cloth. These include glass fibers, ceramic fibers, carbon fibers, organic fibers, quartz fibers and cotton fibers. Replacement fibers for asbestos in cloth uses depend upon the specific application.

Substitutes appear to be available for almost all high-temperature applications of asbestos cloth. If asbestos cloth were not available, EPA expects that the following substitutes would replace asbestos cloth as follows:

Fiberglass cloth products: 50 to 60 percent.

Aramid cloth products: 20 to 25 percent.

Carbon/graphite cloth products: 5 to 10 percent.

Ceramics and silicon-based cloth products: 10 to 15 percent.

Because of their temperature and flame resistance, asbestos clothing products protect wearers from fire and heat. However, substitute products have been developed for asbestos clothing products. Aramid cloth products can substitute for asbestos in protective garments, but are more expensive. Some other textile products made without asbestos are less expensive than the counterpart product made with asbestos cloth. Substitute products for asbestos clothing include nomex, fiberglass, and zetex. Asbestos clothing has been replaced by substitutes in most or all firefighting and industrial applications.

c. *Asbestos-cement pipe and fittings.* Products in this category are manufactured for various uses. Most pipe is used to carry water or sewage. A small amount is used to carry chemicals or is used as air ducts. Pipe varies in construction depending on use and such factors as how deep it will be buried, the rate of fluid transmitted and whether it is under pressure.

EPA believes that at least one suitable substitute is available for each of the many pipe types and sizes. Based on information from manufacturers, EPA concluded that operation and maintenance costs and service life of all products are essentially similar. Asbestos-cement pipe does not dominate any segment of the pipe market, but is popular for certain applications such as carrying water at low pressure. If this rule is promulgated, EPA expects that the following substitutes will replace asbestos-cement pipe as follows:

Polyvinyl chloride (PVC) pipe	72 percent
Ductile iron pipe	23 percent
Prestressed concrete pipe	4.2 percent
Reinforced concrete pipe	0.15 percent

These estimates are only approximate and do not take into account other possible substitutes that EPA considered somewhat less suitable than those noted above. These include various plastic and vitrified clay pipes.

All of the substitutes considered are well established in the pipe market and can be joined to or replaced existing asbestos-cement pipe sections.

d. *Roofing felt.* Asbestos roofing felt is used for built-up roofing, primarily on flat roofs. "Built-up" refers to the practice of layering felt lengths on top of each other with hot roofing tar or asphalt mopped between layers of adhesion and additional weather protection.

Currently, less than 10 percent of roofing felt sold contains asbestos. Organic felt, fibrous glass felt, and single-ply membrane roofing all have greater shares of the flat roof market than asbestos felt.

Of these three well-established products, fibrous glass felt most closely approximates asbestos roofing felt in purchase and installation prices and service life. Organic felt has a lower purchase price, but has lower insulation value and moisture resistance and a somewhat shorter service life. Single-ply membrane roofing consists of a laminate of a modified bitumen or polymeric system such as polyvinyl chloride or ethylene propylene diene monomer. A typical product consists of a five-layer laminate composed of a thick plastic core protected on each surface by a layer of modified bitumen and an outer film of polyethylene. The purchase price of single-ply membrane roofing is several times that of asbestos felt, is about as expensive to install, but is expected to have a longer service life. Single-ply membrane also has the advantage of not requiring the use of hot asphalt during installation.

e. *Flooring felt and felt-backed vinyl sheet flooring.* Asbestos flooring felt was used as a backing for vinyl sheet flooring products. The felt confers dimensional stability and helps prolong floor life when moisture from below the surface is a problem. EPA does not believe that flooring felt is currently being produced in the U.S.

A large number of non-asbestos vinyl flooring products have entered the market in the last 5 years. These products include sheet backed with felt containing fibrous glass, cellulose, polyethylene or polypropylene fibers, ceramic fibers, and plastic foam. Also available are unbacked sheet and numerous traditional flooring products such as ceramic tiles, carpeting, and wood flooring. Among these many products, consumers will find adequate substitutes for any particular use of asbestos containing felt or felt-backed flooring.

EPA has found that price differentials between asbestos and non-asbestos vinyl sheeting are negligible. Overall, the backing is a small part of the total cost for vinyl sheet products. Maintenance and service life are not materially affected by the backing. The wide range of prices found among various vinyl flooring products are mostly attributable to the colors and patterns of the vinyl as well as the wear-layer thickness.

f. *Vinyl-asbestos floor tile.* Vinyl-asbestos floor tile is used in numerous applications, but has been especially popular for use in heavy traffic areas such as in stores, kitchens, and entry ways. Addition of fiber contributes to abrasion and indentation resistance, dimensional stability, and resistance to moisture, heat, and oil.

Currently, the most suitable available substitutes for vinyl-asbestos floor tiles are various asbestos-free vinyl composition floor tiles. In place of asbestos fibers, manufacturers are using synthetic fibers including fibrous glass, polypropylene, polyethylene, and cellulose.

There are also several types of vinyl tiles that contain various fillers and resins in place of fiber. Many non-asbestos vinyl tile products have been on the market for only a few years. Consequently their service lives are not well established. Some industry contacts believe the non-asbestos tiles will last as long as the asbestos tiles, while others believe service lives will be shorter. EPA currently assumes that service lives of the non-asbestos tiles will be about one-third shorter than for the asbestos tiles.

g. *Asbestos-cement sheet.* There are a number of cost competitive substitutes for asbestos-cement sheet. These include both products using substitute fibers and other product substitutes. Glass-reinforced concrete is suitable for most corrosion and heat-resistant applications where asbestos-cement sheet is now used. Glass-reinforced concrete is widely available at a price that has been declining relative to that of asbestos-cement sheet. Cement-wood board is suitable for the general construction applications of asbestos-cement sheet. The use of resins and surface coatings with cement-wood board makes the product suitable in weather-resistant applications.

In the siding market, asbestos-cement products have no cost advantage over galvanized steel, aluminum, or concrete. However, asbestos-cement sheet may have greater corrosion resistance than the other products. In cooling towers, polyvinyl chloride products or ceramic