPER

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Here is a drawing very similar to the previous one but it has more details and appears to have been drawn on the plans by the designer. The cover letter received with it states, "The inspector from hell is still giving our contractor fits". It also stated, "The radiation dampers have been installed as shown on the attached sketch, however, since your installation drawing shows wires supporting the dampers, he wants the wires in addition to the angle supports. Could you please write a letter stating that the installation as detailed is acceptable?" The same problem persists with this one, as with the previous ones. As you can see with this one, the designer specifies it to be mounted in accordance with manufacturer's instructions. At this point he is trying to take the responsibility off of him and put it on the agent or contractor. Think about it. The ceiling he has given them is not a UL approved design. So when the inspector turns this down, due to not being able to get approved installation instructions from the manufacturer, who is responsible? The ceiling will need to be replaced with an approved one so the dampers can be installed correctly. Obviously the contractor is not going to want to eat this one, and he will try to back charge everyone he can to redo this ceiling, even the individual who told him how to build the ceiling that he is going to tear out.

Now for those who are asking the question, "What are we supposed to do?" First suggestion would be getting a copy of the latest edition of the UL Fire Resistance Directory, to look up designs that have been tested and approved. Second, if you have a situation that is not in the book, you can call the mechanical codes department and see what they feel comfortable with doing, and will accept. You can call our factory, and if we do not have an answer for you then we might know of where we can find one.

Some of the designs of which you can think, or the designs that do not show a penetration, may or may not have been tested. These UL tests are not cheap. Unsure of what a full-scale fire test runs on one of the designs in this book, here is an example of some of the cost we have incurred. Our UL Ceiling Radiation Damper cost, (back in 1987), for a large-scale fire test, several damper sizes salt test, and a couple of other small tests, ran us just short of \$40,000 and 10 months. And that was without any failures. If something had not passed then it would have been considerably higher. That \$40,000 did not include \$100,000 plus for machinery to produce it. So when a new product such as this hits the market it takes quite a while before you break even. That is also why manufacturers do not jump to go to UL to test a specific design that may be used on one or two jobs.



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If you have any questions concerning UL products, installations, or even some of these designs, please feel free to give us a call. We'll do our best to get you an answer. The main concern with a U.L. approved ceiling is to prevent heat from getting into the space around the weight bearing trusses. By penetrating the lower barrier and putting a piece of metal in it, that has the potential of radiating heat into that space. Last and probably most important; **Try to remember, just because all the parts of an assembly have been U.L. approved, that does not mean when you put them together that the assembly is a U.L. approved assembly.** In the General Information Section of our catalog, you will find a list of standards and how you may acquire several up-to-date copies of the procedures that partly govern our industry.



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6

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