

SPRAYED FIBER EROSION IN CEILING PLENUMS

Air Return Velocities Are a Key Factor in Determining if Fireproofing Fibers Will be Eroded

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Do mineral fibers from sprayed fireproofing contaminate air conditioning systems? In recent years the question of health hazards from various fibers in the air has raised this type question. With reference to sprayed fireproofing, the question arises from the fact that the space between the underside of the steel floor deck and suspended acoustical ceiling in office buildings is frequently used as a return air plenum. A large proportion of these steel decks are protected by sprayed fireproofing to meet fire codes.

At first glance it is conceivable that the passage of high velocity return air across the fireproofing fibers can cause an erosion of these fibers. They may then be carried in the air stream through the return air ducts, through air filtration systems and then discharged into occupied spaces serviced by the supply portion of the air conditioning system.

It is not within the province of this writer to offer an opinion as to the effect of sprayed mineral fibers upon the health, however some questions can be answered as to the possibility of such fiber erosion. Also, whether the airflow velocities prevailing in an average

return air ceiling plenum are sufficiently high to cause substantial fiber erosion.

Q: How does a typical office building return air system work?

A: The supply air system discharges filtered, conditioned air into occupied office spaces usually from room air diffusers which, in turn, are serviced by duct-fan systems of varying complexities. The supply air reaching the offices is usually a mixture of outside air and recirculated return air. The supply air, after entering the offices, is transferred through grilles located in the suspended acoustical ceiling, then into the plenum space between the top of the ceiling and the underside of the fireproofed steel floor deck. This plenum space is essentially a large return air duct coated on the upper side with sprayed fibers. Return air fans draw this air through the plenum into a much smaller vertical return air collection duct located at one side of the building or into a duct shaft, which in turn delivers the return air back into the supply system.

Q: What is the velocity of the return air in the plenum?

A: Most air conditioning systems in office buildings supply from 1 to 4 cubic feet per minute (cfm) per square foot of floor space. The plenum usually has a free height (from the back of the suspended acoustical ceiling to the bottom of the beams) of at least 1 foot. The return air flow therefore takes place in a simulated duct equal in size to the floor-ceiling area multiplied by the free height of the plenum. In a 1 foot high plenum, the air velocity would be approxi-



Mineral fiber fireproofing material is spray applied to steel decks, columns and girders.

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mately the same as the cfm of air supplied per square foot of floor space; that is, between 1 and 4 feet per minute (fpm). If the plenum is very low—say 6 inches instead of one foot, the velocity of return air in the plenum may double to 2 to 8 fpm. This velocity, 8 fpm, is so low as to be imperceptible. For example, the design air velocity in offices is usually between 35 fpm and 70 fpm.

Q: Does the air flow velocity increase near the return air duct?

A: Yes, in the immediate vicinity of the return air collection duct the above mentioned very low air velocities increase.

Q: How can I determine what the air velocity may be at a specific location?

A: An approximation of the air velocity in the plenum can be

obtained easily and which shows the relationship between air velocity in the return air plenum as a function of distance from the return air collection duct and the velocity in the return air duct. The mechanical drawings will provide information as to the cfm handled by the return air duct. Divide cfm by the size of the duct (in sq. ft.) to arrive at the air velocity in the return duct in fpm. It should be noted, of course, that plenum locations within a radius of 2 feet from the return air duct may be exposed to velocities in the order of 400 to 800 fpm.

Q: Is there a recognized test procedure for determining whether sprayed fiber will erode in a 400 - 800 fpm air stream?

A: Public Buildings Guide Specification "Sprayed Fire Protection," PBS: 4-0920 obtainable from the General Services Administration, Washington, D.C. describes, on

page 9, a testing procedure that consists of an airtight metal duct with a blower and filter on one end and an eroded fiber collection system on the other end. The test is conducted of a sprayed fiber specimen over a period of 24 hours. The G.S.A. requirements are that the fiber erosion shall not exceed 0.025 gram per square foot over this time period with an air velocity of 800 fpm parallel to the test specimen.

Most well known manufacturers' products have been able to meet this G.S.A. requirement in the past, however a change in fibers, fiber density, binder or overspray may require retesting.

Q: How may the high velocity areas of the return air plenum near the return air ducts be protected to avoid erosion of the fibers?

A: The manufacturer of the spray materials should be consulted to determine whether its standard product can withstand the maximum velocities of a specific system or whether additional tamping, overspray or other procedures should be followed at locations near the return air ducts.

Q: Have any studies been made of the effect on health of fibers in air systems?

A: An article entitled, "Fibrous Glass Insulation: Health Hazard Question Resolved" by John M. Barnhart, executive secretary, National Insulation Manufacturers Assn., Inc. published in the August 1971 *ASHRAE JOURNAL*, quotes the finding of five doctors and hygienists to the effect that small quantities of glass fibers are not harmful. Other fibers, such as rockwool, are not mentioned.