Identifying the differences

Metric-sized ply sheets impact conventional application and analysis methods

by **Dave Flickinger** and **Mark S. Graham**

Ply sheets, the primary reinforcement in bituminous built-up roof (BUR) systems, also commonly are used as secondary reinforcement in hybrid roof systems using polymer-modified bitumen membranes. For almost a century, the size of ply sheets has remained unchanged.

Conventional ply sheet rolls, whose dimensions are based on English measurements, are 36 inches (914 mm) wide and 180 feet (54 m) long. But now, meter-wide ply sheet rolls are available from several U.S. manufacturers and are 39⅜ inches (1 m) wide and 161.8 to 165 feet (48.5 to 49.5 m) long. The coverage of a meter-wide ply-sheet roll is the same as that of a conventional one—about 5 squares (45 m^2). The shorter roll length of the metric ply sheet compensates for its additional width.

Why metric?

The metric system is referred to as the System of International Units (SI). The Metric Conversion Act was passed by the U.S. Congress in 1975 and stipulated that the country eventually would switch to the metric system, though no timetable was given. The law set the stage for further legislation—in 1988, the Omnibus Trade and Competitiveness Act required federal agencies to use the SI system in their procurements and designated it as the preferred system for U.S. trade and commerce.

As a result, many U.S. federal agencies use the SI system when developing specifications and procuring bids for federal construction projects. These projects typically require contractors to develop and submit bids in metric units.

Meter-wide felts

NRCA is aware of three U.S. manufacturers that produce metric-sized, fiberglass ply sheets: GAF Materials Corp., Wayne, N.J.; Intec/Permaglass, Port Arthur, Texas; and Malarkey Roofing Co., Portland, Ore. Although the materials used to manufacture meter-wide and conventional ply sheets reportedly are the same, there are some notable physical differences that should be understood by those specifying and installing metric-sized ply sheets.

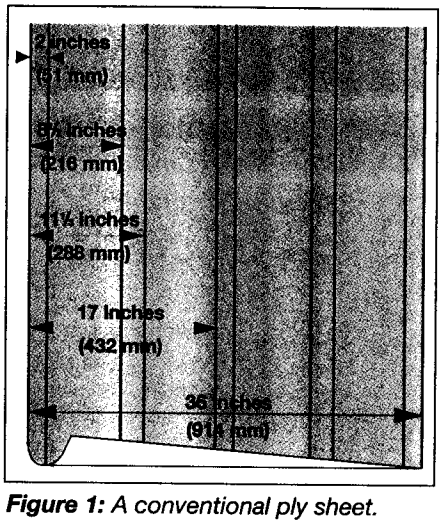


Figure 1: *A conventional ply sheet.*

At first glance, the only apparent difference between conventional and metric-sized ply sheets is width. However, the change in width affects application equipment, lay-line spacing, headlap and size of starter plies.

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Potential advantages during the manufacture of metric-sized ply sheets include increased production rates and reduced material handling and shipping costs. Producing a ply sheet that is 39⅜ inches (1 m) wide represents about a 9 percent increase in production (in terms of total squares) compared with conventional ply-sheet production. The finished roll size, when placed on end, is taller than a conventional roll but has a smaller diameter. Subsequently, more rolls can fit on a single pallet, and fewer pallets of material may be required for a given project.

Application equipment

Installers of metric ply sheets who intend to use mechanical application equipment need to use felt layers

that accommodate the additional roll width of 3⅜ inches (86 mm). Some felt layers can adjust and accept both 36- and 39⅜-inch (914-mm and 1-m) roll widths.

Another concern for applicators is the use of bitumen dispensers. Bitumen dispensers designed for use with conventional felts may not provide the necessary bitumen coverage along the edges of meter-wide ply sheets. This can result in dry felt laps because of voids in bitumen coverage.

Ply-line locations

Ply lines (i.e., lay lines) are markings made by a manufacturer parallel to a sheet's long dimension. Depending on the specified number of plies, the lay lines' locations determine each ply sheet's exposure in the bituminous membrane construction. An applicator uses lay lines as guides for setting each new roll when constructing a bituminous membrane.

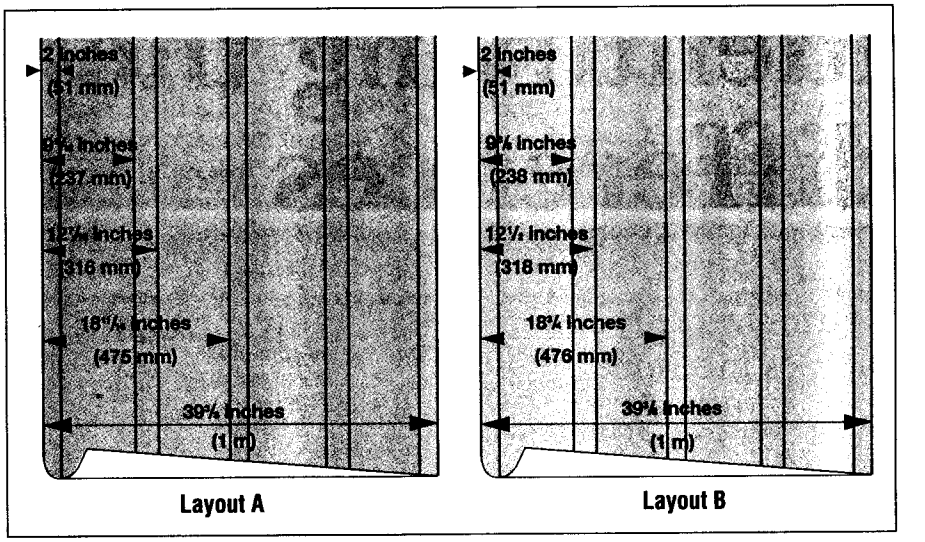


Figure 2: *Metric-sized ply sheets.*

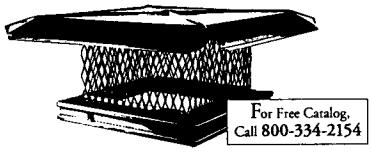
Typically, ply sheets are marked with one, two, three and four ply lines. For conventional ply sheets, ply-line locations are as follows: 36 inches (914 mm) - 2 inches (51 mm) for headlap = 34 inches (864 mm). This then is divided by the one-, two-, three- and four-ply configurations and results in ply lines at 2, 8½, 11⅓ and 17 inches (51, 216, 288 and 432 mm) (see Figure 1). Eight lines are marked (four lines, marked from both edges toward the sheet's center line) to allow applicators to align and set a roll from either side.

It should be noted that the line 2 inches (51 mm) from the edge of the ply sheet marks the one-ply lay line and does not represent a headlap dimension.

Metric ply lines

Determining ply-line spacings for metric-sized ply sheets is more complicated. The ply sheets are manufactured to a common SI unit width (1 m

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Membrane analysis standards

The American Society for Testing and Materials (ASTM) provides two applicable standards for membrane analysis of built-up roof (BUR) systems: ASTM D 2829, "Standard Practice for Sampling and Analysis of Built-Up Roofs," and ASTM D 3617, "Standard Practice for Sampling and Analysis of New Built-Up Roof Membranes."

ASTM D 2829 is used to analyze existing BUR membranes and ASTM D 3617 to analyze new BUR membranes. However, these methods are based on conventionally sized ply sheets and do not adequately address the use of meter-wide felts.

As a result, there is a likelihood of erroneous interpretation of interply mopping weights, ply exposures and headlap distances if analysis of the test cut samples does not identify the use of meter-wide felts in a BUR membrane. Roofing professionals need to be aware that, without modification, these industry-accepted standards may not apply in the analysis of BUR membranes constructed with metric-sized ply sheets.

[39⅜ inches]), but lay-line locations are reported by manufacturers in English units. The conversion is necessary because contractors commonly use English measurement units in estimating and bid development, as well as in application practices.

The conversion process requires some rounding of lay-line spacings to report measurements in usable increments (i.e., ½, ¼, ⅛ and 1/16 of an inch), such as those found on tape measures.

The issue is complicated further because manufacturers do not agree on ply-line locations. Manufacturers of meter-wide felts report two different layouts for ply-line locations (see Figure 2). NRCA recommends that manufacturers of metric-sized ply sheets develop consistent specifications for the manufacture of meter-wide ply sheets.

Headlap dimensions

The NRCA Roofing and Waterproofing Manual, Fourth Edition, defines headlap as "the distance of overlap measured from the uppermost ply or course to the point that it laps over the undermost ply or course." Maintaining headlap during application is necessary to prevent "dropping" plies in a multilayer assembly (i.e., failing to install all the specified plies because of ply misalignment or incorrect exposures).

Membrane analysis standards do not adequately address the use of meter-wide felts.

A 1-inch (25-mm) headlap generally is accepted by roofing professionals as the absolute minimum distance of overlap. The Asphalt Roofing Manufacturers Association/NRCA document, *Quality Control in the Application of Built-Up Roofing,* provides headlap criteria as, "Headlap: as specified, less 1 inch (25 mm) but with a 1-inch (25-mm) minimum. (No maximum limit.)"

Historically, an overall headlap dimension of 2 inches (51 mm) has been incorporated into ply-line spacings. A 2-inch (51-mm) headlap is intended to provide for tolerances in manufacturing and application processes while maintaining a minimum headlap of 1 inch (25 mm). Because of different methods in determining lay lines, manufacturers' headlap dimensions vary.

For instance, one manufacturer uses a consistent headlap of 1⅞ inches (48 mm) for all ply configurations; this is a reduction from the traditional 2-inch (51-mm) headlap width. Other manufacturers use a 2-inch (51-mm) headlap in two-ply configurations and then increase headlap to 2 1/16 inches (52 mm) and 2⅛ inches (54 mm) in three- and four-ply configurations, respectively.

Application tolerances

Reducing a headlap's dimension (width) represents an overall reduction in acceptable application tolerances. These tolerances are important and necessary in controlling a product's quality or application. Because a

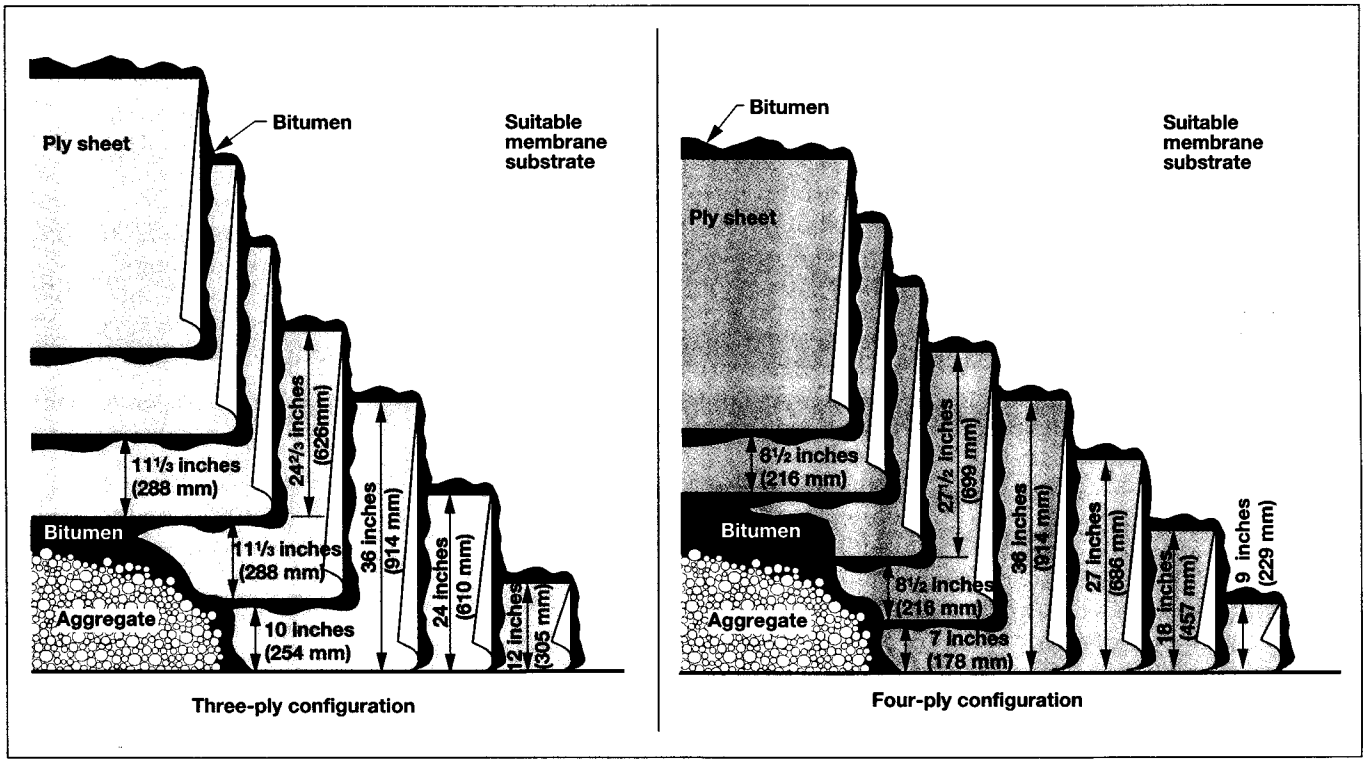


Figure 3: *Exposure and starter-ply dimensions for conventionally sized ply sheets.*

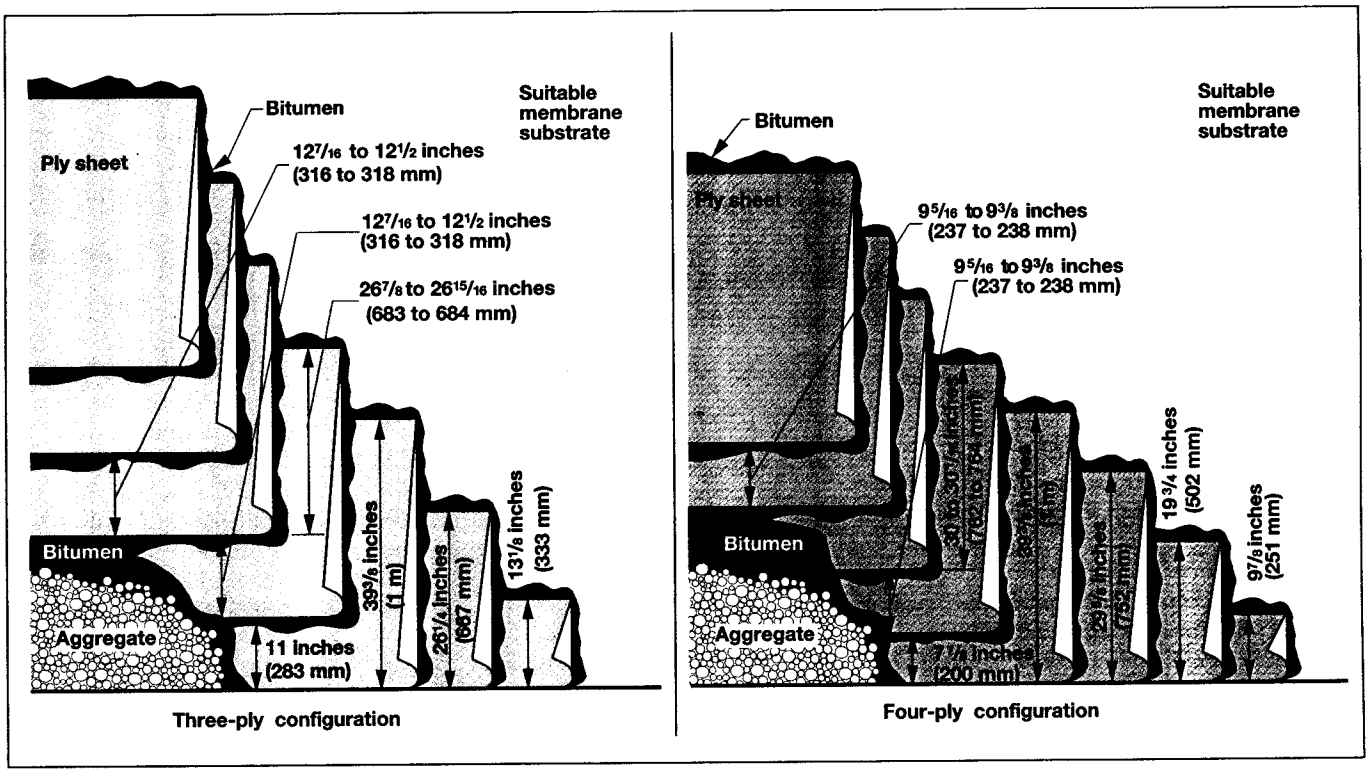


Figure 4: *Exposure and starter-ply dimensions for metric-sized ply sheets.*

BUR membrane is constructed in the field, it requires reasonable tolerances for exposures during the application process. Setting rolls to begin new courses, setting new rolls within the same course, and cutting and re-setting rolls at penetrations will cause variances in alignment and exposures.

Tolerances also are necessary in the manufacture of ply sheets. Some manufacturers report variances in the application of the lay line of as much as plus or minus ¼ of an inch (6 mm). Because of variances in the manufacture and application of ply sheets, proper industry-accepted allowances for these variances are necessary.

Starter sheets

Starter sheets are used as the first courses of a BUR membrane and are cut to size in the field by the applicator. Three starter plies are required for four-ply configurations, two for three-ply configurations and one for two-ply configurations. Correctly measuring and cutting the starter plies is crucial in maintaining headlap during the early courses of a BUR membrane.

As with conventionally sized felts, there are two methods for determining size and installing starter plies. One method involves using starter plies with widths less than the widths of the required exposure(s) and 2-inch (51-mm) headlaps, where the second full-width ply sheet installed is offset at a lesser exposure to compensate for the starter-ply width. This method is shown in *The NRCA Roofing and Waterproofing Manual, Fourth Edition* (see Figure 3).

This procedure minimizes material waste because one sheet width can produce two starter plies. In four-ply configurations, the first and third starter sheets are cut from one sheet width; in three-ply configurations, both starter sheets are cut from one sheet width. After starter sheets are installed, the second full-width ply sheet is offset to a lesser exposure in three- and four-ply configurations. Figure 4 can be used by roofing professionals to determine the appropriate dimensions for meter-wide felt installation, including starter-sheet widths and exposures for three- and four-ply configurations.

A second, less common method is cutting a starter ply to a width equal to the required exposure(s) plus 2 inches (51 mm) for headlap. Offsetting the second full-width sheet is not required because the starter-ply widths correspond to the full-width sheets' exposures and maintain a headlap of 2 inches (51 mm); however, this method results in more material waste.

In summary

Although metric-sized roll goods are not new to the industry, it is important roofing professionals realize the use of these materials may require modification of common work practices in specifying, installing and analyzing them. PR

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