DESIGNER

HANDBOOK

STANDARD PRACTICES FOR STAINLESS STEEL

- ROOFING
- FLASHING
- COPINGS

Stainless Steel
The Value Option®

Table of Contents

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ACKNOWLEDGEMENT

The Specialty Steel Industry of North America (SSINA) wishes to acknowledge that this booklet was originally prepared by the American Iron and Steel Institute, Committee of Stainless Steel Producers. Many of the current SSINA stainless steel producers were represented on this committee.

HOW TO USE THE HANDBOOK

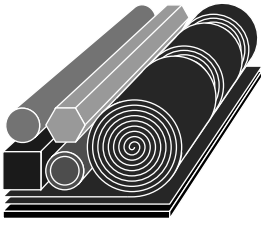
This publication includes revised and updated information on a broad range of stainless steel moisture-protection applications.

In preparing this manual, the Stainless Steel Market Development Committee of the Specialty Steel Industry of North America has drawn on the experience of its members and architects, specification writers, product manufacturers and roofing contractors.

This handbook can be used in conjunction with the Architectural Sheet Metal Manual published by the Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA). For quick reference, appropriate detail drawings in the SMACNA Manual are “keyed” by figures to all stainless steel applications listed in Table I.

It should be noted that for several applications in this handbook thinner metal is indicated as compared with the SMACNA Architectural Manual. The suggestions for thinner stainless steel result from information developed in the field which indicates that realistic reductions in gauge can be employed successfully in a variety of stainless roofing and flashing applications. Refer to the SSINA Designer Handbook “Stainless Steel Architectural Facts.”

Note: While the companies represented on the Committee do not fabricate the products mentioned or perform the work discussed in this manual, their technical sales representatives will be pleased to provide assistance on stainless steel.



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PROPERTIES OF STAINLESS STEEL

Stainless steel is perhaps best-known for its esthetic value and long life. For most roofing and flashing applications, however, functional properties and economic factors are also important. Stainless steel for such applications offers significant performance advantages to the architect and building owner:

- Stainless steel is corrosion resistant all the way through and requires no artificially applied surface coating for protection. In fact, stainless performs best when it is boldly exposed.
- Stainless steel is self-cleaning and requires little or no maintenance and is often the most economical material when total life cycle costing is considered.
- It is not affected by the corrosive alkaline action of mortar or masonry.
- Stainless steel is compatible with and will not stain aluminum, masonry or other building materials.
- The high tensile strength and modulus of elasticity of stainless permit the safe and effective use of thinner gauges than required with other metals. As a result, its installed cost is often competitive with other roofing and flashing materials.
- Its thermal expansion is comparable to copper, is less than aluminum or zinc alloys and is somewhat higher than galvanized steel.
- Stainless is easy to form and solder — either in the shop or in the field.
- Stainless steel is a safe, fire-resistant roofing material. It has a very high melting point of 2550-2650°F, (1400-1450°C) and retains its strength at elevated temperatures.
- It resists wind damage and denting and has superior resistance to metal fatigue.

STANDARD PRACTICES

The use of stainless steel for roofing, flashing and other moisture-protection applications involves no unusual techniques. However, as with all architectural metals, there are certain precautionary measures to be followed in the selection, design, fabrication and installation of stainless steel. These may vary across the country according to local experience, climatic and environmental considerations and shop practice.

CHECKLIST OF DESIGN CONSIDERATIONS

- Specify the proper stainless steel type, temper, finish and thickness for each application.
- Where appearance is important, avoid long or large, flat, unsupported sheet metal areas, to reduce chances of apparent distortion, waviness or “oil canning.”
- Provide adequate drainage, particularly on so-called flat roofs, to avoid the collection and concentration of contaminants.
- Avoid drainage from unwashed iron slag roofs.
- Avoid corrosion-product wash from other metals, such as unpainted steel. While these do not harm the stainless, they can be unsightly.

HOW TO SELECT STAINLESS STEEL

Alloys

Stainless steel is not just one metal. In fact, there are over 50 stainless steels originally recognized as standard alloys by the American Iron and Steel Institute. Chromium is the element that gives these steels their corrosion-resistant qualities. To be stainless steel, the alloy must contain at least 10.5% chromium. Nickel, manganese and molybdenum also contribute to corrosion resistance and/or ease of fabrication. Refer to the SSINA Designer Handbook “Guidelines for the Selection and Use of Stainless Steel.”

The four stainless steels most often specified for roofing and flashing applications are Types 304 and 316, and their low carbon variations, 304L and 316L. All four have excellent corrosion resistance, high strength and ease of fabrication.

Type 304, the basic “18-8” alloy (18% chromium, 8% nickel), is most often specified for roofing, flashing and other architectural applications. Over the years, it has become known as the “all-purpose” stainless steel.

Type 304L is a lower-carbon variation of Type 304 and is preferred if welded components are to be exposed to corrosive environments.

Type 301 is a high-strength variation of Type 304, possessing tensile strengths above 110,000 psi in the annealed condition vs. 84,000 psi for Type 304. Because they work-harden more rapidly to still higher strength levels, Type 301 is usually specified for formed sections or shapes which require extra stiffness or extra load-bearing capacity.

Type 316 contains 2 to 3% molybdenum, and is more corrosion resistant than 304 stainless steels. Although higher in initial cost, 316 usually is preferred for long-term service in aggressive industrial, chemical and seacoast atmospheres.

Temper

While stainless steels are available in a variety of tempers, most roofing and flashing applications utilize the fully annealed condition; or the standard, annealed condition. In this condition, these stainless steels have a yield strength of about 42,000 psi. They exhibit slight “spring-back” and require over-bending in forming to achieve the desired angle or shape. Refer to the SSINA Designer Handbook “Stainless Steel Fabrication.”

Sizes

Flat-rolled products less than $^3/_{16}$"-thick and more than $^3/_8$"-wide are classified as either sheet or strip. If the width is 24 inches or more, the product is designated as sheet; if less than 24 inches, it is referred to as strip.

Both sheet and strip can be ordered in continuous coils as well as flat pieces cut to length. Some steel service centers regularly stock precut sheets.

Gauges

Because stainless steel is stronger than the traditional architectural metals, it can be used for most applications in significantly thinner gauges. This particular advantage often permits stainless steel to be competitive with other architectural metals.

For example, a base flashing requiring the use of 20-oz. (.027-inch) copper can be specified in .015-inch (28-gauge) stainless steel. To give some idea of cost savings involved, 100 square feet of base flashing would weigh 125 lbs. in 20-oz. copper compared to only 66 lbs. in .015-inch stainless. Therefore, stainless steel would have to cost at least twice as much per pound as copper, before the base flashing in thin-gauge stainless would become more expensive on a square-foot basis. (See Table III on page 8 for gauge-weight ratios for stainless steel, aluminum and copper which can be useful in determining material costs.)

Some architects and municipal, state and federal government agencies give detailed instructions in their roofing, sheet metal and insulation specifications to avoid any confusion in thickness or weight that might occur when ordering alternate materials — such as stainless steel vs. copper. It should be recognized that such specifications vary according to the agency concerned.

Stainless steel flashing stock is readily available in .012-inch (30-gauge), .015-inch (28-gauge) and .018-inch (26-gauge). Table I on page 6 lists stainless steel gauge suggestions and other design detailing information for a wide variety of roofing, flashing and rainware applications.

Finishes

Stainless steel sheet is available in eight standard mill finishes. Refer to the SSINA Designer Handbook "Stainless Steel Finishes." Several proprietary finishes ranging from dull matte to nearly mirror bright are also available. Three standard finishes are regularly used for roofing and flashing applications. Two of these are mill-rolled and one is mill-polished.

Mill-Rolled Finishes

No. 2D is a matte, non-reflective sheet finish, which is designated as a No. 1 finish for strip. It is ideally suited for applications involving soldering because its slightly duller surface provides an excellent soldering base that does not have to be abraded for positive adhesion.

In addition, the non-reflective, light gray appearance of the finish helps minimize visible waviness or "oil canning."

No. 2B is a bright, moderately reflective sheet finish, which is designated as No. 2 finish for strip. It is widely used for flashing, roofing, gutters, downspouts and other exposed applications where the architect might want a reflective contrast to other architectural material. When soldered, the surface area to be joined must be roughened to provide good solder adhesion.

Mill-Polished Finishes

No. 4 is the most widely used mill-polished finish used for moisture-protection applications. It has a bright appearance with a visible grain which prevents mirror reflection. Because of its attractive appearance, it is widely used for fascias and other exposed moisture-protection applications.

Special Note: On the mill-*polished* finishes, weld seams or surface imperfections can be blended inconspicuously into the surrounding area by mechanically duplicating the grit lines with the proper abrasive. To match a No. 4 finish, for example, blend-polishing should be done *with the grain* using a 150-grit abrasive.

On the mill-*rolled* finishes, however, weld seams *cannot* be blended to match the surrounding area. The weld seams *can* be polished to achieve a contrast in appearance if that effect is desired. For some components, it may be economical to use a mill-rolled finish and, after fabrication, to apply a uniform polish to all visible surfaces. It should also be noted that any of the mill-rolled finishes can be soldered or welded if the joint is not visible or if surface appearance is not an important factor.

DESIGNING FOR FLATNESS

Surface distortion or waviness, called "oil canning," is sometimes visible, particularly in light-gauge applications. When selecting gauges for unbacked fascias or similar components, one or more of the following suggestions can help in significantly reducing the likelihood of such problems:

- Avoid the use of long or large, flat surfaces.
- Specify specially flattened sheets produced by stretcher- or tension-leveling. This service is available from steel companies and most steel service centers.
- Because highly reflective finishes tend to magnify surface irregularities, use non-reflective or textured finishes to mask apparent waviness and oil canning. Contouring, patterning, ribbing or fluting increase stiffness and thus help to attain visual flatness.
- Use an attachment system that permits movement between building and components without binding or buckling.
- If the design requires large, flat stainless steel panels, use a continuous backing behind the steel by laminating it to a flat, rigid material or honeycomb.

If the metal face is not backed continuously, then the lateral distance between stiffening members varies with the finish, as follows:

Finish	Width/Thickness Ratio
No. 4; other polished finishes	150 max.
No. 2D; matte finish	200 max.
Crimped; textured; patterned	200 and higher

Recommended lateral distances between formed edges, supports or stiffening ribs — when a polished finish is used — will vary with the thickness of the stainless steel, as follows:

Thickness		Lateral Distance, Inches
Inch	Gauge	
.038	20	5.7
.031	22	4.7
.025	24	3.7
.018	26	2.7
.015	28	2.2
.012	30	1.8

Recommended lateral distances — when a No. 2D or matte finish is used — are as follows:

Thickness		Lateral Distance, Inches
Inch	Gauge	
.038	20	7.6
.031	22	6.2
.025	24	5.0
.018	26	3.6
.015	28	3.0
.012	30	2.4

GENERAL SHOP PRACTICES

Care During Fabrication

The supplier's care in packaging should be taken as a guide as to the care required in handling the metal during fabrication. Whenever practical, the stainless steel should be stored in the package in which it was shipped. When surface finish is critical, suitable protection — strippable paper, paper interleaving, etc. — should be provided during fabrication, handling and shipping.

During layout operations, scribelines, center punch marks or other permanent layout markings should be avoided. Grease pencils are an effective alternative. The layout bench should be clean and covered with paper or felt to avoid scratching the stainless steel surface.

During fabrication, sheets should be lifted — never dragged — to avoid scratching. To protect the stainless steel surface when using shearing machines, the hold-down clamps should be cushioned with rubber, felt or plastic, and the dies covered with masking tape.

Reasonable care should be used in bending on press brakes. The bending or forming dies should be clean. To prevent direct contact of the dies with stainless steel surfaces, some fabricators cover the bending dies with smooth surface masking tape. To avoid contamination, do not use carbon steel sponges, carbon steel wool, or grinding wheels which have been used on carbon steel. If brushes, sponges, or steel wool are necessary, they should be made of stainless steel or non-metallics.

During fabrication, it is important to guard against iron or steel pickup from forming dies, handling, grinding or other sources. Such contaminants can rust, causing surface stains or discoloration. Refer to the SSINA Designer Handbook "Stainless Steel Fabrication."

Shop Cleaning of Stainless

Sometimes it is not possible to isolate stainless steel fabrication from that of carbon steel work. Iron or steel particles remaining on the stainless surface can ultimately cause rusting and staining problems, and therefore should be removed. One way of doing this is by washing the stainless with a solution of about 10 to 15% nitric acid by volume in water. The acid must be flushed from the surface with copious amounts of water . . . warm water if possible.

Storing During Fabrication

Between fabricating operations, stainless steel sheets should be placed in support frames instead of on the floor, and they should be stored away from aisles and peak traffic areas, soldering and welding operations and vapor degreasers. When possible, padded dollies and trucks should be used for storing.

JOINING

Soldering

Stainless steel can be soft-soldered as easily as copper, using similar equipment and procedures as used with other roofing metals. However, it is important to recognize that:

- Stainless steel conducts heat more slowly than copper, and the iron should be held in contact with the joint longer to assure solder penetration into the joint.
- Heat is concentrated at the soldering point and retained longer, therefore a cooler iron is more effective when soldering stainless.

As when soldering any metal, the parts to be joined must be thoroughly cleaned of grease, dirt or other foreign matter, using a clean rag and any good solvent. Smooth surfaces should be roughened with clean emery cloth or sandpaper — **but never with ordinary steel wool.**

Fluxes

Until recently, soldering of stainless steels has been restricted to the use of strong chloride-type fluxes to etch the chromium oxide film. Such chloride-type fluxes usually contain zinc or ammonium chlorides, or both, in addition to hydrochloric acid. All are highly corrosive. While these fluxes do aid in producing sound joints, discoloration and severe corrosion — sometimes to the point of perforation of the metal — can result, if the flux residue is not neutralized and washed off after soldering.

The potential hazards resulting from corrosion problems related to insufficient removal or neutralization of chloride flux have been largely overcome through the use of phosphoric acid type of flux. The primary advantage of the flux is that it is active only at soldering temperatures — 350 to 550°F. When cooled to ambient temperature, the phosphoric flux residue is non-corrosive to stainless steel. Therefore, neutralizing is eliminated and the soldered joint only needs to be washed with clean water.

Another advantage of the phosophoric acid flux is the fact that there are no aggressive chemical elements in the cleaning water run-off. This eliminates the danger of possible contamination and subsequent corrosion of adjoining stainless steel that is possible when cleaning chloride flux residue. It is important to remove any solder flux residue exposed to salt-laden atmospheres. Salt in the atmosphere will react with the flux residue and eventually cause corrosion. Therefore, it is suggested that care be taken to thoroughly wash off all flux residue, particularly if the installation is located in a coastal area.

Although 50-50 (half tin, half lead) solder is commonly used for soldering stainless steel, some specifications call for the use of 60% tin and 40% lead solder. Solders of higher tin contents, up to 80%, flow better because they wet the surface more easily. They also provide a better color match with stainless steel and have less tendency to discolor as they age. Such solders usually are used for applications that are visible at close range.

Since with all metals the strength of solder is quite low, it should only be used to seal or fill a joint, but never relied upon to provide structural strength. In considering soldering, it is important to remember that lock-seam soldered joints offer greater integrity than single-lap soldered joints.

Welding

In general, stainless steel can be welded as easily as carbon steel, but in the thin gauges used for roofing and flashing applications, stainless steel is rarely welded. As in soldering, the stainless conducts heat slowly, and the heat tends to concentrate in the weld zone. Jigs or chill bars should be used to minimize distortion when welding the thinner stainless gauges. Stainless also has a higher electrical resistance than does carbon steel, so lower current setting should be used. The welding rod or wire should have an alloy content that is compatible with that of the stainless being joined. This assures that the filler metal will match the parent metal both visually and in terms of corrosion resistance. **Carbon rod should never be used as a substitute.**

Removal of Weld Discoloration

During welding some discoloration, which is a thin oxide layer, will be evident in the heated area near the weld. Mechanical removal of this heat tint should be limited to clean glass bead blasting, flapper wheels, aluminum oxide discs and wire brushing with austenitic stainless steel wire brushes. Sand and grit blasting should be prohibited. Pickling will remove the smeared surface layer left by these mechanical cleaning operations restoring much of the corrosion resistance lost during these mechanical cleaning operations. Electrocleaning with a hand held electrocleaning tool is an equally effective alternative to pickling for heat tint removal.

Mechanical Fastening

Stainless steel fasteners should be used for all stainless steel components that are to be mechanically joined, whether in the shop or in the field. A wide variety of nails, screws, nuts, bolts, washers, rivets and other mechanical joining devices are available in 300 series stainless steels for this purpose. Fasteners made from other materials, even if protected with an applied anti-corrosive coating, will eventually corrode and cause unsightly rusting and staining. Furthermore, they may eventually fail due to galvanic corrosion. Stainless steel fasteners are preferred for joining or attaching components of other metals. Refer to the SSINA Designer Handbook "Stainless Steel Fasteners — A Systematic Approach to their Selection."

PACKING FOR SHIPMENT AND CONSTRUCTION SITE STORAGE

As with other materials, proper care must be given to packing stainless steel components for shipment to the construction site if they are to arrive undamaged and ready for installation. Generally speaking, the same protective measures the supplier provided for the stainless steel — packaging and protective paper coating, etc. — can be used for fabricated architectural components when required.

Stainless steel architectural components such as fascia are often covered with strippable adhesive or plastic coatings to protect them during installation. Most of these adhesive coatings tend to harden or "set" after prolonged storage. Therefore, **all protective coatings should be removed as soon as practical after installation.**

PREPARATION OF ROOF DECK

In installing stainless steel roofing systems, preparation of the roof deck is the same as that required for any other metal roofing. Before applying the steel, the deck must be dry, clean and smooth. All rough spots or projections such as nail heads should be countersunk, and chips, stones and other debris should be removed. A moisture barrier such as 30 lb felt, or ice and water shield *is required* under all roofing systems.

SUGGESTED ROOFING AND FLASHING INSTALLATION PRACTICES

Fasteners

As previously mentioned, stainless steel fasteners should be used for joining stainless steel components. Stainless steel nails for joining panels to roof decks should be flat-head, annular-thread, diamond-point and long enough to penetrate the backing by at least one full inch. Other fasteners, such as screws, also should penetrate the roof deck backing by a full inch.

Clips

Stainless steel clips should be used to secure stainless panels to roof decks and other supporting surfaces. See manufacturers specifications for the size, gauge, style and type of clip required for each roofing system.

Clips should be spaced to meet job requirements and specifications.

Seams And Joints

Lock seams should finish 1/2-inch wide.

Lap seams should overlap a minimum of 3 inches on vertical surfaces or built-in flashings, and a minimum of 4 inches elsewhere.

For water-proofing, seams should be filled with sealant.

Provision For Expansion

Expansion joints should be provided every 24 to 40 feet on continuous runs of stainless steel.

At the point of bend where the stainless turns up a wall, curve or batten, a clearance of approximately 1/4-inch should be provided between the metal and the vertical surface, for metal expansion. Where the end of a gutter or gutter lining abuts a wall, a 1/2-inch clearance should be allowed.

All exposed edges should be hemmed 1/2-inch on the concealed side.

Dissimilar Materials

Where dissimilar metals are in contact, adequate drainage should be provided to avoid standing water which can act as an electrolyte and promote galvanic corrosion. Also it is recommended that the metals be insulated from one another with bitumastic, paint or other inert coating.

Stainless steel can be used in contact with, or inbedded in masonry, concrete and plaster, without danger of corrosive attack.

Final Cleaning

When construction is completed, the stainless surfaces should be thoroughly cleaned with detergent and water to remove loose soil and dirt. Commercial cleaners, containing phosphoric or oxalic acid, can be used on stubborn deposits.

Masonry contractors are urged to utilize a non-hydrochloric-acid type masonry cleaner (such as Sure-Clean), to avoid potential corrosion. Muriatic acid spattering on the stainless steel during masonry cleanup — after the roofing contractor has completed the metal work — will cause severe surface corrosion, unless washed off immediately. In cases where the acid is trapped, the flashings will sustain local perforation and will fail as water barriers.

Table I
DESIGN FACTORS FOR UTILIZING STAINLESS STEEL

Application	SMACNA Manual Figures	Suggested Stainless Steel	Suggested Thicknesses		Weight	Detail Consideration
			Inch	USS Gauge	Lb./Sq. Ft.	
Copings	4-16 thru 4-20	304	.018	26	.788	.018" is suggested for coping up to 12" in width; over 12" use .025". Use .025 to .050 edge strip.
Downspouts and Leaders						
Square or Round	1-31, 1-32	301/304	.015	28	.656	
Downspout Heads	1-25	301/304	.015	28	.656	
Scupper Lining	1-26 thru 1-30	301/304	.015	28	.656	
Downspout Straps	1-33, 1-34	301/304	.015	28	.656	
Basket Strainers	1-23	301/304	.062 dia. wire			
Expansion Joints						
Roof & Ridge	3-1, 3-4, 3-5, 3-6 3-7 thru 3-10	304 304	.015	28	.656	Use at 24- to 40-foot intervals unless expansion is otherwise accommodated.
Flashings — Exposed						
Base, Cap or Counter	2-11, 2-12, 2-13, 4-1, 4-2	304	.015	28	.656	Lap joints 3" — minimum, may be sealed. May be combined with thruwall flashing.
Chimney & Sloping Roof	4-10 thru 4-14	304	.018	26	.788	
Roof Penetrations	4-6 thru 4-9	304	.015	28	.656	
Stepped	4-1	304	.015	28	.656	
Valley	4-2, 4-3	304	.015	28	.656	
Hip & Ridge	4-4, 4-5	304	.015	28	.656	
Parapet Wall Covering	4-21	304	.015	28	.656	
Flashings — Concealed						
Thruwall	2-8, 2-9, 2-10	304	.012	30	.525	Lap joints 3" — minimum.
Lintel	—	304	.012	30	.525	
Spandrel Beam	2-8, 2-9	304	.012	30	.525	Lap joints 2" and solder or seal.
Curtain Wall	—	304	.012	30	.525	
Gutters						
Built-In	1-4, 1-21	301/304	.015	28	.656	Lap joints 1", weld or rivet and solder
Hanging — rectangular Girth	1-1, 1-2, 1-12 thru 1-20	301/304				
up to 15"	1-1 thru 1-4	301/304	.015	28	.656	Note that gauge increases as size of girth increases. Use of gauges thinner than those suggested is likely to result in buckling.
16 to 20"	1-1 thru 1-4	301/304	.018	26	.788	
21 to 25"	1-1 thru 1-4	301/304	.025	24	1.050	
26 to 30"	1-1 thru 1-4	301/304	.031	22	1.313	
31 to 35"	1-1 thru 1-4	301/304	.0375	20	1.575	
over 35"	1-1 thru 1-4	301/304	.050	18	2.100	
Hanging — half round	1-3, 1-20	301/304	.015	28	.656	Specify cold-rolled to 65,000-80,000 psi yield strength. Where thickness exceeds .018", make trail lock seam to determine feasibility of cold-rolled temper.
Hanging — ogee	1-3	301/304	.015	28	.656	
Continuous Cleat	—	301/304	.015	28	.656	
Cover Plates	1-23	301/304	.015	28	.656	
Hangers	1-13 thru 1-20	301/304	.037	20	1.575	
Expansion Joints	1-5 thru 1-11	301/304	.015	28	.656	Space on 30" centers.
Roofing						
Batten Seam	6-7, 6-8, 6-9	304	.015	28	.656	.015" is suggested for 18" panel width; .018" is suggested for 24" width; and .021" is suggested for 30" width. 300 Series fasteners should be used. Attach with 2" x 3" stainless cleats. Pre-tin edges before folding.
Bermuda	6-2, 6-15, 6-16, 6-17	304	.015	28	.656	
Flat Seam	6-3	304	.015	28	.656	
Mansard	6-22	304	.015	28	.656	
Standing Seam	6-1, 6-4, 6-5, 6-6	304	.015	28	.656	
Industrial Panel (metal siding and roofing)	6-27	301/304, or 316				
Scuttles	8-6	304		28	.656	
Snow Guards	8-12	304		.109 dia. wire		

Table II
EXPANSION PROPERTIES OF BUILDING MATERIALS

MATERIAL	TYPICAL COEFFICIENTS OF EXPANSION IN INCH PER INCH PER °F	EXPANSION IN 64ths OF AN INCH PER 100° F TEMPERATURE RISE PER 10' LENGTH (APPROX.)
		1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
STAINLESS STEEL (300 Series)	.0000096	
110 SOFT COPPER	.0000094	
110 COLD ROLLED COPPER	.0000098	
TIN	.0000117	
ALUMINUM 3003	.0000129	
LEAD	.0000150	
ZINC, ROLLED	.0000174	
ZINC ALLOY (With grain)	.0000130	
ZINC ALLOY (Across grain)	.0000098	
MONEL	.0000078	
GALVANIZED STEEL	.0000067	
STEEL	.0000067	
LIMESTONE	.0000044	
GLASS	.0000047	
MARBLE	.0000056	
SLATE	.0000058	
BRICK	.0000031	
CONCRETE	.0000078	

Table III
COMPARABLE THICKNESSES AND WEIGHTS OF STAINLESS STEEL, ALUMINUM AND COPPER

STAINLESS STEEL			ALUMINUM			COPPER		
Thickness (Inch)	Gauge (U.S. Standard)	Lb. sq. ft.	Thickness (Inch)	Gauge (B&S)	Lb. sq. ft.	Thickness (Inch)	Oz. sq. ft.	Lb. sq. ft.
.010	32	.420	.010	30	.141	.0108	8	.500
.0125	30	.525	.0126	28	.177	.0121	9	.563
						.0135	10	.625
.0156	28	.656	.0156	—	.220	.0148	11	.688
			.0179	25	.253	.0175	13	.813
.0187	26	.788						
.0219	25	.919	.020	24	.282	.021	16	1.000
.025	24	1.050	.0253	22	.352			
						.027	20	1.250
.031	22	1.313	.0313	—	.441	.032	24	1.500
.0375	20	1.575	.032	20	.451	.0337	28	1.750
			.0403	18	.563	.0431	32	2.000
			.0453	17	.100			
.050	18	2.100	.0506	16	.126			

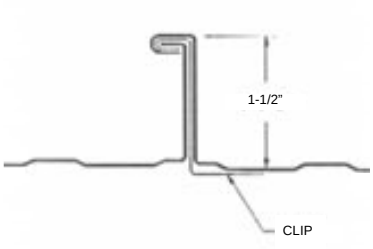
Note that U.S. Standard Gauge (stainless sheet) is not directly comparable with the B&S Gauge (aluminum). A 20-gauge stainless averages .0375" thick; while a 20-gauge aluminum averages .032" thick; and 20-ounce copper is .027" thick. The higher strength of stainless steel permits use of thinner gauges than required for aluminum or copper, which makes stainless more competitive with aluminum on a weight-to-coverage basis and provides stainless with a substantial weight saving compared to copper. For example, 100 sq. ft. of .032" aluminum will weigh about 45 pounds, .021" (16-ounce) copper will weigh about 100 pounds, and .015" stainless will weigh about 66 pounds.

STANDING SEAM ROOFING ...

Typical Designs

PANEL PROFILES AND CLIPS (ARCHITECTURAL)

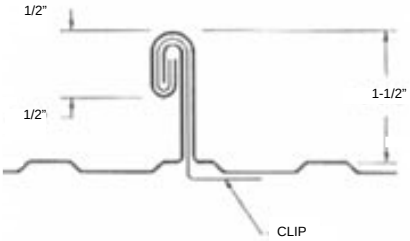
SINGLE INTERLOCK



POWER SEAMED, SINGLE STAGE, CLIPS REQUIRED

1. Requires hand or power seamer.
2. A very secure tight seam.
3. Panels should have a fixed point.
4. Thermal movement requires floating clips in longer panels.
5. Low slope with sealant in seams is recommended.

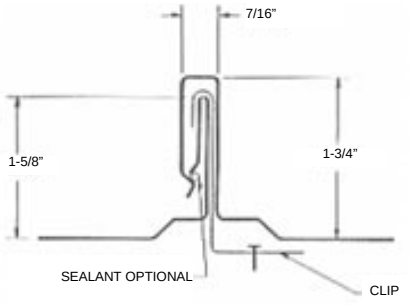
DOUBLE INTERLOCK



POWER SEAMED, DOUBLE STAGE, CLIPS REQUIRED

1. Requires hand or power seamer.
2. The most secure, tight seam of the architectural panels.
3. Panels should have a fixed point.
4. Thermal movement requires floating clips in longer panels.
5. The best seam for low slopes.

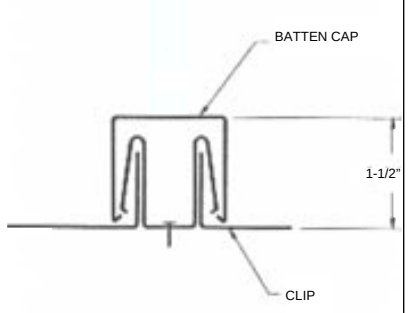
SNAP LOCK



SNAP SEAM, CLIPS REQUIRED

1. Seams snap together.
2. Panel seams and caps must be secured to prevent movement.
3. Seam is open to wind driven moisture, without sealants, plugs and closures.

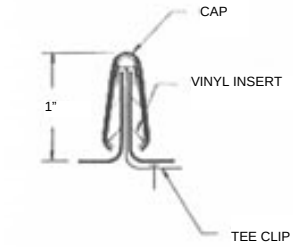
BATTEN CAP



BATTEN SEAM OR BATTEN CAP

1. Straight legs on panel uses a secured clip, to hold panel to substrate, it spaces panel for batten seam or cap, and holds the seam or cap.
2. Panel seams and caps must be secured to prevent movement.
3. Not recommended for low slopes (under 3:12 pitch).
4. Vinyl inserts or sealant in cap is recommended.

INTERLOCK



An ideal application for all types of 300 series fully annealed stainless steel, the standing seam design is used to cover slopes of 3 inches per foot or greater. Suggested thicknesses are: .015-inch, .019 & .024-inch. Pan lengths vary, although pans up to 100 feet long can be formed at the site when portable roll-forming equipment is available.

See manufacturers recomended flashing and panel details.

Continuous, electric resistance-welded standing seam roofs are watertight at any slope. However, this joining method, which also can be applied to flat roofs, requires special portable forming and welding units.

NOTE: CHECK WITH MANUFACTURER FOR SLOPE RECOMMENDATIONS, WIND INFILTRATION AND WATER PENETRATION REQUIREMENTS.

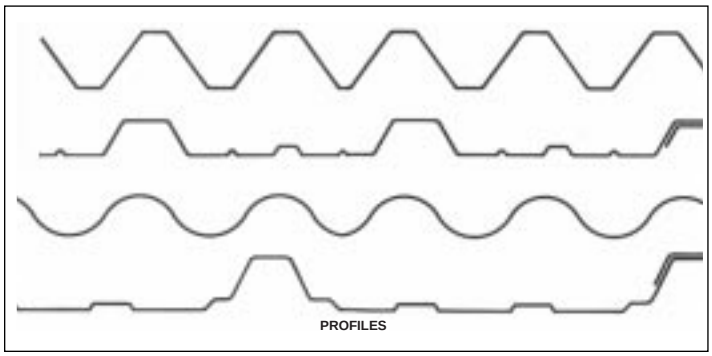
INDUSTRIAL ROOFING PANELS ...

Typical Designs

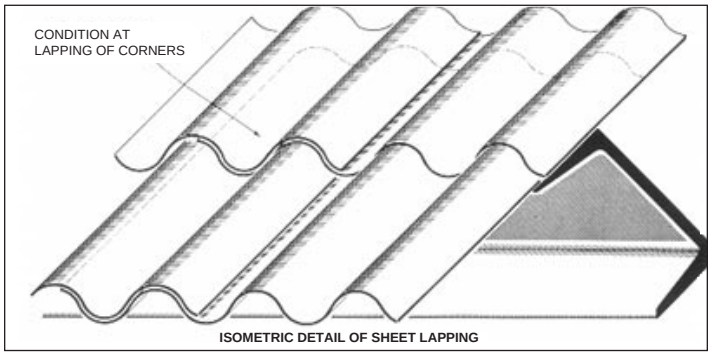
Used as load bearing roofs or siding, industrial panels are usually fabricated from Type 301 or 304 stainless steels. For more severe corrosive atmospheres Type 316 is generally specified.

Mechanically joined with stainless steel fasteners, industrial panels can be designed in a number of ribbed or corrugated profiles in widths up to 36 inches and in lengths up to 42 feet.

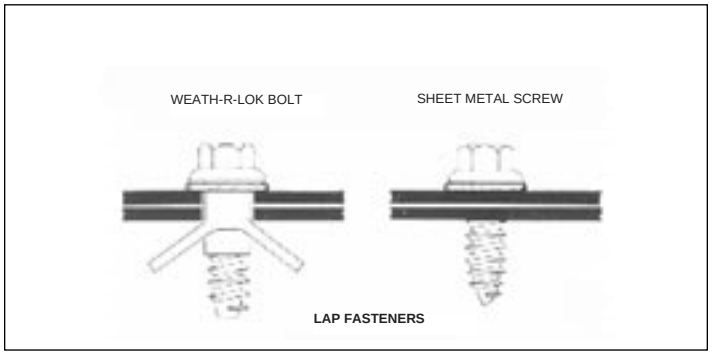
Because their rigidity and strength is increased by cold working, particularly in Type 301, stainless steel panels can be used on roofs with no underlying deck. A ridge cap of formed stainless steel sheet combines with rubber or vinyl closures to make the roof weather-tight. Stainless steel panels backed with insulated sandwich panels also are available and manufacturers of such products should be consulted for design and loading details. See manufacturers recommended details for panels and flashings.



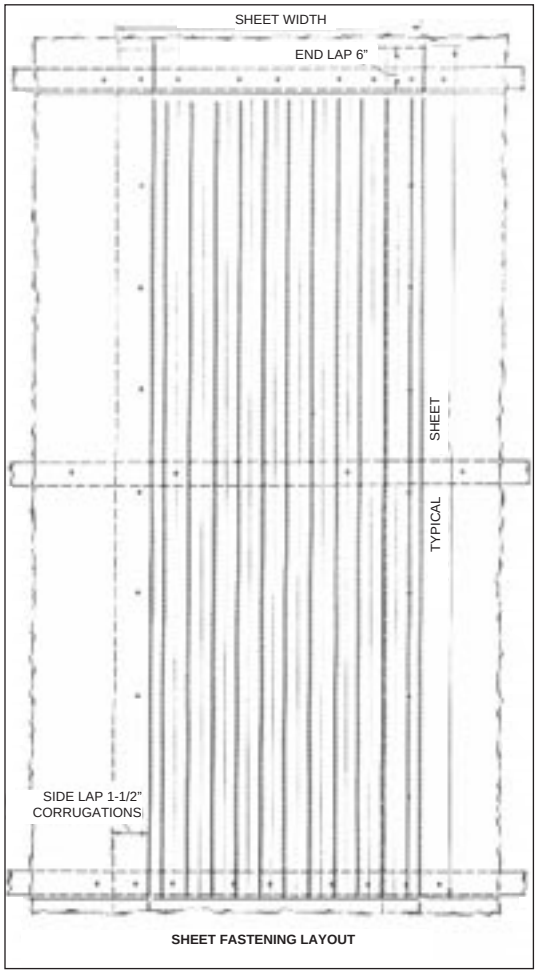
PROFILES



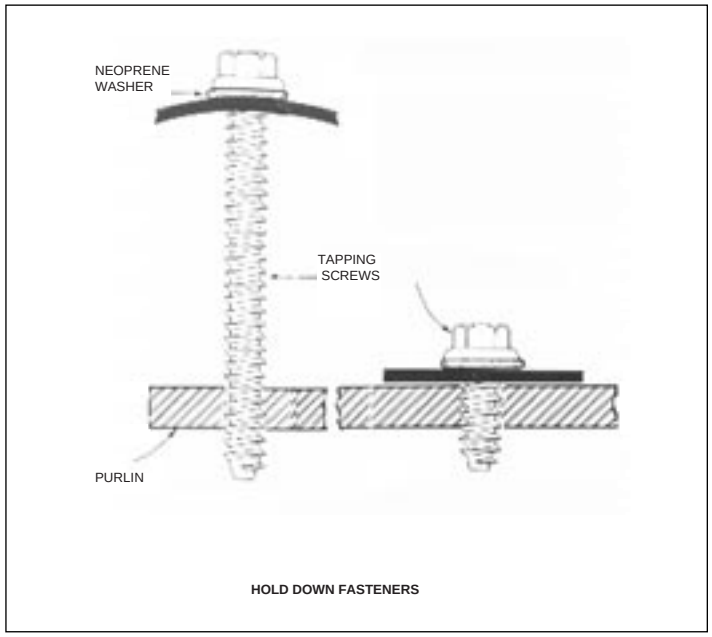
ISOMETRIC DETAIL OF SHEET LAPPING



LAP FASTENERS



SHEET FASTENING LAYOUT



HOLD DOWN FASTENERS

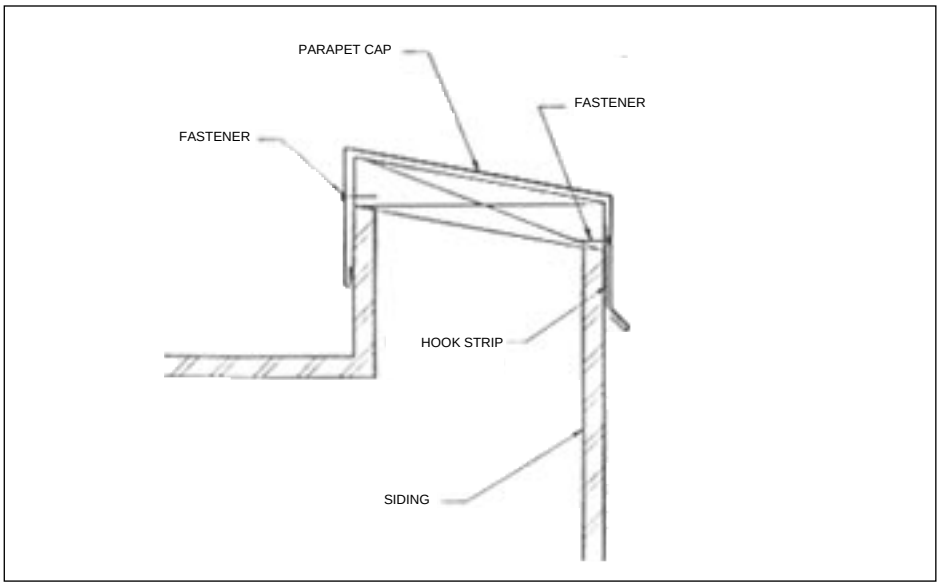
COPINGS ...

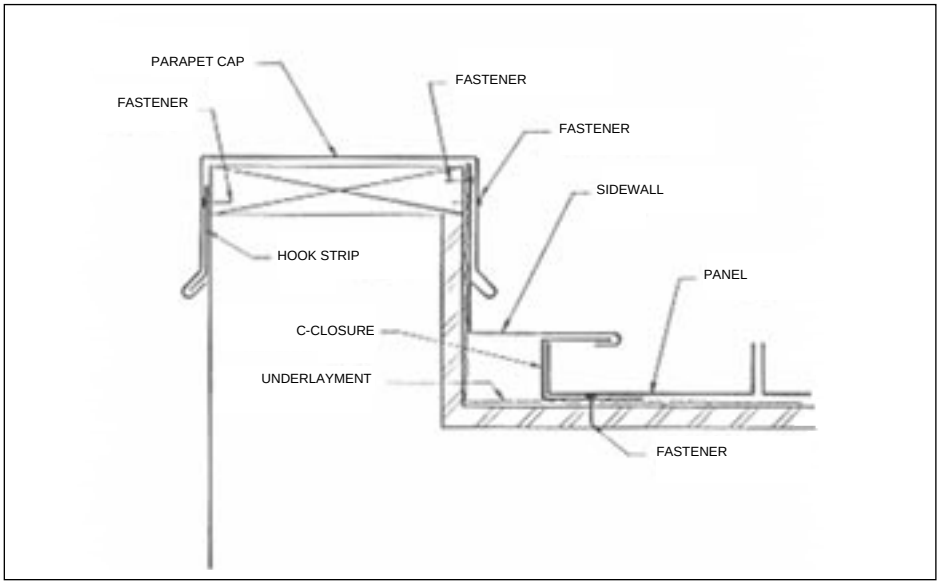
Typical Designs

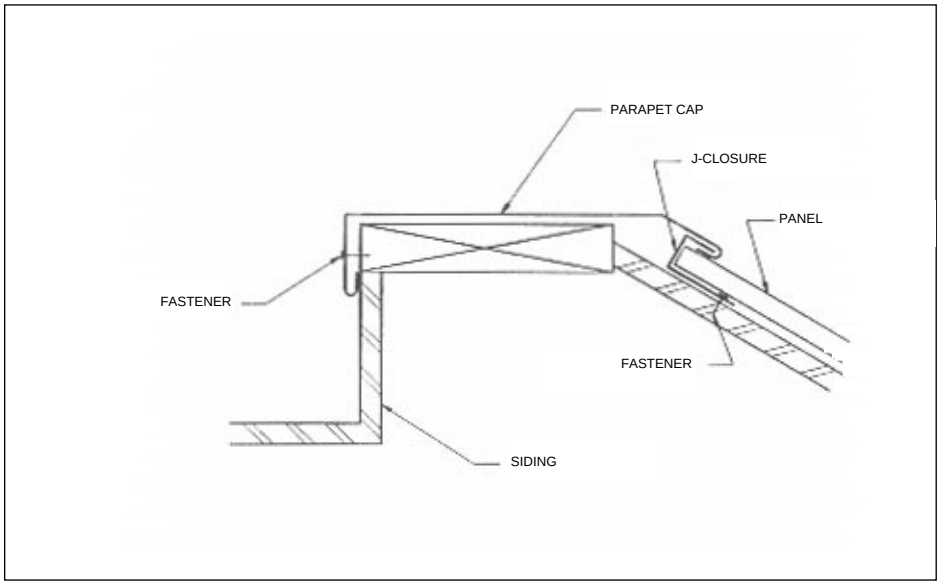
A typical parapet cap or coping formed by sheet metal fabricators is shown here. Some authorities recommend use of building paper or other protection on a wood cap plate. The front edge of the coping is secured to a continuous stainless steel edge strip, minimum thickness .025-inch, or the same gauge as the coping. The inner edge of the coping is secured to an edge strip, or to a counter flashing, which may serve as an edge strip, as shown.

Since the coping also acts as the building edge trim, selection of gauge and finish is important. (See discussion of flatness).

Coping is assembled in 8-, 10-, or 12-foot lengths with lapped, covered or backed-up joints. If a backed-up joint is used, a 12-inch wide back-up plate is recommended and caulking should be used.







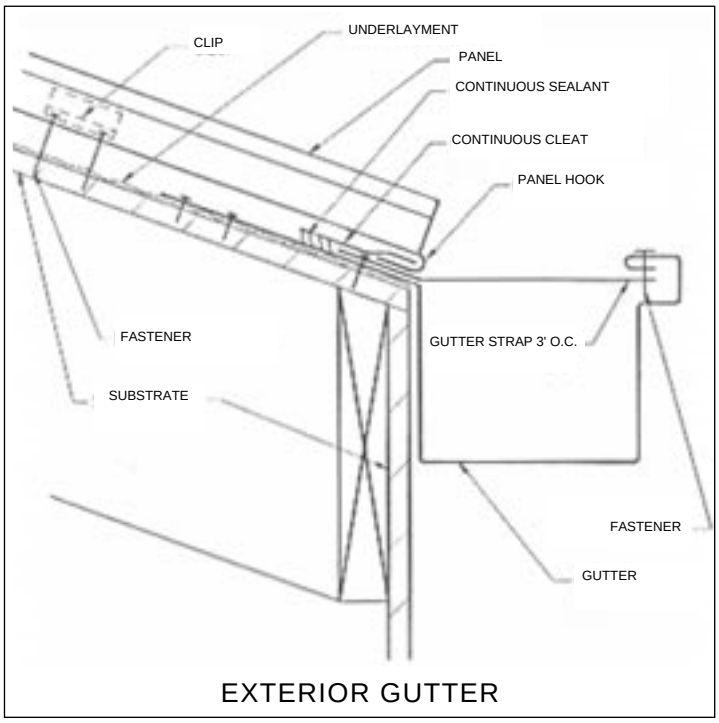
ROOF DRAINAGE ...

Typical Designs

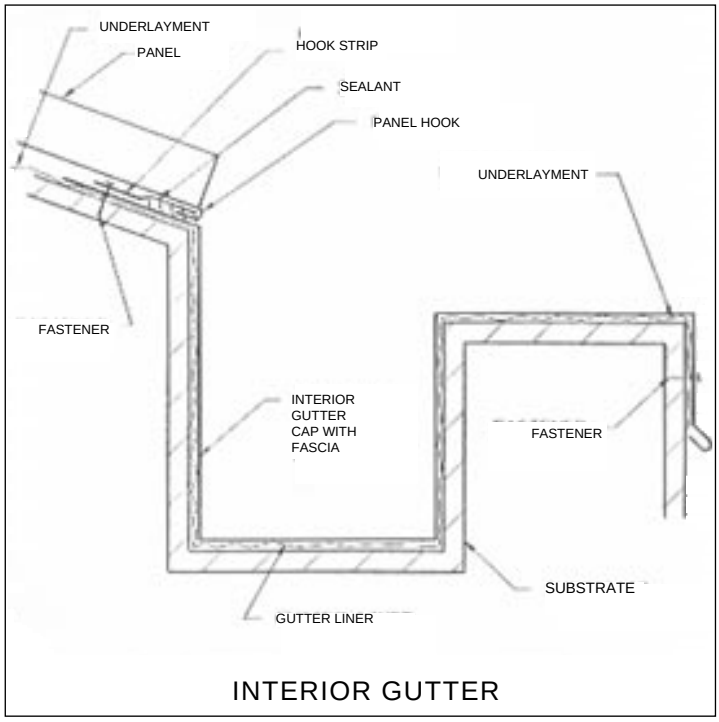
Intended to carry water from a roof, standard gutter and downspout shapes above are available, and special shapes can be custom brake formed. Related hardware is also available in stainless steel. Joints in gutter should be lapped one inch minimum, welded or rivited 2 inches on center and soldered. Joint sealants may also be used. Hangers of .037-inch thickness should be spaced 30 inches on center, and expansion joints using stamped prefabricated gutter configurations with stainless steel flanges should be at 30-foot intervals.

The allowance for expansion ranges from $^{1}/_{4}$- to $^{13}/_{16}$-inch for 30-foot lengths of gutter and from $^{1}/_{4}$ to $1^{3}/_{8}$ inches for 60-foot lengths. Width of the cap for the expansion joint is 2 inches for 30-foot lengths, and $3^{1}/_{4}$ inches for 60-foot lengths.

Type 301 or 304, stainless steel is suitable. Minimum thickness of gutters, leaders, downspouts and elbows is .015-inch.



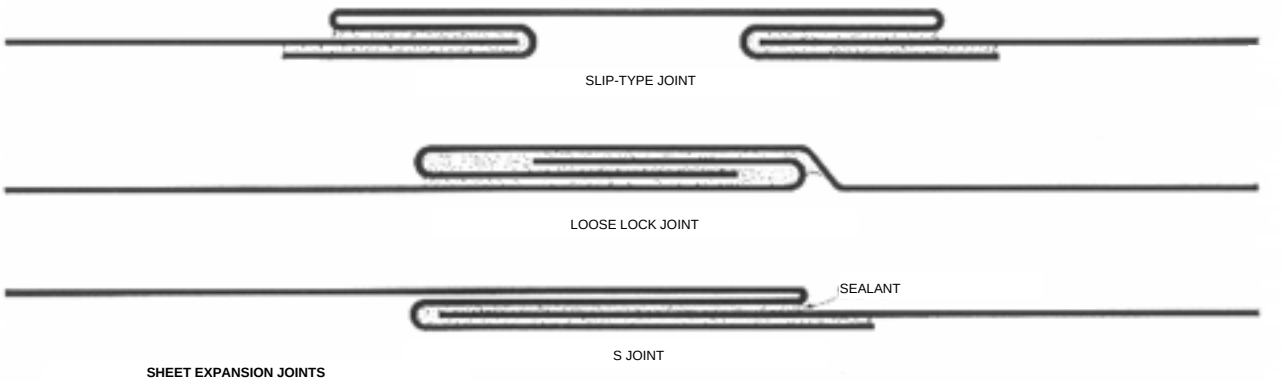
EXTERIOR GUTTER



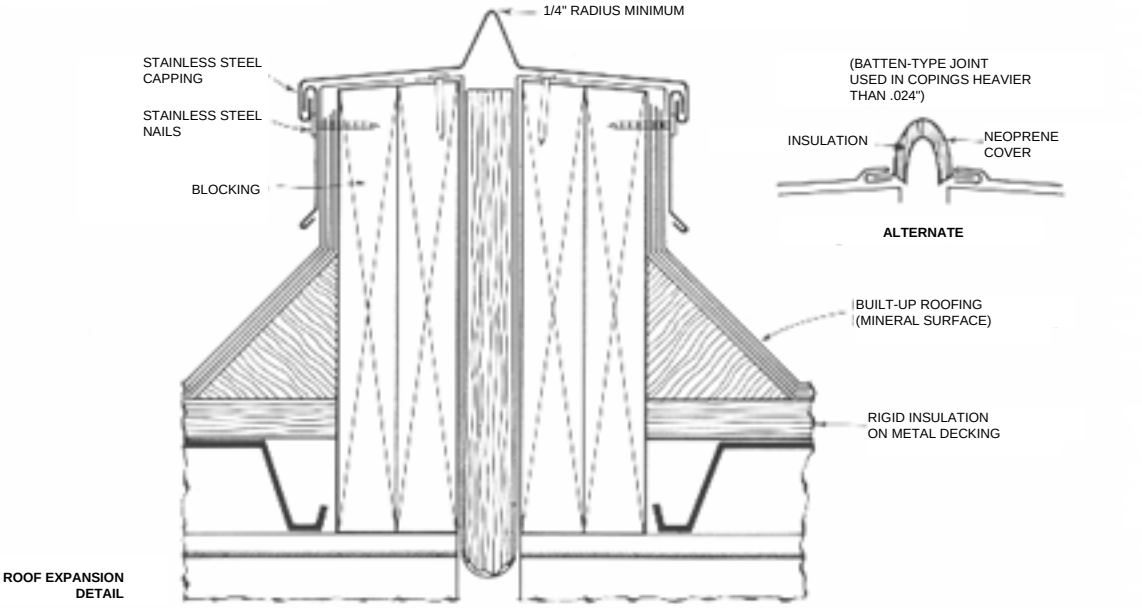
INTERIOR GUTTER

EXPANSION JOINTS ...

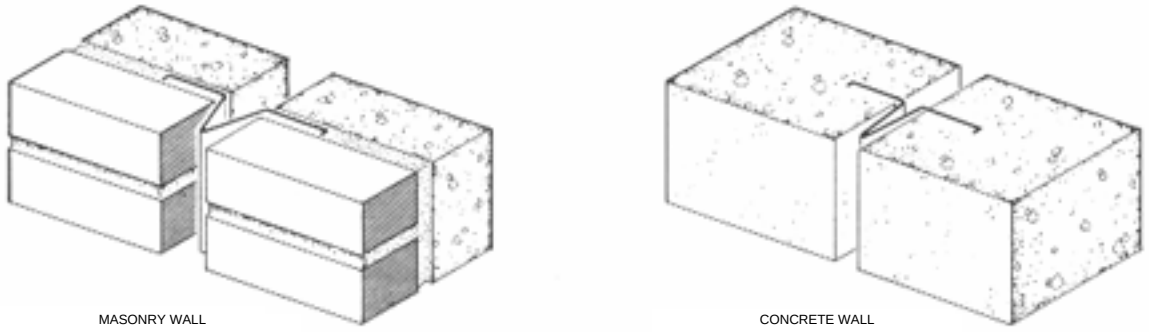
Typical Designs



SHEET EXPANSION JOINTS



ROOF EXPANSION DETAIL



WALL EXPANSION DETAILS

Expansion joints are used: (1) To accommodate movement in stainless steel sheets; (2) To flash building expansion joints which accommodate thermal movement of building.

(1) Expansion joints of the types shown are set into stainless steel roofing and flashing at intervals from 24 to 40 feet (see application details), unless expansion is otherwise accommodated in seams or by use of crimped or deformed stainless sheet.

(2) Building expansion joints themselves should be flashed with stainless steel to prevent moisture penetration.

Typical applications in a roof and vertical walls are shown.

Prefabricated expansion joint systems, some featuring neoprene and stainless in combination, are available.

Manufacturers' literature should be consulted for details.

Type 304, fully annealed stainless steel is recommended, with a minimum thickness of .015-inch.