QWEST Communications International Inc. Technical Publication

COMMERCIAL CUSTOMER PREMISES ELECTRONIC EQUIPMENT ENVIRONMENTAL SPECIFICATIONS AND INSTALLATION GUIDE

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NOTICE

This document describes the Environmental and Installation Requirements, as well as the Powering and Grounding options for Qwest Telecommunications Equipment to be placed on the Customers' Premises. This document applies only to services that require the placement of Qwest digital multiplexing and/or switching equipment. The space may be wholly owned by the customer, leased by Qwest, or owned by the building owner or another tenant. In other words this document covers all Customer Premises applications.

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If further information is required, please contact:

QWEST Communications International Inc.
Manager – New Services Planning
700 W. Mineral Ave. MN-F15.15
Littleton, CO 80120
(303) 707-7107
(303) 707-9497 Fax #
E-mail: jhsmit2@qwest.com

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Qwest
Manager - Writing Services
1801 California, Room 1330
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1. Introduction

1.1 General

This document describes the Environmental and Installation Requirements, as well as the Powering and Grounding options for Qwest Communications Telecommunications Equipment to be placed on the Customers' Premises. This document applies only to services that require the placement of Qwest digital multiplexing and/or switching equipment. The space may be wholly owned by the customer, leased by Qwest, or owned by the building owner or another tenant. In other words this document covers all Customer Premises applications.

1.2 Scope

There are many services sold by Qwest where the economical option for delivering these services is to place Telecommunications Equipment on the Customers Premises. (This publication covers business-type customer premises equipment, such as multiplexers, digital loop carrier, etc. It does not cover residential CPE, such as DSL modems placed in a computer, telephones, etc.). Sometimes the end-user customer of the Qwest services owns the space outright, but allows Qwest to place its equipment there in order to serve them. Other times Qwest leases the space from the customer or a third party. In other cases the equipment is allowed to be placed in space owned by a third party for use by Qwest customers. Some of this telecommunications equipment comes in pre-packaged lockable cabinets that can be placed in many locations in a building. In other applications it is mounted in relay racks in an equipment or mechanical room. Sometimes it will share rooms with other telecommunications equipment providers, or with the telecommunications equipment owned outright by customers (e.g., PBX).

In all cases, decisions must be made up front about items such as backup Power, Alarms, Distributing Frames, Equipment floor space, Equipment Environment, etc. All of this requires the coordinated effort of the various Qwest Marketing groups, Designed Services group, Engineering, Installation/Construction and the Customer. Coordinated effort by these groups in adherence to the requirements and guidelines of this document will ensure that the customer receives safe and reliable telecommunications services from Qwest.

1.3 Reason For Reissue

This publication is being re-issued primarily to update installation requirements, and add guidelines around checking for post-tensioned floors in high rises in Earthquake Zones 3 and 4. New information is also available to help building owners size HVAC.

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2. General

2.1 Safety and Reliability

As mentioned in the introduction, proper up-front coordination between Marketing and the various Engineering Centers can ensure that many of the standards contained in this document are met. Engineering, Installation, and Construction are then responsible for Installing the equipment on the Customers' Premises according to the standards of this document. Finally, installations will be randomly audited by Qwest Quality Inspectors to ensure conformance to the requirements and guidelines of this document.

Reliability of the telecommunications Network on the Customer's Premises increases Qwest's chances of retaining the customer(s), and selling additional services. Also Qwest does not suffer lost revenue due to outages. Reliability increases the customers' ability to serve their customers; thereby increasing their revenues. Safe telecommunications equipment safely installed in a safe environment, with safe backup power, will ensure that neither the customer, their customers, nor Qwest personnel are harmed by potential hazards.

For example, if the guidelines of Section 5 are followed, and the DC rectifiers serving the Qwest telecommunications equipment are fed from an AC source backed up by a building standby generator, service is much more likely to remain working during prolonged commercial AC power outages. If two-hole lugs are used for power and grounding connections, as suggested in Sections 6 and 7, the connections are much less likely to become loose. Loose connections can result in short or open circuits, impairing service from the equipment fed by that circuit. Proper remoting of housekeeping and network element alarms per Section 8 will ensure quick response.

When the telecommunications equipment is properly grounded (Section 6), not only will it be more reliable, but it will protect personnel from shock. Proper installation practices (Section 7) will prevent sharp edges that can cut. Proper implementation of the environmental and power guidelines (Sections 4 and 5) will prevent abnormal battery venting of toxic and explosive gasses.

By taking the extra time and spending a little more money to ensure that the requirements and guidelines of this document are followed, there are both short-term and long-term monetary benefits to the customer and Qwest. The reliable service produced from adherence to these requirements also fosters an incalculable good will that will help ensure a long term relationship between the two parties. These gains (both monetary, and in customer confidence) far outweigh any small added costs that adherence to these standards cause. This document is beneficial to both the customer and Qwest.

As mentioned, requirements and guidelines for Customer Premises equipment space cannot be as strict as those applied to Qwest-owned space, simply because Qwest does not own the space. For purposes of this document the following terms denote whether a requirement is absolute (must be met) or not:

- SHALL, MUST — denotes requirements which must be adhered to for basic personnel safety and basic reliability
- SHOULD, ADVISABLE, DESIRABLE — guidelines which would improve reliability and safety, but do not have to be absolutely followed (suggestions)

Equipment reliability and safety can be ensured by 3rd party testing to Telcordia's NEBS documentation: GR-63-CORE, GR-1089-CORE, and SR-3580. NEBS Level 1 indicates that equipment is not flammable, and will not radiate harmful levels of electro-magnetic wave interference (RF, EMI or EMF). NEBS Level 2 additionally indicates that the equipment will function reliably. NEBS Level 3 additionally indicates that equipment will stand up to earthquakes expected in Zones 3 and 4 (see Section 4.5 for more information on earthquake zones and ratings). Qwest does not require that equipment placed on the Customer Premises be NEBS-certified (we do require that our equipment placed on Customer Premises meet the NEC and applicable UL (or other approved Listing agency) specifications (like UL 1950). However, it is a good idea that Qwest equipment at least be designed to NEBS specifications. If our equipment will be collocated in a room with other telecommunications equipment providers, it doesn't hurt to ask if their equipment is designed to meet NEBS.

2.2 Types of Customer Premises Installations

This document deals with all types of Customer Premises installations. For purposes of this document, Customer Premises installations are divided into two types of sites, regardless of the ownership or lease status of the property.

Most Customer Premises applications that involve telecommunications equipment that can fit into one or two relay racks come pre-packaged in a lockable cabinet. Most of these cabinets sit on the floor, although some may be mounted to walls. In some cases, when more than two relay racks full of equipment are needed to serve the customer, multiple cabinets are placed.

These cabinets can be placed in many different locations in a building, and are unobtrusive, as the equipment inside cannot be seen when the doors are locked. However, these cabinets should not be placed just anywhere. Particular attention should be paid to the environmental requirements of Section 4. As an example, these cabinets generally contain batteries, which need a good environment to remain safe, maintain capacity, and not overload the floor with their weight. The cabinets also contain circuit packs, which need a relatively clean environment that is not too hot. Otherwise the circuit packs will fail before their life cycle is complete.

In most cases where there is a need for more than two relay racks of equipment, the equipment is placed in standard telecommunications relay racks (typically with 23" wide standard mountings). This is the second type of site. Because the telecommunications equipment is "exposed" to view, most of these types of installations are in equipment or mechanical rooms in a building. Again, care must be taken in the selection of the location for this equipment, especially with regard to the environmental requirements of Section 4, such as heat, and floor loading.

The requirements and guidelines that follow in this document apply to both cabinet and relay rack installations.

In a multi-tenant building or campus, multiple customers can be served from one installation anywhere in the building or on the campus. However, Qwest must either lease the space outright from the building owner, or procure space for the placement of equipment from said owner in all Customer Premises installations. Qwest is not allowed to sublease or deal with individual lessees in a building when procuring space for the placement of telecommunications equipment.

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3. Site Survey Check List and Site Selection

The assistance of other engineering groups may be necessary to assure that the site will be ready prior to the digital equipment start date. The building owner's building Engineers may need to be consulted if any building work is required on the Building / Owner or Customer's property for Non-Leased Floor Space. For leased space, the Qwest Real Estate Engineers may be consulted.

Many of the items in the checklists of this section are explained in greater detail in subsequent sections. In fact, similar tables are found in Section 10 of this document for use by Marketing. These Tables in this Section have enough detail to provide good checklists for Field Engineers, and they can refer to Sections 4 through 7 for greater detail. They are intended for use after an initial agreement has been reached with the Premises owner / customer. The Tables in Section 10 are simplified for up front use by Qwest Marketing organizations.

3.1 Unsuitable Customer Premises Locations

Some locations which may be offered by Premises owners, are unsuitable for the installation of Qwest telecommunications digital equipment. These types of locations / rooms are as follows:

- Near flammable materials including easily ignitable dusts and gases.
- Corrosive atmospheric or environmental conditions
- Projections into work areas, passageways or other hazardous locations.
- Upper areas requiring access by ladder.
- Humid, moist or flood-prone areas.
- Near power circuits and electrical equipment.
- Near moving machinery.
- Heat, direct sunlight
- Boiler rooms
- Washrooms
- Janitor's closet
- Any place that contains: Steam pipes, Drains, Clean-outs

In areas that Qwest considers hazardous or inaccessible to its employees, the customer will be required to make the appropriate changes to the space or Qwest will not place telecommunications equipment.

3.2 Floor Space and Clearance Requirements

For leased space, extra space is needed outside of the leased area for Network Interfaces (NIs).

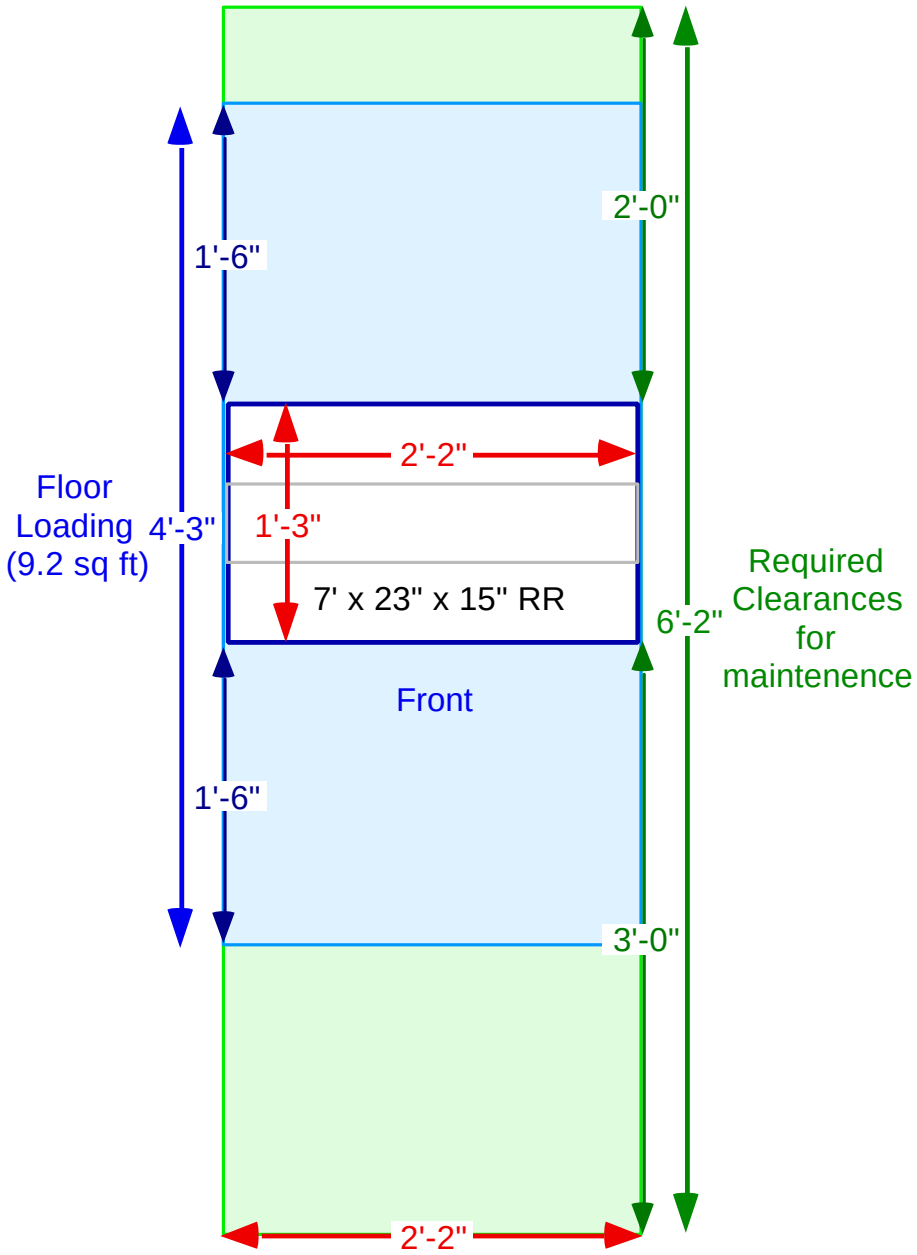

Figure 3-1 Maintenance and Floor Loading Clearances

As a general rule, there should be three feet of clearance in front of relay-rack mounted equipment for maintenance, and two feet behind the equipment (see Figure 3-1). Up to eighteen inches around the relay rack may be used for floor loading calculations (see Section 4.4 for exceptions to this rule, and more information on floor loading). Customer Premises cabinets require three feet of maintenance clearance on both sides of the cabinet (see Figure 4-1).

If it is desired to place relay racks against a wall, all of the equipment and wiring mounted in those racks should be 100% accessible from the front. Some Customer Premises cabinets may be mounted against a wall If there is three feet of space in front of all cabinet doors.

For relay rack lineups that exceed twenty feet in length, the end aisle clearance on both ends should be two feet. This is a good idea even if the lineups do not exceed twenty feet.

3.3 Customer Premises Environment and Space Pre-Site Checklist

Table 3-1 contains a quick reference checklist for some of the items specified in much greater detail in Sections 3, 4, and 7. This checklist should be used before engineering and installation activity begins in a site. Some of the items found in this pre-site survey may cause re-evaluation of the space selected for installation of Qwest digital telecommunications equipment, or will drive an upgrade of the selected site.

Qwest may also desire additional floor space (convenient to where the equipment will be located) to permit secure storage. If so, ensure that the appropriate Qwest Marketing Group becomes involved to negotiate this with the customer.

Table 3-1: Field Engineer's Customer Prem Pre-Site Environmental & Space Checklist

Requirement	Notes/Description	Response
1. Temperature	Are air conditioning and heating systems sufficient to maintain room temperature between 55-85 F? (Necessary if batteries are in room).	
2. Humidity	Is the Operating Relative Humidity between 5% and 55%?	
3. Ventilation (Min 0.5 ach)	Is ventilation sufficient so air is changed with external air at least once every 2 hours? (Absolutely necessary if batteries are in room).	
4. Air Filtration	Is the room air filtered?	
5. Size of Equipment area	Are width, length, and height of area available to Qwest large enough to place the equipment? The space should also be large enough to accommodate anticipated growth. (Refer to appropriate Configuration to determine the floor space requirements of equipment being placed).	
6. Floor loading	The building owner should state what the floor is capable of supporting in terms of lb / ft^2.	_____ lb / ft^2
7. Sealed Floor	Is the floor sealed or covered? (Asphalt tile, linoleum tile, static free carpet, or sealed concrete are acceptable floor coverings).	
8. Walls	Are the walls at least 8'6" (102 inches) tall?	
9. 4'x4' plywood backboard	Is there sufficient wall space for NIs? (For mounting of terminations, a minimum 4' x 4' wall space with a $^3/_4$" fire-retardant plywood backboard, with 36" clearance in front of it, is required).	
10. Batten Boards	Are 2"x 8" batten boards installed with the lower edge at 6'9" (81") for mounting cable rack? (See section 7.2 of this document for further info. and guidelines on the installation of cable rack and framing.)	
11. Fire detector and extinguisher	Is fire safety equipment there? (It's preferable not to place equipment under sprinklers — see Section 4.6 for further info. on fire systems.) Equipment area should have fire detection and a fire extinguisher.	
12. Fire Stopping	Are cable openings into the equipment space fire stopped? (Qwest will fire stop any opening they use to cable to the digital equipment).	
13. Asbestos	Is the room free of asbestos?	
14. Lighting	Is there sufficient lighting in room? (Intensity of 50 ft-candles at 3 feet above floor level is recommended. Make sure lighting not obstructed).	
15. Access	Does Qwest have 24 hr, 7 day a week access?	
16. Security	Is room secure? Is Qwest sole service provider in room? (Locked cabinets recommended in locations not solely occupied by Qwest).	Secure:___ is Qwest Sole Occupant:__
17. Post-Tension Floors	If in Earthquake Zone 3 or 4 (see section 4.5), and building is over 2 stories, must check with bldg owner to see if any floors have post-tensioning cables. If so, or if unsure, must X-ray before making cable holes, or placing ceiling supports or floor anchors.	
If any of the above conditions are not met	Is building owner willing to make the necessary improvements? (For non-leased space, if building owner is not willing to make necessary improvements, Qwest won't place digital electronics. For leased space Qwest can make the upgrades a condition of the lease, or the Qwest Real Estate department can contract the improvements).	

3.4 Customer Premises Power and Grounding Pre-Site Checklists

Tables 3-2 and 3-3 contain quick reference checklists for some of the items specified in much greater detail in Sections 5, 6, and 7. This checklist should be used before engineering and installation activity begins in a site. Some of the items found in this pre-site survey may cause re-evaluation of the space selected for installation of Qwest digital telecommunications equipment, or will drive an upgrade of the selected site.

Table 3-2: Field Engineer's Customer Premises Pre-Site Power Checklist

Requirement	Notes/Description	Response
1. AC Power	Is AC Power available? (Refer to the appropriate Configuration to determine the voltage, breaker size, the quantity of feeds necessary, and the type of receptacle required to feed the equipment being placed).	
1.1	What is the Nominal Voltage and Phase? (120 V 1-Ø, 240 V 1-Ø, 120 / 240 V 1-Ø, 208 / 120 V 3-Ø, or 480 V 3-Ø).	_____ Volts
1.2	Is the customer providing Essential AC Power (AC that is backed up by a standby engine-alternator), and / or Protected AC power (backed up by a UPS). Either of these situations is desirable.	
1.3	Can Qwest equipment be powered directly from AC (no DC plant needed). This is only allowed if the customer provides Protected AC power, and the customer agrees to not hold Qwest liable for power outages; or is allowed where backup is not needed (see section 5.4).	
2. -48 VDC Power	What are the total forecasted List 1 and List 2 drains of the equipment to be served. Ensure that a DC Power plant and batteries are provided to meet these drain needs. (Customer Premises standard cabinet configurations come pre-configured with an appropriately sized DC power plant and batteries.)	
2.1	Is the customer supplying the -48 VDC power? If so, refer to the appropriate Configuration to determine the DC current drain, and the quantity of feeds necessary to feed the equipment being placed, and procure these from the Customer. (Procuring -48 VDC power from the Customer is allowed only under certain circumstances specified in Section 5.3.)	____ # of feeds ____ Amps / feed
3. Residual Ringing	Is there any equipment which requires residual ringing (i.e., the ringing is not sufficiently provided by cards in the shelves)? If so, ensure that a DC plant with ringing, or a residual ring plant, is procured to feed these residual ringing loads.	
If AC or DC power is not available	Is the building owner willing to make the necessary improvements? (In the case of non-leased space, if the building owner is not willing to provide power Qwest will not place digital electronics. In the case of leased space Qwest can make the upgrades a condition of the lease, or Real Estate can contract an electrician to make the necessary improvements).	

Table 3-3: Field Engineer's Customer Premises Pre-Site Grounding Checklist

Requirement	Notes/Description	Response
1. Building Ground	Does the equipment room have a ground bar that is connected to a building ground source by a #6 AWG copper wire? (Recommended building ground sources in order of preference are: driven ground system, metallic water pipe, continuous and bonded building steel, ACEG, or AC neutral — see Section 6.2 for further information — it is most preferable to have at least two of these sources)	
If ground is not available	Is the building owner willing to make the necessary improvements? (In the case of non-leased space, if the building owner is not willing to provide a good ground to Qwest, then Qwest will not place digital electronics. In the case of leased space Qwest can make the upgrades a condition of the lease, or Real Estate can contract an electrician to make the necessary improvements).	

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4. Environmental Requirements

The environment is which Digital Technology Equipment resides must be maintained to proper conditions in order to minimize service outages and economically optimize the usable life of the equipment. These conditions encompass the construction of equipment space, installation or removal of equipment, and ongoing maintenance. Digital Equipment contains a high number of components on the circuit boards. For purposes of this Technical Publication, all equipment placed on the Customers' Premises is classified as Digital Equipment.

The standards of this section shall be read as absolute requirements for all Qwest owned or leased space that houses Digital Equipment. They shall also be fully applicable when equipment is placed in a customer's residence. Vigilance is needed in these cases because residential homes are not generally built to the same environmental standards as work/equipment buildings.

When Digital Equipment owned by Qwest is located in Non-Leased equipment floor space, this Document should be used as an Environmental Recommendation to the Customer or Building Owner for optimal equipment operation.

Qwest has recognized the need for a cleaner and more protective environment in the operating envelopment within which Digital Technologies are deployed. Many operational problems, circuit failures and service outages have been attributed to poor environmental conditions. These must be managed to minimize failure of Digital Technology Equipment. For optimal customer equipment operation, the requirements of the succeeding subsections should be met.

4.1 Temperature and Humidity Guidelines

Low levels of humidity can increase the probability of Electrostatic Discharge (ESD) from personnel not using ESD-protection techniques. High levels of humidity can result in electrolytic corrosion, and can also result in electrical leakage when there is also dust, corrosive chemicals, and chemical corrosion products in the environment.

High Temperature ranges and rapid variations can cause thermal shock to components. Constant circulation of filtered air reduces hot spots and minimizes rapid temperature changes.

Environmental requirements for optimal equipment operation are described in Table 4-1 below:

Table 4-1: Environmental Requirements For Optimal Operation

Normal Operating Temperature Limits (can be tighter)	55° to 85° F
Maximum Rate of Temperature Change	2.5° F per 10 minutes
Short Term Temperature Limits	40° to 120° F
Normal Equipment Extended Operability Temperature	40° to 100° F
Operating Relative Humidity	5% to 55%
Short Term Relative Humidity	5% to 90%

Notes:

1. "Short Term" is defined as not more than 72 consecutive hours and a total of not more than 15 days in 1 year.

2. The Digital Equipment Qwest places in Customer Premises equipment space is designed to operate between the Normal Equipment Extended Operability Temperature ranges of 40° to 100° F. However, the equipment (especially the batteries) will last longer and pose fewer safety dangers if the equipment is operated in a room where ambient is maintained between the Normal Maximum Operating Temperature Limits of 55° to 85° F (and even tighter if possible). Ambient temperature should be measured at a height of 5 feet above the floor, and 15 inches out from the equipment (or in the center of the aisle if it is narrower than 30 inches).

3. Although the lower humidity guideline of 5% is in accordance with Telcordia's NEBS (GR-63-CORE), this assumes that technicians are wearing their wrist straps (or practicing other ESD-dissipation techniques) when working on Digital Equipment. Wrist straps are the most cost-effective method of controlling ESD. Humidification is very costly and does not totally eliminate ESD events (although it does reduce their severity) if wrist straps are not worn. However, if humidification equipment is deployed and used in the site, it should ensure a minimum indoor relative humidity of 20% (humidification up to 40% can be even more effective, but up to 10 times more costly).

Temperature and high humidity are generally controlled with the HVAC (Heating, Ventilation and Air-Conditioning) system. The owner of the Premises is responsible for HVAC systems which can ensure that temperature and humidity meet the guidelines of Table 4-1.

It may be wise to use more than one HVAC unit or system to meet the load needs. This is wise engineering practice, which protects against outages. As an example, there may be two compressors, each sized to handle 60% of the load. Multiple system components should be designed in such a way that if one component fails, the remaining component(s) should be able to maintain the short-term temperature, humidity, and temperature rate of change guidelines of Table 4-1.

In order for a building owner or their engineer to determine if their HVAC system is adequate, they must know the approximate heat releases of the Qwest equipment.

The building HVAC system should easily be able to handle average NEBS heat spread release of 35 W / ft^2. This is equivalent to about 500 W per standard front and rear equipment relay rack, 300 W per front-access only relay rack, and 650 W per Customer Premises 2-sided cabinet. The higher NEBS heat release level (which requires notification of the customer, and potential upsizing of the HVAC for the room), is 80 W / ft^2. This is equivalent to about 1200 W per standard front and rear aisle relay rack, 700 W for front access only relay racks, and about 1500 W for a Premises cabinet.

Average heat release information is given by the vendors. If this cannot be obtained, it can be estimated from List 1 (average) power drains given by the equipment vendors:

$$P_{DC} = I \times V$$

Where I is the List 1 drain in Amperes (Amps), and V is the voltage (normally about -54.5 in a Customer Prem DC plant). The result, P (Power) will be in Watts (W).

Sometimes, the vendor will only give List 2 (peak) power drains. A rough estimate of List 1 drains is 30-40% of the List 2 drain.

If none of the above can be obtained, the rawest estimate can be done using the size of the power plant. Using the formula above, I (the Amps) would be represented by the total capacity of the rectifiers minus one rectifier. For example, if there were five 15 A rectifiers, 5 x 15 = 75, and 75 - 15 = 60 Amps.

Besides Watts, commonly used units for HVAC sizing are BTUs / hr, and tons of air-conditioning. The following conversion factors can be used.

1 W = 3.41 BTUs / hr

1 ton of air-conditioning = 12,000 BTUs / hr

Cabinets, relay racks, or battery stands containing batteries should be placed relatively close to air-conditioning distribution vents. Batteries are more susceptible to high temperatures than other components.

After a power outage, care should be taken to slowly reintroduce cooling or heating in such a manner that rapid temperature changes are avoided (to maintain the guidelines of Table 4-1).

4.2 Ventilation Guidelines

Constant circulation of filtered air reduces hot spots and minimizes rapid temperature changes.

Ventilation with outside air must be periodically accomplished to relieve buildup of toxic and explosive gasses, and for human safety. For occupied buildings, local codes, the Uniform and International Building Codes (UBC and IBC), and ASHRAE Std. 62 specify minimum air change requirements for human occupancy. When telephone equipment is placed on the portions of the Customer's Premises that were designed for human occupancy, these standards have probably already been met. However, when the Customer Premises space was designed as an equipment or mechanical room, care should be taken to ensure that these same specifications are met. The batteries used to back up the telecommunications equipment are capable (under high temperature and/or shorted cell conditions) of venting large amounts of explosive gasses. Even under normal charge conditions batteries can and will ventilate Hydrogen.

Along with the UBC and ASHRAE Standard 62, Telcordia has written two standards (BR 781-810-885 and BR 760-550-102) which govern ventilation for Central Offices. Although these standards were designed for Central Offices, many of the principles therein can be put to use when designing adequate ventilation systems for telecommunications equipment rooms on the Customers' Premises.

Although the above-referenced standards should be used, when calculation simplicity is desired normally unoccupied telecommunications equipment space on a Customer's Premises can be designed for a minimum air change rate of 0.5 ach. Qwest Equipment cabinets are designed to ventilate at a rate of at least 0.5 ach to the surrounding space. Airflow in these cabinets is from bottom to top, since batteries are traditionally placed at the bottom, and they should receive the coolest air possible.

All of these standards specify the minimum amount of outside air that must be used. However, care must be taken to ensure that excessive outside air is not introduced in climates that have temperature, humidity, and air quality extremes.

Outside air ventilation can also be used for cooling, but the environmental control system must temper this use to ensure that the humidity and air quality guidelines of Sections 4.1 and 4.3 are also being met.

For more detailed calculations (by an HVAC engineer), the most troubling gas that must be ventilated is Hydrogen produced by the batteries. IEEE standards recommend no greater than 2% concentration (since Hydrogen begins to be flammable at 4%) in air. The NFPA and other Fire Codes state that buildup can't exceed 1%. If Hydrogen sensing is used (not recommended for Customer Premises due to the high frequency of maintenance required for the sensors), OSHA recommends pre-alarming at 0.4 to 0.5% concentration in air. For calculation purposes, most Customer Premises Buildings will be under the auspices of the Building and Fire Codes, so the 1% figure should probably be used.

Maximum Hydrogen evolution by lead-acid batteries can be calculated from the following formula:

$$1.27 \times 10^{-7}\ m^3/s \quad (0.000269\ ft^3/min) \quad \times C \times I$$

Where C is the number of cells (24 per -48 VDC string), and I = the charging current. Note that the total charging current must be split between parallel strings. Each cell in the string receives an equal amount of current (they are in series), the string current.

Worst case charging current (after a commercial AC outage) is the total Amps of the rectifiers minus the load. For example, if there are five 15 A rectifiers, and a total List 1 drain of 36 Amps, the maximum recharge current is 75-36 = 39 Amperes. Luckily, this maximum recharge current lasts less than an hour, and then drops off to less than 5% of this level for the next 20 hours or so.

Normal float charge current is very low (less than 100 mA per string for batteries of the size used in Customer Premises).

The formula above gives the Hydrogen evolution rate for all lead-acid batteries. This will be the Hydrogen released into the air for flooded / wet cells.

NFPA Fire Codes require that ventilation rates be calculated at the boost charge current rate (which is a current value between recharge and float). Normal boost charge currents for flooded batteries are no more than C / 100, where C is the Ampere-hour capacity of the string at the C_8 rating.

However, the most common type of battery used in Customer Premises locations is the VRLA (commonly called "gelled", "sealed", or "maintenance free"; none of which it is). Under normal use, almost all (95%+) of the Hydrogen and Oxygen evolved from excess charging current by electrolysis recombine (to water) inside the cell (so only 5% or less is released through the pressure valve into the room air). As an example, testing of various manufacturers' VRLA products have shown that gassing at normal float voltage is around 0.5 cc / hr per Ampere-hour for nominal -48 V strings, where the Ampere-hour rating is the 8-hr rate (C_8). For example, a plant with 3 strings of 100 Amp-hr batteries will normally gas about 3 x 100 x 0.5 = 150 cc / hr = 0.00015 m^3 / hr = 0.0053 ft^3 / hr.

Note, however, that during a valve failure, or an overcharge condition such as thermal runaway, a VRLA will gas just as much as a flooded battery.

For ventilation calculation purposes, normal valve operation can be assumed, with the NFPA's mandated boost charging regime. Comparing data from different VRLA battery manufacturers, boost charging under normal temperature conditions yields a gassing rate of about 1 cc / hr per Amp-hr for a nominal -48 V string. Using calculations like those above, a plant with 3 strings of 100 Amp-hr batteries will gas about 300 cc / hr (0.0003 m3 / hr or 0.01 ft3 / hr) at a boost charge rate. (The boost charge voltage of a typical nominal -48 VDC plant is about 1-2 V higher than the float voltage.)

4.3 Air Quality Guidelines

Accumulation of airborne contaminants on circuit boards can result in bridging of electrical and electronic circuits leading to circuit faults or intermittent failures. Contamination may be introduced by dust, textile fibers, human debris, soil contributions, products of combustion, etc.

Normal air quality operating conditions for digital equipment should be **Class 100,000**. This means that there should not be more than 100,000 particles of 0.5 microns or greater per cubic foot of air. This can normally be easily obtained by 85% ASHRAE efficiency filtration (pre-filters are probably advisable, depending on the quality of the outdoor air in the city). Short-term (see Note 1 to Table 4-1 for a definition of “short-term”) guidelines are **Class 150,000**.

Proper filtration to achieve the efficiencies mentioned above should be left to the building owner. Local air qualities will determine the amount of filtration needed, and 85% may be excessive. Also, the ASHRAE dust spot ratings may be changing in the near future.

If the customer wishes to determine particle counts in an equipment area, they may refer to Telcordia GR-63-CORE for further information.

Sometimes, positive pressurization of an equipment area with the ventilation system will reduce contamination.

4.4 Floor Loading Guidelines

Customer Premises cabinets contain lead-acid batteries. Lead is a heavy element, and care must be taken to ensure that floor loading is adequate for the space on which the cabinet is placed. Care must also be taken in "relay-rack type" of Customer Premises installations that the relay rack that contains the batteries, or the battery stand is placed where floor loading is adequate.

Typically, Customer Premises types of sites (human-occupancy buildings) are designed for floor loading of 75 lbs / ft^2 (psf). However, raised computer floors may not be able to support more than 50 lbs / ft^2. Standard Qwest Communications Customer Premises equipment cabinets are generally designed for 75 lbs / ft^2 floors with adequate spacing to the front and rear of the cabinet (see Figure 4-1). If the cabinet is to be placed on a 50 lb / ft^2 floor the weight of the cabinet and each of its individual components (especially the batteries) must be considered. In these cases it may not be possible to fully load the cabinet with equipment. However, if space is provided to the right and left of the cabinet (as well as in front and back), more equipment may be loaded into the cabinet.

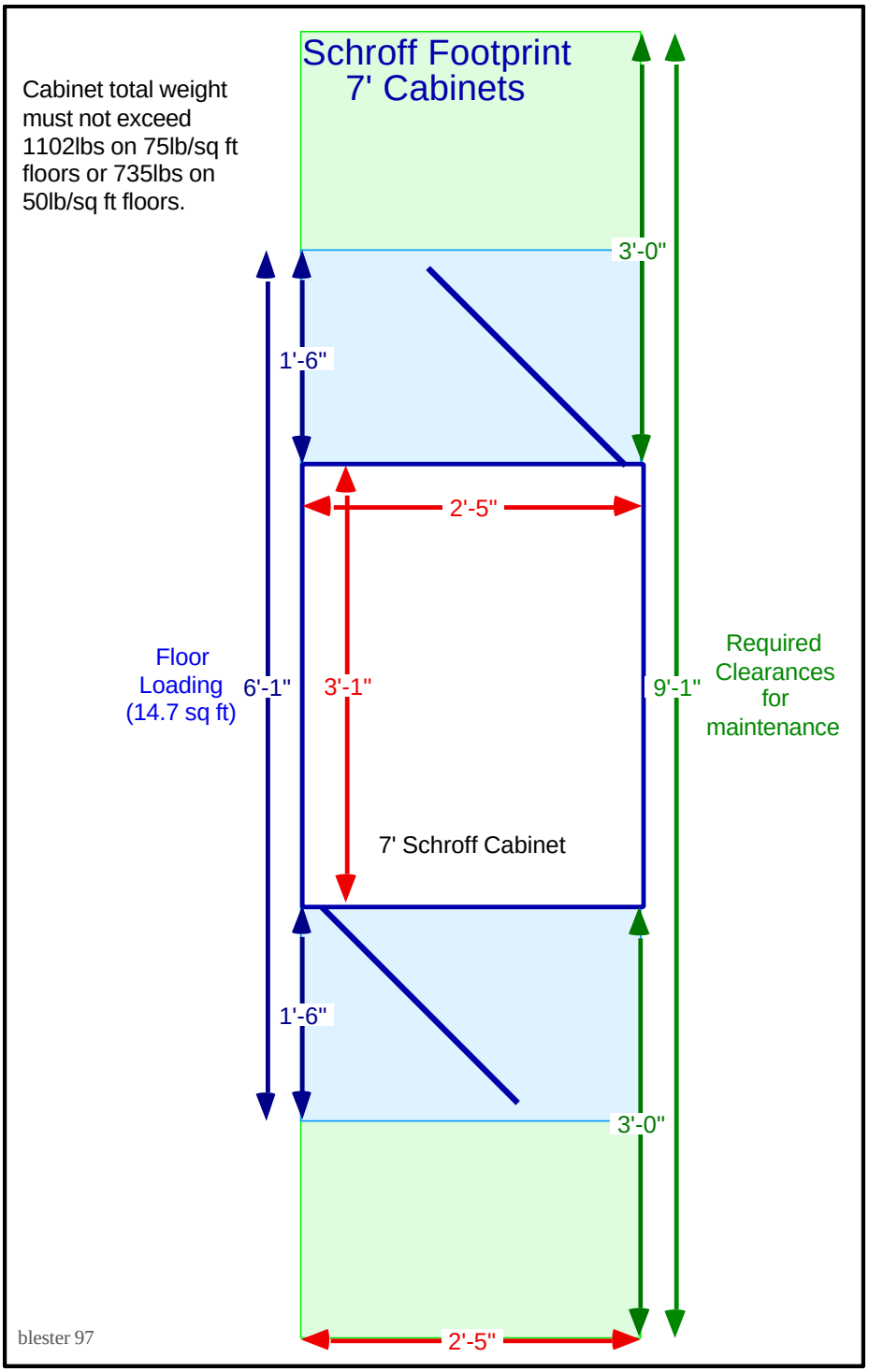

Figure 4-1 Floor Loading Example

Figure 4-1 serves as a good example of how to properly perform floor loading computations. The cabinet itself is approximately 2'5" ft. x 3'1" ft. (7.45 ft^2). However, equipment is generally placed in the front and back of the cabinet, accessible from doors on either the front or back. Generally, the area in front and in back of the cabinet is kept clear to allow the doors to open and shut. Up to 18 inches of this free space in front of and in back of the cabinet can be used for the floor loading calculation. If we also assume that equipment is placed on both sides of the cabinet, there is no free space on either side to use for the floor loading calculation. The total floor loading space for the cabinet is then 2'5" ft. x 6'1" ft. (14.7 ft^2). Assuming the total equipment, cabinet and battery weight is 1100 pounds, we can then compute the total floor loading of the cabinet:

$$Total\ Floor\ Loading = \frac{1100\ lbs}{14.7\ ft^2} = 74.83\ lbs/ft^2$$

The preceding calculation shows that the cabinet will work on a 75 lb / ft^2 floor; however, some equipment will have to be removed from the cabinet, or spacing provided around the sides of the cabinet to ensure that it will not damage a floor designed for 50 lbs / ft^2.

Relay rack type Customer Premises installations are a bit more tricky. In these cases, the power load is generally higher, requiring larger (therefore heavier) batteries. Typically the batteries will be in their own relay rack (sometimes with rectifiers or other power equipment) or on a separate battery stand. Unless the floor is designed for telecommunications Central Office floor loading standards of 150 lbs / ft^2 (all battery stands and relay racks are designed to fall under this 150 lb / ft^2 standard), calculations similar to the example just given should be performed. Because of the generally larger size of these batteries, often extra free space must be allocated around the battery stand to provide adequate floor loading.

There should be three feet of clearance in front of relay-rack mounted equipment (or a battery stand) for maintenance, and two feet behind the equipment (see Figure 3-1). Up to eighteen inches of this front space can be used for floor loading calculations. Up to eighteen inches of the rear space may also be used for floor loading calculations, provided that no other equipment backs up to it. If other equipment is on the other side of the rear aisle, only half of the aisle space (up to eighteen inches) may be used for floor loading calculations. When equipment is front accessible only (backs up to a wall), the few inches behind the relay rack may be used for floor loading calculations. If there is free space around the relay rack on either the right or the left, up to eighteen inches on either (or both) side(s) may be used for floor loading calculations. (Please refer to Figure 3-1 for an example.)

The Customer must tell Qwest Communications personnel what the floor loading of the space under consideration is. This information can generally be gleaned from the architectural and mechanical drawings of the building. If this information cannot be obtained, the following worst case floor loading capacities may be assumed:

- 150 lbs / ft2 for basement (or bottom floor) concrete floors
- 100 lbs / ft2 for concrete floors on other levels
- 50 lbs / ft^2 for raised floors
- 75 lbs / ft^2 for all other floors.

In a few instances, Customer Premises cabinets are wall-mounted. In these cases care must be taken to ensure that the wall can support the weight of the cabinet(s).

4.5 Earthquake Zones and Equipment Ratings

In telecommunications Central Offices care has always been given to ensuring that telecommunications equipment is properly braced to withstand the rigors of an earthquake. The reasons for this are threefold: 1) proper earthquake bracing helps ensure uninterrupted telephone service during a disaster such as an earthquake, and this is when communications services are most needed; 2) proper earthquake bracing helps keep potentially dangerous materials (e.g., batteries) from spills, leaks, etc., which would make them hazardous, and potentially toxic to humans; 3) proper earthquake bracing keeps equipment in place to prevent it from falling on humans.

Although traditionally not as much care has been given to ensuring that equipment in Customer Premises applications is earthquake-braced, the same reasons for having the bracing apply in this environment, and perhaps with added urgency due to the importance of the telecommunications services and numbers of personnel at a typical Customer Premises installation.

Telcordia's GR-63 NEBS document (as well as the UBC) adequately covers earthquake bracing and conformance. Equipment manufacturers who are NEBS Level 3 certified have their equipment tested to these standards. Figure 4-2 shows the Earthquake Zones within Qwest Communications' territory, in conformance with NEBS and the UBC. Zones 0 and 1 are the areas least likely to suffer an earthquake of any significance at all. Zone 2 denotes areas that could potentially suffer a mild earthquake. Zones 3 and 4 are for areas that could suffer violent earthquakes. Equipment designed to each of these standards is braced accordingly.

The aforementioned Uniform Building Code (UBC, which is slowly being melded into the International Building Code — IBC) not only covers standards for equipment bracing, but also for building bracing. In Zones 3 and 4, high rise buildings are often built with post-tensioned floors. This means that there are cables imbedded in the floor which help hold the building together during an earthquake. These cables are tensioned. In buildings taller than 2 stories in earthquake zones 3 and 4, it is imperative that Qwest and the building owner work together to determine if there are post-tensioned floors. If it is determined that there are post-tensioned floors, the building owner should X-ray the floor prior to any cable hole or anchor bolt drilling. If the building owner is uncooperative, and there is a probability of post-tensioned floors, Qwest will need to hire someone to do the x-raying. The Qwest Real Estate Department should have contractors qualified to do this work. Drilling into a post-tensioning cable can result in severe building structure failure consequences.

All Qwest Standard Customer Premises equipment cabinets are designed to Zone 4 as a standard. However, relay rack type installations must take earthquake zoning into consideration. Standard Qwest relay racks, equipment, and battery stands or trays are available for both heavy (Zones 3 and 4) and light (Zones 0, 1, and 2) earthquake zones. The Qwest Engineers will take earthquake zones into account when placing the equipment. Engineers may refer to Qwest Tech Pubs 77350, 77351 or Telcordia's NEBS documents if greater map detail (latitude and longitude lines) is desired than that given below. Another good earthquake bracing reference is ANSI T1E1/93-064. For existing installations, where retrofit to earthquake bracing standards is desired, Telcordia SRs 2432, 2498, and 2536 may be used.

Raised floors may pose a problem regardless of the bracing of the equipment. If equipment is to be placed on a raised floor, special care should be taken to ensure that the floor will hold up to earthquakes of the magnitude suggested by the Zone in which it is geographically located.

When other equipment in a Customer Premises site is in the same area as Qwest equipment, the building owner may want to ensure that the rest of the equipment is adequately braced for the proper earthquake zone to ensure that it cannot adversely affect the telecommunications services in the event of an earthquake.

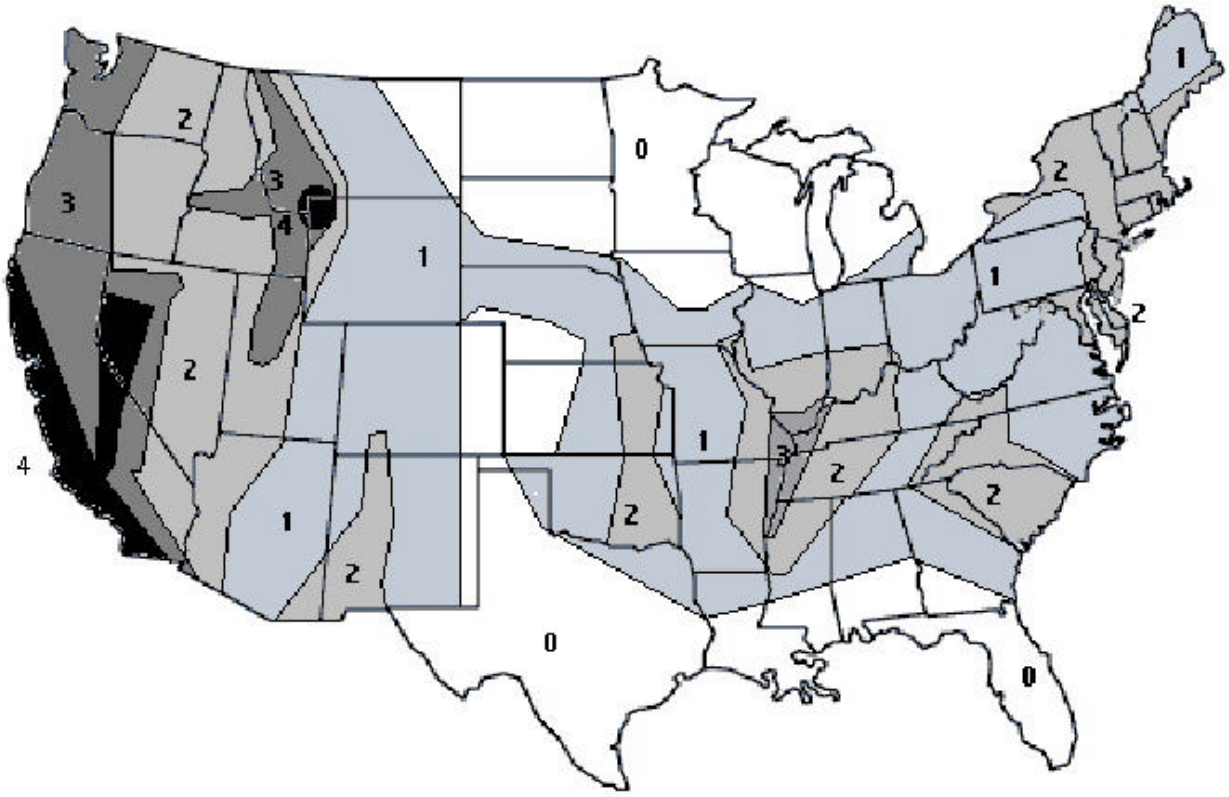

Figure 4-2 Earthquake Zone Map of the Contiguous 48 States

4.6 Fire Systems

The Equipment Floor Space must meet the local Fire Codes. The walls, floors, and doors should be a minimum of one-hour fire-rated. Fire detectors and alarms should be present. Usually none of this is a problem in Customer Premises spaces because these are generally designed for human occupancy, and had to meet codes when built.

Although there is often not a choice in Customer Premises installations, if possible, space with a CO_2 fire suppression system is much preferred over halon or sprinklers. Obviously water can harm the electrical components of telecommunications equipment. If sprinklers exist, see if it is a dry or non-pressurized system. If it is wet or pressurized, the first option is to try to place Qwest equipment in Schroff cabinets. If relay racks are used, an attempt should be made to keep the equipment (especially power bays) out of the direct "line of fire" of the sprinklers. Halon leaves a fine dust coating on everything, which must then be cleaned.

4.7 Fire Stopping

Openings through which Qwest passes its cable (whether pre-existing or opened by Qwest in the installation process) **will be fire-stopped** by Qwest.

Qwest will not normally fire stop cable openings beyond the Network Interface. It would probably be wise for the building owner, his agents, or assignees to fire stop holes they might create for their own cables to limit the spread of fire between rooms.

4.8 Asbestos Management

If Qwest is to construct in an asbestos-contaminated area in order to place its telecommunications equipment, the building owner shall let Qwest know of this issue beforehand. If this is the case, it is the responsibility of the building owner to either remove the asbestos, or put in place an asbestos-management plan that will conform to local and national codes. The Qwest Environmental, Health, and Safety (EHS) group may be contacted if help is desired with this problem.

4.9 Water/Flood Management

As mentioned in Section 4.6, telecommunications equipment does not function well in a wet environment. For this reason, if possible, space where there are sprinkler systems or water pipes above the potential equipment location should be avoided. If equipment is placed in a basement, all penetrations into the basement from outside the building should be properly sealed. It is also preferable in a basement installation that sump pumps and/or drains be present.

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5. Powering Guidelines

This Section on Power addresses the general powering philosophy for Customer Premises sites. For specific installation guidelines for power, see Section 7.7 of this document.

5.1 Power Requirements for Qwest DC Power Plants

All Qwest DC Power Plant Standards are contained in Qwest Technical Publication 77385. Not only are the requirements of this document applicable to Qwest DC Plants, but if Qwest is to use a Customer DC Plant or a Customer UPS, those components should also meet the requirements of Tech Pub 77385. In the following paragraphs of this subsection 5.1, a few of the more salient DC Plant requirements from Pub 77385 are excerpted.

Eight hours of DC Plant backup battery reserve (sized at the List 1 or average drains of the served equipment) are required when the AC feeding the rectifiers (see Section 5.2) is not backed up by a permanent standby engine-alternator. Only four hours of backup is required if the rectifiers are backed up by a permanent standby set. For exceptions to these rules, see Section 5.4. Qwest standard configurations for Customer Premises equipment cabinets always provide for eight hours of battery backup because it is often unknown if the AC service to the rectifiers will be backed up by an engine. (Because this Essential AC feed to Qwest rectifiers is not standard from site to site, Qwest is only responsible for maintaining power to their equipment for the first eight hours of a commercial AC failure.)

Most Customer Premises installations use VRLA (Valve-Regulated Lead-Acid) batteries. That is because most Customer Premises loads are small, and space is often limited (VRLA batteries are more energy-dense, can be placed in strange positions, have less stringent Hazardous Materials regulations, and come in smaller sizes than flooded batteries). However, for larger installations where the -48 VDC load exceeds 100 Amperes, serious consideration should be given to the use of traditional flooded (wet cell) batteries. Flooded batteries last much longer (up to 20 years or more in the right environment, as compared to 9 years or less for VRLA), and are less prone to the dangerous gassing and fire hazard condition of thermal runaway than are VRLA batteries. However, flooded batteries do require more space, and have certain Code requirements not applicable to VRLAs (such as spill containment and compartmentation). Flooded batteries might be a good choice for loads over 100 Amperes in critical applications, such as FAA and airport sites?

When VRLA cells are used, the served equipment must be able to tolerate a maximum voltage of -54.8 VDC. Most equipment should easily work at this voltage (the Telcordia NEBS upper voltage limits for equipment design are -56.0 VDC for normal operability, with a short term maximum of -60.0 VDC). If there is equipment that will not function at -54.8 VDC, flooded batteries must be used.

When VRLA batteries are used, due to their increased risk of failure, a minimum of 2 strings are required. This requirement is waived when there are 96 or fewer DS-0 or POTS circuits. If the service provided is at a higher level than DS-0 (e.g., DS-1, DS-3, etc.) the 2 string minimum is required.

VRLA batteries should be used with temperature-compensated rectifiers or a charge current-limiting circuit to greatly reduce the probability of dangerous thermal runaway. The settings or thresholds for these devices should agree with the ranges specified in Appendix A of Qwest Tech Pub 77385. Temperature sensors for temperature-compensated rectifiers should be placed on the batteries if possible. VRLA batteries also need adequate airspace into which they can release any heat generated during charging. This should be a minimum of 0.5 inches between batteries. It greatly helps in reducing thermal runaway.

Redundant rectifiers (N+1 at 120% minimum of equipment manufacturer List 2 or maximum drains) are required for more than 96 DS-0 or POTS circuits, or for any higher digital signal rate services. This same N+1 redundancy requirement applies to bulk ringing and tone supplies, and converter plants, if they are needed.

As a general rule, each Customer Premises installation should only have a single bulk DC power plant. For example, if there are two cabinets, only one of the cabinets should have a DC plant, which powers both cabinets.

Rectifiers and converters in relay rack types of Customer Premises installations should be designated with voltage and group number.

5.2 Essential AC Power from the Customer

In telecommunications Essential AC power is defined as power that is backed up by a standby engine-alternator. Essential AC power is not uninterruptible. There will be a delay of several seconds to several minutes between the loss of commercial AC and the time the engine-alternator comes up to speed and assumes the load.

The customer must provide AC feeds from an AC power panel to Qwest's rectifiers (or to their own rectifiers if their DC Power Plant is being used). For larger relay-rack mounted installations, these feeds should be run in conduit or raceway by a licensed electrical contractor in accordance with the NEC, with separate breakers and circuits feeding each rectifier. It is also desirable for larger DC plants that the AC Power panel be dedicated only to Qwest. This reduces the effect of harmonic feedback either into or from the rectifiers, which has the potential to interrupt telecommunications services or other building services (harmonic feedback from the rectifiers into the AC system is highly unlikely, as Qwest installs rectifiers whose AC Input is filtered to a high degree). In most installations these AC feeds should be 240 V or 208 V 1-Ø. If 120 V 1-Ø, 208 V 3-Ø, or 480 V 3-Ø are being provided, and the DC Power Plant is Qwest's, the customer must inform the Qwest Engineer so the proper rectifiers can be supplied to operate from the given voltage and phase configuration.

Individual feeds to each rectifier are not required (although they are desirable) for Customer Premises cabinets, since these are typically smaller AC loads than the relay rack type of installations. In these cases the customer is responsible (as a minimum) for providing one or two nearby standard 240 V, 208 V, or 120 V (120 V is most common), 1-Ø, 20 or 30 Ampere Hubbell Twist-Lock™ (or NEMA equivalent) outlet/receptacles. (If Twist-Lock™ receptacles are not provided, receptacles equipped with screw down ground pins that will prevent easy removal of the power cords should be provided instead. Small wall-mount power cabinets are exempt from the Twist-Lock or screw-down ground pin requirement). Qwest usually provides one or two 30 foot AC cords equipped with Hubbell Twist-Lock™ (or NEMA equivalent) plugs for connection to the customer-provided receptacles. The Qwest Engineer and the customer shall work together jointly to determine the proper type of plug/receptacle or AC service needed.

It is highly desirable to both Qwest and the customer (for service reliability) that the AC power panel that feeds the rectifiers be an Essential AC panel. This means that the panel is ultimately fed from an AC source that is backed up by a standby engine-alternator. The standby Engine-Alternator should meet the requirements of NFPA 37 and NFPA 110.

If so-desired, additional reliability can be achieved by feeding the DC plant rectifiers from a power board that is fed by a UPS, which in turn is backed up by a standby engine-alternator (see Section 5.3 for further information).

If no standby engine-alternator or Essential AC feed is available, feeding the rectifiers from a UPS-fed AC power panel is still preferable over a plain Non-Essential AC feed (see Section 5.3 for further information).

The building AC service entrance should have lightning/surge protection. If this is not presently installed, Qwest should request it of the building owner. Not only will it protect Qwest equipment, but all equipment in the building that uses electricity.

When DC power plants are added (especially larger ones), the building owner should be notified of the total power capacity (in Watts or kW) of the rectifier plant in order to ensure that engine-alternator, house service panel, or AC subpanel capacity is not being exceeded with the added load(s). If capacity triggers are exceeded, growth of the AC infrastructure is the responsibility of the customer.

The customer should also give strong consideration to ensuring that at least some of the essential HVAC system components are backed up by Essential AC power in order to ensure that the temperature, humidity, air quality, and temperature rate of rise guidelines of Section 4 can be met, even in the event of a commercial AC power outage.

It is strongly recommended that the building AC service be equipped with surge and lightning protection to protect all equipment in the building from transients.

Unless otherwise specified in the contract, the customer is responsible for the total electric bill, including the portion used by Qwest's equipment because that equipment is serving the customer.

5.3 Powering from Customer Power Supplies

Some products that Qwest sells (e.g., SHARP/SHNS, SST, etc.) have standard contracts which promise the customers rebates or free service should telecommunications services fail and not be restored within certain time frames. With other customers, individual contracts may specify rebates for service interruptions. The most critical Customer Premises sites are those that support FAA circuits, 911 circuits, or airports. For all these types of services, Qwest must provide its own DC power plant, backed up by a minimum of eight hours of battery reserve. In these cases also, the guidelines of Section 5.2, encouraging AC feeds backed up by an engine-alternator and/or UPS, become even more important. If it is desired to use the customer's DC Power Plant, the contract must be rewritten (see Section 9) to specify that rebates and free service rights are waived for power outages.

In some cases, Qwest equipment is placed in an area that already contains other telecommunications equipment (e.g., PBX, etc.) owned by the customer. Often this equipment is powered from a traditional telecommunications -48 VDC plant. In these cases, for services other than those mentioned above, it may be advantageous to both Qwest and the customer, from a space and cost perspective, to provide power to the Qwest equipment from the customer's pre-existing DC Power Plant. The Qwest engineer shall contact the customer representative to determine if this can and / or should be done. If it is done, the customer's plant should meet the guidelines of Qwest Tech Pub 77385, especially, the items pointed out in Section 5.1. The capacity of the DC plant buss bar, distribution bays, rectifiers, and batteries must be looked at and increased if necessary before adding these new loads. It should also be recognized that the best scenario for these DC plants is that only Qwest and the customer are powered from these plants. If other telecommunications vendors are allowed to connect to this DC plant, the chances for unnoticed load additions increases greatly. This affects all of the above-mentioned capacities, and backup powering capacities become difficult to manage, potentially endangering telecommunications services. The Qwest Engineer shall inform the customer of the protector (fuse or breaker) size(s) needed, the distance to the Qwest fuse panel(s), and the number of feeds needed. It is preferable that the customer run the feeds and tie them down on both ends, so that Qwest will not have the opportunity to accidentally knock down other services provided from this plant. However, if the customer is unwilling or incapable of running these feeds, Qwest will do the work with a customer-signed MOP, and customer coverage during the "cut".

Please note that -48 VDC power is not the only telecommunications DC powering voltage. If 130 VDC or 24 VDC power is needed by Qwest equipment, and the customer provides these voltages from primary DC plants or DC-DC converters, the same rules apply as in the previous paragraph. However, if the customer's primary DC power or DC-DC converter plant(s) are at a voltage and polarity different rom that needed by the Qwest equipment, Qwest is still free to use that power, but must provide its own DC-DC converter plant.

There are some rare cases where a customer buys telecommunications services from Qwest that are not required to work when the customers' computers are not functioning (see Section 5.4 for more information). In some of these rare cases the customer's computers may be backed up by UPS. Some Qwest equipment can be AC-powered, or may be DC-powered but fed by rectifiers only (not backed up by batteries). In these cases where the customer does not require any more backup time for telecommunications services, it is permissible to power the telecommunications services from the customer's UPS (the same one backing up their computers).

Any powering or backup powering equipment provided by Qwest will be maintained by Qwest. Maintenance of DC Power Plants, Standby Engine-Alternators, UPS, and the AC infrastructure owned by the customer will be the responsibility of the customer. In these cases the Customer may wish to make arrangements with Qwest regarding the cost of this maintenance (see Section 9 for further information on Contracting). Both Qwest and the customer should ensure that regular preventive maintenance (Qwest recommends every 6 months for DC Plant maintenance, and monthly engine runs) is being performed on power equipment, regardless of the owner. If the property owner is performing maintenance on their own DC plants and/or engines, they may wish to use Telcordia BR 790-100-672 (or the appropriate IEEE battery specification — see Reference section of this document for a list of applicable IEEE publications) and NFPA 37-1994, respectively, for guidelines on frequency and specific actions. Qwest has their own maintenance procedures, which generally meet or exceed the recommendations of Telcordia, the IEEE, and the NFPA. Qwest technicians will determine, in accordance with their "Maintenance Window" guidelines, the proper time to perform proactive maintenance routines on their power plants and other equipment. If the customer desires that the routines are done at specific times of day, week, or month; they must so specify.

When Qwest equipment is located in the same room as a customer UPS which uses flooded batteries, and the voltage of the flooded battery string(s) exceeds 60 VDC, Qwest may request that the Customer clearly mark their battery stand(s): "WARNING HAZARDOUS VOLTAGE."

5.4 Operation without Backup Power

As stated in the previous section, there are some rare cases where a customer buys telecommunications services from Qwest that are not required to work when the customers' computers are not functioning. As an example, a telemarketing company might be using computer modem autodialers and a database. When these computers go down, many of their phone lines are not needed. If this customer has a desire to cut some backup powering costs or has a lack of space to place a DC power plant, they may desire that their telecommunications services do not have to be up when their computer systems are not up. The customer and the Qwest Engineer must work closely together when traditional backup powering is not required. If this is done, both Qwest and the customer must clearly understand the implications (that the telecommunications services may be lost when the AC source is lost), and there must be no penalties to Qwest as a result of AC failure. This shall be spelled out in the contract (see Section 9).

Qwest can provide AC-only powering in two ways. Some equipment Qwest uses for telecommunications services (e.g., some fiber multiplexers) comes in both AC and DC-powered versions. In that case, when traditional backup powering is not needed, the telecommunications equipment can be equipped with AC powered cards, and fed directly. However, much telecommunications equipment is provided only in DC-powered versions. When this is the case, and traditional backup is not needed, Qwest can provide DC rectifiers with the appropriately filtered DC output (to not introduce DC ripple noise greater than 35 dBrnC into the equipment — which is usually filtered by the batteries). These rectifiers are fed by AC power of course, but they are not backed up by batteries. These rectifiers then supply the DC power needed by the load, and when the AC source is lost, telecommunications equipment fails.

The Qwest Engineer shall take special care to ensure that when traditional backup powering is not used, that the telecommunications equipment can quickly auto-initialize and resume telecommunications services after AC power returns.

As mentioned in Sections 5.2 and 5.3, the AC source can be Essential AC backed up by an engine-alternator, and / or fed from the customer's UPS. This is highly advisable if the customers computers are fed from either or both of these AC sources.

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6. Grounding Guidelines

This Section on Grounding addresses general grounding principles. For specific installation guidelines for grounding (including some thoughts around isolated ground planes), see Section 7.8 of this document.

6.1 General Grounding Information

Grounding of telecommunication equipment and its feeding power sources is done for the following reasons:

- Personnel Safety (proper grounding protects personnel from high voltages and currents that could be introduced by lightning or other transients)
- Equipment Safety and Telecommunications Reliability (proper grounding helps ensure equipment circuit packs will not be damaged by the aforementioned transients)
- Equipment ESD Protection (grounded equipment frames provide a safe place for the safe and proper discharge of static electricity from the human body — when the human is using ESD protection techniques such as wrist straps — before that person touches a circuit pack)
- Electrical Noise Abatement (properly grounded equipment can bleed away unwanted AC noise components that can be introduced by magnetic induction or other EMF effects — if left to its own devices this noise can severely disrupt digital and analog transmissions)

The reasons just given make it clear why proper grounding is important. Unfortunately, Customer Premises grounding is often not sufficient to meet Code nor protect people and equipment. The following sections bring out some of the more salient points regarding Customer Premises grounding from Tech Pub 77355, the Qwest Grounding Standard. However, all of the relevant portions of Pub 77355 apply.

6.2 Ground Sources

A ground source is a point from which electrical current will see a low impedance (resistance in the case of DC only) to ground. Per the National Electrical Code, this impedance should not exceed 25 ? . Qwest Tech Pub 77355 prefers that it be lower than 5 ? , although this is not always possible, depending on soil conditions, etc. The following sources usually qualify as good ground sources for Customer Premises locations. They are listed in priority order (but are probably in reverse order of the simplicity to obtain):

- Driven Ground System (As an example, this might be driven ground rods connected in an exothermically welded ring, or a ground well, or a ground mat field, etc. This field can be extended via copper cables to ground bars in a building.)
- Water Pipe (It must be ensured that this pipe is connected to the city water system using metallic pipe only. If there is any PVC, rubber, silicone, or other non-metallic pipe in the system it cannot be used as a ground source. A bond strap across the water meter is required. Water valves and pipe unions should be within the bond.)
- Building Steel (Usually building steel is connected in many places, and is ultimately sunk into the ground, connected to the rebar of the base concrete — which constigates a Ufer ground, or connected to a driven ground system as described above.)
- ACEG (The AC Equipment Ground is defined by the NEC as the “green-wire” ground run with AC circuits which is connected to the AC Neutral — and therefore to the electric company’s multi-grounded neutral — at the AC service entrance or House Service Panel. If the ACEG is used as the ground source, the connection should be made as close as possible to the HSP or nearest separately derived source. Failing that, the ACEG in the nearest AC panel will suffice.)
- AC Neutral (Absence of any of the above sources requires use of the AC Neutral. As with the ACEG, a connection to this ground source should be made as closely as possible to the House Service Panel or nearest separately derived source, or failing that, to the nearest AC panel. In fact, if any of the other ground sources above are used, they must have bonded electrical continuity all the way until there is a connection to the AC Neutral at the HSP.)

Qwest requests that the customer extend at least one (and preferably two) of these ground sources (with a cable sized according to the NEC, at a minimum of #6 AWG — preferably a #2 AWG or larger) to a customer-provided ground bar in the telecommunications equipment room, to which Qwest may tie its equipment. It is also Code-required that the grounding cables running to the bar (both from the customer side and the Qwest side) have a green-colored insulation. Typically, Qwest will collect all of its grounds to a single collection point (see section 6.3). From this point, a cable (appropriately sized per Tech Pub 77355, depending on the size of the installation) should be run between Qwest's ground collection point and the ground bar that represents the extended building ground source. Failing the presence of a ground bar that is an extension of one of the ground sources, Qwest should tie its collection bar to one of the ground sources mentioned above. Standard Qwest Customer Premises cabinets usually come equipped with 30 feet of #6 AWG copper wire for connection to the nearest ground source. If possible, this should be upgraded to a minimum of a #2 AWG stranded, insulated copper conductor.

If a copper entrance facility (cable) is used, the Building Entrance Terminal must be located as close as possible to the Main House Service Panel and grounded to the Building Grounding Electrode (a requirement of the NEC). The customer premises equipment should also be grounded there to eliminate the possibility of differences in electrical potential between the grounds. Equipment misoperation and/or damage may result from the differences in potential. Naturally, if a fiber entrance is used, this requirement is not necessary.

It is desirable that the ground source used be labeled as the telecommunications ground source. For example, it may be labeled as the PGP (Principal Ground Point).

6.3 Telecommunications Ground Collection Point

As mentioned above, Qwest prefers to collect all of its grounds to a single collection point before connecting that point to the chosen ground source. For many Customer Premise Installations, a logical choice is the power plant return buss bar (typically the positive bar of the -48 VDC plant). If this bar is large enough to accommodate the extra grounding connections, the use of an extra ground bar (which adds cost) can be avoided. Figure 6-1 is one example of a suitable power plant return buss bar.

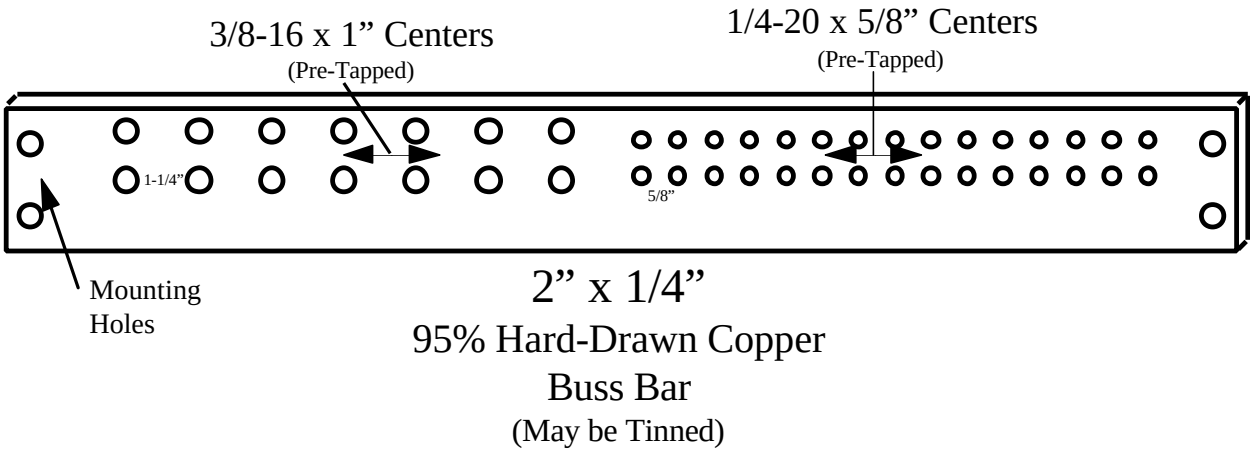

Figure 6-1 Customer Premises Ground Bar

However, some Customer Premises installations are too large, and / or some power plant return busses are too small to allow them to be used as the telecommunications ground collection point. If this is the case, a separate ground bar should be added. Again Figure 6-1 serves as a good example of what such a bar might look like. It could vary greatly in size and number of holes, depending on the size of the installation. The buss bar above is suitable for a 200-Ampere DC power plant. The bar may be mounted inside the cabinet, above a relay rack, in a relay rack, hanging from cable rack (and insulated from it), or mounted on a wall (perhaps inside an electrical cabinet). Qwest will provide the bar, and if the Engineer fails to find a location for it among the telecommunications equipment they will work with the customer to determine a suitable location for mounting.

Note that the bar is built for 2-hole lugs. Two-hole lugs are required for all power and grounding connections except for small wall-mount power plants. When single-hole lugs are used, they must use a star washer to prevent loosening of the connection.

Regardless of whether the power plant return buss bar is used or a separate bar is provided, the following grounds should be connected to this “telecommunications equipment ground collection point”:

- Power Plant Battery Return Buss Bar (Unless this bar is used as the collection point, it shall be connected to the telecommunications ground collection buss with a minimum #6 AWG copper wire. If it is a relay rack type (larger) installation, this connection should be a #2 AWG.)
- Equipment Cabinets (Rails, walls, and doors of equipment cabinets shall be electrically bonded to each other, and then a connection shall be made from each cabinet to the ground collection point directly with a #6 AWG, or indirectly to a #2 AWG stringer run from the collection bar.)
- Relay Racks (Equipment relay racks should be connected to the collection point. If there are multiple relay racks and/or lineups, it may be wise to run a #2 AWG stringer above each lineup. A splice with a #6 AWG can be made to each relay rack frame from this stringer.)
- Splice Cases (The shields of cables entering the space from the Outside Plant feeding Qwest digital equipment should be bonded to a splice case ground point, which is in turn connected to the collection point with a #6 AWG. If there are metallic cables entering the space that do not feed Qwest digital equipment, their sheath grounds should be tied to the customer’s ground bar, as opposed to the Qwest single-point collection bar.)

  If the entrance is copper cable, each metallic pair in the cable must be protected, using a listed protector unit. The ground for the protector should also be connected to the collection point, if they are in the same room. The NEC requires that the protector ground be bonded back to the building grounding electrode, so care must be exercised in equipment placement.
- Rectifier ACEGs (The ACEG of the feeds to the rectifiers should be extended to the collection point. This is not necessary if the ACEG or AC Neutral is serving as the ground source.)
- Appliance Outlet ACEGs (The ACEGs of any appliance outlets in the telecommunications equipment space may be optionally extended to the collection point. As above, this is not necessary if the ACEG or AC Neutral is the ground source.)

- Other Telecommunications Equipment Providers Bays and Cabinets located within 6 feet of Qwest equipment bays or cabinets should be bonded to the bar to avoid potential differences and resulting shock hazard to personnel.
- Other Metallic Cabinets (any other metallic bays, cabinets, or other metal objects in the telecommunications equipment area may be bonded directly to the collection point with #6 AWG, or connected to the collection point through “stringers” as described above. This is especially helpful in reducing ESD problems for cabinets that are used as storage for circuit packs.)

6.4 Isolated Grounding

In rare cases, Qwest will place a remote Class 5 Local circuit switch in a Customer Premise. Most of these switch manufacturers require an isolated ground plane. If this is the case (or if there is other equipment requiring an isolated ground plane — check with the equipment manufacturer), the requirements of Qwest Tech Pub 77355, Chapter 8 (which mirrors Telcordia TR-NWT-000295), must be followed (see also section 7.8.3 of this document for further information).

There is another type of isolated grounding used in the computer industry. This type of grounding is explained in Qwest Tech Pub 77355, Chapter 11. If Qwest Telecommunications equipment is placed in a computer room environment that uses a computer room isolated grounding scheme, a separate integrated ground plane area (separated from any isolated ground plane metal by at least 6 feet), ground source, and ground bar may be needed.

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7. Installation Guidelines

Installation requirements and guidelines for Customer Premises equipment space cannot be as strict as those applied to Qwest-owned space, simply because Qwest does not own the space. For purposes of this section (and the entire document), the following terms denote whether a requirement is absolute (must be met) or not (these same definitions can be found in Section 2.1):

- SHALL, MUST — denotes requirements which must be adhered to for basic personnel safety and basic reliability
- SHOULD, ADVISABLE, DESIRABLE — guidelines which would improve reliability and safety, but do not have to be absolutely followed (suggestions)

7.1 General Installation Guidelines and Requirements

This document provides Service Suppliers with the general requirements affecting building facilities and their care, the installation and removal of telecommunications equipment, and related service requirements to be met prior to such activities. For purposes of this document, the term “Service Supplier” shall include any contractor or contracted agent doing work on a Customer’s Premises in behalf of Qwest (this includes Qwest’s own Installation forces).

This document also provides key material and workmanship requirements for Engineering and Service Suppliers and shall be a basis for audit and evaluation of a job. The workmanship items described in this section are both generic and specific in nature and may be applicable to all installation and removal operations. In addition, the Service Supplier shall adhere to the specific installation (new or reuse), removal, and operational standards established in applicable equipment specifications as well as all handbooks and technical information required to successfully complete installation or removal of the equipment.

Service Suppliers doing business with Qwest for a product type shall show a level of expertise in that technology, based on history, training, or related work experience. Service Suppliers shall be required to comply with all suppliers’, manufacturers’, and Qwest Standards. Lack of documentation or information is not an acceptable reason for noncompliance with this Standard. Service Suppliers shall not deviate from Standards outlined in this Technical Publication without written permission of the Qwest Design Engineer. Standards for Earthquake protection or Fire Life Code Safety cannot be given a waiver by the Qwest Design Engineer without the concurrence of the appropriate AMC Engineer.

The Service Supplier shall be responsible for providing all tools and expendable materials necessary to complete the job.

When a Service Supplier becomes aware of a preexisting defective condition, that impacts the work on the job they are installing or removing; the Service Supplier shall contact the Qwest Design Engineer and take corrective action if authorized. This activity shall be documented in the job log.

Any questions not answered by this section, the job specifications, drawings/records, etc. shall be referred to the Qwest Design Engineer for resolution and documented in the job log by the Service Supplier.

7.1.1 Facility Access and Security

The amount of space and its location for administrative purposes shall be a matter of agreement between the Service Supplier, Qwest, and the Premises owner prior to the start of services. Every attempt shall be made to locate this area outside the room or compartments containing equipment. In those cases where this cannot be accomplished, the area should be set as far away as possible from the equipment locations. Combustible materials should not be stored in an equipment area and should be stored in a packing/unpacking storage room or in a trailer outside of the installation location. Drawings, documentation, and all other flammable materials used in and around equipment and cable racks during the work shift should be removed at the end of each shift and stored in a fire resistant container.

With the concurrence of the Premises owner, temporary trailers or structures may be provided for installation related work or storage room if space is not available at the work location.

Service Suppliers and their hired personnel shall wear a valid company picture identification (above the waist, and visible from the front) at all times while working in behalf of Qwest at Customer Premises locations. This identification shall show: the company name, employee name, and current photograph of the employee.

The Service Supplier shall be in the facility only during authorized scheduled work hours as agreed to and defined in the MOP. Depending on the location, Service Suppliers may also need to inform or obtain permission from the Premises owner (or their authorized representative, such as a guard or building maintenance personnel) each time they enter or leave a facility. The Service Supplier shall determine these requirements with the Premises owner before beginning installation activity.

The Service Supplier shall be responsible for the security of job provided materials and equipment.

The Service Supplier shall be responsible for the security of their personal valuables, tools, materials, and the parking of private and company vehicles.

Unauthorized equipment or devices such as cameras, recording equipment, metal ladders, etc., shall not be permitted in Customer Premises locations without the permission of the Premises owner or their representative.

The Service Supplier shall not bring alcohol, drugs, firearms, weapons, or explosives into any Customer Premises facility.

7.1.2 Facility Environmental Conditions, Upkeep, Storage, and Handling

If environmental concerns are being ignored, Qwest personnel may temporarily halt a job. The Premises owner (or their representative) may also halt a job if they have environmental concerns. Should a job be halted by either of the above for the stated reasons, the Qwest Design Engineer should be contacted immediately.

All building construction or alterations, within the areas requiring Service Supplier occupancy, shall be completed before the scheduled start of the installation or removal activity. Any exceptions shall be subject to agreement between the Service Supplier, Customer Premises representatives, and Qwest representatives.

The Service Supplier and Qwest shall negotiate with the Premises owner to provide suitable openings in buildings to allow material to be placed in position. The same process applies for necessary openings and ducts for cable and conductors in floors and walls as required. The Service Supplier shall not create unauthorized holes and openings in the facility.

The Service Supplier and Qwest shall negotiate with the Premises owner to provide the necessary ceiling inserts, embedded ceiling channel, or appropriate fastening arrangements in areas in which the equipment requires ceiling fastening.

Refer to Section 4.7 of this document for information on fire-stopping responsibilities

Electric power, heat, and general illumination for the equipment work area is the responsibility of the Premises owner. The Service Supplier may negotiate directly with the Premises Owner if these services are not adequate, or may ask the Qwest Design Engineer to serve as an intermediary. Temporary lighting provided by Service Suppliers shall be removed at the end of the job.

The Service Supplier shall not adjust or disable any Heating, Ventilation, Air Conditioning (HVAC) or humidity control, or building alarm system. Any necessary adjustments should be requested through the Premises Owner's representative.

The Service Supplier shall provide fire retardant protection for floors, walls, and equipment when necessary to prevent damage. Walls constructed for temporary purposes during an installation or removal should be constructed with fire retardant materials such as UL Listed lumber meeting FR-S 15P3/AWPA C-20 requirements.

The Service Supplier shall not create unauthorized holes and openings in the facility. The design engineer shall be contacted and shall be responsible for making arrangements with the Premises owner to place necessary openings. Service Suppliers shall not subcontract the core drilling of floors or walls for the purpose of running cable.

The Service Supplier shall be on site to receive and ensure proper storage of all material associated with their jobs. Failure to comply with Qwest "Fire Combustible Policy", any time during a job shall result in serious disciplinary actions. All equipment and materials shall be unpacked and cleaned outside of the facility or in the facility's authorized unpacking area. Equipment and materials shall be free of contaminates prior to being brought into the work area.

The cutting, filing, drilling, and milling or painting of auxiliary framing, cable rack, etc. should be done outside of the equipment area whenever possible. When drilling of equipment or structures, that can not be removed from a facility, proper protection, and the use of a HEPA vacuum shall be required.

General cleaning of the equipment facility or storage area in which work is being done is to be performed by the Service Supplier during the entire installation or removal process. Care shall be taken to generate a minimal amount of airborne dust.

The Service Supplier should use only a High Efficiency Particulate Arrester (HEPA) vacuum, capable of filtering particles larger than 0.3 microns in size, and equipped with a static dissipative hose to capture dust and chips from the drilling of floors, walls, ceiling, ironwork, and equipment during the uncrating process, and while cleaning cable racks and equipment.

The Service Supplier shall be aware of conditions that may result in equipment thermal shock (failure or degraded service brought on by a rapid change in temperature) and notify the Design Engineer of any such condition (the Design Engineer is responsible for contacting the Premises owner for potential equipment placement changes or HVAC system changes).

At the completion of a job, the Service Supplier shall arrange for the disposal of remaining job generated trash, removal of temporary floor, wall, column, and equipment protection placed by the Service Supplier, and removal of the Service Supplier's tools and property. The Service Supplier shall arrange for the turnover of all Qwest owned, and Customer owned materials. All equipment manuals and documentation shall be turned over to the LNO representative for proper storage. Combustible material shall not be left in the equipment frames, bays, or cabinets.

The Service Supplier should establish and maintain documented procedures for the handling, storage, packaging, preservation, and delivery of products.

The Service Supplier should provide methods of handling product that prevent damage or deterioration.

7.1.3 Environmental, Safety, and Health

Qwest has area safety personnel that have been assigned responsibilities for environmental, safety, and health conditions. When questions arise concerning these topics, the appropriate individual may be reached through UNICALL at (800) 654-2525 by requesting the Environmental or Safety Manager for the state where work is taking place.

The Service Supplier shall perform a walk through of the work area, specific to their job, before the start of the installation or removal activity to identify any hazardous conditions and to become familiar with the location of emergency equipment. Any hazardous conditions existing in the work area shall be documented and reported to the Design Engineer and the Premises owner, and recorded in the job log.

At the completion of the job, the Service Supplier shall again walk through the area and ensure that all their tools, equipment, protective materials, and trash, etc. has been removed and that no hazardous conditions have been created by the Service Supplier's employees or their work.

Safety glasses shall be worn while working in the equipment area. Hard hats shall be used when performing overhead removal work, and when working in a mandated hard hat construction area.

It is the Service Supplier's responsibility to instruct their employees in the appropriate safety procedures and practices, the operation and safe use of tools and equipment, and to ensure employee adherence to these procedures and practices.

For any work in a building that requires the use of Radiography x-ray (or similar EMF generating) techniques by contractors, building owners, or vendors for the purpose of locating building structural members and verifying core drill locations, the following shall be part of the contractor's specifications, and part of their MOP document for the work at hand.

1. Prior to starting work, the Contractor must post warning signage on exterior doors or at safe perimeter distances from the exposure area to warn personnel. Example:
   - "WARNING - x-ray equipment is in"
2. During each radiographic operation the contractor shall maintain continuous direct visual surveillance of the operation to protect against unauthorized entry into a high radiation area.
3. Certain equipment (for example, magnetic tape storage devices, etc.) may be susceptible to the electro-magnetic fields produced by an X-ray machine. In order to ensure that sensitive equipment is protected, the location of the radiography must be cleared with the Premises owner. If a particular location cannot be x-rayed due to the sensitive nature of nearby equipment, other, less-intrusive techniques which don't create potentially harmful electro-magnetic fields must be used; or another location to place penetrations must be found.

Service Suppliers employee(s) shall assess the workplace to determine if there are hazards that require the use of personal protective equipment (for example, head, eye, face, hand, or foot protection). The Service Supplier shall ensure that their employee’s or contracted labor are trained / instructed on the proper use of safety equipment.

Protective goggles or face shields shall be provided and worn where there is any danger of flying particles or corrosive materials. Approved safety glasses shall be worn at all times in equipment areas, when working with tools or any other areas where there is a risk of eye injuries such as punctures, abrasions, contusions or burns could occur. Personnel, who need corrective lenses (glasses or contacts) in working environments having harmful exposures, are required to wear approved safety glasses, or protective goggles.

Protective gloves, aprons, shields, or other means shall be provided and required where employees could be cut or where there is reasonably anticipated exposure to corrosive liquids or chemicals (batteries, for example).

Food or beverages shall not be consumed on the premises within the area of the telecommunication equipment.

Supplier shall provide protection against the effects of occupational noise exposure when sound levels exceed the OSHA noise standard.

All tools and equipment (both company and employee owned) used by employees at their workplace shall be in good condition. Note: If tools requiring calibration are on site, these tools shall have the date of calibration attached to that tool. Tools with an expired calibration date shall not be used.

Hand tools such as chisels and punches, which develop mushroomed heads during use, shall be reconditioned or replaced as necessary. Broken or fractured handles on hammers, axes and similar equipment shall be replaced promptly. Worn or bent wrenches shall be replaced regularly. Appropriate handles shall be used on files and similar tools. Tools should be insulated in some manner when working with "electrically hot" equipment.

Jacks, hoists or other lifting devices shall be checked periodically to ensure they are in good operating condition. Hoisting equipment available and used for lifting heavy objects shall have hoist ratings and characteristics appropriate for the task

Tools cutting edges shall be kept sharp so the tool will move smoothly without binding or skipping.

Grinders, saws and similar equipment shall be equipped with appropriate safety guards.

Cord-connected, electrically operated tools and equipment shall be effectively grounded or be of the approved double insulated type.

Portable fans shall be provided with full guards or screens having openings of 1/2 inch or less.

Personnel that operate powder-actuated tools shall be trained in their use and carry a valid operator's card. A Powder-actuated tool shall be stored in its own locked container when not being used. A sign at least 7 inches by 10 inches with bold face type reading "POWDER-ACTUATED TOOL IN USE" shall be conspicuously posted when the tool is being used. Powder-actuated tools shall be left unloaded until they are actually ready to be used. Powder-actuated tools shall be inspected for obstructions or defects each day before use. Powder-actuated tool operators shall have and use appropriate personal protective equipment such as hard hats, safety goggles, safety shoes and ear protectors.

7.1.4 Electrostatic Discharge (ESD)

A wrist strap connected to an appropriate ground terminal shall be worn when removing, inserting, or handling devices and components not in static dissipative packaging. The wrist strap shall be snug fitting and make contact with the skin.

The Service Supplier should test each of their wrist straps daily with either a pass/fail wrist strap test set or by using a Volt-Ohm meter. The reading shall be 1M? ± 15%.

The Service Supplier shall maintain a static safe environment for the handling of circuit packs and other electronic equipment. All containers or packing materials used shall be marked with ESD warning labels. The Service Supplier shall minimize the handling of circuit packs. Devices and components shall be stored in their static dissipative packaging prior to insertion in the equipment. Package and transport all circuit packs, including those presumed defective, in an approved protective static dissipative container. When removing a circuit pack from service, the pack shall be immediately placed in an anti- static, protective container. The correct size container shall be used to adequately contain and physically protect the individual circuit pack.

Circuit packs shall be handled by their front face plates. If additional support is required, use the outermost top and bottom edge, being careful not to touch any components or conductive paths.

Keep synthetic fibers, plastics, foams, etc., which are not anti-static, out of the environment where circuit packs are being handled.

7.1.5 Fire Protection Policy

The first few moments after a fire has started and/or is discovered are of extreme importance. Upon discovery of fire or smoke, immediately notify the building owner's representative. If such a representative cannot be immediately found, call the Fire Department, and notify other building occupants.

Combustible materials should be brought into the equipment areas only when necessary to perform work and will be removed from the area when the work is completed. Manuals, papers, computer printouts, drawings, circuit pack boxes, plastic parts bags or any other combustible material should not be stored or left in or around equipment. These items should be stored in metal cabinets, desks or lockers when not in use.

When cardboard boxes, wooden crates, and other combustible packing materials cannot be placed in a separate area from the equipment room, the following guidelines should be adhered to as closely as possible.

1. Storage area should be as far as possible from working equipment.
2. Area is not adjacent to, near or below AC or DC power equipment, battery strings, fuse or breaker panels, AC panels, bus bars, cable racks carrying power cable, or other similar equipment.
3. Area is not adjacent to heating units, registers or radiators.
4. Area does not create a safety hazard or block access to exits, doors, light switches or any other areas that need to remain accessible to personnel.
5. Area is maintained to the minimum size necessary for daily operation.
6. Combustibles are kept to an absolute minimum and items are stored or stacked neatly on a daily basis and maintained in this manner for the entire cycle of the job.
7. Small items are stored in boxes, metal or plastic containers, or mobile “parts cart”.
8. All items will be removed from this area when no longer needed.
9. Small quantities of solvents and paints for use on the job shall be properly stored in their original, labeled containers.

All wood materials used for construction of temporary walls and equipment or terminal mounting boards must be either UL listed fire retardant pressure treated and factory marked with the UL label or be completely coated with a fire retardant paint.

Nothing shall be placed on top of a unit of equipment that interferes with the airflow necessary for the cooling of that equipment.

All doors in an equipment room should be kept closed at all times. Fire doors and internal security doors shall not be blocked open or have lock assemblies impeded or disabled.

The administrative area to be used by a Service Supplier shall be agreed upon with the Premises owner. This area should be located out of the equipment area if possible, with similar requirements as the equipment storage area. Documentation, drawings and other combustible administrative items needed for daily use should be removed from equipment areas daily or stored in metal containers. This policy applies only to the time that the Service Supplier is actively performing work related to the specific job. If the Service Supplier temporarily closes down work for more than 48 hours while waiting for parts, to perform more critical work on another job, or for any other reason, the storage and administrative areas should be cleared of all combustible material until work is restarted.

Qwest personnel may point out all violations of Qwest combustible policy to the Service Supplier, and ask them to comply.

During the acceptance of a job, the Qwest personnel shall assure that the Service Supplier has left the area free of combustibles and has closed all cable holes.

Adherence to this policy will allow the Service Supplier to perform work efficiently and maintain cost effectiveness while not placing Qwest at undue risk to the safety hazards, economic and service penalties associated with fires in the Central Office. It is the Service Suppliers responsibility to adhere to this policy.

Smoking is not permitted in areas with Qwest digital equipment (unless the Premises owner specifically allows it in an administrative area where the digital equipment is collocated).

7.1.6 Equipment Performance Tests

Performance tests should be conducted on newly installed and/or modified equipment by the Service Supplier to assure the equipment performance meets manufacturers' and Qwest requirements. Qwest may provide an observer(s) on the job to ensure that the tests are performed and that conditions causing unacceptable test results are corrected. The test record summary, indicating tests performed and troubles found and cleared, should be forwarded to the Qwest LNO representative before acceptance of the job and a copy shall be left in the job package, and a copy forwarded to the Qwest Design Engineer.

Where a functional performance test is not performed, a continuity test shall be made on all conductors run and connected by the Installer.

7.1.7 Maintenance Window

A Maintenance Window is a predetermined period of time during each day when specific planned maintenance and infrastructure provisioning work activities should be performed. The purpose of scheduling work during specific times is to minimize the risk of disruption to the Qwest network. Although load and service conditions vary by site, nighttime is generally the time of least traffic in most Qwest sites. Therefore the "Official Maintenance Window" is:

Maintenance Window	
Monday through Friday	10:00 P.M. to 6:00 A.M.
Saturday 10:00 P.M. through	Monday 6:00 A.M.

The Qwest Operations Manager can adjust maintenance window hours to minimize the risk of disruption to the Qwest network. In addition, there are some Customer Premises locations where access at night is not as readily obtained. In Customer Premises locations, the maintenance window should be worked out with the Premises owner, and the customers being served.

Work performed in the "Maintenance Window" generally only applies to "in-service" or "hot" equipment; or the specific times when "dead" equipment is being connected to "live" equipment. (Power and Grounding Installation Guidelines are contained in Chapters 9, 10, and 11 of this standard.). As a minimum, the following qualify as maintenance window activities:

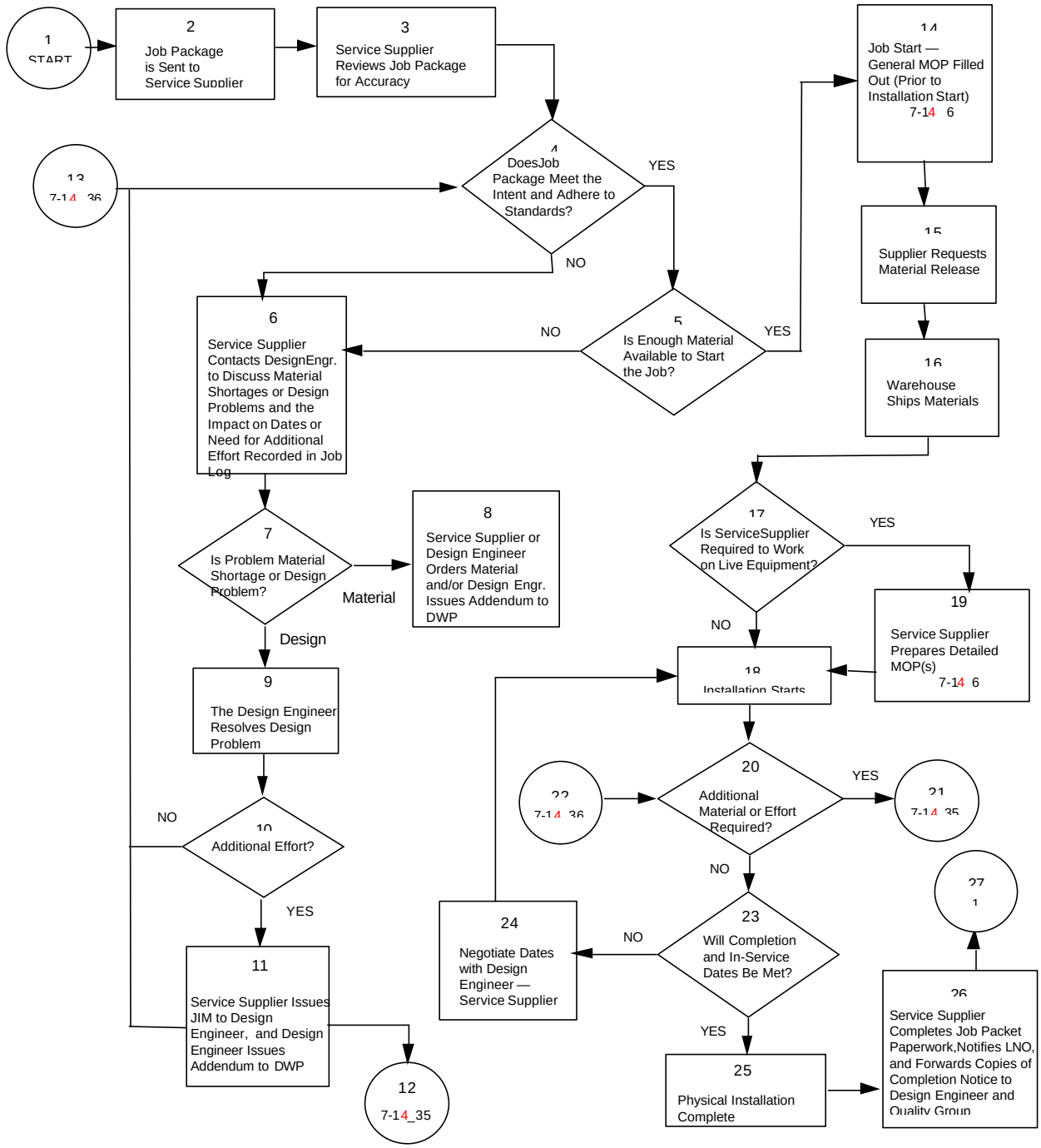
- Any work on the main DC power distribution panel(s) while it / they is / are "hot" (running / live / energized).
- Any connection or disconnection of equipment to the DC power plant bus work while it is "hot" (running / live / energized).
- Any connection or disconnection on the main AC power Board (feeder side) or any work on the AC transfer switch.

7.1.8 Letters of Deviation

There are occasional cases where following the standards contained in Qwest Technical Publications are not possible because of specific, identified conditions within the structure. In a few of these cases, it is possible for a letter detailing the condition, and the method used to provide a safe, reliable and well engineered alternative where the standards cannot be met. This letter shall be written by the Design Engineer authorizing the alternative, who is ultimately responsible for it's success. Letters of deviation are not valid for wholesale or economic concerns. Each instance of deviation shall be documented with an individual letter. These letters are not to be used in continuing non-standard practices that may have been applied in the past, or where new standards have superseded the old, (i.e. Earthquake bracing upgrades caused by seismic zone changes). A copy of the Letter of Deviation shall be provided as part of the Document Work Package (DWP) by the installation forces. The original shall be filed in the engineering job folder and stored as part of the permanent record. Jobs that have a letter of deviation shall be required to be kept in the job folder.

7.1.9 Service Supplier Installation Flow Chart

Please note that references in the following flowchart such as "7-1 36" refer to a specific flowchart entry point in Figure 7-1.



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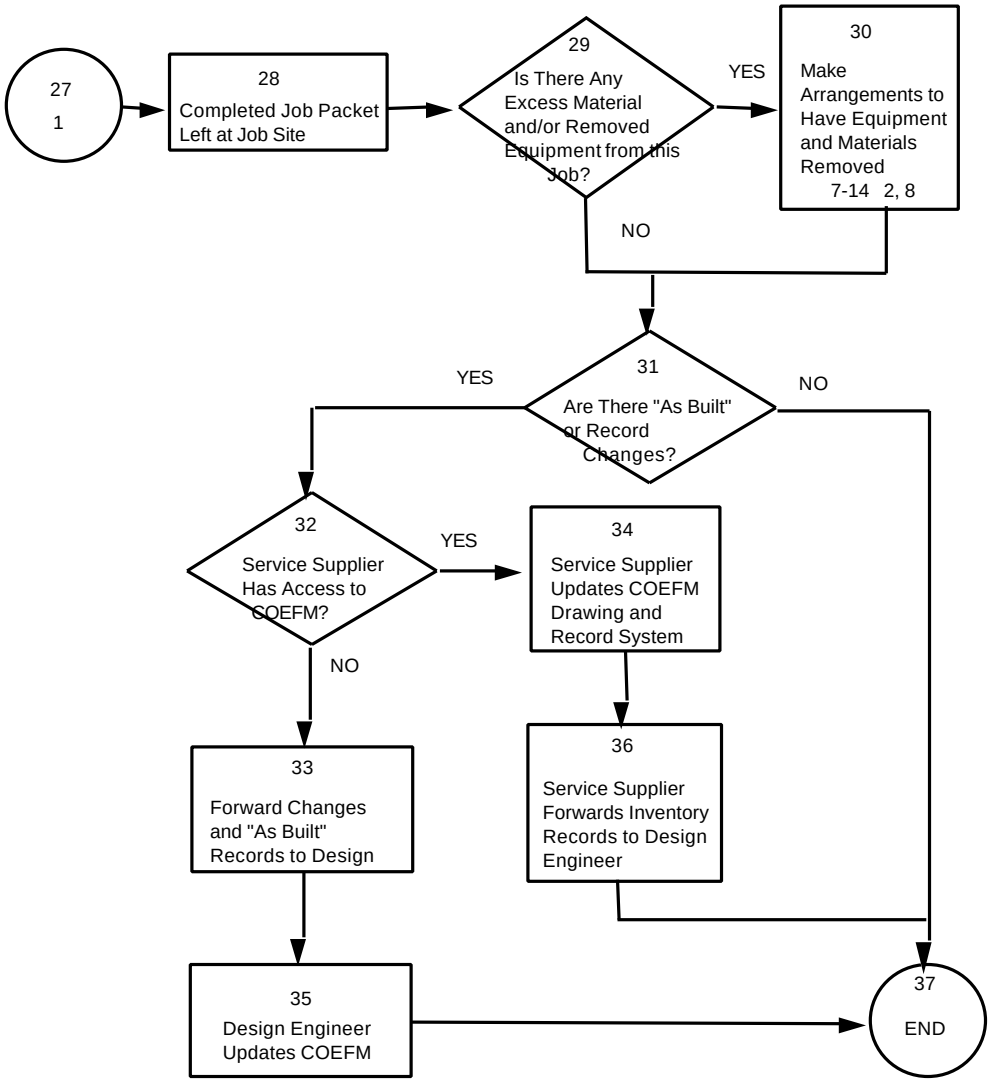


Figure 7-1 Service Supplier Installation Flow Chart

7.2 Assembly and Ironwork

The location of auxiliary framing, cable racks, frames, relay racks, bays, cabinets, and other equipment should conform to any particular plans, drawings, records, and specifications for each installation that are provided by the engineer. If equipment must be placed in a different position than that shown in the drawings, the Service Supplier shall note the "as-built" configuration on the drawings, and send these to the Qwest Design Engineer.

All assemblies and ironwork referred to in this section should be installed to meet Seismic zone requirements for the area in which they are installed. Further information on earthquake zoning and bracing can be found in Sections 4.5 and 7.2.4 of this document.

Overhead clearance in all aisles and equipment areas should typically be maintained at a minimum of 7 feet. This includes auxiliary framing, cable rack, cableway systems and lighting.

Typically in Customer Premises installations, auxiliary framing (if used at all) and cable racking is run across the room, supported from batten boards which are run around the edges of the room. The batten boards are typically 2" x 8" boards anchored to the wall (in Heavy Earthquake Zones, they are specially anchored to the wall), with the bottom of the boards at 6'9". Installation of these batten boards is usually the responsibility of the Premises owner. Information on proper installation of these boards, and how they support the auxiliary framing and cable rack, can be found in Qwest Technical Publication 77351.

7.2.1 Auxiliary Framing

All pairs of auxiliary framing channel or bars shall be of uniform length, aligned per job specification or drawing and closed with end caps or finishing clips when bars or channels extend more than three inches beyond a clip or support. Finishing clips may be omitted where ends of bars or channels extend to within three inches of a wall, column, or other vertical surface

Maximum distance between supports should not exceed six feet. Distance between last supports and auxiliary framing bar ends should not exceed 30 inches. Auxiliary framing bars shall be flush with the end of support clips at a minimum.

All splices, junction details, brackets, and hangers shall be secure and installed per standard convention.

All auxiliary framing splices in the same aisle of adjacent pairs of auxiliary framing shall be avoided. In no case shall two adjacent pairs of auxiliary framing be spliced in the same aisle.

Captive split nuts and slotted clips may be used to secure additional layers of auxiliary framing bars that are added above existing auxiliary framing where disassembly of the existing auxiliary framing is not practical.

7.2.2 Bolts, Nuts, Screws, and Threaded Rods

All bolts, nuts and screws used to secure any part or unit shall be plated to prevent corrosion (exceptions are solid copper and stainless hardware). They shall also be tight, free of damage, and meet specific/manufacturer's torque requirements where required.

The threaded part shall be flush at a minimum and may protrude to an extent not to create a safety or service hazard. Maximum allowable protrusion, where exposure may create a safety or service hazard, shall not exceed the diameter of the threaded unit.

Both ends of bolts, screws or threaded rods shall be free of sharp edges.

Threaded rod splices may be used only under the following conditions:

- The splice has jam nuts installed top and bottom.
- The splice has an inspection hole in the center of the splice to permit visual confirmation that the two rod sections are fully inserted and meet in the center of the splice.
- Where no practical alternative exists for the installation of non-spliced thread rod of the correct length.
- In “Heavy” earthquake zones, splices may used only to extend imbedded threaded rods or anchors.
- Only one splice may be used.

The tips of all cotter pins shall be bent back and rest against the rod or bolt to prevent injury by projecting ends.

7.2.3 Cable Racks

All cable racks shall be of the proper size and type, and located, leveled and aligned per job specification and drawing.

All sections of cable rack shall have both stringers supported at a minimum of one point, regardless of length. An exemption is made for short transition racks or vertical/horizontal bends. Vertical cable rack shall be supported with a minimum of two supports. Stringer splices do not constitute a support.

Cable rack runs consisting of one piece of rack require a minimum of two points of support for each stringer.

Maximum distance between supports should not exceed six feet. Distance between last supports and cable rack ends should not exceed three feet. Sections of cable rack four feet or less in length may be supported by two corner clips at each end. Transition cable racks do not need to be supported, unless they are longer than 6.5 feet. Supporting shall be accomplished by drilling the sides of the cable rack, and installing an angled drop rod bracket on each side.

Open and protruding ends of ladder type cable rack shall be finished with closing details or protective rubber caps.

All splices, junction details, brackets, and hangers shall be secure and installed per standard convention.

All cable rack shall be of the solid bar or channel stringer type.

All panned cable racks should have cable horns installed on both sides, at intervals not to exceed 18 inches. Secured type cable racks should be horned when they contain cables that are not to be secured.

It is preferred that cable rack be placed above the front aisle. Where this is not possible, consideration should be given to heat dissipation, size of the cable rack (loading), and installer access when placing cable rack in the rear aisle.

7.2.4 Earthquake Bracing

When the Qwest engineers determine that special earthquake or disaster bracing is required, they shall so advise in their job specifications. (See Section 4.5 of this document for further information on Earthquake Bracing.)

In a “Heavy” earthquake zone, auxiliary framing, battery stands, equipment frames, etc. shall be located no closer than 6 inches to exterior or interior walls or columns. Columns shall not be boxed.

All auxiliary framing parts shall be equipped with external tooth lock washers in "Heavy" earthquake zone installations.

Splices in the same aisle of adjacent pairs of auxiliary framing shall be avoided. In no case shall more than two adjacent pairs be spliced in the same aisle. Splices shall be staggered at least one aisle apart or approximately five feet (on centers). Only drilled-through, bolted splices shall be permitted.

Auxiliary framing bars must extend a minimum of three inches beyond the last threaded rod support and be through bolted with a $^{3}/_{8}$ inch bolt, spacer, external tooth lockwasher and nut. This requirement is for Heavy earthquake areas only.

Where extension of auxiliary framing bars is possible, the ends of the bars shall be drilled for future splices.

Earthquake bracing with $^{5}/_{8}$" threaded rod shall be limited to 10" or less, and require one end secured to a ceiling or wall. Flat bar $^{3}/_{16}$" can be used up to 1'6", and $^{3}/_{8}$" angle type supports shall be used for distance's over 1'6".

In seismic zone light, two bottom supports are required per bay (not in a lineup). In seismic zone "Heavy, there shall be four bottom floor supports. Frames, bays, or cabinets that use an approved bottom support earthquake strategy may be free standing and are exempt from top support requirements.

Top supports (if used at all) made with threaded rods or bolts may not exceed 8 inches in length. Top junctioning materials shall not constitute a top frame support. A top support shall establish a fastening point to a supportive member other than the frame, bay, or cabinet.

All battery stands shall be floor secured, meet manufacturers' recommendations, and should comply with Qwest minimum requirements for the Earthquake Zone in which the stands are installed.

For seismic reasons, relay racks should be welded (not bolted), and be constructed from iron or steel (not aluminum).

7.2.5 Equipment Removal For Reuse

The Service Supplier shall make a visual inspection of the equipment being removed for reuse to identify and document physical defects or missing parts (broken or bent terminals, broken or warped circuit pack shelves, missing hardware, etc.). The inspection and agreed-to repairs shall be completed prior to the equipment being shipped, documented in the job log, and notification of completion of the repairs sent to the Qwest Design Engineer.

The Service Supplier shall utilize the proper tools and methods and procedures to ensure that the equipment being removed, as well as remaining equipment, is not damaged during the removal process. If the equipment is damaged during the removal activity, the Service Supplier shall notify the Qwest Design Engineer.

Care shall be taken not to damage or remove any shop wiring.

All installers' wiring shall be removed and terminals cleaned unless otherwise instructed by the Qwest Design Engineer.

The Service Supplier shall utilize the proper packing assemblies when preparing to ship equipment removed for reuse. All equipment shall be packed and secured per job specification or manufacturer's instructions to safeguard against possible equipment damage during shipment.

System circuit packs and plug-in units shall be secured in place and remain with equipment shelves, unless otherwise noted by the Design Engineer. When it is necessary to protect the structure of the equipment, circuit pack and plug-in units shall be packaged separately in approved ESD containers and identified with the circuit pack or plug-in number on the outside of the container before shipment. ESD control measures shall be practiced if circuit pack removal is required (see Section 7.1.4).

7.2.6 Fiber Optic Protective/Distribution Systems

All covers and devices used to maintain fiber cable/jumpers within their protective systems shall be in place and secure.

Fiber optic cables and jumpers shall be run on dedicated racks or in dedicated cable ways whenever possible.

A dedicated cable slot/hole/sleeve should be used for fiber cable entering the equipment facility from the CEF with provisions for approved fire/smoke and gas stopping.

7.2.7 Frames, Bays, Cabinets, and Stands

Locate, all frames, bays and piece parts per job specification and drawing/record. All frame parts shall be free of defects, secure, and aligned.

All adjacent frames shall be bolted together where possible.

Relay Racks are preferred to have 23" mounting width (instead of 19") with 1" and 1-$^{3}/_{4}$" mounting holes, unless the equipment being installed dictates otherwise. (19" equipment can be installed in 23" relay racks with appropriate reversible ears, but 23" equipment cannot be squeezed into 19" mounting width racks.

The vertical alignment of all frameworks should be plumb within the allowable deviations shown below:

Table 7-1: Framework Alignment and Clearances

Vertical Alignment (Maximum Allowable Deviation From Plumb)	
Height	**Maximum Deviation**
4’6” or Less	1/16”
Over 4’6” and less than 7’	1/8”
7’ to 9’ inclusive	3/16”
Over 9’	1/4”

Horizontal Alignment
Should Be Level

Aisle Spacing				
Equipment Type	**Standard Front Aisle**	**Min Front Aisle**	**Standard Rear Aisle**	**Min Rear Aisle**
Relay Racks and Cabinets	3'	2'6"	2'6"	2'
Front Access Eqpt in Relay Racks	3'	2'6"	6"	
Battery Stand	3'	2'6"	6" (from wall)	
Equipment with AC Power	3'6"	3'	3' (if accessible) 0" (if rear not accessible)	
Main Aisles and Egress Routes	4'	4'	N / A	

Joined sides of frames shall be properly aligned both vertically and front to rear.

Frame bases, end guards, and spacers shall match and be in alignment. Transition plates or guards shall be installed where this cannot be accomplished.

Cabinets on casters or rollers shall have the rolling system disabled or removed and be anchored to the floor.

The uprights of all frames or cabinets (7 feet high or taller) where the flanges align will be junctioned together. Equipment frames 7 feet high require a minimum of three junction plates. Taller equipment frames require a minimum of four junction plates.

The distance between the TOP of a pipe stand and the BOTTOM of the supported ironwork shall not exceed 2 inches.

7.2.8 Framework Parts

All piece parts (i.e., ironwork, framework, threaded rod, miscellaneous details, etc.) should be installed per equipment drawings / records and shall be secure, aligned, plumb, and free from defects, sharp burrs, points, etc.

All splices on cable racks, auxiliary framing bars or junction bars shall be butted together or butted against junctioning hardware. Gaps shall not exceed ½".

All surfaces of equipment and ironwork parts should be free of rust, dirt and contaminants. If rust is apparent on equipment or parts, they should be cleaned and painted.

All cut ends of cable rack auxiliary framing, threaded rods, and other unprotected metal parts should be plated or painted.

End guards should be provided for end of equipment lineups, and shields provided when frame ends (duct uprights with wiring and cables) are exposed within an equipment lineup.

7.2.9 Mounting of Shelves/Equipment in Relay Racks

When mounting positions are identified in inches or in fractions of inches, these measurements are from the top of the frame base to the bottom of the unit.

All units of equipment shall be installed, aligned and secured in accordance with job specifications and drawings.

All installer mounted units shall be secured with a minimum of four screws in the upper and lower most available mounting holes on each side of the unit. Units exceeding 8 inches in height require 1 additional mounting screw on both sides for each additional 8 inch interval. Additional screws may be required for heavier units or as required by manufacturers' specifications.

All units of equipment shall not extend beyond the front or rear edges of the base or guardrail of the frame. The installer shall notify the Design Engineer when this cannot be accomplished and provide a detailed description in the job log. The Design Engineer must approve the deviation.

Mounting space adapters shall be used where hole spacing is incorrect for the equipment being mounted in the frame, bay, or cabinet. The frame, bay or cabinet shall not be drilled to accommodate equipment mounting.

When bays are up against a wall or back up to other equipment in a cabinet so that rear access is near impossible, every effort should be made to install only front-accessible equipment.

7.2.10 Building Envelope Drilling Procedures

All drilling of the equipment building envelope, consisting of floors, walls, ceiling, or any wall or separation therein, should be accomplished in a safe and environmentally sound manner, which captures and contains any debris using proper HEPA vacuum and protective materials.

Before drilling into any basement floor or basement wall, it shall be the installer's responsibility to determine from the Qwest Design Engineer and the Premises owner whether waterproofing has been provided. Usually this is covered on job drawings or in job specifications. When waterproofing is used, Qwest shall decide the method for securing the frames. Drilling in waterproofed floors, where authorized, is limited to depths not exceeding three inches. If the waterproofing cannot be temporarily broken to accept anchors, the “poured concrete block” method should be considered; however, some frames cannot be secured in this manner (see Qwest Communications Inc. Technical Publication 77351 for more information on the “poured concrete block” method). Frames equipped with pull out units, where an appreciable amount of the weight may be shifted outward, shall not be fastened with the “poured concrete block” method.

Procedures for Dry Drilling, Wet Core Drilling, Floor Tile Punching, and Floor Tile Drilling with a HEPA Vacuum should be used whenever the Service Supplier is performing an installation that involves drilling through floor tiles that contain asbestos or if the Service Supplier is unsure of the asbestos content of the floor tiles. These procedures are outlined in Section 3.20 of Tech Pub 77350. (See Qwest Safety and Loss Prevention Program manual or a Qwest EHS Representative for further information.)

7.2.11 Floor Anchors and Installation Instructions

The Hilti® item #002172179, HSLG M12/0 * 60TN, Qwest PID #2264556 is the preferred floor anchor. These anchors are available in kit form containing two anchors and two 2” x 2” hold-down plates under Hilti® item #002307122, Qwest PID #2285841.

If floor depth or equipment design problems are encountered, the Service Supplier should contact the Design Engineer who will contact the AMC representative and the Premises owner for resolution. The service supplier should document the resolution in the Job Log, and obtain a letter of deviation from the Design Engineer.

Floor Anchor Installation Instructions are as follows:

- Drill the proper diameter and depth hole following the instructions in the previous Section as appropriate.
- Clean loose debris from the hole. Make sure all drilling debris is removed from the hole.
- Make sure the nut and washer are threaded onto the rod with the washer in contact with the top of the sleeve. Any isolation bushings or hold down plates should not be on the anchor at this time.
- Insert the anchor into the hole and tap the anchor down with a hammer until the washer contacts the concrete.
- Pre-torque the anchor to approximately one half of its installation torque (30 foot pounds).
- Loosen the nut several turns and then remove the rod, nut, and washer. The rod assembly may be backed out by using the screwdriver slot.
- Position the frame, bay, or cabinet over the holes. Be careful not to let debris fall into the holes.
- Place the rod through the hole in the base of the frame, bay, or cabinet and thread it into the anchor body until it is fully engaged in the threads in the bottom cone.
- Add all components such as bushings, washers, and hold down plates.
- Tighten the torque nut to the point where the top flange of the nut snaps off (approximately 60 foot pounds). Use a box end or a flare nut wrench or socket to tighten the torque nut. Do not use an open-end wrench, which may distort the torque nut and affect the setting torque.

On raised or other floors, where floor tile drilling and/or punching are required, see Tech Pub 77350, Sections 3.22 through 3.24. When mounting frames, bays, and cabinets on raised floor environments, the floor manufacturer's instructions for mounting shall be followed, and the appropriate number of anchors should be used for the seismic zone in which the equipment is located. As an alternative, the Lucent ED4A306-70 drawing may be followed. For the seismic zone "Light" environments the Group 4 material is the approved method of support, while Group 16 is approved for earthquake zone "heavy" environments.

In raised floor environments where the space underneath the floor is used as an air plenum, all cables placed in this space must be plenum-rated (or placed in fire-resistant conduit), per the NEC.

7.3 Cabling: Forming, Running, and Securing

Note that additional specific requirements for power cabling are found in Section 7.7.

The requirement for cable routing and segregation shall be per job specification and records / drawings, except where manufacturers' requirements, critical routing, and / or critical lead lengths shall take precedence.

Route cables to avoid pileups and blocking of cable runs. All cables shall be run within the confines of the cable rack stringers. Do not run cables on existing cable racks where cable pileup exceeds the top of cable horns. Cable horns are limited to a maximum usable length of twelve inches. See Section 7.3.4, “Cable Pileup.”

Cables shall be run directly, from point to point, with only a maintenance loop of slack (not to exceed 4 feet) stored on the cable rack. In "Heavy" Earthquake Zones, cabling between equipment elements that are secured to different earthquake planes (i.e. floor and ceiling) shall require additional slack between the cable break off and the equipment frame. Typically an additional 9 inch slack loop shall be provided.

Cable spanning horizontal planes shall not exceed 9 inches without additional support. Vertical cable rack offsets of greater than 9 inches in parallel planes shall be made using fixed degree edge clamps. Where it is not practical to use fixed degree edge clamps for vertical offsets, adjustable clamps may be utilized.

Remove all cable running tags and binder grouping material after the completion of testing. Exception: When requested by the Local Network Operations (LNO) personnel and the Qwest Design Engineer concurs with a letter of deviation, on a per job basis, the tags may be left in place if those tags are made of a fire resistant material.

Cable and cable management systems shall be a distance sufficient to maintain a maximum cable enclosure temperature of 115° F. At a minimum, the distance shall be no less than six inches clearance from steam pipes, or other environmental hazards.

If any cable mining must be done, refer to Tech Pub 77350, Section 5.2, for guidelines.

7.3.1 Bending and Forming

Sharp bends in cables shall be avoided to prevent damage to insulation and conductors. Minimum bending radii should be as follows:

- Switchboard and ABAM cables — A minimum radius 3 times the cable diameter.
- Coax, Shielded, Twin Conductor, Armored (BX), and Flex Steel cables — 5 times the diameter of the cable.
- Power and Grounding cables — 12 times the cable or wire diameter.
- Fiber Optic cable and jumpers — See Section 7.3.6, “Fiber Optic Cable.”

7.3.2 Cable Protection and Storage

Protect all cables and wires against damage at all locations where they come in contact with sharp edges or threaded rod, using fiber sheet, plastic edge guard, and / or protective tubing as appropriate.

Store and protect all cabling and wiring identified as “future” in a manner that shall allow for future access.

All cables identified for future use shall be identified at both ends with the far end location of the other end and near end location. All cables shall be stored in a manner that allows for future access. Cables run (extended), but not yet connected, shall be coiled, banded, and stored (outside the rack) in a safe manner.

Plastic electrical tape or heat shrinkable tubing shall be used to wrap / protect the butt location of ABAM and shielded cables.

All cables shall have their exposed ends covered (taped) during the running process (and until they are terminated) to protect existing equipment.

All types of cable rack that have threaded rod(s) in contact with the cable rack, shall have the threaded rod(s) protected with protective tubing.

Provide protection using fiber sheathing on inverted ladder-type cable rack in a horizontal or vertical plane where the wire and cable are in contact with the flange side of the cross straps.

Power wires fastened to the underside of channel type cable rack straps shall be protected.

Cables on distributing frames that are butted at the traverse arm require fiber protection or fanning rings.

Fanning rings shall be required when wires are fanned under transverse arms.

All soft rubber insulated cables require protection when secured with 9-cord, or equivalent, or nylon tie. Cable insulation that will not cold flow is exempt from this requirement. Cold flow is a condition where insulation thins or flows away from an impingement point.

All exposed ends of power or ground cables shall be protected with rubber insulating tape and plastic electrical tape or heat shrinkable end caps. This requirement applies specifically to common feeders serving multiple bays or cables that have been dead ended.

7.3.3 Securing and Supporting

All switchboard cables and wires not in basket type or pan rack are to be sewn with No. 9 cord (twine, waxed polyester, 9 ply) or equivalent. Horizontal runs are to be sewn every sixth strap and when necessary to keep cable in the cable rack or from sagging through the cable rack. Vertical runs (and waterfall rack) are sewn on every alternate strap. Installer may leave securing cord provided that ending stitch is made and cord is properly stored for future use. No more than two square inches of cable shall be secured under a single stitch. Band between cable rack break-off and first frame support is exempt from the two square inch requirement. See Section 7.3.10, “Securing Tables.”

All cables shall be tied with 9 cord, or equivalent, at cable rack break-off points, banded or tied between the cable rack and first support (where this distance exceeds eighteen inches), and banded or tied at the first support on a frame, bay, or cabinet. Where cables extend from a ceiling supported racking system to equipment frames that are floor supported only, or not physically connected to the feeder rack, then an additional 9 inch slack loop shall be provided.

All non-fiber cables and wires should be secured at intervals not to exceed three feet in protected ducts or eighteen inches in open ducts and at all turns or junctions within the frame, bay, or cabinet.

Secure and support all cables before, at, and after turns or junctions of horizontal runs in other than pan, basket, and horned racks.

Cable should not be unsupported for a distance greater than three feet, measured from the last support on the cable rack or waterfall to the first support on the frame, bay, or rack, except where otherwise specified in specifications or drawings.

Distributing frame cabling requires the securing of all cables on first and every alternate traverse arm, at break-off points, turns, and at the terminal strip location. Cables secured to horizontal transverse arm should be secured a minimum of three times. Transverse arms on the horizontal side of the distribution frame should have their cabling equally distributed across the served area.

Grounding conductors 1/Ø AWG and smaller may be secured directly to the side of cable racks (see Section 7.3.10).

Grounding conductors larger than 1/Ø AWG should be suspended on and secured to cable hangers. Cable hangers should be placed at eighteen inch intervals.

7.3.4 Cable Pile-up

The maximum pile-up of switchboard, coax, ABAM, etc. is given in the following table.

Table 7-2: Switchboard/ABAM Cable Pile-up on Horizontal Cable Rack

Width of Cable Rack	**Maximum Pile-up Height**	
	Supports on 5'1" Centers	Supports on 6'0" Centers
12" or less	equal to width of Rack	
15" to 25"	12"	10"
30"	10"	7"

Vertical runs of Switchboard/ABAM are limited to 12 inches.

The maximum pile-up on combined vertical and horizontal cable rack shall not exceed seven inches for Power cable.

The maximum width of horizontal and vertical dedicated power cable rack shall not exceed twenty inches.

The maximum pile-up on cable hangers or "T" bars shall be limited to their width, or the manufacturer's weight restriction for the hanger (whichever is more stringent). One inch cable clearance shall be maintained between hanger and supporting cable rack stringer.

7.3.5 Coaxial Cables

Coaxial cables may be run with other types of cable.

Where possible, coaxial cables should be bundled and segregated to increase protection.

Care shall be taken, when sewing or banding, not to indent or collapse coaxial cables. Fiber sheet or protective-tubing protection may be required.

7.3.6 Fiber Optic Cable

Fiber optic cable and jumpers shall not be pulled, kinked or twisted during installation. Manufacturers' guidelines shall be followed.

Slack on fiber optic cable should be stored in the cable vault or in a designated storage cabinet. Fiber jumper slack shall be stored on reels, trays, or in fiber protective systems. Slack stored in the trough system or on cable rack shall not exceed the maintenance loop (4 foot) maximum length.

Cable ties shall not be used for banding or securing fiber optic cables/jumpers.

Fiber optic jumpers and cables shall be protected from metal work and lacing twine by wrapping with 1 layer of sheet fiber or 3 layers of tape, or protective tubing.

Metallic type fiber optic cables shall be grounded. Components include: protective cable covering, cable sheath and/or any metallic inner strength members.

Fiber optic cable bend radius shall not be less than:

- Simplex cable 1-1/2 inch radius
- Duplex cable 2-3/4 inch radius
- Quad 3-5/16 inch radius
- General rule: bending radius = 10 times the diameter of the cable/lead.

Fiber optic cables and jumpers should be run on dedicated racks or in dedicated cable ways. Fiber optic cable, which qualifies for support by ladder type cable rack, must meet several design specifications. All dielectric construction shall provide ElectroMagnetic Interference (EMI) immunity. For the detailed specifications on fiber optic cable approved for use within Qwest central offices and buildings, contact the Qwest representative for fiber cable standards or Technology Selection. The fiber optic cables (fiber patch cords or jumpers) not equipped with a heavy protective sheathing leaving the FDF shall be continuously protected within an approved FPS until they are terminated on the fiber equipment bays. This totally enclosed protection system shall be equipped and installed with covers on all fittings and straight sections, both horizontal and vertical. FPS systems shall maintain a minimum 12" clearance when located above cable rack. End caps are required on the end of all horizontal or vertical sections. Running fiber optic cables or patch cords with any other type of cable is strictly prohibited unless specified in Qwest Standard Configurations documents.

Hook and loop fastening systems shall be permitted for the banding and securing of fiber optic cables/jumpers.

Fiber ribbon type cables shall not generally be run on cable racks. Dedicated cableways should be utilized, unless the ribbon type cable has specifically been approved for cable rack use by Qwest Technology Selection and Configurations.

7.3.7 Repair of Damaged Cables

Damaged outer jackets of Polyvinyl Chloride (PVC) covered cables shall be repaired with electrical tape. The tape shall be applied in two half-lapped layers with the final two wraps applied without tension and overlapping. The tape shall extend a minimum of two inches past the damaged section.

Seriously damaged sections of outer jackets of PVC covered cables shall be repaired by removing the damaged section and replacing it with the covering from a similar cable. Apply a single half-lapped layer of electrical tape over the new section, extending two inches either side of the repaired section, to secure it in place.

Damaged outer jackets of power cable shall be repaired with an insulation equivalent to that of the original insulation or with an insulating device identified for the purpose.

A run of cable shall be replaced if the number of damaged conductors exceeds five percent of total conductors.

7.3.8 Splicing Cables, and Mated Connectorized Cables

Multiconductor cable shall be rerun if the number of spliced conductors exceeds five percent of the conductors in the cable. Under certain conditions, this requirement may be deviated from with permission of the Qwest Design Engineer. A letter of variance shall be required and the reason shall be documented in the job log.

Splicing of cables shall be kept to a minimum and, if required, shall be done in the vertical duct of frames, bays or cabinets. All splices shall be protected. Splices shall not appear on the cabling surface of cable racks.

Mating of connectorized cables shall be kept to a minimum and if required shall be done in the vertical duct on the splice shelf of frames, bays, or cabinets, or on dedicated rack. Connectors shall not appear on the cabling surface of a cable rack.

Mated connectorized cables shall be mated and secured by using twine, tie wraps, hook and loop systems, screws, spring clips, etc.

Spliced or mated cables shall be protected, designated, and accessible for maintenance.

Protective covers or caps shall be installed on unused connectors to protect contacts from mechanical or ESD damage.

7.3.9 Use of Nylon and Plastic Cable Ties

Cable ties are not approved for securing or banding of cables in cable racks or securing fiber optic cables and jumpers.

Cable ties used for banding and securing of cable, fiber protection, PVC protection etc. shall be of an adequate size, type, strength, etc. for the particular application.

Cable Ties are approved for the following applications:

- Banding together of cables after the cables break off the cable rack or other similar banding operations.
- Banding together of cables or power wire including flexible cordage and soft rubber cables with the use of protection.
- For power cable strain relief ties.
- For banding together armored cables.
- The securing of power, ground, and armored cable to cable brackets and other similar-type wire supporting details in power equipment bays.
- The securing of ground cable to the stringers of cable rack and auxiliary framing bars.

Cable ties shall be trimmed at the locking head with a flush cutting device that provides automatic tensioning.

Under no circumstances shall cable ties have sharp or jagged cut ends protruding from the locking head. A cable tie is considered to have sharp or jagged ends when it is sharp to the touch.

The locking head of reusable cable ties shall be positioned so as not to interfere with the installation or removal of apparatus or equipment

Reusable cable tie tails shall be positioned so as not to present a personnel hazard.

When superimposing additional cable or wire to forms, existing cable ties shall be removed where the heads of tie wraps interfere with additional cable or wires.

Where cable or wire forms are secured to cable securing brackets, the locking head of the cable tie shall be positioned on the side of the bracket opposite the side on which the cables or wires are run. (Exception: when securing cables with cable ties on distributing frame transverse arms, the locking head of the tie shall not appear between layers of cable.)

7.3.10 Securing of Cables— Tables and Figures

Table 7-3: Cable Securing Requirements

Size of Wire	Sew at Strap	# Twine Strands	Ultimate # of Layers	Cables per Stitch
Sewing Horizontal Resting Runs On Dedicated Power And Switchboard Cable Racks				
400 kcmil or larger	Every 4th	4	Limited by Section 7.3.4, Cable Pile-up Requirements	2
250-350 kcmil		2		
4/0 and Smaller				4
Switchboard Cable	Every 6th			6, not to exceed 2 in^2
Sewing Vertical Or Inverted Horizontal Runs On Power and Switchboard Racks				
250 kcmil or larger	Every Strap	4	Limited by Section 7.3.4, Cable Pile-up Requirements	1
4/0 - #4		2		2
#6 and Smaller				not to exceed 2 in^2
Switchboard Cable	Alternate Strap			4, not to exceed 2 in^2
Sewing on Horizontal Runs of Cable Hangers Spaced at 18" Intervals				
250 kcmil or larger	Every Hanger	2	Limited by Section 7.3.4	1
4/0 and smaller				2, not to exceed 2 in^2

There are two general methods of securing cables: sewing and tie wraps. Sewing of cables has historically been done with high quality standards. For drawings showing proper sewing methods, refer to Qwest Tech Pub 77350, Figures 5-1 through 5-10.

Unfortunately, the same standards of quality have not been as evident when securing is done with cable tie wraps. For this reason, the drawings from Tech Pub 77350 on proper methods of cable tie wrapping have been reproduced in the Figures below.

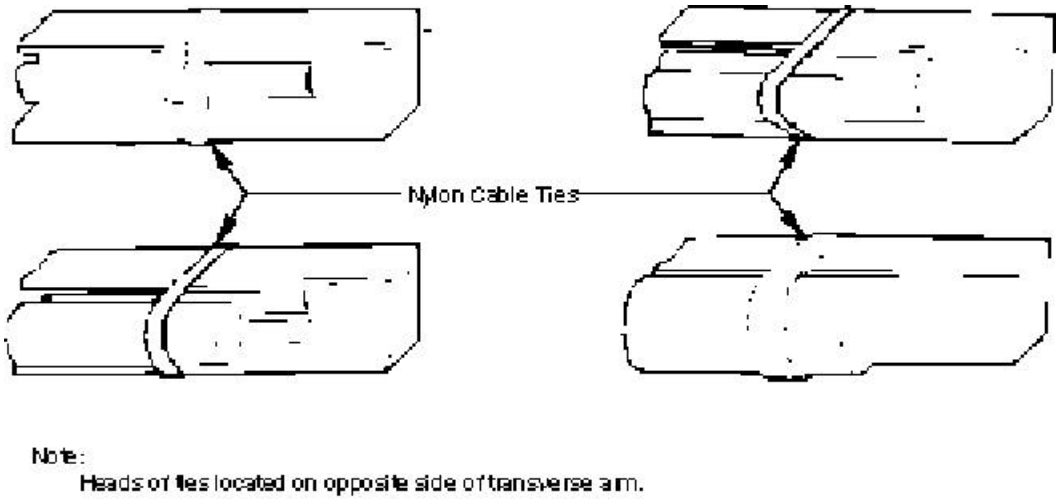


Figure 7-2 Securing Cables to Auxiliary Framing Bars and Cable Rack Rails with Cable Tie Wraps

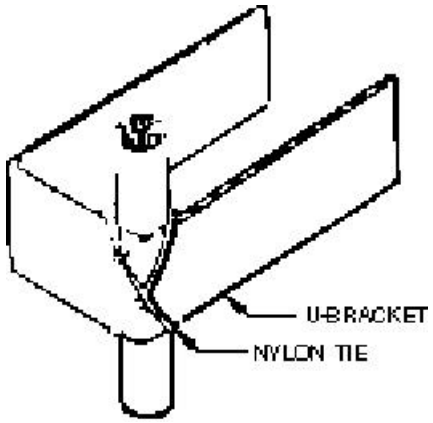


Figure 7-3 Securing Cable to the Inside of U-Type Brackets

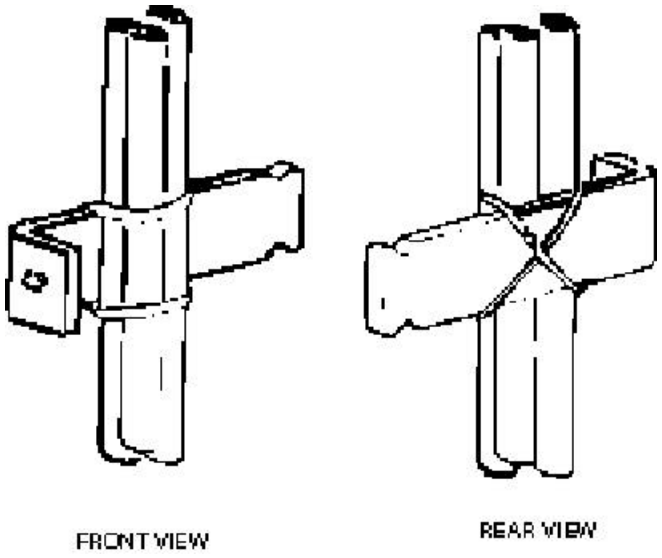


Figure 7-4 Securing Cable to L-Type Brackets

7.4 Wiring

Wire shall be of the type, color, and gauge specified in the drawings / records and / or manufacturer's specifications and instructions.

Wire shall be dressed in such a manner as to avoid congestion, to ensure accessibility, and to maintain clearance between terminals.

All spare and unused wire shall be placed in fiber / protective tubing or secured to the existing form or equipment. Individual bare wire ends shall be insulated. This requirement shall also apply to spares within a frame distribution block enclosure.

Where a functional performance test is not performed, a continuity test shall be made on all conductors run and connected by the Installer. Functional performance and continuity testing shall be recorded in test records. A Copy of the test records shall be left in the Job Packet.

Wires connected in distribution frame blocks shall be dressed to allow visual inspection of terminal connections.

Wires shall be run as directed in the specification and records / drawings.

Wire dress shall be sufficient to provide for one additional skinner length without splicing the conductor.

All wiring shall be protected from hazardous conditions such as sharp edges, excessive strain, etc.

All shop wiring and verification tags shall be removed prior to turnover, except as specified in Section 7.3.

7.4.1 Fanned and Unsewed Forms

Fanning rings shall be placed as provided in job specifications prior to wiring operations. Provide fiber protection at butt locations on transverse arms of distributing frames where fanning rings are not used. When cables fan under the transverse arm, fanning rings are required. Loose wires not held in place by rings or other similar retaining devices shall be banded at each point of breakout.

7.4.2 Sewed Forms

Sewed forms shall be secured in a manner that affords access to the equipment. All wiring added to existing forms shall be properly secured. All ending stitches shall be trimmed of excess twine. Forms designed for hinged equipment shall be capable of accomplishing movement without twisting or damage to the form.

7.5 Connecting

Additional AC power, DC power, and grounding connecting requirements are specified in Sections 7.7.1, 7.7.2 and 7.8.1.

All connections made over solder or on terminals with soldered connections shall be soldered.

All DC wire connections terminated under screw heads shall be made with an approved connector. (Example - ring or fork connectors). Exception: Threaded compression connections specifically designed for bare wire insertion.

All terminals, lugs, and connection points shall be free of contamination and previous connecting materials (i.e., corrosion, paint, grease, dirt, etc.)

Plated surfaces, such as silver, tin, or lead-plated copper, etc., are plated to prevent oxidation and reduce contact resistance and, therefore, shall not be sanded or abraded. If cleaning is required, wipe with a dry cloth.

All types of connections shall be secure (tight) and shall conform to manufacturer’s torque requirements where specified.

For connectorized cables, connectors shall be properly mated and secured with an approved method (i.e., clips, screws, tie wraps, hook and loop systems, etc.).

7.5.1 Coaxial Connections

Correct crimping practices and components shall be used as specified by the manufacturers' of the connector components and crimping tools for coaxial connections. A Qwest approved or manufacturers' specified crimping tool shall be used. Components shall be crimped once only, multiple crimps shall not be allowed. Field testing of all field fabricated coax connections should be performed by using the manufacturers specifications (or the specs in Tech Pub 77350, Section 7.2.1), and results of tests recorded on RG 47-0155. A Copy of this RG 47-0155 “Test Record (Field Fabricated Coax Connections)” should be left in the job packet.

Center conductors shall be secured in the method specified by the manufacturer for the component being used. The component shall either be soldered or crimped, but not both.

7.5.2 Crimp Compression Connectors, Splices, and Taps

Aluminum connectors and lugs are not authorized for use in Qwest installation locations. Copper or tinned copper connectors and lugs shall be used.

All crimp compression connections using the various types of approved commercial connectors shall be properly made with the number of crimps being determined by the manufacturers' requirements pertaining to the wire gauge, type of wire, type of lug, and the crimp compression tool used.

The lug specified or used shall determine the crimp compression tool and die set combination required.

Wires shall be inserted to the full depth of lug. The wire shall be inserted to within $^{1}/_{8}$” of the inspection hole for wire sizes #2 AWG and smaller and within $^{1}/_{4}$” for wire sizes 1/Ø AWG and larger.

Space between wire insulation and body of solderless connectors and power lugs shall be kept to a maximum of one eighth of an inch. If necessary, field prepared connections may use clear (transparent) heat shrink tubing when insulation is necessary to protect the connector from shorting.

All connections shall be accessible for inspection. Power conductor H taps shall be taped with plastic electrical tape, have covers applied, and the covers secured with 9 ply cord.

All connections shall be free of sharp edges, fins, or burrs caused by the crimping process.

Crimps shall not extend onto the tang area.

Individual crimps may not be recrimped after initial application.

Only one wire shall be crimped in a connector barrel.

Compression crimps shall be permitted on solid wire, #18 AWG and smaller, and on solid #2 and #6 AWG tinned copper conductors used specifically for internal connections to the ground system. Connectors used on solid #2 or #6 AWG shall be specifically intended for use on solid wire.

Parallel connector covers for battery and battery return cables for flooded batteries shall be secured with cord or plastic tape. Parallel connectors shall not be located on cable rack stringers or any other metallic object that will cause pressure to be exerted on its protective cover.

Parallel connectors that have a different voltage potential than frame ground shall be plastic taped to prevent accidental closure to ground.

7.5.3 Quick Clip/Slotted Beam Connections

Quick clip terminations shall be made with the correct tool, properly inserting the wire into the working portion of the terminal, and shall be secure.

Only one wire of the proper size and type shall be engaged in each terminal slot. Wire ends from previous connections shall be removed.

Textile (cloth) insulated wire shall not be terminated in slotted beam terminals.

Conductors shall not be placed on deformed terminals.

Previously terminated wire ends shall not be reterminated; use new wire ends.

Clearances for Quick Clip Connecting Slotted Beam Type are as follows:

- Wire ends shall clear metallic parts by one thirty-second of an inch, minimum.
- Wire ends shall protrude one sixteenth of an inch beyond edge of clipped terminal.

7.5.4 Soldered Connections

Connections shall be soldered so as to provide a secure metallic connection between the parts. Solder used shall be 60/40 rosin-core solder.

A minimum of 1-1/4 turns shall be made on all soldered, wrapped connections.

Pig tail components shall be soldered, unless the component is specified by the manufacturer for wire wrap installation, or is modified to add leads suitable for wire wrap connection. Wire wrapped components shall have a minimum of five conforming turns. (See the Figures in Section 7.5.5 for proper wire wrapping examples.)

Solder shall flow and encompass the entire exposed length of the terminal connections.

Sufficient heat shall be applied to connections to prevent cold solder joints. The installer shall consider heat sinks if adjacent components or connections could be damaged by excessive heat.

Solder connections may only be made where approved. Terminals that are not tinned (or are not capable of being tinned) shall not be soldered.

A minimum clearance of $^{1}/_{32}$" shall be maintained between adjacent soldered connections or soldered connections and metal work.

7.5.5 Wire Wrapped Connections

The Figures in this section represent established standards, and compliance to these standards is recommended.

Solderless wire-wrapped connections shall be secure and shall have a minimum of 5 consecutive conforming turns / wraps (Figures 7-5 through 7-8 provide guidelines).

All connections not meeting the minimum requirement shall be reterminated using the solderless wrapped technique. This may require:

- Complete reskinning of the existing lead
- Running a new lead
- Soldering only when the above conditions cannot be met and are not specifically prohibited by other requirements

Some examples of wire wrapping deficiencies are as follows:

- Overlaps
- Excessive separations
- Excessive shiner (+$^{1}/_{8}$")
- Excessive tail (+$^{1}/_{8}$")
- A lead that has been previously terminated

A minimum clearance of $^{1}/_{32}$" shall be maintained between adjacent connections or connections and metal work.

Separations between adjacent wraps shall not exceed 0.005" for 20, 22, 24, and 26 AWG wire; and 0.003" for 28 and 30 AWG wire.

Wire end projections shall not jeopardize minimum clearances and shall be less than $^{1}/_{8}$" in length.

Insulation shall be within $^{1}/_{8}$" of terminal. (Exception: 28 and 30 AWG wire shall have one full wrap of insulation before wire wrapping begins. This requires the use

of a bit designed to provide a “modified” wrap. The turn of insulated wire shall not count as 1 of the minimum consecutive conforming turns.)

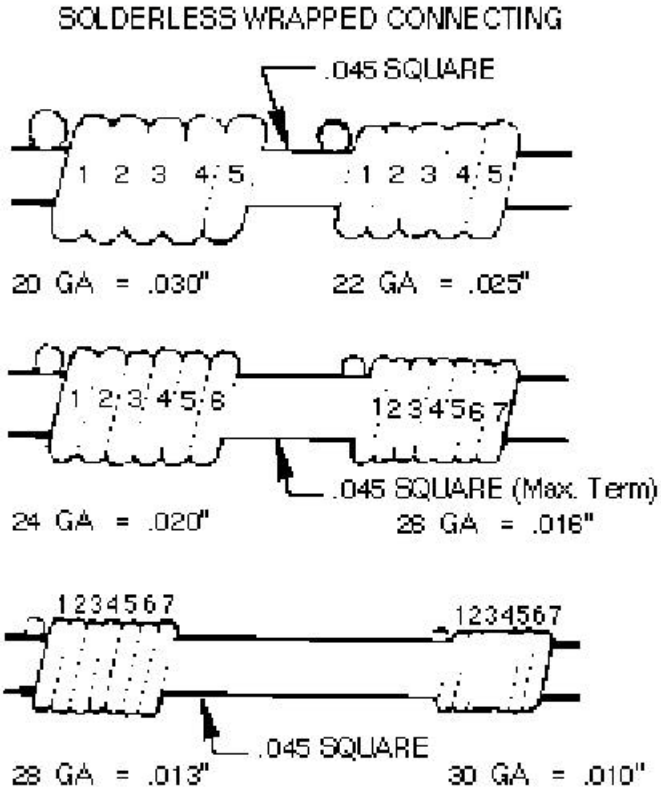


Figure 7-5 Wire Wrapped Connections

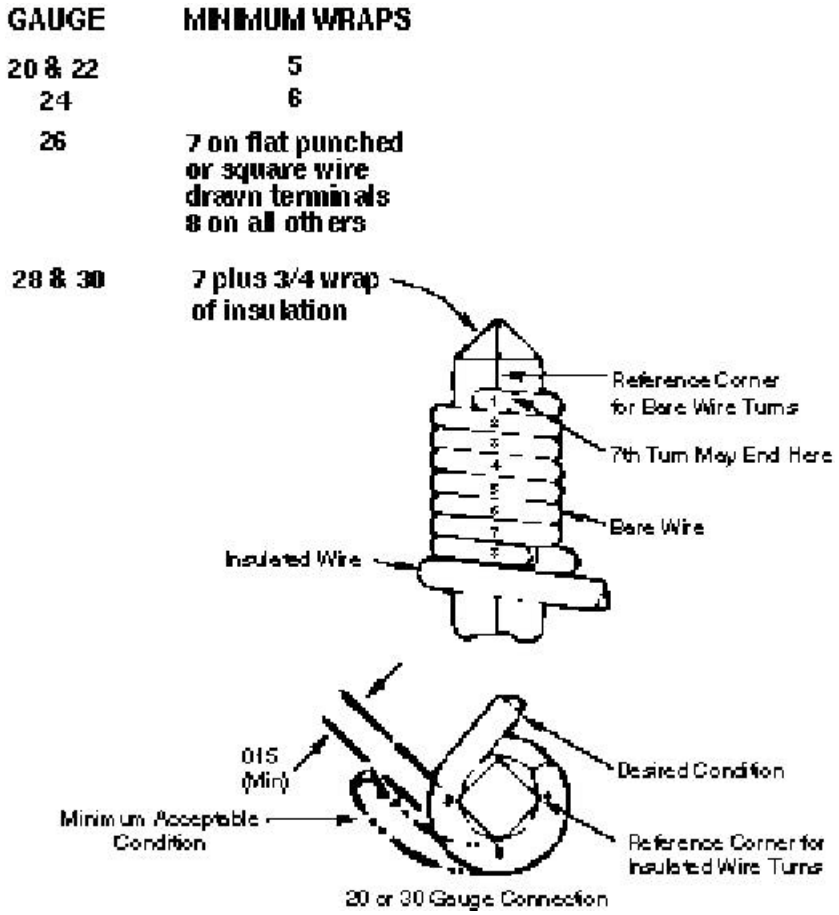


Figure 7-6 Minimum Wraps

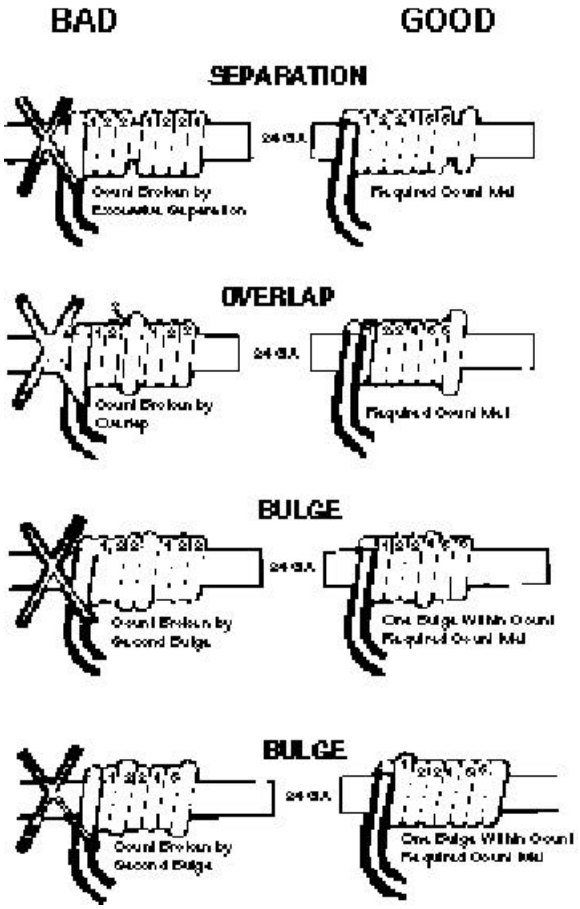


Figure 7-7 Examples of Good and Bad Wire Wraps

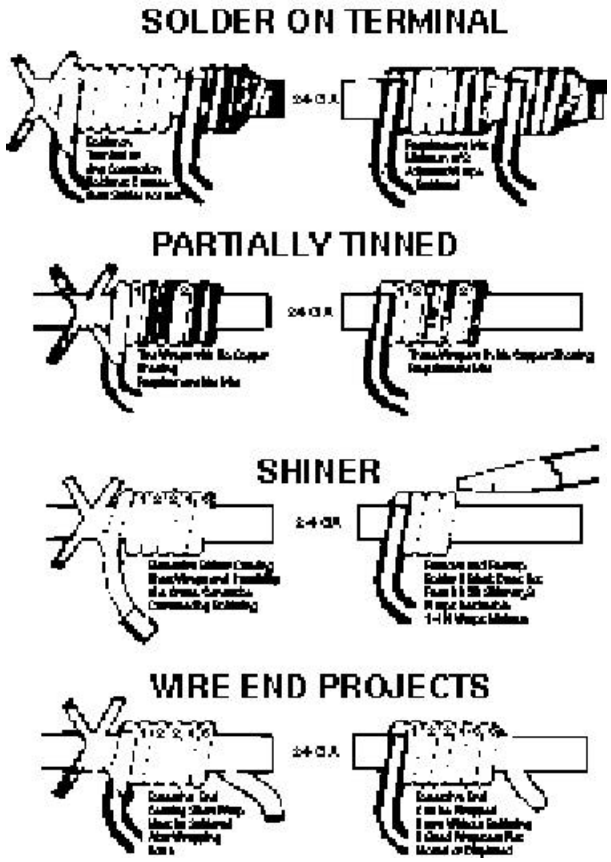


Figure 7-8 More Examples of Good and Bad Wire Wraps

7.6 Equipment Designations

Note that Power and Grounding designation rules are contained in Sections 5, 7.7 and 7.8.

All designations should be accurate, permanent, legible, visible, aligned, secure, the proper color, at the prescribed location, complete, and conform to the existing equipment designation pattern. The Qwest labels in Figures 7-9 and 7-10 should be used for the purpose of identifying power, alarms, timing, DSX, etc. including circuit numbering where necessary, on all equipment in the transport and miscellaneous (MIS, MISC, M, etc.) switch frame environments. Miscellaneous equipment, mounted in a frame, bay, or cabinet, should be designated with either label as appropriate. If the frame, bay, or cabinet is fully equipped with like equipment (subscriber / digital carrier, D-4, etc.), then a single label for the equipment may be used. Labels should be located on the part of the frame, bay, or cabinet that is not normally removable by maintenance personnel and which shall remain fully visible (see Table 7-4 for stenciling rules).

Stamping or approved labeling is required on painted or plated surfaces.

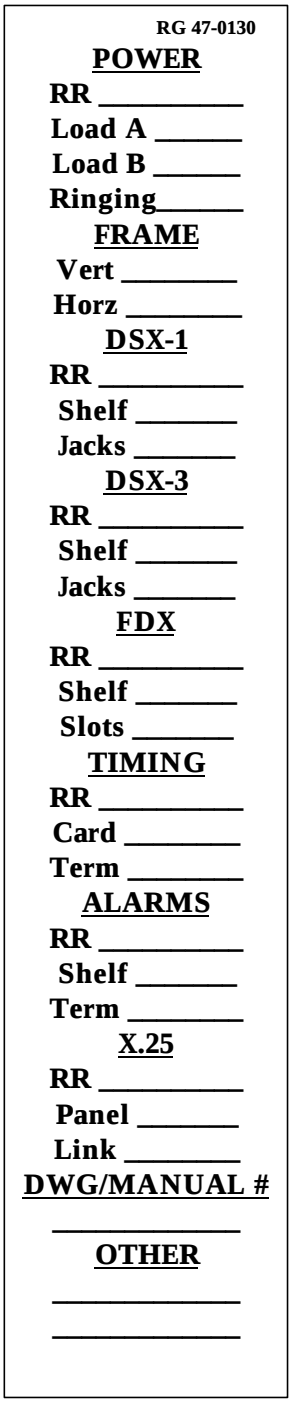
Designation tags, cable sheaths, connectors and approved designating labels may be designated by printing, using a fine point, permanent, black ink marker.

Use black ink on light surfaces and use white ink on dark surfaces. Vermilion (red) is to be used on caution notices.

Designate connectors on connectorized cables as identified in the specification or drawing / record. All connectorized cables that could be removed and improperly replugged shall be identified with connector or jack number. Where connectorized cables are formed and stitched to prevent connecting errors, numbering is optional. A label or fine point, permanent, black ink marker may be used to accomplish these designations on either the cable or the connector.

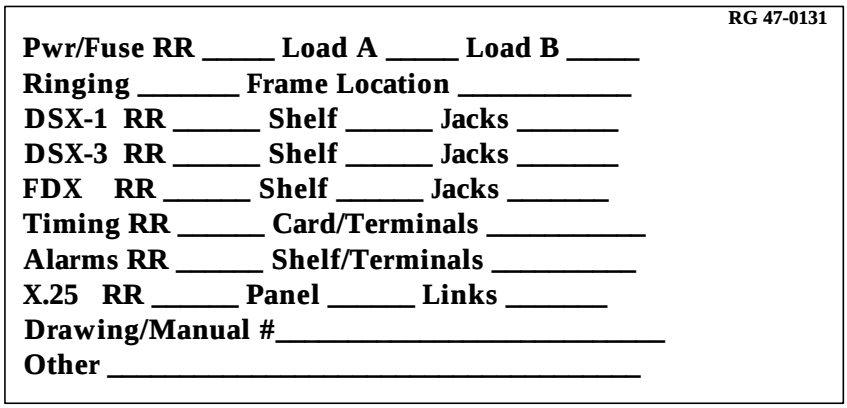
Mark all assignment changes on drawings / records as applicable.

Fiber optic cable rack and protective systems should be labeled “FIBER OPTIC ONLY” at ten foot intervals and on each end.



FRAME UPRIGHT LABEL
(Form RG 47-0130)

Figure 7-9 Frame Upright Label



BASE PLATE OR COVER LABEL
(Form RG 47-0131)

Figure 7-10 Base Plate or Cover label

The labels shown in Figures 7-11 and 7-12 may be ordered through the Qwest AMMS system, using PID numbers 2229963, and 2229971, respectively.

Table 7-4: Stenciling and Font Size

Sizes and Placement of Characters

Equipment Type	Size	Font Size	Front	Rear
Frame / Bay / Cabinet Base, Main Bus & Ground Bars	5/8", 3/4", or 1"	60, 72 or 96	X	X
Frame / Bay / Cabinet Upright / Cable Duct	3/8"	36 point	X	X
Mounting Plates: Shelf / Panel / Unit	3/8"	36 point	X	X
Electronic Components: Connectors / Jack / Plug	1/8" or 3/16"	12 or 18 point		
Fuse / Breaker Panels and Individual Blocks	3/16"	18 point	X	Note 3
Modular Blocks, Individual Fuse / Breaker on a Panel	1/8"	12 point	X	Note 3
Record Book Covers, Pullout Fuse Records	3/8"	36 point	X	
Power Equipment: Group, Load, and Voltage	3/8", 5/8" or 3/4"	36, 60, or 72	X	
Frame Blocks and Covers:				
Group / Frame / Equipment	3/8"	36 point	X	
Unit / Bank / Shelf / Etc.	3/16"	18 point	X	
Block Layout	1/8"	12 point	Note 6	

Notes:

1. Manufacturers design or recommendations for their equipment shall take precedence over these recommendations.

2. All designations shall be located on parts that will not be removed during normal maintenance.

3. Fuse / Breaker designations on the rear shall consist of a position number or similar scheme to help personnel locate the fuse / breaker from the rear.

4. Sizes may be adjusted to fit required information on a limited area of space. All designations shall be legible.

5. Conversion table for Inch and Font.

Inch	Font Size	Inch	Font Size
1/16"	6 point	1/8"	12 point
3/16"	18 point	1/4"	24 point
5/16"	30 point	3/8"	36 point
1/2"	48 point	5/8"	60 point
3/4"	72 point	1"	96 point

6. Circuit blocks shall be designated at a minimum of every other row. Punching designations shall be designated once at circuit #1's location and at any change in circuit type. Circuit designations shall be aligned with the terminal they designate. Terminal designations shall be 1/8" or 12 points maximum and may be adjusted down in size to allow for additional information. All designations shall be legible.

7.6.1 Designation Conventions

Designate all frames, bays, and cabinets, with frame type (BDFB, RR, etc.) and number on the front and rear.

- The recommended locations are: first choice — frame base; second choice — mid-frame to eye level left frame upright, or as the existing office convention dictates.
- The designations shall be readily visible.

Designate each shelf, unit, or position on front and rear or as instructed in the detailed installation specification and drawings / records. When a shelf or unit of equipment is designated by "Equipment Location" EQL such as plate number, the lowest occupied plate number for the shelf or unit shall be referenced.

The recommended convention for numbering of shelves, units, and positions in the same frame is: lowest to highest, bottom to top, left to right; as viewed from the front or as the existing office convention dictates.

Shelf, panel, bank, and fuse panel numbers shall consist of two digits, starting with 01, and be unique within a given frame; i.e., there shall be only one shelf, panel, bank, or fuse panel 01, 02, 05, 19, etc. Typical single frame designations formats could be as follows: SH-01, BK-02, PN-03, FP-04, etc. Units should have an electrical connection (power, fiber, frame, timing, alarm, etc.) in order to be designated. Cooling fans may or may not be designated. Frame filler plates, and cable ways should not be given a shelf number.

Circuit numbers associated with shelves, units, or panels shall be provided when indicated in the specifications or where they are part of the manufacturer's or Qwest's standard design.

It is desirable to designate all equipment line-ups on aisle signs, end guards, columns, or equipment uprights on both ends of the aisle to indicate added frames, bays, and cabinets. Designations should consist of frame type and number (RR, MT, MIS, M, etc.), in the order in which they appear (i.e., top is closest, and bottom is farthest). These designations should be stamped or labeled.

Remove all designations or entries for removed equipment and circuits; i.e., fuse or breaker panels, distributing frames, power bays, equipment frames, cable racks, etc.

Designate equipment drawing number and circuit equipment description (if not apparent) for units in frames, bays or cabinets.

7.6.2 Distributing and Protector Frames

Designate distributing frames with vertical numbers and shelf letters on the first, last and every fifth vertical on both horizontal and vertical frames. The frames shall be designated on the block mounting bar of unequipped positions or on the terminal block / cover for equipped frames.

Designate all connecting blocks and covers on distributing frames as required (Frame, Bay or Cabinet, Equipment Type, Shelf / Plate / Bank, Functional and Numeric).

Modular frames shall be designated front and rear with module number, shelf number, and individual block numbers. Frames that are not accessible from the rear do not require rear designations (when bays are up against a wall or back up to other equipment in a cabinet so that rear access is near impossible, every effort should be made to install only front-accessible equipment).

```
P  P1--:---:---:---P5--:---:---:---:---P10--:---:---:---:---P15-P16

N  N1--:---:---:---N5--:---:---:---:---N10--:---:---:---:---N15-N16

M  M1--:---:---:---M5--:---:---:---:---M10--:---:---:---:---M15-M16

L  L1--:---:---:---L5--:---:---:---:---L10--:---:---:---:---L15-L16

K  K1--:---:---:---K5--:---:---:---:---K10--:---:---:---:---K15-K16

J  J1--:---:---:---J5--:---:---:---:---J10--:---:---:---:---J15-J16

H  H1--:---:---:---H5--:---:---:---:---H10--:---:---:---:---H15-H16

G  G1--:---:---:---G5--:---:---:---:---G10--:---:---:---:---G15-G16

F  F1--:---:---:---F5--:---:---:---:---F10--:---:---:---:---F15-F16

E  E1--:---:---:---E5--:---:---:---:---E10--:---:---:---:---E15-E16

D  D1--:---:---:---D5--:---:---:---:---D10--:---:---:---:---D15-D16

C  C1--:---:---:---C5--:---:---:---:---C10--:---:---:---:---C15-C16

B  B1--:---:---:---B5--:---:---:---:---B10--:---:---:---:---B15-B16

A  A1--:---:---:---A5--:---:---:---:---A10--:---:---:---:---A15-A16
   1   2   3   4   5   6   7   8   9   10   11  12  13  14  15  16
```

Figure 7-11 Distributing Frame Labeling / Designations

7.7 Power and Battery Installation Requirements and Guidelines

7.7.1 DC Power Connections

Contact surfaces shall be cleaned so that direct metal to metal contact is made. Remove non-conductive coatings (such as paint, lacquer and enamel). Copper bars may require the use of low abrasive pads to remove oxidation.

Plated surfaces, such as silver- or lead-plated copper, etc., are plated to prevent oxidation and reduce contact resistance; and therefore, should never be sanded or abraded. If cleaning is required, wipe with a dry cloth.

Mating surfaces shall be flat to ensure maximum cross-sectional area contact.

A non-oxidizing agent (many exist, and most are a grease-like lubricant) shall be applied to inhibit corrosion on all battery and battery return connections. Because this agent is not generally conductive, only a thin film should be applied.

Pressure or clamping devices shall be tight.

Lock washers are advisable to ensure secure connections for DC power and return (except for connections to the batteries). Double or locking nuts also meet this intent. Shake-proof (star) lock washers under mounting screws, and split-ring lock washers with bolts and nuts are best. Lock washers should not be placed between the connecting terminal and the contact surface. Connections that require annual retorquing routines are not acceptable.

Generally only one connector should be attached with the same mounting screw or bolt. Any connector drilled with two holes shall be secured using both holes.

Stranded cables or wires shall not be stripped of strands at the termination point to fit a specific lug of the wrong size onto the cable.

The integrity and quality of a crimp or compression connection is dependent on:

- The correct size of connector for the particular wire size(s) involved.
- Insulation removal so that the wire extends the full length of the barrel or groove.
- The wire end and connector are properly prepared.
- A non-oxidizing agent is used on the wire and connector as required.
- Full insertion of the wire into the connector. The wire shall be inserted to within $^1/_8$" of the inspection hole for wire sizes #2 AWG and smaller, and within $^1/_4$" for wire sizes 1/Ø AWG and larger.
- Compress the connector the correct amount and in the proper sequence using the lug manufacturer's recommended tool and die set.

7.7.2 AC Circuit Installation Considerations

This subsection applies to AC circuits run to serve Qwest equipment, such as those feeding the rectifiers. It does not specifically apply to general electrical outlets and lighting on the Customers' Premises that do not directly serve Qwest equipment, although if Qwest finds NEC violations, they may point these out to the customer.

All connectors, wiring, conduit, fixtures, etc. shall meet the requirements of the NEC, NEMA, UL, and CSA, and any local codes and ordinances that vary from these standards. AC circuits should be installed by licensed electricians. The Service Supplier shall purchase and pay for electrical permits, licenses, and inspections, if they are required.

Electrical work done in Qwest facilities shall be done in compliance with OSHA / NEC for all contract electrical work. Employees who regularly work on or around energized AC electrical equipment or lines shall be annually instructed in the cardiopulmonary resuscitation (CPR) methods.

If electrical equipment or lines are to be serviced, maintained or adjusted, necessary switches shall be opened or wires disconnected whenever possible. When this is done, OSHA procedures for locking out and or tagging out the circuit at the source shall be followed in order to mitigate against the possibility of someone energizing the circuit when it is being worked on. No work shall be performed on LIVE / ENERGIZED AC CIRCUITS by other than a Licensed Personnel (journeyman title or higher).

Multiple plug adapters shall be prohibited.

Exposed wiring and cords with frayed or deteriorated insulation shall be repaired or replaced promptly. Flexible cords and cables shall be free of splices or taps. Clamps or other securing means provided on flexible cords or cables at plugs, receptacles, tools, equipment, etc., shall be securely held in place. All cord, cable and raceway connections shall be intact and secure.

Metal measuring tapes, ropes, handlines or similar devices with metallic thread woven into the fabric shall be prohibited where they could come in contact with energized parts of equipment or circuit conductors.

Use of metal-frame ladders shall be prohibited in areas where the ladder or the person using the ladder could come in contact with energized parts of equipment, fixtures or circuit conductors.

All disconnecting switches and circuit breakers shall be labeled to indicate their use or equipment served.

Interior wiring systems shall include provisions for grounding metal parts of electrical raceways, equipment and enclosures. Electrical raceways and enclosures shall be securely fastened in place.

All energized parts of electrical circuits and equipment guarded against accidental contact by approved cabinets or enclosures. Unused openings (including conduit knockouts) in electrical enclosures and fittings shall be closed with appropriate covers, plugs or plates.

AC circuits serving an Isolated ground plane shall not be extended to serve an Integrated ground plane.

Exposed ACEG conductors shall be green in color or taped at all appearances with green tape. Jacketed conductors may be green insulated or bare copper. Green conductors should not be used for any purpose other than an ACEG conductor, interior ring ground, or other types of grounding conductors.

An ACEG should be run with each circuit (including temporary and permanent extension cords), and should be enclosed in the same conduit or raceway with the phase and neutral conductors. Protective metallic coverings for AC circuits (such as conduit, armor, raceways, boxes, fittings, cabinets, and fixtures) shall be bonded to the ACEG.

Compression connections are preferred for AC terminations. Mechanical and single-hole connectors are permitted where allowed by the NEC, and where they are accessible for inspection. Connectors shall be the proper size specified by the manufacturer for the wire gauge and type, copper or tin-plated copper, and the correct hole size for the mounting hardware.

Wire nut connections should be placed so as to be accessible for maintenance and inspection, and should be made in an approved enclosure (i.e., junction box, conduit box, or pull box). When used, wire nuts shall be of the correct size for the wire gauge and number of conductors being joined.

As a general rule, all EMT and liquid-tight flexible metallic conduit runs should be made with compression or threaded type fittings, couplings, and junction boxes. Set-screw type fittings and stake type fittings are generally unacceptable, except for use with armored cable and flexible metallic conduit.

PVC conduit should generally be avoided because it is not as safe as metallic conduits (they can be grounded).

Conduit, flex conduit, or armored cable generally should not be run in cable rack with switchboard or power cable due to magnetic induction and noise effects.

For circuits where the voltage exceeds 130 VAC, for personnel safety reasons it is desirable that receptacle cover plates be marked with the appropriate voltage (e.g., 208 VAC, 240 VAC, etc.).

When removals involve AC, as with appliance/base outlets, utility outlets, or permanently mounted power strips, all remaining AC conductors shall be properly terminated.

7.7.3 DC Power Conductors

DC Power and Grounding conductors shall be XHHW, traditional RHW with cotton braid, or non-halogen thermoset cross-link RHW. If placed under a raised floor where the area under the floor serves as an air plenum, the conductors must be enclosed in fire-resistant conduit, or be MIC type.

Cable tap connections should be accessible for inspection. Connections that are taped and have covers are considered accessible. Connections covered with heat shrink tubing, other than clear, are not considered to be accessible.

Bus bars should be free of sharp edges, burrs, corrosion, etc.; and should be copper or tin-plated copper. Buss bars should be properly supported, and insulated from surrounding metalwork, especially if they are closer than 3 inches from metal of a differing electrical potential.

Ferrous bolts, screws, nuts, washers, bus bar supports, and clips used in fastening copper to copper, or combinations of metals should be zinc- or cadmium-plated; however, copper, copper-plated, tin-plated copper, and stainless steel parts may also be used.

For relay rack type Customer Premises installations, the equipment end termination of battery and battery return leads should be identified as to their source frame plate or panel, and fuse or breaker position; i.e., BDFB, PB, PDB, ringing, etc. Identification may be accomplished by adding the information on a visible, small fiber or plastic tag attached to the cable with twine or nylon tie. If the fiber tag is equipped with a small metallic ring, this ring shall be removed in hazardous areas.

Equipment fused from power sources outside its common equipment frame shall have its battery and battery return leads designated with the frame, plate or panel, and fuse or breaker position of the source end. Equipment fused within the same frame does not require designation tags on the load end.

All bus bars should be designated as to their potential and group designation in an area on or adjacent to the bar (i.e., -48 Volts, Load A, etc.)

Remote battery return bars associated with power frames and BDFBs should be designated with the potential and associated frame(s).

Shunts shall have their amperage value designated and visible.

7.7.4 DC Fuse Panels, Fuses, and Circuit Breakers

All fuses and circuit breakers shall be of the proper type and capacity for the application (e.g., DC fuses for DC circuits, etc.).

When manufacturers specify that their loads have multiple feeds (i.e., A and B), they should be fused from separate primary power distribution. When separate feeders are not available, diverse cable routing or fuse assignment separation is advisable.

All cartridge, knife-type fuses, and fuse reducers being installed should be cleaned and lubricated with a non-oxidizing agent. This also applies to fuse ferrules, blades, and the contact area of their associated clips.

Dummy fuses should be installed where fuse holders depend on the dummy fuse as a tensioning agent. Dummy fuses are not required for unassigned fuse locations.

All “live front” distribution bays or panels designed to have front protective covers shall have those covers installed. (Live front is defined by the NEC as having exposed electrical potential.)

Unequipped fuse or breaker block positions or panels should have blank panels installed for safety reasons.

When power cables are tapped down in size for entry into an equipment bay or shelf power lug, the taps shall be placed within six feet of the entry point. Taps should be staggered to prevent pileups.

Alarm fuses shall be installed or an alternate system provided to indicate when a feeder fuse has opened. It is advisable to pre-connect all fuse alarms when installing a fuse panel/board whether the fuse locations are fused up or are spare.

Power should be disconnected whenever possible from switches, fuses, clips, or connections before work begins on them. If the potential cannot be removed (due to the need to keep service working), attempt to protect adjacent parts of opposite polarity with insulating materials.

Where applicable, all PBDs, PDs, PDCs, Battery Distributing Fuse Boards (BDFB) and miscellaneous fuse boards shall be clearly designated both front and rear as to frame, panel, row, plate, fuse locations, voltage, and load so as to coincide with equipment and assignment drawings/records. The fuse or breaker position number shall be considered adequate on the rear of each position and does not require tags where each fuse position number is designated on the rear.

It is desirable to designate fuse and breaker panels with voltage designations front and rear.

Designate all locations associating alarm fuse with discharge fuse.

For relay rack types of Customer Premises installations, it is desirable to designate battery discharge fuses with frame number, equipment type, and location associated with the battery discharge fuse. Example (RR 102.35 FP-07).

It is desirable to designate all fuse and breaker panels with row designations (letters and / or numbers). If this is done, designate each fuse or breaker with:

- Position number front and rear.
- GMT, 70 type, and miniature cartridge fuse panels shall be designated by first, every 5th, and last position.
- Capacity on the front of the fuse or breaker panel, or install a fuse designation pin, disc, or paint / adhesive dot. Where this is not possible, the fuse record sheet or book assigned to the panel should be designated.
- Circuit breakers and switches should be designated to show the "ON" position.
- All designation pins for fuses that are not assigned, should be removed or assigned "DNA" on the fuse assignment record. (Exception: This is not required where fuse designation pins are factory installed for guard fuse positions, or where the manufacturer specifies specific fuse values for each position, such as in ringing plants.)

It is desirable to designate all fuse record book covers with associated bay location.

Fuse panel detachable assignment records should be designated with frame, bay, or cabinet number, equipment type, and shelf or mounting location.

List all new or added circuits on fuse or breaker panel sheets (blue or black ink). Update all fuse and breaker record sheets, books, or drawings / records with changes, additions or removals.

Excessive hand written changes or layers of designating tape are not acceptable and require replacement of the fuse record sheet (blue or black ink). More than 10 changes on a sheet are considered excessive.

Correction fluid (white out) should not be used for changes. Correction tape is a better alternative.

7.7.5 VRLA Battery Installation Guidelines

Most Customer Premises installations use Valve-Regulated (VRLA) batteries to provide the DC backup. A UPS system, if present, is also likely to use VRLA batteries. These batteries are used in Customer Premises installations due to their lack of liquid electrolyte and relatively small size. This allows them to be placed in small space-saving configurations. Follow the guidelines below when installing VRLA batteries.

Battery gasses, which are present during a charge or which remain near the cell at the completion of a charge, can exist in sufficient concentration to explode. Sufficient ventilation should be provided for the battery area, as described in Section 4.2. This is true even for VRLA cells. Even though these batteries are often referred to as “sealed” (this is a misnomer), they actually have a one-way pressure release valve that will release Hydrogen gas during heavy charge, when there are shorted cells, or when cell temperatures are high.

Due to this Hydrogen gas, before working on a battery cell, discharge static from yourself by touching a grounded surface.

For personal protection and protection of clothing, use chemical safety goggles, rubber gloves, coveralls and / or aprons as required.

Do not lift cells by means of intercell connectors or cell posts.

Cells from different manufacturers, and cells of different sizes shall not be placed in the same string. For VRLA batteries, cells from different manufacturers, or even cells from the same manufacturer that are not the same size (both physically and in electrical capacity), probably should not even be placed in parallel strings.

Remove shipping compound from battery posts and apply a non-oxidizing agent before installation.

VRLA batteries shall have the install date placed on each cell or monoblock, if the manufacturer has not provided the manufacture date of the battery on the case.

Connections to battery posts / lugs shall be torqued to the manufacturer specification.

VRLA batteries should not generally be boost-charged, equalized, or given an initial charge, due to the ability of the excess charge current to possibly drive weak cells into dangerous thermal runaway. If any of this type of charging is done, it should strictly follow the battery manufacturer's guidelines, which generally do not allow it for more than 24 hours, and under close supervision during those 24 hours. -48 VDC Plant VRLA batteries generally float between -54.0 and -54.8 VDC (consult the battery manufacturer's literature for exact levels; also the rare 23-cell VRLA strings will float lower). Voltages should not be higher than this. If voltages are lower than -54.0 VDC, it may be because the power plant is equipped with temperature compensation. Temperature compensation lowers the float voltage as room and battery temperatures rise to prevent thermal runaway. However, if battery temperatures do not exceed 85° F, and the batteries are being floated below -54.0 VDC, adjust the voltage to at least this minimum.

After installation, ensure that the normalized temperature of the room does not exceed 85° F. If the room temperature exceeds 85° F report this fact to the Premises owner for correction. High room temperatures will severely reduce battery life and could lead to potentially dangerous thermal runaway. If the room temperature does not exceed 85° F, but the batteries do, and are more than 5° F hotter than room ambient, ensure that it has been at least 72 hours since initial installation to allow the batteries to become fully normalized. If battery temperature still exceeds 90° F 72 hours after installation (and there are no room temperature problems), there is probably a problem with the batteries that should be corrected.

7.7.6 Additional Battery Installation Considerations for Flooded Batteries

Flooded (or vented) batteries are superior in performance and lifetime to VRLA cells, but because of their size and liquid electrolyte (spill potential) are not generally used in Customer Premises installations. When flooded batteries are used, either for DC backup, or as the backup source to a UPS system, the guidelines below should be followed by installers. These guidelines are in addition to those given in the previous section for VRLA batteries.

Cells from different manufacturers, and cells of different sizes shall not be placed in the same string. For flooded strings, strings from different manufacturers, and even strings of differing sizes, can be placed in parallel strings.

Before installation of flooded cells, the installer should ensure that goggles, Nitrile gloves, a rubber apron, an eyewash kit, and a spill cleanup kit are on site (see Qwest SLPP Manual for information on the contents of a spill kit).

Do not use oil-based lubricants to move / slide or clean the batteries.

Flooded cells may be tipped as much as 30 degrees to get through windows or past other obstructions, provided that they are not left in this state for more than 20 minutes.

Before installation, clean the battery cases with distilled water, and clean and neutralize battery posts.

Designate battery stands with individual cell numbers, string name, and voltage. Cell positions shall be designated on the stand directly beneath each cell or as directed by the battery manufacturer. Designate the Temperature / Reference (T / R) cell on the stand directly below the cell.

Designate battery string with installed date. The date should be applied on the shelf by cell #1. Reused battery strings shall have the original install date and the reinstall date designated. Single cell replacements shall have the install date designated on the cell or at the cell position.

If the battery needs the addition of water to be filled to a point between the fill lines, use distilled water. Deionized water may be used if distilled water is not available.

For flooded batteries, avoid opening or making any cell connection, working on or near any cell, or use of open flame until the battery has been floated or kept on open circuit for 48 hours after the end of initial or boost charge. (The boost-charging regimen releases copious amounts of explosive Hydrogen gas.)

Flooded cells (both entire strings and single-cell replacements) must receive an initial boost charge not to exceed 250 hours. Follow the battery manufacturer's guidelines, and those given in Qwest Tech Pub 77350, Sections 10.3 through 10.5. Because of the gassing that occurs during boost charging, special ventilation may be needed. The initial boost-charging regimen must also be periodically monitored, as cells have the capacity to overflow. Due to the gassing, the cells cannot be touched during the initial charge period, nor for a 48-hour open circuit normalization period thereafter. After two weeks of float following the initial charging, electrolyte levels may be adjusted.

Flooded -48 VDC Plant batteries generally float between -52.08 and -52.8 VDC (the latter is preferred). Float voltages should not be outside of this range (although short-term boost and equalize voltages will be).

Never seal a battery. Flame arrestors shall be in place at all times, except during transport and storage, when the manufacturer's vented shipping caps shall be used.

7.8 Proper Grounding Methods

Bonding and grounding must be done properly. Improper connections can loosen, corrode, etc. Lack of adherence to the standards found in Technical Publication 77355 can adversely affect digital equipment (by adding noise, allowing ESD damage, etc.). The rest of this section points out some of the more salient grounding methods and rules garnered from Pubs 77355, 77350, and 77390. However, all of Tech Pub 77355 is applicable.

7.8.1 DC Grounding Connections

All connections to buss bars, relay racks, cabinets, etc., should be made with 2-hole crimp connectors (see Figure below), and lubricated with a thin film of anti-oxidant. Any paint or sealant coat at the point where the metals will meet should be stripped to bare metal. The 2-hole crimp connector should be copper or tinned copper.

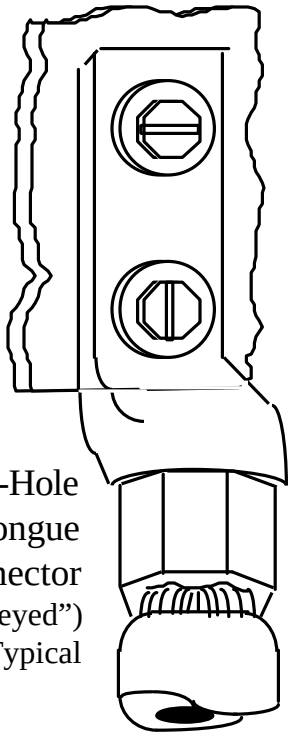


Figure 7-12 Two-Hole Crimp Connector

Connections between cables may be an exothermic weld or an approved mechanical crimp (e.g., C-tap or H-tap).

Contact surfaces should be cleaned so that direct metal to metal contact is made. Non-conductive coatings (such as paint, lacquer and enamel) on equipment should be removed to assure good electrical continuity. Copper bars may require the use of low abrasive pads to remove oxidation.

Plated surfaces, such as silver- or lead-plated copper, etc., are plated to prevent oxidation and reduce contact resistance; and therefore, should never be sanded or abraded. If cleaning is required, wipe with a dry cloth.

Mating surfaces shall be flat to ensure maximum cross-sectional area contact.

A non-oxidizing agent (many exist, and most are a grease-like lubricant) shall be applied to inhibit corrosion on all grounding connections. Because this agent is not generally conductive, only a thin film should be applied.

Pressure or clamping devices shall be tight.

Lock washers are advisable to ensure secure bonding and grounding connections. Double or locking nuts also meet this intent. Shake-proof (star) lock washers under mounting screws, and split-ring lock washers with bolts and nuts are best. Lock washers should not be placed between the connecting terminal and the contact surface. Connections that require annual retorquing routines are not acceptable.

Generally only one connector should be attached with the same mounting screw or bolt. Any connector drilled with two holes shall be secured using both holes.

Stranded cables or wires shall not be stripped of strands at the termination point to fit a specific lug of the wrong size onto the cable.

The integrity and quality of a crimp compression connection is dependent on:

- The correct size of connector for the particular wire size(s) involved.
- The insulation is removed so that the wire extends the full length of the barrel or groove.
- The wire end and connector are properly prepared.
- A non-oxidizing agent is used on the wire and connector as required.
- Full insertion of the wire into the connector. The wire shall be inserted to within $^{1}/_{8}$" of the inspection hole for wire sizes #2 AWG and smaller, and within $^{1}/_{4}$" for wire sizes 1/Ø AWG and larger.
- Compress the connector the correct amount and in the proper sequence using the lug manufacturer's recommended tool and die set.

Grounding conductors, bonds and taps to ground conductors should be arranged to flow fault currents in the direction of the ground source.

All chassis, shield, and equipment ground bonds may be made using a solderless wrapped connection (wire-wrapped), a soldered connection, or a single-hole ring-type crimped connector mounted to a properly prepared surface of the frame, bay, or cabinet with suitable hardware and a shakeproof lock washer.

7.8.2 DC Grounding Conductors

The minimum bending radius of a grounding conductor is 12 inches. 180 degree bends in grounding conductors are not permitted.

A grounding conductor shall not be secured or supported by metallic clamps that completely encircle the conductor. Grounding conductors shall not be run in metallic conduit.

It is desirable that grounding conductors be traceable in order to find grounding problems that could be causing electrical noise or compromising personnel safety. For this reason they are not generally run in cable racks; instead they are secured to hangers or to the side of the racks. If grounding conductors are run in cable racks or trays, they would be easier to trace if they were marked differently than the other cables (e.g., colored green, etc.).

It is desirable that identification tags be affixed to each end of all equipment bonding and grounding cables. Either or both sides of a tag may be used for designations. The information on the identification tags should contain the location where the opposite end of the cable is terminated. Short lengths of bonding or grounding cables, #6 AWG and smaller, which are entirely visible, and shall remain so for their entire expected life, are exempted from this rule and are not required to be designated.

It is desirable to place “Do Not Disconnect” tags on all removable grounding electrodes and all terminating locations of main ground reference conductors.

7.8.3 Isolated and Integrated Ground Considerations

In most Customer Premises installations, all of the grounding is Integrated. In some rare cases, installations will have switching equipment that requires an Isolated Ground System. In these cases, the Isolated and Integrated ground planes must be properly designed, installed and maintained to provide adequate protection of personnel, equipment and service in accordance with Qwest Tech Pub 77355 and the National Electrical Code.

When other telecommunications equipment (owned by the customer or other companies), or other metallic objects in a room will be placed within 6 feet of the Qwest equipment, they should also be ultimately grounded to the same ground source (e.g., bar) that Qwest is using. This will avoid potential differences between equipment that can be hazardous to personnel and/or damage equipment. This is the responsibility of the customer.

All bars that constitute the ground window shall be designated "GROUND WINDOW" once, adjacent to the bars and visible from the floor. The individual bars shall be designated for "ISOLATED" and "INTEGRATED" areas and each separate bar designated with its appropriate title. i.e. Main Ground Bus (MGB), Single Point Ground (SPG), etc.

Designate deliberate bond points made through surface contact, for Foreign Object Grounding (FOG) paths with "GRD" in $^{3}/_{8}$ inch or 36 point font. Designations shall be placed so that they are visible from the floor.

7.9 Hazardous Material Handling

Hazardous materials are those materials that are potentially hazardous to human health and the environment. The handling, packaging, storage, transportation and disposal of these materials are governed and regulated by various federal, state, and local laws that are very specific and restrictive on the handling of such materials. Violations can lead to fines and/or imprisonment for employees, Service Suppliers, and subcontractors for the illegal disposition of a regulated material.

Hazardous Material and Waste Handling Guidelines are covered in Qwest's Safety and Loss Prevention Program (SLPP) Manual (most specifically, Section C-46). Qwest employees should be able to contact their Environmental Health and Safety (EHS) representative with questions.

The Service Supplier shall comply with Local, State, and Federal Regulations involving hazardous waste and/or materials. On jobs requiring dismantling of equipment or removal of equipment containing hazardous materials, the Service Supplier shall contact the Qwest representative before starting any removal work. The U S Environmental Protection Agency (EPA) has published regulations pertaining to the management and disposal of hazardous waste materials in compliance with the Resource Conservation and Recovery Act (RCRA).

In Customer Premises telecommunications locations, the following hazardous materials might be found:

- Relays using Mercury (Hg)
- Circuit Packs with components containing Mercury (Hg)
- Ballasts and transformers containing PCBs
- Radioactive Tubes
- Asbestos Resistors
- Asbestos Floor Tiles
- Flooded and VRLA Lead-Acid Batteries (and possibly their intercell connectors and bolts) containing Lead (Pb) and Sulfuric acid (H_2S0_4), and capable of producing Hydrogen Gas (H_2) and Hydrogen Sulfide Gas (H_2S)
- Cable and Sleeves containing Lead (Pb)
- Cleaning supplies which might contain Solvents and CFCs
- Paint with hazardous materials such as Lead (Pb), etc.

7.10 Installation Documentation

7.10.1 Commonly Used Installation/Removal Forms

The Service Supplier shall be responsible for the proper filling out and distribution of, all applicable forms and documents. Qwest forms listed in this section shall be used, without any alteration, except where specifically noted in this and other sections.

The following forms and labels are commonly used in the Installation and Removal process:

Table 7-5: Common Installation / Removal Forms

Form Number	Name/Description
RG 33-0017 *	Straight Bill of Lading
RG 33-0043 ‡	Document and Material Disposition
RG 47-0001 ‡	Storage Battery Report
RG 47-0002	Installation Revised / Completion Notice
RG 47-0004	Job Information Memorandum
RG 47-0005	Method of Procedure (page 1)
RG 47-0006	Method of Procedure (page 2–*n*)
RG 47-0009 ‡	Report of Equipment Disconnected from Existing Plant
RG 47-0010 ‡	Request for Disposition of Qwest Communications Material
RG 47-0013 ‡	Service Interruption / Degradation Report
RG 47-0130	Frame Upright Equipment Designation Label
RG 47-0131	Base Plate or Cover Equipment Designation Label
RG 47-0132 ‡	Cable Hole Open Label
RG 47-0133 ‡	Fire Stopped Cable Hole Label
RG 47-0144 ‡	Temporary Removal and Installation Tag
RG 51-0083 *	Job Packet Envelope

Notes:

1. The asterisk (*) following a form number indicates that it is not available in this document. The ‡ mark indicates that the form is not available in this document, but is available in Tech Pub 77350, Chapter 8 or Chapter 13. Only the forms most commonly used in the Customer Premises Installation and Removal process have been included in this document.
2. It is permissible to photocopy (or use an electronic copy of) the forms and labels here or in Tech Pub 77350 (including reproducing them).
3. These Forms and Labels can also be ordered by those who have access to the Qwest AMMS system.

7.10.2 Job Packet and Job Log

The Service Supplier should use the RG 51-0083 Job Packet Envelope for all installation or removal activities where documentation and job papers are to be turned over to Qwest. Local Network Organization (LNO) should designate a "Job Packet Storage Area" for each equipment facility. Job Packets must be kept as turned over by the Service Supplier for a minimum of 180 days after job completion date. Job packet contents that have been stored longer than the final hold date shall be discarded by the LNO representative after essential documentation has been removed and filed. It is recommended that the "Job Packet Storage Area" label be black lettering on a yellow background.

The Service Supplier should complete all information required on the face of the envelope. It is permissible for the Service Supplier to modify the back of the envelope to include their logo or any additional information. The front of the envelope shall not be modified.

The Job Packet may contain, but is not necessarily limited to:

- Design Work Package (Detailed Job Specification)
- All Methods Of Procedure (MOPs) related to job (RG 47-0005 and RG 47-0006)
- Completion Notice (RG 47-0002) or completion date noted on the outside of the Job Packet
- Job Log
- Test Records
- Bills of Lading (RG 33-0017)
- Job Information Memorandums (RG 47-0004)
- Drawings / Records ("installer marked" shall be identified)
- Battery Charge Records for flooded cells (RG 47-0001)
- Letters of Deviation (if issued)
- Service Interruption report if problem occurred (RG 47-0013)

A Job Log in the format of the suppliers choice should be provided and will typically include, but not be limited to the following:

- Deviations from the Specification or Standards approved by the Design Engineer
- Material shortages and impact on job progress
- Engineering changes
- Communications with Design or Detail Engineers, Quality, LNO, and NROC Personnel, etc.
- NMA Confirmation Log Number
- Security or Safety Problems

A copy of the Job Log should be included in the Job Packet.

7.10.3 Job Completion or Extension Reporting

The Service Supplier shall report the completion of a job on the day the job completes to Qwest on Form RG 47-0002, "Installation Revised / Completion Notice" Service Suppliers should obtain Qwest LNO acceptance before sending a final Completion Notice to the Design Engineer. Advanced or partial completion of the job shall also be reported on this form.

One copy of this form shall be forwarded to the Design Engineer and one copy to: Qwest ICC, 6912 S. Quentin St., Rm. 101, Englewood, Colorado 80112.

Where possible, the Service Supplier should obtain an "LNO Representative" signature on RG 47-0002 prior to the distribution of copies. The LNO Representative shall mark RG 47-0002 as "Accepted" or "Not Accepted", with appropriate comments.

7.10.4 Job Information Memorandum (JIM)

A JIM (RG 47-0004) is a formal publication issued by the Service Supplier to explain differences between actual job conditions and the engineering information provided. It may be used to request authorization for additional effort, **but is not authorization for that effort**. Additional effort shall be authorized only through the issuance of an Amendment to the original Design Work Package (DWP), referencing the JIM.

A JIM must include a specific detailed description of each additional work effort associated with an installation job. The JIM must include the exact number of hours required to complete each specific work effort. The specific work effort and number of hours must be authorized in advance in writing by the Design Engineer before the work may begin. In an emergency, the Design Engineer may authorize the work to begin with verbal authorization to be followed up with written authorization within 24 hours. The same specific detailed description and number of hours must be agreed to verbally by both the Design Engineer and Service supplier. The cost of the JIM will be determined by the number of hours times the contracted loaded hourly rate of the Service supplier.
If an identified problem requires issuing an Engineering Complaint, the installer shall issue a JIM stating the specifics and forward a copy to the Design Engineer. The Design Engineer will forward to NROC Subject Matter Expert (SME) for investigation.

The original copy of a JIM shall be forwarded to the Design Engineer and a copy of the JIM left in the Job Packet.

7.10.5 Service Interruption/Degradation Report

When a Service Interruption / Degradation Report is required the Service Supplier shall notify the LNO site manager and Design Engineer. A copy of the report shall be sent to the LNO manager, Design Engineer, Job Packet, and Route Cause and Analysis Center, 700 West Mineral Ave., Room NE F29.3, Littleton, Colorado 80120 (FAX: 303-707-9330). The service supplier shall obtain the Abnormal Network Condition Report (ANCR) number from the Qwest person that was notified, and include it in the report.

7.10.6 Returning Material

When the Services Supplier needs to return excess Common Systems material to the warehouse, they shall complete form RG 47-0010, “Request For Disposition of Qwest Communications Material”. The Service Supplier shall note the return quantity on the appropriate line of the form (material must be a complete unit). To arrange for pick-up the Service Supplier shall call the NAVL Agency for their geographical area. The following information shall be provided to the NAVL Agency:

- BVAPP #
- Address ID
- FRC
- RC

The Service Supplier shall attach a copy of the completed form RG 47-0010 to each box before releasing excess material to the NAVL Agency at the point of pick-up.

NAVL Agencies shall warehouse all excess materials separate from inbound BVAPP materials. Upon receipt of the excess material, the NAVL Agency shall forward a copy of all RG 47-0010 forms to the On-Site Qwest / NAVL representatives.

Qwest / NAVL On-site representatives will provide direction for disposition of excess material to the NAVL Pack-and Hold Agency.

All claims will be processed by the pack-and-hold service center: (303) 707-3108

Clearly write any damage or shortage on the delivery receipt. This includes damage such as “boxes crushed, punctured, wet, or damaged”.

Contact the pack-and-hold service center as soon as possible.

For claims, the following documentation is required:

- Copy of the delivery receipt
- Copy of the packing slip
- Statement concerning the circumstances
- Other documentation may be required

Damages, overages, and shortage may require material return process. You will be directed by the pack-and-hold service center to file a “vendor claim” for over, short or damaged material. the Service Supplier shall complete the RG 47-0010, then call and FAX a copy to the Qwest Network Procurement Center (NPC) Expediter.

To file a claim for common system material that is incorrect upon receipt of shipment, complete the “Report of Unsatisfactory Shipment” on the back of the packing slip. Call the NPC expediter to reorder material and arrange for material return.

To release material from a warehouse or get a job status, call the NPC expediter.

To order common systems material, the Service Supplier shall coordinate with the Design Engineer. Services Suppliers shall complete RG 47-0010, and send a copy to the Design Engineer, and the NPC.

To return material to a Qwest salvage yard, the Service Supplier shall complete RG 47-0010, and designate material as junk. Qwest Business Resources, Inc. salvage yards are as follows:

Table 7-6: Qwest Salvage Yards

4400 S. 76th Circle Omaha, NE 68127 402 593-1026 402 593-1046 fax	Serves: MN, ND, NE, IA, & Eastern SD
5151 Fox, Bldg "E" Denver, CO 80216 303 295-6830 303 295-6864 fax	Serves: CO, WY, MT, UT, & Western SD
4342 N. 38th Drive or 4220 N. 38th Drive Phoenix, AZ 85019 602 352-4633 602 269-8481 fax	Serves: AZ, NM
5950 N.E. 122nd Portland, OR 97230 503 251-7937 503 251-7918 fax	Serves: OR, WA, ID

A Service Supplier shall not scrap material without approval from the Design Engineer, or instructions in the DWP. Once authorization has been obtained, locate the MRC for your area, and call the SMC to make transportation arrangements. A copy of the RG 47-0010 shall be attached to each container or equipment grouping, and a copy sent to the Design Engineer and / or placed in the Job Packet.

7.10.7 Installation/Removal Documentation Flow Charts

Please note that references in the following flowcharts such as “7-13 22” refer to a specific flowchart entry point in Figure 7-13.

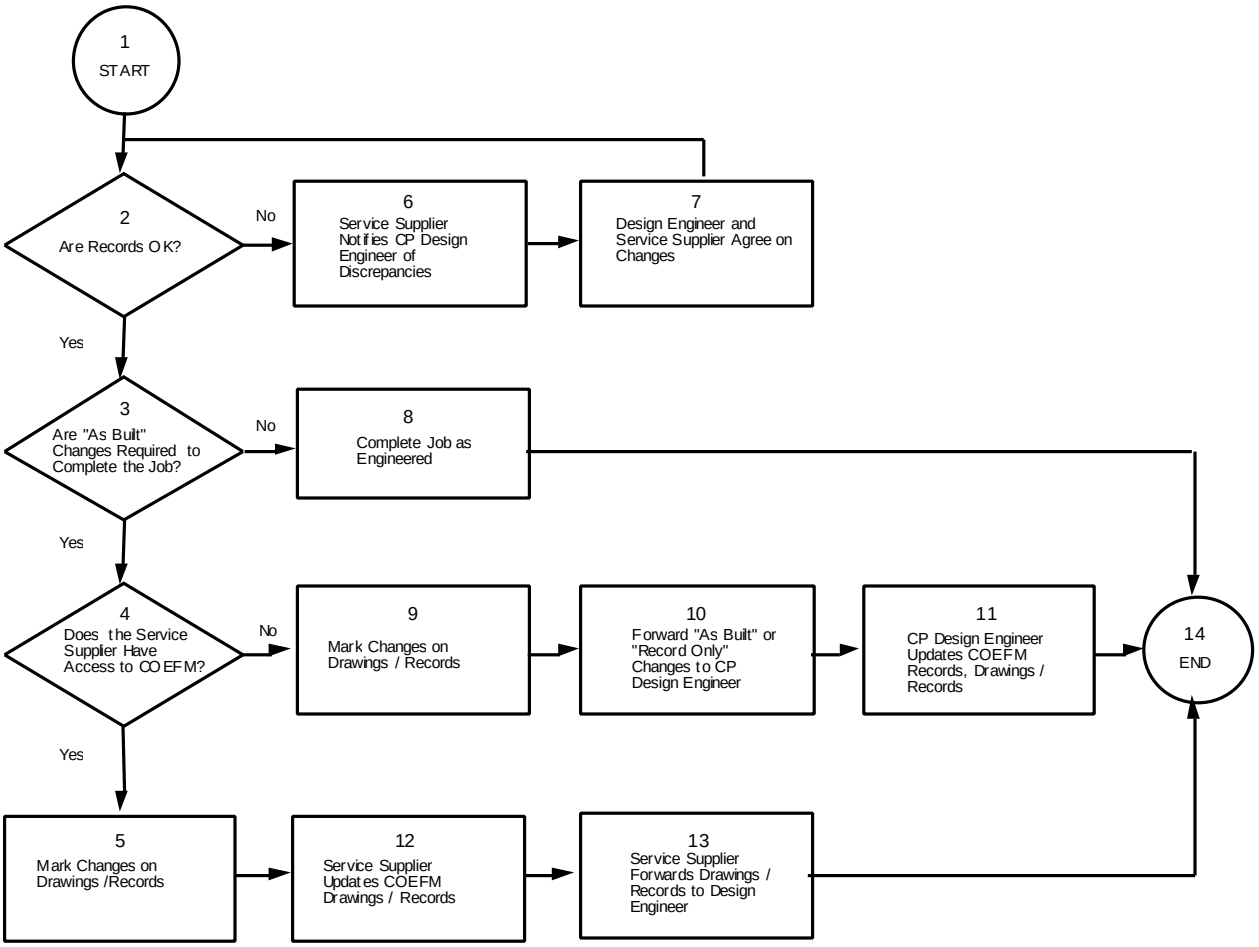


Figure 7-13 Drawings/Records Flow Chart

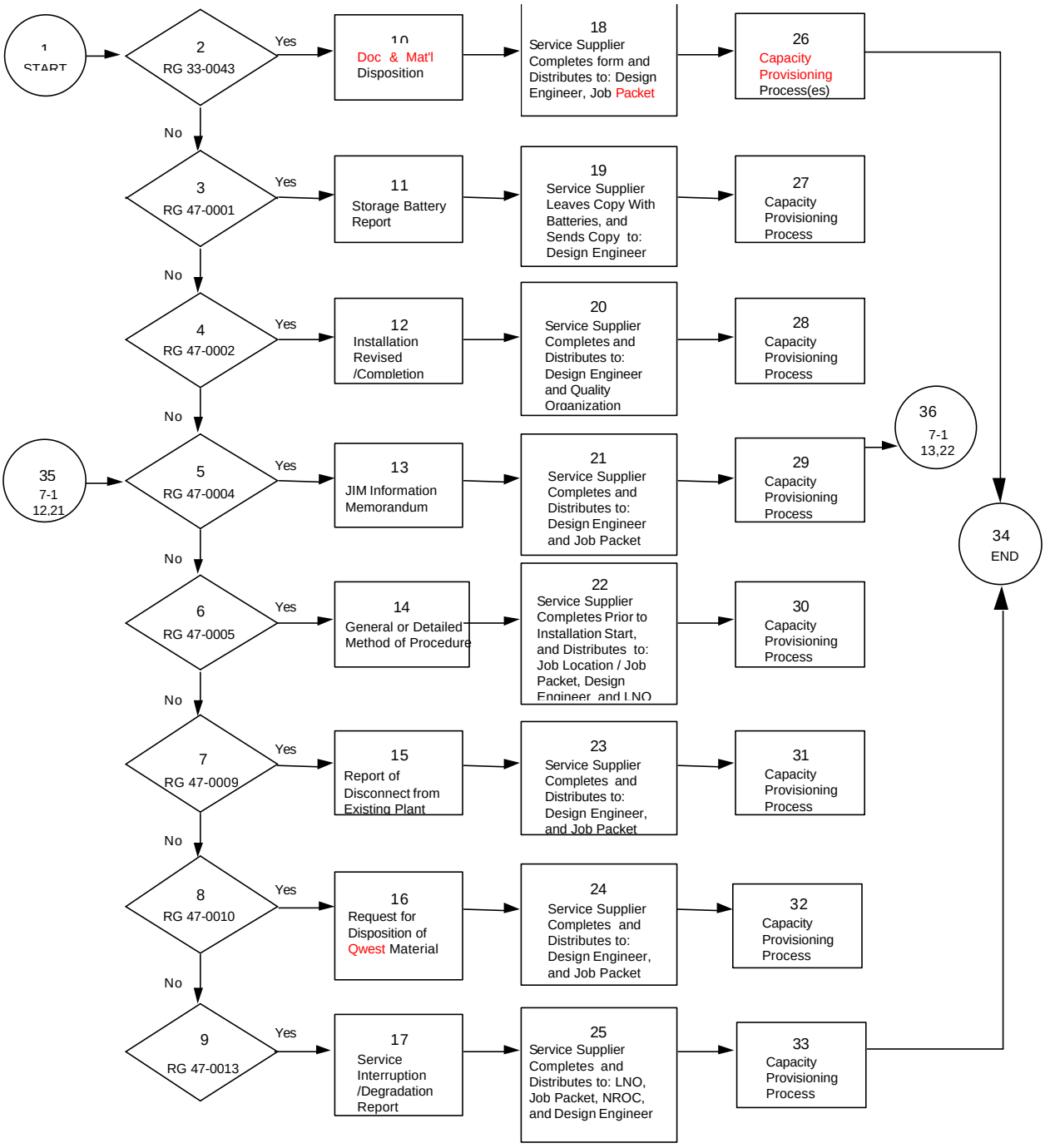


Figure 7-14 Installation / Removal Forms Flow Chart

7.11 Installation Methods of Procedure (MOPs)

This section details the minimum requirements for the preparation of a Method Of Procedure (MOP) required for all work operations performed on equipment being added, removed or modified in any manner, in Qwest equipment facilities. The MOP is a written document which details either General or Detail procedures and operations which shall be followed in their entirety.

The Service Supplier shall be responsible for the writing of the MOP before the start of any installation activity. Where possible, a Qwest Representative, a designated member of the Local Network Operations organization (LNO), should review and concur in its content. That individual may or may not have specific work related activities detailed on the MOP. Responsibility for work functions and operations are indicated on the MOP through a check off system. While Qwest personnel signatures are normally required on MOPs for Central Office installation activity, it is recognized that this will not always be possible in Customer Premises installations. However, even though it is not an absolute requirement, the Service Supplier should make an effort to meet with a Qwest LNO representative, have them review the MOP, and sign off on it. Whether Qwest signatures are obtained or not, a MOP shall be posted for all installation activities.

The Service Supplier Representative responsible for the preparation of the MOP should be knowledgeable in the proper use and completion of the MOP form and in the case of Detail MOPs, should be experienced in the specific work operations involved and familiar with Qwest standards.

The Service Supplier shall send a copy of the General or Detailed MOP to the Design Engineer and the LNO representative (where possible) as a replacement for the discontinued “Installation Start Notification.”

A properly written MOP is intended to prevent the occurrence of costly service interruptions and to assure that work is performed in a safe and secure manner. It is the responsibility of the supplier preparing the MOP to clearly and accurately represent all work to be performed and to detail all required steps, procedures and locations where work is to be performed. Every effort shall be made by the Service Supplier and Qwest Representative to work cooperatively to assure that no degradation of equipment or service will occur.

All completed MOP forms shall be retained by the Service Supplier at the site where the work operation will take place. During installation process, a copy of the MOP shall be posted in a convenient location, preferably near the actual equipment being installed, modified, or removed. Completed MOP forms shall be included with job documentation.

It shall be understood by all parties that the content of individual MOPs shall be used to help affix responsibility for work operations, procedural errors, service outages and accidents that may occur during the exercise of the detailed procedures. It is in the interest of all involved parties to assure that each MOP is complete and accurate.

Entries on MOP form RG 47-0005 are to appear in their proper respective fields and be legible and understandable. The form is designed to be utilized in computer word processor type systems. Where these systems are not employed, a Service Supplier may make entries in permanent ink. One exception is in the Work Description Details Section where hand written entries may be too small to provide clarity. In those instances, entries several lines high may be used for the hand written characters as long as they remain associated with their respective numbered steps.

Any overtime, night shift or change of shift bonus associated with MOP work activity must be approved by the Design Engineer responsible for the order number under which the work activity is being performed.

The MOP form may be used to combine both the General and Detail process where the job complexity is such that separate forms are not justified. However, this does not allow for the short cutting of any of the required information as detailed in this section. When the MOP is intended to serve as a combined MOP, both the General and Detail boxes shall be checked.

7.11.1 General MOPs

A General MOP, written to install, remove or modify equipment, shall be prepared for each BVAPP order number and location. This also includes such activities as software loads, Product Change Notices (PCNs) and AC or DC power activities. MOP form RG 47-0005 provides a check off box to indicate that this form is being used as a General MOP.

The Work Description section of a General MOP defines, in broad terms, the activity to be performed as well as the amount and type of equipment involved. Extended breaks (greater than 30 days) in installation activity require cleanup and abandonment of the area and a new authorized General MOP upon restart of the activity.

7.11.2 Detailed MOPs

A separate Detail MOP shall be required for all work to be performed on live equipment, whether presently in service or not. This includes any work on equipment that is in an area where potential hazards to equipment or personnel exist. A job order number may have a number of Detail MOPs, one or more for each major work task (i.e., power, transmission, CNs, PCNs, etc.). MOP form RG 47-0005 is provided with a check off box to indicate that this form is being used as a Detail MOP.

The work description section of a Detail MOP defines each step of the process and, in effect, is the step-by-step procedure under which the activity shall be performed. This includes all precautionary steps before, during and after each work effort. For service-affecting work, the MOP should also include backout procedures. Success of the particular activity depends highly on the accuracy and completeness of this form.

Any document referenced in the step-by-step procedure, should be on site and readily available for use.

7.11.3 MOP Header Fields

The MOP header provides spaces for the following information which shall be completed without exception:

- **City** in which the work will be performed.
- **State** in which the work will be performed. This field may use commonly accepted state abbreviations.
- **Office** in which the work will be performed. If the office is the only one in that city, the term MAIN may be used; otherwise, use the proper name for the office such as; 8th Street, Garden Park, etc.
- **Phone** number for the office in which the work is to be performed. Where possible, this phone line shall appear and be available in the equipment room where the work operation will take place.
- **Start Date** shall indicate the actual date on which the work activity is to begin. This information may be in the MM/DD/YY format.
- **Start Time** shall indicate the point at which the work activities defined under WORK DESCRIPTION DETAILS may begin. Only those activities defined as preparation, such as tool preparation, site protection, site and equipment tagging or marking and information resource consolidation, may occur prior to this time. The actual Start Time entry shall take careful consideration of such factors as high/low traffic periods and circuit application and shall be determined by the Local Network Operations Supervisor. General MOP shall indicate the normal work shift start time.
- **Completion Date** shall indicate the actual date on which the work activity will conclude. This information may be in the MM/DD/YY format.

- **Completion Time** shall indicate the point at which all activity defined under WORK DESCRIPTION DETAILS must stop. Sufficient time shall be provided in the MOP planning stage so as not to place the Completion Time in jeopardy. No further work will be allowed after the Completion Time except for such non-service effecting activities as records correction and site cleanup. General MOP shall indicate the normal shift complete time.
- **Order Number** shall be the BVAPP order number as it appears on the equipment order.
- **Supplier Order Number** shall be entered if the Service Supplier has a unique number, in addition to the BVAPP order number, associated with either the detail specification or the installation process itself.
- **System Type** shall reflect only the equipment involved in this MOP such as SWITCH, TRANSMISSION, ALARMS, POWER, etc.

The header information provides a location to indicate individual page numbers as well as the total pages in the entire MOP. A statement below the header information includes the authorization to duplicate this blank form when additional entry space is required. An expansion sheet (RG 47-0006) is also available if desired. In either case, multiple sheets of either type shall be consecutively numbered as appropriate, (i.e., 1 of 3, 2 of 3, 3 of 3).

7.11.4 MOP Work Description Details

The purpose of this section is to define, in specific terms, either the generic equipment types and work activity covered under a General MOP or to provide specific step-by-step procedures to be followed for a Detail MOP. The header information on the form indicates the intended application of the MOP.

To assist the Service Supplier in completing the Work Description Details, the left side of MOP form RG 47-0005 provides a subject matter checklist that may be helpful in the planning phase. The list is not intended to be all inclusive and simply asks, “Have You Considered” the following items.

The Service Supplier shall collect all essential information available for the job and confer (where possible) with the Qwest Representative regarding the proposed sequence of work operations. An initial MOP walk-through, if needed or requested, shall be conducted at the work site, to identify potential hazards and special conditions that may effect work operations. Those items shall include such considerations as building and equipment conditions, customer service, safety issues, corrective measures and security procedures.

The work description portion of a Detail MOP shall be completed by the installer who will be responsible for the work operation. The Service Supplier representative shall be familiar with MOP procedures,and Qwest Installation Standards as defined in various applicable publications; and be qualified to perform the work operations detailed within the MOP, regardless of whether they will actually perform each step of the procedure themselves. An exception would be a manufacturer's Product Change Notice (PCN) where the process has been predetermined and has common application to a number of like order numbers. In those instances, the supplier shall be responsible for reviewing the unique building, safety and service considerations at each site.

An installer's qualifications for involvement in the MOP writing process and work procedures shall be the responsibility of the Service Supplier. Each Supplier shall accept the responsibility for the work performed by their employees and their subcontractors.

The work description portion of a General MOP may be prepared by a representative of the Service Supplier provided that person is familiar with the generic equipment type and activity represented in the job detail specification.

All work detailed in the MOP shall conform to standards specified in this Tech Pub, and other publications referenced herein.

The work description in the MOP shall include all steps necessary to perform the work. Each step shall be numbered in the space provided and appear in the order in which they will occur in the work operation.

The Work Description Details portion of the MOP shall contain narrative references to all applicable steps. The check list entitled **"Have You Considered"** is intended purely to enhance the completeness of the narrative write-up and may not be used to indicate the subjects' application to this MOP. Some examples would be if tools need to be insulated, the narrative should say "All required tools have been properly insulated." If fuses are to be involved a statement such as, "30 A fuses and spares are available for fuse panel 0101.01 and alarms have been tested", etc.

Examples of write-up considerations are (note that this list is not all-inclusive):

- **Equipment Added**, including all frames, bays, units and apparatus
- **Equipment Removed**, including all frames, bays, units and apparatus tagged or identified
- **Equipment Compatibility** with existing units and circuits
- **Affected Working Circuits** not listed as added or removed on this work specification.
- **Restricted Work Hours** — to be listed in the MOP header information (Qwest requires that some potentially service-affecting activities be performed in the

Maintenance Window [see Section 7.1.7]; and there are other opportune times for certain types of installation work, often depending on the particular loads and needs of that site)

- **Work Area Protection** to adjacent equipment and building
- **Special Tools/Materials**, such as circuit pack pullers, hoists, ungrounded drills, HEPA vacuum, etc.
- **Tool Insulation**, including taping and inspection of all insulated tools
- **Safety Considerations**, including goggles, floor clutter, rubber gloves and aprons, insulated power blankets, etc.
- **Emergency Equipment and Procedures Available**, including first aid, hazardous material, fire, etc.
- **Procedures Available** that are manufacturer or product specific
- **Fuse Alarm Operation** checked for added and affected circuits
- **Location of Spare Fuses** — has been checked for availability
- **Records Correction** where existing information has been altered
- **Hazardous Material Handling and Storage** policies, labeling, storage supplies and required paperwork available
- **Personnel Experience** considered for both work effort and MOP responsibility
- **Before and After Tests —** to be performed on applicable circuits
- **Backout Procedures** — covered in the eventuality that hardware, software errors or time restrictions preclude service restoration by the designated COMPLETION TIME
- **Referenced Documents** should be on site and readily available for use
- **Technical References** are available and understood
- **Required Qwest Support** has been discussed and is available (if necessary)
- **Emergency Restoration Plans** have been discussed and are in place for any eventuality
- **Fuses and Leads Tagged** for identification purposes, including any AC circuits under LOCKOUT condition

- **Office Records/Drawings Available** on site when necessary
- **Supplier Drawings Available** on site when necessary, as well as installation instructions and manuals
- **MOP Referenced Documents** — on site and available for use

For each numbered procedure or step listed, a check off box has been included to indicate whether the step is the responsibility of the Local Network Operations Technician providing coverage or the responsibility of the Service Supplier (in the case of Customer Premises installations, it is usually going to be the responsibility of the Service Supplier).

7.11.5 MOP Write-Up Review

Following the preliminary MOP write-up, the Service Supplier Personnel who will be performing the work operations and, if possible, the Local Network Operations Personnel who will be responsible for coverage, should conduct a dry run of the detailed procedures. At this time, any shortcomings or omissions in the write-up shall be addressed.

7.11.6 MOP Approval/Signing Authorities

The signing authority for each MOP appears at the bottom of the RG 47-0005 form. This authorization extends to all sheets in each MOP regardless of the number of sheets employed. If the MOP extension form RG 47-0006 is utilized, that form has no signing authority and has the notation “THIS FORM MAY NOT BE SUBMITTED WITHOUT RG 47-0005 CONTAINING THE SIGNING AUTHORITY”. The total number of sheets is indicated in the header information of the form. The Service Supplier and all signing parties are responsible for verification that their particular copy of the MOP is complete in all its pages.
On a General MOP, the Service Supplier Representative may be the person performing the actual work activity. This person may be a Service Supplier’s supervisor or any duly appointed personnel in the suppliers analysis center. The Qwest Representative field may be signed by the Local Network Operations Supervisor and/or any duly appointed LNO Technician where possible. (It will not always be possible for the Service Supplier to conveniently find LNO personnel. LNO signatures are not mandatory for General MOPs. In the cases where Qwest is the Service Supplier, the installer may sign in any or all of the fields.) All signing parties shall fill in their proper title, daytime phone number and date of signature in the appropriate field.

On a Detailed MOP, the “Service Supplier Representatives” field may be signed by the Service Supplier Supervisor and shall be signed by the Supplier Personnel performing the work. The “Qwest Representative” field may be signed by the LNO Supervisor or, with the LNO Supervisor’s consent, an LNO Technician. (LNO signatures are not mandatory even for Detailed MOPs; however, in these cases it is strongly recommended that the Service Supplier make reasonable efforts to obtain them.)

If Qwest, or the contracted Installation Service Supplier is making connections to a Customer-owned DC plant distribution panel or buss, it would be wise to get the Customer's signature (somewhere near the signature section, since there's no specific line for it) on the Detailed MOP for this work.

7.11.7 Service Interruptions

If a service interruption occurs during installation or removal activity, service must be restored quickly. The LNO personnel and the Service Supplier personnel shall work cooperatively to ensure that actual outage time is kept to a minimum.

Qwest **UNICALL (1-800-654-2525)** and the NROC **Network Management Center (1-800-879-1200)** shall be called immediately and informed of the outage and of the actual or expected term of the outage.

All particulars that led to the service outage shall be documented on Qwest Service Interruption Form RG 47-0013 and presented to the Qwest Representative within 24 hours of the outage. (Further procedures for processing this form are outlined in Section 7.10.5.)

(For more detailed information on Service Interruptions see Telcordia SR-TSY-000963.)

7.11.8 Method of Procedure Flow Chart

Please note that references in the following flowchart such as “7-15 9” refer to a specific flowchart entry point in Figure 7-15. References such as 7.10.1 refer to other section numbers in this document.

7.12 Installation Forms

The most commonly used Customer Premises installation forms are included on the following pages. Some of the additional forms that are needed based on the practices described in this Tech Pub may also be found in Tech Pub 77350.

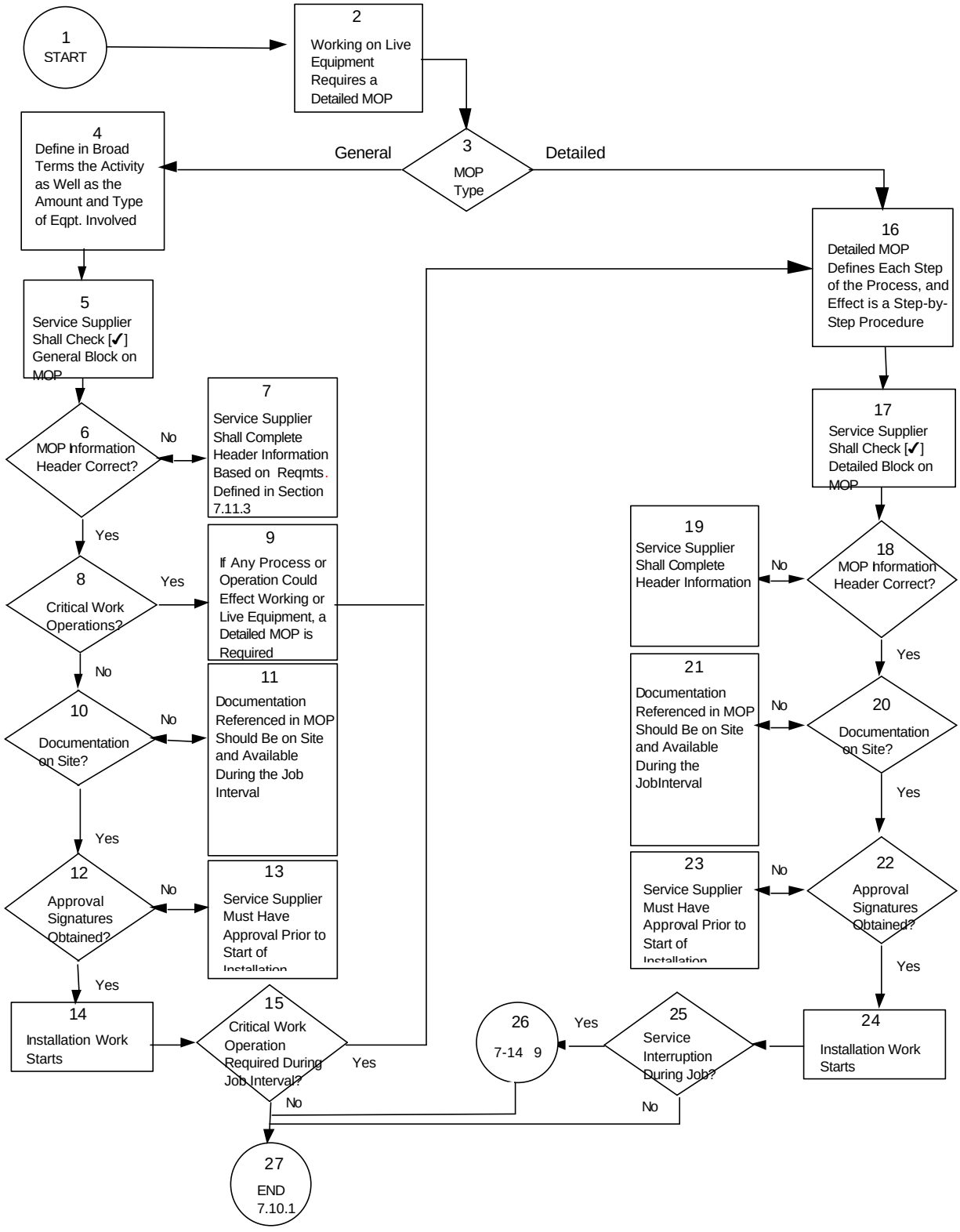


Figure 7-15 MOP Flow Chart

Installation / Revised Completion Notice

☐ **Confirmation of Installation Completion** ☐ **Advance**

Marked Drawings ☐ **Partial**

Date Sent to Design Engineer_____ ☐ **Final**

Network Monitoring and Analysis

NMA Confirmation Number _____

☐ **Request for Revised Completion** ☐ **Reschedule**

City, State, and Zip	Office / Office Location	
Design Engineer's Name	Authority, Estimate No.	Order No.
Scheduled Dates:	Start	Complete
Actual or Rescheduled Dates	Start	Complete

Equipment Involved; Exception Items

Reason for Reschedule

Service Supplier Company Name and Signature	Date

For Qwest Use Only

This is: ☐ **Accepted** ☐ **Not Accepted**

If Not Accepted, Reasons.

Operations Representative	Date
Design Engineer	Date

RG47-0004
(2/96)

Job Information Memorandum

City and State	**Office**	**Order No.**	**JIM No.**

Service Supplier Company Name

Subject

Spec. Item Number

Confirming Telephone Call
From _____ To _____ Date _____

Drawing Change Req ☐ Yes ☐ No

Job Cost Affected ☐ Yes ☐ No

Additional Material Req ☐ Yes ☐ No

Spec Appendix Req ☐ Yes ☐ No

Problem Description

Suggested Remedy

Effect on Job Completion Date

Originator	Telephone No.

Address

City	State	Zip Code

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(5/99)

Method Of Procedure
COE Installation / Removal / Modification

NROC Contact No.: 1-800-830-0722 — General ☐

NROC Power Contact No: 1-800-713-3666 — Page 1 of ____ — Detail ☐

City, State	Office	Office Location	Phone
Start Date	Start Time	Completion Date	Completion Time

QWEST	Supplier / Vendor	System Type
BVAPP: Job ID:	Name: Job #:	Switch [ ] Type: _____ Toll [ ] Power [ ] Radio [ ] Fiber [ ] Real Estate [ ] Other [ ]

Detail below all steps necessary to explain the work to be performed. Steps should be numbered, and appear in the order in which they will occur, with the work operation responsibility indicated by checking the appropriate box(es). Work should not begin until this form has been reviewed and signed by Qwest and Supplier representatives. This form may be duplicated if additional space is required. All information must comply with Qwest Tech Pub 77350.

Have you Considered?	Step	Description	Qwest	Supplier
* Equipment added (list **all** added equipment and work locations).				
* Equipment removed.				
* Equipment compatibility.				
* Affected working circuits.				
* Restricted work hours.				
* Work Area Protection.				
* Special tools / materials.				
* Tool insulation.				
* Safety considerations.				
* Emergency equipment & procedures available.				
* Fuse alarm operation.				
* Location of spare fuses.				
* Records correction.				
* Hazardous materials. Handling and disposal.				
* Personnel experience.				
* Before and after tests.				
* Back-out procedures.				
* Technical references.				
* Required QWEST support.				
* Emergency restoration plans.				
* Fuses and leads tagged.				
* Office records / drawings available.				
* Supplier drawings available.				
* MOP Referenced documents on site and available.				

The undersigned approve the procedures herein described as complete, whether a general or detail procedure. No changes shall be made without approval of both the Qwest Operations representative and the Installation Supplier Representative or Contract agent.

Name (Print & Signature)	Title	Contact Numbers	Date
Person Performing/In-charge of Work (Required)		**(24) Hour Emergency Contact Number:**	__/__/__
Real Estate or Service Supplier Representative (Required)		Phone:	__/__/__
Qwest Operations Manager or (designated representative) (Required)		Phone	__/__/__
Qwest Operations Support Technician		Phone	__/__/__

RG47-0006
(5/99)

Method Of Procedure
COE Installation / Removal / Modification

Service Assurance Contact No.: 1-800-830-0722

General ☐

Service Assurance Power Contact No: 1-800-713-3666

Page ____ of ____

Detail ☐

City, State	Office	Office Location	Phone
Start Date	Start Time	Completion Date	Completion Time

U S WEST	Supplier / Vendor	System Type
BVAPP: Job ID:	Name: Job #:	Switch [ ] Type:_____ Toll [ ] Power [ ] Radio [ ] Fiber [ ] Real Estate [ ] Other [ ]

Step	Description	Qwest	Supplier

***** THIS FORM MAY NOT BE SUBMITTED WITHOUT RG47-0005 CONTAINING THE SIGNING AUTHORITY *****

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Tables

8. Alarming

Qwest Communications, or their authorized Installation vendor, is responsible for ensuring that equipment, power, and some environmental alarms are remotely connected and tested to the Qwest Network Reliability Operations Center (NROC) and / or Business and Government Services (BGS) centers. These Qwest centers are responsible for proper alarm monitoring, analysis and dispatch.

The customer is responsible for ensuring that Qwest technicians have access to the telecommunications equipment 7 days a week, 24 hours a day to perform reactive and proactive maintenance.

Qwest Engineering is responsible for determining the alarm requirements, and the method of alarm transport.

Alarm transport methods are varied. For SONET-based equipment, its equipment alarms are transported back to the central office over dedicated channels within the SONET bandwidth. At that point there must be a connection (typically an X.25 circuit) between the Central Office headend and the alarm system. And the alarms must be databased with the NMA database group for proper messaging and routing. Finally, alarms should be tested for continuity with a Qwest center technician.

Some other non-SONET equipment also has dedicated alarm channels. For example, some Digital Loop Carrier (DLC) systems will allocate a portion of their overhead transport bandwidth back to the central office for the transmission of alarms. At the central office end, these alarms must generally be picked off the Central Office Terminal (COT), and connected to an alarm monitoring system (for example, an e-telemetry device such as Dantel®). These alarms must also be tested for continuity.

Some equipment is less intelligent, and requires another alarm transport medium to get back to the CO. Power equipment, such as rectifiers and fuse panels are good examples of this. Some transmission equipment also does not have its own alarming. And environmental alarms (such as high temperature, fan failures, etc.) need an alarm transport medium for their failures. The most common type of alarm transmission system for these “housekeeping” alarms is the overhead bitstream of the fiber multiplexer. (This method of transmission is described in greater detail further on in this Section.) If the site does not have a multiplexer, nor spare alarm channels on the transmission equipment, another alarm transmission device (e.g., a small e-telemetry system) must be installed for the housekeeping alarms. This device will also probably require a four-wire copper data circuit to transmit alarms back to the CO. Whether a fiber mux overhead or another transmission medium is used, alarms must still be ultimately connected in the CO, and tested for continuity to the appropriate Qwest alarm center.

For provisioning and testing, the following contacts can be used:

E-Telemetry and X.25 Database and Circuit Provisioning Contacts for: Arizona, Colorado, New Mexico, Utah, Washington, and Wyoming:

NMA – Scan Points Database	303-896-5837
Etel Circuits	303 896-5861
X.25 Provisioning	303 896-5921
SONET / X.25 Database	303 896-5939
FAX:	303 896-9386 / 9391

X.25, and E-Telemetry Database and Provisioning Contacts for North & South Dakota, Idaho, Iowa, Minnesota, Montana, Nebraska, and Oregon:

Contact: 763 536 3888
FAX: 763 536-3799

The NMA Database groups require the following information for testing and database work: ETEL number, remote address, and display number (for e-telemetry points); the X.25 circuit ID (for X.25 points); plus the assigned alarm points, and BVAPP number.

No network element shall be turned up for service without alarms. The Service Supplier shall list all alarms and the reason they can not be tested at job closure in the (Job Log). The Service Supplier shall close the job with exceptions listing equipment alarm status on RG 47-0013. The Service Supplier shall still be responsible to correct any problems associated with the installed product alarms. The Service Supplier shall negotiate with the Design Engineer for any additional alarm testing effort required, because of Qwest caused delays or problems. The supplier shall record all test results on RG47-0157 or equivalent and place a copy in the job package.

Alarms that are equipped for future use, and require software translations or cross-connections, which are to be made in the future do not require an ETEL number or X.25 circuit ID. The Installer shall be required to perform standard continuity and power verifications on these circuits.

When testing is complete, the NMA group will provide a confirmation log number to the Service Supplier. This log number shall appear in the Job Log and on the Installation Revised Completion Notice (Form RG 47-0002).

Fire, humidity, air-conditioner failure, and other similar building alarms will not normally be monitored by Qwest, and are the responsibility of the building owner. However, high temperature may be monitored by Qwest, and if detected, the Premises management will be informed and asked to correct the problem immediately.

If the DC power plant of the site is owned by the customer, the customer is responsible for monitoring that plant, unless specifically negotiated otherwise with Qwest.

Fiber multiplexers, which are installed in many Customer Premises locations are capable of carrying housekeeping alarm data in a portion of their overhead bandwidth. This is known as the overhead bitstream, and as noted is to be used for alarms that are not carried on the normal SONET equipment channels. Most of these muxes allow contact open or contact closure connections, and there are usually between 4 and 18 points, depending on the multiplexer. These overhead bitstream alarms are given text names and descriptions through programming of the mux. These alarms are transmitted back over the overhead bitstream to the CO mux. If the CO mux is then connected to an X.25 packet network, the names and descriptions given the alarms can then pass through to the Qwest alarm monitoring system, NMA, given that NMA is properly programmed to accept these points. (If the CO mux is not connected to an X.25 packet network, the alarms must be pulled off the CO mux, and placed on another alarm transmission device as simple binary alarms. These must then be programmed to NMA in the traditional way for that alarming device.) The X.25 connection is the preferred method. Telcordia and Qwest have jointly developed standard TL1 messages to be programmed into the muxes for eventual transmission to NMA over the X.25 circuit. The minimum set of standard overhead bitstream TL1 messages used by Qwest is given in Table 8-1. This TL1 condition type for these messages must totally describe the event within the 10 character limit (the messages are limited to 10 characters because some of the muxes used by Qwest will only allow that many characters for a condition type). (Most muxes also have an additional 40 character open text field for each alarm with which to further describe it.)

The generic building alarms shown in the Table (BLDGMJ and BLDGMJCR) may use replacements for the acronym “BLDG”, depending on the site type. For example, there could be a CPEMJ, or a HUTMJCR, or a CPECABMN alarm. There may also be other derivations from the messages given below. All of this housekeeping alarm wiring and programming work is to be done by Qwest or their hired installers.

Table 8-1: Qwest Standard TL1 Condition Types for Overhead Bitstream Transmission
(Page 1 of 2)

CONDTYPE (ALMTYPE)	**NTFCN CODE**	**Description of Condition Type** (some of this may be used in the 40-character **ALMMSG** field)
BATTDISC	MJ	battery disconnect breaker manually or automatically operated
BATTTEMP	MJ	high (or low) battery temperature
BLDGMJ	MJ	any building environmental major — used when points are limited
BLDGMJCR	MJ	any environmental major or critical — used when points limited
COMLACFAIL	MJ	AC power failure
POWER		
CRITICAL or CR	CR	system critical (may have other characters before or after in ALMTYPE)
DIFFTEMP	CR	high differential temperature between the batteries and the ambient
DISTFUSE	MJ	power distribution fuse or breaker fail / operation
FUSE		
CKTBRKR	MJ	any breaker operated
ERR	MJ	bit error rate in transmission (may have other characters before / after in ALMTYPE)
EXPLOSIVE	CR	combustible gas alarm
EXPLGS		
GASDETECT		
CLFAN	MJ	ventilation / circulation / cooling fan or ventilation system failure
FAN		
VENTILATE		
VENTN		
FE	MN / MJ / CR	far end alm (may have other characters before or after in ALMTYPE)
FIRE	CR	fire or smoke alarm
HITEMP	MJ	high or low site temperature
HILOTEMP		
TEMP		
LWTEMP	MN	
HILOVOLT	MJ	high or low DC plant voltage
HIVOLTAGE	MJ	high DC plant voltage
RECTHI		
LOS	MJ	loss of signal (may have other characters before or after in ALMTYPE)
BATDSCHRG	MJ	low battery voltage — battery on discharge
LOVOLTAGE		
LWBATVG		
LVDDISC	CR	low voltage disconnect switch operated
LVDFAIL	CR	low voltage disconnect device has failed
MAJOR or MJ	MJ	system major (may have other characters before or after in ALMTYPE)
MINOR or MN	MN	system minor (may have other characters before or after in ALMTYPE)
MISCn	MN / MJ	an alarm on overhead point #n — describe in the ALMMSG field
HKAn		

Table 8-1: Qwest Standard TL1 Condition Types for Overhead Bitstream Transmission
(Page 2 of 2)

CONDTYPE (ALMTYPE)	**NTFCN CODE**	**Description of Condition Type** (some of this may be used in the 40-character **ALMMSG** field)
N48B1MJ	MJ	any power major alarm combined on this point
N48B1MJCR	MJ	power major or critical — used when there aren't enough points to separate
N48B1MN	MN	any power minor alarm combined on this point
N48B1CR	CR	any power critical alarm combined on this point
PWR-48	MN/MJ/CR	any power alarm or combination of alarms (may append criticality to ALMTYPE)
NE	MN/MJ/CR	near end alm (may have other characters before or after in ALMTYPE)
OPENDOOR	MJ	open door (intrusion alarm)
OPENDR		
RECT	MN/MJ	DC plant rectifier failure (minor for 1 rectifier, major for multiple rectifier fails)
RECTFAIL		
RECTLO		
RINGFUSE	MJ	ringing distribution fuse operated
RINGMN	MN	ringing plant generic minor (e.g., one ring generator failed, etc.)
RINGMJ	MJ	ringing plant generic major (e.g., both ringing generators have failed, etc.)
RPTR	MN/MJ/CR	repeater alarm (may have other characters before or after in ALMTYPE)
SYNC	MJ	synchronization/timing alarm; possibly a clock failure
VHILOVOLT	CR	very high or very low voltage

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9. Customer Responsibilities and Agreement

Individual Agreements / Contracts with Customers are negotiated by the appropriate Qwest Marketing Groups, possibly with the help of the Qwest Contracting Organization. These agreements or contracts should generally include the following provisions related to environment, power, grounding, and installation. Many of these provisions are taken from state tariffs, BIC policy, Cable Wire and Service Termination Policy, MPOP Policy, and / or New Construction Policy (Qwest personnel can refer to these documents if further information is required).

- The space provided shall comply with the UBC, NEC, and any other relevant local, state, or national codes
- The Customer shall allow employees or agents of Qwest free access to the premises and facilities where the digital equipment is located on a 7 x 24 basis. This is necessary to ensure timely alarm response, reliable service, and to enable Qwest to meet the service guarantees of selected service offerings.
- All operations at the customer's premises will be performed at the expense of the customer and will be required to conform to whatever rules and regulations that Qwest may adopt as necessary to maintain a proper standard of service.
- The customer is required to provide adequate building space, lighting, and atmospheric control (humidity, temperature, and ventilation) for the proper installation, operation and maintenance of the telephone equipment on the customer's premises.
- When Qwest equipment installed on the customer's premises requires power for its operation, the customer is required to provide such power. The customer is required to provide adequate commercial power, wiring and the electrical outlets necessary for the proper operation of the telephone equipment on their premises. The customer should also extend a suitable ground source to the telecommunications equipment area.
- Qwest requires 36" of floor space in front of all wall mounted equipment, Bay mounted equipment, and cabinet mounted equipment. Qwest requires 24" of floor space behind bay mounted equipment unless all equipment is front access only. If there are multiple equipment bay line-ups, the 36" of space can be shared by Bays that face each other, in other words front aisles can be minimum of 36". Rear aisles can be a minimum of 24". Equipment floor space requirements reflect OSHA and BIC standards. Where applicable, provide a sufficient amount of clear-wall surface or floor space for mounting of any equipment according to manufacturer's guidelines.

- Where concealed telephone wiring is required on the customer's Premises, the customer shall furnish, install and maintain the necessary outlet boxes and conduit.
- Any special structural work required for the supporting telephone facilities on the customers premises shall be provided at the expense of the customer.
- Items to be negotiated may include: Building Alteration, Earthquake bracing, Environmental Alarms, etc. If the Customer desires that Qwest perform maintenance on non-Qwest equipment (such as the customer's DC power plant), this must be negotiated in the contract.
- As stated in Section 5.1, Qwest provides 8 hours of battery backup for sites that are not backed up by an engine (rectifiers backed up by an engine is known as Essential AC feed). Because this Essential AC feed to Qwest rectifiers is not standard from site to site, Qwest is only responsible for maintaining power to their equipment for the first 8 hours of a commercial AC failure. In other words, if lost service calls for rebates, rebates shall only be granted if the service failure occurs within the first 8 hours during a commercial AC failure. Outages not related to commercial AC failures are liable to rebate regardless of time frame. Also, if primary backup power is provided from a Customer's power supply (either -48 VDC power plant, or an AC UPS), Qwest shall be exempted from any lost service rebates due to the failure or malfunction of these Customer power supplies.
- In some cases, the customer may not desire backup power (see Section 5.4 for further information). Reduced costs should be negotiated with Qwest, and the Qwest engineer should be informed in order to provide the appropriate configuration. If this is done, Qwest shall be exempted from any lost service rebates due to the failure of commercial power.

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10. Marketing Checklist(s)

According to the guidelines given in Sections 3 to 6 of this document, certain things should be ensured with the customer before a deal for Customer Premises services is closed. The checklists of this section provide a simple method for the various marketing arms of Qwest (e.g., Business and Government Services, Small Business, etc.) to ensure adherence to this document. This will provide telecommunications services that are more reliable and safe. The various Qwest Marketing groups may pass these checklists on to internal Engineering, which will provide the Engineer with valuable information to help them make decisions when engineering the site.

10.1 Location and Environment Checklist

The checklist on the following page summarizes some of the more important environmental issues that need to be broached with the customer before an agreement is ever made. They include temperature and ventilation, floor loading, space size and access, fire systems, and a few other things.

Some of the environmental requirements in Table 10-1 are not applicable in the rare instances where the equipment is not backed up by a DC battery plant or a UPS (see Section 5.4). For those requirements, it is so noted with an asterisk in the requirement column. There are other requirements that are not applicable to all situations. Those exceptions will be noted in the Notes / Description column of the Table.

10.2 Powering Checklist

The checklist on the following page summarizes some of the more important power and grounding issues that need to be broached with the customer before an agreement is ever made. They include Essential AC power provided by the customer, use of a customer DC power plant, availability of a ground source in the equipment area, and a few other things.

There are some requirements in the following table that are not applicable to all situations. Those exceptions will be noted in the Notes / Description column of the Table 10-2.

Table 10-1: Marketing Checklist for Equipment Location and Operating Environment in Customer Premises Installations

Requirement	Notes/Description	Response
1. Room at 85° F or less *	Not only will lower temperatures lengthen battery life, they help prevent potentially dangerous Hydrogen venting. A max. temperature of 85° F will also lengthen equipment life.	
2. Minimum 0.5 ach *	Ensuring ventilation is sufficient so that the air is changed with external air at least once every 2 hours will avoid battery Hydrogen buildup, and will help prevent overheat and possible shutdown of transmission equipment.	
3. Size of equipment area	The width, length, and height of the area available helps the engineer decide how much service and how much backup power can be provided. If a building alteration is needed, this must be negotiated with the customer. The space should also be large enough to accommodate anticipated growth. The ceiling should be at least 8'6" (102") from the floor.	
4. Avoid raised computer floors *	In most cases, raised floors should be avoided, due to their weakness, battery weight, and poor earthquake bracing. If a raised floor cannot be avoided, the floor loading capacity of that floor should be obtained, and calculations should be run in accordance with Section 4.4 of this Pub 77368.	
5. Post-Tensioned Floors X-Rayed Prior to Drilling	In heavy earthquake zones, in buildings over 2 stories, the building owner must identify if the floor or ceiling of the planned equipment area has post-tensioning cables for building seismic support. If so, the exact location of these cables must be identified (typically by X-Ray) before floors or ceilings are drilled for anchoring bays.	
6. Elevator or hoist access to space	Equipment must be able to be brought to the area where it is to be installed. Access openings should be min. 36" x 48".	
7. Walls	A few customer prem cabinets are of the "wall-mount" type. The wall should be sturdy enough to support the equipment in these cases. For mounting of terminations, a minimum 4' x 4' wall space with a $^{3}/_{4}$" fire-retardant plywood backboard, with 36" clearance in front of it, is required.	
8. Fire detectors	The equipment area should have adequate fire detection.	
9. Avoid sprinklers and halon	Areas with sprinklers and halon fire systems should be avoided if possible because they will damage the equipment, and can go off inadvertently. Areas with water pipes above the equipment should also be avoided for similar reasons.	
10. 7 x 24 access	Qwest needs 24 hour a day, 7 day a week access to the equipment area to be able to respond to alarms, minimize service outage lengths, and ensure safe and reliable service.	
11. Asbestos problems	Space that has asbestos should be avoided. If it cannot be avoided, the customer must have an asbestos abatement/ management plan before the work begins, per the EPA.	

Table 10-2: Marketing Checklist for AC and DC Power Issues in Customer Premises Locations

Requirement	Notes/Description	Response
1. AC source backed by engine	It is preferable that the AC source provided to power Qwest's rectifiers be on the Essential buss (backed up by the customer's or building engine). This will extend the life of the batteries and greatly increase reliability by shortening discharge duration.	
2. AC source backed by UPS	If the customer owns a UPS, it is preferable that they feed Qwest's rectifiers from this UPS. More preferable is a UPS backed by an engine as the AC source. This will extend the life of the batteries and greatly increase reliability by shortening discharge duration.	
3. Hubbell outlets available	Standard NEMA Twist-Lock or "ground screw-down" connector(s) are within 30 feet of the space where Qwest pre-packaged equipment cabinets will be placed. For relay rack type installations, a nearby AC service cabinet with spare capacity is to be provided to feed the rectifiers. See Section 5.2 for more detail.	
4. Proper AC voltage available	For relay rack installations, Qwest rectifiers will work from nominal 208 VAC or nominal 240 VAC service. For pre-packaged Customer Premises cabinet installations, the appropriate configuration should be consulted to determine the nominal voltage, breaker size, and quantity and type of outlets required.	
5. Customer DC plant available	If the customer has a well-maintained existing DC plant with 8 hours of battery backup, and there are no penalties to Qwest for outages, money and space can be saved by powering relay rack type installations from the customer's DC plant.	
6. Ground source in equipment area	The customer should extend a reliable ground source to the equipment area. (See Section 6.2 of this Pub 77368 for further detail on appropriate ground sources.) A good ground source will protect personnel and equipment from power and lightning surges, and help avoid noise on the telecommunications circuits.	
7. Customer requires backup	In most cases Qwest will provide a DC plant with 8 hours of battery reserve. If the customer does not require telecommunications during power outages, and there are no penalties to Qwest for outages, arrangements can be made for UPS-only backup or no backup at all. See Sections 5.3 and 5.4 for more detail.	

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11. References

11.1 Acronyms and Definitions

A	Amp / Ampere / Amperes (a measure of electric current)
AC	Alternating Current (electricity from the power utility; typically available at 120 / 240 V, single-phase, or 120 / 208 V, three-phase in a Customer Premises location)
ACEG	AC Equipment Ground (commonly known as the "green-wire" ground run with most AC circuits)
ach	air changes per hour
aka	also known as
AMC	Qwest standard Architectures, Models, and Configurations group
AMMS	Automated Material Management System (an internal Qwest miscellaneous material ordering system)
ANCR	Abonormal Network Condition Report (used for outage reporting to the FCC)
ANSI	American National Standards Institute
ASCII	American Standard Code for Information Interchange (standard computer codes representing text characters and symbols)
ASHRAE	American Society for Heating, Refrigeration, and Air-conditioning Engineers
AWG	American Wire Gauge (wire size standard)
BDFB	Battery Distribution Fuse Board / Bay
BGS	Qwest Business and Government Services division
BIC	Building Industry Consultant (guidelines for termination of telecommunications services on a Customer's Premises)
BRI	Business Resources Inc. (a Qwest subsidiary used for contracting, procurement, building engineering and operation, etc.)
BTU	British Thermal Units (a measure of heat energy)
BVAPP	Billing Verification and Payment Process (a number or set of numbers assigned to Qwest engineering jobs for use in internal billing systems' tracking)

cc	cubic centimeter, equal to 1 millimeter (ml)
CFC	Chloro-FlouroCarbon (an ozone destroying chemical used as a propellant or coolant)
CN	Change Notice (initiated by an equipment supplier to make changes to their equipment — may be the same as a PCN where CN is a specific term used by the suppliers, and PCN is the generic term used by Qwest and Telcordia)
CO	Central Office
COT	Central Office Terminal (CO end of a remote terminal, whether it be DLC, a mux, etc.)
CPE	Customer Premise Equipment (common catch-all for equipment such as telephones, modems, etc., usually owned by the customer, which connect to the Qwest [or other telecomm carriers'] Network).
CSA	Canadian Standards Association
DC	Direct Current (electricity normally used by telecommunications equipment; rectified from AC, typically to -48 V)
dBrnC	decibels referenced to Noise Level C (an audible noise measurement of the AC ripple component of a DC voltage or current)
DLC	Digital Loop Carrier (a fiber or T-1 based digital multiplexing transmission system to transport multiple channels closer to the customer on a few copper pairs or fiber)
DS-0	Digital Signal level 0 (a 64 kbps digital circuit/channel; the digital equivalent of POTS)
DS-1	Digital Signal level 1 (a 1.544 Mbps digital circuit/channel; which may be subdivided into 24 DS-0 circuits)
DS-3	Digital Signal level 3 (an approximately 51 Mbps digital circuit/channel; which may be subdivided into 28 DS-1 circuits plus an overhead)
DWP	Design Work Package (the Qwest job number — formerly known as a TEO, or Telephone Equipment Order)
EHS	Environmental, Health, and Safety (an internal Qwest group)
EMF	Electro-Magnetic Fields (frequencies in the air or on nearby conductors which can induce unwanted currents and voltages into telecommunications equipment, disrupting normal communications)
EMI	Electro-Magnetic Interference (see EMF)

EMT	Electrical Metallic Tubing (a type of conduit used for AC circuits)
EPA	Environmental Protection Agency
ESD	Electro-Static Discharge (discharge of accumulated static electricity from the human body)
FCC	Federal Communications Commission
FRC	Field Reporting Code (Account Codes used to classify telecommunications capital investments)
HazMat	Hazardous Material (as defined by the EPA)
HEPA	High Efficiency Particulate Arrestor (specially rated filters and devices that remove most of the dust and particulates from the air)
HSP	House Service Panel (at the commercial AC service entrance to a building)
HVAC	Heating, Ventilation and Air-Conditioning
I	symbol in electrical formulas for current (Amperes)
ICBO	International Conference of Building Officials
ICC	International Code Council
IFCI	International Fire Code Institute
JIM	Job Information Memorandum (a form issued to Engineering to indicate changes are needed to the engineering job and / or additional material must be ordered)
kbps	kilobits per second (digital transmission frequency / speed)
kHz	a measure of thousands of sound waves per second
kVA	kilo-Volt-Amperes (a measure of total electrical power used or provided)
kW	kiloWatts (thousands of Watts)
LEWIS	Loop Electronics Warehouse and Installation Services Center
LNO	Local Network Operations (Qwest Communications' internal Outside Plant field Operations forces)
Mbps	Megabits per second (one Megabit = 1000 kilobits)
ml	milliliter
MOP	Method of Procedure (a detailed plan for installation / removal work)
MPOP	Main / Minimum Point of Presence (the main point of interface / demarcation between Qwest and the Customer)
MRC	Material Reclamation Center (Qwest's old Salvage Yards — Qwest now uses NAVL pack-n-hold warehouses or their own LEWIS Centers for this function)

mux	fiber multiplexer (combines several signals / channels / circuits into one larger bandwidth signal)
NAVL	North American Van Lines
NEBS	Network Equipment — Building System (see the Telcordia reference in Section 11.3 of this document)
NEC	National Electrical Code (NFPA Standards Document 70)
NEMA	National Electrical Manufacturers' Association
NFPA	National Fire Protection Association
NI	Network Interface (the point of demarcation between Qwest equipment, and the copper or fiber plant owned by the customer)
NMA	Network Monitoring and Analysis (a Telcordia UNIX program and computer system used for gathering and analyzing remote alarms)
NPC	Network Procurement Center (an internal Qwest group responsible for cutting Purchase Orders and procuring material for installation jobs, among other things)
NROC	Qwest Communications Network Reliability Operations Center (alarm monitoring and proactive maintenance — formerly known as SA)
NTC	National Traffic Center (former U S WEST designation for the new SMC)
OSHA	Occupational Safety and Health Administration (Division of U.S. Dept. of Labor)
OSP	OutSide Plant (all telecommunications locations outside the CO, including Customers Premises
Ø	Phase (the Greek letter Phi, denoting the number of electrical phases of power supplied or received, which directly correlates to the number of wires)
?	Ohms (the Greek letter Omega, signifying the impedance or resistance in an electrical circuit)
P	Power (measured in Watts)
PB	Power distribution (fusing and / or breakers) Bay
PBD	Power Board (the main DC plant distribution bays / panels)
PBX	Private Branch Exchange (a small switch owned by customers)
PDB	Power Distribution Bay
PDF	Portable Document Format (a common electronic format for literature of all types, which can be read by Adobe's free "Acrobat Reader")

POTS	Plain Old Telephone Service (a 3.4 kHz minimum analog voice channel)
PCB	PolyChlorinated Biphenyls (a hazardous material)
PCN	Product Change Notice (initiated by an equipment supplier to make changes to their equipment — may be the same as a CN where CN is a specific term used by the suppliers, and PCN is the generic term used by Qwest and Telcordia)
PID	Product IDentification number
psf	pounds per square foot
Pub	abbreviation of Publication (as in Qwest Technical Publication)
PVC	Poly-Vinyl Chloride (a plastic tubing pipe commonly used as water pipe)
RC	Responsibility Code (internal accounting codes assigned to Qwest employees for the internal tracking and cross-charging of expenses)
RCRA	Resource Conservation and Recovery Act
RF(I)	Radio Frequency (Interference) — see EMF
rms	root mean square (a method of obtaining the AC sine wave voltage or current constant equivalent value — as opposed to the peak voltage — this is the effective level that a person will feel, and can be used in computations)
RT	Remote Terminal (remote end — closest to the customer — of a multiplexing system used to provide service to the customers)
SA	former name of Qwest Communications NROC (see above)
SHNS	Self-Healing Network Services (a redundant fiber ring service)
SHARP	Self-Healing Alternate Route Protect (a fiber service with alternate routing)
SLPP	Safety and Loss Prevention Program (a manual of environmental health and safety practices produced by the Qwest EHS group)
SMC	Ryder's Qwest Shipment Management Center
SONET	Synchronous Optical Network (a transmission standard to which most modern telecommunications equipment is built and communicates)
SST	Synchronous Service Transport
T-1	T-carrier 1 (a basic telephone multiplexing scheme of 24 x 64 kbps channels, for a total 1.544 Mpbs bitstream — T-1 is the architecture to carry a DS-1)
TEO	Telephone Equipment Order (the new term is DWP)

TL1	Transaction Language 1 (a standard set of ASCII text alarm and command messages developed by Telcordia, and expanded by Qwest, which are sent over X.25 links)
Tech	abbreviation of Technical (as in Qwest Technical Publication)
UBC	Uniform Building Code
UFC	Uniform Fire Code (presently published by the WFCA and IFCI, but soon to be the new name of NFPA 1)
Ufer	A term for a grounding system using concrete — derived from the last name of a gentleman who proved that rebar-reinforced concrete that has good contact with the soil provides good electrical continuity, unless the concrete is coated
UL	Underwriters' Laboratories
UNIX	a powerful, workstation- and server-based operating system invented by Bell Labs in the late '60s, but still highly popular today for complex computing tasks
UPS	Uninterruptible Power Supply (a commercially available assembly of rectifiers, batteries and inverters — or in rare cases a motor-generator set and a flywheel — which ensures that clean AC power is available, and on loss of commercial AC, usually provides 15-30 minutes of backup — it is available in various kVA sizes)
VAC	AC rms Voltage (a measure of the strength of the electrical "pressure")
VDC	DC Voltage
VRLA	Valve-Regulated Lead-Acid (a type of battery commonly used in the OSP)
W	Watts (a measure of "real" electrical power used or produced)
WFCA	Western Fire Chiefs Association
X.25	a packet data network transmission protocol, used by Qwest for alarm transmission to their NMA system

11.2 Qwest Technical Publications

Pub 77350	Telecommunications Equipment Installation and Removal Guidelines, Issue K, June 2001
Pub 77351	Engineering Standards General Equipment Requirements, Issue F, June 2001
Pub 77355	Grounding - Central Office and Remote Equipment Environment, Issue D, September 2001
Pub 77385	Power Equipment and Engineering Standards, Issue F, January 2001
SLPP	Safety and Loss Prevention Program, Issue 2, December 2000

11.3 Telcordia Documents

BR-101-170-005	Quality and Reliability — Electrostatic Discharge, Issue 3, June 1996
BR 760-550-102	Building Ventilation, Issue 3, October 1981
BR 781-810-885	Central Office Ventilation, Issue 1, August 1987
BR 790-100-672	Battery Maintenance Practices for Flooded and Valve Regulated Acid Batteries, Issue 1, December 1993
GR-26-CORE	Generic Requirements for CEVs, Issue 1, December 1994
GR-27-CORE	Generic Requirements for Environmental Control Systems for EEEs, Issue 1, November 1994
GR-63-CORE	Network Equipment — Building System (NEBS) Requirements: Physical Protection, Issue 1, October 1995
SR-TSY-000963	Network Switching Element Outage Performance Monitoring Procedures, Issue 1, April 1989
SR-NWT-002432	Earthquake Retrofit Bracing Guidelines for Qwest Battery Stands, Issue 1, August 1992
SR-NWT-002498	Earthquake Retrofit Bracing Guidelines for Qwest Network Equipment (Phase I), Issue 1, October 1992
SR-NWT-002536	Earthquake Retrofit Bracing Guidelines for Qwest Network Equipment (Phase II), Issue 1, November 1992

SR-3400	Economic Impact of Increasing the Operating Temperature Range Within Telecommunications Central Offices: The Wideband Study, Issue 1, November 1994
SR-3580	Network Equipment — Building System (NEBS): Criteria Levels, Issue 1, November 1995
SR-3700	Economic Impact of Humidifying Telecommunications Central Offices: The Humidity/ESD Study, Issue 1, September 1995
TR-NWT-000295	Isolated Ground Planes: Definition and Application to Telephone Central Offices, Issue 2, July 1992

11.4 Other Documents

ANSI/TIA 607	BICSI Commercial Building Telecommunications Grounding Standard, 2001 Edition
ANSI T1E1/93-064	Network Equipment Earthquake Resistance Standard, Revision 1
ASHRAE Std. 62	Ventilation for Acceptable Indoor Air Quality, 1989 Issue
International Building Code (IBC), published by the International Code Council (ICC), 2000 Edition	
International Fire Code (IFC), published by the International Code Council (ICC) and the International Fire Code Institute (IFCI), 2000 Edition	
IEEE Std 450-1995	IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications
IEEE Std 484-1996	IEEE Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications
IEEE Std 485-1997	IEEE Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations
IEEE Std 1184-1994	IEEE Guide for the Selection and Sizing of Batteries for Uninterruptible Power Systems
IEEE Std 1187-1996	IEEE Recommended Practice for the Design and Installation of Valve-Regulated Lead-Acid Storage Batteries for Stationary Applications

IEEE Std 1188-1996	IEEE Recommended Practice for Maintenance, Testing, and Replacement of Valve-Regulated Lead-Acid Batteries for Stationary Applications
IEEE Std 1189-1996	IEEE Guide for the Selection of Valve-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications
NFPA 1	Fire Protection Code (Uniform Fire Code), 1997 Edition
NFPA 37	Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines, 1998 Edition
NFPA 70	National Electrical Code (NEC), 2002 Edition
NFPA 110	Standard for Emergency and Standby Power Systems, 1999 Edition

OSHA 29 CFR Standard 1926.417, Lockout and Tagging of Circuits

Uniform Building Code (UBC) Vols. 1-3, published by the International Conference of Building Officials (ICBO), 1997 Edition

Uniform Fire Code	Vols. 1-2, published by the Western Fire Chiefs Association (WFCA), 1997 Edition
UL 1950	Safety of Information Technology Equipment, Including Electrical Business Equipment, 3rd Edition, 1995

11.5 Ordering Information

All documents are subject to change and their citation in this document reflects the most current information available at the time of printing. Readers are advised to check status and availability of all documents.

Those who are not QWEST employees may order;

American National Standards Institute (ANSI) documents from:

American National Standards Institute
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Phone: (908) 699-5800 (Others)
Web: www.telcordia.com

QWEST Technical Publications from:

http://www/qwest.com/techpub

IEEE Documents may be obtained from:

Institute of Electrical and Electronics Engineers, Inc.
345 East 47th Street
New York, NY 10017-2394

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