Tool and Equipment Applications

Carpenters Training Committee for Northern California (CTCNC)

OFFICE MODULAR SYSTEMS INSTALLER

APPRENTICESHIP PROGRAM

Course of Instruction

Year	Class#	Class Title (All classes 36 hours - Four (4) Days - 7:00am - 4:30pm)
1	1201	Orientation to Health and Safety
	1202	Introduction to Office Modular Systems Installation
	1203	Tool and Equipment Applications
	1204	Print Reading – Measurement and Layout
2	1205	Modular System Construction and Quality Control I
	1206	Modular System Construction and Quality Control II
	1207	Drapery & Window Coverings, Fine Furnishings
	1208	Floor to Ceiling Wall System Construction

This material was produced using the following elements:

Microsoft Word™
2013 Vectorworks™
2014 Windows™ 7
Adobe Acrobat Pro

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Revised 2/12/2018 DK/jt

CARPENTERS TRAINING COMMITTEE

FOR NORTHERN CALIFORNIA

SEXUAL HARASSMENT & APPRENTICE CONDUCT

Sexual harassment in any form or degree by an employee or apprentice against another individual, regardless of their relationship or respective status, is strictly against the policy of the Carpenters Training Committee for Northern California and will not be tolerated. Any such action or activity shall be reported immediately to the person in charge of the training facility. The matter will be promptly investigated and appropriate action will be taken. Copies of all complaints and actions are to be forwarded to the Assistant Director of Field Operations.

Apprentices shall not use lewd and vulgar language while they are on the premises of the Carpenter's Training Center. Any such action shall be reported immediately to the person in charge of the training facility. The matter will be promptly investigated and appropriate action will be taken.

Any person violating the above policies shall be subject to disciplinary action, which may include suspension or expulsion from the training center and/or cancellation from the program.

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1203

TOOL AND EQUIPMENT APPLICATIONS

Carpenters Training
Committee for Northern
California

COURSE OBJECTIVES

At the completion of this course, the apprentice will learn to correctly identify and safely use a variety of the tools used in the modular trade. The student will also be able to study a product list, understand the plan, layout the project and properly assemble three different clusters of cubicles that are commonly used in the field. This includes assembling the frames, leveling the mockup, installing the electrical hookups and the tiles. In addition, the apprentice will learn and follow the correct procedure for dismantling and repackaging the product.

SPECIFIC OBJECTIVES

Upon the completion of this unit, the student will be able to:

1. Correctly set up the laser level.
2. Check to see if the laser is accurate.
3. Given a skilsaw and lumber, safely complete a variety of cuts.
4. Safely use a rotohammer to drill holes in concrete.
5. Correctly identify and set a variety of concrete anchors.
6. Use a skilsaw, 1/2" drill motor, jigsaw and belt sander to complete a project.
7. Identify the terminology commonly used for the components of modular installation.
8. Know the difference between spine, rib and wing panels.
9. Determine the high spot on a floor and adjust the glides accordingly.
10. Correctly install powerways and receptacles and test to make sure they are powered.
11. Install a base power in feed.
12. Assemble a cluster of four Teknion Leverage cubicles.
13. Assemble a cluster of four Steelcase Answer cubicles.
14. Assemble a cluster of four Knoll Dividend cubicles.
15. Carefully dismantling the product in the correct order.

MODULAR APPRENTICE TOOL LIST

Minimum tools required for a Modular Installer should include:

1. Hard Hat
2. Safety Glasses
3. Work Boots
4. Safety Vest
5. 25' Tape Measure
6. Carpenter Bags or Cloth Apron
7. Tool box or Bag
8. Dead Blow/Rubber Mallet
9. Wonder Bar
10. Socket Set- Up to 3/4" Sockets
11. Adjustable Wrench
12. Set of Straight and Phillips Screwdrivers
13. Set of Wrenches
14. Bits---P1, P2, P3 Straight Slot and Phillips Head Bits
15. Robertson Square Bit
16. Magnetic Bit Holder
17. Hex Drive Magnetic Bits—1/4", 5/16", 3/8" and 1/2"
18. Utility Knife
19. Electric Meter Tester
20. Hack Saw
21. 9" Torpedo Level (Magnetic Preferred)
22. Chalk box and chalk

MODULAR INSTALLER GRADING AND EVALUATION

Grading

A uniform weighing system will be used as follows:

1. Class Participation and Attitude ……... 10%
2. All Tests Except Final Exam …….. 10%
3. Hands On Lessons……. 50%
4. Final Exam …… 30%

Assignment Of Grades Will Be As Follows:

A 92 – 100%

B 82 – 91%

C. 73 -81%

D 68 – 72%

F Less than 68%

Criteria for Evaluation

1. Completion of assignments
2. Accuracy
3. Participation
4. Following instructions

1203 TOOL AND EQUIPMENT APPLICATION

PRE-TEST

1. T F It's not necessary for an installer to carry a utility knife.
2. T F Mallets should be the non-marking, dead blow type.
3. T F PPE is not necessary for a modular installer since they work inside.
4. T F Extension cords should be inspected before each use.
5. T F Plastic base trim is best cut with a skilsaw.
6. T F A worm drive skilsaw and direct drive skilsaw are the same.
7. T F Rip cuts, miter cuts, bevel cuts, compound miter cuts, and plunge cuts, can all be made with a skilsaw.
8. T F Masonry drill bits are for wood.
9. T F Skilsaws not only cut wood, they cut fingers too.
10. T F Skilsaw hazards include saw blade, kickbacks, noise, and airborne saw dust.
11. T F Cordless drills are not used in modular installation assembly.
12. T F Phillips, Robertson, Torx, Allen, and Hex, screws are not used in modular installation assembly.
13. T F Skilsaws cut from the underside up.
14. T F Cordless impact drivers have a 1/4" hex drive quick release anvil.
15. T F A keyless chuck is a vise that holds a drill bit or other accessory tight in the drill.
16. T F Drill motor hazards include chips, dust, shavings, keyed chucks, exposed cutting edges and pinched drill bits (kickback).
17. T F Hammer drills and rotary hammers not only spin, they add a hammering action.
18. T F A hammer drill is used to drill into wood.
19. T F Round shank, SDS shank (slotted drill system), and spline shank are the three different shanks for rotary hammer and hammer drills.
20. T F Belt sanders are used for shaving down metal trim.
21. T F A jig saw cuts with an up and down motion.

Chapter 1 Tool List

Shown below are most of the basic tools that the installer would need to perform a variety of different installations. Some are used daily, others are only used occasionally.

1. Utility knife with extra blades—the most used tool in the trade. A sharp blade is essential, so carry extras. A utility knife is a very handy tool, but it can also be dangerous; many injuries are the result of improper use.

2. Set of straight and Philips screw drivers-you should have the set of the three different sizes, 1's, 2's and 3's.

3. Tape measure 25'—essential for layout and general use.

4. Mallet (dead blow)—used to connect frames, setting cantilevers and general dismantling. The hammers weigh generally between 24 to 32 ounces, the size you use is personal preference. The mallet should be non-marking, most black, soft, rubber-tipped mallets will leave a mark.

5. Pry bar (wonder bar)—used, among others things, to pry up panels in the leveling process, lift up desks to access the glides and take crates apart

6. Cordless drill with extra battery—essential for installing panels, components, different varieties of wall mounted brackets and drilling

7. Magnetic bit holders in different lengths, locking and non-locking.

8. Assorted screw tips, Allen tips, torque tips, magnetic nut drivers, square, or Robertson's bits. Different systems require different tips, not having the right tip causes delays.

9. Socket set with 3/8” drive (1/4" drive is useful with smaller sockets), standard and metric. Should have standard sizes of 1/16" to 3/4" and the equivalent in millimeters.

10. Open end/ratcheting wrenches and speed wrenches. Used for tightening and loosening a variety of nuts and bolts

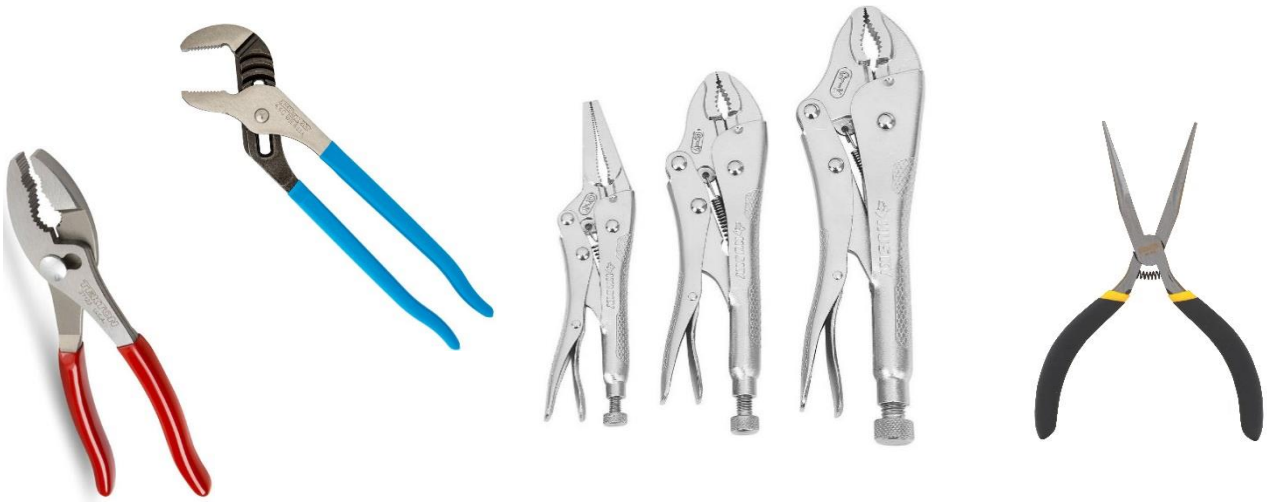
11. Level (torpedo and 2’ magnetic preferred),

Used to plumb and level panels and components.

12. Allen wrenches, standard and metric.

Many of the installations are connected with Allen screws—the most common sizes are 3/16, 5/32 and 1/4. An Allen set is preferred.

13. Pliers, channel lock pliers, vise grip pliers, needle nose



14. Speed square or combination square—used for laying out square cuts and checking for square.

15. A pair of quick grip clamps---used for clamping surfaces together, used as a second set of hands.

16. Tin snips---used for cutting banding, trim pieces etc. The yellow handled snips cut straight and are the most common.

17. Hack saw---Used to modify cubicle parts and pieces.

18. Straight Claw Hammer

19. Razor cutters---Used for quick, easy, clean cuts on plastic trim

20. Stud finder---Used to locate studs on finished walls.

21. Drill bits---A variety of sizes and types are needed, mostly metal bits

22. Metal file---Used to file down sharp metal edges after making cuts

23. Electrical plug in tester---used to test the electrical to see if a system or panel is energized or not

24. Carpenters pouch—helps to keep your most used tools accessible at all times.

25. A tool box or rolling tool bag

26. Adjustable wrench

In addition, you should always have the correct PPE, including hard hat, safety glasses, work boots and high visibility safety vest.

NOTES:

Chapter 2 Skilsaws

THIS CHAPTER IS PLANNED TO PROVIDE ANSWERS TO THE FOLLOWING QUESTIONS:

- **What are the different types of portable electric circular saws?**
- **What are the different parts of the portable electric circular saw?**
- **What are the hazards and safety features of the portable electric circular saw?**
- **How do you select the proper blade for the material being cut?**

INTRODUCTION

Take a regular machete, (like those used to chop sugarcane) attach a "Beach" malted-milk mixer motor to it, throw in a shaft and some gears, a 2-inch round blade and a switch; and presto - the first portable electric circular saw. In 1921, Edmund Michel in New Orleans, Louisiana did just that; he invented what some people consider the first electric handsaw. In 1924 he founded the Michel Electric Handsaw Company. In 1926, the company was renamed Skilsaw Incorporated.

Fig. 2-1 Skilsaw Model E

The development of the Skilsaw Model E portable electric circular saw in 1928 was the breakthrough that led to the modern portable electric circular saws that can be found at virtually every construction site in the country today.

Portable electric circular saws are one of the most common power tools in use today. For most carpenters, the circular saw is like an extension of their body... almost indispensable. With the appropriate blade, circular saws are capable of cutting wood, steel, masonry, ceramic tile and more. Circular saw sizes range from three inches to sixteen inches (classified by the diameter of the blade). Regardless of the size of the blade, circular saws come in two varieties or styles; worm drives and direct drives (or sidewinders).

DESIGN VARIATIONS

Worm drive

The invention, in 1928, of the Model E by Skilsaw Inc. led directly to the Model 77, today's most popular worm drive circular electric saw. A worm drive is the toughest, most powerful circular saw. The saw derives its name from a pair of gears - the worm and the

work gears that position the motor shaft and the blade at right angles to each other.

Fig. 2-2 Worm Gear

The gears are used to increase the torque transferred to the blade, which makes the saw well suited for heavy-duty use.

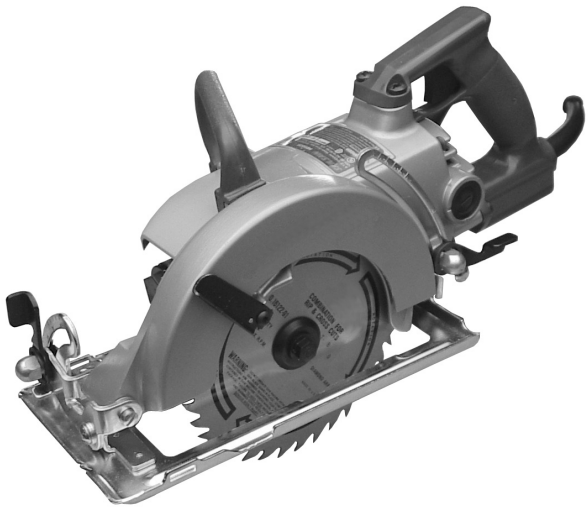


Fig. 2-3 Worm drive Skilsaw

The worm drive saw also contains an oil-filled reservoir, similar to a crankcase, that lubricates the two gears. Also, it dulls the circular saw's ear-splitting scream. In addition, the blade's position on the left side of the motor makes it easy for a right-handed person to see and follow the cutting line as they are working.

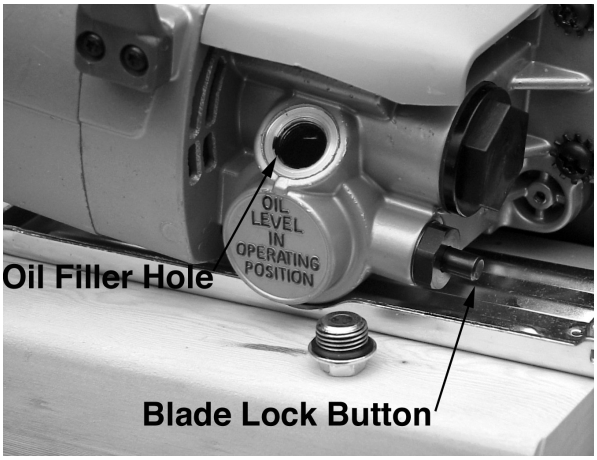


Fig. 2-4 Skilsaw Oil Plug

Direct Drive (Sidewinders)

Sidewinders are the most popular model of circular saw. Because of their light weight, they are ideal for anyone doing less than major construction jobs. The motor housing sits perpendicular to the blade, with the blade and the motor aligned alongside each other for a compact profile.

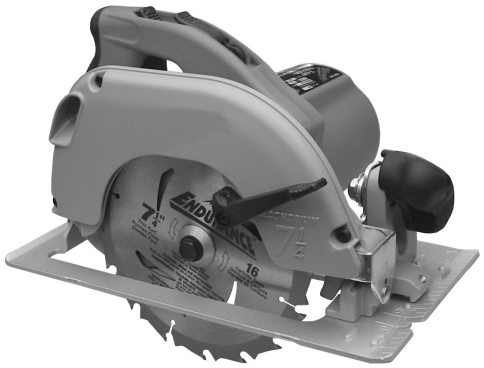


Fig. 2-5 Sidewinder

The initial sidewinder saw that was developed had the motor mounted on the right-hand side. Manufacturers were hoping to keep the blade on the left-hand side (like the worm drive) so the (right-handed) user could actually see the blade and the line of cut. The early motors were large and heavy and as the saw approached the end of a cut, the weight of the saw dropping down and to the right could either split or crack the wood. To help eliminate this problem, the manufacturers mounted the motor on the left side and the blade on the right. This allowed the weight of the saw to sit on the piece of material being cut rather than on the cut-off side

Blade Left/Blade Right

If you are left-handed and want a circular saw with the blade on the right, you have to use a sidewinder saw. If you are right-handed and want a circular saw with the blade on the left, you can use either a sidewinder or a worm drive. Sidewinder saws generally can be found in both right blade and left blade model. On the other hand, worm drive saws made by major manufacturers today are made only with the blade on the left.

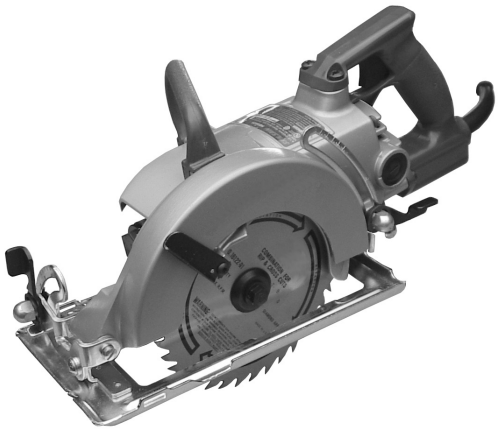


Fig. 2-6 Left Blade

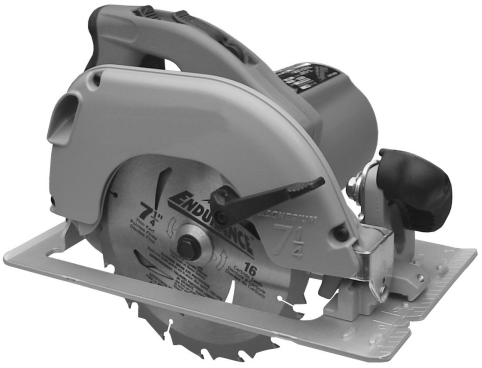


Fig. 2-7 Right Blade

THE POWER OF THE MOTOR

The more powerful the motor fitted to a saw, the bigger the jobs you can do. Generally speaking the larger the blade and the deeper the cut, the more power needed to complete the job safely.The power of an AC / Corded saw is measured by the amperage of the motor. Generally the more amps the motor uses, the more powerful the saw. Motors on corded electric circular saws range from about 6 amps to more than 15 amps.

The power of a DC / Cordless saw is measured by the volts of the battery used. Generally the more volts the motor uses, the more powerful the saw. Motors on cordless electric circular saws range from 9.6 volts to 24 volts.

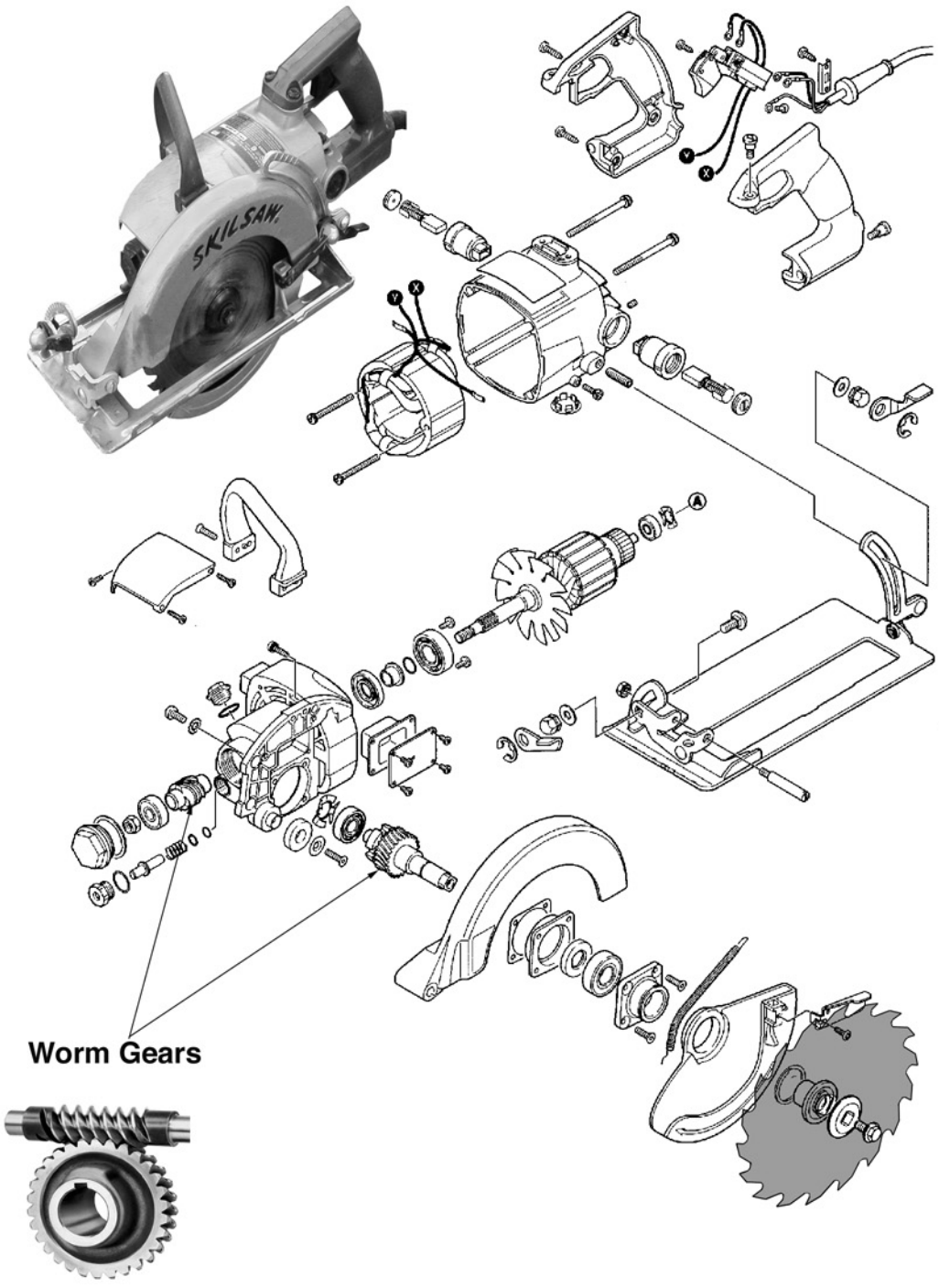


Fig. 2-8 Worm-drive Parts

Sidewinder or Direct Drive Circular Saw

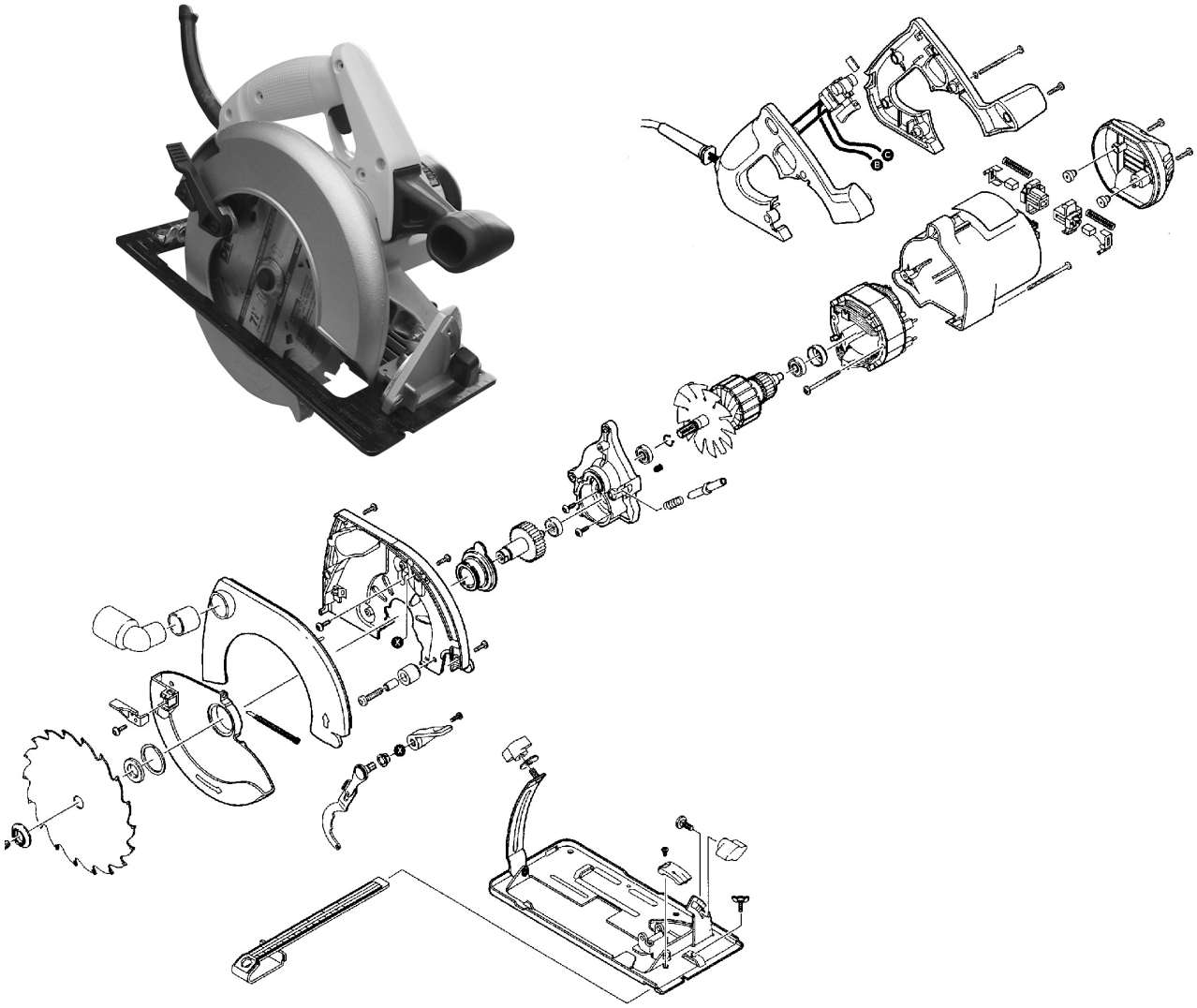


Fig. 2-9 Sidewinder Parts

Fig. 2-10 Makita Label - Cordless

Fig. 2-11 Porter Label - AC

Corded / Cordless

If your job is large and tough, you probably should use a corded electric circular saw. The corded saws can range from four inch trim saws all the way to sixteen inch beam saws. If your needs include more than a six and one half inch blade, then you should seriously consider a corded saw. If your needs can be satisfied with a blade six and one half inches or smaller, then you may be able to use a cordless saw.

SAW BLADES

The most important part of a saw is the blade. Without a good blade, a circular electric saw is about as useful as a hand saw. Less expensive blades are made from steel. Stronger and more durable blades are cast from steel with carbide tips. Regardless of the material, the key to proper use lies in choosing the right blade for the job. The second key lies in making sure that whatever blade you use, the blade is sharp.

Choosing the Correct Blade Type

RIP

A rip blade is used when sawing a board in the direction of the board's grain. This blade generally has the fewest number of teeth (16 to 20 on a 7 $^{1}/_{4}$″ blade). These blades will generally leave a very rough cut and should be used mostly with softwoods.

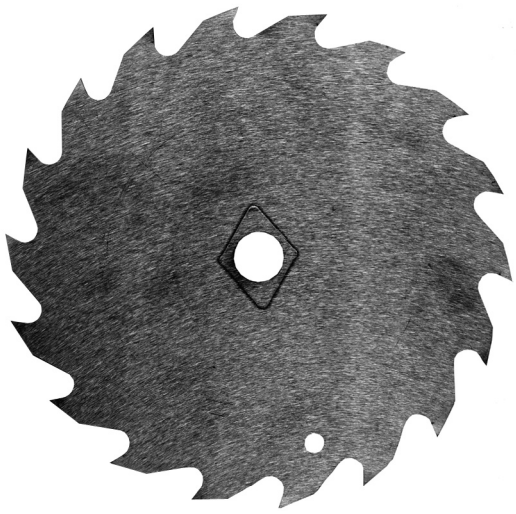


Fig. 2-12 Rip Blade

CROSSCUT OR CUT OFF

A crosscut or cut off blade is used when cutting across the grain of the board. This blade generally has more teeth than a rip blade (as many as 60 teeth on a 7 $^{1}/_{4}$″ blade) These blades will generally leave a smooth cut and can be used with both softwoods and hardwoods.

Fig. 4-13 Crosscut or Cut Off

COMBINATION

A combination blade, as it's name implies, is used for both ripping and cross cutting lumber. This blade uses both large and small teeth. (24 to 28 on a 7 $^{1}/_{4}$″ blade) and the teeth are of average size. These blades will generally leave a very rough cut and should be used mostly with softwoods.

Fig. 4-14 Combination

FINISH

A finish blade is used when cutting veneered plywood paneling used for cabinets or paneling, and trim (both softwood and hardwood). This blade has a mass of tiny teeth (as many as 150 teeth on a 7 $^{1}/_{4}$″ blade). These blades cut slowly without splintering.

Fig. 4-15 Plywood Blade

Fig. 2-16 Hollow Ground Blade

CARBIDE TIPPED BLADES

Carbide tipped blades come in any of the above configurations and are used in similar fashion. The major advantage of the carbide tipped blade is that it will not dull as fast as a steel blade. Special carbide tipped blades can also be used to cut non-ferrous metals (such as aluminum, brass copper and lead), ferrous metals (such as steel and iron), fiber-cement, plastic and nail embedded wood.

Fig. 4-17 Carbide Blade

ABRASIVE BLADES

These blades are used for cutting stone, concrete, ceramic tile and metals. Rather than teeth, this blade has an abrasive edge that literally grinds through material.

Fig. 2-18 Abrasive Metal

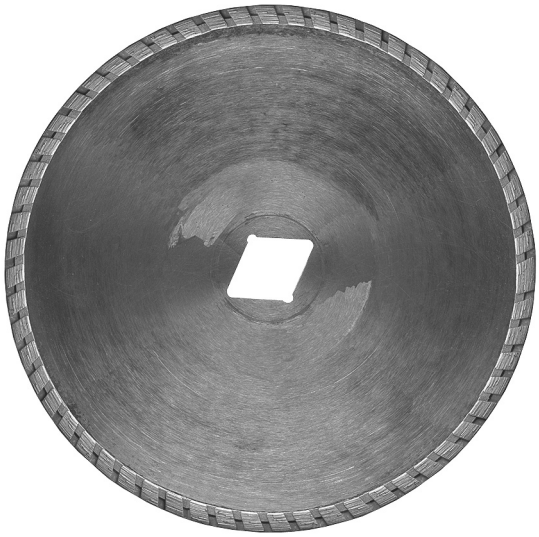


Fig. 2-19 Dry Diamond Blade

Sharp Blades

A dull or damaged blade slows the speed of cutting, places a heavy load on your saw motor, and can cause kickback. Blades become dull even from cutting regular lumber. Pay attention to both the feel and the sound of your tool. If you find yourself forcing the saw forward to cut instead of just guiding it through the cut, chances are the blade is dull or coated with wood pitch. You can also hear when the blade is getting dull as the noise from your saw becomes noticeably louder. Never use a circular electric saw with a dull blade. Always change the blade when you feel or hear that it is getting dull.

Tooth Designs

The teeth on circular saw blades can be sharpened by grinding the teeth in one of the following ways:

ALTERNATE TOP BEVEL TOOTH GRIND
For cross cutting and ripping in all woods. The tooth top is alternately beveled at a 15 degree angle to the blade axis.

TRIPLE CHIP GRIND
For cutting non-ferrous metals and plastic. Alternate tooth design where one tooth is ground with a square top, and the next has both corners beveled at 45 degrees. A dual cutting action is created whereby the beveled tooth acts as a router and is followed by the square top tooth which finishes and cleans the cut.

FLAT TOP TOOTH GRIND
For heavy-duty cutting.

TRI-GRIND
Combination of Alternate top bevel with Flat Top Grind. This is used mostly for cutting very hard material, plastic, metal, particle board and cement composition board.

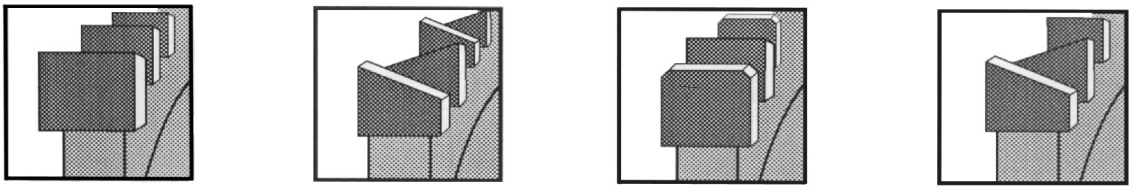
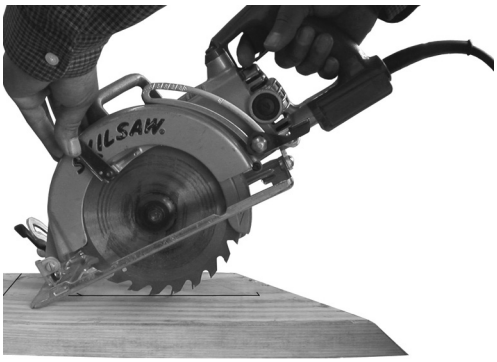
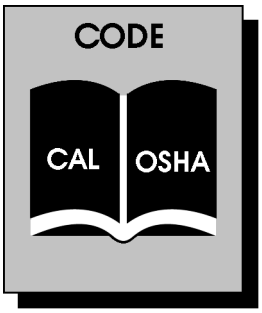


Fig. 4-20 Tooth Designs

The circular electric handsaw is a safe tool when used and maintained in a safe condition. The saw is easy to use, but is a potential hazard with the blade whizzing around at a few thousand revolutions per minute. Always make sure that all of the safety features are working properly before using any circular electric saw. Never disable the blade guard. Handle the tool safely. Eye and ear protection should be used at all times. Always be aware of the position of the blade in relation to your body. The blade in a circular electric saw will do severe damage if it comes in contact with any part of your body.



Never disable the lower Blade Guard



California General Industry Safety Orders

Article 59; 0
Section 4307 Portable Power Driven Circular Hand Saws.
(a) The teeth on the upper half of the blade shall be permanently shielded from contact.
(b) The lower half (point of operation) of the saw blade shall be guarded to the root of the teeth with a telescopic or hinged guard that, for normal operation, opens up as the saw is fed into the cut and automatically returns to the position covering the saw teeth when removed from the cut.
(1) Telescopic guards shall be equipped with a lifting lug or lever, remote from the blade teeth, that will permit the operator to safely shift the guard for starting unusual cuts.
(2) Saws with hinged guards shall be equipped with 2 handles so arranged that neither hand is exposed to the hazard of the rotating blade. One handle shall be on the hinged guard, and of such design that its use will avoid exposure of the hand or fingers between the retracted guard and the blade.
(c) Guards shall not be prevented from operating automatically by pins, wedges, or other devices that hold them back in an inoperative position.
(d) Saws with hazardous defects, such as damaged guards or switches, shall be removed from service until repairs are complete.

SUMMARY

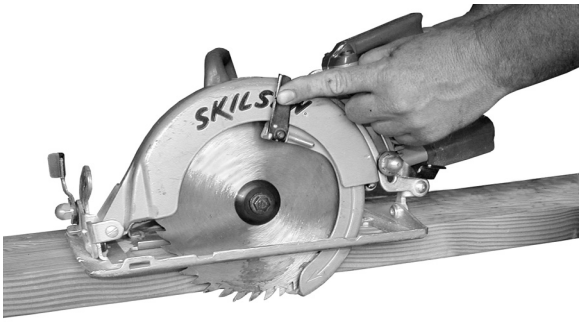
The portable electric circular saw changed the way carpenters work. Productivity on construction sites has skyrocketed due to the circular saw. Imagine what work would be like if we had to use a handsaw everywhere we now use the portable electric circular saw. This "almost indispensable" tool almost revolutionized carpentry.

Along with the gain in productivity has come an increase in injuries due to unsafe work practices. Always use the safety features built into the circular saws. Use your personal protective equipment (PPE), including eye protection, ear protection and dust masks if needed.

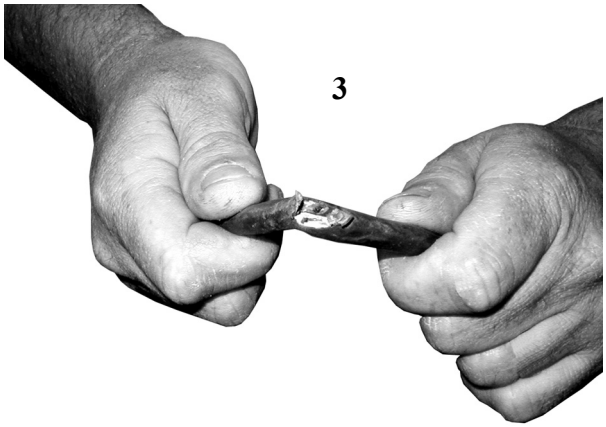
SKILSAW PRACTICE

1. Take a saw from the tool box and carefully inspect the following items:

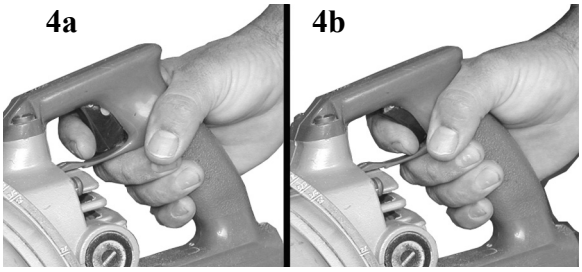
- Make sure that the lower blade guard operates properly. Lift the lower guard lift lever with your finger. Does it close immediately when released?



- Check the cord for possible damage. Are there any cuts abrasions or exposed wires?



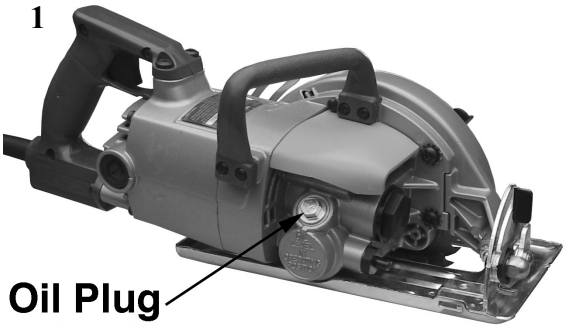
- Check that the trigger works properly. Does the saw start when you press the trigger? And more important, does the saw stop when you release the trigger?



2. Check the oil level before using the saw:

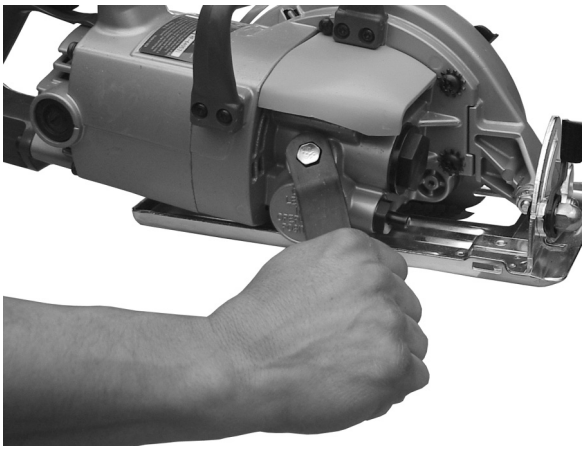
- Locate oil plug.

1



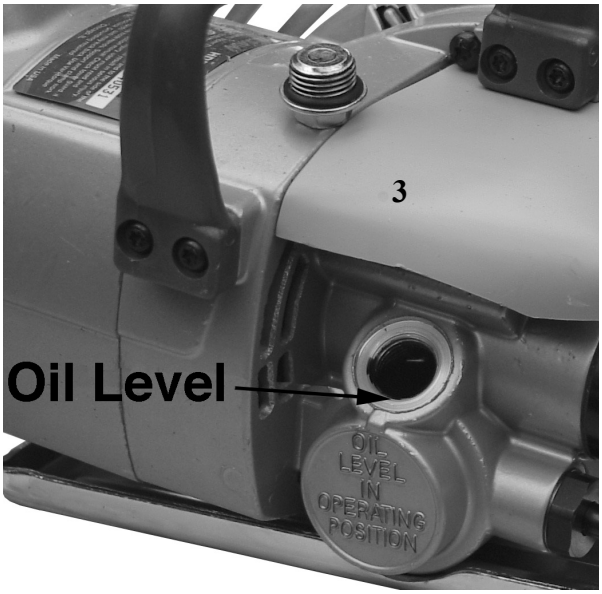
- Use blade wrench to remove plug.

2

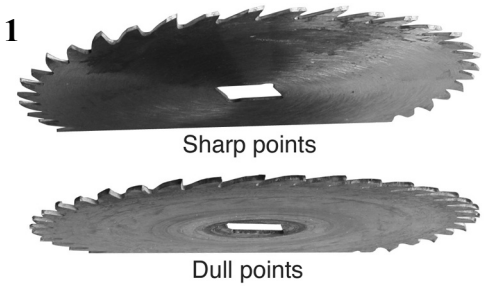


- With saw sitting level and flat - oil should be at the edge of the filler hole.

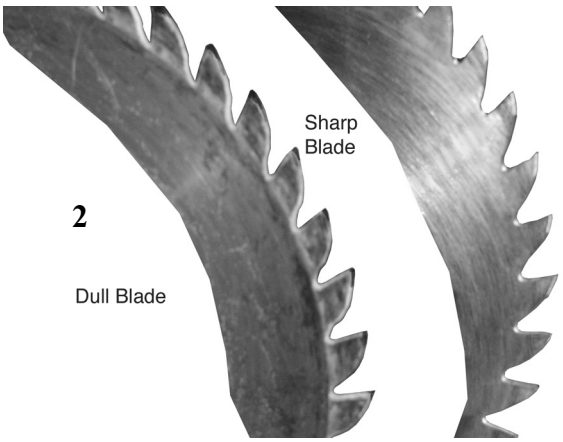
3



3. Carefully examine the blade for sharpness.

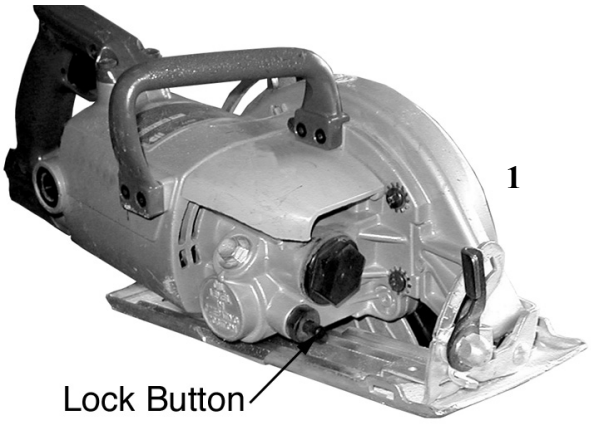


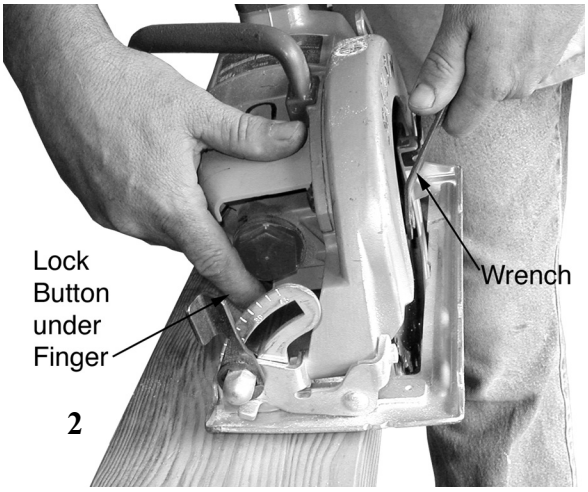
- Examine the blade tips or points.
- Look for sharp, bright points on a sharp blade.
- Look for rounded, dark points on a dull blade.
- If visual inspection leaves you unsure, next make a practice cut, listen to the sound and feel the effort needed to push the saw through the board.



4. If the blade is dull, remove the blade from the saw and replace it with a sharp blade.

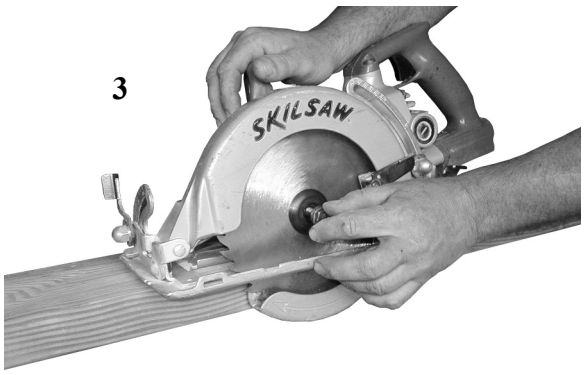
- Hold in the lock button while using a wrench to turn the “blade stud” clockwise to remove it.





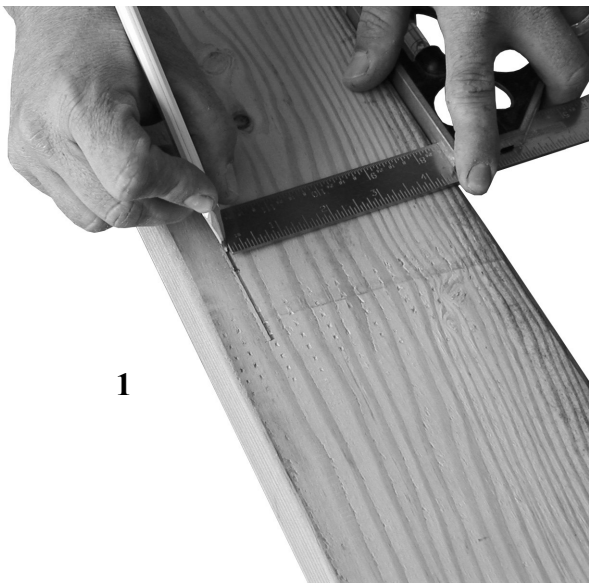
2

- Remove the dull blade and replace it with a sharp blade. The teeth on the blade should face the front of the saw on the bottom of the blade.



3

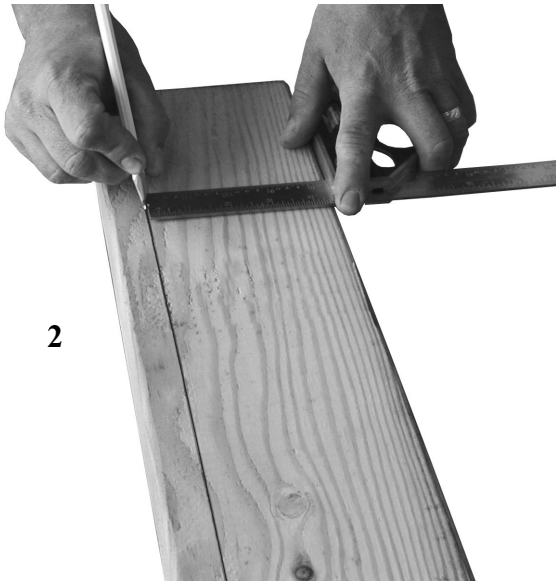
5. Take an 8′ 2x6 and cut it into (2) two 4′ pieces, take one of the 4′ 2x6's and rip the board down to 4 $^{1}/_{2}$″.



1

- Using your square and a pencil, mark a line 4 $^{1}/_{2}$″ from the edge of the board.

- Continue the line down the entire length of the 2x6.



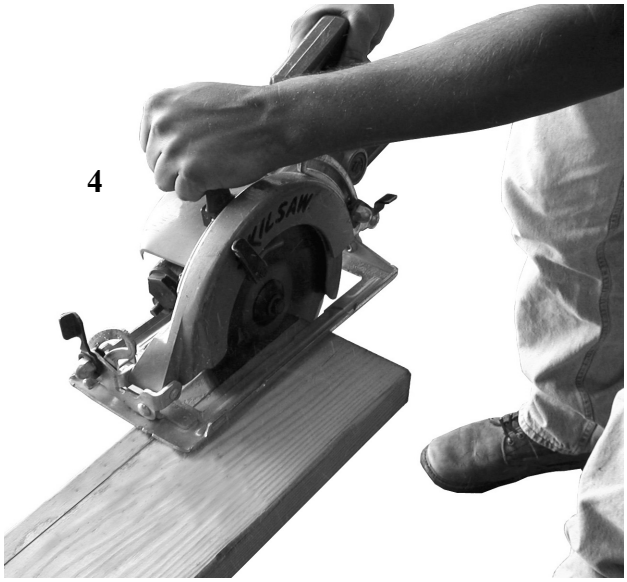
2

- Adjust the blade on your saw for the correct depth-of-cut. Teeth should be $^{1}/_{8}$ inch below bottom of material.

3

- Carefully follow the line and rip the 2x6 down to 4 $^{1}/_{2}$″.

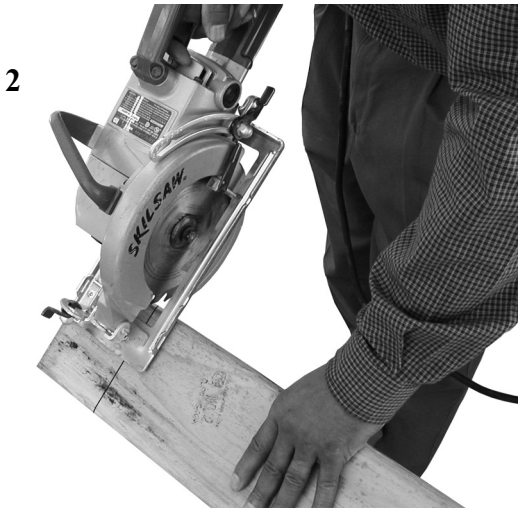
4



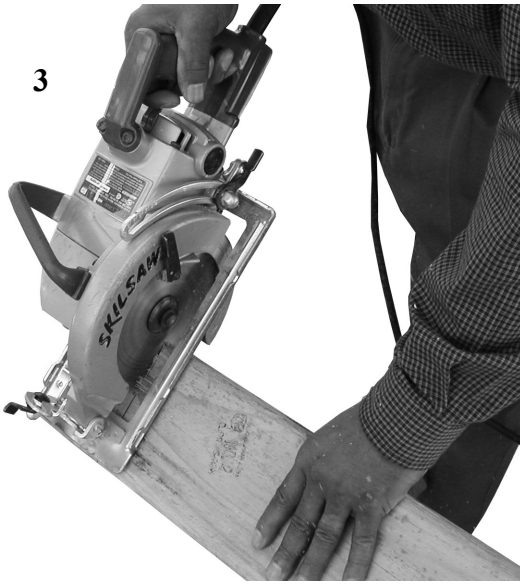
6. Layout and make a square cut several inches from one end of the other 2x6″ x 4′ board.


1

- Lay out the square cut with combination square or speed square.

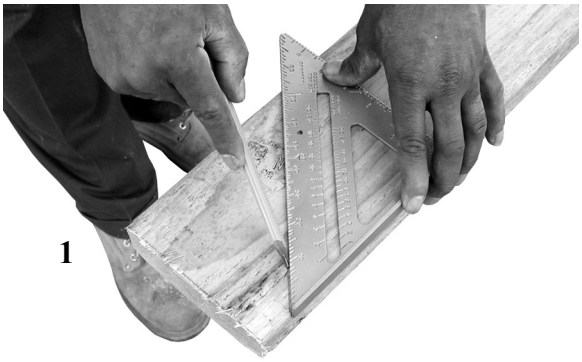

2

- Line up the saw with the square line. (Notice the operator has tilted the saw so that the cut is made going down).


3

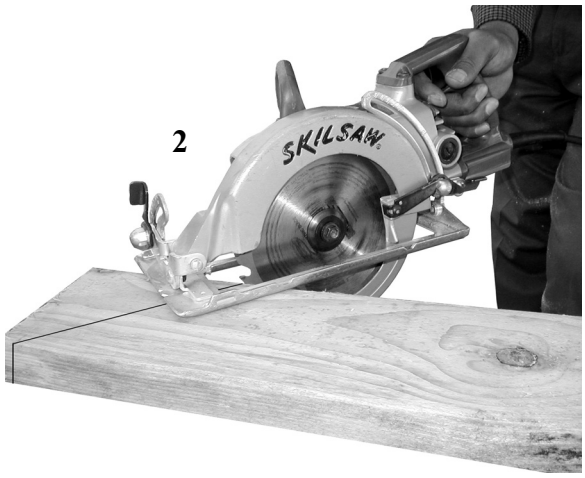
- Cut the line with your saw. (With the board tilted, gravity moves the saw and your job is to stay on the line).

7. From your square cut, measure 18″ (+ -) 1″. Layout and make a 45 degree miter cut on the 2x6″ x 4′ board.



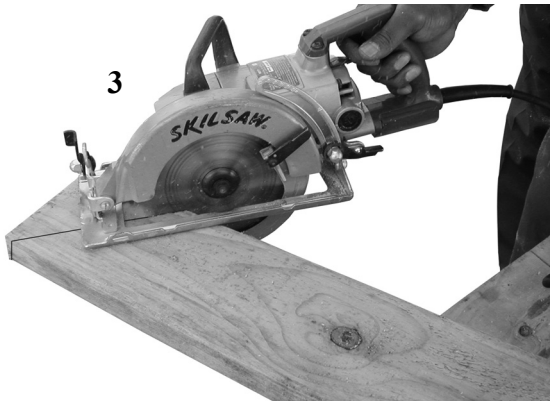
1

- Layout miter cut with combination square or speed square.



2

- Line up saw with layout line.



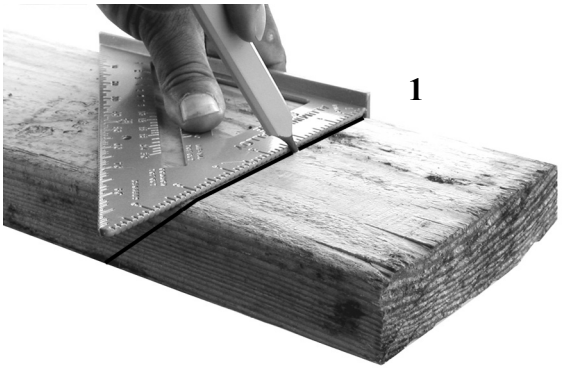
3

- Cut the layout line.

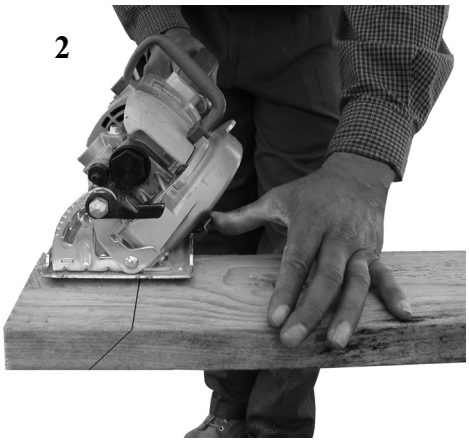
4

- Follow the line all the way through.

8. Layout and make a bevel cut several inches from one end of the 2x6 board.


1

- Layout the bevel cut with combination square or speed square.


2

- Line up the saw straight with the layout line.


3

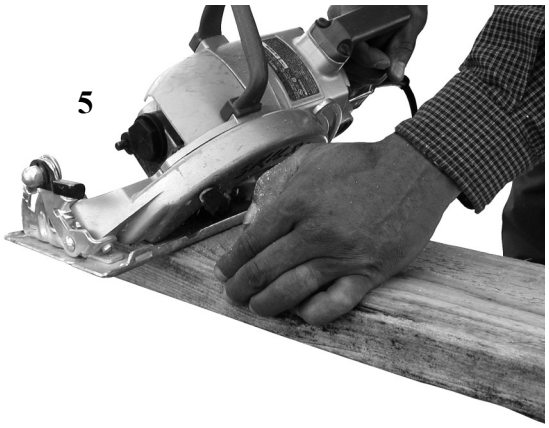
- Make sure the saw table is flat on the board and the blade is straight with the layout line.

- With your free hand, raise the blade guard with the lifting lever.

4

- Carefully follow the layout line all the way across the board.

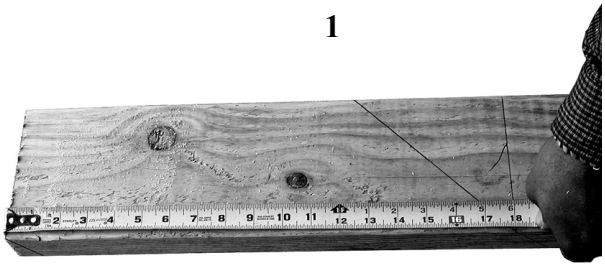
5



9. From your bevel cut, measure, layout and make a compound miter cut on the 2x6 board.

- Measure 18″ from the long point on the bevel cut to the long point of the compound miter cut.

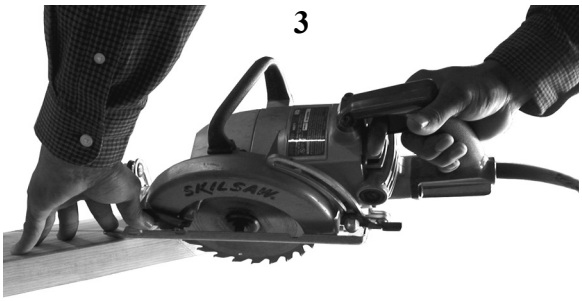
1



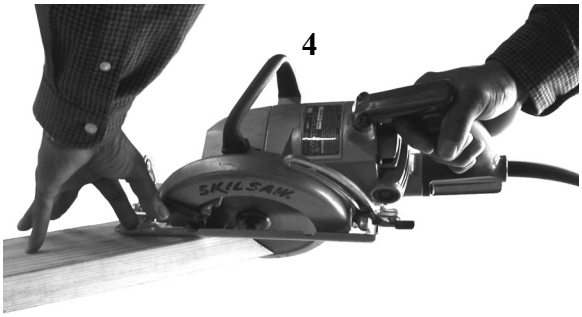
- Layout the compound miter cut with combination square or speed square.

2

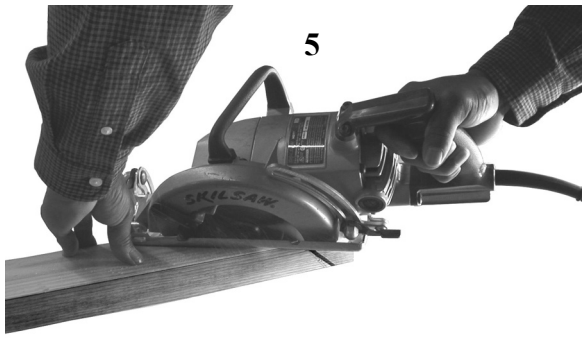
- Align the saw so that it is straight with the layout line. Lift the blade guard with the guard lifting lever.



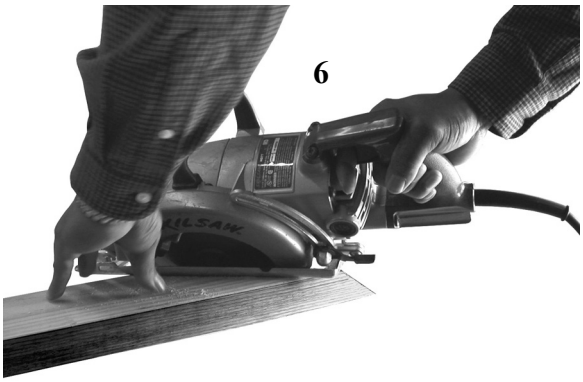
- Follow the layout line straight across the board.



- Keep your hand and fingers away from the moving blade.



- Hold the saw still after completing the cut until the blade stops moving.



10. On the 2x6 board with the compound miter and bevel cuts, measure, layout and make a 9" plunge cut.

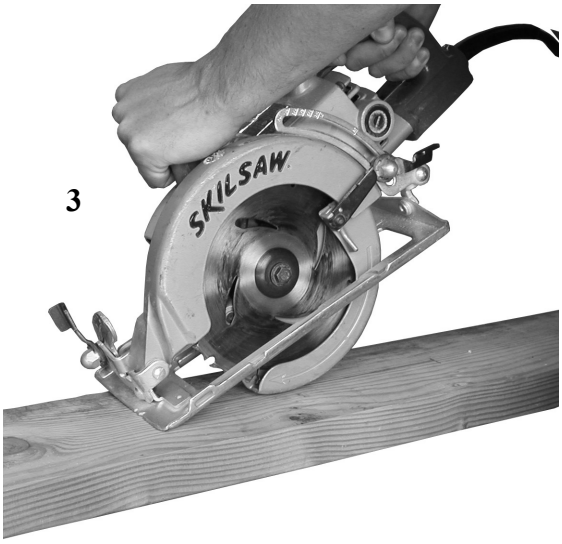
1

- Center the plunge cut in the board.

2

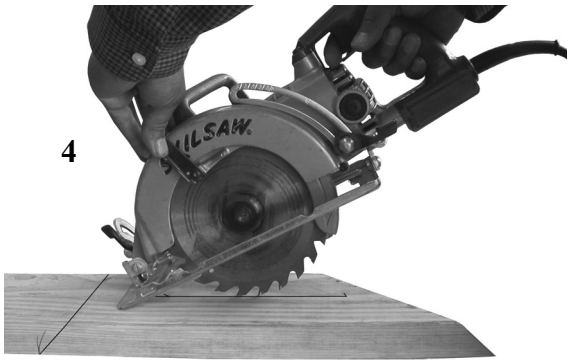
- Set the depth adjustment according to the material being cut.

3



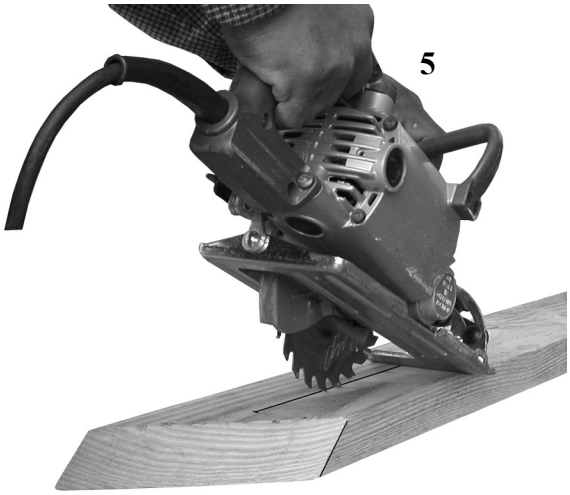
- Tilt saw forward with the blade lined up with the line you've drawn.

4

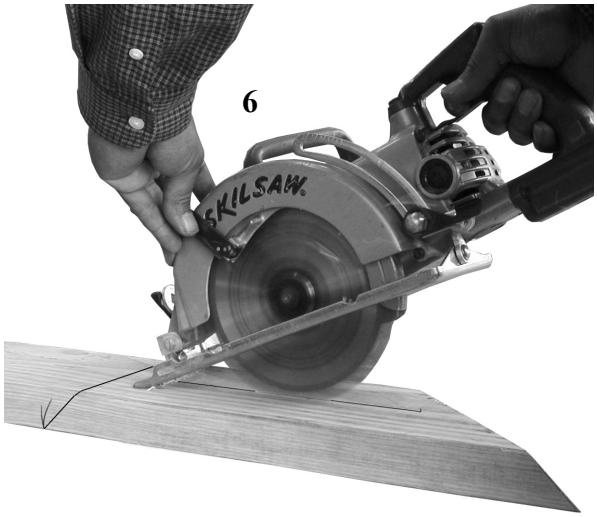


- Raise the lower guard, using the lift lever and hold the saw by the rear handle.

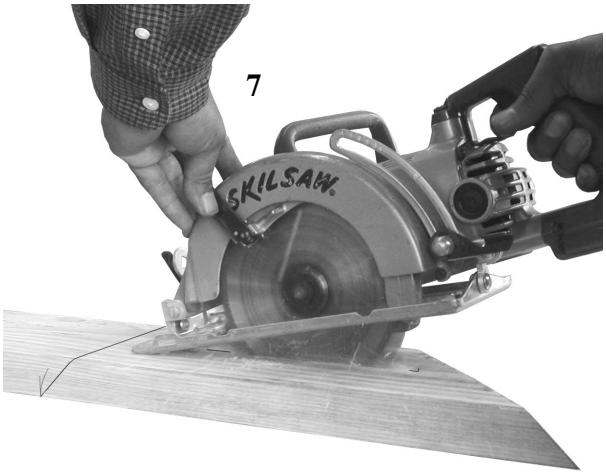
- With the blade just clearing the material to be cut, start the motor.



- Gradually lower the back end of the saw using the front end of the foot as the hinge point.



- As the blade starts cutting the material, release the lower guard immediately.



DO's&DONT'sDO's&DONT'sDO's&DONT'sDO's&DONT'sDO's&DONT'sDO's&DONT

USING A SKILSAW

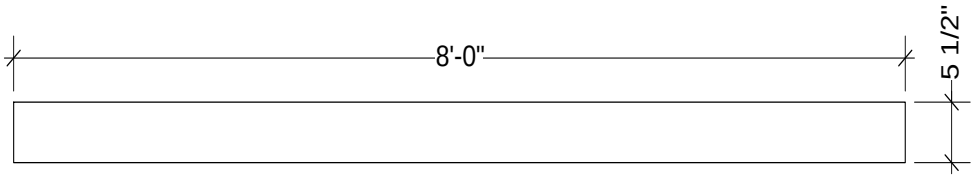
Do's

- Do keep you work area clean.
- Do stay alert, watch what you are doing and use common sense when operating a power tool.
- Do use safety equipment, always wear eye protection.
- Do replace damaged tools or cords immediately.
- Do keep your hands away from cutting area and blade.
- Do check the lower guard for proper closing before each use.

Don'ts

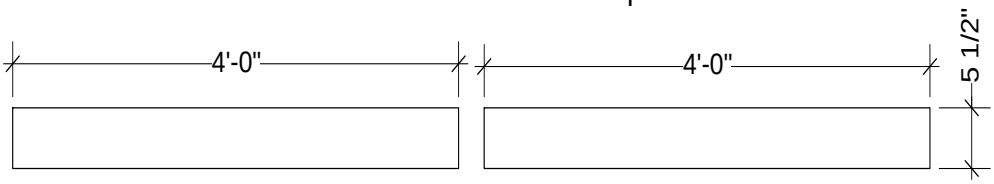
- Don't operate power tools in explosive atmospheres, such as in the presence of flammable liquids, gases or dust.
- Don't use the tool while tired or under the influence of drugs. alcohol or medication.
- Don't wear loose clothing or jewelry.
- Don't expose power tools to rain or wet conditions.
- Don't abuse the cord. Never use the cord to carry the tool or pull the plug from an outlet.
- Don't reach under the work.
- Don't use dull or damaged blades.
- Don't cut over your foot or your leg. Use a saw horse.

Practice Exercise



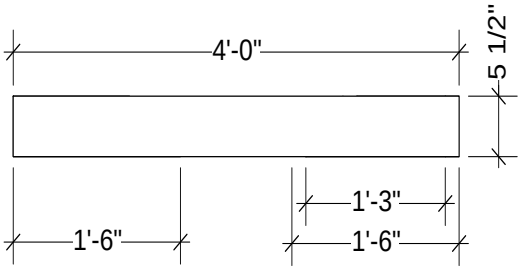
Plan View

Cut the 2 x 6 into two 4'-0" pieces

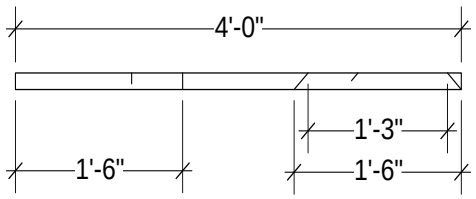


Plan View

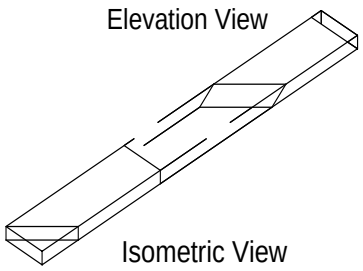
Cut one of the 4'-0" 2 x6 into two pieces



Plan View

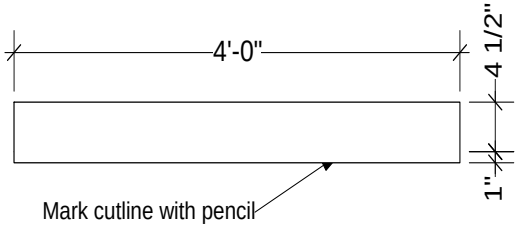


Elevation View

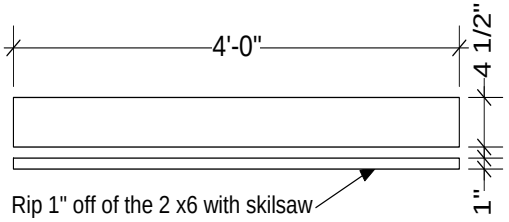


Isometric View

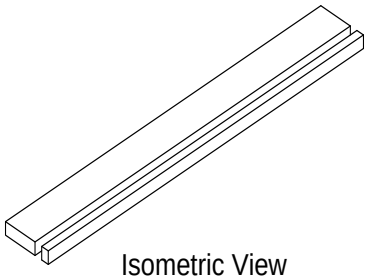
Rip one of the 4'-0" 2 x6 down to 4 1/2"



Plan View



Plan View



Isometric View

NOTES:

Chapter 3 Cordless Drill/Impact Driver

Cordless tools have changed much of the jobsite. As batteries improve and cordless tools become lighter and easier to use, cordless tools will take the place of many corded tools. Cordless drills and drivers are now common in the work place and modular installers probably will use a cordless drill for most installation operations. We will discuss these cordless drills

Cordless drills are manufactured by most of the major toolmakers. While there are some minor differences, the basic functions are very similar. The drill is power by rechargeable batteries, which range from 9.6 volts to 36 volts. The batteries are usually Nickel cadmium or, more commonly, lithium ion. The lithium batteries have been replacing the Ni-Cad because they do not contain any liquid and therefore do not leak. They are also much lighter, recharge faster and have more power.

The drill will come with a charger to recharge the battery. Generally, there are lights on the charger that indicate that the battery is charging and also when the battery is fully charged. The lights vary on individual models, so the user must be familiar with the charger that is being used. Most batteries can be fully charged in one hour, some can charge in as little as 15 minutes. In most cases, having two batteries insures that the tool will be able to run uninterrupted.

Most cordless drills will have many or all of the following features. The variable speed switch controls the speed at which the tool will drill. The trigger controls the speed, the more you squeeze the trigger, the faster the tool will operate. Use lower speeds for starting holes without a center punch, drilling in metals or plastics, driving screws or any other applications that require high torque. Higher speeds are better for drilling wood and wood products.

The forward/reverse button changes the direction of the tool. It is usually located in a place that the operator can change direction with one hand. The motor should be stopped before switching the direction. If the button is left in the middle it locks the tool in the off position.

Torque is the amount of force that the drill exerts when it is rotating. There is a numbered ring on the drill that adjusts the amount of torque. The lower the number, the less torque. Higher numbers increase the torque and are used to drive larger fasteners. The clutch will slip at various levels, so driving a trial screw will help determine which torque setting is needed. When using the tool to drill, there is generally a drill symbol on the tool. Switching the tool to this symbol will lock the clutch for drilling and there will be no slippage of the clutch.

Cordless drills usually come with a speed control switch, which allows the drill to be switched between a slower (1) and faster (2) speed. The lower speed is used when driving screws while the faster speed is used for drilling operations.

The chuck is essentially a vise that holds the bit or other accessory tight in the drill. Cordless drills come with a keyless chuck, that is, there is no key inserted into the chuck to tighten or loosen it. To insert a bit, rotate the chuck until it is open enough to insert the bit. Next, tighten the chuck by holding the rear half of the chuck while rotating the front half.

When using the drill to drive screws, select the speed and torque to match the planned operation. Insert a magnetic tip holder into the chuck and use the appropriate screw tip.

Screwdriver tips come in different sizes and, if the proper tip is not used, there is a chance the tip will slip and mar the head of the screw. This is unacceptable in applications where the screw is visible, also if the screw is damaged, it could be difficult to drive the screw in or, remove the screw if needed to.

In modular systems installation, many different types of screw bits are used, covered here are the most commonly encountered.

Phillips---this common screw head was created as a solution to the problems associated with the slotted screw. The tip fits into a recessed socket shape in the head of the screw and eliminates much of the slippage common with the slotted screws. Phillips come in different sizes, most common are #1, #2 and #3 (the larger the number, the bigger the bit). The bits are often labeled with a P or PH. Phillips are often criticized for stripping out at lower torque levels than other "cross head" designs.

Robertson (square)---This common screw head is square-shaped with a slight taper to the bit and the same taper in the screw. It retains a screw better than Phillips, which makes it easier to use. Square headed tips are self-centering, they will stop a cordless from stripping it out (when the torque on the drill is set properly) and they can be removed even when they are old and rusty.

Torx (star drive) ---This screw head is shaped like a star with six rounded points. It is popular because it is resistant to stripping out, has an extended bit life and reduces operator fatigue because it minimizes the need to bear down on the drive tool to prevent stripping. There is a tamper resistant security Torx head that has a small pin inside the recess.

Hex----This screw head has a hexagonal recess and may be driven with a hex screwdriver, also known as an Allen wrench or Allen key.

Nut driver---This is used to drive screws with a protruding hex head.

Phillips, square bits and allen bits come in different lengths for certain situations. The allen bits (hex) come in standard and metric sizes, so it is important to have a variety of the allen bits. It is good practice to keep a number of the more common sizes and types of bits in case one breaks. The knowledge of the correct bit is important to properly drive the screw.

The cordless impact driver; delivers a stronger rotational and downward force than does the cordless drill. This is a great tool, but if not used correctly, it could cause damage to the fastener, either stripping or breaking the fastener. Best suited for driving concrete anchors and large fasteners. This driver has a ¼' hex drive quick release anvil (chuck), which makes inserting the bit quicker. The cordless impact driver is a small, light, and compact tool, ideal for tight spots. The impact has many of the same features as the cordless drills, but it will not accept round drill bits due to the lack of a vice type chuck.

The cordless drill and impact have benefited the modular installer by saving time and allowing for the freedom of movement that not having a power cord provides.

Chapter 4 Drill Motors and Rotary Hammers

- **What are drill motors and rotary hammers?**
- **What are the hazards of drill motors and rotary hammers?**
- **What are the different types of bits used with drills and rotary hammers?**

INTRODUCTION

Carpenters drill holes in three types of materials: wood, steel, and concrete. Compressed air and electricity turn drills. However, electricity, either corded (AC) or cordless [battery], is the most common power source. Pneumatic drills have limited use in special applications. In addition to the hazards of electrical tools, drills possess hazards unique to their operation and use. Drill is one of those construction words that has a dual meaning. Carpenters refer to the cutting tool as a drill [drill bit]. They also call the tool that turns the bit a drill (drill motor).

DRILL MOTORS

There are there four sizes of electric drill motors used in general construction, $^1/_4$ inch, $^3/_8$ inch, $^1/_2$ inch, and $^3/_4$ inch. The numbers indicate the size of the drill bit shank inserted into the drill motor. The larger size drill motors are heavier, turn slower and supply more torque [power to bore a hole]. Drill motors have a keyed chuck to hold the drill bit. They also have triggers [on/off switches] and forward/reverse switches. Some models have speed control triggers. Many drill motors have a detachable side handle that helps to control the tool. It is good safety practice to use the side handle.

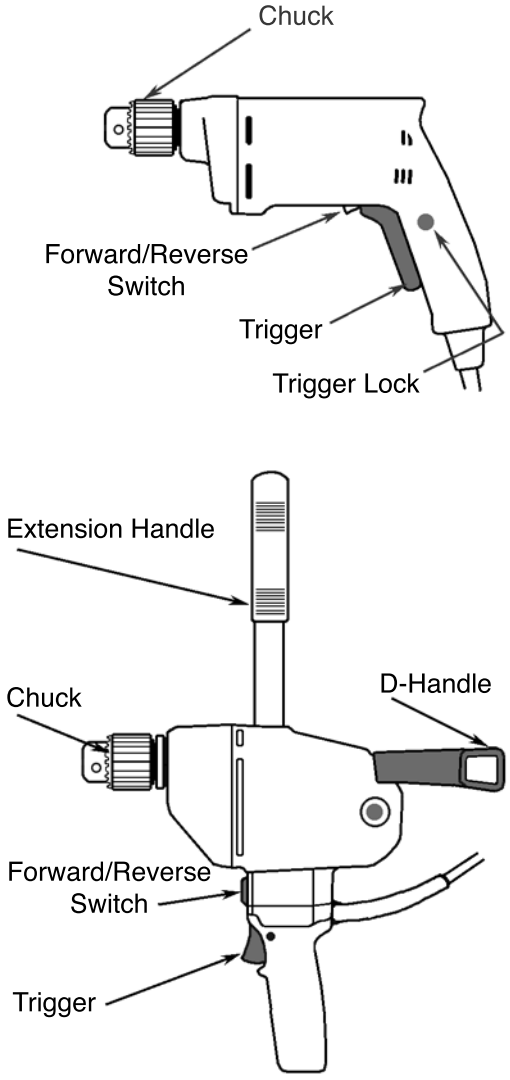


Fig. 1 Drill Motors

DRILL MOTOR HAZARDS

In addition to the hazards connected with any power tool use, the are hazards particular to drill motors.

- Chips, dust and shavings

  Drill bits produce wood chips, sawdust, and metal shavings.

  Always protect your eyes by wearing safety glasses.

- Keyed chucks

  The drill is secured in the drill motor with a chuck. The chuck is tightened around the drill bit shank with a chuck key.

  Always disconnect the power before inserting or changing a drill bit. Fingers entangled in a chuck key, drill bit, and rotating chuck will suffer major injury.

- Exposed cutting edges

  There is no effective way to guard the cutting edges on the drill bit.

  Do not start the drill unless it is in contact the work.

  Drill bits also have screw tips, spiral shape or projections that can entangle clothing and hair.

  Do not wear loose clothing.

  Confine long hair.

- Pinched drill bits (kickback)

  If a drill bit binds in the hole, the drill motor will turn in the opposite direction. The carpenter may not have enough strength to stop the rotation. You fingers, hand, or arm can be jammed between the tool and another object. Or you could be thrown off balance.

  Increase your control by using an side handle to increase your leverage on the tool.

  Use caution and drill at a slower speed when drilling into wood with knots or nails.

  Also use caution when drilling steel as the bit can bind when it punches through.

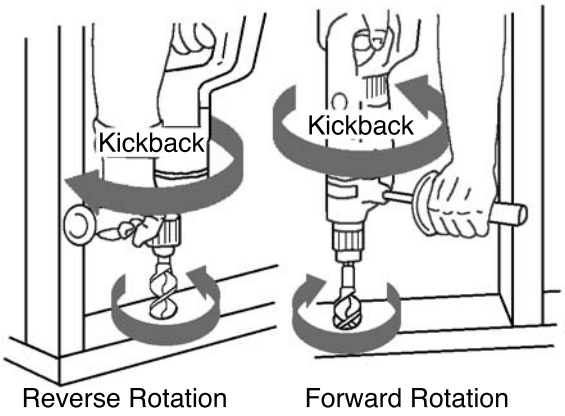


Fig. 2 Kickback

DRILL BITS

There is a large number of bit styles and sizes available to the carpenter. High speed steel drill bits are use to drill both steel and wood. Auger, ship's auger and paddle (spade) bits all work well in wood. Self-feed bits and holesaws are commonly used for large diameter holes.

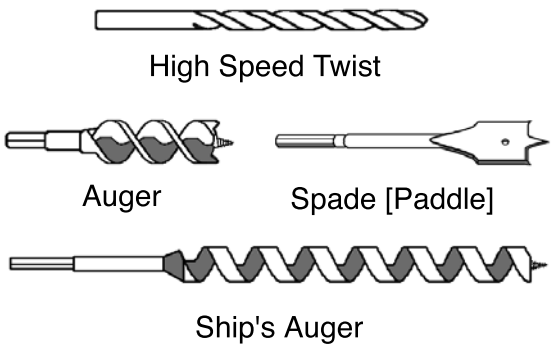


Fig. 3 Drill Bits

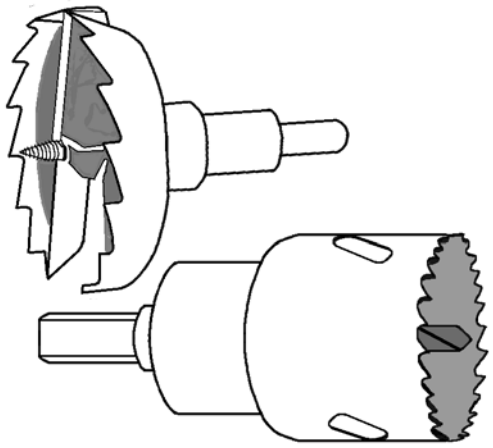


Fig. 4 Self Feed Bit & Holesaw

selector that toggles between drill only and hammer-drill operation, a variable speed trigger, extenuation handle and a depth gauge.

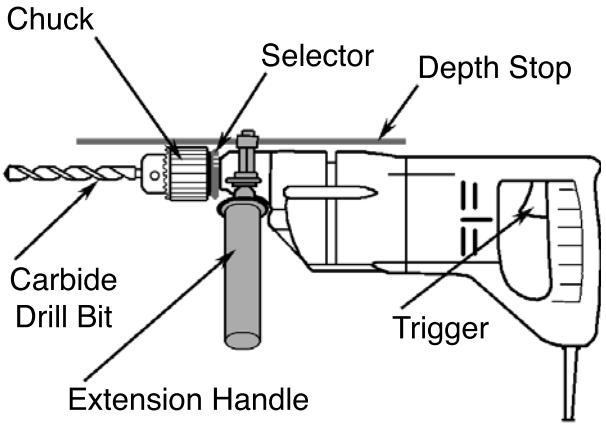


Fig. 5 Hammer Drill

ROTARY HAMMERS AND HAMMER DRILLS

An electric drill works well for drilling holes in wood or metal. However, a hammer drill or rotary hammer is the tool of choice for drilling concrete and masonry. Hammer drills and rotary hammers not only spin; but they add a hammering action. Rather than cutting the concrete they methodically pulverize it.

Hammer drills use a standard keyed chuck with round shank bits. In the drill only mode they can be used to drill wood and metal. In the hammer-drill mode they drill concrete. There are two factors that affect the drilling speed of a hammer drill. They are rotation speed and pressure against the work surface. The greater the pressure the greater the hammering action. However hammer drills produce a fairly low impact compared to rotary hammers and are useful for drilling small holes (up to $^{3}/_{8}$″ diameter) at high speed. Hammer drills come with a chuck that accepts round shank bits, a

Rotary hammers are too slow to drill wood and metal, so they are used on concrete and masonry only. A rotary hammer uses a motor driven piston to bring about a more violent hammering action than the hammer drill. The action is independent of operator pressure. The bit is engaged by the weight of the tool against the work surface (a welcome feature when drilling on an overhead or vertical surface).

Depending on the model, the rotary hammer can be used to drill holes up to 1 $^{3}/_{4}$ inch in diameter and core holes up to 6 inches in diameter. In the rotary hammer, the chuck is replaced with a tool holder which has locking mechanism to prevent the bit from falling out. Also, the tool holder eliminates bit slippage because it accepts a splined or grooved bit shank see Fig. 10 on page 95. The selector permits the operator to use drill, hammer or hammer-drill mode. Rotary hammers also come equipped with variable speed triggers, side handles, and depth gauges. Because rotary hammers generate an intense hammering

action and eliminate bit slippage, they drill faster than hammer drills.

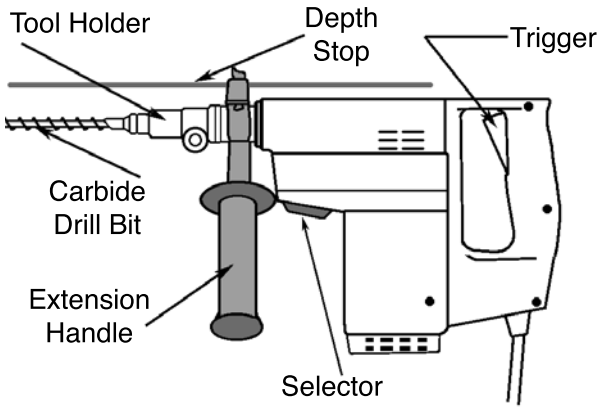


Fig. 6 Rotary Hammer

ROTARY HAMMERS AND HAMMER DRILLS HAZARDS

- Concrete chips and dust

  Drilling with a carbide bit produces concrete dust and chips.

  Always protect your eyes by wearing safety glasses with side shields.

  Protect your lungs with respiratory protection.

- Pinched drill bits (kickback)

  Concrete is usually reinforced with a web of steel reinforcing bars. A carbide bit may jam against the edge of the steel bar and stop turning. The power tool will kick back as described above.

  Always use an extension handle (side handle) to restrain of the tool.

- Noise

  The racket of rotary hammers and hammer drills pounding on concrete can damage your hearing.

  Wear hearing protection such as ear plugs or muffs whenever you work with or around these tools.

- Vibration

  The rapid, repetitious vibration of the hammer drill and the rotary hammer will take its toll on the carpenter's arm and upper body,

  Wear padded gloves, change body and hand position frequently and take breaks as necessary to reduce the wear and tear on the body.

- Utilities

  There may be electrical, water or gas lines buried in a concrete wall, floor or deck. Cutting into these utilities can cause electrocution or explosion.

  If drilling or cutting cannot be avoided; turn off the electricity, shut off and drain gas and water pipes.

Fig. 7 Personal Protective Equipment

MASONRY DRILL BITS

Either carbide steel tips or diamond chips provide the cutting edge of concrete and masonry bits. Carbide steel is more common,. Diamond drill and core bits are used on specialized machines that are used to cut large diameter holes.

The carbide drill bit has a piece of tungsten carbide steel welded to the end of a spiral rod. The carbide steel pulverizes the concrete and the spiral rod removes the material from the hole.

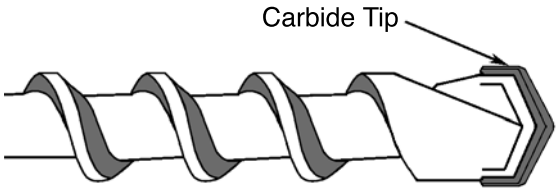


Fig. 8 Tungsten Carbide Bit

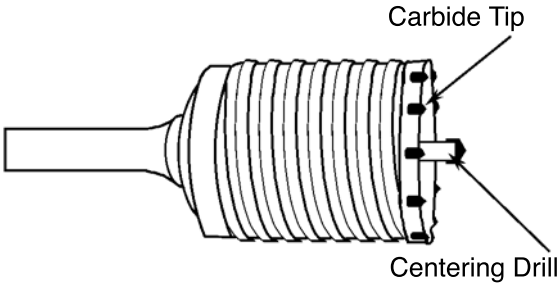


Fig. 9 Core Bit

The concrete core bit is a cylinder with a series of carbide teeth welded to the end see Fig. 9 on page 95

The core bit is guided by a centering bit. It cuts a circle in the concrete to form a plug rather than removing all of the material. This lets the operator to drill a large diameter hole.

There three types of bit shanks. Check the manufacturer's operators manual for the correct drill shank for the tool. Using the wrong bit shank can damage the bit, the tool, or both. Hammer drills use a round shank, must like a twist drill. Rotary hammers use a splined shank or a SDS (slotted drill system) shank. They are not interchangeable.

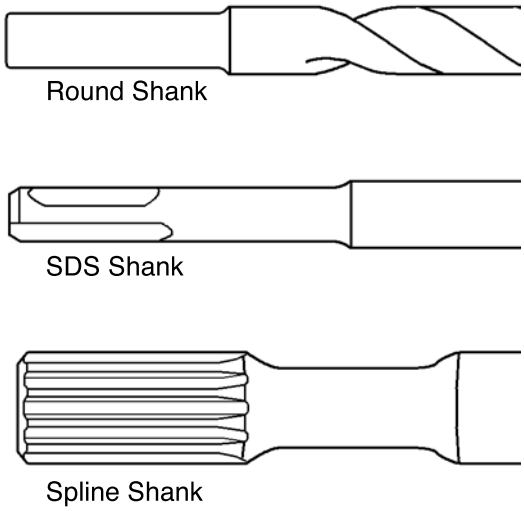


Fig. 10 Drill Shanks

SUMMARY

Drill motors are used to drill holes in wood and metal. Hammer drills and rotary hammers are used to drill holes in concrete. It is up to the carpenter to select the correct tool and drill bit for the job. Kickback, chips, dust, and noise are some of the hazards of these tools.

NOTES:

Using Drill Motors and Rotary Hammers

INTRODUCTION

In this lesson you will use drill motor and rotary hammer to fasten a piece of wood to concrete.

LESSON OBJECTIVES

At the end of this lesson the student will be able to safely use a drill motor and rotary hammer to fasten a wood sill to concrete with an anchor.

SPECIFIC OBJECTIVES

On completion of this lesson the student will be able to:

1. Given a drill motor and rotary hammer, identify their parts.
2. Given a drill motor and rotary hammer, identify their hazards and safety features.
3. Given a drawing, drill motor, rotary hammer, bits, and materials; safely attach to a wood sill to concrete with a wedge anchor.

APPLICATION IN THE FIELD

During new construction, remodeling and retro-fitting, carpenters are called upon to anchor (fasten) wood structural members to concrete. If the fastener was not present in the concrete, then some type of wedge anchor often used. This work involves drilling holes $^{1}/_{2}$ inch diameter or larger in both wood and concrete. The carpenter must be able to select the correct bit and tool for each material, safely use the drill, and install the anchor.

EVALUATION

Each student will be evaluated on their participation in the construction, the quality of their work, and the score on the post test. A post test will be administered after the lesson is completed.

REFERENCES

1. Student Lesson Book

EQUIPMENT

To be supplied by the training facility (per 20 students)

1. Three (3) $^{1}/_{2}$ inch electric drill motors
2. Three (3) Rotary hammers
3. Three (3) Skilsaws
4. Six (6) Saw horses
5. Six (6) Extension cords
6. Three (3) 10″ adjustable wrenches.

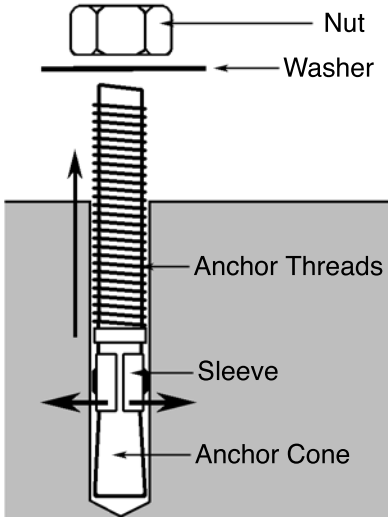
STUDENT TOOLS

1. Hammer 16 - 20 oz.
2. Set nail bags or overalls
3. Measuring tape 1″ x 25′
4. Pencil
5. Combination square or speed square
6. Utility knife

INTRODUCTION

Wedge anchors are commonly used to fasten a wood sill [bottom piece of a wood stud wall] to a concrete floor or wall. This task requires the use of a drill motor and rotary hammer along with the suitable drill bits.

FASTENERS



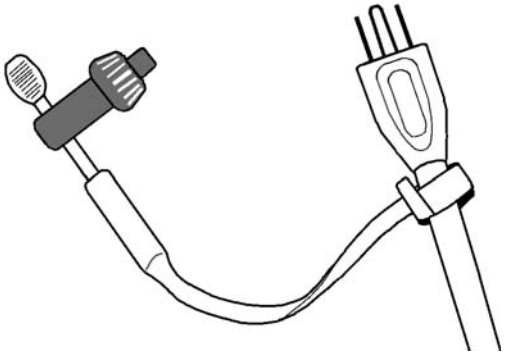
Wedge anchors use friction between the concrete wall of the hole and the anchor.

Tightening the nut on the anchor threads will pull the anchor up out of the hole.

As the anchor body moves, the cone at the bottom is forced into the sleeve.

The sleeve expands against the hole, wedging the anchor against the concrete.

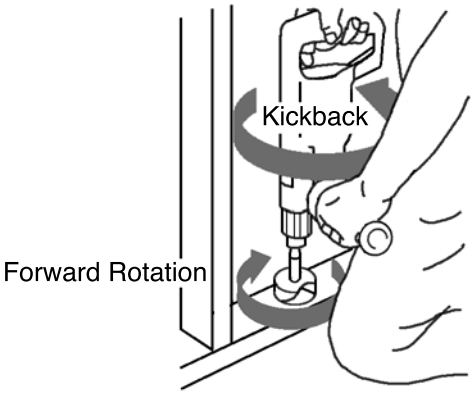
DRILL MOTOR SAFETY



- Unplug the drill before changing bits.

  Remove the chuck key before starting the drill.

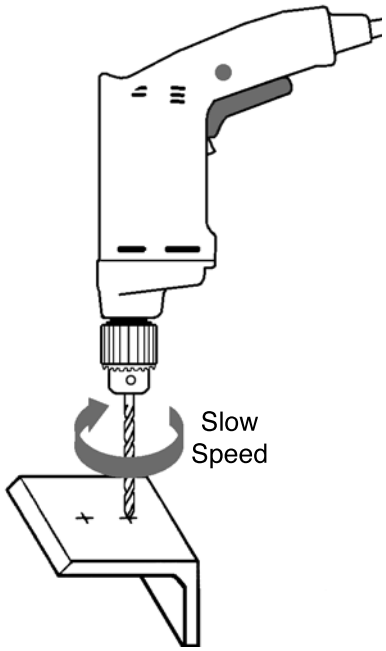
  Use the side handle whenever possible.



- Brace the side handle when there is a risk of kickback.

- Clamp or secure small pieces of material before drilling.

  When drilling harder materials use a slower drill speed.



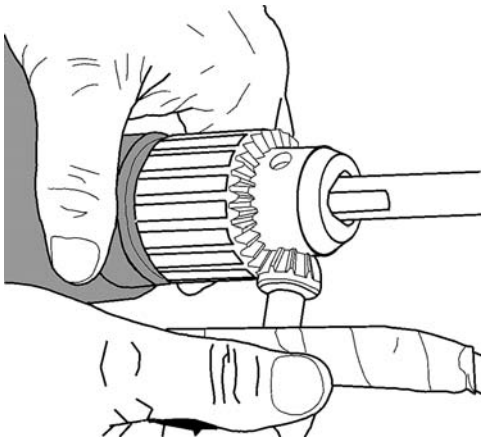
ROTARY HAMMER SAFETY

- Hold tool by insulated gripping surface when tool may come in contact with hidden wiring or its own cord.
- Be sure the bit is secured in place before using.
- Wear ear protection
- Use a metal detector to determine if there are gas or water lines hidden beneath the concrete surface.
- Always use the side handle for maximum control over torque reaction or kickback. Never attempt to use this tool with one hand; always use two hands.
- Always wear eye protection with this tool.
- Use thick cushioned gloves and limit exposure time to vibration.
- Position the cord clear of the rotating bit. Do not wrap the cord around your arm or wrist.
- Avoid burns. Do not touch the bit or other parts immediately after use.

DRILL MOTOR USE

Select drill bit.

Hole in wood must be $^{1}/_{16}$″ larger than anchor diameter.



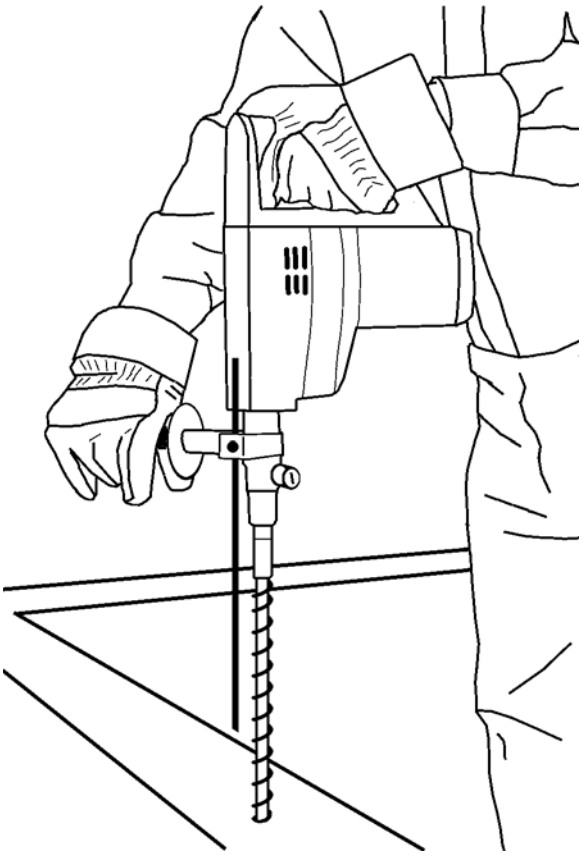
Open the chuck jaws and insert bit.

Lift bit $^{1}/_{16}$″ above the bottom of the chuck to avoid damage to chuck screw.

Hand tighten to align the bit

Put the chuck key in each of the three holes in the chuck and turn clockwise.

ROTARY HAMMER USE



Check the condition of the general condition of tool, cord, and trigger (should start and stop when trigger is squeezed and released).

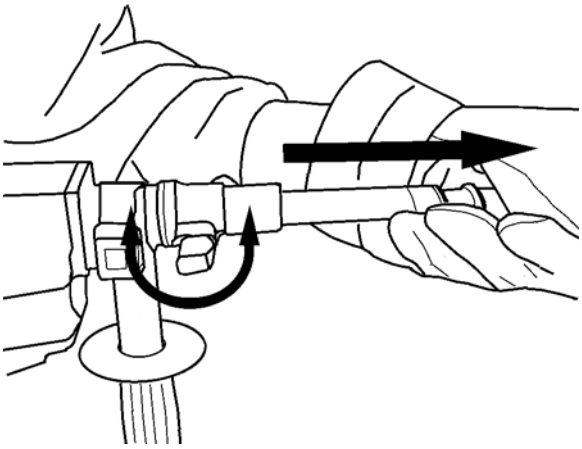
Install side handle.

Choose the correct carbide bit (look on the anchor carton for the bit diameter).

Install carbide bit in tool holder and lock.

Tug on bit to be sure it is firmly inserted and will not fall out.

Set depth gauge if used.



INSTALLING WEDGE ANCHORS

Assemble the project.

Layout hole 6 inches from the end of a 2x4

Drill hole

Place drill point on layout and start drill slowly

Push on drill motor so the drill “bits” into the wood

Increase drill speed

Keep the drill perpendicular to the wood

Slow drill as it exits the backside of the material

Switch the drill motor off, then to reverse and back out of the hole

Mark 2x4 - 12 inches from the end

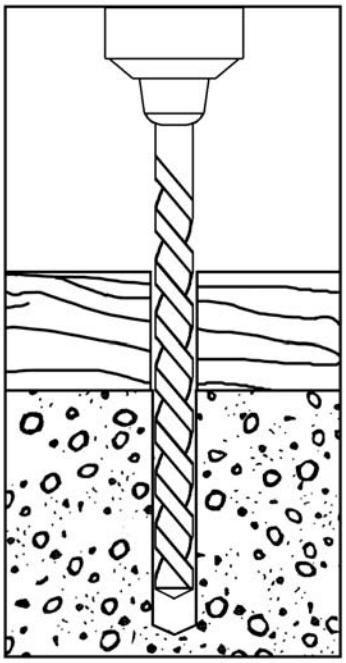
Cut 2x4 to length

Drill hole in concrete for anchor by inserting masonry bit through hole in the wood.

Start drilling at low speed and gradually increase the speed. This lets you start cleanly and keeps the drill from skipping sideways.

Drill hole while maintaining light pressure on tool and keeping a firm grip on the side handle.

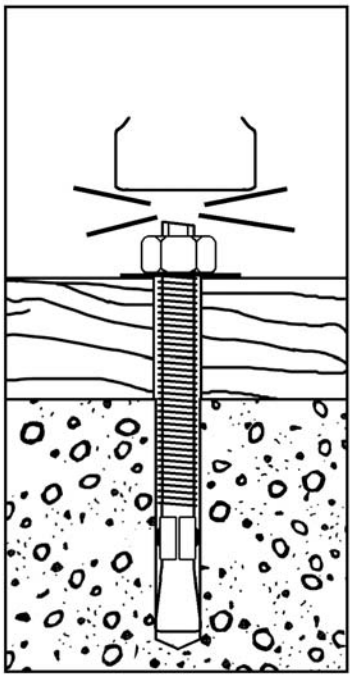
Clean concrete dust from the hole with a syringe.



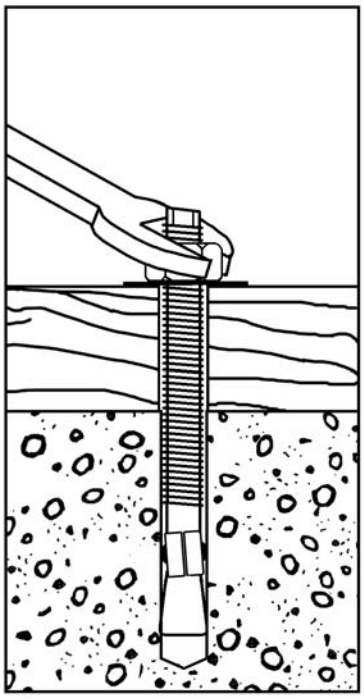
Assemble wedge anchor and nut.

Leave the nut flush with the end of the anchor to protect the threads.

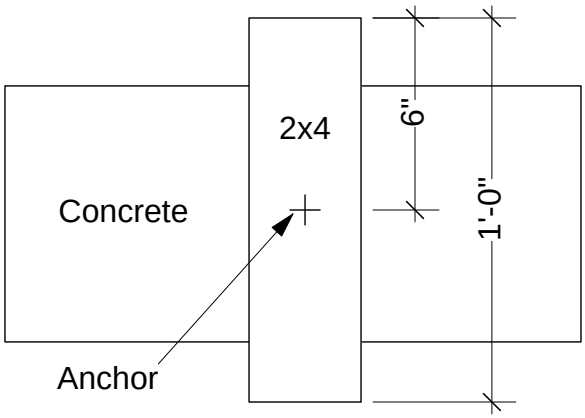
Drive the anchor through the material to be fastened until the washer is tight to the surface of the material.

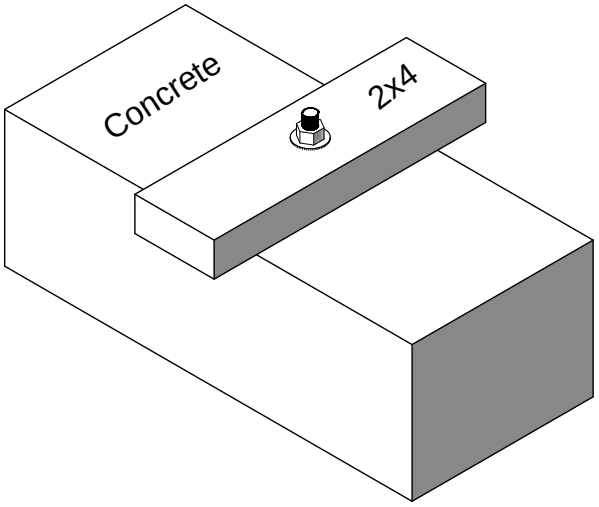


Expand anchor by tightening the nut four to five turns past the hand tight.



Practise Exercise





CARPENTERS TRAINING COMMITTEE FOR NORTHERN CALIFORNIA	Installing Wedge Anchors	*Date:* 03/18/03	Sheet 1 of 1	
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USING DRILL MOTOR & ROTARY HAMMER

INSTRUCTIONS:

Use the check list to verify you have completed each step of the electric drywall screwdriver lesson.

Your instructor will use the check list to verify that you have correctly completed each step.

Use the material, tools, the student lesson book and the check list to build and assemble the project.

Checklist -Using Drill Motor & Rotary Hammer

		Student	Instructor
1.	Student can identify the drill motor & rotary hammer parts and describe their function	_____	_____
2.	Student completed screwdriver safety check	_____	_____
3.	Student drilled hole in sill $^{1}/_{16}''$ greater than the anchor diameter and in proper location	_____	_____
4.	Student completed rotary hammer safety check	_____	_____
5.	Student safely drilled hole in concrete	_____	_____
6.	Student secured sill to concrete	_____	_____
7.	Anchor passes pry test	_____	_____

NOTES:

Concrete Anchors

Modular installation often calls for concrete anchoring. Typical modular items that get anchored to the floor, walls or ceilings, are file cabinets, floor to ceiling wall systems, shelving, benches, ganged and individual seating and a variety of partition screens. In medical facilities, almost all items need to be secured to the floor and many to the walls as well. The type of anchor used is usually specified by the engineer, if that is the case, do not substitute another anchor. While there are many different types and manufacturers of anchors, there are some basic procedures that need to be followed:

- The hole needs to be drilled straight (vertical). If it is drilled at an angle, the anchor may not work.
- Clean the drilled hole of concrete dust, any dust acts as a lubricant and it will not allow the anchor to grab tight.
- Set the anchor without damaging the threads. Some workers ruin the threads by mushrooming the top of the anchor and compressing the threads.

The dust that is produced when drilling into the concrete contains silica, so precautions need to be taken to minimize the dust. This could mean keeping the dust down by watering the area or using a hepa filter vacuum.

Another potential safety hazard when drilling into concrete is drilling into rebar, plumbing or electrical conduits. These can catch your bit and twist the drill violently from your hands. Post tensioned slabs pose a great risk given the tensioning cables are under thousands of pounds of pressure. Post tensioning cables should be marked by the contractor.

ANCHORS

Concrete Lag Shield---This is a two-part fastener. A hole is drilled the length of the anchor plus 1/2". Clean the hole and drive the shield into the hole until flush with the concrete. Next, insert the lag screw through your material and into the shield and tighten.

Drop-in Anchor---This is a one-piece anchor. A hole the size of the outside diameter is drilled and thoroughly cleaned and wire brushed. The depth of the hole is equal to the length of the anchor. If the hole is too deep, the anchor will not engage. The anchor is then dropped in the hole and hammered down with a driving tool that is compatible with the anchor.

When the anchor is firmly driven down, insert the bolt through your material and into the anchor and tighten.

Wedge anchor (red head) ----This is a one piece anchor with a nut and washer. Drill a hole the same size as the outside diameter of the anchor. The depth of the hole should be the minimum embedment, plus the thickness of the material plus the nut and the washer. Clean the hole thoroughly. The anchor is then inserted through the material, and driven down. Be careful not to damage the threads. Tighten the nut to the desired torque.

Tapcon----This is a one-piece anchor with a hex head or a Phillips head. The length of the screw should be the material thickness plus the desired embedment, it is recommended that the hole always be at least 1/4" deeper than the embedment. The masonry bit needs to be correct size for the screw size, for instance, a 1/4" screw needs a 3/16" hole. Once the hole is drilled, clean the hole thoroughly. Next, insert the pointed end through the material and into the hole, and then use a nut driver or a Phillips #3 tip to drive the screw down until snug. Be careful not to overtighten the screw.

Powder actuated drive pins---This is a steel pin that is shot from a powder actuated gun. The pin comes with a washer that is usually fastened onto the pin, this helps to cinch down the material. The pin must be long enough to go through the material and be embedded the proper amount. The depth that the pin is embedded is determined by the power load that used with the powder actuated gun. Always test the depth by starting with the lightest load of shot and increase the load until the right depth is attained.

Hilti Kwik Hus EZ---This is a one-piece anchor that is similar to the Tapcon. The length of the anchor is figured as the thickness of the material plus the embedment. The hole should be at least 3/8" deeper than the length of the screw. The hole drilled should use a bit that is the same as the outside dimension of the anchor. Once the hole is drilled it needs to be thoroughly cleaned. The anchor is inserted through the material and then screwed down, usually with an impact driver.

There are other types of concrete anchors; they all are variations of those we covered above. With most anchors you only get one chance to put it in and have it grab correctly, so it is important to follow the installation instructions carefully. The most common installation problem is not cleaning the hole properly, so be sure to blow it out, or wire brush it or vacuum it to remove the dust. As with any task, the more times you install anchors, the more efficient you will be.

NOTES:

Chapter 5 Portable Band Saw

When you need to cut metal on the job site, a good option is to use a portable band saw, often times known as a portaband. These saws come in both corded and battery powered, and they also come in different capacities. The saw has a continuous blade that loops around two parallel pulleys and slices through the material; the blade should be sharp for effective cutting.

There are several safety concerns when using the portable band saw, the main one being that the blade is exposed. You should be wearing eye protection and hearing protection and you should avoid any loose clothing or jewelry that could get caught in the moving blade. The material that you are cutting should be secured, usually with a clamp, because the blade can cause the material to spin or rotate. Additionally, be aware that the blade and the material being cut will be hot, so allow them to cool before handling.

The tool is a freehand tool, that is, it doesn't have a fence like a miter saw. It takes practice to be able to make square cuts. You should use both hands while cutting. Place the saw against the material before you turn it on and use light pressure to cut. Let the saw do the work, do not force the tool or it will break the blade or stray off of your cut line. Use a slow speed for harder metal and a faster speed for softer material. When you reach the end of the cut, the material may flex or bend, putting more pressure on the blade. To compensate for this, slow the pace of the cut. Once you are through the material, release the trigger and allow the blade to come to a stop before putting it down. Keep debris from your work area.

The portable band saw is a useful tool to use for cutting metal on the job, including drapery components and wall system components.

NOTES:

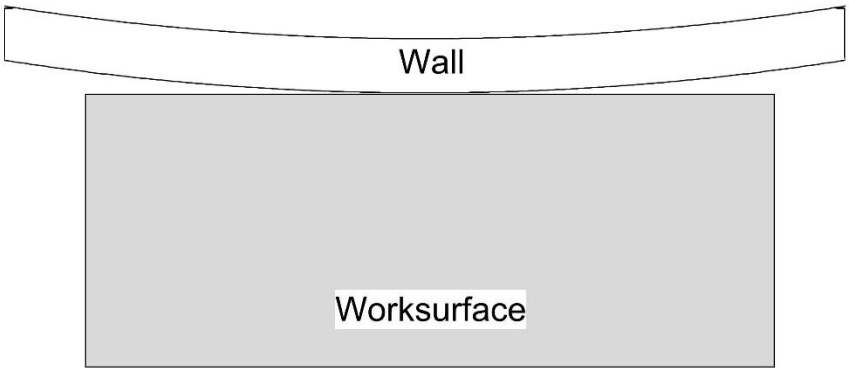
Chapter 6 Portable Belt Sander

The portable belt sander is excellent for shaving down the edge of a work surface, for example, when scribe cutting around columns, or curved walls. The size of the sander is determined by width and length of the sanding belt; they can range from 2” to 4” wide and 21" to 24" long. Different from a vibrating sander, the belt sander has a more powerful motor with a rotating abrasive belt. The belt sander has two handles; a trigger handle and a front handle, as it can be difficult to control due to the strength of the motor. The belt sander has a directional arrow that shows which way the abrasive belt should go on. The abrasive belt usually comes in three different grits, fine, medium and coarse. The belt also has a directional arrow to indicate which way to install the belt. If the belt is installed backwards, it will tear. The belt is installed by loosening the belt tension lever (which moves the tracking roller), slipping the belt over both rollers and then tightening the tension lever. Turn the sander on and adjust the belt so that it does not rub against the inside of the sander. The cord of the sander can be a hazard if it comes in contact with the belt, so the operator must take care to keep the cord out of the way. The belt sander shaves down the material on the back stroke. When the sander is in contact with the wood surface, it should remain moving to avoid sanding a groove or unwanted deep impression. When the belt sander is running, keep your fingers and hands clear from the edge of the abrasive belt, it can cause serious injury.

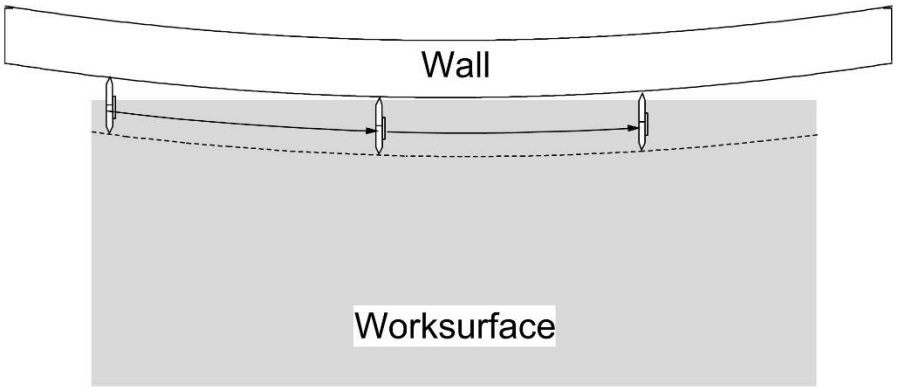
Scribing

When installing worksurfaces, there are times when the worksurface will need to be scribed and planed to fit tight against a wall or another surface. The process of scribing means that edge of one piece is cut or sanded to match the irregular surface of another surface. Here are the steps involved in scribing.

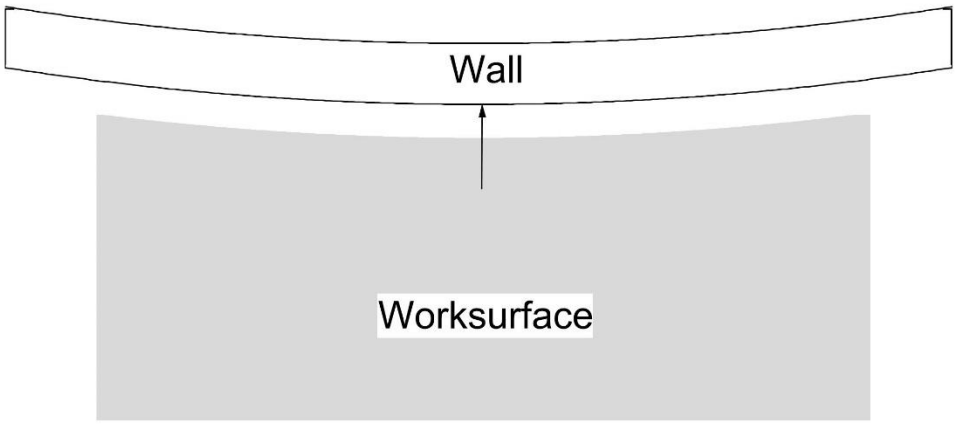
Step 1 Place the two surfaces to be matched against each other.



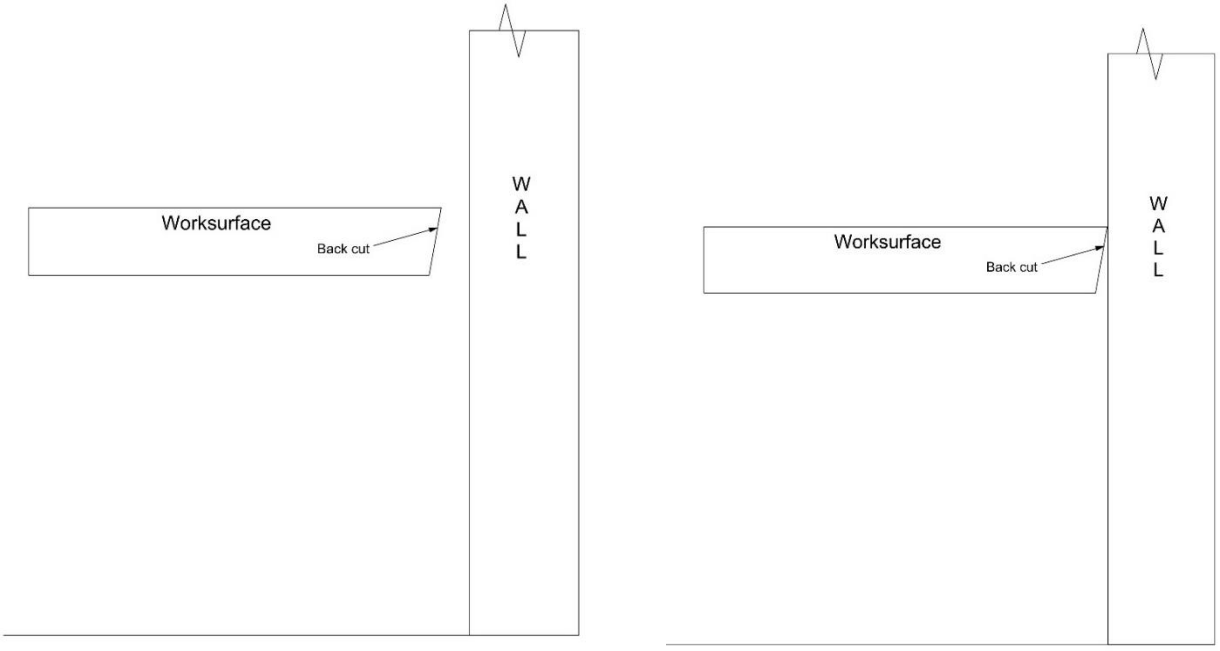
Step 2 Use a compass set to the largest gap between the work surfaces and draw a line by running the compass along the entire irregular surface. If a compass is not available, use a block of wood or something else that is a set thickness and mark a line with it.



Step 3 If there is a significant amount of material to be removed, you may need to use a jigsaw to cut out most of the material. If this is the case, only cut near the line, do not try and cut right on the line, this should be done with a different tool; the belt sander. Use the belt sander to trim the edge right to the scribe line.



Step 4 Bring the two surfaces together and make sure there is a tight fit, if not, keep sanding. It is helpful to sand to the line with a back cut. This means that you tip the sander slightly so that the only part of the material that touches the wall is the upper edge.



Any small imperfections can be touched up with a file or a rasp.

NOTES:

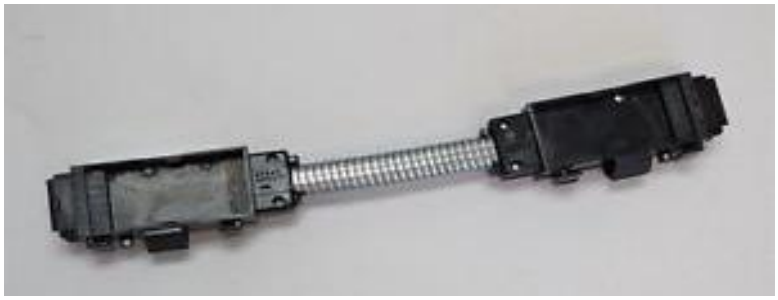
Chapter 7 Modular Glossary

Part of being successful in the modular installation trade is knowing the terminology that is commonly used in the field. Presented here is a glossary of the terms you should be aware of.

Panel: Product that creates walls of different heights and lengths, which are joined together to provide visual privacy, defining space for workstations. Frames are the structural element of the panel and the coverings which are known as skins or tiles are attached to the frame. The frame and tiles together are a finished panel

Glides: Small adjustable feet at the bottom of panels, desks and other freestanding furniture for the purpose of leveling

Powerway or Raceway: Integrated wiring in the base of panel onto which duplex receptacles are installed to provide power for equipment in workstations. Data cables also run in the powerways to provide for telephone and computer hookup.

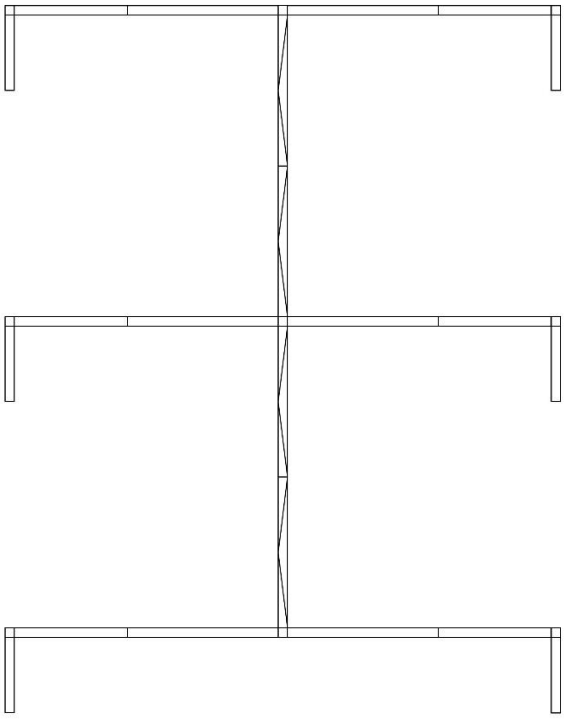


Duplex receptacle outlet: Premade duplex receptacle that are designated for only one specific circuit line. The lines are labeled 1, 2, or 3 and sometimes 4. This is setup this way to keep from overloading any one circuit.

Kick plate (race way cover): A trim plate that covers the powerway. This is gives a finished look and protects the user from the electrical wiring. Knockouts are provided where outlets will be

Top cap: A trim piece that runs on top of the panel to finish the panel. Sometimes it will cover connection points.

Spine, rib, wing: These are terms that describe the location of the panels in the panel run or cluster. The spine panels are the main panels that provide stability to the run. The spines usually carry the electrical and cabling. The ribs are the panels that branch out at 90° to the spine. The wings are the panels that support the rib panels.



Filler post, T cover, corner cover: All of these vertical trim pieces go where panels come together perpendicular to each other. A filler post is an actual post that fills the void where the corners of the panels meet at one point. The T cover and the corner cover are just snap on pieces that achieve the same result, that is, they dress up the corner

End of run, finished end These are the vertical trim pieces that finish off the end of stand-alone panel.

Drop down and drop down cover This is when you connect two panels of different heights. The cover finishes the end of the step up.

Panel connectors There is a variety of panel connectors that are defined by their position in run. An in-line is a 180° connection for straight runs. A 90° or "L" is for corner connection. A 3-way or "T" is used to connect three panels at one location. A 4-way or "X" is used to connect 4 panels at one location. There are also special connections such as a 120° or "Y" that connects two or three panels to form a Y configuration.

Power strap, pass through strap A power strap connects the powerways together from panel to panel. When there is a panel connector, a pass through strap is used because it is longer than a power strap.

BPI, power pole Base Power In is the connection from the building's power to the systems furniture. One end of the BPI is used installed by the installer, the other end is the responsibility of the electrician. The BPI is used when the hookup is from the floor or a wall. When the power comes from the ceiling, a power pole is used.

Ped, BBF, FF: Ped is short for pedestal. A pedestal is a storage unit made up of drawers that are located under the work surface. The pedestal could be a support for the worksurface, or it could be freestanding and placed underneath. There are several types of pedestals, but the most common ones are the BBF and the FF. BBF stands for box-box-file, meaning there are two small drawers (boxes) over one larger file drawer. The FF stands for file-file, meaning that there are two larger drawers that accommodate a standard file system.

Cantilever, side support, column support, corner bracket, end panel: These are all types of worksurface supports. Cantilevers are usually an A-frame bracket that attaches to the panel and, in turn, the worksurface is attached to the cantilever. The cantilever could be handed (only a left or only a right), or it could be shared (split underneath the ends of two work surfaces). Cantilevers are the most common type of support. Side supports mount on a wing wall and they support the end of the worksurface. A column support is a round or square post with a leveling glide at the bottom and is used where the work surface does not connect to a panel. Corner bracket supports the corner of the worksurface, however, not all workstations have corner work surfaces. An end panel is used to support the end of the worksurface where a pedestal is not used. An end panel is also used to help level the worksurface.

Flat bracket, tie plate: A flat bracket is a strap that ties together the worksurfaces to create a tight seam between the two pieces. It is mounted underneath the worksurfaces. It is used as a support for a worksurface return (an L configuration) and also a bridge (a U shaped configuration). A tie plate, also called a mending plate, is a smaller flat bracket that is used on the outer edge of a cantilever bracket and helps to tighten and maintain a tight seam between the two worksurfaces.

Wall start: This is a connector that attaches a panel to a wall. The connector is either screwed to studs or toggle screwed to the drywall. It is important that you establish the high spot of your run before you attach the wall start in order to have enough room for height adjustments.

Wall track: This is a slotted channel that mounts to a wall that will support the components, for example, overheads, tackboards and worksurfaces.

Tack board: This is a bulletin board that mounts to the panel and allows for posting items. Typically these are installed between the top of the worksurface and the bottom of any overhead storage bin. They mount with brackets into the slotted channels in the panel and there is height adjustment in one inch increments.

Double ped desk: A freestanding desk that has pedestals on both sides. If there is a single pedestal, the desk would be handed, i.e. a left or a right.

Return: A smaller worksurface that forms a 90° angle to the main worksurface. These are attached with flat brackets and they need support at the end. This support could be a pedestal, an end panel or a cantilever.

Bridge: A smaller worksurface that ties between two parallel worksurfaces to create a larger continuous workspace. These are connected with flat brackets at each end.

Credenza: This is a storage unit located behind a desk used for papers or supplies. Often found in executive offices or conference rooms.

Work surface This is the actual desk top. It is usually made of particle board and laminate and it can come in unlimited shapes and sizes. The work surface sometimes is scribed and cut to fit to conform to the workspace, for instance, cutting around a column.

Overhead or binder bin, or flipper door unit: These are upper storage units attached to the panels or wall track. There is a variety of styles including sliding doors, hinged doors, or flipper doors which open like an overhead storage on an airplane. The bins either come as one unit or they may be a kd, which stands for knocked down. A knocked down unit would include all the parts such as the sides, top, bottom and doors and they would need to be assembled.

Task light: Fixture or apparatus designed to illuminate a specific work area. This is almost always installed to the bottom of an overhead. It is attached by screws or a mounting rail.

P-top: This is a P shaped top that forms a peninsula which means that it is open on three sides. It is connected to a panel on one end and supported by column at the other.

Staight top: The standard worksurface, referred to by its dimensions, usually the depth first and then the width. For example, 24 deep x 48 wide (read as 24 x 48 on the label and the plans)

Corner top: This another type of worksurface, one that goes into the corner. It is supported by a cantilever at each end and a corner bracket in the corner.

Half height shelf, full height shelf: These are shelves that have two ends (sides), but no top or front. As the name implies, half height shelfs have lower ends while the full height have taller ends that may act as bookends for binders and other items stored on the shelf. These are usually attached to the panel about 12" from the top of panel so that a standard binder will not stick above the top of panel.

Off modular bracket: This is a bracket that allows you to attach somewhere other than the end of a panel. For instance, an off modular bracket can be used to attach a panel to the center, or off center, of another panel. Because there are no slots, there is a separate off modular bracket at the top of the panel and the bottom of the panel, and sometimes they are connected by another piece.

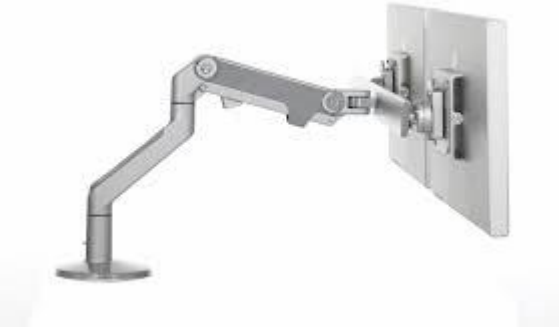
Standard slots (panel slots): On the side of the panels the frame is slotted to accept the various component brackets that will be used in the assembly. There are slots at one-inch increments that allow for adjustability in the location of the components

Case goods: This is the term used for products that are already assembled into one unit. Typical case goods would be file cabinets, completed desks and returns, bookcases and storage cabinets. Some assembly might be needed and they may have to be leveled and secured against earthquakes.

Trans action top: A small worksurface that is used in reception stations or between cubicles that is used for transactions such as signing documents or displays.

Key board tray: This is an ergonomically adjustable board that mounts to the underside of the worksurface and holds the computer keyboard. These are quite common and nowadays they have for articulating adjustments such as tilting and swiveling.

Monitor arm: This is an articulating arm that holds the computer monitor. It could be clamped to the back of the worksurface or bolted through the worksurface. They can be single or dual and they come many ergonomic adjustments.



CPU holder: When desktop computers are used, this holder mounts to the underside of the worksurface and keeps the tower unit away from your feet and manages the wiring.

2, 3, 4 or 5 high lateral file: These are files that are 30" to 48" wide. The height is determined by the number of file drawers, anywhere from 2 to 5 high. Oftentimes these are grouped together and when they are they need to be leveled and "ganged" (bolted together). Sometimes these are braced to the wall for seismic purposes.

Common top: This is a top that mounted on top of a group (bank) of lateral files. The size depends on the number of files.

Stacker: This a partial frame that is used to add height to an existing frame. It is usually to add privacy and or add decorative elements to a cubicle.

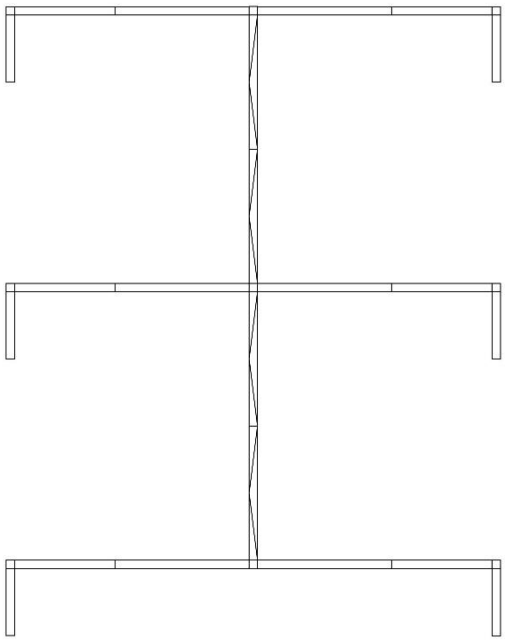
Grommet: A grommet is an access hole in the worksurface that acts as a pass-through for computer cables, phone cables and anything that needs to be plugged in. A grommet sleeve and a cover are inserted into a drilled hole to dress up the opening.

NOTES:

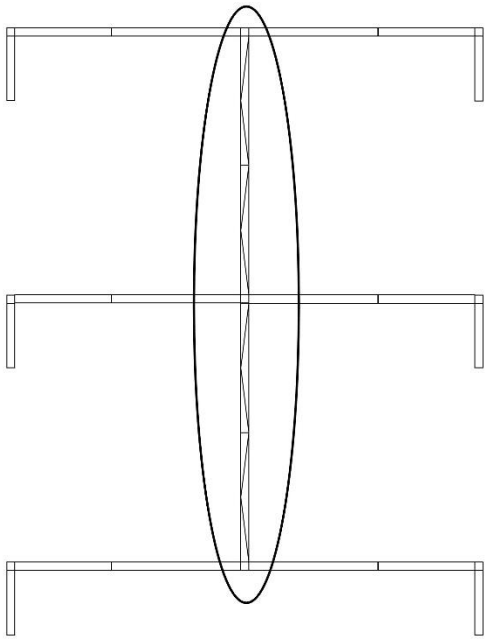
Lesson 2 Sequence of the Job ---Assembly

Assembling the Product

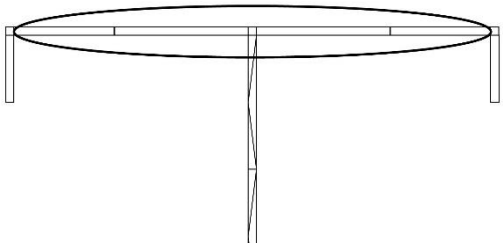
Once the staging is completed, assembly can begin. Like any construction, work begins with the layout. If the layout was not done during the prep phase, the exact location of the assembly needs to be laid out now. The layout is dependent on which type of furniture is to be installed, for example, some panels are 3" thick while others could be 3 1/2" thick. Another aspect of layout is to make sure that all aisles are compliant with the American Disability Act (ADA) which ensures adequate access for all. The plan will usually specify the width of the hallways and aisles. If there are existing problems with the building, for instance, the power feed is located in the wrong place in the floor, the lead person should inform the contractor and the project manager and a decision should be made prior to the assembly. It is not cost effective to have to move or reconfigure the assembly, so there could be delays while a decision is being made. This happens more often than you would think.



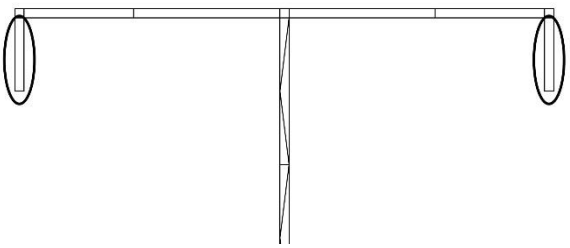
Shown above is a floor plan of a set of cubicles to be assembled. We need to identify the panels by the position they are in. For example, the panels circled below are what are known as the spine because it runs down the middle and provides stability to the entire assembly.



The panels that branch out from the spine are known as the ribs and they are shown below.

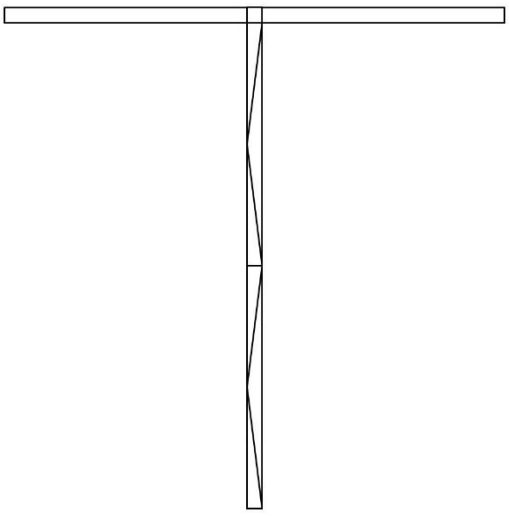


Finally, we have the return walls, which are known as wings.



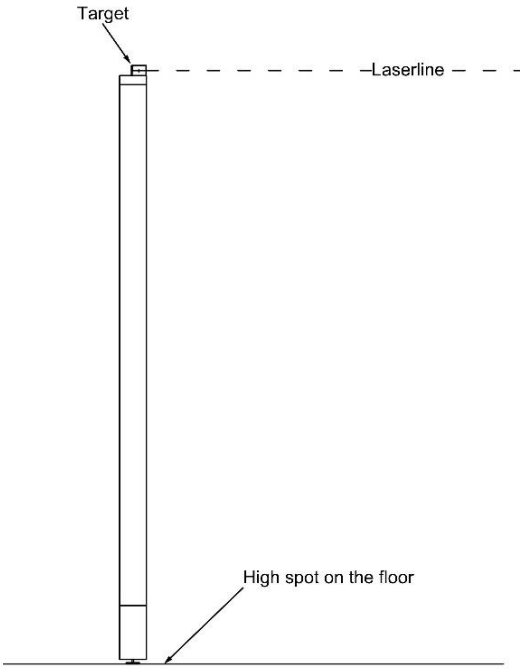
The panels that look like this are the panels that carry the power and data to the workspaces.

Once the layout is completed, begin by putting together the frames or panels. Usually work begins with a 3 way or a 90° connector since the panels will be able to stand on their own. For this particular plan, we would start with the spine and several ribs, as shown below, and work from there.



At the completion of the assembly the next step is to level the frames. This needs to be done before the skins are applied.

Leveling is done by adjusting the glides up or down. Glides are small adjustable feet at the bottom of the panels. It is important to consider the assembly as a whole, the entire frame system needs to be level from one end to another. The glides usually have about 2" to 3" adjustment built into them, so heights must be established so that you do not run out of adjustment.



Leveling is almost always done using a laser. The laser is attached to a something metal like a corner, or it could be mounted on a tripod. The high spot of the floor is the first thing that needs to be determined. Measure from the floor up to the laser line at various points along the run of your panels. The smallest measurement that you read is the highest spot on the floor. For example, a spot that measures 65" is higher than one that measures 65 1/2".

If there is not a laser available, you can measure down from the acoustical ceiling since it is already level.

Once the high point is determined, adjust the leveling glide so that only 1/4" is showing. This will allow some play if necessary. The lower the assembly, the better it looks: it does not look good to have the bottom of the panels sitting 3" off the floor. You rarely can begin leveling at the highest spot, so the laser needs to be set to height slightly above panel height at the high spot.

The next step in the process is to ready the electrical. This is done by strapping together the powerways. The powerway, which is integrated wiring that carries the power to the receptacles, is located at the bottom of the panel. Powerways are usually capable of handling three or four electrical circuits. The receptacles are usually duplex outlets. Install the BPI, which stands for Base Power In. This is the connection that brings power to the powerway. The BPI gets its power from either the floor or the ceiling. If the power is coming from the floor, there is a core drilled in the floor that contains the main power feed. If this core is not in the correct place, adjustments must be made. This may mean shifting the entire assembly to access the core, or, in some cases, a new core must be drilled. If possible, test the power before finishing the assembly.

Trims

At this time, the trim is generally installed. There are horizontal and vertical trim. The trim is used to conceal fasteners and exposed ends. The horizontal trim includes the top cap. This piece runs along the top edge of the panel and covers the connector hardware. There are end caps that finish the run. Vertical trim includes the end of panel run trim that dresses up any stand-alone edge.

Components

The components are then installed. The components are the overheard storage or shelves, the countertops, the cantilevers and the pedestals. You work from the top down, since if the countertop was already installed, putting in the overhead storage or shelves would be very difficult. Since the panels have already been leveled, you can measure down from the top of the panel to keep everything level and avoid dealing with a high or low floor. The height of the cantilevers need to be established. Nowadays, there are ergonomic considerations in the height of the countertop, for instance a person in a wheelchair will need the countertop to be lower than the average. The countertop is usually set in the 27" – 30" range, however, it may be set higher or lower depending on the worker's need. It could be that each workstation in an assembly is set at a different height, so careful attention must be paid to the details on the plans.

Once the cantilevers are installed, the pedestals are set. These serve as the storage for the cubicle and they should be set level so that drawers do not tip forward. If the pedestals serve as a support for the countertop, they would need to be shot in and it may be difficult to accommodate different ergonomic heights.

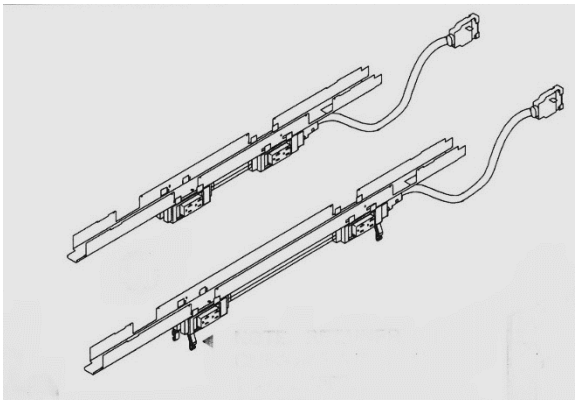
As we have seen, installation of the product follows a logical sequence that allows for the most efficient use of the installers time.

NOTES:

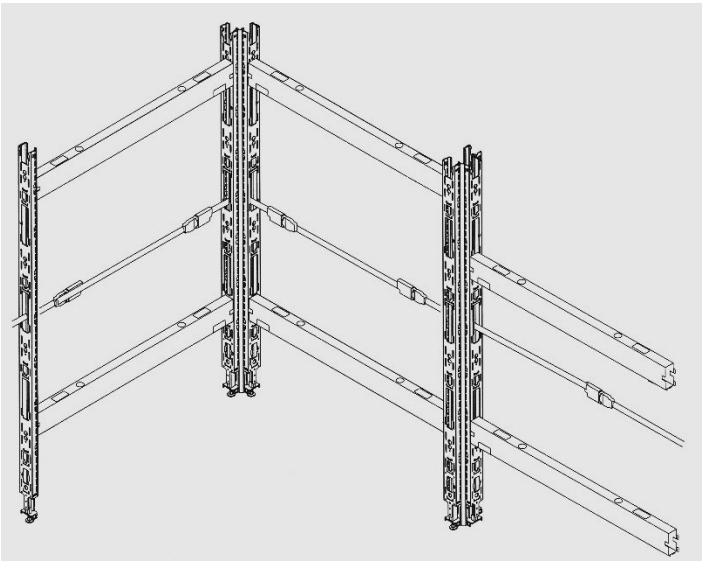
Chapter 8 Powering Systems Furniture

The modern cubicle workspace must come equipped with electrical power in order to run the computer, printer and other electrical devices that are standard parts of today's workspaces. The earliest cubicles did not include any electrical, it wasn't until the mid-70s that cubicles came with internal wiring. The installer should be familiar with the power system for the cubicles that they are installing to ensure the power works and that there are not any safety problems.

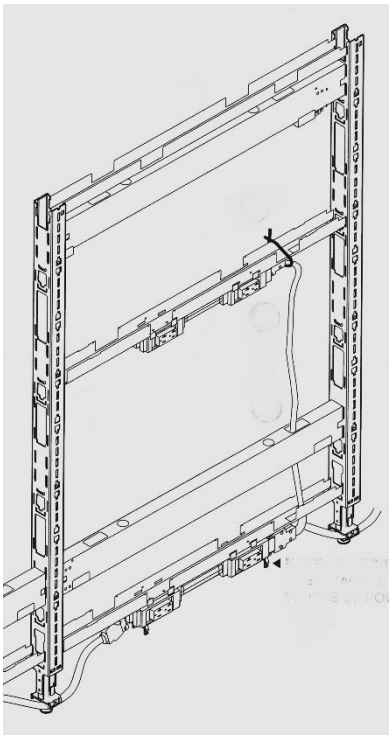
Systems furniture come with powered and non-powered panels. Not all panels in a cube need to have power, for instance, most wing panels are non-powered. The spine and the first rib panels almost always have power. The power panel is a panel that has a power raceway (sometimes called a power kit or power way) that houses the wires. The power raceway is designed to connect together with the use of power straps (harnesses) that jump from raceway to raceway. Shown below is a Steelcase power raceway.



Each manufacturer has their own system, for instance, some systems have different size straps for connecting power ways according to different panel connections such as L's (90°), T's (3 way connections) and X's (4 way connections). There is also what is called a pass through which runs through a non-power panel. Shown here is a Steelcase pass through.



Each panel has its own individual size power way which is usually located at the base of the panel. Most panels have the option of running the power at what is called belt line height for easier access, which is above the work surface. This drawing shows the belt line height



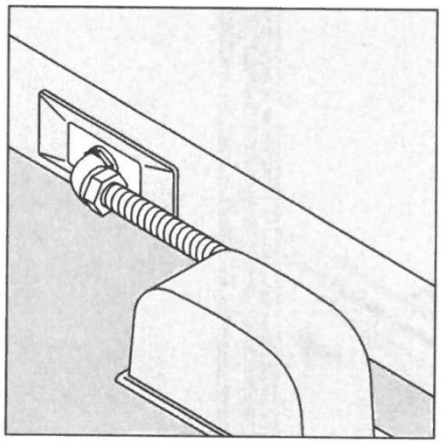
The power ways hold the receptacles (duplex outlets) that are installed per the drawing or plan. The power way at the base has a kick plate that covers the power way. The kick plates have knock outs where the receptacles will be accessed and some systems have knock outs to access data jacks as well. When belt line electrical is installed, some systems have what are known as technology tiles or skins which have factory cut outs for the receptacles and data jacks. If this is not the case, other systems will require field cuts in the tiles or skins to access the receptacles and data jacks. The belt line electrical works in conjunction with the base power by using what is called a jumper cable or transfer cable. This can be seen in the drawing.

Most systems run four different circuits, which are called lines. The lines are either labeled as 1, 2, 3, and 4, or A, B, C, and D. Shown here is a Herman Miller receptacle labeled with a C.

Typically lines 1, 2, and 3 share the ground and neutral wires, while the 4 line usually has a separate ground and neutral. When there is a large demand for power, such as a computer, that is usually run on line number 4.

To energize the power in the systems furniture, it has to be connected to the building power supply. This is done through the use of a base power in feed or through the use of a power pole. These connect to the power way and then is hard wired to the building's power by a certified electrician. The location of the power feed is usually noted on the drawing or the plan.

If the feed is not in the proper location, the installation may have to be moved some to make it work, or in some cases, the feed will need to be moved. Base power in feed comes up from the floor while the power pole brings the power from the ceiling down. Shown here in a Steelcase floor in feed.



Standard Power In Feed - Floor

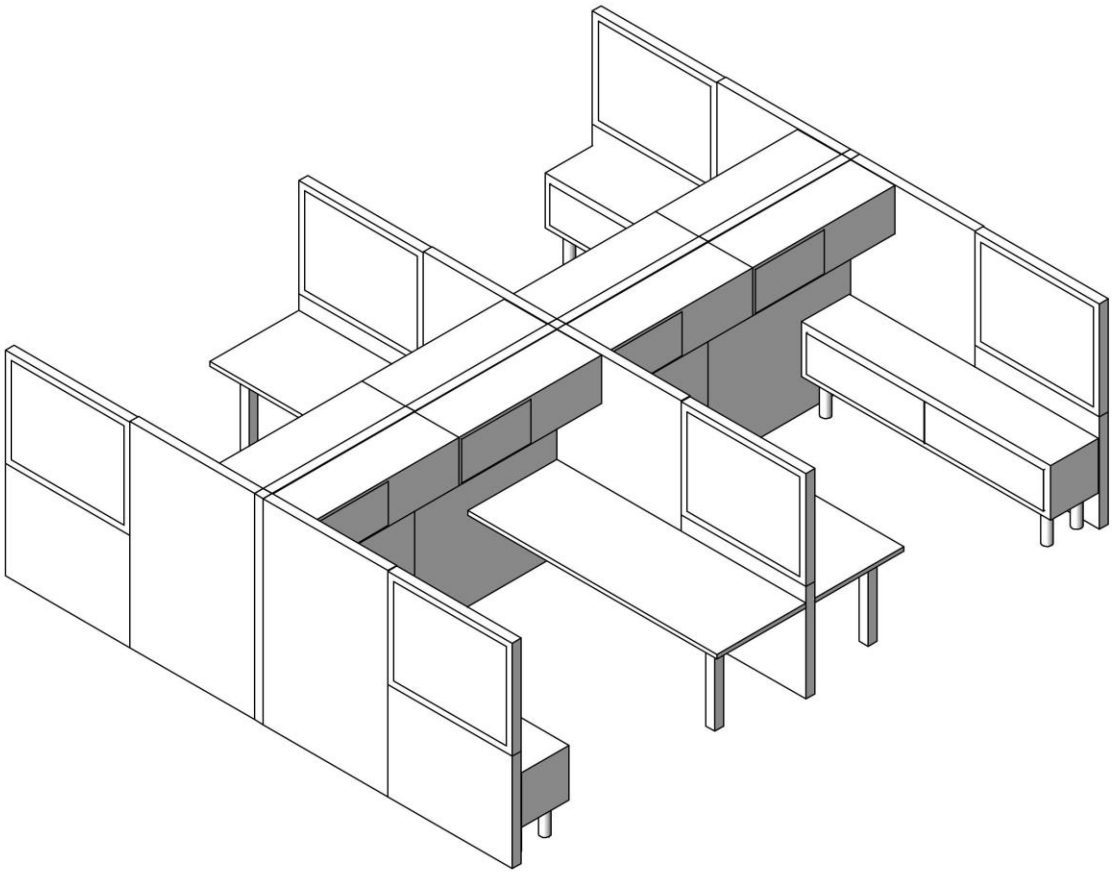
In certain cities, an electrical permit is required. If this is the case, the permit is usually pulled (obtained) by the office staff of the installation company. However, it is the responsibility of the lead man or the foreman to get it signed off by the inspector. In order to pass inspection, all power must be tested to make sure that it is working properly. In addition, all components must have a UL sticker. The UL is the Underwriters Laboratory, which is a private company that tests electrical products to make sure that they are electrically safe. Another condition in order to pass inspection is to make sure that all components are covered, no exposed wiring.

Testing the power in the panels is usually done with a three prong plug-in tester. The tester will show if the receptacle is energized and if there is a problem with the ground or the neutral. In some cases the voltage will need to be tested with a voltage tester. If a receptacle does not work, there could be a few different issues that could be the cause of the problem. First, make sure that the feed is installed correctly and that it has been hard wired by an electrician. If those are done correctly, it could be that a strap or harness is missing, or that the harnesses not properly engaged. Another problem could be that the circuit breaker is off. Finally, though it is rare, the power way or the receptacle may be defective.

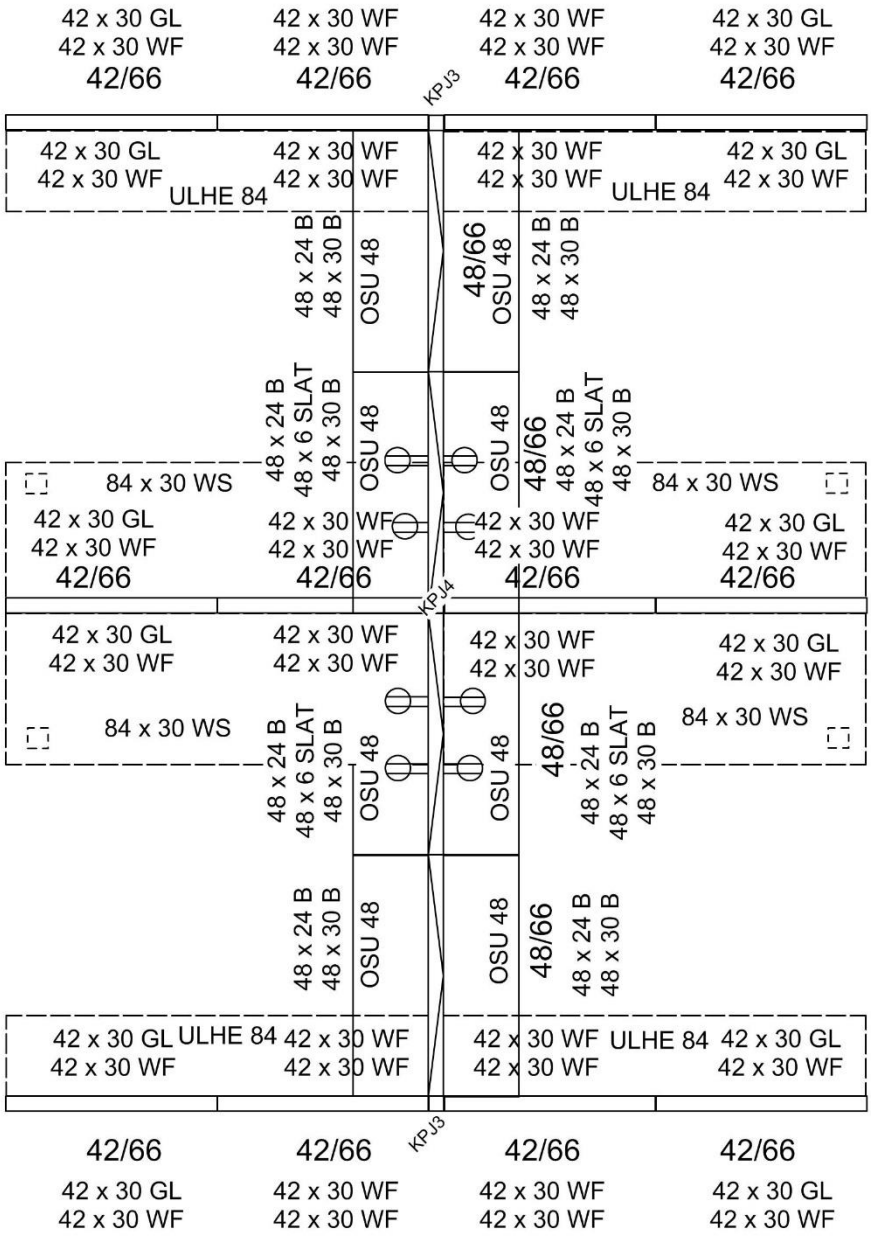
Electricity is a safety issue and that means that care must be taken by the installer to correctly connect the electrical components so that the system is safe for the user.

NOTES:

Lesson 3



TEKNION LEVERAGE



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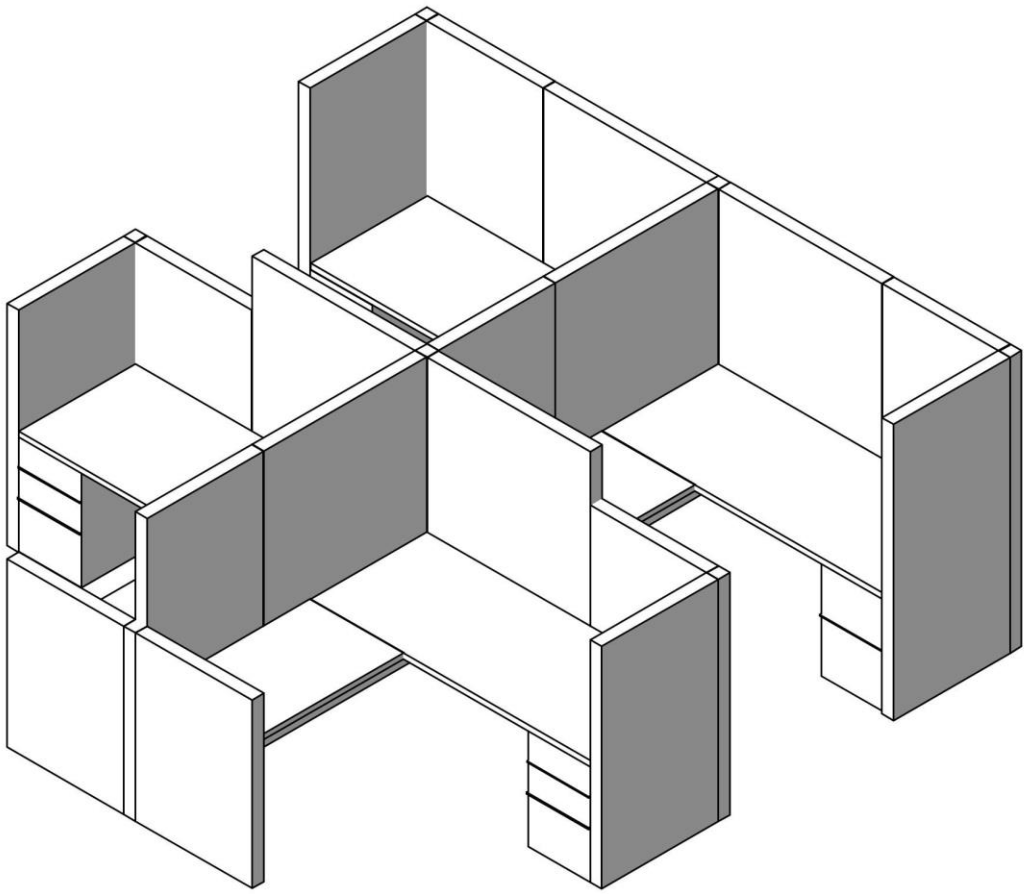
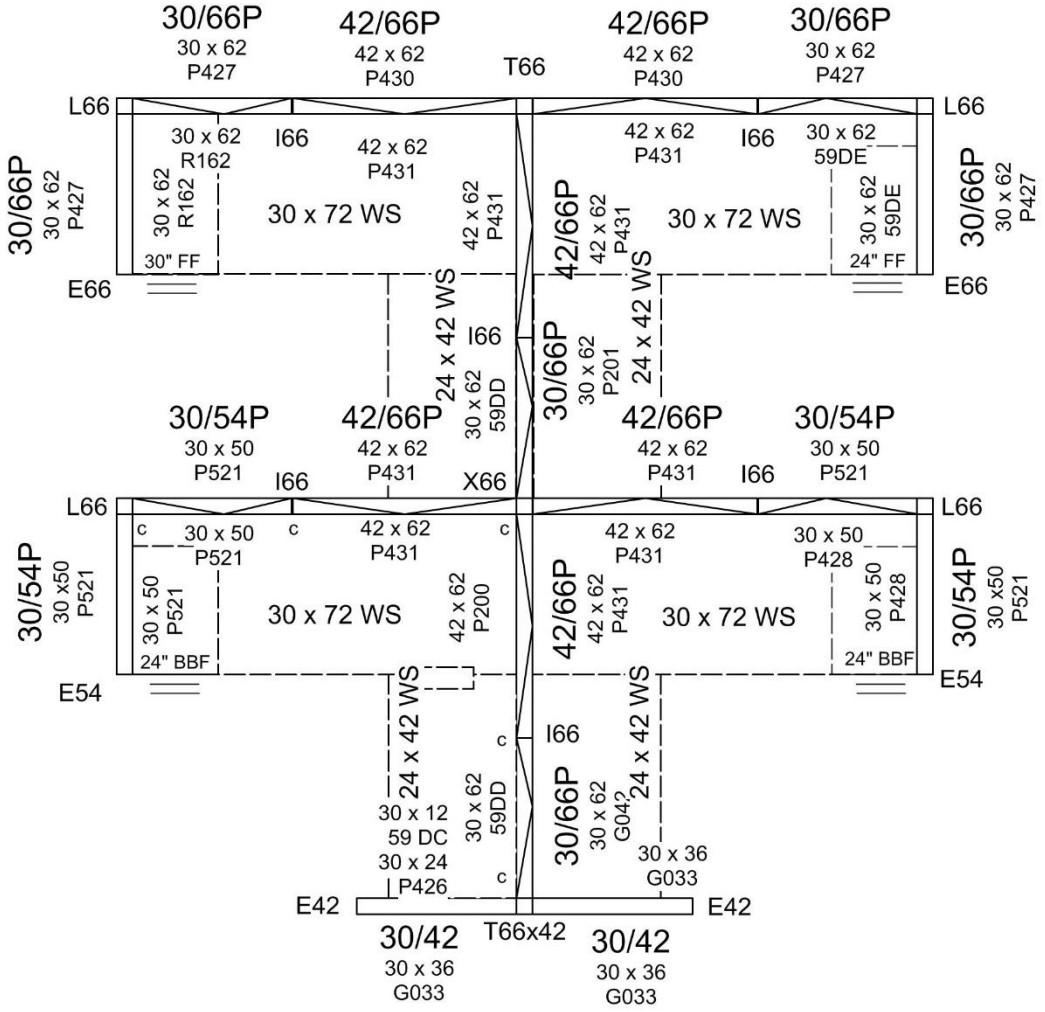
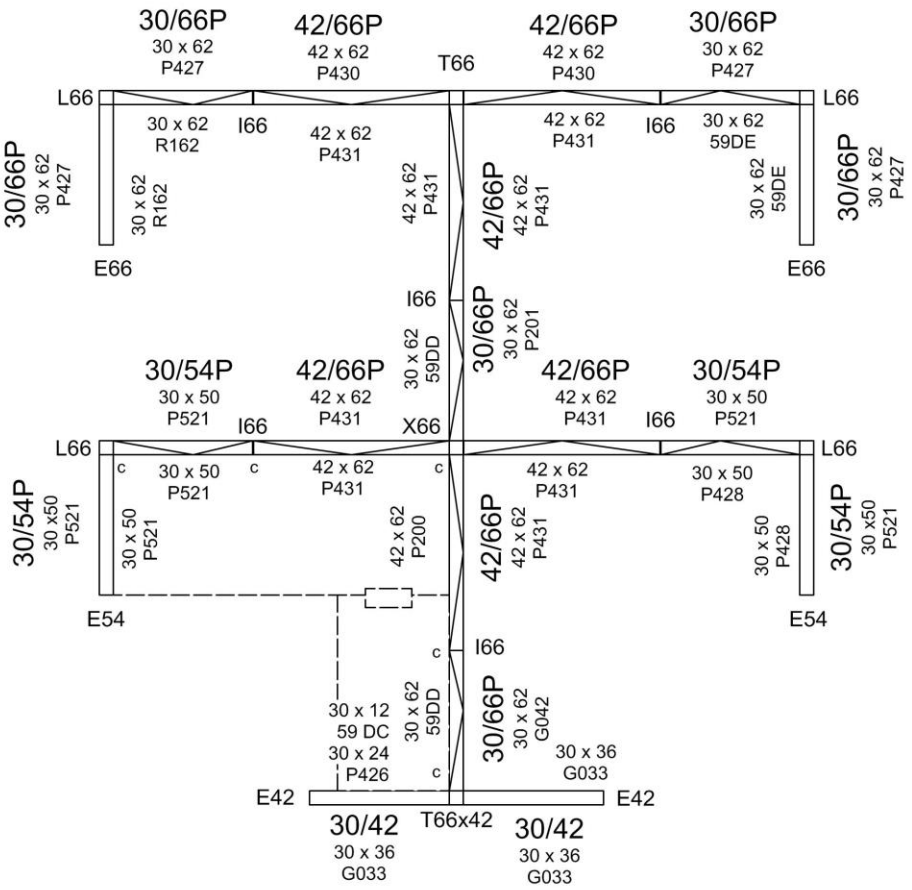
	Floor Plan	Drawn By: .dk	Scale: 3/8= 1'	



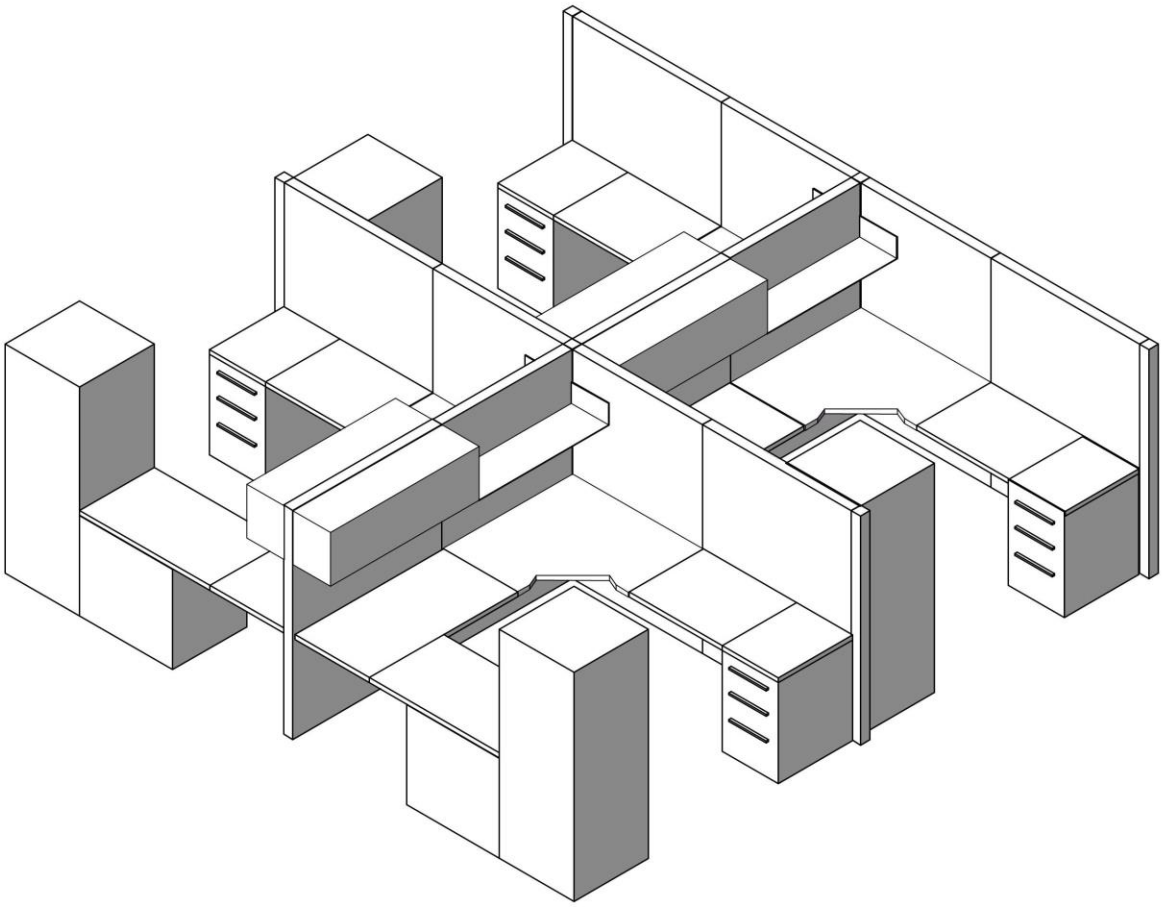
STEELCASE ANSWER



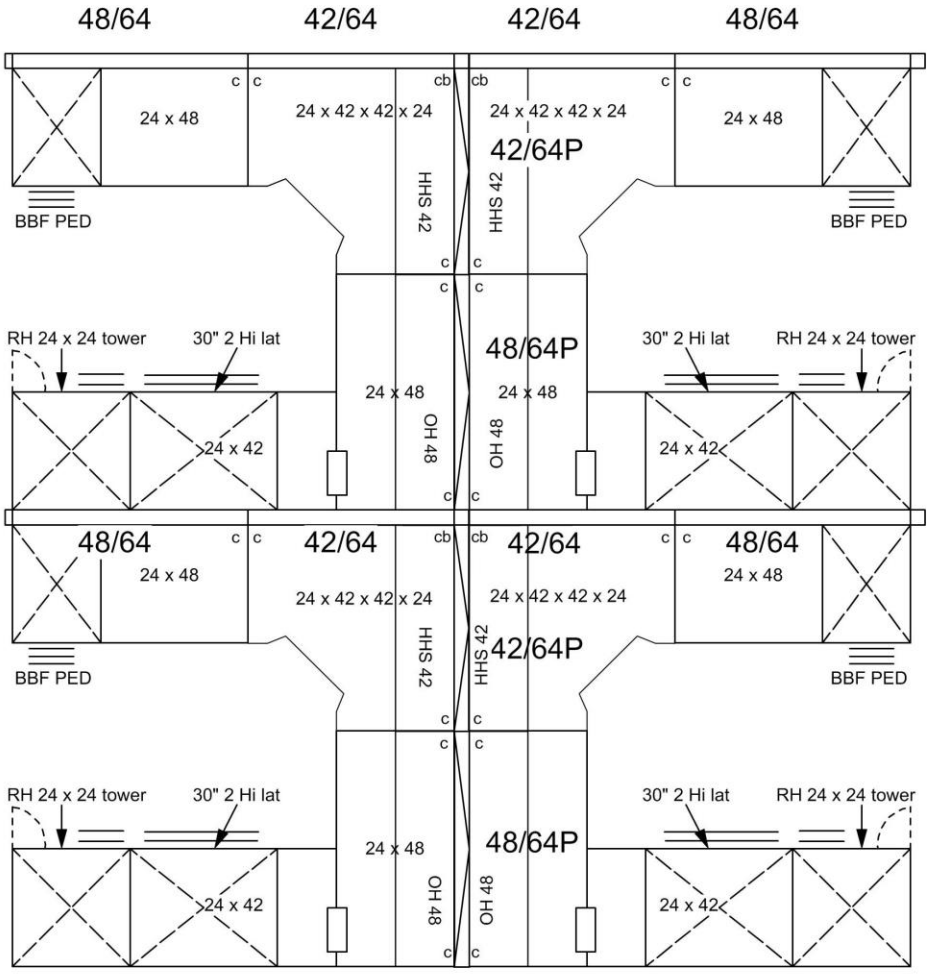
CARPENTERS TRAINING COMMITTEE FOR NORTHERN CALIFORNIA	Steelcase Answer	Date: 3/28/17	Sheet 1 of 2	1203
	Floor Plan/Frames & Skins	Drawn By: .dk	Scale: 3/8= 1'	



CARPENTERS TRAINING COMMITTEE FOR NORTHERN CALIFORNIA	Steelcase Answer	Date: 3/28/17	Sheet 1 of 2	1203
	Floor Plan/Frames & Skins	Drawn By: .dk	Scale: 3/8= 1'	



KNOLL DIVIDEND



CARPENTERS TRAINING COMMITTEE FOR NORTHERN CALIFORNIA	Knoll Dividend	*Date:* 3/28/17	Sheet 1 of 1	1203
	Floor Plan	*Drawn By:* .dk	Scale: 3/8= 1'	

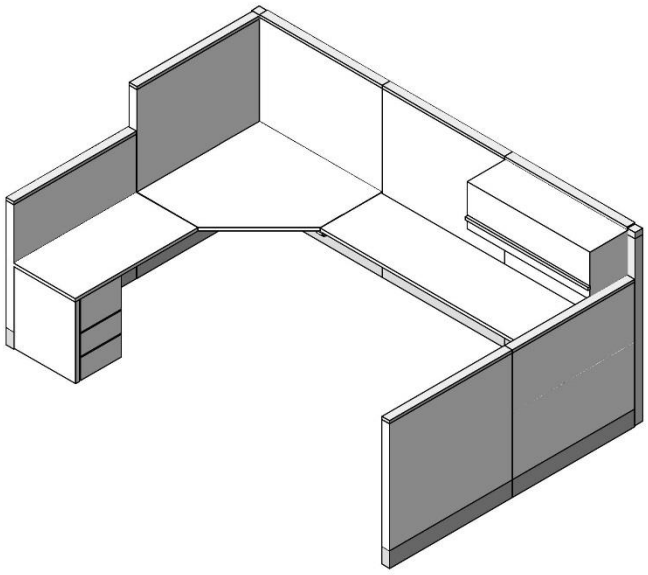
NOTES:

Chapter 9 Demolition

As we have stated, one advantage of modular construction is the flexibility that furniture systems and demountables lend to being able to change or reorganize the workspace. Thus, changes to the workplace often occur, and this involves demolition of the existing systems. While the word "demolition" sounds like you are just destroying everything, in fact, there is a logical way to dismantle the systems. Following a step by step approach will ensure that the demolition will be done in a safe manner with a minimum of damage to the materials and the remaining workspace.

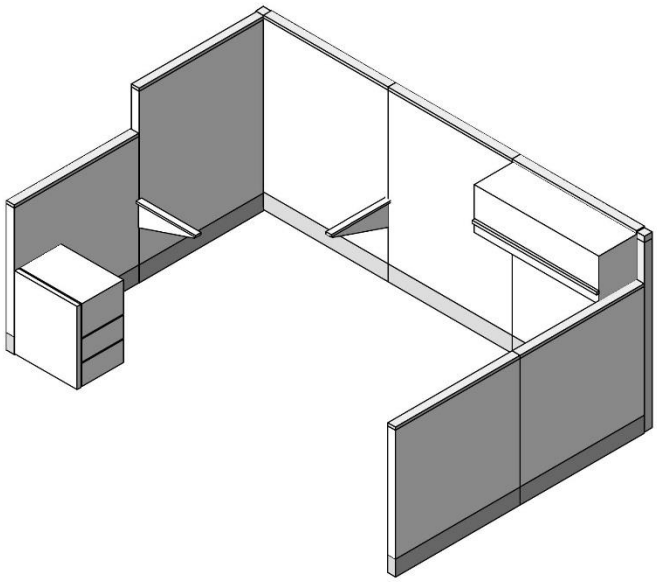
The demolition of each space depends on the system present, however, there is a suggested sequence that applies in most circumstances.

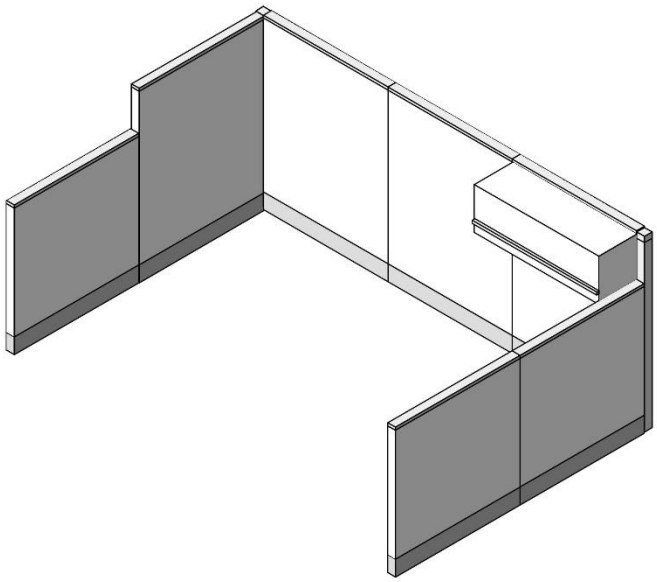
Here are the steps for demoing furniture systems:



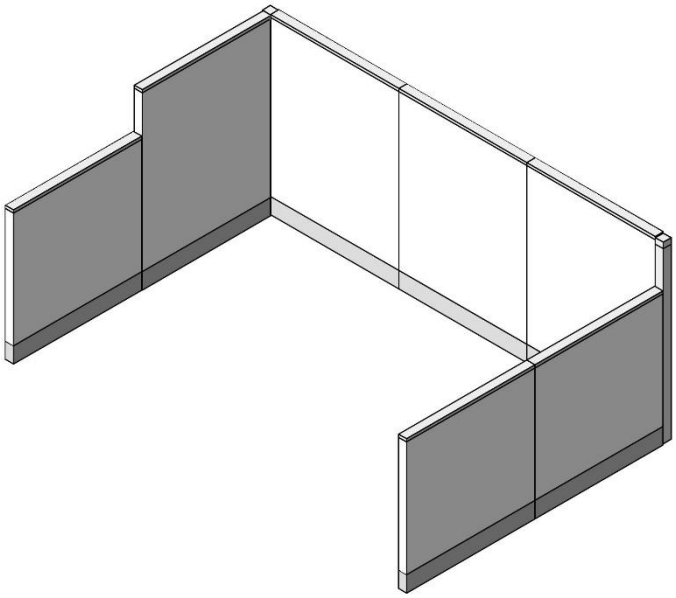
Step 1 Begin by taking out any of the components.

- Work surfaces (desks)
- Supports including the pedestals and the cantilever supports
- Remove any lateral files



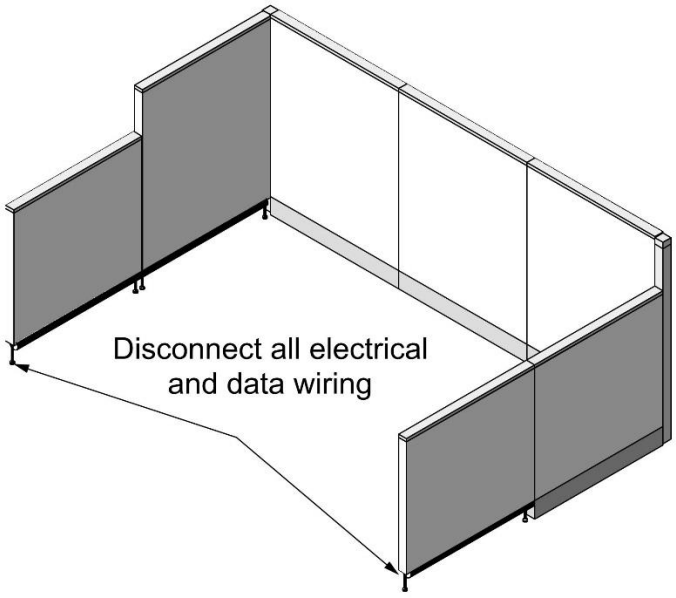


Step 2 Remove any overhead storage. Remember these units are heavy, so if a unit is over 36", you will need help to detach it. The reason that you removed the desks first was so you could position yourself directly under the load. As we learned in Ergonomics, this is the position where you are the strongest. Avoid twisting while lowering and carrying the load.

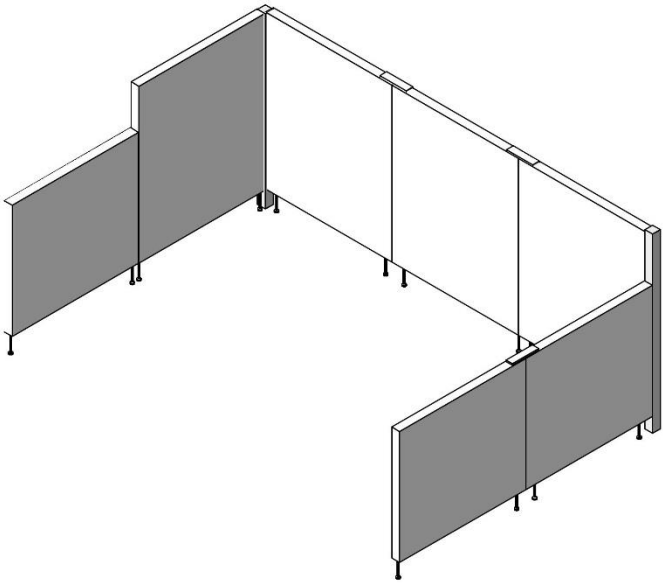


Step 3 Take off the kick plates to gain access to the electrical

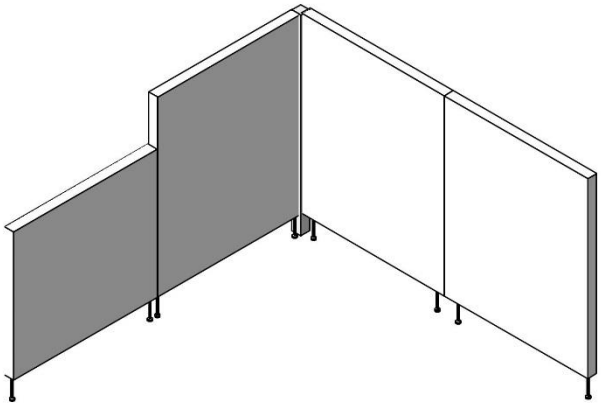
Step 4 Disconnect all the electrical and remove all the electrical wiring and the data wiring. As we learned, you should be cautious around any electrical source, and be sure that the power is disconnected.

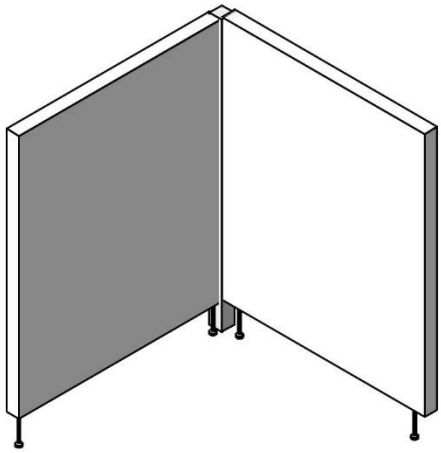


Step 5 Remove the top caps. This will give you access to the connections between the panels and allow you to disconnect one panel from the next.



Step 6 Systematically disconnect the walls. Since you may be working by yourself, you must disconnect the walls so that they don't fall, usually this means that you leave a "L" configuration as the last part of the demolition.





Step 7 Cleanup. The system may be thrown away or it may be saved and reused. If it is to be thrown away, put like parts together, such as all the top caps. Any recyclable parts can be separated out.

Here are the steps for demoing of demountable walls.

Step 1 Disconnect all the electrical and data wiring

Step 2 Take out any doors

Step 3 Remove the skins (tiles)

Step 4 Disconnect seismic bracing

Step 5 Drop the walls

Step 6 Remove ceiling and floor tracks

Since the demountable system is heavy, the demolition is generally done with a pair of workers.

1203- UBC Chapter 12

Study Guide

Instructions: For each question, indicate which one of the four answers is correct or most nearly correct.

1. A drawing of an individual workstation used more than once in an installation is called a (an) _____?

    a. Commonality

    b. Mirror

    c. Copy

    d. Typical

2. A universal support leg is required for every _____ of work surface run to prevent sagging.

    a. 3'

    b. 5'

    c. 8'

    d. 10'

3. Where is a powerway generally located on most panels?

    a. Top of the panel

    b. The base of the panel

    c. In the middle of the panel

    d. The installer decides

4. Anchor brackets are sometimes specified at panel power entry points to prevent panel movement that may result in damage to which of the following?

a. Finish floor

b. Panel fabric

c. Wiring

d. Unit assemblies

Match the following definitions with the appropriate key term.

5. Return unit _____
6. Wall tracks _____
7. Creep factor _____
8. Powerway _____
9. Glides _____
10. Spine _____
11. Variable height bracket _____
12. Wing _____
13. Top cap _____
14. Unit assembly _____

A. Standards attached to walls for mounting overhead binder bins, shelves, or accessories where panels are not required.

B. The main run of a cluster of cubicles

C. Connector bracket that joins panels of different heights; also called hi-lo bracket

D. Additional length added to a panel run caused by connections between panels

E. Decorative component used to cover the top edge of a panel

F. Small adjustable feet at the bottom of panels, desks, and other freestanding furniture for the purpose of leveling.

G. Work surface with end panels, a back panel, and various pedestals of file drawers; customarily shipped knocked-down to be assembled at the jobsite.

H. Smaller work surface stemming from the user's primary work surface, creating an L-shape in the plan.

I. Integrated wiring in the base of a panel onto which duplex receptacles are installed to provide power for equipment in workstations; also called a raceway

J. Product attached to the spine run to provide stabilization

1203 UBC Chapter 13

Study Guide

Instructions: For each question, indicate which one of the four answers is correct or most nearly correct.

1. Installers should be given _____ on how to incorporate unique or special requirements before installation begins.

    a. Instructions

    b. Tools

    c. Materials

    d. Transportation

2. After all the preparatory steps have been completed, actual panel systems furniture installation begins with which of the following steps?

    a. Assemble the unit assemblies

    b. Wire up the facility power

    c. Set up the panels

    d. Connect the powerways

3. When a panel starts at an existing wall, what attachment brackets must be installed first?

    a. Floor

    b. Cantilever

    c. Ceiling

    d. Wall

4. What do panel systems furniture lighting assemblies normally attach to?

   a. The bottom of an overhead bin or shelf

   b. The edge of a work surface

   c. Pedestal booms

   d. A freestanding component

5. What kind of brackets support work surfaces from underneath and tie them into panels?

   a. Work surface

   b. Z

   c. Cantilever

   d. Connector

6. _____ can be made to freestanding furniture to meet the personal preferences of workstation occupants.

   a. Reconfigurations

   b. Repairs

   c. Assemblies

   d. Adjustments

7. Before reconfiguration, facility power must be disconnected from existing panel systems and electrical _____ in the panels must be disconnected.

   a. Wiring

   b. Powerways

   c. Harnesses

   d. Box

8. This consists of dismantling existing panel systems furniture and reassembling the components into a new arrangement.

a. Remodeling

b. Reconfiguration

c. Reassembly

d. Reconsideration

9. When a panel or a cabinet attaches at a point that is not on the seam it is known as:

a. T mount

b. Flush mount

c. Off-modular

d. On-module

NOTES:

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