

Passing inspection: what do warrantors want?

single-ply installation, to paraphrase a famous remark about the opera, ain't over till the big company signs. The big company in this case is the manufacturer—without its representative's signature on the warranty, the contractor can't really say the job is complete. But before most manufacturers will put their resources on the line, their inspectors must certify that the quality of the installation is up to the manufacturer's standards. Technically, the contractor is still on the job until the inspector okays the work.

Having one's craftsmanship scrutinized can be a traumatic process, but it needn't be, according to the manufacturers. They say that if a crew starts with a commitment to quality and carries through with careful attention to details, the fruits of their labors will almost always pass inspection with flying colors.

It doesn't hurt, however, to know what the manufacturers and inspectors are looking for. To find out, we've asked two single-ply companies, one representing EPDM manufacturers and one representing PVC companies, to share their inspection guidelines.

Getting EPDM right the first time

One of the manufacturers responding to our inquiry was the Firestone Building Products Co. Ed Kane, P.E., the EPDM manufacturer's product services manager, explained that for his company the inspection process is a necessary part of the job. "Because most EPDM systems are sold with a manufacturer's warranty, the process of issuing the warranty includes an inspection to verify that installation standards have been satisfied," he said.

Kane said that for roofing contractors, staying competitive means being able to pass inspections with a minimum of hassle. Because repair items cited by inspectors represent call-backs and additional expenses, contractors must get the job done right the first time to stay ahead.

Kane asked some of Firestone's top contractors how they consistently built roofs that earned passing grades. Most said quality construction started with effective crew preparation. Jerry Hughes of Comdustrial

**A
guide
to
error-
free
roofing**

Roofing in Hatfield, Pa., said he selects crews for their work attitude. Comdustrial wants crews that recognize their role in achieving a perfect job. The company also wants workers who can use their heads. A thinking crew member, Hughes explained, will admit when he or she doesn't know what to do instead of guessing and moving on. Crew members with the right attitude will prepare for the job, Hughes says. For example, a project foreman might get ready for a new project that starts on a Monday by reviewing an installation training video tape at home over the weekend.

Byron Warnick of CEI Southwest in Dallas told Kane that leadership is the key to good work attitudes. If the company believes in perfection, then the crew members will take it seriously. Warnick also believes in keeping the crews small and responsible for specific parts of the job to cultivate the pride of ownership in crew members. CEI Southwest expects all crew members to master quality application techniques, Warnick said. Every member of the crew, rather than just one or two specialists, is responsible for the details, he explained.

Preplanning provides foundation

Kane also learned from the contractors that building roofs that can pass inspection takes planning and preparation. He found that estimators at quality-oriented companies are expected to understand the project better than the building owner or the specifier. To reach this level of understanding, the estimators must seek out poorly defined situations and address them up front. They also must involve the manufacturer in the planning stage to enlist the company's support in the search for a roofing solution. This early involvement by the manufacturer helps eliminate questions after the work is done, according to Kane.

With plans completed, it becomes the job of the operations manager or project manager to work with the building owner on the project start date, and with the purchasing department to acquire materials, according to Kane. The manager also schedules company personnel, reviews plans at the weekly production meeting and coordinates a job-

Firestone's application steps and related inspection criteria

Common EPDM Membrane System Installation Parameters		Major Inspection Criteria
A. Liquid contact adhesive seam	A.1 Provide minimum lap	3 inches for most systems
	A.2 Clean properly	Remove all contaminants with unleaded gas
	A.3 Apply adhesive properly	Brush on continuous uniform adhesive film*
	A.4 Close without gaps (fishmouths)	Provide continuous flat seam
	A.5 Apply lap sealant	Adequate coverage; tooled in place*
B. Vertical flashing application (Walls, curbs, etc.)	B.1 Inspect substrate for required conditions	Sound substrate; do not cover through-wall flashing
	B.2 Provide minimum flashing height	8 inch; extend above maximum ponding limit
	B.3 Use proper wall adhesive	Bonding adhesive
	B.4 Flashing to membrane seam	See "liquid contact adhesive seam" above
	B.5 Provide minimum base lap	6 inches for cured EPDM flashing; 3 inches for FormFlash
	B.6 Avoid bridging at base	Less than 1/4 inch*
	B.7 Provide joint cover for cured wall flashing	6-inch-wide FormFlash*
	7.a Lap joint	FormFlash 3 inches minimum vertical and horizontal
	7.b Butt joint	Must be less than 1/4 inch; FormFlash 3 inches onto deck membrane*
C. Inside corner	B.8 Termination	Required at top of all vertical flashing*
	8.a Nail off under counterflashing	12 inches on center 3 inches above counterflashing lip
	8.b Termination bar	Acceptable bar with slotted fastener holes; 1/4-inch gap between 10-foot bars; Smooth, nonporous & sound substrate (not wood)* ; Continuous compression along bar; Do not continue around corners; Fasten within 1 inch from each end; Water Blok between membrane & substrate; Lap sealant along top of bar
	B.9 For cured membrane flashing on high walls	Provide intermediate horizontal attachment
	C.1 Use correct material	Uncured FormFlash
D. Outside corner	C.2 Continue far enough around corner	6 inches
	C.3 Provide minimum height	6 inches
	C.4 Provide minimum base lap	6-inch lap; less than 1/4-inch bridging*
	C.5 Correctly fold "pig ear"	Fold onto the vertical not the horizontal*
	C.6 Flash over "pig ear"	Begin in the corner and continue 3 inches beyond the "pig ear"
	C.7 Flashing to membrane seam	See "liquid contact adhesive seam" above
	D.1 Use correct material	Uncured FormFlash
E. Roof drain	D.2 Continue far enough around corner	2 inches
	D.3 Provide minimum height	8 inches
	D.4 Provide minimum base lap	3-inch lap, less than 1/4-inch bridging*
	D.5 Continue far enough each side of corner	6 inches
	D.6 Flashing to membrane seam	See "liquid contact adhesive seam" above
	E.1 Use correct material	Cured EPDM membrane
F. Flashing	E.2 Provide clearance from field seams	18 inches
	E.3 Carefully cut opening in membrane	1 inch smaller than drain ring; always larger than drain pipe
	E.4 Provide drain ring sealant	Water Blok on drain bowl ring under the membrane
	E.5 Securely fasten the drain ring	All bolts present and tightened*

*Most common errors

Because differences between systems do exist, crews must be careful to follow each manufacturer's specific guidelines.

site visit. This visit is preferably made by the manager, the general superintendent and the job foreman two weeks before the scheduled start of the job. During the visit, these supervisors review the roof plan and the selected details, pinpointing questionable issues. An early visit allows plenty of time for operations and the estimator to resolve the problems that are discovered.

Watching for common errors

According to Kane, Firestone has broken down the installation of an EPDM system into 10 basic procedures. The table listed in the first sidebar accompanying this article further divides these 10 procedures into application steps and provides most of the related inspection criteria for a Firestone RubberGard® roofing system.

The application steps for different manu-

facturers' systems should be similar to the steps that Firestone has provided, but the inspection criteria must be verified with the company. Because differences between systems do exist, however, crews must be careful to follow each manufacturer's specific guidelines. This can be especially tricky for crews that work with a variety of systems. Mike Accetta of United States Roofing in Norristown, Pa., told Kane that the manufacturers' requirements are different enough to make the flawless procedures a crew uses on one system today incorrect when used on another system tomorrow. For this reason, Accetta says, he reminds crew members that they must also change their installation procedures when they change jobs.

Firestone's checklist can be used by contractors to conduct their own inspections, Kane suggests. By beginning each day with

Common EPDM Membrane System Installation Parameters

Major Inspection Criteria

F. Field fabricated pipe flashing	F.1	Inspect penetration for required conditions	1 inch minimum diameter, round, clean, immobile, not hot
	F.2	Wood nailer	For large penetrations, some systems
	F.3	Use correct material	Uncured FormFlash
	F.4	Provide minimum height	8-inch minimum; extend above maximum ponding limit
	F.5	Provide minimum base flange	4-inch lap; less than 1/4-inch bridging*
	F.6	Provide minimum base turn-up onto pipe	2 inches
	F.7	Provide minimum wrap turn-out onto base	2 inches
	F.8	Provide minimum wrap lap	2 inches
	F.9	Provide top sealant	Use lap sealant—do not install clamp at top
	F.10	Flashing to membrane seam	See "liquid contact adhesive seam" above
	F.11	Provide clearance from field seams	18 inches
G. Prefabricated pipe flashing	G.1	Inspect penetration for required conditions	1-inch to 6.5-inch outside diameter, round, clean, immobile, not hot
	G.2	Wood nailer	For large penetrations, some systems
	G.3	Use correct size	Snug fit when cut at incremental ribs*
	G.4	Do not overlap adjacent flanges	If necessary use field fabricated flashing*
	G.5	Do not cut or patch	If necessary use field fabricated flashing*
	G.6	Provide top sealant	Use lap sealant—install s.s. clamp at top
	G.7	Flashing to membrane seam	See "liquid contact adhesive seam" above
	G.8	Provide clearance from field seams	18 inches
H. Penetration pocket	H.1	Inspect penetration for required conditions	Clean, immobile, not hot*
	H.2	Use correct size	1-inch minimum clearance between penetration and pan
	H.3	Wood nailer fastened to deck	Wide enough to extend beyond pan flange*
	H.4	Provide pan flange sealant	Water Blok between pan flange and nailer
	H.5	Securely fasten metal to wood nailer	No more than 6 inches between fasteners
	H.6	Provide minimum height	2-inch minimum pan height; 2-inch minimum new pourable sealer depth
	H.7	Provide minimum base lap	3-inch-wide lap to membrane; less than 1/4-inch bridging
	H.8	Flashing to membrane seam	See "liquid contact adhesive seam" above
	H.9	Correctly prepare sealing material	Thoroughly stir two-part pourable sealer*
	H.10	Correctly place sealing material	Mound pourable sealer to prevent ponding*
I. Scupper	I.1	Wood nailer	Sized to extend beyond the scupper flange*
	I.2	Form metalwork	Rounded flange corners, watertight fabrication*
	I.3	Provide scupper flange sealant	Water Blok between flange and membrane
	I.4	Scupper securely fastened	No movement; flange held continuously flat
	I.5	Use correct material to flash onto scupper	Uncured FormFlash; less than 1/4 inch bridging*
	I.6	Provide minimum flashing to membrane lap	3 inches minimum; 3 inches beyond fasteners
	I.7	Provide minimum flashing into scupper lap	3 inches minimum; 3 inches beyond fasteners
	I.8	Flashing to membrane seam	See "liquid contact adhesive seam" above
J. Roof perimeter (Walls, edges, etc.)	J.1	Into horizontal wood nailer	
	J.1.a	Wood nailer	2 inches to 6 inches minimum; extend beyond metal flange; fasten 4 inches on center*
	1.b	Fasten membrane	Over and down nailer; fasten into face 6 inches on center
	J.2	Into vertical wall or curb	No gap greater than 1 inch above the plane of the roof
	2.a	Wood nailer (with 45 degree bevel)	3/4-by-2 3/4-inch pressure treated wood; fastened 16 inches on center
	2.b	Metal batten	Anchor 12 inches on center; apply S-40 to fastener heads
	J.3	Flash over perimeter attachment	See "vertical flashing application" above
	3.a	Horizontal	Cover flange, 3 inches past fasteners, extend 3 inches onto membrane*
	3.b	Vertical	FormFlash 3-inches onto deck membrane, 3-inches above fastening strip

*Most common errors

a review of the previous day's work, crews can catch and correct errors before they proliferate throughout the whole project. The timing of this inspection is also useful because it gives bridging and fishmouths time to become evident without allowing extensive problems to continue. CEI Southwest's Warnick told Kane that he prefers to have the crew continue to work while this daily inspection is being conducted, instead of having the workers stop to explain progress or ask questions about business or personnel matters. He keeps distractions to a minimum because he believes that catching errors is such an important task it deserves his employees' uninterrupted attention.

Kane says that in addition to the daily inspection, a final inspection should be conducted before the manufacturer's representative arrives. This inspection, which should

be carried out by the estimator, the project manager or general superintendent, and the project foreman, can do more than simply prepare the crew for the manufacturer's inspection. It can also help crew members summarize the overall coordination of the project and identify situations that can be more efficiently addressed in the future.

Passing the final exam

The manufacturer's inspection is the final step before the job is completed and warranted. Kane says manufacturers should conduct this inspection promptly. By scheduling a timely inspection, he explains, a manufacturer can help a contractor's cash flow if the owner has tied the final project payment to receipt of the warranty. In some cases this situation is alleviated by special warranty programs that issue the warranty before the final

The manufacturer's inspection is the final step before the job is completed and warranted.

Sarnafil's inspection guide for PVC roofing systems

Fully adhered roofing systems

- Is the membrane fully adhered to the substrate? If in doubt, make a test cut.
- Use a blunt screwdriver to check all welded seams. Make a 100 percent inspection of hand-welded seams.
- Check welded seams. If defects are found, increase the number of seams inspected.
- Check for glue in seams.
- Be sure insulation is properly installed.
- Be sure flashings are properly installed.
- Check for water or sponginess underfoot.

For mechanically fastened systems

- Check for proper bar and fastener spacing.

If possible, check fasteners from the underside of the deck for proper spacing and proper length.

- Be sure that bars and PVC cord have been installed around all penetrations and at the base of the walls.
- Use a blunt screwdriver to examine seams, check 100 percent of hand-welded seams.
- Check 100 percent of machine-welded seams—more if defects are found.
- Look for broken or improperly installed fasteners.
- Look for asphalt contamination.
- Be sure insulation is properly installed.

- Be sure flashings are properly installed.
- Check for water or sponginess underfoot.

Guide for ballasted systems

- Seams should be left uncovered on new jobs, raked clean on existing jobs.
- Use a blunt screwdriver to spot check hand-welded seams and 10 percent of machine-welded seams—more if defects are found.
- Check the ballast. Was clean, well-rounded gravel used?
- Check for punctures.
- Was substrate properly installed?
- Were flashings properly installed?

The building owner and architect may also want to be present at the inspection, especially if they have any complaints or questions they would like to raise.

inspection for work performed by prequalified contractors. Timely inspections are also important because they allow manufacturers to catch problems before they appear on other jobs.

Before the inspection is conducted, the manufacturer will notify the contractor so that personnel knowledgeable about the project can attend. Many companies send at least one serviceperson with repair materials to every inspection for a more expedient close-out of the project. When quality control measures are employed during the installation, inspectors will usually find only minor oversights that can be easily fixed when they examine the finished system.

After the inspection, the results should be shared at production meetings to keep everyone in the company up to date. The errors that are found prior to or during the manufacturer's inspection should be logged so that the crews will know where to focus their concentration on future jobs.

The inspection criteria Firestone has listed in its checklist comprises a sizable list. Yet when the results of inspections are reviewed, Kane says, the majority of errors found involve only the 26 items that are marked with asterisks. Kane hopes that by using this table or one modified to suit the system that is being installed, contractors will be able to install roofs right and profitably the first time.

PVC inspections a simple matter

Finding installation problems early is important for PVC contractors, too, according to PVC manufacturer Sarnafil, Inc. When inspections are carried out in a proper and timely manner, problems caused by shoddy workmanship, poor installation procedures or unusual environmental conditions can be caught before they become major headaches. Fortunately, modern membrane roofing is a good deal easier to inspect than built-up roofing, Sarnafil says, because punctures and similar types of damage are readily visible.

According to Sarnafil, it's relatively simple

to conduct a PVC roofing inspection to verify that the system is living up to its warranty. All it takes are a few easy-to-follow steps and a knowledge of what to look for.

The first step is to contact the roofing supplier, whose representative should be on hand when the roof is inspected. Scheduling the inspection with the supplier will depend on the weather. The building owner and architect may also want to be present at the inspection, especially if they have any complaints or questions they would like to raise. If this is the case, these parties must be contacted as well to coordinate the timing of the inspection with their schedules.

Before the formal inspection takes place, Sarnafil suggests a preliminary inspection be conducted by the contractor and the roofing supplier's representative. The best time for this preliminary inspection is in the morning before the formal inspection. This way both inspections can be completed in a single day and at less expense to all concerned. It will also save everyone time if these inspections can be punched out completely in a single visit, eliminating the need for any of the parties to return to the jobsite, and letting everyone know with just one inspection just what repairs will be needed.

Sarnafil suggests that contractors prepare for the inspection by reviewing any documents relating to the installation. During this review, particular attention should be paid to records that indicate problems encountered by the installers or unusual conditions that existed at the time of the installation.

Sarnafil has provided its own checklist to guide contractors involved in PVC roof inspections. Developed specifically for three different types of roofing systems, the list outlines what to look for when checking roofing jobs.

Sarnafil uses "Inspection for Warranty" forms for recording a roof's inspection history. In this way, a running record of roof inspection and maintenance is kept on hand for ready reference at any time.