Table 1. Moisture Content with Unbroken Vapor Retarders (1980) (6621 degree days)

Panel Type	Insulation-Sheathing Interface			Sheathing-Siding Interface		
	Jan	Feb	Mar	Jan	Feb	Mar
Fiberboard, R-13 batt, 6-mil poly (R-16)						
Fiberboard, R-11 blanket, asphalted paper (R-14)						
Plywood, R-11 blanket, asphalted paper (R-14)						
Fiberboard (6" stud), R-19 batt (compressed), 6-mil poly (R-21)						
1" extruded polystyrene, R-13 batt, 6-mil poly (R-20)						
1" extruded polystyrene, R-11 blanket, asphalted paper (R-18)						
1" foil-faced polyisocyanurate with vent strip, R-13 batt, 6-mil poly (R-23)						
1" foil-faced polyisocyanurate, R-13 batt, 6-mil poly						

low (<12% moisture content); moderate (12-16%); high (16-20%); condensation (>20%)

Table 2. Moisture Content with Electrical Outlets (1981) (6010 degree days)

Panel Type	Insulation-Sheathing Interface			Sheathing-Siding Interface		
	Jan	Feb	Mar	Jan	Feb	Mar
Fiberboard, R-13 batt, 6-mil poly (R-16)						
Fiberboard, R-11 blanket, asphalted paper (R-14)						
Plywood, R-11 blanket, asphalted paper (R-14)						
Fiberboard (6" stud), R-19 batt (compressed), 6-mil poly (R-21)						
1" extruded polystyrene, R-13 batt, 6-mil poly (R-20)						
1" extruded polystyrene, R-11 blanket, asphalted paper (R-18)						
1" foil-faced polyisocyanurate with vent strip, R-13 batt, 6-mil poly (R-23)						
1" foil-faced polyisocyanurate, R-13 batt, 6-mil poly						

low (<12% moisture content); moderate (12-16%); high (16-20%); condensation (>20%)

Researchers at the Forest Products Laboratory exposed eight test rooms to ambient conditions near their facilities in Madison, Wis. The rooms were kept at 67°F to 70°F and about 40-percent relative humidity over two heating seasons. Table 1 shows the performance of the north-facing walls with unbroken vapor barriers. Table 2 shows their performance the following year with one standard electrical outlet in each wall. Almost all penetrated walls performed worse. Condensation was assumed to occur if probes recorded over 20 percent moisture content. No condensation occurred in rooms with unbroken poly vapor retarders and when condensation did occur, there was no long-term accumulation of free water. Interestingly, all wood in the walls showed moisture contents below 12 percent by early April. Copies of the full report (FPL 433) "Condensation Potential in High Thermal Performance Walls—Cold Winter Climate," by G.E. Sherwood, are available from NTIS, 5285 Port Royal Rd., Springfield, Va., 22161 (703) 487-4650. Order No. ADA 129452.

and have heard of only one problem with moisture (frost under the plywood facing) and that was under near-arctic conditions. I'd be more concerned about caulking the panel joints well, so moist interior air would not leak out and contact cold surfaces—not to mention lose heat. Nonetheless, a coat of vapor barrier paint wouldn't hurt.

Q: *How did you figure the amount of vapor transmission through the foam?*

A: Perm ratings are like U-values. So if you can calculate heat transmission you can calculate vapor transmission. Perms measure the grains of water transported per hour per square foot per inch of mercury vapor pressure (the difference between the inside and outside vapor pressures). So, multiply the perm rating times the number of hours, times the square feet of wall, times the pressure difference and you can count the grains of water.

Q: *Is it safe to add retrofit insulation without also adding a vapor barrier?*

A: If you add fibrous insulation to a cavity wall, it will increase the risk of a condensation problem and may exacerbate existing problems, such as peeling paint. Nonetheless, various field studies in both moderate and cold climates have failed to find serious moisture problems in the walls of retrofitted homes with or without vapor barriers. There are mitigating factors in older homes. Of the ones that were monitored for relative humidity, few were much over 40 percent. Plus most had highly permeable wood-plank sheathing, which tends to store and release any condensate. A reasonable approach would be to seal around moldings, electrical outlets, and other wall penetrations and keep household relative humidity in the 40 percent range. When you redecorate, consider vapor barrier paint on outside walls.

Q: *What conditions create high indoor humidity?*

A: In a very tight house, the normal moisture generated by human respiration and perspiration, along with cooking and cleaning can cause a moisture buildup. With additional sources, high moisture levels can build up in a not-so-tight home. A frequent cause of problems is an unvented, uncovered crawl space. A water table three feet below the surface can release 12 gallons of water vapor per 1000 square feet in one day. Covering the soil with a heavy poly cover should reduce this by about 80 percent and reduce ventilation requirements by a factor of 10. Other moisture sources are unvented dryers and combustion appliances, drying firewood, and houseplants. See "Controlling Moisture in Houses," 1/84.

Q: *How can I both insulate and ventilate a crawl space?*

A: One option is to insulate the floor with a vapor barrier on the warm side of the insulation (over the joists) and to leave the crawl space vented in all but the coldest weather. Low-permeance rigid insulation would also serve well here. Thermally operated foundation vents can make the system automatic.

Q: *Why do you have to vent an attic or cathedral ceiling if you don't have to vent a wall?*

A: No vapor-retarding system is perfect. And due to the stack effect, a disproportionate amount of warm moist air will find its way into the ceiling and attic. Also attic and roof ventilation help for summer cooling and preventing ice dams.

Q: *How about a full basement? Where does the vapor barrier go?*

A: I was hoping you wouldn't ask that. My opinion is that the basement wall should be treated much like the rest of the building shell—waterproofed on the outside and vapor-proofed on the inside (if you are finishing the interior). Exterior insulation will help by keeping the foundation wall warmer and less likely to condense water in winter or summer. By the way, if you've got standing water in your basement, vapor barrier placement is a moot point. Solve the leakage problem first.