HARDENING OF INTERMEDIATE OR AUXILIARY STATION COMMUNICATION EQUIPMENT GENERAL EQUIPMENT REQUIREMENTS

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1. GENERAL

A. Scope

1.01 This section covers the general equipment requirements for hardening intermediate or auxiliary station communication equipment (such as auxiliary repeater stations for long- or short-haul carrier routes) and installing shock mountings to provide a communications installation capable of withstanding shock environment of specified severity resulting from nuclear explosions. Installations that have been engineered to meet prescribed requirements during and after such exposure are said to be "hard" or to have been "hardened."

(a) The requirements herein which refer to "equipment bays" apply only to standard cable duct-type repeater bays which are adapted for shock isolation by means of suitable clamping plate and adapter plate details to stiffen the frames and accommodate the shock mount system.

(b) General equipment requirements for hardening of central office and main station communication equipment are covered in Section 800-610-157.

1.02 This section is reissued to make changes which are listed under Reasons for Reissue at the end of this section.

1.03 The requirements covered in this section shall be followed, except as modified, by applicable specifications and drawings.

B. Building Construction

1.04 The hardening requirements covered herein are based on the assumption that the equipment will be installed in special underground buildings of shock-resistant reinforced concrete construction which have been designed to withstand an atmospheric overpressure pulse of 100 psi resulting from a nuclear explosion. Bell Laboratories shall be consulted before proceeding with any jobs involving survival of exposure to atmospheric overpressure other than 100 psi.

1.05 In the long-haul carrier intermediate repeater stations built to date, the ceiling height is 8 feet 0 inch. The building design allows for

equipment to be adequately fastened to the floor and for supporting the overhead structures and the upper ends of equipment bays from the ceiling.

1.06 Continuous channel inserts are provided in the floor and ceiling.

C. Basic Principles

1.07 The hardened equipment units (including such items as mounting plates, panels, and relay rack units) within the equipment bays are designed to withstand direct vibratory accelerations up to 3G. Acceleration in excess of 3G is absorbed by the shock mount system.

1.08 Equipment bays are provided with a suspension-type shock mount system to take the vertical and horizontal shock load that would result from a nuclear explosion.

1.09 Cable racks, cable terminals, auxiliary framing, lighting fixtures, and other associated framework are fastened directly to the ceiling and are entirely independent of the shock-mounted equipment bays.

1.10 Cables feeding from cable racks to the equipment bays are provided with sufficient slack to permit relative motion in any direction between cable racks and equipment.

2. DESIGN CONSIDERATIONS

A. Basic Criteria

2.01 The object of hardening individual equipment units is to enable them to withstand a direct transient input of 3G peak acceleration without shock mounting. The performance criteria which hardened equipment shall meet when subjected to this shock are as follows.

(a) The equipment shall suffer no physical damage.

(b) Established connections shall remain intact, but momentary interruptions of the transmission path due to vibration of components, chattering of relay contacts, etc, will be permissible during the period of shock. Continuity of normal switching operations will not apply to connections which are in the process of being established during the shock period.

(c) The equipment shall be capable of functioning subsequent to the period of shock without manual reset.

B. Modification of Apparatus and Wiring

2.02 Standard equipment and apparatus that is to be specified for use in hardened applications should be investigated to ascertain its capability of meeting the requirements specified in 2.01.

2.03 Tests have been made on a wide and representative variety of apparatus and equipment codes to determine the severity levels required to cause failure in operation and permanent physical damage. These tests show that the fragility level of Bell System equipment varies from about 1G to at least 20G.

2.04 Most equipment units will require some modification, but standard communication equipment and apparatus that can ordinarily be shipped safely without special or unusual packing precautions will, in general, need a relatively small number of comparatively simple changes to achieve the 3G fragility level required for use in hardened installations.

2.05 When modification of an existing design of unit is required to make the unit suitable for use in hardened installations and will not be required for normal use, the modification shall be covered by a list added to the J code. The list shall require stamping 3GHDN in close proximity to the stamped J code. The list shall be worded, "Equipment and assembly required in addition to List _____ to meet the requirements of Section 800-610-157."

2.06 When an existing design has been shown to meet the requirements of this section or a new unit has been designed to meet them, the unit need not be stamped. An engineering note to which reference is made for any code falling into this classification shall be added to the covering specification, reading as follows: "This unit, as manufactured, meets the requirements of Section 800-610-157."

2.07 It is not practicable to list all of the modifications that may be required to strengthen equipment units and apparatus so that they will be suitable for use in hardened applications. However, the following list of the most frequently

required modifications should serve as a guide to the general type of modification likely to be required. The modifications in this list shall be incorporated wherever applicable in the manufacturing information for all hardened equipment units or apparatus.

(a) Plug-in or snap-on type apparatus or covers, other than electron tubes having positively locked shields, shall be secured by adequate holding clamps.

(b) ◗Pigtail-connected electronic parts which either exceed 1/2-ounce weight or have leads greater than 1 inch shall be given adequate independent mechanical support to prevent lead breakage. This can be accomplished by mounting on cards or by use of brackets as follows:

BRACKET	USED WITH
P-40H709	Individually mounted U- or Y-type relays
P-40H710	280- or B-type relays
P-41N399	Wire-spring relays◖

(c) Replace fragile apparatus items with more rugged designs. Other things being equal, use the lightest weight item available. In doubtful cases, consult the appropriate apparatus development organization for suitable apparatus codes.

(d) Add cable form bracing to reinforce unsupported cable arms such as those feeding jack fields in accordance with Section 800-612-156 and ED-64578-30.

(e) Replace mounting plate piece parts having open-end notches for the mounting screws with mounting plates having holes or closed-end slots.

(f) Where transformers or other relatively heavy pieces of apparatus are mounted near the center of panels, steps shall be taken to adequately strengthen the panel or independently support the heavy part.

C. ◗Hardness Test Specification, X-76048

2.08 All WECo supplied equipment in hardened intermediate or auxiliary stations, essential to the operation of the hardened communication system, shall be capable of surviving the appropriate test or tests as specified in X-76048.◖

D. Modification of Bays

2.09 ***Equipment bays*** shall be modified in accordance with the following drawing.

J68819G-1—Auxiliary Repeater Bay Arranged for Shock Isolation Assembly, Equipment and Wiring

E. Shock Mount System

2.10 The shock mount system is a composite of four open wound helical steel springs which can act either in tension or compression. These springs are held in position between steel attachment plates. The top plate of the system is fastened to the ceiling, and the equipment bay is suspended from the bottom plates.

2.11 Shock mount systems will be furnished by the Barry Wright Corporation of Watertown, Mass. as type 19890-4 or by the Robinson Technical Products Corporation of Teterboro, N.J. as type K2193-1.

2.12 In some early installations a shock mounting system of somewhat different construction has been installed. This system, furnished by the Barry Wright Corporation of Watertown, Mass. as Barrymount Isolation System Type 17590-1, consists of a set of top and bottom shock mounts as illustrated in Fig. 1. Both top and bottom mounts are similar in construction in that each mount is a composite of four elastic members, held in position between steel attachment plates. The flexing members of the shock mounts are molded rubber links, shaped somewhat like a dogbone, thus, the mount is sometimes referred to as a "dogbone." The ends of each dogbone are pivoted in steel clevis blocks which are welded to the top and bottom attachment plates. The top mount is fastened to the top of the bay with eight 3/8-16 by 1-1/2 inch HH cap screws and hexagonal nuts and to the continuous channel ceiling inserts with four 1/2-13 by 1-1/2 inch HH cap screws. The bottom mount is fastened to the bottom of the bay with six 3/8-16 by 1-1/4 inch HH cap screws and hexagonal nuts and to the continuous channel floor inserts with four 1/2-13 by 7-inch threaded steel rods and hexagonal nuts.

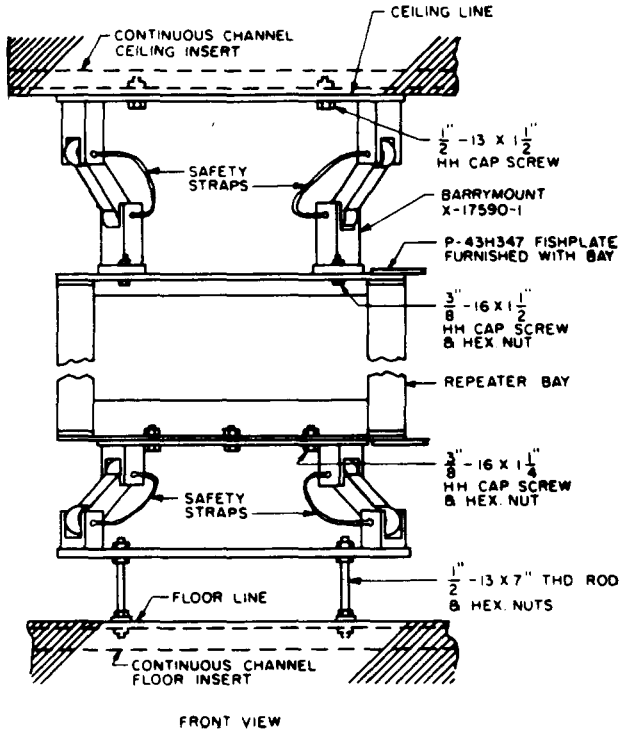

Fig. 1—Early Type Shock Isolator Installation for Auxiliary Repeater Bays (Mfr Disc.—Replaced by Fig. 4)

2.13 Fig. 2 illustrates a typical layout of an underground auxiliary repeater station showing arrangement of bays, cable racks, and 42A cable terminals. Shock-mounted repeater bays are located at least 6 inches from the wall to permit freedom of movement. Cable terminals are centrally located on the ceiling in front of the bays.

F. Cable Terminals

2.14 Fig. 3 illustrates a typical underground auxiliary station showing the arrangement of cable racks and cable terminals in relationship to the repeater bays.

2.15 Lead-sheathed entrance cables shall be terminated in 42A cable terminals centrally located on the ceiling in front of the bays. For protection reasons, the bay framework must be bonded by a flexible ground strap to the associated cable terminal.

2.16 Flexible cables shall be used between the cable terminals and the shock-mounted equipment bays to permit movement of the bays with respect to the cable terminals and lead cable. The flexible connecting cables between cable terminals and bays must all be the same length in any one repeater installation.

3. INSTALLATION REQUIREMENTS

A. Shock Mount System

3.01 ***The shock mount system*** shall be fastened to the top of the bay and ceiling in accordance with Fig. 4 and 5. Eight 3/8-16 by 1-1/2 inch HH cap screws and hexagonal nuts shall be used to fasten the bottom attachment plates to the top of the bay. The top attachment plate shall be bolted to the continuous channel ceiling inserts with four 1/2-13 by 1-1/2 inch HH cap screws.

B. Junctioning of Bays

3.02 Adjacent shock-mounted bays shall be junctioned together using the four P-43H847 fishplates which are provided with all bays except the first bay in a lineup.

C. Cable Racks and Cabling

3.03 Cabling and wiring to and from shock-mounted bays shall be run on inverted ladder-type cable rack located above and in front of the bays.

3.04 Cables shall be installed in accordance with Section 800-614-152. All cables or wires entering a shock-mounted bay must be provided with enough slack to permit a 4-inch movement of the bay in any direction relative to the cable rack.

REASONS FOR REISSUE

1. 2.07(b) covering pigtail-connected electronic parts was revised to clarify the size of the parts which require support; also to add brackets P-40H709 and P-40H710.

2. 2.08 covering Hardness Test Specification, X-76048, was added.

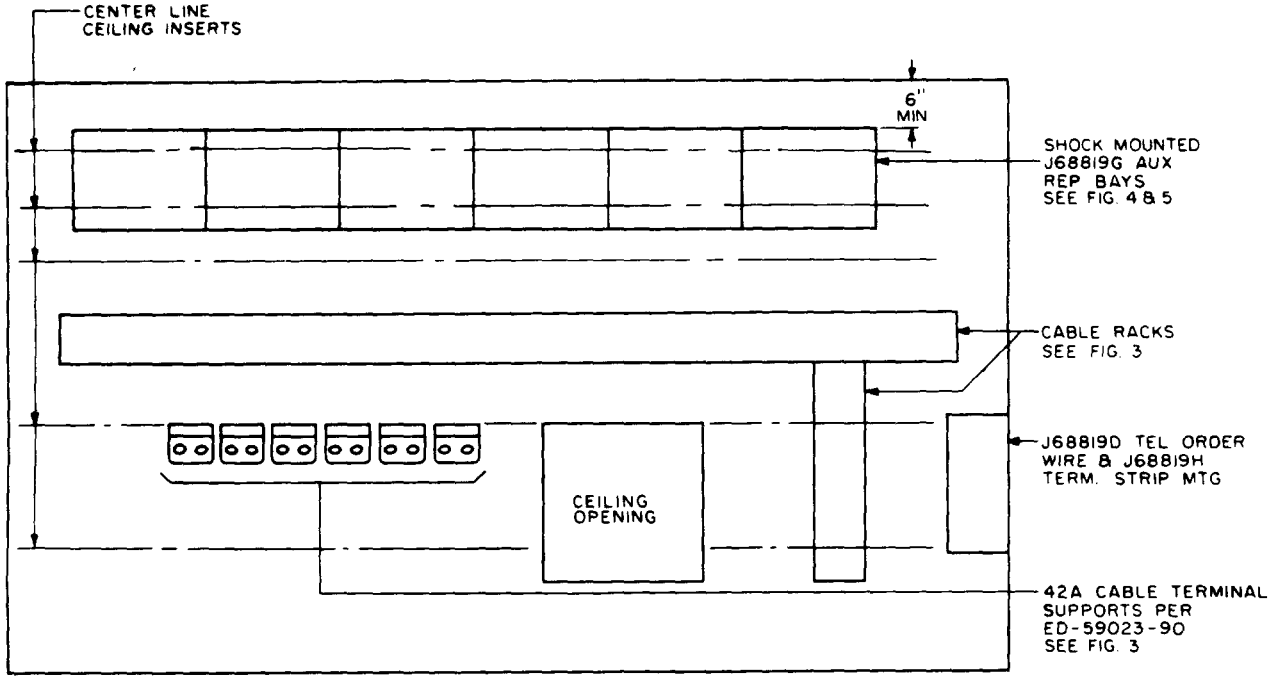

Fig. 2—Typical Layout of an Underground Auxiliary Repeater Station

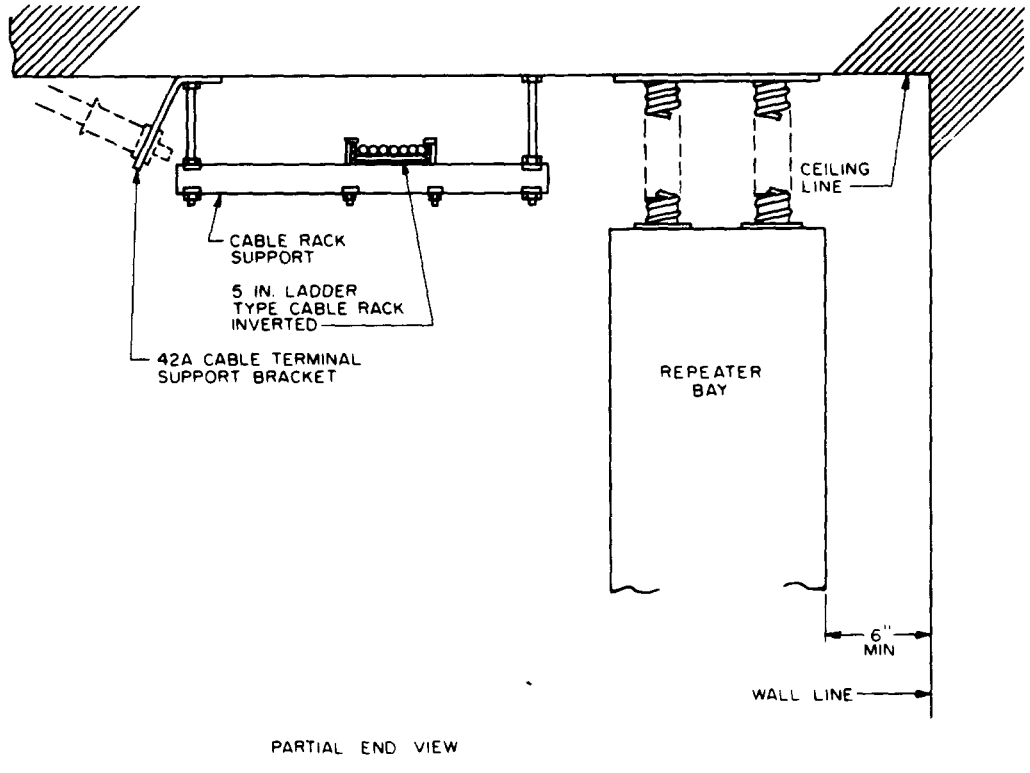

Fig. 3—Typical Cable Rack Arrangement

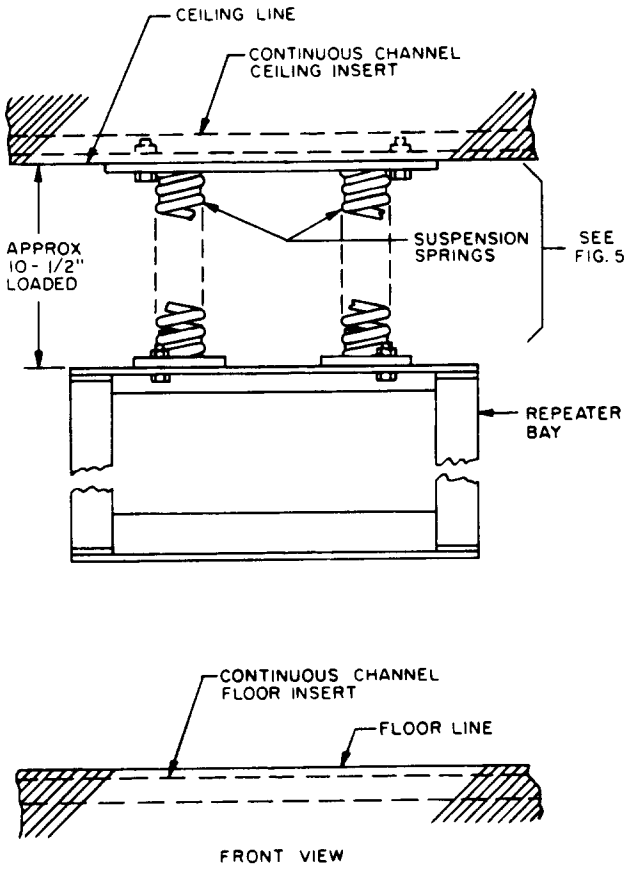

Fig. 4—Typical Shock-Mounted Auxiliary Repeater Bay

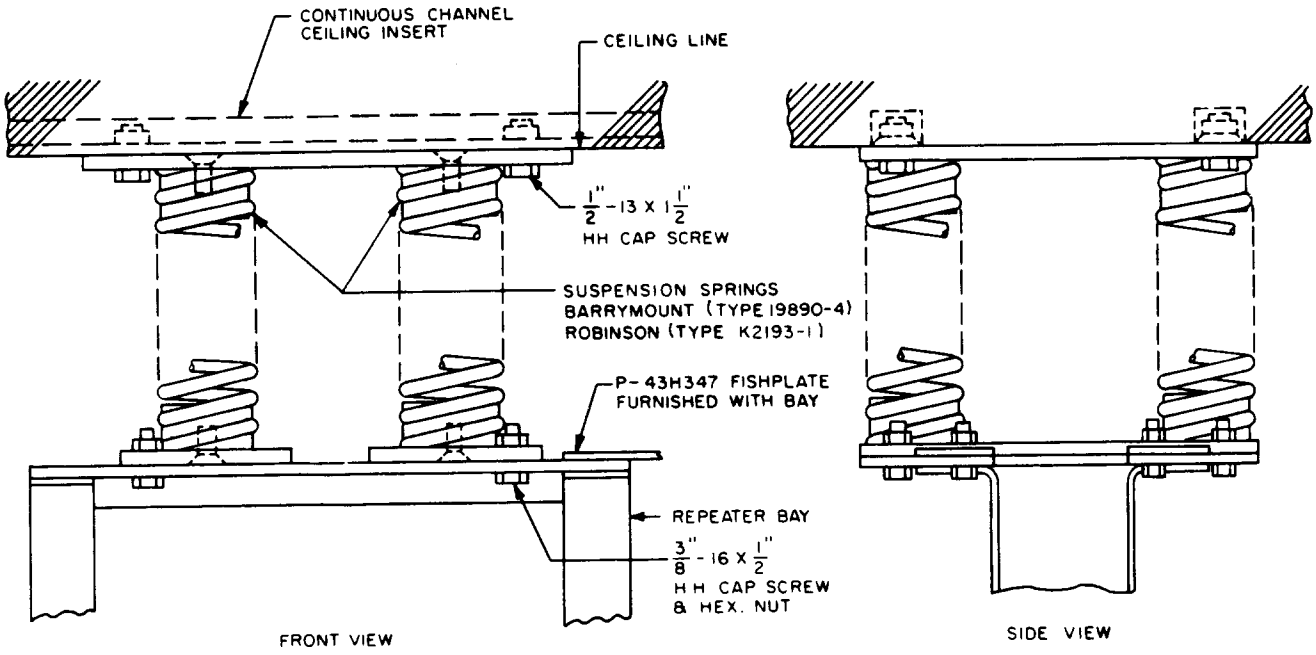

Fig. 5—Fastening Shock Mount System