Department of Energy

Condition Assessment Survey (CAS) Program

Deficiency Standards & Inspections Methods Manual

Prepared by:
Parsons Brinckerhoff Facilities Services, Inc.

for
The United States Department of Energy
Office of Organization, Resources and Facilities Management
1000 Independence Avenue, S.W.
Washington, DC 20585

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CAS PROGRAM OVERVIEW

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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.

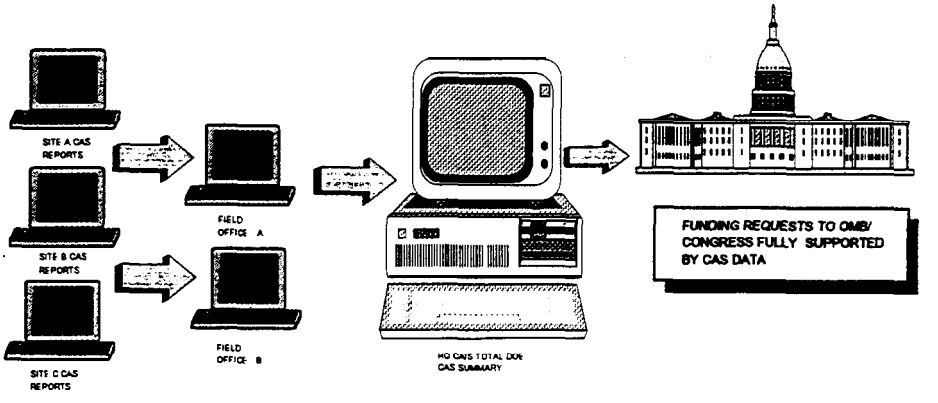
The current state of condition assessment across all DOE assets is mixed. While DOE regulations dictate facility assessments be made, no one methodology is mandated to conduct them. As a result, DOE surveys have varied from site to site, with some locations providing exhaustive in-depth analysis while 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.

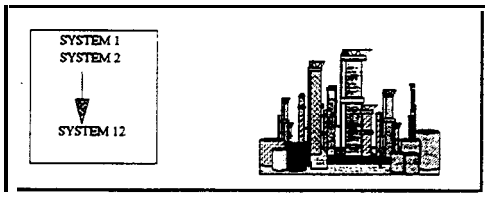
Develop Supportable Funding Requests:

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

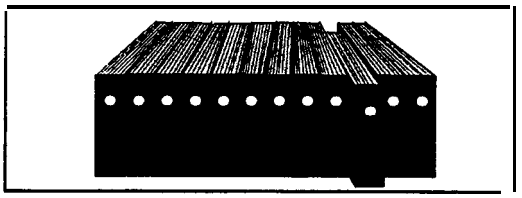
WHAT IS CAS?

A SYSTEMATIC INSPECTION APPROACH INSTITUTED AT ALL SITES



WORK BREAKDOWN STRUCTURE

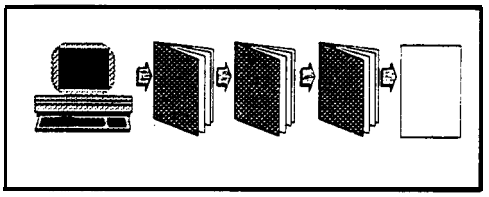
① FACILITIES DIVIDED IN TWELVE SYSTEMS



CAS MANUALS

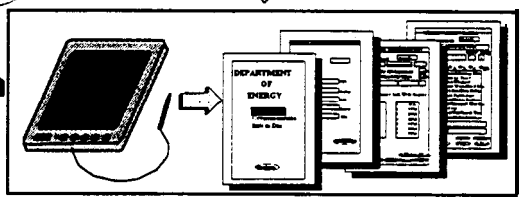
② 12 CAS SYSTEM MANUALS CONTAINING. DEFICIENCY & INSPECTION STANDARDS

CAS SYSTEM



CAIS DATA PROGRAM

④ CAIS DATA SUPPORT CAS INSPECTION ANALYSES



STATEOF-THE-ART HAND-HELD COMPUTER

③ HAND-HELD COMPUTER INSPECTION PROGRAM BASED ON 12 CAS MANUALS

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	0.04 SYSTEM
ROOFING	0.05 SYSTEM
INTERIOR FINISHES & CONSTRUCTION	0.06 SYSTEM
CONVEYING SYSTEMS	0.07 SYSTEM
MECHANICAL SYSTEMS	0.08 SYSTEM
ELECTRICAL SYSTEMS	0.09 SYSTEM
*PROD/LAB/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	THERMAL &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:

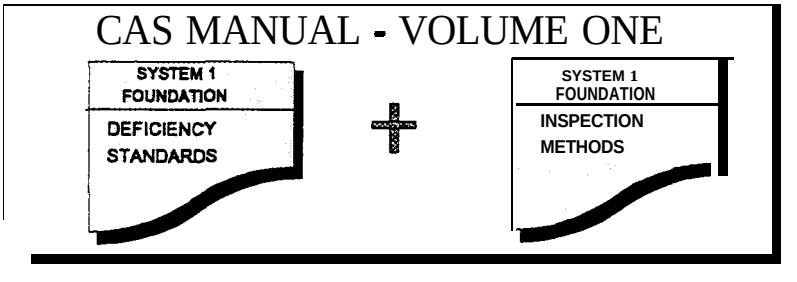
EXAMPLE: Roofing (CSI 07000)

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

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 Inspectron 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.

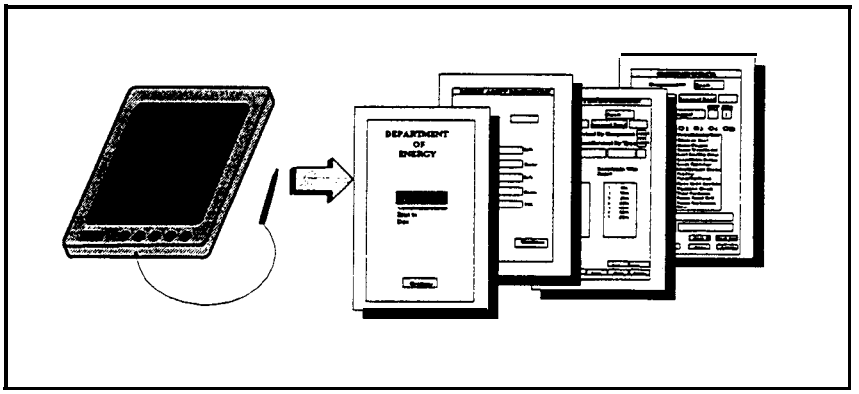
Appendix D Revisions Summary - All revisions listed in chronological sequence. The last revision listed will be the most current modification.

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.

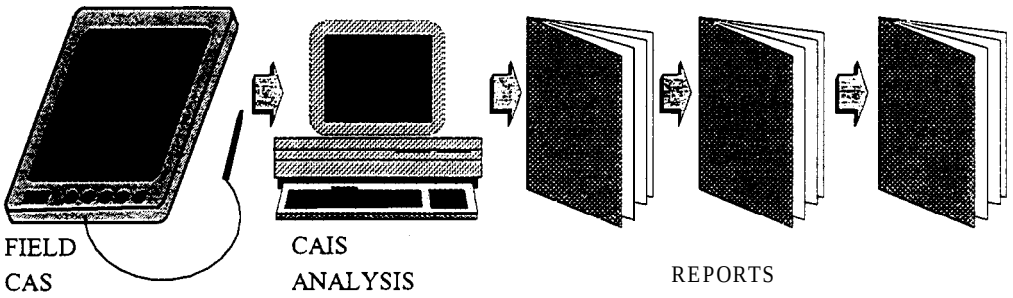
In short, the CAS process will be conducted in a carefully structured, "standardized" manner to ensure that the quality of raw inspection data is consistent throughout all DOE installations.

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:

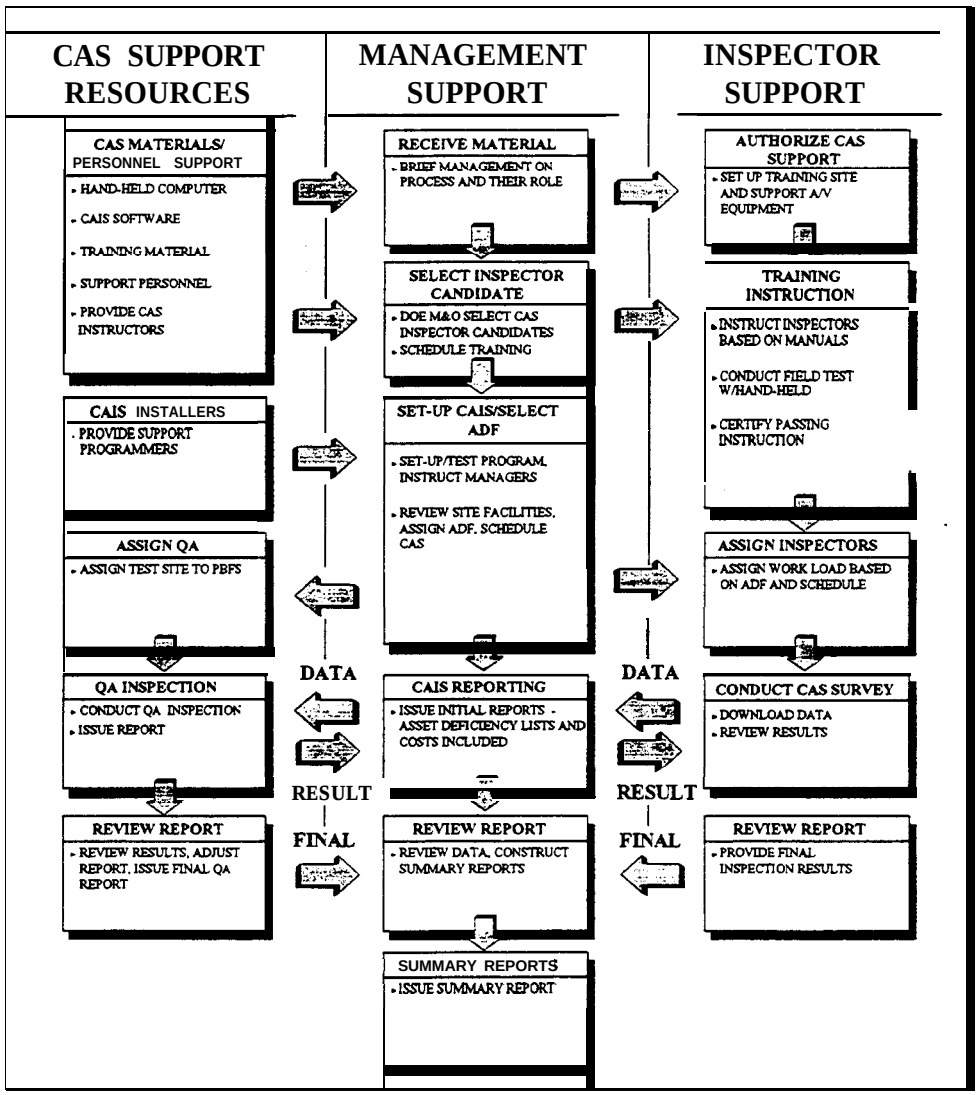
Costs to accomplish repairs and replacements are generated by the manipulation of field data in the CAIS program, which employs several methods including determining cost as a percentage of total replacement and/or direct entry of costs. (See Section 1, Subsection 1.1 for discussion of cost development.)

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.

INTRODUCTION

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:

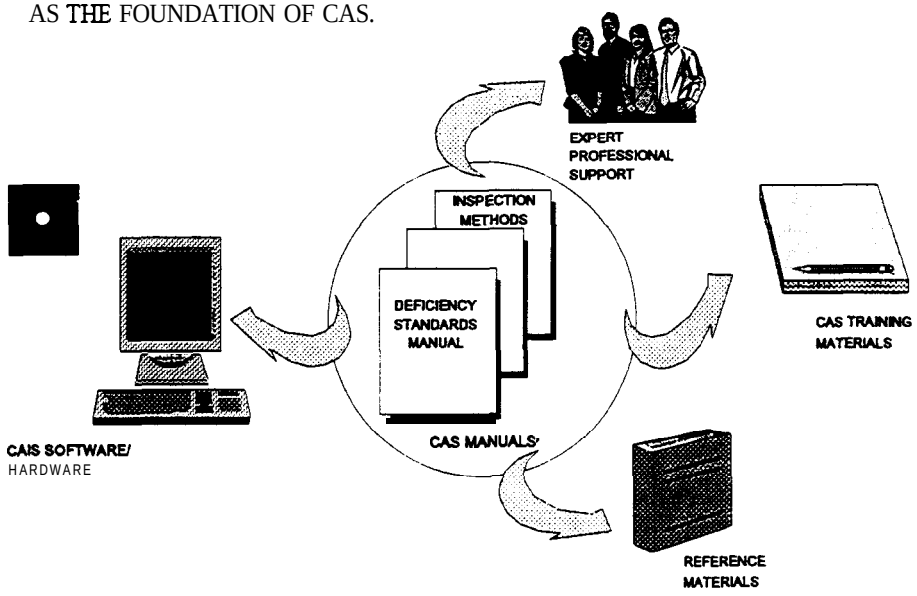
Without highly skilled, knowledgeable inspectors, the CAS Program will not succeed. The integrity of these inspectors and their expertise will ensure that the base data supporting the entire CAS process will be an accurate reflection of the condition of the DOE inventory of facilities and assets.

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:

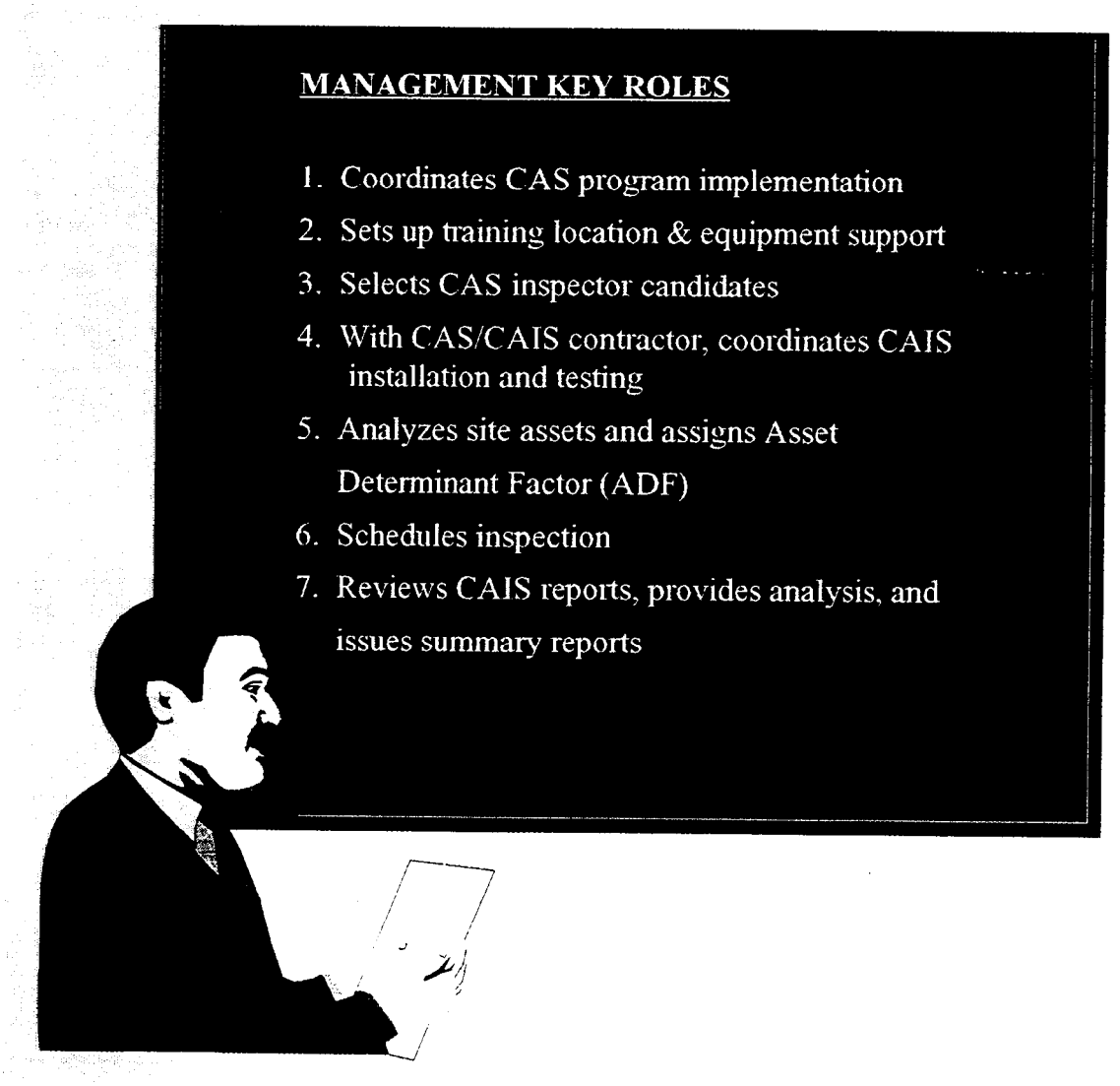
A key CAS Program element is the CAIS. Expert programmers will supervise the installation of the PC-based program and provide guidance and instruction for DOE M&O managers in using the system.

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.

INTRODUCTION

HOW IS CAS IMPLEMENTED?



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.

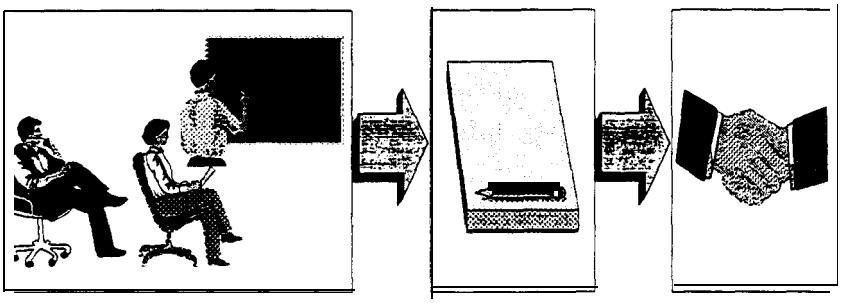
Report Analysis:

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.

HOW IS CAS IMPLEMENTED?

CAS INSPECTOR CERTIFICATION

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



CLASSROOM TRAINING

TESTING

CERTIFICATION

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 not 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.

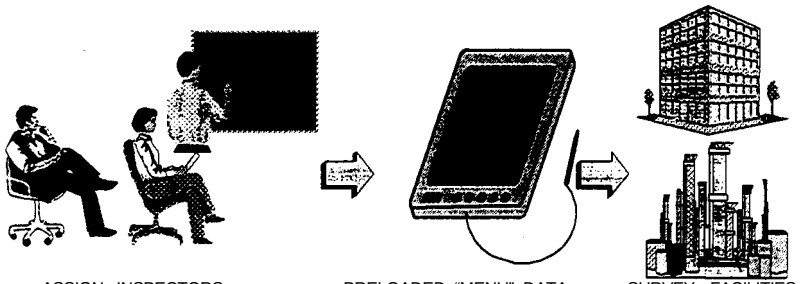
Certification Test:

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.

HOW IS CAS IMPLEMENTED?

THE SURVEY PROCESS

- CERTIFIED CAS INSPECTORS 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



ASSIGN INSPECTORS PRELOADED "MENU" DATA SURVEY FACILITIES

INTRODUCTION

HOW IS CAS IMPLEMENTED? • The Survev 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).

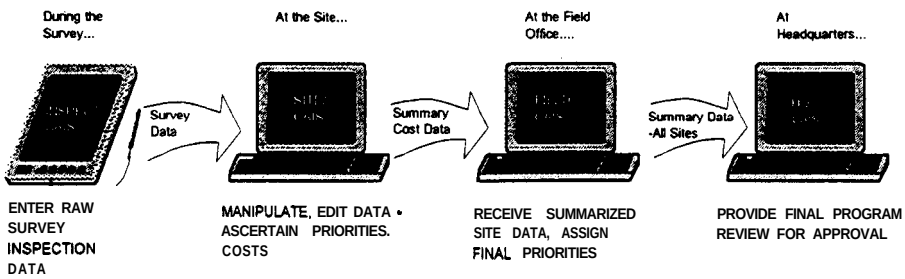
CAS **Report** Generated by CAIS:

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.

HOW IS CAS IMPLEMENTED?

SUMMARY REPORTS

- IMPROVE ACCURACY AND PROVIDE QA FOR 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.

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 comoonent level)[1]	ALL
2	Existing temporary asset (>3 years) program projected to last <5 vears	Limited CAS Inspection (base CAS - assembly level only)	ALL
	Asset decommissioned - "warm mothball" (maintained for future unidentified function)	ARCH(ext), MECH & ELEC (base CAS - assembly level or optional component level)'	0.04, 0.05, 0.08, 0.09
	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 comoonent level)[1]	0.05
6	Asset ARCHITECTURAL only	ARCH/STRUCTURAL inspection (base CAS - assembly level or optional component level)'	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)[1]	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)'	0.12
10	As develooed bv each site	As constructed by site[2]	As Required

GENERAL NOTES:

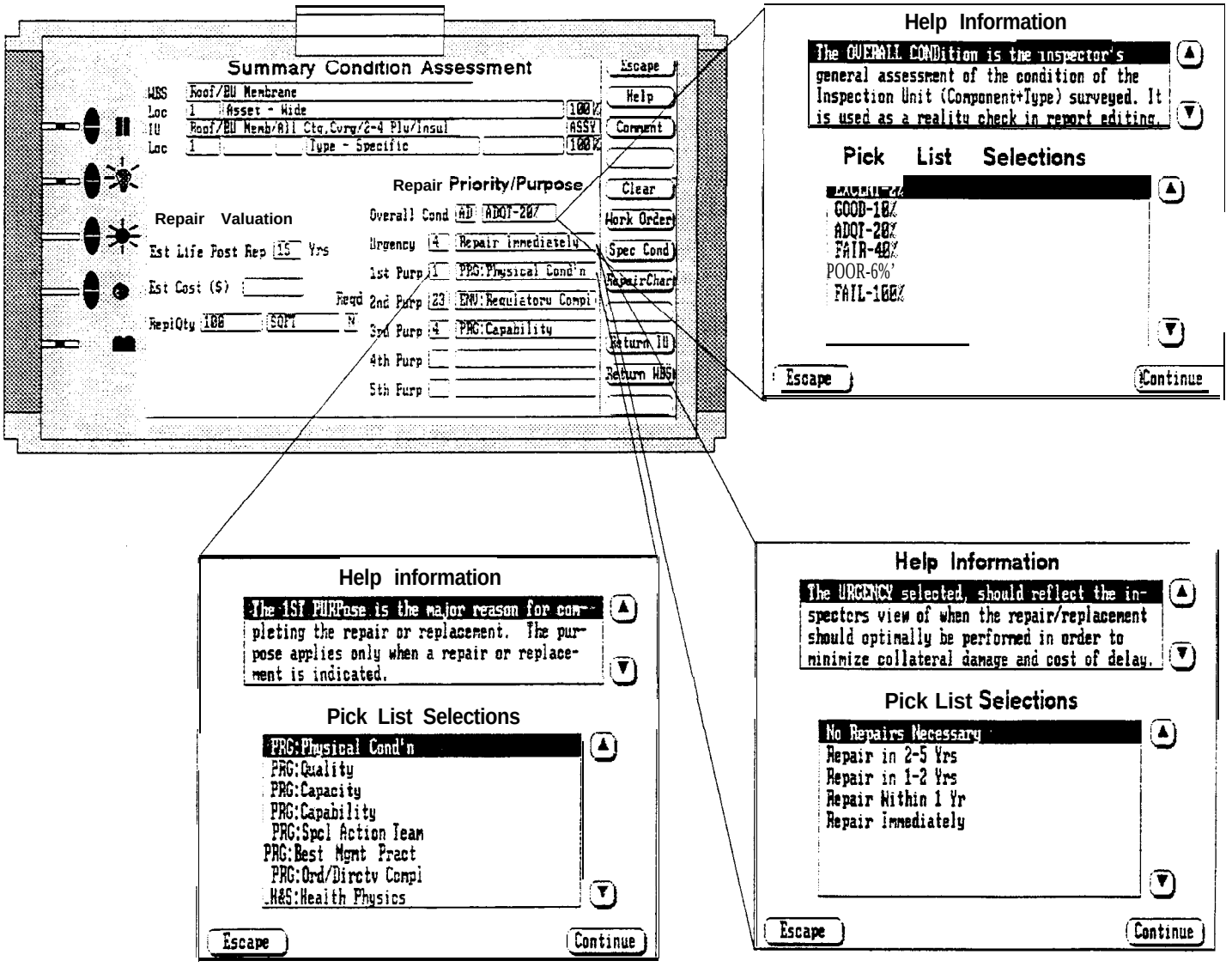
1. Survey may combine levels (eg., ADF #1, Systems 0.01-0.06, 0.11, and 0.12 Assembly level survey; 0.07, 0.08, and 0.09 Component level survey.)
2. Other surveys may be structured on an as-required by sites.
3. ADF values are guidelines only and systems mav be added to base ADF values as reauired.

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 all systems.
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 nonstandard 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 meats requirements; some corrective repair and/or preventive maintenance required at cost c 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.

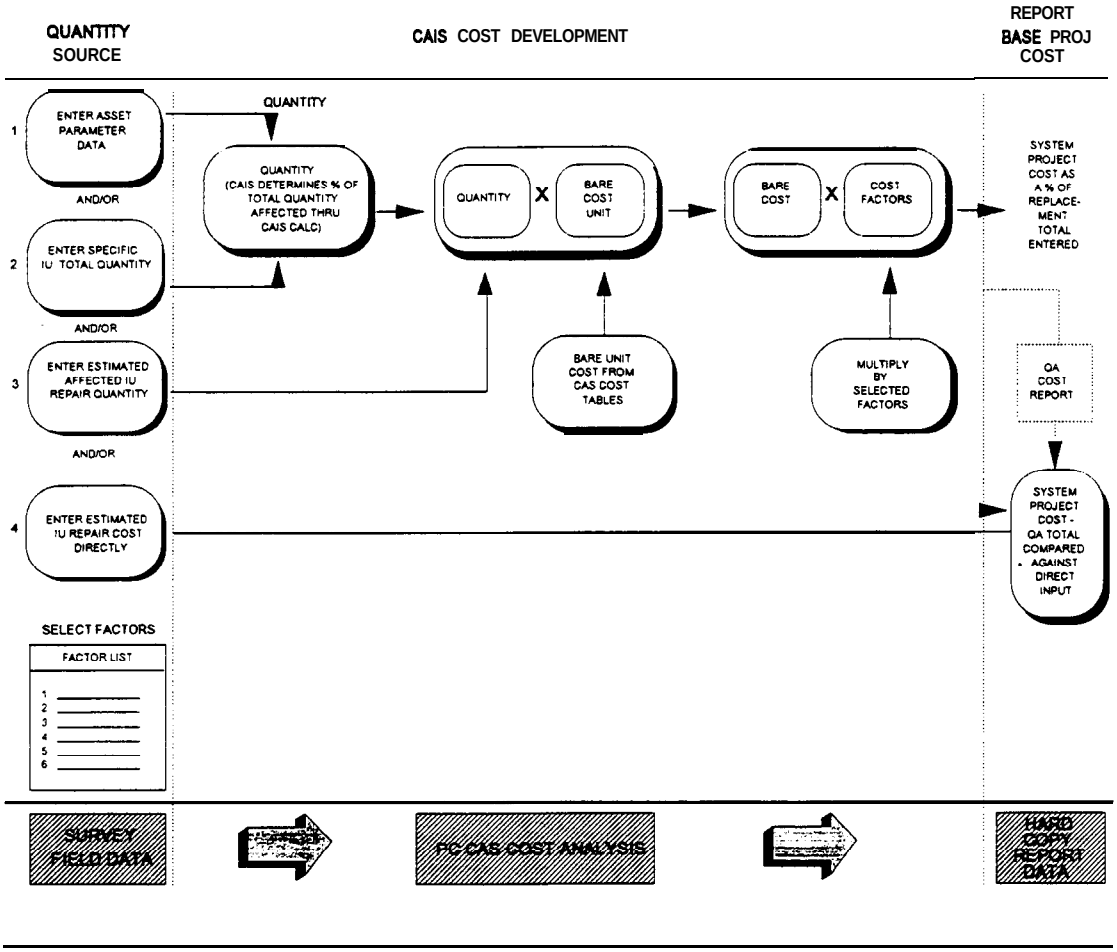
PURPOSE CODP	DEFINITION
P2	PRG: Capacity
H2	H&S: Industrial Safety
E2	ENV: Solid Waste Management
s4	S&S: Security
•	Partial list based on CAMP Order DOE 4330.4A dated 10-17-90.

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 vear.
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 Deriod: intearate 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

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

TOOLS

Tool and material requirements for the performance of inspections will vary from one system to another and will depend on the scope of the inspection.

Standard Inspection Methods are primarily non-invasive visual observations. Few tools or materials are required. However, rather than repeat each individually, the Guides refer to a class "Standard Inspection Tools - Conveying." The Inspector should carry these items with him at all times; additional tools or materials may be required and will be identified individually on the Guide Sheets.

STANDARD TOOL GROUP (Conveying)

- Flashlight
- Mirror
- Rags
- Small flat screwdriver
- Small Phillips screwdriver

STANDARD TOOL GROUP (Additional)

- Acoustical Analyzer
- InfraScope
- Moisture Detector
- Sample Bottles for Chemical Analysis
- Shock Pulse Monitor
- Stroboscope
- Ultrasonic Analyzer
- Vibration Analyzer

NON-STANDARD INSPECTIONS

Non-Standard Inspection Methods are invasive visual observations with many tests. Many tools and materials are required. However, rather than repeat each individually, the Guides refer to a class "Non-Standard Inspection Tools - Conveying." Additional tools or materials may be required and will be identified individually on the Guide Sheets.

NON-STANDARD TOOL GROUP (All Trades)

- 12 foot measuring tape
- 3/8 inch drive socket set and rachet
- Assorted center punches, drift punches, steel chisel
- Ball peen hammer
- Crescent wrenches 4 and 8 inches
- Emery cloth
- Extension cords and inspection lights
- File
- Grease guns and oilers
- Hack saw and spare blades
- Open and box end wrenches 1/4 inch and 3/8 inch
- Pipe wrenches to 14 inches
- Pliers - vise grip (2), slip joint, needlenose, diagonal, cutting pliers, side cutters
- Pocket knife
- Small level and square
- Small set of Allen wrenches
- Standard and phillips head screwdrivers - various sizes
- Various cleaning tools - brushes, scrapers, etc.
- Wire brush

GUIDE SHEET TOOL & MATERIAL LISTING

TOOLS (Continued)

Additional **Non-Standard** Inspection Tools - Mechanical - (Plumbing)

- 3/4 inch socket set
- Crescent wrenches to 14 inch
- Flaring tools
- Packing kit and packing
- Pipe wrenches to 24 inch
- Small acetylene outfit
- Tubing cutters

Other Tools & Materials for Non-Standard inspections

- Displacement gauges
- Dye penetrants
- Moisture detector
- Sample bottle for chemical analysis

END OF SUBSECTION

TESTING METHODS

GENERAL

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 will not be required on all assets. Where indicated, results will be recorded in the Data Collection Method.

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 versus Non-Standard based on techniques employed.

The 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 leak detection, vibration analysis, and stroboscopic observations.

The 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 dye penetrant tests for gearing and smoke testing a duct.

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

- Acoustic Emission
- Acoustic Resonance
- Chemical Analysis
- Shock Pulse Monitoring
- Stroboscopes
- Thermography
- Ultrasonic Testing
- Velocity/Volume Flow Meters (Mechanical)
- Vibration Analysis

STANDARD TEST DESCRIPTION

Acoustic Emission

Acoustic waves are generated at weak points in a structure under stress. This may result from the propagation of the fault itself (cracking of metal or concrete) or the expansion of a liquid or gas through the fault.

Sonic detectors may be used to monitor these emissions and locate the fault. Although useful in identifying cracks and voids, it is best used to identify leaks.

Acoustic Resonance

Applying energy to a structure (single impact or cyclic) will establish a resonant vibration in the structure. The resonant frequency emissions will differ in areas with faults. Sonic detectors may be used to monitor these emissions and locate the fault. This method is primarily used to identify cracks and voids.

TESTING METHODS

STANDARD TEST DESCRIPTION (Continued)

Chemical Analysis

Most fluids and gases used in mechanical systems have a prescribed chemical content. Routine sampling of actual content and analysis through visual, chemical, and/or spectrometric means can identify improper chemical maintenance levels, wear products, and contamination. This method is excellent analyzing piping systems, bearings, and gears.

Shock Pulse Monitoring

Bearings transmit very weak mechanical shock waves throughout their housings as they go through each compression cycle. Ultrasonic transducers can be calibrated to sense these waves and differentiate them from other equipment vibrations. Analyzing the monitor output allows operator to determine bearing condition and remaining useful life.

Stroboscopes

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

Thermography

Thermal radiation is emitted by all bodies in proportion to body temperature. 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.

Ultrasonic Testing

Ultrasonic emissions are attenuated by materials during transmission and are reflected by material interfaces. A generated pulse echo can be monitored to identify location of interfaces. Measuring the velocity and attenuation of the pulse can be used to determine characteristics of the material. This method is commonly used to identify flaws in metal structures.

Velocity/Volume Flow Meters (Mechanical)

Various piping configurations (pitot tubes) can be inserted into a gas/fluid stream to determine static and velocity heads produced by the media. Using known piping or duct characteristics, these data is readily converted to velocity and volumetric flow rates. Many devices currently on the market are portable and contain parameter processors to allow immediate readout. While primarily used to balance water distribution systems and process monitoring, these devices can be used to ascertain restrictions in distribution systems and piping corrosion.

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. By measuring and recording these parameters at key points on equipment, an equipment 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.

TESTING METHODS

NON-STANDARD TEST METHODS

- Borescopic Inspections
- Displacement Gauges
- Dye Penetrants
- Television Inspection

NON-STANDARD TEST DESCRIPTION

Borescopic Inspections

Using a combination of lens and fiber optic cables, light can be directed to areas otherwise inaccessible to the human eye. The reflected image is usually magnified by the borescope, enhancing detection capabilities. This is an excellent tool for small tank and pipe inspections, internals of engines, pumps, etc.

Displacement Gauges

This is a generic term used to cover a group of devices used to measure the relative motion between two points. These devices employ electro-optical equipment for large structures and mechanical or electrical gauges for closely spaced points. They are primarily used in mechanical testing for identifying warpage, shaft distortion, bearing wear, etc.

Dye Penetrants

Certain dyes have the ability to penetrate small surface cracks in materials. Examination, in some cases under ultraviolet light, is used to identify faults not otherwise visible. This is particularly useful for metals that have been stressed.

Television Inspections

Using remotely operated cameras and lighting systems, the user can scan and record inaccessible surfaces. This is an excellent tool for large tanks and underground pipe inspections.

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 the 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.

TABLE ONE

Assembly/Component	Year One	Year Two	Year Three	Year Five	Year Ten
General Components: Blowers			S	NS	
Drive Assemblies		S		NS	
Elevators, Traction	S		NS		
Elevators, Hydraulic	S		NS		
Equipment Controls			S	NS	
Escalators		S		NS	
Hydraulic Plant		S		NS	
Motor-Generators				S	NS
Motors				S	NS
Pipe & Accessories				S	NS
Pneumatic Ductwork & Accessories				S	NS

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

INSPECTION FREQUENCY

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 manufacturer product specifications and tests that determine the average "outside" time parameter a given System Assembly/Component will last. The Standard Design Life Tables that follows lists 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
0.07 CONVEYING SYSTEM		
Passenger elevators - high speed, automatic (25 hp; 75% efficiency)	20	100
Passenger elevators - hydraulic (25 hp; 75% efficiency)	20	100
Freight elevators - hydraulic (35 hp; 75% efficiency)	20	100
Single-width (32") escalator ($7^1/_2$ hp; 75% efficiency)	15	100
Moving walk (4' 0" wide) (4 hp; 75% efficiency)	5	25
Hand-operated dumbwaiter, 1000 lb	20.	100
Electric-operated dumbwaiter, 5000 lb (5 hp; 75% efficiency)	20	100

END OF SUBSECTION

SYSTEM WORK BREAKDOWN STRUCTURE

GENERAL

Facilities are composed of various assemblies/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; 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

0.07 SYSTEM - CONVEYING

0.07.01	ELEVATORS
0.07.01 .01	Hydraulic Elevator
0.07.01.02	Traction Elevator
0.07.01.03	Escalators
0.07.02	SPECIAL CONVEYORS
0.07.02.01	Pneumatic Tube Systems

SYSTEM WORK BREAKDOWN STRUCTURE

WBS LEVEL TABLE		
0.05	LML 1	0.08
ROOFING	SYSTEM	MECHANICAL
0.05.01	LML 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	LMLS	0.08.01.01.01.01
NOT USED	TYPE	3/4" DIA. COPPER

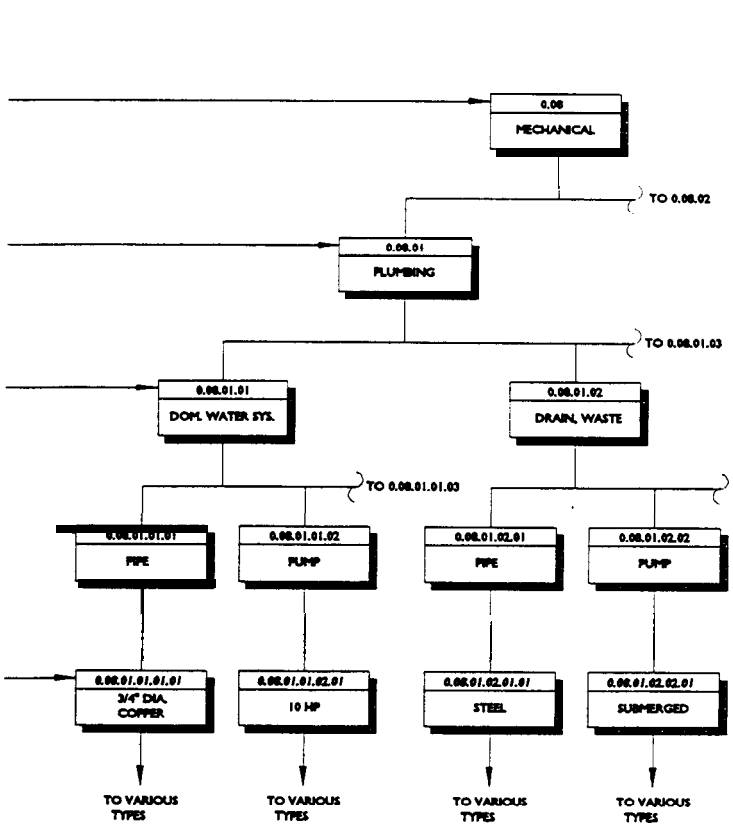


FIG. 1

SYSTEM WORK BREAKDOWN STRUCTURE

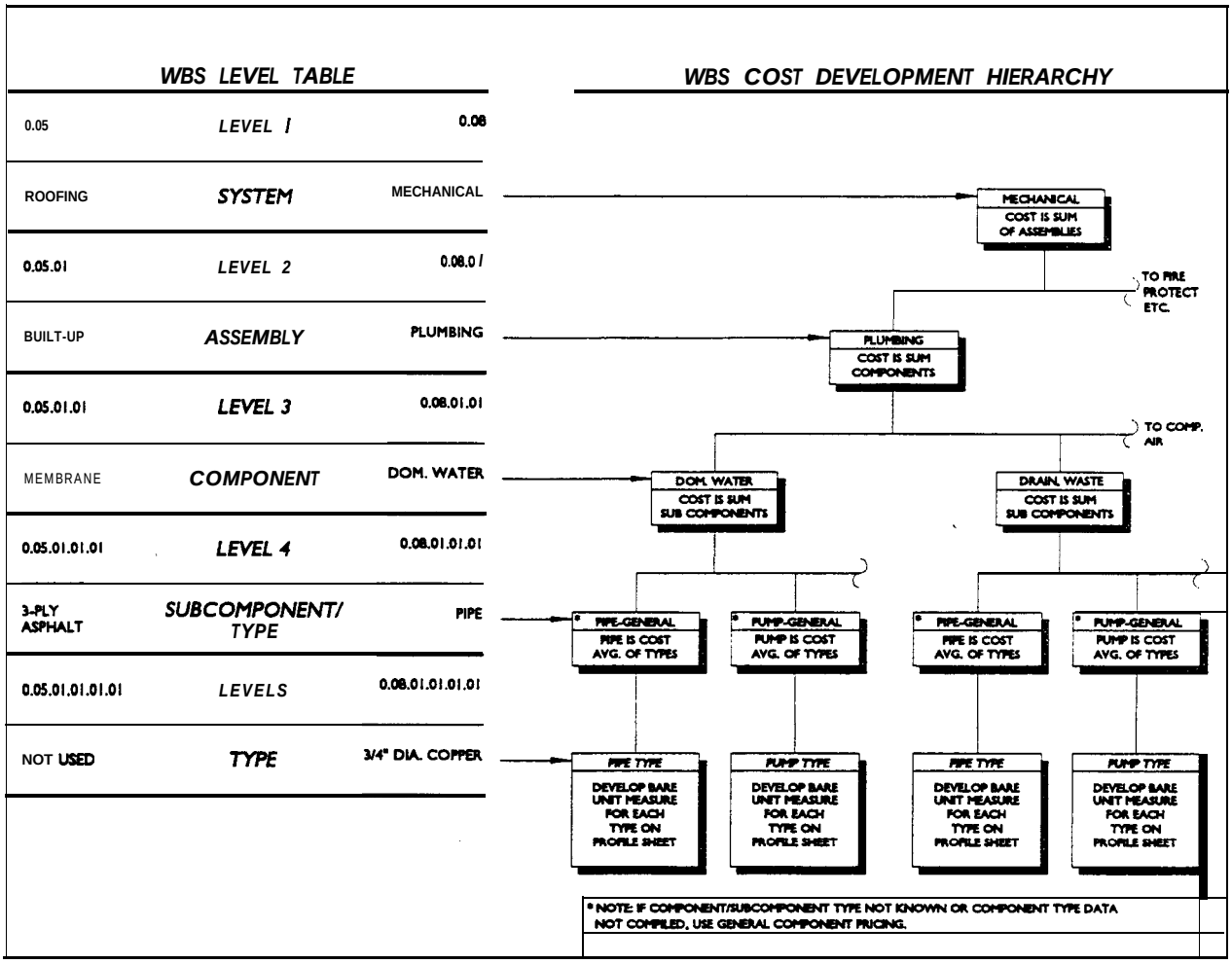


FIG. 2

END OF SUBSECTION

0.07.01 **.01** HYDRAULIC ELEVATORS (CSI 14240)

DESCRIPTION

Hydraulic Elevators provide a means for conveyance between building or structure elevations. They use hydraulic power to raise (push up) and lower a cab. Unlike traction elevators, lift cabling is generally not required. These units are primarily used for set-vice or freight transport because of their level limitations (typically two to six floors), although some small office buildings use them.

This system includes the elevator cab, lift cylinder assembly, miscellaneous hoistway apparatus, hydraulic unit (tank, pump and motor), instrumentation, equipment panels and controls, and related pipe, fittings, instrumentation, and valves.

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Elevator Cabs (CSI 14240)

Cabs for hydraulic units vary with the service they provide. They are classified as either passenger, service, or freight.

When strictly used for freight, they are generally made of heavy-gauge steel and have a single panel or screened, vertical lift door. The door is typically manually operated but counter-weighted to facilitate opening. Lighting is generally a single fixture.

Passenger service cabs are generally more elaborate. The interior is typically lined with aesthetically appealing wall covering, carpet, or tiles and brightened with decorative, multi-fixture lighting. Doors are typically double panel, horizontally opened units.

Service elevators combine the passenger and light freight characteristics.

All cabs have some alignment device attached (guide shoes or rollers) that slides over rails in the hoistway, maintaining vertical alignment in the shaft.

Lift Cylinder Assembly (CSI 14240)

The lift cylinder assembly is a simple cylinder and piston arrangement attached to the underside of the cab. High pressure oil from the hydraulic system is pumped under a piston to raise the cab, and this slowly released to a holding tank to lower the cab. Hydraulic controllers allow for cab positioning in the hoistway.

The piston is sometimes telescopic, allowing for a more compact assembly in the bottom of the hoistvvay. Hydraulic seals are used at the piston/cylinder interface and at each section in the telescope.

The cylinder itself is normally mounted in sand and concrete in the floor of the hoistway. The cylinder is topped with buffers (typically springs) to cushion cab descent.

Miscellaneous **Hoistway** Apparatus (CSI 14240)

There are three major assemblies in the hoistway: guide rails, hoistway doors, and control switches (discussed under “Equipment Controls and Panels”).

Guide rails are mounted to the hoist-way surface with brackets. They are typically installed on either side of the cab to control vertical alignment.

Hoistway doors are employed at each level access. They are primarily safety devices. On freight elevators, the hoistway doors are typically double panel, vertical motion units. The lower half drops below floor level while the upper half raises sufficiently to allow access by a lift truck or similar freight dolly.

On passenger units, the doors are similar to the cab doors: double panel, horizontal motion, and motorized for ease of operation.

0.07.01 .OI HYDRAULIC ELEVATORS (CSI 14240)

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS (Continued)

Hydraulic lank (CSI 15175)

Tanks are used to collect or store the hydraulic fluid. They should have sufficient capacity to provide for adequate fluid reserve and must be adequately covered to prevent foreign materials from entering the system. Tanks should be vented to atmosphere.

Tanks should be located and supported so that the entire exterior is accessible for periodic maintenance and repair. They must provide a means of checking the fluid level without removing the cover or any other part. Tanks must be equipped with a means for internal inspection, conforming to the requirements of ASME/ANSI 17.1 Rule 304.3g.

Pumps (CSI 15160)

Pumps are used to develop the fluid pressure to raise the elevator car and its load. Positive displacement pumps are typically used in hydraulic systems. Each pump or group of pumps must be equipped with a pump relief valve. No relief valve is required for centrifugal pumps driven by induction motors if the shutoff, or maximum pressure of the pump can develop and is not greater than 135 percent of the working pressure at the pump.

Pumps should be arranged to provide easy access for periodic maintenance and repair.

Motors (CSI 15170)

Most motors for hydraulic pumps are open AC induction units operating in a relatively narrow speed range.

Instrumentation (CSI 15130)

A main line pressure gauge must indicate correct pressure to not less than 1.5 times the pressure setting of the relief valve. Pressure gauges are typically provided at the suction and discharge of each pump and on the tank. They should be installed by pipe and fittings in such a manner that they cannot be isolated from the hydraulic system except by the stop cock. The stop cock shall have a "T" or lever handle set in line with the direction of flow through the valve when open.

Tanks usually have one or more gauge glasses attached directly to the tank and are equipped with automatic shutoff in case of glass failure.

Temperature gauges are frequently provided on the main hydraulic sump

Equipment Controls & Panels (CSI 15950)

Control panels are typically provided in each cab and on the main hydraulic unit.

The cab control panel usually encloses the floor selection switches, lighting control, manual override switches, and any alarms associated with the cab itself.

The hoistway doors will normally employ safety devices such as photocells and/or safety strips to detect door blockage.

The hydraulic control panel encloses the motor controller, limit relays, and overload devices.

Most units employ a typical motor starter and disconnect for the standard AC motor.

Hydraulic tanks are typically equipped with a liquid level controller that will render the elevator inoperative if the level in the tank falls below the minimum permissible level.

The hoistway and cab contains many equipment controls for positioning and safety: floor stop and limit switches, creepage and leveling switch cams, and car gate switches. These are interlocked to prevent operation with open doors and gates and to prevent door opening unless the car is properly positioned.

0.07.01 .OI HYDRAULIC ELEVATORS (CSI 14240)

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Equipment Controls 8 Panels (CSI 15950) (Continued)

The hoistway switches also operate hydraulic control valves to raise and lower the main piston for positioning purposes.

Some units will have temperature sensors to limit unit operation.

Piping & Fittings (CSI 15090)

Piping and fittings provide hydraulic fluid distribution. The distribution network is typically a single pipe system installed above ground. If piping is installed below ground, it should be provided with corrosion protection. All pipe connections are welded, grooved, threaded, or bolted flange type.

Flexible connections are typically pump suction and discharge to mihimize vibration effects. Flexible hose and fitting assemblies should not be installed in the hoistway nor project into or through any walls.

Strainers are typically provided at the suction side of the pump. They are used to protect the pumps, cylinder surfaces, and metering devices.

All fittings should be compatible with the type of piping materials used in the system to minimize corrosion induced by galvanic action.

Dielectric Unions should be provided with appropriate end connections for the pipe materials in which installed (screwed, soldered, or flanged), to effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion.

Flanges or escutcheons should be fitted over pipe penetrations through walls in public areas.

Valves (CSI 15100)

Regulating valves are also used to control the flow of hydraulic fluid to and from the'main cylinder and thereby control cab speed and positioning. These are typically operated by the control system. However, a manually operated valve, located on or adjacent to control valves, should be installed to permit lowering in emergencies.

Manual valves are primarily used to permit isolation and drainage of units and other components for maintenance.

Each pump or group of pumps must have a pump relief valve installed between the pump and the check valve. The valve must be installed in such a manner that it cannot be isolated from the hydraulic system. The valve must be set to relieve at a pressure less than 125 percent of working pressure and must be of sufficient size to pass the maximum rated capacity of the pump without raising system pressure more than 20 percent above the valve relief pressure.

A check valve must be installed that will hold the elevator car and its load at any point when the pump stops or the system pressure drops below minimum operating pressure. A vacuum relief valve is typically installed on the pressure tank to prevent tank collapse.

All valves should be installed in accessible locations, properly tagged, and protected from damage.

OTHER RELATED COMPONENTS

See the following subsections for related components:

0.07.01.02 Traction Elevators 2.1.2-I

NOTE: Similar parts are addressed in separate sections for individual piping system sections of CSI Division 15.

0.07.01 .OI HYDRAULIC ELEVATORS (CSI 142401

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DEFICIENCY FACTORS
0.07.01 .01 HYDRAULIC ELEVATORS (CSI 14240)

PROBABLE FAILURE POINTS

- Severe cab damage due to normal wear and tear, vandalism.
- Leakage in cylinder or piping due to corrosion, seal wear.
- Pump or motor burnout due to overloading.

SYSTEM ASSEMBLY/DEFICIENCIES

Elevator Cabs	
Doors Inoperative:	Control failure, defective wiring.
Severe Physical Damage:	Cracks, distortion due to physical abuse, fatigue.
Severe Corrosion:	Aging, lack of maintenance.
Lift Cylinder Assembly	
Inoperative:	Control failure, pipe or cylinder leakage, defective wiring.
Cylinder or Piston Corrosion:	Normal aging, poor maintenance.
Leakage:	Damaged seals, normal wear, poor maintenance.
Damage:	Cracks, distortion due to physical abuse, fatigue.
Loose or Missing Fasteners:	Poor maintenance, wear.
Miscellaneous Hoistway Apparatus	
Guide Rails Worn:	Normal wear and tear, poor maintenance.
Hoistway Doors Inoperative:	Normal wear and tear, poor maintenance, vandalism.
Hoistway Doors Damaged:	Normal wear and tear, abuse.
Loose or Missing Fasteners:	Poor maintenance, wear.
Hydraulic Tank	
Severe Corrosion:	Poor maintenance.
Leakage:	Corrosion, physical damage, inadequate support, improper joining.
Pump	
Missing:	Taken out for service or repair, not returned.
Inoperative, Won't Turn:	Failed bearings, locked impeller.
Excessive Noise:	Wear, imbalance, misalignment.
Excessive Vibration:	Wear, imbalance, misalignment.
Severe Corrosion:	Aging, lack of maintenance.
Seal Leakage:	Worn mechanical seal, defective packing.
Defective Bearing:	Age, normal wear, improper lubrication.
Excessive Load:	Bearing wear, misalignment.
Inadequate Capacity:	Low pressure, low flow caused by wear.

DEFICIENCY FACTORS
0.07.01 .01 HYDRAULIC ELEVATORS (CSI 14240)

SYSTEM ASSEMBLIES/DEFICIENCIES

Motors

Missing:	Taken out for service, not returned.
Inoperative:	Damaged bearings, corrosion.
Excessive Noise, Vibration:	Bearing wear, fan imbalance, misalignment.
Excessive Corrosion:	Poor maintenance.
Damaged :	Abuse, poor maintenance, stress.
Defective Coupling:	Age, normal wear, improper lubrication.
Defective Bearings:	Age, normal wear, improper lubrication.

Instrumentation

Missing:	Taken out for service or repair and not replaced.
Inoperative:	Failed internal mechanism, corrosion, loss of sensing medium.
Inaccurate:	Wear, corrosion, imbalance in internal components, miscalibration.
Illegible:	Corrosion, physical damage.

Equipment Controls & Panels

Motor Starter Inoperative:	Linkage wear, open coil, overloading.
Control Housing Corrosion:	Aging, poor maintenance.
Bypassed Controls:	Defective or inaccurate.
Damaged Wiring:	Frayed, burned.
Relays Pitted or Burned:	Normal wear, overloading.

Piping & Fittings

Leakage:	Corrosion, physical damage, inadequate support, improper joining.
Excessive Corrosion:	Normal aging, poor maintenance.
Physical Damage:	Abuse, stress, improper maintenance.
Strainers Inoperative:	Corrosion, abuse.

Valves

Leakage:	Improper packing, corrosion.
Severe Corrosion:	Aging, poor maintenance, leakage.
Physical Damage:	Abuse, stress.
Inoperative:	Corrosion, damaged operating mechanism.
Poor Regulation:	Worn seat/disc, defective sensing mechanism, blocked lines.
Inadequate Seating:	Worn seat/disc, check valve frozen by corrosion.

DEFICIENCY FACTORS
0.07.01 .01 HYDRAULIC ELEVATORS (CSI 142401

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DEFICIENCY FACTORS
0.07.01 .01 HYDRAULIC ELEVATORS (CSI 14240)

END OF SUBSECTION

07.01.02 TRACTION ELEVATORS (CSI 14210)

DESCRIPTION

Traction Elevators provide a means for conveyance between building or structure elevations. They use motor-driven sheaves, cables, and counterweights to raise and lower a cab. Primarily used for passenger service, these units are more sophisticated than hydraulic units, employing additional control equipment to provide smoother acceleration and faster transportation.

This system includes the elevator cab, a cable, counterweight assembly, a drive assembly, miscellaneous hoistway apparatus, a motor-generator set, and equipment panels and controls.

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Elevator Cabs (CSI 14210)

Cabs for traction units vary with the service they provide. They are classified as either passenger, service, or freight.

Cabs for passenger service are generally elaborate. They are made of light metal supported on a structural frame. The cab interior is typically lined with aesthetically appealing wall covering, carpet, or tiles, and brightened with decorative, multi-fixture lighting. Kick plates and hand rails are usually provided. Ventilation is also provided to exhaust cab air. Doors in passenger cabs are typically double panel, horizontally opened units. Panels are provided to indicate floor level.

Units strictly used for freight are fairly simple. They are generally made of heavy-gauge steel and employ a single panel or screen, vertical lift door. They generally have no interior finish or fittings. The door is typically manually operated, but counter-weighted to facilitate door opening. Lighting is generally a single fixture.

Service elevators combine the passenger and light freight characteristics.

All cabs have some alignment device attached (guide shoes or rollers) that slides over rails in the hoistway, maintaining vertical alignment in the shaft.

Cables & Counter Weight Assembly (CSI 14210)

Multiple cables are used to lift and lower the cab. They are attached on one end to sockets on the top of the cab and on the other end to a set of counterweights. The cables pass over the main drive sheave, which provides the driving force to raise the cab.

The counterweights are generally cast iron plates mounted in a rack. Because they serve to counter the weight of the cab itself, very little force is actually required to move the cab.

Variations in the above cabling descriptions can be found using additional pulleys and threading arrangements. These include 2:1 roping, double wrapping, and underslung roping.

Load compensation cables are sometimes used to offset the effect of rope (cable) weight in large buildings. These are attached to the bottom of the cab and to the lower end of the counterweight and pass through a load compensator in the elevator pit.

Like the cabs, the counterweights have an alignment device attached (guide shoes or rollers) that slides over rails in the hoistway, maintaining vertical alignment in the shaft.

Drive Assembly (CSI 14210)

Drive assemblies are classified as geared or gearless.

Gearless drives are used in medium-to-high-speed operations. The main drive assembly in a gearless unit consists of the drive motor, drive sheaves, and a brake mounted generally on a common shaft and supported on a single frame.

07.01.02 TRACTION ELEVATORS (CSI 142101

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Drive Assembly (CSI 14210) (Continued)

Geared machines are used for slow-speed (less than 350 fpm) operations. In a geared drive, the motor, brake assembly, and a worm gear are mounted on one shaft, and a helix gear and sheave are mounted on another.

The drive motor on a gearless machine is always a DC unit and may be either open or closed.

However, a geared machine may be AC or DC. For smooth acceleration and general speed control, a DC unit is preferred in most instances.

The brake is usually a solenoid-operated drum brake.

Miscellaneous **Hoistway** Apparatus (CSI 14210)

There are five major assemblies in the hoistway: guide rails, hoistway doors, the governor, buffers, and control switches (discussed under "Equipment Controls and Panels").

Guide rails are mounted to the hoistway surface with brackets. They are typically installed on either side of the cab to control vertical alignment.

Hoist-way doors are employed at each level access. They are primarily safety devices. On freight elevators, the hoistway doors are typically double panel, vertical motion units. The lower half drops below floor level while the upper half raises sufficiently to allow access by a lift truck or similar freight dolly.

On passenger units, the doors are similar to the cab doors: double panel, horizontal motion, and motorized for ease of operation.

Various governor assemblies are used to monitor and limit cab speed. A single cable, attached to the cab and passed over a sheave, is frequently used to activate a set of flyweights. Excessive cab speed causes the flyweights to trip an electrical switch, shutting off the drive motor and engage the braking circuit. If car motion continues to increase, a set of jaws mounted on the cab will engage the guide rails, bringing the cab to a gradual stop.

Buffers are installed in the elevator pit to cushion cab stopping if it overtravels the lower limits. These units are either springs or oil-filled dampers.

Motor Generator Set (CSI 14210)

All gearless machines run off of DC power and require a motor generator (M-G) set to provide the conversion. By preference, most geared machines also use DC power. The M-G set is normally located in the elevator equipment room (generally a separate penthouse).

Equipment Controls & Panels (CSI 15950)

Control panels are typically provided in each cab, at each service level and on the main unit in the machine room. The cab control panel usually encloses the floor selection switches, lighting control, manual override switches and any alarms associated with the cab itself. Modern units also include a phone for emergency communications.

Selector switches and indicators are located at each service level to initiate a service request and indicate cab status.

The hoistway doors will normally employ safety devices such as photocells and/or safety strips to detect door blockage.

The main control panel encloses the motor controller, limit relays, and overload devices. Where multiple cars are included, scheduling (dispatching) controls are also included.

07.01.02 TRACTION ELEVATORS (CSI 14210)

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Equipment Controls & Panels (CSI 15950) (Continued)

The hoistway and cab contains many equipment controls for positioning and safety: floor stop and limit switches, creepage and leveling switch cams and car gate switches. These are interlocked to prevent operation with open doors and gates and to prevent door opening unless the car is properly positioned.

OTHER RELATED COMPONENTS

See the following subsections for related components:

NOTE: Similar parts are addressed in separate sections for individual piping system sections of CSI Division 15.

07.01.02 TRACTION ELEVATORS (CSI 14210)

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DEFICIENCY FACTORS
07.01.02 TRACTION ELEVATORS (CSI 14210)

PROBABLE FAILURE POINTS

- Severe cab damage due to normal wear and tear, vandalism.
- Excessive cabling wear due to improper lubrication, poor maintenance.
- Motor burnout due to overloading.

SYSTEM ASSEMBLY/DEFICIENCIES

Elevator Cabs

Doors Inoperative:	Control failure, defective wiring.
Severe Physical Damage:	Cracks, distortion due to physical abuse, fatigue.
Severe Corrosion:	Aging, lack of maintenance.

Cabling & Counterweights

Loose or Missing Fasteners:	Poor maintenance, wear.
Excessive Lift Cable Wear:	Manufacturing defects, improper lubrication.
Lift Cable Damage:	Splits, fraying, distortion due to physical abuse, fatigue.
Counterweight Guides/Rollers Worn:	Normal aging, poor maintenance.
Compensator Wear or Damage:	Normal wear and tear.

Drive Assembly

Missing:	Taken out for service or repair, not returned.
Inoperative, Won't Turn:	Failed bearings, worn or damaged gears.
Sheave Damaged:	Cracked, fatigued by excessive load.
Excessive Noise:	Wear, imbalance, misalignment.
Excessive Vibration:	Wear, imbalance, misalignment.
Severe Corrosion:	Aging, lack of maintenance.
Seal Leakage:	Worn mechanical seal, defective packing.
Defective Bearing:	Age, normal wear, improper lubrication.
Brake Drum Wear or Damage:	Age, normal wear, improper adjustment.

Miscellaneous Hoistway Apparatus

Guide Rails Worn:	Normal wear and tear, poor maintenance.
Loose or Missing Fasteners:	Poor maintenance, wear.
Excessive Governor Cable Wear:	Manufacturing defects, improper lubrication.
Governor Cable Damage:	Splits, fraying, distortion due to physical abuse, fatigue.
Rail Brake Worn:	Improper governor adjustment, defective speed controls
Hoistway Doors Inoperative:	Normal wear and tear, poor maintenance, vandalism.
Hoistway Doors Damaged:	Normal wear and tear, abuse.
Loose or Missing Fasteners:	Poor maintenance, wear.

DEFICIENCY FACTORS
07.01.02 TRACTION ELEVATORS (CSI 14210)

SYSTEM ASSEMBLIES/DEFICIENCIES (Continued)

Motor Generator	
Missing:	Taken out for service, not returned.
Inoperative:	Damaged bearings, corrosion.
Excessive Noise, Vibration:	Bearing wear, fan imbalance, misalignment.
Excessive Corrosion:	Poor maintenance.
Damaged:	Abuse, poor maintenance, stress.
Defective Bearings:	Age, normal wear, improper lubrication.
Equipment Controls & Panels	
Control Housing Corrosion:	Aging, poor maintenance.
Bypassed Controls:	Defective or inaccurate.
Damaged Wiring:	Frayed, burned.
Relays Pitted or Burned:	Normal wear, overloading.

END OF SUBSECTION

0.07.01.03 ESCALATORS (CSI 14310)

DESCRIPTION

Escalators provide a means for conveyance between building elevations. They use motor-driven sprockets and chains to continuously drive a series of steps in a loop between floors. Primarily used for passenger service, these units are more easily installed in older buildings than elevators. They are also more "user friendly," avoiding the waiting time and queuing associated with elevators.

This system includes a supporting structure, the loop of steps, a handrail assembly, a drive assembly, and equipment panels and controls.

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

support structure (CSI 14310)

The support structure for an escalator is typically a built-up welded steel truss, usually manufactured in three or four major sections and assembled on-site. All system assemblies will include upper and lower access units (called "combs") and one or more incline sections. The number of incline sections is determined by the total height desired (distance between floors). All inclines are installed at 30 degrees.

The support structure provides multiple tracks to support and guide the step loop. One set is needed for the leading or drive rollers, and another for the trailing rollers. The support system also provides handrail guides for the moving handrail system.

The support structure is covered with panels to provide both safety and aesthetic appeal. Access plates lead to equipment spaces to allow maintenance. The large inner and outer panels are called balustrades. The cover plate at the step level is referred to as the skirt. The entrance and exit floor panels are called combs or aprons.

step Loop (CSI 14310)

The transport surface typically consists of steps mounted on wheeled axles suspended between two continuous chains. The wheeled axles provide rolling vertical support while the chains provide lifting force. Additional rollers are provided on the trailing edge of each step to guide the folding action (opening and closing) at the access aprons.

The steps are designed with a comb pattern to prevent materials from being caught between the tread and the riser.

Handrail Assembly (CSI 14310)

All escalators are required to have a moving handrail for passenger support. It should move at the same speed as the steps to allow for single passenger grip during transit.

The handrail is generally made of rubber or some synthetic material. It is typically driven like a v-belt, using friction type drive sheaves activated by the main drive assembly. Idler sheaves are used to maintain tension.

Motors (CSI 15170)

Motors employed in escalators are generally open AC motors.

Drive Assembly (CSI 14310)

Escalator drive units are typically chain and sprocket assemblies driven by a single unit similar to a gearhead motor. Very long escalators may require additional drives.

A drive brake and governor are frequently built onto the drive unit. In addition, emergency brakes are mounted on the main drive sprockets to stop the escalator in the event of a chain break. The brake is usually a solenoid operated drum brake.

0.07.01.03 ESCALATORS (CSI 14310)

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS (Continued)

Equipment Controls & Panels (CSI 15950)

Control panels are typically provided on each escalator at one or both landings. Switches are generally provided for starting, stopping, and reversing the escalator. At least one panel will include an emergency stop switch. The panel nearest the drive unit will also include the motor starter and control relays.

OTHER RELATED COMPONENTS

See the following subsections for related components:

DEFICIENCY FACTORS
0.07.01.03 ESCALATORS (CSI 14310)

PROBABLE FAILURE POINTS

- Severe step or structure damage due to normal wear and tear, vandalism
- Excessive chain wear due to improper lubrication, poor maintenance.
- Motor burnout due to overloading.

SYSTEM ASSEMBLY/DEFICIENCIES

Structure

Severe Physical Damage:	Cracks, distortion due to physical abuse, fatigue.
Severe Corrosion:	Aging, lack of maintenance.
Guide Rails Worn:	Normal wear and tear, poor maintenance.

Step Loop

Loose or Missing Fasteners:	Poor maintenance, wear.
Excessive Chain Wear:	Manufacturing defects, improper lubrication.
Roller Wear or Damage:	Normal wear and tear.

Handrail Assembly

Loose or Missing Fasteners:	Poor maintenance, wear.
Excessive Handrail Wear:	Manufacturing defects, abuse, normal wear and tear.
Sheave Wear or Damage:	Normal wear and tear.

Motors

Missing:	Taken out for service, not returned.
Inoperative:	Damaged bearings, corrosion.
Excessive Noise, Vibration:	Bearing wear, fan imbalance, misalignment.
Excessive Corrosion:	Poor maintenance.
Damaged:	Abuse, poor maintenance, stress.
Defective Coupling:	Age, normal wear, improper lubrication.
Defective Bearings:	Age, normal wear, improper lubrication.

Drive Assembly

Missing:	Taken out for service or repair, not returned.
Inoperative, Won't Turn:	Failed bearings, worn or damaged gears.
Sprocket Damaged:	Cracked, fatigued by excessive load.
Excessive Noise:	Wear, imbalance, misalignment.
Excessive Vibration:	Wear, imbalance, misalignment.
Severe Corrosion:	Aging, lack of maintenance.
Seal Leakage:	Worn mechanical seal, defective packing.
Defective Bearing:	Age, normal wear, improper lubrication.

DEFICIENCY FACTORS
0.07.01.03 ESCALATORS (CSI 14310)

SYSTEM ASSEMBLIES/DEFICIENCIES

Drive Assembly (Continued)

Drive Brake Drum Wear or Damage:	Age, normal wear, improper adjustment.
Emergency Brake Worn:	Improper governor adjustment, defective speed controls.

Equipment Controls & Panels

Control Housing Corrosion:	Aging, poor maintenance.
Bypassed Controls:	Defective or inaccurate.
Damaged Wiring:	Frayed, burned.
Relays Pitted or Burned:	Normal wear, overloading.

END OF SUBSECTION

0.07.02.01 PNEUMATIC TUBE SYSTEMS (CSI 14580)

DESCRIPTION

Pneumatic tube systems provide a means for the conveyance of small objects between buildings and building elevations. They employ a blower to alternately create a pressure or vacuum in a tubing network, thus creating a differential pressure across objects in the tube. By controlling the pressure difference and the position of diverters, objects can be routed to any point in the system.

This system includes a blower, motor, diverter valves, station controls, a main control station, the connecting tubing, fittings, and supports.

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Blower (CSI 14580)

Because the function of the blower is to quickly create a pressure or vacuum in the tubing network, it needs to move a large volume of air quickly. Most blowers are high speed, high volume centrifugal fans. Style and construction varies significantly between manufacturers.

Typically a single, one speed, one direction, direct-drive blower is installed and runs intermittently in response to demand. Air direction is controlled by valve positioning. Variations include multiple blowers and multi-speed, reversible, and indirect drive characteristics.

The blower is typically suspended in a dropped ceiling near the system central control station.

Motors (CSI 15170)

Open AC induction are units typically used to drive the blowers. Most are direct-drive, although some are belt-driven units.

Diverter Valves (CSI 14580)

Although some pneumatic tube systems are single-pass systems with one send and one receive station, most systems interconnect multiple stations that can both send and receive. Rather than install independent tubing running between every station, designers use tube manifolds similar to those found in piping systems.

The tube manifold consists of a metal box with one or more diverter valves installed. The diverter valve is typically a short section of duct, flexibly attached on one end to a main duct and free to align with two or more distribution ducts on the other. The free end of the duct and/or the distribution duct ends are cut and sealed to minimize air leakage when the diverter is properly positioned. An air motor (pneumatic cylinder) is typically used to position the diverter.

Limit switches or other sensors detect improperly positioned diverters. Diverter valves are generally mounted in equipment spaces or in dropped ceilings.

Station Controls (CSI 14580)

The typical send/receive station is a recess-mounted metal box with a few switches, lights, and an access door.

The door generally employs a safety interlock (pneumatic or solenoid operated deadbolt) to prevent use when the station is in operation. A limit switch is usually located on the door to prevent system use when the door is open.

Station Controls (CSI 14580)

In manual loading systems, a limit switch is triggered when a carrier is inserted in the dispatch tube. A control panel allows the user to select a destination. As long as the door is shut and a carrier in place, the associated switching notifies the master control panel which aligns all diverter valves and activates the blower, forcing the carrier through the network. The same limit is frequently used to notify the station when it has received a carrier.

0.07.02.01 PNEUMATIC TUBE SYSTEMS (CSI 14580)

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Station Controls (CSI 14580) (Continued)

Some systems have automated loading and unloading pneumatically operated arms. Limit switches are used to sequence and time arm motion.

Master Control Panel (CSI 15850)

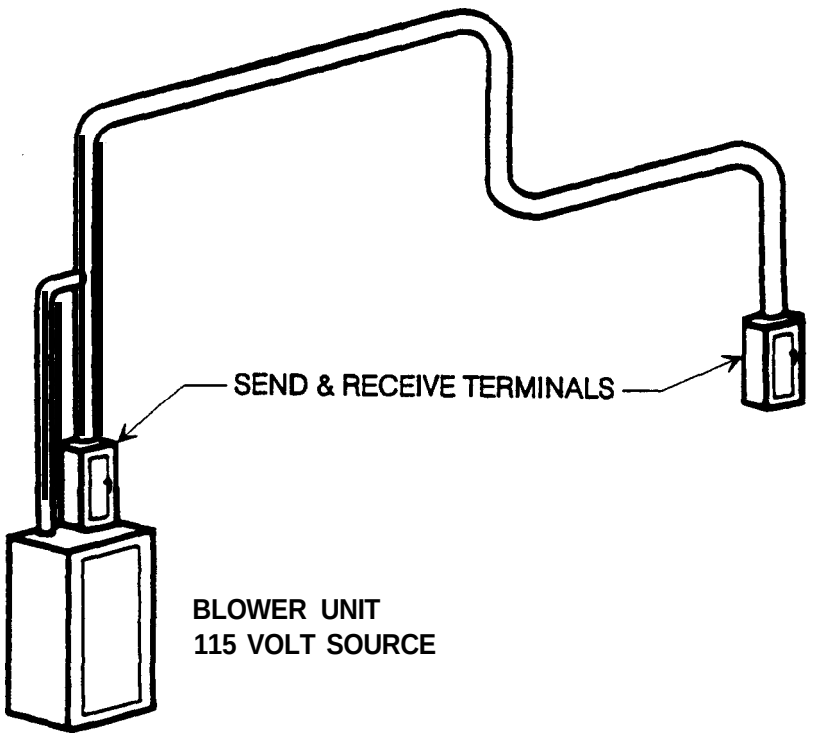
A master control panel is typically provided near the main blower to hold the motor starter and system control relays.

Tubing & Fittings (CSI 14580)

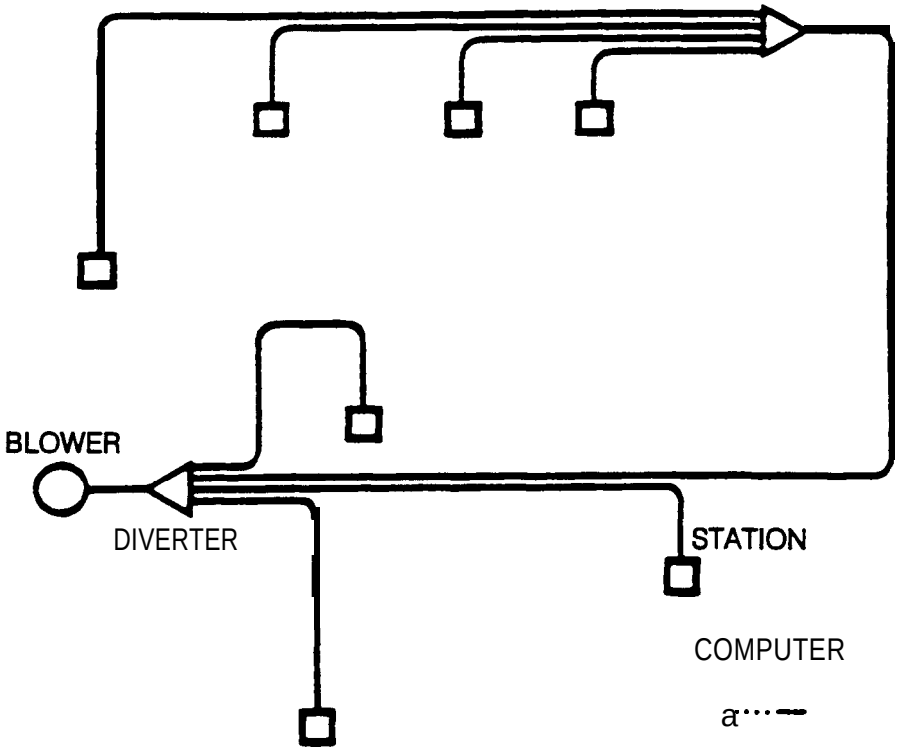
The pneumatic tube distribution system consists of large diameter tubing connecting the main blower, the diverter boxes, and the local stations. The tubing is usually galvanized or plastic. To prevent carrier jams, very large radius bends are used. Also, many tube couplings are designed for easy disassembly to facilitate clearing jams when they do occur.

Supports & Anchors (CSI 15140)

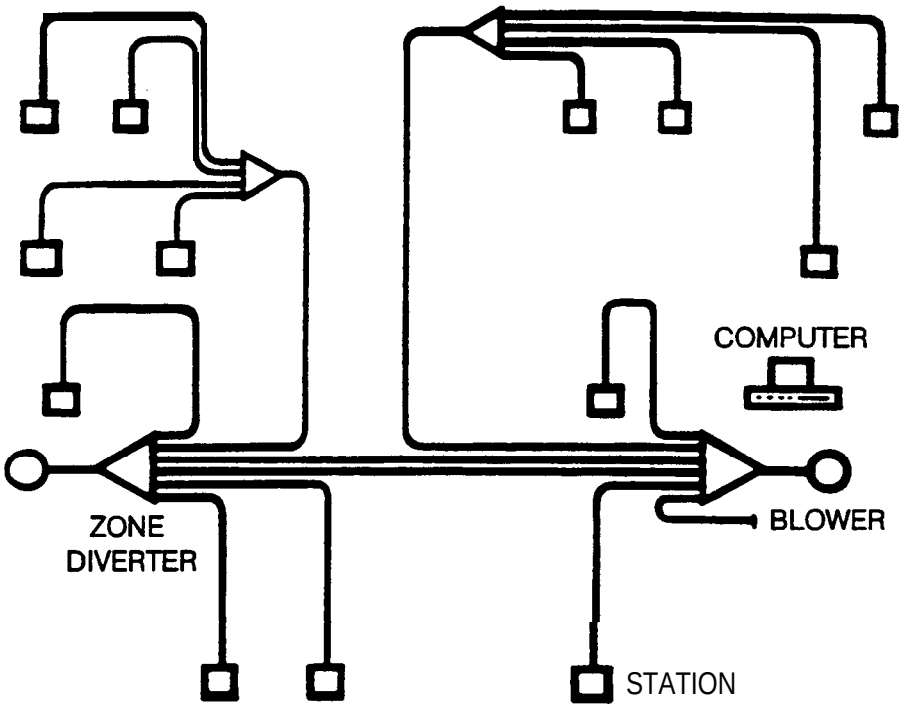
Tube hangers and supports are provided to support tubing and allow for expansion and contraction. They should be securely attached to building construction at sufficiently close intervals.



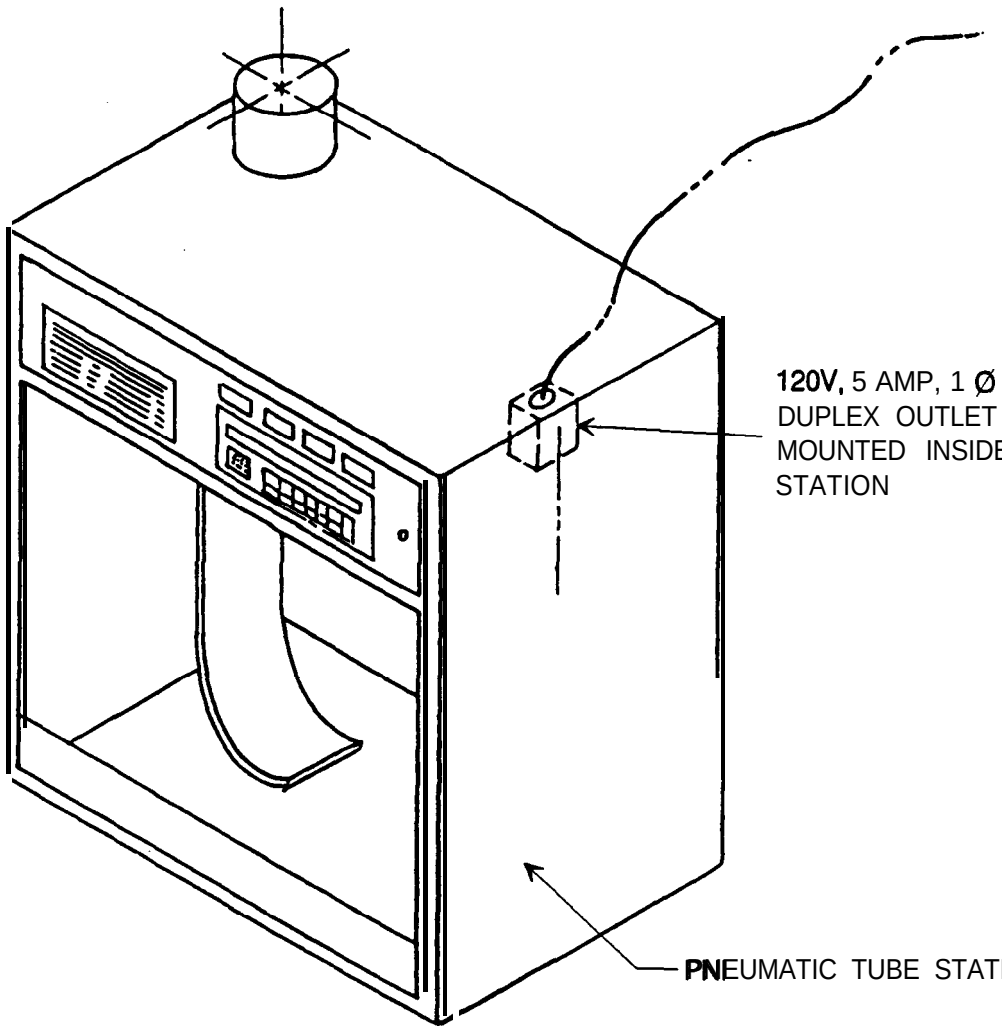
SYSTEM ASSEMBLY DETAILS-CONVEYING SYSTEMS	TYPICAL POINT TO POINT SYSTEM		
PNEUMATIC TUBE SYSTEMS (CSI 14580)	Revision No.	Issue Date 5/93	Drawing No. A070201-1



SYSTEM ASSEMBLY DETAILS-CONVEYING SYSTEMS	TYPICAL MULTI-STATION SINGLE ZONE SYSTEM		
PNEUMATIC TUBE SYSTEMS (CSI 14580)	Revision No.	Issue Date 5/93	Drawing No. A070201-2



SYSTEM ASSEMBLY DETAILS-CONVEYING SYSTEMS	TYPICAL MULTI-STATION MULTI-ZONE SYSTEM		
PNEUMATIC TUBE SYSTEMS (CSI 14580)	Revision No.	Issue Date 5/93	Drawing No. A070201-3



SYSTEM ASSEMBLY DETAILS-CONVEYING SYSTEMS	STATION		
PNEUMATIC TUBE SYSTEMS (CSI 14580)	Revision No.	Issue Date 5/93	Drewhg No. A070201-4

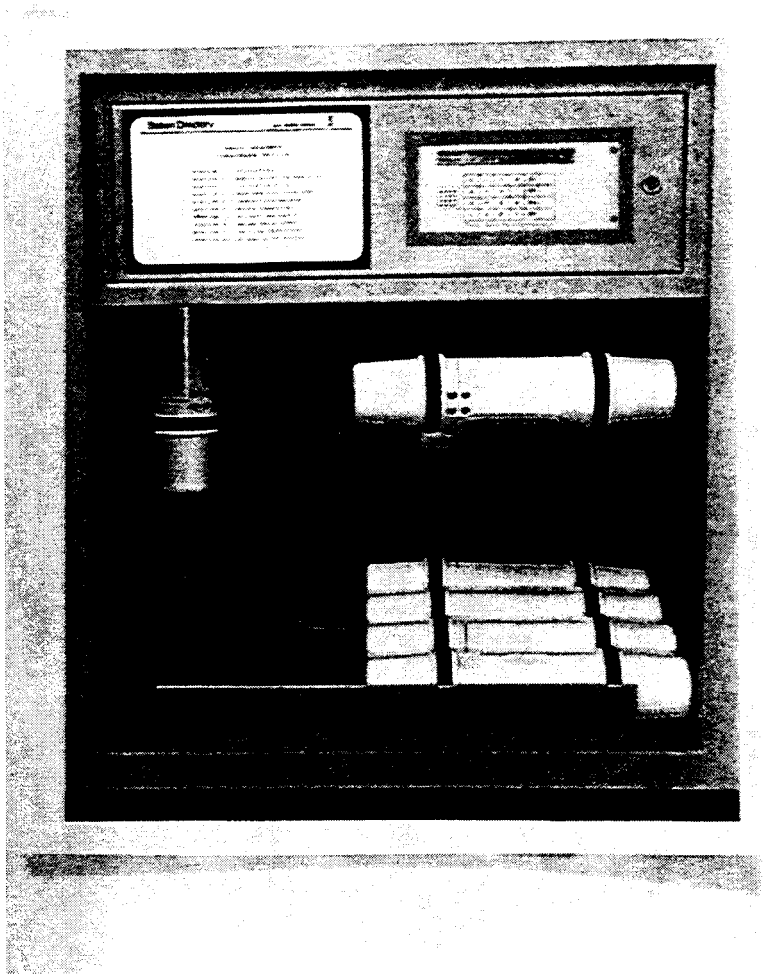


PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DETAILS-CONVEYING SYSTEMS	TYPICAL STATION IN MULTI-STATION SYSTEM		
PNEUMATIC TUBE SYSTEMS (CSI 14580)	Revision No.	**Issue** Date 5/93	**Drawing** No. A070201-5

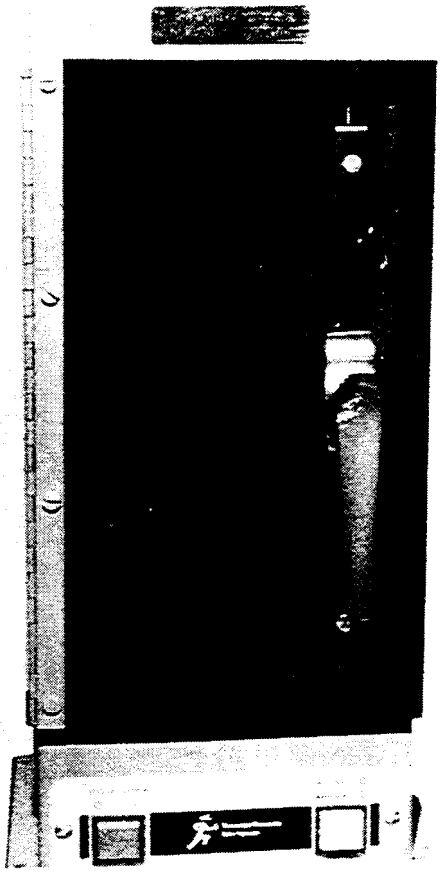


PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DETAILS-CONVEYING SYSTEMS	TYPICAL STATION IN POINT TO POINT SYSTEM		
PNEUMATIC TUBE SYSTEMS (CSI 14580)	Revision No.	Issue Date 5/93	Drawing No. A070201-6

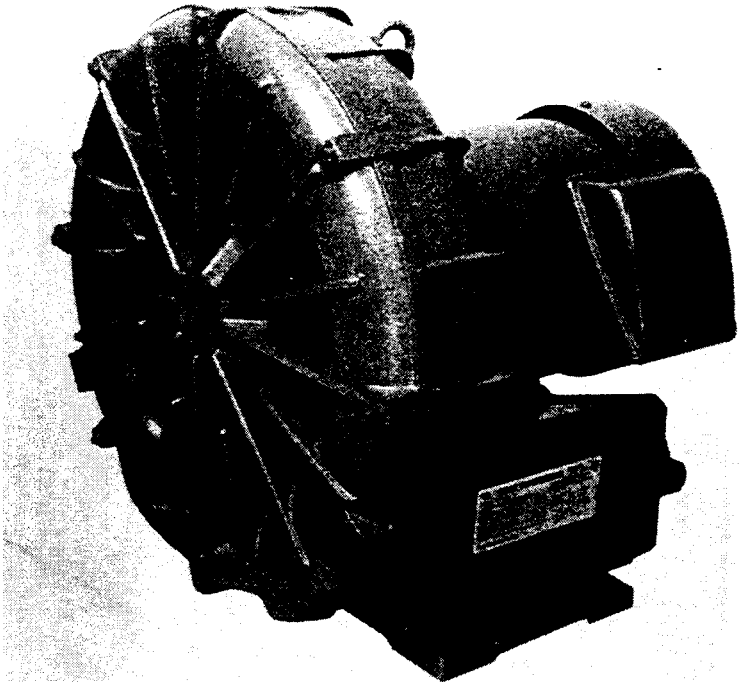
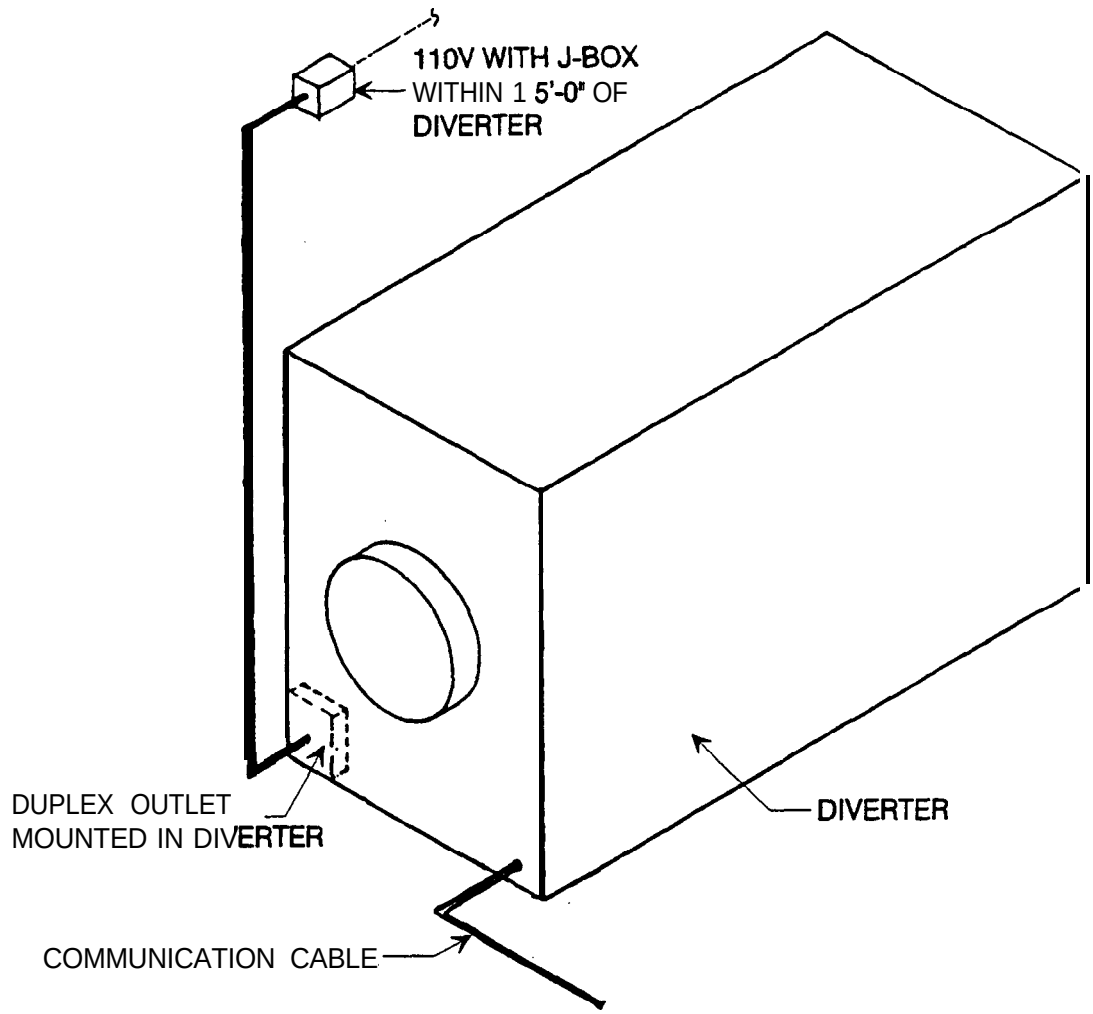
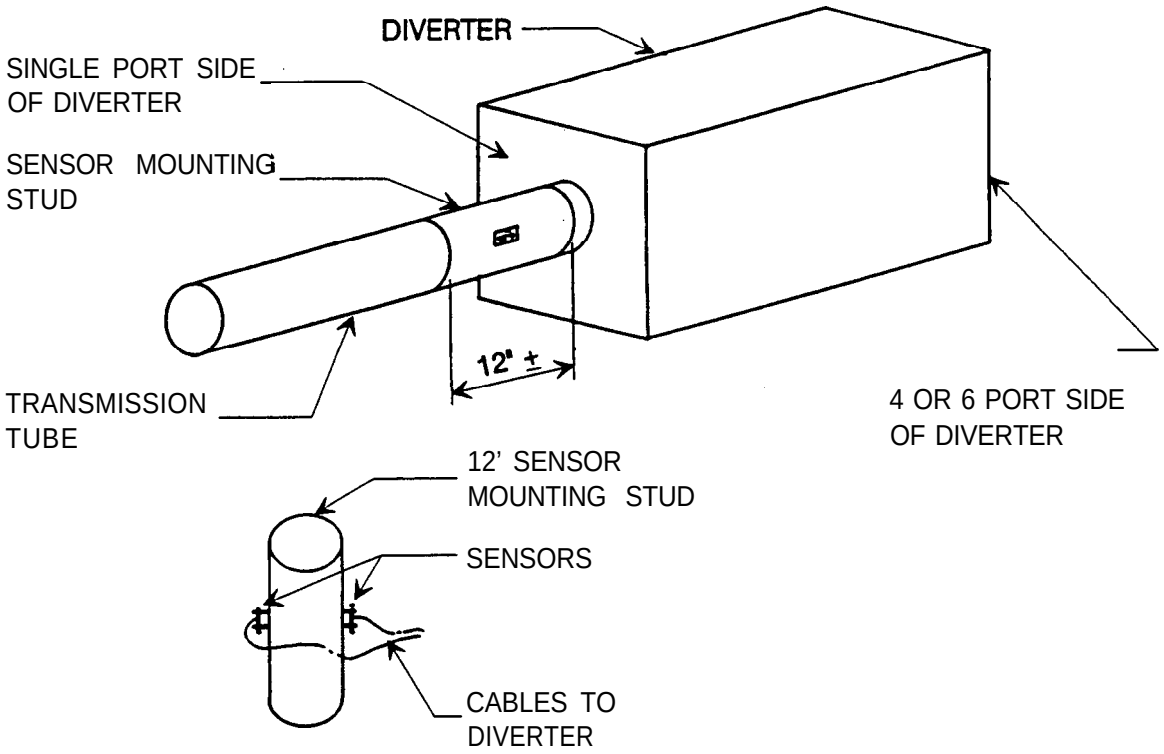


PHOTO ILLUSTRATION

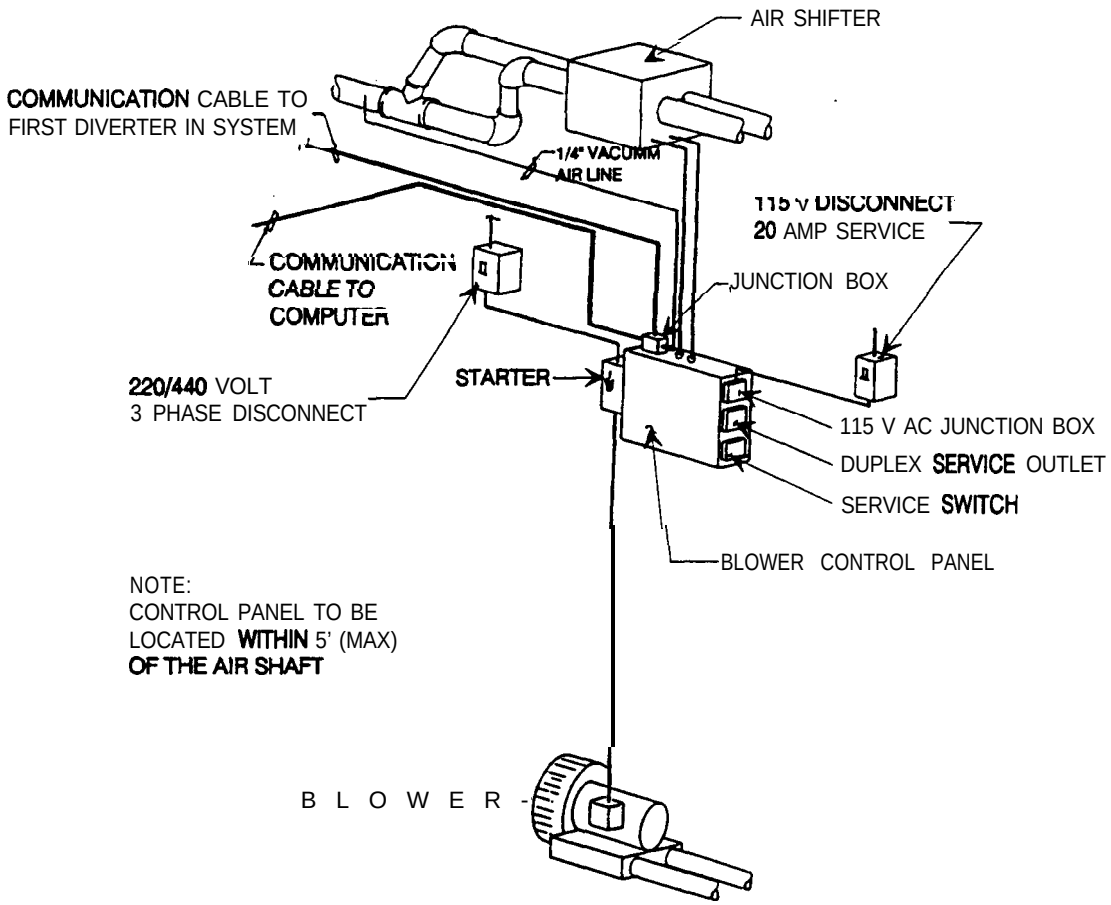
SYSTEM ASSEMBLY DETAILS-CONVEYING SYSTEMS	BLOWER ASSEMBLY		
PNEUMATIC TUBE SYSTEMS (CSI 14580)	Revision No.	Issue Date 5/93	Drawing No. A070201-7



SYSTEM ASSEMBLY DETAILS-CONVEYING SYSTEMS	DIVERTER		
PNEUMATIC TUBE SYSTEMS (CSI 14580)	Revision No.	Issue Date 5/93	Drawing No. A070201-8



SYSTEM ASSEMBLY DETAILS-CONVEYING SYSTEMS	SENSOR MOUNTING AT DIVERTER		
PNEUMATIC TUBE SYSTEMS (CSI 14580)	Revision No.	Issue Date 5/93	Drawing No. A070201-9



SYSTEM ASSEMBLY DETAILS-CONVEYING SYSTEMS	ELECTRICAL DIAGRAM BLOWER CONTROL PANEL AND AIR SHIFTER		
PNEUMATIC TUBE SYSTEMS (CSI 14580)	Revision No.	Issue Date 5/93	Rawhg No. A070201-10

DEFICIENCY FACTORS
0.07.02.01 PNEUMATIC TUBE SYSTEMS (CSI 14580)

PROBABLE FAILURE POINTS

- Excessive jamming due to wear in diverter valve mechanisms, poor maintenance.
- Motor burnout due to overloading.

SYSTEM ASSEMBLY/DEFICIENCIES

Blowers

Missing:	Taken out for service or repair, not returned.
Inoperative, Won't Turn:	Failed bearings, locked impeller.
Excessive Noise:	Wear, imbalance, misalignment.
Excessive Vibration:	Wear, imbalance, misalignment,
Severe Corrosion:	Aging, lack of maintenance.
Defective Bearing:	Age, normal wear, improper lubrication.
Excessive Load:	Bearing wear, misalignment.
Inadequate Capacity:	Low pressure, low flow caused by wear.

Motors

Missing:	Taken out for service, not returned.
Inoperative:	Damaged bearings, corrosion.
Excessive Noise, Vibration:	Bearing wear, fan imbalance, misalignment.
Excessive Corrosion:	Poor maintenance.
Damaged:	Abuse, poor maintenance, stress.
Defective Coupling:	Age, normal wear, improper lubrication.
Defective Bearings:	Age, normal wear, improper lubrication.

Diverter Valves

Inoperative:	Corrosion, physical damage to operating mechanism.
Leakage:	Corrosion, physical damage, improper joining, worn seal.
Corrosion:	Leaks, contamination, use of incompatible materials.
Physical Damage:	Bent pins, broken linkage, cracked housing.
Poor Regulation:	Defective sensors, worn parts.
Inadequate Seating:	Worn parts.
Loose or Missing Fasteners:	Poor maintenance, wear.

Station Controls

Severe Physical Damage:	Cracks, distortion due to physical abuse, fatigue.
Severe Corrosion:	Aging, lack of maintenance.

DEFICIENCY FACTORS
0.07.02.01 PNEUMATIC TUBE SYSTEMS (CSI 14580)

SYSTEM ASSEMBLIES/DEFICIENCIES

Station Controls (Continued)	
Loose or Missing Fasteners:	Poor maintenance, wear.
Cylinders Inoperative, Won't Move:	Damaged shafts, worn operator seals.
Bypassed Controls:	Defective or inaccurate.
Damaged Wiring:	Frayed, burned.
Master Control Panel	
Severe Physical Damage:	Cracks, distortion due to physical abuse, fatigue.
Severe Corrosion:	Aging, lack of maintenance.
Loose or Missing Fasteners:	Poor maintenance, wear.
Bypassed Controls:	Defective or inaccurate.
Damaged Wiring:	Frayed, burned.
Relays Pitted or Burned:	Normal wear, overloading.
Tubing & Fittings	
Leakage:	Corrosion, physical damage, inadequate support, improper joining.
Excessive Corrosion:	Use of incompatible materials, leaks, lack of maintenance.
Physical Damage:	Bent, broke, crimped, crushed.
Supports & Anchors	
Missing:	Improper installation, poor maintenance.
Improper Alignment:	Improper installation, poor maintenance.
Poor Allowance for Expansion:	Improper installation, poor maintenance.

GUIDE SHEET CROSS REFERENCE TABLES

GUIDE SHEETS

The following Guide Sheets provide a general overview of the inspection methods and requirements used to provide a general Hydraulic Elevator System inspection.

Assembly/Component	Control Number
STANDARD	
Equipment Controls..	GSS 0.07.01.03
Hydraulic Plant..	GSS 0.07.01 .04
Motors	GSS 0.07.01.05
Pipe & Accessories..	GSS 0.07.01.07
Elevators, Hydraulic	GSS d.07.02.01
NON-STANDARD	
Equipment Controls..	GSS 0.07.01.03
Hydraulic Plant..	GSS 0.07.01.04
Motors	GSS 0.07.01.05
Pipe & Accessories..	GSS 0.07.01.07
Elevators, Hydraulic	GSS 0.07.02.01

GUIDE SHEET CROSS REFERENCE TABLES

GUIDE SHEETS

The following Guide Sheets provide a general overview of the inspection methods and requirements used to provide a general Traction Elevator System inspection.

Assembly/Component	Control Number
STANDARD	
Drive Assemblies	GSS 0.07.01.02
Equipment Controls..	GSS 0.07.01 .03
Motors	GSS 0.07.01.05
Motor-Generators..	GSS 0.07.01.06
Elevators, Traction	GSS 6.07.02.02
NON-STANDARD	
Drive Assemblies	GSS 0.07.01.02
Equipment Controls..	GSS 0.07.01.03
Motors	GSS 0.07.01.05
Motor-Generators..	GSS 0.07.01.06
Elevators, Traction	GSS 0.07.02.02

GUIDE SHEET CROSS REFERENCE TABLES

GUIDE SHEETS

The following Guide Sheets provide a general overview of the inspection methods and requirements used to provide a general Escalator System inspection.

Assembly/Component	Control Number
STANDARD	
Drive Assemblies	GSS 0.07.01.02
Equipment Controls..	GSS 0.07.01.03
Motors	GSS 0.07.01.05
Escalators	GSS 0.07.02.03
NON-STANDARD	
Drive Assemblies	GSS 0.07.01.02
Equipment Controls..	GSS 0.07.01.03
Motors	GSS 0.07.01.05
Escalators	GSS 0.07.02.03

GUIDE SHEET CROSS REFERENCE TABLES

GUIDE SHEETS

The following Guide Sheets provide a general overview of the inspection methods and requirements used to provide a general Pneumatic Tube System inspection.

Assembly/Components	Control Number
STANDARD	
Blowers	GSS 0.07.01.01
Equipment Controls	GSS 0.07.01.03
Motors	GSS 0.07.01.05
Pneumatic Ductwork & Accessories	GSS 0.07.03.01
NON-STANDARD	
Blowers	GSS 0.07.01 .01
Equipment Controls	GSS 0.07.01.03
Motors	GSS 0.07.01.05
Pneumatic Ductwork & Accessories	GSS 0.07.03.01

END OF SUBSECTION

INSPECTION METHODS - STANDARD

GUIDE SHEETS

Guide Sheets provide a general overview of the inspection methods and requirements used to provide a general component inspection. Sheets have been developed for each major assembly/component as shown TABLE ONE below:

TABLE ONE

INSPECTION METHODS - STANDARD

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INSPECTION METHODS - STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: BLOWERS
CONTROL NUMBER: GSS 0.07.01 .01

APPLICATION

This guide applies to blowers and fans used as prime movers in conveying systems.

SPECIAL INSTRUCTIONS

This is a general inspection, and specific deficiencies should be handled on a service or repair call basis.

CONCURRENT ACTIONS

Inspect associated:
- Motors
- Pneumatic Duct & Accessories
- Equipment Controls

INSPECTION ACTIONS

Condition Assessment Survey of Conveying Systems to include visual survey, examination of building records, and analysis. Points include:

1. Note any unusual noise or vibration in the unit housing - check for pulsations.
2. Inspect outer casing for stress cracks, corrosion, other physical damage.
3. Check access plates and doors for corrosion, leakage, loose or missing fasteners.
4. Check supports for loose, damaged, missing fasteners.
5. Check fan motor for proper operation; note any corrosion, physical damage.
6. Note any unusual noise, excessive vibration in the fan/motor assembly.
7. Note any damage in air flow dampers and linkage.
8. Examine integral equipment controls and wiring.
9. Note any inoperative motor starters.
10. Check conduit, control housings, and panels for corrosion.
11. Note any controls that have been bypassed for operation.

TOOLS & MATERIALS

Standard Inspection Tools - Conveying

INSPECTION METHODS . STANDARD

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INSPECTION METHODS . STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: DRIVE ASSEMBLIES
CONTROL NUMBER: GSS 0.07.01.02

APPLICATION

This guide applies to drive components (reducers, couplings, belts, chains, brakes, etc.) employed in conveying equipment (traction elevators, escalators, etc.).

SPECIAL INSTRUCTIONS

This is a general inspection, and specific deficiencies should be handled on a service or repair call basis.

CONCURRENT ACTIONS

Inspect associated:
- Conveyor
- Elevator
- Escalator
- Motors
- Equipment Controls

INSPECTION ACTIONS

Condition Assessment Survey of Conveying Systems to include visual survey, examination of building records, and analysis. Points include:

1. Check general appearance of drive components.
2. Note corrosion buildup on exposed surfaces.
3. Note component leakage locations (at corroded section, corroded or loose fittings, defective seals).
4. Check for excessive noise or vibration in components.
5. Check exposed sections of braking mechanisms for scoring, indications of burning, excessive wear.
6. Check chains, belts, fasteners, etc. for looseness, missing components.

TOOLS & MATERIALS

Standard Inspection Tools - Conveying

INSPECTION METHODS - STANDARD

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INSPECTION METHODS ▪ STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: EQUIPMENT CONTROLS & PANELS
CONTROL NUMBER: GSS 0.07.01.03

APPLICATION

This guide applies to all stand-alone equipment control panels and related components (fittings, conduit, BX, etc.) installed as part of a conveying system. It does not include the equipment-mounted controls.

SPECIAL INSTRUCTIONS

This is a general inspection, and specific deficiencies should be handled on a service or repair call basis.

CONCURRENT ACTIONS

Inspect associated:
- Elevators
- Escalators
- Hydraulic Plants
- Motors
- Blowers

INSPECTION ACTIONS

Condition Assessment Survey of Conveying Systems to include visual survey and analysis. Points include:

1. Check instrumentation for proper operation; note damage, defects, inaccuracies, illegible text, leakage, missing components.
2. Check external control mechanisms for defects; missing or damaged knobs, switches, rheostats, slide valves, etc.
3. Check attached piping for leakage, corrosion, loose or missing fasteners.
4. Check attached conduit/BX corrosion, loose or missing fasteners.
5. Note panel enclosure for defects; corrosion, loose fasteners.
6. Check doors and access plates for damaged seals.
7. Check panel interior for corrosion, leakage.
8. Note bypassed controls.
9. Check for worn or frayed wiring.
10. Check controllers for improper mounting; loose or missing fasteners, connections to pipe or wiring.

TOOLS & MATERIALS

Standard Inspection Tools - Conveying

INSPECTION METHODS - STANDARD

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INSPECTION METHODS - STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: HYDRAULIC PLANTS
CONTROL NUMBER: GSS 0.07.01.04

APPLICATION

This guide applies to hydraulic plants (tanks, pumps, controls, etc.) used for elevators and similar conveying devices.

SPECIAL INSTRUCTIONS

This is a general inspection, and specific deficiencies should be handled on a service or repair call basis.

CONCURRENT ACTIONS

Inspect associated:
- Elevators
- Pipe & Accessories
- Motors
- Equipment Controls

INSPECTION ACTIONS

Condition Assessment Survey of Conveying Systems to include visual survey, examination of building records, and analysis. Points include:

1. Check general appearance of system.
2. Note ferrous oxide build-up on tank surfaces.
3. Note leakage locations at corroded tank section, corroded or loose fittings, defective seals.
4. Check tank for damage; distortion, cracks.
5. Check pump for excessive noise and vibration.
6. Note leakage/wear in pump shafting.
7. Note any valve stem leakage: improper packing adjustment, worn or missing packing.
8. Check valves for damage, cracked housing, bent stem.

TOOLS & MATERIALS

Standard Inspection Tools - Conveying

INSPECTION METHODS - STANDARD

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INSPECTION METHODS . STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: MOTORS
CONTROL NUMBER: GSS 0.07.01.05

APPLICATION

This guide applies to all drive motors and related components (conduit, fittings, switches, starters, controls, etc.) used in conveying systems.

SPECIAL INSTRUCTIONS

This is a general inspection, and specific deficiencies should be handled on a service or repair call basis.

NOTE: Motors greater than 10 HP will be surveyed by the electrical crew.

CONCURRENT ACTIONS

Inspect associated:
- Drive Assemblies
- Hydraulic Plants
- Blowers
- Equipment Controls

INSPECTION ACTIONS

Condition Assessment Survey of Conveying Systems to include visual survey, and analysis. Points include:

1. Observe operation of motor - note normal unit start-up and shut-off; record any excessive vibration or noise.
2. Inspect motor exterior housing for stress cracks, corrosion, other physical damage.
3. Check motor interior housing (open motors only) for dirt, physical damage, signs of overheating.
4. Check motor mounts for loose, damaged, missing fasteners.
5. Check conduit, BX, Greenfield connections at motor for loose or missing fittings, physical damage, improper electrical connections.
6. Check motor bearing seals for leakage.

TOOLS & MATERIALS

Standard Inspection Tools - Conveying/Electrical

INSPECTION METHODS ▪ STANDARD

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INSPECTION METHODS - STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: MOTOR-GENERATORS
CONTROL NUMBER: GSS 0.07.01.06

APPLICATION

This guide applies to all motor-generator sets and related components (conduit, fittings, switches, controls, etc.) used in conveying systems.

SPECIAL INSTRUCTIONS

This is a general inspection, and specific deficiencies should be handled on a service or repair call basis.

NOTE: Motor-generators greater than 10 HP will be surveyed by the electrical crew.

CONCURRENT ACTIONS

Inspect associated:
- Drive Assemblies
- Equipment Controls

INSPECTION ACTIONS

Condition Assessment Survey of Conveying Systems to include visual survey, and analysis. Points include:

1. Observe operation of motor-generator; note normal start-up and shut-off; record any excessive vibration or noise.
2. Inspect exterior housing for stress cracks, corrosion, other physical damage.
3. Check interior housing (open units only) for dirt, physical damage, or signs of overheating.
4. Check mounts for loose, damaged, or missing fasteners.
5. Check conduit, BX, Greenfield connections for loose or missing fittings, physical damage, improper electrical connections.
6. Check bearing seals for leakage.

TOOLS & MATERIALS

Standard Inspection Tools - Conveying/Electrical

INSPECTION METHODS . STANDARD

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INSPECTION METHODS . STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: PIPE & ACCESSORIES
CONTROL NUMBER: GSS 0.07.01.07

APPLICATION

This guide applies to piping and related distribution components (fittings, valves, hangers, insulation, etc.) used in conveying systems such as hydraulic elevators.

SPECIAL INSTRUCTIONS

This is a general inspection, and specific deficiencies should be handled on a service or repair call basis.

CONCURRENT ACTIONS

Inspect associated:
- Escalators
- Hydraulic Plants
- Equipment Controls

INSPECTION ACTIONS

Condition Assessment Survey of Conveying Systems to include visual survey, examination of building records, and analysis. Points include:

1. Check general system appearance.
2. Note ferrous oxide and cuprous oxide build-up on piping surfaces.
3. Note pipe leakage locations at corroded section, corroded or loose fittings, defective caulk joints.
4. Note piping distortion: bent, sagging, crimped, crushed.
5. Check piping expansion joints for proper operation: leaks, loose fasteners.
6. Check pipe supports and hangers for defects: loose, missing fasteners, improper alignment, improper allowance for expansion.
7. Record defects in piping insulation: missing, damaged, wet.
8. Check wall and floor pipe penetrations for defects: missing seal, improper fire rating seal, lack of required flange cover or escutcheon.
9. Note any valve stem leakage: improper packing adjustment, worn or missing packing.
10. Check valves for damage: cracked housing, bent stem.

TOOLS & MATERIALS

Standard Inspection Tools - Conveying

INSPECTION METHODS ▪ STANDARD

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INSPECTION METHODS - STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: HYDRAULIC ELEVATORS
CONTROL NUMBER: GSS 0.07.02.01

APPLICATION

This guide applies to elevator cabs, hoistways, and related components (lift cylinders, buffers, guide rails, fittings, valves, etc.) for all hydraulic elevators.

SPECIAL INSTRUCTIONS

This is a general inspection, and specific deficiencies should be handled on a service or repair call basis.

CONCURRENT ACTIONS

Inspect associated:
- Hydraulic Plants
- Pipe & Accessories
- Motors
- Equipment Controls

INSPECTION ACTIONS

Condition Assessment Survey of Conveying Systems to include visual survey, examination of building records, and analysis. Points include:

1. Check general appearance of car.
2. Inspect interior controls and indicators for damage/proper operation.
3. Note damage to interior panels, ceiling, floor caused by wear, fatigue, vandalism.
4. Note excessive corrosion of metal work.
5. Check car doors for proper operation; note distortion or binding in operating mechanisms.
6. Check lift cylinder/plunger for smooth and proper operation.
7. Check accessible portion of plunger for excessive wear/scoring.
8. Check lift cylinder and immediate piping for leakage.
9. Check cylinder hardware for defects:(loose, missing fasteners, corrosion.
10. Check buffer for wear, damage, corrosion, loose fasteners.
11. Inspect floor (exterior) controls and indicators for damage/proper operation.
12. Note damage to hoistway doors and frames caused by wear, fatigue, vandalism.
13. Note excessive corrosion of metal work.
14. Check hoistway doors for proper operation - note distortion or binding in operating mechanisms.

TOOLS & MATERIALS

Standard Inspection Tools - Conveying

INSPECTION METHODS . STANDARD

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INSPECTION METHODS . STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: TRACTION ELEVATORS
CONTROL NUMBER: GSS 0.07.02.02

APPLICATION

This guide applies to elevator cabs, hoistways and related components (fittings, cables, buffers, etc.) for all traction elevators.

SPECIAL INSTRUCTIONS

This is a general inspection, and specific deficiencies should be handled on a service or repair call basis.

CONCURRENT ACTIONS

Inspect associated:
- Drive Assemblies
- Motors
- Motor Generators
- Equipment Controls

INSPECTION ACTIONS

Condition Assessment Survey of Conveying Systems to include visual survey, examination of building records, and analysis. Points include:

1. Check general car appearance.
2. Inspect interior controls and indicators for damage/proper operation.
3. Note damage to interior panels, ceiling, floor caused by wear, fatigue, vandalism.
4. Note excessive corrosion of metal work.
5. Check car doors for proper operation; note distortion or binding in operating mechanisms.
6. Check lift cables/counterweights for smooth and proper operation.
7. Check accessible portion of cables for excessive wear/fraying.
8. Check counterweight hardware for defects: loose, missing fasteners; corrosion.
9. Check buffer for wear, damage, corrosion, loose fasteners.
10. inspect floor (exterior) controls and indicators for damage/proper operation.
11. Note damage to hoistway doors and frames caused by wear, fatigue, vandalism.
12. Note excessive corrosion of metal work.
13. Check hoistway doors for proper operation; note distortion or binding in operating mechanisms.

TOOLS & MATERIALS

Standard Inspection Tools - Conveying

INSPECTION METHODS . STANDARD

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INSPECTION METHODS - STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: ESCALATORS
CONTROL NUMBER: GSS 0.07.02.03

APPLICATION

This guide applies to escalator flights, mounting structures, and related components (guides, covers, fittings, etc.) for all escalators.

SPECIAL INSTRUCTIONS

This is a general inspection, and specific deficiencies should be handled on a service or repair call basis.

CONCURRENT ACTIONS

Inspect associated:
- Drive Assembly
- Motors
- Equipment Controls

INSPECTION ACTIONS

Condition Assessment Survey of Conveying Systems to include visual survey, examination of building records, and analysis. Points include:

1. Check general escalator appearance.
2. Inspect local controls and indicators for damage/proper operation.
3. Note damage to side panels, handrails caused by wear, fatigue, vandalism.
4. Note excessive metal work corrosion.
5. Check flights for proper operation; note distortion or binding in operating mechanisms.

TOOLS & MATERIALS

Standard Inspection Tools - Conveying

INSPECTION METHODS - STANDARD

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INSPECTION METHODS - STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: PNEUMATIC DUCTWORK &ACCESSORIES
CONTROL NUMBER: GSS 0.07.03.01

APPLICATION

This guide applies to duct and related distribution components (control stations, diverter valves, fittings, hangers, etc.) used in pneumatic tube conveying systems.

SPECIAL INSTRUCTIONS

This is a general inspection, and specific deficiencies should be handled on a service or repair call basis.

CONCURRENT ACTIONS

Inspect associated:
- Blowers
- Equipment Controls

INSPECTION ACTIONS

Condition Assessment Survey of Conveying Systems to include visual survey, examination of building records, and analysis. Points include:

1. Examine exposed duct.
2. Note any unusual noise or vibration.
3. Inspect duct for cracks, corrosion, other physical damage, leakage.
4. Examine diverter access plates and doors - note corrosion, leakage, loose or missing fasteners.
5. Check diverters for proper operation.
6. Check supports for corrosion, damaged, loose or missing fasteners.
7. Check wall penetrations for proper fire protection.

TOOLS & MATERIALS

Standard Inspection Tools - Conveying

INSPECTION METHODS • STANDARD

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INSPECTION METHODS . NON-STANDARD

GUIDE SHEETS

Guide Sheets provide a general overview of the inspection methods and requirements used to provide a general component inspection. Sheets have been developed for each major assembly/component as shown in TABLE TWO below:

TABLE TWO

INSPECTION METHODS . NON-STANDARD

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INSPECTION METHODS . NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: **BLOWERS**
CONTROL NUMBER: GSNS 0.07.01 .01

APPLICATION

This guide applies to all non-standard inspection procedures for blowers and fans used as prime movers in conveying systems.

SPECIAL INSTRUCTIONS

1. Review mechanical and electrical plans to determine systems and areas affected by equipment/system outage.
2. Review manufacturer's or installer's instructions.
3. Inspection should be scheduled when system is not in use.
4. Notify affected personnel and obtain permission to take unit out of service.
5. Obtain necessary tools, equipment, and materials.

CONCURRENT ACTIONS

Inspect associated:
- Motors
- Pneumatic Duct & Accessories
- Equipment Controls

INSPECTION ACTIONS

Condition Assessment Survey of Conveying Systems to include visual survey, examination of building records, and analysis. Points include:

Prior to Shutdown:

1. Measure effective delivery of blower in CFM.
2. Run unit through a complete operation cycle to check for potential malfunctions.
3. Check fan RPM with tachometer or stroboscope (compare with specs).
4. Perform vibration analysis on the fan.

Unit Shutdown:

5. Turn off unit and lock out disconnect.
6. Tag out all electrical devices.

Shutdown Inspection:

7. Inspect fan assembly.
8. Check fan blading for erosion, corrosion, distortion, broken welds or fasteners.
9. Check fan shafting for distortion.
10. Check fan shaft play in bearings.
11. Check fan interior housing for erosion, corrosion.
12. Examine damper actuators. Check for worn, distorted shafting or linkage. Note leakage of pneumatic operators and relays.
13. Check wiring for loose connections, frayed or broken insulation.
14. Check electric controls for worn or pitted contacts, improper safety devices (heaters, fuses).
15. Ensure related motors and equipment controls are inspected using their respective guide sheets.

INSPECTION METHODS . NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: BLOWERS (Continued)
CONTROL NUMBER: GSNS 0.07.01 .01

INSPECTION ACTIONS

Return to Service:

16. Ensure all tools, equipment, and materials used for inspection have been removed from the unit.
17. Ensure all parts, guards, and covers have been reinstalled.
18. Notify affected personnel and obtain permission to place unit back in service.
19. Remove lockout on disconnect and restore unit to service.
20. Remove tags from all devices.

TOOLS & MATERIALS

1. Non-Standard Inspection Tools - Conveying
2. As required for the type of test being performed.

INSPECTION METHODS . NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: DRIVE ASSEMBLIES
CONTROL NUMBER: GSNS 0.07.01.02

APPLICATION

This guide applies to all non-standard inspection procedures for drive components (reducers, couplings, belts, chains, brakes, etc.) employed in conveying equipment (traction elevators, escalators, etc.).

SPECIAL INSTRUCTIONS

1. Review mechanical and electrical plans to determine systems and areas affected by equipment/system outage.
2. Inspection should be scheduled when system is not in use.
3. Notify affected personnel and obtain permission to take unit out of service.
4. Obtain necessary tools, equipment, and materials.
5. This is an invasive inspection and should be performed in conjunction with a system shutdown and overhaul. Specific deficiencies should be handled on a repair call basis.

CONCURRENT ACTIONS

Inspect associated:
- Conveyor
- Elevator
- Escalator
- Motors
- Equipment Controls

INSPECTION ACTIONS

Condition Assessment Survey of Conveying Systems to include visual survey, examination of building records, and analysis. Points include:

Prior to Shutdown:

1. Observe operation of drive assembly through full cycle; note erratic performance.
2. Check for noise and vibration; note location.

Unit Shutdown:

3. Turn off unit and lock out disconnect.
4. Tag out all electrical devices.

Shutdown Inspection:

5. Remove guards and access plates to access drive components.
6. Remove sample of oil from sumps/gearboxes; check for excessive wear products, general condition of oil. Send sample to lab for analysis on large drives.
7. Remove cover to gearbox; inspect gear teeth for wear, fatigue, cracks, and check suspicious areas with dye penetrant.
8. Inspect brake rotors/drums for scoring, overheating, excessive wear.
9. Check brake operator linkages/springs for loose fasteners, wear, damage.
10. Check solenoid brake operator for signs of overheating.
11. Check hydraulic brake operator for signs of leakage.
12. Check sheaves/sprockets for excessive wear, broken teeth, cracks, loose or missing fasteners.
13. Check chains/belts for proper tension and condition.
14. Check mounting hardware of all components for loose or missing fasteners, corrosion.

INSPECTION METHODS - NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: DRIVE ASSEMBLIES (Continued)
CONTROL NUMBER: GSNS 0.07.01.02

INSPECTION ACTIONS

Return to Operation:

15. Replace all access covers and plates.
16. Ensure all tools, equipment, and materials used for inspection have been removed from the unit.
17. Ensure that all guards and covers have been reinstalled.
18. Notify affected personnel and obtain permission to place unit back in service.
19. Remove lockout on disconnect and restore unit to service.
20. Remove tags from all devices.

TOOLS & MATERIALS

1. Non-Standard Inspection Tools - Conveying
2. As required for the type of test being performed.

INSPECTION METHODS - NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: EQUIPMENT CONTROLS & PANELS
CONTROL NUMBER: GSNS 0.07.01.03

APPLICATION

This guide applies to all non-standard inspection procedures for controllers typically found on Conveying equipment. It includes motor controllers, switches, and related components (sensors, wiring, fittings, and enclosures).

SPECIAL INSTRUCTIONS

1. Review mechanical and electrical plans to determine systems and areas affected by equipment/system outage.
2. Review manufacturer's or installer's instructions.
3. This is an invasive inspection and should be performed in conjunction with a system shutdown and overhaul.
4. Notify affected personnel and obtain permission to take unit out of service.
5. Obtain necessary tools, equipment, and materials.

CONCURRENT ACTIONS

Inspect Associated:
- Piping & Accessories
- Fans
- Pumps
- Motors
- Motor Generators

INSPECTION ACTIONS

Condition Assessment Survey of Conveying Systems to include visual survey, examination of building records, and analysis. Points include:

Unit Shutdown:

1. Turn off unit and lock out disconnect.
2. Tag out all electrical devices.
3. Isolate devices mechanically by securing air and hydraulic lines.
4. Tag out all secured valves.

Shutdown Inspection:

5. Open and inspect controller enclosures.
6. Check enclosures for corrosion.
7. Check motor starters for burned or pitted contacts, damaged casings.
8. Inspect system controls; check contacts for pitting, burning.
9. Check wiring for fraying, loose fasteners, signs of overheating.
10. Check miscellaneous electrical components (resistors, capacitors, inductors, controller boards, etc.) for physical damage, signs of overheating.
11. Check physical condition of temperature controllers.
12. Check physical condition of pressure controllers.
13. Check physical condition of level controllers.
14. Check physical condition of speed controllers.

INSPECTION METHODS • NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: EQUIPMENT CONTROLS & PANELS (Continued)
CONTROL NUMBER: GSNS 0.07.01.03

INSPECTION ACTIONS

Return to Service:

15. Ensure all tools, equipment, and materials used for inspection have been removed from the unit.
16. Ensure that all guards and covers have been reinstalled.
17. Notify affected personnel and obtain permission to place unit back in service.
18. Restore valving to normal position.
19. Remove lockout on disconnect and restore unit to service.
20. Remove tags from all devices.

TOOLS & MATERIALS

1. Non-Standard Inspection Tools - Conveying
2. As required for the type of test being performed.

INSPECTION METHODS • NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: HYDRAULIC PLANTS
CONTROL NUMBER: GSNS 0.07.01.04

APPLICATION

This guide applies to all non-standard inspection procedures for hydraulic plants (tanks, pumps, controls, etc.) used for elevators and similar conveying devices.

SPECIAL INSTRUCTIONS

1. Review mechanical and electrical plans to determine systems and areas affected by equipment/system outage.
2. Inspection should be scheduled when system is not in use.
3. Notify affected personnel and obtain permission to take unit out of service.
4. Obtain necessary tools, 'equipment, and materials.
5. This is an invasive inspection and should be performed in conjunction with a system shutdown and overhaul. Specific deficiencies should be handled on a repair call basis.

CONCURRENT ACTIONS

Inspect associated:
- Elevators
- Pipe & Accessories
- Motors
- Equipment Controls

INSPECTION ACTIONS

Condition Assessment Survey of Conveying Systems to include visual survey, examination of building records, and analysis. Points include:

Prior to Shutdown:

1. Operate system controls to effect a full cycle of operation.
2. Monitor pressure gauges and compare against rating data.
3. Check operation of level controls: proper pump cut-in and cut-out.
4. Perform vibration analysis on pump bearings.

Unit Shutdown:

5. Turn off unit and lock out disconnect.
6. Tag out all electrical devices.
7. Isolate unit mechanically by securing oil and water lines.
8. Tag out all secured valves.

Shutdown inspection:

9. Drain/pump out tank thoroughly.
10. Remove tank access plates and ventilate interior.
11. Inspect tank interior.
12. Check interior walls for erosion, corrosion.
13. Check interior floats/rods for damage, distortion.
14. Check internal heating/cooling coils for leakage, corrosion.
15. Check condition of magnetic strainer.
16. Open and inspect pump.
17. Check interior housing for cracks, fatigue, erosion and corrosion; check suspicious areas with dye penetrant.

INSPECTION METHODS - NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: HYDRAULIC PLANTS (Continued)
CONTROL NUMBER: GSNS 0.07.01.04

INSPECTION ACTIONS

Shutdown Inspection:

18. Check gearing for wear, cracking, breaks.
19. Check interior shafting for signs of fatigue.
20. Check pump shafting for damage from packing/mechanical seal.
21. Rotate (cycle) shafting and check for distortion in shaft and gears.
22. Check clearances (compare with manufacturer's spec).
23. Close pump.
24. Rotate (cycle) pump to check for binding.
25. Measure runout play in bearings due to wear (compare with manufacturer's spec).
26. Check coupling for wear, damage, loose fasteners.
27. Check coupling for misalignment.
28. Open and inspect pump strainers; check for pump internal wear products.
29. Note general condition of the strainer.

Return to Operation:

30. Ensure all tools, equipment, and materials used for inspection have been removed from the unit.
31. Ensure that all guards and covers have been reinstalled.
32. Refill system to normal operating level.
33. Notify affected personnel and obtain permission to place unit back in service.
34. Restore valving to normal position.
35. Remove lockout on disconnect and restore unit to service.
36. Remove tags from all devices.

TOOLS & MATERIALS

1. Non-Standard Inspection Tools - Conveying
2. As required for the type of test being performed.

INSPECTION METHODS . NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: MOTORS
CONTROL NUMBER: GSNS 0.07.01.05

APPLICATION

This guide applies to all non-standard inspection procedures for all drive motors and related components (conduit, fittings, switches, starters, controls, etc.) used in conveying systems.

SPECIAL INSTRUCTIONS

1. Review mechanical and electrical plans to determine systems and areas affected by equipment/system outage.
2. Review manufacturer's or installer's instructions.
3. Inspection should be scheduled when system is not in use.
4. Notify affected personnel and obtain permission to take unit out of service.
5. Obtain necessary tools, equipment, and materials.

NOTE: Motors greater than 10 HP will be surveyed by the electrical crew.

CONCURRENT ACTIONS

Inspect associated:
- Escalators
- Hydraulic Plants
- Blowers
- Equipment Controls

INSPECTION ACTIONS

Condition Assessment Survey of Conveying Systems to include visual survey, examination of building records, and analysis. Points include:

Prior to Shutdown:

1. Observe operation of motor; note normal unit start-up and shut-off and the associated time interval.
2. Check voltage at motor and current draw. Compare to motor ratings and the requirements of the associated pump or compressor.
3. Check motor RPM with tachometer or stroboscope (compare with manufacturer's spec).
4. Perform vibration analysis on the motor.

Unit Shutdown:

5. Turn off unit and lock out disconnect,
6. Tag out all electrical devices.

Shutdown Inspection:

7. Open motor and inspect interior housing for stress cracks, corrosion, other physical damage.
8. Check stator windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
9. Check rotor windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
10. Check commutator/slip rings for loose parts, physical damage, wear.
11. Check brushes for wear, proper tension.
12. Check bearings for lube leakage into motor.

INSPECTION METHODS - NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: MOTORS (Continued)
CONTROL NUMBER: GSNS 0.07.01.05

INSPECTION ACTIONS

Shutdown Inspection:

13. Check motor shafting for wear.
14. Reassemble motor.
15. Rotate motor shaft and check for binding, rubbing.
16. Measure runout play in bearings due to wear (compare with manufacturer's spec).
17. Open and inspect local disconnect;' check for proper tension on blading, good blades alignment, signs of overheating.
18. Open and inspect motor starter; check for contacts for pitting, good alignment, smooth action, signs of overheating.
19. Check wiring in disconnect and starter for worn, frayed insulation, loose connections.

Return to Service:

20. Ensure all tools, equipment, and materials used for inspection have been removed from the unit.
21. Ensure that all guards and covers have been reinstalled.
22. Notify affected personnel and obtain permission to place unit back in service.
23. Restore switches to normal position.
24. Remove lockout on disconnect and restore unit to service.
25. Remove tags from all devices.

TOOLS & MATERIALS

1. Non-Standard inspection Tools - Conveying/Electrical
2. As required for the type of test being performed

INSPECTION METHODS - NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: MOTOR-GENERATORS
CONTROL NUMBER: GSNS 0.07.01.06

APPLICATION

This guide applies to all non-standard inspection procedures for all motor-generator sets and related components (conduit, fittings, switches, controls, etc.) used in conveying systems.

SPECIAL INSTRUCTIONS

1. Review mechanical and electrical plans to determine systems and areas affected by equipment/system outage.
2. Review manufacturer's or installer's instructions.
3. Inspection should be scheduled when system is not in use.
4. Notify affected personnel and obtain permission to take unit out of service.
5. Obtain necessary tools, equipment, and materials.

NOTE: Motors greater than 10 HP will be surveyed by the electrical crew.

CONCURRENT ACTIONS

Inspect associated:
- Elevators
- Drive Assemblies
- Equipment Controls

INSPECTION ACTIONS

Condition Assessment Survey of Conveying Systems to include visual survey, examination of building records, and analysis. Points include:

Prior to Shutdown:

1. Observe operation of motor-generator; note normal unit start-up and shut-off and the associated time interval.
2. Check voltages at set and current draw. Compare to ratings and the requirements of the associated systems.
3. Check motor RPM with tachometer or stroboscope (compare with manufacturer's spec).
4. Perform vibration analysis on the set.

Unit Shutdown:

5. Turn off unit and lock out disconnect.
6. Tag out all electrical devices.

Shutdown Inspection:

7. Open motor-generator set and inspect interior housing for stress cracks, corrosion, other physical damage.
8. Check stator windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
9. Check rotor windings for dirt, moisture, physical damage, signs of overheating, loose fasteners.
10. Check commutator/slip rings for loose parts, physical damage, wear.
11. Check brushes for wear, proper tension.
12. Check bearings for lube leakage into set.

INSPECTION METHODS - NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: MOTOR-GENERATORS (Continued)
CONTROL NUMBER: GSNS 0.07.01.06

INSPECTION ACTIONS

Shutdown Inspection:

13. Check shafting for wear.
14. Reassemble motor-generator set.
15. Rotate shafting and check for binding, rubbing.
16. Measure runout play in bearings due to wear (compare with manufacturers spec).
17. Open and inspect local disconnect; check for proper tension on blading, good blade alignment, signs of overheating.
18. Open and inspect controller; check for contacts for pitting, good alignment, smooth action, signs of overheating.
19. Check wiring in disconnect and starter for worn, frayed insulation, loose connections.

Return to Service:

20. Ensure all tools, equipment, and materials used for inspection have been removed from the unit.
21. Ensure that all guards and covers have been reinstalled.
22. Notify affected personnel and obtain permission to place unit back in service.
23. Restore switches to normal position.
24. Remove lockout on disconnect and restore unit to service.
25. Remove tags from all devices.

TOOLS & MATERIALS

1. Non-Standard Inspection Tools - Conveying/Electrical
2. As required for the type of test being performed.

INSPECTION METHODS - NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: PIPE & ACCESSORIES
CONTROL NUMBER: GSNS 0.07.01.07

APPLICATION

This guide applies to all non-standard inspection procedures for piping and related distribution components (fittings, valves, hangers, insulation, etc.) used in conveying systems such as hydraulic elevators.

SPECIAL INSTRUCTIONS

1. Review mechanical and electrical plans to determine systems and areas affected by equipment/system outage.
2. Inspection should be scheduled when system is not in use.
3. Notify affected personnel and obtain permission to take unit out of service.
4. Obtain necessary tools, equipment, and materials.
5. This is an invasive inspection and should be performed in conjunction with a system shutdown and overhaul. Specific deficiencies should be handled on a repair call basis.

CONCURRENT ACTIONS

Inspect associated:
- Escalators
- Hydraulic Plants
- Equipment Controls

INSPECTION ACTIONS

Condition Assessment Survey of Conveying Systems to include visual survey, examination of building records, and analysis. Points include:

1. Open and inspect all backflow preventors; check for worn or loose discs, guide assemblies seats: Note any corrosion buildup that could interfere with preventor operation.
2. Open and inspect strainers in distribution piping; check damage to basket; note excessive corrosion that may restrict flow or permit solids passage through system.
3. Cycle all major valves to check for proper operation; note binding; proper seating.
4. Open critical valves; check for worn or loose discs and guide assemblies; check for worn seats; note any corrosion buildup that could interfere with valve operation.
5. Open and inspect section of distribution piping; check interior for scale buildup; note excessive scaling that will restrict flow through system.
6. With system in operation but out of normal service, cycle regulating valves to check for smooth operation and proper response to control adjustments. Record any defects, inability to obtain needed performance.
7. Perform leak test on pressurized systems.

TOOLS & MATERIALS

1. Non-Standard Inspection Tools - Conveying
2. As required for the type of test being performed.

INSPECTION METHODS - NON-STANDARD

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INSPECTION METHODS . NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: HYDRAULIC ELEVATORS
CONTROL NUMBER: GSNS 0.07.02.01

APPLICATION

This guide applies to all non-standard inspection procedures for elevator cabs, hoistways, and related components (lift cylinders, buffers, guide rails, fittings, valves, etc.) used for all hydraulic elevators.

SPECIAL INSTRUCTIONS

1. Review mechanical and electrical plans to determine systems and areas affected by equipment/system outage.
2. Inspection should be scheduled when system is not in use.
3. Notify affected personnel and obtain permission to take unit out of service.
4. Obtain necessary tools, equipment, and materials.
5. This is an invasive inspection and should be performed in conjunction with a system shutdown and overhaul. Specific deficiencies should be handled on a repair call basis.

CONCURRENT ACTIONS

Inspect associated:

- Hydraulic Plants
- Pipe & Accessories
- Motors
- Equipment Controls

INSPECTION ACTIONS

Condition Assessment Survey of Conveying Systems to include visual survey, examination of building records, and analysis. Points include:

Prior to Shutdown, Ride the Elevator and:

1. Check operation of all car and floor controls; note erratic performance.
2. Check for noise and vibration; note location.

Unit Shutdown:

3. Turn off unit and lock out disconnect.
4. Tag out all electrical devices.
5. Isolate unit mechanically by securing hydraulic lines.
6. Tag out all secured valves.

Shutdown Inspection:

7. Inspect top of car, general condition.
8. Check contacts, cams, switches, and cables for missing components, loose fasteners, damage, excessive wear.
9. Inspect guides, rollers for wear and other damage.
10. Check clearances between car and hoistway.
11. Inspect door operating mechanisms internally; check for worn cables, linkages; loose fasteners.
12. Check plunger attachment to car; note signs of stress or fatigue.
13. Check extended plunger for wear, scoring, cracking.
14. Check mounting hardware of guide rails for loose or missing fasteners, corrosion.
15. Activate electrical and hydraulic circuits.
16. Manually activate the elevator for hoistway inspection.

INSPECTION METHODS . NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: HYDRAULIC ELEVATORS (Continued)
CONTROL NUMBER: GSNS 0.07.02.01

INSPECTION ACTIONS

Shutdown Inspection:

17. Check hoistway for damaged/defective concrete/block, etc.
18. Check guide rails for wear, loose fasteners.
19. Check electrical conduit, cables, pendants, etc. for wear, damage, loose fasteners.

Return to Operation:

20. Ensure all tools, equipment, and materials used for inspection have-been removed from the unit.
21. Ensure that all guards and covers have been reinstalled.
22. Notify affected personnel and obtain permission to place unit back in service.
23. Restore valving to normal position.
24. Remove lockout on disconnect and restore unit to service.
25. Remove tags from all devices.

TOOLS & MATERIALS

1. Non-Standard Inspection Tools - Conveying
2. As required for the type of test being performed.

INSPECTION METHODS . NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: TRACTION ELEVATORS
CONTROL NUMBER: GSNS 0.07.02.02

APPLICATION

This guide applies to all non-standard inspection procedures for elevator cabs, hoistways, and related components (fittings, cables, buffers, etc.) for all traction elevators.

SPECIAL INSTRUCTIONS

1. Review mechanical and electrical plans to determine systems and areas affected by equipment/system outage.
2. Inspection should be scheduled when system is not in use.
3. Notify affected personnel and obtain permission to take unit out of service.
4. Obtain necessary tools, equipment, and materials.
5. This is an invasive inspection and should be performed in conjunction with a system shutdown and overhaul. Specific deficiencies should be handled on a repair call basis.

CONCURRENT ACTIONS

Inspect associated:
- Drive Assemblies
- Motors
- Motor Generators
- Equipment Controls

INSPECTION ACTIONS

Condition Assessment Survey of Conveying Systems to include visual survey, examination of building records, and analysis. Points include:

Prior to Shutdown, Ride the Elevator and:

1. Check operation of all car and floor controls; note erratic performance.
2. Check for noise and vibration; note location.

Unit Shutdown:

3. Turn off unit and lock out disconnect.
4. Tag out all electrical devices.

Shutdown Inspection:

5. Inspect top of car, general condition.
6. Check attachment of hitch plate to car; note signs of stress and fatigue.
7. Inspect hoist rope attachment for wear, fraying, other physical damage; note any corrosion.
8. Check contacts, cams, and switches for missing components, loose fasteners, damage, excessive wear.
9. Inspect guides, rollers for wear and other damage.
10. Check clearances between car and hoistway.
11. Inspect door operating mechanisms internally; check for worn cables, linkages; loose fasteners.
12. Check mounting hardware of guide rails for loose or missing fasteners, corrosion.
13. Inspect compensator for damage, wear, corrosion, loose fasteners.
14. Inspect governor tension sheave for damage, wear, corrosion, loose fasteners.
15. Activate electrical circuits.
16. Manually activate the elevator for hoistway inspection.
17. Check hoistway for damaged/defective concrete/block etc.

INSPECTION METHODS - NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: TRACTION ELEVATORS (Continued)
CONTROL NUMBER: GSNS 0.07.02.02

INSPECTION ACTIONS

Shutdown Inspection:

18. Inspect hoist cables for wear, fraying, other physical damage; note any corrosion.
19. Inspect governor cable for wear, fraying, other physical damage; note any corrosion.
20. Check guide rails for wear, loose fasteners.
21. Check electrical conduit, cables, pendants, etc. for wear, damage, loose fasteners.
22. Inspect counterweight assembly; note any corrosion, loose fasteners..

Return to Operation:

23. Ensure all tools, equipment, and materials used for inspection have been removed from the unit.
24. Ensure that all guards and covers have been reinstalled.
25. Notify affected personnel and obtain permission to place unit back in service.
26. Remove lockout on disconnect and restore unit to service.
27. Remove tags from all devices.

TOOLS & MATERIALS

1. Non-Standard Inspection Tools - Conveying
2. As required for the type of test being performed.

INSPECTION METHODS • NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: ESCALATORS
CONTROL NUMBER: GSNS 0.07.02.03

APPLICATION

This guide applies to all non-standard inspection procedures for escalator flights, mounting structures, and related components (guides, covers, fittings, etc.) used for all escalators.

SPECIAL INSTRUCTIONS

1. Review mechanical and electrical plans to determine systems and areas affected by equipment/system outage.
2. Inspection should be scheduled when system is not in use.
3. Notify affected personnel and obtain permission to take unit out of service.
4. Obtain necessary tools, equipment, and materials.
5. This is an invasive inspection and should be performed in conjunction with a system shutdown and overhaul. Specific deficiencies should be handled on a repair call basis.

CONCURRENT ACTIONS

Inspect associated:
- Drive Assembly
- Motors
- Equipment Controls

INSPECTION ACTIONS

Condition Assessment Survey of Conveying Systems to include visual survey, examination of building records, and analysis. Points include:

Prior to Shutdown, Ride the Escalator and:

1. Check operation of all flight controls; note erratic performance.
2. Check for noise and vibration; note location.

Unit Shutdown:

3. Turn off unit and lock out disconnect.
4. Tag out all electrical devices.
5. Block off escalator access and post signage.

Shutdown Inspection:

6. Remove skirt and balustrade panels to access structure.
7. Check truss and tracks for corrosion, loose fasteners, physical damage.
8. Inspect tracks for excessive wear, burrs.
9. Check steps, rollers, and axles for damage, loose fasteners, corrosion.
10. Inspect flight chains for excessive wear, stretch, fatigue, broken links.
11. Inspect top and bottom sprocket assemblies for wear, loose fasteners.
12. Check mounting hardware of hand rails for loose or missing fasteners, corrosion,
13. inspect top and bottom hand rail sheave assemblies for wear, loose fasteners.
14. Replace all access covers and plates.

INSPECTION METHODS - NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: ESCALATORS (Continued)
CONTROL NUMBER: GSNS 0.07.02.03

INSPECTION ACTIONS

Return to Ooeration:

15. Ensure all tools, equipment, and materials used for inspection have been removed from the unit.
16. Ensure that all guards and covers have been reinstalled.
17. Notify affected personnel and obtain permission to place unit back in service.
18. Remove lockout on disconnect and restore unit to service.
19. Remove tags from all devices.

TOOLS & MATERIALS

1. Non-Standard Inspection Tools - Conveying
2. As required for the type of test being performed.

INSPECTION METHODS . NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: PNEUMATIC DUCTWORK &ACCESSORIES
CONTROL NUMBER: GSNS 0.07.03.01

APPLICATION

This guide applies to all non-standard inspection procedures for duct and related distribution components (control stations, diverter valves, fittings, hangers, etc.) used in pneumatic tube conveying systems.

SPECIAL INSTRUCTIONS

1. Review mechanical and electrical plans to determine systems and areas affected by equipment/system outage.
2. Review manufacturer's or installer's instructions.
3. Inspection should be scheduled when system is not in use.
4. Notify affected personnel and obtain permission to take unit out of service.
5. Obtain necessary tools, equipment, and materials.

CONCURRENT ACTIONS

Inspect associated:
- Blowers
- Equipment Controls

INSPECTION ACTIONS

Condition Assessment Survey of Conveying Systems to include visual survey, examination of building records, and analysis. Points include:

Unit Shutdown:

1. Turn off related blowers and fans.
2. Tag out all electrical devices.

Shutdown Inspection:

3. Inspect accessible duct interior.
4. Check interior walls for erosion, corrosion, physical damage.
5. Examine interior of diverter boxes.
6. Check interior walls for erosion, corrosion, housing distortion.
7. Check for damage to diverter tubes; corrosion, distortion, leaking seals.

Shutdown Inspection:

8. Check diverter operating cylinders for leaks, scoring, binding.
9. Check operating linkage/cables for wear, distortion, binding.
10. Inspect control stations for mechanical damage, worn parts, loose or missing fasteners.
11. Check wiring for loose connections, frayed or broken insulation.
12. Check electric controls for worn or pitted contacts, improper safety devices (bypassed or damaged interlocks, fuses).

Return to Service:

13. Ensure all tools, equipment, and materials, used for inspection have been removed from the unit.
14. Ensure all parts, guards and covers have been reinstalled.
15. Notify affected personnel and obtain permission to place unit back in service.
16. Remove lockout on disconnect and restore unit to service.
17. Remove tags from all devices.

INSPECTION METHODS - NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: PNEUMATIC DUCTWORK &ACCESSORIES (Continued)
CONTROL NUMBER: GSNS 0.07.03.010.

TOOLS & MATERIALS

1. Non-Standard Inspection Tools - Conveying
2. As required for the type of test being performed.

END OF SUBSECTION

DATA COLLECTION METHODS

GENERAL

The heart of the CAS System is built around the hand-held data collection device and the CAIS software that supports it. As discussed in the Introduction, this is a "new way" of seeing and recording specific standardized information. Several phases are involved in the CAS inspection process. They include:

PHASE I — PRESURVM

- Facility managers review assets and assign each an Asset Determinant Factor (ADF) to define the level and type of inspection to be accomplished (see Subsection 1 .1 for definition).
- Facility managers assign specific assets to CAS inspectors.
- The CAS Inspector reviews existing asset data (including as-builts and past repair reports) and the Work Breakdown Structure (WBS) systems requiring inspection, which are then subdivided as necessary. (For example, a large roof may be subdivided into four (4) WBS items such as North, South, East and West sections.)
- The inspector establishes the Inspection Units (IU) to be surveyed based on the WBS (or multiple WBS). IUs may also be added in the field.
- Facility manager and/or staff downloads asset data into the hand-held data collection device.

PHASE 2 — SURVEY

- Conduct CAS inspection.
- Upload data into PC-based CAIS.
- Review raw data "universal" reports.

PHASE 3 — POSTSURVEY

- Correct data, as necessary, issue final "universal" report, and create other required reports for facility managers.
- Data and reports are created and issued through DOE hierarchy (see introduction).

DATA COLLECTION METHODS

ENTERING DATA: DATA COLLECTION MENU

SURVEY STEP: **LOGIN** SCREEN 1.0

The screen contains identification data including the inspector's name, ID number, and discipline to be inspected. This data may be input or preloaded. From this screen, several information and help pop-up aids can be accessed. Help functions would provide screen-specific instructions, and information functions would list special management instructions and/or schedules specifically for the inspector.

SURVEY STEP: ASSET IDENTIFICATION SCREEN 2.0

Asset identification including class, type, ADF number (see subsection 1.1 for ADF description), and asset ID numbers are captured on this screen. Pop-up screens with preformatted picklists (for type and class) are provided for the inspector's review and selection. Additional support screens include ASSET LIST showing the inspector's assigned asset list and status: ASSET DIMENSIONS indicating key elements required for inspection (such as asset gross square footage, perimeter, height, etc.); and ASSET DESCRIPTION for recording asset name and address. Such information would be entered (or verified) by the inspector prior to the actual asset CAS inspection.

SURVEY STEP: WBS SELECTION SCREEN 3.0

This screen displays the preselected systems and WBS listings based on the ADF selected for the particular asset. Although all WBS assemblies for a system will be listed, the inspector selects only assemblies applicable to the specific asset. For example, although all system 0.05 Roof WBS categories are listed, the inspector would eliminate all non-applicable categories by "de-selecting" non-applicable items. Once this process is complete, the inspector can re-sort the included WBS items. Columns are also provided that indicate the survey status for each WBS item.

At this point, the inspector can subdivide the WBS. For example, the inspector may elect to split a large roof into four sections, each as a separate WBS, or isolate a pump from a WBS containing several pumps. This feature will allow the inspector to logically build his survey based on the unique properties and requirements of each asset.

Finally, while most WBS structuring will be accomplished prior to the CAS inspection, WBS subdivision can also be done in the field.

DATA COLLECTION METHODS

ENTERING DATA: DATA COLLECTION MENU (Continued)

SURVEY STEP: INSPECTION UNIT (IIl) SELECTION SCREEN 4.0

While screen 3.0 defines the WBS structure, screen 4.0 concerns selecting the IU for each WBS category. In the CAIS software, the base CAS (see subsection 1.1 for definition) is preset at the assembly level for all systems. For example, a WBS Roof System, Built-up Membrane Roofing (0.05.01), is set at the assembly level. At this point the inspector would select the type of assembly based on a preselected picklist. (Such a picklist at the assembly level might include various roof assembly groupings; eg., 3 to 5-ply asphalt with gravel coating and composite insulation.) If a more detailed inspection is required, the inspector would "de-select" the base CAS assembly level by crossing through the LVL Box "Assy." This action would bring up the next level "component." In our roof example, this would mean that the inspector would now assess the membrane, flashing, and insulation as separate components. As with the assembly level, the inspector would choose a type from a selected picklist for each component. Although IUs are usually determined prior to the survey, multiple IUs may also be developed during the inspection. For example, a WBS of the south quadrant built-up roof may be divided into two IUs (eg., sw corner and remaining roof) if the inspector chooses to highlight and isolate some abnormal conditions from the main IU.

Additional information developed on this screen would include the percentage of WBS served by the IU, the estimated quantity (this figure will also be independently generated by CAIS status (see subsection 1.1), estimated life remaining useful without repair (WOR), and estimated age.

SURVEY STEP: DEFICIENCY ASSESSMENT SCREEN 4.1

With the WBS and IU established, the inspector now conducts the CAS inspection for each WBS IU. As the inspector surveys the asset, a preformatted picklist containing all deficiencies that may affect the particular WBS IU is reviewed. The default setting shows a zero in each coverage block, indicating no deficiencies. As the survey proceeds, the inspector "de-selects" this normal setting by entering a percentage of coverage under condition categories listed (light, moderate, severe, and fail). For example, inspector entries for WBS roofing, IU built-up membrane, deficiency "splitting" of 10% light, 0% moderate, 0% severe, 0% fail, would be interpreted by CAIS software as 90% normal, and light splitting occurring over 10% of the membrane. If the inspector cannot determine the condition using standard inspection methods, he can indicate the need for a non-standard inspection (NSIP) by de-selecting the "NO" in the NSIP column. To complete the inspection, the aforementioned procedures would be carried out for each deficiency noted by the inspector.

DATA COLLECTION METHODS

ENTERING DATA: DATA COLLECTION MENU (Continued)

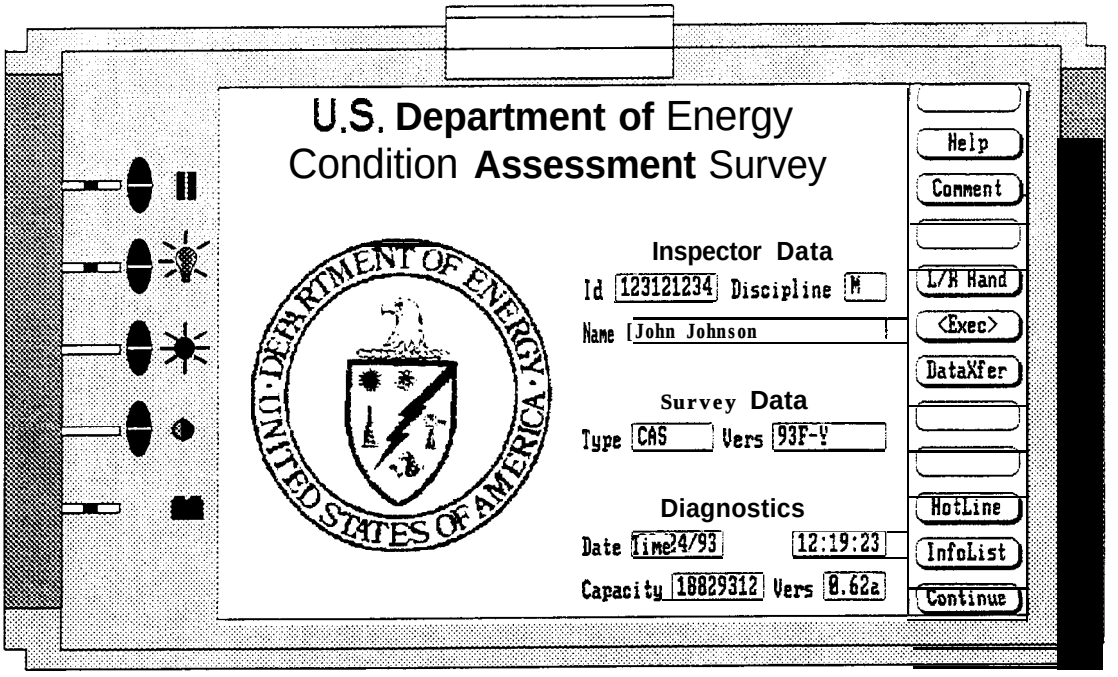
SURVEY STEP: SUMMARY CONDITION ASSESSMENT SCREEN 5.0

This final screen summarizes the WBS IU in three major categories: urgency, purpose, and condition. In each category, the inspector will call up a picklist and select the category he feels is most appropriate for the WBS IU surveyed. (For the purpose category, the inspector may select multiple headings.) Additionally, the inspector may elect to enter an estimated cost and/or quantity. (This is optional as CAIS will generate these data based on the inspector's survey information.) The inspector will also enter an estimated remaining life post-repair. As an option, a work order may be generated based on the CAS survey information. This option is generated by selecting the WORK ORDER function key and filling out pertinent data. Finally, the inspector may choose to describe the repair more fully by selecting the REPAIR CHARACTER key.

After completing all WBS IUs, the CAS inspection for the system is complete. This procedure is repeated for each applicable system. Once all systems for the asset are complete, the information is uploaded to the PC-based CAIS program for data analysis and report generation.

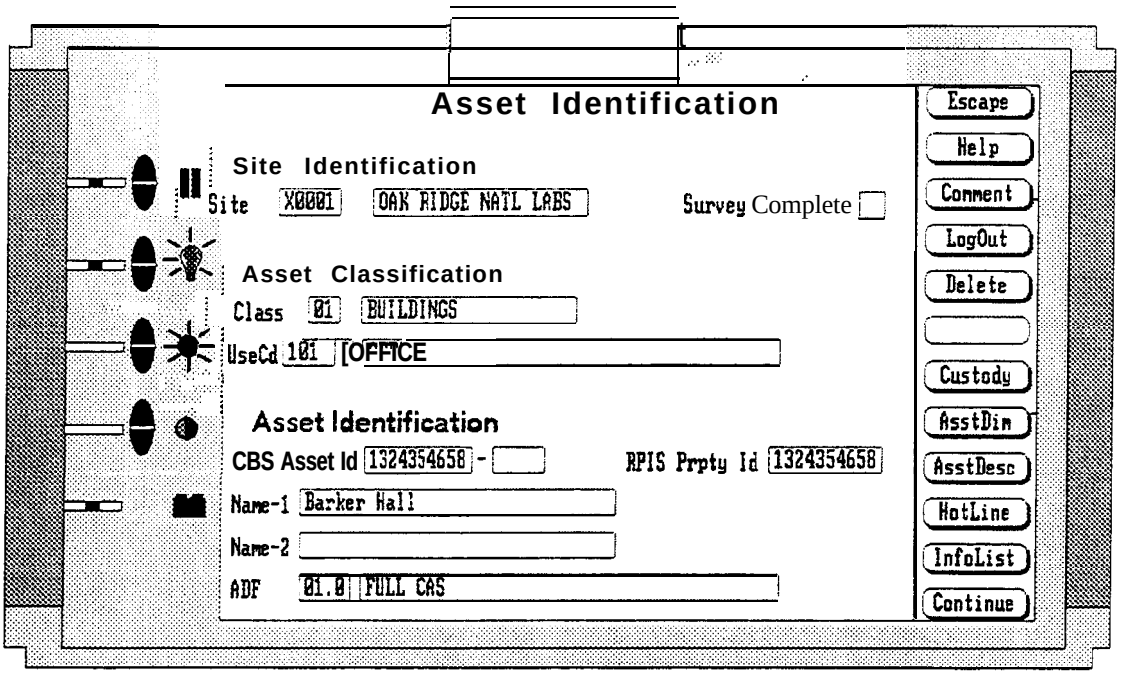
In the remainder of this subsection, actual data screens, as they will appear to the inspector, are displayed to illustrate a typical inspection. As previously noted, five main screens are used in the system supported by numerous "pop-up" lists, information, comment, and other auxiliary screens. In our examples, main screens are numbered 1.0 - 5.0; secondary screens are labeled 1.1, 1.2, etc.; and general support screens use the series 99.0. Key inspector actions on each screen are highlighted. Support function keys are listed below these main functions.

SURVEY STEP LOGIN Screen 1.0



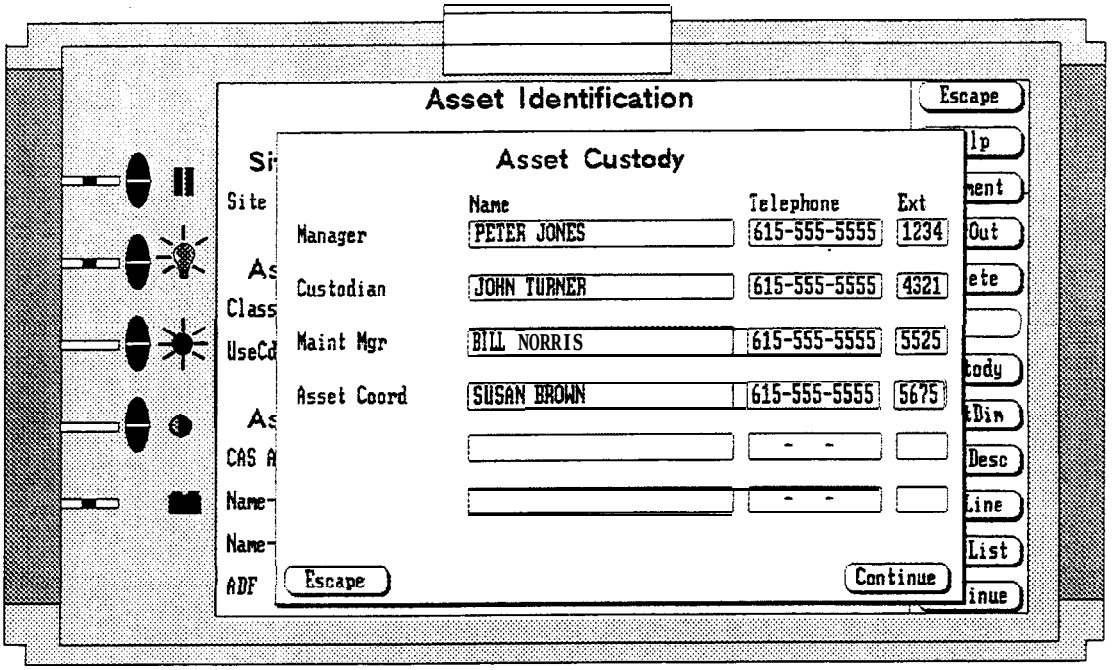
SCREEN	ACTION	COMMENT
1.0	1. Enter Name and Employee Id #	May be preloaded for security
	2. Tap "Discipline" title for picklist, cursor select or enter by pen	Picklist preformatted A=Arch, C=Site/Civil, E=Elec, M=Mech
	3. Tap "Type" and "Vers" title under Survey Data for picklist cursor select or enter by pen	Picklist preformatted for type of survey to be performed and version date for record
	4. Diagnostics data is system generated and for information purposes only	N/A
	5. Press (Continue) to go to Screen 2.0	By pressing (Continue) information is verified; corrections made by crossing through data and entering new information.
(Help)	Press to bring up screen help	Screen 99.1
(Comment)	Press to bring up screen for entering inspector comments	Screen 99.2
(LH/RH)	Press to change screen between Left or Right Hand use	N/A
(<Exec>)	Press to exit to the Grid System Menu	This option can be password protected
(DataXfer)	Press to transfer data to site computer	Used for data upload/download procedures
(Hotline)	Press for important contacts and telephone numbers	Screen 99.3
(InfoList)	Press to bring up information/directions preloaded for inspector	Screen 99.4

SURVEY STEP ASSET IDENTIFICATION Screen 2.0



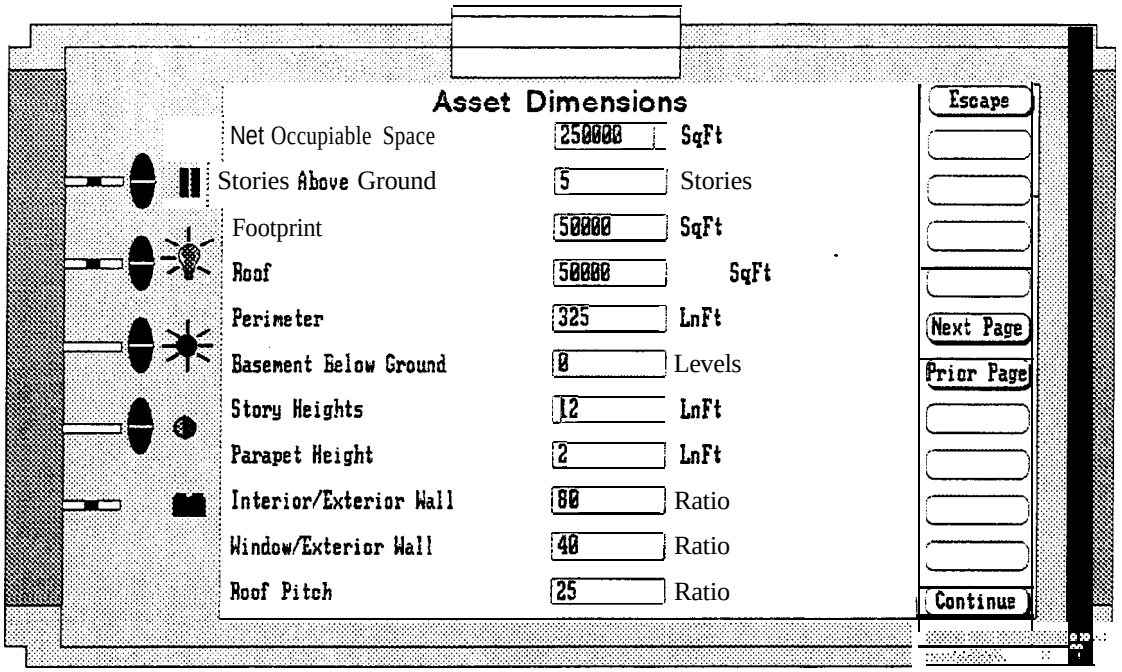
SCREEN	ACTION	COMMENT
2.0	1. Tap "Site" title for picklist Cursor select or enter by pen	Picklist can be preloaded, site code appears automatically to match name selected
	2. Tap "Class" title for picklist Cursor select or enter by pen or skip to item 4	Picklist preformatted based on RPIS categories
	3. Tap "Use Cd" title for picklist Cursor select or enter by pen or skip to item 4	Picklist preformatted based on RPIS categories
	4. Enter Asset Identification information by selecting "CAS Asset Id" corresponding "RPIS Prpty Id" and "Name-1 or Name-2" will be generated	This data can be preloaded
	5. Enter a Split Asset by creating an extension to "CAS Asset ID" and selecting a new name	This data can be preloaded or created by inspector
	6. Enter Asset Determinant Factor "ADF" provided by Site Mgr.	Determined by Site Manager prior to survey
	7. Press box next to Survey Complete upon completion of Asset Survey	N/A
	8. Press (Continue) to go to Screen 3.0	By pressing (Continue) information is verified, corrections made by crossing through data and entering new information
(Escape)	Press to return to Screen 1.0	By pressing (Escape) information is not verified and any changes made are lost
(Help)	Press to bring up screen help	Screen 99.1
(Comment)	Press to bring up screen for entering inspector comments	Screen 99.2
(Logout)	Press to save all data entered and leave survey	N/A
(Custody)	Press to bring up asset contact names	Screen 2.1 This data can be preloaded
(AssetDim)	Press to bring up screen for entering or verifying key asset dimensions	Screen 2.2 This data can be preloaded
(AssetDes)	Press to bring up screen for entering or verifying asset name, address and descriptions	Screen 2.3 This data can be preloaded
(HotLine)	Press for important contacts and telephone numbers	Screen 99.3
(InfoList)	Press to bring up information/directions preioaded for inspector	Screen 99.4

SURVEY STEP ASSET CUSTODY SCREEN Screen 2.1



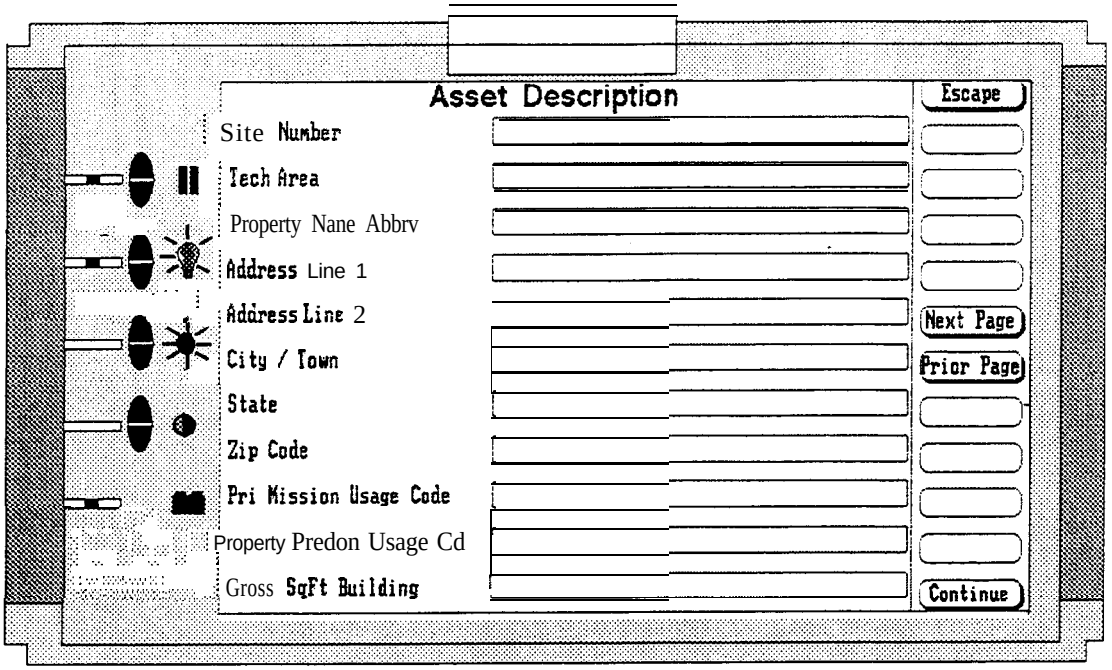
SCREEN	ACTION	COMMENT
2.1	1. Pop up window displays important names and numbers for asset. Cross through data and make any changes	Data can be either preloaded or inspector generated.
	2. Press Continue to return to Screen 2.0	By pressing Continue information is verified; corrections made by crossing through data and entering new information.
Escape	Press to return to Screen 2.0	By pressing- information is not verified and any changes made are lost.

SURVEY STEP ASSET DIMENSIONS Screen 2.2



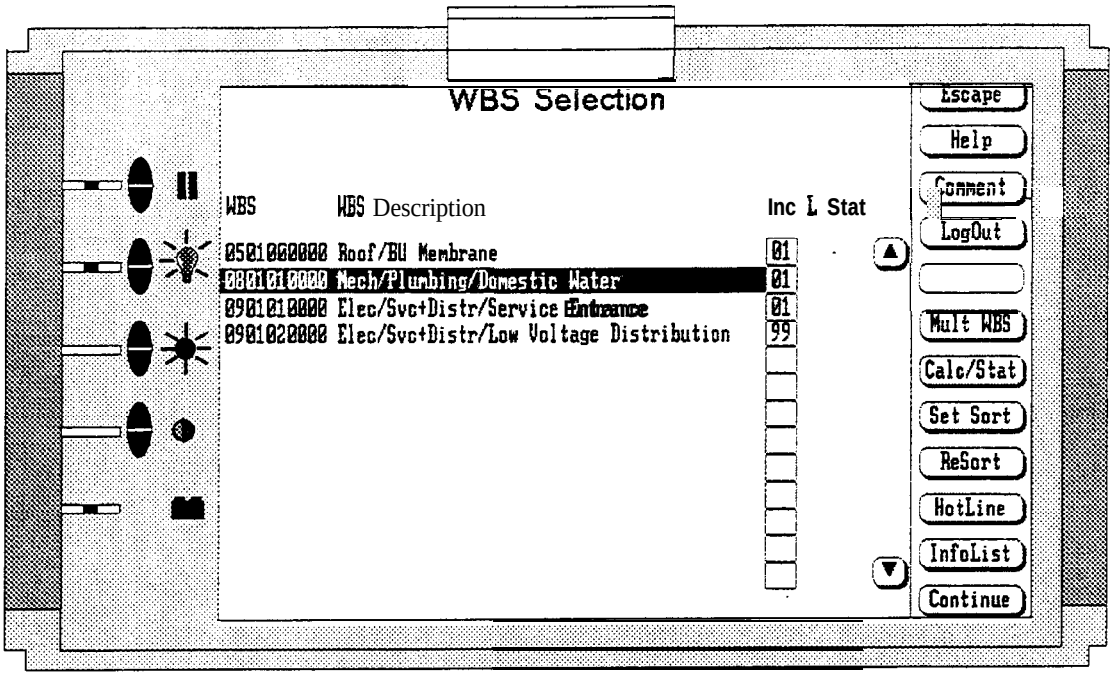
SCREEN	ACTION	COMMENT
2.2	1. Screen displays important dimension related to the asset verify data or cross through data and make any changes	Data can be either preloaded or inspector generated.
	2. Press (Continue) to return to Screen 2.0	By pressing (Continue) information is verified; corrections made by crossing through data and entering new information.
(Escape)	Press to return to Screen 2.0	By pressing (Escape) information is not verified and any changes made are lost.
(NextPage)	Press to bring up next screen of important dimensions	Data can be either preloaded or inspector generated.
(PriorPage)	Press to return to previous asset dimension screen	Data can be either preloaded of inspector generated.

SURVEY STEP ASSET DESCRIPTION Screen 2.3



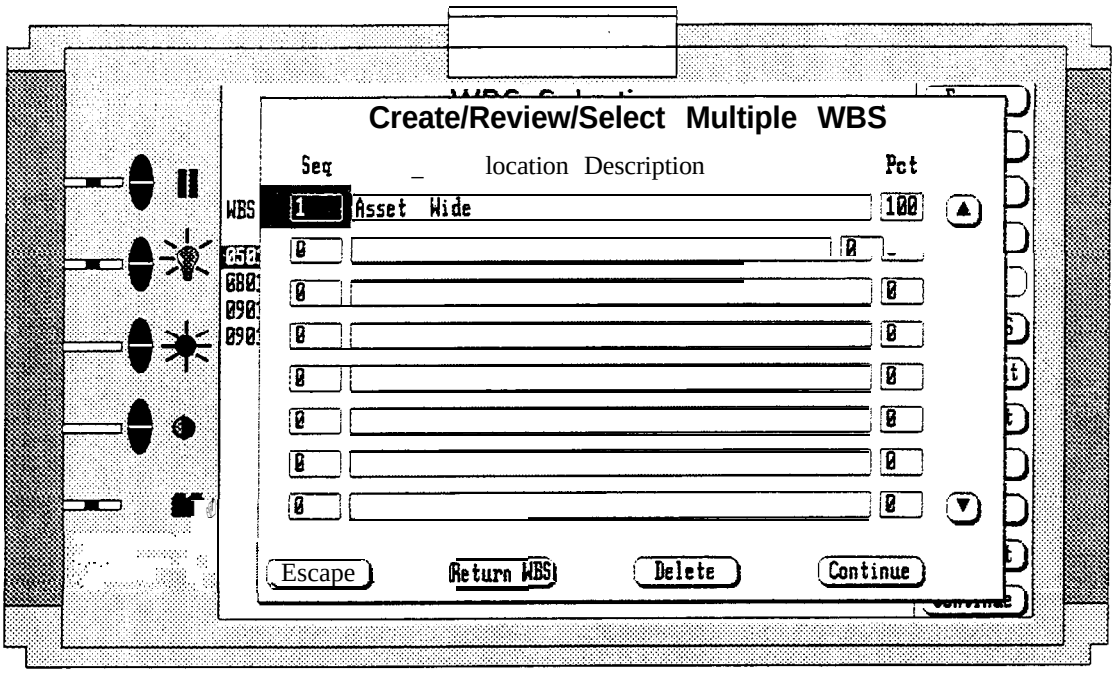
SCREEN	ACTION	COMMENT
2.3	1. Screen displays important asset description information verify data or cross through and make changes	Data can be either preloaded or inspector generated
	2. Press (Continue) to return to Screen 2.0	By pressing (Continue) information is verified; corrections made by crossing through data and entering new information
(Escape)	Press to return to Screen 2.0	By pressing -information is not verified and any changes made are lost
(NextPage)	Press to bring up next screen of important descriptions	Data can be either preloaded or inspector generated
(PriorPage)	Press to return to previous asset description screen	Data can be either preloaded or inspector generated

SURVEY STEP WBS SELECTION Screen 3.0



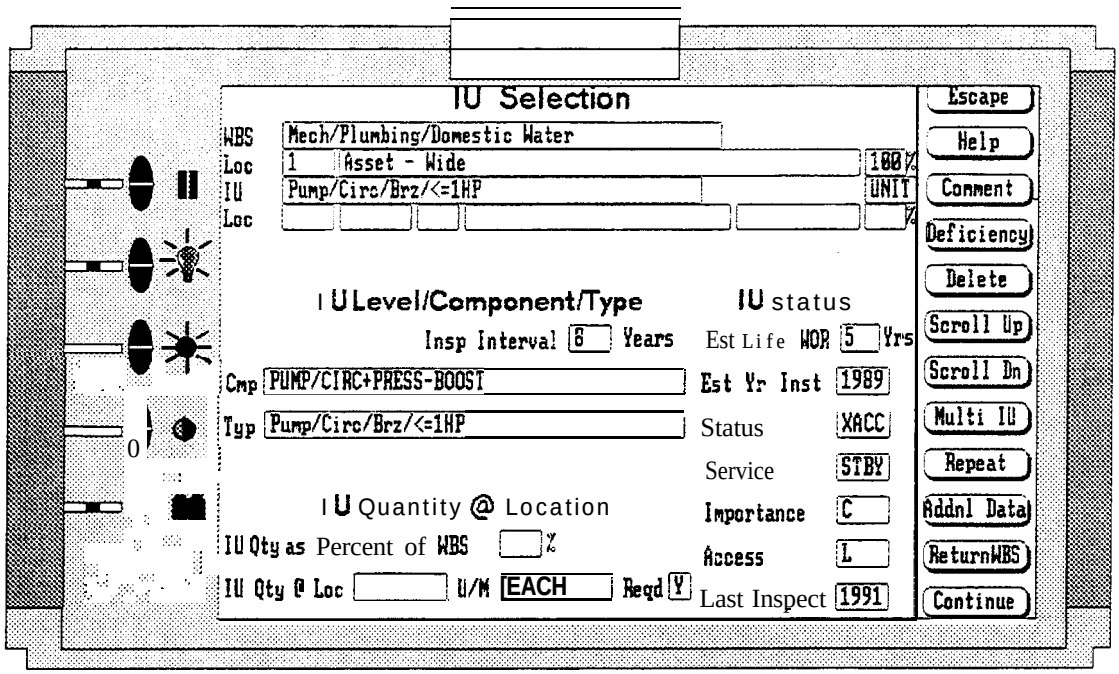
SCREEN	ACTION	COMMENT
3.0	1. Select WBS item to inspect from picklist	Picklist preformatted and is presorted by ADF numbers. Columns at end of WBS list show; "inc" (included) by sort order 1,2,3...; "M" (multiple items); and "Stat" (Status) (In Progress, Complete, or Not Started [*])
	2. All WBS for ADF included on screen, cross through number in "Inc" column to deselect	By crossing through "inc" number, WBS item is deselected
	3. Press (Continue) to go to Screen 4.0	By pressing (Continue) information is verified and inspections units under the selected WBS are loaded
(Escape)	Press to **return to Screen** 2.0	By **pressing** (Escape) **information** is not verified and any changes made are lost.
(Help)	Press to bring up screen help	Screen 99.1
(Comment)	Press to bring up screen for entering inspector comments	Screen 99.2
(Logout)	Press to save all data entered and leave survey	N/A
(Multi WBS)	Press to create, view or select multiple WBS and locations	Screen 3.1
(CalcSort)	Press to recalculate the status of or number of multiple locations	N/A
(SetSort)	Resets the sort sequence of systems, etc. by accessing a **pop-up** window	N/A
(Resort)	Press to resort list in order of priority of WBS items selected	N/A
(HotLine)	Press for important contacts and telephone numbers	Screen 99.3
(InfoList)	Press to bring up information/directions preloaded for inspector	Screen 99.4
▲	Press Scroll Up button	Used to scroll up through information.
▼	Press Scroll Down button	Used to scroll down through information.

SURVEY STEP CREATE/REVIEW/SELECT MULTIPLE WBS Screen 3.1



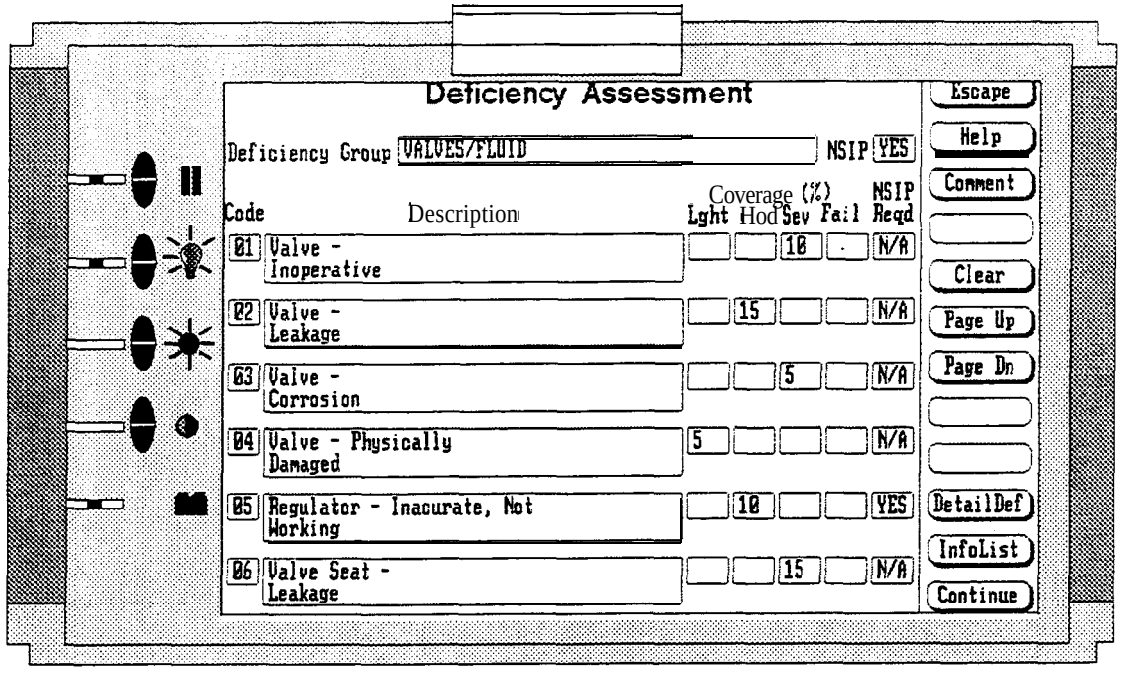
SCREEN	ACTION	COMMENT
3.1	1. Define locations of multiple WBS. Could be multiple systems or multiple parts of single system.	Inspector developed
	2. Define percentage of Asset serviced by WBS section	Inspector developed
	3. Press (Continue) after selecting multiple WBS locations from list and continue to Screen 4.0 to select Inspection Unit (IU).	By pressing (Continue) information is verified; corrections made by crossing through data and entering new information or selecting another item
(Escape)	Press to return to Screen 3.0	By pressing (Escape) information is not verified and any changes made are lost
(RtrnWBS)	Press to return to WBS selection screen to make additional selections	N/A
(Delete)	Press to delete a highlighted entry on screen	N/A
▲	Press scroll up button	Used to scroll up through information.
▼	Press scroll down button	Used to scroll down through information.

SURVEY STEP IU SELECTION Screen 4.0



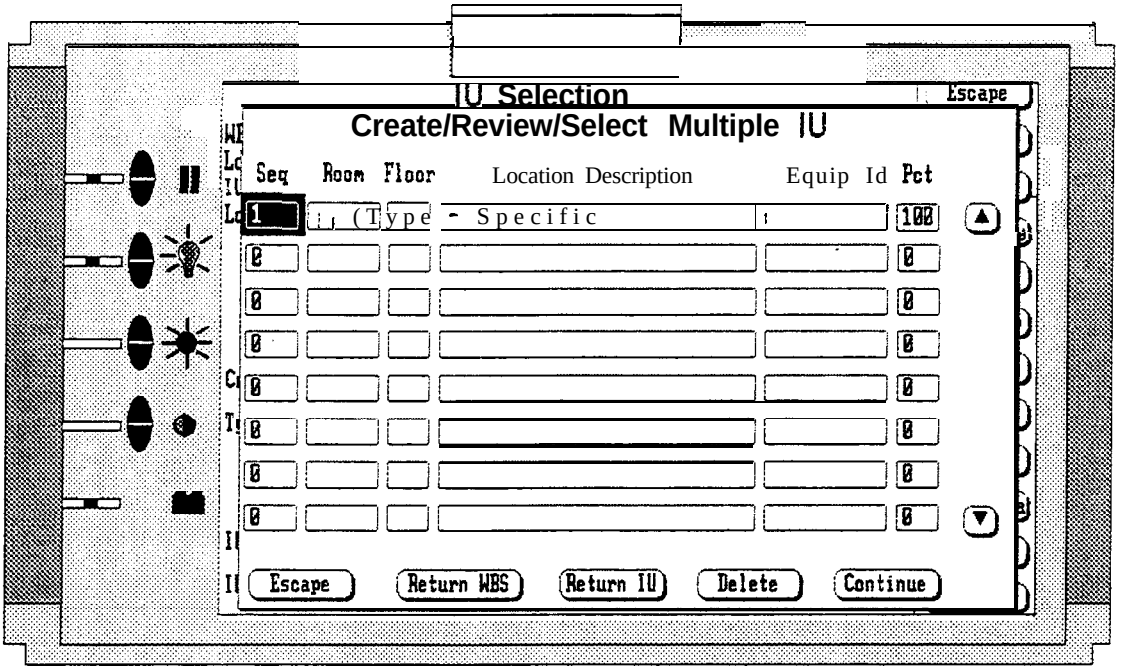
SCREEN	ACTION	COMMENT
4.0	1. Tap "Cmp" title for component picklist Cursor select or enter by pen	Picklist is preformatted
	2. Tap "Typ" title for type of component picklist Cursor select or enter by pen	Picklist is preformatted
	3. Press (Deficiency) to bring up deficiency assessment screen	Screen 4.1 brings up deficiency picklist for WBS IU
	4. Enter estimated life without repair	Inspector generated
	5. Enter estimated year "IU" installed	Inspector generated
	6. Tap "Status" title for picklist Cursor select or enter by pen	Picklist is preformatted
	7. Tap "Service" title for picklist Cursor select or enter by pen	Picklist is preformatted
	8. Tap "Importance" title for picklist	Picklist is preformatted
	9. Tap "Access" title for picklist Cursor select or enter by pen	Picklist is preformatted
	10. Enter year "IU" last inspected	Inspector generated
	11. Enter percentage of WBS served by inspection unit	Inspector generated
	12. Enter quantity of inspection unit at location as required	Inspector generated
	13. Press (Continue) to go to Screen 5.0	By pressing (Continue) information is verified; corrections made by crossing through data and entering new information
(Escape)	Press to return to Screen 3.0	By pressing-information is not verified; and any changes made are lost
(Help)	Press to bring up screen help	Screen 99.1
(Comment)	Press to bring up screen for entering inspector comments	Screen 99.2
(Delete)	Press to delete an inspection unit record	N/A
(Scroll Up)	Press to scroll up thru inspection units selected	N/A
(Scroll Dn)	Press to scroll down thru inspection units selected	N/A
(Multi IU)	Press to create. view. or select multiple IU's and locations	Screen 4.2
(Repeat)	Press to repeat or copy inspection unit selection data as a new entry	N/A
(AddnlData)	Press to bring up Additional Data screen and enter boiler plate information	Screen 4.3 • Inspector generated
(RtrnWBS)	Press to save data entered and go to Screen 3.0 for next selection	By pressing (RtrnWBS) information is verified; corrections made by crossing through data and entering new information

SURVEY STEP DEFICIENCY ASSESSMENT Screen 4.1



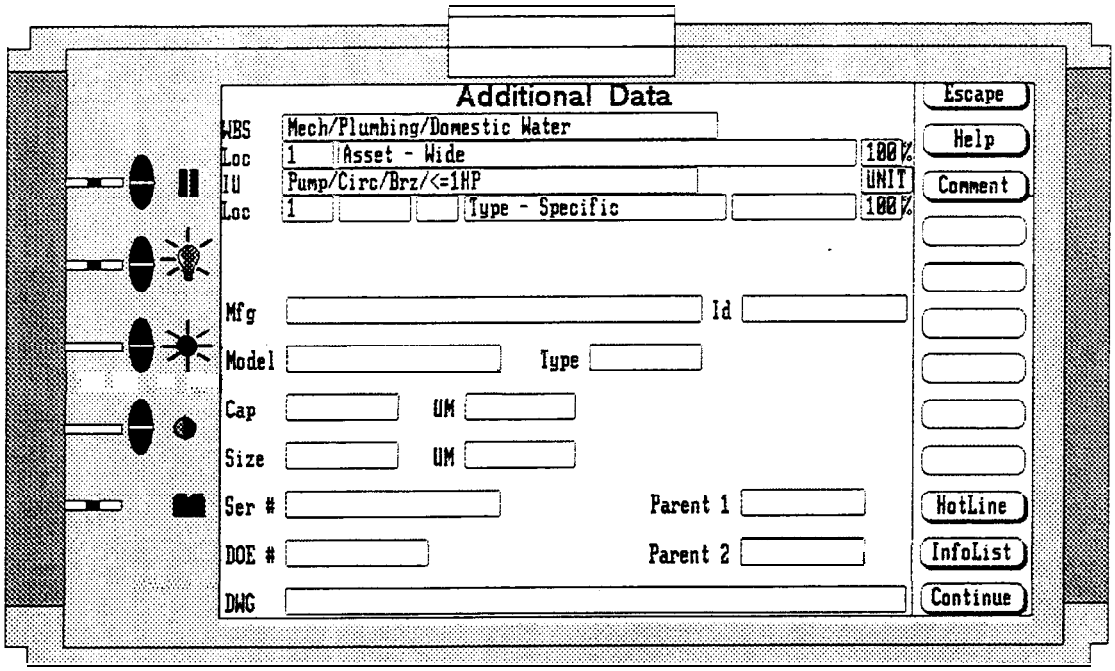
SCREEN	ACTION	COMMENT
4.1	1. Select deficiency from list	Picklist preformatted
	2. Select degree of severity of deficiency	Inspector developed
	3. Enter percentage of coverage under selected severity	Inspector developed
	4. Indicate whether non-standard inspection/test procedures are required or recommended	Inspector choice, preset at "No"; line through to deselect
	5. Press (Continue) to go to Screen 5.0	By pressing (Continue) information is verified; corrections made by crossing through data and entering new information
(Escape)	Press to return to Screen 4.0	By pressing (Escape) information is not verified and any changes made are lost
(Help)	Press to bring up screen help	Screen 99.1
(Comment)	Press to bring up screen for entering inspector comments	Screen 99.2
(Clear)	Press to unselect a deficiency	N/A
(Page Up)	Press to scroll up though data by page	N/A
(Page Dn)	Press to scroll down through data by page	N/A
(Detail Def)	Press to bring up long description of selected deficiency	N/A
(InfoList)	Press to bring up information/directions preloaded for inspector	Screen 99.4

SURVEY STEP CREATE/REVIEW/SELECT MULTIPLE IU Screen 4.2



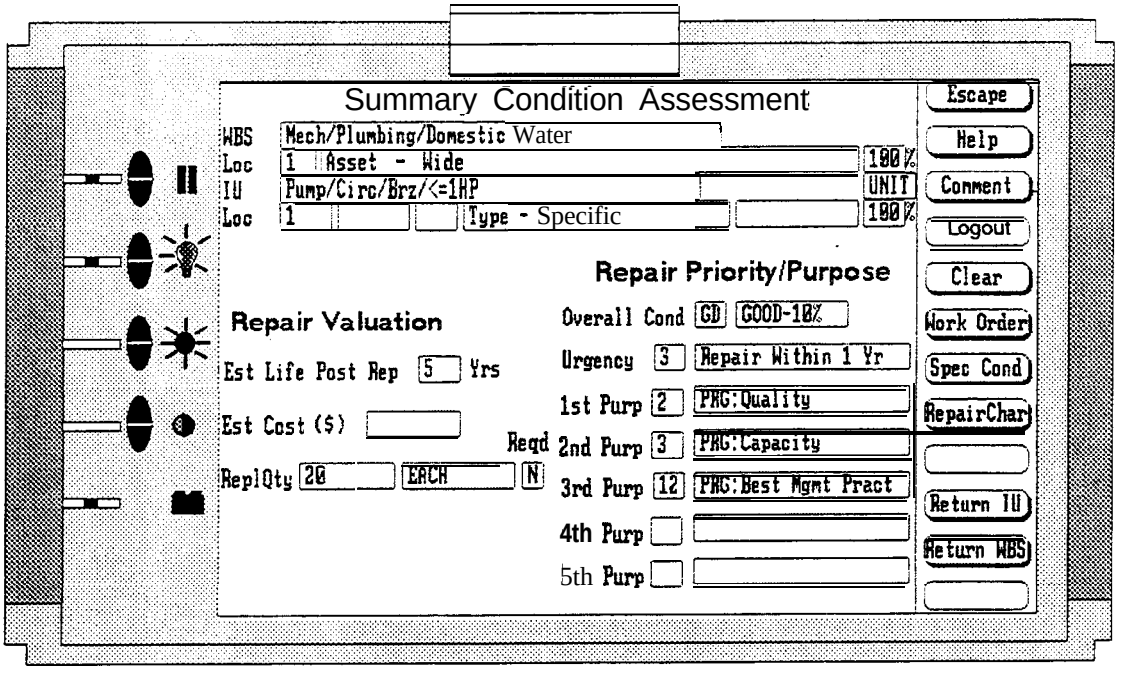
SCREEN	ACTION	COMMENT
4.2	1. Define locations of Multiple IU's by room, floor and/or location description - optional equipment identification number can be added	Inspector developed
	2. Define percentage of Asset or WBS serviced by IU	Inspector developed
	3. Press (Continue) after selecting Multiple IU location from list and continue to Screen 4.1 to select deficiencies	By pressing (Continue) information is verified; corrections made by crossing thru data and entering new information or selecting another item
(Escape)	Press to return to Screen 4.0	By pressing (Escape) information is not verified and any changes made are lost
(RtrnWBS)	Press to return to Screen 3.0	N/A
(RtrnIU)	Press to return to Screen 4.0	N/A
(Delete)	Press to delete a highlighted entry on screen	N/A
▲	Press scroll up button	Used to scroll up through information
▼	Press scroll down button	Used to scroll down through information

SURVEY STEP ADDITIONAL DATA Screen 4.3



SCREEN	ACTION	COMMENT
4.3	1. Enter boiler plate data about component being inspected	Inspector generated from data on the component, drawing specifications or determined in the field. This data can be used for inventorying inspection units
	2. Press (Continue) to go to Screen 4.0	By pressing (Continue) information is verified; corrections made by crossing through data and entering new information
(Escape)	Press to return to Screen 4.0	By pressing (Escape) information is not verified; and any changes made are lost
(Help)	Press to bring up screen help	Screen 99.1
(Comments)	Press to bring up screen for entering inspector comments	Screen 992
(Hotline)	Press for important contacts and telephone numbers	Screen 99.3
(InfoList)	Press to bring up information/directions preloaded for inspector	Screen 99.4

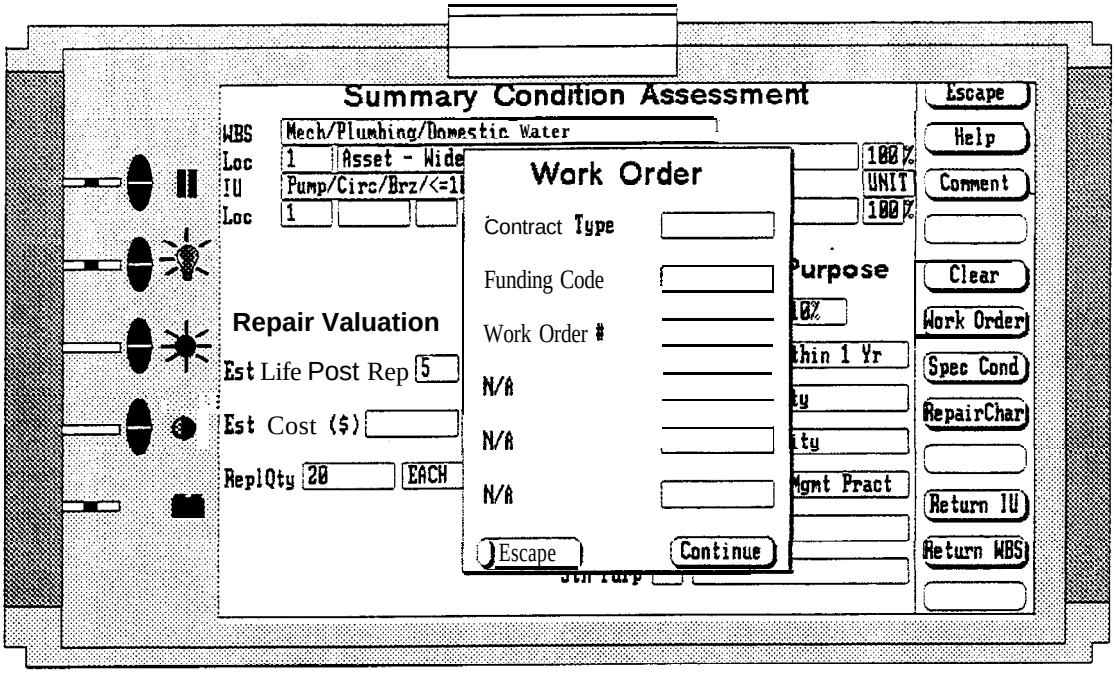
SURVEY STEP SUMMARY CONDITION ASSESSMENT Screen 5.0



SCREEN	ACTION	COMMENT
5.0	1. Tap "Overall Condition" title for picklist Cursor select or select by pen	Picklist preformatted, inspector determined
	2. Tap "Urgency" title for picklist Cursor select or enter by pen	Picklist preformatted, inspector determined
	3. Tap "Purp" title for picklist Cursor select or enter by pen Multiple purposes can be specified	Picklist preformatted inspector determined
	4. Enter estimated life of IU after repairs in years	Inspector determined
	5. Enter an estimated cost for repairs (optional)	Inspector determined
	6. Enter repair quantity as required	Inspector determined
	7. Press to save data entered and go to Screen 4.0 for next selection	By pressing (ReturnIU) information is verified; corrections made by crossing through data and entering new information
	8. Press to save data entered and go to Screen 3.0 for next selection	By pressing (ReturnWBS) information is verified; corrections made by crossing through data and entering new information
(Escape)	Press to return to Screen 4.0	By pressing (Escape) information is not verified and any changes made are lost
(Help)	Press to bring up screen help	Screen 99.1
(Comment)	Press to bring up screen for entering inspector comments	Screen 99.2
(Logout)	Press to save all data entered and leave survey	N/A
(Clear)	Press to clear or delete an entry	N/A
(Work Order)	Press to bring up work order screen pop-up	Screen 5.1
(Spec Cond)	Press to bring up special condition screen pop-up	Screen 5.2
(Repair Char)	Press to bring up special repair characteristics screen pop-up	Screen 5.3

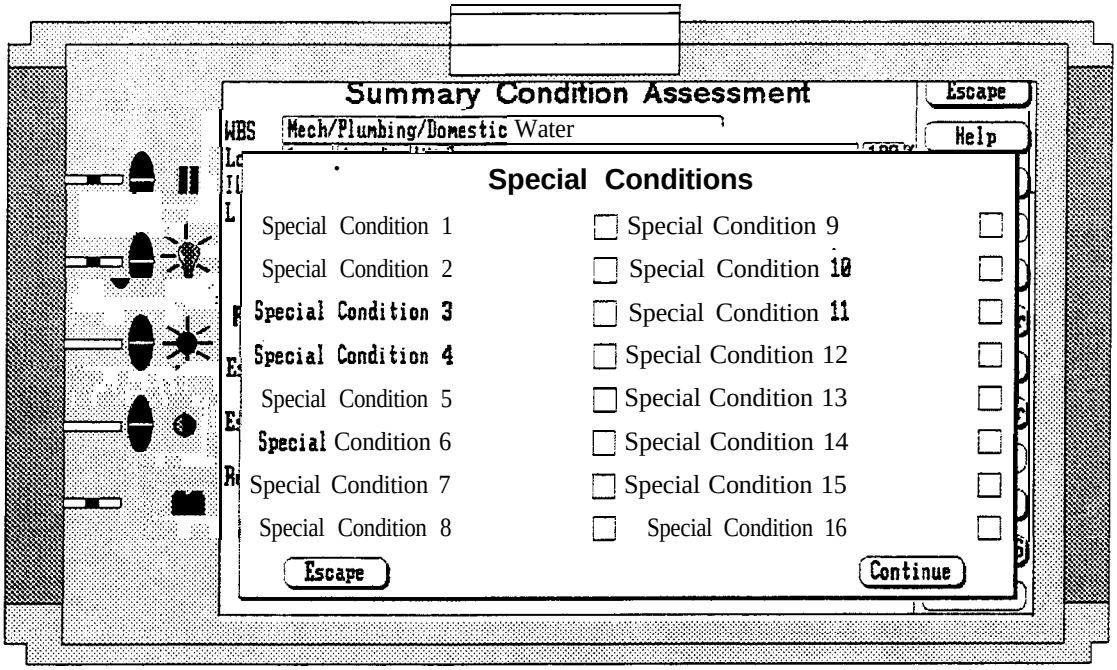
SURVEY STEP WORK ORDER GENERATION

Screen 5.1



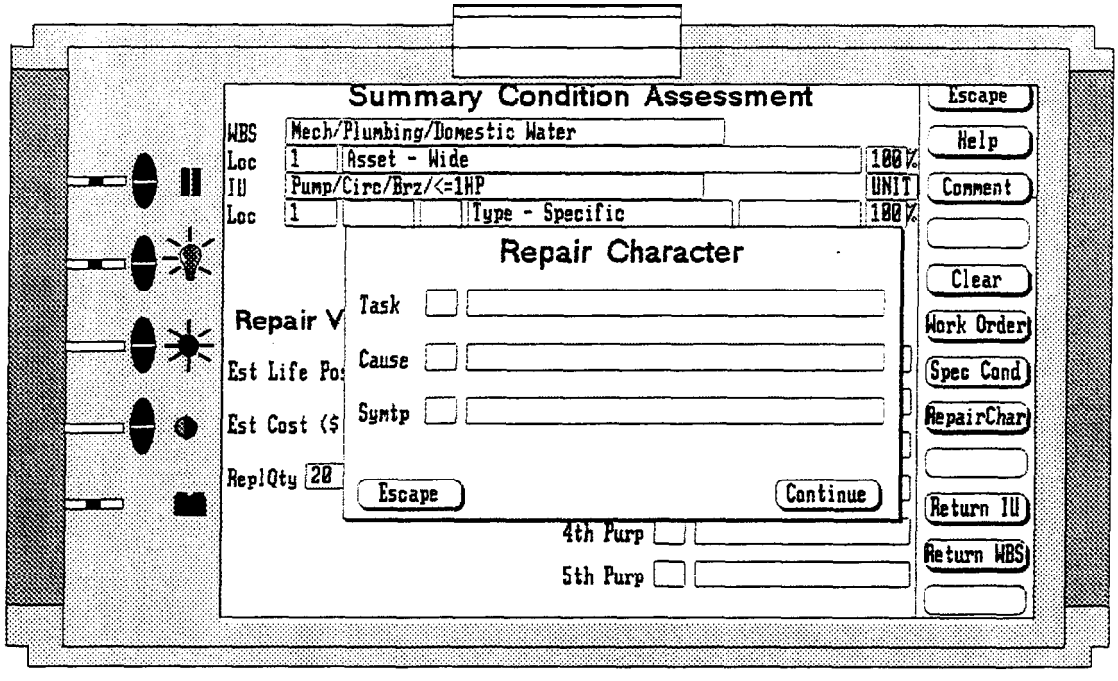
SCREEN	ACTION	COMMENT
5.1	1. Enter data to define Work Order number to tag repair to create a job estimate for repairs	Inspector generated as determined by Site Manager prior to survey
	2. Press (Continue) to go to Screen 5.0	By pressing (Continue) information is verified; corrections made by crossing through data and entering new information
	3. Press (Escape) to return to Screen 5.0	By pressing (Escape) information is not verified; and any changes made are lost

SURVEY STEP SPECIAL CONDITIONS SELECTION Screen 5.2



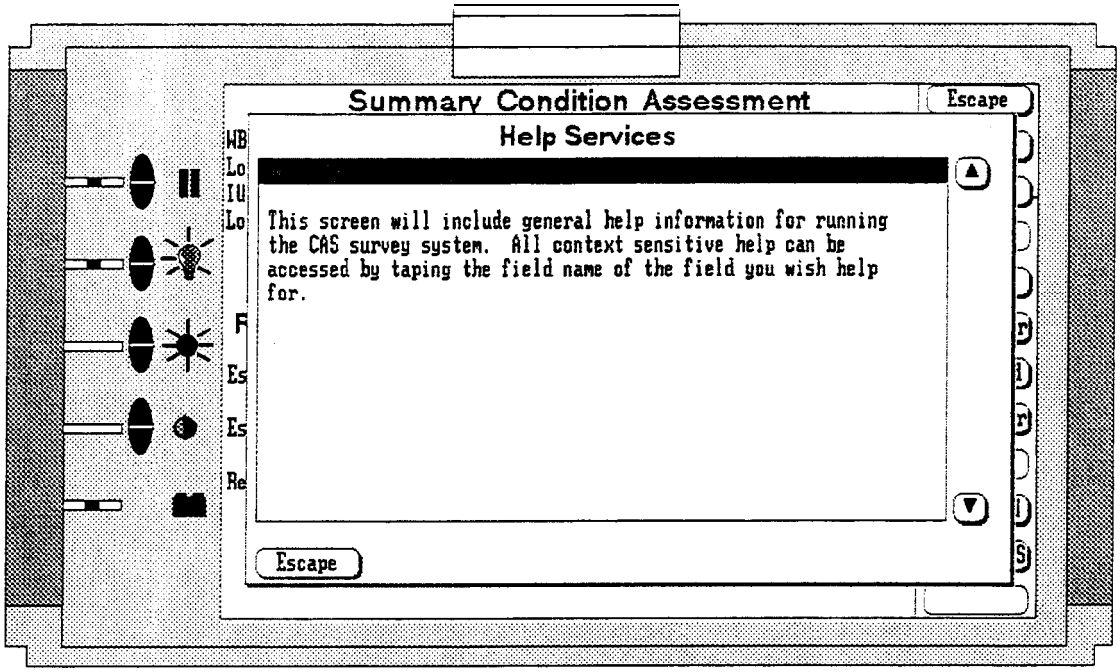
SCREEN	ACTION	COMMENT
5.2	1. Press box next to special condition to select	Picklist is preloaded by site. Selections determined by Site Manager prior to survey
	2. Press Continue to go to Screen 5.0	By pressing Continue information is verified; corrections made by crossing through data and entering new information
	3. Press-to return to Screen 5.0	By pressing Escape information is not verified; and any changes made are lost

SURVEY STEP REPAIR CHARACTER DOCUMENTATION Screen 5.3



SCREEN	ACTION	COMMENT
5.3	1. Enter repair characteristics for tracking related deficiencies	Inspector generated from input of asset users to document what is deficient, what caused deficiency and any symptoms. Picklist can be preformatted
	2. Press (Continue) to go to Screen 5.0	By pressing (Continue) information is verified: corrections made by crossing through data and entering new information
	3. Press (Escape) to return to Screen 5.0	By pressing (Escape) information is not verified; and any changes made are lost

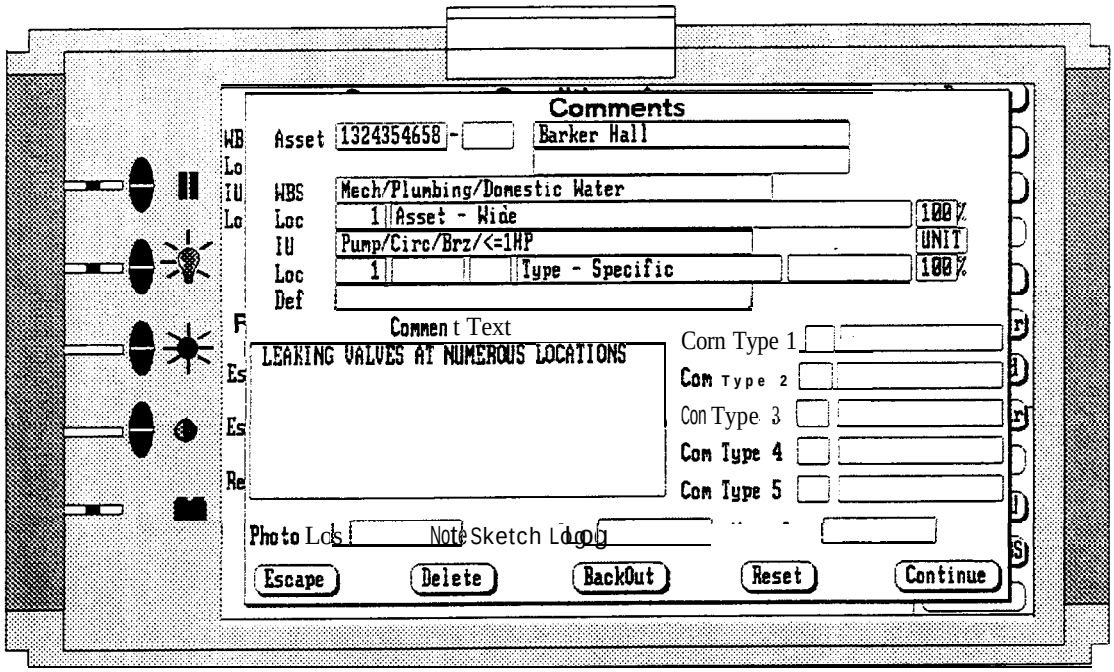
SURVEY STEP HELP Screen 99.1



SCREEN	ACTION	COMMENT
99.1	N/A	Screen pop-up help information Dynamic help for locations selected Screen data cannot be changed
Escape	Press to **exit** Help Screen and return to previous screen	N/A
▲	Press scroll up button	Used to scroll up through information
▼	Press scroll **down** button	Used to scroll down through information

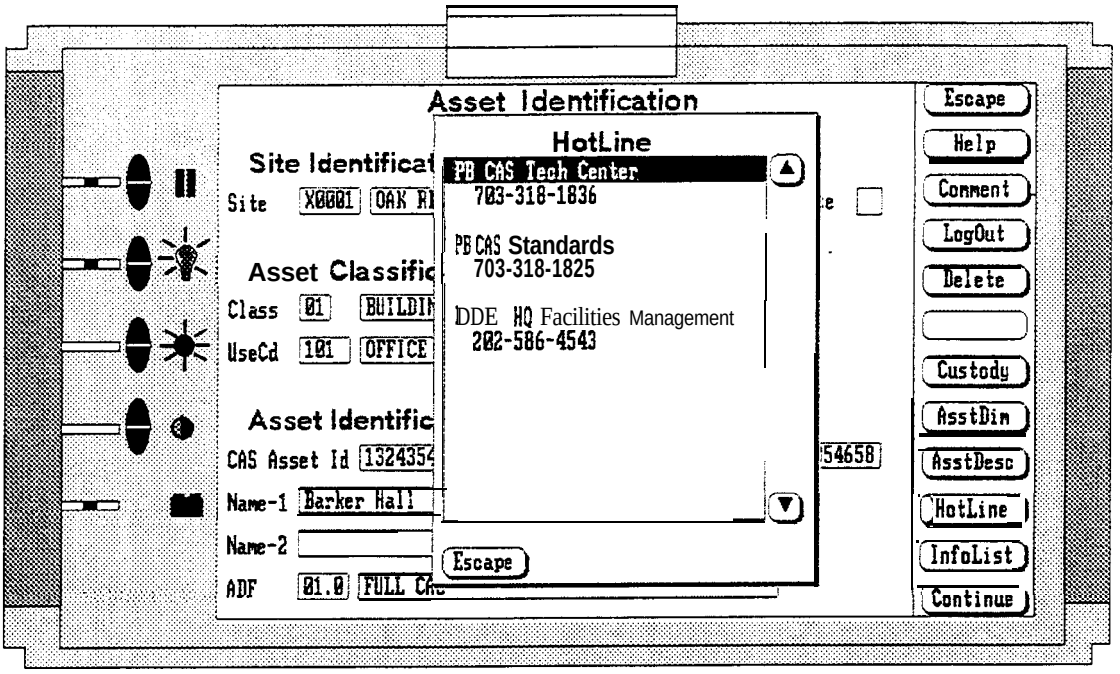
SURVEY STEP COMMENT SCREEN

Screen 99.2



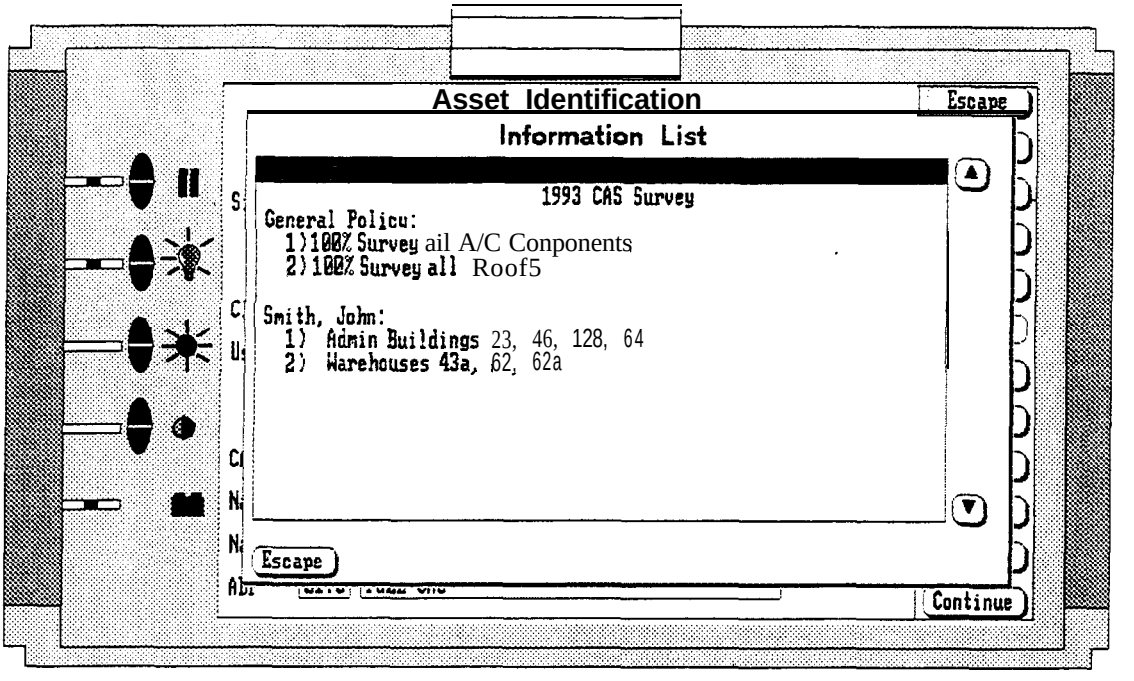
SCREEN	ACTION	COMMENT
99.2	1. Select a Comment Type Selection	Picklist preformatted
	2. Enter Comment inside comment text field (QWERTY keyboard can be called in to use)	Text field expands as required
	3. Enter a Photo, Sketch, or Note Log tag number	Can be standardized or inspector generated
	4. Press (Continue) to return to previous screen	By pressing (Continue) information is verified; corrections made by crossing thru data and entering new information
(Escape)	Press to exit comment screen and return to **previous** screen	By pressing-information is not verified and any changes made are lost
(Delete)	Press to delete a selected comment	N/A
(Backout)	Press to move backwards through the navigation screen at top	This option allows an inspector to move backwards to enter or change a comment tagged to a previous screen
(Reset)	Press to move forward through the navigation screen at top	This option allows an inspector to move forward after entering a comment on a previous screen to continue the inspection

SURVEY STEP HOTLINE SCREEN **Screen 99.3**



SCREEN	ACTION	COMMENT
99.3	N/A	Screen pop-up for important contacts and telephone numbers Preformatted and adjusted by Site Manager. Screen data cannot be changed by inspector.
Escape	Press to exit Hotline screen and return to previous screen	N/A
▲	Press scroll up button	Used to scroll up through information
▼	Press scroll down button	Used to scroll down through information

SURVEY STEP INFO SCREEN Screen 99.4



SCREEN	ACTION	COMMENT
99.4	1. CAS inspection parameters & schedules as inputted by site manager	Cannot be changed by inspector
Escape	Press to exit InfoList screen and return to previous screen	N/A
▲	Press scroll up button	Used to scroll up through information
▼	Press scroll down button	Used to scroll down through information

DATA COLLECTION METHODS

END OF SUBSECTION

FEDERAL SPECIFICATIONS

REFERENCE NUMBER	TITLE
29 CFR 1910	Occupational Safety & Health Standards
DOE 5480.7	Fire Protection
DOE 8430.1 A	DOE General Design Criteria
FS **WW-P460b**	Pipe Fittings, Bronze, Cast
FS WW-P47b	Pipe Fittings, Ferrous, Threaded
GSA PBS P 5850.1 B	Maintenance Guidelines

FEDERAL SPECIFICATIONS

END OF SUBSECTION

NATIONAL STANDARDS

AIR MOVEMENT & CONTROL ASSOCIATION (AMCA)

AMCA 99	Standards Handbook
AMCA 201	Fans and Systems
AMCA 210	Laboratory Methods of Testing Fans for Rating Purposes
AMCA 300	Test Code for Sound Rating
AMCA 301	Method for Calculating Fan Sound Ratings from Laboratory Test Data

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI 816.4	Cast-Iron Threaded Fittings
ANSI 816.5	Steel Flanges and Flanged Fittings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME AI **7.1**	Elevators and Escalators
ASME B16	Fittings Flanges and Valves
ASME 816.1	Cast-Iron Pipe Flanges
ASME 816.11	Forged-Steel Pipe Fittings
ASME 816.22	Copper Tube Fittings
ASME 816.3	Malleable-Iron Pipe Fittings
ASME 816.39	Malleable-Iron Pipe Unions
ASME B16.5	Steel Pipe Flanges
ASME 816.9	Wrought-Steel Pipe Fittings

AMERICAN SOCIETY FOR TESTING & MATERIALS (ASTM)

ASTM A 36	Trapeze and Riser Supports.
ASTM A 47	Malleable-Iron Pipe Fittings
ASTM A 53	Steel Pipe
ASTM AI 06	Steel Pipe Fittings
ASTM AI 20	Steel pipe
ASTM AI 26	Cast iron Valves
ASTM A234	Steel Fittings
ASTM A366	Carbon Steel Sheets
ASTM A460	Stainless Steel Sheets
ASTM A525	G90 zinc coating, mill phosphated.
ASTM A526	Galvanized steel for panel surfaces, internal channels, and trim items
ASTM A527	Galvanized steel as used in breechings
ASTM A536	Ductile-iron pipe fittings
ASTM A569	Black, carbon, hot-rolled steel as used in breechings
ASTM B 62	Bronze Valves
ASTM B 66	Copper Tubing as Drawn Temper, Type L or annealed Type K
ASTM **B117**	Erosion Testing of cooling towers
ASTM **B209**	Aluminum Sheets
ASTM C423	Testing sound absorption coefficients
ASTM **C920**	Flanged joint mastics

NATIONAL STANDARDS

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	Brazing Filler Metals Classification BAg1 (silver).
AWS **D1.1**	Structural Welding Code - Steel
AWS DI.2	Structural Welding Code - Aluminum
AWS DI.3	Structural Welding Code - Sheet Steel
AWS D5.2	Standard for Welded Steel, Elevated Tanks, Standpipes and Reservoirs for Water Storage
AWS **D9.1**	Sheet Metal Welding Code

INSTITUTE OF ELECTRICAL & ELECTRONIC ENGINEERS (IEEE)

IEEE 112	Test Method B for motor efficiency

NATIONAL ASSN OF **PLUMBING/HEATING/COOLING** CONTRACTORS (NAPHCC)

NSPC	National Standard Plumbing Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	Flammable and Combustible Liquids Code
NFPA 68	Explosion Venting
NFPA 70	National Electrical Code
NFPA 71	Standard for Installation, Maintenance and Use of Signaling Systems
NFPA 72E	Automatic Fire Detectors

UNDERWRITERS LABORATORIES (UL)

UL 58	Steel Underground Tanks for Flammable and Combustible Liquids
UL MH 1316	Standard for Glass-Fiber Reinforced Plastic Underground Storage Tanks for Petroleum Products

END OF SUBSECTION

INDUSTRY PUBLICATIONS

PUBLICATIONS	PUBLISHER
UL Building Materials Directory	Underwriters Laboratories, Inc. 333 Pfingsten Road Northbrook, IL 60062

INDUSTRY PUBLICATIONS

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OTHERRELATEDREFERENCES

"Maintenance Engineering Handbook", Lindley R. Higgins, McGraw -Hill Book Company, New York, 1977

"Building and Plant Maintenance Deskbook", Roger W. Liska, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1980.

"Means Facilities Maintenance Standards", Roger W. Liska, R.S. Means Company, Inc., Kingston, Massachussets, 1988.

"Means Mechanical Estimating, Standards and Procedures", William D. Mahoney, R.S. Means Company, Inc., Kingston, Massachussets, 1987.

"The BOCA National Building Code/ 1990", Building Officials & Code Administrators International, Inc., Country Club Hills, Illinois, 1989.

"The BOCA National Mechanical Code/ 1990", Building Officials & Code Administrators International, Inc., Country Club Hills, Illinois, 1990

"Mechanical and Electrical Equipment for Buildings", William J. McGuinness et al., John Wiley and Sons, Inc. , New York, New York 1971.

OTHERRELATEDREFERENCES

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APPENDIX A

ABBREVIATIONS

A, Amp	Ampere, Area
A/E	Architect-Engineer
AA	Aluminum Association
AABC	Associated Air Balance Council
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
ABMA	American Boiler Manufacturers Association
ABS	Acrylonitrile-Butadiene-Styrene
AC	Alternating Current, Air Conditioning
ACFM	Actual Cubic Feet per Minute
ACGIH	American Conference of Governmental Industrial Hygienists
ACI	American Concrete Institute
ACSM	American Congress on Surveying and Mapping
ADF	Asset Determinant Factor
ADJ	Adjustable
ADM	Action Description Memorandum
ADP	Automated Data Processing
AEC	U.S. Atomic Energy Commission
AFM	U.S. Air Force Manual
AFR	U.S. Air Force Regulation
AFWL	U.S. Air Force Weapons
AGA	American Gas Association
AHU	Air Handling Unit
Al A	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ALARA	As Low as Reasonably Achievable
Allow	Allowance
Amb	Ambient
AMC	U.S. Army Materiel Command
AMCA	Air Movement Contractors Association
AMC-R	Army Materiel Command Regulation
Amp	Ampere
ANS	American Nuclear Society
ANSI	American National Standards Institute
API	American Petroleum Institute
Approx.	Approximately
AR	U.S. Army Regulation
AREA	American Railway Engineering Association
ARI	American Refrigeration Institute
ARMA	Asphalt Roofing Manufacturers Association
ASBC	American Standard Building Code
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigeration & Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATM	Atmosphere
AVG	Average
AVLIS	Atomic Vapor Laser Isotope Separation
AWG	American Wire Gauge

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AWS	American Welding Society
AWWA	American Water Works Association
BAT	Best Available Technology
BATEA	Best Available Technology Economically Achievable
BCPCT	Best Conventional Pollutant Control Technology
BESEP	Base Electronic System Engineering Plan
BHP	Brake Horsepower
BI	Black Iron
BIA	Brick Institute of America
BIL	Basic Impulse Insulation Level
BKRS	Breakers
BLDG	Building
BOCA	Building Official Code Association
BOD	Biochemical Oxygen Demand
	Building Research Advisory Board (now Building Research Board)
BRB	Building Research Board
BRG	Bearing
BTU	British Thermal Unit
°C	Degrees Centigrade (Celsius)
C&GS	U.S. Coast and Geodetic Survey (now National Geodetic Survey)
C M	Clean Air Act
CAMS	Continuous Air Monitoring System
CAS	Condition Assessment Survey
CCTV	Closed Circuit Television
CDR	Conceptual Design Report
CEM	Continuous Emissions Monitoring
CERC	U.S. Army Coastal Engineering Research Center
CERCLA	Comprehensive Environmental Response, Compensation, & Liability Act
CF	Cubic Feet
CFC	Chlorofluorocarbon
CFM	Cubic Feet per Minute
CFR	Code of Federal Regulations
CGA	Compressed Gas Association
CHW	Chilled Water
CI	Cast Iron
CIP	Cast-in-Place, Cast Iron Pipe
CISCA	Ceiling and Interior Systems Contractors Association
CISPI	Cast Iron Soil Pipe Institute
CMP	Corrugated Metal Pipe
CO_2	Carbon Dioxide
COE	U.S. Army Corps of Engineers
COMPR	Compressor
COP	Coefficient of Performance
CP	Concrete Pipe
CPLG	Coupling
CPSC	Consumer Product Safety Commission
CPVC	Chlorinated Polyvinyl Chloride
CRI	Carpet and Rug Institute
CRT	Cathode Ray Tube
C_v	Flow coefficient
c w	Cold Water
CWA	Clean Water Act

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CYL	Cylinder
DAC	Derived Air Concentration
DARCOM	U.S. Army Development, Acquisition and Readiness Command
DB	Dry Bulb, Decibel
DBA	Design Basis Accident
DBE	Design Basis Earthquake
DBF	Design Basis Fire
DBFL	Design Basis Flood
DBG	Distance Between Guides
DBT	Design Basis Tornado
DBW	Design Basis Wind
DC	Direct Current
DCG	Derived Concentration Guide
DCPA	Defense Civil Preparedness Agency
DL	Dead Load
DM	NAVFAC Design Manual
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOP	Dioctylphthalate
DOT	U.S. Department of Transportation
DP	Differential Pressure
DP-1	Assistant Secretary for Defense Programs
DP-34	Director of Safeguards and Security Agreement
DPDT	Double-Pole Double-Throw
DSC	Differential Scanning Calorimetry
DTA	Differential Thermal Analysis
DWT	Double Wrap Traction
DWV	Drain, Waste & Vent
DX	Direct Expansion
DYN	Dyne
EA	Each
ECC	Emergency Control Center
ECP	Entry Control Point
EMCS	Energy Monitoring and Control System
ECS	Emergency Control Station
EDE	Effective Dose Equivalent
EED	Electroexplosive Device
EIA	Electronics Industries Association
EIFS	Exterior Insulation and Finish System
EIMA	Exterior Insulation Manufacturers Association
EIS	Environmental Impact Statement
Elev	Elevator
EM	U.S. Army Engineering Manual
EMS	Energy Management System
EMT	Electrical Metallic Tubing
EO	Executive Order
EOC	Emergency Operating Center
EPA	U.S. Environmental Protection Agency
EPS	Emergency Power System
Equip	Equipment
ERDA	Energy Research and Development Administration (precursor to DOE)
ESF	Engineered Safety Feature

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Est	Estimated
Ext	Exterior
°F	Degrees Fahrenheit
F M	Federal Aviation Administration
FAI	Fauske and Associates, Inc.
FAR	Federal Acquisition Regulation
FCC	Federal Construction Council
FEMA	Federal Emergency Management Agency
FGA	Flat Glass Marketing Association
FGCC	Federal Geodetic Control Committee
FGD	Flue Gas Desulphurization
FHWA	Federal Highway Administration
FHDA	Fir and Hemlock Door Association
Fig	Figure
FIPS	Federal information Processing Standards
Fixt	Fixture
Flr	Floor
FM	Factory Mutual
Fndtn	Foundation
FPM	Feet Per Minute
FPT	Female Pipe Thread
FR	Federal Register
fr	Frame
FS	Federal Specifications
FSAR	Final Safety Analysis Report
Ft	Foot, feet
Ft/lb	Foot-Pound
FWPCA	Federal Water Pollution Control Act
fy	Yield strength
G	Gauss
g	Gram
GA	Gypsum Association
ga	Gauge
Gal	Gallon
Galv	Galvanized
GDC	General Design Criteria, DOE 6430.1A
GPD	Gallon Per Day
GPH	Gallon Per Hour
GPM	Gallons Per Minute
GSA	General Services Administration
HE	High Explosives
HE-Pu	High Explosives-Plutonium
HF	High Frequency, Hydrogen Fluoride
HI	Hydraulic Institute
HID	High Intensity Discharge
HLW	High-Level Waste
HOA	Hand-Off-Automatic
HP	Horsepower
HR	Hour
Htg	Heating
Htr	Heater
HTW	High Temperature Water

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HVAC	Heating, Ventilating, and Air-Conditioning
Hvy	Heavy
HW	Hot Water
Hyd	Hydraulic
HX	Heat Exchanger
HZ	Hertz, frequency
IAPMO	International Association of Plumbing and Mechanical Officials
I AS	Intrusion Alarm System
ICBO	International Conference of Building Officials
ICRP	International Commission on Radiological Protection
ID	Inside Diameter
IDA	Intrusion Detection and Assessment
IDS	Intrusion Detection System
IEEE	Institute of Electrical and Electronic Engineers
IES	Illumination Engineering Society
IFM	Irradiated Fissile Material
IFMSF	Irradiated Fissile Material Storage Facility
IHE	Insensitive High Explosives
IMC	Intermediate Metal Conduit
In	Inch
Incl	Installed, Including
Inst	Installation
Insul	Insullation
IP	Iron Pipe
IPS	Iron Pipe Size
IPT	Iron Pipe Threaded
ISDSI	Insulated Steel Door Systems Institute
IU	Inspection Unit
IUEC	International Union of Elevator Contractors
J	Joule
°K	Degrees Kelvin
K	Subgrade modulus, Thousand, heavy wall copper tubing
Kg	Kilogram
kHz	Kilohertz
Kip	1000 pounds
Km	Kilometer
kPa	kilo Pascal
KV	Kilovolt
kVA	kiloVolt Ampere
kW	kilowatt
kWh	kilowatt hour
lb	Pound
lb/hr	Pounds Per Hour
lbf	Pounds Per Foot
LCC	Life-Cycle Cost
LCD	Liquid Crystal Display
LF	Linear Feet
LL	Live load psf - pounds per square foot
LLW	Low-Level Waste
LP	Liquid Petroleum, Low Pressure
LPG	Liquified Petroleum Gas
Lt	Light

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LV	Low Voltage
MA	Management and Administration (U.S. DOE)
mA	milliAmpre
MAA	Material Access Area
Mach	Machine
Maint	Maintenance
MAWP	Maximum Allowable Working Pressure
MBA	Material Balance Area
MBH	Thousand BTUs per Hour
MBMA	Metal Building Manufacturers' Association
MC&A	Material Control and Accountability
MCF	Thousand Cubic Feet
Mfg	Manufacturing
Mfr	Manufacturer
MCC	Motor Control Center
mg	Milligram
mg/l	Milligrams per liter
MGPH	Thousand Gallons Per Hour
Mhs	Megahertz
MI	Miles, total level route
MIL-HDBK	US. DOD military handbook
MIN	Minute
min	Minimum
Misc	Miscellaneous
ml	Millileter
ML/SFA	Metal Lath/Steel Framing Association
mm	Millimeter
M&O	Management and Operations
MPH	Miles Per Hour
MPT	Male Pipe Thread
mr/h	milli roentgen/hour
mrad/h	milli roentgen, absorbed dose/hour
mrem	milli roentgen equivalent man
MSSA	Master Safeguards and Security Agreement
Mtng	Mounting
MVA	Million-Volt-Amps
N_2	Nitrogen
N/A	Not Applicable
NAAMM	National Association of Architectural Metal Manufacturers
NACE	National Association of Corrosion Engineers
NAD	North American Datum
NAEC	National Association of Elevator Contractors
NAESA	National Association of Elevator Safety Authorities
NAPHCC	National Association of Plumbing-Heating-Cooling Contractors
NASA	National Aeronautics and Space Administration
NAVFAC	Naval Facilities Engineering Command
NBC	National Building Code
NBS	National Bureau of Standards
NC	Noise Criteria
NCEL	Naval Civil Engineering Laboratory (references listed under NAVFAC)
NCMA	National Concrete Masonry Association
NDA	Non-Destructive Assay

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NEC	National Electrical Code
NEII	National Elevator Industry Incorporated
NEMA	National Electrical Manufacturers Association
NEMI	National Elevator Manufacturing Industry, Inc. (now NEII)
NEPA	National Environmental Policy Act
NFGS	Naval Facilities Guide Specification (references listed under NAVFAC)
NFPA	National Fire Protection Association
NGS	National Geodetic Survey (formerly U.S.Coast and Geodetic Survey)
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act
NIJ	National Institute of Justice
NIST	National Institute of Standards and Technology (see NBS)
NOAA	National Oceanic and Atmospheric Administration
NO	Normally Open
NO_x	Oxides of Nitrogen
NPDES	National Pollutant Discharge Elimination System
NPDWS	National Primary Drinking Water Standards
NPSH	Net Positive Suction Head
NPT	National Pipe Thread
NRC	Nuclear Regulatory Commission
NRCA	National Roofing Contractors Association
NRTA	Near-Real-Time Accountancy
NRTL	Nationally Recognized Testing Laboratory
NSA	National Security Agency
NSPC	National Standard Plumbing Code
NSPS	New Source Performance Standards
NTIA	National Telecommunications and Information Administration
NTMA	National Terrazzo and Mosaic Association
NUREG	Nuclear Regulatory Commission-produced reference document
NWWDA	National Wood Window and Door Association
OA	Outside Air
OBA	Operating Basis Accident
OBE	Operating Basis Earthquake
OC	On Center
OCS	Office of Computer Services (U.S. DOE)
OD	Outside Dimension
ODH	Oxygen Deficiency Hazards
O & M	Operations and Maintenance
OMB	Office of Management and Budget
OP AMP	Operational Amplifier
Oper	Operator
OPFM	Office of Project and Facilities Management (U.S. DOE)
OS&Y	Outside Screw and Yoke
OSHA	Occupational Safety and Health Administration
OSR	Operational Safety Requirement
OSS	Office of Safeguards and Security (U.S. DOE)
OSTI	Office of Scientific and Technical Information (U.S. DOE)
OWG	Oil, Water, or Gas
Oz	Ounce
P	Minimum reinforcing ratio
PA	Protected area
PB	Polybutylene

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PCB	Polychlorinated biphenyls
PCI	Prestressed Concrete Institute
PEL	Permissible Exposure Limit
PC	Protection Factor
Ph	Phase
PI	Point of Intersection, Proportional-plus Integral
PIV	Post Indicator Valve
PLF	Pounds per Linear Foot
Pkg	Package
PMFL	Probable Maximum Flood
POL	Petroleum, Oil, and Lubricants
POTW	Publicly-Owned Treatment Works
PPHF	Plutonium Processing and Handling Facility
PPM	Parts Per Million
PRV	Pressure Regulating Valve
PSAR	Preliminary Safety Analysis Report
PSF	Plutonium Storage Facility, Pound-force per square foot
PSI	Pound-force per square inch
PSIA	Pounds per square inch absolute
PSIG	Pound-force per square inch gauge
PTI	Post Tensioning Institute
Pu	Plutonium
PUBN	Publication
PURPA	Public Utility Regulatory Policy Act
PVC	Polyvinyl Chloride
QA	Quality Assurance
Qty	Quantity
R	Resistance
R12, R22	Refigerant (12,22, etc.)
°R	Degrees Rankine
RCP	Reinforced Concrete Pipe
RCRA	Resource Conservation and Recovery Act
RDF	Refuse-Derived Fuel
REM	Roentgen Equivalent Man
Reqd	Required
RFCI	Resilient Floor Covering Institute
RG	Regulatory Guide
RLWF	Radioactive Liquid Waste Facility
RPFM	Real Property and Facilities Management (U.S. DOE)
RPIS	Real Property Inventory System (U.S. DOE)
RPM	Revolutions Per Minute
RSWF	Radioactive Solid Waste Facility
RTD	Resistance Temperature Detector
S&S	Safeguards and Security
SAR	Safety Analysis Report
SARS	Safety Analysis and Review System
SAS	Secondary Alarm Station
SC	Safety Class
SCFM	Standard Cubic Feet per Minute
SCR	Sillicon Control Rectifier
SCS	U.S. Department of Agriculture, Soil Conservation Service
SDI	Steel Deck Institute, Steel Door Institute

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SDWA	Safe Drinking Water Act
SF	Safety Factor
SGFT	Structural Glazed Facing Tile
SISL	Special Isotope Separation Laser
SJI	Steel Joist Institute
SMA	Screen Manufacturers Association
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SNG	Supplementary Natural Gas
SNM	Special Nuclear Materials
SO_2	Sulfur dioxide
SOP	Standard Operating Procedure
SP	Special Publication (of the American Concrete Association)
SPCC	Spill Prevention Control and Countermeasure
SPDT	Single-Pole Double-Throw
SPRI	Single Ply Roofing Institute
SPST	Single-Pole Single-Throw
ssco	Single Speed Center-Opening
SQFT	Square foot
SSE	Safe Shutdown Earthquake
SSFI	Scaffolding, Shoring, and Framing Institute
SSSP	Site Safeguards and Security Plan
SSPC	Steel Structures Painting Council.
ssss	Single Speed Side-Sliding
STC	Sound Transmission Classification
Std	Standard
STP	Standard Temperature and Pressure
Sys	System
SWI	Steel Window Institute
SWP	Safe Working Pressure
SWT	Single Wrap Traction
T	Ton, Temperature
TCA	Tile Council of America, Inc.
TCDD	Tetrachlorodibenzo-p-dioxin
TDS	Total Dissolved Solids
TEC	Total Estimated Cost
TID	Tamper Indicating Device
TIMA	Thermal Insulation Manufacturers Association
TLV	Threshold Limit Value
TM	U.S. Army technical manual
tot	Total
TR	DOD technical report
Transf	Transformer
TRU	Transuranic
TSCA	Toxic Substances Control Act
TSD	Treatment, Storage and Disposal
Tstat	Thermostat
TYP	Typical
TV	Television
U value	Overall heat transfer coefficient value
UBC	Uniform Building Code
UCRF	Uranium Conversion and Recovery Facility
UEF	Uranium Enrichment Facility

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UEU	Unirradiated Enriched Uranium
UEUSF	Unirradiated Enriched Uranium Storage Facility
UF_4	Uranium tetrafluoride
UF_6	Uranium hexafluoride
UFAS	Uniform Federal Accessibility Standards
UHF	Ultra High Frequency
UL	Underwriters Laboratory
UMC	Uniform Mechanical Code
UO_2	Uranium dioxide
UO_3	Uranium trioxide
UPA	Unit Process Area
UPC	Uniform Plumbing Code
UPHF	Uranium Processing and Handling Facility
UPS	Uninterruptible Power Supply
URF	Uranium Recovery Facility
USC	U.S. Code
USCE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
USPHS	U.S. Public Health Service
USPS	U.S. Postal Service
V	Volt
VA	Volt-Ampere
Vac	Vacuum
VAV	Variable Air Volume
VCT	Vinyl Composition Floor Tile
Vel	Velocity
Vent	Ventilating
VHF	Very High Frequency
Vol	Volume
W	Watt
WB	Wet Bulb
WBT	Wet Bulb Temperature
WC	Water Column
WG	Water Gauge
WB	Wet Bulb
WBS	Work Breakdown Structure
WPCF	Water Pollution Control Federation
WRC	Water Resources Council
Yd	Yard
Yr	Year

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SYMBOLS

°R'	Degrees Rankine
°K	Degrees Kelvin
°F	Degrees Fahrenheit
°C	Degrees Centigrade (Celcius)
>	Greater Than
<	Less Than
≥	Greater Than or Equal To
≤	Less Than or Equal To
%	Percent
#	Pound, Number
α, A	Alpha
β, B	Beta
ϕ, Φ	Theta
λ, Λ	Lambda
μ, M	Mu
π, Π	Pi
σ, Σ	Sigma
ω, Ω	Omega

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APPENDIX B

GLOSSARY

A-Side:	The left side of an elevator car or hoistway; determined by standing at a front landing entrance and facing the hoist-way.
A-Stand:	(1) On a geared machine, the structure that supports the outboard bearing and end of the drive sheaveshaft. (2) On a gearless machine, the structure that supports either end of the rotating armature shaft assembly and its bearings.
AC Control:	A system where control of the elevator is accomplished through the use of an AC motor driving the hoist machine.
Acceleration:	The operation of advancing the elevator drive motor speed from zero to normal operating speed.
Access Doors:	Doors that provide access to machine rooms, overhead machine spaces, escalator trusses, and other equipment.
Access Switch:	A keyed switch, usually located at a terminal landing, by which means an elevator may be operated with the gate or door and the hoistway door at this landing open to provide a means of access to the top of the car or the hoistway pit.
Accessible:	Having access thereto but which first may require the removal of an access panel, door, or similar obstruction.
Actuator:	A controlled motor that can effect a change in the controlled variable (temperature, pressure) by operating a control element such as a valve or damper.
Adjust:	To regulate the specified fluid flow rate and air patterns at the terminal equipment (eg., reduce fan speed, throttling).
Adjustable Resistor:	A resistor that has taps, sliding bands, or a wiper that when moved allows all or part of the resistor to be used.
Air cord:	A small diameter wire rope commonly used as part of the driving mechanism on door hangers, door operators, and gates. It is also used to drive signal and selector devices. Commonly called Aircraft Cable.
Alert-to-Stop:	That portion of the control used to stop the elevator in response to a call.
Align:	To install and/or adjust to be in a straight line. Usage generally applies to the straightness of guide rails and to the straightness between the centerlines of a motor shaft and a machine shaft.
Aligning Clip:	A clip with a small hole and a set screw, designed to fit over the blade of a rail and hold the aligning wire in the center of the rail. Sometimes called a bug or Johnson clip.

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Aligning Gauge: A thin, flat gauge used for aligning guide rails designed to fit over the blade of the guide rail. It is notched to show when the plumb wire is in the center of the rail and 1/2 inch from the face of it. Used to ensure a straight rail from top to bottom.

Alpha-Numeric Display: A type of display, often used at an alarm receiver console, that uses alphabetic characters (letters and numbers) to convey information.

Ambient Temperature: The temperature of the outdoor air; temperature of the surrounding atmosphere.

Ambient: Surrounding environmental conditions.

Ammeter: An instrument for measuring electrical current flow.

Ampere: A unit of electric current equivalent to a flow of one coulomb per second or to a steady current produced by one volt across a resistance of one ohm.

And Gate: A solid state device manufactured so that its output is at a 1 state only when all inputs are at a 1 state.

Angle of Contact: That portion of a sheave contacted by a rope. Measured in degrees of contact. Sometimes referred to as the angle of wrap or arc of contact.

Annunciator, Car: An electrical device in the car which indicates, visually, the landings at which an elevator landing signal registering device has been activated.

Anti-Creep Feature: An arrangement that compensates for oil leakage in an hydraulic elevator by maintaining the car within one inch of the landing from any point within the interlock zone, without regard to position of the hoistway door.

Approved Equipment: Equipment that has been accepted by the authority having jurisdiction. One frequent criterion for approval is that the equipment must be listed by Underwriters' Laboratories (UL) or approved by Factory Mutual (FM).

Area Differential System: A valve operated by means of opposing pistons of different sizes.

Astragal: A moulding on the leading edge of hoistway and car doors. Usually a rubber moulding extending the full height on center opening doors, and either metal or rubber running the full width of the upper panel on biparting freight type doors.

Automatic **Fire** Alarm System: A system using fire detectors, such as heat, smoke, and flame detectors to automatically initiate alarms.

Auxiliarized **Alarm** System: A building alarm system connected to transmit fire alarm signals to the base alarm headquarters through a municipal type base alarm system.

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Axial Fans:	Fans that produce pressure from a velocity passing through the impeller, with no pressure being produced by centrifugal force.
B-Side:	The right side of an elevator car or hoistway. It is determined by standing at a front landing entrance and facing the hoistway.
Backflow Preventer:	A device or means to prevent backflow.
Baggage Stops:	Protuberances mounted on deck boards of an escalator to prevent passengers from sliding packages or baggage on top of the deck boards as they ride the escalator.
Balance:	To proportion flows within the distribution system (submains, branches, and terminals) according to specified design quantities.
Balanced Traffic:	In group automatic supervisory systems, a period during which the number of up-calls and down-calls is approximately equal.
Balancing Damper:	A plate or adjustable vane installed in a duct branch to regulate the flow of air in the duct.
Balustrade:	The side of an escalator extending above the steps. It includes skirt panels, interior panels, decks, and handrails.
Bar Lock:	A type of door interlock used with manually operated doors.
Basement Machine:	An installation where the elevator machine is placed in the basement or adjacent to hoistway at an upper floor, i.e., not directly over the hoistway.
Basement One-to-One Single Wrap:	An arrangement of hoist ropes with one end of each hoist rope fastened to the counterweight. The ropes then continue up and over the idler sheaves in the overhead and down the hoistway around the machine drive. The ropes then continue up the hoistway, over the idler sheave in the overhead, down, and fasten to the car.
Bayonet Gauge:	A pair of gauges to be attached to the end of a piece of EMT or pipe. These gauges indicate the distance between guides and whether or not the rails are square with one another. Commonly called a rail gauge.
Beam Clamp:	An arrangement of formed steel plates and bolts that can be applied to the flanges of a beam and used to suspend hoisting equipment.
Beam Haunch:	A poured concrete section that extends beyond the beam to support the landing door sill.
Beam Pocket:	An opening in the hoistway hall provided to insert the ends of a machine beam or other beam so the loads can be supported by the wall.

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Belt Elevator:	An elevator in which the prime mover is connected to the machine by a single belt or multiple belts, all parts of which act together, and in which the reversal of direction of the elevator is accomplished by reversing the prime mover. A double belt elevator is an elevator in which the source of power is connected to the machine by a double belt system employing idling pulleys and a belt shifter, and in which direction reversal of the elevator is accomplished by shifting the belts without reversing the prime mover.
Bendergain:	The allowance used when measuring the length of sheet metal, conduit, or any other material that must be of an accurate length when bent.
Blade:	The planed surface of a guide rail on which the car guides ride.
Blind Hoistway:	A section of hoistway without door openings.
Bobbin Cable Hanger:	A type of insulated hanger support for the hanging of traveling cables.
Bolster Assembly:	The bottom horizontal member of the car sling to which the platen plate attaches on an hydraulic elevator.
Bottom Terminal Landing:	The lowest landing served by the elevator that is equipped with a hoistway door and provided with a hoistway door locking device permitting egress from the hoistway side.
Branch:	(1) The outlet or inlet of a fitting that is not in line with the run and takes off at an angle to the run (eg., tees, wyes, crosses, laterals, etc.) (2) Duct or pipe serving a single terminal.
Branch Main:	Duct or pipe serving two or more terminals.
Broken Step Chain Safety Switch:	A switch mounted in the lower end of an escalator designed to stop the escalator electrically if the step chain breaks. It also activates under slack chain or sudden impact conditions.
Broken Tape Switch:	A switch that initiates action to prevent further operation of an elevator in the event the selector drive tape breaks.
Buffer:	A device designed to stop a descending car or counterweight beyond its normal limit of travel by storing or absorbing and dissipating the kinetic energy of the car or counterweight.
Buffer Channel:	A channel iron placed on the pit floor of an electric elevator to support buffers and guide rails.
Buffer Stroke:	The distance that a buffer can be compressed.

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Buffer Switch:	(1) A mechanically activated switch that removes power from an elevator drive motor when the car strikes an oil buffer. It will not allow the car to run until the buffer is returned to 90% of its fully extended position after the load is removed. (2) A means of preventing operation of an elevator if the oil level in a buffer is below the minimum allowable level.
Cab:	A self-contained enclosure mounted on an elevator platform in which passengers or freight are carried.
Cabinet Units:	Small air handling units that house an air filter, heating coil, and a centrifugal blower.
Cable Chain:	A chain designed to operate over a smooth sheave, as opposed to a roller chain which operates over a sprocket.
Cable Spreader:	A device used to separate traveling cables for hanging.
Call:	A demand for service placed or registered in an elevator signal system. The signal may be registered from either the car or the landing.
Call Registered Light:	A light mounted behind a translucent push button or adjacent to a solid button that lights when the button is activated to indicate the call has been placed in the signal system.
Canopy:	That part of an elevator cab located above and supported by the walls. It contains the ceiling and completely encloses the top of the cab.
Car (Elevator):	The load carrying unit, including the platform, car frame, enclosure, and car door or gate.
Car Call:	A call registered on a car operating panel.
Car Operating Station:	A panel mounted in the car containing the car operating controls, such as call register buttons, door open and close, alarm, emergency stop, and whatever other buttons or key switches are required for operation.
Car Platform:	The structure that forms the floor of the car and directly supports the load.
Car Steady Plates:	The device that supports the car canopy. They are installed between the side stiles and the canopy for the purpose of holding the cab steady and plumb.
Car Top Inspection Station:	A control panel on top of an elevator car that when activated removes the car from normal service and allows the car to run at inspection speed from the car top station only.
Carbon Dioxide (CO_2):	A gas used for fire extinguishing purposes.

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Cathode Ray lube (CRT):	A vacuum tube in which a hot cathode emits electrons that are accelerated as a beam through a high voltage anode, focused or deflected electrostatically or electromagnetically and allowed to fall on a fluorescent screen. Often used as a display or read-out device for computers and similar applications.
Centrifugal Pump:	A rotating pump in which the amount of fluid discharged per revolution is variable depending on the pressure in both the intake and discharge lines.
Check Valve:	A device that permits a liquid or gas to flow in one direction only.
Chinese Fingers:	A split, wrap-around cable grip used to support wires. "Kellem's Grip" is a trade name for one type of this device.
Circle Tracks:	The tracks that guide step trailing wheels around the ends of an escalator.
Circuit:	Any path capable of being followed by an electric current.
Clearance, Bottom Car:	The vertical distance from the pit floor to the lowest structural or mechanical part, equipment, or device installed beneath the car platform, except the guide shoes or rollers, safety jaw assemblies, and platform aprons or guards, when the car rests on its fully compressed buffers.
Clearance, lop Car:	The shortest vertical distance between the top of the car crosshead, or between the top of the car where no crosshead is provided, and the nearest part of the overhead structure or any other obstruction when the car is level with the top terminal landing.
Clearance,Top Counterweight:	The shortest vertical distance between any part of the counterweight structure and the nearest part of the overhead structure or any other obstruction when the car is level with the top terminal landing.
Cleated Risers:	Vertical cleats on an escalator step riser that mesh with slots on the adjacent step tread as the steps move from incline to horizontal.
Collision Switch:	A device activated by the car and/or counterweight to provide information to the control that a collision between car and counterweight is iminent. This device is part of a package to regulate the operation of an elevator during or after an earthquake.
Comb Plate:	The section of floor plate on which the comb teeth segments are mounted at the upper and lower landings of an escalator. The teeth are mounted on the inner edge while the outer edge butts against the floor plate.
Combustible:	A material capable of being ignited or burned.

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Command Functions:	Ability of an alarm system to control some functions of other building systems. For instance, when an alarm occurs, the alarm system may "command" fans to shut down or fire doors to close.
Compensating Chain:	A welded link chain used for hoist rope weight compensation. One end of the chain is attached to the underside of the elevator car, and the other end is fastened to the counterweight or stationary fastening in the hoistway.
Compensating Rope Sheave Switch:	A device that automatically causes the power to be removed from the elevator driving machine.
Compensating Rope Sheave:	A sheave mounted in the elevator pit that maintains tension on and guides the compensating ropes.
Compensating Ropes:	Wire ropes, usually two or more, installed to obtain hoist rope weight compensation. One end is fastened to the underside of the elevator car, the other end is fastened to the counterweight.
Compound Roping:	An arrangement of hoist ropes in which one end of each hoist rope passes from a dead-end hitch in the overhead, down and under a car sheave,up over a drive sheave, down around a counterweight sheave, and up to another dead-end hitch in the overhead. The car speed is 1/2 the rope speed. Commonly called 2 to 1 roping.
Conductor:	A pipe inside the building that conveys storm water from the roof to a storm or combined building drain.
Conduit:	Tubing, usually metal or plastic, that protects wiring from damage.
Contactor:	An electrical device similar to a relay used for controlling heavy electrical equipment remotely. A contactor contains a coil and usually several sets of contacts for switching power on or off in response to energizing or deenergizing the coil.
Contacts:	Metallic surfaces, usually of precious metal or plated with precious metal, are used for switching electrical current off and on in relays, contactors, and in switches. Contacts are used in sets or pairs. Two contacts are required to open or close an electrical circuit.
Continuity:	An electrical condition in which there is no interruption between two points. Continuity is usually checked with an ohmmeter or the resistance measuring scale of a multimeter. If there is continuity, the resistance measured is less than infinite.
Corrosivity:	The tendency of a metal to wear away another metal by chemical attack.
Counterweight:	A weight that counterbalances the weight of an elevator car plus approximately 40% of the capacity load.

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Current:	A flow of electric charge. The amount of electric charge flowing past a point per unit time measured in amperes.
Dashpot:	A damping device used to delay movement. A piston moves in a cylinder allowing a trapped liquid or gas to leave the trapped space at a controlled rate through a hole in the piston or by another route. An air dashpot is frequently used in water-flow detection devices to delay the signal and eliminate false signals due to water pressure surges.
Data Gathering Panel (DGP):	DGP equipment is used in multiplex systems as the connecting point for initiating circuits and other building alarm equipment. The DGP communicates with the main alarm console by transmitting status information when interrogated. Also known as an Interface Panel.
Dead-End Hitch:	The point of termination and fastening of hoist ropes, or of any wire rope or cord.
Deceleration:	The operation of reducing the elevator drive motor speed from normal operating speed to stop. Also referred to as Retardation or Slowdown.
Deenergize:	The removal of electrical power from an electrically operated device such as a relay or contactor.
Deflection:	Movement from a normal position. When applied to the indicator needle of a meter, it means the movement of the needle from its normal position.
Deflector Sheave:	A grooved sheave used to direct hoist ropes to the desired location in the hoistway or overhead.
Derailment Switch:	A device activated by the counterweight at any point in the hoistway to provide information to the control that the counterweight has left its guides. Used to regulate operation of an elevator in a predetermined manner during or after an earthquake.
Diagnosis:	Analysis of physical or electrical symptoms to determine condition.
Dielectric:	A nonconductor of electricity; an insulator or insulating material.
Diode:	An electric device that restricts current flow chiefly to one direction, usually a semiconductor device.
Direct-Plunger Elevator:	An hydraulic elevator in which the plunger or cylinder is directly attached to the car frame or platform.
Directional Limit Switches:	Mechanical switches mounted at the top and bottom of a hoistway and operated by a cam on the car to prevent normal operation of the elevator above the top landing in the up direction or below the bottom landing in the down direction.

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Directional Start Switch:	A key operated switch located gnerally in the newel base of an escalator. Allows the designated authority to select movement of the stairs for up or down direction. Sometimes located in the adjacent walls or columns.
Dispatcher:	One who dispatches or sends out vehicles.
Display:	Usually an arrangement of numbers and/or alphabetic characters selectively visible in accordance with coded electrical information received.
Door Cam:	A device mounted on the car door that unlocks and drives the hoistway doors. (Sometimes called a Vane.)
Door Closer:	A device used to close a door for the purpose of limiting the spread of smoke or fire.
Door Guide (GIB):	A device mounted on the bottom edge of a horizontally sliding door panel that fits into a groove in the sill to guide and hold the door panel in alignment.
Door Hanger:	A rolling assembly fastened to the top of the door panel that supports and allows horizontal sliding movement of the door panels. The door track on which the hanger rolls is part of the door hanger assembly.
Door Operator:	A motor driven device mounted on the car that opens and closes the car doors.
Double Wrap:	A common roping arrangement on gearless traction elevators, whereby the hoist ropes pass around a secondary sheave mounted beneath the main drive sheave and back over the drive sheave again, the purpose being to increase the traction of the ropes on the drive sheave.
Down Leveling Valve:	A small valve to operate a hydraulic elevator at a slow speed for leveling in the down direction.
Drive Unit:	The combination of motor and gear reduction unit that forms the drive mechanism for all moving parts of an escalator.
Duct Static Pressure:	The pressure acting on the walls of a duct; the total pressure less the velocity pressure; the pressure existing by virtue of the air density and its degree of compression.
Electomagnetic:	Refers to a device containing an electromagnet consisting of a soft core wound with a current carrying coil of insulated wire.
Energize:	Apply electrical power to an electrically operated device such as a relay or contactor.
Evacuation Alarm:	An alarm to warn occupants of an area to leave the area.
Expansion Joint:	A joint whose primary purpose is to absorb the longitudinal expansion and contraction in the line due to temperature changes.

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Expansion Loop:	A large radius loop in a pipe line that absorbs the longitudinal expansion and contraction in the line due to temperature changes.
Expansion Tank:	A device to control pressure in an hydraulic system by storing excess water volume resulting from increased operating temperatures.
External Corrosion:	Corrosion of that portion of a metal structure (pipe) exposed to external elements such as air, water, or soil.
Facilities:	(1) Buildings and other structures, their functional systems and equipment, and other fixed systems and equipment installed therein; outside plant, including site development features such as landscaping, roads, walks, and parking areas; outside lighting and communication systems; central utility plants; utilities supply and distribution systems; and other physical plant features. As used in these criteria, the term "nuclear facilities" is synonymous with this same term as contained in DOE 5480.5.
False Alarm:	An alarm produced by a malfunction.
Fan Coil Unit:	An air handling unit that houses an air filter, heating or cooling coil, drain pan, and centrifugal fan, and operates by moving air through an opening in the unit and across the coils.
Fault:	An electrical defect in a circuit of an alarm system.
Filtering:	Removing unwanted electrical signals by using an electrical or electronic signal.
Final Limit Switch:	One of two mechanically operated switches mounted in an elevator hoist-way, one at the top and one at the bottom, which if activated by the car traveling more than a preset distance beyond a terminal landing, cuts off power to the elevator drive machine motor.
Fixed Plate Heat Exchanger:	A static device that transfers sensible heat through plates separating a warm air stream from a cold air stream.
Float Valve:	A valve which is activated by a float and system of levers.
Galvanizing:	Coating iron or steel surfaces with a protective layer of zinc.
Gate Contact:	A mechanically operated switch that prevents the operation of the elevator unless the elevator car gate or door is closed.
Gate Valve:	A device that regulates the flow of a liquid or gas by raising or lowering a plate into the pipeway.
Gate:	The moveable portion of the car or hoistway entrance that closes the opening providing access to the car or the landing.
Geared Traction Machine:	A traction machine in which the power from the motor is transmitted to the drive sheave through reduction gears.

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Gearless Traction Machine: A type of elevator hoisting machine on which the ropes pass over a traction drive sheave that is an integral part of the armature. Called gearless because no geared reduction unit is utilized.

Go-Devil: A moveable hoistway working platform generally built on the job site by the elevator constructors for the purpose of installing the brackets and guide rails.

Governor: (1) A mechanical speed control mechanism. For elevators, it is a wire-rope driven centrifugal device used to stop and hold the movement of its driving rope. This initiates the activation of the car safety device.. It opens a switch that cuts off power to the drive motor and brake if the car travels at a preset overspeed in the down direction. Some will also cut off power if an overspeed occurs in the up direction. (2) On escalators, a direct-driven centrifugal device which, when activated by overspeed, cuts off power to the dirve motor and service brake.

Ground: A conducting connection to the earth or to a portion of an electric circuit that is at zero potential with respect to the earth,

Group Supervisory: A device that automatically controls the operation of all the elevators in a group. Accordingly, it contains all the timers, relays, and controls necessary for its operation.

Guide Rollers: Guide shoes which use rollers that rotate on the guide rails rather than slide on the rails.

Guide Shoes: Devices used mainly to guide the car and counterweight along the path of the guide rails. They also assure that the lateral motion of the car and counterweight is kept at a minimum as they travel along the guide rails.

Halfway Box: A junction box mounted in the hoistway just above the halfway point of car travel, from which the stationary ends of the traveling cables are hung.

Halon: A term used to describe any one of several halogenated gaseous compounds. The term is followed by a four or five digit number to identify a specific gas.

Handrail: The moving handhold provided for escalator passengers that moves over the top of the balustrade and newels.

Impeller: The rotating part in a pump that increases the supply pressure by centrifugal force.

Indicating Device: A device that indicates an alarm, supervisory, or trouble condition. Frequently, audible and visual devices such as bells, horns, lamps, and flashing lights are used as indicating devices.

Initiating Devices: A device used to initiate the sequence of electrical events that results in a fire alarm or supervisory signal.

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Inspection Service:	A type of operation usually controlled by a key-operated switch in the car that removes the car from normal service and permits operation of the car at slow speed for inspection purposes.
Inspection:	Visual and mechanical checking of the condition of facilities, performed on a regularly scheduled basis, to determine the extent of the maintenance and repair work required and to ensure the proper operation of the systems.
Insulation:	Thermal insulation is a material used for covering pipes, ducts, vessels, etc. to effect a reduction of heat loss or gain.
Interface:	Equipment that provides terminals for interconnecting two different systems, such as for interconnecting a building fire alarm system to the base alarm system.
Jack:	The assembly of the plunger and cylinder of a direct-plunger hydraulic elevator.
Jack Hole:	A man-made cavity extending into the earth for the placement of the cylinder of a hydraulic elevator.
Joints:	Joints include girth joints; branch, and subbranch intersections; so-called duct collar tap-ins; fitting subsections; louver and air terminal connections to ducts; access door, access panel frames, and jambs; duct, plenum, and casing abutments to building structures.
Junction Box:	A box containing provisions for making electrical circuit connections.
King Rail:	One rail of a set used as the reference rail. It is set accurately and the opposite rail is set by reference to it.
Land the Weights:	To land the counterweights on its buffer or on supports placed on the pit floor under the counterweight.
Line Voltage:	The voltage supplied by ordinary commercial sources, normally 115-125 volts.
Listed by UL:	Equipment and devices found by Underwriters Laboratories through sample testing to comply with the applicable standards.
Locking Plate:	A plate used with slotted brackets to lock a guide rail in place on a bracket after the rail has been aligned.
Lower Carriage:	The equipment located at the bottom of the escalator truss, that guides the step chain around the lower end of an escalator.
Lowering Valve:	The valve that allows the hydraulic elevator to travel at rated speed in the down direction.
M-G Set:	A unit consisting of a motor and a DC generator. This unit is used to generate the DC power that runs the hoisting machine.

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Machine Room:	The space in which the driving machine for an elevator or group of elevators is located.
Main:	Duct or pipe containing the system's major or entire fluid flow.
Maintenance:	Day-to-day, periodic, or scheduled work required to preserve or restore a facility or equipment to a condition that it can be effectively utilized for its designed purpose.
Master Box:	A municipal fire alarm box that may be tripped manually at the box or remotely by electronic means.
Matrix:	A rectangular array of indicator, usually lamps or LED's, for identification of zone status in larger alarm systems.
Minnie tine:	The rope attached between the governor rope and the safety. Sometimes called a Tail Rope or Safety Rope.
Mullion:	Vertical supports for handrails, skirts, and glass panels on escalators with glass balustrades.
Newel Wheel:	A cast-iron or steel wheel that carries the handrail around the top and bottom ends of the escalator.
Newels:	Extensions of the balustrade of an escalator at both the lower and upper limits of travel located to assist passengers in boarding and de-boarding the escalator.
Nudging:	A system used with automatic door operation which, if the door remains open more than a predetermined time, will sound a warning signal and close the doors at a reduced speed and torque. The warning will continue to sound, but should the protective device be activated during this operation, the doors will not reopen. When the obstruction is removed, the doors will continue to close and will resume normal operation.
Obscure:	To hinder the normal passage of light from its source to a receiver.
Ohmmeter:	An instrument for measuring resistance to the flow of electrical current.
Oil Buffer:	A buffer using oil as a medium that absorbs and dissipates the kinetic energy of a descending car or counterweight.
One-to-One Roping:	An arrangement of elevator hoist ropes in which one end of each hoist rope passes from the car hitch over the machine sheave to the counterweight hitch. With one-to-one roping, the car, counterweights, and hoist ropes all travel at the same speed.
Open Circuit:	A circuit that has been broken by opening a switch or breaking a wire.
Overspeed Governor Switch:	A part of an escalator machine. It is actuated by centrifugal force and trips a switch when the motor speed has increased 20% over its rated name plate speed.

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Overspeed Switch:	A switch, when actuated, that cuts off power to the drive motor and brake when the elevator car travels at a preset overspeed.
Oxidation:	The combining of oxygen with another element to form a new substance, such as in burning and rust formation.
pH:	A term used to describe the hydrogen ion activity or concentration of a solution.
Pinion:	A small cogwheel or gear which engages a larger gear or a rack.
Pit:	(1) That portion of a hoistway extending from the sill level of the lowest landing to the floor at the bottom of the hoistway. (2) The recess in the floor that houses the lower end of the inclined section of an escalator.
Pitot lube:	An instrument for measuring velocity pressure in flowing air or water.
Platen:	The steel plate that connects the plunger to the bolster plate assembly of a hydraulic elevator.
Plumbing Fixture:	A receptor or device that is either permanently or temporarily connected to the water distribution system of the premises, and demands a supply of water therefrom, or discharges used water, liquid-borne waste materials, or sewage directly or indirectly to the drainage system of the premises, or which requires both a water supply connection and a discharge to the drainage system of the premises.
pneumatic:	Pertaining to air or other gases.
Polarity:	The possession of two opposing qualities.
Positive Displacement pump:	A pump that uses gears, vanes, pistons, screws, or other means to discharge a specific amount of fluid for each pump revolution. Used in the operation of the hydraulic elevator.
Power Disconnect:	A switch for connecting and disconnecting electrical power.
Pressure Maintenance Pump:	Pump intended to maintain pressure in system.
Pressure Maintenance Pump Unit:	Assembled unit consisting of pressure maintenance pump, driver, controller, and accessories.
procedure:	Standardized approach and execution of sequence of work operations to yield reproducible results.
Proportioning:	The action by which foam liquid and water are mixed to form a foam solution.
Pump Head:	The pressure differential produce by an operating pump.
Rail:	Steel T-sections with machined guiding surfaces installed vertically in a hoistway to guide and direct the course of travel.

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Readily Accessible:	Direct access without requiring the use of tools from removing or moving any panel, door or similar obstruction.
Rectified:	Converted from alternating current (AC) to direct current (DC).
Redundant:	Duplicate or extra.
Regulated:	Processed for constant and precise output
Repair:	Restoration of a facility or equipment to a condition to allow it to be used for its intended purpose.
Response lime:	This term when used to specify performance of a rapid action deluge fire protection system represents the elapsed time between the initiation of the incident and water application to the material being protected.
Seam:	A seam is defined as a joining of two longitudinally (in the direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on the perimeter are deemed to be joints.
Service Brake:	The brake that normally stops an escalator. It will also stop the escalator whenever the power is interrupted from any cause or by any of the safety devices.
Shall:	Denotes a requirement.
Should:	Denotes a recommendation.
Shunt Trip:	Term used to describe the method of tripping transmitting device in which elements of a building alarm system are connected in parallel (shunt) with the transmitter trip coil.
Sight Glass:	A glass tube sealed within a fluid system, providing a means to examine - visually - the fluid in the system.
Skirt Panels:	The lowest panels within the balustrade, located adjacent to the ends of the steps and running parallel to the step travel on both sides.
Skirt Switch:	A safety switch that will shutdown the escalator if there is excessive deflection of the skirt.
Solenoid Valve:	A valve actuated by an electric coil.
Solid State:	Related to the technology of semiconductors that led to the development of transistors, diodes, light emitting diodes (LED's), and other devices.
Standby Battery:	A battery used as a secondary power supply for operation of a set of fire alarm equipment.
Steady Plate:	The metal guide that aligns the canopy of the elevator cab to the stiles of the car frame. Its purpose is to hold the cab plumb.
Stepped Down:	Refers to AC voltage reduced by the use of a step down transformer to a lower AC voltage.

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Strain Box:	A box or portion of a vertical raceway in which devices are provided to support hoistway wiring. They are spaced at 100 foot intervals.
Submain:	Duct or pipe containing part of the systems' capacity and serving two or more branch mains.
Suction Hat:	A strainer in the bottom of an oil reserve tank to prevent foreign matter from entering the oil line of an hydraulic elevator.
Supports:	Devices for supporting and securing pipe, fixtures, and equipment.
Systems Testing, Adjusting & Balancing:	(1) The balance of air and water distribution (2) adjustment of total system to provide design quantities (3) electrical measurement (4) verification of performance of all equipment and automatic controls (5) sound and vibration measurement.
Tamper Switch:	A switch that causes a trouble or supervisory signal if an equipment cover or valve is opened.
Test:	To determine quantitative performance of equipment.
Top-of-Car Inspection Station:	Controls on top of the elevator car used to operate the car at inspection speed. It provides a means of operating an elevator from on top of the car at slow speed during adjustment, inspection, maintenance, and repair.
Transformer:	A device used to transfer alternating current energy from one circuit to another. A transformer consists of a pair of inductively coupled coils of wire, wound on. a laminated metal core.
Transmitter:	A device that forms an electrical signal intended for connection to an alarm system.
Transponder:	A receiver/transmitter activated for transmission by reception of a predetermined signal. "Transponder" is made up of parts of the words "Transmitter" and "responder".
Trim:	Accessory piping connected to sprinkler valve.
Tripping (trip test):	The operation of a dry pipe valve.
Trouble Signal:	A signal indicating an alarm system abnormal condition requiring correction for the alarm system be fully operational with all features.
Truss:	An assembly of structural steel of tubular steel shapes that forms the supporting structure for the escalator.
Unit Valve:	A control valve for hydraulic elevators in which all valve functions are included in the same body.
Up-Start Valve:	A bypass valve or part of a multi-functioning valve that bypasses hydraulic fluid while starting in the up direction.

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Vacuum Relief Valve:	A device to prevent excess vacuum in a pressure vessel.
Voltage:	Electrical potential difference, usually expressed in volts.
Volute:	The spiral cavity formed by a pump casing surrounding the pump impeller.
Wainscot:	The walls of an elevator cab extending from the platform to the underside of the car top.
Wellway:	That portion of the building that receives and supports the escalator truss.
Working Pressure:	The pressure measured at the cylinder of an hydraulic elevator when the car and its rated load is moving up at rated speed. In some cases, it is the pressure measured at the cylinder when the car is leveling up with rated load.
Zoning:	The procedure that involves designating elevators to serve a specific floor or group of floors.

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END OF SUBSECTION

APPENDIX C

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APPENDIX D

REVISIONS SUMMARY

AT A GLANCE SUMMARY OF ALL

REVISIONS UP TO LATEST REVISION DATE

APPENDIX D

END OF SUBSECTION