ROOFING APPLICATION STANDARD (RAS) NO. 115
STANDARD PROCEDURES FOR ASPHALT SHINGLE INSTALLATION

1. Scope

1.1 This roofing application standard has been developed to provide a prescriptive method of complying with the requirements of Chapters 15 and 16 (High-Velocity Hurricane Zones) of the *Florida Building Code, Building* specifically for installing asphalt shingles.

2. Definitions

2.1 For definitions of terms used in this application standard, refer to ASTM D1079 and the *Florida Building Code, Building*.

3. General

3.1 Asphalt shingles shall not be installed on roof mean heights greater than 33 feet, unless specifically specified in the roof assembly's Product Approval. Roof slope criteria shall be in accordance with Table 1515.2.

3.2 Where asphalt shingles are to be installed over insulated roof deck, a suitable nailable substrate, in accordance with Section 1520.5.7 must be installed over the insulation prior to the installation of approved underlayment and shingles.

3.3 Asphalt shingles shall be installed in compliance with the Product Approval installation specifications, but in no case with less than six approved roofing nails (12 ga. by $1^1/_4$ in. corrosion-resistant annular ring shank roofing nails) or approved fastening devices which penetrate through the sheathing or wood plank a minimum of $^1/_8$ in. or penetrate a 1 in. or greater thickness of lumber a minimum of 1 in. except where architectural appearance is to be preserved, in which case a minimum of $^3/_4$ in. nail may be used.

4. Underlayment

4.1 Underlayment shall be in accordance with Chapter 15 (High-Velocity Hurricane Zones) of the *Florida Building Code, Building*.

4.2 Underlayments shall be fastened with approved minimum 12 gage by $1^1/_4$ in. corrosion-resistant annular ring shank roofing nails fastened through minimum 32 gage by $1^5/_8$ in. diameter approved tin caps. Underlayment shall be attached to a nailable deck in a grid pattern of 12 inches (305 mm) between the overlaps, with 6-inch (152 mm) spacing at the overlaps. Nails shall be of sufficient length to penetrate through the sheathing or wood plank a minimum of $^3/_{16}$ in. or penetrate 1 inch (25 mm) or greater thickness of lumber a minimum of 1 in., except where architectural appearance is to be preserved, in which case a minimum of $^3/_4$ in. nail may be used.

5. Metal Accessories

5.1 All metal accessories shall be in compliance with Section 1517.6 of the *Florida Building Code, Building* and RAS 111.

5.2 Eave and gable drip metal vertical face shall be a minimum of $1^1/_2$ inches and shall extend down not less than $^1/_2$ inch below the sheathing or other member immediately contiguous thereto. In all cases, the deck flange shall be not less than 2 inches in width. Where required, a continuous clip (hook strip) shall be installed in compliance with RAS 111.

5.3 Eave and gable drip metal shall be joined by a minimum 4 inch lap. Eave and gable drip metal shall be installed over the underlayment and be fastened with minimum 12 gauge annular ring shank nails at a maximum spacing of 4 in. o.c. The nails shall be manufactured from similar and compatible material to the termination profile. All composite materials shall be fastened with nonferrous nails. All metal profiles shall be installed in compliance with RAS 111.

5.4 Valley metal shall be a minimum 16 in. wide rolled or preformed material of thickness' in compliance with Section 1517.6 of the *Florida Building Code, Building*. Valley metal shall be set over the underlayment, or over an optional 18 in. sweat sheet. Fasten valley metal with minimum 12 gage by $1^1/_4$ in. annular ring shank roofing nails of similar materials 12 in. o.c. 1 in. in from each exterior edge, except where architectural appearance is to be preserved, in which case a min $^3/_4$ in. nail may be used. The entire edge of the flange shall be sealed, covering all nail penetrations with flashing cement and membrane. All horizontal laps shall be a minimum of 6 in. and shall be fully embedded with approved flashing cement. No nails shall be permitted in the center of the valley.

6. Shingle Installation

6.1 At all intersections, eaves, rakes, valleys and gable ends, the shingles and starter strips shall be set in a minimum 8-in. wide strip of approved flashing cement. Maximum thickness of flashing cement shall be $^1/_8$ in. as excessive use of the cement may cause blistering, or bleed through. Shingles shall not extend more than $^1/_4$ in. beyond the eave and rake drip.

6.2 Starter strip shall be a row of either self-sealing nonlaminated shingles or approved starter shingles.

6.3 If self-sealing nonlaminated shingles are used for the starter strip, remove the tab portion of each shingle and position the remaining strip along the eaves. Install such that the factory-applied adhesive is face up and closest to the eaves edge. Trim material from the end of the first shingle in the starter strip according to manufacturer's specifications to ensure that the cutouts of the first course of shingles are not placed over the starter strip joints. Fasten starter strips parallel to the eaves along a line above the eave line according to manufacturer's installation instructions. Position fasteners to insure they will not be exposed under the cutouts in the first course.

6.4 Starter shingles shall be nailed along a line not greater than 4 in. above the eave line nailing not greater than 6 in. o.c.

6.5 Starter joints shall be staggered with succeeding shingle joints, and the number of starter joints shall be kept to a minimum.

6.6 First course shall be laid straight, checking it regularly during application against a horizontal chalk line. A few vertical chalk lines aligned with the ends of shingles in the first course will ensure proper alignment of cutouts. A shingle hatchet is an acceptable alternative to the use of succeeding chalk lines. The first course starts with a full shingle, while succeeding courses shall be installed in strict compliance with the shingle manufacturers' Product Approval course layout detail.

6.7 Valley courses shall be terminated with shingles not less than 12 in. in length. Rake courses shall terminate with shingles not less than 6 in. in length. To obtain the correct exposure for square-tab strip shingles, align the butts with the top of the cutouts in the course below. Install no-cutout shingles and those with variable butt lines according to the manufacturer's installation instructions to obtain correct exposure.

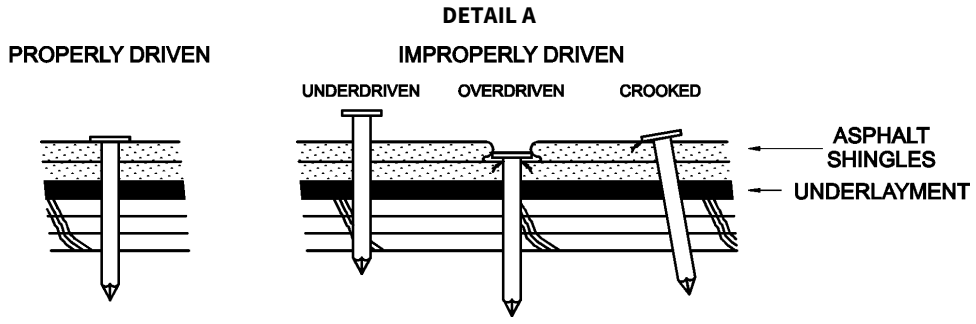
NOTE: Follow manufacturer's instructions concerning shingle alignment. See "Exposure, Course Layout, and Fastening Detail" in shingle manufacturer's Product Approval.

7. Fastening

7.1 Use six approved nails per shingle. Place the fasteners in strict compliance with shingle manufacturers Product Approval course layout, fastening details.

7.2 Align the shingles properly to avoid exposing fasteners in the course below. Drive the fasteners straight and do not break the shingle surface with the fastener head. Do not drive fasteners into knot holes or cracks in the roof deck. Repair faulty fastening immediately. If fastener is improperly driven or exposed, remove the fastener and repair the hole in the shingle with approved flashing cement or replace the entire shingle.

7.3 Shingle nails shall be located in accordance with the manufacturer's product approval. Ensure no cutout or end joint is less than 2 inches from a nail in an underlying course. Start nailing from the end nearest the shingle just laid and proceed across. Do not attempt to realign a shingle by shifting the free end after two nails are in place. Drive nails straight so that the edge of the nail head does not cut into the shingle. Nail heads should be driven flush with the shingle surface. Fasteners shall not be improperly driven (see Detail A).



8. Valleys

8.1 Valleys may be applied in open, closed or woven fashion. Valley metal shall be in compliance with Section 5.4.

8.2 Open valley: Snap two chalk lines, one on each side of the valley centerline over the full length of the valley flashing. Locate the upper ends of the chalk lines 6 in. apart in the center of valley at the ridge (i.e., three inches to either side of the valley centerline). The lower ends should diverge from each other a minimum of $^{1}/_{8}$ in. per linear foot of valley length, (i.e., for an eight foot long valley the chalk lines shall be 7 inches apart at the eaves).

As shingles are applied toward the valley, trim the last shingle in each course to fit on the chalk line. Never use a shingle trimmed to less than 12 inches in length to finish a course running into a valley. If necessary, trim a tab off the adjacent shingle in the same course to allow a longer portion to be used, trim 1 inch on a 45-degree angle from the upper corner to direct water into the valley and prevent it from penetrating between the courses. Finally, to form a tight seal, cement the shingle to the valley lining with a minimum eight-inch width of asphalt flashing cement. There should be no exposed nails along the valley flashing.

8.3 Closed cut valley: With valley flashings already in place, apply the first course of shingles along the eaves of one of the intersecting roof planes and across the valley. For proper flow of water over the trimmed shingle, always start applying the shingles on the roof plane that has the lower slope or lesser height. Extend the end shingle at least twelve inches onto the adjoining roof. Do not make a joint in the valley. If a shingle falls short, add in one or two tab sections so that joint occurs outside the line of the valley. Apply succeeding courses in the same manner, extending them across the valley and onto the adjoining roof. Press shingle tightly into the valley. Use normal shingle fastening methods except that no nails should be within six inches of the valley centerline and two nails shall be placed at the end of each shingle crossing the valley. Snap a chalk line two inches from the centerline of the valley on the under-shingled side. Then apply shingles on the under shingled side. Trim the shingles as they are being installed to the chalk lines to ensure a neat installation. Trim one inch on a 45-degree angle from the upper corner of each shingle upon installation. This will direct water into the valley. Finally embed each end shingle in a 3-inch (76 mm) wide strip of flashing cement.

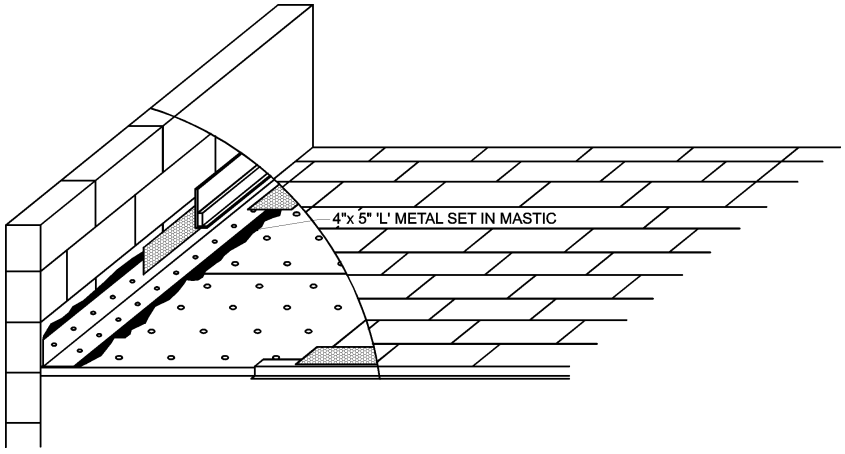
8.4 Woven valley: The valley flashing should already be in place as described earlier. Shingles on the intersecting roof surfaces may be applied toward the valley from both roof areas simultaneously or each roof area may be worked separately up to a point about three feet from the center of the valley and the gap closed later. Regardless of which procedure is followed, apply the first course along the eaves of one roof area up to and over the valley with the last shingle extending at least 12 inches onto the intersecting roof. Then apply the first course of the intersecting roof along the eaves and extend it across the valley over the top of the shingle already crossing the valley and at least 12 inches onto the other surface. Apply successive courses alternately from the adjoining areas, weaving the valley shingle over the other. Press each shingle tightly into the valley. Use normal shingle fastening methods except that no nails should be within six inches of the valley centerline and two nails shall be placed at the end of each shingle crossing the valley.

9. Flashing

9.1 All shingles that butt against wall flashings shall be step bulled with approved flashing cement a minimum of eight inches, and all roof planes that butt against vertical walls shall be flashed in one of the following manners:

9.2 Option A: All wall abutments shall be flashed with a minimum of 4 in. by 5 in. “L” metal flashings of materials and thickness in accordance with Section 1517.6 of the *Florida Building Code, Building*. The metal “L” flashing shall be set in approved flashing cement and set flush to base of wall and over underlayment (see Detail B). Both horizontal and vertical metal flanges shall be fastened 6 inches o.c. with approved fasteners. Fastening shall be in accordance with RAS 111. All laps shall be a minimum of 4 inches fully sealed in approved flashing cement. Flashing shall start at the lower portion of the roof to ensure water-shedding capabilities of all metal laps. The entire edge of the metal flashing shall be sealed covering all nail penetrations with approved flashing cement and membrane. The metal “L” flashing shall be counter flashed. All metal counter flashing shall be installed in accordance with RAS 111.

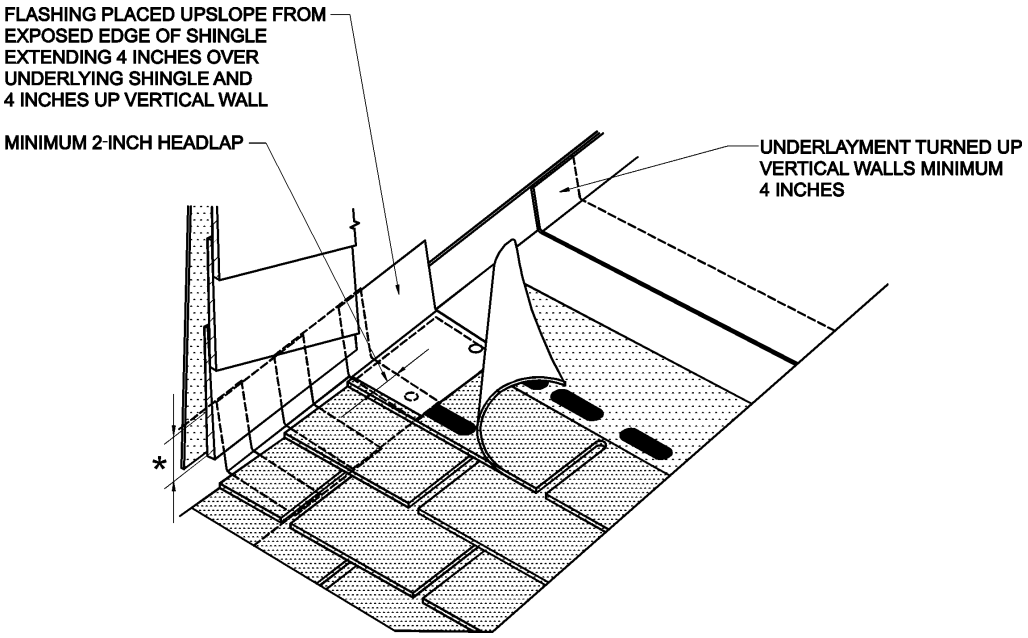
DETAIL B



9.3 Option B: Roof planes that butt against vertical walls shall be step flashed with 10 in. long metal shingles which are 2 in. wider than the exposed face of the roofing shingles (see Detail C). Place the first flashing unit over the end of the starter strip and position it so that the tab of the end shingle in the first course covers it completely. Secure the horizontal arm to the roof with two approved roofing nails. Do not nail flashing to the wall; settling of the roof could damage the seal. Apply the first course of shingles up to the wall. Position the second step flashing strip over the end shingle in the first course 5 inches up from the butt so that the tab of the end shingle in the second course covers it completely. Fasten the horizontal arm to the roof. The second course of shingles follows, the end is flashed as in the preceding courses and so on to the top of the intersection. Bring siding or other wall treat-

ment down over the vertical sections of the step flashing to serve as cap flashing. Wall treatment or cap flashing shall terminate a minimum of 1 in. above the roofline. All metal counter flashing shall be installed in accordance with RAS 111.

DETAIL C



9.4 Head/apron flashing at all vertical end walls: Apply shingles up the roof until a course must be trimmed to fit at the base of the vertical wall. Adjust the exposure slightly in the previous two courses so that the last course is at least 8 inches wide. Apply a continuous piece of metal flashing over the last course of shingles by embedding it in approved flashing cement and nailing it to the roof. The metal flashing strip shall be bent to extend at least 5 inches up the vertical wall and at least 4 inches onto the last shingle course. Do not nail the strip to the wall. Apply an additional row of shingles over the metal flashing strip, trimmed to the width of the strip. Bring siding down over the vertical flashing to serve as cap flashing. Wall treatment or cap flashing shall terminate a minimum of 1 in. above the roofline. Do not nail siding into the vertical flashing. If the vertical front wall meets a side wall, as in dormer construction cut flashing so that it extends at least 7 inches around the corner. Continue up the side wall with step flashing as detailed above.

10. Soil Stacks and Vent Pipes

10.1 Apply shingles up to the vent pipe. Cut a hole in a shingle to go over the pipe and set the shingle in ASTM D4586 flashing cement. A preformed flashing flange that fits snugly over the pipe is then placed over the shingle and vent pipe and set in approved flashing cement. Place the flange over the pipe to lay flat on the shingle below. After the flashing is in place, resume shingle application. Cut shingles in successive courses to fit around the pipe and embed them in approved flashing cement where they overlap the flange. Avoid excessive use of cement as it may cause blistering. Do not drive fasteners close to the pipe. The lower part of the flange shall overlap the lower shingles and the side and upper shingles shall overlap the flange.

10.2 For ventilator and exhaust stacks located at the ridge, follow the same procedure, but bring the shingles up to the pipe from both sides and bend the flange over the ridge to lie in both roof planes, overlapping the roof shingles at all points. Ridge shingles are then positioned to cover the flange. Embed the ridge shingles in approved flashing cement where they overlap the flange. Roof ventilators and ridge vents shall be installed and flashed in accordance with their Product Approval.

11. Chimneys

11.1 Chimneys shall be flashed with a two-piece base and cap flashing to allow for differential movement. Apply shingles up to the front edge of the chimney before any flashings are installed. Apply a coat of ASTM D41 asphalt primer if the chimney is constructed of masonry or metal to seal the surface and to provide good adhesion to all points where flashing cement will later be applied.

11.2 Install flashing in accordance with Section 9 above. Apply the base flashing to the low side of the chimney first. Bend the base flashing so that the lower section extends at a minimum of 4 inches over the shingles and the upper section extends a minimum of 12 inches up the vertical face of the chimney. Work the flashing firmly and smoothly into the joint between the shingles and chimney. Set both the roof and chimney overlaps in approved flashing cement placed over the shingles and on the chimney face. The flashing shall be secured in accordance

with RAS 111. Use metal step flashing for the sides of the chimney, positioning the units in the same manner as flashing on a vertical side wall, in accordance with Details A and B herein. Secure each flashing unit to the masonry with approved flashing cement and to the deck with approved nails. Embed the end shingles in each course that overlap the flashing in an 8 inch bed of approved flashing cement. Place the rear base flashing over the cricket and the high side of the chimney. Chimney crickets shall be waterproofed in compliance with the shingle manufacturers published literature. All chimney flashings shall be counter flashed. Metal counter flashing shall be in accordance with RAS 111.

12. Hips and Ridges

12.1 Apply premanufactured hip and ridge shingle components or cut hip and ridge shingles from manufacturer's strip shingles. Lay hip and ridge away from prevailing wind. Insure all fasteners are covered. Exposure shall not exceed 5 inches unless specified in the roof assembly's Product Approval. Taper the lap portion of each cap shingle slightly so that it is narrower than the exposed portion.

12.2 Hip and ridge shingles shall comply with Section 1518.7.4 of the *Florida Building Code, Building*.

ROOFING APPLICATION STANDARD (RAS) NO. 117-20 STANDARD REQUIREMENTS FOR BONDING OR MECHANICAL ATTACHMENT OF INSULATION PANELS AND MECHANICAL ATTACHMENT OF ANCHOR AND/OR BASE SHEETS TO SUBSTRATES

1. Scope

1.1 The standards set forth herein provide a means of determining proper attachment of anchor and/or base sheets and insulation panels.

1.2 All testing shall be conducted by an approved testing agency. This roofing application standard has been developed to provide a responsive method of complying with the requirements of Chapters 15 and 16 (High-Velocity Hurricane Zones) of the *Florida Building Code, Building*. Compliance with the requirements, procedures and examples specified herein, when using the tables contained in RAS 128, do not require additional signed and sealed engineering design calculations. All other calculations must be prepared, signed and sealed by a Professional Engineer or Registered Architect.

2. Anchor and Base Sheets, General

2.1 All damaged stress plates shall be removed and replaced.

2.2 Insulation shall only be attached with approved insulation fasteners.

3. Insulation, General

3.1 All insulation fasteners shall be installed in compliance with the fastener manufacturer's published installation instructions and the limitations set forth in the Product Approval. Insulation attachment for panels in the field area of the roof shall use a fastener spacing in compliance with Figures 1 through 4 of this Application Standard, as referenced in the Roof Assembly Product Approval. Fastener placement guidelines shall be as follows:

- Fasteners installed at insulation panel edges shall be spaced not greater than $13^1/_2$ inches nor less than $4^1/_2$ inches from the edge of the panel unless otherwise specified in the Product Approval.

FIGURE 1—FASTENER PLACEMENT FOR 2 FOOT BY 4 FOOT BOARDS

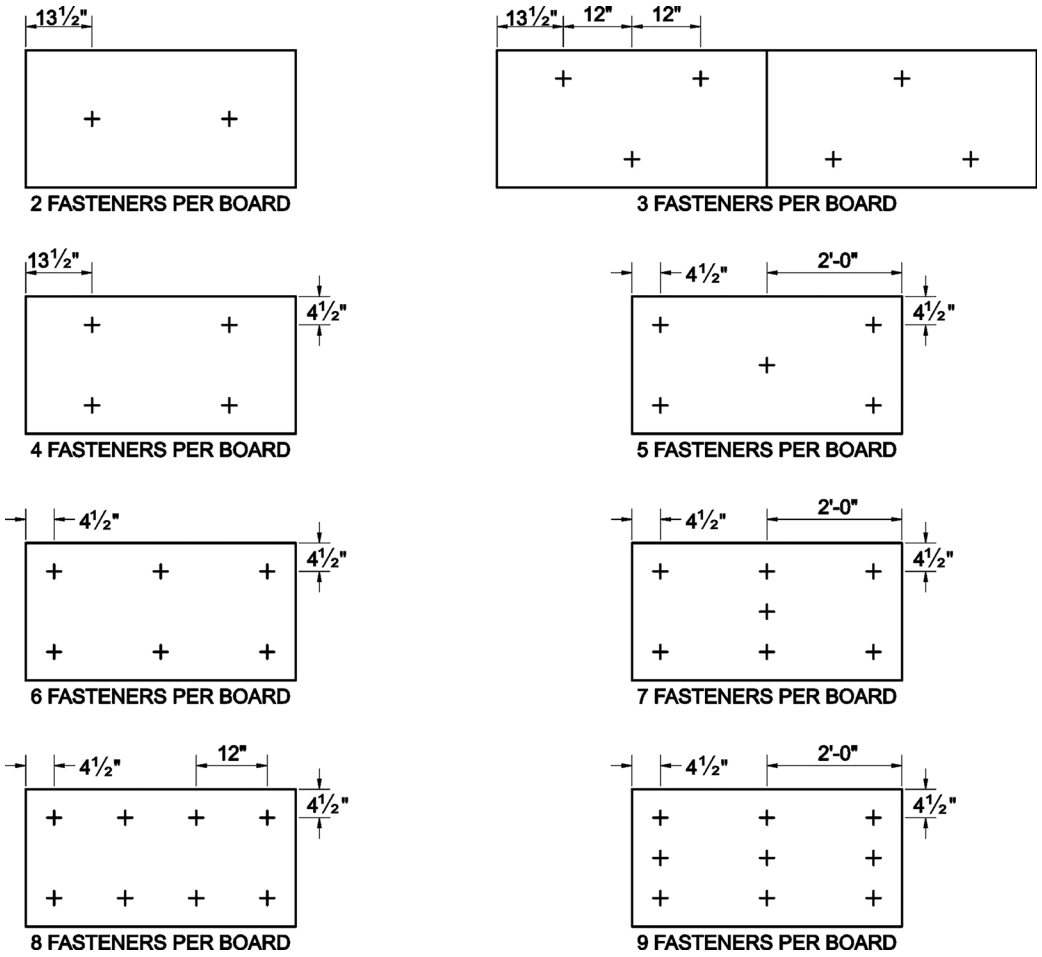
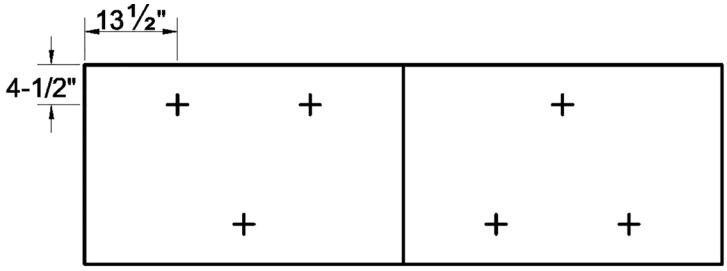
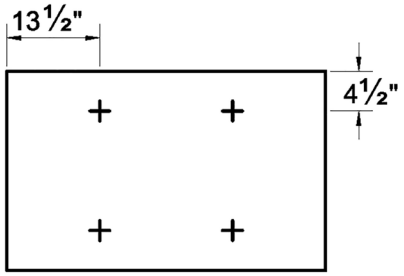


FIGURE 2—FASTENER PLACEMENT FOR 4 FOOT BY 4 FOOT BOARDS



3 FASTENERS PER BOARD



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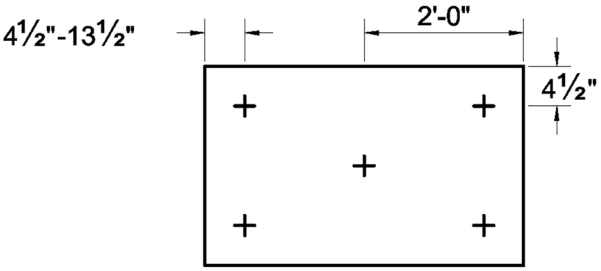

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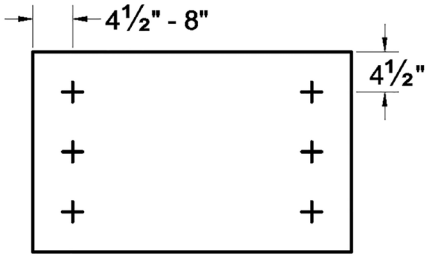

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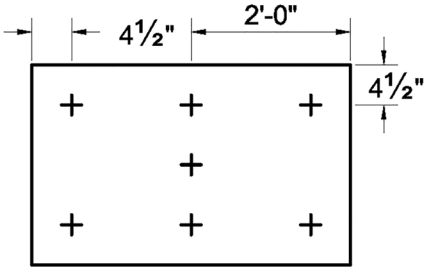

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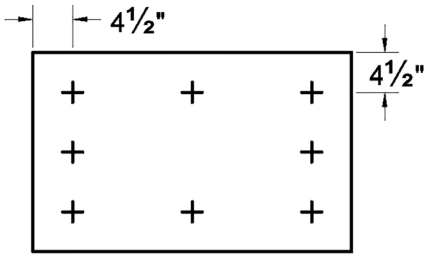

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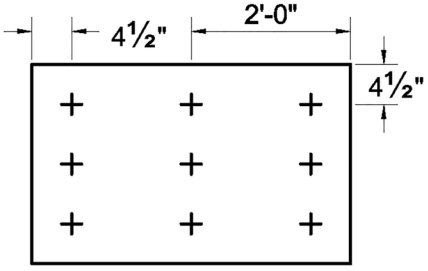

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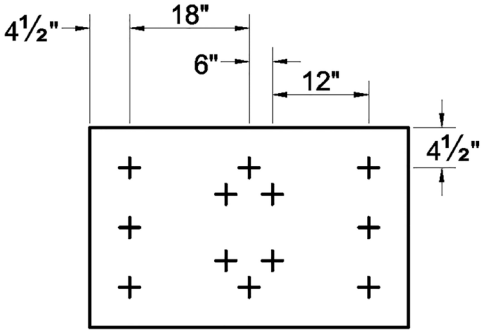

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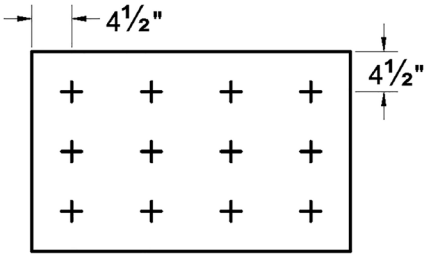


12 FASTENERS PER BOARD

FIGURE 3—FASTENER PLACEMENT FOR 4 FOOT BY 4 FOOT BOARDS

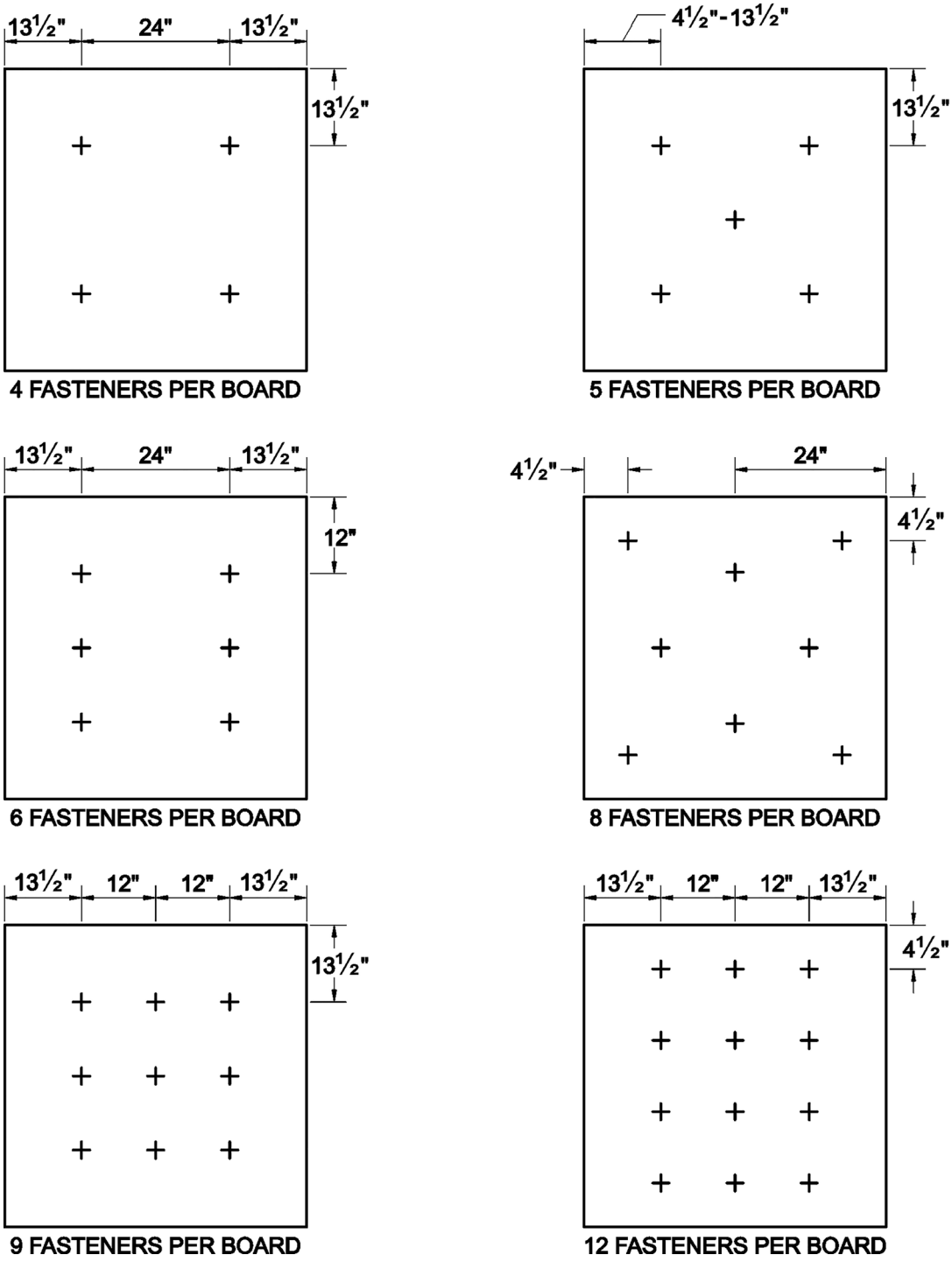
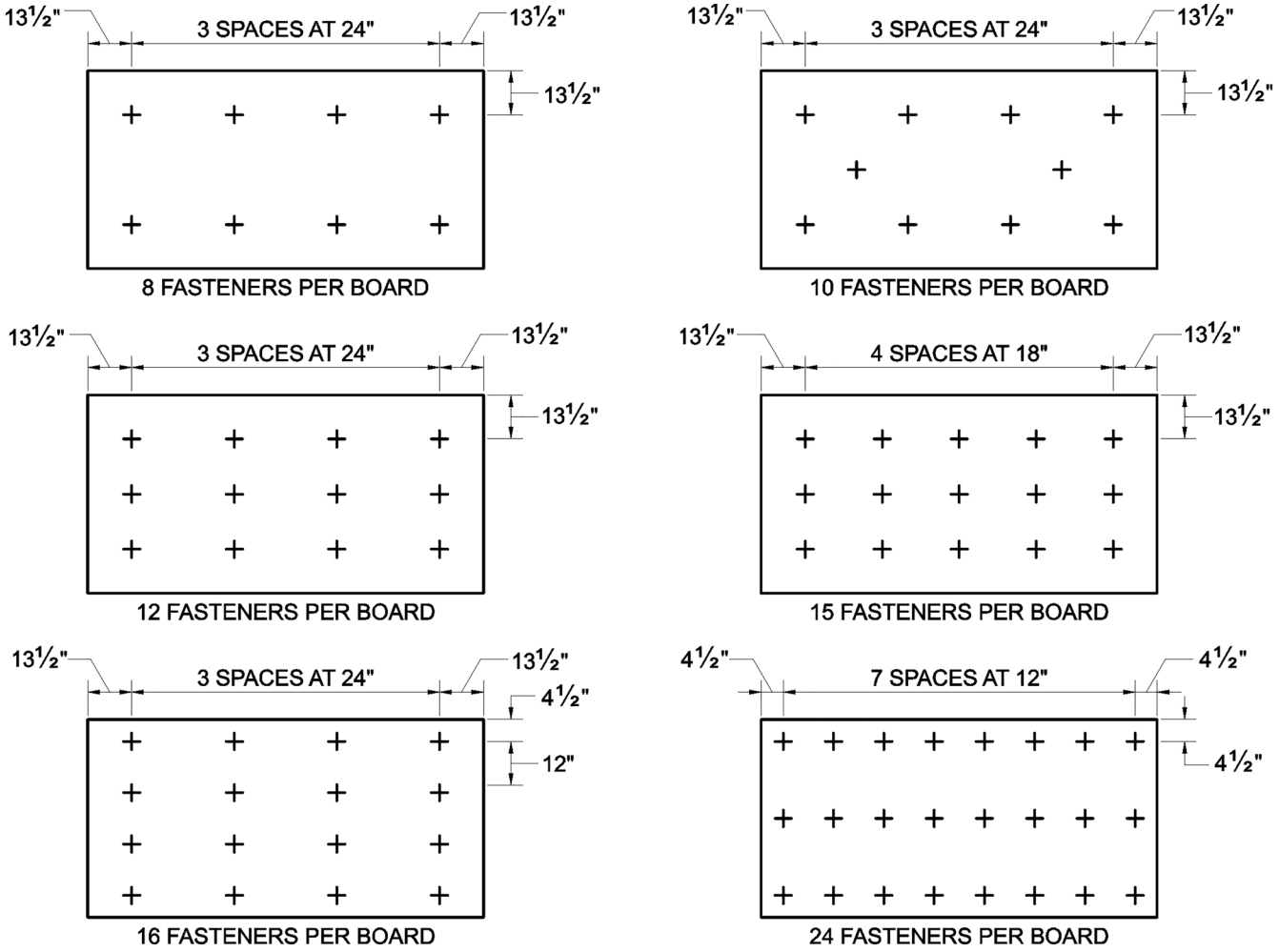


FIGURE 4—FASTENER PLACEMENT FOR 4 FOOT BY 8 FOOT BOARDS



3.2 All insulation fasteners and stress plates shall be tested in compliance with Chapter 15 (High-Velocity Hurricane Zone) of the *Florida Building Code, Building.* Minimum withdrawal resistance for insulation fasteners shall be 275 lbf.

3.3 For recover or reroof applications over an existing steel deck, having a thickness less than 22 gage, insulation fasteners shall be tested for withdrawal resistance in compliance with TAS 105.

3.4 Insulation fasteners and stress plates, and minimum acceptable insulation panel size and thickness shall be as listed in the roof assembly Product Approval.

3.5 Installation of more than one insulation layer using a single fastener shall utilize the fastening pattern and fastener designated for the top insulation panel.

3.6 Mixing of insulation panels (e.g., different manufacturer's, insulation types) shall not be acceptable when applied in the same layer.

3.7 Only as much insulation as can be roofed shall be installed each working day. Water shall not be allowed to run in the flutes of steel deck ribs under completed roof sections.

3.8 Insulation panels shall be installed with minimum joint dimensions and shall be tightly butted. Maximum joint widths shall be $^{3}/_{8}$ in.

3.9 All insulation joints shall be staggered. Tapered insulation shall be installed in accordance with manufacturer's recommendations.

3.10 Tapered insulation may be substituted for any flat stock type listed in the Roof System Assembly Product Approval. The fastening requirements shall remain the same and have a minimum thickness as specified in the Roof System Assembly Product Approval.

3.11 Insulation pieces that are cut from larger panels and are smaller than one square foot shall not be acceptable.

3.12 All insulated decks containing interior drains shall be sumped at the drains. Sump area insulation shall be tapered at a minimum slope of $^{1}/_{8}$ of an inch per foot to the drain. The drain sump area shall be a minimum of (24 in. by 24 in.) 576 square inches, unless restricted by a wall or any other obstruction.

3.13 All overdriven fasteners or fasteners driven at an angle, shall be removed and replaced. If the insulation facer has been broken by a stress plate, that section of insulation panel shall be removed and replaced.

3.14 Attachment of any low density insulation panel, fiberglass or mineral wool, shall be with self-locking fasteners.

3.15 Insulation fasteners and stress plates shall be installed with tooling specified by the fastener manufacturer.

3.16 Predrilling, if any, shall be with the diameter bit listed in the withdrawal resistance test report. The drill bit tolerance range noted in the test report shall be maintained throughout the project. Should a change in bit size be required due to varying density of the deck material, an additional withdrawal resistance test shall be conducted to confirm fastener performance. Drill holes shall not spalled.

3.17 When installing "hammer-in" concrete fasteners, all deformed stress plates shall be removed and replaced.

3.18 Concrete dust shall be removed by brushing or forced air from the insulation top surface prior to the application of hot asphalt or adhesive.

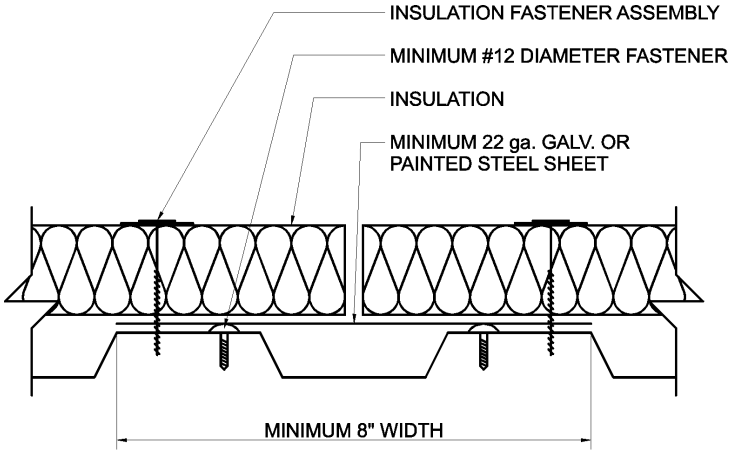
3.19 Roof insulation and roll goods, either on the ground or on the roof top, shall be kept dry. The building official shall instruct the removal of the insulation or roll goods from the job when elevated moisture levels are found.

4. Insulation Attachment Over Steel Decks

4.1 Steel deck insulation fasteners shall penetrate the top flange of a steel deck not less than $^{1}/_{2}$ in.

4.2 The two opposite edges of any insulation panel shall be supported on the top flanges of the steel deck, and shall have a minimum bearing width of $1^{1}/_{2}$ in. unless restricted by top flange width. Alternatively, minimum 22 gage galvanized or painted sheet steel may be placed over the deck ribs and secured with minimum #12 diameter fasteners spaced 18 in. o.c. (see Figure 5).

FIGURE 5—USE OF STEEL SHEET TO ENSURE SUPPORT OF INSULATION PANEL GAGES



4.3 Steel deck sections shall properly "nest," allowing insulation panels to have full contact with the top flanges. If any deck sections do not "nest" properly, the sections shall be repaired prior to the application of the roof insulation. Cutting, scoring or hollowing of the insulation panels is not acceptable.

5. Insulation Attachment Over Concrete Decks

5.1 Threaded concrete fasteners shall be a minimum of a #14 diameter. "Hammer-in" concrete fasteners having a length less than or equal to 8 in. shall have a minimum diameter of $^{3}/_{16}$ in. "Hammer-in" concrete fasteners having a length in excess of 8 in. shall have a minimum diameter of $^{1}/_{4}$ in.

5.2 Insulation fasteners shall penetrate the concrete deck a minimum of $1^{1}/_{4}$ in.

6. Lightweight Insulating Concrete

6.1 New pours of lightweight insulating concrete shall be tested for fastener withdrawal in compliance with Section 1917 of the *Florida Building Code, Building.*

6.2 Rigid roof insulation panels can not be applied directly over lightweight concrete decks unless prohibited in the Product Approval.

6.3 For recover or reroof applications where the proposed mechanical attachment is through the lightweight insulating concrete and to the structural deck, a TAS 105 withdrawal resistance test of the proposed fastener shall be conducted. Calculations based on the TAS 105 shall be submitted to the building official for evaluation of the proposed fastening method.

7. Wood Decks

7.1 Approved insulation fasteners shall be used for insulation attachment to wood decks. Nails are not acceptable for insulation attachment.

8. Perimeter, and Corner Roof Areas

8.1 The roofing assembly Product Approval shall list the maximum design pressure for the accepted assembly. Such pressure shall be applicable to Zone 1′ or 1, as applicable and as defined in ASCE 7. Should the roof assembly Product Approval allow extrapolation to Zone 1, 2 or 3, as applicable and as defined in ASCE 7, the following shall apply:

- The maximum extrapolation shall not be greater than 300 percent except as noted in Section 9.2.
- The minimum fastener separation shall not be less than 4 in. o.c.
- If Zone 1, 2 or 3, as applicable, shall have calculated design pressures which are less than or equal to the maximum design pressures noted in the roof assembly Product Approval, then specified anchor/base sheet or insulation attachment shall also apply in these areas.
- If the minimum design pressure exceeds the roof assembly maximum design pressure such roofing system may be granted a one-time approval by the authority having jurisdiction, provided the applicant demonstrates, by testing and/or rational-analysis that such roofing system complies with the provision of the *Florida Building Code.*

8.1.1 In recover or reroof applications, if testing in compliance with TAS 105 of the insulation fasteners results in a minimum characteristic resistance force less than 275 lbf (1224 N), a Professional Engineer, or Registered Architect shall perform a moisture survey, in compliance with TAS 126, and examine the deck's integrity. The moisture survey and examination results, along with the withdrawal resistance test results and a proposed deck repair/replacement specification, shall be submitted to the building official for review prior to issuance of a roofing permit.

Subsequent to repair or replacement of the deck, a withdrawal resistance of the fasteners shall be conducted. The same criteria noted above shall apply.

8.2 As an alternate to data extrapolation, or in the event data extrapolation is not allowed, in-situ (on-site) field uplift resistance testing of the in place roof assembly may be conducted in elevated pressure zones to confirm uplift resistance performance. Testing shall be conducted in compliance with TAS 124. Such Field uplift resistance testing shall be conducted to 1.45 times the design pressure for the tested pressure zone, and submitted to the building official for review.

9. Insulation Attachment—New Construction/Reroof Application

9.1 Example of Data Extrapolation:

9.1.1 Given:
Zone 1′: *-37.0 psf*
Zone 1: *-64.0 psf*
Zone 2*: -84.0 psf*
Zone 3*: -115.0 psf*

Consider a Roof Assembly Product Approval, which includes a system having an accepted maximum design pressure of -45 pound per square foot (2155 Pa). The Product Approval specifies 4-foot by 4-foot insulation panels attached with four fasteners per panel.

9.1.2 Determine the required number of fasteners per insulation panel to meet the design pressures in the elevated pressure zones.

General Equation:

$$\left(\frac{Known\ \#\ of\ fasteners}{max\ design\ pressure}\right) = \left(\frac{unknown\ \#\ of\ fasteners}{elevated\ design\ pressure}\right)$$

Zone 1:

$$\left(\frac{4\ fasteners}{45\ psf}\right) = \left(\frac{X\ fasteners}{64\ psf}\right) = 5.7\ fasteners$$

All fractions shall be rounded up to the next whole number. Therefore, the Zone 1 insulation panels shall be fastened with six fasteners per 4-foot by 4-foot panel. Fastener locations shall be in compliance with Figure 3.

Zone 2:

$$\left(\frac{4\ fasteners}{45\ psf}\right) = \left(\frac{X\ fasteners}{84\ psf}\right) = 7.5\ fasteners$$

All fractions shall be rounded up to the next whole number. Therefore, the Zone 2 insulation panels shall be fastened with eight fasteners per 4-foot by 4-foot panel. Fastener locations shall be in compliance with Figure 3.