Technical Innovations
1271 La Quinta Dr. Ste 6
Orlando, FL 32809
407-601-1975
www.homedome.com

Assembly Instructions for PRO-DOME Observatory PD-15

S/N _____

Congratulations.

You have purchased a PRO-DOME® observatory, which will serve you well in the years to come. We are sure your new dome will increase your enjoyment of observing, and help you be a more active astronomer.

Even though you will be constructing the equivalent of a small building, the PRO-DOME is easy to assemble. However, it is essential that you read these instructions because the assembly involves the handling of fairly large structural pieces, use of power tools, and the need to perform mechanical assembly. Assembly should be an enjoyable experience, so take your time and be careful.

We hope and believe that you will be happy with this product. We ask that you let us know of any suggestions or criticisms of our products. We have incorporated many ideas from customers into these instructions, and into the PRO-DOME design. We thank all who contributed (and you are the beneficiary!) If, at any time, you have questions, please feel free to give us a call so we can help you. Our aim is for you to be satisfied!

JERRY SMITH
Technical Innovations

CAUTION

Handling fiberglass improperly can result in skin injury, while failure to perform several easy, but crucial, steps in the PRO-DOME assembly can cause the PRO-DOME not to operate properly. In addition, failure to follow recommended assembly may result in injury during or after construction. Please at least scan all parts of these instructions, even those parts covering skills you already have.

Technical Innovations is not responsible and assumes no liability for any damage or injury arising from assembly or use of this product. While the instructions include cautions and warnings, it is ultimately the customer who must exercise good judgment and care in the assembly and while the observatory is in use to avoid damage to materials or persons, and it is the customer who assumes all risk and liability.

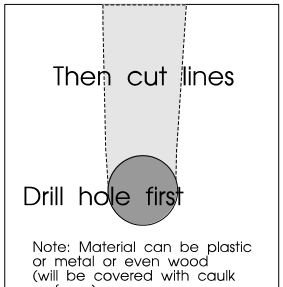
Table of Contents

PARTS LIST PD-15

Fiberglass Pieces
Front Quadrants, one each Left & Right
Rear Quadrants (with notch in slot edge), one each Left & Right
Dome Support Ring Sections (4 pcs including door swingout)
Rear Cover (1)
Top Shutter (1)
Front Shutter (1)
Base Ring Sections (7 including molded door, stub sections)

Fittings and hardware
Stainless Steel Carriage Bolts
Stainless Steel Flat Head Bolts
Nuts, washers
Front Latch (40 in long)
Rear Latch (27 in. long)
Shutter Catcher/Wind Restraint Brackets (2)
Wheels (48) and Side Rollers (24)
Handles (2)
Shutter Restraint System (cables, bolts, etc.)
Shutter bearing strips (5 pcs) & surface cleaner
Front Shutter Edge Molding
Rear Opening Cover (Soffit)
Semidoor hardware (upper and lower latches, piano hinge, safety latchers, bolts)
Electric Dome Drive (4 motor plates, hardware, cable)
Electric Shutter (drive motor, cables, pulleys)
Power supply (PS-2) w/ hardware
Caulk
Instructions

Tools Required by Purchaser (not included with PD-15)
3/8 in electric drill, bits
(two drills are even more efficient)
Countersink (82 deg. preferred)
File or rasp
Metal rule (25 ft. or longer)
Carpenter level or water level
Hand tools: clamps, screw drivers, socket wrench set, etc.
Large metal square & straight edge
Duct tape
Caulking gun
Gloves, Eye Protection
Stepladders (6 ft., 12 ft.)
Worktable - Sawhorses & plywood OK
Extension cords
Foundation bolts, fender washers
Shims & spacers for leveling**

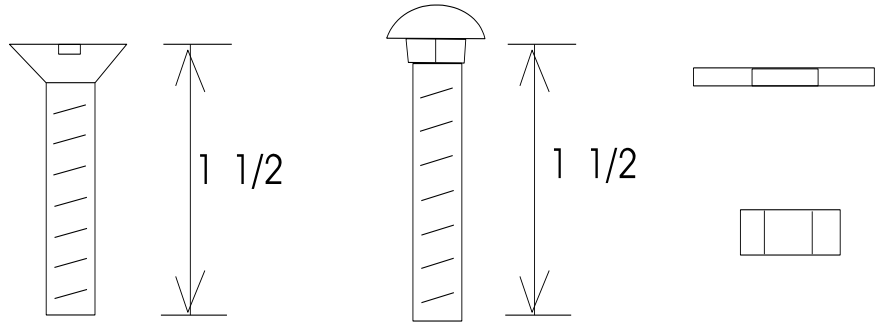


** Shims – have several thicknesses available (such as 1/8", ¼"). The design shown here is useful because you can slide it in under the fiberglass and around a bolt without having to remove everything.

BOLT COUNT FOR BASIC PD-15

BOLT LOCATION	Flat 1½"	Carr 1¼"	Flat 1"	Carr 1"	Flat 3/4"	NUTS	WASHERS	Special
Greenwich Flange		20				20	20	
Base Ring			5	5		10	10	
DSR safety				4		4	4	
Equatorial Flange					40	40	40	
Rear Cover	20					20	20	
Shutter Latches				9		9	9	
Shutter Catchers				6		6	6	
Shutter Stop		2				2	2	
Handles				4		4	4	
Rollers	48					49	0	
Side Rollers								25 self tap
TOTALS	69	22	5	28	40	168	15	
Wall Ring (Opt)				34		34	34	

Notes: 1. Non-1/4-20 hardware for Semidoor, latches, etc. not shown
2. Extra bolts, nuts, etc. are provided



FLAT HEAD SCREW/BOLT CARRIAGE BOLT NUT & WASHER

SCREW LESSON

The outer diameter of small screws is a number such as #6, or #8. #8 is bigger than #6. In larger sizes, the diameter is in fractions of an inch (e.g., 1/4 inch). The second number (e.g., 6-32, 1/4-20) is the number of threads per inch. The third number (e.g., 6-32x1/2) is the length in inches.

1. INTRODUCTION TO INSTRUCTIONS

The assembly of the PRO-DOME involves several steps. These include:

* obtaining necessary permits
* building the foundation
* assembling the wall (if any)
* assuring that the top of the wall is level
* installing the base ring and rollers
* assembling the dome
* installing the shutters
* installing the fittings and hardware

Building Permits

In some areas, building permits are needed for the installation of the PRO-DOME, although there are sometimes exemptions for small accessory structures. If you need a permit, you will need to apply for it, and include a sketch of the proposed location, and a sketch of the proposed installation. If the PRO-DOME is to be installed on a school or house or other inhabited building, special fire or other codes may apply in addition to structural integrity requirements. Check with the local officials: it is much easier to handle the questions before you build, than to find out later you are in violation of the local law.

Foundation

The PRO-DOME must rest on a secure foundation if it is on the ground, or framing support if it is to be installed on a deck or other structure. The major purpose of the foundation is not to support the weight, since the PRO-DOME only weighs about 650 pounds. Rather, its purpose is to provide stable support under all environmental conditions.

The foundation must support the observatory so that the walls and dome do not twist as the ground freezes or thaws or becomes dry vs. wet (this could cause the dome to become hard to turn).

FIG 4,5,6

The foundation must hold the PRO-DOME down in the case of severe wind. Depending on the area of the country, hurricane or other winds 80 mph (or more!) can occur, so building codes require that buildings and their foundations resist such winds. (An 80 mph wind on the PRO-DOME can generate a force of over 1500 lb.!). In addition, in most cases, the foundation system must provide some means of leveling the observatory.

The foundation may be part of a building or house, a deck, a ring foundation, piers into the ground, or a concrete pad (often with wood or carpet covering). If you want suggestions, please contact us for more information on constructing foundations.

Foundation bolts

Selecting the appropriate foundation bolts to hold the bottom ring to your surface is your responsibility. The most common bolts are lag bolts into anchors in a concrete pad, or carriage bolts through a wood deck. In all cases, it is absolutely necessary to use washers at least 1 1/2 inch diameter under the bolt heads. In general, we recommend using 3/8 inch diameter bolts spaced about 16-18 inches apart along the bottom flange. Lag bolts

should penetrate the pad or deck at least two inches. Be sure to allow enough length in case you need to use shims under the wall or base.

Installation Practices

Many of the installation steps take longer to read than to do. While no complex carpentry or other skills are needed, you will need to perform some measurements, locate and drill holes, and install bolts. Sometimes edges of fiberglass may need to be sanded or trimmed. However, no experience is needed in working with fiberglass, and no application of fiberglass needs to be done. None of the pieces weigh more than about 75 pounds, so even though they are bulky, they are relatively easy to handle.

We would strongly urge that you have several workers to help you assemble the PD-15. This allows you to check on each other, and will help avoid mistakes. A second person can help a great deal in holding items in place while the first drills holes and installs bolts. Certain steps in the PD-15 assembly normally require four or more persons working in concert.

Before beginning construction, all workers should read through the directions and study the pictures. Note especially the terminology that we use for the various parts. We urge that you **not** try to build the dome in an order different from that in the instructions: some of the short cuts that look attractive have traps in them (we know - we've gotten stuck!)

Finally, if you make a mistake, don't panic. In most cases you can just take the components apart, drill new holes, and do it over. If you want to, you can always go back later and patch any mistakes with resin (that is one of the virtues of fiberglass!) And if you get really stuck, give us a call and we will try to help.

Bolt Hole Drilling Guide

Some of the assembly steps inside this manual refer to “marks” on the fiberglass to identify hole locations for drilling that may or may not still show up on the fabricated fiberglass sections. We strongly recommend that the Bolt Hole Drilling Guide be reference every time you start an assembly step that involves drilling holes. This guide will reflect the prorper measurements and locations and will eleiminate some confusion that may arising in the step description. Some holes are drilled as “guide” holes (where two sections of fiberglass overlap) and are then used for the “final” hole drilling when the two sections are properly aligned abd are ready to be bolted together. This is the way that the drilling guide is broken out.

2. SAFETY PRECAUTIONS

Constructing a PRO-DOME requires you to follow several safety precautions and use common sense, since the activity does include mechanical and manual operations. Care is needed in the use of tools and you should follow the precautions provided by the manufacturers of any tools you may use. Since you will be constructing a small building, you will need to use step ladders: be careful. While the fiberglass parts are not very heavy, they are bulky: use care in handling them so that neither you nor the parts are injured. Carefully read all the instructions, and think through your activities before you commence. Make liberal use of props, tape, clamps, or other aids in the construction.

CAUTION

If the dome is to be installed on any support or wall more than three feet above the ground, or in a location with difficult outside access, we **STRONGLY** recommend that you pre-assemble the base ring, dome, shutters, and all fittings on the ground. You can then assemble the dome in a convenient and safe situation. Once pre-assembled, it only takes an hour or two to disassemble the parts. You can then reassemble in place, knowing how the parts fit together, and with direct experience in handling the pieces.

Fiberglass

Fiberglass is really a misnomer: the material is fiberglass reinforced plastic (FRP). In our case, the plastic is polyester resin (not epoxy). In its "raw" state, polyester resin is a syrupy liquid, After mixing about 15 drops of catalyst per ounce of resin, it hardens in about an hour. Because the hardened resin is somewhat brittle, it is reinforced with fiberglass for strength, and to prevent the propagation of cracks. The fiberglass can be in the form of woven material which has the resin spread onto and into it, or long fiberglass strands which are chopped into 2 inch pieces, then mixed with resin that is sprayed into a mold.

Fiberglass has many virtues, but also two potential problems:

FIBERGLASS IS FLAMMABLE
FIBERGLASS CAN IRRITATE THE SKIN

Yes, fiberglass will burn, or rather, the plastic in it will burn. Once started, it does burn very hot (you might want to try a 1 square inch piece in a fireplace to see). Therefore, use common sense as you would with wood or any other flammable construction material. Keep fire and open flame away from all parts of your PRO-DOME. Also, do not let fiberglass dust or trimmings accumulate. Be especially careful about this where there is any risk of flame or fire.

The fiberglass within the FRP is glass, and it can cut or abrade the skin. Sharp edges of the dome pieces can cut, so be careful. Whenever handling FRP pieces, always wear gloves to be on the safe side. Of course, the surfaces of the FRP are smooth, because they have been coated with a layer of resin (called Gel-coat) that covers the glass.

Fiberglass dust can irritate the eyes and skin. When cutting or trimming or filing or drilling -- in short, whenever doing something to the FRP that makes dust -- always use gloves and eye protection. Also, wear a long sleeved shirt and long pants. In addition, be sure to change your clothes and wash thoroughly when you are done the dusty part. If there is lots of dust, change how you are doing things to reduce the dust exposure! Reasonable care is all that is needed; however, failure to follow reasonable care could lead to eyes or skin that itches for a day or so. Hand lotion can help relieve itchy skin. If itching persists, see your physician.

Construction and Operation Cautions

During construction and operation, there are specific cautions that must be followed. The PRO-DOME observatory is not a toy, so be sure that children (and adults) do not climb upon it. Since the observatory does contain moving parts, users must be careful to avoid injury. Keep your fingers away from the moving parts where they might become caught.

The shutters CAN BE DANGEROUS. Each shutter weighs about 50 lb., and slides on the slot edges. They are normally interlocked, and under control of the user. However, if they should not latch properly, or if they are separated for maintenance work, the shutters (especially the front shutter) can begin sliding with little warning. It is ESSENTIAL that care be used never to let the top or front shutter rest by itself at the top of the dome without proper anchoring (if the two are latched together as they normally are, there is no risk). To help prevent injury, you should consider installing a safety device on the front of the dome to limit unexpected downward movement of the front shutter.

To prevent high winds from damaging the dome, it is **essential** that the shutters be fully latched and the front shutter fastened when the dome is not in use.

3. SPECIAL ASSEMBLY INSTRUCTIONS

This section contains special instructions that apply to several parts of the assembly. We have written these for the relatively unskilled assembler. However, even those who are skilled in carpentry or other mechanical assembly SHOULD read and follow these instructions, especially concerning leveling the structure.

Nomenclature

FIG 13

Parts of the PRO-DOME observatory have special names. These include the following.

- **Reverse Flange** - This is the curved topmost flange that is a part of the top flange of the base ring or wall. The purpose is to hold the dome down in case of wind, and also to provide a drain for any water that might enter the dome.
- **Equatorial Flange** - This is the internal flange at the "base" of the dome quads where the equator would be on the earth.
- **Front of Dome** - The dome is that portion of the observatory that rotates. The front of the dome is the location of the front shutter.
- **Front of Observatory** - The observatory wall (or observatory building) is stationary and does not rotate. Usually, we define the entrance door to be the "front" of the observatory. These considerations are important when you install the foundation and walls, since you will want the door to be in the proper location relative to where you want to enter the observatory.
- **Home Position -** When the slot opening is lined up with the door, it is in the HOME position.
- **Base Ring** – the ring that has the rotation rollers.
- **Foundation Ring** – the bottom most ring of the wall that bolts to your foundation. It will be the same as the base ring if you are not using extra wall rings.

See later chapters for details.

Locating Holes

In assembling the PRO-DOME, you will need to drill holes and insert bolts to hold the various pieces together. But how will you find where the holes are to be and what is the hole drilling procedure?

In some cases, we have marked the hole locations with dimples or with small cross marks on the smooth side of the fiberglass. These holes are to be drilled before assembly. During assembly, if some of the holes do not quite line up, and if you are SURE no assembly mistake has been made, you can use your drill to "open up" the holes to accommodate a bolt. Hole sizes will be given in the instructions (most will be 5/32”, 1/4", 9/32", 3/8" or 5/16").

We have includes a Bolt Hole Drilling Guide at the end of this manual. We highly recommend that this guide be referenced every time a step calls for locating or measuring hole locations prior to actual drilling.

Drilling and Bolting

FIG 1

Many PRO-DOME parts are held together with carriage bolts or flat head bolts, 3/4 or 1 inch long. Carriage bolts have round tops, with a square shank that catches in the hole, preventing turning of the bolt. Flat head bolts are installed in a countersunk hole. We provide stainless steel carriage and flat head bolts, washers, and nuts to minimize corrosion.

In most cases, bolt holes are drilled before pieces are assembled. Drilling in fiberglass requires use of eye and skin protection, but otherwise presents no problems except that bits become dull after 50-100 holes. If a flat head screw is to be used, you will also need to use a "countersink" to create the sloping hole to accommodate the screw head. If available, use an 82 degree countersink, and cut the material just enough to recess the flat head.

Once the holes are drilled, assemble the pieces by installing the carriage bolt or screw in the proper direction (the instructions will tell you in each case). Be sure the bolt head is snug into the hole. Install a 1/4 inch washer and nut, and tighten. If the nut will not turn, check for fiberglass dust in the threads -- clean the nut and bolt and try again. Do not force the nut! A drop of oil may help as well.

If you drill a hole in the wrong location, either re-drill a new hole in the correct location, or, for small errors, enlarge the hole on the "nut end" piece, and install one or more large washers, or metal or wood plates, before installing the nut.

Here are some additional tips for drilling holes in fiberglass, or cutting it:

- Drill a pilot hole smaller than the final hole to keep the drill from wandering during the final drilling.
- A common twist drill will produce a triangular hole. In some cases, this can cause a problem. To prevent this, simply drill a hole a few 64ths smaller than the final hole, then finish drill with the desired size.
- Drilling fiberglass produces fine glass dust. If you leave it in the hole, the dust will get into screw threads and make nuts hard to turn. Clean the holes (rag on a screwdriver) and use a bit of oil on the screw to reduce the problem.
- A drilled hole will usually have a ragged edge. In most places, this is not a problem; however, you may want to know several tricks to prevent this. These include predrilling undersize holes, back up the fiberglass with a piece of scrap wood while drilling, drill partway through on one side, then do the other side. You can also lightly countersink every hole after drilling.
- We often call for use of a countersink (makes a conical hole). If you don't have one, you can use a large bit (eg 1/2 inch bit on a 1/4 inch hole) to make the cut. However, be careful not to go too deep. Also, note that the angle of the cone may not match very well the bolt that will go in it (usually 82 deg).
- Sometimes the gelcoat will chip when drilling or sawing. If this is a problem, there are tricks to use. These include putting masking tape on the gelcoat before drilling/cutting, use high speed cutting with low pressure, using fine toothed cutting blades, and drilling preliminary undersize holes.

Leveling the Foundation, Wall, and Base Rings

The more level the foundation is, the easier your overall installation will be. In any case, the top of your base ring or wall must be level (or at least planar). If the base ring is not level, the dome will not be supported

uniformly on its rollers. This can cause a variety of problems not only with turning the dome, but also with the shutter operation as the shutter opening may be distorted. At least 1/4 inch accuracy in leveling is needed; however, 1/8 inch is even better.

While the "bottom line" is to achieve a level base ring, any wall built below the base ring should also be level and/or provide a means of leveling the base ring. Leveling techniques using shims or adjusting bolts are discussed below in the foundation section.

There are many ways to perform the leveling. Here are details on several of the best.

* If you have a **transit or theodolite**, you can use it.
* If you have a **split image transit** or **eye held level**, don't bother. It is not accurate enough and/or is too hard to use for this application.
* **String levels** are not sensitive enough.
* The **human eye** can see out-of-plane errors in the ring; however, it is very confusing to identify which portion is too high or low, and hard to estimate the amount. It is also hard to keep track of errors in the portions of the ring crossways to the line of sight, versus those more parallel.
* **Carpenter levels**, if sensitive, can be used, but will not do the job if simply moved around the circumference. See below.
* **Water levels** are far and away the easiest and best way to level the base ring or wall. They can be made or bought (about $15), and are described below. (We once spent two frustrating hours with a carpenter level and split image transit and could not do better than 1/2 inch, but a water level did the job to 1/8 inch in ten minutes!)

Leveling with Carpenter Level

FIG 2

The two to four foot carpenter level can serve to level the structure. However, you will find that if you simply move it along the circumference, it is impossible to level the ring accurately. The problem is the subtle shifts of the bubble as you move around the ring.

A much better method is to set up a support at the center of the dome, at a height equal to the top of the wall ring or the item to be leveled. Use a bar from this center to the outer ring, and place the level on the bar. Now as you swing the bar around, you can track which parts of the ring are high or low relative to the center. It is easy then to adjust the wall ring to a level condition.

Leveling with Water Level

FIG 3

This is the best! A water level is made of two see-through containers, connected by a flexible, long tube, filled with colored water. (Hint - Use food coloring.) After adjusting the water levels, one container is set on a reference point (e.g., one spot on the ring) while the second one is moved to different points around the ring and the difference in elevation measured. The water level in the moveable container will rise (or fall) with the fall (or rise) of the level of the point you are measuring when compared to the reference point.

Commercial water levels read directly in inches, so it is easy to make accurate leveling corrections. Homemade water levels will work fine, so long as they don't leak. Water levels are tough to use in freezing weather!

Making the Observatory Circular, and maybe Centered

While only the base ring **MUST** be accurately circular, it is highly desirable that all portions of the dome, including the foundation and walls, be circular. On the other hand, while aesthetically desirable, it is not

necessary that the observatory be centered on some "magic" point, with all parts concentric (note that the telescope pier need not be at the center of the dome).

Identify the center of the observatory and mark it with a a screw driven firmly into the foundation, or a small post sunk solidly into the ground. Mark the exact center of the screw or the post with a small nail driven into it but projecting 1/4 inch. You can now use this as the center for marking the foundation, your foundation bolt circle, etc.

The easiest way to start is to draw inner and outer diameters for your wall or base ring directly on the foundation. You will match the inner edge of the foundation ring bottom flange to the inner diameter that you drew. The outer diameter is there as a reference too, but use the inner mark because it is easier to keep in view.

FIG 2

To check the "centeredness" of successive (higher) wall rings, you will want a "center point" that is at the height of your wall. We will describe one easy method of providing this center.

As you build the observatory higher, you can use a plumb bob from beneath a tripod (surveyor or camera tripod) to establish a center at any height you want. If you have no tripod, nail a box together, or stack cinder blocks so that you can hang a plumb bob over your center point. With a little care, you should be able to perform the centering to about 1/8 inch. In either case, you can then use a tape measure to measure the radius to each point around the wall, so as to show that the wall is both circular and centered.

Several dimensions will be used later in the assembly of your dome. We put them in a table below, for your reference.

ITEM	OUTER DIAMETER AVERAGE (IN.)	CIRCUMFERENCE (IN.)
Base Ring	179.00	562.00
DSR	180.57	567.00*
Dome	180.00 (nom)	565.00

* Measured 1 in. below upper flange of DSR

4. FOUNDATION

The PRO-DOME must rest on a secure foundation if it is on the ground, or framing support if it is to be installed on a deck or other structure. The major purpose of the foundation is not to support the weight, since the PRO-DOME only weighs about 650 pounds. Rather, its purpose is to provide a stable support under all environmental conditions.

The foundation must support the observatory so that the walls and dome do not twist as the ground freezes or thaws or becomes dry vs. wet (this could cause the dome to become hard to turn).

The foundation must hold the PRO-DOME down in the case of severe wind. Depending on the area of the country, hurricane or other winds up to 80 mph can occur, so building codes require that buildings and their foundations resist such winds. (An 80 mph wind on the PRO-DOME can generate a force of over 1500 lb.!). In addition, in most cases, the foundation system must provide some means of leveling the observatory (usually using shims).

The simplest foundation fastening technique is to drill 5/8 in. holes in the foundation, install anchors, and use 3/8 lag bolts (with washers), and shims as necessary for leveling. An alternative is to use studs (threaded rod or bolts) cast into the foundation with adjusting nuts. Both schemes are shown in figures below. In any case, the foundation should be built to be as level as possible, so that height adjustments to level the walls are minimal and easy to do.

Technical Innovations has supplied several sample foundation and anchoring designs, but any support or foundation design **must be approved** by your local building code officials. We make no warranty that the designs will be legal or function in your particular circumstances. These can be "mixed and matched" to meet your needs. All these designs are suitable for do-it-yourself construction; however, if you are not comfortable with such a project, check your local library for books on foundations and concrete construction.

Ring Foundation

FIG 4

An excellent foundation is a concrete ring. The thickness and depth of the ring depend on local law and weather conditions, but typically might be five inches in radial thickness and two feet deep. The top of the foundation should be several inches above the ground, and sloped very slightly outward for drainage. Lag bolts with anchors or foundation bolts cast into the foundation are both feasible. Then, if using wall rings, holes are drilled in the lower wall ring flange to match the bolt locations.

When building a ring foundation, don't forget to allow some holes through the foundation for power or other cables! You may also want steps or a ramp cast at the same time, depending on how you wish to enter the dome.

Pier Foundation

FIG 6

Instead of a continuous ring, you may want to install piers. We recommend twenty piers -- these may be pressure treated posts, concrete, or other material. Again, your building code official must approve any design.

One advantage of wood piers is that it is easy to locate and drill holes for the foundation bolts. Also, wood piers may be easier to install at remote locations. A disadvantage may be that digging twelve holes is a lot of work in some soils!

Concrete Pad

FIG 7

Another alternative is to pour a concrete pad that will serve both as a floor and as the foundation. This is perfectly feasible, but may be more costly than other alternatives. You may find the floor to be uncomfortably hard and cold; however, outdoor carpet or a wood floor will correct that. If you use a concrete pad, install your pier before pouring the floor, or at least leave a hole so you can have a separate pier or post for the telescope. You will also want access for cables from the outside to the dome walls and to the central pier. Depending on your local laws, you may need separate footings for the pad. In most areas, the pad should be about 4 in. thick, should have heavy reinforcing wire in it, and should have some gravel drainage beneath it. Be sure to install a sheet of plastic under the concrete to keep out moisture.

Wood Deck

Another type of foundation is to construct the observatory on a wood deck. This is perfectly feasible; however, it is obviously important that the deck be well constructed to withstand wind forces. It is also vital that the wood be treated to prevent rot. Such an installation will normally have a hole near the center of the observatory for a separate pier extending down to the ground. If the deck is more than a few feet above the ground, be sure to provide strong railings. The interior floor of the deck can be left as is, or additional flooring (eg., plywood and outdoor carpet) can be added.

5. WALL AND BASE RING ASSEMBLY

Now we are ready to build the observatory! Even if your installation does not include a wall (other than the base ring), be sure to read the material on wall rings because wall ring and base ring assembly are very similar.

CAUTION

If the dome is to be installed on any support or wall more than three feet above the ground, or in a location with difficult outside access, we **STRONGLY** recommend that you pre-assemble the wall rings, base ring, dome, shutters, and all fittings on the ground so that you can assemble the dome in a convenient and safe situation. Once pre-assembled, it only takes a few hours to disassemble the parts. You can then reassemble in the final location, knowing how the parts fit together, and with direct experience in handling the pieces.

The assembled PD15 weighs about 700 lb, including shutters, but not including any wall rings. Although the pieces can be moved by hand and assembled in place (after preassembly), you may find it easier and safer to assemble and test the observatory at ground level, then rent a crane to lift the entire assembly into position. This will require the help of persons with professional rigging experience.

The wall may be constructed using your own plans or using wall rings supplied by Technical Innovations (or both). However, if you build your own wall, you will find that it may be difficult to construct a door that will operate properly with the PRO-DOME semidoor. Any wall must also be able to handle wind loads, prevent twisting as the dome is turned, be water tight and resistant to the weather, look good, and, last but not least, provide a solid, level support for the lower flange of the observatory base ring.

If you are constructing a wall of your own design, we urge that you send a copy of your proposed wall design to Technical Innovations. We can review it, and may have suggestions or cautions that will make the wall easier to build, or otherwise help assure a successful installation.

Wall/Base Ring and Semi-Door Assembly Instructions

FIG 9, 9B

Constructing all or part of a wall with PRO-DOME wall rings is very easy because sections form a ring of the right size which can then stacked and bolted to the desired height. The wall rings are the same design as the base ring, so the same assembly for each is followed. The base ring is different from the wall ring by having a reverse upper flange, an access hole for aid in assembly, and holes cut into the upper flange for the rollers and motor drives.

The PRO-DOME wall ring (and base ring) is divided into five equal length sections of the circle. Four of the sections are single piece, full length, 72 degree sections. The fifth section contains the molded semidoor section, a left hand stub section (left hand as seen from the outside of the wall), and a right hand stub section: the three pieces (with spacing for the latches and hinge) are equal in length to the full length sections. The door hinge will be on the right hand side of the door, as seen from the outside.

Because the Semi-door is made of sections with the same height as the wall sections, the wall to which the door is mounted should be at least 1/8 in. above the foundation to allow the door to open easily. When you install the first wall ring, if the leveling and shimming process does not result in at least this much space under the ring, you should insert the necessary shims around the ring. After assembly of the observatory, you will seal this space with caulk or other sealant.

We and our customers have developed two different ways to construct the wall. Each has advantages. We will describe both, and you can pick the one you are most comfortable with.

In general, assembly is one ring at a time, but modified for walls higher than two feet. You will bolt the four full length sections together, clamp the door in place with spacers, and check the circumference before bolting the stubs to the adjacent wall ring sections. You will then build the next ring similarly. You will align the door jambs, and bolt the rings together. You can then add more rings, finishing with the base ring. NOTE: For walls higher than two feet, you should change the order somewhat, creating the entire door, the left stubs and right stubs as pre-built units before assembling the rings.

First Ring Assembly

FIG 9B

To assemble your **first** (lowest) ring, select four full length sections, a left stub, right stub, and molded door. You will notice that one end of each section is "stepped" inward (the "male" end) and this fits into the plain "female" end of the next section. The male end will aim to the RIGHT as seen from the outside of the section. The female end of each section has two marks on the web (12 in. high portion) which are the locations for the joint bolts. The lower flange of each full length section of the wall/base ring also has four suggested location marks for the bolts used to fasten the ring to the foundation or to use for fastening successive rings together. The stub and door sections have two suggested foundation/interconnect bolt locations.

You will now identify and drill holes in the sections, fit the sections together, and check the circumference before drilling and bolting the final joint. The first ring is a little tricky, because you have to fit the pieces together to make the ring, while fitting it to the foundation, as well.

If you are going to use the pre-marked holes to locate foundation bolts, find the four marks on the lower (not the upper) flange, and mark the approximate locations on the upper (inside), rough, inside surface of the flange (don't drill them yet). Do this for each piece.

Find the two marks on the outside of the female end of each piece and drill 5/16 in. joint holes.

HINT: In this case (and in others during dome construction), you may find that the marks for some pre-marked hole locations are not present or don't fit your desires. When this is the case, simply lay out your own hole locations while keeping at least the same number of holes specified. If you have doubts about the locations, give us a call for advice.

Now assemble the four full length sections and the right hand (male) stub on a reasonably level surface, with male ends pointing right. Insert a male end tightly into a female end, and using the previously drilled holes as a guide, drill holes in the male end. Install 1 in. carriage bolts, washers, and nuts in the joint from the outside in. Do all four joints. Be sure that both the upper and lower parts of each joint are fully seated: often the second joint needs to be pushed together to avoid a conical shape to the wall.

Insert the left (female) stub. Place a piece of 1/8 material (such as cardboard) between the left hand door jamb and the left hand door edge and hold the pieces together with a C-clamp. Do the same on the right hand side of the door section.

You will now check the circumference before drilling the final holes (in the male end of the left stub).

Measure the circumference (i.e., the distance around the ring about one inch down from the top) with a metal tape rule. Your goal is a circumference of 562.00 inches (+/- 1/4 in.), corresponding to an average diameter of 179 inches. If the circumference is too small, pull the sections apart as necessary. If too large, push the last

joint closer together (cut some of the female end if necessary). When you are satisfied, drill the final two holes in the male end and install the bolts.

Note that while your wall ring has an **average** diameter of 179 inches, it is likely not to be an exact circle. That is, across one diameter it will be 178 while another may be 180 inches. Wall rings can easily be "nudged" two inches out of circular shape (and conversely, are easy to nudge INTO circular shape). To gain a bit of experience, take a few minutes with the wall ring on a level surface, and measure -AND WRITE DOWN THE RESULTS- the diameter for at least six different "diameters" (directions) across the ring.

The easiest way to take diameter measurements is use a steel tape from the inside (blue) surface to the opposite blue side of the ring. If you swing the tape measure a few inches left and right, you will note the spot with the longest measurement, which is the diameter.

Try adjusting the ring to become circular to within about 1/2 in. maximum range (e.g., 178 3/4 to 179 1/4). This is an easy task, but only if you keep track of your work with a drawing!

Installing First Ring on Foundation

Now the job is to put the first completed wall ring on the foundation with the door section at the desired front (i.e., the entrance) of the observatory. You will need to provide at least 20 3/8 or 1/2 in. bolts or anchors into the foundation to hold the observatory in place during high winds.

The challenge is to mount the ring onto the foundation, while assuring that it is circular, and getting holes in the lower flange to line up with your foundation bolts or anchors! If you are going to have a semi-door, you will also want to have a minimum of about 1/4 in. of shim under the wall so that the door will open easily.

If you have a PD15 with a door, you should also consider shims under the wall. Because the door sections are the same height as the wall ring sections, the door height is the same as the wall. Therefor, if the bottom of the wall is on the base, the bottom of the door will scrape the floor, and the door will be difficult to open. Most floors are not flat, and require some shimming to produce a level wall. To give door clearance, you should have about ¼ in. of shim under the wall.

Lag Bolts and Anchors. If you are going to use lag bolts and anchors, you will already have marked the holes on the inside of the lower flange (but don't drill them yet). You can't simply drill holes in the flange, mark the concrete, and drill the concrete because when you drill into concrete the hole will wander away from the mark as the bit hits stones in the concrete. Proceed as follows.

FIG 7

- Place the ring on the foundation, and adjust it to be circular to within about 1/4 in. or better.
- Use a magic marker and draw the inner and outer outline of the base flange onto the foundation. Mark the azimuth locations around the ring on the foundation for the foundation holes. After marking the ring so that you can reinstall it in the same position, remove it.
- Mark and drill your anchor holes with a masonry bit. Install the anchors.
- You will likely find that the drill bit will have wandered, but not to worry. Draw a pair of 12 in. guidelines to the actual location of each anchor on the foundation.
- Reinstall and re circularize (ugh, what a word) the ring. Using the guidelines and a straightedge, you can easily mark the wall ring flange for the exact hole locations to match the anchors in the foundation.
- Remove the ring and drill your foundation bolt holes in the lower ring. Once the holes are drilled, again make sure the ring is circular, and install the bolts and washers into your anchors.

FIG 5

Cast Foundation Bolts. If you are using foundation bolts already cast into the foundation, proceed as follows.

- Set the ring lightly on top of the foundation bolts. Make the ring circular, then mark the bolt locations on the underside of the wall ring flange.
- Drill your foundation bolt holes in the lower flange of the wall ring
- Install the wall ring on the foundation bolts as shown on the sketch.

Whichever fastening method is used, you will want at least 20 bolts to fasten the lowest ring to the foundation. You must install washers under the bolt heads or nuts as shown, so that the wind and other forces will be spread out on the flanges. Use steel washers at of at least 1 in. diameter. As noted above, you should also assure that the stub sections next to the door must end up shimmed at least 1/8 in. above the foundation, to allow the door to open and close easily.

Using your level, adjust the foundation nuts or insert shims to level the wall ring to an accuracy of at least 1/4 inch (preferably 1/8 in). You might also use upside down DSR sections to help guide leveling the wall. Tighten all bolts.

You now have the first wall ring bolted to the foundation, with the door section clamped in place in the ring.

Door and Stub Sections Assembly

If your observatory has just one ring, there is no door assembly to be done (although you will need to install the hinge and latches as described below). If you have two rings, you just drill 5/16 holes in the lower flange of the base ring door section and stubs, align the parts with the corresponding wall ring pieces, and use 1 in. carriage bolts to assemble. However, **if you have three or more rings, you will want to be more accurate in your assembly of the door and stub sections** to accomplish a good looking installation.

The challenge is that as you build the stubs or door higher, small assembly errors or shape imperfections in the pieces will add cumulatively, and cause the door or stubs to lean in or out, or to one side. The easiest way to avoid this is to assemble the entire door **and** stub sections using an alignment jig on a flat surface where you can keep the stacked pieces more nearly square and in line.

FIG 22

You can make an alignment jig as shown in Fig. 22. Or, working on a flat surface, you can clamp a straight 2x6 to the vertical end of the stack of sections (e.g. on the closed end of the stubs). Apply additional clamps to join the sections together while pressing them down against the flat surface. With care and rechecking, you will find it easy to keep the pieces aligned as you drill and bolt each section. You will find, of course, that the sections will not form a perfectly flat surface. Don't worry, slight variations will not affect either appearance or operation: your purpose here is to assure that the door and stub edges and face are, on the average, in the correct planes.

You should attach the hinge to the right side of the door (as seen from outside). Because you may need to adjust its location, we suggest only a few screws be used. The outer surface of the hinge should be even with the outer wall surface (i.e., the hinge pin will be slightly within the door/stub space). It is usually easier to wait until later to attach the hinge to the right hand stub.

Completing the wall

This section will suggest how to assemble the additional wall rings and final base ring. Normally, the leveling does not need to be repeated with successive wall ring (until you get to the base ring) unless you want to do it. Proceed as follows.

- If you have preconstructed the door and stub sections as described above, install them in place as follows. Clamp the door to the stub sections with a spacer on the left side to allow space for opening. Bolt the stubs to the foundation, being sure to use a level to make the parts vertical.
- Select the wall ring sections for your next ring.
- Pre-drill the holes in the lower flange of the wall ring that will join the new ring to the old ring (usually four bolts for each full length section).
- Assemble on a flat surface, check the circumference, and complete the joint bolting as you did for the first ring.
- Place the new ring over the old ring, with the vertical joints aligned. Work your way around the ring, and use a straight edge to assure that the new ring is circular, and exactly over the first ring. If the first ring was not properly circular, you can go ahead and make the new ring circular, thus leading to slight overhang or setback from the first ring. This is perfectly OK. However, for the door to work properly, the door jamb edges of each successive ring MUST be accurately above each other.
- Drill 5/16 holes through the previously drilled lower flange holes of the new wall ring into the upper flange of the previously installed wall ring. Then install 1 in. bolts, nuts, and washers and tighten the bolts. Bolt heads should be on top for a neat job.

When your top wall ring is in place, check again to assure it is level, and close to circular (equal diameters around the ring). If not, correct the difference by adjusting the foundation bolts or shims. Repeat with all the wall rings to be used.

Base Ring Installation

Assemble the base ring just as you did the wall rings, except that the base ring sections are NOT interchangeable (because of the dome drive motor spacings). You must use the proper layout. Because the base ring is the final ring, it is particularly important that it be circular and level.

Roller Mounting

FIG 9, 9C,11

There are two types of rollers: the 3 in. diameter hard rubber rollers that **support** the dome, and the white 2 in. dia HDPE side rollers that keep the dome **centered** on the base ring. First install the support rollers.

The **support** rollers project through the base ring upper flange. Some of the holes are 3in. long for the rollers, while four of them are about 7in. long for the dome drive the dome drive motors. There is also a hole for the azimuth sensor (used if you are installing automation equipment.) Do not put a roller in this hole.

Hold a roller in place in each hole to check that the roller will turn freely in the hole (the outer edge of each roller hole must be smooth and flush with the inside of the base ring web). If it is not, use a file or rasp and smooth the fiberglass until it is flush. Use sandpaper to smooth the edges. Wear gloves and eye protection when drilling, cutting, or filing the fiberglass.

If a template has been provided, use it to as a guide for drilling pilot roller holes. If no template is provided, transfer the template design in Fig. 11 to metal or cardboard, or use the dimensions in the figure to locate the roller axle locations. Drill a 1/4 hole and countersink the outside for mounting each wheel. Install a 1 1/2 inch flat head bolt from the outside through the roller. Install a “thread guard (hub cap) and nut on the inside. Check that the wheel turns freely. If it does not, remove the wheel and find and remove the interfering material.

FIG 9C

The **centering** or **side** rollers are mounted on the base ring upper flange. Using Fig. 9C as a guide, hold each roller in place projecting out 1/8-3/16 in. (use a 1/8 in. thick piece of material as a guide), and drill a 13/64 hole for the axle. Use a 1/4-20 thread cutting screw and drive it straight into the hole. Drive the screw in until it just touches the roller: the roller must turn freely. If the screw becomes loose, place a spare 1/4-20 nut on the underside and tighten.

Dome Drive Preparation

FIG 53

The dome drive motor holes are the longer ones (about 7 in.). Refer to Fig. 53 for locations of the motor drive plate pivot and spring support. Install those items now in the four locations.

FIG 9C

Base Ring Assembly

You should now assemble the Base Ring as you did the wall rings. However, note that the sections must be in the correct order, as shown in Fig. 9C. This will assure that the motor drive holes are equally spaced around the wall. Be sure that the resulting base ring is accurately circular.

You will long since have noted that one of the base ring sections has a circular hole in the reverse and upper flanges! This is the **access hole** that allows you to get at the top of the dome equatorial flange, and the underside of the DSR so that you can install the dome bolts. This hole will usually be located in the right rear portion of the dome, as seen from the front.

Later you will install the Electric Dome Drive motors. Some ED hardware (pivot and hook) is fastened to the base ring, so you may want to install it now.

FIG 22

Hinge Installation

We assume that you have already installed the hinge on the door. Partially open the door, with a 1/8 in. shim under it. Align outer surface of the hinge with the outer surface of he wall, and mark the top, middle, and bottom screw holes on the stub jamb. Drill 7/32 in. holes, and install the hinge with three of the 6-32x3/4 in. flat head screws and nuts provided. (Don't install all the screws until the hinge is fully checked out).

Check that the door opens and closes without binding. The left hand edge of the closed door may show a gap of as much as 1/2 in. at the top, but should fit well at the bottom. The top of the wall and door will be pulled closed by the latch to be installed.

Once satisfied with the hinge positioning, install a screw in every second hole in both sides of the hinge.

Latch Installation

FIG 22

The PRO-DOME door is locked with an upper latch and a lower latch. Both are controlled from the upper latch panel.

Upper Latch. The upper latch is shown in Figure 22, and consists of two latch plates, one to be mounted on the inside of the upper left of the door, and one on the upper left door jamb. The latch has two active components: a swing bar and a draw latch. With the door closed, the swing bar is closed, thus aligning the door and wall outer surface. The operator then hooks the draw latch on the door jamb onto the staple on the door, and closes the draw latch. This pulls the door edge towards the door jamb, closing the gap and securing the door.

Using the figure as a guide, mount the two latch plates as shown. Countersink the mounting holes, and use 1/4-20x3/4 in flat head screws and nuts. The screw locations are not critical. To assure that the surfaces of the latches are in the same plane, we suggest you close the swing bar when marking the latch plate mounting holes. If the reverse flange is in the way, drill through it or cut out a section, as desired.

You can adjust the lateral position of the draw latch by loosening the screws holding its mounting plate and sliding it to either side.

Lower Latch. The lower latch is shown in Figure 22, and consists of a vertically mounted cable operated slide bolt that engages a user provided hole in the foundation. You may choose to mount the slide bolt horizontally using a pulley to direct the control cable vertically. The latch is operated by TEE handle on the upper latch plate.

Mount the slide bolt as shown, using 10-32 flat head screws. Drill holes in the door section flanges so that you can feed the control cable up to the control arm on the backside of the upper latch plate. Loop the cable through the control arm, and use the clamp provided to obtain proper operation.

The TEE handle and control arm may be also be adjusted. The TEE handle screws tightly onto the threaded rod shaft. The shaft and TEE handle should be unscrewed at least one full turn out of the threaded bushing holding them. The control arm is threaded onto the rear of the threaded shaft, and is held with a jam nut. To adjust, loosen the nut, turn the control arm as desired, then tighten the nut tightly against the arm.

Wall Bracing

If your wall is three or more feet high, you will find that when the door is open, you can move the upper edges of the door frame (jamb). This movement is normal, and causes no functional difficulty. However, if you prefer to stabilize the wall, we suggest using 1/4 x 1 1/2 in. aluminum bar as a brace on the inside of the wall. The top end should reach about 2/3 of the height of the wall, and can be angled and bolted to the lower flange of a wall ring. The lower end of the bar should be anchored to the floor or foundation, at a distance of about 1/4 of the wall height. Be sure to paint the brace white so that it can be seen inside the observatory at night!

An alternative is to use 1/16 in. thick, four inch wide stainless steel plates bolted and caulked to the edges of the door and door jamb (this increases the wall circumference by about ¼ in.). These plates stiffen the wall and door. Use of these plates is recommended for walls of four or more feet high.

This completes the wall and base ring installation. We advise that you NOT caulk the wall and base ring seams until the dome has been fully assembled and rotation checked.

You are now ready to begin construction of the dome portion of your observatory!

6. DOME PRE-CONSTRUCTION

The wall and base ring are done: now comes the real fun. You will prepare and pre-assemble portions of the shutters and dome. The next chapter covers the actual assembly of the dome. Because a partially assembled dome is at the mercy of the weather, it is **very** desirable to complete all preliminary work so that the actual dome assembly can be done in 4-6 hours.

FIG 10,10B

Assembling the PD-15 does not require cranes or other special equipment (although they can be used, if desired). Instead, judicious use of multiple workers will allow the dome to be completed quickly and safely, **IF** proper precautions are followed. It is very desirable that at least some of the work team have experience in construction beyond the "homeowner" level. It is essential that work be carefully thought through and coordinated. Far better to take a few extra hours, than risk injury or damage to the dome!

Most of the pre assembly work can be done by one or two persons. However, bolting the quads together takes at least three people, while a five workers plus a supervisor is necessary for the actual dome assembly.

- The directions are written assuming the availability of five reasonably strong people to move quadrant pairs.
- Be sure to follow the sequence of assembly given here. Failure to do so may allow construction errors to accumulate, and cause rotation problems.
- Do not attempt dome or quad assembly on a windy day: fiberglass quadrants make great sails. They will not look pretty flying into something or someone. Check the weather forecast for your area before beginning.
- At various times during assembly, you may have quadrants resting without bolts on the dome support ring. We urge that you use jigs, clamps, or duct tape or other means to prevent a quadrant falling off the wall and becoming damaged.
- As noted above, if the dome is to be installed on a wall more than two feet high, or in an place with difficult outside access, you MUST pre-assemble the dome and wall on the ground. You can then partially disassemble it, and then reassemble the dome in the final location, knowing how the parts fit together, and with direct experience with handling the pieces.
- We recommend that you **fully** prepare all the pieces of the shutters and dome (as described in this chapter) **before** you assemble them into a dome. Using this procedure, you can take all the time you wish to drill bolt holes, install shutter hardware and so on, and then be assured that the actual dome assembly can be accomplished in a few hours.
- If you do not complete assembly of the dome so that it can be properly closed, you may be exposing the partially completed dome to damage if high winds occur. If you find yourself in this position, consider temporarily disassembling the dome or at least adding braces, clamps, or other devices to assure safety of the dome. A short time spent in disassembly and reassembly may save your dome!

Dome Support Ring (DSR)

FIG 12

Select the DSR sections to use for the front (DSR section with swing-out), rear, and sides and place them on the base ring rollers. If some of the DSR section ends (on the horizontal flange) are not cut on the dome radius, trim them at this time. If needed, use a file (wear gloves) to bevel the insides of the ends of the skirts and the flanges so that the DSR will ride over any projections on the base ring (see drawing). This is also a good time to brush off any excess grit on the underside of the DSR.

Referring to the figure, mark and drill ¼" holes in the front and rear DSR section. Countersink from below. The holes will be used for holding the dome quads in place during initial assembly.

Using masking tape or duct tape on the outside of each DSR joint, tape the DSR sections end to end so that the ends of the horizontal flanges are butted together with minimal, but equal gaps. Use ¼ in. shims every 18 in. between the skirt and base ring wall to make sure there is about ¼ in. between the blue side of the DSR and the white side of the base ring all the way round. Once adjusted, drill a single hole through each DSR overlap lip and install any convenient small screw or bolt to join the DSR sections together (don't let the screw go through and scratch the base ring). The screws can be removed later, or left in if they are stainless. Check the DSR circumference against the table value in Ch. 3.

Check that the DSR sections ride around the dome without binding.

Note that the DSR sections are coated with an organic abrasive material on the underside to provide traction for the dome drive motors. Some of this will drop off, especially early in use.

Rotate the DSR so that DSR bolt 20L (in the left rear) is visible in the access hole. Tape the DSR to the base ring so that it cannot rotate. You now have the DSR ready to receive the dome.

FIG 16B, 14, 32

Rear Cover Preparation

The rear cover is the narrowest of the three and has a downward lip at the top (front) end. The rear cover fills in the circle at the rear of the dome, and stabilizes the two quadrant pairs near the zenith.

Referring to the drawing, check that the front (horizontal and vertical) edges of the rear cover are beveled on the outside to allow the front shutter to ride up and over. If not, use a file or rasp to bevel the edges as necessary. Sand the remaining edges if necessary. Check that the latch hole on the rear cover is properly beveled: at the front of the hole the bevel is vertical (but with rounded edges), and an the rear of the hole the bevel is on the outside.

Identify the marks on the flanges of the rear cover. Drill 5/16 in holes along the **center** of the flange. Because the marks are a bit off the center line, use them only for the spacing.

While you have the rear cover off the dome, place the electric shutter on the rear cover as shown in Fig.32. Drill and countersink the mounting holes (do not mount the motor yet). Note that the multi-sheave pulleys are on the centerline of the rear cover (ie., the ES15 drive is off center, overall). Predrilling will make motor installation easier later.

Front Shutter Preparation

FIG 16B

Select the front shutter (the middle width shutter). Referring to the drawing, check that the rear top corners are beveled on the inside to ride up over the rear cover. Check that the latch receiving hole edges are beveled properly (flat on the front side of the hole, and beveled on the inside on the rear of the hole. Sand any sharp edges of the shutter (since your hand may touch these at some time).

Install a pair of handles with centerline 6 1/4 inches from the lower/front edge of the shutter. Space the handles so that the central bolts are about 3 in. from one another. Use 3/4 in. carriage bolts from the outside. (The lock deadbolts will serve as handles on the inside).

FIG 19

Because the underside of the front shutter slides on the slot edges, low friction strips are provided for the front and top shutters. You will install them now.

To assure good adhesion for double back tape on back of the strips, you will need to clean the underside of the shutter adjacent to the flanges. Use GOOF-OFF, Fiberglass dewaxer, or other solvent or paint remover, preferably containing methylene chloride. You will put two strips pieces end to end adjacent to each flange of the shutter, with the pre-bent ends around the ends of the shutter. Because the shutter is more than eight feet long, one piece is used at full length, the second is cut to fit with a minimal gap with the joint between the two being cut on a diagonal (save the pieces: you will use them on the top shutter.) Remove about 10 in. of wax paper from the double back adhesive tape at a time and press the strips firmly into place.

DANGER: A non-anchored shutter installed on the dome will slide easily and can cause injury. Be sure the shutter is always latched or otherwise prevented from unexpected movement.

Drill two 1/4holes 7.5 inches from the front edge, 2 inches inside each side flange (measured on the outside of the shutter). These holes are for bolts connecting to the electric shutter cables. Later, when you install the shutter cable connector, you will cut away a section of the glide strip around these bolts.

Although you can install it later, you should consider installing the deadbolt lock at this time. See Ch. 10 for detailed instructions.

Finally, install the vinyl "grommet" to provide a softer leading edge for the end of the front shutter. Push on, or use light hammer blows, as needed. If your head bumps the edge of the partially open shutter, you will appreciate this (we did, the second time).

Top Shutter Preparation, Latch, Wind Restraint

FIG 16B, 24

You will now install the latches on the top shutter. The short latch will go on the rear of the shutter and engage the hole in the rear cover, while the longer latch is on the front of the top shutter and engages the hole in the front shutter. The installation of each latch follows the same steps: we will describe the front latch installation.

Install the latches as shown in the figure. Mark a line across each end of the shutter, 9 1/4 in. from the end of the shutter. Center a latch on the shutter, with the latch holes on the line. Mark the hole locations on the shutter (five for the front, and four for the rear latch). Drill 5/16 holes and install each latch with 1 in. stainless steel carriage bolts. The "points" of both latches should aim toward the center of the shutter. Note the countersunk holes for the nuts and washers.

If not installed at the factory, now install the two low friction strips (left over from the front shutter) on underside of the top shutter adjacent to the flanges. Start about five inches behind the front latch and continue as far as possible toward the rear of the shutter. Cut a length from your fifth piece of strip and install on the midline of the shutter between the two latches. You will have a pre-bent end piece left over.

The wind restraint system uses cables to hold the top shutter in place, and most of the installation is described in Chapter 11. However, one part of the installation is to install J-guides (J shaped plastic guides through which the cables move) onto the flanges of the top shutter. You should do that now.

The PD15 top shutter requires 6 equally spaced J-guides on each flange. Fig. 24 shows how these are arranged. Holding each J-guide in place, drill 3/16 holes through the flange. Countersink on the inside, and install a 10-32x3/4 flat head screw outwards with locknut in each hole.

Dome Quadrants Sub-Assembly

FIG 13

Caution: Do NOT attempt to assemble the quads outdoors on a windy day. Also, we strongly recommend that at least three, and preferably four people work together to do this task. The dome pieces are bulky, and heavy, so you will need extra pairs of hands for lifting and balancing.

The dome is made of four slightly different dome quadrants. We refer to these as the right and left, as viewed from the front of the dome. The right front quadrant is the same design as the left rear (and vice versa) **except** that the rear quadrants have a notch cut into their slot edges which accommodates the rear cover.
Pick the right front and right rear (left is notched) quad. Refer to the drawing to identify what we call the equatorial (lower) flange, the slot edge, and the Greenwich flange (inner flange joining the two quadrants). Locate the dimples on the underside of the equatorial flanges. Drill 5/16 holes at these dimples. One of the quads has marks on its Greenwich flange. Locate the marks and predrill 5/16 in. holes. NOTE: Drill only ten holes, i.e., every other mark - (there are twice as many marks as needed, a mistake in the mold).

The goal now is to bolt the Greenwich flanges together so that the joints on the slot edge where the shutter rides, and the outside surface are smooth, and so the outside surfaces of the dome quadrants match closely.

Place the front and rear quadrants together on a reasonably level surface (not yet on the DSR!). Provide 4 in. of so of support under the equatorial flanges so that the slot edge tabs are not damaged. Adjust the positions of the quadrants so that the equatorial and slot edges are aligned, and the outer dome surfaces meet as smoothly as possible outside the Greenwich flange. You will want to use C-clamps and short lengths of wood to facilitate alignment of the slot edges and equatorial flange. Once clamped together, use the previously drilled holes in the Greenwich flange as a guides in drilling holes into the second quad. Install 1 1/4 in. carriage bolts through the two Greenwich flanges and tighten. Once bolted together, the two quadrants will stand together without support.

Caution: Do not get under the quads with only C-clamps holding them-they may slip. Always have C-clamps, PLUS a prop or a person holding the quad pair.

Now assemble the second pair of quads in the same manner.

Shutter Cable Pulley Installation

FIG 31, 32

At this point, you will have both quad pairs assembled, each with its equatorial holes drilled. Choose one set for the LEFT quad pair (as viewed from the front) and one for the RIGHT pair. Label the front and rear of each with masking tape to avoid confusion.

We will now install the shutter cable pulleys. Although this work can be done after the dome is assembled, it is much easier to do it now, and the later electric shutter installation will go much faster.

Figure 32 shows the RIGHT quad pair, with the shutter cable pulleys mounted on the inside face of the slot edge. The pulleys are numbered from the front to the back. #1 is a plain 1 1/4 in. diameter pulley with fender washer. Mount the #1 pulley directly onto the slot edge tab, 2 in. from the lower edge of the tab with a 1/4-20x1 in. carriage bolt pointed inside. Place a 2 in. large washer under the nut.

Pulleys #2-#11 are plastic pulley assemblies, each containing two pulley rollers. To locate these pulleys, measure ten 18 in. intervals along the slot edge starting from the front pulley. For pulleys #2 to #10, drill a 5/16 mounting hole 2 1/2 in. from the slot edge. Mount them with 1 1/2 in. carriage bolts. The angled tab should be about 1/4 inch below the slot edge. Do not mount #11 — it will be installed after dome assembly. But you will drill the hole for #11 pulley now, using the dimension in Figure 32 (the bolt hole is **2 ½ in.** from the notched slot edge of the rear quad.)

Similarly, mount the pulleys on the left dome quad pair.

Congratulations! You have now completed the preparation work. The assembly of the dome will now go quickly (in about four hours)!

Caution: if the quad pairs and other parts will be left outside overnight, be sure to secure them against unexpected wind gusts.

7. DOME ASSEMBLY AND SHUTTER INSTALLATION

Now comes the Big Assembly Event! Recheck the cautions at the beginning of the previous chapter, making sure that you are fully prepared for the steps ahead.

Before proceeding, all workers should thoroughly review what is to be done. Each quadrant pair (i.e., half a dome) weighs about 250 lb. and is awkward to handle. Four or five persons (the "workers") of average strength can handle them, with an additional person (the "supervisor") providing supervision and bolting services.

If you have doubts about safely handling the pieces, or if you do not have sufficient workers available, **DO NOT** proceed. Please call Technical Innovations, and we can make suggestions for use of jigs, braces, and other construction aids that will fit your situation.

Check that the DSR is ready to receive the quadrants, that the front and rear pairs of bolt holes for the quadrants have been drilled in the DSR, and that hole 20L is located at the access hole.

Suggestion: Prepare the wood spacers discussed below, before you begin dome assembly.

Suggestion: When you put the quad pair on the DSR, you will find that the quad pair seems longer front to back than the dome wall, and that the quad pair wants to fall off the DSR (one of the jobs of the workers is to keep it on). You can help control the quad pair by preparing a 1/4 in. rope to loop from the front slot edge tab across the interior of the dome to the rear slot edge tab. As soon as the quad pair is put on the DSR (as described below), you can pull the tabs together so the quad pair does not spread front to back.

FIG 15

We will assume that the first quad pair will fit on the LEFT side of the dome (as seen from the front). Have the workers lift the quad pair onto the DSR, sliding it under the reverse flange. The left front of the equator flange should almost touch the left hand end of the DSR swingout. With the workers holding the quadrant pair on the DSR, the supervisor should tape the quad pair and DSR together. With the 20L quad hole lined up with the 20L DSR hole over the access hole, install 3/4 in. a flat head bolt upwards through these holes, tighten finger tight.

With the workers walking outside the dome while holding the dome onto the DSR, rotate the DSR and quad pair so that the (front) 1L DSR hole lines up with the access hole. Adjust the dome quads so that the dome 1L hole also lines up, and install a bolt. With two bolts, the quads will remain upright.

You will notice that the outer surface of the dome at the Greenwich flange may be inward from the DSR and inch or so, and that the equatorial flange may rub against the inner edge of the reverse flange. This is normal: this will be adjusted after you install the rear cover and when you install the remaining equatorial flange bolts.

Now install the right pair of quadrants in the same way and place it on the DSR. Insert 1R and 20R bolts to secure it.

Make and install wood spacers to hold the slot opening to the correct width while you work on the dome. Cut two 2x4s of the correct length to set the **outside** of the slot edges to 50 in. (2x4s will be about 49.5 in. long). Install one in the front about 12 in. above the base ring. Install the second higher up, about two feet in front of the Greenwich flange. Use 2 in. drywall screws through small holes drilled in the slot edge, about 1.5 in in from the slot edge (do NOT use short screws as later assembly forces may pull them out). When installing the spacers, you may need to remove the front pair of equator flange bolts. The spacers substitute for these bolts in holding the dome to the DSR.

FIG 14

Rear Cover Installation

Using two people outside and one inside, install the rear cover so that it straddles the rear slot edges, with the lower edge of the rear cover approximately even with the lowest part of the slot edge. The rear cover should fit into the recess cut in the slot edge, so that the transition from slot edge onto the rear cover is reasonably smooth.

Make sure the right and left sides are equal, and that the rear cover is square (even) with the slot edge toward the front. You may want to use a prop or C-clamps to hold it in position. Using the previously drilled holes in the rear cover as guides, drill 1/4 in. holes into the slot edge at the bottom rear of the rear cover and install 1 1/4 in. flat head bolts, washers, and nuts.. This will keep the rear cover in place

You will now drill and bolt your way down the rear cover, starting from the front. If the slot edges are not snug against the inside front of the rear cover, use 2x4s or other means to force the slot edges outward. If the rear cover flanges have bumps or excessive thickness, this is the time to remove the rear cover and grind/sand them off. With the parts fitted together, start at the top of the rear cover and drill both left and right holes, and install 1 1/4 in. flat head bolts, washers, and nuts. After the first pair, remove the bottom rear pair installed earlier so the shutter can move as you install bolts. Then work downwards, doing the next pair of left and right holes, and so on. The inside worker may need to push the slot edges **out**ward against the insides of the rear cover flanges. Be sure the rear cover is fully seated against the slot edge, and is not "outward", especially at its front edge toward the top of the dome. When installing the rear cover, you may need to remove the rear equatorial bolts installed when you first put the quads on the DSR.

You may notice that as you install the rear cover, the forces you exert will modify the shape of the quad pairs already installed. This is normal.

When the rear cover is bolted on, you have the two dome halves joined together, resting on the DSR. The dome is held in place with the spacers and the rear cover. If you have had to remove the front or rear bolts, you will be re-drilling the holes later. Tape the DSR to the dome so that the dome cannot rotate.

Dome Inspection

You should now examine the dome as assembled so far.

Because the dome is not yet bolted down, its shape will not yet be correct. However, you should adjust the dome on the DSR so that it is symmetrically located left/right and front/back.

Adjust the front slot opening so that it is equally spaced left/right relative to the DSR swingout. Mark the DSR with a pencil as a future guide.

Recheck that the DSR sections are joined together properly

FIG 15

Final Dome Bolting

Now you will install the remaining bolts in the equatorial flanges, with the front first.

Rotate the dome so that the 1R location is at the access hole. While keeping the slot opening centered on the DSR swingout, push in on the dome so that the rear of the slot edge is within 1/4 in. of the DSR. Using the previously drilled hole in the equatorial flange as a guide for drilling 5/16 hole down through the DSR, drill a new 1R hole in the DSR. Countersink from beneath, and install 3/4 in. flat head bolt upwards. Rotate to the 1L position and repeat. This bolts the front of the dome in its final position to the DSR.

Now rotate the dome to the 20R position over the access hole. Again, push in on the dome so that the slot edge is within 1/4 in. of the DSR, while assuring that the dome is centered Left/Right at the Greenwich location on the DSR. Install the 20R and 20L bolts as before.

Stand back and recheck your work. If you have a substantial error, fix it at this time. If OK, now go ahead and do the remainder of the equatorial bolts. Although a bit more work, you will get the most circular dome result if you alternate left and right sides, and do about every fourth bolt in your first pass. Then go back and do all the in between bolts.

Remove any wood blocks, spacer shims, and tape or DSR lip bolts, and turn the dome! If you assembled the dome correctly, it will turn with about 35-40 pounds of force. But don't panic if it doesn't. See Sec. 10 for how to investigate and fix any problems. Note: except for completing installation of the shutters (for weather protection of the dome), you should fix any rotation problems BEFORE completing installation. And don't caulk the wall rings, base ring, or dome equatorial flange until you have a smoothly operating dome.

Shutter Catchers

FIG 14

Install the two shutter "catcher" brackets at this time (see drawing). Locate the catchers flush with the bottom of the rear cover, and placed all the way to the edges with the wind restraint tabs extending past the rear cover. Drill 5/16 holes in the rear cover and install the catchers with 1 in. bolts.

Shutter Installation

The instructions below tell you how to install the shutters and operate them manually with ropes. You should do this before attaching the electric shutter (described in the next chapter) to assure that the shutter operates safely and smoothly.

WARNING: When the low friction strips are in place on the shutter, the front shutter will move very easily. As noted in Section 2, uncontrolled motion of the shutters can result in damage to the shutters or in serious personal injury. Always have the shutters under full front **and** rear control when moving them. **NEVER** rest the front shutter alone at the top of the dome arc since it can begin sliding with no warning and slam down on the front or on a person. This is not normally an issue, because the front and top shutter are normally safely latched except when they are toward the rear of the dome, and the front shutter is controlled by cables. You can install the shutter safety device described in Fig 18 or a similar device to limit uncontrolled shutter movement.

Place the front shutter on the **rear** of the dome with the handle up and toward the front, and the flanges straddling the rear cover. The shutter will not rest on the shutter catchers, because the handles rest against the rear cover lip.

Also on the rear, install the top shutter so that it rests in the shutter catchers, and straddles the front shutter. The longer (front) latch should be toward the front of the dome, and the short latch toward the rear.

Together, the shutters weigh about 140 lb. This weight can be dangerous. The shutters are designed to be under control BOTH when opening and when closing, as the weight moves from the front to the back of the dome. You MUST NOT pull (or push) the shutters from only one side of the dome UNLESS you also have a means of restraining the shutters as they move over the top of the dome. For test purposes, you may use lengths of 1/4 in. ropes connected to the handles, one rope going to the front to be controlled by a person there, and one to be controlled by a person at the rear of the dome.

Initial Manual Shutter Operation

Starting with both shutters on the back of the dome, pull the front shutter toward the front (i.e., up and over). It should slide easily, though the weight will make it hard to move. With the rear cover in place, workers may have to help lift the front shutter to get it started. As it moves past the top of the dome, the front latch of the top shutter will drop into the hole in the front shutter, so that you will begin moving both front and top shutters together. As the front latch and hole become visible on the underside of the front shutter, visually check that the latch is fully seated. Assuming that it is, and **while restraining the shutters from the rear**, continue pulling forward and down. The rear latch on the top cover will engage the hole in the rear cover, and the shutters will lock into the closed position.

Note: if the front latch does not fully engage, restore the shutters to the back of the dome, and retry. If the latch does not seat properly on the second try, **DO NOT** attempt to use the shutters until you have found and corrected the problem (See Chapter 12).

To open the shutters manually, again use persons stationed in front and rear of the dome. The person in the rear will pull on the rope, sliding the front shutter up and back. **Both** the top and front shutter should move back. If **both** shutters do not move together (e.g., if the front shutter delatches and begins moving under the top shutter), **immediately** return the shutters to the closed position and use the information in Chapter 12 to identify the problem).

Assuming proper operation, as the front latch rides over the rear cover lip, it will partially unlatch, completing unlatching when the top shutter rests on the shutter catcher. Continue moving the front shutter back until it is seated. DO NOT let go the front shutter until it is fully opened and resting at the top edge of the rear cover, as it will slide uncontrolled to the back where it may be damaged.

Shutter Latch Check

Your last step is to check that the latches fully seat when the dome is closed and front shutter locked down (so that the wind cannot lift either shutter). Go inside the dome, and have the workers controlling the ropes pull the shutters closed. Check that both latches not only dropped into their receiving holes, but that they *fully* lock the rear cover and front shutter. If not (for example, if inside hardware is preventing full closure), be sure to correct the problem before continuing.

The PRO-DOME is designed so that the closed and latched dome can be secured simply by locking only one item: the front (lower) edge of the front shutter. Whether or not security is an issue for you, you MUST use some kind of securing device (lynch pins, bolts or padlocks) to prevent wind from lifting the front shutter when the observatory is closed. That is, both flanges of the front shutter must be held to the slot edge. Ropes, bungee cords, and the like will not protect the dome from wind!

The PRO-DOME is supplied with a key operated dead bolt that engages both slot edges, and the installation is given in a later section. If you defer installation of this system, you must immediately install some alternative means of making the shutters secure. The simplest system is to drill a hole in each shutter flange through the slot edge and insert spare 1/4 or larger bolts. Almost as simple is to install a small hasp on each front lower inside of the slot edge. Install the staple on the inside of the front shutter. Use hooks or padlocks, if desired. Hasps can also be installed on the outside of the dome, with the staple on the outside of the front shutter flange. Or you can install a hasp on the DSR, and put a single staple on the lower center of the front shutter. Fancier locks or latches can be used, either exposed or tucked up under the front shutter.

Failure to immediately install and use a locking device of some type may result in severe damage to your dome in event of a wind storm.

8. ELECTRIC SHUTTER INSTALLATION

Introduction

Installation of the electric shutter for the PD-15 as the next step is desirable though not absolutely necessary. Although manual operation of the PD-15 shutter is possible, the weight of the shutters makes manual operation difficult and potentially dangerous. As discussed above, the shutters must be controlled by ropes or other means from **both** front and rear of the dome as the shutter moves from front to back, or vice versa. In addition, substantial strength is needed to produce more than 100 lb. of force needed for the movement.

We recommend that the electric shutter be installed so that the shutters can be operated conveniently and safely. Note that emergency manual operation of the shutter is provided, as discussed below.

FIG 31, 32

Electric Shutter Theory

The PD-15 shutters are operated by moving only the front of the front shutter in the direction desired. The top shutter will automatically move, latch, and unlatch from the front shutter.

The electric shutter has two cable loops, one on each side (i.e., on the right and left) of the shutter, and both loops are driven in the same direction, at the same rate. Each cable loop travels on pulleys already installed on the slot edge. Each cable loop connects to the front of the front shutter. As the cable loops are driven in one direction, the shutter opens, and vice versa. Because the loop is connected in both the open and close directions from the attachment point, the cables limit the shutter movement under all conditions. For example, when opening, the cable lifts up the front shutter uphill along the slot edge, but also controls (i.e., restrains) the shutter as it moves downhill on the rear of the dome.

The cable is 3/32 inch diameter, stainless steel wire rope. The cable is driven by special multi-sheave pulleys driven by a pair of low voltage electric motors. The motors receive current from the 16 V power supply (supplied) via contact plates and rollers that transfer power from the dome base to the rotating dome when the dome is in the HOME position.

The two motors each have a slip clutch on a common shaft. The motor shaft is connected to the primary pulley shaft by a chain drive via a speed reducer "jack shaft". The primary pulley shaft is connected to the secondary pulley shaft by a chain. Thus, the motors in effect drive both the primary and secondary pulleys.

Each pulley contains approximately 20 sheeves, or grooves, for the cables (the pulley grooves look like a single spiral groove or screw thread but a closer look will show they separate grooves). Each cable loop passes over the two pulleys approximately eight times, moving from one groove to the next. Thus, the pulleys have the traction of eight turns of cable around a shaft without the characteristic of moving along the shaft as the shaft turns.

Installation of the electric shutter includes
* installing the Power Supply
* installing the cable pulleys
* installing the motor drive on the rear cover
* installing the cables for proper operation.
* installing the contact plate/slider to get power to the motors
* connecting the motor drive to the power supply

* adjusting the cables for proper operation.

Power Supply Installation

The power supply will serve both the electric shutter and electric dome rotation systems. The power supply has a front mounted switch for the shutter, and a top mounted switch for the dome drive. Electric terminals are located inside the power supply, and are accessible by removing the rear cover. The power to the motors is a low 16 VDC; however, 120 VAC is present in the power supply whenever it is plugged in. **Always remove the plug from the power outlet when removing the back of the power supply.**

FIG 42

The power supply may be mounted in two ways, depending on how you will enter the dome. If you enter from inside (up through a floor) or through a door in your own wall, simply mount the power supply wherever convenient (usually on the inside wall next to the door) with the front switch facing into the dome. If you enter from outside through the semidoor (requiring shutter operation), you will need to operate the shutter from outside with the front switch facing outward. You should mount the power supply on an inside wall, to the immediate right of the semidoor (as seen from outside). Place the power supply where desired, and mark where the key switch and front toggle switch hit the wall. Drill and/or file 1 in. diameter holes in the wall. Install the power supply in accord with Fig. 42.

You can then operate the key switch and the electric shutter from the outside.

Cable Pulley Installation

The shutter cables are carried in pulley assemblies mounted to the slot edge. You will already have mounted all but two pulleys on each slot edge when you prepared the dome quadrant pairs. You will now install the remaining pulley assemblies.

You will have drilled a mounting hole for the rearmost plastic pulley assembly (#11) when you prepared the dome quad pairs. Mount the pulley assembly with a 1 1/2 in. carriage bolt installed from the outside.

Drive Motor Installation

FIG 31,32

The motor has drive cables pre-installed at the factory. **DO NOT** move the cables on the pulleys or operate the motor until you have completed the installation steps below.

To install the drive motor, place the drive motor on the rear cover, so that it will be 24 in. down from the rear cover lip, and with the multi-sheeve pulleys on the center line of the rear cover. Mark the four mounting hole locations on the rear cover and drill 1/4 holes, then countnersink them. With an outside person assisting, install the motor with 1/4-20x1 in. flat head bolts. The bolt heads should be smooth on the outer surface.

Now you will install the #12 rearmost pulley as shown in Fig. 31 and 32. The goal is to install the pulleys so that the cables from the shutter drive enter the pulleys with minimum angles.

To mount the right hand (RH) #12 pulley, first unroll the RH cables, but DO NOT loosen them on the drive pulleys. Now thread the RH cables through the pulleys as shown in Fig. 31. Place the pulley against the slot edge so that the cables are as close as possible to horizontal, and enter pulley with minimum angle. Mark the hole locations on the slot edge, and drill and bolt (1 in. carriage bolts) the pulley to the slot edge. Some of these holes will penetrate the rear cover , as well as the slot edge. Mount the left hand pulley similarly.

FIG 32

Cable Installation

You previously drilled two holes in the front cover for the shutter cable connection. Install the plastic Slot Edge Guide part of the Shutter-To-Cable-Connector-Assembly (SCCA) provided. Use a razor knife to remove the glide strip where the SCCA will be mounted, then use a 1 1/4 in. carriage bolt and nut. In a few minutes, you will connect the cables to the SCCS, and then attach the SCCA to the carriage bolt with a locknut.

Reinstall the shutters on the rear of the dome, with the front shutter handles resting on the lip of the rear cover.

Right OPEN - thread the SHORT cable through the UPPER rear pulley on the right side (facing the rear cover from the inside), then over the upper pulley #11 to the shutter connector. Loop the cable through the SCCA and tighten the screws.
Right CLOSE - Thread the LONG cable through the LOWER rear pulley on the right, down over the LOWER pulleys, around the OUTSIDE of the lower pulley back over the UPPER pulleys and up to the forward end of the same SCCA. Pull the cable snugly tight and clamp as before.

Left OPEN - thread the SHORT cable through the UPPER rear pulley on the left side (facing the dome from the inside), then over the upper pulley #11 to the shutter connector. Connect as above.
Left CLOSE - Thread the LONG cable through the LOWER rear pulley on the left, down over the LOWER pulleys, around the OUTSIDE of the lower pulley back over the UPPER pulleys and up to the same SCCA as above.

Install each SCCA with cables onto its carriage bolt. The nut already holding the Slot Edge Guide will provide a spacer behind the SCCA. Install a lock nut (NOT aa regular nut) onto the carriage bolt. With all four cables installed, equalize the tension in each by pulling the cable tight on the SCCAs.

You may now remove the cable clamps on the drive motor multi-sheave pulley. The cable tensions will decrease, so re tighten the cable tensions.

Note: With the SCCA attached to the front shutter, you cannot now move the shutter by hand. If you ever need to move the shutter manually, you may leave the cables attached to the SCCA and remove the SCCAs from their bolts, releasing the shutter. If you do so, BE CAREFUL that you have a person to hold the shutter so that it does not move suddenly.

Contact Plate Installation

Refer to Fig. 32 for the installation arrangement. Be sure to place the dome in the home position (normally with the DSR swingout hinge centered above the door hinge). The contact sliders will be mounted on brackets attached to the inner surface of the dome, and the contact plates will be mounted on the reverse flange. Be sure that the location of the plates and the contact sliders is correct and will not interfere with other parts of the dome as it turns. Mount the contact plates about 4 in. apart using their adhesive backing, with the terminal screws toward the center of the dome. Center the sliders on each contact plate, and mount the slider brackets with the bolts provided. Adjust the slider brackets for moderate force of the sliders on the contact plates.

Motor Drive Wiring

FIG 41

Be sure to remove the power supply plug from the outlet before opening the back of the power supply!

The motors on the drive unit are pre-wired with black to red and red to black to make the both motors drive the primary shaft in the same direction.

- Use the ten foot length of wire, and connect the contact rollers to the motor terminal strip overhead.
- Connect the 20 ft. wire to the contact plates and to the FRONT SWITCH terminals inside the power supply.

NOTE: If your observatory is the PD15 model with matching wall rings, you will gain access to the dome by opening the shutter then opening the door. In this case, we recommend that you install another wire that will permit emergency access in case the power supply, toggle switch or contacts should fail. Use the 18" long #14 cable with spade terminals at one end, ring terminals at the other end. Connect the spade terminals to the motor wires on the terminal strip, the ring termianls to the two bolts near the motor that connect the motor bracket to the rear cover. This connection allows you to use a battery from the outside for emergency access.

Cable Adjustment

Initial operation of the shutter motor will change the tensions in the cables. The tensions on each side of the shutter must be adjusted to avoid either excessive tension (that unnecessarily loads the motor drive) or slack tension (that may prevent operation of the drive pulleys and/or lead to cables jumping out of the cable pulleys).

Recheck that all installation steps have been taken, that bolts are tight, and that cable clamps are properly fixed.

Final Step before operation: Remove any remaining clamps or tape on the cables on the drive pulleys on the motor drive. Save the clamps for use as spares.

Plug in and turn on the power supply. Press DOWN and quickly release the front switch. The motor and pulleys should have turned, and the shutter should have moved down (toward the front of the dome). If it moved up (or if the cables tightened above the front shutter), reverse the electric wires to the shutter drive motor at the contact plates (the goal is to make DOWN on the switch correspond to CLOSE the shutter).

Check the cables. Tighten loose cables by adjusting the cables on the shutter connectors.

Again operate the power supply switch briefly. As you operate the switch for longer durations first in one direction and then the other, constantly check the cables, pulleys, and connections to assure proper tension and operation. It is normal for the cables to change in tension during operation. However, the cables should never be so slack that they sag or make loops. As you gain assurance that the system is operating properly, use the electric motor to fully open and close the dome.

If you encounter a situation where the shutter is blocked (i.e., stops suddenly) during opening or closing, you must stop the motor at once. Before doing anything else, draw a diagram of where the shutters are in relation to the slot edge and in relation to each other. Also, make a sketch of where the shutters are in relation to each other on the outside o the dome. This will help you understand what might be hitting or causing the blockage. The leading edge of one of the moving shutters is likely hitting something "head on" or perhaps scraping on a bolt head beneath the fiberglass part. Or the wind restrain cables may be too tight (check the tension while you are outside the dome).

See Chapter 12, Problem Solving, for more suggestions; if you cannot diagnose the situation on you own, you may call or email to us.

Finally, operate the shutter to the fully closed position, and check inside that the shutter latches are fully seated in the holes. Mark the position of the shutter to assure proper closure. If you have not already done so, you may wish to drill 1/4 in. holes thorough the shutter flange and slot edge to accept lynch (locking) pins. If you use locking pins, be sure to remove them before operating the shutter motor!

When the cable adjustments are complete, with both cables doing roughly equal work, you may want to trim the ends of the cables. The stainless cable is hard to cut--one of the most convenient tools is a 7WR Vise Grip brand pliers with a built-in wire cutter. Be careful that the ends of the cables do not strike you or another person in the eye. We recommend keeping at least a foot of extra cable ends on each shutter connector. You may wrap the slack end around the cable and tape it. Do not leave loops, clamps, or other arrangements or hardware that can hook onto the slot edge pulleys.

Operation

The electric shutter motor operates whenever the switch is operated. That is, the motor does NOT stop automatically when the shutter reaches its end point. Be careful not to operate the shutter past the proper open or closed point. On the other hand, be careful to close the shutter fully with the latches fully engaged.

We recommend that when closing the shutter, release the switch when the shutter is still 3-4 in. above fully closed. The shutter will coast down into approximate lock position. You can then jog the shutter switch to place the shutter at the desired position.

Electric Shutter Maintenance

The electric shutter requires little maintenance once it is properly adjusted. DO NOT oil the cable or cable drive motor multi-sheave pulleys. Every six months apply oil *sparingly* to the roller pulley ball bearings (not to the pulley cable surfaces). Occasionally check that the cable tensions are reasonable.

In normal operation, the tension end of each cable winds tightly onto the multi-sheave pulley, but the slack end unwinds loosely. Therefore, when you look at each winding, you will usually see one end of the winding tight and the other end loose. If the tension is correct, the slack turns will bow out from the multi-sheave pulley by about 3/8 in for several turns. This slack is very important, for it allows automatically for variations and cable stretching in the drive system. If the tension is too loose, the slack turns can become too large, and may become

snarled or overlapped. This can cause slow shutter operation, and obvious heavy loading of the shutter drive motors. You can check for this by visual inspection of the windings.

If the windings have become snarled, you can easily straighten it out using your fingers. You may wish to have an assistant hold the shutter to reduce cable tension not properly adjusted, or you can remove the shutter connector for the cable affected, Note that the cable cannot become knotted in this condition, therefore it is not necessary to remove the cable from the pulley to rewind it.

If you should ever need to rewind the pulley, be sure the shutter is safe as discussed above. If one cable is still attached, let it continue to hold the shutter. Connect one end of the cable to the shutter connector, thread the cable through the slot edge pulleys, and wind it onto the multi-sheave pulleys as shown in Fig. 31. Each winding should have 8 full turns around the two multi-sheave pulleys.

If you need to rewind both cables, we recommend that you put the shutters in the open position. Then wind the cable onto the multi-sheave pulleys with about 7-8 ft free to go over each of the upper pulleys (Fig. 31).

If you find that the motors turn, but the shutter does not move, you need to identify where in the power train the slippage is occurring. If the motors turn, but the main drive shaft does not (Fig. 31), try tightening the motor clutch adjustable clamps. If the multi-sheave pulleys turn, but the cable does not move, the tension may be very slack or there may be oil on the cable. Finally, check that nothing is binding or otherwise blocking the shutter movement. Remember that this drive system has tremendous reserve driving capacity, and that the tension and other adjustments are not critical. Be careful when testing the drives to avoid injury.

Manual Operation

There are two ways to operate the shutter manually. The first way is to remove the connectors from the front shutter. **Caution: Never remove the cables or connectors unless the shutters are fully open or fully closed. Half-open shutters can move without warning and can cause injury.** You can then move the shutters manually, using ropes front and rear as discussed above. Use great caution when using this method.

The second method is useful if the shutter electric motor is not operative, but the drive chains and cables are still operable. Disconnect the power supply at the contact plate or drive motor. Use a screwdriver to fully loosen the clutch clamps on both motors (let them flop around). You may now use a vise-grip pliers or other method to turn the motor shaft to raise or lower the shutter (slow but safe).

Emergency Entry

If the shutter is closed and fails to open, first check:

* Did you remove the cable clamps on the motor?
* Did you forget to remove your padlock that is preventing the dome from opening?
* Is 120 V power being supplied to the observatory?
* Is the circuit breaker tripped on the power supply?
* Is the dome in the home position (you may want to move the dome back and forth to see if the problem is a poor or dirty contact)
* Is some part binding, so that if you help, the motor can open the dome?
* Is the key switch turned on?

If you cannot find the problem, and your entry to the dome is from the outside, you can apply battery power for emergency entry. You will recall that you wired the terminals on the motor directly to the bolts that hold the motor bracket to the dome.

Use a pair of wires on the outside of the dome to connect a 12V battery (fence battery, two 6v lantern cells, cigarette lighter cable from a car) to the bolts that hold the motor. You do not need to open the shutter all the way; rather, move it just a few inches so that you can open the door. When selecting a battery for this purpose, "think safety" — we recommend against using a car or other massive battery unless you have a fuse or other protection against a possible short circuit.

9. ELECTRIC DOME DRIVE INSTALLATION

Introduction

The electric dome drive consists of four drive plates equally spaced around the base ring. Each drive plate has a low voltage DC motor that drives 3 in. rollers via a cog belt. The rollers in turn press against the abrasive traction coating on the underside of the dome support ring, thus turning the dome.

Installation consists of

* installing the drive plates
* wiring the drive plates

Drive Plate Installation

FIG 51,53

Each motor drive plate moves up and down on a pivot bearing, and is held against the DSR by a spring loaded arm. The pivot bearing and spring bolts should have been installed when the base ring was installed. If they were not, refer to Ch. 5 for instructions. With the DSR installed, you will turn the dome, then open the DSR swingout to gain access to the outer part of the base ring. If you do this, remember NEVER NEVER turn the dome with the swingout open--the dome slot can open up and the dome can fall off the wall! **ALWAYS** close and lock the swingout, even if turning the dome only a few inches.

See Fig. 51 &53 for the dome drive plate hole locations. On Fig. 53, the lower right hole is for the lift arm pivot. To locate its vertical position, slide the drive plate onto the pivot bearing. The drive plate should slide smoothly up and down on the pivot, and the rollers should easily contact the underside of the DSR. Then while holding the drive plate against the DSR, swing the lift arm to a horizontal position with the connecting arm vertical, and mark the lift arm pivot hole, drill, and install the bolt as shown. Reinstall the drive plate, but leave it in the lowered position.

Drive Plate Wiring

FIG 52

Refer to Fig. 52 Use the 7 ft. wire to connect from the TOP SWITCH terminals to the first drive motor. Then use the 17 ft. wires to connect to each successive motor. Be sure each is wired with the same polarity. Remove power supply from outlet while connecting to internal terminals.

Turn on the power supply. Operate the top switch briefly to the right while watching the drive rollers on each drive plate. Verify that each one turns clockwise so as to turn the dome clockwise (viewed from above).

If you encounter a situation where the rotation is blocked (i.e., stops suddenly), you must stop the motors at once. Before doing anything else, draw a diagram of where the slot opening is in relation to the door or some other reference point on the base ring. Also, make a similar sketch of the dome as seen on the outside. This may help you understand what might be hitting or causing the blockage. The dome support ring is likely hitting something “head on” or perhaps scraping on a bolt head beneath it, or perhaps a bolt on the dome equator flange is hitting the underside of the reverse flanage.

See Chapter 12, Problem Solving, for more suggestions; if you cannot diagnose the situation on you own, you may call or email to us.

Dome Drive Operation

Caution: The dome drive units are very powerful and can cause injury or damage. Always be sure that they are clear of any wires, that no one is in contact with the units, that hair, clothing, and fingers cannot be caught in the motors. Each drive plate can exert as much as forty (40) lb. of traction, so exercise care.

If ever the rotation is blocked, do not keep running the motors to try to overcome it. You will succeed in damaging the motors (ruining the drive belt and flattening the rubber tires.) Instead, stop the motors and make the sketches as described above so you can proceed with a logical analysis.

Caution: The PD15 is designed to be rotated ONLY when the DSR Swingout and semidoor are FULLY closed and LATCHED. Always check that the DSR is closed before operating the drive motors. Operating the dome with the DSR unlatched can cause the dome slot to expand, and the dome to fall off the wall.

To prepare the drives for operation, raise each drive plate so that it is in spring loaded contact with the DSR. Check that the DSR Swingout and Semi-door are CLOSED and latched. The power supply switch should now operate to turn the dome in the desired direction.

10. SHUTTER LOCK INSTALLATION

PRO-DOME Lock Installation

Note: The deadbolt locking assembly is an optional accessory that can be purchased from Technical Innovations for maximum security, but we recommend that it **NOT** be installed if the observatory will be running DDW with remote operation. The dome when closed is quite secure with the ES15 cabling and would require significant effort for someone to break into the observatory. It is **essential** that the lynch pin device provided with the dome be used, as discussed above. These pins can be inserted (from outside the "standalone"dome when fully closed to secure against forcasted extreme storm conditions.

The PRO-DOME Deadbolt Lock is a key actuated deadbolt locking system installed on the lower edge of the front shutter of the HOME-DOME/PRO-DOME. The lock is built into a TEE handle. The deadbolts are 3/8 in. diameter steel rods that engage holes in the slot edge. The deadbolt occupies space above the handles on the inside of the front shutter, and thus reduces the past-zenith opening of the shutter by about five inches. If you need the maximum past zenith opening, you may contact us for alternative suggestions on providing a locking function.

Parts List

(1) Lock Handle with key, cam, mounting screws
(2), deadbolt guides
(2) two deadbolts
(2) 3/8-16 nuts
(4) 1/4-20x3/4 SS carriage bolts/nuts/washers

Installation

Installation requires an electric drill and a standard set of drill bits. The lock requires a 7/8 in. diameter hole which may be drilled or filed (see discussion below). A hacksaw may be needed to cut the deadbolt rod.

FIG 23

The figure shows an inside view of the lower end of the front shutter. The instructions are written for the normal location on the centerline above the handles as shown. If the maximum possible past zenith shutter opening is needed, the lock position can be changed (call TI for suggestions).

The centerline location and the deadbolt guide positions are suggested locations. Because dome assembly (especially Shutter Cable Connector Assembly and handle locations can vary, you should hold the assembly in position and check that these are good locations. Check clearances:

- The deadbolt, when retracted must clear the slot edge pulleys as the front shutter moves over the dome
- The deadbolt must clear the Shutter Cable Connector Assembly when the shutter is closed
- The cam must clear the shutter handle hardware when operated

To avoid mistakes, you should recheck component positions and clearances before drilling holes and mounting each component.

Holding the lock in the position desired, mark the centerline for the assembly and the lock mounting holes as shown. The easiest way to make the 7/8 in. hole is to drill a small guide hole, then use a 3/4 in. spade bit (as used for wood boring). To reduce splintering, drill partway through from one side, then finish the hole from the inside. An alternative that just takes a few minutes is to drill the largest hole you can (say, 3/8 or 1/2 in.), then use a round file or rasp and open the hole to 7/8 in. diameter.

Remove the large nut and the "cam" lever from the rear of the lock (note which side of the cam faces the lock). Mount the lock into the holes with the screws provided. Reinstall the cam. Be sure to use a lockwasher under the nut to avoid loosening of the nut.

When the lock is turned so that the bars are fully extended, they should just touch the inner surface of the front shutter flanges. You may adjust the "length" by adjusting the deadbolts, or you may cut off some of the length using a hacksaw and plenty of oil. Use a file or grinder to round the cut ends of the bar. Use the nuts provided to lock the deadbolt length.

With the lock and deadbolt assembled, turn the lock into the UNLOCK (retracted) position. Slide a deadbolt guide onto each deadbolt, and mount the guides on the shutter surface using the 1/4-20 carriage bolts.

Now, from inside the dome, FULLY close the shutter and turn the lock toward the LOCK (extended) position. The bolts will strike the inside of the slot edge. Mark where they hit. Recheck clearances, and then open the shutter and drill 3/8 in. diameter holes through the slot edge (but not the shutter flanges).

Now, close the shutter, and have an assistant turn the lock from the outside. The deadbolts should go into the holes. Enlarge or file the holes as needed so that the deadbolts move into the holes properly. When the deadbolts are adjusted properly, they should penetrate the slot edge holes and touch the inner side of the shutter flanges. When complete, tighten the stop nuts on the deadbolts prevent loosening of the deadbolts, and tighten the main nut on the lock.

Note, if you want an even stronger locking action, you may want the deadbolt to penetrate the shutter flange as well. Simply unscrew the deadbolts from the cam to gain the additional length.

This completes installation of your lock system. You will notice that the key can be removed in both positions, for your convenience.

Caution: With the electric shutter installed, you MUST unlock the dome before operating the shutter or damage may result. We recommend putting the keys for the dome deadbolt lock and the electric shutter on the same key ring to help avoid this mistake!

11. FINISH WORK & ACCESSORIES

You have finished the big work: building the dome. However, there are a number of additional items to install that will increase the safety and convenience of your dome. These include:

- Shutter Restraint System
- DSR Safety Brackets
- Soffit
- Caulking

Shutter Restraint System

FIG 24

The Shutter Restraint System is a cable and spring system that applies a calibrated radially-inward force to the top shutter to prevent wind from lifting the top shutter or the adjacent end of the front shutter. This system allows the observatory to be operated under higher wind conditions because it assures the engagement of the top shutter latches when closing the shutter. Of course, it also prevents the wind from blowing the shutter off the dome when the shutter is open. If this system is not installed, the Home-Dome/Pro-Dome should NOT be operated if the wind is more than about 15 mph, a very light breeze. With the system installed, the dome is safe to operate to about 30 mph, a very stiff wind. Note that this system does not affect the wind strength of the properly closed observatory--that is a function of the strength and design of the fiberglass, latches, and front shutter hold-down. However, it will improve the resistance to shutter lift off if the shutters are not fully and properly latched.

Description of Operation. With reference to the figure, each flange of the top shutter has J-shaped guides through which passes a 1/16 in. stainless steel cable. The cable is anchored at the rear of the dome, and in the front connects to a special spring that is mounted on a post.

When the shutter is closed, the spring and cable at are **very** low tension, virtually zero. When the shutter is to be opened, the front and top shutter move back, and the rear latch of the top shutter leaves its latch receiving hole. This raises the rear of the top shutter, putting tension on the spring and cable. This tension remains essentially constant as the shutters move to the rear, but increases again when the front latch of the top shutter disengages from the front shutter. When the shutters are in the rear, there is thus a controlled force inward on the top shutter, so that the wind cannot lift it away from the dome. The spring is designed so that it has only a limited travel, so even a high wind cannot do more than lift the shutter an inch or so. When the shutter is to be closed, the inward force then assures that the latches properly engage the receiving holes.

Where the cable is outside the top shutter J-guides, small cable posts mounted on the dome keep the cable from sliding across the dome surface.

You have already installed the J-guides on the Top Shutter. You will now install the remaining items.

Spring Post. Close the shutters. Adjust the top shutter so that it is equi-spaced left/right from the slot edge. Mark the dome surface about 4 inches in front of the top shutter, and in line with the cable guides. Drill a 9/32 hole and install the spring post and spring using the carriage bolt supplied. Repeat for the other side of the top shutter.

Rear Cable Bracket. The rear cable bracket is part of the shutter catcher (already mounted), and is a lip with two small holes that will project out from under the fully opened top shutter.

Cable Installation. One end of the cable attaches to the spring, the other end to the rear bracket. One end of the cable has a permanent termination loop, the other end is bare where you will use a split bolt as a cable clamp. You should decide whether you want the cable clamp at the rear or at the top front of the dome depending on where it is more convenient for you to adjust the cable tension. The normal installation is with the cable clamp at the rear.

Assuming a rear cable clamp, to install the cable, feed the free end of the cable through the spring bracket and through the loop. With the top shutter back in the shutter catcher, feed the free end of the cable through the J-guides and attach the end to the cable bracket with the cable clamp. Pull the cable to put about 1/2 inch of tension on the spring and snugly tighten the cable clamp (you will readjust/tighten it later).

Cable Guide Post. The twelve cable posts prevent the cable from sliding across the dome (this is primarily an aesthetic issue). Open the shutter fully. With the top shutter centered left/right on the slot edge, run a pencil line directly underneath the cable over the top and rear of the dome. Install a pair of cable posts 3/4 in. outside this line equidistant between the spring post and the top shutter. Thus, the cable will drop onto the dome inside the cable post which keeps the cable from moving more than 3/4 in. over. After both sides are done, close the shutters (moving the top shutter to the top) and similarly install two more pairs on the rear of the dome.

Cable Tension Adjustment. With the shutters **closed**, adjust the cable tensions so that the cables are LIMP, ie., NO tension. Tighten the cable clamps tightly and test the system by operating the shutter. You should see a slight spring tension as the shutter opens and the latches leave the receiving holes. You should notice only a slight increase in the force required to operate the shutters compared to no wind restraints. If you do see a significant increase in shutter force, relieve the tensions slightly and retry.

DSR Safety Brackets

FIG 10

The DSR safety brackets help prevent dome rotation while the door is open. If the dome is turned when the DSR swingout is open, the slot opening can spread out, and the dome can fall off its wall. This is why there is a warning against EVER turning the dome with the door or swingout open. The brackets prevent the DSR swingout from moving more than an inch away from the door, and virtually prevent dome rotation under that condition. The brackets mount on the door about four inches in from the door edges, with vertical location to permit dome rotation without interference. The brackets are installed with 1 in. carriage bolts,

Soffit.

FIG 17

The soffit (fabricated from dark blue PVC) covers the opening between the rear cover and DSR. Installing the soffit is optional: many persons choose to leave the opening to maintain more ventilation in the dome.

Safety Device.

FIG 18

We recommend that you install a safety device to prevent the front shutter from an uncontrolled sliding to the front of the dome. This situation should not normally occur, since the shutter should always either be open, or closed, latched to the top shutter, or under control of the user: it can only happen if the front shutter is left by itself at the top of the dome. The figure shows one simple device (an alternative is a stop bolt installed in the slot edge whenever the front shutter is raised). Install the device that is convenient to your style of observatory use.

Anti-rotation Bolts.

Although optional, anti-rotation bolts may be desirable for preventing rotation when you are NOT observing and for doubly assuring that severe wind storms do not damage the dome. We suggest using 1/4 or 3/8 carriage or other bolts, washers, wing nuts, or other devices convenient for you. You should drill four holes down through the equatorial flange, DSR, **and** base ring. You can then insert long bolts to prevent rotation when your dome is not in use. During windy periods, especially when you know a severe wind storm is coming, it is desirable that you place nuts on these bolts and tighten them to make sure the wind cannot lift the dome off the base ring and vibrate it against the reverse flange.

Caulking.

If you are satisfied with the dome assembly and operation, it is time to caulk the joints.

If the dome has been exposed to rain, it almost certainly has water between some of the flanges: it can stay there for weeks! Before caulking, the water should be removed or else the caulk will not make a good bond. You can wait, and verify dryness by looking into the joints or inserting a paper strip. But an easier way to get the water out is to use compressed air or similar means to blow out the water.

If it is too cold or wet to caulk, you may use vinyl tape from a department or hardware store and apply it to the joints. Do not use duct or electrical tape, since these leave sticky residues that are difficult to clean. Tape should be removed as soon as the weather improves. Use tape or *low* quality caulk if you plan to disassemble the dome in a short time (good caulk is hard to remove!).

Our experience is that simply injecting caulk into the exterior seams from the outside forms a completely effective seal. We provide clear silicon caulk (the clear looks better than the white after it is dry). With the seams clean and dry, simply inject a smooth bead. We recommend that you not try to smooth the bead with your finger or other tool because then the silicon caulk tends not to form a smooth surface. Extend the caulk down along the skirt side joints on the DSR. Check that you have applied caulk on the joints between the quadrants (Greenwich Flange), including the joint as it extends up and under the shutter flanges at the top of the dome.

If you do want to inject caulk into the seams, you can do so by loosening the flange bolts and installing small wedges. Inject caulk into the opening, being careful not to overdo it at the points where the DSR sections abut. You do not want caulk to ooze down into the roller area. Remove the wedges, and tighten the bolts.

If you have not already caulked the wall ring and base ring joints, now is the time. Again, you can choose to apply caulk only to the outside of the joint, or you may partially disassemble the parts to inject caulk into the joints.

If there is a gap between the bottom of the wall and the foundation, now is the time to fill it. We recommend expanding foam, which you can inject into the gap. It will ooze out inside and out, but after it hardens, you can cut off the ooze with a sharp knife. Paint the outside with latex paint so the sun won't cause deterioration.

12. PROBLEM SOLVING

This section describes some problems that may occur and how to solve them. Most problems are easily solved with a careful, step by step approach.

The first thing to do is stop and make notes of what you were doing when the problem occurred, including making sketches of the dome. Exactly how were things positioned in relation to each other when you observed the problem? Usually the difficulty involves moving parts. When you stop to record exactly where things are, you'll find it easier to be more methodical than if you just keep taking action at random.

In the event that some parts need to be modified, or if portions of the dome must be disassembled and then reassembled, don't despair: these activities are easy to carry out. You will find that fiberglass is very forgiving of errors, and that fixing problems is usually very easy, once the problem is understood. If you find that you need to, call Technical Innovations and we will try to help.

Dome Rotation Problems

One possible problem at this point is that the dome does not turn easily, i.e., it turns easily at some points of the circle, and not at others, or it may turn in one direction and not the other. A systematic look will generally locate the problem.

First, check that all the blocks are removed, and that there is no foreign material (tape, wood scraps, etc.) between the DSR and the base ring. A bolt or nut under the DSR can make horrible noises at particular rotation points, and also resist rotation. Check that the DSR lip screws have been removed (or are not touching the base ring). Check that the rollers are all clean. Check that nothing is catching on a sharp edge (this will normally show up as a sudden stoppage of the rotation). If this is the case, find the offending spot and bevel or modify it. If you think the problem is under the DSR (e.g. a lost bolt), see the section "**Base Ring Service**" below for how to inspect that area safely.

If nothing is catching on an edge, i.e., the dome simply is much harder to turn at some points, the problem is likely to be binding of the DSR against the base ring. This can have several causes:

FIG 21

- the Base Ring was made too large
- the DSR was made too small
- Base Ring and DSR are out of round.

Check your base ring and DSR circumference measurements. (Compare to the chart in Chapter 3.) The DSR circumference should be at least 2.5 in. greater than the Base Ring, giving a DSR diameter at least 0.8 in. greater than the base ring. If the DSR to Base ring diameter difference is too large, (Case 3 in figure), binding will not occur but you will have substantial side to side movement as you turn the dome. If the DSR to base ring diameter is too small (Case 4), binding will occur.

Case 1 shows correct circumferences, with the dome centered on the base ring. As you turn the dome, you can push the dome off center (Case 2), given the DSR-base ring gap. This is normal.

Now, suppose the circumferences are OK, but the base ring and/or DSR are out of round. If centered, Case 5 shows that the gap may be uniform around the dome. But if you turn the dome 90 deg. (Case 6), you will see a different pattern of gap measurements. If you suspect this case, carefully take several sets of measurements, pushing the dome in both directions, and compare the results to determine exactly what is happening.

The most common cause of the problem was that the base ring was not circular during initial assembly (e.g., was forced onto improperly located foundation bolts). If the base ring was out of round, this would then cause the DSR to assume an out of round shape when bolted to the dome quadrants.

In either case, examine the situation carefully, make careful measurements, and think out carefully what is happening before making changes. If necessary, set up a good center point so that you can measure the "radius" of the Base Ring and DSR at different points on the circumference, and plot the results. Proceed step by step, rather than "just trying things". Try loosening the bolts holding the item (e.g. one of the DSR sections) to its improper shape, modify the shape (use people power, twisted ropes, duct tape, clamps, or other means), drill new holes, and install and tighten new bolts. Don't worry about making extra holes in the DSR or other parts (the extra holes won't show, and the parts are all sufficiently strong to accommodate the extra holes).

Shutter Engagement Problems

FIG 16B

Shutter or latch engaging problems are nearly always caused by the edge of one item catching the edge of another. To solve, simply examine closely the location of each shutter as you have the problem, and identify the offending points. Fix it by beveling or adjusting the interfering edge properly. If the problem is a cavity (rather than a projection), fill the cavity with epoxy or polyester resin (or BONDO from an Auto store) and file to obtain the desired shape.

If the latches of the shutters do not properly engage, do NOT use the dome until the problem is corrected.

Shutter Dis-engagement Problems

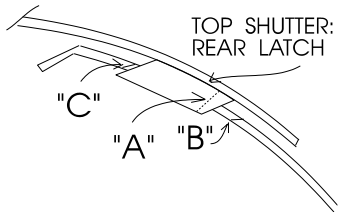
When the shutter is opened the first few times after the observatory is constructed, you should make several observations as the shutter moves up the first foot:

- watch that the top shutter moves back as the front shutter is slid upward
- look up inside to check that the rear latch has disengaged
- look up inside to check that the front latch is still partially engaged (i.e., still in the hole)

When opening, if the front latch disengages while the rear latch remains engaged (the opposite of what should happen), then when the rear of the front shutter reaches the latch it will force a disengagement. The top shutter will then slide to the back OUT OF CONTROL and will usually break the shutter catchers. This can damage the shutter, and is dangerous and must be corrected.

The cause of this behavior may be one or both of the following:

- some condition at the rear latch or hole prevents easy disengagement of the rear latch
- some condition allows the front latch to disengage too easily.



The top shutter rear latch should disengage very easily as the top shutter is pushed back. Difficulty can be caused by:

- The rear latch may be excessively rounded at the ends of the rear face with a perpendicular bevel ("A" in figure). Because the rear edge of the hole is triangular, the ends of the latch will initially contact the rear of the hole, and a perpendicular face will not slide up out over the edge. Correction is to cut off the ends, or modify the bevel from perpendicular to sloped (as is the remainder of the rear face)
- The rear of the rear latch hole may be beveled too sharply ("B" in drawing). This can cause grooves or cuts in the rear face of the latch which worsen the problem. Correction is to sand the face to under 45 deg with smooth edges. If the rear face of the latch is grooved, sand or shave it smooth.
- The front of the hole may be beveled too sharply, causing the latch to jam in place ("C" in drawing). Sand the front of the hole to a more vertical face, and smooth the edges.

The front latch should NOT disengage until the front latch passes over the down lip of the rear cover and the rear of the top shutter has reached the shutter catchers. Too easy disengagement can be caused by lack of vertical bevel on front face of latch. Correction is to create a bevel about 1/4 in. high (sand, plane, or cut).

Note, sometimes there may be excessive force required to disengage the front latch even when they are back in the correct position. This may be caused by warped shutters, a front shutter glide that has come loose, excessive electric shutter tension, or other problems that lift the front of the top shutter and/or the rear of the front shutter away from the dome. The cure may be to reduce an excessive front latch vertical bevel, or to make vertical the front edge of the front hole.

Shutter Blow-off

With the shutter restraint system in place, it is virtually impossible for the shutters to blow off. If the top and/or front shutter should blow off your dome, it is almost always that the latches were not fully engaged holding the top shutter to the rear cover and front shutter, or that the front shutter was not fastened to the front slot edges. Please review the shutter installation instructions, and recheck your latches and locking system. Never use ropes or bungee cords to hold the shutters in place: they allow too much movement of the shutter.

Base Ring Service

If you identify a problem that requires you to work under the DSR, you can do this WITHOUT disassembling the dome from the DSR. Simply turn the dome to the position needed, and open the DSR swingout, thus allowing access to the base ring beneath. However, remember, UNDER NO CIRCUMSTANCES should you turn the dome even a few inches unless the DSR is closed and locked. Failure to follow this rule may cause the dome to fall off the wall.

13. USE AND CARE OF YOUR PRO-DOME

Your PRO-DOME should give you many years of faithful service. Feel free to modify it, drill holes in it, and generally add your own personal touches to it. The walls are strong. You can use any fastening means (including fiberglass) to add desks, benches, etc.

Use the dome, but exercise reasonable care: it is NOT a toy. Don't let adults or children on top of the dome. And keep flames away: remember, fiberglass is flammable. If you use a heater, be careful to keep it away from contact with the fiberglass.

Your closed and locked observatory is designed to withstand the full range of normal adverse weather conditions, including extremely high winds. However, it is not designed for occupied use under high wind conditions. It is not possible to place a specific limit on the wind velocity that is acceptable, although most users find that winds above about 30 mph are not comfortable. If you wish to use the dome under higher wind velocities, you should contact us for suggested changes to improve shutter operation under high wind conditions.

Although your dome is very weather tight, be sure to cover your telescope with a sheet of plastic when not in use. If the air temperature drops so that the dew point is below the dome temperature, condensation can form, and drip from the top of the dome. This is rarely a problem except for domes attached to a house or other source of water vapor (in that case, you **must** have double doors or other means of keeping the water vapor out of the dome). If condensation is a problem, try a dehumidifier or a small heater or 100-200 watt lamp near the center of the dome and call us for additional help.

Your PRO-DOME requires very little care. Overall, the care of the dome is similar to that of a fiberglass boat, although since the dome is not in a marine environment, it will require less maintenance (and there is little chance for barnacles to grow!).

If you wish to keep it looking as new as possible for as long as possible, wash it with mild detergent (no abrasives) every 6-12 months to remove dirt and grime. You may want to apply rubbing compound and wax to the outer surface to help it remain "clean looking" longer, and help protect the finish. If the appearance is important to you, this should be done as soon as you build your dome if it is located close to trees, or if you have lots of dirt in the rain in your area. With occasional waxing the surface should last for many decades, though it may become slightly yellowish. You may wish to talk with auto or marine or boat supply stores for advice or materials for fiberglass maintenance and repair.

Three brands of fiberglass treatment that we have tried and like are

- 3M Marine Fiberglass Restorer and Wax (combines rubbing compound and wax in one application)
- IOSSO Fiberglass Reconditioner (restores color, removes oxidation and chalking, toll free number 1-888-747-4332)
- Meguiar's Cleaner and Wax (excellent cleaning and shine, easy to use)

It is possible that the surface of the fiberglass may become chipped or damaged during assembly. Or, after many years, it may develop some surface crazing or blisters. Normally, these chips or discolorations will cause no functional problems. That is, while they may affect appearance, they do not significantly affect the strength of fiberglass beneath. However, if you do wish to repair the surface, you can use epoxy or polyester resin to cover the area for a functional fix, and add gel-coat for an aesthetic fix. Contact an auto or any marine or boat supply (see the Yellow Pages) for a fiberglass repair kit containing white Gel-coat (i.e., resin with white pigment) which can be applied easily.

If major damage to the dome occurs (e.g., you forgot and left the dome open during a major windstorm), virtually any damage can be functionally repaired using a fiberglass repair kit. You'll find a kit for this purpose in an auto parts shop or marine supply. If you wish, you may contact Technical Innovations for advice and/or replacement parts.

After 15-25 years, the surface may begin showing its age, usually by a dulling or chalking of the finish. (But then, so will we all!) Unless the surface is damaged, the only care really needed is wax. However, if you wish to repair the surface, you may reapply gel coat, or you may paint the dome using a high grade epoxy paint. In either case, you will need to prepare the surface properly by cleaning and some abrasion. Again, give us a call, or check with your local marine or auto supply stores for advice and materials.

APPENDIX 1 RECENT CHANGES IN MANUAL

#	DATE	DESCRIPTION
1	11/09/98	Start
2	030799	Update ES1502d w/ new SCCA
3	031099	Minor typos, no center shutter catcher, P40-41 modifying SCCA installation, flat heads on rear cover
4	07/10/00	Foundation bolts, hole drilling notes, measuring dia., define basering, describe shims
5	100900	Rremove lower front crossover of ES cables, remove glide strip under SCCA
6	03/07/01	Describe holes in base ring, update figure 9C
7	3/21/01	New position for Pulley #11;
8	3/30/01	Recommend drawing sketches as part of problem solving; take out reference to triangle plates. Clarify lock position. Update drawings #24, 51, 23
9	6/6/01	Flat Head bolts on ES

APPENDIX 2 LIST OF ILLUSTRATIONS

Figure Numer	**Title**	File
1,2,3	Bolt detail, Carpenter Level, Water Level	HD101
4,5,6	Foundation optons, Foundation bolts & leveling	HD102
7	Concerete Pad Detail, Pad with Bolts & Shims	PD103
8	none	
9	PD15 Wall/base ring cross section	HD105g
9B	PD1 First ring installation	PD1514
9C	PD15 Wall/Base ring identification	PD1516b
10	Front view Pro Dome	PD106c
11,12,13	Roller hole, DSR bevels, Quadrant flanges	HD120b
14,15	Rear cover installation, Quadrant Bolt ID	HD118b
16B	Shutter operation	PD109B
17,18	Soffit, shutter safety device	PD110
19	Shutter anti-friction strip	PD111
20	none	
21	Rotation tests	PD112
22	Wall with Semi-door	PD113C
23	PD15 Locking system	LOCK1D
24	Shutter restraint system	PD117
31	ES15 Model 2	Es1501E
32	Electric shutter installation	ES1502d
41	Power Supply schematic	PS1C
42	Power supply layout	PS2c
51	Dome Drive Plate	ED1
52	Drive Motor wiring	ED9
53	Drive mounting holes	ED2

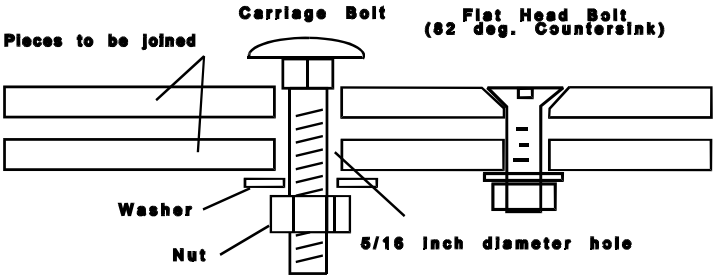


Figure 1
Bolt Detail

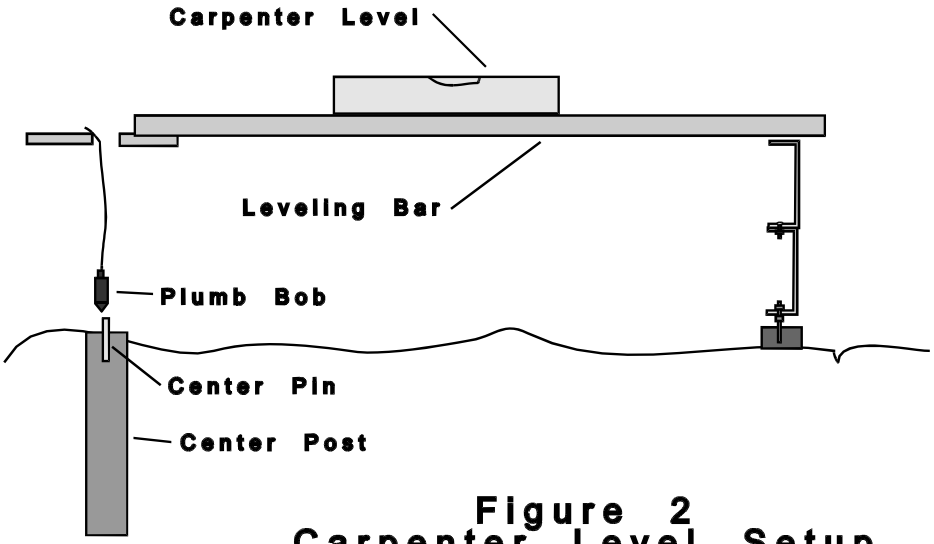


Figure 2
Carpenter Level Setup

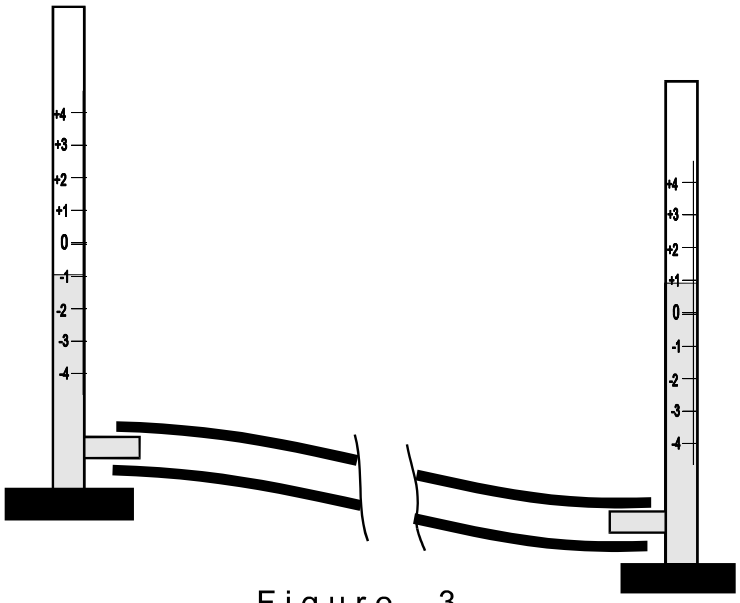


Figure 3
Water Level

HD101

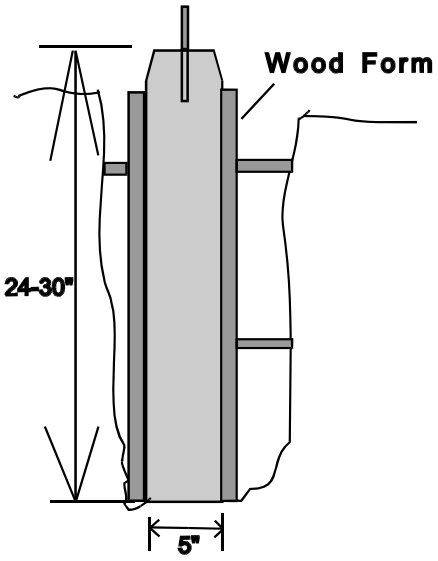


Figure 4
Ring Foundation Cross-section
(Poured Concrete)

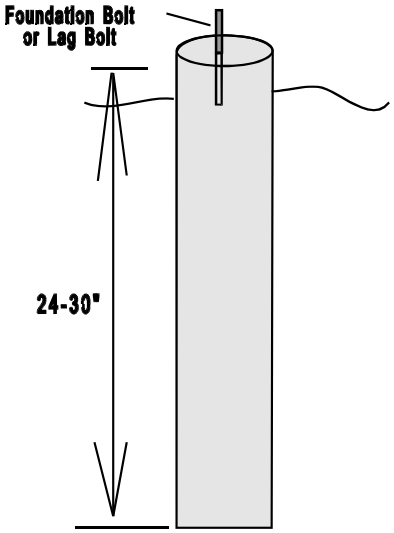


Figure 6
Wood Pier Foundation
(Post in Ground)

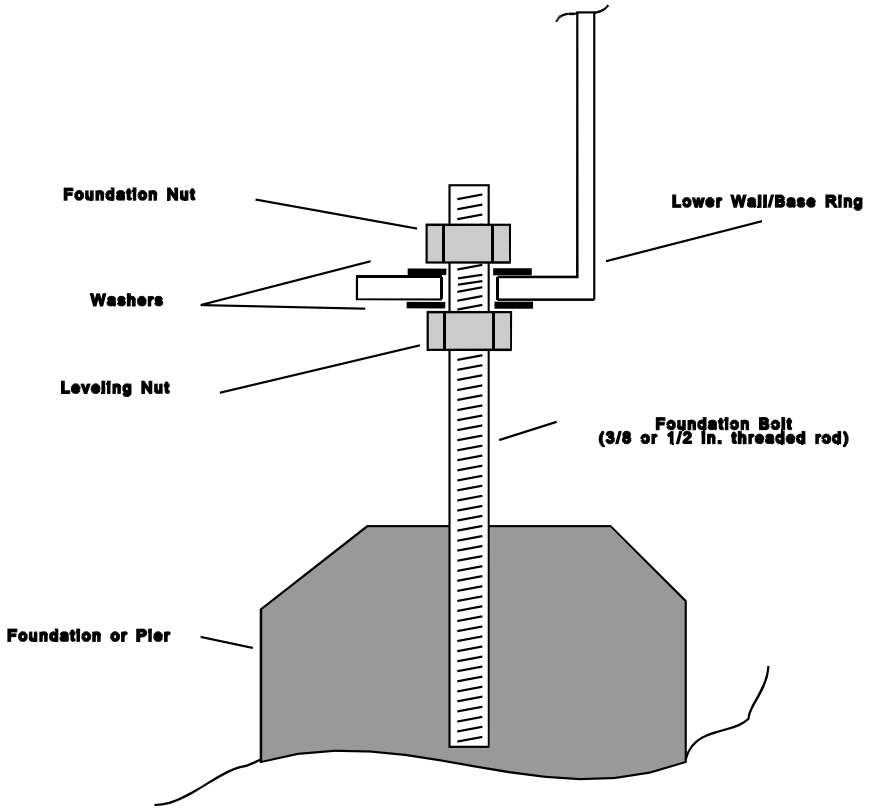
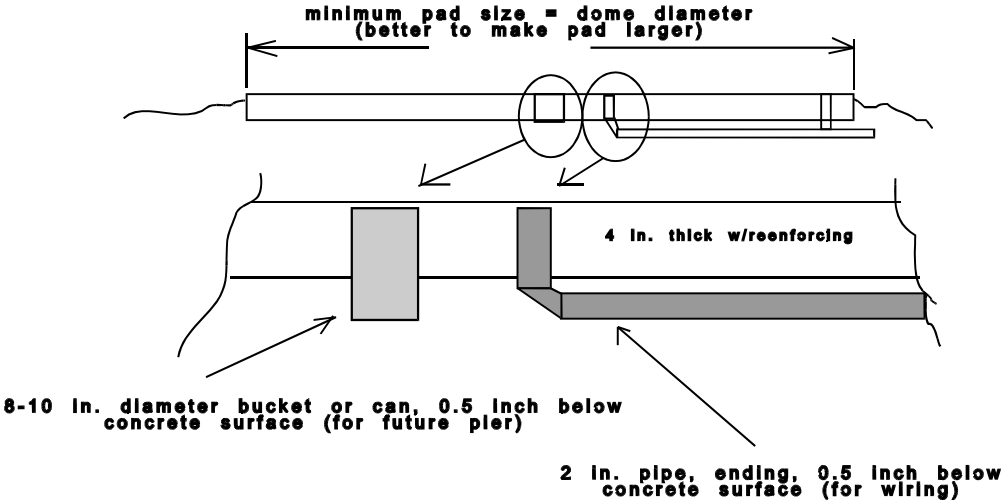
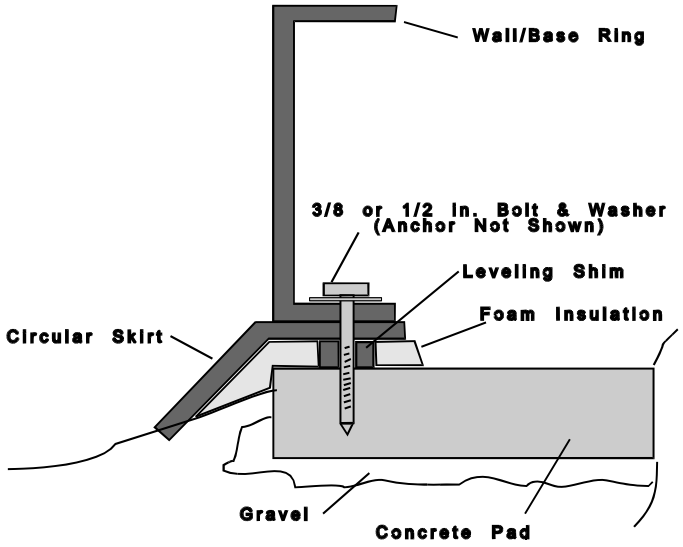


Figure 5
Foundation Bolts & Leveling

HD102



CONCRETE PAD DETAIL



FOUNDATION MOUNTING AND SKIRT DETAIL

Pad with Bolts & Shims Figure 7

DRAWINGS NOT TO SCALE PD-103

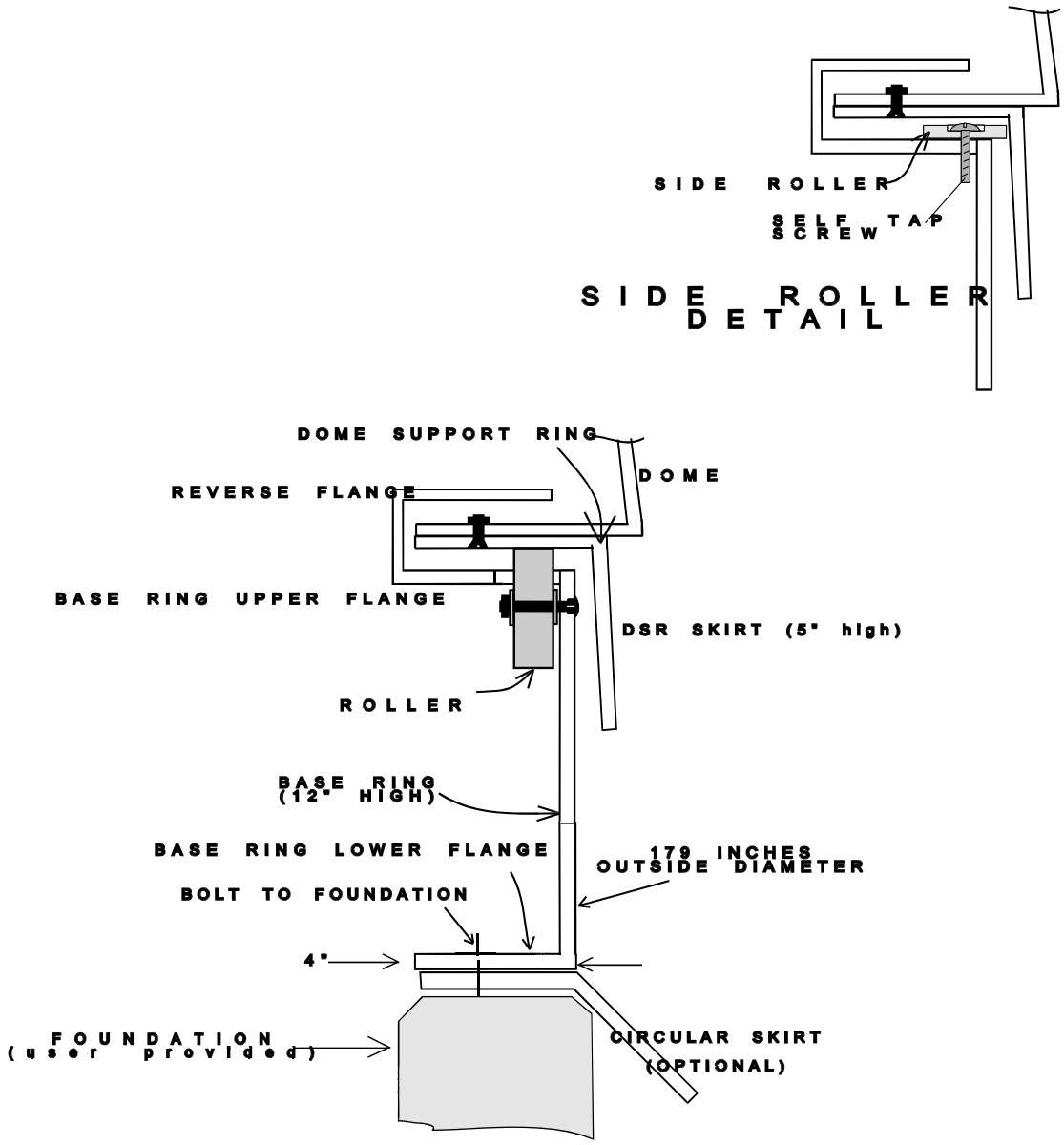
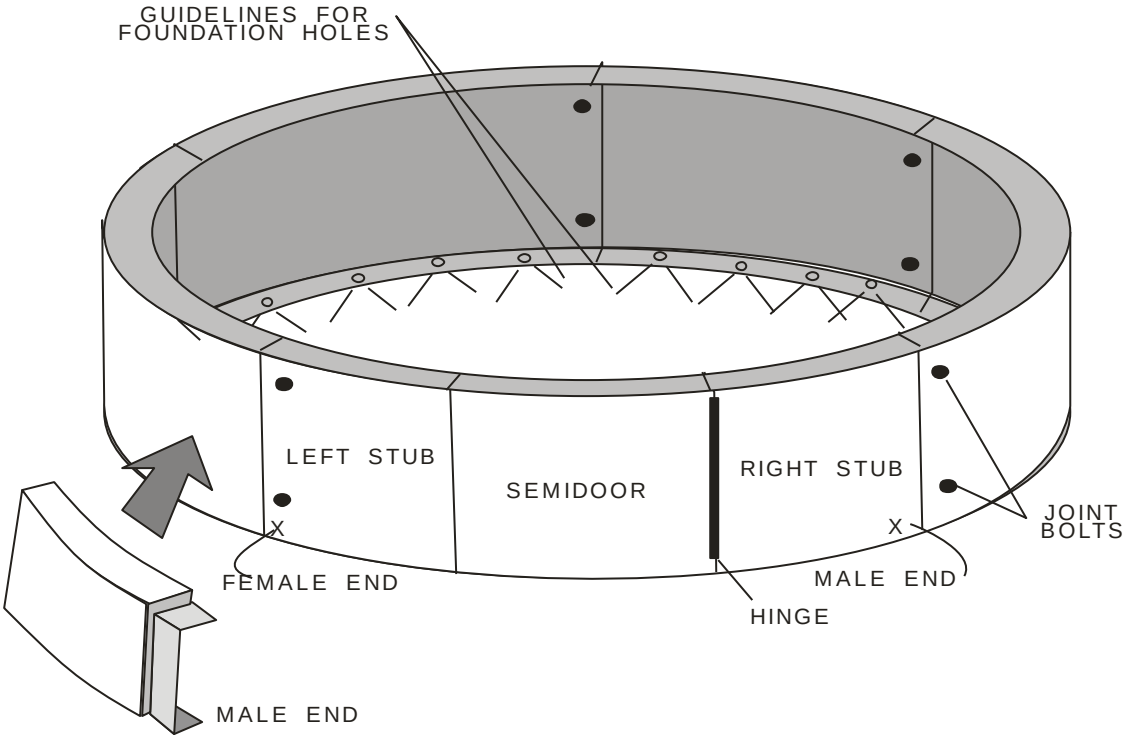


FIG. 9 - PRO-DOME 15 Wall/Base Ring

(NOT TO SCALE)

hd105g



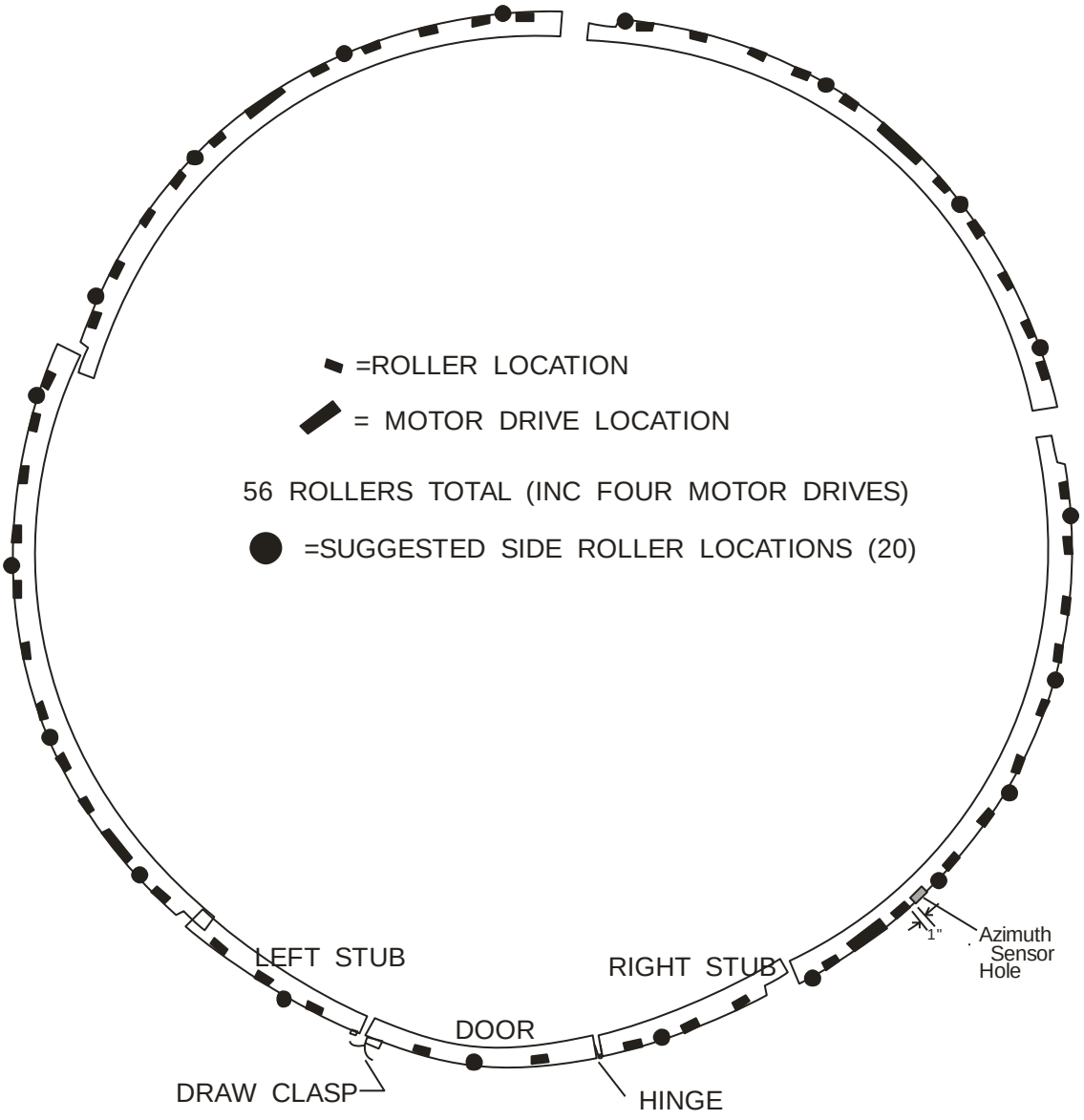
Note: Complete ring is made of five equal segments, one of which contains the left & right stubs & semidoor. Ring can also be ordered without the door.

NOTE: See text for discussion re shims under wall to provide door clearance.

FIGURE 9B

PD1514

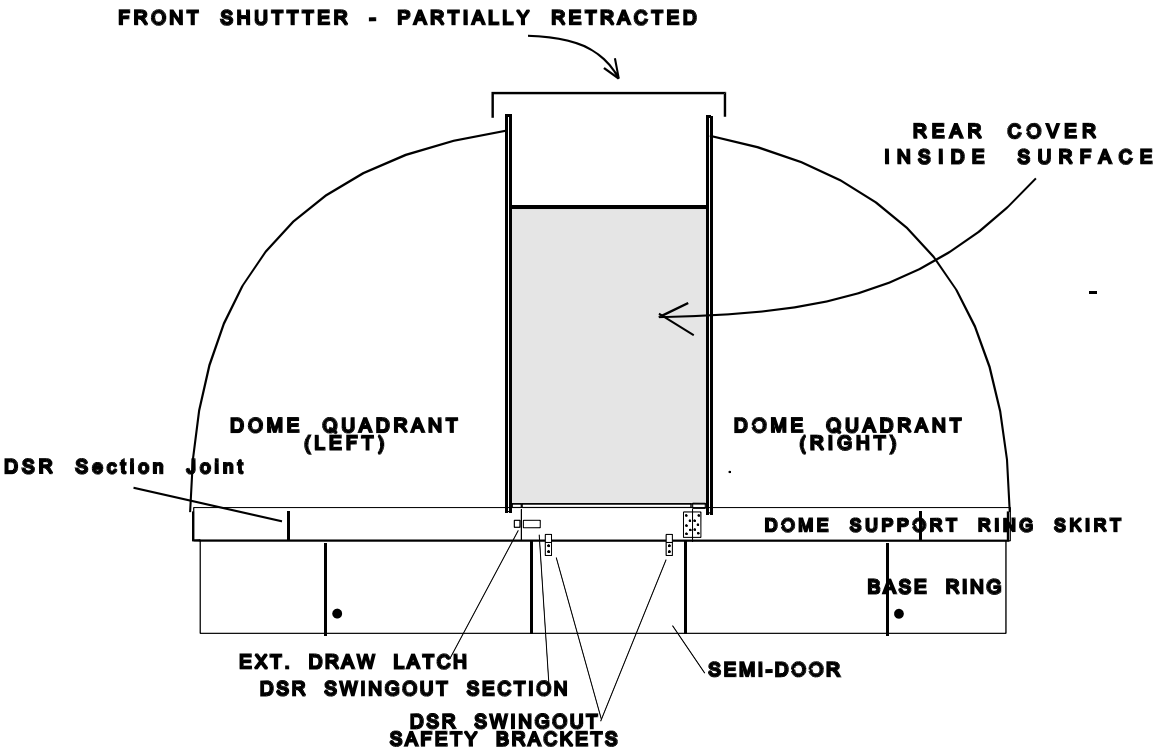
110898



PD-15 Wall/Base Ring Identification
(4 motor installation)

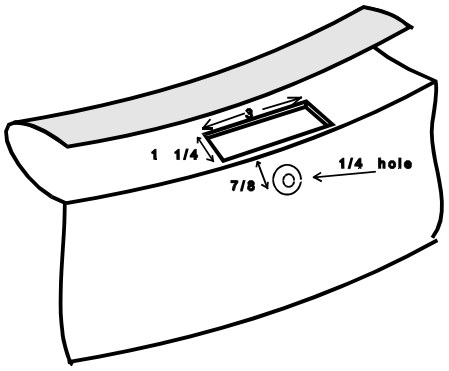
FIG 9C

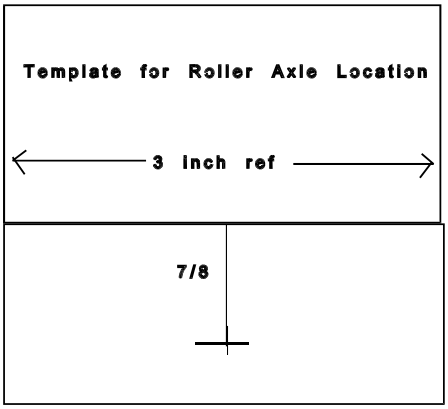
pd1516b
022801



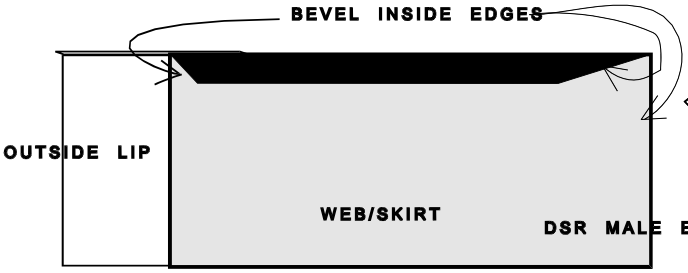
Front View PRO-DOME Figure 10

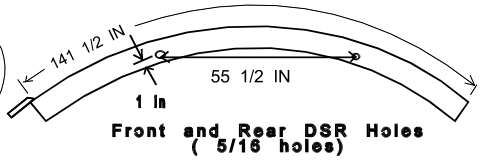
PDI06C





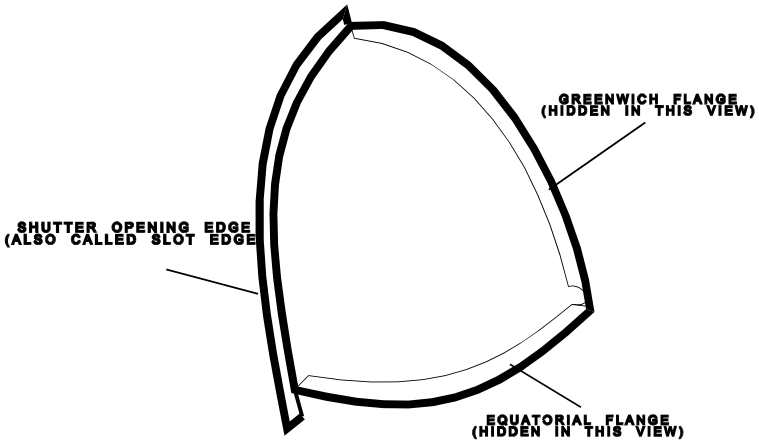
BASE RING - ROLLER HOLE
Figure 11





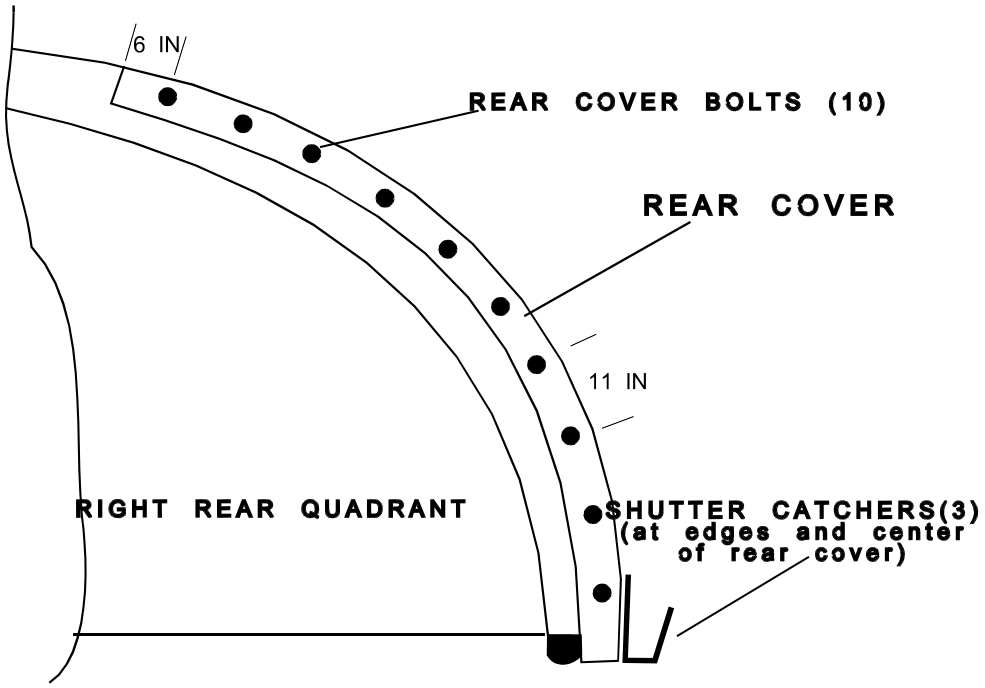
PD15

DSR - CROSSECTION SHOWING BEVEL
Figure 12

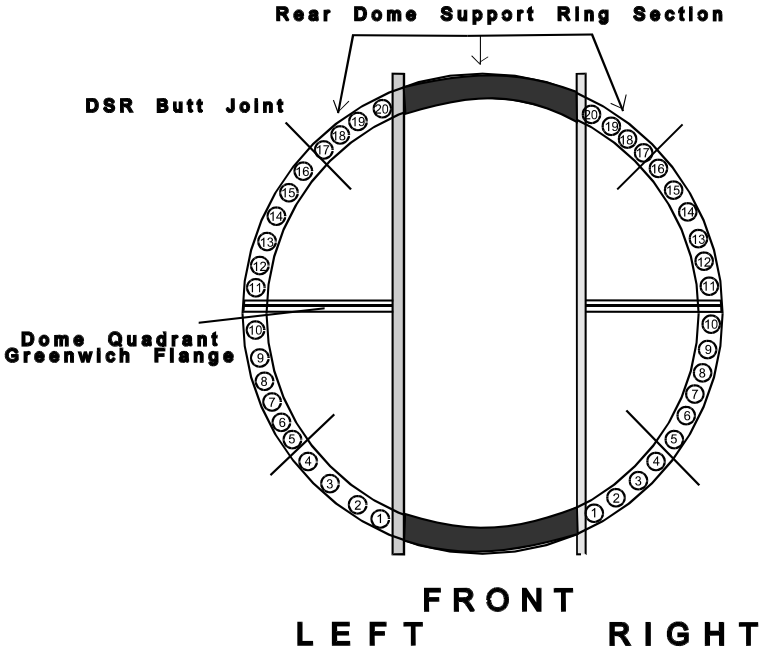


RIGHT FRONT QUADRANT - FLANGE NOMENCLATURE
Figure 13

hd120b



REAR COVER INSTALLATION
Figure 14



Quadrant: Bolt Identification
Figure 15

hd118b
PD15
110898

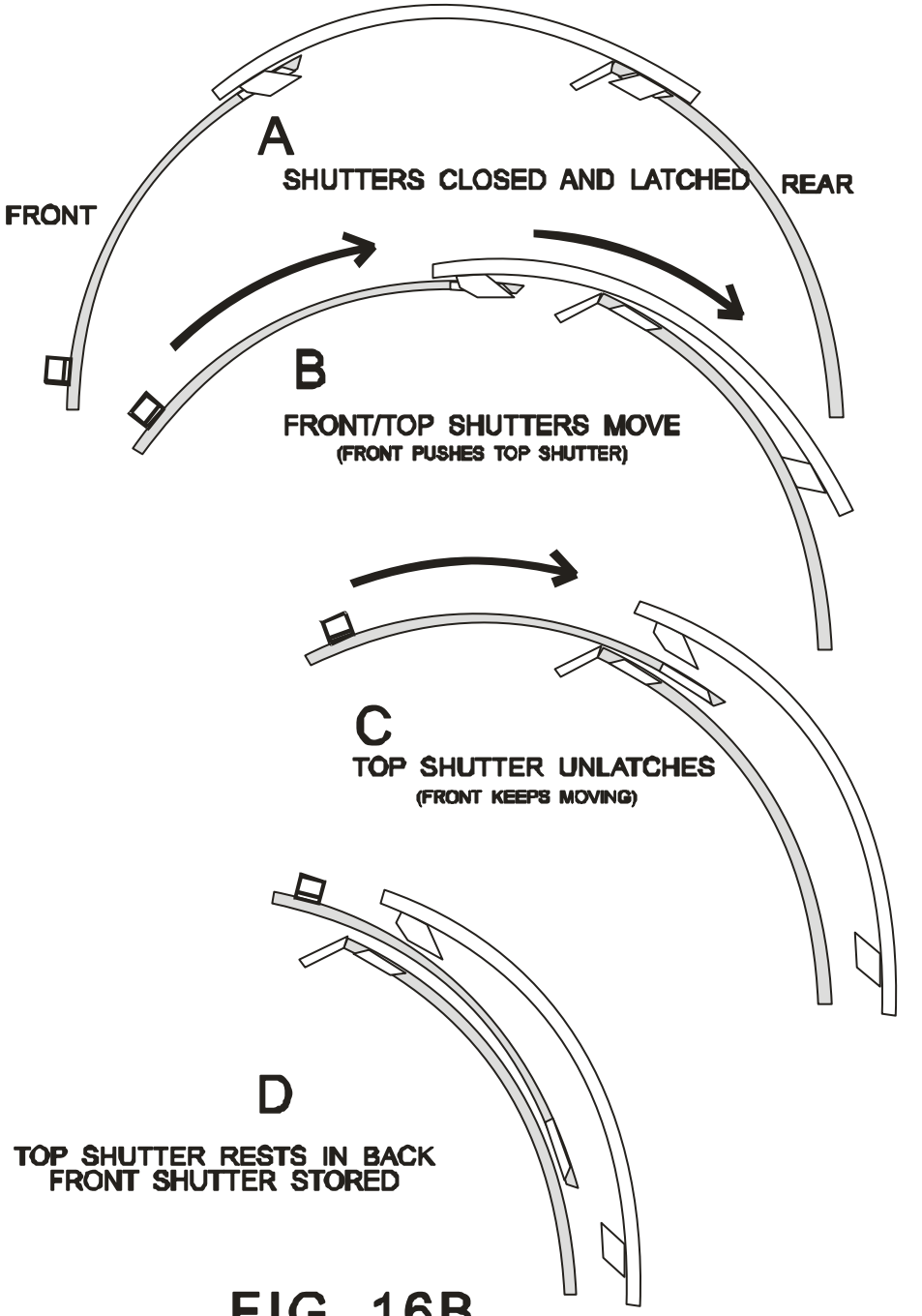
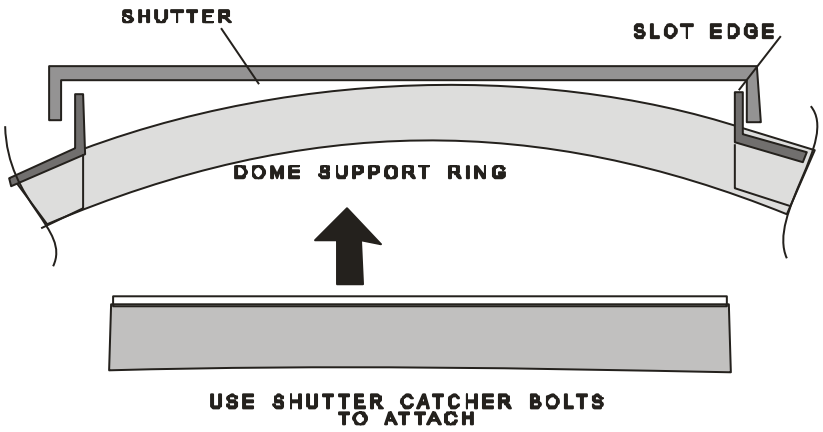


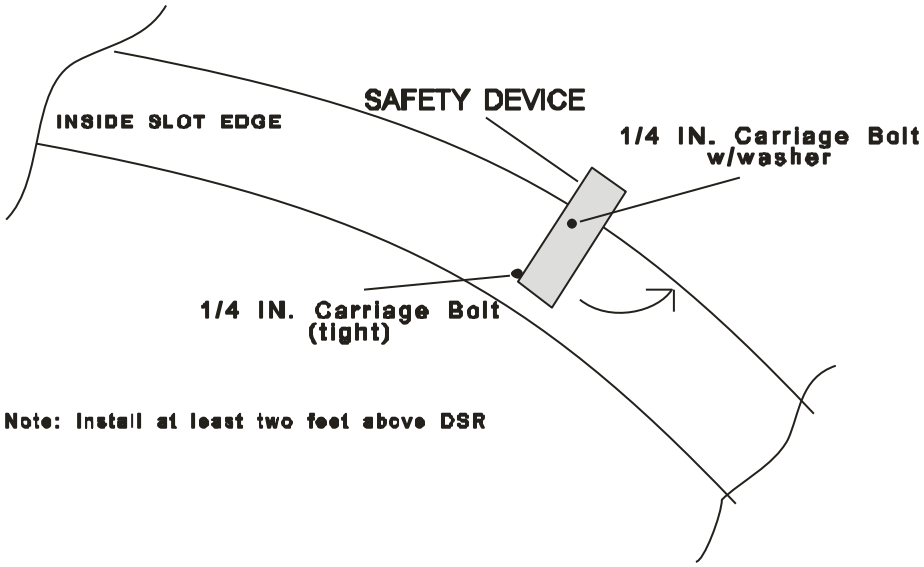
FIG 16B
SHUTTER OPERATION

NOT TO SCALE

PD109B



SOFFIT (PRO-DOME ONLY)
Figure 17



SHUTTER SAFETY DEVICE
Figure 18

PD110

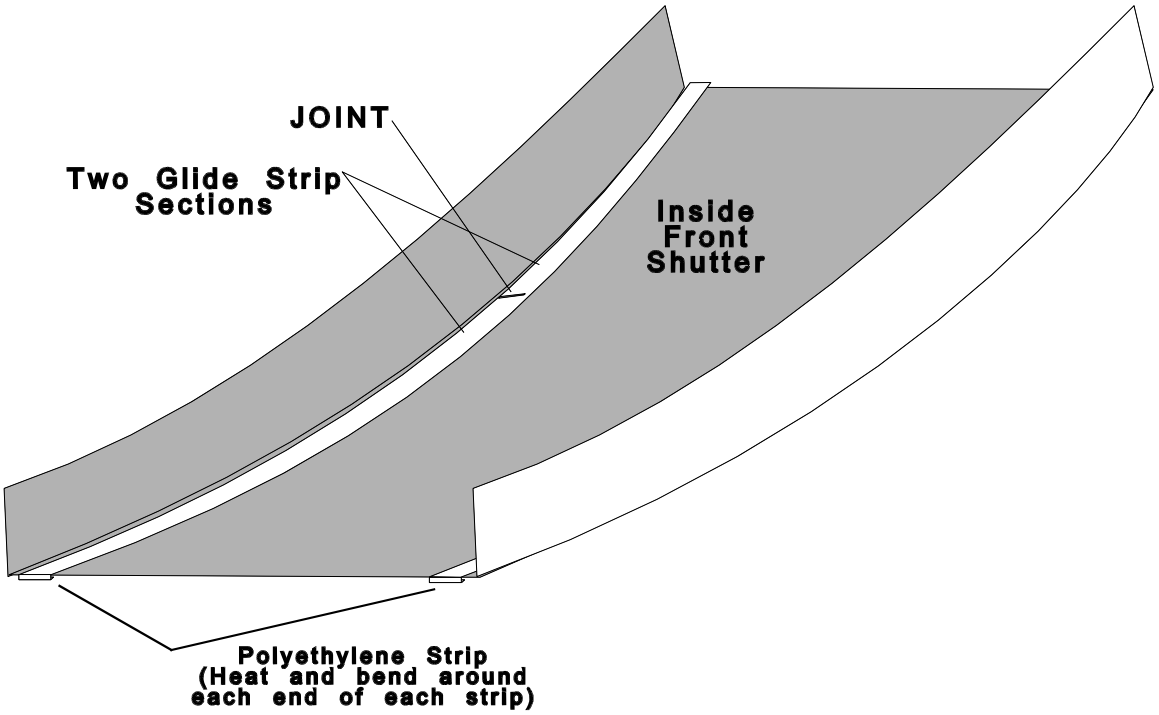


FIG 19 SHUTTER ANTIFRICTION STRIP

PD111
110898

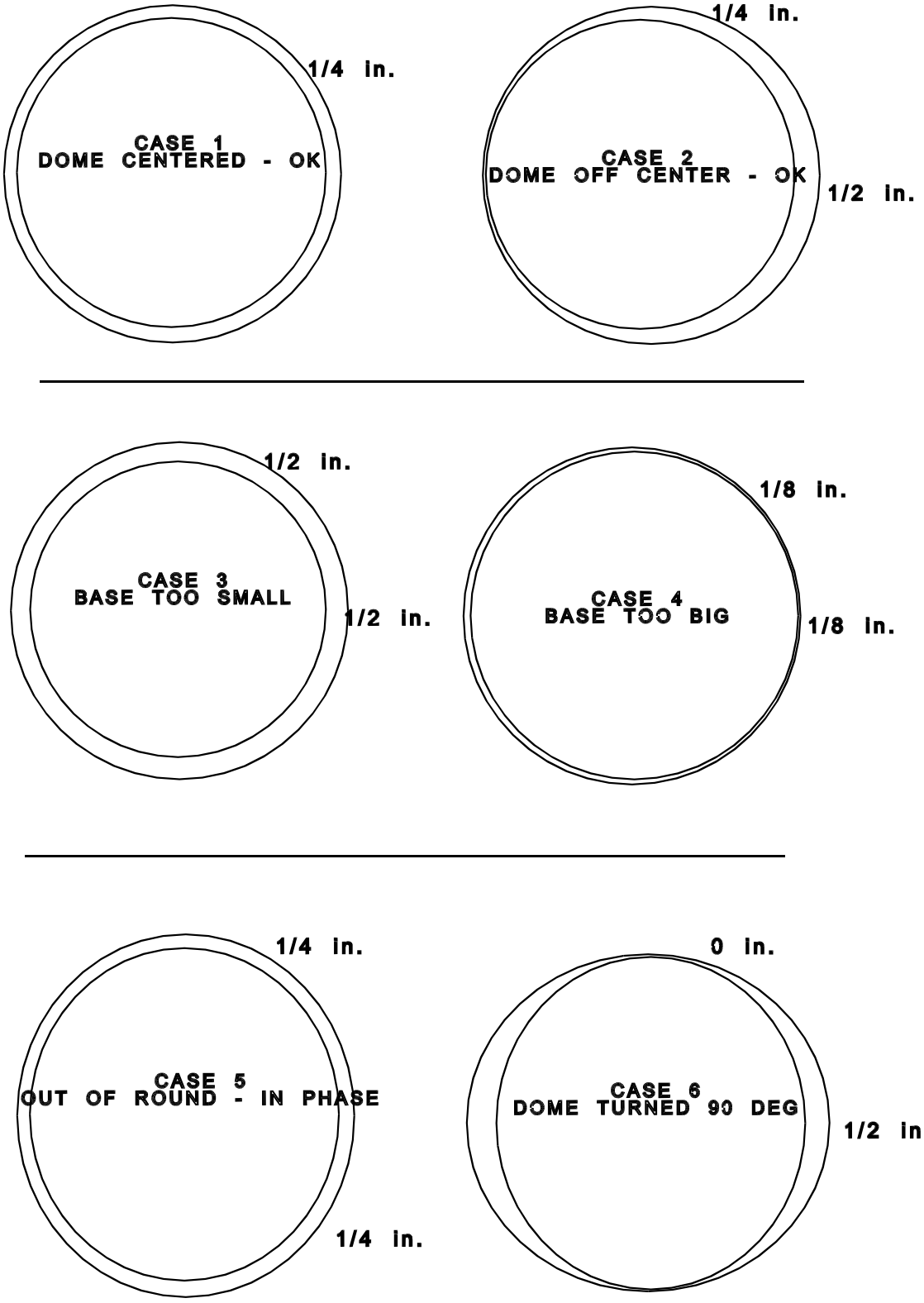
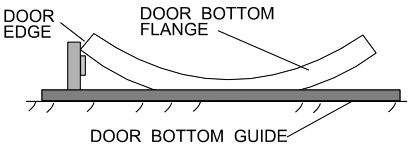
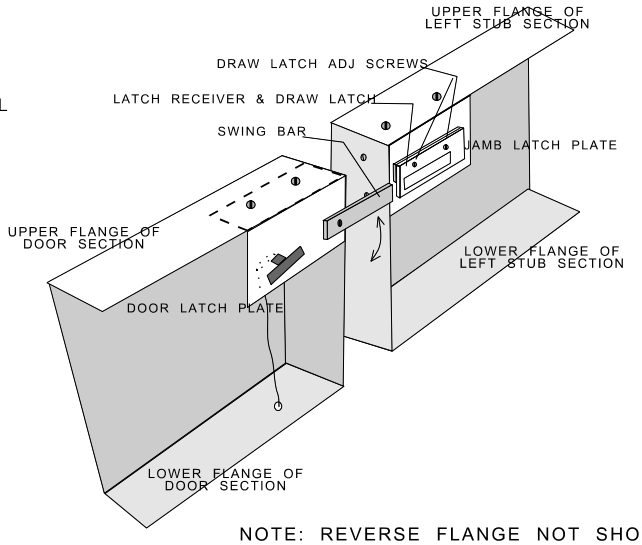


FIG 21 - ROTATION TESTS

PD112



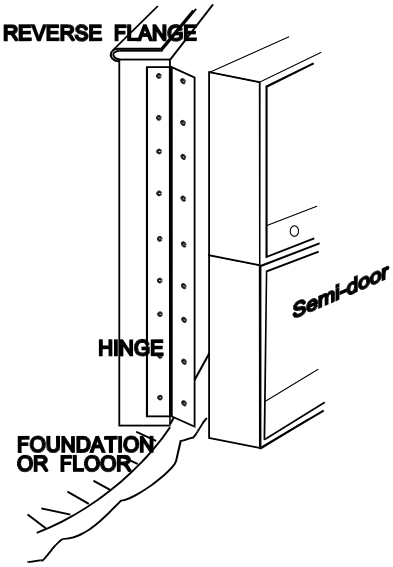
DOOR & STUB ASSEMBLY JIG

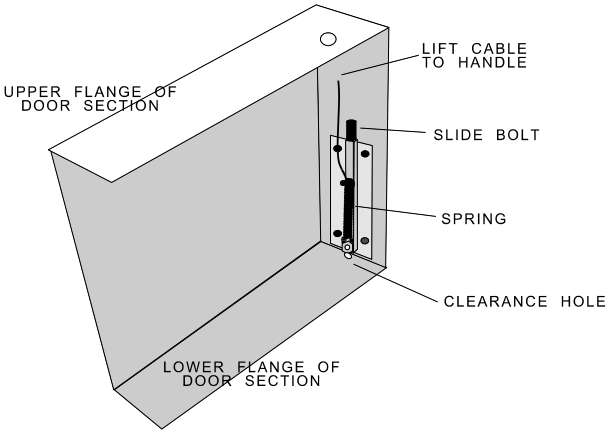


NOTE: REVERSE FLANGE NOT SHOWN

SEMIDOOR UPPER BOLT ASSEMBLY

VIEW FROM INSIDE DOME



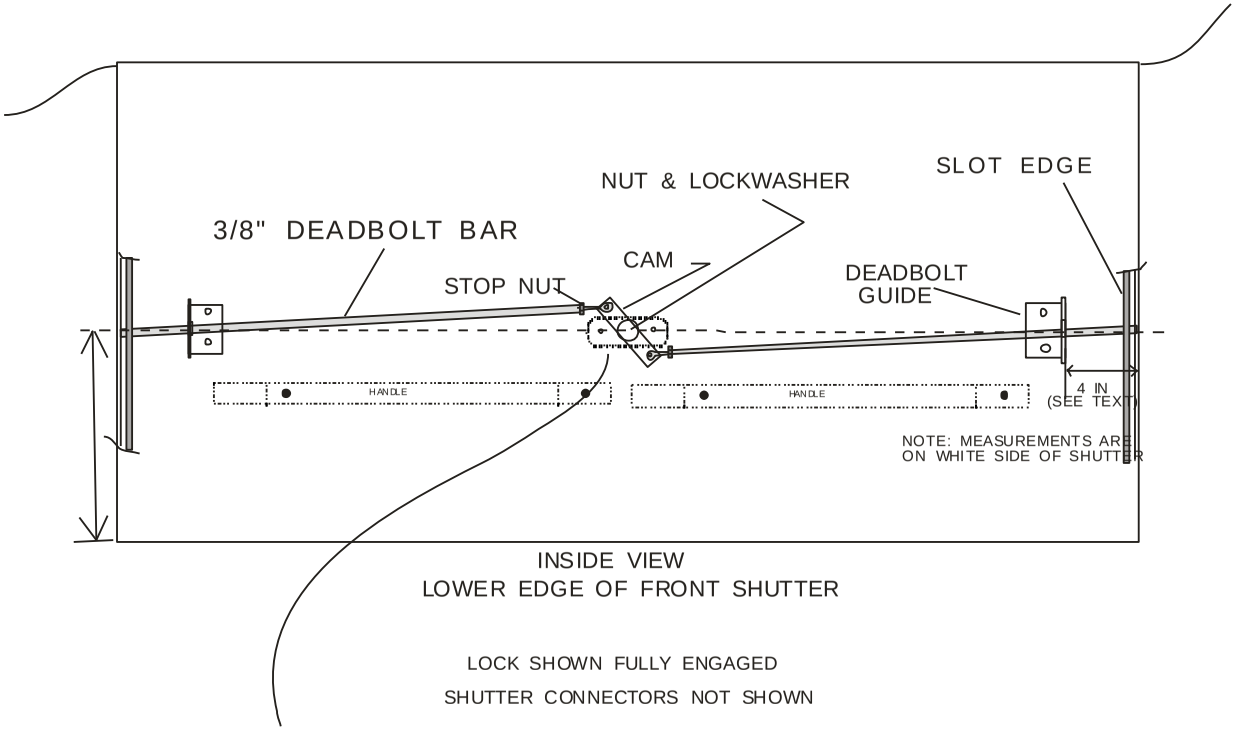


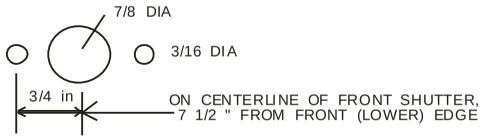
SEMIDOOR LOWER BOLT ASSEMBLY

VIEW FROM INSIDE DOME

FIG. 22 WALL WITH SEMI-DOOR

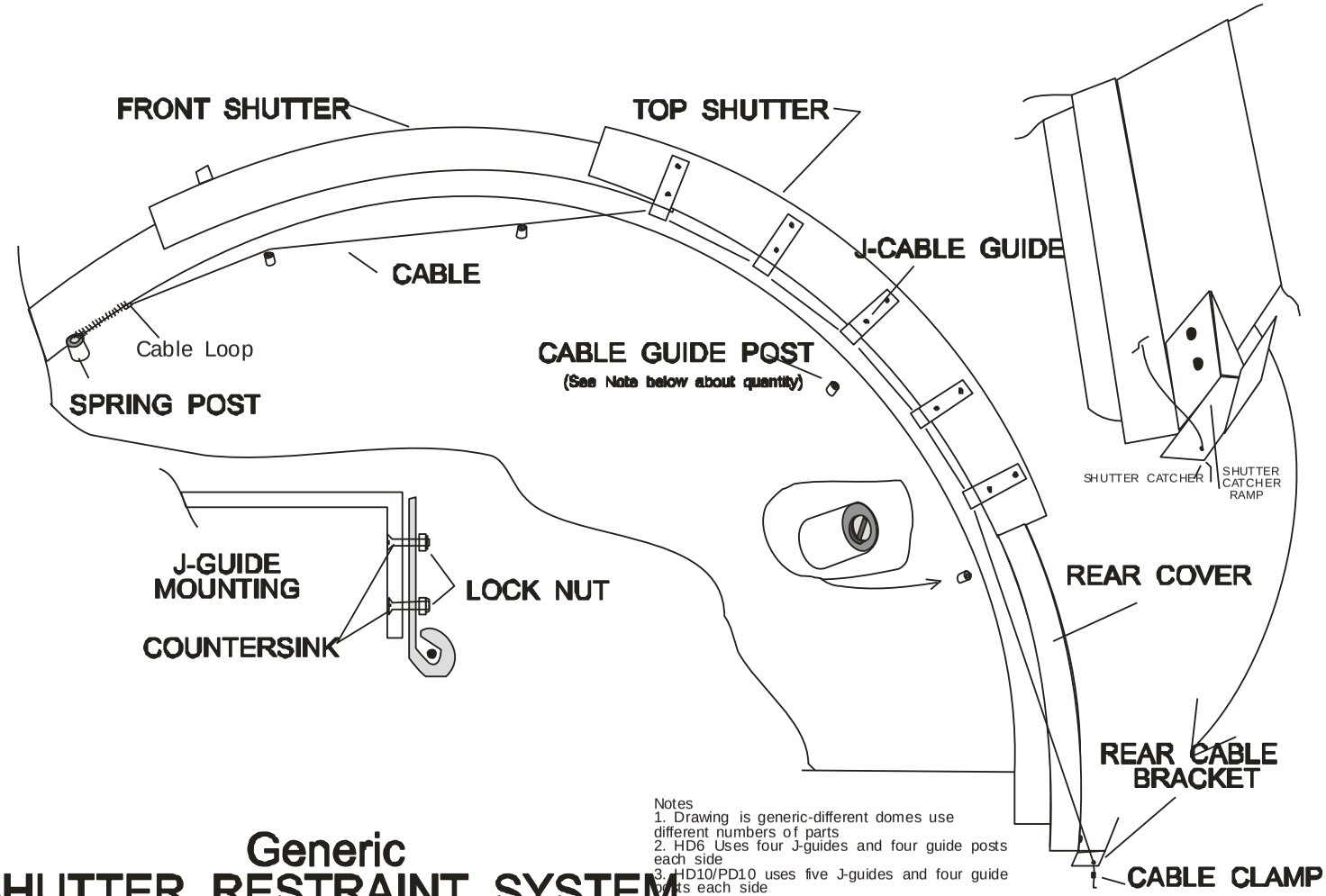
PD113C





DETAIL: HOLE LOCATIONS

Fig. 23 - PD-15 LOCKING SYSTEM



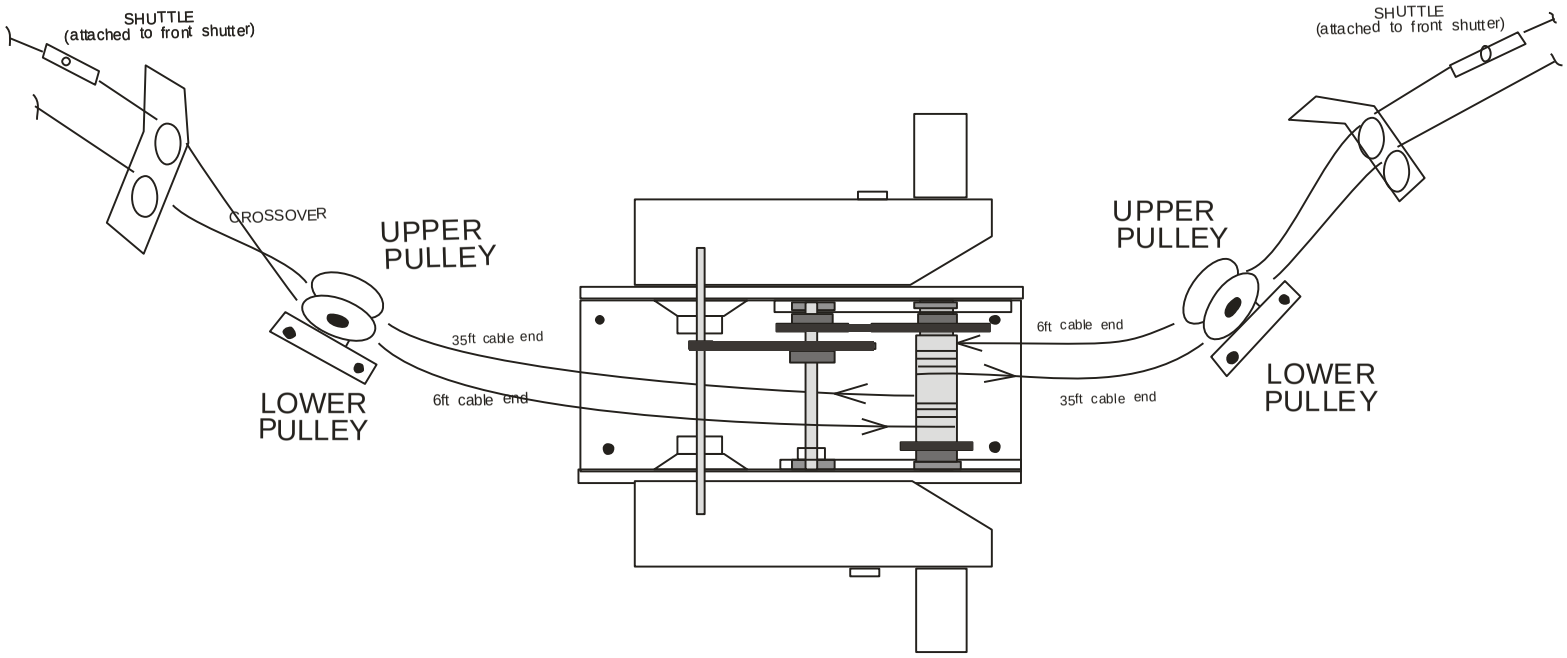
Notes
1. Drawing is generic-different domes use different numbers of parts
2. HD6 Uses four J-guides and four guide posts each side
3. HD10/PD10 uses five J-guides and four guide posts each side
4. PD15 uses six J-guides and six guide posts each side
5. Space J-guides equally starting about 4" from the ends of the shutter

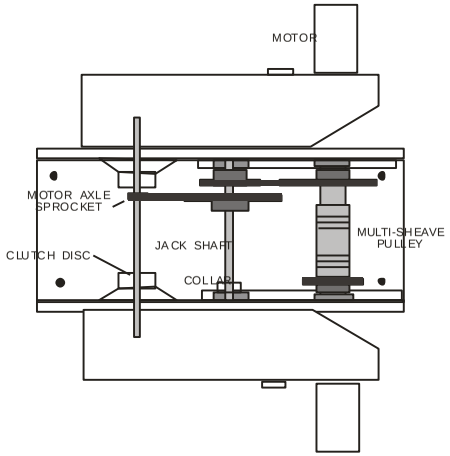
Note: Cable clamp and spring may be switched end for end. Use rear (Outward) hole

Generic
SHUTTER RESTRAINT SYSTEM

FIG 24

PD117
082101





ARROWS SHOW OPENING (RAISING) SHUTTER. EACH WINDING HAS ABOUT 6-8 TURNS (4 ARE SHOWN)

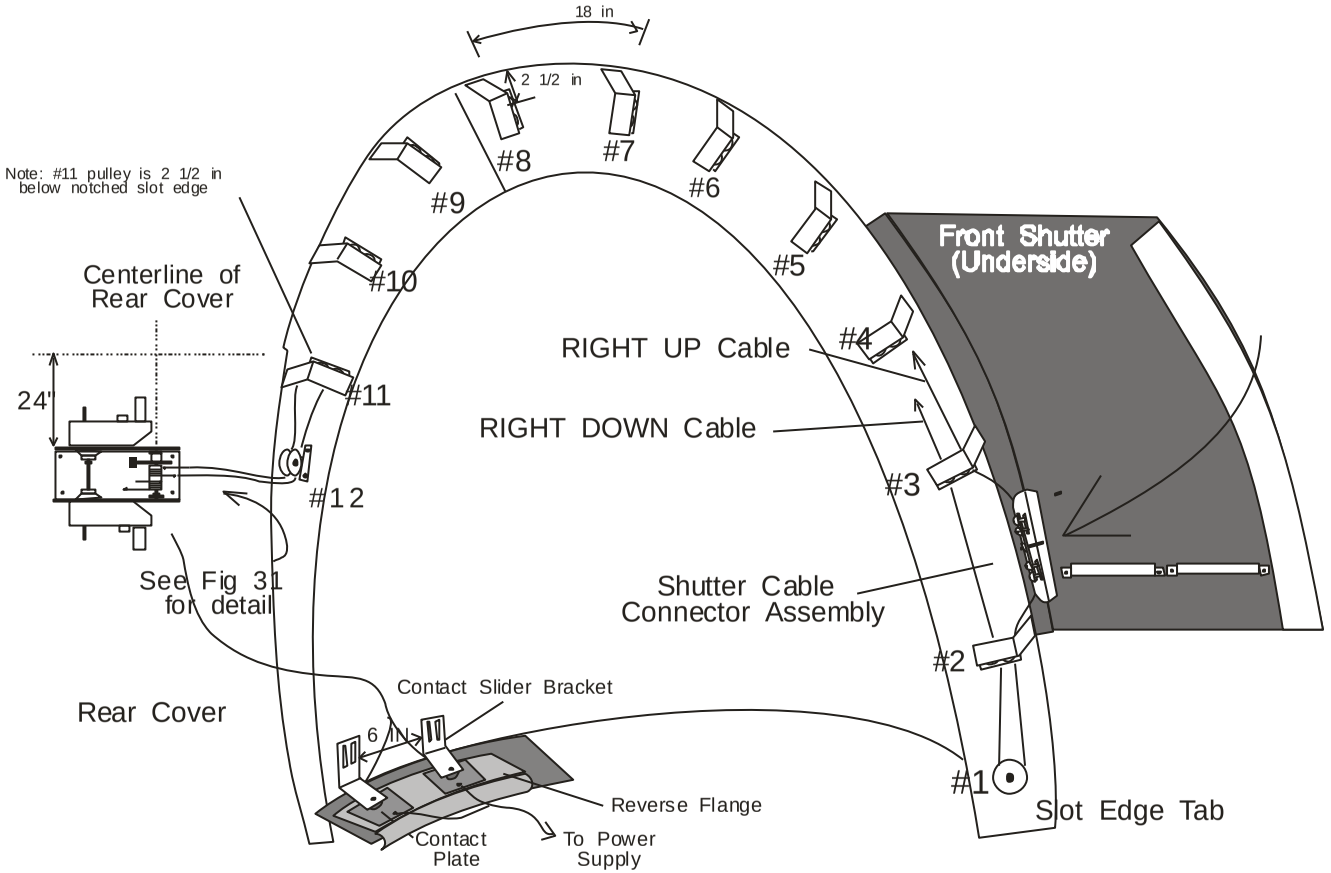
Cables are 3/32 in SS
50 ft. long

ES15 MODEL 2

FIG 31

ES1501E
110898

ES1501D

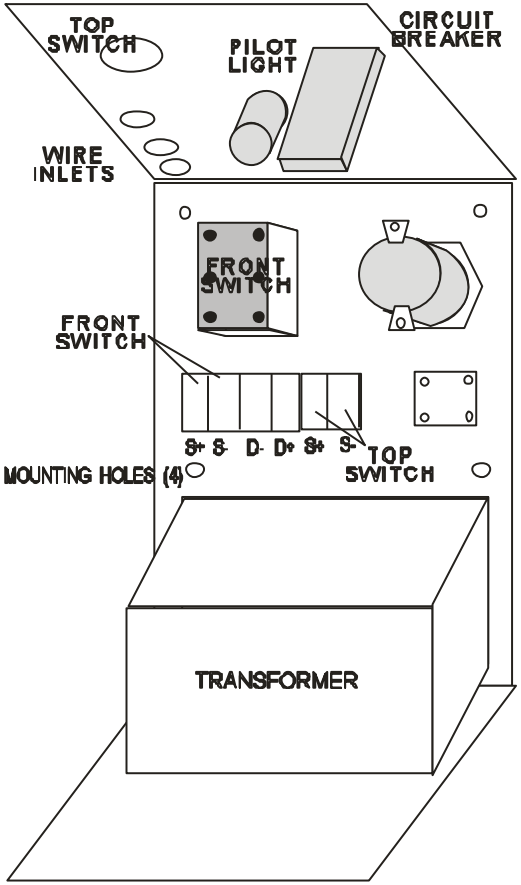


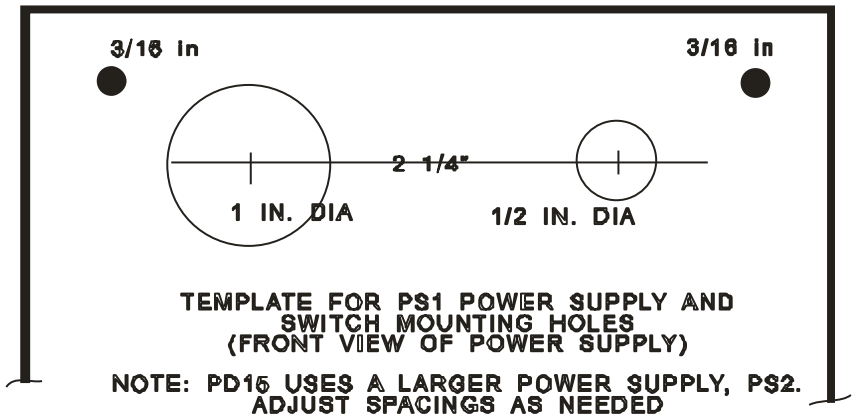
Electric Shutter Installation

Note-Schematic to show general design
(not to scale, partial construction only)

Fig. 32

ES1502d
032201
092401 pulleys in 1/4





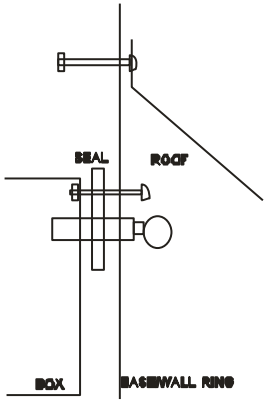
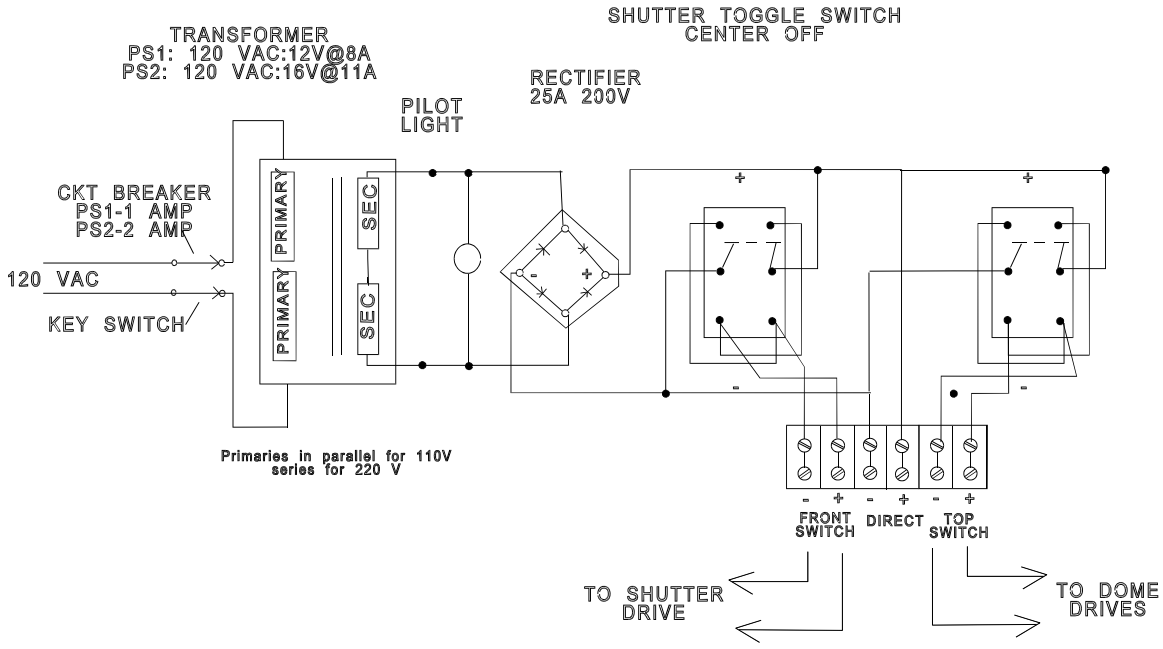


FIG. 42 POWER SUPPLY LAYOUT

PS2o
121599



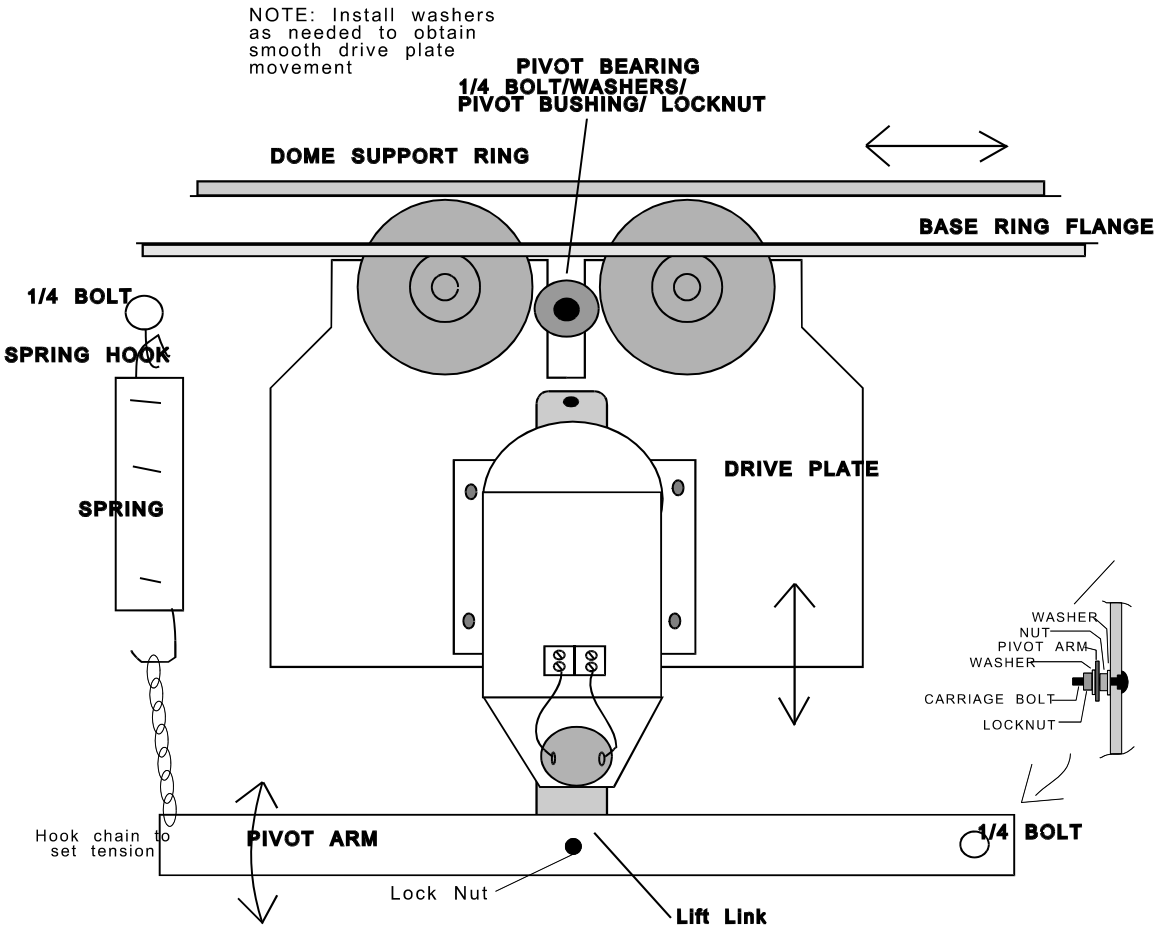
POWER SUPPLY PS-1/PS-2

120 VAC INPUT
PS1: 12 VDC @ 8 A OUTPUT
PS2: 16VDC @11 A Output

Technical Innovations, Inc.
22500 Old Hundred Rd.
Barnesville, Md. 20838
301-972-8040

Fig. 41

PS1c



NOTE: DRIVE BELT AND BELT IDLER ARMS DELETED FOR CLARITY

NOTE: You may switch pivot arm left-right if desired.

NOTE: Motor for HD6S is horizontal

FIG. 51
DOME DRIVE PLATE

NOT TO SCALE

ED1

060101

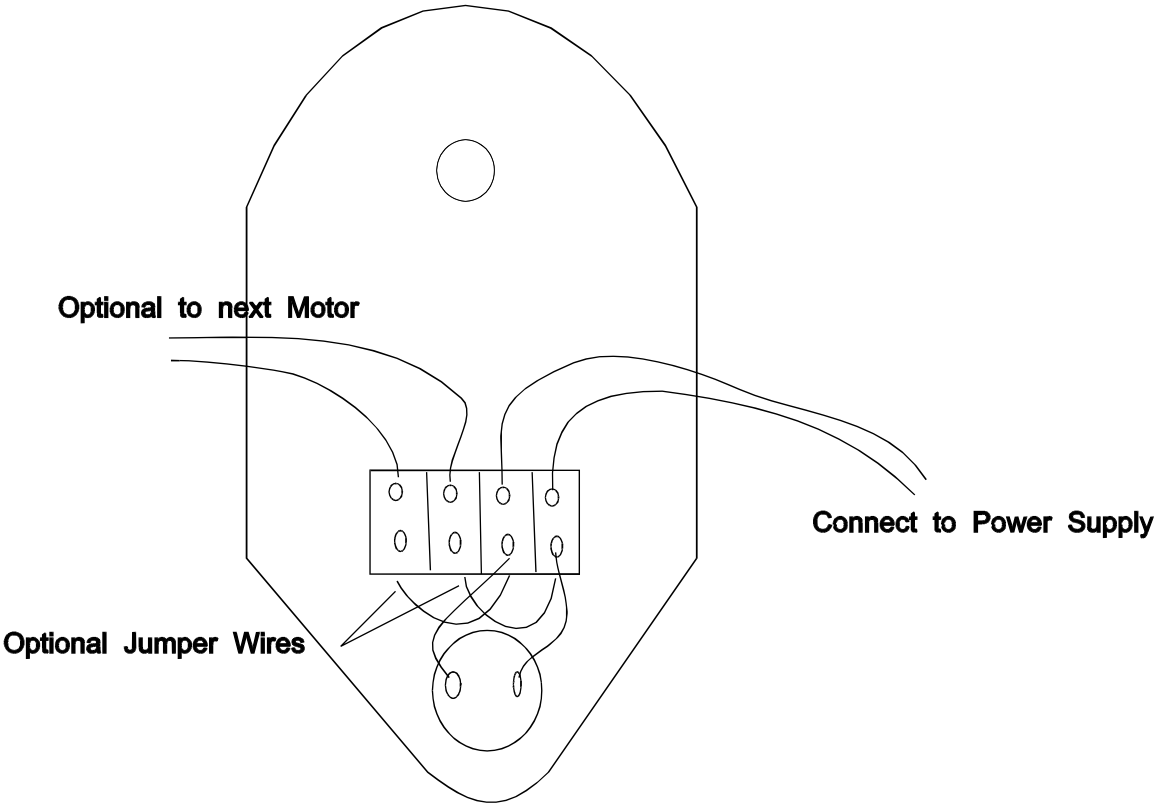


Fig. 52
Drive Motor Wiring

ED-9

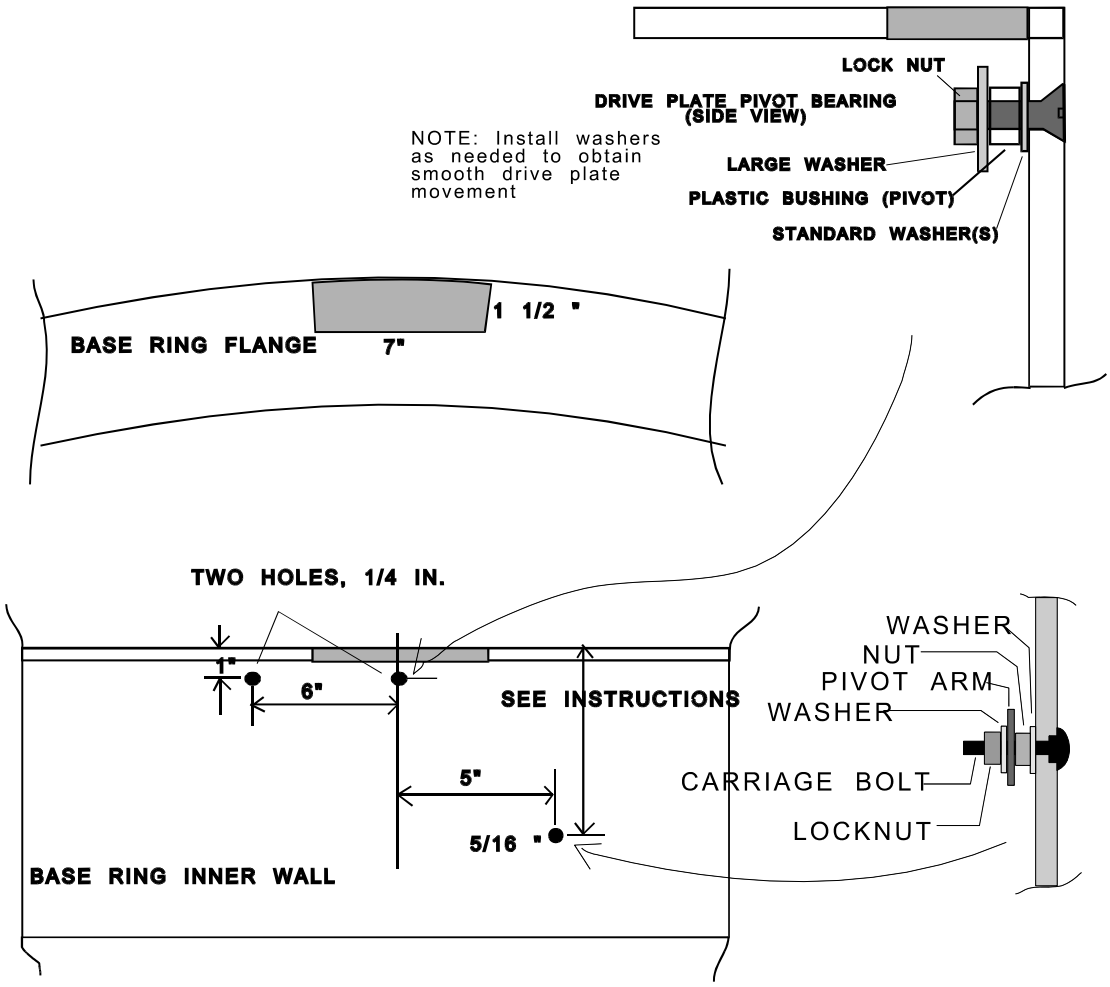
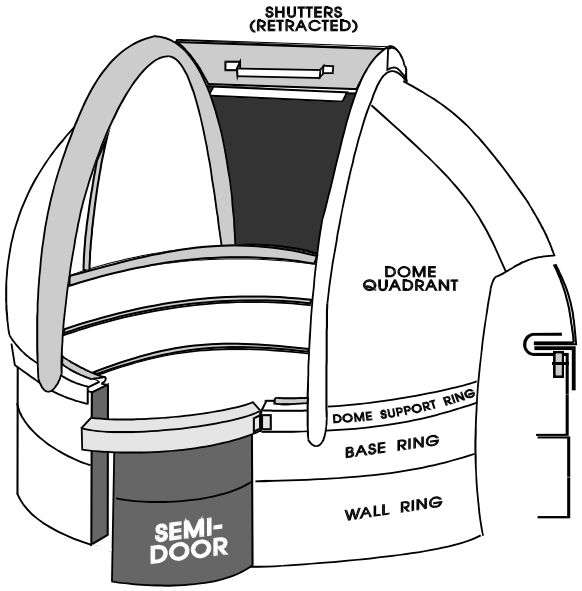


FIG 53 - DRIVE MOUNTING HOLES

ED2

PRO-DOME-15 SPECIFICATIONS



PRO-DOME 10 (Not To Scale)

Nominal Dome Diameter	15 Feet
Actual Diameter - Base/Wall Ring O.D.	179 inches
- Base/Wall Ring Flanges I.D.	171 inches
Height at Center (Dome plus Base Ring)	102 inches
Base/Wall Ring Heights (ea)	12 inches
Material of Construction	Fiberglass Polyester Resin .125 in.thick min. Selected flanges .25 in.
Surfaces (Interior and Exterior)	Gel-coat
Color Outside/Inside (Standard)	White/Dark Blue
Shutter Opening - Width	48 inches nom.
- Height	18 inches past zenith
Shutters	1 ea. front & top
Shutter movement	Up and over, self-storing in rear
Rollers	48 (3 in. diameter)
Weight - Dome plus Shutters	650 lb.
- Base/Wall Rings, ea.	100 lb.
Dome rotation	Electric/ 4 drive motors
Shutter opening/closing	Electric
Semi-Door opening - PD-15	36 inches

Home-Dome/Pro-Dome — Operating Instructions

WARNING: An observatory with motors is a machine, not a passive structure. Even without motors, it has moving parts. You can be injured or you can cause equipment damage if you do not know what you are doing when using an observatory. Read these instructions for minimal safety guidance. Read the instruction manual for detailed information on observatory use.

Remote Control Observatory: Be particularly careful when you are inside an observatory that is being controlled from elsewhere. A remote control observatory will move without warning when it receives a command from a user in the control room. It can also move under its own control, without audible (buzzer) warning under some circumstances. If you are inside the dome when it moves (or buzzes), but you do not want it to move, immediately STOP the movement by activating the **ALL STOP** switch on the control unit.

1. Designate one person to be responsible and in charge of the observatory. This person should assure that routine maintenance is performed, and that all users or visitors are properly trained. Untrained visitors must be informed not to touch or move any item.
2. Post this sheet in the observatory. All users of the observatory should be familiar with these instructions, and should have access to the observatory installation manual and to remote control manuals (if installed).
3. No one should ever climb on the dome, for repair or any other reason. The observatory is not a toy: children should not play on or in the observatory.
4. The observatory is made of fiberglass, which is flammable. Keep all open flames and ignition sources away from the observatory.
5. Do not attempt to use the observatory in high winds. Installations with wind brackets should restrict operation to below 20 mph, a stiff breeze. Installations with top shutter cables should restrict operation to below 30-35 mph, a fairly strong wind. If in doubt, use a hand or electronic wind meter to monitor wind speed.
6. Close the shutter when leaving the observatory. Closing the observatory means fully closing the front and top shutter and locking down the front shutter. Both top shutter latches must fully engage their respective receiving holes.
7. Never rotate the dome unless the semidoor and Swingout DSR (or Splice Plate) are fully closed AND latched.
8. Users must be particularly careful when using observatories on tall structures, or observatories with inside entrances and trapdoors.
9. If shutters should improperly disengage, be extremely cautious in solving the problem. Never leave an unrestrained shutter resting on the top of the dome: It can slide without warning.
10. If any electrical system presents a fire or shock hazard, immediately discontinue use until repaired.
11. Always have functioning interior lighting, as well as a functioning flashlight and a set of tools to allow prompt attention to identified problems.
12. Maintain a log for all users to record times of use and any problems encountered.

Routine Maintenance

Follow these steps after the first month of operation, and quarterly thereafter.

1. Check all bolts and nuts for tightness. These include foundation bolts, wall ring bolts, roller mounting bolts, etc.
2. Inspect shutter glide strips for proper installation.
3. Inspect side rollers (use the DSR Swingout or Splice Plate) per directions in the instruction manual.
4. Inspect all metal rollers for free movement, proper alignment, etc.
5. Inspect motor drives for proper action, alignment, etc.
6. Inspect all cables for wear or kinks (replace) and proper tension. Clean if they have caked dirt.
7. Oil electric shutter cables on 6' and 10' domes. Do NOT lubricate cables of PD-15 shutter.
8. Optionally, clean and wax the exterior dome surface.

hdins/useins1

LIMITED WARRANTY

This warranty covers substantial defects in dome materials and workmanship for one year from date of shipment. For electronic accessories, the limited warranty period is 90 days. In the event of such defects, Technical Innovations will repair or replace the part at no charge or provide free repair material to you.

In addition, the warranty provides for the buyer to return the HOME-DOME/PRO-DOME observatory or accessories if not satisfied within 60 days of shipment, providing the following conditions are met: 1) the product must be returned disassembled; 2) the buyer pays for packing and return shipping; 3) the buyer agrees to pay a 10% restocking fee; 4) the product as a whole and the individual pieces are returned in an undamaged and resalable condition and 5) the seller has been notified of the reasons for the return.

The warranty does not cover any problems which result from improper transportation or set-up of the HOME-DOME/PRO-DOME, abuse, misuse or acts of God (such as flood.) Also, consequential or incidental damages are not recoverable under this warranty. Some states do not allow the exclusion of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

In addition, the duration of the implied warranties of Merchantability and Fitness for a Particular Purpose is limited to one year. Some states do not allow limitation on how long an implied warranty lasts, so the above limitation or exclusion may not apply to you. This warranty is available only to the original purchaser, and any sale or transfer voids all warranties provided.

Finally, these warranties are void in the following circumstances: 1) the HOME-DOME/PRO-DOME is not assembled and installed according to the directions; and, 2) the HOME-DOME/PRO-DOME is not installed in accordance with local building code.

This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

If something goes wrong, contact Technical Innovations, either in writing at 1271 La Quinta Dr. Ste. 6, Orlando, FL 32809 USA, or by phone at (407) 601-1975.

WARNING AND DISCLAIMER

It is the responsibility of the purchaser to assure that the HOME-DOME/PRO-DOME installation will comply with local building codes, whether stand-alone or on-building. We will be glad to work with you and code officials to achieve compliance. We provide sample designs for foundations and walls; however, these are for your information and carry no warranty that they will necessarily meet your needs or satisfy local code requirements.

During assembly, you will be using tools, including power tools, and handling fiberglass pieces. Some fiberglass pieces may have sharp edges which can cut the skin. Also, dust from fiberglass may cause itching. You must follow reasonable safety precautions and wear gloves and eye protection.

The HOME-DOME/PRO-DOME observatory is made principally of fiberglass, which contains polyester resin, a material made of plastic, which is flammable. Keep your HOME-DOME/PRO-DOME away from fire or flame.

The HOME-DOME/PRO-DOME, and electronic accessories, should be used only for its intended purpose as an astronomical observatory. The HOME-DOME/PRO-DOME is not a toy. Misuse can cause serious injury. Use by children should be allowed only under direct adult supervision. Do not let anyone, whether adult or child, play on or climb on your HOME-DOME/PRO-DOME.

The observatory should be kept closed and locked when not in use, and in addition, it should be secured against rotation when not in use. HOME-DOME/PRO-DOME owners should notify their property insurance carrier when the dome is installed and adjust coverage as needed.

Specifications and materials are subject to change without notice and without requirement to retrofit earlier shipments.

NOTICE

The terms and conditions of your purchase agreement with Technical Innovations shall be governed by and construed in accordance with the laws of the State of Maryland. In all cases, legal title to merchandise passes to the customer when the shipment leaves our plant or business office.

hdins\warranty.doc

GAITHERSBURG, MD. 20879
301-977-9000

Power Supply Installation Instructions

Apr. 17, 1996

Introduction

The Power Supply used in the HOME-DOME electric shutter and dome drive systems is a simple full wave rectifier supply, capable of 12 VDC output at about 10 amperes. It has a push button circuit breaker on the transformer primary. The power supply has a built in key switch and two toggle switches for the electric shuter and dome drive, respectively. Barrier strips are provided inside the unit for connection to the shutter and/or dome drive motors. The power supply operates on 120 VAC 60 Hertz. (Power supplies are wired for 220 V on request.) The pilot light operates from the 12VAC present inside.

DANGER: you MUST disconnect the power cord from the outlet whenever the back is off the power supply. With the back removed, 120 VAC is exposed within the power supply.

Mounting the Power Supply

The power supply may be mounted so that the key switch and one toggle switch face outside (through the wall of the HOME-DOME) for use in controlling the electric shutter, when entry to the dome is from the outside. This is called the "outside facing mounting". The alternative is to face the power supply inside (used for inside access, or when only the dome drive is used).

It is permissible to mount the power supply sideways (so that the front toggle switch moves side to side), if desired. Simply be sure that you turn the hole template sideways.

With either mounting, the first task is to choose the mounting location. In general, the location should be close to a 120 VAC outlet. Note: do not plug in the unit until the installation is complete. If it is to an outside facing installation, the location should be convenient for control of the electric shutter. We recommend a position to the right hand side of the normal entry location (and to the immediate right of a semidoor, if installed). Before installing the power supply, check that wire provided for the electric shutter and/or electric dome drive will reach to the power supply.

For INSIDE facing mounting, refer to Figure 2 for the template. Remove the back of the power supply (it snaps off after the removal of four small screws). Drill two 3/16 in. diameter mounting holes through the back of the power supply. Use the holes just drilled to mark the holes on the inside of the wall, and, and drill the holes. Mount the back onto the wall using two 10-32x1/2 in. screws. Note these are stainless steel mounting screws, so will not rust.

Outside facing mounting also requires two screw holes for the mounting, as well as holes for the toggle and key switches. You will also be mounting a "roof" to keep rain off the switches. Use the template from Figure 2 and mark the large holes on the wall. The larger holes may be drilled with large drills, or use a smaller drill and file out the fiberglass. As before, use the template as a guide, and drill the two mounting holes in the front panel of the power supply. Hold the power supply (minus the back) against the inside wall with your switches in the previously prepared holes. Drill the mounting holes, and insert the screws.

You may mount the roof as shown, which will help prevent rain entry into the switches.

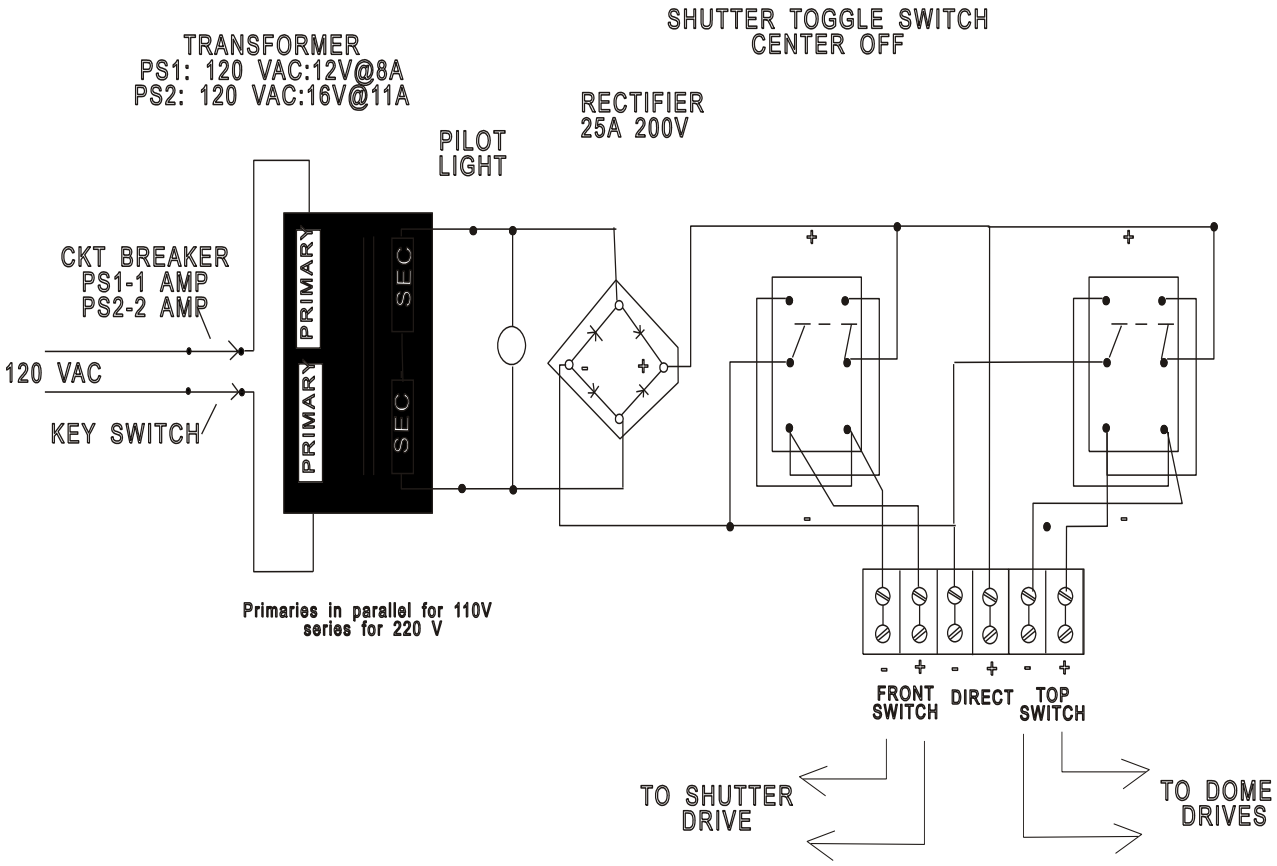
This completes installation of the power supply. Note: the power cord can be fed around any flanges on the inner side of the wall, or you may cut holes (large enough for the plug) in the flanges (this will give a neater installation).

Wiring the Power Supply

Wiring to the shutter or dome drive motors enters the power supply through the holes with grommets, and connect to the barrier strip inside.

The barrier strip has six terminals. The left pair is connected to the front (shutter) toggle switch, and the right pair is connected to the top (dome drive) switch. The middle pair is connected directly to the 12 v power. Connect your accessories as needed to the various terminals.

ps10ins.doc



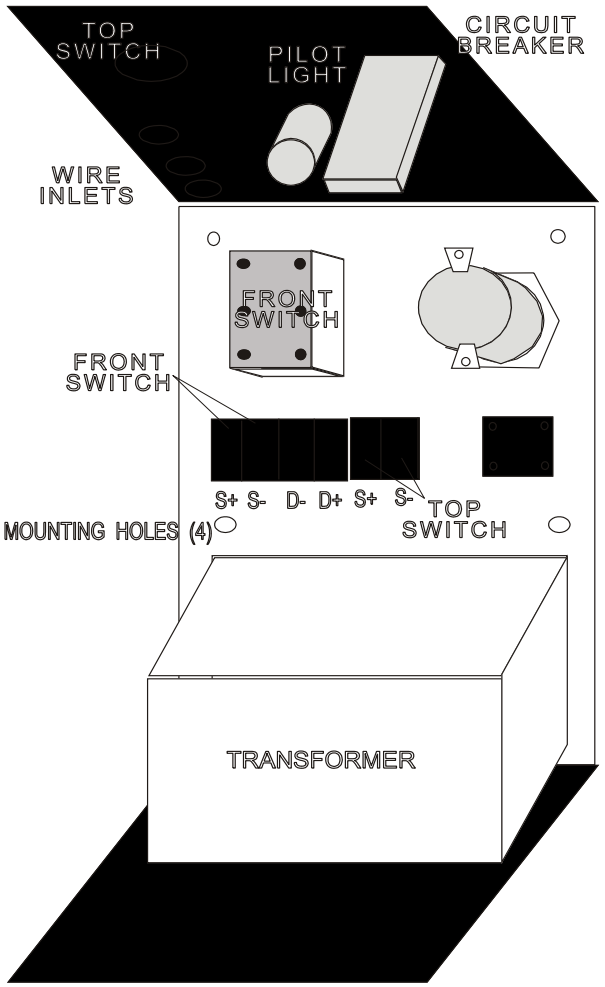
POWER SUPPLY PS-1/PS-2

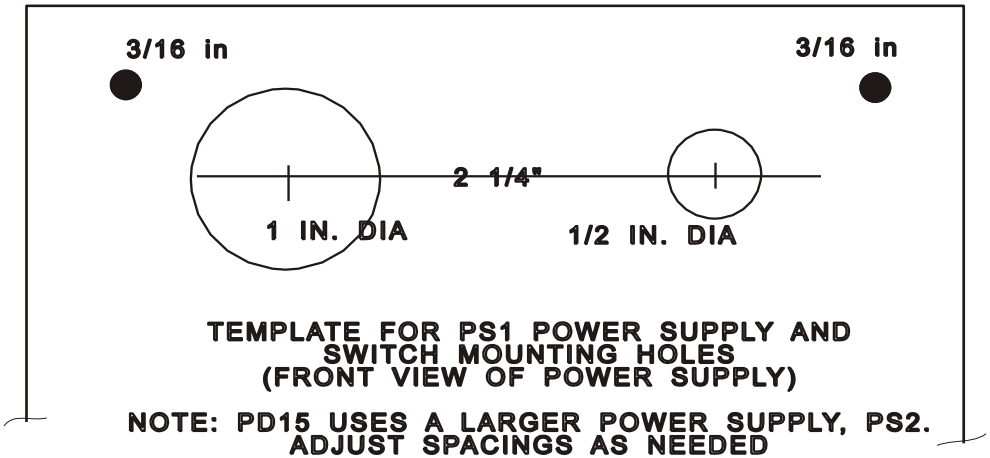
120 VAC INPUT
PS1: 12 VDC @ 8 A OUTPUT
PS2: 16VDC @11 A Output

Technical Innovations, Inc.
22500 Old Hundred Rd.
Barnesville, Md. 20838
301-972-8040

Fig. 41

PS1c





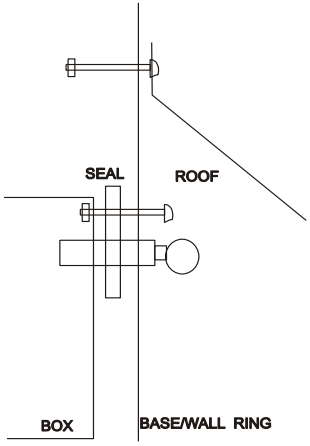


FIG. 42 POWER SUPPLY LAYOUT

PS2c
121599

Bolt Hole Drilling Guide
PD15

Introduction and Terminology

When the dome has not been preassembled, there are a number of holes that need to be drilled in order to attach one fiberglass section to another or install miscellaneous add-on parts.
Throughout the process, it is extremely important to maintain roundness and levelness, while keeping a pleasing "cosmetic" appearance. Most times there will a hole going through two pieces of fiberglass which will then be bolted tightly together. Even though the sections must be moved around until the final position meets the specifications, (especially base and wall rings), we know closely enough where the holes will be located to be able to drill one of the holes ("Guide") then use that hole as a guide when we drill through the second piece ("Final"). The drilled identified as "Final" will be immediately followed by bolting the part or adjacent fiberglass section, together.
Wall and base ring sections join together end-to-end ("Overlap"), but bolt to the corresponding section above, and except for the very bottom ring, below ("Stack").
The reference "Right" or "Left" has the orientation of standing outside the door (or "Home" position) position, facing the dome and looking in.

Construction Overview

The recommended dome construction steps are detailed in the manual, but an overview of the sequence is as follows:

1. Installation Preparation – Foundation, leveling, tools, organization and planning
2. Pre-drilling
3. Bottom ring (base or wall) prep and install
4. Mounting bottom ring (base or wall) to foundation
5. Installation of walls (if relevant)
6. Rotation system install (wheels and side rollers)
7. Prep and install DSR
8. Prep dome quadrants
9. Install rear shutter panel
10. Install dome halves to DSR
11. Prep front and top shutter sections
12. Install shutter
13. Finish items

Bolt Hole Drilling Guide

1. Right Stub Section, Overlap, Guide

The 72 degree base ring and wall sections each have one end "stepped in" ("male") and the other end a "flat" continuation of the wall ("female"). On the two stub sections (a left and right for the Base ring and each wall ring), one has the "stepped in" end (on left side of door standing

outside looking in) while the other has a flat end. Since all of the initial “Guide” holes for base and wall ring sections are made at the “flat” end, only the right stub section is drilled at this time. Two holes are drilled (9/32 inch bit) on the “flat” end of the section. The locations are, 2 inches down from the top and 2 inches up from the bottom, with both 1 1/4 inch in from the end edge.

2. Stub Sections, Stack, Final

The right and left stub sections are “stacked” with the base ring stub at the top. The horizontal flanges (top and bottom) match up with the sections above and/or below. The sections should be all clamped together using a straight-edge along the sides to keep them in line. Where the bottom flange of one section is in contact with the top flange of the section below, three holes will be drilled (9/32 inch drill bits), through both flanges for bolting the sections together. Two holes will be drilled on the “door” side (closed edge) and one on the side that overlaps the adjacent ring section. The two holes on the door side are staggered, with the inside one about ½ inch from the outside wall and ½ inch from the end cap, and the second ½ inch from the flange edge and 1 inch from the end cap. The third hole is centered on the flange, 8 inches from the overlap end.

3. Door Sections, Stack, Final

The door sections are “stacked” with the base ring door at the top. The horizontal flanges (top and bottom) match up with the sections above and/or below. The sections should be all clamped together using a straight-edge along the sides to keep them in line. Where the bottom flange of one section is in contact with the top flange of the section below, four holes will be drilled (9/32 inch drill bits), through both flanges for bolting the sections together. Two holes will be drilled on each of the “stub” sides. The two holes on each of the door flange ends are staggered, with the inside one about ½ inch from the outside wall and ½ inch from the end cap, and the second ½ inch from the flange edge and 1 inch from the end cap.

4. Wheels, Final

Locate the wheel cutouts in each base ring section, base ring stubs and top door (on the underside of the reverse flange). Find the center of each cutout and measure down the outside wall of the base ring 7/8” (or use the template provided with the dome hardware). Drill 1/8” guide hole to assure accurate location, drill out hole (5/16 inch bit) and then countersink the outside of the hole to a depth that results in the head of the 2 ½” Flat Head bolt to be close to flush with the outside wall surface. There are large cutouts in each of the four base ring segments for the ED motor assemblies. See the ED installation section in the manual for drilling instructions.

5. Side Rollers, Final

There are 20 side rollers that get distributed approximately equal distance apart around the top surface of the base ring under the reverse flange, (See **Figure 9C** in the manual for placement).

The side roller is mounted horizontally on the top surface so that it extends between 1/8 and 3/16 inch out from the base ring wall surface. Measure ¾ inch inward (or use template) and mark for the Side Roller mounting hole. Drill out these holes using a 1/8" guide hole and a 13/64 drill bit.

6. Hinge, Final (PD15 with Door)

The hinge will first be mounted on the end caps of the right side door stack. The hinge is one inch shorter than the wall/base ring height to leave ½ inch at each the top and bottom of the door. The hinge is positioned such that it is flush with the outside wall edge, pivot pin to the outside and held in place with clamps. The hinge is attached using the two end holes then every other hinge hole in- between. Drill the holes, using the hinge holes as guides, with a 5/32 inch drill bit. Bolt the hinge (6-32 ¾" flat head bolts) to the door. Position the door (and open side of hinge against the right wall stub cap end. Position so that door swings freely, then clamp into position. Drill wall side of hinge (using hinge holes as guides) with 5/32 inch drill bit.

7. Base/Wall Ring Sections, Overlap, Guide

The four 72 degree wall sections each have one end "stepped in" ("male") and the other end a "flat" ("female"), continuation of the wall. All of the initial "Guide" holes for base and wall ring sections are made at the "flat" female end, and all sections can be drilled at this time. Two holes are drilled (9/32 inch bit) on the "flat" (male) end of the section. Their locations are, 2 inches down from the top and 2 inches up from the bottom - with both 1 1/4 inch in from the end edge.

8. Bottom Base/Wall Ring, Overlap, Final

The 72 degree wall sections each have one end "stepped in" ("female"), that slide in behind the "flat" end of the adjoining sections and/or stub sections. The bottom ring is fitted together in this fashion until a continuous circle is formed (along with the two stub and door sections) on top of the pad or mounting surface. Using clamps, this ring is adjusted until it is circular and meets the circumference measurement tolerances. All of the initial "Guide" holes for these ring sections are on the outside of each joint and are used as guides to drill the Final overlap holes (9/32 inch bit). The sections are bolted at this point to form the solid bottom ring.

9. Bottom Base/Wall ring, Mounting Flange, Final

With the bottom ring of correct circumference, circular, and placed on the mounting surface at the desired location, the anchor holes can be drilled. Anchor holes will be made through the bottom flange of this ring approximately every 18 inches around the circumference. Using a small (1/8 inch) bit, drill "Guide" hole through the flange and into the mounting surface below. Depending upon material the ring may need to be moved and holes for bolt anchors drilled out. The ring is moved back into place and the mounting holes in the fiberglass flange drilled out to match the anchor bolt size decided upon (normally 3/8 inch bolt).

10. Wall Ring Sections, Stack, Guide

Five holes (9/32 inch bit) are drilled into the bottom horizontal flange of all four of 72 degree base ring and wall ring sections, **EXCEPT** the ones making up bottom most ring – which will mount to the pad or structure. Two holes are drilled in the center of the flange, 11 inches from each end. The remaining three holes are evenly spaced between the end two, with approximately 23 inches between each of the holes.

11. Wall Ring Sections, Overlap, Final

With the ring below of correct circumference, circular, and bolted to either another ring below it, (or the mounting surface), the next ring up is fit together, at positioned on top of that ring. Using clamps the ring is centered on the ring below and adjusted such that it is circular and of the correct circumference. With each ring segment securely clamped together (and to the ring below), final holes are drill through the "stepped-in" male ends from the outside, using the corresponding female end guide holes.

12. Wall Ring Sections, Stack, Final

With the ring of correct circumference, circular, bolted at the overlap ends and securely clamped to the ring below it, the final stack holes are drilled from above, using the stack guide holes previously drilled in its bottom flange.

13. Upper Latch, Final

The upper latch is made up of two parts, the "latch" section (which is mounted on the inside upper left hand corner of top door section), and the "receiver" section (which is mounted on the inside upper right hand corner of the top - base ring - left stub section). (Remember that even though these are mounted on the inside of the door, the left/right orientation references are ALLWAYS from the outside of the dome looking in). Position the "latch" bracket against the door section corner so that it is flush with the outside of the section flanges. Drill two (use 9/32 inch drill bit) evenly spaced and centered holes through the top and side flanges and bracket. The hole on the side flange will be countersunk for flathead bolts. Repeat the same steps for the "receiver" bracket in the stub base ring section,

14. DSR Overlaps, Final

With the wall/base rings of correct circumference, circular, and bolted together, the DSR sections are set into place with each end overlapping the adjacent. Once adjustments are made to obtain the correct DSR circumference, a 5/32 hole is drilled in the center of each overlap section. Countersink the hole on the inside surface of the inside overlap

15. Top Shutter, J-Guides, Final

Six J-Guides (2 holes each - 3/16 inch bit) are mounted onto each of the side flanges of the top shutter panel. One of the J-Guides should be used as a template for the pair of holes, and positioned such that loop section only extends just past the flange edge. The first pair holes are drilled 5 inches in from one end of the shutter panel and the second pair 5 inches in from the other end. The remaining 4 are evenly spaced between the first two (approximately 18.25 inches between each. All 24 holes (both sides) will be counter-sunk on the inside of the flanges to prepare for the 10-32 flathead machine screws.

16. Top Shutter, Latch Bars, Final

The shutter latch bars (long – 5 holes and short – 4 holes) are mounted near the ends of the top shutter. The long is near the front edge and the short near the rear edge. In both cases a centerline is used 9.25 inches in from each shutter edge. The latch bars are each centered on the shutter with the latch holes centered on that line. NOTE: there are "marks" in the white fiberglass surface to locate these latch bars. Place the latch bar over the marks to make sure that they match up. Mark the bolt hole locations and drill 9/32 inch holes at each point (total of 9 holes). Start at one end after recheck the latch bar alignment after each hole is drilled.

17. Front Shutter, Handles, Final

The shutter handles (two, mounted side by side) are attached on the outside of the Front shutter section, near the front. The handles will be mounted on a centerline which is 6.25 inches in from the front edge of the front shutter section. Space the handles such that the inside bolt of each is 1.5 inches out from the shutter center. Mark the bolt hole locations then drill the four 9/32 inch holes.

18. Front Shutter, ES15 SCCA Assembly, Final

The two shutter motor cable holders (SCCA assembly) are mounted on the inside of the Front shutter section, near the front and close to the shutter section side flanges. **NOTE: The Shutter Glide Strips must be installed on the front shutter before completing this step**. The holes will be drilled through the attached glide strip, and part of that strip will need to be cut away in order to mount the SCCA assembly on each side. The hole for each of the SCCA assemblies is 7.5 inches up from the front edge of the front shutter section (same centerline for the deadbolt system) and 2 inches in from the side flange.

19. Rear Shutter, ES15 Motor Assembly, Final

The ES15 shutter motor assembly is mounted onto the top area of the rear shutter panel. The motor assembly is positioned so that it is centered along a shutter centerline. The top edge of the motor assembly case (the white plastic three sided frame) is located 14 ½ inches down from

the center of the rear shutter panel top cut out slot. Mark the four hole locations in the back of the motor assembly, remove the assembly, and drill four 9/32 holes at the marked locations. Countersink the outside (white surface) of these holes so that the flat head bolts used are flush.

20. Rear Shutter, Shutter Catchers, Final

The pair of shutter catchers (which are mounted on the outside at the bottom of the rear shutter panel) have a right and a left unit. They are positioned such that they are flush with the bottom and side (each outside bottom corner of rear shutter panel), and the "arm" with wind restraint cable hole, extends out from panel. Mark and drill four 9/32 holes (two for each shutter catcher).

21. Rear Shutter, Side Flanges, Guide

Twenty holes (9/32 inch bit) are centered and drilled (10 on each side) through the side flanges of the rear shutter panel. From the top end (next to large latch slot and tapered edge), the first hole is drilled 1 inch down from the bottom tab, followed by a second hole 2 inches further down, then the third hole 11.25 inches down from the second. The fourth hole is measured from the bottom of the shutter panel, 3 inches up from bottom of the tab edge. The remaining six holes are then evenly spaced, each approximately 13.25" apart. All twenty holes will be countersunk on the outside of the shutter panel flange

22. Front Right Dome Quadrant, DSR Flange, Guide

Ten holes (9/32 inch bit) are drilled into the bottom horizontal, DSR, flange of the front right dome quadrant. The first hole is drilled 5 inches from the front edge followed by the next nine, each approximately 12 inches apart. The tenth bolt will be 3 inches from the Greenwich Flange. All holes should be 1.25 inches in from the flange edge (not centered on the flange).

23. Front Left Dome Quadrant, DSR Flange, Guide

Ten holes (9/32 inch bit) are drilled into the bottom horizontal, DSR, flange of the front left dome quadrant. The first hole is drilled 5 inches from the front edge followed by the next nine, each approximately 12 inches apart. The tenth bolt will be 3 inches from the Greenwich Flange. All holes should be 1.25 inches in from the flange edge (not centered on the flange).

24. Front Right Dome Quadrant, Greenwich Flange, Guide

Ten holes (9/32 inch bit) are drilled into enter, Greenwich flange of the front left dome quadrant. The first hole is drilled 4 inches up from the bottom edge (next to DSR flange), followed by the second 8 inches up from the first and the next eight, each approximately 12 inches apart. This will result in the last bolt hole approximately 3 inches from the top f the flange

25. Front Left Dome Quadrant, Greenwich Flange, Guide

Ten holes (9/32 inch bit) are drilled into the center, Greenwich flange of the front left dome quadrant. The first hole is drilled 4 inches up from the bottom edge (next to DSR flange), followed by the second 8 inches up from the first and the next eight, each approximately 12 inches apart. This will result in the last bolt hole approximately 3 inches from the top f the flange

26. Rear Right Dome Quadrant, DSR Flange, Guide

Ten holes (9/32 inch bit) are drilled into the bottom horizontal, DSR, flange of the rear right dome quadrant. The first hole is drilled 5 inches from the front edge followed by the next nine, each approximately 12 inches apart. The tenth bolt will be 3 inches from the Greenwich Flange. All holes should be 1.25 inches in from the flange edge (not centered on the flange).

27. Rear left Dome Quadrant, DSR Flange, Guide

Ten holes (9/32 inch bit) are drilled into the bottom horizontal DSR flange of the rear left dome quadrant. The first hole is drilled 5 inches from the front edge followed by the next nine, each approximately 12 inches apart. The tenth bolt will be 3 inches from the Greenwich Flange. All holes should be 1.25 inches in from the flange edge (not centered on the flange).

28. Rear Right Dome Quadrant, Greenwich Flange, Final

The Rear Right and Front Right dome quadrants are joined together at the Greenwich Flange to form the Right Dome Half. Bring and clamp the two quadrants together, making sure that the seams line up on the outside and that the bottoms are flat/horizontal. Using the guide holes drilled in the Front Right Dome Quadrant, drill 9/32 inch holes through the Rear quadrant Greenwich Flange. Due to the flex in fiberglass, start at the bottom and bolt each hole after drilling. You will be able to make small adjustments at each hole to line up the outer edges of the two quadrants to have a flush smooth appearance.

29. Rear Left Dome Quadrant, Greenwich Flange, Final

The Rear Left and Front Left dome quadrants are joined together at the Greenwich Flange to form the Left Dome Half. Bring and clamp the two quadrants together, making sure that the seams line up on the outside and that the bottoms are flat/horizontal. Using the guide holes drilled in the Front Left Dome Quadrant, drill 9/32 inch holes through the Rear quadrant Greenwich Flange. Due to the flex in fiberglass, start at the bottom and bolt each hole after drilling. You will be able to make small adjustments at each hole to line up the outer edges of the two quadrants to have a flush smooth appearance.

30. Right Dome Half, ES Pulleys, Final

The ES15 electric shutter system uses a pulley system made up of twelve units – a single “loop return” pulley, ten over/under double guide pulley in plastic holders, and a double “side-by-side” pulley assembly on an aluminum bracket.
The hole for the first single “loop return” pulley is drilled in the center of the Greenwich flange tab (at the front of the dome half), 2 inches up from the bottom of the flange tab.
The next ten pulleys (the over/under double guide), are spaced 18 inches apart, starting from the single “loop return” pulley. There is one hole for each plastic holder and is located 2.5 inches down from the outside edge of the Greenwich Flange (this will result in approximately ¾ inch overhang at the bottom and provide top clearance for the SCCA as it travels back and forth with the shutter). Make sure that the tenth (and last of the over/under) ends up 2.5 inches below the start of the notched-out section for the rear shutter panel.
The double pulley assembly (drilled after rear shutter panel and ES15 motor assembly are installed), will use the shutter cables as guides. Position the aluminum bracket in a way that allows the cables to be as close as possible to horizontal and that they enter the pulley at minimal angle. Mark the hole locations then drill the two 9/32 holes on each side.

31. Left Dome Half, ES Pulleys, Final

NOTE: Left Dome Half exactly the same as Right Dome Half
The ES15 electric shutter system uses a pulley system made up of twelve units – a single “loop return” pulley, ten over/under double guide pulley in plastic holders, and a double “side-by-side” pulley assembly on an aluminum bracket.
The hole for the first single “loop return” pulley is drilled in the center of the Greenwich flange tab (at the front of the dome half), 2 inches up from the bottom of the flange tab.
The next ten pulleys (the over/under double guide), are spaced 18 inches apart, starting from the single “loop return” pulley. There is one hole for each plastic holder and is located 2.5 inches down from the outside edge of the Greenwich Flange (this will result in approximately ¾ inch overhang at the bottom and provide top clearance for the SCCA as it travels back and forth with the shutter). Make sure that the tenth (and last of the over/under) ends up 2.5 inches below the start of the notched-out section for the rear shutter panel.
The double pulley assembly (drilled after rear shutter panel and ES15 motor assembly are installed), will use the shutter cables as guides. Position the aluminum bracket in a way that allows the cables to be as close as possible to horizontal and that they enter the pulley at minimal angle. Mark the hole locations then drill the two 9/32 holes on each side.

32. Right Dome Half, Wind Restraint, Final

Start at seam of dome quadrants (top, middle); measure **BACK** 4 inches; go out from the shutter flange 3.5 inches and drill ¼” cable post hole.
Measure **FORWARD** 22 inches; go out from the shutter flange 3.5 inches and drill ¼” cable post hole.
Measure **FORWARD** 24 inches; go out from the shutter flange 3.5 inches and drill ¼” cable post hole.

Measure **FORWARD** 24 inches; go out from the shutter flange 3.5 inches and drill ¼" cable spring post hole.
Start at the rear of dome half; measure forward (up) 27 inches from bottom of shutter flange tab; go out from the shutter flange 3.5 inches and drill ¼" cable post hole.
Measure **FORWARD** 27 inches; go out from the shutter flange3.5 inches and drill ¼" cable post hole.
Measure **FORWARD** 27 inches; go out from the shutter flange3.5 inches and drill ¼" cable post hole.

33. Left Dome Half, Wind Restraint, Final

NOTE: Left Dome Half, Wind Restraint Final is exactly the same as Right Dome Half
Start at seam of dome quadrants (top, middle); measure **BACK** 4 inches; go out from the shutter flange 3.5 inches and drill ¼" cable post hole.
Measure **FORWARD** 22 inches; go out from the shutter flange 3.5 inches, and drill ¼" cable post hole.
Measure **FORWARD** 24 inches; go out from the shutter flange 3.5 inches and drill ¼" cable post hole.
Measure **FORWARD** 24 inches; go out from the shutter flange 3.5 inches and drill ¼" cable spring post hole.
Start at the rear of dome half; measure forward (up) 27 inches from bottom of shutter flange tab; go out from the shutter flange 3.5 inches and drill ¼" cable post hole.
Measure **FORWARD** 27 inches; go out from the shutter flange3.5 inches and drill ¼" cable post hole.
Measure **FORWARD** 27 inches; go out from the shutter flange3.5 inches and drill ¼" cable post hole.

34. Rear Right Dome Quadrant, Shutter Flange, Final

The rear shutter panel is placed so that it straddles the shutter flanges at the rear of the two dome halves and is positioned such that the top of the rear shutter panel fits into the start of the notched out area and the bottom is approximately equal with the bottom of the shutter flange rear bottom edge. Using the guide holes drilled into the rear shutter panel, drill 9/32 inch holes through the rear right dome quadrant shutter flange. Push down on panel at each hole to make sure that it is as flush as possible to the dome flange before drilling.

35. Rear Left Dome Quadrant, Shutter Flange, Final

The rear shutter panel is placed so that it straddles the shutter flanges at the rear of the two dome halves and is positioned such that the top of the rear shutter panel fits into the start of the notched out area and the bottom is approximately equal with the bottom of the shutter flange rear bottom edge. Using the guide holes drilled into the rear shutter panel, drill 9/32 inch holes through the rear left dome quadrant shutter flange. Push down on panel at each hole to make sure that it is as flush as possible to the dome flange before drilling.

36. DSR, Final

The two dome halves are properly positioned on the DSR (with top and front spacers) and the guide holes in the dome half DSR flange are used to drill 9/32 inch holes through the DSR. These holes are then countersunk on the bottom side of the DSR for flathead machine screw. The large “access hole” in the Right Rear wall segment is used for this step.

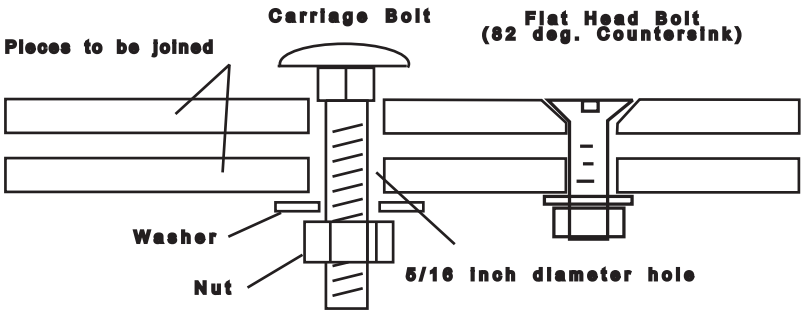


Figure 1
Bolt Detail

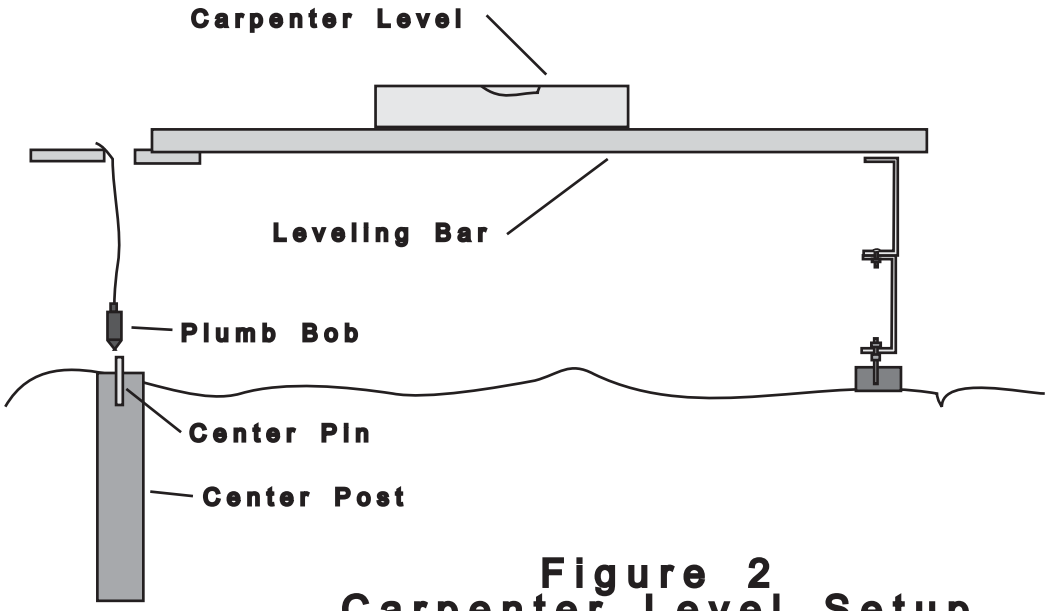


Figure 2
Carpenter Level Setup

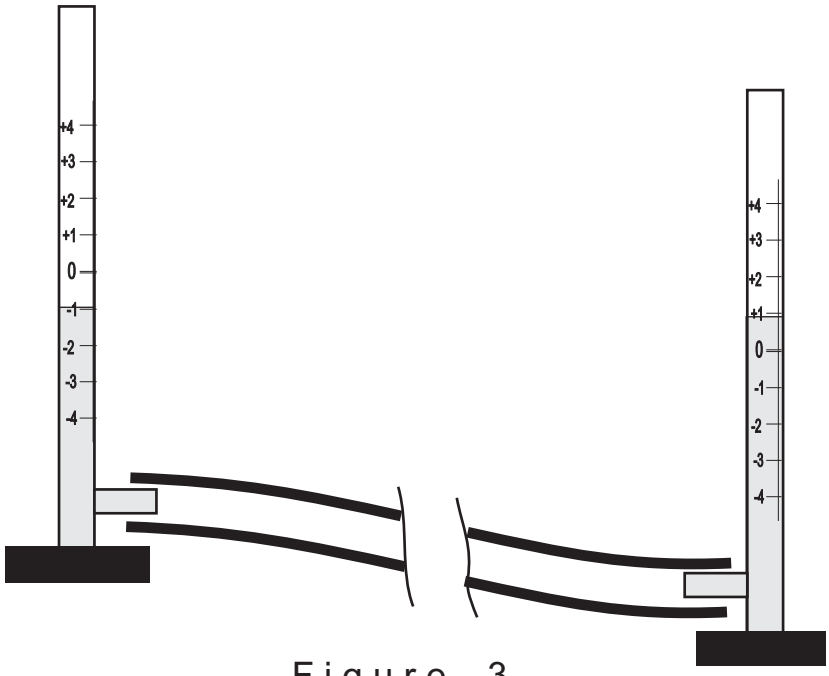


Figure 3
Water Level

HD101

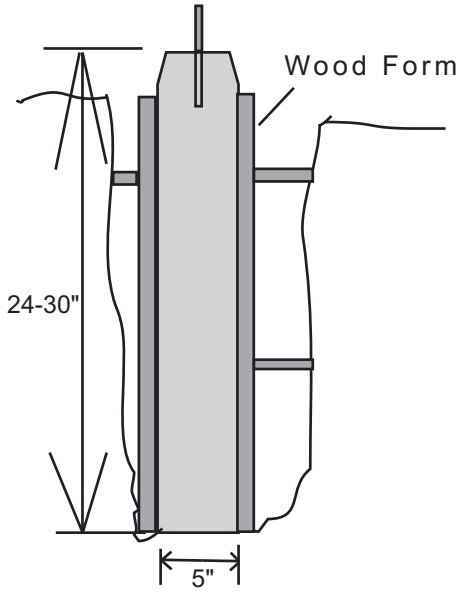


Figure 4
Ring Foundation Cross-section
(Poured Concrete)

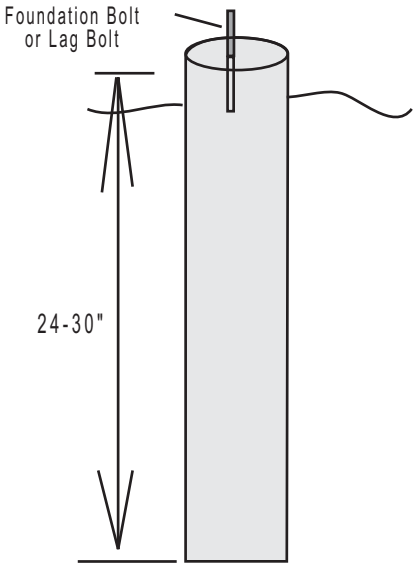


Figure 6
Wood Pier Foundation
(Post in Ground)

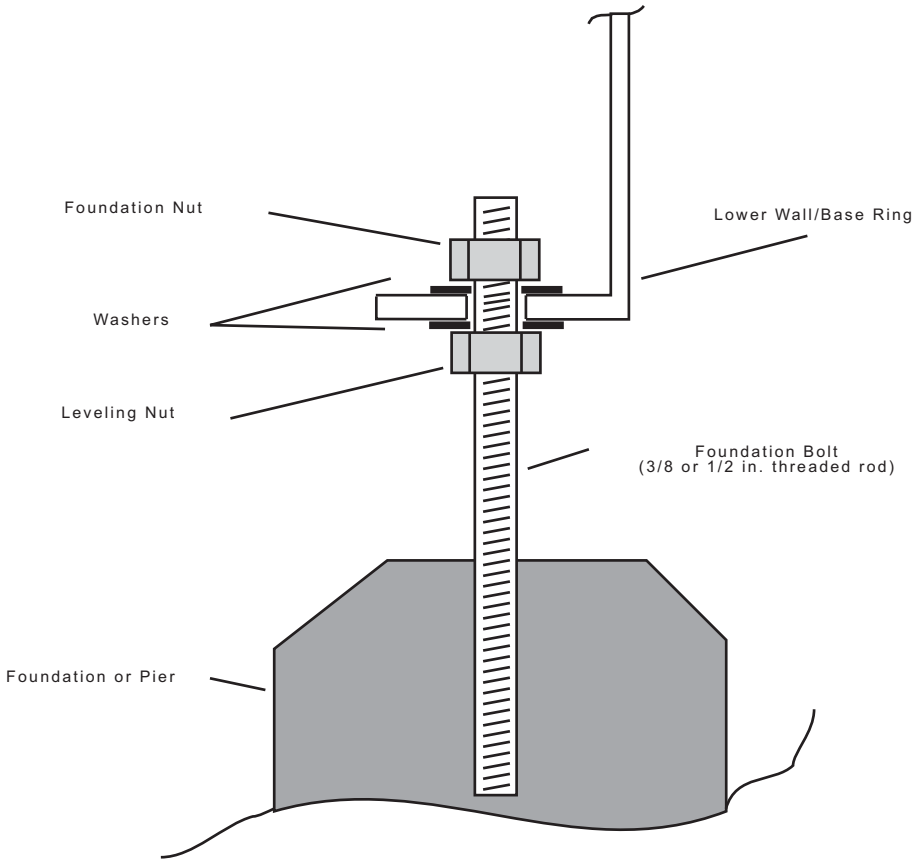
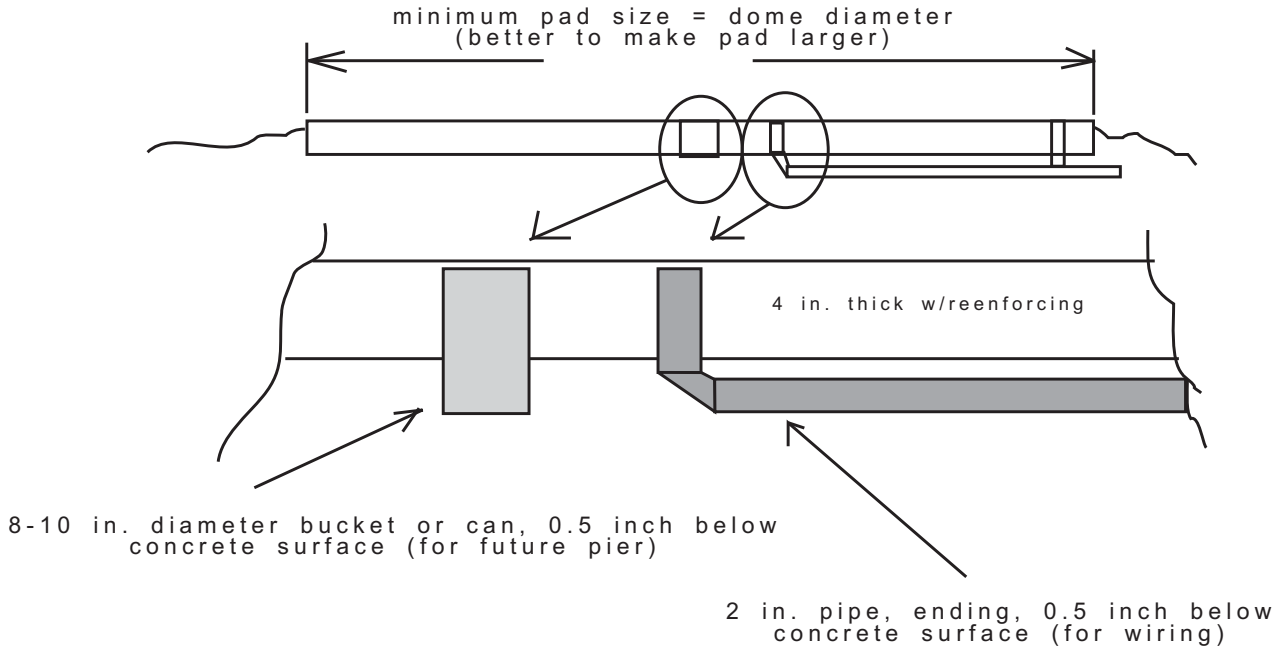
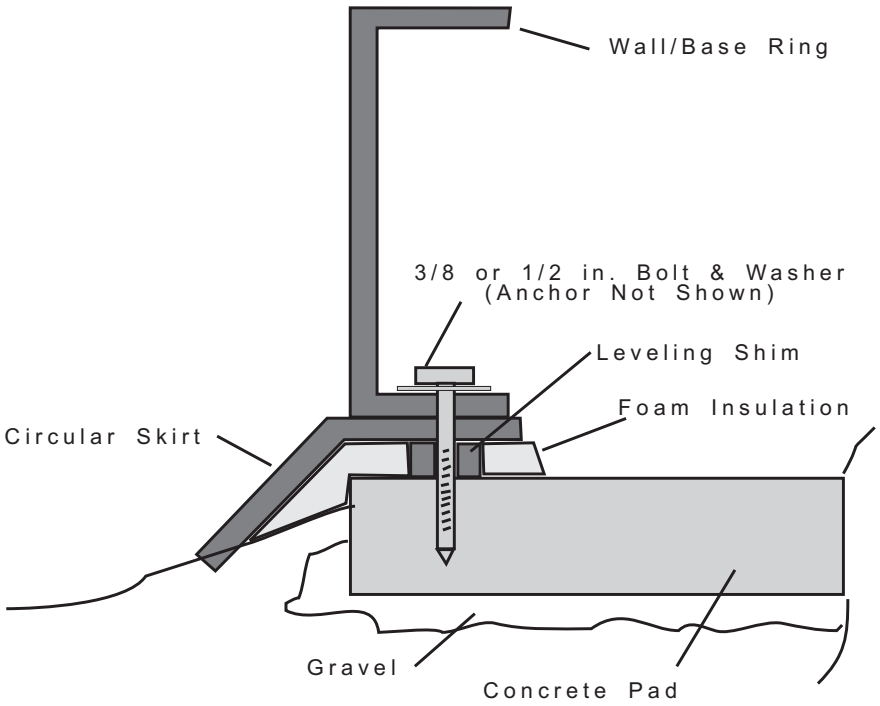


Figure 5
Foundation Bolts & Leveling



CONCRETE PAD DETAIL



FOUNDATION MOUNTING AND
SKIRT DETAIL

Pad with Bolts & Shims Figure 7

DRAWINGS NOT TO SCALE

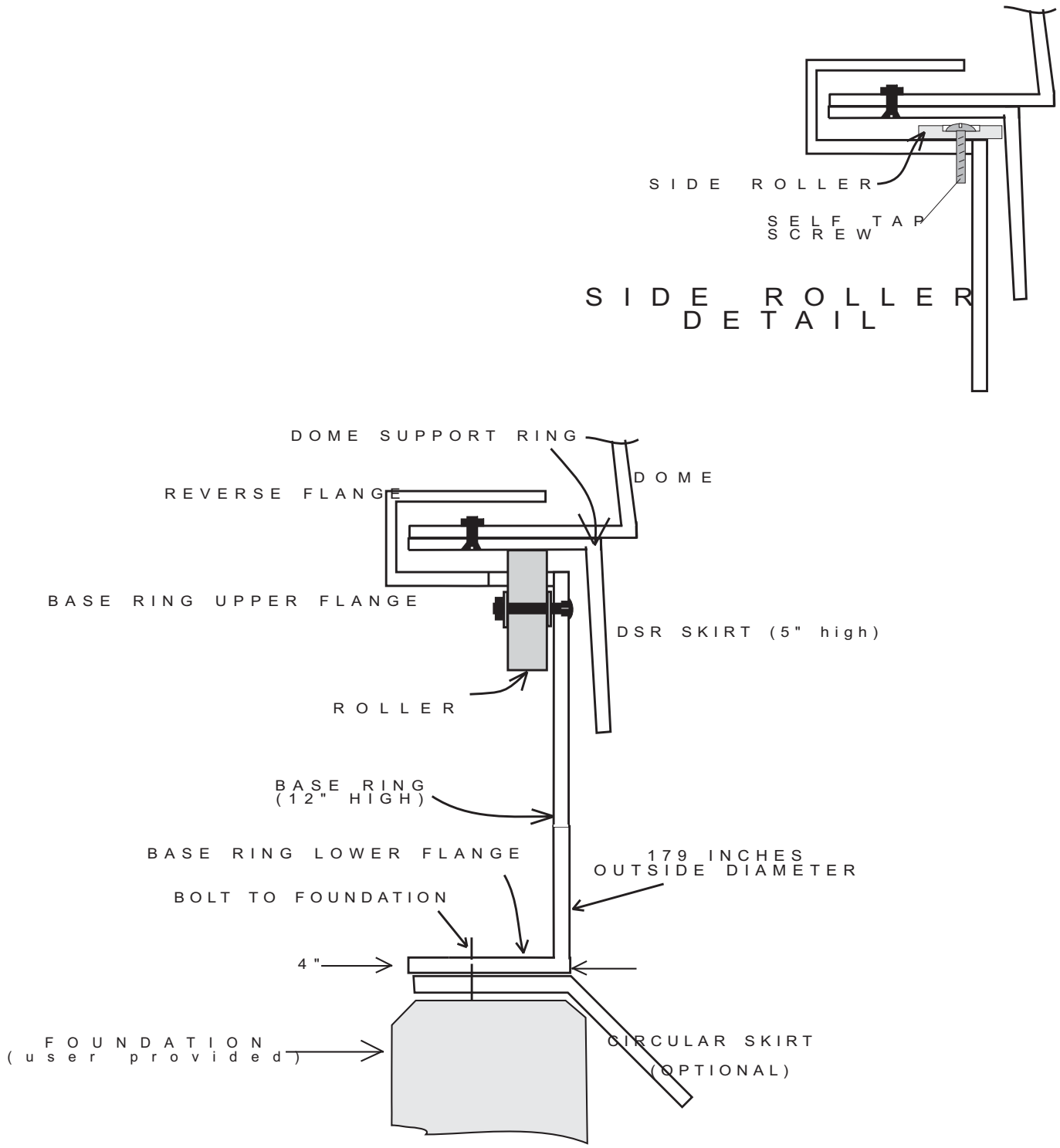
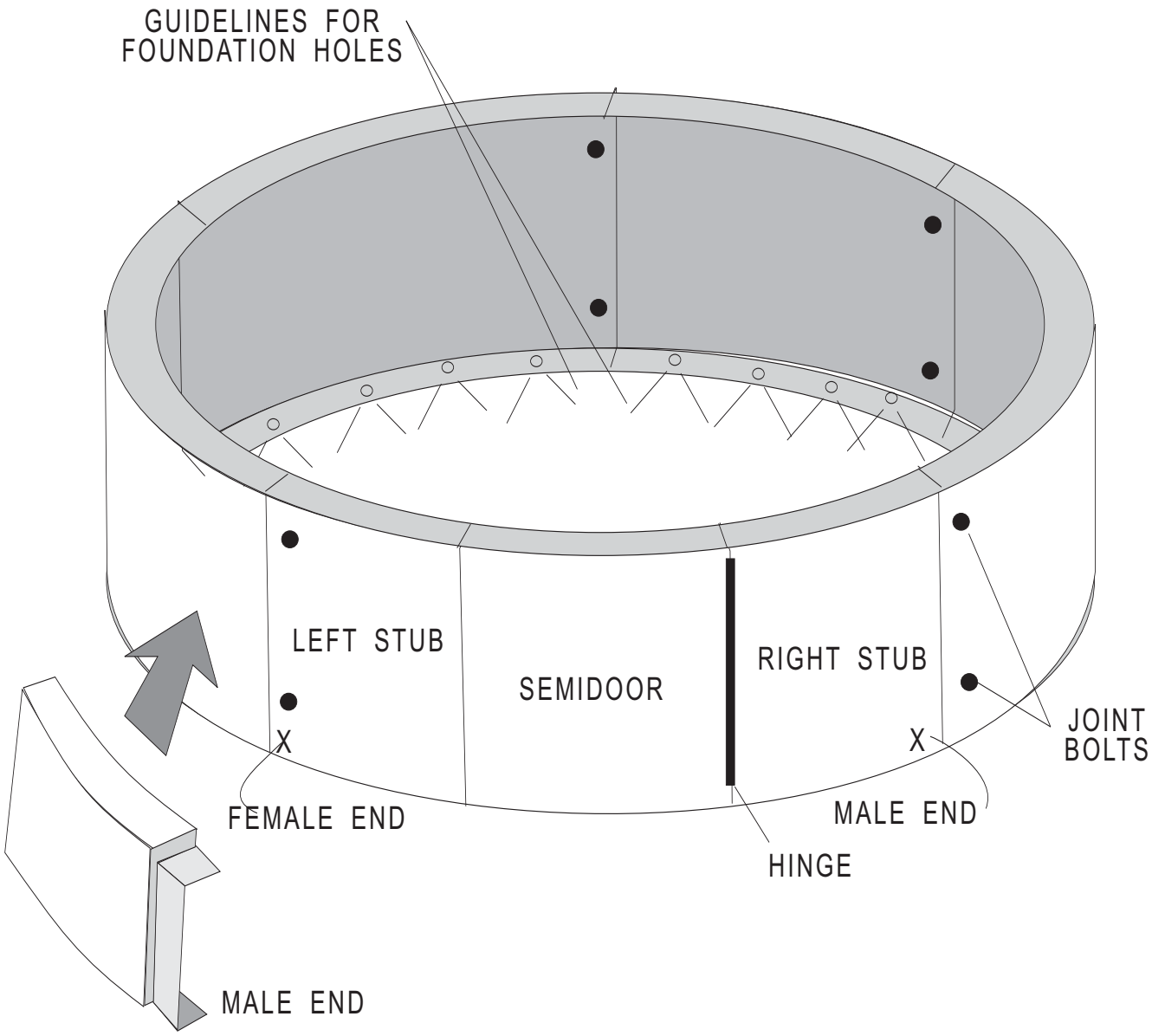


FIG. 9 - PRO-DOME 15 Wall/Base Ring

(NOT TO SCALE)



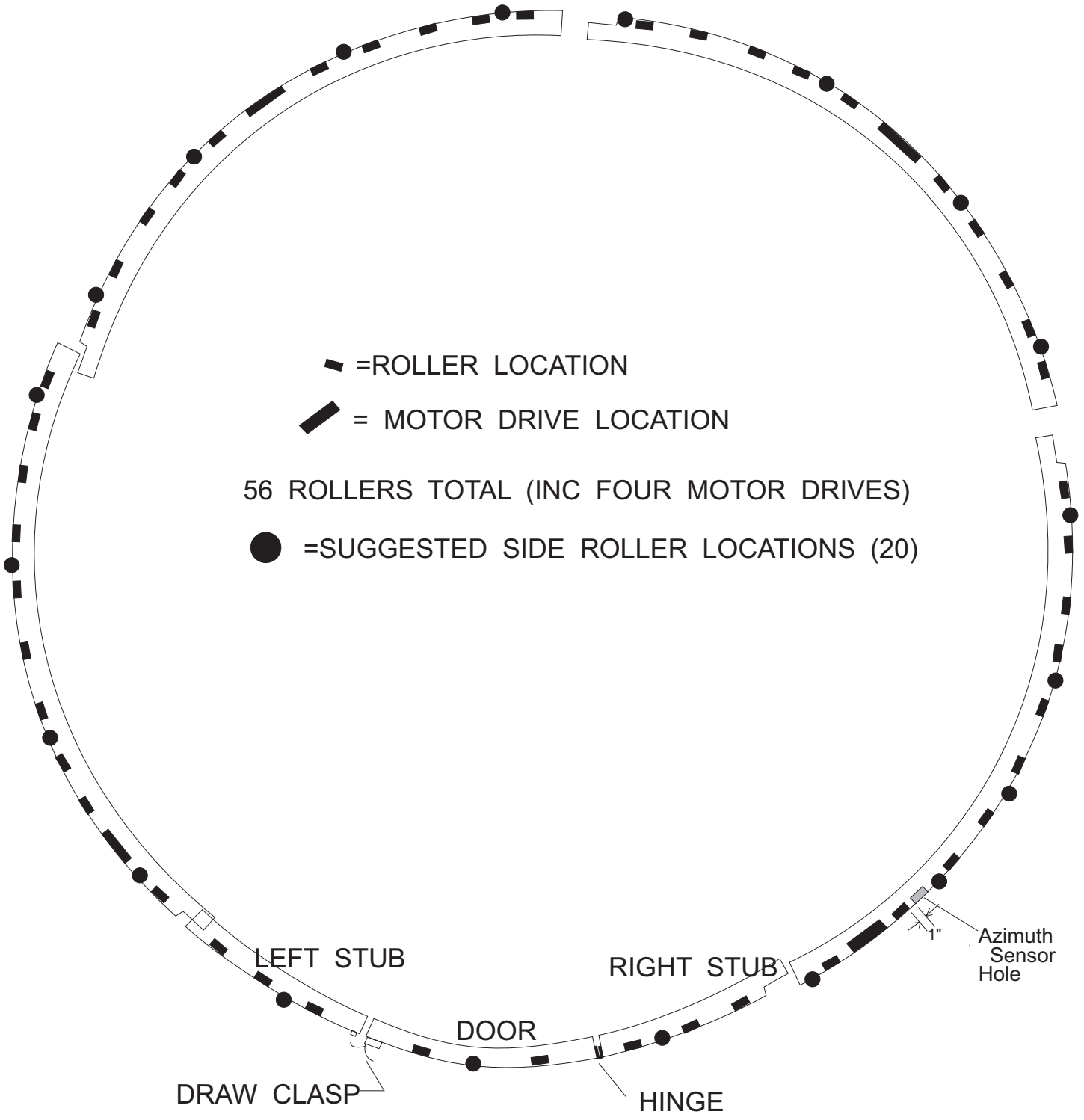
Note: Complete ring is made of five equal segments, one of which contains the left & right stubs & semidoor. Ring can also be ordered without the door.

NOTE: See text for discussion re shims under wall to provide door clearance.

PD-15, FIRST RING INSTALLATION FIGURE 9B

PD1514

110898

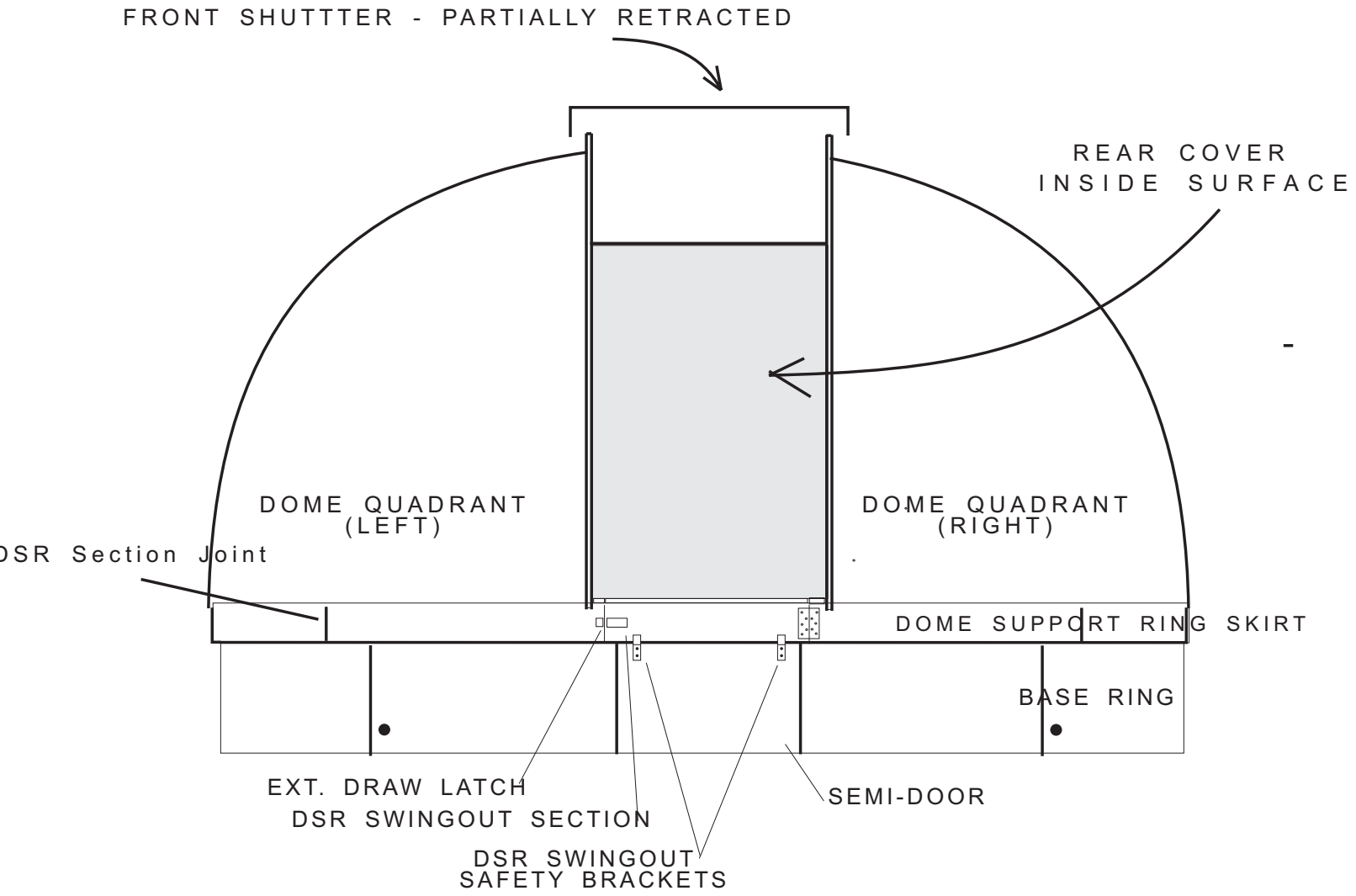


PD-15 Wall/Base Ring Identification
(4 motor installation)

FIG 9C

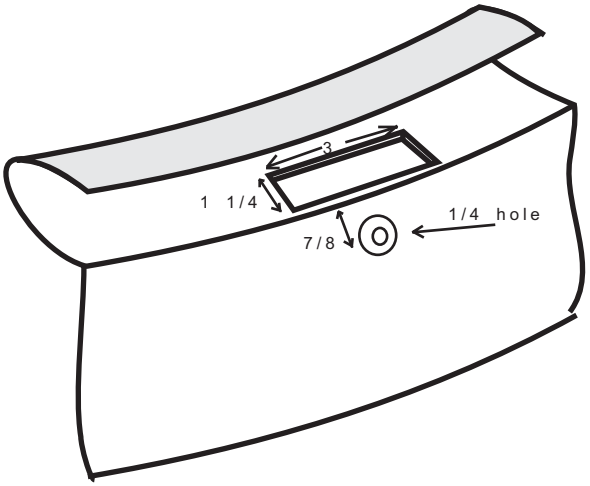
pd1516b

022801

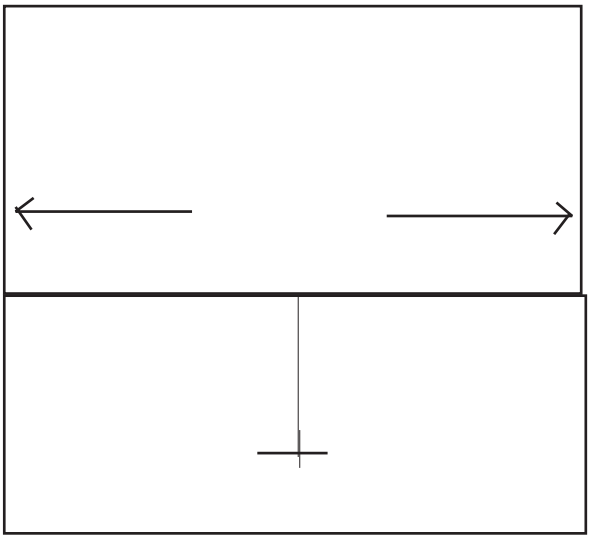


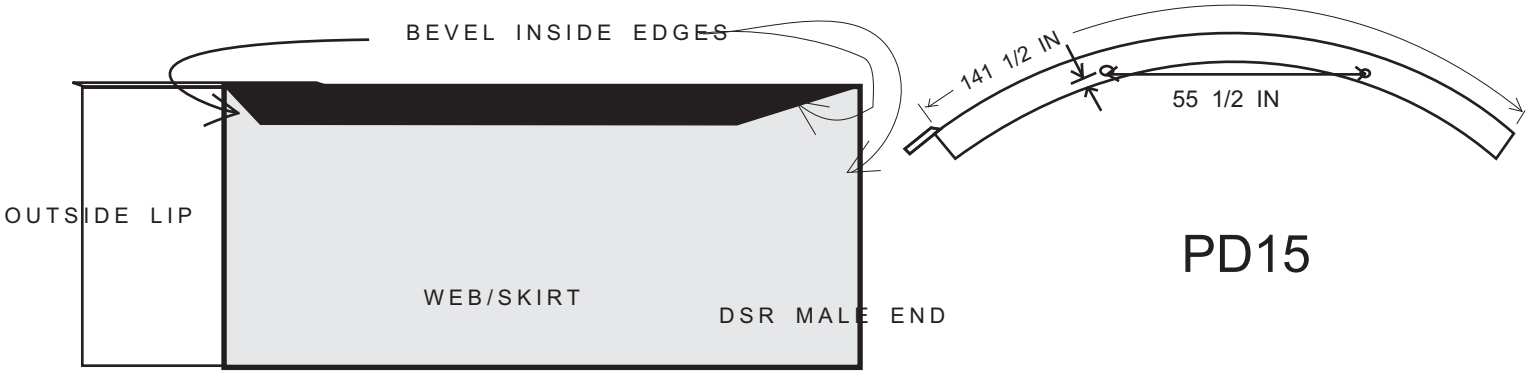
Front View PRO-DOME Figure 10

PDI06C

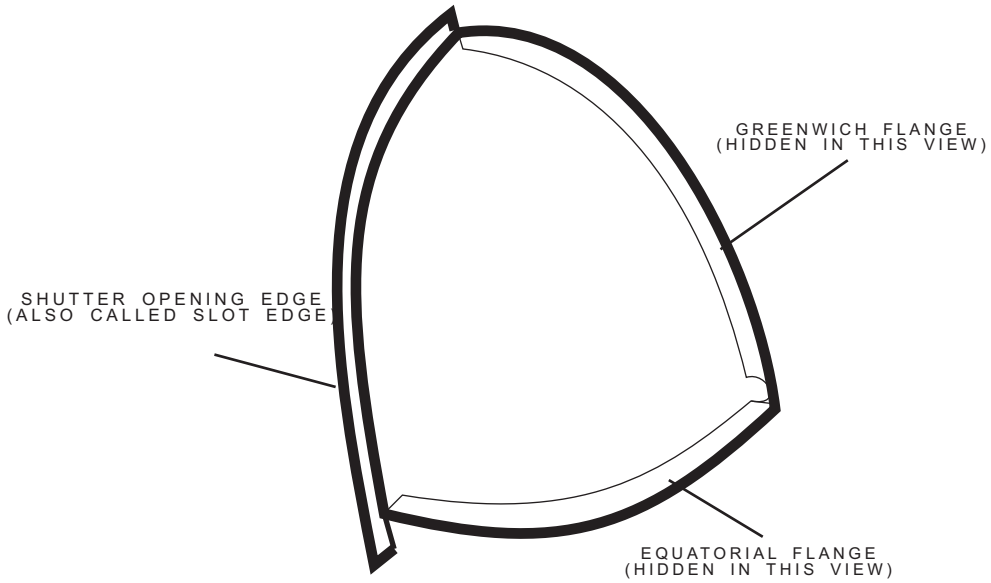


BASE RING - ROLLER HOLE
Figure 11



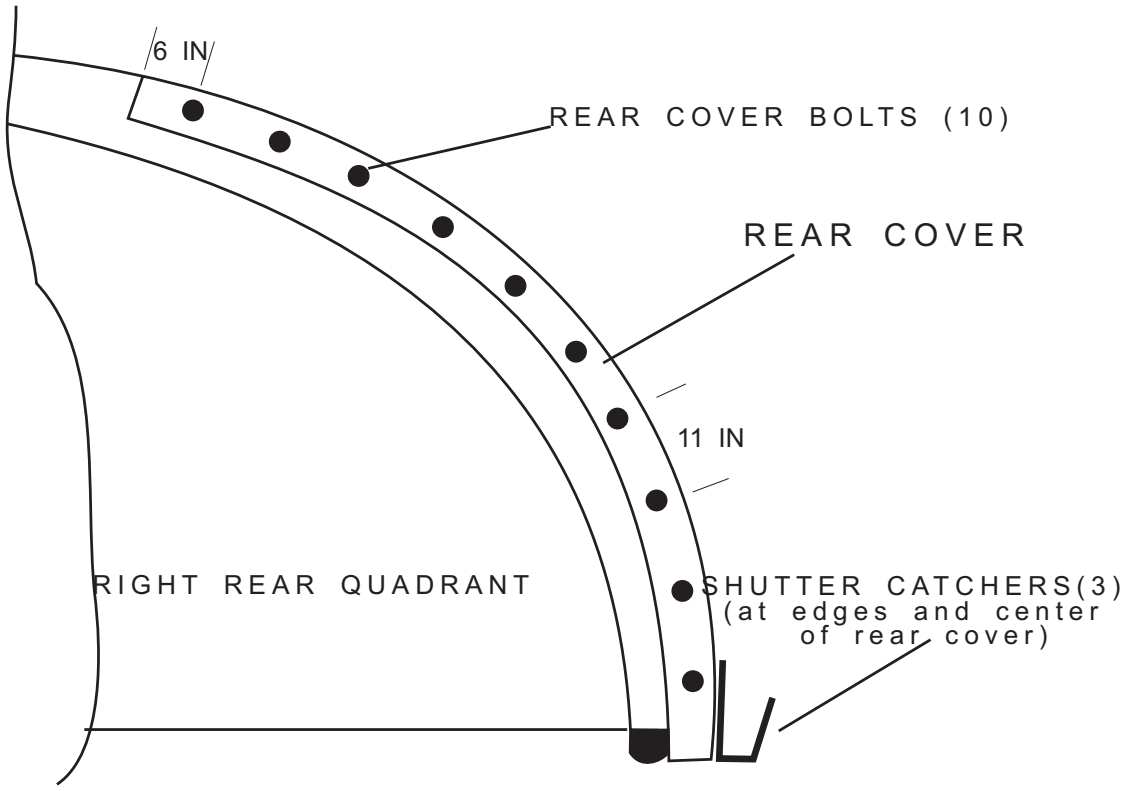


DSR - CROSSECTION SHOWING BEVEL
Figure 12

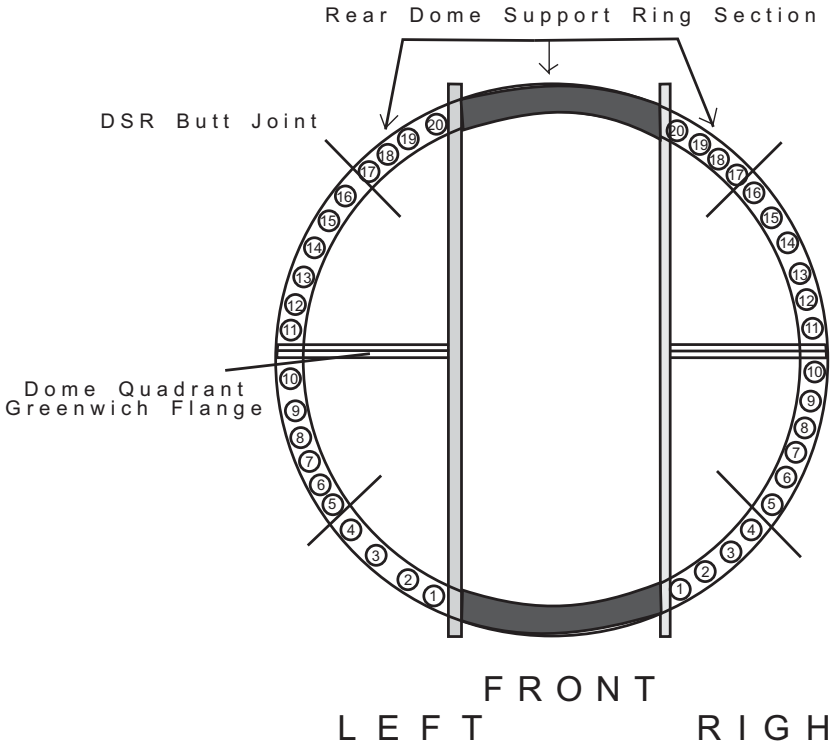


RIGHT FRONT QUADRANT - FLANGE NOMENCLATURE
Figure 13

hd120b



REAR COVER INSTALLATION
Figure 14



Quadrant: Bolt Identification
Figure 15

hd118b

PD15

110898

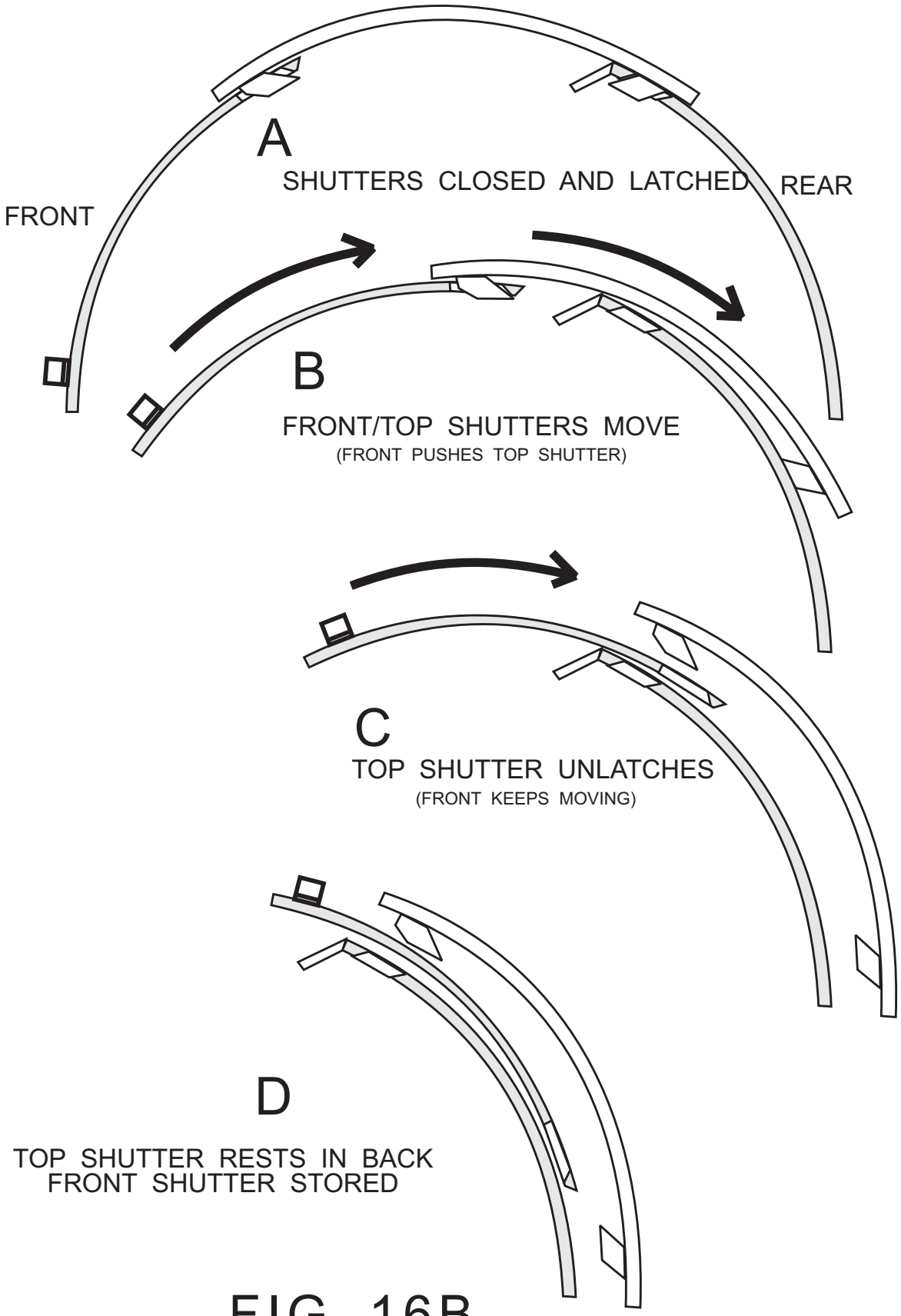
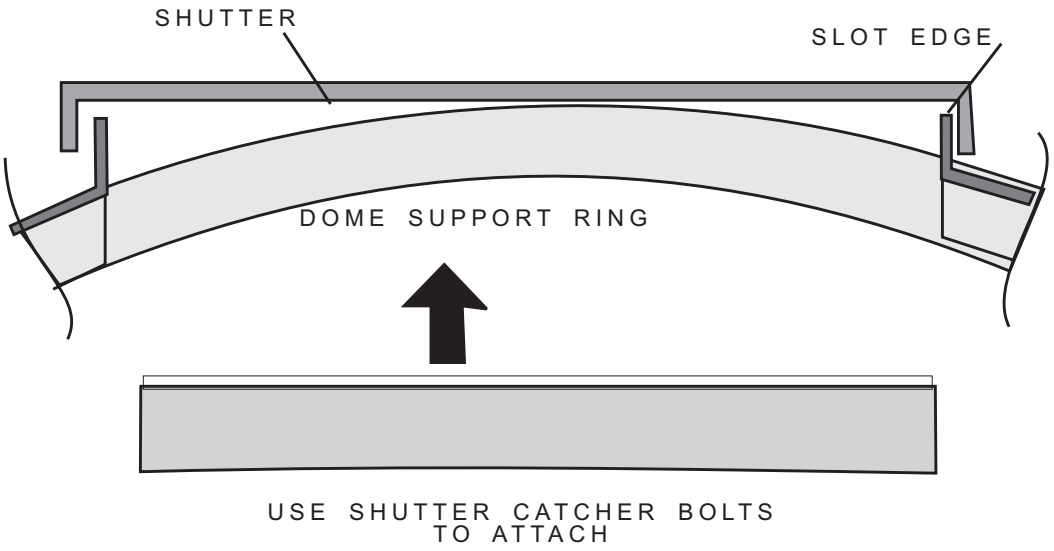


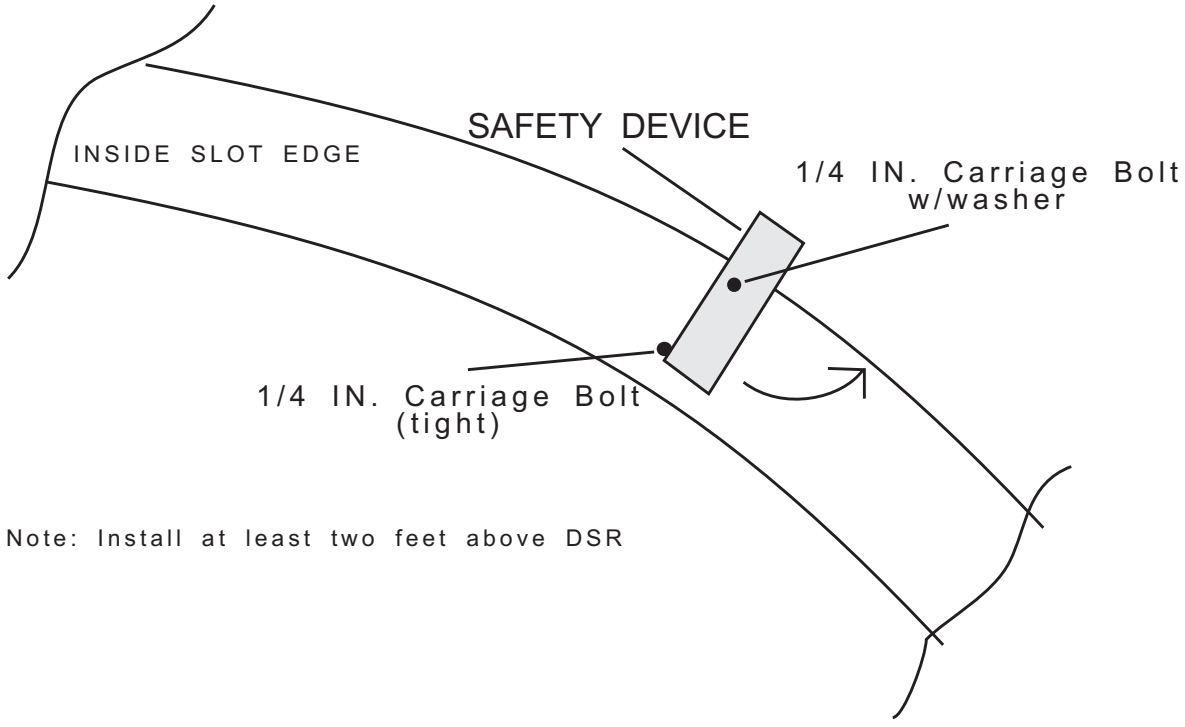
FIG 16B
SHUTTER OPERATION

NOT TO SCALE

PD109B



SOFFIT (PRO-DOME ONLY)
Figure 17



SHUTTER SAFETY DEVICE
Figure 18

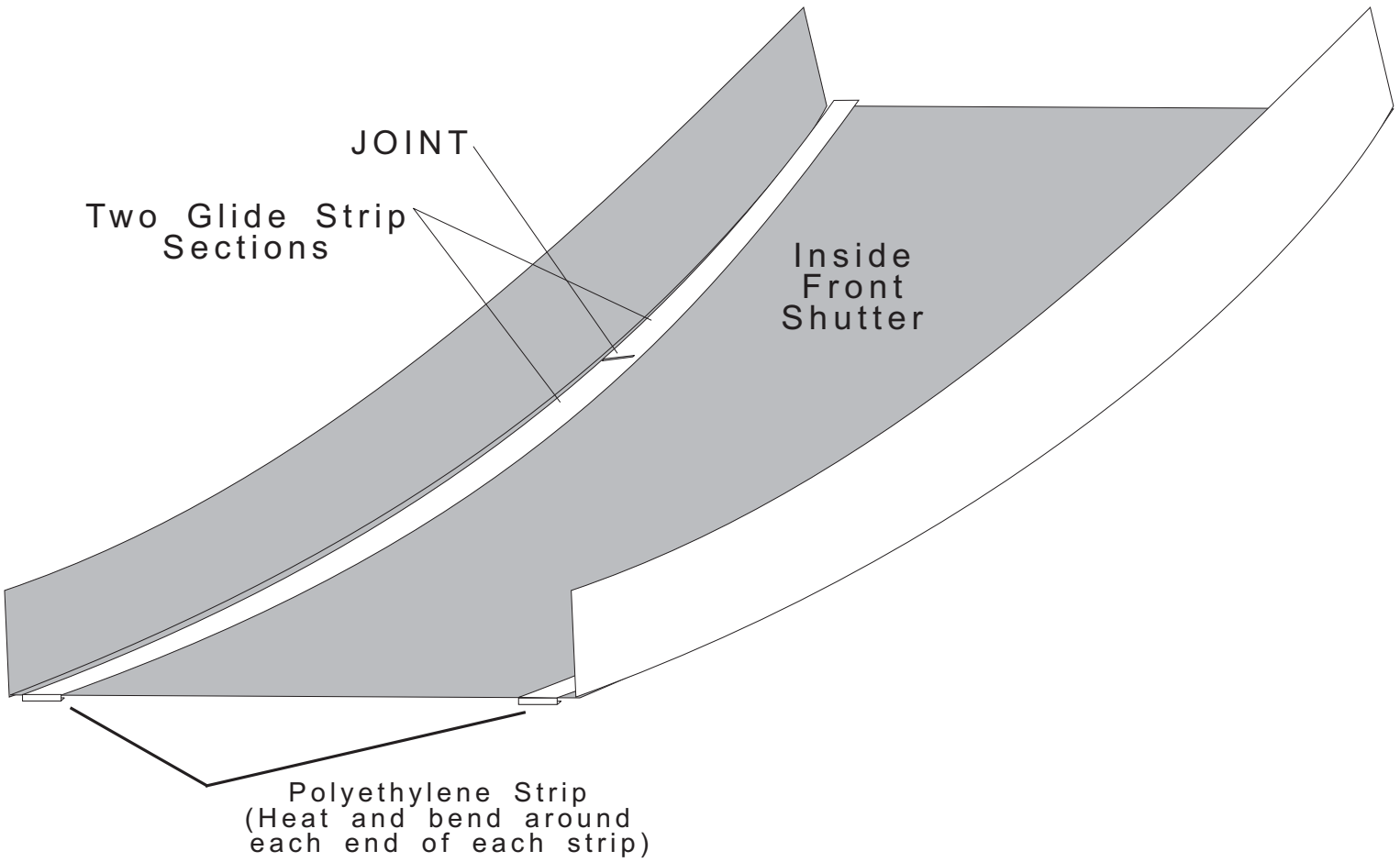


FIG 19 SHUTTER ANTIFRICTION STRIP

PD111
110898

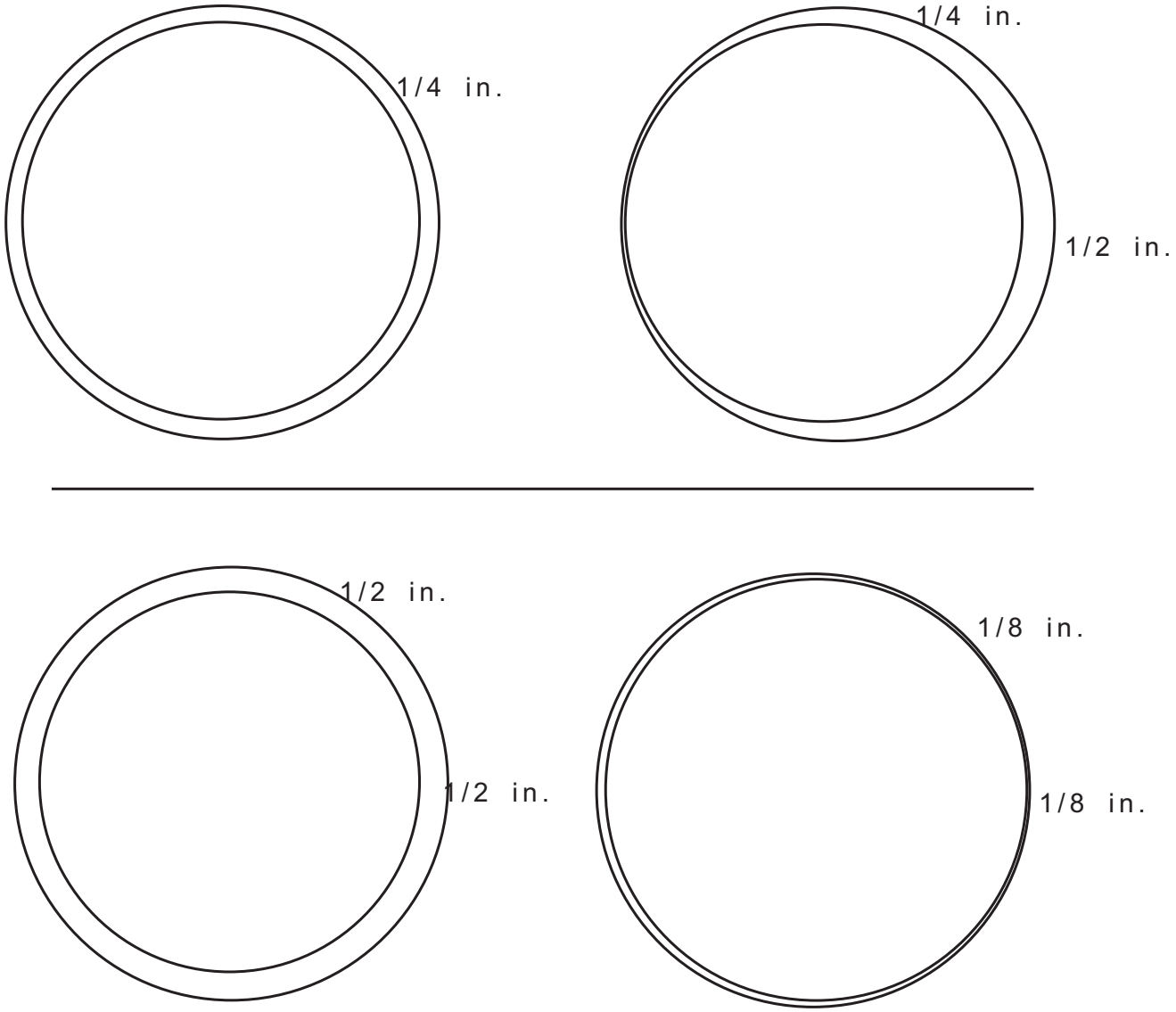
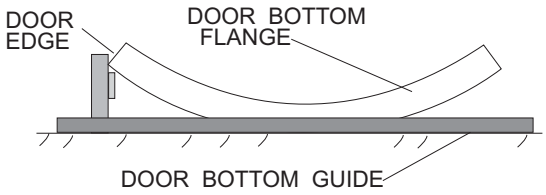
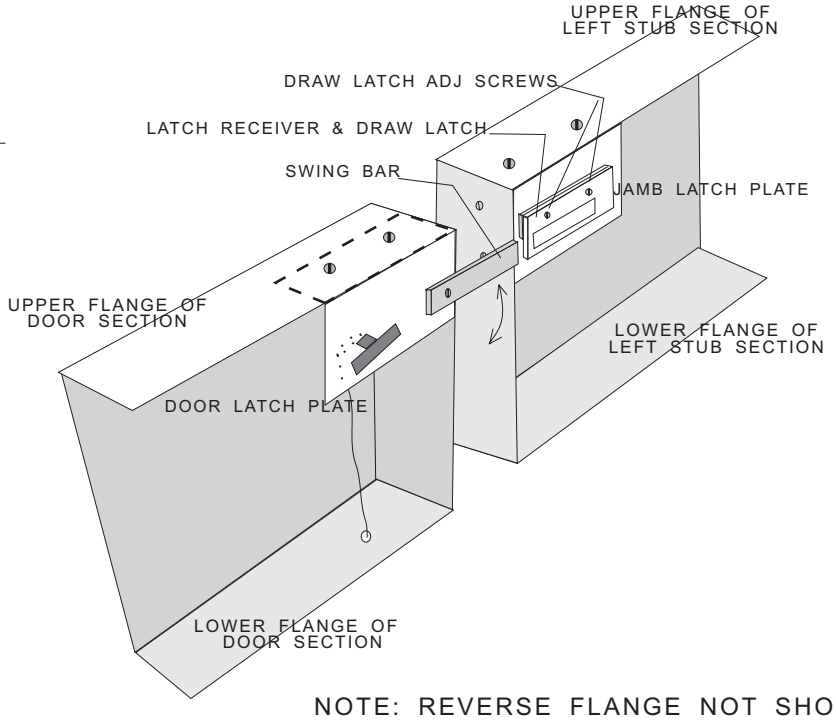


FIG 21 - ROTATION TESTS

PD112



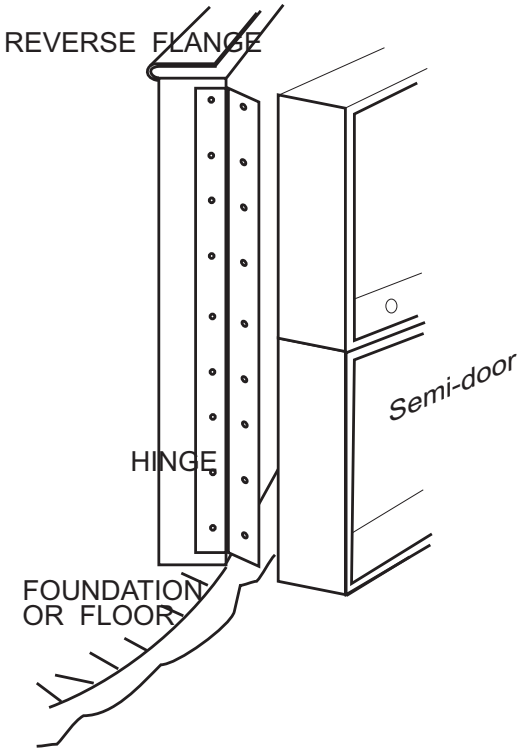
DOOR & STUB ASSEMBLY JIG

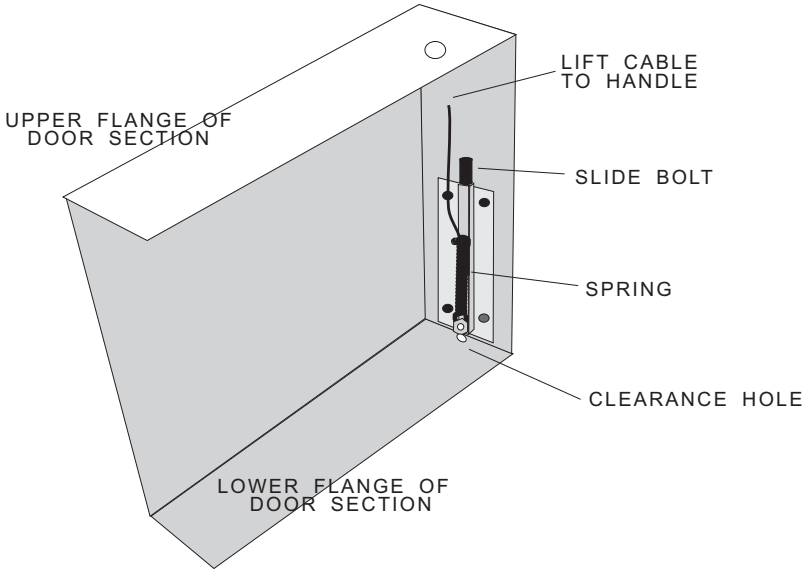


NOTE: REVERSE FLANGE NOT SHOWN

SEMIDOOR UPPER BOLT ASSEMBLY

VIEW FROM INSIDE DOME



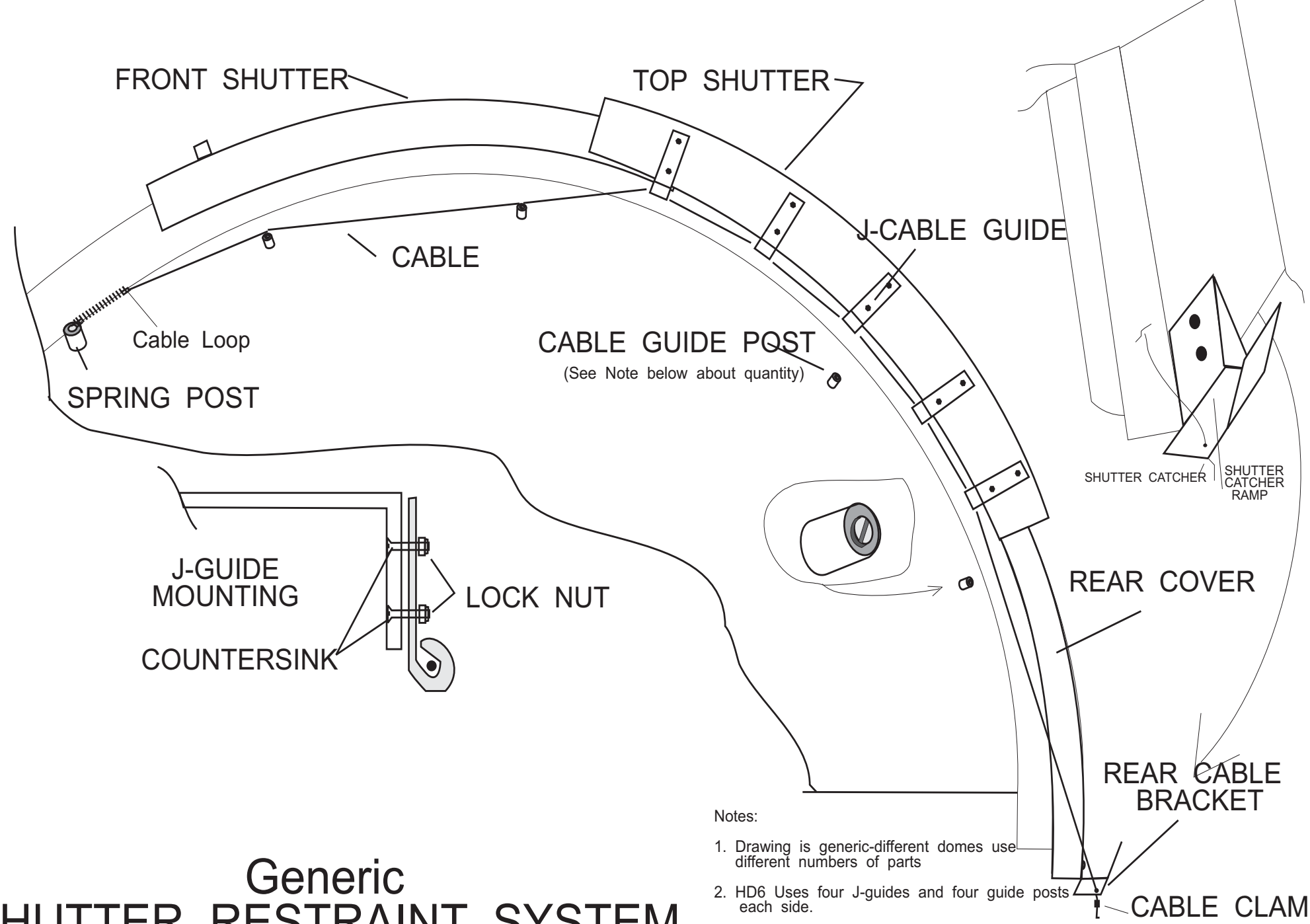


SEMIDOOR LOWER BOLT ASSEMBLY

VIEW FROM INSIDE DOME

FIG. 22 WALL WITH SEMI-DOOR

PD113C



Notes:

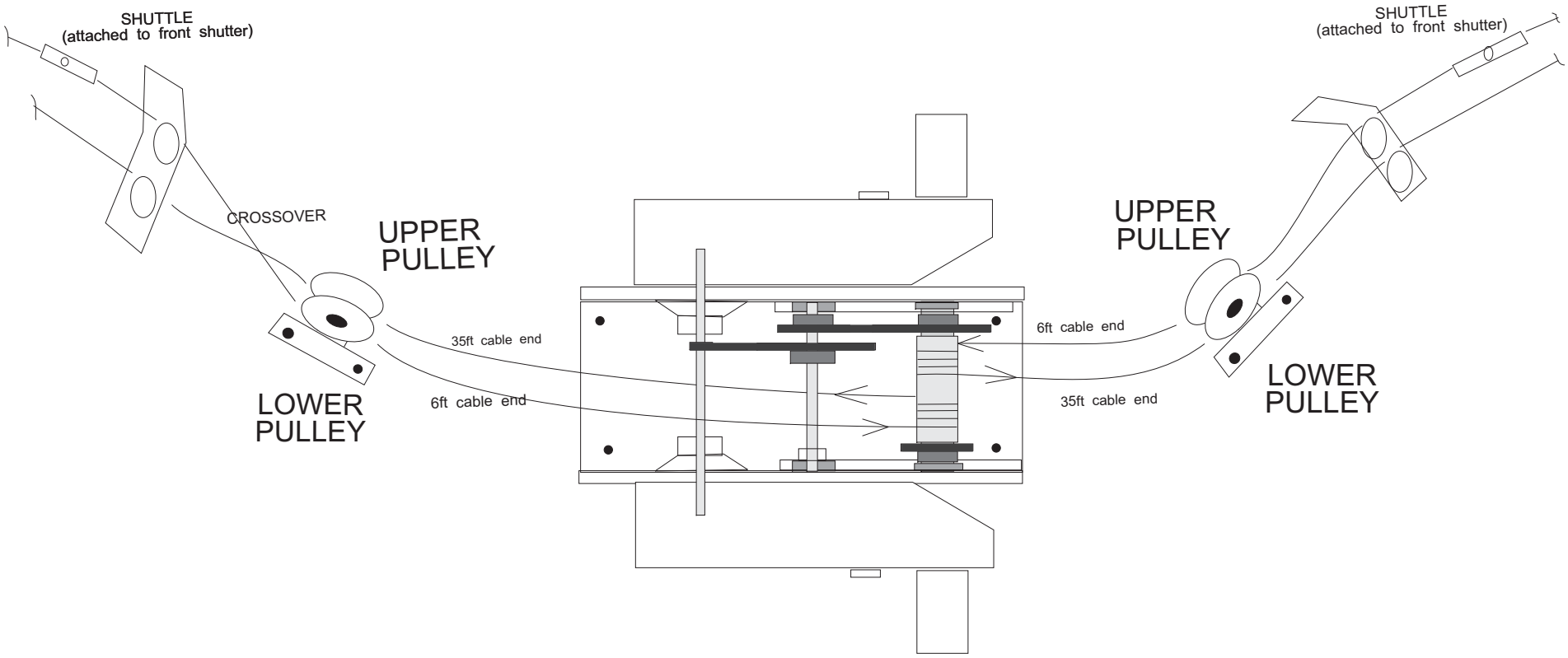
1. Drawing is generic-different domes use different numbers of parts
2. HD6 Uses four J-guides and four guide posts each side.
3. HD10/PD10 uses five J-guides and four guide posts each side
4. PD15 uses six J-guides and six guide posts each side
5. Space J-guides equally starting about 4" from the ends of the shutter

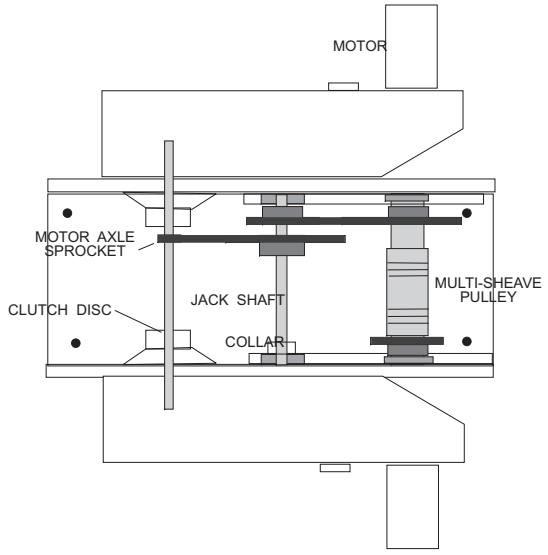
Note: Cable clamp and spring may be switched end for end. Use rear (Outward) hole

Generic
SHUTTER RESTRAINT SYSTEM

FIG 24

PD117
082101





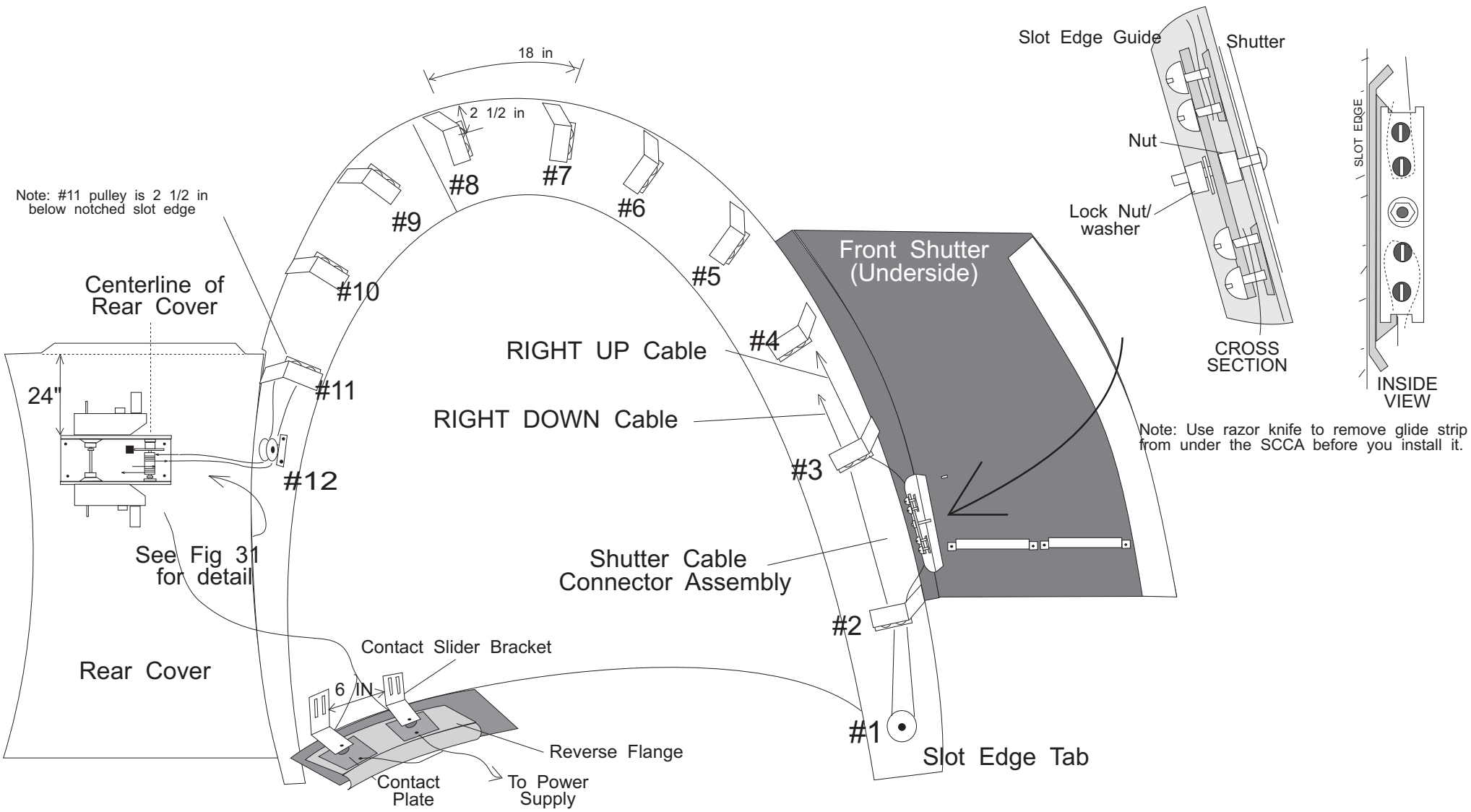
ARROWS SHOW OPENING (RAISING) SHUTTER. EACH WINDING HAS ABOUT 6-8 TURNS (4 ARE SHOWN)

Cables are 3/32 in SS
50 ft. long

ES15 MODEL 2

FIG 31

ES1501E
110898

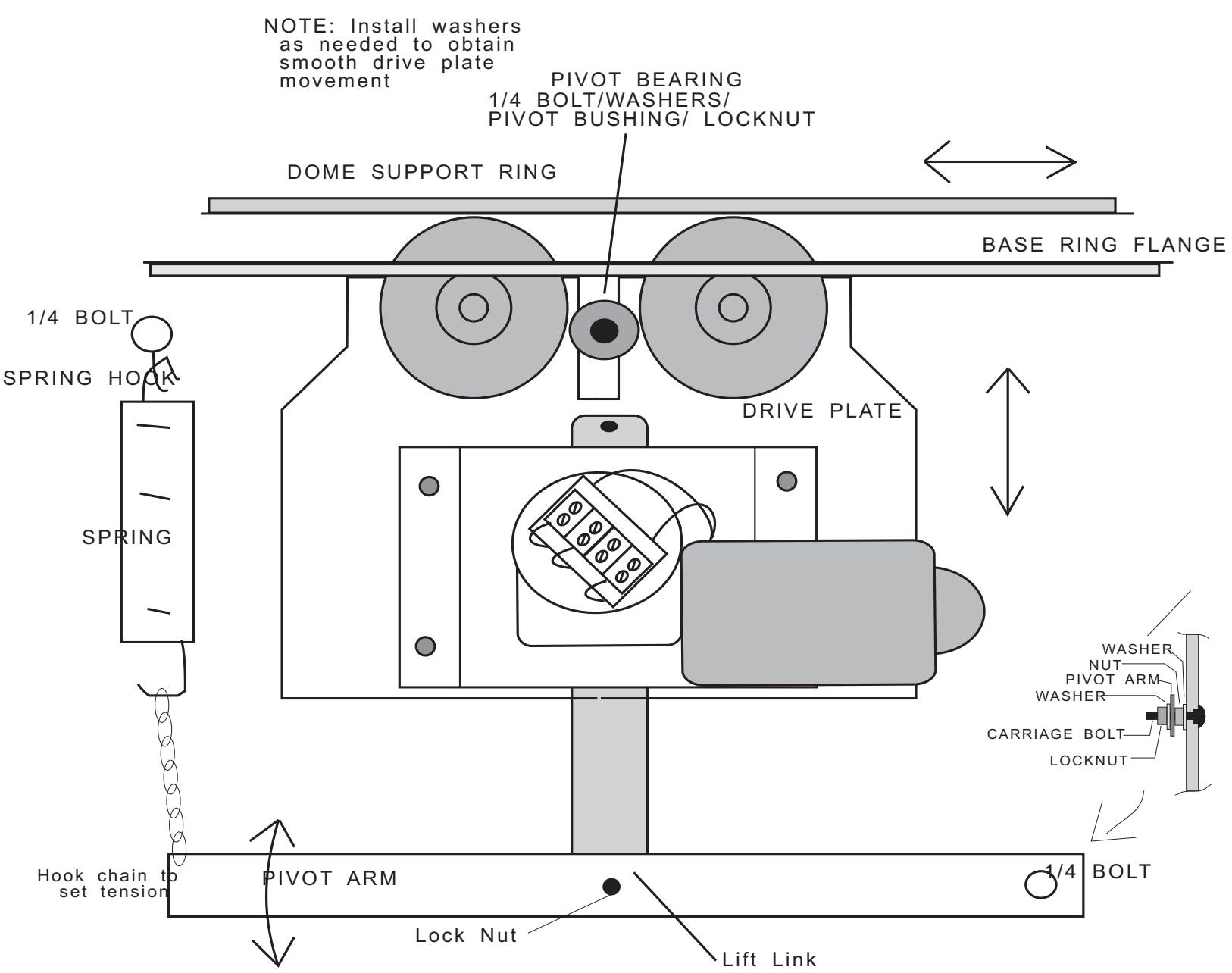


Electric Shutter Installation

Note-Schematic to show general design
(not to scale, partial construction only)

Fig. 32

ES1502d
032201
092401 pulleys in 1/4



NOTE: DRIVE BELT AND BELT IDLER ARMS DELETED FOR CLARITY

NOTE: You may switch pivot arm left-right if desired.

NOTE: Motor for HD6S is horizontal

FIG. 51
DOME DRIVE PLATE

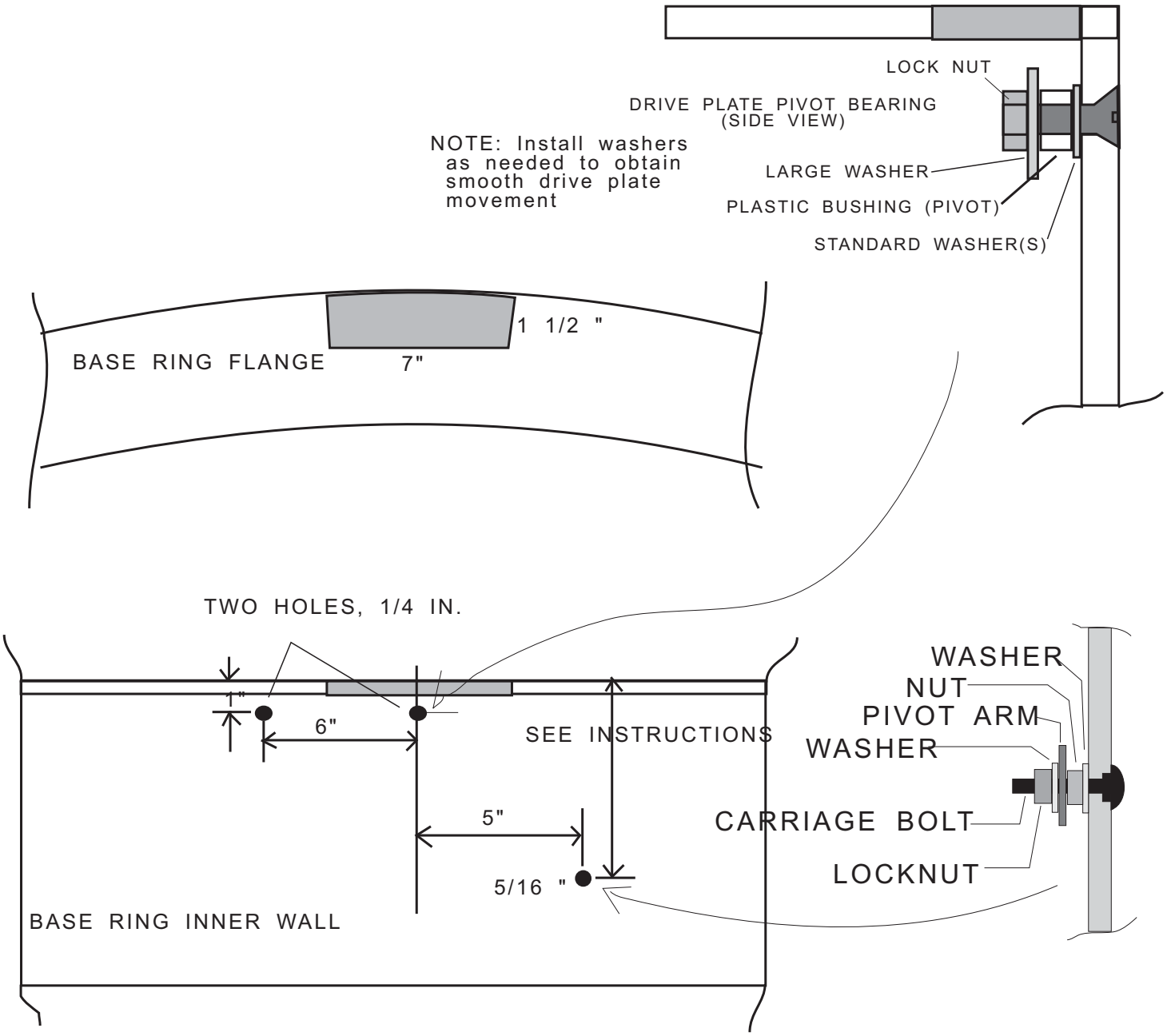


FIG 53 - DRIVE MOUNTING HOLES

ED2

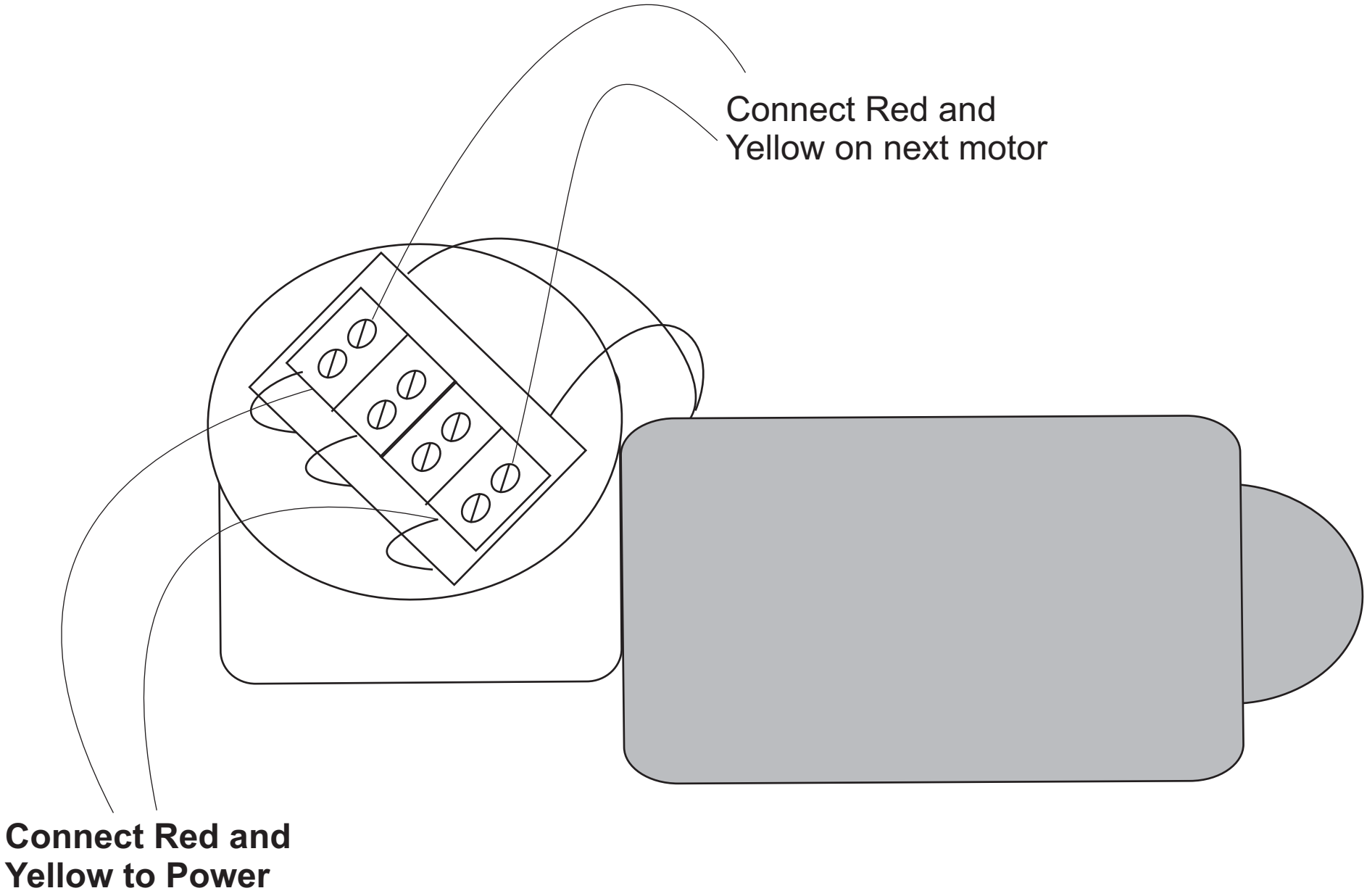


Fig. 52
Drive Motor Wiring