

NBSIR 76-1058

Performance of Mobile Homes - Summary Report

J. H. Pielert
W. E. Greene, Jr.
L. F. Skoda
W. G. Street

Office of Building Standards and Codes Services
Center for Building Technology
Institute for Applied Technology
National Bureau of Standards
Washington, D. C. 20234

April 1976

Final Report

Prepared for
**Office of Policy Development and Research
Division of Energy, Building Technology and Standards
U.S. Department of Housing and Urban Development
Washington, D. C. 20410**

NBSIR 76-1058

PERFORMANCE OF MOBILE HOMES - SUMMARY REPORT

J. H. Pielert
W. E. Greene, Jr.
L. F. Skoda
W. G. Street

Office of Building Standards and Codes Services
Center for Building Technology
Institute for Applied Technology
National Bureau of Standards
Washington, D. C. 20234

April 1976

Final Report

Prepared for
Office of Policy Development and Research
Division of Energy, Building Technology and Standards
U.S. Department of Housing and urban Development
Washington, D. C. 20410



U.S. DEPARTMENT OF COMMERCE, Elliot L. Richardson, *Secretary*
James A. Baker, III, *Under Secretary*
Dr. Betsy Ancker-Johnson, *Assistant Secretary for Science and Technology*
NATIONAL BUREAU OF STANDARDS, Ernest Ambler, *Acting Director*

Table of Contents

	Page
Abstract	ii
SI Conversion Units	iii
1.0 Introduction	1
1.1 Project Objectives and Approach	1
1.2 Summary Comments	2
1.3 Overview of Mobile Homes	2
1.3.1 Mobile Home Industry	2
1.3.2 Standards Development	3
1.3.3 Enforcement Process	3
2.0 Mobile Home Performance Data	3
2.1 Mobile Home Performance Data Acquisition	3
2.1.1 HUD Sample	3
2.1.2 Private Sample	4
2.1.3 Field Sample	4
2.2 Mobile Home Performance Data Characteristics	4
2.2.1 Problem Data Characteristics	5
3.0 Evaluation of Problems Related to the ANSI A119.1 Standard	6
3.1 Construction (Part B)	6
3.2 Plumbing Systems (Part C)	17
3.3 Heating Systems (Part D)	23
3.4 Electrical Systems (Part E)	24
4.0 Evaluation of Problems Related to the Mobile Home Enforcement Process	26
4.1 Construction	26
4.2 Plumbing Systems	28
4.3 Heating Systems	33
4.4 Electrical Systems	40
5.0 Durability Related Problems	50
6.0 Summary Comments and Recommendations	52
References	55
Acknowledgements	56
Figures	57
Tables	65
Appendix A - Organization and Use of the Problem Summation Tables	89
Appendix B - Problem Summation Tables--HUD Sample	98
Appendix C - Problem Summation Tables--Private Sample	110
Appendix D - Problem Summation Tables--Field Sample	125

Performance of Mobile Homes-Summary Report

by

J. H. Pielert, W. E. Greene, Jr., L. F. Skoda and W. G. Street
Center for Building Technology

Abstract

This project was sponsored at the National Bureau of Standards by the Department of Housing and Urban Development, Office of Policy Development and Research, Division of Energy, Building Technology and Standards, with the objective of documenting mobile home performance problems and relating them to possible inadequacies in the ANSI A119.1 Standard for Mobile Homes and the mobile home enforcement process. Additionally, the durability of mobile home components was a study objective for potential use in mortgage insurance evaluation. The mobile home performance data were obtained for 4,105 mobile homes, categorized and related to the project objectives. This summary report is the last of a series of four project reports. It documents the project approach, results of the various tasks, and presents conclusions and recommendations. This was a problem-oriented study and did not attempt to document the many areas of satisfactory mobile home performance.

Key Words: Computer Techniques; Construction; Enforcement Process; Housing; Hurricane Agnes; Mobile Homes; Mobile Home Parks; Performance Data; Regulatory Process; Standards

SI CONVERSION UNITS

In view of the present accepted practice in this country for building technology, common U.S. units of measurement have been used throughout this publication. In recognition of the position of the United States as a signatory to the General Conference on Weights and Measures, which gave official status to the metric SI system of units in 1960, appropriate conversion factors have been provided in the table below. The reader interested in making further use of the coherent system of SI units is referred to:

NBS SP330, 1972 Edition, "The International System of Units"

E380-72 ASTM Metric Practice Guide (American National Standard Z210.1)

Table of Conversion Factors to Metric (S.I.) Units

Physical Quantity	To Convert From	To	Multiply By
Length	inch	meter	$2.54* \times 10^{-2}$
	foot	m	$3.048* \times 10^{-1}$
Area	inch ²	m ²	$6.4516* \times 10^{-4}$
	foot ²	m ²	9.290×10^{-2}
Volume	inch ³	m ³	1.639×10^{-5}
	foot ³	m ³	2.832×10^{-2}
Temperature	Fahrenheit	Celsius	$t_c = (t_{\circ F} - 32) / 1.8$
Temperature difference	Fahrenheit	Kelvin	$\Delta t^{\circ K} = (\Delta t_{\circ F}) / 1.8$
Pressure	inch Hg (60°F)	newton/m ²	3.377×10^3
Mass	lbm	kg	4.536×10^{-1}
Mass/unit area	lbm/ft ²	kg/m ²	4.882
Moisture content rate	lbm/ft ² week	kg/m ² s	8.073×10^{-6}
Density	lbm/ft ³	kg/m ³	1.602×10^1
Thermal conductivity	Btu/hr ft ² (°F/in)	$\frac{W}{mK}$	1.442×10^{-1}
U-value	Btu/hr ft ² °F	$\frac{W}{m^2 K}$	5.678
Thermal resistance	°F/(Btu/hr ft ²)	K/(W/m ²)	1.761×10^{-1}
Heat Flow	Btu/hr ft ²	W/m ²	3.155

*Exact value; others are rounded to fourth place.

1.0 INTRODUCTION

1.1 PROJECT OBJECTIVES AND APPROACH. Recently, many individuals and groups have questioned the effectiveness of mobile homes in providing safe, adequate and low-cost shelter. Although life-safety aspects such as fire safety and susceptibility to wind damage receive the most publicity, functional characteristics appear to be of broader concern to mobile home owners. It is recognized that the mobile homes supply process (manufacturing, transportation, siting^{1/}) differs greatly from conventional site-built housing and is partly responsible for some of their unique performance problems. Unfortunately, there is a limited amount of organized documentation of these performance problems, making it difficult to pinpoint what aspect of the mobile home supply process may be in need of change or improvement.

To respond to this recognized deficiency of information, a project funded at the National Bureau of Standards (NBS) by the Office of Policy Development and Research of the Department of Housing and Urban Development (HUD) was structured around the following objectives:

1. Identification and documentation of significant mobile home performance problems.
2. Determine the relationship of these problems to provisions of the ANSI A119.1 Standard for Mobile Homes [1]^{2/}.
3. Determine the relationship of these problems to the mobile home enforcement process (plan review, design certification, plant inspection.)
4. Relate problem data to the durability of mobile home components (mortgage insurance concern.)
5. Identification of needed areas of research relative to the mobile home supply process.

The project scope and the unique data acquisition and analysis methodology developed to accomplish the objectives are presented in reference [2]. The project was organized into two principal tasks. Task I was designed to collect and analyze existing mobile home performance data relative to the structural, electrical, heating and plumbing systems. These data, presented in reference [3], were obtained from Federal and state agencies responsible for the regulation of mobile homes, consumer groups, and owner of mobile homes. Task II involved the field inspection of mobile homes to determine the causes and consequences of the performance problems found during Task I. The results of Task II are documented in reference [4].

This report summarizes the results of the project where the data obtained in Tasks I and II are synthesized to determine if a relationship exists between the identified problems, the ANSI A119.1 Standard, and the mobile home enforcement process. The mobile home problems documented can be generally related to (1) malfunctioning components (structural, electrical, mechanical and plumbing) resulting in conditions affecting health and safety and adversely impacting on the longevity of the unit, (2) inadequate durability of components, and (3) poor design and construction practice. Routine maintenance concerns are also included but are tabulated separately.

This is a problem oriented study which does not reflect the many mobile home owners who are happy with the performance of their units. The number of mobile homes included is small when compared to the total number of mobile homes in use in the United States. While the results of this study may not be statistically applicable to mobile homes in general, it is believed that the problems documented are representative of those encountered with mobile homes in this country.

^{1/} Siting encompasses placement and leveling the mobile home on its foundation, installation, steps, skirting and connection of utilities.

^{2/} References are listed at end of paper.

1.2 SUMMARY COMMENTS. The data presented in this report and in references [2], [3] and [4] represent a significant base of information from which the project objectives can be addressed. While the study does include data on 4105 mobile homes, this number is small when compared to the total number of units now occupied in the United States. It is felt that the problems identified in the study are typical of mobile homes now in use; however, it is not intended that the data can be statistically extrapolated to the total mobile home population in the United States.

Problem data were separated into five different categories; (1) inadequacies or omissions in the ANSI A119.1 Standard for Mobile Homes, (2) deficiencies in the mobile home enforcement process, (3) routine maintenance problems, (4) mechanical/electrical appliance problems, and (5) miscellaneous or undefined problems. Sections 3.0, 4.0 and 5.0 present detailed discussion of the various problems in these categories.

Problems in the ANSI A119.1 category are organized within the construction, plumbing, heating and electrical systems. The major problem areas in the construction system were rain leaks, failure of interior paneling attachment, inadequate bottomboard durability, corrosion of exterior fasteners, and excessive metal roof membrane flexibility (roof rumble.) Plumbing problems included questionable quality of fixtures, loose fixture connections, watertightness of shower enclosures, and freezing of piping. Heating and electrical problems consisted of questionable location of furnace thermostat and inadequate fastening of electrical boxes.

The mobile home enforcement category included problems which indicated deficiencies in the mobile home regulatory process (plan and specification review, certification, and in-plant inspection). In the construction area, this included instances where thermal insulation in the walls and roof were found missing or improperly installed. Typical problems in the plumbing area included piping water leaks, inadequate grade (slope) of drain pipe, water heater relief valve drain problems, and corrosion of piping. Heating system problems included use of unlisted or inadequately installed components, inadequate accessibility of appliances, joints of supply and vent systems not airtight, inadequate separation of combustion air system, inadequate marking of appliances and improper flexible gas connector usage. Electrical problems included lack of durability and long-term performance of devices, improper location of receptacles and devices, inadequate number of branch circuits, and problems related to workmanship such as insufficient cable support, inadequate cable protection, etc.

Problems related to durability of mobile home components are discussed in Section 5.0 which includes most of the items in the Mechanical/Electrical Appliance category.

Many specific recommendations are made in the body of the report for revisions to the ANSI A119.1 Standard and improvements in the mobile home enforcement process. The following areas were identified for additional mobile home work.

- A. The effect of transportation and site set-up.
- B. The effect of wind forces both during transportation and on site.
- C. Durability of mobile home components.
- D. Application of the performance approach to the development of mobile home standards.
- E. Pre-occupancy inspection of mobile home after set-up.

1.3 OVERVIEW OF MOBILE HOMES

1.3.1 Mobile Home Industry. Mobile homes have risen to a position of importance in housing in the United States representing approximately one-fifth of all new housing starts in each of the past five years - 1970 through 1974 (Figure 1). Considering only the single family housing classification, mobile homes have provided 30 percent of the total during the same period (Figure 2). The production of mobile homes increased dramatically from 103,700 units in 1960 to 566,920 in 1973; however, consistent with trends in conventional housing, production fell to 329,300 units in 1974 (Figure 3). Mobile homes represented 94% of the houses produced in 1974 in the under \$20,000 new housing market as shown in Figure 4.

1.3.2 Standards Development. The mobile home industry is unique within the building industry in that there is a single model standard, ANSI A119.1 Standard for Mobile Homes [1], which covers the major aspects of the mobile home building process; i.e., construction, plumbing, heating and electrical. Park considerations are included in ANSI A119.3 Standard for Mobile Home Parks [5]. These standards are developed using the consensus process by ANSI Committee A119 on Mobile Homes and Recreational Vehicles.

States that have legislated mobile home construction requirements have most frequently adopted ANSI A119.1 as a whole or have used it as a model upon which to base their standards. As of June 1, 1974, 45 States had adopted or were in the process of adopting ANSI A119.1 or portions thereof. An NBS publication by Cooke, Zelenka, and Tejuja [6] presents deviations various States have made in the ANSI A119.1 Standard when modifying it for use in their regulatory programs.

1.3.3 Enforcement Process. Enforcement of a mobile home standard is primarily the responsibility of the State in which the mobile home is manufactured and generally includes certification of the design by that State's regulatory agency and in-plant inspection to insure compliance to the approved design. Generally, when a mobile home is transported and sold in a State other than in which it was manufactured, standard compliance becomes the responsibility of the State in which it is sold and is subject to that State's regulatory process.

There are two basic enforcement programs which are used separately or in combination by the States. Some States set up mobile home agencies to enforce mobile home regulations while others utilize independent third-party organizations to perform such services in their behalf. A typical combination would be for the State to set up an in-house agency for plan certification while employing a third party to perform in-plant inspection. An NBS publication by Cooke, Tejuja, Dikkers and Zelenka [7] outlines the various programs in use by the 50 States as of early 1974.

2.0 MOBILE HOME PERFORMANCE DATA

2.1 MOBILE HOME PERFORMANCE DATA ACQUISITION. The three major mobile home performance data sources were: (1) data accumulated by HUD as a result of using mobile homes as temporary housing following Hurricane Agnes, (2) data collected from State regulatory agencies and federal sources, and (3) data resulting from the field inspection of Hurricane Agnes units, private sector units and units being used by other government agencies. These data bases are referred to as the HUD Sample, Private Sample and Field Sample.

2.1.1 HUD Sample. The Department of Housing and Urban Development purchased approximately 18,000 mobile homes that were used as temporary housing for victims of the Hurricane Agnes disaster which occurred in June 1972. The largest concentration of these mobile homes was in the Wilkes-Barre, Pennsylvania area and totaled approximately 12,500 units. The urgent need for mobile homes following the hurricane was such that units were purchased from manufacturers and dealers from as far away as Texas and Florida and shipped to Wilkes-Barre. In many instances, the exigencies of time precluded specifying that the mobile homes meet the requirements of standards such as ANSI A119.1 or the code of the State in which the home was purchased.

A large maintenance operation was established in Wilkes-Barre to make the units ready for occupancy and to maintain the units when occupied. The maintenance crews also refurbished homes between occupancies or prior to shipment to storage sites around the country.

Data for approximately 10,000 of the 12,500 units were brought to NBS from Wilkes-Barre on loan from HUD. Since it was not possible to evaluate data for the entire 10,000 units, a method of selecting a representative sample without bias was devised by the Statistical Engineering Section of the NBS Institute for Basic Standards. The resulting HUD Sample consisted of 2,881 randomly selected units chosen without regard to performance problems or attributes such as manufacturer, size, etc. Maintenance and refurbishment data were accumulated for these units.

This sample is unique since all the units were manufactured at approximately the same time (1971-1972) and were put into use under emergency conditions. The temporary nature of the mobile home parks and private site placements created problems that would not have been encountered under normal circumstances. The conditions were further complicated by the fact that the occupants were living in mobile homes by necessity and not by choice. In general, the mobile homes were treated as rental units with the HUD Maintenance Staff being called upon to perform all maintenance services. The mobile home performance data in the HUD Sample reflects a wide range of problems from routine maintenance to major component failures.

2.1.2 Private Sample. Acquisition of performance data on mobile homes from sources other than HUD was established as a basic requirement of the project.

States with large mobile home populations were selected to gain access to a quantity of mobile home performance data in an efficient manner. These agencies regulating mobile homes varied widely from State-to-State and were attached to building code, consumer affairs, community development, labor and motor vehicle organizations, etc. In addition to the State organizations, Federal agencies such as the Veterans Administration and Department of Defense, mobile home owners' organizations, privately owned mobile home parks with rental units, and various consumer groups were contacted. There were no attempts made to interview private mobile home owners on an individual basis. After a preliminary review of performance data available around the country, data from 14 sources listed in Table 1 were selected for detailed evaluation. Problem files for a total of 967 mobile home units were obtained from these sources making up the Private Sample.

2.1.3 Field Sample. Since the degree of problem detail obtained in Task I varied considerably, the field inspection of mobile homes was necessary to determine specific causes and consequence of the identified performance problems. A total of 257 units were inspected in the Field Sample and included mainly those used by HUD for temporary housing following the Hurricane Agnes disaster in addition to a small number of units from the private sector.

2.2 MOBILE HOME PERFORMANCE DATA CHARACTERISTICS. An attempt was made to gather all identifying attributes possible for each mobile home included in the three samples. Tables 2 through 5 summarize the State of manufacture, the year of manufacture, unit width data, and agency certifying seals for the units in the total combined sample.

With regard to the performance problems identified in the study, four major categories listed below were established to classify the problems. An additional miscellaneous category was used to tabulate a small number of problems of an undefined nature.

- A. Problems Related to deficiencies and inadequacies of the ANSI A119.1 Standard for Mobile Homes
- B. Problems Related to Mobile Home Enforcement Process
- C. Routine Maintenance Problems
- D. Mechanical Electrical Appliance Problems
- E. Miscellaneous Problems

This categorization of problems permits documentation of all mobile home performance problems obtained from the data sources or observed during the field inspections. Computer techniques are used to organize the data into tables (See Appendix A). Computer printouts showing the performance problem distribution are in Appendix B (HUD Sample), Appendix C (Private Sample), and Appendix D (Field Sample). The problem distribution in these four major categories for all data samples in percent of total problems is summarized in Table 6.

Table 7 shows the rank ordered distribution of problems relative to the five categories for the Private Sample data. The rank ordered problem distribution within each of the four major categories are shown in Tables 8 through 11.

Table 12 shows the rank ordered distribution of problems relative to the five categories for the Field Sample data. The rank ordered problem distribution within each of the four

major categories are shown in Tables 13 through 16.

Table 17 shows the rank ordered distribution of problems relative to the five categories for the HUD Sample data. The rank ordered problem distribution within each of the four major categories are shown in Tables 18 through 21.

2.2.1 Problem Data Characteristics. Since each of the three data samples exhibit unique problem distributions, as seen in Tables 6 through 21, it is necessary to consider the characteristics of the data in each sample in evaluating the severity of the various problems.

Since the mobile homes in the HUD Sample were generally treated as rental units by the occupants, a large portion of the problems were routine maintenance in nature of the type that a home owner would normally repair on his own rather than seeking professional assistance.

Private Sample data generally consisted of consumer complaints and the resulting on-site inspection reports of enforcement officials. The data would tend to be of a more severe nature than the HUD Sample since the mobile home owner would generally not go to the enforcement agency for assistance with problems of a routine maintenance nature. Also, enforcement official inspections generally concentrated on problems associated with code violations and enforcement program inadequacies.

The inspection procedures used in accumulating the Field Sample data were structured to concentrate on problems related to Standard violations and enforcement program inadequacies. Since most of the mobile homes were unoccupied at the time of the inspections, problems with appliances of a routine maintenance nature were less prominent.

The various characteristics of the three data samples should be considered in evaluating the problems discussed in Sections 3.0, 4.0 and 5.0 of this report.

3.0 EVALUATION OF PROBLEMS RELATED TO THE
ANSI A119.1 STANDARD

3.1 CONSTRUCTION (PART B) - The following problems are taken from the data presented in Appendices B, C and D. The percentage of mobile homes in each sample which have the problem is tabulated along with the pertinent paragraphs of the 1974 and 1975 editions of the ANSI A119.1 Standard for Mobile Homes (NFPA 501B-1973 and 1974 editions). A discussion of the problem is included with recommendations for changes in the Standard and other phases of the mobile home supply process where appropriate.

3.1.1 ROOF SYSTEM-RAIN LEAKS (RLWR)^{3/}

Sample	% of Mobile Homes in Sample with Problem
HUD	17.4
Private	27.9
Field	40.1

Pertinent ANSI A119.1 References (1974 and 1975)^{4/}

Principle No. 7. To provide against the entrance of water and winds at all joints, connections, and openings in exterior surfaces.

B7.1 Weather Resistance. Exterior covering shall be of moisture and weather resistive materials attached with corrosion resistant fasteners to resist wind and rain. Metal coverings shall be of corrosion resistant materials.

Discussion - Roof membrane rain leaks were generally evidenced by staining of ceiling panels. The leaks appeared to be caused by one or more of the following factors:

- a. Flexibility of the metal roofing membrane.
- b. Lack of effective sealants.
- c. Inadequate joint constructions in the metal roofing.
- d. Flashing procedures at roof penetrations.
- e. Ineffective joint design details of roof-exterior wall interface.

Other factors impacting the severity of this problem include transportation induced forces and deflections, and improper site set-up and leveling procedures. Also, the roof leak problem can be aggravated by persons walking on the roof for purposes of repair or maintenance which can affect the integrity of the roof membrane joints. The ANSI A119.1 Standard states, in general performance terms, that the mobile home shall be moisture resistant. However, there is no way for enforcement officials to completely evaluate a mobile home design to determine the expected performance in this area.

^{3/} Symbol refers to computer code used to identify the problem (Appendices B, C and D).

^{4/} Excerpted and reprinted with permission from NFPA 501B, Standard for Mobile Homes, Copyright 1973 and 1974, National Fire Protection Association, Boston, Massachusetts.

Recommendations

1. A method of evaluation should be developed and included in the Standard if enforcement officials are to determine if the moisture resistant performance specified in B7.1 is provided by the manufacturer.
2. Manufacturers should provide the mobile home owner with instructions for routine preventative maintenance of the roof. This could include coating of all roof membrane joints at specified intervals.
3. There should be provided at least a one-year warranty on roof leakage.
4. Inspection for rain leaks should be part of a pre-occupancy inspection program and the area of any leaks should be repaired before occupancy of the unit is authorized.

3.1.2 PARTITION WALLS AND SIDEWALLS - FAILURE OF ATTACHMENT OF INTERIOR PANELING TO WALL FRAMING (INSSI.)

The higher percentage of this problem in the Field Sample may have been due to the frequent occurrence of water leaks causing wood panel buckling.

Sample	% of Mobile Homes in Sample with Problem
HUD	15.2
Private	25.4
Field	38.1

Pertinent ANSI A119.1 References

1974

B6.7 Interior Partition. Whenever an interior partition is designed to serve as a secondary structural member, it shall be constructed with adequate strength for the purpose intended.

B6.10 Design Load Deflections. When a structural assembly is subjected to total design live loads, the deflection shall not exceed the following:

- Floor L/240*
- Roof and Ceiling L/180 (see Appendix II)*
- Sidewalls L/180*

Where L = the clear span between supports or two times the length of a cantilever.

1975

B6.7 Interior Walls. Interior walls shall be constructed with structural capacity adequate for the intended purpose and shall be capable of resisting a horizontal load of not less than five pounds per square foot.

B6.10 Design Load Deflection. When a structural assembly is subjected to total design live loads, the deflection for structural framing members shall not exceed the following:

- Floor L/240
- Roof and Ceiling L/180 (See Appendix, Part B)
- Headers, Beams, Girders L/180 (Vertical Loads Only)

Where L = the clear span between supports or two times the length of a cantilever.

Discussion - This problem represents a failure of the attachment of the wood wall paneling to wall framing. Field inspection revealed that paneling is often attached with smooth staples which appear to provide inadequate fastening strength. The use of adhesive attachment in conjunction with staples was seldom found in the field investigation, and when it was encountered, continuous glue lines between the paneling and studs were rarely observed. The use of 1/8 inch and 3/16 inch thickness interior wood paneling provides questionable flexural rigidity between wall studs. Field observations indicated that some of the paneling appeared susceptible to dimensional changes due to moisture which could account for the buckling observed in conjunction with rain leaks.

The structural function of interior wall paneling is to aid in resisting forces due to transportation, site set-up, wind, and occupancy. These data bring into question the adequacy of the wall construction in resisting these forces; especially since the ANSI A119.1 Standard does not provide specific design criteria for transportation and site set-up.

The ANSI A119.1 Standard does not adequately define performance criteria that would insure successful attachment of paneling to the framing members. The ANSI A119.1-1975 was improved to require interior walls to be designed for 5 psf horizontal load; however, the sidewall deflection limit of L/180 in the 1974 edition (B6.10) was deleted in 1975.

Recommendations

1. B6.10 should be modified to again incorporate a deflection limit on walls subjected to design loads. Consideration should be given to reimposing the L/180 limit as in ANSI A119.1-1974 or adopting L/240 as required in paragraph 601-11e of FHA Minimum Property Standards [8].
2. The effects of wind loads and forces resulting from transportation and site set-up should be studied to develop additional design criteria for wall design.
3. Adhesive bonding should be used with mechanical fasteners in attaching wood paneling to the wall framing.

3.1.3 EXTERIOR WALLS - RAIN LEAKS (EXWR)

The high occurrence of window leaks (paragraph 3.1.5) and door leaks (paragraph 3.1.6) in the Private Sample should also be considered in evaluating these data.

Sample	% of Mobile Homes in Sample with Problem
HUD	15.9
Private	6.4
Field	14.4

Pertinent ANSI A119.1 Reference (1974 and 1975)

B7.1 Weather Resistance. Exterior covering shall be of moisture and weather resistive materials attached with corrosion resistant fasteners to resist wind and rain. Metal coverings shall be of corrosion resistant materials.

Discussion - Penetration of rain water is the predominate problem with exterior walls. These leaks occurred through the exterior siding and at windows, doors, and other penetrations. The rain leaks at windows and doors occurred at the juncture with the exterior wall. Rain leaks through windows and doors are discussed in paragraphs 3.1.5 and 3.1.6. The usual manufacturing procedure is to attach the siding material to the wall framing, cut out openings for windows and doors and install windows and doors over the exterior siding. Caulking must be used where the frame of these components mate with the siding in order to prevent rain water penetration.

Lack of effective sealing of joints in exterior walls can be caused by:

1. Excessive distortion of the walls due to transportation and set-up. The resulting differential movement between the window/door frame and exterior wall covering can disturb the caulking seal applied in the factory.
2. Manufacturing procedures of installing window and door frames over exterior siding which is not good flashing practice.
3. Poor workmanship characterized by improper application of sealant, the omission of sealant in some areas around frames, etc.
4. Inferior caulking that becomes brittle and cracks in a relatively short time.

Recommendations

1. A water penetration test procedure should be established for exterior wall assemblies similar to that adopted for windows (MHMA Specification 1-71-Rev. 1973). The test should include simulation of the effects of transportation.
2. The use of sealants between components of wall assemblies should be required to meet one or more of the following Federal Specifications:

TT-S-00230
 TT-S-001657
 TT-S-001543A
 TT-S-00227E

3. Paragraph B7.1 of ANSI A119.1 should be revised as follows:

B7.1 Exterior covering and component joints shall be of moisture and weather resistive materials attached with corrosion resistant fasteners to resist wind and rain. Metal coverings shall be of corrosion resistant materials.

3.1.4 EXTERIOR WALL SYSTEM - FAILURE OF ATTACHMENT OF EXTERIOR COVERING TO WALL FRAMING (EXSS1.)

Sample	% of Mobile Homes in Sample with Problem
HUD	6.9
Private	12.0
Field	17.1

Pertinent ANSI A119.1 Reference (1974 and 1975)

B6.6 Walls. The walls shall be of sufficient strength to withstand the load requirements as defined in 6.3.1, 6.3.2 and 6.4 of this Part, without exceeding the deflections as

specified in 6.10. The connections between the bearing walls, floor, and roof framework members shall be fabricated in such a manner as to provide support for the material used to enclose the mobile home and to provide for transfer of all lateral and vertical loads to the floor and chassis.

Discussion - Typical of these problems was pulling of the fastener head through the metal siding and loosening of the fasteners. These problems could be related to excessive vibration and racking during transportation and site set-up of the unit. Wind induced forces could also cause connection loosening and fastener pull through problems.

Recommendation - A research study should be initiated to investigate the acceleration forces and stresses induced by transportation and site set-up in mobile homes. A study of wind effects on exterior wall connections, over an extended period of time, should also be initiated. The results of these studies would form the basis for the development of more realistic design criteria for incorporation into the current Standard.

3.1.5 WINDOWS - RAIN LEAKS (WNWR)

Sample	% of Mobile Homes in Sample with Problem
HUD	2.7
Private	13.9
Field	3.9

Pertinent ANSI A119.1 References

1974

B7.1 Weather Resistance. Exterior covering shall be of moisture and weather resistive materials attached with corrosion resistant fasteners to resist wind and rain. Metal coverings shall be of corrosion resistant materials.

B8.5.1 Windows. All windows shall comply with requirements set forth in Table B-2 and, in addition, shall meet the requirements for windows as detailed in the "Window Specifications for Utilization in Mobile and Factory-Built Homes (MHMA Spec. No. 1-71 - Rev. 1972).

1975

B7.1 Same as 1974.

B8.5.1 Windows. All windows shall meet the requirements for windows as detailed in the Window Specifications for Utilization in Mobile and Factory-Built Housing, (MHMA Spec. No. 1-71-Rev. 1973).

Discussion - These problems are concerned with the penetration of rain water through windows. Rain leaks at the juncture of the window frame and the wall are discussed in 3.1.3. The referenced Mobile Home Manufacturers Association (MHMA) Spec No. 1-71 includes a wind-driven rain test which appears adequate in evaluating window performance. This specification was first included in the 1973 edition of ANSI A119.1. A large majority of the mobile homes in this study were 1972 models, or older, and may have used windows which did not meet the MHMA Specification.

Recommendation - Use of windows which meet the latest revision of MHMA Spec. No. 1-71 may alleviate the rain leak problem.

3.1.6 EXTERIOR DOORS - RAIN LEAKS (DEWR)

Sample	% of Mobile Homes in Sample with Problem
HUD	3.2
Private	13.0
Field	3.1

Pertinent ANSI A119.1 Reference (1974 and 1975)

B7.1 Weather Resistance. Exterior covering shall be of moisture and weather resistive materials attached with corrosion resistant fasteners to resist wind and rain. Metal coverings shall be of corrosion resistant materials.

Discussion - This problem concerns the penetration of rain water through exterior doors. Rain leaks at the juncture of the door frame and the exterior wall are discussed in 3.1.3. ANSI A119.1-1975 does not include a wind-driven rain test for exterior doors. MHMA Spec. 3-74 "Exterior Passage Door Specifications for Utilization in Mobile and Factory Built Housing" is weak in the area of water penetration as indicated by the following from paragraph 1.4.4:

"No leakage shall pass interior face of the test specimen at a test pressure of 9 psf when tested in accordance with ASTM E-331. Note: The development of this standard was primarily instituted to answer energy conservation requirements. Insufficient time to establish further water penetration criteria was allowed; therefore, the MHMA Door Subcommittee is presently effecting further testing and criteria for revision to this standard at a later date."

Recommendation - MHMA Spec. 3-74 appears to be a step in the right direction. Work on the development of additional water penetration criteria to augment this specification should be undertaken.

3.1.7 FLOOR SYSTEM - INADEQUATE BOTTOMBOARD WEATHER AND RODENT RESISTANCE (FLWR, FLRR, PREQ5., HGPG1.)

Sample	No. of Problems*
HUD	129
Private	290
Field	127

*Table represents a summation of problems in the Construction, Plumbing and Heating Parts of A119.1 relative to bottomboard durability.

Pertinent ANSI A119.1 References (1974 and 1975)

B7.1 Weather Resistance. Exterior covering shall be of moisture and weather resistive materials attached with corrosion resistant fasteners to resist wind and rain. Metal coverings shall be of corrosion resistant materials.

B7.4 Rodent Resistance. Exterior surfaces shall be sealed to resist the entrance of rodents.

C5.2.5 Rodent Resistance. All exterior openings around piping and equipment shall be sealed to resist the entrance of rodents.

D5.1.1.1 Rodent Resistance. All exterior openings around piping, ducts, plenums or vents shall be sealed to resist the entrance of rodents.

Discussion - The problems grouped in this category concern penetrations in the bottomboard material (underside covering material) which affects the weather and rodent resistance of the mobile home. As illustrated in the referenced paragraphs of the ANSI A119.1 Standard, Part B (Construction), Part C (Plumbing) and Part D (Heating) contain essentially the same requirement against rodent penetration. A summation of these problems for the three samples represents 7.2% of all ANSI A119.1 related problems.

The failure of the bottomboard barrier could lead to penetration of the underside of the home by wind, rain, rodents, insects and dust. The low tear and puncture strength characteristics of most bottomboard materials presently being used allows them to be easily damaged. In many

cases, the attachment of the bottomboard material to the main floor frame failed, possibly as a result of low "wet strength" or due to forces imposed during transportation and site set-up.

The referenced ANSI A119.1 Standard paragraphs give the required performance of the bottomboard in general terms without specifying methods for enforcement officials to determine if the performance of a material is acceptable. This problem can be attributed to the Standard which does not provide specific performance requirements for the strength and durability of the bottomboard along with methods to evaluate the adequacy of the barrier.

Recommendations

1. The bottomboard construction of mobile homes should be upgraded.
2. Performance requirements for mobile home bottomboard materials and attachment methods should be developed and incorporated in the ANSI A119.1 Standard. These requirements should include tear resistance, puncture resistance, wet strength and water penetration resistance.

3.1.8 EXTERIOR WALLS - CORROSION OF EXTERIOR FASTENERS (EXDR)

Exterior fasteners were routinely inspected in the Field Sample Survey. Mobile home occupants (HUD and Private Samples) did not generally consider this a major problem.

Sample	% of Mobile Homes in Sample with Problem
HUD	--
Private	1.3
Field	49.4

Pertinent ANSI A119.1 Reference (1974 and 1975)

B7.1 Weather Resistance. Exterior covering shall be of moisture and weather resistive materials attached with corrosion resistant fasteners to resist wind and rain. Metal coverings shall be of corrosion resistant materials.

Discussion - In many cases, corrosion of exterior fasteners were noted on mobile homes less than two years old. While this initially may be only an aesthetic problem, it could eventually lead to a loss of the structural attachment of the exterior covering. The ANSI A119.1 Standard specifies "corrosion resistant fasteners;" however, it gives no level of performance for enforcement officials to evaluate the adequacy of a proposed fastener.

Recommendations

1. The ANSI A119.1 Standard should include performance specifications that would insure long-term durability of exterior fasteners.
2. The specification should be such that hot-dip galvanized, electro-galvanized, aluminized steel, stainless steel, double cadmium plated, aluminum screws, or any other corrosion-resistant fastener type could be considered for use by the manufacturers.

3.1.9 ROOF SYSTEM - FAILURE OF ATTACHMENT OF CEILING MATERIAL TO TRUSS (RFSS4.)

Sample	% of Mobile Homes in Sample with Problem
HUD	0.1
Private	6.3
Field	--

Pertinent ANSI A119.1 References (1974 and 1975)

Principle No. 3. To provide structural strength and rigidity sufficient for design loads, both in transit and on site.

B5.3 Structural Analysis. The strength and rigidity of the component parts and/or the integrated structure shall be determined by engineering analysis or by suitable load tests to simulate the actual loads and conditions of application that occur on site.

Discussion - The loss of attachment between ceiling material and roof trusses occurred almost totally in the Private Sample. This problem can be related to transportation forces, site set-up and occupancy. Another contributing factor would be the excessive occurrence of roof rain leaks and the resulting water damage to ceiling material which generally exhibits a lack of wet strength. Except for the referenced paragraphs which call for good engineering design, ANSI A119.1 does not give specific design criteria for the attachment.

Recommendations

1. The susceptibility of mobile home roofs to rain leaks should be reduced which would help alleviate the incidence of ceiling material attachment failure.
2. Results from a study of the effects of transportation and site set-up on mobile homes could be used to develop design criteria for the ceiling system.

3.1.10 ROOF SYSTEM - EXCESSIVE METAL MEMBRANE DEFLECTION AND ROOF RUMBLE (RDEF)

As expected, these data are predominantly in the Private Sample where mobile home owners were unhappy with the excessive noise. The HUD Sample units were occupied on a temporary basis while the majority of the Field Sample units were unoccupied.

Sample	% of Mobile Homes in Sample with Problem
HUD	--
Private	4.7
Field	0.4

Pertinent ANSI A119.1 References (1974 and 1975)

Principal No. 3. To provide structural strength and rigidity sufficient for design loads, both in transit and on site.

B5.3. Structural Analysis. The strength and rigidity of the component parts and/or the integrated structure shall be determined by engineering analysis or by suitable load tests to simulate the actual loads and conditions of application that occur on site.

Discussion - This problem primarily consisted of excessive noise or "roof rumble" during windy weather conditions. The basic cause of the problem is the lack of rigidity of the metal roof membrane. Typical roof construction consists of a sheet metal installed over the wood trusses attached only around the outside perimeter edges of the mobile home. This method of attachment allows deflection of the roof membrane between trusses under the oscillating wind conditions. A sheathing material and/or insulation is sometimes placed between the metal membrane and the roof trusses. Roof rumble occurs when the metal roofing "slaps" against the roof trusses or sheathing material or the metal itself "oil cans" under wind loading. While walking on the roof is not recommended, it may be necessary to do so when performing routine maintenance. This could damage the metal membrane because of its lack of rigidity between roof trusses.

Recommendations

1. Establish criteria to limit the deflection of metal roofing membrane between trusses. This would impart rigidity to the membrane and greatly reduce the occurrence of "roof rumble."
2. The manufacturer should alert the mobile home owner to the fact that "roof rumble" may occur and caution against walking on the roof.

3.1.11 FLOOR SYSTEM - FAILURE OF ATTACHMENT OF DECKING TO FLOOR JOISTS (FASS1.)

Sample	% of Mobile Homes in Sample with Problem
HUD	0.1
Private	3.8
Field	--

Pertinent ANSI A119.1 References

1974

B6.9 Floors. Floor assemblies shall be designed in accordance with accepted engineering practice to support a uniform live load of 40 lb/ft², plus the dead load of the materials. In addition (but not simultaneously), floors shall be able to support a 200-pound concentrated load on a 2-inch diameter disc at the most critical location with a maximum deflection not to exceed 1/8 inch relative to floor framing.

1975

B6.9 Floors

- (a) Floor assemblies shall be designed in accordance with accepted engineering practice standards to support a minimum uniform live load of 40 lb/ft² plus the dead load of the materials. In addition (but not simultaneously), floors shall be able to support a 200-pound concentrated load on a two-inch diameter disc at the most critical location with the maximum deflection not to exceed 1/8 inch relative to floor framing. Perimeter joists of more than six inches depth shall be stabilized against overturning from superimposed loads as follows: at ends by solid blocking not less than two-inch thickness by full depth of joists, or by connecting to a continuous header not less than two inch thickness and not less than the depth of the joist with connecting device; at eight feet maximum intermediate spacing by solid blocking or by wood cross-bridging of not less than one inch by three inches, metal cross-bridging of equal strength, or by other approved methods.

- (b) Wood floors or subfloors in kitchens, bathrooms (including toilet compartments), laundry rooms, water heater compartments, and any other areas subject to excessive moisture shall be moisture resistant or shall be made moisture resistant by sealing or by an overlay of nonabsorbent material applied with water-resistant adhesive.

Discussion - This problem is concerned with inadequate attachment of the decking to the floor joists. Attachment is generally by staples or nails and adhesive bonding. The fasteners often pull through particle board floor decking commonly used in mobile homes, especially if it should become water soaked from plumbing or rain leaks. The requirements as presented for floors in the referenced ANSI A119.1 Standard paragraphs are consistent with most codes and standards that exist for conventional housing. However, conventional housing is not subject to the dynamic forces of transportation and site set-up that are imposed on mobile homes. Therefore, consideration for these special conditions should be made during the design process. As presently written, the Standard does not provide design criteria for these special load conditions.

Recommendations

1. Develop design criteria for floors which take into account the effects of transportation and site set-up. This could result from a program to determine the magnitude of dynamic forces to which mobile homes are subjected during transit and set-up.
2. A performance criteria should be developed using these measured dynamic loads to assure adequate attachment strength for floor decking to floor joists.
3. A test procedure could be developed and specified so that regulating agencies can evaluate compliance with the criteria.

3.1.12 DOUBLEWIDE MISALIGNMENT (RFSS5.)

There were no doublewide units in the HUD and Field Sample Data.

Sample	% of Mobile Homes in Sample with Problem
HUD	--
Private	2.9
Field	--

Pertinent ANSI A119.1 Reference (1974 and 1975)

Principle No. 7 (Part B). To provide against the entrance of water and wind at all joints, connections, and openings in exterior surfaces.

Discussion - Misalignment of the two sections forming a doublewide mobile home generally resulted in a rain water leak.

This problem can be attributed primarily to two causes: (1) failure of the manufacturer to hold dimensional tolerances during the fabrication phase, and (2) improper leveling and blocking of the two halves during site set-up. Except for general requirements of Principle No. 7, the ANSI A119.1 Standard does not include guidance for dimensional tolerance requirements to be used by the manufacturer in the production of doublewide units. ANSI A119.3 Standard for Mobile Home Parks [5] does not include dimensional tolerance requirements for mobile home set-up.

Recommendations

1. The ANSI A119.1 Standard should include a section on dimensional tolerances of mobile home construction with particular attention given to doublewide units.
2. A mobile home installation guide should be supplied with each mobile home by the manufacturer.
3. The ANSI A119 Committee on Mobile Homes should undertake further study of the installation problems.

Note: In response to this need, ANSI Committee A119 has established a new Sectional Committee on Mobile Home Installation with the following scope, "to develop standards or recommend practices for the proper placement of mobile homes on any lot, covering such items as piers, skirting, removal of running gear and any additional provisions for tiedowns and connections to utilities not covered in either the ANSI A119.1 Standard for Mobile Homes or the ANSI A119.3 Standard for Mobile Home Parks." The successful completion of this effort should help alleviate this problem with doublewides which are providing an ever increasing share of the mobile home market.

3.1.13 ROOF SYSTEM - CUTTING STRUCTURAL ROOF COMPONENTS TO ALLOW FOR INSTALLATION OF VENT PIPES OR STACKS (RLCC)

Where possible, roof trusses over the furnace were inspected in the field study. The mobile home occupant would not generally know of this problem as evidenced by the low frequency of occurrence in the HUD and Private Samples.

Sample	% of Mobile Homes in Sample with Problem
HUD	--
Private	0.3
Field	1.9

Pertinent ANSI A119.1 References (1974 and 1975)

B5.2 *Construction.* All construction methods shall be in conformance with accepted engineering practices to insure durable, livable, and safe housing. Exposed metal structural members shall be protected to resist corrosion.

B5.3 *Structural Analysis.* The strength and rigidity of the component parts and/or the integrated structure shall be determined by engineering analysis or by suitable load tests to simulate the actual loads and conditions of application that occur on site.

Discussion - This problem was observed over furnace compartments where roof trusses were cut to allow for installation of roof jacks. Even though there were a small number of instances, it is serious enough to warrant a revision in the Standard. The basic cause of this problem was a result of poor design of the mobile home and/or inadequate plant inspection. Although the referenced ANSI A119.1 paragraphs cover this type of violation in a general sense, it is believed that there should be specific wording in the Standard that would prevent the cutting of major structural roof components without justification by engineering analysis.

Recommendation - Add the following requirement to ANSI A119.1:

"Cutting of roof truss components for passage of electrical, plumbing or mechanical systems are not permitted without justification by engineering analysis."

3.1.14 TIEDOWNS - IMPROPERLY LOCATED BETWEEN ROOF TRUSSES (TIDN2.)

Inspection for this problem was possible only in the field inspection study.

Sample	% of Mobile Homes in Sample with Problem
HUD	--
Private	--
Field	1.0

Pertinent ANSI A119.1 Reference (1974 and 1975)

B6.5.1 Tiedowns. All mobile homes shall have tiedowns with provisions for distributing the load of these tiedowns and provisions for the attachment to ground anchors so as to resist wind overturning and sliding as imposed by the respective design loads of this part.

Discussion - It was noted in the field inspection task that over-the-roof hurricane straps were sometimes located between roof trusses and not at a truss where a path of load transfer from wall to wall is provided.

ANSI A119.1-1975 does not specifically address this point other than calling for good design. The proposed Tentative Interim Admendment (TIA) on Windstorm Protection for the ANSI A119.1 Standard has the following requirement:

"6.6.1.2(c) When continuous straps are provided as vertical ties, such ties shall be positioned at rafters and studs."

Recommendation - Adoption of Windstorm Protection TIA should alleviate this problem.

3.2 PLUMBING SYSTEMS (PART C) - The following problems are taken from the data presented in Appendices B, C and D. The percentage of mobile homes in each sample with the problem is tabulated along with the pertinent paragraphs of the 1974 and 1975 editions of the ANSI A119.1 Standard for Mobile Homes (NFPA 501B-1973 and 1974 editions). A discussion of the problem is included with recommendations for changes in the Standard and other phases of the mobile home supply process where appropriate.

3.2.1 QUALITY OF FIXTURES - DURABILITY OF FAUCET ASSEMBLIES (PFGRI.)

Sample	% of Mobile Homes in Sample with Problem
HUD	15.6
Private	11.1
Field	13.6

Pertinent ANSI A119.1 References

1974

C6.1 Minimum Standards. Materials, fixtures, or devices used or entering into the construction of plumbing systems in any mobile home shall be free from defects and shall conform to approved standards or the applicable standards listed in the Appendix of this Part, Table C-1.

1975

C6.1 Minimum Standards. Materials, fixtures, or devices used or entering into the construction of plumbing systems in any mobile home shall be free from defects and shall conform to approved standards.

Note: See Appendix for Reference Table for Standards on Plumbing System Components.

Discussion - The majority of these problems concerned early faucet failures requiring replacement. The replacement of faucet washers (routine maintenance) is not included in these data. The ANSI A119.1 Standard is deficient with regards to specifying a minimum quality of faucet; therefore, a large percentage of faucet assemblies did not perform adequately.

Recommendations

1. The ANSI A119.1 Standard should include performance criteria on faucet assemblies that would insure the owner of some useful life (in years).
2. The Appendix to Part C of ANSI A119.1 should include acceptable durability standards for faucet assemblies.
3. A requirement for permanently marking the faucet assemblies with the manufacturers' name and model number should be adopted to enable enforcement officials to check for compliance.

3.2.2 TOILET FLUSHING DEVICES - REPAIR OR REPLACEMENT OF TOILET FLUSHING DEVICES (TØIL2.)

Sample	% of Mobile Homes in Sample with Problem
HUD	5.9
Private	5.6
Field	5.4

Pertinent ANSI A119.1 Reference (1974 and 1975)

C9.2.1.2 *Toilet flushing devices shall be designed to replace the water seal in the bowl after each operation. Flush valves, flushometer valves, and ball cocks shall operate automatically to shut off at the end of each flush or when the tank is filled to operating capacity.*

Discussion - The general quality of toilet assemblies installed by mobile home manufacturers appears to be equivalent to those used in conventional housing. When the effects of transportation are considered, however, these data indicate that the toilet flushing device may not be adequate for the forces and vibrations encountered.

Recommendations

1. The effect of transport induced forces on plumbing fixtures including toilet flushing devices should be examined in an overall study of transportation induced forces on mobile homes.
2. From these studies, performance criteria could be developed for plumbing fixtures (including toilet flushing devices) that would insure the owner of the mobile home reduced maintenance costs and extended life for these devices.

3.2.3 TOILET - LOOSE TOILET TO FLOOR CONNECTIONS (TØIL5.)

Sample	% of Mobile Homes in Sample with Problem
HUD	4.1
Private	8.2
Field	9.3

Pertinent ANSI A119.1 References

1974

C9.2.1.5 Floor Connection. Toilets shall be securely bolted to the floor by means of an approved flange or other approved fitting. Bolts and screws, when used, shall be of solid brass or other corrosive-resistant material and shall be not less than 1/4 inch in diameter. A watertight seal shall be made between the toilet and flange or other approved fitting by use of a gasket or sealing compound.

1975

C9.2.1.5 Floor Connection. Toilets shall be securely bolted to an approved flange or other approved fitting which is secured to the floor by means of corrosion-resistant plated screws. The bolts shall be of solid brass or other corrosion-resistant material and shall be not less than 1/4 inch in diameter. A watertight seal shall be made between the toilet and flange or other approved fitting by use of a gasket or sealing compound. (See also Paragraph 6.9(b) of Part B.)

Discussion - This problem concerns the connection of the toilet assembly to the floor of the mobile home. The toilets frequently become loose and require tightening or seal replacement. In some cases, this looseness resulted in waste water leakage (which can cause deterioration of the bathroom floor) and the release of sewer gases and odors into the home. Since toilets are normally tightened down on the seal in the factory, it is likely that the vibrations due to transportation and set-up account for the loosening of many connections. This toilet connection method is the same as that used in conventional housing; however, mobile homes are subjected to these additional transit induced forces which do not appear to be adequately taken into consideration during the design and fabrication process.

Recommendations

1. The effect of transport induced forces on the floor connection of the toilet should be included in an overall study of transportation forces on mobile homes.
2. The feasibility of transporting the mobile home with the toilet loose and temporarily shimmed to be tightened after set-up should be considered.
3. Tightening of all plumbing fixtures should be part of a pre-occupancy inspection.
4. The following clarifying statement should be added to the Standard:

"Attachment to Structure. Plumbing fixtures shall be securely attached to the mobile home to resist transportation, set-up and normal use forces. Piping shall not be used to support the weight of the fixtures."

3.2.4 WATERTIGHTNESS OF TUB/SHOWER ENCLOSURES - WATER LEAKAGE AT JOINTS OF SHOWER ENCLOSURES (SHRR3.)

This problem could not readily be evaluated in the field study since unoccupied mobile homes were generally inspected.

Sample	% of Mobile Homes in Sample with Problem
HUD	1.7
Private	13.8
Field	2.3

Pertinent ANSI A119.1 Reference

1974

C9.2.2.1 - Each shower stall shall be provided with an approved watertight receptor with sides and back extending 1 inch above the finished dam or threshold. In no case shall the depth of a shower receptor be less than 2 inches or more than 9 inches measured from the top of the finished dam or threshold to the top of the drain. The wall area in shower compartments shall be constructed of smooth, noncorrosive, and nonabsorbent waterproof materials to a height not less than 6 feet above the floor level. Such walls shall form a watertight joint with each other and with the receptor or shower floor. The floor shall slope uniformly to the drain at not less than one-fourth nor more than one-half inch per foot.

1975

C9.2.2.1 - Each compartment stall shall be provided with an approved watertight receptor with sides and back extending 1 inch above the finished dam or threshold. In no case shall the depth of a shower receptor be less than 2 inches or more than 9 inches measured from the top of the finished dam or threshold to the top of the drain. The wall area shall be constructed of smooth, noncorrosive, and nonabsorbent waterproof materials to a height not less than 6 feet above the compartment floor level. Such walls shall form a watertight joint with each other and with the receptor or shower floor. The floor of the compartment shall slope uniformly to the drain at not less than one-fourth nor more than one-half inch per foot.

Note: See also Appendix to Part B on Selection of Material and Installation of Wood Product Based Wall Surfacing for Tub and Shower Enclosures.

Discussion - The problem of leaking shower enclosures can be attributed primarily to the breakdown of the moisture seal at corners, edges and joints of the enclosure material. The 1975 edition of the ANSI A119.1 Standard includes a new appendix that specifies material and installation requirements for wood product based wall surfacing materials for tub and shower enclosures. However, this new appendix does not include specific requirements relative to the materials to use when caulking and sealing corners and edges to prevent water leakage. Even if shower enclosure joints are sealed against moisture in the factory, transportation and set-up forces can damage the joints causing leakage. Aging of sealants is also a concern.

Recommendations

1. The ANSI A119.1 Standard should be amended to include the use of the sealants meeting Federal Specification Nos. TT-S-00230, TT-S-001543A, and TT-S-00227E when the design of a shower stall enclosure requires sealing.
2. A pre-occupancy check should include an evaluation of the seals of shower enclosure joints.

3.2.5 WATERTIGHTNESS OF JOINT AT DRAIN - SHOWER DRAIN LEAKAGE (SHRS2.)

Sample	% of Mobile Homes in Sample with Problem
HUD	4.2
Private	3.7
Field	3.5

Pertinent ANSI A119.1 References

1974

C9.2.2.2 *The joint around the drain connection and around the toilet outlet in combination compartments shall be made watertight by a flange, clamping ring, or other approved or listed means.*

C14.4 *Shower Stalls. Nonmetallic shower stalls and receptors shall be tested for leaks prior to being covered by finish material. Each pan shall be filled with water to the top of the dam for not less than 15 minutes.*

1975

C9.2.2.2 *The joint around the drain connection shall be made watertight by a flange, clamping ring, or other approved listed means.*

C14.4 *Shower Compartments. Nonmetallic shower compartments and receptors shall be tested for leaks prior to being covered by finish material. Each pan shall be filled with water to the top of the dam for not less than 15 minutes.*

Discussion - This general problem may be related to forces or vibrations induced as a result of transportation and set-up. The connections used are similar to those used in conventional housing.

Recommendations

1. The effect of dynamic loads on plumbing piping connections should be included in an overall study of transportation and set-up forces on mobile homes.
2. A pre-occupancy check should include an evaluation of the tightness of the plumbing piping system.

3.2.6 PROTECTIVE REQUIREMENT: FREEZING OF WATER SUPPLY PIPING (PREQ4.)

Most of these problems occurred in HUD Agnes units (HUD and Field Samples).

Sample	% of Mobile Homes in Sample with Problem
HUD	3.3
Private	0.1
Field	4.7

Pertinent ANSI A119.1 Reference (1974 and 1975)

C5.2.4 Freezing. All piping and fixtures subject to freezing temperatures shall be insulated or protected to prevent freezing under normal occupancy.

Discussion - The predominance of these data in the HUD and Field Samples indicated that conditions unique to the HUD Wilkes-Barre operation may be responsible for many of these problems. In many cases, it is known that due to the emergency conditions following the Agnes disaster, some mobile homes awaiting occupancy were unheated resulting in freezing of pipes. A contributing factor was the difficulty in draining the water supply and drain systems. Also, there were malfunctions of heat tape which allowed piping within the floor cavity to freeze. Cases of inadequate insulation were noted but the HUD procured mobile homes may have been manufactured for southern climates and not for Central Pennsylvania.

Recommendations

1. The following sentence should be added to Section C5.2.4:

"The plumbing system shall be designed for convenient drainage of both the water supply and drain systems."

2. The plan review and plant inspection aspects of the enforcement process should be tightened to insure that plumbing piping is adequately insulated for the intended climate.
3. There is a potential weakness in the mobile home design where reliance is place on heat tape to prevent freezing of plumbing pipe. Heat tapes wear out requiring periodic replacement and the typical mobile home occupant normally will not be alerted to the failure until pipes are frozen.

3.2.7 VENT TERMINAL - VENT CAPS - REMOVAL POTENTIAL (VVTL3.)

Vent pipe terminations on roofs were routinely inspected during the field study. Mobile home occupants would not normally be aware of the problem.

Sample	% of Mobile Homes in Sample with Problem
HUD	--
Private	0.1
Field	7.4

Pertinent ANSI A119.1 References

1974

C13.5.3 Vent Caps. All vent caps shall be of a removable type to permit testing under Paragraph 14.2.

1975

C13.7 Vent Caps. Vent caps, if provided, shall be of the removable type (without removing the flashing from the roof) where required to perform the tests under Paragraph 14.2.1 and 14.2.2 or when the vent is used as a clean out.

Discussion - These data are related to the necessity of removing permanent flashing from around roof penetrations in order to test or maintain plumbing vent systems as required in C14.2. The 1975 revision requires that vent caps be the removable type "without removing the flashing from the roof" which is an improvement.

Recommendation - For testing and maintenance of the mobile home plumbing systems (according to C14), it is important that plumbing vents be identified. The following addition to Section C13.7 should be considered:

"When vent caps used for roof space ventilation are identical to the vent caps used for the plumbing system, plumbing system caps shall be identified with permanent markings."

3.3 HEATING SYSTEMS (PART D) - The following problems are taken from the data presented in Appendices B, C and D. The percentage of mobile homes in each sample with the problem is tabulated along with the pertinent paragraphs of the 1974 and 1975 editions of the ANSI A119.1 Standard for Mobile Homes (NFPA 501B-1973 and 1974 editions). A discussion of the problem is included with recommendations for changes in the Standard and other phases of the mobile home supply process where appropriate.

3.3.1 APPLIANCES - QUESTIONABLE LOCATION OF FURNACE THERMOSTAT (HAINL.)

The location of the thermostat was routinely checked in the field study. Mobile home occupants generally did not recognize this as a problem.

Sample	% of Mobile Homes in Sample with Problem
HUD	--
Private	0.4
Field	8.6

Pertinent ANSI A119.1 Reference (1974 and 1975)

Not covered in ANSI A119.1-1974 or 1975.

Discussion - This category involved the location of furnace thermostats on walls adjacent to the furnace. In some cases, the thermostat was attached to a wall common to the furnace compartment or on an exterior wall. This proximity to the furnace or to a cold exterior wall has an adverse effect on the operation of the thermostatic control.

Recommendation - Add the following requirement to ANSI A119.1:

"The furnace thermostat shall be placed a minimum of three (3) feet from the vertical edge of the furnace compartment door. It shall not be located on an exterior wall or on a wall separating the furnace compartment from a habitable room."

3.4 ELECTRICAL SYSTEMS (PART E) - The following problems are taken from the data presented in Appendices B, C and D. The percentage of mobile homes in each sample with the problem is listed along with the pertinent paragraphs of the 1974 and 1975 editions of the ANSI A119.1 Standard for Mobile Homes (NFPA 501B - 1973 and 1974 editions). A discussion of the problem is included with recommendations for changes in the Standard and other phases of the mobile home supply process where appropriate.

3.4.1 WIRING METHODS - FASTENING BOXES, FITTINGS, CABINETS (EWFB)

Boxes were routinely inspected for tightness in the field study. Mobile home occupants would not generally recognize this as a problem (Private and HUD Samples).

Sample	% of Mobile Homes in Sample with Problem
HUD	--
Private	5.6
Field	26.8

Pertinent ANSI A119.1 Reference (1974 and 1975)

E8.13 - Boxes, fittings and cabinets shall be securely fastened in place. Exception: Snap-in type boxes or boxes provided with special wall or ceiling brackets that securely fasten boxes in walls and ceilings may be used (E11.5 in 1974).

Discussion - The basic problem was that switch boxes, duplex outlet boxes and boxes that serviced ceiling fixtures were not adequately attached to their surroundings. Where mechanical fastenings of boxes to wall paneling was used (screws, nails, or staples) and the wall paneling was less than 1/4 inch thick, the paneling did not offer a sufficient thickness of material to adequately anchor the boxes. Where snap-in boxes were used, the clearance between box and paneling becomes critical and in the majority of cases these clearances were excessive resulting in inadequately anchored boxes.

Loose ceiling fixtures were noted where snap-in type boxes were used in vegetable fiberboard ceiling materials. Some of these ceiling materials do not have the necessary degree of structural integrity to provide proper anchorage for snap-in type boxes or mechanically fastened boxes. As in the case of snap-in boxes anchored to wall paneling, the dimensions of the cutouts into which the box fits are critical. The cutout dimensions are specially critical when vegetable fiberboard ceiling materials are used.

Another possible cause for the loosening of the mechanical fasteners used to attach boxes and fittings are the vibrations induced during transportation of the mobile home.

These observed problems can be related to an inadequacy in the ANSI A119.1 Standard that simply states that "boxes, fittings and cabinets shall be securely fastened in place," and does not define "securely fastened in place" or indicate how it can be evaluated in the enforcement process.

Recommendations

1. A solution to this problem could be to adopt the National Electrical Code (N.E.C.) requirements for support of boxes that require attachment to structural members directly, or to approved metal or wooden braces that are attached to structural members. The pertinent paragraph in N.E.C. is 370-13 "Supports" which states that:

"Boxes shall be securely and rigidly fastened to the surface upon which they are mounted, or securely and rigidly embedded in concrete or masonry. Boxes shall be supported from a structural member of the building either directly or by using a substantial and approved metal or wooden brace, or shall be supported as is otherwise provided in this Section. If of wood, the brace shall not be less than one-inch thickness. If of metal, it shall be corrosion-resistant and shall not be less than No. 24 MSG.

Where mounted in new walls in which no structural members are provided or in existing walls in previously occupied buildings, boxes not over 100 cubic inches in size, specifically approved for the purpose, shall be affixed with approved anchors or clamps so as to provide a rigid and secure installation."

2. An alternative to adoption of the N.E.C. prescriptive requirement would be to develop a performance specification giving strength and rigidity requirements for box and fitting attachments to ceiling and wall components.

3.4.2 LIGHTING FIXTURES - DURABILITY OF LIGHTING FIXTURES (EXUR)

Sample	% of Mobile Homes in Sample with Problem
HUD	3.5
Private	5.5
Field	4.7

Pertinent ANSI A119.1 References

1974

E5.1 - Electrical materials, devices, appliances, fittings and other equipment installed, intended for use in, or attached to the mobile home shall be listed by a nationally recognized testing agency and shall be connected in an approved manner when in service. Facilities shall be provided to securely fasten appliances when the mobile home is in transit (see Section 23 for provisions on grounding).

1975

E7.1 - Electrical materials, devices, appliances, fittings and other equipment installed, intended for use in, or attached to the mobile home shall be approved for the application and shall be connected in an approved manner when in service. Facilities shall be provided to securely fasten appliances when the mobile home is in transit (see Section 9 for provisions on grounding).

Discussion - Poor durability performance of lighting fixtures was a general problem found in the study. Although the fixtures had been approved for use "by nationally recognized testing agencies" many were of a low quality and required frequent repair or replacement. It is difficult for the enforcement officials to require some useful life of the fixtures since the ANSI A119.1 Standard (like most of the housing standards) does not address durability other than in general terms.

Recommendation - A study of durability of electrical devices, including lighting fixtures, should be initiated for all types of housing.

3.4.3 OUTDOOR OUTLETS, FIXTURES, ETC. - LACK OF WATERPROOFING (EBTF)

Sample	% of Mobile Homes in Sample with Problem
HUD	1.3
Private	1.9
Field	2.7

Pertinent ANSI A119.1 References

1974

E22.1 - *Outdoor fixtures and equipment shall be recognized for outdoor use. Outdoor receptacles or convenience outlets shall be of gasketed-cover type.*

1975

E13.1 - *Same as E22.1 - 1974.*

Discussion - The majority of problems were caused by convenience outlets that did not remain waterproof or by the use of non-waterproof outlets in exterior applications. The Standard does not require mobile homes to have exterior convenience outlets but does state that if they are provided, they must be waterproof.

The mobile home manufacturers cannot be held responsible in the many instances where mobile homes delivered to the Wilkes-Barre area in the aftermath of Hurricane Agnes had to be equipped with outside outlets for heat tape connections and weatherproof fixtures were not available for installation; non-waterproof outlets were used in these cases. This does point out a problem if the mobile home occupant should require use of heat tape and an exterior outlet is not available on the unit.

Recommendation - The ANSI Standard should be amended to require at least one weatherproof outlet on a separate fused circuit in the vicinity of the water inlet pipe for heat tape use.

4.0 EVALUATION OF PROBLEMS RELATED TO THE MOBILE HOME ENFORCEMENT PROCESS

4.1 CONSTRUCTION - The following problems are taken from the data presented in Appendices B, C and D. The percentage of mobile homes which have the problem is listed along with the pertinent paragraphs of the 1974 and 1975 editions of the ANSI A119.1 Standard for Mobile Homes (NFPA 501B - 1973 and 1974 editions). A discussion of the problem is included with recommendations for changes in the enforcement process or other phases of the mobile home supply process where appropriate.

4.1.1 EXTERIOR WALLS - EXCESSIVE HEAT LOSS (EXHL)

Wall cavities of mobile homes in the Field Study were generally not inspected for sufficient amounts of insulation since it would require removal of permanent construction. Data in the HUD and Private Samples resulted from occupant complaints.

Sample	% of Mobile Homes in Sample with Problem
HUD	5.5
Private	1.7
Field	0.4

Pertinent ANSI A119.1 Reference (1974 and 1975)

B7.5 Heat Loss. The total calculated heat loss of the living unit at the outdoor design temperature as certified in 7.5.1 of this Part shall not exceed 40 Btu/hr/ft² of the total floor area or 275 Btu/hr lineal ft. of the perimeter of the space to be heated to 70°F, whichever is greater. The minimum total resistance value (R), excluding framing, of the wall (less windows and doors), ceiling and floor shall not be less than:

- Wall 8.0
- Ceiling 16.0
- Floor 10.0

Discussion - Problems recorded in this category were generally indications of missing or inadequate amounts of thermal insulation in portions of exterior walls including hot water heater compartment doors. The frequent problem of insufficient insulation in the HUD mobile homes may be explained in part, at least, by the fact that some probably were not insulated for the Central Pennsylvania climate. Missing insulation is an indication of an inadequate enforcement program (plant inspection).

Recommendations

1. In-plant monitoring of the construction process must be improved to eliminate the possibility of insufficient or missing insulation or the application of insulation that is cut too short for the intended purpose or not properly fitted.
2. Adoption of the Tentative Interim Admendment on Energy Conservation being developed by the ANSI A119.1 Committee is recommended.

4.1.2 ROOF SYSTEM - EXCESSIVE HEAT LOSS (RHLS)

The Field Sample data are quite significant since of the 20 units inspected in the roof cavity for missing insulation or insulation cut short, three (1.2% of Field Sample) were found to have insulation deficiencies.

Sample	% of Mobile Homes in Sample with Problems
HUD	0.1
Private	0.9
Field	1.2

Pertinent ANSI A119.1 Reference (1974 and 1975)

B7.5 Heat Loss. The total calculated heat loss of the living unit at the outdoor design temperature as certified in 7.5.1 of this Part shall not exceed 40 Btu/hr/ft² of the total floor area or 275 Btu/hr lineal ft. of the perimeter of the space to be heated to 70°F, whichever is greater. The minimum total resistance value (R), excluding framing, of the wall (less windows and doors), ceiling and floor shall not be less than:

Wall 8.0
 Ceiling 16.0
 Floor 10.0

Discussion - Thermal insulation between roof trusses were found to be missing or cut short of the wall resulting in the potential for excessive heat loss. Inadequate in-plant inspection probably accounted for most of these construction deficiencies.

Recommendation - Improved in-plant inspection during the manufacturing process is needed to insure that the required thermal insulation is used.

4.2 PLUMBING SYSTEMS - The following problems are taken from the data presented in Appendices B, C and D. The percentage of mobile homes which have the problem is listed along with the pertinent paragraphs of the 1974 and 1975 editions of the ANSI A119.1 Standard for Mobile Homes (NFPA 501B - 1973 and 1974 editions). A discussion of the problem is included with the recommendations for changes in the enforcement process or other phases of the mobile home supply process where appropriate.

4.2.1 PLUMBING PIPING - WATER LEAKS (JCT1.)

Sample	% of Mobile Homes in Sample with Problem
HUD	23.3
Private	17.7
Field	22.6

Pertinent ANSI A119.1 Reference (1974 and 1975)

C7.1 Tightness. Joints and connections in the plumbing system shall be gastight and watertight for the pressures required under testing procedures.

Discussion - These problems include plumbing piping joint leaks of supply, drain and vent systems. This category includes all piping problems not related to freezing, material defects or corrosion. Possible reasons for approximately one-fifth of the mobile homes in the study exhibiting plumbing leaks are: (1) poor workmanship, (2) inadequate in-plant inspection, and (3) inadequate design for forces induced during transit and site set-up.

Recommendations

1. Improved in-plant inspection of the manufacturing process is needed to insure that workmanship standards are maintained.
2. An evaluation of the dynamic loading effects of transportation and site set-up on joints and piping should be conducted.

4.2.2 DRAINAGE SYSTEM - INADEQUATE GRADE OF HORIZONTAL PIPING (DSGR)

Sample	% of Mobile Homes in Sample with Problem
HUD	0.1
Private	5.7
Field	0.4

Pertinent ANSI A119.1 References

1974

Same as 1975 except the phrase "Except for fixture connections on the inlet side of the trap," is deleted.

1975

C12.7 Grade of Horizontal Drainage Piping. Except for fixture connections on the inlet side of the trap, horizontal drainage piping shall be run in practical alignment and have a uniform grade of not less than 1/4 inch per foot toward the mobile home drain outlet. Where it is impractical, due to the structural features or arrangement of any mobile home, to obtain a grade of 1/4 inch per foot, the pipe or piping may have a grade of not less than 1/8 inch per foot, when a full size cleanout is installed at the upper end.

Discussion - The inadequate slope of horizontal drain piping is an enforcement problem in that the ANSI A119.1 Standard is very specific as to minimum slope requirements.

Recommendation - The in-plant inspection process should be improved in the area of plumbing piping for Standard compliance.

4.2.3 WATER DISTRIBUTION SYSTEM - PROBLEMS WITH WATER HEATER RELIEF VALVE DRAINS (WIRV3.)

Hot water heater relief valve drains were routinely inspected during the field study. Occupants of units included in the HUD and Private Samples would not generally consider this a problem.

Sample	% of Mobile Homes in Sample with Problem
HUD	0.1
Private	0.8
Field	15.6

Pertinent ANSI A119.1 References (1974 and 1975)

1974

C11.3.1.3 - Relief valves shall be provided with full-sized drains which shall extend outside directed downward and terminate beneath the mobile home. Drain lines shall be of a material listed for hot water distribution and shall drain fully by gravity, shall not be trapped and shall not have their outlets threaded.

1975

C11.3.1.3 - Relief valves shall be provided with full-size drains which shall be directed downward and discharged beneath the mobile home. Drain lines shall be of a material listed for hot water distribution and shall drain fully by gravity, shall not be trapped, and shall not have their outlets threaded.

Discussion - Most of these data occurred in HUD Agnes units and could have resulted from field replacement or repair of hot water heaters. The problems are of three general types which are violations of C11.3.1.3; (1) relief valve terminates above the floor or in the floor and does not directly "discharge beneath the mobile homes," (2) relief valve drain end threaded, and (3) relief valve drain undersize as compared to the relief valve outlet. These observed violations would only result in a problem if a water heater malfunction occurred requiring the relief valve drain to function. Violation (1) would result in water discharge into the mobile home damaging flooring, carpeting, floor insulation, etc. Violations (2) and (3) could result in a life-safety hazard, such as pressure build-up and explosion of the hot water heater, if a threaded-end drain were capped or an undersized drain installed.

Recommendations

1. Excluding hot water heater problems caused by modifications in the field, the standard violations indicate an inadequate enforcement program (in-plant inspection).

2. As a clarification, revise C11.3.1.3 as follows (revised portion underlined):

"Relief valves shall be provided with drains of cross sectional area equivalent to that of the relief valve outlet and be directed downward and discharge beneath the mobile home. Drain lines shall be of a material listed for hot water distribution and shall drain fully by gravity, shall not be trapped, shall not have their outlets threaded, and the end of the drain shall be visible for inspection."

4.2.4 PLUMBING PIPING - INADEQUATE HANGERS AND SUPPORTS (PHAS)

Sample	% of Mobile Homes in Sample with Problem
HUD	2.1
Private	2.8
Field	0.8

Pertinent ANSI A119.1 References (1974 and 1975)

C.10. Hangers and Supports

C10.1 Strains and Stresses. Piping in a plumbing system shall be installed without undue strains and stresses, and provision shall be made for expansion, contraction, and structural settlement.

C10.2 Piping Supports. Piping shall be secured at sufficiently close intervals to keep the pipe in alignment and carry the weight of the pipe and contents.

C10.3 Hangers and Anchors

C10.3.1 Hangers and anchors shall be of sufficient strength to support their proportional share of the pipe alignments and prevent rattling.

C10.3.2 Piping shall be securely attached to the structure by proper hangers, clamps or brackets which provide protection against motion, vibration, road shock, torque in the chassis, or other unusual conditions.

Discussion - Plumbing piping support criteria in ANSI A119.1 are presented in a performance format with requirements such as "secured at sufficiently close intervals," "sufficient strength," and "securely fastened." C10.3.2 specifically requires design for the anticipated forces of transportation and site set-up. This would appear to be adequate as long as the enforcement agency requires the manufacturer to provide documentation showing such compliance.

Recommendations

1. The enforcement process (plan review and in-plant inspection) should be improved to insure adequate support of the plumbing piping.
2. A study of the effects of transportation on mobile homes should include its impact on the plumbing system.

4.2.5 FITTINGS - CORROSION OF WATER SUPPLY PIPING (WDML)

Water piping was routinely inspected during the field study. Corrosion of piping would generally not be reported as a problem by mobile home occupants (HUD and Private Samples) unless it resulted in a water leak.

Sample	% of Mobile Homes in Sample with Problem
HUD	--
Private	0.3
Field	8.6

Pertinent ANSI A119.1 References

1974

C11.4.2 Fittings. Appropriate fittings shall be used for all changes in direction or size and where pipes are joined. The material and design of fittings shall conform to the type of piping used.

1975

C11.4.2 Fittings. Appropriate fittings shall be used for all changes in size and where pipes are joined. The material and design of fittings shall conform to the type of piping used.

Discussion - Corrosion of water distribution piping was observed with systems composed of similar metals as well as those of dissimilar metals (copper to galvanized steel). The A119.1 Standard requires special consideration for the design of fittings when piping materials are joined.

Recommendations

1. The enforcement process should be improved at the plan review stage to insure that necessary precautions are taken to prevent corrosion of piping at fittings.
2. In-plant inspection procedures should verify that these precautions are implemented in the manufacturing process.
3. As a clarification of good practice, C11.4.2 should be modified as follows:

"Fittings - Appropriate fittings shall be used for all changes in size and where pipes are joined. The material and design of fittings shall conform to the type of piping used. Special consideration shall be given to prevent corrosion when dissimilar metals are joined."

4.2.6 PLUMBING FIXTURE MALFUNCTIONS (VVGL)

Sample	% of Mobile Homes in Sample with Problem
HUD	--
Private	1.2
Field	0.1

Pertinent ANSI A119.1 Reference (1974 and 1975)

C13.1 General. Each plumbing fixture trap shall be protected against siphonage and back pressure, and air circulation shall be insured throughout all parts of the drainage system by means of vents installed in accordance with the requirements of this section and as otherwise required by this standard.

Discussion - These problems are related to poorly functioning plumbing fixtures or reported sewer gas odors in the mobile home. Even though the amount of data is small with most occurring in the Private Sample, it is significant because of the potential life-safety hazard if sewer gas should back up into the mobile home. Plumbing systems which were inadequately sealed or vents which were plugged could have caused this problem. Even if the plumbing piping is sealed correctly in the factory, joints could become loose during transportation and site set-up.

Recommendations

1. Adequate plant workmanship and conformance with the ANSI A119.1 Standard should be verified by improved in-plant inspections as part of the enforcement process.
2. The drainage system, vent system and plumbing fixtures should be tested prior to occupancy to insure tightness of the system which may have been affected by transportation and set-up.

4.2.7 TOILET FLUSH TANKS - USE OF NONAPPROVED FLUSHING DEVICES (WØSC6.)

The ball cock was routinely inspected in the field study. Mobile home occupants (HUD and Private Samples) would not report this as a problem unless a malfunction occurred.

Sample	% of Mobile Homes in Sample with Problem
HUD	--
Private	--
Field	3.9

Pertinent ANSI A119.1 Reference (1974 and 1975)

C11.2.6 Flush Tanks. Toilet flush tanks shall be equipped with an approved anti-siphon ball cock which shall be installed and maintained with its outlet or critical level mark not less than 1 inch above the full opening of the overflow pipe.

Discussion - These problems concern the use of a submerged ball cock flushing devices in violation of C11.2.6. These devices could allow flushing tank water to back flow into the potable water supply.

Recommendation - Improved plan review and in-plant inspection is required.

4.2.8 VENT PIPE PENETRATION PROBLEM (VVTLL1.)

Although only a limited number of roof vents were inspected during the field study, this problem was observed with sufficient frequency to warrant discussion here.

Sample	% of Mobile Homes in Sample with Problem
HUD	--
Private	0.5
Field	0.8

Pertinent ANSI A119.1 Reference (1974 and 1975)

C13.6.1 Roof Extension. Each vent pipe shall extend through its flashing and terminate vertically, undiminished in size, not less than 2 inches above the roof. Vent openings shall not be less than 3 feet, 0 inches away from any motor-driven air intake that opens into habitable areas.

Discussion - These problems are concerned with extension of the vent pipe 2 inches above the roof as required by C13.6.1. Vents were observed which terminated within the roof cavity, at the roof level or the vent opening was blocked by insulation which could cause trap seal failure.

Recommendation - The required extension of vents above the roof is quite specific in C13.6.1 and the violations would indicate a problem with the enforcement process (in-plant inspection).

4.3 HEATING SYSTEMS - The following problems are taken from the data presented in Appendices B, C and D. The percentage of mobile homes in each sample with the problem is listed along with the pertinent paragraphs of the 1974 and 1975 editions of the ANSI A119.1 Standard for Mobile Homes (NFPA 501B - 1973 and 1974 editions). A discussion of the problem is included with recommendations for changes in the Enforcement Process or other phases of the mobile home supply process where appropriate.

4.3.1 VENT SYSTEM - USE OF UNLISTED APPLIANCE COMPONENTS OR INADEQUATELY INSTALLED COMPONENTS (HAVE)

Sample	% of Mobile Homes in Sample with Problem
HUD	2.5
Private	14.6
Field	12.5

Pertinent ANSI A119.1 Reference (1974 and 1975)

D6.4.1 - The venting as required by 6.1.2 shall be accomplished by one or more of the methods given in (a) and (b) below:

- (a) An integral vent system listed or certified as part of the appliance.
- (b) A venting system consisting entirely of listed components, including roof jack, installed in accordance with the terms of the appliance listing and appliance manufacturer's instructions (see 6.3.2).

Discussion - These problems concern the vent systems of heating appliances (furnace and hot water heater) which do not consist entirely of listed components or were not installed in accordance with the terms of the appliance listing or the manufacturer's instructions. The cause of this problem appears to be regulatory in nature with the inspection process allowing the installation of venting systems which do not conform to D6.4.1.

Recommendation - The plan and specification review and plant inspection phases of the enforcement process should be improved to insure that vent systems conform to D6.4.1.

4.3.2 APPLIANCES - INADEQUATE ACCESSIBILITY FOR REPAIR AND REPLACEMENT (HAAC)

Appliance accessibility was routinely inspected during the field study. Mobile Home occupants (HUD and Private Samples) would not generally recognize this as a problem.

Sample	% of Mobile Homes in Sample with Problem
HUD	3.5
Private	1.3
Field	19.5

Pertinent ANSI A119.1 Reference (1974 and 1975)

D6.7 Accessibility. Every appliance shall be accessible for inspection, service, repair, and replacement without removing permanent construction. Sufficient room shall be available to enable the operator to observe the burner, control, and ignition means while starting the appliance.

Discussion - Accessibility to hot water heaters for replacement or repair was quite limited in many cases. D6.7 is quite specific in requiring "accessibility for inspection, service, repair and replacement without removing permanent construction." The placement within permanent kitchen cabinet construction makes it difficult to repair and impossible to replace without removing permanent construction. The location adjacent to living areas or closets often requires the removal of wall paneling for access.

Recommendation - The enforcement process (plan review and in-plant inspection) should be improved to insure accessibility to appliances as required by D6.7.

4.3.3 VENT SYSTEM - LOOSE VENT PIPING (HAVE3.)

Sample	% of Mobile Homes in Sample with Problem
HUD	0.8
Private	9.1
Field	10.5

Pertinent ANSI A119.1 Reference (1974 and 1975)

D6.4.2 - Venting and combustion air systems shall be installed in accordance with the following:

- (a) Components shall be securely assembled and properly aligned using the method shown in the appliance manufacturer's instructions.
- (b) Draft hood connectors shall be firmly attached to draft hood outlets or flue collars by sheet metal screws or by an equivalent means.
- (c) Every joint of a vent, vent connector, exhaust duct and combustion air intake shall be secure and in alignment.

Discussion - Problems listed in this category are related to loose piping in the venting and combustion air systems for gas and oil furnaces and gas hot water heaters. This could be a life-safety hazard if flue gases should discharge into an appliance compartment which shares a common atmosphere with the living area. In describing the type of vent connections required, D6.4.2 (b) specifies required performance attributes such as "firmly attached" and "by an equivalent means" which could present difficulties in obtaining uniform enforcement. It is also possible that the vent system attachment may meet the requirements of the Standard as the mobile home leaves the plant but forces induced during transportation and site set-up could have a deteriorating effect on the attachments.

Recommendations

1. Because of the life-safety implications, the enforcement process (plan review and in-plant inspection) should provide thorough evaluation of the joints of the fuel burning vent system.
2. A pre-occupancy check should be required including an inspection of the venting and combustion air system.
3. A study of the dynamic effects of transportation and set-up on mobile homes should include an evaluation of these effects on venting and combustion air system joints.
4. Clarify the intent of D6.4.2(b) as follows:

"D6.4.2(b) - Draft hood connectors shall be firmly attached to draft hood outlets or flue collars by sheet metal screws or by equivalent effective mechanical fasteners."

4.3.4 SUPPLY AIR SYSTEM - JOINTS AND SEAMS NOT AIRTIGHT (HARG)

Duct risers to floor registers were routinely inspected during the field study.

Sample	% of Mobile Homes in Sample with Problem
HUD	--
Private	6.5
Field	19.5

Pertinent ANSI A119.1 References

1974

D6.10.3 Joints and Seams. Joints and seams of ducts shall be securely fastened and made substantially airtight. Slip joints shall have a lap of at least 1 inch and shall be individually fastened. Tape or caulking compound may be used for sealing mechanically secure joints. Where used, tape or caulking compound shall not be subject to deterioration under long exposures to temperatures up to 200°F and to conditions of high humidity, excessive moisture, or mildew.

D6.10.5 Registers. Fittings connecting the registers to the duct system shall be constructed of metal or material which complies with the requirements of Class 1 or 2 ducts under UL Standard 181. Registers shall be constructed of metal or conform with the following:

D6.10.5.1 - Be made of a material classified SE-0 or SE-1 when tested as described in Underwriters' Laboratories, Inc. Standard for Tests of Flammability of Plastic Materials, UL94-1972.

1975

D6.10.3 Same as 1974.

D6.10.5 Registers or Grills. Fittings connecting the registers or grills to the duct system shall be constructed of metal or material which complies with the requirements of Class 1 or 2 ducts under Underwriters' Laboratories, Inc. Standard for Air Ducts, UL181-1972. Registers or grills shall be constructed of metal or conform with the following:

D6.10.5.1 Same as 1974 except SE-0 changed to 94VE-0 and SE-1 changed to 94VE-1.

Discussion - The problems grouped in this category are of three distinct types: (1) riser from the horizontal air supply duct to the floor register is either missing or constructed of duct tape, (2) debris in the duct such as trash, flooring covering, etc., and (3) restriction of air flow through the floor register. The use of duct tape risers is a violation of D6.10.5 where the riser material must meet the requirements of UL 181-1972. The absence of a riser and the presence of construction debris in the duct are workmanship problems reflecting on the in-plant inspection process. The restriction of air flow from the duct to the floor register can be caused by undersize floor openings, sheet metal bent into the air flow of the duct, or improper workmanship associated with the installation of floor covering.

Recommendation - In-plant inspection should be improved to eliminate obvious violations of the Standard.

4.3.5 FUEL-BURNING APPLIANCES - INADEQUATE SEPARATION OF COMBUSTION AIR SYSTEM FROM ATMOSPHERE OF MOBILE HOME (HAMS)

The major portion of these data resulted from the mobile home inspections by state enforcement officials (Private Sample).

Sample	% of Mobile Homes in Sample with Problem
HUD	--
Private	5.8
Field	0.4

Pertinent ANSI A119.1 References

1974

D6.3.2 - All fuel-burning appliances, except ranges, ovens, illuminating appliances and clothes dryers, shall be installed to provide for the complete separation of the combustion system from the interior atmosphere of the mobile home. Combustion air inlets and flue gas outlets shall be listed or certified as components of the appliance. The required separation may be obtained by:

- (a) The installation of direct vent system (sealed combustion system) appliances, or
- (b) The installation of appliances within enclosures so as to separate the appliance combustion system and venting system from the interior atmosphere of the mobile home. There shall not be any door, removable access panel, or other opening into the enclosure from the inside of the mobile home. Any opening for ducts, piping, wiring, etc., shall be sealed.

1975

D6.3.2 - All fuel-burning appliances, except ranges, ovens, illuminating appliances, clothes dryers, solid fuel-burning fireplaces and solid fuel-burning fireplace stoves, shall be installed to provide for the complete separation of the combustion system from the interior atmosphere of the mobile home. Combustion air inlets and flue gas outlets shall be listed or certified as components of the appliance. The required separation may be obtained by:

- (a) Same as 1974.
- (b) Same as 1974.

Discussion - Some of these problems were violations of D6.3.2(b) where the furnace and water heater compartments were not adequately sealed from the atmosphere of the mobile home. Others resulted when the direct vent systems of sealed combustion system appliances [D6.3.2 (a)] were not sealed adequately due to manufacturing problems or separation caused by transit and set-up. This could be a life-safety problem if combustion air was taken from the interior atmosphere of the mobile home depleting oxygen available to the occupants.

Recommendations

- 1. Because of safety-related concerns, the in-plant inspection of sealed combustion systems for appliances listed in D6.3.2 should be more thorough.
- 2. A check of the sealed combustion system for these appliances should be part of a pre-occupancy inspection to insure that a dangerous condition does not exist.

4.3.6 GAS SUPPLY CONNECTION - INADEQUATE PERMANENT MARKING (HGID)

The presence of a gas identification tag was routinely checked in the field study. Mobile home occupants (HUD and Private Samples) would not generally recognize this as a problem.

Sample	% of Mobile Homes in Sample with Problem
HUD	--
Private	0.7
Field	17.9

Pertinent ANSI A119.1 References

1974

D5.1.11 Identification of Gas Supply Connections. Each mobile home shall have permanently affixed to the exterior skin at or near each gas supply connection or the end of the pipe, a tag of 3 inches by 1-3/4 inches minimum size, made of etched, metal-stamped or embossed brass, stainless steel, anodized or alclad aluminum not less than 0.020 inch thick, or other approved material (e.g., 0.005 inch plastic laminates), which reads (as appropriate) either:

1975

D5.1.11 Identification of Gas Supply Connections. Each mobile home shall have permanently affixed to the exterior skin at or near each gas supply connection or the end of the pipe, a tag of 3 inches by 1-3/4 inches minimum size, made of etched, metal-stamped or embossed brass, stainless steel, anodized or alclad aluminum not less than 0.020 inch thick, or other approved material (e.g., 0.005 inch plastic laminates), which reads (as appropriate) in accordance with one of the following label designs depending upon the fuel used. The connector capacity indicated on this tag shall be equal to or greater than the total Btuh rating of all intended gas appliances.

Discussion - The absence of a gas supply connection identification tag was noted mostly on HUD Agnes units. It is possible that the tags were on the units when manufactured but were lost or removed later. However, this would be contrary to the intent of D5.1.11 which requires that the tag be "permanently affixed to the exterior skin." This would indicate that something more than a "paste-on" tag should be used. The change in the 1975 editions of the ANSI A119.1 as compared to 1974 is related to the wording on the tag and not the attachment method.

Recommendations

1. The enforcement program (plan review and in-plant inspection) should include the requirement that the manufacturer use permanently attached identification tags. The "paste-on" type which can be easily removed should not be accepted.
2. As a clarification, D5.1.11 (1975 edition) should be revised as follows (addition underlined):

"D5.1.11 - Each mobile home shall have permanently affixed to the exterior skin with mechanical fasteners at or near each gas supply connection or the end of the pipe, a tag of 3 inches by 1-3/4 inches minimum size, made of etched, metal stamped or embossed brass, stainless steel, anodized or alclad aluminum not less than 0.020 inch thick, or other approved material (e.g., 0.005 inch plastic laminates), which reads (as appropriate) in accordance with one of the following label designs depending upon the fuel used. The connector capacity indicated on this tag shall be equal to or greater than the total Btuh rating of all intended gas appliances."

4.3.7 GAS PIPING - INADEQUATE HANGERS AND SUPPORTS (HGHS)

Gas piping support was routinely checked in the field study. Mobile home occupants (HUD and Private Samples) would not generally recognize this as a problem.

Sample	% of Mobile Homes in Sample with Problem
HUD	--
Private	2.2
Field	10.5

Pertinent ANSI A119.1 Reference (1974 and 1975)

D5.1.18 Hangers and Supports. All gas piping shall be adequately supported by galvanized or equivalently protected metal straps or hangers at intervals of not more than 4 feet, except where adequate support and protection is provided by structural members. Solid-iron-pipe gas supply connections(s) shall be rigidly anchored to a structural member within 6 inches of the supply connections(s).

Discussion - An inadequate number of hangers for gas piping is related to the enforcement process since D5.1.18 is quite specific as to minimum spacing requirements.

Recommendation - Improve plan and specification review and in-plant inspection to assure compliance with the requirements of D5.1.18.

4.3.8 SUPPLY DUCT SYSTEM - SYSTEM NOT AIR TIGHT (HACS3.)

Sample	% of Mobile Homes in Sample with Problem
HUD	--
Private	4.1
Field	0.4

Pertinent ANSI A119.1 Reference (1974 and 1975)

D6.10.1.3 Airtightness of Supply Duct Systems. A supply duct system shall be considered substantially airtight when the static pressure in the duct system, with all registers sealed and with the furnace air circulator at high speed, is at least 80 percent of the static pressure measured in the furnace casing, with its outlets sealed and the furnace air circulator operating at high speed. For the purpose of this paragraph and 6.10.2 pressures shall be measured with a water manometer or equivalent device calibrated to read in increments not greater than 1/10 inch water column.

Discussion - These problems were recorded from visual observations of enforcement officials investigating consumer complaints (Private Sample) and do not necessarily reflect the failure of the supply air system to pass the test requirements of D6.10.1.3. Assuming the supply system was adequately sealed at the factory, it is possible that effects of transportation and site set-up could loosen the system causing excessive leakage.

Recommendations

1. In-plant inspection should insure that testing according to D6.10.1.3 is conducted.
2. The airtightness of the supply duct system should be verified as part of a pre-occupancy inspection.

4.3.9 APPLIANCES - INADEQUATE MARKINGS (HAMK)

Required markings on appliances were routinely inspected in the field study. Mobile home occupants (HUD and Private Sample) would not generally recognize this as a problem.

Sample	% of Mobile Homes in Sample with Problem
HUD	--
Private	0.2
Field	10.9

Pertinent ANSI A119.1 References (1974 and 1975)

D6.6 Marking

D6.6.1 - Information on clearances, input rating, lighting and shutdown shall be attached to the appliances with the same permanence as the nameplate, and so located that it is easily readable when the appliance is properly installed.

D6.6.2 - Each fuel-burning appliance shall bear permanent marking designating the type(s) of fuel for which it is listed.

Discussion - The bulk of these data are related to the absence of required appliance markings. Possible explanations for the missing markings are (1) markings may not have been attached when manufactured, or (2) they may have been removed by occupants or maintenance personnel.

Recommendation - While there can be little control over what happens to the mobile home after it is occupied, in-plant inspections must verify that required markings are permanently attached to the appliances.

4.3.10 APPLIANCE CONNECTIONS - INADEQUATE FLEXIBLE GAS CONNECTOR APPLICATIONS (HGAC)

Flexible gas connectors were inspected during the field study. Unless a malfunction occurred, mobile home occupants would not generally recognize this as a problem.

Sample	% of Mobile Homes in Sample with Problem
HUD	--
Private	0.4
Field	4.3

Pertinent ANSI A119.1 References

1974

D5.1.13 Appliance Connections. All gas-burning appliances shall be connected to the fuel piping with materials as provided in 5.1.2 of this Part or with listed appliance connectors. Listed appliance connectors when used shall not run through walls, floors, ceilings or partitions. Connectors of aluminum shall not be used outdoors.

1975

D5.1.13 Appliance Connections. All gas burning appliances shall be connected to the fuel piping. Materials as provided in Section 5.1.2 of this Part or listed appliance connectors shall be used. Listed appliance connectors when used shall not run through walls, floors, ceilings or partitions. Connectors of aluminum shall not be used outdoors.

Discussion - The problems in this category consist of two types: (1) flexible gas connectors running through the floor to the underside of the mobile home in violation of D5.1.13, and (2) flexible connectors installed on appliances with excessively sharp bends. The second is an example of poor workmanship with the sharp bend being an area of potential gas leak. In many of the instances observed, it was not possible to determine whether they originated in the factory or were related to repair or replacement of the heating units after the mobile home was placed in service.

Recommendation - These examples of poor practice associated with flexible gas connectors which originate during the manufacturing process should be caught by in-plant inspection.

4.3.11 VENTING SYSTEM - TERMINATION BENEATH THE MOBILE HOME (HAVE5.)

Sample	% of Mobile Homes in Sample with Problem
HUD	--
Private	1.2
Field	0.4

Pertinent ANSI A119.1 References (1974 and 1975)

D6.2.3 The exhaust duct shall not terminate beneath the mobile home.

D6.4.3 Venting Systems shall not terminate underneath a mobile home.

Discussion - Most of these problems involved the venting of dryers through the floor to the underside of the mobile home. It could not be determined if this was done by the manufacturer or the occupant; however, it is fair to assume that the occupants were responsible for a great deal of these violations of the ANSI A119.1 Standard. A space provided for a dryer was not always accompanied by a venting system. If the manufacturer provides space for a clothes dryer, he should provide an approved venting system and not rely on the mobile home occupant to improvise.

Recommendations

1. The enforcement process (plan review and in-plant inspection) should be improved to prevent dryer vent systems provided by the manufacturer from terminating under the mobile home.
2. Additionally, revise D6.2.3 as follows:

D6.2.3 - If space for a clothes dryer is provided, provision for an exhaust duct, which does not terminate beneath the mobile home, shall be installed.

4.4 ELECTRICAL SYSTEMS - The following problems are taken from the data presented in Appendices B, C and D. The percentage of mobile home units in each data sample with the problem is listed along with the pertinent paragraphs of the 1974 and 1975 editions of the ANSI A119.1 Standard for Mobile Homes (NFPA 501B - 1973 and 1974 editions). A discussion of each problem is included with recommendations for changes in the enforcement process or other phases of the mobile home supply process as appropriate.

4.4.1 RECEPTACLE OUTLETS - POOR INSTALLATION WORKMANSHIP AND DURABILITY (EFIN)

Sample	% of Mobile Homes in Sample with Problem
HUD	2.5
Private	1.8
Field	1.2

Pertinent ANSI A119.1 References

1974

E19.1 Receptacle Outlets. All receptacle outlets shall be of the grounding type and shall be installed in accordance with Sections 210-7 and 210-21.b of the National Electrical Code (ANSI C1-1971; NFPA No. 70-1971).

1975

E6.1 All receptacle outlets shall be:

- (a) of grounding type;
- (b) installed according to Section 210-7 of the National Electrical Code (NFPA No. 70-1974; ANSI C1-1974); and
- (c) except when supplying specific appliances, be parallel-blade, 15 ampere, 125-volt, either single or duplex.

Note: For ground-fault circuit interrupter requirements, refer to Section 210-8(a) of the National Electrical Code (NFPA No. 70-1974; ANSI C1-1974).

Discussion - The problems associated with receptacle outlets can be classified into two categories: installation workmanship and durability. The substandard workmanship problems are related to inadequate electrical inspection during manufacturing. The Standard (E5.1-1974 Edition) simply states that devices "shall be listed by a nationally recognized testing agency" which does not necessarily insure long-term durability. This problem of inadequate durability is not unique to mobile homes within the housing area.

Recommendations

1. Improved in-plant inspection is required to reduce workmanship problems.

2. A study of durability of electrical devices, including receptacle outlets, should be initiated for all types of housing.

4.4.2 SERVICE GROUNDING - FAULTY INSTALLATION (EGSE)

This problem occurred predominately in the HUD Agnes units (HUD and Field Samples). It can possibly be attributed to the emergency conditions encountered with these units.

Sample	% of Mobile Homes in Sample with Problem
HUD	1.7
Private	0.6
Field	0.8

Pertinent ANSI A119.1 References

1974

E23.1 Service Grounding. Service grounding shall be accomplished as follows:

E23.1.1 - The green-colored grounding wire in the supply cord or permanent feeder wiring shall be connected to the grounding bus in the distribution panelboard or disconnecting means.

E23.1.2 - The distribution panelboard shall have a grounding bus, or approved grounding means for the various grounding connections.

E23.1.3 - The grounding bus shall have sufficient terminals for all grounding conductors.

1975

E9.1 General. Grounding of both electrical and nonelectrical metal parts in the mobile home shall be through connection to a grounding bus in the mobile home distribution panelboard. The grounding bus shall be grounded through the green-colored conductor in the supply cord or the feeder wiring to the service ground in the service-entrance equipment located adjacent to the mobile home location. Neither the frame of the mobile home nor the frame of any appliance shall be connected to the neutral conductor in the mobile home.

Discussion - Service grounding problems may be the result of improper initial installation of service wiring in mobile homes at the site. The possibility of loose connectors at the load center caused by vibration during transportation also exists. The ANSI A119.1 Standard appears to be adequate in this regard.

Recommendation - A pre-occupancy inspection of mobile homes should include a check of the load center to make sure that all electrical connections are properly made.

4.4.3 RECEPTACLE OUTLETS - IMPROPER WALL LOCATION (ERLW)

The location of wall receptacles was routinely inspected in the field study. Mobile home occupants (HUD and Private Sample) would not generally recognize this as a problem.

Sample	% of Mobile Homes in Sample with Problem
HUD	--
Private	1.8
Field	10.9

Pertinent ANSI A119.1 References

1974

E6.1 - Except in the bath and hall areas, receptacle outlets shall be installed at wall spaces 2 feet wide or more, so that no point along the floor line is more than 6 feet, measured horizontally, from an outlet in that space. Except as explained in the following, receptacle outlets are not required for wall spaces occupied by kitchen or wardrobe cabinets. In addition, a receptacle outlet shall be installed:

- (a) Over or adjacent to counter tops in the kitchen (at least one on each side of the sink if counter tops are on each side and 12 inches or over in width).
- (b) Adjacent to the refrigerator and free-standing gas-range space.
- (c) At counter top spaces for built-in vanities.
- (d) At counter top spaces under wall-mounted cabinets.

1975

E6.3 - Same as E6.1 (1974).

Discussion - This problem concerns the location of receptacle outlets which do not conform to the requirements of the Standard. It is strictly enforcement related (plan review and in-plant inspection).

Recommendation - Improve plan review and in-plant inspection.

4.4.4 BRANCH CIRCUITS REQUIRED - INADEQUATE CAPACITY FOR GENERAL APPLIANCES (EBCR3.)

Sample	% of Mobile Homes in Sample with Problem
HUD	--
Private	5.3
Field	--

Pertinent ANSI A119.1 References

1974

E7.1.3 - General Appliances (including Furnace, Water Heater, Range, and Central or Room Air Conditioner, etc.). There shall be one or more circuits of adequate rating in accordance with the following:

- (a) Ampere rating of fixed appliances not over 50 percent of circuit rating if lighting outlets (receptacles, other than kitchen, dining area, and laundry, considered as lighting outlets) are on same circuit;
- (b) For fixed appliances on a circuit without lighting outlets, the sum of rated amperes shall not exceed the branch-circuit rating for other than motor loads or 80 percent of the branch-circuit rating for air conditioning or other motor loads;
- (c) The rating of a single portable appliance on a circuit having no other outlets shall not exceed 80 percent of the circuit rating;
- (d) The rating of range branch circuit shall be based on the range demand as specified for ranges in Section 8 of this Part;
- (e) Where laundry facilities are provided in a mobile home, a 20 ampere branch circuit shall be provided with a 20 ampere outlet within six feet of the intended location of the appliance.

1975

E4.10 - A 15-ampere multiple receptacle shall be acceptable when connected to a 20-ampere laundry circuit.

E5.1.3 - Same as E7.1.3 (1974).

Discussion - All reported problems in this category resulted from consumer complaints in the Private Sample. The majority of these problems are attributed to inadequate circuit ampere rating for general appliances. The problems with laundry facility circuitry was either that the circuit was nonexistent, was too low an amperage rating or the provided outlet was not within the specified distance from the laundry appliance. The ANSI A119.1 Standard is clear in this regard and the problems can be attributed to inadequate electrical inspection during the manufacturing process or inadequate plan review prior to manufacturing.

Recommendation - The Standard should be enforced by improved plan review and in-plant inspection procedures.

4.4.5 WALL SWITCHES - IMPROPER CONNECTION AND INADEQUATE DURABILITY (ESWL)

Sample	% of Mobile Homes in Sample with Problem
HUD	1.0
Private	1.3
Field	0.8

Pertinent ANSI A119.1 References

1974

E5.1 - Electrical materials, devices, appliances, fittings and other equipment installed, intended for use in, or attached to the mobile home shall be listed by a nationally recognized testing agency and shall be connected in an approved manner when in service. Facilities shall be provided to securely fasten appliances when the mobile home is in transit. (See Section 23 for provisions on grounding.)

E18.1 - Switches shall be rated as follows:

- (a) For lighting circuits, switches shall be rated not less than 10 amperes-- 125 volts and in no case less than the connected load.
- (b) For motors or other loads, switches shall have ampere or horsepower ratings or both adequate for loads controlled (An "AC general use" snap switch may control a motor 2 horsepower or less with full-load current not over 80 percent of the switch ampere rating.)

1975

E7.1 - Electrical materials, devices, appliances, fittings, and other equipment installed, intended for use in, or attached to the mobile home shall be approved for the application and shall be connected in an approved manner when in service. Facilities shall be provided to securely fasten appliances when the mobile home is in transit. (See Section 9 for provisions on grounding.)

E8.8 - Switches shall be rated as follows:

- (a) For lighting circuits, switches shall have a 10-ampere, 120-125 volt rating; or higher if needed for the connected load.
- (b) For motors or other loads, switches shall have ampere or horsepower ratings, or both, adequate for loads controlled. (An "AC general-use" snap switch shall be permitted to control a motor 2 horsepower or less with full-load current not over 80 percent of the switch ampere rating.)

Discussion - Problems associated with switches can be classified into two categories, namely, workmanship (hook-up or connection) and durability. Workmanship problems can be attributed to inadequate electrical inspection during the manufacturing process. As to durability, the ANSI A119.1 Standard simply states that devices "shall be listed by a nationally recognized testing laboratory" which does not necessarily assure durability.

Recommendations

1. The enforcement process (plan review and in-plant inspection) should be improved to insure that equipment is installed in a proper manner.
2. A study of durability of electrical devices, including switches, should be initiated for all types of housing.

4.4.6 CABLE SUPPORT - INSUFFICIENT CABLE SUPPORT (EWSU)

Sample	% of Mobile Homes in Sample with Problem
HUD	--
Private	2.7
Field	5.8

Pertinent ANSI A119.1 References

1974

E11.9 - Cables shall be supported within 12 inches of outlet boxes, the service entrance box, and splice boxes on appliances. Supports are required every 4-1/2 feet at other places.

1975

E8.1 - Except as specifically limited in this Part, the wiring methods and materials specified in the National Electrical Code (NFPA No. 70-1974; ANSI C1-1974) shall be used in mobile homes.

Discussion - These problems relate to cable support techniques which do not meet the requirements of E11.9 (1974 edition.) The reference to NEC in E8.1 (1975 edition) removes specific cable support requirements by calling for good workmanship.

A specific problem observed during the field study related to cable support was the passing of electrical wiring and water supply piping through the same small wall penetration without any attempt at isolation of the two.

Recommendations

1. Improved in-plant inspection of electrical wiring methods are needed.
2. The ANSI A119.1 Standard-1975 should be revised back to the same as it was in ANSI A119.1-1974 which clearly defines support requirements for cables.
3. The following requirement should be added to Part C - Plumbing Systems:

"C5.2.6 Piping Location. Piping and electrical wiring shall not pass through the same holes in walls, floor or roof. Plastic piping shall not be exposed to excessive heat or radiation from the flame of hot water heaters."

4.4.7 ELECTRICAL MARKING - IMPROPER MARKING OF FUSES AT DISTRIBUTION CENTER (EMKE)

Markings of distribution centers were not inspected during the field study or reported by occupants in the HUD Sample. Enforcement officials (Private Sample) did routinely inspect for proper marking.

Sample	% of Mobile Homes in Sample with Problem
HUD	--
Private	3.6
Field	--

Pertinent ANSI A119.1 References

1974

E25.1 The main circuit breakers or fuses shall be plainly marked "Main."

E25.2 If a fused distribution panel is used, the maximum fuse size for the mains shall be plainly marked as follows, with lettering at least 1/4 inch high where visible when fuses are changed: "Maximum Main Fuses 40 (or 50) amp."

1975

E4.1 The branch-circuit equipment shall be permitted to be combined with the disconnecting means as a single assembly. Such a combination shall be permitted to be designated as a distribution panelboard. If a fused distribution panelboard is used, the maximum fuse size for the mains shall be plainly marked with lettering at least 1/4-inch high and visible when fuses are changed.

Note: See Section 110-22 of the National Electrical Code (NFPA No. 70-1974; ANSI C1-1974) concerning identification of each disconnecting means and each service, feeder, or branch circuit at the point where it originated and the type marking needed.

Discussion - This problem concerns inadequate marking of the maximum size of main fuses at the distribution center. These problems are an indication of inadequacies in the enforcement process (plan review or in-plant inspection) since the ANSI A119.1 Standard is clear as to the type and size of markings required.

Recommendation - The enforcement process (plan review and in-plant inspection) should be improved.

4.4.8 DISCONNECTION MEANS AND BRANCH CIRCUITS - MALFUNCTIONS AND IMPROPER MARKINGS AND INSTALLATION OF DISTRIBUTION PANELBOARDS (EDIS)

Sample	% of Mobile Homes in Sample with Problem
HUD	--
Private	3.4
Field	1.6

Pertinent ANSI A119.1 References

1974

E9.1 Mobile homes shall contain a distribution panelboard having a main overcurrent protective device rated not in excess of the current carrying capacity of the feeder assembly, installed with supply cord and branch circuits wired at the factory.

E9.2 - The distribution equipment, either circuit breaker or fuse type, shall be located a minimum of 24 inches from the floor level of the mobile, measured to the bottom of the equipment or shall be specifically approved for the purpose.

E9.5 - A distribution panelboard main circuit-breaker shall be rated 50 amperes and employ a 2-pole circuit breaker rated 40 amperes for a 40-ampere supply cord, or 50 amperes for a 50-ampere supply cord. A distribution panelboard employing a disconnect switch and fuses shall be rated 60 amperes and shall employ a single 2-pole, 60-ampere fuseholder with 40- or 50-ampere main fuses for 40- or 50-ampere supply cords, respectively. The outside of the distribution panelboard shall be plainly marked with the fuse size. The main circuit breakers or fuses shall be plainly marked "Main."

E9.8 - Overcurrent protection shall be provided for branch circuits and feeders in accordance with Article 240 of the National Electrical Code (ANSI C1-1971; NFPA No. 70-1971) as applicable. The branch circuit overcurrent devices shall be rated:

- (a) not more than the circuit conductors; and
- (b) not more than 150 percent of the rating of a single appliance rated 10 amperes or more which is supplied by an individual branch circuit but
- (c) not more than the fuse size marked on the air conditioner or other motor-operated appliance.

E 9.10 - When circuit breakers are provided for branch-circuit protection, 230-volt circuits shall be protected by 2-pole common or companion trip, or handle-tied paired circuit breakers.

1975

E4.1 - The branch-circuit equipment shall be permitted to be combined with the disconnecting means as a single assembly. Such a combination shall be permitted to be designated as a distribution panelboard. If a fused distribution panelboard is used, the maximum fuse size for the mains shall be plainly marked with lettering at least 1/4-inch high and visible when fuses are changed.

Note: See Section 110-22 of the National Electrical Code (NFPA No. 70-1974; ANSI C1-1974) concerning identification of each disconnecting means and each service, feeder, or branch circuit at the point where it originated and the type marking needed.

E4.6 - A distribution panelboard main circuit breaker shall be rated 50 amperes and employ a 2-pole circuit breaker rated 40 amperes for a 40-ampere supply cord, or 50 amperes for a 50-ampere supply cord. A distribution panelboard employing a disconnect switch and fuses shall be rated 60 amperes and shall employ a single 2-pole, 60-ampere fuseholder with 40- or 50-ampere main fuses for 40- or 50-ampere supply cords, respectively. The outside of the distribution panelboard shall be plainly marked with the fuse size.

E4.9 - The branch circuit overcurrent devices shall be rated:

- (a) not more than the circuit conductors; and
- (b) not more than 150 percent of the rating of a single appliance rated 10 amperes or more which is supplied by an individual branch circuit; but
- (c) not more than the fuse size marked on the air conditioner or other motor-operated appliance.

E4.11 - When circuit breakers are provided for branch-circuit protection, 230-volt circuits shall be protected by 2-pole common or companion trip, or handle-tied paired circuit breakers.

Discussion - The problems placed in this category were miscellaneous problems concerning the distribution panelboard, inadequately marked branch circuits and panelboards located too close to the floor. These are enforcement problems related to inadequate in-plant inspection since the ANSI A119.1 Standard is quite specific in these areas.

Recommendation - More stringent in-plant inspection procedures for electrical installations should be implemented.

4.4.9 CABLE PROTECTION - INADEQUATE PROTECTION MEASURES (EWPR)

Units in the field study were routinely inspected for adequate cable protection as were most units in the Private Sample. Mobile home occupants (HUD Sample) would not generally recognize this as a problem.

Sample	% of Mobile Homes in Sample with Problem
HUD	--
Private	2.6
Field	1.6

Pertinent ANSI A119.1 References

1974

E11.12 - *Nonmetallic cable located 15 inches or less above the floor, if exposed, shall be protected from physical damage by covering boards, guard strips, or conduit. Cable likely to be damaged by stowage shall be so protected in all cases.*

1975

E8.3 - *Same as E11.12 (1974).*

Discussion - Since the Standard clearly states that cables must be protected if located within 15 inches of the floor, this problem may be attributed to inadequate electrical inspection during manufacturing (enforcement process) or improper design.

Recommendation - The in-plant inspection program for evaluating wiring methods should be improved.

4.4.10 PASSING OF CABLE THROUGH WALL STUDS - INADEQUATE PROTECTION (EWPS)

This item was routinely inspected during the field study.

Sample	% of Mobile Homes in Sample with Problem
HUD	--
Private	0.4
Field	9.7

Pertinent ANSI A119.1 References

1974

E11.7 - *Metal-clad and nonmetallic cables may be passed through the centers of the wide side of 2 by 4 studs. However, they shall be protected where they pass through 2 by 2 studs or at other studs or frames where the cable or armor would be less than 1-1/2 inches from the inside or outside surface. Steel plates on each side of the cable, or a tube, with not less than No. 16 manufacturer's standard gage wall thickness, are required to protect the cable. These plates or tubes shall be securely held in place.*

1975

E8.4 - Metal-clad and nonmetallic cables shall be permitted to pass through the centers of the wide side of 2-inch by 4-inch studs. However, they shall be protected where they pass through 2-inch by 2-inch studs or at other studs or frames where the cable or armor would be less than 1-1/2 inches from the inside or outside surface. Steel plates on each side of the cable, or a tube, with not less than No. 16 MSG wall thickness shall be required to protect the cable. These plates or tubes shall be securely held in place.

Discussion - This problem involves inadequate protection of electrical cables passing through wall studs. The Standard is specific in this regard and the problem is a result of inadequate electrical inspection during manufacturing (enforcement process).

Recommendation - The in-plant inspection program for evaluating wiring methods should be improved.

4.4.11 LISTED AND APPROVED DEVICES - LOOSE CONNECTIONS (ERXY1.)

The tightness of electrical connections was routinely inspected in the field study.

Sample	% of Mobile Homes in Sample with Problem
HUD	--
Private	0.2
Field	7.4

Pertinent ANSI A119.1 References

1974

E5.1 - Electrical materials, devices, appliances, fittings, and other equipment installed, intended for use in, or attached to the mobile home shall be listed by a nationally recognized testing agency and shall be connected in an approved manner when in service. Facilities shall be provided to securely fasten appliances when the mobile home is in transit. (See Section 23 for provisions on grounding.)

E17.1 - Connection of conductors to terminal parts shall ensure a thoroughly good connection without damaging the conductors and shall be made by means of pressure connectors (including set screw type), solder lugs, or splices to flexible leads. No. 8 or smaller solid connectors and No. 10 or smaller stranded conductors may be connected by means of clamps or screws with terminal plates having upturned lugs, or by means of approved screwless terminals. Terminals for more than one conductor shall be of a type approved for the purpose.

1975

E7.1 - Electrical materials, devices, appliances, fittings, and other equipment installed, intended for use in, or attached to the mobile home shall be approved for the application and shall be connected in an approved manner when in service. Facilities shall be provided to securely fasten appliances when the mobile home is in transit. (See Section 9 for provisions on grounding.)

E8.1 - Except as specifically limited in this Part, the wiring methods and materials specified in the National Electrical Code (NFPA No. 70-1974; ANSI C1-1974) shall be used in mobile homes.

Discussion - The loose connections occurred mainly at the wire connection to duplex outlets or switches that were made at the binding head screws. In some cases, it was obvious that little or no attempt was made to tighten the binding head screws on the devices which is not only poor workmanship, but also gross negligence.

Recommendation - The in-plant inspection part of the enforcement process should be improved to ensure that good electrical wiring practices are being used.

4.4.12 LISTED AND APPROVED - ALUMINUM/COPPER DEVICES USE WITH ALUMINUM WIRING (ERXY11.)

The compatibility of the electrical devices and wiring was routinely inspected in the field study.

Sample	% of Mobile Homes in Sample with Problem
HUD	--
Private	0.1
Field	7.0

Pertinent ANSI A119.1 References

1974

E5.1 - Electrical materials, devices, appliances, fittings, and other equipment installed, intended for use in, or attached to the mobile home shall be listed by a nationally recognized testing agency and shall be connected in an approved manner when in service. Facilities shall be provided to securely fasten appliances when the mobile home is in transit. (See Section 23 for provisions on grounding.)

1975

E7.1 - Electrical materials, devices, appliances, fittings, and other equipment installed, intended for use in, or attached to the mobile home shall be approved for the application and shall be connected in an approved manner when in service. Facilities shall be provided to securely fasten appliances when the mobile home is in transit. (See Section 9 for provisions on grounding.)

Discussion - This problem is concerned with the practice of using electrical devices which are not specifically approved for use with aluminum wire.

Recommendation - Follow the expected lead of the National Electrical Code concerning the use of special devices with aluminum wire when their position on the subject is clarified.

4.4.13 WIRING PRACTICES - INADEQUATE CONTINUITY OF CABLE SHEATH (EWCS)

Sample	% of Mobile Homes in Sample with Problem
HUD	--
Private	0.4
Field	1.9

Pertinent ANSI A119.1 References

1974

E11.6 - The sheath of nonmetallic cable or the armor of metal-enclosed cable shall be continuous between outlet boxes and other enclosures.

1975

E8.1 - Except as specifically limited in this Part, the wiring methods and materials specified in the National Electrical Code (NFPA No. 70-1974; ANSI C1-1974) shall be used in mobile homes.

Discussion - The ANSI A119.1-1974 Standard clearly states that cable sheath "shall be continuous between outlet boxes and other enclosures." The ANSI A119.1-1975 is not as specific but refers to the National Electrical Code where the requirements are similar. The problem is related to the enforcement process (inadequate electrical inspection during manufacture). It is also an example of poor workmanship.

Recommendation - The in-plant inspection part of the enforcement process must be improved to ensure that good electrical wiring practices are being used.

5.0 DURABILITY RELATED PROBLEMS

Problems of a durability nature are quite prevalent in the mobile home performance data accumulated during this project. Many of these problems have already been discussed in Sections 3.0 and 4.0 since they are, in some cases, closely related to the four major problem subsections established to categorize the data (ANSI A119.1, Enforcement Process, Mechanical/Electrical Appliances and Routine Maintenance).

5.1 WINDOW (NCWD) AND DOOR HARDWARE (NCXH AND NCPH)

Sample	% of Mobile Homes in Sample with Problem		
	Exterior Door	Partition Door	Window
HUD	26.2	3.4	6.8
Private	8.3	7.9	12.2
Field	24.5	5.4	5.8

Discussion - Data from the Routine Maintenance Subsection indicated that the most troublesome hardware problems were associated with exterior doors. Window closing mechanisms and latches exhibited the most problems followed by partition door hardware.

ANSI A119.1-1975 does not include a reference specification for either exterior door locks or partition door hardware which may be a contributing factor to the poor performance indicated by the data. There is an existing specification for Locks and Lock Trim (ANSI A156.2-1975) which could be referenced in ANSI A119.1.

In the case of windows, ANSI A119.1-1975 does reference (B8.5.1) MHMA Specification No. 1-71-Rev. 1973, "Window Specification for Utilization in Mobile and Factory Built Housing." This specification was developed primarily for energy conservation and weather resistance concerns. Performance requirements which would insure window hardware durability are not included. There is a proposed American National Standard, ANSI A134.5, "Specifications for Aluminum Mobile Home Windows" which does contain such performance requirements.

Recommendations

1. Reference ANSI A156.2-1975, "American National Standard for Locks and Lock Trim" in ANSI A119.1.
2. When approved as an American National Standard, reference ANSI A134.5, "Specification for Aluminum Mobile Home Windows," in ANSI A119.1.

5.2 FLOOR COVERING (FDUR1.)

As mobile home owners, occupants of Private Sample units would be more concerned with floor covering durability than the occupants of HUD or Field Sample units which were rented.

Sample	% of Mobile Homes in Sample with Problem
HUD	1.0
Private	13.3
Field	3.5

Discussion - Durability and workmanship problems were encountered with sheet vinyl floor coverings and carpeting. The sheet vinyl problems almost exclusively involved buckling of the floor covering at joints of the particle board decking. Carpeting problems, which comprised the greater percentage of the complaints, had to do with poor quality of materials. ANSI A119.1 Standard does not include specifications which would insure minimum quality of floor coverings.

Recommendation - Floor covering specifications of HUD/FHA Minimum Property Standards (MPS) [8] should be incorporated into ANSI A119.1.

5.3 EXTERIOR DOORS (DEDU)

Sample	% of Mobile Homes in Sample with Problem
HUD	0.1
Private	3.6
Field	2.7

Discussion - The durability problems encountered involved deterioration and delamination of facing materials; including aluminum, wood, hardboard and vinyl. The majority of these problems were encountered in the Private and Field Samples. As discussed in 3.1.6, ANSI A119.1-1975 does not include a door specification. Proposed MHMA Spec. 3-74, "Exterior Passage Door Specification for Utilization in Mobile and Factory Built Housing," does not include performance tests which would evaluate durability. It is similar to the performance criteria in the HUD/FHA Minimum Property Standards for doors, windows and glazing, which covers only air leakage, water infiltration, and physical load testing.

Recommendation - Methods should be developed for evaluating durability characteristics of exterior doors which would be applicable to all types of housing.

5.4 APPLIANCES AND MECHANICAL EQUIPMENT

5.4.1 General. Durability of appliances (furnace, range, refrigerator, hot water heater, etc.) is covered only very generally in the ANSI A119.1 Standard with the statement that appliances shall be "listed or certified by a nationally recognized testing agency for use in mobile homes." The definition of "listed," given in Parts D and E of the Standard is, "Equipment or materials included in a list published by a nationally recognized testing laboratory that maintains periodic inspection of production of listed equipment or materials and whose listing states either that the equipment or material meets nationally recognized standards or has been tested and found suitable for use in a specified manner."

An in-depth analysis of existing standards for appliances in regard to durability is beyond the scope of this study. As a comparison, standards for furnaces, hot water heaters, ranges, refrigerators and clothes dryers, as outlined in the HUD/FHA MPS and ANSI A119.1, are presented in Table 22. The standards presented in ANSI A119.1 are more extensive than those in the MPS and no correlation between the two is evident for any of the appliances. This is understandable for furnaces since they are generally designed specifically for mobile homes and tend to differ considerably from those used in conventional housing. However, some correlation between MPS and ANSI A119.1 could be expected for hot water heaters since similar appliances are used in both types of housing.

The other major appliances found in mobile homes and conventional houses (ranges and refrigerators) are essentially not covered in either standard. ANSI A119.1 does give a specification for commercial cooking equipment and refrigerators using gas fuel, but not for refrigerators. The MPS does not cover standards for ranges or refrigerators.

5.4.2 Problem Distribution. Problems associated with mechanical/electrical appliances and equipment accounted for 5,508 (17.2%) of the total number of problems (31,982) categorized for all samples. The distribution of these 5,508 problems for the Private, Field and HUD Samples can be seen in Tables 11, 16 and 19. Mechanical/electrical appliance and equipment problems were found in 52.8% of all mobile homes in the three samples.

Table 23 presents the rank ordering of problem occurrence for the combined sample by component as follows: furnace, hot water heater, range, exhaust fan, refrigerator, smoke detector, and electrical baseboard heating units. A further breakdown of problem occurrences associated with the three most troublesome components (furnaces, hot water heaters and ranges) are presented in Figures 5, 6, 7 and 8.

6.0 SUMMARY COMMENTS AND RECOMMENDATIONS

This project was undertaken by the National Bureau of Standards at the request and sponsorship of the Division of Energy, Building Technology and Standards of the Department of Housing and Urban Development with the objective of documenting mobile home performance problems and relating them to possible inadequacies in the ANSI A119.1 Standard for Mobile Homes and the mobile homes enforcement process. Additionally, the durability of mobile home components was a study objective for potential use in mortgage insurance evaluation.

The data presented in this report and in references [2], [3] and [4] represent a significant base of information from which the above objectives can be addressed. It should be pointed out that the number of mobile homes included in this study is small when compared to the total number of units now occupied in the United States. Also, the emphasis in this project, by design, was to concentrate on reported mobile home problems and does not reflect the large number of mobile home occupants who have been satisfied with the performance of their units. A problem oriented study of this type on conventional housing would probably be just as revealing.

Problem data were separated into five different categories, as described in Appendix A and presented in Appendices B, C and D, for the three data samples. These were related to (1) ANSI A119.1 Standard for Mobile Homes, (2) Mobile Home Enforcement Process, (3) Routine Maintenance, (4) Mechanical/Electrical Appliances, and (5) Miscellaneous. In many cases, a performance problem could be related to more than one of these categories. A judgment was made by the project staff as to which major category a problem should be placed. The problem discussions in Sections 3.0, 4.0 and 5.0 attempt to touch on the various reasons for the problem occurrence.

Problems placed in the ANSI A119.1 category indicated areas where the Standard was inadequate or where omissions were evident. The major problem areas in the Construction system were rain leaks, failure of interior paneling attachment, inadequate bottomboard durability, corrosion of exterior fasteners, and excessive metal roof membrane flexibility (roof rumble.) Plumbing problems included questionable quality of fixtures, loose fixture connections, watertightness of shower enclosures, and freezing of piping. Heating and electrical problems in the ANSI A119.1 category consisted of questionable location of furnace thermostat and inadequate fastening of electrical boxes.

The Mobile Home Enforcement category included problems which indicated deficiencies in the mobile home regulatory process (plan and specification review, certification, and in-plant inspection.) In the Construction area, this included instances where thermal insulation in the walls and roof were found missing or improperly installed. Typical problems in the Plumbing area included piping water leaks, inadequate grade (slope) of drain pipe, water heater relief valve drain problems, and corrosion of piping. Heating system problems included use of unlisted or inadequately installed components, inadequate accessibility of appliances, joints of supply and vent systems not airtight, inadequate separation of combustion air system, inadequate marking of appliances and improper flexible gas connector usage. Electrical problems included lack of durability and long-term performance of devices, improper location of receptacles and devices, inadequate number of branch circuits, and problems related to workmanship such as insufficient cable support, inadequate cable protection, etc.

Problems related to durability of mobile home components are discussed in Section 5.0. Most of the problems in the Mechanical/Electrical Appliance category are included in this discussion. While many of the problems in the Routine Maintenance category were of a normal wear and tear nature, of the types expected in all types of housing, some were related to durability and were also included in Section 5.0.

The body of this report contains many specific recommendations on revisions to the ANSI All9.1 Standard for Mobile Homes and suggested improvements in the mobile home enforcement process. However, many of the identified problems point out that the state-of-the-art at this time will not permit a specific recommended solution. The following comments and recommendations are submitted in response to this obvious need for additional mobile home research:

1. The forces resulting from transportation and site set-up of the mobile home are not documented sufficiently to allow incorporation of specific design criteria into the ANSI All9.1 Standard for Mobile Homes. Throughout this report, the effect of these forces on the construction, plumbing, heating and electrical systems are implied but cannot be specifically substantiated. It is recommended that a research program be initiated to determine the effect of transportation and set-up on mobile home performance.
2. The effect of wind forces on mobile homes, both during transportation and on site, are unknown. The configuration of the mobile homes and siting conditions differ considerably from other structures making it difficult to apply results of available wind research. It is recommended that a research program be initiated to determine the magnitude and distribution of wind forces on mobile homes as well as the response of the structural system to expected wind forces. Available mobile home wind research data are quite limited.
3. Available data indicate that mobile homes are subjected to deteriorative forces after leaving the factory and prior to occupancy due to transportation and site set-up. It is recommended that a required inspection be considered for mobile homes after set-up and prior to occupancy to evaluate the adequacy of the construction, plumbing, heating and electrical systems. This could include an evaluation of the following which were documented in this study to be problem areas: tightness of the heating vent system; electrical system for shorts; plumbing system for gas, oil or water leaks; tie-down system; and the operation of plumbing fixtures and appliances. Since the enforcement process is generally accomplished at the state or local level, a handbook outlining this pre-occupancy inspection procedure should be developed for national use.
4. The problems related to the mobile home enforcement process were associated with inadequate plan/specification review or in-plant inspection. A uniform procedural guide for these phases of the process should be established for national use.

5. The data presented in this report suggests that durability of mobile home components is a problem. However, there are few existing standards available within the housing industry which provide for evaluation of long-term durability performance of components such as door hardware, plumbing fixtures, and electrical devices. The development of such standards should be encouraged.

6. The ANSI A119.1 Standard for Mobile Homes consists of a combination of performance and prescriptive type requirements. Prescriptive requirements are generally written around systems, components or materials that are currently in use. This approach tends to freeze technology and discourage the use of innovative concepts. The further application of the performance approach to mobile home standards could allow the mobile home industry, which is quite competitive and receptive to cost effective innovations to produce a quality product which could be purchased by a larger segment of the population.

References

- [1] ANSI A119.1 (NFPA 501B) "Standard for Mobile Homes," National Fire Protection Association, Boston, Massachusetts.
- [2] J.H. Pielert, W.E. Greene, L.F. Skoda, W.G. Street; Performance of Mobile Homes - Data Acquisition and Analysis Methodology; National Bureau of Standards (U.S.) NBSIR 75-641, February 1975 (NTIS Accession No. COM-75-11209).
- [3] W.G. Street, W.E. Greene, J.H. Pielert, L.F. Skoda; A Compilation of Problems Related to the Performance of Mobile Homes; National Bureau of Standards (U.S.) NBSIR 75-690, April 1975 (NTIS Accession No. COM-75-11207).
- [4] L.F. Skoda, J.H. Pielert, W.E. Greene, W.G. Street; Performance of Mobile Homes - A Field Inspection Study; National Bureau of Standards (U.S.) NBSIR 75-688, June 1975 (NTIS Accession No. COM-75-11222).
- [5] ANSI A119.3 "Standard for Mobile Home Parks," National Fire Protection Association, Boston, Massachusetts.
- [6] P.W. Cooke, L.P. Zelenka, H.K. Tejuja; Mobile Home Construction Standards Adopted by State Regulatory Programs - An Analysis; National Bureau of Standards (U.S.) NBSIR 75-680, March 1975 (NTIS Accession No. COM-75-10423).
- [7] P.W. Cooke, H.K. Tejuja, R.D. Dikkers, L.P. Zelenka; State Building Regulatory Programs for Mobile Homes and Manufactured Buildings - A Summary; National Bureau of Standards (U.S.) Technical Note 853, September 1974.
- [8] HUD Minimum Property Standards - Volume 1 (One and Two Family Dwellings), U. S. Department of Housing and Urban Development Publication 4900.1, 1973 Edition.

Acknowledgement

The authors are indebted to many persons for contributions and guidance that made this report possible. Special thanks are given to NBS staff members who participated in the regulatory and field inspection activities and provided invaluable assistance in the data reduction effort. Staff members from the Center for Building Technology included R. Beausoliel, T. Ray and W. Niessing. E. Budnick and J. Scott of the Center for Fire Research provided expertise in Fire Protection Engineering and J. Peebles of the Plant Division was responsible for the electrical discipline. M. Vogt of Technical Analysis Division prepared the computer programs used for data analysis. J. Finnan and T. Porter, working under outside contracts, provided valuable support to important project tasks.

The cooperation of the staff of the Office of Emergency Preparedness (OEP) of the Department of Housing and Urban Development, both in Washington, D.C. and at Wilkes-Barre, Pennsylvania, contributed significantly to the success of this project. Mr. James McCollom of HUD, Office of Policy Development and Research, provided liaison between NBS staff and OEP operations personnel, as well as valuable technical advice resulting from a previous HUD study of the Hurricane Agnes mobile homes.

The authors are particularly grateful to the many Federal, State and private organizations who cooperated with the NBS study team by making mobile homes available for field inspection, as well as providing mobile home performance data.

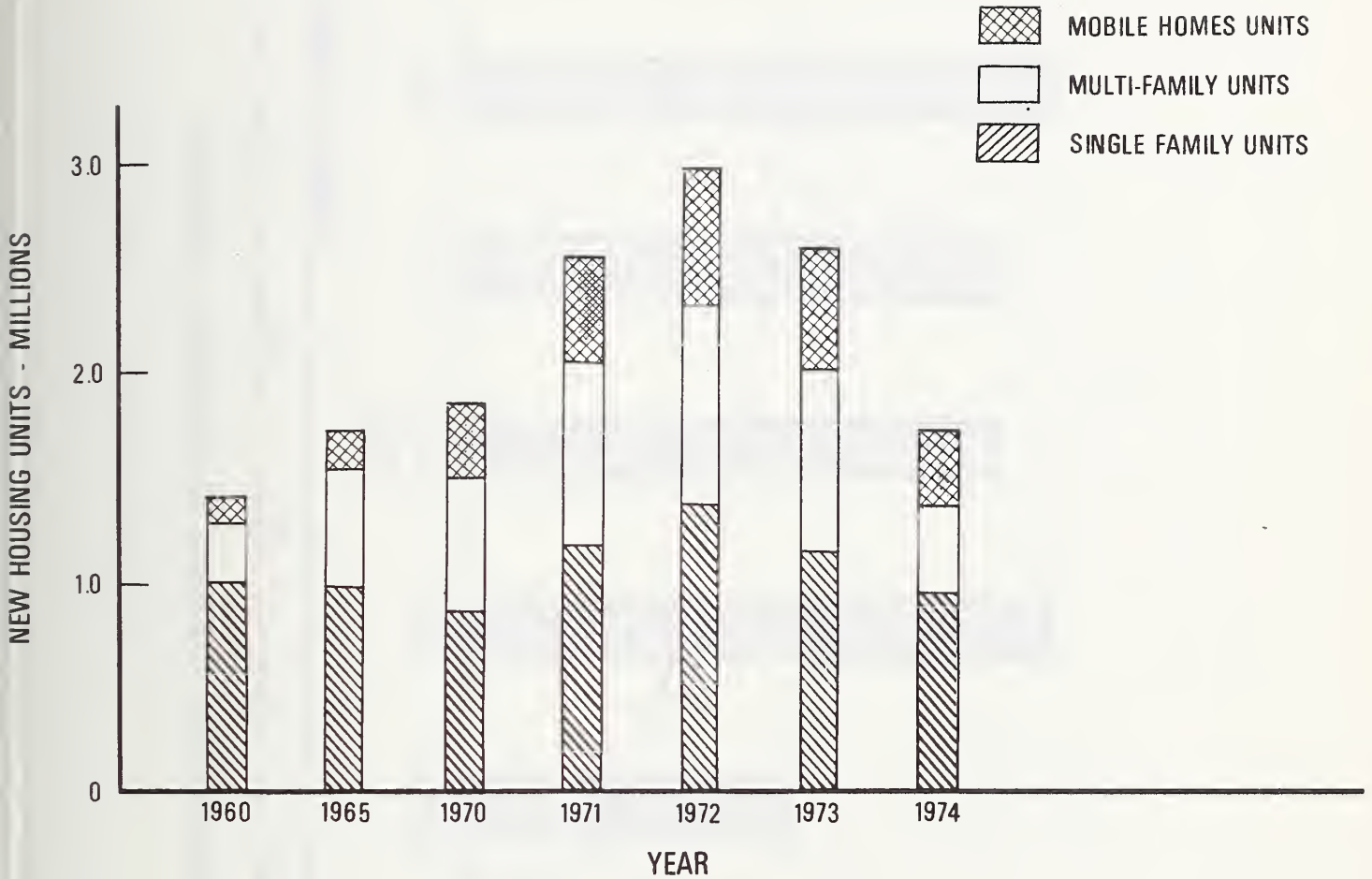
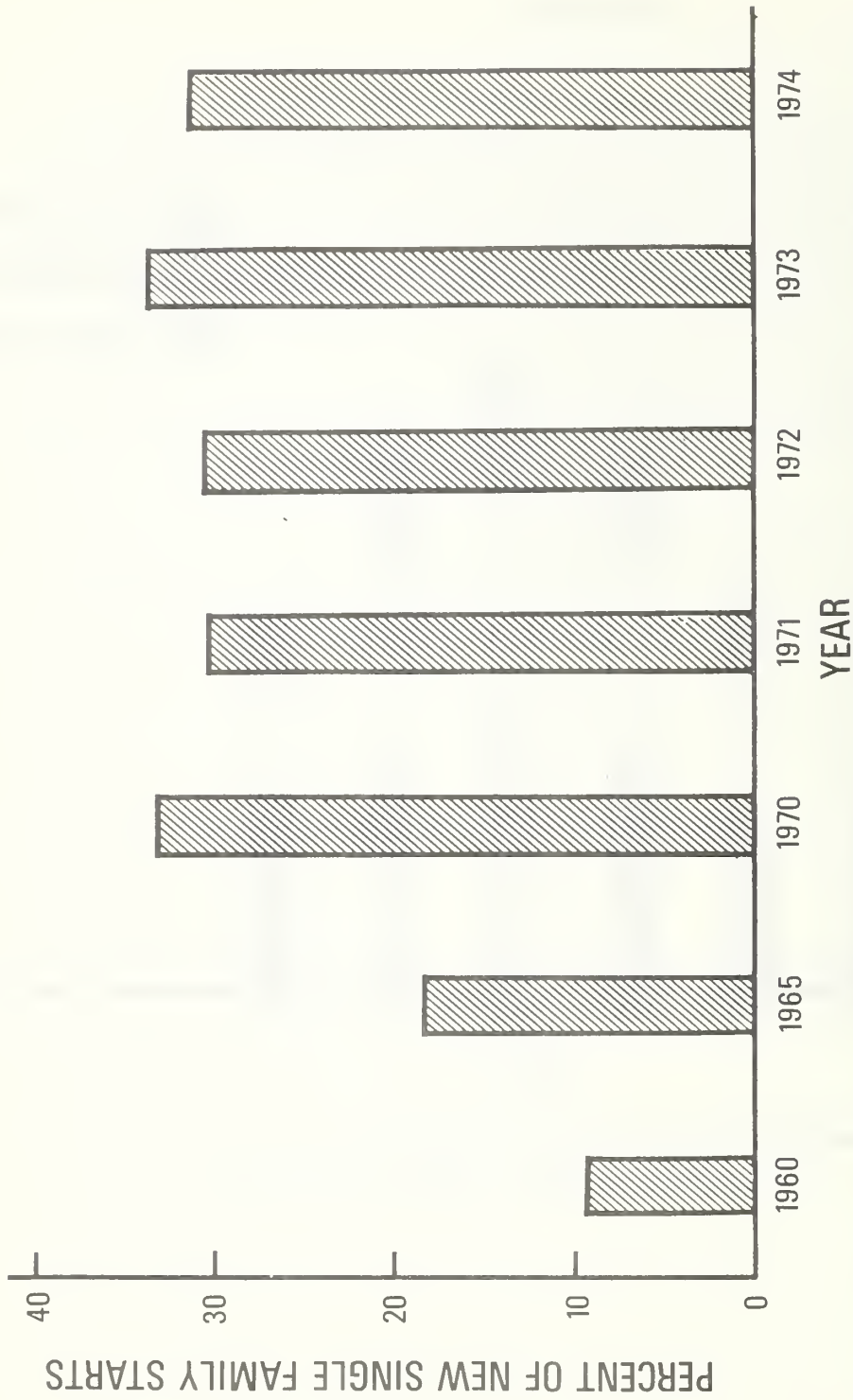


Figure 1 - New Housing Units Produced in U.S. Versus Year
 Source: Bureau of the Census



SOURCE: U.S. CENSUS BUREAU.

Figure 2 Mobile Home Production as Percentage of New Single Family Housing Units

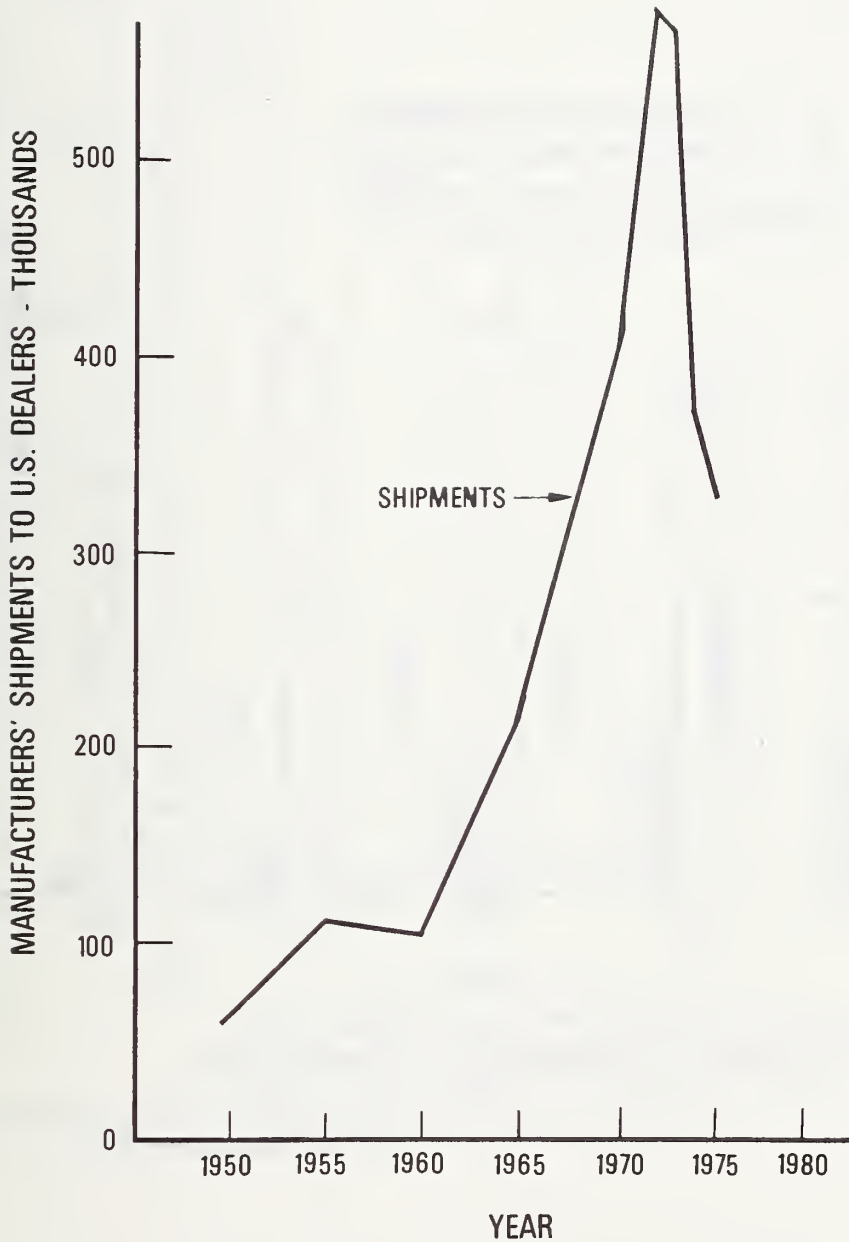


Figure 3 Mobile Home Shipments

Source: Manufactured Housing Institute
 "Quick Facts" 1974 Data

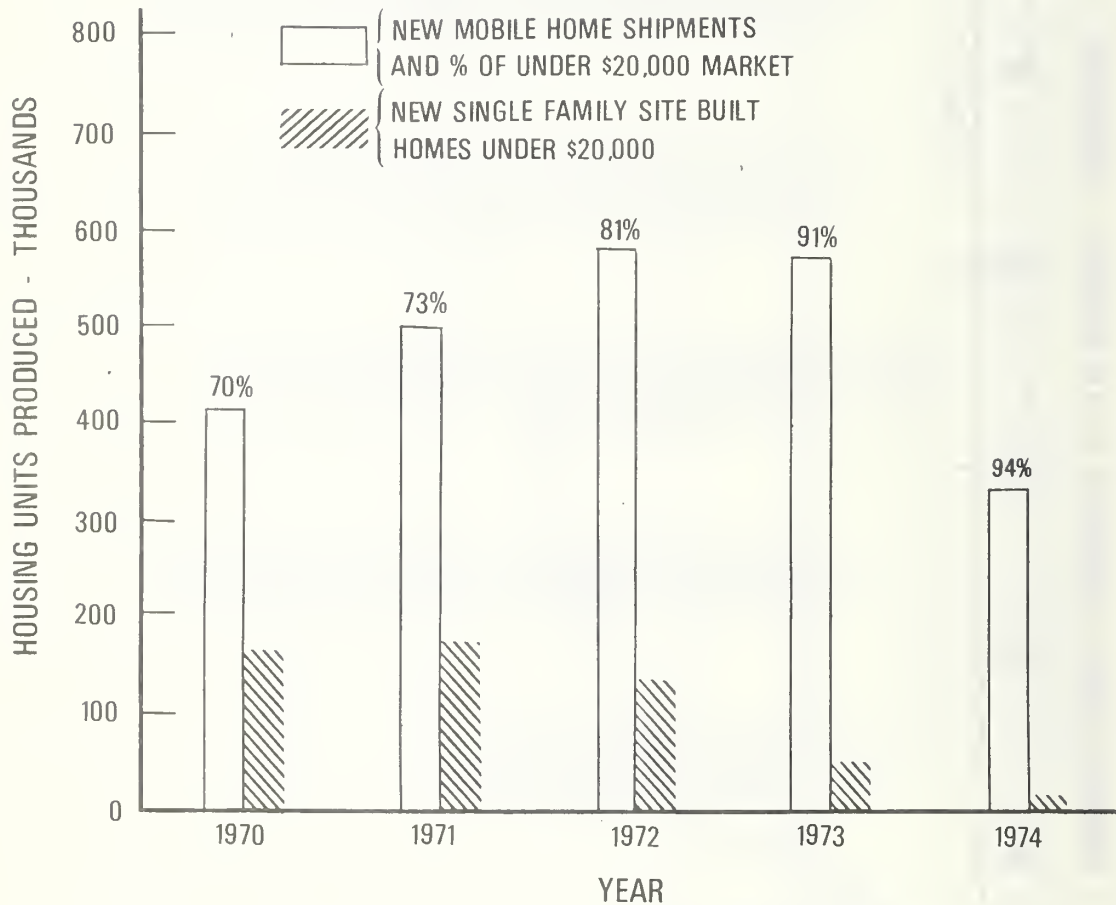


Figure 4 The Under \$20,000 New Home Market

Source: Manufactured Housing Institute
"Quick Facts" 1974 Data

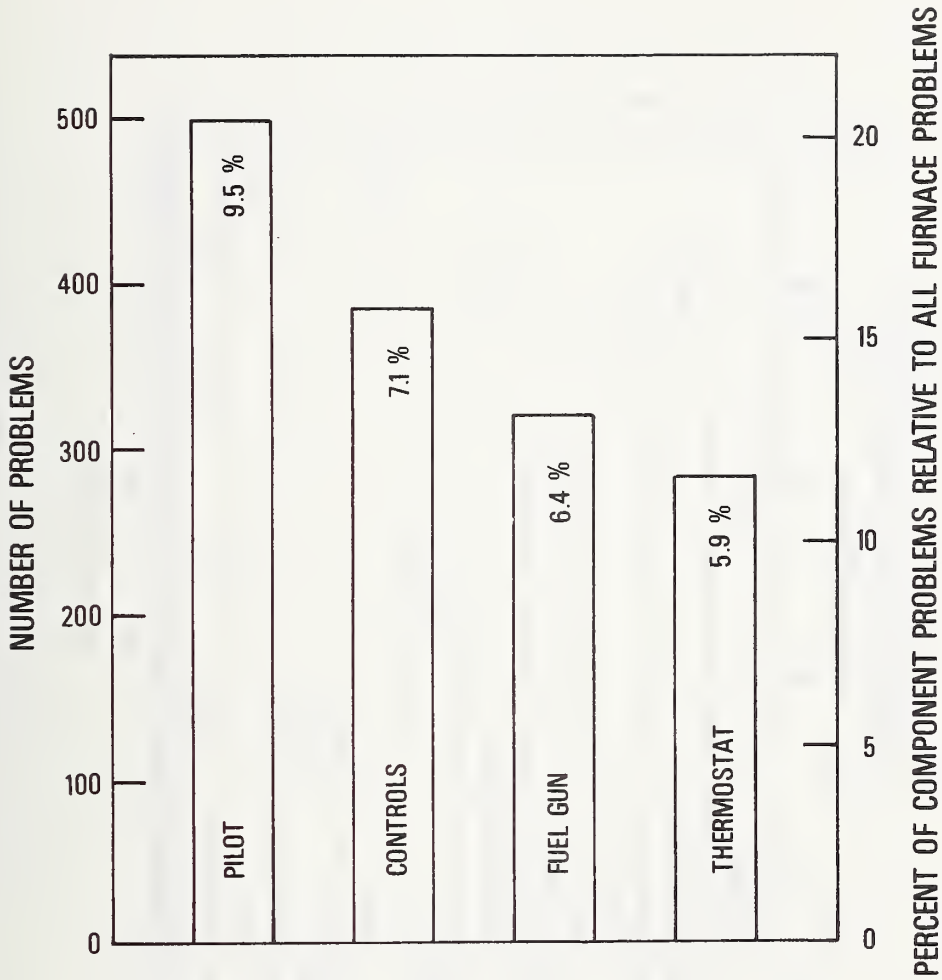


Figure 5 - Problem Distribution for Furnace Components (Total Sample)

Notes

1. Total sample includes HUD, Field, and Private Data
2. Percentages in bars indicate portion of mobile homes in total sample with component problem

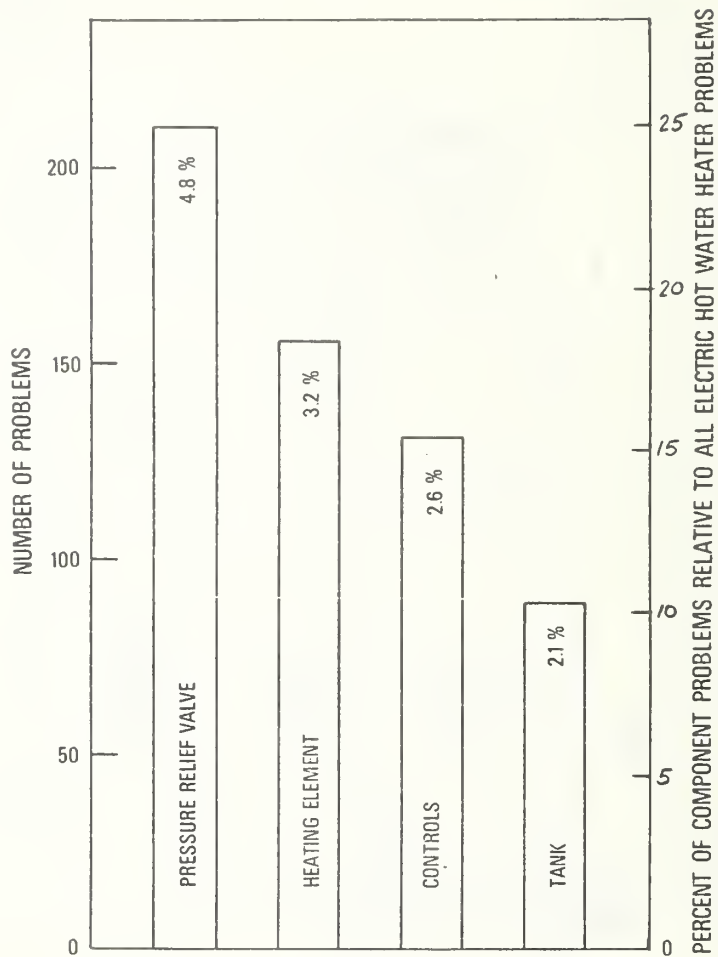


Figure 6 - Problem Distribution for Electric Water Heater Components (Total Sample)

Notes

1. Total sample includes HUD, Field, and Private Data
2. Percentages in bars indicate portion of mobile homes in total sample with component problem

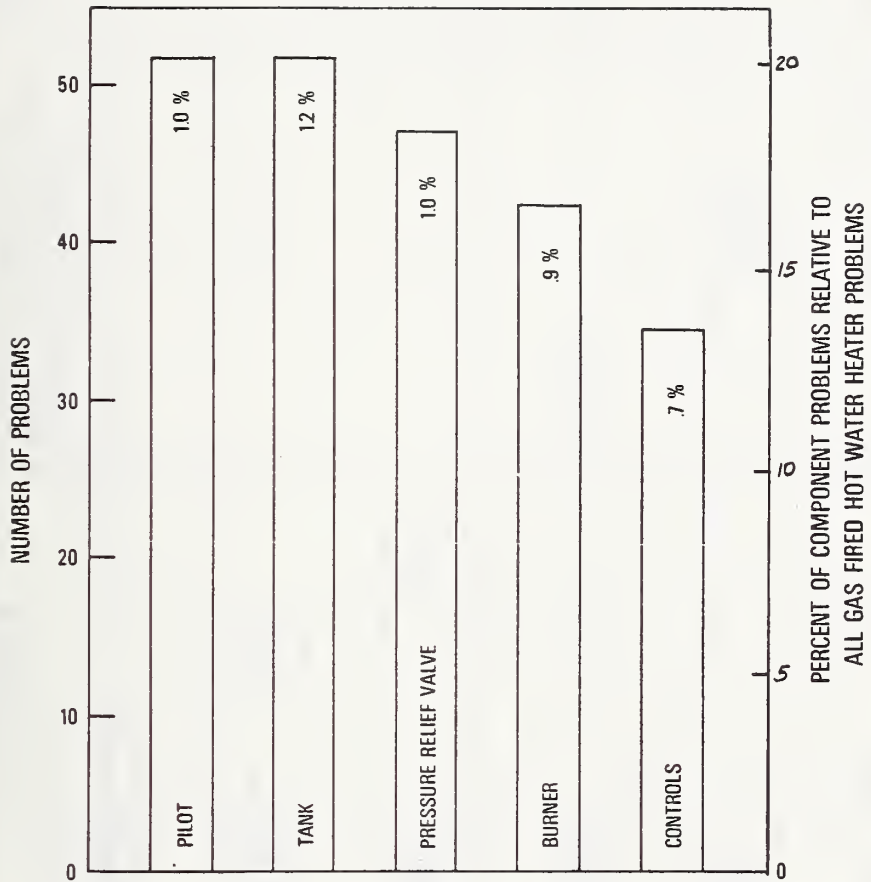


Figure 7 - Problem Distribution for Gas Fired Water Heaters (Total Sample)

Notes

1. Total sample includes HUD, Field, and Private Data
2. Percentages in bars indicate portion of mobile homes in total sample with component problem

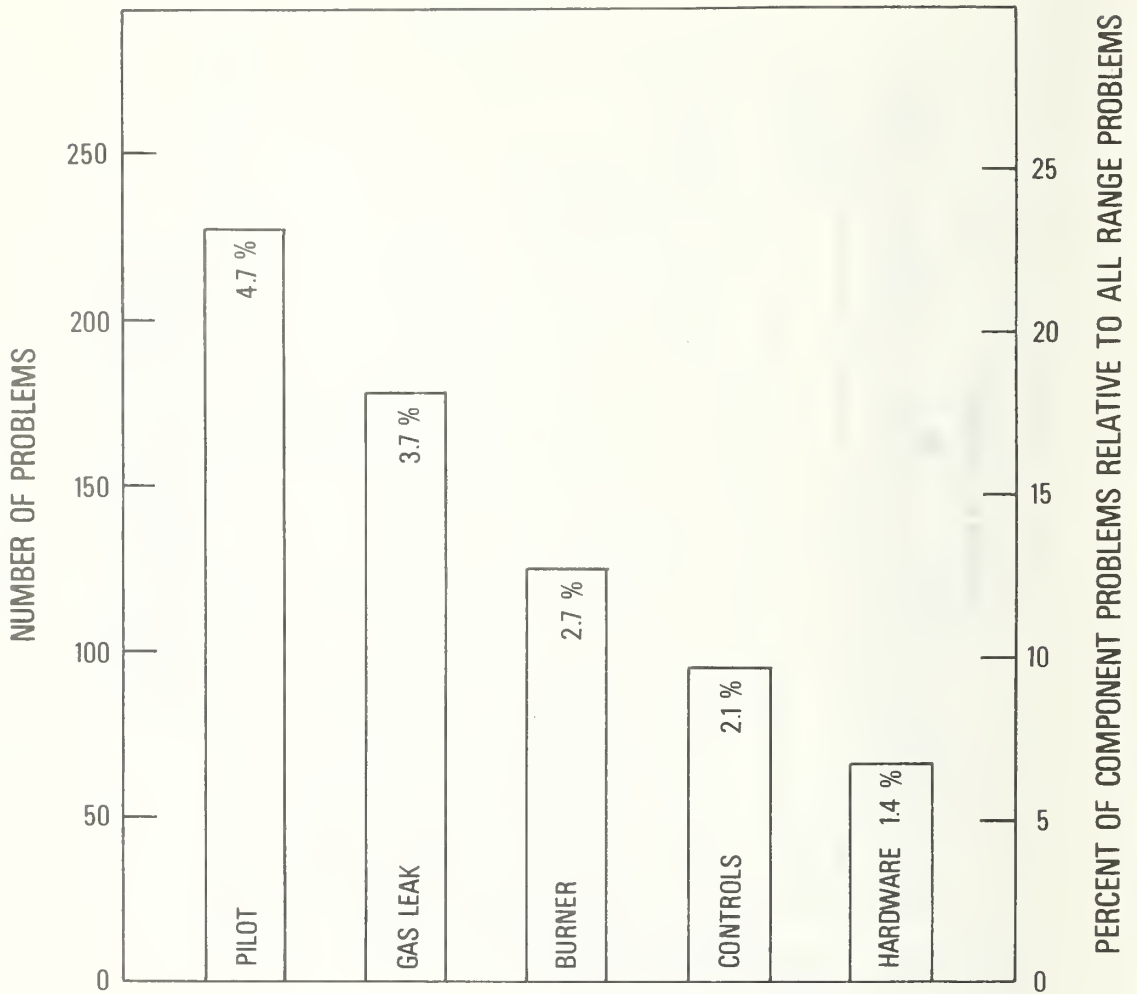


Figure 8 - Problem Distribution for Range Components (Total Sample)

Notes

1. Total sample includes HUD, Field, and Private Data.
2. Percentages in bars indicate portion of mobile homes in total sample with component problem

Table 1
Mobile Home Performance Problem Data Sources (PRIVATE SAMPLE)

Source and Location	Visit to Source Agency	Approximate Number of Mobile Home Cases Potentially Available (early 1974)	Number of Mobile Home Cases Obtained
<u>Texas</u> - Dept. of Labor and Standards - Mobile Home Div. - (Austin)	Yes	257	171
<u>California</u> - Dept. of Housing and Community Development - Div. of Codes and Standards - (Sacramento)	Yes	3,000	162
<u>Arizona</u> - Division of Building Codes - (Phoenix)	No	273	1
<u>Florida</u> - Dept. of Highway Safety and Motor Vehicles - (Tallahassee)	Yes	1,400	142
<u>Virginia</u> - Dept. of Agriculture and Commerce - Office of Consumer Affairs - (Richmond)	Yes	300	32
<u>Georgia</u> - Office of Comptroller General - State Fire Marshall - (Atlanta)	No	300	-
<u>Louisiana</u> - Office of the Governor - Office of Consumer Protection - (Baton Rouge)	No	700	3

Table 1 (con't)

Source and Location	Visit to Source Agency	Approximate Number of Mobile Home Cases Potentially Available (early 1974)	Number of Mobile Home Cases Obtained
Washington - Dept. of Labor and Industries - Mobile Home, Commercial Coach and Recreational Vehicle Section - (Seattle)	Yes	300	152
Veterans Administration Office - (Jacksonville, Florida)	Yes	250	47
Veterans Administration Regional Office - (Montgomery, Alabama)	Yes	125	40
Veterans Administration Center - (Jackson, Mississippi)	No	123	1
Alabama Farm Bureau - (Montgomery, Alabama)	Yes	200	199
American Mobilehome Association - (Lakewood, Colorado)	No	10	8
Minnesota - Dept. of Administration - Building Code Division - (St. Paul)	No	25	9

Table 2

State of Manufacture and Number of Units
For the Combined (HUD, Field and Private)
Mobile Home Sample

<u>State</u>	<u>Number of Units</u>
Alabama	272
Alaska	2
Arizona	1
Arkansas	60
California	160
Colorado	4
Florida	168
Georgia	235
Idaho	31
Illinois	37
Indiana	329
Kansas	19
Kentucky	15
Louisiana	23
Maryland	4
Michigan	85
Minnesota	38
Mississippi	68
Missouri	6
New York	21
North Carolina	131
North Dakota	2
Ohio	65
Oklahoma	7
Oregon	61
Pennsylvania	307
South Carolina	52
South Dakota	2
Tennessee	40
Texas	151
Utah	2
Virginia	46
Washington	58
Wisconsin	6
Wyoming	1
Unknown	<u>1596</u>
Total	<u>4105</u>

Table 3

Year of Manufacture vs. Number of Units
Combined HUD, PRIVATE and FIELD SAMPLE

<u>Year</u>	<u>No. of Units</u>
1974	32
1973	382
1972	1791
1971	208
1970	18
1969	4
1968	1
1965	2
1962	2
Unknown	<u>1665</u>
Total	4105

Table 4

Width vs. Number of Units
Combined HUD, PRIVATE and FIELD SAMPLE

<u>Width</u>	<u>No. of Units</u>
10.0 Feet	2
11.0 "	1
12.0 "	2366
13.0 "	2
14.0 "	84
16.0 "	1
20.0 "	17
24.0 "	284
Unknown	<u>1348</u>
Total	4105

Table 5

Seals of Certifying Agency
Combined HUD, PRIVATE and FIELD SAMPLE

<u>Agency</u>	<u>Type of Agency</u>	<u>No. of Units with Seal</u>
Alabama	State	336
Arkansas	"	1
California	"	161
Colorado	"	4
Delaware	"	1
Florida	"	84
Georgia	"	75
Minnesota	"	8
Mississippi	"	12
Tennessee	"	14
Texas	"	124
Virginia	"	21
Washington	"	51
Total State Seals		892
Pittsburgh Testing Lab.	Third Party	1
National Consumer Testing Lab.	" "	22
Underwriters Lab.	" "	46
Total Third Party		69
MHMA/TCA ^{1/}	Trade Association	1326
HUD Specification ^{2/}	Federal	449
Others (Misc.)	Manufacturers, etc.	14
Total Other Seals		1789
Total Seals		2750 ^{3/}
Units With No Seals Attached ^{4/}		487
Units With No Seal Information ^{5/}		1126

- ^{1/} Trade Association - Mobile Home Manufacturers Association and Trailer Coach Association.
- ^{2/} HUD Purchase Contract required compliance with ANSI A119.1
- ^{3/} Exceeds 2492 mobile homes with seals because some units have more than one seal.
- ^{4/} Available data indicated that units had no attached seals.
- ^{5/} No information available to indicate if mobile homes had seals.

TABLE 6

Problem Distributions Within All Samples*

Category of Problem	Private Sample	Field Sample	HUD Sample
ANSI A119.1 Standard	36.7%	29.6%	19.1%
Enforcement	28.9	30.5	10.3
Routine Maintenance	24.0	26.5	45.7
M/E Appliances & Equipment	5.9	10.6	21.4
Miscellaneous	4.5	2.8	3.4

* Percentages based on total number of problems in each sample.

TABLE 7

SUMMARY OF REPORTED MOBILE HOME PROBLEMS ALL CATEGORIES -- PRIVATE DATA (967 UNITS)

CATEGORY OF PROBLEM	Level	REPORTED PROBLEMS		MOBILE HOME UNITS REPORTING PROBLEMS IN CATEGORY		AVERAGE NUMBER OF PROBLEMS PER UNIT IN SAMPLE
		Number	% of Total	Number	% of Total Units	
ANSI STANDARD A119.1-1974	2	2280	36.7	808	83.6	2.36
ENFORCEMENT	2	1791	28.9	639	66.1	1.85
ROUTINE MAINTENANCE	2	1490	24.0	686	71.1	1.54
MECHANICAL/ELECTRICAL APPLIANCES AND EQUIPMENT	2	367	5.9	271	28.0	.38
MISCELLANEOUS	2	278	4.5	239	24.7	.29
(TOTAL)		(6206)	(100.0)	-	-	6.42

TABLE 8

ANSI STANDARD A119.1 - 1974 RELATED PROBLEMS - PRIVATE DATA (967 UNITS)

ANSI STANDARD A119.1 - 1974 PART	Level	ANSI STANDARD A119.1- 1974 RELATED PROBLEMS		MOBILE HOME UNITS WITH PROBLEMS		AVERAGE NUMBER OF PROBLEMS PER UNIT IN SAMPLE
		Number	% of Total	Number	% of Total Units	
PART B - Construction	3	1479	64.9	679	70.2	1.53
PART C - Plumbing	3	681	29.9	453	46.8	.71
PART E - Electrical	3	61	2.7	54	5.6	.06
PART D - Heating	3	59	2.6	58	6.0	.06
(TOTAL)		(2780)	(100)	-	-	2.36

TABLE 9

ENFORCEMENT RELATED MOBILE HOME PROBLEMS - PRIVATE DATA (967 UNITS)

ENFORCEMENT CATEGORY	Level	ENFORCEMENT RELATED PROBLEMS		MOBILE HOME UNITS WITH PROBLEMS		AVERAGE NUMBER OF PROBLEMS PER UNIT IN SAMPLE
		Number	% of Total	Number	% of Total Units	
HEATING	3	533	29.8	302	31.2	.55
PLUMBING	3	469	26.2	314	32.5	.49
ELECTRICAL	3	463	25.9	299	30.9	.48
CONSTRUCTION	3	326	18.2	235	24.3	.34
(TOTAL)		(1791)	(100.1)	-	-	1.86

TABLE 10
 ROUTINE MAINTENANCE RELATED MOBILE HOME PROBLEMS - PRIVATE DATA (967 UNITS)

ROUTINE MAINTENANCE CATEGORY	Level	ROUTINE MAINTENANCE RELATED PROBLEMS		MOBILE HOME UNITS WITH PROBLEMS		AVERAGE NUMBER OF PROBLEMS PER UNIT IN SAMPLE
		Number	% of Total	Number	% of Total Units	
CONSTRUCTION	3	1127	75.6	579	59.9	1.17
PLUMBING	3	223	15.0	186	19.2	.23
ELECTRICAL	3	131	8.8	112	11.6	.14
HEATING	3	7	.5	7	.7	.01
UNDEFINED	2	2	-	-	-	-
(TOTAL)		(1490)	(99.9)			1.55

TABLE 11

MECHANICAL/ELECTRICAL APPLIANCES AND EQUIPMENT RELATED PROBLEMS - PRIVATE DATA (967 UNITS)

MECHANICAL/ELECTRICAL APPLIANCES AND EQUIPMENT COMPONENTS	Level	MECHANICAL/ELECTRICAL APPLIANCES AND EQUIPMENT RELATED PROBLEMS		MOBILE HOME UNITS WITH PROBLEMS		AVERAGE NUMBER OF PROBLEMS PER UNIT IN SAMPLE
		Number	% of Total	Number	% of Total Units	
RANGE - GAS/ELECTRIC	3	112	30.5	97	10.0	.12
FURNACE, HOT AIR, GAS OR OIL	3	87	23.7	77	8.0	.09
EXHAUST FAN	3	72	19.6	71	7.3	.07
HOT WATER HEATERS	3	52	14.2	50	5.2	.05
REFRIGERATOR	3	32	8.7	28	2.9	.03
ELECTRIC BASEBOARD HEATING UNITS	3	1	.3	1	.1	.00
UNDEFINED	2	11	3.0	-	-	.01
(TOTAL)		(367)	(100.0)	-	-	.37

TABLE 12
SUMMARY OF REPORTED MOBILE HOME PROBLEMS - FIELD DATA (257 UNITS)
ALL CATEGORIES

CATEGORY OF PROBLEM	Level	REPORTED PROBLEMS		MOBILE HOME UNITS REPORTING PROBLEMS IN CATEGORY		AVERAGE NUMBER OF PROBLEMS PER UNIT IN SAMPLE
		Number	% of Total	Number	% of Total Units	
ENFORCEMENT	2	1075	30.5	228	88.7	4.18
ANSI STANDARD ALL 19.1-1974	2	1045	29.6	236	91.8	4.07
ROUTINE MAINTENANCE	2	934	26.5	169	65.8	3.63
MECHANICAL/ELECTRICAL APPLIANCES & EQUIPMENT	2	374	10.6	106	41.2	1.46
MISCELLANEOUS	2	100	2.8	53	20.6	.39
(TOTAL)		(3528)	(100.0)	-	-	13.73

TABLE 13

ENFORCEMENT RELATED MOBILE HOME PROBLEMS - FIELD DATA (257 UNITS)

ENFORCEMENT CATEGORY	Level	ENFORCEMENT RELATED PROBLEMS		MOBILE HOME UNITS WITH PROBLEMS		AVERAGE NUMBER OF PROBLEMS PER UNIT IN SAMPLE
		Number	% of Total	Number	% of Total Units	
PLUMBING	3	493	45.9	183	71.2	1.92
HEATING	3	324	30.1	152	59.1	1.26
ELECTRICAL	3	189	17.6	114	44.4	.74
CONSTRUCTION	3	69	6.4	61	23.7	.27
(TOTAL)		(1075)	(100.0)	-	-	4.19

TABLE 14

ANSI STANDARD A119.1 - 1974 RELATED PROBLEMS - FIELD DATA (257 UNITS)

ANSI STANDARD A119.1 - 1974 PART	Level	ANSI STANDARD A119.1-1974 Related Problems		MOBILE HOME UNITS WITH PROBLEMS		AVERAGE NUMBER OF PROBLEMS PER UNIT IN SAMPLE
		Number	% of Total	Number	% of Total Units	
PART B - Construction	3	661	63.3	228	88.7	2.57
PART C - Plumbing	3	208	19.9	108	42.0	.81
PART E - Electrical	3	91	8.7	69	26.8	.35
PART D - Heating System	3	85	8.1	76	29.6	.33
(TOTAL)		(1045)	(100.0)	-	-	4.06

TABLE 15

ROUTINE MAINTENANCE RELATED MOBILE HOME PROBLEMS - FIELD DATA (257 UNITS)

ROUTINE MAINTENANCE CATEGORY	Level	ROUTINE MAINTENANCE RELATED PROBLEMS		MOBILE HOME UNITS WITH PROBLEMS		AVERAGE NUMBER OF PROBLEMS PER UNIT IN SAMPLE
		Number	% of Total	Number	% of Total Units	
CONSTRUCTION	3	550	58.9	143	55.6	2.14
PLUMBING	3	216	23.1	94	36.6	.84
ELECTRICAL	3	124	13.3	74	28.8	.48
HEATING	3	44	4.7	34	13.2	.17
(TOTAL)		934	(100.0)	-	-	3.63

TABLE 16

MECHANICAL/ELECTRICAL APPLIANCES AND EQUIPMENT RELATED PROBLEMS - FIELD DATA (257 UNITS)

MECHANICAL/ELECTRICAL APPLIANCES AND EQUIPMENT COMPONENTS	Level	Mechanical/Electrical Appliances and Equipment Related Problems		Mobile Home Units With Problems		AVERAGE NUMBER OF PROBLEMS PER UNIT IN SAMPLE
		Number	% of Total	Number	% of Total Units	
FURNACE, HOT AIR, GAS OR OIL	3	181	48.4	77	30.0	.70
HOT WATER HEATERS	3	82	21.9	52	20.2	.32
RANGE - GAS/ELECTRIC	3	72	19.3	36	14.0	.28
EXHAUST FAN	3	25	6.7	14	5.4	.10
REFRIGERATOR	3	10	2.7	9	3.5	.04
SMOKE DETECTOR	3	3	.8	3	1.2	.01
ELECTRIC BASEBOARD HEATING UNITS	3	1	.3	1	.4	.00
(TOTAL)		(374)	(100.1)	-	-	1.45

TABLE 17

SUMMARY OF REPORTED MOBILE HOME PROBLEMS ALL CATEGORIES - HUD DATA (2881 UNITS)

CATEGORY OF PROBLEM	Level	REPORTED PROBLEMS		MOBILE HOME UNITS REPORTING PROBLEMS IN CATEGORY		AVERAGE NUMBER OF PROBLEMS PER UNIT IN SAMPLE
		Number	% of Total	Number	% of Total Units	
ROUTINE MAINTENANCE	2	10,178	45.7	2285	79.3	3.53
MECHANICAL/ELECTRICAL APPLIANCES AND EQUIPMENT	2	4767	21.4	1790	62.1	1.65
ANSI STANDARD A119.1-1974	2	4243	19.1	1628	56.5	1.47
ENFORCEMENT	2	2294	10.3	1265	43.9	.80
MISCELLANEOUS	2	766	3.4	527	18.3	.27
(TOTAL)		(22,248)	(99.9)	-	-	7.72

TABLE 18

ROUTINE MAINTENANCE RELATED MOBILE HOME PROBLEMS - HUD DATA (2881 UNITS)

ROUTINE MAINTENANCE CATEGORY	Level	ROUTINE MAINTENANCE RELATED PROBLEMS		MOBILE HOME UNITS WITH PROBLEMS		AVERAGE NUMBER OF PROBLEMS PER UNIT IN SAMPLE
		Number	% of Total	Number	% of Total Units	
CONSTRUCTION	3	5175	50.8	1769	61.4	1.80
PLUMBING	3	2940	28.9	1443	50.1	1.02
ELECTRICAL	3	1382	13.6	893	31.0	.48
HEATING	3	681	6.7	515	17.9	.24
(TOTAL)		(10,178)	(100.0)	-	-	3.54

TABLE 19

MECHANICAL/ELECTRICAL APPLIANCES AND EQUIPMENT RELATED PROBLEMS - HUD DATA (2881 UNITS)

MECHANICAL/ELECTRICAL APPLIANCES AND EQUIPMENT COMPONENTS	Level	MECHANICAL/ELECTRICAL APPLIANCES AND EQUIPMENT RELATED PROBLEMS		MOBILE HOME UNITS WITH PROBLEMS		AVERAGE NUMBER OF PROBLEMS PER UNIT IN SAMPLE
		Number	% of Total	Number	% of Total Units	
FURNACE, HOT AIR, GAS OR OIL	3	2146	45.0	1133	39.3	.75
HOT WATER HEATERS	3	1444	30.3	939	32.6	.50
RANGE - GAS/ELECTRIC	3	792	16.6	544	18.9	.28
EXHAUST FAN	3	180	3.8	168	5.8	.06
REFRIGERATOR	3	153	3.2	133	4.6	.05
SMOKE DETECTOR	3	37	.8	35	1.2	.01
ELECTRIC BASEBOARD HEATING UNITS	3	13	.3	12	.4	.00
UNDEFINED	2	2	.0	-	-	.00
(TOTAL)		(4767)	(100.0)	-	-	1.65

TABLE 20

ANSI STANDARD A119.1-1974 RELATED PROBLEMS - HUD DATA (2881 UNITS)

ANSI STANDARD A119.1-1974 PART	Level	ANSI STANDARD A119.1-1974 RELATED PROBLEMS		MOBILE HOME UNITS WITH PROBLEMS		AVERAGE NUMBER OF PROBLEMS PER UNIT IN SAMPLE
		Number	% of Total	Number	% of Total Units	
PART B - Construction	3	2680	63.2	1236	42.9	.93
PART C - Plumbing	3	1563	36.8	959	33.3	.54
(TOTAL)		(4243)	(100.0)	-	-	1.47

TABLE 21

ENFORCEMENT RELATED MOBILE HOME PROBLEMS - HUD DATA (2881 UNITS)

ENFORCEMENT CATEGORY	Level	ENFORCEMENT RELATED PROBLEMS		MOBILE HOME UNITS WITH PROBLEMS		AVERAGE NUMBER OF PROBLEMS PER UNIT IN SAMPLE
		Number	% of Total	Number	% of Total Units	
PLUMBING	3	962	41.9	680	23.6	.33
CONSTRUCTION	3	623	27.2	473	16.4	.22
ELECTRICAL	3	490	21.4	391	13.6	.17
HEATING	3	219	9.5	201	7.0	.08
(TOTAL)		(2294)	(100.0)	-	-	.80

Table 22 - Comparison of Appliance Standards Included in the Minimum Property Standards [8] and ANSI A119.1 Standard for Mobile Homes [1].

MPS		A119.1	
<u>Furnaces</u>			
Oil	UL-727 and 730	Liquid Fuel-Burning Heating Appliances for Mobile Homes and Travel Trailers	UL 307(a) 1969
Gas	AGA Listed		
Electric	UL-573, NFPA-70	Gas-Heating Appliances for Mobile Homes and Travel Trailers.	UL 307(a) 1965
		Gas-Fired Gravity and Forced Air Central Furnaces	Z21.47 1973
		Gas-Fired Gravity and Fan Type Floor Furnace	Z21.48 1973
		Gas-Fired Gravity and Fan Type Sealed Combustion System Wall Furnaces	Z21.44 1973
		Installation of Oil Burning Equipment	Z95.1 1973 NFPA 31 1972
		Installation of Gas Appliances, Gas Piping in Buildings	Z21.30 1964 NFPA 54 1969
<u>Domestic Water Heaters</u>			
Oil	UL-732	Commercial Gas-Fired and Electrically-Heated Hot Water Generating Equipment	NSF-5 1959
Gas	AGA Listed		
Electric	UL-174	Automatic Storage Type Water Heaters with Input Less than 75,000 BUTH	Z21.10.1 1971 Addenda

Table 22 - Continued

MPS

A119.1

Ranges

NONE	Commercial Cooking and Warming Equipment	NSF-4 1967
	Household Cooking Gas Appliances	Z21.1 1972

Refrigerators

NONE	Refrigerators Using Gas- Fuel	Z21.19 1971
------	----------------------------------	----------------

Clothes Dryers

NONE	Gas Clothes Dryers	A21.5.1 1972
------	--------------------	-----------------

TABLE 23

MECHANICAL/ELECTRICAL APPLIANCES - EQUIPMENT RELATED PROBLEMS - TOTAL SAMPLE (4105 UNITS)

MECHANICAL/ELECTRICAL APPLIANCES-EQUIPMENT COMPONENT	Level	RELATED PROBLEMS		MOBILE HOME UNITS WITH PROBLEMS		AVERAGE NUMBER OF PROBLEMS PER UNIT IN SAMPLE
		Number	% of Total	Number	% of Total In Sample	
FURNACE, HOT AIR, GAS/OIL <u>1/</u>	3	2414	43.8	1287	31.4	0.590
HOT WATER HEATERS <u>2/</u>	3	1578	28.6	1041	25.4	0.380
RANGE - GAS/ELECTRIC <u>3/</u>	3	976	17.7	677	16.5	0.240
EXHAUST FAN	3	277	5.0	253	6.2	0.070
REFRIGERATOR	3	195	3.5	170	4.1	0.050
SMOKE DETECTOR	3	40	0.7	38	0.9	0.010
ELECTRIC BASEBOARD HEATING UNITS	3	15	0.3	14	0.3	0.004
UNDEFINED	2	13	0.2	-	-	
(TOTAL)		(5508)	(99.8)			1.344

1/ For component problem distribution see Figure 5.2/ For component problem distributions see Figures 6 and 7.3/ For component problem distribution see Figure 8.

Appendix A

Organization and Use of the Problem Summation Tables

Organization and Use of Problem Summation Tables

It was necessary to develop a data handling system using computer techniques because of the large quantity of data collected. The system devised consisted of a listing of performance problems, a coding technique to record the problems and computer programs to organize and present the data [2].

Organization of Problem Summation Tables

The Performance Problem List is organized around four major subsections and a miscellaneous subsection. The mobile home performance problems significant to the project are categorized under one of the four major subsections listed below and indicated in figure A1.

- A. Problems Related to ANSI A119.1 Standard for Mobile Homes
- B. Problems Related to Mobile Home Enforcement Process
- C. Routine Maintenance Problems
- D. Mechanical/Electrical Appliance Problems

This categorization of problems allows documentation of all mobile home performance problems obtained from the various sources.

The ANSI A119.1 Standard for Mobile Homes subsection represents virtually the entire 1974 edition of the Standard [1], with coding symbols being assigned to appropriate paragraphs. In the case of the Plumbing (Part C), Heating (Part D) and Electrical (Part E) sections of the Standard, the paragraph numbers and key words appear just as they do in the Standard. Construction (Part B) differs in that it is organized around the major construction components such as roof, walls, doors, etc. Therefore, some Standard paragraph numbers which pertain to several components are repeated (example, weather resistance). The problems reported under the ANSI Standard A119.1 subsection are related to inadequacies or omissions in the Standard.

The Mobile Home Enforcement Process subsection is organized similar to the ANSI A119.1 subsection to document problems related to deficiencies in the mobile home regulatory process.

The Routine Maintenance subsection in the catalog is organized under the same general headings as the ANSI A119.1 Enforcement Process subsections; i.e., construction, plumbing, heating and electrical.

The Mechanical/Electrical Appliance subsection of the catalog is grouped by appliance; i.e., furnace, range, hot water heater, refrigerator, exhaust fan and smoke detector. Since components of each appliance are listed, it was possible to pinpoint the component problem where the detail of the data permitted.

Use of Problem Summation Tables

A problem level concept is employed in the Performance Problem List to organize and assist in the evaluation of the data. Figure A1 illustrates problem levels 1, 2 and 3 and figure A2 isolates ANSI A119.1 (Construction) to illustrate levels 2 through 7. The problem summation tables in Appendices B, C and D show the problem level for each item in the last column and in some cases the problem list has been extended to an 8th level. The problem level concept was established as a tool to order the data and does not impart any degree of importance or significance to the individual problems as they relate to one another.

Using Tables A1, A2 and A3 as references, the use of the Problem Summation Tables is illustrated as follows.

Columns labeled (A), (B), (C), (D), (HOMES), (% Homes), and (Level) defined below are the same for Tables A1, A2 and A3.

Column (A) - The code assigned to identify a particular problem as recorded in the Performance Problem List.

Column (B) - A brief description of the problem or area of concern including the appropriate part of paragraph number in the ANSI A119.1 Standard for Mobile Homes [1].

Column (C) - The number of problems that have been coded with the code identified on that line in Column A. Reported information on the problem has not allowed coding below the level of detail of the particular line (see column labeled "LEVEL.") For example, consider problem code NPLM on Table A1 (Plumbing - Routine Maintenance); 395 of the 3,379 problems were recorded under the general plumbing category, while problem definition allowed the remaining 2,984 (3,379 - 395) problems to be recorded with greater detail.

Column (D) - The summation of all problems at a discrete level. For example, the total number of problems associated with Routine Maintenance is 12,602 (Table A1) which is made up of the following summation of level 3 problems.

Construction	6,852
Plumbing	3,379
Electrical	1,637
Heating	732
Undefined (Column C)	2
Total	12,602

The number of problems at a given level is the summation of problems at the next lower level. As another example, the number of level 1 problems (31,982) consists of the following level 2 problems: 12,602 Routine Maintenance problems; 7,568 ANSI A119.1 problems; 5,508 Mechanical/Electrical Appliance problems, 5,160 Enforcement problems, and 1,144 Miscellaneous problems.

Column (HOMES) - The values in this column indicate the number of mobile homes in the sample that had one or more of the problems identified on each line (1,723 mobile homes with 3,379 Plumbing - Routine Maintenance problems in Table A1).

Column (% Homes) - The entries in this column indicate the percentage of the total number of mobile homes reviewed in the sample which had the problem identified on each line. For example, under Plumbing - Routine Maintenance in Table A1.

$$\frac{1,723 \text{ homes with problems}}{4,105 \text{ homes in sample}} \times 100 = 42.0\%$$

Column (Level) - These entries define the level of detail of the problem for each line.

Columns labeled (% 2nd and % 1st) in Table A1 are defined below:

Consider the example of "Construction (CONS) - ANSI Standard A119.1"

Column (% 2nd) - The entries in this column are the percentage of 2nd level problems that are contained at the third level of detail.

$$\frac{\text{Level 3 Problems}}{\text{Level 2 Problems}} = \frac{4,820}{7,568} \times 100 = 63.7\%$$

Column (% 1st) - The entries in this column are the percentages of 1st level problems that are contained at each lower level of detail.

$$\frac{\text{Level 3 Problems}}{\text{Level 1 Problems}} = \frac{4,820}{31,982} \times 100 = 15.1\%$$

Columns labeled (% 3rd), (% 2nd), and (% 1st) in Table A2 are defined below:

Consider the example of "Exterior Walls (EXTW) - Construction - ANSI Standard A119.1."

Column (% 3rd) - The entries in this column are the percentages of 3rd level problems which are contained at each 4th level of detail.

$$\frac{\text{Level 4 Problems}}{\text{Level 3 Problems}} = \frac{995}{4,820} \times 100 = 20.6\%$$

Column (% 2nd) - Percentages relating 4th levels to the 2nd level of detail.

$$\frac{\text{Level 4 Problems}}{\text{Level 2 Problems}} = \frac{995}{7,568} \times 100 = 13.1\%$$

Column (% 1st) - Percentages relating 4th level to the 1st level.

$$\frac{\text{Level 4 Problems}}{\text{Level 1 Problems}} = \frac{995}{31,982} \times 100 = 3.1\%$$

Column labeled (% 7th), (% 6th), (% 5th), (% 4th), and (% 3rd) on Table A3 are defined below:

Consider the example of "Faucet Assembly (NPKA) - Water Supply Piping-Plumbing Routine Maintenance."

Column (% 7th and 6th) - Entries in these columns are percentages denoting the portions of the 7th and 6th level problems for each 8th and 7th level problem. These columns are blank on Table A3 since there are no 7th and 8th level problems shown on this page.

Column (% 5th), (% 4th), (% 3rd) - Entries in these columns related the number of problems at a given level to preceding levels (6, 5, 4 and 3).

$$\frac{\text{Level 6 Problems}}{\text{Level 5 Problems}} = \frac{131}{478} \times 100 = 27.4\% \text{ (Column \% 5th)}$$

$$\frac{\text{Level 7 Problems}}{\text{Level 4 Problems}} = \frac{131}{1,196} \times 100 = 11.0\% \text{ (Column \% 4th)}$$

$$\frac{\text{Level 7 Problems}}{\text{Level 3 Problems}} = \frac{131}{3,379} \times 100 = 3.9\% \text{ (Column \% 3rd)}$$

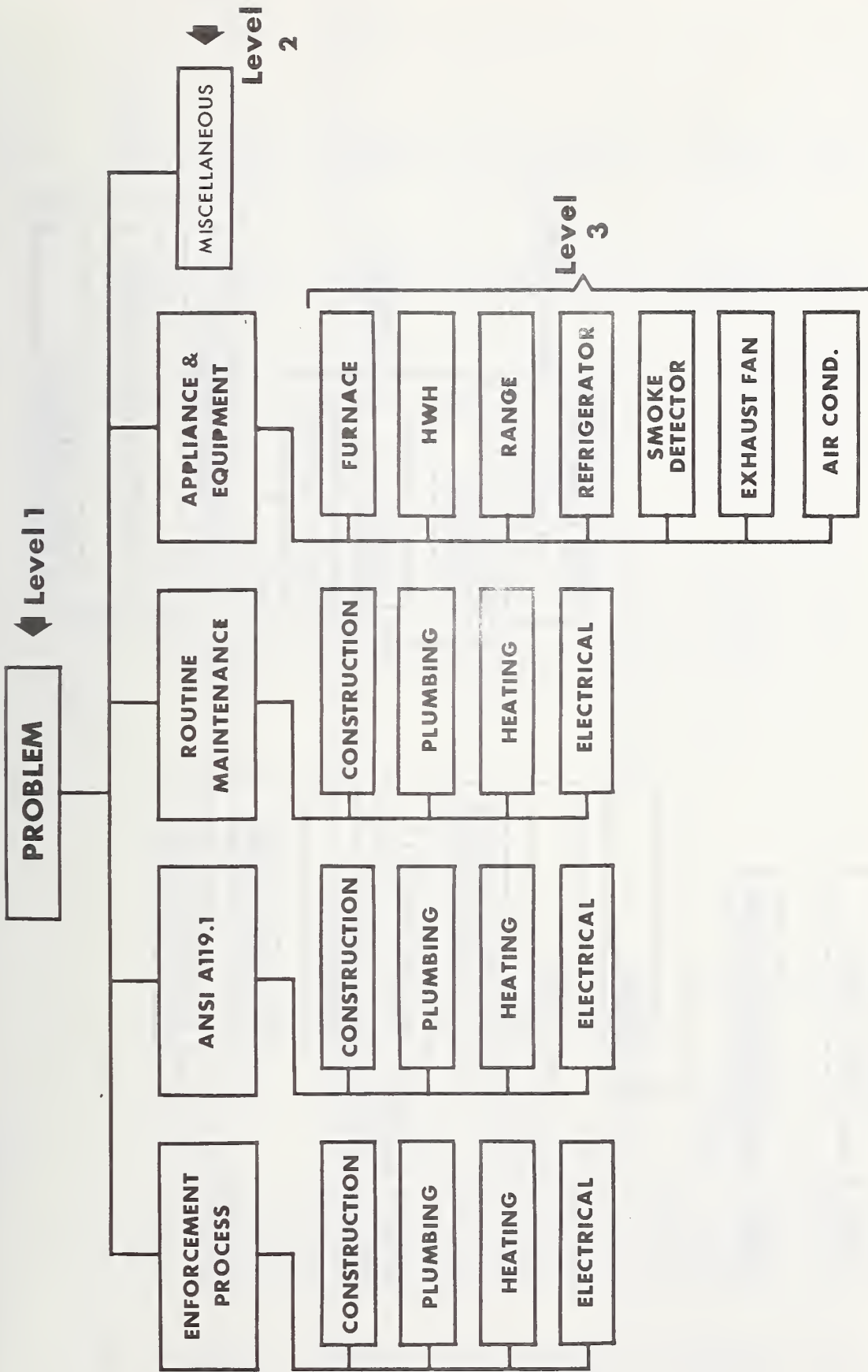


Figure A1 Organization of Performance Problem List (Levels 1, 2 and 3)

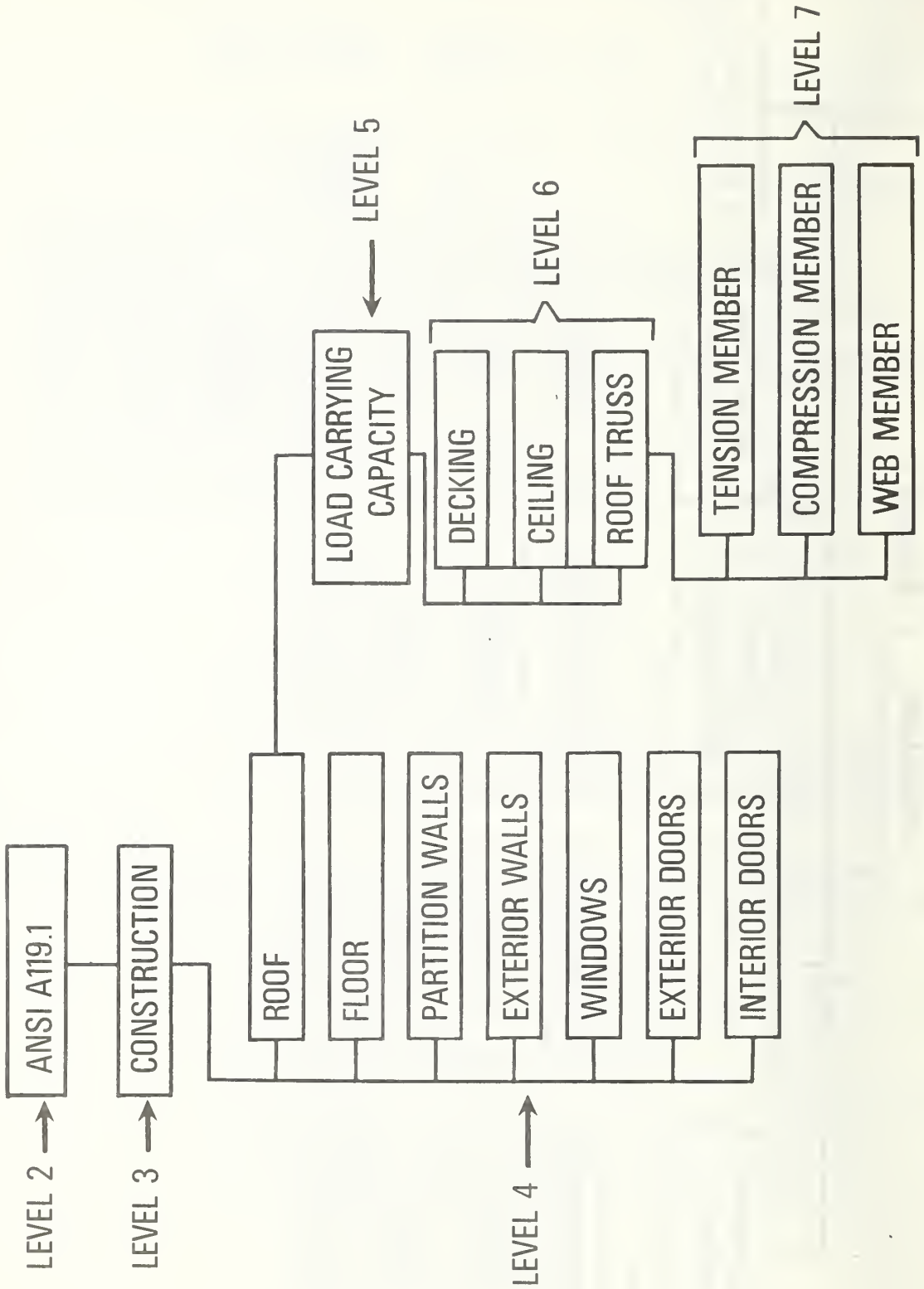


Figure A2 Organization of Performance Problem List (Levels 2 through 7)

FIRST LEVEL SUMMATION:
TOTAL NUMBER OF PROBLEMS

N.J.
31982

(A)	(B)	(C)	(D)	#2ND	#1ST	(%HOMES)	(%HOMES)	(LEVEL)
SECOND AND THIRD LEVEL SUMMATIONS:								
NANS	ROUTINE MAINTENANCE	(2)	12002	39.4	3142	76.5		2
NCON	CONSTRUCTION	(12)	0852	54.4	2491	60.7		3
NPLM	PLUMBING	(395)	3379	26.3	1723	42.0		3
NELC	ELECTRICAL	(202)	1637	13.0	1079	26.3		3
NHTG	HEATING	(53)	732	5.8	556	13.5		3
ANSI	ANSI A119.1	(0)	7508	23.7	2672	65.1		2
ICONS	PART B CONSTRUCTION	(0)	4820	63.7	2143	52.2		3
PLUM	PLUMBING	(0)	2452	32.4	1520	37.0		3
ELEC	ELECTRICAL	(0)	152	2.0	123	3.0		3
HEAT	HEATING SYSTEM	(0)	144	1.9	134	3.3		3
APFO	MECHANICAL/ELECTRICAL APPLIANCES -EQUIPMENT	(13)	5508	17.2	2167	52.8		2
AFHA	FURNACE,HOT AIR,GAS OR OIL	(714)	2414	43.8	1287	31.4		3
AHW	HOT WATER HEATERS	(501)	1578	28.6	1041	25.4		3
ARGF	RANGE - GAS/ELECTRIC	(278)	976	17.7	677	16.5		3
AEFX	EXHAUST FAN	(277)	277	5.0	253	6.2		3
ACRF	REFRIGERATOR	(157)	195	3.5	170	4.1		3
ASDE	SMOKF DETCTOR	(40)	40	.7	38	.9		3
AFFR	ELECTRIC BASEBOARD HEATING UNITS	(4)	15	.3	14	.3		3
ANSI	ENFORCEMENT	(0)	5160	16.1	2132	51.9		2
PLUM	PART C PLUMBING	(0)	1924	37.3	1177	28.7		3
ELEC	PART E ELECTRICAL	(0)	1142	22.1	804	19.6		3
HEAT	PART D HEATING SYSTEM	(28)	1076	20.9	655	16.0		3
CONS	PART B CONSTRUCTION	(6)	1018	19.7	769	18.7		3
MISC	MISCELLANEOUS		1144	3.0	815	20.0		2

TOTAL NUMBER OF MOBILE HOMES REVIEWED = 4105

NOTE: Level 2 categories rank ordered by frequency of occurrence.

FOURTH LEVEL SUMMARY:

(A) (B) (C) (D) #1ST (HUMES) (#HUMES) (LLEVEL)

NANS
ROUTINE MAINTENANCE

Table with columns for item code, description, and numerical values. Includes items like CONSTRUCTION, EXTERIOR DOORS, WINDOWS, PARTITIONS DOORS, EXTERIOR STAIRS, SKIRTING, BLOCKING, HOT WATER HEATER COMPARTMENT, FLOOR, SITE GRADING, TIE DOWN STRAPS LOUSE, ETC.

Table with columns for item code, description, and numerical values. Includes items like PLUMBING, WATER SUPPLY PIPING, FIXTURES, SEWER, PRESSURE REGULATOR, WASHING MACHING, DISH WASHER.

Table with columns for item code, description, and numerical values. Includes items like ELECTRICAL, DISTRIBUTION PANEL BOARD, RECEPTICAL OUTLETS, POWER POLE/LIFELINE, SWITCHES, INTERIOR LIGHTING FIXTURES, EXTERIOR LIGHT FIXTURE, SERVICE.

Table with columns for item code, description, and numerical values. Includes items like HEATING, GAS SUPPLY PIPING, INSTALLED SPACE HEATERS, OIL SUPPLY PIPING.

ANSI A119.1

Table with columns for item code, description, and numerical values. Includes items like CONSTRUCTION, ROOF SYSTEM, PARTITION WALLS, FLOOR SYSTEMS, TRANSIT CONSIDEKATIONS, DOORS EXTERIOR, WINDOWS.



(A) (B) (C) (D) ***** (2) 12602 ***** 3142 76.5 ***** * NANS ***** 2 * *****

Table with columns: NCDX, Description, (C), (D), and numerical values. Includes categories like CONSTRUCTION, EXTERIOR DOORS, HARDWARE, PLUMBING, etc. Ends with a large arrow pointing to the right.

Appendix B

Problem Summation Tables - HUD Sample

RUD SAMPLE DATA

FIRST LEVEL SUMMARY:
TOTAL NUMBER OF PROBLEMS

NO.
22243

SECOND AND THIRD LEVEL SUMMATIONS:

NAVS	ROUTINE MAINTENANCE	NO.	42ND	%1ST	HOMES	%HOMES	LEVEL
NCUN	CONSTRUCTION	(11)	50.8	23.3	1709	79.3	2
NPLM	PLUMBING	(3+4)	28.9	13.2	1443	61.4	3
NELC	ELECTRICAL	(200)	13.6	6.2	893	51.0	2
NHTG	HEATING	(45)	6.7	3.1	515	17.9	3
APFQ	MECHANICAL/ELECTRICAL APPLIANCES -EQUIPMENT	(2)	21.4		1790	62.1	2
AFHA	FURNACE/HOT AIR/GAS OR OIL	(637)	45.0	9.6	1133	35.3	2
ARHW	HOT WATER HEATERS	(459)	30.3	6.5	939	32.6	3
ARGE	RANGE - GAS/ELECTRIC	(202)	10.6	3.6	544	18.9	2
AEEA	EXHAUST FAN	180	3.8	.8	168	5.3	3
ACRF	REFRIGERATOR	(120)	3.2	.7	133	4.6	3
ASDE	SMOKE DETECTOR	37	.8	.2	35	1.2	3
AFBB	ELECTRIC BASEBOARD HEATING UNITS	(2)	.3	.1	12	.4	3
ANSI	ANSI A119.1	(0)	4243	19.1	1628	56.5	2
CUNB	PART B CONSTRUCTION	(0)	2680	63.2	1236	42.9	3
PLUM	PART C PLUMBING	(0)	1563	36.8	959	33.3	3
ANSI	ENFORCEMENT	(0)	2294	10.3	1265	43.9	2
PLUM	PART C PLUMBING	(0)	902	41.9	680	23.6	3
CUNB	PART B CONSTRUCTION	(0)	623	27.2	473	10.4	3
ELEC	PART E ELECTRICAL	(0)	490	21.4	391	13.6	3
HEAT	PART D HEATING SYSTEM	(0)	219	9.5	201	7.0	3
MISC	MISCELLANEOUS		766	3.4	527	13.3	2

HUD SAMPLE DATA

FOURTH LEVEL SUMMATION:

NO. %3RD %2ND %1ST HOMES #HOMES LEVEL

***** ROUTINE MAINTENANCE *****
 * NANS (0) 10178 45.7 2285 79.3 2 *

NO.	%3RD	%2ND	%1ST	HOMES	#HOMES	LEVEL	
NCN	(11)	5175	50.8	23.3	1769	61.4	3
NCXD	(345)	2167	41.9	21.3	1166	40.5	4
NCWD	(138)	1029	19.9	10.1	692	24.0	4
NCES	(489)	9.4	4.8	2.2	385	13.4	4
NCPD	(217)	471	9.1	4.6	303	12.6	4
NCNM	(370)	7.1	3.6	1.7	280	9.7	4
NCBL	(142)	289	5.6	1.3	239	8.3	4
NCHH	(5)	170	3.3	1.7	157	5.4	4
NCFL	(8)	125	2.4	1.2	106	3.7	4
NCMG	(40)	.8	.4	.2	40	1.4	4
NCTD	(14)	.3	.1	.1	13	.5	4

NO.	%3RD	%2ND	%1ST	HOMES	#HOMES	LEVEL	
NPLM	(344)	2940	28.9	13.2	1443	50.1	3
NPWS	(426)	1192	40.5	11.7	839	29.1	4
NPFX	(11)	959	32.6	9.4	649	22.5	4
NPBT	(411)	14.0	4.0	1.6	340	11.8	4
NPPR	(23)	.8	.2	.1	21	.7	4
NPMW	(9)	.9	.3	.1	9	.3	4
NPDW	(2)	.2	.1	.0	2	.1	4

NO.	%3RD	%2ND	%1ST	HOMES	#HOMES	LEVEL	
NELC	(200)	1382	13.6	6.2	893	31.0	3
NEDP	(119)	584	42.3	5.7	442	15.3	4
NERC	(14)	289	20.9	2.8	256	8.9	4
NEPP	(157)	11.4	1.5	.7	141	4.9	4
NESS	(84)	89	6.4	.9	78	2.7	4
NEIF	(47)	47	3.4	.5	44	1.5	4
NEEF	(9)	.7	.1	.0	9	.3	4
NESR	(7)	.5	.1	.0	7	.2	4

NO.	%3RD	%2ND	%1ST	HOMES	#HOMES	LEVEL	
NHTG	(45)	681	6.7	3.1	515	17.9	3
NHCP	(440)	64.6	4.3	2.0	367	12.7	4
NHSP	(107)	15.7	1.1	.5	96	3.3	4
NHOP	(84)	89	13.1	.9	69	2.4	4

***** MECHANICAL/ELECTRICAL APPLIANCES -EQUIPMENT *****
 * APEO (2) 4767 21.4 1790 62.1 2 *

NO.	%3RD	%2ND	%1ST	HOMES	#HOMES	LEVEL	
AFHA	(637)	2146	45.0	9.6	1133	39.3	3
AFPL	(72)	456	21.2	9.6	359	12.5	4
AFCL	(23)	336	15.7	7.0	262	9.1	4
AFEG	(29)	283	13.2	5.9	242	8.4	4
AFWT	(199)	240	11.2	5.0	205	7.1	4
AFBL	(62)	62	2.9	1.3	57	2.0	4
AFGR	(35)	1.6	.7	.2	35	1.2	4
AFDR	(31)	1.4	.7	.1	30	1.0	4

FOURTH LEVEL SUMMARY:									
	NO.	%3RD	%2ND	%1ST	HOMES	%HOMES	LEVEL		
AFAB		27	1.3	.6	.1	27	.9	4	
AFAB		26	1.2	.5	.1	25	.9	4	
AFSC		7	.3	.1	.0	7	.2	4	
AFRM	(6)	6	.3	.1	.0	6	.2	4	
AHWW	(459)	1444	30.3	0.5		939	32.6	3	
AHEL	(202)	746	15.7	3.4		510	17.7	4	
AHGS	(16)	239	5.0	1.1		175	6.1	4	
ARGE	(202)	792	16.6	3.0		544	18.9	3	
ARPL	(79)	205	4.3	.9		175	6.1	4	
ARGL	(58)	152	3.2	.7		129	4.5	4	
ARBU	(38)	109	2.3	.5		98	3.4	4	
ARCL	(3)	63	1.7	.4		76	2.6	4	
ARHW	(3)	37	.8	.2		35	1.2	4	
ARLW	(4)	4	.5	.1		3	.1	4	
AEEF	(100)	100	3.8	.8		168	5.8	3	
ACPF	(120)	153	3.2	.7		133	4.0	3	
ACRG	(10)	16	0.5	.3		10	.6	4	
ACRL	(1)	11	7.2	.2		11	.4	4	
ACRR	(1)	2	1.3	.0		2	.1	4	
ACRN	(1)	2	1.3	.0		2	.1	4	
ASDF	(37)	37	.8	.2		35	1.2	3	
AFEB	(2)	13	.3	.1		12	.4	3	
AFST	(2)	8	61.2	.2		8	.3	4	
AFNC	(0)	3	23.1	.1		3	.1	4	
***** ANS1 All9.1 *****									
* ANS1	(0)	4243		19.1		1628	50.5	2	*

CONS	(0)	2000	63.2	12.0		1230	42.5	3	
R00F	(2)	755	28.2	17.8		505	17.5	4	
R67B7	(0)	721	26.9	17.0		402	10.0	4	
INTW	(0)	557	20.6	13.1		449	15.0	4	
TRAN	(0)	517	11.8	7.5		213	7.0	4	
FLOOR	(0)	131	4.9	3.1		125	4.3	4	
DEXT	(0)	105	3.9	2.5		97	3.4	4	
WINDW	(0)	90	3.4	2.1		79	2.7	4	
DINT	(0)	4	.1	.0		4	.1	4	
PLUM	(0)	1503	36.6	7.0		959	33.3	3	
PFIA	(0)	1432	91.6	33.7		697	31.1	4	

HUD SAMPLE DATA

FOURTH LEVEL SUMMATION:

	NO.	%3RD	%2ND	%1ST	HOMES	%HOMES	LEVEL
PREQ C5.2	(0)	8.3	3.0	.6	116	4.0	4
WDTN C11	(0)	.1	.0	.0	1	.0	4
VANV C13	(0)	.1	.0	.0	1	.0	4

 * ANSI ENFORCEMENT *****
 * ***** 2294 ***** 10.3 ***** 1265 ***** 43.9 ***** 2 *
 * *****

PLUM	PART C		%3RD	%2ND	%1ST	HOMES	%HOMES	LEVEL
		(0)	962	41.9	4.3	680	23.6	3
JCTI C7.1	JOINTS + CONNECTIONS/TIGHT [GAS, WATER	(944)	944	41.2	4.2	671	23.3	4
DSYS C12	DRAINAGE SYSTEM	(0)	5	.2	.0	4	.1	4
PFIA C9	PLUMBING FIXTURES	(0)	3	.1	.0	3	.1	4
PFAP C5.1.4	PROHIBITED FITTINGS AND PRACTICES	(2)	2	.1	.0	1	.0	4
TANC C8	TRAPS AND CLEANOUTS	(0)	2	.1	.0	2	.1	4
PHAS C10	HANGERS AND SUPPORTS	(0)	2	.1	.0	2	.1	4
WDTN C11	WATER DISTRIBUTION SYSTEM	(0)	2	.1	.0	2	.1	4
VANV C13	VENTS AND VENTING	(2)	2	.1	.0	1	.0	4

CUNS	PART B		%3RD	%2ND	%1ST	HOMES	%HOMES	LEVEL
		(0)	623	27.2	2.8	473	16.4	3
EXTW B6/B7	EXTERIOR WALLS	(0)	386	62.0	1.7	339	11.8	4
DEXT B6/B7/B8	DOORS EXTERIOR	(151)	152	24.4	.7	152	5.3	4
WNDW B6/B7/B8	WINDOWS	(53)	54	8.7	.2	54	1.9	4
ROOF B6/B7	ROOF SYSTEM	(0)	16	2.6	.1	14	.5	4
FLOF B6/B7	FLOOR SYSTEMS	(2)	8	1.3	.3	5	.2	4
INTW B6/B7	PARTITION WALLS	(0)	6	1.0	.3	5	.2	4
TRAN B-APP.	TRANSIT CONSIDERATIONS	(1)	1	.2	.0	1	.0	4

FLEC	PART E		%3RD	%2ND	%1ST	HOMES	%HOMES	LEVEL
		(0)	450	21.4	2.2	391	13.6	3
EWOR E11	WIRING METHODS	(168)	168	34.3	.8	153	5.3	4
EXUR E20	LIGHTING FIXTURES	(117)	117	23.9	.5	102	3.5	4
FFRO E19	RECEPTACLE OUTLETS	(0)	84	17.1	.4	71	2.5	4
EGDB E23	GROUNDING AND BUNDING	(0)	51	10.4	.2	50	1.7	4
EBFA E22	OUTDOOR OUTLETS, FIXTURES, AIR-COOLING	(0)	39	8.0	.2	37	1.3	4
ESWL E18	WALL SWITCHES	(31)	31	6.3	.1	28	1.0	4

HEAT	PART D		%3RD	%2ND	%1ST	HOMES	%HOMES	LEVEL
		(0)	219	9.5	1.0	201	7.0	3
HAPL D6	APPLIANCES	(0)	205	93.6	.9	187	6.5	4
HLPG D4.2.5	LP GAS SAFETY DEVICES	(0)	13	5.9	.1	13	.5	4
HPSY D5	PIPING SYSTEM	(0)	1	.5	.0	1	.0	4

FOURTH THROUGH EIGHTH LEVEL SUMMATIONS:

 * NANS ROUTINE MAINTENANCE (U) 10178

NO.	%7TH	%6TH	%5TH	%4TH	%3RD	HOMES	%HOMES	LEVEL
NCUN	(11)	5175				1769	61.4	3
<u>CONSTRUCTION</u>								
NCXD	(345)	2107			41.9	1166	40.5	4
NCXH		1083		50.0	20.9	756	26.2	5
NCXF		385		17.8	7.4	319	11.1	5
NCST		132		6.1	2.6	113	3.9	5
NCXR		91		4.2	1.8	82	2.8	5
NCSS		46		2.1	.9	43	1.5	5
NCXS		43		2.0	.8	38	1.3	5
NCDD		42		1.9	.8	39	1.4	5
NCWD	(138)	1029			19.9	692	24.0	4
NCWR		345		33.5	6.7	261	9.6	5
NCWH		242		23.5	4.7	196	6.8	5
NCWT		134		13.0	2.6	117	4.1	5
NCWF		119		11.6	2.3	100	3.5	5
NCWS		51		5.0	1.0	46	1.6	5
NCES		48.9			9.4	385	13.4	4
NCPD	(217)	471			9.1	363	12.6	4
NCPE		146		31.0	2.8	123	4.3	5
NCPH		108		22.9	2.1	98	3.4	5
NCSSM		370			7.1	280	9.7	4
NCBL	(142)	289			5.6	239	8.3	4
NCBE		109		37.7	2.1	98	3.4	5
NCRR		38		13.1	.7	36	1.2	5
NCCH	(5)	170			3.3	157	5.4	4
NCCH		128		75.3	2.5	121	4.2	5
NCCH		37		21.8	.7	35	1.2	5
NCFL	(8)	125			2.4	106	3.7	4
NCFV		117		93.6	2.3	101	3.5	5
NCMG		40			.8	40	1.4	4
NCCTD		14			.3	13	.5	4
<u>PLUMBING</u>								
NPLM	(344)	2940				1443	50.1	3
<u>WATER SUPPLY PIPING</u>								
NPWS	(426)	1192			40.5	839	29.1	4
NPWE	(462)	760		64.3	26.1	597	20.7	5
NPWR		304		39.7	10.3	271	9.4	6
NPFX	(11)	959			32.6	649	22.5	4
NPKS	(245)	388			40.5	341	11.8	5
NPKA		113		29.1	11.8	109	3.8	6
NPKF		20		5.2	2.1	20	.7	6
NPFT		10		2.6	1.0	10	.3	6
NPXX	(0)	253			26.4	210	7.5	5
NPTT		114		45.1	11.9	95	3.3	5
NPTP		90		35.6	9.4	86	3.0	5
NPTA		26		10.3	2.7	24	.8	5
NPBS		23		9.1	2.4	21	.7	5
NPBA	(108)	187			19.5	171	5.9	5
NPBC		57		30.5	5.9	53	1.8	6
NPBF		17		9.1	1.8	16	.6	6
NPBF		5		2.7	.5	5	.2	6

HUD SAMPLE DATA

FOURTH THROUGH EIGHTH LEVEL SUMMATIONS:

	NO.	%7TH	%6TH	%5TH	%4TH	%3RD	HOMES	#HOMES	LEVEL
NPCR	(74)				12.5	7.1	111	3.9	5
NPCA				27.0	3.1	1.0	29	1.0	5
NPCP				13.3	1.7	.5	15	.5	6
NPBT						14.0	340	11.4	4
NPPR						.8	21	.7	4
NPMW	(9)					.3	9	.3	4
NPDW	(2)					.1	2	.1	4
NELC	(200)						673	31.0	3

NEDP						42.3	442	15.3	4
NEDF	(119)			04.0		27.3	236	10.0	5
NECR				8.6		3.0	49	1.7	5
NEDT				6.5		2.7	33	1.1	5
NECC	(14)					20.9	250	8.9	4
NERD	(2)			78.9		18.5	200	7.2	5
NEHT				95.6		15.5	200	6.9	6
NELF				3.5		.0	6	.3	6
NFRI	(37)			16.3		3.4	42	1.5	5
NEPE				21.3		.7	10	.3	6
NEDP						11.4	141	4.9	4
NESW	(84)					6.4	70	2.7	4
NESF						.4	5	.2	5
NETF	(47)					3.4	44	1.5	4
NEEF						.7	9	.3	4
NESR						.5	7	.2	4

NHTG	(45)						515	17.9	3

NHQP						64.0	367	12.7	4
NHSP						15.7	96	3.3	4
NHOP	(84)					13.1	69	2.4	4
NHQP						5.6	5	.2	5

* APFQ	(2)						1750	62.1	2

AFHA	(637)						1133	37.3	3

APPL						21.2	359	12.5	4
APPL	(72)					17.9	310	10.8	5
AFCU	(23)				84.2	15.7	202	5.1	4
AFCU	(37)					8.2	146	5.1	5
AELS					77.4	40.8	117	4.1	6
AFFR					1.7	.9	3	.1	0
AFFU						28.5	63	2.9	5
AFTC	(16)					11.3	35	1.2	6
AFCV					39.0	4.2	14	.5	6
AFCU					14.6	4.2	13	.5	6
AFCU					14.6	3.0	9	.3	6
AFCU					10.4	3.0	9	.3	6
AFCU					4.2	1.2	3	.1	6
AFTW	(37)				11.9	1.9	36	1.3	5
AFFG	(29)				.9	.1	3	.1	6
AFFN	(67)				44.9	5.9	242	8.4	4
							118	4.1	5

FOURTH THROUGH EIGHTH LEVEL SUMMATIONS:

DESCRIPTION	NO.	%7TH	%6TH	%5TH	%4TH	%3RD	HOMFS	#HOMES	LEVEL
WONG INITIALLY INSTALLED									
AFW	60.						60	2.1	0
AFFL	95			47.2	21.2	2.8	91	3.2	5
AFPP	17				33.6	4.4	16	.8	5
AFPO	12				4.2	.6	11	.4	5
AFPM	3				1.1	.1	3	.1	5
AFWT	(199)					11.2	205	7.1	4
AFTA	41				17.1	1.9	38	1.3	5
AFBL	62					2.9	57	2.0	4
AFGR	35					1.0	35	1.2	4
AFDR	31					1.4	30	1.0	4
AFAB	27					1.3	27	.9	4
AFTR	29					1.2	25	.9	4
AFSC	7					.3	7	.2	4
AFBM	6					.3	6	.2	4
<hr/>									
AHW	(459)						939	32.6	3
<hr/>									
HOT WATER HEATERS									
AHL	(202)					51.7	510	17.7	4
AHER	199				26.7	13.8	185	6.4	5
AHEH	141				18.9	9.8	119	4.1	5
AHEC	(32)				16.8	8.7	102	3.5	5
AHEM	61			43.8	8.2	4.2	53	1.8	6
AHER	18			14.4	2.4	1.2	16	.8	6
AHEE	14			11.2	1.9	1.0	11	.4	6
AHTK	70				9.4	4.8	69	2.4	5
AHTE	67			95.7	9.0	4.8	66	2.3	6
AHEP	6				.8	.4	6	.2	5
AHES	3				.4	.2	3	.1	5
AHGS	(16)					18.6	175	6.1	4
AHTG	(1)					3.8	50	1.7	5
AHTL	51			98.1	21.8	3.8	49	1.7	5
AHPL	47				19.7	3.3	40	1.4	5
AHP	36			76.6	15.1	2.5	32	1.1	5
AHRV	44				18.4	3.0	39	1.4	5
AHRR	41				17.2	2.8	37	1.3	5
AHRL	29			63.4	10.9	1.8	24	.8	6
AHNZ	9			22.0	3.8	.6	8	.3	6
AHRG	3			7.3	1.3	.2	3	.1	6
AHCL	32				13.4	2.2	25	.9	5
AHCT	12			37.5	5.0	.5	10	.3	6
AHCR	10			31.3	4.2	.7	9	.3	5
AHCB	4			12.5	1.7	.3	3	.1	5
AHPG	5				2.1	.3	4	.1	5
AHAV	2				.9	.1	2	.1	5
<hr/>									
ARGE	(202)						544	18.9	3
<hr/>									
RANGE - GAS/ELECTRIC									
ARPL	(77)					25.9	175	5.1	4
ARPL	126				81.5	15.9	112	3.9	5
ARGL	152					19.2	125	4.5	4
ARBU	(56)					13.8	98	3.4	4
ARBY	36				33.0	4.5	31	1.1	5
ARBS	15				13.8	1.9	14	.5	5
AKCL	(38)					10.5	76	2.6	4
ARTH	18				21.7	2.3	16	.8	5
AROB	17				20.5	2.1	17	.6	5

FOURTH THROUGH EIGHTH LEVEL SUMMATIONS:

	NO.	%7TH	%5TH	%4TH	%3RD	HGMS	%HOMES	LEVEL
ARSA								
ARWB								
ARHC	(3)	12.0		1.3		10	3	5
ARHK		57.5		4.7		35	1.2	5
ARHD		29.7		2.8		22	.0	5
ARHW		2.7		1.4		10	.3	5
				.1		1	.0	5
				.5		3	.1	4
AEEX	180					168	5.0	3
ACRF	I 120	153				133	4.6	3
ACRG								
ACRL	I 10			10.5		16	.6	4
ACRS				7.2		11	.4	4
ACRC				9.1		1	.0	5
ACRR	(1)			1.3		2	.1	4
ACRZ				1.3		2	.1	4
ACRN				50.0		1	.0	5
				.7		1	.0	4
				1.3		1	.0	4
ASDE	37					35	1.2	3

	(2)	13				12	.4	3
AFER								
AFST	I 2			61.5		8	.3	4
AFTF				75.0		6	.2	5
AFNC	(0)			23.1		3	.1	4
AFPT				100.0		3	.1	5

***** ANSI 119.1 *****
 * ANSI ***** (0) 4243 ***** 1628 50.5 *****

CJMS	PART B	CONSTRUCTION	I 0	2650		1236	42.9	3
ROOF	B6/B7	ROOF SYSTEM	I 2	755		505	17.5	7
RLMP	B7.1	RAIN LEAK - WATER RESISTANCE MLM. PENE	(050)	746		500	17.4	5
	B7.1	MEMBRANE PENETRATION	(19)	67		72	2.5	5
	B7.1	AT VENT PIPE (PLUMBING)		26	29.9	25	.9	7
	B7.1	AT VENT PIPE (HEATING)		25	28.7	25	.6	7
	B7.1	AT MEMBRANE JOINT (WITHIN FIELD) OF R		17	19.5	16	.0	7
	B7.1	INTERSECTION OF ROOF AND EXTERIOR WALL		9	1.2	9	.3	5
	B7.1	DURABILITY	I 0	4	.5	4	.1	5
	B6.5	MEMBRANE	(0)	4	100.0	4	.1	5
	B6.5	FASTENING OF STRUCTURAL SYSTEMS		2	.4	3	.1	5
	B6.5	CEILING TO TRUSS ATTACHMENT		2	66.7	2	.1	5
	B6/B7	ROOFING TO TRUSS ATTACHMENT		1	33.3	1	.0	6
	B7.1	EXTERIOR WALLS	I 0	721		402	10.0	4
	B7.1	WEATHER RESISTANCE - RAIN LEAKS	I 48	715		457	15.9	5
	B7.1	WINDOWS		367		320	11.1	5
	B7.1	DOORS		259		215	7.5	0
	B7.1	PENETRATION OF EXTERIOR COVERING	(0)	6	2.7	6	.2	5
	B7.1	DURABILITY		4	.8	4	.1	6
	B7.1	EXTERIOR COVERING		2	66.7	2	.1	6
	B7.1	INTERIOR COVERING		2	33.3	2	.1	5

HUD SAMPLE DATA

FLOOR TH THROUGH EIGHTH LEVEL SUMMATIONS:

	H6/B7	PARTITION WALLS	NU.	%3RD	%4TH	%5TH	%6TH	%7TH	HOMES	#HOMES	LEVEL
INTW	B6/B7	FASTENING OF STRUCTURAL SYSTEMS	(0)						449	15.6	4
INSS	B6.5/6.7	PANELING OF WALL FRAMING	(0)		97.7				438	15.2	5
INSS1	B6.5/6.7	DURABILITY OF PANELING	544	20.3	100.0				438	15.2	6
INDR		LOAD CARRYING CAPACITY	8	.3	1.4				7	.2	5
INCC	B6.7	PANFLING	(0)		.9				4	.1	5
INCC1	B6.7	TRANSIT CONSIDERATIONS	5	.2	100.0				4	.1	6
TRAN	B-APP.	A FRAME ASSEMBLY	317	11.8					218	7.6	4
TRAN1	B.1	LONGITUDINAL MEMBERS	(53)		56.8				147	5.1	5
TRAN12		TRANSVERSE MEMBERS	120	4.5	66.7				98	3.4	6
TRAN13		TYPES	7	.3	3.9				7	.2	6
TRAN6	R.8	BRAKES	40	1.5	12.6				34	1.2	2
TRAN9	R.9	SPRING/SPRING HANGERS	39	1.5	12.3				38	1.3	5
TRAN4	R.4	WHEELS/RIMS	31	1.2	9.8				29	1.0	5
TRAN7	R.5	AXLES	15	.6	4.7				15	.5	5
TRAN5	R.2	COUPLING MECHANISM	7	.3	2.2				7	.2	5
TRAN2	B6/B7	FLOOR SYSTEMS	5	.2	1.6				4	.1	4
FLWR	B7.1	WEATHER RESISTANCE	(0)						125	4.3	4
FLWR1	B7.1	UNDERNEATH OF FLOOR SYSTEM	(2)		52.0				80	2.8	5
FDUR		DURABILITY	80	3.0	51.1		97.6		78	2.7	6
FDUR1		FLOOR COVERING	37	1.4	28.2				37	1.3	5
FDUR2		FLOOR COVERING TO DECKING	28	1.0	75.7				28	1.0	6
FDUR3		DECKING	5	.2	13.5				5	.2	6
FASS	B6.5	FASTENING OF STRUCTURAL SYSTEMS	3	.1	8.1				3	.1	5
FASS2	B6.5	FLOOR SYSTEM TO METAL FRAME	11	.4	8.4				11	.4	5
FASS1	B6.5	DECKING TO FLOOR JOISTS	7	.3	5.3				7	.2	6
FDEF	B6.10	DEFLECTION	4	.1	3.4				4	.1	6
FDEF1	B6.10	DECKING	(0)		.8				1	.0	5
DEWR	B6/B7/B8	DOORS EXTERIOR	1	.0	100.0				1	.0	4
DEWR	B7.1	WEATHER RESISTANCE - WATER LEAK	(0)						97	3.4	4
DEDU		DURABILITY	100	3.7	95.2				93	3.2	5
WINDW	B6/P7/B8	WINDOWS	5	.2	4.6				4	.1	5
WNR	B7.1/B8.5	WEATHER RESISTANCE - WATER LEAK	(0)						79	2.7	4
WNR		DURABILITY	88	3.3	97.8				78	2.7	5
DINT	B8.3-2/3	DOOR INTERIOR	2	.1	2.2				2	.1	5
ODU		DURABILITY	4	.1	75.0				4	.1	4
DILH	B8.3-2/3	LOCKS, HARDWARE	3	.1	25.0				3	.1	5
PLUM	PART C	PLUMBING	(0)						959	33.3	3
PFIA	C9	PLUMBING FIXTURES	(0)						897	31.1	4
PFIX	C9.2	FIXTURES	(0)						623	21.6	5
TOIL	C9.2.1	TOILETS	(314)						505	17.5	6
TOIL2	C9.2.1.2	TOILET FLUSHING DEVICES	187	7.7	77.7				105	5.9	7
TOIL5	C9.2.1.5	FLOOR CONNECTION	138	29.2	22.7				119	4.1	7
TOIL1	C9.2.1.1	TOILET DESIGN	1	.2	16.7				1	.0	7
SHRS	C9.2.2	SHOWER STALLS	(0)		.1				163	5.7	6
SHRS2	C9.2.2.2	WATERTIGHTNESS OF JOINT AT DRAIN	130	22.3	12.3				120	4.2	7
SHRS3	C9.2.2.3	WATERTIGHTNESS OF SHOWER/ENCL	54	70.7	15.8				50	1.7	5
PFGR	C9.1	GENERAL REQUIREMENT	608	29.3	6.6				448	15.6	6
PFGR1	C9.1.1	QUALITY OF FIXTURES	803	42.5	42.5				116	4.0	4
PREQ	C5.2	PROTECTIVE REQUIREMENT	(0)		100.0				95	3.3	5
PREQ4	C5.2.4	FREEZING	107	32.9	8.3				22	.8	5
PREQ5	C5.2.5	RODENT RESISTANCE	22	17.1	1.4				1	.0	4
WDIN	C11	WATER DISTRIBUTION SYSTEM	(0)						1	.0	4
WHSD	C11.3	WATER HEATER SAFETY DEVICES	(0)		100.0				1	.0	5

HUD SAMPLE DATA

FOURTH THROUGH EIGHTH LEVEL SUMMATIONS:

				N/O	%7TH	%6TH	%5TH	%4TH	\$3RD	HUMES	\$HUMES	LEVEL
FDEF	R6.10	DEFLECTION	(	0)				25.0	.3	1	.0	5
FDEF2.	R6.10	FLUJR JOISTS	(	0)			100.0	25.0	.3	1	.0	6
FLCC	R6.9	LOAD CARRYING CAPACITY	(	0)			100.0	12.5	.2	1	.0	5
FLCC1.	R6.9	DECKING	(	0)			100.0	12.5	.2	1	.0	6
INTW	R6/87	PARTITION WALLS	(	0)				1.0	1.0	5	.2	4
INSS	R6.5/6.7	FASTENING OF STRUCTURAL SYSTEMS	(	0)				100.0	1.0	5	.2	5
INSS2.	R6.5/6.7	WALL TO ROOF SYSTEM	(	3			50.0	50.0	.5	2	.1	6
INSS4.	R6.5/6.7	DLUF FRAMING	(	3			50.0	50.0	.5	3	.1	6
TRAN	B-APP.	TRANSIT CONSIDERATIONS	(	1)				50.0	.5	1	.0	4
			(	1)					.2	1	.0	4
ELEC	PART E	ELECTRICAL	(	0)	490					391	13.6	3
EWOR	E11	WIRING METHODS	(	168)	168				34.3	153	5.3	4
EXUR	E20	LIGHTING FIXTURES	(	117)	117				23.9	102	3.5	4
FFRO	E19	RECEPTACLE OUTLETS	(	0)	64				17.1	71	2.5	4
EFIN	E19.1	INSTALLATION IN ACCORDANCE	(	0)	84		100.0		17.1	71	2.5	5
EGDB	E23	GROUNDING AND BUNDLING	(	51)	51				10.4	50	1.7	4
EGSE	E23.1	SERVICE GROUNDING	(	51)	51				10.4	50	1.7	5
EBFA	E22	OUTDOOR OUTLETS, FIXTURES, AIR-COOLING	(	0)	39				8.0	37	1.3	4
FBTF	F22.1	TYPE OF OUTDOOR FIXTURES AND EQUIPMENT	(	31)	31				3.0	37	1.3	5
ESWL	E16	ALL SWITCHES	(	31)	31				3.3	28	1.0	4
HEAT	PART D	HEATING SYSTEM	(	0)	219					201	7.0	3
HAPL	D6	APPLIANCES	(	0)	205				93.6	187	6.5	4
HAAC	D6.7	ACCESSIBILITY - INSPECTION, SERVICE, E	(	0)	102			49.8	46.6	101	3.5	5
HAAC2.	D6.7	HOT WATER HEATER-POUR ACCESS	(	0)	102		100.0	49.8	46.6	101	3.5	6
HAVA	D6.4	VENTING, VENTILATION AND COMBUSTION	(	0)	76			37.1	34.7	71	2.5	5
HAVE	D6.4.1	VENTING SYSTEM	(	0)	76			100.0	37.1	71	2.5	6
HAVE4.	D6.4.2	VENTING SHALL NOT TERMINATE UNDER	(	53)	53		59.7	69.7	25.9	49	1.7	7
HAVE3.	D6.4.2	JOINTS OF VENT SYSTEM SECURE	(	1)	22		28.9	29.9	10.7	22	.8	7
HAVE31.	D6.4.1	FURNACE	(	18)	18		81.8	23.7	8.8	18	.6	8
HAVE32.	D6.4.1	HOT WATER HEATER	(	3)	3		13.6	3.9	1.4	3	.1	8
HAVE2.	D6.4.1	SYSTEM CONSISTING OF LISTED COMPON	(	17)	17			1.3	.5	1	.0	7
HACA	D6.10	CIRCULATING AIR SYSTEM	(	0)	13			9.8	8.2	18	.6	6
HACS	D6.10.1	SUPPLY SYSTEM	(	0)	1			5.6	.5	1	.0	5
HACS3.	D6.10.1.3	AIR TIGHTNESS OF SUPPLY DUCT SYSTEM	(	0)	9		100.0	5.6	.5	1	.0	7
HAIC	D6.3	INSTALLATION OF APPLIANCES	(	0)	9			4.4	4.1	8	.3	5
HANP	D6.3.3	NEGATIVE PRESSURE CREATED BY AIR	(	0)	9		100.0	4.4	4.1	8	.3	5
HANP2.	D6.3.3.2	LOCATION OF AIR INLETS AND OUTLETS	(	0)	9		100.0	4.4	4.1	8	.3	7
HLPG	D4.2.5	LP GAS SAFETY DEVICES	(	0)	13			5.9	5.9	13	.5	4
HPSY	D5	PIPING SYSTEM	(	0)	1				.5	1	.0	4
HGPS	D5.1	GAS PIPING SYSTEMS	(	1)	1			100.0	.5	1	.0	5

Appendix C

Problem Summation Tables - Private Sample

FIRST LEVEL SUMMATION:
TOTAL NUMBER OF PROBLEMS

NJ.
6206

ANSI	ANSI ALL9.1	(	0)	2280	36.7	2ND	1ST	HOMES	4HOMES	LEVEL
CONS	PART H CONSTRUCTION	(	0)	1475	64.9	23.8		608	83.6	2
PLUM	PART C PLUMBING	(	0)	681	29.9	11.0		453	70.2	3
ELEC	PART E ELECTRICAL	(	0)	51	2.7	1.0		54	46.8	3
HFAT	PART J HEATING SYSTEM	(	0)	59	2.6	1.0		58	5.6	3
ANSI	ENFORCEMENT	(	0)	1791	28.9			639	66.1	2
HEAT	PART D HEATING SYSTEM	(	26)	533	29.8	8.6		302	31.2	3
PLUM	PART C PLUMBING	(	0)	469	26.2	7.6		314	32.5	3
FLEC	PART E ELECTRICAL	(	0)	463	25.9	7.5		299	30.9	3
CONS	PART B CONSTRUCTION	(	6)	326	18.2	5.3		235	24.3	3
ANS	ROUTINE MAINTENANCE	(	2)	1490	24.0			608	71.1	2
CON	CONSTRUCTION	(	1)	1127	75.6	18.2		579	59.9	3
NPLM	PLUMBING	(	34)	223	15.0	3.6		186	19.2	3
NELC	ELECTRICAL	(	56)	131	8.8	2.1		112	11.6	3
NHTG	HEATING	(	4)	7	.5	.1		7	.7	3
APFO	MECHANICAL/ELECTRICAL APPLIANCES -EQUIPMENT	(	11)	367	5.9			271	28.0	2
ARGF	RANGE - GAS/ELECTRIC	(	65)	112	30.5	1.8		97	10.0	3
AFHA	FURNACE*HOT AIR*GAS OR OIL	(	38)	87	23.7	1.4		77	8.0	3
AFEX	EXHAUST FAN	(	72)	52	19.6	1.2		71	7.3	3
AHW	HOT WATER HEATERS	(	14)	52	14.2	.8		50	5.2	3
ACRF	REFRIGERATOR	(	28)	52	8.7	.5		28	2.9	3
AFBB	ELECTRIC BASEBOARD HEATING UNITS	(	1)	1	.3	.0		1	.1	3
MISC	MISCELLANEOUS			278	4.5			239	24.7	2

111

FOURTH LEVEL SUMMATION:

#	ANSI	CONSTRUCTION	NO.	3RD	2ND	1ST	HOMES	%HOME	LEVEL
*****	ANSI A119.1	CONSTRUCTION	(U)	2200	30.7		079	70.2	3
*****		ROOF SYSTEM	(U)	1479	04.9	23.0			
*****		ROOF SYSTEM	(U)	460	31.1	20.2	353	30.5	4
*****		PARTITION WALLS	(U)	308	20.8	13.5	279	28.9	4
*****		FLOOR SYSTEMS	(U)	291	19.7	12.8	247	25.5	4
*****		DOORS EXTERIOR	(U)	105	11.2	2.7	155	10.0	4
*****		WINDOWS	(U)	138	9.3	6.1	135	14.0	4
*****		EXTERIOR WALLS	(U)	85	5.7	3.7	74	7.7	4
*****		TRANSIT CONSIDERATIONS	(U)	27	1.8	1.2	27	2.8	4
*****		DOOR INTERIOR	(U)	4	.3	.2	4	.4	4
*****		TIEDOWNS	(U)	1	.1	.0	1	.1	4
*****		PLUMBING	(U)	681	29.9	11.0	453	40.8	3
*****		PLUMBING FIXTURES	(U)	520	70.4	22.0	378	35.1	4
*****		PROTECTIVE REQUIREMENT	(U)	160	23.5	7.0	147	15.2	4
*****		VENTS AND VENTING	(U)	1	.1	.0	1	.1	4
*****		ELECTRICAL	(U)	61	2.7	1.0	54	5.6	4
*****		WIRING METHODS	(U)	61	100.0	2.7	54	5.6	4
*****		HEATING SYSTEM	(U)	59	2.0	1.0	56	0.0	3
*****		PIPING SYSTEM	(U)	55	93.2	2.4	54	5.6	4
*****		APPLIANCES	(U)	4	6.8	.2	4	.4	4
*****	ANSI ENFORCEMENT		(U)	1791	28.9		039	06.1	2
*****		HEATING SYSTEM	(U)	503	29.6	8.0	302	31.2	3
*****		APPLIANCES	(U)	456	05.0	7.3	278	23.7	4
*****		PIPING SYSTEM	(U)	49	9.2	2.7	42	4.3	4
*****		PLUMBING	(U)	469	26.2	7.0	314	32.5	3
*****		JUNTS + CONNECTIONS/TIGHT	(U)	201	42.9	11.2	171	17.7	4
*****		DRAINAGE SYSTEM	(U)	78	10.6	4.4	71	7.3	4
*****		TRAPS AND CLEANOUTS	(U)	59	12.6	3.3	53	5.5	4
*****		WATER DISTRIBUTION SYSTEM	(U)	30	8.1	2.1	37	3.8	4
*****		VENTS AND VENTING	(U)	35	7.5	2.0	31	3.2	4
*****		PLUMBING FIXTURES	(U)	30	6.4	1.7	30	3.1	4
*****		HANGERS AND SUPPORTS	(U)	27	5.8	1.5	27	2.8	4
*****		ALIGN OF FITTINGS/DIRECTION OF FLOW	(U)	1	.2	.1	1	.1	4
*****		ELECTRICAL	(U)	463	25.9	7.5	299	40.9	3
*****		WIRING METHODS	(U)	104	33.3	0.6	136	14.1	4
*****		LIGHTING FIXTURES	(U)	61	13.2	3.4	53	5.5	4

PRIVATE SAMPLE DATA

FOURTH LEVEL SUPPLEMENT:		N)	%3RD	%2ND	%1ST	HUMES	%HOMES	LEVEL
ERCR	E7	(0)	55	11.9	3.1	.9	53	5.5
EMKE	E25	(3)	39	2.2	.0	35	3.0	4
EDIS	E9	(8)	33	7.1	1.8	33	3.4	4
EGDB	E23	(8)	31	6.7	1.7	28	2.9	4
ERFA	E22	(1)	21	4.5	1.2	19	2.0	4
EREC	E6	(1)	20	4.3	1.1	18	1.9	4
ERFO	E19	(0)	17	3.7	.9	17	1.6	4
ESWL	F18	(15)	15	3.2	.8	13	1.3	4
EPNW	F10	(5)	6	1.3	.3	6	.6	4
FUND	E12	(0)	6	1.3	.3	6	.6	4
ERXY	E5.U	(1)	3	.6	.2	3	.3	4
EFPL	E13	(1)	1	.2	.1	1	.1	4
ETER	E17	(0)	1	.2	.1	1	.1	4
CUNS	PART d	(6)	326	18.2	5.3	235	24.3	3
EXTW	R6/B7	(0)	150	48.0	8.4	136	14.1	4
FLOF	R6/B7	(26)	80	24.5	4.5	71	7.3	4
ROOF	R6/B7	(0)	51	15.6	2.8	42	4.3	4
INTW	R6/B7	(0)	27	8.3	1.5	21	2.2	4
WNDW	R6/R7/B8	(0)	7	2.1	.4	7	.7	4
DEXT	R6/R7/B8	(0)	4	1.2	.2	4	.4	4
DINT	R8.3.2/3	(1)	1	.3	.1	1	.1	4

* NANS *****								
* ROUTINE MAINTENANCE *****								

NCND	CONSTRUCTION	(1)	1127	75.6	18.2	579	55.9	3
NCND	WINDOWS	(58)	452	40.1	30.3	333	34.4	4
NCPD	EXTERIOR DOORS	(47)	286	25.4	19.2	242	25.0	4
NCPL	PARTITIONS DOORS	(27)	250	22.2	18.8	197	20.4	4
NCBL	BLOCKING	(15)	74	6.6	5.0	70	7.2	4
NCBH	HOT WATER HEATER COMPARTMENT	(0)	30	2.7	2.0	26	2.7	4
NCFL	FLOOR	(1)	13	1.2	.9	13	1.3	4
NCSS	SKIRTING	(9)	9	.8	.6	9	.9	4
NCES	EXTERIOR STAIRS	(7)	7	.6	.5	4	.4	4
NCED	TIE DOWN STRAPS LOOSE, ETC	(5)	5	.4	.3	5	.5	4
NPLW	PLUMBING	(34)	223	15.0	3.0	166	19.2	3
NPFX	FIXTURES	(0)	168	75.3	11.3	142	14.7	4
NPBT	SEWER	(3)	3	.3	.5	8	.6	4
NPMW	WASHING MACHING	(5)	5	2.2	.3	5	.5	4
NPDW	DISH WASHER	(5)	5	2.2	.3	5	.5	4
NPWS	WATER SUPPLY PIPING	(1)	3	1.3	.2	3	.3	4
NELC	ELECTRICAL	(50)	131	8.8	2.1	112	11.6	3
NEDP	DISTRIBUTION PANEL BOARD	(8)	31	23.7	2.1	31	3.2	4
NEWS	SWITCHES	(15)	16	12.2	1.1	15	1.6	4
NERC	RECEPTICAL OUTLETS	(7)	15	11.5	1.0	13	1.3	4
NEIF	INTERIOR LIGHTING FIXTURES	(12)	12	9.2	.8	12	1.2	4
NESR	SERVICE	(1)	1	.8	.1	1	.1	4

PRIVATE SAMPLE DATA

FOURTH LEVEL SUMMARY:

HTG	HEATING	NUM	%3RD	%2ND	%1ST	HJMS	%HJMS	LEVEL
NHGP	GAS SUPPLY PIPING	(4)	7	.5	.1	7	.7	3
			3	42.9	.2	.0	.3	4
***** MECHANICAL/ELECTRICAL APPLIANCES - EQUIPMENT *****								
* APFD		(11)	367	5.9		271	28.0	2
								3
***** RANGE - GAS/ELECTRIC *****								
ARGE		(65)	112	30.5	1.8	97	10.0	3
ARHW	HARDWARE	(5)	25	22.3	.4	21	2.2	4
ARBU	BURNER	(7)	9	8.0	.1	9	.9	4
ARGL	GAS LEAK	(3)	9	8.0	.1	8	.8	4
ARPL	PILOT	(3)	3	2.7	.0	3	.3	4
ARCL	CONTROLS	(0)	1	.9	.3	1	.1	4
***** FURNACE HOT AIR GAS OR OIL *****								
AFHA		(38)	67	23.7	1.4	77	8.0	3
AFWT	WALL THERMOSTAT	(18)	18	20.7	.3	18	1.9	4
AFDF	FURNACE DOORS	(1)	11	12.8	.2	11	1.1	4
AFCL	CONTROLS	(0)	8	9.2	.1	8	.8	4
AFBL	BLOWER ASSEMBLY	(3)	4	4.6	.1	4	.4	4
AFBM	BLOWER MOTOR	(2)	2	2.3	.0	2	.2	4
AFFG	FUEL GUN	(0)	2	2.3	.0	2	.2	4
AFTF	FILTER	(0)	2	2.3	.0	2	.2	4
AFAB	BURNER ASSEMBLY	(0)	1	1.1	.3	1	.1	4
AFSC	FUEL SUPPLY CONNECTION	(0)	1	1.1	.3	1	.1	4
AFEX	EXHAUST FAN	(14)	72	19.6	1.2	71	7.3	3
***** HOT WATER HEATERS *****								
AHWW		(14)	52	14.2	.8	50	5.2	3
AHEL	ELECTRIC HOT WATER HEATER	(10)	36	69.2	.6	35	3.8	4
AHGS	GAS HOT WATER HEATER	(0)	2	3.8	.0	2	.2	4
***** REFRIGERATOR *****								
ACRF		(28)	32	6.7	.0	28	2.9	3
***** REFRIGERANT SYSTEM *****								
ACRK		(3)	3	9.4	.0	2	.2	4
ACRG	GASKETING (OURS)	(0)	1	3.1	.0	1	.1	4
***** ELECTRIC BASEBOARD HEATING UNITS *****								
AFEB		(1)	1	.3	.0	1	.1	3

FOURTH THROUGH EIGHTH LEVEL SUMMATIONS: NU. 87TH 85TH 84TH 63RD HOMES HOMES LEVEL

 * ANSI *****
 ***** ANSI A119.1 *****

 ***** (0) 228J *****

 ***** (0) 1479 *****

 ***** (5) 460 *****
 ***** (238) 304 *****
 ***** (2) 56 *****
 ***** 23 *****
 ***** 14 *****
 ***** 13 *****
 ***** 4 *****
 ***** 10 *****
 ***** 101 *****
 ***** 67 *****
 ***** 28 *****
 ***** 6 *****
 ***** 36 *****
 ***** 9 *****
 ***** (0) 3 *****
 ***** (0) 1 *****
 ***** (0) 1 *****
 ***** (0) 2 *****
 ***** (0) 2 *****
 ***** (0) 308 *****
 ***** (0) 302 *****
 ***** 302 *****
 ***** 0 *****
 ***** (0) 291 *****
 ***** (3) 158 *****
 ***** 102 *****
 ***** 21 *****
 ***** 12 *****
 ***** 09 *****
 ***** 44 *****
 ***** 38 *****
 ***** 4 *****
 ***** 1 *****
 ***** (1) 28 *****
 ***** (0) 27 *****
 ***** (0) 12 *****
 ***** 12 *****
 ***** (0) 105 *****
 ***** 129 *****
 ***** 36 *****
 ***** (0) 138 *****
 ***** 136 *****
 ***** (2) 85 *****
 ***** (0) 70 *****
 ***** 40 *****

CONS	PART	CONSTRUCTION	NU.	87TH	85TH	84TH	63RD	HOMES	HOMES	LEVEL
ROOF	B6/B7	ROOF SYSTEM	460			31.1		353	36.5	4
RLWR	B7.1	GAIN LEAK - WATER RESISTANCE ML.M. PENF	304		06.1	20.6		270	27.5	5
RLMP	B7.1	MEMBRANE PENETRATION	56		18.4	3.8		54	5.6	6
RLMP3.	B7.1	AT VENT PIPE (HAFATING)	23	41.1	7.6	5.0		23	2.4	7
RLMP2.	B7.1	AT VENT PIPE (PLUMHING)	14	25.0	4.6	3.0		14	1.4	7
RLMP4.	B7.1	AT DOUBLE WIDE JOINT	13	23.2	4.3	2.8		13	1.3	7
RLMP5.	B7.1	AT TIP DUT JOINT	4	7.1	1.3	.9		4	.4	7
RIEW	B7.1	INTERSECTION OF ROOF AND EXTERIOR WALL	10	3.3	2.2	.7		10	1.0	6
RFSS	B6.5	FASTENING OF STRUCTURAL SYSTEMS	101	22.0	6.8	94		94	9.7	5
RFSS4.	B6.5	CEILING TO TRUSS ATTACHMENT	67	66.3	14.6	4.5		66	6.8	6
RFSS5.	B6.5	DOUBLE WIDE MISALIGNMENT	28	27.7	6.1	1.9		28	2.9	6
RFSS3.	B6.5	ROOFING TO TRUSS ATTACHMENT	6	5.9	1.3	.4		6	.6	6
RDEF	B6.10	DEFLECTION	45	80.0	9.6	3.0		45	4.7	5
RDEF1.	B6.10	DECKING	36	20.0	7.8	2.4		36	3.7	6
RDEF2.	B6.10	ROOF TRUSS	9	.7	.2	.0		9	.9	6
RLCC	B6.4	LOAD CARRY CAPACITY	3					3	.3	5
RDEL	B6.4	DECKING	1	33.3	.2	.1		1	.1	6
RTRK	B6.4	ROOF TRUSS	1	33.3	.2	.1		1	.1	0
RTPS4.	B6.4	ROOF TRUSS CUT FOR ROOF JACK	1	100.0	33.3	.2		1	.1	7
CELL		CELLING	1		33.3	.2		1	.1	0
ROUR		DURABILITY	2					2	.2	5
ROURL.		MEMBRANE	2					2	.2	6
INTW	B0/B7	PARTITION WALLS	308	100.0		.4		279	28.9	4
INSS	B6.5/6.7	FASTENING OF STRUCTURAL SYSTEMS	302	98.1	20.4	20.8		275	28.4	5
INSSI.	B6.5/6.7	PANELING TO WALL FRAMING	302	100.0	70.1	20.4		275	28.4	6
INDR		DURABILITY OF PANELING	0		1.9	.4		6	.6	5
FLOP	B6/B7	FLOOR SYSTEMS	291			19.7		247	25.5	4
FDUR		DURABILITY	158		7.4	9.3		129	15.3	5
FDURL.		FLOOR COVERING	102		35.1	6.9		99	10.2	6
FDUR3.		DECKING	21	73.9	19.2	7.2		21	2.2	6
FDUR2.		FLOOR COVERING TO DECKING	12	8.7	4.1	.6		12	1.2	6
FLR	B7.4	RODENT RESISTANCE	09	23.7	4.7	4.7		09	7.1	5
FASS	B6.5	FASTENING OF STRUCTURAL SYSTEMS	44		15.1	3.0		42	4.3	5
FASL.	B6.5	DECKING TO FLOOR JOISTS	38	66.4	13.1	2.6		37	3.8	6
FASS2.	B6.5	FLOOR SYSTEM TO METAL FRAME	4	9.1	1.4	.3		4	.4	6
FASS4.	B6.5	WEATHER BARRIER	1	2.3	.3	.1		1	.1	6
FLWR	B7.1	WEATHER RESISTANCE	28	9.6	1.9	1.9		27	2.8	5
FLWPI.	B7.1	UNDERNEATH OF FLOOR SYSTEM	27	96.4	9.3	1.8		26	2.7	6
FDFE	B6.10	DEFLECTION	12	4.1	.8	.8		12	1.2	5
FDEF1.	B6.10	DECKING	12	100.0	4.1	.8		12	1.2	5
DEXT	B6/B7/B8	DOORS EXTERIOR	105			11.2		155	16.0	4
DEWR	B7.1	WEATHER RESISTANCE - WATER LEAK	129	78.2	8.7	8.7		129	13.0	5
DEDU		DURABILITY	36	21.8	2.4	2.4		35	3.6	5
WNDR	B6/B7/B8	WINDOWS	138			9.3		135	14.0	4
WNDR	B7.1/B8.5	WEATHER RESISTANCE - WATER LEAK	136	98.6	9.2	9.2		134	13.9	5
WNDR		DURABILITY	2	1.4	.1	.1		1	.1	5
EXTW	B6/B7	EXTERIOR WALLS	85			5.7		74	7.7	4
EXWR	B7.1	WEATHER RESISTANCE - RAIN LEAKS	70	32.4	4.7	4.7		62	6.4	4
EXWRL.	B7.1	PENETRATION OF EXTERIOR COVERING	40	57.1	47.1	2.7		40	4.1	4

PRIVATE SAMPLE DATA

FOURTH THROUGH EIGHTH LEVEL SUMMATIONS:

	N.P.	%7TH	%6TH	%5TH	%4TH	%3RD	HUMES	%HUMES	LEVEL
EXR2.	19			27.1	22.4	1.3	19	2.0	0
EXR3.	11			15.7	12.9	.7	11	1.1	0
EXDR	13	(U)			19.3	.9	13	1.3	5
EXDR1.	6			61.5	9.4	.5	6	.8	6
EXDR4.	3			23.1	3.5	.2	3	.3	0
EXR2.	2			15.4	2.4	.1	2	.2	6
TRAN	27	(U)				1.8	27	2.6	4
TRAN1.	17	(1+)		17.6	63.0	1.1	17	1.8	5
TRAN13.	3				11.1	.2	3	.3	6
TRAN11.	10				37.3	.7	10	1.0	5
DIINT	4	(U)				.3	4	.4	4
DILH	4			100.0		.3	4	.4	5
TIDN	1	(U)				.1	1	.1	4
TIDN2.	1			100.0		.1	1	.1	5
PLUM	681	(U)					453	46.8	3
PFIA	520	(U)				76.4	378	39.1	4
PFIK	378	(U)			72.7	55.5	305	31.5	5
TOIL	192	(32)		50.3	36.9	28.2	167	17.3	6
TOIL5.	84			43.8			79	8.2	7
TOIL2.	61			31.8	11.7	9.0	54	5.6	7
TOIL6.	14			7.3	2.7	2.1	14	1.4	7
TOIL1.	1			.5	.2	.1	1	.1	7
SHRS	186	(2)		49.2	35.8	27.3	176	18.2	0
SHRS3.	130			73.1	30.0	20.0	133	13.0	7
SHRS2.	37			19.9	7.1	5.4	36	3.7	7
SHRS1.	11			5.9	2.9	2.1	11	1.1	7
PEGP	142	(U)			27.3	20.9	137	14.1	5
PEGR1.	142			100.0	27.3	20.9	107	11.1	5
PRFO	160	(U)				23.5	147	15.2	4
PRFO5.	159				99.4	23.3	145	15.1	5
PRFO4.	1				.6	.1	1	.1	5
VAVV	1	(U)				.1	1	.1	4
VVTL	1	(U)			100.0	.1	1	.1	5
VVTL3.	1			100.0	100.0	.1	1	.1	5
ELFC	61	(U)					54	5.0	3
EWDR	61	(U)				100.0	54	5.6	4
EWFB	61				100.0	100.0	54	5.6	5
HEAT	59	(U)					50	6.0	3
HPSV	55	(U)				93.2	54	5.0	4
HGPG	55	(U)			100.0	93.2	54	5.6	5
HGPG1.	55	(U)			100.0	100.0	54	5.6	3
HAPL	55	(U)			100.0	100.0	54	5.6	7
HAIC	4	(U)				6.8	4	.4	4
HAIN1.	4	(U)			100.0	6.8	4	.4	5
	4			100.0	100.0	6.8	4	.4	5
ANSI ENFORCEMENT	1791	(U)					639	66.1	2

FOURTH THROUGH EIGHTH LEVEL SUMMATIONS:

HEAT	PART D	HEATING SYSTEM	(	28)	533	%5TH	%4TH	%3RD	HOMES	%HOMES	LEVEL
HAPL	D6	APPLIANCES	(	0)	456				278	31.2	3
HACA	D6.10	CIRCULATING AIR SYSTEM	(	1)	187				148	15.3	4
HACS	D6.10.1	SUPPLY SYSTEM	(	20)	74				69	7.1	6
HACS3.	D6.10.1.3	AIR TIGHTNESS OF SUPPLY DUCT SYSTEM			40	54.1	8.8	7.5	40	4.1	7
HACS2.	D6.10.1.2	SIZING OF DUCT			6	8.1	1.3	1.1	6	.6	7
HACS1.	D6.10.1.1	DUCT MATERIAL			2	2.7	.4	.4	2	.2	7
HARG	D6.10.5	REGISTERS	(	8)	67	35.8	14.7	12.6	62	6.4	6
HARG6.	D6.10.5	DUCT TUBE RISER			33	49.3	17.6	7.2	32	3.3	7
HARG2.	D6.10.5.2	STRUCTURAL REQUIREMENTS			9	13.4	2.0	1.7	9	.9	7
HARG4.	D6.10.5	DIRT, FLOOR COVERING AND DUCT			9	13.4	2.0	1.7	9	.9	7
HARG3.	D6.10.5	RISER MISSING OR DAMAGED			6	9.0	3.2	1.3	6	.6	7
HARG5.	D6.10.5	AIR BLOCKAGE			2	3.0	.4	.4	2	.2	7
HARA	D6.10.2	RETURN AIR SYSTEM	(	3)	25	13.4	5.5	4.7	25	2.6	6
HARA4.	D6.10.2.4	PERMANENT UNCLOSEABLE OPENINGS			11	44.0	5.9	2.4	11	1.1	7
HARA1.	D6.10.2.1	RETURN AIR OPENINGS			6	24.0	3.2	1.3	6	.6	7
HARA2.	D6.10.2.2	DUCT MATERIALS	(	4)	5	20.0	2.7	1.1	5	.5	7
HARA22.	D6.10.2.2.2	FLAME SPREAD NOT MORE THAN 200			1	4.0	.5	.2	1	.1	8
HASJ	D6.10.3	JOINTS AND SEAMS			17	20.0	3.7	3.2	17	1.8	6
HASU	D6.10.4	SUPPORTS			3	1.6	.7	.6	3	.3	6
HAVA	D6.4	VENTING, VENTILATION AND COMBUSTION	(	9)	182				149	15.4	5
HAVE	D6.4.1	VENTING SYSTEM	(	2)	173				141	14.6	6
HAVE3.	D6.4.1	JOINTS OF VENT SYSTEM SECURE	(	34)	96				88	9.1	7
HAVE32.	D6.4.1	HOT WATER HEATER			44	45.8	9.6	8.3	44	4.6	8
HAVE31.	D6.4.1	FURNACE			18	18.8	3.9	3.4	18	1.9	8
HAVE2.	D6.4.1	SYSTEM CONSISTING OF LISTED COMPUN			56	32.4	30.8	10.5	54	5.6	7
HAVE5.	D6.4.3	VENTING SYSTEM TERMINATION			12	6.9	2.6	2.3	12	1.2	7
HAVE4.	D6.4.2	VENTING SHALL NOT TERMINATE UNDER			4	2.3	.9	.8	4	.4	7
HAVE6.	D6.4.4	VENTILATION OF KITCHEN			3	1.7	.7	.6	3	.3	7
HAIC	D6.3	INSTALLATION OF APPLIANCES	(	1)	66				62	6.4	5
HAMS	D6.3.2	SEPARATION OF COMBUSTION SYSTEM			59	89.4	12.9	11.1	56	5.8	6
HAIN	D6.3.1	LISTING AND INSTRUCTIONS			4	6.1	.9	.8	4	.4	6
HANP	D6.3.3	NEGATIVE PRESSURE CREATED BY AIR	(	0)	2	3.0	.4	.4	2	.2	6
HANP2.	D6.3.3.2	LOCATION OF AIR INLETS AND OUTLETS			2	100.0	.4	.4	2	.2	7
HAAC	D6.7	ACCESSIBILITY - INSPECTION, SERVICE, E	(	7)	13				13	1.3	5
HAAC2.	D6.7	HOT WATER HEATER-POOR ACCESS			5	38.5	1.1	.9	5	.5	6
HAAC1.	D6.7	FURNACE-POOR ACCESS			1	7.7	.2	.2	1	.1	6
HALN	D6.8	LOCATION - RELATIVE TO COMBUSTIBLES			3	.7	.6	.6	3	.3	5
HACD	D6.2	CLOTHES DRYER	(	0)	2	.4	.4	.4	2	.2	5
HADE	D6.2.1	EXHAUST			1	50.0	.2	.2	1	.1	6
HAPD	D6.2.2	PROHIBITED DUCT CONNECTION			1	50.0	.2	.2	1	.1	6
HAMK	D6.6	MARKING			2	.4	.4	.4	2	.2	5
HAMK1.	D6.6.1	FURNACE CLEARANCES AND OPERATIONS	(	0)	2	100.0	.4	.4	2	.2	6
HAGL	D6.1	GENERAL - LISTED	(	1)	1	.2	.2	.2	1	.1	5
HPSY	D5	PIPE SYSTEM	(	0)	49				42	4.3	4
HGVS	D5.1	GAS PIPING SYSTEMS	(	1)	48				41	4.2	5
HGHS	D5.1.18	HANGERS AND SUPPORTS			22	45.8	44.9	4.1	21	2.2	6
HGID	D5.1.11	IDENTIFICATION OF GAS SUPPLY CONNECTION			7	14.6	14.3	1.3	7	.7	6
HGAC	D5.1.13	APPLIANCE CONNECTION	(	0)	4	8.3	8.2	.8	4	.4	6
HGAC2.	D5.1.13	FLEXIBLE CONNECTOR THRU UNDERSIDE OF U			4	100.0	8.2	.8	4	.4	7
HGVS	D5.1.14	VALVES - SHUTOFF LISTED TYPE			4	8.3	8.2	.8	4	.4	6
HGPM	D5.1.2	MATERIALS - USED/REPAIRED DEFECTS	(	2)	3	6.3	6.1	.6	3	.3	6
HGPM5.	D5.1.2	CORROSION OF METALS			1	33.3	2.0	.2	1	.1	7
HGJC	D5.1.7	PIPE JOINT COMPOUND - SCREW JOINTS			2	4.2	4.1	.4	2	.2	6

PRIVATE SAMPLE DATA

FOURTH THROUGH EIGHTH LEVEL SUMMATIONS:		NO.	%7TH	%6TH	%5TH	%4TH	%3RD	NUMES	%HOMES	LEVEL
EMCB	E25.1					28.2	2.4	11	1.1	3
EMFS	E25.2					2.0	.2	1	.1	5
EDIS	E9	(8)				7.1	7.1	33	3.4	4
EDPU	E9.1					39.4	2.8	13	1.3	5
EUCB	E9.10					18.2	1.3	6	.0	5
EDMK	E9.5					15.2	1.1	5	.2	5
EDUP	E9.8					3.0	.2	1	.1	5
EGDR	E23	(8)				6.7	6.7	28	2.9	4
EIGD	E23.3	(2)				41.9	2.8	12	1.2	5
EIGD2.	F23.3.2	(3)		23.6		22.0	1.5	7	.7	0
EIGD21.	F23.3.2.1		28.0			6.5	.4	2	.2	7
EIGD25.	F23.3.2.5		28.6			6.5	.4	2	.2	7
EIGD1.	E23.3.1			15.4		6.5	.4	2	.2	6
EIGD4.	E23.3.4			15.4		6.5	.4	2	.2	6
EGSE	E23.1	(4)		15.4		19.4	1.3	6	.6	5
EGSE1.	E23.1.1			19.7		3.2	.2	1	.1	0
FGSE2.	E23.1.2			10.7		3.2	.2	1	.1	6
EIBN	E23.4	(2)		9.7		6	.6	3	.3	5
EIBN3.	F23.4.3.			33.3		3.2	.2	1	.1	0
ENIN	F23.2	(1)		3.2		3.2	.2	1	.1	5
EBFA	F22	(1)		4.5		4.5	4.5	19	2.0	4
EBTF	F22.1	(1)		95.2		4.3	4.3	18	1.9	5
CREC	E6	(1)		4.3		4.3	4.3	18	1.9	4
ERLW	E6.1	(12)		4.1		4.1	4.1	17	1.8	5
ERLW1.	E6.1(A)			15.8		15.0	.6	3	.3	0
ERLW3.	E6.1(C)			10.5		10.0	.4	2	.2	0
ERLW4.	F6.1(D)			10.5		10.0	.4	2	.2	0
EFIN	F19	(0)		3.7		3.7	3.7	17	1.8	4
ESWL	E19.1	(17)		100.0		100.0	3.7	17	1.8	5
EPOW	E18	(15)		3.2		3.2	3.2	13	1.3	4
EPEF	E10.9	(5)		1.3		1.3	.6	0	.6	4
EUND	E12	(0)		10.7		10.7	.2	1	.1	5
ERXY	E5.0	(1)		100.0		100.0	1.3	0	.6	4
ERXY1.	F5.1	(1)		06.7		06.7	.4	2	.2	5
ERXY11.	E5.1	(1)		33.3		33.3	.2	1	.1	0
EFPL	E13	(1)		50.0		50.0	.2	1	.1	4
EFER	E17	(0)		.2		.2	.2	1	.1	4
ETCP	E17.1	(1)		100.0		100.0	.2	1	.1	5
CONS	PART B	(6)	326					235	24.3	3
EXTW	B6/B7	(0)	150					136	14.1	4
EXSS	B6.5/6.6	(1)	121			90.7	37.1	116	12.0	5
EXSS1.	B6.5/6.6		105		80.8	70.0	32.2	101	13.4	6
EXSS5.	B6.5/6.6		9		7.4	6.0	2.8	9	.9	0
EXSS3.	B6.5/6.6		3		2.5	2.0	.9	3	.3	0
EXSS4.	B6.5/6.6		2		1.7	1.3	.6	2	.2	0
EXSS2.	B6.5/6.6		1		.8	.7	.3	1	.1	0
EXHL	B7.5	(1)	19		12.7	5.9	3.4	16	1.7	5
EXHL2.	B7.5.4		11		57.9	7.3	3.4	10	1.0	6
EXHL1.	B7.5		7		36.8	4.7	2.1	7	.7	6
EXCC	B6.6	(1)	9		6.0	6.0	2.8	9	.9	0
EXCC2.	B6.6		0		69.7	4.0	1.8	6	.6	6
EXCC1.	B6.6		1		11.1	.7	.3	1	.1	0

FOURTH THROUGH EIGHTH LEVEL SUMMATIONS:

ITEM	QTY	%6TH	%5TH	%4TH	%3RD	HOMES	%HOMES	LEVEL
EXCC3.	86.6							
EXCR	87.2							
FLOOR	86/87							
FDEF	86.10							
FDEF2.	86.10							
FLCC	86.9							
FLCC2.	86.9							
FLCC1.	86.9							
FLHL	87.5							
FLHL1.	87.5							
FLHL2.	86.5							
FASS	86.5							
FASS3.	86.5							
FLDN	86.5.1							
RODF	86/87							
RDEF	86.10							
RDEF3.	86.10							
RHS	87.5							
RHS2.	87.5.4							
RHS1.	87.5							
KFS	86.5							
PFSS1.	86.5							
PFSS2.	86.5							
PFSS6.	87.2							
RCNR	87.2							
RCNK2.	87.2							
RLCC	86.4							
RTRS	86.4							
RPF51.	86.4							
RRES	87.4							
INTW	86/87							
INSS	86.5/6.7							
INSS5.	86.5/6.7							
INSS2.	86.5/6.7							
INSS3.	86.5/6.7							
INCC	86.7							
INCC2.	86.7							
INFS	87.3							
WINW	86/87/88							
WINH	87.5.4							
WNCC	86.3							
WNL	86.3.1							
DEXT	86/87/88							
DEHL	87.5.4							
DEL	86.3							
DINT	86.3.2/3							

ITEM	QTY	%6TH	%5TH	%4TH	%3RD	HOMES	%HOMES	LEVEL
INTERIOR COVERING	1	11.1		.7	.3	1	.1	0
CONDENSATION RESISTANCE	1	.7			.3	1	.1	5
FLOOR SYSTEMS	80				24.5	71	7.3	4
DEFLECTION	21		26.2		6.4	21	2.2	5
FLOOR JOISTS	16		85.7		5.5	16	1.9	0
LOAD CARRYING CAPACITY	15		60.0	11.2	4.6	14	1.4	5
FLOOR JOISTS	9		26.7	5.0	1.2	9	.9	6
DECKING	4					4	.4	0
HEAT LOSS	12		66.7	10.0	2.5	10	1.0	5
INSULATION	8		33.3	5.0	1.2	8	.8	0
AIR INFILTRATION	4					4	.4	6
FASTENING OF STRUCTURAL SYSTEMS	4					4	.4	5
FASTENING OF EXTERIOR WALLS	4					4	.4	5
FLOOR SYSTEM TO EXTERIOR WALLS	4					4	.4	5
DRILLING/NOTCHING OF STRUCTURAL MEMBERS	2		100.0	5.0	1.2	4	.4	5
ROOF SYSTEM	2		2.5		.6	2	.2	5
DEFLECTION	51				15.0	42	4.3	4
CEILING	21		95.2	41.2	6.4	20	2.1	5
HEAT LOSS	20				6.1	19	2.0	6
AIR INFILTRATION	14			27.5	4.3	9	.9	5
INSULATION	8		57.1	15.7	2.5	8	.8	6
FASTENING OF STRUCTURAL SYSTEMS	6		42.9	11.8	1.3	6	.6	5
TRUSS CONSTRUCTION	2		23.8	3.9	.8	2	.2	6
TIP OUT MISALIGNMENT	2		28.6	3.9	.6	2	.2	6
TRUSS-TO-WALL CONSTRUCTION	2		28.0	3.9	.6	2	.2	6
CEILING VENTILATED	4			7.6	1.2	4	.4	5
CONDENSATION RESISTANCE	1		25.0	2.0	.3	1	.1	6
LOAD CARRY CAPACITY	3		5.9	5.9	.9	3	.3	5
ROOF TRUSS	2		66.7	3.9	.6	2	.2	0
TENSION MEMBER FAILURE	1		50.0	2.0	.3	1	.1	7
JOINT RESISTANCE	2		3.9	3.9	.6	2	.2	5
PARTITION WALLS	27				8.3	21	2.2	4
FASTENING OF STRUCTURAL SYSTEMS	16		55.3	4.9	1.3	13	1.3	5
PARTITION TO EXTERIOR WALL	5		37.5	22.2	1.8	5	.6	0
WALL TO ROOF SYSTEM	4		25.0	14.8	1.2	4	.4	0
WALL TO FLOOR SYSTEM	2		12.5	7.4	.6	2	.2	0
LOAD CARRYING CAPACITY	10		37.0	3.1	.7	7	.7	5
WALL FRAMING	8		80.0	29.6	2.5	5	.5	0
INTERIOR FLAME SPREAD - PANELING	1		3.7		.3	1	.1	5
HEAT LOSS - AIR INFILTRATION	5		71.4	1.5	.5	5	.5	4
LOAD CARRYING CAPACITY - RACKING	1		14.3	.3	.1	1	.1	5
GLAZING	1		14.3	.3	.1	1	.1	5
DOORS EXTERIOR	4				1.2	4	.4	4
HEAT LOSS - AIR INFILTRATION	3		75.0	.9	.3	3	.3	5
LOAD CARRYING CAPACITY - RACKING	1		25.0	.3	.1	1	.1	5
DOOR INTERIOR	1				.3	1	.1	4

 * NANS ROUTINE MAINTENANCE (2) 1490 *****

 NCON CONSTRUCTION (1) 1127 579 59.9

 NCWD WINDOWS (58) 452 40.1
 NCWS SCREENS 140 139 14.4
 NCWH HARDWARE 133 116 12.2

PRIVATE SAMPLE DATA

FOURTH THROUGH EIGHTH LEVEL SUMMATIONS:

	NO.	%7TH	%6TH	%5TH	%4TH	%3RD	HOMES	%HOMES	LEVEL
NCWF	IMPROPER FIT	95			21.0	8.4	94	7.7	3
NCWR	REGLAZED	17			3.8	1.5	17	1.8	3
NCWT	STORM	9			2.0	.8	5	.9	4
NCXD	EXTERIOR DOORS	(47)			36.5	25.4	242	25.0	5
NCXF	IMPROPER FIT	110			30.4	9.8	106	11.0	5
NCXH	HARDWARE	67			6.3	7.7	80	8.3	5
NCXS	SCREENS	18			3.5	1.0	17	1.8	5
NCST	STORM	10			3.1	.8	10	1.0	5
NCDD	CANOPY	9			1.7	.4	9	.9	5
NCRR	REGLAZED	5					5	.5	5
NCPD	PARTITIONS DOORS	(27)			52.0	22.2	197	20.4	4
NCPP	IMPROPER FIT	130			37.2	8.3	115	12.3	5
NCPH	HARDWARE	93			73.0	6.8	70	7.2	4
NCBL	BLOCKING	54			6.8	.4	52	5.4	5
NCBF	LEVELING	5					5	.5	5
NCBR	RACKING OF DOORS	5					5	.5	5
NCBH	HOT WATER HEATER COMPARTMENT	(0)			66.7	1.8	19	2.0	5
NCCH	COMPARTMENT DOOR	20			33.3	.9	10	1.0	5
NCJI	INSULATION	(1)			92.3	1.1	12	1.2	5
NCFL	FLOOR	13					9	.9	4
NCV	HEATING DUCT VENT	9					4	.4	4
NCM	SKIRTING	7					4	.4	4
NCFS	EXTERIOR STAIRS	5					5	.5	4
NCFD	TIE DOWN STRAPS LOOSE, ETC								
NPLM	PLUMBING	(34)	223				186	19.2	3
NPFX	FIXTURES	(0)	168			75.3	142	14.7	4
NPKS	KITCHEN SINK	(39)	61		36.3	27.4	55	5.7	5
NPKF	FLANGE SEAL	13		21.3	7.7	5.8	12	1.2	6
NPKA	FAUCET ASSEMBLY	9		14.8	5.4	4.0	9	.9	6
NPGB	BATHJOB WITH SHOWERHEAD	(38)	49		29.2	22.0	46	4.8	5
NPCK	CLOGGED DRAIN	6		12.2	3.6	2.7	6	.6	6
NPCA	FAUCET ASSEMBLY	5		10.2	3.0	2.2	4	.4	6
NPFT	TOILETS	(0)	34		20.2	15.2	30	3.1	5
NPXX	CLOGGED DRAIN	10		29.4	6.0	4.5	9	.9	6
NPTA	TOILET SEAT	10		29.4	6.0	4.5	9	.9	6
NPTT	FLUSH TANK	9		26.5	5.4	4.0	6	.8	6
NPTP	TANK TOP	5		14.7	3.0	2.2	5	.5	6
NPBS	LABORATORIES	(13)	24		14.3	10.8	23	2.4	5
NPBC	CLOGGED DRAIN	6		25.0	3.6	2.7	6	.6	6
NPBA	FAUCET ASSEMBLY	5		20.8	3.0	2.2	5	.5	5
NPBT	SEWER	8				3.6	8	.8	4
NPMW	WASHING MACHING	(5)	5		2.2	.5	5	.5	4
NPDW	DISH WASHER	(5)	5		2.2	.5	5	.5	4
NPWS	WATER SUPPLY PIPING	(1)	3		1.3	.3	3	.3	4
NPWF	EXTERIOR	(1)	2		66.7	.9	2	.2	5
NPWB	FROZEN	1		50.0	33.3	.4	1	.1	6
NELC	ELECTRICAL	(58)	131				112	11.6	3
NEDP	DISTRIBUTION PANEL BOARD	(6)	31			23.7	31	3.2	4
NECB	CIRCUIT BRKAKERS	(15)	10		74.2	17.6	23	2.4	5
NESW	SWITCHES	1		6.3		.8	15	1.6	4
NEFP	FACPLATE	(7)	15			11.5	1	.1	5
NERC	RECEPTICAL OUTLETS						13	1.3	4

FOURTH THROUGH EIGHTH LEVEL SUMMATIONS:

NERD	OUT DOOR	(0)	7	46.7	5.3	0	0.6	5
NELF	LIGHT FIXTURE		6	40.0	4.6	5	0.5	6
NFHT	HEAT TAPE		1	1.3	0.8	1	0.1	6
NERI	INTERIOR	(0)	1	0.7	0.8	1	0.1	5
NERF	FACEPLATE		1	100.0	0.8	1	0.1	6
NEIF	INTERIOR LIGHTING FIXTURES	(12)	12	0.7	9.2	12	1.2	4
NESR	SERVICE		1		0.8	1	0.1	4
NHTG	HEATING	(4)	7			7	0.7	3
NHGP	GAS SUPPLY PIPING		3	42.9		3	0.3	4

 * APEQ MECHANICAL/ELECTRICAL APPLIANCES -EQUIPMENT (11) 367 ***** 271 28.0 ***** 2 *

ARGE	RANGE - GAS/ELECTRIC	(0)	112			97	10.0	3
ARHW	HARDWARE		25		22.3	21	2.2	4
ARHO	OVEN DOORS	(5)	19	76.0	17.0	15	1.6	5
ARHK	KNOPS		1	4.0	0.9	1	0.1	5
ARRU	BURNER	(7)	9		6.0	9	0.9	4
ARKV	OVEN		1	11.1	0.9	1	0.1	5
ARBS	SURFACE		1	11.1	0.9	1	0.1	5
ARGL	GAS LEAK		9		8.0	8	0.8	4
ARPL	PILLOT	(3)	3		2.7	3	0.3	4
ARCL	CONTROLS	(0)	1	100.0	0.9	1	0.1	4
APTI	TIMER		1			1	0.1	3

AFHA	FURNACE HOT AIR GAS OR OIL	(38)	87			77	8.0	3
AFWT	WALL THERMOSTAT		18		20.7	18	1.9	4
AFDF	FURNACE DOORS	(16)	11		12.6	11	1.1	4
AFCL	CONTROLS	(0)	8		9.2	8	0.8	4
AFIw	INTERNAL WIRING		6	75.0	6.9	6	0.6	3
AFBU	BURNER	(0)	1	12.5	1.1	1	0.1	5
AFTC	THERMOCOUPLE		1	100.0	1.1	1	0.1	6
AFRW	BLOWER	(0)	1	12.5	1.1	1	0.1	5
AFLS	LIMIT SWITCH		1	100.0	1.1	1	0.1	6
AFBL	BLOWER ASSEMBLY	(3)	4		4.6	4	0.4	4
AFBD	BELT DRIVE	(2)	1	25.0	1.1	1	0.1	5
AFBM	BLOWER MOTOR	(0)	2		2.3	2	0.2	4
AFFG	FUEL GUN		2	100.0	2.3	2	0.2	5
AFGL	GAS LEAK		2		2.3	2	0.2	5
AFTR	FILTER		2		2.3	2	0.2	4
AFAB	BURNER ASSEMBLY		1		1.1	1	0.1	4
AFSC	FUEL SUPPLY CONNECTION		1		1.1	1	0.1	4
AFFX	EXHAUST FAN		72			71	7.3	3

AHWW	HOT WATER HEATERS	(14)	52			50	5.2	3
AHEL	ELECTRIC HOT WATER HEATER	(10)	36		69.2	35	3.6	4
AHTK	TANK	(0)	16	44.4	30.8	16	1.7	4
AHTE	LEAK		16	100.0	30.8	16	1.7	4

PRIVATE SAMPLE DATA

FOURTH THROUGH EIGHTH LEVEL SUMMATIONS:

		NU.	%7TH	%6TH	%5TH	%4TH	%3RD	H2MES	%H2MES	LEVEL
AHEK	PRESSURE RELIEF VALVE	0				10.7	11.5	6	.6	5
AHEH	HEAT ELEMENT	4				11.1	7.7	4	.4	5
AHGS	GAS HOT WATER HEATER	2	(0)			3.8	3.8	2	.2	4
AHPL	PILOT	1	(0)			50.0	1.9	1	.1	5
AHPR	RELIGHT PILOT	1			100.0	50.0	1.9	1	.1	6
AHBR	BURNER	1	(0)			50.0	1.9	1	.1	5
AHRL	LEAK	1			100.0	50.0	1.9	1	.1	6
ACRF	REFRIGERATOR	32	(28)					28	2.9	3
ACRR	REFRIGERANT SYSTEM	3	(3)				9.4	2	.2	4
ACRG	GASKETING (DOORS)	1					3.1	1	.1	4
AFEH	ELECTRIC BASEBOARD HEATING UNITS	1	(1)					1	.1	3

Appendix D

Problem Summation Tables - Field Sample

FIELD SAMPLE DATA

FIRST LEVEL SUMMATION:
TOTAL NUMBER OF PROBLEMS

NJ.
3523

SECOND AND THIRD LEVEL SUMMATIONS:

ANSI	ENFORCEMENT	(	)	NO.	%2ND	↓1ST	HOMES	*HOMES	LEVEL
		(	)	1075		30.5	228	58.7	2
PLUM	PART C PLUMBING	(	)	493	45.9	14.0	183	71.2	3
HEAT	PART D HEATING SYSTEM	(	)	324	30.1	9.2	152	59.1	3
ELEC.	PART E ELECTRICAL	(	)	189	17.6	5.4	114	44.4	3
CONS	PART B CONSTRUCTION	(	)	69	6.4	2.0	61	23.7	3
ANSI	ANSI A119.1	(	)	1045		29.0	236	91.8	2
CONS	PART B CONSTRUCTION	(	)	661	63.3	18.7	228	38.7	3
PLUM	PART C PLUMBING	(	)	208	19.9	5.9	108	42.0	3
ELEC	PART E ELECTRICAL	(	)	91	8.7	2.0	69	26.8	3
HEAT	PART D HEATING SYSTEM	(	)	85	8.1	2.4	70	29.6	3
NANS	ROUTINE MAINTENANCE	(	)	934		20.5	169	65.0	2
NCON	CONSTRUCTION	(	)	550	58.9	15.6	143	25.6	3
NPLM	PLUMBING	(	17)	216	23.1	6.1	94	36.6	3
NELC	ELECTRICAL	(	6)	124	13.3	3.5	74	28.8	3
NHTG	HEATING	(	4)	44	4.7	1.2	34	13.2	3
APEQ	MECHANICAL/ELECTRICAL APPLIANCES -EQUIPMENT	(	)	374		10.6	106	41.2	2
AFHA	FURNACE/HOT AIR,GAS OR OIL	(	39)	181	48.4	5.1	77	30.0	3
AHW	HOT WATER HEATERS	(	28)	82	21.9	2.3	52	20.2	3
ARGE	RANGE - GAS/ELECTRIC	(	11)	72	19.3	2.0	36	14.0	3
AEEF	EXHAUST FAN	(		25	6.7	.7	14	5.4	3
ACRE	REFRIGERATOR	(	9)	10	2.7	.3	9	3.5	3
ASDE	SMOKE DETECTOR	(		3	.8	.1	3	1.2	3
AFEB	ELECTRIC BASEBOARD HEATING UNITS	(	1)	1	.3	.0	1	.4	3
MISC	MISCELLANEOUS			100		2.8	53	20.6	2

FIELD SAMPLE DATA

FOURTH LEVEL SUMMATION:

 * ANSI ENFORCEMENT (J) 1075 30.5 228 88.7 2 *

PLUM	PART C	PLUMBING	NU.	%3RD	%2ND	%1ST	HUMLS	LEVEL
WDTN	(0)	218	44.2	20.3	0.2	156	60.7	4
DSYS	(0)	152	30.8	14.1	4.3	84	32.7	4
JCT1	(105)	105	21.3	9.8	3.0	58	22.6	4
VANV	(0)	7	1.4	.7	.2	0	2.3	4
PFIA	(0)	5	1.0	.5	.1	4	1.6	4
PFAP	(0)	3	.6	.3	.1	3	1.2	4
PHAS	(2)	2	.4	.2	.1	2	.8	4
TANC	(0)	1	.2	.1	.0	1	.4	4
HEAT	(0)	324	30.1	9.2	152	59.1	3	

HAPL	(0)	174	53.7	15.2	4.9	125	48.6	4
HPSY	(0)	149	46.0	13.9	4.2	57	37.7	4
HLPG	(0)	1	.3	.1	.0	1	.4	4

ELFC	PART E	ELECTRICAL	NU.	%3RD	%2ND	%1ST	HUMLS	LEVEL
FWRK	(21)	88	46.6	8.2	2.5	64	24.9	4
FRFC	(0)	36	19.0	3.3	1.0	28	10.9	4
FRXY	(0)	19	10.1	1.8	.5	19	7.4	4
EXUR	(14)	15	7.9	1.4	.4	12	4.7	4
EBFA	(5)	12	6.3	1.1	.3	12	4.7	4
EGDR	(0)	5	2.6	.5	.1	5	1.9	4
EDIS	(0)	4	2.1	.4	.1	4	1.6	4
EPOM	(0)	4	2.1	.4	.1	4	1.6	4
ESWL	(3)	3	1.6	.3	.1	2	.8	4
EFRO	(0)	3	1.6	.3	.1	3	1.2	4
CONS	(0)	69	6.4	2.0	61	23.7	3	

FXTW	(0)	48	69.6	4.5	1.4	47	18.3	4
ROOF	(0)	14	20.3	1.3	.4	11	4.3	4
FLOOR	(0)	2	2.9	.2	.1	2	.8	4
INTW	(0)	2	2.9	.2	.1	2	.8	4
TIDN	(0)	2	2.9	.2	.1	2	.8	4
DFXT	(0)	1	1.4	.1	.0	1	.4	4

 * ANSI ALL9.1 (0) 1045 29.6 236 91.8 2 *

CONS	PART B	CONSTRUCTION	NU.	%3RD	%2ND	%1ST	HUMLS	LEVEL
FXTW	(0)	189	28.0	18.1	5.4	144	56.0	4
ROOF	(0)	170	25.7	16.3	4.8	107	41.6	4
INTW	(0)	118	17.9	11.3	3.3	98	38.1	4
TRAN	(0)	63	12.6	7.9	2.4	53	20.6	4
FLOOR	(0)	73	11.0	7.0	2.1	59	23.0	4
DFXT	(0)	15	2.3	1.4	.4	15	5.8	4

FIELD SAMPLE DATA

FOURTH LEVEL SUMMATION:

	NO.	#3RD	#2ND	#1ST	HOMES	#HOMES	LEVEL
WINDW	(0)	12	1.8	1.1	.3	10	3.9
WINDW	(0)	1	.2	.1	.0	1	.4
PLUMB	(0)	208	19.5	2.7		108	42.0
PFIA	(0)	138	66.3	13.2	3.9	72	28.0
PREO	(0)	50	24.0	4.8	1.4	45	17.5
VANV	(0)	20	9.6	1.9	.6	19	7.4
ELEC	(0)	51	8.7	2.6		65	26.8
EWOR	(0)	91	100.0	8.7	2.6	69	26.8
HEAT	(0)	85	8.1	2.4		76	29.6
HPSY	(0)	61	11.8	5.0	1.7	60	23.3
HAPL	(0)	24	28.2	2.3	.7	22	8.6

* NANS							
ROUTINE MAINTENANCE							
(0)	534			26.0		165	65.8

NCON	(0)	550	58.9	15.0		143	55.6

NXCD	(4)	244	44.4	20.1	6.9	97	37.7
NXWD	(23)	122	22.2	13.1	3.5	66	25.7
NXES	(15)	41	7.5	4.4	1.2	25	9.7
NXPD	(15)	40	7.3	4.3	1.1	27	10.5
NXSM	(0)	32	5.8	3.4	.9	21	8.2
NXHH	(9)	27	4.9	2.9	.8	20	10.1
NXRL	(1)	20	3.6	2.1	.6	15	5.6
NXFL	(1)	13	2.4	1.4	.4	9	3.5
NXMG	(1)	7	1.3	.7	.2	7	2.7
NXCTD	(4)	4	.7	.4	.1	4	1.6

NPLM	(17)	216	23.1	9.1		94	30.0

NPWS	(15)	79	36.6	8.5	2.2	53	20.6
NPFX	(0)	65	31.9	7.4	2.0	42	16.3
NPRT	(0)	39	18.1	4.2	1.1	26	10.1
NPFR	(0)	12	5.0	1.3	.3	9	3.5

NELC	(6)	124	13.3	3.5		74	26.0

NEDP	(10)	55	44.4	5.9	1.6	40	15.6
NERC	(1)	33	26.6	3.5	.9	26	10.1
NEPP	(6)	18	14.5	1.9	.5	17	6.6
NESW	(6)	7	5.6	.7	.2	6	2.3
NEEF	(1)	3	2.4	.3	.1	3	1.2
NEIF	(1)	1	.8	.1	.0	1	.4
NESP	(1)	1	.8	.1	.0	1	.4

NHTG	(4)	44	4.7	1.2		34	13.2

NHGP	(23)	52.3	2.5	.7		20	7.0
NHSP	(10)	22.7	1.1	.3		8	3.1

FIELD SAMPLE DATA

FOURTH LEVEL SUMMARY:

NHQP		(	7)	7	15.9	.7	.2	HUMES	2HUMLS	LEVEL
	OIL SUPPLY PIPING							6	2.3	4
***** MECHANICAL/ELECTRICAL APPLIANCES - EQUIPMENT *****										
* APEQ		(	0)	374			10.6	106	41.2	2 *
***** MECHANICAL/ELECTRICAL APPLIANCES - EQUIPMENT *****										
AFHA	FURNACE HOT AIR GAS OR OIL	(	39)	181	48.4	5.1	5.1	77	30.0	3
AFPL	PILOT/ELECTRONIC IGNITION	(	3)	40	22.1	10.7	1.1	32	12.5	4
AFGL	CONTROLS	(	0)	35	19.3	9.4	1.0	21	8.2	4
AFFG	FUEL GUN	(	0)	32	17.7	8.6	.9	20	7.8	4
AFWT	WALL THERMOSTAT	(	17)	21	11.6	5.6	.6	18	7.0	4
AFRM	BLOWER MOTOR	(	2)	4	2.2	1.1	.1	2	.8	4
AFTR	FILTER			3	1.7	.8	.1	3	1.2	4
AFAB	BURNER ASSEMBLY			2	1.1	.5	.1	2	.8	4
AFBI	BLOWER ASSEMBLY	(	2)	2	1.1	.5	.1	2	.8	4
AFDR	FURNACE DOORS			1	.6	.3	.0	1	.4	4
AFGR	GAS REGULATOR			1	.6	.3	.0	1	.4	4
AFSC	FUEL SUPPLY CONNECTION			1	.6	.3	.0	1	.4	4
AHWW	HOT WATER HEATERS	(	28)	82	21.9	2.3	2.3	52	20.2	3
AHEL	ELECTRIC HOT WATER HEATER	(	17)	43	52.4	11.5	1.2	29	11.3	4
AHGS	GAS HOT WATER HEATER	(	2)	11	13.4	2.9	.3	9	3.5	4
ARGE	RANGE - GAS/ELECTRIC	(	11)	72	19.3	2.0	2.0	36	14.0	3
ARPL	PILOT	(	3)	18	25.0	4.8	.5	16	6.2	4
ARGL	GAS LFAK			17	23.6	4.5	.5	14	5.4	4
ARCL	CONTROLS	(	2)	11	15.3	2.9	.3	10	3.9	4
ARBU	BURNER	(	0)	6	8.3	1.6	.2	5	1.9	4
APTW	INTERNAL WIRING			6	8.3	1.6	.2	2	.8	4
ARHW	HARDWARE	(	0)	3	4.2	.8	.1	3	1.2	4
AFEX	EXHAUST FAN			25	6.7	.7	.7	14	5.4	3
ACRF	REFRIGRATOR	(	9)	10	2.7	.3	.3	9	3.5	3
ACFL	CONTROLS	(	0)	1	10.0	.3	.0	1	.4	4
ASDE	SMOKE DETECTOR			3	.8	.1	.1	3	1.2	3
AFEB	ELECTRIC BASEBOARD HEATING UNITS	(	1)	1	.3	.0	.0	1	.4	3

FIELD SAMPLE DATA

FOURTH THROUGH EIGHTH LEVEL SUMMATIONS:

***** ENFORCEMENT *****
 * ANS I (U) 1075 *****

PLUM	PART C	PLUMBING	NO.	7TH	8TH	9TH	HOMES	HOMES	LEVEL
WDTN	C11	WATER DISTRIBUTION SYSTEM	(J)	218	44.2	183	71.2	3	
WOSC	C11.2	WATER OUTLETS AND SUPPLY CONNECTIONS	(J)	145	29.4	156	60.7	4	
WOSCI	C11.2.1	WATER CONNECTION PIPE SIZE, LOCATION	(J)	144	66.5	134	52.1	5	
WOSC6	C11.2.6	FLUSH TANK			92.4	133	51.8	6	
WOSC4	C11.2.4	APPLIANCE CONNECTIONS/PROTECT BY AIR GAP			6.9	10	3.9	7	
WMSD	C11.3	WATER HEATER SAFETY DEVICES	(J)	50	.7	45	17.5	8	
WHPV	C11.3.1	RELIEF VALVES	(J)	50	100.0	45	17.5	9	
WHRV3	C11.3.1.3	RELIEF VALVE DRAIN	(J)	44	22.9	40	15.6	10	
WHRV33		TERMINATES ABOVE FLOOR			86.0	19	7.4	11	
WHRV37		THREADED END			38.0	19	7.4	12	
WHRV31		IMPROPER LOCATION			27.3	12	4.7	13	
WHRV34		UNDERSIZE PIPE			11.4	5	1.9	14	
WHRV35		TERMINATES ABOVE FLOOR			10.0	5	1.9	15	
WHRV1	C11.3.1.1	TEMPERATURE AND PRESSURE RELIEF VALVES	(J)	3	6.0	3	1.2	16	
WHRV2	C11.3.1.2	PRESSURE AND TEMPERATURE LIMITS OF VAL	(J)	3	6.0	3	1.2	17	
WDM1	C11.4	MATERIALS	(J)	23	10.6	22	8.6	18	
WDM2		CORROSION OF PIPE			59.6	16	6.2	19	
WDM1.1		CORROSION OF DISSIMILAR METALS			30.4	7	2.7	20	
DSYS	C12	DRAINAGE SYSTEM	(J)	152	30.8	84	52.7	21	
DOUT	C12.2	DRAIN OUTLETS	(J)	149	30.2	92	31.9	22	
DOUT3	C12.2.3	HOSE COUPLERS AND CAPS	(J)	146	98.0	82	31.9	23	
DOUT32	C12.2.3.2	SIZE COMPARED TO PIPING, WATER-TIGHT C	(74)	73	99.3	82	31.9	24	
DOUT33	C12.2.3.3	MINIMUM DIAMETER - DRAIN CONNECTION			49.3	73	26.4	25	
DOUT2	C12.2.2	CLEARANCE FROM DRAIN OUTLET			.7	1	.4	26	
DSML	C12.1	MATERIALS	(J)	1	.7	1	.4	27	
DSML2	C12.1.2	FITTINGS	(J)	2	.4	2	.8	28	
DSML22	C12.1.2.2	FITTINGS FOR COPPER TUBING MATERIALS	(J)	2	1.3	2	.8	29	
DSML23	C12.1.2.3	FITTINGS FOR PLASTIC PIPE	(J)	1	.7	1	.4	30	
DSGR	C12.7	GRADE OF HORIZONTAL DRAINAGE PIPING	(J)	1	50.0	1	.4	31	
JCT1	C7.1	JOINTS + CONNECTIONS/TIGHT IGAS, WATER	(105)	105	50.0	1	.4	32	
VAV1	C13	VENTS AND VENTING	(J)	7	21.3	58	22.6	33	
VVTL	C13.5	VENT TERMINAL	(J)	6	1.4	6	2.3	34	
VVTL1	C13.5.1	ROOF EXTENSION	(J)	6	1.2	5	1.9	35	
VVTL2	C13.5.2	FLASHING	(J)	2	65.7	2	.6	36	
VMAT	C13.2	MATERIALS	(J)	1	33.3	4	1.6	37	
VMAT2	C13.2.2	FITTINGS	(J)	1	16.7	1	.4	38	
VMAT23	C13.2.2.3	FITTINGS FOR PLASTIC PIPE	(J)	1	14.3	1	.4	39	
PFIX	C9	PLUMBING FIXTURES	(J)	5	100.0	1	.4	40	
PFIX	C9.2	FIXTURES	(J)	5	1.0	4	1.6	41	
WACD	C9.2.4	CLOTHES WASHING MACHINE	(J)	5	100.0	4	1.6	42	
WACD2	C9.2.4.2	STANDPIPE SPECIFICATIONS	(J)	5	1.0	4	1.6	43	
PFAP	C5.1.4	PROHIBITED FITTINGS AND PRACTICES	(J)	3	100.0	3	1.2	44	
PFAP5	C5.1.4.5	IMPROPER LOCATION OF PIPE, FIXTURE/EQUIP	(J)	3	.6	3	1.2	45	
PHAS	C10	HANGERS AND SUPPORTS	(J)	2	100.0	2	.8	46	
TANC	C8	TRAPS AND CLEANOUTS	(J)	1	.4	1	.4	47	
TRAP	C8.1	TRAPS	(J)	1	100.0	1	.4	48	
TRAP2	C8.1.2	DUAL FIXTURES	(J)	1	100.0	1	.4	49	

FIELD SAMPLE DATA

FOURTH THROUGH EIGHTH LEVEL SUMMATIONS:

HEAT PART D HEATING SYSTEM () () 324

NU. %5TH %4TH %3RD HOMES %HOMES LEVEL

HEAT	PART D	HEATING SYSTEM	(	)	324	NU.	%5TH	%4TH	%3RD	HOMES	%HOMES	LEVEL
HAPL	D6	APPLIANCES	(	)	174				53.7	152	59.1	3
HACA	D6.10	CIRCULATING AIR SYSTEM	(	)	58			33.3	17.9	125	48.6	4
HARG	D6.10.5	REGISTERS	(	)	55			31.6	17.0	51	19.8	5
HARG6.	D6.10.5	DUCT TUBE RISER	(	)	19		94.8	10.9	5.9	50	19.5	6
HARG5.	D6.10.5	AIR BLOCKAGE	(	)	11		34.5	6.3	3.4	19	7.4	7
HARG3.	D6.10.5	RISE MISSING OR DAMAGED	(	)	6		20.0	3.4	1.9	11	4.3	7
HARG4.	D6.10.5	DIRT FLOOR COVERING AND DUCT	(	)	6		10.9	3.4	1.9	6	2.3	7
HARG2.	D6.10.5.2	STRUCTURAL REQUIREMENTS	(	)	2		10.9	3.4	1.9	6	2.3	7
HACS	D6.10.1	SUPPLY SYSTEM	(	)	2		3.6	1.1	.6	2	.8	7
HACS3.	D6.10.1.3	AIR TIGHTNESS OF SUPPLY DUCT SYSTEM	(	)	2		3.4	1.1	.6	2	.8	7
HARA	D6.10.2	RETURN AIR SYSTEM	(	)	1		50.0	1.7	.6	1	.4	7
HARAL.	D6.10.2.1	RETURN AIR OPENINGS	(	)	1		100.0	1.7	.6	1	.4	7
HAAC	D6.7	ACCESSIBILITY - INSPECTION, SERVICE, F	(	)	50			28.7	15.4	50	19.5	5
HAAC2.	D6.7	HOT WATER HEATER-PIJK ACCESS	(	)	49		98.0	28.2	15.1	49	19.1	6
HAAC1.	D6.7	FURNACE-PIJK ACCESS	(	)	1		2.0	.6	.3	1	.4	6
HAVA	D6.4	VENTING, VENTILATION AND COMBUSTION	(	)	33		19.0	10.2	3.3	33	12.8	5
HAVE	D6.4.1	VENTING SYSTEM	(	)	32		97.0	16.4	9.9	32	12.5	6
HAVE3.	D6.4.1	JOINTS OF VENT SYSTEM SECURE	(	)	27		84.4	15.5	8.3	27	10.5	7
HAVE31.	D6.4.1	FURNACE	(	)	25		92.6	14.4	7.7	25	9.7	8
HAVE32.	D6.4.2	HOT WATER HEATER	(	)	1		3.1	.6	.3	1	.4	8
HAVE4.	D6.4.1	VENTING SHALL NOT TERMINATE UNDER	(	)	2		6.3	1.1	.6	2	.8	7
HAVE1.	D6.4.1	SYSTEM LISTED AS PART OF APPLIANCE	(	)	1		3.1	.6	.3	1	.4	7
HAVE5.	D6.4.3	VENTING SYSTEM TERMINATION	(	)	1		3.1	.6	.3	1	.4	7
HANK	D6.6	MARKING	(	)	32			18.4	9.9	28	10.9	5
HAFU1.	D6.6.2	FURNACE	(	)	16		50.0	9.2	4.9	16	6.2	6
HANK1.	D6.6.1	FURNACE CLEARANCES AND OPERATIONS	(	)	13		40.6	7.5	4.0	13	5.1	6
HAFU2.	D6.6.2	HOT WATER HEATER	(	)	2		6.3	1.1	.6	2	.8	6
HANK2.	D6.6.1	HOT WATER HEATER CLEARANCES AND OPERATIO	(	)	1		3.1	.6	.3	1	.4	6
HAIC	D6.3	INSTALLATION OF APPLIANCES	(	)	1			.6	.3	1	.4	5
HAMS	D6.3.2	SEPARATION OF COMBUSTION SYSTEM	(	)	1		100.0	.6	.3	1	.4	5
HPSY	D5	PIPING SYSTEM	(	)	149				46.0	97	37.7	4
HGPS	D5.1	GAS PIPING SYSTEMS	(	)	149			100.0	46.0	97	37.7	5
HGLS	D5.1.10	LOCATION OF GAS SUPPLY CONNECTION	(	)	61		40.9	40.9	18.8	61	23.7	7
HGLS1.	D5.1.10.1	LP-GAS SYSTEMS	(	)	61		100.0	40.9	18.8	61	23.7	7
HGID	D5.1.11	IDENTIFICATION OF GAS SUPPLY CONNECTION	(	)	46			30.9	30.9	46	17.9	6
HGHS	D5.1.18	HANGERS AND SUPPORTS	(	)	27		18.1	18.1	8.3	27	10.5	6
HGAC	D5.1.13	APPLIANCE CONNECTION	(	)	11		7.4	7.4	3.4	11	4.3	6
HGAC2.	D5.1.2	FLEXIBLE CONNECTOR THRU UNDERSIDE OF U	(	)	7		63.6	4.7	2.2	7	2.7	7
HGAC1.	D5.1.2	FLEXIBLE CONNECTOR/SHARP RADIUS BEND	(	)	4		36.4	2.7	1.2	4	1.6	7
HGPM	D5.1.2	MATERIALS - USED/REPAIRED DEFECTS	(	)	3		2.0	2.0	.9	3	1.2	6
HGPM5.	D5.1.2.2	CORROSION OF METALS	(	)	2		66.7	1.3	.6	2	.8	7
HGPM2.	D5.1.2.3	FITTINGS FOR GAS PIPING	(	)	1		33.3	.7	.3	1	.4	7
HGPD	D4.2.5	PIPING DESIGN - LP GAS/NATURAL GAS	(	)	1		.7	.7	.3	1	.4	6
HLPG	D4.2.5	LP GAS SAFETY DEVICES	(	)	1		.3	.3	.3	1	.4	4
ELEC	PART F	ELECTRICAL	(	)	169					114	44.4	3
EWOR	E11	WIRING METHODS	(	)	68				40.6	64	24.5	4
EWPS	E11.7	PASSING OF CABLE THROUGH STUDS	(	)	25		28.4	13.2	6.5	25	9.7	5
EWSP	E11.9	CABLE SUPPORT	(	)	16		18.2	8.5	5.8	15	5.8	5
EWLF	E11.6	LOOSE CONNECTIONS	(	)	15		17.0	7.9	5.8	15	5.8	5
EWCS	E11.6	CONTINUITY OF CABLE SHEATH	(	)	5		5.7	2.6	1.9	5	1.9	5
EWPR	E11.12	CABLE PROTECTION	(	)	4		4.5	2.1	1.6	4	1.6	5

FIELD SAMPLE DATA

FOURTH THROUGH EIGHTH LEVEL SUMMATIONS:

	NO.	%TH	%6TH	%5TH	%4TH	%3FD	%HOMES	%HOMES	LEVEL
EWC	E11.1	TUBING, CONDUIT, CABLE TERMINATION			1.1	.5	1	.4	5
EWSN	E11.10	CABLE SUPPORT - NON-METALLIC OUTLET			1.1	.5	1	.4	5
EREC	E6	RECEPTACLE OUTLETS REQUIRED	(0)			19.0	28	10.9	4
ERLW	E6.1	LOCATION ON WALLS	(17)			19.0	28	10.9	3
ERLW1.	E6.1(A)	COUNTER TOPS IN KITCHENS			25.0	4.8	9	3.5	6
ERLW2.	E6.1(B)	ADJACENT TO APPLIANCES			11.1	2.1	4	1.6	6
ERLW3.	E6.1(C)	COUNTER TOP SPACES FOR BUILT-IN			8.3	1.6	3	1.2	6
ERLW4.	E6.1(D)	COUNTER TOP SPACES UNDER WALL-CABINETS			8.3	1.6	3	1.2	6
ERXY	E5.0	MATERIALS AND EQUIPMENT	(0)			10.1	19	7.4	4
ERXY1.	E5.1	LISTED AND APPROVED	(1)			10.1	19	7.4	5
ERXY11.	E5.1	ALUMINUM/COPPER DEVICES	(18)		94.7	94.7	18	7.0	6
EXUR	E20	LIGHTING FIXTURES	(14)			7.9	12	4.7	4
EXGE	E20.1	GENERAL	(0)			.5	1	.4	5
EXGE1.	E20.1.1	COMBUSTIBLE WALL OR CEILING FINISH	(1)			6.7	1	.4	6
EBFA	E22	OUTDOOR OUTLETS, FIXTURES, AIR-COULING	(5)			6.3	12	4.7	4
ERTF	E22.1	TYPE OF OUTDOOR FIXTURES AND EQUIPMENT	(7)		58.3	3.7	7	2.7	5
EGDB	E23	GROUNDING AND BONDING	(0)			2.6	5	1.9	4
EGSE	E23.1	SERVICE GROUNDING	(2)			1.1	2	.8	5
EIGD	E23.3	INTERIOR GROUNDING - ELECTRICAL	(0)			1.1	2	.8	5
EIGD2.	E23.3.2	GROUNDING OF ELECTRICAL EQUIPMENT	(0)			1.1	2	.8	5
EIGD25.	E23.3.2.5	GROUNDING AT LIGHT FIXTURE	(2)		100.0	1.1	2	.8	7
EIBN	E23.4	BONDING OF NONCURRENT - CARRYING MET	(0)			.5	1	.4	5
EIBN1.	E23.4.1	EXPOSED NONCURRENT - CARRYING METAL	(1)			20.0	1	.4	6
EDIS	E9	DISCONNECTING MEANS AND BRANCH CIRCUIT	(0)			2.1	4	1.6	4
EDLF	E9.2	LOCATION ABOVE FLOOR	(0)			2.1	4	1.6	5
EPOW	E10	POWER SUPPLY	(0)			2.1	4	1.6	4
EPEF	E10.9	ENTRANCE OF FEEDER ASSEMBLY TO HOME	(4)			2.1	4	1.6	4
FSWL	E18	WALL SWITCHES	(3)			1.6	2	.8	4
EFRO	E19	RECEPTACLE OUTLETS	(0)			1.6	3	1.2	4
EFIN	E19.1	INSTALLATION IN ACCORDANCE	(3)			1.6	3	1.2	5
CONS	PART B	CONSTRUCTION	(0)			23.7	61	23.7	3
EXTW	B6/87	EXTERIOR WALLS	(0)			69.6	47	18.3	4
EXSS	B6.5/6.6	FASTENING OF STRUCTURAL SYSTEMS	(0)			93.8	44	17.1	5
EXSS1.	B6.5/6.6	EXTERIOR COVERING TO WALL FRAMING	(45)		100.0	65.2	44	17.1	6
EXCC	B6.6	LOAD CARRYING CAPACITY	(1)			2.1	1	.4	5
FXHL	B7.5	HEAT LOSS	(0)			2.1	1	.4	5
EXHL1.	B7.5	INSULATION RESISTANCE	(1)			2.1	1	.4	6
EXCR	B7.2	CONDENSATION RESISTANCE	(1)			2.1	1	.4	5
ROOF	B6/87	ROOF SYSTEM	(0)			20.3	11	4.3	4
RDEF	B6.10	DEFLECTION	(0)			10.1	7	2.7	5
RDEF3.	B6.10	CEILING	(7)		50.0	10.1	7	2.7	6
RLCC	B6.4	LOAD CARRY CAPACITY	(0)			4.3	2	.8	5
RTRS	B6.4	ROOF TRUSS	(1)			21.4	2	.8	5
RTPS1.	B6.4	TENSION MEMBER FAILURE	(1)			21.4	2	.8	7
RHLS	B7.5	HFAT LOSS	(2)		60.7	2.9	2	.8	5
RHLS1.	B7.5	INSULATION	(0)			4.3	3	1.2	5
RREC	B7.6	METALLIC ROOF BUNDLING/EXTERIOR COVERINGS	(3)			4.3	3	1.2	6
FLOB	B6/87	FLOOR SYSTEMS	(1)			7.1	1	.4	5
FLCC	B6.9	LOAD CARRYING CAPACITY	(0)			2.9	2	.8	4
FLCC1.	B6.9	DECKING	(0)			50.0	1	.4	5
FLDN	B6.9.1	DRILLING/CUTTING OF STRUCTURAL MEMBERS	(1)			50.0	1	.4	5
INTW	B6/87	PARTITION WALLS	(0)			2.9	2	.8	4
INSS	B6.5/6.7	FASTENING OF STRUCTURAL SYSTEMS	(0)			100.0	2	.8	5
INSS2.	B6.5/6.7	WALL TO ROOF SYSTEM	(1)			50.0	1	.4	6

FOURTH THROUGH EIGHTH LEVEL SUMMATIONS:

	NO.	%7TH	%6TH	%5TH	%4TH	%3RD	HUMES	%HUMES	LEVEL
INSS4-	1	50.0	50.0	50.0	50.0	1.4	1	.4	6
TIDN	2				2.9		2	.8	4
TIDN1-	2	100.0	100.0	100.0	2.9		2	.8	5
DEXT	1				1.4		1	.4	4
DELC	1	100.0	100.0	100.0	1.4		1	.4	5

 * ANSI
 * ANSI ALL9.1

CONS	PART B	CONSTRUCTION	(	)	601	228	88.7	3	
EXTW	B6/B7	EXTERIOR WALLS	(	0)	189	26.6	144	56.0	4
EXDR	B7.1	DURABILITY	(	0)	132	69.8	127	49.4	5
EXDR4-	B7.1	EXTERIOR FASTENERS	(	0)	128	97.0	126	49.0	6
EXDR2-	B7.1	INTERIOR COVERING	(	3		2.3	2	.8	6
EXDR1-	B7.1	EXTERIOR COVERING	(	1		.8	1	.4	6
EXWR	B7.1	WEATHER RESISTANCE - RAIN LEAKS	(	5)		30.2	37	14.4	5
EXWR2-	B7.1	WINDOWS	(	28		14.8	21	8.2	6
EXWR3-	B7.1	DOORS	(	16		8.5	15	5.8	6
EXWR1-	B7.1	PENETRATION OF EXTERIOR COVERING	(	8		4.2	7	2.7	6
ROOF	B6/B7	ROOF SYSTEM	(	0)	170	25.7	107	41.6	4
RLWR	B7.1	RAIN LEAK - WATER RESISTANCE MEM. PENE	(	144)	162	95.3	103	40.1	5
RIEW	B7.1	INTERSECTION OF ROOF AND EXTERIOR WALL	(	1)	11	6.5	11	4.3	6
RLMP	B7.1	MEMBRANE PENETRATION	(	7		4.1	7	2.7	6
RLMP1-	B7.1	AT MEMBRANE JOINT (WITHIN FIELD OF R	(	28.6		1.2	2	.8	7
RLMP2-	B7.1	AT VENT PIPE (PLUMBING)	(	28.6		1.2	2	.8	7
RLMP3-	B7.1	AT VENT PIPE (HEATING)	(	28.6		1.2	2	.8	7
RLCC	B6.4	LOAD CARRY CAPACITY	(	0)	5	2.9	5	1.9	5
RTRS	B6.4	ROOF TRUSS	(	0)	4	80.0	4	1.6	6
RTRS4-	B6.4	ROOF TRUSS CUT FOR ROOF JACK	(	0)	4	80.0	4	1.6	7
RDEL	B6.4	DECKING	(	1		2.4	1	.4	6
RDURL-	B6.4	DURABILITY	(	0)	2	1.2	2	.8	5
RDEF	B6.10	MEMBRANE	(	0)	2	3	2	.8	6
RDEF1-	B6.10	DEFLECTION	(	0)	1	1.2	1	.4	5
INTW	B6/B7	DECKING	(	0)	1	.6	1	.4	6
INSS	B6/5/6.7	PARTITION WALLS	(	0)	118	100.0	98	38.1	4
INSS1-	B6-5/6.7	FASTENING OF STRUCTURAL SYSTEMS	(	0)	118	100.0	98	38.1	5
TRAN	B-APP.	PANELING TO WALL FRAMING	(	0)	118	100.0	98	38.1	6
TRAN1-	B.1	TRANSIT CONSIDERATIONS	(	0)	83	12.6	53	20.6	4
TRAN12-	B.1	A FRAME ASSEMBLY	(	1+)	57	68.7	47	18.3	5
TRAN13-	B.1	LONGITUDINAL MEMBERS	(	34		8.6	34	13.2	6
TRANB-	B.8	TRANSVERSE MEMBERS	(	9		5.1	9	3.5	6
TRAN5-	B.5	TIRES	(	7		1.4	8	3.1	5
TRAN4-	B.4	AXLES	(	4		1.4	6	2.3	5
TRAN7-	B.7	SPRING/SPRING HANGERS	(	4		1.1	3	1.2	5
TRAN2-	B.2	WHEELS/SPRINGS	(	4		.6	3	1.2	5
TRAN9-	B.9	COUPLING MECHANISM	(	1		4.8	3	1.2	5
FLOR	B6/B7	BRAKES	(	1)	1	1.2	1	.4	5
FLWR	B7.1	FLOOR SYSTEMS	(	0)	73	11.0	59	23.0	4
FLWR1-	B7.1	WEATHER RESISTANCE	(	0)	38	52.1	36	14.0	5
FLWR1-	B7.1	UNDERNEATH OF FLOOR SYSTEM	(	0)	38	52.1	36	14.0	6
FLWR1-	B7.1	DURABILITY	(	0)	27	37.0	19	7.4	5
FLWR1-	B7.1	FLOOR COVERING	(	0)	14	51.9	9	3.5	6
FLWR2-	B7.1	FLOOR COVERING TO DECKING	(	0)	9	33.3	9	3.5	6
FLWR3-	B7.1	DECKING	(	0)	4	14.8	3	1.2	6

FIELD SAMPLE DATA

FOURTH THROUGH EIGHTH LEVEL SUMMATIONS:

	NO.	%7TH	%5TH	%4TH	%3RD	HOMES	%HOMES	LEVEL
FLIF	87.3	(0)	0.0	0.0	0.0	5	1.0	5
FLIF1.	87.3	(0)	100.0	0.0	0.0	5	1.0	0
FDEF	86.10	(0)	100.0	1.4	0.2	1	0.4	5
FDEF1.	86.10	(0)	100.0	1.4	0.2	1	0.4	6
FASS	86.5	(0)	100.0	1.4	0.2	1	0.4	5
FASS2.	86.5	(0)	100.0	1.4	0.2	1	0.4	0
FLR	87.4	(0)	100.0	1.4	0.2	1	0.4	5
DEXT	86/87/88	(0)	2.3	2.3	2.3	15	3.0	4
DEWR	87.1	(0)	3.3	3.3	1.2	8	3.1	5
DEDU	87.1	(0)	4.7	4.7	1.1	7	2.7	5
WINDW	86/87/88	(0)	1.8	1.8	1.8	10	3.9	4
WNR	87.1/88.5	(0)	100.0	1.8	1.8	10	3.9	4
TIDN	86.5.1	(0)	0.2	0.2	0.2	1	0.4	4
TIDN2.	86.5.1	(0)	0.2	0.2	0.2	1	0.4	5
PLUM	PART C PLUMBING	(0)	208	108	42.0	108	42.0	3
PFIA	C9 PLUMBING FIXTURES	(0)	138	72	28.0	72	28.0	4
PFI1.	C9.2 TOILETS	(0)	81	55	21.4	55	21.4	5
PFI2.	C9.2.1 TOILETS	(18)	65	46	17.9	46	17.9	0
TOIL5.	C9.2.1.5 FLOOR CONNECTION	(0)	26	24	9.3	24	9.3	7
TOIL2.	C9.2.1.2 TOILET FLUSHING DEVICES	(0)	21	14	5.4	14	5.4	6
SHRS	C9.2.2 SHOWER STALLS	(0)	16	15	5.8	15	5.8	7
SHRS2.	C9.2.2.2 WATER TIGHTNESS OF JOINT AT UR/AIN	(0)	10	9	3.5	9	3.5	7
SHRS3.	C9.2.2.3 WATER TIGHTNESS OF SHOWFR/ENCL	(0)	6	6	2.3	6	2.3	7
PFGR	C9.1 GENERAL REQUIREMENT	(0)	57	35	13.6	35	13.6	5
PFGR1.	C9.1.1 QUALITY OF FIXTURES	(0)	50	35	13.6	35	13.6	6
PFGR2.	C9.1.1 PROTECTIVE REQUIREMENT	(0)	50	45	17.5	45	17.5	4
PRE05.	C5.2.5 RODENT RESISTANCE	(0)	34	34	13.2	34	13.2	5
PRE04.	C5.2.4 FREEZING	(0)	15	15	5.8	15	5.8	5
VANV	C13 VENTS AND VENTING	(0)	20	19	7.4	19	7.4	4
VVTL	C13.5 VENT TERMINAL	(0)	20	19	7.4	19	7.4	5
VVTL3.	C13.5.3 VENT CAPS	(0)	20	19	7.4	19	7.4	6
ELEC	PART E ELECTRICAL	(0)	91	69	26.8	69	26.8	3
EMFB	E11 WIRING METHODS	(0)	91	69	26.8	69	26.8	4
EMFB	F11.5 FASTENING BOXES, FITTINGS, CABINETS	(0)	91	69	26.8	69	26.8	5
HEAT	PART D HEATING SYSTEM	(0)	85	76	29.6	76	29.6	3
HPSY	D5 PIPING SYSTEM	(0)	61	60	23.3	60	23.3	4
HGPS	D5.1 GAS PIPING SYSTEMS	(0)	61	60	23.3	60	23.3	5
HGPG	D5.1.1 GENERAL	(0)	61	60	23.3	60	23.3	6
HGPG1.	D5.1.1.1 RODENT RESISTANCE	(0)	61	60	23.3	60	23.3	7
HAPL	D6 APPLIANCES	(0)	24	22	8.6	22	8.6	4
HAPC	D6.3 INSTALLATION OF APPLIANCES	(0)	24	22	8.6	22	8.6	5
HAIN1.	D6.3 MIS-LOCATION OF FURNACE THERMISTAT	(0)	24	22	8.6	22	8.6	6

* NANS ROUTINE MAINTENANCE *****								

NCN	CONSTRUCTION	(0)	550	143	55.0	143	55.0	3
NCXD	EXTERIOR DOORS	(4)	244	97	37.7	97	37.7	4

FOURTH THROUGH EIGHTH LEVEL SUMMATIONS:

	NO.	%TH	%5TH	%4TH	%3RD	HUMES	%HUMES	LEVEL
NCKH								
NCKF	121			49.6	22.0	03	24.5	5
NCKX	58			15.6	6.9	30	11.7	5
NCST	19			7.8	3.5	16	9.2	5
NCXR	10			4.1	1.8	7	2.7	5
NCXK	7			2.9	1.3	6	2.3	5
NCCD	4			1.6	.7	3	1.2	5
NCXS	2			.8	.4	2	.6	5
NCWD	122	(23)		30.3	22.2	66	25.7	4
NCWR	37			15.6	6.7	25	9.7	5
NCWH	19			15.6	3.5	15	5.6	5
NCWT	15			15.6	3.5	17	6.6	5
NCWF	15			12.3	2.7	14	5.4	5
NCWS	9			7.4	1.6	9	3.5	5
NCES	41				7.5	25	9.7	4
NCPD	40	(15)		47.5	7.3	27	10.5	4
NCPH	19			15.0	3.5	14	5.4	5
NCPF	6				1.1	6	2.3	5
NCMS	32				5.8	21	8.2	4
NCHH	27	(0)			4.9	26	10.1	5
NCHD	15			55.6	2.7	15	5.8	5
NCHI	12			44.4	2.2	12	4.7	5
NGBL	20	(9)			3.6	15	5.6	4
NGBE	9			45.0	1.6	6	2.3	5
NGBR	2			10.0	.4	2	.8	5
NGFL	13	(1)			2.4	9	3.5	4
NGFV	12			92.3	2.2	9	3.5	5
NCMG	7				1.3	7	2.7	4
NCTD	4				.7	4	1.0	4
NPLM		(17)	216			94	36.6	3
NPWS		(15)			36.6	53	20.6	4
NPWE		(46)			81.0	43	16.7	5
NPWB				28.1	8.3	14	5.4	6
NPFX		(0)			31.9	42	16.3	4
NPKS		(13)			13.4	23	8.9	5
NPKA				42.0	4.2	8	3.1	6
NPKC				13.0	4.2	4	1.6	6
NPKE				20.7	2.8	4	.4	6
NPFT				3.4	.5	1	.4	6
NPXX		(0)		30.4	9.7	17	6.0	5
NPTT				17.4	5.6	8	3.1	6
NPTA				33.3	3.2	7	2.7	6
NPBS				9.5	.9	2	.8	6
NPBC		(3)		15.9	5.1	7	2.7	5
NPBA				36.4	5.8	3	1.2	5
NPBB		(5)		36.4	1.9	2	.8	5
NPBB				11.6	3.7	7	2.7	5
NPBA				25.0	.9	2	.8	6
NPBA				12.5	.5	1	.4	6
NPBT		39			18.1	20	10.1	4
NPBR		12			5.6	9	3.5	4
NELC		(6)	124			74	28.8	3
NEDP		(10)	55		44.4	40	15.6	5
NEDF			32	50.2	25.8	22	8.6	5

FIELD SAMPLE DATA

FOURTH THROUGH EIGHTH LEVEL SUMMATIONS:

	NU.	47TH	46TH	45TH	44TH	43KD	HCMES	%HOMES	LEVEL
NECB					14.00	6.00	8	3.1	0
NEDT					9.1	4.0	5	1.9	5
NERC	(1)				20.6	20.6	26	10.1	4
NERD	(1)				24.2	24.2	24	9.3	5
NFHT			36.7		76.8	21.0	21	6.2	6
NELF			10.0		5.1	2.4	3	1.2	6
NERI	(0)				0.1	1.6	2	.8	0
NERF			100.0		6.1	14.5	17	0.0	4
NEPP						5.0	6	2.3	4
NESW	(6)				14.3		1	.4	5
NESF							3	1.2	4
NEEF	(1)					.8	1	.4	4
NEIF						.8	1	.4	4
NESR	1					.8	1	.4	4
NHTG	(4)						34	13.2	3
NHGP						52.3	20	7.8	4
NHSP						22.7	8	3.1	4
NHOP	(7)					15.9	6	2.3	4

* APEQ MECHANICAL/ELECTRICAL APPLIANCES -EQUIPMFNT *****									

* APEQ MECHANICAL/ELECTRICAL APPLIANCES -EQUIPMFNT *****									

AFHA	(39)	161					77	30.0	3
AFPL	(3)	40				22.1	32	12.5	4
APK1.		37			92.0	20.4	31	12.1	0
AFCL	(2)	35				19.3	21	8.2	4
AFBU	(1)	16			45.7	3.8	9	3.5	0
AFCV		8			50.0	4.0	4	1.6	0
AFTC		6			37.5	17.1	0	1.9	0
AFCR		1			0.3	2.9	1	.4	0
AFBW	(1)	15			42.9	0.3	12	4.7	0
AFLS	(1)	14			93.3	7.7	11	4.3	0
AFTW	(1)	2			5.7	1.1	2	.8	0
AFES		1			50.0	0.6	1	.4	0
AFEG	(0)	32				17.7	20	7.0	4
AFFL		28			07.5	15.5	10	6.2	0
AFFN	(1)	3			0.7	1.7	3	1.2	0
AFFW		2			6.3	1.1	2	.8	0
AFFO	(17)	21			3.1	0.0	1	.4	0
AFMT		4			19.0	11.6	16	7.0	4
AFTA		4				2.2	2	.0	0
AFBM	(2)	4			25.0	0.6	1	.4	0
AFBG		1			25.0	0.6	1	.4	0
AFMM		3			1.7	1.1	2	.6	0
AFTR	(2)	2			1.1	1.1	2	.6	0
AFAB		2				0.0	1	.4	0
AFBL		1				0.0	1	.4	0
AFOR		1				0.0	1	.4	0
AFGR		1				0.6	1	.4	0
AFSC		1				0.6	1	.4	0

FIELD SAMPLE DATA

FOURTH THROUGH EIGHTH LEVEL SUMMATIONS:

AHWM	HOT WATER HEATERS	(	2S)	02	%7TH	%6TH	%5TH	%4TH	%3RD	HUMES %HUMES	LEVEL
AHEL	ELECTRIC HOT WATER HEATER	(	17)	43					52.4	29	11.3
AHEH	HFAT ELEMENT	(	0)	9				20.9	11.0	8	3.1
AHEC	CONTROLS	(	0)	6				14.0	7.3	5	1.9
AHER	RESET BUTTON	(	0)	4		66.7		9.3	4.9	3	1.2
AHEM	THERMOSTAT	(	0)	2		33.3		4.7	2.4	2	.8
AHER	PRESSURE RELIEF VALVE	(	0)	5				11.6	6.1	5	1.9
AHTK	TANK	(	0)	3				7.0	3.7	3	1.2
AHTE	LEAK	(	0)	3				7.0	3.7	3	1.2
AHEP	PFSSUKE REGULATOR	(	2)	3		100.0		7.0	3.7	3	1.2
AHGS	GAS HOT WATER HEATER	(	2)	11				7.0	3.7	3	1.2
AHPL	PILLOT	(	2)	4				36.4	4.9	2	.8
AHPR	RELIGHT PILOT	(	2)	2		50.0		18.2	2.4	2	.8
AHRV	PRESSURE RELIEF VALVE	(	0)	3				27.3	3.7	3	1.2
AHGL	CONTROLS	(	0)	2				18.2	2.4	2	.8
AHCT	THERMOSTAT	(	0)	2				100.0	2.4	2	.8
ARGE	RANGE - GAS/ELECTRIC	(	11)	72						36	14.0
ARPL	PILLOT	(	3)	16					25.0	16	6.2
ARPL	RELIGHT PILOT	(	3)	15				83.3	20.8	13	5.1
ARGL	GAS LEAK	(	2)	17					23.6	14	5.4
ARGL	CONTROLS	(	2)	11					15.3	10	3.9
AROB	OVEN BURNER	(	0)	4				36.4	5.6	4	1.6
ARSB	SURFACE BURNER	(	0)	3				27.3	4.2	3	1.2
ARTH	THERMOSTAT	(	0)	2				18.2	2.6	2	.8
ARBU	BURNER	(	0)	6					8.3	5	1.9
APBV	OVEN	(	0)	3				50.0	4.2	3	1.2
ARBS	SURFACE	(	0)	3				50.0	4.2	2	.8
AKIW	INTERNAL WIRING	(	0)	6					8.3	2	.8
ARHW	HARDWARE	(	0)	3					4.2	3	1.2
ARHO	OVEN DOORS	(	0)	3				100.0	4.2	3	1.2
AEEH	EXHAUST FAN	(	9)	10						14	5.4
ACRF	REFRIGERATOR	(	0)	1					10.0	1	.4
ACRL	CONTROLS	(	0)	1				100.0	10.0	1	.4
ACRA	FAN	(	0)	1						1	.4
ASDE	SMUKE DETECTOR	(	1)	3						3	1.2
AFEB	ELECTRIC BASEBOARD HEATING UNITS	(	1)	1						1	.4

U.S. DEPT. OF COMM. BIBLIOGRAPHIC DATA SHEET	1. PUBLICATION OR REPORT NO. NBSIR 76-1058	2. Gov't Accession No.	3. Recipient's Accession No.
4. TITLE AND SUBTITLE PERFORMANCE OF MOBILE HOMES - SUMMARY REPORT		5. Publication Date April 1976	
		6. Performing Organization Code	
7. AUTHOR(S) J. H. Pielert, W. E. Greene, Jr., L. F. Skoda, W. G. Street		8. Performing Organ. Report No.	
9. PERFORMING ORGANIZATION NAME AND ADDRESS NATIONAL BUREAU OF STANDARDS DEPARTMENT OF COMMERCE WASHINGTON, D.C. 20234		10. Project/Task/Work Unit No.	
		11. Contract/Grant No.	
12. Sponsoring Organization Name and Complete Address (Street, City, State, ZIP) Office of Policy Development and Research Division of Energy, Building Technology and Standards Department of Housing and Urban Development Washington, D.C. 20410		13. Type of Report & Period Covered Final	
		14. Sponsoring Agency Code	
15. SUPPLEMENTARY NOTES			
<p>16. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)</p> <p>This project was funded at the National Bureau of Standards by the Department of Housing and Urban Development with the objective of documenting mobile home performance problems and relating them to possible inadequacies in the ANSI A119.1 Standard for Mobile Homes and the mobile home enforcement process. Additionally, the durability of mobile home components was a study objective for potential use in mortgage insurance evaluation. Mobile home performance data were obtained for 4,105 mobile homes, categorized and related to the project objectives. This summary report is the last of a series of four project reports. It documents the project approach, results of the various tasks, and presents conclusions and recommendations. This was a problem oriented study and did not attempt to document the many areas of satisfactory mobile home performance.</p>			
<p>17. KEY WORDS (six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)</p> <p>Computer Techniques; Construction; Enforcement Process; Housing; Hurricane Agnes; Mobile Homes; Mobile Home Parks; Performance Data; Regulatory Process; Standards</p>			
<p>18. AVAILABILITY <input type="checkbox"/> Unlimited</p> <p><input checked="" type="checkbox"/> For Official Distribution. Do Not Release to NTIS</p> <p><input type="checkbox"/> Order From Sup. of Doc., U.S. Government Printing Office Washington, D.C. 20402, SD Cat. No. C13</p> <p><input type="checkbox"/> Order From National Technical Information Service (NTIS) Springfield, Virginia 22151</p>		<p>19. SECURITY CLASS (THIS REPORT)</p> <p>UNCLASSIFIED</p>	<p>21. NO. OF PAGES</p> <p>142</p>
		<p>20. SECURITY CLASS (THIS PAGE)</p> <p>UNCLASSIFIED</p>	<p>22. Price</p>