

*Underlayments are our business* **Tarco**



**Rethinking  
Roofing  
Underlayments**



**LeakBARRIER**

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# Rethinking Roofing Underlayment

## Part One: Traditional, specialty, and synthetics

As the number of roofing underlayment products in the market grows, roofing contractors are becoming more discerning in their choices for various applications. Contractors today can pick from a vast array of underlayment products, encompassing three major categories: Traditional, specialty and synthetics.



*(Left to right) Traditional asphalt saturated roll roofing, hybrid specialty underlayment, synthetic underlayment*

Part One of this paper aims to place into perspective the various types of underlayments.

Never before have so many choices been available. To choose the best underlayment for a particular application, contractors must first decide which product category best suits the application and then examine the fine differences between specialized products within that category.

Underlayment product selection is influenced by many factors including primary roof covering, substrate type, roof design criteria, building codes, material cost, labor cost, life cycle expectations, walkability, exposure rating, warranties, climate and customer preference, to name a few. A thorough understanding of the advantages and disadvantages of specific products in each of the major categories will lead to the right choice of underlayment for any given application.

Part One of this paper aims to place into perspective the various types of underlayments. It begins with an historical perspective of traditional asphalt-saturated organic felt. The entries of alternatives into the residential roofing industry are then examined from a marketing perspective, including premium self-adhering and synthetic underlayment products. The factors which allowed for the successful introduction of these new product categories into the residential roofing market are then briefly explored. The development and use of premium, modified bituminous self-adhering underlayment is then examined in greater detail. Finally, an overview of synthetics is given and the role of synthetics in present day roofing is discussed.

Part Two will describe the materials and manufacturing processes associated with the three categories of underlayments with special emphasis on synthetic underlayment products. Part Three will evaluate the features and benefits of the various types of underlayments with respect to specific applications.

Tarco offers underlayment products in each of the three broad categories. When it comes to underlayment selection, the needs of our customers come first. Furthermore, underlayments are our primary business so the company is able to share an in-depth knowledge about underlayment selection and installation.

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## **The industry standard — An historical perspective**

The earliest type of underlayment is asphalt-saturated organic felt, also known as felt paper or tar paper. As asphalt shingles were developed for roofing, felt paper was used as an underlayment, serving a dual purpose: it prevented wood sap from being soaked into shingles and dissolving the asphalt; and it also shed water from under shingles, thereby protecting the deck from damage from moisture.

Industry specifications for organic felt as well as bitumen were needed primarily because sources of the bitumen and other materials as well as the manufacturing methods varied widely and affected the quality of the asphalt saturated organic felts. Standardization evolved over several years so that today the quality of these types of felts is tightly controlled by industry standards. Examples of standards include the American Society for Testing and Materials (ASTM) “Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing” (ASTM D226 / D226M [www.astm.org/Standards/D226.htm](http://www.astm.org/Standards/D226.htm)); and “Standard Specification for Asphalt-Saturated Organic Felt Underlayment Used in Steep Slope Roofing” (ASTM D4869 / D4869M, [www.astm.org/Standards/D4869.htm](http://www.astm.org/Standards/D4869.htm)); as well as test methods relating to asphalt physical- and chemical-properties characterization and properties of dry felts. These standards, test methods and specifications apply specifically to asphalt saturated organic felt, with the intended purpose of ensuring consistency in product quality. While it is reassuring to know that the “tear strength” of a synthetic material far exceeds the minimum requirement for asphalt felts, it is not meaningful to claim a synthetic felt “meets the standard” for one particular property mentioned in a standard that applies to asphalt felts. The standards developed for asphalt saturated felts were not intended for non-asphalt based underlayments. Separate standards have been developed for other types of roofing underlayment.

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## **Market dynamics in the new millenium**

For more than a century, asphalt-saturated organic felts went unchallenged in residential roofing as the underlayment material for use beneath asphalt shingles and other types of primary roof coverings. Yet within the past twenty-five or so years, two completely new categories of roofing underlayments entered the steep-slope roofing marketplace, namely, modified bitumen and synthetics. Although traditional asphalt-saturated felt has long been the mainstay of residential roofing, strong forces have been at work in the underlayment marketplace in the past fifteen years. Traditional asphalt saturated felt has its drawbacks and weaknesses, primarily the following:

- ◆ It does not perform well as a secondary water barrier
- ◆ It tears easily

- It is prone to degradation from UV (ultra-violet) exposure and therefore cannot be left exposed for long periods after installation

Additional industry- and economic-drivers favoring the introduction of new underlayment categories are as follows.

### Storm damage

Severe storm seasons affected the underlayment marketplace in more ways than one. The extreme hurricane activity along the coastal states in the middle of the last decade created a demand for labor as well as a shortage in primary roofing materials such as tiles and shingles in some markets. Cases were recorded of roofing contractors waiting weeks or months for delivery of primary roof materials. As a result, underlayments were left exposed for as long as six months and, in some cases, traditional felt material had to be torn off and new felt installed. Asphalt saturated felts do not perform well when left exposed for long periods of time. Exposure limits came into focus as an important benefit of alternatives to traditional felt.

New construction and a better understanding of ventilation allowed for the installation of residential roofs with a water-tight secondary water barrier.



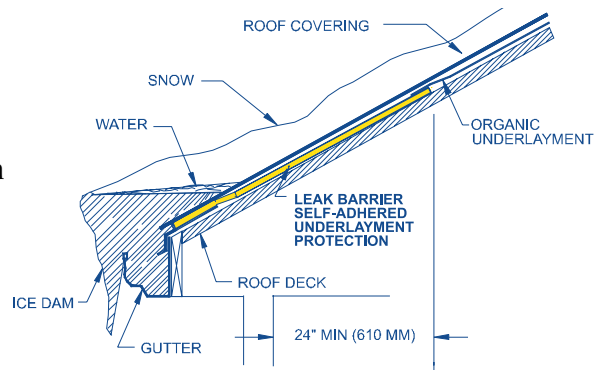
*Widespread, severe storm damage and subsequent labor shortages brought exposure limits into focus.*

### Better home designs

New construction and a better understanding of ventilation allowed for the installation of residential roofs with a water-tight secondary water barrier. Much new construction occurred in Southern regions where air-conditioning is more common than heating. These new home designs with modern roof venting systems favor alternative underlayment materials, including premium self-adhering underlayments as well as synthetic underlayments.

### Ice damming

For Northern climates, protection against ice dams was addressed through the use of extra protection along the eaves. This extra protection was mandated in various building codes such as the International Building Code (IBC) and the International Residential Code (IRC).



*Ice damming*

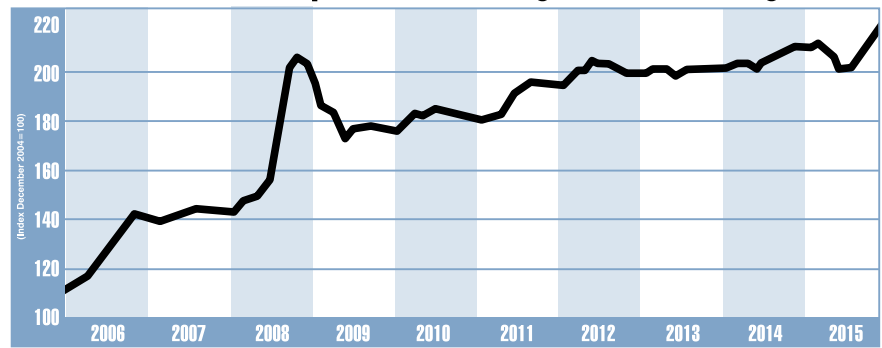
### 💧 Consequential damage

After natural calamities such as the numerous hurricanes that wreaked havoc in Florida in the early 2000s, insurance companies began to encourage the use of secondary water barriers. The extra cost of the secondary water barrier more than offsets potential losses from consequential damages.

### 💧 Asphalt prices

As energy prices rose, oil refiners developed new, cost-effective ways to crack the heavier organic molecules found in crude oil to produce gasoline. This dramatically affected the supply of asphalt and resulted in sharp increases in asphalt prices. This new technology continues to place severe pricing pressure on asphalt, making synthetic underlayment, which does not contain asphalt, cost effective compared to asphalt-saturated felt. It should be noted, however, that similar macro-economic conditions also contributed to a spike in the prices of the polymers used in synthetics.

**Producer Price Index: Asphalt and Tar Paving Mixtures Including Bitumen**



**Historical asphalt pricing**

All of the above factors played a role in increasing the awareness of alternatives to traditional felt paper. Despite the bubble burst in the housing market and the subsequent economic recession, premium self-adhering underlayment and synthetics have succeeded in gaining a secure foothold in the underlayment marketplace. In some areas and in certain applications, double-digit growth per annum was reported for these new product categories. Yet asphalt-saturated organic felts remain the workhorse for many steep sloped applications, enjoying a lion's share of the market in residential roofing.

It is recognized that the quality and type of underlayment can influence the outcome of a roof installation as much as the choice of primary roof.

### Alternatives gain respect

It is recognized that the quality and type of underlayment can influence the outcome of a roof installation as much as the choice of primary roof. Labor savings coupled with superior performance encourages contractors to offer underlayment alternatives to customers as a standard feature, rather than an upgrade from traditional felts, especially for tile and metal roof applications. The superior dry-in benefits and UV resistance of premium underlayment gives contractors increased flexibility in scheduling installation of primary roof coverings. The secondary water barrier provides extra protection when the primary roof fails for whatever reason.

The basic construction of traditional, self-adhering and synthetic underlayment is examined in greater detail in the remainder of this paper. Many products have been introduced over the last twenty or so years, including specialty products designed for specific roof type applications and climatic conditions.

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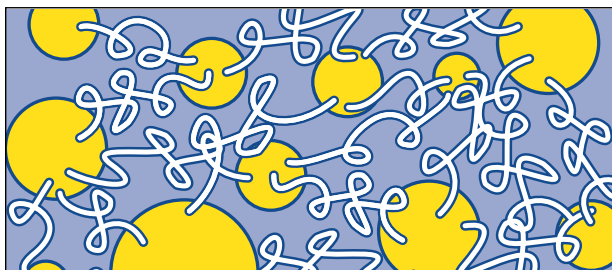
## Specialty underlayments

The emergence of specialty underlayment for residential roofing applications developed over many years. Various modified bitumens were developed in Europe in the 1960s and were eventually manufactured in the US in the 1980s. For more information on the early history of modified bitumens, see the article titled “History and development of modified bitumen” by Ray Johnson (8th Conference on Roofing Technology, NRCA, National Roofing Contractors Association, 1987, pp. 81-84, available online at <http://docserver.nrca.net/technical/464.pdf>).

Initially, modified bitumen membranes were intended for commercial roofing systems but, by the turn of the century, premium underlayment products made from modified bitumen were offered to residential roofing contractors. Tarco launched a comprehensive line of LeakBarrier® branded premium self-adhering underlayments in 2001 and has experienced double-digit growth for many years. Contractors appreciated the labor savings, longer exposure limits and durability of these products. Special underlayment products were developed for use under shingles, metal and tiles. An overview of such underlayment products for the residential market can be found in the article titled “Underlayment Combinations for Stormy Weather,” by Steve Ratcliff, which appeared in the November 2010 issue of *RCI Interface* magazine (Download from here: [www.tarcoroofing.com/images/pdf/RatcliffNov10.pdf](http://www.tarcoroofing.com/images/pdf/RatcliffNov10.pdf)).

As roofers became familiar with premium underlayments, the idea of a secondary water barrier became increasingly popular. This idea was elaborated in an article “Keeping the Water Out: Self-adhering underlayment can serve as a secondary water barrier” by Steve Ratcliff, which appeared in *Professional Roofing* magazine, in February 2009 ([www.professionalroofing.net/article.aspx?id=1438](http://www.professionalroofing.net/article.aspx?id=1438)). For that article, Florida roofing contractors were interviewed regarding their experiences using self-adhering underlayment as a secondary water barrier and a case was made for using self-adhering underlayment in this manner, nationwide.

Premium underlayment is typically made from specialized formulations of modified bitumen. These are usually blends of asphalt and polymeric modifiers such as styrene-butadiene-styrene (SBS) or atactic polypropylene (APP) as well as stabilizers such as limestone, talc and other materials. These blends primarily consist of asphalt but the polymer forms a sort of molecular fishnet that limits the flow of the asphalt and shapes the form of the membrane.



**Blend of SBS and asphalt**

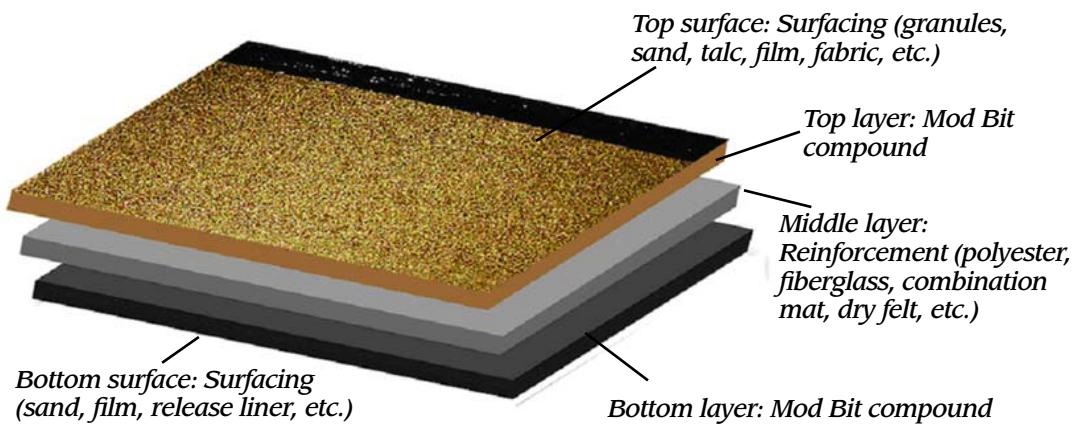
As roofers became familiar with premium underlayments, the idea of a secondary water barrier became increasingly popular.

For residential roofing, Tarco developed no less than twelve types of premium underlayment products for various applications as outlined in its quick reference product guide (which is available for download here: <http://www.tarcoroofing.com/images/pdf/QRProductGuide2015rev4-15.pdf>). This new category of underlayment is now well established among residential roofing contractors.

Premium underlayment products are especially attractive to contractors who install metal roofing, tile roofing and premium asphalt shingles (also known as designer or architectural shingles). For these roofing systems, there is an expectation that the primary roof would last for many decades. Given the UV protection afforded by the primary roof, the life expectancy of the modified bitumen underlayment is quite long. These underlayment products are analogous to modified bitumen membranes used in commercial roofing and are typically made with fiberglass or polyester reinforcement. In the case of metal roofing, the modified bitumen compound is formulated to withstand high temperatures.

A number of case studies of particular tile, metal and shingle applications can be found in the Case Study section at the Tarco website ([www.tarcoroofing.com](http://www.tarcoroofing.com)). Premium self-adhering underlayment products offer many advantages. Most allow for relatively long exposure times and they also self-seal around fasteners. Additionally, these products do not suffer from the wicking of moisture through nail holes. When a fastener is driven through the modified bitumen layer, the material flows around the nail, adheres to it and fully seals the membrane.

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**A typical specialty underlayment**

Between the quality level of the traditional asphalt-saturated organic felt and that of premium modified bitumen underlayment, there is room for a mid-grade material in the form of synthetic underlayment. It is noteworthy that the “synthetic underlayment” product category is capturing market share from conventional felt as well as the premium self-adhering underlayments.

## Understanding synthetic underlayment

The most recent wave of products to make a splash in the roofing marketplace are “synthetic underlayments.” These thin sheets of plastic can be used beneath shingle, tile or metal, where their light weight feature results in major labor savings for roofing contractors. Considering that the last fifty years could be arguably called the “age of plastics,” it is not surprising that polymers have found a niche in residential roofing.

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## Initial reluctance toward synthetics

The roofing industry initially was reluctant to adopt the new synthetics. The industry had some experience with modified bitumen, especially in commercial roofing. In fact, the industry literally had decades of experience with modified bitumen. As a result, residential roofing contractors were eager to adopt the premium self-adhering underlayment and these were readily accepted by the industry. But experience with the synthetics was lacking. Synthetic underlayment gained notoriety as being unsafe because the sheets would become slippery when wet. Especially the early versions were deemed unsafe and hence many contractors preferred to use familiar materials.

Also, synthetic materials allowed water to be drawn through fastener holes through a capillary effect. The plastic would stretch and surface tensions would allow water to wick through the hole, alongside the fasteners. The result is that the so-called secondary water barrier would leak. Staples were not suitable for fastening these thin plastic sheets. Furthermore, despite claims of labor savings, they were sometimes difficult to install, especially under windy conditions, because of their flimsy, lightweight construction.

Another factor that made roofing contractors wary of synthetics was the large number of companies entering the marketplace. *Caveat Emptor* (let the buyer beware) supplanted experience and industry standards. The fact that many of these new synthetic underlayment companies were completely unfamiliar with the roofing industry did not help with the product development.

Another drawback of synthetics is that they are typically provided as thin sheets that could leak if punctured. Users of single ply roofs made of thermoplastic olefins (TPOs), rubber (EPDMs) and other polymers have long struggled with this drawback. A “single ply” plastic roof typically does not make a reliable, long-lived primary roofing material. Even if the roof escapes being punctured, prolonged exposure to ultraviolet radiation severely compromises the life cycle of single ply roofing systems. Roofers and building owners have struggled with such roof materials in low-sloped, commercial roofing applications for years.

Nonetheless, in some regions of the country and for certain residential roofing applications, roofing contractors quickly began adopting synthetics. Market growth and market share have in some cases surpassed double digits. Scores of companies now offer synthetic underlayment to roofing contractors.

Synthetics also offer some other less obvious benefits. For example, the sheets of synthetic underlayment can be custom printed with the logos and custom messaging of roofing contractors, allowing them to locally advertise their services on the job site.

In residential roofing, the underlayment need only shed water because of the steep slopes of the roof. And furthermore, the primary roof (whether shingle, tile, metal or other material) protects the underlying material from physical damage caused by ultraviolet radiation and wind-blown debris. This led to the idea of using an extremely thin layer of plastic as an underlayment.

Modern polymer chemistry offers a 100-percent plastic substitute, altogether eliminating asphalt. Many polymers are completely water resistant and also resistant to several chemicals. After all, they are non-biodegradable! That may be a disadvantage for products that are “used once and thrown away” but it is an advantage for roofing.

Another factor that made roofing contractors wary of synthetics was the large number of companies entering the marketplace.

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## Product configuration

Engineered polymers are delivered to the factory in the form of plastic pellets, which are fabricated into underlayment products. The final configuration can vary but, in most cases, a single sheet of polypropylene (PP) is bonded to a woven scrim made from polypropylene filaments. Product differences are predicated on differences in the woven scrim dimensions, filament diameter and sheet thickness. For convenience, the final underlayment can be characterized in terms of the areal density, or weight per unit area, which is typically expressed in grams per square meter (gsm). However, any number of configurations could yield the same area density. A more accurate description of an underlayment product requires an understanding of the exact configuration.

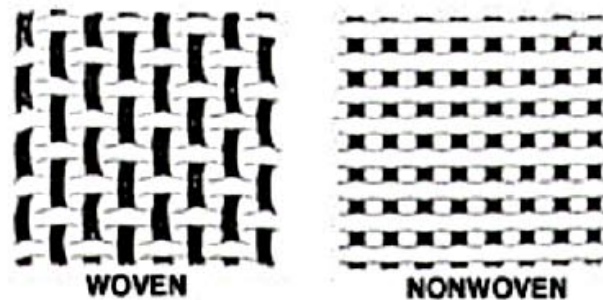
Let's take a closer look at the mesh and sheets and the process for bonding them together into synthetic underlayment products. A synthetic underlayment is typically made from a woven PP scrim bonded to one or more PP sheets.

The technology for manufacturing scrims is well established and widely available.

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## What is a scrim?

The scrim is woven from polypropylene threads or filaments. Scrims are used in everyday life to bag oranges, grapefruits and onions in the food processing industry. One can see them at local grocery stores or in the refrigerator. An internet search for images of "polypropylene scrim" will instantly yield hundreds of examples of scrim material used in everyday life. The technology for manufacturing scrims is well established and widely available. Manufacturing costs have been driven down in a competitive market place.



*Scrim*

Of course, a woven scrim by itself is not very useful as a roofing underlayment. It is necessary to bond a PP sheet to the PP scrim or coat the PP scrim on both sides with a suitable coating. The woven scrim provides good strength and stability to the underlayment. The scrim material is defined by several factors, including the spacing of the individual filaments and the diameter of the filaments.

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## Thickness, density and weight

Thickness values are not so meaningful because the thickness varies locally, depending on the configuration of the synthetic underlayment. Moreover, as seen in the previous section, areal weight alone does not uniquely describe the product because two completely different configurations could have the same overall weight, depending on the amount of scrim.

Nonetheless, synthetic underlayment products are frequently characterized in terms of weight or, more precisely, areal weight, so it will be worthwhile to examine in this section, what exactly is the weight per unit area? The units for areal weight are typically given as grams per square meter (GSM, or gsm). Areal weight is easy-to-measure and meaningful. It describes the amount of polymer in the underlayment, allowing synthetic underlayment products to be compared to each other and also to other types of underlayments.

A cubic centimeter is the same volume as one meter square by one micrometer thick. (That's because 10,000 micrometers add up to a centimeter, and there are 10,000 square centimeters in a square meter.) Therefore textbook values of "density" or "specific gravity" are the same as the areal density for a sheet that is one micrometer thick. In other words, a one micrometer deep puddle of water that is one square meter in dimension would weigh one gram. Conversely, 1,000 grams of water could produce a puddle that is one millimeter deep with an area of one square meter.

So, one rule-of-thumb is to multiply specific density values by 1,000 to obtain the weight of a sheet that is one millimeter in thickness. The density of PP ranges from 0.855 g/cc to 0.946 g/cc. A one millimeter thick layer of PP would therefore have an areal weight between 855 gsm and 946 gsm. The GSM (grams per square meter) specification can be converted into an average thickness using the volume density of polypropylene.

$$\text{Density} \times \text{Thickness} = \text{Areal Density}$$

$$\text{Thickness} = \text{Areal Density} / \text{Density}$$

Polypropylene is just slightly less dense than water. It floats. Its density is about 0.946 grams per cubic centimeter. Consequently, the average thickness of a polypropylene sheet in micrometers (or microns) is approximately equal to the areal density (in GSM) divided by 0.946. Simply expressed, the average thickness (in microns) of a sheet of polypropylene underlayment is slightly greater than the areal density (in GSM).

$$\text{Thickness [in microns]} = \text{Areal density [in gsm]} / 0.946$$

PP areal densities ranging from 75 to 150 gsm correspond to thicknesses from 80 to 160 microns, or 3 to 6 mils (since 25.4 microns equals one mil).

For comparison, one square is equivalent to 9.29 square meters (since 10 feet equals 3.048 meters). Multiply 75 GSM by 9.29 m<sup>2</sup> per square to obtain about 700 grams per square, which is about a pound and a half per square. Hence, a typical economy-grade synthetic underlayment has a unit weight less than one third that of a 15# felt roll. But it is also approximately only one third as thick, a fact which is often understated or ignored in advertising synthetic underlayment.

Hence, a typical UDL 15  
synthetic weighs only  
one tenth as much as a  
15 pound felt.

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## More about underlayment

Part One above placed into perspective the various types of underlayments, beginning with an historical perspective of traditional asphalt-coated organic felt. The market dynamics driving the introduction of alternatives into the residential roofing industry were then examined, along with overviews of premium self-adhering and synthetic underlayments.

Part Two will describe the materials and manufacturing processes associated with the three categories of underlayments with special emphasis on synthetic underlayment products. Furthermore, the main features and benefits of synthetics compared to the other two product categories will be evaluated in Part Three.

Such information will aid in understanding where synthetics are being used most successfully and where they are superfluous; and where a premium self-adhering underlayment is a better choice. Thus, the reader will be in a better position to choose between broad underlayment product categories and choose a specific underlayment within those product categories. 💧

# Rethinking Roofing Underlayment

## Part Two: Materials and manufacturing

There are many similarities between traditional, specialty and synthetic underlayment products.

Roofing contractors should know their materials inside and out. To fully understand underlayment one must have a basic understanding of raw materials as well as manufacturing. Subtle variations at the molecular level have large effects on the properties of materials; furthermore, variations on the macroscopic scale also affects performance.

There are many similarities between traditional, specialty and synthetic underlayment products. Here we begin with a description of the raw materials for synthetics. Afterwards, we will briefly compare analogous manufacturing processes for traditional asphalt-coated felts and premium modified bitumen membranes as well as synthetics, pointing out the similarities as well as the differences in manufacturing.

It is worthwhile to first briefly consider polymer chemistry as it relates to all kinds of underlayments and synthetics in particular.

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### Raw materials

The physical properties of synthetics are essentially those of the polymers from which they are made. The king of the polymers is polyethylene, or PE. It is produced in the highest volume globally and its production (or consumption!) is considered a measure of industrial growth.

The second most common polymer in the world is polypropylene, or PP. According to a report from GBI Research the global PP market is predicted to reach 62.4 million metric tons by 2020. In terms of end-use consumption, construction currently accounts for 5 percent of the PP market.\*

E.W. Fawcett and R.O. Gibson of Imperial Chemical Industries in London discovered polyethylene accidentally, in 1933, when they reacted ethylene at extremely high pressures. However, large volume production did not become economically viable until catalysts were developed to control the way carbon compounds are fabricated into materials on the molecular scale.

German Karl Ziegler discovered the first titanium-based catalysts, and Italian Giulio Natta used them to control the growth of polypropylene polymers. These two chemists were deservedly awarded the Nobel Prize in Chemistry in 1963 for the development of Ziegler-Natta catalysts, the workhorse in the commercial manufacture of various polyolefins since 1956. They ushered in the age of plastics by allowing for the production of plastics on a grand scale.

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### Meet the olefins

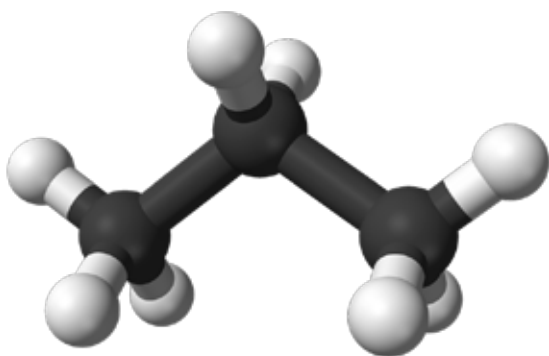
In organic chemistry, an “olefin” or “alkene” is a molecule containing at least one double bond between carbon atoms. Polyethylene (PE) and polypropylene (PP) are “poly” olefins. The double bond is the means by which these molecules are joined together in long polymer chains.

\*As reported in European Plastic News, Sept 9, 2013  
<http://www.plasticsnews.com/article/20130909/NEWS/130909948/global-pp-market-to-reach-62-4-million-metric-tons#>

Ethylene “mers” can be strung together like beads on a string to form polyethylene. Different kinds of polyethylene can be made, depending on the number of “mers” in the “polymer.” A single polyethylene chain may contain thousands or tens of thousands of carbon atoms. (The prefix “poly-” derives from Greek word *polus*, meaning “much”; or from the Greek word *polloi*, meaning “many.” Furthermore, the suffix “-mer” is derived from the Greek word *meros*, meaning “part.”) There are other tricks that can be played in the production of polyethylene. These mostly have to do with how the hydrogen atoms are lined up along the chain of carbon atoms.

The properties of PP are distinctly different from those of PE.

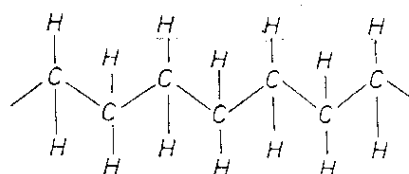
The properties of PP are distinctly different from those of PE. That’s because PP does not grow like a long string of beads but branches can shoot out in every direction. The “middle” carbon atom of the starting olefin (propene, also known as propylene) can attach to another carbon atom, resulting in four carbon atoms that are not on a straight line. Thus, polypropylene does not grow neatly along a straight line but rather grows into a kind of three-dimensional web on the molecular level.



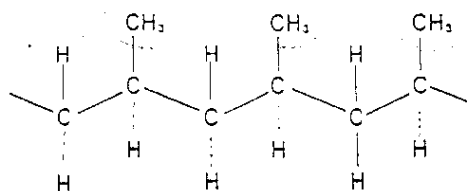
**A molecule of propane is made up of three carbon atoms and eight hydrogen atoms. The olefin known as propylene or propene has only six hydrogen atoms but it has two double bonds.**

<http://commons.wikimedia.org/wiki/File:Propane-3D-balls-B.png>

## Polyethylene



## Polypropylene



### Polyolefins

<http://imgarcade.com/1/polypropylene-molecule/>

Consequently, PP has quite different mechanical properties compared to PE. If PE is one-dimensional then PP is three-dimensional.

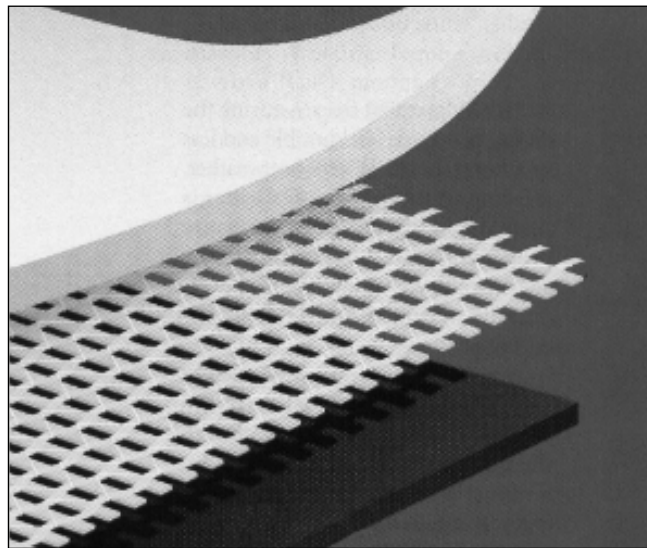
As it turns out, the properties of PP are more suitable for underlayment than those of PE. PP does not have problems with stress-cracking and it has better resistance at higher temperatures. PP is similar to PE, but there are specific differences, including higher rigidity and hardness and a higher softening point. (PP doesn’t melt below 160 °C, while PE anneals at around 100 °C.)

Since the sixties, “engineered polymers” have become a cornerstone of modern technology. The polymer is only the beginning. It is typically procured from a company that specializes in the production of engineered polymers. The plastic

pellets are then further processed for specific applications, for example, the manufacture of synthetic underlayment.

Ideally, the manufacturer of the roofing underlayment is knowledgeable of engineered polymers and its technical staff can work with polymer producers to optimize the formulas for polymers that are blended for use in the production of the underlayment. Moreover, the underlayment company should be intimately involved with the manufacturing processes. Manufacturing facilities have been constructed that are dedicated to the production of roofing underlayment and the configuration of the underlayment can be continually improved as more is learned from the end users.

Such is the case with Tarco. Tarco underlayment is made in the most modern facilities available today in the industry. These facilities are dedicated to the production of underlayment materials.



***Typical configuration of a synthetic roof underlayment***

<http://www.buildings.com/article-details/articleid/17390/title/from-rags-to-riches.aspx>

# Manufacturing Processes

## The manufacture of asphalt-saturated organic felt

Being made from 100 percent post-consumer recycled material, dry organic felt mat is an eco-friendly or “green” material.

The manufacture of asphalt-saturated felt begins with the delivery of dry organic felt to the factory. This material is made out of cellulose fibers obtained from post-consumer as well as post-industrial waste such as newspapers, cardboards and wood. The cellulose fibers are reduced to a water-based pulp, formed into sheets, dried, cut into strips, and wound onto rolls. Being made from 100 percent post-consumer recycled material, dry organic felt mat is an eco-friendly or “green” material.

The dry felt is delivered to the plant by truck (Figure 1) and stored on-site (Figure 2). Meanwhile, hot asphalt is delivered by tanker truck (Figure 3) and pumped into one of several asphalt storage tanks (Figure 4). The asphalt is kept hot by electric and natural gas-fired heaters located at the asphalt storage tanks. The liquid asphalt circulates in a loop through the saturator and back to the asphalt tanks.



*Figure 1 - Dry felt delivery*



*Figure 2 - Dry felt stock in warehouse*



*Figure 3 - Asphalt unloading*



*Figure 4 - Asphalt storage tanks*

Rolls of dry felt are loaded onto the unwind stand (Figure 5) and unrolled through the dry looper section (Figure 6). The dry looper consists of a series of rollers, pulled along by a chain, which is used to form loops, maintain tension on the paper and allow product accumulation.



**Figure 5 – Unwind stand**



**Figure 6 – Dry looper**

From the dry looper, the dry felt enters the saturator (Figure 7). The saturator consists of a series of rollers, commonly referred to as “gates.” The bottom rollers of these gates are submerged in hot asphalt, maintained usually at a temperature of 450 °F. The gates can be raised or lowered to change the level of saturation of the asphalt into the felt paper. The level of saturation has a direct correlation



**Figure 7 – Saturator**

**The greater the saturation, the higher the weight.**

to the finished product weight; the greater the saturation, the higher the weight. Saturation level depends on various factors such as:

- ◆ Type of dry felt, whether soft or hard
- ◆ Temperature of the asphalt
- ◆ “Dwell time”, which is the amount of time that dry felt resides in the saturator
- ◆ Speed of the production line

After the felt is saturated, it passes over a series of three to five scraper blades to remove excess asphalt. The second blade can be adjusted in-or-out to increase or decrease the amount of asphalt removed from the surface of the paper. The

saturator is totally enclosed; asphalt vapors from the process are routed to the scrubber/cooler (for cooling) and to the fiber-bed-filter mist eliminator for control of emissions.

The asphalt saturated felt enters the cooling section (also known as “the black rack” or the “striking section”) where it is drawn over several rollers and allowed to cool in ambient conditions (Figure 8). The cooling section is also enclosed and the vapors are routed to the scrubber/cooler and then to the mist eliminator for emissions control. From the cooling section, the saturated felt rolls onto the finish looper, which is another series of rollers that forms the saturated felt into hanging loops (Figure 9). The asphalt saturated felt is pulled into the winder, where the rolls are formed and cut into varying lengths (Figure 10). The roll is pushed along a conveyor, where it is wrapped with a paper label and stacked vertically on pallets. When a pallet is full, it is automatically banded and stored in the warehouse ready for shipment.



***Figure 8 – Black rack***



***Figure 9 – Finish looper***



***Figure 10 – Winder***

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## The manufacture of modified bituminous underlayment

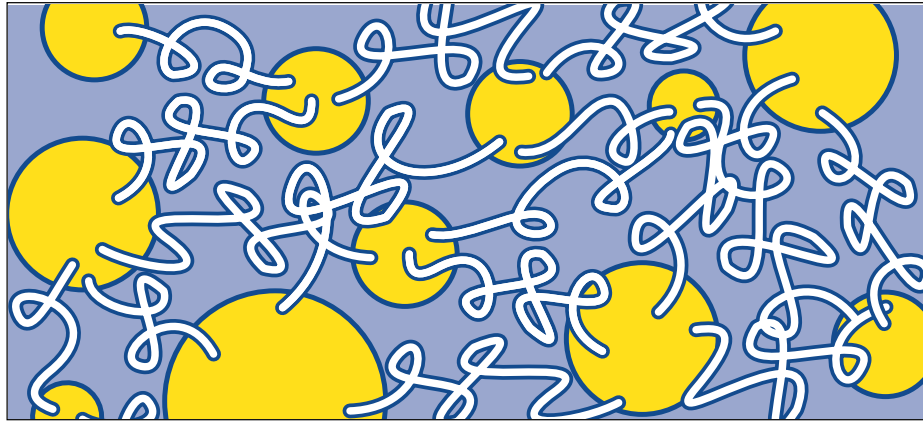
Modified bituminous self-adhering underlayments benefit from today's technologies and offer significant improvements. Typically, these membranes are made of bitumen compounds such as asphalt that have been modified with polymers to be more rubber-like and easier to handle. Better quality products, such as Tarco's LeakBarrier Ice and Water Armor, are made from superior-quality asphalt sources. These underlayments have a removable release film that simplifies installation.

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### Polymer-modified bitumens

The tough fiberglass mat gives strength against rips and tears and makes it easy to handle the membrane.

The blend of SBS and asphalt is something like spaghetti and meatballs mixed with sauce. As illustrated in Figure 11, the "spaghetti" is the butadiene and the "meatballs" are styrene. Strands of rubbery butadiene run between spheres of styrene, giving the membrane rubberlike properties. The "sauce" is the asphalt, which imparts water resistance to the membrane. This entire mixture is spread upon a sturdy fiberglass mat, which can be compared to the dinner plate.



*Figure 11 – Blend of SBS and asphalt*

The thick, mostly-asphalt membrane resists water yet is easy to install. The tough fiberglass mat gives strength against rips and tears and makes it easy to handle the membrane. The SBS polymer soaks up asphalt like a sponge, fixes its shape and form, and imparts flexibility and resilience to the membrane. As a result, the membrane is self-sealing around nails. Imagine driving a nail through a rubber ball. The flexible membrane pushes tightly against the nails, blocking moisture from penetrating.

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### Manufacturing steps for modified bitumen roofing

The manufacture of polymer modified bituminous specialty underlayment products consists of several distinct steps:

- ◆ Mixing and filler addition
- ◆ Saturating/coating the reinforcement and thickness control
- ◆ Surfacing

- ◆ Cooling
- ◆ Cutting and Winding (into roll form)

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## Mixing and filler addition

Asphalt is blended with polymeric additives such as atactic polypropylene (APP), styrene butadiene styrene (SBS), polyethylene (PE) and other chemicals in mixing tanks or vessels (Figure 12). Typical mixing tanks have a capacity of



**Figure 12 – Polymer additives**



**Figure 14 – Polymer addition**



**Figure 13 – Mix tanks**

25,000 lbs, which is approximately 3,000 gallons (Figure 13). Asphalt is heated to approximately 400 °F and the various polymers are added into the tank (Figure 14). The exact quantities depend on the specific product formulation. Mix tanks are equipped with agitators or blades that keep the asphalt and polymers in circulation at high speeds. The blending process could take from two hours up to six hours, depending upon the quantity and type of polymers as well as the equipment specifications. During this process, the polymers break down and bond with asphalt, resulting in a homogeneous asphalt-polymer network or matrix. Other ingredients such as oil and tackifying resins are added as needed. Filler material

such as limestone or talc is added into the mix tank and allowed to blend, usually for one hour or so. In some cases, the polymer modified asphalt blend is transferred to a holding tank before being transferred to the production line.

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### **Saturating/Coating the reinforcement and thickness control**

From the mix tank or holding tank, the modified asphalt blend is transferred to the coater in the production line. From the unwind stand (Figure 15) located at one end of the production line, the reinforcement (also known as carrier or mat) such as dry felt, glass mat or polyester is unwound from master rolls (Figure 15).



**Figure 15 – Unwind stand**

The coater section typically consists of a rectangular tank and a series of rollers. When the reinforcement enters the coater, it is saturated with the modified-asphalt blend (Figure 16). Simultaneously, the modified asphalt coating is applied to the upper and lower surfaces of the saturated reinforcement.



**Figure 16 – Coater**

The level of saturation is greatly dependent upon several factors such as:

- ◆ Dwell time of the reinforcement in the coater
- ◆ Run speed
- ◆ Type of modified bitumen compound
- ◆ Viscosity of the modified bitumen compound
- ◆ Temperature of the modified asphalt blend
- ◆ Type of reinforcement

Also present at the coater section are metering rolls, which are employed to achieve the desired product thickness by controlling the amount of modified asphalt blend applied on either side of the reinforcement.

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## Surfacing

Once the saturated and coated reinforcement exits the coater section, the necessary surfacing material is applied. Surfacing materials are added for various reasons. For example, sand, talc or liquid parting agent (LPA) is applied to the upper surface of the product to keep the material from sticking within itself when wound into roll form. Silicone-coated release film is applied to the self-adhesive compound on the bottom side to prevent roll sticking and to maintain the adhesive characteristics of the finished product (Figure 17).



**Figure 18 – Granule application**

◀ **Figure 17 – Release film application**

Alternatively, polymeric film or fabric materials are applied to the topside, depending on the product configuration and end use. In the case of mineral surfaced membranes or underlayments, mineral or ceramic granules are applied to the top side of the finished product. However, non-granulated sheets bypass this step (Figure 18).

Depending upon the type of surfacing, various auxiliary equipment and devices are utilized in the production line. For example, during the production of a fabric surfaced underlayment, a fabric applicator is employed.

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## Cooling

The sheet is then fed through water-cooled drums to allow it to cool rapidly (Figure 19). In some cases, the sheet travels through a chilled water bath. Alternatively, water spray may be used to cool the sheet. Some manufacturing lines are equipped with dryers to air dry the sheets. After cooling, the sheet enters the accumulator section, which consists of a series of rollers that allow the material to form into loops (Figure 20).



**Figure 19 – Cooling section**



**Figure 20 – Dry looper ►**

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## Cutting and winding

From the finished product looper at the accumulator section, the sheet travels to the winder, where it is cut to the required lengths and wound into roll form (Figure 21). The finished rolls are labeled or taped for product identification and paper tubes or cores are inserted into the inner diameter of the rolls to provide stability during storage and shipment. The rolls are stacked on pallets, secured using stretch film or shrink bags, and stored in the warehouse prior to shipment to customer locations.



**Figure 21 – Winder**

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## The manufacture of synthetics

Producing synthetic underlayment from polypropylene (PP) pellets is a marvel of modern manufacturing. The process can be sub-divided into several distinct stages as follows:

- ◆ Spinning the fibers or filaments
- ◆ Weaving the PP filaments into scrim
- ◆ Extrusion coating on scrim
- ◆ Extruding PP nonwoven fabric
- ◆ Bonding various layers together to form the synthetic felt
- ◆ Printing, cutting and packing into individual rolls

Let's take a closer look at the manufacturing equipment used at each stage, from the point where the plastic pellets are extruded to the point where the components are finally assembled together into synthetic underlayments and packaged for the roofing marketplace.

An appreciation of the manufacturing processes will make it easier to understand the fine differences between product offerings, including the features and benefits of different products from the same manufacturer. For polymer-based fabrics, it is a maxim that the "figure of merit" is tear resistance divided by weight. The use of woven polymers in synthetic underlayments greatly increases their tear resistance and imparts other properties as well. It is found that a woven scrim with widely spaced fibers combined with flat nonwoven (extruded) polymer sheets provides high tear resistance.

For polymer-based fabrics, it is a maxim that the "figure of merit" is tear resistance divided by weight.

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## Producing filaments

The textile industry has been making fabrics from polymers for more than fifty years; as a result, the processes and equipment are highly evolved. A fiber of continuous length is typically referred to as a "filament." With modern equipment it is possible to convert a thousand pounds of polymers into filaments without a single break occurring. In the textile industry, molten polypropylene passes through an adapter into a die that has a pattern of holes in it. The liquid polymer being forced through these holes solidifies in a short distance, typically about 100 centimeters or 40 inches (one meter), and it can be further stretched or treated before winding onto spindles.

In the manufacture of synthetic underlayment, the threads used to manufacture scrim are made by slitting an extruded polypropylene sheet into many strips, which are further processed into threads or filaments.

The primary raw material employed in the manufacture of PP filaments or fibers is polypropylene granules, which can also be referred to as "pellets." Depending on the color requirement of the final product, color pigment is incorporated into the master batch. Furthermore, depending on the end use and expected outdoor exposure of the finished product, ultraviolet stabilizers (UV additives) are included in the master batch. The various ingredients are blended at precise formulations at the mixer (Figure 22) and then conveyed through a suction pipe to the hopper, which then follows to the extruder hopper.



**Figure 22 – Mixer**



**Figure 23 – Extruder hopper**



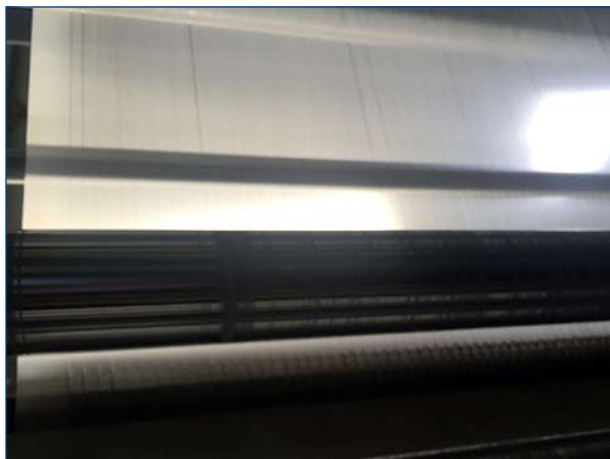
**Figure 24 – Cooling the film**

Ideally, the polymer melt will have a consistent chemical composition and, hence, also predictable physical properties.

The extruder hopper allows the raw materials to enter the feed section of extruder (Figure 23) in a continuous fashion, by gravity. The feed section is connected with the pipes to the water supply system for flow and return of chilled water. The cooling system eliminates slippage of the raw materials as they are pumped in the direction of a series of drums towards the die.

Raw materials are continuously fed at a rate proportional to the speed of the extruder screw. The temperatures at each of the heating zones are maintained to assure proper mixing, melting and conveying of material. The extruder screw plasticizes the granules into melt form and conveys it forward. At the exit end of the extruder screw, a screen pack consisting of varying mesh sizes screens out the un-melted particles. The polymer melt must be filtered to ensure there are no bubbles or contaminants. Ideally, the polymer melt will have a consistent chemical composition and, hence, also predictable physical properties. The lengths of molecules within the polymer melt will not vary greatly such that the viscosity, melt flow characteristics, and melting temperatures do not vary over the length of the filaments (or “strips” or “threads” or “tapes”).

The polymer emerging from the slot die is chilled to a solid form at a water tank and the chilled film passes through two pairs of scrapers on the way to the squeeze-off rollers, where the remaining drops of water are removed. (Figure 24).



**Figure 25 – Slitting the film into filaments**



**Figure 26 – Film slit into filaments**

Then the film enters a slitter where a spreader roller straightens any wrinkles in the film, and slitting blades cut the film into fibers or filament (Figures 25 and 26). The width of individual fibers is adjusted by using spacers of suitable size in between the slitting blades.

A system of godets is used to draw the filaments. (In the textile industry, a “godet” is a roller for guiding synthetic filaments during drawing. It is derived from a French word for a “cup” or a Dutch word for a “cylindrical piece of wood.”) Filaments from a first godet station pass through a hot air oven and enter a second godet station, which is maintained at ambient temperature. The speed of this second godet is four- to-five times higher than the speed of the first godet. (The speed corresponds to draw ratio, which is chosen according to the properties of the raw material and the expected quality of the fibers.) The filaments then enter a third godet station, which is maintained cold using a chilled water circulating system, thereby freezing the molecules and aligning them in an oriented state (Figure 27).

Such oriented filaments possess high tensile strength and other desirable physical characteristics. Ultimately, these threads are gathered into spindles and wound onto spools, which will in turn feed the weaving machines (Figure 28). Various properties of the filaments can be inspected to maintain quality control before the spools are sent to the next processing step (Figures 29 and 30).

Such oriented filaments possess high tensile strength and other desirable physical characteristics.



**Figure 27 – Producing filaments**



**Figure 28 – Winding filaments into spools**



**Figure 29 – Quality control equipment**



**Figure 30 – Quality control equipment**

## Weaving the scrim

The filaments are woven into scrims on circular weaving looms.

Just as spinning polymers into filaments involves highly evolved equipment, so too does the weaving of the filaments into scrim. The weaving pattern resembles one that might be used to weave a stocking hat or a sweater arm. Such weaving processes are demonstrated in YouTube videos, which can be found by searching for “circular loom.” The main difference is the high-speed operation of a large circular loom.



**Figure 31 – Thread-to-weaving**



**Figure 32 – Circular loom**

Dozens of spools of filament are fed into an automated circular weaving loom, including both the “woof” and “weft” filaments (Figure 31). The filaments are woven into scrims at the circular loom (Figure 32). Miles of woven fabric are produced by each loom and, typically, many looms run in parallel at the same factory (Figure 33).



**Figure 33 – Woven scrim formation**



**Figure 34 – Winding scrim into rolls**

The closeness of weave is represented by mesh in terms of X by Y, where “X” represents the warp mesh and “Y” represents the weft mesh. (The “mesh” is also known as the “count” or “weave.”) The warp weave is in the machine direction; the weft weave is in the cross-machine direction. The number of tapes in one inch in warp direction is known as warp mesh (X). These tapes are passed through a series of inline process equipment for reed weaving on the circular loom. Technically speaking, the equipment includes eyelets, a roller, intake combs, a water-tank-chilled roller, eyelet bows, compensators, heddle belts, and reed rings of suitable dent. (See any good textile-industry glossary for definitions of these terms.) In this manner, the loom is threaded to define the weave in warp direction. The weft filaments are woven through the weave filaments in the circular loom. Finally, the woven scrim is wound into rolls of suitable width and length (Figure 34).

## Extrusion coating on woven scrim

Extrusion coating is the process of coating a polymeric resin on a woven scrim substrate by extruding a thin film of molten resin and pressing it onto or into the woven scrim substrate or both, with or without the use of adhesives. This process of extrusion coating on woven scrim is conducted on an extrusion coating machine. The basic raw material for coating the woven fabric is polyolefin. Other raw materials used are the color master batch, UV master batch, and so on.

The blended raw materials are fed to the extruder hopper. The woven scrim in suitable roll form is loaded onto an unwind stand and guided through the rollers to the die. The molten material from the die is extruded on to the woven scrim surface in film form. The molten film laminated to the woven scrim is passed under heavy pressure through rubber roll and a chilled roll; and eventually it is wound into roll form at the winder. Thus, one side of the coating process is completed. The one-side coated roll is once again loaded onto the unwind stand and the other side is coated in the same manner. The excess material (overhang) is trimmed off the edges and the final product is wound in roll form at the winder.

## Extruded nonwoven fabrics

Meanwhile, in another part of the factory, the sheets of nonwoven polypropylene are also extruded. Blown extrusion is commonly used in the manufacture of trash

The molten material from the die is extruded on to the woven scrim surface in film form.

It is a simple matter to transfer an emboss pattern from a preformed mechanical roll to the sheet shortly after it comes out of the die and before it has fully cooled.

bags and shopping bags; in the case of blown extrusion, a tube of melted polymer is expanded with air pressure. However, the nonwoven sheets used for synthetic felts are too thick to be blown. Rather the polymer melt is forced through a die that has a thin rectangular hole for an exit.

The dies must guide the polymer melt from the circular outlet of the extruder screw to a thin, flat planar flow. This flow must be uniform across the entire cross sectional area of the die. The sheets may then be passed between additional rolls for cooling and to establish the desired sheet thickness and surface texture. At this stage, the surface of the extruded sheets could be enhanced in such a way to allow for improved walkability of the finished product. It is a simple matter to transfer an emboss pattern from a preformed mechanical roll to the sheet shortly after it comes out of the die and before it has fully cooled.

Colored dyes are best added at this stage. While it is possible to print on polypropylene sheets after they have been extruded, polypropylene cannot be dyed after it has been extruded in the sense of dyeing in an aqueous bath as is done with other textiles. Of course, that is because the very properties that make polypropylene a good (water resistance) roofing underlayment also make it impossible to dye. Nonetheless, vivid colors can be obtained by adding the dyes to the melt before the sheets are extruded.

The woven scrim and the nonwoven fabric are sandwiched together at the pressure roller.

## Bonding the layers together

By now, it is clear that a synthetic underlayment really has a multi-layer configuration. Once the woven and nonwoven components are ready, they need to be bonded together. Typically, synthetic underlayments are composed of two layers with the nonwoven fabric as the top layer and the woven scrim as the bottom layer.



*Figure 35 – Woven scrim roll ready for lamination*



*Figure 36 – Nonwoven fabric roll ready for lamination ►*

From the unwind stand at the coating machine, the master roll of woven scrim is unwound and guided through a series of drums (Figure 35). From another unwind stand, the nonwoven fabric is unwound and guided through a series of guide rollers (Figure 36). The woven scrim and the nonwoven fabric are sandwiched together at the pressure roller (Figure 37). It is important to set the



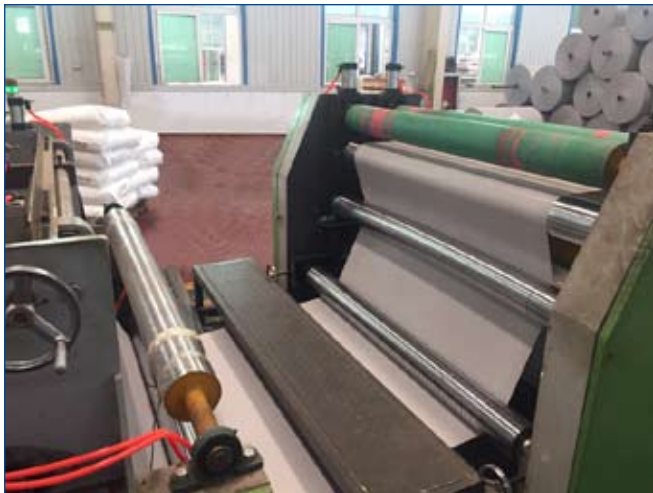
**Figure 37 – Lamination process**



**Figure 38 – Application of surface coating.**

suitable temperature, pressure, and tension in order to eliminate the possibility of film burn-through or deformation in the mesh surface. However, the process parameters must be adjusted so as to achieve the target bonding strength. In addition, coatings can be added on either surface of the material (Figure 38).

The resulting laminate then follows a series of chilled rollers to the winder where any excess overhang is trimmed off from the sides and the material is slit to the desired lengths and wound into roll form (Figure 39).



**Figure 39 – Ready for winding at the winder**

The underlayment material is then stored in the form of master rolls (Figure 40). The Master Roll is a space saving method for storing synthetic underlayment but not a very efficient way to bring it to market.



**Figure 40 – Master Rolls**



**Figure 41 – Printer**



**Figure 42 – Printing head**



**Figure 43 – Printed Master Rolls**

For specialty underlayment, the mat is in many cases a woven or nonwoven polymer, which is sandwiched between layers of modified bitumen material.

## Printing and packaging in roll form

Printing is typically done at this final stage. The material is printed with the necessary artwork at the printing press (Figure 41). Standard products include markings to show where to apply fasteners and also product name and other useful information (Figure 42). For a nominal charge, the logo of the end-user could also be printed on the synthetic underlayment at this stage (Figure 43).

The final step of the manufacturing process involves packaging the synthetic felts into lightweight rolls that can be easily handled by the roofing contractor. Synthetic roofing underlayments are thinner and lighter than conventional asphalt saturated roofing felts. Consequently it is possible to package them in rolls that can cover a total area of ten squares, rather one or two squares, and yet the roll will still be light enough to be handled by one person. Making the rolls wider also results in labor savings since the roofer can cover twice the area with the same sheet length if the sheet is twice as wide.



**Figure 44 – Rewinder**



**Figure 45 – Winding into small rolls**

At the re-winder (Figure 44), the master rolls are unwound and cut to desired lengths and then wound into roll form onto plastic or paper cores (Figure 45).

## Analogous manufacturing processes

Now that the underlying polymer chemistry, materials properties and manufacturing processes have been outlined for synthetics, it is easier to draw comparisons with traditional and specialty underlayments.

All of these manufacturing processes involve rollers for moving sheets of material through various processes. Thicknesses, temperatures and materials properties must be tightly controlled.

For conventional felts, the original shape of the sheet is obtained by heating and compressing the nonwoven organic felt material. This material is then saturated with asphalt to impart water resistance.

For specialty underlayment, the mat is in many cases a woven or nonwoven polymer, which is sandwiched between layers of modified bitumen material.

It is easy to understand how the final product features are obtained by starting with various sheets or scrims and processing them further with asphalt or polymer coatings. It is also easy to understand how these features relate to the practical considerations of the roofing contractor.

There are many parallels that can be drawn between the manufacture processes of synthetics compared to those for traditional felts and specialty underlayment.

## Summary

A thorough knowledge of the underlayment manufacture is useful for understanding specific product features of various types of underlayment; how they can be modified to match the underlayment to the application; and how the performance, ease of handling, walkability and other features can be improved.

In Part Three, specific examples of underlayment products will be examined with reference to the manufacturing processes described above. 💧

# Rethinking Roofing Underlayment

## Part Three: Features, applications and products

For the contractor, the most important considerations are suitability for the application, walkability, exposure limits, ease of application, and costs.

Part One gave an historical perspective on the three general types of underlayment while Part Two elaborated on how they are made. Now it remains to describe the features and benefits of specific underlayment products and how to best match them to the applications.

Building owners are mainly concerned with the tradeoffs between performance and cost. An underlayment is not going to be visible so aesthetics plays no role in selecting an underlayment. For the contractor, the most important considerations are suitability for the application, walkability, exposure limits, ease of application, and costs. These factors are obviously interrelated. For example, any of the first four factors can influence cost; similarly, improving the exposure limits may affect the ease of application; and so on.

Different contractors may stress different factors. For some, labor may be a more important consideration than materials costs. For others, exposure limits may be the overriding factor.

Some building owners are more cost conscious than others. One building owner may put quality and durability above all other factors while another may be looking for the least expensive solution. Not all homeowners may be in the market for a 30-year roof. Climatic conditions of the geographic location may be a factor, too.

Furthermore, ease-of-application affects labor costs, which in turn affect total installed cost. Labor costs could be reduced using a self-adhering underlayment; yet these materials may be heavier to lift to the rooftop than other available options. It is up to the individual contractor to weigh these factors and select the optimal solution for any given project.

Taking these caveats into account, let's look at each of these factors in turn, using Tarco products as the benchmarks for each underlayment type. Tarco is a market leader in underlayment products. The company is a leading manufacturer of asphalt-saturated felt; and it has also developed a comprehensive line of LeakBarrier premium modified bituminous underlayments; furthermore, it has launched a line of LeakBarrier EasyLay UDL synthetic underlayment products. Consequently, since it sells all types, Tarco is well qualified to advise contractors on the relative merits of various underlayment products.



*A truckload of Tarco products*



*Quick Reference Product Guide*

## Suitability for applications and end use

The type of primary roof determines the kind of underlayment more than any other factor, especially in the case of a tile or metal roofing system. This alone can be the determining factor in the selection process.

### For tile roofing applications

An underlayment for use under tiles needs to be durable enough to support the weight of stacks of tiles. This requirement eliminates all but the most tried-and-true underlayment for tile applications.

Considering that a tile roofing system sheds water but is not itself a watertight barrier, it is desirable for the underlayment to serve as secondary water barrier. In Florida, hot-mopped 90# organic felt was the benchmark underlayment for tile roofing systems for many decades and is written into many of the building codes. In 2006, Tarco introduced Fast90 self-adhering membranes for use under tile roofs to meet the needs of tile-roofing contractors seeking a peel-and-stick alternative to hot-mopped 90# organic felt.

Many contractors prefer a temperature-resistant, self-adhering underlayment such as Tarco PS200<sup>HT</sup> high-temperature underlayment, Tarco EasyLay UDL SA, or Tarco NR600 Ultra, which are designed for use under metal and tile. The modified bitumen compound is especially formulated to withstand the high temperatures that might be present under tile or metal roofs. Though the product is self-adhering it can also be nailed down. The nails penetrate through the top compound, the fiberglass reinforcement and the bottom compound of the underlayment. The modified bitumen is self-sealing around the nails. The PS200<sup>HT</sup> product has a polyester surface that provides excellent traction. The non-skid polyester fabric surface not only provides for excellent walkability but also helps prevent tiles staged on the roof for installation from sliding.

The modified bitumen compound is especially formulated to withstand the high temperatures that might be present under tile or metal roofs.



***PS200<sup>HT</sup> being installed***



***Tiles staged on the underlayment***

Synthetic underlayment can also be used under tiles. Tarco recommends its heaviest synthetic underlayment for use under tile applications. LeakBarrier EasyLay UDL Basic is suitable for use under mechanically attached tiles. However, the thicker UDL 50 is suitable for foam applications as well as mechanically attached tiles. UDL 50 has a nominal thickness of 16 mils (compared to 10 mils for UDL Basic and 8 mils for UDL 15) yet it is lightweight (4.5 pounds per square).

**LeakBarrier EasyLay UDL Basic is suitable for use under mechanically attached tiles. However, the thicker UDL 50 is suitable for foam applications as well as mechanically attached tiles.**



***EasyLay UDL 50***

The surface of EasyLay UDL 50 is compatible with foam applications. The tan color provides a cooler surface to work with and the polyolefin material is stable at high-temperatures. It is rated for temperatures up to 320 °F.

Since the installation of tiles can be subject to delays, it is wise to use an underlayment with long exposure limits. The polyester top surface of PS200<sup>HT</sup> and NR600 Ultra protects against UV rays so the underlayment can be left exposed for 120 to 180 days while exterior work is being done prior to the installation of the tiles. EasyLay UDL 50 has an exposure limit of six months.

In summary the following underlayment choices are recommended for tile roof applications.

- ◆ **Good:** EasyLay UDL Basic is suitable for use under tiles that are mechanically attached in climates where rainy weather and secondary water barrier protection are not major concerns.

- ◆ **Better:** EasyLay UDL 50 is a better choice as a tile underlayment, especially for foam installations. The greater thickness and high temperature formulation makes for a more rugged underlayment that can stand up to the loads associated with tile installations.
- ◆ **Best:** Traditional hot-mopped asphalt over 90# felt is an excellent choice where labor is available and the contractor is willing to work with hot-mopped asphalt. Fast90 provides an easy-to-install alternative to hot-mopped asphalt. PS200<sup>HT</sup> self-adhering membrane, EasyLay UDL SA and NR600 Ultra are ideally suited for a superior tile roofing system.

Underlayment designated for use in metal roofing applications must be able to withstand high roof temperatures.

## For metal roofing applications

Tarco offers an array of underlayment products for use under metal roofing.

Since a metal roof can have great longevity but typically does not provide complete moisture protection, it is very common to use a self-adhering modified bitumen underlayment beneath a metal roofing system. These membranes may be more expensive than synthetic felts but the added protection could be highly valuable, considering the consequential damage to the interior in the case of damage to the primary roof. If the deck is firmly attached to the building and the self-adhering underlayment is bonded to the deck then superior protection is assured even in the event of loss of the metal roof or metal roofing panels.



*Tarco underlayment installation for metal roofing*

Mineral surfaced underlayment is not suitable for metal roofing applications because the high thermal expansion of metal compared to most roof decks causes the metal to slide over the underlayment. Mineral granules would abrade through any corrosion resistant coatings and otherwise damage the metal panels and so they are to be avoided. However, without mineral surfacing, walkability becomes an issue. The polyolefin top surface must be textured or chemically treated in such a way as to provide good traction.

Another factor to consider is temperature resistance, considering the high temperatures that can be reached under metal roofing systems. Underlayment designated for use in metal roofing applications must be able to withstand high roof temperatures.



***PS200<sup>HT</sup> under metal roof, in Hawaii***

In fact, there are four different types of modified bitumen underlayment suitable for use in high temperature metal roofing applications, namely LeakBarrier PS200<sup>HT</sup>, LeakBarrier PS200<sup>MU</sup>, LeakBarrier EasyLay UDL SA, and LeakBarrier NR600 Ultra. The differences are in the formulation of the modified bitumen compound; the type of reinforcement; the overall thickness and weight of the underlayment; and the top surfacing.



***PS200<sup>HT</sup>***

PS200<sup>HT</sup> has a top surface made from a polyester fabric, which allows for better walkability and cooler surface temperatures. The specially engineered Hybrid Polymer System formulation allows the underlayment to withstand high temperatures. Of the three modified bitumen self-adhering metal roofing underlayment products, PS200<sup>HT</sup> has the best temperature resistance. It is rated to withstand temperatures up to 260 °F.

PS200<sup>MU</sup> is especially designed for use in metal roof applications. Unlike PS200<sup>HT</sup>, PS200<sup>MU</sup> should not be used in adhesive (foam) set tile applications. It is formulated for temperature resistance up to 250 °F. Thus PS200<sup>MU</sup> is not recommended for extreme high temperature environments such as under copper or zinc metal roofing. PS200<sup>MU</sup> is slightly less thick than PS200<sup>HT</sup>. The nominal thickness is 48 mil for the former compared to 60 mil for the latter. Both are reinforced with a glass fiber mat but PS200<sup>MU</sup> has a polyolefin top surface while PS200<sup>HT</sup> has a more rugged polyester top surface.



***PS200<sup>MU</sup>***



***PS200<sup>MU</sup> job in Houston***

EasyLay UDL SA can be used in shingle, shake, slate, tile, and metal roofing applications.

LeakBarrier EasyLay UDL SA is a state-of-the-art roof underlayment that combines the salient features of a synthetic membrane with revolutionary self-adhesive technology in order to deliver exceptional long-term weather barrier performance. Manufactured using a multi-laminate configuration consisting of nonwoven poly fabric, UV stabilized polyolefinic coating, and woven poly scrim that provides a non-abrasive surface with good walkability, EasyLay UDL SA has an aggressive self-adhesive modified bituminous compound that is self-sealing around nails and can adhere to a variety of substrates.

EasyLay UDL SA can be used in shingle, shake, slate, tile, and metal roofing applications. Designed for use in steep-slope roofing, it can be utilized in new roofing and re-roofing applications as well. EasyLay UDL SA is ideal for use in high temperature environments.



***EasyLay UDL SA***

LeakBarrier NR600 Ultra Ice and Water Armor is a state-of-the-art SBS modified, non-reinforced, self-adhesive roofing underlayment for use under tile, metal, slate, and asphalt shingles. Surfaced with a highly durable polyester reinforcement that provides exceptional strength and excellent walkability, NR600 Ultra is specially formulated for use in high temperature environments and self-seals around nails. The unique self-adhesive compound on the side lap ensures an immediate bond between adjacent rolls, resulting in instant watertight laps.



***LeakBarrier NR600 Ultra***

LeakBarrier NR600 Ultra is a premium underlayment designed to prevent leaks caused by ice and water damming and wind-driven rain. Ideally suited for use in mechanical and foam-attached tile roof systems, it is also an excellent choice as an underlayment for shingles, slate, and metal. NR600 Ultra is highly effective in critical roofing areas such as valleys, ridges, coping joints, chimneys, vents, dormers, skylights, and low-slope sections.

A self-adhering  
synthetic underlayment  
is also now available for  
use in metal roofing

Increasingly, synthetic underlayment also is being used as a lower cost alternative to self-adhering modified bitumen underlayment. Both EasyLay UDL Basic and UDL 50 are suitable for use in metal roofing applications. This underlayment must be mechanically attached using capped nails. A self-adhering synthetic underlayment is also now available for use in metal roofing. The top surface is a polyolefinic film laminate similar to the mechanically attached UDL products. The peel-and-stick modified bitumen offers many of the advantages of the premium modified bitumen metal roofing underlayment but at a lower cost.

When installing a metal primary roofing system that could last for 50 years or more, contractors and homeowners are more likely to specify the highest quality of premium modified bitumen underlayment beneath the metal roof. However, depending on the type of metal roof, the climate and the building design, a synthetic underlayment or self-adhering synthetic underlayment may be adequate.

In summary the following underlayment choices are recommended for metal roof applications.

- ◆ **Good:** EasyLay UDL Basic is suitable for use under steep sloped metal roofs. This synthetic product must be mechanically attached. Its light weight makes it especially easy to install and it has long exposure limits. Traditional asphalt saturated felt has been used in metal applications but it could prove costly to remove the metal roof to replace the felt.
- ◆ **Better:** EasyLay UDL 50 is one of the best choices as a metal roofing underlayment because the relatively thick multilayer polyolefin construction provides extra layers of moisture protection and seals well around nail caps. Yet another Tarco LeakBarrier product, EasyLay HPP asphalt-saturated underlayment combines a polyester fabric with time-proven, moisture-resistant asphalt to provide excellent weatherability and handling.
- ◆ **Best:** Premium self-adhering metal roofing underlayment products such as EasyLay UDL SA with temperature resistant formulations are always the best choice for metal roofing applications.



**EasyLay UDL Basic**

## For shingle applications

When the primary roof is made of shingles, the roofing contractor has the most options for roofing underlayment. The first consideration is that the shingles themselves may vary in quality. Modern “technical” shingles or architectural shingles may be designed to last 50 years or more. It behooves the contractor in this case to offer his customers an underlayment that has a similar warranty as the shingles.

Climate and building design are also important considerations. Shingles tend to be prevalent in Northern climates. The cooler roof temperatures can cause condensation of water vapor from the interior of the home unless special precautions are taken. The use of a secondary water barrier may be ill-advised in some circumstances, depending on the roof system design, insulation and ventilation.

Ice-damming can be a problem where snow and ice could thaw in the central expanses of the roof only to re-freeze near the eaves.

A premium modified bitumen Ice & Water membrane is recommended along the eaves of a roof under these conditions. LeakBarrier MS300 and SS400 Ice & Water Armor can be used under shingles. MS300 is a fiberglass reinforced, self-adhesive modified bituminous roofing underlayment with mineral granules on the surface for enhanced skid resistance. It is perfect for use for extra protection along the eaves of a steep-sloped asphalt shingle roof.



**MS300**

**MS300 installation ►**



The use of a secondary water barrier may be ill-advised in some circumstances, depending on the roof system design, insulation and ventilation

Roofing contractors may choose synthetic felt over traditional felt for use under shingles because of the convenience of the lighter weight of synthetic felt.

Again, climate may be an important factor to balance against the needs of the contractor for walkability and labor savings. A steep sloped asphalt roof is designed to shed water. In many climates, the use of traditional asphalt saturated felt is adequate for shingle roofing applications. Contractors are familiar with the handling and use of inexpensive 15# roll roofing. This felt can be easily attached with staples and provides a good alternative to synthetic felts. A modified bitumen secondary water barrier may not be justified cost-wise in these applications. Also, the area of roof to be covered is not often large and so exposure to the elements is not an issue. Contractor familiarity with handling of asphalt saturated felt may also be a factor.

Roofing contractors may choose synthetic felt over traditional felt for use under shingles because of the convenience of the lighter weight of synthetic felt. This again is at the contractor's discretion although the impermeability of the synthetic felt is a factor. The synthetic felt provides a secondary water barrier which also acts as an impermeable vapor barrier. The consequences of both should be evaluated with respect to the design of the home and the climate.



*EasyLay UDL 15*

In summary, asphalt shingles are compatible with a wide range of underlayment options. The following underlayment choices are recommended for shingle applications.

- ◆ **Good:** Conventional felt is suitable for asphalt shingle applications. The synthetic felts cost more but will be easier to carry to the roof top.
- ◆ **Better:** A lightweight synthetic such as EasyLay UDL 15 attached with capped nails may be a better choice for under shingles because of its longer life and light weight. A heavier synthetic such as EasyLay UDL Basic or EasyLay UDL 50 can be used as an upgrade to EasyLay UDL 15. A conventional asphalt saturated felt for the main expanses of roof can be reinforced with LeakBarrier MS300 self-adhering modified bitumen membranes in vulnerable areas of the roof. These can be self-adhered and nailed to the roof deck as needed.
- ◆ **Best:** Premium self-adhering roofing underlayment such as MS300 could also be used to cover the entire roof, creating a secondary water barrier. Such premium underlayment products are ideal for use under premium grades of asphalt shingles where a long life is expected; and where the design of the house is compatible with the use of a secondary water barrier. It is important to ensure that the roofing system is properly ventilated. Such complete coverage with a secondary water barrier made of a premium modified bituminous underlayment is also recommended in high wind areas where shingle loss can be a problem.

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## For shakes, slate and other applications

By far the most common primary roofs for residential construction are shingles, metal and tiles, in approximately that order. Less commonly, cedar shakes, slate, plastic shingles and other materials are used for residential roofing. The same principles that apply to metal roofing, tile roofing and shingle roofing also apply

to these exotic materials. What will be the expected life of the primary roof? What will be the maximum temperatures beneath the roof? What stresses must be endured during the installation process?

The selection of an underlayment suitable for these less frequently encountered roofing systems is governed by the same considerations discussed above, which should be evaluated on a case-by-case basis for each project.

Table 3-1 serves as a guide to which underlayments are suitable for various primary roof applications. Further, Table 3-2 tabulates various underlayment product features for easy comparison.

<b>Product selection matrix</b>								
<b>Application Method/End Use</b>	<b>Synthetic – Economy grade</b>	<b>Synthetic – Mid Grade</b>	<b>Synthetic – Premium Grade</b>	<b>Synthetic – Premium Self-Adhesive</b>	<b>Self-Adhesive Shingle Underlayment</b>	<b>Self-Adhesive Underlayment – Granule Surfaced</b>	<b>Self-Adhesive Underlayment – Fabric Surfaced</b>	<b>Self-Adhesive Underlayment – Film Surfaced</b>
<b>Application Method</b>								
Mechanically Attached	●	●	●	●				
Self-Adhered					●	●	●	●
<b>End Use</b>								
Shingles	●	●	●	●	●	●	●	●
Cedar Shakes	●	●	●	●	●	●	●	●
Tiles (Mechanically Attached)		●	●	●	●	●	●	●
Tiles (Foam Attached)			●	●		●	●	
Metal		●	●	●			●	●
Valley Liner	●	●	●	●	●	●	●	●
Low Slope Roofing		●	●	●				
Steep Slope Roofing	●	●	●	●	●	●	●	●

*Table 3-1*

## Product features and benefits

No matter the primary roof, each underlayment product can be evaluated and compared with others in terms of various features such as weight per roll, weight per square, roll width, fastener type required for installation, walkability and ease of handling. Table 3-2 lists many of these product features side-by-side for easy comparison and a more detailed discussion follows.

Product Category	Type	Reinforcement	Composition (materials)	Thickness, nominal (mil)	Roll Size (sq ft)	Nominal Weight (lb)	Specific Weight, nominal (lb/sq)	Warranty*
<b>TRADITIONAL</b>								
15# Felt	Organic	Organic Felt	Asphalt Saturated	25	432	33	7.6	n/a
30# Felt	Organic	Organic Felt	Asphalt Saturated	40	216	33	15.2	n/a
<b>SYNTHETICS</b>								
Synthetic underlayment Economy grade	Synthetic	Polypropylene	PP scrim plus coating	8	1,000	22	2.2	20 years
Synthetic underlayment Mid grade	Synthetic	Polypropylene	PP scrim plus coating	12	1,000	32	3.2	30 years
Synthetic underlayment Premium grade	Synthetic	Polypropylene	PP scrim plus coating	16	1,000	43	4.3	50 years
Synthetic underlayment Premium Self-Adhesive	Synthetic	Polypropylene	SBS self-adhesive	40	216	50	23	30 years
<b>SPECIALTY</b>								
Shingle underlayment Slag surfaced	Mod Bit	Fiberglass	SBS self-adhesive	56	200	60	30	n/a
Shingle underlayment Sand surfaced	Mod Bit	Fiberglass	SBS self-adhesive	48	200	50	25	n/a
Shingle underlayment Film surfaced	Mod Bit	None	SBS self-adhesive	40	200	55	27.5	30 years
Tile/Metal Underlayment Fabric surfaced	Mod Bit	Fiberglass	SBS self-adhesive	60	200	55	27.5	30 years
Tile/Metal Underlayment Film surfaced	Mod Bit	Fiberglass	SBS self-adhesive	48	200	50	25	30 years
Tile Underlayment Granule Surfaced	Mod Bit	Organic Felt	SBS self- adhesive	100	108	75	69.4	20 years

**Table 3-2**

## Weight, width and coverage per roll

The weight of a roll of underlayment is just one feature. How many rolls of underlayment need to be transported to the job site and lifted to the rooftop?

A synthetic underlayment has the obvious advantage that a roll of synthetic underlayment could cover five to ten squares (depending on its thickness) whereas a premium self-adhering modified bituminous product will cover only

one or two squares per roll. Rolls of synthetics are also wider (typically 48 inches compared to 36 inches) so less rows are required typically are required to cover a large expanse of roof.

Table 3-2 includes a column titled “specific weight.” This number represents the nominal weight normalized to the cover one square of area (100 square feet) rather than the weight per roll. It approximates the total weight of material that will need to be hauled to the roof to cover one square of roof area.

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## Fasteners and methods of attachment

The reason staples or uncapped nails are not recommended for synthetic felt is that holes can stretch and open up wider around the nails or staples.

A traditional tar paper felt or premium modified bitumen can generally be attached with staples or nails. Capped nails could also be used but are not essential as in the case of synthetics. Table 3-1 lists the usual method of attachment for each of the types of underlayment products.

The reason staples or uncapped nails are not recommended for synthetic felt is that holes can stretch and open up wider around the nails or staples. Stresses are intensified around the fastener as the underlayment shifts. To make matters worse, water has a low surface tension on a polymer surface. Water does not bead up on a typical polymer. Rather it drains through the holes around the fasteners. A synthetic felt will wick water through a fastener hole because of a capillary effect. That is why capped nails are mandatory for attaching a synthetic felt to the roof deck.

Asphalt repels water and in general wicking is avoided when using an asphalt-coated or asphalt-saturated product or any premium underlayment with a layer of modified bitumen included in its construction. A product with a layer of modified bitumen has the additional advantage of self-sealing around nails, essentially plugging up any holes. A self-adhering underlayment further prevents the spread of leaks between the underlayment and the deck to which it is attached.

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## Walkability

Walkability or traction is a property that can actually be quantified, although there is a subjective or human aspect to it. The steepness of the slope, the type of footwear of the roofer, and the coordination of the roofer certainly influence walkability. To test walkability objectively, an underlayment can be installed on a small roof section in a controlled laboratory environment. The slope of the roof section can be gradually increased until a point is reached where the underlayment becomes difficult to walk on. This allows for an objective comparison between a many types of underlayment. The surface can be dry or wet.

Obviously, a mineral surfaced (granulated) underlayment will have the best walkability. Asphalt saturated organic membranes also have excellent walkability. The original asphalt coated EasyLay (made with high performance polyester or “HPP”) has a special nonwoven polyester cloth top surface with an asphalt coating that provides excellent walkability similar to traditional asphalt-saturated organic felt. EasyLay HPP was designed to handle in a manner similar to traditional felt both in terms of walkability as well as weight and flexibility.

Premium modified bitumen underlayment products also are available with various types of top surfacing materials that are each engineered for walkability.

In general, synthetic felt is going to have more slipperiness and less walkability than either traditional felts or modified bituminous underlayment.

One reason for using a woven scrim in synthetics is that the texture of the scrim improves the walkability. In general, synthetic felt will have more slipperiness and less walkability than either traditional felts or modified bituminous underlayment. Yet, for most slopes of roofs, walkability should be manageable, even considering the need to install a large number of capped nails to attach the synthetic felt to the deck.

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## Ease of handling

A related property falls under the heading of ease of handling. Does the underlayment lay flat and stay where it is positioned? Could the peel-and-stick membrane be slightly re-positioned once the “sticky side” touches down on the roof? This property has to do with the tackiness of the adhesive. Ideally, at first, it should be sticky but not too sticky. Once it is placed into its final position and a little pressure is applied, one should expect the underlayment to bond permanently to the deck.

Oftentimes these factors are difficult to fully evaluate until one uses an underlayment on an actual roof project. Unforeseen problems may not arise until one is installing an underlayment on an actual rooftop. Extremes of temperature, roof slope and wind conditions can all affect the ease of handling of underlayment and the outcome of a roofing project, whether it is a success or failure.

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## Exposure limitations

Asphalt saturated organic felts require protection from damage and the weather. Rolls need to be stored upright in a dry location and should never be installed when wet or over a wet roof deck. Traditional asphalt-saturated organic felts have a reputation for becoming wrinkled when left exposed for extended periods and rained on. They can warp when exposed to UV radiation and moisture. When installing organic-felt, roll-roofing underlayment, the roofer must be conscientious of weather conditions and take care not to install when rainfall is anticipated before the primary roof can be installed.

Exposure limits can only be loosely quantified to some degree. They can be compared to the shelf life of food products, as indicated by “sell by” or “best by” expiration dates.

Premium modified bitumen underlayment has much longer exposure limits than traditional felt. Exposure limits are typically specified as 30 days, 90 days or six months for this type of underlayment depending on the top layer. Modified bitumen formulations can include UV stabilizers and typically last much longer than asphalt saturated felts.

Polypropylene is highly resistant to any damage from moisture. It can also withstand considerable amounts of UV radiation without warping. Hence, synthetic felts characteristically have very long exposure limits. However, it is a rare project in which the primary roof is not completely installed within 90 days after installing the underlayment so values of exposure limits beyond 90 days or six months are a moot point.

Modified bitumen formulations can include UV stabilizers and typically last much longer than asphalt saturated felts.

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## Product customization

The nature of the manufacturing process for synthetic felts lends itself well to product customization as could be appreciated from reading Part Two of this series on “Rethinking Roofing Underlayment.”

The synthetic felts are initially wound in large master rolls which may contain hundreds of squares of the underlayment. When this underlayment is processed in local manufacturing plants, there is an opportunity to customize the product in many ways.

As discussed earlier, polypropylene holds ink well and lends itself well to printing processes. Therefore the synthetic felts can be overwritten with markings to show where fasteners should be attached or various alignment marks to aid in installation. Moreover, the roofing contractor's company logo or other advertisement can be colorfully printed right on the underlayment so that the underlayment will essentially serve as a billboard, promoting the roofing contractors services to the entire neighborhood until the primary roof is installed. This customization is relatively inexpensive and is a great way to promote one's services.



***Customization – Any roof as a billboard***

The rolls can also be cut to practically any-sized width that the roofer desires. Consult a Tarco customer service representative or sales representative for more information on how UDL products can be customized to the needs of the roofing contractor.



***Custom printing***

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## Warranty coverage

With the primary roof protecting the modified bitumen underlayment from the UV rays of sunlight, underlayment with asphalt or modified bitumen content can last as long as any synthetic underlayment.

Metal or tile roofs typically have long service lives so there is an expectation that the underlayment also will last for decades. In these applications, the metal or tile primary roof protects the underlayment from physical damage but they are not completely watertight. Hence, a watertight underlayment is necessary to protect the interior of the building from moisture penetration. The two system components – primary roof and secondary water barrier – complement each other perfectly.

Tarco offers 30 year warranties on several LeakBarrier Ice and Water Armor underlayment products including PS200<sup>MU</sup>, PS200<sup>HT</sup>, EasyLay UDL SA, and NR600 Ultra.

Not all modified bituminous LeakBarrier underlayment products carry a 30 year warranty. For examples, MS300 (mineral surfaced) and SS400 (smooth surfaced) are simply warrantied to be free from manufacturer's defects. Likewise, asphalt saturated organic felts are warrantied to be free from manufacturer's defects. That is because the expected life of organic felt is so dependent on how the material is handled and installed by the roofer.

Even though the polypropylene has very long exposure limits, storage in direct sunlight is not recommend since any polymer will degrade somewhat when exposed to UV radiation.

For the synthetic underlayments, Tarco warranties vary depending on product configurations such as thickness, unit weight, etc. The UDL products are offered with a limited material warranty of 20 years, 30 years and 50 years, respectively, for EasyLay UDL 15, EasyLay UDL Basic and EasyLay UDL 50. The thicker the membrane is, the longer the warranty. Even though the polypropylene has very long exposure limits, storage in direct sunlight is not recommend since any polymer will degrade somewhat when exposed to UV radiation.

The above information serves as a general guide to what can be expected. The warranties reflect to a greater or lesser degree the ease-of-use and reliability of the product. One should consult the warranty information for each product for the specifics of the warranties.

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## Cost considerations

Today's roofers have a wide range of underlayment products from which to choose. Once it has been determined which underlayment products are suitable for a particular project then the roofer and the building owner need to have an open discussion about cost considerations, which include not only the quality of the materials but also labor costs.

With respect to materials, traditional asphalt saturated organic felts will be the lowest cost materials available. Next in terms of cost is EasyLay UDL 15. Considering that one roll of synthetic felt will cover as much as five to 10 times the area that is covered by one roll of organic felt, the materials costs in terms of roof area are nearly the same. However, these costs go up as the thicker synthetic felts are selected. While there is some labor savings in terms of transporting the materials to the roof, both of these types of underlayment use mechanical attachment and hence there are attendant materials and labor costs.

Where the primary roof consists of high-quality metal panels, clay tiles or architectural shingles, underlayment materials will only be a fraction of the cost of the roofing system and the building owner is not likely to compromise on quality.

The cost of the underlayment compared to the primary roof is another consideration. Where the primary roof consists of high-quality metal panels, clay tiles or architectural shingles, underlayment materials will only be a fraction of the cost of the roofing system and the building owner is not likely to compromise on quality. Here the most important cost consideration belongs to the roofing contractor, who will want to choose an underlayment that will minimize labor costs without compromising quality.

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## Product evolution – What is next?

With the evolution and refinement of synthetic underlayment products and modified bituminous underlayments, the roofing contractor currently has several low-cost, high performance types of underlayment products from which to choose. As for the future, more refinements in the areas of ease of application and customization can be expected. No major new material advances are expected in the near future, because polymer processing is a mature industry and the manufacturing processes are well established. Possibly there will be tweaks in the walkability and the exposure limits.

It is expected that all three major categories of underlayment – including conventional asphalt saturated felt, specialty modified bituminous membranes and synthetic polyolefin felts – will each one have a role to play in the roofing of residential buildings in the 21st century. 💧