

PORCELAIN INSULATORS
GUIDE BOOK FOR COLLECTORS
(Unipart Pin Types)

By Jack H. Tod

THIRD EDITION

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Pass & Seymour, Inc., Syracuse, NY
H. K. Porter Co., Electric Division., Pittsburg, PA
Square-D Co., Electronic Equipment Div., Peru, IN
Westinghouse Electric Corp., I & D Prod. Div., Derry, PA

Many collectors throughout the country have over the years furnished data on insulator styles, markings and company histories. It would take a book in itself to just list the names of all those who have contributed pieces of information that make this book a more complete reference. Each one deserves a big vote of thanks from me and all other collectors.

Several collectors furnished key information on historical matters, all as a result of their personal research work, and I have included in the appropriate sections credits for that work.

Elton N. Gish of Port Neches, Texas must be singled out for special recognition and thanks for all his contributions to this book. Over the past 15 years, Elton has contributed considerable information on insulator styles and markings and probably more key historical data than all the other contributors combined. So much of the information on the insulators and history of the early companies of the 1890-1910 period came from his research material that I consider him a co-author of those sections.

I also owe Elton my personal thanks for his work of several months to completely review and proof the manuscript for this Third Edition -- making numerous corrections and refinements of the factual data.

PREFACE

Collecting porcelain insulators in the 1960's was severely handicapped by the lack of a reference system to describe the insulator styles short of sketching or photographing every one in correspondence, and we had no books with information on the manufacturers, the markings, or the styles of insulators that had been made. The original impetus of my research was to create the Universal Style Chart for easy reference to the styles, but also to publish the other information gained as a byproduct of the research for my main purpose.

A concentrated research effort in 1970-71, including extended trips to visit all the manufacturers in the eastern U.S., culminated with the publication of the First Edition in Nov. 1971. Unabated research continued for the next several years, including more lengthy trips in 1972 and 1973 to visit the plants a second or third time. At most of the plants, I toured the manufacturing areas at least once, and I had general access to the test facilities, engineering labs and offices, drawing files, old files in storage, the old and current dumpage areas, etc. Obviously the companies were very interested themselves in the old history of their own plants and those of others, and they were very supportive to my research in every way.

Continued research naturally produces a continuous stream of new information, so the 1971 publication was a matter of drawing a line somewhere and publishing all that had been learned. This gave a fresh starting point, where everything not published was then new information. This same procedure was followed when book supplements were published in 1972, 1973 and January 1975.

Within one more year, after even more information had been learned, the flow of any important new facts had slowed considerably. A Second Edition was thus published in 1976 to combine all the previously published information together with new additions up to that point.

Commencing in 1981, copies of the Second Edition were annually updated with text corrections and additions, marginal annotations and addenda pages. This was possible because the original Second Edition had gone out of print in 1981, and I then started to annually make additional copies by reproduction and hand-binding methods.

The accumulated corrections and additions were a factor in deciding to publish a Third Edition, as was the desire to avoid the need for hand-making copies in succeeding years. However, the most important consideration was the desire to utilize considerable new historical information accruing in just the past couple of years.

The text of this Third Edition has been completely rewritten to add this very important new material and at the same time delete or revise other portions of the text. We are now able to replace former qualified guesses in certain histories with documented facts. In some cases, this paints a completely different picture of what happened 80 to 100 years ago. A number of very important styles have been added to the Universal Style Chart. All the recent new markings have been added, and several very rare markings formerly missing are now illustrated.

The pricing tabulation in Chapter 8 has been greatly expanded, now listing values for virtually every style except the very common ones. A value is also given for many of the more valuable specific insulators of a given style, marking and glaze color. The values listed are consensus of eight knowledgeable collectors and/or dealers, all individual figures weighted to allow for high or low rating tendencies and to reflect the expertise of some raters on categories in which they are authorities.

PERSONAL SKETCHES

(Jack H. Tod, author and publisher)

Graduate electrical engineer, 1950, Univ. of Arizona. With Motorola 1950-1960, Phoenix, Government Electronics Division, satellite and missile guidance systems design work.

In private business 1960-1967, professional coin dealer.

Started collecting both glass and porcelain U.S. insulators in the mid-1960's, with entire interest pointed towards porcelains by 1970. Inactive in collecting since 1980.

Since 1970, most available time spent researching and writing about insulators and related activities. Editor of the "Porcelain Insulator News" column in "Crown Jewels" magazine 1971-1984. Wrote and published several books on insulators (see Bibliography), co-authored and published the foreign porcelain books. Additionally, did work on and/or published insulator books by two other authors.

Charter member #13, National Insulator Association. Very active in NIA work before, during and after the 1973 organization. Co-authored or authored the NIA bylaws, code of ethics, show standards, membership handbook. Committee chairman on bylaws and show standards for several years, thereafter a consultant on those. Recipient of the NIA Outstanding Service Award (1978), and NIA Honorary Life Membership Award (1983).

(Elton N. Gish, collector, researcher and insulator columnist)

Graduate chemical engineer, 1972, Lamar University. Employed by Texaco at their refinery in Port Arthur as senior project engineer in the Operations Planning Division.

Started collecting insulators in 1970, specializing in Brookfield insulators. Within 2 or 3 years started to specialize in early porcelain classics. An equally important hobby is his insulator research work, most notably on companies and insulators in the 1890-1920 period.

Editor of the "Porcelain Insulator News" column in "Crown Jewels" magazine 1984-present. Recipient of the "McDougald" special award for work on the magazine (1987). Consultant on histories, styles and markings for "Porcelain Insulators Guide Book".

Charter member #41, National Insulator Association. Recipient of the Sterling Finch Memorial Award (1987) for service to the hobby.

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Chapter 1

THE EVOLUTION OF PORCELAIN INSULATORS

The invention and later perfection of the telegraph by Morse in 1844 created an immediate need for line insulators. Although glass insulators were rapidly developed for this use, there are some references to "flint" or "porcelain" insulators having been used on telegraph lines as early as about 1853. There also exist a number of specimens reputedly recovered from military telegraph lines constructed in the 1860-1880 period.

When the telephone was introduced by Alexander Graham Bell in 1877, insulators were soon required in very large quantities. Railway signal systems had also been developed by this time, largely as the result of relay techniques developed for the telegraph systems. The glass insulators had reached a state of development by that time where they could be made cheaply in large quantities, and they generally performed satisfactorily for signal use. This is probably why there is little mention in any source of porcelain line insulators being made or used in the 1870's and 1880's.

In 1881, Thomas Edison invented the incandescent lamp, and in 1882 he installed a 1200-horsepower generator in a New York warehouse and began furnishing power (at 1300 VDC) to "subscribers" for operation of electric lights. Existing telegraph lines with glass insulators were used in this distribution network. The average citizen considered these new-fangled lights just a fad, and a dangerous one at that. When the City of Syracuse, New York was considering the installation of 148 electric street lights in 1882, an alderman introduced a motion "that all poles be enclosed by a ten-foot high wood paling fence in order that pedestrians would be protected from the dangerous electricity that would run down the poles on wet nights".

In the following year, a New York grocer became the first person to use transmitted electric power for a purpose other than lighting when he hooked an electric motor to Edison's line and connected it to his coffee grinder. The first electric railway came into use in 1885 when Richmond, Virginia converted 12 horse-drawn trolley cars to electric motor drive. The "fad" obviously wasn't dying out; it was spreading.

As demand for electric power rose rapidly in the 1880's, the line loss became a limiting factor. The D.C. voltage running into the subscribers' homes could not be further increased, since serious electrical shocks were already a problem. But there was a solution. Why not use an Alternating Current (A.C.) system, wherein transformers can be used to step up or step down line voltages as required? The power can be generated at a low voltage, stepped up for distribution, and then stepped down again for use by the customer.

The first A.C. system in this country using transformers was put into operation in 1886 at Great Barrington, Massachusetts. Even a moderate step-up of the distribution voltages held line losses to practical values. But it wasn't long before a different problem came up. The glass insulators in use had reached their insulating limitations. It was at this time that larger glass insulators were designed for power distribution. Fred M. Locke of Victor, N.Y. started in the business of selling ones made to his design by the glass insulator manufacturers of the day. Dist-

tribution voltages quickly rose to the limits of these king-sized glass insulators.

In just a few years time, the people who had previously been yelling "Just a fad, just a fad" changed their tune. The eastern cities, which were already being darkened by the shadows of thousands of telegraph and telephone wires above the streets, saw linemen stringing power distribution lines as fast as the poles could be erected. Some cities and localities had dozens of separate power generating stations, each supplying different distribution circuits.

By the early 1890's, most power distribution had fallen into the hands of our pioneer electric utility companies. The hodgepodge of small generators was already creating many technical problems, and it certainly wasn't an efficient way to create electricity. Waterpower was the answer. A number of waterpower generators came into use, and power was sent to the cities over "transmission" lines using the large glass insulators at (or above) their ratings. Once again, insulators were a stumbling block. At the relatively low transmission voltages, the line losses were becoming intolerable.

Further progress was stymied. Transmission engineers probably hounded Fred Locke daily to come up with a better insulator, and Locke's catalogs made it very clear he only guaranteed his insulators up to "the potential stated" in the catalog. Pass & Seymour had started making wet process porcelain pin type insulators in 1890, and it was firmly established that porcelain was the answer to a better insulator, but for some unknown reason they restricted their designs to telegraph sizes. Locke had various porcelain companies manufacture high-voltage porcelain insulators to his designs in the 1894-1897 period, at first unsuccessfully by dry process methods but thereafter by the wet process method.

Once "glaze-welding" techniques were applied to the manufacture of insulators in the 1896-1897 period, progress was rapid. Insulators were readily manufactured which operated reliably at any transmission voltages contemplated for that period of time. Both Imperial Porcelain Works and R. Thomas & Sons Co. started marketing high-voltage insulators at this time. Fred Locke, who had initially been a jobber for the Imperial Porcelain insulators, built his own insulator plant in Victor, N.Y. in 1898.

A real breakthrough had been made. Long transmission lines of higher and higher voltage were built and, for a few years at least, insulators were available for higher voltages than the state of the art had reached for transformers, switching equipment and other associated items. By 1900, Locke was making pin type insulators for two long 60 Kv (60,000 volts) transmission lines in California, and these served well until the line was later re-insulated for a higher voltage.

It wasn't long before pin type insulator design once again became a stumbling block in the progress of high-voltage transmission, but a new type of insulator came to the rescue in the 1906-1907 period. These were the "under-hung" insulators which, after a few years, became known as "suspension" insulators. These disk-like insulators can be connected in series in what are termed "strings" to achieve a very high degree of insulation. Soon, lines were constructed for the unheard-of voltage of 100 Kv. Over the years, voltages crept higher and higher, even up to 345 Kv, and then up to a 500 Kv line (370 miles long), then to a recent 735 Kv line. As of this writing, lines are now in operation in excess of one million volts.

The advent of the suspension insulator did not spell the end of the pin type transmission insulators. Pin types continued to be used for most lines up to 66 Kv, and some were even used at 88 Kv. Pin types for these higher voltages were of multipart construction, and uniparts were limited

to much lower voltages. In 1922, Jeffery-Dewitt Insulator Co. spearheaded the development of large unipart pin types which were commonly used at 33 Kv, and most other companies made similar designs in later years.

The development and promotion of line post insulators by Lapp Insulator Company in more recent years is slowly ending the use of pin type insulators for transmission use, and line post insulators are making inroads into the field of primary distribution insulators. Although there will always be a need for pin types in secondary distribution systems, some insulator companies stopped manufacturing pin types altogether in recent years. As of this time, only six companies continue to make pin types.

It is interesting to trace the evolution of insulator designs and manufacturing techniques since the first wet process units were made in the 1890's, and some of this will be related in greater detail in later chapters. Most designs went through gradual changes as methods of production were refined. However, it is noted that some of the very earliest designs are still in production to this day with only slight changes in shape or dimension.

In the early days, changes came about rapidly, partly because of mechanical or electrical necessity and partly because some customers tended to dictate changes to manufacturers. Many of these changes came about because of ever-increasing conductor sizes and methods of tying on the conductor. Conductor grooves on early units were as small as 1/4" diameter, and they increased in various increments to the point where some modern units have grooves up to 2" diameter. The changes were sometimes so rapid that manufacturers drawings weren't redrawn; the draftsman just changed the dimensions with his erasure. One drawing I saw had the tie-wire groove dimensioned on both sides of the outline drawing -- one side as 3/8" and the other side as 1/2"!

As fast as the manufacturers could adjust their tooling to a given design, someone dictated another change. They were continually called upon to make units for special purposes, but they cataloged only the more popular designs and kept the other designs in the background. Nevertheless, catalog listings continued to grow, and at least several companies evidently thought it prestigious to have fat catalogs with a great many designs, some differing from others by the most picayunish detail.

The number of styles made by the different manufacturers grew to the point where it became difficult for the engineers in utility companies to make decisions of what unit to use on their lines. Furthermore, just when the utility became satisfied with a design and started to standardize their lines, the insulator company quit making it and offered something else instead. In an effort to stick with insulators of even approximately the same conductor and tie-wire groove configurations, some utilities rapidly changed back and forth between half a dozen or more manufacturers. To remedy all this confusion, the National Electrical Manufacturers Association (NEMA) set up standards for insulators of all types. These standards not only limited the unipart pin type styles to five standard designs to cover the secondary distribution voltage ranges, but detailed complete specifications for testing, marking, packaging, etc. Even though some long-established styles are still manufactured, most companies now prefer to concentrate on the manufacture of the NEMA styles.

Most of the evolutionary changes in production methods or insulator design that are of great enough interest to be included in this book are covered in detail in later chapters.

As mentioned at the beginning of this chapter, porcelain telegraph and telephone insulators were made in very early times. Units made by dry press methods could compete in price with glass insulators, and they

were entirely satisfactory for many communications requirements, especially local telephone lines. Once the wet process insulator industry had been founded to make power insulators, they also found time to make these telephone styles by wet process. It is difficult to see how these units could compete in price with glass insulators, but they were never sold in large quantities, and they could have been made as slack-time production items at little real expense. Most companies made these from about 1910 to the late 1950's. Since these units were priced lower than the small distribution types, many were bought for use in low-voltage power applications and for signal uses when better reliability was a factor.

Telephone insulator styles had been fairly well standardized many years before they were made in wet process porcelain. There is no significant design evolution in these porcelains except for minor changes to accommodate new production techniques.

It is appropriate to end this chapter in the same manner in which it was started -- namely, glass insulators. Glass insulators had always found use in low-voltage power applications, and jobbers continued to list them right along with lines of porcelain insulators. Thousands of glass insulators are still in use in street lighting and secondary power distribution systems. In the 1920's, Corning Glass Company started producing a number of unipart pin type insulators with their Pyrex glass, including some very large types for transmission systems.

The most interesting story though, is that Whitall Tatum Company (later Armstrong) and Hemingray Glass Company both sought to directly compete with porcelain insulators in the very large market for secondary distribution insulators. They made types of glass insulators that duplicated in most cases the porcelain designs, and almost from the start they manufactured these in a dark amber glass to simulate the brown color that utility companies had become used to seeing on their lines. Apparently, the only sales point was that of economy. Possibly the glass companies did not realize that historically the power companies usually considered initial insulator cost secondary to the factors of reliability and long term performance. The glass counterparts were demonstrably more fragile than porcelain, and they had no treatment to prevent radio interference problems. These insulators never did make a big hit, and even today many of them are being removed from lines and replaced with porcelains.

Chapter 2

THE MANUFACTURE OF ELECTRICAL PORCELAIN

THE NATURE OF ELECTRICAL PORCELAIN

Electrical porcelain is a ceramic made with such materials and fired to such temperatures as to render it nonporous in itself, without the addition of protective coverings such as glazes. Haviland china wouldn't meet the technical quality standards of a modern insulator plant. Electrical wet process porcelain has absolute zero porosity, a property possessed by few, if any other, ceramic products.

The prime constituents of the porcelain insulator are flint, ball clays, china clay (kaolin) and feldspar. Additionally, aluminum oxide (alumina) may be substituted for some or all of the flint to obtain higher strength porcelain bodies. Glaze formulas are similar to that of the body material except for an increase in glass-forming and fluxing ingredients. All of the raw materials for porcelain insulators must be carefully selected for quality and mixed in exacting quantities.

Each of the constituents performs a function of its own or complements the function of one of the other materials. The ball clays impart plasticity in the soft working state of porcelain and give the material strength in its dry, unfired condition. The kaolin controls stability during the firing process by reducing the tendency toward warpage. The feldspars are the glass formers during the firing process, although the clays and flint also participate. The flint partly dissolves during the firing process, and a strong bond is created between the remaining core of the flint crystals and the surrounding glass. The completely vitrified porcelain body can be visualized as a microscopic crystalline structure completely bonded together with glass. Even though the end product is approximately 65% glass, it is chemically and structurally entirely different from ordinary commercial glass.

PREPARATION OF THE PLASTIC CLAY

Each manufacturer has slight variations in the way they prepare the clays, and some will delete or combine certain steps, or will use processes not used by other companies. The procedure below is a workable composite of the various company procedures, and some lesser steps have been omitted for the sake of brevity.

Comprehensive tests are performed on incoming materials to determine their quality before the freight cars are unloaded, and the material is then transferred to storage bays or gravity feed silos for use as needed. Clay batches are made by mixing carefully weighed quantities of each ingredient with a precise amount of water, and also by recycling "scrap" clay recovered from the many trimming and turning operations in the plant. The batch is thoroughly mixed until all clay particles are broken down, and the result is a mixture with a consistency approximately that of a heavy cream -- called "slip". This slip is processed through a number of screen filters at various stages, passes over a magnetic filter to remove iron particles and then goes to a vacuum tank where all possible air is

removed from it. It is then pumped into large filter presses where the water content is reduced to about 22%, resulting in "plastic clay".

The filter cakes, approximately 1" thick by 30" diameter are about the same consistency as regular modeling clay, and it is this "green" clay from which the insulators are made (see Chapter 3).

KILN FIRING

The insulators are made from the green clay by various processes, dried, glazed and dried again. Still, after this tremendous amount of work, we don't have any porcelain. If you dissolved this unfired insulator in a bucket of water, let the water evaporate, and broke the hard cake up with a hammer, you would be back to just about what the freight car brought from the clay pits. The porcelain is born through the process of firing at high temperature.

Firing is a very exacting science. Regardless of how good the raw materials were and how much care was used in making the insulator shapes, the finished insulator will be no good unless the firing is perfect. The engineers who design and operate the kilns have made a career of this work, but there are so many variables in the chemistry that takes place during vitrification that it is still necessary to test insulators 100% to weed out defective pieces. Since it just about doubles the cost of the ware when it is fired, every inspection possible is taken to try to weed out probable defective pieces before they get to the kiln.

Until the 1920's, all insulators were fired in large "beehive" or "periodic" kilns. Smaller ware is placed in ceramic containers called "saggers" to facilitate stacking, and larger ware is placed atop these saggers. When the kiln is fully loaded, it is sealed and the firing is controlled by time and proper burner settings. Some companies still employ beehive kilns for firing very tall pieces, and pin types and other smaller pieces are simultaneously fired to make efficient use of the kiln space.

By 1925 most companies began installing "tunnel" kilns. As different from the "periodic" kilns, these are continually fired. The ware is loaded on kiln cars which travel slowly through the length of the kiln over a period of a little more than two days. As the ware moves through the kiln, the temperatures are very closely controlled at every point of its travel, and the 2200° temperature in the vitrification zone is held to the remarkably close tolerance of plus or minus 10°. The firing zone is only approximately 5 hours duration, preceded by 30 hours of rising temperature and followed by about 18 hours of controlled cooling zones. Something must at all times be going into the kiln and coming out the other end, and it is obviously a challenging job in an insulator factory to schedule all fabrication and test operations to fit the exact capacity of the kilns in use.

Chapter 3

HOW PIN TYPE INSULATORS ARE MADE

THE CASTING PROCESS

To make insulators by casting, clay "slip" is poured into plaster of Paris molds, sometimes under pressure, and the clay solidifies as the excess moisture is absorbed by the mold. The insulator is soon released from the mold as further drying causes shrinkage. It simplifies matters if the piece is first cast in a unipart outer mold, allowed to dry to a leather-hard state, and then machine turned for addition of the tie-wire groove. Mold lines are sponged off the cast insulator or sanded off after drying, and they usually are not visible on the finished pieces.

The quality (non-porosity) of cast insulators is equal to or better than that of the average insulator made by plastic processes. However, casting is a much more expensive process than even a semi-automatic hot press method with plastic clay and is reserved for manufacture of difficult porcelain shapes which cannot be made by the normal wet process.

There have been some pin type insulators made by casting for various reasons. Possibly the only small uniparts to have been so made were those manufactured by Pass & Seymour in the 1890's, and cast specimens are known which are believed to be from that source. Pass & Seymour is known to have also made at least one small pin type style with a cemented-in bushing to provide threads.

As noted in detail in other chapters, Spiral and Helical insulators were also made by casting because of their very irregular shapes, and Jeffery-Dewitt made their large, two-skirter uniparts by casting from the time they were first introduced in 1922.

THE "WET" PROCESS

Technically, insulators made by the "casting" process could be referred to as "wet" process units as far as quality of the end product is concerned, but the term "wet" process is specifically reserved for insulators made from clays in the plastic state. The terms "plastic process" or "hot press" are occasionally used when it is important to explicitly exclude cast insulators.

The modern methods of wet process manufacture differ very little from those used when the first wet process pin types were made. The major changes have resulted from the introduction of semi-automatic and automatic processes throughout the years. Different manufacturers use slightly different methods, and the process described below is a composite of the most widely used methods for making the average style and size of pin type insulator.

The "green" leaf clay (approximately 22% moisture) from the filter presses is fed into a "pug mill" which shreds the leaves under a vacuum and then reforms and extrudes the clay through a round steel die several inches in diameter. The extruded clay is cut into uniform short lengths called "pugs", each of which has sufficient clay to make one insulator. In the more modern processes, a vertical pug mill is combined with the

insulator-forming machine such that measured pug lengths are automatically dropped into the forming mold of the machine.

The major part of the insulator shaping is done in a semi-automatic "hot press" machine which has a revolving turret-type head that successively moves the work to several stations where individual shaping operations are performed. The term "hot press" stems from the fact that any of the rotating forming tools plunged into the insulator body are maintained at a high temperature by gas jet flames. The resulting instant drying of the clay surface immediately against the hot rotating tool prevents the plastic clay mass from sticking to the forming tool.

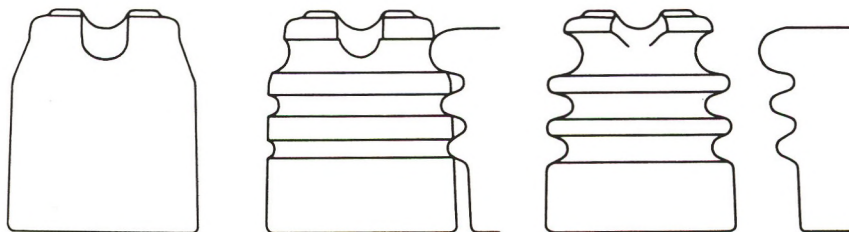
At the first station of the turret, the clay pug drops into an empty steel mold. At the second station a blanking die firmly presses the clay into the outer mold to form the outside shape of the insulator. At the next station, in what is called the "plunging" operation, a rotating die is pressed down upon the blanked piece to form the inside shape of the insulator. The pin hole is made without threads in this operation, and at the next station the threads are formed in either of two ways: In the "plunge-and-reverse" method, a threading mandrel is plunged in a rotary motion into the hole, and then the rotation is reversed during its extraction; in the "wobbler" method, a smaller mandrel is lowered straight into the pin hole, and the threads are formed by a gyrating motion of the tool. (See section on "Threading Methods".)

At the last station, the formed insulator is removed from the mold, and the next station for the empty mold is the starting point under the vertical pug mill.

It is obvious that the outside mold of the hot press machine must have sides that taper towards the top of the insulator in order to make it possible to extract the insulator from the mold. The tie-wire groove and any other side petticoats are therefore added later with a trimming operation.

Before leaving the subject of forming the basic insulator shape, it is well to describe the traditional hand method of forming which was used before the advent of automated machinery. A ball of green clay was first "thrown" in a rotating exterior mold and roughly plunged by hand to fill the shape of the mold. A swiveled "jiggering" tool with the insulator's inside profile was then pressed into the rotating clay to form the final shape. The threads were added at another work station by the plunge-and-reverse method. Jiggering is still used for some larger shapes of insulators that do not lend themselves to the normal pressing methods.

The insulators formed on the hot press are first allowed to dry to a "leather hard" condition and are then finished by "green trimming". The operator places the insulator on a vertical spindle, steps on a footswitch to rotate the spindle, and then advances a profile trimmer blade horizontally against the insulator as indicated in the accompanying illustration. After the trimmer blade is retracted and the insulator stops ro-



Green trimming a pin type. Left to right: An untrimmed unit, one in process of being trimmed, and the finished insulator.

tating, the operator sponges off any sharp edges, applies the trademark stamp (if an incuse or recess-embossed type of marking) and replaces the finished unit with the next piece. A good operator can perform all these operations on one insulator in a matter of several seconds.

After the trimming and finishing operations, the insulators then go through a thorough drying cycle of several days to a week or more, and if under-glaze markings are being used, they are applied after the drying cycle is complete, but before glazing.

Glazing comes next, and this is now done on automatic glazing machines, the development of which was largely spurred by the necessity for more complicated glazing on radio-treated units. The automatic machines have an endless belt of pegs on which the dried insulators are placed for passage through the glaze baths. Insulators which are glazed in this manner have a uniformity that cannot be achieved by hand glazing methods in high production. (See section on "Glazes".) After glazing, the units are again thoroughly dried and then fired. (See section on "Kiln Firing" in Chapter 2.) Firing is followed by 100% electrical test and inspection before packing. If sandblast markings are being used, these are applied immediately after the testing.

THE "DRY" PROCESS

For reasons which will become obvious later, insulators made by this process are also referred to as "dry press" units, and occasionally you will run across the term "dust process" in older literature.

Plastic clay is dried until the moisture content is reduced to about 12%, after which it is granulated by various methods to yield particles about the size of coffee grounds. The material is somewhat similar in action to snow; it can be manipulated around in loose form, but it is just wet enough to permit it to "ball" when pressed together in a steel die. The operator pulls a quantity of granules over the mold, strikes the excess off flush and then operates the press ram to form the insulator. Better compacting is achieved if the pressure is released once and then reapplied a second time.

The dry process is very well adapted to the manufacture of difficult porcelain shapes that cannot be made by wet process, and many companies made only dry process ware. It has the disadvantage that the end product is porous to varying degrees. While this is not a disqualifying factor for very low voltage applications, it rules out the use of dry process units for power use even at secondary distribution voltages.

Not counting the press ram and guide sleeve, dry process insulator molds are usually three-part types. Mold lines were usually not removed by sponging or dry-sanding and are discernable on these units unless the glaze was very heavy. Unfortunately, the presence of mold lines on a pin type insulator is not in itself a definite indication that it was made by dry process. The plunging molds for some irregular wet process styles (especially those made by Pittsburg High Voltage Insulator Co.) were made in two parts, and these "mold seams" appear on the insulators.

THREADING METHODS

The method of threading glass insulators wasn't patented until 1865, and the glass insulators made prior to that were threadless for use on unthreaded pins. Similarly the very early porcelain and crude "pottery" insulators were unthreaded. The few known styles of threadless porcelain

insulators are shown in the Universal Style Chart, U-970 through U-990. With a couple of exceptions, all of these threadless specimens are very rare. Since porcelain insulators were largely the result of development of electrical power distribution in the 1890's when threaded pins were the standard mounting method, essentially all porcelain pin types are of the threaded style.

Since the very first threaded insulators, the 1" pin size was the standard, but when larger insulators were designed for power use, 1-3/8" also became a standard pin size, and most of the larger insulators were offered with either size pin hole. The very large pin types were usually furnished only with the 1-3/8" pin hole. At one brief time, there was an effort by one manufacturer to have larger pins of 1-5/8" and 2" adopted as additional standards, but this was short lived. All of the pin holes in the Universal Style Chart drawings in this book are shown as 1" size except for those units which were offered only in the 1-3/8" size, but some of those shown with 1" threads were also made with the larger size.

In the late 1920's, the Lapp Insulator Company originated the use of zinc thimbles (ZT). These 1" or 1-3/8" die-stamped thimbles are cemented into "sanded hole" insulators, and they work very well on lead-head or steel pins. Most manufacturers soon adopted zinc thimbles as an option, especially for 1-3/8" pin holes, but porcelain threads were furnished for use on wooden pins. Insulators in the Universal Style Chart are shown with zinc thimble if they were manufactured only in that manner.

Another option offered by most manufacturers for a time were metal inserts with 3/4" and 1-1/8" machine threads for use with Lee pins of that thread type. A series of adaptors was made so that the normal peg threads could be converted to those threads.

The above information on thread types and sizes is given only for the sake of completeness. It is suggested that collectors ignore what they see in the pin hole in forming all but very specialized collections.

For the sake of drafting ease, and because any given style in the Universal Style Chart is used for all manufacturers that made that style, a uniform method of representing the threads is used. The threads are shown to the correct depth, but with a uniform flat top on most drawings. The shape of the top of the pin hole is occasionally useful in the identification of unmarked units by people who have made a study of this detail, but otherwise no particular significance should be attached to it. All holes are shown with full threads at the hole opening, but in the actual insulators, there are many variations in the shape of the top of the hole. Some units (notably deep-hole varieties of telephone styles) have threads that start gradually from a tapered hole entrance.

For many years threads were formed by "plunge-and-reverse" threading where a threaded mandrel is rapidly plunged with a rotating motion down into the formed insulator, and then the rotation is reversed as the mandrel is extracted.

Lapp Insulator Company patented on February 21, 1922 what is termed the "wobbler" method of threading. A smooth hole is first plunged, and then the insulator moves under a special threading tool which has threads smaller in diameter than those in the finished piece. This tool is lowered into the smooth hole, and the threads are formed by the rolling or wiping action of the non-revolving tool in what can be described as a gyrating motion. A minimum amount of clay is moved, and the rounded hole top thus achieved is said to minimize internal stresses in this critical area after firing. Some other companies now use this method of threading pin types, and you can usually determine if insulators were made by this "wobbler" method by close inspection of the top of the pin hole and carefully noting the exact shape of the termination of the top thread.

Specimens mostly like the U-432A and U-958 styles, plus similar ones made as cemented multiparts, exist with four vertical flutes or splines cutting into the threads. Since there have been at least two instances of these having been found in use as substation switch or bus insulators, the insulators being cemented to steel mounting bolts, it is probable that the threads were purposely deformed with a fluting tool during the manufacturing process. This would assure that the insulators would be very rigidly mounted by cementing, an absolute necessity for such insulators used in switch assemblies.

GLAZES

If all insulators were made in a dull white bisque without glaze, it is certain that few, if any, collectors would ever give them any attention. It is usually the glaze that makes porcelain insulators such artistic pieces, and some are truly objects of beauty. But to the manufacturer and user, the glaze is a functional necessity for electrical and mechanical reasons.

For the first 40 years of pin type manufacture, each cataloger was very specific in pointing out that the only reason for the use of glaze was to provide a smooth surface which would be easily washed off by rain. Even while they wrote those words, they forgot what they wrote in the preceding paragraph about their company offering optional glaze colors. In other words, different glaze colors could be used for coding certain circuits. Most importantly, different glazes have always been used to obtain insulator colors which would blend in with the surroundings. All white insulators would certainly be an eyesore, and they would offer unlimited numbers of targets for rocks and bullets.

Well-applied glazes also increase the reliability of the insulator. Regardless of how good the porcelain may be, there is always the possibility of a localized spot of porosity or a hairline imperfection, and Lapp Insulator Company found by extensive testing that a sound glaze nearly always prevented failure of units from these causes. Ever since 1919, Lapp has glazed all suspensions and the shells of multipart pin types all over. They are fired in upright position by using small stools to support the center of the piece during firing. After assembly, none of these insulators have any exposed surface which is unglazed. The catalog wording is ambiguous in this respect; Lapp unipart pin types were fired in an upright position, but they do have an unglazed petticoat rest.

Insulators made before the mid-1890's were fired twice -- once before glazing (biscuit) and once after glaze was applied (glost). Insulators since that time have all been made "single fire", and a good deal of the ceramic engineer's time was spent in evolving glazes which would produce a good fit with the body. It was always known that the exact character and fit of the glaze had a significant effect on the overall strength of the finished insulator and that some glazes would increase the strength by as much as 20 per cent. Considerable investigative work in the 1930's led to methods for achieving controlled "compression glazes" to produce these stronger insulators, and these have been used ever since -- still another "reason" for glazing insulators.

Glazes are applied by various means such as dipping, flowing-on, air spray gun, and painting. Painting-on is rarely used except for touching up spots missed by the other methods or in reworking units which have already been glazed and fired once. Flowing-on is usually restricted to large porcelain items that can not be conveniently dipped. Almost all manufacturers have glazed pin types by dipping for many years. At least

one manufacturer made a regular practice of the spraying method for a long time, but this method does not lend itself to the multiglazes required to produce the radio-treated units. All the companies still making pin types now use automatic glazing methods except for special shapes.

When porcelain pin type insulators are fired in the kiln, they are not supported on special kiln "furniture" as are some other objects such as most dinnerware and art objects. If the entire insulator were glazed, it would weld itself to the sagger or kiln car when fired. Therefore one surface is selected as a firing surface, and this is left unglazed. Various manufacturers and individuals refer to this as the "firing surface", "firing foot", "firing chime", "setting surface", "firing rest", etc. For simplification in cataloging, this will be referred to in this book as simply the "rest". The various types of rests are then referred to as: Top-rest (T.R.), skirt-rest (S.R.) and petticoat-rest (P.R.).

The manufacturer usually selected the most convenient surface as the "rest". For instance, the units with rounded tops are fired upright, and these are either skirt-rest or petticoat-rest, depending on which element extends furthest. Units which have one or more petticoats flush with the skirt nearly always have a flat crown and are top-rests, but there are several exceptions. Some units with petticoat recessed only slightly have both the skirt and petticoat unglazed, and these should be listed as skirt-rest.

Many cable insulators have flat top surfaces and also one extended petticoat, and a few generalizations could be made, such as: All Lapp units are petticoat-rest, most Illinois units are petticoat-rest, most Pinco units are top-rest, etc. However, some designs were made either way by the same manufacturer, possibly because of a change in factory procedures, or because different customers preferred top-rest or bottom-rest. It is suggested that in cataloging collections, all units that do not have a round top be listed as to position of the "rest".

All telephone styles made in this country are bottom-rest (S.R. or P.R.) with one notable exception: A number of specimens similar to U-171 were made top-rest by Pittsburg High Voltage Insulator Co. At least some specimens of these were found on Canadian lines, but I have also seen them in past years on railroad lines in the eastern U.S. The bottom part of the various two-part transpositions are top-rest.

The common method used by present-day ceramicists to achieve an unglazed firing surface is to coat this surface with some substance such as beeswax or paraffin before dipping the unit in the glaze bath. In modern methods, a shallow reservoir of molten paraffin is located at each glazing station, and the operator routinely dips the firing surface of the insulators into the paraffin as he transfers them from the drying oven cart to the pegs of the automatic glazing wheel. The glaze slip does not adhere to this area, and the paraffin burns away during the subsequent firing.

The simplest "glaze-resist" method was not always used in pin type insulator manufacture. All the early units were made by glazing all-over and then laboriously removing the unwanted glaze from the firing surface by various methods -- carving, belt sanding, rasping, etc. After comparing the "rest" of a number of early specimens with that of modern specimens, one can readily detect which method was used on a given specimen. Even after studying many specimens, I have not been able to pin down the start of the glaze-resist era, but it appears that it was in the early 1920's. If we could determine this approximate date, it would be very helpful in dating and identifying specimens.

Certainly the older method must be classed as "the hard way" when compared to the modern glaze-resist method. Although it was in 1850 when Dr. James Young applied for his patent "to obtain ... paraffin from bit-

uminous shales", this wax did not become available in commercially economical quantities until about the time of the first World War, in the form of a by-product of the distillation of petroleum. The only other suitable "resist" in the early days was beeswax, and that was an expensive item in the quantities which would have been required by the insulator manufacturers.

Specimens of U-11 have turned up which were fired by still another method. The insulators were glazed all-over and placed on a layer of refractory sand for firing, identical with the method formerly used by some companies in firing guy strain insulators. These U-11 specimens do not have any unglazed firing surface, and grains of sand are glaze-welded to the base rim. Ohio Brass Company designed and manufactured a pin type style which had four small glazing teats on the crown. These insulators were glazed all-over and after firing upside down were broken off of the firing surface, leaving only four small white spots on the crown. This break-out type (nicknamed "Teat-rest") is known on U-610A and is relatively scarce. These same insulators are also found as having been fired upright on the petticoat, the four crown teats glazed over and unbroken.

Pin type insulators have been glazed with practically every color of the rainbow. There have been whites, yellows, all shades of blue, greys, greens, a bright red, sky colors, and every shade and tone of brown from light cream to coal black. Throughout the major portion of history of pin type porcelains, the standard color has been nominally brown. The predominate brown was a rich mahogany for many years, but there was a tendency to go to an unglamorous chocolate brown in the 1950's. During the 1960's there was a gradual shift to the "sky" color as standard glaze.

Most colors other than the browns came out about the way the glaze man intended, and they are easy to describe, such as: Dull green, olive drab green, apple green, etc. The browns are a different story. Many adjectives could be used to describe these in addition to the use of the names for all the color hues. You will see adjectives such as light, medium, dark, speckled, banded, peppery, mottled, faded, bright, iridescent, mixed, etc. Color prefixes of the browns include cream, tan, mahogany, walnut, maroon, red, orange, yellow, green, steel, fawn, buff, chocolate, black and others. Even then, it is sometimes difficult to find words to describe some of the hues.

It should be mentioned that many of the variations of the browns resulted from the glaze slip being made from clays which were chemically very sensitive to the peak firing temperatures. There could be extreme color variations among units coming out of the kiln the same day, or even on two units sitting side by side on the same kiln car. This wide color variation is most noticeable on older units made by Thomas, Westinghouse and Ohio Brass Co. Some of the glaze color tendencies of different manufacturers are mentioned in the sections dealing with the particular companies. The average collector usually does not collect identical items just because of these unintentional color variations.

Chapter 4

RADIO-TREATED INSULATORS

When radio broadcasting became widespread in the late 1920's, there was a steady increase in the number of complaints about radio interference caused by the power distribution systems. One big source of interference was at the insulators on lines operating above about 6.6 Kv in the vicinity of broadcast receivers remote from the broadcast stations, and also where power lines were close to airports or radio communication centers.

Without getting too technical, let it suffice to say that a corona discharge at the head of the insulator results from the air space in the proximity of the conductor and tie wire being overstressed electrically. Similarly, the air spaces between the insulator and the threaded pin also cause radio interference. There is an obvious solution to the problem, and this involves making the entire head of the insulator conductive. Since the conductive portion of the insulator is now at the same voltage potential as the line and tie wire, there is no longer a voltage gradient across the air spaces, and therefore no corona. Similarly, the insulator pin hole is made conductive to "short" the entire pin hole surface to the metal peg.

A number of the insulator manufacturers started to look for a solution to this problem in the late 1920's, and many different schemes were tried. The problem became more serious as each year passed. The search for a really practical and economical fix became rather frantic by the mid-1930's. The ultimate solution came by 1940. Even though most companies were making good radio-treated units by very similar processes, each one claimed to have the very best method. In the 1940 Thomas catalog, a five-page spread is used to expound the virtues of their patented under-glaze-treated "Quiet Types". In the 1939 Westinghouse catalog, it took 674 words to explain why the Westinghouse copper-oxide glaze was best.

A number of different companies made claims to doing the pioneering work on this problem, and it is difficult to credit any one company with this. Here are some typical claims from company publications. Westinghouse (1939): "Westinghouse was the first manufacturer to attempt a solution of the radio interference problem." H. K. Porter (1959): "THOMAS was the first insulator manufacturer to bring out and patent the means to eliminate this disturbing noise interference."

Lapp Insulator Company had introduced the metal thimble for 1-3/8" pin holes for large insulators in about 1927, mainly as a result of using a standard, sanded pin hole which could be used with the various mounting schemes. However, a side benefit was that when the zinc thimble was used on metal pins, this presented a partial fix for radio interference problems. The Cook Porcelain Insulator Company did not have a radio-treated option in 1929, but their catalog of that year included optional 1-3/8" pin hole thimbles which, in their words, "precludes radio interference". Even though the Pinco 1949 catalog stated that their "No-Corona" units had been used since 1929, no such units ever appeared in any Pinco catalog until 1941, and it is possible that this was grossly stretching the point that they first offered zinc thimbles in 1929!

In 1929, Ohio Brass Co. came up with an interim solution by offering a "Conduction Paint". The entire conductor, tie wire and insulator head

are coated with this paint to eliminate the radio interference, and this paint also has the advantage that it can be used to treat insulators which are already in service. It was cataloged for many years after its introduction for that reason.

The first attempts to eliminate the corona or brush discharge at the head of the insulator consisted of filling all the stressed air spaces with insulating compounds, asphalt or gums which had higher dielectric strength than air. This worked fine in the laboratory, but the material would not resist the weather, and its effectiveness was lost as soon as any cracks or voids developed.

The next attempts all involved methods for making the entire top of the insulator conductive by various means. One of the first really practical methods was to cement a metal cap directly onto a standard pin type insulator, and Thomas introduced a line of these "Radio Cap" insulators in 1930. The "cap" had the same general appearance as a normal insulator top -- normal crown with conductor and tie-wire grooves.

In about 1934, Ohio Brass Company developed and announced the first "Clamptop" pin type insulators. Although it was indicated that these were developed "to overcome all the evils of tie wire practice", it was emphasized that the metal clamp top provided a perfect solution to the radio interference problem. Unfortunately, some of the radio interference had stemmed from the cemented joints of multipart insulators, and neither the Thomas or Ohio Brass metal caps did anything to eliminate that.

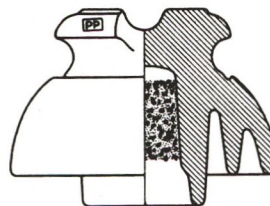
Several methods of metalizing the insulator top were tried, the first being to treat the desired areas with a composition containing copper oxide which, upon firing, left a metallic film of microscopic thickness. Once again, these worked fairly well in the lab, but the thin film could not withstand conductor abrasion and weathering, especially in industrial locations where sulphur fumes were present.

In about 1932, Westinghouse had developed and patented another process wherein they used a copper-oxide glaze which was an insulator except where the copper oxide was reduced by a treatment with nascent hydrogen after firing. The desired area was coated with a paste, and after about ten minutes, the paste was wiped off and the treated area immediately coated with hot solder. Needless to say, this method was not easy to control in production, and it was an expensive one.

It should also be pointed out that both the above methods had a serious disadvantage from an electrical standpoint. There was such an abrupt change in the surface conductivity at the edge of the treated area that corona reared its ugly head again at this point. Furthermore, the coatings were rather fragile to the elements, and once scratched or holed in any manner, the units were even worse than untreated ones.

In 1933, Ohio Brass Co. began experimenting with low-resistance matt glazes for use in bushings and certain pin type applications, but existing Westinghouse patents precluded further tailoring of the glazes as a means of radio treatment for pin types. To get around the Westinghouse patents on conductive glaze methods, Ohio Brass developed and announced in 1934 a method of spraying a metallic coating of copper on the desired area. These were called "Silentypes" in the catalog and "Red Tops" around the Barberton insulator plant. The edge-corona problem was licked by providing a recessed flux control groove (see style U-876, for instance). The copper coating was applied very carefully through a metal masking that was made to exactly fit into this groove. These units were also furnished with aluminum coatings for use with aluminum conductors and tie wires. They worked very well, but they were also expensive to make.

A specimen I found in the Porcelain Products Inc. dump at Parkersburg, W. Va. indicates PP Inc. also experimented with the metalized-top design as a means of eliminating radio interference.



5½ × 4

During these early years of the 1930's, Westinghouse had developed a semi-matt conductive glaze, covered by several patents, and they later licensed this process to Locke and possibly others. Although the metallic coating used by Ohio Brass was possibly superior in performance, O-B found themselves over a barrel as far as price competition was concerned. Therefore, in the summer of 1938 they opened negotiations with Westinghouse for a license to the Westinghouse process. O-B tested samples sent by Westinghouse and found that the basic process had many possibilities but was still far from being perfected. Some samples tested very well, but others were worse than untreated units. But now that O-B intended to get a licensing agreement in any event, they proceeded full speed with their own development work to perfect a reliable conductive glaze.

At about the end of 1938 a "glitch" appeared when Thomas was granted a patent on an "Under-Glaze" treatment. This method involves first treating the desired area with a metallic oxide, and then glaze-dipping the entire unit with the normal glaze in the usual manner. The end result after firing is a glaze which is rendered slightly conductive by the underlying coating in that area. Thomas was also willing to consider licensing, and they sent to O-B a number of sample insulators and a quantity of their under-glaze composition for testing. The Thomas insulators did test very well, and they had other advantages such as the smooth glaze finish which was so desirable. However, O-B found some difficulty in obtaining uniform conductivity with the O-B cover glaze formulas unless glaze thickness was controlled very closely.

The Thomas method appeared the most attractive to O-B, but another "glitch" developed: Thomas and Westinghouse became involved in a controversy over basic patent rights. During this period of uncertainty about patent rights, O-B kept up their development and testing work. Shortly after the patent situation cleared up, O-B scored a real breakthrough by developing an excellent conductive-glaze formula. With full manufacturing and sales rights for the Westinghouse conductive-glaze process and all its improvements tucked under its belt, Ohio Brass now bid Thomas adios and went into full production of their new "Conduction Glaze Silentype" insulators. These were first announced to the trade in January 1940 by way of a new product announcement and double-page ad in "Electrical World".

And so ends the story of a 10-year period of the most concentrated, and at times frustrating, development work ever performed on pin type insulators. The work involved in solving this problem makes the development of the first high-voltage insulators in the 1894-1900 period look like child's play. I don't think it is necessary to point out who really deserves all the credit; the names of the three companies who share this honor are repeated many times in the paragraphs above.

By about 1941, most companies were making radio-treated units either by the under-glaze, over-glaze or conduction-glaze processes under license from Thomas and Westinghouse, and little ado was made over these units thereafter. The units were furnished optionally either way at the same

price, and radio-treated units soon became standard production on insulators intended for use on either primary distribution or transmission lines. Since the interference is only a problem on lines above about 6.6 Kv, it is unusual to find small secondary distribution styles such as the "hat" styles with radio treatment, but some do exist. All the telephone styles naturally carry only small signal voltages and were never made with radio treatment.

Radio-treated units are usually obvious because of their different-colored top sections. The treated area is usually black (sometimes a matt finish, even rough), but some under-glaze treatments cause various other colors -- notably ochre or light brown under white or sky glaze. It is sometimes difficult to tell if a specimen is radio treated if the treatment is under dark brown glaze or on brown units with a conductive glaze. Inspect the pin hole on these; it will be black on units with radio treatment. When cataloging collections, notation should be made if the unit has radio treatment, and the convenient abbreviation is "RT".

Chapter 5

SPECIAL INSULATOR DESIGNS

GLAZE-WELDED INSULATORS

The biggest problem in the development of the first high-voltage insulators in the 1890's was that of making an insulator which had adequate puncture strength at high voltages. Even the best wet process porcelain of those days tended to have regions of localized porosity, and methods had not been developed to obtain complete vitrification of thick sections. Just as "strings" of suspension insulators of later years were connected in series to obtain high insulation values, the first high-voltage pin types were made by cascading two or more porcelain sections until the required degree of protection against voltage puncture was achieved.

The "glaze-welding" of two or more shells is essentially a mechanical solution to the problem of mounting the porcelain shells in place. It did offer the added electrical benefit that the various glaze layers increased the reliability against puncture, because the glazes are not porous and were less prone to impurities and trapped gas pockets. The mechanical aspect is emphasized by the fact that "glaze-welding" gave way eventually to cemented multipart insulators, and there was an overlap for a number of years where both methods were used. Some companies later cataloged identical units simultaneously -- one with glaze-welded shells, the other with cemented shells.

John W. Boch of R. Thomas & Sons invented and perfected in 1897 the method of making multiple-shell insulators by mechanically connecting the shells together with glaze. The separate shells were first glazed and fired in the normal manner. Then these shells were fitted together with a generous amount of glaze slip and refired to vitrify the glaze filling, and thus weld the shells together. Thomas called this the "Glaze-Filling" process, and they were granted a patent on it March 8, 1898. Some accounts state that these "Glaze-Filled" units were on the market in 1897.

The term glaze-welding refers to a somewhat different process, but one which yields essentially the same result. The separate shells are each dipped in glaze, then assembled in proper position and fired as a single unit. When the touching glaze layers melt and run together, the units become permanently "welded" together. The process is analogous to sweating two pieces of metal together with solder.

Fred Locke put very prominent notices in his catalogs that "ALL INFRINGERS of the articles marked 'PATENTED' in this catalog will be prosecuted. All Insulators, Pins, and Fittings, of the designs shown in this catalogue, without my name and patent marks, are infringements." Evidently, he must have thought this was a one-way street, as he was having other companies make his new high-voltage insulator designs by either the glaze-filling or glaze-welding process covered by the Thomas patent. In his 1897 catalog he referred to these simply as "fused together with glaze". But in his 1899 catalog, he changed the description to: "Each shell is glazed separately, then fused together, thus presenting, in three shells, six thicknesses of glaze in addition to the extra glaze used to fuse the shells together." Note the words "extra glaze"; Thomas did, and they

filed suit against Locke for patent infringement, also naming Electrical Porcelain & Mfg Co. (of Trenton, NJ).

Thomas won the suit, which was decided November 26, 1901 -- a nice Christmas present for Thomas, and a poor way to start out the new year for Locke, as he had to make an accounting for damages. It is interesting to note that glaze-welds are conspicuous by their absence in the 1902 Locke catalog -- as is Locke's customary patent "INFRINGERS" notice of the past. (See Appendix C for more details regarding this suit.)

Some of the early glaze-weld units have threaded center parts made by the dry process, and the threads go all the way through this section. Essentially then, these units look like 3-shell units but are really only 2-shell units from an electrical standpoint. I have seen these mostly on Locke units up to 1901 dating. Units made by Imperial Porcelain for Locke, and later for their own sale, appear to have wet process center parts, but some also have "through-holes" in the center part. All this is evidence that making threads in "blind" holes may have been difficult in the early years of porcelain insulator development.

Even by 1900, the absolute necessity for glaze-welded units was rapidly diminishing. Locke was now making a line of high-voltage units by cementing together two porcelain pieces (or porcelain/glass combinations), and the state of the art was rapidly advancing to the point where thicker porcelain sections could be made with some degree of reliability. All the various wet process companies made some glaze-weld units for a number of years. Most of the remnant glaze-weld designs exited en masse in about 1915, but one design was made by several companies until about 1918.

You can usually tell if an insulator is made by glaze-welding by careful inspection of the recesses between the petticoats. Some units will have at least some spot around the "joints" where the glaze did not entirely fill the joint. If you tap the edge of an ordinary insulator with a pencil, you get a very high-pitched thud at best, but glaze-welds usually emit a bell-like sound. The glaze-filled units have some bell-like sound, but this is not distinctive if all the glaze-filling was complete and filled all the spaces between the shells.

The above account deals with glaze-welding as a means of providing thicker head sections on pin types. It should be pointed out that glaze-welding is a useful technique for manufacturing difficult porcelain shapes of all kinds, and it has been employed for a long time in the ceramics industry for that purpose. Good examples of this technique on insulators are the glaze-weld fog bowls U-854 and U-855, the U-186 and the Illinois dry-process transpositions U-197 and U-197A.

Glaze-weld insulators are desirable collector items. The very early units made by Imperial, Thomas and Fred Locke are collector classics, and nearly all those may be attributed to manufacturer either directly by the markings or by the particular style being cataloged by one of the companies. Some of these Fred Locke units and most of those made by Imperial bear markings of the actual manufacturing date.

Some of the glaze-weld drawings in the Universal Style Chart were made from specimens, and the juncture lines on these are guesswork, since it seemed pointless to section classic specimens just to get this unseen detail exact on the drawings.

FOG TYPE INSULATORS

As nearly as I can ascertain, it was in 1926 when Lapp Insulator Co. developed and introduced the first "Fog type" insulators, and they have produced most of the different Fog pin types since that time. It must be

immediately explained that the term "Fog" is a misnomer for these insulators. These insulators were designed to cope not only with fog, but with all forms of contamination such as that caused by cement plants, salt air, steel mills, ordinary smoke and dust, etc. Since they are generally referred to as "Fog" types, we will continue to do so, even though Ohio Brass Co. correctly called them "Smogtype" insulators when they introduced them in 1935. It was interesting to me that Ohio Brass used a footnote in their 1935 catalog sheet to explain "Smog" with the Webster definition. I doubt if readers need this footnote with the present-day urban environment.

Insulation degradation due to contaminants was a problem on telegraph lines even before the telephone or incandescent lamp were invented, and in 1878, W. C. Johnson and S. E. Phillips were granted a patent on a pin type insulator with an oil reservoir made by inwardly upturning the insulator skirt. In 1894, G. H. Wilson sketched an improvement of this idea by the addition of an accessory oil reservoir to be first placed on the pin and into which projected the inner petticoat of the insulator. These ideas were being hatched back when the only problem was that of maintaining a high leakage resistance on signal lines.

With ordinary insulators, the outside of the insulator remained fairly clean, while the inner petticoat areas continued to accumulate dirt and all forms of mineral deposits. As long as normal weather persisted, the signal got through, but when the contaminants on the underside were wetted with fog or driving rain, the line went dead.

When high-voltage power insulators entered the scene, the same types of contaminants accumulated in the same places, and this time the failures were not just higher leakage current, but also voltage flashover. Like the telegraphers, power companies kicked and cussed, but nobody could find a good solution to the problem. To keep lines in operation in contaminated areas it became necessary to physically clean the insulators periodically, sometimes almost monthly! It should be remembered that the contaminated insulators operated all right when dry, but flashovers were quickly triggered when the fog rolled in; and thus, the name "Fog Types" was later born when insulators were designed to cope with this problem.

We lived with this problem for many years because of the inability of the transmission engineers and insulator designers to see the forest for the trees, so to speak. Ever since Morse's first telegraph quit working when the crude wooden insulator blocks became wet, the engineer had been fighting moisture itself. This must have created a mental block of sorts, and engineers became obsessed with the idea that if a high-voltage insulator got wet all over at once, flashover would occur. The era of "rain shed" insulators was at hand, and some die-hards who had not fought the problem of contaminants remained faithful to the early precept for a long time.

The real solution to the problem came about rather quickly, and somewhat accidentally. On early lines, the effort was to keep everything dry, and even dead-ending was done with special "rain shed" dead-end insulators. When suspension insulators came into use, it wasn't long before some were used at canted angles, and then later in full dead-end orientation. It was soon observed that it was always the vertical strings that flashed over, not the horizontal ones, and the nut was cracked. In no time, all the past false thinking was realized, and a new concept of insulator design was soon born. Laboratory investigations later proved conclusively that insulators operated under wet conditions even better in horizontal position than they did in vertical position. This was because the insulators remained cleaner when all surfaces were exposed to rainwater washing action and because the wet flashover voltage is approximately 10% higher in the horizontal position; this increase is due to uniform wetting of the

insulator surface and to the elimination of drip, which shorts out part of the insulator when operated vertically. In a nutshell, uniform wetting causes a uniform voltage gradient across the insulator surface, thus eliminating high voltage drop across certain dry regions which would, in turn, trigger flashover.

It would appear that the nature of the problem and the most probable solution became known at a fairly early date, and it is puzzling why it took so long for any company to invent a new design of pin type to cope with it. Designers were firmly in the "rain shed" rut due to the cloudy thinking of so many years, and most companies probably felt that their customers would think they were going off their rocker if they tried to sell them a high-voltage insulator with water running all the way down its leakage path. This was also during the same 1910-1925 period when the entire industry was in a unified fight to lick a much more serious problem: Flashover outages on contaminated lines were one thing, but dropping lines from arterial suspension line towers due to mechanical failure of suspension insulators was a much more serious problem.

All the larger insulator companies of this period were progressive and methodically chipped away at insulator design problems. However, Lapp Insulator Co. seemed to feast on innovation, and the company has a very impressive list of "firsts" in the industry. Throughout its history, the emphasis at Lapp was on special porcelains -- things that other companies couldn't or wouldn't tackle. Here was a problem to be solved; Lapp solved it.

What Lapp did in designing the new Fog types was to essentially come up with a design that turned all past philosophy 90° over on its side. They did away with the old vertical petticoats that accumulated dirt underneath the insulator, and they added horizontal petticoats on the outside where they would be washed by rain. Furthermore, their new vertical profile resulted in a very uniform voltage drop across the insulator under all wet conditions, whereas the old "rain shed" types had a mixture of dry and wet, fat and skinny sections which created highly stressed areas that triggered flashovers.

It was 32 years from the time the first high-voltage insulator prototype was fired by Fred Locke in his kitchen stove until the "Fog" problem was solved, and this new Lapp design was really the first basic pin type change in all this time. I am curious as to the expression on the face of the utility company purchasing agent the first time a Lapp salesman set one of these radically new insulators on his desk. Nevertheless, they were successfully introduced and soon were demonstrating their worth in many applications. The design must have been a real winner, since designs made to this day are substantially identical with the first Fog type made by Lapp. It was such a success that Lapp made Fog type suspensions and other insulator types on the same principle, and it was the forerunner of all the modern "post" insulators (also a Lapp development). For further pertinent information, please see the sections on "Helical", "Hi-Top" and "Fog Bowl" insulators.

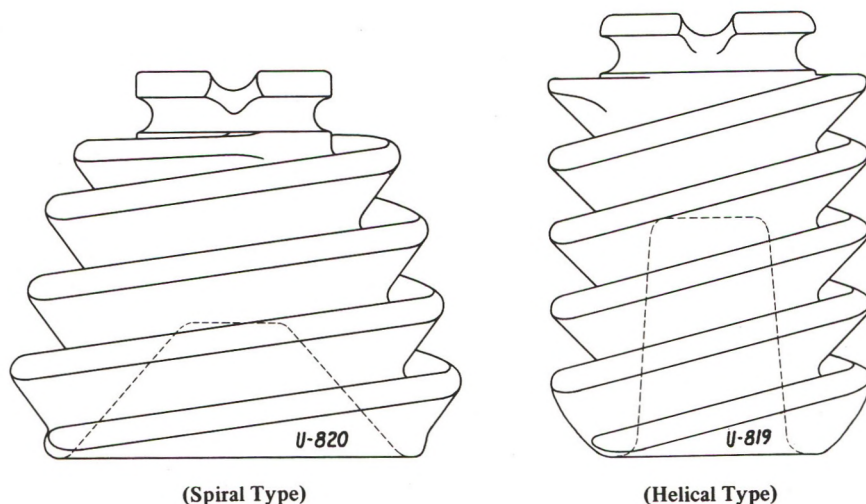
There is one specific insulator design that was originated as a "Fog" design. This was the bell-shaped (U-418) pin type made by Illinois, Thomas and Westinghouse. Locke Insulator Corp. had a drawing dated Nov 12, 1922 for the U-418 style Fog Bell, and this may be the true origin of this design. The original Thomas drawing of this style is dated June 10, 1927, and the description in the 1930 Thomas catalog reads: "An excellent insulator with ample leakage surface, especially designed for use in salt-fog belts, around cement works, coke ovens, mills, railroads and dusty locations." To avoid confusion with conventional types and other bell-shaped designs, it is best to refer to this design as a "Fog Bell".

Locke also had drawings dated Feb 13, 1934 for the Fog Type styles U-831 and U-839. However, it is probable that these designs were only being considered during the project which led to Locke's development of the Hi-Top styles in 1933-34 and which went into production in 1935.

Before leaving the subject of Fog type insulators I cannot resist directing the reader's attention to style U-405 in the Universal Style Chart. This unit, with its two drip-pointed side petticoats not unlike the Lapp designs, was made and cataloged by New Lexington High Voltage Porcelain Company -- in 1908!

SPIRAL AND HELICAL INSULATORS

In the late 1920's, the "Spiral" insulator was conceived by Brent Mills and Charles L. Stroup. Mr. Mills was at that time a sales engineer in Chicago with Lapp Insulator Company, and Mr. Stroup was a transmission engineer with Public Service Company of Northern Illinois. This first design was a pin type, slightly conical in shape, and was thus referred to as the "Spiral" insulator.



These men had always been greatly concerned about insulator contamination problems, and their Spiral design was a further extension of the principles embodied in the new Fog type insulators developed by Lapp. The outer surface of the insulator consisted of one petticoat which spiraled from the tie-wire groove down to the bottom of the insulator in approximately five turns, not unlike a corkscrew. The outer edge of the spiraling petticoat was turned up (as opposed to having a drip point) in order to make a trough for rainwater.

The reasoning was very logical; if the new Fog types were better because of better washing and uniform surface wetting, the Spiral should be that much better. The conical shape aided in catching the maximum amount of rainwater, and the spiraling trough assured that the insulator would be thoroughly washed and uniformly wetted all the way around. Lapp made some sample units which Mills and Stroup had tested for performance. The wet flashover results were discouraging, and the design was layed aside because they decided it had no value.

Mr. Stroup later went with Jeffery-Dewitt Insulator Company, and the work on the Spiral design was renewed with vigor at J-D. It is difficult to reconcile Mr. Mills' account of the disappointing test results on the Lapp experimental samples with all the work that Mr. Stroup did on this

design at J-D; maybe they were reading the wrong scale on the voltmeter on the early tests! Mr. Stroup filed for patent on the design Mar 16, 1929, and the patent (No. 1,869,397) was granted Aug 2, 1932.

In any event, J-D made a number of these units essentially identical with the original Mills-Stroup design and put them into test service in the fall of 1929. (Recent research has established that this line was located in Wilmette, Illinois.) Units removed after five years service adjacent to a cement plant there contained considerable cement deposit in the grooves but tested nearly as good as new units.

A complete double-circuit line near a steel mill was constructed with these units in 1930, and they were found to be remarkably clean after nine years of service. (Recent research has established that this line was located in Gary, Indiana.)

(I am indebted to Mr. Robert Winkler of Michigan City, Indiana for his persistent research which led to the documented information given above on the exact locations and dates of the test lines for Spiral insulators, and also the recovery of specimens of Spirals now in the hands of collectors.)

In the mid-1930's both J-D and Lapp had evolved "post" type designs of Helical insulators (vertical profile, not conical). J-D had several such designs under test, and these had two staggered helical petticoats of four turns each. In Brent Mills' book, a Lapp unit is pictured which has four separate spirals of three turns each, to further increase the pitch of the helix.

Although these Helical insulators had considerable merit, they disappeared from the scene by 1940. The design was a victim of being an expensive and difficult one trying to compete with cheap and easy ones -- the established "Fog type" and "Hi-Top" insulators. J-D was accustomed to making their pin type insulators by the casting process, but other companies didn't cater to this method for high production insulators that could be made much more inexpensively by plunging and turning methods.

Only several specimens of Spiral insulators have been recovered by collectors, all from the original 1929 Wilmette line, but there is hope that at least a few more might be recovered in the future. No specimens of the Helical insulators have been recovered by collectors.

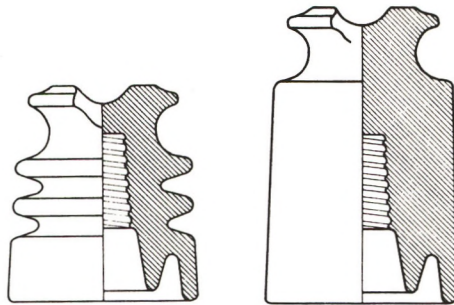
In the Universal Style Chart, the drawing for the U-820 Spiral was made from the specimen in the Lapp Insulator Co. museum in New York, and the drawing for the U-819 Helical was from a drawing in the Lapp files.

"HI-TOP" INSULATORS

During the depression years of the 1930's, Locke initiated a program to review completely all the pin type insulator designs and come up with a line of improved styles which would cover the entire voltage range with fewer insulator styles. This work led to the development in 1934 of the Hi-Top insulators, and these were put into production in 1935. They are covered by Patent No. 2,084,866, Jun 22, 1937, Bentley Plimpton, Victor, N.Y., assignor to Locke Insulator Corp., Baltimore, Md.

We refer to these as "Hi-Top" insulators not only to give Locke (GE) recognition for having developed them, but also because Locke used Hi-Top as their tradename (registered on 3-30-37, used since 5-10-33) for these styles. The insulators bore a HI-TOP marking. The name was probably derived from the fact that the insulators have a high top in the electrical sense. Note in the accompanying illustration how tall the unit would be

mechanically if all the vertical leakage path were straightened out. Most other companies soon followed with the manufacture of these designs, but because of the Locke trademark registration called them by other names: "Hi-Type" (P.P. Inc.); "high type" (J-D); "Kingpin" (O-B); etc.



A standard Locke #88 unit and a hypothetical design which would be an electrical equivalent if all the side petticoats were stretched out.

The Hi-Tops were a natural extension of the principles used in the development of Fog types by Lapp in 1926. The Fog types were proven to be the answer for a considerable portion of the insulator market, and some of the other companies (especially Thomas and O-B) were following Lapp's lead in designing Fog type suspension insulators. It was only natural that Locke would think of incorporating the latest design principles into any new line of pin types.

One radically new feature of these new Locke pin types was that the side petticoats did not have drip points like the Lapp design. I do not have sufficient background information on the evolution of this design by Locke engineers to say how this came about. It is obvious that this design can be made by normal trimmer methods, whereas it requires something extra to form drip-point petticoats. However, it would appear to me that this could have been done as an improvement over the drip-point design from an operating standpoint. In the Locke design, even a slight rainfall will wash the entire outer surface of the insulator as it runs (without dripping) down the side of the insulator. Furthermore, in conditions of fog or light rainfall, the entire surface is wetted uniformly with no dry underside of the petticoats.

The Lapp catalogs state that "Under a heavy rain the contamination rapidly flushes away ... because the petticoats are so spaced that the rain falling on one petticoat splashes and cleans the underside of the one above." Various companies make different insulator styles with drip points in one case, without them in others. Thomas, possibly confused as I am, took no chances back in 1940; they cataloged two essentially identical Fog suspension designs with four outside petticoats -- one design with drip points, the other without drips. The current trend is for most of the companies to make all external petticoat items with drip points.

The Hi-Tops made by all the various companies are similar to the original Locke designs. The biggest difference is that some made them with extended petticoats. All the sizes have a top conductor groove except for the smallest size; it is a side-tie for low voltage use and should not be confused with telephone transposition insulators.

It is also interesting to note that Lapp, who was always the foremost proponent of the drip-pointed Fog insulators, also produced a line of Hi-Top styles in the 1930's.

Styles U-816, U-816A and U-816B were cataloged by Locke in 1941 as "TOUGHTYPE" Hi-Tops, their drawings being dated 2-9-33. These were Locke patent 2,088,433 of 7-27-37. The heavy bottom skirt was intended to prevent malicious damage from gunfire and thrown missiles.

FOGBOWL INSULATORS

"Fogbowl" insulators are designed for use in areas of heavy contamination where there is insufficient rainfall to clean ordinary Fog type insulators. The theory is then just the opposite; that is, provide as complete an enclosure as is possible around a large portion of the leakage path, leaving a bottom hole just large enough to give adequate clearance from the mounting pin.

If you now consider that areas with "insufficient rainfall" are not ones normally associated with the fog belts, this name is also a misnomer to some degree. However, these insulators have found wide use in coastal areas where the combination of salt air and fog was the big problem.

The modern version of the fogbowl most probably originated with the Ohio Brass Company. Their drawing for the U-854 fogbowl design is dated March 27, 1930. The more streamlined glaze-weld U-855 appears on an O-B drawing dated Feb 28, 1931. These were made for the city of Los Angeles. Ohio Brass commenced manufacture of the one-piece (not glaze-welded) fogbowls in 1938, and all glaze-weld styles were out of production by 1941.

General Electric Co. has records of the Locke Insulator Corp. being active in fogbowl designs back to 1932, and a design similar in principle to the U-856A glaze-weld fogbowl is covered by Patent No. 1,955,609, Apr 17, 1934, Davidge H. Rowland, Baltimore, MD, assignor to Locke Insulator Corp., Baltimore, MD. Specimens in the hands of collectors indicate that the Locke designs were essentially copies of the contemporary O-B designs. Apparently Locke soon lost interest in fogbowls -- probably because they started promoting their Hi-Top designs during this period.

Specimens (U-846) extant in collections indicate that Victor Insulators, Inc. did make at least some fogbowl insulators. No drawings or engineering data on these could be located in the I-T-E plant files.

Needless to say, this is considered a "difficult" porcelain design and can't be made by normal methods. The early units were made by simply glaze-welding the bowl to the top insulator portion, and both parts could be made by normal plunging and turning operations. A technique was later developed whereby the entire insulator was plunged with an elongated skirt extending well beyond the normal length. This skirt was then turned inward by the "throwing" process. See U-855 and U-848 styles which show the same size and style made by the old and new processes respectively.

As of the 1970's, Ohio Brass Co. and I-T-E were the only two companies still making fogbowls, although McGraw-Edison Company was toying with the idea of making them in the 1960's. The various styles made in the 1930's and 1940's were never produced in large quantities, and they are relatively scarce in the hands of collectors, but the recent ones made by O-B and I-T-E are commonly available in collector circles.

TRANSPPOSITION INSULATORS

Telephone transposition insulators, U-191 through U-225 in the Universal Style Chart, are used for effecting a rotation in communications pairs on open wire pole lines, much as twisted pairs are used inside the communications cables containing more than one pair of wires.

Optimum transposition patterns on pole lines can be very complex, especially on poles carrying a number of different circuits, but a simplified explanation can be given. If an open wire telephone pair is not transposed (rotated), one wire of the pair remains closer to the adjacent pair throughout its length than the other wire, and the difference in capacitance of each of these wires to the foreign pair causes "crosstalk"

between the pairs. In essence, by rotating the pair, each wire takes its turn being next to the neighboring pair, and the capacitance imbalance is canceled out. Similarly, transposing the two wires of a telephone pair eliminates or reduces "hum" that would otherwise be induced by overhead or nearby power wires.

For the same general reasons of reducing crosstalk between pairs on long toll lines, it is also desirable to transpose complete pairs with each other on the individual crossarms. This involved rolling at one time all four wires of the two pairs involved. At the same time, the two wires of each pair were usually also transposed themselves. To achieve this, it required a mechanical means for mounting all four of the wires vertically at one pin position on a given pole. Special underhung pin brackets were employed on which either four regular pin types or two transposition pin types could be mounted.

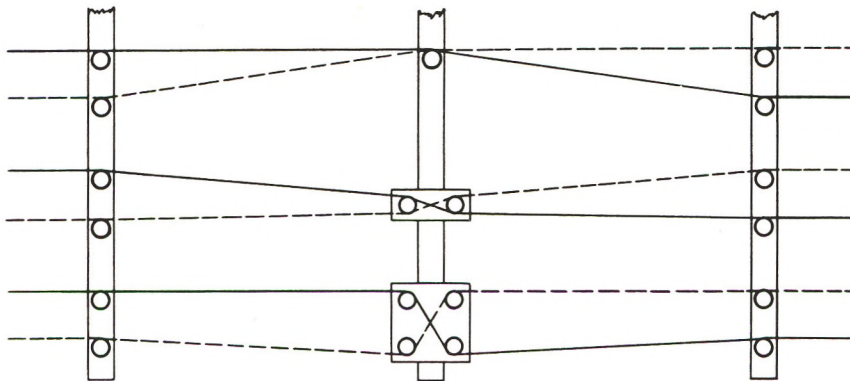


Figure 1. Different methods of transposing conductors.

Three methods of transposing the two wires of a given pair are shown in the accompanying illustration.

The bottom two methods utilize ordinary single-groove line insulators or various types of special spool insulators designed to fit X-type steel brackets. With specially designed brackets and spool insulators (called "Case" transpositions after the inventor), point transpositions appearing similar to the bottom illustration can be made midspan.

The top illustration is termed a "rolling" transposition, since the two wires are rolled over during their course over two pole spans. This requires that both wires be mounted vertically at the same pin position on the middle pole, and this is done either with two ordinary insulators on a special bracket or with a single "transposition insulator" with two separate wire grooves.

The use of the special two-groove transposition insulators made it much simpler to construct lines or to add transposition occurrences in existing lines, since it required only a single insulator on the regular pin. Without this special insulator, it required two separate insulators, special brackets and pins, and the stringing (or restringing!) of one or both of the pair wires underneath the crossarm.

The best design for a "rolling" transposition insulator is one such as U-202 which has grooves which are widely spaced and nearly in the same vertical plane. But it is also desirable to minimize the wet weather leakage path between the two wires, so there is merit to designs such as U-197 and U-215, for instance.

There are a number of power insulators which are mistakenly referred to as telephone transpositions simply because they have more than one "groove" on their side. The most common of these are the "loop" insulat-

ors such as U-399 and the small, side-tie distribution insulators such as U-776. Similarly, telephone "exchange" insulators should not be referred to as transpositions. Some power and telephone styles were erroneously labeled as transpositions in manufacturers' catalogs.

DRY-SPOT INSULATORS

Intermediate-location taps and terminal connections on telephone and railway signal lines are customarily made with "bridle" wire pairs which are insulated with rubber and an outer protective cotton-braid covering. If these bridle wires are merely tacked to the pole and crossarm and the ends stripped and spliced to the open wire lines, any condition of rain or moisture causes a serious leakage path from the overhead lines to ground. This path is from the tap on the overhead line, up onto and along the wet bridle wire insulation to the points where that wire touches any grounded elements, such as the pole itself or any other anchoring point.

The problem can be cured by breaking the continuity of the leakage path along the wet insulation of the bridle wire between where it splices to the overhead line and the first point where it touches the crossarm or pole. The solution is to keep even a short segment ("spot") of the insulation dry so that point along the insulation will not conduct current.

Any mechanical means that would shelter a short length of the insulation covering from the rain would work, and many methods have been used. A common method used on railway signal lines is the use of "in-line" dry-spot insulators which hang vertically just below the splices on the overhead line. These are small tube-like insulators with one or more drip-pointed petticoats on the sides. The bridle wire end is fed through this tube and encapsulated tightly within it with a waterproofing compound, and the bridle wire exits the bottom of the device from a dry, protected area.

Another method is to utilize some protected cavity in a pin type on the crossarm to afford a dry spot for a section of the bridle wire. The pin types used as dry-spot insulators have ordinary side grooves so they can be mounted on a peg by substituting them for one of the regular line insulators on the crossarm.

In the dry-spot insulators U-173, U-174 and U-175, the cavity between the skirt and inner petticoat affords the dry spot. These are furnished by the factory with a short length of insulated wire embedded within this cavity. One end is wrap-spliced to the overhead line. The other end is spliced to one of the bridle wires. To avoid creation of another leakage path from this splice along the wet insulation of the continuing bridle wire, this splice itself must be waterproofed with tape and/or some type of tar compound. Naturally it requires that two of these dry-spot insulators be mounted on the crossarm for each pair of bridle wires.

The U-188 specially designed dry-spot furnishes a dry spot for both wires of the bridle pair. The top cap is removable so that each of the tap wires can be run up through a base hole to the dry cavity and back down through another exit hole. The threads of the base part and cap are coated with a wax to prevent leakage of moisture into the dry cavity.

DUPLEX & MINE INSULATORS

Duplex and Mine insulators, U-81 through U-100 in the Universal Style Chart, are characterized by having a threaded hole all the way through the insulator. Since it is obviously not practical to mount the normal pin types upside down under conditions where freezing moisture could fracture

the insulator, duplex and mine insulators are made for use on downward-projecting pegs. They can be thought of as normal insulators without tops and which screw up onto the peg.

The name "Duplex" insulator comes from the fact that they were used to double up circuits where crossarm space was at a premium. A special wooden duplex pin was made which was normally 11-1/2" long and which fit the 1-1/4" crossarm hole. This pin had insulator threads on the projecting bottom end in addition to the normal top threads. In use, two wires of an existing pair were duplexed at one crossarm hole, and an additional pair could be added by duplexing in the extra hole obtained. Some two-wire circuits such as street lamps were also run without crossarms by the use of duplex pins on simple angle brackets attached to the pole side.

Mine insulators have a more obvious use, in that wires in mine tunnels were nearly always strung on the top side of the tunnel instead of along the sides, and this necessitated downwardly projecting pins.

Whereas duplex insulators tended to be dainty styles with small wire grooves and which looked like normal insulators without tops, the mine insulators are of a more rugged style and have larger wire grooves. Of course, this does not preclude the interchangeable use of these designs in pole line or mine operations.

The U-100 style is very unusual (and rare) in that it is a transposition insulator, but one designed to be used on a duplex pin. The only plausible explanation for its creation was that it could be used to make a rolling transposition of two pairs (four wires total) with the use of a duplexing pin instead of a metal J-pin to mount an ordinary transposition under the crossarm.

MISCELLANEOUS SPECIAL DESIGNS

The purpose of this section is to give information on a number of individual styles in the Universal Style Chart, all of which have special uses, covering patents, or specific markings. Unless it is noted within the entry, the particular insulator manufacturer for the item is unknown. Markings found on these special designs are at the end of this chapter.

U-25, U-70, U-71. Thus far, we do not know the reason for the hole through the crown of these insulator styles.

U-76. This insulator is essentially identical in its exterior design with the 4-groove telephone spool, except for being a pin type.

U-100. This is a transposition insulator for use on a duplexing pin. See preceding section on "Duplex" insulators.

U-173, U-174, U-175. These are "dry-spot" insulators, and see that section in this chapter for a description of their use. This design was shown on a PINCO drawing dated Sep 30, 1925, and is covered by Patent No. 1,703,853 of Feb 26, 1929 (filed on 4-29-27), Rufus Gould, New York City, assignor of 1/2 to the Postal Telegraph Co., New York, N.Y.

The U-173 was manufactured by Pinco, and some of the known specimens are marked on the crown with the incuse "PATENT/APPLIED/FOR" marking shown in this section. The U-175 was manufactured by Locke, and the one known specimen bears the Locke insulator-insignia marking #7 (used 1922-1928). The U-174 is unattributed to any manufacturer.

U-181. A self-tying design, Patent No. 726,846, May 5, 1903, Joseph R. Bell, Peckville, PA. The manufacturer is unknown, and only one broken specimen is known as of this writing.

U-182. Made in two pieces. This is Patent No. 315,660, Apr 14, 1885, Henry Prenzel, Philadelphia, PA. It is one of the many self-tying designs intended for telegraph use, the line conductor being held in the grooved bottom piece when the top half is screwed onto the peg. Only one specimen of this insulator is known.

U-183. A self-tying design covered by Patent No. 928,878, August 3, 1909, Joseph W. Ranson, Batavia, Ohio. After laying the conductor in a straight groove across the crown, the insulator was turned 90°, and the conductor was bent and guided by inclined surfaces up into a pair of misaligned half-grooves at right angles to the first groove.

U-184. This is a self-tying design, the specific configuration being covered by Patent No. 715,375, Dec 9, 1902, Morton Harloe, Hawley, PA.

There are two varieties of specimens known. The early version has an underglaze marking showing 2 patent dates -- No. 621,661 of Mar 21, 1899 and No. 669,691 of Mar 12, 1901. Neither of these patents relates to the U-184 design, but both involved, among other things, the opposed fingers to hold a conductor. The later version has an embossed marking with three patent dates -- these two early ones plus the 1902 date for the patent specifically covering the U-184 design.

These porcelain pin types are unattributed to any porcelain manufacturer. Harloe also made this style in glass for a brief period, and those were made in his glass manufactory at Hawley, PA.

U-185. A self-tying design, Patent No. 881,967 of March 17, 1908, Charles R. Slusser, Montpelier, Idaho. It differs from the other "finger type" designs in that the conductor is free to slide through the hole in the crown after being slightly bent to pass through the fingers.

U-186. Referred to as a "twist-lock" insulator, covered by Patent No. 1,107,111, Aug 11, 1914, Benjiman S. Purkey, Tacoma, Wash. After the insulator is screwed onto the peg, it is backed off about 1/4 turn and the conductor is dropped into the crown slot, and the insulator again screwed down to secure the wire in place. The conductor runs slack-wire through the insulator crown. Specimens carry the crown embossing shown at the end of this section -- "PATENED. AUG 11 - 14/OTHER PAT'S./PEND'G." (Note the spelling error "patened".) Specimens are unattributed as to manufacturer but appear to have been made by Pittsburg. This is a 3-piece glaze-weld, two identical, reversible parts at the top glaze-welded to the base part.

A similar (improved?) design is covered by Patent No. 1,251,416, Dec 25, 1917, Benjiman S. Purkey, Tacoma. The bottom of the wire slot has raised gripping ridges concentric with the insulator axis, for the purpose of preventing the slack-wire action. No specimens are known of this version.

U-187. A slack-wire form of pin type tree insulator, Patent Number 971,785, Oct 4, 1910, Alfred L. Pierce, Wallingford, Conn. After the conductor is placed in the slot of the bottom section, the top cap is held in place with a tie wire over its extended lips and under the protruding brows of the bottom part. The top cap has a marking, usually very faint, of "PIERCE/PAT. 10.4.10". These insulators were made by Pittsburg.

Specimens of U-187 exist with the bottom section having a definite

"milk bottle" profile instead of the straight sides as shown on the U-187 drawing in the Universal Style Chart.

U-188. A "dry-spot" insulator, the only such pin type which makes provision for a dry spot for both of the tap bridle wires in one insulator. See the section on "dry-spot" insulators in this chapter for a description of the use of these insulator types.

Research has shown that this insulator was originally introduced by American Electric Co., Chicago and was termed the "AMERELEC" dry-spot insulator, and one specimen only is known with a marking of "American Electric Co. Inc." This specimen differs from all the other later ones in that its skirt bottom is noticeably flared outward to a greater degree.

The more common version of the U-188 was sold by Automatic Electric Co., Chicago from 1929 to 1951, and all these are marked "A. E. Co. INC.", which coincidentally would be the correct abbreviation for both American Electric and Automatic Electric.

Both markings indicate "patent pending", from the earliest units to the last ones sold in 1951, but exhaustive patent research failed to turn up any patent on this design; see Appendix H for details of this. All the U-188 specimens, both versions, were manufactured by Square-D Co., Peru, Indiana, and most specimens have a Square-D marking identifier on the top bridge of the bottom section, under the top cap. For additional information and the U-188 markings, see entries in Chapter 11 for American Electric, Automatic Electric, and Square-D Company.

U-189, U-189A, U-189B. This is Patent No. 1,140,050, May 18, 1915, R.A. Manwaring and J.T. Hessel, New Haven, Conn. These were designed to hold the vertical conductor from street light mastarms to the main overhead line. The insulator was mounted upright on the pole side with brackets, and the conductor was tied into one of the four vertical grooves.

See the two markings for these styles at end of this section. The U-189 and U-189B bear the two-element PEIRCE marking, and that is a trade-name of the Hubbard Company. These dry process insulators are unattributed to manufacturer, but they have identical characteristics to ones made by Square-D Company, Peru, Indiana, and that company is known to have been a supplier of many insulator types to Hubbard.

The U-189A bears the other marking of M&H/PAT./MAY 18/1915, and each vertical rib of the insulator carries one element of the marking. These U-189A specimens have a light blue glaze, and they are unattributed as to manufacturer.

U-190, U-190A. These were made by Lapp Insulator Co., initially for Commonwealth Edison (first Lapp drawings dated 2-6-33). They were "Dummy Potheads" and are mounted on the crossarm to provide a dummy terminal for the live cable plug when it is disconnected from the underground cable pothead on the pole. The dummy pothead comes with a porcelain cap, and this cap is moved over to the cable pothead during the disconnect period.

To afford an easy means of mounting the dummy pothead, it is made in the form of a pin type with a side groove, and it is substituted for one of the ordinary pin types on the crossarm.

There are several other slight variations of these from those shown in the Universal Style Chart -- differing only slightly in size or type and size of the socket in the crown top.

U-212. This style is listed with the transposition insulators in the Universal Style Chart, and it could have been used that way, but certain aspects of the design suggest it was probably designed for use as a "break

insulator" for applications such as series-connected street lights.

U-219, U-219A. These two styles are telephone transpositions cataloged and sold by Thomas -- the U-219 in the 1907 catalog and the U-219A in the 1912 catalog. Specimens are known of each, but very rare, and they are classic communications styles eagerly sought by collectors.

Because of the extreme importance of these two insulators to collectors, they were added to the Universal Style Chart in 1982 even though they are cemented multiparts, not "uniparts". They are the only U.S. styles of multipart communications insulators. I will forever be curious as to why Thomas did not simply make these by the much easier method of glaze-welding the two parts together.

U-339, U-339A. Specimens of both these styles are known, but their particular use is unknown. The U-339 was made by Pittsburg High Voltage, and the U-339A was made by Fred M. Locke.

U-376, U-376A, U-376B. Covered by Patent No. 676,881, June 25, 1901, Harry Etheridge, McKeesport, PA. These have a smooth pin hole with a single annular groove at its top and are rotatable on a special pin with a hook on top which locks into the groove. Specimens of each style exist and are all rare.

Etheridge insulators were listed in the 1904 Thomas catalog and the 1902 catalog of C. S. Knowles, a jobber of Imperial insulators. Additionally, the U-376 exists with a "LIMA, N.Y." marking. The different styles vary because of conductor groove size and pin hole size. There could be additional variations as yet unreported. There are no known specimens of the special Etheridge spring-lock pins used for these insulators.

U-401, U-401A. These are "Fay Clamp Insulators", Pat. No. 894,616, July 28, 1908, John L. Fay, St. Louis, MO. Mr. Fay was a line superintendent of the Union Electric Light & Power Co. in St. Louis. The porcelain pressure plug is held by a galvanized bail clamp. These insulators were made by Ohio Brass Co., and both styles are rare.

These insulators had been made by 1910, and their first use was in about April 1911 for the St. Louis arc light circuits. Nearly 20,000 were in use in St. Louis by October 1912.

U-819, U-820. For information on these styles, please see the section in this chapter on "Spiral and Helical Insulators".

U-966. This style is noteworthy for several reasons. It was originally designed for use on the early Niagara-Buffalo transmission line and is covered by Design Patent No. 34,211, Mar 12, 1901, Lewis B. Stillwell, Niagara Falls, N.Y. It is the only item in the Style Chart with a 1-5/8" pin hole size.

These are glaze-welds, and specimens are known with the markings of Thomas, Imperial and Pittsburg, in addition to unmarked ones. It is not known whether Thomas or Imperial was the first to manufacture this style. Among the known specimens, there are some minor varieties as to the exact size, profile and crown detail.

U-970 through U-990. These are early "threadless" styles for use on unthreaded pins. The U-980, U-981 and U-988 are rated as very scarce, and the others are all either rare or very rare. Several are unique.

PAT. AUG. 3
1909

(U-183) emb.

HARLOE'S PAT.
MAR. 21, '09.
MAR. 12, '01.

(U-184) u-g

HARLOE'S PAT.
MAR. 21 '99
MAR. 12 '01
DEC. 9 '02

(U-184) emb.

PATENED. AUG 11 - 14
OTHER PATS.
PEND'G.

SLUSSER
INSULATOR
PAT. PEND.

(U-185)

"Twist-Lock" (emb.)
(note spelling error)

(U-186) inc.

PIERCE
PAT. 10.4.10

(U-187) inc.

PEIRCE
1605

PAT'D
5-18-15

(U-189) inc.
(U-189A) inc.

M&H
PAT.
MAY 18
1915

(U-189A) inc.

Chapter 6

NOMENCLATURE & NICKNAMES

NOMENCLATURE

To facilitate discussions about insulators, it is helpful to have a mutually understood nomenclature. Even the different manufacturers are not consistent in what they call the various parts of an insulator, and the terminology set forth herein is a consensus of the terms used in the industry and by insulator collectors. The insulator in Fig. 1 is a hypothetical design concocted to illustrate the various terms. (See Appendix A also.)

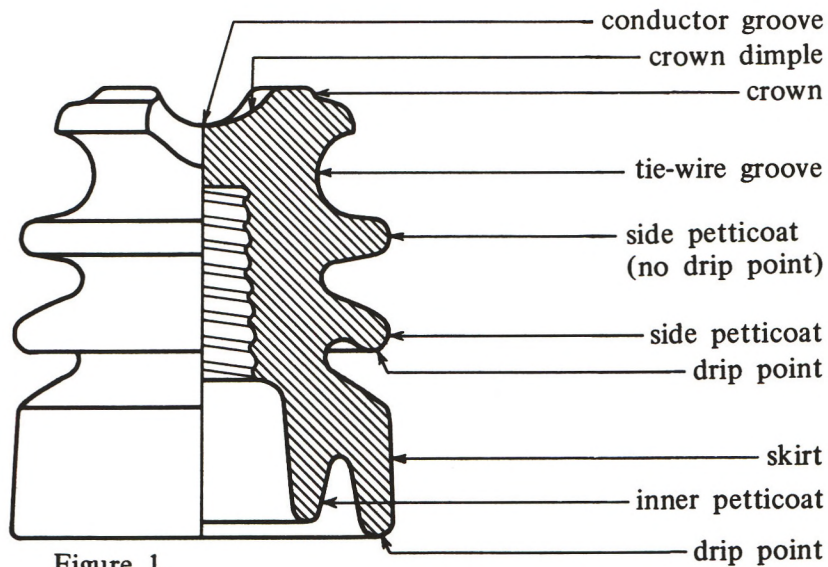


Figure 1.

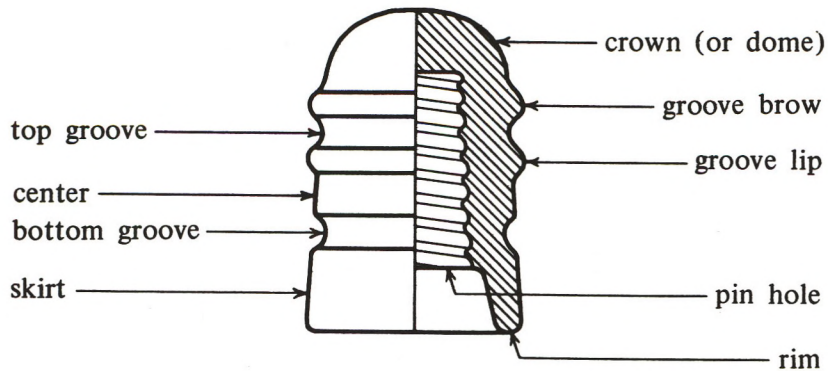


Figure 2. Telephone insulator nomenclature.

The purpose of the side projections on insulators is to increase the leakage path distance, much the same as the inner petticoats do; and so, we term them "side petticoats", even though they are referred to in the industry as variously skirts, petticoats, fins, ribs, corrugations, etc.

On porcelain insulators a "drip point" is where falling water will drip to a lower level instead of continuing to run down the surface of the insulator. Side petticoats projecting straight out do not have a drip point, whereas the overhung side petticoats do have a drip point.

In the insulator industry, all of the downward projections at the base of the insulator are also called petticoats. This results in the terminologies of "double-petticoat" and "triple-petticoat" for the insulators shown in Fig. 3. Regardless of the number of petticoats on given insulator styles, collectors (and some in industry) also usually always refer to the outermost of these as the insulator "skirt". Thus, the insulator shown in Fig. 2 is usually called a "no-petticoat" style.

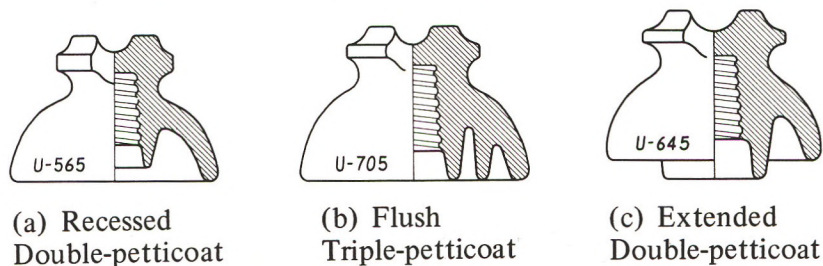


Figure 3. Different types of petticoat designs.

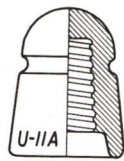
Fig. 3 also illustrates generally the influence that firing considerations have on the length of the inner petticoat. Cable styles with the recessed petticoat were nearly always fired upside down on the crown, but some smaller styles were fired upright on the base rim. The styles with all petticoats flush were all intended to be fired upside down. A major reason for nearly all cable styles evolving into designs with an extended inner petticoat such as Fig. 3(c) was so that they could be fired upright on the inner petticoat, thereby eliminating any unglazed crown or skirt rim. Collectors use the following abbreviations to describe the location of the unglazed firing surface:

T.R. (Top Rest) S.R. (Skirt Rest) P.R. (Petticoat Rest)

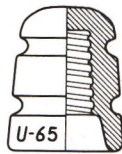
NICKNAMES

It is convenient to have names for each of the basic classes of insulator styles, and these are shown on the following pages. Some of these are standard terminology in the insulator industry, but most of them are nicknames evolved by insulator collectors. There are two broad classes of insulators as used for telephone lines or power lines, although there are some small styles used for both types of lines. The skirt-rest "hat" styles were nearly always designed for communications lines, but the more rugged petticoat-rest "hats" with the larger wire grooves were designed for use as secondary distribution power insulators.

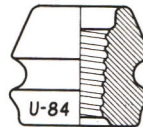
(TELEPHONE STYLES)



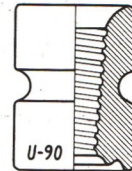
Pony



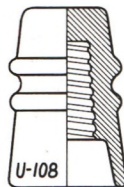
Exchange



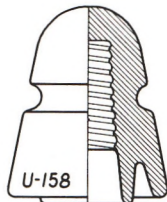
Duplex



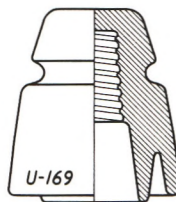
Mine



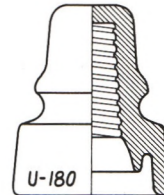
Toll



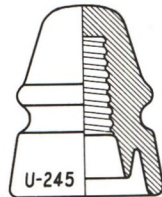
Beehive



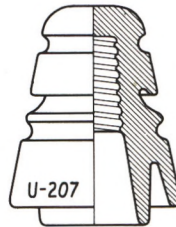
Haystack



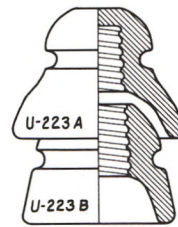
Stovepipe



S. R. Hat
(Signal)

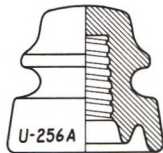


Transposition

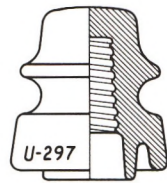


Two-Piece
Transposition

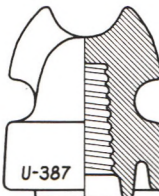
(POWER STYLES)



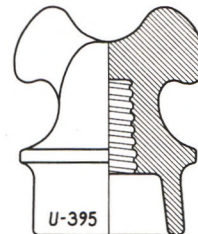
S. R. Hat
(Distribution)



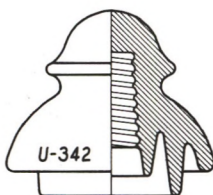
P. R. Hat
(Distribution)



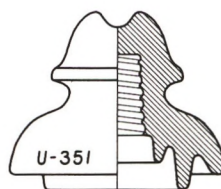
Roman Helmet



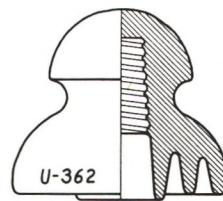
Mickey Mouse



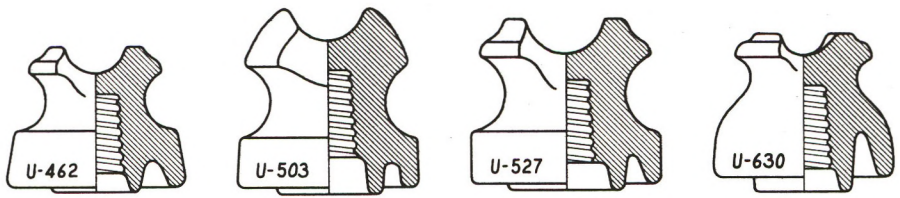
Wide Hat



Grooved Hat



Mushroom

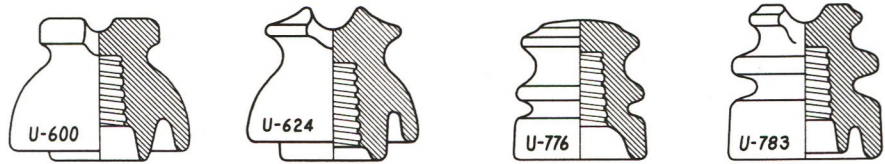


Straight Cable

Truncate

Feeder Cable

Curve Cable

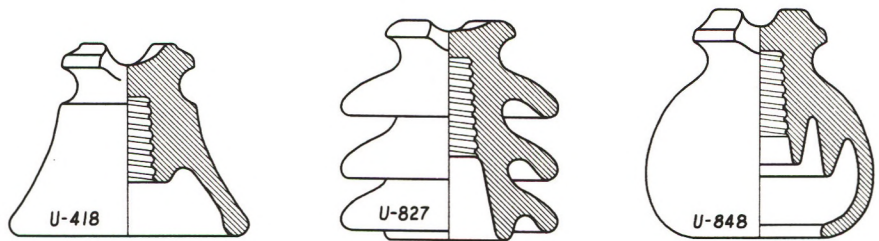


Crown Type

Peaked Crown

Side-tie Hi-Top

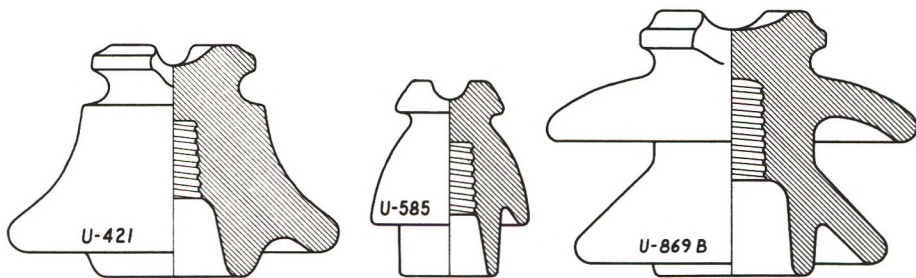
Hi-Top



Fog Bell

Fog Type

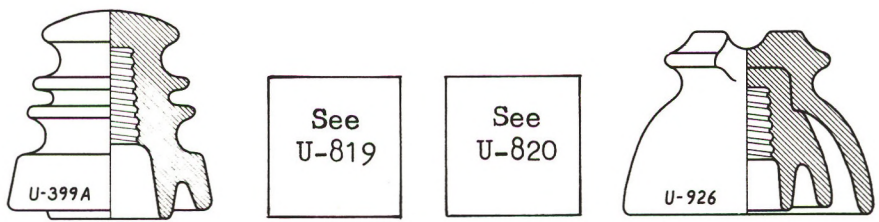
Fog Bowl



Rugged Bell

Pogo

Two-Skirter



Loop

Spiral

Helical

Glaze-Weld

Chapter 7

COLLECTING PORCELAIN INSULATORS

The majority of those interested in porcelain insulators collect in a general way, adding to their collections any specimens of unusual style or pretty color. Counting the multitude of styles, manufacturers and colors, there is a seemingly endless number of different porcelain pin types, and a collector almost immediately finds out that it isn't practical to collect one of everything different that comes along. There isn't much point in collecting items that can't be displayed and worked with. Boxes of insulators marked "collection" and stored in the attic don't add much to the enjoyment of collecting.

For this reason, it is best to start off with some guidelines which will keep the size of your collection manageable. You will soon figure out which part of the collecting spectrum interests you most, and then try to learn the art of passing up insulators that just don't interest you!

Specializing in one or more limited classes of insulators can offer other advantages beside that of keeping the collection in check enough that it can be displayed. For one thing, the search for new additions to a specialized collection is considerably more challenging than the mode of "I need everything". Exhibits based on specialized collections, even if small in number, are usually eye-catchers, and the collector becomes well informed in his particular field. Everyone will collect what appeals to himself, but here are several examples of specialized collections:

1. General collection of telephone styles only
2. White-glazed units of all types
3. Bright colors only (cobalt, green, yellow, etc.)
4. The early classic styles, circa 1890-1910
5. Insulators made by a given manufacturer
6. Rare and unusual styles only
7. Matching glass and porcelain styles

ACQUIRING INSULATORS

The time-honored method of collecting insulators is to hike the hills in search of old abandoned telephone and power lines, and this is half the joy of collecting. Since porcelain insulators and high-voltage go hand in hand, collectors should take extreme precautions to first ascertain that the line is positively down, abandoned and dead on both ends before touching the wires or removing any insulators.

Utility companies are continually tearing down old lines or completely re-insulating existing lines, and many of the older units with their small conductor grooves or lacking radio treatment are scrapped out at the salvage yards. It is among these insulators that some very nice collector items can be found. Surprisingly, a majority of the utilities, especially the smaller ones, will grant you permission to gather specimens from their discards being readied for the dump if you approach them in the open with propriety instead of sneaking up to their back fence. If you strike

up a friendly relationship with a small utility, they can even tip you off as to when some old line is going to be dismantled.

Some of the very best insulator finds have been made by visiting flea markets, second hand stores, antique stores, yard sales, etc. There are limits as to how you can further your collection by hiking the hills or visiting the utility company in your own area, so you soon end up trading insulators with collectors from distant areas or buying them at insulator shows. This is especially true if you collect specialized items.

TRADING INSULATORS

Increasing your collection by trading with other collectors is not only an economical way to collect, but it is a good way to make new collecting friends, and it also provides some incentive to get out on weekends to look for more "trader" specimens. You can nearly always pry out a duplicate porcelain insulator from a fellow collector if you offer him an attractive trade of other porcelain or glass insulators.

Setting up a "sales" table at insulator shows is one of the best ways to make some good trades on an instant basis. You may sell and buy some insulators at the shows, but you'll probably have a lot more action and fun trading with others who have also set up tables. Whether or not you are traveling to set up at some show, you may be able to visit collectors along the way, so don't forget to take along a stock of good traders.

Trading by mail has been very popular among insulator collectors and became practical with the advent of the style charts for glass and porcelain insulators. Before the Universal Style Chart of porcelain pin types was published, it was very cumbersome to describe given styles on trade lists or in correspondence. But now, if you list a specimen by its style number, marking and color, this is very definitive, and the correspondent knows exactly what the specimen is. For instance, the following listing obviously describes exactly a given specimen:

U-208 Thomas, red-brown, mint

In the case of porcelain pin types, it is helpful to the correspondent if you also describe any unusual aspects such as the firing rest being in an unexpected position, or the unit has a radio-treated crown, or it has a pin size unusual for that style, etc. Collectors use standard abbreviations for these features to make listing simple and brief.

If the marking is an unusual one for the company, that should be noted, and all the markings of any company are separately numbered in this Guide Book to facilitate that. Collectors specializing in Fred M. Locke insulators are interested in which of the many Fred Locke markings are on the specimen, so all the known markings of that type are listed with reference numbers in Appendix D.

Shipping charges are an important factor when selling or mail trading porcelain insulators. Some porcelain pin types are very heavy, and some agreement should be reached between the traders regarding the shipping costs of such items, especially on insulators of relatively low value. This is even more important on sell lists or advertisements, since the shipping cost on a large item might greatly exceed the listed sell price.

CLEANING PORCELAIN INSULATORS

Cleaning of many antique items is not practiced, but it has become customary for insulator collectors to clean insulators. Insulator collecting had its first big boost from people wanting to collect "pretty glass", and many of the specimens were not really pretty until cleaned. I know of very few collectors who prefer to collect and display insulators which are dirty and have not been cleaned. The general grime an insulator acquires by sitting on a crossarm peg for 75 years in most cities isn't a thing of beauty. Some tips on cleaning methods are therefore in order.

Ordinary sand and dirt can be removed in the kitchen sink. A discarded toothbrush works well for cleaning the pin hole, and the petticoat slots can be cleaned best with an old, nearly-stiff paint brush. Whereas glass insulators must be carefully washed in room-temperature water to guard against cracking from thermal shock, porcelains are more rugged in this respect and can be moved back and forth from hot and cold water with no fear of damage.

Some specimens may have a tar-like deposit left by deteriorated insulation of conductors and tie wires. The bulk of this can be removed by scraping it off with a sharp knife just like you use a razor blade to remove paint or putty from a window pane. The remaining amount can be removed with a rag and any solvent such as acetone or lighter fluid.

Rust stains left from iron conductors or silvery marks from aluminum conductors can be broken down by soaking in or swabbing with hydrochloric (muriatic) acid, which is the same as used in swimming pools. Be careful with this acid. Wear rubber gloves. After treating with the acid, the residuals can be removed with fine steel wool or an S.O.S. pad.

(IMPORTANT. In mixing acid with water to dilute it, "Do what you ought'r, pour the acid into the water." Pouring the water into the acid instead can create a very explosive situation! Be careful, and remember this rule.)

In many cases, the smoke and grime on the surface of the insulator can be removed with water and an S.O.S. pad. In other cases, the alkaline coatings are so stubborn as to defy mechanical efforts to remove them, and collectors then resort to chemical cleaners. The most commonly used chemical is oxalic acid, available in crystal form at most drugstores and some craft hobby stores.

Use a plastic bucket, and wear rubber gloves. A good solution is two ounces of oxalic crystals per gallon of water. Soak insulators for as long as required, hours to a day or more. On stubborn cases, use an S.O.S. pad after the acid treatment, and then repeat the acid treatment if necessary.

Pins cemented into pin holes on switch and bus insulators can be removed with hydrochloric acid -- if you have the patience. It may take up to a month to do it, but it's the only way to do it with chemicals that are easily obtainable and relatively safe to use.

A final word of caution about use of hydrochloric acid. Its fumes are highly toxic and corrosive. Use it only outside the house, and stay "upwind" from it. If you place your soaking bucket even near the back porch, you will rust everything in sight and even etch your window. Keep the bucket in the far end of the yard, but not too close to the neighbor's windows either!

Since most porcelain insulators have some generally dark glaze over the snow-white body material, even slight mechanical damage to porcelains stands out in a display. For those collectors who, like myself, like to do it, I have included in Appendix-I a description of the methods used to restore damaged porcelain specimens to displayable condition.

Chapter 8

PRICING GUIDE

IMPORTANT -- Information in the following text is an integral part of pricing porcelain insulators, and I suggest you read it. If you skip this and jump directly into the pricing tables, you could easily make some serious pricing errors -- in either direction.

The pricing of an insulator is based purely on the supply and demand. Absolute rarity of the insulator is of little or no consequence. For example, a particular modern 7" cable insulator of a big manufacturer may be very rare, but if no collector wanted to buy one of those, it would have limited value, if any. On the other hand, insulators such as telephone transpositions may have had wide distribution, but they have substantial collector value because virtually all collectors deem them desirable for collections.

It would be virtually impossible to tabulate prices for every conceivable insulator that is already known, much less the countless thousands of others that might turn up in the future. Counting style, marking and color, there could be 50,000 or more combinations. This pricing guide is a simplified method for approximating collector value for any particular specimen that you might have.

The tables on the following pages list estimated values for all the more important unipart pin types, in most cases specifying the particular color and/or marking which fits the price indicated. All U- styles not shown in the tabulation are generally common styles or of limited appeal to collectors for one reason or another. They have a value of about \$1 to \$3 unless they carry rare markings or are of an unusual or pretty glaze color.

There are some unusual styles listed in the old catalogs, specimens of which are still unknown. These are listed as "unknown" in the price tabulation instead of being omitted. As opposed to the common styles not being listed, these unpriced listings serve to alert readers that any of these unusual styles which turn up would have considerable value.

There are four factors which bear on the value of a specimen, regardless of whether it is a common or rare style -- Markings, Glaze color, Antiquity and Condition. The following paragraphs comment on how each of these factors affects the insulator value, and you should adjust the price accordingly.

Remember, market values are not set by the actions of any one individual, some of whom don't take the time to educate themselves very well on current values. If one collector or dealer "dumps" a small lot of \$15 insulators at a show for \$2 apiece, this is just bargain day for all the knowledgeable people who can get to the table in time. On the other hand, when a dealer puts a \$10 sticker on some item everyone else is selling for only \$3, do your shopping elsewhere.

MARKINGS

Common: "unmarked" (N.N. = No Name), Chance, Illinois, I.E.P., I-T-E, Knox, Lapp, L-M, Locke, M-E, O-B, Pinco, P.P. Inc., Thomas, V-I Inc., Westinghouse

Uncommon: Brown-Boveri, Cook, Findlay, Franklin, G.E. Co., Gladco, G.P. Co., Gould Inc., Harford, J-D, Square-D Co.

Scarce: B & O, Fred M. Locke, "G", Imperial, "M P", "MACOMB", FEDCO

Rare: Johns-Manville, N.A.T. Co., N.E.P., POSTAL, P.R.R., SOO

Very Rare: "American Elec Co Inc", C.C.V.F., "Cooke Wilson E. S. Co.", Lima, New Lexington, O. P. Co., "Pittsburg"

GLAZE COLORS

Brown, White and "Sky" are common colors and add nothing to value. Unusual colors (blue, green, yellow, mustard, etc.) increase the value by a factor of 3 to 5 times over that of common colors.

White glaze adds some to the value of styles which did not normally come in white or which are not equally common in brown or white.

Very early styles made by Imperial and Thomas were normally white glaze, and brown specimens of these are mostly quite rare.

ANTIQUITY

Any very old specimens (early styles, crude, etc.) will have considerable collector appeal, and they can have substantial premium value over comparable modern styles, even if unmarked and with brown glaze.

All the early "classics" (Imperial, Fred M. Locke and early Thomas items) are desirable collector items, and the rarer styles are among the higher priced of all the porcelain pin types. Several styles have been found in moderate quantity on old lines and are priced modestly, so don't get carried away in buying the old items without checking values first. All these early styles are included in the following price tabulation.

CONDITION

Value is naturally decreased for damaged specimens. Slight damage isn't bad on very old specimens, and might even be expected, but the same amount of damage on a common or modern item can be ruinous to its value. It is nearly impossible to find undamaged specimens of the early styles that have skirts tapering to a sharp edge, most notably the Fred M. Locke styles with widely flared skirts.

U-		\$\$
11A	"G"	5
15	Findlay, blue	12
25	NN	12
32	Square-D, blue	5
38	F M Locke, brn	8
38	F M Locke, wht	20
39	F M Locke	8
40	F M Locke	85
42	"MACOMB"	80
47	"FEDGO", brn	12
47	"FEDGO", wht	5
50	"G"	5
55	(Sim. 55) "G"	8
55	F M Locke	100
57	"MACOMB" on skirt	3
57	"MACOMB" on crown	12
58	Knox	8
59	Illinois	8
67	F M Locke	60
70	NN	8
71	(unknown)	
76	NN, wht	20
81	NN	12
82	NN	12
84	NN	15
85	NN, brn or wht	15
89	NN	12
90	NN, wht	15
90	Thomas, wht	25
91	NN	15
93	NN, wht	15
94	O-B, wht	20
97	O-B	12
98	Cooke Wilson etc., wht	100
98A	NN, wht	15
98A	G. P. Co.	35
98B	NN	?
100	NN	125
104	NN	5
105	NN	6
106	NN	6
106A	NN	6
107	NN	6
108	NN, brn	6
108	NN, wht	15
109	NN	6
110	NN	10
114	NN	6
124	"MACY INSULATOR", emb.	60
126	P.P., Inc.	5
128	NN	5
129	P.P., Inc.	5
134	Knox	5

U-		\$\$
141	(unknown)	
142	NN, brn or wht	8
143A	NN, wht	8
144	NN	5
146	(unknown)	
148	"N.A.T.Co."	20
148	"SOO"	50
150	O-B	6
152	"M P"	20
154	NN	2
154	"POSTAL", incuse	25
154	"POSTAL", under-glaze	30
157	Knox	5
160	Illinois, wht	5
171A	NN, green	25
173	with Patent Apld For	15
174	NN	30
175	Locke	40
177	NN	15
179	NN	3
179	"P.R.R." on crown	20
180	O-B, brn	1
180	O-B, wht	10
180	O-B, bright mustard	15
180	O-B, blue	30
181	NN (J R Bell patent)	300
182	NN (Prenzel patent)	150
183	"PAT," etc. (Ranson)	75
184	Harloe, 2-date, wht	135
184	Harloe, 3-date, wht	125
185	"SLUSSER" etc., wht	175
186	"PAT'D" etc. (Purkey)	60
187	"PAT." etc. (Pierce)	100
188	A. E. Co., brn	6
188	A. E. Co., wht	25
188	AMER ELEC. CO., wht	125
189	"PEIRCE" etc., brn	45
189B	"PEIRCE" etc., brn	45
189A	"M & H" etc., lt blue	110
190	NN, without top cap	10
190A	NN, without top cap	10
190	NN (cap for U-190)	15
191	NN	10
191A	NN	10
192	NN	12
192A	NN	12
192A	F M Locke	60
193	NN	10
194	NN or Lapp	50
195	NN	10
197	"MACOMB"	130
197A	"MACOMB"	175
198	NN, brn	125

U-		\$\$
198	NN, wht	150
199	NN or Thomas	20
199A	NN or Thomas	35
200	NN	60
200A	NN	60
201	NN	12
201	NN, light blue	75
201	G. P. Co.	25
201A	NN	12
201B	NN	12
202	NN	10
202A	NN, brn	10
202A	NN, blue	100
205	Cook	20
206	O-B	10
206	(similar) Whse	10
206	NN, cobalt blue	50
206A	O-B, bluish gray	20
207	NN	8
207A	NN	8
207B	NN	8
207C	NN	8
207D	NN	8
208	Thomas	8
208A	NN	8
209	NN	8
210	NN	8
211	G. P. Co.	20
212	NN or Locke	135
213	Cook	30
215	Lapp	25
216	Lapp	30
217	NN or Illinois	15
217A	Illinois	15
219	NN (multipart tramp)	175
219A	NN (multipart tramp)	175
220	F M Locke	225
222A	"P.R.R." (top only)	75
223	NN, wht	150
223	"P.R.R.", wht	190
224	NN	125
225	NN or Locke	125
228	NN	10
228A	NN	10
229	"G"	10
230	NN, wht	6
236	"G"	7
239	"THOMAS" embossed mrkg	4
239B	"MACOMB"	25
241A	Johns-Manville, brn	20
241A	Johns-Manville, wht	45
242	F M Locke	100
244	"MACOMB"	5

U-		\$\$
244A	"MACOMB"	40
244B	"MACOMB"	50
248	"G"	10
259	F M Locke, brn	65
259	F M Locke, wht	75
271	"G"	10
274	"O. P. CO.", brn	100
274	"O. P. CO.", wht	125
282B	G.P.Co., 1 or 2, wht	6
282B	G.P.Co., mrkg #3, wht	12
293A	"B & O", wht	15
293B	"B & O", wht	15
294A	"THOMAS" embossed mrkg	8
317	Square-D, brn	8
317	Square-D, wht	20
330	NN or F M Locke	140
330A	F M Locke	140
334	NN	6
335	NN	6
336	NN (Canadian)	15
337	NN	6
339	NN	175
339A	F M Locke	250
340	NN or thru common name	brown 2 to 5 white 8 to 12
351		
353	NN or thru common name	brown 5 to 8 white 10 to 15 lt blue 20 to 30
362		
363	NN	10
364	(unknown)	
365	NN, wht	60
366	(unknown)	
367	O-B, brn or light gray	20
368	O-B, brn or light gray	15
370	NN, wht	50
373	(unknown)	
375	(unknown)	
376	"LIMA", light blue	450
376A	NN (Etheridge patent)	250
376B	NN (Etheridge patent)	250
377	NN	10
378	NN	10
379	"VICTOR"	12
380	F M Locke, brn	100
380	F M Locke, wht	125
381	NN	10
382	(unknown)	
384	NN	12
384A	NN	10
384B	NN, brn	10
384B	NN, dark blue	150
386	Locke	10

U-		\$\$
387	Locke	10
388	Thomas, brn	8
388	Thomas, wht	10
389	NN or Thomas	75
390	Locke	45
392	NN, brn	100
393	NN, wht	30
393A	NN, wht	25
394	(unknown)	
395	NN, brn	40
395	NN or date, light blue	225
395	NN or date, white	275
396	Findlay	20
397	P.P., Inc.	10
398	Thomas	10
399	P.P., Inc.	10
399A	Findlay	15
399B	Cook	15
399B	L-M, cobalt blue	50
399C	Locke, wht	20
399D	(unknown)	
400	O-B	15
400A	O-B	15
401	(unknown complete)	
401	NN, insul. base only	65
401A	NN, insul. base only	50
401B	I.E.P. or L-M	20
402	Knox	10
402A	NN	10
403	Lapp	15
403A	Lapp	20
403B	P.P., Inc.	15
404	(unknown)	
405	(unknown)	
406	(unknown)	
407	NN or Locke	200
408	NN	150
408A	NN	150
410	NN	120
410A	(unknown)	
411	(unknown)	
412	(unknown)	
412A	(unknown)	
412B	(unknown)	
414	Victor Insulators Inc.	25
416	NN	100
418	NN or thru name	brown 5 to 8 white 10 to 15
419A		
421	Westinghouse	15
425	Lapp	5
425A	Chance	5
425B	PP-Knox	5

U-		\$\$
431	NN	6
432	NN	8
432A	NN	8
435	(unknown)	
437A	NN or Whse, wht	8
441	F M Locke	60
443	"MACOMB"	30
447	F M Locke, brn	75
447	F M Locke, wht	60
474	"N.E.P."	30
519	"LIMA"	100
520	(unknown)	
529	"P.R.R."	50
529A	F M Locke	75
529A	"VICTOR"	15
535	(unknown)	
535A	(unknown)	
537	P.P., brn or green	5
540	NN	5
541	NN	10
552	"NEW LEXINGTON, O."	100
560	Imperial, wht	75
582	NN or thru name	brown 4 to 8 common
588		
590	(unknown)	
591	NN	20
592	(unknown)	
593	(unknown)	
595	NN	15
599B	"MACOMB"	100
605	NN or Locke	5
608A	F M Locke, brn	10
608A	F M Locke, wht	20
610A	"M P"	20
611A	F M Locke, brn	8
611A	F M Locke, wht	20
616	NN	10
639	F M Locke, brn	50
639	F M Locke, wht	50
648	F M Locke, brn	40
648	F M Locke, wht	45
648	"VICTOR"	8
648	"LIMA"	150
669	F M Locke	75
670A	F M Locke, brn	35
670A	F M Locke, wht	70
675	F M Locke, brn	65
675	F M Locke, wht	45
694	NN or thru name	brown 10 to 15 common
697A		
699	Locke	15

Chapter 9

UNIVERSAL STYLE CHART

The Universal Style Chart on the following pages is an indispensable tool of the porcelain collector, since it allows a definitive description of any unipart pin type by simply noting the drawing reference number.

Every drawing in this chart was made especially for this book by consulting the drawings shown in hundreds of old manufacturer catalogs from 1890 to date, by researching the drawing files of the active manufacturers and by making drawings from many specimens not shown in any catalogs.

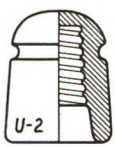
Some early catalogs picture units only with artist sketches which are unsuitable for making accurate drawings, and these early styles have been added to the chart only as specimens have turned up to allow accurate drawings to be made.

All drawings in the chart are uniformly 1/4 scale. Where large two-skirters are dimensioned such as 7 - 9 x 6 $\frac{1}{2}$, the first two numbers are the skirt diameters reading from the bottom up, and the last number is the height. Except for some of the smaller styles, most factory nominal dimensions have been rounded off to the nearest 1/8". Some artistic liberty is taken in showing details of the crown and conductor grooves, and older specimens vary in this respect from unit to unit and changed somewhat when new molds or trimmer blades were made. Do not expect each specimen to exactly fit the illustrated details or to agree exactly with the nominal dimensions shown. Specimens differing only slightly from the style shown can be listed as "U-647 Sim.", for instance.

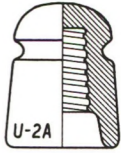
Numerous different styles were created over the years as companies switched to designs with extended petticoats, and occasionally back the other way. Similarly, companies changed designs to ones with a circular dimple to minimize the unglazed firing surface or to accommodate preformed tie-wire methods. If you are cataloging some style not in the chart for these reasons, use a description such as "Sim. U-651, dimple top".

An effort has been made to exclude from the chart all insulators not of U.S. origin. A complete Universal Style Chart of all foreign pin type porcelains is included in the book "Worldwide Porcelain Insulators". See the bibliography listing for this book.

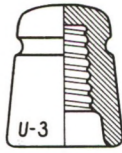
New styles will continue to be added to the chart as they are discovered, but only if they are early classic insulators or more recent styles which are significantly important to collectors, not just minor variations of the many styles already in the chart. Collectors can assist in adding new styles to the chart through correspondence and without the need for mailing the actual specimens. We have developed a method whereby accurate drawings can be made from shadow profiles of the insulator plus several measured dimensions. See Appendix J for a description of this method.



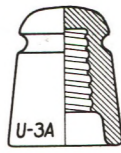
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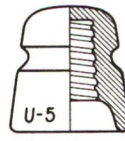
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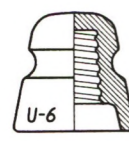
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$2\frac{3}{8} \times 2\frac{7}{8}$



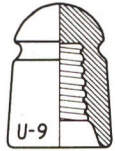
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$2\frac{1}{2} \times 2\frac{1}{2}$



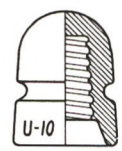
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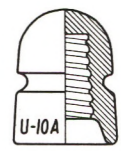
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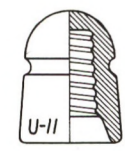
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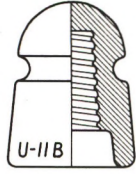
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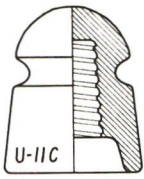
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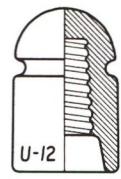
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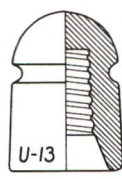
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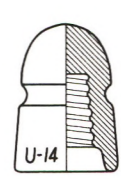
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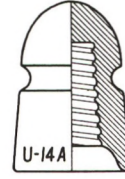
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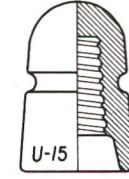
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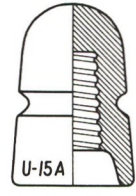
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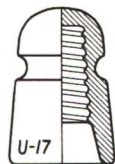
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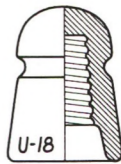
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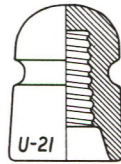
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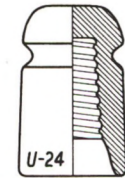
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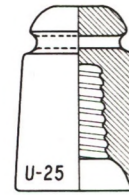
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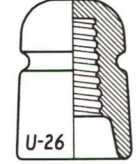
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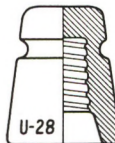
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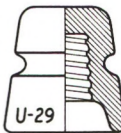
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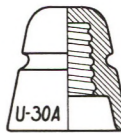
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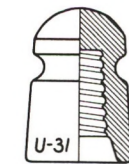
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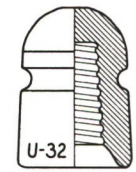
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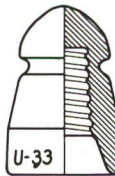
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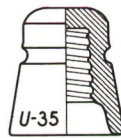
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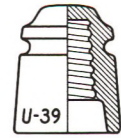
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$2\frac{3}{8} \times 2\frac{3}{4}$



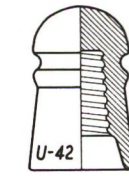
$2 \times 2\frac{5}{8}$



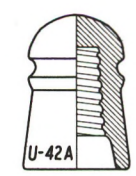
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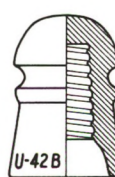
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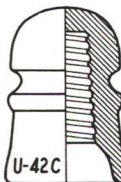
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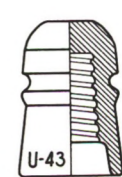
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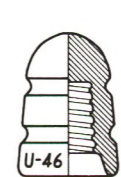
$2\frac{3}{8} \times 3\frac{3}{8}$



$2\frac{1}{2} \times 3\frac{3}{8}$



$2\frac{1}{8} \times 3\frac{1}{4}$



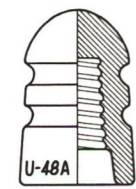
$2\frac{1}{8} \times 3$



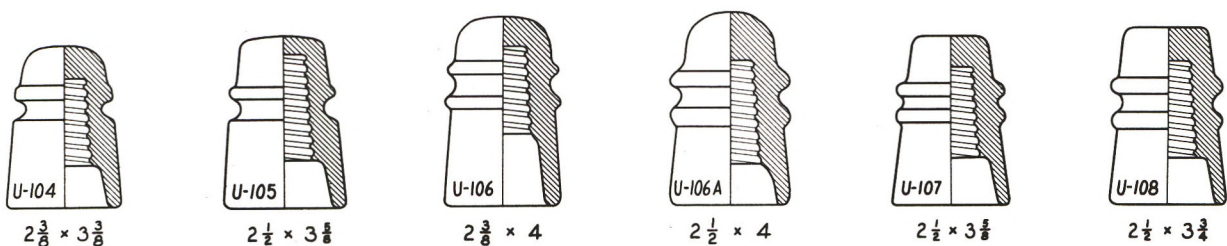
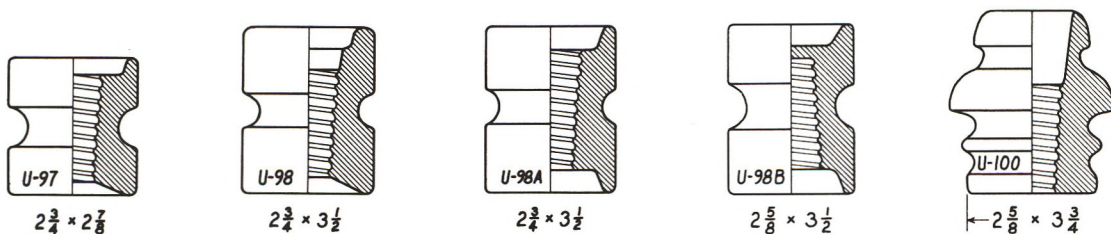
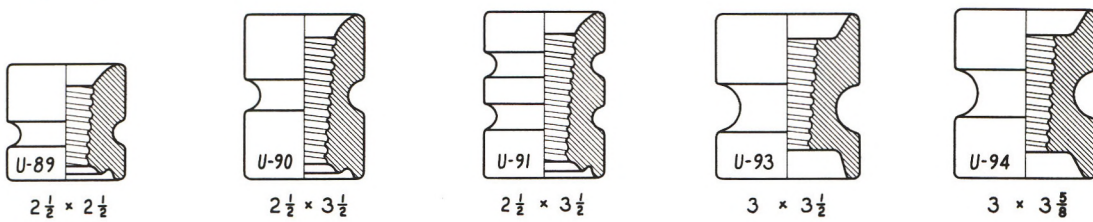
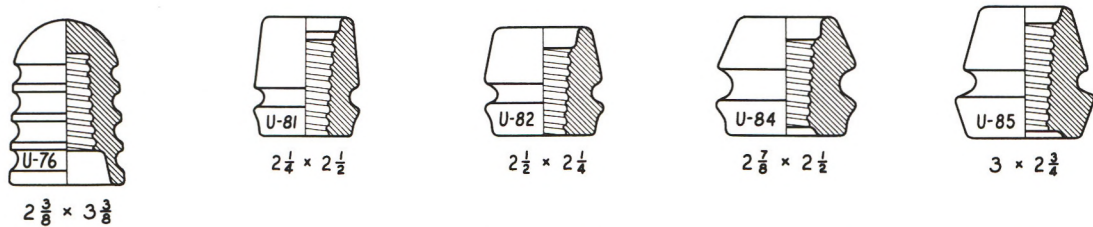
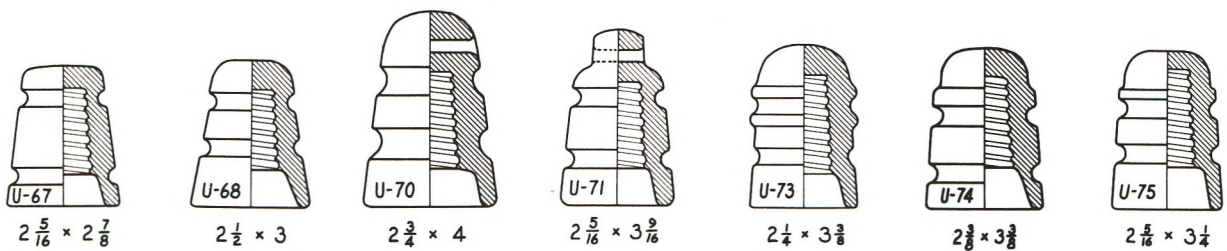
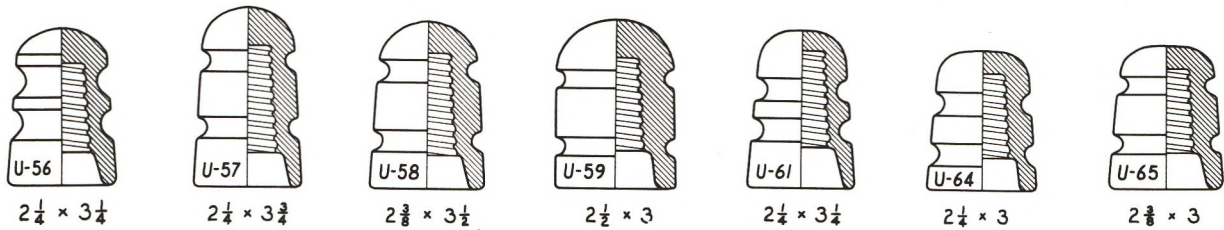
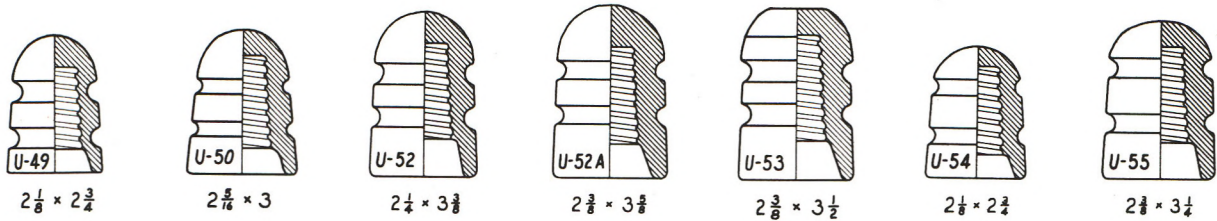
$2\frac{3}{16} \times 3\frac{1}{2}$

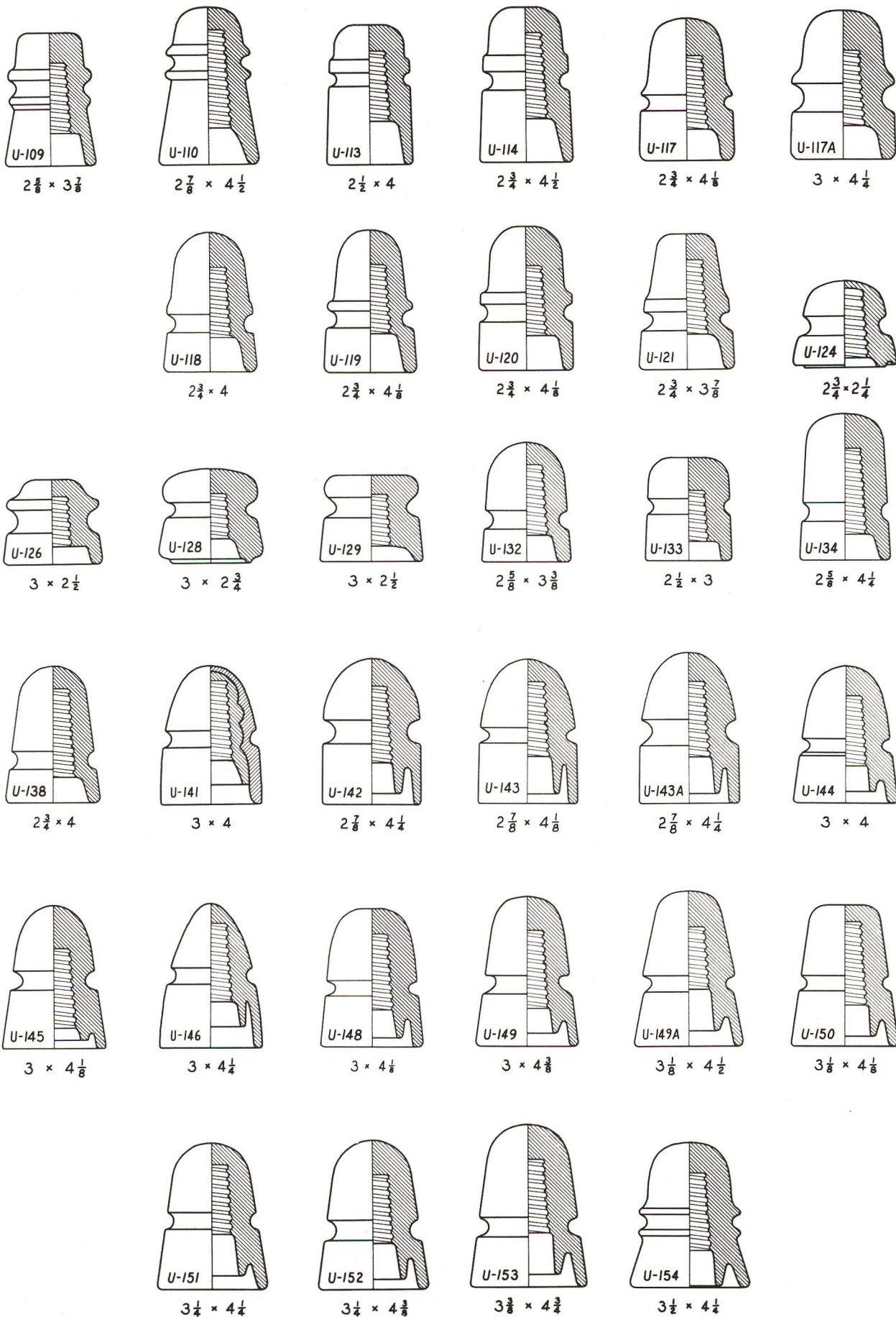


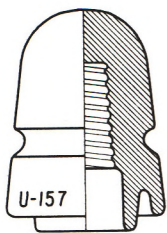
$2\frac{3}{8} \times 3\frac{3}{8}$



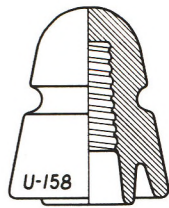
$2\frac{3}{8} \times 3\frac{5}{8}$



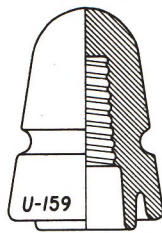




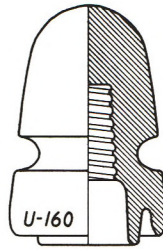
U-157
 $3\frac{1}{4} \times 4\frac{1}{2}$



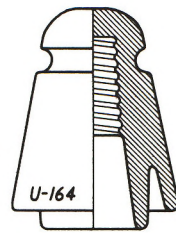
U-158
 $3\frac{3}{8} \times 4$



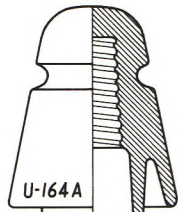
U-159
 $3\frac{1}{4} \times 4\frac{1}{2}$



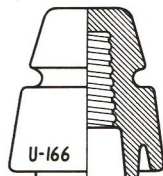
U-160
 $3\frac{1}{4} \times 5$



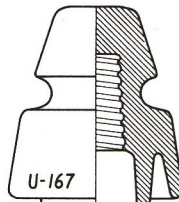
U-164
 $3\frac{1}{2} \times 4\frac{3}{8}$



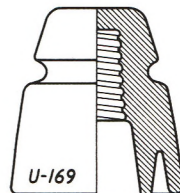
U-164A
 $3\frac{1}{2} \times 4\frac{3}{8}$



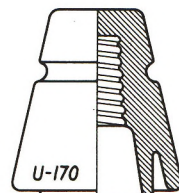
U-166
 $3\frac{1}{4} \times 3\frac{5}{8}$



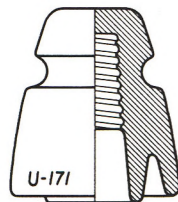
U-167
 $3\frac{5}{8} \times 4\frac{1}{4}$



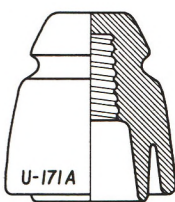
U-169
 $3\frac{5}{8} \times 4$



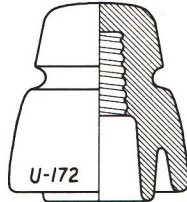
U-170
 $3\frac{5}{8} \times 4$



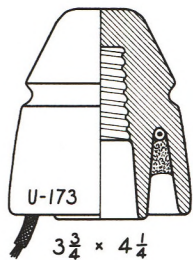
U-171
 $3\frac{5}{8} \times 4$



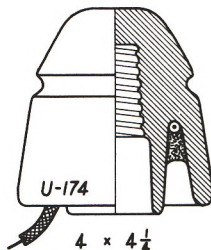
U-171A
 $3\frac{1}{2} \times 3\frac{7}{8}$



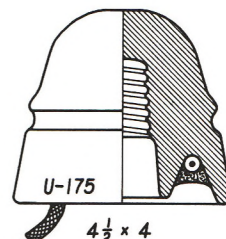
U-172
 $3\frac{3}{4} \times 4\frac{1}{8}$



U-173
 $3\frac{3}{4} \times 4\frac{1}{4}$



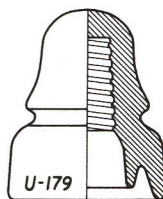
U-174
 $4 \times 4\frac{1}{4}$



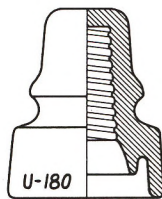
U-175
 $4\frac{1}{2} \times 4$



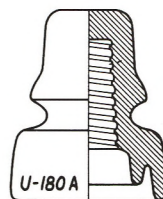
U-177
 $3\frac{5}{8} \times 4$



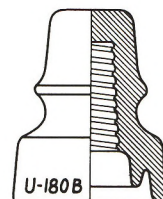
U-179
 $3\frac{1}{4} \times 4$



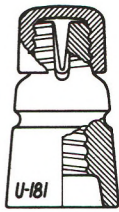
U-180
 $3\frac{1}{4} \times 4$



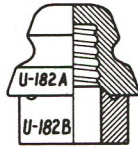
U-180A
 $3\frac{1}{4} \times 4$



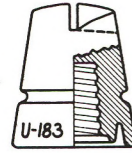
U-180B
 $3\frac{1}{4} \times 4$



U-181
 $2\frac{3}{8} \times 4\frac{1}{8}$



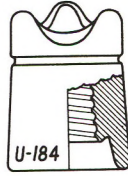
U-182A
U-182B
 $2\frac{1}{4} - 2\frac{3}{4} \times 2\frac{7}{8}$



U-183
 $2\frac{7}{8} \times 3$



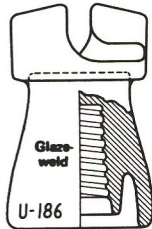
U-184
 $2\frac{1}{2} \times 3\frac{1}{2}$



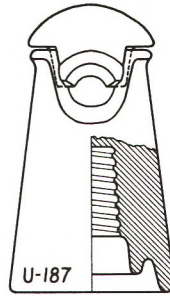
U-184
 $2\frac{1}{2} \times 3\frac{1}{2}$



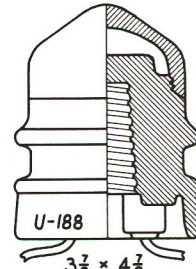
U-185
 $2\frac{1}{8} \times 3\frac{1}{2}$



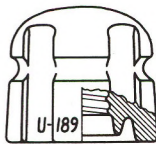
U-186
 $3 \times 4\frac{5}{8}$



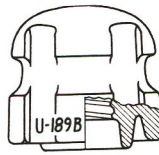
U-187
 $3\frac{3}{8} \times 5\frac{7}{8}$



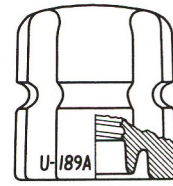
U-188
 $3\frac{7}{8} \times 4\frac{7}{8}$



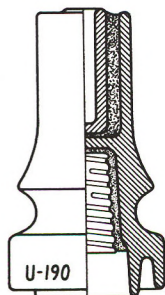
U-189
 $3\frac{1}{8} \times 2\frac{3}{4}$



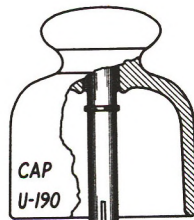
U-189B
 $3\frac{1}{8} \times 3$



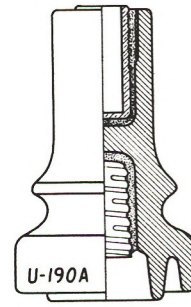
U-189A
 $3\frac{3}{8} \times 3\frac{5}{8}$



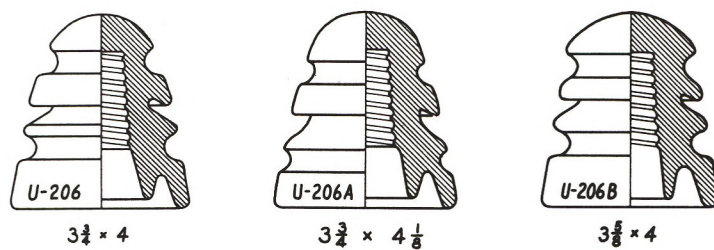
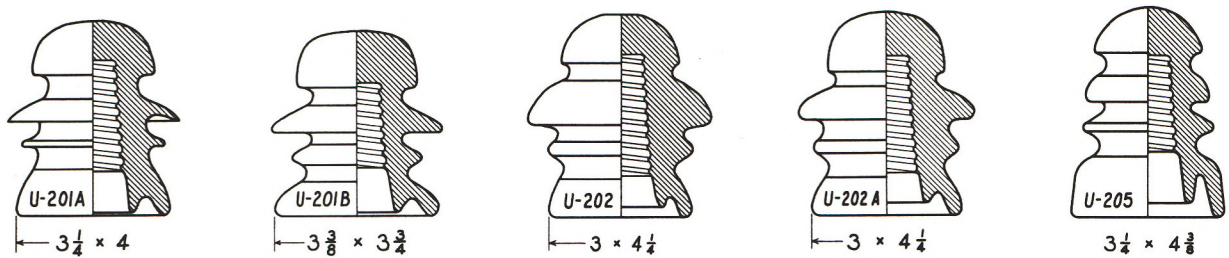
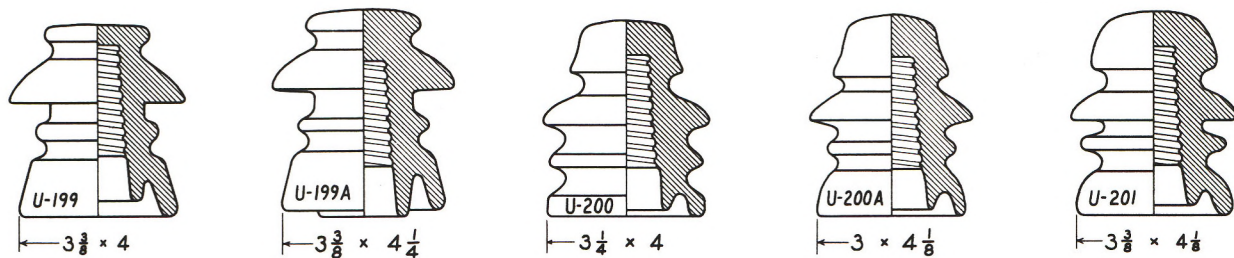
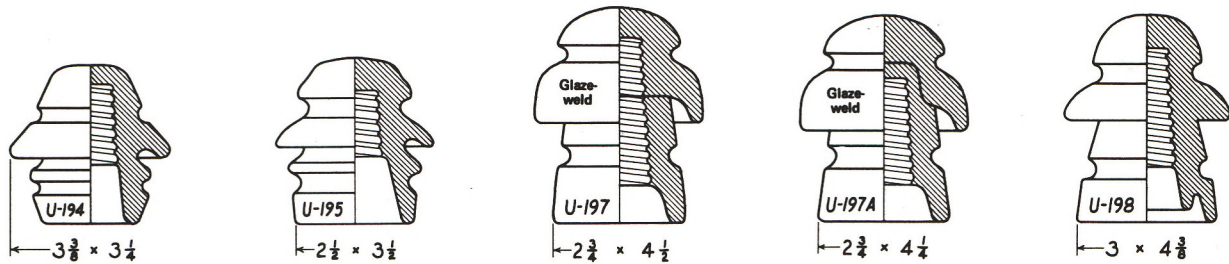
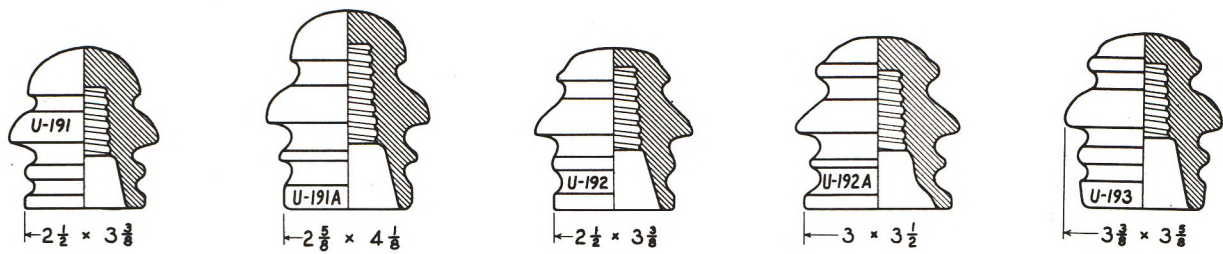
U-190
 $3\frac{1}{4} \times 6$

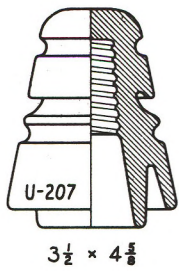


CAP
U-190
 $3\frac{5}{8} \times 4\frac{1}{8}$

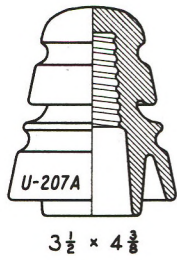


U-190A
 $3\frac{3}{4} \times 6$

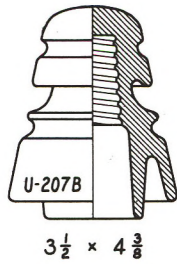




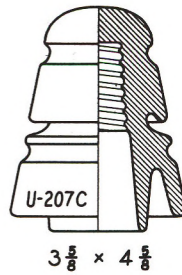
U-207
 $3\frac{1}{2} \times 4\frac{5}{8}$



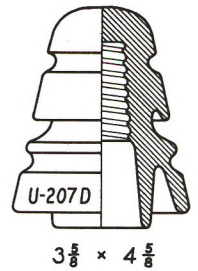
U-207A
 $3\frac{1}{2} \times 4\frac{3}{8}$



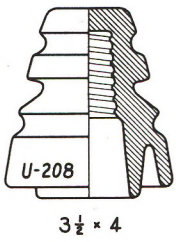
U-207B
 $3\frac{1}{2} \times 4\frac{3}{8}$



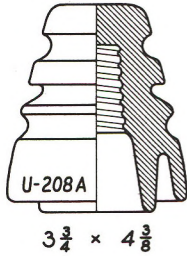
U-207C
 $3\frac{5}{8} \times 4\frac{5}{8}$



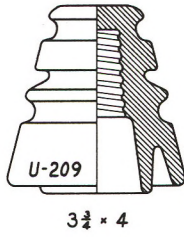
U-207D
 $3\frac{5}{8} \times 4\frac{5}{8}$



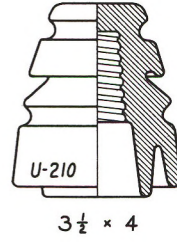
U-208
 $3\frac{1}{2} \times 4$



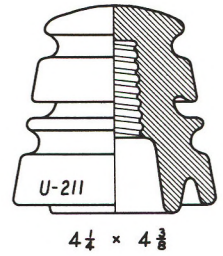
U-208A
 $3\frac{3}{4} \times 4\frac{3}{8}$



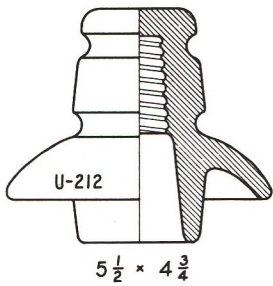
U-209
 $3\frac{3}{4} \times 4$



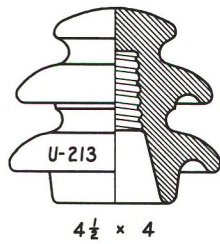
U-210
 $3\frac{1}{2} \times 4$



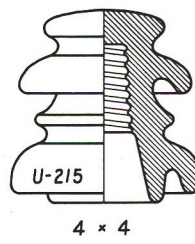
U-211
 $4\frac{1}{4} \times 4\frac{3}{8}$



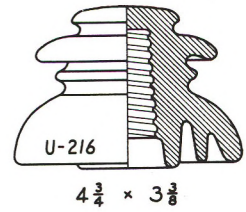
U-212
 $5\frac{1}{2} \times 4\frac{3}{4}$



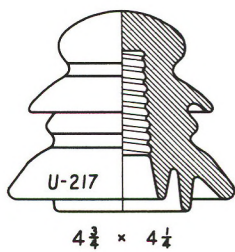
U-213
 $4\frac{1}{2} \times 4$



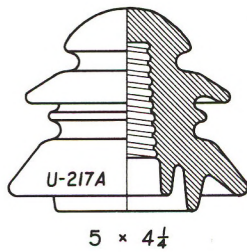
U-215
 4×4



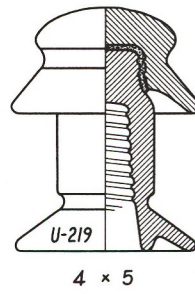
U-216
 $4\frac{3}{4} \times 3\frac{3}{8}$



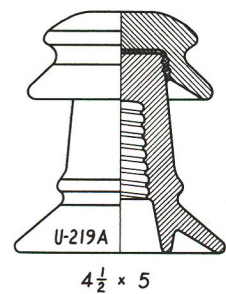
U-217
 $4\frac{3}{4} \times 4\frac{1}{4}$



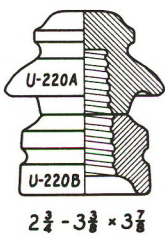
U-217A
 $5 \times 4\frac{1}{4}$



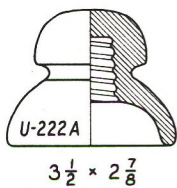
U-219
 4×5



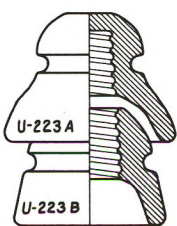
U-219A
 $4\frac{1}{2} \times 5$



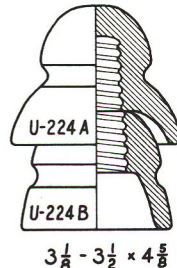
U-220A
U-220B
 $2\frac{3}{4} - 3\frac{3}{8} \times 3\frac{7}{8}$



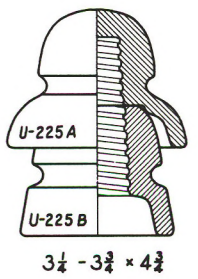
U-222A
 $3\frac{1}{2} \times 2\frac{7}{8}$



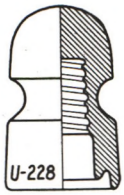
U-223A
U-223B
 $3\frac{1}{4} - 3\frac{1}{2} \times 4\frac{1}{2}$



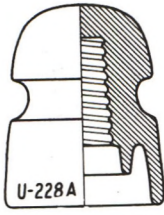
U-224A
U-224B
 $3\frac{1}{8} - 3\frac{1}{2} \times 4\frac{5}{8}$



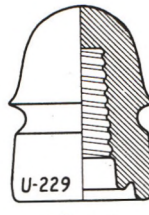
U-225A
U-225B
 $3\frac{1}{4} - 3\frac{3}{8} \times 4\frac{3}{4}$



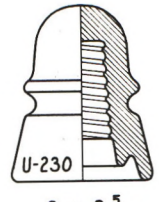
U-228
 $2\frac{3}{8} \times 3\frac{3}{4}$



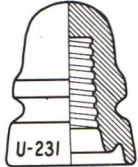
U-228A
 $3\frac{1}{4} \times 4\frac{1}{8}$



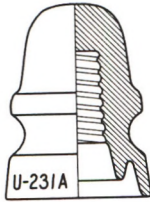
U-229
 $2\frac{7}{8} \times 4$



U-230
 $3 \times 3\frac{5}{8}$



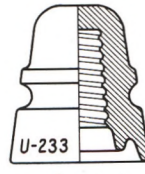
U-231
 $2\frac{3}{4} \times 3\frac{3}{8}$



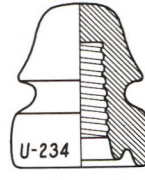
U-231A
 3×4



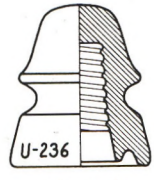
U-232
 $2\frac{3}{4} \times 3\frac{1}{2}$



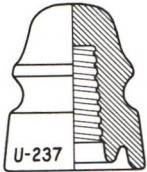
U-233
 $2\frac{7}{8} \times 3\frac{1}{4}$



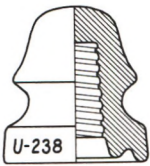
U-234
 $2\frac{7}{8} \times 3\frac{3}{8}$



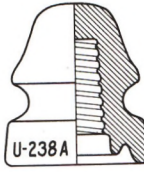
U-236
 $2\frac{7}{8} \times 3\frac{3}{8}$



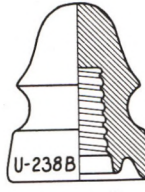
U-237
 $2\frac{7}{8} \times 3\frac{1}{2}$



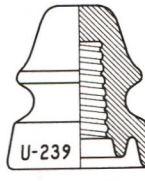
U-238
 $3 \times 3\frac{1}{4}$



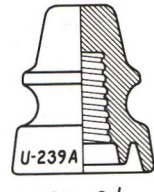
U-238A
 $3 \times 3\frac{3}{8}$



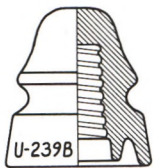
U-238B
 $3 \times 3\frac{5}{8}$



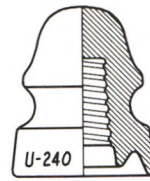
U-239
 $3 \times 3\frac{3}{8}$



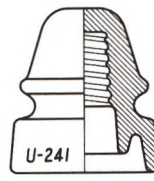
U-239A
 $3 \times 3\frac{1}{2}$



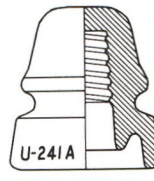
U-239B
 $3 \times 3\frac{1}{4}$



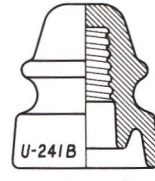
U-240
 $3 \times 3\frac{1}{2}$



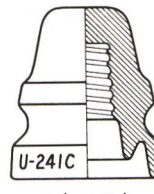
U-241
 $3\frac{1}{8} \times 3\frac{3}{8}$



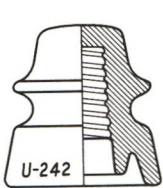
U-241A
 $3\frac{1}{8} \times 3\frac{3}{8}$



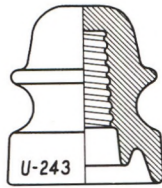
U-241B
 $3\frac{1}{8} \times 3\frac{3}{8}$



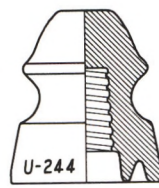
U-241C
 $3\frac{1}{8} \times 3\frac{1}{2}$



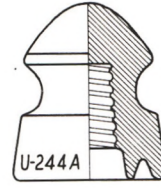
U-242
 $3\frac{1}{4} \times 3\frac{3}{8}$



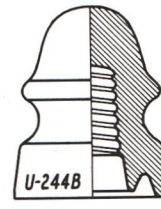
U-243
 $3\frac{1}{4} \times 3\frac{3}{8}$



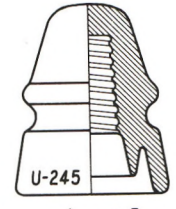
U-244
 $3\frac{1}{8} \times 3\frac{3}{8}$



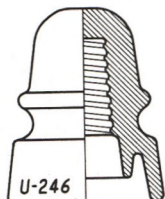
U-244A
 $3\frac{1}{8} \times 3\frac{5}{8}$



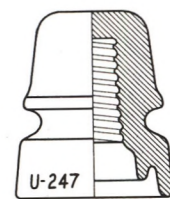
U-244B
 $3\frac{1}{4} \times 4$



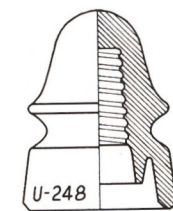
U-245
 $3\frac{1}{4} \times 3\frac{7}{8}$



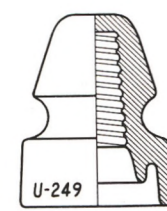
U-246
 $3\frac{1}{4} \times 4$



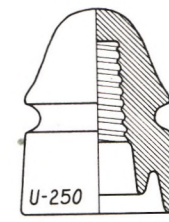
U-247
 $3\frac{1}{4} \times 3\frac{7}{8}$



U-248
 $3\frac{1}{4} \times 4\frac{1}{8}$



U-249
 $3\frac{1}{4} \times 4$



U-250
 $3\frac{1}{4} \times 4\frac{1}{4}$



U-252
 $3\frac{1}{8} \times 2\frac{5}{8}$



U-254
 $3\frac{1}{4} \times 2\frac{7}{8}$



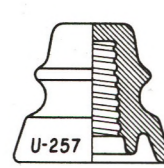
U-255
 $3\frac{1}{8} \times 3\frac{1}{4}$



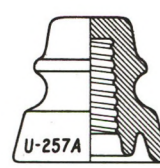
U-256
 $3\frac{1}{4} \times 3$



U-256A
 $3\frac{1}{4} \times 3$



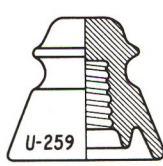
U-257
 $3\frac{1}{4} \times 2\frac{7}{8}$



U-257A
 $3\frac{1}{4} \times 3$



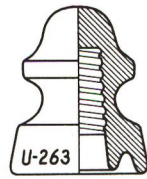
U-258
 $3\frac{1}{4} \times 3\frac{1}{8}$



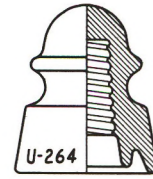
U-259
 $3\frac{1}{4} \times 3$



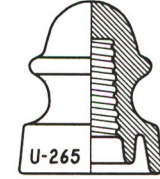
U-260
 $3\frac{1}{8} \times 3$



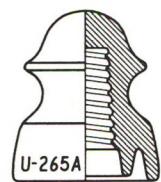
U-263
 $2\frac{7}{8} \times 3\frac{1}{2}$



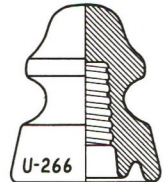
U-264
 $3 \times 3\frac{1}{2}$



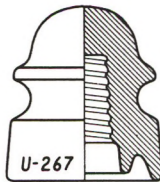
U-265
 $3 \times 3\frac{1}{2}$



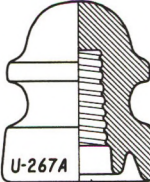
U-265A
 $3 \times 3\frac{1}{2}$



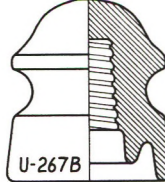
U-266
 $3\frac{1}{8} \times 3\frac{3}{4}$



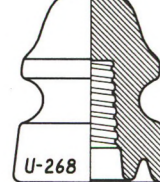
U-267
 $3\frac{1}{4} \times 3\frac{3}{8}$



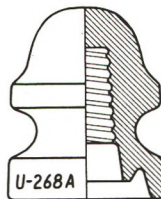
U-267A
 $3\frac{1}{4} \times 3\frac{3}{4}$



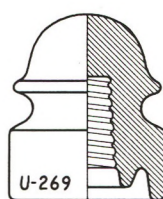
U-267B
 $3\frac{3}{8} \times 3\frac{3}{4}$



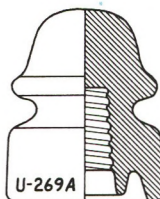
U-268
 $3\frac{1}{4} \times 4$



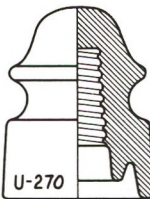
U-268A
 $3\frac{1}{4} \times 4$



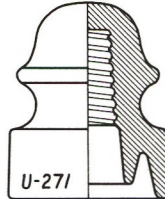
U-269
 $3\frac{1}{4} \times 3\frac{7}{8}$



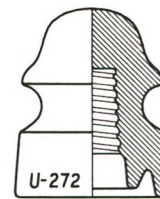
U-269A
 $3\frac{1}{4} \times 4$



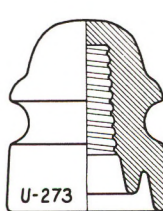
U-270
 $3\frac{1}{4} \times 4$



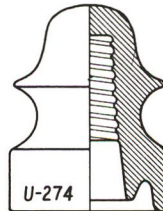
U-271
 $3\frac{3}{8} \times 4\frac{1}{8}$



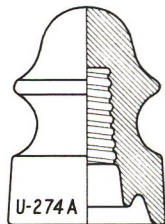
U-272
 $3\frac{1}{4} \times 4$



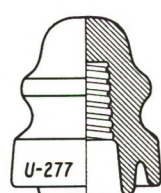
U-273
 $3\frac{3}{8} \times 4$



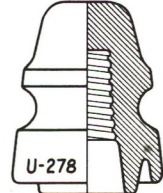
U-274
 $3\frac{1}{4} \times 4\frac{1}{4}$



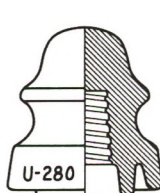
U-274A
 $3\frac{1}{4} \times 4\frac{1}{2}$



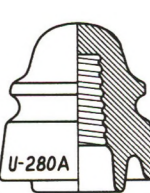
U-277
 $3\frac{1}{8} \times 3\frac{3}{4}$



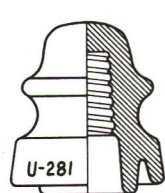
U-278
 $3\frac{1}{8} \times 4$



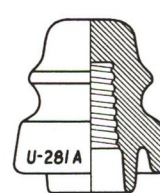
U-280
 $3\frac{1}{4} \times 3\frac{1}{2}$



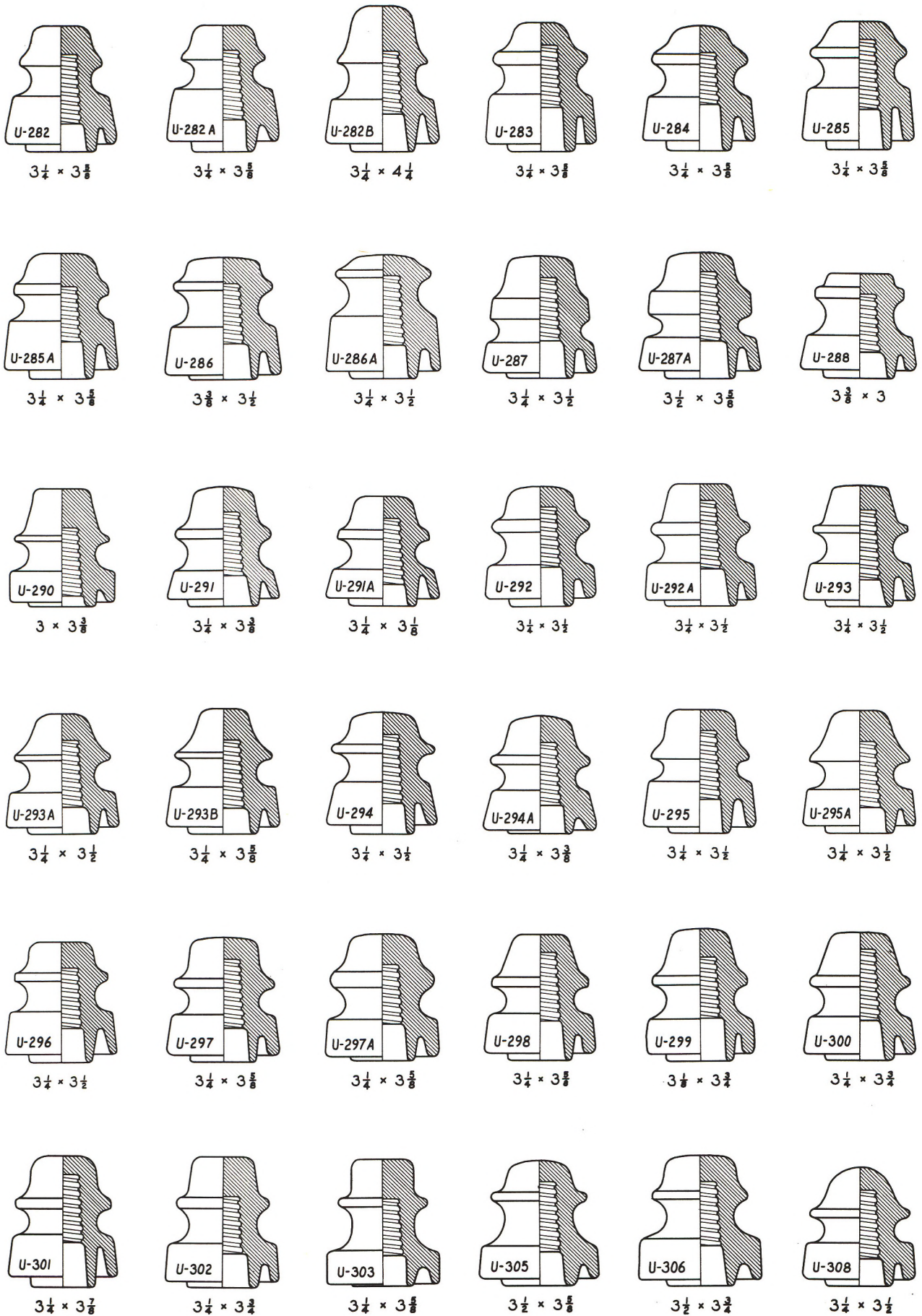
U-280A
 $3\frac{1}{4} \times 3\frac{1}{2}$

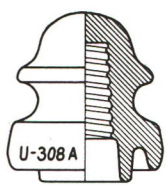


U-281
 $3\frac{1}{4} \times 3\frac{3}{8}$

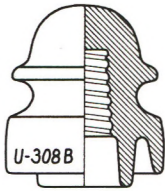


U-281A
 $3\frac{1}{4} \times 3\frac{3}{8}$

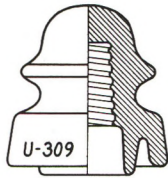




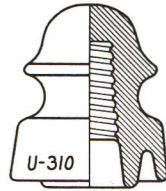
$3\frac{1}{4} \times 3\frac{1}{2}$



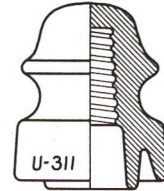
$3\frac{1}{4} \times 3\frac{3}{4}$



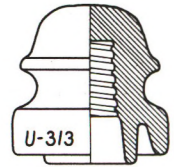
$3\frac{3}{8} \times 3\frac{1}{2}$



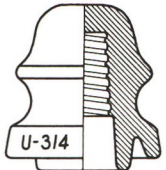
$3\frac{3}{8} \times 3\frac{3}{4}$



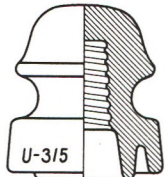
$3\frac{1}{4} \times 3\frac{7}{8}$



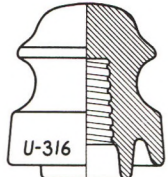
$3\frac{1}{4} \times 3\frac{1}{4}$



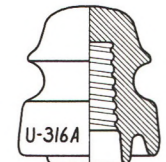
$3\frac{1}{4} \times 3\frac{1}{2}$



$3\frac{1}{4} \times 3\frac{5}{8}$



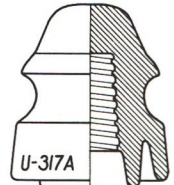
$3\frac{1}{4} \times 3\frac{5}{8}$



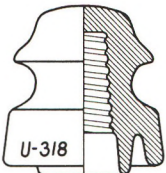
$2\frac{7}{8} \times 3\frac{1}{4}$



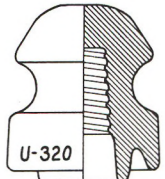
$3\frac{1}{4} \times 3\frac{1}{2}$



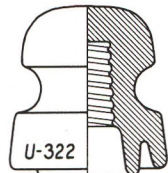
$3\frac{1}{4} \times 3\frac{3}{4}$



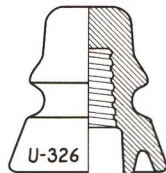
$3\frac{3}{8} \times 3\frac{1}{2}$



$3\frac{1}{4} \times 3\frac{1}{2}$



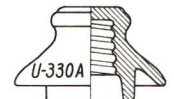
$3\frac{1}{4} \times 3\frac{1}{2}$



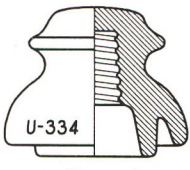
$3\frac{1}{4} \times 3\frac{5}{8}$



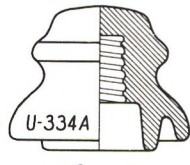
$3\frac{1}{4} \times 2\frac{1}{4}$



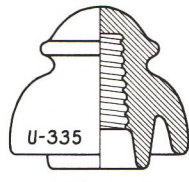
$3\frac{1}{8} \times 2$



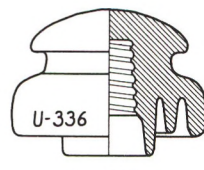
$3\frac{7}{8} \times 3\frac{1}{8}$



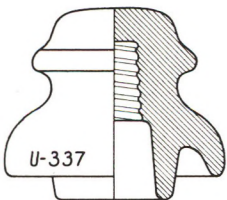
$3\frac{3}{4} \times 3$



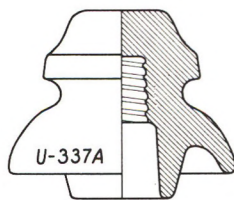
$3\frac{3}{4} \times 3\frac{3}{8}$



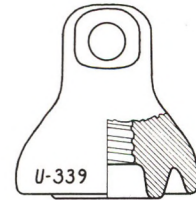
4×3



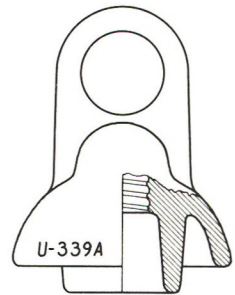
$4\frac{1}{2} \times 4$



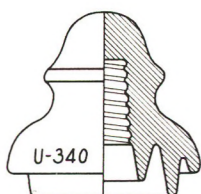
$4\frac{5}{8} \times 3\frac{7}{8}$



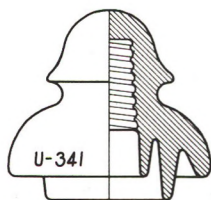
$3\frac{3}{4} \times 4$



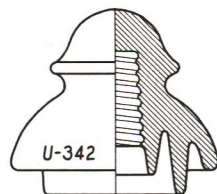
$4\frac{1}{2} \times 5\frac{7}{8}$



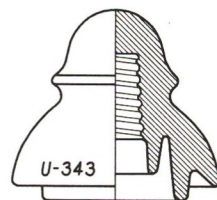
$4 \times 3\frac{7}{8}$



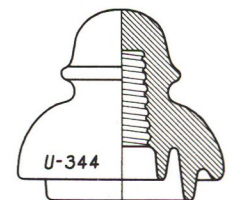
$4\frac{1}{4} \times 4$



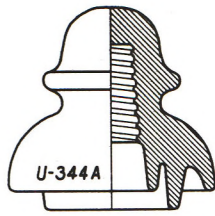
$4\frac{3}{8} \times 3\frac{7}{8}$



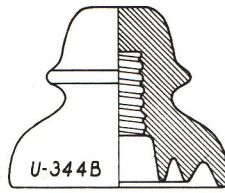
$4\frac{3}{8} \times 4$



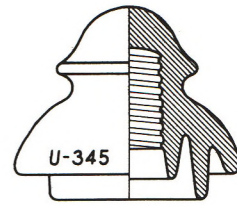
$4\frac{3}{8} \times 4$



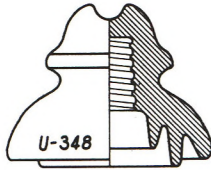
U-344A
 $4\frac{3}{8} \times 4\frac{1}{8}$



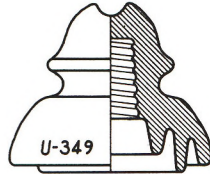
U-344B
 $4\frac{1}{2} \times 3\frac{3}{4}$



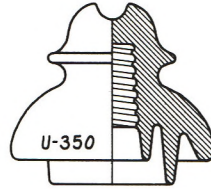
U-345
 $4\frac{3}{4} \times 3\frac{7}{8}$



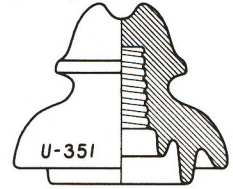
U-348
 $4\frac{1}{4} \times 3\frac{3}{8}$



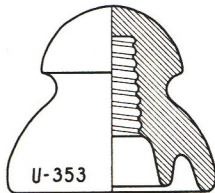
U-349
 $4\frac{1}{4} \times 3\frac{1}{2}$



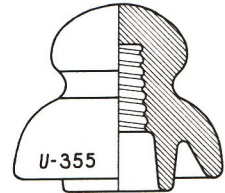
U-350
 $4\frac{1}{4} \times 3\frac{3}{4}$



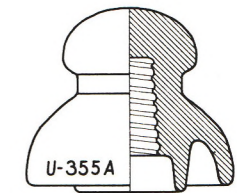
U-351
 $4\frac{1}{2} \times 3\frac{3}{4}$



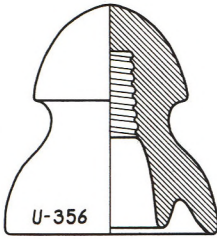
U-353
 $4\frac{1}{4} \times 3\frac{3}{4}$



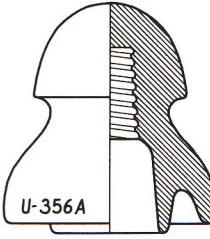
U-355
 $4\frac{1}{4} \times 3\frac{3}{4}$



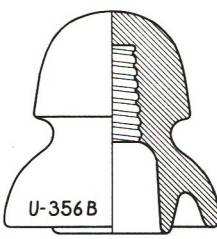
U-355A
 $4\frac{1}{4} \times 3\frac{3}{4}$



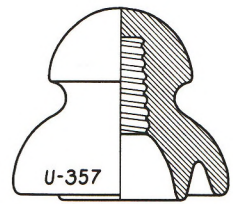
U-356
 $4\frac{1}{2} \times 4\frac{3}{4}$



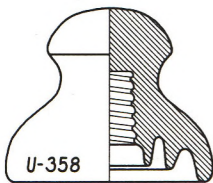
U-356A
 $4\frac{3}{8} \times 4\frac{3}{4}$



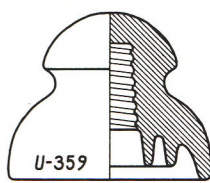
U-356B
 $4\frac{3}{8} \times 4\frac{1}{2}$



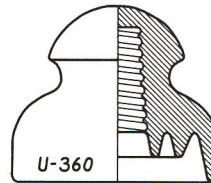
U-357
 $4\frac{1}{2} \times 4$



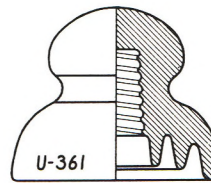
U-358
 $4\frac{1}{4} \times 3\frac{5}{8}$



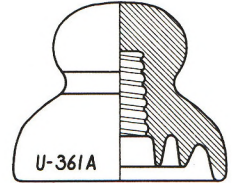
U-359
 $4\frac{1}{4} \times 3\frac{1}{2}$



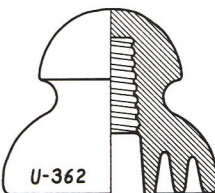
U-360
 $4\frac{1}{4} \times 3\frac{5}{8}$



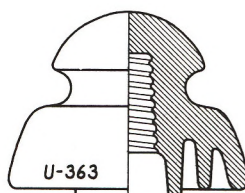
U-361
 $4\frac{1}{4} \times 3\frac{1}{2}$



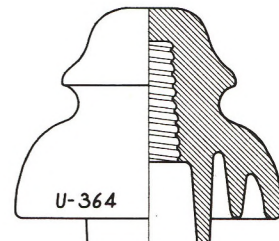
U-361A
 $4\frac{3}{8} \times 3\frac{5}{8}$



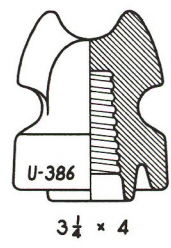
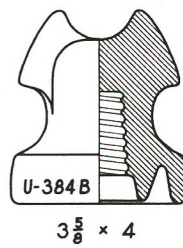
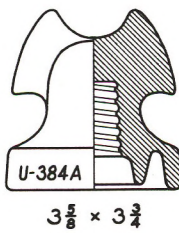
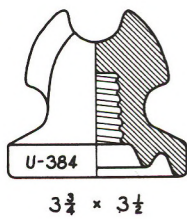
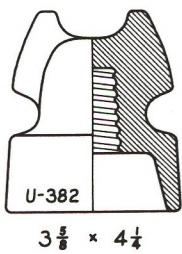
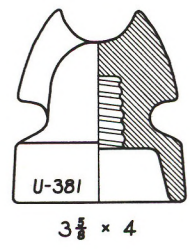
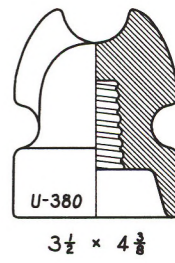
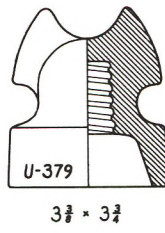
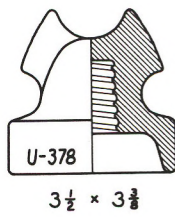
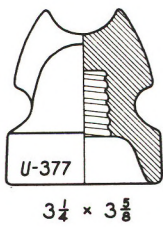
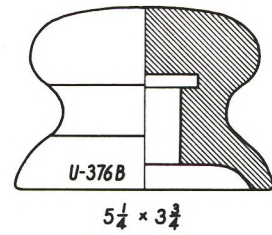
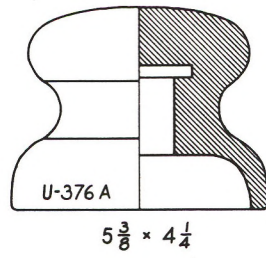
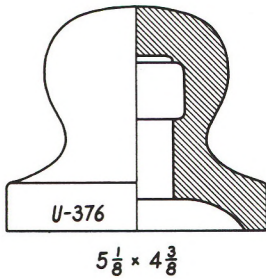
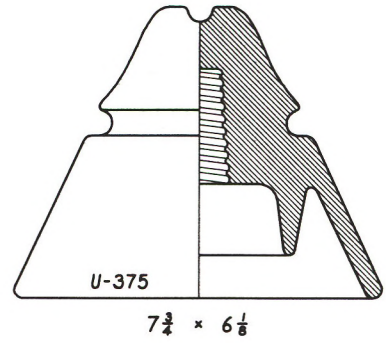
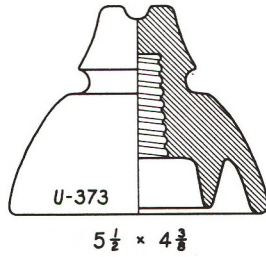
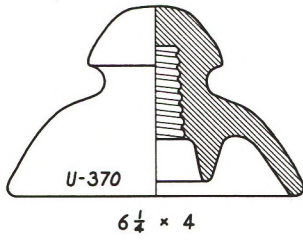
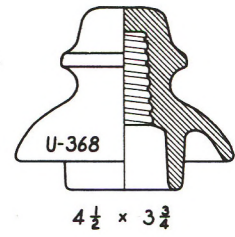
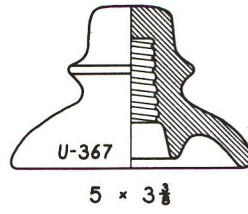
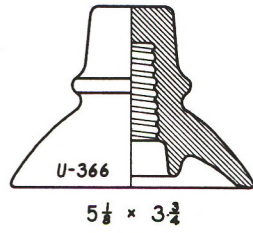
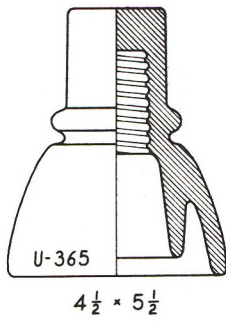
U-362
 $4\frac{1}{2} \times 4$

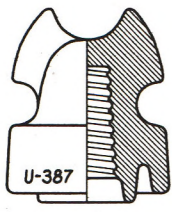


U-363
 5×4

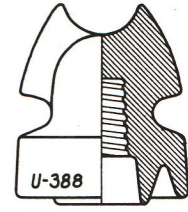


U-364
 $5\frac{1}{2} \times 5$

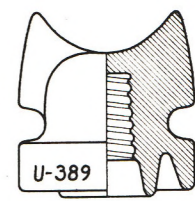




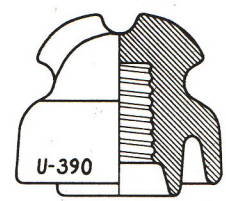
U-387
 $3\frac{3}{8} \times 4$



U-388
 $3\frac{5}{8} \times 4\frac{1}{8}$



U-389
 $3\frac{5}{8} \times 3\frac{3}{4}$



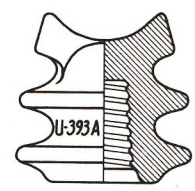
U-390
 $4\frac{1}{4} \times 3\frac{3}{4}$



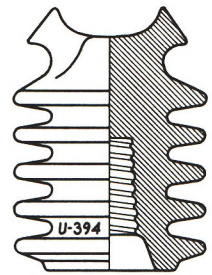
U-392
 $3\frac{5}{8} \times 3\frac{1}{2}$



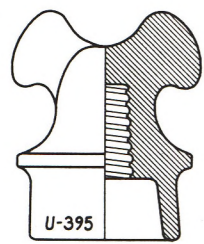
U-393
 $3\frac{5}{8} \times 3\frac{1}{2}$



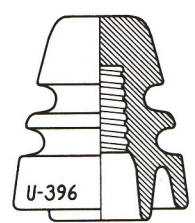
U-393A
 $3\frac{5}{8} \times 3\frac{1}{2}$



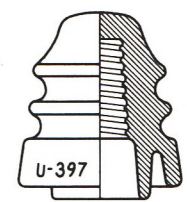
U-394
 $4 \times 5\frac{1}{2}$



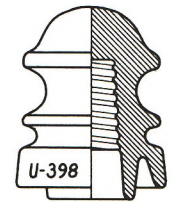
U-395
 $3\frac{1}{4} \times 4\frac{3}{4}$



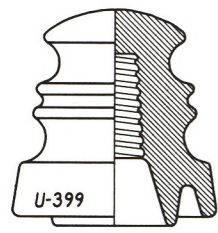
U-396
 $3\frac{5}{8} \times 4\frac{1}{4}$



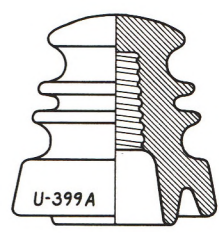
U-397
 $3\frac{3}{8} \times 3\frac{7}{8}$



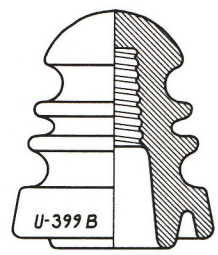
U-398
 $3\frac{1}{8} \times 4$



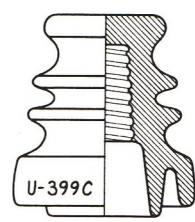
U-399
 $4\frac{1}{4} \times 4\frac{3}{8}$



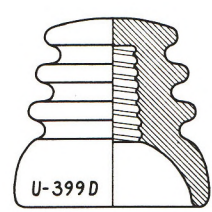
U-399A
 $4\frac{1}{4} \times 4\frac{3}{8}$



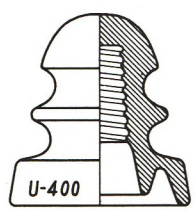
U-399B
 $4\frac{1}{4} \times 4\frac{7}{8}$



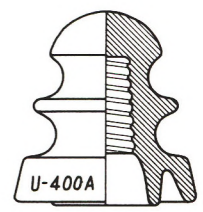
U-399C
 $3\frac{3}{4} \times 4\frac{1}{8}$



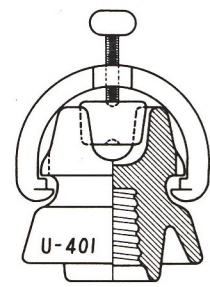
U-399D
 $4 \times 3\frac{7}{8}$



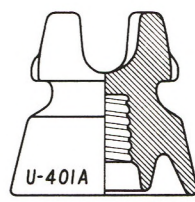
U-400
 $3\frac{3}{4} \times 4$



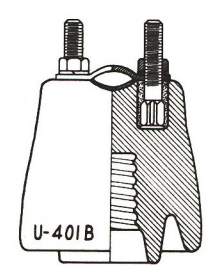
U-400A
 $3\frac{3}{4} \times 4$



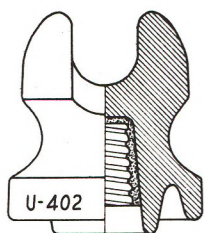
U-401
 $3\frac{3}{4} \times 3\frac{5}{8}$



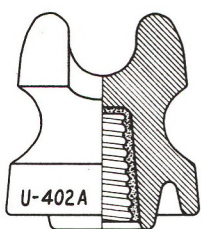
U-401A
 $3\frac{3}{4} \times 3\frac{3}{4}$



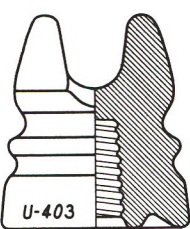
U-401B
 $4\frac{3}{4} \times 4\frac{3}{4}$



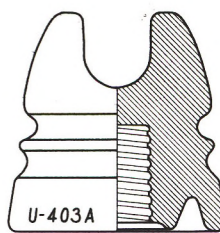
4 × 4½



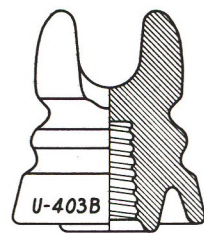
4 × 4¾



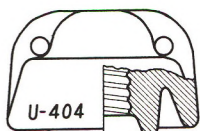
4 × 4¾



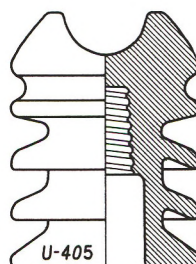
4½ × 4½



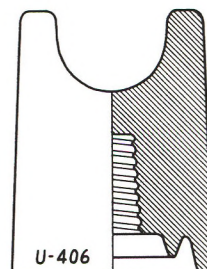
4 × 4½



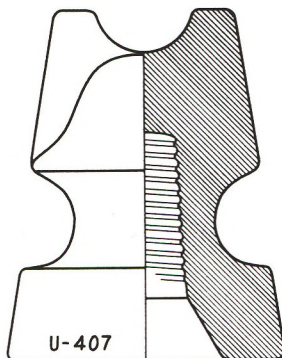
3¾ × 2¾



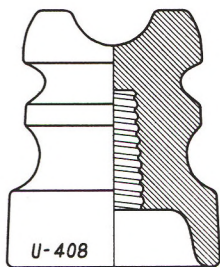
4 × 5¾



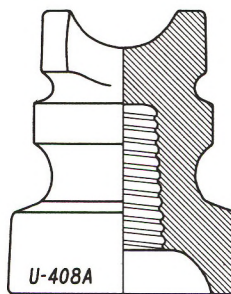
4¼ × 5½



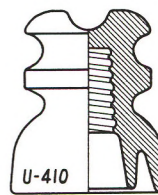
5¾ × 7⅛



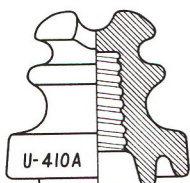
4½ × 5¾



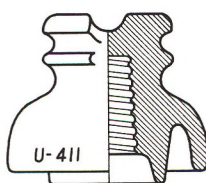
4½ × 5½



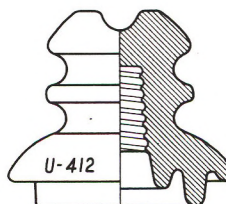
3¼ × 3¾



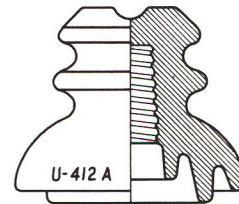
3¾ × 3½



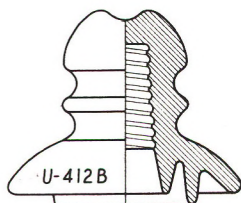
4¼ × 3½



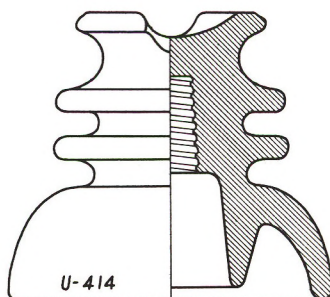
4⅞ × 4



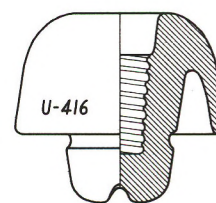
4⅞ × 4



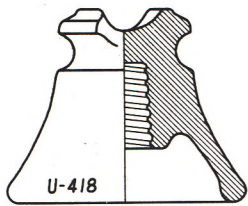
4¾ × 4



6⅞ × 6

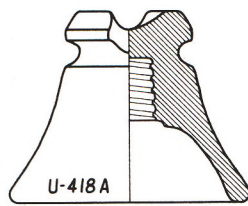


4¼ × 4



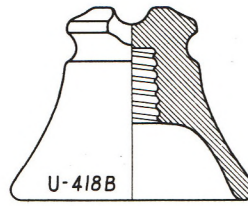
U-418

5 × 4



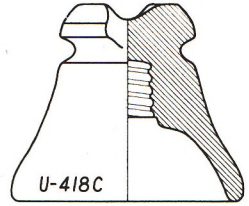
U-418A

5 × 4



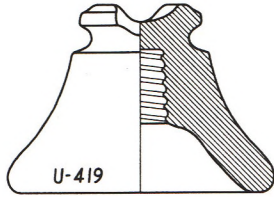
U-418B

5 × 4



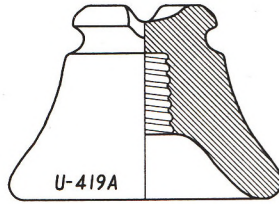
U-418C

4 $\frac{3}{4}$ × 4



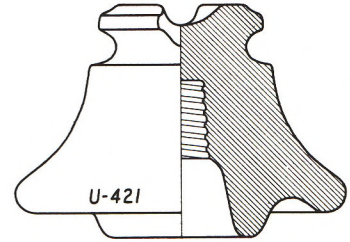
U-419

5 $\frac{1}{2}$ × 3 $\frac{7}{8}$



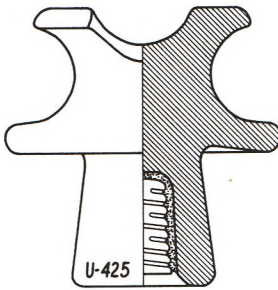
U-419A

5 $\frac{5}{8}$ × 4



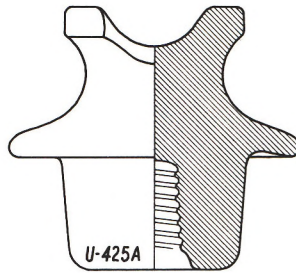
U-421

6 $\frac{7}{8}$ × 4 $\frac{3}{4}$



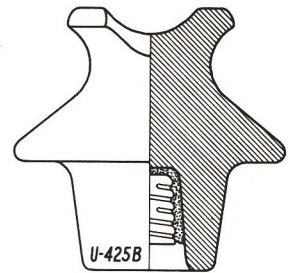
U-425

5 $\frac{7}{8}$ × 5 $\frac{1}{2}$



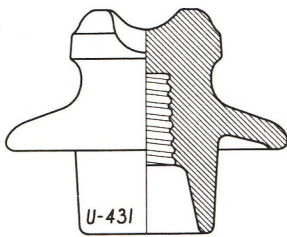
U-425A

6 × 5 $\frac{1}{2}$



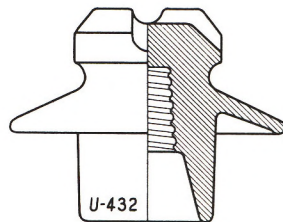
U-425B

5 $\frac{5}{8}$ × 5 $\frac{1}{2}$



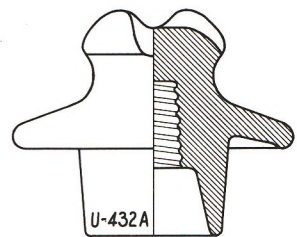
U-431

5 $\frac{7}{8}$ × 4 $\frac{5}{8}$



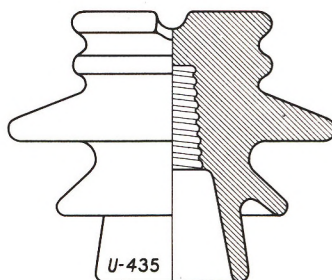
U-432

5 $\frac{3}{4}$ × 4 $\frac{1}{2}$



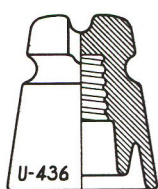
U-432A

5 $\frac{3}{4}$ × 4 $\frac{5}{8}$

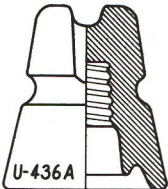


U-435

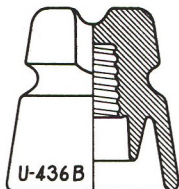
6 $\frac{7}{8}$ × 5 $\frac{3}{4}$



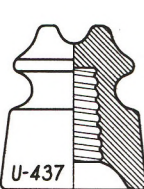
U-436
 $3\frac{1}{8} \times 3\frac{1}{2}$



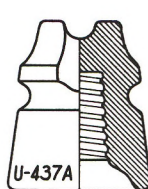
U-436A
 $3\frac{3}{8} \times 3\frac{3}{4}$



U-436B
 $3\frac{1}{2} \times 3\frac{3}{4}$



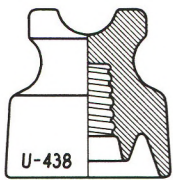
U-437
 $3 \times 3\frac{3}{8}$



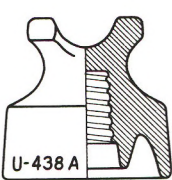
U-437A
 $3 \times 3\frac{1}{2}$



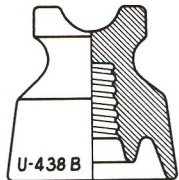
U-437B
 $2\frac{5}{8} \times 2\frac{7}{8}$



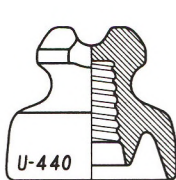
U-438
 $3\frac{1}{2} \times 3\frac{1}{2}$



U-438A
 $3\frac{1}{2} \times 3\frac{3}{8}$



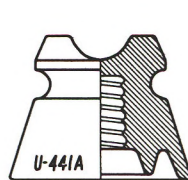
U-438B
 $3\frac{1}{2} \times 3\frac{1}{2}$



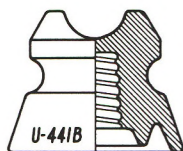
U-440
 $3\frac{1}{2} \times 3\frac{1}{8}$



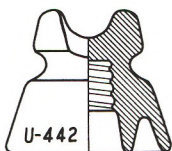
U-441
 $3\frac{1}{4} \times 2\frac{7}{8}$



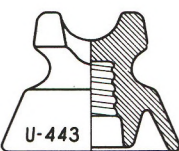
U-441A
 $3\frac{3}{8} \times 2\frac{7}{8}$



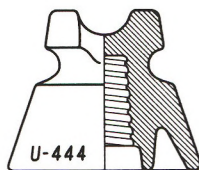
U-441B
 $3\frac{3}{8} \times 2\frac{7}{8}$



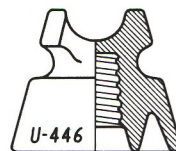
U-442
 $3\frac{3}{8} \times 2\frac{7}{8}$



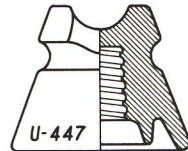
U-443
 $3\frac{3}{4} \times 2\frac{7}{8}$



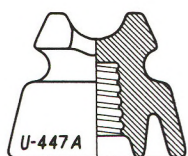
U-444
 $4 \times 3\frac{3}{8}$



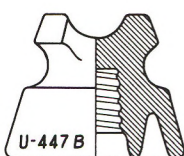
U-446
 $3\frac{1}{2} \times 2\frac{7}{8}$



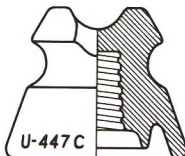
U-447
 $3\frac{3}{4} \times 3$



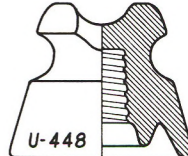
U-447A
 $3\frac{3}{4} \times 3$



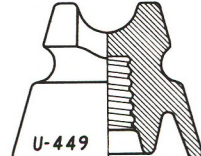
U-447B
 $3\frac{3}{4} \times 3$



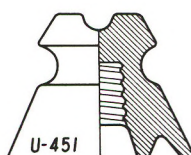
U-447C
 $3\frac{3}{4} \times 3\frac{1}{8}$



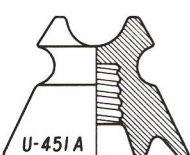
U-448
 $3\frac{7}{8} \times 3\frac{1}{4}$



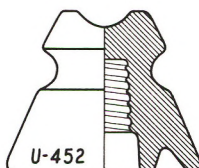
U-449
 $4 \times 3\frac{1}{4}$



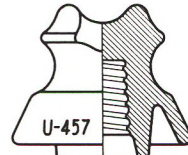
U-451
 $3\frac{7}{8} \times 3$



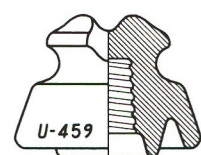
U-451A
 $3\frac{7}{8} \times 3$



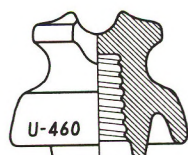
U-452
 $4 \times 3\frac{3}{8}$



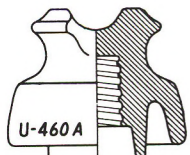
U-457
 $3\frac{3}{4} \times 3\frac{1}{4}$



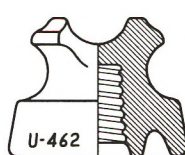
U-459
 $3\frac{7}{8} \times 3$



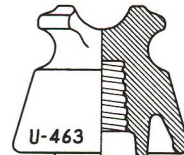
U-460
 $3\frac{3}{4} \times 3\frac{1}{8}$



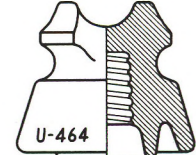
U-460A
 $3\frac{3}{4} \times 3\frac{1}{4}$



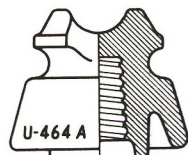
U-462
 $3\frac{3}{4} \times 3$



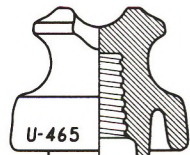
U-463
 $3\frac{3}{4} \times 3\frac{1}{4}$



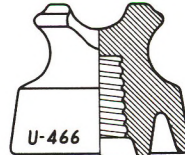
U-464
 $3\frac{3}{4} \times 3\frac{1}{4}$



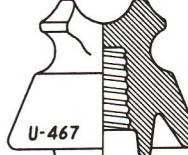
U-464A
 $3\frac{3}{4} \times 3\frac{1}{4}$



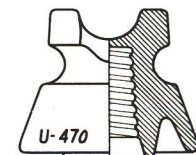
U-465
 $3\frac{3}{4} \times 3\frac{1}{4}$



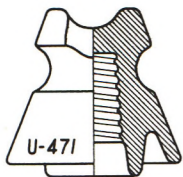
U-466
 $3\frac{3}{4} \times 3\frac{1}{4}$



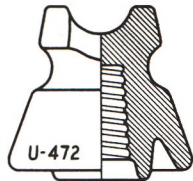
U-467
 $4 \times 3\frac{3}{8}$



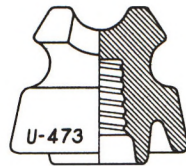
U-470
 $3\frac{3}{4} \times 3\frac{1}{8}$



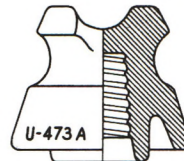
U-471
 $3\frac{5}{8} \times 3\frac{1}{2}$



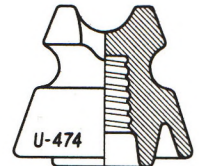
U-472
 $3\frac{7}{8} \times 3\frac{5}{8}$



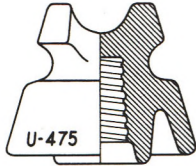
U-473
 $3\frac{3}{4} \times 3\frac{1}{4}$



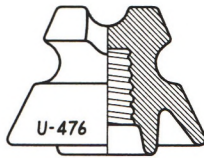
U-473A
 $3\frac{3}{4} \times 3\frac{1}{4}$



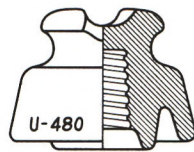
U-474
 $3\frac{3}{4} \times 3\frac{1}{4}$



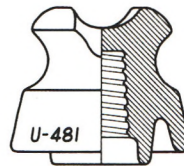
U-475
 $4 \times 3\frac{3}{8}$



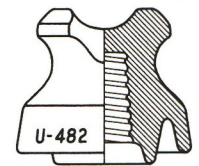
U-476
 $4\frac{1}{8} \times 3\frac{1}{8}$



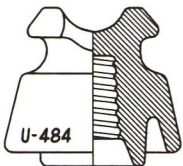
U-480
 $3\frac{7}{8} \times 2\frac{7}{8}$



U-481
 $3\frac{3}{4} \times 3\frac{1}{4}$



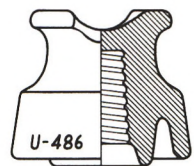
U-482
 $3\frac{3}{4} \times 3\frac{3}{8}$



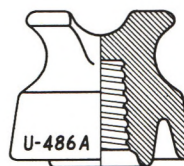
U-484
 $3\frac{3}{4} \times 3\frac{1}{4}$



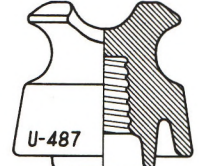
U-485
 $3\frac{3}{4} \times 3\frac{3}{8}$



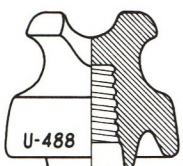
U-486
 $3\frac{3}{4} \times 3\frac{1}{4}$



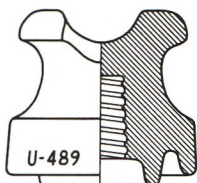
U-486A
 $3\frac{3}{4} \times 3\frac{1}{4}$



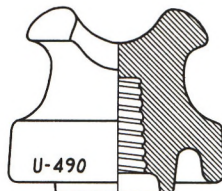
U-487
 $3\frac{3}{4} \times 3\frac{1}{2}$



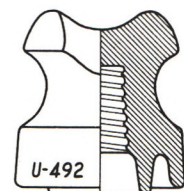
U-488
 $3\frac{3}{4} \times 3\frac{1}{4}$



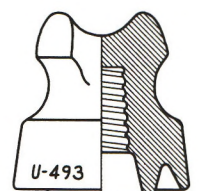
U-489
 $4 \times 3\frac{3}{8}$



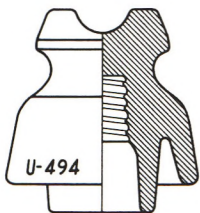
U-490
 $4\frac{1}{2} \times 3\frac{3}{8}$



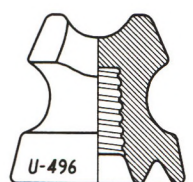
U-492
 $3\frac{1}{2} \times 3\frac{3}{4}$



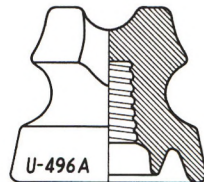
U-493
 $3\frac{3}{4} \times 3\frac{3}{4}$



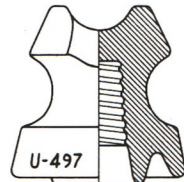
U-494
 $4 \times 4\frac{1}{4}$



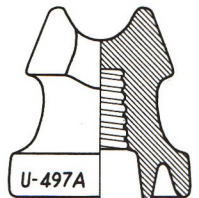
U-496
 $3\frac{3}{4} \times 3\frac{1}{2}$



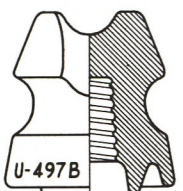
U-496A
 $4 \times 3\frac{3}{8}$



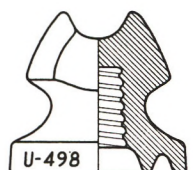
U-497
 $3\frac{3}{4} \times 3\frac{3}{4}$



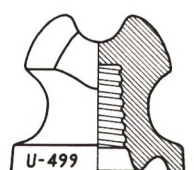
U-497A
 $3\frac{3}{4} \times 4$



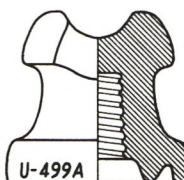
U-497B
 $3\frac{1}{2} \times 3\frac{3}{4}$



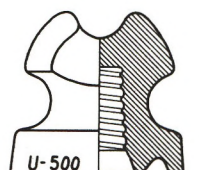
U-498
 $3\frac{3}{8} \times 3\frac{3}{8}$



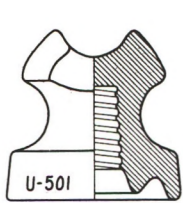
U-499
 $3\frac{3}{8} \times 3\frac{3}{8}$



U-499A
 $3\frac{3}{4} \times 3\frac{3}{8}$



U-500
 $3\frac{3}{4} \times 3\frac{1}{2}$



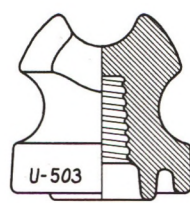
U-501

$3\frac{3}{4} \times 3\frac{1}{2}$



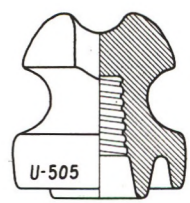
U-502

$3\frac{1}{2} \times 4$



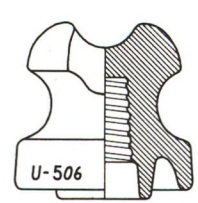
U-503

$3\frac{3}{4} \times 3\frac{3}{4}$



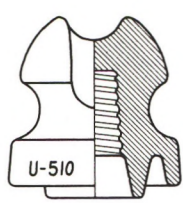
U-505

$3\frac{3}{8} \times 3\frac{7}{8}$



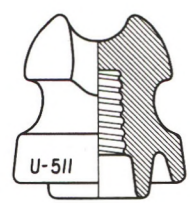
U-506

$3\frac{3}{4} \times 3\frac{3}{8}$



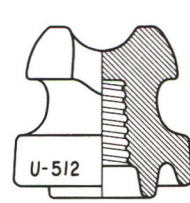
U-510

$3\frac{5}{8} \times 3\frac{3}{4}$



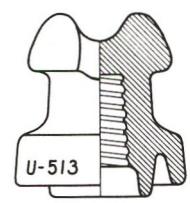
U-511

$3\frac{5}{8} \times 3\frac{3}{4}$



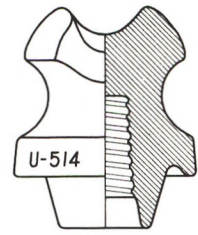
U-512

$3\frac{3}{4} \times 3\frac{1}{2}$



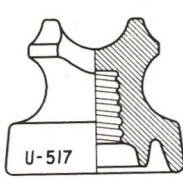
U-513

$3\frac{1}{2} \times 3\frac{3}{4}$



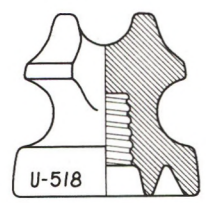
U-514

$3\frac{3}{4} \times 4\frac{1}{2}$



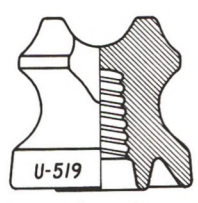
U-517

$3\frac{3}{4} \times 3\frac{1}{4}$



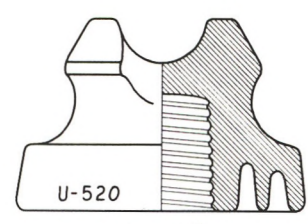
U-518

$3\frac{3}{4} \times 3\frac{3}{4}$



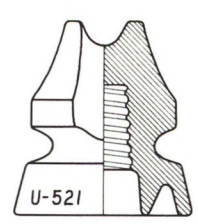
U-519

$3\frac{7}{8} \times 3\frac{1}{2}$



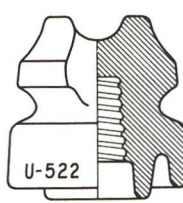
U-520

$6 \times 3\frac{7}{8}$



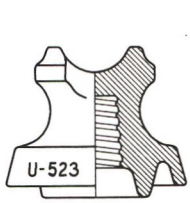
U-521

$3\frac{5}{8} \times 4$



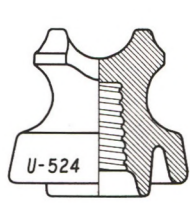
U-522

$3\frac{3}{4} \times 3\frac{3}{4}$



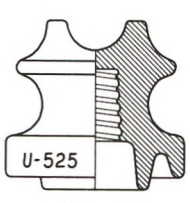
U-523

$3\frac{3}{4} \times 3\frac{1}{8}$



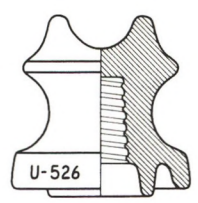
U-524

$3\frac{3}{4} \times 3\frac{1}{2}$



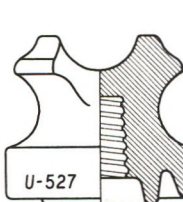
U-525

$3\frac{3}{4} \times 3\frac{1}{2}$



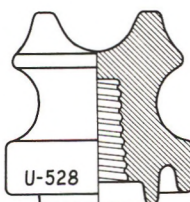
U-526

$3\frac{3}{4} \times 3\frac{3}{4}$



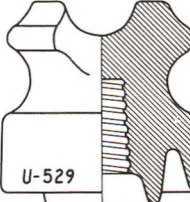
U-527

$4 \times 3\frac{1}{2}$



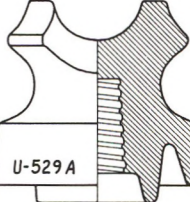
U-528

4×4



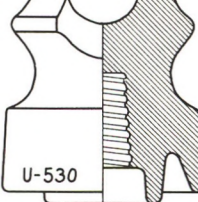
U-529

$4\frac{1}{4} \times 4\frac{1}{4}$



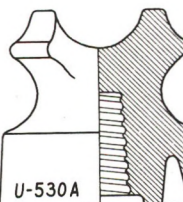
U-529A

$4\frac{1}{4} \times 4\frac{1}{4}$



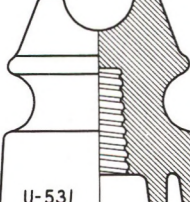
U-530

$4\frac{1}{4} \times 4\frac{1}{2}$



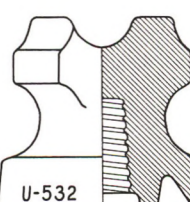
U-530A

$4\frac{1}{4} \times 4\frac{1}{2}$



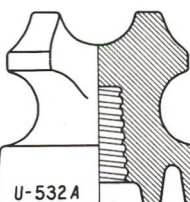
U-531

$4\frac{1}{4} \times 4\frac{3}{4}$



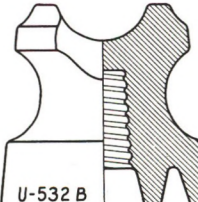
U-532

$4\frac{3}{8} \times 4\frac{3}{8}$



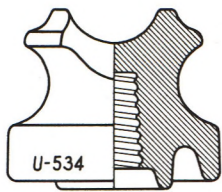
U-532A

$4\frac{3}{8} \times 4\frac{3}{8}$

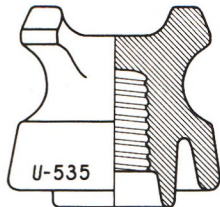


U-532B

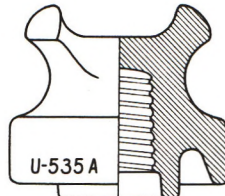
$4\frac{3}{8} \times 4\frac{1}{2}$



U-534
 $4\frac{1}{2} \times 3\frac{3}{4}$



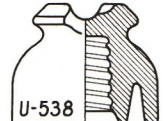
U-535
 $4\frac{1}{4} \times 4$



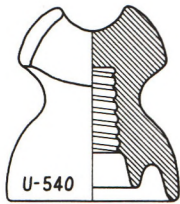
U-535 A
 $4\frac{1}{2} \times 3\frac{7}{8}$



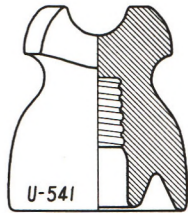
U-537
 $3 \times 2\frac{7}{8}$



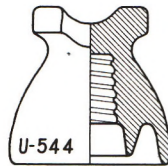
U-538
 $3 \times 2\frac{1}{2}$



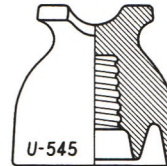
U-540
 $3\frac{3}{8} \times 4$



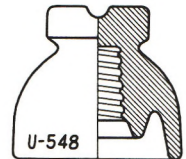
U-541
 $3\frac{3}{4} \times 4\frac{1}{2}$



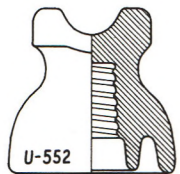
U-544
 $3\frac{1}{4} \times 3\frac{1}{4}$



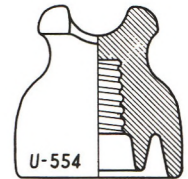
U-545
 $3\frac{3}{8} \times 3\frac{1}{4}$



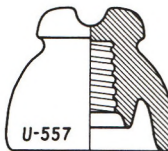
U-548
 $3\frac{1}{2} \times 3\frac{1}{8}$



U-552
 $3\frac{1}{2} \times 3\frac{3}{8}$



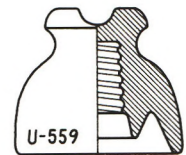
U-554
 $3\frac{1}{2} \times 3\frac{1}{2}$



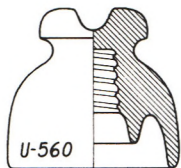
U-557
 $3\frac{1}{2} \times 3$



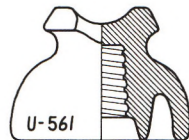
U-558
 $3\frac{1}{2} \times 3\frac{1}{8}$



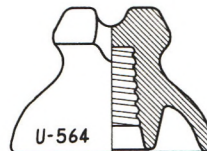
U-559
 $3\frac{1}{2} \times 3\frac{1}{8}$



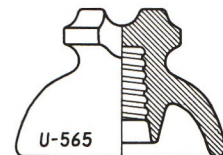
U-560
 $3\frac{1}{2} \times 3\frac{1}{4}$



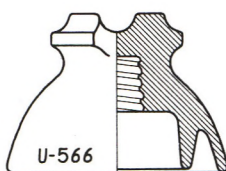
U-561
 $3\frac{3}{4} \times 2\frac{3}{4}$



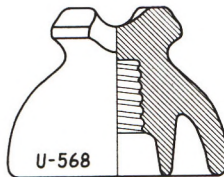
U-564
 $4\frac{1}{4} \times 3$



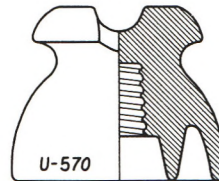
U-565
 $4\frac{1}{4} \times 3$



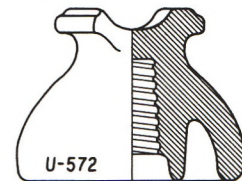
U-566
 $4\frac{5}{8} \times 3\frac{1}{4}$



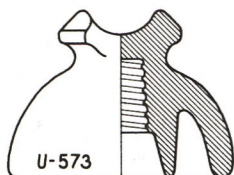
U-568
 $4\frac{5}{8} \times 3\frac{1}{2}$



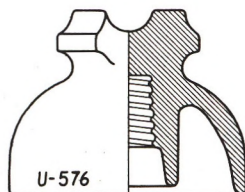
U-570
 $4\frac{1}{2} \times 3\frac{3}{8}$



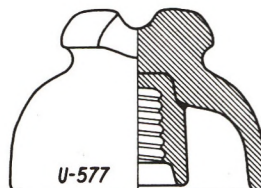
U-572
 $4\frac{3}{4} \times 3\frac{3}{8}$



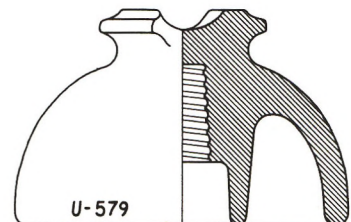
U-573
 $4\frac{3}{4} \times 3\frac{1}{2}$



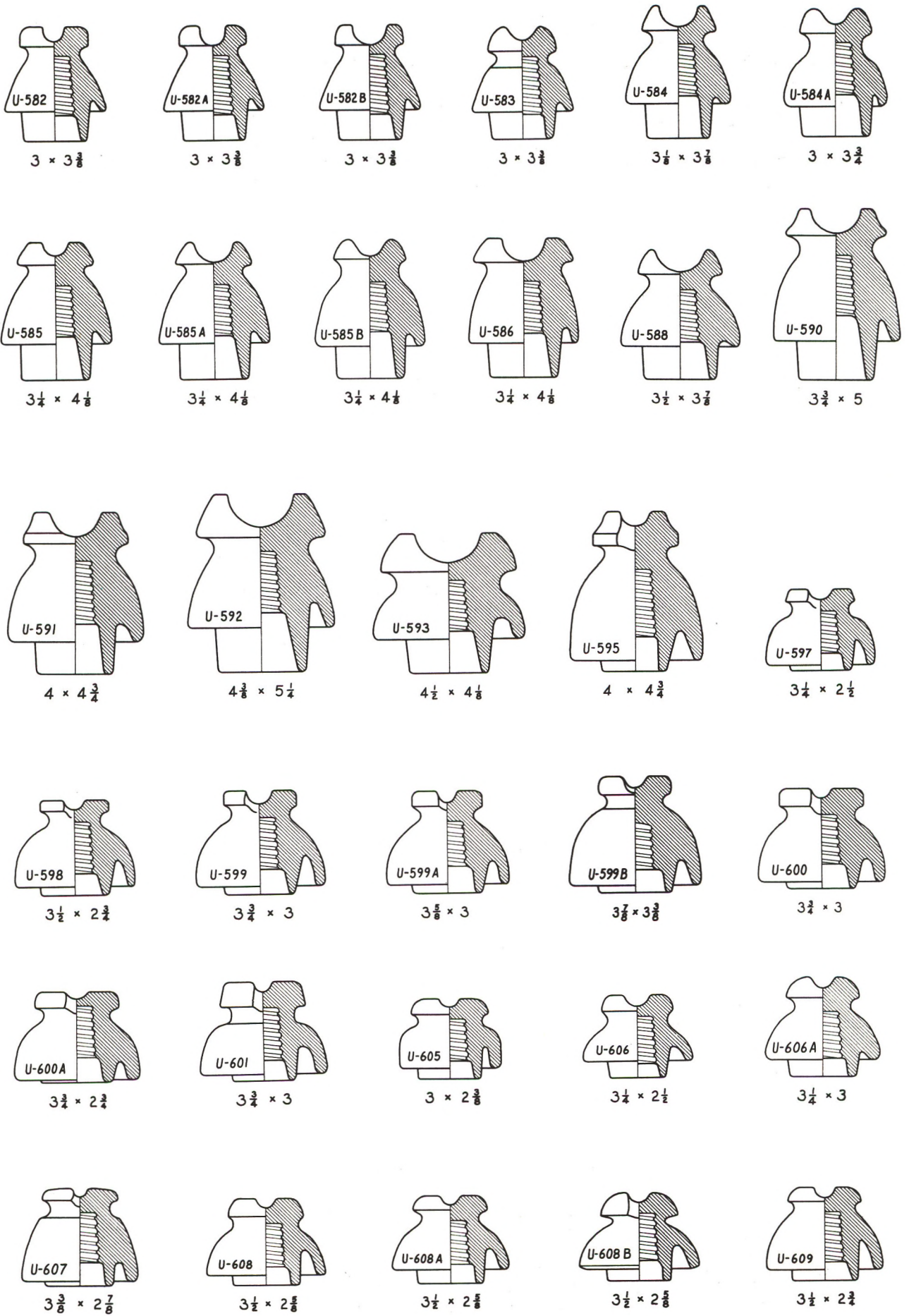
U-576
 $5 \times 3\frac{3}{8}$

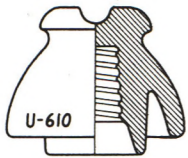


U-577
 $5\frac{1}{4} \times 3\frac{3}{4}$

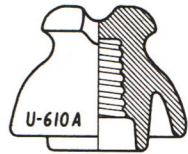


U-579
 $7 \times 4\frac{1}{2}$

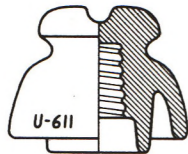




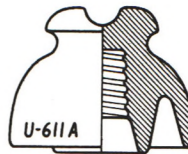
U-610
 $3\frac{3}{8} \times 3$



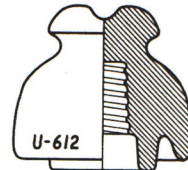
U-610A
 $3\frac{3}{8} \times 3$



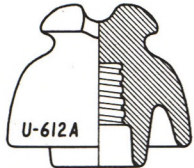
U-611
 $3\frac{3}{8} \times 3$



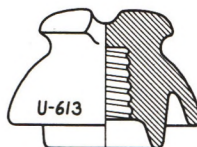
U-611A
 $3\frac{7}{8} \times 3$



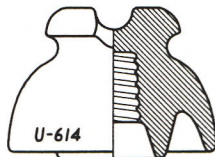
U-612
 $3\frac{3}{8} \times 3\frac{3}{8}$



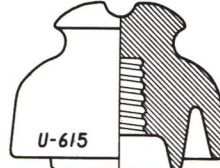
U-612A
 $3\frac{7}{8} \times 3\frac{3}{8}$



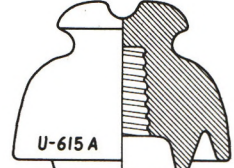
U-613
 $4 \times 2\frac{7}{8}$



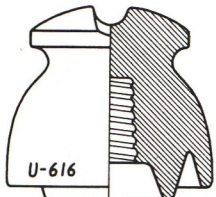
U-614
 $4\frac{1}{4} \times 3\frac{1}{8}$



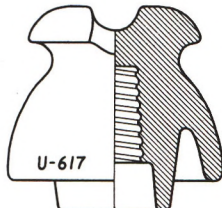
U-615
 $4\frac{1}{2} \times 3\frac{1}{2}$



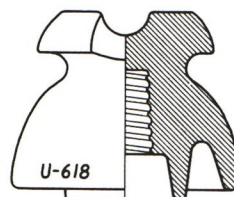
U-615A
 $4\frac{3}{8} \times 3\frac{1}{2}$



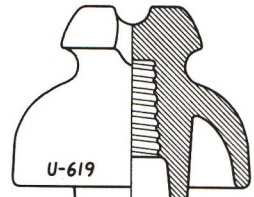
U-616
 $4\frac{3}{8} \times 4$



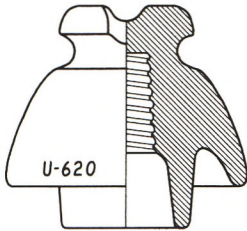
U-617
 $4\frac{1}{2} \times 4\frac{1}{4}$



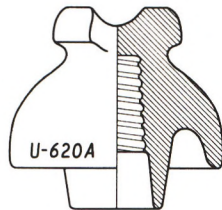
U-618
 $4\frac{3}{4} \times 4$



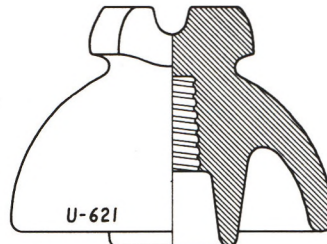
U-619
 $5 \times 4\frac{1}{8}$



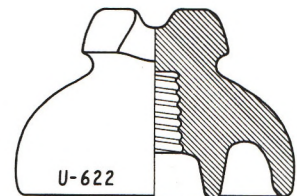
U-620
 $5 \times 4\frac{5}{8}$



U-620A
 $4\frac{3}{8} \times 4\frac{1}{8}$



U-621
 $6\frac{3}{4} \times 5$



U-622
 $5\frac{3}{4} \times 3\frac{7}{8}$



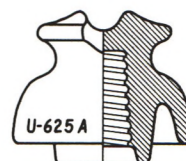
U-623
 $3\frac{3}{8} \times 3$



U-624
 $3\frac{1}{2} \times 3\frac{1}{4}$



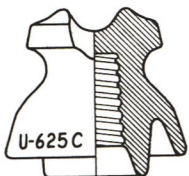
U-625
 $3\frac{3}{4} \times 3\frac{1}{4}$



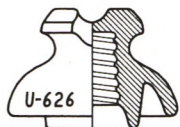
U-625A
 $3\frac{3}{4} \times 3\frac{1}{4}$



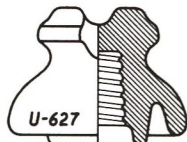
U-625B
 $3\frac{7}{8} \times 3\frac{1}{2}$



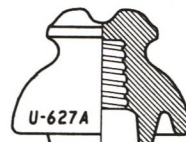
U-625C
 $3\frac{3}{4} \times 3\frac{1}{2}$



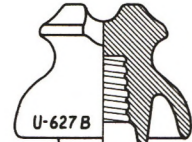
U-626
 $3\frac{1}{2} \times 2\frac{1}{2}$



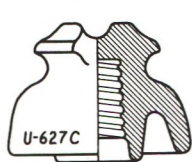
U-627
 $3\frac{3}{4} \times 2\frac{7}{8}$



U-627A
 $3\frac{3}{4} \times 2\frac{7}{8}$



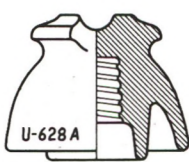
U-627B
 $3\frac{3}{4} \times 3$



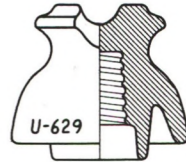
$3\frac{7}{8} \times 2\frac{7}{8}$



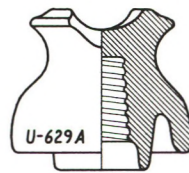
$3\frac{3}{4} \times 3\frac{1}{8}$



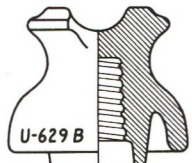
$3\frac{7}{8} \times 3$



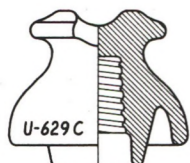
$3\frac{3}{4} \times 3\frac{1}{4}$



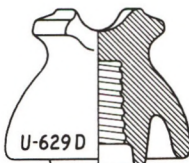
$3\frac{3}{4} \times 3\frac{3}{8}$



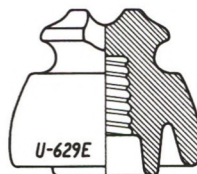
$3\frac{3}{4} \times 3\frac{3}{8}$



$3\frac{3}{4} \times 3\frac{1}{4}$



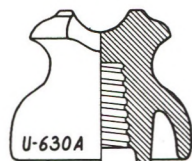
$3\frac{7}{8} \times 3\frac{1}{4}$



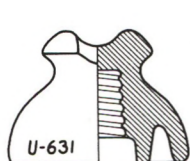
$3\frac{7}{8} \times 3\frac{3}{8}$



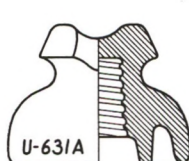
$3\frac{3}{4} \times 3\frac{1}{4}$



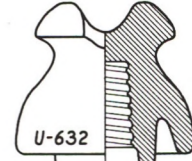
$3\frac{3}{4} \times 3\frac{3}{8}$



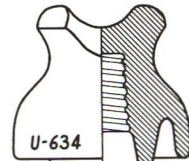
$3\frac{3}{4} \times 3$



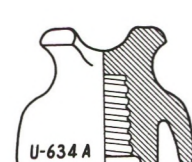
$3\frac{3}{4} \times 3$



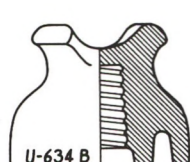
$3\frac{3}{4} \times 3\frac{1}{2}$



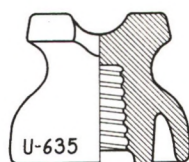
$3\frac{3}{4} \times 3\frac{1}{4}$



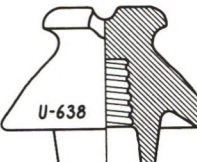
$3\frac{3}{4} \times 3\frac{1}{4}$



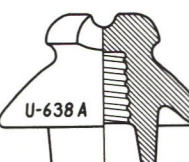
$3\frac{3}{4} \times 3\frac{1}{4}$



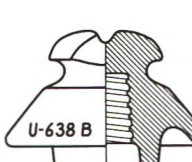
$3\frac{3}{4} \times 3\frac{3}{8}$



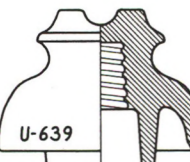
$4\frac{1}{2} \times 3\frac{1}{2}$



$4\frac{1}{2} \times 3\frac{3}{8}$



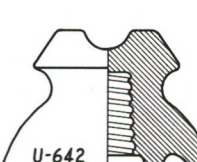
$4\frac{1}{2} \times 3\frac{1}{2}$



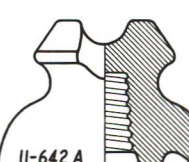
$4\frac{1}{2} \times 3\frac{3}{4}$



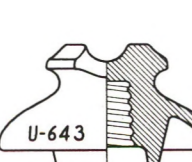
$4\frac{1}{2} \times 3\frac{3}{8}$



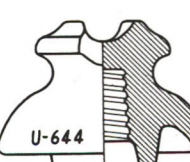
$4\frac{1}{2} \times 3\frac{1}{2}$



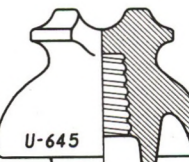
$4\frac{1}{2} \times 3\frac{1}{2}$



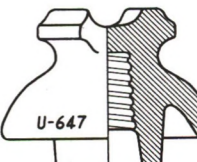
$4\frac{1}{2} \times 2\frac{3}{4}$



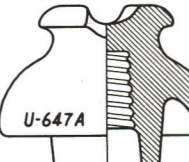
$4\frac{1}{2} \times 3\frac{1}{4}$



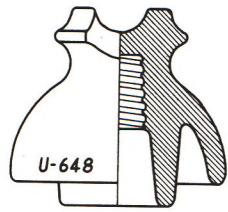
$4\frac{1}{2} \times 3\frac{1}{2}$



$4\frac{1}{2} \times 3\frac{1}{2}$

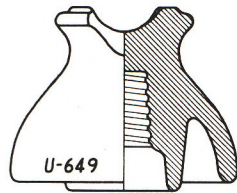


$4\frac{1}{2} \times 3\frac{1}{2}$



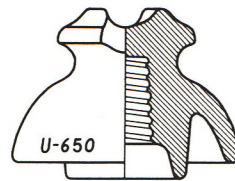
U-648

$4\frac{1}{2} \times 4\frac{1}{8}$



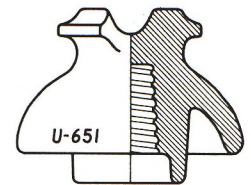
U-649

$4\frac{3}{4} \times 3\frac{3}{4}$



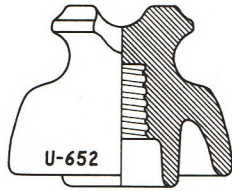
U-650

$4\frac{3}{4} \times 3\frac{1}{2}$



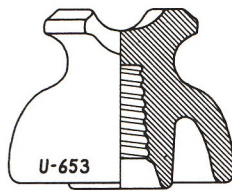
U-651

$4\frac{3}{4} \times 3\frac{3}{8}$



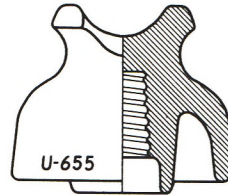
U-652

$4\frac{3}{4} \times 3\frac{3}{4}$



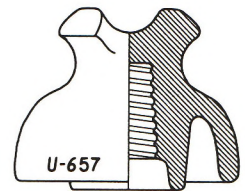
U-653

$4\frac{3}{4} \times 3\frac{3}{4}$



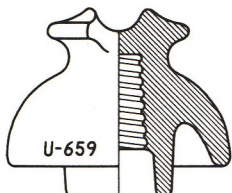
U-655

$4\frac{5}{8} \times 3\frac{7}{8}$



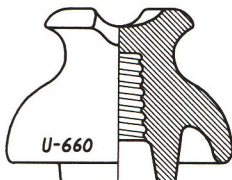
U-657

$4\frac{3}{4} \times 3\frac{3}{4}$



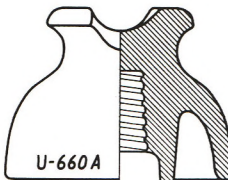
U-659

$4\frac{3}{4} \times 3\frac{3}{4}$



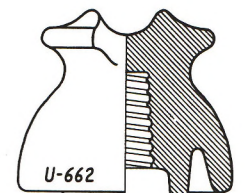
U-660

$4\frac{3}{4} \times 3\frac{3}{4}$



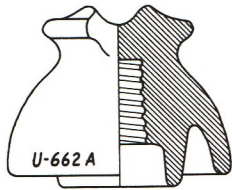
U-660A

$4\frac{3}{4} \times 3\frac{3}{4}$



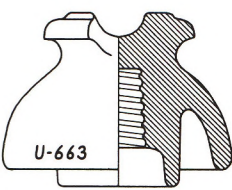
U-662

$4\frac{1}{2} \times 4$



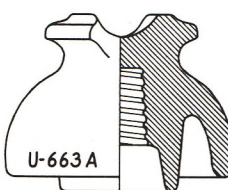
U-662A

$4\frac{3}{4} \times 3\frac{3}{4}$



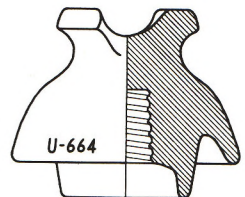
U-663

$4\frac{3}{4} \times 3\frac{3}{4}$



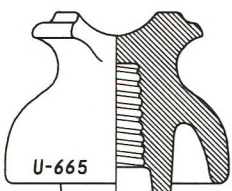
U-663A

$4\frac{3}{4} \times 3\frac{3}{4}$



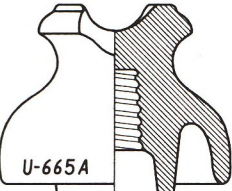
U-664

$4\frac{3}{4} \times 4$



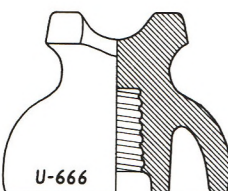
U-665

$4\frac{3}{4} \times 4$



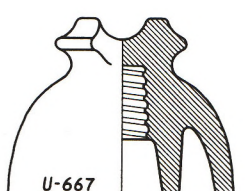
U-665A

$4\frac{3}{4} \times 4\frac{1}{8}$



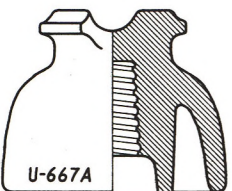
U-666

$4\frac{3}{4} \times 4$



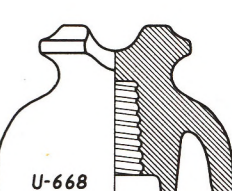
U-667

$4\frac{3}{4} \times 4$



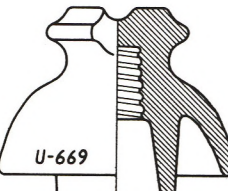
U-667A

$4\frac{3}{4} \times 4$



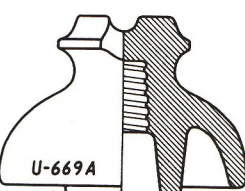
U-668

$5 \times 3\frac{3}{4}$



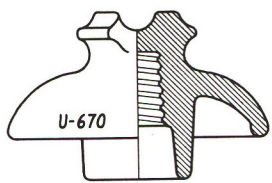
U-669

$5 \times 4\frac{1}{8}$



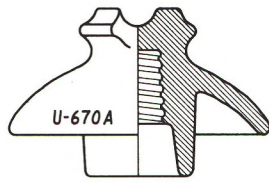
U-669A

$5\frac{1}{2} \times 4\frac{1}{8}$



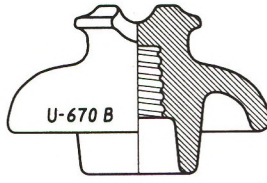
U-670

$5\frac{1}{2} \times 3\frac{1}{2}$



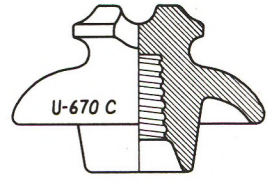
U-670A

$5\frac{1}{2} \times 3\frac{1}{2}$



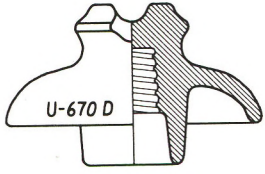
U-670B

$5\frac{1}{2} \times 3\frac{1}{2}$



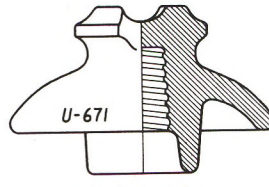
U-670C

$5\frac{3}{8} \times 3\frac{1}{2}$



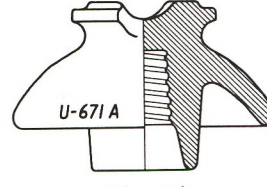
U-670D

$5\frac{3}{8} \times 3\frac{3}{8}$



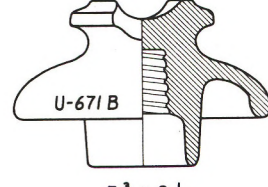
U-671

$5\frac{1}{2} \times 3\frac{1}{2}$



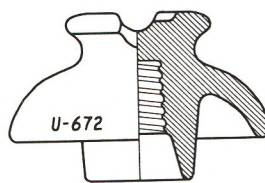
U-671A

$5\frac{1}{2} \times 3\frac{1}{2}$



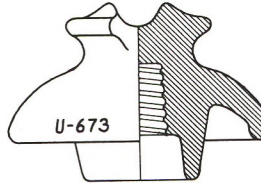
U-671B

$5\frac{3}{8} \times 3\frac{1}{2}$



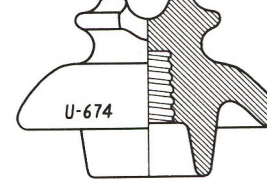
U-672

$5\frac{1}{2} \times 3\frac{1}{2}$



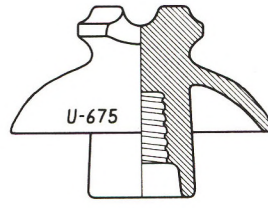
U-673

$5\frac{1}{2} \times 3\frac{3}{4}$



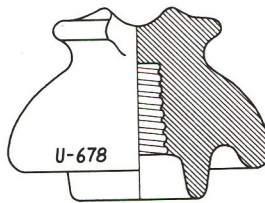
U-674

$5\frac{1}{2} \times 3\frac{3}{4}$



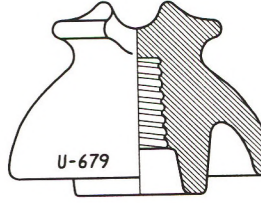
U-675

$5\frac{1}{2} \times 4$



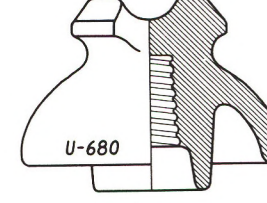
U-678

$5\frac{1}{2} \times 4$



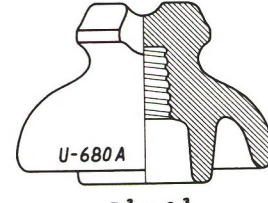
U-679

$5\frac{1}{2} \times 4$



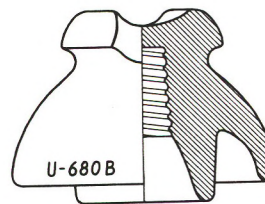
U-680

$5\frac{1}{2} \times 4$



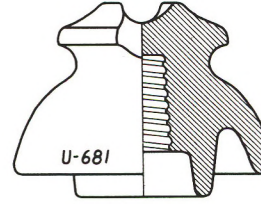
U-680A

$5\frac{3}{8} \times 3\frac{3}{4}$



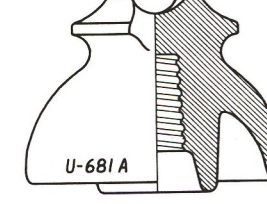
U-680B

$5\frac{1}{2} \times 4$



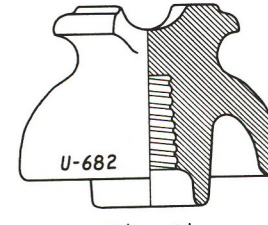
U-681

$5\frac{1}{2} \times 4$



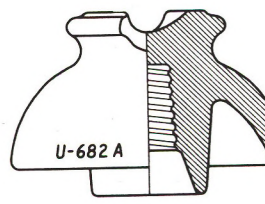
U-681A

$5\frac{1}{2} \times 4$



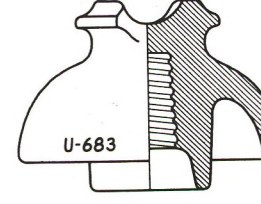
U-682

$5\frac{1}{2} \times 4\frac{1}{2}$



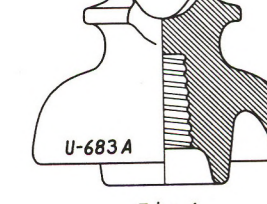
U-682A

$5\frac{3}{4} \times 3\frac{7}{8}$



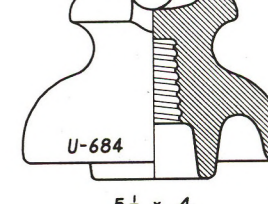
U-683

$5\frac{1}{2} \times 4$



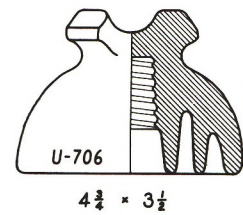
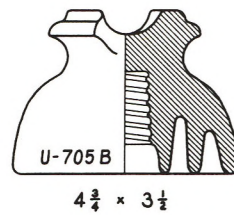
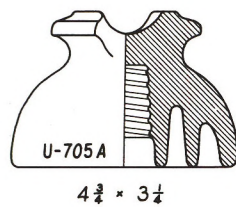
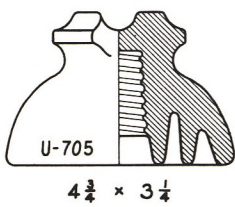
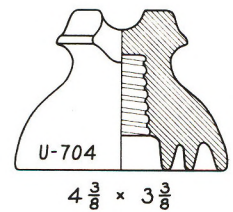
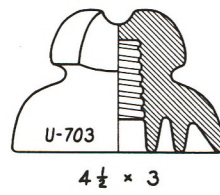
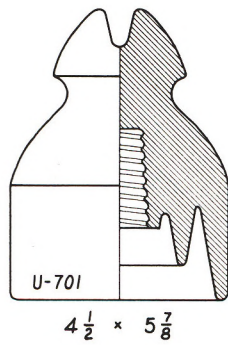
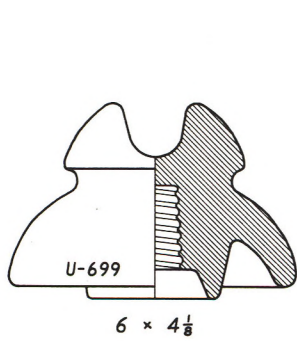
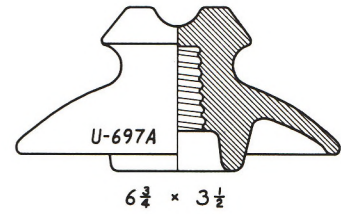
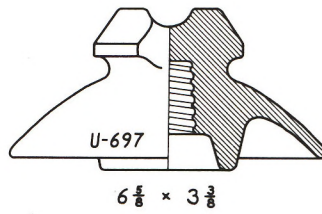
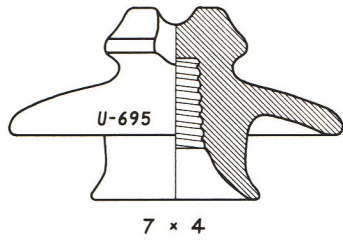
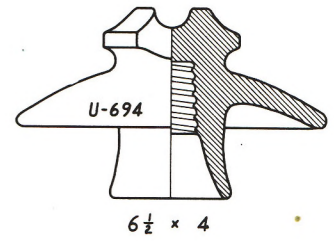
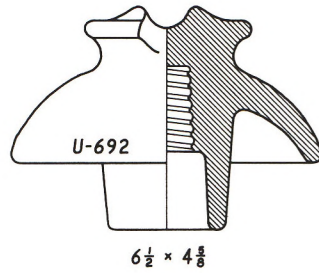
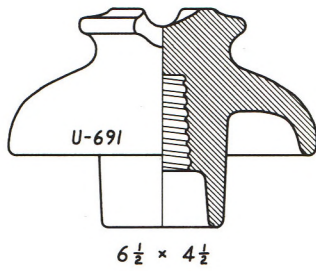
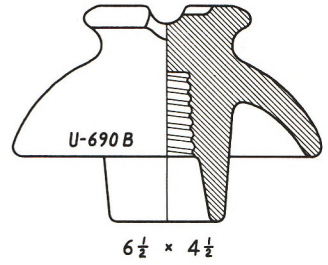
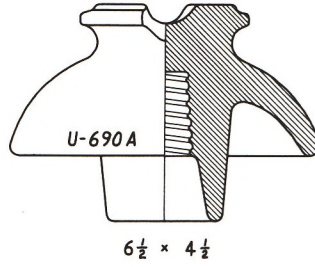
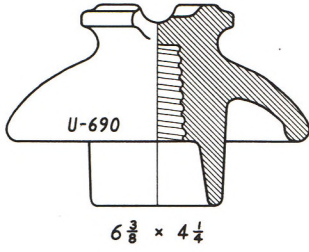
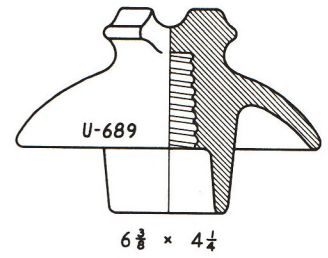
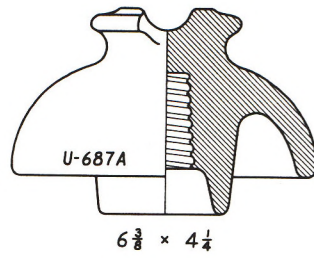
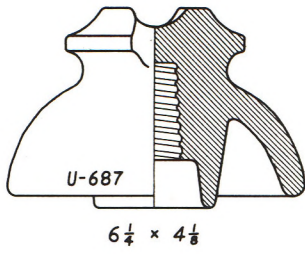
U-683A

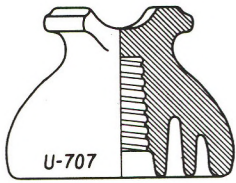
$5\frac{1}{2} \times 4$



U-684

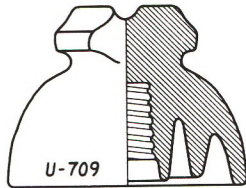
$5\frac{1}{2} \times 4$





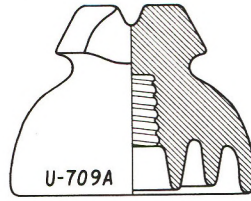
U-707

$$4\frac{3}{4} \times 3\frac{5}{8}$$



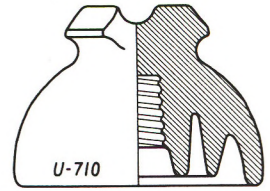
U-709

$$5 \times 3\frac{3}{4}$$



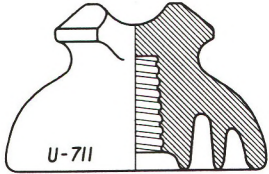
U-709A

$$5 \times 3\frac{7}{8}$$



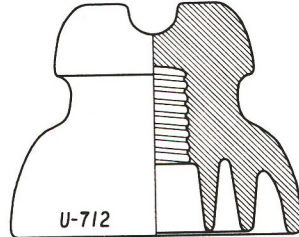
U-710

$$5\frac{1}{4} \times 3\frac{3}{4}$$



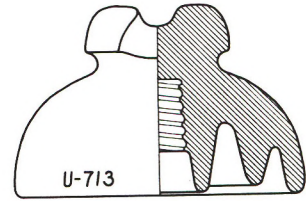
U-711

$$5\frac{1}{2} \times 3\frac{1}{2}$$



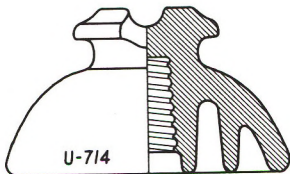
U-712

$$6 \times 4\frac{3}{4}$$



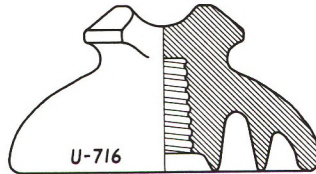
U-713

$$6 \times 3\frac{7}{8}$$



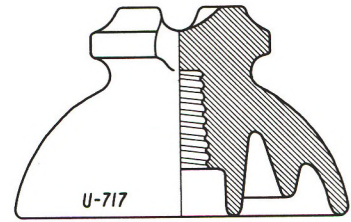
U-714

$$6 \times 3\frac{1}{2}$$



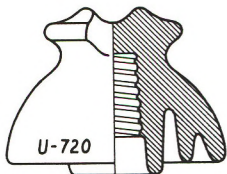
U-716

$$6\frac{1}{2} \times 3\frac{1}{2}$$



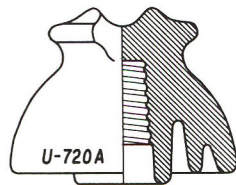
U-717

$$7 \times 4\frac{3}{8}$$



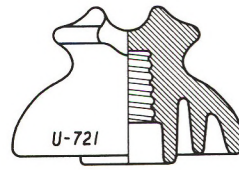
U-720

$$4\frac{5}{8} \times 3\frac{1}{2}$$



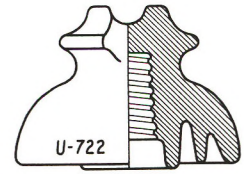
U-720A

$$4\frac{1}{2} \times 3\frac{1}{2}$$



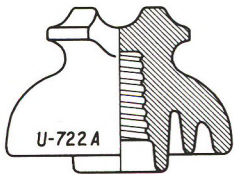
U-721

$$4\frac{7}{8} \times 3\frac{3}{8}$$



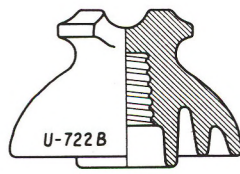
U-722

$$4\frac{3}{4} \times 3\frac{3}{8}$$



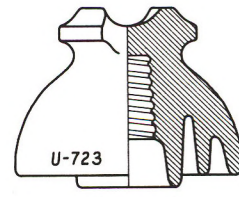
U-722A

$$4\frac{3}{4} \times 3\frac{1}{2}$$



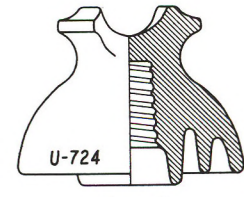
U-722B

$$4\frac{7}{8} \times 3\frac{3}{8}$$



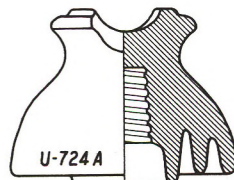
U-723

$$4\frac{3}{8} \times 3\frac{3}{8}$$



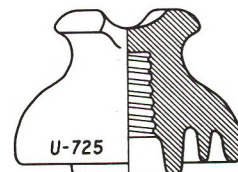
U-724

$$4\frac{3}{4} \times 3\frac{3}{4}$$



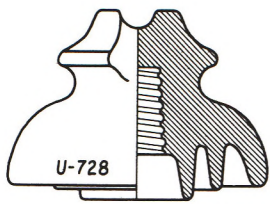
U-724A

$$4\frac{3}{4} \times 3\frac{3}{4}$$



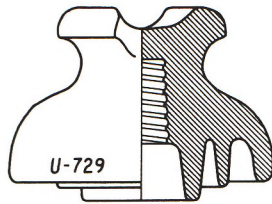
U-725

$$4\frac{3}{4} \times 3\frac{1}{2}$$



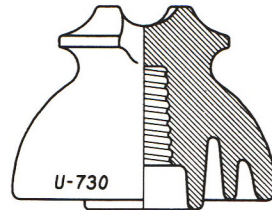
U-728

$5\frac{1}{2} \times 3\frac{3}{8}$



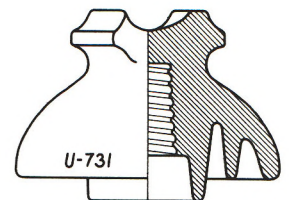
U-729

$5\frac{1}{2} \times 4$



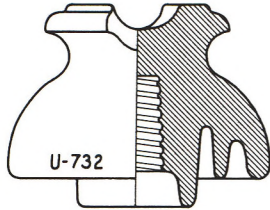
U-730

$5\frac{1}{2} \times 4\frac{1}{4}$



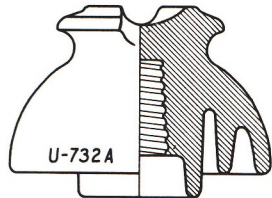
U-731

$5\frac{1}{2} \times 4$



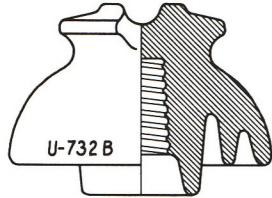
U-732

$5\frac{1}{2} \times 4\frac{1}{4}$



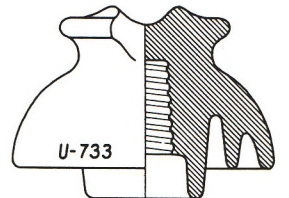
U-732A

$5\frac{1}{2} \times 4$



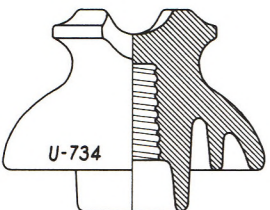
U-732B

$5\frac{1}{2} \times 4$



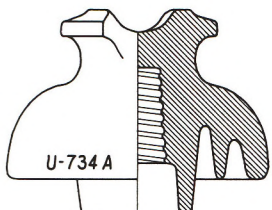
U-733

$5\frac{1}{2} \times 4$



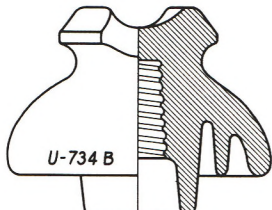
U-734

$5\frac{1}{2} \times 4\frac{1}{4}$



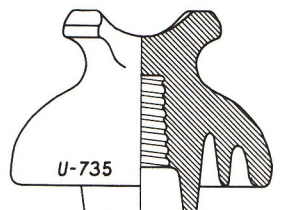
U-734A

$5\frac{1}{2} \times 4\frac{1}{4}$



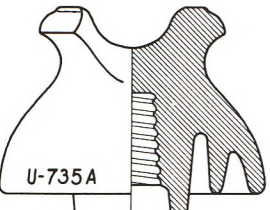
U-734B

$5\frac{1}{2} \times 4\frac{1}{4}$



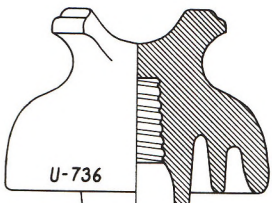
U-735

$5\frac{1}{2} \times 4\frac{3}{8}$



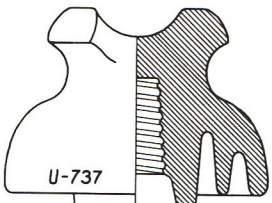
U-735A

$5\frac{1}{2} \times 4\frac{3}{8}$



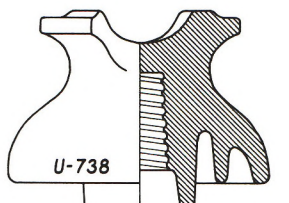
U-736

$5\frac{1}{2} \times 4\frac{3}{8}$



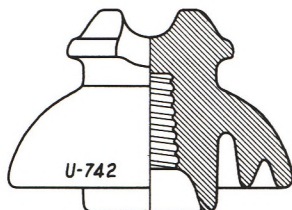
U-737

$5\frac{1}{2} \times 4\frac{3}{8}$



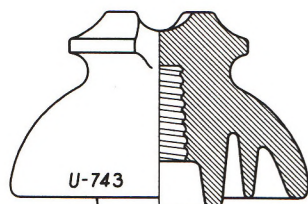
U-738

$5\frac{1}{2} \times 4\frac{1}{2}$



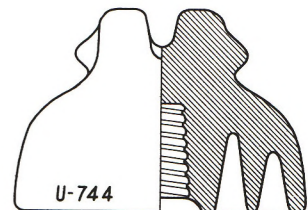
U-742

$6 \times 4\frac{1}{8}$



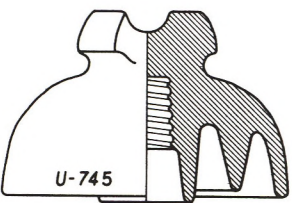
U-743

$6\frac{1}{4} \times 4$



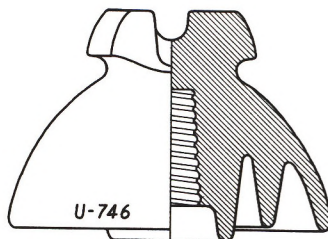
U-744

$6 \times 4\frac{3}{8}$



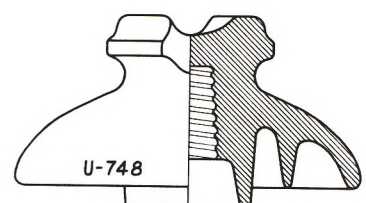
U-745

6×4



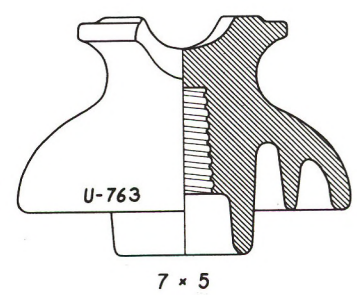
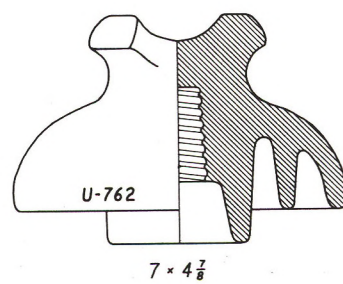
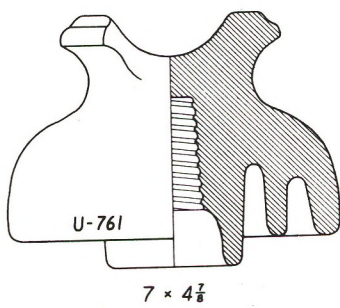
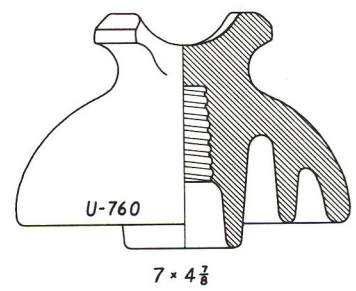
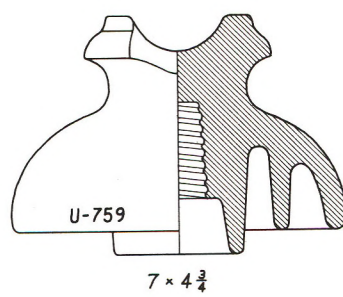
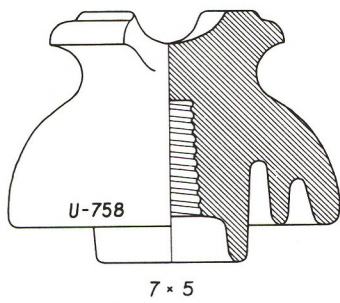
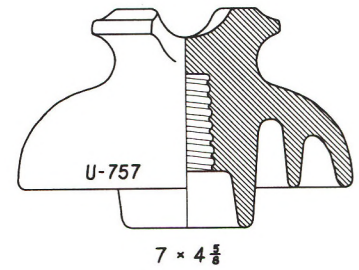
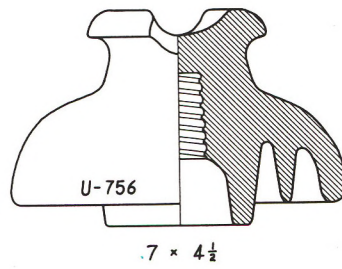
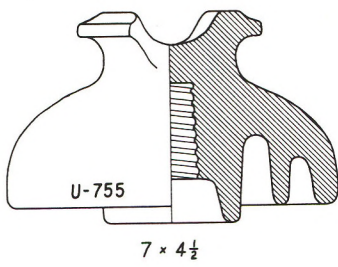
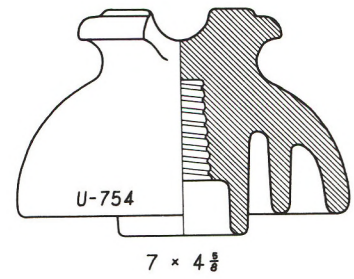
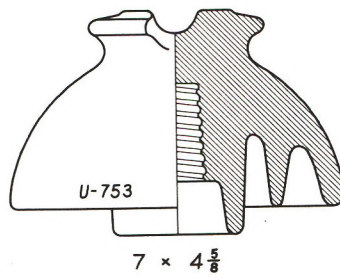
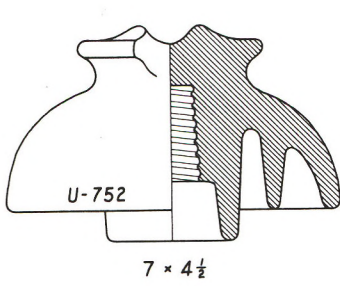
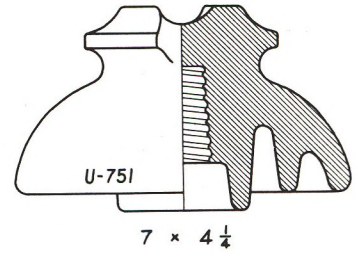
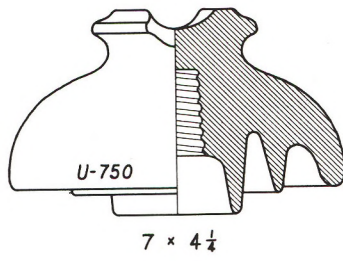
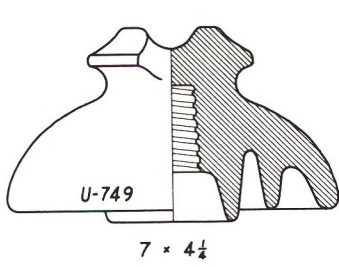
U-746

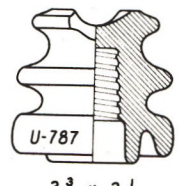
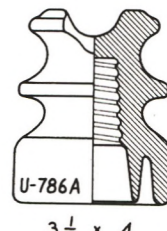
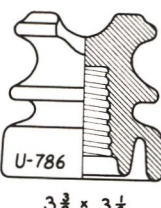
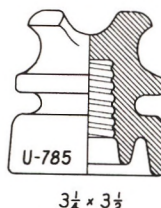
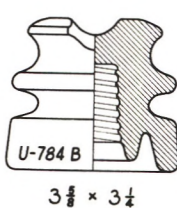
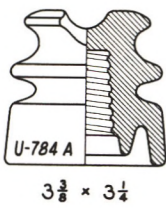
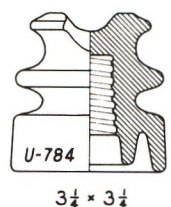
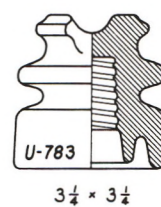
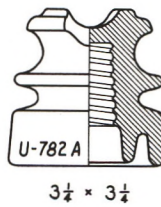
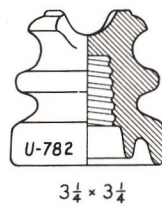
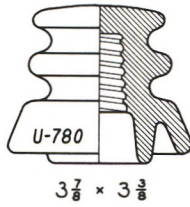
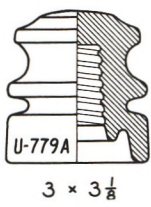
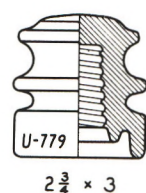
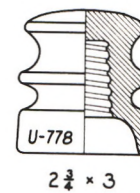
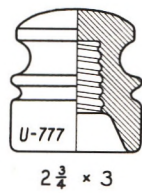
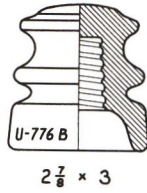
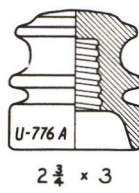
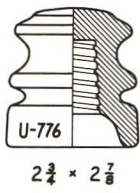
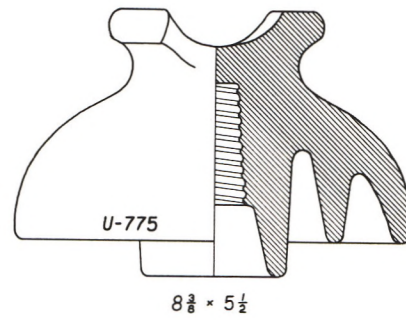
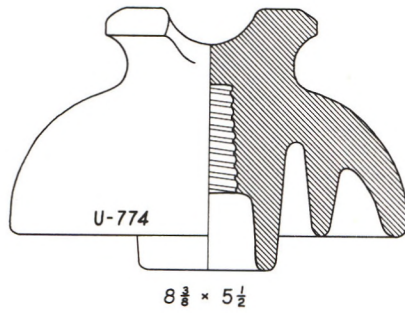
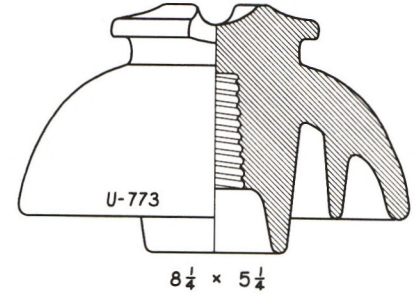
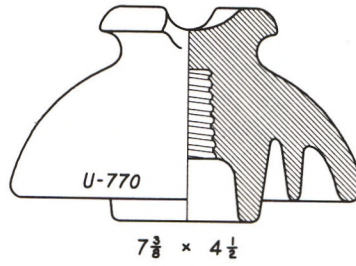
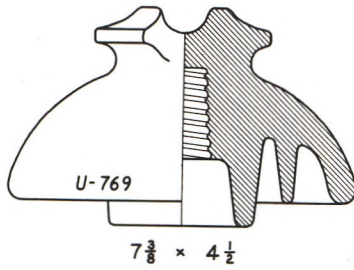
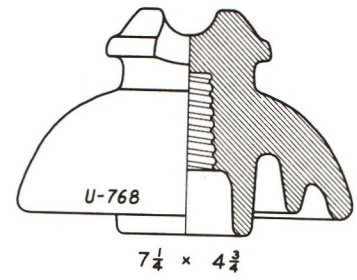
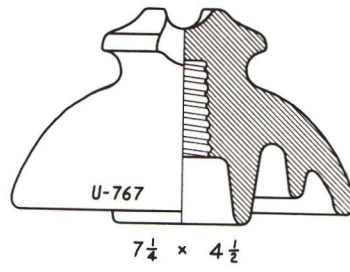
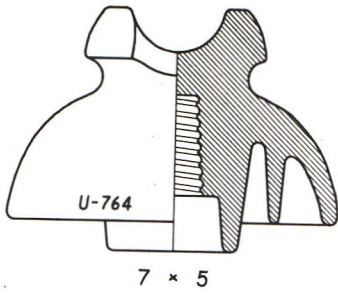
$6\frac{3}{4} \times 4\frac{7}{8}$

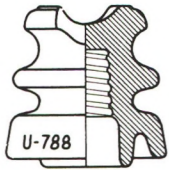


U-748

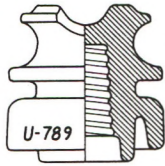
7×4



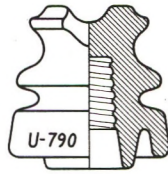




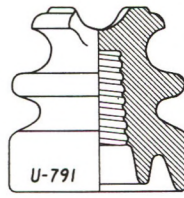
U-788
 $3\frac{3}{8} \times 3\frac{3}{8}$



U-789
 $3\frac{1}{2} \times 3\frac{1}{2}$



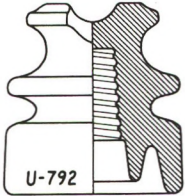
U-790
 $3\frac{3}{8} \times 3\frac{3}{8}$



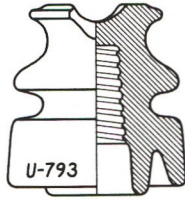
U-791
 $3\frac{3}{4} \times 3\frac{3}{4}$



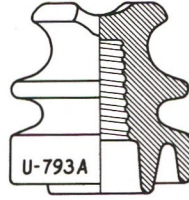
U-791A
 $3\frac{3}{4} \times 4$



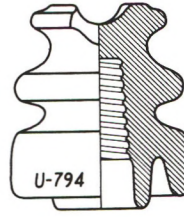
U-792
 $3\frac{3}{4} \times 4$



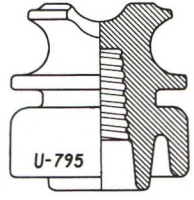
U-793
 $3\frac{3}{4} \times 4$



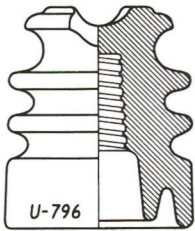
U-793A
 $3\frac{3}{4} \times 4$



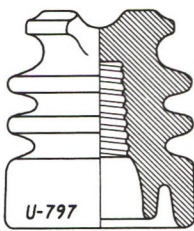
U-794
 $3\frac{3}{4} \times 4\frac{1}{2}$



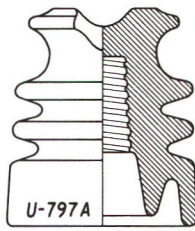
U-795
 $3\frac{3}{4} \times 4\frac{1}{2}$



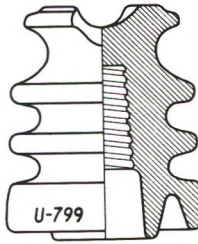
U-796
 $4 \times 4\frac{3}{8}$



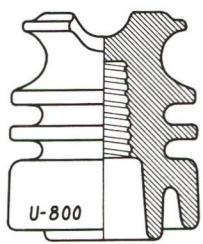
U-797
 $4 \times 4\frac{3}{8}$



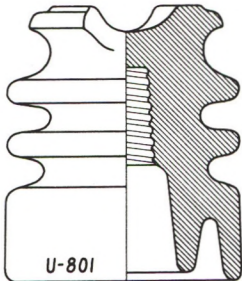
U-797A
 $4 \times 4\frac{1}{2}$



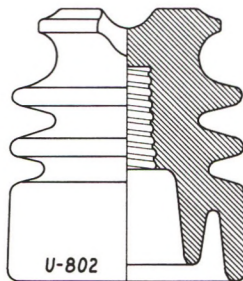
U-799
 $4\frac{1}{8} \times 5$



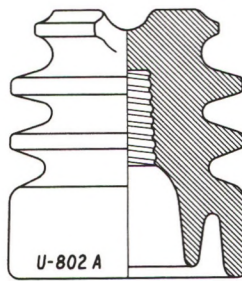
U-800
 $4 \times 4\frac{3}{4}$



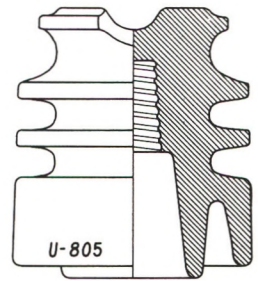
U-801
 $5 \times 5\frac{1}{2}$



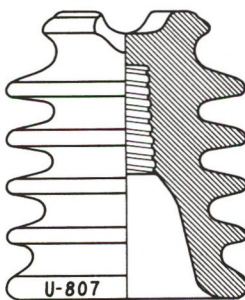
U-802
 $5 \times 5\frac{1}{2}$



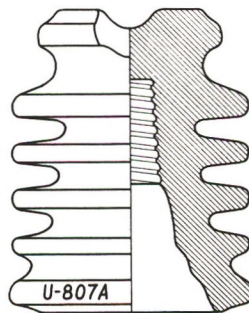
U-802A
 $5 \times 5\frac{1}{2}$



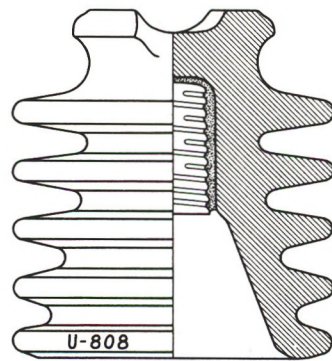
U-805
 5×6



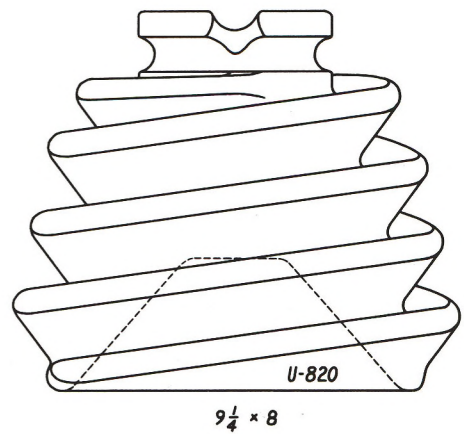
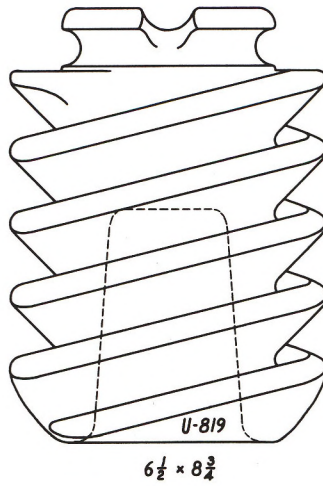
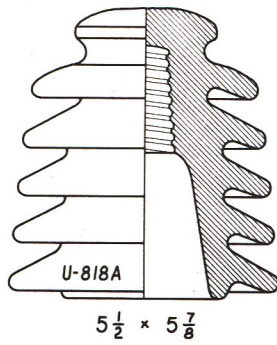
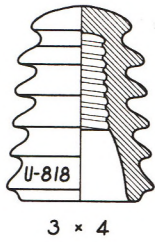
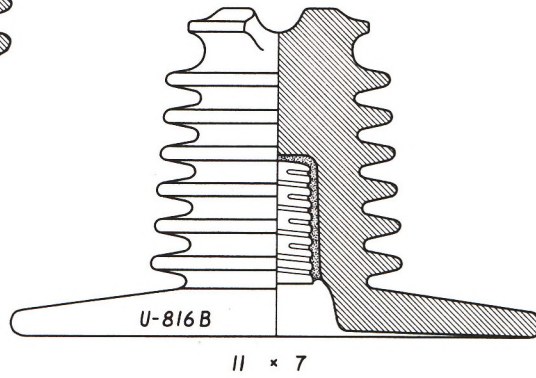
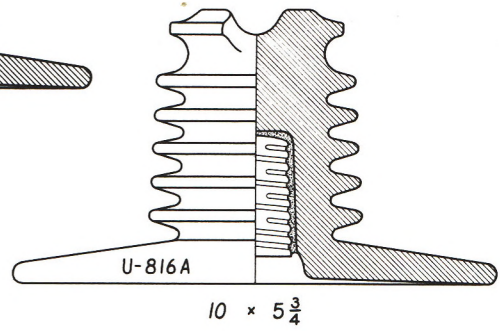
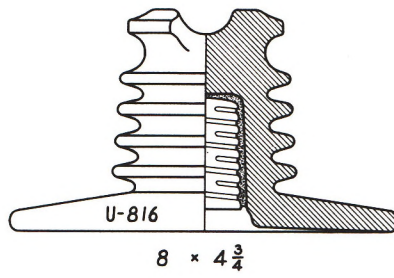
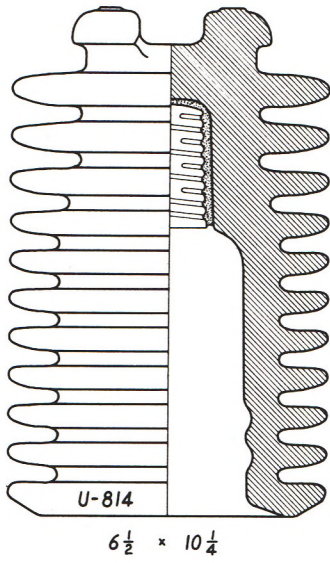
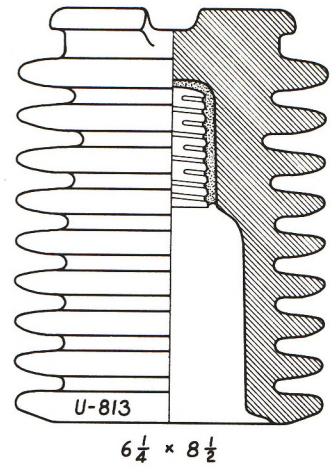
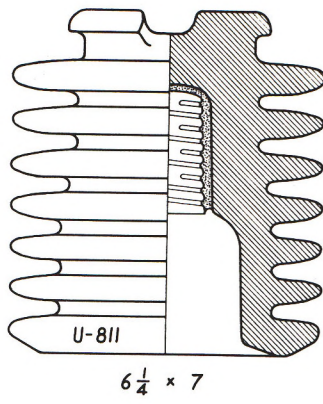
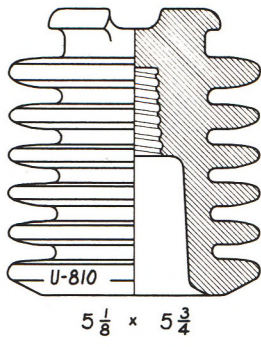
U-807
 5×6

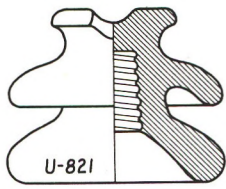


U-807A
 $5 \times 6\frac{1}{4}$

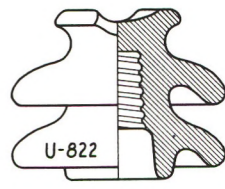


U-808
 $6\frac{1}{2} \times 7$

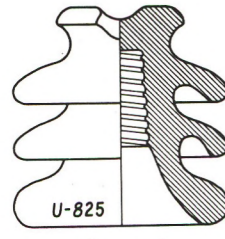




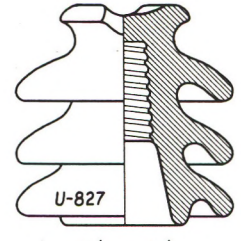
U-821
 $4\frac{1}{2} \times 3\frac{1}{2}$



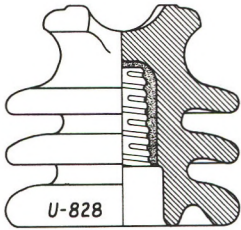
U-822
 $4\frac{1}{2} \times 3\frac{1}{2}$



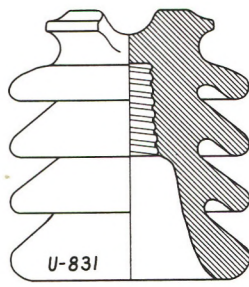
U-825
 $4\frac{1}{2} \times 4\frac{1}{2}$



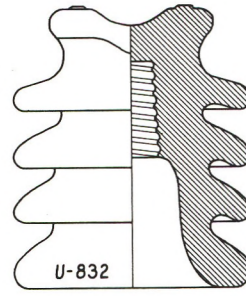
U-827
 $4\frac{1}{2} \times 4\frac{1}{2}$



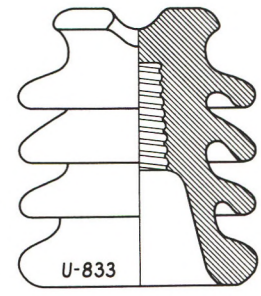
U-828
 $5 \times 4\frac{3}{8}$



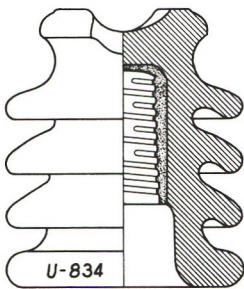
U-831
 $5 \times 5\frac{7}{8}$



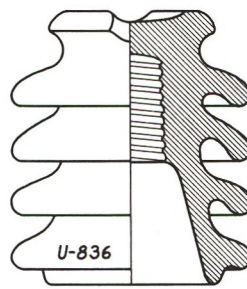
U-832
 $5 \times 5\frac{7}{8}$



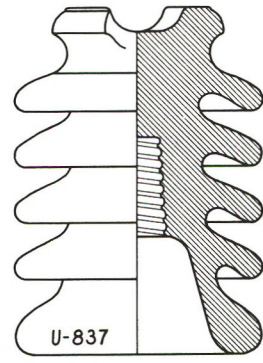
U-833
 $5 \times 5\frac{1}{2}$



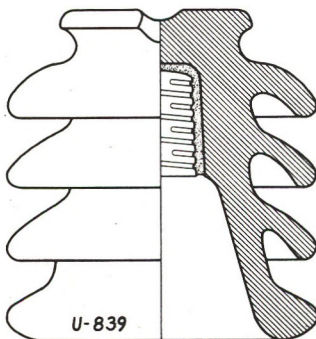
U-834
 $5 \times 5\frac{1}{2}$



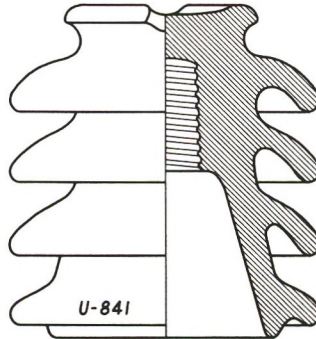
U-836
 $5 \times 5\frac{3}{4}$



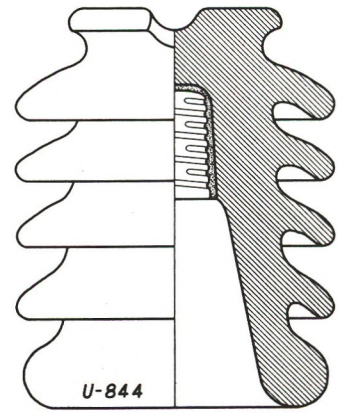
U-837
 5×7



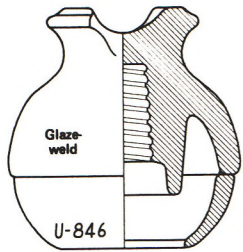
U-839
 $6\frac{1}{2} \times 7$



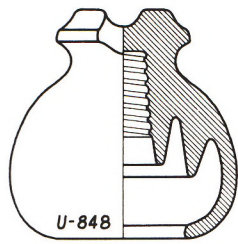
U-841
 $6\frac{1}{2} \times 7$



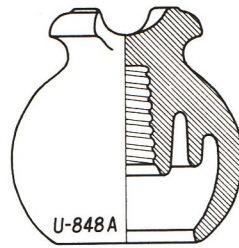
U-844
 $6\frac{1}{2} \times 8\frac{3}{8}$



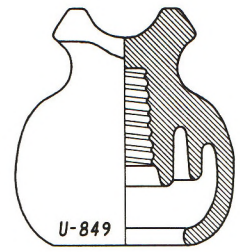
$4\frac{3}{4} \times 4\frac{7}{8}$



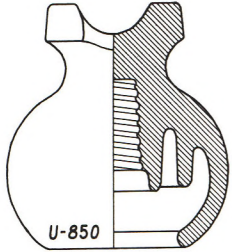
$4\frac{3}{4} \times 4\frac{3}{4}$



$4\frac{3}{4} \times 4\frac{3}{4}$



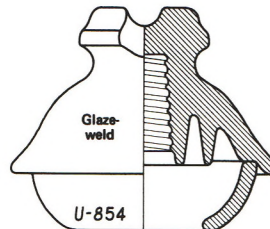
$4\frac{5}{8} \times 4\frac{7}{8}$



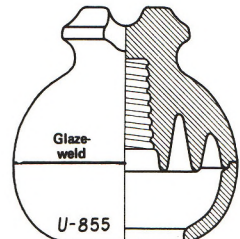
$4\frac{5}{8} \times 5\frac{1}{8}$



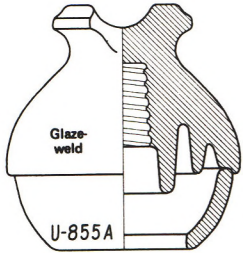
$5\frac{1}{2} \times 4\frac{1}{2}$



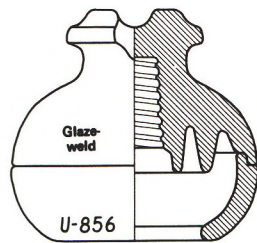
$5\frac{5}{8} \times 4\frac{5}{8}$



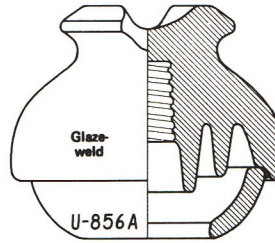
$4\frac{3}{4} \times 4\frac{7}{8}$



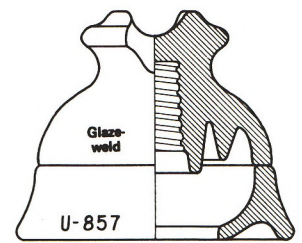
$4\frac{3}{4} \times 5$



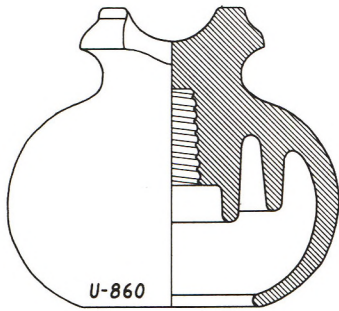
$5 \times 4\frac{3}{4}$



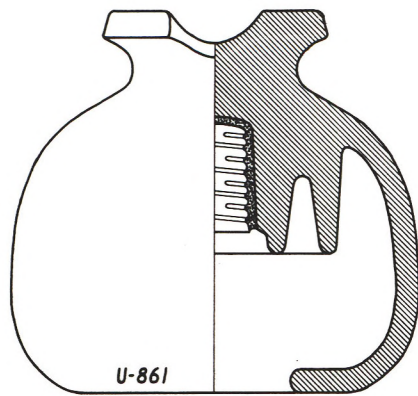
$5\frac{5}{8} \times 4\frac{3}{4}$



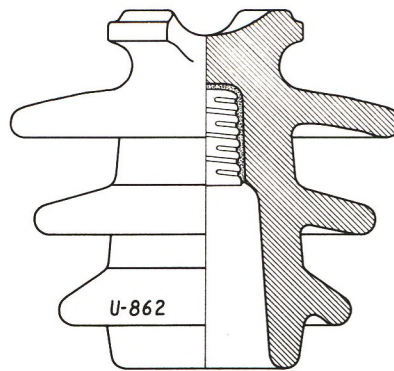
$5\frac{3}{4} \times 4\frac{3}{4}$



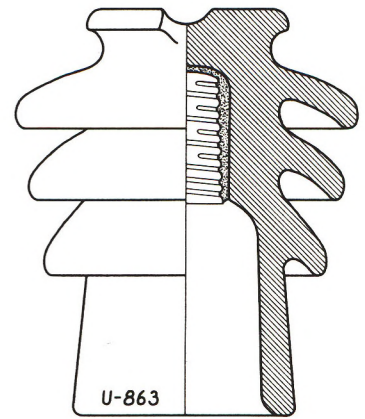
$7 \times 6\frac{3}{16}$



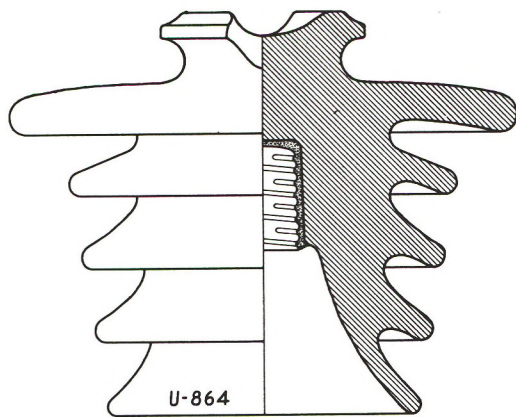
$8\frac{1}{2} \times 8$



$6-7-8 \times 7\frac{3}{8}$

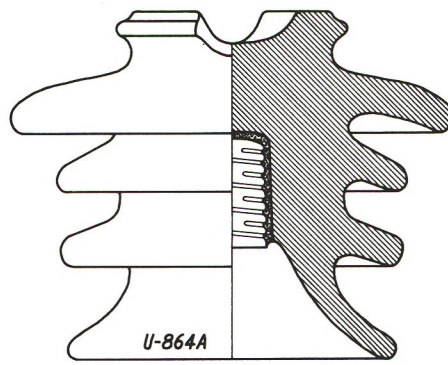


$4\frac{1}{2} - 7 \times 8\frac{3}{8}$



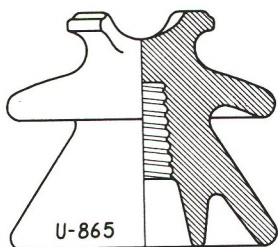
U-864

$6\frac{1}{2}$ ---- $10\frac{1}{2} \times 8\frac{1}{4}$



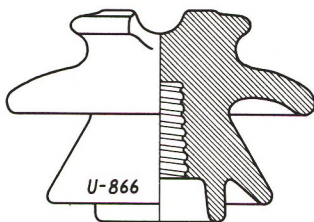
U-864A

$6\frac{3}{4}$ ---- $9\frac{1}{4} \times 7\frac{1}{8}$



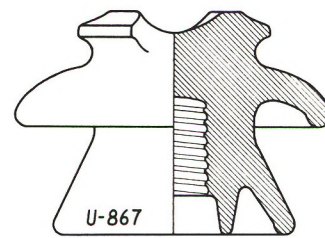
U-865

$5\frac{1}{2} - 5\frac{1}{2} \times 4\frac{1}{2}$



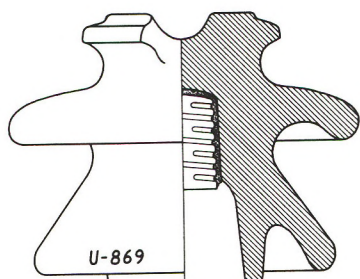
U-866

$4\frac{3}{4} - 6\frac{1}{2} \times 4\frac{3}{8}$



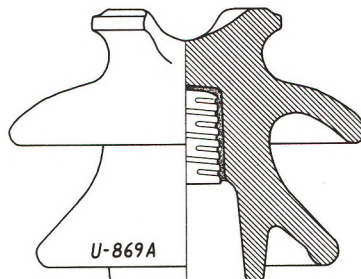
U-867

$5 - 6\frac{1}{2} \times 4\frac{1}{2}$



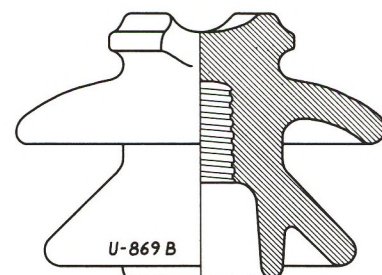
U-869

$6\frac{1}{2} - 7\frac{1}{2} \times 5\frac{3}{4}$



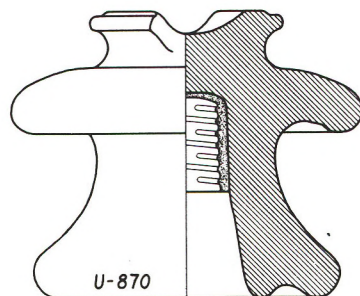
U-869A

$6\frac{1}{2} - 7\frac{1}{2} \times 5\frac{3}{4}$



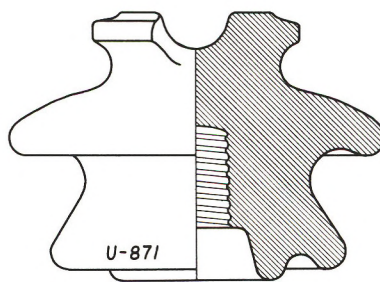
U-869B

$6\frac{1}{2} - 7\frac{3}{4} \times 5\frac{5}{8}$



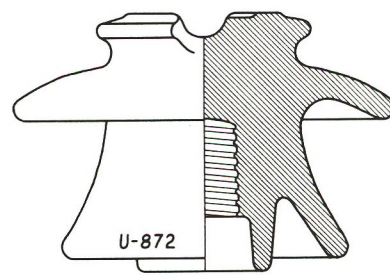
U-870

$6\frac{1}{2} - 7\frac{1}{2} \times 5\frac{3}{4}$



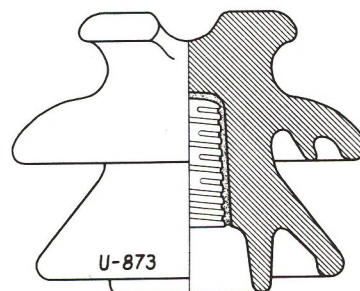
U-871

$6\frac{1}{4} - 8 \times 5\frac{3}{8}$



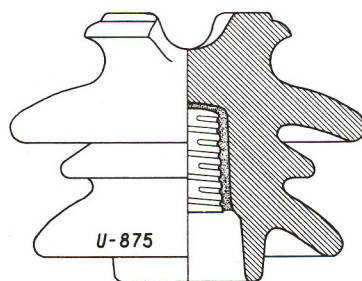
U-872

$6 - 8 \times 5\frac{3}{8}$



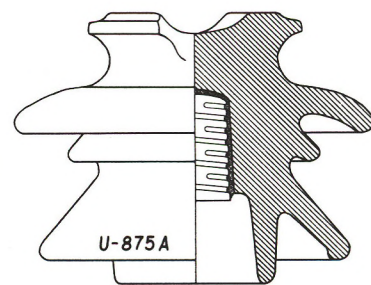
U-873

$6\frac{1}{2} - 7\frac{1}{2} \times 5\frac{3}{4}$



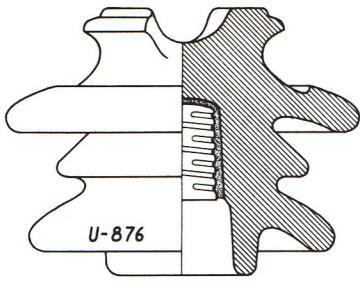
U-875

$6\frac{1}{2} - 7\frac{1}{2} \times 5\frac{5}{8}$



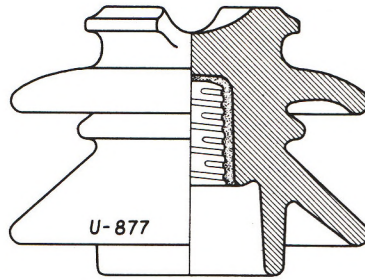
U-875A

$6\frac{1}{2} - 7\frac{1}{2} \times 5\frac{3}{4}$



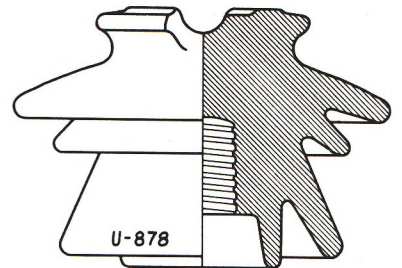
U-876

$6\frac{1}{2} - 7\frac{1}{2} \times 5\frac{3}{8}$



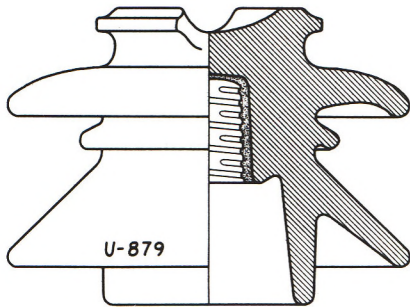
U-877

$7\frac{1}{2} - 7\frac{1}{2} \times 5\frac{1}{2}$



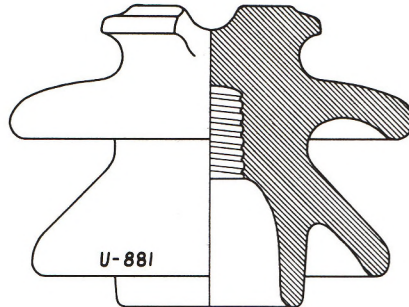
U-878

$6 - 8 \times 5\frac{3}{8}$



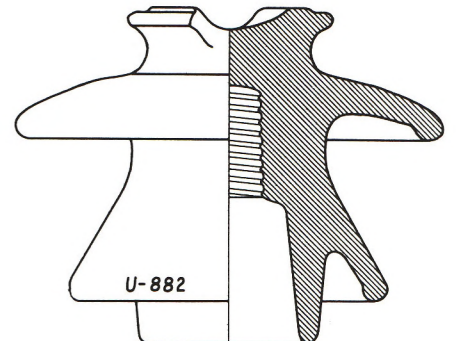
U-879

$8\frac{1}{2} - 8\frac{1}{2} \times 6\frac{1}{4}$



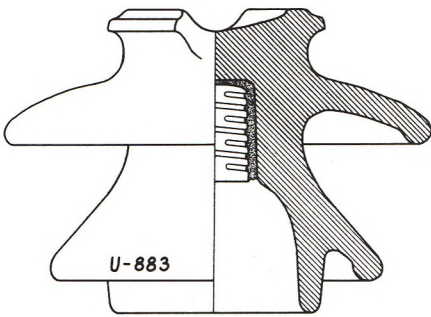
U-881

$7\frac{1}{2} - 8\frac{1}{2} \times 6\frac{1}{2}$



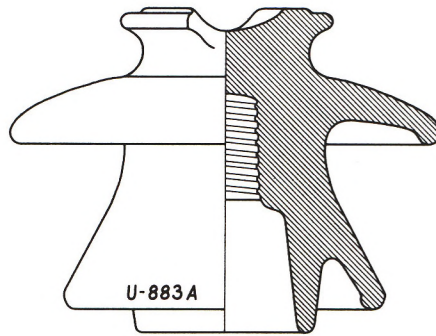
U-882

$6\frac{3}{4} - 9 \times 7$



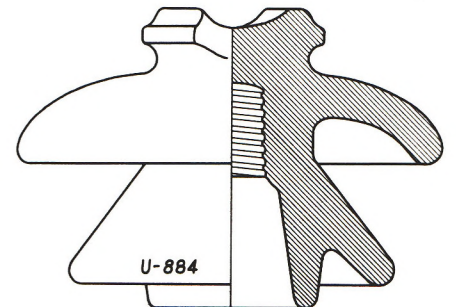
U-883

$7 - 9 \times 6\frac{1}{2}$



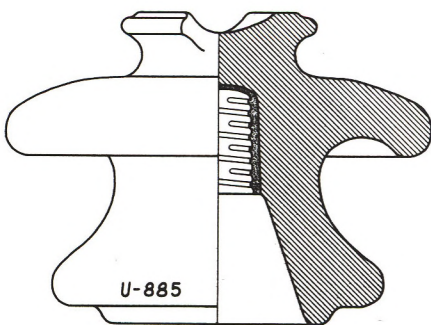
U-883A

$7 - 9 \times 6\frac{1}{2}$



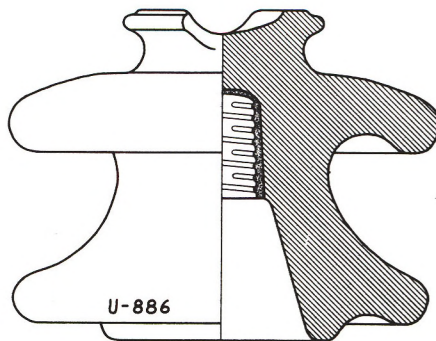
U-884

$7 - 9 \times 6\frac{1}{4}$



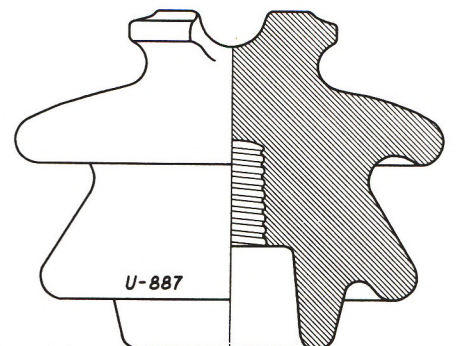
U-885

$7 - 9 \times 6\frac{1}{2}$



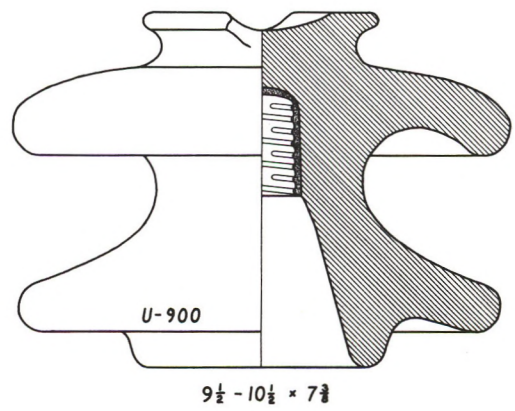
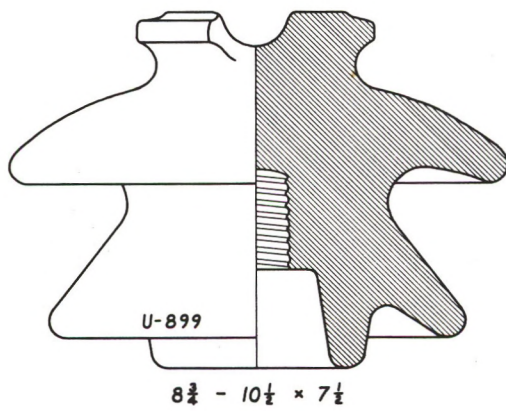
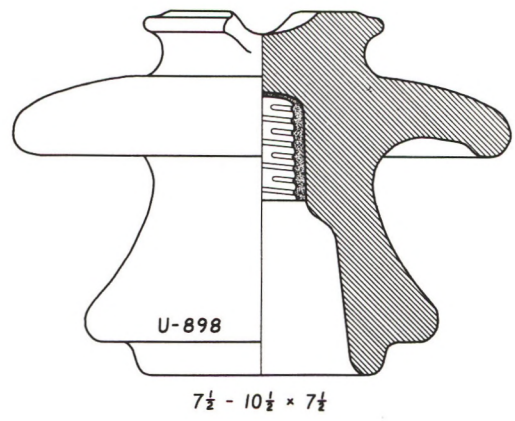
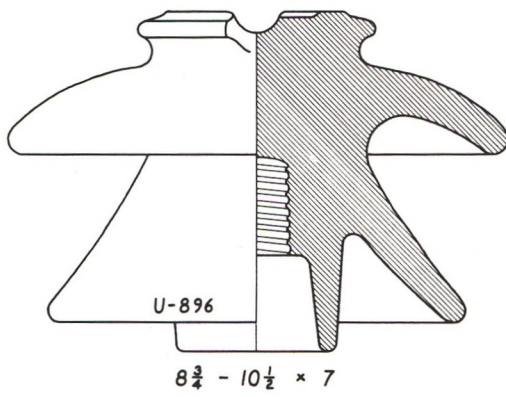
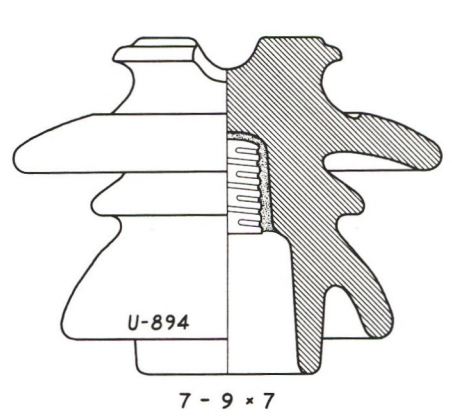
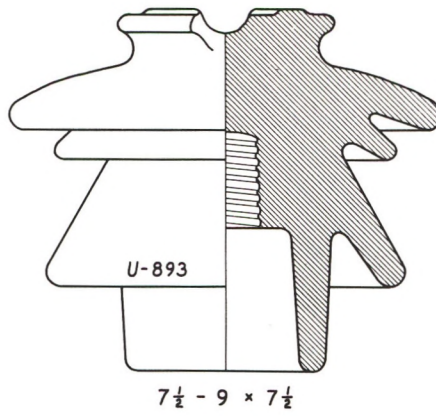
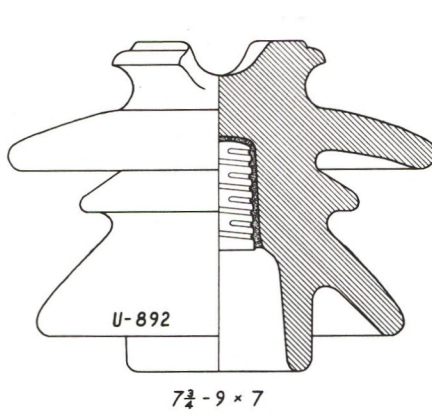
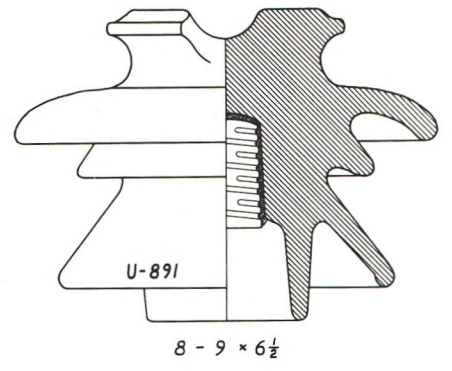
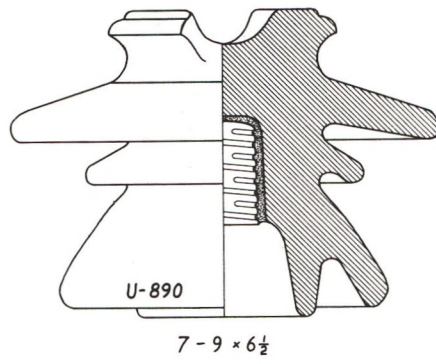
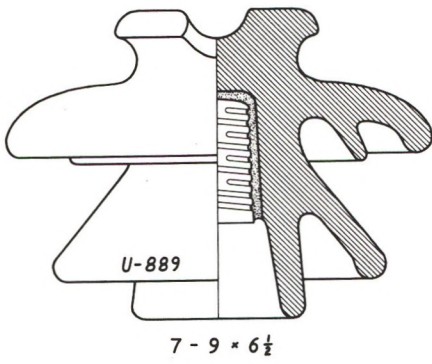
U-886

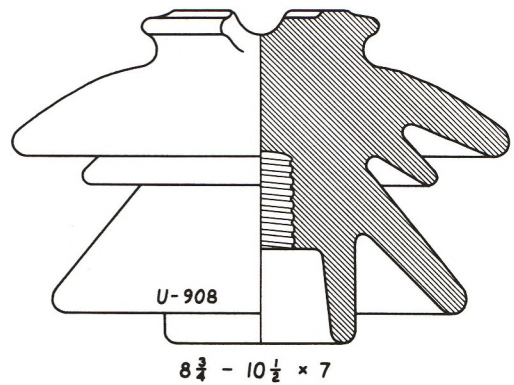
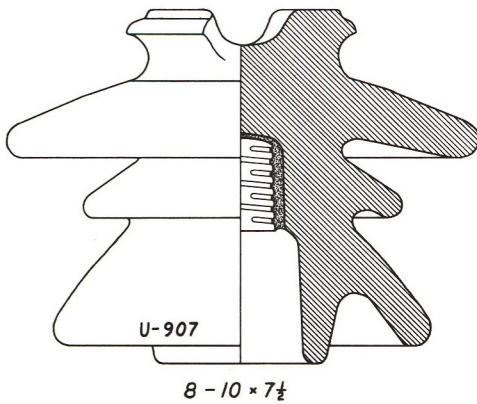
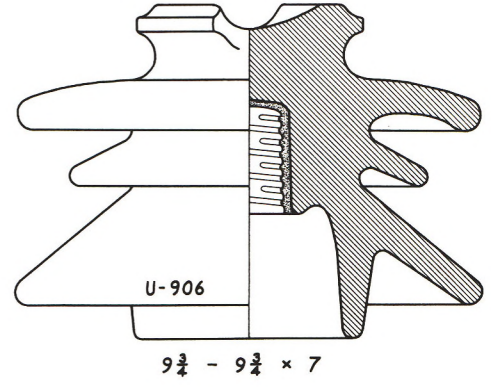
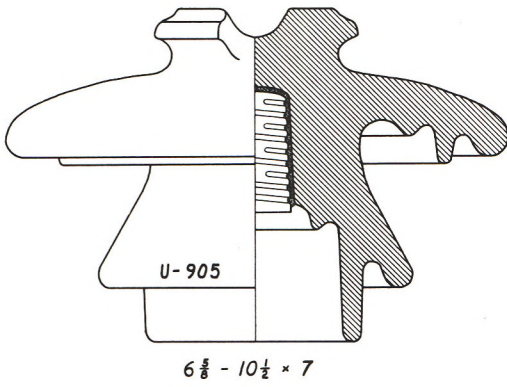
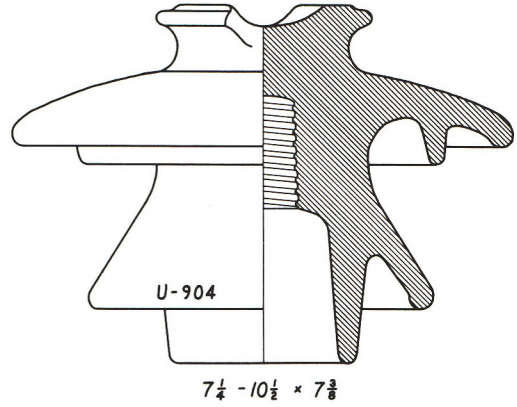
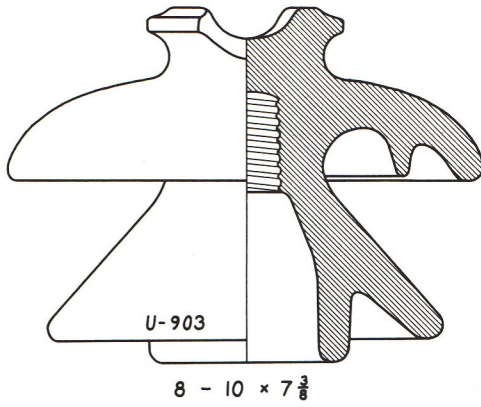
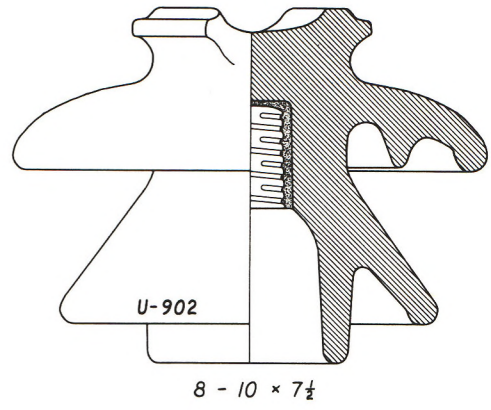
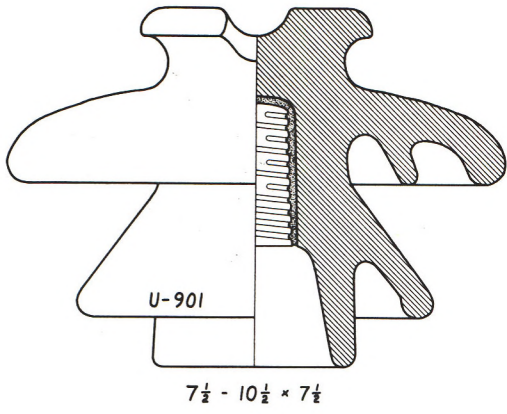
$8\frac{1}{2} - 9 \times 7$

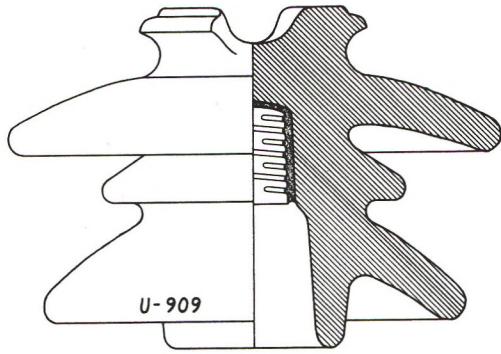


U-887

$8 - 9 \times 7\frac{1}{4}$

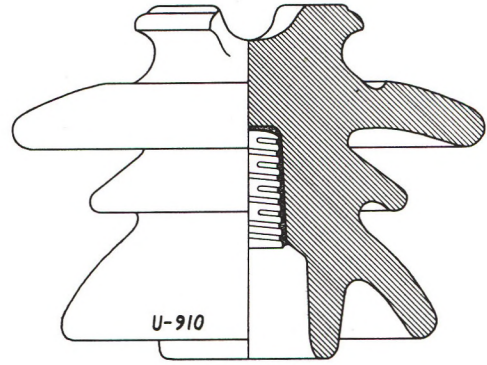






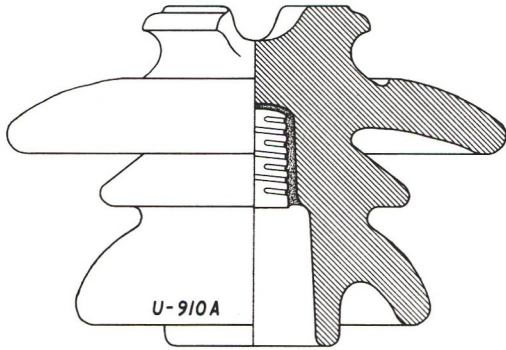
U-909

$9 - 10\frac{1}{2} \times 7\frac{1}{4}$



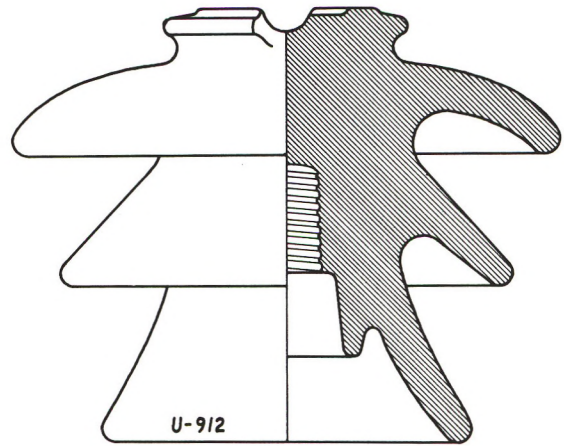
U-910

$8 - 10 \times 7\frac{1}{2}$



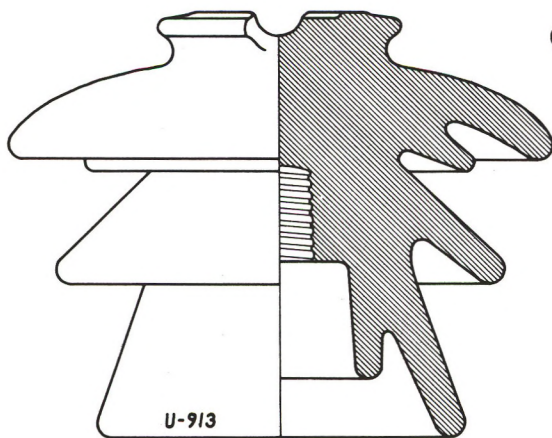
U-910A

$7\frac{1}{2} - 10\frac{1}{2} \times 7\frac{1}{4}$



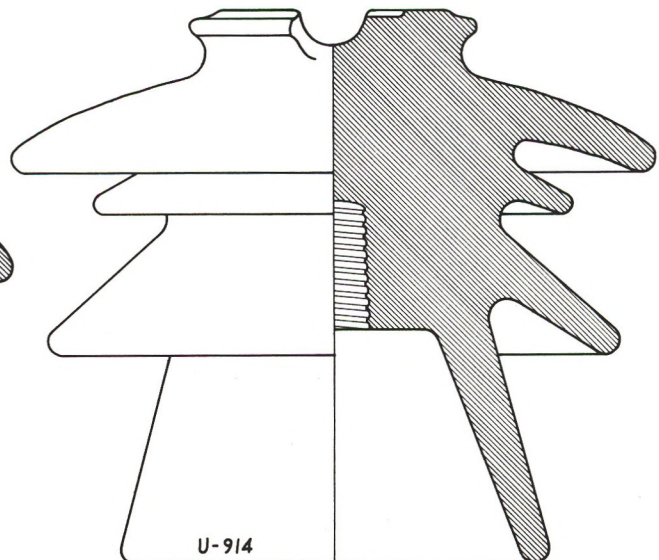
U-912

$7\frac{3}{4} - 9\frac{1}{2} - 11\frac{1}{2} \times 9$



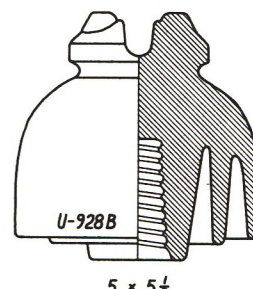
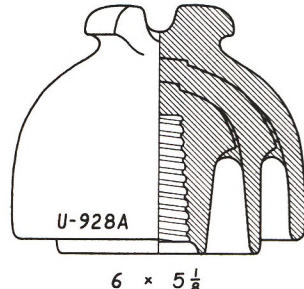
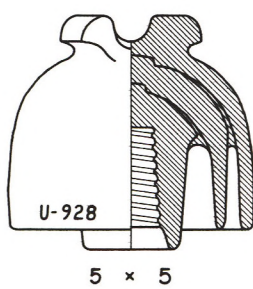
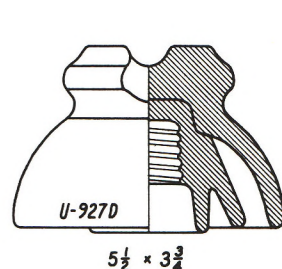
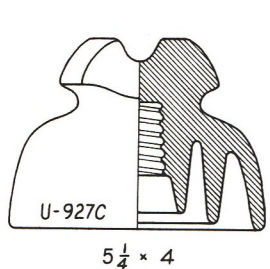
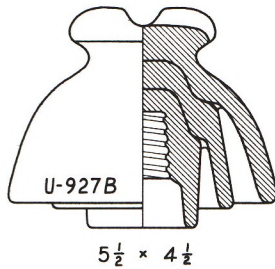
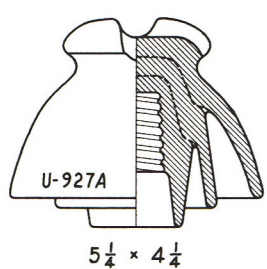
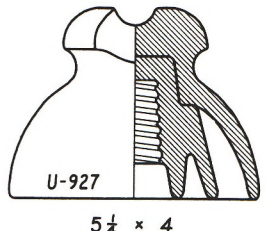
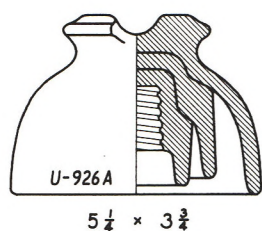
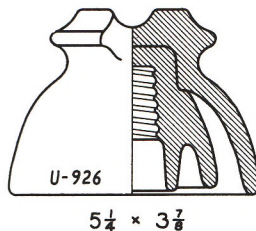
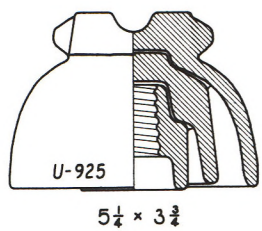
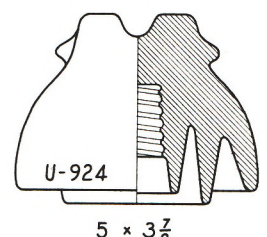
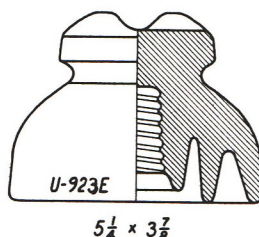
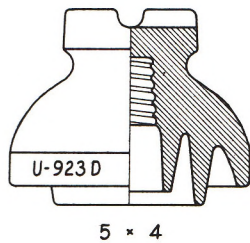
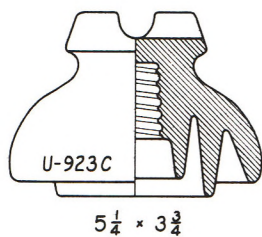
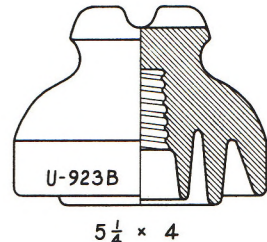
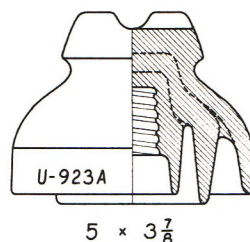
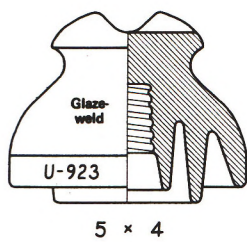
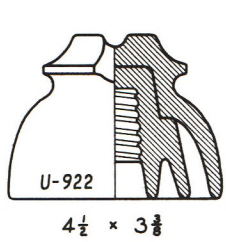
U-913

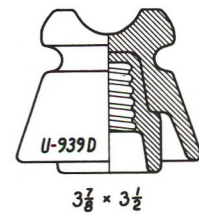
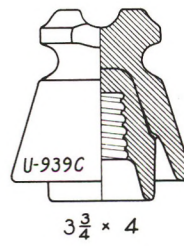
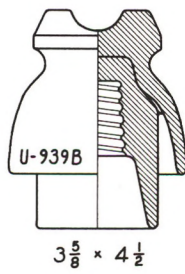
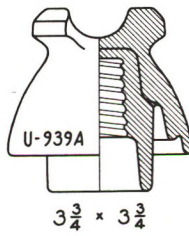
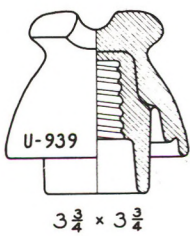
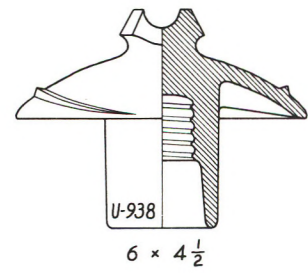
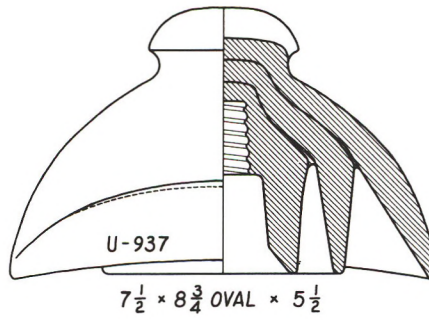
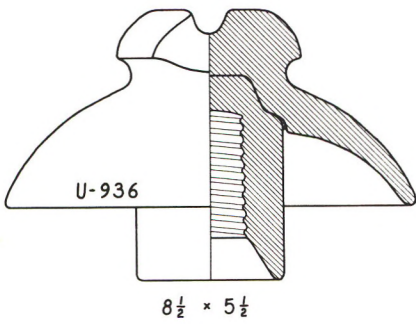
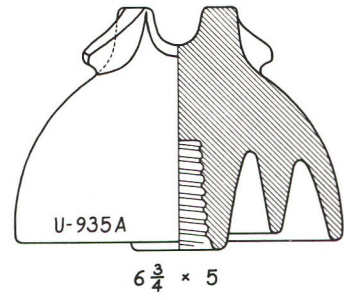
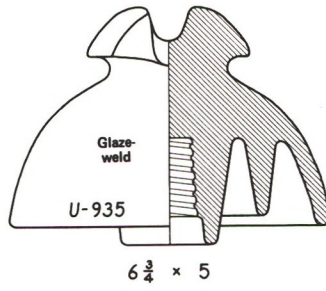
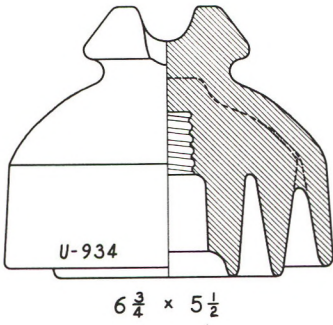
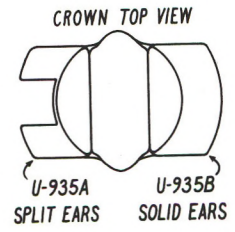
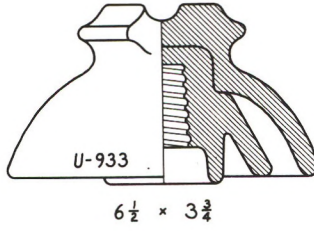
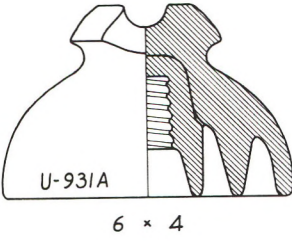
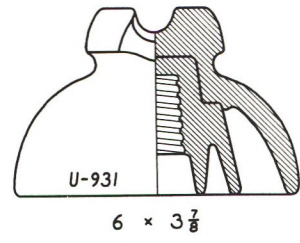
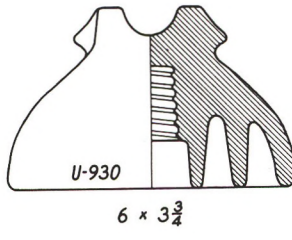
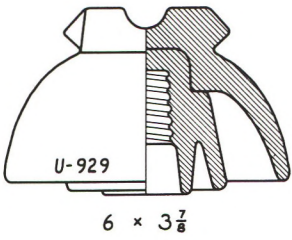
$7\frac{3}{4} - 9\frac{1}{2} - 11\frac{1}{2} \times 9$



U-914

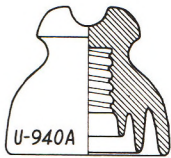
$9 - 12 - 13\frac{1}{2} \times 11\frac{3}{4}$



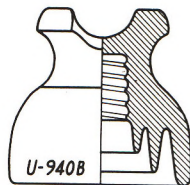




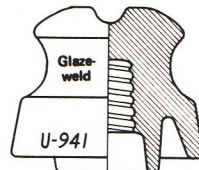
U-940
 $3\frac{3}{8} \times 3$



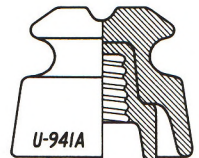
U-940A
 $3\frac{3}{8} \times 3$



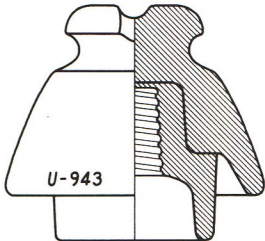
U-940B
 $3\frac{1}{2} \times 3\frac{3}{8}$



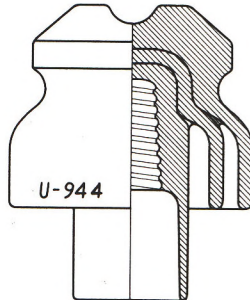
U-941
 $4 \times 3\frac{3}{8}$



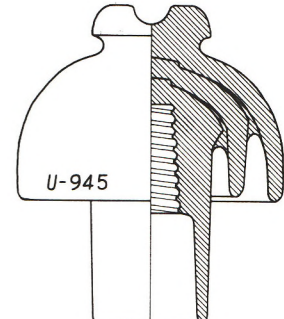
U-941A
 $3\frac{3}{4} \times 3\frac{1}{4}$



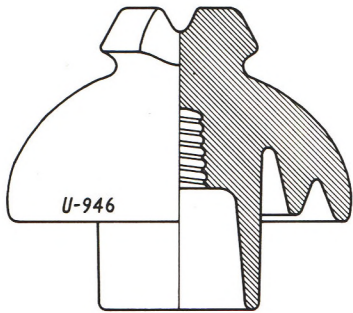
U-943
 $5\frac{3}{8} \times 4\frac{7}{8}$



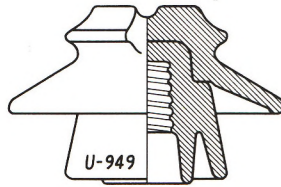
U-944
 5×6



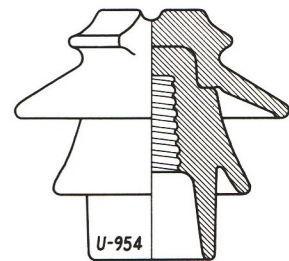
U-945
 $5\frac{1}{2} \times 6\frac{1}{2}$



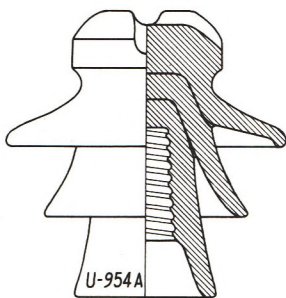
U-946
 $7\frac{3}{8} \times 6\frac{1}{4}$



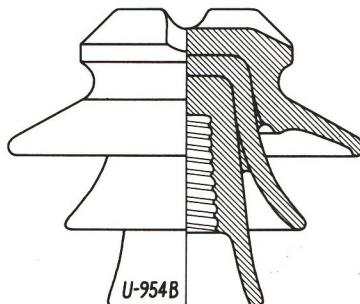
U-949
 $5\frac{3}{4} \times 3\frac{3}{4}$



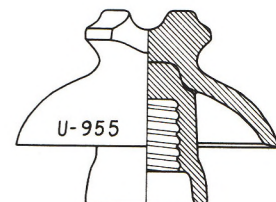
U-954
 $5\frac{3}{4} \times 5\frac{1}{4}$



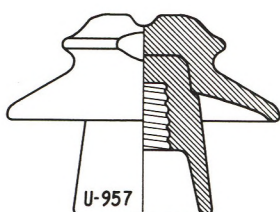
U-954A
 $5\frac{3}{4} \times 5\frac{7}{8}$



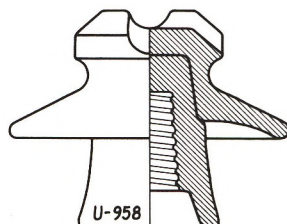
U-954B
 $6\frac{7}{8} \times 5\frac{3}{4}$



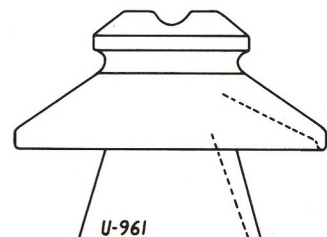
U-955
 $5\frac{1}{2} \times 4$



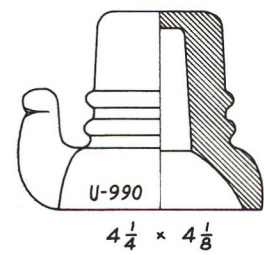
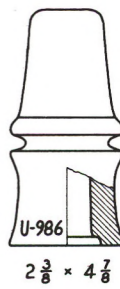
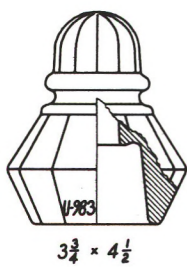
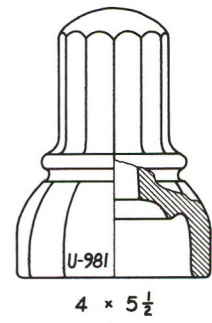
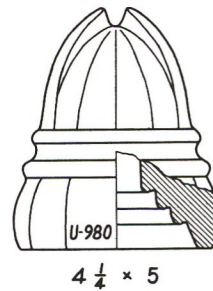
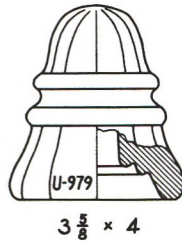
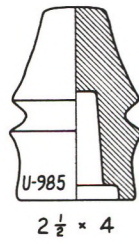
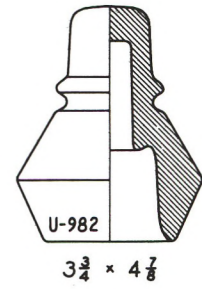
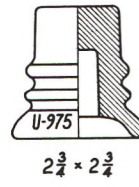
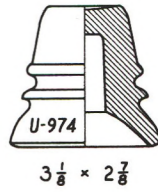
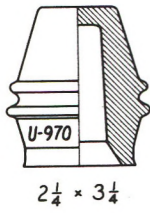
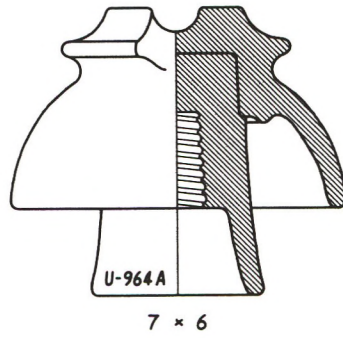
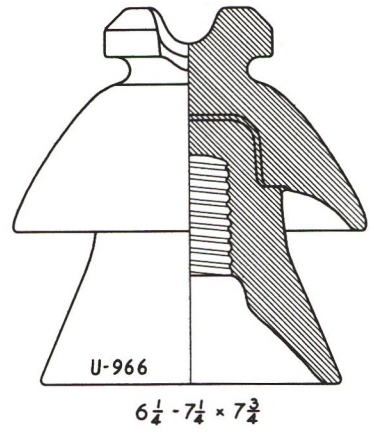
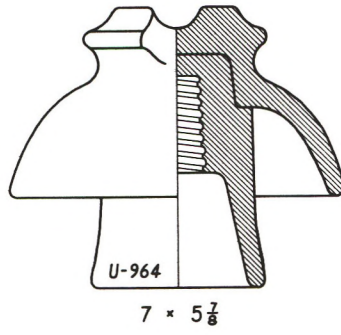
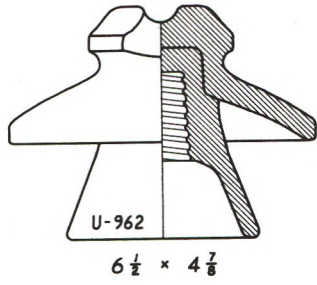
U-957
 $5\frac{5}{8} \times 4\frac{1}{4}$



U-958
 $5\frac{3}{4} \times 4\frac{3}{4}$



U-961
 $3\frac{7}{8} - 6\frac{1}{2} \times 4\frac{7}{8}$



MANUFACTURER'S MARKINGS

Insulator markings are very important to collectors, since they allow specimens to be attributed to given manufacturers, and usually indicate the approximate year when the item was manufactured and placed in service. Specimens with markings are usually deemed more desirable and can command a premium over the unmarked ones if that style comes either marked or unmarked. Some of the classic styles do not come with a marking, but fortunately many of these are unique to a certain manufacturer and period. We usually can fully attribute them by referring to the old catalogs.

Some markings are very indistinct and may go unnoticed unless the specimen is carefully inspected. Markings that are not totally readable even in the very best inside lighting may readily become fully readable if you use a 4-power magnifier with the marking in sunlight. If only a few letters can be discerned, or even a general shape of the marking stamp can be visualized, you can compare this with those shown in this book in an attempt to identify the marking.

Both the under-glaze and incuse types of markings can be overlooked due to their faintness on specimens with a dark brown glaze. Possibly the weakest of these markings is the under-glaze Triangle-M marking on Illinois insulators, mostly on telephone styles and small secondary distribution insulators. The smaller varieties of the Locke insulator-insignia marking stamps are many times very faint, and the word "VICTOR" or "LOCKE" in the marking, which allows the marking to be dated to two periods, is most times unreadable in room lighting. However, I have in all cases been able to determine which word was used by looking at the marking with a magnifier in strong sunlight.

A number of insulators will be found with miscellaneous letter and number markings either by themselves or in addition to the normal trade-name marking. These characters are variously related to manufacturing lot, customer order numbers, operator numbers, inspector stamps, etc. No particular significance should be attached to them.

An exception is that numerals in more modern marking stamps usually indicate the year of manufacture, and some of these stamps also carry a coding to indicate the particular quarter of the year, usually with some arrangement of dots in the marking. In cases where marking stamps have numerals or dot codes to indicate dates, we have noted this in the text accompanying the markings, and we have described the dating codes used when this information was available from the companies.

The term "embossed marking" is habit for glass insulator collectors, since all markings on glass insulators are embossed, but "embossed" is a misnomer for porcelain insulators except for one class of markings. Misunderstandings can result from the indiscriminate use of this term when listing or discussing porcelain insulators. Since there are several different types of markings on porcelains, it is more correct to generically term them as "marked" or "unmarked" or to be explicit in describing the type of marking involved. The different marking methods are described in this chapter, and the particular method used is indicated for each of the markings shown throughout this book.

EMBOSSSED (emb.)

This marking is seen on units made in dry press molds. The marking is punched into the mold itself and results in raised letters on insulators, all markings being identical for any specimens made in a given mold. The marking is not bold at times and may be indistinct with heavy glazes.

The most well-known "embossed" markings on dry press units are FEDCO, "G", MACOMB, P.P. INC., SQUARE-D and THOMAS. Other "embossed" markings which are rare: COOKE WILSON E. S. CO., MACY INSULATOR, O. P. Co., and "BOCH'S INSULATOR PAT. APPL'D. FOR" (see Thomas).

There is one "embossed" marking on wet process pin types. This is the O-B trademark of Ohio Brass Company. From 1907 to about 1940, the O-B monogram was engraved into the plunging mold in some location that would not be later worked in a trimming operation.

RECESSED-EMBOSSSED (r-e)

A psuedo-embossing is obtained on wet process units by designing the marking stamp to have incuse lettering. When the device is struck on the leather-hard insulator after the trimming has been completed, the marking on insulators has raised lettering on a recessed background. Ohio Brass Company used this marking type on pin types after about 1940.

INCUSE (inc.)

"Incuse" markings result from striking the leather-hard clay with a marking stamp which has letters or designs raised in relief. This is by far the most common marking method on the older pin types.

UNDER-GLAZE (u-g)

The "under-glaze" markings mean just that. The dried insulators are marked with ordinary rubber (or plastic) inkpads stamps before glaze dipping. After the insulator is fired, the glaze becomes transparent and the marking shows through very nicely.

A number of companies have used this marking method exclusively for many decades, and other companies used it on certain occasions. Most all companies have favored this marking method in recent years because of its several obvious advantages. The rubber marking stamps can be made cheaply and quickly in any quantity needed, even if of complicated designs, and they are easy to use. Unlike incuse markings, they are always legible and do not mechanically deface the insulator surface.

SAND BLAST (s-b)

These markings are made by holding the finished insulator against the contoured head of a sandblast machine. Because of the general inflexibility and cost of the dies and equipment involved, it has never been a popular method of marking unipart pin types. The only unipart insulators ever marked by sand blast were the Line Material and McGraw-Edison units made in the 1960's and 1970's at the Macomb, Illinois plant, and one used in recent years by Ohio Brass Company on larger insulators.

Chapter 11

PORCELAIN INSULATOR MANUFACTURERS

This chapter contains information on all known U.S. manufacturers of pin type porcelain insulators. The information was compiled from all the sources listed under "Reference Credits" in the Bibliography of this book and by studying the insulators themselves.

Considerable information is on file for most of the companies but, except for previously unpublished information considered of sufficient importance or interest to discuss in detail, the histories are given in relatively brief form. Corporate affairs and dates are included if they help outline the chronology of events in the industry, and since certain of these data will date the insulators and their markings.

All the companies are listed under their operational name. This may differ from the name of the corporate parent company.

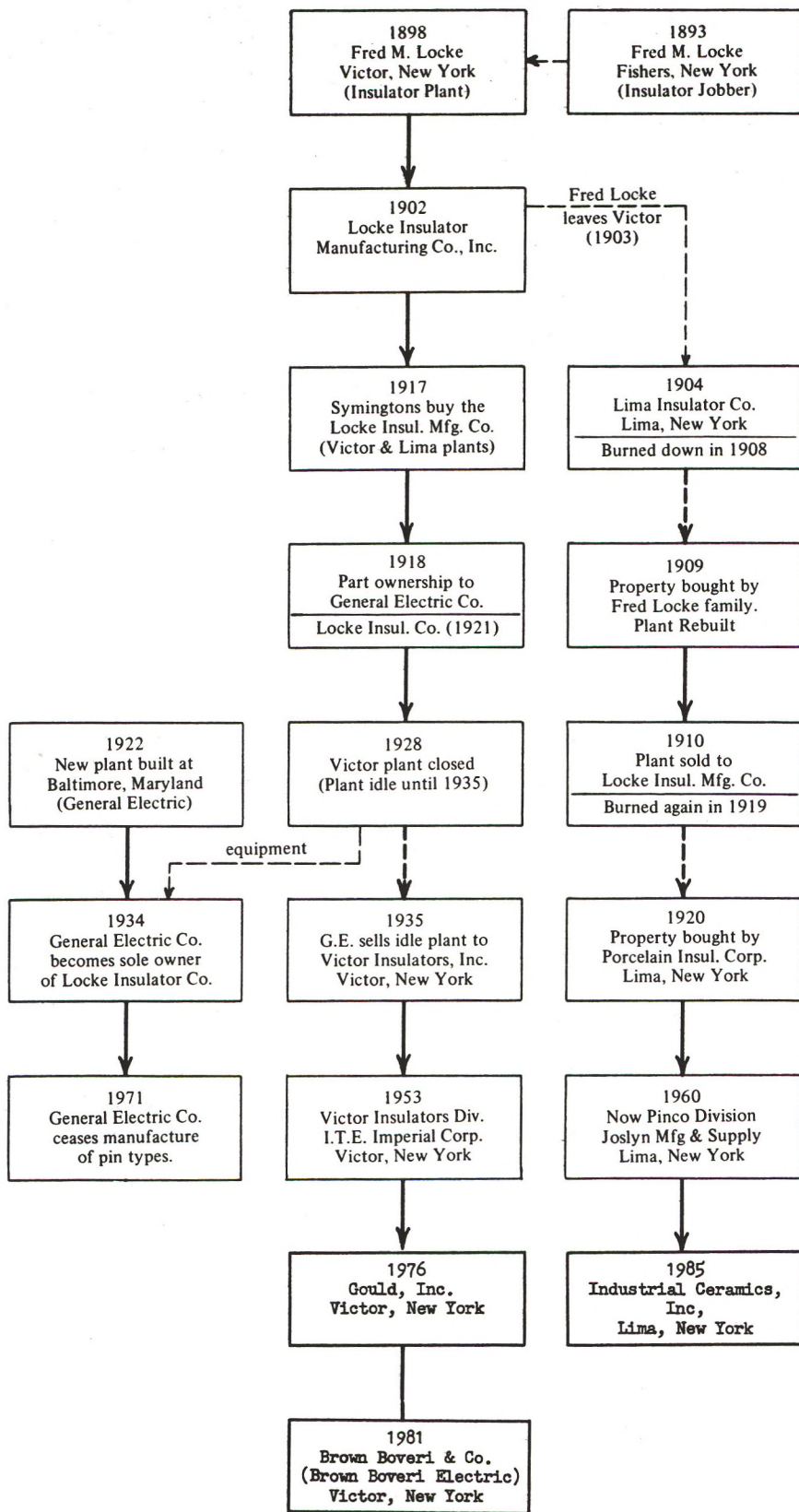
The electrical porcelain industry became very specialized as to the manufacturing processes and products made. Management personnel and the skilled workers tended to move back and forth between all these companies which have so much in common. Manufacturing and selling insulators was a very competitive business, and this resulted in bankruptcies or buyouts of the weaker companies by the stronger ones.

Because of this gigantic corporate chess game of who-owned-what, it would be very confusing to follow the course of the majority of the companies if they were all just listed alphabetically in this chapter. To help the reader understand the historical connections between all the related companies, three "Family Trees" are included, and the histories of those companies follows each Tree in the order of their appearance in the Tree. Those companies not involved in these "Family Trees" are listed in alphabetical order at the end of the list. For quick reference, one can save time by consulting the Table of Contents for page numbers.

All the pin type markings ever used are listed under the particular company that used them. Several markings, mostly "customer" markings, are unattributed to manufacturer or customer, and these are shown at the very end of the chapter.

It should be understood that all of the larger manufacturers made comparable lines of pin types at any point in time. The tendency of any particular company to vary from the norm is described, and unusual styles or glaze colors of companies are noted.

FAMILY TREE No. 1



(Please refer to "Family Tree" No. 1 on page 100.)

The history of Fred Locke and his insulators covers a comparatively brief period of time, but this detailed account is given because it is so important and interesting to historians and collectors. It is made possible by numerous original records extant and by contemporaneous writings of people personally familiar with the operation and people involved.

While Fred M. Locke was working as a telegraph operator, he started a business selling electrical and telegraph supplies of all sorts, and soon his biggest interest was pole line equipment -- crossarms, brackets, pins and insulators. He had most of these items made to his specifications, and contracts were given to the Brookfield Glass Co. of Brooklyn, New York to make large glass insulators to his designs. Most of these glass insulators are embossed "Fred M. Locke, Victor, N.Y.". In 1894, he established a small plant at Fishers, New York, a short distance from Victor. He used this facility to manufacture what items he could, and it also served as headquarters for all his jobbing operations.

By 1895, at least several porcelain companies had commenced making high-voltage porcelain insulators. It is possible, if not probable, that all of these insulators made up to that year were made by dry process. There is evidence that in about 1895 Fred Locke was jobbing insulators made by Electrical Porcelain & Mfg Co., and also an inference that he had that company make some styles to his designs.

By 1897, at least five companies were making high-voltage insulators, and it is known that at least two of these were making these by the wet process -- R. Thomas & Sons, and Imperial Porcelain Works. Fred Locke had Imperial make one or more insulator styles to his specifications, and at least one of these styles exists with a marking of "Manufactured for F. M. Locke, Victor, N.Y. of Imperial Porcelain"

Even at this early date, it appeared that wet process porcelain insulators would be the ones used in the future by the very rapidly expanding electrical energy field. Any aggressive company willing to risk capital to enter the high-voltage insulator business could, if successful, experience explosive growth and profits in future years.

Since Fred Locke already had the combined experience of selling electrical equipment including insulators, plus the manufacturing of some of the items at his small plant at Fishers, N.Y., he decided to enter the insulator manufacturing business himself. In 1898 he leased property in Victor, N.Y. which had previously been occupied by a sawmill and, with the financial help of the local citizenry, Locke was now in the insulator manufacturing business for himself instead of only selling the products of others.

A copy of the original document covering this transaction reads:

"I, Fred M. Locke of Victor, N.Y. hereby acknowledge the receipt from the persons whose names are attached to the annexed subscription list -- the same being hereto attached as a part hereof -- the articles named in the annexed schedule, it also being a part hereof. These articles have been purchased by those parties and turned over to me for my free use in establishing and carrying on my Electrical and Telegraph Supply Manufactory on the land just leased by me for that purpose from Mrs. Rebecca J. Conover, and in consideration of such purchase and transfer I hereby agree with them to enter honestly into the manufacturing of such supplies at that point and to endeavor in all

laudible ways to establish and continue a business which shall be a credit and benefit to the town and and vicinity. I agree to use those articles as not abusing them in said business and when I quit business to return them, natural waste and ware [sic.] being allowed for. Witness my hand and seal this 22nd day of June 1898.

s. Fred M. Locke

Arthur S. Watts states in his history (see Bibliography), "In 1898, Mr. Locke started the manufacture of plastic ...", and also, "The first kiln was ... built in the spring of 1898" The loan document Fred Locke wrote and signed in June 1898 tends to use future tense throughout, but it could have been written after the fact to placate those to whom he was indebted. It has a hollow ring to it in that items were given to him for his free use -- to be returned after being worn out, and if Locke quit the business.

The "annexed schedule" to which Locke referred listed equipment such as engine, planer, boiler, shafting, hangers, pulleys, belting, buzz saws, etc., all of which would be logical for a defunct sawmill. The "annexed subscription list" enumerates 45 citizens who contributed from \$3 to \$100 each, for a total of \$753. Among those names are Theodore Conover for \$5, and also "A Friend" for \$10.

Locke's early porcelain manufacturing operation was a hole-in-the-wall affair at best, but it rather quickly grew to the point where he was supplying a major portion of the high-voltage insulators. The only two real competitors at that time were Thomas and Imperial.

Both Thomas and Fred Locke were making insulators by glaze-welding two or more shells together to achieve larger insulators, and both had letters patents on particular processes for accomplishing this -- Thomas one patent and Locke several patents. Not only was this idea not novel to the ceramics trade, but the several methods described in the various patents were all basically the same and led to the same end result in the finished insulator. The two companies became embroiled in patent court suits over this. (See Appendix C for interesting highlights of that.)

Fred Locke purchased the leased site in Victor in early 1902, and the company was incorporated as the Locke Insulator Manufacturing Company in September 1902. In late 1903, Fred Locke, who was at that time president of the corporation, became disassociated with the company. Reasons for this are unknown, but it has been speculated that the directors were not satisfied with the way Fred Locke was managing the plant or conducting the business affairs.

For a man so important in this budding new industry, Fred Locke was a very interesting individual. He was a rather practical and progressive person, always a hard worker, but all of the following adjectives would seem appropriate at some place in the story: Arrogant, egotistical, domineering, daring, optimistic, and opportunistic. He was a promoter and a good salesman. Like many other men of that period, he showed signs of being ignorant of electrical theory and in many cases used brute force mechanical solutions to electrical problems. In all aspects of the business, he did some outright stupid things at times, yet was brilliant at times. All of these traits can be gleaned from the early writings of people who knew Fred Locke, but also from the catalogs and sales releases written by Locke himself.

The company grew because of, or in spite of, the fact that Locke kept his thumb on all aspects of the operation down to the most trivial things. Aside from directing the actual operations of the plant, he wrote his own

catalogs and sales releases, conducted the business matters and external affairs of the company, and was probably the primary field and sales representative for "Victor" insulators.

The early Locke catalogs read like many mailorder catalogs I have seen. Every sentence was a boast why his products were positively the best in the world and that no others should be considered. A very typical sentence from the 1897 catalog is, "The [this] insulator is made from the same material that I use in all my insulators, the best." A number of pages are devoted to signed testimonials of users and long lists of power lines on which his insulators were in use.

The insulators made for Locke and by Locke in this early period from 1895 to about 1903 are very interesting and are considered by collectors to be among the "classics". Drawings for the Universal Style Chart could not be made initially for some of the styles because the earliest catalogs pictured only artists sketches unsuitable for making accurate line drawings or because some styles were not cataloged and were unknown at that time. Over the years one surprise specimen discovery after another has led to the point where we feel that nearly all the styles made by Fred Locke are now in the Universal Style Chart.

Shortly after Fred Locke started making his own insulators at Victor, he adopted designs which differed from the former ones and from those of other manufacturers in a spectacular way. Whereas the industry norm for high-voltage insulators was for very rounded skirts and deep slots between a number of inner petticoats, these new Locke styles had large, singular, nearly-flat skirts.

His reason for doing this was revealed when he wrote an extensive chronology of his insulator design evolution for the November 1901 issue of a trade magazine, "The Journal of Electricity, Power and Gas". A very condensed account of his reasoning follows, and words in quotations are those of Fred Locke.

He said that, for the "triple petticoats" of the time, the idea was "dominant that the more surface embodied in the petticoats between the pin and line the better the insulators produced. But with the higher potentials, it was found that we were contending against insidious surface leakage, and thus by interposing large surfaces in the shape of petticoats in order to insulate, we presented the greatest detriment to efficient insulation." Locke's "perfect insulator" would then be one with "no surface whatsoever, and just enough distance between wire and pin to prevent arcing" He stated his best designs then were the new "Victor" designs where "the top is extended laterally, or in an umbrella shape," and where "all other surface is cut out."

I wonder if other engineers would agree with me that Locke's theory about this was flawed, and that the resultant designs were really inferior to the conventional design? At least none of the other manufacturers subscribed to Locke's off-base reasoning. Locke was all alone with this concept, and he even carried these ideas over to Lima Insulator Co. after he left Locke Insulator Mfg Co. in Victor.

Locke also had a personal theory that wet weather difficulties could be abated if rainwater didn't drip from the insulator skirt to the cross-arm. He had several styles which included arced eaves on two opposite sides of the skirt and aligned with the wire groove, such that rainwater running out of these eaves would miss the crossarm. A more spectacular design was one with a large, nearly-flat skirt which had a pronounced upward border at the outer edge. This border had spouts axially aligned with the conductor groove to drain the water away from the crossarm. This design was used only on cemented multipart insulators, not on uniparts.

This brainstorm was even worse than his umbrella idea. The whole design was ridiculous. Here was an insulator capable of accumulating dirt and all types of contaminants atop its pan-like skirt, with the underside of the skirt immediately wetted by fog and thoroughly soaked in a driving rain by wind whip plus splatter from the crossarm and lower portions of the insulator. The conventional triple-petticoated insulators had none of these problems.

Most of the insulators made by Fred Locke tend to stand out at a glance even if one ignores distinctive styles, diagnostic glazes and the identifying markings. Other insulator manufacturers were careful to round all edges and corners to reduce breakage and maintain even glazing around those points. At the Victor plant, Locke's manufacturing methods resulted in many designs with skirts terminating in sharp edges, and the conductor and tie-wire grooves are abruptly cut into the insulator surface. Instead of having graceful lines, they look stark and nearly unfinished.

The glazes used on these early Locke insulators are very characteristic. The "brown" glaze is generally somewhat of a tan or yellowish-tan color and is said to have resulted from the use of local clays. His white glaze was generally a muddy, off-white color, not a snowy white as seen on porcelains made by Thomas and Imperial during that period.

It is not a foolproof rule, but it generally can be said that all the Fred Locke insulators which have graceful lines, rounded edges and shiny white glazes were those manufactured for Locke by Imperial. Indeed, a number of these specimens have markings indicating that.

One story often related in early written accounts is that Fred Locke was said to have "fired insulators in his kitchen stove". Knowing the limits of a kitchen stove and the nature of "porcelain", I assumed that this must have referred to making models of some sort, and most certainly before he had an insulator manufacturing plant. Nevertheless, it sounded more like a mere embellishment to the already interesting story on Fred Locke and his entry into the insulator business.

Our research has finally corroborated the story through the above-referenced 1901 trade journal article where Fred Locke himself wrote, "Experiments with the aid of a cook stove were first carried on; finally, with a small kiln, from the use of which I became convinced that a porcelain could be made suited to withstand almost any voltage."

An unbelievable stroke of good luck occurred in 1972. A cleanout of the Victor plant buildings yielded all sorts of very old catalogs, insulators and other related trivia from file cabinets, test labs, attics and every conceivable dusty corner, and I ended up with a super prize. This "insulator" was what has become known to collectors as "the Locke model", and it is now in the hands of collectors. Because of its historical importance to the birth of the porcelain insulator industry in the U.S., it is possibly the most cherished insulator specimen extant.

The specimen is a rather crudely made and fired pottery piece which approximates the U-939A glaze-weld porcelain insulator made for Locke by Imperial. It is likewise two pieces glaze-welded together. A chipped spot on the crown shows that the body material was made of coarse yard clay, pebbles and all included. The glaze is also crude and imperfect.

When found, the skirt bore a rubber stamp marking which was clearly identical to the Fred M. Locke under-glaze markings found on the regular porcelain specimens of that style. It is very unfortunate that the marking was nearly totally expunged by handling before it was realized that the stamping was merely overstruck on the fired piece and not secured by the glaze itself.

Regardless of your appraisal of Fred Locke from my account and that

of others, you have to admit that he was one of the real pioneers in the porcelain insulator industry, and some have even gone so far as to deem him the true father of the industry. When you hold this "Locke model" insulator in your hands, you know that Fred Locke not only also held it in his hands but that he probably also molded it himself and fired it in his cook stove!

There are numerous interesting markings on Fred Locke insulators, so many that a complete tabulation of all the known varieties of handstamps is given in Appendix D. With only one exception, all of the markings are either under-glaze or incuse markings.

The exception is an embossed (raised letters) marking similar to the marking number (1) at the end of this section. This appears in the crown cross-grooves of U-923C, a dry process insulator and undoubtedly one of the insulators made for Fred Locke in the 1895-1896 period by Electrical Porcelain & Mfg Co. See marking #2-1 in Appendix D. Specimens of this insulator are rare.

The varieties of under-glaze markings are few in number, and insulators bearing these markings are very scarce to rare.

With the exception of marking #3-1 in the Appendix, all the myriad of incuse Fred Locke markings are found on insulators made at the Victor plant, and most probably all before 1904. It is unusual to find one of these early insulators without one or more of these handstamp markings.

Fred Locke adopted the tradename "VICTOR" and cataloged insulators under the name "VICTOR Insulators". The incuse VICTOR marking No. 4 was used on at least some insulators starting in late 1900. Since Locke was so carried away with indicating his patents on insulators and the inclusion of prominent notices about patent infringers in his catalogs, I find it incredible that he never bothered to register this "VICTOR" tradename with the U.S. Patent Office.

Even more so than in recent times, the items manufactured in bygone eras were deemed to have a sales advantage if they could be prominently marked as being "patented". Even the notations "patent applied for" or "patent pending" were considered an advertising plus. Fred Locke carried this notion to an extreme with his insulator markings. I had one insulator marked with the VICTOR tradename, a 1901 manufacturing date, and a marking stamp which included 6 patent dates. Before he left the company, his ultimate stamp had 7 patent dates.

(For continuing information on the personal life of Fred Locke after he left Locke Insulator Mfg Co., please see in this chapter the history section on Lima Insulator Company.)

FRED M. LOCKE
Victor, N. Y.
(2) inc.

F. M. LOCKE VICTOR, N. Y.
PAT'D MAY 22 1894
FRED M. LOCKE
(3) inc.

VICTOR
(4) inc.

(1) inc.

PAT. MAY '89 MAY 22, '94

LOCKE AND GENERAL ELECTRIC CO.

(Please refer to "Family Tree" No. 1 on page 100.)

It is not possible to clearly separate these two names, since General Electric only acquired full ownership of the company over a period of years and, at least for some time, operated the company without substantial change. Even after General Electric became sole owner, they continued to use the LOCKE marking and sold under the name "Locke Insulators".

The newly incorporated Locke Insulator Manufacturing Company changed rapidly and markedly after Fred Locke left the company in 1903. John S. Lapp, who had previously worked for Fred Locke, was then hired as general manager, and he was responsible for putting the company on an organized, profitable and progressive basis. He recognized the need to design insulators from a sound engineering standpoint instead of the previous haphazard and empirical methods, and he continually imported whatever scientific talent was required for the job.

So much technical talent came to Victor, learned the insulator game and moved on to other companies during the next few decades that the Locke operation of that era has been referred to as the "Victor school". Some of these people later held key positions in other insulator companies.

Three of these people started new insulator companies, covered elsewhere in this history, and it is convenient to summarize these events at this point. Fred Locke himself left in 1903 and was involved in founding of the Lima Insulator Company in 1904. Walter Goddard left Locke in 1912 and founded the Canadian Porcelain Company. In 1916, John S. Lapp left the company and founded Lapp Insulator Company.

In January 1910, Locke Insulator Mfg Co. bought the Lima Insulator Company plant at Lima, N.Y. This plant had just been rebuilt after being destroyed by a fire in 1908. Both the Victor and Lima plants were thereafter operated as essentially a combined operation. The Lima plant once again burned in January 1919, and the property remained idle until it was sold in 1920.

In 1917 the Locke operation was bought by the Symington family. The relations between Locke and General Electric had always been close, and as a result of some business consideration of unknown character, General Electric became a minority owner of Locke in about 1918. In 1921, the name was changed to The Locke Insulator Corporation.

At about this time, a new plant was started in Baltimore, and production commenced there in 1922. The Victor plant continued in operation until 1928 at which time it was closed. All the salvageable equipment was moved to Baltimore or sold, and the Victor plant remained idle until sold in 1935.

General Electric became sole owner of Locke Insulator Corporation in 1934. The name was changed to Locke, Inc. in 1948. In 1951, the company became a part of the G.E. corporate structure, and the operation became Locke Dept. of General Electric Co., and still later to Insulator Department, and finally to Insulator Products Dept. of General Electric Co. The company discontinued the manufacture of pin type insulators in 1971.

As soon as Fred Locke left Victor in 1903 and new management took over, a number of changes were made in the insulator line, manufacturing methods and other areas.

Insulators were designed on a sounder engineering basis and of more conventional styles. The white glaze formerly used on some Fred Locke styles was abandoned, and new and better glazes were used for a standard

brown glaze. All of the Fred Locke marking devices were retired, and the insulators were thereafter simply marked with singular markings, usually consisting of a form of the company tradename.

At least for a time, the company continued with the use of the VICTOR trademark, but this still wasn't registered until belatedly in 1914. In about 1908, the company commenced use of a marking which consisted of the outline of a transmission insulator in which were included the tradename "VICTOR" and the legend "R=∞" (resistance equals infinity). This marking (No. 5 below) was at first rather large, and a reduced version came into use at some later time (No. 6 below). This trademark was registered in 1920 (stated use since 6-10-08).

Approximately coincident with the start of production in 1922 at the new plant in Baltimore, the insulators were forever after sold as "Locke" insulators, and the insulator-insignia marking was changed to substitute the word LOCKE for VICTOR (marking No. 7 below). This marking was registered in 1923 (stated use since 4-1-22). The logo was carried in Locke literature until 1932, but it was not used on insulators after 1928.

Starting in 1928, at the time all production became carried on at the Baltimore plant, the marking became simply "LOCKE", but sometimes with suffixes for identification purposes. General Electric was able to furnish data on when the character of the marking was changed from time to time, and these data are shown in the following table. This allows most specimens to be dated to a relatively short time span. Insulator catalog number 8881 is used as an illustration in the tabulation.

General Electric started use of the "GE" marking in 1968 and continued its use on pin types until their manufacture was ceased in 1971.

1928 -	1936	LOCKE		
1936 -	Nov 1938	LOCKE/8881		GE
Nov 1938 -	Dec 1939	8881		9995
Dec 1939 -	Sep 1943	LOCKE/8881	GE	NP-69
Sep 1943 -	Aug 1945	LOCKE/8881/USA	9995	USA
Aug 1945 -	Mar 1950	LOCKE/USA	NP-68	
Mar 1950 -	Nov 1962	LOCKE/8881/USA	(1) inc.	(2) inc.
Nov 1962 -	Dec 1968	LOCKE		
May 1963 -	Dec 1968	LOCKE R (radio proof)		
Dec 1968 -	Jan 1969	GE/8881/68 (year)		
Jan 1969 -	1971	GE/8881/69/USA (year)		



(5) inc.



(6) inc.



(7) inc.

LOCKE

(8) u-g

LOCKE

(9) inc.

LOCKE

(10) inc.

LOCKE
44

(11) inc.

LOCKE
44C
USA

(12) inc.

LOCKE
HI TOP
33

(13) inc.

LOCKE
HI-TOP
77V
USA

(14) inc.

LOCKE

(15) u-g

error
handstamps
reported

LOCRE

LOCKE
HI-TOP
77V
ASU

VICTOR INSULATORS, INC.

(Please refer to "Family Tree" No. 1 on page 100.)

General Electric Company stripped and closed the original Locke plant in Victor in 1928, having combined all their porcelain operations in the Baltimore plant. A group of ex-G.E. employees sought to enter the insulator business on their own. They selected Victor, New York as a location, and Victor Insulators was incorporated in April 1935. It was announced in the following month that G.E. had sold the old Locke plant to this group, and this raised some eyebrows. Evidently G.E. must have felt the plant had little salvage value as an insulator plant, and selling an unwanted asset for cash during the lean depression years appeared logical. The selling price was reputedly only \$30,000. This was a small sum compared to what it would have cost to purchase property and construct even moderate size plant buildings. But the cake came with plenty of frosting. The kilns, drying ovens, heavy equipment and considerable tooling were still intact, not to mention the considerable factory space available for immediate use. The facilities were refurbished as rapidly as possible, and Victor Insulators, Inc. issued their first catalog in 1935.

The company was purchased by I-T-E Imperial Corporation in 1953. It was then operated as the Victor Insulators Division of I-T-E.

Throughout its 18 year history, Victor Insulators used only one basic marking on their pin types, their trademark (registered in 1942) of a V inside a rectangle. Both incuse and under-glaze markings were used, and there are several sizes of these marking stamps.



(1) inc.



(2) u-g

I-T-E IMPERIAL CORPORATION

(Please refer to "Family Tree" No. 1 on page 100.)

I-T-E bought out Victor Insulators, Inc. at Victor, N.Y. in 1953 and operated it as the Victor Insulators Division of I-T-E Imperial Corporation. After purchasing the plant, I-T-E made considerable modernization improvements and expanded the plant capabilities. The product line was completely altered, old designs being dropped and more modern designs being added. This plant was then considered to be one of the major producers of pin type insulators.

All I-T-E pin types were marked with an incuse I-T-E trademark and occasionally with other codings below the trademark. For instance, the letter C, F and J on the units indicate the style of pre-formed tie wire for which the insulator neck was designed.



(1) inc.



WL

(2) inc.

GOULD, INC.

(Please refer to Family Tree No. 1 on page 100.)

I-T-E Imperial merged with Gould, Inc. on May 1, 1976, and the name change to Gould, Inc. became official on December 1, 1976. The I-T-E marking formerly used on pin type insulators made at the Victor Insulator plant was phased out in 1977, and the pin types were then marked with an incuse stamp representing the Gould logo.



(1) inc.

BROWN, BOVERI & COMPANY

(Please refer to "Family Tree" No. 1 on page 100.)

In 1980, Gould entered into a joint venture with Brown, Boveri & Co. of Baden, Switzerland, and the Victor, N.Y. insulator plant was operated as Gould-Brown Boveri, with continued use of the Gould logo marking. In late 1981, Gould sold its interest in the joint venture to BBC, and the former I-T-E divisions became Brown Boveri Electric, Inc., a subsidiary of BBC, and the BBC insulator marking commenced at that time.

BBC

(1) inc.

LIMA INSULATOR COMPANY

(Please refer to "Family Tree" No. 1 on page 100.)

This company was incorporated in July 1904, soon after Fred Locke left the Locke Insulator Mfg Co. in Victor, N.Y. The plant was built in Lima, N.Y. Some of the people involved in starting Lima Insulator Co. had previous connections with the Victor operation, including Fred Locke. In September 1908, the Lima plant was almost totally destroyed in a fire. The bankrupt company was purchased for a pittance in April 1909 by the Locke family, and the factory was rebuilt.

In January 1910, the entire Lima operation was sold to the Locke Insulator Mfg Co., and the Victor and Lima plants were thereafter operated essentially as a combined unit. However, the plant once again burned to the ground in January 1919, and the property remained idle until it was sold in 1920 to yet another group of people who established an insulator company there. (See Pinco.)

Insulators made by Lima closely paralleled the styles being made at the Locke plant in Victor. At least some of the insulators were marked with the LIMA, N.Y. marking, but specimens bearing this marking are rare.

In future years Fred Locke continued to be active in the electrical insulator field. He ultimately had a total of 47 letters patents and 3 design patents, all before 1918, except one granted 11-23-26. There was one interesting group of 9 patents in the 1914-1917 period relating to boro-silicate glass and for its use in insulator manufacture. Locke licensed these patents to Corning for the manufacture of their Pyrex glass

insulators, Locke receiving Corning royalties for many years.

LIMA, N.Y. Lima 36

(1) inc.

(2) u-g

THE PORCELAIN INSULATOR CORPORATION (PINCO)

(Please refer to "Family Tree" No. 1 on page 100.)

PINCO was formed in 1920 by William F. Harvey and others, and the plant is located at Lima, New York. The site of the Lima Insulator Co., which had burned in 1919, was purchased from Locke Insulator Mfg Co. and the new factory was completed in less than a year -- the first insulators being made in 1921. The insulators were marked "PINCO" for Porcelain Insulator Co., and "PINCO" was registered as a trademark in 1922 (stated use since 6-21-21).

From the outset, one of the major stockholders in PINCO was M. L. Joslyn, the founder of Joslyn Manufacturing & Supply Co. which had always been a leading supplier of pole line equipment. PINCO insulators were sold through Joslyn. The PINCO catalog No. 1 was printed under the name of Porcelain Insulator Corporation, but subsequent editions also carried the Joslyn name, indicated as "Exclusive Distributors in the U.S." Joslyn eventually acquired the outstanding PINCO stock, and from 1960 onwards the company was the Pinco Division of Joslyn Mfg & Supply Co.

There was also a longtime arrangement between Joslyn and Illinois Electric Porcelain, but I am not familiar with the details. The Joslyn general catalogs listed their porcelain factories as PINCO at Lima and Illinois Electric Porcelain at Macomb. The catalogs listed the PINCO power pin types along with the Illinois lines of "standard porcelain" items and all the Illinois telephone styles of pin types. These latter items were therefore not made by PINCO at the Lima plant. The 1934 Joslyn catalog also lists the entire line of Illinois wet process power insulators.

PINCO first made the large unipart insulators in 1927. They claimed to have "advanced the state of the art" with these new uniparts of large size, made by their patented "Harvey Process", although Jeffery-Dewitt was making similar units by the casting process as early as 1922.

Most early PINCO units have a light reddish-mahogany glaze with some approaching the orange range. Later units tend to have a darker mahogany glaze. Commencing in the 1960's, "sky" glaze became the standard color. Special glazes used on Pinco units on special order include white, cobalt blue and a dark drab green.

The insulators were initially marked with the incuse PINCO, usually on the crown but occasionally on the skirt. The coded markings such as PINCO-V indicate the particular trimmer operator, and these were used up to about 1929 or 1930. The smaller incuse marking came next and had a brief life. The incuse patent marking No. 10 was used in the 1920's on the U-173 dry-spot insulator.

PINCO under-glaze markings started in the 1930's, and the unboxed "PINCO" was used through 1945. The dot above the letters and then below the letters, left to right, indicated the year of manufacture, probably from 1936 through 1945.

The boxed markings No. 5 through No. 8 came next. The manufacturing date was indicated by a dot, an underscored letter or a suffix number, and the tabulation of the year codes is given after the marking illustrations.

The actual date of manufacture was included in the marking from 1967 on, as shown in marking No. 9.

The prominent numbers in the markings are catalog numbers. Suffix "-R" indicates "Radio Free". Underscored catalog numbers indicate styles with crowns specially designed to accomodate preformed tie wires.

PINCO Date Coding

PINCO	1946	PINCO	1956		
PINCO	1947	PINCO	1957	PINCO	PINCO-U
PINCO	1948	PINCO-1	1958	(1) inc.	(2) inc.
PINCO	1949	PINCO-2	1959		
PINCO	1950	PINCO-3	1960		
PINCO	1951	PINCO-4	1961		
PINCO	1952	PINCO-5	1962		PINCO
PINCO	1953	PINCO-6	1963	PINCO	63
PINCO	1954	PINCO-7	1964	(3) inc.	(4) u-g
PINCO	1955	PINCO-8	1965		
		PINCO-9	1966		



(5) u-g



(6) u-g



(7) u-g



(8) u-g

PINCO
223-R
071768

(9) u-g



(10) inc.

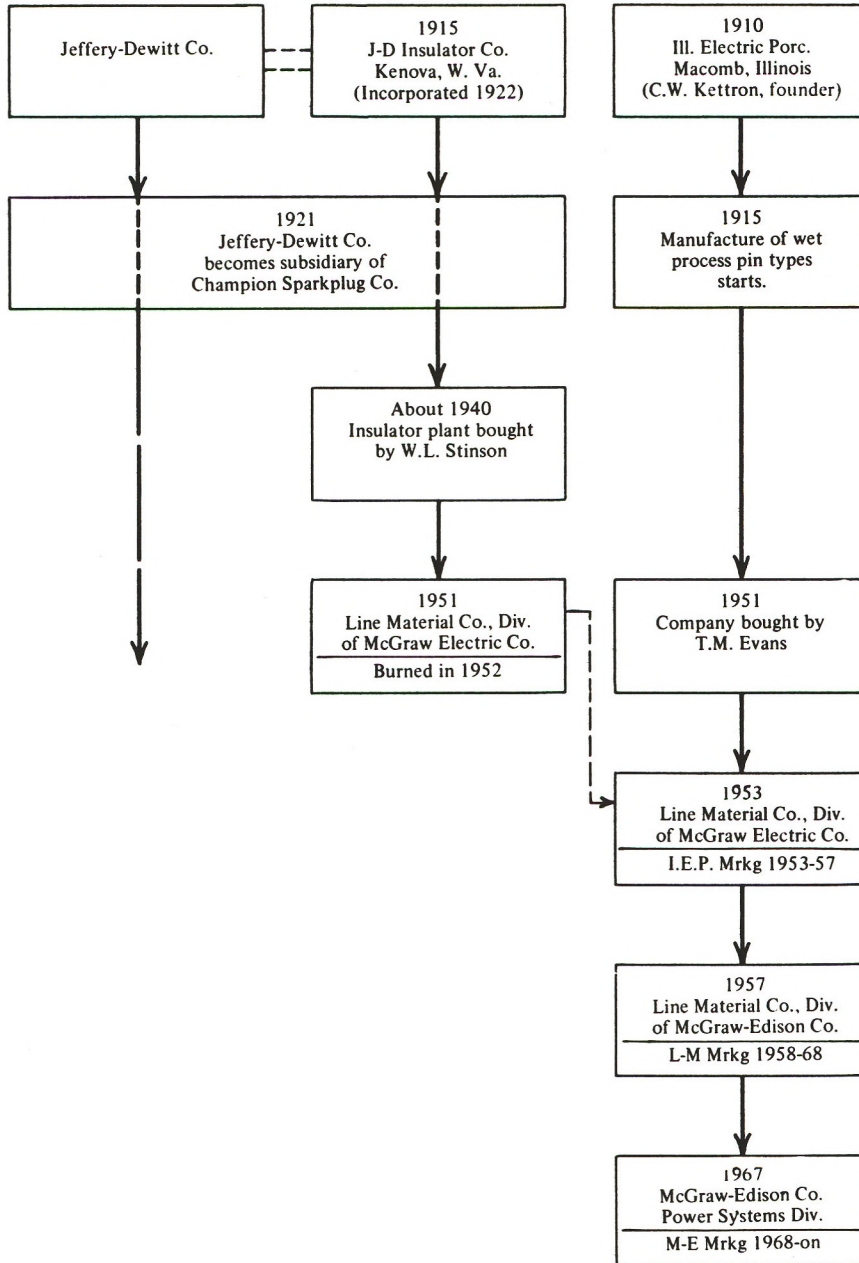
INDUSTRIAL CERAMICS, INC.

(Please refer to "Family Tree" No. 1 on page 100.)

This company was formed in Dec 1985 for the manufacture of insulators and other ceramic electrical products. They bought the Pinco plant in Lima, N.Y. They continue to use the PINCO marking on certain insulators, but they ceased manufacture of pin type insulators in 1987.

They also bought the Westinghouse plant in Derry, PA, but this does not involve pin type insulators.

FAMILY TREE No. 3



ANDERSON PORCELAIN COMPANY

(Please refer to "Family Tree" No. 2 on page ¹²⁰~~112~~.)

This factory was built in 1899 at East Liverpool, Ohio, and the manufacture of small electrical porcelain insulators commenced in 1900. One reference states that in 1905 a line of pin type and strain insulators was added. Specimens of other insulator types have been found with markings of this company, but no pin types have been found which are attributed to Anderson.

The company was merged into General Porcelain Co. in 1911, but when General Porcelain built its large new plant in Parkersburg, WV in 1913, the Anderson property fell into disuse and was sold in 1916.

OHIO PORCELAIN COMPANY

(Please refer to "Family Tree" No. 2 on page ¹²⁰~~112~~.)

This company was formed in 1897, and the small plant in East Liverpool, Ohio manufactured small electrical porcelain insulators. It was one of a number of small companies involved in the 1911-1913 General Porcelain Company mergers and was closed shortly thereafter. The company used an "O. P. CO." marking on their dry press insulators.

A U-27 $\frac{1}{4}$ pin type specimen was found at a landfill site in East Liverpool, and it had an embossed "O. P. CO." marking on top of the wire groove brow. We attribute this insulator to Ohio Porcelain. Subsequently other specimens, both white glaze and brown glaze, have been located, and these are still very rare.

O . P . Co.

(1) emb.

THE NEW LEXINGTON HIGH VOLTAGE PORCELAIN COMPANY

(Please refer to "Family Tree" No. 2 on page ¹²⁰~~112~~.)

This company was incorporated in March 1903 and was located in New Lexington, Ohio. Some of the New Lexington insulator styles at the outset were basically copies of contemporary Locke and Thomas designs, but New Lexington cataloged a number of unipart cable types unique to their manufacture. They also made numerous styles of large multipart pin types which are quite distinctive because of a pronounced "lilly shell" shape of the skirts.

It is evidenced by catalogings that a number of other companies sold the New Lexington insulators as jobbers -- most notably Ohio Brass Co., J. H. Parker & Sons and Johns-Manville. Even though New Lexington's own catalogs for the years 1908 and 1909 are known, jobbers continued to sell the New Lexington line after that.

The company rarely marked their insulators, and their marking was simply "NEW LEXINGTON, O." as shown below. Any New Lexington specimens

with the marking are rare. Because their ordinary unipart styles are so similar to styles of other companies, the unmarked specimens are difficult to attribute to New Lexington with certainty. An exception are the several unique styles cataloged only by New Lexington. The company cataloged several very distinctive styles for which specimens have not been located to date.

The actual operational life span of the company was only about ten years, and during most of that time they had only two competitors. The company's fortunes possibly started to change when two other large manufacturers commenced operations --Pittsburg High Voltage in 1908, and Ohio Brass Company in 1910. In any event, New Lexington rather abruptly fell by the wayside soon thereafter. The story of its demise and its influence on subsequent companies is so interesting and important that it is given here in some detail.

By 1912, the company came into serious financial difficulties. The Perry County Bank had a mortgage on the plant and sued to recover the \$4,392.67 due it. The company also was behind in payments for a second mortgage with one of the trustees and owed him \$23,171.05 plus \$619.31 in taxes he paid to protect his interests. (The trustee never collected a cent from the subsequent sale of the property.)

On October 5, 1912, G. S. Courtright, another trustee of the corporation, bought the property from the company through a sheriff's sale. He paid \$4334 for the property. In subsequent financial shuffling, the property was sold for \$1 to Consumers Insulator Co. on Nov 15, 1914, then for \$1 to Virginian Potteries (Charleston, WV) on Dec 8, 1916 (adjudged bankrupt Mar 23, 1918).

On June 19, 1918 the property was purchased by General Porcelain Co. for \$7750. The personal property included in the sale price included "One lot of moulds; one stock of electric insulators, approximately 50,000; one lot of soup bowls, approximately 5,000 finished and 3,500 partly finished; one lot of raw material, including 190 tons of various kinds of clay; 167 bushels of plaster of paris; 3,000 pounds of outside oxide magnesia; six bushels of whiting; and 125 gallons of oil."

General Porcelain immediately stripped the plant and sold the idle property on July 25, 1918 -- and under the condition that the property would not be used to manufacture electrical porcelain or door knobs for five years.

An inventory breakdown from the earlier sheriff's sale in 1912 is of interest as to the types of insulators made. The factory contents were: "2000 50Kv insulators; 700 27Kv insulators; 600 30Kv insulators; 2450 33Kv insulators; 1450 40Kv insulators; 1200 16Kv insulators; 12000 4Kv to 10Kv insulators; 600 13Kv insulators; 25 Tons of Tennessee Ball Clay No. 3; 15 Tons of Tennessee Ball Clay No. 7; 40 Tons of Georgia China Clay; 15 Tons of Feldspar Clay; 5 Tons of Fluid Clay; 57 Barrels of King's Potter Plaster." (Note the totals for number of insulators and tons of clay are only about half that listed in the 1918 sale to G. P. Co.)

(I am indebted to Mr. Rick Soller of Oshkosh, Wisconsin for his extensive research of the New Lexington High Voltage history through all the court records and other sources. All the above facts of what happened to this company after it was first founded are solely the result of Mr. Soller's research.)

All this might furnish some clues as to why New Lexington got into financial problems. The large insulator inventory indicates they might have been good at making them but were pretty poor at selling them. Then there are all those "soup bowls", when several dozen other companies in

Trenton and along the Ohio River were already going broke making those.

It would be interesting to know what that stock of finished insulators would have been worth in 1918 dollars. Even if General Porcelain Co. gave the stripped plant away free and considered all the tooling useless, they should have felt like bandits with all those insulators for \$7750!

NEW LEXINGTON, O.

(1) inc.

GENERAL PORCELAIN COMPANY

(Please refer to "Family Tree" No. 2 on page 112.)

In 1913, General Porcelain Company was formed by the combination of a number of small electrical porcelain companies, most of whom had properties in East Liverpool, Ohio. The company constructed a relatively large insulator plant at Parkersburg, WV and was headquartered there. All the other plants were dismantled and the equipment sent to Parkersburg, the various properties being sold off within a short while after they were abandoned. The one exception was the G. F. Brunt plant which was still used by General Porcelain until the early 1920's before being abandoned.

When the company bought the defunct and idle plant of New Lexington High Voltage Porcelain Co. (Ohio) in 1918, this was probably the most important factor leading to G. P. Co. entering the high-voltage insulator business. They not only got all of the tooling and raw materials for making wet process pin type insulators, but also a very large stock of unsold New Lexington high-voltage insulators. They did sell these insulators on their own account, and even when G. P. Co. issued their first catalog of pin type insulators in 1923, they listed the New Lexington styles also, retaining the original New Lexington catalog numbers for those items.

It is unknown exactly when G. P. Co. started making wet process pin types on their own at Parkersburg, but a number of their own specific styles were shown in the 1923 catalog.

The company used the G.P.Co. markings shown below. The marking with the initials inside an oval is an approximation of their trademark (unregistered), and this is a rare marking. Since the company was not one of the larger companies during its life span, and since it marked only part of the production output, even the other two markings are not common.

It is generally possible for knowledgeable collectors to attribute even the unmarked specimens made by the company. Many of their insulators with brown glaze have a diagnostic "peppery speckling" appearance. Also, the exact shape of most styles are unique to the company, and the unmarked specimens can be matched with the same ones which do bear markings.

The operation of this company under the name of General Porcelain Company was terminated in 1927 when the company was merged with others to form Porcelain Products, Inc.

G.P.Co.

(1) inc.

GPCO

(2) inc.



(3) inc.

FINDLAY ELECTRICAL PORCELAIN COMPANY

(Please refer to "Family Tree" No. 2 on page 112.)

This company, located in Findlay, Ohio, was founded in 1911 as the successor company of another electrical porcelain company who owned and operated this plant site for the prior 6 years. "Findlay" soon became one of the largest manufacturers of all types of standard porcelain items and specialty electrical porcelains. This company was one of those merging to form General Porcelain Company in 1927.

At some point in time, the company commenced the manufacture of wet process pin type insulators, all of which were telephone and low-voltage power distribution styles.

The standard Findlay glaze on pin types was a muddy chocolate brown, but they made many insulators with other glazes -- white, blue, yellow, butterscotch, etc. The markings used on their pin types consisted of the FINDLAY trademark (unregistered) in various forms and a Diamond-F, both with or without the insulator catalog numbers. Compared with insulators made by the larger manufacturers, specimens with any of the Findlay markings are relatively scarce.

FINDLAY 182 FINDLAY

(1) inc.

(2) inc.



(3) inc.



(4) inc.



(5) inc.



(6) inc.

FINDLAY-1 94

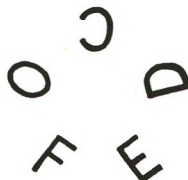
(7) inc. "error" marking

FEDERAL PORCELAIN COMPANY

(Please refer to "Family Tree" No. 2 on page 112.)

This company, located in Carey, Ohio, was founded in 1917 and was one of the companies which merged with others to form Porcelain Products Co. in 1927.

They made a general line of dry press electrical porcelain insulators but also at least one style of small dry press pin type. The marking shown below is known on specimens of the U-47 telephone style with white or brown glaze and is attributable to this company.



(1) emb.

PORCELAIN PRODUCTS, INCORPORATED

(Please refer to "Family Tree" No. 2 on page 112.)

This company was formed in 1927 by the merger of a number of electrical porcelain manufacturers (see "Tree"). All of these companies were engaged in manufacture of dry press insulators. Only Findlay and General Porcelain Company had also been making wet process insulators, including lines of pin type insulators.

Findlay was chosen as the headquarters location, although the plant at Findlay was ultimately closed as a manufactory. Within several years after the merger, four of the plants had been closed and the equipment moved to the two surviving plants. Wet process manufacture was generally confined to the Parkersburg plant, and dry process manufacture was done in the original Federal Porcelain plant at Carey, Ohio.

The company's general offices were moved to Parkersburg in 1955. The offices for the Carey dry process plant remained at Findlay but were moved to the Carey property in 1957, approximately one year after Porcelain Products, Inc. became a wholly-owned subsidiary of A. B. Chance Co.

The first markings used on wet process pin types were variations of incuse logotype stamps with a Rectangle-PP (a registered trademark 1928.) Later markings, all under-glaze types, were variations of the P.P., Inc. trademark. Dated markings start in the 1950's and go through 1958, when the subsidiary became an operating division of A. B. Chance Co.

Small telephone styles were made by dry process at the Carey plant, most probably with the old press dies formerly used by Federal Porcelain at that plant. These had embossed markings as shown below. These markings are usually indistinct and are sometimes completely illegible with a heavy glaze thickness.



(1) inc.



1958

(3) u-g



(5) emb.



(2) u-g

P. P. INC.

(4) emb.

PORCELAIN PRODUCTS COMPANY

(Please refer to "Family Tree" No. 2 on page 112.)

As noted in other sections, A. B. Chance Co. had acquired all of the Porcelain Products, Inc. operations in 1956 as a wholly-owned subsidiary and continued the use of the P.P., Inc. marking at that time.

On January 1, 1959 A. B. Chance reorganized its porcelain operation. The Parkersburg plant making wet process insulators became an operating division of A. B. Chance and thereafter used a "CHANCE" marking. The dry

process plant at Carey remained as a wholly-owned subsidiary of Chance and was renamed "Porcelain Products Company". A new "P. P. CO." marking was created for this manufacture.

In 1963 A. B. Chance sold Porcelain Products Company (the Carey, OH plant) to Clarcken Company of St. Louis, MO. Although the company is still operated under the name "Porcelain Products Company", Clarcken Co. uses a trademark of only "PP" as shown below.

In September 1975 Porcelain Products Co. bought Knox Porcelain Corp. (Knoxville) and incorporated the Knox items into the products sold by PP representatives. They started marking these products with both the KNOX and PP logos (under-glaze stamps), reportedly by using a single integral handstamp marking device.



(1) u-g



(2) u-g

KNOX PORCELAIN CORPORATION

(Please refer to "Family Tree" No. 2 on page 112.)

This company is located in Knoxville, Tennessee and was founded in 1923 as a manufacturer of dry press electrical porcelain. In 1927 it was purchased by a group of Knoxville businessmen, O. A. Dorsett becoming the president and general manager.

Although the exact circumstances are not known, Mr. Kettron, president of Illinois Electric Porcelain Co., helped Mr. Dorsett get started with wet process porcelain manufacture. (Mr. Kettron and Mr. Dorsett were close friends.)

For a number of years, the entire Knox line exactly duplicated the Illinois insulators, and Knox used the same Illinois catalog numbers. The Knox styles have some slight characteristic finishing differences that set them apart to knowledgeable collectors, and most of the insulators of both companies were marked. As time passed, Knox also created a number of styles of their own design.

In September 1975 Knox Porcelain Corp. was bought by Porcelain Products Company (Ohio), and the insulators were then marked with a compound marking of both companies (see section above).



(1) inc.



(2) r-e



(3) u-g

A. B. CHANCE COMPANY

(Please refer to "Family Tree" No. 2 on page 112.)

The A. B. Chance Co. acquired Porcelain Products, Inc. in May 1956. This included the wet process porcelain plant in Parkersburg, WV and the dry process plant in Carey, OH. Porcelain Products, Inc. was operated as a wholly-owned subsidiary of A.B. Chance Co., and the "P.P. Inc." marking was continued on pin type insulators through 1958.

On January 1, 1959 there was a corporate change in the company, the Parkersburg operation becoming the Insulator Division of A. B. Chance Co., and the marking on insulators was changed to the "CHANCE" trademark. (See also "Porcelain Products Company" in this chapter.)

Starting in 1967, letter codes have been used on stamps for insulators designed to accommodate preformed tie wires. Starting also in 1967, the new trademark "C" marking has been used, and the number inside this marking is the year of manufacture.



(1) u-g

(1967)



(2) u-g

(1963)



(3) u-g

CHANCE

(4) u-g

(1958)

**CHANCE
1959**

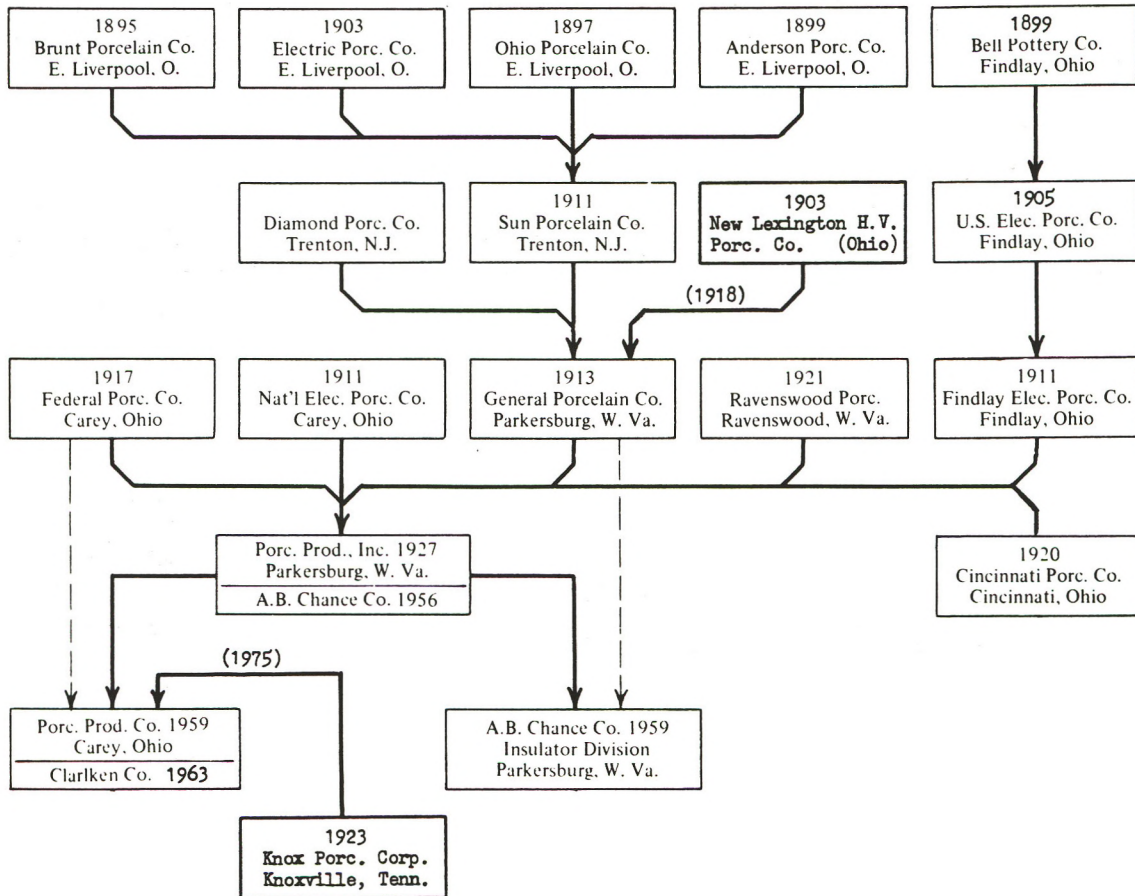
(5) u-g

**55-6
C
80**

(6) u-g

(1967 & later)

FAMILY TREE No. 2



JEFFERY-DEWITT INSULATOR COMPANY

(Please refer to "Family Tree" No. 3 on page ¹¹²~~120~~.)

This old-line company became interested in porcelain insulators for the power industry soon after suspension insulators came into general use. In 1915 they built a special plant at Kenova, WV for the manufacture of these insulators. This wholly-owned subsidiary was called the Jeffery-Dewitt Insulator Company.

The Jeffery-Dewitt Company became a subsidiary of the Champion Spark-plug Company in 1921, and this included the J-D insulator plant at Kenova. In about 1940 the plant was sold to W. L. Stinson. It was purchased in 1951 by Line Material Company, a division of the McGraw Electric Company, and it continued operation under the direction of Mr. Stinson.

The history of this plant came to an end in 1952. On October 29, a fire completely destroyed the porcelain products plant, along with all the new equipment so recently installed by Line Material Co. (See "Line Material Company" for continuation of this lineage.)

The J-D manufacture of suspension insulators, not a topic of this book, must be mentioned, since it had an important bearing on the future course of the company. These insulators were of a radically new design with the cap and pin attached to the shell with eight-pointed "spiders", the prongs of which were secured in the porcelain holes by a lead alloy. This novel scheme looked like it would cure "cement growth" failures then occurring with other designs. Later, when these J-D units started to have alarmingly high failure rates, customers rapidly returned to the use of conventional designs and to the most reliable suspension insulator of the period, the "Hewlett" disk-type suspension insulator.

Just as with large unipart pin types made later by J-D, the porcelain parts of their suspension insulators were made by the casting process, which in itself was not a factor in the unreliability of the insulator. The failures were due to the mechanical factors of the porcelain body and the lead alloy embedding the spider prongs both being operated in tension.

By the time J-D's suspension insulator business fell apart, they had also developed very large unipart pin types made by the casting process, and such units were first installed on lines up to 66Kv in 1922. These types of insulators probably saved J-D financially, and they did not have competition in these until 1927 when Pinco started making large uniparts by normal plastic process. Other manufacturers added similar lines in the 1930's. Although other companies made styles up to 10 $\frac{1}{2}$ " size, J-D made these up to 13 $\frac{1}{2}$ " size (see U-914 style). For one year J-D cataloged even bigger styles, but it is unknown whether any of those were made.

The J-D cast two-skirters were probably not competitive with similar styles made by plastic process by other companies, and this undoubtedly made the company look for alternate products. They cataloged their first small plastic process pin types in 1929 and increasingly relied on the sale of these smaller insulators as time went on.

The loss of sales in the then-competitive market for large uniparts was possibly a factor in J-D's subsequent development work on the Spiral and Helical insulators (U-820 and U-819 respectively) in the late 1920's. These styles were of such an irregular shape that they had to be made by casting, and if they could have been successfully introduced, J-D would have once again had a cast design all to themselves. The venture ended up being a financial negative when all the development costs resulted in only small production runs to make units for field tests in 1929 and 1930. (See the section on "Spiral and Helical Insulators" in Chapter 5.)

By 1940 the Lapp fog types and the Locke Hi-Tops essentially captured

the market for "contamination" pin type insulators, and it dealt a severe blow to the J-D prosperity, all development work on the Spirals and Helicals going for naught. After the cast suspensions and the large uniparts, the cast Spirals eventually turned out to be strike three. After 25 years of fairly constant activity, the J-D casting room was fresh out of ideas. When Bill Stinson bought the company in 1940 it was essentially bankrupt. He managed to operate it profitably with more conventional lines of insulators, and the good market for insulators immediately after World War II resulted in a fair comeback for J-D by the time it was purchased by the McGraw Electric Company in 1951.

Another hallmark of J-D was their customary light blue glaze which was so distinctive that it came to be known as simply the "J-D Blue". It was their standard glaze on suspensions and on pin types above 23Kv size. Brown was their standard glaze on pin types 23Kv and lower.



(1) u-g

ILLINOIS ELECTRIC PORCELAIN COMPANY

(Please refer to "Family Tree" No. 3 on page 120.)

This company, located in Macomb, Illinois, was founded in 1910 by C. W. Kettron as a dry press manufacturer of knobs and tubes.

Major plant additions were made in 1913, 1920 and 1948. Illinois installed a large tunnel kiln in 1925, one of the first to be used in the industry, and in the 1948 building program a smaller kiln was added. Both these kilns were later replaced by two fully automated, more modern ones, and business volume dictated whether one or both kilns were in use.

In 1951 the company was sold by the Kettron family to T. M. Evans. He was elected president of the corporation and served until May 1953, at which time the McGraw Electric Company purchased controlling interest. (See "Line Material Co." for a continuation of this lineage.)

The initial production was small standard porcelain items, but the company commenced the manufacture of dry press pin types shortly thereafter. Even though manufacture of wet process pin types started in 1915, the company continued to sell the dry press styles for some time.

All this early production, both standard porcelain and pin types, was embossed with the company's trademark "MACOMB" (unregistered).

The first MACOMB transposition insulator (U-197) is very unusual in that threads were made in both parts, and there was no means for axially aligning the two holes and no effort made to align the thread pitch in the two parts. Either of these two faults makes it difficult or impossible to screw the insulator down onto the peg. The second design (U-197A) had the threads formed entirely in the bottom part of the glaze-weld.

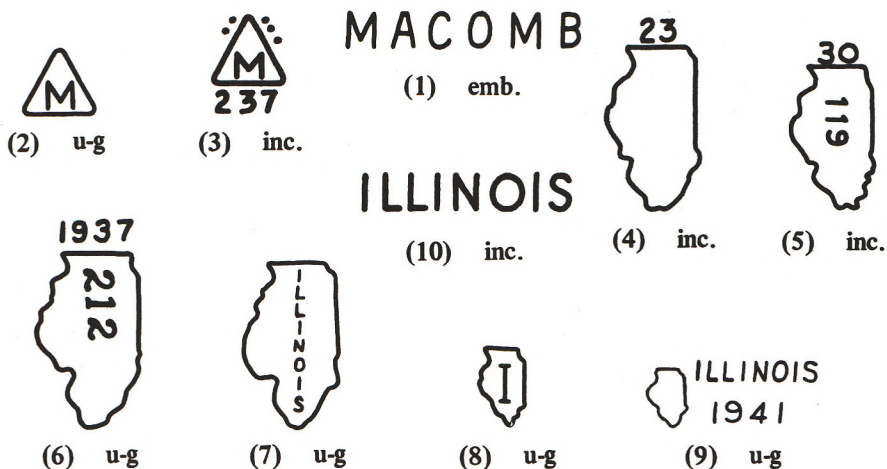
The manufacture of wet process pin types commenced in 1915, and the company ultimately became one of the major manufacturers of high-voltage insulators. The dry press insulators were phased out in the 1920's, some of the styles being replaced with similar styles made by wet process.

In 1915 when a convenient handstamp marking was needed for the wet process pin types, Illinois adopted a new Triangle-M trademark (registered Dec 14, 1915). The earliest (estimated 1915-1920) Triangle-M marking

on pin types was of the under-glaze type, usually with blue ink. Later Triangle-M markings were of the incuse type. These include the insulator catalog number immediately below the triangle and also a manufacturing date code in the form of dots around the apex of the triangle.

The change from the Triangle-M marking to the Illinois "map" marking (registered 5-3-49, used since 1926) came about in the 1927 catalog, but specimens exist that are dated as early as 1923. The two-digit number at the top of the map is the year of manufacture, and the number within the map is the insulator catalog number. This was an incuse marking until about 1930 and an under-glaze marking (black ink) in later years. There was an overlap of these two methods all through the 1930's.

The "ILLINOIS" marking No. 10 below can be dated from its registration 9-14-48 where it specifies "used since Dec 1935". There were a number of other marking stamps used by Illinois, but no records have been located which date their use.



LINE MATERIAL COMPANY

(Please refer to "Family Tree" No. 3 on page 120.)

In 1951 the McGraw Electric Company bought the Jeffery-Dewitt porcelain insulator plant in Kenova, WV, and they turned over the management of this company to their subsidiary, Line Material Company. This plant burned down in October 1952.

Although L-M inferred that they would soon rebuild the Kenova plant, they did not. Instead, on May 28, 1953 the McGraw company bought the Illinois Electric Porcelain plant at Macomb, Illinois from Tom Evans.

Records show that the corporate name of this subsidiary was changed to Illinois McGraw Electric Company on June 1, 1954. The marking used on insulators was changed to "I.E.P./date" in 1954, which stood for Illinois Electric Porcelain.

In 1957 the parent company McGraw Electric Company merged with Thomas A. Edison Industries to form the McGraw-Edison Company, and the "I.E.P." marking then stood for Illinois Edison Porcelain, a Division of McGraw-Edison Co.

This "I.E.P." marking was used only until early 1958 when the marking was changed to incorporate the L-M trademark and year of manufacture. The L-M marking continued until 1967 when the new M-E marking came into

use. (See the following "McGraw-Edison" section.)

IEP
1956
(1) inc.

19  59
(2) inc.


1959
(3) u-g

1965

(4) s-b

McGRAW-EDISON COMPANY

(Please refer to "Family Tree" No. 3 on page 120.)

This is just a continuation of the Line Material Company story. In May 1967 two divisions of McGraw-Edison Company (Line Material Industries and Pennsylvania Transformer) merged to form the McGraw-Edison Power Systems Division. Since that time, all products by these joint divisions have been referred to as "McGraw-Edison", and the "M E" marking on insulators commenced at that time.

The first "M E" marking type was made by sandblast, a continuation of the method most recently used for the L-M marking at Macomb. The year of manufacture is included, together with a code for the month, variously one, two or three dots at different corners of the rectangle.

In 1974 the company commenced use of under-glaze markings, marking No. 2 below. A new form of under-glaze marking, No. 3 below, came into use a few years later, the two-digit number being the year of manufacture and the dots indicating the year quarter -- successively 3 dots, 2 dots, 1 dot, and no dot.

1969

(1) s-b

1974
M
E
(2) u-g

ME
•8•0
(3) u-g

OTHER COMPANIES (in alphabetical order)

THE AKRON HIGH POTENTIAL PORCELAIN COMPANY

A company (name unknown) was formed about 1900 for the manufacture of general ceramic products. The plant was located in Barberton, Ohio, which is now a suburb of Akron. Several years later, this company was

reorganized by another group as the Akron High-Potential Porcelain Company, and they soon became involved in the manufacture of wet process pin type insulators -- most probably between 1903 and 1905.

Either coincident with or very shortly after the company's entry into this business, Ohio Brass Company formed a business relationship with Akron H-P and by 1907 was the exclusive customer for Akron H-P insulators. When Akron H-P had financial difficulties resulting in its being thrown into receivership in 1910, Ohio Brass Co. bought the company. Presumably production of insulators for O-B just continued without interruption or change. (See the section on "Ohio Brass Co." for more details.)

There are no known pin type insulators with Akron H-P markings which would allow them to be attributed to the company before Ohio Brass gained control of the company or became the outright owner.

AMERICAN ELECTRIC CO., INC.

American Electric Co., founded in 1893, was headquartered in Chicago and manufactured telephone apparatus and accessories. In the 1920's they developed the U-188 "dry-spot" insulator, terming it the "Amerelec Dry-Spot Insulator", and these were manufactured for them in the 1925-1929 period by Square-D Company, Peru, Indiana.

The original dry press mold set had the marking "AMERICAN ELEC. CO. INC." marking shown below, and only one specimen is known with this marking. It has a white glaze.

A later mold set is slightly different in shape, having a skirt which is slightly longer and less flared, and the marking on it is "A.E. Co. INC. / CHICAGO ILL.". Insulators made from this mold set exist with either a white (scarce) glaze or a brown glaze.

Both mold sets indicate that a patent was pending, but I am convinced that no patent was ever granted for this design. (Please see Appendix H for details.)

For other information on the U-188 insulators, please see the history on "Automatic Electric Company".

Front side

AMERICAN ELEC. CO. INC.

(1) r-e

Back side

PATENT PENDING.

(1) r-e

AMERICAN PORCELAIN COMPANY

This company was established in 1914 in East Liverpool, Ohio. The original plant was built in 1845 and had been occupied by three former pottery companies between 1845 and 1914. American changed the product to electrical porcelain and made all forms of dry press insulators until its operations were suspended in 1932.

A 1921 electrical industry directory listed American Porcelain Co. among companies manufacturing pin type insulators. Although it is not conclusive proof of manufacture by this company, a dry press U-98 pin type insulator was found in this plant's dumpage. The specimen carried a customer marking of "COOKE WILSON E. S. CO." (see "Miscellaneous Markings").

AUTOMATIC ELECTRIC COMPANY

This company, later a part of General Telephone & Electronics Corp. and with a name change to GTE Automatic Electric, Inc., manufactured and sold telephones, switching systems and related products to the independent telephone industry. The original company was founded in 1891, and the name became Automatic Electric Company in 1926. It was headquartered in Northlake, Illinois (Chicago). In 1929 two or more companies were involved in some form of corporate merger, including American Electric and Automatic Electric. (See Appendix H for details.)

Automatic Electric Co. sold the U-188 dry-spot insulators from 1929 to about 1951, at least originally under the name "Amerclec Dry-Spot Insulators". The insulators were made by Square-D Co., Peru, Indiana in both white and brown glaze.

These insulators were from the second U-188 mold set with the marking of "A.E. Co. INC." It is just coincidental that the initials in the marking are the same for both companies involved in the sale of the U-188 insulators. However, the unique specimen from the first mold set in comparison with the relative abundance of these from the second mold set is a strong suggestion that the first mold set had a very brief life, and the other insulators with the A.E. marking were sold by American Electric up until 1929 and by Automatic Electric thereafter.

Because of the long 22-year time span over which the U-188 was sold by Automatic Electric Co., those with the later A.E. marking are usually attributed to this company as a matter of convenient listing.

A.E. Co. I N C.

C H I C A G O I L L

Front side (emb.)

PAT. PEND'G.

Back side (r-e)

BENNINGTON POTTERIES

Some historical accounts refer to the use of flint or porcelain insulators as early as the 1850's on telegraph lines. We have sufficient evidence to attribute five of the known threadless styles to Bennington Potteries, Bennington, Vermont.

The U-979, U-980 and U-981 (known as the Elliott designs) are similar as to the flint-type "stoneware" material from which they are made and their interior and exterior construction. The twelve-fluted exteriors are distinctively alike. In "Gleason's Pictorial" of October 22, 1853, there is a woodcut illustration of the Bennington display at the Crystal Palace Exhibit, and all three of these insulator styles are clearly shown among the other Bennington ware.

The U-982 and U-983 are also attributed to Bennington. Both have a distinctive mottled-brown glaze like the diagnostic glaze used by Bennington in the 19th century. The U-982 was discovered first, and the specimen was accompanied by a document linking the insulator to an old museum and mentioning Bennington. The subsequent discovery of U-983 specimens was a more solid connection, since it had the Bennington-type glaze and also the twelve-fluted sides already attributed to Bennington.

THE COOK PORCELAIN INSULATOR CORPORATION

Cook Porcelain was headquartered in Cambridge, Ohio, and the factory was listed as in Byesville, Ohio. It is estimated that their manufacture of wet process pin type insulators commenced in the early 1920's and ceased in the early 1930's. A rather complete line of pin types is shown in the Cook catalogs of the 1926 to 1930 period.

COOK

(1) inc.

DELTA-STAR (H. K. Porter Co.)

In May 1957 the Thomas plant at Lisbon, Ohio was acquired by Porter and absorbed into its Delta-Star Electric Division (formerly Delta-Star Electric Company). Insulators were sold under the Delta-Star trade name. Porter closed the plant in 1963.

Catalogs indicate that Delta-Star production emphasis was on the ten standard N.E.M.A. pin types, but the most recent plant dumpage at the Lisbon plant consisted of suspension insulators, from which the sandblast Delta-Star marking below was taken. There are no known specimens of pin types with a Delta-Star marking. If they continued the manufacture of pin types in the 1957-1963 period, they were probably marked with the former THOMAS marking devices.



(1) s-b

ELECTRICAL PORCELAIN & MANUFACTURING COMPANY

This company, located in Trenton, NJ, was incorporated in April 1895. They manufactured dry process insulators and are credited with the first single-fired electrical porcelain items. Prior to that time, units were first fired unglazed, and then refired with glaze at a lower temperature.

In 1895 Fred Locke contracted this company to manufacture insulators to his design. Specimens of insulator style U-923C are dry process insulators with an embossed Fred Locke marking, and it is believed these were made by Electrical Porcelain & Manufacturing Company. Other than these particular insulators, no others are known which can be attributed to this manufacturer with any degree of certainty.

FRANKLIN PORCELAIN COMPANY

This company, located in Norristown, PA, was organized in the early 1920's, and it is estimated that their manufacture ceased in 1928 or 1929. Franklin Porcelain insulators were cataloged and sold by Electric Service

Supplies Company, a large distributor of railway, power and industrial equipment, and this company acquired controlling or total interest in the Franklin Porcelain Company at some time after its formation.

The cataloged line of pin types covered all power styles from small distribution sizes up to larger designs. The three markings shown below are attributed to this company. The Circle-delta marking is found on wet process guy strains similar to the FP pin types in glaze color and quality of manufacture and is believed to be a Franklin marking. It is unknown on pin type insulators.



(1) inc.



(2) inc.

FP

(3) inc.



(4) inc.

GENERAL ELECTRIC COMPANY

General Electric Company's connection with manufacture of electrical porcelain dates from 1887. The Bergman Electric Co. of New York interested a local potter by the name of John J. Krauss in this manufacture, and they began experimenting with dry process insulator items in 1887 and went into production in 1888, Bergman taking the total output. Bergman Electric was absorbed by the Edison Machine Company which later became General Electric Company.

An article in the May 1, 1895 issue of "The Electrical Engineer" gives important information on the early operations of General Electric and on their manufacture of dry press pin types as follows.

The company moved its original porcelain operation from New York to Schenectady, NY in 1892, and this was all dry process manufacture until 1902. The 1895 article describes the manufacture by G. E. Co. of "large double-petticoat insulators for the important power transmission plant at Folsom-Sacramento (Cal)."

Somewhat later, an article Sep 26, 1896 in "The Electrical Engineer" described in detail a contract G.E. had with the Pioneer Electric Power Company of Ogden, Utah for the construction of "the most notable power-transmission plant yet attempted, both from the point of view of amount of power and the distance of transmission." Power transmission was with 15,000 volts on two 3-phase lines 36 miles long from Ogden to Salt Lake City -- terminal distribution voltage of 2300 volts. Completion of this entire project was scheduled for November 1896.

The article stated that the six wires would be "strung on insulators of a special porcelain developed by the General Electric Company to withstand high potentials"

No documentation has been located which would attribute any specific pin type styles to G. E. Co. from this period, but it is suspected that either or both of the U-701 and U-744 styles were G. E. products of that era, most probably for the Folsom or Ogden transmission lines.

(For information about General Electric participation in the insulator industry in more modern times, please see in this chapter the section on "Locke and General Electric Co.")

GLADDING CERAMIC INSULATOR COMPANY, INC.

The company's origin stems from Gladding, McBean Co. (Lincoln, Cal.) which was founded in 1875. The Gladding family split off from that company in 1924 and founded the Gladding Company in San Jose for the manufacture of tile products. Their new company for the manufacture of insulators, Gladding Ceramic Insulator Co., was incorporated in Feb 1963, and the plant construction commenced in July 1963.

The first shipment of porcelain insulators was made in Sept 1964. Sales are mostly to Pacific Gas & Electric Co., and products include pin types U-735A and Sim U-762, plus standard sizes of guy strains and secondary rack spools. Except for a small initial shipment of pin types with an incuse marking, all insulators have been marked with the under-glaze marking shown below.



(1) u-g

HARTFORD FAIENCE COMPANY

This company, located in Hartford, CT, dates back to the 1860's as the Atwood Company, then Atwood Faience Company, and finally to Hartford Faience Company. The manufacture of dry press electrical porcelain items began in 1905, but no dry press pin types are known which can be attributed to this company.

Manufacture of wet process pin types was started some years later, and these were first shown in Catalog No. 1 dated 1925. Graybar Electric Co. was a Hartford distributor starting in 1927. It is unknown when the last Hartford pin types were manufactured, but direct sales to utilities ceased in 1947. Subsequently this plant made specialty porcelain items sold directly to other manufacturers.

Hartford's marking on pin types is shown below. The number in the marking was the catalog number.

H
A106

(1) inc.

THE IMPERIAL PORCELAIN WORKS

This plant was located on the northwest corner of Mulberry St. and Klagg Ave. in Trenton, NJ. The large masonry building and one associated wooden structure remained on the property in the 1970's.

The company was founded in July 1891 by Frederick A. Duggan. He had formerly been with Trenton China Co. which had become bankrupt and gone into receivership in June 1891. Benjamin B. Dinsmore, also formerly with Trenton China Co., went with Mr. Duggan in 1891 and later acquired a part interest in Imperial. Duggan had purchased the plant of Dowd Stilt Works and converted it to the manufacture of electrical Porcelain.

The Imperial plant was totally destroyed by fire Feb 3, 1907 with a

loss of \$70,000, but it was ultimately rebuilt. The company continued to make standard porcelain dry press porcelain at least into the 1920's, but it went defunct in the 1930's, like so many other electrical porcelain companies, because of the depression and electrical house wiring codes.

At some point in the mid-1890's Imperial gained a capability for the manufacture of wet process porcelain. In early 1896 Imperial asked Locke for permission to quote on his requirements for high-voltage transmission insulators. Locke sent an order, along with a sample of the insulator he was having made elsewhere. This was a dry process insulator of rather poor quality and could have well been one made for Locke by the Electrical Porcelain & Mfg Co., also of Trenton, NJ. Imperial produced the order with wet process insulators, and these were highly satisfactory when tested at Cornell University. Fred Locke therefore commenced procuring his porcelain insulators from Imperial.

Possibly the earliest of those made for Locke by Imperial was the oval-shaped U-937 which was used on the Niagara-Buffalo line completed by Nov. 15, 1896. This unusual design also had eaves on the skirt and was Locke's patent 590,806 (filed 12-16-96, granted 9-28-97). The electrical trade journal articles of 1896 pictured and described these insulators as "made by Fred M. Locke", and Locke listed the U-937 style in his catalog of 1897. The known specimens of this insulator are all from the Niagara line and bear only an Imperial marking #1 below (some are unmarked). One other insulator, the U-923, could have initially been made by Imperial for Locke during this same period.

Subsequently the insulators made for Locke have both Fred Locke and Imperial markings on the same insulator. For a brief period thereafter, Imperial used a 4-line marking stamp stating "Manufactured for F. M. LOCKE Victor, N.Y. of Imperial Porcelain"

It is unknown exactly when Imperial started making and selling insulators for their own account, aside from the contracts with Locke. However, Imperial announced in an advertisement that they would mark all their high-voltage insulators with the "crown" trademark (mark #3 below) starting July 15, 1897. Evidently this was also coincident with the time when they marked all insulators with the manufacturing date. Specimens all bearing the crown trademark are usually dated, the earliest one known being 7-1-97.

Considering that Imperial was one of the first U.S. manufacturers to make wet process high-voltage insulators, the quality of their product was exceptionally good from the outset. (As of this writing in 1988, some Imperial insulators are still in service in California, 90 years later!)

The commencement of dating by Imperial in 1897 makes it possible to track the chronology of events through extant specimens. For instance, we know that as early as 1897 Imperial was making designs not associated with any Fred Locke catalogings. Also, it shows that all Imperial units were white glaze until this gave way to a brown glaze in the 1900's.

Imperial ceased the manufacture of pin types at some time shortly after 1900, and the latest dating known on an Imperial specimen is 9-2-04. It is not known exactly when this occurred, or why it occurred, but there are a number of facts which can be pieced together to create a logical scenario.

Even though Imperial had the best insulators on the market early in the game, they did not "think big" in their sales promotion of pin types. Their small plant at 457 Mulberry Street was already crowded with their primary business of making dry process standard porcelain insulators.

The competition was also becoming fierce. By 1903 Locke had reorganized for rapid expansion. In 1904 Thomas expanded production of, and heavily promoted, their new line of "Glaze-Filled" insulators. In 1903

New Lexington started in the insulator business, and by about 1905 Akron High-Potential started making high-voltage insulators.

By the early 1900's both Fred Locke and Thomas had patents covering certain aspects of manufacturing the larger insulators by glaze-welding. Imperial had previously been making its larger insulators as glaze-welds, and Imperial could have been enjoined from this manufacturing method unless they secured a license under the patents. In the 1902 C. S. Knowles catalog all of the smaller one-piece Imperial styles of current manufacture were shown, but the larger styles formerly made by glaze-welding were conspicuous by their absence.

When the Imperial plant was totally destroyed by fire 2-3-07, this probably ended what life there may have been left in Imperial pin types at that time. The plant was rebuilt for Imperial's participation in the then-booming "nail knob" business, and they let all the other much larger wet process manufacturers fight between themselves over the pin types.

MANUFACTURED BY
IMPERIAL PORCELAIN WORKS
TRENTON, N. J.

(1) inc.

MANUFACTURED BY
Imperial Porcelain Works,
TRENTON, N. J.

(2) inc. (note error)



(3) inc.

Other Known errors:

TRENTON, N.I.	on (2)
PORCELIAN	on (3)
PORCELIINN	on (3)
PORCELANN	on (3)

LAPP INSULATOR COMPANY, INC.

This company, located in LeRoy, NY, was founded in late 1916 by John S. Lapp, the general manager until 1916 of Locke Insulator Mfg Co. The company was incorporated in Dec 1916, and in less than a year the factory had been built to the point where the first shipments of insulators were made.

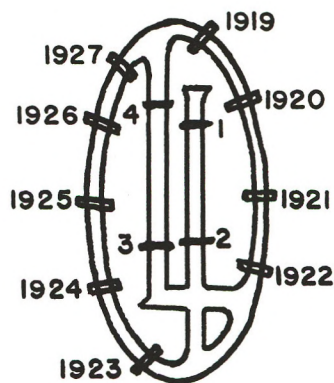
Lapp manufactured a complete line of unipart and multipart pin type insulators from the start. In 1957 they ceased manufacture of uniparts, and a few years later also abandoned multipart pin types. The company had become heavily involved with "post" insulators which they themselves had pioneered, and also in the late 1960's had built another facility in Georgia for automated production of suspension insulators.

The Fog-type insulators (U-818 through U-844) were another pioneering development of Lapp starting in the 1920's, and these were the basis for many future types of insulators of all kinds with petticoats oriented on the side of the insulator.

As different from the ordinary "brown" glaze of other manufacturers, many of the Lapp insulators had a distinctive orangy glaze somewhat like a light-colored pumpkin pie. Some later units were made with a chocolate-brown glaze. White and blue glazes were used on some of the distribution styles, especially in the 1930's.

A Monogram-LI inside an oval was the Lapp Insulator trademark (registered 3-15-21, first use 5-1-19), and this trademark appears in all the various marking stamps used.

During the first 10 years manufacture, an incuse marking of the trademark was used. Commencing in 1919, the marking devices were notched in two places to provide a factory code for the manufacturing date. This code is shown in the diagram at the right. The position of the notch in the oval indicates the year. The position of the notch in the LI monogram indicates the year quarter, as numbered in the illustration.



As a specific illustration of such a coded marking, the actual-size example at the right would be for an insulator made in the 4th quarter of 1922.



In 1927 Lapp started using under-glaze markings. These markings may also include the manufacturing date, insulator catalog number, or both. Markings No. 2 through No. 8 below are typical examples of these. All of the larger insulators were marked, but at times only about every fifth pin type was marked as a manufacturing and usage identifier. Unmarked specimens on any given pole line would be in the majority.

- | | | |
|--------------|-------------|-------------|
|
(1) inc. |
(2) u-g |
(3) u-g |
|
(4) u-g | |
(5) u-g |
|
(6) u-g |
(7) u-g |
(8) u-g |

THE OHIO BRASS COMPANY (O-B)

The Ohio Brass Company, located in Mansfield, Ohio, was founded in 1888, and the name stems from their early manufacture of what the company fondly refers to as "mule jewelry". In the 1890's the company underwent a rapid expansion and became heavily involved in the manufacture and sale of equipment for street railways, mining operations and other fields. In order to catalog and sell all items associated with these systems, O-B sought to either get into the porcelain insulator business or to become an agent for an existing company which made suitable insulators.

Research has established the fact that O-B was a selling agent for Locke's "Victor" insulators sometime during the 1903-1907 period, and an O-B general catalog of about 1905 vintage lists the Locke line of "Victor" Porcelain Insulators.

A study of early catalogs and other data indicates that during this same period, O-B was also involved with the Akron High-Potential Insulator Company. A catalog No. 6 issued by O-B June 1, 1903 shows insulators that are identical with the cuts in an early Akron H-P catalog, down to the last little dot in the drawings. These Akron H-P drawings are, in turn, direct copies of the illustrations in the Locke Catalog No. 6 of about 1902 vintage.

There are several accounts of Ohio Brass giving technical and financial assistance to Akron H-P during this period. It would appear that O-B maintained their selling agreement with Locke to have a reliable source for insulators, but at the same time was attempting to help Akron H-P produce a similar line that would eventually eliminate the need for Locke insulators. Evidently Locke learned that O-B had started selling Akron H-P insulators which were exact copies of the Locke designs, and the selling agreement was promptly cancelled. As a stopgap measure, O-B jobbed the insulators of New Lexington High Voltage Porcelain Co. in early 1907 until they could quickly get Akron H-P production to the required level.

In July 1907 O-B announced, "We recently made an agreement with a thoroughly modern and up-to-date High Tension Insulating plant, whereby we have obtained exclusive control of their entire output. This places us in a position" Of course, this was the Akron H-P plant at Barberton, Ohio. It was also stated that all this manufacture was marked with the O-B name. The first O-B insulator catalog followed quickly in October 1907.

Akron H-P subsequently kept losing money and was finally thrown into receivership. Since O-B already had quite a bit at stake in the way of advanced funds, they purchased the plant in August 1910 (in a receiver's sale, it is thought). O-B was now in the insulator business.

It should be briefly mentioned that in 1922 Ohio Brass incorporated the Dominion Insulator & Mfg Co., Ltd. in Niagara Falls, Ontario, Canada. In 1928 this name was changed to Canadian Ohio Brass Company, and it is one of the major divisions of Ohio Brass -- manufacturing a complete line of insulators paralleling those made by O-B in this country.

Ohio Brass has always made all styles of pin types from telephone styles to large multiparts. Except for a few classic O-B styles of early vintage, the line has always consisted of very conventional styles. The O-B designs and production methods serve as a good record for tracing the state of the art and for dating evolutionary changes of all manufacturers, since the O-B line represents the technology of one single manufacturer from 1907 to date, unbroken by company sales, mergers or idle periods.

Ohio Brass was an early participant in the development of fog types in suspension insulators, but they cataloged no fog designs in pin type

insulators. O-B was probably the originator of "fog bowl" designs, and they are credited with developing modern manufacturing techniques for fog bowls and promoting their use and general acceptance.

For a number of years (date span undetermined), O-B used a particular clay in the glaze formula which resulted in glaze colors that are unique to this period of O-B manufacture. Their insulators with this glaze have a beautiful, mottled combination of light tan-browns, grays and black. Depending on the exact firing conditions, some are almost completely an iridescent tan-brown. Others range all the way to a steel-black color.

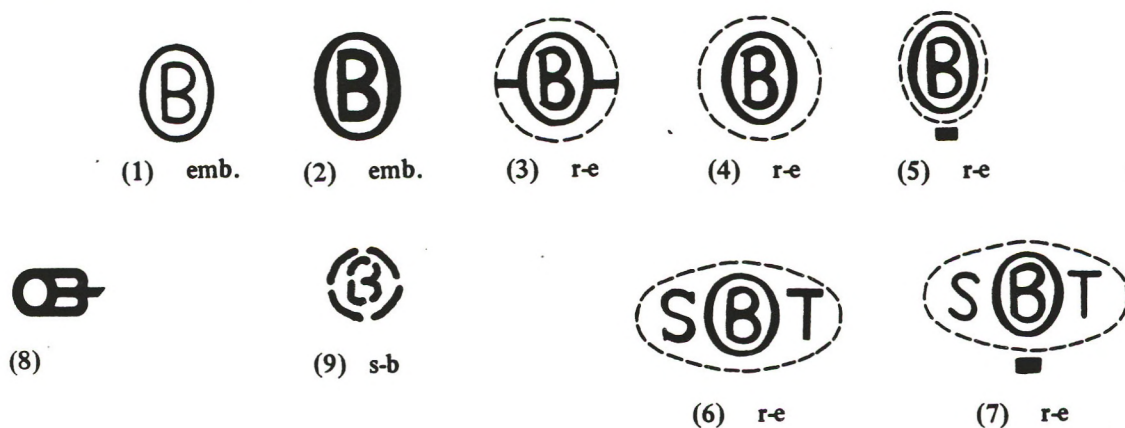
O-B is also the only U.S. manufacturer of a pin type insulator with a true red glaze (fire-engine red). An order for no more than 300 to 400 units was made for a municipal fire alarm system in a southern state. The Barberton plant had no end of difficulties making these, and their glaze engineer said they would horsewhip any O-B salesman who ever accepted an order for more red insulators. Any red glaze formula tried fired black at the 2200° temperature. They finally resorted to firing all the insulators bisque, then glazing them and refiring them a few at a time at lower temperature in the small laboratory kiln.

The Ohio Brass trademark (registered 3-10-08) was a Monogram-OB, and O-B always used this as a marking. From 1907 to about 1940 this marking was a true embossing. The marking was engraved on the crown area of the plunging mold in an area not subject to later trimming.

The trademark is recess-embossed after 1940 and nearly always in the flattest area of the skirt. The "S- -T" variation indicated insulators of the "Silent Type", their trade name for radio-free insulators. The small indenture under either marking after the mid-1960's signifies the insulator neck is compatible with preformed tie wires.

Starting in the 1970's a manufacturing date (month-year) was added to the marking. Recently O-B also started using sandblast markings on the larger unipart and multipart pin types.

In the 1970's O-B adopted a new trademark (No. 8 below), and it was stated that this marking would be phased in on new designs and tooling. Although this new trademark has long been seen on metal parts associated with insulators, even very recent markings on the porcelains continue to be forms of the old Monogram-OB marking.



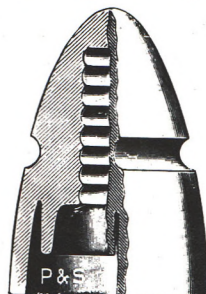
PASS & SEYMOUR, INC.

This history has to be of the greatest importance to porcelain students, since Pass & Seymour was the first U.S. company to manufacture pin type insulators by the wet process. The company was formed in 1890 as a partnership and was located in Syracuse, NY. Mr. Pass was associated with

the Onondaga Pottery Co. of Syracuse, and Mr. Seymour was with Thompson-Houston Co. as superintendent of the Syracuse lighting plant.

History records that Mr. Seymour was genuinely interested in solving the problem of providing better insulators, and he sought out Mr. Pass to provide the porcelain know-how. The company was allegedly formed for the express purpose of making high-tension, wet process insulators. Initially they rented an idle horseshoe plant along the Erie Canal in Syracuse, and for many years people referred to this plant as the "Insulator Works". The company moved to its present location in 1900, the year in which it was incorporated.

CHINA DOUBLE PETTICOAT LINE INSULATORS.



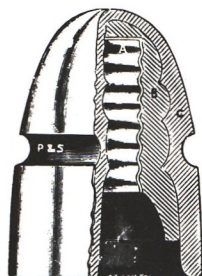
TESTS OF OUR China Double Petticoat Line Insulators have been made by experts, and show very high insulation resistance. In an atmosphere of 92 per cent. humidity, the insulation resistance was too high to be measured by the instrument, the capacity of which was over 150,000 megohms. Glass under the same conditions showed 30,000 megohms.

After being smoked until they were well covered and submitted to a moist atmosphere of 92 per cent. humidity, they showed an average insulation resistance of 57,216 megohms. Under same conditions glass showed an average of only about 4,000 megohms.

These insulators are especially adapted for high pressure mains of alternating circuits. The saving of coal will soon pay for increased cost over glass insulators.

Trade Number 15 Deep Groove, Double Petticoat..... Price 13 cents each.
 " " 16 Telegraph Pattern, Double Petticoat..... " 13 "
 In lots of 500, 10 per cent. discount.

PATENT PARAFFINE LINE INSULATOR.



WE OFFER this new Line Insulator to those who desire high insulation Tests made by experts show an insulation resistance of 113,000 megohms in an atmosphere of 82 per cent. humidity. Glass under same conditions showing an average of 21,000 megohms. The outer shell C is "Syracuse China." The threaded metal bushing A is held firmly by the porous cement B. The cement is thoroughly filled with paraffine wax, which melts at a low temperature, thus renewing the surface.

Patented June 14, 1892.
 Trade Number P. & S., No. 17..... Price 18 cents each.
 In lots of 500, 10 per cent. discount.

Page from early Pass & Seymour catalog, circa 1892. The No. 16 shape may be U-144. (Courtesy of Pass & Seymour, Inc.)

The activities of this early manufacturer can be partially pieced together by several clues -- a statement made by Mr. Pass, the insulators shown in P & S catalogs, and existing specimens which appear to be ones made by the company.

In the 1939 Watts article (see Bibliography), Mr. Richard Pass, who was president of the company then, is quoted as saying, "High-tension insulators were manufactured by throwing and turning during the early years, and later some smaller high-tension insulators were cast."

The beehive styles in the accompanying catalog page would obviously be the "smaller" ones, and which were cast. The U-144 specimens appear to have been made by casting, and they could have been the unpictured #16 "Telegraph Pattern" in their catalog. These insulators have diagnostic differences from insulators made by the plastic process, and they also

bear indisputable evidence of being "twice-fired", a method not used on porcelain pin type insulators after the mid-1890's.

The earlier styles made by plastic process, as different from these "smaller" ones, were probably cable types. This would also fit Seymour's original intent to produce a true high-tension insulator. Specimens of cable insulators exist which are of very high quality and bearing glazes appearing identical to the distinctive glaze on the U-144 specimens.

For an unknown reason, P & S ceased making the larger styles after a very brief period. There could have been difficulty in making the larger pieces by jiggering plastic clay which, in turn, probably led to casting as the only alternative. These cast insulators would not have been competitive with comparably rated glass insulators then being made for Fred Locke by Brookfield.

The catalogs show that P & S continued to make these small beehive styles a while longer, but even these were marketed only to about 1896. There are no known specimens of the two very distinctive styles pictured in the catalog (styles U-141 and U-146).

Very soon after the company was founded, they also manufactured dry process insulators for electrical wiring and the related fixtures. This then became their primary business and was probably a factor in their discontinuing the pin types. Even today nearly a century later, the company is still one of the largest manufacturers of those electrical items -- and still at the same address in Syracuse!

PERU ELECTRIC MANUFACTURING COMPANY

This company was founded in 1892 as the Peru Electric Works in Peru, Indiana, and they manufactured dry process porcelain items for electrical devices. In the latter part of 1893 a fire destroyed the porcelain building, and Peru rebuilt in an idle plant across the tracks.

Subsequently the company commenced the manufacture of high-voltage pin types. An article in the 5-19-98 issue of "The Electrical Engineer" describes and pictures the extensive exhibit of Peru Electric at a large electrical trade fair and stated, "They are exhibiting a full line of Peru specialties, such as high potential triple-petticoat, porcelain insulators, Peru style, and"

The exhibit photo shows several large arrangements of high-voltage insulators, and one array are clearly identifiable as the U-928B style. The single known specimen of U-928B is a dry process insulator, and we have attributed it to Peru Electric Mfg Co.

The modern Square-D plant building and parking lots completely cover the old Peru plant site and early dumpage areas, and no evidential shards of the early Peru pin types could be found.

PITTSBURG HIGH VOLTAGE INSULATOR CO.

(Note: "PITTSBURG" was founded during a brief time when the spelling of the city was that instead of the former and later "Pittsburgh".)

This company, located in Derry, PA, was founded in 1908 and was the forerunner of the Westinghouse porcelain operation. The original small plant previously owned by at least two china companies was greatly expanded by Pittsburg, and they stated that the plant was more than doubled between the issuance of their No. 2 and No. 3 catalogs.

Although Westinghouse became the selling agent for Pittsburg around 1910 or 1911 and had bought a controlling interest in the company in 1914, catalogs continued to be issued under the name of Pittsburg High Voltage. The latest such catalog I have seen is one of 1921 entitled "Export Catalog No. 20". The operation was wholly owned by Westinghouse by 1922, and the insulator line was included in the Westinghouse general catalogs from 1921 onward.

Pittsburg evidently had an obsession about not wanting to lose a sale for the lack of a suitable design, and they really got carried away with this in their cataloging. For instance, their 1918 catalog lists no less than nine "hat-shaped", double-petticoat, distribution insulators, some of which differed from others only because of a slightly different radius of the crown or some such factor. Along with these, they listed six different pony or semi-toll styles. While other companies cataloged only the more popular styles of each voltage class, Pittsburg evidently cataloged everything for which they had tooling.

There is also evidence that Pittsburg went out of their way to make special designs for their customers even though they already had a large line. Part of their production was for export to Canadian railroads and electric utilities, and many of those styles were still different. They were essentially a "short order house" for users of insulators.

Although the modern Westinghouse plant completely overlies all the former Pittsburg plant and dump site, I managed to locate a landfill site in Derry quite remote from the plant where Pittsburg had done all their early dumping for a number of years. Specimens and shards recovered answered many questions about Pittsburg insulators -- the unique styles they had made, special customer markings they had used, etc.

Dump specimens indicated Pittsburg's use of the following markings: JOHNS-MANVILLE, P.R.R., SOO, POSTAL and N.A.T.Co. Additionally, export styles for Canadian railroads were found with C.P.R. and C.N.R. markings.

Although already known from the nature of the specimens extant, the plant dumpage also confirmed Pittsburg's use of the various date stamp markings shown below. Typical examples of "full date" stampings used by Pittsburg are shown below. The latest such date known is FEB 17 1921 and is considerably later than most other dates known.

JUN 17 1913

JUN 20 1915

(incuse)

Typical examples of the "date control" markings seen on Pittsburg insulators are shown below. All six of the suffixes normally found on ink pad dating stamps are known on insulators. It is thought that the suffix element such as "PAID" might have been year codes, for instance the years 1916 through 1921. However, it could have been simply an identification of the trimmer operator on different shifts or some similar thing. We have not been able to locate a factory print outlining the meaning.

FEB 14 PAID

SEP 20 REC'D

NOV 30 ANS'D

JAN 18 ENT'D

APR 21 A.M.

APR 12 P.M.

(incuse)

Other than the date stamp markings mentioned above, Pittsburg never marked any of their own insulators with the exception of a very few known specimens bearing "Pittsburg" markings as shown below. The marking No. 1 is very rare, and only one specimen is known with marking No. 2.

All the many unmarked Pittsburg insulators are usually fairly easy to attribute to the company by their particular style, distinctive glazes and manufacturing techniques unique to Pittsburg manufacture. (For more information in this regard, please see Appendix G.)

Pittsburg

"Pittsburg"

(1) inc.

(2) inc.

THE SQUARE-D COMPANY

The Square-D Company is an old-line company that manufactures and sells many forms of electrical equipment. From 1925 to 1951 the company operated a dry process porcelain plant at Peru, Indiana for manufacture of electrical porcelain items for their use and sale to other manufacturers, and this included some styles of pin type insulators. All of these pin types bear markings incorporating either the company's name or their Square-D trademark (registered 9-5-22, used since 10-15-14).

Two ordinary styles were made. Marking No. 1 was used on U-32 which is known only with blue glaze. Markings No. 2 and No. 3 were used on the U-317 which is known in brown glaze, and more rarely in white glaze.

Square-D also made the U-188 dry-spot insulators for American Electric Co., and later for Automatic Electric Co., and these have a Square-D identifier marking on the crown ridge of the insulator's base part.



(1) (r-e)



(2) emb.



(3) emb.

THE STAR PORCELAIN COMPANY

This company was located in Trenton, NJ and was founded in 1899 for the manufacture of dry process electrical porcelain. In the Arthur Watts 1939 article, there is a reference to Star having made a line of high-voltage insulators from 1901 to 1907. There is no other information regarding this, and no pin type insulators are known which can be attributed to this company.

THE R. THOMAS & SONS COMPANY

This company, initially located in East Liverpool, Ohio, was founded in 1873 as American Knob Works. This was a one-kiln operation for the manufacture of door knobs.

The company was reorganized and expanded in 1884 for the manufacture of electrical porcelain insulators, and the name was changed to R. Thomas & Sons. The first kiln of this ware was marketed in 1884, and in 1885 the company began production of low-voltage insulators in a big way. By 1887 Thomas was marketing these insulators to most of the large electrical

supply companies. They were the main supplier of the period and remained so for at least the next 20 years.

After a very rapid expansion which culminated in Thomas having bought the entire porcelain plant of Westinghouse Electric Co. in East Liverpool, Thomas incorporated in 1892 under the name R. Thomas & Sons Co.

A plant constructed in Lisbon, Ohio by Thomas China Company for the manufacture of semi-porcelain china was owned by A. G. Thomas, a member of the Thomas Company "family", was absorbed into R. Thomas & Sons Co. in 1905 and converted to the manufacture of porcelain insulators. Thomas had outgrown the old East Liverpool facilities with its entry into high-voltage insulator manufacturing.

The Lisbon plant was converted and enlarged to a modern insulator manufacturing plant in 1918, and the old East Liverpool plant was closed in 1927. In May 1957 the R. Thomas & Sons Co. was bought by H. K. Porter Company and absorbed into its Delta-Star Electric Division. (Please see the section on "Delta-Star".)

Thomas entered the high-voltage insulator business in the 1896-1897 period. Early in 1897 John W. Boch of Thomas perfected a method for the manufacture of the larger insulators by glaze-welding shells together, and Thomas filed for patent on this 10-23-97, the patent granted 3-8-98. Fred Locke was also filing for patents on very similar processes at this time, and the two companies fought all this out in the patent courts for a number of years. (See Appendix C for details.)

When the smoke cleared on the legal problems with the patents about 1902, Thomas increased production of the high-voltage insulators, marketing them very aggressively by 1904. The one edge Thomas had with the Boch patent resolution was their method of filling all the space between the insulator shells with glaze, and they widely advertised their line as the new Thomas "Glaze-Filled" Insulators.

Thomas concentrated on these larger glaze-filled insulators for several years, and it was not until about 1907 that a reasonably large line of the smaller uniparts was cataloged. This line was rapidly expanded, and the 1912 catalog included a wide assortment of unipart pin types of standard and special design. This is also the earliest Thomas catalog I have seen where they displayed multipart designs cemented together.

The various known Thomas markings are shown below. Except for the wordy markings used on the early Boch insulators, the company marked the insulators with just the THOMAS name. The "MERSHON" marking shown at the end of this chapter should also be counted as a Thomas marking, since the U-945 style is a Thomas insulator.

Marking No. 9 below is embossed on an early dry process U-928 Boch insulator. The marking wording seems to infer these were made after the 10-23-97 patent filing date, which further infers that Thomas still had not made the U-928 style by wet process by that time.

Marking No. 7 is the incuse marking commonly seen on the wet process Boch insulators. Individual type lines of this marking stamp were held together haphazardly, and specimens exist with jumbled type lines as illustrated with the two example markings No. 10 and No. 11.

Marking No. 4 is embossed on the skirts of Thomas U-239 and U-294A dry process insulators, and these were cataloged by Thomas in the 1907 to 1920 period.

The "Q-T" marking No. 5 stands for their "Quiet Type" (radio free) insulators. The marking was applied after glaze dipping (over-glaze) and before firing in order that it would be visible on the fired unit. Those that I have seen were in orange ink.

(Thomas markings on next page)

THOMAS
(1) inc.

THOMAS
(2) inc.

THOMAS
(3) inc.



(9) emb.

THOMAS
(4) emb.

Q-T
(5) over-glaze

THOMAS
(6) inc.

BOCH PATENT
8681 118 H03W
M'F'D BY
THE R. THOMAS & SONS CO.

(10) inc.

BOCH PATENT
MARCH 8TH 1898
M'F'D BY
THE R. THOMAS & SONS CO.
(7) inc.

THOMAS
(8) u-g

BOCH PATENT
M'F'D BY
MARCH 8TH 1898
THE R. THOMAS & SONS CO.
(11) inc.

WESTINGHOUSE ELECTRIC CORPORATION

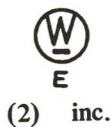
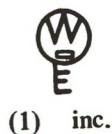
(See "Pittsburg High Voltage" for earlier history of this plant.)

When Pittsburg High Voltage Insulator Co. became wholly owned by Westinghouse in 1921 or 1922, the name was changed to Westinghouse High Voltage Insulator Company, and from 1921 onward the insulator line was carried in the Westinghouse general catalog.

In 1923 Westinghouse built a smaller plant in Emeryville, CA, and this plant was as fully equipped to manufacture porcelain insulators as was the Derry, PA plant. Test facilities were maintained at both plants. The Emeryville plant was closed in 1944, and pin type insulator manufacture at Derry was discontinued in 1953.

The markings used by the company on insulators were always simply the company trademark. Examples of markings on their pin types are shown below.

Many of the Westinghouse pin types are also marked with the catalog number, usually an incuse stamping on the crown area, but also with ink stamp markings on unglazed top rests.



MISCELLANEOUS MARKINGS

(Also see markings for "Miscellaneous Special Designs" in Chapter 5.)

There are a number of markings on porcelain pin types which either cannot be attributed to any certain manufacturer or which were applied by a manufacturer for individual customers. These markings are shown below with what information is available on each one. All these markings are incuse handstamps unless indicated otherwise.

The markings below are special markings applied by a manufacturer for U.S. railroads. The P.R.R. and SOO were made by Pittsburg H.V.

The "P.R.R." is for Pennsylvania Railroad, and it has been found on U-179, U-222, U-223 and U-529, all made by Pittsburg High Voltage.

The "SOO" marking is for Soo Line Railroad and has been found on the U-148 as made by Pittsburg.

The "B & O" is for Baltimore & Ohio Railroad and is most commonly found on U-293A and U-293B, both with white glaze. Manufacturer unknown.

The "M P" is attributed to either Missouri Pacific Railroad or Missouri Pacific Telegraph Co. It is found on U-152, and also more rarely on a cable Similar U-610A.

P. R. R.

P. R. R.

SOO

B & O

M P

The "POSTAL" markings are for Postal Telegraph Co. and are found on a small percentage of the U-154 made by Pittsburg High Voltage. The incuse marking is seen on light mottled-brown specimens. The under-glaze is seen on very dark brown specimens, usually making the marking barely discernible. There are size variations of the under-glaze marking.

POSTAL

(incuse)

POSTAL

(u-g)

The "N.A.T. Co." stands for North American Telegraph Co., and it is found on U-148 insulators as made by Pittsburg High Voltage.

N.A.T. CO.

In the 1900-1910 period Johns-Manville jobbed the insulators made by Ohio Brass, Thomas and New Lexington in addition to their own insulators made of a fibrous composition material. The marking below is found on U-241A insulators made for J-M by Pittsburg High Voltage and on multipart insulators made for J-M by New Lexington.

JOHNS-MANVILLE

(1) inc.

The following marking appears on the rare U-945 and pertains to the Mershon patent No. 605,256, June 7, 1898, Ralph D. Mershon. These insulators are of Thomas manufacture.

MERSHON TYPE
PATENT
JUNE 7, 98

The following customer marking is found on dry press U-98 mine insulators attributed to American Porcelain Co. COOKE WILSON was probably an Electrical Supply Co.

COOKE WILSON E. S. CO.

(embossed)

The "G" marking exists on a particular line of dry press insulators, but it has not yet been attributed to any manufacturer. The marking is known on U-11A, U-50, Sim U-55, U-229, U-236, U-248, Sim U-250, U-272 and possibly others.

G

(emb.)

G

(emb.)

The following markings are all unattributed.

The "ϕ" marking exists on the crown of some U-610 specimens. Some of these were found in Canada, and the marking approximates the Monogram-CP marking of Canadian Porcelain Co., but it is definitely a "ϕ" depiction.

The "GK" has been found on the crown of some U-297 insulators in the New England area.

The large, lazy-S marking appears on the crowns of some U-296 and U-388 insulators made by Thomas and used in the Portland, Oregon area.

The "C.C.V.F." appears on the crown of a U-529A found in Florida.

The "C. F. Co." marking was found on a U-729 along with a LAPP marking. Lapp was unable to locate any record of its use.

The "N.E.P." appears on the crown of some U-474 specimens. This is unattributed but is suspected as being New England Power Co.

The 'GLEN' marking (rare) is known on white U-38 specimens most probably manufactured by Fred M. Locke, circa 1898-1901.

The "MACY INSULATOR" marking is embossed on the crown of U-124 insulators found near Macy, Indiana. It is unattributed, but the insulators were probably manufactured by Square-D Co., Peru, Indiana.

ϕ

GK

S

C.C.V.F.

N.E.P.

'GLEN'

u-g

MACY INSULATOR
INDIANA
MACY

(emb.)

C.C.V.F.

APPENDIX A -- GLOSSARY OF TERMS

(Also see "Nomenclature" in Chapter 6.)

- Cable Type -- Generally any insulator with a top conductor groove.
- Crown Type -- Generally any cable style having a nearly flat surface all the way across the crown.
- Distribution -- Medium high voltage power networks between customer service lines and a primary line of higher voltage.
- Dry Process -- (or "dry press") Manufacturing by pressure molding granulated particles of relatively dry plastic clay.
- Feeder Type -- Insulators for supporting the large-diameter, low-voltage feeder cables to high-current loads.
- Firing Surface -- The unglazed surface on which porcelain objects rest while being fired in the kiln.
- Fog Insulator -- Broad term for any insulator designed to cope with contamination problems (Fog Bells, Fogbowls, Fog Types, etc.)
- Glaze-weld -- Two or more porcelain bodies fitted together and subsequently "welded" together when the firing melts the glaze coatings.
- Mold Line -- A mark left by juncture lines of multipart forming molds.
- Multipart -- Made in two or more pieces and then cemented together.
- No Name -- (abbreviation NN), an unmarked insulator specimen.
- Patent-top -- Any style which has a specially designed top to eliminate the need for a tie wire. Also "self-tying" and "tieless".
- Radio-treated -- An insulator having a special conductive glaze applied to the crown and pin hole to eliminate radio interference.
- "Red Top" -- An industry and collector nickname for large unipart insulators made by Ohio Brass Co. which have completely copper coated tie wire grooves and crowns. For instance, see style U-910.
- "Rest" -- Same as "firing surface".
- "Sim U-860" -- Description of a specimen not closely matching the closest reference drawing in the Universal Style Chart. If significantly different, the description might note the character of the difference as, for example, "Sim U-860, crown as U-850".
- Thimble -- Threaded metallic inserts cemented into the pin hole.
- Transmission -- The High voltage power lines between the power generating source and the lower voltage primary distribution networks.
- Unipart -- Fired in one piece and not having parts cemented together. By definition then, glaze-welded insulators are "uniparts".
- Wet Process -- A manufacturing process where the unit is made by forming from plastic clays. (Also "hot press" and "plastic process".)

APPENDIX B -- ABBREVIATIONS

COLORS:	DESCRIPTIVE:	MARKINGS:
blk -- black	lt -- light	emb. -- embossed
brn -- brown	dk -- dark	r-e -- recess-embossed
blu -- blue	sm -- small	inc. -- incuse
grn -- green	med -- medium	u-g -- under-glaze
gry -- gray	lg -- large	s-b -- sand-blasted
org -- orange		
wht -- white		
yel -- yellow		
	COMPANY NAMES:	
	BBC -- Brown Boveri Electric, Inc.	
	G.E. -- General Electric Co.	
	G.P. -- General Porcelain Co.	
	I-C -- Industrial Ceramics, Inc.	
	Ill. -- Illinois Electric Porcelain	
	ITE -- I-T-E Imperial Corp.	
	J-D -- Jeffery-Dewitt	
	J-M -- Johns-Manville	
	L-M -- Line Material Co.	
	M-E -- McGraw-Edison Co.	
	N-L -- New Lexington H.V. Porc. Co.	
	O-B -- Ohio Brass Co.	
	P&S -- Pass & Seymour, Inc.	
	PPI -- Porcelain Products, Inc.	
	Ptsbg -- Pittsburg H.V. Insulator Co.	
	V-I -- Victor Insulators, Inc.	
	Whse -- Westinghouse Electric Corp.	
MISCELLANEOUS:		
Sim -- Similar to		
MLOD -- Mold Line Over Dome		
MLTD -- Mold Line To Dome		
RT -- Radio Treated		
ZT -- Zinc Thimble		
P.R. -- Petticoat Rest		
S.R. -- Skirt Rest		
T.R. -- Top Rest		
NN -- No Name		

APPENDIX C -- R. THOMAS & SONS vs. FRED M. LOCKE et al

There was a continuing legal battle between Thomas (Boch) and Fred M. Locke over their patents on similar methods for manufacturing insulators by glaze-welding. There are many unresearched patent court documents, but following are highlights from the patents and known court cases.

The starting point was in 1896 when Imperial Porcelain Works was experimenting with glaze-welds for Locke, and Thomas was similarly experimenting for their own benefit. As a result of Imperial's work in January 1897, Locke filed a patent application Feb 5, 1897 for a glaze-welding process. This application was rejected, appealed and again rejected.

Meanwhile, John Boch (for Thomas) had made a patent application on a similar process. In September 1897 Fred Locke filed for an interference against Boch on his patent. Boch countered with a motion to dissolve the interference claim, but this was denied in a Feb 11, 1898 decision.

During the interference proceedings, under the court rules, Boch had access to Locke's file in the patent office. Even before the proceedings were resolved, Boch filed a new application Oct 23, 1897 for a patent on the "glaze-filling" process which was at least different from merely letting the normal glaze coatings on the shells fuse together upon firing. Locke later accused Boch of stealing the idea from the Locke application, if indeed it was patentable at all.

Boch was subsequently granted the "glaze-filling" patent Mar 8, 1898 for his application filed Oct 23, 1897.

The fate of Locke's Feb 5, 1897 application is unknown. This patent

could have been dropped, since the court had already ruled that merely glaze-welding porcelain parts was one of the "ordinary processes of porcelain manufacture." Indeed, Locke filed for a patent Apr 23, 1898 having glaze-welding as one of its claims, and the patent was granted Jun 7, 1898 in spite of the existing Boch patent.

Locke persisted in trying to get a patent (any patent!) on some form of proprietary method of glaze-welding insulator parts, and one patent application was carried all the way to the Court of Appeals, where it was again denied on the basis that merely fusing porcelain parts together was not novel. (Decision of Dec 11, 1900.)

Manufacturers evidently persisted in trying to use manufacturing methods which would accomplish what Thomas was doing, yet somehow not infringe upon the Boch patent. In a suit brought by Thomas against Fred Locke and Electrical Porcelain & Mfg Co., Locke didn't dispute that there had been an infringement on the Boch patent in his manufacturing methods if the Boch process was indeed patentable, but which Locke contended it was not. But this didn't set too well with the judge in light of the fact that after Boch was granted the patent in 1898, Locke himself then endeavored to obtain a patent for the same identical process, copying the Boch application verbatim!

In any event, Thomas won this suit after a drawn out court fight, and the validity of the Boch patent of Mar 8, 1898 was sustained. (Decision of Nov 26, 1901.) Locke and others were ordered to pay damages.

Fred Locke then took off in a new direction with rapid fire patent applications of Mar 12, Apr 19 and May 5, 1902, all of which were subsequently granted. These were all for processes generally involving glaze-welding of insulator shells per se. He had undoubtedly reminded his patent lawyer of his past patent difficulties where simple fusing was deemed unpatentable and that a particular method of doing it was essential in the patent claims. The fact that a couple of these patents covered processes which were impractical or impossible seemed irrelevant to Locke, as he could still add these patents to the marking stamps on insulators.

Whereas the Boch process was for making "perfect" insulators by the filling of all nooks and crannies with extra glaze, Locke's new patent 754,284 was for air spaces purposely left between the separate shells.

Then there was Locke's patent 702,661 wherein molten glaze was to be poured into the crack and allowed to cool. This seems impractical mechanically, since all the glaze involved would not be fused as in firing.

But the crowning achievement was Locke's patent 702,660 filed Mar 12, 1902, less than four months from the date the Boch patent was upheld in the courts Nov 26, 1901. The patent was granted Jun 17, 1902. This was a carbon copy of the Boch process. Whereas in the Boch process, the separate shells were nested together and then glaze poured into them, the Locke process was for "dipping them in liquid glaze, the outer shells being dipped bottom side upward and allowing a portion of the liquid glaze to remain in the outer shell or shells, nesting them together in this position with their petticoats uppermost and then firing them so as to fuse the parts together so as to form practically but a single piece."

It is interesting to note that the insulator drawing Locke used in this patent is a direct copy of the insulator drawing used in the Boch patent, and that's really thumbing your nose at the opposition. At last Fred Locke had actually stolen from Thomas the legal right to make insulators by the Boch process. Not wanting to press his luck further, he was at least smart enough to not advertise the insulators as "Glaze-Filled"!

This feat also set another record when Locke added the Jun 17, 1902 patent date to his ultimate marking stamp for insulators -- one having seven patent dates. (See marking #7-1 in Appendix D.)

APPENDIX D -- FRED M. LOCKE MARKINGS

We have tabulated below all the known handstamp markings used at the Victor plant during the early years under Fred M. Locke. The particular marking used on a specimen has significance to any collector specializing in Fred Locke insulators.

An effort has been made to accurately record each marking down to the last period and apostrophe. In stamps having all capitals but of different sizes, the larger letters are underlined. The nature of the markings indicates the factory assembled the stamps from a mixture of type fonts, probably secured at the "flea markets" of that time. Type styles and the size of letters and numerals are numerous, and they were used haphazardly in the makeup of some stamps.

Individual type rows were held together in such loose fashion that one line sometimes failed to imprint the insulator on very rounded areas. For instance, many bold, one-line markings are reported which were really only the top or bottom line of markings such as 1-6 through 1-8.

Careless fashioning of the many stamps made is also evidenced by the numerous errors in patent dates. All errors in these dates are noted.

For easy reference, an arbitrary reference number has been assigned to each marking stamp, such as 4-2. The first number indicates the number of patent dates in the marking.

Three markings here are interesting in that they use "FRED." rather than "FRED" as the abbreviation for Locke's name Frederick. Of Locke's nearly 50 patents, he signed only the first one "Frederick M. Locke", and he signed "Fred" on all other documents I have seen. He obviously didn't like to be referred to by anything other than Fred.

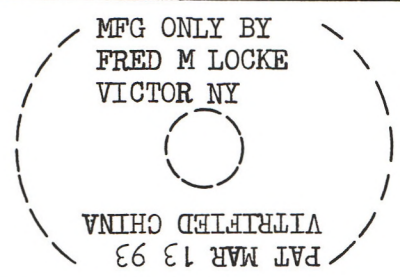
Patents were an important marketing factor in past eras, and with a lingering tendency even today. Anything from medicines to smoking pipes might sell better with a patent date or number on them, so why not insulators too. If one patent date would make it sell better, then maybe 5, 6 or even 7 dates would be better still. At least Fred Locke thought so.

(All markings are incuse stamps unless indicated otherwise.)

VICTOR	0-1
F. M. LOCKE, VICTOR, N.Y.	0-2
FRED M. LOCKE Victor, N.Y.	0-3
FRED M. LOCKE, VICTOR, N.Y.	0-4 (incuse)
FRED M. LOCKE, VICTOR, N.Y.	0-5 (under-glaze)
<u>FRED M. LOCKE,</u> <u>VICTOR, N.Y.</u>	0-6
F. M. LOCKE, VICTOR, N.Y.	0-7
<u>F M LOCKE VICTOR</u>	0-8

Pat'd March 13, 1893 1-1 "March 13" is an error date.
FRED M. LOCKE. Correct patent date is March 14.

PAT'D MAR. 13. 1893 1-2
FRED M. LOCKE.



1-3 Recess-embossed, circularly on bottom of porcelain pin bases. There are variations of wording layout. March 13 error date persists. The correct patent date is March 14, 1893. Some have backward "D" in FRED.

PAT'D MAY. 22, 1894, 1-4
FRED M. LOCKE.

F. M. Locke 1-5 Note "LockE" type size error.
PAT
DEC. 15. 96

PAT'D JUNE 7, 1898. 1-6 One variant has 7 and 1898 in smaller type than other letters.
F. M. LOCKE, VICTOR, N.Y.

PAT'D JUNE 7, 1898. 1-7 Two identical markings exist, one with all type 25% smaller.
F. M. LOCKE, VICTOR, N.Y.

PAT'D JUNE 7, 1898. 1-8
FRED M. LOCKE, VICTOR, N.Y.

Pat'd June 7, 1898 1-9 Lower-case letters in top line.
FRED M. LOCKE. No address given.

Pat'd June 7, 1898 1-10 Similar 1-9 but big type for
FRED M. LOCKE. "1898", low 7, dot before June.

PAT MAY 89 MAY 22 94
 VICTOR, N.Y.
 F. M. LOCKE,

2-1 Embossed in top crossgroove of insulator.

PAT. MAY '89 MAY 22, '94
 F. M. LOCKE
 VICTOR, N.Y.

2-2 Incuse handstamp in top crossgroove of insulator.

Manufactured for F. M. LOCKE, Victor, N.Y. of Imperial Porcelain Pat'd May 89, May 22, 1894. Nov. 24, 96. Other Patents Pending	3-1	Incuse. Known on U-923, U-925, U-940, and possibly others.
<u>PAT. NOV 24 & DEC 15 '96</u> <u>SEP. 28, 97 JUNE, 7 98</u> <u>F. M. LOCKE. VICTOR, N.Y.</u>	4-1	Sans serif type, the "ICTOR" small type. A variant has the 8 upright and "JUNE,7'98"
<u>PAT. NOV. 24 & DEC 15-96</u> <u>SEPT. 28-97 JUNE 7, 98</u> <u>FRED. M. LOCKE-VICTOR, N.Y.</u>	4-2	Sans serif, 3 sizes, some numerals largest. Both "VI" large. Note period after "FRED."
<u>PAT. NOV. 24 & DEC 15-96</u> <u>SEP-28 & JUNE 7 98</u> <u>F ? ?</u>	4-3	Sans serif, 3 type sizes, 2nd line incorrectly infers 9-28-98 instead of correct date 9-28-97
<u>PAT'D NOV. 24 & DEC 15 96</u> <u>SEP-28 & JUNE 7 98</u> <u>FRED. M. LOCKE. VICTOR. N.Y.</u>	4-3a	Very similar #4-3 stamp except for top line. Extra small N.Y. Note period after "FRED."
<u>PAT-NOV 24 & DEC 15 96</u> <u>SEP 28-97 JUN 7-98</u> <u>? ? ? ? ? ?</u>	4-4	Sans serif, largest of 3 type sizes underlined. No trace of third line on specimen.
FRED M. LOCKE, Victor, N.Y. Pat'd. May 89, May 22-94, Nov. 24-96, Dec. 15-96 Sept. 28-97 Other Patents Pending.	5-1	Under-glaze. Rare and seen on early Locke styles as made by Imperial Porcelain.
Pat'd Nov. 24 & Dec 15, 1896, Sept 26, 1897, June 7, 1898, May 29, 1900, Apr.30, 1901. FRED M. LOCKE, VICTOR, N.Y.	6-1	Sans serif type.
PATD NOV. 24 & DEC.15, '96; SEP. 28, '97, JUNE 7, '98; MAY 29, '00 & APR. 30, '01. FRED M. LOCKE, VICTOR, N.Y.	6-2	Sans serif type. The bottom line of type is twice the size of others. Note the semicolons in this stamp.
FRED. M. LOCKE, VICTOR, N.Y. PAT. MAY '89, MAY 22, '94, NOV. 24, '96, DEC 15, '96, SEPT. 28 97, JUNE 7 '98. OTHER PATS. PENDING.	6-3	Under-glaze. Period after "FRED." Known on U-3, U-611A, U-925, U-927D, U-941A
PAT'D Nov. 24, Dec. 15, 1893, Sept. 26, 1897, June 7, 1898, May 29, 1900, April 30, 1901, June 17, 1902, F. M. Locke	7-1	Error "1893" instead of 1896. Error "Sept. 26" instead of Sept. 28. No address given.

APPENDIX E -- PATENTS

Of the hundreds of patents granted on pin type insulators and manufacturing processes, those listed below are of possible interest to porcelain insulator collectors. Partial information on each patent can be obtained from the Official Gazettes of the U.S. Patent Office, available at most universities and some of the larger public libraries. A complete copy of any patent can be obtained from the U.S. Dept. of Commerce, Patent and Trademark Office, Copy Fulfillment Services, Washington, D.C. 20231. Patents must be identified by number, and the cost is \$1.50 each. Average delivery time is 4 to 6 weeks.

Patent No.	Date	Inventor and Invention
289,449	12- 4-83	N. Rousseau, transposition (Sim U-197 style)
315,660	4-14-85	H. Prenzel, no-tie-wire type (U-182)
353,120	11-23-86	R. Brown, duplex pin type (U-81 etc.)
402,752	5- 7-89	F. Locke/J. Lapp, "hook" insulator (not a pin type)
430,296	6-17-90	S. Oakman, dovetails on crown (U-377 etc.)
476,813	6-14-92	Pass & Seymour, paraffined cement & thimble (U-141)
493,434	3-14-93	F. Locke, porcelain-base crossarm pin assembly
520,367	5-22-94	F. Locke, side petticoats between 2 grooves (tramps)
D26,323	11-24-96	F. Locke, (design patent), top shell for pin types
573,092	12-15-96	F. Locke, combination of materials for pin types
590,806	9-28-97	F. Locke, oblong shape with skirt eaves (U-937)
600,475	3- 8-98	J. Boch, glaze-weld ("glaze-filling") process
605,109	6- 7-98	F. Locke, glaze-weld, very extended petticoat
605,256	6- 7-98	R. Mershon, very long petticoat, eaves (U-945)
D32,741	5-29-00	F. Locke, (design pat.) top shell with eaves & spout
D34,211	3-12-01	L. Stillwell, (design patent), specifically U-966
D34,450	4-30-01	F. Locke, (design patent), top shell for pin types
676,881	3-25-01	H. Etheridge, self-locking insul. & pin (U-376 etc.)
700,463	5-20-02	W. Walter, strengthening ribs under skirts (U-938)
702,660	6-17-02	F. Locke, g-w process (add extra glaze, then fire)
702,661	6-17-02	F. Locke, g-w process (add molten glaze, then cool)
715,375	12- 9-02	M. Harloe, no-tie-wire type (U-184)
726,846	5- 5-03	J. Bell, no-tie-wire type, screw top cap (U-181)
745,284	11-24-03	F. Locke, g-w process (air spaces over shell tops)
881,967	3-17-08	C. Slusser, no-tie-wire type (U-185)
894,616	7-28-08	J. Fay, "Fay Clamp Insulator" (U-401, U-401A)
917,031	4- 6-09	C. Eveleth (G.E. Co.), breakaway skirt segments
929,878	8- 3-09	J. Ranson, no-tie-wire type (U-183)
971,785	10- 4-10	A. Pierce, tree insulator, specifically U-187
1,107,111	8-11-14	B. Purkey, no-tie-wire, slack wire style (U-186)
1,140,050	5-18-15	Manwaring/Hessel, vert'l conductor grooves (U-189's)
1,703,853	2-26-29	R. Gould (Postal Tel.), dry-spot (U-173 type)
1,869,397	8- 2-32	C. Stroup, "helical" side petticoat (see Chapter 5)
1,955,609	4-17-34	D. Rowland (Locke Insul. Co.), glaze-weld fogbowl
2,084,866	6-22-37	B. Plimpton (Locke), outer petticoats ("Hi-Top")
2,088,433	7-27-37	B. Plimpton (Locke), "TOUGHTYPE" Hi-Tops (U-816's)

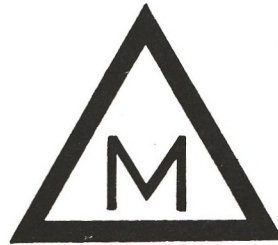
APPENDIX F -- TRADEMARK REGISTRATIONS

Trademark registrations are shown below for markings pertinent to pin type insulators, as published through year 1960 by the patent office. It is surprising how many prominent insulator company trademarks were not registered, and also that some were registered only after many years of established use. The "Used since:" date given by the companies is in some cases helpful in dating markings, but companies obviously erred in some.

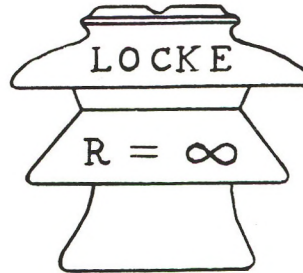
- (1) # 68,192 3-10-08 Ohio Brass Company
- (2) #100,131 10-6-14 Locke Insulator Mfg Co., Used since: 10-13-10
(actually since 1900, started by Fred Locke)
- (3) #107,575 12-14-15 Ill. Elec. Porc. Co., Used since: 1-1-15
- (4) #134,717 9-14-20 Locke Insulator Mfg Co., Used since: 6-10-08
- (5) #140,418 3-15-21 Lapp Insulator Co., Used since: 5-1-19
- (6) #144,588 7-12-21 Jeffery-Dewitt Insulator Co., Used since: 8-1-15
- (7) #153,282 3-14-22 Porcelain Insulator Corp., Used since: 6-21-21
- (8) #158,544 9-5-22 Square-D Co., Used since: 10-15-14
- (9) #167,606 5-1-23 Locke Insulator Corp., Used since: 4-1-22
- (10) #211,881 4-20-26 Franklin Porcelain Co., Used since: July 1925
- (11) #248,390 - -28 Porcelain Products, Inc., Used since: 10-1-27
- (12) #344,701 3-30-37 Locke Insulator Corp., Used since: 5-10-33
- (13) #396,924 8-11-42 Victor Insulators, Inc., Used since: 8-25-41
- (14) #502,121 9-14-48 Ill. Elec. Porcelain Co., Used since: Dec 1935
- (15) #509,294 5-3-49 " " Since: 1926 (1923 specimens exist)



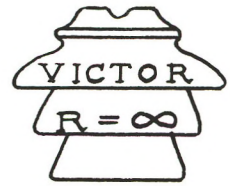
(11)



(3)



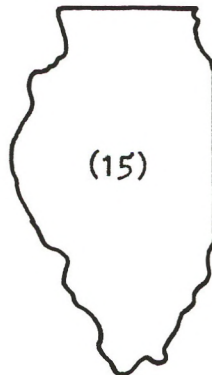
(9)



(4)



(10)



(15)

VICTOR

(2)



(13)



(5)

J-D

(6)



(8)



(1)

HI-TOP

(12)

ILLINOIS

(14)

"PINEO"

(7)

APPENDIX G -- PITTSBURG INSULATORS

Pittsburg High Voltage Insulator Co. cataloged a very large number of pin type styles, more than any other company, and tended to go after the "short order" business not pursued by other companies. They not only made many types of special designs for customers and applied customer markings on many different items, but they also made foreign styles for export overseas and quite a variety of beehive and other styles for the Canadian railroad companies.

Pittsburg differed from all other manufacturers in that many of their styles were made in two-part pressing molds. All these items have a Mold Line Over Dome (MLOD) continuous from one rim to the other. This method allowed them to make unusual styles such as U-395 by wet process and side grooves on ordinary styles could be made in the pressing operation and not have to be added later in a "green trimming" operation. (Fred Locke used a similar process on several styles, causing a MLOD, but those items are either marked Locke or are diagnostically identifiable as such.)

Pittsburg got carried away with this idea of eliminating the extra trimming operation on ordinary styles. I have noted all the following Pittsburg styles made by this method: U-5, 42B, 42C, 68, 73, 81, 84, 106, 110, 117, 149A, 154, 203A, 224, 230, 243, 256, 359, 361, 377, 393, 393A, 395, 410, 438A, 499, 529, 540, 570. There would be others I never saw.

Some of these Pittsburg MLOD insulators from actual use on lines are flawed at the mold line, and the factory dumpage was full of insulators which cracked at the mold line during firing. In view of this basic flaw in the manufacturing method, I queried John Stout, plant manager of the McGraw-Edison insulator plant at Macomb, Ill. His reply was, in part:

... I think you are right in the idea that this was a method to get special shapes as long as there are no undercuts in one operation. I have made insulators by the dry process by this procedure and some experience in pressing wet process clay by the same technique.

As you know, ceramic materials from which insulators are made are not spherical particles but a combination of plates and particles in which one axis is longer than the other. During a forge type pressing of a plastic body these particles are highly oriented at the parting line where the excess clay escapes and the dies come together. A differential shrinkage occurs at the parting line resulting in cracks and a plane of weakness relative to electrical and mechanical strength. Just trimming of the flush line is not sufficient to remove this weakness. We find that in pressing plastic clay the parting line of the two dies must be moved to one end or a side and not part within the body surface of an insulator. It is for this reason the type operation to which you describe has never been popular.

This peculiar characteristic, together with several other factors, allows us to attribute nearly all Pittsburg insulators, even though very few have any identifiable marking applied. Most collectors are aware of other Pittsburg characteristics described below.

Virtually all Pittsburg insulators have unglazed pin holes, the top of which is either (1) perfectly flat or (2) some combination of concentric circles. Excluding dry press items, this characteristic is unique to Pittsburg insulators. Experienced collectors can usually tell Pittsburg insulators by their glaze -- beautiful caramels banded with darker brown, reddish-mahoganies, rich walnut brown and a bright baby blue.

APPENDIX H -- DRY-SPOT INSULATORS

A "dry-spot" insulator is used at intermediate taps or terminals on pole lines to provide a dry section of insulation on the "bridle" wires of the tap connection, thereby breaking the wet-weather leakage path from the pole line pair to ground. (See section on "Dry-Spot Insulators" in Chapter 5 for more details.)

The general need for "dry-spotting" originated long ago. A British patent (U.S. #898,921, Sept. 15, 1908) covers a pin type with a screw cap on its top for the same purpose as the U-188. A patent (#1,703,853, Feb. 26, 1929) for a different dry-spot method was one-half assigned to Postal Telegraph Cable Co. It was made (U-173) by Porcelain Insulator Corp., and their drawing for this was dated Sept. 30, 1925.

The U-188 was originally attributed solely to Automatic Electric Co. because they were marketed for a long period by that company and because the "A.E.Co." initials in the insulator marking fit so well. My investigation into the true origin of the U-188 design began in earnest when a U-188 specimen turned up with a marking of "AMERICAN ELEC CO INC". This struck a familiar chord, since I had in my files a copy of the original engineering draft of the Automatic Electric Co. sales sheet on this dry-spot (dated July 1, 1929), and it has "Amerelec" inserted with a caret before each use of the words "Dry-Spot Insulator". The data sheet also uses the identical photo cuts from another catalog page 134, most probably that of American Electric Company.

American Electric was established in 1893. Automatic Electric was established in 1891. Both companies were in the telephone equipment supply business and also had other interests in the U.S. and England, two being Automatic Electric Co., Ltd. of London and Associated Tel. and Tel. Co., Chicago (physical facilities in England).

Two or more of these various companies, including both American Electric and Automatic Electric, were involved in some form of corporate merger in about 1929 and became Associated Electric Labs, Inc., Chicago, the individual companies probably operating as subsidiaries. Automatic Electric Co. had advised me they sold the U-188 from about 1929 to 1951.

I have personally checked all the 2946 patents for insulators under Class 174, nearly 1000 other insulator-related patents under other classifications, and every single patent (nearly 1000) ever granted to American Electric Co., Automatic Electric Co. and associated companies from 1920 through 1936, and there was no patent on the U-188 granted to any of these companies. It would also seem logical that, had a patent been granted, the manufacturer would have altered the die marking to reference the patent instead of retaining the PATENT PENDING marking for over 20 years and until production of the style was discontinued in 1951.

My conclusions regarding the U-188 are therefore: (1) That it was designed by and originally sold by American Electric Co., Inc., (2) that it was sold from 1929 onward by Automatic Electric Co., Inc. after the companies became related corporate-wise, and (3) that a patent was never granted on the design even if an application for one was made.

The U-188 and the series of styles such as U-173, U-174 and U-175 are the only U.S. styles of dry-spots ever made in the form of pin types. There are a number of other forms of "in line" dry-spot insulators which have been used for the same purpose, but these are beyond the scope of this book on pin types. Interested readers can see, for instance, patent 1,700,166 on such an "in line" type of dry-spot insulator.

APPENDIX I -- RESTORING PORCELAIN INSULATORS

A small ping or chip on a porcelain insulator with any glaze other than white is a real distraction as soon as you glance at the display shelf. It's even worse when a fairly large chip is missing. The complete opacity of the porcelain underbody makes a neat and easy repair possible.

First, fill in the chip or any missing parts with Plaster of Paris, tile cement or whatever. The harder cements are more durable. Wet the porcelain first to achieve a better bond. Build up the area at least as far as the insulator surface contour, allowing some for shrinkage, but do not worry about any unevenness in your patch work. After drying thoroughly, you can carve, file or sand the filler perfectly smooth to match the insulator contour.

Now paint the repaired area with a matching color. You can duplicate any mottling or light color bands by slightly rubbing the paint off to create a lighter color in those areas. If you use a flat paint, let it dry and then coat with a clear lacquer to impart the required glossiness.

Many damages are just small pings or a flaking of the glaze where really little material is actually missing, yet the damaged spot is distracting in a display. If you just touch those spots with the right color of lacquer, this is a sufficient fix.

Here's another hint. Some specimens may be so badly scratched and abraded all over that restoration looks hopeless, but this isn't always so. First complete any major repairs as described above. Then paint entirely over all scratches and abrasions with a matching color and immediately wipe off the painted area. The paint will fill the scratches and come off elsewhere.

After everything dries thoroughly, apply a coat of floor wax to the entire insulator. This is tricky. While rotating the insulator, apply the wax evenly and quickly with a small piece of folded paper towel by starting at the top of the insulator and working to the bottom. After the outside dries so you can handle it, do the inside if required. After the first coat has completely dried, a second coat can be applied if needed. If you botch it, take the wax off with ammonia and try again.

After the waxing, the insulator may have a slightly tacky feel which is unnatural. To remedy this, spray or wipe the insulator with any type of oil and then wipe off all of this you can get off with a soft rag.

As an alternative to waxing to impart glossiness, you can spray the insulator with polyurethane plastic. This is very difficult to do on the irregular insulator surface without getting "runs". Go easy on the spray.

Broken skirts and crown ears have a knack for wiping out a portion of the marking. Assuming you know the exact form of the marking, you can complete it after making the major repairs. Scribe in missing parts of any incuse marking, and paint on missing parts of under-glaze markings.

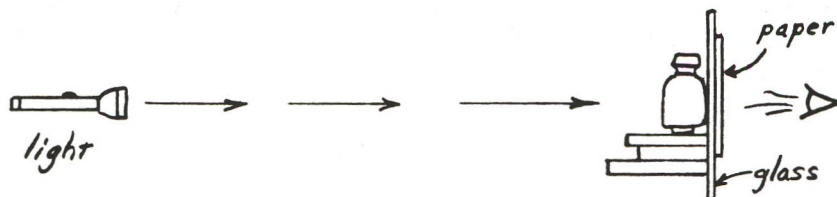
Now the final and most important step. Print the word "RESTORED" or "REPAIRED" on a sticker and attach it to the underpart of the insulator. Anchor the sticker with at least one coat of clear lacquer.

This form of restoration is easy to do and takes no special equipment or skills. It is amazing how a completely unsightly specimen can be restored so it is no longer an embarrassment on the display shelf. There aren't enough of those old classics to go around, so each time we can restore a decrepit one to displayable condition, we are ahead of the game. My historical reference collection naturally contained some broken specimens retrieved from old factory dumps, and the need to keep these on the reference shelf led to my interest in restoration. These specimens still served their purpose as a reference but were no longer an eye sore!

APPENDIX J -- INSULATOR DRAWINGS BY SHADOW PROFILE

We can make essentially perfect mechanical drawings of any insulator specimens remotely, without needing to see the specimens. They need not be loaned by mail. All we need is a "shadow profile" and a few measured dimensions of the interior which do not show in the profile. This is all very easy to do, and here's how to do it in very little time.

The making of accurate shadow profiles requires a crisp shadow that can be easily traced, and a light source far enough away from the insulator to nearly eliminate parallax size error.



As shown in the diagram, block up the insulator perfectly vertical and closely against a window pane of the house. Place a light source up to 20' or more (the farther the more accurate) from the window. Tape tack a piece of ordinary (not heavy) paper to the window pane on the opposite side from the insulator, and trace the shadow onto the paper.

An ordinary spot flashlight with fresh batteries gives crisp shadows even from further distances than required. The flashlight must be placed vertically and horizontally so that the light beam is perpendicular to the window pane. Use a small box or any rectangular object placed against the window to sight along its edge to position the light correctly.

Before tracing the profile, turn on the light and rotate the insulator until its top groove is lined up with the light beam, as you will notice by its shadow as you are turning it.

Trace the shadow with a sharp pencil. Do not work in a dark room. Ordinary room lighting will not wash out the shadow contrast on the tracing paper, and it allows you to see where the pencil tip is moving as you trace the profile.

We need the raw tracing just as made. Do not work on it to heavy it up or take out the wiggles in your lines, and do not sketch in any other details or any dimension lines, etc. Just a bare profile by itself!

You can make a sketch or a second profile on separate paper for the purpose of sketching hidden details or to aid in showing various dimensions of the insulator's interior.

We need no dimensions of the exterior of the insulator which shows in the shadow profile. We need interior dimensions such as the pin hole depth, depth petticoats are recessed, depth of slots between petticoats and depth of collar where threads start. Also the centerline or overall (specify) diameter of interior petticoats, thickness of skirt and petticoats at their ends.

If the insulator has a crown groove which is dipped or cut away at the sides (such as U-482 or U-500), or a dimple in its crown such as on U-481, these features will not show in the shadow profile. You can make a rough sketch on separate paper (not on the raw profile) to show where these lines should be on a drawing.

You can make the entire setup within the house if you have a scrap of glass such as from an idle wall picture. Just prop up the glass vertically on the kitchen table, the flashlight down a hallway or whatever. If necessary, you can lengthen the light beam by using a mirror. In that case, the light from the mirror itself to the insulator should be perpendicular to the plane of your tracing glass.

BIBLIOGRAPHY

(Books on Porcelain Insulators)

- Albers, Marilyn and Tod, Jack H., Worldwide Porcelain Insulators. This book is a very comprehensive treatment of foreign porcelains and is the primary collector reference on them. It contains the Universal Style Chart of all known styles of worldwide (except U.S.) porcelain pin types, histories of manufacturers, all known markings, and shows attributions of styles and markings to manufacturer and country. Softbound, 1982, 8½" x 11", 84 pages, \$8.75 plus 80¢ shipping from Marilyn Albers, 14715 Oak Bend Drive, Houston, TX 77079.
- Albers, Marilyn and Tod, Jack H., Worldwide Porcelain Insulators -- 1986 Supplement. An additional 160 styles added to the Universal Style Chart since the 1982 book, plus much more information on manufacturers, insulator markings and countries of origin. Softbound, 1986, 8½" x 11", 42 pages, \$9.50 plus 80¢ shipping from Marilyn Albers, 14715 Oak Bend Drive, Houston, TX 77079.
- Bethman, David, Collector's Guide to Pricing Porcelain Insulators. This book lists specific values for over 1200 porcelain pin types, each keyed to U- number, marking and glaze color. The values given are representative of current "sticker price" at a large insulator show or on collector or dealer sale lists. Softbound, 1982, 8½" x 11", 50 pages, \$6 plus 80¢ shipping from David Bethman, 3307 Bennett Dr., Bellingham, WA 98225.
- Brown, Gerald, Collectible Porcelain Insulators. Photos, sketches, catalog pages and general information on all forms of porcelain insulators and related items. Although this book contains many pin types, its greatest value is as a general reference on other forms of insulators from small knobs through multipart pin types. Third Edition, 1983, softbound, 8½" x 11", 262 pages, \$20 ppd., from Quinith Brown Janssen, Box 265, Shepherdstown, WV 25443.
- Brown, Gerald, Fred M. Locke And His Insulators. A specialized book on Locke insulators. Very comprehensive. An absolute must for anyone specializing in Locke insulators. Published 1977, softbound, 7" x 8½", 90 pages. (Out of print.)
- Kareofelas & Cranfill, Dictionary of Glass - Ceramic Insulators Reprint. Has reprints of selected pages from old insulator and poleline hardware catalogs. Considerable interesting information and a useful reference on many forms of insulators and related items not shown in other publications. Softbound, 8½" x 11", 160 pages, \$6 plus \$1.05 shipping from Frank Peters (books), c/o Sara Peters, 4237 E. Fountain Way, Fresno, CA 93726.
- Mills, Brent, Porcelain Insulators and How They Grew. A detailed history of the porcelain insulator industry, mainly the major manufacturers of wet process porcelain pin types. Has no information on dry press insulators or the manufacturers specializing in them. This book is not collector oriented with style drawings and prices, but it is recommended for the library of serious collectors. Hardbound, 1970, 6" x 9", 228 pages, \$10 ppd., from Chris Hedges, P.O. Box 10368, Kansas City, MO 64111.

Peters, Frank, (catalog reprints). The Locke Insulator Mfg. Co., catalog #9 (1906), 64 pages. C. S. Knowles catalog #20 (1902), 50 pages. Very typical examples of early porcelain catalogs, well worth the \$3 each (both for \$5). From Frank Peters (books), c/o Sara Peters, 4237 E. Fountain Way, Fresno, CA 93726.

Tod, Jack H., Electrical Porcelain -- A History of the Industry in the United States. A very comprehensive reference book on all forms of electrical porcelain insulators other than pin types and high-voltage insulators. Contains the history of electrical porcelain insulators from their inception to modern times, histories of all the companies (over 100) known to have made electrical porcelain insulators, every known manufacturer's marking on electrical porcelain, illustrations and descriptions of all wiring insulator types, manufacturing processes, all pertinent registered trademarks. Softbound, 1977, 8½" x 11", 180 pages, \$14.75 plus \$1.05 shipping, from Jack H. Tod, 3427 N. 47th Place, Phoenix, AZ 85018.

Tod, Jack H., Insulator Patents, 1880-1960. From thousands of hours of patent search, every patent (695) the author found which in any way pertains to collectible insulators. Each entry has the patent number and date, invention name, inventor, and the insulator drawing from the Official Patent Gazette. All patents are cross-indexed by date, patent number and use classification. Information on how to obtain complete patents from Washington, D.C. Softbound, 1985, 8½" x 11", 130 pages, \$20 plus 80¢ shipping, from Jack H. Tod, 3427 N. 47th Place, Phoenix, AZ 85018.

(Selected Books on Glass Insulators)

Albers, Marilyn and Woodward, N.R., Glass Insulators From Outside North America, First Revision. The primary reference on foreign glass pin type insulators, with Consolidated Design Chart and its reference numbers for all foreign styles (nearly 250), complete listing and attribution to manufacturer of all the foreign insulator embossings, histories of manufacturers. Softbound, 1986, 8½" x 11", 68 pages, \$11.95 plus 80¢ shipping, from Marilyn Albers, 14715 Oak Bend Drive, Houston, TX 77079.

Milholland, Marion & Evelyn, Most About Glass Insulators. One of two primary reference books on North American glass insulators -- pin types plus others. Pictures every style and tabulates all known color and embossing varieties for each style. The Fourth Revision, 1976, hardbound, 6" x 9", 456 pages, \$20 ppd. Also accompanying Price Guide, 1986, softbound, 6" x 9", 153 pages, \$12 ppd. Both from Evelyn Milholland, 3734-B Tacoma Ave., Tacoma, WA 98408.

Woodward, N. R., The Glass Insulator in America, 1973 Report. A primary reference book used by collectors of glass insulators. Histories of the manufacturers, the Consolidated Design Chart with reference numbers for all the designs, descriptive list of all pertinent patents, cross-indexed list of manufacturers of each design. Softbound, 1973, 8½" x 11", 90 pages. (The 1973 Report is out of print. A new edition is in preparation for 1988 publication.)

(Periodicals)

McDougald, Carol (Editor & Publisher), Crown Jewels of the Wire (issued monthly). The only nationally circulated magazine devoted exclusively to the insulator collecting hobby. Feature articles, porcelain insulator column, foreign insulator column, letters from collectors, show calendar, show reports, classified ads, etc. Each October issue is a combined name-and-address directory of all subscribers with the membership list of the National Insulator Association. Softbound, 5½" x 8½", \$13 per 12 issues, P.O. Box 38312, Cleveland, OH 44138.

Sovereign, Michael (Editor), The Crown Point. A bimonthly newsletter devoted to collectors of lightning rod materials. Covers balls, vanes, pendants, arrows, etc. Six issues (Year) \$6; sample issue for long S.A.S.E. From the editor, 525 E. Illinois St., Wheaton, IL 60187.

(Insulator Collector Organizations)

The National Insulator Association, founded in 1973, is the most important and largest collector organization. It is active in many ways to advance the hobby for members and nonmembers alike. The "N.I.A." sponsors three large insulator shows annually, one in conjunction with its annual convention, the others in each of the other two geographic regions, and it sanctions all the worthwhile local insulator shows.

(Reference Credits, Porcelain Insulators Guide Book)

Brewer-Titchner Corp., The History of Hi-Line Hardware Since 1882. Related early history of porcelain insulators, 1960, pages 1-8.

Ohio Brass Co., Birth of an Insulator. Detailed picture and word story of the manufacture of insulators by wet process. O-B publication 2253-H-4. Ohio Brass Co., 380 Main St., Mansfield, OH 44902.

Watts, Arthur S., Early History of Electrical Porcelain Industry in the United States. Paper published in Bulletin of the American Ceramic Society, Vol. 18, No. 10, pages 404-408.

Additionally this research relied upon the following: Material contained in the catalogs, publications and advertisements of all the various manufacturers; records of the U.S. Patent Office; articles and news reports in all related electrical trade journals; public library vertical files and porcelain industry history books in cities located in the Ohio and New Jersey "porcelain belt"; personal interviews with the management and engineering people at all active insulator plants; and considerable contributions of documented information from insulator collectors and other researchers.

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