Shopping for Entry Doors

by Clayton DeKorne

Look for tight seals and sound finishes rather than high R-value

On the glossy pages of most door catalogs lie a dazzling array of door patterns, glass options, and hardware, but any technical information describing the construction and long-term performance of the door is usually in small type. This article takes a look behind all the trappings at the basic components of entry doors.

Skins and Finishes

In an effort to combine the look of wood with the performance of an insulated core, manufacturers have resorted to composite materials, some more effective than others.

Fiberglass. Therma-Tru first introduced a fiberglass composite shell in 1982. Since then, many other manufacturers have introduced similar products. The fiberglass surface is embossed with a wood grain pattern, and can be stained. From the street, these doors look convincingly like wood, but up close they won't fool the discerning eye.

Fiberglass has the advantage of good durability. It doesn't dent, and can't be gouged as easily as wood, especially if a carpenter slams the corner of a toolbox into the face. It is also easier to repair than steel because you don't have to match a perfectly smooth surface. According to production manager Bill Ziggler of Ryan Homes, his company specs fiberglass for entry doors to avoid construction damages, but uses steel on service doors, which don't suffer as much traffic.

Fiberglass lacks the absorbency of wood and requires a heavily pigmented stain. For good results, you need to closely follow the manufacturer's instructions for staining fiberglass doors. Some manufacturers specify cleaning the surface with lacquer thinner, not paint thinner or turpentine, which reportedly leave a residue that interferes with the absorption of the stain.

Fiberglass doors can be sanded only with a very light (320 grit or finer) paper. Heavy sanding will obliterate the textured finish and leave a noticeable bald spot.

Stainable steel. Steel door manufacturers have also been trying to match the look of wood. Several manufacturers apply a vinyl coating that is embossed with a wood grain pattern. Like fiberglass, vinyl can be stained with a high-solids stain.

Typically, the vinyl is about 10 mils thick. The coating scratches more easily than fiberglass, but is not as fragile as varnished wood. Deep scratches are very noticeable if the metal shines through, and touch-up is difficult. Like fiberglass, a scratch cannot be sanded out without destroying the grain pattern.

The skin on a residential steel door is usually made from 22- to 25-gauge galvanized steel. Compared to a commercial-grade door, which has a 16- to 20-gauge steel skin, residential doors are easily dented, especially if you open the door with a stack of 2x4s. Dents can be filled with automotive body putty, if necessary. Often, a thicker-grade steel can be special-ordered on a residential model.

Wood over steel. The most recent innovations use real wood veneers.

Perma Door's new *Grand* series doors have a solid 9/16-inch red oak or Honduras mahogany skin over an 1 1/8-inch steel door (see Figure 1). Although this door is constructed with dissimilar materials that will expand and contract at different rates, the honeycomb core is designed to absorb this movement, according to the manufacturer. Only the outermost cells in the core are filled with foam, creating a dead air space in the center of the panel. Expansion and contraction of the skins reportedly progresses through the cell structure to the interior cavity, while the outside dimensions of the door remain unchanged.

Last year Weathershield introduced a similar design in its Signature series doors. The skin is formed of cross-banded oak veneer over a 24-gauge steel skin and polyurethane core.

Both manufacturers claim the doors have survived extensive in-house weathering tests. However,

Perma Door Grand | **Weathershield Signature**

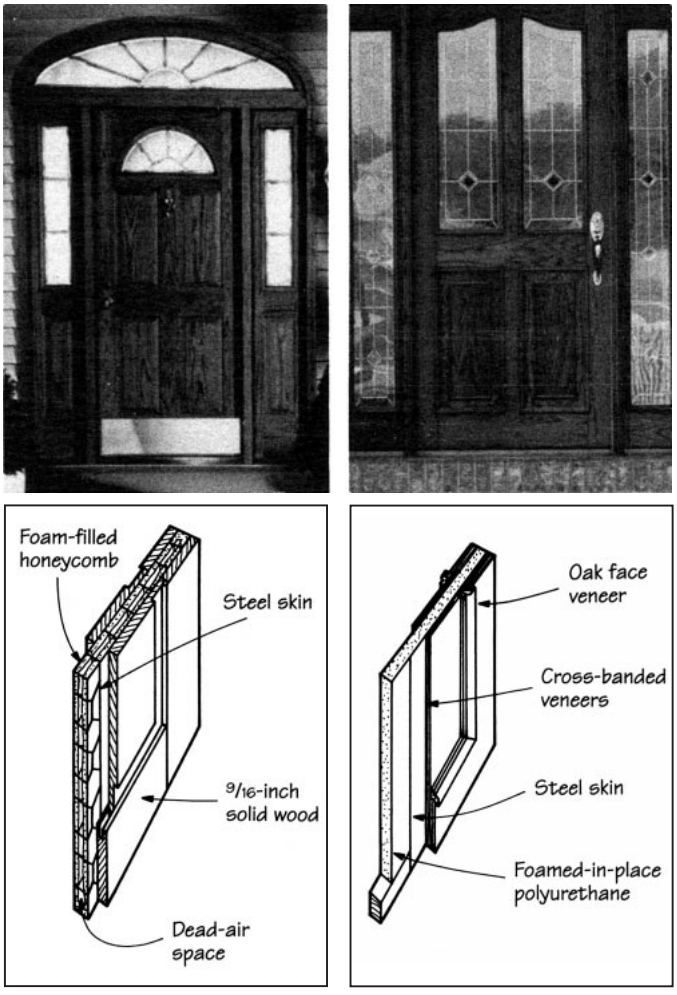

Figure 1. *Combining wood and steel.* *The latest innovations in door technology bond wood facings to an insulated steel core. Perma Door's Grand series doors (left) has a solid 9/16-inch red oak or Honduras mahogany skin over steel and a foam-filled Kraft honeycomb core. Weathershield's Signature series doors (right) are made with cross-banded oak veneer over a steel skin and foamed-in-place polyurethane core.*

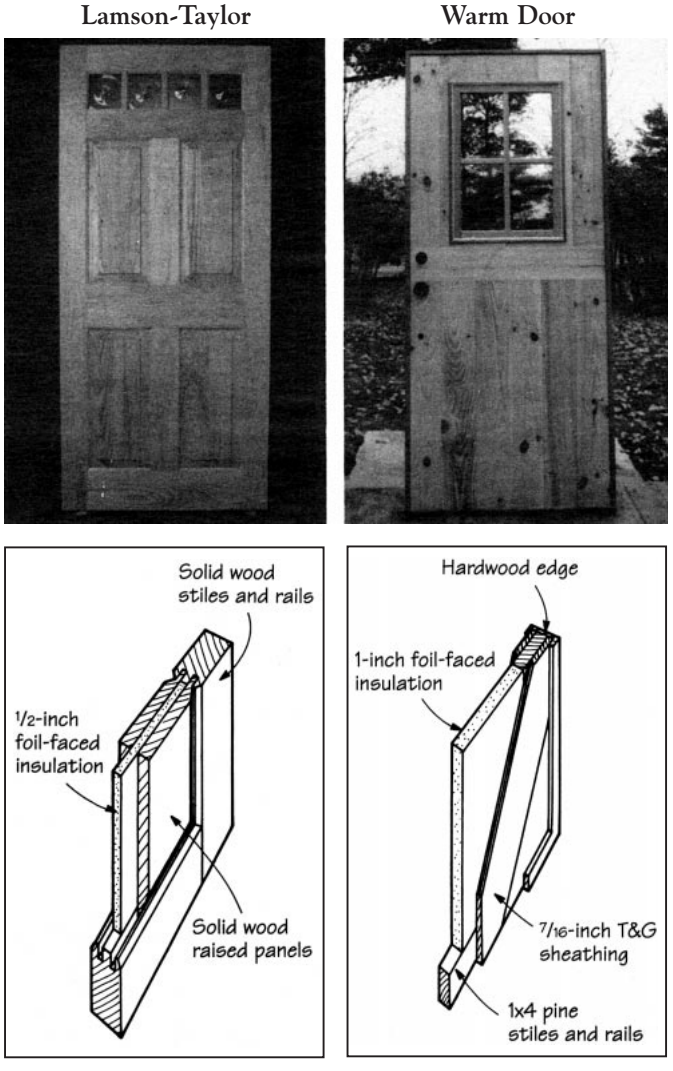

Figure 2. *Insulated wood doors.* *Lamson-Taylor (left) offers traditional panel doors insulated with 1/2-inch rigid foam. Entrances (right) builds the Warm Door — a sheathed door with 1 inch of rigid foam core.*

it's too early to tell whether these doors will survive thermal movements in the field.

The latest innovation, the Ultimate Door, combines steel on the outside and wood on the inside. Essentially, the manufacturer starts with a steel door, and replaces the interior skin with wood stiles and rails, and veneered MDF raised panels, leaving about 3/4 inch of foam insulation. The stiles and rails are glued and screwed to the existing wood stiles and rails on the original steel door. At this point, the manufacturer, Formanek Door Co. of Senca, Kan., only makes the door slab, which it sells to distributors who create the pre-hung package.

Wood Doors

Many cold-climate carpenters have at some point built a solid wood door around a piece of rigid foam. At least two doormakers — Lamson-Taylor and Entrances — have refined this craft. These are expensive, but there's no mistaking that they are the real thing.

Lamson-Taylor builds both traditional frame and panel doors, and sheathed doors. The panel doors are constructed with full mortise-and-tenon stiles and rails, with 1/2-inch foil-faced foam insulation between the two faces of each raised panel, as shown in Figure 2. The sheathed doors are built with 1/2-inch foam in a pine frame that is sheathed with 1/8-inch lauan plywood, and then faced with 1/2-inch wood. The facing boards are grooved and then splined, creating a parquet-style sheathing that allows for a wide variety of designs.

Entrances builds the *Warm Door* similar to Lamson Taylor's sheathed doors, but uses 1 inch of foam without the lauan substrate and 7/16-inch tongue-and-groove sheathing.

Pella Rolscreen recently entered the door market with a high-tech solid wood door designed to prevent problems with warping. Dubbed the *WarpGuard*, Pella's door starts with a laminated-wood core similar to a glulam (see Figure 3). Each face is covered with an aluminum vapor barrier and cross-banded wood veneers. According to Greg Galloway of Pella Rolscreen, the engineers of the Warpgaurd considered using a foam core, but opted for structure and tightness, rather than high insulation value.

Core Construction

Typically, an insulated door starts with a framework of wood stiles and rails. Heavy-gauge steel reinforcing plates are added to the stiles on the hinge side, and wood blocks added to the latch side for lock reinforcement. The framework is then covered by a steel or fiberglass skin and filled with polyurethane foam.

The foam is measured carefully to ensure a specified density of about 2 to 2 1/2 pounds per cubic foot. At this density, polyurethane is an excellent insulator. It has an R-value of 8.3 per inch when first sprayed, but as the foam ages the insulating value drops and levels off at about R-6 or R-7. Because the foam can't be inspected in the door shell, there is also a chance that voids will be left in the core.

To avoid such problems, Pease Industries and Taylor Building Products use an expanded polystyrene core. Expanded polystyrene has a lower R-value (R-4.5 per inch) than urethane foam, but it can be cut and placed into the wood frame before the skin is applied, and remains stable. Also, polystyrene is not made with CFCs.

Starting in 1993, door manufacturers will be charged a surtax on all doors made with CFC-blown foams. In response, many manufacturers are looking to "water-based" foams (foam that uses water as a blowing agent) to get a higher R-value than polystyrene. According to Scott Spence of Taylor Building Products, however, the water-based technology isn't there yet. Taylor uses polystyrene in its steel doors but still uses urethane foam in its fiberglass doors.

Door manufacturers go to great lengths to stiffen doors and prevent climate changes from warping the door (see Figure 4). For example, Pease Industries folds the steel skin of its Ever-Strait doors into the wood stiles, essen-

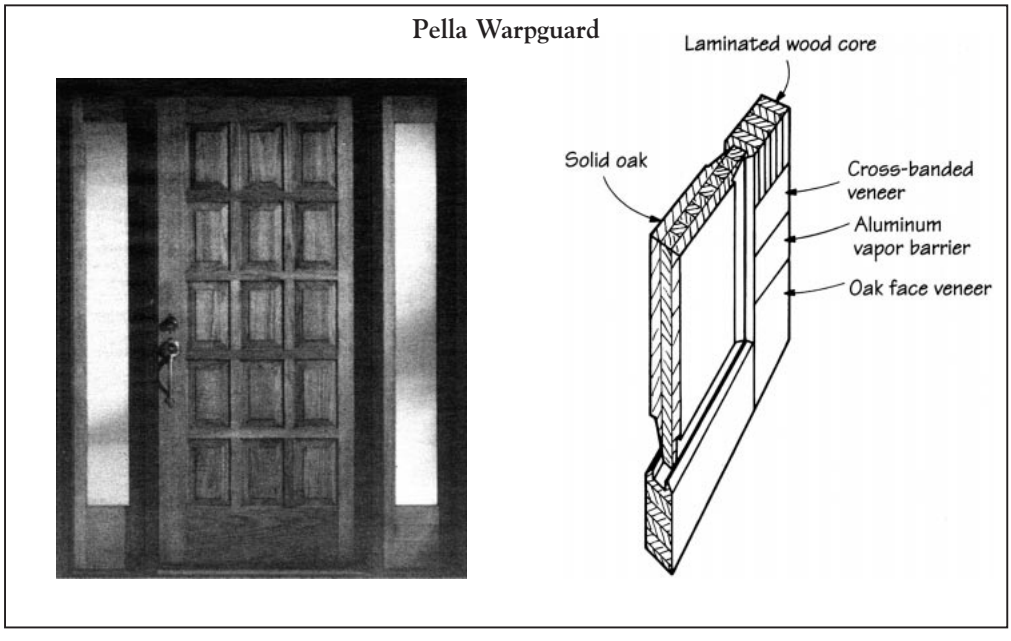

Figure 3. *Engineered wood door.* *The Pella WarpGuard is engineered to prevent warping. Its laminated wood core is covered with an aluminum vapor barrier and multiple cross-banded wood veneer.*

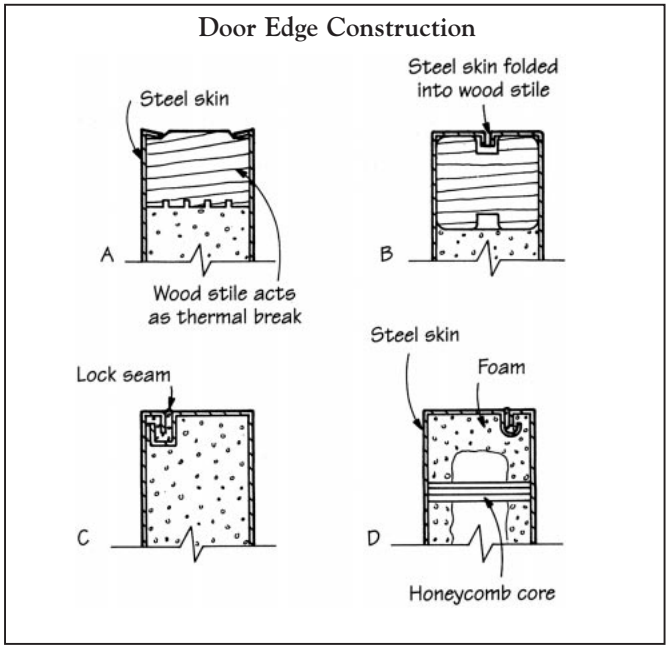

Figure 4. *Door edges.* *The most common thermal break is an exposed wood stile (A). Pease Industries folds the steel skin into the stiles to stiffen the doors (B). Benchmark (C) fabricates all its doors without wood stiles and joins the skin with a folded lock seam for strength. PermaDoor (D) also eliminates the wood stiles and rails but uses a foam-filled lock seam and a foam-filled honeycomb core for strength.*

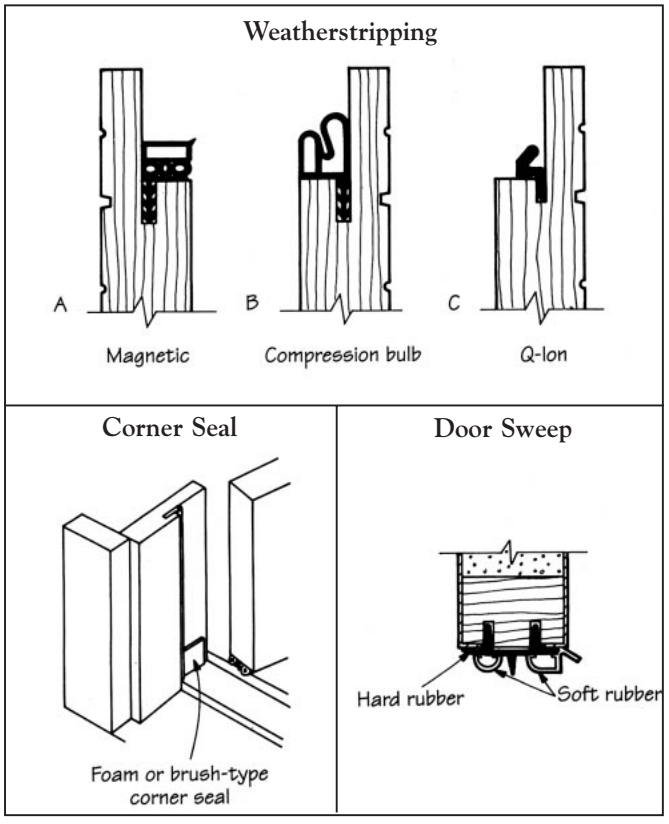

Figure 5: *A tight door sealing system includes weatherstripping, corner seals, and door sweep.*

Weatherstripping. *Magnetic seals (A) are extruded with an "accordion" or bellows-type gasket that allows the magnetic strip to seal to irregularities of the door surface. Compression seals (B) often have a secondary bulb or fin for added reinforcement.*

Q-lon (C) is a long-lasting neoprene rubber fin that has become an industry standard.

Corner seals. *Look for corner seals to fill the gap where the weatherstripping meets the door sweep.*

Door sweeps. *Bottom edge seals have multiple fins and bulbs to seal out wind and water. Most are made of "dual-durometer" synthetic rubbers that combine soft, flexible fins or bulbs with a hard, rigid cap to fasten to the door.*

The "Real" Energy-Efficiency of Doors

Manufacturers of insulated doors have fallen into the habit of advertising inflated R-values that are based on a calculation that idealizes the construction of the door and doesn't account for the door's real-life performance in a jamb. These theoretical values hover around R-15 for a 1¾-inch polyurethane insulated steel door. Tested values, on the other hand, are typically between R-9 and R-11.

Compared to these tested R-values, the R-value of solid wood doors is low — about R-2 for a standard 1¾-inch door. But the difference is less than some manufacturers imply.

The total energy savings you can expect from replacing a wood door with a polyurethane insulated door amounts to about 10 gallons of fuel oil, or $12 per year, in a cold (6,000 heating degree day) climate. If you have electric heat (at 7¢ per kwh) the savings is a more respectable $24.

A bigger issue than energy savings is condensation control. Condensation forms on surfaces that are cold enough to fall below the dew point of the surrounding air. For this reason, a thermal break must be used on steel doors and aluminum thresholds to reduce conduction around the edges of the door.

Even with a thermal break, condensation can still be a problem due to infiltration. On a door, condensation will typically form around the frame where cold air leaks in. To combat this, good weatherstripping is the answer. Tight weatherstripping will also eliminate uncomfortable drafts and keep the entry carpet dry.

The best way to evaluate the quality of the weatherstripping is to look at the results of standard air infiltration and water penetration tests listed in the door specs.

The results of the air infiltration tests (listed as ASTM E-283, ISDSI 101, or NWWDA IS-9) are measured in cfm of air per foot of crack length at 1.57 psf of pressure (equivalent to a 25 mph wind). For a tight seal, choose a door with a rating below .05 cfm per foot of crack length.

A door either passes or fails the water penetration test (listed as ASTM E 331, or ISDSI 104). The test sprays a minimum of five gallons of water per hour while a 25 mph wind blows on the door. If any leakage is reported, the door fails.

— *C.D.*

tially creating an I-beam in section. Benchmark fabricates all its doors without wood stiles to protect against warping with changes in humidity. The steel skin is joined at the edges in a lock seam that has been folded over to gain added strength. PermaDoor also eliminates the wood stiles and rails, but uses a composite core of polyurethane in a resin-impregnated Kraft honeycomb.

Regardless of the door construction, some movement from temperature and humidity changes is likely. Consider installing a three-point lock to hold the door tight to the weatherstripping as the door moves. Resource Conservation Technology (2633 N. Calvert St., Baltimore, MD 21218; 301/366-1146) sells a three-point lock that can be retrofitted into any wood-edge door. Weathershield Signature and Pease Artistry doors have three-point locks as standard features.

Weatherstripping

Weatherstripping materials and configurations vary widely (see Figure 5). Tests for air and water entry will give you some indication of how new weatherseals will perform, but they won't tell you how well the seals will hold up over time. Here are some general guidelines to go by:

- Compression bulbs that the door closes against can permanently set in cold temperatures or after extended use. Thermoset materials, such as Schlegal's Q-lon, have the best track record for staying flexible.
- Magnetic seals form a more reliable seal than compression and fin seals, but are only available on steel doors. One exception is Pease Industries, which wraps the edges of its wood and fiberglass doors with brass to attract a magnetic strip.
- Look for brush-type or foam-wedge corner pads to seal the gap that inevitably forms where the weatherstrip meets the door sweep. Avoid wool-pile corner seals, which can absorb and hold water.
- Frost can build up on aluminum thresholds unless the extrusion has a thermal break.

- Adjustable sills provide a positive seal along the bottom of the door, even in out-of-square openings, but have questionable long-term performance. Sills take a lot of abuse. Traffic and dirt can clog the adjustment mechanisms over time. Look for adjustable sweeps instead.
- Accessibility standards require a threshold that's no higher than 1/2 inch in multi-family and light-commercial buildings. Weathershield offers a low-profile sill with a thermal break that complies.

Once you choose a system, avoid painting the weatherstripping, so it will stay flexible.

Pre-Hung Packages

Most door manufacturers offer complete "entry systems," which include glass lites, decorative surface moldings (called plants), frames, thresholds, weatherstripping, hardware, sidelites, transom windows, and even small amenities such as peep holes and mail slots. But what you see in the catalog is not always what you get at the lumberyard.

Manufacturers wholesale to distributors who put together the pre-hung packages. Even if the distributor uses only the slab, he can advertise that manufacturer's brand. He may buy the lites, hardware, and frame from other sources to reduce costs. If this is the case, beware. When the glazing fogs up, or the weatherstripping fails, you can forget about the manufacturer's warranty.

Several door manufacturers provide labels on the door and its components to certify that parts all share the same brand name. If you don't find these tags, ask your supplier. In most cases, he can offer the whole brand-name package but you probably won't get a sale price on it. ■

Clayton DeKorne is an associate editor with The Journal of Light Construction.

Sources of Supply

Acorn Building Components
Stainable steel entry doors
12620 Westwood
Detroit, MI 48223
313/272-5700

Benchmark
Stainable steel entry doors
P.O. Box 7387
Fredericksburg, VA 22404
703/898-5700

Castle Gate Entry Systems
Fiberglass and stainable steel entry doors
P.O. Box 76
Pittsburgh, KS 66762
800/835-0364

Ceco Door
Fiberglass and stainable steel entry doors
1 Tower Ln.
Oakbrook Terrace, IL 60181
312/242-2000

Entrances
Insulted wood entry doors
RFD 1, Box 246A
Westmoreland, NH 03467
603/399-7723

Formanek Ultimate Door Co.
Wood/steel composite entry doors
P.O. Box 198
Linsay, NE 68644
402/428-2020

Johnson Metal Products
Stainable steel entry doors
P.O. Box 667
Richmond, IN 47374
317/962-8515

Lamson-Taylor Custom Doors
Insulated wood entry doors
Tucker Rd.
South Ackworth, NH 03607
603-835-2992

Peachtree Doors
Fiberglass and steel entry doors
4350 Peachtree Industries Blvd.
Norcross, GA 30071
404/497-2000

Pease Industries
Fiberglass, steel, and wood entry doors
P.O. Box 14-8001
Fairfield, OH 45614-8001
800/543-1180

Pella/Hunt
Steel entry doors
P.O. Box 520547
Longwood, FL 32752-0547
800/524-3700

Pella/Rolscreen
Laminated wood core doors
102 Main Street
Pella, IA 50219
800/524-3700

Perma Door
Wood/steel composite, steel, and fiberglass entry doors
9017 Blue Ash Rd.
Cincinnati, OH 45242
513/745-6400

Stanley Door Systems
Stainable steel entry doors
1225 E. Maple
Troy, MI 48084
313/528-1400

Taylor Building Products
Fiberglass and steel entry doors
631 N. 1st St.
West Branch, MI 48661
517/345-5110

Therma-Tru
Fiberglass and steel entry doors
2806 N. Reynolds Rd.
Toledo, OH 43615
419/891-7400

Weathershield Windows & Doors
Wood/steel composite and steel entry doors
Medford, WI 54451
715/748-2100