

TERMINATION MODULE

FINAL RESOLUTION

Conductor Insulation Damage of T-MODS Located In Termination Cabinets.

Description

The Power Generation Control Complex (PGCC) is developed and supplied by General Electric under the M-1 NSSS contract. The PGCC uses termination cabinets to interface between field cables. Most cables interface on a termination module (T-MOD) which consists of an AN connector for the cable from the PGCC floor section and a terminal board for the incoming field cable (see attached Figs. 3-4, 3-5, and 3-6). NCR 3030 was issued on September 28, 1978 to identify damaged conductor insulation within the T-MOD connecting an AN connector and the terminal board. The damages were first observed during an implementation of rework of termination cabinet ITC-621 at the SSES site. Of the total 450 T-MOD units for SSES Unit 1, 127 units were found to exhibit one or more of the following defects:

- 1) Severe indentations on the insulation (no exposed wire).
- 2) Abrasion (scuffing) of the insulation (no exposed wire).
- 3) 'Nicks and dings' on the insulation; i.e., minor 1/32" to 1/8" long) lateral and longitudinal cuts (exposed wire).
- 4) Severe longitudinal gouging. Wire was exposed (1/8" to 1/2" long) and the gouged insulation indicated sharp edge cutting in both directions.

General Electric's QA verification procedure for the manufacturing process was insufficient to detect the damage insulation.

Cause

It was determined by GE that 95% of the damaged units were Hi-Density Termination Modules (21 and 48 pin assemblies which use twisted shielded pair and triple cables - 20 awg wire with ferrule terminations on the shields). During the reassembly (i.e., pin insertion and extraction using the standard Amphenol tooling of the termination modules) continual difficulty was observed. The ferrule edge during extraction, and the sharp insertion tool edge during assembly, impacted on the densely packed wires at the connector area. Further damage (3 abrasions out of 900 conductors) was observed during the reassembly operation. The assembled units were then re-inspected and the three added defects were noted.

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It was also noted that the sharp edges of the termination module frames caused indentations on the wire insulation of improperly stacked units. It was seen that this was caused by the sharp edge of the steel frame of one module laid against the unprotected wire bundles of an adjacent module. Handling precautions are required to prevent this type of damage, since it can potentially occur any time two modules contact each other.

In summary, the possible cause of insulation damage can be attributed to:

- 1) Improper Assembly - Pin Insertion/Extraction
- 2) Handling and Storage
- 3) Producibility - Hi-Density modules
 - Conductor free length
 - Ferrule concept

Analysis of the Safety Implications

The system design was reviewed and the following was concluded for the worst condition. The insulation damage of the T-MODS varies from barely visible to the unaided eye to 1/2" exposed bare wire. Although no insulation breakdown was observed during the hi-pot testing (standard 2.2 KVDC) of individual conductors to connector shell and other pins of the same connector, the frequency of occurrence is such that if the defects were left undetected/uncorrected, shorting of conductors must be assumed possible. Some of the affected systems are RHR, RCIC, and Core spray. Loss of T-MOD conductors may prevent the circuits from performing their designed safety related functions. Such an eventuality presents an unacceptable condition even through there may be redundant subsystems remaining unaffected. In addition General Electric's QA program had failed to detect any defects during the manufacturing process.

Project Engineering has determined the PGCC T-MODS deficiency to be reportable under 10CFR 50.55(e).

Corrective Action

All Unit 1 defective units have been returned to GE San Jose for rework. To preclude re-occurrence on the rework of Unit 1 T-MODS, the following actions have been taken by GE:

1. Improper Assembly

The methods, planning process, and operator training have been upgraded since the Susquehanna I T-MODS were built in the first quarter of 1976. This, with the producibility changes, will minimize difficulties observed during the reassembly operations for T-Mods. General Electric's quality program applied to the Unit I termination modules was defective in one major area. The in-process inspection system did not include the physical inspection of the pin insertion process. (The assumption that continuity and insulation testing would detect all functionally significant insulation damage has not been confirmed).

Added in-process inspection points and a revised detailed inspection plan have been added to the assembly operation of the T-Mods.

2. Handling and Storage

Operator training in the handling of T-Mods with proper physical separation and stacking will reduce observed problems in this area. In addition, the T-Mods, when complete, will be styrofoam wrapped and taped to preclude storage and shipping damage. (This practice was implemented in early 1977.)

3. Producibility

On the Unit 1 rework of the T-Mods, several producibility changes which have been implemented on subsequent projects will be applied:

- a. Tensolite wire which is less susceptible to abrasion and 'dinging' will be applied to reworked T-Mods.
- b. An alternate method of shielding which does not require the ferrule concept will be applied to reworked T-mods.
- c. Longer free conductor length for ease of assembly will be applied to reworked T-Mods.

Conclusion

The repair/rework and re-test of the T-MODS for SSES Unit 1 has been accomplished per GE procedures and criteria. The deficiency has now been corrected and the potential safety hazard has been eliminated. The SSES Unit 1 reworked T-Mods have been shipped and installed at the jobsite.

A portion of the Unit 2 T-Mods were manufactured in the same time period as the Unit 1 T-Mods. Inspection will be performed at SSES per a GE document FDI MDBC. Defective units will be returned to GE for repair before fuel load. GE fabrication personnel training, inspection and revised fabrication techniques has precluded reoccurrence of similar problems on the remaining Unit 2 T-Mods.

The inspections to be conducted in accordance with FDI MDBC include a 100% visual inspection of terminal strips for cracked, broken or missing barriers and conductor insulation for nicks, abrasion and cuts. The existence of any of these conditions is cause for rejection.

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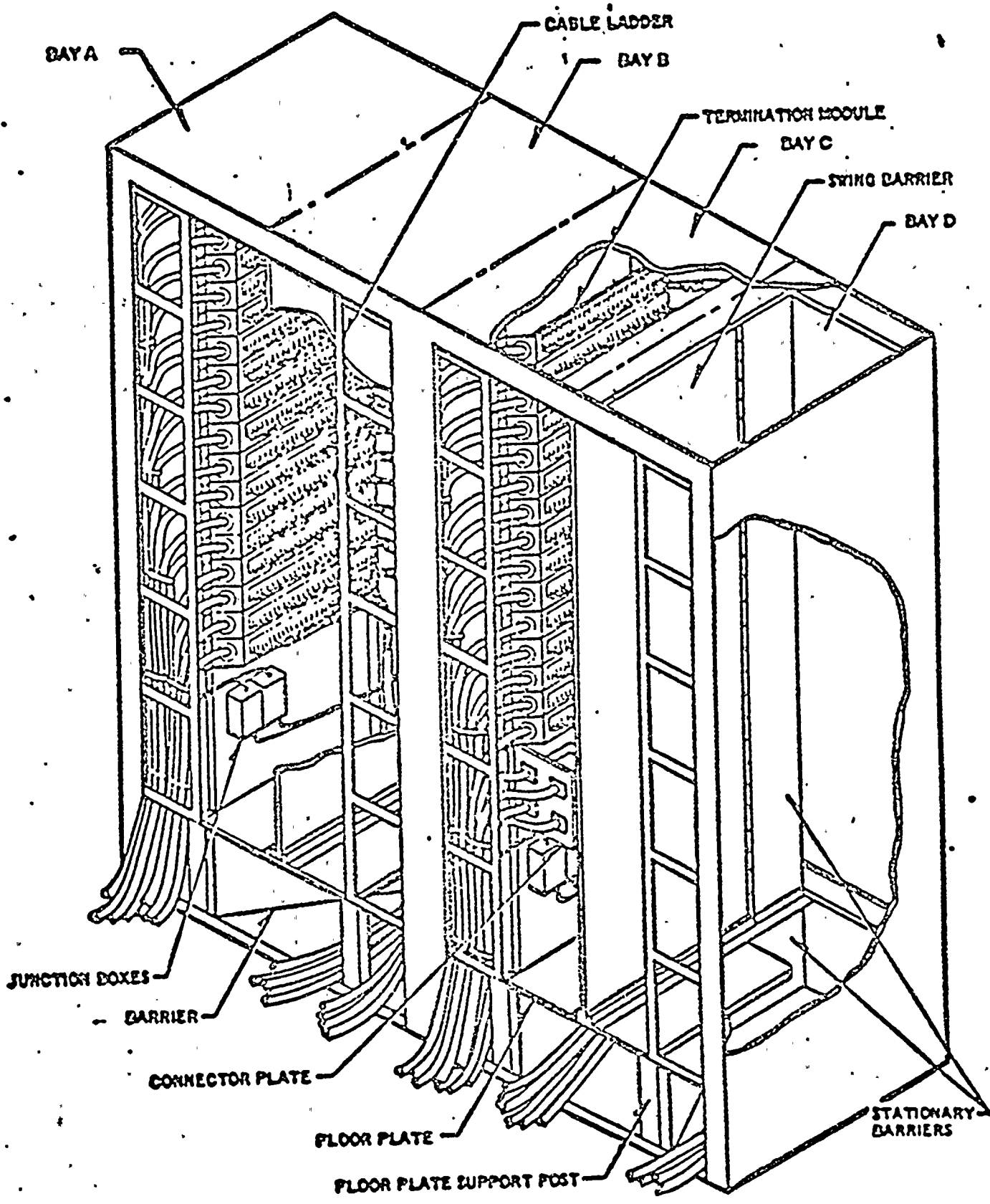


Figure 2-4. Assembled Termination Cabinet (Doors removed for clarity)

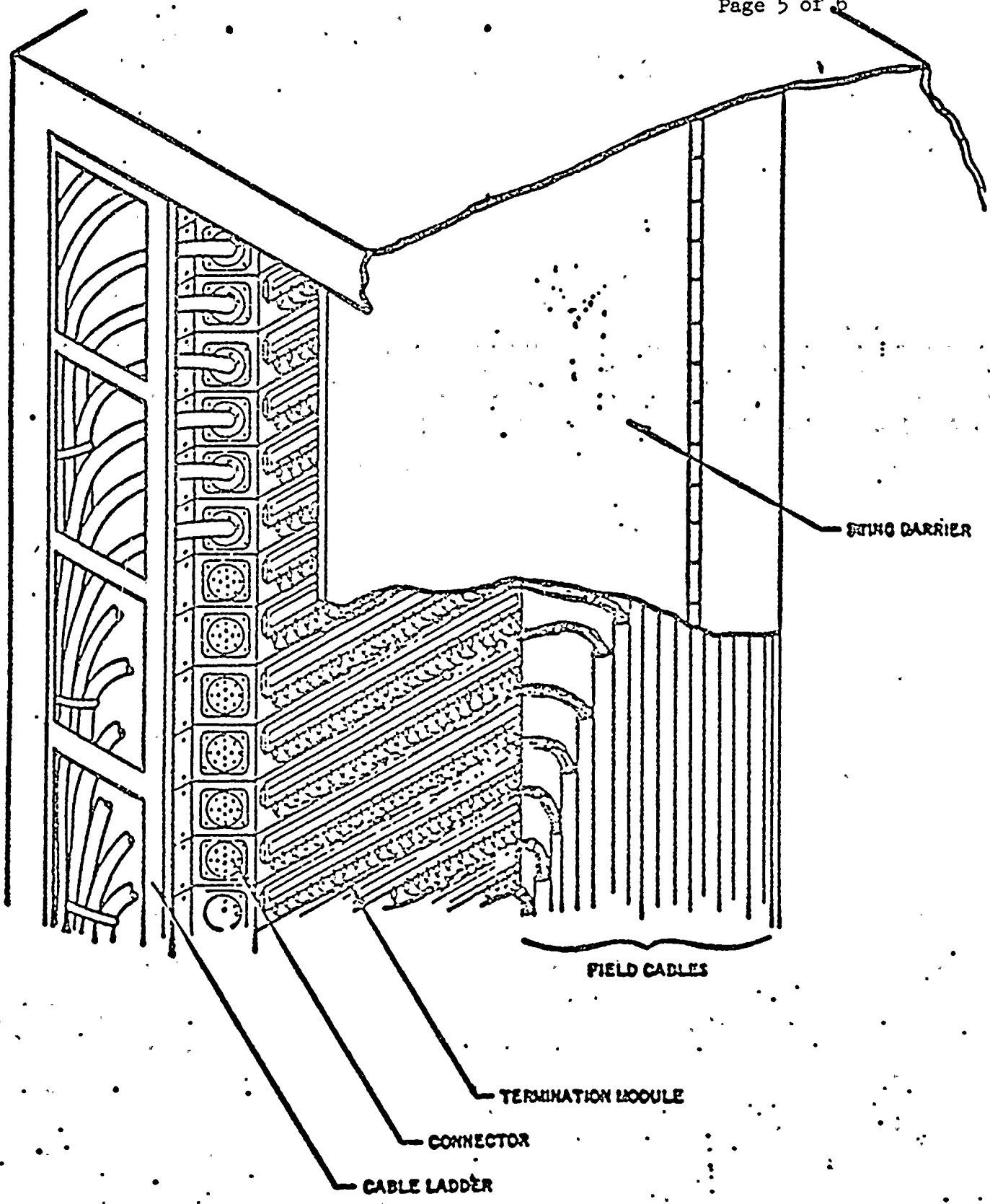


Figure S-5. Termination Cabinet Assembly

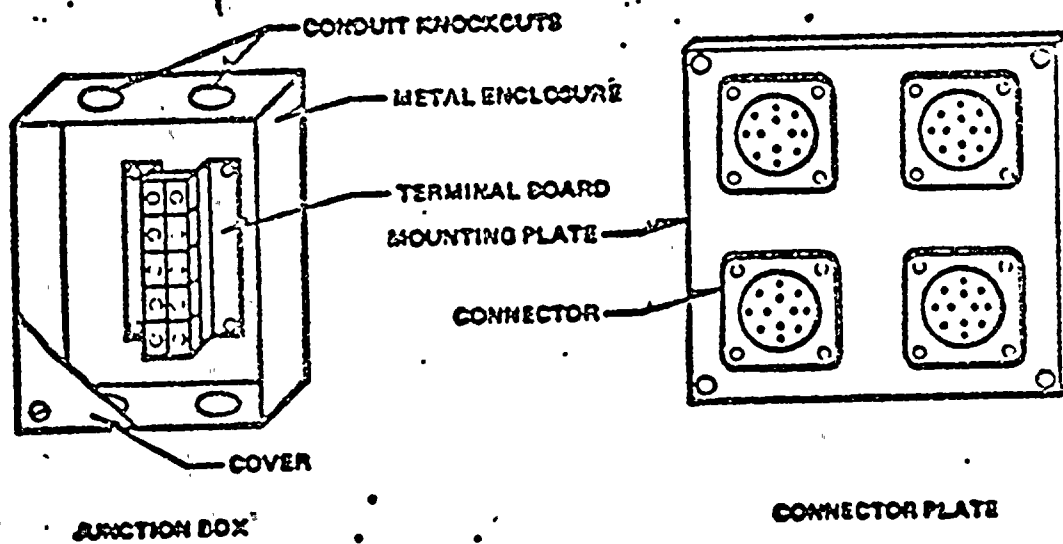
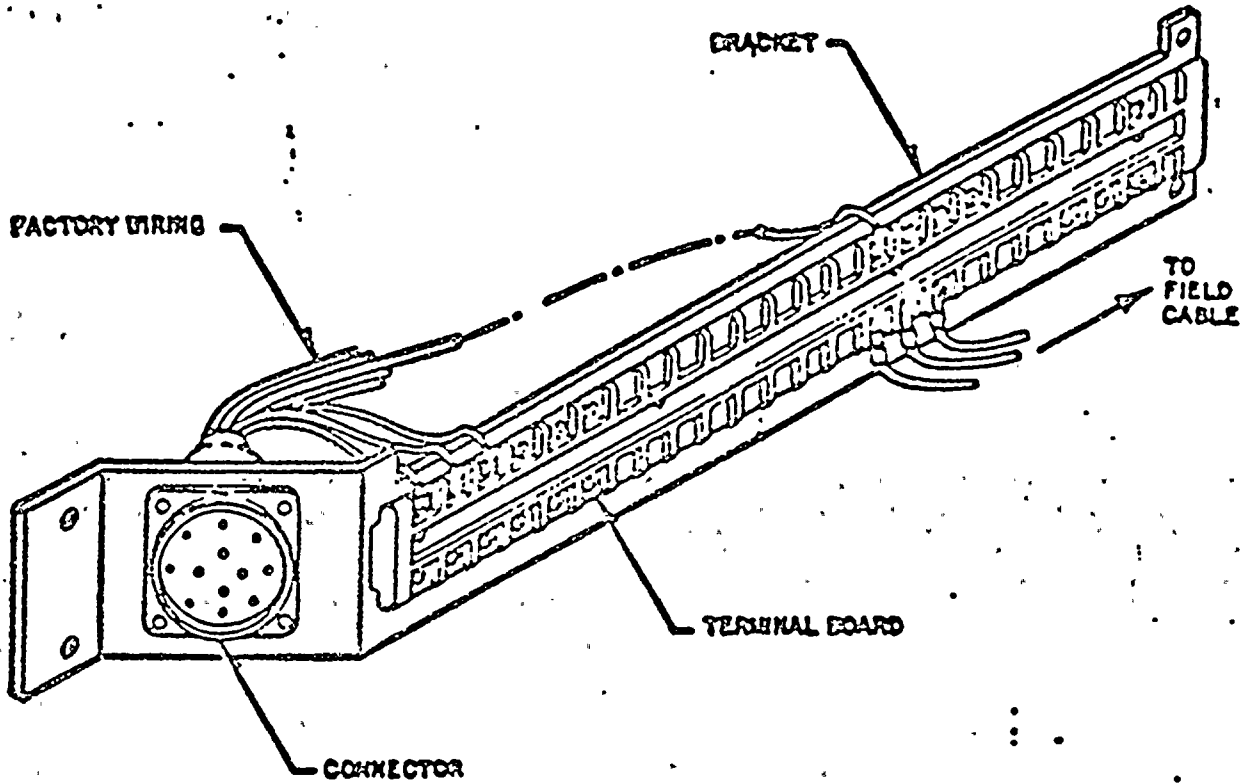


Figure 3-8. Termination Devices



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