Department of Energy

Condition Assessment Survey (CAS) Program

Deficiency Standards & Inspections Methods Manual

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for
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1000 Independence Avenue, S.W.
Washington, DC 20585

VOLUME 9: 0.09 ELECTRICAL
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Printed with soy ink on recycled paper

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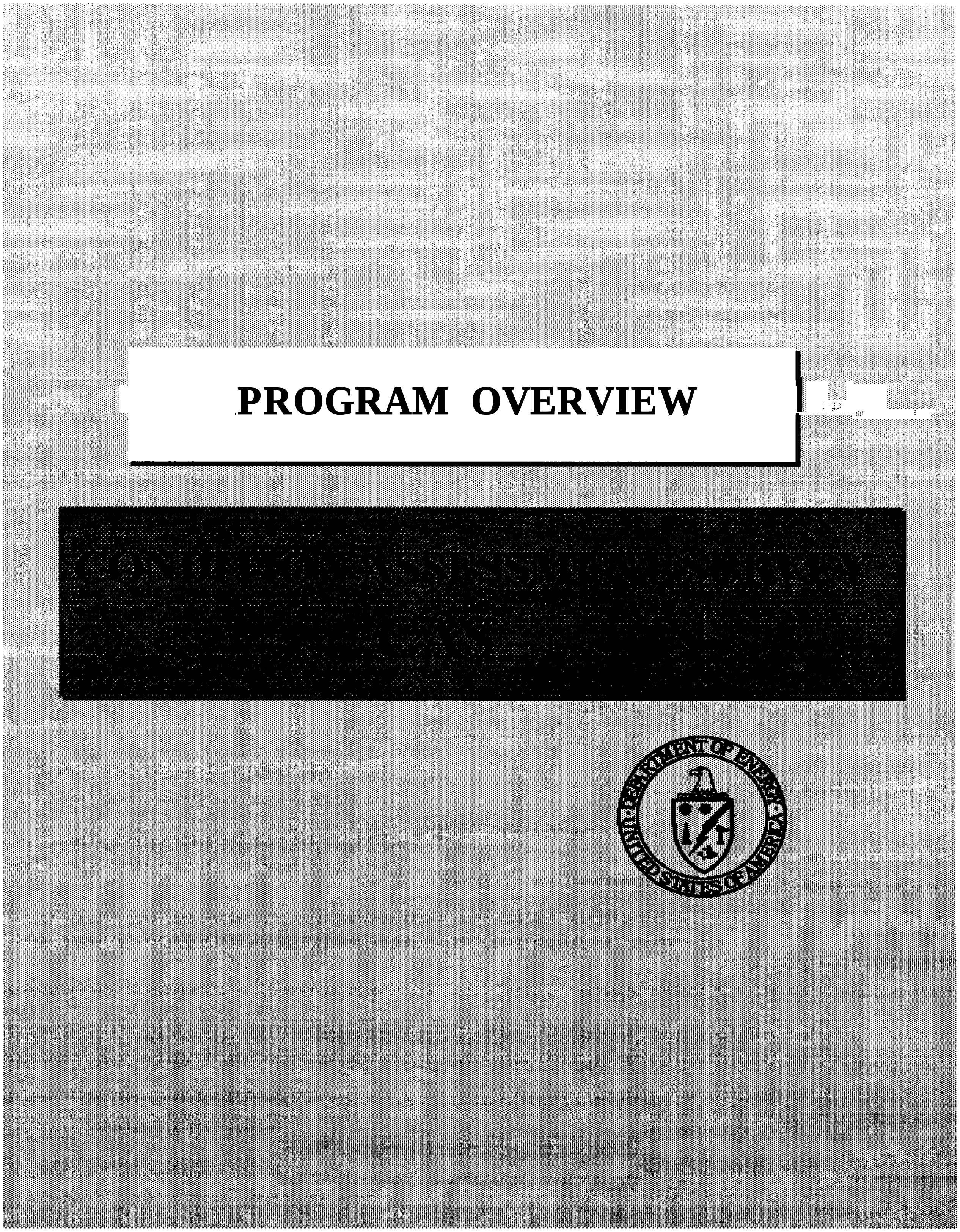


INTRODUCTION

CAS PROGRAM OVERVIEW

WHAT IS CAS?

WHY CAS?

HOW IS CAS IMPLEMENTED?

INTRODUCTION

GENERAL

Welcome to the DOE Condition Assessment Survey (CAS) Program. In the next few pages you will be introduced to a new way of seeing familiar things. As an introduction to CAS, this Program Overview will explain how the various parts of CAS have been developed and integrated to meet the needs of DOE sites, Field Offices, and Headquarters. Our discussion will center around three broad topics:

- **WHY CAS?**

  This section will discuss issues DOE has faced in previous inspection approaches and explain the CAS goals of providing creative "standardized" solutions.

- **WHAT IS** CAS?

  Here, key elements of the CAS Program and how they relate to each other will be examined.

- HOW IS CAS IMPLEMENTED?

  Strategies for beginning to use CAS and the key roles facility managers and CAS inspectors play within the CAS process are detailed.

Again, welcome to the CAS Program. Your role in this program is essential to its overall success.

INTRODUCTION

WHY CAS?

DOE NATIONWIDE INVENTORY:

- 10,000 BUILDINGS AND 15,000 STRUCTURES ON 52 SITES NATIONWIDE
- LACK OF DOE STANDARDS
- VARYING DEGREES OF INSPECTION
- INCONSISTENT RESULTS LEADING TO INEQUITIES AMONG SITES

INTRODUCTION

WHY CAS? ▪ The State of DOE

The use of standards, from simple weights and measures to complex computer language, has been a fundamental part of human development. Because of standards, we can be assured that a meter of length in one place is the same in another. This question of standards has become increasingly important for DOE. Over the past 50 years, DOE and predecessor agencies have been at the forefront of the nation's technical advances. This investment has left the department a vast array of facilities under its care. With 10,000 facilities and 15,000 miscellaneous structures comprising over 100,000,000 square feet at 52 sites across the country, the problem of design, construction, and maintenance of all DOE physical plants is acute. Add aging facilities, revised missions, and changing technology, and condition assessment becomes a vital tool to use to ensure facilities will continue to meet DOE's and the nation's program goals.

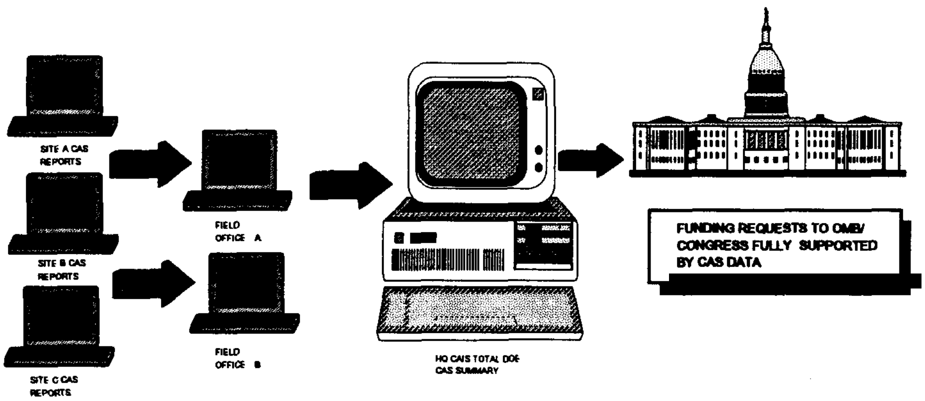
The current state of condition assessment across all DOE assets is mixed. While DOE regulations dictate facility assessments be made, no one methodology is mandated to conduct them. As a result, DOE surveys have varied from site to site, with some locations providing exhaustive in-depth analysis while others have used a more limited approach. Because of such different interpretations, it is difficult to judge the validity and comparability of data being provided. This, in turn, has led to funding requests that cannot be fully substantiated to Congress.

This lack of standards for use in the facility assessment process and the resultant inconsistencies in developing program budgets have convinced DOE that a standardized, clearly defined methodology for condition assessment is essential to support DOE's program missions.

INTRODUCTION

WHY CAS?

- ASSESS PHYSICAL CONDITION OF EXTENSIVE AND VARIED DOE FACILITY AND EQUIPMENT INVENTORY
- STANDARDIZE INSPECTION PROGRAM FOR ALL SITES
- IDENTIFY REPAIR/REPLACEMENT NEEDS TO FACILITATE KEY BUDGET DECISION MAKING
- DEVELOP SUPPORTABLE FUNDING REQUESTS BASED ON “UNIVERSAL” STANDARDS



INTRODUCTION

WHY CAS? - Four Key Requirements

In today's economic environment, it is essential that the DOE knows with confidence the condition of its vast asset inventory. To accomplish this, a method to review all DOE assets in a "standardized" approach is required. In designing guidelines for such a program, DOE established four key requirements:

Assess physical Condition of All Assets:

To be valid, all sites eventually must be included in the program. Universal participation will ensure that all DOE sites and installations will be using the same "score card."

Standardize Inspection Programs:

To remove the problem of inconsistent and misinterpreted facility inspection data, a "standard" evaluation method used by all DOE sites is required. Results from such a program will allow DOE to determine a "base condition" for all of its assets.

Identify Repair/Replacement Funding:

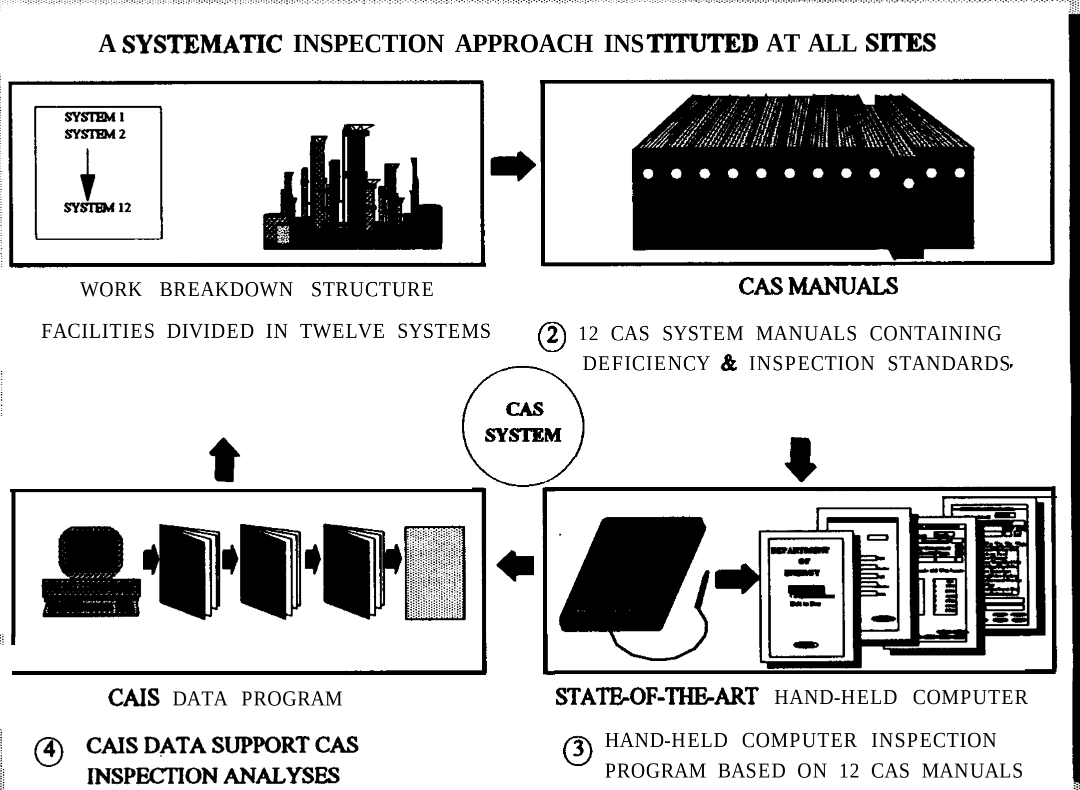
Using inspection data from all sites, a general picture across all DOE assets and programs can be used to direct limited resources to crucial areas. Standardized reports form "a level playing field" to ensure that all programs and missions will receive a fair analysis.

Develop Supportable Funding Requests:

In today's atmosphere of fiscal constraint, requests for funds from Congress require extensive justification, backed up by reliable, consistent field data, if such programs are to be successfully supported.

INTRODUCTION

WHAT IS CAS?



INTRODUCTION

WHAT IS CAS? • The Work Breakdown Structure (WBS)

The CAS system has been developed to answer the critical questions facing DOE. Using state-of-the-art hand-held computers and system software programs, the CAS process will establish a systemized, standard approach to facility and asset evaluations. This program will help DOE provide the necessary assets as it seeks to bring our nation's premier research and development agency into the year 2000 and beyond.

The condition assessment process involves evaluating separate building "systems" that comprise the entire facility. These systems traditionally fall under three broad professional disciplines: architectural (including structural), mechanical, and electrical. Specialty assessments (e.g. industrial hygiene, chemical engineering) are usually performed as adjuncts to these primary disciplines when required. The WBS employed under CAS is based on the 12 system assemblies that R.S. Means employs in its square foot cost analysis. Using this system as a foundation to define assemblies and components in the CAS Program will create a direct link to a broadly accepted industry-wide standard.

TABLE ONE

WORK BREAKDOWN STRUCTURE

SYSTEM (R.S. MEANS CAT.)	CONTROL NO.
FOUNDATIONS & FOOTINGS . .	0.01 SYSTEM
SUBSTRUCTURE	0.02 SYSTEM
SUPERSTRUCTURE..	0.03 SYSTEM
EXTERIOR CLOSURE	0.64 SYSTEM
ROOFING..	0.05 SYSTEM
INTERIOR FINISHES & CONSTRUCTION	0.66 SYSTEM
CONVEYING SYSTEMS	0.07 SYSTEM
MECHANICAL SYSTEMS..	0.08 SYSTEM
ELECTRICAL SYSTEMS	0.09 SYSTEM
● PROD/IAB/OTHER EQUIPMENT..	0.10 SYSTEM
SPECIALTY SYSTEMS..	0.11 SYSTEM
SITEWORK	0.12 SYSTEM

CONSTRUCTION SPECIFICATIONS

DIVISION (MASTERFORMAT)	DESCRIPTION
01000	.... GENERAL REQUIREMENTS
02000	.... SITEWORK
03000	.... CONCRETE
04000	.... MASONRY
05000	.... METALS
06000	.... WOOD & PLASTICS
07000	.... THERMA L & MOISTURE PROTECTION
08000	.... DOORS &WINDOWS
09000	.... FINISHES
10000	.... SPECIALTIES
11000	.... EQUIPMENT
12000	.... FURNISHINGS
13000	.... SPECIAL CONSTRUCTION
14000	.... CONVEYING SYSTEMS
15000	.... MECHANICAL
16000	.... ELECTRICAL

The WBS of the CAS Program will be linked to the MASTERFORMAT system developed by the Construction Specifications Institute (CSI) and used as the basis for the DOE Design Guide (DOE 6430.1A). These CSI numbers will be referenced after each system assembly and component in the CAS Manuals as follows:

EXAMPLE: Roofing (CSI 07000)

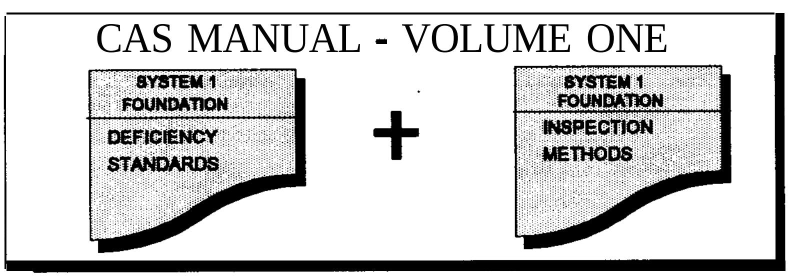
*NOTE: This section supersedes Means 0.10 category and includes FIS 700 Series Asset Codes.

INTRODUCTION

WHAT IS CAS?

DEFICIENCY STANDARDS & INSPECTION METHODS MANUAL

- DEVELOPED SEPARATELY FOR EACH SYSTEM
- DEFICIENCY STANDARDS CONTAIN NARRATIVE AND GRAPHICS FOR DESCRIBING DEFICIENCIES AFFECTING SYSTEM ASSEMBLIES
- INSPECTION METHODS CONTAIN PROCEDURES TO IDENTIFY TYPE, SEVERITY, AND PERCENT COVERAGE OF EACH COMPONENT OR SYSTEM DEFICIENCY ILLUSTRATED



INTRODUCTION

WHAT IS CAS? - DOE CAS Manual Format

Using these 12 systems as the basic organizing principal, the DOE CAS Manual will contain Deficiency Standards and Inspection Methods. It will be divided into 12 volumes corresponding to these established WBS systems. The internal organization of manuals is outlined below:

SECTION 1 - SYSTEM INFORMATION

1.1 Asset Determinant **Factor/CAS** Repair **Codes/CAS** Cost Factors - Discusses the Asset Determinant Factor (ADF), a decision matrix used to provide a graded approach to inspections commensurate with the use and relative importance of the asset inspected. Also addresses the CAS repair codes, and a general overview of cost estimating techniques.

1.2 Guide Sheet Tools **&** Materials **Listing** - Contains tools and materials groups used in conjunction with the inspection methods process for the system outlined in each volume.

1.3 Testing Methods - Contains the specific requirements for testing methods applicable to the systems.

1.4 Inspection Frequency - Schedule of CAS inspection frequencies for systems/components.

1.5 Standard System Design Life Tables - Standard design life tables for the system assemblies/components.

1.6 System Work Breakdown Structure **(WBS)** - Complete listing of all assemblies/components.

1.7 General System/Material Data - General material data relevant to system deficiency problems. (Optional, not included for all systems.)

SECTION 2 - DEFICIENCY STANDARDS

Each major assembly/component is defined by a brief narrative and accompanying graphic(s) that visually illustrate the general characteristics. Major deficiencies affecting this assembly/component are described, including probable failure points. A deficiency characteristics profile and graphic illustrations are provided with each deficiency defined.

SECTION 3 - INSPECTION METHODS

This section contains discussions of methods and procedures involved in inspecting each of the WBS systems. Each system contains an Inspection Method, including a narrative and a System/Component Inspection Guide Sheet Listing that provides a general overview for each defined major assembly/component type. This information will be developed for Standard and Non-Standard Inspections and testing methods that would be used in conjunction with Standard or Non-Standard Inspection Methods. Also included is a simulated example, ‘walking” the inspector through the data collection process.

SECTION 4 • REFERENCES

All major reference standards used and/or associated with the system are described, including government, industry, and DOE references.

APPENDICES

Appendix A Abbreviations - All abbreviated terms contained in the CAS manuals.

Appendix B Glossary - All technical terms directly related to the particular systems discussed will be defined in this subsection.

Appendix C Technical Bulletins/Updates/Advisories - This subsection contains technical information issued by the government and/or private industry that may affect specific data as developed in the particular volume. DOE guidelines may also be included in this subsection.

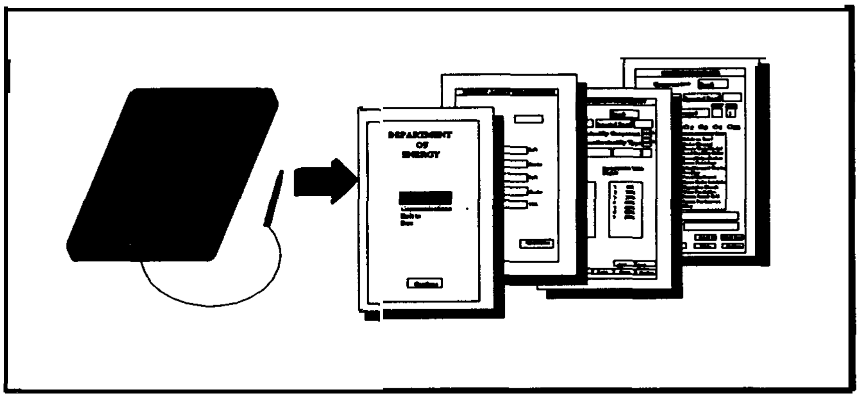
Appendix **D** Revisions Summary - All revisions listed in chronological sequence. The last revision listed will be the most current modification.

INTRODUCTION

WHAT IS CAS?

STATE-OF-THE-ART TECHNOLOGY **STREAMLINES** FIELD CONDITION ASSESSMENT SURVEY PROCESS

- HAND-HELD COMPUTER "PROMPTS" INSPECTOR WITH PRELOADED SOFTWARE SYSTEM "MENUS"
- INSPECTOR SELECTS DEFICIENCIES, SEVERITY, PERCENTAGE OF COVERAGE, LOCATION, ETC. FROM "MENU" SYSTEM



INTRODUCTION

WHAT IS CAS? - State-Of-The-Art Technology

At the outset of this introduction, we talked about a “new way” of seeing familiar things. The traditional methods of facility assessment inspection, using hard copy forms then entering data either by laptop or into a PC, have given way to a new, exciting technology: The Pen-Based Computer. This hardware, and the Condition Assessment Information System (CAIS) software developed to support it, form the heart of the DOE CAS data collection process. Using the CAS manuals as the basis to develop the inspection process, CAIS software will create pre-stocked survey “menus”. These will be used to record defined deficiencies in terms of severity and coverage. With this user-friendly device, inspectors will simply use a pen-like device to record their observations directly on the prompted inspection screens developed for each system.

The advantages in using this technology for the DOE CAS Program are exceptional. The efficiency gained by using the hand-held computer technology to prompt the inventory and facility inspection process will be significant. This eliminates the manhour-intensive and error-prone process of converting manually developed data into an automated database. This technology system ensures that all pertinent data is collected, guiding the inspector through each step of the process. This method will significantly enhance the effectiveness of quality assurance/quality control of the DOE CAS Program, permitting editing as data is entered, eliminating illogical or erroneous choices.

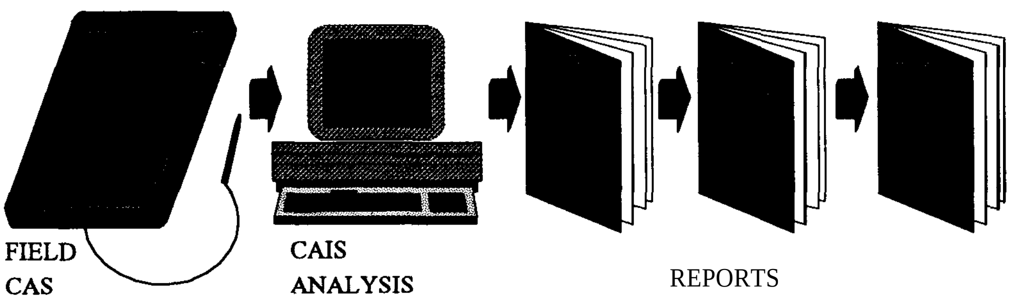
In short, the CAS process will be conducted in a carefully structured, “standardized” manner to ensure that the quality of raw inspection data is consistent throughout all DOE installations.

INTRODUCTION

WHAT IS CAS?

CAIS PROGRAM FOR HAND-HELD & PCs SUPPORT THE CAS PROGRAM

- INSPECTION DATA DOWNLOADED TO PC-BASED CAIS PROGRAM
- DATA ANALYZED, CATEGORIZED, AND SORTED
- REPORTS GENERALIZED, INCLUDING UNIVERSAL AND SUMMARY VERSIONS
- REPORTS WILL INCLUDE DEFICIENCY DESCRIPTIONS, COSTS TO REPAIR/REPLACE, AND SCHEDULE



INTRODUCTION

WHAT IS CAS? . The CAIS Connection

Asset condition information is uploaded directly to the PC and the CAIS program, eliminating the laborious hand input of data. If the hand-held is the "eyes and ears" of CAS, then the CAIS database is the "brain." In the program, raw data is sorted and analyzed to create CAS reports. Several key factors are determined during the process:

Deficiencies Affecting Survey Assets:

The inspector describes each deficiency noting its severity and coverage, i.e. how much of the component or assembly reflects the deficiency. The inspector also codes each component or assembly as to condition and the urgency and purpose of proposed repair or replacement actions.

Corrective Repairs:

Based on these recorded deficiencies, corrective actions and their associated repair codes are defined and processed by the CAIS database.

Project Costs:

Costs to accomplish repairs and replacements are generated by the manipulation of field data in the CAIS program, which employs several methods including determining cost as a percentage of total replacement and/or direct entry of costs. (See Section 1, Subsection 1.1 for discussion of cost development.)

Asset **Reports:**

Preformatted reports and tables are generated by the CAIS System. Report types include "universal" reports listing all deficiencies and observations recorded by the Inspector, summary asset reports, and summary site reports. Data within the CAIS system can also be manipulated readily to create "custom" reports.

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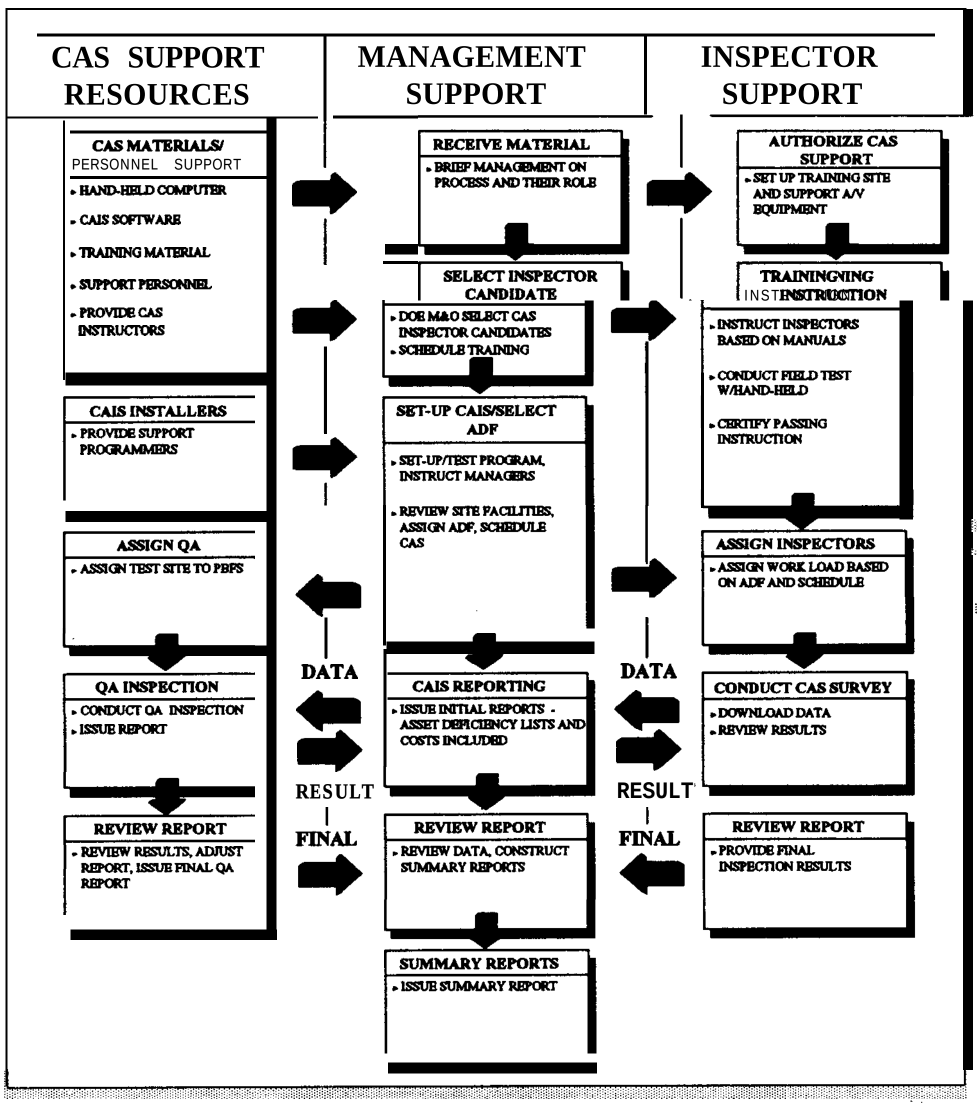
HOW IS CAS IMPLEMENTED?



INTRODUCTION

HOW IS CAS IMPLEMENTED? - Support Roles

While CAS manuals, hardware and the CAIS database are the main building blocks of the CAS Program, CAS support personnel will form the standing framework. Your role in the implementation process is crucial if the CAS system is to succeed. In reviewing this process, three key support groups are highlighted.

CAS Contractor Support Personnel:

In conjunction with DOE managers and Site Management & Operations (M&O) contractors, CAS contractor support personnel will work closely with DOE in setting up and conducting the training program, installing CAIS, and validating CAS through a Quality Assurance (QA) program. This team of CAS trainers, CAIS programmers, and QA engineers and architects will form, along with DOE M&O personnel, the strong team required to support the CAS Program as it proceeds.

Manager **Support:**

No group is more important in implementing CAS than the DOE managers and M&O contractors. Their in-depth knowledge of the sites and their personnel will help guide and strengthen the entire CAS system.

CAS Inspectors:

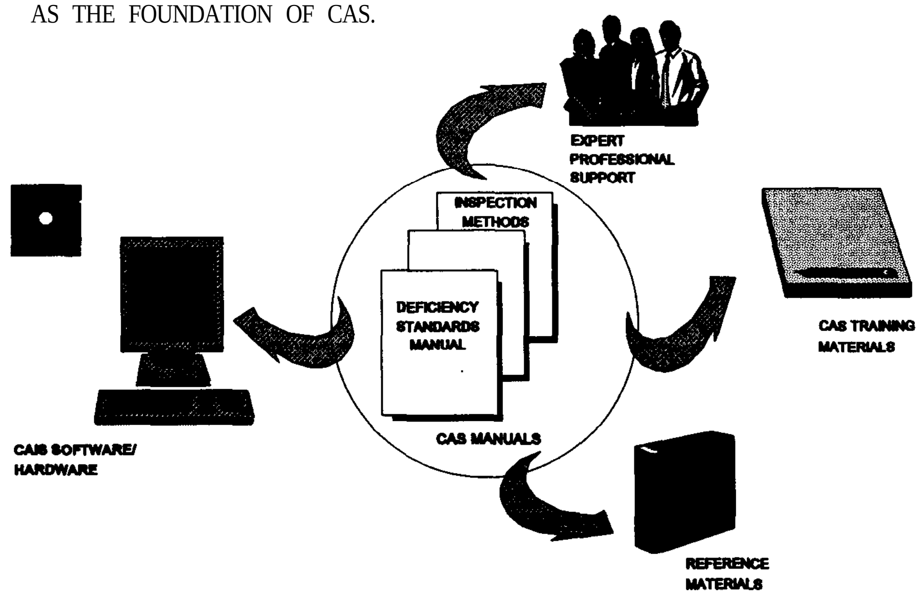
Without highly skilled, knowledgeable inspectors, the CAS Program will not succeed. The integrity of these inspectors and their expertise will ensure that the base data supporting the entire CAS process will be an accurate reflection of the condition of the DOE inventory of facilities and assets.

INTRODUCTION

HOW IS CAS IMPLEMENTED?

CAS SUPPORT RESOURCES

- DEFICIENCY STANDARDS AND INSPECTION METHODS MANUALS SERVE AS THE FOUNDATION OF CAS.



INTRODUCTION

HOW IS CAS IMPLEMENTED? - CAS **Support** Resources

We have spoken generally of the CAS Process and those resources (manuals, hardware, CAIS software) required to implement the system. Additionally, the CAS contractor will supply all of the technical personnel to support, implement, and guide the CAS Program. Among those key professionals are:

CAS Training Instructors:

Professionals with a technical background and well-versed in training methods, will train CAS inspector candidates. Their mission will be to instruct and guide CAS inspector candidates through the entire process, supervise field exercises, and provide final testing. Their goal is that all candidates will be successful participants in the CAS Inspection process.

CAIS Programmers:

A key CAS Program element is the CAIS. Expert programmers will supervise the installation of the PC-based program and provide guidance and instruction for DOE M&O managers in using the system.

CAS/CAIS Hotline:

The Contractor will provide support resources in order to field questions from various site locations. Expert engineers, architects, and computer programmers will answer with written and/or verbal responses all inquiries originating from the field.

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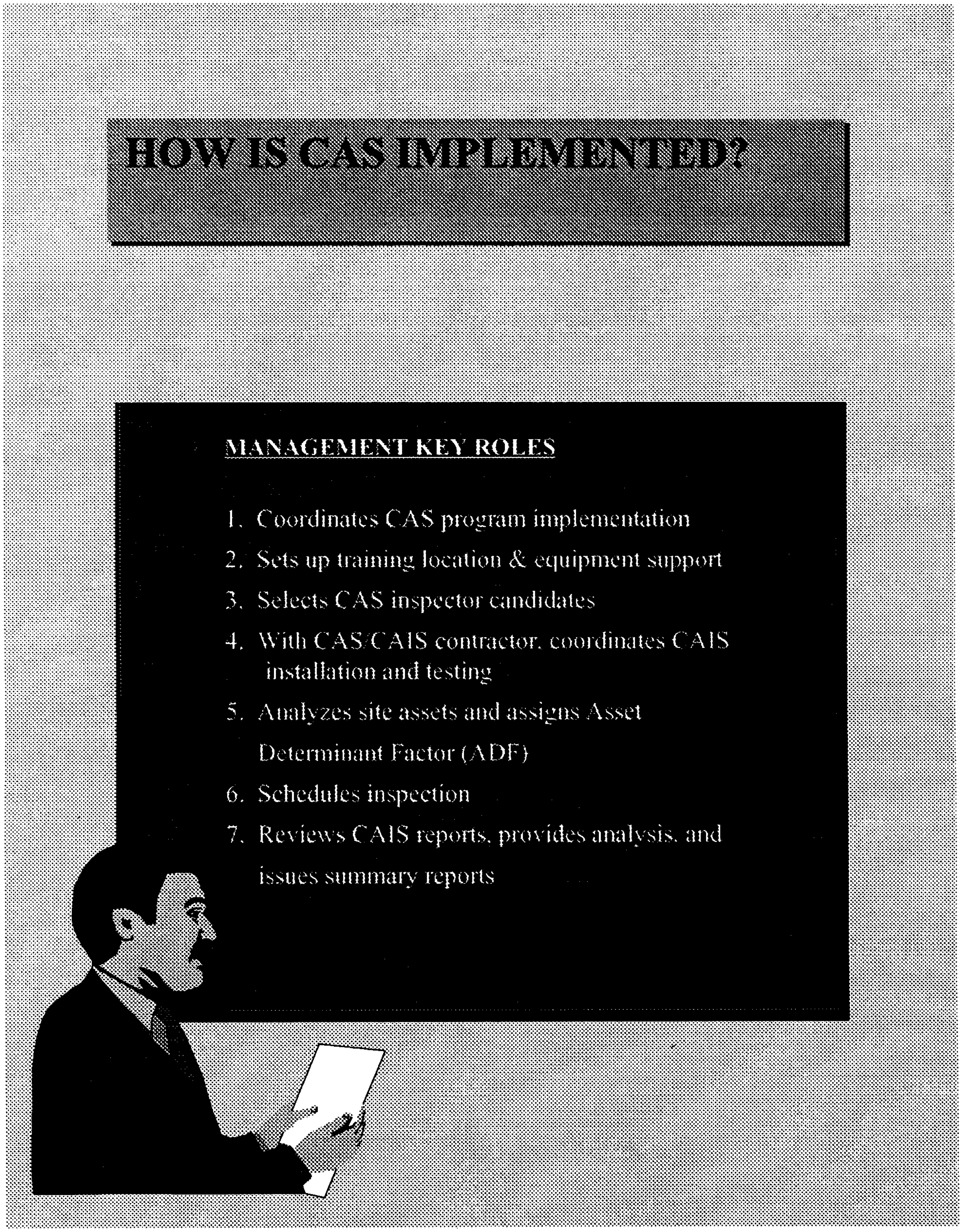


INTRODUCTION

HOW IS CAS IMPLEMENTED? - The Management Role

The critical role DOE M&O managers will play in the CAS process cannot be overstated. Their understanding and direct input will guide the construction of the CAS Program. Their chief responsibilities are:

Initial **Implementation:**

CAS start-up will include a general briefing by the CAS contractor at designated sites to instruct all key managers in the process and their responsibilities. DOE M&O management actions include training site set-up (to hold maximum of 25 students), arrangements for required A/V equipment (overheads, slide projectors, etc.), and CAS inspector candidate selection (see Guidelines for Implementation of CAS Certification Training under separate cover).

Setting Up **CAIS:**

In conjunction with CAIS programmers, DOE M&O managers will be instructed in the function and various uses of CAIS software. Data input, system operation, report generation with predetermined report format, and how data can be manipulated to customize reports, will be examined during this training.

ADF Selection & CAS Schedule:

A vital element of the CAS Program is the development of a CAS “strategy.” DOE M&O managers will be instructed in the use of the Asset Determinant Factor (ADF) to sort site assets into varied inspection effort levels. See Section 1, Subsection 1.1 Asset Determinant Factor (ADF), CAS Repair Codes, and CAS Cost Factors. The ADF will guide the DOE M&O managers in scheduling the survey and assigning CAS Inspectors to various assets.

Report Analysis:

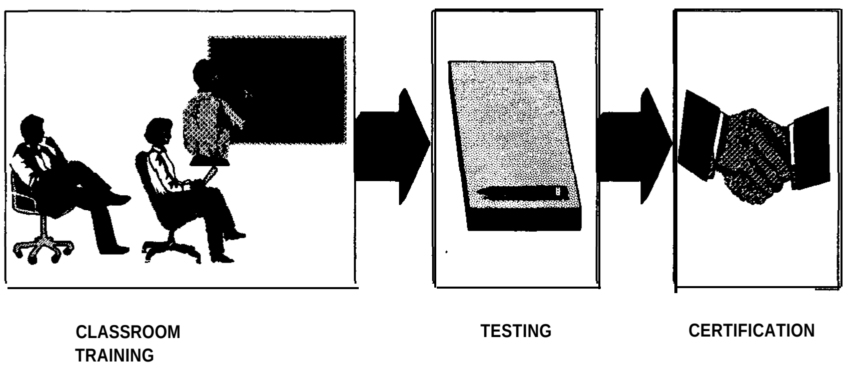
The process of up-loading CAS field data to the PC-based CAIS program will be demonstrated to the M&O CAS managers. Analysis processes will be examined using predetermined, formatted reports. Final management project “sorts” and prioritization schemes, and construction of summary reports for higher authorities, will comprise the basic CAS report development sequence.

INTRODUCTION

HOW IS CAS IMPLEMENTED?

CAS INSPECTOR CERTIFICATION

- INSPECTOR CANDIDATES ARE TWINED, TESTED, AND CERTIFIED USING THE CAS PROGRAM



INTRODUCTION

HOW IS CAS IMPLEMENTED? CAS **Inspector** Certification

While the CAS manuals, hand-held computer, and CAIS software program are the tools of the CAS system, the CAS Inspector is the system "operator." The old adage, "The data output is only as good as the data input," truly applies to the inspectors' role in the CAS process. As part of the effort to assure accurate, consistent results, the CAS Program includes an Inspector training phase that will "certify" all candidates in the use of the CAS system. It should be noted that it is <u>not</u> the training course's intent to train personnel to be inspectors: it is assumed that candidates will come to the CAS Program with a strong background and past experience in the disciplines they will inspect (see Guidelines for Implementation of CAS Certification Training (GICT) under separate cover for detailed information). Key phases of the course include:

Prequalification:

Based on experience levels set by GICT, candidates are selected by the M&O contractors and sent to the CAS training program.

Classroom Training:

Classroom instruction will be conducted at the sites selected by DOE. Course materials, based on the Deficiency Standards and Inspection Methods sections in the manuals, will clearly demonstrate the nature of the CAS system and how it is to be used. Hand-held computers will be used during the course. At course conclusion, these units will be turned over to the inspectors for use in the CAS Program and become the property of the site that the inspectors represent.

Field Exercise:

During the training course, a field exercise using the hand-held will be conducted at a predetermined test asset. This survey and its results will be an integral part of the inspection education program.

Certification Test:

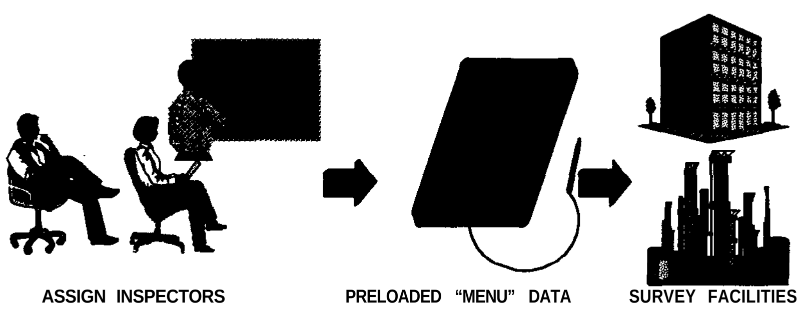
At the completion of the CAS training, each candidate is required to take and pass a written examination based on the material covered in the class. It is the goal of the training team to pass 100% of the candidates. Those having difficulty will receive additional instructor attention during the class as required. After passing this examination, candidates will be fully certified CAS Inspectors.

INTRODUCTION

HOW IS CAS IMPLEMENTED?

THE SURVEY PROCESS

- CERTIFIED CAS MSPECTORS FOR EACH MAJOR DISCIPLINE ARE ASSIGNED FACILITY ASSETS TO INSPECT
- PRE-LOADED SURVEY ROUTINES FOR EACH SYSTEM ARE PROVIDED THROUGH HAND-HELD COMPUTER CAS SOFTWARE PROGRAM



INTRODUCTION

HOW IS CAS IMPLEMENTED? - The Survey Process

At the completion of CAS training and upon the M&O managers' ADF asset selection and development of survey schedules, certified CAS inspectors will be assigned assets to inspect. This step initiates the CAS process, which will involve several major phases.

Start-up:

The objective during start-up is to prepare a profile information file for the asset being surveyed and to verify preloaded information (RPIS data, name, and address, etc.). Such a review might include part and/or all of the material listed below:

- As-built and/or construction documents
- Square footage, type of construction, and age of each building
- Existing studies, surveys, and reports; and
- Existing repair, alteration, or construction projects

Conduct CAS Inspection/Evaluation:

With the benefit of the information contained in the asset file, the CAS Inspector will perform a thorough evaluation of the WBS systems required for each of the assigned assets. The Inspector will initially review the asset file to note particular problems. With this accomplished, the CAS Inspector will methodically survey each of his assets and record deficiencies (in terms of severity and coverage) and other observations on the preprogrammed hand-held computer. He accomplishes this data recording through "menu" screens contained in the CAS hand-held computer software, which will guide the CAS Inspector through the process (see Section 3 for full detailed information outlining step-by-step the CAS inspection process).

CAS **Report** Generated by CAIS:

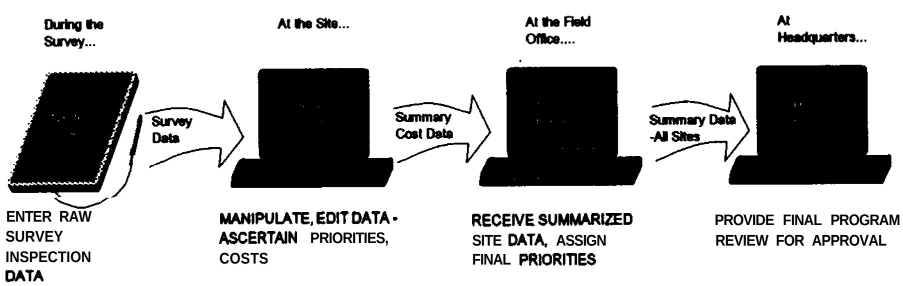
After completing the CAS Inspection, information is uploaded to the PC-based CAIS system. "Universal" reports showing all asset deficiencies, observations, associated cost, scheduling priorities, and repair purposes will be produced. As part of the QA, the Inspector will review this information with the manager to ensure that all aspects of the inspection asset information are correct.

INTRODUCTION

HOW IS CAS IMPLEMENTED?

SUMMARY REPORTS

- IMPROVE ACCURACY AND PROVIDE QA FQR ALL SITE INSPECTION DATA
- FINAL REVIEW OF PRELIMINARY REPORTS BY THE MANAGERS TO "PRIORITIZE" REPAIR/REPLACEMENT REQUIREMENTS FROM ASSET TO ASSET
- ISSUE SUMMARY RESULTS WITH FULL BACK-UP AT SITE



INTRODUCTION

HOW IS CAS IMPLEMENTED? - Report Development

With the completion of the CAS inspector's survey, data uploaded into the PC-based CAIS program is analyzed to provide the survey reports. The primary preformatted reports include:

'Universal' Report:

This document contains all the information recorded concerning deficiencies found in the WBS systems surveyed in each asset. The report lists all deficiencies and observations system by system. The summary section provides the cost of repairing surveyed asset deficiencies and repair codes showing condition, purpose, and urgency. Costs are calculated in CAIS based on deficiencies noted. Inspectors can also directly input repair costs either as a percentage of replacement costs or as an absolute dollar value.

Asset **Summary** Report:

This report contains summary asset deficiency data at the WBS system level only. The report lists deficiency/corrective repair action by codes (see Subsection 1 .1 for more information). All assets surveyed by the Inspector will be listed here. Manager input to these reports includes resorting the priority list (including additions and/or deletions) and recommendations.

Site Asset Summary Report:

After all inspector surveys have been processed, analyzed, and final recommendations input by the manager, this preliminary site-wide report lists all assets included and preliminary manager sorts (Asset Summary Report). Manager input includes selecting of final projects recommended for the budget cycle, including cost and priority schedules.

Site Summary Report:

This report, issued to DOE Headquarters, contains a site project summary and synopsis of back-up data. This report will serve as the basis for establishing the site maintenance and repair backlog which in turn supports funding recommendations to OMB and Congress.

OTHER REPORTS

QA Report:

As part of the QA process, the contractor QA team will randomly select assets inspected by site CAS Inspectors. Results will be analyzed to determine both accuracy and content of the CAS Program to ensure the validity of CAS procedures.

Custom Reports:

Data within the CAS/CAIS database can be manipulated to create various reports. Examples might include a report showing all site roofs, cost magnitude, and/or by building type.

INTRODUCTION

CAS SUMMARY

- STANDARD APPROACH TO CONDITION ASSESSMENT
- EASE/ACCURACY OF DATA COLLECTION
- SITE-CONTROLLED DATABASE
- SUMMARY DATA TO FIELD OPERATIONS & HQ LEVELS
- MORE CREDIBLE DOE BUDGET SUBMISSIONS

INTRODUCTION

THE CAS SYSTEM: - A Summary

In summary, the CAS System has been designed to support the vital process of creating a facility condition baseline that is founded on recognized, fully defined Standards. This established baseline will determine the direction and cost of future assets required to define the DOE's changing mission against a background of government fiscal constraint. As you have seen, your role in this overall program is vital if the CAS framework is to be created and supported. The CAS System is your tool for .constructing the essential, realistic requirements needed to obtain budgetary funding. Obtaining these funds is the final measure of whether a site program will move forward or be eliminated.

We began this introduction by promising you a "new way" of seeing familiar things. The CAS Program's combination of state-of-the-art technology and the DOE M&O's talented professionals will be the essential mix to successfully initiate and sustain the CAS process.

INTRODUCTION

END OF SUBSECTION

ASSET DETERMINANT FACTOR/CAS REPAIR CODES/CAS COST FACTORS

GENERAL

The CAS Program is built on the physical analysis of each asset through the inspection of the major systems as defined by the WBS. System-specific deficiencies (as defined for each assembly/component in the Deficiency Standards section of this Manual) and the extent of their severity "bracket" the general asset conditions as of the inspection date. Recording actual deficiencies, however, is only part of the process. The CAS process also documents the urgency and purpose of repairs or replacements as well as the overall condition of the assembly/component surveyed.

The following elements are important parts of the CAS process and will be discussed in detail in this subsection:

- ASSET DETERMINANT FACTOR (ADF): Discusses various possible levels of CAS inspections, and the manager's role in determining the type survey appropriate for each asset.
- CAS REPAIR CODES: Describes categories used by the inspector to document the urgency and purpose of repairs and replacements, and the general condition of the assembly/-component.
- CAS COST FACTORS: The general overview of CAS cost development and the factors used to build project costs are outlined in this section.

CAIS Interface:

As outlined in the Introduction "A CAS Program Overview," the Condition Assessment Information System (CAIS) is a key element. CAIS software will provide critical data analyses required to process CAS raw field data, including repair codes and costing factors for recorded facility asset conditions. The CAS Manuals, the hand-held data collection device and software, and the CAIS Program together form the foundation of the CAS process.

In DOE's vast inventory, asset conditions vary widely in terms of age and use, new or renovated facilities are mixed with assets built during the 1940s and 1950s. It is therefore recognized that not all assets at a given site require the full CAS inspection. The ADF has been developed as a tool that provides site facility managers with a means to categorize each site asset by identifying the type of survey to conduct.

CAS Survey Levels:

For the purposes of allowing flexible CAS Program implementation, three broad categories of asset inspections are defined:

- CAS - Base Level: Assessment is primarily a visual inspection (augmented in some instances by simple testing; eg., light level measured by light meter) recorded at the assembly level of the Work Breakdown Structure (WBS). Deficiencies typical to each assembly are recorded in terms of severity and coverage.
- CAS - Component Level: Provides more extensive inspection information based on conducting the assessment at a component level. Components are defined as major parts of an assembly.
- CAS - Limited: Survey not requiring assessments of all systems for a given asset.

ASSET DETERMINANT FACTOR/CAS REPAIR CODES/CAS COST FACTORS

ASSET DETERMINANT FACTOR (ADF)

Ten key categories to be used as ADF guidelines are illustrated below. These classifications are sensitive to key DOE criteria, including short-term and mothballed facilities.

ADF#	Guidance	Description	Systems
1	Existing asset (>3 years), program projected to last 5 years	Full CAS Inspection (base CAS - assembly level or optional component level)[1]	ALL
2	Existing temporary asset (>3 years) program projected to last <5 years	Limited CAS Inspection (base CAS - assembly level only)	ALL
3	Asset decommissioned - "warm mothball" (maintained for future unidentified function)	ARCH(ext), MECH & ELEC (base CAS - assembly level or optional component level)[1]	0.04, 0.05, 0.08, 0.09
4	Asset decommissioned - "cold mothball" (to be removed, dismantled, destroyed at some future date)	Exterior envelope (base CAS - assembly level only)	0.04, 0.05
5	Asset ROOF inspection only	ROOF inspection (base CAS - assembly level or optional component level)[1]	0.05
6	Asset ARCHITECTURAL only	ARCH/STRUCTURAL inspection (base CAS - assembly level or optional component level)[1]	0.01, 0.02, 0.03, 0.04, 0.05, 0.06, and 0.11
7	Asset MECHANICAL only	MECHANICAL inspection (base CAS - assembly level or optional component level including incidental electrical)'	0.07, 0.08
8	Asset ELECTRICAL only	ELECTRICAL inspection (base CAS - assembly level or optional component level)[1]	0.09
9	Asset SITE inspection only	SITE inspection (base CAS - assembly or optional component level) [1]	0.12
10	As developed by each site	As constructed by site[2]	As Reauired

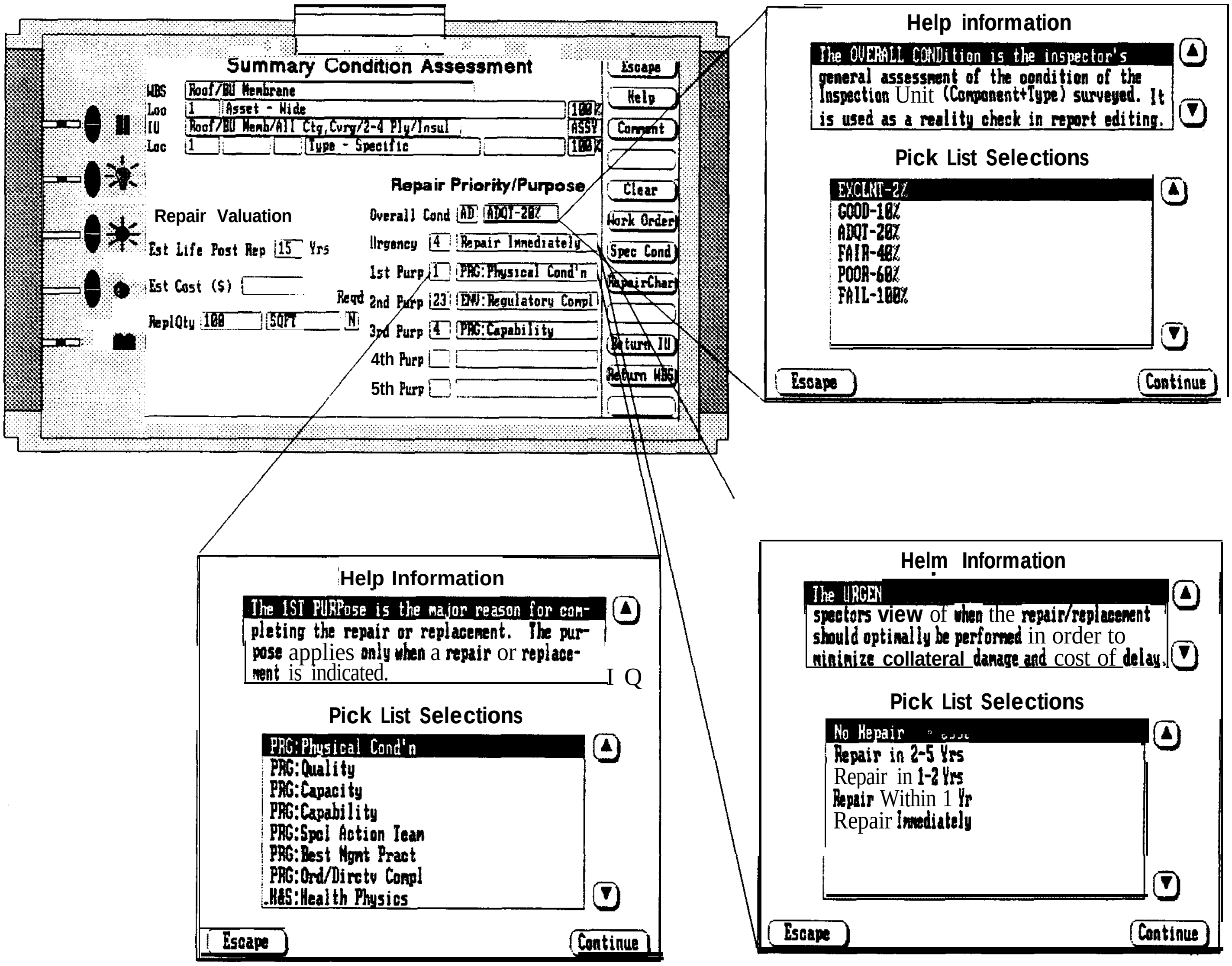
GENERAL NOTES:
1. Survey may combine levels (eg., ADF #1, Systems 0.01-0.06, 0.11, and 0.12 Assembly level survey; 0.07, 0.08, and 0.09 Component level survey.)
2. Other surveys may be structured on an as-required by sites.
3. ADF values are auidelines onlv and svstems mav be added to base ADF values as required.

ASSET DETERMINANT **FACTOR/CAS** REPAIR **CODES/CAS** COST FACTORS

ASSET DETERMINANT FACTOR (ADF) (Continued)

ADF #	Definition
1	Assets within this factor represent "typical" DOE facility assets. These assets are over three years old and serve current programs projected to last over five years. A full CAS inspection at the assembly level is required. Component level CAS may be conducted as resources permit.
2	For temporary facilities supporting short-term programs (less than five years), a limited CAS inspection at assembly level involving systems 0.05 Roofing, 0.07 Conveying, 0.08 Mechanical, and 0.09 Electrical is recommended.
3	For currently unused assets that will be considered for future program development. In this case, only exterior envelope and interior mechanical and electrical systems are assessed at the assembly level.
4	For facilities deemed unfit for future use, a limited CAS inspection is recommended. This would involve exterior envelope only to ensure that asset will not deteriorate prior to scheduled decommission and disposal action (eg., destroy, dismantle).
5	Covers circumstances when only a roof inspection is required.
6	For assets requiring architectural survey only, including 0.01 Foundations and Footings, 0.02 Substructure, 0.03 Superstructure, 0.04 Exterior Closure, 0.05 Roofing, and 0.06 Interior Finishes and Construction, and 0.11 Specialty Systems.
7	For assets requiring mechanical survey only, including 0.07 Conveying, and 0.08 Mechanical.
8	For assets requiring electrical survey only, 0.09 Electrical.
9	General site survey system 0.12 Site Systems only.
10	This factor allows sites to build their own inspection. These will be reviewed by Headquarters for possible addition to the ADF Guidelines.

CAS REPAIR CODES



Refer to the following page for definitions of the three (3) major CAS Repair Codes.

ASSET DETERMINANT FACTOR/CAS REPAIR CODES/CAS COST FACTORS

CAS REPAIR CODES

One of the key aspects of the assessment process, once significant deficiencies are recorded, is determining the repair category. CAS defines three major repair codes: condition, purpose, and urgency. Condition is derived both by the CAIS algorithm based on raw deficiency data and by the inspector's subjective judgment. Purpose and urgency are each selected by the inspector. Definitions for each major code are listed as follows:

(CAS **Repair Codes** are **guidelines** only. Codes may vary as required by sites.)

CONDITION CODE	DEFINITION
A	Excellent: Performs to original specifications as measured using non-standard tests; easily restorable to 'like new' condition; only minimal routine maintenance required at cost <2% of replacement value.
B	**Good:** Performs to original specifications as measured using historical data and non-standard tests; routine maintenance or minor repair required at cost <5% of replacement value.
C	**Adequate:** Performance meets requirements; some corrective repair and/or preventive maintenance required at cost <10% of replacement value.
D	Fair: Performance fails to meet code or functional requirement in some cases; failure(s) are inconvenient; extensive corrective maintenance and repair required at cost <25% of replacement value.
E	Poor: Consistent substandard performance; failures are disruptive and costly; fails most code and functional requirements; requires constant attention, renovation, or replacement. Major corrective repair or overhaul required at cost <60% of replacement value.
F	Fail: Non-operational or significantly substandard performance. Replacement required because repair cost is >60% of replacement cost.

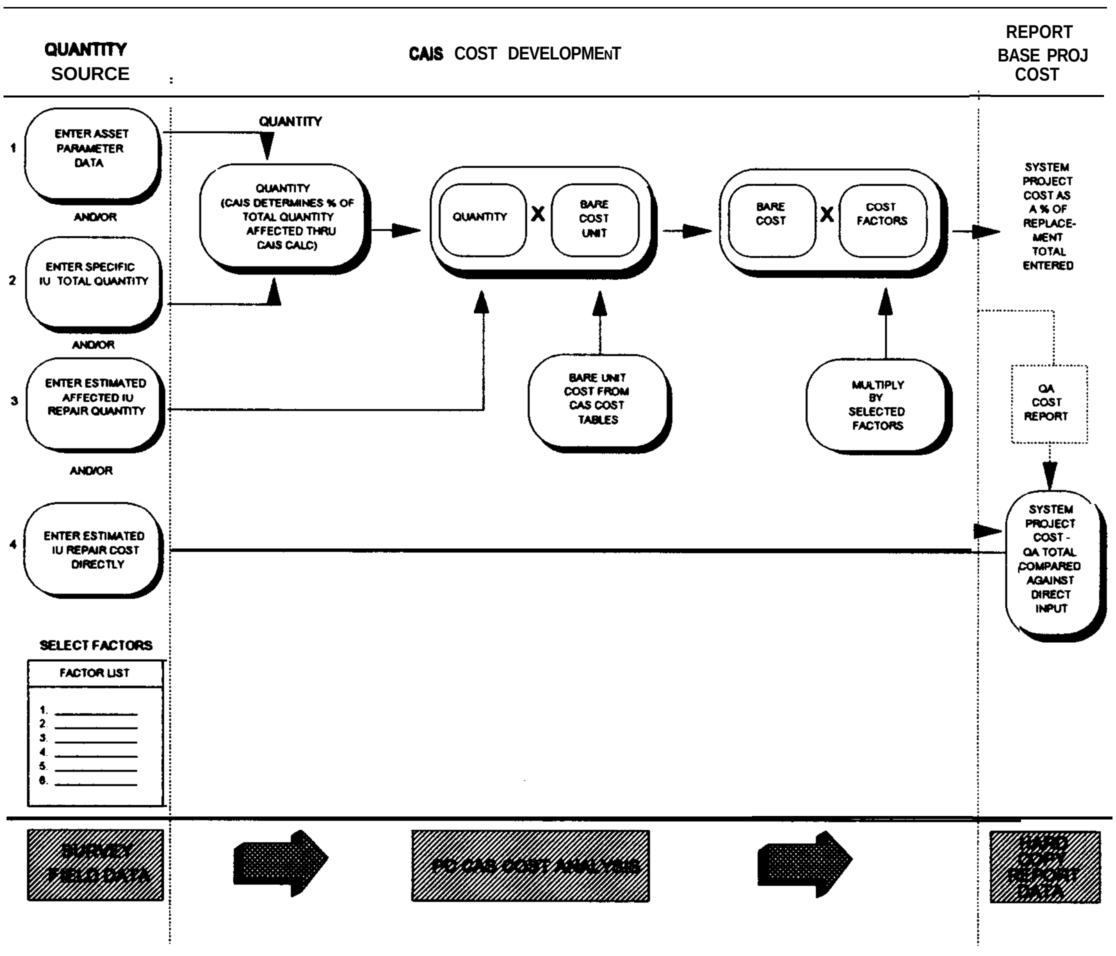
PURPOSE CODE*	DEFINITION
P2	PRG: Capacity
H2	H&S: Industrial Safety
E2	ENV: Solid Waste Management
S4	S&S: Security
•	Partial list based on CAMP Order DOE 4330.4A dated 10-17-90.

URGENCY CODE	**DEFINITION**
1	Repair Immediately: Asset condition critical; initiate corrective action immediately.
2	Repair within 1 Year: Asset condition serious: initiate corrective action within 1 year.
3	Repair in 1 to 2 Years: Asset condition degraded; initiate repair in 1 - 2 years.
4	Repair in 3 to 5 Years: Asset stable for period: integrate repairs into appropriate schedules.
5	No Repairs Necessary: Continue life cycle maintenance actions.

ASSET DETERMINANT FACTOR/CAS REPAIR CODES/CAS COST FACTORS

The following illustrates the cost development process for the Department of Energy CAS/CAIS Project and the various processes involved.

COST DEVELOPMENT PROCESS



END OF SUBSECTION

GUIDE SHEET TOOL & MATERIAL LISTING

SAFETY REQUIREMENTS

GENERAL

Inspections shall comply with all Federal, State and Local regulations and all applicable safety and health regulations or requirements (including reporting requirements) of DOE.

TOOLS

This subsection contains tool and material listings for use in standard and non-standard electrical inspections in addition to the basic tool group outlined below.

Accomplishing the activities identified in the maintenance and inspection guides requires tools: basic, craft (standard), and specialized (non-standard). Specialized tools included in the non-standard tool group consist of special instruments and unique tools and are identified in the guides.

All crafts involved in inspection and electrical maintenance systems employ a standard or basic tool set. This basic tool set may vary somewhat between equally qualified personnel; however, the following is a representative set of common basic tools.

BASIC TOOL GROUP

- Ammeter, Clamp-on, O-l 00 A Scale
- Goggles
- Hard Hat
- Hearing Protection
- Infrared Camera
- Infrared Thermometer
- Light, Portable, Battery Operated
- Other Tools and Materials
- Screwdriver(s), Phillips & Slotted Head
- StaticScope, 5000 Volt
- Tape, Measuring, Non-metallic, 10 feet
- Vibration/Noise Analyzer
- Volt-Ohm-Ampere Meter, Pocket Size, Analog or Digital
- Wrench, Adjustable, 10 inches

NOTE: It is not the intent of this manual to have sites perform non-standard tests. These guidelines may be used in the event standard inspection is not sufficient to determine system condition. Such non-standard inspections will be provided by others (e.g., consultants, outside labs).

GUIDE SHEET TOOL & MATERIAL LISTING

GENERAL

This section identifies the tools and materials normally available to an inspector to accomplish a system survey. These tools must be augmented to reflect the facility being surveyed, the inspector's instructions, and other on-going activities. Those tools required to accomplish Non-Standard inspections are normally part of the equipment available to the maintenance staff and are not identified in this section. The Guide Sheet(s) may identify selected major items of equipment.

NON-STANDARD INSPECTIONS

Non-Standard Inspection methods are invasive visual observations often coupled with tear-down analysis of the system and/or component. Given this invasive and possibly destructive analysis, selected test equipment and supplies and materials are required. Selected items are identified in the following lists and on the appropriate non-standard method Guide Sheet; however, if the identified test set or specific item of test equipment is not available, laboratory standard meters may be configured to acquire acceptable values.

NON-STANDARD INSPECTION TOOL GROUP

- Adjustable wrench set
- Allen wrench set
- Cleaning materials
- Electrical Insulation materials
- Electrician's knife
- Extension cord
- File
- Flashlight
- Hack saw with blade assortment
- Hammer, ball peen
- Locks
- Measuring tape, non-metallic
- Pipe wrench
- Pliers, vise grip
- Pliers, slip joint
- Pliers, lineman
- Portable light
- Screwdrivers, Phillips & Slotted Head
- Socket set, 3/8 inch with ratchet
- Tags, caution and hold
- Wrench set, open end
- Wrench set, box end

NON-STANDARD TEST EQUIPMENT

- Ammeter, precision
- Borescope
- Circuit breaker test set
- Constant current test set
- Constant Voltage test set
- Contact resistance test set
- Current transformer, laboratory standard
- Eddy current test set
- Gas analyzer
- Ground resistance test set
- Growler
- High-potential test set
- High-Voltage, live line, rubber gear
- High-Voltage sticks
- Industrial analyzer
- Insulation materials
- MegOhmmeter
- MicroAmmeter, precision
- Micrometers
- MilliAmmeter, precision
- MilliVoltmeter, precision
- Oil analyzer
- Oscilloscope
- Potential transformer, laboratory standard
- Power Factor meter
- Protective relay test set
- Protective relay tool set
- Recorder: time, Voltage, and Ampere
- Sample bottles and thief
- Slings
- Statiscope
- Thermometer, precision
- Timer, electric
- Turns ratio test set
- Vibration analyzer
- Voltmeter, precision
- Watt-hour meter, standard
- Wattmeter

END OF SUBSECTION

NOTE: Size and power requirements of some of these items may be such that the item to be tested is removed to some central facility in lieu of moving test equipment from site to site.

TESTING METHODS

GENERAL

The testing method associated with the Standard facility Inspection is visual, with possible limited voltage and current measurements using small hand-held devices. The inspector in a standard method survey will not normally interrupt or deenergize an electrical circuit to accomplish specific tests or analysis. Any test that requires the circuit to be deenergized and/or opened is considered non-standard and should be accomplished as part of a scheduled outage. In addition to visual examinations by the inspector, non-contact examinations as described in standard test methods in following pages may be used.

During the course of the Condition Assessment Survey, various tests will be employed to better ascertain the condition of the assets. These are indicated on the Component Specific Guide Sheets included in Section 3 of this Manual.

Testing methods do not specify the following:

- Expertise of user (to use the instrument or interpret results).
- The advantage of one testing method versus another.
- The limitations of the testing method.
- Whether the user must be trained and licensed to operate (such as the Nuclear Moisture Meter Test, which requires licensing).

Standard vs Non-Standard

Inspection Methods are classified as Standard or Non-Standard based on techniques employed.

Standard Methods are generally quick, visual, hands-off walk-throughs not requiring a component to be taken out of service. Few tests are required in the associated Guide Sheets. Where tests are indicated, they are non-invasive. Examples include vibration analysis and thermographic observations.

Non-Standard Methods are generally those that require a component to be taken out of service to allow internal inspections or variations in operation not allowed while in service. Examples include insulation resistance tests and rotating machinery tests.

The testing methods associated with the Non-Standard facility Inspection go beyond the visual and non-contact process and involve invasive and possible destructive testing procedures. Given the invasive nature, the non-standard survey should be accomplished in conjunction with scheduled maintenance to ensure that the system is fully serviceable and operable on completion of the survey. Specific non-standard tests are described in NFPA 70B. A description of some of the testing methods for electrical systems are provided on the following pages.

Some tests could be conducted as part of either type inspection. For discussion purposes, they will be classified according to their "out-of-service" requirements; i.e., if a test can be conducted while equipment is in service, it will be listed under Standard Test Methods.

STANDARD TEST METHODS

- Infrared
- Noise
- Stroboscopes
- Thermography
- Vibration Analysis

NOTE: It is not the intent of this manual to have sites perform non-standard tests. These guidelines may be used in the event standard inspection is not sufficient to determine system condition. Such non-standard inspections will be provided by others (e.g., consultants, outside labs).

TESTING METHODS

STANDARD TEST DESCRIPTION

infrared

A process in which the temperature of a device is derived based on the remote sensing of infrared radiation.

Noise

The measurement of the noise level and frequency emitted from a piece of operating equipment. The noise level and frequency contain information that may refine survey data.

Stroboscopes

By varying the illumination frequency on an object in motion, it is possible to produce a freeze-frame or slow-motion image of the object. Application allows inspection of operating equipment showing leakage, distortion, vibration, etc. that would not be evident during shutdown. This can also be used to determine equipment rotating speed.

Thermography

Thermal radiation is emitted by all bodies in proportion to the temperature of the body. This radiation can be filtered with optical lenses to allow discrimination by the human eye. It can also be focused on sensors and processed to provide temperature readouts and/or graphical displays of temperature distribution. It is more commonly used to produce energy loss profiles of structures, ascertain water leakage in roofing, and identify overheated connections in electrical distribution systems.

Vlbration Analysis

Probes in contact with or transducers mounted on operating equipment can sense motion (vibration) in terms of displacement, velocity, and acceleration. Instrumentation can convert these signals into digital/analog readouts and graphical displays of signal strength (amplitude) at various frequencies. By measuring and recording these parameters at key points on equipment, a signature can be developed. Periodic monitoring will allow changes (trends) and rates of change in the signature to be identified. Worn or broken parts will change the vibration signature frequency. These techniques can be used as precursors to equipment failures and predictors of remaining useful life.

NON-STANDARD TEST METHODS

- Circuit Breaker Time Travel Analysis Test
- Contact Resistance Test
- Dielectric Absorption Test
- Equipment Ground Impedance Test
- Fault Gas Analysis Test
- Grounded Conductor Neutral Test
- Grounding Electrode Resistance Test
- High Potential Test
- Insulating Liquid Analysis Test
- Insulation Power Factor Test
- Insulation-Resistance Test
- Polarization Index Test
- Protective Device Test
- Rotating Machinery Tests
- Transformer Polarity Test
- Transformer Turns Ratio Test
- Vibration Test or Vibration Analysis

NON-STANDARD TEST DESCRIPTION

Circuit Breaker Time Travel Analysis Test

This test is employed only on medium- and high-Voltage circuit breakers and measures the effectiveness of breaker operation. This test will produce a graphical display of the breaker contacts versus time.

TESTING METHODS

NON-STANDARD TEST DESCRIPTION (Continued)

Contact Resistance lest

This test determines the resistance in the contacts of a switch or circuit breaker. It is normally accomplished using a special instrument capable of measuring resistances of 10 microOhms or less. The test may be accomplished using ammeters and Voltmeters if these devices are of sufficient accuracy. Contact resistance should be kept as low as possible to minimize heating damage to the contacts.

Dielectric Absorption lest

Dielectric absorption testing is similar to insulation resistance testing except that much higher Voltages are used in the test process. It is not unusual to have Voltages in excess of 100,000 Volts. Unlike the insulation resistance test, this test is independent of insulation temperature and volume.

Equipment Ground Impedance Test

This test is accomplished to determine the integrity of the grounding path from the point of test back to the source point. This test is very important to ensure personnel safety and to improve power sources to microprocessor equipment.

Fault Gas **Analysis** lest

An analysis of the gases present in the nitrogen filled cap of sealed pressurized oil-filled transformers can provide potential failure information. Decomposition occurs when arcing occurs in the oil. Some decomposition products appear as combustible gases, which rise to the top of the transformer.

Grounded Conductor Impedance lest

This test determines the quality of the grounded conductor (neutral) from the point of test back to the source. A low impedance neutral is necessary to reduce interference to microprocessors and other similar devices from harmonic currents. Equipment used to conduct equipment ground impedance tests are often used to conduct this test.

Grounding Electrode Resistance Test

This test determines the effectiveness of the grounding system, and is usually performed to validate the effectiveness of a made grounding system using driven ground rods. The test is performed periodically because soil conditions change and may increase ground resistance to a point where personnel and equipment are in jeopardy.

High Potential Test

A high potential test applies a Voltage across an insulation at or above the DC equivalent of the 60 Hertz operating crest Voltage. This test can be applied as a dielectric absorption test or a step-Voltage test.

Insulating **Liquid** Analysis Test

These regular tests of insulating oils and askarels are conducted on a semiannual basis in accordance with specific ASTM standards. The results are measured against values established in NFPA 70B. The sampling process is critical to accuracy.

Insulation power Factor Test

Insulation power factor testing is the measurement of the power factor of the charging Volt amperes. This test is sensitive to humidity and temperature. The test Voltage is always greater than 500 Volts, and a desirable Voltage is at least 2500 Volts.

TESTING METHODS

NON-STANDARD TEST DESCRIPTION (Continued)

Insulation Resistance lest

Insulation is tested by applying a known Voltage across the insulation; the resulting current flow is measured with a meter calibrated in Ohms. The Voltage source for most low-Voltage testing is a megOhmmeter (megger), and the results are volume sensitive.

Because insulation testing is often temperature-sensitive, consistent testing conditions will ensure a more accurate test.

Polarization Index lest

The polarization index is a special application of the dielectric absorption test. The index is the ratio' of insulation resistance at two 'different times after applying the test Voltage. The interval between readings is normally 10 minutes. An index of less than one indicates the insulation is not adequate.

Protective Device Tests

There is no way to test the operation of fuses because excess current destroys the fuse under test, Only a continuity test with a low-current device that verifies continuity is effective.

Circuit breaker testing is determined by the breaker type. Most molded-case circuit breakers are not adjustable and therefore not tested for calibration. However, such breakers are tested to ascertain trip currents and trip times. These tests are performed with special test equipment that measures the current applied and the application time.

Other types of circuit breakers such as power circuit breakers have adjustable devices or use protective relays as current- and time-sensitive devices. These circuit breakers and protective relays are tested using equipment to measure the applied current and the application time. The applied current and application time are compared to established standards, manufacturer's literature, or an approved engineering study.

Rotating Machinery Tests

Rotating machinery tests are standard tests applied to rotating equipment of 600 Volts or less using hand crank, rectifier, or battery operated instruments . For equipment rated over 600 Volts, a 1 000- or 2500-Volt motor-driven or rectifier-operated test set is employed.

Rotating equipment should be tested immediately following shutdown while the equipment is hot and dry. Temperatures should be recorded and converted to a base temperature to permit comparisons over long periods of time.

In addition to the tests cited above, the following are applied to rotating equipment:

- Over-Potential Testing: A test in which an overvoltage is applied to the equipment insulation. The test Voltage is normally 50 percent of the new equipment Voltage, which is twice-rated Voltage plus 1000 Volts.
- Surge Comparison Test: A test used to determine turn-to-turn, group-to-group, and phase-to-phase winding flaws. These flaws are not detectable in overvoltage and insulation resistance testing.

Other tests that may be performed include slot discharge and corona tests, winding impedance tests, power factor value tests, and core loss tests. These tests are conducted in response to a specific need or to further refine an analysis based on other tests. Such tests are normally supervised by an engineering department,

TESTING METHODS

NON-STANDARD TEST DESCRIPTION (Continued)

Transformer Polarity Test

The polarity test is used to determine the vectorial relationship of the various transformer windings. This relationship is very important in the protection scheme of transformers.

Transformer Turns Ratio Test

The turns ratio test is used to determine the number of turns of one winding relative to another winding. The test is normally performed with instruments designed for that purpose. If a turns ratio test set is not available, the test can be performed with two Voltmeters or two ammeters. These devices should have an accuracy of at least 0.25 percent of full-scale.

Vibration Test or Vibration Analysis

Probes in contact with or transducers mounted on operating equipment can sense motion (vibration) in terms of displacement, velocity, and acceleration. Instrumentation can convert these signals into digital/analog readouts and graphical displays of signal strength (amplitude) at various frequencies. An equipment signature can be developed by measuring and recording these parameters at key points on equipment. Periodic monitoring will allow changes (trends) and rates of change in the signature to be identified. Worn or broken parts will change the signature, and that change may be used as a predictor.

TESTING METHODS

END OF SUBSECTION

INSPECTION FREQUENCY

CAS INSPECTION SCHEDULE

The following constitutes recommended inspection frequencies for the listed assemblies and components. The purpose of these inspections is to support CAS and are not necessarily for maintenance purposes. Each site has the option of varying the inspection frequencies to meet individual site requirements.

The recommended base CAS inspection frequencies are listed below in Table One for the system described in this manual. The base CAS constitutes standard inspections only and utilizes the standard guide sheets as a reference.

TABLE ONE

Assembly/Component	**Year One**	**Year Two**	**Year Three**	**Year Five**
Service & Distribution Service Entrance Assembly:	S	NS		
Busway	S			NS
Conductors & Fittings	S			NS
Disconnects	S	NS		
Metering	S	NS		
Panelboards	S	NS		
Raceway & Fittings	S			NS
Service & Distribution Low Voltage Distribution:	S	NS		
Busway	S			NS
Conductors & Fittings	S			NS
Disconnects	S	NS		
Metering	S	NS		
Motors	S		NS	
Motor Control Center	S	NS		
Panelboards	S	NS		
Raceway & Fittings	S			NS
Switchboards	S	NS		
Transfer Switch	S	NS		
Transformer	S		NS	
Service & Distribution Medium Voltage Distribution:	S	NS		
Busway	S			NS
Conductors & Fittings	S			NS
Disconnects	S	NS		
Metering	S	NS		
Motors	S		NS	
Motor Control Center	S	NS		

S - STANDARD GUIDE SHEET — NS - NON STANDARD GUIDE SHEET

INSPECTION FREQUENCY

Assembly/Component	**Year One**	**Year Two**	**Year Three**	**Year Five**
Service & Distribution (Continued)				
Medium Voltage Distribution:				
Raceway & Fittings	S			NS
Switchboards	S	NS		
Transfer Switch	S	NS		
Transformer	S		NS	
Lighting:				
Luminaires	S			NS
Special Systems:				
Cable Trays	S			NS
Communication Circuits	S			NS
Control Units	S	NS		
Data Processing Electrical Equipment	S	NS		
Generators Emergency/Standby	S	NS		
Health Care Electrical System	S	NS		
Heating, Baseboard	S		NS	
Lightning Protection & Surge Suppression	S	NS		
Petroleum Dispensing	S	NS		
Signal Circuits	S	NS		
Uninterruptible Power Supplies	S	NS		
Electrical Site Systems:				
Overhead Systems	S			NS
Underground Systems	S			NS
Switchyards	S	NS		
Substations	S	NS		

S - STANDARD GUIDE SHEET — NS - NON STANDARD GUIDE SHEET

END OF SUBSECTION

STANDARD SYSTEM DESIGN LIFE TABLES

GENERAL

The Standard (nominal) Design Life of a given System Assembly/Component is defined as the projected service design life measured from the date of installation to the date of replacement. These time periods are based on manufacturers' product specifications and tests that determine the average "outside" time parameter a given System Assembly/Component will last. The Standard Design Life Tables that follow list design life and replacement cost parameters for WBS. TABLE ONE below illustrates key column headings.

TABLE ONE

ITEM DESCRIPTION	Replacement Life, Years*	percent Replaced
Note 1:	Used to document the replacement life* of significant WBS System Assembly/Components.	
Note 2:		Used to estimate percent of WBS System Assembly/Component cost replaced at the year specified (measured from installation date to end date specified by the replacement life period*).

*Note: The term Replacement Life is synonymous with Design Life.

STANDARD SYSTEM DESIGN LIFE TABLES

TABLE TWO

ITEM **DESCRIPTION**	Replacement **Life,** Years	percent Replaced
0.09 ELECTRICAL		
0.09.01 Service **&** Distribution		
0.09.01.02 Low Voltage		
Circuit breakers, metal-clad drawout, below 600V, all sizes	Life	N/A
Circuit breakers, fixed type, below 600V, all sizes	Life	N/A
Disconnect switches. enclosed. all sizes	Life	N/A
Transformers, liquid-filled, 0-750 kVA, below 600V	Life	100
Transformers, dry type, 0-750 kVA, below 600V	30	100
Switchgear bus, indoor & outdoor, bare, below 600V	20	100
Bus duct, indoor and outdoor, all voltages	20	100
Cable terminations, all types of insulation, above ground and aerial, below 600V	Life	N/A
Motor starters, contact type, below 600V	18	100
Motors, synchronous, below 600V	15	100
Motors, direct current, all sizes	15	100
Motors, induction, below 600V	15	100
0.09.01.03 Medium Voltage		
Circuit breakers, metal-clad drawout, all sizes above 600V	Life	N/A
Circuit breakers, fixed type, all sizes, above 600V	Life	N/A
Disconnect switches, enclosed, all sizes	Life	N/A
Transformers, liquid-filled, 500-2499 kVA, above 600V	Life	100
Transformers, dry type, 0-750 kVA, over 600V	30	100
Transformer, dry type, 500-2499 kVA, above 600V	30	100
Switchgear bus, indoor and outdoor, insulated, above 600V	20	100
Switchgear bus, indoor and outdoor, bare, above 600V	20	100
Bus duct, indoor and outdoor, all voltages	20	100
Cable, thermoplastic, above 600V	Life	N/A
Cable, thermosetting, above 600V	Life	N/A
Cable, paper-insulated, lead-covered, above 600V	Life	N/A
Cable, other, above 600V	Life	N/A
Cable joints, all types of insulation, in duct or conduit, below ground, above 600V	Life	N/A
Cable joints, thermoplastic insulation, above 600V	Life	N/A

STANDARD SYSTEM DESIGN LIFE TABLES

ITEM DESCRIPTION	Replacement Life, Years	percent Replaced
0.09.02 Lighting		
Fluorescent interior lighting fixtures, 2 each, 40W tubes (20,000 burning hours)	20	100
Incandescent interior lighting fixtures, 1 each, 200W (1000 burning hours)	20	100
High-intensity mercury vapor lighting fixtures, 250W (24,000 burning hours)	20	100
High-intensity metal-halide (multivapor) lighting fixtures, 250W (10,000 burning hours)	20	N/A
High-pressure sodium vapor lighting fixtures, 250W (20,000 burning hours)	20	100
Low-pressure sodium vapor lighting fixtures, 100W (18,000 burning hours)	20	100
0.09.03 Special Systems		
0.09.03.05 Emergency Power		
Generators, steam-turbine-driven, 1000kW (600 psi @ 750°F with 4" mercury back pressure)	25	100
Generators, gas-turbine driven, 1000kW	25	100
Generators, reciprocating diesel, 100kW	25	100
0.09.03.07 Electric Heating, Baseboards		
Baseboard heating units, prewired, including accessories.	20	100

STANDARD SYSTEM DESIGN LIFE TABLES

END OF SUBSECTION

SYSTEM WORK BREAKDOWN **STRUCTURE**

GENERAL

Facilities are composed of various assembly/components which, in turn, form the primary facility systems. These systems, such as foundations, roofs, heating and cooling units, and electrical distribution, have varying life spans. They require maintenance, repair, and renovation over a period of time and do not all “fail” at the same time. Systems have varying life spans. Their condition may be influenced by the deterioration of other assembly/component parts within the systems.

To consider each facility and their major systems, the CAS Program uses the Work Breakdown Structure (WBS) based on the R.S. Means square foot costing system. This industry accepted standard, allows a logical “breakdown” of facilities into their major systems, assemblies, components, etc. The WBS is a heirarchical structure and this concept is illustrated in Figure 1. The development of project costs are then applied within this framework as shown in Figure 2.

The Work Breakdown Structure for this volume follows.

SYSTEM WORK BREAKDOWN STRUCTURE

0.09 SYSTEM - ELECTRICAL

0.09.01	SERVICE & DISTRIBUTION
0.09.01.02	Service Entrance
0.09.01.02	Low Voltage Distribution
0.09.01.03	Medium Voltage Distribution
0.09.02	LIGHTING
0.09.02.01	Luminaires
0.09.03	SPECIAL SYSTEMS
0.09.03.01	Cable Tray
0.09.03.02	Communication Circuits
0.09.03.03	Control Units
0.09.03.04	Data Processing Electrical Equipment
0.09.03.05	Generators, Standby/Emergency
0.09.03.06	Health Care Facilities Electrical Equipment
0.09.03.07	Heating, Baseboard Radiation
0.09.03.08	Lightning Protection & Surge Suppression
0.09.03.09	Petroleum Dispensing Facilities Electrical Equipment
0.09.03.10	Signal Circuits
0.09.03.11	Uninterruptible Power Supplies

SYSTEM WORK BREAKDOWN STRUCTURE

WBS LEVEL TABLE

0.05	*LEVEL I*	0.00
ROOFING	*SYSTEM*	**MECHANICAL**
0.05.01	*LEVEL 2*	**0.08.01**
BUILT-UP	*ASSEMBLY*	**PLUMBING**
0.05.01.01	*LEVEL 3*	**0.08.01.01**
MEMBRANE	*COMPONENT*	**DOM.** WATER
0.05.01.01.01	LEVEL 4	**0.08.01.01.01**
3-PLY ASPHALT	***SUBCOMPONENT/ TYPE***	**PIPE**
0.05.01.01.01.01	*LEVELS*	**0.08.01.01.01.01**
NOT **USED**	***TYPE***	**3/4" DIA. COPPER**

WBS ORGANIZATION HIERARCHY

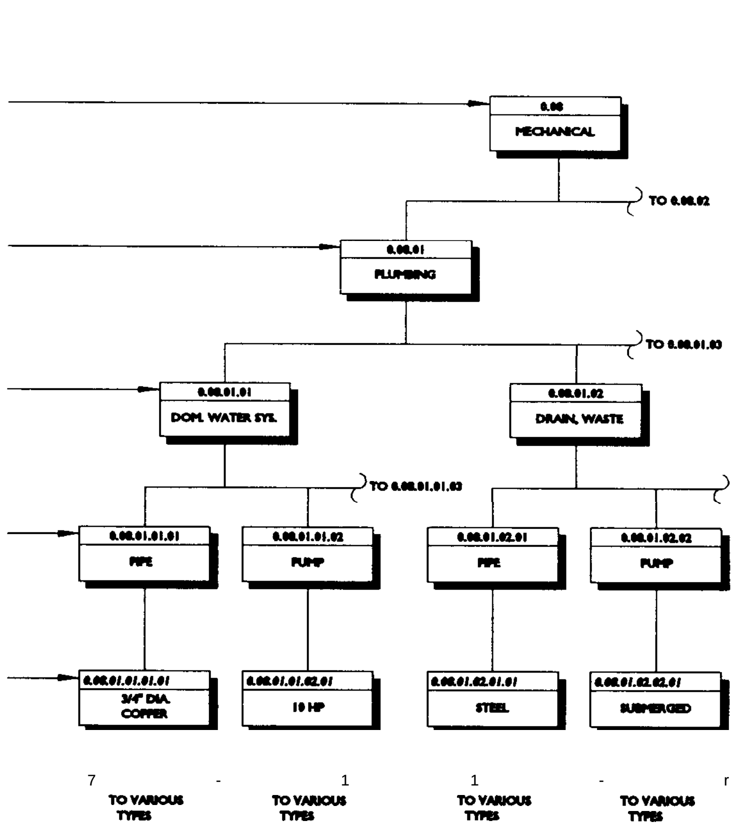


FIG. I

SYSTEM WORK BREAKDOWN STRUCTURE

WBS LEVEL TABLE

0.0	*LEVEL I*	**0.08**
ROOFING	*SYSTEM*	MECHANICAL
0.05.01	*LEVEL 2*	**0.08.01**
BUILT-UP	*ASSEMBLY*	**PLUMBING**
0.05.01.01	***LEVEL 3***	**0.08.01.01**
MEMBRANE	*COMPONENT*	**DOM. WATER**
0.05.01.01.01	***LEVEL 4***	**0.08.01.01.01**
3-PLY ASPHALT	***SUBCOMPONENT/ TYPE***	**PIPE**
0.05.01.01.01.01	*LEVELS*	**0.08.01.01.01.01**
NOT USED	***TYPE***	**3/4" DIA. COPPER**

WBS COST DNELOPMENT HIERARCHY

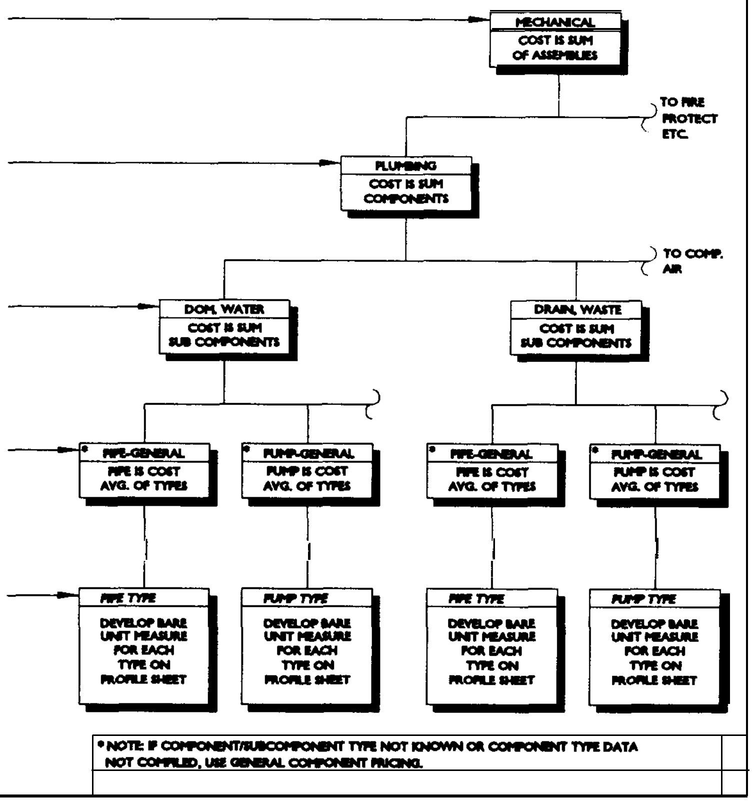


FIG. *2*

END OF SUBSECTION

0.09.01 .Ol SERVICE ENTRANCE (CSI 16420)

DESCRIPTION

The typical service entrance is part of the electrical system that connects the service lateral or service drop to the facility system. This narrative is a description of a typical low-Voltage system that includes but is not limited to metering, conduit, conductors, and overcurrent protection.

Service Entrance Equipment

Types of service entrance equipment in this section include the following:

- Circuit Breakers, Overcurrent
- Conductors
- Enclosures
- Fuse, Overcurrent
- Metering
- Disconnect Switches
- Raceways

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Circuit Breakers (CSI 16475)

Circuit breakers are used as the service entrance disconnect means and overcurrent device. Several different types of circuit breakers may be used in the service entrance assembly. A short summary of several different circuit breakers follows.

Air Circuit Breakers are factory-assembled, electrically operated, low-Voltage breakers. Bolted type, stationary-mounted breaker elements have NEMA Type 1 enclosures. Ground-fault protection devices are integral. Breakers are constructed with overcurrent trip devices.

Current-Limitina Circuit Breakers:

Molded-case current-limiting circuit breakers have common trip and thermal-magnetic circuitry. These breakers have independently operating limiter elements in series with each pole that automatically reset after circuit interruptions. They are constructed with an overcenter, trip-free toggle-type mechanism, a quick-make/quick-break action, and a positive handle indication. Current-limiting breakers are provided with permanent trip units containing individual thermal and magnetic trip elements in each pole. Trip elements are calibrated for 40°C ambient temperature. Circuit breakers have mechanical screw type lugs for use with copper conductors.

Molded-Case Circuit Breakers:

Factory-assembled, molded-case circuit breakers have permanent thermal and instantaneous magnetic trips in each pole, with fault-current limiting protection and overcenter, trip-free, toggle-type operating mechanisms with quick-make, quick-break action and positive handle trip indication. Push-to-trip buttons are on the enclosure cover to mechanically trip circuit breakers. Breakers are constructed for mounting and in any physical position and operating in an ambient temperature of 40°C. Breakers are provided with mechanical screw type removable connector lugs, AL/CU rated, and with NEMA Type 1 general purpose enclosures.

Solid-State Trip Circuit Breakers:

Solid-state trip circuit breakers have ampere setting adjustment knobs for changing current carrying capability of units and ground-fault protection components with an external neutral current transformer (CT). Electronic components are provided for timing and monitoring internal currents and for initiating automatic tripping action. These breakers are constructed with trip-free mechanisms, positive handle indication and a push-to-trip button on cover for mechanical tripping. Breakers are constructed for mounting in any physical position, and operating in an ambient temperature of 40°C. Breakers have mechanical screw type removable connectors, AL/CU rated, with NEMA Type 1 general purpose enclosures.

0.09.01 .01 SERVICE ENTRANCE (CSI 16420)

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Circuit **Breakers** (CSI **16475)** (Continued)

Insulated Case Circuit Breakers:

Factory-assembled, electronically operated, insulated case circuit breakers and draw-out breaker elements in NEMA Type 1 general purpose enclosures with ground-fault protection with delay sensors as integral part of breakers. Circuit breakers are equipped with solid-state controls and programming units.

Circuit Breaker Accessories:
- Auxiliary contacts
- Bell alarm with lockout
- Enclosure-mounted interlock
- Shunt trip
- UnderVoltage release

Internal Breaker Accessories:
- Alarm switch
- Auxiliary contacts
- Shunt trip
- UnderVoltage trip

Fuse, **Overcurrent** (CSI **16475)**

Fuses used as service entrance overcurrent devices have electrical characteristics as identified by the following fuse types:

- Class L time-delay
- Class L fast-acting
- Class RKI time-delay
- Class RKI current-limiting
- Class J current-limiting
- Class RK5 time-delay
- Class K5 one-time
- Class H
- Class T

Metering (CSI **16430)**

Meter sockets and meters are often placed in the service entrance assembly. When included in the assembly, the meter sockets must comply with the requirements of the local utility company or other metering authority supplying electrical power to the service-entrance equipment of the facility.

Safety Switch **&** Fuse Unit (CSI **16440)**

A safety switch and fuse unit may also be used as the service entrance disconnect means and overcurrent device. As with circuit breakers, this subassembly satisfies the requirement of the National Electric Code that the overcurrent device and the disconnect means be immediately adjacent. Three phase-safety switches and fuse units consist of a 3-pole, single-throw switch with three power fuses, front-mounted operating handle with mechanical interlock between switch and access door to fuses, with underground cable entry and a set of terminal blocks, small wiring, and ground bus.

Disconnect Switch (CSI **16440)**

If a safety switch with fuse unit (as described above) or a circuit breaker is not used as the disconnect means, then a disconnect must be installed adjacent to the service entrance overcurrent device. Service entrance disconnects are heavy-duty switches with appropriate NEMA enclosure.

Cables/Wires (CSI 16120)

The service entrance conductors may be individual conductors or service entrance cables. Conductors will be enclosed in raceways. Cables used as service entrance conductors or service entrance cables must be in accordance with the following listing:

- Type SE, for aboveground installation
- Type USE, for underground installation

0.09.01 .01 SERVICE ENTRANCE (CSI 164201

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS (Continued)

Raceways (CSI 16110)

If the service entrance consists of conductors and not a service entrance cable, then the service entrance conductors are to be enclosed in a raceway. Service entrance raceways are normally rigid steel conduit and fittings, although other forms of raceway may be used.

0.09.01 .Ol SERVICE ENTRANCE (CSI 16420)

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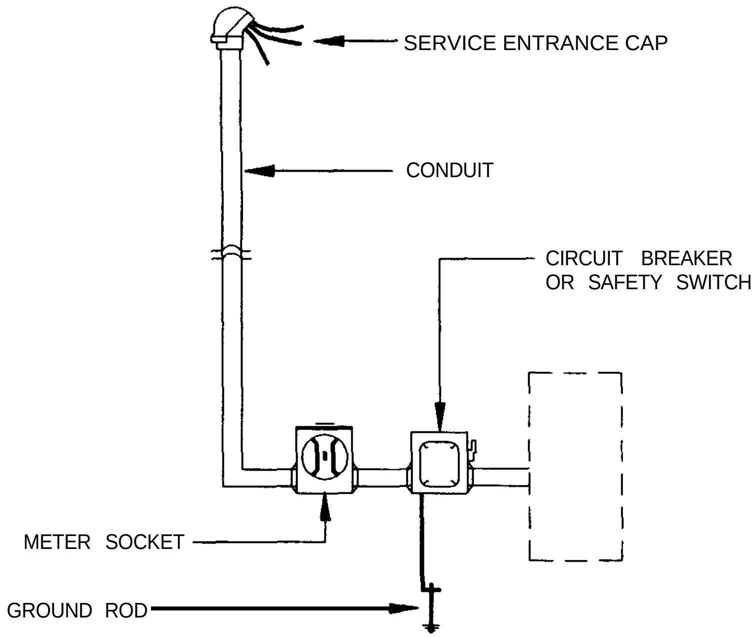


ELECTRICAL SERVICE AND DISTRIBUTION

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	SERVICE ENTRANCE ASSEMBLY		
SERVICE AND DISTRIBUTION SERVICE ENTRANCE SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. A090101-1

DEFICIENCY FACTORS
0.09.01 .Ol SERVICE ENTRANCE (CSI 16420)

PROBABLE FAILURE POINTS

- Ampacity - inadequate for the application.
- Disconnect Means - Not adjacent to or part of the overcurrent protection system.
- Drip Loop - Configuration insufficient to prevent water from entering the service entrance system.
- Ground Connection - Inadequate or missing.
- Meter Socket - improperly secured or damaged.
- Overcurrent Device - Not compatible with the service entrance rating and connected load.
- Raceway - Deterioration has occurred reducing conductor protection.
- Readily Accessible - The service entrance equipment is not accessible without special effort.
- Service Conductors/Cable - Damaged or undersized.
- Service Entrance Cap - Fitting used to protect conductors entering raceway is defective or missing.
- Unauthorized Conductors - Present in the service entrance raceway.

SYSTEM ASSEMBLY/DEFICIENCIES

Busway

Damaged Metering:	Device inoperative. Metering device broken or other physical damage. Tampering of device or circuit.
Defective Busbar:	Current limiting busway not used as required. Dirty or other contamination. Discolored, warped, or other signs of high temperature. inadequately torqued to insulators. Joints inadequately torqued. Joint/splice inadequately insulated when required. Joint/splice insulation burned, discolored, and unravelled. Resistance less than one megOhm per each kiloVolt of rating between buses and or from buses to non-energized parts.
Defective Bushing/Insulator:	Cable clamp loose, missing, broken, corroded, burned, or other physical damage. Dirty, oily, greasy, or other surface contamination. Missing, cracked, chipped, or other damage. Not adequately secured. Oil leakage. Tracked or carbonized.
Defective Contactor:	Arc suppression components broken, eroded, cracked, or missing. Broken strands in braided shunts. Coil discolored, burned, or other sign of high temperature. Coil inoperative at 85% of rated Voltage. Contact pressure not per manufacturer's specifications. Contacts burned, pitted, or other physical damage.

DEFICIENCY FACTORS
0.09.01 .01 SERVICE ENTRANCE (CSI 16420)

SYSTEM ASSEMBLIES/DEFICIENCIES

Busway

Defective Contactor (Continued):	Contacts not properly aligned. Control circuits improperly connected. Dash pot inoperative, broken, or missing. Device sticks magnetically. Drum contacts inadequately torqued. High contact resistance. Improper fluid in dash pot. Improper rolling action of drum contacts. Improper size. Indicator lamps inoperative. Indicator lens missing, cracked, or broken. Missing, loose, broken, or corroded hardware. No engineering study to support thermal trip device rating. Noisy. Plugging relays dirty or other contamination. Pushbuttons not labeled. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts. Rheostat contact surface corroded, oxidized, uneven, or other physical defect. Rheostat holding coil missing or inoperative. Rheostat ventilation impeded. Terminals, contact blocks, bus bars, and connectors loose or discolored. Thermal trip device wrong size.
Defective Control Module:	Circuit boards improperly installed and/or connected. Inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, cracked, chipped, corroded, burned, or other damage to components and/or circuit boards. Not clean and moisture-free.
Defective Heater:	Heater element resistance to ground less than one megOhm per each kiloVolt of rating. Heater not adequately secured to mounting surface. Improper conductors from source. Improper temperature in device enclosure. Inoperative heater element. Sensing device broken, missing, or inoperative. Sensing device malcalibrated.
Improper Busway Enclosure:	Corroded, rusted, dented, or other physical damage. Dirty, missing, or inappropriate filters. Gaskets missing, damaged, misaligned, or other physical deformity. Not secured to mounting surface. Interlock broken, missing, or inoperative.

DEFICIENCY FACTORS
0.09.01 .01 SERVICE ENTRANCE (CSI 16420)

SYSTEM ASSEMBLIES/DEFICIENCIES

Busway

Improper Busway Enclosure (Continued):	Loose, broken, damaged, corroded, or missing fastening hardware. Missing, broken, damaged, or inoperative security device. Missing or damaged barriers. No curbing or berm for oil containment. Not accessible. Not adequate for application. Not clean and moisture-free. Not grounded properly. Oil leaks. Unused openings not covered or plugged. Ventilation openings defective, nonoperative, obstructed, or not properly guarded.
Improper Control Wiring:	Bimetallic connectors not used as required. Bundled and trained inappropriately. Control circuits improperly connected. Control wiring insulation resistance less than one megOhm per each kiloVolt of rating. Improper sensor pick-up or drop-out point. Improper termination. Inadequate fuse/connection tension. Inadequately torqued at termination. Inappropriate for application. Inconsistent time delays. Incorrect overcurrent protection. Indicator lamps inoperative. Indicator lens missing, cracked, or broken. Inoperative. Inoperative interlock. Insulation charred, burned, or discolored. Insulation improperly removed from conductor. No engineering study to support installed fuse. Splices improperly insulated. Terminal boards improperly installed. Unauthorized splice.
Improper Disconnect:	Adjustable settings misadjusted. Arc suppression devices broken, cracked, missing, tracked, chipped, or other physical damage. Contacts bent or not aligned. Defective phase barriers. Does not sustain rated current per NEMA AB4-1991. Does not trip on instantaneous overcurrent per NFPA 70B. Handle broken, bent, or other physical deformity. High conductor, lug temperature. High contact resistance. Improper application.

DEFICIENCY FACTORS
0.09.01 .01 SERVICE ENTRANCE (CSI 16420)

SYSTEM ASSEMBLIES/DEFICIENCIES

Busway

improper Disconnect (Continued):	Improper switch time. Improperly sized. Improperly wired. Interlock broken, missing, or inoperative. Movable contacts bent, malaligned, or other physical deformity. Movable contacts pitted, burned, or discolored. No engineering study to support adjustable settings. Not accessible. Not adequate for application. Not clean and moisture-free. Not grounded properly. Not secured to mounting surface. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts. Series trip device missing, broken, or inoperative. Shunt trip device missing, broken, or inoperative. Stationary contacts bent, malaligned, or other physical deformity. Stationary contacts pitted, burned, or discolored. Terminals, contact blocks, bus bar and connectors loose, burned, or discolored. Time-delay overcurrent trip not per manufacturer's specifications. UnderVoltage trip missing, broken, maladjusted, or inoperative.
Improper Fitting:	Exposed conductors. Improper fitting for application. Insert broken, cracked, missing, or other damage. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, broken, cracked, loose, or other damage. Unused openings not covered or plugged.
Improper Fuse Unit:	Fuse clips bent, malaligned, discolored, or other physical damage. Improper fuse type used. Improperly sized. Poor fuse to clip contact. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts.
Improper Installation:	Crossover improperly installed or connected. Elbow improperly installed or connected. Fused protector not used as required. Hanger not adequately secured to structure. Improper bending radius.

DEFICIENCY FACTORS
0.09.01.01 SERVICE ENTRANCE **(CSI 16420)**

SYSTEM ASSEMBLIES/DEFICIENCIES

Busway

improper Installation (Continued):	Improper joint. Improper trench. Improperly supported by other raceway. Inadequate grounding. Inadequate ventilation. Missing vertical run hardware. No bushing or equivalent protection. Not adequately protected from severe physical damage. Not adequately secured to mounting surface. Not appropriate for location. Not clearly and permanently marked where required. Not secured within three feet of end of run. Protector improperly located. Protectors are not installed as required. Supported by other raceway. Switchboard flange improperly installed or connected. Tee improperly installed or connected. Unauthorized conductor present. Unlisted protector or non-identified protector employed. Unused openings not covered or plugged
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.
Improper Mount:	Device not secured to mount. Device mounting surface chipped, cracked, broken, or other physical damage. Dirty, oily, greasy, or other surface contamination. Mounting structure inadequate. Mounting structure not secured to mounting surface. Not aligned.
Inaccurate Metering:	Calibration standard not established. Defective or inoperative sensor or transducer. Metering device inadequately sized. Metering device not calibrated.

Conductors & Fittings

Improper Cable/Conductor:	Ampacity not properly rated. Bimetallic connectors not used as required. Broken wire strands. Burned, melted, discolored conductor material. Defective or deficient cable/conductor penetrations. High splice temperature. Improper bending radius. Improper insulation Voltage. improper splice materials used. Improper termination. Improper trench. Improperly made splice.

DEFICIENCY FACTORS
0.09.01 .Ol SERVICE ENTRANCE (CSI 16420)

SYSTEM ASSEMBLIES/DEFICIENCIES

Conductors & Fittingat

Improper Cable/Conductor (Continued):	inappropriate for application. Insulation inappropriate for application. Insulation improperly removed. Insulation is burned, charred, discolored, or other physical damage. Insulation resistance less than one megOhm per each kiloVolt of rating. Insulation unraveled, frayed, brittle, or other physical damage. Nicked or ringed conductor. Not properly bundled or trained. Not properly connected to device. Not properly derated for installation. Not properly supported. Not protected physically. Unauthorized splice.
Improper Fitting:	Exposed conductors. Improper fitting for application. Insert broken, cracked, missing, or other damage. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, broken, cracked, loose, or other damage. Unused openings not covered or plugged.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.

Disconnects

Defective Bushing/Insulator:	Cable clamp loose, missing, broken, corroded, burned, or other physical damage. Dirty, oily, greasy, or other surface contamination. Missing, cracked, chipped, or other damage. Not adequately secured. Oil leakage. Tracked or carbonized.
Defective Control Module:	Circuit boards improperly installed and/or connected. Inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, cracked, chipped, corroded, burned, or other damage to components and/or circuit boards. Not clean and moisture-free.
Defective Heater:	Heater element resistance to ground less than one megOhm per each kiloVolt of rating. Heater not adequately secured to mounting surface. Improper conductors from source.

DEFICIENCY FACTORS
0.09.01 .01 SERVICE ENTRANCE (CSI 16420)

SYSTEM ASSEMBLIES/DEFICIENCIES

Disconnects

Defective Heater (Continued):	Improper temperature in device enclosure. Inoperative heater element. Sensing device broken, missing, or inoperative. Sensing device malcalibrated.
Defective Pressure Relief:	High internal pressure. No internal pressure.
Improper Control Wiring:	Bimetallic connectors not used as required. Bundled and trained inappropriately. Control circuits improperly connected. Control wiring insulation resistance less than one megOhm per each kiloVolt of rating. Improper sensor pick-up or drop-out point. Improper termination. Inadequate fuse/connection tension. Inadequately torqued at termination. Inappropriate for application. Inconsistent time delays. Incorrect overcurrent protection. Indicator lamps inoperative. Indicator lens missing, cracked, or broken. Inoperative. Inoperative interlock. Insulation charred, burned, or discolored. Insulation improperly removed from conductor. No engineering study to support installed fuse. Splices improperly insulated. Terminal boards improperly installed. Unauthorized splice.
Improper Disconnect:	Adjustable settings misadjusted. Arc suppression devices broken, cracked, missing, tracked, chipped, or other physical damage. Contacts bent or not aligned. Defective phase barriers. Does not sustain rated current per NEMA AB4-1991. Does not trip on instantaneous overcurrent per NFPA 70B. Handle broken, bent, or other physical deformity. High conductor, lug temperature. High contact resistance. Improper application. Improper switch time. Improperly sized. Improperly wired. Interlock broken, missing, or inoperative. Movable contacts bent, malaligned, or other physical deformity. Movable contacts pitted, burned, or discolored. No engineering study to support adjustable settings.

DEFICIENCY FACTORS
0.09.01.01 SERVICE ENTRANCE (CSI 16420)

SYSTEM ASSEMBLIES/DEFICIENCIES

Disconnects

Improper Disconnect (Continued):	Not accessible. Not adequate for application. Not clean and moisture-free. Not grounded properly. Not secured to mounting surface. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts. Series trip device missing, broken, or inoperative. Shunt trip device missing, broken, or inoperative. Stationary contacts bent, malaligned, or other physical deformity. Stationary contacts pitted, burned, or discolored. Terminals, contact blocks, bus bar and connectors loose, burned, or discolored. Time-delay overcurrent trip not per manufacturer's specifications. UnderVoltage trip missing, broken, maladjusted, or inoperative.
Improper Enclosure:	Corroded, rusted, dented, or other physical damage. Dirty, missing, or inappropriate filters. Gaskets missing, damaged, misaligned, or other physical deformity. Not secured to mounting surface. Insufficient work space. Interlock broken, missing, or inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, broken, damaged, or inoperative security device. No curbing or berm for oil containment. Not accessible. Not adequate for application. Not clean and moisture-free. Not grounded properly. Oil leaks. Unused openings not covered or plugged. Ventilation openings defective, nonoperative, obstructed, or not properly guarded.
Improper Fuse Unit:	Fuse clips bent, malaligned, discolored, or other physical damage. Improper fuse type used. Improperly sized. Poor fuse to clip contact. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts.

DEFICIENCY FACTORS
0.09.01 .OI SERVICE ENTRANCE (CSI 16420)

SYSTEM ASSEMBLIES/DEFICIENCIES

Disconnects (Continued)

improper Insulating Liquid:	Contaminated internal device. Low insulation resistance. Low liquid level. Oil does not meet criteria of NFPA 70B. Pressure leak.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.
Improper Protective Relay:	Cover loose, missing, broken, chipped, cracked, or other physical damage. Current, Voltage, and time pick-up/drop-out values not per manufacturer's specifications. Housing chipped, cracked, broken, or other physical damage. Improper application. Improperly wired. inoperative. Malcalibrated. Missing and/or out-of-date calibration tag. Movable contacts bent, malaligned, or other physical deformity. Movable contacts pitted, burned, or discolored. Not clean and moisture-free. Not secured to mounting surface. No engineering study to support adjustable setting. Stationary contacts bent, malaligned, or other physical deformity. Stationary contacts pitted, burned, or discolored. Terminals loose, broken, missing, burned, discolored, or corroded.
Inaccurate Metering:	Calibration standard not established. Defective or inoperative sensor or transducer. Metering device inadequately sized. Metering device not calibrated.
Improper Mount:	Device not secured to mount. Device mounting surface chipped, cracked, broken, or other physical damage. Dirty, oily, greasy, or other surface contamination. Mounting structure inadequate. Mounting structure not secured to mounting surface. Not aligned.

DEFICIENCY FACTORS
0.09.01 .01 SERVICE ENTRANCE (CSI 16420)

SYSTEM ASSEMBLIES/DEFICIENCIES (Continued)

Metering

Damaged Metering:	Device inoperative. Metering device broken or other physical damage. Tampering of metering device or circuit.
Defective Busbar:	Current limiting busway not used as required. Dirty or other contamination. Discolored, warped, or other signs of high temperature. Inadequately torqued to insulators. Joint/splice inadequately insulated when required. Joint/splice insulation burned, discolored, and unravelled. Joints inadequately torqued. Resistance less than one megOhm per each kiloVolt of rating between buses and or from buses to non-energized parts.
Defective Bushing/Insulator:	Cable clamp loose, missing, broken, corroded, burned, or other physical damage. Dirty, oily, greasy, or other surface contamination. Missing, cracked, chipped, or other damage. Not adequately secured. Oil leakage. Tracked or carbonized.
Defective Control Module:	Circuit boards improperly installed and/or connected. Inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, cracked, chipped, corroded, burned, or other damage to components and/or circuit boards. Not clean and moisture-free.
Improper Control Wiring:	Bimetallic connectors not used as required. Bundled and trained inappropriately. Control circuits improperly connected. Control wiring insulation resistance less than one megOhm per each kiloVolt of rating. Improper sensor pick-up or drop-out point. improper termination. Inadequate fuse/connection tension. Inadequately torqued at termination. Inappropriate for application. Inconsistent time delays. Incorrect overcurrent protection. Indicator lamps inoperative. Indicator lens missing, cracked, or broken. Inoperative. Inoperative interlock. Insulation charred, burned, or discolored. Insulation improperly removed from conductor. No engineering study to support installed fuse.

DEFICIENCY FACTORS
0.09.01 .01 SERVICE ENTRANCE (CSI 16420)

SYSTEM ASSEMBLIES/DEFICIENCIES

Metering

Improper Control Wiring (Continued):	Splices improperly insulated. Terminal boards improperly installed. Unauthorized splice.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.
Improper Mount:	Device not secured to mount. Device mounting surface chipped, cracked, broken, or other physical damage. Dirty, oily, greasy, or other surface contamination. Mounting structure inadequate. Mounting structure not secured to mounting surface. Not aligned.
Inaccurate Metering:	Calibration standard not established. Defective or inoperative sensor or transducer. Metering device inadequately sized. Metering device not calibrated.

Raceway & Fittings

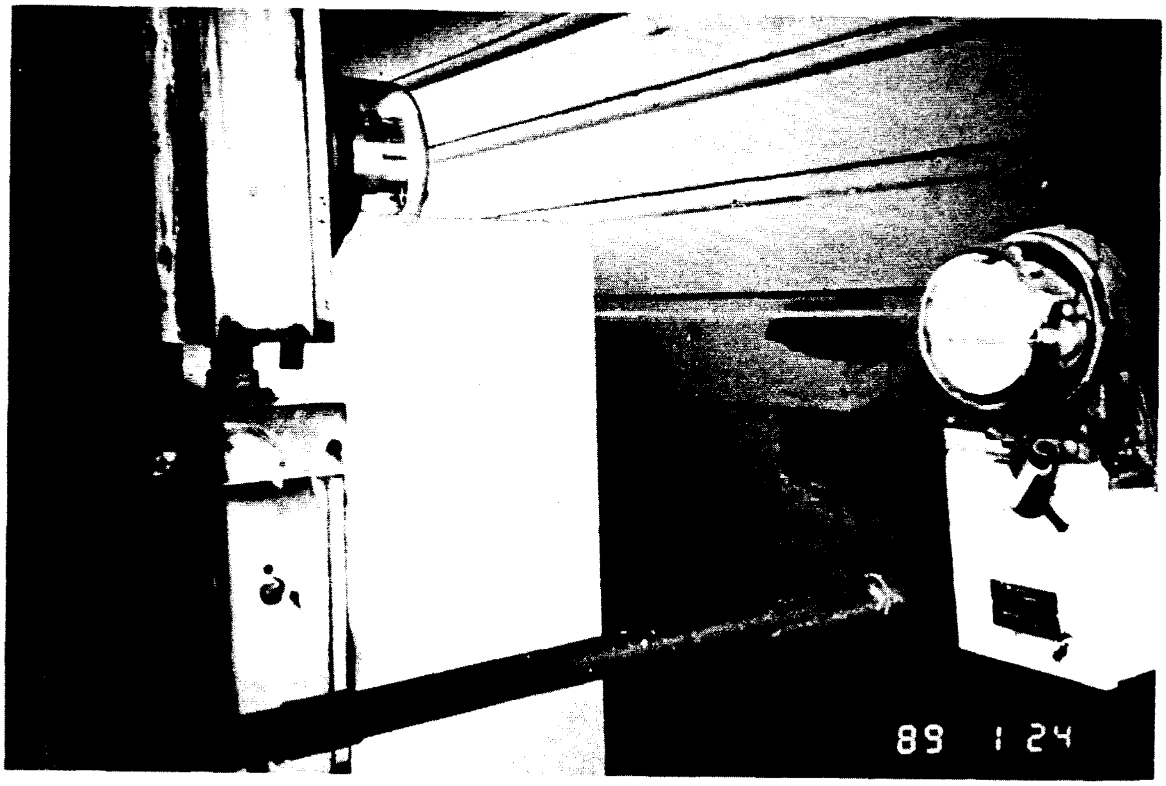
Defective Control Module:	Circuit boards improperly installed and/or connected. Inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, cracked, chipped, corroded, burned, or other damage to components and/or circuit boards. Not clean and moisture-free.
Improper Fitting:	Exposed conductors. Improper fitting for application. Insert broken, cracked, missing, or other-damage. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, broken, cracked, loose, or other damage. Unused openings not covered or plugged.
Improper Installation:	Excessive bends. Hanger not adequately secured to structure. Improper bending radius. Improper joint. Improper trench. Improperly supported by other raceway. Inadequate grounding. Missing vertical run hardware. No bushing or equivalent protection. Not adequately protected from severe physical damage. Not adequately secured to mounting surface. Not appropriate for location. Not clearly and permanently marked where required.

DEFICIENCY FACTORS
0.09.01 .Ol SERVICE ENTRANCE (CSI 16420)

SYSTEM ASSEMBLIES/DEFICIENCIES

Raceway & Fittings

improper Installation (Continued):	Not secured within three feet of end of run. Supported by other raceway. Overfilled. Unauthorized conductor present. Unused openings not covered or plugged.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.
improper Mount:	Device not secured to mount. Device mounting surface chipped, cracked, broken, or other physical damage. Dirty, oily, greasy, or other surface contamination. Mounting structure inadequate. Mounting structure not secured to mounting surface Not aligned.
Improper Raceway:	Inappropriate for application. Corroded, rusted, dented, or other physical damage. Hanger corroded, rusted, or other physical damage. Not clean and moisture-free.



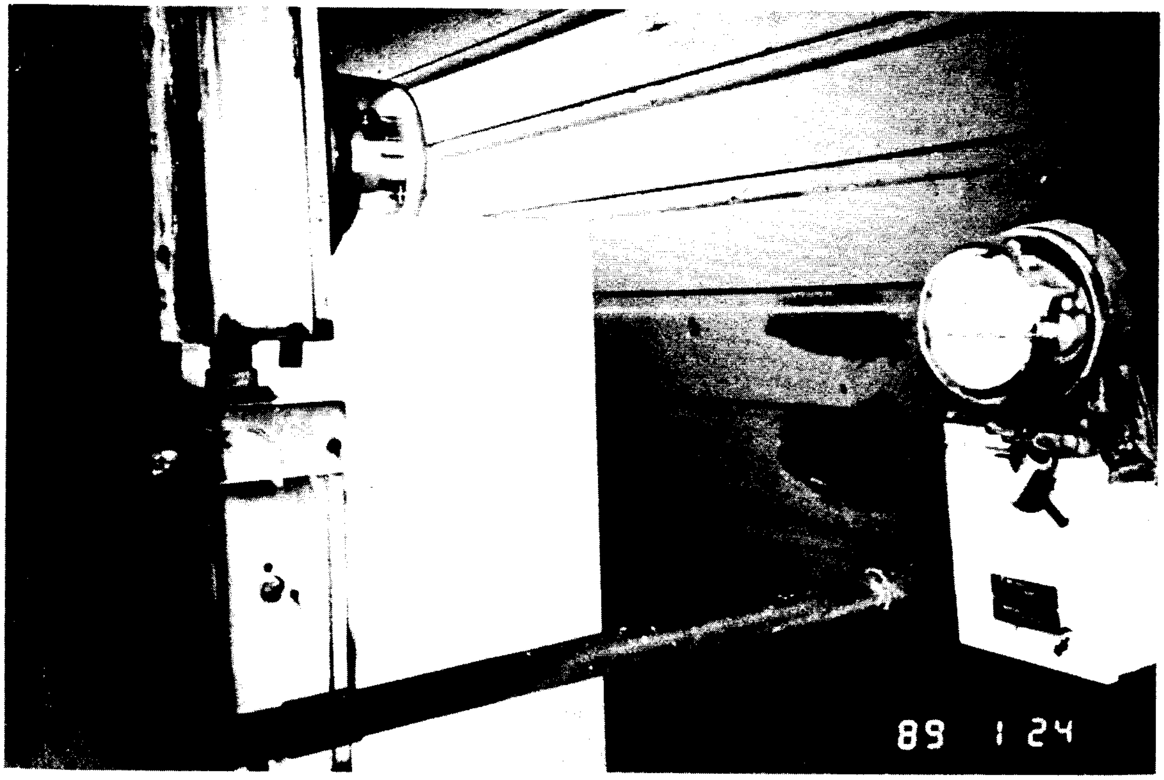
IMPROPER RACEWAY

DEFICIENCY:

1. RUSTED, CORRODED, DENIED OR OTHER ‘PHYSICAL DAMAGE

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	RACEWAY AND FITTINGS		
SERVICE AND DISTRIBUTION SERVICE ENTRANCE SYSTEM (CSI 16420)	Revision No.	Issue Date 5/93	Drawing No. D090101-1

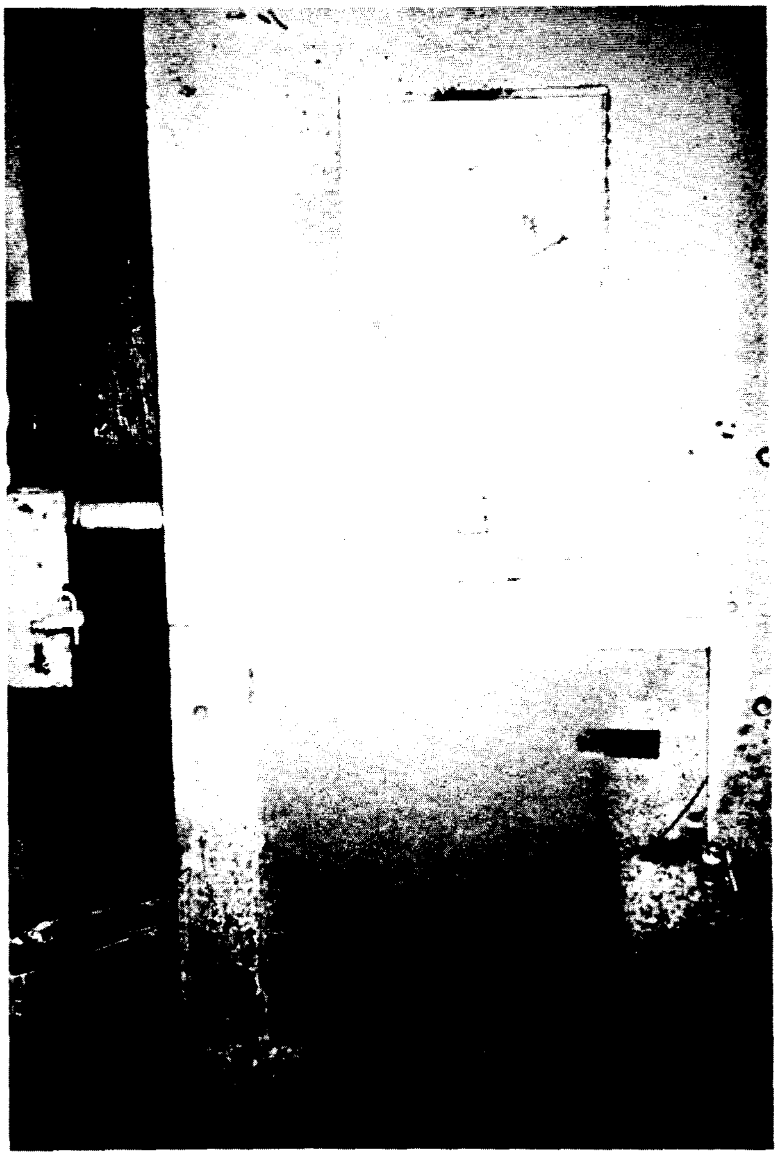


IMPROPER ENCLOSURE

DEFICIENCY:
1. CORRODED, RUSTED, DENTED OR OTHER PHYSICAL DAMAGE

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	DISCONNECTS		
SERVICE AND DISTRIBUTION SERVICE ENTRANCE SYSTEM (CSI 16420)	Revision No.	Issue Date 5/93	Drawing No. D090101-2



IMPROPER ENCLOSURE

DEFICIENCY:
1. CORRODED, RUSTED, DENTED OR OTHER PHYSICAL DAMAGE

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	DISCONNECTS		
SERVICE AND DISTRIBUTION SERVICE ENTRANCE SYSTEM (CSI 16420)	Revision No.	Issue Date 5/93	Drawing No. D090101-3

DEFICIENCY FACTORS
0.09.01 .Ol SERVICE ENTRANCE (CSI 16420)

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DEFICIENCY FACTORS
0.09.01 .01 SERVICE ENTRANCE (CSI 16420)

END OF SUBSECTION

0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM **(CSI** 16400)

DESCRIPTION

The Low Voltage Distribution System has an operating Voltage of 1000 Volts RMS or less and connects the service entrance to the load user device. This includes but is not limited to raceway, busway (bus duct), switches, transformers, panelboards, switchboards, motor control centers, metering, conductors, and overcurrent protection.

LOW VOLTAGE DISTRIBUTION SYSTEM EQUIPMENT

Types of low Voltage distribution system equipment in this section include the following:

- Busway (Bus Duct)
- Conductors and Fittings
- Disconnects
- Metering
- Motors
- Motor Control Centers
- Panelboards
- Raceway & Fittings
- Switchboards
- Transfer Switches
- Transformers

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Busway (Bus Duct) (CSI **16465)**

A device consisting of a grounded metal enclosure containing factory-mounted, bare, or insulated conductors that usually consist of copper or aluminum bars, rods, or tubes. The maximum rated Voltage is 600 Volts. Busway may be intended for a specific application and is so marked.

Conductors **&** Fittings (CSI 16120)

Insulated conductors with a Voltage rating of 2000 Volts RMS or less are normally used in a low Voltage distribution system and may be individual conductors protected by raceway or assembled into a cable with an external sheath. The sheath normally does not provide protection to the conductors. Fittings are used to terminate and protect a conductor by holding, guiding, or shielding it from damage.

Disconnects (CSI **16440)**

A disconnect is a device used to disconnect a load from a source. It is normally a switch or a circuit breaker. Switches include:

<u>Safety Switch (CSI 16490)</u>:

A device designed to interrupt rated current at rated Voltage with or without a fuse unit as an integral part of the switch enclosure.

<u>Isolation Switch (CSI 16490)</u>:

A device intended to disconnect or isolate a load from its source; is not intended to operate under load as a safety switch.

<u>Circuit Breakers (CSI 16475)</u>:

Devices include molded-case and power circuit breakers. They interrupt at rated Voltage, rated current, and fault current without damaging the device.

0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS (Continued)

Metering (CSI 16430)

Metering is a collection of devices such as Voltmeters, ammeters, switches, and ancillary devices used to measure various electrical parameters. The metering may be used to control the electrical system or to indicate selected parameters monitored by an operator. Ancillary metering devices may also be used for other control systems such as overcurrent or overVoltage relaying.

Motors (CSI 16400)

Motors are devices used to convert electrical energy to mechanical energy. Motors larger than 10 horsepower are included in this standard. Direct current motors are considered special purpose and are not included in this standard.

In addition to converting electrical energy to mechanical energy, motors may perform other functions such as power factor correction. Motors that perform such functions are considered special purpose and are not included in this standard.

Motor Control Centers (CSI 16480)

Motor control centers are assemblies of one or more circuit breakers, contactors, disconnects, fuses, and other devices used to control electric motors. Motor control centers may be part of a low Voltage distribution center.

Panelboards (CSI 16470)

Panelboards are assemblies of enclosures, covers, and electrical interiors with buses. As an assembly, they may be part of the low Voltage distribution assembly. The electrical interior may contain one or more circuit breakers, switches, or fuse assemblies connected to the buses. The devices that constitute the electrical interior are normally used for overcurrent protection and switching. The panelboard interior is normally accessible only from the front of the enclosure.

Raceway & Fittings (CSI 16110)

Raceways are enclosed channels for holding wire, cables, or busbars. The more common forms of raceway include flexible and rigid conduit, tubing, and wireways. Fittings include such items of hardware as bushings, locknuts, and conduit bodies.

Switchboards (CSI 16425)

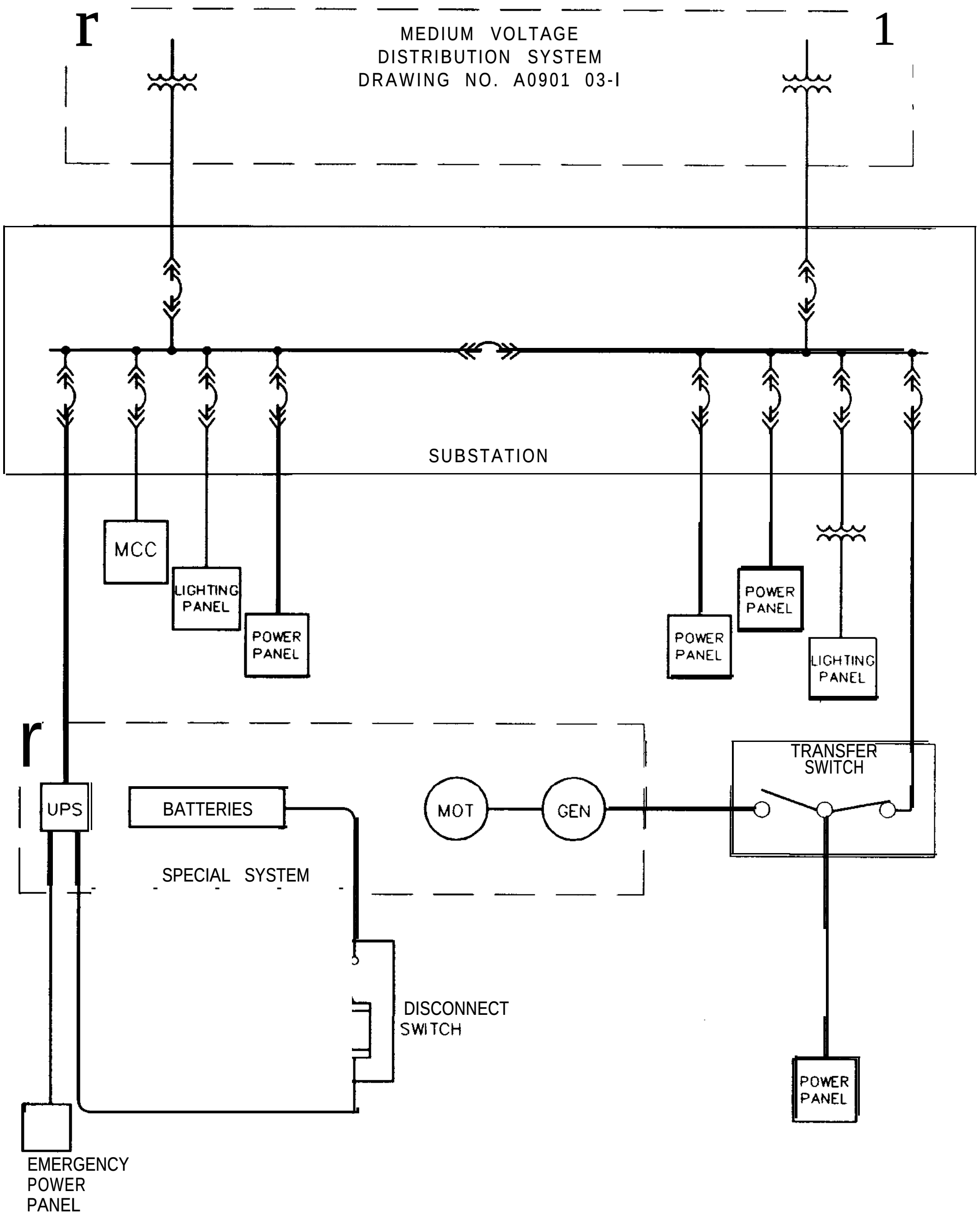
Switchboards are assemblies of switches, circuit breakers, fuses, metering equipment, relays, and/or other forms of equipment that control or record the electric current distributed throughout a building or area. Switchboards are used in all Voltage ranges; however, in ranges other than low Voltage, the switchboard is often referred to as switchgear.

Transfer Switches (CSI 16490)

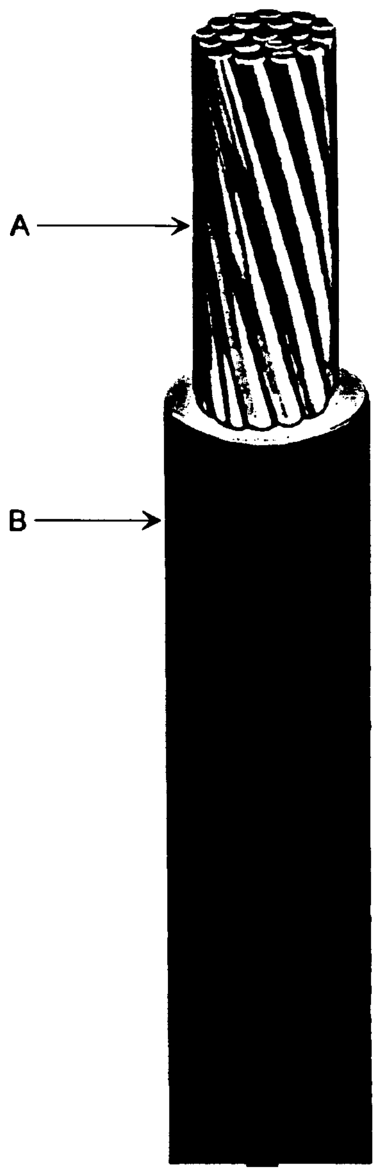
A Transfer Switch is a device intended to transfer a load from one source to another source. Special precautions must be taken because multiple sources are present within the switch enclosure.

Transformers (CSI 16460)

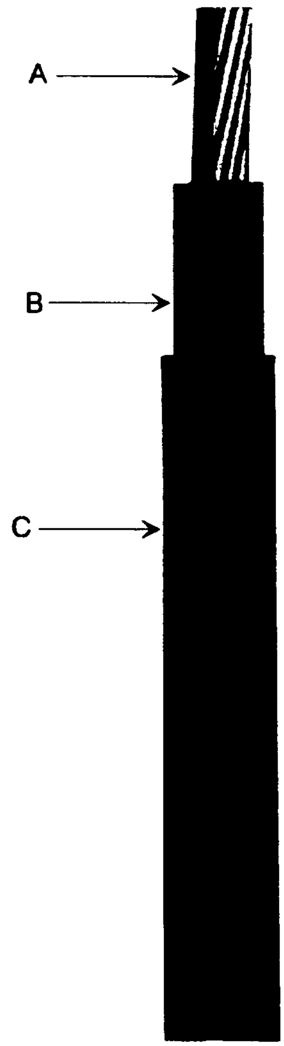
A transformer is a device used to change the Voltage delivered to a load or to isolate a load electrically from its source. As used here,, the term does not include units installed as part of some other device or load.



SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	**LOW VOLTAGE DISTRIBUTION SYSTEM**		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	issue Date 5/93	Drawing No. A090102-1

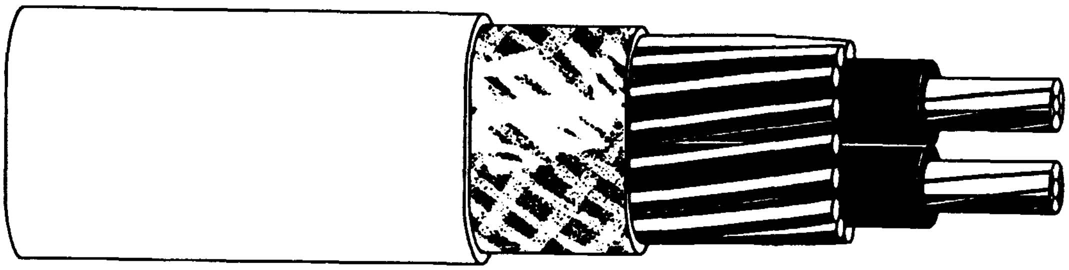


A CONDUCTOR
B INSULATION

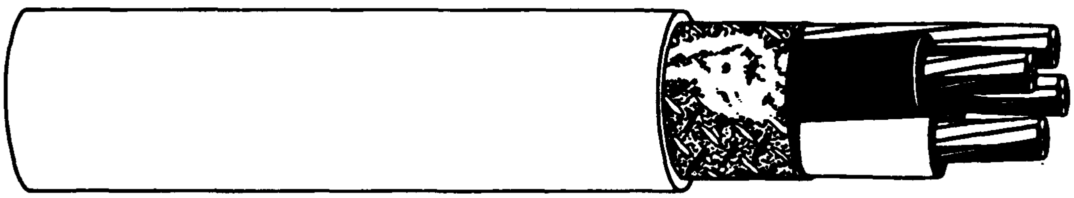


A CONDUCTOR
B INSULATION
C JACKET

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	CONDUCTORS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. A090102-2

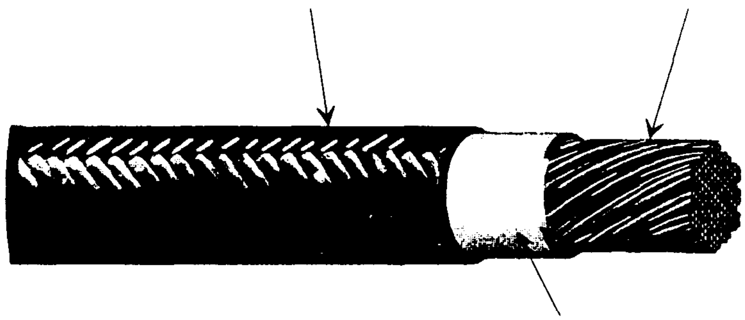


SERVICE ENTRANCE, UNDERGROUND



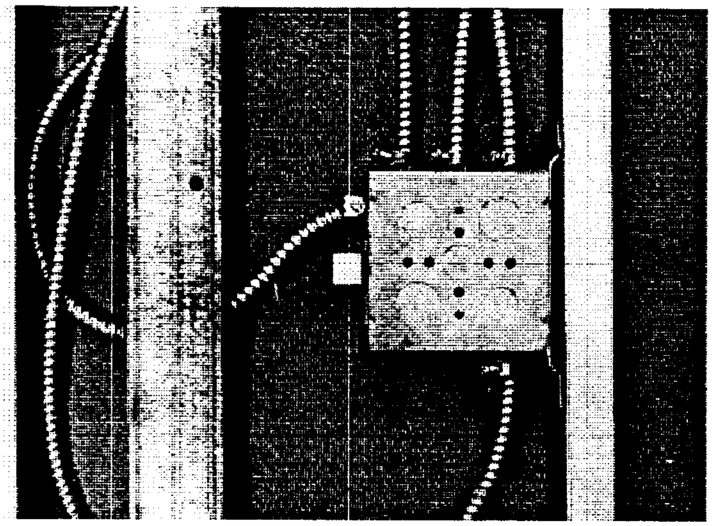
SERVICE ENTRANCE, RISER

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	CONDUCTORS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. A090102-3

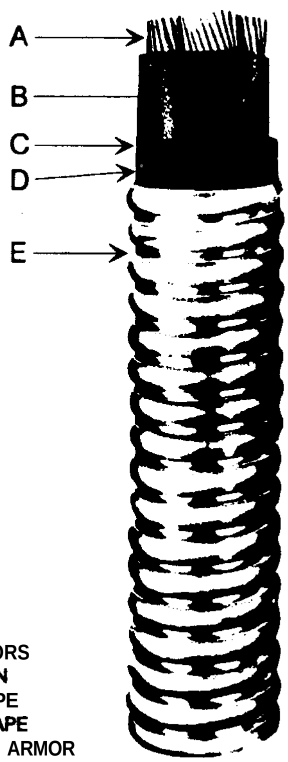


HIGH TEMPERATURE CONDUCTOR

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	CONDUCTORS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. A090102-4

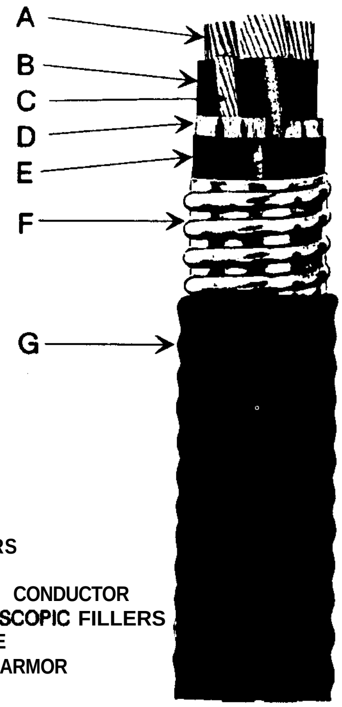


TYPE AC ARMORED CABLE W/ FITTINGS AND OUTLET BOX



A CONDUCTORS
B INSULATION
C BINDERTAPE
D MARKER TAPE
E INTERLOCK ARMOR

TYPE MC CABLE

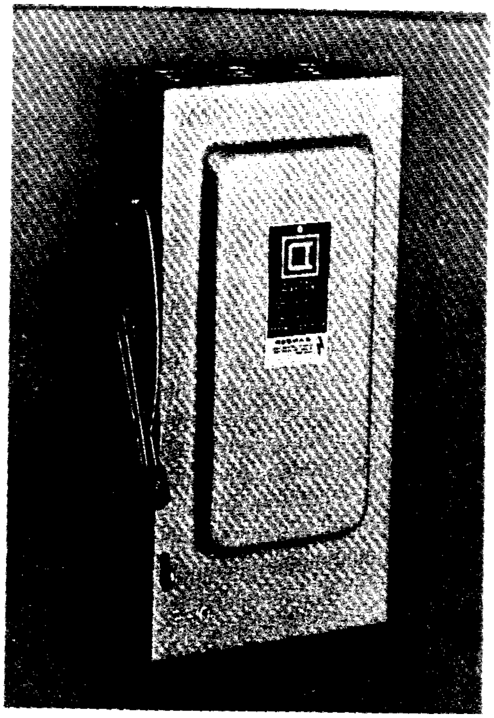


A CONDUCTORS
B INSULATION
C GROUNDING CONDUCTOR
D NON-HYGROSCOPIC FILLERS
E BINDER TAPE
F INTERLOCK ARMOR
G JACKET

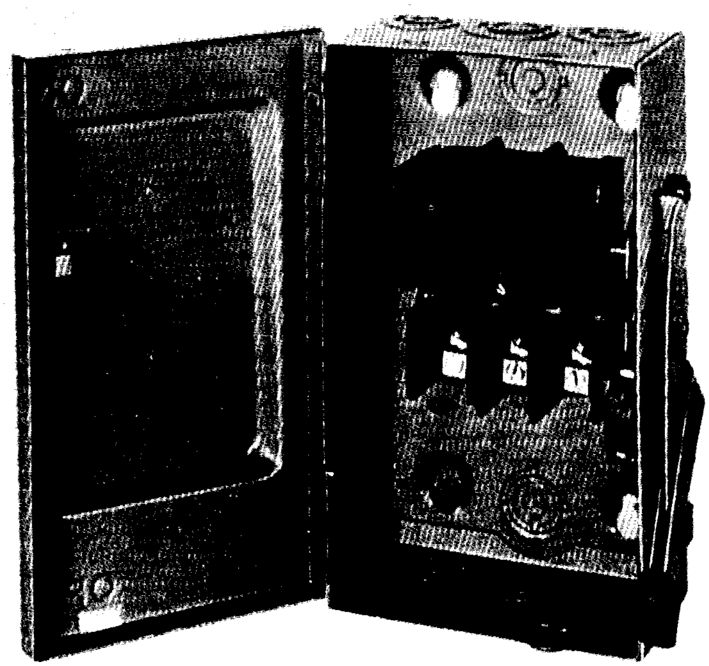
TYPE MC CABLE

BOTTOM SOURCE: THE OKONITE COMPANY, POWER, CONTROL AND INSTRUMENTATION CABLES

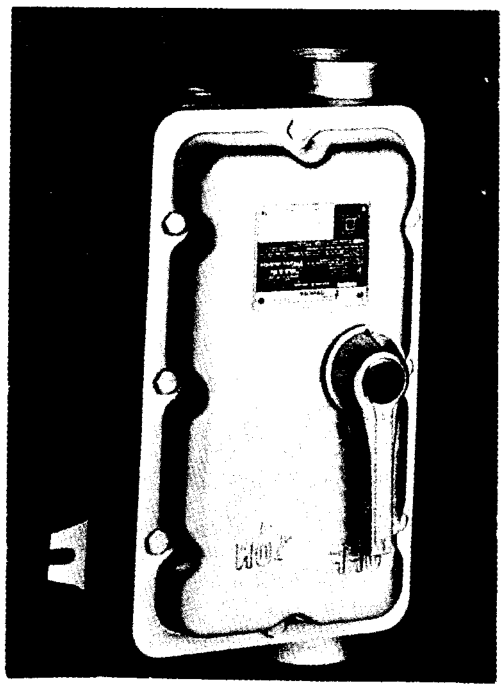
SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	CONDUCTORS AND FITTINGS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5\93	Drawing No. A090102-5



NEMA 1



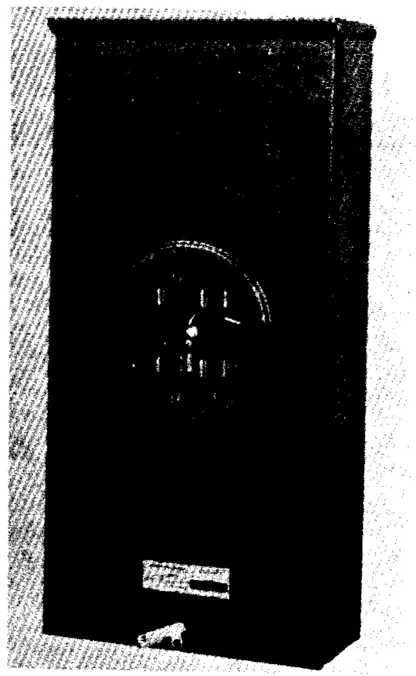
NEMA 1



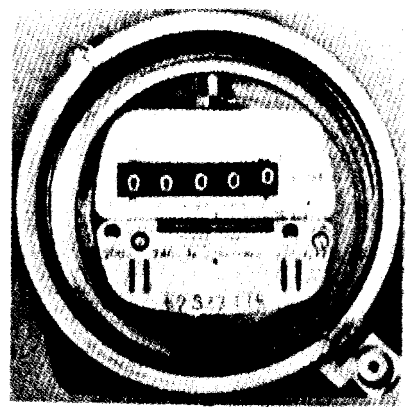
NEMA 7/9

SOURCE: SQUARE D COMPANY, CUT SHEETS

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	DISCONNECTS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. A090102-6



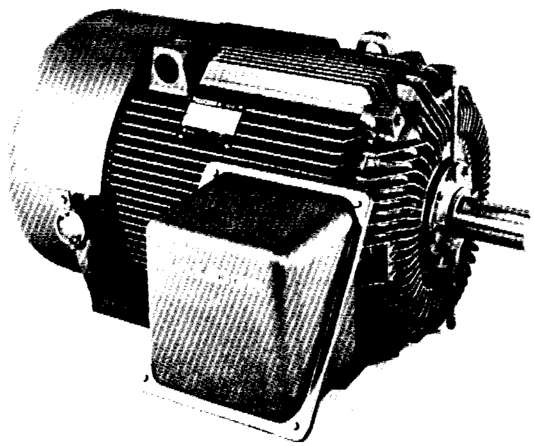
ENCLOSURE W/ METER SOCKET



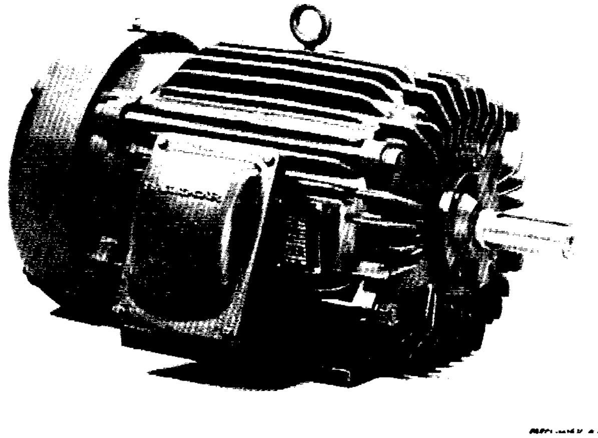
KWH METER

LEFT SOURCE: ANCHOR ELECTRIC, METERING, SERVICE EQUIPMENT, POWER OUTLETS
RIGHT SOURCE: CHALLENGER ELECTRICAL EQUIPMENT CWP.. CHALLENGER SELECTOR

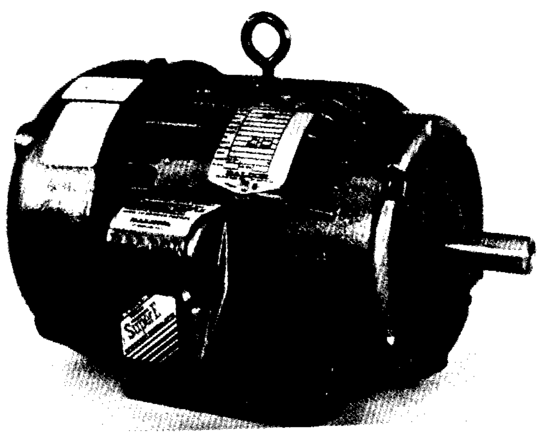
SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	METERING		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. A090102-7



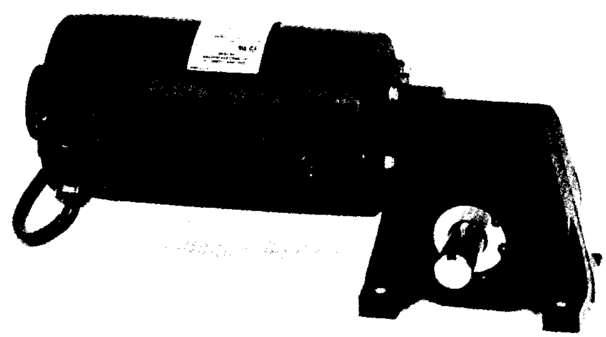
TEFC- SEVERE DUTY



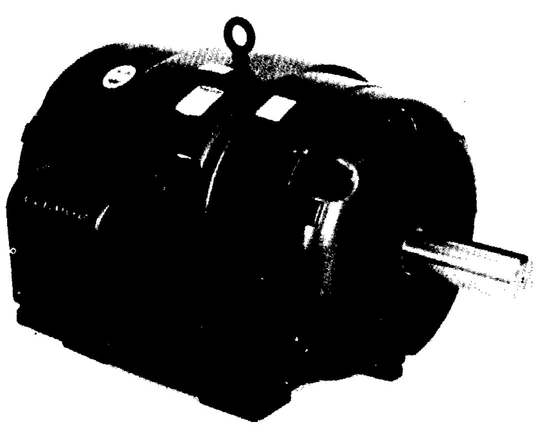
EXPLOSION PROOF



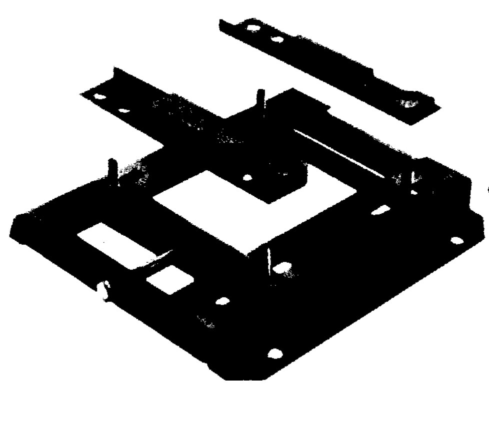
TEFC- INTEGRAL HORSEPOWER



GEAR MOTOR



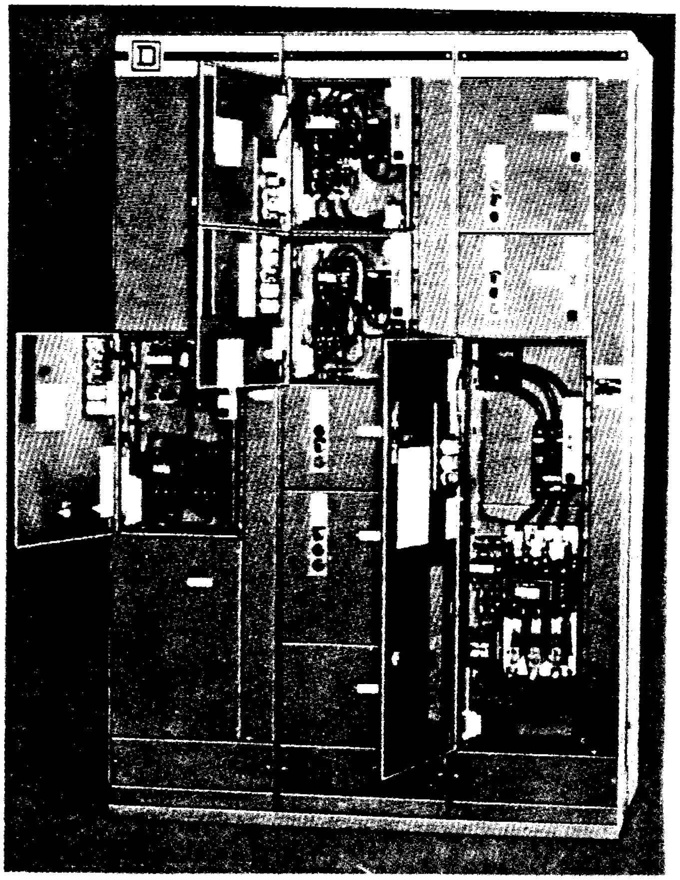
ODP- HEAW DUTY



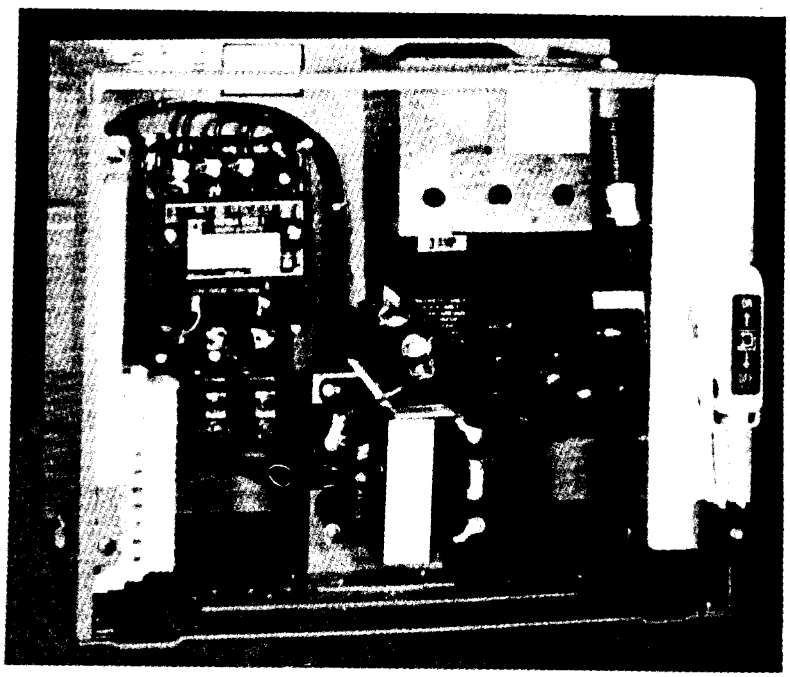
MOTOR MOUNTING BASE

SOURCE: BALDOR MOTORS AND DRIVES

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	MOTORS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSL 16400)	Revision No.	Issue Date 5/93	Drawing No. A090102-8



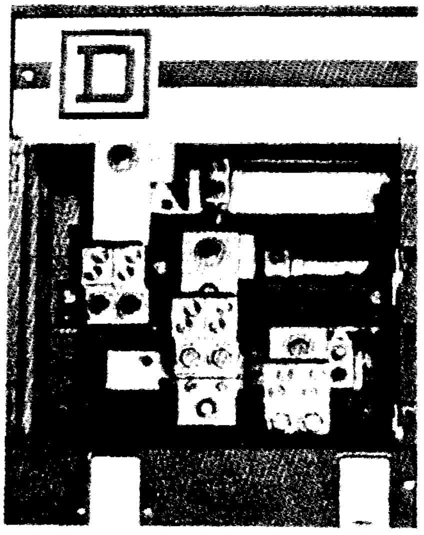
MCC



STARTER UNIT

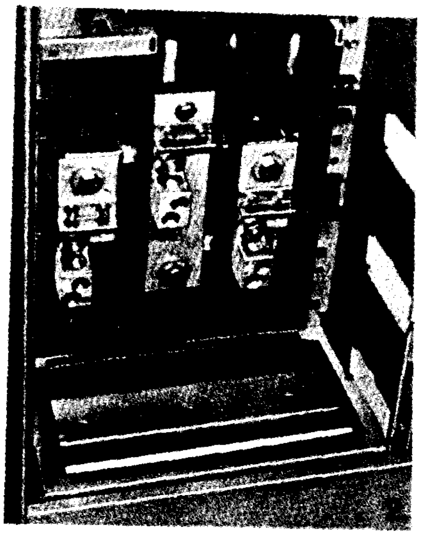
SOURCE: SQUARE D CO., MODEL 4, MOTOR CONTROL CENTERS

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	MOTOR CONTROL CENTERS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. A090102-9



TOP MAIN LUGS

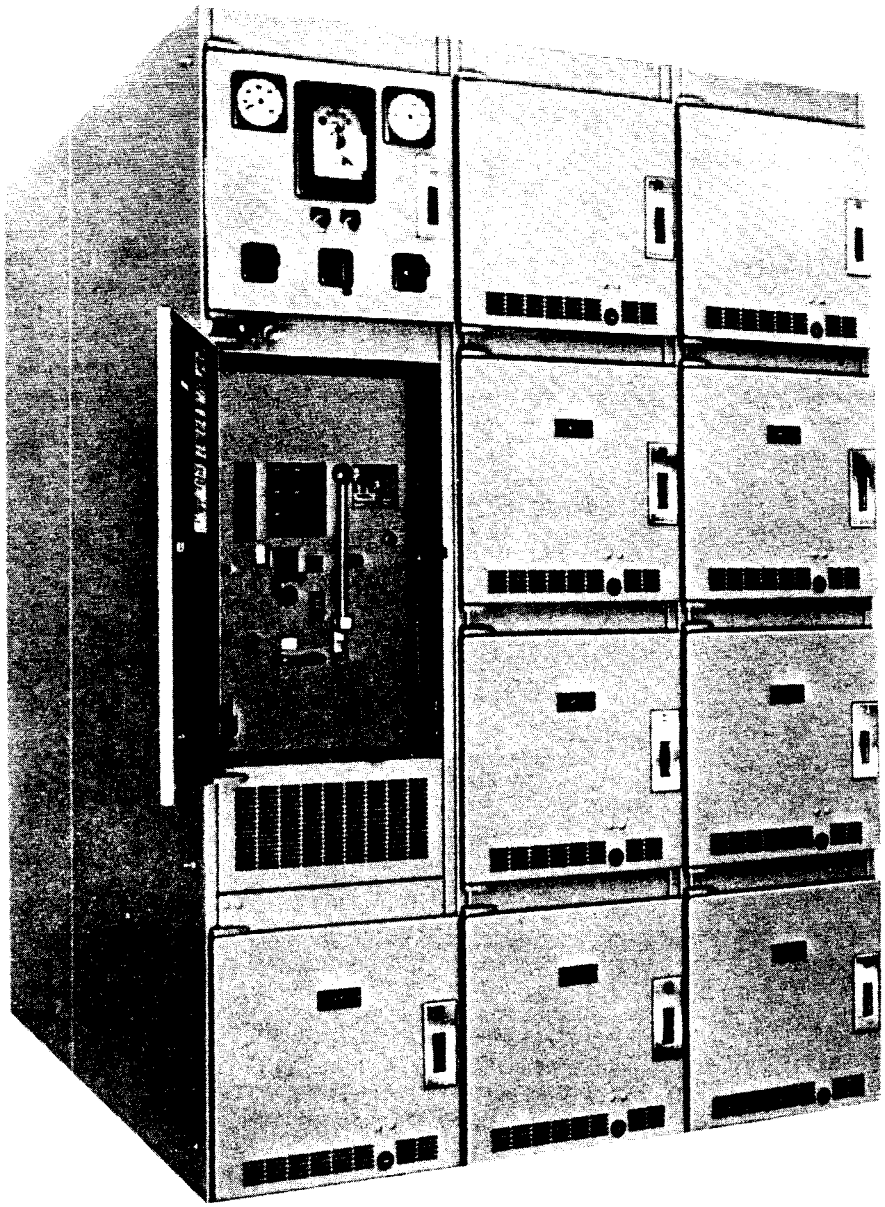
VERTICAL SECTION



BOTTOM MAIN LUGS

SOURCE: SQUARE D CO.. MODEL 4. MOTOR CONTROL CENTERS

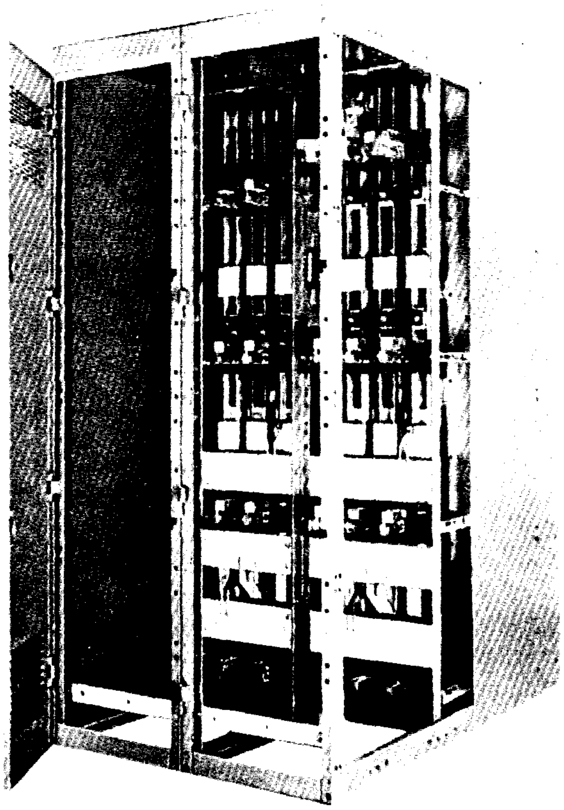
SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	MOTOR CONTROL CENTERS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. A090102-10



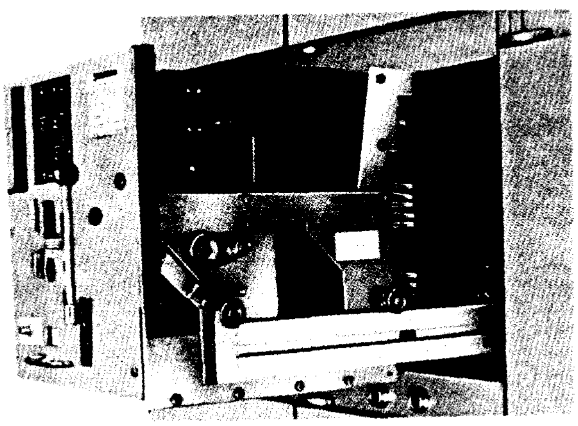
METAL-ENCLOSED DRAWOUT SWITCHGEAR/SWITCHBOARDS

SOURCE: SQUARE D. POWER-ZONE II SWITCHGEAR

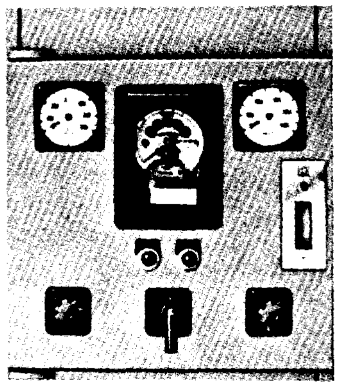
SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	SWITCHBOARDS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. A090102-11



BUS AND CABLE COMPARTMENTS



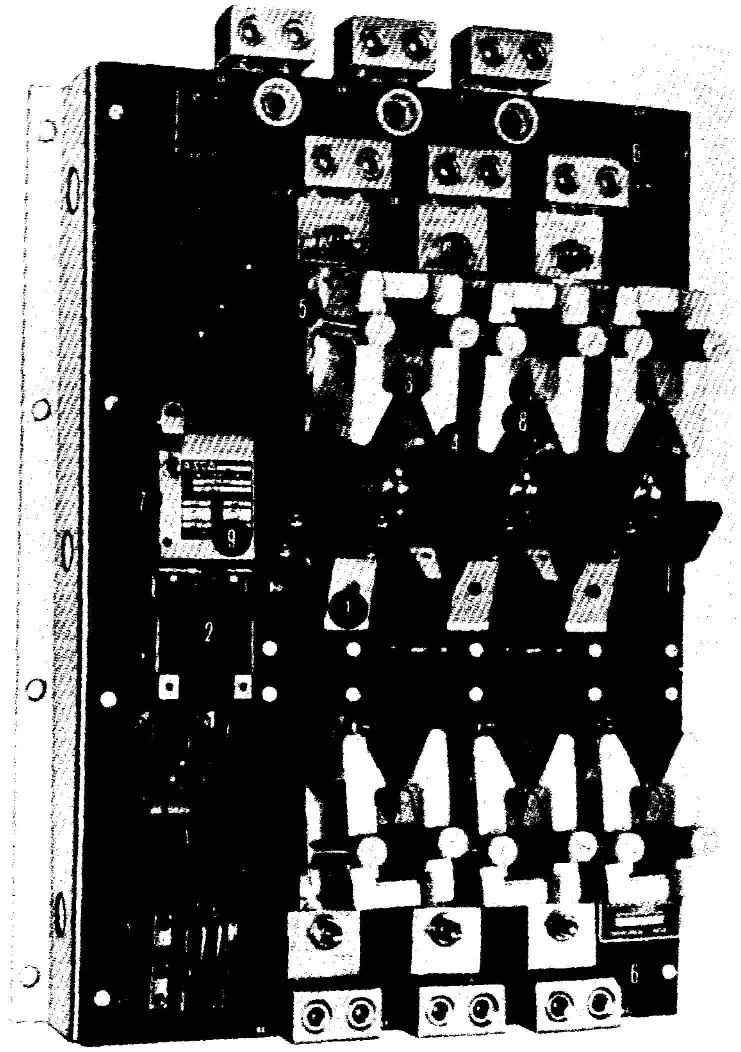
DRAWOUT BREAKER



METERING

SOURCE: SQUARE D. POWER-ZONE II SWITCHGEAR

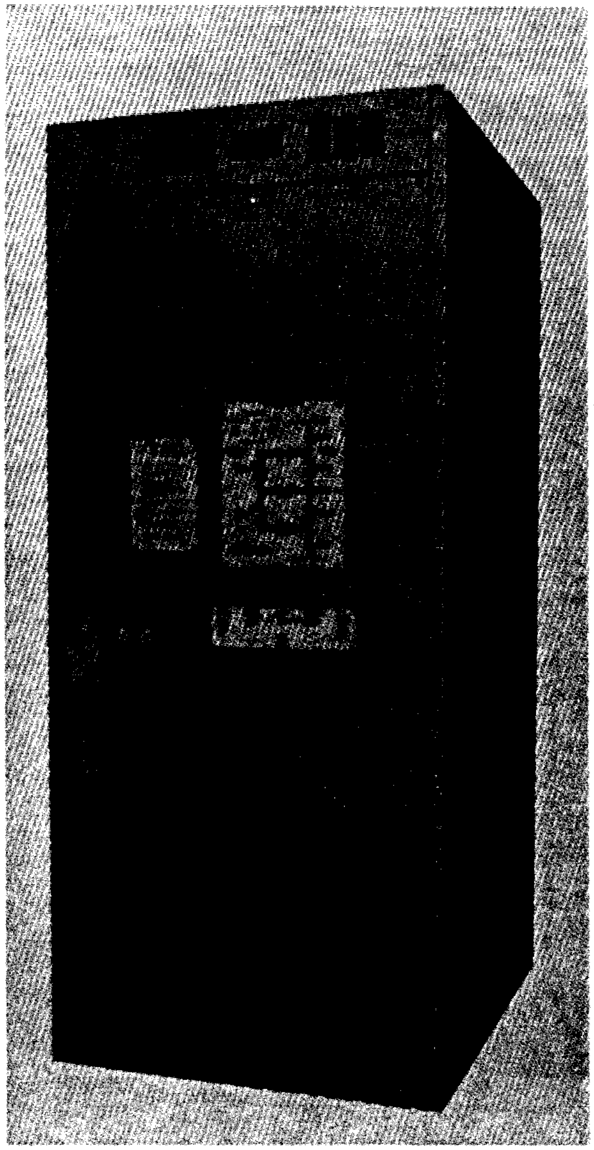
SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	SWITCHBOARDS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. A090102-12



1. FLEXIBLE CONNECTOR
2. DOUBLE-THROW MECHANISM
3. ARC SPLITTERS
4. MAIN CONTACT
5. STATIONARY CONTACT
6. TOP, EMERGENCY SOURCE LUGS
   BOTTOM, NORMAL SOURCE LUGS
7. CHANGE WIRING
8. ARC SPLITTERS
9. SOLENOID

SOURCE: ASCO. AUTOMATIC TRANSFER SWITCHES

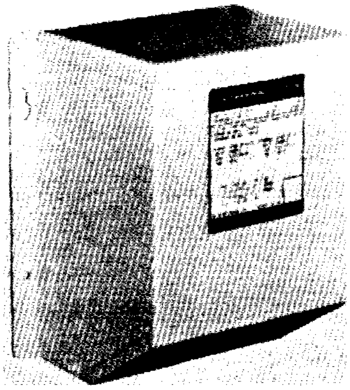
SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	TRANSFER SWITCH		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. A090102-13



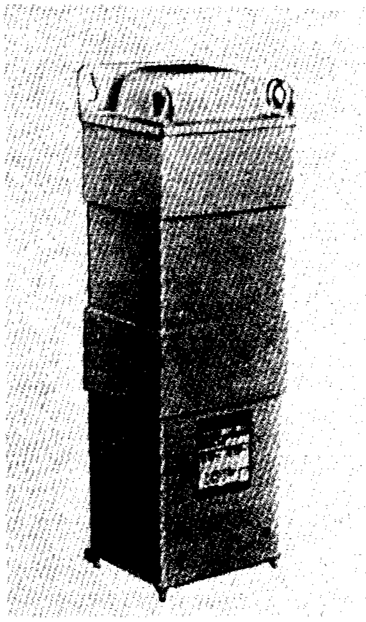
ENCLOSURE

SOURCE: ASCO. AUTOMATIC TRANSFER SWITCHES

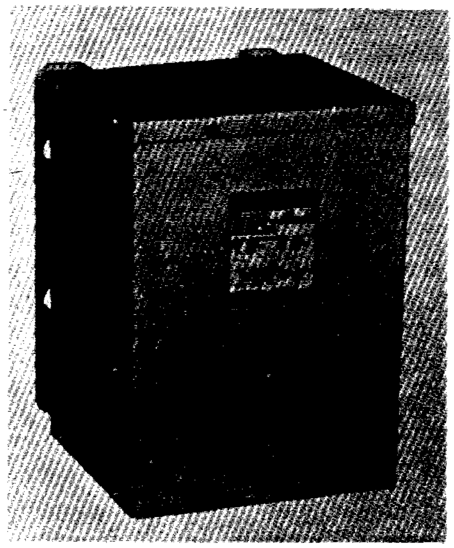
SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	TRANSFER SWITCH		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. A090102-14



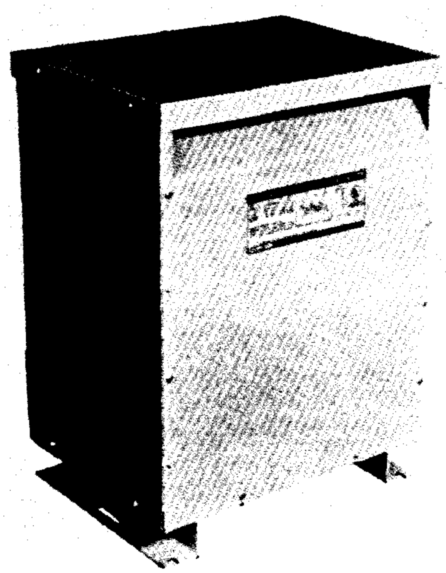
A



B



C



D

600V CLASS (DRY TYPE)	
STYLE	SIZE (kVA)
A	.05 THRU 3
B	3 THRU 15
C	5 THRU 25
D	25 THRU 1000

SOURCE: EATON CORP. POWER CONTROL DIV.(CUTLER-HAMMER PRODUCTS, ENGINEER'S MAN.)

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	TRANSFORMERS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. A090102-15

DEFICIENCY FACTORS
0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)

PROBABLE FAILURE POINTS

- Busway (Bus Duct) plug in components may not be secured.
- Conductors with burned or brittle insulation or with no fitting protection.
- Equipment location is often a storage location, reducing component accessibility.
- Motor Control Centers are undersized causing nuisance tripping.
- Motor shaft bearings are significant wear points.
- Panelboards containing circuit breakers that will not sustain rated current.
- Poor ground connections are safety hazards.
- Raceway and fittings that are rusted, corroded, or damaged. (Notable in outdoor applications.)
- Switchboards are altered for new uses without eliminating previous access points.
- Switches with burned, pitted, or defective contacts.
- The system grows and exceeds design ampacity ratings.
- Transformers used for lighting or power are infrequently serviced.

SYSTEM ASSEMBLY/DEFICIENCIES

Busway

Damaged Metering:	Device inoperative. Metering device broken or other physical damage. Tampering of metering device or circuit.
Defective Busbar:	Current limiting busway not used as required. Dirty or other contamination. Discolored, warped, or other signs of high temperature. Inadequately torqued to insulators. Joint/splice inadequately insulated when required. Joint/splice insulation burned, discolored, and unravelled. Joints inadequately torqued. Resistance less than one megOhm per each kiloVolt of rating between buses and or from buses to non-energized parts.
Defective Bushing/Insulator:	Cable clamp loose, missing, broken, corroded, burned, or other physical damage. Dirty, oily, greasy, or other surface contamination. Missing, cracked, chipped, or other damage. Not adequately secured. Oil leakage. Tracked or carbonized.
Defective Contactor:	Arc suppression components broken, eroded, cracked, or missing. Broken strands in braided shunts. Coil discolored, burned, or other sign of high temperature. Coil inoperative at 85% of rated Voltage. Contact pressure not per manufacturer's specifications.

DEFICIENCY FACTORS
0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)

SYSTEM ASSEMBLIES/DEFICIENCIES

Busway (Continued)

Defective Contactor:	Contacts burned, pitted, or other physical damage. Contacts not properly aligned. Control circuits improperly connected. Dash pot inoperative, broken, or missing. Device sticks magnetically. Drum contacts inadequately torqued. High contact resistance. Improper fluid in dash pot. Improper rolling action of drum contacts. Improper size. Indicator lamps inoperative. Indicator lens missing, cracked, or broken. Missing, loose, broken, or corroded hardware. No engineering study to support thermal trip device rating. Noisy. Plugging relays dirty or other contamination.' Pushbuttons not labeled. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts. Rheostat contact surface corroded, oxidized, uneven, or other physical defect. Rheostat holding coil missing or inoperative. Rheostat ventilation impeded. Terminals, contact blocks, bus bars, and connectors loose or discolored. Thermal trip device wrong size.
Defective Control Module:	Circuit boards improperly installed and/or connected. Inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, cracked, chipped, corroded, burned, or other damage to components and/or circuit boards. Not clean and moisture-free.
Defective Heater:	Heater not adequately secured to mounting surface. Improper conductors from source. Improper temperature in device enclosure. Inoperative heater element. Heater element resistance to ground less than one megOhm per kiloVolt of rating. Sensing device broken, missing, or inoperative. Sensing device malcalibrated.
Improper Busway Enclosure:	Corroded, rusted, dented, or other physical damage. Hanger corroded, rusted, or other physical damage. Inappropriate for application. Interlock broken, missing, or inoperative. No bushing or equivalent protection.

DEFICIENCY FACTORS
0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)

SYSTEM ASSEMBLIES/DEFICIENCIES

Busway

Improper Busway Enclosure (Continued):	Not clean and moisture-free. Supported by other raceway. Unused openings not covered or plugged. Ventilation obstructed.
Improper Control Wiring:	Bimetallic connectors not used as required. Bundled and trained inappropriately. Control circuits improperly connected. Control wiring insulation resistance less than one megOhm per each kiloVolt of rating. improper sensor pick-up or drop-out point. Improper termination. Inadequate fuse/connection tension. Inadequately torqued at termination. Inappropriate for application. Inconsistent time delays. Incorrect overcurrent protection. Indicator lamps inoperative. Indicator lens missing, cracked, or broken. Inoperative. Inoperative interlock. Insulation charred, burned, or discolored. Insulation improperly removed from conductor. No engineering study to support installed fuse. Splices improperly insulated. Terminal boards improperly installed. Unauthorized splice.
Improper Disconnect:	Adjustable settings misadjusted. Arc suppression devices broken, cracked, missing, tracked, chipped, or other physical damage. Contacts bent or not aligned. Defective phase barriers. Does not sustain rated current per NEMA AB4-1991. Does not trip on instantaneous overcurrent per NFPA 70B. Handle broken, bent, or other physical deformity. High conductor, lug temperature. High contact resistance. Improper application. Improper switch time. Improperly sized. Improperly wired. Interlock broken, missing, or inoperative. Movable contacts bent, malaligned, or other physical deformity. Movable contacts pitted, burned, or discolored. No engineering study to support adjustable settings. Not accessible.

DEFICIENCY FACTORS
0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)

SYSTEM ASSEMBLIES/DEFICIENCIES

Busway

Improper Disconnect (Continued):	Not adequate for application. Not clean and moisture-free. Not grounded properly. Not secured to mounting surface. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts. Series trip device missing, broken, or inoperative. Shunt trip device missing, broken, or inoperative. Stationary contacts bent, malaligned, or other physical deformity. Stationary contacts pitted, burned, or discolored. Terminals, contact blocks, bus bar and connectors loose, burned, or discolored. Time-delay overcurrent trip not per manufacturer's specifications. UnderVoltage trip missing, broken, maladjusted, or inoperative.
Improper Fitting:	Exposed conductors. Improper fitting for application. Insert broken, cracked, missing, or other damage. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, broken, cracked, loose, or other damage. Unused openings not covered or plugged.
Improper Fuse Unit:	Fuse clips bent, malaligned, discolored, or other physical damage. Improper fuse type used. Improperly sized. Poor fuse to clip contact. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts.
Improper Installation:	Crossover improperly installed or connected. Elbow improperly installed or connected. Fused protector not used as required. Hanger not adequately secured to structure. Improper bending radius. Improper joint. Improper trench. Improperly supported by other raceway. Inadequate grounding. Inadequate ventilation. Missing vertical run hardware. No bushing or equivalent protection, Not adequately protected from severe physical damage. Not adequately secured to mounting surface.

DEFICIENCY FACTORS
0.09.01 .02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI I 6400)

SYSTEM ASSEMBLIES/DEFICIENCIES

Busway

Improper Installation (Continued):	Not appropriate for location. Not clearly and permanently marked where required. Not secured within three feet of end of run. Protector improperly located. Protectors are not installed as required. Supported by other raceway. Switchboard flange improperly installed or connected. Tee improperly installed or connected. Unauthorized conductor present. Unlisted protector or non-identified protector employed. Unused openings not covered or plugged.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.
Improper Mount:	Device not secured to mount. Device mounting surface chipped, cracked, broken, or other physical damage. Dirty, oily, greasy, or other surface contamination. Mounting structure inadequate. Mounting structure not secured to mounting surface. Not aligned.
Inaccurate Metering:	Calibration standard not established. Defective or inoperative sensor or transducer. Metering device inadequately sized. Metering device not calibrated.

Conductors & Fittings

Improper Cable/Conductor:	Ampacity not properly rated. Bimetallic connectors not used as required. Broken wire strands. Burned, melted, discolored conductor material. Defective or deficient cable/conductor penetrations. High splice temperature. Improper bending radius. Improper insulation Voltage. Improper splice materials used. Improper termination. Improper trench. Improperly made splice. Inappropriate for application. Insulation inappropriate for application. Insulation improperly removed. Insulation is burned, charred, discolored, or other physical damage. Insulation resistance less than one megOhm per each kiloVolt of rating. Insulation unraveled, frayed, brittle, or other physical damage.

DEFICIENCY FACTORS
0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)

SYSTEM ASSEMBLIES/DEFICIENCIES

Conductors & Fittings

Improper Cable/Conductor (Continued):	Nicked or ringed conductor. Not properly bundled or trained. Not properly connected to device. Not properly derated for installation. Not properly supported. Not protected physically. Unauthorized splice.
Improper Fitting:	Exposed conductors. Improper fitting for application. Insert broken, cracked, missing, or other damage. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, broken, cracked, loose, or other damage. Unused openings not covered or plugged.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.

Disconnects

Defective Bushing/Insulator:	Cable clamp loose, missing, broken, corroded, burned, or other physical damage. Dirty, oily, greasy, or other surface contamination. Missing, cracked, chipped, or other damage. Not adequately secured. Oil leakage. Tracked or carbonized.
Defective Control Module:	Circuit boards improperly installed and/or connected. inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, cracked, chipped, corroded, burned, or other damage to components and/or circuit boards. Not clean and moisture-free.
Defective Heater:	Heater not adequately secured to mounting surface. Improper conductors from source. Improper temperature in device enclosure. Inoperative heater element. Heater element resistance to ground less than one megOhm per each kiloVolt of rating. Sensing device broken, missing, or inoperative. Sensing device malcalibrated.
Defective Pressure Relief:	High internal pressure. No internal pressure.
Improper Control Wiring:	Bimetallic connectors not used as required. Bundled and trained inappropriately.

DEFICIENCY FACTORS
0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)

SYSTEM ASSEMBLIES/DEFICIENCIES

Disconnects

Improper Control Wiring (Continued):
Control circuits improperly connected.
Control wiring insulation resistance less than one megOhm per each kiloVolt of rating.
Improper sensor pick-up or drop-out point.
Improper termination.
Inadequate fuse/connection tension.
Inadequately torqued at termination.
Inappropriate for application.
Inconsistent time delays.
Incorrect overcurrent protection.
Indicator lamps inoperative.
Indicator lens missing, cracked, or broken.
Inoperative.
Inoperative interlock.
Insulation charred, burned, or discolored.
Insulation improperly removed from conductor.
No engineering study to support installed fuse.
Splices improperly insulated.
Terminal boards improperly installed.
Unauthorized splice.

Improper Disconnect:
Adjustable settings misadjusted.
Arc suppression devices broken, cracked, missing, tracked, chipped, or other physical damage.
Contacts bent or not aligned.
Defective phase barriers.
Does not sustain rated current per NEMA AB4-1991.
Does not trip on instantaneous overcurrent per NFPA 70B.
Handle broken, bent, or other physical deformity.
High conductor, lug temperature.
High contact resistance.
Improper application.
improper switch time.
Improperly sized.
Improperly wired.
Interlock broken, missing, or inoperative.
Movable contacts bent, malaligned, or other physical deformity.
Movable contacts pitted, burned, or discolored.
No engineering study to support adjustable settings.
Not accessible.
Not adequate for application.
Not clean and moisture-free.
Not grounded properly.
Not secured to mounting surface.
Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts.
Series trip device missing, broken, or inoperative.

DEFICIENCY FACTORS
0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)

SYSTEM ASSEMBLIES/DEFICIENCIES

Disconnects

Improper Disconnects (Continued):	Shunt trip device missing, broken, or inoperative. Stationary contacts bent, malaligned, or other physical deformity. Stationary contacts pitted, burned, or discolored. Terminals, contact blocks, bus bar and connectors loose, burned, or discolored. Time-delay overcurrent trip not per manufacturer's specifications. UnderVoltage trip missing, broken, maladjusted, or inoperative.
Improper Enclosure:	Corroded, rusted, dented, or other physical damage. Dirty, missing, or inappropriate filters. Gaskets missing, damaged, misaligned, or other physical deformity. Insufficient work space. Interlock broken, missing, or inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, broken, damaged, or inoperative security device. No curbing or berm for oil containment. Not accessible. Not adequate for application. Not clean and moisture-free. Not grounded properly. Not secured to mounting surface. Oil leaks. Unused openings not covered or plugged. Ventilation openings defective, nonoperative, obstructed, or not properly guarded.
Improper Fuse Unit:	Fuse clips bent, malaligned, discolored, or other physical damage. Improper fuse type used. Improperly sized. Poor fuse to clip contact. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts.
Improper insulating Liquid:	Contaminated internal device. Low insulation resistance. Low liquid level. Oil does not meet criteria of NFPA 70B. Pressure leak.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.

DEFICIENCY FACTORS
0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)

SYSTEM ASSEMBLIES/DEFICIENCIES

Disconnects (Continued)

Improper Mount:	Device not secured to mount. Device mounting surface chipped, cracked, broken, or other physical damage. Dirty, oily, greasy, or other surface contamination. Mounting structure inadequate. Mounting structure not secured to mounting surface. Not aligned.
Improper Protective Relay:	Cover loose, missing, broken, cfiipped, cracked, or other physical damage. Current, Voltage, and time pick-up/drop-out values not per manufacturer's specifications. Housing chipped, cracked, broken, or other physical damage. Improper application. Improperly wired. Inoperative. Malcalibrated. Missing and/or out-of-date calibration tag. Movable contacts bent, malaligned, or other physical deformity. Movable contacts pitted, burned, or discolored. Not clean and moisture-free. Not secured to mounting surface. No engineering study to support adjustable setting. Stationary contacts bent, malaligned, or other physical deformity. Stationary contacts pitted, burned, or discolored. Terminals loose, broken, missing, burned, discolored, or corroded.
Inaccurate Metering:	Calibration standard not established. Defective or inoperative sensor or transducer. Metering device inadequately sized. Metering device not calibrated.

Metering

Damaged Metering:	Device inoperative. Metering device broken or other physical damage. Tampering of metering device or circuit.
Defective Busbar:	Current limiting busway not used as required. Dirty or other contamination. Discolored, warped, or other signs of high temperature. Inadequately torqued to insulators. Joint/splice inadequately insulated when required. Joint/splice insulation burned, discolored, and unravelled. Joints inadequately torqued.

DEFICIENCY FACTORS
0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 164001

SYSTEM ASSEMBLIES/DEFICIENCIES

Metering

Defective Busbar (Continued):	Resistance less than one megOhm per each kiloVolt of rating between buses and/or from buses to non-energized parts.
Defective Bushing/Insulator:	Cable clamp loose, missing, broken, corroded, burned, or other physical damage. Dirty, oily, greasy, or other surface contamination. Missing, cracked, chipped, or other damage. Not adequately secured. Oil leakage. Tracked or carbonized.
Defective Control Module:	Circuit boards improperly installed and/or connected. Inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, cracked, chipped, corroded, burned, or other damage to components and/or circuit boards. Not clean and moisture-free.
Improper Control Wiring:	Bimetallic connectors not used as required. Bundled and trained inappropriately. Control circuits improperly connected. Control wiring insulation resistance less than one megOhm per each kiloVolt of rating. Improper sensor pick-up or drop-out point. Improper termination. Inadequate fuse/connection tension. Inadequately torqued at termination. Inappropriate for application. Inconsistent time delays. Incorrect overcurrent protection. Indicator lamps inoperative. Indicator lens missing, cracked, or broken. Inoperative. Inoperative interlock. Insulation charred, burned, or discolored. Insulation improperly removed from conductor. No engineering study to support installed fuse. Splices improperly insulated. Terminal boards improperly installed. Unauthorized splice.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.
Improper Mount:	Device not secured to mount. Device mounting surface chipped, cracked, broken, or other physical damage. Dirty, oily, greasy, or other surface contamination. Mounting structure inadequate.

DEFICIENCY FACTORS
0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)

SYSTEM ASSEMBLIES/DEFICIENCIES

Metering

improper Mount (Continued):	Mounting structure not secured to mounting surface. Not aligned.
Inaccurate Metering:	Calibration standard not established. Defective or inoperative sensor or transducer. Metering device inadequately sized. Metering device not calibrated.

Motors

Defective Bearings:	High temperature. Rough or irregular rotation. Leaking seals. Improper bearing. Noisy.
Defective Control Module:	Circuit boards improperly installed and/or connected. Inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, cracked, chipped, corroded, burned, or other damage to components and/or circuit boards. Not clean and moisture-free.
Defective Heater:	Heater not adequately secured to mounting surface. Improper conductors from source. Improper temperature in device enclosure. Inoperative heater element. Heater element resistance to ground less than one megOhm per each kiloVolt of rating. Sensing device broken, missing, or inoperative. Sensing device malcalibrated.
Improper Cable/Conductor:	Ampacity not properly rated. Bimetallic connectors not used as required. Broken wire strands. Burned, melted, discolored conductor material. Defective or deficient cable/conductor penetrations. High splice temperature. Improper bending radius. Improper insulation Voltage. Improper splice materials used. Improper termination. Improper trench. Improperly made splice. Inappropriate for application. Insulation inappropriate for application. Insulation improperly removed. Insulation is burned, charred, discolored, or other physical damage.

DEFICIENCY FACTORS
0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)

SYSTEM ASSEMBLIES/DEFICIENCIES

Motors

Improper Cable/Conductor (Continued):	Insulation resistance less than one megOhm per each kiloVolt of rating. Insulation unraveled, frayed, brittle, or other physical damage. Nicked or ringed conductor. Not properly bundled or trained. Not properly connected to device. Not properly derated for installation. Not properly supported. Not protected physically. Unauthorized splice.
Improper Fitting:	Exposed conductors. Improper fitting for application. Insert broken, cracked, missing, or other damage. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, broken, cracked, loose, or other damage. Unused openings not covered or plugged.
Improper Housing:	Broken, leaking, obstructed, inoperative, or inadequate heat exchanger. Corroded, rusted, dented, or other physical damage. Dirty, missing, or inappropriate filters. End bells corroded, rusted, dented, missing, or other physical damage. Gaskets missing, damaged, malaligned, or other physical deformity. Loose, broken, damaged, corroded, or missing fastening hardware. Not accessible. Not adequate for application, incorrect NEMA rating. Not clean and moisture-free. Not properly grounded. Not secured to mounting base or surface. Unused openings not covered or plugged. Ventilation openings defective, nonoperative, obstructed, or not properly guarded.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.
Improper Mount:	Device not secured to mount. Device mounting surface chipped, cracked, broken, or other physical damage. Dirty, oily, greasy, or other surface contamination. Mounting structure inadequate. Mounting structure not secured to mounting surface. Not aligned.

DEFICIENCY FACTORS
0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)

SYSTEM ASSEMBLIES/DEFICIENCIES

Motors (Continued)

Improper Motor Application:	inappropriate starting system. Improper motor size. Improper rotation. Improper speed. Improper connection of bimetallic elements. Improper winding connections.
Improper Rotor/Stator:	Bent, scored, or other damage to rotor shaft. Burned, charred, or other signs of high temperature. Damaged internal and/or external cooling fan. Noisy laminations. Non-uniform air gap. Open turns or coils. Shorted turns or coils. Splice insulation unraveled, brittle, cracked, or other damage. Unbalanced rotor assembly.
Inaccurate Metering:	Calibration standard not established. Defective or inopertaive sensor or transducer. Metering device inadequately sized. Metering device not calibrated.

Motor Control Centers

Defective Bushing/Insulator:	Cable clamp loose, missing, broken, corroded, burned, or other physical damage. Dirty, oily, greasy, or other surface contamination. Missing, cracked, chipped, or other damage. Not adequately secured. Oil leakage. Tracked or carbonized.
Defective Contactor:	Arc suppression components broken, eroded, cracked, or missing. Broken strands in braided shunts. Coil discolored, burned, or other sign of high temperature. Coil inoperative at 85% of rated Voltage. Contact pressure not per manufacturer's specifications. Contacts burned, pitted, or other physical damage. Contacts not properly aligned. Control circuits improperly connected. Dash pot inoperative, broken, or missing. Device sticks magnetically. Drum contacts inadequately torqued. High contact resistance. Improper fluid in dash pot. Improper rolling action of drum contacts. Improper size. Indicator lamps inoperative. Indicator lens missing, cracked, or broken.

DEFICIENCY FACTORS
0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)

SYSTEM ASSEMBLIES/DEFICIENCIES

Motor Control Centers

Defective Contactor (Continued):	Missing, loose, broken, or corroded hardware. No engineering study to support thermal trip device rating. Noisy. Plugging relays dirty or other contamination. Pushbuttons not labeled. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts. Rheostat contact surface corroded, oxidized, uneven, or other physical defect. Rheostat holding coil missing or inoperative. Rheostat ventilation impeded. Terminals, contact blocks, bus bars, and connectors loose or discolored. Thermal trip device wrong size.
Defective Control Module:	Circuit boards improperly installed and/or connected. Inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, cracked, chipped, corroded, burned, or other damage to components and/or circuit boards. Not clean and moisture-free.
Defective Heater:	Heater not adequately secured to mounting surface. Improper conductors from source. Improper temperature in device enclosure. Inoperative heater element. Heater element resistance to ground less than one megOhm per each kiloVolt of rating. Sensing device broken, missing, or inoperative. Sensing device malcalibrated.
Defective Pressure Relief:	High internal pressure. No internal pressure.
Improper Bus:	Discolored, warped, or other signs of high temperature. Not properly torqued. Not adequately secured or braced. Resistance less than one megOhm per each kiloVolt of rating between buses and/or from buses to non-energized parts. Insulated connections unraveled, brittle, cracked, or other physical damage. Barriers missing or damaged.
Improper Control Wiring:	Bimetallic connectors not used as required. Bundled and trained inappropriately. Control circuits improperly connected. Control wiring insulation resistance less than one megOhm per each kiloVolt of rating.

DEFICIENCY FACTORS
0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)

SYSTEM ASSEMBLIES/DEFICIENCIES

Motor Control Centers

Improper Control Wiring (Continued):
- Improper sensor pick-up or drop-out point.
- Improper termination.
- Inadequate fuse/connection tension.
- Inadequately torqued at termination.
- Inappropriate for application.
- Inconsistent time delays.
- Incorrect overcurrent protection.
- Indicator lamps inoperative.
- Indicator lens missing, cracked, or broken.
- Inoperative.
- Inoperative interlock.
- Insulation charred, burned, or discolored.
- Insulation improperly removed from conductor.
- No engineering study to support installed fuse.
- Splices improperly insulated.
- Terminal boards improperly installed.
- Unauthorized splice.

Improper Disconnect:
- Adjustable settings misadjusted.
- Arc suppression devices broken, cracked, missing, tracked, chipped, or other physical damage.
- Contacts bent or not aligned.
- Defective phase barriers.
- Does not sustain rated current per NEMA AB4-1991.
- Does not trip on instantaneous overcurrent per NFPA 708.
- Handle broken, bent, or other physical deformity.
- High conductor, lug temperature.
- High contact resistance.
- Improper application.
- Improper switch time.
- Improperly sized.
- Improperly wired.
- Interlock broken, missing, or inoperative.
- Movable contacts bent, malaligned, or other physical deformity.
- Movable contacts pitted, burned, or discolored.
- No engineering study to support adjustable settings.
- Not accessible.
- Not adequate for application.
- Not clean and moisture-free.
- Not grounded properly.
- Not secured to mounting surface.
- Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts.
- Series trip device missing, broken, or inoperative.
- Shunt trip device missing, broken, or inoperative.
- Stationary contacts bent, malaligned, or other physical deformity.

DEFICIENCY FACTORS
0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)

SYSTEM ASSEMBLIES/DEFICIENCIES

Motor Control Centers

Improper Disconnect (Continued):	Stationary contacts pitted, burned, or discolored. Terminals, contact blocks, bus bar and connectors loose, burned, or discolored. Time-delay overcurrent trip not per manufacturer's specifications. UnderVoltage trip missing, broken, maladjusted, or inoperative.
Improper Enclosure:	Corroded, rusted, dented, or other physical damage. Dirty, missing, or inappropriate filters. Gaskets missing, damaged, misaligned, or other physical deformity. Interlock broken, missing, or inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, broken, damaged, or inoperative security device. No curbing or berm for oil containment. Not accessible. Not adequate for application. Not clean and moisture-free. Not grounded properly. Not secured to mounting surface. Oil leaks. Unused openings not covered or plugged. Ventilation openings defective, nonoperative, obstructed, or not properly guarded.
Improper Equipment Protection:	Improper or inadequate primary overcurrent device. Improper or inadequate secondary overcurrent device. No engineering study to support protection scheme. Incorrect calibration of protective devices or sensors. improper or inadequate differential protection. Time delay suppression devices missing, broken, or inoperative.
Improper Fuse Unit:	Fuse clips bent, malaligned, discolored, or other physical damage. Improper fuse type used. Improperly sized. Poor fuse to clip contact. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts.
improper Insulating Liquid:	Low liquid level. Low insulation resistance. Pressure leak. Contaminated internal device. Oil does not meet criteria of NFPA 70B.

DEFICIENCY FACTORS
0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)

SYSTEM ASSEMBLIES/DEFICIENCIES

Motor Control Centers (Continued)

Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.
Inaccurate Metering:	Calibration standard not established. Defective or inoperative sensor or transducer. Metering device inadequately sized. Metering device not calibrated.
Improper Mount:	Device not secured to mount. Device mounting surface chipped, cracked, broken, or other physical damage. Dirty, oily, greasy, or other surface contamination. Mounting structure inadequate. Mounting structure not secured to mounting surface. Not aligned.

Panelboards

Damaged Metering:	Device inoperative. Metering device broken or other physical damage. Tampering of metering device or circuit.
Defective Bushing/Insulator:	Cable clamp loose, missing, broken, corroded, burned, or other physical damage. Dirty, oily, greasy, or other surface contamination. Missing, cracked, chipped, or other damage. Not adequately secured. Oil leakage. Tracked or carbonized.
Defective Control Module:	Circuit boards improperly installed and/or connected. Inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, cracked, chipped, corroded, burned, or other damage to components and/or circuit boards. Not clean and moisture-free.
Defective Heater:	Heater not adequately secured to mounting surface. Improper conductors from source. Improper temperature in device enclosure. Inoperative heater element. Heater element resistance to ground less than one megOhm per each kiloVolt of rating. Sensing device broken, missing, or inoperative. Sensing device malcalibrated.
Improper Bus:	Discolored, warped, or other signs of high temperature. Not properly torqued. Not adequately secured or braced.

DEFICIENCY FACTORS
0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 164001

SYSTEM ASSEMBLIES/DEFICIENCIES

Panelboards

Improper Bus (Continued):	Resistance less than one megOhm per each kiloVolt of rating between buses and/or from buses to non-energized parts. Insulated connections unraveled, brittle, cracked, or other physical damage. Barriers missing or damaged.
Improper Control Wiring:	Bimetallic connectors not used as required. Bundled and trained inappropriately. Control circuits improperly connected. Control wiring insulation resistance less than one megOhm per each kiloVolt of rating. Improper sensor pick-up or drop-out point. Improper termination. Inadequate fuse/connection tension. Inadequately torqued at termination. Inappropriate for application. Inconsistent time delays. Incorrect overcurrent protection. Indicator lamps inoperative. Indicator lens missing, cracked, or broken. Inoperative. Inoperative interlock. Insulation charred, burned, or discolored. Insulation improperly removed from conductor. No engineering study to support installed fuse. Splices improperly insulated. Terminal boards improperly installed. Unauthorized splice.
Improper Disconnect:	Adjustable settings misadjusted. Arc suppression devices broken, cracked, missing, tracked, chipped, or other physical damage. Contacts bent or not aligned. Defective phase barriers. Does not sustain rated current per NEMA AB4-1991. Does not trip on instantaneous overcurrent per NFPA 70B. Handle broken, bent, or other physical deformity. High conductor, lug temperature. High contact resistance. Improper application. Improper switch time. Improperly sized. Improperly wired. Interlock broken, missing, or inoperative. Movable contacts bent, malaligned, or other physical deformity. Movable contacts pitted, burned, or discolored. No engineering study to support adjustable settings.

DEFICIENCY FACTORS
0.09.01.02 LOW VOLTAGE **DISTRIBUTION** SYSTEM (CSI 16400)

SYSTEM ASSEMBLIES/DEFICIENCIES

Panelboards

Improper Disconnect (Continued):	Not accessible. Not adequate for application. Not clean and moisture-free. Not grounded properly. Not secured to mounting surface. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts. Series trip device missing, broken, or inoperative. Shunt trip device missing, broken, or inoperative. Stationary contacts bent, malaligned, or other physical deformity. Stationary contacts pitted, burned. or discolored. Terminals, contact blocks, bus bar and connectors loose, burned, or discolored. Time-delay overcurrent trip not per manufacturer's specifications. UnderVoltage trip missing, broken, maladjusted, or inoperative.
Improper Enclosure:	Corroded, rusted, dented, or other physical damage. Dirty, missing, or inappropriate filters. Gaskets missing, damaged, misaligned, or other physical deformity. Not secured to mounting surface. Interlock broken, missing, or inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, broken, damaged, or inoperative security device. No curbing or berm for oil containment. Not accessible. Not adequate for application. Not clean and moisture-free. Not grounded properly. Oil leaks. Unused openings not covered or plugged. Ventilation openings defective, nonoperative, obstructed, or not properly guarded.
Improper Fuse Unit:	Fuse clips bent, malaligned, discolored, or other physical damage. Improper fuse type used. Improperly sized. Poor fuse to clip contact. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.

DEFICIENCY FACTORS
0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)

SYSTEM ASSEMBLIES/DEFICIENCIES

Panelboards (Continued)

Improper Mount:	Device not secured to mount. Device mounting surface chipped, cracked, broken, or other physical damage. Dirty, oily, greasy, or other surface contamination. Mounting structure inadequate. Mounting structure not secured to mounting surface. Not aligned.
Inaccurate Metering:	Calibration standard not established. Defective or inoperative sensor or transducer. Metering device inadequately sized. Metering device not calibrated.

Raceway & Fittings

Improper Fitting:	Exposed conductors. Improper fitting for application. Insert broken, cracked, missing, or other damage. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, broken, cracked, loose, or other damage. Unused openings not covered or plugged.
Improper Installation:	Excessive bends. Hanger not adequately secured to structure. Improper bending radius. Improper joint. Improper trench. Improperly supported by other raceway. Inadequate grounding. Missing vertical run hardware. No bushing or equivalent protection. Not adequately protected from severe physical damage. Not adequately secured to mounting surface. Not appropriate for location. Not clearly and permanently marked where required. Not secured within three feet of end of run. Supported by other raceway. Overfilled. Unauthorized conductor present. Unused openings not covered or plugged.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.
Improper Mount:	Device not secured to mount. Device mounting surface chipped, cracked, broken, or other physical damage. Dirty, oily, greasy, or other surface contamination. Mounting structure inadequate.

DEFICIENCY FACTORS
0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI I-6400)

SYSTEM ASSEMBLIES/DEFICIENCIES

Raceway & Fittings

Improper Mount (Continued):	Mounting structure not secured to mounting surface. Not aligned.
improper Raceway:	Inappropriate for application. Corroded, rusted, dented, or other physical damage. Hanger corroded, rusted, or other physical damage. Not clean and moisture-free.

Switchboards

Damaged Metering:	Device inoperative. Metering device broken or other physical damage. Tampering of metering device or circuit.
Defective Bushing/Insulator:	Cable clamp loose, missing, broken, corroded, burned, or other physical damage. Dirty, oily, greasy, or other surface contamination. Missing, cracked, chipped, or other damage. Not adequately secured. Oil Leakage. Tracked or carbonized.
Defective Control Module:	Circuit boards improperly installed and/or connected. Inoperative.. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, cracked, chipped, corroded, burned, or other damage to components and/or circuit boards. Not clean and moisture-free.
Defective Heater:	Heater not adequately secured to mounting surface. Improper conductors from source. Improper temperature in device enclosure. Inoperative heater element. Heater element resistance to ground less than one megOhm per each kiloVolt of rating. Sensing device broken, missing, or inoperative. Sensing device malcalibrated.
Defective Pressure Relief:	High internal pressure. No internal pressure.
Improper Bus:	Discolored, warped, or other signs of high temperature. Not properly torqued. Not adequately secured or braced. Resistance less than one megOhm per each kiloVolt of rating between buses and/or from buses to non-energized parts. Insulated connections unraveled, brittle, cracked, or other physical damage. Barriers missing or damaged.

DEFICIENCY FACTORS
0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)

SYSTEM ASSEMBLIES/DEFICIENCIES

Switchboards (Continued)

Improper Control Wiring:

Bimetallic connectors not used as required.
Bundled and trained inappropriately.
Control circuits improperly connected.
Control wiring insulation resistance less than one megOhm per each kiloVolt of rating.
Improper sensor pick-up or drop-out point.
Improper termination.
Inadequate fuse/connection tension.
Inadequately torqued at termination.
Inappropriate for application.
Inconsistent time delays.
Incorrect overcurrent protection.
Indicator lamps inoperative.
Indicator lens missing, cracked, or broken.
Inoperative.
Inoperative interlock.
Insulation charred, burned, or discolored.
Insulation improperly removed from conductor.
No engineering study to support installed fuse.
Splices improperly insulated.
Terminal boards improperly installed.
Unauthorized splice.

improper Disconnect:

Adjustable settings misadjusted.
Arc suppression devices broken, cracked, missing, tracked, chipped, or other physical damage.
Contacts bent or not aligned.
Defective phase barriers.
Does not sustain rated current per NEMA AB4-1991.
Does not trip on instantaneous overcurrent per NFPA 708.
Handle broken, bent, or other physical deformity.
High conductor, lug temperature.
High contact resistance.
Improper application.
Improper switch time.
Improperly sized.
Improperly wired.
Interlock broken, missing, or inoperative.
Movable contacts bent, malaligned, or other physical deformity.
Movable contacts pitted, burned, or discolored.
No engineering study to support adjustable settings.
Not accessible.
Not adequate for application.
Not clean and moisture-free.
Not grounded properly.
Not secured to mounting surface.

DEFICIENCY FACTORS
0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)

SYSTEM ASSEMBLIES/DEFICIENCIES

Switchboards

Improper Disconnect (Continued):	Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts. Series trip device missing, broken, or inoperative. Shunt trip device missing, broken, or inoperative. Stationary contacts bent, malaligned, or other physical deformity. Stationary contacts pitted, burned, or discolored. Terminals, contact blocks, bus bar and connectors loose, burned, or discolored. Time-delay overcurrent trip not per manufacturer's specifications. UnderVoltage trip missing, broken, maladjusted, or inoperative.
Improper Enclosure:	Corroded, rusted, dented, or other physical damage. Dirty, missing, or inappropriate filters. Gaskets missing, damaged, misaligned, or other physical deformity. Not secured to mounting surface. Interlock broken, missing, or inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, broken, damaged, or inoperative security device. No curbing or berm for oil containment. Not accessible. Not adequate for application. Not clean and moisture-free. Not grounded properly. Oil leaks. Unused openings not covered or plugged. Ventilation openings defective, nonoperative, obstructed, or not properly guarded.
Improper Equipment Protection:	Improper or inadequate primary overcurrent device. Improper or inadequate secondary overcurrent device. No engineering study to support protection scheme. Incorrect calibration of protective devices or sensors. Improper or inadequate differential protection. Time delay suppression devices missing, broken, or inoperative.
Improper Fuse Unit:	Fuse clips bent, malaligned, discolored, or other physical damage. Improper fuse type used. Improperly sized. Poor fuse to clip contact. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts.

DEFICIENCY FACTORS
0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)

SYSTEM ASSEMBLIES/DEFICIENCIES

Switchboards (Continued)

Improper Insulating Liquid:	Low liquid level. Low insulation resistance. Pressure leak. Contaminated internal device. Oil does not meet criteria of NFPA 70B.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.
Improper Mount:	Device not secured to mount. Device mounting surface chipped, cracked, broken, or other physical damage. Dirty, oily, greasy, or other surface contamination. Mounting structure inadequate. Mounting structure not secured to mounting surface. Not aligned.
Improper Protective Relay:	Cover loose, missing, broken, chipped, cracked, or other physical damage. Current, Voltage, and time pick-up/drop-out values not per manufacturer's specifications. Housing chipped, cracked, broken, or other physical damage. Improper application. Improperly wired. Inoperative. Malcalibrated. Missing and/or out-of-date calibration tag. Movable contacts bent, malaligned, or other physical deformity. Movable contacts pitted, burned, or discolored. Not clean and moisture-free. Not secured to mounting surface. No engineering study to support adjustable setting. Stationary contacts bent, malaligned, or other physical deformity. Stationary contacts pitted, burned, or discolored. Terminals loose, broken, missing, burned, discolored, or corroded.
Inaccurate Metering:	Calibration standard not established. Defective or inoperative sensor or transducer. Metering device inadequately sized. Metering device not calibrated.

Transfer Switches

Damaged Metering:	Device inoperative. Metering device broken or other physical damage. Tampering of metering device or circuit.

DEFICIENCY FACTORS
0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)

SYSTEM ASSEMBLIES/DEFICIENCIES

Transfer Switches (Continued)

Defective Bushing/Insulator:	Cable clamp loose, missing, broken, corroded, burned, or other physical damage. Dirty, oily, greasy, or other surface contamination. Missing, cracked, chipped, or other damage. Not adequately secured. Oil leakage. Tracked or carbonized.
Defective Control Module:	Circuit boards improperly installed and/or connected. Inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, cracked, chipped, corroded, burned, or other damage to components and/or circuit boards. Not clean and moisture-free.
Defective Heater:	Heater not adequately secured to mounting surface. Improper conductors from source. Improper temperature in device enclosure. Inoperative heater element. Heater element resistance to ground less than one megOhm per each kiloVolt of rating. Sensing device broken, missing, or inoperative. Sensing device malcalibrated.
Defective Pressure Relief:	High internal pressure. No internal pressure.
Defective Solenoid:	Inoperative. Sticks magnetically. Noisy. Coil discolored, burned, or other sign of high temperature. High pick-up Voltage. Fitting missing or inappropriate. Missing, loose, broken, or corroded hardware. Relay dirty or other contamination. Improper size.
Improper Bus:	Discolored, warped, or other signs of high temperature. Not properly torqued. Not adequately secured or braced. Resistance less than one megOhm per each kiloVolt of rating between buses and/or from buses to non-energized parts. Insulated connections unraveled, brittle, cracked, or other physical damage. Barriers missing or damaged.

DEFICIENCY FACTORS
0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)

SYSTEM ASSEMBLIES/DEFICIENCIES

Transfer Switches (Continued)

improper Control Wiring:	Bimetallic connectors not used as required. Bundled and trained inappropriately. Control circuits improperly connected. Control wiring insulation resistance less than one megOhm per each kiloVolt of rating. Improper sensor pick-up or drop-out point. Improper termination. Inadequate fuse/connection tension. Inadequately torqued at termination. Inappropriate for application. Inconsistent time delays. Incorrect overcurrent protection. Indicator lamps inoperative. Indicator lens missing, cracked, or broken. Inoperative. Inoperative interlock. Insulation charred, burned, or discolored. Insulation improperly removed from conductor. No engineering study to support installed fuse. Splices improperly insulated. Terminal boards improperly installed. Unauthorized splice.
Improper Disconnect:	Adjustable settings misadjusted. Arc suppression devices broken, cracked, missing, tracked, chipped, or other physical damage. Contacts bent or not aligned. Defective phase barriers. Does not sustain rated current per NEMA AB4-1991. Does not trip on instantaneous overcurrent per NFPA 70B. Handle broken, bent, or other physical deformity. High conductor, lug temperature. High contact resistance. Improper application. Improper switch time. Improperly sized. Improperly wired. Interlock broken, missing, or inoperative. Movable contacts bent, malaligned, or other physical deformity. Movable contacts pitted, burned, or discolored. No engineering study to support adjustable settings. Not accessible. Not adequate for application. Not clean and moisture-free. Not grounded properly. Not secured to mounting surface.

DEFICIENCY FACTORS
0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)

SYSTEM ASSEMBLIES/DEFICIENCIES

Transfer Switches

Improper Disconnect (Continued):	Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts. Series trip device missing, broken, or inoperative. Shunt trip device missing, broken, or inoperative. Stationary contacts bent, malaligned, or other physical deformity. Stationary contacts pitted, burned, or discolored. Terminals, contact blocks, bus bar and connectors loose, burned, or discolored. Time-delay overcurrent trip not per manufacturer's specifications. UnderVoltage trip missing, broken, maladjusted, or inoperative.
Improper Enclosure:	Corroded, rusted, dented, or other physical damage. Dirty, missing, or inappropriate filters. Gaskets missing, damaged, misaligned, or other physical deformity. Not secured to mounting surface. Interlock broken, missing, or inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, broken, damaged, or inoperative security device. No curbing or berm for oil containment. Not accessible. Not adequate for application. Not clean and moisture-free. Not grounded properly. Oil leaks. Unused openings not covered or plugged. Ventilation openings defective, nonoperative, obstructed, or not properly guarded.
Improper Insulating Liquid:	Contaminated internal device. Low liquid level. Low insulation resistance. Pressure leak. Oil does not meet criteria of NFPA 70B.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.
Inaccurate Metering:	Calibration standard not established. Defective or inoperative sensor or transducer. Metering device inadequately sized. Metering device not calibrated.
Improper Mount:	Device not secured to mount. Device mounting surface chipped, cracked, broken, or other physical damage.

DEFICIENCY FACTORS
0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)

SYSTEM ASSEMBLIES/DEFICIENCIES

Transfer Switches

Improper Mount (Continued):	Dirty, oily, greasy, or other surface contamination. Mounting structure inadequate. Mounting structure not secured to mounting surface. Not aligned.

Transformers

Contaminated Transformer:	Contaminated coils and core.
Damaged Metering:	Device inoperative. Metering device broken or other physical damage. Tampering of metering device or circuit.
Defective Bushing/Insulator:	Cable clamp loose, missing, broken, corroded, burned, or other physical damage. Dirty, oily, greasy, or other surface contamination. Missing, cracked, chipped, or other damage. Not adequately secured. Oil leakage. Tracked or carbonized.
Defective Control Module:	Circuit boards improperly installed and/or connected. Inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, cracked, chipped, corroded, burned, or other damage to components and/or circuit boards. Not clean and moisture-free.
Defective Heater:	Heater not adequately secured to mounting surface. Improper conductors from source. Improper temperature in device enclosure. Inoperative heater element. Heater element resistance to ground less than one megOhm per each kiloVolt of rating. Sensing device broken, missing, or inoperative. Sensing device malcalibrated.
Defective Pressure Relief:	High internal pressure. No internal pressure.
Defective Transformer:	Cooling fans inoperative. Corona. Inadequate rating. Low insulation resistance. Low liquid level. Noisy. Pressure leak. Shorted or open coil or winding. Tap changer inoperative.

DEFICIENCY FACTORS
0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)

SYSTEM ASSEMBLIES/DEFICIENCIES

Transformers (Continued)

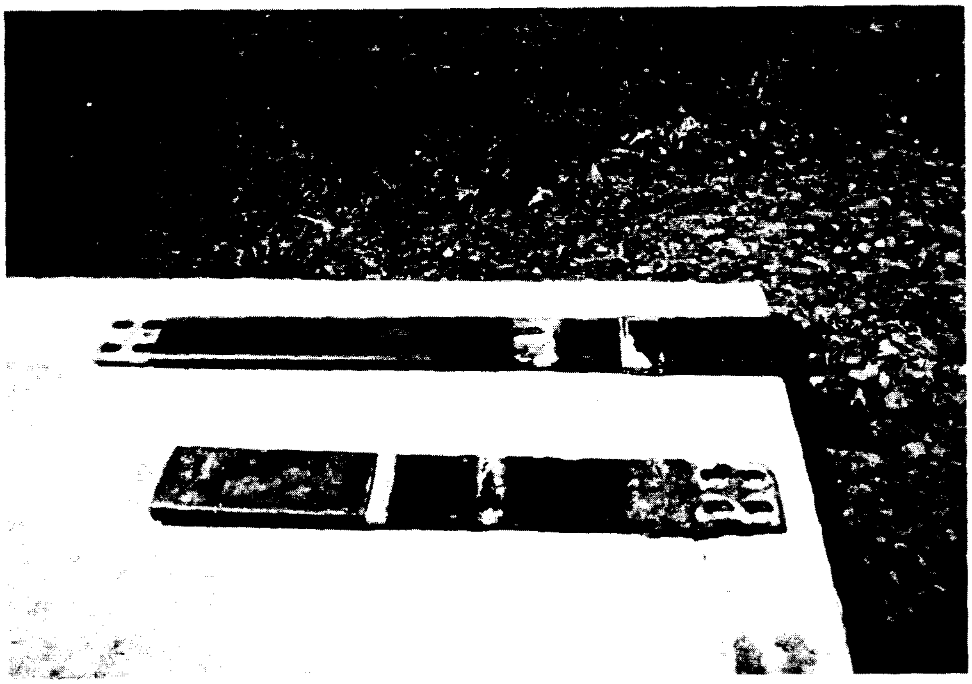
Defective Ventilation:	High operating temperature. Ventilation inlets clogged. Ventilation obstructed. Location not adequately ventilated.
Improper Control Wiring:	Bimetallic connectors not used as required. Bundled and trained inappropriately. Control circuits improperly connected. Control wiring insulation resistance less than one megOhm per each kiloVolt of rating. Improper sensor pick-up or drop-out point. Improper termination. Inadequate fuse/connection tension. Inadequately torqued at termination. Inappropriate for application. Inconsistent time delays. Incorrect overcurrent protection. Indicator lamps inoperative. Indicator lens missing, cracked, or broken. Inoperative. Inoperative interlock. Insulation charred, burned, or discolored. Insulation improperly removed from conductor. No engineering study to support installed fuse. Splices improperly insulated. Terminal boards improperly installed. Unauthorized splice.
Improper Enclosure:	Corroded, rusted, dented, or other physical damage. Dirty, missing, or inappropriate filters. Gaskets missing, damaged, malaligned, or other physical deformity. Interlock broken, missing, or inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, broken, damaged, or inoperative security device. No curbing or berm for oil containment. Not accessible. Not adequate for application. Not clean and moisture-free. Not grounded properly. Not secured to mounting surface. Oil leaks. Pedestal mounting surface chipped, broken, or other physical damage. Unused openings not covered or plugged. Ventilation openings defective, nonoperative, obstructed, or not properly guarded.

DEFICIENCY FACTORS
0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 164001

SYSTEM ASSEMBLIES/DEFICIENCIES

Transformers (Continued)

Improper Equipment Protection:	improper or inadequate primary overcurrent device. Improper or inadequate secondary overcurrent device. No engineering study to support protection scheme. Incorrect calibration of protective devices or sensors. Improper or inadequate differential protection. Time delay suppression devices missing, broken, or inoperative.
Improper Insulating Liquid:	Contaminated internal device. Low insulation resistance. Low liquid level. Oil does not meet criteria of NFPA 70B. Pressure leak.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.
Inaccurate Metering:	Calibration standard not established. Defective or inoperative sensor or transducer. Metering device inadequately sized. Metering device not calibrated.

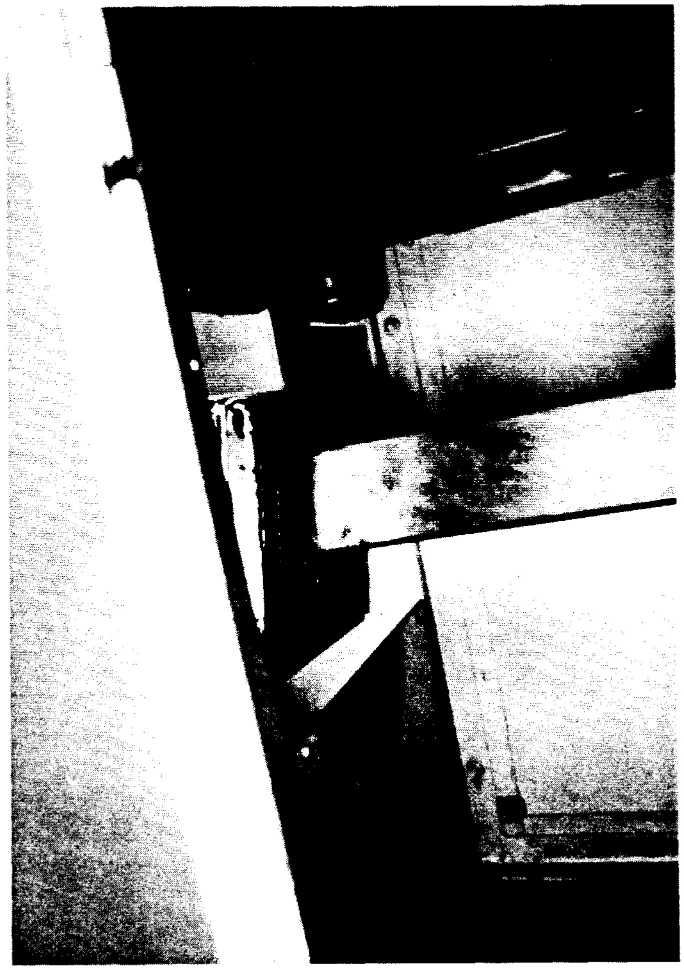


DEFECTIVE BUSBAR

DEFICIENCY:
1. DISCOLORED, WARPED OR OTHER SIGN OF HIGH TEMPERATURE

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	BUSWAY (BUS DUCT)		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. D090102-1

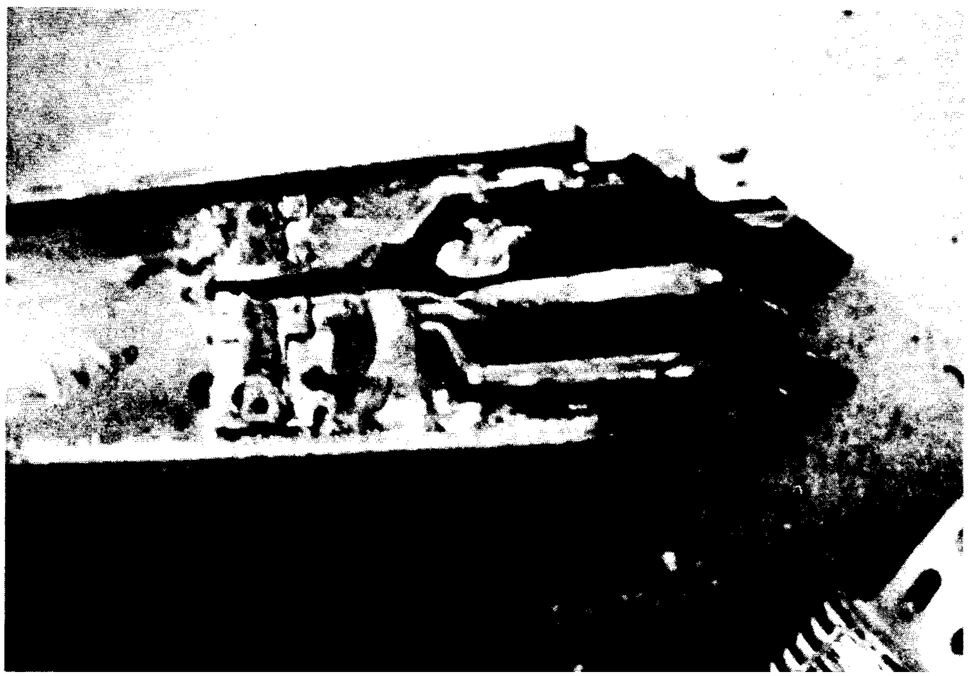


IMPROPER FITTING

DEFICIENCY:
1. INSERT BROKEN, CRACKED, MISSING OR OTHER DAMAGE

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	BUSWAY (BUS DUCT)		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. D090102-2



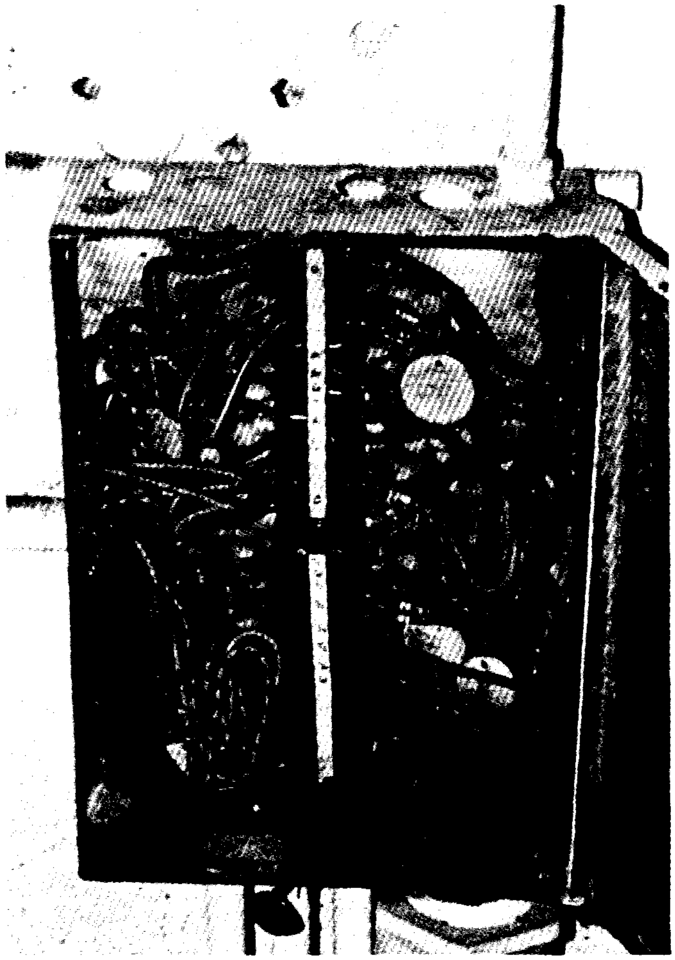
DEFECTIVE BUSBAR

DEFICIENCIES

1. JOINTS INADEQUATELY TORQUED
2. DISCOLORED, WARPED OR OTHER SIGNS OF HIGH TEMPERATURE

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	BUSWAY (BUS DUCT)		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. D090102-3



IMPROPER CABLE/CONDUCTOR

DEFICIENCY:

1. NOT PROPERLY BUNDLED OR TRAINED

IMPROPER FITTING

DEFICIENCY:

1. UNUSED OPENINGS NOT COVERED OR PLUGGED

PHOTO ILLUSTRATION

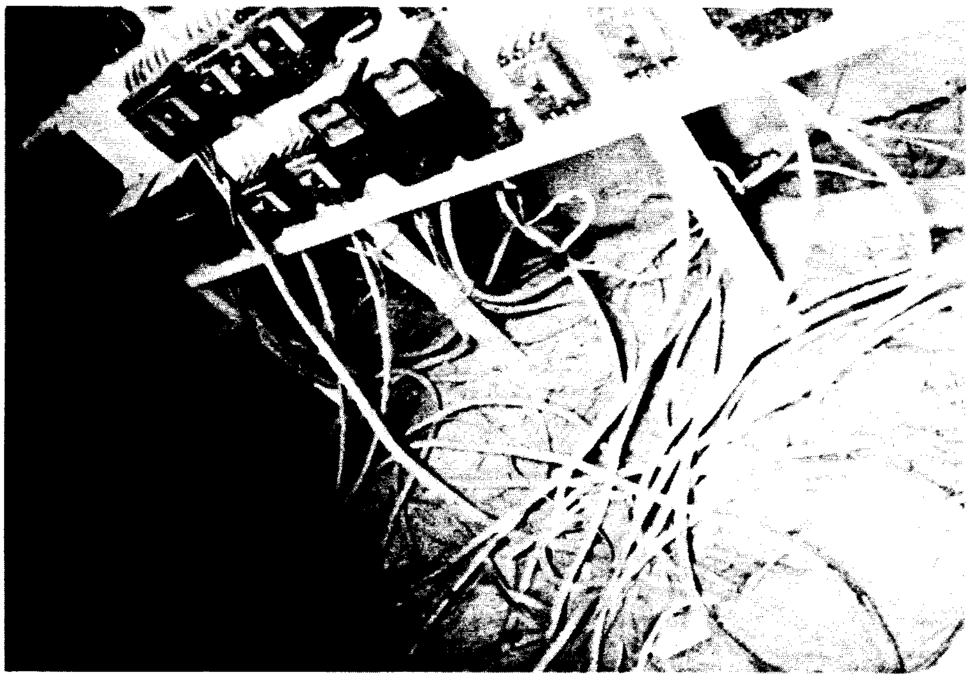
SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	CONDUCTORS AND FITTINGS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. D090102-4

IMPROPER CABLE/CONDUCTOR

DEFICIENCY:
1. NOT PROPERLY BUNDLED OR TRAINED
2. NOT PROTECTED PHYSICALLY

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	CONDUCTORS AND FITTINGS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. D090102-5



IMPROPER CABLE/CONDUCTOR

DEFICIENCIES:
1. NOT PROPERLY SUPPORTED IN VERTICAL RUN
2. NOT PROPERLY BUNDLED OR TRAINED
3. NOT PROTECTED PHYSICALLY

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	CONDUCTORS AND FITTINGS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawhg No. D090102-6

REVIEW PENDING

APPROVAL PENDING

IMPROPER CABLE/CONDUCTOR

DEFICIENCIES:
1. NOT PROTECTED PHYSICALLY
2. INSULATION IS BURNED, CHARED, DISCOLORED OR OTHER PHYSICAL DAMAGE

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	CONDUCTORS AND FITTINGS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. D090102-7

REVIEW PENDING

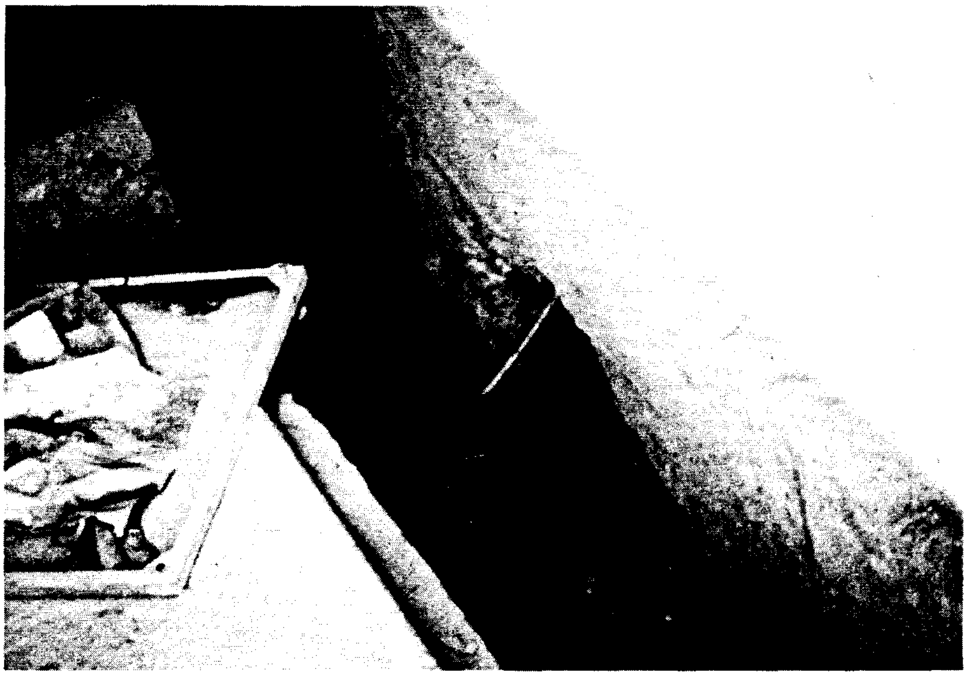
APPROVAL PENDING

IMPROPER CABLE/CONDUCTOR

DEFICIENCIES:
1. BROKEN WIRE STRANDS
2. NOT PROPERLY CONNECTED TO DEVICE

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	CONDUCTORS AND FITTINGS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. D090102-8

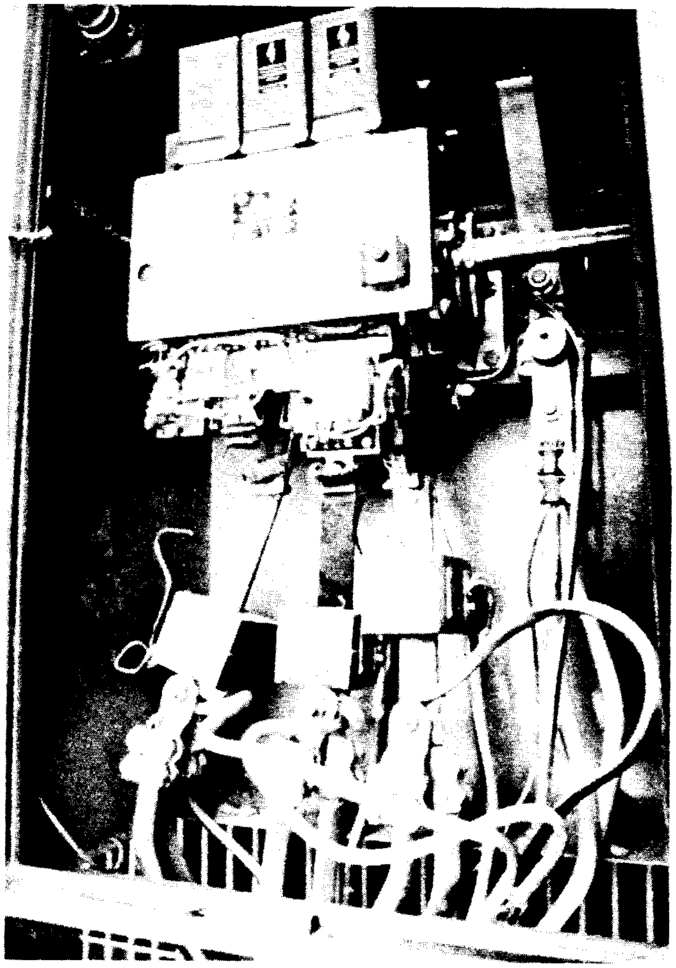


IMPROPER FITTING

DEFICIENCY:
1. MISSING, BROKEN, CRACKED OR OTHER DAMAGE

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	CONDUCTORS AND FITTINGS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. D090102-9

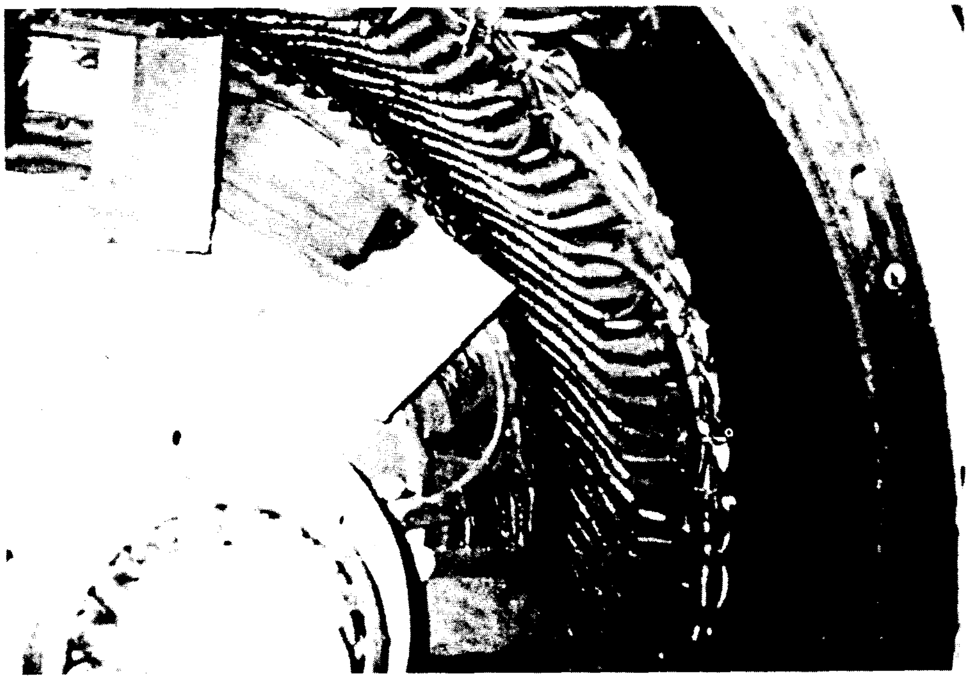


IMPROPER ENCLOSURE

DEFICIENCIES:
1. NOT CLEAN AND MOISTURE FREE
2. NOT ADEQUATE FOR APPLICATION
3. UNUSED OPENINGS NOT COVERED OR PLUGGED

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	DISCONNECTS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. D090102-10

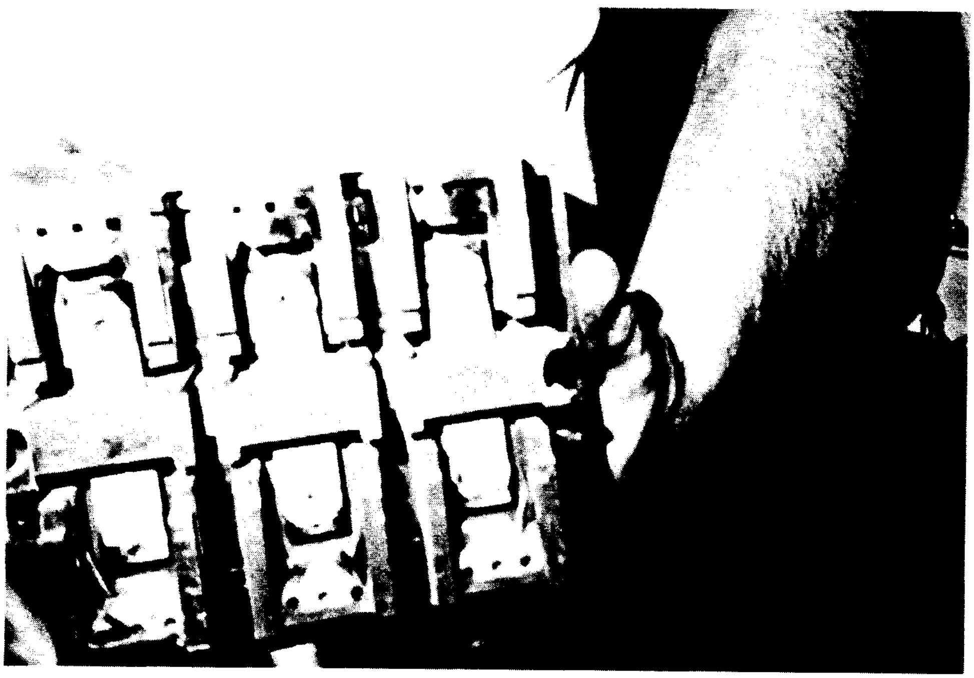


IMPROPER ROTOR/STATOR

DEFICIENCY:
1. BURNED, CHARRED OR OTHER SIGNS OF HIGH TEMPERATURE

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	MOTORS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawhg No. D090102-11

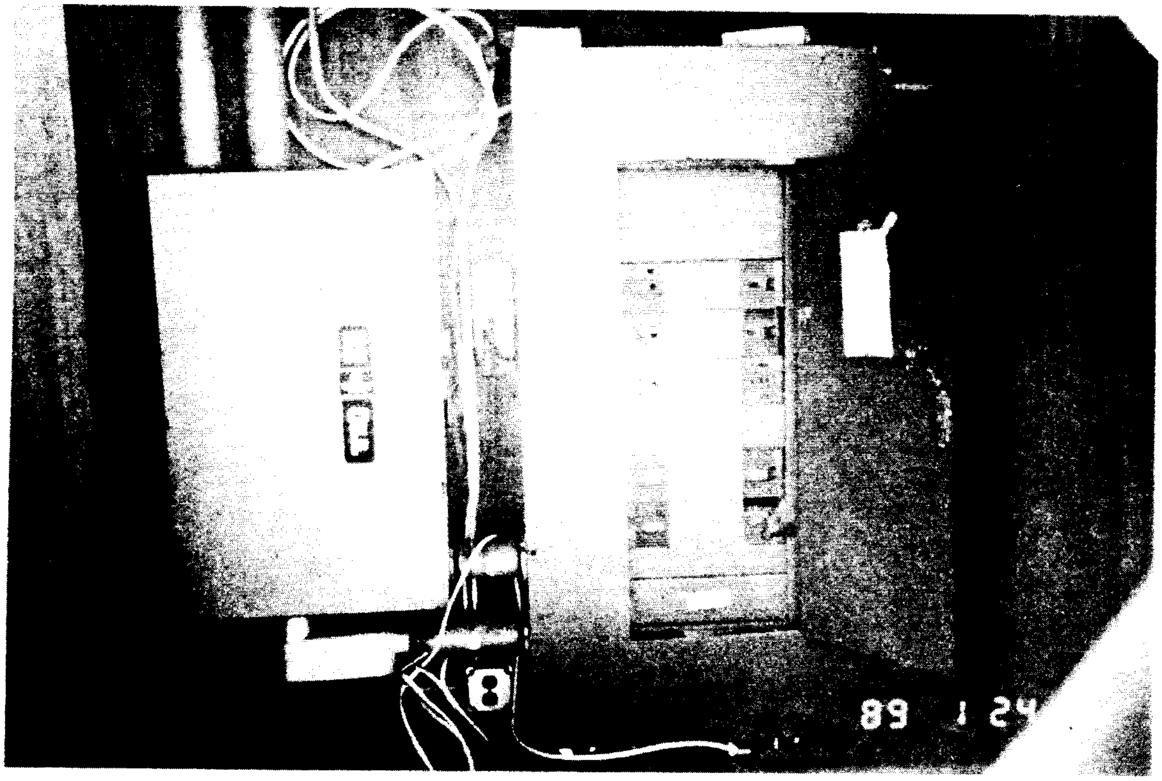


DEFECTIVE CONTACTOR

DEFICIENCY:
1. CONTACTS BURNED, PITTED OR OTHER PHYSICAL DAMAGE

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	MOTOR CONTROL CENTERS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. D090102-12



IMPROPER ENCLOSURE

DEFICIENCY:
1. UNUSED OPENINGS NOT COVERED OR PLUGGED

PHOTO ILLUSTRATION

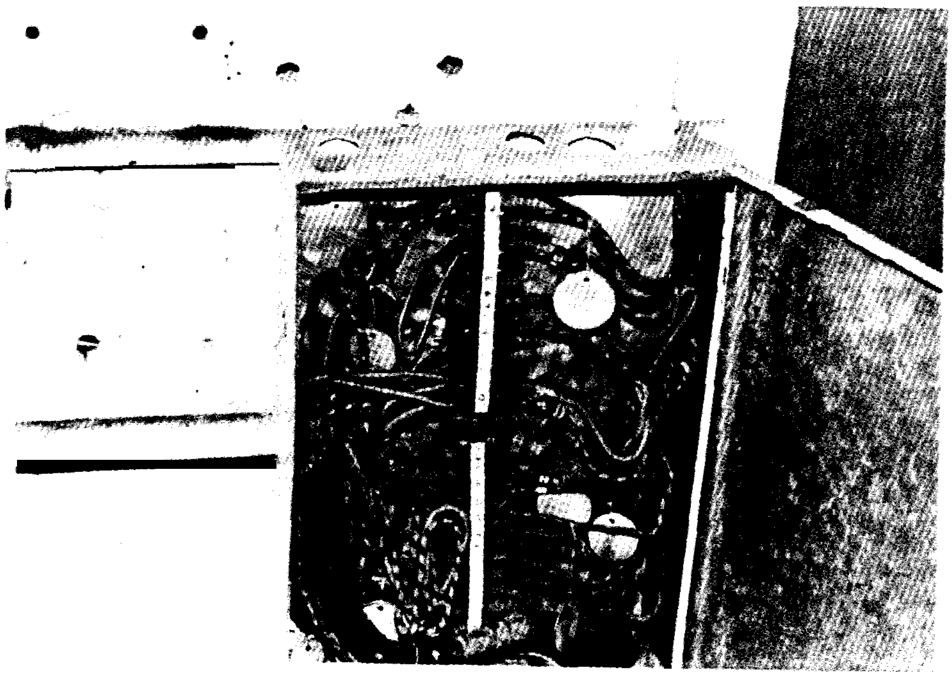
SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	PANELBOARDS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. D090102-13

IMPROPER ENCLOSURE

DEFICIENCIES:
1. CORRODED, RUSTED, DENTED OR OTHER PHYSICAL DAMAGE
2. LOOSE, BROKEN, DAMAGED, CORRODED OR MISSING FASTENING HARDWARE

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	PANELBOARDS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. D090102-14



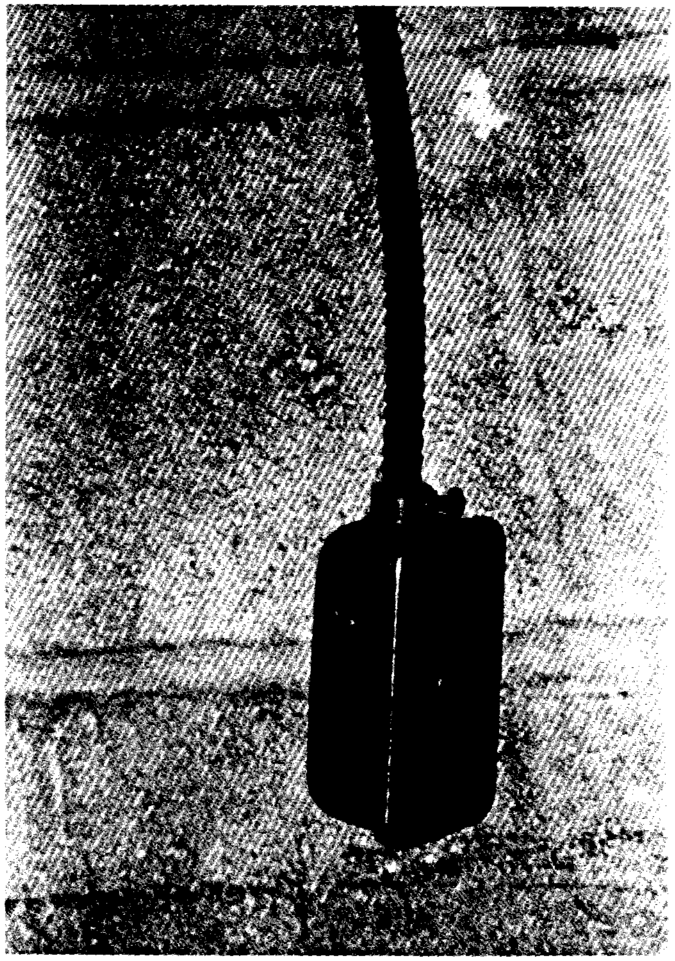
IMPROPER INSTALLATION

DEFICIENCY:

1. UNUSED OPENINGS NOT COVERED OR PLUGGED

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	RACEWAY AND FITTINGS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. D090102-15



IMPROPER INSTALLATION

DEFICIENCY:

1. NOT ADEQUATELY SECURED TO MOUNTING SURFACE

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	RACEWAY AND FITTINGS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. D090102-16

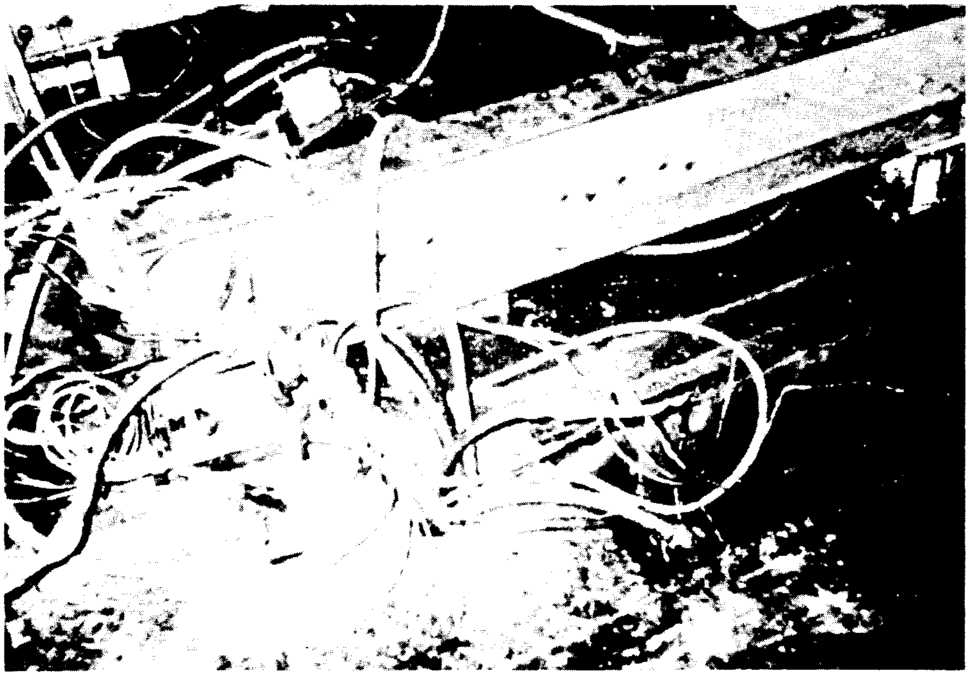
IMPROPER INSTALLATION

DEFICIENCY:

1. NOT ADEQUATELY SECURED TO MOUNTING SURFACE

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	RACEWAY AND FITTINGS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. D090102-17



IMPROPER RACEWAY

DEFICIENCY:
1. INAPPROPRIATE FOR APPLICATION

IMPROPER FITTING

DEFICIENCIES:
1. MISSING, BROKEN, CRACKED, LOOSE OR OTHER DAMAGE
2. EXPOSED CONDUCTORS

PHOTO ILLUSTRATION

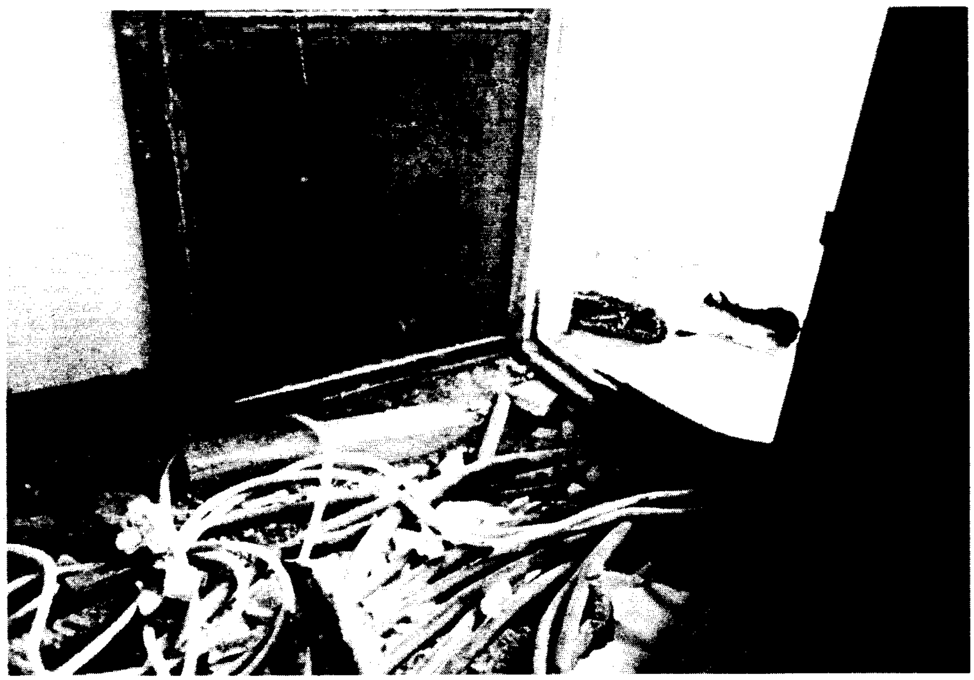
SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	RACEWAY AND FITTINGS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. D090102-18

IMPROPER RACEWAY

DEFICIENCY:
1. CORRODED, RUSTED, DENTED OR OTHER PHYSICAL DAMAGE

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	RACEWAY AND FITTINGS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. D090102-19



IMPROPER RACEWAY

DEFICIENCY:
1. INAPPROPRIATE FOR APPLICATION

PHOTO ILLUSTRATION

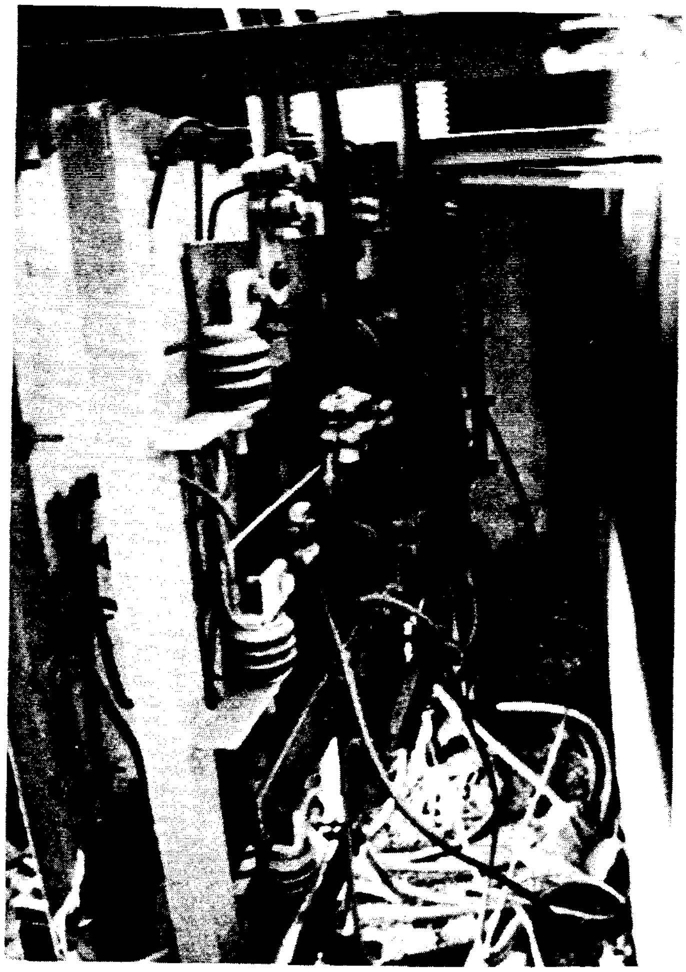
SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	RACEWAY AND FITTINGS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. D090102-20

IMPROPER RACEWAY

DEFICIENCY:
1. INAPPROPRIATE FOR APPLICATION

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	RACEWAY AND FITTINGS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. D090102-21



IMPROPER ENCLOSURE

DEFICIENCIES:
1. NOT CLEAN AND MOISTURE FREE
2. NOT ADEQUATE FOR APPLICATION

DEFECTIVE BUSHING/ INSULATOR

DEFICIENCY:
1. DIRTY, OILY, GREASY OR OTHER SURFACE CONTAMINATION

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	SWITCHBOARDS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. D090102-22

IMPROPER BUS

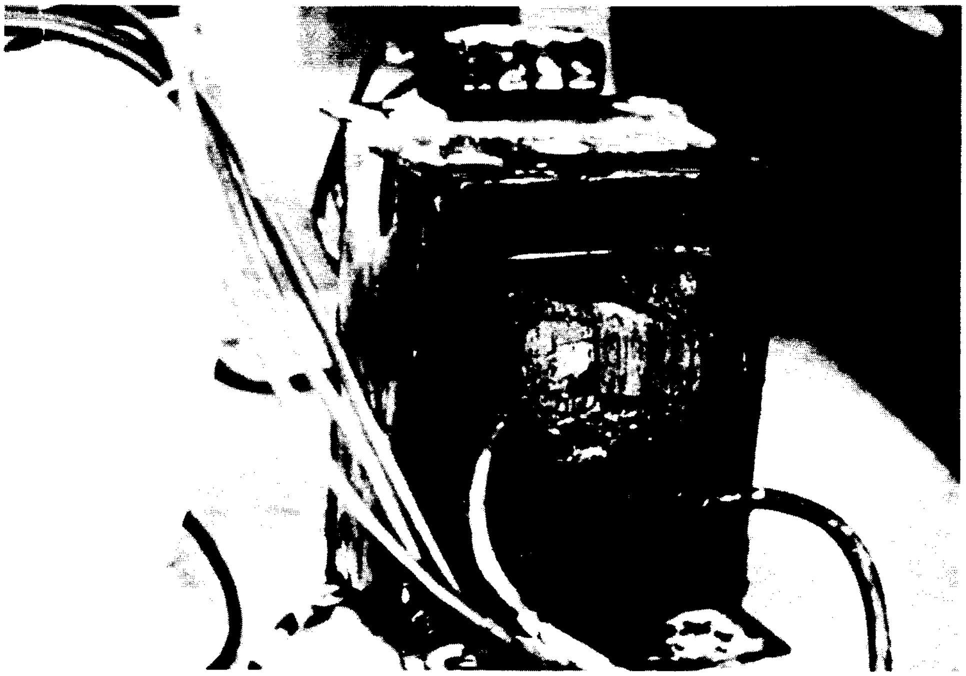
DEFICIENCIES:
1. DISCOLORED, WARPED OR OTHER SIGNS OF HIGH TEMPERATURE
2. NOT PROPERLY TORQUED

INACCURATE METERING

DEFICIENCIES:
1. METERING DEVICE INADEQUATELY SIZED
2. DEFECTIVE OR INOPERATIVE SENSOR OR TRANSDUCER

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	SWITCHBOARDS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. D090102-23

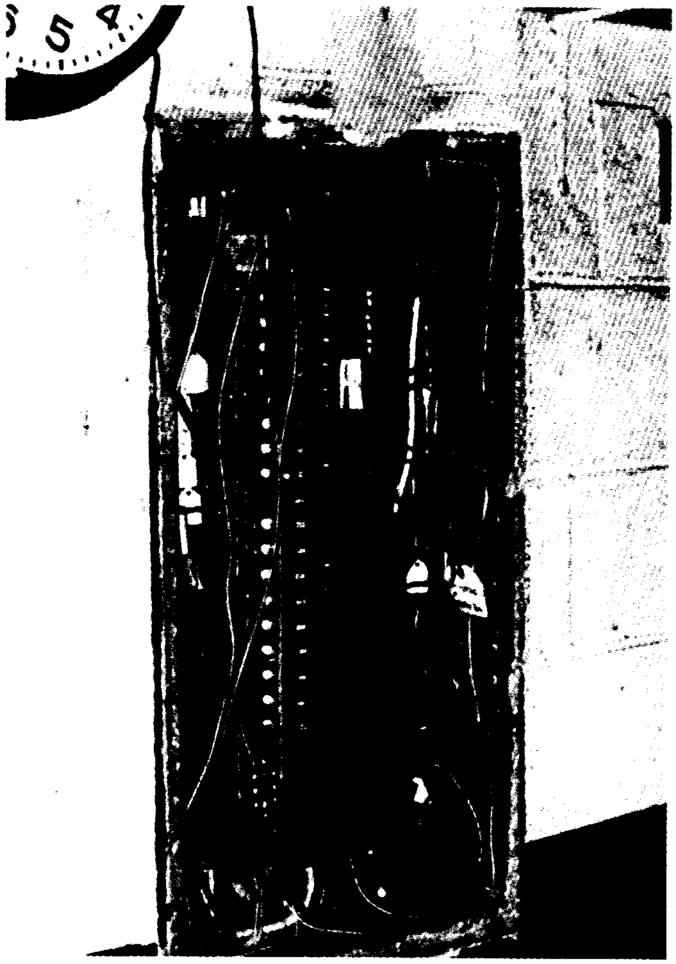


CONTAMINATED TRANSFORMER

DEFICIENCY:
1. CONTAMINATED COILS AND CORE

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	TRANSFORMERS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. D090102-24



IMPROPER CABLE/CONDUCTOR:
1. NOT PROPERLY BUNDLED OR TRAINED
2. NOT PROTECTED PHYSICALLY

IMPROPER MARKING:
1. MISSING OR INSUFFICIENT DATA

PHOTO ILLUSTRATION

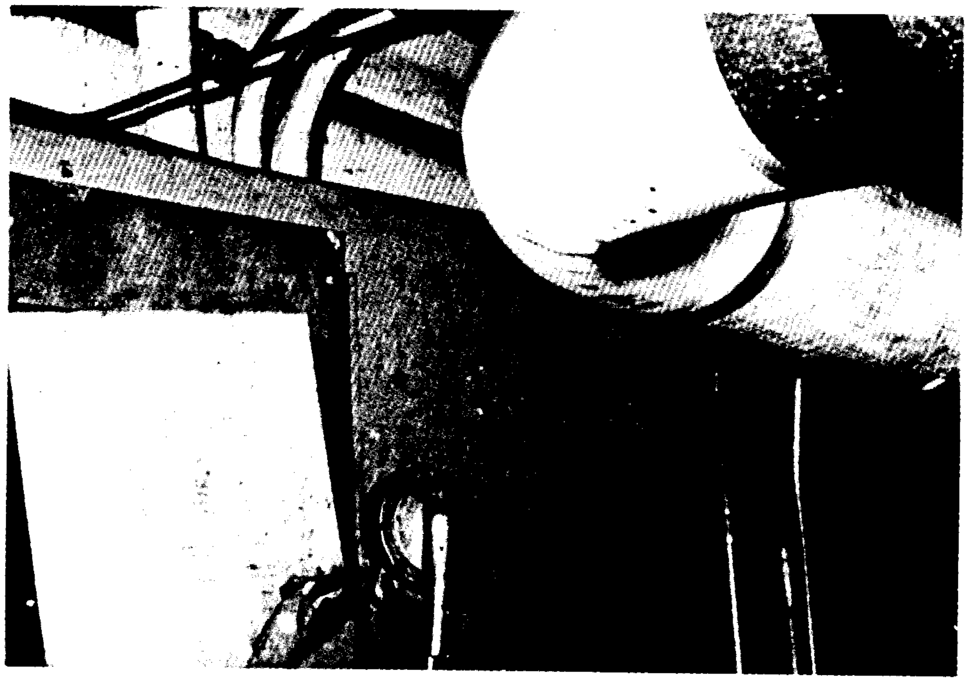
SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	CONDUCTORS AND FITTINGS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. D090102-25

IMPROPER CABLE/CONDUCTOR:

1. NOT PROPERLY CONNECTED TO DEVICE
2. NOT PROPERLY SUPPORTED
3. NOT PROTECTED PHYSICALLY

PHOTO ILLUSTRATION

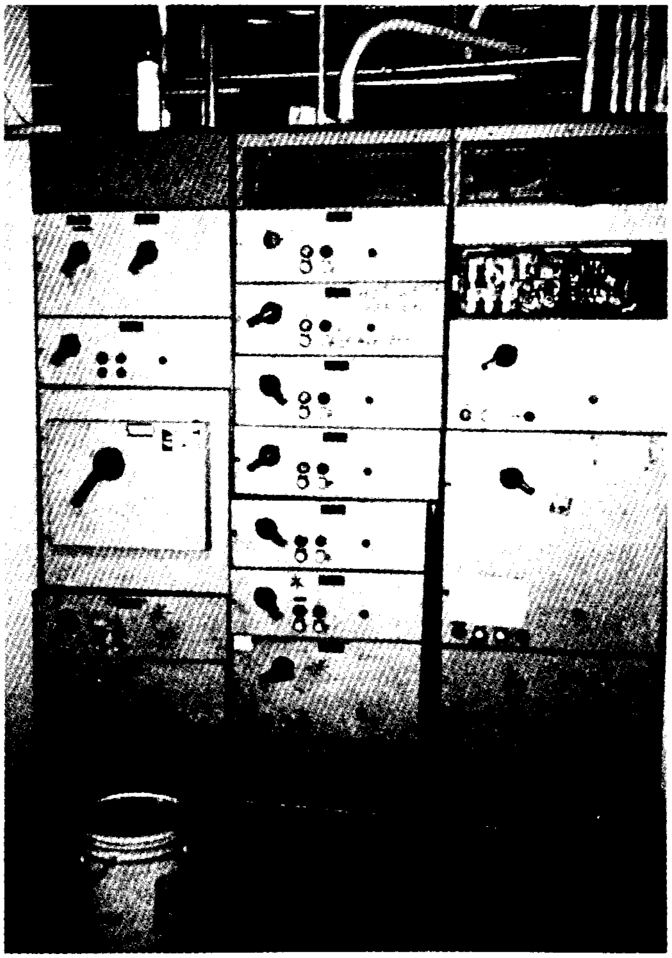
SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	CONDUCTORS AND FITTINGS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. D090102-26



IMPROPER ENCLOSURE
1. NOT ACCESSIBLE

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	DISCONNECTS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. D090102-27

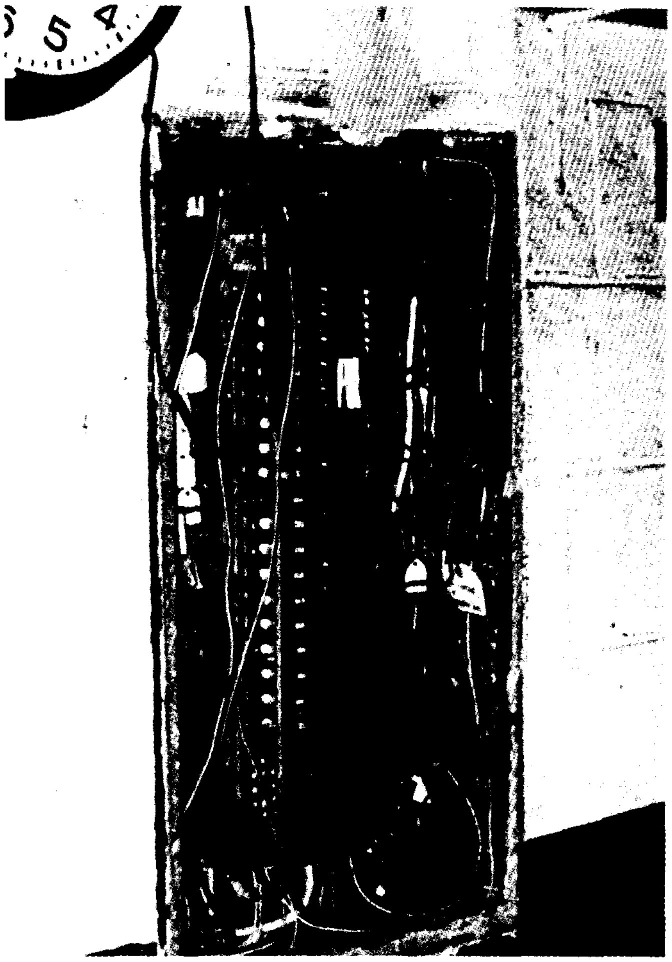


IMPROPER ENCLOSURE:
1. UNUSED OPENINGS NOT COVERED OR PLUGGED
2. LOOSE, BROKEN, DAMAGED, CORRODED OR MISSING FASTENING HARDWARE

IMPROPER CONTROL WIRING:
1. INDICATOR LENS MISSING, CRACKED OR BROKEN

PHOTO ILLUSTRATION

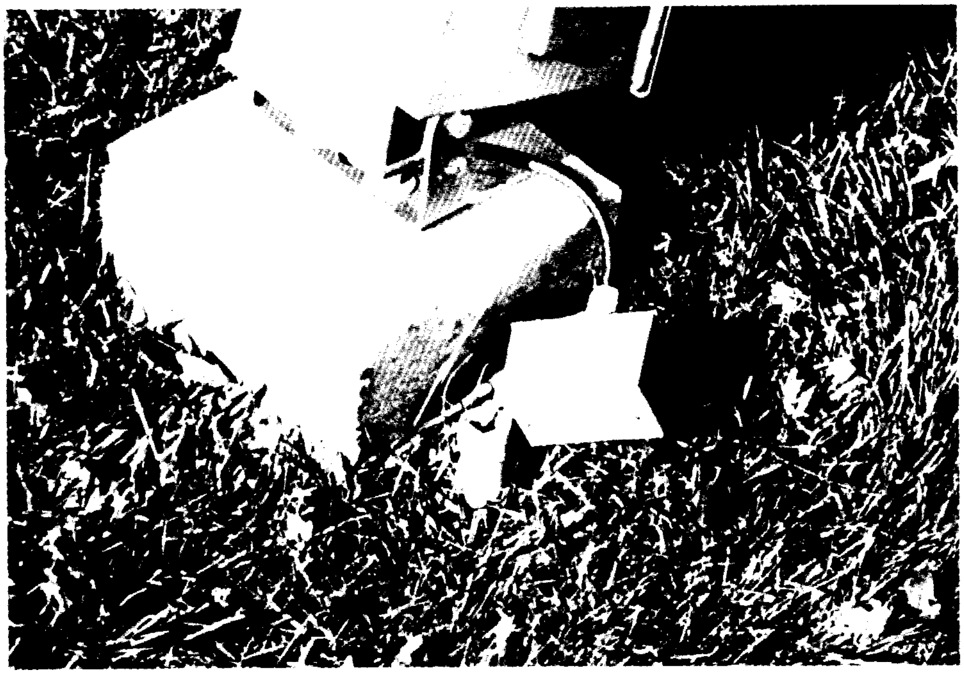
SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	MOTOR CONTROL CENTERS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION **SYSTEM (CSI 16400)**	Revision No.	Issue Date 5/93	Drawing No. D090102-28



IMPROPER ENCLOSURE:
1. LOOSE, BROKEN, DAMAGED, CORRODED OR MISSING FASTENING HARDWARE

PHOTO ILLUSTRATION

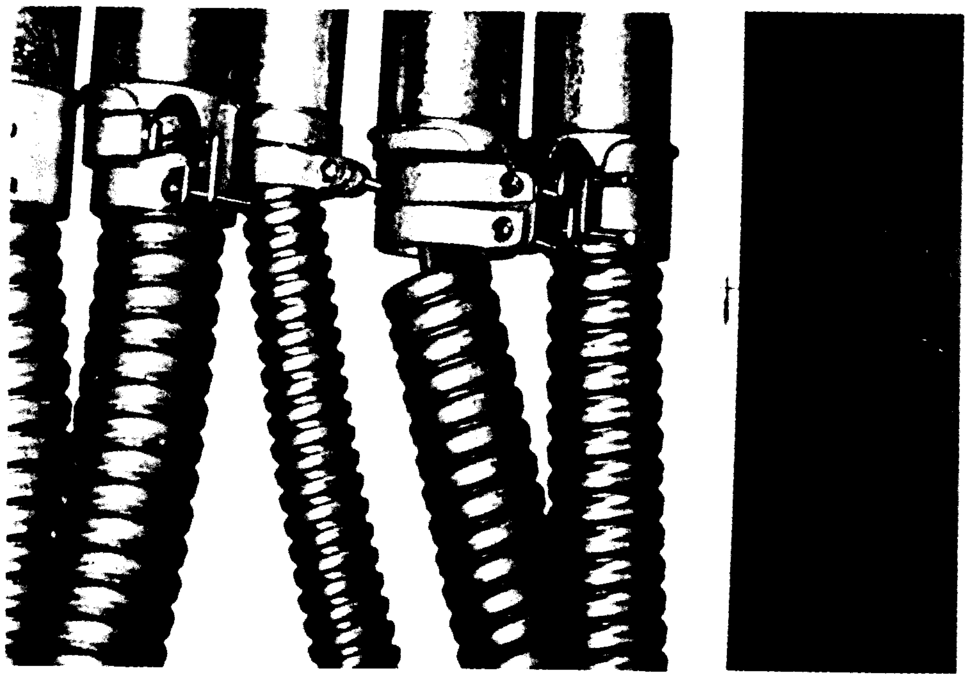
SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	PANELBOARDS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. D090102-29



IMPROPER FITTING:
1. EXPOSED CONDUCTORS
2. MISSING, BROKEN, CRACKED, LOOSE OR OTHER DAMAGE

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	RACEWAY AND FITTINGS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. D090102-30

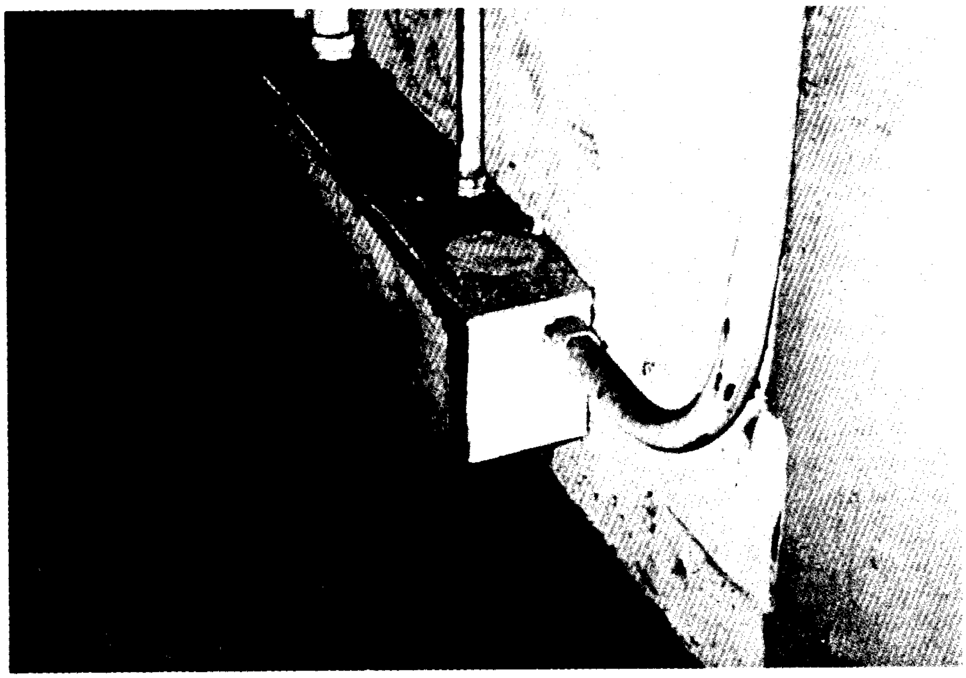


IMPROPER FITTING:
1. EXPOSED CONDUCTORS
2. MISSING, BROKEN, CRACKED, LOOSE OR OTHER DAMAGE
3. LOOSE, BROKEN, DAMAGED. CORRODED OR MISSING FASTENING HARDWARE

IMPROPER INSTALLATION:
1. IMPROPER JOINT

PHOTO ILLUSTRATION

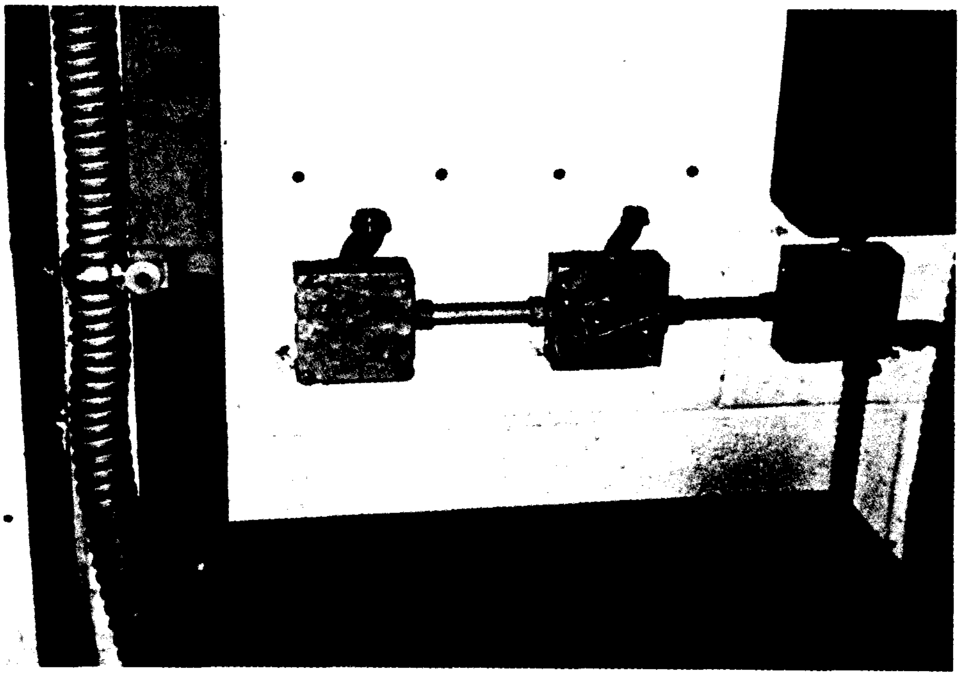
SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	RACEWAY AND FITTINGS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION **SYSTEM (CSI 16400)**	Revision No.	Issue Date 5/93	Drawing No. D090102-31



IMPROPER FITTING:
1. LOOSE, BROKEN, DAMAGED, CORRODED OR MISSING FASTENING HARDWARE

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	RACEWAY AND FITTINGS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. D090102-32



IMPROPER FITTING:
1. EXPOSED CONDUCTORS
2. LOOSE, BROKEN, DAMAGED, CORRODED OR MISSING FASTENING HARDWARE
3. UNUSED OPENINGS NOT COVERED OR PLUGGED

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	RACEWAY AND FITTINGS		
SERVICE AND DISTRIBUTION LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)	Revision No.	Issue Date 5/93	Drawing No. D090102-33

DEFICIENCY FACTORS

0.09.01.02 LOW VOLTAGE DISTRIBUTION SYSTEM (CSI 16400)

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DEFICIENCY FACTORS
0.09.01.02 LOW VOLTAGE **DISTRIBUTION** SYSTEM (CSI 16400)

END OF SUBSECTION

0.09.01.03 MEDIUM VOLTAGE (CSI 16300)

DESCRIPTION

The Medium Voltage System has an operating Voltage greater than 1000 Volts and less than 100,000 Volts RMS. The medium Voltage system may provide electrical energy directly to medium Voltage utilization equipment or provide electrical energy to a substation for Voltage reduction to 1000 Volts or less. This description includes but is not limited to raceway, busway (Bus Duct), switches, transformers, interrupter switches, switchboards and switchgear, motors, motor control centers, metering, conductors, and overcurrent protection.

MEDIUM VOLTAGE DISTRIBUTION SYSTEM EQUIPMENT

Types of medium Voltage distribution system equipment in this section include the following:

- Busway (Bus Duct)
- Conductors & Fittings
- Disconnects
- Load Interrupter Switch
- Metering
- Motors
- Motor Control Centers
- Raceway & Fittings
- Switchgear
- Transfer Switches
- Transformers

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Busway (Bus Duct) (CSI 16300)

A busway consists of a grounded metal enclosure containing factory-mounted, bare or insulated conductors that are usually copper or aluminum bars, rods, or tubes. In this Voltage application, the device is more properly named metal-enclosed bus.

Conductors & Fittings (CSI 16120)

Insulated conductors are normally used in medium Voltage distribution systems; they may be individual conductors protected by raceway or may be assembled into a cable with an external sheath. The sheath normally does not provide physical protection for the conductors, but, semiconductors may be part of the sheath for potential equalization. Fittings are used to terminate and to protect a conductor by holding, guiding, or shielding it from damage.

Disconnects (CSI 16300)

A disconnect is a device used to disconnect a load from a source. The device is normally a switch or a circuit breaker. Switches include:

Isolation Switch:

A device intended to disconnect or isolate a load from its source. Such a device is not intended to operate under load as a safety switch.

Circuit Breakers:

Devices that interrupt at rated Voltage, rated current, and fault current without damage to the device.

Load **Interrupter Switch** (CSI **16360)**

A load interrupter switch is a medium Voltage, metal-enclosed switch that combines the functions of a disconnect switch and a load interrupter. The load interrupter function of the switch is accomplished through the combination of a quick-break action of contacts and an arc chute that rapidly extinguishes the arc. This device interrupts (at rated Voltage) currents not exceeding the continuous-current rating of the device and is coordinated electrically and mechanically for circuit protection. The switch may be an air or oil type.

0.09.01.03 MEDIUM VOLTAGE (CSI 16300)

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS (Continued)

Metering (CSI 16430)

Metering is a collection of devices such as Voltmeters, ammeters, switches, and ancillary devices used to measure various electrical parameters. The metering may be used to control the electrical system or to indicate selected parameters monitored by an operator. Ancillary metering devices may also be used for other control systems such as overcurrent or overvoltage relaying.

Motors (CSI 16300)

Motors are devices used to convert electrical energy to mechanical energy. Motors larger than 10 horsepower are included in this standard. Direct current motors are considered special purpose and are not included in this standard.

In addition to converting electrical energy, to mechanical energy motors may perform other functions such as power factor correction. Motors that perform such functions are considered special purpose and are not included in this standard.

Motor Control Centers (CSI 16300)

Motor control centers are assemblies of one or more circuit breakers, contactors, disconnects, fuses, and other devices used to control electric motors. Motor control centers may be part of a medium Voltage distribution center.

Raceways & Fittings (CSI 16110)

A Raceway is an enclosed channel for holding conductors, cables, or busbars. The more common forms include flexible and rigid conduit, tubing, and wireways. Fittings include such hardware as bushings, locknuts, and conduit bodies.

Switchboards (CSI 16345)

Switchboards are assemblies of switches, circuit breakers, fuses, metering equipment, relays, and/or other forms of equipment that control or record the electric current distributed throughout a building or area. Switchboards are used in all Voltage ranges; however, in Voltage ranges other than low Voltage, the switchboard is referred to as switchgear.

Switchgear (CSI 16345)

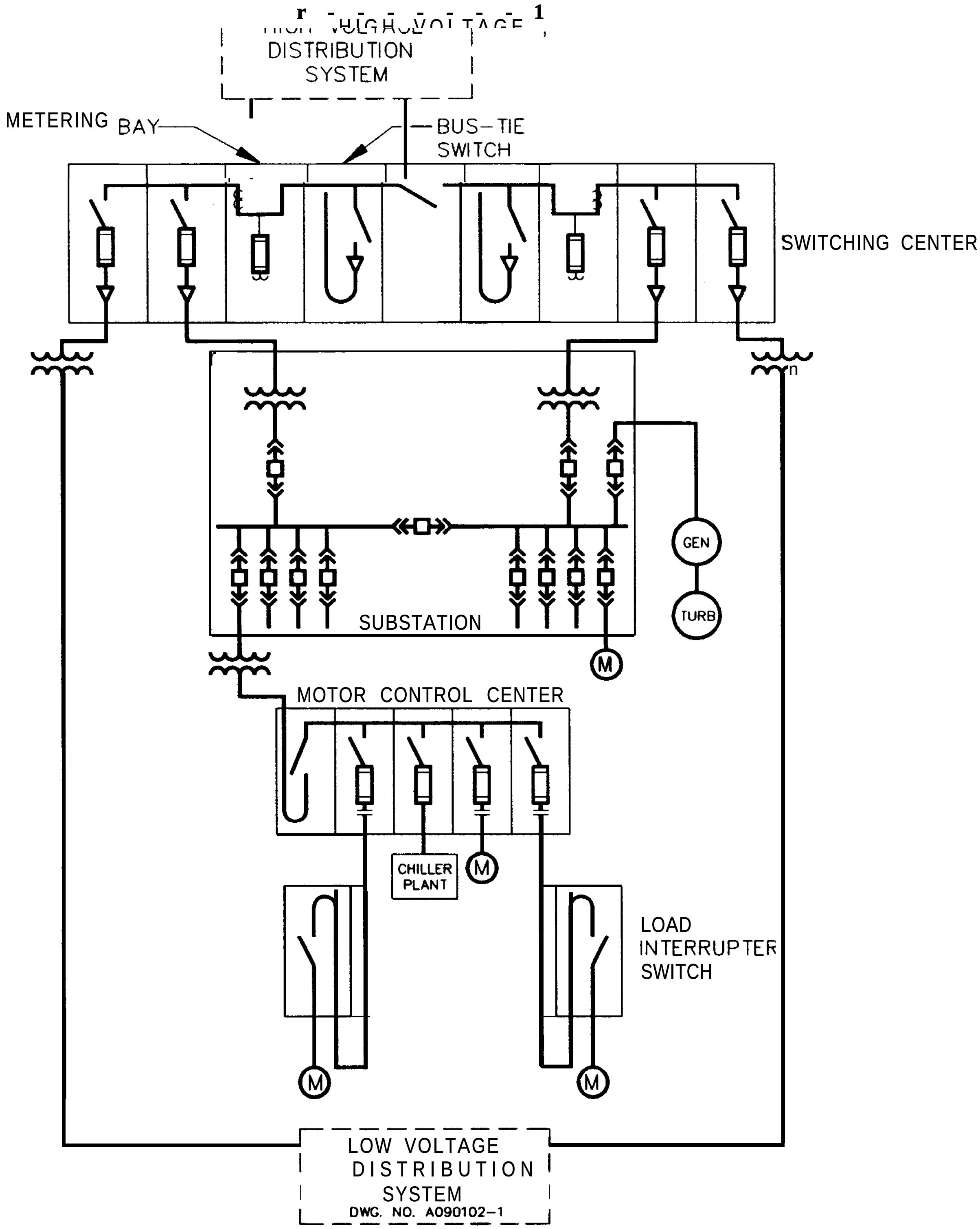
See Switchboards.

Transfer Switches (CSI 16300)

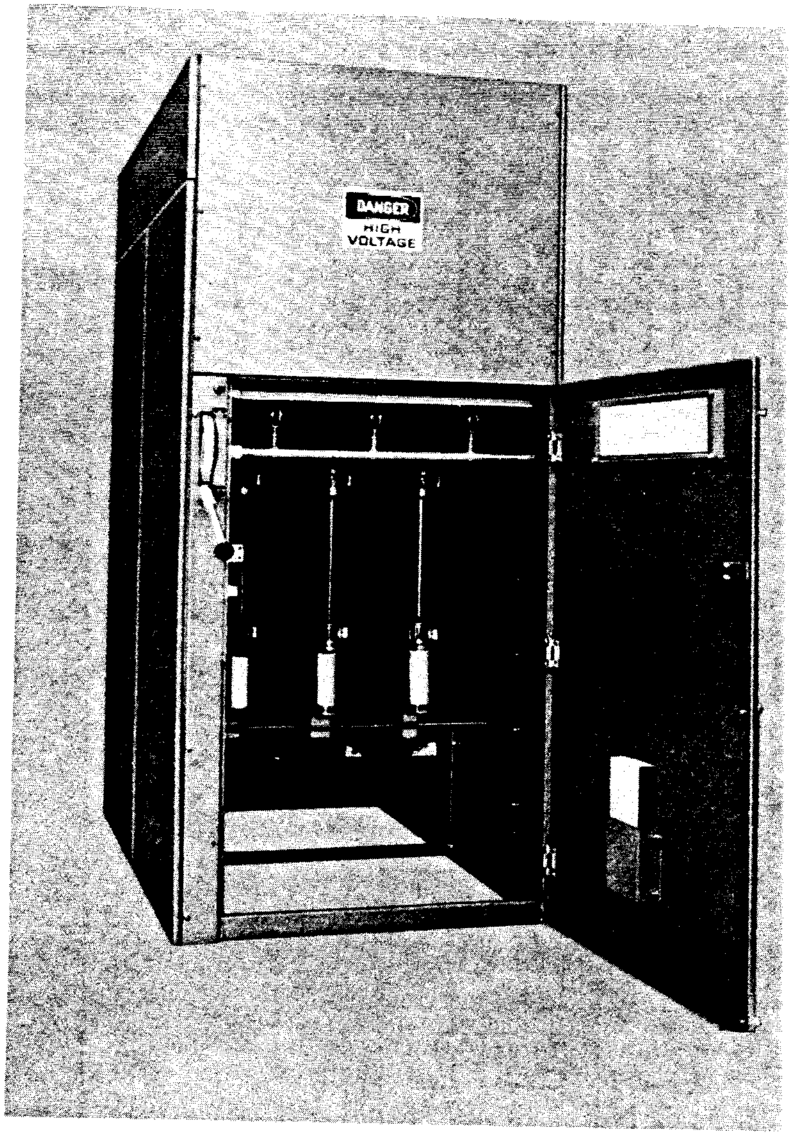
A Transfer Switch is a device intended to transfer a load from one source to another source. Special precautions must be taken with a transfer switch because multiple sources may be present within the switch enclosure.

Transformers (CSI 18320)

A transformer is a device used to change the Voltage delivered to a load or to isolate a load electrically from its source. As used here, the term does not include units installed as part of some other device or load.



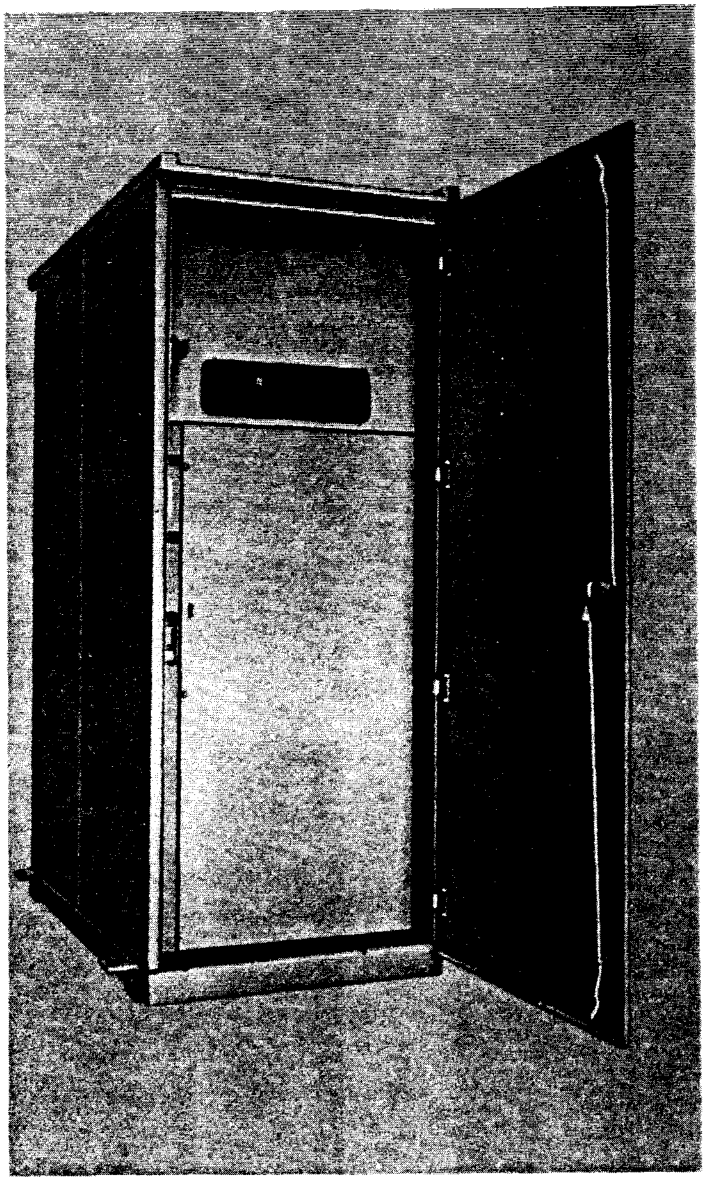
SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	MEDIUM VOLTAGE DISTRIBUTION SYSTEM		
SERVICE AND DISTRIBUTION MEDIUM VOLTAGE DISTRIBUTION SYSTEM (CSI 16300)	Revision No.	Issue Date 5/93	Drawing No. A090103-1



INDOOR ENCLOSURE

SOURCE: SQUARE D COMPANY, CUT SHEETS

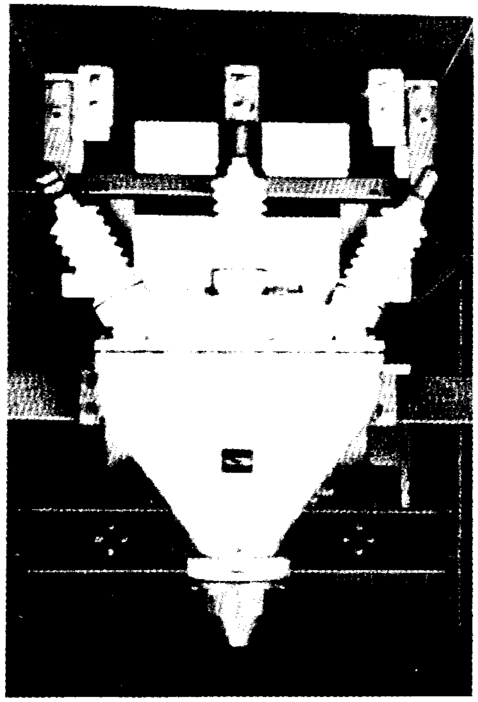
SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	DISCONNECTS		
SERVICE AND DISTRIBUTION MEDIUM VOLTAGE DISTRIBUTION SYSTEM (CSI 16300)	Revision No.	bum Date 5/93	Drawing No. A090103-2



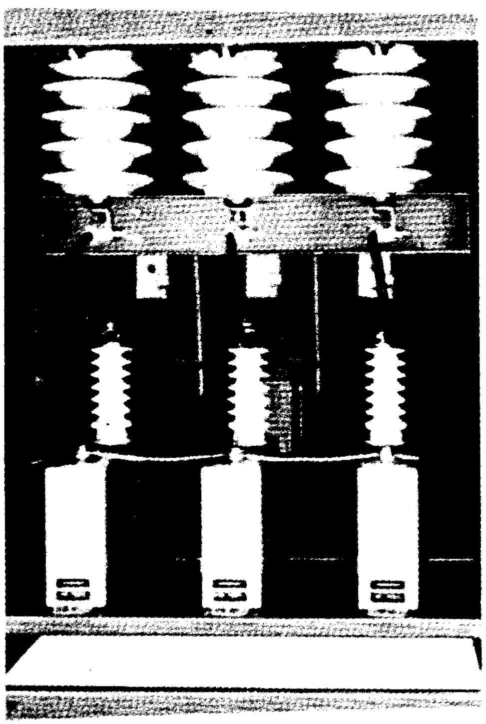
OUTDOOR ENCLOSURE

SOURCE: SQUARE D COMPANY, CUT SHEETS

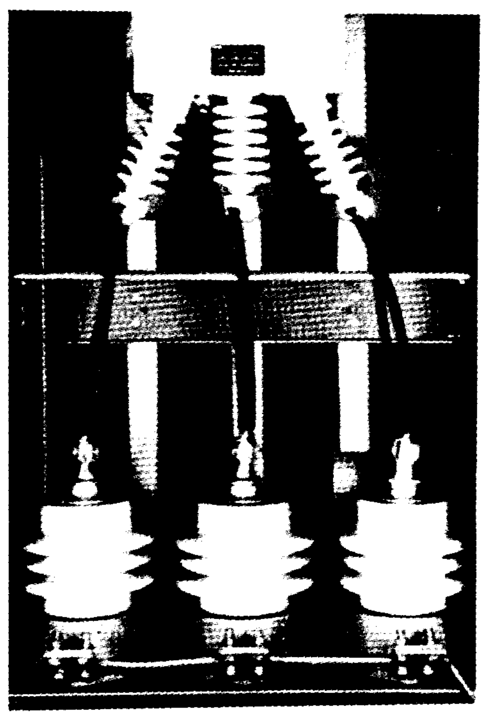
SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	DISCONNECTS		
SERVICE AND DISTRIBUTION MEDIUM VOLTAGE DISTRIBUTION SYSTEM (CSI 16300)	Revision No.	Issue Date 5/93	Drawing No. A090103-3



POTHEAD



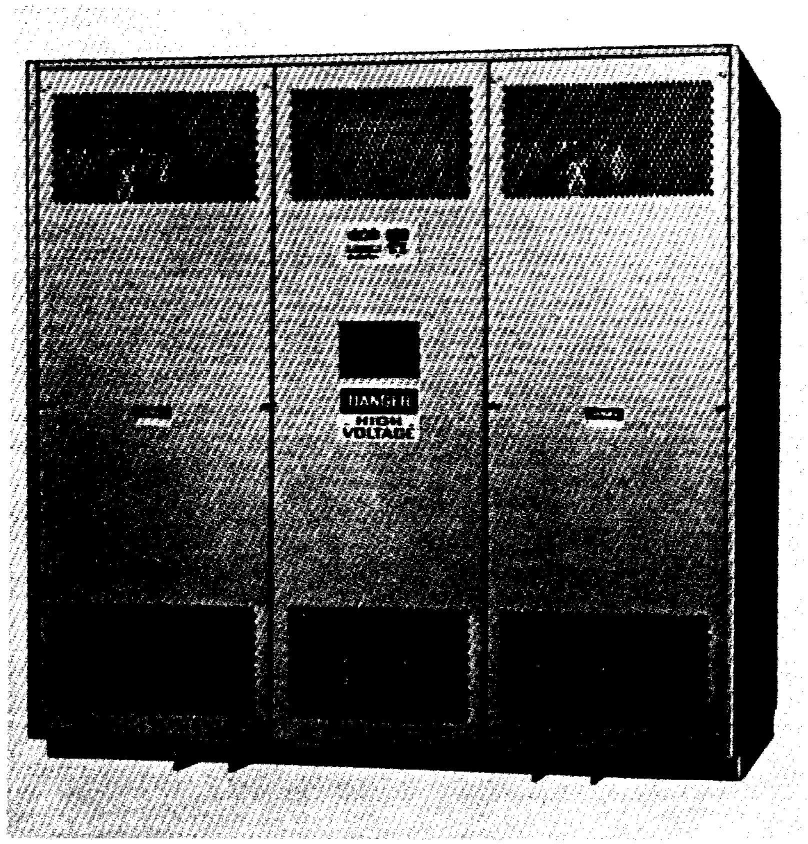
INSTRUMENTTRANSFORMERS



SURGE ARRESTOR&

CE: SQUARE D COMPANY, CUT SHEETS

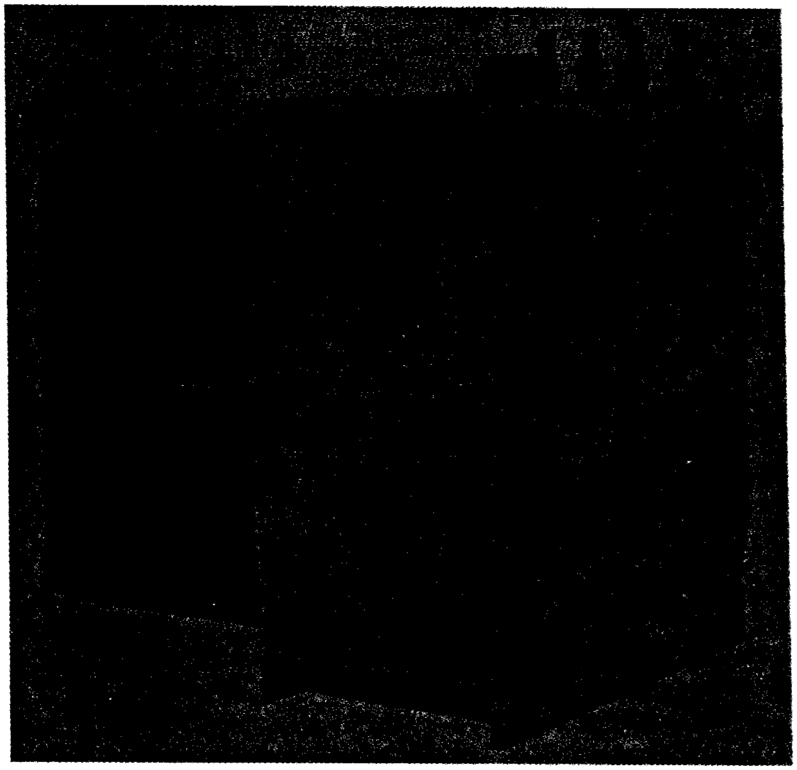
SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	DISCONNECTS		
SERVICE AND DISTRIBUTION MEDIUM VOLTAGE DISTRIBUTION SYSTEM (CSI 16300)	Revision No.	Issue Date 5/93	Drawing No. A090103-4



DRY TYPE

SOURCE: SQUARE D CO., TRANSFORMER GUIDE SPECIFICATIONS

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	TRANSFORMERS		
SERVICE AND DISTRIBUTION MEDIUM VOLTAGE DISTRIBUTION SYSTEM (CSI 16300)	Revision No.	Issue Date 5/93	Drawing No. A090103-5



LIQUID TYPE

SOURCE: SQUARE D CO., TRANSFORMER GUIDE SPECIFICATIONS

DEFICIENCY FACTORS
0.09.01.03 MEDIUM VOLTAGE (CSI 16300)

PROBABLE FAILURE POINTS

- Busway (Bus Duct) plug in components not secured.
- Conductors with burned or brittle insulation or with no fitting protection.
- Equipment location is often a storage location, reducing component accessibility.
- Motor control centers are undersized causing nuisance tripping.
- Motor shaft bearings are significant wear points.
- Poor ground connections.
- Raceway and fittings that are rusted, corroded, or damaged. (notable in outdoor applications.)
- Switches with burned, pitted, or defective contacts.
- Switchgear altered for new uses without revising previous safety set points.
- The system grows and exceeds design ampacity ratings.
- Transformers used for lighting or power are infrequently serviced.

SYSTEM ASSEMBLY/DEFICIENCIES

Busway

Damaged Metering:	Device inoperative. Metering device broken or other physical damage. Tampering of metering device or circuit.
Defective Busbar:	Current limiting busway not used as required. Dirty or other contamination. Discolored, warped, or other signs of high temperature. Inadequately torqued to insulators. Joint/splice inadequately insulated when required. Joint/splice insulation burned, discolored, and unravelled. Joints inadequately torqued. Resistance less than one megOhm per each kiloVolt of rating between buses and/or from buses to non-energized parts.
Defective Bushing/Insulator:	Cable clamp loose, missing, broken, corroded, burned, or other physical damage. Dirty, oily, greasy, or other surface contamination. Missing, cracked, chipped, or other damage. Not adequately secured. Oil Leakage. Tracked or carbonized.
Defective Contactor:	Arc suppression components broken, eroded, cracked, or missing. Broken strands in braided shunts. Coil discolored, burned, or other sign of high temperature. Coil inoperative at 85% of rated Voltage. Contact pressure not per manufacturer's specifications. Contacts burned, pitted, or other physical damage. Contacts not properly aligned.

DEFICIENCY FACTORS
0.09.01.03 MEDIUM VOLTAGE (CSI 16300)

SYSTEM ASSEMBLIES/DEFICIENCIES

Busway

Defective Contactor (Continued):	Control circuits improperly connected. Dash pot inoperative, broken, or missing. Device sticks magnetically. Drum contacts inadequately torqued. High contact resistance. Improper fluid in dash pot. Improper rolling action of drum contacts. Improper size. Indicator lamps inoperative. Indicator lens missing, cracked, or broken. Missing, loose, broken, or corroded hardware. No engineering study to support thermal trip device rating. Noisy. Plugging relays dirty or other contamination. Pushbuttons not labeled. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts. Rheostat contact surface corroded, oxidized, uneven, or other physical defect. Rheostat holding coil missing or inoperative. Rheostat ventilation impeded. Terminals, contact blocks, bus bars, and connectors loose or discolored. Thermal trip device wrong size.
Defective Control Module:	Circuit boards improperly installed and/or connected. Inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, cracked, chipped, corroded, burned, or other damage to components and/or circuit boards. Not clean and moisture-free.
Defective Heater:	Heater not adequately secured to mounting surface. Improper conductors from source. Improper temperature in device enclosure. Inoperative heater element. Heater element resistance to ground less than one megOhm per each kiloVolt of rating. Sensing device broken, missing, or inoperative. Sensing device malcalibrated.
Improper Busway Enclosure:	Corroded, rusted, dented, or other physical damage. Dirty, missing, or inappropriate filters. Gaskets missing, damaged, misaligned, or other physical deformity. Not secured to mounting surface. Interlock broken, missing, or inoperative.

DEFICIENCY FACTORS
0.09.01.03 MEDIUM VOLTAGE (CSI 16300)

SYSTEM ASSEMBLIES/DEFICIENCIES

Busway

Improper Busway Enclosure (Continued):	Loose, broken, damaged, corroded, or missing fastening hardware. Missing, broken, damaged, or inoperative security device. No curbing or berm for oil containment. Not accessible. Not adequate for application. Not clean and moisture-free. Not grounded properly. Oil leaks. Unused openings not covered or plugged. Ventilation openings defective, nonoperative, obstructed, or not properly guarded.
Improper Control Wiring:	Bimetallic connectors not used as required. Bundled and trained inappropriately. Control circuits improperly connected. Control wiring insulation resistance less than one megOhm per each kiloVolt of rating. Improper sensor pick-up or drop-out point. Improper termination. Inadequate fuse/connection tension. Inadequately torqued at termination. Inappropriate for application. Inconsistent time delays. Incorrect overcurrent protection. Indicator lamps inoperative. indicator lens missing, cracked, or broken. Inoperative. Inoperative interlock. Insulation charred, burned, or discolored. Insulation improperly removed from conductor. No engineering study to support installed fuse. Splices improperly insulated. Terminal boards improperly installed. Unauthorized splice.
Improper Disconnect:	Adjustable settings misadjusted. Arc suppression devices broken, cracked, missing, tracked, chipped, or other physical damage. Contacts bent or not aligned. Defective phase barriers. Does not sustain rated current per NEMA AB4-1991. Does not trip on instantaneous overcurrent per NFPA 70B. Handle broken, bent, or other physical deformity. High conductor, lug temperature. High contact resistance. Improper application. Improper switch time.

DEFICIENCY FACTORS
0.09.01.03 MEDIUM VOLTAGE (CSI 16300)

SYSTEM ASSEMBLIES/DEFICIENCIES

Busway

Improper Disconnect (Continued):	Improperly sized. improperly wired. Interlock broken, missing, or inoperative. Movable contacts bent, malaligned, or other physical deformity. Movable contacts pitted, burned, or discolored. No engineering study to support adjustable settings. Not accessible. Not adequate for application. Not clean and moisture-free. Not grounded properly. Not secured to mounting surface. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts. Series trip device missing, broken, or inoperative. Shunt trip device missing, broken, or inoperative. Stationary contacts bent, malaligned, or other physical deformity. Stationary contacts pitted, burned, or discolored. Terminals, contact blocks, bus bar and connectors loose, burned, or discolored. Time-delay overcurrent trip not per manufacturers specifications. UnderVoltage trip missing, broken, maladjusted, or inoperative.
Improper Fitting:	Exposed conductors. Improper fitting for application. Insert broken, cracked, missing, or other damage. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, broken, cracked, loose, or other damage. Unused openings not covered or plugged.
Improper Fuse Unit:	Fuse clips bent, malaligned, discolored, or other physical damage. Improper fuse type used. Improperly sized. Poor fuse to clip contact. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts.
Improper Installation:	Crossover improperly installed or connected. Elbow improperly installed or connected. Fused protector not used as required. Hanger not adequately secured to structure. Improper bending radius. Improper joint.

DEFICIENCY FACTORS
0.09.01.03 MEDIUM VOLTAGE (CSI 16300)

SYSTEM ASSEMBLIES/DEFICIENCIES

Busway

Improper Installation (Continued):	Improper trench. Improperly supported by other raceway. Inadequate grounding. Inadequate ventilation. Missing vertical run hardware. No bushing or equivalent protection. Not adequately protected from severe physical damage. Not adequately secured to mounting surface. Not appropriate for location. Not clearly and permanently marked where required. Not secured within three feet of end of run. Protector improperly located. Protectors are not installed as required. Supported by other raceway. Switchboard flange improperly installed or connected. Tee improperly installed or connected. Unauthorized conductor present. Unlisted protector or non-identified protector employed. Unused openings not covered or plugged.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.
Inaccurate Metering:	Calibration standard not established. Defective or inoperative sensor or transducer. Metering device inadequately sized. Metering device not calibrated.

Conductors & Fittings

Defective Control Module:	Circuit boards improperly installed and/or connected. Inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, cracked, chipped, corroded, burned, or other damage to components and/or circuit boards. Not clean and moisture-free.
Improper Cable/Conductor:	Ampacity not properly rated. Bimetallic connectors not used as required. Broken wire strands. Burned, melted, discolored conductor material. Defective or deficient cable/conductor penetrations. High splice temperature. Improper bending radius. Improper insulation Voltage. Improper splice materials used. Improper termination. Improper trench. Improperly made splice. Inappropriate for application.

DEFICIENCY FACTORS
0.09.01.03 MEDIUM VOLTAGE (CSI 16300)

SYSTEM ASSEMBLIES/DEFICIENCIES

Conductors & Fittings

improper Cable/Conductor (Continued):	Insulation inappropriate for application. Insulation improperly removed. Insulation is burned, charred, discolored, or other physical damage. Insulation resistance less than one megOhm per each kiloVolt of rating. Insulation unraveled, frayed, brittle, or other physical damage. Nicked or ringed conductor. Not properly bundled or trained. Not properly connected to device. Not properly derated for installation. Not properly supported. Not protected physically. Unauthorized splice.
improper Fitting:	Exposed conductors. Improper fitting for application. Insert broken, cracked, missing, or other damage. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, broken, cracked, loose, or other damage. Unused openings not covered or plugged.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.

Disconnects

Defective Bushing/Insulator:	Cable clamp loose, missing, broken, corroded, burned, or other physical damage. Dirty, oily, greasy, or other surface contamination. Missing, cracked, chipped, or other damage. Not adequately secured. Oil leakage. Tracked or carbonized.
Defective Control Module:	Circuit boards improperly installed and/or connected. Inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, cracked, chipped, corroded, burned, or other damage to components and/or circuit boards. Not clean and moisture-free.
Defective Heater:	Heater element resistance to ground less than one megOhm per each kiloVolt of rating. Heater not adequately secured to mounting surface. Improper conductors from source. Improper temperature in device enclosure.

DEFICIENCY FACTORS
0.09.01.03 MEDIUM VOLTAGE (CSI 16300)

SYSTEM ASSEMBLIES/DEFICIENCIES

Disconnects

Defective Heater (Continued) :	Inoperative heater element. Sensing device broken, missing, or inoperative. Sensing device malcalibrated.
Defective Pressure Relief:	High internal pressure. No internal pressure.
Improper Control Wiring:	Bimetallic connectors not used as required. Bundled and trained inappropriately. Control circuits improperly connected. Control wiring insulation resistance less than one megOhm per each kiloVolt of rating. Improper sensor pick-up or drop-out point. Improper termination. Inadequate fuse/connection tension. Inadequately torqued at termination. Inappropriate for application. Inconsistent time delays. Incorrect overcurrent protection. Indicator lamps inoperative. Indicator lens missing, cracked, or broken. Inoperative. Inoperative interlock. Insulation charred, burned, or discolored. Insulation improperly removed from conductor. No engineering study to support installed fuse. Splices improperly insulated. Terminal boards improperly installed. Unauthorized splice.
Improper Disconnect:	Adjustable settings misadjusted. Arc suppression devices broken, cracked, missing, tracked, chipped, or other physical damage. Contacts bent or not aligned. Defective phase barriers. Does not sustain rated current per NEMA AB4-1991. Does not trip on instantaneous overcurrent per NFPA 708. Handle broken, bent, or other physical deformity. High conductor, lug temperature. High contact resistance. Improper application. Improper switch time. Improperly sized. Improperly wired. Interlock broken, missing, or inoperative. Movable contacts bent, malaligned, or other physical deformity. Movable contacts pitted, burned, or discolored. No engineering study to support adjustable settings. Not accessible.

DEFICIENCY FACTORS
0.09.01.03 MEDIUM VOLTAGE (CSI 16300)

SYSTEM ASSEMBLIES/DEFICIENCIES

Disconnects

Improper Disconnect (Continued):	Not adequate for application. Not clean and moisture-free. Not grounded properly. Not secured to mounting surface. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts. Series trip device missing, broken, or inoperative. Shunt trip device missing, broken, or inoperative. Stationary contacts bent, malaligned, or other physical deformity. Stationary contacts pitted, burned, or discolored. Terminals, contact blocks, bus bar and connectors loose, burned, or discolored. Time-delay overcurrent trip not per manufacturer's specifications. UnderVoltage trip missing, broken, maladjusted, or inoperative.
Improper Enclosure:	Corroded, rusted, dented, or other physical damage. Dirty, missing, or inappropriate filters. Gaskets missing, damaged, misaligned, or other physical deformity. Insufficient work space. Interlock broken, missing, or inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, broken, damaged, or inoperative security device. No curbing or berm for oil containment. Not accessible. Not adequate for application. Not clean and moisture-free. Not grounded properly. Not secured to mounting surface. Oil leaks. Unused openings not covered or plugged. Ventilation openings defective, nonoperative, obstructed, or not properly guarded.
Improper Fuse Unit:	Fuse clips bent, malaligned, discolored, or other physical damage. Improper fuse type used. Improperly sized. Poor fuse to clip contact. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts.

DEFICIENCY FACTORS
0.09.01.03 MEDIUM VOLTAGE **(CSI** 16300)

SYSTEM ASSEMBLIES/DEFICIENCIES

Disconnects (Continued)

Improper Insulating Liquid:	Contaminated internal device. Low insulation resistance. Low liquid level. Oil does not meet criteria of NFPA 70B. Pressure leak.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.
Improper Mount:	Device not secured to mount. Device mounting surface chipped, cracked, broken, or other physical damage. Dirty, oily, greasy, or other surface contamination. Mounting structure inadequate. Mounting structure not secured to mounting surface. Not aligned.
improper Protective Relay:	Cover loose, missing, broken, chipped, cracked, or other physical damage. Current, Voltage, and time pick-up/drop-out values not per manufacturer's specifications. Housing chipped, cracked, broken, or other physical damage. Improper application. Improperly wired. Inoperative. Malcalibrated. Missing and/or out-of-date calibration tag. Movable contacts bent, malaligned, or other physical deformity. Movable contacts pitted, burned, or discolored. Not clean and moisture-free. Not secured to mounting surface. No engineering study to support adjustable setting. Stationary contacts bent, malaligned, or other physical deformity. Stationary contacts pitted, burned, or discolored. Terminals loose, broken, missing, burned, discolored, or corroded.
Inaccurate Metering:	Calibration standard not established. Defective or inoperative sensor or transducer. Metering device inadequately sized. Metering device not calibrated.

Metering

Damaged Metering:	Device inoperative. Metering device broken or other physical damage. Tampering of metering device or circuit.

DEFICIENCY FACTORS
0.09.01.03 MEDIUM VOLTAGE (CSI 163001

SYSTEM ASSEMBLIES/DEFICIENCIES

Metering (Continued)

Defective Busbar:,	Current limiting busway not used as required. Dirty or other contamination. Discolored, warped, or other signs of high temperature. Inadequately torqued to insulators. Joint/splice inadequately insulated when required. Joint/splice insulation burned, discolored, and unravelled. Joints inadequately torqued. Resistance less than one megOhm per each kiloVolt of rating between buses and or from buses to non-energized parts.
Defective Bushing/Insulator:	Cable clamp loose, missing, broken, corroded, burned, or other physical damage. Dirty, oily, greasy, or other surface contamination. Missing, cracked, chipped, or other damage. Not adequately secured. Oil leakage. Tracked or carbonized.
Defective Control Module:	Circuit boards improperly installed and/or connected. Inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, cracked, chipped, corroded, burned, or other damage to components and/or circuit boards. Not clean and moisture-free.
Improper Control Wiring:	Bimetallic connectors not used as required. Bundled and trained inappropriately. Control circuits improperly connected. Control wiring insulation resistance less than one megOhm per each kiloVolt of rating. Improper sensor pick-up or drop-out point. Improper termination. Inadequate fuse/connection tension. Inadequately torqued at termination. Inappropriate for application. Inconsistent time delays. Incorrect overcurrent protection. Indicator lamps inoperative. Indicator lens missing, cracked, or broken. Inoperative. Inoperative interlock. Insulation charred, burned, or discolored. Insulation improperly removed from conductor. No engineering study to support installed fuse. Splices improperly insulated. Terminal boards improperly installed. Unauthorized splice.

DEFICIENCY FACTORS
0.09.01.03 MEDIUM VOLTAGE (CSI 16300)

SYSTEM ASSEMBLIES/DEFICIENCIES

Metering (Continued)

improper Marking:	Nameplate missing or illegible. Missing or insufficient data.
Inaccurate Metering:	Calibration standard not established. Defective or inoperative sensor or transducer, Metering device inadequately sized. Metering device not calibrated.

Motors

Defective Bearings:	High temperature. Rough or irregular rotation. Leaking seals. Improper bearing. Noisy.
Defective Control Module:	Circuit boards improperly installed and/or connected. Inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, cracked, chipped, corroded, burned, or other damage to components and/or circuit boards. Not clean and moisture-free.
Defective Heater:	Heater not adequately secured to mounting surface. Improper conductors from source. Improper temperature in device enclosure. Inoperative heater element. Heater element resistance to ground less than one megOhm per each kiloVolt of rating. Sensing device broken, missing, or inoperative. Sensing device malcalibrated.
Improper Cable/Conductor:	Ampacity not properly rated. Bimetallic connectors not used as required. Broken wire strands. Burned, melted, discolored conductor material. Defective or deficient cable/conductor penetrations. High splice temperature. Improper bending radius. Improper insulation Voltage. Improper splice materials used. Improper termination. Improper trench. Improperly made splice. Inappropriate for application. Insulation inappropriate for application. Insulation improperly removed. Insulation is burned, charred, discolored, or other physical damage.

DEFICIENCY FACTORS
0.09.01.03 MEDIUM VOLTAGE (CSI 163001

SYSTEM ASSEMBLIES/DEFICIENCIES

Motors

Improper Cable/Conductor (Continued):	Insulation resistance less than one megOhm per each kiloVolt of rating. Insulation unraveled, frayed, brittle, or other physical damage. Nicked or ringed conductor. Not properly bundled or trained. Not properly connected to device. Not properly derated for installation. Not properly supported. Not protected physically. Unauthorized splice.
Improper Fitting:	Exposed conductors. Improper fitting for application. Insert broken, cracked, missing, or other damage. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, broken, cracked, loose, or other damage. Unused openings not covered or plugged.
Improper Housing:	Broken, leaking, obstructed, inoperative, or inadequate heat exchanger. Corroded, rusted, dented, or other physical damage. Dirty, missing, or inappropriate filters. End bells corroded, rusted, dented, missing, or other physical damage. Gaskets missing, damaged, malaligned, or other physical deformity. Loose, broken, damaged, corroded, or missing fastening hardware. Not accessible. Not adequate for application, incorrect NEMA rating. Not clean and moisture-free. Not properly grounded. Not secured to mounting base or surface. Unused openings not covered or plugged. Ventilation openings defective, nonoperative, obstructed, or not properly guarded.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.
Improper Motor Application:	Inappropriate starting system. Improper motor size. Improper rotation. Improper speed. Improper connection of bimetallic elements. Improper winding connections.

DEFICIENCY FACTORS
0.09.01.03 MEDIUM VOLTAGE (CSI 16300)

SYSTEM ASSEMBLIES/DEFICIENCIES

Motors (Continued)

improper Mount:	Device not secured to mount. Device mounting surface chipped, cracked, broken, or other physical damage. Dirty, oily, greasy, or other surface contamination. Mounting structure inadequate. Mounting structure not secured to mounting surface. Not aligned.
Improper Rotor/Stator:	Bent, scored, or other damage to rotor shaft. Burned, charred, or other signs of high temperature. Damaged internal and/or external cooling fan. Noisy laminations. Non-uniform air gap. Open turns or coils. Shorted turns or coils. Splice insulation unraveled, brittle, cracked, or other damage. Unbalanced rotor assembly.
inaccurate Metering:	Calibration standard not established. Defective or inopertaive sensor or transducer. Metering device inadequately sized. Metering device not calibrated.

Motor Control Centers

Defective Bushing/Insulator:	Cable clamp loose, missing, broken, corroded, burned, or other physical damage. Dirty, oily, greasy, or other surface contamination. Missing, cracked, chipped, or other damage. Not adequately secured. Oil leakage. Tracked or carbonized.
Defective Contactor:	Arc suppression components broken, eroded, cracked, or missing. Broken strands in braided shunts. Coil discolored, burned, or other sign of high temperature. Coil inoperative at 85% of rated Voltage. Contact pressure not per manufacturer's specifications. Contacts burned, pitted, or other physical damage. Contacts not properly aligned. Control circuits improperly connected. Dash pot inoperative, broken, or missing. Device sticks magnetically. Drum contacts inadequately torqued. High contact resistance. Improper fluid in dash pot. Improper rolling action of drum contacts.

DEFICIENCY FACTORS
0.09.01.03 MEDIUM VOLTAGE (CSI 16300)

SYSTEM ASSEMBLIES/DEFICIENCIES

Motor Control Centers

Defective Contactor (Continued):	Improper size. Indicator lamps inoperative. Indicator lens missing, cracked, or broken. Missing, loose, broken, or corroded hardware. No engineering study to support thermal trip device rating. Noisy. Plugging relays dirty or other contamination. Pushbuttons not labeled. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts. Rheostat contact surface corroded, oxidized, uneven, or other physical defect, Rheostat holding coil missing or inoperative. Rheostat ventilation impeded. Terminals, contact blocks, bus bars, and connectors loose or discolored. Thermal trip device wrong size.
Defective Control Module:	Circuit boards improperly installed and/or connected. Inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, cracked, chipped, corroded, burned, or other damage to components and/or circuit boards. Not clean and moisture-free.
Defective Heater:	Heater not adequately secured to mounting surface. Improper conductors from source. Improper temperature in device enclosure. Inoperative heater element. Heater element resistance to ground less than one megOhm per each kiloVolt of rating. Sensing device broken, missing, or inoperative. Sensing device malcalibrated.
Defective Pressure Relief:	High internal pressure. No internal pressure.
Improper Bus:	Discolored, warped, or other signs of high temperature. Not properly torqued. Not adequately secured or braced. Resistance less than one megOhm per each kiloVolt of rating between buses and/or from buses to non-energized parts. Insulated connections unraveled, brittle, cracked, or other physical damage. Barriers missing or damaged.

DEFICIENCY FACTORS
0.09.01.03 MEDIUM VOLTAGE **(CSI 16300)**

SYSTEM ASSEMBLIES/DEFICIENCIES

Motor Control Centers (Continued)

improper Control Wiring:	Bimetallic connectors not used as required. Bundled and trained inappropriately. Control circuits improperly connected. Control wiring insulation resistance less than one megOhm per each kiloVolt of rating. Improper sensor pick-up or drop-out point. Improper termination. Inadequate fuse/connection tension. Inadequately torqued at termination. Inappropriate for application. Inconsistent time delays. Incorrect overcurrent protection. Indicator lamps inoperative. Indicator lens missing, cracked, or broken. Inoperative. Inoperative interlock. Insulation charred, burned, or discolored. Insulation improperly removed from conductor. No engineering study to support installed fuse. Splices improperly insulated. Terminal boards improperly installed. Unauthorized splice.
improper Disconnect:	Adjustable settings misadjusted. Arc suppression devices broken, cracked, missing, tracked, chipped, or other physical damage. Contacts bent or not aligned. Defective phase barriers. Does not sustain rated current per NEMA AB4-1991. Does not trip on instantaneous overcurrent per NFPA 70B. Handle broken, bent, or other physical deformity. High conductor, lug temperature. High contact resistance. Improper application. Improper switch time. Improperly sized. Improperly wired. interlock broken, missing, or inoperative. Movable contacts bent, malaligned, or other physical deformity. Movable contacts pitted, burned, or discolored. No engineering study to support adjustable settings. Not accessible. Not adequate for application. Not clean and moisture-free. Not grounded properly. Not secured to mounting surface.

DEFICIENCY FACTORS
0.09.01.03 MEDIUM VOLTAGE (CSI 16300)

SYSTEM ASSEMBLIES/DEFICIENCIES

Motor Control Centers

Improper Disconnect (Continued):	Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts. Series trip device missing, broken, or inoperative. Shunt trip device missing, broken, or inoperative. Stationary contacts bent, malaligned, or other physical deformity. Stationary contacts pitted, burned, or discolored. Terminals, contact blocks, bus bar and connectors loose, burned, or discolored. Time-delay overcurrent trip not per manufacturer's specifications. UnderVoltage trip missing, broken, maladjusted, or inoperative.
Improper Enclosure:	Not clean and moisture-free. Not adequate for application. Corroded, rusted, dented, or other physical damage. Not secured to mounting surface. Unused openings not covered or plugged. Not grounded properly. Corroded, rusted, dented, or other physical damage. Dirty, missing, or inappropriate filters. Gaskets missing, damaged, misaligned, or other physical deformity. Interlock broken, missing, or inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, broken, damaged, or inoperative security device. No curbing or berm for oil containment. Not accessible. Not adequate for application. Not clean and moisture-free. Not grounded properly. Not secured to mounting surface. Oil leaks. Unused openings not covered or plugged. Ventilation openings defective, nonoperative, obstructed, or not properly guarded.
Improper Equipment Protection:	Improper or inadequate primary overcurrent device. Improper or inadequate secondary overcurrent device. No engineering study to support protection scheme. Incorrect calibration of protective devices or sensors. Improper or inadequate differential protection. Time delay suppression devices missing, broken, or inoperative.

DEFICIENCY FACTORS
0.09.01.03 MEDIUM VOLTAGE (CSI 16300)

SYSTEM ASSEMBLIES/DEFICIENCIES

Motor Control **Centers** (Continued)

improper Fuse Unit:	Fuse clips bent, malaligned, discolored, or other physical damage. Improper fuse type used. Improperly sized. Poor fuse to clip contact. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts.
Improper Insulating Liquid:	Low liquid level. Low insulation resistance. Pressure leak. Contaminated internal device. Oil does not meet criteria of NFPA 70B.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.
Improper Mount:	Device not secured to mount. Device mounting surface chipped, cracked, broken, or other physical damage. Dirty, oily, greasy, or other surface contamination. Mounting structure inadequate. Mounting structure not secured to mounting surface. Not aligned.
Inaccurate Metering:	Calibration standard not established. Defective or inoperative sensor or transducer. Metering device inadequately sized. Metering device not calibrated.

Raceway & Fittings

Defective Control Module:	Circuit boards improperly installed and/or connected. Inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, cracked, chipped, corroded, burned, or other damage to components and/or circuit boards. Not clean and moisture-free.
Improper Fitting:	Exposed conductors. Improper fitting for application. Insert broken, cracked, missing, or other damage. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, broken, cracked, loose, or other damage. Unused openings not covered or plugged.
Improper Installation:	Excessive bends. Hanger not adequately secured to structure. Improper bending radius.

DEFICIENCY FACTORS
0.09.01.03 MEDIUM VOLTAGE **(CSI 16300)**

SYSTEM ASSEMBLIES/DEFICIENCIES

Raceway & Fittings

improper Installation (Continued):	Improper joint. Improper trench. Improperly supported by other raceway. Inadequate grounding. Missing vertical run hardware. No bushing or equivalent protection. Not adequately protected from severe physical damage. Not adequately secured to mounting surface. Not appropriate for location. Not clearly and permanently marked where required. Not secured within three feet of end of run. Supported by other raceway. Overfilled. Unauthorized conductor present. Unused openings not covered or plugged.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.
Improper Mount:	Device not secured to mount. Device mounting surface chipped, cracked, broken, or other physical damage. Dirty, oily, greasy, or other surface contamination. Mounting structure inadequate. Mounting structure not secured to mounting surface. Not aligned.
Improper Raceway:	Inappropriate for application. Corroded, rusted, dented, or other physical damage. Hanger corroded, rusted, or other physical damage. Not clean and moisture-free.

Switchgear

Damaged Metering:	Device inoperative. Metering device broken or other physical damage. Tampering of metering device or circuit.
Defective Bushing/Insulator:	Cable clamp loose, missing, broken, corroded, burned, or other physical damage. Dirty, oily, greasy, or other surface contamination. Missing, cracked, chipped, or other damage. Not adequately secured. Oil leakage. Tracked or carbonized.
Defective Control Module:	Circuit boards improperly installed and/or connected. Inoperative. Loose, broken, damaged, corroded, or missing fastening hardware.

DEFICIENCY FACTORS
0.09.01.03 MEDIUM VOLTAGE (CSI 16300)

SYSTEM ASSEMBLIES/DEFICIENCIES

Switchgear

Defective Control Module (Continued):	Missing, cracked, chipped, corroded, burned, or other damage to components and/or circuit boards. Not clean and moisture-free.
Defective Heater:	Heater not adequately secured to mounting surface. Improper conductors from source. Improper temperature in device enclosure. inoperative heater element. Heater element resistance to ground less than one megOhm per each kiloVolt of rating. Sensing device broken, missing, or inoperative. Sensing device malcalibrated.
Defective Pressure Relief:	High internal pressure. No internal pressure.
Improper Bus:	Discolored, warped, or other signs of high temperature. Not properly torqued. Not adequately secured or braced. Resistance less than one megOhm per each kiloVolt of rating between buses and/or from buses to non-energized parts. Insulated connections unraveled, brittle, cracked, or other physical damage. Barriers missing or damaged.
Improper Control Wiring:	Bimetallic connectors not used as required. Bundled and trained inappropriately. Control circuits improperly connected. Control wiring insulation resistance less than one megOhm per each kiloVolt of rating. Improper sensor pick-up or drop-out point. Improper termination. Inadequate fuse/connection tension. Inadequately torqued at termination. Inappropriate for application. Inconsistent time delays. Incorrect overcurrent protection. Indicator lamps inoperative. Indicator lens missing, cracked, or broken. Inoperative. Inoperative interlock. Insulation charred, burned, or discolored. Insulation improperly removed from conductor. No engineering study to support installed fuse. Splices improperly insulated. Terminal boards improperly installed. Unauthorized splice.

DEFICIENCY FACTORS
0.09.01.03 MEDIUM VOLTAGE (CSI 16300)

SYSTEM ASSEMBLIES/DEFICIENCIES

Switchgear (Continued)

Improper Disconnect:	Adjustable settings misadjusted. Arc suppression devices broken, cracked, missing, tracked, chipped, or other physical damage. Contacts bent or not aligned. Defective phase barriers. Does not sustain rated current per NEMA AB4-1991. Does not trip on instantaneous overcurrent per NFPA 706. Handle broken, bent, or other physical deformity. High conductor, lug temperature. High contact resistance. Improper application. Improper switch time. Improperly sized. Improperly wired. Interlock broken, missing, or inoperative. Movable contacts bent, malaligned, or other physical deformity. Movable contacts pitted, burned, or discolored. No engineering study to support adjustable settings. Not accessible. Not adequate for application. Not clean and moisture-free. Not grounded properly. Not secured to mounting surface. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts. Series trip device missing, broken, or inoperative. Shunt trip device missing, broken, or inoperative. Stationary contacts bent, malaligned, or other physical deformity. Stationary contacts pitted, burned, or discolored. Terminals, contact blocks, bus bar and connectors loose, burned, or discolored. Time-delay overcurrent trip not per manufacturer's specifications. UnderVoltage trip missing, broken, maladjusted, or inoperative.
Improper Enclosure:	Corroded, rusted, dented, or other physical damage. Dirty, missing, or inappropriate filters. Gaskets missing, damaged, misaligned, or other physical deformity. Not secured to mounting surface. Interlock broken, missing, or inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, broken, damaged, or inoperative security device. No curbing or berm for oil containment.

DEFICIENCY FACTORS
0.09.01.03 MEDIUM VOLTAGE (CSI 16300)

SYSTEM ASSEMBLIES/DEFICIENCIES

Switchgear

improper Enclosure (Continued):	Not accessible. Not adequate for application. Not clean and moisture-free. Not grounded properly. Oil leaks. Unused openings not covered or plugged. Ventilation openings defective, nonoperative, obstructed, or not properly guarded.
Improper Equipment Protection:	Improper or inadequate primary overcurrent device. Improper or inadequate secondary overcurrent device. No engineering study to support protection scheme. Incorrect calibration of protective devices or sensors. Improper or inadequate differential protection. Time delay suppression devices missing, broken, or inoperative.
Improper Fuse Unit:	Fuse clips bent, malaligned, discolored, or other physical damage. Improper fuse type used. Improperly sized. Poor fuse to clip contact, Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts.
Improper Insulating Liquid:	Low liquid level. Low insulation resistance. Pressure leak. Contaminated internal device. Oil does not meet criteria of NFPA 70B.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.
Improper Mount:	Device not secured to mount. Device mounting surface chipped, cracked, broken, or other physical damage. Dirty, oily, greasy, or other surface contamination. Mounting structure inadequate. Mounting structure not secured to mounting surface. Not aligned.
Improper Protective Relay:	Cover loose, missing, broken, chipped, cracked, or other physical damage. Current, Voltage, and time pick-up/drop-out values not per manufacturer's specifications. Housing chipped, cracked, broken, or other physical damage. Improper application. Improperly wired.

DEFICIENCY FACTORS
0.09.01.03 MEDIUM VOLTAGE (CSI 16300)

SYSTEM ASSEMBLIES/DEFICIENCIES

Switchgear

Improper Protective Relay (Continued):	Inoperative. Malcalibrated. Missing and/or out-of-date calibration tag. Movable contacts bent, malaligned, or other physical deformity. Movable contacts pitted, burned, or discolored. Not clean and moisture-free. Not secured to mounting surface. No engineering study to support adjustable setting. Stationary contacts bent, malaligned, or other physical deformity. Stationary contacts pitted, burned, or discolored. Terminals loose, broken, missing, burned, discolored, or corroded.
Inaccurate Metering:	Calibration standard not established. Defective or inoperative sensor or transducer. Metering device inadequately sized. Metering device not calibrated.

Transfer **Switches**

Damaged Metering:	Device inoperative. Metering device broken or other physical damage. Tampering of metering device or circuit.
Defective Bushing/Insulator:	Cable clamp loose, missing, broken, corroded, burned, or other physical damage. Dirty, oily, greasy, or other surface contamination. Missing, cracked, chipped, or other damage. Not adequately secured. Oil leakage. Tracked or carbonized.
Defective Control Module:	Circuit boards improperly installed and/or connected. Inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, cracked, chipped, corroded, burned, or other damage to components and/or circuit boards. Not clean and moisture-free.
Defective Heater:	Heater not adequately secured to mounting surface. Improper conductors from source. Improper temperature in device enclosure. Inoperative heater element. Heater element resistance to ground less than one megOhm per each kiloVolt of rating. Sensing device broken, missing, or inoperative. Sensing device malcalibrated.

DEFICIENCY FACTORS
0.06.01.03 MEDIUM VOLTAGE (CSI 16300)

SYSTEM ASSEMBLIES/DEFICIENCIES

Transfer Switches (Continued)

Defective Pressure Relief:	High internal pressure. No internal pressure.
Defective Solenoid:	Inoperative. Sticks magnetically. Noisy. Coil discolored, burned, or other sign of high temperature. High pick-up Voltage. Fitting missing or inappropriate. Missing, loose, broken, or corroded hardware. Relay dirty or other contamination. Improper size.
Improper Bus:	Discolored, warped, or other signs of high temperature. Not properly torqued. Not adequately secured or braced. Resistance less than one megOhm per each kiloVolt of rating between buses and/or from buses to non-energized parts. Insulated connections unraveled, brittle, cracked, or other physical damage. Barriers missing or damaged.
Improper Control Wiring:	Bimetallic connectors not used as required. Bundled and trained inappropriately. Control circuits improperly connected. Control wiring insulation resistance less than one megOhm per each kiloVolt of rating. Improper sensor pick-up or drop-out point. Improper termination. Inadequate fuse/connection tension. Inadequately torqued at termination. Inappropriate for application. Inconsistent time delays. Incorrect overcurrent protection. Indicator lamps inoperative. Indicator lens missing, cracked, or broken. Inoperative. Inoperative interlock. Insulation charred, burned, or discolored. Insulation improperly removed from conductor. No engineering study to support installed fuse. Splices improperly insulated. Terminal boards improperly installed. Unauthorized splice.
Improper Disconnect:	Adjustable settings misadjusted. Arc suppression devices broken, cracked, missing, tracked, chipped, or other physical damage. Contacts bent or not aligned.

DEFICIENCY FACTORS
0.09.01.03 MEDIUM VOLTAGE (CSI 163001

SYSTEM ASSEMBLIES/DEFICIENCIES

Transfer Switches

Improper Disconnect (Continued):	Defective phase barriers. Does not sustain rated current per NEMA AB4-1991. Does not trip on instantaneous overcurrent per NFPA 70B. Handle broken, bent, or other physical deformity. High conductor, lug temperature. High contact resistance. Improper application. Improper switch time. Improperly sized. Improperly wired. Interlock broken, missing, or inoperative. Movable contacts bent, malaligned, or other physical deformity. Movable contacts pitted, burned, or discolored. No engineering study to support adjustable settings. Not accessible. Not adequate for application. Not clean and moisture-free. Not grounded properly. Not secured to mounting surface. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts. Series trip device missing, broken, or inoperative. Shunt trip device missing, broken, or inoperative. Stationary contacts bent, malaligned, or other physical deformity. Stationary contacts pitted, burned, or discolored. Terminals, contact blocks, bus bar and connectors loose, burned, or discolored. Time-delay overcurrent trip not per manufacturer's specifications. UnderVoltage trip missing, broken, maladjusted, or inoperative.
Improper Enclosure:	Corroded, rusted, dented, or other physical damage. Dirty, missing, or inappropriate filters. Gaskets missing, damaged, malaligned, or other physical deformity. Interlock broken, missing, or inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, broken, damaged, or inoperative security device. No curbing or berm for oil containment. Not accessible. Not adequate for application. Not clean and moisture-free. Not grounded properly. Not secured to mounting surface.

DEFICIENCY FACTORS
0.09.01.03 MEDIUM VOLTAGE (CSI 16300)

SYSTEM ASSEMBLIES/DEFICIENCIES

Transfer Switches

Improper Enclosure (Continued):	Oil leaks. Unused openings not covered or plugged. Ventilation openings defective, nonoperative, obstructed, or not properly guarded.
Improper Insulating Liquid:	Low liquid level. Low insulation resistance. Pressure leak. Contaminated internal device. Oil does not meet criteria of NFPA 70B.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.
Improper Mount:	Device not secured to mount. Device mounting surface chipped, cracked, broken, or other physical damage. Dirty, oily, greasy, or other surface contamination. Mounting structure inadequate. Mounting structure not secured to mounting surface. Not aligned.
Inaccurate Metering:	Calibration standard not established. Defective or inoperative sensor or transducer. Metering device inadequately sized. Metering device not calibrated.

Transformers

Contaminated Transformer:	Contaminated coils and core.
Damaged Metering:	Device inoperative. Metering device broken or other physical damage. Tampering of metering device or circuit.
Defective Bushing/Insulator:	Cable clamp loose, missing, borken, corroded, burned, or other physical damage. Dirty, oily, greasy, or other surface contamination. Missing, cracked, chipped, or other damage. Not adequately secured. Oil leakage. Tracked or carbonized.
Defective Control Module:	Circuit boards improperly installed and/or connected. Inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, cracked, chipped, corroded, burned, or other damage to components and/or circuit boards. Not clean and moisture-free.

DEFICIENCY FACTORS
0.09.01 .03 MEDIUM VOLTAGE (CSI 16300)

SYSTEM ASSEMBLIES/DEFICIENCIES

Transformers (Continued)

Defective Heater:	Heater element resistance to ground less than one megOhm Heater not adequately secured to mounting surface. improper conductors from source. Improper temperature in device enclosure. Inoperative heater element.per each kiloVolt of rating. Sensing device broken, missing, or inoperative. Sensing device malcalibrated.
Defective Pressure Relief:	High internal pressure. No internal pressure.
Defective Transformer:	Cooling fans inoperative. Corona. Inadequate rating. Low insulation resistance. Low liquid level. Noisy. Pressure leak. Shorted or open coil or winding. Tap changer inoperative.
Defective Ventilation:	High operating temperature. Location not adequately ventilated. Ventilation inlets clogged. Ventilation obstructed.
Improper Control Wiring:	Bimetallic connectors not used as required. Bundled and trained inappropriately. Control circuits improperly connected. Control wiring insulation resistance less than one megOhm per each kiloVolt of rating. Improper sensor pick-up or drop-out point. Improper termination. Inadequate fuse/connection tension. Inadequately torqued at termination. Inappropriate for application. Inconsistent time delays. Incorrect overcurrent protection. Indicator lamps inoperative. Indicator lens missing, cracked, or broken. Inoperative. Inoperative interlock. Insulation charred, burned, or discolored. Insulation improperly removed from conductor. No engineering study to support installed fuse. Splices improperly insulated. Terminal boards improperly installed. Unauthorized splice.

DEFICIENCY FACTORS
0.09.01.03 MEDIUM VOLTAGE (CSI 16300)

SYSTEM ASSEMBLIES/DEFICIENCIES

Transformers (Continued)

improper Enclosure:	Corroded, rusted, dented, or other physical damage. Dirty, missing, or inappropriate filters. Gaskets missing, damaged, misaligned, or other physical deformity. Not secured to mounting surface. Interlock broken, missing, or inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, broken, damaged, or inoperative security device. No curbing or berm for oil containment. Not accessible. Not adequate for application. Not clean and moisture-free. Not grounded properly. Oil leaks. Unused openings not covered or plugged. Ventilation openings defective, nonoperative, obstructed, or not properly guarded.
Improper Equipment Protection:	Improper or inadequate primary overcurrent device. Improper or inadequate secondary overcurrent device. No engineering study to support protection scheme. Incorrect calibration of protective devices or sensors. Improper or inadequate differential protection. Time delay suppression devices missing, broken, or inoperative.
Improper Insulating Liquid:	Contaminated internal device. Low insulation resistance. Low liquid level. Oil does not meet criteria of NFPA 708. Pressure leak.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.
Inaccurate Metering:	Calibration standard not established. Defective or inoperative sensor or transducer. Metering device inadequately sized. Metering device not calibrated.
Improper Mount:	Device not secured to mount. Device mounting surface chipped, cracked, broken, or other physical damage. Dirty, oily, greasy, or other surface contamination. Mounting structure inadequate. Mounting structure not secured to mounting surface. Not aligned.

DEFICIENCY FACTORS
0.09.01.03 MEDIUM VOLTAGE (CSI 16300)

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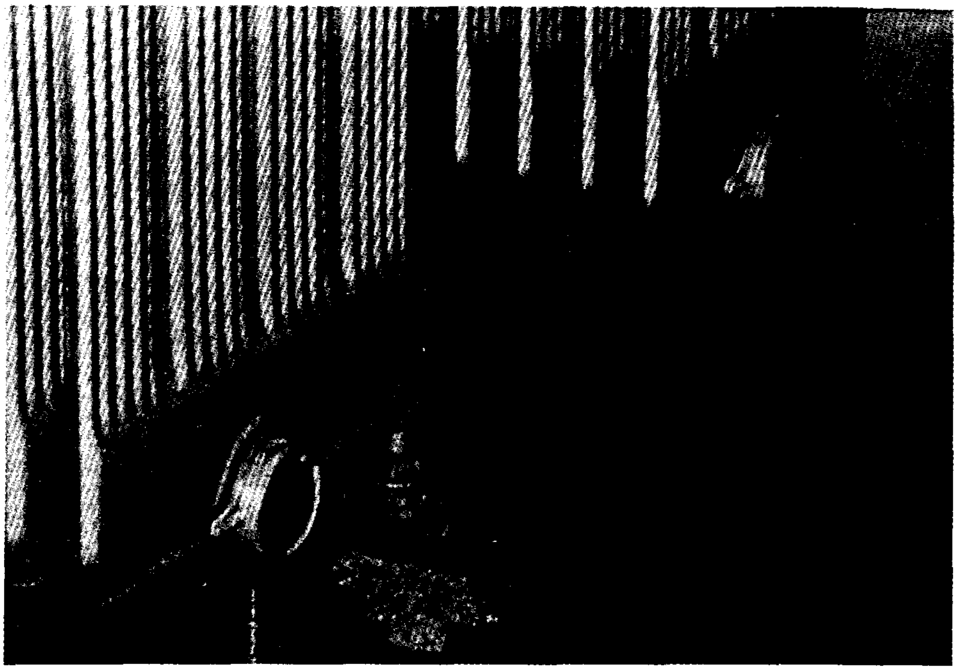


IMPROPER ENCLOSURE

DEFICIENCIES:

1. OIL LEAKS
2. NO CURBING OR BERM FOR OIL CONTAINMENT

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	TRANSFORMERS		
SERVICE AND DISTRIBUTION MEDIUM VOLTAGE DISTRIBUTION SYSTEM (CSI 16300)	Revision No.	Issue Date 5/93	Drawing No. D090103-1

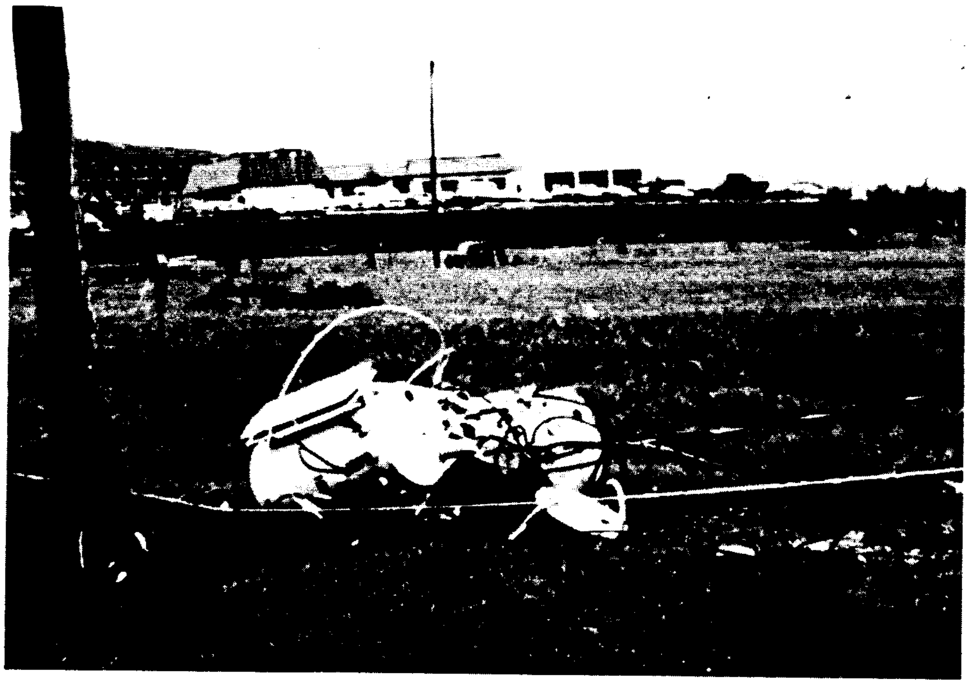
REVIEW PENDING

IMPROPER ENCLOSURE

DEFICIENCIES:
1. CORRODED, RUSTED, DENTED OR OTHER PHYSICAL DAMAGE
2. NOT SECURED TO MOUNTING SURFACE

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	TRANSFORMERS		
SERVICE AND DISTRIBUTION MEDIUM VOLTAGE DISTRIBUTION SYSTEM (CSI 16300)	Revision No.	Issue Date 5/93	Drawing No. D090103-2

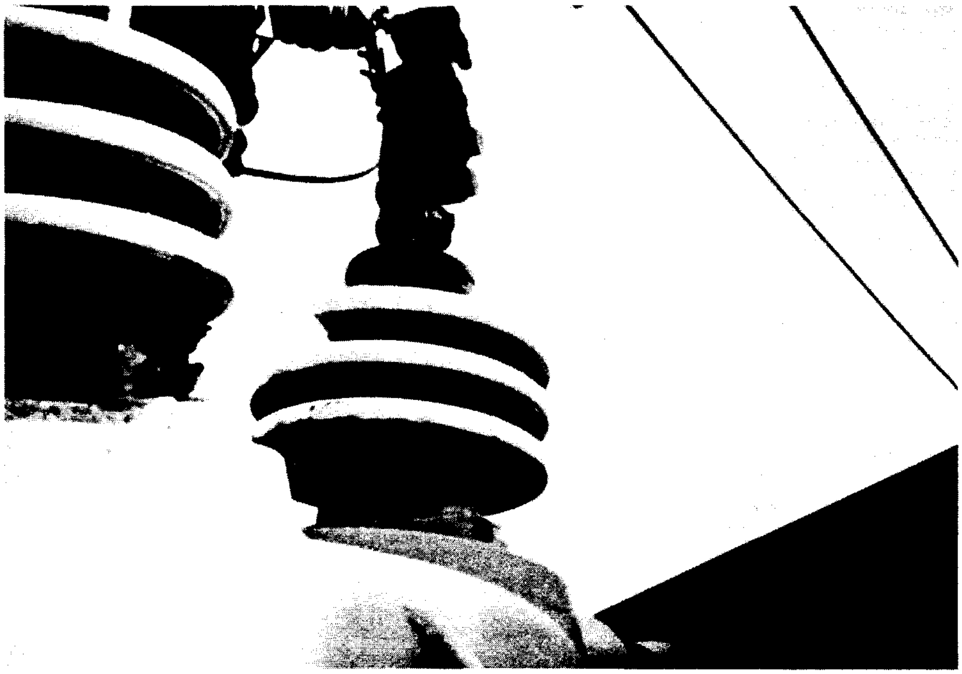


IMPROPER ENCLOSURE

DEFICIENCY:
1. NOT SECURED TO MOUNTING SURFACE

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	TRANSFORMERS		
SERVICE AND DISTRIBUTION MEDIUM VOLTAGE DISTRIBUTION SYSTEM (CSI 16300)	Revision No.	Issue Date 5/93	Drawing No. D090103-3

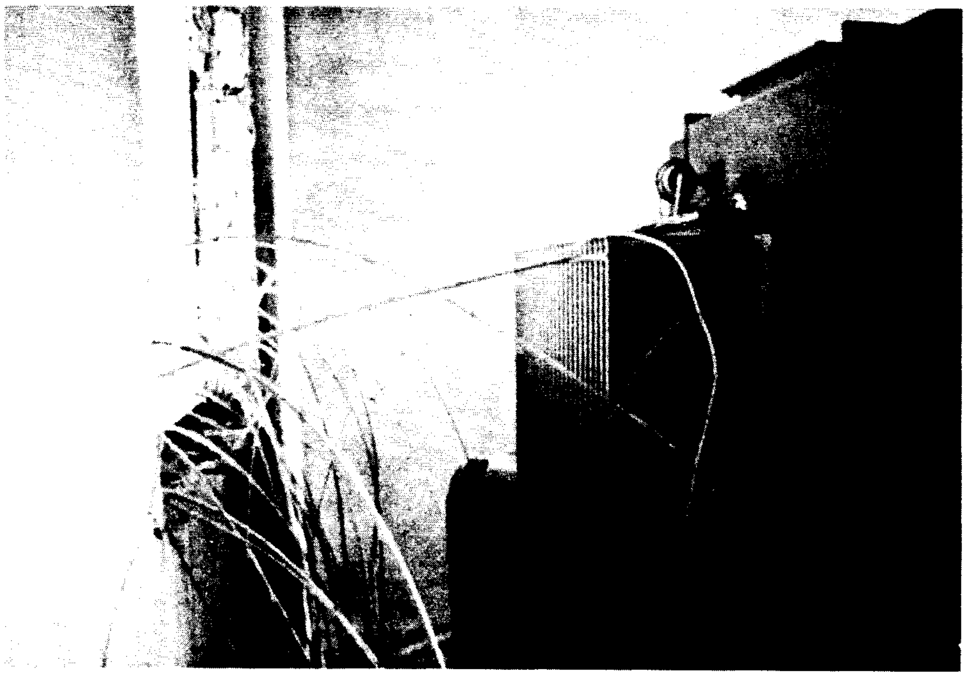


DEFECTIVE BUSHING/ INSULATOR

1. MISSING, CRACKED, CHIPPED OR OTHER DAMAGE

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	TRANSFORMERS		
SERVICE AND DISTRIBUTION MEDIUM VOLTAGE DISTRIBUTION SYSTEM (CSI 16300)	Revision No.	Issue Date 5/93	Drawing No. D090103-4



DEFECTIVE VENTILATION

DEFICIENCY:

1. VENTILATION OBSTRUCTED

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	TRANSFORMERS		
SERVICE AND DISTRIBUTION MEDIUM VOLTAGE DISTRIBUTION SYSTEM (CSI 16300)	Revision No.	Issue Date 5/93	Drawing No. D090103-5

DEFICIENCY FACTORS
0.09.01.03 MEDIUM VOLTAGE (CSI 16300)

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DEFICIENCY FACTORS
0.09.01.03 MEDIUM VOLTAGE (CSI 16300)

END OF SUBSECTION

0.09.02 LIGHTING (CSI 16500)

DESCRIPTION

The Lighting System converts electrical energy to energy in the visible frequency spectrum; it consists of the luminaire and the necessary devices to connect the luminaire to the low Voltage distribution system. The lighting system may be one using incandescent, fluorescent, or High Intensity Discharge (HID) equipment.

LIGHTING SYSTEM EQUIPMENT

Types of lighting system equipment in this section include the following:

- Emergency Luminaires
- Exterior Luminaires
- Hazard Luminaires
- Interior Luminaires
- Position Luminaires

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Emergency Luminaires (CSI 16535)

Emergency luminaires are an assembly of components such as ballasts, batteries, charger/inverter, housing, lamps, lens, reflector, and sockets used to convert electrical energy to light in the visible spectrum. Emergency luminaires are classified by type and application. Examples of lamp types are incandescent, fluorescent, and halogen. Examples of application are exit signs and egress illumination.

Exterior Luminaires (CSI 16520)

Exterior luminaires are an assembly of components such as ballasts, housing, lamps, lens, reflector, and sockets used to convert electrical energy to light in the visible spectrum. Exterior luminaires are classified by type and application. Examples of light types are incandescent, fluorescent, and HID. Examples of application are flood, site, roadway, hazard, and position lighting. Exterior luminaires used for hazard and position lighting are not included in this description.

Hazard Luminaires (CSI 16520)

Hazard luminaires are an assembly of components such as ballast, housing, lamp, lens, reflector, and socket used to convert electrical energy to light in the visible spectrum. Hazard luminaires are classified by type and application. Examples of lamp. type are incandescent and flashtube. Examples of application are rotating and flashing beacons and strobe lights.

Interior Luminaires (CSI 16510)

Interior luminaires are an assembly of components such as ballasts, housing, lamps, lens, reflector, and sockets used to convert electrical energy to light in the visible spectrum. Interior luminaires are classified by type and application. Examples of lamp types are incandescent, fluorescent, and HID. Examples of applications are direct, indirect, and emergency lighting. Interior luminaires used for emergency lighting are not included in this description.

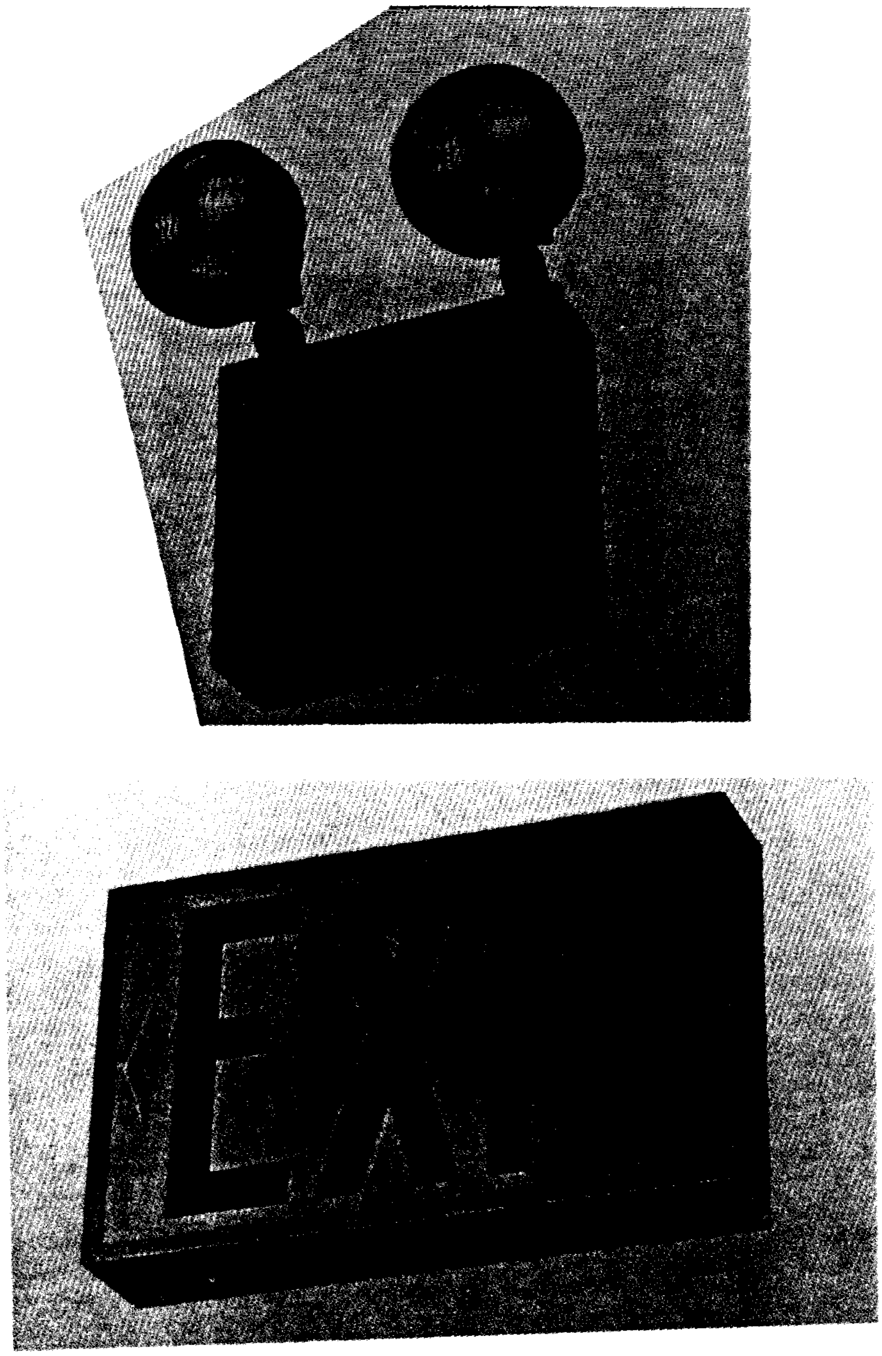
Position Luminaires (CSI 16520)

Position luminaires are an assembly of components such as ballast, housing, lamp, lens, reflector, and socket used to convert electrical energy to light in the visible spectrum. Position luminaires are classified by type and application. Examples of lamp types are incandescent, glow, and flashtube. Examples of application are channel location markers, airport approach navigation lighting, runway lighting, and taxiway lighting. Position luminaires on planes, boats, and vehicles are not included in this description.

0.09.02 LIGHTING (CSI 16500)

OTHER RELATED COMPONENTS

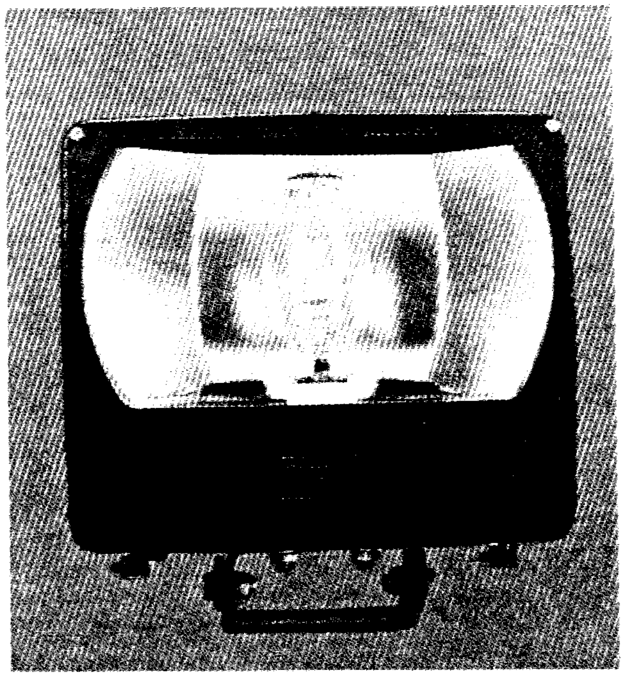
See the following subsections for related components:

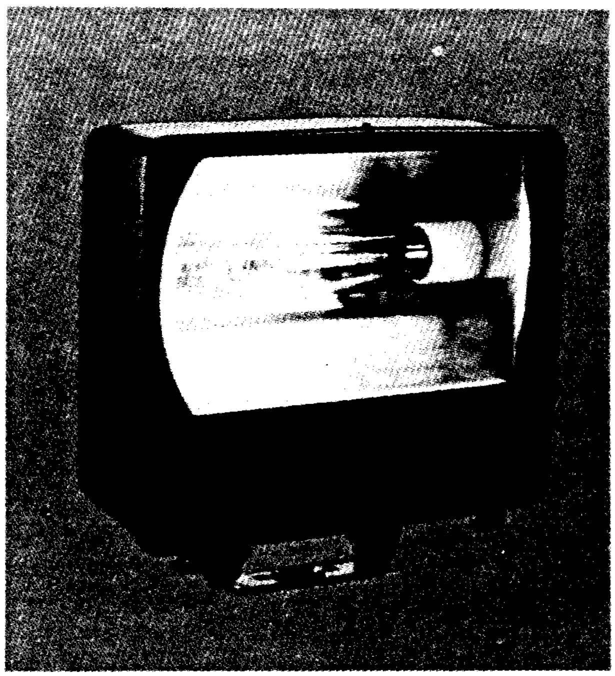


EMERGENCY LUMINAIRES

SOURCE: EDWARDS COMPANY SIGNALING PRODUCTS DIVISION 1991

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM 1	LIGHTING		
LIGHTING LUMINAIRES (CSI 16500)	Revision No.	Issue Date 5/93	Drawing No. A090201-1

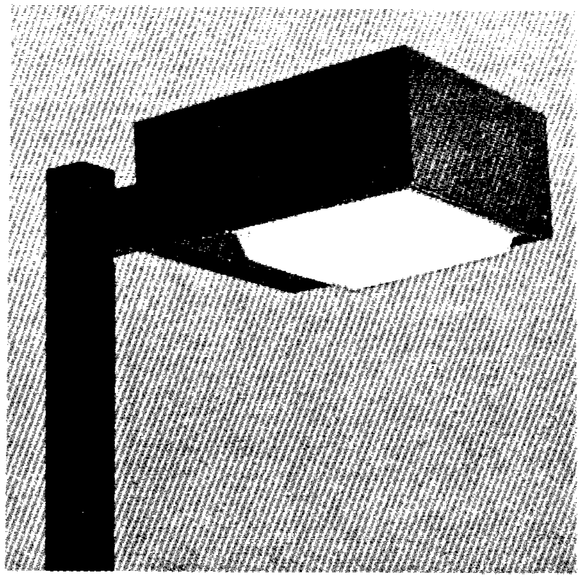


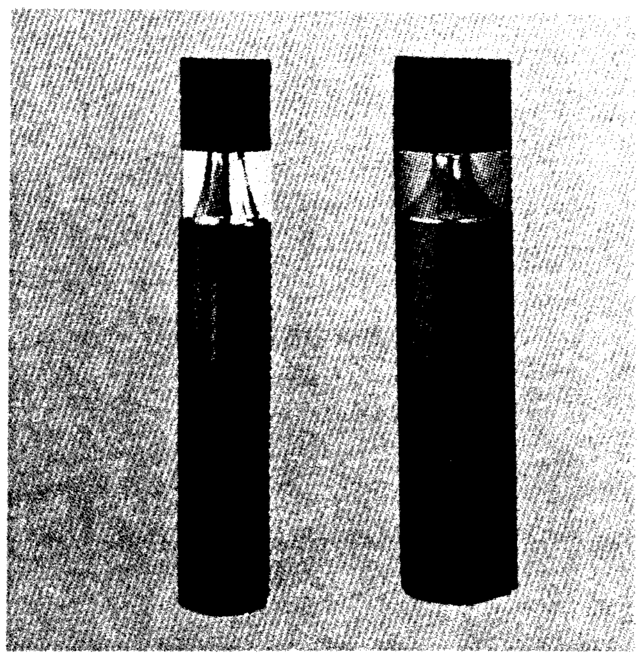


EXTERIOR LUMINAIRES

SOURCE: LITHONIA HI-TEK CATALOG, 1989 Lithonia Lighting, rev. 7/90

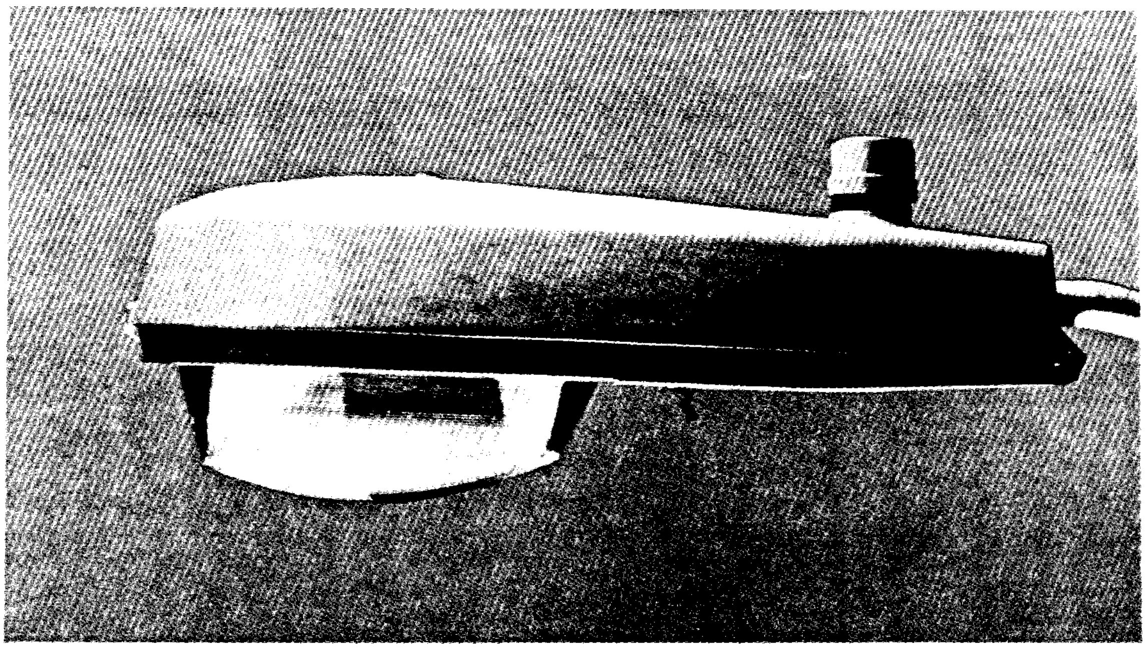
SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	LIGHTING	
LIGHTING LUMINAIRES (CSI 16500)	Revision No.	Issue Date	Drawing No.
		5/93	A090201-2





EXTERIOR LUMINAIRES

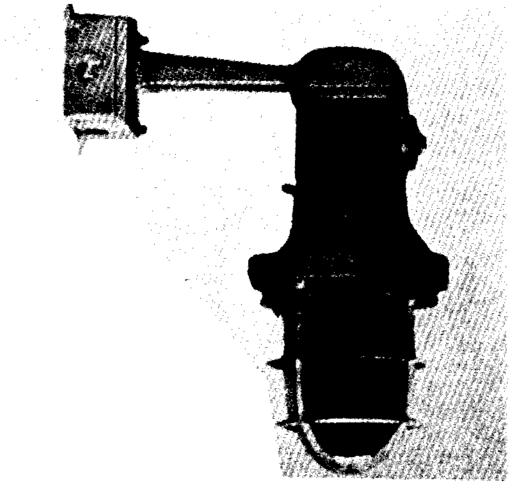
SOURCE: LITHONIA HI-TEK CATALOG, 1989 Lithonia Lighting, rev. 7/90

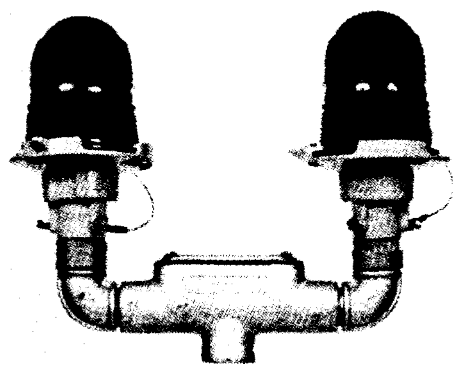


EXTERIOR LUMINAIRES

SOURCE: HUBBELL LIGHTING DIVISION CATALOG, JAN. 1986

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	LIGHTING		
LIGHTING LUMINAIRES (CSI 16500)	Revision No.	Issue Date 5/93	Drawing No. A090201-4





HAZARD LUMINAIRES

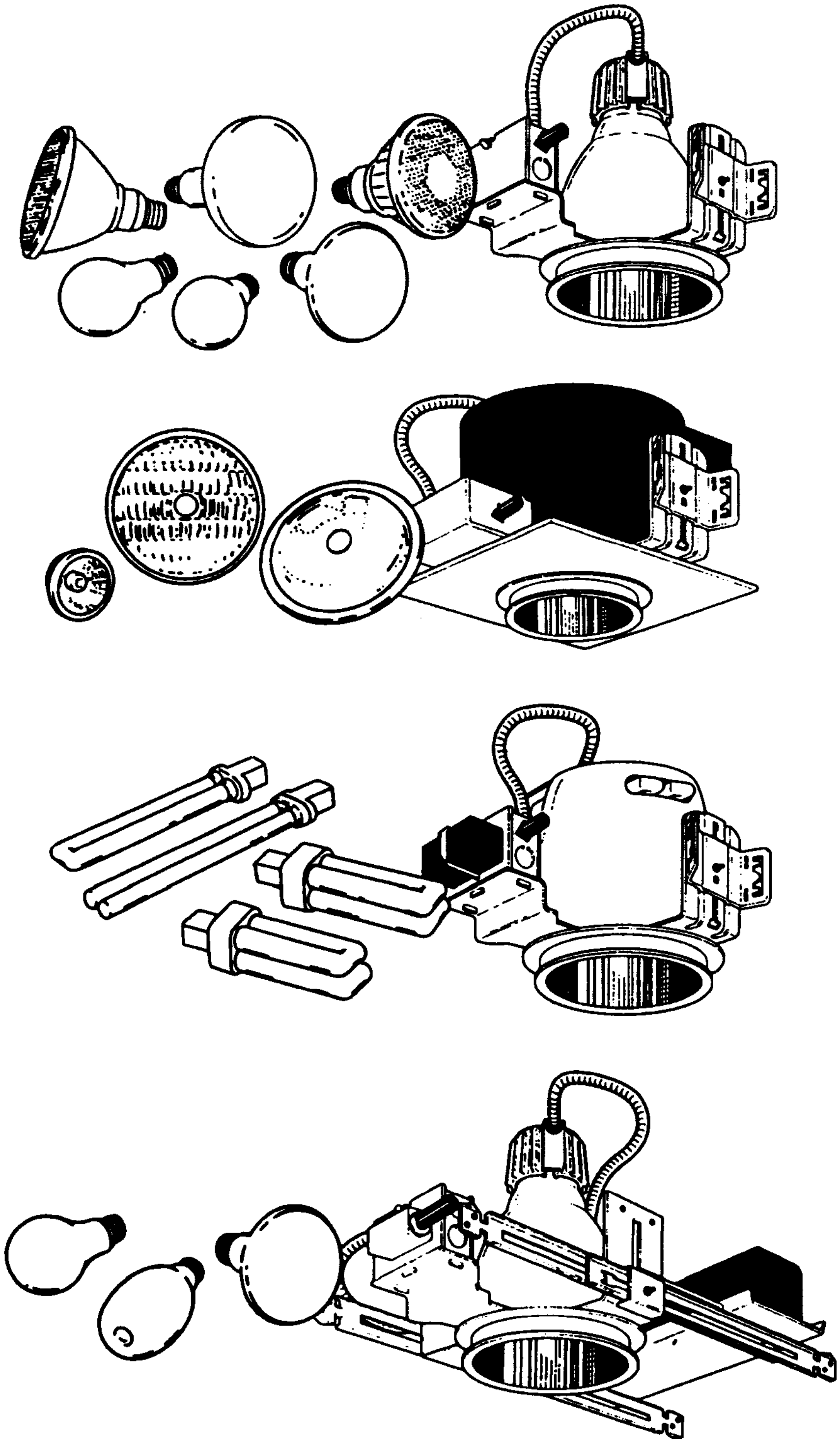
SOURCE: EDWARDS COMPANY SIGNALING PRODUCTS DIVISION CATALOG 1991
SOURCE: COOPER INDUSTRIES, CROUSE-HINDS AIRPORT LIGHTING PRODUCTS CATALOG, FEB. 1991

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	LIGHTING		
LIGHTING LUMINAIRES (CSI 16500)	Revision No.	Issue Date 5/93	Drawing No. A090201-5

INTERIOR LUMINAIRES

SOURCE: HUBBELL LIGHTING DIVISION CATALOG, JULY 1986

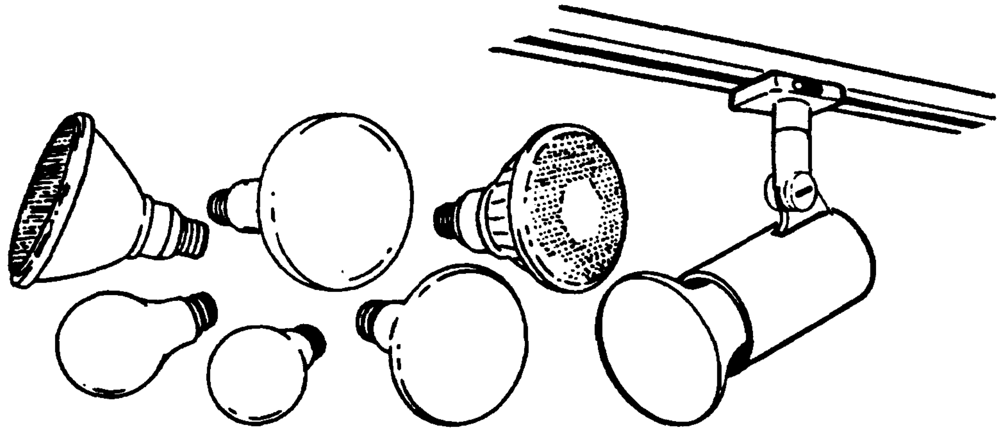
SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	LIGHTING		
LIGHTING LUMINAIRES (CSI 16500)	Revision No.	Issue Date 5/93	Drawing No. A090201-6



INTERIOR LUMINAIRES

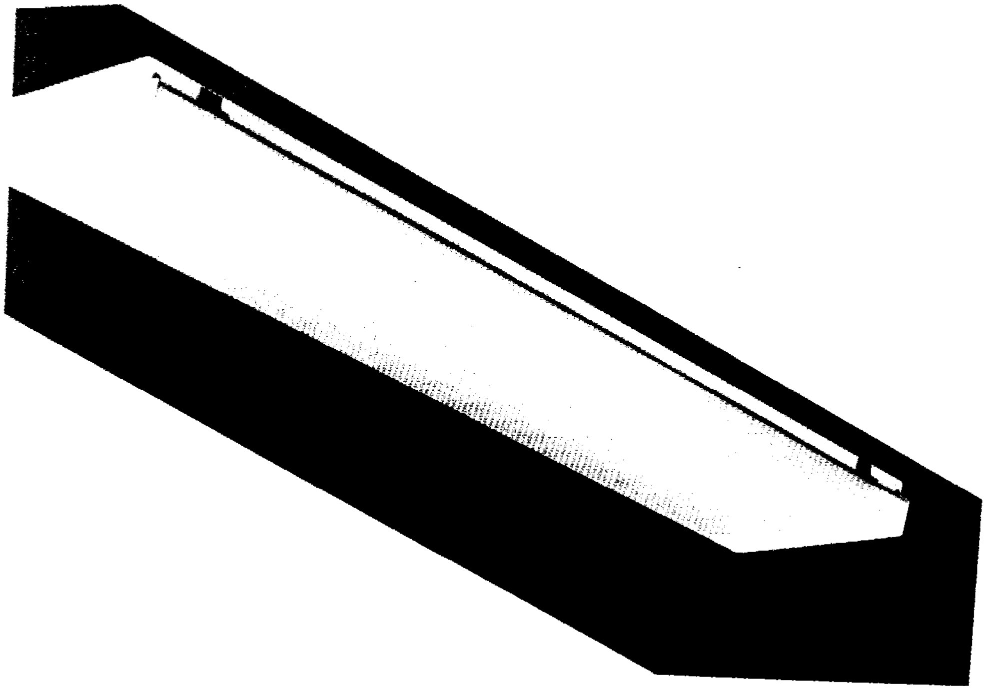
SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	LIGHTING	
	Revision No.	Issue Date	Drawing No.

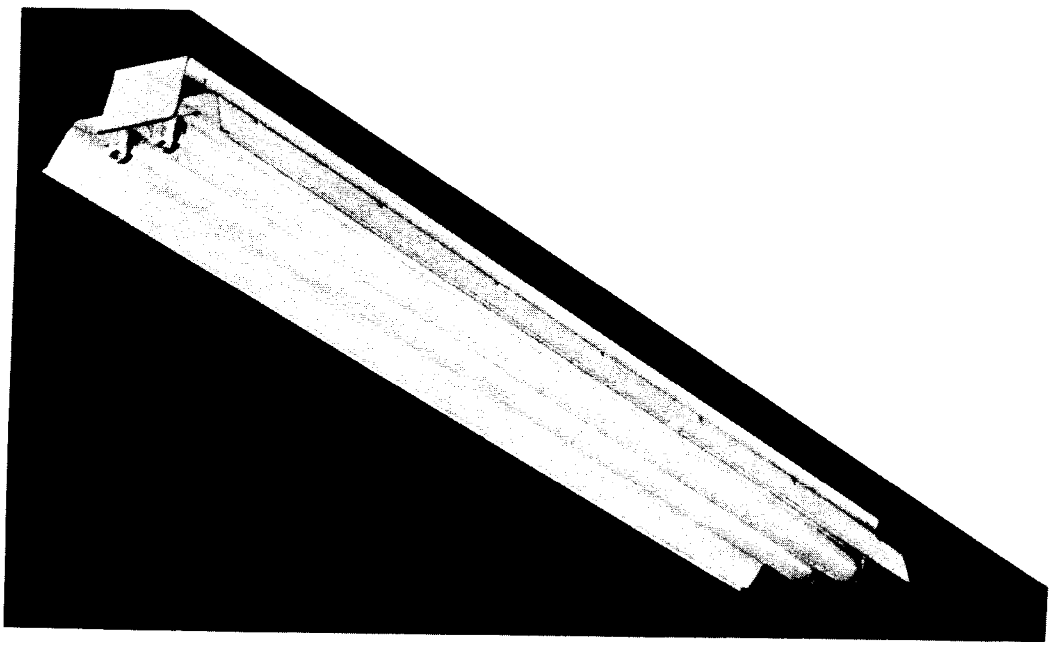
	Revision No.	Issue Date	Drawing No.
LIGHTING LUMINAIRES (CSI 16500)		5/93	A090201-7



INTERIOR LUMINAIRES

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	LIGHTING		
LIGHTING LUMINAIRES (CSI 16500)	Revision No.	Issue Date 5/93	Drawing No. A090201-8

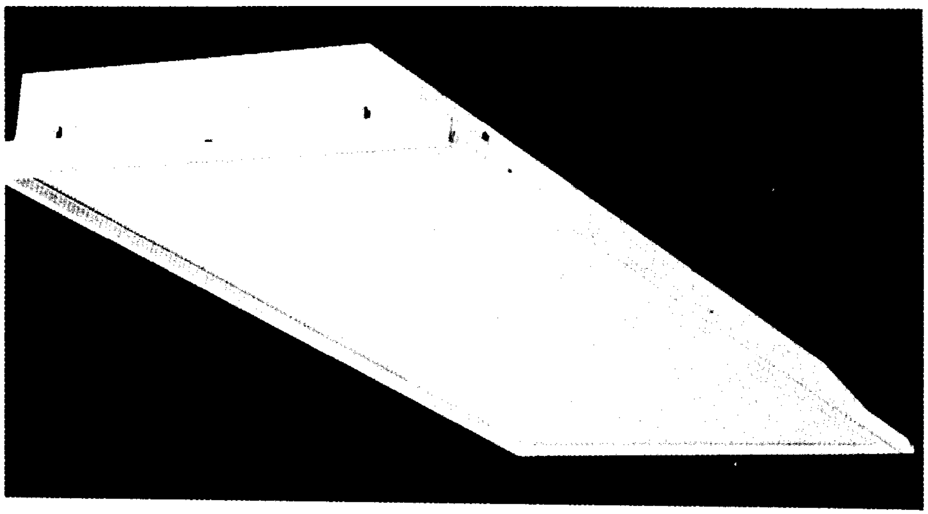




INTERIOR LUMINAIRES

SOURCE: DAY-BRITE/BENJAMIN, COMMERCIAL, INDUSTRIAL AND OUTDOOR LIGHTING CATALOG; DAY-BRITE LIGHTING, THOMAS INDUSTRIES, INC. 1990

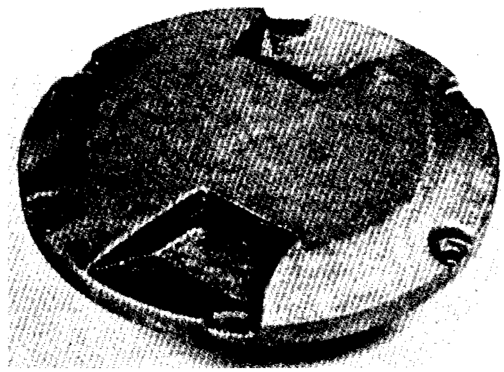
SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	LIGHTING		
LIGHTING LUMINAIRES (CSI 16500)	Revision No.	Issue Date 5/93	Drawing No. A090201-9

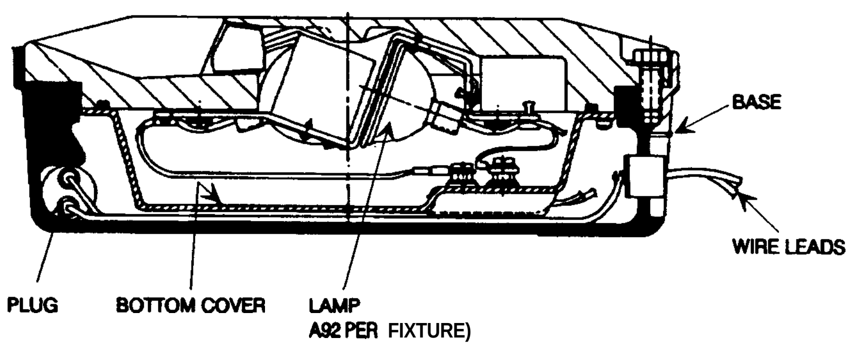


INTERIOR LUMINAIRES

SOURCE: DAY-BRITE/BENJAMIN, COMMERCIAL, INDUSTRIAL AND OUTDOOR LIGHTING CATALOG; DAY-BRITE LIGHTING, THOMAS INDUSTRIES, INC. 1990

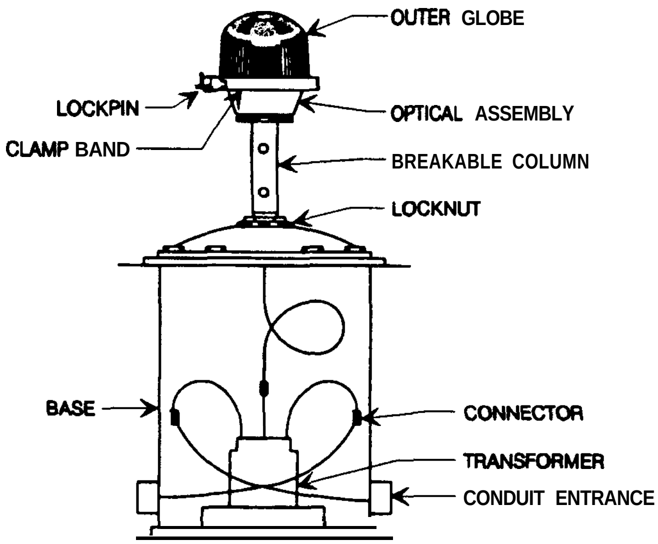
SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	LIGHTING		
LIGHTING LUMINAIRES (CSI 16500)	Revision No.	Issue Date 5/93	Drawing No. A090201-10





POSITION LUMINAIRES

SOURCE: COOPER INDUSTRIES, CROUSE-HINDS AIRPORT LIGHTING PRODUCTS CATALOG, 1990, 1991

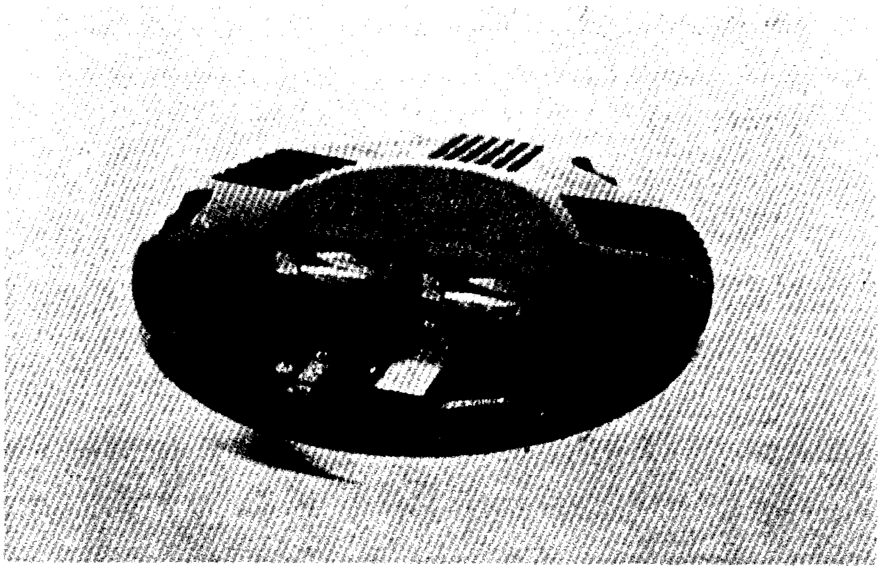


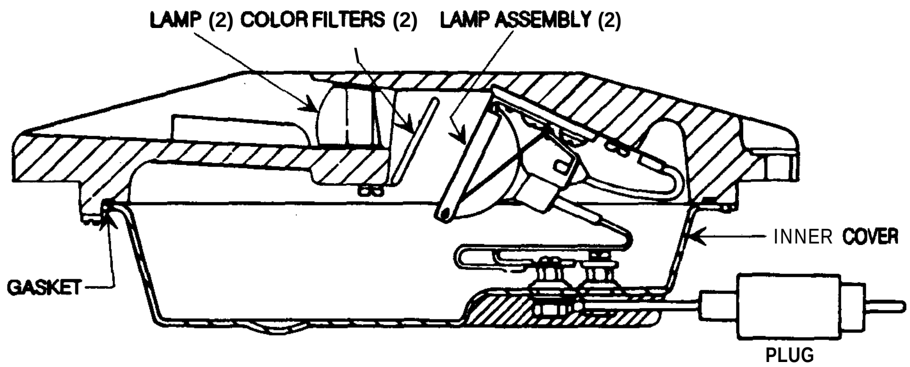
BABE MOUNTED HRLQ

POSITION LUMINAIRES

SOURCE: COOPER INDUSTRIES, CROUSE-HINDS AIRPORT LIGHTING PRODUCTS CATALOG, 1990, 1991

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	LIGHTING		
LIGHTING LUMINAIRES (CSI 16500)	Revision No.	Issue Date 5/93	Drawing No. A090201-12





POSITION LUMINAIRES

SOURCE: COOPER INDUSTRIES, CROUSE-HINDS AIRPORT LIGHTING PRODUCTS CATALOG, 1990,1991

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	LIGHTING		
LIGHTING LUMINAIRES (CSI 16500)	Revision No.	Issue Date 5/93	Drawing No. A090201-13

DEFICIENCY FACTORS
0.09.02 LIGHTING (CSI 16500)

PROBABLE FAILURE POINTS

- Ballast is inoperative or noisy.
- Housing has improper application for location; not securely attached to mounting surface.
- Lamp is inoperative or wrong size.
- Lenses are cracked and/or not fully secured.
- Markings are illegible or missing.
- Reflector may be dirty, rusted, or corroded.
- Sockets have cracked porcelain and/or not securely attached to mounting surface.

SYSTEM ASSEMBLIES/DEFICIENCIES

Lighting

Defective Ballast:	Corroded, rusted, dented, or other physical damage. Defective capacitor. Dirty, oily, greasy, or other surface contamination. Improper and/or inadequate line voltage. inappropriate for application. Inoperative thermal protector. Inoperative. Missing. Noisy. Not adequately secured. Not properly grounded. Oil leakage. Transformer coils discolored, burned, or other signs of high temperature.
Defective Battery Charger:	Abnormal output. Corroded, rusted, dented, or other physical damage. Inappropriate for application. Indicator lamps inoperative. Indicator lens missing, cracked, or broken. Indicator meter inoperative or missing. Inoperative. Noisy. Not adequately secured. Not clean and moisture-free. Test switch inoperative or missing. Top, bottom, or side cover missing.
Defective Battery/Application:	Corroded terminal. Cracked case. Flame arrestor missing or broken. Improper liquid level. Inoperative. Insufficient ampacity. Liquid leakage. No emergency shower readily available. No eyewash readily available.

DEFICIENCY FACTORS
0.09.02 LIGHTING (CSI 16500)

SYSTEM ASSEMBLIES/DEFICIENCIES

Lighting

Defective Battery/Application (Continued):	No protective personnel gear available. Not properly marked. Not properly ventilated. Not securely attached to mounting surface. Overcharged. Pressure release vent inoperative. Rack(s) unstable, uneven, or inaccessible. Undercharged. Ventilation obstructed or clogged.
Defective Control Module:	Circuit boards improperly installed and/or connected Inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, cracked, chipped, corroded, burned, or other damage to components and/or circuit boards. Not clean and moisture-free.
Defective Dimmer Switch:	Dirty, oily, greasy, or other surface contamination. Discolored, burned, or other signs of high temperature. Inadequate capacity. Inoperative. Missing, cracked, or broken components. Noisy. Not adequately secured. Not properly grounded.
Defective Fixture Hanger:	Inappropriate for application. Missing, broken, corroded, or other physical damage. Not adequately secured to mounting surface.
Defective Fixture Wiring:	Bundled or trained inappropriately. Improper splice. Inadequately torqued at termination. Inappropriate for application. Insulation charred, burned, or discolored. Insulation improperly removed from conductor. Insulation less than one megohm per each kiloVolt of rating. Insulation nicked, cut, cracked, or other physical damage. Splice(s) improperly insulated. Unauthorized splice.
Defective Globe:	Dirty, oily, greasy, or other surface contamination. Inappropriate for application or location. Missing, cracked, chipped, or other damage. Not adequately secured.
Defective Lamp:	Blackening at end of arc tube. Broken or cracked arc tube. Dirty, oily, greasy, or other surface contamination.

DEFICIENCY FACTORS
0.09.02 LIGHTING (CSI 16500)

SYSTEM ASSEMBLIES/DEFICIENCIES

Lighting

Defective Lamp (Continued) :	Ignitor inappropriate for application. Ignitor inoperative. Improper burning position. Inadequate base to socket contact pressure. Inappropriate for application. Inoperative. Low light output level. Missing, cracked, chipped, or other damage.
Defective Lens:	Dirty, oily, greasy, or other surface contamination. Inappropriate for application. Missing, cracked, chipped, or other damage. Not adequately secured.
Defective Reflector:	Dirty, oil, greasy, or other surface contamination Inappropriate for application. Missing, cracked, chipped, or other damage. Not adequately secured.
Defective Safety Guard:	Inappropriate for application. Not adequately secured. Missing, broken, or other damage.
Defective Socket:	Dirty, oily, greasy, or other surface contamination. Inadequate socket contact pressure. inadequate termination. Missing, cracked, chipped, or other damage. Not adequately secured. Pitted, burned, or discolored.
Improper Housing:	Corroded, rusted, dented, or other physical damage. Enclosure not secured to mounting surface. Missing. Not accessible. Not adequate for application or location. Not clean and moisture-free. Not grounded properly. Not securely attached to mounting surface. Top, bottom, or side cover missing. Unused openings not covered or plugged. Vent defective or nonoperative. Ventilation obstructed or clogged.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.

DEFICIENCY FACTORS
0.09.02 LIGHTING (CSI 16500)

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DEFECTIVE BALLAST

DEFICIENCY:
1. MISSING

DEFECTIVE LAMP

DEFICIENCY:
1. MISSING, CRACKED, CHIPPED OR OTHER DAMAGE

DEFECTIVE LENS

DEFICIENCY:
1. MISSING, CRACKED, CHIPPED OR OTHER DAMAGE

DEFECTIVE REFLECTOR

DEFICIENCY:
1. MISSING, CRACKED, CHIPPED OR OTHER DAMAGE

DEFECTIVE SOCKET

DEFICIENCY:
1. MISSING, CRACKED, CHIPPED OR OTHER DAMAGE

IMPROPER HOUSING

DEFICIENCY:
1. TOP, BOTTOM OR SIDE COVER MISSING

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	EXTERIOR LUMINAIRES		
LIGHTING LUMINAIRES (CSI 16500)	Revision No.	Issue Date 5/93	Drawing No. D090201-1

IMPROPER HOUSING

DEFICIENCY:
1. MISSING

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	EXTERIOR LUMINAIRES		
LIGHTING LUMINAIRES (CSI 16500)	Revision No.	Issue Date 5/93	Drawing No. D090201-2

DEFICIENCY FACTORS
0.09.02 LIGHTING (CSI 16500)

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DEFICIENCY FACTORS
0.09.02 LIGHTING (CSI 16500)

END OF SUBSECTION

0.09.03.01 CABLE TRAY (CSI 16110)

DESCRIPTION

The Cable Tray System is a unique part of an electrical system used only as mechanical support for approved raceways, multiconductor cable wiring methods, or specially approved multiconductor cables designed for use in cable trays. Cable trays may also be used for large single conductors in industrial establishments where conditions of maintenance and supervision ensure that only qualified personnel service the cable tray system. Cable trays are not a wiring method as defined by the National Electrical Code (NEC). This system has merit when used in industrial applications in which power, control, or signal cables are used and flexibility is desired.

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Cable Tray (CSI 16110)

A unit or assembly of units or sections and associated fittings that form a rigid structural system used to support cables. Cable trays include ladders, troughs, channels, solid-bottom trays, and similar structures.

Fittings:

A variety of fittings are an inherent part of a cable tray system and include but are not limited to the following:

- Elbows - A fitting designed to maintain tray dimensions and characteristics as the direction of the tray is altered. Elbows that alter direction by 90 degrees are common, although elbows with other degrees are available.
- Reducers - A fitting designed to reduce the dimensional characteristics of a cable tray system.
- Vertical Riser - A cable tray section used to alter the vertical rise or elevation of a tray. The rise may be a full 90 degrees as an outside riser or a combination of matched inside and outside risers. Matched risers of 30 and 45 degrees are common.
- Tee Fittings - A fitting designed to turn a cable tray system from a single direction into two directions, either horizontal or vertical.
- Connectors - Fittings used to connect a cable tray system to the enclosure of electrical devices; motor control centers, switchgear, and switchboards are common.

0.09.03.01 CABLE TRAY (CSI 161101

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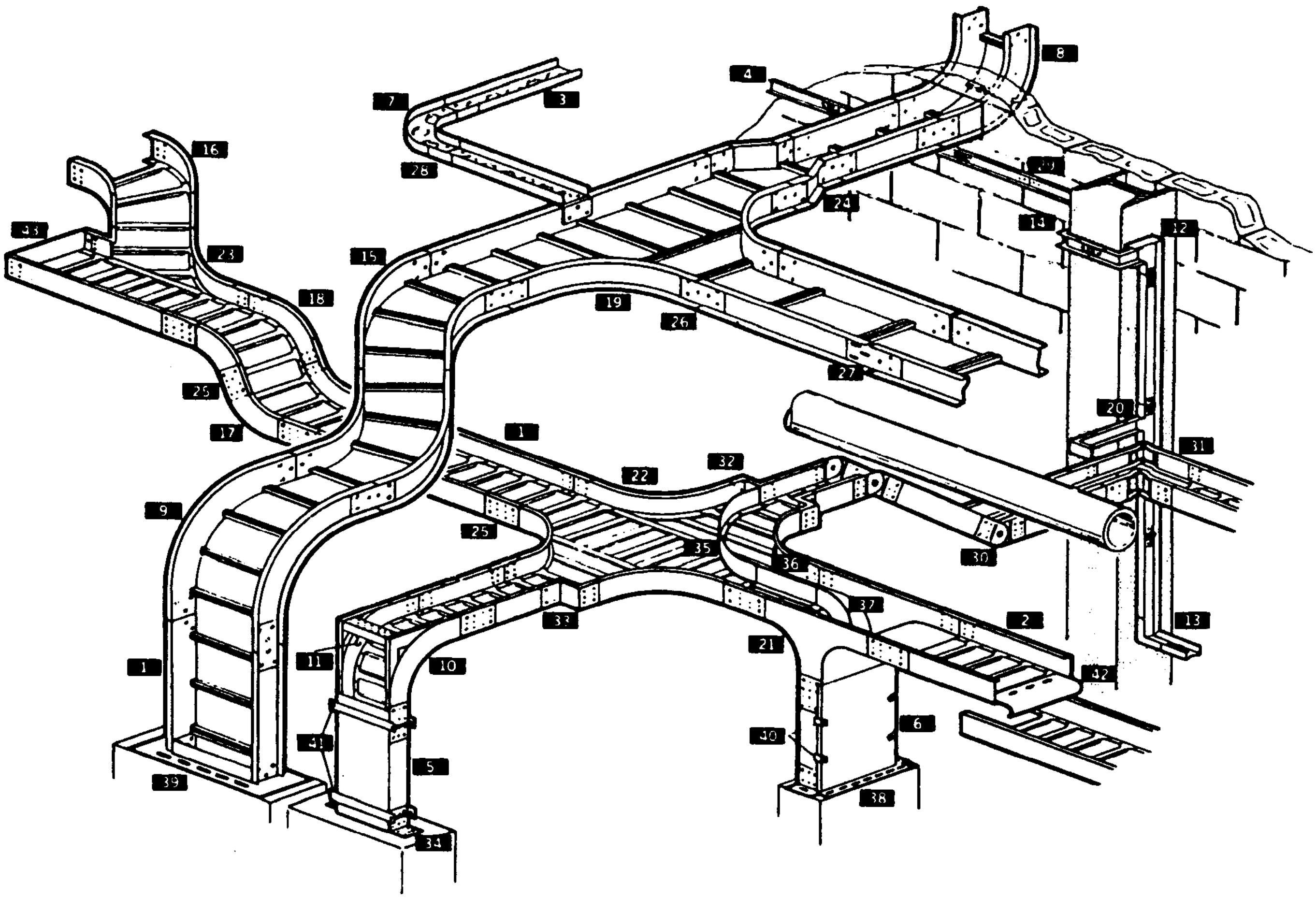

1. STRAIGHT LENGTH
2. STRAIGHT LENGTH
3. STRAIGHT LENGTH
4. STRAIGHT LENGTH
5. FLAT COVERS
6. FLANGED COVERS
7. HORIZONTAL FITTINGS
6. INSIDE 90° VERTICAL ELBOW
9. OUTSIDE 90° VERTICAL ELBOW
10. CABLE SUPPORT ELBOW
11. "J" HOOKS FOR HANGING CABLE
12. 90° RACEWAY CONNECTORS
13. 90° INSIDE ELBOW RACEWAY
14. 90° OUTSIDE ELBOW RACEWAY
15. 45’ HORIZONTAL ELBOW
16. 45° HORIZONTAL ELBOW
17. 45’ INSIDE VERTICAL ELBOW
18. 45° OUTSIDE VERTICAL ELBOW
19. HORIZONTAL TEE
20. TEE CONNECTOR RACEWAY
21. VERTICAL TEE
22. HORIZONTAL CROSS
23. 45° HORIZONTAL CROSS
24. REDUCERS
25. CHANNEL CONNECTOR
26. PLATE CONNECTOR
27. EXPANSION CONNECTOR
26. 4’ CHANNEL CONNECTOR
29. STRAIGHT RACEWAY CONNECTOR
30. ADJ. VERTICAL CONNECTOR
31. ADJ. HORIZONTAL CONNECTOR
32. STRAIGHT REDUCER
33. OFFSET REDUCER
34. ANGLE CONNECTOR
35. ADJ. HORIZONTAL DIVIDER
36. STRAIGHT DIVIDER
37. VERTICAL ELBOW DIVIDER
36. TROUGH-TO-BOX CONNECTOR
39. TROUGH-TO-BOX CONNECTOR
40. COVER CONNECTOR CLIP
41. COVER CONNECTOR STRAP
42. DROPOUT
43. BLIND END

SOURCE: P-W INDUSTRIES PRODUCT CATALOG

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	CABLE TRAY		
SPECIAL SYSTEMS CABLE TRAY (CSI 16600)	Revision No.	Issue Date 5/93	Drawing No. A090301-1

DEFICIENCY FACTORS
0.09.03.01 CABLE TRAY (CSI 16100)

PROBABLE FAILURE POINTS

- Damaged cable tray - rusted, corroded, or other damage.
- Damaged tray fittings - rusted, corroded, or other damage.
- Improper installation - tray or fitting not secured.

SYSTEM ASSEMBLIES/DEFICIENCIES

Cable Tray

Defective Control Module:	Circuit boards improperly installed and/or connected Inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, cracked, chipped, corroded, burned, or other damage to components and/or circuit boards. Not clean and moisture-free.
Deficient Penetration:	Approved seals not used in boundaries.
Improper Installation:	Conductor or cable not appropriate for installation. Conductor or cable not listed. Conductors not properly isolated in raceway (if required). Conductors not trained or bundled for ventilation. Crossover improperly installed or connected. Elbow improperly installed or connected. Hanger not adequately secured to structure. Improper joint. Improperly supported by other raceway. Inadequate grounding. Inadequate ventilation. Missing vertical run hardware. Not adequately protected from severe physical damage. Not adequately secured to mounting surface. Not appropriate for location. Not clearly and permanently marked where required. Not secured within three feet of end of run. Supported by other raceway. Switchboard flange improperly installed or connected. System overfilled. Tee improperly installed or connected.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.
Improper Cable Tray:	Corroded, rusted, dented, or other physical damage. Hanger corroded, rusted, or other physical damage. Inappropriate for application. Not clean and moisture-free. Ventilation obstructed.

DEFICIENCY FACTORS
0.09.03.01 CABLE TRAY (CSI 16110)

END OF SUBSECTION

0.09.03.02 COMMUNICATIONS CIRCUITS (CSI 16700)

DESCRIPTION

Communication Circuits are a unique part of an electrical system used for point-to-point connection of communication devices. As used herein, communication circuits describe the equipment and wiring between two or more communication devices in a communication system. The communication devices and device internal circuits are not part of the communication circuit but are part of a communications system. The communication system is not addressed in this part of Volume 9: 0.09 Electrical.

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Communication Circuits (CSI 16700)

A variety of equipment is an inherent part of communication circuits. They include but are not limited to the following:

- Fittings: Special components used normally shield and/or protect the conductors used in a communication circuit. The fitting will sustain the characteristics of the communication circuit if required.
- Seals: Special fittings or materials used to secure the penetration of a barrier by communication circuits or to isolate one area from another where communication circuits interrupt that isolation. The seal maintains the characteristics of the communication circuit if required.
- Protectors: Items of equipment used to establish boundary conditions of Voltage and current permitted in the communication circuit. Such devices are concerned primarily with isolating the communication device from excessive Voltage surges.

OTHER RELATED COMPONENTS

See the following subsections for related components:

0.09.03.02 COMMUNICATION CIRCUITS (CSI 16700)

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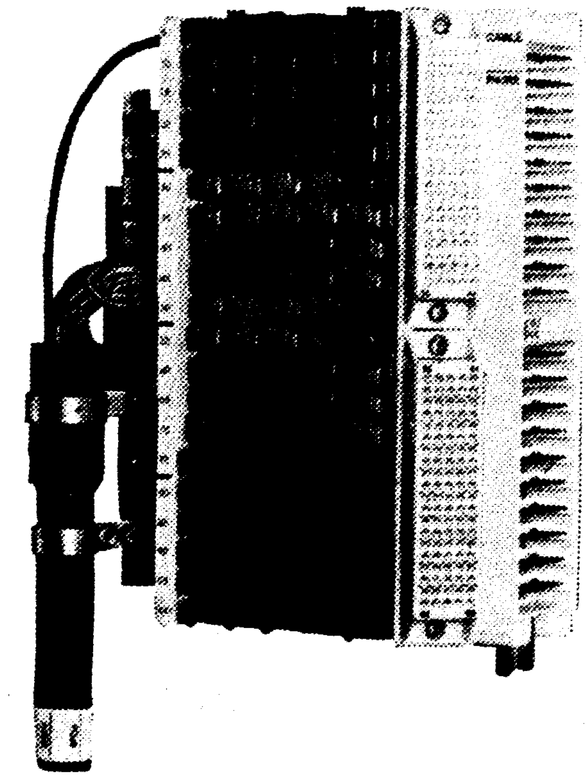
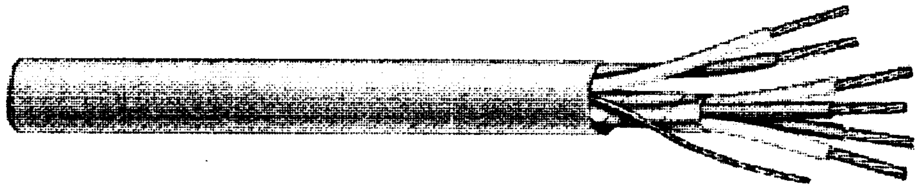


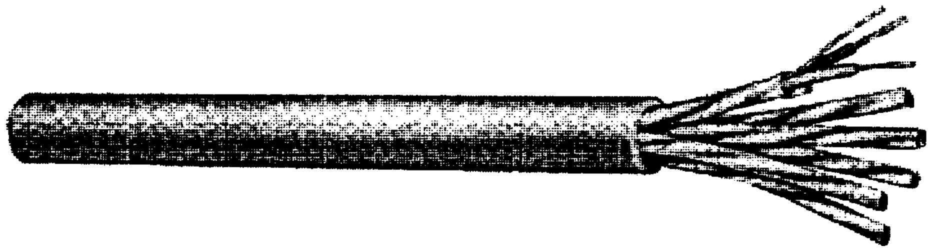
CABLE CONNECTOR/PROTECTOR

SOURCE: RELIANCE COMM/TEC

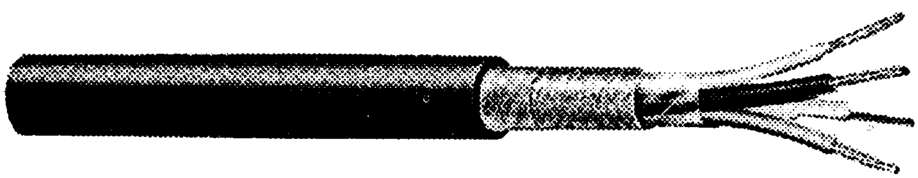
SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	COMMUNICATION CIRCUITS		
SPECIAL SYSTEMS COMMUNICATION CIRCUITS (CSI 16700)	Revision No.	issue Date 5/93	Drawing No. A090302-1



SHIELDED AUDIO AND COMMUNICATION CABLE



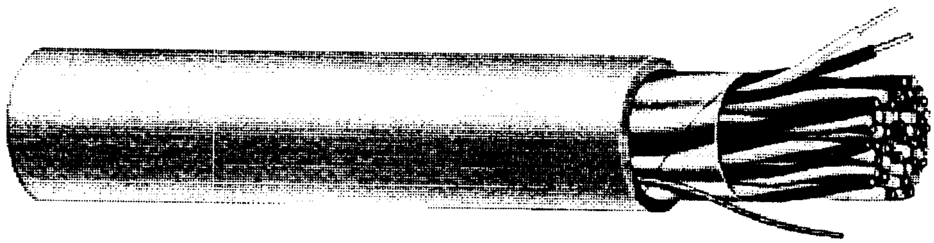
COMMUNICATION AND CONTROL CABLE



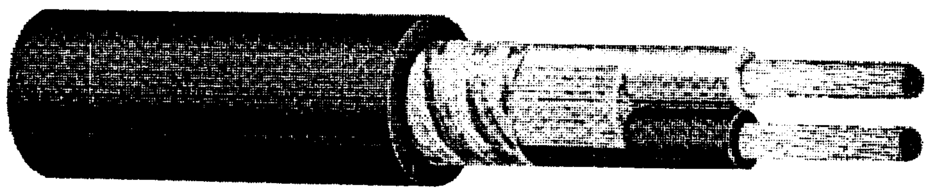
SHIELDED COMMUNICATION AND CONTROL CABLE

SOURCE: CAROL CABLE COMPANY, INC.

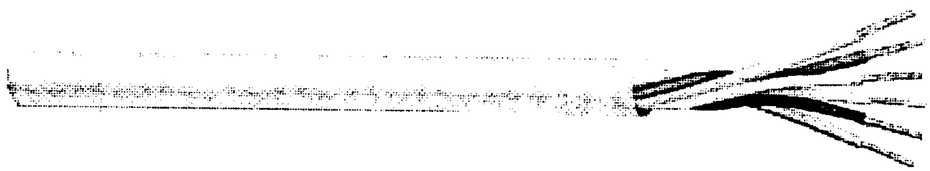
SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	CABLE		
SPECIAL SYSTEMS COMMUNICATION CIRCUITS (CSI 16700)	Revision No.	Issue Date 5/93	Drawhg No. A090302-2



SHIELDED AUDIO/ DATA MULTIPLE PAIR CABLE



UNSHIELDED CONTROL CABLE



UNSHIELDED AUDIO CABLE

SOURCE: CAROL CABLE COMPANY, INC

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	CABLE		
SPECIAL SYSTEMS COMMUNICATION CIRCUITS (CSI 16600)	Revision No.	Issue Date 5/93	Drawing No. A090302-3

DEFICIENCY FACTORS
0.09.03.02 COMMUNICATION CIRCUITS (CSI 16700)

PROBABLE FAILURE POINTS

- Improper installation - conductor improperly located, conductor not listed for application.
- Defective fitting - insert broken, cracked, or missing.

SYSTEM ASSEMBLIES/DEFICIENCIES

Communication Circuits

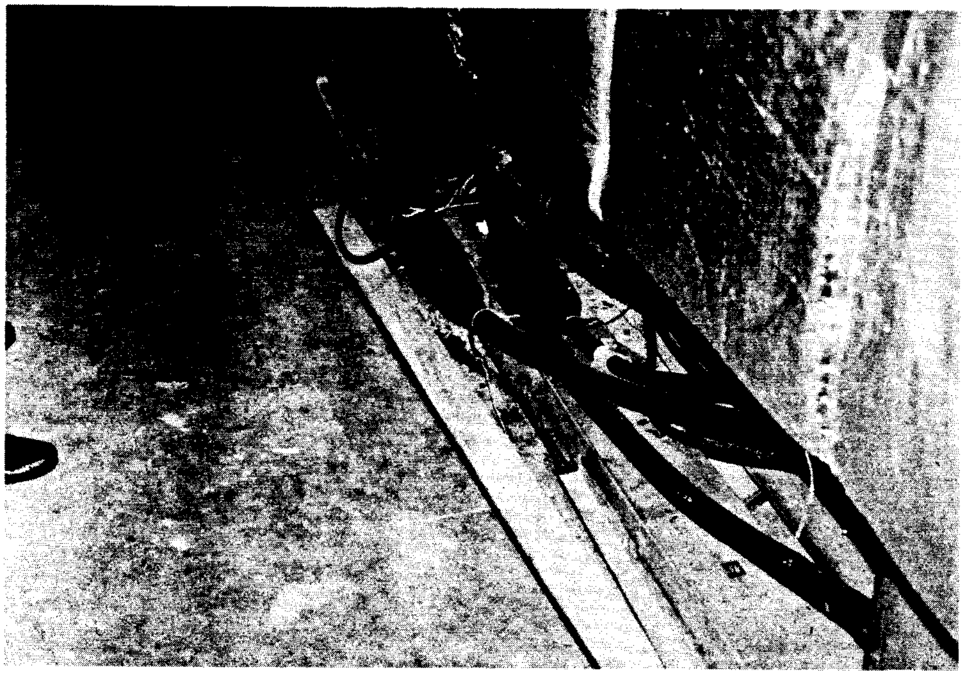
Defective Control Module:	Circuit boards improperly installed and/or connected Inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, cracked, chipped, corroded, burned, or other damage to components and/or circuit boards. Not clean and moisture-free.
Deficient Penetration:	Approved seals not used in boundaries. Boundary penetration not in raceway or approved device.
Improper Cable/Conductor:	Ampacity not properly rated. Bimetallic connectors not used as required. Broken wire strands. Burned, melted, discolored conductor material. Defective or deficient cable/conductor penetrations. High splice temperature. Improper bending radius. Improper insulation voltage. Improper splice materials used. Improper termination. improper trench. Improperly made splice. Inappropriate for application. Insulation inappropriate for application. Insulation improperly removed. Insulation is burned, charred, discolored, or other physical damage. Insulation resistance less than one megOhm per each kiloVolt of rating. Insulation unraveled, frayed, brittle, or other physical damage. Nicked or ringed conductor. Not properly bundled or trained. Not properly connected to device. Not properly derated for installation. Not properly supported. Not protected physically. Unauthorized splice.
Improper Fitting:	Exposed conductors. Improper fitting for application. Insert broken, cracked, missing, or other damage. Loose, broken, damaged, corroded, or missing fastening hardware.

DEFICIENCY FACTORS
0.09.03.02 COMMUNICATION CIRCUITS (CSI 16700)

SYSTEM ASSEMBLIES/DEFICIENCIES

Communication Circuits

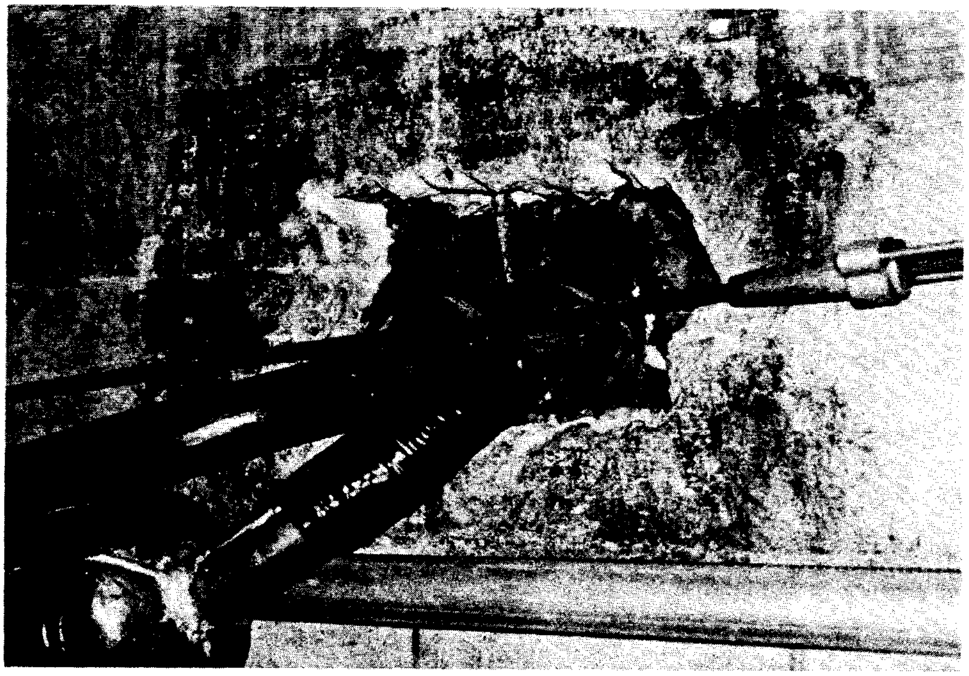
Improper Fitting (Continued):	Missing, broken, cracked, loose, or other damage. Unused openings not covered or plugged.
Improper Installation:	Conductor or cable not appropriate for riser installation. Conductor or cable not listed. Conductors not properly isolated in raceway if required. Conductors not trained or bundled for ventilation. Fused protector not used as required. Improper conductor in environmental controlled air space. Improper joint. Improperly placed on crossarm. Improperly placed on poles. Inadequate climbing space. Inadequate grounding. Inadequate ventilation. Insufficient clearance from live electrical conductors. Insufficient clearance over structures. Less than 6 feet to lightning conductors. Metallic sheath improperly grounded. Missing vertical run hardware. No bushing or equivalent protection. Not adequately protected from severe physical damage. Not adequately secured to mounting surface. Not appropriate for location. Not bundled, trained or secured. Not clearly and permanently marked where required. Not properly spaced from combustible materials. Protector improperly located. Protectors not installed as required. Unlisted protector or non-identified protector employed. Unused openings not covered or plugged.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.
Improper Raceway:	Inappropriate for application. Corroded, rusted, dented, or other physical damage. Hanger corroded, rusted, or other physical damage.



IMPROPER CABLE/CONDUCTOR:
1. NOT PROPERLY BUNDLED OR TRAINED
2. NOT PROTECTED PHYSICALLY

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	CABLE DEFICIENCIES		
SPECIAL SYSTEMS COMMUNICATION CIRCUITS (CSI 16700)	Revision No.	Issue Date 5/93	Drawing No. D090302-1



IMPROPER CABLE/CONDUCTOR:
1. NOT PROPERLY SUPPORTED
2. NOT PROTECTED PHYSICALLY

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ELECTRICAL SYSTEM	CABLE DEFICIENCIES		
SPECIAL SYSTEMS COMMUNICATION CIRCUITS (CSI 16700)	Revision No.	Issue Date 5/93	Drawing No. D090302-2

DEFICIENCY FACTORS
0.09.03.02 COMMUNICATION CIRCUITS (CSI 16700)

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DEFICIENCY FACTORS
0.09.03.02 COMMUNICATION CIRCUITS (CSI 16700)

END OF SUBSECTION

0.09.03.03 CONTROL UNITS (CSI 16900)

DESCRIPTION

Control Units are electrical component assemblies used to control electrical systems. As used herein, control units do not include motor controllers or motor control centers. A control unit may be manually activated or use a transducer output or both to initiate a change in the controlled variable. Common control units in use today utilize the output from motion sensors, photoelectric devices, pressure sensors, timers, and other similar devices in initiating lighting and alarm systems. Manual control units have extensive application in stage lighting where lighting technicians are employed.

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Control Units (CSI **16900)**

A variety of devices are an inherent part of communication circuits. They include but are not limited to the following:

- Timers: Devices, which if energized, will operate to close and/or open contacts after an established time period. The altered state of the contact initiates a change in a controlled medium. Timers are predominantly electrically energized; however, pneumatic, mechanical, and hydraulic energy sources are also utilized.
- Opto-Electronic Units: Devices that convert light into an electric current or convert electric current into light. Phototubes and cadmium sulfide photocells have enjoyed early and long use in converting light into electrical energy. This electrical energy is then used to control some other medium.
- Clocks: Clocks are basically timers; however, in lieu of an established period of operation, the clock is used to initiate or terminate a medium at a specific time. The clock, as a control device, enjoys wide use where non-technical personnel are involved.

OTHER RELATED COMPONENTS

See the following subsections for related components:

0.09.03.03 CONTROL UNITS (CSI 16900)

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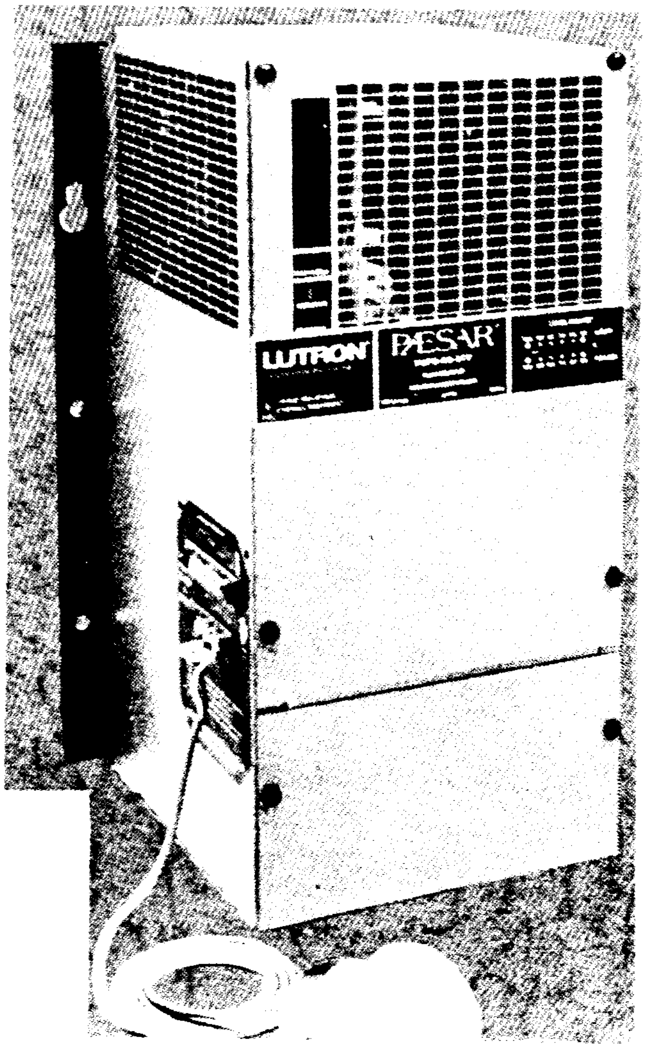
REVIEW PENDING

REVIEW PENDING

CONTROL PANEL

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY. DETAILS-ELECTRICAL SYSTEM	CONTROL UNITS		
SPECIAL SYSTEMS CONTROL UNITS (CSI 16600)	Revision No.	Issue Date 5/93	Drawing No. A090303-1



FLUORESCENT LIGHTING CONTROLLER

PHOTO ILLUSTRATION

SOURCE: LUTRON

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	CONTROL UNITS		
SPECIAL SYSTEMS CONTROL UNITS (CSI 16600)	Revision No.	Issue Date 5/93	Drawhg No. A090303-2

DEFICIENCY FACTORS
0.09.03.03 CONTROL UNITS (CSI 16900)

PROBABLE FAILURE POINTS

- Improper control - improper set points for sensed medium, improper aiming of directional elements.
- improper installation - uncontrolled access, inappropriate for application, not clean and moisture-free.

SYSTEM ASSEMBLIES/DEFICIENCIES

Control Units

Defective Bushing/Insulator:	Cable clamp loose, missing, broken, corroded, burned, or other physical damage. Dirty, oily, greasy, or other surface contamination. Missing, cracked, chipped, or other damage. Not adequately secured. Oil leakage. Tracked or carbonized.
Defective Contactor:	Arc suppression components broken, eroded, cracked, or missing. Broken strands in braided shunts. Coil discolored, burned, or other sign of high temperature. Coil inoperative at 85% of rated Voltage. Contact pressure not in accordance with manufacturer's specifications. Contacts burned, pitted, or other physical damage. Contacts not properly aligned. Control circuits improperly connected. Dash pot inoperative, broken, or missing. Device sticks magnetically. Drum contacts inadequately torqued. High contact resistance. Improper fluid in dash pot. Improper rolling action of drum contacts. Improper size. Indicator lamps inoperative. Indicator lens missing, cracked, or broken. Missing, loose, broken, or corroded hardware. No engineering study to support thermal trip device rating. Noisy. Plugging relays dirty or other contamination. Pushbuttons not labeled. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts. Rheostat contact surface corroded, oxidized, uneven, or other physical defect. Rheostat holding coil missing or inoperative. Rheostat ventilation impeded. Terminals, contact blocks, bus bars and connectors loose or discolored. Thermal trip device wrong size.

DEFICIENCY FACTORS
0.09.03.03 CONTROL UNITS (CSI 16900)

SYSTEM ASSEMBLIES/DEFICIENCIES

Control Units (Continued)

Defective Control Module:	Circuit boards improperly installed and/or connected Inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, cracked, chipped, corroded, burned, or other damage to components and/or circuit boards. Not clean and moisture-free.
Defective Heater:	Heater not adequately secured to mounting surface. Improper conductors from source. Improper temperature in device enclosure. Inoperative heater element. Heater element resistance to ground less than one megOhm per each kiloVolt of rating. Sensing device broken, missing, or inoperative. Sensing device malcalibrated.
Defective Photocell:	Dirty, oily, greasy, or other surface contamination. Discolored, burned, or other signs of high temperature. Improper aiming direction. Inappropriate for application. Inappropriate turn-off/turn-on ratio. Inoperative. Missing, chipped, cracked, or other damage. Not adequately secured to mounting surface. Not clean and moisture-free.
Improper Bus:	Barriers missing or damaged. Dirty or other contamination. Discolored, warped or other signs of high temperature. Insulated connections unraveled, brittle, cracked, or other physical damage. Loose joints as measured using thermographic test.
Improper Cable/Conductor:	Ampacity not properly rated. Bimetallic connectors not used as required. Broken wire strands. Burned, melted, discolored conductor material. Defective or deficient cable/conductor penetrations. High splice temperature. Improper bending radius. Improper insulation voltage. Improper splice materials used. Improper termination. Improper trench. Improperly made splice. Inappropriate for application. Insulation inappropriate for application. Insulation improperly removed. insulation is burned, charred, discolored, or other physical damage.

DEFICIENCY FACTORS
0.09.03.03 CONTROL **UNITS (CSI** 16900)

SYSTEM ASSEMBLIES/DEFICIENCIES

Control Units

improper Cable/Conductor (Continued):	Insulation resistance less than one megOhm per each kiloVolt of rating. Insulation unraveled, frayed, brittle, or other physical damage. Nicked or ringed conductor. Not properly bundled or trained. Not properly connected to device. Not properly derated for installation. Not properly supported. Not protected physically. Unauthorized splice.
Improper Control Wiring:	Bimetallic connectors not used as required. Bundled and trained inappropriately. Control circuits improperly connected. Control wiring insulation resistance less than one megOhm per each kiloVolt of rating. Improper sensor pickup or dropout point. Improper termination. Inadequate fuse/connection tension. Inadequately torqued at termination. Inappropriate for application. Inconsistent time delays. Incorrect fuse installed. Indicator lamps inoperative. Indicator lens missing, cracked, or broken. Inoperative. Inoperative interlock. Insulation charred, burned, or discolored. Insulation improperly removed from conductor. No engineering study to support installed fuse. Splices improperly insulated. Terminal boards improperly installed. Unauthorized splice.
Improper Disconnect:	Adjustable settings misadjusted. Arc suppression devices broken, cracked, missing, tracked, chipped, or other physical damage. Contacts bent or not aligned. Defective phase barriers. Does not sustain rated current per NEMA AB4-1991. Does not trip on instantaneous overcurrent per NFPA 70B. Handle broken, bent, or other physical deformity. High conductor, lug temperature. High contact resistance. Improper application. Improper switch time. Improperly sized. Improperly wired.

DEFICIENCY FACTORS
0.09.03.03 CONTROL UNITS (CSI 169001

SYSTEM ASSEMBLIES/DEFICIENCIES

Control Units

Improper Disconnect (Continued):	Interlock broken, missing, or inoperative. Movable contacts bent, malaligned, or other physical deformity. Movable contacts pitted, burned, or discolored. No engineering study to support adjustable settings. Not accessible., Not adequate for application. Not clean and moisture-free. Not grounded properly. Not secured to mounting surface. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts. Series trip device missing, broken, or inoperative. Shunt trip device missing, broken, or inoperative. Stationary contacts bent, malaligned, or other physical deformity. Stationary contacts pitted, burned, or discolored. Terminals, contact blocks, bus bar, and connectors loose, burned, or discolored. Time-delay overcurrent trip not per manufacturer's specifications. UnderVoltage trip missing, broken, maladjusted, or inoperative.
Improper Enclosure:	Corroded, rusted, dented, or other physical damage. Not secured to mounting surface. Interlock broken, missing, or inoperative. No curbing or berm for oil containment. Not accessible. Not adequate for application. Not clean and moisture-free. Not grounded properly. Oil leaks. Pedestal mounting surface chipped, broken, or other physical damage. Unused openings not covered or plugged. Vent defective or nonoperative. Ventilation obstructed.
Improper Equipment Protection:	Improper or inadequate primary protection device. Improper or inadequate secondary protection device. Improper or inadequate differential protection device. No engineering study to support protection scheme.
Improper Fitting:	Exposed conductors. Improper fitting for application. Insert broken, cracked, missing, or other damage. Loose, broken, damaged, corroded, or missing fastening hardware.

DEFICIENCY FACTORS
0.09.03.03 CONTROL UNITS (CSI 16900)

SYSTEM ASSEMBLIES/DEFICIENCIES

Control Units

Improper Fitting (Continued):	Missing, broken, cracked, loose, or other damage. Unused openings not covered or plugged.
Improper Fuse Unit:	Fuse clips bent, malaligned, discolored, or other physical damage. Improper fuse type used. Improperly sized. Poor fuse to clip contact. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.

DEFICIENCY FACTORS
0.09.03.03 CONTROL UNITS **(CSI** 169001

END OF SUBSECTION

0.09.03.04 DATA PROCESSING ELECTRICAL EQUIPMENT (CSI 16740)

DESCRIPTION

Data Processing Electrical Equipment as used herein is equipment, power-supply wiring, equipment interconnecting wiring, and grounding of electronic computer/data processing equipment and systems, including terminal units, in an electronic computer/data processing room. The electronic computer/data processing equipment and its associated internal wiring are not part of this general description. Further, this standard does not cover installations of electronic computer/data processing equipment that can be made without special rooms or fire protection.

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Data processing Electrical Equipment (CSI 16746)

A variety of equipment is an inherent part of data processing electrical equipment. It includes but is not limited to the following:

- Disconnects: Required and used to isolate the electrical service to the data processing equipment and heating/ventilating/air conditioning (HVAC) equipment used for the controlled area.
- Seals: Special fittings or materials used to secure the penetration of a barrier by data processing circuits or to isolate one area from another where data processing circuits interrupt that isolation. The seal maintains the characteristics of the data processing area.

OTHER RELATED COMPONENTS

See the following subsections for related components:

0.09.03.04 DATA PROCESSING ELECTRICAL EQUIPMENT (CSI 16740)

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DEFICIENCY FACTORS
0.09.03.04 DATA PROCESSING ELECTRICAL EQUIPMENT (CSI 16740)

PROBABLE FAILURE POINTS

- Ground circuit - multiple ground circuits.
- Improper facility - unauthorized materials present, not clean, improperly stored.
- Disconnect - no HVAC disconnect, no disconnect for installed equipment.

SYSTEM ASSEMBLIES/DEFICIENCIES

Data Processing Electrical Equipment

Defective Control Module:	Circuit boards improperly installed and/or connected Inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, cracked, chipped, corroded, burned, or other damage to components and/or circuit boards. Not clean and moisture-free.
Defective Ground Circuit:	Metal parts of ADP equipment not grounded. Multiple ground circuits.
Deficient Penetration:	Approved seals not used in boundaries.
improper Cable/Conductor:	Ampacity not properly rated. Bimetallic connectors not used as required. Broken wire strands. Burned, melted, discolored conductor material. Defective or deficient cable/conductor penetrations. High splice temperature. Improper bending radius. Improper insulation voltage. Improper splice materials used. Improper termination. Improper trench. Improperly made splice. Inappropriate for application. Insulation inappropriate for application. Insulation improperly removed. Insulation is burned, charred, discolored, or other physical damage. Insulation resistance less than one megOhm per each kiloVolt of rating. Insulation unraveled, frayed, brittle, or other physical damage. Nicked or ringed conductor. Not properly bundled or trained. Not properly connected to device. Not properly derated for installation. Not properly supported. Not protected physically. Unauthorized splice.

DEFICIENCY FACTORS
0.09.03.04 DATA PROCESSING ELECTRICAL EQUIPMENT (CSI 16740)

SYSTEM ASSEMBLIES/DEFICIENCIES

Data Processing Electrical Equipment (Continued)

Improper Facility:	Non-ADP personnel present. Not isolated by fire-resistant-rated walls, floors, ceilings. Smoke and fire damper system inoperative or missing. Unauthorized supplies and materials present. Unlisted equipment installed.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.
Malapropos Disconnect:	Disconnect for all ADP equipment not present. Disconnect for HVAC equipment not present. Smoke and fire damper connection absent or inoperative.

END OF SUBSECTION

0.09.03.05 GENERATORS, STANDBY/EMERGENCY (CSI 16620)

DESCRIPTION

Standby/Emergency Generators are one or more generator sets intended to provide power during the interruption of the normal electrical services. These generator sets may also be referred to as standby units, standby generators, emergency generators, alternate power sources, or emergency units in addition to local nomenclature. The generator sets may use reciprocating, rotary, and turbine engines as the primary energy source. Electric, motor-driven generators are not included in this standard but are part of Uninterruptible Power Supplies (UPS), 2.3.1 l-l. The generator sets may operate automatically or may require a manual action to initiate operation.

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Generators, Standby/Emergency Equipment (CSI 16620)

This section addresses the equipment normally found on a packaged unit or that installed in an area dedicated to standby/emergency equipment. Automatic transfer switches, switchboards, and other such electrical devices used to distribute generator output are not addressed as part of this standard.

- Alternators: The part of the assembly used to produce an alternating current output. The alternating current may be rectified to produce a direct current output in low Voltage/low power applications.
- Exciters: Devices or assemblies used to provide field current to alternators and generators. The exciter may be one of several types with the electronic unit as part of a Voltage regulator appearing in more modern units.
- Generators: That part of the assembly used to produce a direct current output using brushes and a commutator. However, long standing usage of this term has come to mean a unit that produces an electrical power output and is employed without specific designation as an AC or DC machine.
- Voltage Regulators: Components or assemblies used to maintain the output Voltage at a predetermined level or within a predetermined range of Voltage at various power levels. The Voltage regulator may operate manually or automatically using mechanical or electronic means to accomplish regulation.

0.09.03.05 GENERATORS. STANDBY/EMERGENCY **(CSI 16620)**

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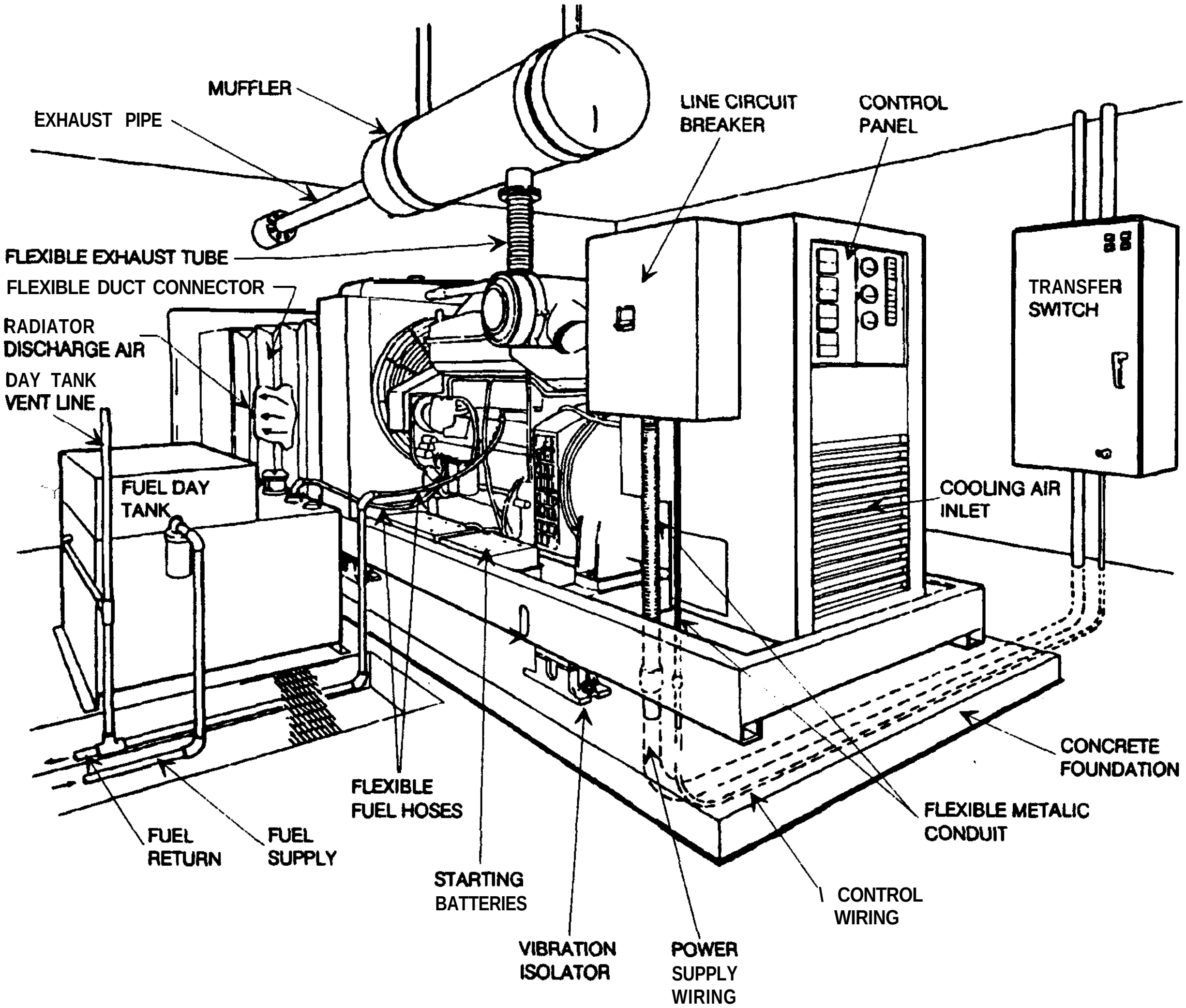

TYPICAL DIESEL GENERATOR SET INSTALLATION

SOURCE: CUMMINS, ONAN, APPLICATION MANUAL FOR LIQUID-COOLED GENERATOR SETS

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	GENERATORS, STANDBY/EMERGENCY		
SPECIAL SYSTEMS GENERATORS, STANDBY/ EMERGENCY (CSI 16600)	Revision No.	Issue Date 5/93	Drawing No. A090305-1

DEFICIENCY FACTORS
0.09.03.05 GENERATORS, STANDBY/EMERGENCY (CSI 16620)

PROBABLE FAILURE POINTS

- Inoperative - no starting air pressure, defective electrical start system, no fuel, or contaminated fuel supply.
- Inadequate liquid - low crankcase oil level, low radiator coolant level, low corrosion inhibitor level in coolant.
- Low output Voltage - defective Voltage regulator, improperly adjusted controls.
- Low power output - improper prime mover operation, improperly adjusted engine controls.

SYSTEM ASSEMBLIES/DEFICIENCIES

Generators, Standby/Emergency Equipment

Damaged Metering:	Device inoperative. Metering device broken or other physical damage. Tampering of metering device or circuit.
Defective Bearings:	High temperature. Improper bearing. Leaking seals. Rough or irregular rotation. Noisy.
Defective Bushing/Insulator:	Cable clamp loose, missing, broken, corroded, burned, or other physical damage. Dirty, oily, greasy, or other surface contamination. Missing, cracked, chipped, or other damage. Not adequately secured. Oil leakage. Tracked or carbonized.
Defective Control Module:	Circuit boards improperly installed and/or connected Inoperative. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, cracked, chipped, corroded, burned, or other damage to components and/or circuit boards. Not clean and moisture-free.
Defective Engine:	Air filters clogged. Air filters missing or damaged. Dirty, greasy, or other contamination. Fuel leaks. Inoperative. Low compression. Oil leaks. Radiator dirty, oily, greasy, or other surface contamination. Radiator passages clogged. Will not carry rated load.
Defective Exciter/Voltage Regulator:	Does not flash field. Does not maintain output Voltage.

DEFICIENCY FACTORS
0.09.03.05 GENERATORS, STANDBY/EMERGENCY (CSI 16620)

SYSTEM ASSEMBLIES/DEFICIENCIES

Generators, Standby/Emergency Equipment **(Continued)**

Defective Exhaust System:	Leaks in system. No sound attenuation. Not vented to atmosphere.
Defective Heater:	Heater not adequately secured to mounting surface. Improper conductors from source. Improper temperature in device enclosure. inoperative heater element. Heater element resistance to ground less than one megOhm per each kiloVolt of rating. Sensing device broken, missing, or inoperative. Sensing device malcalibrated.
Defective Start System:	Air receivers discharged. Batteries discharged. Battery charger inoperative. Low air capacity. Solenoid inoperative. Starter motor inoperative.
Deficient Local Fuel System:	Control valves dysfunctional. Fuel filters dirty, missing, or wrong size. Fuel stale or old. Storage tank dented, rusted, corroded, or other physical damage. Water present.
Deficient Penetration:	Approved seals not used in boundaries.
Improper Cable/Conductor:	Ampacity not properly rated. Bimetallic connectors not used as required. Broken wire strands. Burned, melted, discolored conductor material. Defective or deficient cable/conductor penetrations. High splice temperature. Improper bending radius. Improper insulation voltage. Improper splice materials used. Improper termination. Improper trench. Improperly made splice. Inappropriate for application. Insulation inappropriate for application. Insulation improperly removed. Insulation is burned, charred, discolored, or other physical damage. Insulation resistance less than one megOhm per each kiloVolt of rating. Insulation unraveled, frayed, brittle, or other physical damage. Nicked or ringed conductor.

DEFICIENCY FACTORS
0.09.03.05 GENERATORS, STANDBY/EMERGENCY (CSI 16620)

SYSTEM ASSEMBLIES/DEFICIENCIES

Generators, Standby/Emergency Equipment

Improper Cable/Conductor (Continued):	Not properly bundled or trained. Not properly connected to device. Not properly derated for installation. Not properly supported. Not protected physically. Unauthorized splice.
Improper Control Wiring:	Bimetallic connectors not used as required. Bundled and trained inappropriately. Control circuits improperly connected. Control wiring insulation resistance less than one megOhm per each kiloVolt of rating. Improper sensor pickup or dropout point. Improper termination. Inadequate fuse/connection tension. Inadequately torqued at termination. Inappropriate for application. Inconsistent time delays. Incorrect fuse installed. Indicator lamps inoperative. Indicator lens missing, cracked, or broken. Inoperative. Inoperative interlock. Insulation charred, burned, or discolored. Insulation improperly removed from conductor. No engineering study to support installed fuse. Splices improperly insulated. Terminal boards improperly installed. Unauthorized splice.
Improper Disconnect:	Adjustable settings misadjusted. Arc suppression devices broken, cracked, missing, tracked, chipped, or other physical damage. Contacts bent or not aligned. Defective phase barriers. Does not sustain rated current per NEMA AB4-1991. Does not trip on instantaneous overcurrent per NFPA 70B. Handle broken, bent, or other physical deformity. High conductor, lug temperature. High contact resistance. Improper application. Improper switch time. Improperly sized. Improperly wired. Interlock broken, missing, or inoperative. Movable contacts bent, malaligned, or other physical deformity. Movable contacts pitted, burned, or discolored. No engineering study to support adjustable settings.

DEFICIENCY FACTORS
0.09.03.05 GENERATORS, STANDBY/EMERGENCY (CSI 16620)

SYSTEM ASSEMBLIES/DEFICIENCIES

Improper Disconnect (Continued):	Not accessible. Not adequate for application. Not clean and moisture-free. Not grounded properly. Not secured to mounting surface. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts. Series trip device missing, broken, or inoperative. Shunt trip device missing, broken, or inoperative. Stationary contacts bent, malaligned, or other physical deformity. Stationary contacts pitted, burned, or discolored. Terminals, contact blocks, bus bar, and connectors loose, burned, or discolored. Time-delay overcurrent trip not per manufacturer's specifications. UnderVoltage trip missing, broken, maladjusted, or inoperative.
Improper Enclosure:	Corroded, rusted, dented, or other physical damage. Interlock broken, missing, or inoperative. No curbing or berm for oil containment. Not accessible. Not adequate for application. Oil leaks. Pedestal mounting surface chipped, broken, or other physical damage. Unused openings not covered or plugged. Vent defective or nonoperative. Ventilation obstructed.
improper Fitting:	Exposed conductors. Improper fitting for application. Insert broken, cracked, missing, or other damage. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, broken, cracked, loose, or other damage. Unused openings not covered or plugged.
Improper Fuse Unit:	Fuse clips bent, malaligned, discolored, or other physical damage. Improper fuse type used. Improperly sized. Poor fuse to clip contact. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts.
improper Marking:	Nameplate missing or illegible. Missing or insufficient data.

DEFICIENCY FACTORS
0.09.03.05 GENERATORS, STANDBY/EMERGENCY (CSI 16620)

SYSTEM ASSEMBLIES/DEFICIENCIES (Continued)

Improper Rotor/Stator:	Burned, charred, or other signs of high temperature. Noisy laminations. Non-uniform air gap. Open turns or coils. Rotor shaft bent, scored, or other damage. Shorted turns or coils. Splice insulation unraveled, brittle, cracked, or other damage. Unbalanced rotor assembly.
Inaccurate Metering:	Calibration standard not established. Defective or inoperative sensor or transducer. Metering device inadequately sized. Metering device not calibrated.

DEFICIENCY FACTORS
0.09.03.05 GENERATORS, **STANDBY/EMERGENCY (CSI 16620)**

END OF SUBSECTION

0.09.03.06 HEALTH CARE FACILITIES ELECTRICAL EQUIP. (CSI 16600)

DESCRIPTION

The Health Care Facilities Electrical Equipment System is a unique part of an electrical system used in health care facilities to ensure patient safety. Electrical circuits and equipment in health care facilities receive additional safe guards due to the wide variety of medical instrumentation and diagnostic equipment used in patient areas. As used herein, health care facilities electrical equipment describes the equipment and wiring of the facility; it does not include any medical device.

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Health Care Facilities Electrical Equipment (CSI **16600)**

A variety of electrical equipment is inherent to a health care facility's electrical equipment system. This variety includes normal items such as transformers and disconnects, as well as special or unique items such as hospital-rated receptacles.

Hospital-Rated Components:

Hospital-rated components are electrical devices that have been tested and certified for use in health care facilities electrical systems.

OTHER RELATED COMPONENTS

See the following subsections for related components:

0.09.03.06 HEALTH CARE FACILITIES ELECTRICAL EQUIP. (CSI 16600)

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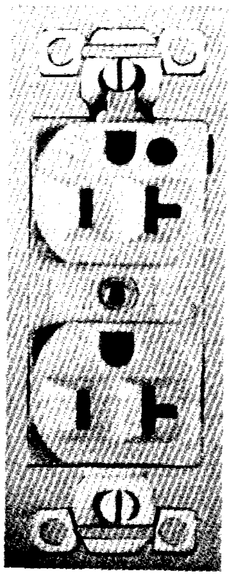

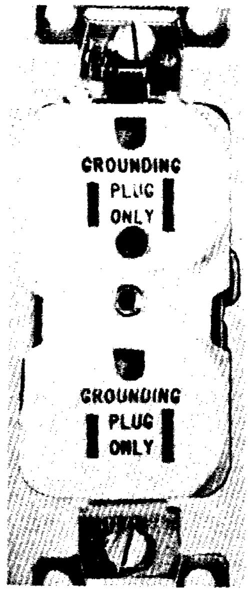

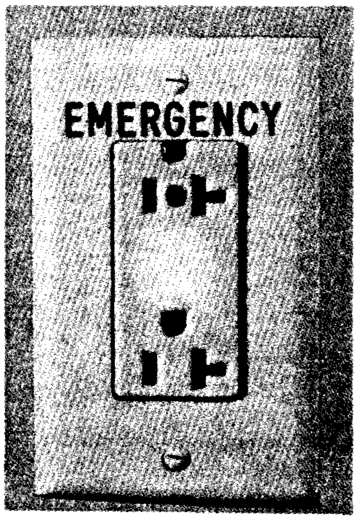

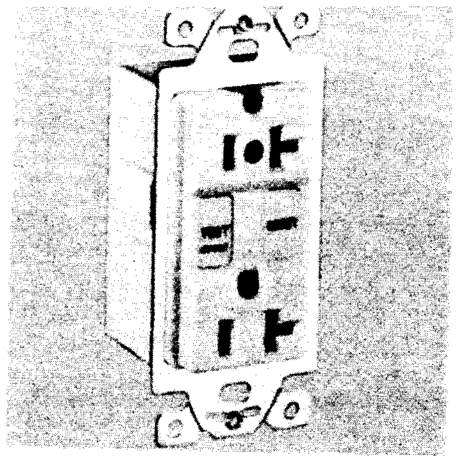

RECEPTACLES HOSPITAL GRADE

SOURCE: BRYANT WIRING DEVICE CATALOG, BRYANT WIRING DEVICE DIVISION, WESTINGHOUSE ELECTRIC CORPORATION

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	HEALTH CARE FACILITIES ELECTRICAL EQUIPMENT		
SPECIAL SYSTEMS HEALTH CARE FACILITIES ELECT. EQUIPMENT (CSI 16600)	Revision No.	Issue Date 5/93	Drawing No. A090306-1

DEFICIENCY FACTORS
0.09.03.06 HEALTH CARE FACILITIES ELECTRICAL EQUIP. **(CSI 16600)**

PROBABLE FAILURE POINTS

- Improper Installation - device not hospital-rated, inadequately grounded equipment.

SYSTEM ASSEMBLIES/DEFICIENCIES

Health Care Facilities **Electrical** Equipment

Deficient Penetration:	Approved seals not used in boundaries.
Improper Cable/Conductor:	Ampacity not properly rated. Bimetallic connectors not used as required. Broken wire strands. Burned, melted, discolored conductor material. Defective or deficient cable/conductor penetrations. High splice temperature. Improper bending radius. Improper insulation voltage. Improper splice materials used. Improper termination. Improper trench. Improperly made splice. Inappropriate for application. Insulation inappropriate for application. Insulation improperly removed. Insulation is burned, charred, discolored, or other physical damage. Insulation resistance less than one megOhm per each kiloVolt of rating. Insulation unraveled, frayed, brittle, or other physical damage. Nicked or ringed conductor. Not properly bundled or trained. Not properly connected to device. Not properly derated for installation. Not properly supported. Not protected physically. Unauthorized splice.
improper Grounding:	Conductive surfaces have unacceptable potential difference. Grounding conductor not appropriately sized. Insulated copper conductor not used. Metal raceway or appropriate cable not used. Panelboards not bonded together.
Improper Location:	Accessible to public. Does not protect all circuits. Equipment and/or components not rated for Class 1 application. Inadequate ventilation. Metal raceway or approved cable not used. Single pole breakers with handle tie employed. Storage device for flexible cord not provided. Unlisted components employed.

DEFICIENCY FACTORS
0.09.03.06 HEALTH CARE FACILITIES ELECTRICAL EQUIP. (CSI 16600)

SYSTEM ASSEMBLIES/DEFICIENCIES

Health Care Facilities Electrical Equipment (Continued)

Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.
Inadequate Essential System:	Isolation of authorized systems not maintained as required. Metal raceway not used where required. System not properly maintained or tested. Transfer switches not used. Two energy sources not used. Unauthorized loads connected to emergency system.
Inadequate Service (Patient Area):	Four receptacles not present. One circuit does not originate in normal system. Receptacles not hospital grade. Receptacles not tamper resistant in pediatric areas. Two circuits not present.

END OF SUBSECTION

0.09.03.07 HEATING. BASEBOARD RADIATION **(CSI 16813)**

DESCRIPTION

The Baseboard Radiation Heating System addresses equipment used in fixed space heating. This system may be the principal source of heat or may be an augmentation to another heating source. When used as augmentation for another source, the baseboard radiation heating system is normally a local system and is not integrated into the other system. Typical examples are areas created in which the original heating zone is disturbed by partitions or ductwork incident to creation of the new area. Uses of baseboard radiation heating are often found in foyers and other similar areas not occupied on a continuous basis.

The baseboard radiation heating equipment section addresses only the unique equipment used in baseboard radiation heating or the special and/or unique requirements imposed on standard electrical components and assemblies used with radiation baseboard heating.

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Heating, Baseboard Radiation (CSI 16813)

Radiator, Electric Baseboard:

This is the heating element of the system. It is available in several heat or kilowatt ratings and is selected to meet a requirement based on area and application.

Thermostat:

This is the control device for the radiator. It senses temperature, and around some set point, cycles the heating element on and off to produce the desired heating effect, The location of the thermostat is critical in achieving the desired heating effect.

0.09.03.07 HEATING, BASEBOARD RADIATION (CSI 16613)

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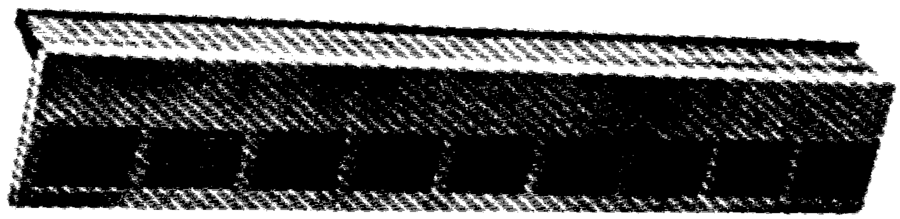


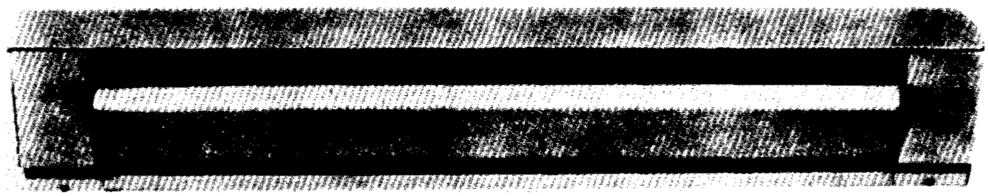
DRAFT BARRIER HEATER

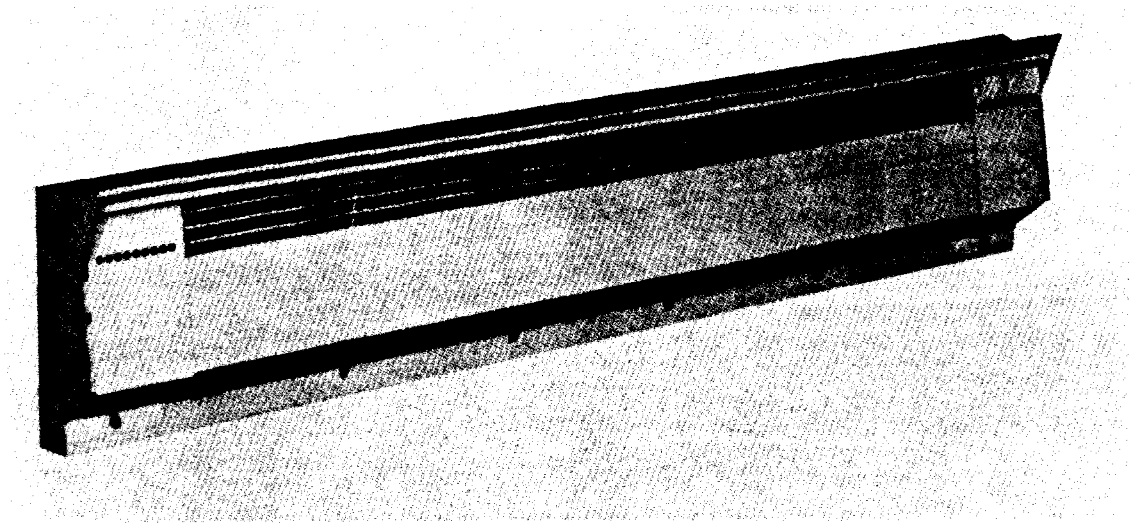
PEDESTAL HEATER

SILL LINE HEATER

SOURCE: RAYWALL, ELECTRIC HEAT PRODUCTS

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	HEATING, BASEBOARD RADIATION		
SPECIAL SYSTEMS HEATING, BASEBOARD RADIATION **(CSI 16600)**	Revision No.	Issue Date 5/93	Drawing No. AO90307-1

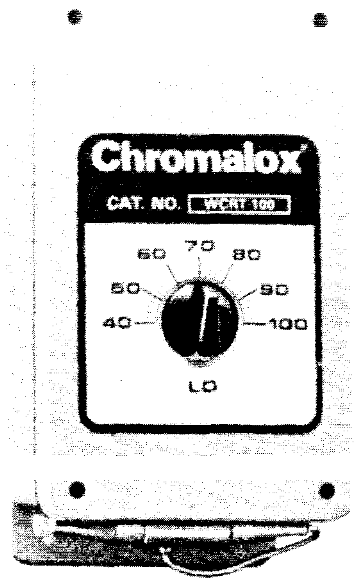




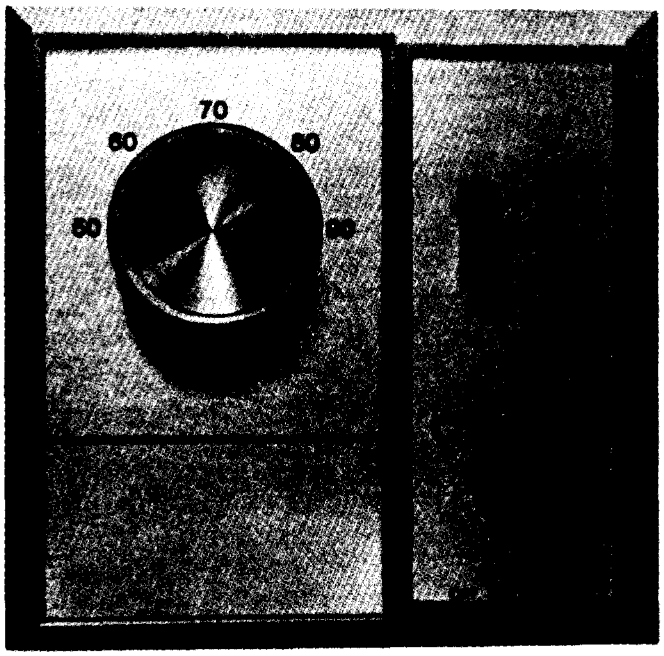
BASEBOARD HEATERS

SOURCE: RAYWALL, ELECTRIC HEAT PRODUCTS

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	HEATING, BASEBOARD RADIATION		
SPECIAL SYSTEMS HEATING, BASEBOARD RADIATION (CSI 16600)	Revision No.	Issue Date 5/93	Drawing No. A090307-2



ROOM THERMOSTAT



ROOM THERMOSTAT

SOURCE: CHROMALOX. ELECTRIC HEATING PRODUCTS. CONTROLS AND SYSTEMS

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	HEATING, BASEBOARD RADIATION		
SPECIAL SYSTEMS HEATING, BASEBOARD RADIATION (CSI 16600)	Revision No.	Issue Date 5/93	Drawing No. A090307-3

DEFICIENCY FACTORS
0.09.03.07 HEATING, BASEBOARD RADIATION (CSI 16813)

PROBABLE FAILURE POINTS

- improper location - thermostat too close to heating element, heating element not appropriate, not isolated from combustible materials.
- Improper disconnect - unit switch/thermostat used as disconnect.

SYSTEM ASSEMBLIES/DEFICIENCIES

Heating, Baseboard Radiation

Improper Cable/Conductor:	Ampacity not properly rated. Bimetallic connectors not used as required. Broken wire strands. Burned, melted, discolored conductor material. Defective or deficient cable/conductor penetrations. High splice temperature. Improper bending radius. Improper insulation voltage. Improper splice materials used. Improper termination. Improper trench. Improperly made splice. Inappropriate for application. Insulation inappropriate for application. Insulation improperly removed. Insulation is burned, charred, discolored, or other physical damage. Insulation resistance less than one megOhm per each kiloVolt of rating. Insulation unraveled, frayed, brittle, or other physical damage. Nicked or ringed conductor. Not properly bundled or trained. Not properly connected to device. Not properly derated for installation. Not properly supported. Not protected physically. Unauthorized splice.
Improper Control Wiring:	Bimetallic connectors not used as required. Bundled and trained inappropriately. Control circuits improperly connected. Control wiring insulation resistance less than one megOhm per each kiloVolt of rating. Improper sensor pickup or dropout point. Improper termination. Inadequate fuse/connection tension. Inadequately torqued at termination. Inappropriate for application. Inconsistent time delays. Incorrect fuse installed. Indicator lamps inoperative. Indicator lens missing, cracked, or broken.

DEFICIENCY FACTORS
0.09.03.07 HEATING, BASEBOARD RADIATION (CSI 16613)

SYSTEM ASSEMBLIES/DEFICIENCIES

Heating, Baseboard Radiation

Improper Control Wiring (Continued):	Inoperative. Inoperative interlock. Insulation charred, burned, or discolored. Insulation improperly removed from conductor. No engineering study to support installed fuse. Splices improperly insulated. Terminal boards improperly installed. Unauthorized splice.
Improper Disconnect:	Adjustable settings misadjusted. Arc suppression devices broken, cracked, missing, tracked, chipped, or other physical damage. Contacts bent or not aligned. Defective phase barriers. Does not sustain rated current per NEMA AB4-1991. Does not trip on instantaneous overcurrent per NFPA 70B. Handle broken, bent, or other physical deformity. High conductor, lug temperature. High contact resistance. Improper application. Improper switch time. Improperly sized. Improperly wired. Interlock broken, missing, or inoperative. Movable contacts bent, malaligned, or other physical deformity. Movable contacts pitted, burned, or discolored. No engineering study to support adjustable settings. Not accessible. Not adequate for application. Not clean and moisture-free. Not grounded properly. Not secured to mounting surface. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts. Series trip device missing, broken, or inoperative. Shunt trip device missing, broken, or inoperative. Stationary contacts bent, malaligned, or other physical deformity. Stationary contacts pitted, burned, or discolored. Terminals, contact blocks, bus bar, and connectors loose, burned, or discolored. Time-delay overcurrent trip not per manufacturer's specifications. UnderVoltage trip missing, broken, maladjusted, or inoperative.

DEFICIENCY FACTORS
0.09.03.07 HEATING, BASEBOARD RADIATION (CSI 16613)

SYSTEM ASSEMBLIES/DEFICIENCIES

Heating, Baseboard Radiation (Continued)

Improper Enclosure:	Corroded, rusted, dented, or other physical damage. Not secured to mounting surface. Interlock broken, missing, or inoperative. No curbing or berm for oil containment. Not accessible. Not adequate for application. Not clean and moisture-free. Not grounded properly. Oil leaks. Pedestal mounting surface chipped, broken, or other physical damage. Unused openings not covered or plugged. Vent defective or nonoperative. Ventilation obstructed.
Improper Equipment Protection:	Improper or inadequate primary protection device. Improper or inadequate secondary protection device. improper or inadequate differential protection device. No engineering study to support protection scheme.
Improper Installation:	Conductor or cable not appropriate for installation. Conductor or cable not listed. Conductors not trained or bundled for ventilation. Hanger not adequately secured to structure. Improper joint. Inadequate grounding. Inadequate ventilation. Missing vertical run hardware. No bushing or equivalent protection. Not adequately protected from severe physical damage. Not adequately secured to mounting surface. Not appropriate for location. Not clearly and permanently marked where required. Not properly spaced from combustible materials. Not secured within three feet of end of run. Unauthorized conductor present. Unused openings not covered or plugged.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.

DEFICIENCY FACTORS
0.09.03.07 HEATING, BASEBOARD RADIATION (CSI 16613)

END OF SUBSECTION

0.09.03.08 LIGHTNING PROTECTION & SURGE SUPPRESSION (CSI 188701

DESCRIPTION

Lightning Protection and Surge Suppression is the part of an electrical system established to protect the system. Voltage surges on electrical systems of any Voltage class may occur as a result of induced Voltages caused by lightning strikes in the vicinity of the system or connected system. Voltage surges may also be caused by switching of inductive components on or near the electrical system. Protection is achieved by employing devices that shunt or discharge surge currents resulting from the Voltage surge.

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Lightning Protection & Surge Suppression (CSI 16670)

A variety of equipment is used for lightning protection and surge protection. Lightning protection may involve shielding of the protected system by placement of conductors with air terminals; by connection of special devices to the electrical circuit being protected; or by a combination of shielding and connected devices. The shielding conductor and air terminals comply with NFPA 78 or an established engineering study for the protected system. Connected devices include but are not limited to the following types of devices.

- Arrestors: Devices constructed with a non-linear resistive element in series with a spark gap and enclosed in a casing normally made of porcelain. Common non-linear elements are made of thyrite. Several devices may be constructed in series to meet the normal operational Voltages of the system(s).
- Expulsion Arrestors: Devices with a spark gap connected in series with a hollow fiber tube. Gases are created in the hollow tube and ejected in an explosive manner, reducing follow-up current flow to a level interruptible by the spark gap.
- Choke Coils: Surge protection is achieved using choke coils, which offer a large reactance to the lightning-induced Voltage surge. The choke coil shunts the lightning-induced surge away from the protected apparatus and to a strategically placed arrestor.

OTHER RELATED COMPONENTS

See the following subsections for related material:

0.05.08 Roofing - Drawing No. A0508-11

0.09.03.08 LIGHTNING PROTECTION & SURGE SUPPRESSION (CSI 18670)

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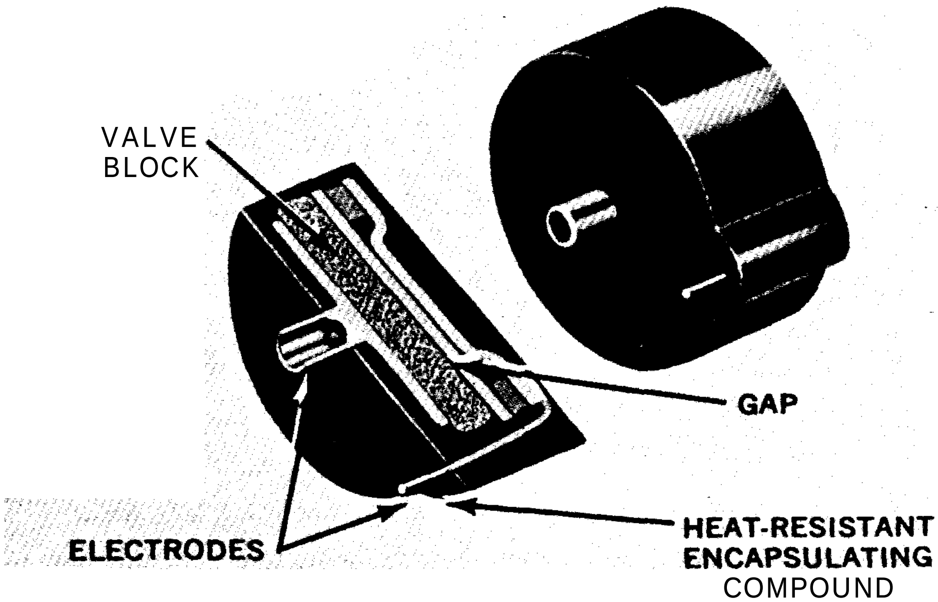
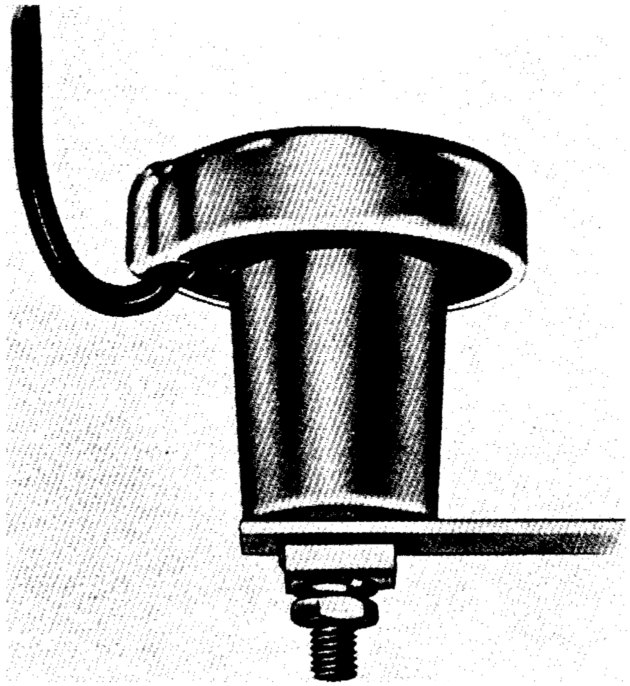
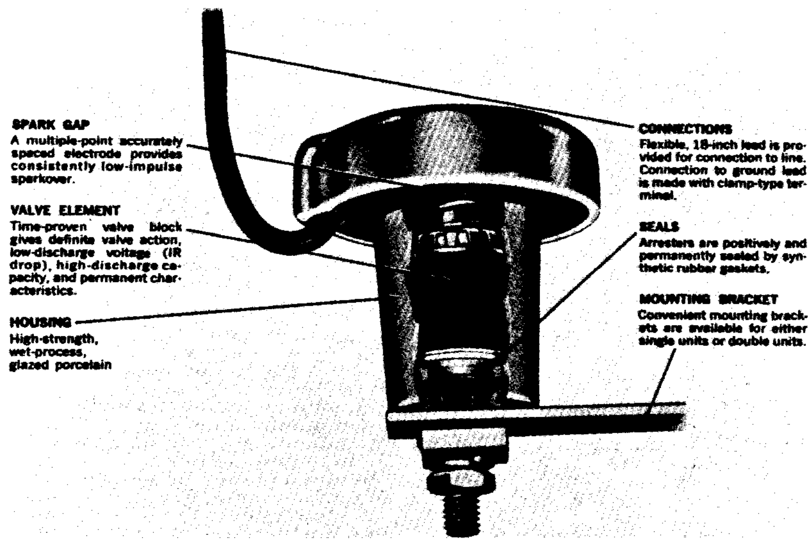


SURGE DIVERTER

SOURCE COOPER INDUSTRIES, McGRAW-EDISON POWER SYSTEMS, ELECTRICAL APPARATUS SPECIFIER'S CATALOG



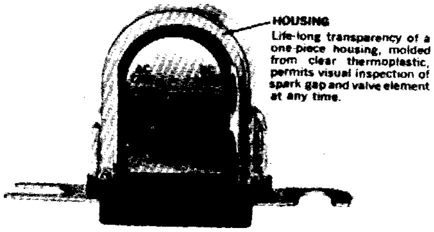
TYPE S3
SECONDARY SURGE ARRESTER



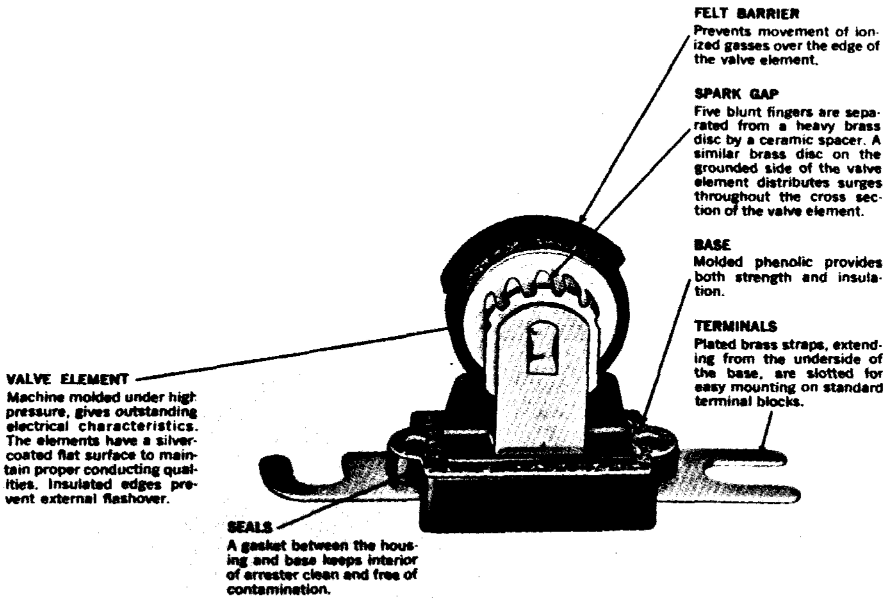
TYPE S3
SECONDARY SURGE ARRESTER

SOURCE: COOPER INDUSTRIES, McGRAW-EDISON POWER SYSTEMS, ELECTRICAL APPARATUS SPECIFIER'S CATALOG

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	TYPE S3 SECONDARY SURGE ARRESTER		
SPECIAL SYSTEMS LIGHTNING PROTECTION AND SURGE SUPPRESSION (CSI 16600)	Revision No.	Issue Date 5/93	Drawing No. A090308-2



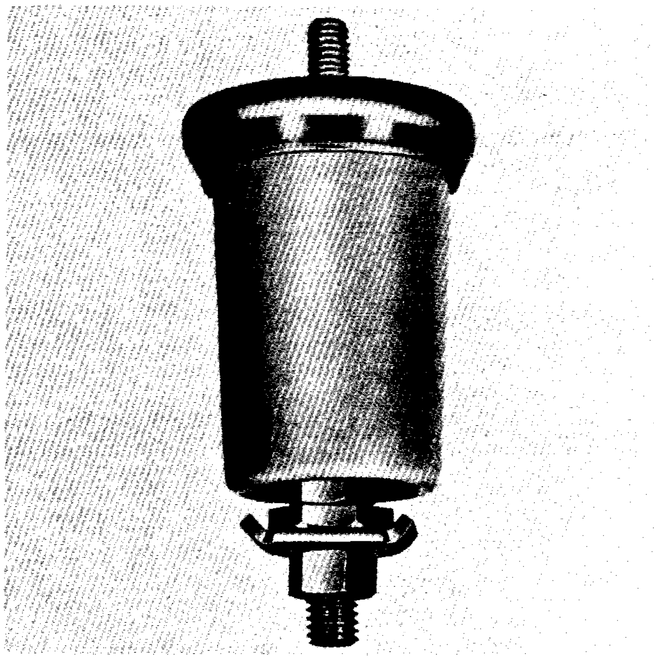
TYPEL
SURGE ARRESTER



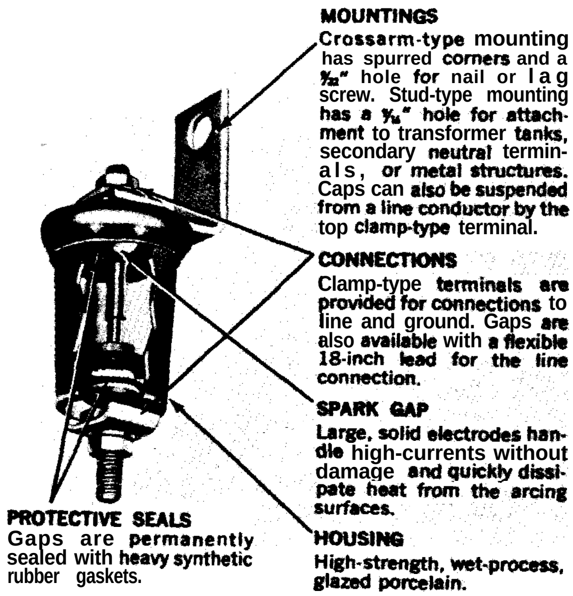
TYPE L
SURGE ARRESTER

SOURCE: COOPER INDUSTRIES, McGRAW-EDISON POWER SYSTEMS. ELECTRICAL APPARATUS SPECIFIER'S CATALOG

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	TYPE L SURGE ARRESTER		
SPECIAL SYSTEMS LIGHTNING PROTECTION AND SURGE SUPPRESSION (CSI 16600)	Revision No.	Issue Date 5/93	Drawing No. A090308-3



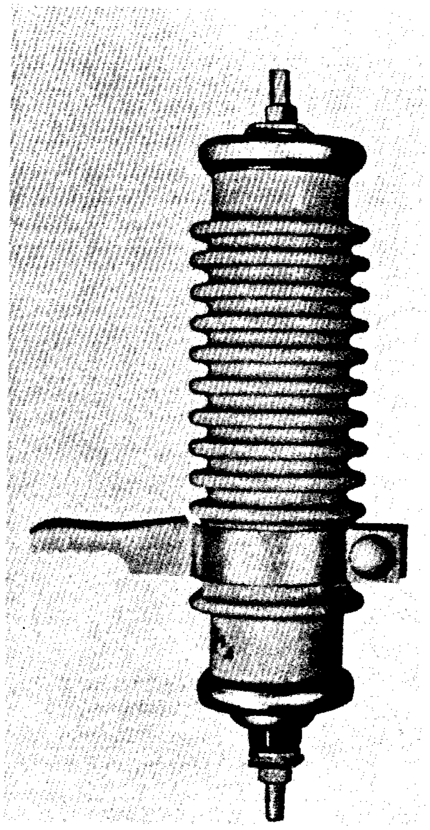
PROTECTIVE GAP
SURGE ARRESTER

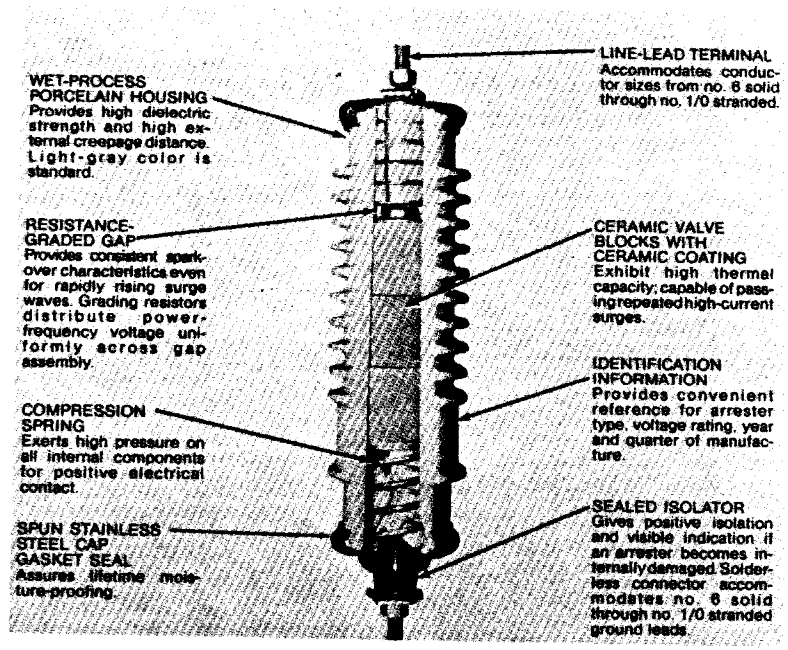


PROTECTIVE GAP
SURGE ARRESTER

SOURCE: COOPER INDUSTRIES, McGRAW-EDISON POWER SYSTEMS, ELECTRICAL APPARATUS SPECIFIER'S CATALOG

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	PROTECTIVE GAP SURGE ARRESTER		
SPECIAL SYSTEMS LIGHTNING PROTECTION AND SURGE PROTECTION (CSI 16600)	Revision No.	Issue Date 5/93	Drawing No. A090308-4

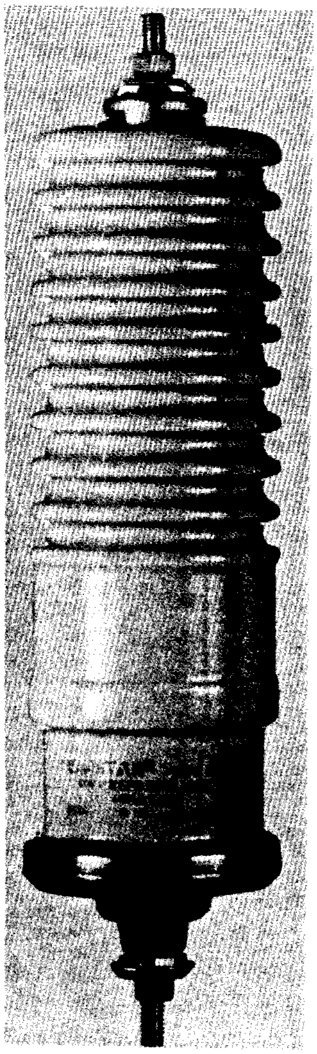


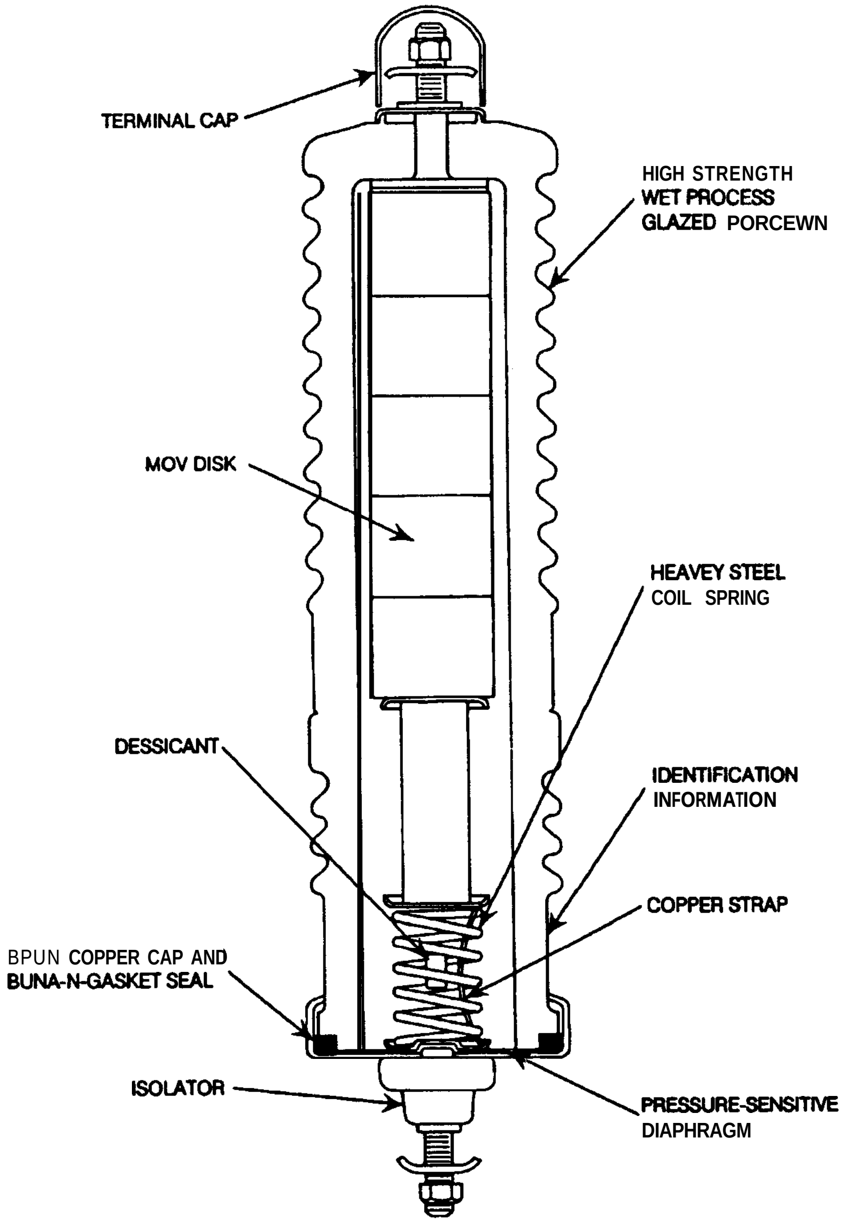


DISTRIBUTION CLASS
TYPE ES
SURGE ARRESTER

SOURCE: COOPER INDUSTRIES, McGRAW-EDISON POWER SYSTEMS, ELECTRICAL APPARATUS SPECIFIER'S CATALOG

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	DISTRIBUTION CLASS, TYPE ES SURGE ARRESTER		
SPECIAL SYSTEMS LIGHTNING PROTECTION AND SURGE SUPPRESSION (CSI 16600)	Revision No.	Issue Date 5/93	Drawing No. A090308-5

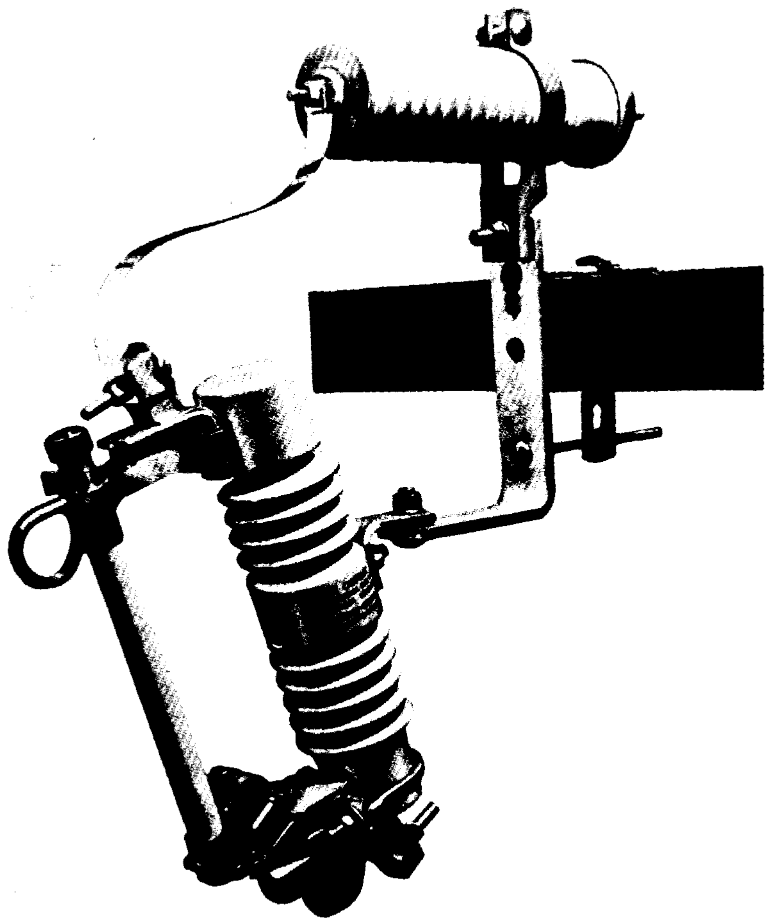




HEAVY-DUTY DISTRIBUTION CLASS
TYPE AZL
SURGE ARRESTER

SOURCE: COOPER INDUSTRIES, McGRAW-EDISON POWER SYSTEMS, ELECTRICAL APPARATUS SPECIFIER'S CATALOG

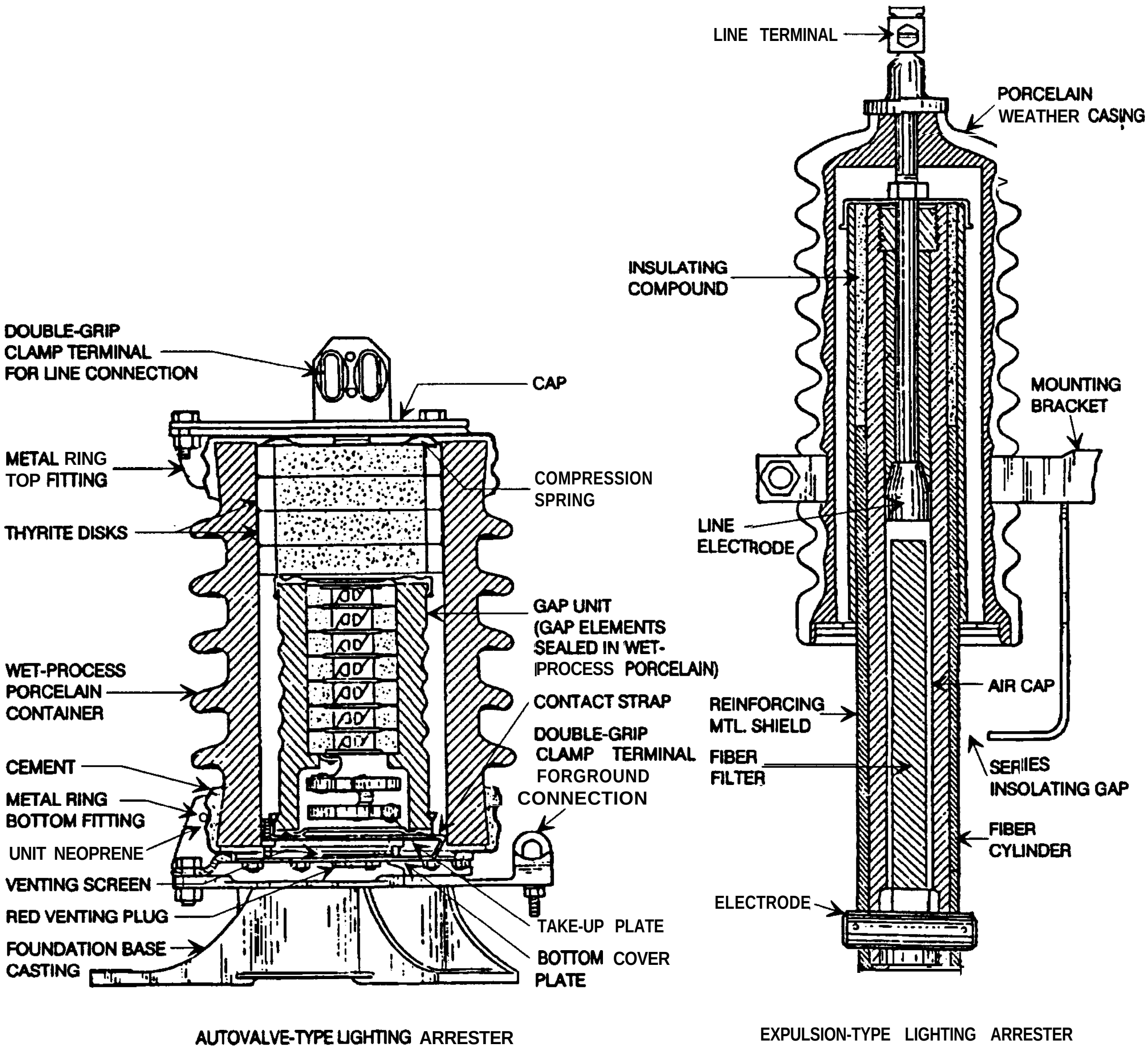
SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	HEAVY-DUTY DISTRIBUTION CLASS TYPE AZL SURGE ARRESTER		
SPECIAL SYSTEMS LIGHTNING PROTECTION AND SURGE SUPPRESSION (CSI 16600)	Revision No.	Issue Date 5/93	Drawing No. A090308-6



DISTRIBUTION CLASS
SURGE ARRESTER/FUSE CUTOUT

SOURCE: COOPER INDUSTRIES, McGRAW-EDISON POWER SYSTEMS, ELECTRICAL APPARATUS SPECIFIER'S CATALOG

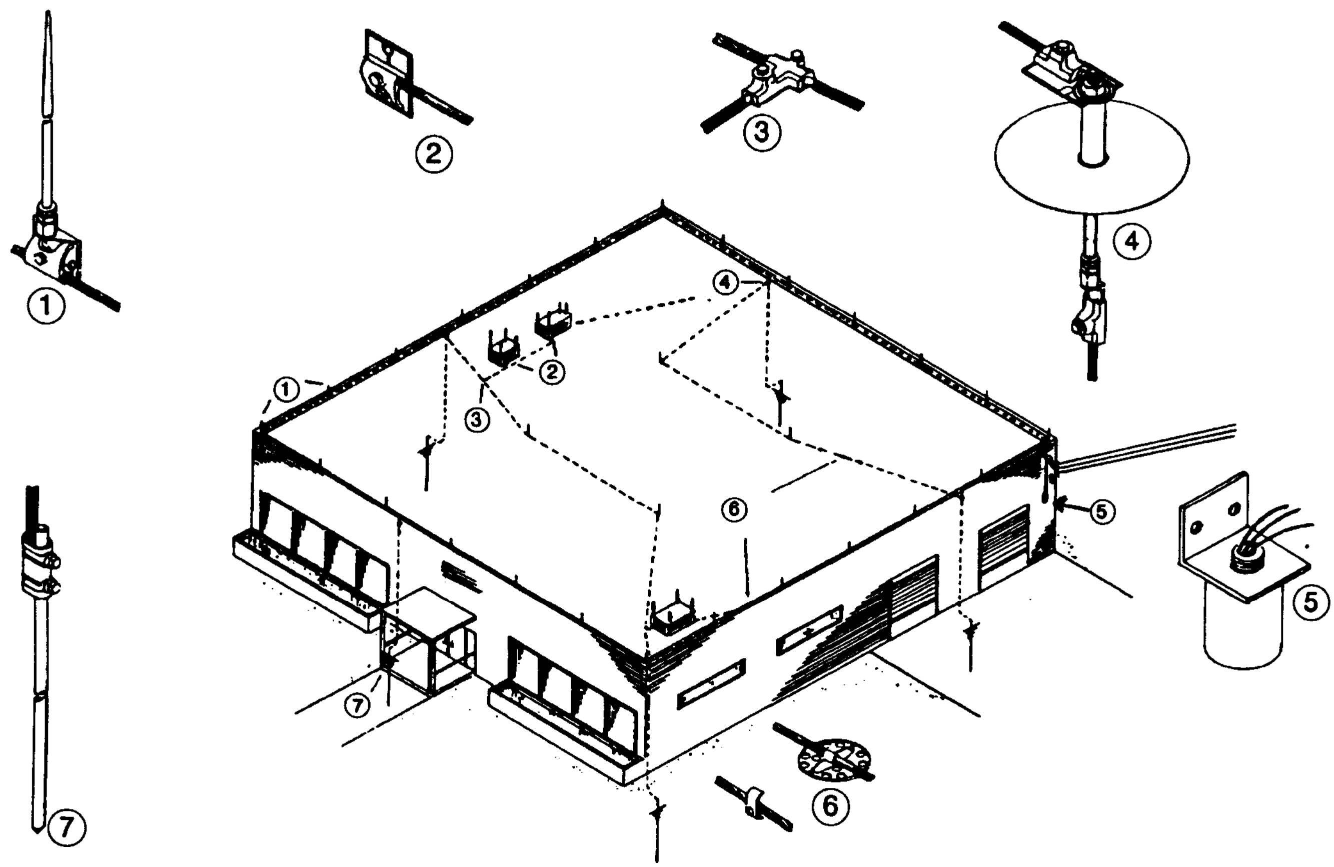
SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	DISTRIBUTION CLASS SURGE ARRESTER/FUSE CUTOUT		
SPECIAL SYSTEMS LIGHTNING PROTECTION AND SURGE SUPPRESSION (CSI 16600)	Revision No.	Issue Date 5/93	Drawing No. A090308-7



LIGHTNING ARRESTERS

SOURCE: ELECTRCAL ENGINEERS' HANDBOOK, PENDOR-DEL MAR, 4TH EDITION

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	LIGHTING ARRESTERS		
SPECIAL SYSTEMS LIGHTNING PROTECTION AND SURGE SUPPRESSION (CSI 16600)	Revision No.	Issue Date 5/93	Drawing No. A090308-8



TYPICAL BUILDING LIGHTING PROTECTION

SOURCE: THOMPSON LIGHTING PROTECTION INC

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	TYPICAL BUILDING LIGHTNING PROTECTION		
SPECIAL SYSTEMS LIGHTNING PROTECTION AND SURGE SUPPRESSION (CSI 16600)	Revision No.	Issue Date 5/93	Drawing No. A090308-9

DEFICIENCY FACTORS
0.09.03.08 LIGHTNING PROTECTION & SURGE SUPPRESSION
(CSI 166701

PROBABLE FAILURE POINTS

- Lightning Protection - inadequate ground, inadequately sized ground conductor.
- Installation - cone of protection inadequate, grounding conductor with excessive bends.
- Inoperative device - thyrite element broken, fiber tube destroyed.
- Choke coils - not clean and moisture-free.

SYSTEM ASSEMBLIES/DEFICIENCIES

Lightning Protection & Surge Suppression

Defective Housing:	Dirty, oily, greasy, or other surface contamination. Missing, cracked, chipped, or other surface damage. Not adequately secured. Tracked or carbonized. Not grounded properly. Gasket missing, damaged, malaligned, or other physical deformity.
Deficient Penetration:	Approved seals not used in boundaries.
Improper Cable/Conductor:	Ampacity not properly rated. Bimetallic connectors not used as required. Broken wire strands. Burned, melted, discolored conductor material. Defective or deficient cable/conductor penetrations. High splice temperature. Improper bending radius. Improper insulation voltage. Improper splice materials used. Improper termination. Improper trench. Improperly made splice. Inappropriate for application. Insulation inappropriate for application. Insulation improperly removed. Insulation is burned, charred, discolored, or other physical damage. Insulation resistance less than one megOhm per each kiloVolt of rating. Insulation unraveled, frayed, brittle, or other physical damage. Nicked or ringed conductor. Not properly bundled or trained. Not properly connected to device. Not properly derated for installation. Not properly supported. Not protected physically. Unauthorized splice.

DEFICIENCY FACTORS
0.09.03.08 LIGHTNING PROTECTION & SURGE SUPPRESSION
(CSI 16670)

SYSTEM ASSEMBLIES/DEFICIENCIES

Lightning Protection & Surge Suppression (Continued)

improper Connection:	Ground wire not bonded at ends of metal enclosures. Metallic interconnection not used in grounding. Not connected to authorized ground point. Shield wire not properly grounded. Spark gap or listed device not used as required in grounding. Wrong wire size used in connections.
Improper Location:	Accessible to public. Does not protect all circuits. Equipment and or components not rated for class 1 application. Flammable liquids located in area. Inadequate ventilation. Location not properly bounded. Metal raceway or approved cable not used. Unacceptable ground path length. Unacceptable number of bends in ground wire. Unlisted components employed.
improper Marking:	Nameplate missing or illegible. Missing or insufficient data.
improper Rating:	Not appropriate for system. Rating not adequate for operating circuit Voltage. Silicon carbide type not rated at 125% of applied Voltage. Spark gap or listed device under Voltage rated.
Inoperative Device:	Air horns bent, malformed, or other physical damage. Fiber tube destroyed. Isolator has opened ground circuit. Thyrite discs broken, missing, or other physical damage.

END OF SUBSECTION

0.09.03.09 PETROLEUM DISPENSING FACILITIES ELECTRICAL EQUIP. (CSI 16600)

DESCRIPTION

Petroleum Dispensing Facilities Electrical Equipment as used herein is the electrical equipment used in facilities where gasoline and other volatile flammable liquids or liquidified flammable gases are transferred. Electrical equipment used in other areas such as repair rooms, compressor rooms, and similar locations is included unless flammables having a flash point below 38° Centigrade (100° F) are not present.

The majority of electrical devices and materials found in petroleum dispensing facilities are either routine electrical items and used in uncontrolled areas or items rated and intended for use in controlled or hazardous areas.

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Petroleum Dispensing Facilities Electrical Equipment (CSI **16600)**

Seals are required to maintain the integrity of the controlled area by closing area penetrations.

0.09.03.09 PETROLEUM DISPENSING FACILITIES ELECTRICAL EQUIP. (CSI 16600)

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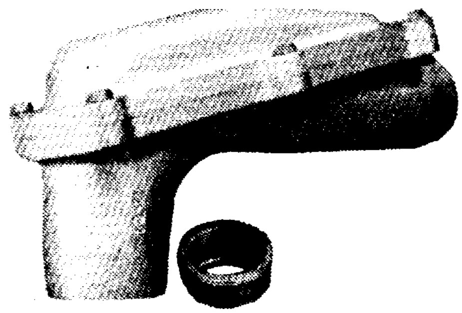
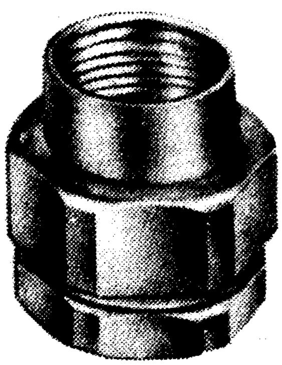
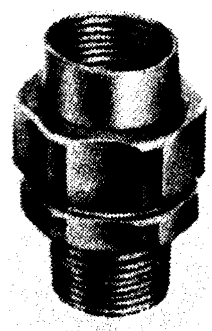


PULLING ELBOW



UNION

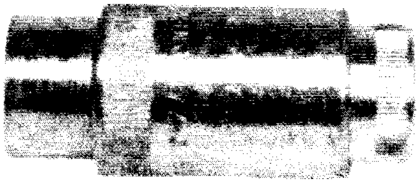


UNION

HAZARDOUS FITTINGS

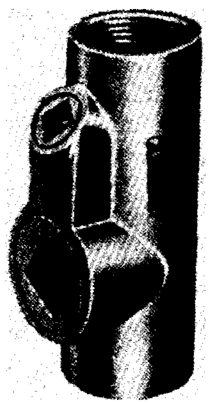
SOURCE: O-Z/GEDNEY, ELECTRICAL FITTINGS AND ENCLOSURES

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	HAZARDOUS FITTINGS		
SPECIAL SYSTEMS PETROLEUM DISPENSING FACILITIES ELECTRICAL EQUIPMENT (CSI 16600)	Revision No.	Issue Date 5/93	Drawing No. A090309-1



EXPANSION UNION

EXPANSION UNION



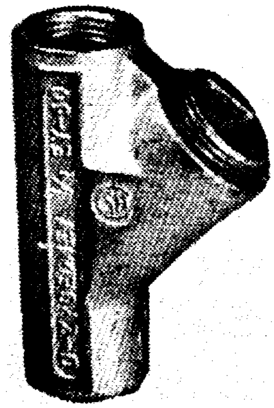
SEALING FITTING

SEALING FITTING

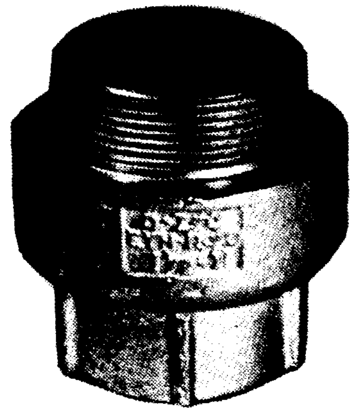
HAZARDOUS FITTINGS

SOURCE: O-Z/GEDNEY, ELECTRICAL FITTINGS AND ENCLOSURES

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	HAZARDOUS FITTINGS		
SPECIAL SYSTEMS PETROLEUM DISPENSING FACILITIES ELECTRICAL EQUIPMENT (CSI 16600)	Revision No.	Issue Date 5/93	Drawing No. A090309-2



SEALING FITTING



SEALING HUB

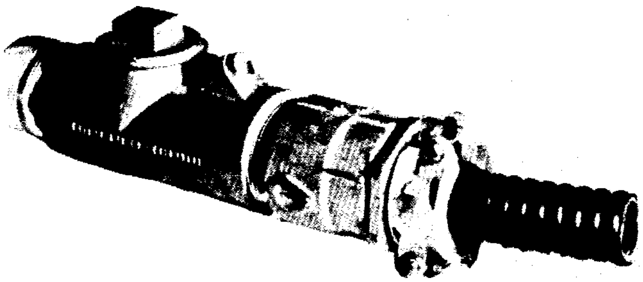
DRAIN/ SEALING FITTING

DRAIN/ SEALING FITTING

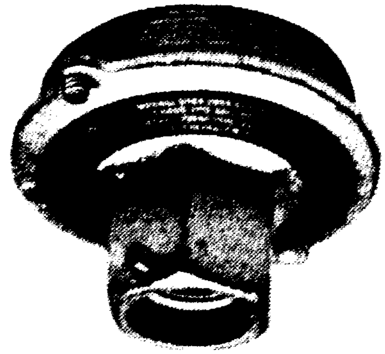
HAZARDOUS FITTINGS

SOURCE: O-Z/GEDNEY, ELECTRICAL FITTINGS AND ENCLOSURES

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	HAZARDOUS FITTINGS		
SPECIAL SYSTEMS PETROLEUM DISPENSING FACILITIES ELECTRICAL EQUIPMENT (CSI 16600)	Revision No.	Issue Date 5/93	Drawing No. A090309-3

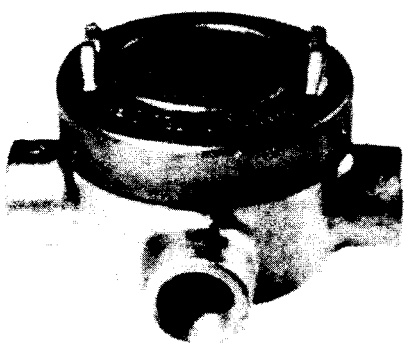


TERMINATOR/ SEALING FITTING

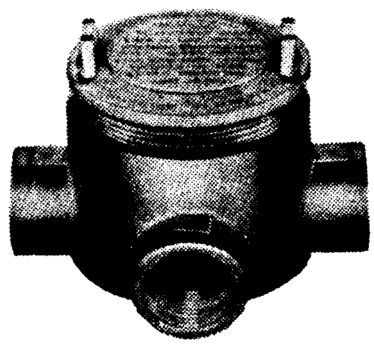


PENDANT/ OUTLET BOX

HAZARDOUS FITTINGS



OUTLET BOX

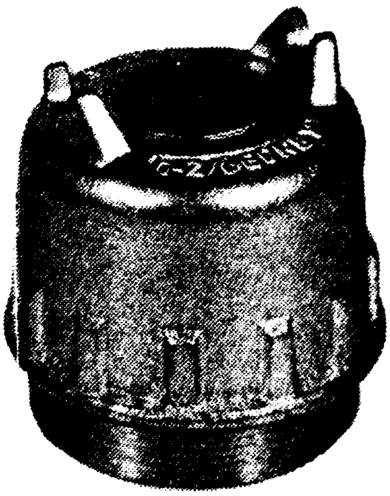


OUTLET BOX

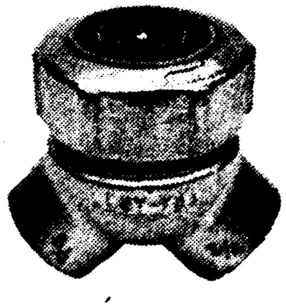
HAZARDOUS BOXES

SOURCE: O-Z/GEDNEY, ELECTRICAL FITTINGS AND ENCLOSURES

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	HAZARDOUS FITTINGS		
SPECIAL SYSTEMS PETROLEUM DISPENSING FACILITIES ELECTRICAL EQUIPMENT(CSI 16600)	Revision No.	Issue Date 5/93	Drawing No. A090309-4



EXTENSION/ OUTLET BOX



ELBOW

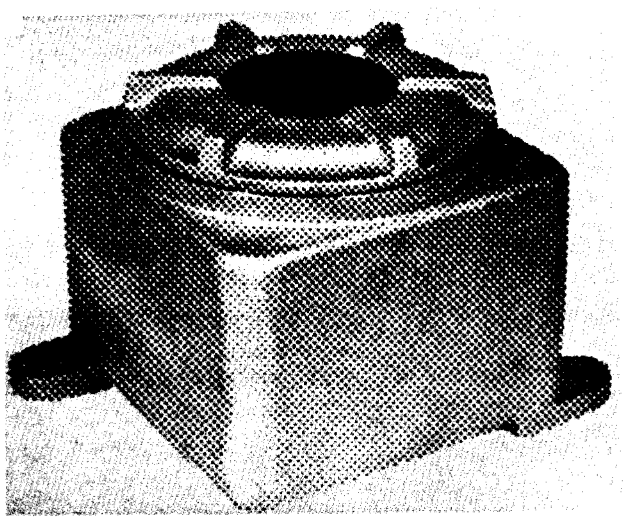
ELBOW

HAZARDOUS FITTINGS

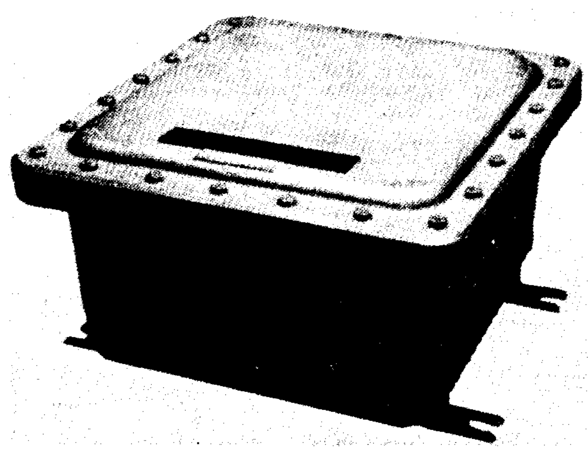
SOURCE: O-Z/GEDNEY, ELECTRICAL FITTINGS AND ENCLOSURES

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	**HAZARDOUS FITTINGS**		
SPECIAL SYSTEMS PETROLEUM DISPENSING FACILITIES ELECTRICAL EQUIPMENT (CSI 16600)	Revision No.	Issue Date 5/93	Drawing No. A090309-5

HAZARDOUS FITTING



JUNCTION BOX



JUNCTION BOX

HAZARDOUS BOXES

SOURCE: O-Z/GEDNEY, ELECTRICAL FITTINGS AND ENCLOSURES

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	HAZARDOUS BOXES		
SPECIAL SYSTEMS PETROLEUM DISPENSING FACILITIES ELECTRICAL EQUIPMENT (CSI 16600)	Revision No.	Issue Date 5/93	Drawing No. A090309-6

DEFICIENCY FACTORS
0.09.03.09 PETROLEUM DISPENSING FACILITIES ELECTRICAL EQUIP. (CSI 16600)

PROBABLE FAILURE POINTS

- Improper device - not rated for application, single pole breaker used as disconnect.
- Inadequate ground - metal portions of equipment not grounded.

SYSTEM ASSEMBLIES/DEFICIENCIES

Petroleum Dispensing Facilities Electrical Equipment

Defective Seal:	Seals leak, missing, or damaged at dispenser.
Deficient Penetration:	Approved seals not used in boundaries.
Improper Cable/Conductor:	Ampacity not properly rated. Bimetallic connectors not used as required. Broken wire strands. Burned, melted, discolored conductor material. Defective or deficient cable/conductor penetrations. High splice temperature. Improper bending radius. Improper insulation voltage. Improper splice materials used. Improper termination. Improper trench. Improperly made splice. Inappropriate for application. Insulation inappropriate for application. Insulation improperly removed. insulation is burned, charred, discolored, or other physical damage. Insulation resistance less than one megOhm per each kiloVolt of rating. Insulation unraveled, frayed, brittle, or other physical damage. Nicked or ringed conductor. Not properly bundled or trained. Not properly connected to device. Not properly derated for installation. Not properly supported. Not protected physically. Unauthorized splice.
Improper Device Application:	Boxes, box assemblies, or fittings not approved for use. Heaters not approved for application. Improper connection of bimetallic elements. Pendant devices improperly suspended. Signal, alarm, remote-control, and communication devices not approved for Class 1 use.
Improper Disconnect:	Adjustable settings misadjusted. Arc suppression devices broken, cracked, missing, tracked, chipped, or other physical damage. Contacts bent or not aligned. Defective phase barriers.

DEFICIENCY FACTORS
0.09.03.09 PETROLEUM DISPENSING FACILITIES ELECTRICAL EQUIP. (CSI 16600)

SYSTEM ASSEMBLIES/DEFICIENCIES

Petroleum Dispensing Facilities Electrical Equipment

Improper Disconnect (Continued):

Does not sustain rated current per NEMA AB4-1991.
Does not trip on instantaneous overcurrent per NFPA 70B.
Handle broken, bent, or other physical deformity.
High conductor, lug temperature.
High contact resistance.
improper application.
Improper switch time.
improperly sized.
Improperly wired.
Interlock broken, missing, or inoperative.
Movable contacts bent, malaligned, or other physical deformity.
Movable contacts pitted, burned, or discolored.
No engineering study to support adjustable settings.
Not accessible.
Not adequate for application.
Not clean and moisture-free.
Not grounded properly.
Not secured to mounting surface.
Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts.
Series trip device missing, broken, or inoperative.
Shunt trip device missing, broken, or inoperative.
Stationary contacts bent, malaligned, or other physical deformity.
Stationary contacts pitted, burned, or discolored.
Terminals, contact blocks, bus bar, and connectors loose, burned, or discolored.
Time-delay overcurrent trip not per manufacturer's specifications.
UnderVoltage trip missing, broken, maladjusted, or inoperative.

Improper Enclosure:

Bonding jumpers are not present as required.
Drainage system missing or inadequate.
Improper connection devices.
Improper raceway used.
Improper use of general purpose enclosure.
Lightning protection missing or inadequate.
Live or energized components are exposed.
Not properly marked.
Not rated for Class 1 location.

Improper Location:

Accessible to public.
Does not protect all circuits.
Equipment and or components not rated for Class 1 application.
Flammable liquids located in area.

DEFICIENCY FACTORS
0.09.03.09 PETROLEUM DISPENSING FACILITIES ELECTRICAL EQUIP. (CSI 16600)

SYSTEM ASSEMBLIES/DEFICIENCIES

Petroleum Dispensing Facilities Electrical Equipment

Improper Location (Continued):	Inadequate ventilation. Location not properly bounded. Metal raceway or approved cable not used. Storage device for flexible cord not provided. Unauthorized penetration between vault and Class 1 location. Unlisted components employed. Vault not used as required for transformer and/or capacitor.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.
Improper Underground Wiring:	Improper conductor insulation. Inappropriate cable used. Inappropriate raceway used.

DEFICIENCY FACTORS
0.09.03.09 PETROLEUM DISPENSING FACILITIES ELECTRICAL EQUIP. (CSI 166001

END OF SUBSECTION

0.09.03.10 SIGNAL CIRCUITS (CSI 16740)

DESCRIPTION

As used herein, Signal Circuits are the circuits often defined as a remote control circuit, a low-energy power circuit, a low-Voltage power circuit and circuits supplying energy to an appliance that gives a recognizable signal; e.g., doorbells, buzzers, code-calling systems, signal lights, etc. The device being energized by a signal circuit is not addressed by this standard. If appropriate, the circuit will be classified further as a Class 1, 2, or 3 as defined by NFPA 70.

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Signal Circuits (CSI 16740)

Equipment used in signal circuits as defined herein are standard electrical devices and ‘materials with additional constraints imposed on use. If the circuit is one in which power is not required to be limited to some established level, then the circuit is rated as Class 1. If the circuit has Voltage and current limited normally in accordance with NFPA standards, the circuit is rated as Class 2 or Class 3 and equipment and material rated for that class is used.

OTHER RELATED COMPONENTS

See the following subsections for related components:

0.09.03.10 SIGNAL CIRCUITS (CSI 16740)

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DEFICIENCY FACTORS
0.09.03.10 SIGNAL CIRCUITS (CSI 16740)

PROBABLE FAILURE POINTS

- Misclassification - unrated components used in rated requirement, power or Voltage limiting devices not used.
- improper installation - conductors improperly installed, terminated.

SYSTEM ASSEMBLIES/DEFICIENCIES

Signal Circuits

Deficient Penetration:	Approved seals not used in boundaries.
Improper Cable/Conductor:	Ampacity not properly rated. Bimetallic connectors not used as required. Broken wire strands. Burned, melted, discolored conductor material. Defective or deficient cable/conductor penetrations. High splice temperature. Improper bending radius. Improper insulation voltage. Improper splice materials used. Improper termination. Improper trench. Improperly made splice. Inappropriate for application. Insulation inappropriate for application. Insulation improperly removed. Insulation is burned, charred, discolored, or other physical damage. Insulation resistance less than one megOhm per each kiloVolt of rating. Insulation unraveled, frayed, brittle, or other physical damage. Nicked or ringed conductor. Not properly bundled or trained. Not properly connected to device. Not properly derated for installation. Not properly supported. Not protected physically. Unauthorized splice.
Improper Fitting:	Exposed conductors. Improper fitting for application. Insert broken, cracked, missing, or other damage. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, broken, cracked, loose, or other damage. Unused openings not covered or plugged.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.

DEFICIENCY FACTORS
0.09.03.10 SIGNAL CIRCUITS (CSI 16740)

SYSTEM ASSEMBLIES/DEFICIENCIES

Signal Circuits (Continued)

Improper Overcurrent Device:	interchangeable devices used in signal circuits. No engineering study for adjustable settings. Not of proper size. Not properly located for signal circuit application. Overcurrent device exceeds 167 percent of signal circuit source rating. Signal circuit conductors less than 14AWG not properly protected.
Improper Power Supply:	Not durably marked for class and rating. Parallel connection of unlisted power supplies.
Improper Rating:	Maximum non-transformer source output exceeds 2500 Volt-Amperes. System exceeds 30 Volts and 1000 Volt-Amperes to load.

END OF SUBSECTION

0.09.03.11 UNINTERRUPTIBLE POWER SUPPLIES (CSI 16610)

DESCRIPTION

Uninterruptible Power Supplies are equipment used to sustain electrical energy to some load when the primary source of electrical energy is unavailable. This sustained source may have a limited operational span when compared to the primary electrical energy source. The limited operational span is traceable normally to the energy source of the uninterruptible power supply. This energy source is normally rechargeable and is maintained at the requisite level by the primary energy source.

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Uninterruptible Power Supplies (CSI 16610)

Components such as timers, control devices, and energy source are included as appropriate. Older units often used battery banks and inverter/converters to provide the basic uninterruptible power supply. These systems used motor controllers, Voltage regulators, circuit breakers, transformers, and other electrical devices in meeting the requirement of the uninterruptible power supply. Newer uninterruptible power supplies often rely on solid-state technology to provide the required output; however, the alternate energy source continues to be a battery bank in normal applications.

OTHER RELATED COMPONENTS

See the following subsections for related components:

0.06.03.11 UNINTERRUPTIBLE POWER SUPPLIES (CSI 16610)

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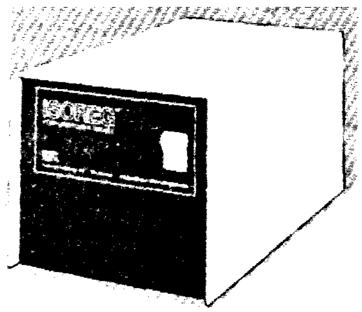
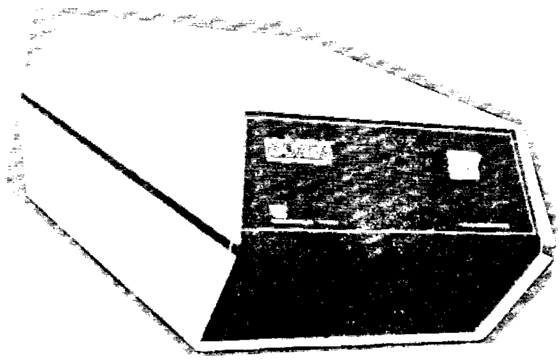
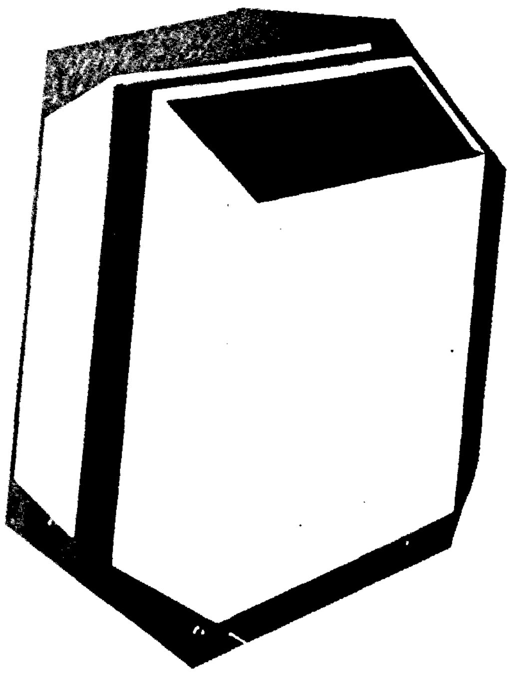


125 VA-375 VA



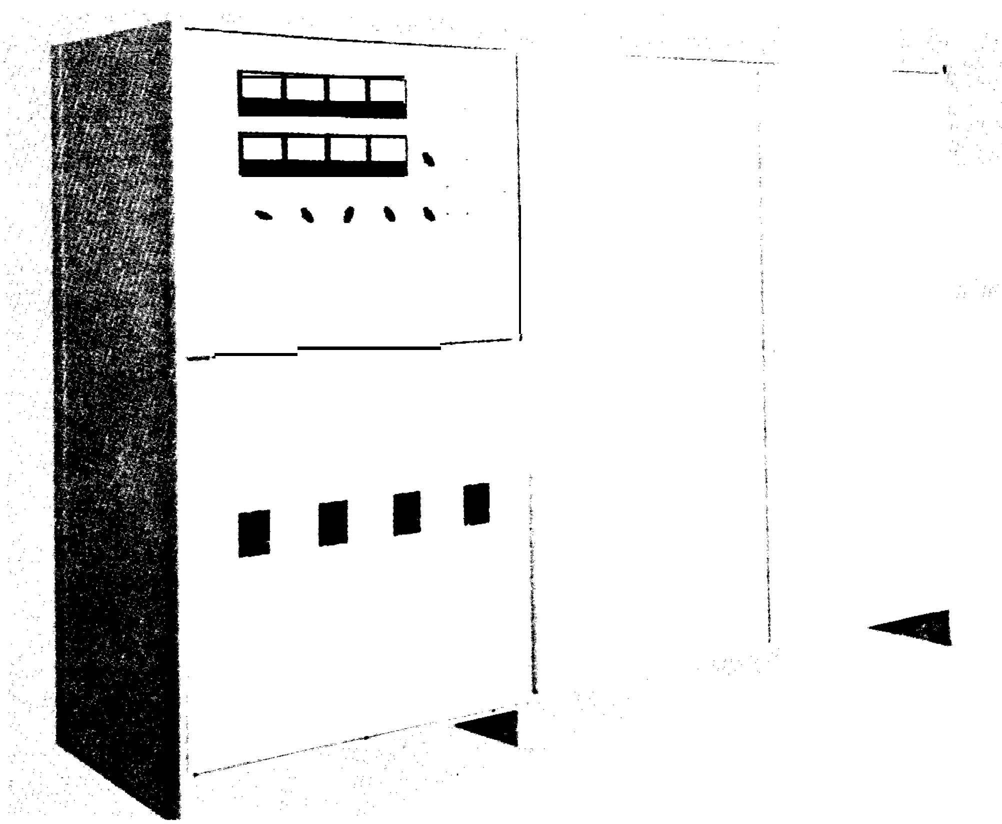
750VA-2500 VA



5 kVA-20 kVA

SOURCE: ISOREG CATALOG

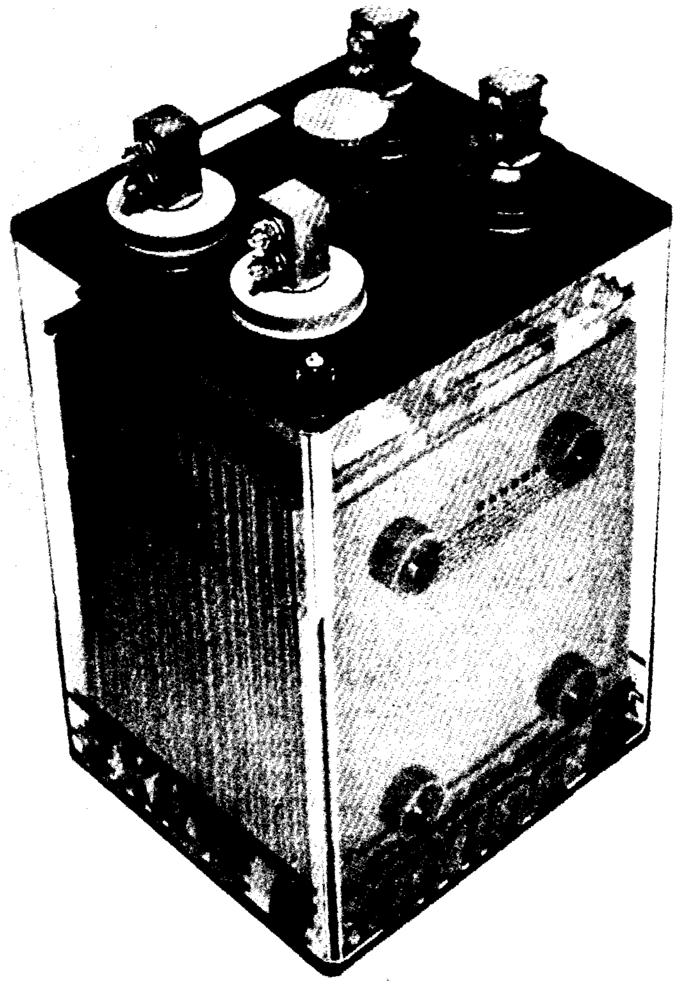
SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	LOW POWER UPS UNITS		
SPECIAL SYSTEMS UNINTERRUPTIBLE POWER SUPPLIES (CSI 16600)	Revision No.	Issue Date 5/93	Drawing No. A090311-1



125 kVA-300 kVA

SOURCE: INTERNATIONAL POWER MACHINES CATALOG

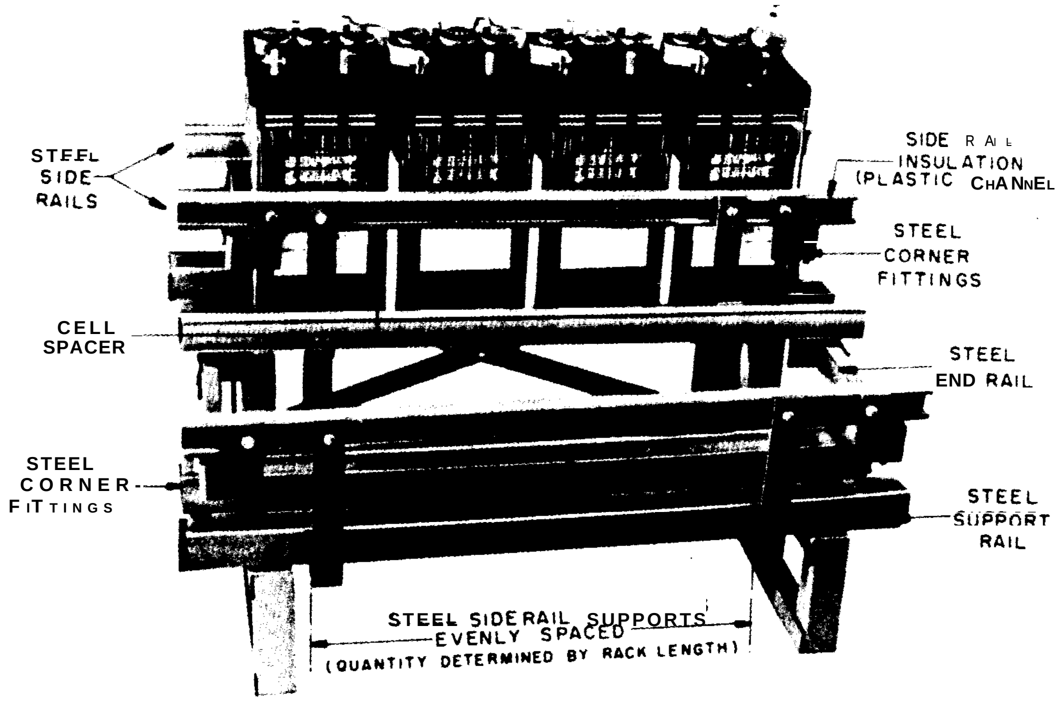
SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	LARGE POWER UPS UNIT		
SPECIAL SYSTEMS UNINTERRUPTIBLE POWER SUPPLIES (CSI 16600)	Revision No.	Issue Date 5/93	Drawing No. A090311-2



BATTERY CELL

SOURCE: EXIDE, STATIONARY BATTERIES AND CHARGERS CATALOG

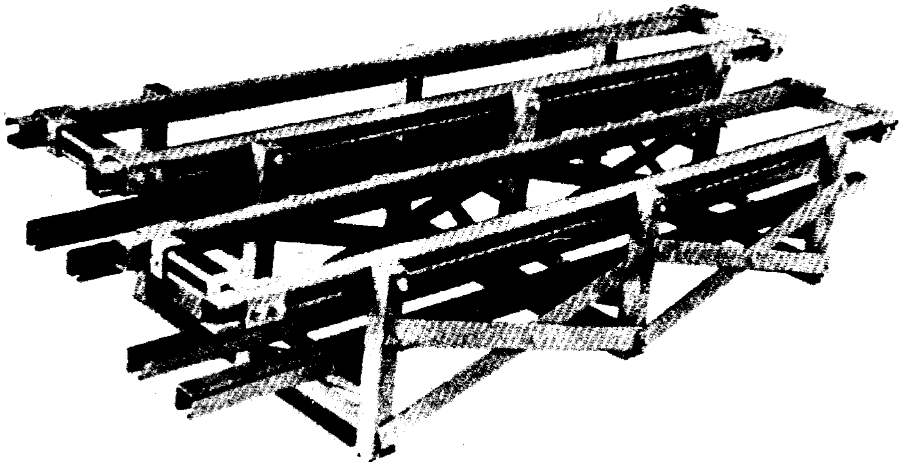
SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	BATTERY CELL		
SPECIAL SYSTEMS UNINTERRUPTIBLE POWER SUPPLIES (CSI 16600)	Revision No.	Issue Date 5/93	Drawing No. A090311-3



BATTERY RACK

SOURCE: EXIDE, STATIONARY BATTERIES AND CHARGERS CATALOG

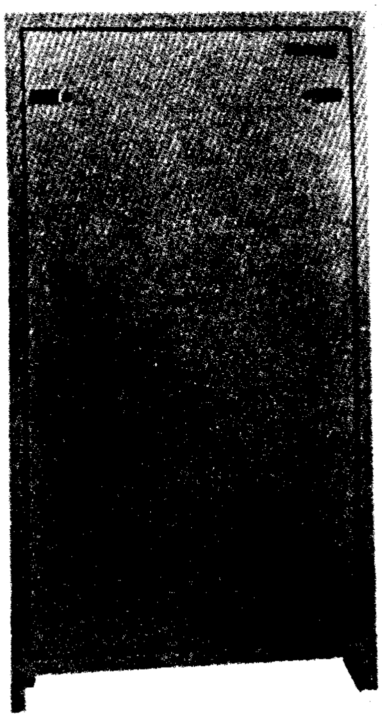
SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	BATTERY RACK		
SPECIAL SYSTEMS UNINTERRUPTIBLE POWER SUPPLIES (CSI 16600)	Revision No.	Issue Date 5/93	Drawing No. A090311-4

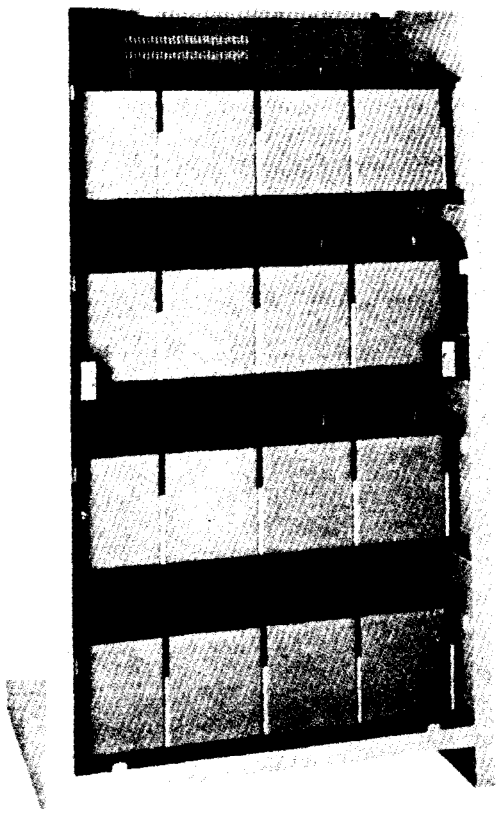


BATTERY RACK SEISMIC RATED

SOURCE: EXIDE, STATIONARY BATTERIES AND CHARGERS CATALOG

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	BATTERY RACK SEISMIC RATED		
SPECIAL SYSTEMS UNINTERRUPTIBLE POWER SUPPLIES (CSI 16600)	Revision No.	Issue Date 5/93	Drawing No. A090311-5

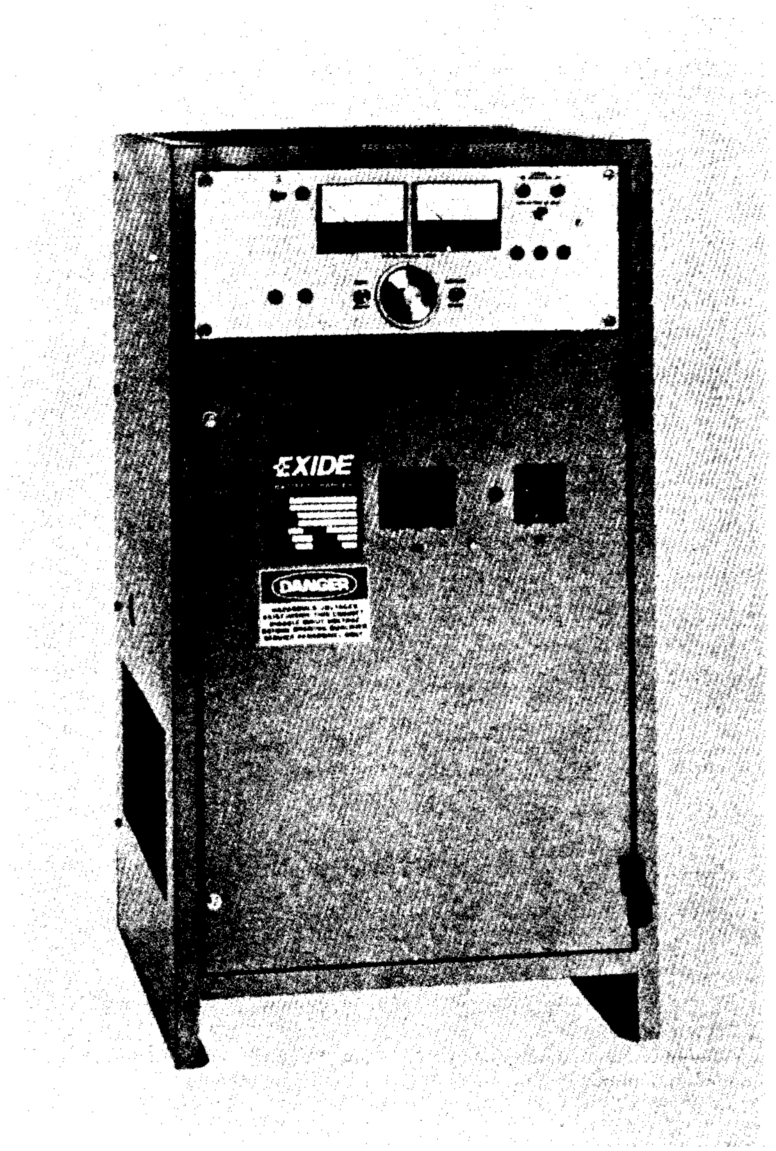




BATTERY CABINET

SOURCE: EXIDE, STATIONARY BATTERIES AND CHARGERS CATALOG

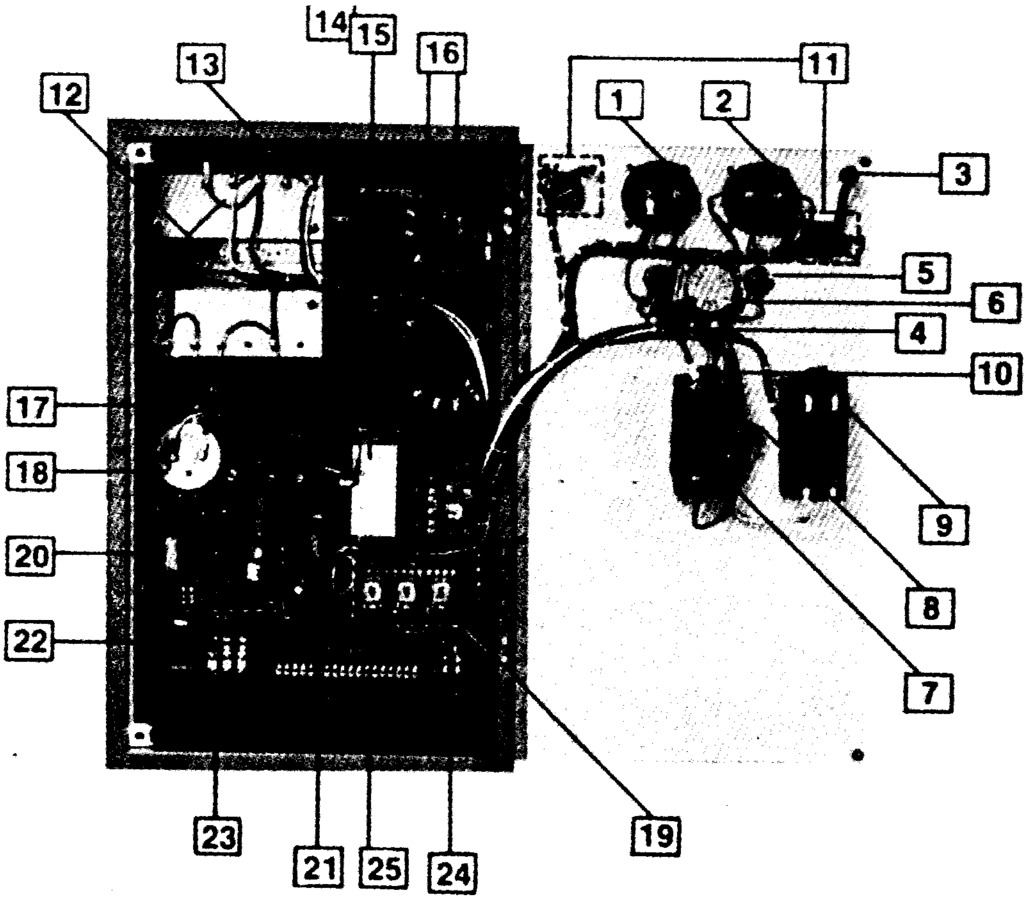
SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	BATTERY CABINET		
SPECIAL SYSTEMS UNINTERRUPTIBLE POWER SUPPLIES (CSI 16600)	Revision No.	Issue Date 5/93	Drawing No. A090311-6



BATTERY CHARGER

SOURCE EXIDE. STATIONARY BATTERIES AND CHARGERS CATALOG

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	BATTERY CHARGER		
SPECIAL SYSTEMS UNINTERRUPTIBLE POWER SUPPLIES (CSI 16600)	Revision No.	Issue Date 5/93	Drawing No. A090311-7



BATTERY CHARGER

1. DC AMMETER
2 DC VOLTMETER
3. AC POWER "ON" LIGHT
4. EQUALIZE ADJUST POT
5. FLOAT ADJUST POT
6. EQUALIZE TIMER
7. DC CIRCUIT BREAKER
8. DC FUSES
9. AC CIRCUIT BREAKER
10. DC SURGE SUPPRESSOR
11. STATUS INDICATING LIGHTS & SWITCHES
12. POWER ISOLATION TRANSFORMER W/AC RECONNECTION T.B.
13. AC SURGE SUPPRESSOR
14. SCR RECTIFIER/ HEAT SINK ASSEMBLY
16. POLARITY AND BLOCKING DIODE ASSEMBLIES
16. FILTER CHOKES
17. BLEEDER RESISTOR
18. FILTER CAPACITORS
19. ALARM RELAY
20. ALARM CONTROL MODULE(S)
21. CONTROL MODULE
22. CURRENT LIMIT ADJUST POT
23. INPUT LINE & GROUND TERMINALS (TB1)
24. OUTPUT TERMINALS (TB2)
25. REMOTE ALARM TERMINALS (TB3)

SOURCE EXIDE. STATIONARY BATTERIES AND CHARGERS CATALOG

SYSTEM ASSEMBLY DETAILS-ELECTRICAL SYSTEM	BATTERY CHARGER		
SPECIAL SYSTEMS UNINTERRUPTIBLE POWER SUPPLIES (CSI 16600)	Revision No.	Issue Date 5/93	Drawing No. A090311-8

DEFICIENCY FACTORS
0.09.03.11 UNINTERRUPTIBLE POWER SUPPLIES (CSI 16610)

PROBABLE FAILURE POINTS

- Defective Alternate Energy Source - batteries discharged, overcharged.
- inoperative - malaligned controls and or devices, maladjusted controls.

SYSTEM ASSEMBLIES/DEFICIENCIES

Uninterruptible Power Supplies

Damaged Metering:	Device inoperative. Metering device broken or other physical damage. Tampering of metering device or circuit.
Defective Bearings:	High temperature. Improper bearing. Leaking seals. Rough or irregular rotation. Noisy.
Defective Battery/Application:	Corroded terminal. Cracked case. Flame arrestor missing or broken. Improper liquid level. Inoperative. Insufficient Ampere hour capacity. Liquid leakage. Low capacity. No emergency shower readily available. No eyewash readily available. No protective personnel gear available. Not properly marked. Not properly ventilated. Not securely attached to mounting surface. Overcharged. Pressure release vent inoperative. Rack(s) unstable, uneven, or inaccessible. Undercharged. Ventilation obstructed or clogged.
Defective Bushing/Insulator:	Cable clamp loose, missing, broken, corroded, burned, or other physical damage. Dirty, oily, greasy, or other surface contamination. Missing, cracked, chipped, or other damage. Not adequately secured. Oil leakage. Tracked or carbonized.
Defective Exciter/Voltage Regulator:	Does not flash field. Does not maintain output Voltage.
Defective Heater:	Heater not adequately secured to mounting surface. Improper conductors from source. Improper temperature in device enclosure. Inoperative heater element.

DEFICIENCY FACTORS
0.09.03.11 UNINTERRUPTIBLE POWER SUPPLIES (CSI 16610)

SYSTEM ASSEMBLIES/DEFICIENCIES

Uninterruptible Power Supplies

Defective Heater (Continued):	Heater element resistance to ground less than one megOhm per each kiloVolt of rating. Sensing device broken, missing, or inoperative. Sensing device malcalibrated.
Defective Rectifier/Inverter:	Corroded, rusted, dented, or other physical damage. Inappropriate for application. Indicator lamps inoperative. Indicator lens missing, cracked, or broken. Indicator meter inoperative or missing. Inoperative. Noisy. Not adequately secured. Not clean and moisture-free. Test switch inoperative or missing. Top, bottom or side cover missing.
Improper Cable/Conductor:	Ampacity not properly rated. Bimetallic connectors not used as required. Broken wire strands. Burned, melted, discolored conductor material. Defective or deficient cable/conductor penetrations. High splice temperature. Improper bending radius, Improper insulation voltage. Improper splice materials used. Improper termination. Improper trench. Improperly made splice. Inappropriate for application. Insulation inappropriate for application. Insulation improperly removed. Insulation is burned, charred, discolored, or other physical damage. Insulation resistance less than one megOhm per each kiloVolt of rating. Insulation unraveled, frayed, brittle, or other physical damage. Nicked or ringed conductor. Not properly bundled or trained. Not properly connected to device. Not properly derated for installation. Not properly supported. Not protected physically. Unauthorized splice.
Improper Control Wiring:	Bimetallic connectors not used as required. Bundled and trained inappropriately. Control circuits improperly connected.

DEFICIENCY FACTORS
0.09.03.1 1 UNINTERRUPTIBLE POWER SUPPLIES (CSI 16610)

SYSTEM ASSEMBLIES/DEFICIENCIES

Uninterruptible Power Supplies

Improper Control Wiring (Continued):	Control wiring insulation resistance less than one megOhm per each kiloVolt of rating. Improper sensor pickup or dropout point. Improper termination. Inadequate fuse/connection tension. Inadequately torqued at termination. Inappropriate for application. Inconsistent time delays. Incorrect fuse installed. Indicator lamps inoperative. Indicator lens missing, cracked, or broken. Inoperative. Inoperative interlock. insulation charred, burned, or discolored. Insulation improperly removed from conductor. No engineering study to support installed fuse. Splices improperly insulated. Terminal boards improperly installed. Unauthorized splice.
Improper Device Application:	Boxes, box assemblies, or fittings not approved for use. Heaters not approved for application. Improper connection of bimetallic elements. Improper rotation. Improper speed. Inappropriate starting system. Pendant devices improperly suspended.
Improper Disconnect:	Adjustable settings misadjusted. Arc suppression devices broken, cracked, missing, tracked, chipped, or other physical damage. Contacts bent or not aligned. Defective phase barriers. Does not sustain rated current per NEMA AB4-1991. Does not trip on instantaneous overcurrent per NFPA 706. Handle broken, bent, or other physical deformity. High conductor, lug temperature. High contact resistance. Improper application. Improper switch time. Improperly sized. Improperly wired. Interlock broken, missing, or inoperative. Movable contacts bent, malaligned, or other physical deformity. Movable contacts pitted, burned, or discolored. No engineering study to support adjustable settings. Not accessible. Not adequate for application. Not clean and moisture-free.

DEFICIENCY FACTORS
0.09.03.11 UNINTERRUPTIBLE POWER SUPPLIES (CSI 166101

SYSTEM ASSEMBLIES/DEFICIENCIES

Uninterruptible Power Supplies

Improper Disconnect (Continued):	Not grounded properly. Not secured to mounting surface. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts. Series trip device missing, broken, or inoperative. Shunt trip device missing, broken, or inoperative. Stationary contacts bent, malaligned, or other physical deformity. Stationary contacts pitted, burned, or discolored. Terminals, contact blocks, bus bar, and connectors loose, burned, or discolored. Time-delay overcurrent trip not per manufacturer's specifications. UnderVoltage trip missing, broken, maladjusted, or inoperative.
Improper Enclosure:	Corroded, rusted, dented, or other physical damage. Not secured to mounting surface. Interlock broken, missing, or inoperative. No curbing or berm for oil containment. Not accessible. Not adequate for application. Not clean and moisture-free. Not grounded properly. Oil leaks. Pedestal mounting surface chipped, broken, or other physical damage. Unused openings not covered or plugged. Vent defective or nonoperative. Ventilation obstructed.
Improper Fitting:	Exposed conductors. Improper fitting for application. Insert broken, cracked, missing, or other damage. Loose, broken, damaged, corroded, or missing fastening hardware. Missing, broken, cracked, loose, or other damage. Unused openings not covered or plugged.
Improper Fuse Unit:	Fuse clips bent, malaligned, discolored, or other physical damage. Improper fuse type used. Improperly sized. Poor fuse to clip contact. Resistance less than one megOhm per each kiloVolt of rating between poles and/or from poles to non-energized parts.
Improper Marking:	Nameplate missing or illegible. Missing or insufficient data.

DEFICIENCY FACTORS
0.09.03.11 UNINTERRUPTIBLE POWER SUPPLIES (CSI 16610)

SYSTEM ASSEMBLIES/DEFICIENCIES

Uninterruptible Power Supplies (Continued)

Improper Motor Application:	Inappropriate starting system. Improper motor size. Improper rotation. Improper speed. improper connection of bimetallic elements. Improper winding connections.
Improper Rotor/Stator:	Bent, scored, or other damage to rotor shaft. Burned, charred, or other signs of high temperature. Noisy laminations. Non-uniform air gap. Open turns or coils. Shorted turns or coils. Splice insulation unraveled, brittle, cracked, or other damage. Unbalanced rotor assembly.
Inaccurate Metering:	Calibration standard not established. Defective or inoperative sensor or transducer. Metering device inadequately sized. Metering device not calibrated.

DEFICIENCY FACTORS
0.09.03.11 UNINTERRUPTIBLE POWER SUPPLIES (CSI 16610)

END OF SUBSECTION