need clean foil and a uniform gap.

Urethanes and isocyanurates are foamed with fluorocarbons such as Freon®, which have better thermal resistance than air. Over time, nature will take its course: air will replace the gas in the foam. The thermal resistance will fall from R-7 or R-8 per inch to R-4.5 to R-5 per inch. This process will take anywhere from two to 20 years in typical building applications. In a hermetically sealed impermeable casing, such as a refrigerator panel, the R-value may survive indefinitely. With no facing, the conductance of urethane can increase by 40 percent in less than a year.

Due to the foam's instability, the Federal Trade Commission and several states as well require that suppliers list an "aged" R-value based on accelerated aging tests. Based on the criteria of the California Energy Commission, which are more rigorous than the FTC's, major polyisocyanurate manufacturer Upjohn downgrades its product from R-7.1 per inch to R-5.4. Thermax lists its aged R-value at 7.2 per inch. In an actual installation with nail holes and exposed edges, it's anybody's guess as to what you're actually getting.

If used on the interior, foil-faced polyisocyanurate can serve nicely as a vapor retarder for the cost of taping the joints. Strap out the drywall ¾-inch and get a boost in R-value—plus a good wirechase if you strap horizontally. I frequently see exterior applications of these foil-faced products in cold climates. Unless you do your dew point arithmetic very carefully, this seems risky. And techniques for venting the stud cavity do more harm than good.

The polystyrene family

For insulating below grade on the exterior, your main choices are expanded polystyrene (EPS or beadboard) and extruded polystyrene (such as Styrofoam or Foamular). There are over 150 different manufacturers of the former and only three or four of the latter. Lately there's been a lot of hoopla about which is better. As far as I can tell, EPS is okay below grade but the user should be a little more concerned about product quality and good drainage.

Garden-variety low-density beadboard is generally cheaper per unit of R-value, often by up to 40 percent. Its R-value is just under R-4 per inch compared with R-5 for the extruded variety. Extruded polystyrene has greater compressive strength, lower permeability, and greater uniformity in manufacturing.

In tests conducted by Dow, in which samples of various rigid insulations were buried for up to 18 months, the 2-inch samples of low-density EPS did about as well as Dow's product. In more rigorous lab tests of submersion, freeze-thaw, and vapor drive, the extruded board outshone the competition. EPS manufacturers claim these tests neither replicate field conditions nor comply with accepted test procedures for these types of products. And, they point out that EPS is hardly a sponge; it floats most of the docks in America and maintains 94 percent of its dry volume when submerged.

Above grade, polystyrene's big push has been its use as a non-structural sheathing. This places a continuous thermal shell around the whole building, insulating studs and band joists, which add up to over 20 percent of the wall area of most homes. Insulating sheathing helps control infiltration as well if installed neatly. Studies by NBS and others have failed to turn up moisture problems in walls constructed in this fashion.

Problems have been reported, though, with horizontal wood sidings applied directly to insulating sheathings. Clapboards have come loose, cupped, and cracked. The nail-pulling is attributed to the thermal movement of the foam. The wood problems are attributed to the tendency of these relatively impervious insulations to aggravate thermal and moisture cycling in the siding, since they soak up little heat and moisture themselves. One solution may be to strap out the siding, though this reduces the savings obtained by eliminating the sheathing in the first place.