Continental Electronics

DALLAS, TEXAS

Pre-Installation Manual

816R FM TRANSMITTERS

RF Specialties® Group

Continental Electronics
816R Series FM TRANSMITTERS

PRE-INSTALLATION GUIDE

This manual is intended to be a guide to help you prepare your transmitter facility for the installation of your new Continental FM Transmitter. This manual contains mechanical, electrical, and cooling information for the transmitter. It also contains shipping information and telephone numbers for Continental support personnel who will be working with your order. Please don't hesitate to call on us if you have any questions.

Please make this manual available to your installation engineer.

Continental Electronics

Factory Contacts

---

24 Hour Emergency Phone Numbers
Technical Service: (214) 388-5800
Parts Service: (214) 388-3737

*** Main Switchboard: (214) 381-7161**
Fax: (214) 381-3250
*8:00 AM - 5:00 PM Central Time, Monday - Friday
(Except Holidays)

Sales Department
Ext. 2304: Bret Brewer, Broadcast Marketing Manager

Contract Administration - Order Processing
Ext. 2346: Carol d'Happart, Contract Administrator

Shipping Department
Ext. 2378: Scott Robertson

4212 South Buckner Blvd
Dallas, Texas 75227

---

http://www.contelec.com

103328

816R Series FM TRANSMITTER PRE-INSTALLATION INFORMATION

GENERAL INFORMATION

Output Power

The 816R series transmitters cover the power range of 2.5kW to 35kW. The following table lists the power rating for each transmitter model in this series:

816R-1C	2.5kW - 11kW
816R-2C	10kW - 21.5kW
816R-3C	10kW - 25kW
816R-4C	10kW - 27.5kW
816R-6C	10kW - 30kW
816R-5C	15kW - 35kW

Table 1, Transmitter Rated Power

816R Series, (Except 816R-5C, 35kW Transmitter)

All the 816R series transmitters are completely self contained, including the harmonic or low pass filter, except the 816R-5C which has a separate plate transformer and rectifier cabinet. The primary power is connected to the main transmitter cabinet in all transmitters.

816R-5C, 35kw Transmitter

The 816R-5C plate transformer and rectifier cabinet has no controls, fans or blowers, interlocks, or circuit breakers and may be placed at any convenient location within 100 feet of the main transmitter cabinet. The ends of the plate transformer cabinet may be placed against other equipment or wall and the back may be placed as close as six inches from a wall or other equipment. It is only necessary to have access to the top and front side of the plate transformer cabinet. It will be necessary have one 2 inch and one 1 inch conduit between the main transmitter cabinet and the plate transformer cabinet. Primary power is connected to the main transmitter cabinet.

816R-1C	1611 lbs
816R-2C	1962 lbs
816R-3C	2000 lbs
816R-4C	2000 lbs
816R-5C	
Main transmitter cabinet	1657 lbs
Plate Transformer Cabinet	901 lbs
816R-6C	2100 lbs

Table 2, Transmitter Weight (approx)

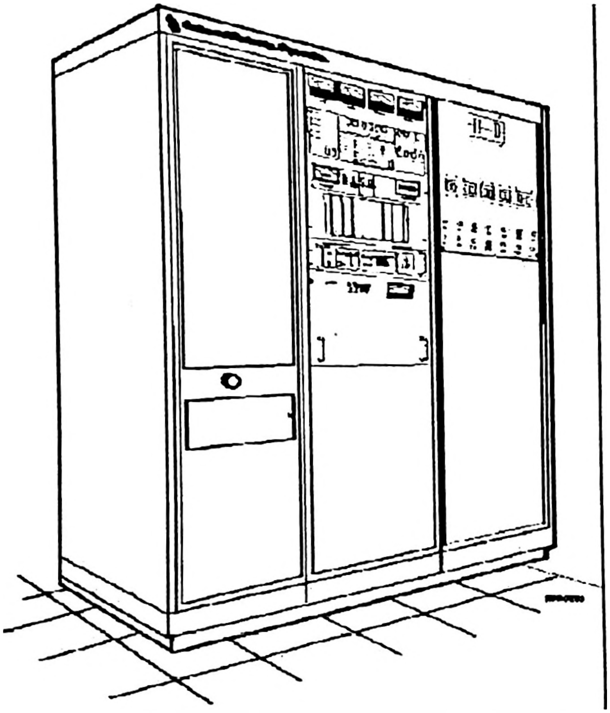


Figure 1, 816R-1C, 2C, 3C, 4C, and 6C

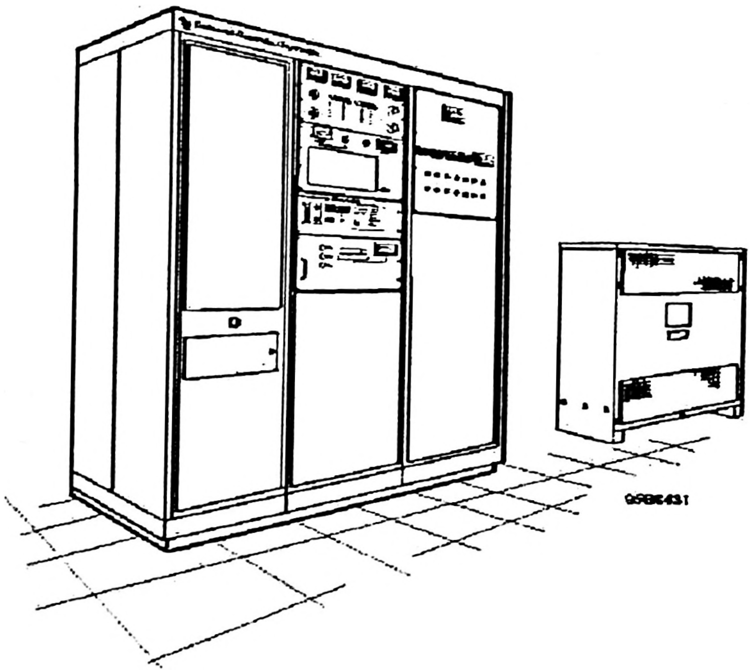


Figure 2, 816R-5C

TRANSMITTER ROOM

Figure 3 shows a sample floor layout for the 816R series FM Transmitters. There should be a minimum of 36 inches clearance at the front and rear of the transmitter. There is no requirement for maintenance access to the ends of the transmitter and the ends of the transmitter can be placed against other cabinets or a wall.

There should be adequate electrical outlets in the room so that extension cords are not necessary. The transmitter room should be planned so that the area around the transmitter is clear at all times for safety reasons. A workbench and storage space should be included in the transmitter room plans.

Arrange for all cable entrances to be on the same wall close to each other for proper grounding. Grounding will be discussed in another area of this manual.

In order to minimize the effects of wind on transmitter and building cooling, arrange for all air openings to be on the same wall.

Refer to Figures 4 and 5 for location of transmitter air intake and exhaust, wire entrances, and cabinet dimensions.

Concrete walls and floors must be sealed to eliminate the very fine concrete dust.

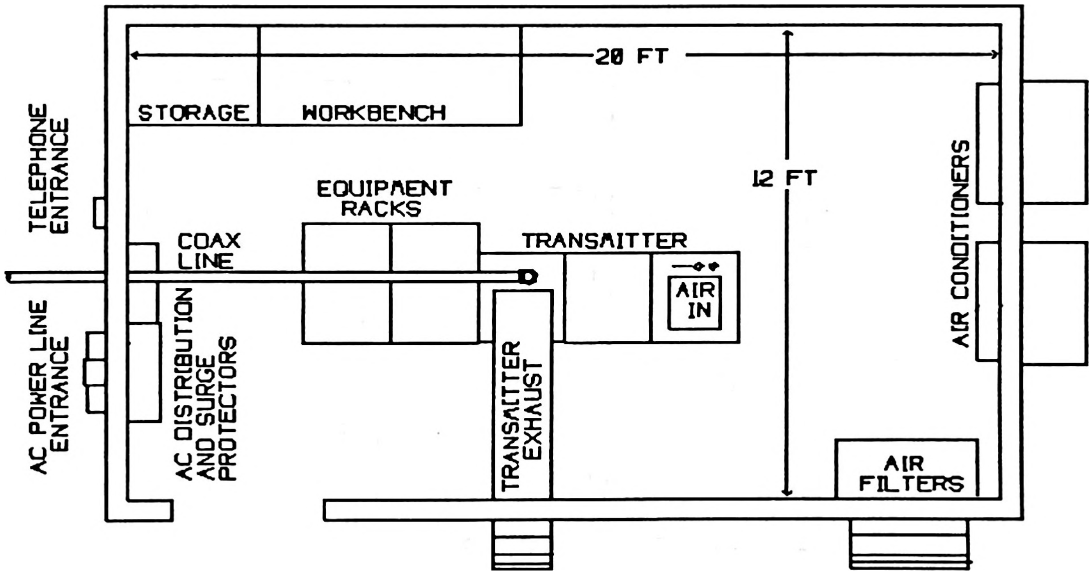


Figure 3, Sample Floor Plan

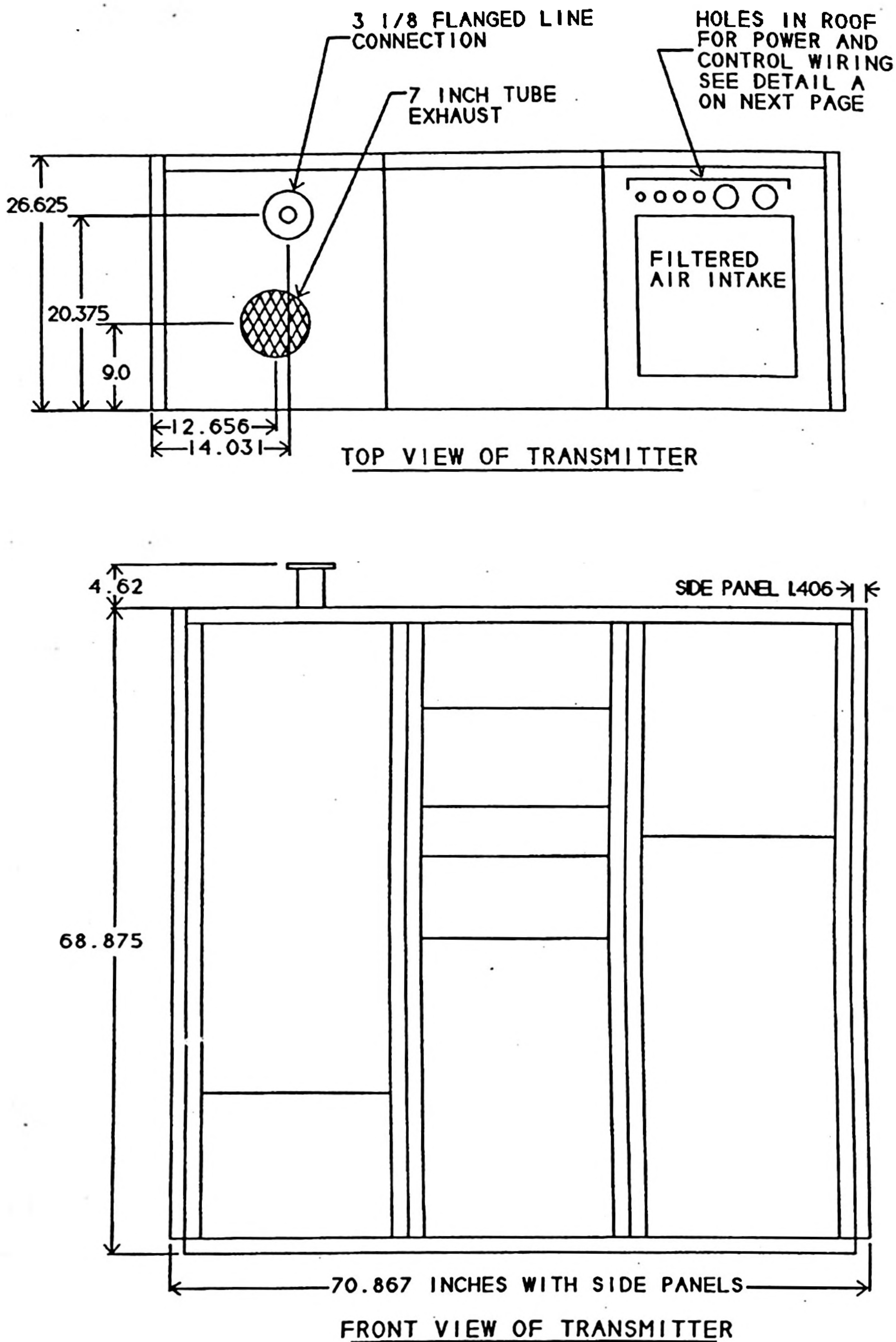


Figure 4, 816R Transmitter Cabinet Dimensions

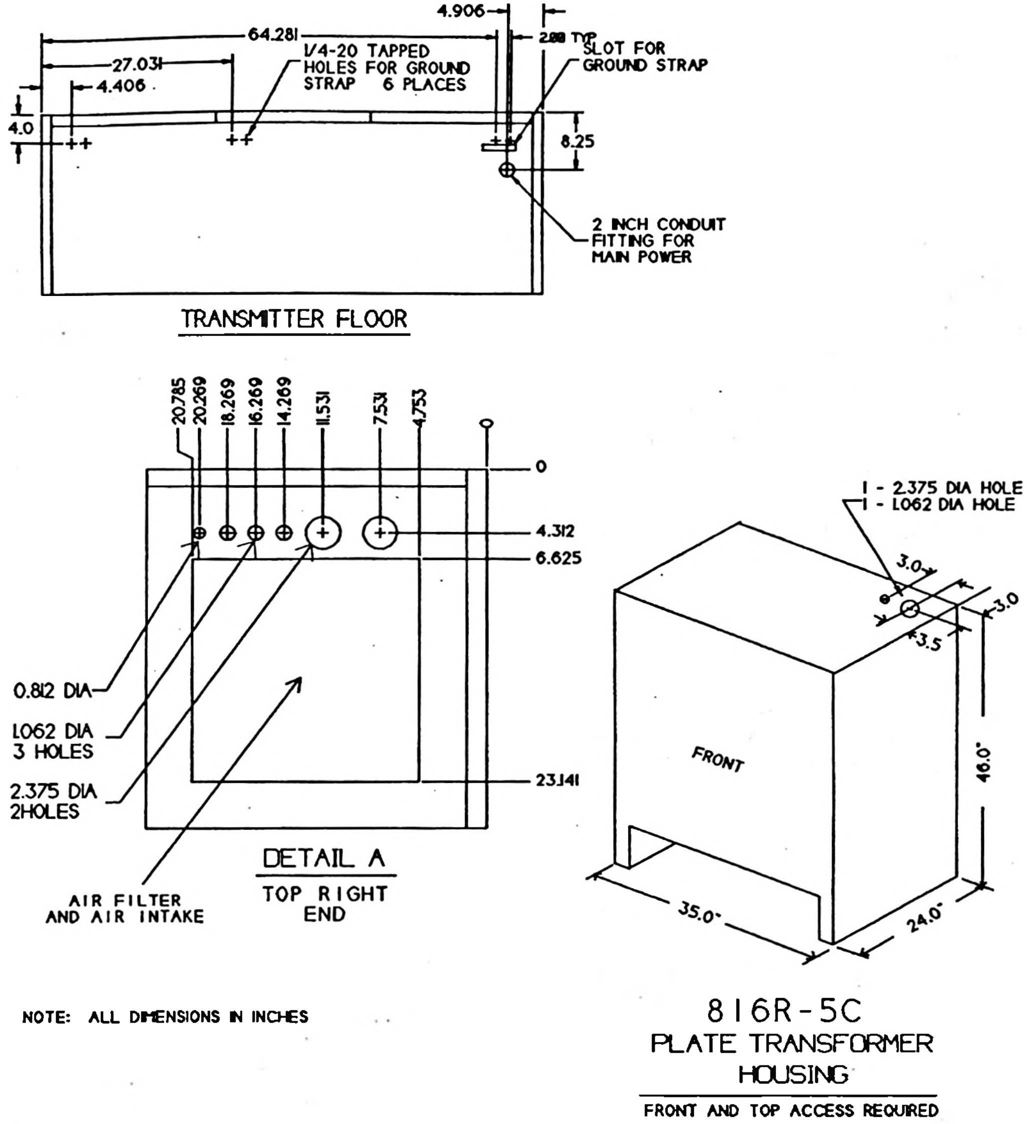


Figure 5, 816R Series Transmitter Dimensions

ELECTRICAL REQUIREMENTS

AC Voltage Requirements.

The transmitter requires three phase 200 to 250 volts, 50 or 60 Hz, AC primary power of either Wye or closed Delta configuration (**Do not use open delta**). Line-to-line balance must be within five percent both for voltage and phase when the transmitter is operating at desired power. Rotary phase converters are acceptable where commercial three phase power is not available. There are special considerations when rotary phase converters are used. The filament circuit must not be connected to the "manufactured" phase. Please call Continental Technical Service if considering this option.

Figures 4 and 5 show the location of the openings in the top and floor of the transmitter that can be used to bring the power cables into the transmitter. Power cables may be brought in through either a two-inch knockout in the top of the cabinet or through a two-inch round opening in the floor of the transmitter. If the floor opening is chosen, make certain that the AC wires do not come closer than two inches to the windings of the high voltage transformer.

In order to prevent heating of the fuse or breaker box contacts, the fuse disconnect box or the circuit breaker box should have a 200 amp rating. (Lower rated breakers or fuses may be used in the 200amp box). Use Table 3 on page 7 to determine circuit breaker or fuse rating for your transmitter power output. Fuses should be the slow blow type if used. The size of the power wiring is determined by local electrical code and good engineering practice, considering breaker or fuse rating. For safety reasons the breaker or fuse box must be located close to Transmitter.

Transient Protection

AC line transient suppressors are suggested for the primary lines. It is important to select the appropriate line to ground voltage rating for your transient protectors. The line to line voltage for a wye configuration is 208 volts and the voltage from each line or leg to ground of a wye power source is 120 volts AC. Refer to Figure 6, below.

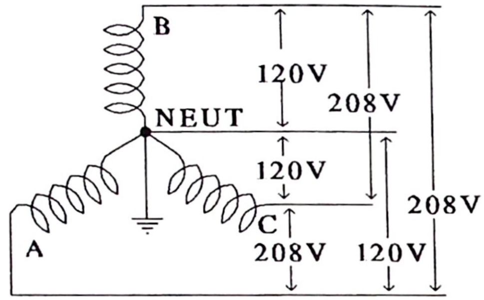


Figure 6, 120/208 volt Wye

Two of the three legs, phase A and C, of a conventional delta configuration are 120 volts AC with respect to ground and the third leg, Phase B, is 208 volts with respect to ground and should be positively identified before voltage is applied to transient suppressors. Refer to Fig 7.

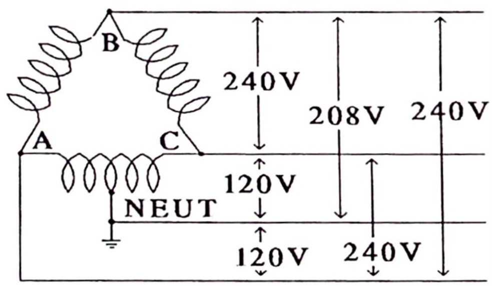


Figure 7, 120/240 volt Delta

This "high leg" is the B phase and should be marked with an orange color identifier. Before

AC power is applied to the transient suppressors, verify the voltage rating of the suppressors and the "high leg" connection to the suppressors where delta configuration is used. For recommendation, call your Sales Representative or Continental Technical Service.

TPO	kWatts	kVA	Approximate Line Current 210 volts line	Approximate Line Current 240 volts line
35kW	54.7	58.3	160 amps	140amps
30kW	47.6	50.7	139amps	122amps
27.5kW	43.2	46.9	130amps	113amps
25kW	40	43.5	120amps	105amps
20kW	32.1	34.9	96amps	84amps
15kW	25	27.2	75amps	65amps
10kW	18.8	20.5	56amps	50amps
5 kW	11.4	12.4	34amps	30amps
2.5 kW	7.9	9.1	25amps	22amps

Table 3, Electrical Power Requirements

ELECTRICAL GROUNDING

Grounding and equipment bonding is essential for personnel safety and reliable operation of your transmitter. An FM transmitter can operate without proper grounding but is almost certain to sustain extensive damage from power line and lightning transients. Without proper grounding and bonding, all equipment in a transmitter building will be extremely dangerous to personnel in that building during an electrical storm.

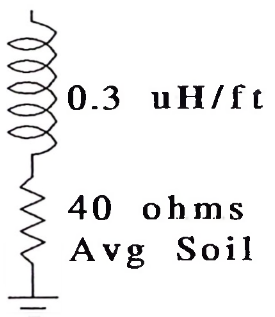
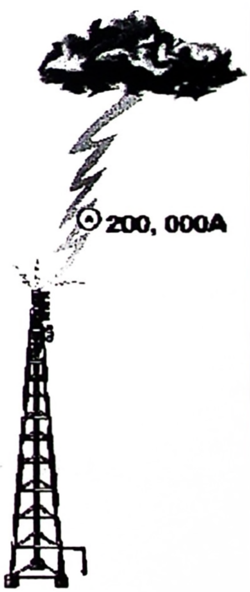


Figure 8, Ground Rod Imperfect Ground

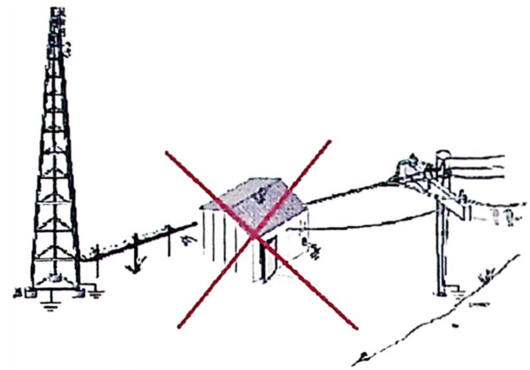
There is no perfect ground. A path to ground consists of inductive reactance and resistance. A ten foot ground rod in average soil will have about 40 ohms resistance and a round conductor connecting to the ground rod will have about 0.3 microhenries of inductance per foot.



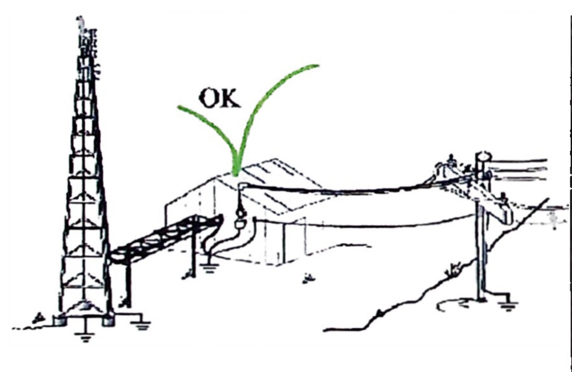
It is not uncommon for a lightning strike to have 200,000 amperes current. A typical lightning strike will have 20,000 to 30,000 amperes and a rise time of approximately one microsecond. If you consider a lightning strike of just 1,000 amperes, the voltage at the ground rod can be about 40,000 volts peak due to resistance alone. This is the reason for installing several ground rods at the tower and at your common earth ground point. To be effective, multiple ground rods should not be closer than ten feet. Usually four rods, connected with four inch copper strap, spaced around the tower will be required. Round conductors have approximately the same inductance regardless of size. Wide flat copper strap should be used to reduce the ground conductor inductance. If the soil conductivity is poor, it may be necessary to install a counterpose system much like that used for ground systems at AM towers.

Lightning does not have to make a direct strike on the power line to generate damaging currents and voltages. A strike close to the power lines will induce a current in all the lines including the ground conductor. Since there is no perfect ground, a lightning strike on or near the power company lines will cause fault currents to take a path to ground through your transmitter site ground system as well as the power company ground system. When your tower takes a lightning strike, fault currents will take a path to ground through the power company ground system as well as your ground system. **Install your ground system so that fault currents do not take a path through your equipment.**

Each coaxial cable and all protection devices for electrical and telephone lines that enter your



transmitter building must be grounded outside the building. The ideal situation would be where all cables and electrical service cables enter the building at one small area which is close to the station "earth ground" point. Individual ground straps from each coaxial line, a ground strap from the telephone protection block, a ground strap from the AC power transient protection suppressors, a ground strap from the transmitter, and a ground strap from each equipment rack in the building would come together at this common ground point. Do not install the ground system in a serial manner. Let there be just one ground



connection point and all ground connection are made at that point. This type of grounding system minimizes the possibility of fault currents taking a path through equipment to get to the "earth ground."

For personnel safety, all equipment inside the building must be bonded together. This includes any metal equipment or objects such as transmitters, cable trays, racks, transformers, conduits, etc.

Ground straps should be four inch wide copper to provide a low inductance path to ground. All strap connections must be secured between bolted plates or brazed because of the very high currents that are present during a lightning strike. Soft solder connection can melt and your ground path will open.

TRANSMITTER ROOM COOLING

Exhaust Ducted to the Outside

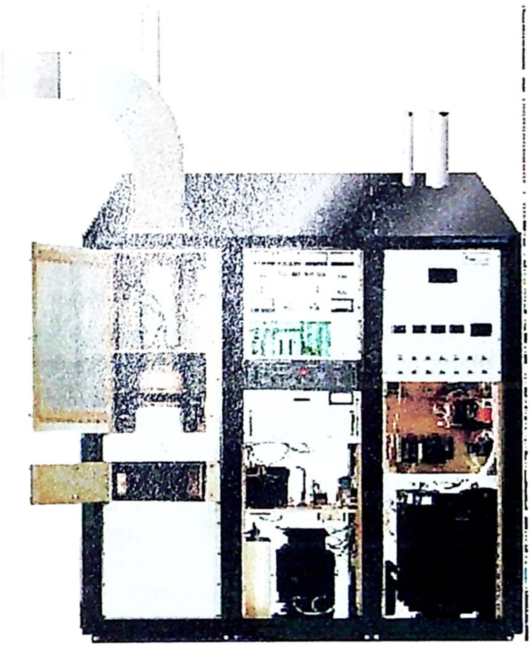


Figure 9, Smooth, Long Radius Duct

The transmitter exhaust may be ducted to the outside when air conditioning or ventilating the transmitter space. Careful consideration must be given to location of transmitter, air intake, and air outlet vents. First, consider where to place the transmitter. The transmitter exhaust will be vented to the outside and transmitter will take air from the room. Since the transmitter will exhaust to the outside, the exhaust vent on the transmitter should be placed as close as possible to an outside wall. The exhaust ductwork must be insulated to reduce heating to the room.

Do not duct the transmitter exhaust through the building roof. It is extremely difficult to leakproof ductwork through the roof. When the seal at the roof fails, water will come directly into the transmitter.

The ducts must be kept as short as possible to minimize back pressure at the transmitter outlet. Remember that elbows, vent caps, and hoods all add extra resistance to air flow through the transmitter. In most installations, the transmitter can be placed so that no more than eight feet of exhaust duct is needed. If this is possible, 16 inch round duct or the equivalent rectangular duct will be acceptable. Do not use more than two elbows. Use elbows that have long radius and are smooth inside. Refer to Figure 9. **Do not use flexible duct or adjustable elbows that can be adjusted for any angle between straight and 90 degrees**. These types have very rough interior surfaces with high turbulence and air resistance.

NOTE: Back-pressure

The maximum back-pressure at the transmitter exhaust must not exceed 0.1 inch H_2O.

There must be approximately 500 cfm of filtered replenishment air coming into the room from the outside if you duct the tube exhaust to the outside. The transmitter will "starve" for air if you fail to provide for this "make up" air. **A restriction of the air into the building has the same detrimental effect on transmitter cooling as a restriction at the transmitter tube exhaust.** It is not a good practice to connect more than one transmitter to the same exhaust duct. Let each transmitter have its own individual exhaust duct. Connect the ductwork directly to top of the transmitter using sheet metal screws. The transmitter cover is approximately two inches above the RF cavity and no harm will be done by attaching the duct to the transmitter cover.

Where possible, use large ductwork instead of duct fans. Duct fans may be required if the duct run is long or you have several elbows, but duct fans increase air resistance if they fail; therefore, some method of monitoring air flow and interlocking the transmitter must be used if there is no alternative to the use of duct fans.

It is a good practice to place the transmitter exhaust and the building air intake on the same building wall. This arrangement allows pressure from the wind to be applied equally to both inlet and exhaust, thus neutralizing the effects of wind on the air system. The exhaust air will be hot, and if returned to the room, will place an additional load on the air cooling system. Make sure that there is no possibility that the exhaust air can be returned to the building air intake. This is usually accomplished by placing the air intake high on the wall and directing the exhaust air downward and away from the intake opening. Always place the intake opening as high as possible to provide the cleanest air to the air intake.

COOLING BY AIR CONDITIONING

Air conditioning a transmitter space results in a clean environment for the transmitter and in some geographical areas, is essential because of high ambient temperatures, high humidity or very dirty conditions. You may duct the tube exhaust to the outside or re-circulate the tube exhaust back into the room. There is seldom a valid reason to duct the transmitter air intake to the outside. The transmitter cabinet fan is designed to move a large volume of air but not against air resistance. Where intake ducting is used, the intake duct must be very large in order to prevent air starvation. If the outside air is hot enough to require air conditioning, the transmitter should have the advantage of the cooler, cleaner air from the room.

Air Conditioning units are mechanical and may fail. It is ideal to have two identical units that are set to slightly (5 degrees) different temperature settings. Because air conditioners operate most efficiently when running continuously, select units that are marginal in their capacity when operating alone. Arrange a selector switch to swap the thermostats from one air conditioner to the other. This will allow both units to accumulate equal running time without changing the thermostat settings.

The following paragraphs will help you determine the heat load that the transmitter generates but does not include other equipment or the building heat load from the outside environment. Your HVAC contractor should be able to calculate the building cooling requirements.

CAUTION:

When you are totally dependant upon air conditioning equipment for cooling, the transmitter will overheat if the air conditioning equipment fails. Temperature monitoring, temperature interlocks, and remote alarms are essential where air conditioning is used.

Tables 4 and 5 show the approximate amount of heat that can be exhausted and heat that is vented to the room where the transmitter is ducted to the outside.

TPO	Heat Ducted outside	Heat To Room
30kW	51,199BTU	8,870BTU
27.5kW	45,879BTU	7,800BTU
25kW	43,495BTU	7,700BTU
20kW	37,525BTU	7,526BTU
15kW	31,024BTU	6,560BTU
10kW	24,096BTU	5,938BTU
5kW	16,954BTU	4,889BTU
2.5kW	13,809BTU	4,621BTU

Table 4, Heat Load, 816R-1C, 2C, 3C, 4C and 6C
(See Table 1 for transmitter rated power)

TPO	Heat Ducted Outside	Heat To Room
35kW	53,925BTU	13,310BTU
30kW	48,123BTU	11,945BTU
25kW	37,800BTU	11,347BTU
20kW	35,100BTU	9,951BTU
15kW	29,352BTU	8,532BTU

Table 5, Heat Load, 816R-5C

When the transmitter is ducted to the outside, you must account for cooling the replenishment air. If the outside air temperature is 100 degrees and you maintain 80 degrees in the transmitter room, you will require almost 11,000 BTU of air conditioning just to cool the 500 CFM of outside air.

Closed Air Conditioning System

If the transmitter can not be placed near an outside wall or the outside air is very dirty and can not be effectively filtered, you may want to vent the transmitter to the room and close off all outside opening to the room. This will provide the cleanest possible environment for the transmitter but with added air conditioning costs.

The transmitter heat load is very simple to calculate in this instance. The AC input power will be converted to RF and heat. The RF goes to the antenna and the heat will be vented to the room and must be cooled. Subtract the transmitter power output from the AC input power and the result is the power in watts that is converted to heat. The factor for converting watts to BTU is 3413 BTU/kWatt. If you have a TPO of 25kW, the transmitter AC power input will be about 40kW and there will be 15kW of heat. Multiply 15 by 3413 and you have 51,195BTU of heat delivered to the room from the transmitter or approximately four tons of air conditioning requirement for just the transmitter. Avoid the possibility of exhaust air returning to the transmitter air intake. If the ceiling is high, 10 feet or more, it is not likely that exhaust air will get back into the air intake.

The following table shows the approximate total transmitter heat load at different transmitter power output levels.

TPO	Total Heat Load
35kW	67,236BTU
30kW	60,068BTU
27.5kW	53,679BTU
25kW	51,195BTU
20kW	45,052BTU
15kW	37,584BTU
10kW	30,034BTU
5kW	21,843BTU
2.5kW	18,430BTU

Table 6, 816R Series Total Heat Load
(See Table 1 for transmitter rated power)

Air Cooled Test/Reject Loads

Air cooled test and reject loads should be placed in an area that is ventilated rather than air conditioned where possible. An air cooled test load operating at 25kW will place a heat load of more than 85,000 BTU on the cooling system.

If one transmitter fails in a 40kW combined system, the air cooled reject load will place a heat load of more than 34,000 BTU on the cooling system while on one transmitter.

COOLING BY VENTILATION

The 816R series transmitters can operate in a room environment where temperatures can be as low as -4 °F to as high as 122 °F. However it is generally accepted that reliability can be greatly improved with building temperatures that are lower than 80° F.

Exhaust Fans.

There are times when exhaust fans may be used to cool a transmitter space. It is better in this situation to vent the transmitter directly to the room or through a short duct to the attic and use exhaust fans in the room or the attic. It is important to arrange the transmitter exhaust so that there is no chance of re-circulation of exhaust air back into the transmitter.

If the room has a high ceiling (more than 10 feet), install a drop ceiling about eight feet from the floor. Vent the transmitter exhaust directly into the space above the drop ceiling. Let the transmitter take air from the room. Install air registers at the four corners of the drop ceiling that will allow air from the room to escape into the area above the drop ceiling. Install an exhaust fan that will evacuate the area above the drop ceiling. This method will not have the exhaust fan competing with the transmitter fan and blower, will prevent re-circulation (providing exhaust fan does not fail), and will provide ventilation for the transmitter space. There are variations of this scheme that will allow re-circulation (controlled by a thermostat) in the winter to heat the transmitter space.

Although exhaust fans and blowers are the most common method of ventilating transmitter spaces, they are not the best in some cases. Three reasons are listed below for choosing another method when there is a choice.

1. An exhaust fan allows unfiltered air into the transmitter room by expelling air from the room or building and pulling air into the room through any and all openings in the room. The transmitter space should be as clean and dust free as possible. It is not likely that the transmitter space can be air tight except for the filtered air intake. The unfiltered openings will allow dust and dirt into the transmitter space.

2. An exhaust fan may allow dead air spaces since it does not "stir" the air in a room. There is usually only one intended air inlet to a transmitter space and the air movement is from that inlet directly to the exhaust fan.

3. In installations where the transmitter is ducted to the outside and takes air from the room, the exhaust fan is competing with the transmitter cabinet fan and cavity blower for air through the same room air inlet. In this situation, the greater capacity of the exhaust fan will reduce the transmitter cooling if the room air inlet is not large in size. Where exhaust fans or blowers are used, the room air intake must be large enough so that the room in not under negative pressure. Negative pressure at the transmitter air inlet has the same detrimental effect as back pressure of the same amount at the transmitter air exhaust.

Positive Pressure.

Positive pressure ventilation forces air into the room and the air escapes through openings in the room and through the transmitter exhaust if ducted to the outside. The air may be forced into the room with propeller type fans or with centrifugal blowers. Propeller type fans move more air with smaller motors than will centrifugal blowers. A 30 or 36 inch fan is quiet and can move more than 3000 cfm of air into a room and use only a 1/4HP motor. Some of the advantages of positive pressure ventilation are:

1. All the air entering the room comes through one opening which can be easily filtered. When doors or windows are opened, air moves out through these opening.

2. A fan blowing air into a room will "stir" the room air, reducing the risk of dead air space. Deflectors at the fan can be used to direct air into areas that might not otherwise have moving air.

3. All fans aid each other. The fan that is forcing air into a room is aiding the transmitter fans in cooling the transmitter. All the fans, the room fan, the transmitter cabinet fan, and the power amplifier cavity blower are moving air in the same direction through the transmitter.

4. Like the exhaust system, the pressure system will also ventilate the room. The transmitter will exhaust about 500 cu-ft/min. of air to the outside. If the room fan is capable of moving three or four thousand cu-ft/min. of air into the room, another opening in the room must be provided for room ventilation.

An example of positive room ventilation will be described here. This is intended as an example and can be modified to meet your particular requirements.

Position the left end or the rear of the transmitter near an outside wall in order to keep the exhaust ductwork as short as possible. Position the transmitter so that the exhaust duct will not interfere with the coaxial RF output line. If the total duct run is eight feet or less and there are no more than two elbows, 16 inch round or the equivalent rectangular duct can be connected directly over the transmitter exhaust output using sheet metal screws. (Use care when drilling holes for sheet metal screws so as to avoid metal shavings falling into the transmitter.) The duct will have to be turned down at the outside to prevent rain and snow from getting into it. A bell type transition should be used at the end of the duct to reduce turbulence.

The duct at the transmitter exhaust will have a damper that will direct the exhaust to the outside or re-circulate the exhaust air back into the room.. The damper will be motor controlled so that the opening to the room will be closed off at the same time that the air from the transmitter will be directed to the outside. With the damper in the second position, the air from the transmitter will be directed to the room instead of outside. This arrangement will allow the transmitter to exhaust to the outside in the summer and re-circulate to the inside in the winter.

A fan that has enough capacity to change the room air at least once each minute is installed in the wall. This fan pulls filtered air into the room through motor controlled louvers. A 3000 cfm fan will change the air once a minute in a 15X20 foot room having a 10 foot ceiling.

An opening with motor controlled louvers is provided in the same wall where the fan is mounted. The reason for intake fan and room air outlet being on the same wall is to minimize the effects of wind on the ventilation system. If both inlet and outlet are on the same wall, the effects of wind, regardless of direction, is neutralized since the wind pressure is the same on both. The transmitter air exhaust should be on this wall also. The transmitter exhaust should be positioned so that there is no risk of re-circulation.

With motor control on inlet and outlet louvers and transmitter duct damper, it is possible to control the operation of louvers, dampers, and the ventilation fan with thermostats. Set the thermostats to maintain the required equipment operating temperature at all times. Three conditions are described below:

1. At temperatures above 85 °F, a condition of maximum ventilation and cooling will result. The transmitter will be ducted to the outside and the intake fan will be running. The outlet wall louvers will also be opened to permit room ventilation.

2. For temperatures between 65 °F and 85 °F, a condition of minimum ventilation will exist at times when it is not necessary to run the room intake fan, but the transmitter should be vented to the outside. Under these conditions the transmitter exhaust dampers

will direct the transmitter exhaust to the outside, the outlet wall louvers will be closed, the fan will be off, and the inlet fan louvers will be open to allow fresh filtered air into the room and transmitter.

3. For temperatures below 65 °F, a condition of re-circulation for heating will exist. The transmitter exhaust damper will be positioned to allow transmitter exhaust air into the room and all outside outlets and inlets will be closed.

The system described will require two heating type thermostats and control relays. One will be set to approximately 65 °F and the second will be set to approximately 85 °F.

The thermostats should be mounted approximately six feet off the floor and in an area of the room where the temperature is not influenced by heat radiated by the transmitter or by direct air flow from the room intake fan.

The transmitter space should also be provided with a thermostatically controlled heater that can be set to approximately 50 °F. This will provide heat during maintenance periods or during times that the transmitter is off-the-air, if not a 24 hour operation.

TRANSMITTER DELIVERY

The delivery time from pickup at our factory to major points within the US is approximately five working days and approximately eight working days for outlying areas.

The transmitter will be transported by large tractor and trailer combination (18 wheeler). You should request a site survey before shipment, if the transmitter site is difficult to access. This survey will determine if the large truck can deliver directly to your site and if additional people or special equipment or handling is required. There is a small charge for this survey.

The Van Line will provide a driver and one helper to deliver, remove transmitter from shipping skid, and place the transmitter where you want it on the ***ground floor*** of your facility when accessible by 18 wheeler.

Continental will arrange insurance when booking the transporting of your transmitter if you, the consignee, request insurance. The insurance will stop at the point of delivery by the Carrier (Van Line) that picks up at the factory unless special arrangements are made before shipment.

Please contact Scott Robertson, our shipping co-ordinator, at (214) 381-7161, ext 2378, if you have any questions about shipping, delivery, site survey, or insurance.

YOUR COMMENTS PLEASE:

It is our goal to provide useful information to you. It is by our Customer's suggestions and comments that we are able to improve our service and products. Please let us know what you think of this "Pre-Installation Guide" and what are your suggestions for improvement?

Please send your comments and suggestions to:

E-Mail
rgarrett@contelec.com

or

FAX

Richard Garrett (214) 381-3250

or

Continental Electronics
Richard Garrett
4212 South Buckner Blvd.
Dallas, TX 75227