



FASST

Field Associate Sound System Training

Construction Methods

The intent of this module is to familiarize the installer with methods and terminology used on a construction site. It will focus on items that are important to an A/V installation.

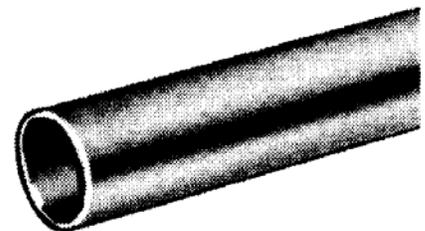
Prewire

The prewire stage of an installation is considered to be all work prior to installation of loudspeakers and headend equipment. For most installations, this includes getting all wires in prior to fixtures and other floor obstructions being put in place that can inhibit ladder and lift movements. This is also a good time to meet with the General Contractor (GC) and Electrical Contractor (EC) to make sure all mechanical and electrical needs are taking care of.

Electrical

An A/V installer typically needs two things from an EC. Power and conduits.

Electrical conduits or EMT (Electrical Metallic Tubing) are made of rigid galvanized steel and are often referred to as *pipe*. $\frac{3}{4}$ " diameter is the standard size used by most electricians and often is satisfactory for three or four 18awg speaker lines. However, 90 degree bends in the conduit will reduce the number of conductors that fit into the pipe. A nice electrician will put a pull string in the conduits or have a pull box installed somewhere on the line if the run makes more than three 90 degree turns.



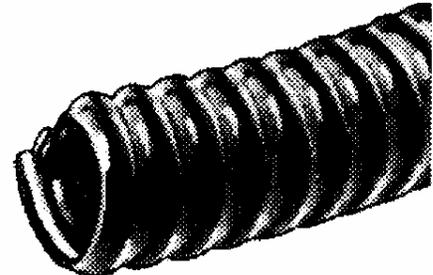
Rigid Metallic Tubing



90° Long Elbow

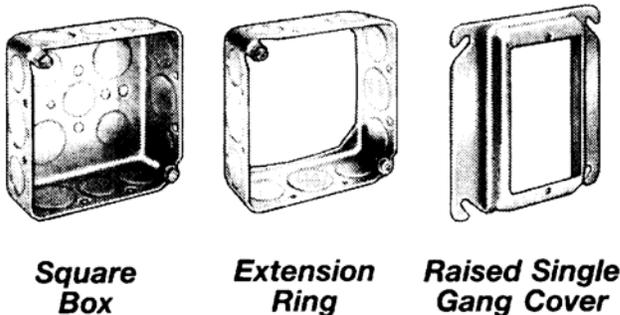
Metallic conduits serve two purposes. The first is to protect cables from damage and possible fire. The second is to provide a path (or conduit) between two locations. For A/V systems conduits occasionally are used between each device, but more often they are used to create a path through inaccessible spaces. Examples of inaccessible spaces include concrete floors, masonry walls, and drywall ceilings. In these instances, the conduits must be installed first and then built around. When conduits are used in this fashion, they are referred to as *stubs*.

Many local electrical codes require that any electrical cable in walls be in a pipe that is 'stubbed out' at an accessible point above the ceiling. Separate stubs should be installed for microphone signals and amplified signals to minimize as much induction as possible. For the A/V installer, stubs make life so much better, because it is much easier to push a cable down a metal tube than to fish it down an insulated wall. However, it is also more expensive and customers typically try to limit the amount of conduit used. One needs to be careful with un-terminated pipe as the sharp end that can cut through PVC and Teflon jackets shorting cables out. Ideally, some sort of grommet or other fitting should be used on the end to protect the cable.



Flexible Conduit

Flexible conduit, sometimes referred to as BX, does have certain applications where it is used for A/V work. The most common is to use it as a jumper between a junction box and a loudspeaker in a drop tile ceiling. Flex is also used in walls after the wall has been constructed. Depending upon the length of the flex, a fish tape can eliminate a lot of frustration getting a cable in it.



Square Box

Extension Ring

Raised Single Gang Cover

In addition to the conduits, the electrician is responsible for installing the electrical boxes that A/V systems use for volume controls and input plates. When these devices are installed prior to the wall being constructed, they are mechanically attached to the wall studs. This mounting method is preferred to give the box the necessary support to keep it from being pulled out of the wall.

For volume controls wall plates, a square 4" X 4" box is normally used if installed before the drywall. The standard 1 1/2" depth is not acceptable for most 70 volt attenuators. Have the electrician install the 2 1/8" deep box or mount an extension ring to the standard box in order to have enough depth. These boxes are finished off using a 1/2" or 5/8" raised cover. The cover is determined by the thickness of the drywall being used on the site. The raised portion is designed to stick through the drywall and have the mounting threads reasonable flush with the surface of the drywall to accommodate the screws that are provided with most wall plates. Notice in the figure to the left that the box and extension ring do not have the necessary mounting holes to attach a wall plate.



Switch Box

If the box is installed after the drywall, a switch box is used. There are gangable switch boxes that can be used as a single gang box or connected together to allow whatever size is needed. The space inside these boxes is typically much smaller than the square boxes and can make terminations difficult if the installer is unable to push the cable back out of the box.

These boxes do not require a cover plate since they are already flush and have the required screw threads.

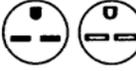
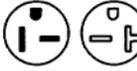
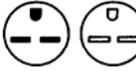
The determining factor for using a single or double gang box/cover is the size of the transformer and the plate that it is mounted on. Generally, 10 watt attenuators come on a single gang plate and 35, 75, and 100 watt attenuators are double gang. Volume Controls are generally mounted at 48" AFF (Above Finish Floor). This is consistent with light switches. Input/output plates are typically mounted at 18" AFF.

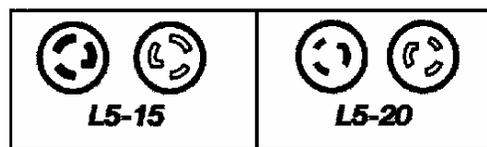
If a customer wants to add a volume control into an existing space, there are cut in rings that are available for this purpose. Caddy makes a couple versions that don't pull out of the wall like the old MP1's did.



Our remaining electrical needs lie in getting power to all A/V equipment including televisions and projectors. A single 15 amp circuit in a duplex outlet is normally sufficient for sound systems with a single amplifier. Since the amplifiers have the largest current draw of the audio equipment, the installer can use the number of amps as a gauge to determine if a larger 20 amp circuit or multiple circuits may be needed.

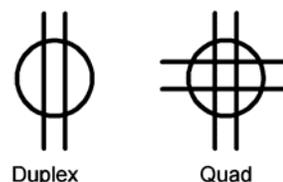
The following figures show the typical outlet configurations for plugs and receptacles. 5-15 and 5-20 are the most common. The L5-15 and L5-20 are locking versions of the same connector

NEMA Plug and Receptacle Configurations		 1-15	 5-15	 5-20
 6-15	 6-20	 6-30	 7-15	 10-20
 10-30	 10-50	 14-30	 14-50	 18-60



Typical Locking Plug Configurations

On blueprints, duplex and quad outlets are usually identified with the following symbols:



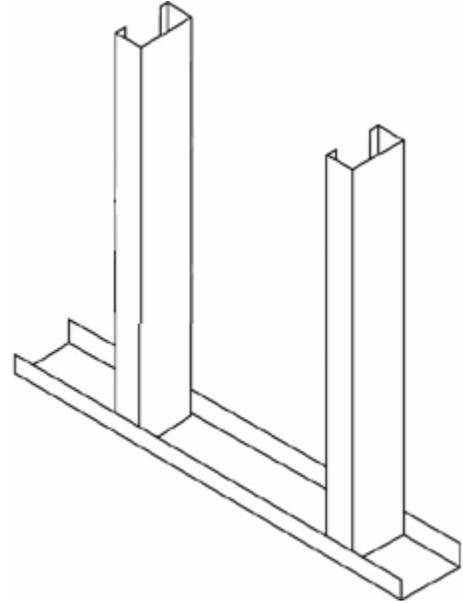
Other electrical considerations:

- All circuits for video equipment should be on the same phase to eliminate hum bars.
- Electricians can make mistakes. It never hurts to check the outlets for correct wiring and solid connections. Inexpensive outlet testers are available that check the most common errors.
- In multiple floor locations, often there is a chase between floors in electrical closets. These can be used to pull between floors. If there isn't anything available, the GC can have the floor cored and sleeved. It isn't cheap though.
- Low voltage cable can never be installed in the same conduit with 120 volt power

Wall Construction

Most retail and large hotel construction uses aluminum studs. Restaurants and motels tend to favor wood construction. A lot of this depends upon the codes of the buildings in which they are located. Wood tends to be cheaper and more commonly found in free standing structures.

The typical span between studs is 16", but 24" is common as well. Then you always have those who have difficulty with a ruler. The walls usually have a header on top of the studs that is similar to the footer as seen in the image to the right. This header may or may not be up against the ceiling structure. If a volume control was to be placed on this wall in an open cable situation, the installer would need to drill a hole in the header to drop the cable down. A grommet needs to be install around this hole to protect the cable.



It is important to know where the studs are when hanging large devices like wall racks and televisions. $\frac{3}{4}$ " plywood is generally recommended to help distribute the weight across 3 or more studs. Many times the GC will supply and mount the plywood if the AV installer deems it necessary. Mounting to aluminum studs can be done with toggle bolts or lag bolts and fender washers. Wood studs are best suited for lag bolts with fender washers.

Most applications now use drywall to cover the studs. Drywall comes in either $\frac{1}{2}$ " or $\frac{5}{8}$ " thickness and is sometimes installed in two layers. Wood is sometimes installed over the drywall for esthetic purposes. If a wood surface is being mounted to, make sure that the wood is structural and not just a façade.

If you run into difficult to cut materials or expensive wall covers, it is usually a good policy to let the GC make the hole for you. It certainly doesn't hurt to ask and could save time and money.

Ceiling Construction

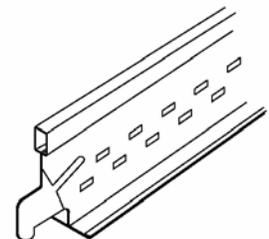
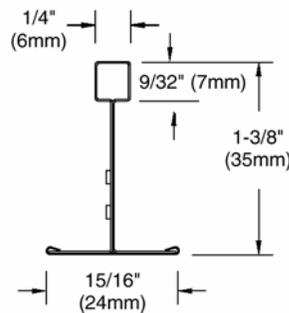
There are a number of different ceiling types, with the most common being drop tile, drywall, and open structure.

Drop Tile Ceilings

Drop tile ceilings incorporate a grid that is suspended from the ceiling with pencil rod. The drop distance can be a few inches up to 20+ feet. The grid is normally in 2' X 4' or 2' X 2' sections. After the grid is set in place, the tiles or pads drop into the grid. Most tiles cannot be installed into a humid environment as they tend to soak up the moisture and begin to sag. Therefore many construction sites will not install them before the air conditioning is on. It is best if the AV installer can have all cable installed prior to the tiles being put in place to minimize breakage and dirty fingers, plus it takes much longer.



Some local codes require that all cable be supported tight to the structure. In this instance, if the distance between the grid and structure is much more than a couple feet, the cable needs to be installed prior to the grid installation. The best way to pull cable in a drop tile ceiling is after the grid is up, but before the tiles have been put in place. This cable should always be tied up at least 12" so that it does not lay on the grid.



Tee Grid

When installing a loudspeaker in a drop tile ceiling, the installer cuts a hole in the tile and installs the loudspeaker assembly such that the can, supports and loudspeaker are behind the tile and the grill is visible from underneath. Don't cut the hole larger than the grill. It doesn't look very good. Nor do your fingerprints on a white tile.

Open grid ceilings use a similar (but more attractive) grid over all or a portion of the space, but do not put the tiles in. The grid can be used to support light fixtures and loudspeakers or nothing at all. Since the area above the grid is visible, the color of cable is important as well as how the cable is pulled. Most customers with a ceiling like this prefer not to see any cable at all.

Open to Structure ceilings

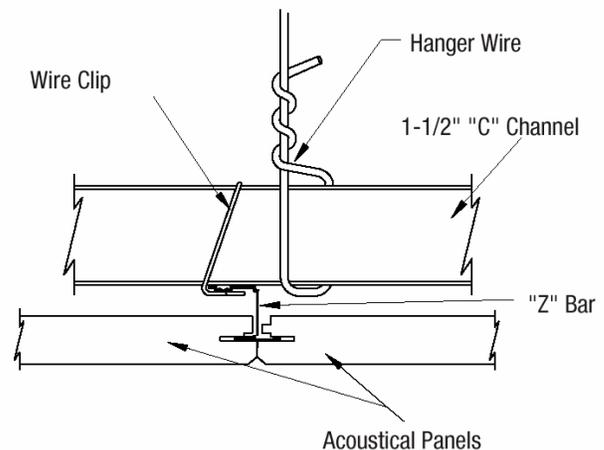
This could also be called no ceiling as there is nothing to there. Similar to the open grid, wires need to be concealed as much as possible. If the ceiling is going to be painted, the GC may want the speaker cable installed so that it can be painted as well. Open ceilings have become very popular in the last few years. They can present a challenge for loudspeaker placement and can often require a lift install the cable near the structure.

Drywall Ceilings

Often referred to as a hard ceiling, all cable must be installed prior to the drywall installation, unless conduit is provided between each device. Drywall ceilings also require a grid that provides a mounting point and support for the drywall.

Z-Spline Ceiling

Thankfully not as popular as the other types. It is a bit#@ to service and time consuming for the installer as the loudspeakers need to be installed while the tiles are being installed. A Z-spline ceiling must be installed one tile at a time working across the room. It is not possible to access a center tile without first removing a path of tiles from the key tile.



CONCEALED "Z" System

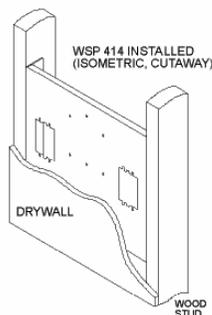
Plenum Ceilings

For our purposes, a plenum is an enclosed air space. Restaurant and retail stores are often constructed with the space above the ceiling acting as a return air plenum. By doing this, the builder does not have to install return air ducts for the HVAC system. However, anything in this space must not emit toxic fumes when subjected to fire. During a fire, any toxic fumes would be circulated back down where people may be trying to get out. Therefore, the cable manufacturers use a Teflon jacket that satisfies these requirements. Cables with this jacket are said to be *plenum rated* and are typically labeled as CL2P or CMP.

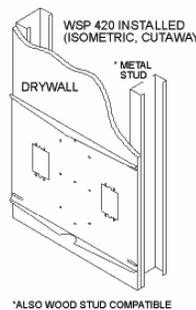
Ceiling Mounted Devices.

Any device that is mounted over people has the potential to hurt or fatally injure someone. It is imperative that all devices, no matter how small, be correctly mounted, supported and secured. All grid mounted loudspeakers should use angle iron rails to distribute the weight to the grid. Surface mount loudspeakers mounted from a drywall ceiling or wall should be mounted with toggle bolts. Ceiling mount televisions must be mounted directly to the building structure. Bracket manufacturers make different adaptors that are designed to safely install these devices in a number of different applications. If you are unsure or uncomfortable with an installation, don't do it. Consult a knowledgeable resource in regards to the situation.

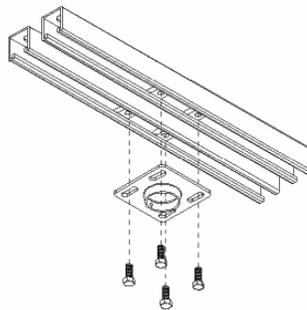
Several of the adaptors shown below require the installer to be involved at a fairly early stage in the construction process. Any kind of structural work that needs to be done should be completed in the prewire stage when the installer still has access to the structural support beams.



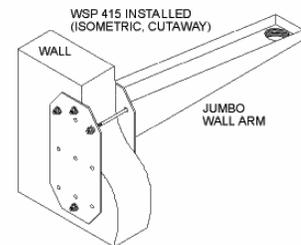
**Internal Wall
Adaptor**



**External Wall
Adaptor**



Ceiling adaptor



**Behind Wall
Support**

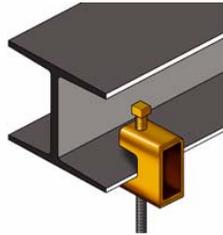
Roofs

Since we do a significant amount of satellite music, there is a good chance you may need to pull an RG-6 or RG-11 coax from the headend up to the roof. Hopefully there is stub with a weather head up to the roof to allow the cable to pass. If not, ask the GC what options there are. The next best alternative is to see if there is any access near the HVAC system. Often there is. The last option may involve penetrating the side of the building and caulking around the cable. What ever you do, do not ever penetrate the roof. A membrane roof is a continuous sheet that is very expensive to repair.

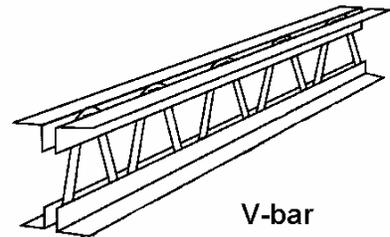
Acceptable structural mounting points:



Angle Iron



I - Beam



V-bar