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# DESIGN MODIFICATIONS AND 1962 COST ANALYSIS FOR A STANDARDIZED SERIES OF FALLOUT SHELTERS

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## PRICE QUOTATIONS AND MATERIAL SOURCES

An attempt has been made in this study to present factual cost data. Cost data research provided material source information and this information has been included in the report. Because of the large number of items required for each of the shelters described in this report, time was not sufficient to permit searching out every possible supplier of the desired manufactured products. One or more product sources have been listed in Appendices A and B of the report for each item required. However, no imputation is made (1) that these are the only sources for the items listed; nor (2) that these sources in particular are approved or preferred by this Laboratory or the Navy Department or the Office of Civil Defense.


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## ADMINISTRATIVE INFORMATION

This study was conducted for the Department of Defense, Office of Civil Defense, under work order No. OCD-OS-62-40, Project 1607, dated 12 Jan 1962 (Amendment No. 5 to Agreement CDM-SR-59-54).

## ACKNOWLEDGMENTS

The contributions of others to the technical work and to this report are gratefully acknowledged. Marvin A. Larson, consulting structural engineer of San Francisco, provided structural design work; Lee C. Pong, NRDL mechanical engineer, made numerous labor and material cost studies; F. Abramo, Head of the NRDL Drafting Branch, and other members of his branch prepared the construction drawings; and C.A. Holstein provided invaluable technical editorial assistance in helping prepare this report. The helpful comments and suggestions of others in this Laboratory and in industry are sincerely appreciated.

## ABSTRACT

Major emphasis is on recent design modifications and 1962 cost estimates for the personnel fallout shelter described in USNRDL-TR-366, Specifications and Costs of a Standardized Series of Fallout Shelters (1959). The shelter is designed to accommodate at least 100 persons for 14 days. It is believed that the shelter will provide the specified fallout and blast protection, the required interior environment, and the essential "hotel-type" equipment at minimum cost. The shelter items are specified by several packages, each having one or more different arrangements of items, depending on the degrees of protection and comfort desired. The proper selection of packages will result either in a 35-psi or 10-psi blast and fallout shelter sited above or below grade. The radiation protection factor is at least 1000. "Most austere" to "least austere" living accommodations can be selected. Average cost data for the packages by item are tabulated for quantities up to 1000. Respective costs (less overhead, profit, etc.) for four complete shelters (combinations of most austere and least austere with 35-psi and 10-psi) have been estimated and are presented graphically. Costs for shelter quantities were estimated by means of learning curves. The costs range (one-off) from $19,800 for the least-austere 35-psi shelter to $14,200 for the most-austere 10-psi shelter. The design modifications are based on findings of the USNRDL Shelter Research Program for the period, 1959 to June 1962.

## SUMMARY PAGE

### The Problem

Make design modifications in the prototype shelter, constructed at Camp Parks, California, in 1959, and in the other shelter systems described in Ref. 1 (1959), in order to increase utility with emphasis on cost reductions.

Evaluate protective and operational characteristics of the series of shelters and modify design as required.

Determine 1962 costs of shelter items and installation.

### Findings

The shelter design given in Ref. 1 has been modified on the basis of shelter engineering evaluation, actual construction experience, and experimental firestorm and occupancy experience gained from the USNRDL shelter research program. The design modifications and construction details are given in the construction drawings of Appendix "A." It is believed that the modified shelter will provide the specified blast and fallout protection, the required interior environment, and the essential living accommodations at minimum cost. The drawings are for both aboveground and belowground 100-person shelters having a shelter residual number of no more than 0.001 and a blast protection rating of at least 35-psi overpressure.

The average 1962 costs in quantities to 1000 of all items that have been specified for the standardized series of shelters have been estimated (see tables in Appendix B). These costs have been compared with 1959 estimated costs; the comparisons, with comments, are shown in Table 39 of Appendix B. For example, the 1959 estimated costs of the most austere 35-psi shelter for single and mass installations are $14,100 and $12,200, respectively, compared with the 1962 estimated costs of $16,200 and $12,000. During the period 1959 through 1962, the increase in labor and material costs masks one of the primary purposes of the study, namely, modifying the component design with a view to reducing costs.

The total average 1962 costs of four classes of shelters (10 and 35-psi shelters each provided with two levels of living accommodations) in quantities to 1000 have been estimated (see Fig. 2). The total average 1962 costs have also been estimated for three classes of shelters (least austere and 10-psi, most austere and 10 psi, and 35 psi) which include only the basic-shelter, entrance, and installation packages (see Fig. 3). (Such shelters could be used for civil defense control and communication centers or for military and civilian command control centers having limited personnel and hence would not necessarily be equipped with such packages as the ventilation, hotel, auxiliary power, and electrical packages as proposed for the 100-man shelters.)

### Recommendations

Recommendations are made for further investigation before implementing a national shelter program. These recommendations, which are discussed in detail in Section 5, include:

Theoretical analysis and field testing of single flexible steel arches under megaton-detonation blast loading.

Studies on adequate spacing between multiple flexible-steel-arch structures positioned side by side.

Studies on static and dynamic response of soils of interest under megaton-detonation blast loading.

Determination of fundamental performance specifications for a national protective shelter system.

Determination of adequate radio equipment for national and local shelter systems.

Field test of the fire protection package.

Study of shock-proofing requirements for equipment and facilities inside the basic structure and entrance way of the shelter.

Study of the effects of shock and blast loading on the small buried fuel and water storage tanks and their piping systems.

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(Note: Suffix M denotes modified Ref. 1 drawing. Suffix N denotes new drawing.)

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## LIST OF TABLES (Con't)
(Appendix B)

# SECTION 1

# INTRODUCTION

## 1.1 BACKGROUND AND PROBLEM

Reference 1 describes in detail the prototype underground shelter designed by USNRDL for the Bureau of Ships and the Office of Civil Defense and constructed at Camp Parks, Pleasanton, California. This shelter was designed to provide personnel protection against radioactive fallout from nuclear detonations, with some consideration given to protection against blast, heat, and mass fire. The shelter was designed on the basis of experimental data and experience obtained up to 1959, and its unit cost was estimated with 1959 data.

Reference 1 also discusses the importance of protective shelters, the basic concepts and factors that were considered in designing the prototype shelter, and the experimental and calculated data that were used. In addition, this reference presents, for the prototype shelter, the performance specifications, the design drawings for the several "packages" composing the shelter, and detailed cost estimates for the items in each package. Each package provides a choice among several alternative arrangements of items depending on the protection and comfort levels desired.

The shelter performance specifications are summarized as follows:

1. Shielding against residual (fallout) gamma radiation, with an attenuation factor of at least 1000.

2. Protection against 35-psi side-on blast overpressure from a nuclear air burst of at least 40-KT yield.

3. Protection for 100 people of all age groups and both sexes.

4. An entrance way permitting entry of 100 people within 5 minutes, and an adequate emergency exit.

5. Capability for manual seal-up of the shelter for a 24-hour period.

6. Adequate living accommodations and facilities for 100 people for 14 days:

a. Bunk-type beds for a planned maximum of 96 people (the other 4 persons being on night watch).

b. Food and drinking water.

c. Provisions for heating soup, milk, coffee, and C-type rations.

d. Minimum dining facilities, with water for minimum sanitary use.

e. First-aid medical supplies.

f. Toilet facilities.

g. Air-handling equipment with filter having capability of removing particulate to 0.3-micron size.

h. Electric light and power.

i. Citizen band-type radio transmitter with standard AM broadcast receiver.

j. Radiological instrumentation.

k. Periscope for visual contact with above ground area.

The basic design of the prototype shelter includes the following combination of packages:

Basic-shelter package No. S-2.
Entrance package No. E-2.
Ventilation package No. V-1B except that the air conditioner was not installed
Hotel package No. H-1C.
Control package No. C-2.
Auxiliary power package No. P-5.
Fire protection package F-1.
Installation package No. I-3.

After the shelter was constructed in August 1959, it underwent the following tests:

1. August 1959: simulated occupancy test with 100 simulated shelterees to establish ventilation adequacy.

2. November 1959: preliminary human occupancy test in which 17 men lived 2 days in the shelter to check out equipment and experimental plan.

3. December 1959: first full-scale human occupancy test in which 100 male volunteers lived 14 days in the shelter.

4. April 1960: a firestorm experiment in which 300 tons of fuel on 4 acres around the shelter were burned to determine protection needs under mass-fire conditions.

5. May-June 1960: simulated occupancy tests to collect data on ventilation needs.

6. July 1960: second full-scale occupancy test with 100 male volunteers living 5 days in the shelter in hot weather.

7. September 1960: a radiation shielding experiment to check the shielding of the entrance way and the exhaust ventilator.

8. November 1960: a mixed population occupancy test with 100 men, women, and children living 2 days in the shelter.

9. January 1961 and later: fallout ingress experiments to determine whether filtering is needed in the ventilation system.

Questions requiring the present study were: How do the 1959 cost estimates of Ref. 1 compare with actual construction costs? What design improvements could be made, as indicated by test results and construction experience? What cost reduction could be realized by such design improvements? How do the 1959 cost estimates of Ref. 1 compare with 1962 costs?

## 1.2 OBJECTIVES AND APPROACH

1. Evaluate the protective and operational characteristics of the Camp Parks prototype shelter, based on occupancy experience and experimental work, and modify the design as necessary to improve usefulness and/or reduce cost.

2. Make a cost analysis to include: (a) updating the 1959 one-off costs of Ref. 1 on the basis of design modifications, construction experience, and 1962 material and labor cost; (b) analyzing the one-off cost differences between the 1959 costs and the 1962 modified-design costs, and determine the current total cost of the shelter; and (c) if time permits, extending the analysis to include determination of the average cost per shelter in quantities of 10, 100, and 1000.

## 1.3 LIMITATIONS OF RESULTS

For shelter construction, the design modifications made are adequate for the purpose the shelter was designed for. However, during the course of this study, several areas of improvement became clear and have either been incorporated in the design drawings or will be described in forthcoming reports. The cost data are as accurate and detailed as it was possible to make them, based on contractors' estimates or quotations and other available information. Again, as in Ref. 1, the costs do not include such items as general overhead expenses of the general contractor and subcontractors, profits, and miscellaneous site expenses.



# SECTION 2

# DESIGN MODIFICATIONS BY PACKAGES

## 2.1 GENERAL CONSIDERATIONS

Evaluations were made of the design features of all the components in each of the shelter packages to determine modifications that could be made to improve utility and/or reduce costs. Construction materials and items were judged and selected on the basis of economy, durability, availability, proved performance, and ease of fabrication and installation.

The design drawings, presented in Appendix A, have been updated to show the modifications made and to clearly show all the pertinent design features, the material specifications, the fabrication and installation procedures, and the tests and specific treatment of certain selected materials required by the contractor. The items in the shelter packages remain largely as they are described in Ref. 1 with the exception that the electrical arrangement and design have been moderately modified and the required items grouped into a new Electrical Package with six arrangements. This package consists of miscellaneous electrical items required for specific combinations of hotel package (including food-heating appliances), ventilation package, air conditioning, and auxiliary power package.

The remainder of this section briefly discusses the modifications of the various packages essentially in the order the packages are discussed and described in Ref. 1. The drawings of Appendix A, which give the modifications, supersede the drawings of Ref. 1. (The suffix M (appearing in the drawing title block) denotes a modified drawing; N, a new drawing.) A cutaway drawing of the modified shelter is presented in Fig. 1.

## 2.2 BASIC-SHELTER PACKAGE

1. Notes have been added to the drawing on general configurations (Fig. A-1M) specifying the detailed procedure for the contractor to follow to ensure adequate burial of the shelter. Installation details have been included for adequate burial of the 35 psi basic structure and entranceway when construction may be required on sites where bedrock or ground water is near the surface.

2. The expansion joint filler now specified (Fig. A-2M) is just as adequate as that formerly specified in Ref. 1, but it is less costly.

3. A procedure has been included (Figs. A-2N-1 and A-2N-2) for determining the design and construction details of the sidewall and endwall foundations for both 10-psi and 35-psi shelters to cover the range of soil types that may be encountered in the United States. This procedure was developed through the design analysis based on parameters defined in para. 5.

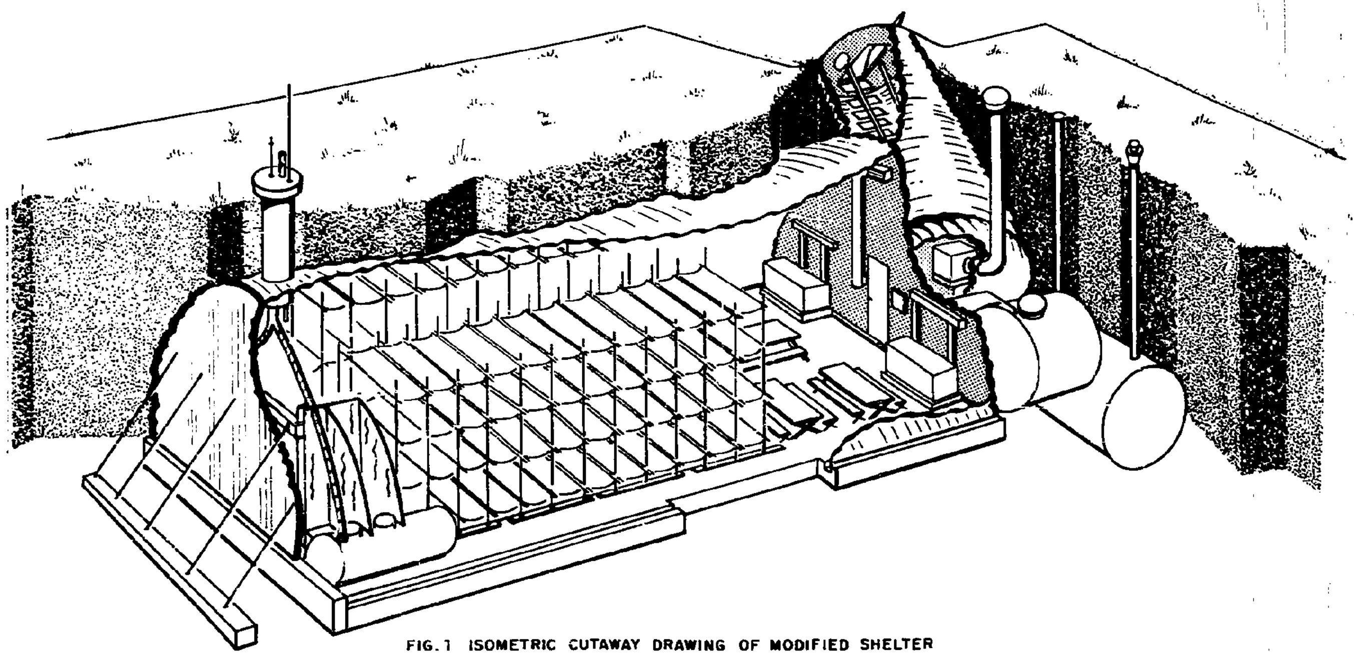


FIG. 1 ISOMETRIC CUTAWAY DRAWING OF MODIFIED SHELTER

4. Notes have been added to the drawing (Fig. A-3M) on entrance and endwall support details specifying (a) the base metal to be used in fabricating the basic arch structure, the endwalls, and the entranceway; (b) the manufacturing tolerances; (c) the erection procedure to be followed by the contractor; and (d) the basic quality control of workmanship in fabrication and erection.

5. The design of the endwall supports has been modified to reduce costs without decreasing the structural strength.

In order to design suitable blast-resistant foundations for the flexible-steel-arch shelter when it is sited on soils varying from hardpan to compact inorganic sand and silt, the author reviewed available data that disclosed the performance of this type of basic-shelter structure when subjected to blast. Considerable pertinent theoretical and experimental information was found in Refs. 2 to 6.

In brief, it was determined from Refs. 2 and 3 that specific experimental data relating to the dynamic response of the foundation of the flexible-steel-arch structure is available for one environmental condition, namely, when the foundation is placed on a "clayey silt" soil having the following characteristics: dry density, 77 $lb/ft^3$; water content, 13%; angle of shearing resistance, 30°; cohesion, 2400 $lb/ft^2$ average; modulus of elasticity, 6400 $lb/ft^2$; Poisson's ratio (assumed), 0.3; and seismic velocity of backfill, 2300 ft/sec. The designs of the sidewall and endwall foundations were similar to those indicated as type 4, Fig. A-2N-1 and type 1, Fig. A-2N-2, respectively and the overpressure blast wave resulting from the low-yield nuclear detonation had a positive overpressure duration of about 0.35 sec. The cited field experiment subjected three flexible-steel-arch structures to blast overpressures of 60 psi and 100 psi. Brief construction details of the three structures are as follows:

Structure 3.3a, subjected to 100 psi; A Navy stock No. 10 gage, steel-arch, ammunition storage magazine modified as follows: the end bulkheads were of 3-gage corrugated steel plate supported by tiebacks and deadmen, and steel curved-arch ribs were placed at 4-ft intervals.

Structure 3.3b, subjected to 60 psi; A Navy stock No. 10 gage steel-arch magazine modified as follows: the end bulkheads were of 8-gage corrugated steel plate supported by tiebacks and deadmen.

Structure 3.3c, subjected to 60 psi; A Navy stock No. 10 gage steel-arch magazine modified as follows: the end bulkheads were of 3-gage corrugated steel plate supported by tiebacks and deadmen and steel curved-arch ribs were placed at 4-ft intervals.

Analysis of the foundation behavior of the three structures[2] indicated that (a) nearly the full effective overpressure was acting on the footings, and that it was, in all cases, great enough to cause local shear failure hence, the permanent footing vertical displacement, which varied from 1.5 to 3 inches;[2] (b) for structure 3.3a, this full effective overpressure was also great enough to probably cause general shear failure of the soil to start with; and (c) the comparatively short duration of the pressure pulse (0.35 sec) did not allow the development of complete failure; however, the general vertical displacement of the footings was about 3 inches.[2] For megaton-detonation overpressure pulses, one can expect the pulse duration to be about 5 seconds, and effects should be similar to those of static loads. This fact was then the basis for the design modifications of the sidewall and endwall footings. The footings were designed on the basis of the following:

1. The foundation load was computed for the full effective overpressure (static conditions).

2. The foundation load was limited to the values of general shear failure for the respective soils (Figs. A-2N-1 and A-2N-2).

3. Permanent footing displacements of 1-1/2 inches are expected.

4. Increase in soil strength due to dynamic consolidation was disregarded.

5. Resistance due to earth and footing mass inertia was disregarded.

## 2.3 ENTRANCE PACKAGE

1. With the installation as shown in Ref. 1, investigation revealed that about 30% of the ventilation air was being short-cycled and did not reach the shelter interior. To correct this condition, weather stripping was added to the entrance endwall door, and flashing was installed at the connection between the entry tube and the endwall (Fig. A-5M).

2. The design of the shelter endwall entry door was modified (Fig. A-5M) to obviate its fabrication in strict accordance with the Federal specification. Commercial-grade doors, which can be fabricated at less cost and are satisfactory in performance, can now be installed.

## 2.4 VENTILATION PACKAGE

Minor modifications have been made in the exhaust vent design to reduce costs. Refer to Figs. A-7M and A-8M for details.

## 2.5 HOTEL PACKAGE

Certain miscellaneous minor items of the hotel packages listed in Ref. 1 have been grouped into lots to simplify the presentation. Modification of specific components and items are described below.

### 2.5.1 Bunk System

The bunk system described in Ref. 1 has been extensively tested, as outlined in Appendix C. The test results pointed to many required design changes, which have been incorporated in the present design (see Fig. A-10M). These changes, described in detail in Appendix C, have resulted in a new bunk system that is quite satisfactory and less costly.

2.5.2 Furniture

The design of the wooden tables and chairs that were specified to be used in Ref. 1 has been modified to reduce cost without affecting the 14-day usability period required of this furniture. See Fig. A-9M.

2.5.3 Water, Fuel, and Sanitary Tanks

The design of these tanks has been modified to decrease their cost without affecting their performance in the intended environment. See Figs. A-11M and A-17M.

2.5.4 Sanitary-Tank Platform and Curtains

The design of these units has been modified to decrease their cost without affecting their performance for the use intended. See Fig. A-11M.

2.5.5 Water and Fuel Piping

The design of these systems has been modified to decrease the possibility of the water and fuel piping connections breaking at their point of entry to the shelter during the positive blast pulse. See Fig. A-17M.

2.5.6 Emergency Exit Tools

Reference 1 specified the use of a small wrecking bar only for emergency use. Consideration in this study was given to the need for tools for emergency use in the shelter and it was determined that an 8-pound sledge hammer and a 4-foot-long wrecking bar would greatly increase the possibility of shelteree survival in the event that exits were covered with debris. This equipment has been specified in this report to be furnished in every hotel package.

2.5.7 Habitability Equipment and Items

The following miscellaneous items have been added to the hotel packages. The need for these items was revealed during the various NRDL shelter habitability experiments:

Recreational equipment (included in Hotel Packages H-1C, H-2C, and H-3C).
Waterless hand cleaner (added to all Hotel Packages).
Plastic soup spoons (added to all Hotel Packages).
Paper food plates (added to all Hotel Packages).
Disposable diapers (added to all Hotel Packages).
Sanitary napkins (added to all Hotel Packages).

2.6 CONTROL PACKAGE

2.6.1 Radio Transceivers

Reference 1 specified the use of the Vocaline Model JRC-400, or the equivalent, for use as a low-power transceiver, and the Gonset 3025, or the equivalent, for the high-power "transceiver."

Investigation revealed that the citizens-band JRC-400 low-power transceiver is a line-of-site unit and that its performance would be unsatisfactory even for a distance of a few hundred feet if obstructions, such as hills or buildings, were between it and the intended receiver. In addition, the manufacturer reported that his plant no longer produces the unit, since its carrier frequency oscillator was found to be unstable according to FCC regulations.

The investigation also revealed that the most dependable low-cost commercial transceiver is the Vocaline Commaire Model ED-27M, or the equivalent. This unit transmits in the 27-MC band, which is in the citizens band. Experience with this type of unit is that it is dependable in a hilly and/or builtup area to a range of about 5 to 6 miles. The unit comes equipped with a 4-channel selector switch and can be purchased equipped with 1 to 4 channels. Therefore, because of these advantages and because of the lack of an adequate nationwide disaster communications system that would enable specification of adequate shelter transceiver equipment, this unit has been specified in this report. The unit equipped for 1-channel operation has been specified for use in the personnel shelter, while the unit equipped for 2-channel operation has been specified for use in the sector shelter. (Refer to Sec. 5 for further discussion on radio communication equipment.)

2.6.2 Radiation Detection Equipment

Reference 1 specified that this equipment consist of a 1-to-200-mr dosimeter, a 1-to-100-r dosimeter, and a dosimeter charger. The present study revealed that commercial purchase of these items would cost about $15.00 each or a total of $45.00. The study also revealed that many large commercial radio companies were selling a radiation-detection package that meets OCD specifications and consists of a dosimeter having a 0-to-120-r range (this scale is calibrated as a rate meter), a dosimeter with a 0-to-600-r range, and a charger for a total of $26.00. Therefore, this is specified in the present report.

2.6.3 Periscope

The periscope specified in Ref. 1 required that a lens system be provided that had a 40° solid angle field of view. Experiment performed during the NRDL shelter test program revealed that this angle could be reduced to 17° without any sacrifice of usability. Based on this finding, a periscope was developed (in collaboration with the Tinsley Laboratory, Inc. of Berkeley, Calif.) that is satisfactory for use in shelters and is less costly. See Fig. A-13M.

## 2.7 AUXILIARY POWER PACKAGE

Reference 1 specified an electric-starting engine generator. The present study revealed that a manual-starting engine generator is preferable because its use will eliminate the problem of a discharged battery after the long period that this unit will be on standby (idle). The manual-starting unit will also cost less for initial purchase and installation, as well as for maintenance when on standby.

The fuel tanks have been modified to get more efficient use out of the basic sheet metal stock as "provided to the fabricator by the steel manufacturer." Also, the dished tank heads specified in Ref. 1 have been replaced by flat, flanged tank heads. Both changes will result in considerable savings in tank costs.

Greater reliability has been ensured for proper starting of the motor generator after a long standby period by including the installation of a small gravity-feed day tank at the engine proper. The fuel in the day tank will be sufficient to ensure an adequate supply of fuel in the carburetor for starting the engine after a long standby period.

The rating of the auxiliary power package for a given combination of ventilation and hotel packages is specified in Table 28.

## 2.8 FIRE PROTECTION PACKAGE

Two items specified in Ref. 1 for this package have been changed:

1. The pelleted carbon dioxide absorber (Baralyme) has been substituted by a more efficient granular absorber (Baralyme) (or equivalent).

2. The two-stage oxygen bottle regulator has been substituted by a single-stage regulator.

## 2.9 INSTALLATION PACKAGE

Considerable adjustment has been made in the volume values of Table 3.13 for excavation, backfill and compaction, and backfill, as well as in the respective material and labor costs (see Table 22). (Adjusted costs per cubic yard for these operations are given in Table 23.) For detailed instructions for carrying out the above operations and for erecting the steel work, see Figs. A-1M and A-3M, respectively.

## 2.10 ELECTRICAL PACKAGE

The design of the electrical lighting and power system of Ref. 1 has been modified as shown in Fig. A-12N. The design was dependent on the maximum electrical load that would result when the electric equipment specified in the various shelter packages were energized. Governing equipment were lighting, control equipment, food immersion heater, hot plate, vent fan, and air conditioner. A study of the probable combination of the shelter packages indicated the need for three separate electrical lighting and power distribution systems, as shown in detail on Fig. A-12N as Arrangement A, Arrangement B, and Arrangement C.

Arrangement A is the most austere electrical system; it provides lighting in the messing and reading area equivalent in intensity to that of normal street lighting. Minimum acceptable lighting has also been provided in the entry way and toilet area. The power distribution system provides power to the ventilation blower motor, to 3 duplex receptacles (one serving the shelter control equipment), and to the air conditioner if it is used.

Arrangement B provides lighting in the messing and reading area equivalent in intensity to that found normally in hallways of office buildings (5 foot-candles). The bunking and recreational area is provided with a light intensity of 2 foot-candles, which is equivalent to that found in a restaurant dining area having a subdued environment. Lights have also been provided in the entry way and toilet area. The power distribution system provides power to 4 duplex receptacles, the ventilation motor, and the air conditioner if it is used.

Arrangement C provides lighting in the messing and reading area equivalent in light intensity to 15 foot-candles. The bunking and recreational area has been provided with 5 foot-candles. The 15-foot-candle illumination level is equivalent to that usually provided in office and hospital waiting rooms. Lighting has also been provided in the toilet area and entry way. The power distribution system provides power to 5 duplex receptacles, to the ventilation motor, and to the air conditioner if it is used.

Auxiliary electrical systems have been provided for both the air conditioner and the service equipment required for a specific auxiliary-power package.

The electrical items required for various combinations of ventilation and hotel packages have been grouped into 6 electrical packages: W-1 to W-6. All the items are described in Table 25, the items in a given electrical package are listed by number in Table 27, and the electrical package for a given combination of ventilation and hotel packages is specified in Table 28. Figure A-12N gives the installation arrangement of electrical items.

## SECTION 3

## COST ANALYSIS OF PACKAGES BY ITEM

### 3.1 GENERAL

This section is concerned with the second objective stated in 1.2. The 1959 costs given in Ref. 1 were based on the Federal Stock Catalogue costs and the manufacturer's prices (contractor's costs) for mass-produced items, and on NRDL cost estimates for other items. Both the 1959 cost data and the available 1962 cost data were limited (as explained in 3.1.1). The analysis was extended to include multiple-unit item costs (3.1.2). Cost estimates are briefly discussed in 3.2 and are presented in tables in Appendix B.

### 3.1.1 Scope of Cost Data Used

Material and labor costs of constructing the prototype shelter have been analyzed for the items in the various shelter packages used. However, a detailed analysis proved difficult because the general contractor and his subcontractors had not set up a sufficiently detailed cost-accounting system. It was determined that most general contractors and subcontractors consider a detailed cost-accounting system too expensive and hence are reluctant to, or do not, allocate the necessary funds to support such a system. In addition, a general contractor will usually not award a specialized job to a subcontractor on a competitive basis; he will place such a job with a subcontractor whose past experience he has approved.

Another difficulty was trying to determine "hidden" costs. Therefore, the cost estimates resulting from the analysis do not include the following:

| GENERAL DESCRIPTION | DETAILED DESCRIPTION |
|---|---|
| General overhead expenses of general contractors and subcontractors prorated for a specific job. | Office rent, fuel, lights, telephone, stationary, other miscellaneous office supplies, advertising, trade journal magazines, donations, legal expenses not chargeable to a specific job, fire and liability insurance on office, contractor association fee, and salaries of office employees, such as clerks and estimators. |
| Specific job overhead. | Salaries of foreman and timekeepers, cost of temporary toilet, construction-site buildings, tool sheds, field telephone, temporary light and power, cleanup of premises, inspection fees, building permits, site surveys, tools and equipment amortization, contractors insurance and other coverage for a specific job, bid bonds, performance bonds, joint industry bond payments, employer's liability and auto insurance, motor vehicle and heavy equipment operation and maintenance, and employees' welfare fund, vacations, paid holidays, overtime, pensions, hospitalization, convalescent fund payments, apprenticeship payments, and unemployment compensation insurance. |
| Profits | General contractor and subcontractor profits. |
| Miscellaneous site expenses. | Site acquisition, relocating existing utilities, actual electrical and water connections, hard material encountered during excavation (such as ledge rock, boulders more than one-half cubic yard in volume, and cemented material requiring blasting for removal), requirement for select material due to native soil not being suitable for backfill, additional costs due to strikes. |
| Purchase of nondomestic construction materials. | As per requirements of "Buy American Act" (U.S. Code 10a-d). |

### 3.1.2 Method of Estimating Multiple-Unit Item Costs

Although this objective was mainly to analyze the one-off item costs, it became apparent as the study progressed that additional investigation would be rewarding from the point of view of estimating, with a good degree of accuracy, the multiple-unit costs for single-shelter installations (that is, not a shelter-maze system). This extension of the analysis was done, and the method of estimating the multiple-unit costs is described in the following paragraphs.

The direct one-off labor costs by items were projected to multiple-unit labor costs by means of the 80% learning curve, which is expressed by:

$$y = ax^b$$

where y is the average direct man-hours, x is the cumulative item output, and a and b are parameters. The value of a is the direct man-hour cost for unit number one, and the value of b defines the slope of the cost versus cumulative output curve. For an 80% learning curve, the value of b is taken as minus 1/3. Under this condition of learning, the reduction in direct labor cost is 20% with each doubling of cumulative output. In the author's opinion, this curve best represents the learning experience that can be expected in building trades that are involved with the construction of a shelter of this type.

In applying this curve to the basic costing problem, it was necessary to determine the learning level for each purchased item as well as the direct labor required for the assembly, fabrication, and installation of the item. Information presented by David Novick of the Rand Corporation in his report, "Use of the Learning Curve,"[7] proved invaluable.

At the outset of this cost investigation, it was decided to use purchased-item cost data furnished by the actual manufacturer of the specific item wherever possible. This approach was taken so that actual in-plant experience levels would be incorporated in the final results. It is hoped, then, that the final results reflect minimum errors due to the following pertinent problem areas:

1. Limited knowledge of the accumulation of prior related learning for the applicable item.

2. Accounting for the fact that every item being considered must be produced before the cumulative improvement embodied in the last produced item can be utilized in the cost study. Data submitted by the actual manufacturer of the purchased item proved of special significance because the data reflect factual improvements that can be contributed by management and by equipment and direct-labor improvements.

The multiple-unit costing projection is based on the condition that <u>single units</u> only are to be installed in one local area. For instance, one can visualize a national shelter program in which specific central groups would be given the job of installing single shelters at various strategic locations in a suburban area. It was assumed that each group would be responsible for installing as many as 10,000 such units; however, it was further assumed that the average contractor would not be involved in the installation of more than 1000 units.

As stated previously, this analysis did not include an investigation of the cost of multiple-shelter installations (shelter-maze system) based on common shelter components (such as an entryway, engine generator room, water system, sanitary system, and ventilation system) and/or an increase in room length. Time and funds did not permit investigation in this area, and reliable cost data cannot be worked up until a specific design has been developed. It is obvious, however, that maze-type shelter configurations offer many advantages, for example, a considerable reduction in the cost per shelteree.

## 3.2 COST ESTIMATES

The cost estimates resulting from this analysis have been tabulated (see Appendix B) for each shelter package. For each package, there are three tables: a table giving the material and labor costs of the package by items, a table giving the cost differentials between 1959 and 1962 costs for each item in the package, and a table that summarizes the individual cost for each of the package arrangements. These tables are presented in the order the shelter packages are discussed in Section 2.

By examination of the tables for a given package, one can find the increase or decrease in costs by item. Also, one can find the significant cost changes. For example, for the ventilation-package blowers, an important finding of the cost analysis is that the 1959 ventilation blower prices listed in Ref. 1 were excessive, and that savings per unit shelter -- based on 1962 prices and considering what the increase in the 1959 prices would have been over the past 3 years -- are $107, $63, and $39, respectively, for the 675-cfm 0.2-WG, the 675-cfm 0.7-WG, and the 1600-cfm 0.2-WG vent blowers.

## SECTION 4

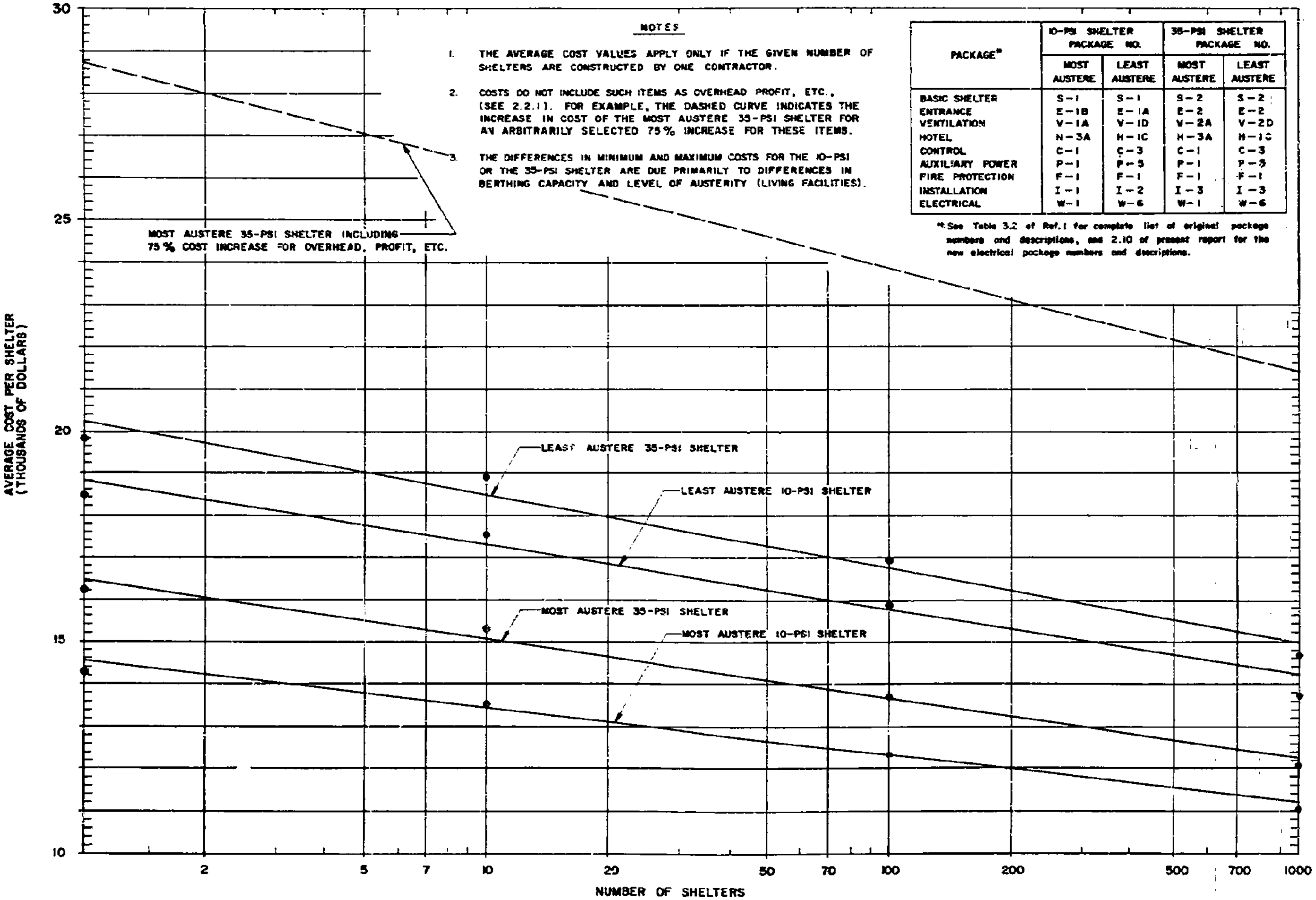
## DISCUSSION OF RESULTS

The design of the shelter specified in Ref. 1 has been modified to include current shelter development and engineering experience (see Sec. 2 for details), and modified and new construction drawings have been prepared accordingly (see Appendix A).

Material and labor costs for the items in the various shelter packages have been updated to 1962 (see tables of Appendix B). These costs represent the range of actual costs to a greater degree of accuracy than costs that might be obtained from an individual contractor on a bid basis.

To illustrate the cost range of the various shelters that are possible by combining different packages, four combinations of shelter packages have been selected. The average 1962 costs per shelter unit for each of these combinations is shown in Fig. 2 in quantities of 1, 10, 100, and 1000. The percentage contributions of the packages to the total one-off cost for each of these combinations are given in Table 28. Comparisons of the 1959 and 1962 total costs for the four combinations are listed in Table 29.

Prospective shelter builders have shown interest in the use of the basic structure and entrance way for nonpersonnel purposes, such as underground control centers for civil defense. Therefore, Fig. 3 has been included to show the average 1962 cost just for the basic-shelter package installed with an entrance way only.




| PACKAGE* | 10-PSI SHELTER PACKAGE NO. | | 35-PSI SHELTER PACKAGE NO. | |
|---|---|---|---|---|
| | MOST AUSTERE | LEAST AUSTERE | MOST AUSTERE | LEAST AUSTERE |
| BASIC SHELTER | S-1 | S-1 | S-2 | S-2 |
| ENTRANCE | E-1B | E-1A | E-2 | E-2 |
| VENTILATION | V-1A | V-1D | V-2A | V-2D |
| HOTEL | H-3A | H-1C | H-3A | H-1C |
| CONTROL | C-1 | C-3 | C-1 | C-3 |
| AUXILIARY POWER | P-1 | P-5 | P-1 | P-5 |
| FIRE PROTECTION | F-1 | F-1 | F-1 | F-1 |
| INSTALLATION | I-1 | I-2 | I-3 | I-3 |
| ELECTRICAL | W-1 | W-6 | W-1 | W-6 |

*See Table 3.2 of Ref. 1 for complete list of original package numbers and descriptions, and 2.10 of present report for the new electrical package numbers and descriptions.

FIG. 2 AVERAGE COST PER SHELTER Vs. NUMBER OF SHELTERS FOR MINIMUM AND MAXIMUM 10-PSI AND 35-PSI SHELTERS.

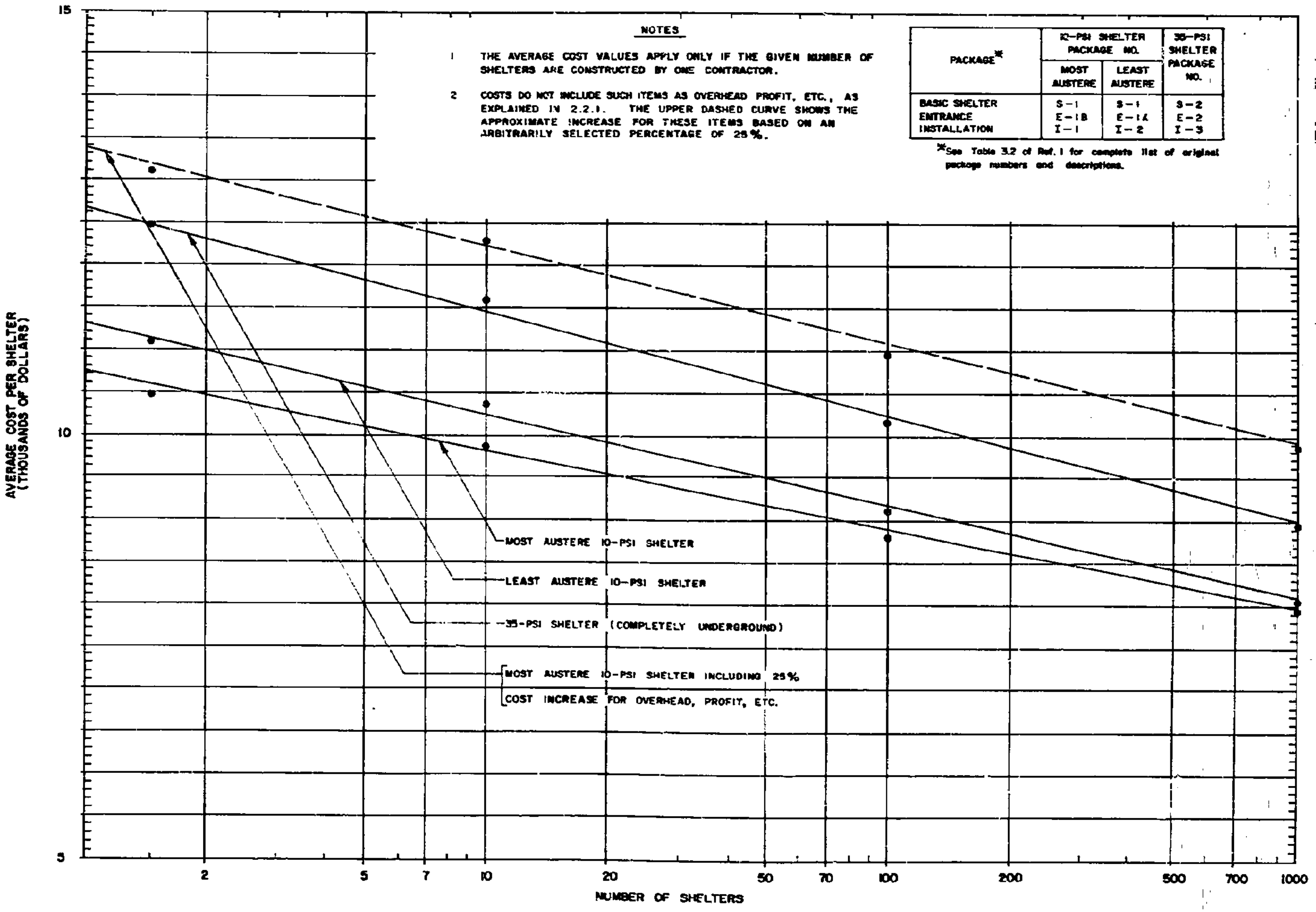



FIG. 3 AVERAGE COST OF ONLY THE BASIC-SHELTER, ENTRANCE, AND INSTALLATION PACKAGES VS. NUMBER OF SHELTERS FOR THE 35-PSI SHELTER AND THE MINIMUM AND MAXIMUM 10-PSI SHELTERS.

# SECTION 5

# RECOMMENDATIONS FOR FURTHER INVESTIGATION

## 5.1 GENERAL

The results of this study point up the need for the following:

Theoretical analysis and field testing of single flexible steel arches under megaton-detonation blast loading.

Studies on adequate spacing between multiple flexible-steel-arch structures positioned side by side.

Studies on static and dynamic responses of soils of interest under megaton-detonation blast loading.

Determination of fundamental performance specifications for a national protective shelter system.

Determination of adequate radio equipment for national and local shelter systems.

Field test of the fire protection package.

Study of shock-proofing requirements for equipment and facilities inside the basic structure and entrance way of the shelter.

Study of the effects of shock and blast loading on the small buried fuel and water storage tanks.

## 5.2 THEORETICAL ANALYSIS AND FIELD TESTING OF SINGLE FLEXIBLE STEEL ARCHES UNDER MEGATON-DETONATION BLAST LOADING

The corrugated flexible steel arch that has been selected for use as a blast and fallout shelter has successfully withstood blast loading of nuclear bombs in the kiloton range. However, it is obvious that any civil defense personnel shelter designed for blast should be able to withstand blast-overpressure pulses resulting from megaton detonations.

Review of the design theory of the operation of the unreinforced corrugated arch under blast loading indicates that flexural deformation of the arch must be fully inhibited by the static and dynamic resistance of the soil. This condition can be achieved when the arch structure has been properly buried; that is:

1. An adequate foundation has been provided.

2. The arch is totally below grade or provided with adequate berm and has been nested in structurally adequate soil.

3. Adequate cover has been provided over the crown of the arch in order that the passive resistance of the soil is sufficient to prevent flexural deformation.

In the opinion of the author, the third requirement above must be investigated further—both theoretically and experimentally—to determine cover depths and/or structural stiffening of the arch crown so that it will resist megaton-detonation blast loading. Such investigation should terminate in full-scale field tests that subject the finally designed arch structure to such loading. In addition, each test arch structure should be provided with different types of endwalls, entrance way, blast door, and necessary shelter protuberances.

The following three types of flexible-arch configurations are suggested for theoretical analysis and test purposes:

Structure A: An unreinforced structural-plate arch (multiplate or equal). This test should include various arch-plate thicknesses, say 10 gage, 7 gage, and 1 gage. Variations in the number of longitudinal plate-connecting bolts per foot should also be incorporated in the test. This variation should be 4, 6, and 8 bolts per foot. This test will not require the installation of different structures, since all the variations specified can be included in a single structure having sufficient length. The possible combinations of the 3 types of bolting and 3 different thicknesses of arch ring are 9. Consequently, a test structure having at least 9 rings will be required. The test of bolted connections is required to gain sufficient knowledge to properly design a yielding foundation. This principle suggests that the arch footings be designed so that the minimum vertical soil resistance under the footings will be enough to support the structure, its cover, and such incidental live loads as may be applied. The maximum vertical reaction pressure of the soil against the bottom of the footings should be no more than the horizontal bolted-seam strength in order that the foundation may yield when subjected to blast loading without the horizontal seams fracturing.

Structure B: A corrugated metal arch reinforced peripherally at intervals by curved I-beams which are located either inside or outside the structure. Variations in the size and spacings of the I-beams should be included in this test structure. Variations in arch-plate thickness should also be included.

Structure C: A corrugated metal arch reinforced by curved I-beams (located either inside or outside the structure) occupying about the central top third of the arch periphery. This field test will develop data that can be used for the purpose of designing arch reinforcements that may be necessary as a result of inadequate soil pressure on the top of the arch.

## 5.3 STUDIES ON ADEQUATE SPACING BETWEEN MULTIPLE FLEXIBLE-STEEL-ARCH STRUCTURES POSITIONED SIDE BY SIDE

When these shelters are placed close together side by side, they are not in as favorable a situation as a single arch structure that is fully supported by the surrounding earth. As noted in 5.2, theoretical studies and field-test results indicate that an underground arch with adequate earth cover has its flexural deformations almost totally inhibited by the static and dynamic resistance of the soil. When this is the case, the design engineer neglects flexure in the underground arch.

When the arch is subjected to blast loading, it becomes essential that no major flexural moments be developed in the structure. Loading of the soil around the arch will develop highly concentrated reactions near the foundations of a very closely adjacent arch structure. Consequently, the soil resistance in the vicinity of the arch foundations must completely inhibit flexural deformations of the arches. Therefore, the allowable minimum distance between adjacent arches in order that this condition exist must be determined.

## 5.4 STUDIES ON STATIC AND DYNAMIC RESPONSES OF SOILS OF INTEREST UNDER MEGATON-DETONATION BLAST LOADING

Construction capable of protecting personnel from the effects of nuclear weapons is greatly dependent on the dynamic response of the structure's foundation. The numerous dynamic-response investigations to date have been mainly directed toward analytical and experimental work, the purpose having been to determine the response of structural materials, structural components, and total structures to blast-type loading. These investigations were started with well-defined building materials, such as steel, wood, and reinforced concrete.

No great amount of effort has been made to determine the dynamic response of nonhomogeneous materials, such as soils. In recent years, however, the need for knowledge of the dynamic properties of soils has increased. Currently, the knowledge of the dynamic response of foundations is greatly behind that of the superstructures. To emphasize the present "state of the art" of soil dynamics, the following quote from Ref. 6 is given: "The primary objective of developing a mathematical expression for the displacement of long footings based on a punching failure and applicable to any soil type has been met. However, the theory as defined by the derived equations cannot be regarded as more than a preliminary attempt to theorize a very complex physical phenomenon. The assumptions have been restrictive to the extent that precise correlation between the predicted and measured values of footing displacement should not be expected . At this time, even the magnitude of the deviations cannot be assessed because of the lack of experimental data."

In view of the foregoing, it is recommended that theoretical study of soil dynamics be continued and be followed with a comprehensive laboratory and field-test program.

## 5.5 DETERMINATION OF FUNDAMENTAL PERFORMANCE SPECIFICATIONS FOR A NATIONAL PROTECTIVE SHELTER SYSTEM

It is strongly recommended that the general approach to shelter design be improved. The task faced by the shelter design engineer can best be illustrated by an analogy. He faces a task similar to a bridge engineer who is told to design a bridge to span a body of water at minimal cost. No specific information is given on parameter values to which he must adapt his design -- length of the span, depth of the water, knowledge of the bordering terrain, type and magnitude of expected traffic, etc. Before the bridge engineer can develop a design, he must be furnished with specific information of the values of such parameters.

Similarly, at present, the shelter engineer is told to design a shelter at minimal cost, and very little other information is clearly stated. The environments the shelter engineer has to contend with are as complex as the one in the bridge design case. He is faced with a wide range of parameters and their combinations -- blast overpressure effects, thermal effects, initial and residual radiation effects, etc. These effects in turn vary with the weapon yield; for example, if a structure is built to withstand 35 psi from a 40-KT detonation, it may not be able to withstand 35 psi from a 10-megaton detonation because of the difference in the blast pulse shape. The shelter engineer is not qualified to specify design criteria for a national shelter system; others are better equipped to do this. He can design adequate minimal-cost shelters only after detailed specifications have been furnished in clearly stated terms to meet each particular situation. To indicate how the basic problem might be solved, a general scheme for designing shelters on a large scale is briefly outlined below.

In the first step, a group, made up probably of weapon-effects and intelligence experts studying possible patterns of attack on the United States, should determine the most probable weapons effects, their combinations, and the degree of protection required for each locality in the United States. The problem is complex, but it must be solved as a first step in this type of planning.

In the second step, contact would be made between this first group and the shelter design engineers, and they would decide on the number and types of shelter designs (say, 10 or 20) required to cover the full range, or a fraction of the range, of the weapons effects and the national protection desired. Specific design criteria would then be furnished the shelter engineer.

In the third step, the shelter design engineer could then proceed in the work he is best qualified to perform: designing each of the shelters decided upon at minimal cost. An important point in this phase of shelter planning will be brought out. In standard engineering procedures, the engineer is usually required to introduce a safety factor in his design. In shelter design, the engineer should be required to meet only the maximum criteria values set forth by the first group. At present, however, the engineer has no way of knowing the value of a reasonable safety factor in this type of design; as a consequence, if he is forced to incorporate safety factors in his design, this will conflict with his objective of designing a minimal-cost design. The concept of a safety factor can best be left to the discretion of another group mentioned next.

In the fourth step, a master control group would decide which of the 10 or 20 shelter designs should be assigned to each locality of the United States. If this group were to decide that a stronger shelter than the one indicated for the particular location was desirable then a stronger shelter could be selected from those available. This step would indirectly take care of the safety factors.

## 5.6 DETERMINATION OF ADEQUATE RADIO EQUIPMENT FOR NATIONAL AND LOCAL SHELTER SYSTEMS

Comments on the radio equipment specified in Ref. 1 are given in 2.6.1. The present investigation indicates that, on a national basis, the Office of Civil Defense has been assigned five broadcast channels for disaster purposes in the frequency range, 1768.5 to 1796.5 kc. In addition, the California Disaster Office has been assigned only one "Scene of Disaster" channel at 1761.5 kc. Furthermore, local city-government experience with minor local problems indicates that five channels of information will be completely inadequate to handle even local disaster conditions. A preliminary analysis of the problem indicates that, before an adequate disaster communications system can be developed, a complete national, state, county, and city organization and control system, with a dependable radio communication system, will have to be set up. The details of the communication system with its performance requirements can then be specified.

The author of this report attempted to determine (by field check) what communications problems, if any, would exist in the event of an actual local disaster. The Director of the Disaster Council and Corps, City and County of San Francisco, A.G. Cook, R.Adm. USN (Ret), was asked if, in his estimation, planned communication facilities were adequate to handle disaster problems that may arise as a result of nuclear detonations in the San Francisco Bay Area. He reported that "In my opinion, existing communication facilities and radio frequency channels are grossly inadequate, and in the event of a local disaster, I no doubt would resort to the use of other existing public safety communications systems."

It was also of interest to note that the law requires all operators of this type of equipment to be licensed. Further investigation of operating characteristics of existing commercial communications equipment revealed the fact that very costly equipment is necessary to cover moderate ranges, for instance, between San Francisco and Sacramento, a distance of about 75 miles.

## 5.7 FIELD TEST OF FIRE PROTECTION PACKAGE

The use and performance of the carbon dioxide absorber (Baralyme) should be tested under field conditions. The main purpose of such testing would be to determine whether the proposed method of using this material to absorb $CO_2$ generated is satisfactory over the wide range of shelter air temperatures and humidities that may be expected. The proposed method for using this material is merely to spread it out in thin layers on the bunks. However, this method may not be satisfactory in an actual shelter close-up situation, and some other method may be required, such as a more costly blower-canister system.

## 5.8 STUDY OF SHOCK-PROOFING REQUIREMENTS FOR SHELTER FACILITIES AND EQUIPMENT ITEMS

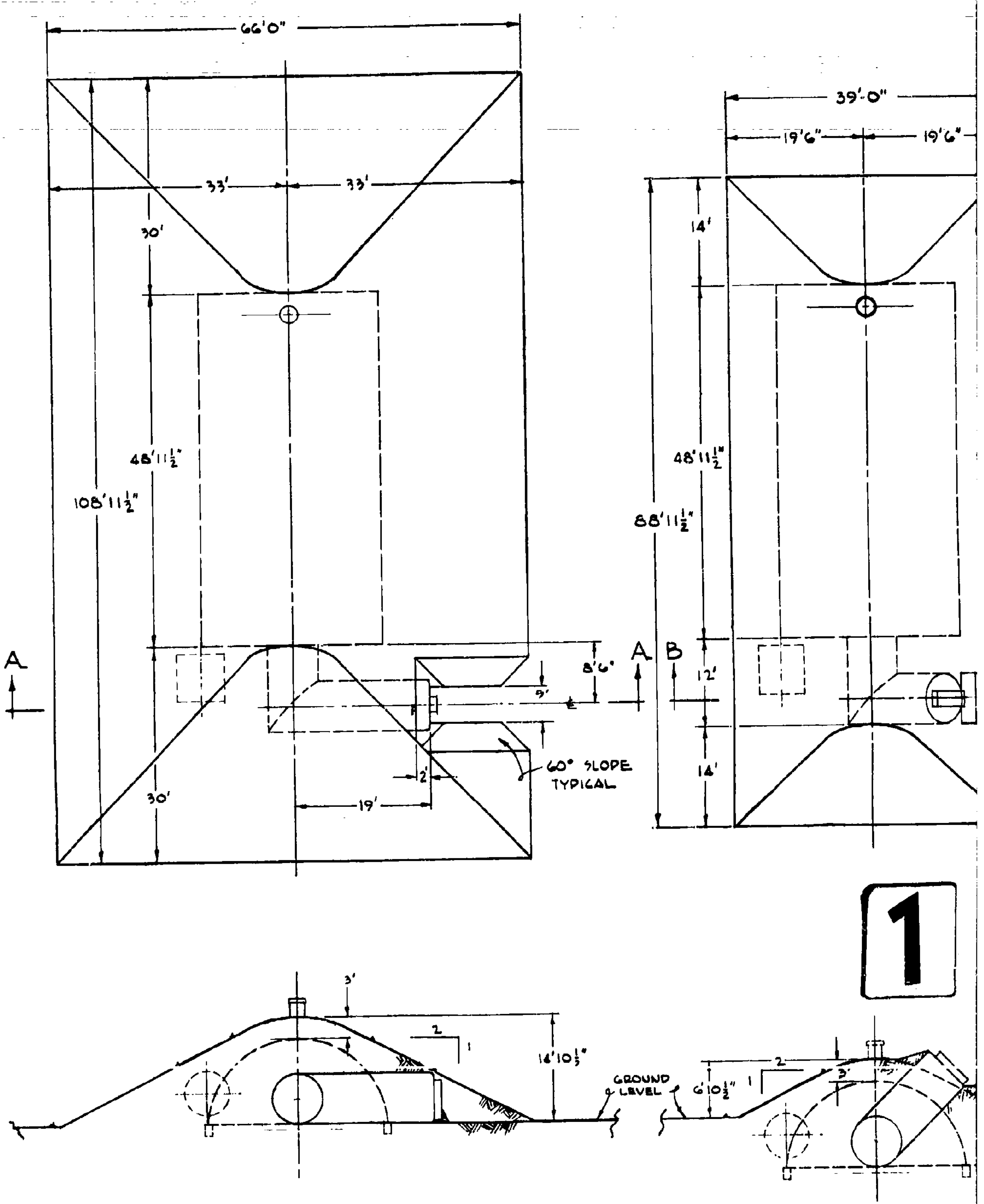
A detailed study should be undertaken to determine what shock-proofing is needed for the various facilities and equipment items specified for the shelter, and then to determine the most economical and effective method of shock-proofing them.

## 5.9 STUDY OF THE EFFECTS OF SHOCK AND BLAST LOADING ON SMALL, BURIED FUEL AND WATER STORAGE TANKS

Theoretical analysis and field testing are needed to (1) determine the effects of shock and blast loading on small, thin-walled buried tanks for storage of water and fuel; and (2) establish design criteria in order that the tanks can be readily designed to withstand a specified overpressure and a specified blast pulse duration which is dependent on the weapon yield.

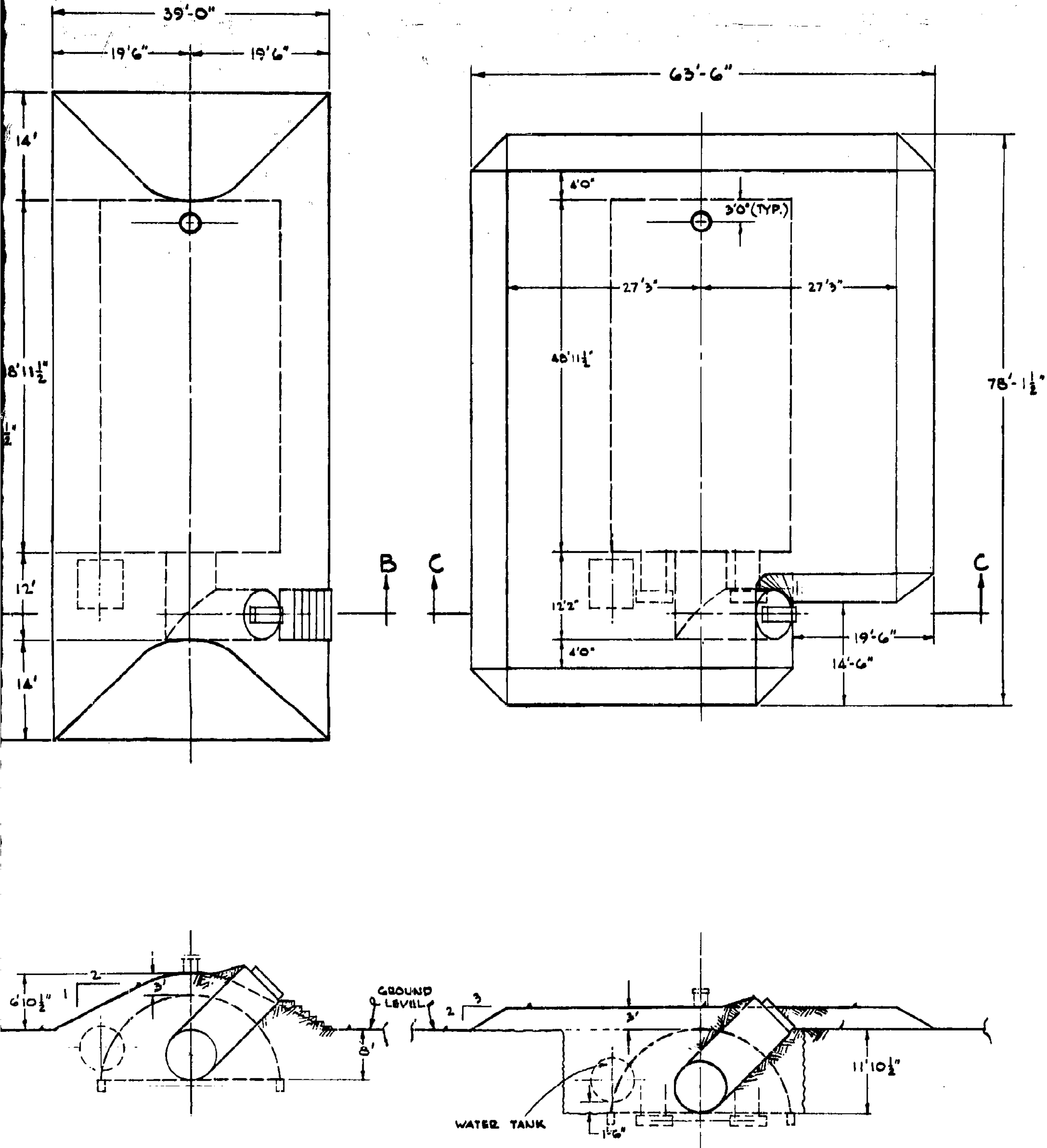
# APPENDIX A

## CONSTRUCTION DRAWINGS




SECTION A-A

SECTION B-

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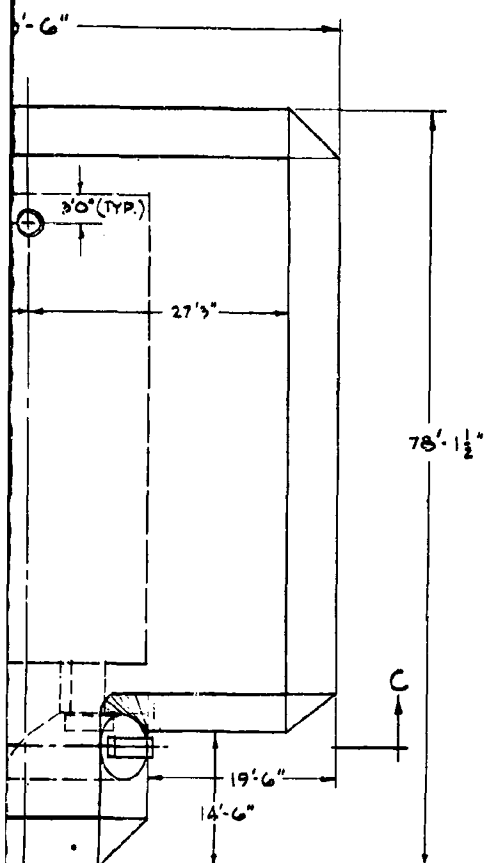



## LIST OF MATERIAL

QUANTITIES SHOWN ARE FOR

| PC. NO. | NAME | NO. REQ. | MAT'L. | MAT'L. SPECS. | STOCK SIZE | REMARKS |
|---|---|---|---|---|---|---|
| | | | | | | |

GENERAL NOTES FOR EARTH WORK

1. EXCAVATION: Excavations shall be carried to the dimensions indicated on the drawings. Excavations carried below the depth indicated shall be refilled to the proper grade with approved material and compacted to at least 90% of maximum density. (See Note 6).

2. SELECT MATERIAL: The maximum diameter of select material (if required) shall be 3 inches, and not more than 25% shall pass a No. 200 sieve. The plasticity index of the material shall not exceed 8 when tested in accordance with ASTM tests designated D423-54T and D424-54T. Material shall be free of roots, vegetable matter, and other organic substances.

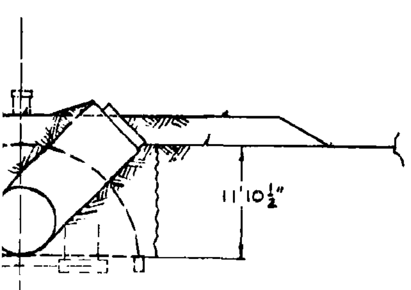
3. BACKFILL AND GRADING: Backfilling shall be accomplished essentially simultaneously on the sides and ends of the shelter, with work starting at the bottom midpoint of the sides and progressing symmetrically upward in such a manner that fill at the midsection is always deeper than at the ends. Care shall be exercised in placing and compacting the backfill to prevent deformation of the metal arch. Deformation, if any, shall not exceed 2% of the design radius.

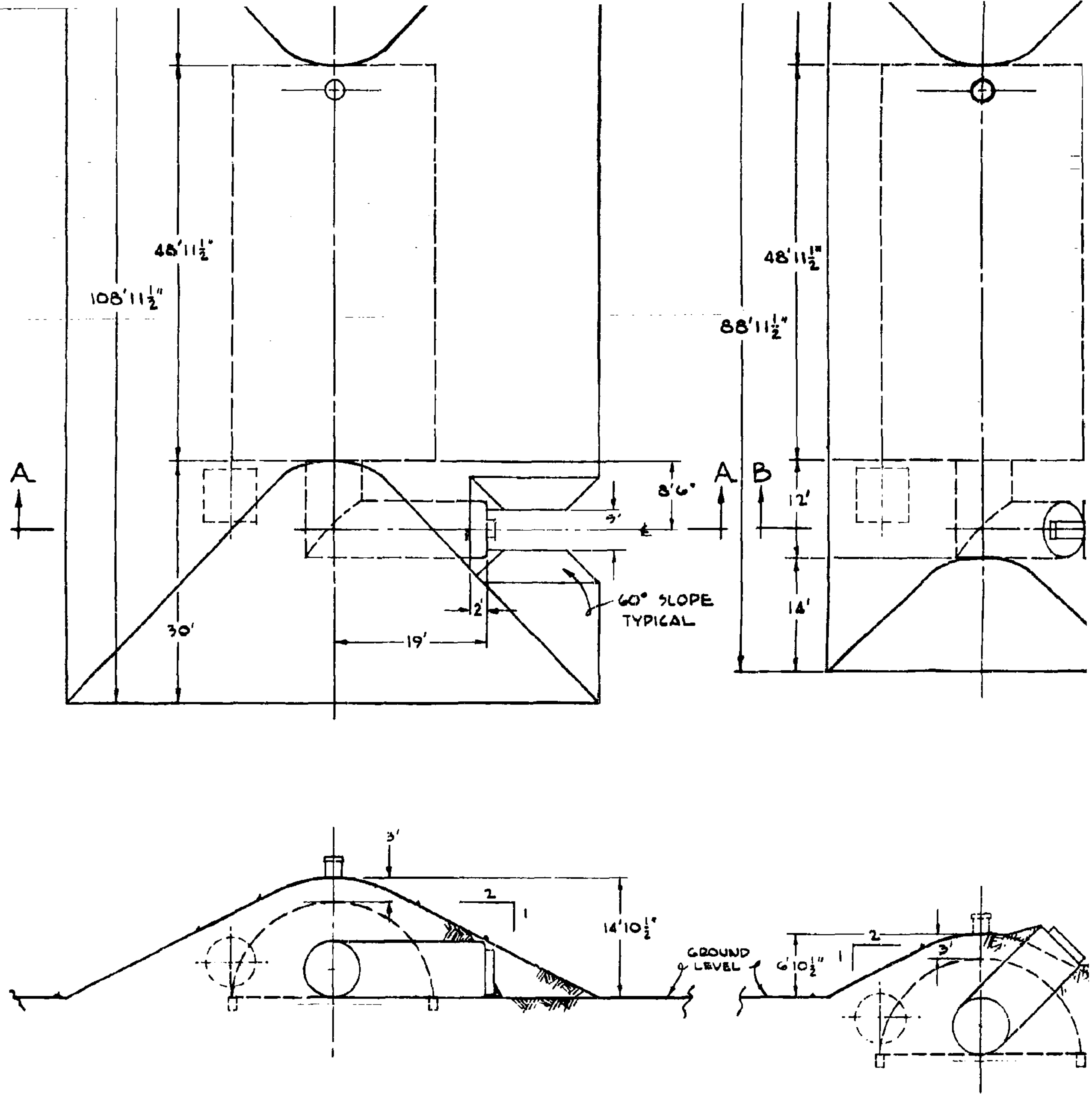
4. BACKFILL: Backfill for the sides and entrance end shall be accomplished with either native or select backfill to a point 8 ft above the floor slab. The decision as to whether to use select material for this purpose will be based on the amount of effort and earth handling required in order to use native soil to obtain backfill compaction as specified. Sand shall be used for backfill under the storage tanks as indicated (see Fig. A-17M). Backfill at the non-entrance end and above the 8-ft level may be excavated material if it is free of rocks and clods larger than 3 inches in diameter, vegetable matter, and other deleterious substances.

5. COMPACTION: All backfill material to be compacted shall be placed at optimum moisture content, moisture being added or removed as required, and shall be deposited in layers not exceeding 6 inches thick. Backfill material shall be compacted to 90% of maximum density. Compaction by watering shall not be permitted.

6. MAXIMUM DENSITY: The maximum density shall be determined in accordance with the testing procedure of AASHO (American Association of State Highway Officials) designation T-99-49, modified as follows:
   - (a) The rammer shall weigh 10 pounds.
   - (b) The rammer shall be dropped from a height of 18 inches above the sample.
   - (c) The samples shall be compacted in 5 layers, each approximately 1 inch thick, with each layer receiving 55 blows.
   - (d) The mold shall be 6 inches in diameter and 7 inches high, with a metal spacer disc 5-15/16 inches in diameter and 2-1/2 inches high, using a false bottom in the mold during compaction.
   - (e) All material retained on a 3/4-inch sieve shall be removed and replaced with an equal portion of material between the No. 4 and 3/4-inch sieves.
   - (f) A separate batch of material shall be used for each compaction test specimen. No material shall be reused for compaction.

7. The most satisfactory installation for a 35-psi minimum-cost shelter is as shown. It is conceivable that construction may be required on sites where bedrock or the water table is near the surface. In this event, the shelter can be placed at grade or below (as site conditions permit) and then completely covered with an extensive fill. The earth cover over the arch is to be graded as shown on Sketch "A". Note that the earth mound over the portion of the arch structure that protrudes above grade must be shaped so that the faces of the earth mound are no steeper than 4 horizontal to 1 vertical and so that the distance from the toe of the slope (the intersection of the slope with the original grade) to the nearest point on the structure is at least four times the height of the mound. The shelter endwalls are to be covered in accordance with Sketch "B".






SECTION A-A

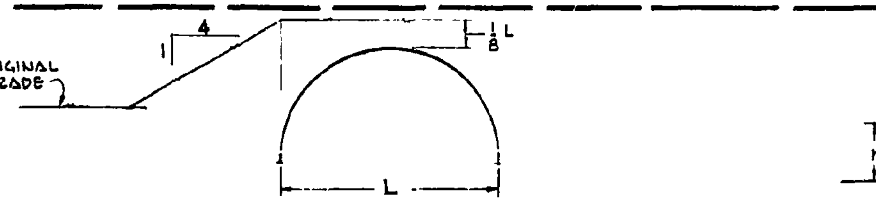
SURFACE

10 PSI MAX.

SECTION B-

SEMI--BURI

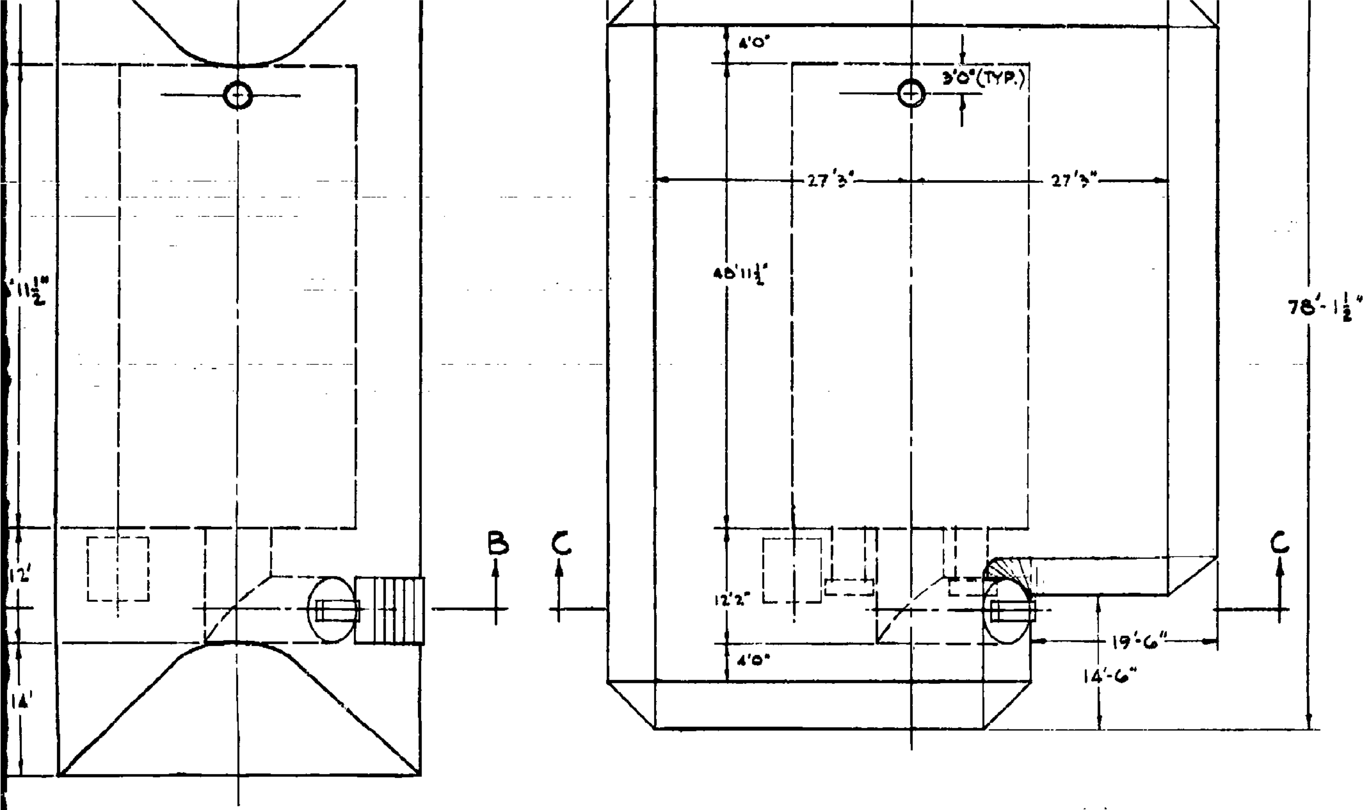
10 PSI MAX.




SKETCH "A"
ARCH BERM

BERM CONFIGURATION
35 PSI SHELTER WHEN
PROTRUDES ABOVE GR

4

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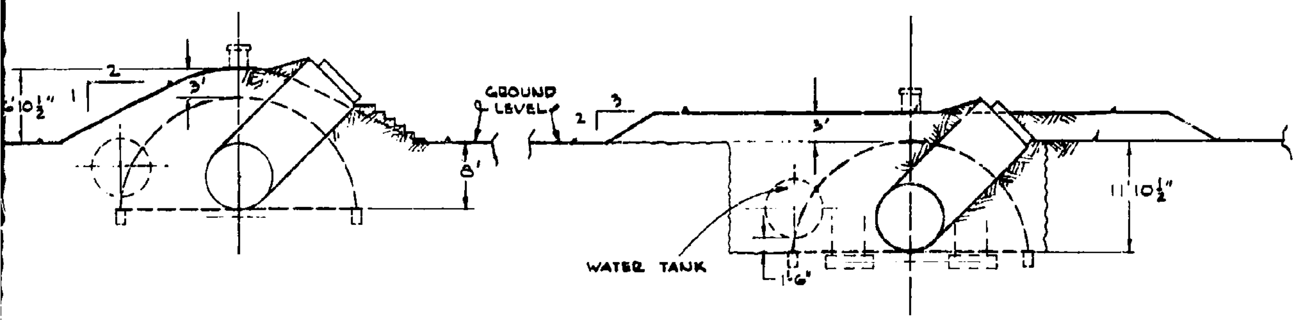



SECTION B-B

SEMI--BURIED

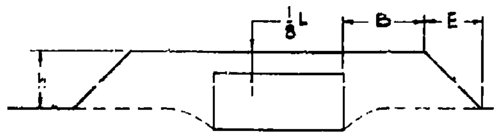
10 PSI MAX.

SECTION C-C

BURIED - SEE NOTE № 7

35 PSI MAX.

BERM CONFIGURATION FOR 35 PSI SHELTER WHEN ARCH PROTRUDES ABOVE GRADE




SKETCH "B"

BERM OVER ARCH ENDWALL

| h FT | B FT | E FT |
|---|---|---|
| 1 | 4 | 2 |
| 3 | 5 | 4 |
| 5 | [illegible] | 7 |
| 7 | 11 | 10 |
| 9 | 14 | 13 |
| 11 | 17 | 16 |
| 13 | 20 | 19 |

5

ENGINEERING & DESIGN
IS APPROVED BY: Louis G. Porter...

not more than 25% shall pass a No. 200 sieve. The plasticity index of the material shall not exceed 8 when tested in accordance with ASTM tests designated J423-54T and D424-54T. Material shall be free of roots, vegetable matter, and other organic substances.

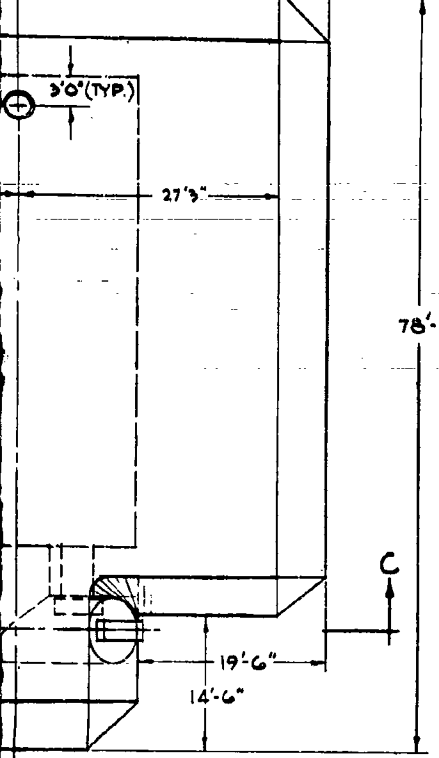
3. BACKFILL AND GRADING: Backfilling shall be accomplished essentially simultaneously on the sides and ends of the shelter, with work starting at the bottom midpoint of the sides and progressing symmetrically upward in such a manner that fill at the midsection is always deeper than at the ends. Care shall be exercised in placing and compacting the backfill to prevent deformation of the metal arch. Deformation, if any, shall not exceed 2% of the design radius.

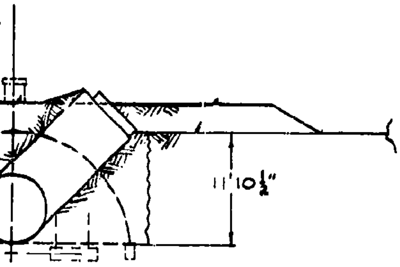
4. BACKFILL: Backfill for the sides and entrance end shall be accomplished with either native or select backfill to a point 8 ft above the floor slab. The decision as to whether to use select material for this purpose will be based on the amount of effort and earth handling required in order to use native soil to obtain backfill compaction as specified. Sand shall be used for backfill under the storage tanks as indicated (see Fig. A-17M). Backfill at the non-entrance end and above the 8-ft level may be excavated material if it is free of rocks and clods larger than 3 inches in diameter, vegetable matter, and other deleterious substances.

5. COMPACTION: All backfill material to be compacted shall be placed at optimum moisture content, moisture being added or removed as required, and shall be deposited in layers not exceeding 6 inches thick. Backfill material shall be compacted to 90% of maximum density. Compaction by watering shall not be permitted.

6. MAXIMUM DENSITY: The maximum density shall be determined in accordance with the testing procedure of AASHO (American Association of State Highway Officials) designation T-99-49, modified as follows:
   (a) The rammer shall weigh 10 pounds.
   (b) The rammer shall be dropped from a height of 18 inches above the sample.
   (c) The samples shall be compacted in 5 layers, each approximately 1 inch thick, with each layer receiving 55 blows.
   (d) The mold shall be 6 inches in diameter and 7 inches high, with a metal spacer disc 5-15/16 inches in diameter and 2-1/2 inches high, using a false bottom in the mold during compaction.
   (e) All material retained on a 3/4-inch sieve shall be removed and replaced with an equal portion of material between the No. 4 and 3/4-inch sieves.
   (f) A separate batch of material shall be used for each compaction test specimen. No material shall be reused for compaction.

7. The most satisfactory installation for a 35-psi minimum-cost shelter is as shown. It is conceivable that construction may be required on sites where bedrock or the water table is near the surface. In this event, the shelter can be placed at grade or below (as site conditions permit) and then completely covered with an extensive fill. The earth cover over the arch is to be graded as shown on Sketch "A". Note that the earth mound over the portion of the arch structure that protrudes above grade must be shaped so that the faces of the earth mound are no steeper than 4 horizontal to 1 vertical and so that the distance from the toe of the slope (the intersection of the slope with the original grade) to the nearest point on the structure is at least four times the height of the mound. The shelter endwalls are to be covered in accordance with Sketch "B".




TION C-C

RIED - SEE NOTE № 7

35 PSI MAX.

| B FT | E FT |
|---|---|
| 4 | 2 |
| 5 | 4 |
| 8 | 7 |
| 11 | 10 |
| 14 | 13 |
| 17 | 16 |
| 20 | 19 |

6

ENGINEERING & DESIGN IS APPROVED BY: Lewis G. Porteous DATE: 22 May 62

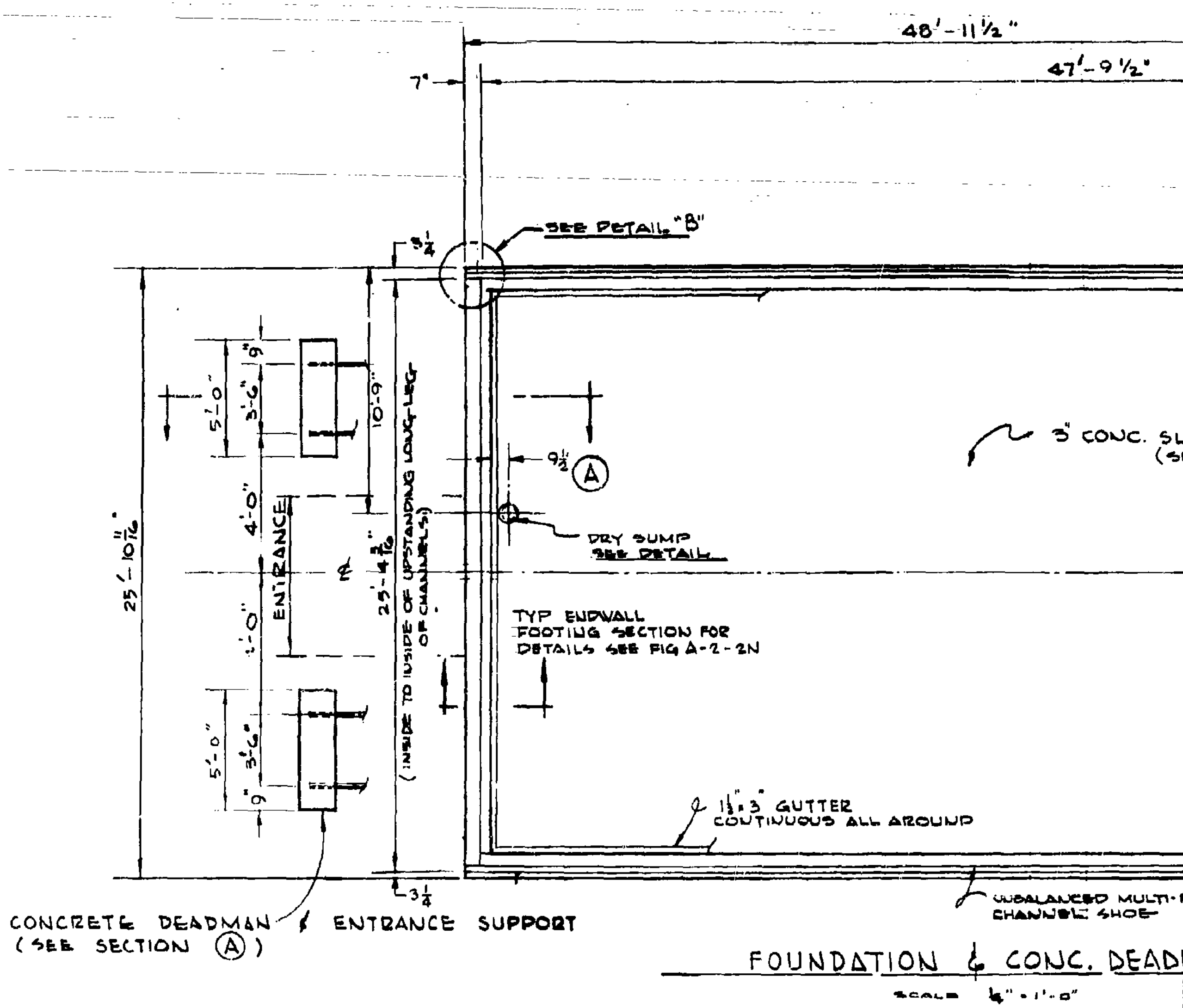
| REVISION | DATE | DESCRIPTION | BY | APP. |
|---|---|---|---|---|

UNITED STATES
NAVAL RADIOLOGICAL DEFENSE LABORATORY
SAN FRANCISCO 24, CALIFORNIA

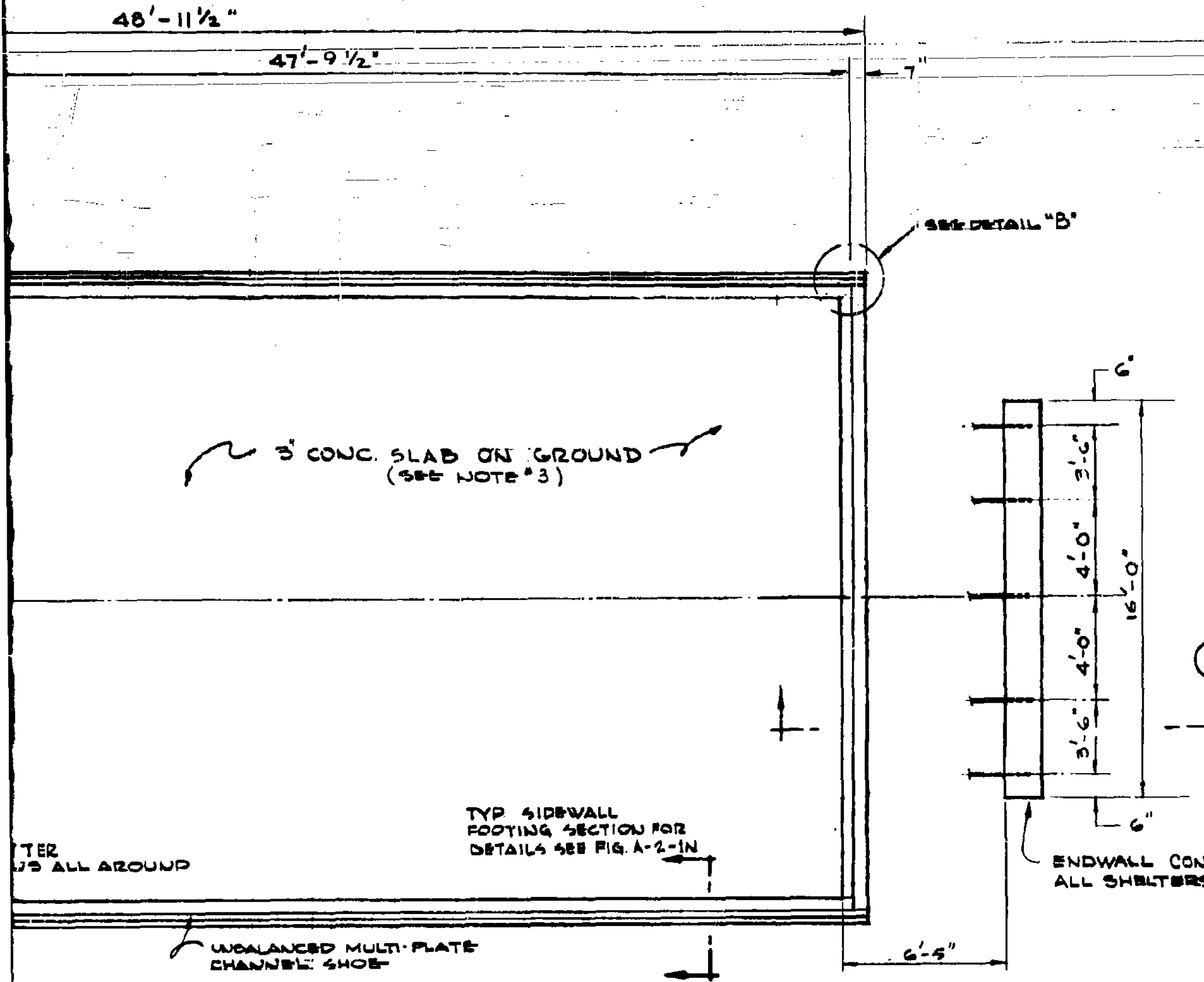
DRAWN: FJA
CHECKED: FKL
PROJ. ENGR.
SUPV.
BRANCH HEAD
DIVISION HEAD
DEVELOPMENTAL DWG
SCOPE APPROVED: LGP DATE: 5-22-62

FIG. A-1M
GENERAL CONFIGURATIONS

DWG. NO. S-62-970 SHT. 1 OF 19

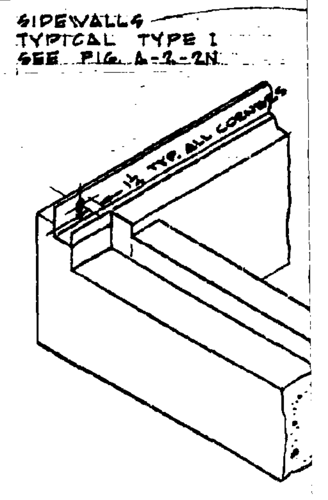

48'-11½"
47'-9½"
7"
SEE DETAIL "B"
3¼
25'-10 11/16"
5'-0"
3'-6"
9"
10'-9"
4'-0"
ENTRANCE
1'-0"
25'-4 3/16"
(INSIDE TO INSIDE OF UPSTANDING LONG-LEG OF CHANNELS)
9½
A
DRY SUMP
SEE DETAIL
3" CONC. SL
TYP ENDWALL
FOOTING SECTION FOR
DETAILS SEE FIG A-2-2N
1½" x 3" GUTTER
CONTINUOUS ALL AROUND
CONCRETE DEADMAN & ENTRANCE SUPPORT
(SEE SECTION A)
UNBALANCED MULTI-
CHANNEL SHOE
FOUNDATION & CONC. DEAD
SCALE ¼" = 1'-0"

1



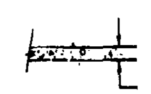

NDATION & CONC. DEADMAN PLAN

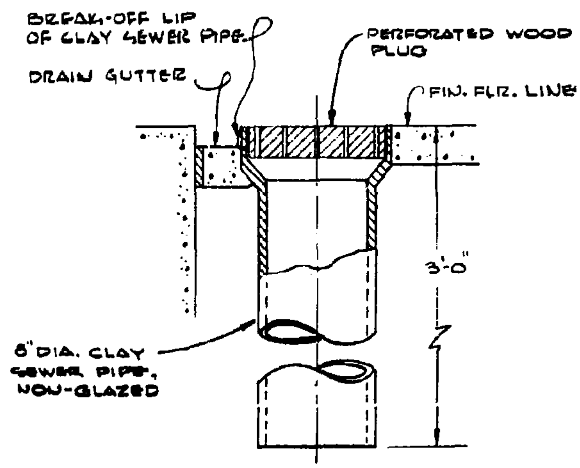
SCALE ⅛" = 1'-0"




DETAIL "B

¾" = 1'-0"






DETAIL of DRY SUMP

SCALE: 1½" = 1'-0"

GENERA

1.

2.

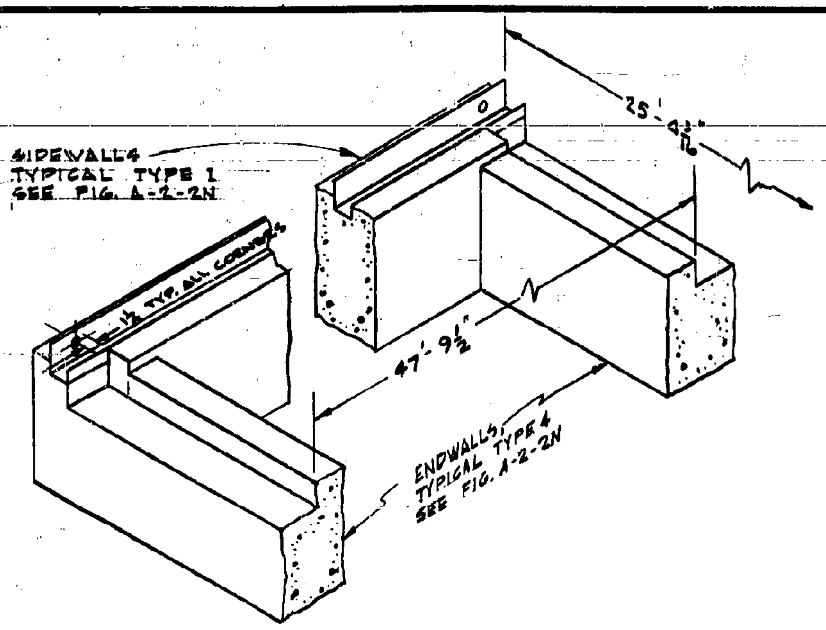
3.

4.

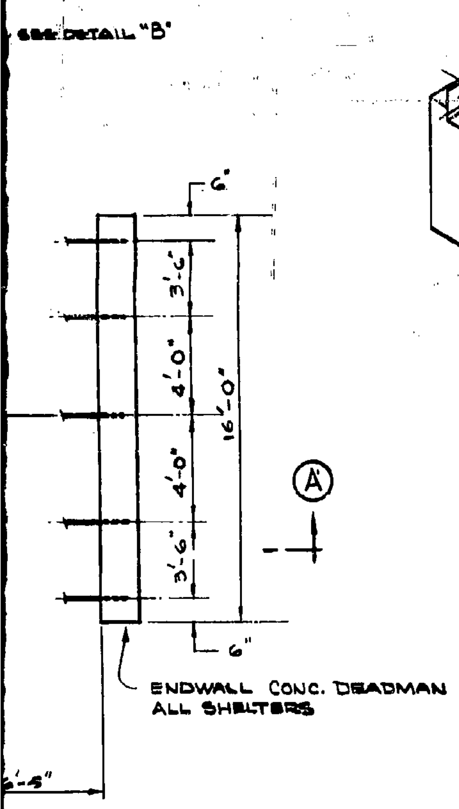
5.

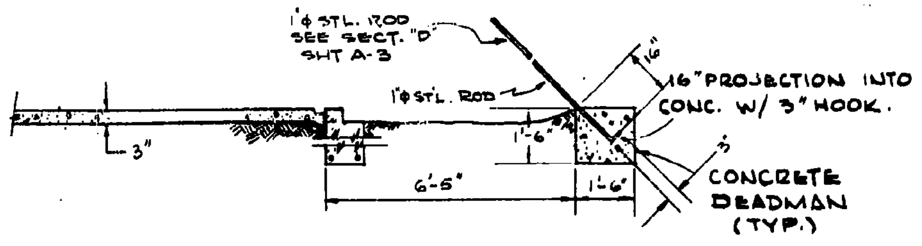
6.

2

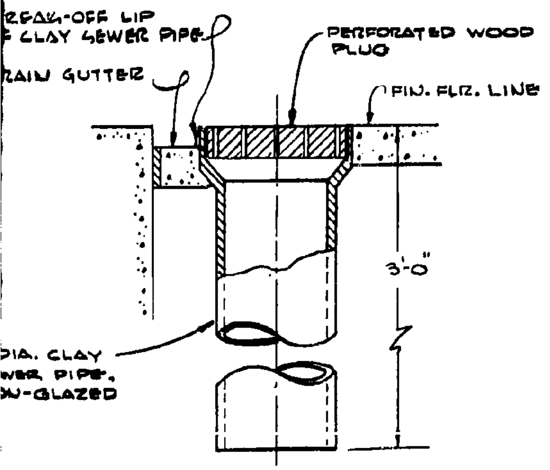



DETAIL "B"
¾" = 1'-0"




SECTION (A)




DETAIL of
DRY SUMP
SCALE: 1½" = 1'-0"

3

## GENERAL NOTES:

1. CONCRETE SHALL HAVE A MINIMUM ULTIMATE COMPRESSIVE STRENGTH of 2500 PSI AT 28 DAYS.
2. ALL FOUNDATIONS SHOWN ON THIS DWG. ARE SYMBOLIC ONLY. FOR ACTUAL DESIGN & CONSTR. DETAILS OF THE FOUNDATION TO SUIT A PARTICULAR SITE, REFER TO FIGS. A-2-1N & A-2-2N
3. THE SURFACE of THE SLAB SHALL BE FLOATED TO A SMOOTH FINISH WITH A STEEL FLOAT, AND IT SHALL NOT VARY MORE THAN ½" WHEN MEASURED WITH A 10-FT. TEMPLATE.
4. LUMBER SHALL BE DOUGLAS FIR, CONSTR. GRADE
5. CEMENT SHALL CONFORM WITH REQUIREMENTS OF FEDERAL SPECIFICATIONS SS-C-192b, TYPE I.
6. REINFORCING STEEL SHALL BE INTERMEDIATE GRADE BILLET STEEL CONFORMING TO FEDERAL SPECIFICATION QQ-S-632, TYPE II, GRADE C.

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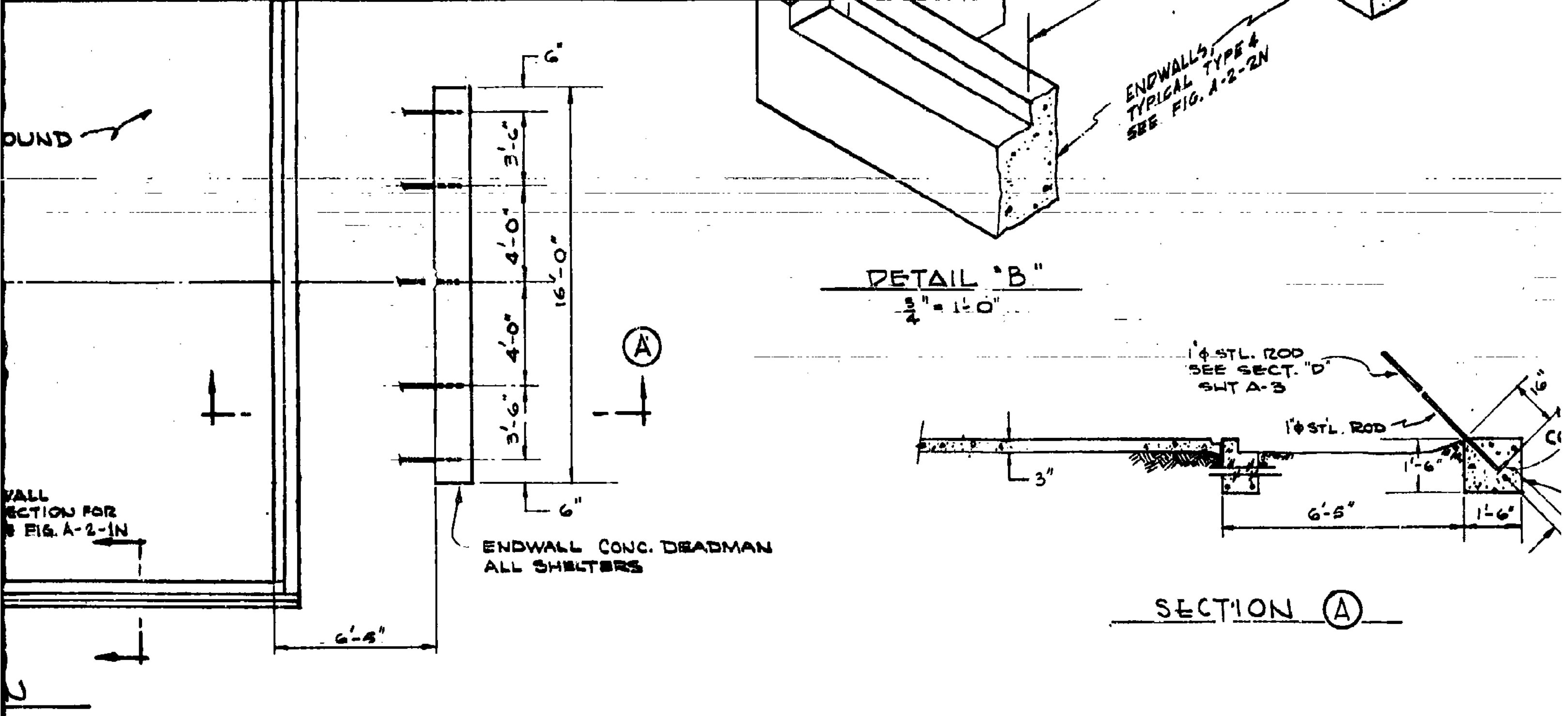
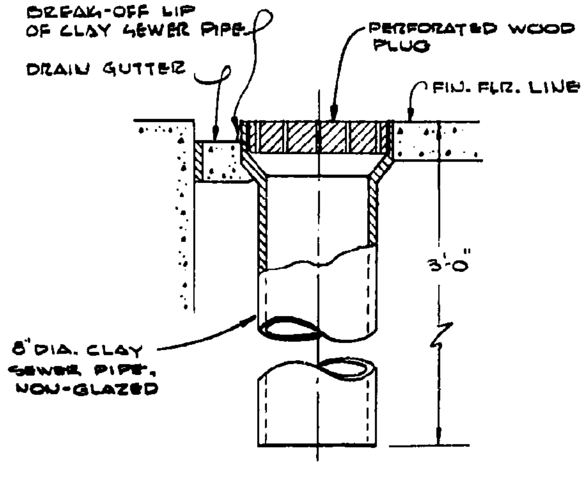
UNITED STATES
NAVAL RADIOLOGICAL DEFENSE LABORATORY
SAN FRANCISCO 24, CALIFORNIA




DETAIL of
DRY SUMP
SCALE: 1½" = 1'-0"

GENERAL NOTES:

1. CONCRETE SHALL HAVE A MINIMUM
COMPRESSIVE STRENGTH of 2500 PS
2. ALL FOUNDATIONS SHOWN ON THIS DWG. ARE
FOR ACTUAL DESIGN & CONSTR. DETAILS OF
TO SUIT A PARTICULAR SITE, REFER TO F
3. THE SURFACE of THE SLAB SHALL B
TO A SMOOTH FINISH WITH A STEEL FLO
IT SHALL NOT VARY MORE THAN
MEASURED WITH A 10-FT. TEMPLAT
4. LUMBER SHALL BE DOUGLAS FIR, C
5. CEMENT SHALL CONFORM WITH REQUIRE
FEDERAL SPECIFICATIONS SS-C-192b
6. REINFORCING STEEL SHALL BE INTERMEI
BILLET STEEL CONFORMING TO FEDERAL S
QQ-S-632, TYPE II, GRADE C.

4

| REVISION | DATE | DESCRIPTION |
|---|---|---|

UNITED STATES
NAVAL RADIOLOGICAL DEFENSE LA
SAN FRANCISCO 24, CALIFORNI

| | |
|---|---|
| DRAWN | FJA |
| CHECKED | FJa |
| SECTION HEAD | |
| BRANCH HEAD | DEVELOPMENTAL DWG |
| DIVISION HEAD | |

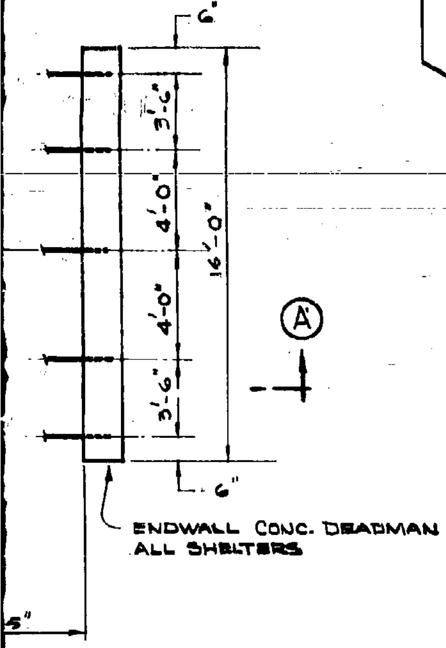
FIG. A
FOUNDATION, FLO
DEADMEN ARRA

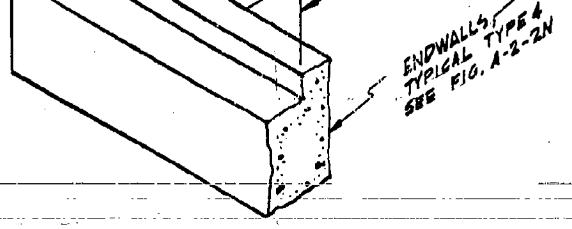
| DATE | SCALE | PROJECT |
|---|---|---|
| 26 FEB 62 | NOTED | |

SATISFACTORY TO: LGP
DATE 5-22-62

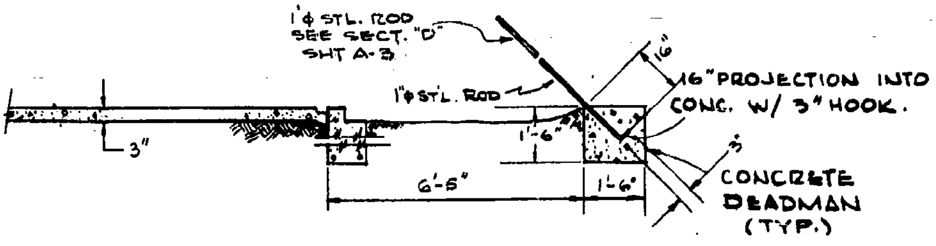
DRAWING S-62
SHEET

ENGINEERING & DESIGN
IS APPROVED BY: Lewis G. Portman DATE: 22 May 62

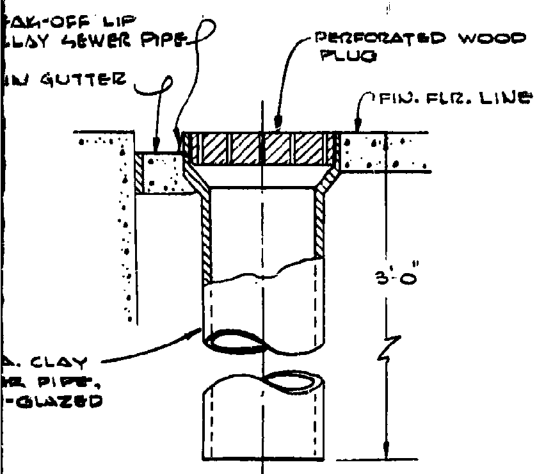



DETAIL "B"
3/4" = 1'-0"




SECTION (A)




DETAIL of DRY SUMP
SCALE: 1½" = 1'-0"

## GENERAL NOTES:

1. CONCRETE SHALL HAVE A MINIMUM ULTIMATE COMPRESSIVE STRENGTH of 2500 PSI AT 28 DAYS.
2. ALL FOUNDATIONS SHOWN ON THIS DWG. ARE SYMBOLIC ONLY. FOR ACTUAL DESIGN & CONSTR. DETAILS OF THE FOUNDATION TO SUIT A PARTICULAR SITE, REFER TO FIGS. A-2-1N & A-2-2N
3. THE SURFACE of THE SLAB SHALL BE FLOATED TO A SMOOTH FINISH WITH A STEEL FLOAT, AND IT SHALL NOT VARY MORE THAN ½" WHEN MEASURED WITH A 10-FT. TEMPLATE.
4. LUMBER SHALL BE DOUGLAS FIR, CONSTR. GRADE
5. CEMENT SHALL CONFORM WITH REQUIREMENTS OF FEDERAL SPECIFICATIONS SS-C-192b, TYPE I.
6. REINFORCING STEEL SHALL BE INTERMEDIATE GRADE BILLET STEEL CONFORMING TO FEDERAL SPECIFICATION QQ-S-632, TYPE II, GRADE C.

5

| REVISION | DATE | DESCRIPTION | BY | APP. |
|---|---|---|---|---|
| | | | | |

UNITED STATES
NAVAL RADIOLOGICAL DEFENSE LABORATORY
SAN FRANCISCO 24, CALIFORNIA

| | |
|---|---|
| DRAWN | FJA |
| CHECKED | FJa |
| SECTION HEAD | DEVELOPMENTAL DWG |
| BRANCH HEAD | |
| DIVISION HEAD | |

**FIG. A-2M**
**FOUNDATION, FLOOR SLAB, AND DEADMEN ARRANGEMENTS**

| DATE | SCALE | PROJECT | FINISH | HEAT TREAT |
|---|---|---|---|---|
| 26 FEB 62 | NOTED | | | |

SATISFACTORY TO: LGP
DATE 5-22-62
DRAWING NUMBER S-62-970 SHEET 2 OF 19
ALT.

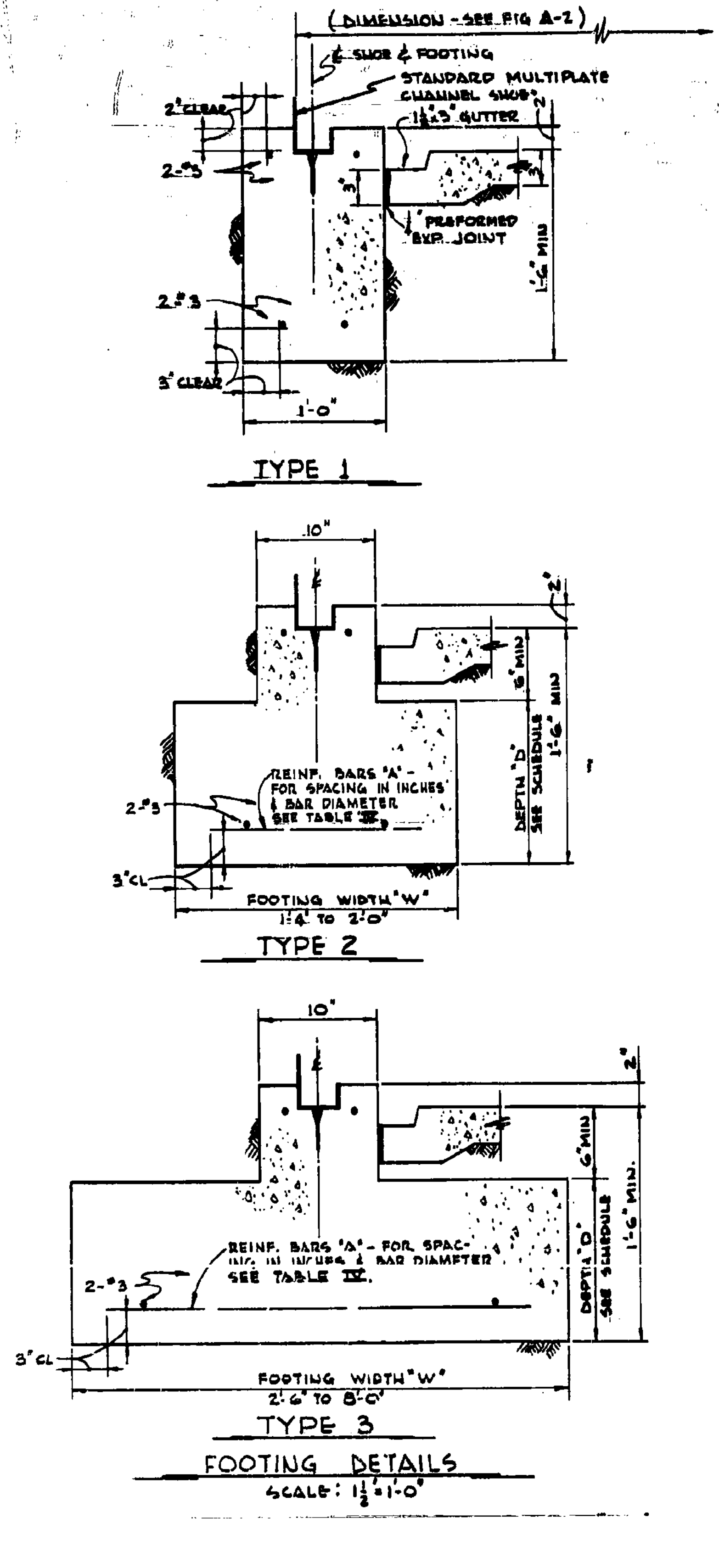
ENGINEERING & DESIGN IS APPROVED BY: Lewis G. Partsons DATE: 22 May 62

TABLE I

UNIFORM BEARING LOADS TO SIDEWALL FOOTINGS

| BACKFILL SOIL TYPE | FOOTING LOAD -L... |
|---|---|
| | $*P_o$ = 10 PSI |
| Gravel, sand, gravel and sand, gravel-sand-silt and gravel-sand-clay mixtures, or crushed rock | 10,000 LB/L.F. |
| Inorganic clay, gravelly clay, sandy clay, or silty clay of medium to low compressibility and plasticity | 10,000 |
| Inorganic silt, very fine sand, fine sand and silt, or soft, plastic, compressible clay | 20,000 |

$*P_o$ = design blast overpressure rating of shelter.




SIDWALL...

| TYP... BENEA... |
|---|
| HARDP... GRAVE... |
| COARS... COHES... AS GR... GRAVE... |
| FINE... SOIL... SAND... GRAV... |

| FOOTING WIDTH "W"(FT & IN.) FROM TABLE III | 10,00... |
|---|---|
| | D |
| 1-0 | - |
| 1-4 | 0-10 |
| 1-8 | 0-10 |
| 2-0 | 0-10 |
| 2-6 | 0-10 |
| 3-0 | 0-10 |
| 4-0 | 0-10 |
| 5-0 | 0-10 |
| 6-0 | 0-10 |
| 8-0 | 0-10 |

1

1. Normal safe beari...
2. Bearing values fo... in direct proport...
3. Compact gravel, s... resistance to pen...
4. Loose gravel, san...

TABLE I
NG LOADS TO SIDEWALL FOOTINGS

| | FOOTING LOAD -LBS/LIN. FT. | |
|---|---|---|
| | *$P_o$ = 10 PSI | *$P_o$ = 35 PSI |
| vel and sand, and gravel-sand- crushed rock | 10,000 LB/L.F. | 30,000 LB/L.F. |
| ravelly clay, sandy of medium to low nd plasticity | 10,000 | 45,000 |
| ery fine sand, t, or soft, plastic, | 20,000 | 60,000 |

pressure rating of shelter.

TABLE II
NORMAL SAFE BEARING CAPACITY OF VARIOUS SOILS

| | SOIL TYPE | Normal Safe Bearing Capacity-Lbs/Sq.Ft. |
|---|---|---|
| | HARDPAN, cemented gravel ledge rock | 20,000 lb/s.f. minim. |
| | | |
| COARSE-GRAINED NON-COHESIVE SOILS | Compact gravel or sand and gravel | 8,000 lb/s.f. |
| | Loose gravel or sand and gravel | 6,000 |
| | Compact coarse sand | 6,000 |
| | Loose coarse sand | 4,000 |
| | Compact fine sand | 4,000 |
| | Loose fine sand | 2,000 |
| | | |
| FINE-GRAINED COHESIVE SOILS | Hard clay | 8,000 |
| | Firm or medium clay | 4,000 |
| | Soft clay | 2,000 |
| | Adobe | 1,000 |
| | | |
| INTER-MEDIATE TYPE SOILS | Compact inorganic sand and silt | 1,500 |
| | Loose inorganic sand and silt | 500 |
| | | |

TABLE III
SIDEWALL FOOTING WIDTHS AS REQ'D BY FOOTING LOAD AND NORMAL SAFE BEARING CAPACITY

| TYPE OF SOIL BENEATH FOOTING | NORMAL SAFE BEARING CAPACITY | FOOTING WIDTH REQUIRED IN FEET AND INCHES FOR FOOTING LOAD SHOWN (POUNDS/LIN. FOOT) | | | | |
|---|---|---|---|---|---|---|
| | | 10,000 | 20,000 | 30,000 | 45,000 | 60,000 |
| HARDPAN, CEMENTED GRAVEL, OR LEDGE ROCK | 20,000 lb/s.f. | 1-0 | 1-0 | 1-0 | 1-0 | 1-0 |
| | | | | | | |
| COARSE-GRAINED NON-COHESIVE SOILS, SUCH AS GRAVEL, SAND, AND GRAVEL AND SAND | 12,000 lb/s.f. | 1-0 | 1-0 | 1-4 | 2-0 | 2-6 |
| | 10,000 | 1-0 | 1-4 | 1-8 | 2-6 | 3-0 |
| | 8,000 | 1-0 | 1-8 | 2-0 | 2-6 | 3-0 |
| | 6,000 | 1-0 | 1-8 | 2-6 | 3-0 | 4-0 |
| | 4,000 | 1-4 | 2-6 | 3-0 | 4-0 | 5-0 |
| | 3,000 | 1-8 | 3-0 | 4-0 | 5-0 | 6-0 |
| | 2,000 | 2-6 | 4-0 | 5-0 | 6-0 | 8-0 |
| | 1,500 | 3-0 | 5-0 | 6-0 | 8-0 | - |
| | 1,000 | 4-0 | 6-0 | 8-0 | - | - |
| | | | | | | |
| FINE-GRAINED COHESIVE SOILS, SUCH AS CLAY AND SANDY, SILTY OR GRAVELLY CLAY | 12,000 lb/s.f. | 1-0 | 1-0 | 1-0 | 1-0 | 1-4 |
| | 10,000 | 1-0 | 1-0 | 1-0 | 1-0 | 1-4 |
| | 8,000 | 1-0 | 1-0 | 1-0 | 1-4 | 1-8 |
| | 6,000 | 1-0 | 1-0 | 1-4 | 1-8 | 2-6 |
| | 4,000 | 1-0 | 1-4 | 1-8 | 2-6 | 4-0 |
| | 3,000 | 1-0 | 1-8 | 2-6 | 4-0 | 5-0 |
| | 2,000 | 1-4 | 2-6 | 4-0 | 5-0 | 8-0 |
| | 1,500 | 1-8 | 3-0 | 5-0 | 8-0 | - |
| | 1,000 | 2-6 | 5-0 | 8-0 | - | - |
| | | | | | | |

TABLE IV
FOOTING STEEL REINFORCEMENT SCHEDULE FOR SIDEWALL FOOTINGS *

| FOOTING WIDTH "W" (FT & IN.) FROM TABLE III | FOOTING LOAD LBS/LIN. FT. (FROM TABLE I) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10,000 LB/L.F. | | 20,000 LB/L.F. | | 30,000 LB/L.F. | | 45,000 LB/L.F. | | 60,000 LB/L.F. | |
| | D | REINF. "A" | D | REINF. "A" | D | REINF. "A" | D | REINF. "A" | D | REINF. "A" |
| 1-0 | - | None | - | None | - | None | - | None | - | None |
| 1-4 | 0-10 | None | 0-10 | None | 0-10 | None | 0-10 | None | 0-10 | None |
| 1-8 | 0-10 | None | 0-10 | None | 0-10 | None | 1-0 | None | 1-0 | None |
| 2-0 | 0-10 | #3 @ 24 inches | 0-10 | #3 @ 24 inches | 1-0 | #3 @ 24 inches | 1-2 | #3 @ 24 inches | 1-3 | #3 @ 24 inches |
| 2-6 | 0-10 | #3 @ 6 " | 0-10 | #3 @ 6 " | 0-10 | #3 @ 4 " | 1-0 | #3 @ 3½ " | 1-0 | #3 @ 2½ " |
| 3-0 | 0-10 | #3 @ 6 " | 0-10 | #3 @ 5 " | 0-10 | #3 @ 3½ " | 1-0 | #3 @ 3 " | 1-0 | #3 @ 2½ " |
| 4-0 | 0-10 | #3 @ 6 " | 0-10 | #3 @ 5 " | 0-10 | #3 @ 3 " | 1-0 | #3 @ 3 " | 1-0 | #3 @ 2 " |
| 5-0 | 0-10 | #3 @ 6 " | 0-10 | #3 @ 4 " | 0-10 | #3 @ 2½ " | 1-0 | #4 @ 3½ " | 1-2 | #4 @ 3½ " |
| 6-0 | 0-10 | #4 @ 10 " | 0-10 | #4 @ 5 " | 0-10 | #4 @ 3½ " | 1-0 | #5 @ 4½ " | 1-2 | #5 @ 4 " |
| 8-0 | 0-10 | #4 @ 7 " | 0-10 | #4 @ 3½ " | 0-10 | #5 @ 3½ " | 1-0 | #6 @ 4½ " | 1-2 | #6 @ 4 " |

* Reinforcement steel is fabricated in increments of ⅛ inch on the diameter. The designation #3 indicates a rod ⅜ inch in diameter.

TERMS USED IN TABLES

1. Normal safe bearing capacity as shown is for a footing 3'-0" wide at a depth of 1'-6" below grade.

2. Bearing values for coarse-grained soils as shown in Table II are for a footing 3'-0" wide, and are to be reduced in direct proportion to footing width for footings less than 3'-0" wide.

3. Compact gravel, sand, or sand and gravel are deposits which require picking for removal, and offer high resistance to penetration by excavating tools.

The sidewall footing
rating for which the shel
to and over the shelter,
footings.

Table I establishes
Enter with the overpressu
load in pounds per lineal
soil, use that giving the

Next, determine the
beneath the footings. Th
excavated site, or record
capacity" is the bearing
structures for resistance

The normal safe bear
qualified soils engineer,
bearing capacities from I

Bearing capacity is
bearing capacities are de
size and shape of the foo
proportioning footings fo
adjacent grade. Where be
adjustments must be made.

Footings for shelter
of the soil under dynamic
directly, but is an indic
results to be achieved, t
bearing capacity of the s
have a safety factor of 2
conditions.

Bearing values estab
factor in this range. An
excessive settlement unde
static bearing capacity s

Normal safe bearing
great variation in values
may be due to actual vari
variation in the actual s
in various parts of the U
than those in Table II a
by a soils engineer, adju

Enter Table III with
of soil beneath the footi
soils are intermediate in
grained, cohesive" groups
of the two may be used.

In establishing foot
of footing width on beari
soils. No further adjust

The detailed design
Table IV with the footing
thickness of the footing
footing details are as sh

ILLUSTRATIVE EXAMPLE:

A shelter is to be d
will bear on a clay-type
will be clean sand and gr
the footing load is found
a bearing value of 3,000
4,000 pounds per square f
since it is the smaller v
foot and fine-grained coh
width of 2'-6" is found.
of 2'-6", the thickness i
spacing. Other footing d

TABLE II
NG CAPACITY OF VARIOUS SOILS

| TYPE | Normal Safe Bearing Capacity-Lbs/Sq.Ft. |
|---|---|
| gravel ledge rock | 20,000 lb/s.f. minim. |
| | |
| sand and gravel | 8,000 lb/s.f. |
| nd and gravel | 6,000 |
| d | 6,000 |
| | 4,000 |
| | 4,000 |
| | 2,000 |
| | |
| | 8,000 |
| y | 4,000 |
| | 2,000 |
| | 1,000 |
| | |
| sand and silt | 1,500 |
| nd and silt | 500 |
| | |

III
D AND NORMAL SAFE BEARING CAPACITY

| FOOTING WIDTH REQUIRED IN FEET AND INCHES FOR FOOTING LOAD SHOWN (POUNDS/LIN. FOOT) | | | | |
|---|---|---|---|---|
| 10,000 | 20,000 | 30,000 | 45,000 | 60,000 |
| 1-0 | 1-0 | 1-0 | 1-0 | 1-0 |
| | | | | |
| 1-0 | 1-0 | 1-4 | 2-0 | 2-6 |
| 1-0 | 1-4 | 1-8 | 2-6 | 3-0 |
| 1-0 | 1-8 | 2-0 | 2-6 | 3-0 |
| 1-0 | 1-8 | 2-6 | 3-0 | 4-0 |
| 1-4 | 2-6 | 3-0 | 4-0 | 5-0 |
| 1-8 | 3-0 | 4-0 | 5-0 | 6-0 |
| 2-6 | 4-0 | 5-0 | 6-0 | 8-0 |
| 3-0 | 5-0 | 6-0 | 8-0 | - |
| 4-0 | 6-0 | 8-0 | - | - |
| | | | | |
| 1-0 | 1-0 | 1-0 | 1-0 | 1-4 |
| 1-0 | 1-0 | 1-0 | 1-0 | 1-4 |
| 1-0 | 1-0 | 1-0 | 1-4 | 1-8 |
| 1-0 | 1-0 | 1-4 | 1-8 | 2-6 |
| 1-0 | 1-4 | 1-8 | 2-6 | 4-0 |
| 1-0 | 1-8 | 2-6 | 4-0 | 5-0 |
| 1-4 | 2-6 | 4-0 | 5-0 | 8-0 |
| 1-8 | 3-0 | 5-0 | 8-0 | - |
| 2-6 | 5-0 | 8-0 | - | - |
| | | | | |

LE FOR SIDEWALL FOOTINGS *

| (FROM TABLE I) | | | | |
|---|---|---|---|---|
| L.F. | 45,000 LB/L.F. | | 60,000 LB/L.F. | |
| INF. "A" | D | REINF. "A" | D | REINF. "A" |
| None | - | None | - | None |
| None | 0-10 | None | 0-10 | None |
| None | 1-0 | None | 1-0 | None |
| @ 24 inches | 1-2 | #3 @ 24 inches | 1-3 | #3 @ 24 inches |
| @ 4 " | 1-0 | #3 @ 3½ " | 1-0 | #3 @ 2½ " |
| @ 3½ " | 1-0 | #3 @ 3 " | 1-0 | #3 @ 2½ " |
| @ 3 " | 1-0 | #3 @ 3 " | 1-0 | #3 @ 2 " |
| @ 2½ " | 1-0 | #4 @ 3½ " | 1-2 | #4 @ 3½ " |
| @ 3½ " | 1-0 | #5 @ 4½ " | 1-2 | #5 @ 4 " |
| @ 3½ " | 1-0 | #6 @ 4½ " | 1-2 | #6 @ 4 " |

* Reinforcement steel is fabricated in increments of ⅛ inch on the diameter. The designation #3 indicates a rod ⅜ inch in diameter.

BLES

wide at a depth of 1'-6" below grade.

footing 3'-0" wide, and are to be reduced 3'-0" wide.

equire picking for removal, and offer high

## LIST OF MATERIAL

QUANTITIES SHOWN ARE FOR

| PC. NO. | NAME | NO. REQ. | MAT'L. | MAT'L. SPEC. | STOCK SIZE | REMARKS |
|---|---|---|---|---|---|---|
| | | | | | | |

## PROCEDURE FOR DETERMINING THE DESIGN AND CONSTRUCTION DETAILS OF THE SHELTER'S SIDEWALL FOOTINGS

The sidewall footing to be used with a particular shelter is dependent on (a) the overpressure rating for which the shelter is to be designed, (b) the type of soil used for backfill adjacent to and over the shelter, and (c) the type and bearing capacity of the in-place soil beneath the footings.

Table I establishes the bearing load that must be supported by the continuous sidewall footings. Enter with the overpressure rating and the type of soil used for backfill to determine the foundation load in pounds per lineal foot of footing. Where doubt exists as to proper classification of backfill soil, use that giving the higher footing load in Table I.

Next, determine the type of soil and the normal safe bearing capacity of the in-place soil beneath the footings. The type of soil is determined by preliminary borings, inspection of the excavated site, or records of previous construction in the immediate area. The "normal safe bearing capacity" is the bearing value that would be used in proportioning footings of building and other structures for resistance to normal service loads exclusive of wind, earthquake, or impact loads.

The normal safe bearing capacity can be established by (a) a special soils investigation by a qualified soils engineer, (b) use of tabulated "permissible," "allowable," or "presumptive" safe bearing capacities from local building codes, or (c) use of recommended bearing values from Table II.

Bearing capacity is expressed in terms of pounds per square foot of footing area. The actual bearing capacities are dependent not only on the type and properties of the soil, but also on the size and shape of the footing. Values shown in Table II and as used in succeeding steps of proportioning footings for shelters are for a footing 3 feet wide at a depth of 1-1/2 feet below adjacent grade. Where bearing values are stated in terms of other widths or depths, appropriate adjustments must be made by a qualified soils engineer.

Footings for shelters are proportioned on the basis of the expected ultimate bearing capacity of the soil under dynamic conditions of loading. The normal safe bearing capacity is not used directly, but is an indication of the expected ultimate dynamic bearing capacity. For consistent results to be achieved, the normal safe bearing capacity must be reasonably related to the actual bearing capacity of the soil. It is assumed herein that values of normal safe bearing capacity have a safety factor of 2.5 to 3.0 with respect to actual foundation failure under static loading conditions.

Bearing values established by a soils engineer can usually be expected to contain a safety factor in this range. An exception may occur where low bearing values are prescribed to avoid excessive settlement under sustained loads. In this case, higher values based on the actual static bearing capacity should be used.

Normal safe bearing capacities established by building codes of different jurisdictions show great variation in values for soils of apparently similar description. To some extent, this variation may be due to actual variation in properties of local soil formations. It may also be due to variation in the actual safety factors. Values in Table II represent a fair average of building codes in various parts of the United States. Where local building code values are much higher or lower than those in Table II and are not justified by local conditions, as determined by a soils analysis by a soils engineer, adjustment can be made in the local code values.

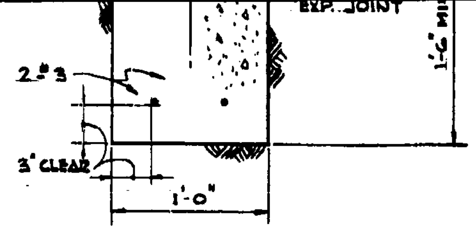
Enter Table III with the foundation load from Table I and the type and bearing capacity of soil beneath the footings to determine the required width of footing in feet and inches. If soils are intermediate in characteristics between the "coarse-grained, noncohesive" and the "fine-grained, cohesive" groups of soils, an intermediate width of footing may be selected, or the wider of the two may be used.

In establishing footing widths as shown in Table III, allowance has been made for the effect of footing width on bearing capacity, and the difference bewteen static and dynamic resistance of soils. No further adjustment is necessary for these factors.

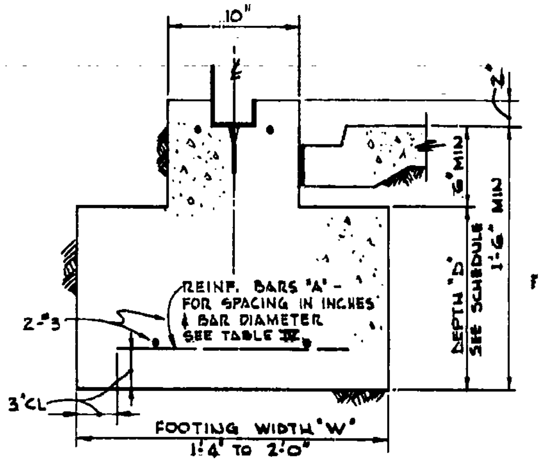
The detailed design of footings is shown in Types 1, 2, and 3 and in Table IV. Enter Table IV with the footing load from Table I and the footing width from Table III to determine the thickness of the footing base and the size and spacing of transverse reinforcing bars. Other footing details are as shown in the appropriate Type 1, 2, or 3.

**ILLUSTRATIVE EXAMPLE:**

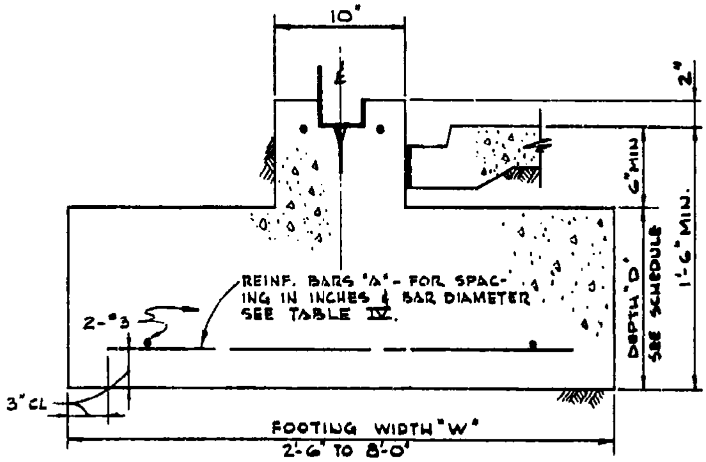
A shelter is to be designed and constructed for a nominal 35-psi overpressure rating. Footings will bear on a clay-type soil of medium-stiff consistency. Backfill over and around the shelter will be clean sand and gravel. From Table I, with overpressure of 35-psi and sand-gravel backfill, the footing load is found to be 30,000 pounds per lineal foot. The local building code establishes a bearing value of 3,000 pounds per square foot for medium-stiff clay, while Table II gives 4,000 pounds per square foot. The building code value of 3,000 pounds per square foot will be used, since it is the smaller value. From Table III, with a footing load of 30,000 pounds per lineal foot and fine-grained cohesive soil of 3,000 pounds per square foot bearing value, a required footing width of 2'-6" is found. From Table IV, for a footing load of 30,000 pounds per foot and a footing width of 2'-6", the thickness is found to be 10", and the transverse reinforcement is No. 3 bars at 4-inch spacing. Other footing details are as shown in Type 3.




TYPE 1




TYPE 2




TYPE 3

## FOOTING DETAILS

SCALE: $1\frac{1}{2}$" = 1'-0"

Details not noted on Types 2 and 3 are same as shown on Type 1. Footing thickness "D" and transverse reinforcing bars "A" are scheduled in Table IV.

## GENERAL NOTES

1. Concrete for footings shall have compressive strength not less than 2,500 lb/sq.in. at 28 days.

2. Reinforcing bars shall be intermediate grade deformed bars to ASTM Specs. A15 and A305.

4

| FOOTING "W" (FT&I FROM TAB |
|---|
| 1-0 |
| 1-4 |
| 1-8 |
| 2-0 |
| 2-6 |
| 3-0 |
| 4-0 |
| 5-0 |
| 6-0 |
| 8-0 |

1. Norma
2. Beari in di
3. Compa resis
4. Loose
5. Hard diffi
6. Mediu finge
7. Soft
8. Coars on a and m
9. Clay readi
10. Silt and l

| | | |
|---|---|---|
| FINE-GR... COHESIVE | Soft clay | 2,000 |
| | Adobe | 1,000 |
| | | |
| INTER-MEDIATE TYPE SOILS | Compact inorganic sand and silt | 1,500 |
| | Loose inorganic sand and silt | 500 |
| | | |

TABLE III
SIDWALL FOOTING WIDTHS AS REQ'D. BY FOOTING LOAD AND NORMAL SAFE BEARING CAPACITY

| TYPE OF SOIL BENEATH FOOTING | NORMAL SAFE BEARING CAPACITY | FOOTING WIDTH REQUIRED IN FEET AND INCHES FOR FOOTING LOAD SHOWN (POUNDS/LIN. FOOT) | | | | |
|---|---|---|---|---|---|---|
| | | 10,000 | 20,000 | 30,000 | 45,000 | 60,000 |
| HARDPAN, CEMENTED GRAVEL, OR LEDGE ROCK | 20,000 lb/s.f. | 1-0 | 1-0 | 1-0 | 1-0 | 1-0 |
| | | | | | | |
| COARSE-GRAINED NON-COHESIVE SOILS, SUCH AS GRAVEL, SAND, AND GRAVEL AND SAND | 12,000 lb/s.f. | 1-0 | 1-0 | 1-4 | 2-0 | 2-6 |
| | 10,000 | 1-0 | 1-4 | 1-8 | 2-6 | 3-0 |
| | 8,000 | 1-0 | 1-8 | 2-0 | 2-6 | 3-0 |
| | 6,000 | 1-0 | 1-8 | 2-6 | 3-0 | 4-0 |
| | 4,000 | 1-4 | 2-6 | 3-0 | 4-0 | 5-0 |
| | 3,000 | 1-8 | 3-0 | 4-0 | 5-0 | 6-0 |
| | 2,000 | 2-6 | 4-0 | 5-0 | 6-0 | 8-0 |
| | 1,500 | 3-0 | 5-0 | 6-0 | 8-0 | - |
| | 1,000 | 4-0 | 6-0 | 8-0 | - | - |
| | | | | | | |
| FINE-GRAINED COHESIVE SOILS, SUCH AS CLAY AND SANDY, SILTY OR GRAVELLY CLAY | 12,000 lb/s.f. | 1-0 | 1-0 | 1-0 | 1-0 | 1-4 |
| | 10,000 | 1-0 | 1-0 | 1-0 | 1-0 | 1-4 |
| | 8,000 | 1-0 | 1-0 | 1-0 | 1-4 | 1-8 |
| | 6,000 | 1-0 | 1-0 | 1-4 | 1-8 | 2-6 |
| | 4,000 | 1-0 | 1-4 | 1-8 | 2-6 | 4-0 |
| | 3,000 | 1-0 | 1-8 | 2-6 | 4-0 | 5-0 |
| | 2,000 | 1-4 | 2-6 | 4-0 | 5-0 | 8-0 |
| | 1,500 | 1-8 | 3-0 | 5-0 | 8-0 | - |
| | 1,000 | 2-6 | 5-0 | 8-0 | - | - |
| | | | | | | |

TABLE IV
FOOTING STEEL REINFORCEMENT SCHEDULE FOR SIDEWALL FOOTINGS *

| FOOTING WIDTH "W" (FT & IN.) FROM TABLE III | FOOTING LOAD LBS/LIN. FT. (FROM TABLE I) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10,000 LB/L.F. | | 20,000 LB/L.F. | | 30,000 LB/L.F. | | 45,000 LB/L.F. | | 60,000 LB/L.F. | |
| | D | REINF. "A" | D | REINF. "A" | D | REINF. "A" | D | REINF. "A" | D | REINF. "A" |
| 1-0 | - | None | - | None | - | None | - | None | - | None |
| 1-4 | 0-10 | None | 0-10 | None | 0-10 | None | 0-10 | None | 0-10 | None |
| 1-8 | 0-10 | None | 0-10 | None | 0-10 | None | 1-0 | None | 1-0 | None |
| 2-0 | 0-10 | #3 @ 24 inches | 0-10 | #3 @ 24 inches | 1-0 | #3 @ 24 inches | 1-2 | #3 @ 24 inches | 1-3 | #3 @ 24 inches |
| 2-6 | 0-10 | #3 @ 6 " | 0-10 | #3 @ 6 " | 0-10 | #3 @ 4 " | 1-0 | #3 @ 3½ " | 1-0 | #3 @ 2½ " |
| 3-0 | 0-10 | #3 @ 6 " | 0-10 | #3 @ 5 " | 0-10 | #3 @ 3½ " | 1-0 | #3 @ 3 " | 1-0 | #3 @ 2½ " |
| 4-0 | 0-10 | #3 @ 6 " | 0-10 | #3 @ 5 " | 0-10 | #3 @ 3 " | 1-0 | #3 @ 3 " | 1-0 | #3 @ 2 " |
| 5-0 | 0-10 | #3 @ 6 " | 0-10 | #3 @ 4 " | 0-10 | #3 @ 2½ " | 1-0 | #4 @ 3½ " | 1-2 | #4 @ 3½ " |
| 6-0 | 0-10 | #4 @ 10 " | 0-10 | #4 @ 5 " | 0-10 | #4 @ 3½ " | 1-0 | #5 @ 4½ " | 1-2 | #5 @ 4 " |
| 8-0 | 0-10 | #4 @ 7 " | 0-10 | #4 @ 3½ " | 0-10 | #5 @ 3½ " | 1-0 | #6 @ 4½ " | 1-2 | #6 @ 4 " |

* Reinforcement steel is fabricated in increments of ⅛ inch on the diameter. The designation #3 indicates a rod ⅜ inch in diameter.

TERMS USED IN TABLES

1. Normal safe bearing capacity as shown is for a footing 3'-0" wide at a depth of 1'-6" below grade.
2. Bearing values for coarse-grained soils as shown in Table II are for a footing 3'-0" wide, and are to be reduced in direct proportion to footing width for footings less than 3'-0" wide.
3. Compact gravel, sand, or sand and gravel are deposits which require picking for removal, and offer high resistance to penetration by excavating tools.
4. Loose gravel, sand, or sand and gravel are deposits which can readily be removed by shoveling only.
5. Hard clay requires picking for removal. A fresh sample can be molded in the fingers only with the greatest difficulty.
6. Medium or firm clay can be removed by spading. A fresh sample requires substantial pressure to mold in the fingers.
7. Soft clay can be molded in the fingers with relatively slight pressure.
8. Coarse gravel is particles retained on a No. 10 mesh sieve. Coarse sand passes No. 10 and is retained on a No. 40 mesh sieve. Fine sand passes a No. 40 mesh sieve and is retained on a No. 270 mesh sieve. Gravel, sand, and mixtures of gravel and sand possess little or no cohesion when dry.
9. Clay is an extremely fine-grained soil which has sufficient cohesion when dry to form hard lumps which cannot readily be broken in the fingers.
10. Silt is particles smaller than fine sand but coarser than clay. Its cohesive strength when dry is slight, and lumps can easily be broken in the fingers.

load in pounds ... soil, use that ...

Next, dete... beneath the foo... excavated site, ... capacity" is th... structures for ...

The normal ... qualified soils ... bearing capacit...

Bearing ca... bearing capacit... size and shape ... proportioning f... adjacent grade. ... adjustments mus...

Footings f... of the soil und... directly, but i... results to be ... bearing capacit... have a safety f... conditions.

Bearing va... factor in this ... excessive settl... static bearing ...

Normal saf... great variatio... may be due to ... variation in th... in various part... than those in T... by a soils engi...

Enter Tabl... of soil beneath... soils are inter... grained, cohesi... of the two may ...

In establi... of footing widt... soils. No furt...

The detail... Table IV with t... thickness of th... footing details...

ILLUSTRATIVE E...

A shelter ... will bear on a ... will be clean ... the footing loa... a bearing value... 4,000 pounds pe... since it is the... foot and fine-g... width of 2'-6" ... of 2'-6", the t... spacing. Other...

5

ENGINEERING & DESIGN IS APPROVED BY: Lewis W. Port...

| | |
|---|---|
| | 2,000 |
| | 1,000 |
| | |
| d and silt | 1,500 |
| and silt | 500 |
| | |

AND NORMAL SAFE BEARING CAPACITY

| TING WIDTH REQUIRED IN FEET AND INCHES FOOTING LOAD SHOWN (POUNDS/LIN. FOOT) | | | | |
|---|---|---|---|---|
| 000 | 20,000 | 30,000 | 45,000 | 60,000 |
| 0 | 1-0 | 1-0 | 1-0 | 1-0 |
| | | | | |
| 0 | 1-0 | 1-4 | 2-0 | 2-6 |
| 0 | 1-4 | 1-8 | 2-6 | 3-0 |
| 0 | 1-8 | 2-0 | 2-6 | 3-0 |
| 0 | 1-8 | 2-6 | 3-0 | 4-0 |
| 4 | 2-6 | 3-0 | 4-0 | 5-0 |
| 8 | 3-0 | 4-0 | 5-0 | 6-0 |
| 6 | 4-0 | 5-0 | 6-0 | 8-0 |
| 0 | 5-0 | 6-0 | 8-0 | - |
| 0 | 6-0 | 8-0 | - | - |
| | | | | |
| 0 | 1-0 | 1-0 | 1-0 | 1-4 |
| 0 | 1-0 | 1-0 | 1-0 | 1-4 |
| 0 | 1-0 | 1-0 | 1-4 | 1-8 |
| 0 | 1-0 | 1-4 | 1-8 | 2-6 |
| 0 | 1-4 | 1-8 | 2-6 | 4-0 |
| 0 | 1-8 | 2-6 | 4-0 | 5-0 |
| 4 | 2-6 | 4-0 | 5-0 | 8-0 |
| 8 | 3-0 | 5-0 | 8-0 | - |
| 6 | 5-0 | 8-0 | - | - |
| | | | | |

FOR SIDEWALL FOOTINGS *

| (FROM TABLE I) | | | | |
|---|---|---|---|---|
| | 45,000LB/L.F. | | 60,000LB/L.F. | |
| "A" | D | REINF. "A" | D | REINF. "A" |
| | - | None | - | None |
| | 0-10 | None | 0-10 | None |
| | 1-0 | None | 1-0 | None |
| 24 inches | 1-2 | #3 @ 24 inches | 1-3 | #3 @ 24 inches |
| " | 1-0 | #3 @ 3½ " | 1-0 | #3 @ 2½ " |
| 3½ " | 1-0 | #3 @ 3 " | 1-0 | #3 @ 2½ " |
| 3 " | 1-0 | #3 @ 3 " | 1-0 | #3 @ 2 " |
| 2½ " | 1-0 | #4 @ 3½ " | 1-2 | #4 @ 3½ " |
| 3½ " | 1-0 | #5 @ 4½ " | 1-2 | #5 @ 4 " |
| 3½ " | 1-0 | #6 @ 4½ " | 1-2 | #6 @ 4 " |

* Reinforcement steel is fabricated in increments of ⅛ inch on the diameter. The designation #3 indicates a rod ⅜ inch in diameter.

S

e at a depth of 1'-6" below grade.

ing 3'-0" wide, and are to be reduced
0" wide.

ire picking for removal, and offer high

adily be removed by shoveling only.

olded in the fingers only with the greatest

equires substantial pressure to mold in the

essure.

rse sand passes No. 10 and is retained
ned on a No. 270 mesh sieve. Gravel, sand,
en dry.

n when dry to form hard lumps which cannot

its cohesive strength when dry is slight,

soil, use that giving the higher footing load in Table I.

Next, determine the type of soil and the normal safe bearing capacity of the in-place soil beneath the footings. The type of soil is determined by preliminary borings, inspection of the excavated site, or records of previous construction in the immediate area. The "normal safe bearing capacity" is the bearing value that would be used in proportioning footings of building and other structures for resistance to normal service loads exclusive of wind, earthquake, or impact loads.

The normal safe bearing capacity can be established by (a) a special soils investigation by a qualified soils engineer, (b) use of tabulated "permissible," "allowable," or "presumptive" safe bearing capacities from local building codes, or (c) use of recommended bearing values from Table II.

Bearing capacity is expressed in terms of pounds per square foot of footing area. The actual bearing capacities are dependent not only on the type and properties of the soil, but also on the size and shape of the footing. Values shown in Table II and as used in succeeding steps of proportioning footings for shelters are for a footing 3 feet wide at a depth of 1-1/2 feet below adjacent grade. Where bearing values are stated in terms of other widths or depths, appropriate adjustments must be made by a qualified soils engineer.

Footings for shelters are proportioned on the basis of the expected ultimate bearing capacity of the soil under dynamic conditions of loading. The normal safe bearing capacity is not used directly, but is an indication of the expected ultimate dynamic bearing capacity. For consistent results to be achieved, the normal safe bearing capacity must be reasonably related to the actual bearing capacity of the soil. It is assumed herein that values of normal safe bearing capacity have a safety factor of 2.5 to 3.0 with respect to actual foundation failure under static loading conditions.

Bearing values established by a soils engineer can usually be expected to contain a safety factor in this range. An exception may occur where low bearing values are prescribed to avoid excessive settlement under sustained loads. In this case, higher values based on the actual static bearing capacity should be used.

Normal safe bearing capacities established by building codes of different jurisdictions show great variation in values for soils of apparently similar description. To some extent, this variation may be due to actual variation in properties of local soil formations. It may also be due to variation in the actual safety factors. Values in Table II represent a fair average of building codes in various parts of the United States. Where local building code values are much higher or lower than those in Table II and are not justified by local conditions, as determined by a soils analysis by a soils engineer, adjustment can be made in the local code values.

Enter Table III with the foundation load from Table I and the type and bearing capacity of soil beneath the footings to determine the required width of footing in feet and inches. If soils are intermediate in characteristics between the "coarse-grained, noncohesive" and the "fine-grained, cohesive" groups of soils, an intermediate width of footing may be selected, or the wider of the two may be used.

In establishing footing widths as shown in Table III, allowance has been made for the effect of footing width on bearing capacity, and the difference bewteen static and dynamic resistance of soils. No further adjustment is necessary for these factors.

The detailed design of footings is shown in Types 1, 2, and 3 and in Table IV. Enter Table IV with the footing load from Table I and the footing width from Table III to determine the thickness of the footing base and the size and spacing of transverse reinforcing bars. Other footing details are as shown in the appropriate Type 1, 2, or 3.

ILLUSTRATIVE EXAMPLE:

A shelter is to be designed and constructed for a nominal 35-psi overpressure rating. Footings will bear on a clay-type soil of medium-stiff consistency. Backfill over and around the shelter will be clean sand and gravel. From Table I, with overpressure of 35-psi and sand-gravel backfill, the footing load is found to be 30,000 pounds per lineal foot. The local building code establishes a bearing value of 3,000 pounds per square foot for medium-stiff clay, while Table II gives 4,000 pounds per square foot. The building code value of 3,000 pounds per square foot will be used, since it is the smaller value. From Table III, with a footing load of 30,000 pounds per lineal foot and fine-grained cohesive soil of 3,000 pounds per square foot bearing value, a required footing width of 2'-6" is found. From Table IV, for a footing load of 30,000 pounds per foot and a footing width of 2'-6", the thickness is found to be 10", and the transverse reinforcement is No. 3 bars at 4-inch spacing. Other footing details are as shown in Type 3.

6

| REVISION | DATE | DESCRIPTION | BY | APP. |
|---|---|---|---|---|

UNITED STATES
NAVAL RADIOLOGICAL DEFENSE LABORATORY
SAN FRANCISCO 24, CALIFORNIA

| | |
|---|---|
| DRAWN | FJA |
| CHECKED | [signature] |
| PROJ. ENGR. | |
| SUPV. | |
| BRANCH HEAD | |
| DIVISION HEAD | |
| SCOPE APPROVED: [signature] | DATE: 5/23/62 |

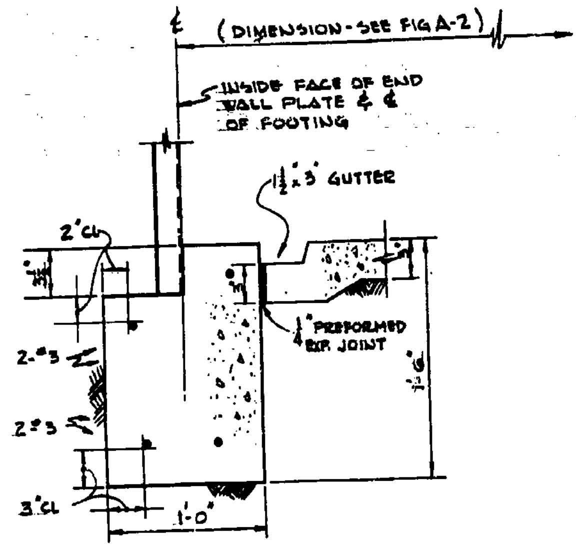
DEVELOPMENTAL DWG.

FIG. A-2N-1
SHELTER SIDEWALL
FOUNDATION DETAILS

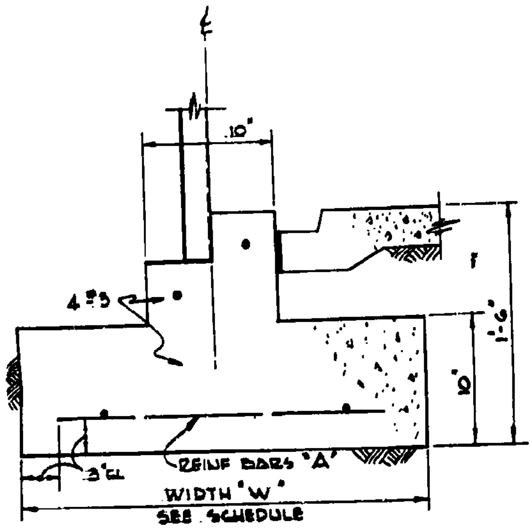
| DATE | SCALE | PROJECT | TECH MEMO |
|---|---|---|---|
| | | | |

DWG. NO. S-62-970 SHT. 3 OF 19 ALT.

ENGINEERING & DESIGN IS APPROVED BY: [signature] DATE: 22 MAY 62




TYPE 4




TYPE 5

ENDWALL FOOTING DETAILS

SCALE: 1½"=1'-0"

UN

| BA |
|---|
| Gravel<br>Gravel<br>clay m |
| Inorga<br>clay,<br>compre |
| Inorga<br>sand a<br>compre |

$^*P_o$ = Des

ENDWALL FOOTING WIDT

| TYPE OF SOIL BENEATH FOOTINGS | NORM BEA |
|---|---|
| | |
| Coarse-grained, non-cohesive soils, such as gravel, sand, or sand and gravel. | |
| Fine-grained cohesive soils, such as clay and sandy, silty or gravelly clay. | |

FOOTI

| FOOT 'W' (F |
|---|
| |
| |
| |
| |
| |

1

TABLE A

UNIFORM BEARING LOADS TO ENDWALL FOOTINGS

| BACKFILL SOIL TYPE | FOOTING LOAD (LB. /LIN. FT.) | |
|---|---|---|
| | *Po = 10 PSI | *Po = 35 PSI |
| Gravel, sand, gravel and sand, Gravel--sand-silt and gravel-sand clay mixtures, or crushed rock | 2,500 LB/L.F. | 7,500 LB/L.F. |
| Inorganic clay, gravelly clay, sandy clay, or silty clay of medium to low compressibility and plasticity | 2,500 | 7,500 |
| Inorganic silt, very fine sand, fine sand and silt, or soft, plastic, compressible clay | 5,000 | 15,000 |

$^*P_o$ = Design blast overpressure rating of Shelter.

TABLE B

ENDWALL FOOTING WIDTHS AS REQUIRED BY FOOTING LOAD AND NORMAL SAFE BEARING CAPACITY

| TYPE OF SOIL BENEATH FOOTINGS | NORMAL SAFE BEARING CAPACITY | FOOTING LOAD - LB. /LIN. FT. | | | | |
|---|---|---|---|---|---|---|
| | | 2,500 | 5,000 | 7,500 | 10,000 | 15,000 |
| Coarse-grained, non-cohesive soils, such as gravel, sand, or sand and gravel. | 10,000 | | | | | 1-0 |
| | 6,000 | | | | 1-0 | 1-4 |
| | 4,000 | | | 1-0 | 1-4 | 2-0 |
| | 3,000 | | 1-0 | 1-4 | 1-8 | 2-6 |
| | 2,000 | 1-0 | 1-4 | 2-0 | 2-6 | 3-0 |
| | 1,500 | 1-0 | 1-8 | 2-6 | 3-0 | - |
| | 1,000 | 1-4 | 2-0 | 3-0 | - | - |
| Fine-grained cohesive soils, such as clay and sandy, silty or gravelly clay. | 4,000 or more | | | | | 1-0 |
| | 3,000 | | | | 1-0 | 1-4 |
| | 2,000 | | | 1-0 | 1-4 | 1-8 |
| | 1,500 | | 1-0 | 1-4 | 1-8 | - |
| | 1,000 | 1-0 | 1-4 | 1-8 | - | - |

TABLE C

FOOTING STEEL REINFORCEMENT SCHEDULE FOR TYPE 5

| FOOTING WIDTH 'W' (FT. & IN.) | REINF. BARS "A" (All Loads) |
|---|---|
| 1-4 | None |
| 1-8 | None |
| 2-0 | #3 @ 24 |
| 2-6 | #3 @ 6 |
| 3-0 | #3 @ 6 |

QUANT

PC. NO.

PROCEDURE

The endwall footin
pressure rating for whi
backfill adjacent to an
in-place soil beneath t

Table A establishe
footings. Enter with t
determine the foundatio
to proper classificatio

Next, determine th
soil beneath the footin
of the excavated site,
safe bearing capacity i
buildings and other str
earthquake, or impact l

The normal safe be
by a qualified soils en
safe bearing capacities
from Table II, Fig. A-

For definition of
Fig. A-B-1N.

Enter Table B with
of soil beneath the fo
If soils are intermedi
and the "fine-grained,
selected, or the wider

The detailed desi
reinforcement for the
with the footing width

In the event the
total footing design (

2

OTINGS

| FOOTING LOAD (LB. /LIN.FT.) | |
|---|---|
| *Po = 10 PSI | *Po = 35 PSI |
| 2,500LB/L.F. | 7,500LB/L.F. |
| 2,500 | 7,500 |
| 5,000 | 15,000 |

helter.

NORMAL SAFE BEARING CAPACITY

| ) - LB. /LIN. FT. | | |
|---|---|---|
| 7,500 | 10,000 | 15,000 |
| | | |
| | | |
| | | 1-0 |
| | 1-0 | 1-4 |
| 1-0 | 1-4 | 2-0 |
| 1-4 | 1-8 | 2-6 |
| 2-0 | 2-6 | 3-0 |
| 2-6 | 3-0 | - |
| 3-0 | - | - |
| | | |
| | | 1-0 |
| | 1-0 | 1-4 |
| 1-0 | 1-4 | 1-8 |
| 1-4 | 1-8 | - |
| 1-8 | - | - |
| | | |

LIST OF MATERIAL

QUANTITIES SHOWN ARE FOR

| PC. NO. | NAME | NO. REQ. | MAT'L. | MAT'L. SPECS. | STOCK SIZE | REMARKS |
|---|---|---|---|---|---|---|
| | | | | | | |

## PROCEDURE FOR DETERMINING THE DESIGN AND CONSTRUCTION DETAILS OF THE SHELTER'S ENDWALL FOOTINGS

The endwall footing to be used with a particular shelter is dependent on (a) the over-pressure rating for which the shelter is to be designed, (b) the type of soil used for backfill adjacent to and over the shelter, and (c) the type and bearing capacity of the in-place soil beneath the footings.

Table A establishes the bearing load that must be supported by the continuous endwall footings. Enter with the overpressure rating and the type of soil used for backfill to determine the foundation load in pounds per lineal foot of footing. Where doubt exists as to proper classification of backfill soil, use that giving the higher footing load in Table A.

Next, determine the type of soil and the "normal safe bearing capacity" of the in-place soil beneath the footings. The type of soil is determined by preliminary borings, inspection of the excavated site, or records of previous construction in the immediate area. The normal safe bearing capacity is the bearing value that would be used in proportioning footings of buildings and other structures for resistance to normal service loads exclusive of wind, earthquake, or impact loads.

The normal safe bearing capacity can be established by (a) a special soils investigation by a qualified soils engineer, (b) use of tabulated "permissible," "allowable," or "presumptive" safe bearing capacities from local building codes, or (c) use of recommended bearing values from Table II, Fig. A-2-1N.

For definition of normal safe bearing capacity (Table B), see notes that appear in Fig. A-2-1N.

Enter Table B with the foundation load from Table A and the type and bearing capacity of soil beneath the footings to determine the required width of footing in feet and inches. If soils are intermediate in characteristics between the "coarse-grained, noncohesive," and the "fine-grained, cohesive" groups of soils, an intermediate width of footing may be selected, or the wider of the two may be used.

The detailed design of the range of footings are shown as Types 4 and 5. Steel reinforcement for the footing design shown as Type 5 is determined by entering Table C with the footing width as is given in Table B.

In the event the endwall footing width as determined in Table B is 1 foot, the total footing design (including steel) is that shown as Type 4.

| | |
|---|---|
| 5,000 | 15,000 |

Shelter.

D NORMAL SAFE BEARING CAPACITY

| AD - LB. /LIN. FT. | | |
|---|---|---|
| 7,500 | 10,000 | 15,000 |
| | | |
| | | |
| | | 1-0 |
| | 1-0 | 1-4 |
| 1-0 | 1-4 | 2-0 |
| 1-4 | 1-8 | 2-6 |
| 2-0 | 2-6 | 3-0 |
| 2-6 | 3-0 | - |
| 3-0 | - | - |
| | | |
| | | 1-0 |
| | 1-0 | 1-4 |
| 1-0 | 1-4 | 1-8 |
| 1-4 | 1-8 | - |
| 1-8 | - | - |
| | | |

determine the foundation load in pounds per lineal foot of footing. Where doubt exists as to proper classification of backfill soil, use that giving the higher footing load in Table A.

Next, determine the type of soil and the "normal safe bearing capacity" of the in-place soil beneath the footings. The type of soil is determined by preliminary borings, inspection of the excavated site, or records of previous construction in the immediate area. The normal safe bearing capacity is the bearing value that would be used in proportioning footings of buildings and other structures for resistance to normal service loads exclusive of wind, earthquake, or impact loads.

The normal safe bearing capacity can be established by (a) a special soils investigation by a qualified soils engineer, (b) use of tabulated "permissible," "allowable," or "presumptive" safe bearing capacities from local building codes, or (c) use of recommended bearing values from Table II, Fig. A-2-1N.

For definition of normal safe bearing capacity (Table B), see notes that appear in Fig. A-2-1N.

Enter Table B with the foundation load from Table A and the type and bearing capacity of soil beneath the footings to determine the required width of footing in feet and inches. If soils are intermediate in characteristics between the "coarse-grained, noncohesive," and the "fine-grained, cohesive" groups of soils, an intermediate width of footing may be selected, or the wider of the two may be used.

The detailed design of the range of footings are shown as Types 4 and 5. Steel reinforcement for the footing design shown as Type 5 is determined by entering Table C with the footing width as is given in Table B.

In the event the endwall footing width as determined in Table B is 1 foot, the total footing design (including steel) is that shown as Type 4.

4

ENGINEERING & DESIGN IS APPROVED BY: Louis B. Pottenue DATE: 22 May 62

| REVISION | DATE | DESCRIPTION | BY | APP. |
|---|---|---|---|---|

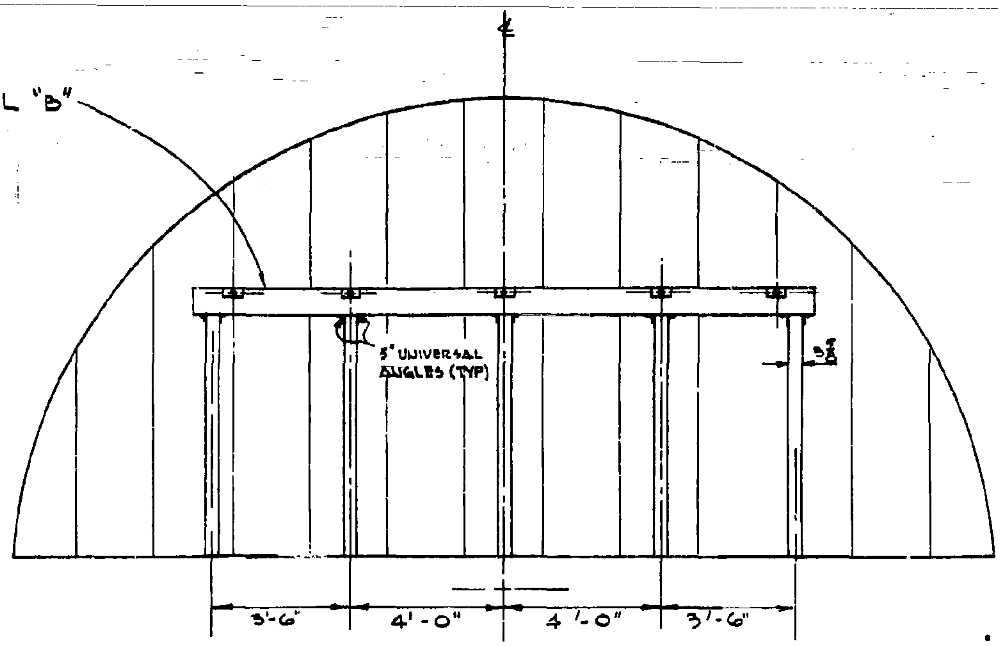
UNITED STATES
NAVAL RADIOLOGICAL DEFENSE LABORATORY
SAN FRANCISCO 24, CALIFORNIA

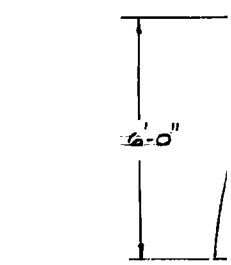
| | |
|---|---|
| DRAWN | FJA |
| CHECKED | FA |
| PROJ. ENGR. | DEVELOPMENTAL DWG. |
| SUPV. | |
| BRANCH HEAD | |
| DIVISION HEAD | |
| SCOPE APPROVED: LBP | DATE: 5-22-62 |

FIG. A-2N-2
SHELTER ENDWALL FOUNDATION DETAILS

| DATE | SCALE | PROJECT | TECH MEMO |
|---|---|---|---|

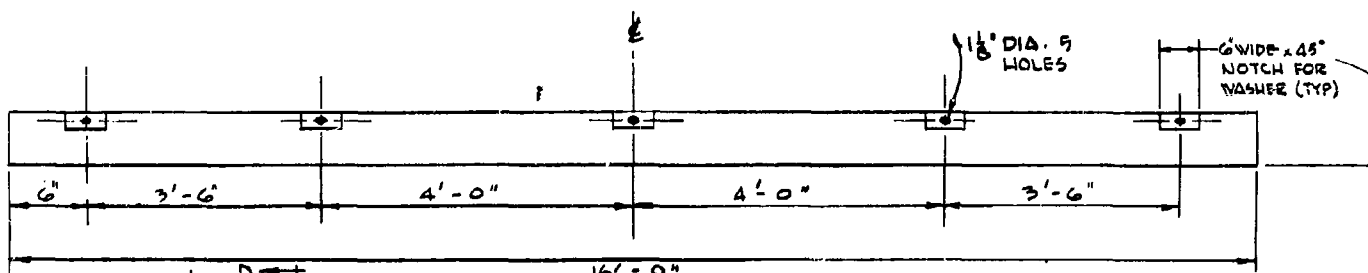
DWG NO. S-62-970 SHT. 4 OF 19 ALT.

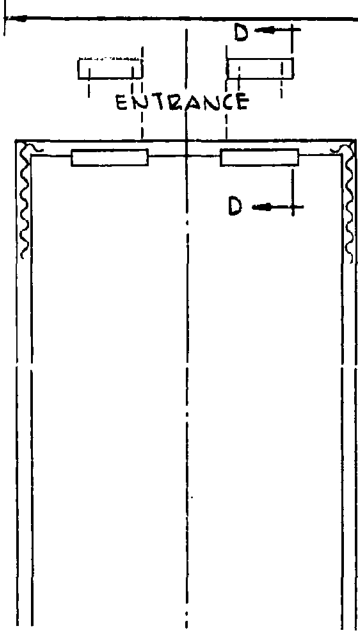



## ELEVATION "B"

ENDWALL — LOOKING OUT
SCALE: 3/8" = 1'-0"

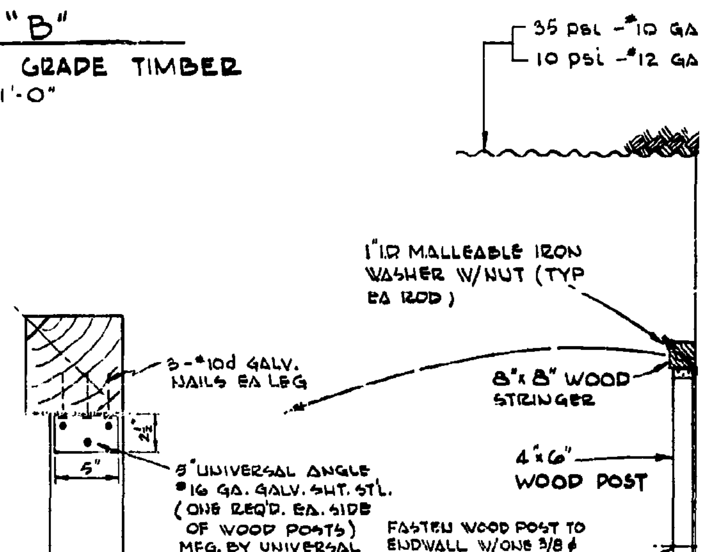



## DETAIL "B"

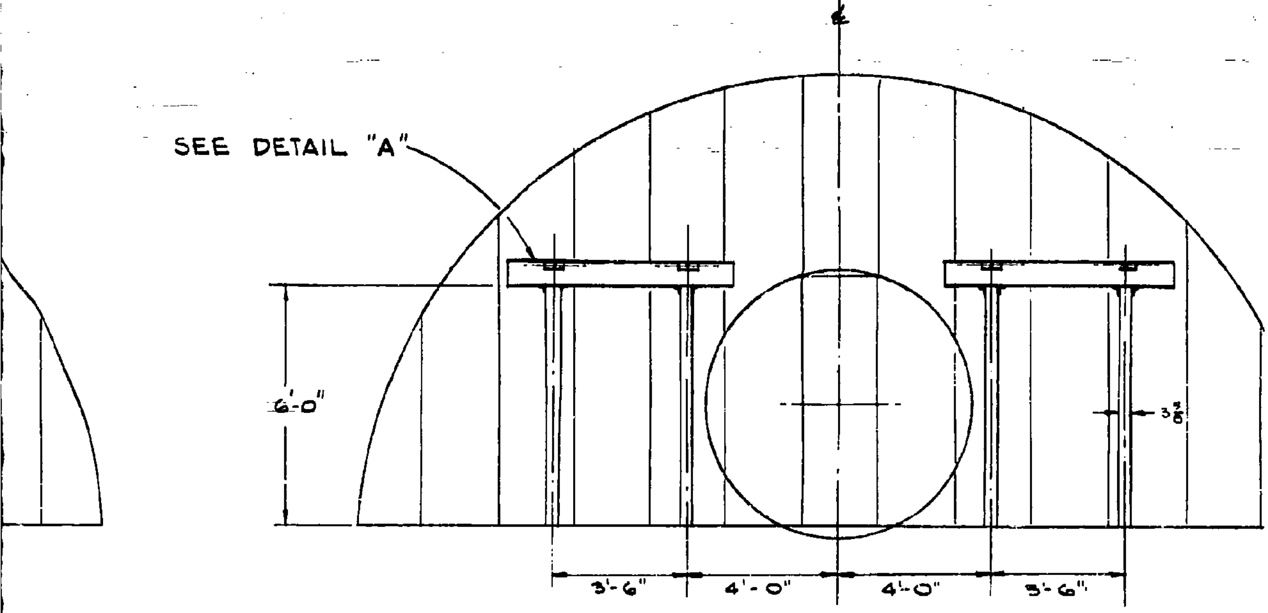
MAT'L - STRUCTURAL GRADE TIMBER
SCALE: 3/4" = 1'-0"

1



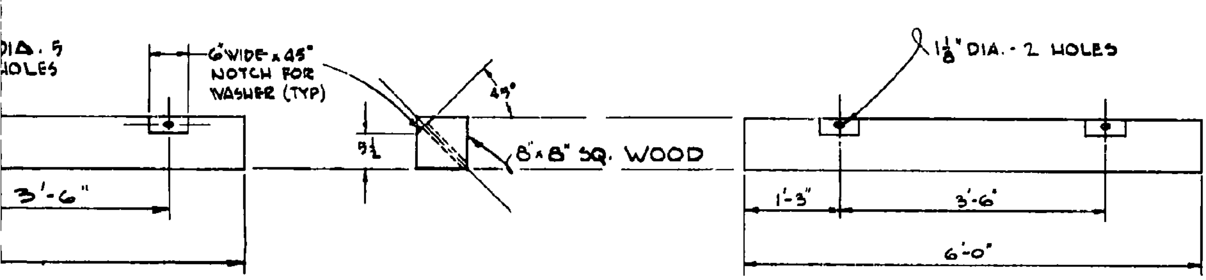

HOT PITCH CAULKING POURED BOTH SIDES OF ARCH TO SEAL UNUSED BOLT HOLES

| QUANTITIES SHOWN ARE FOR | |
|---|---|
| PC. NO. | NAME |



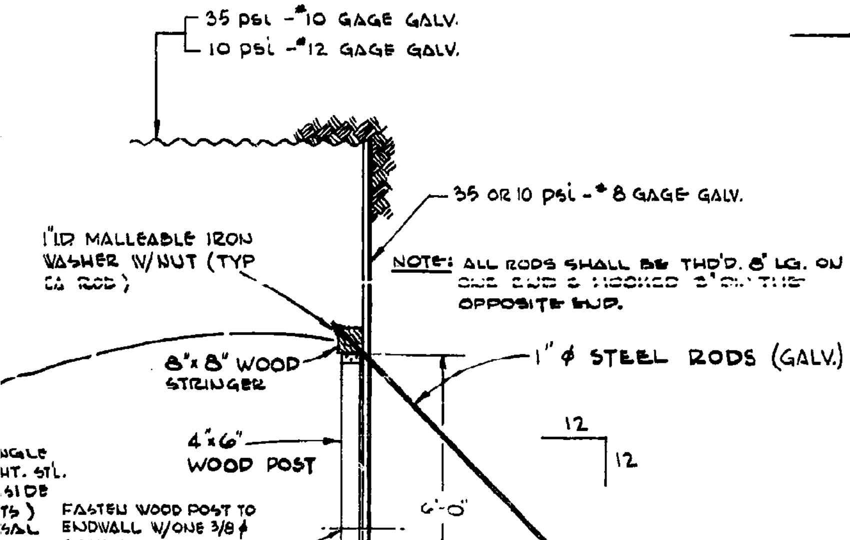

## ELEVATION "A"

ENTRANCE - LOOKING OUT
SCALE: 3/8" = 1'-0"




## DETAIL "A"

2 PCS. REQ'D.
SCALE: 3/4" = 1'-0"




1. THE METAL ARCH SHALL BE FI... OTHERWISE SPECIFIED HEREIN... SPECIFICATION M36-57.
   (a) PLATES SHALL BE FABRICAT... BASE METAL FOR WHICH IS MA... ABOVE REFERENCED SPECIFICAT... PROCESS BEFORE FORMING. A... RATE OF NOT LESS THAN 2. O... BE FABRICATED OF THE SAME...
   (b) DIMENSIONS, WEIGHTS & GA...
      (1) CORRUGATIONS SHALL HA... DEPTH OF 2 INCHES WITH A... CORRUGATION SHALL BE A...
      (2) PLATES SHALL BE EITHE... 4.531 OR 5.781 LBS/SQ. FT. ... ENTIRE LOT - PLUS 5%, MIN...
   (c) FORMING & PUNCHING PLA... PROPER RADIUS & THE BO... LIKE DIMENSIONS & CURVA... THE LONGITUDINAL JOINT... 2 INCHES APART, WITH ONE... CORRUGATION. THE CENTER... OF THE BOLT FROM THE ED... FORMING CIRCUMFERENTIA... CENTER TO CENTER. ALL B... PLATES SHALL BE SO CU... FORMED IN ACCORDANCE...
   (d) BOLTS & NUTS SHALL BE H... THE CORRUGATED METAL AR... FIT. MATERIAL SHALL CONF... THE BOLT HEADS SHALL ... WILL BE OBTAINED, WITHOU... HEAD IS USED ON THE CR... ROUNDED ON ONE FACE TO... THE VALLEY OF THE CORRU...
   (e) CHANNELS. - UNBALANCED C... COLD-FORMED METAL OF N... FOR ANCHORING TO THE F... HOLES TO MATCH THE HOLE...
2. SHELTER ENDWALLS SHALL B... INDICATED.
   (a) STRUCTURAL PLATES & CHA... REQUIREMENTS OF ASTM ... TO FORMING, THE STEEL ... AT NOT LESS THAN 2 OU...
   (b) BOLTS & NUTS. - CONNECTI... THE REQUIREMENTS OF SU...
3. ENTRANCE TUNNEL SHALL BE ... GAGE AS INDICATED, CONFO... M36-57, COPPER BEARIN... SHALL BE MANUFACTURER...
4. ARCH & PIPE ERECTION. - THE ... ACCORDANCE WITH THE MAN... INDICATED. ALL SEAMS OR JOI... 1½ INCH x 1/8 INCH "PERMAGU... ONE STRIP SHALL BE PRES... PLATES COMPRISING A JOIN... STRUCTURE, INCLUDING THE ... ARCH, SHALL BE SEALED IN...
5. REPAIR AFTER ERECTION. - ... SHALL BE WIRE BRUSHED & ... CONFORMING TO SPECIFICA...

**2**

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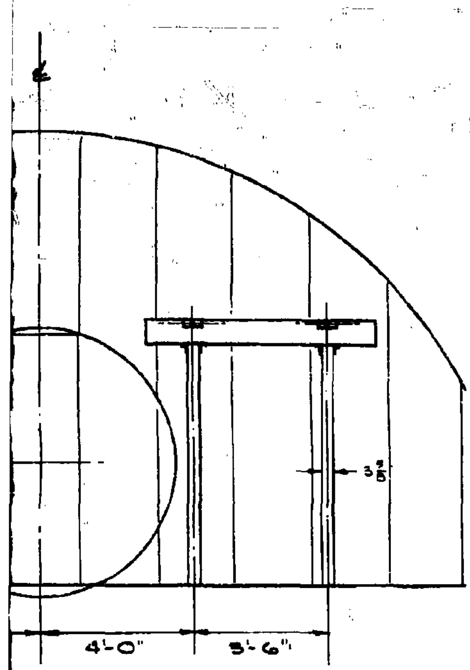
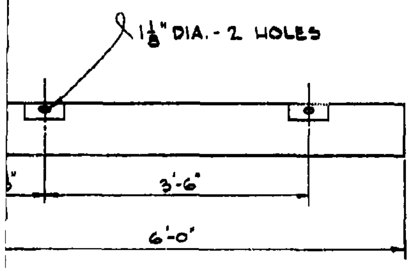
|---|---|




ATION "A"

- LOOKING OUT

E: 3/8" = 1'-0"




## DETAIL "A"

2 PCS. REQ'D.
SCALE: 3/4" = 1'-0"

. ON

ALV.)

**LIST OF MATERIAL**

QUANTITIES SHOWN ARE FOR

| PC. NO. | NAME | No. REQ. | MAT'L. | MAT'L. SPECS. | STOCK SIZE | REMARKS |
|---|---|---|---|---|---|---|
| | | | | | | |

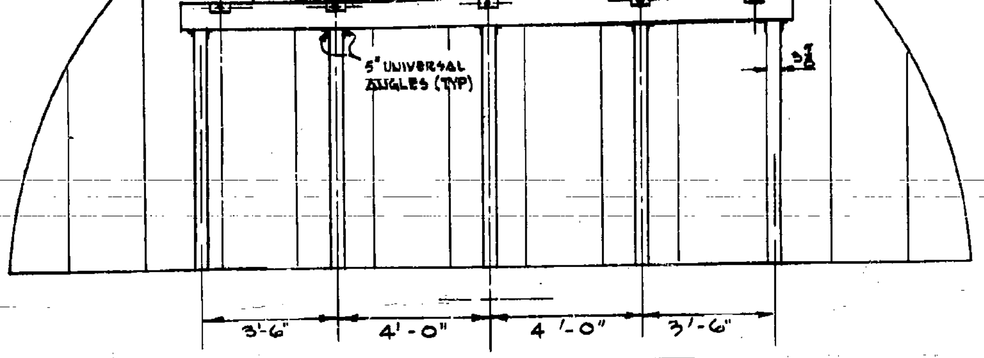
## GENERAL NOTES

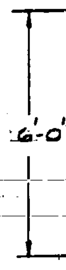
1. THE METAL ARCH SHALL BE FIELD ASSEMBLED OF CORRUGATED METAL PLATES & EXCEPT AS OTHERWISE SPECIFIED HEREIN, SHALL COMPLY WITH THE APPLICABLE REQUIREMENTS OF ASSHO SPECIFICATION M36-57.
   (a) PLATES SHALL BE FABRICATED FROM GALV. COPPER BEARING ST'L. PLATES, THE BASE METAL FOR WHICH IS MADE BY THE OPEN HEARTH PROCESS & WHICH COMPLIES WITH THE ABOVE REFERENCED SPECIFICATION. THE BASE METAL SHEETS SHALL BE GALV. BY THE HOT-DIP PROCESS BEFORE FORMING. A COATING OF PRIME WESTERN SPELTER SHALL BE APPLIED AT THE RATE OF NOT LESS THAN 2 OZ. PER SQ. FT. OF DOUBLE EXPOSED SURFACE. ALL PLATES SHALL BE FABRICATED OF THE SAME BASE METAL.
   (b) DIMENSIONS, WEIGHTS & GAGE.
      (1) CORRUGATIONS SHALL HAVE A PITCH OF 6 INCHES WITH A TOLERANCE OF 1/4 INCH, & A DEPTH OF 2 INCHES WITH A TOLERANCE OF 1/8 INCH. THE RADIUS ON THE INSIDE OF THE CORRUGATION SHALL BE AT LEAST 1 1/16 INCHES.
      (2) PLATES SHALL BE EITHER #12 OR #10 GAGE, AS SPECIFIED, & SHALL WEIGH AFTER GALV. 4.531 OR 5.781 LBS/SQ. FT. RESPECTIVELY. WEIGHT TOLERANCES THAT ARE PERMISSIBLE: ENTIRE LOT - PLUS 5%, MINUS 5%; INDIVIDUAL PLATES - PLUS 5%, MINUS 10%.
   (c) FORMING & PUNCHING PLATES. AFTER CORRUGATING, EACH PLATE SHALL BE CURVED TO THE PROPER RADIUS & THE BOLT HOLES SHALL BE SO PUNCHED THAT ALL PLATES HAVING LIKE DIMENSIONS & CURVATURE ARE INTERCHANGEABLE IN THE ERECTION PROCESS. ON THE LONGITUDINAL JOINTS OF THE ARCH, BOLT HOLES SHALL BE IN STAGGERED ROWS 2 INCHES APART, WITH ONE HOLE PUNCHED IN THE VALLEY & ONE IN THE CREST OF EACH CORRUGATION. THE CENTER OF NO HOLE SHALL BE CLOSER THAN 1 3/4 TIMES THE DIAMETER OF THE BOLT FROM THE EDGE OF THE PLATE. BOLT HOLES IN THOSE EDGES OF THE PLATES FORMING CIRCUMFERENTIAL SEAMS SHALL BE SPACED NOT MORE THAN 12 INCHES CENTER TO CENTER. ALL BOLT HOLES SHALL BE 1/8 INCH LARGER THAN THE BOLTS. PLATES SHALL BE SO CURVED THAT, WHEN BOLTED TOGETHER, THE ARCH SHALL BE FORMED IN ACCORDANCE WITH THE PLAN DIMENSIONS.
   (d) BOLTS & NUTS SHALL BE HOT-DIP GALV. & SHALL BE PROVIDED BY THE MANUFACTURER OF THE CORRUGATED METAL ARCH. THREADS SHALL BE AMERICAN STANDARD COARSE, CLASS 2 FREE FIT. MATERIAL SHALL CONFORM TO THE REQUIREMENTS OF ASTM SPECIFICATIONS A325. THE BOLT HEADS SHALL BE SO SHAPED THAT ADEQUATE BEARING OF THE BOLT HEAD WILL BE OBTAINED, WITHOUT THE USE OF WASHERS REGARDLESS OF WHETHER THE BOLT HEAD IS USED ON THE CREST OR VALLEY OF THE CORRUGATIONS. THE NUTS SHALL BE ROUNDED ON ONE FACE TO SECURE PROPER BEARING & NOT TO CUT THE GALVANIZING IN THE VALLEY OF THE CORRUGATIONS.
   (e) CHANNELS. - UNBALANCED CHANNELS, WHERE REQ'D. ON THE PLANS SHALL BE HOT-DIP GALV. COLD-FORMED METAL OF NOT LESS THAN 3/16 INCH IN THICKNESS, WITH SLOTTED TONGUES FOR ANCHORING TO THE FOOTINGS. ONE VERTICAL LEG SHALL BE PUNCHED WITH SLOTTED HOLES TO MATCH THE HOLES IN THE PLATE.
2. SHELTER ENDWALLS SHALL BE ASSEMBLED AT THE SITE OF STRUCTURAL PLATES AS INDICATED.
   (a) STRUCTURAL PLATES & CHANNELS SHALL BE FABRICATED OF STEEL CONFORMING TO THE REQUIREMENTS OF ASTM SPECIFICATION A245-58T, GRADE C, & SHALL BE #8 GA. PRIOR TO FORMING, THE STEEL SHALL BE HOT-DIP GALVANIZED WITH PRIME WESTERN SPELTER AT NOT LESS THAN 2 OUNCES PER SQ. FT. OF DOUBLE EXPOSED SURFACE.
   (b) BOLTS & NUTS. - CONNECTIONS SHALL BE MADE WITH BOLTS & NUTS CONFORMING TO THE REQUIREMENTS OF SUBPARAGRAPH 1(d).
3. ENTRANCE TUNNEL SHALL BE FABRICATED OF GALVANIZED, CORRUGATED METAL PIPE, GAGE AS INDICATED, CONFORMING TO THE REQUIREMENTS OF ASSHO SPECIFICATION M36-57, COPPER BEARING STEEL. EXCEPT AS INDICATED OTHERWISE, THE JOINTS SHALL BE MANUFACTURERS STANDARD FOR SIMILAR SERVICE.
4. ARCH & PIPE ERECTION. - THE METAL ARCH & ENTRANCE PIPE SHALL BE ERECTED IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS & TO THE LINES & GRADES INDICATED. ALL SEAMS OR JOINTS BETWEEN OVERLAPPING PLATES SHALL BE SEALED WITH 1 1/2 INCH x 1/8 INCH "PERMAGUM" STRIPS.
   ONE STRIP SHALL BE PRESSED OVER EACH ROW OF BOLT HOLES ON ONE OF THE PLATES COMPRISING A JOINT, PRIOR TO BOLTING UP. ALL JOINTS OF THE CORRUGATED STRUCTURE, INCLUDING THE JUNCTION BETWEEN THE TUNNEL & THE ENDWALL OF THE ARCH, SHALL BE SEALED IN A SIMILAR MANNER.
5. REPAIR AFTER ERECTION. - GALVANIZED SURFACES DAMAGED DURING CONSTRUCTION SHALL BE WIRE BRUSHED & GIVEN 2 COATS OF ZINC-DUST ZINC-OXIDE PAINT CONFORMING TO SPECIFICATION MIL-P-15145A.

**3**

| REVISION | DATE | DESCRIPTION | BY | APP. |
|---|---|---|---|---|
| | | | | |

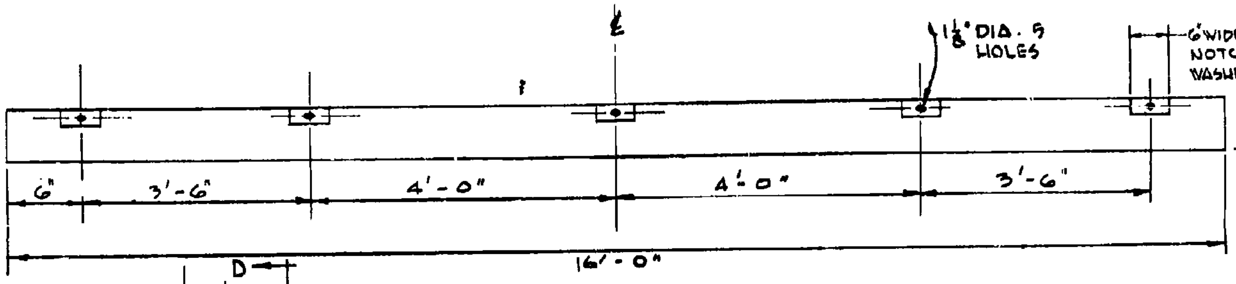
UNITED STATES



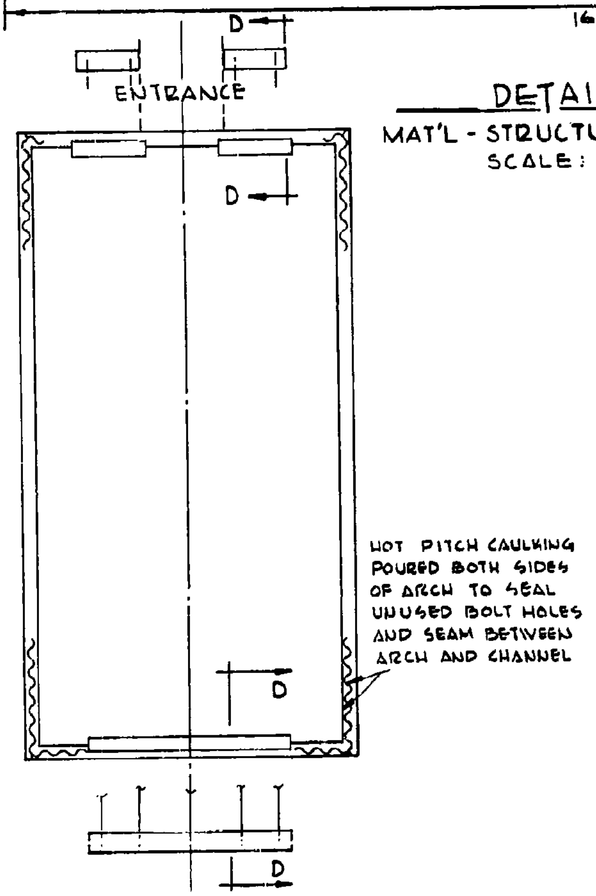

ELEVATION "B"

ENDWALL — LOOKING OUT
SCALE: 3/8" = 1'-0"

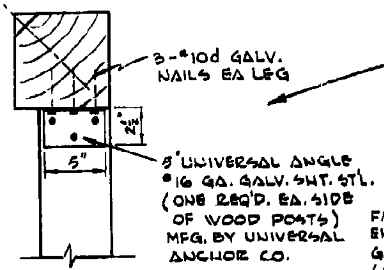



DETAIL "B"

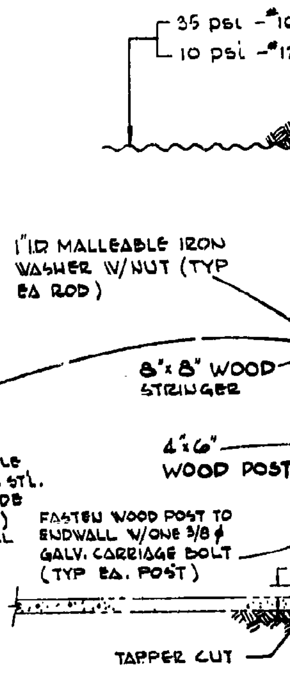
MAT'L - STRUCTURAL GRADE TIMBER
SCALE: 3/4" = 1'-0"




PLOT PLAN
SCALE: 1/8" = 1'0"
FOR DETAILS SEE FIG. A-2M




SCALE: 1 1/2" = 1'-0"

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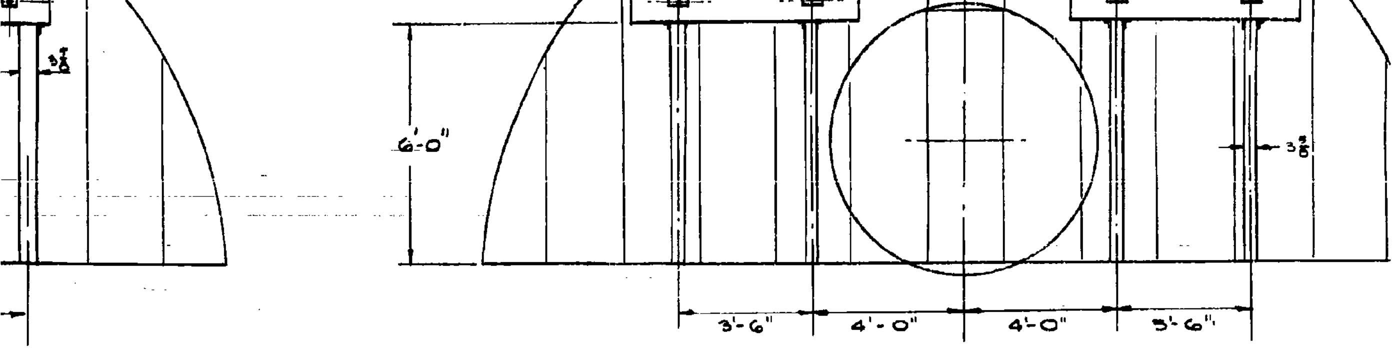
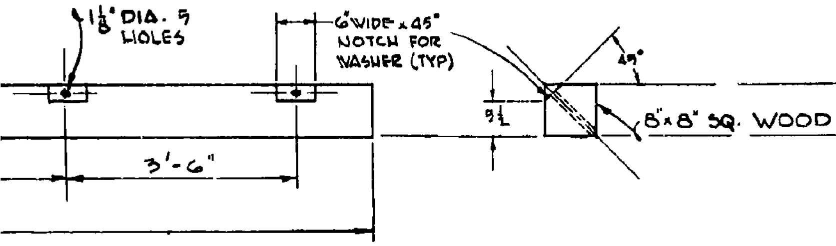
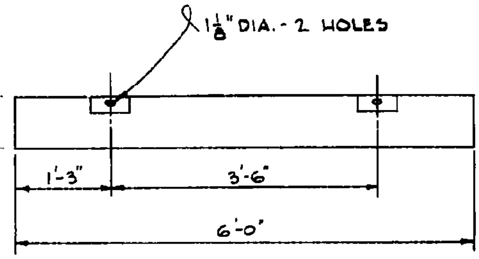
TYPICAL REIN




ELEVATION "A"

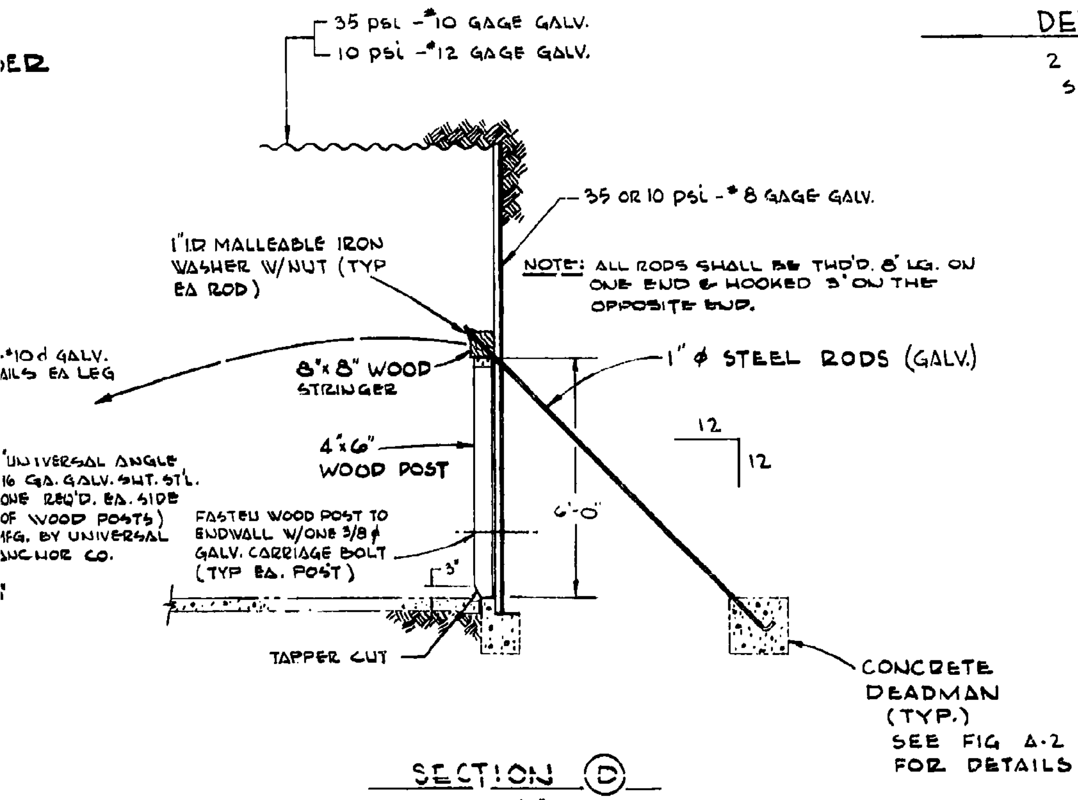
ENTRANCE - LOOKING OUT
SCALE: 3/8" = 1'-0"




DETAIL "A"

2 PCS. REQ'D.
SCALE: 3/4" = 1'-0"




SECTION (D)

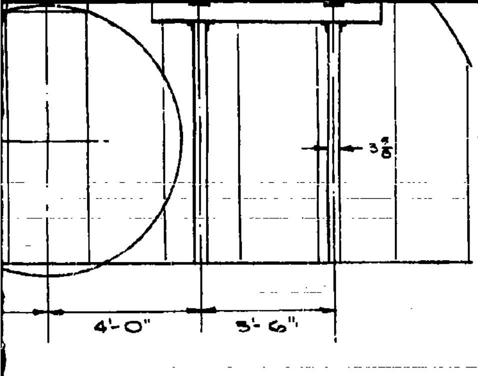
SCALE: 3/8" = 1'-0"

TYPICAL REINFORCING POST DETAIL

(1) CORRUGATION
DEPTH OF 2 IN
CORRUGATION
(2) PLATES SHA
4.531 OR 5.781
ENTIRE LOT - PL
(c) FORMING & PU
PROPER RADIU
LIKE DIMENSION
THE LONGITUD
2 INCHES APAR
CORRUGATION.
OF THE BOLT F
FORMING CIRCU
CENTER TO CEN
PLATES SHALL
FORMED IN AC
(d) BOLTS & NUTS
THE CORRUGATE
FIT. MATERIAL
THE BOLT HEA
WILL BE OBTAIN
HEAD IS USED
ROUNDED ON
THE VALLEY OF
(e) CHANNELS. - UN
COLD-FORMED
FOR ANCHORIN
HOLES TO MATC
2. SHELTER ENDWALL
INDICATED.
(a) STRUCTURAL PL
REQUIREMENTS
TO FORMING,
AT NOT LESS
(b) BOLTS & NUTS.
THE REQUIREME
3. ENTRANCE TUNNEL
GAGE AS INDICAT
M36-57, COPPE
SHALL BE MANU
4. ARCH & PIPE EREC
ACCORDANCE WIT
INDICATED. ALL SEA
1½ INCH x 1/8 INCH
ONE STRIP SHA
PLATES COMPRIS
STRUCTURE, INCL
ARCH, SHALL BE
5. REPAIR AFTER E
SHALL BE WIRE
CONFORMING TO

5

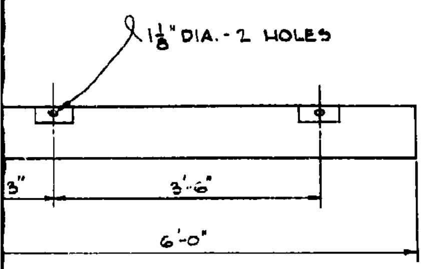
ENGINEERING & DESIGN IS APPROVED BY: Lewis H. Porteous DATE: 22 May 6_




ATION "A"

- LOOKING OUT

LE: 3/8" = 1'-0"




DETAIL "A"

2 PCS. REQ'D.
SCALE: 3/4" = 1'-0"

G. ON

GALV.)

CRETE
DMAN
YP.)
EE FIG A-2
OR DETAILS

(1) CORRUGATIONS SHALL HAVE A PITCH OF 6 INCHES WITH A TOLERANCE OF 1/4 INCH, & A DEPTH OF 2 INCHES WITH A TOLERANCE OF 1/8 INCH. THE RADIUS ON THE INSIDE OF THE CORRUGATION SHALL BE AT LEAST 1 1/16 INCHES.

(2) PLATES SHALL BE EITHER #12 OR #10 GAGE, AS SPECIFIED, & SHALL WEIGH AFTER GALV. 4.531 OR 5.781 LBS/SQ. FT. RESPECTIVELY. WEIGHT TOLERANCES THAT ARE PERMISSIBLE: ENTIRE LOT - PLUS 5%, MINUS 5%; INDIVIDUAL PLATES - PLUS 5%, MINUS 10%.

(c) FORMING & PUNCHING PLATES. AFTER CORRUGATING, EACH PLATE SHALL BE CURVED TO THE PROPER RADIUS & THE BOLT HOLES SHALL BE SO PUNCHED THAT ALL PLATES HAVING LIKE DIMENSIONS & CURVATURE ARE INTERCHANGEABLE IN THE ERECTION PROCESS. ON THE LONGITUDINAL JOINTS OF THE ARCH, BOLT HOLES SHALL BE IN STAGGERED ROWS 2 INCHES APART, WITH ONE HOLE PUNCHED IN THE VALLEY & ONE IN THE CREST OF EACH CORRUGATION. THE CENTER OF NO HOLE SHALL BE CLOSER THAN 1 3/4 TIMES THE DIAMETER OF THE BOLT FROM THE EDGE OF THE PLATE. BOLT HOLES IN THOSE EDGES OF THE PLATES FORMING CIRCUMFERENTIAL SEAMS SHALL BE SPACED NOT MORE THAN 12 INCHES CENTER TO CENTER. ALL BOLT HOLES SHALL BE 1/8 INCH LARGER THAN THE BOLTS. PLATES SHALL BE SO CURVED THAT, WHEN BOLTED TOGETHER, THE ARCH SHALL BE FORMED IN ACCORDANCE WITH THE PLAN DIMENSIONS.

(d) BOLTS & NUTS SHALL BE HOT-DIP GALV. & SHALL BE PROVIDED BY THE MANUFACTURER OF THE CORRUGATED METAL ARCH. THREADS SHALL BE AMERICAN STANDARD COARSE, CLASS 2 FREE FIT. MATERIAL SHALL CONFORM TO THE REQUIREMENTS OF ASTM SPECIFICATIONS A 325. THE BOLT HEADS SHALL BE SO SHAPED THAT ADEQUATE BEARING OF THE BOLT HEAD WILL BE OBTAINED, WITHOUT THE USE OF WASHERS REGARDLESS OF WHETHER THE BOLT HEAD IS USED ON THE CREST OR VALLEY OF THE CORRUGATIONS. THE NUTS SHALL BE ROUNDED ON ONE FACE TO SECURE PROPER BEARING & NOT TO CUT THE GALVANIZING IN THE VALLEY OF THE CORRUGATIONS.

(e) CHANNELS. - UNBALANCED CHANNELS, WHERE REQ'D. ON THE PLANS SHALL BE HOT-DIP GALV. COLD-FORMED METAL OF NOT LESS THAN 3/16 INCH IN THICKNESS, WITH SLOTTED TONGUES FOR ANCHORING TO THE FOOTINGS. ONE VERTICAL LEG SHALL BE PUNCHED WITH SLOTTED HOLES TO MATCH THE HOLES IN THE PLATE.

2. SHELTER ENDWALLS SHALL BE ASSEMBLED AT THE SITE OF STRUCTURAL PLATES AS INDICATED.

(a) STRUCTURAL PLATES & CHANNELS SHALL BE FABRICATED OF STEEL CONFORMING TO THE REQUIREMENTS OF ASTM SPECIFICATION A245-58T, GRADE C, & SHALL BE #8 GA. PRIOR TO FORMING, THE STEEL SHALL BE HOT-DIP GALVANIZED WITH PRIME WESTERN SPELTER AT NOT LESS THAN 2 OUNCES PER SQ. FT. OF DOUBLE EXPOSED SURFACE.

(b) BOLTS & NUTS. - CONNECTIONS SHALL BE MADE WITH BOLTS & NUTS CONFORMING TO THE REQUIREMENTS OF SUBPARAGRAPH 1(d).

3. ENTRANCE TUNNEL SHALL BE FABRICATED OF GALVANIZED, CORRUGATED METAL PIPE, GAGE AS INDICATED, CONFORMING TO THE REQUIREMENTS OF ASSHO SPECIFICATION M 36-57, COPPER BEARING STEEL. EXCEPT AS INDICATED OTHERWISE, THE JOINTS SHALL BE MANUFACTURERS STANDARD FOR SIMILAR SERVICE.

4. ARCH & PIPE ERECTION. - THE METAL ARCH & ENTRANCE PIPE SHALL BE ERECTED IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS & TO THE LINES & GRADES INDICATED. ALL SEAMS OR JOINTS BETWEEN OVERLAPPING PLATES SHALL BE SEALED WITH 1 1/2 INCH x 1/8 INCH "PERMAGUM" STRIPS.
ONE STRIP SHALL BE PRESSED OVER EACH ROW OF BOLT HOLES ON ONE OF THE PLATES COMPRISING A JOINT, PRIOR TO BOLTING UP. ALL JOINTS OF THE CORRUGATED STRUCTURE, INCLUDING THE JUNCTION BETWEEN THE TUNNEL & THE ENDWALL OF THE ARCH, SHALL BE SEALED IN A SIMILAR MANNER.

5. REPAIR AFTER ERECTION. - GALVANIZED SURFACES DAMAGED DURING CONSTRUCTION SHALL BE WIRE BRUSHED & GIVEN 2 COATS OF ZINC-DUST ZINC-OXIDE PAINT CONFORMING TO SPECIFICATION MIL-P-15145A.

| REVISION | DATE | DESCRIPTION | BY | APP. |
|---|---|---|---|---|

UNITED STATES
NAVAL RADIOLOGICAL DEFENSE LABORATORY
SAN FRANCISCO 24, CALIFORNIA

| | |
|---|---|
| DRAWN | FJA |
| CHECKED | FJO |
| SECTION HEAD | |
| BRANCH HEAD | |
| DIVISION HEAD | |

DEVELOPMENTAL DWG.

6

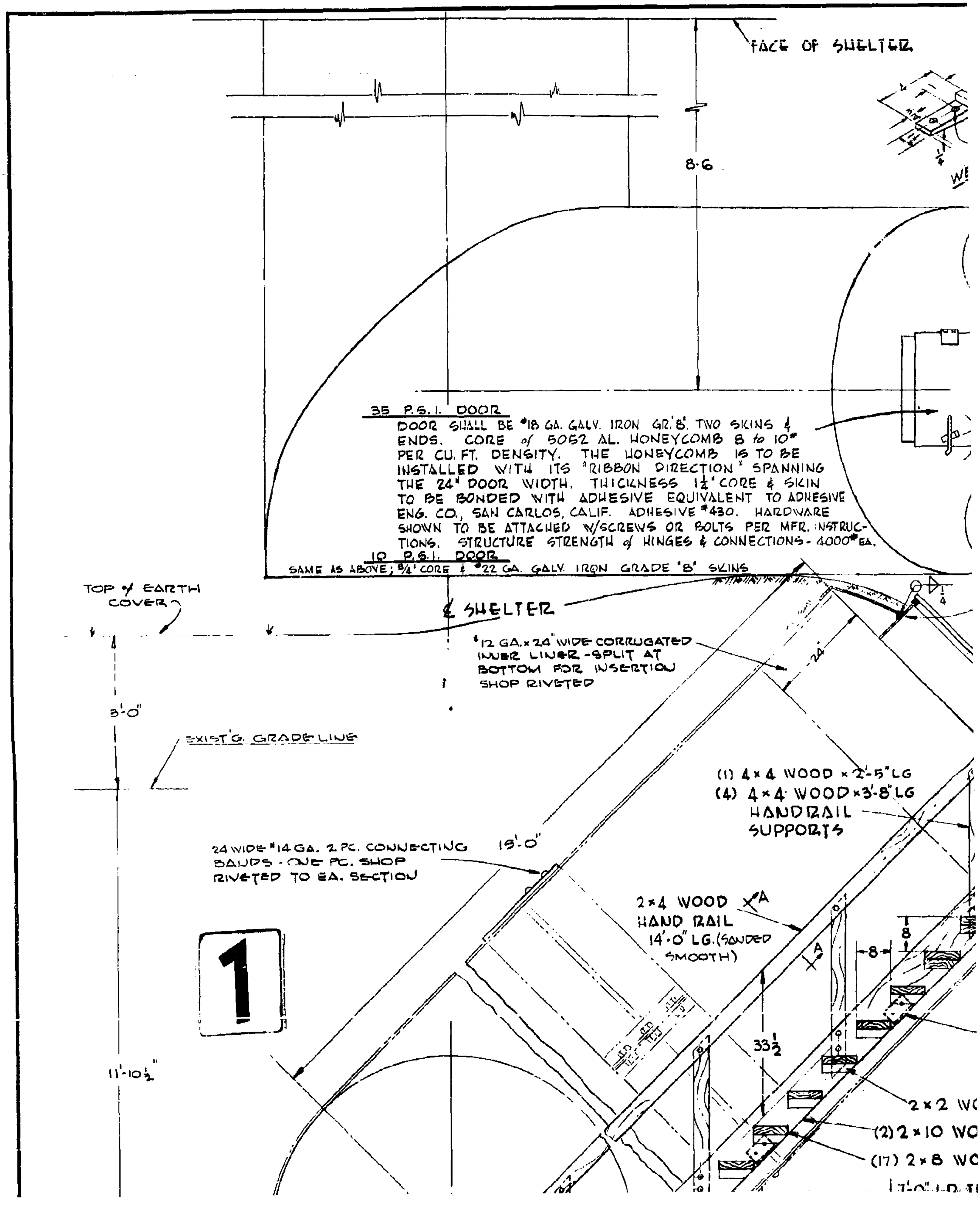
FIG. A-3M
ENTRANCE & END WALLS
SUPPORT DETAILS

| DATE | SCALE | PROJECT | FINISH | HEAT TREAT |
|---|---|---|---|---|
| 26 FEB 62 | NOTED | | | |

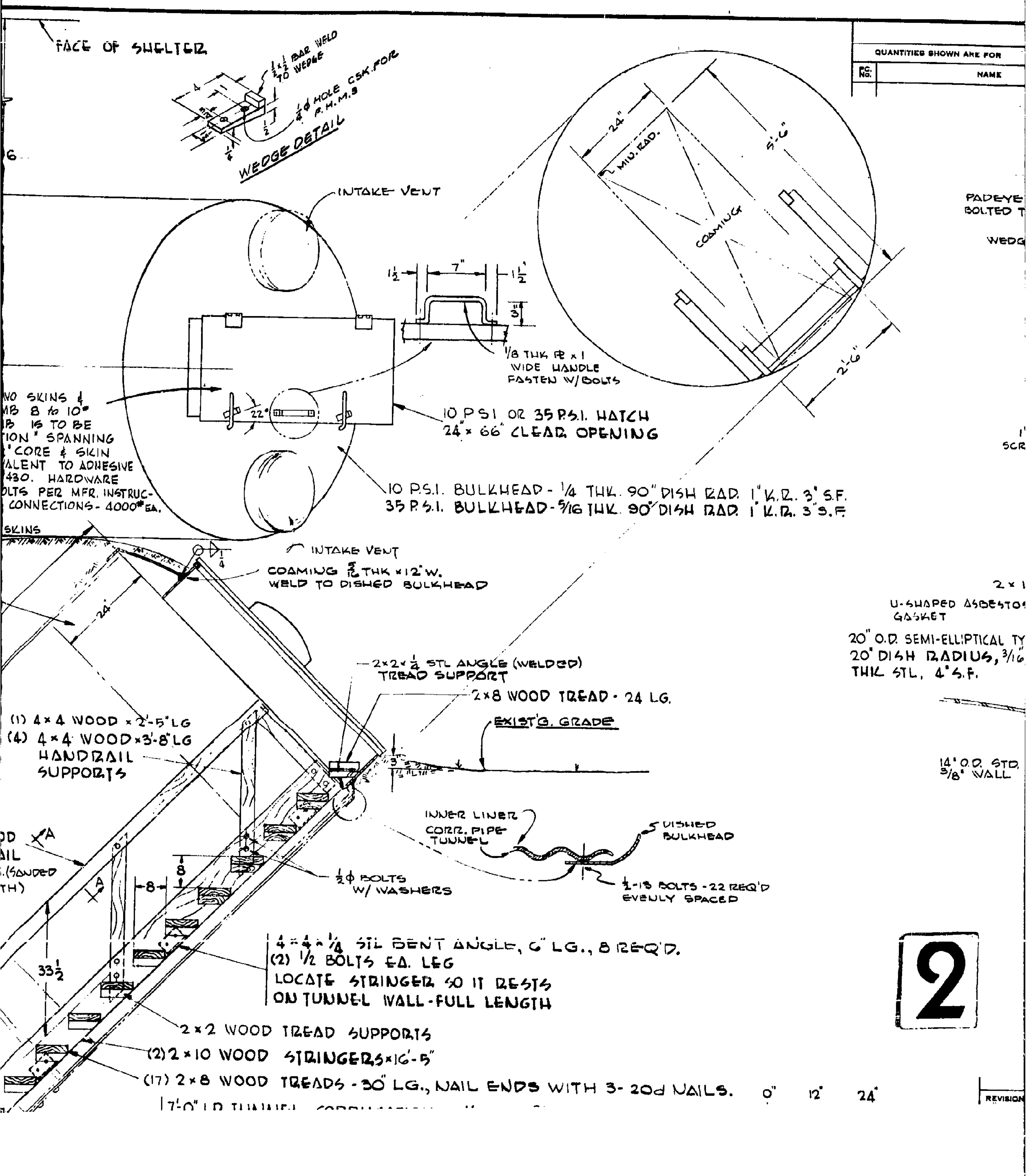
ENGINEERING & DESIGN IS APPROVED BY: Lewis G. Pottesure DATE: 22 May 62

SATISFACTORY TO: LGP
DATE 5-22-62

DRAWING NUMBER S-62-970
SHEET 5 OF 19
ALT.

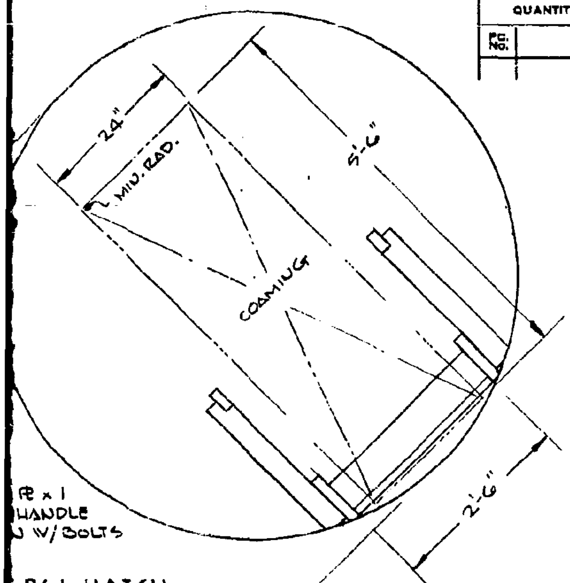


FACE OF SHELTER
8-6
35 P.S.I. DOOR
DOOR SHALL BE #18 GA. GALV. IRON GR.'B'. TWO SKINS & ENDS. CORE of 5052 AL. HONEYCOMB 8 to 10# PER CU. FT. DENSITY. THE HONEYCOMB IS TO BE INSTALLED WITH ITS "RIBBON DIRECTION" SPANNING THE 24" DOOR WIDTH. THICKNESS 1½" CORE & SKIN TO BE BONDED WITH ADHESIVE EQUIVALENT TO ADHESIVE ENG. CO., SAN CARLOS, CALIF. ADHESIVE #430. HARDWARE SHOWN TO BE ATTACHED W/SCREWS OR BOLTS PER MFR. INSTRUCTIONS. STRUCTURE STRENGTH of HINGES & CONNECTIONS - 4000# EA.
10 P.S.I. DOOR
SAME AS ABOVE; 3/4" CORE & #22 GA. GALV. IRON GRADE 'B' SKINS
TOP of EARTH COVER
℄ SHELTER
#12 GA. x 24" WIDE CORRUGATED INNER LINER - SPLIT AT BOTTOM FOR INSERTION SHOP RIVETED
24"
3'-0"
EXIST'G. GRADE LINE
(1) 4 x 4 WOOD x 2'-5" LG
(4) 4 x 4 WOOD x 3'-8" LG HANDRAIL SUPPORTS
24 WIDE #14 GA. 2 PC. CONNECTING BANDS - ONE PC. SHOP RIVETED TO EA. SECTION
19'-0"
2 x 4 WOOD HAND RAIL 14'-0" LG. (SANDED SMOOTH)
A
A
8
8
1
33½
11'-10½"
2 x 2 WO
(2) 2 x 10 WO
(17) 2 x 8 WO



FACE OF SHELTER
1/2 x 1/2 BAR WELD TO WEDGE
1/4 φ HOLE CSK. FOR F.H.M.S
WEDGE DETAIL
QUANTITIES SHOWN ARE FOR
PC. NO.
NAME
24"
MIN. RAD.
5'-6"
COAMING
2'-6"
PADEYE
BOLTED T
WEDG
INTAKE VENT
1 1/2
7"
1 1/2
3"
1/8 THK PL x 1 WIDE HANDLE FASTEN W/BOLTS
22°
10 PSI OR 35 P.S.I. HATCH
24" x 66" CLEAR OPENING
10 P.S.I. BULKHEAD - 1/4 THK. 90" DISH RAD. 1" K.R. 3" S.F.
35 P.S.I. BULKHEAD - 5/16 THK. 90" DISH RAD. 1" K.R. 3" S.F.
WO SKINS &
MB 8 to 10"
B IS TO BE
ION" SPANNING
" CORE & SKIN
ALENT TO ADHESIVE
430. HARDWARE
OLTS PER MFR. INSTRUC-
CONNECTIONS - 4000# EA.
SKINS
INTAKE VENT
COAMING 5/16 THK x 12" W. WELD TO DISHED BULKHEAD
1/4
24"
2 x I
U-SHAPED ASBESTOS GASKET
20" O.D. SEMI-ELLIPTICAL TY
20" DISH RADIUS, 3/16
THK STL, 4" S.F.
2x2x1/4 STL ANGLE (WELDED) TREAD SUPPORT
2x8 WOOD TREAD - 24 LG.
(1) 4 x 4 WOOD x 2'-5" LG
(4) 4 x 4 WOOD x 3'-8" LG
HANDRAIL SUPPORTS
EXIST'G. GRADE
14' O.D. STD.
3/8" WALL
INNER LINER
CORR. PIPE TUNNEL
DISHED BULKHEAD
1/2-13 BOLTS - 22 REQ'D EVENLY SPACED
1/2 φ BOLTS W/ WASHERS
8
8
33 1/2
4 x 4 x 1/4 STL BENT ANGLE, 6" LG., 8 REQ'D.
(2) 1/2 BOLTS EA. LEG
LOCATE STRINGER SO IT RESTS ON TUNNEL WALL - FULL LENGTH
2 x 2 WOOD TREAD SUPPORTS
(2) 2 x 10 WOOD STRINGERS x 16'-5"
(17) 2 x 8 WOOD TREADS - 30" LG., NAIL ENDS WITH 3-20d NAILS.
0" 12" 24"
REVISION
2

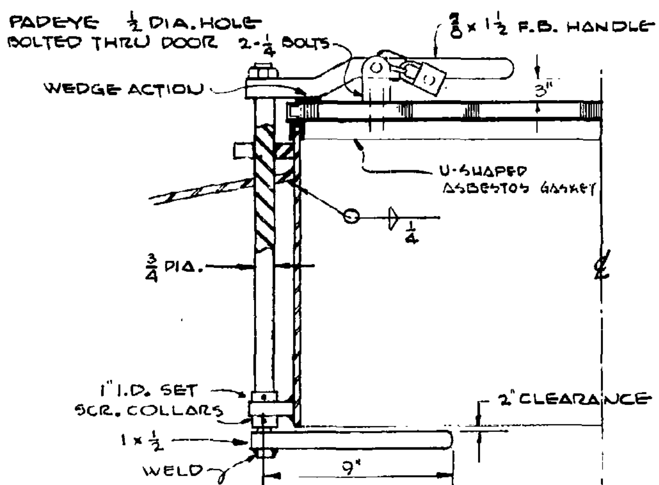
| LIST OF MATERIAL | | | | | | |
|---|---|---|---|---|---|---|
| QUANTITIES SHOWN ARE FOR | | | | | | |
| PC. NO. | NAME | NO. REQ. | MAT'L. | MAT'L. SPECS. | STOCK SIZE | REMARKS |
| | | | | | | |




R x 1
HANDLE
N W/ BOLTS

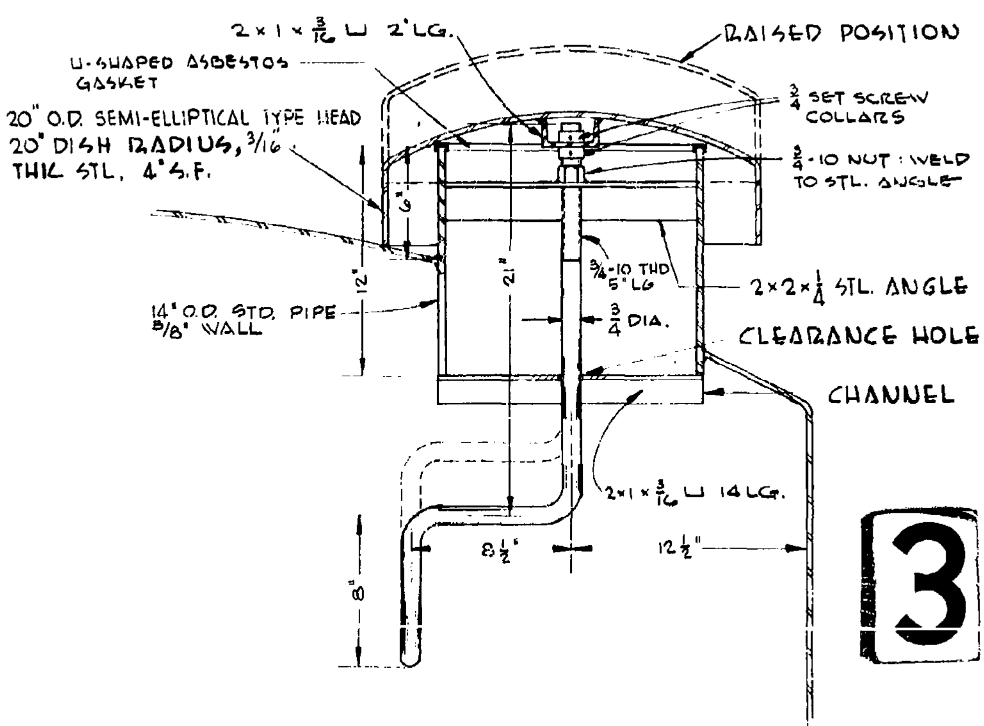
5 P.S.I. HATCH
R OPENING

- 1/4 THK. 90" DISH RAD. 1" K.R. 3" S.F.
- 5/16 THK. 90" DISH RAD. 1" K.R. 3" S.F.




DOOR LOCKING DEVICE

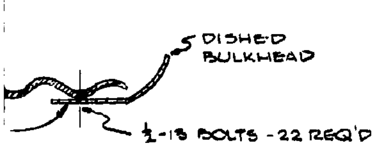
NO SCALE




LDED)

D TREAD - 24 LG.

G. GRADE




5" LG., 8 REQ'D.

TS
TH

3

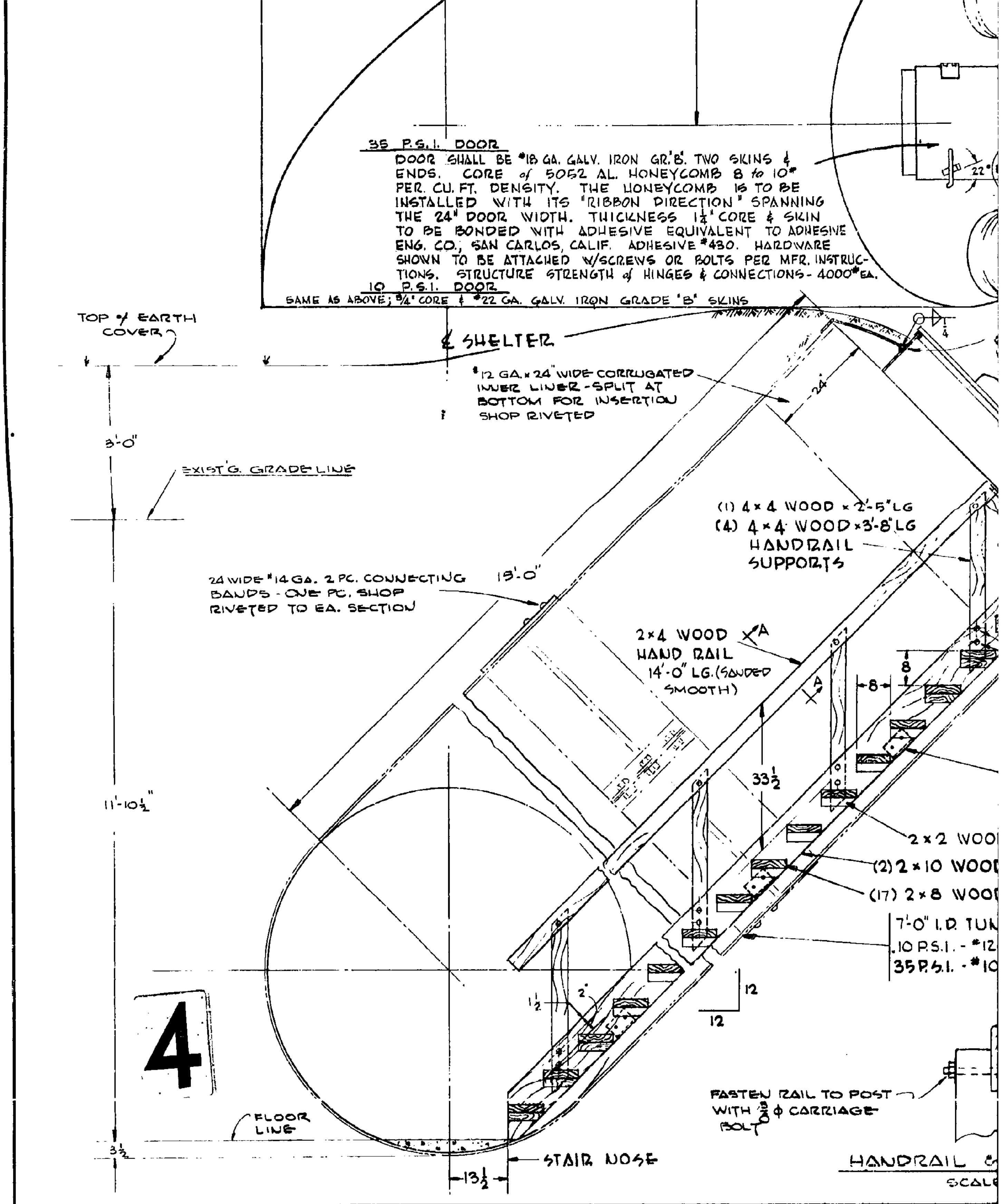
S WITH 3-20d NAILS.

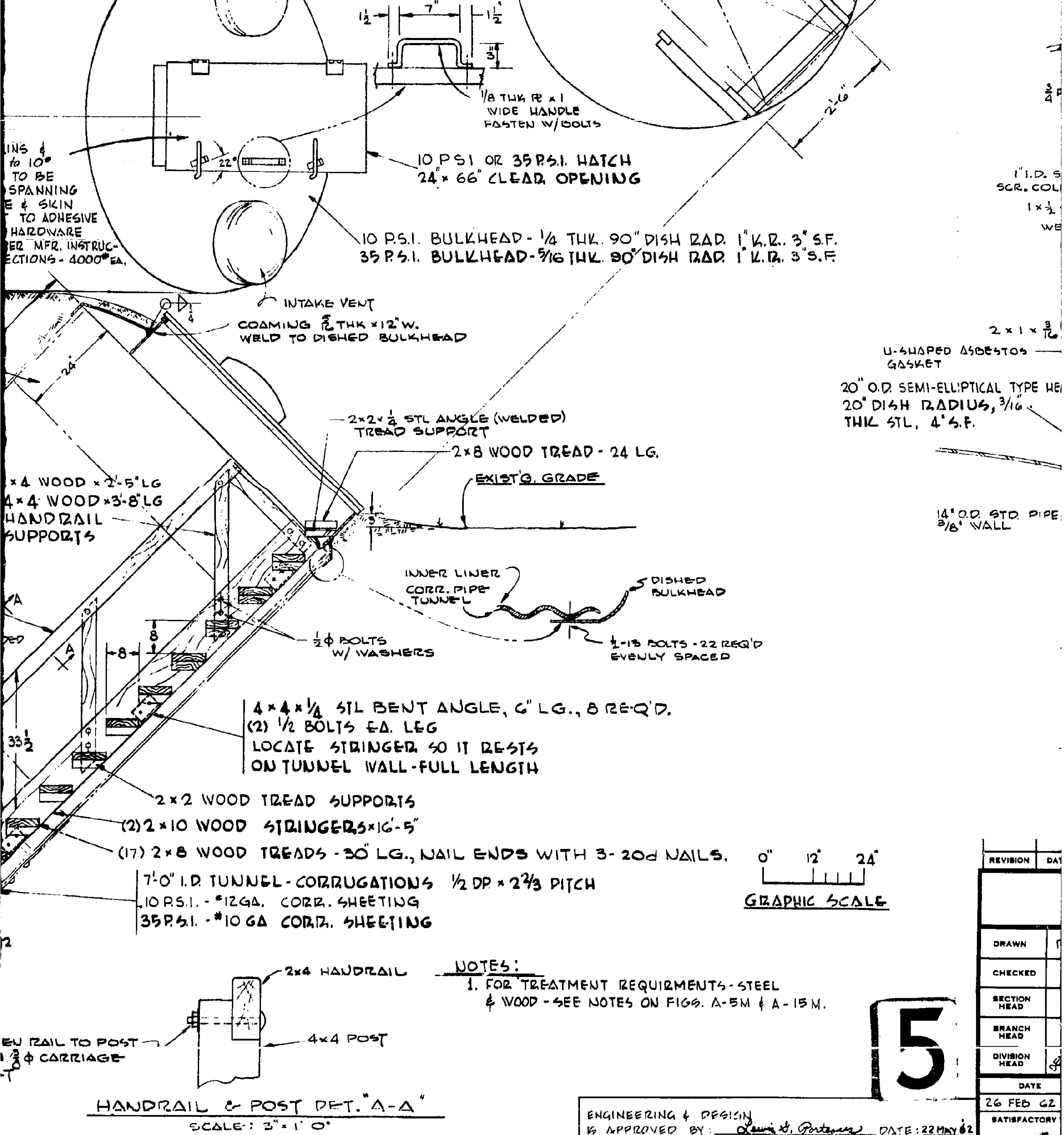
2 2/3 PITCH

0" 12" 24"

| REVISION | DATE | DESCRIPTION | BY | APP. |
|---|---|---|---|---|

UNITED STATES


35 P.S.I. DOOR
DOOR SHALL BE #18 GA. GALV. IRON GR.'B'. TWO SKINS & ENDS. CORE of 5052 AL. HONEYCOMB 8 to 10# PER. CU. FT. DENSITY. THE HONEYCOMB IS TO BE INSTALLED WITH ITS "RIBBON DIRECTION" SPANNING THE 24" DOOR WIDTH. THICKNESS 1¼" CORE & SKIN TO BE BONDED WITH ADHESIVE EQUIVALENT TO ADHESIVE ENG. CO., SAN CARLOS, CALIF. ADHESIVE #430. HARDWARE SHOWN TO BE ATTACHED W/SCREWS OR BOLTS PER MFR. INSTRUCTIONS. STRUCTURE STRENGTH of HINGES & CONNECTIONS - 4000# EA.
10 P.S.I. DOOR
SAME AS ABOVE; ¾" CORE & #22 GA. GALV. IRON GRADE 'B' SKINS
TOP of EARTH COVER
℄ SHELTER
#12 GA.×24" WIDE CORRUGATED INNER LINER - SPLIT AT BOTTOM FOR INSERTION SHOP RIVETED
24"
3'-0"
EXIST'G. GRADE LINE
(1) 4×4 WOOD × 2'-5" LG
(4) 4×4 WOOD × 3'-8" LG
HANDRAIL SUPPORTS
24 WIDE #14 GA. 2 PC. CONNECTING BANDS - ONE PC. SHOP RIVETED TO EA. SECTION
15'-0"
2×4 WOOD HAND RAIL 14'-0" LG. (SANDED SMOOTH)
A
8
8
33½
11'-10½"
2×2 WOO
(2) 2×10 WOO
(17) 2×8 WOO
7'-0" I.D. TU
10 P.S.I. - #12
35 P.S.I. - #10
12
12
1½
2"
4
FLOOR LINE
3½
FASTEN RAIL TO POST WITH ⅜ φ CARRIAGE BOLT
STAIR NOSE
13½
HANDRAIL
SCAL



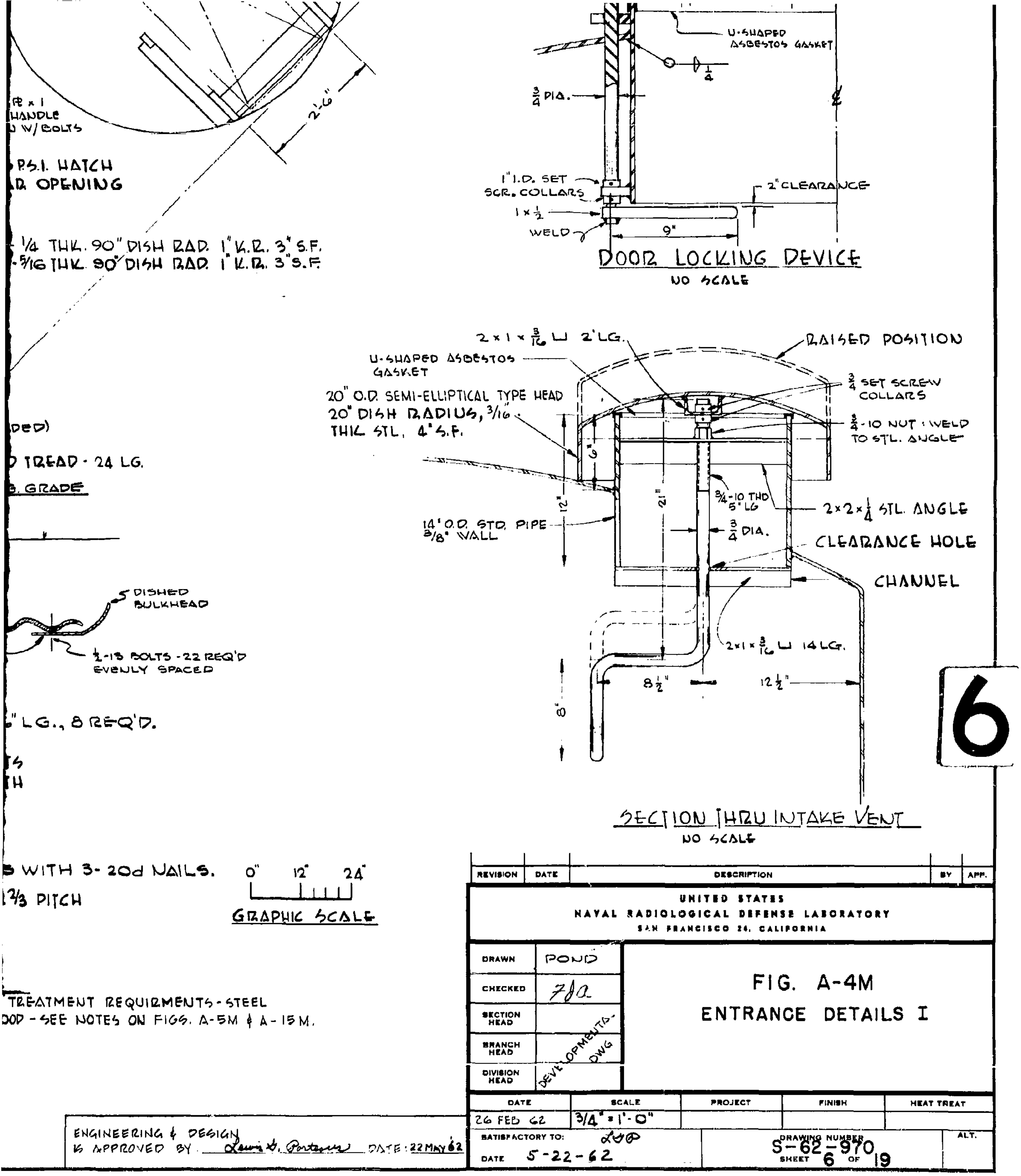

NOTES:

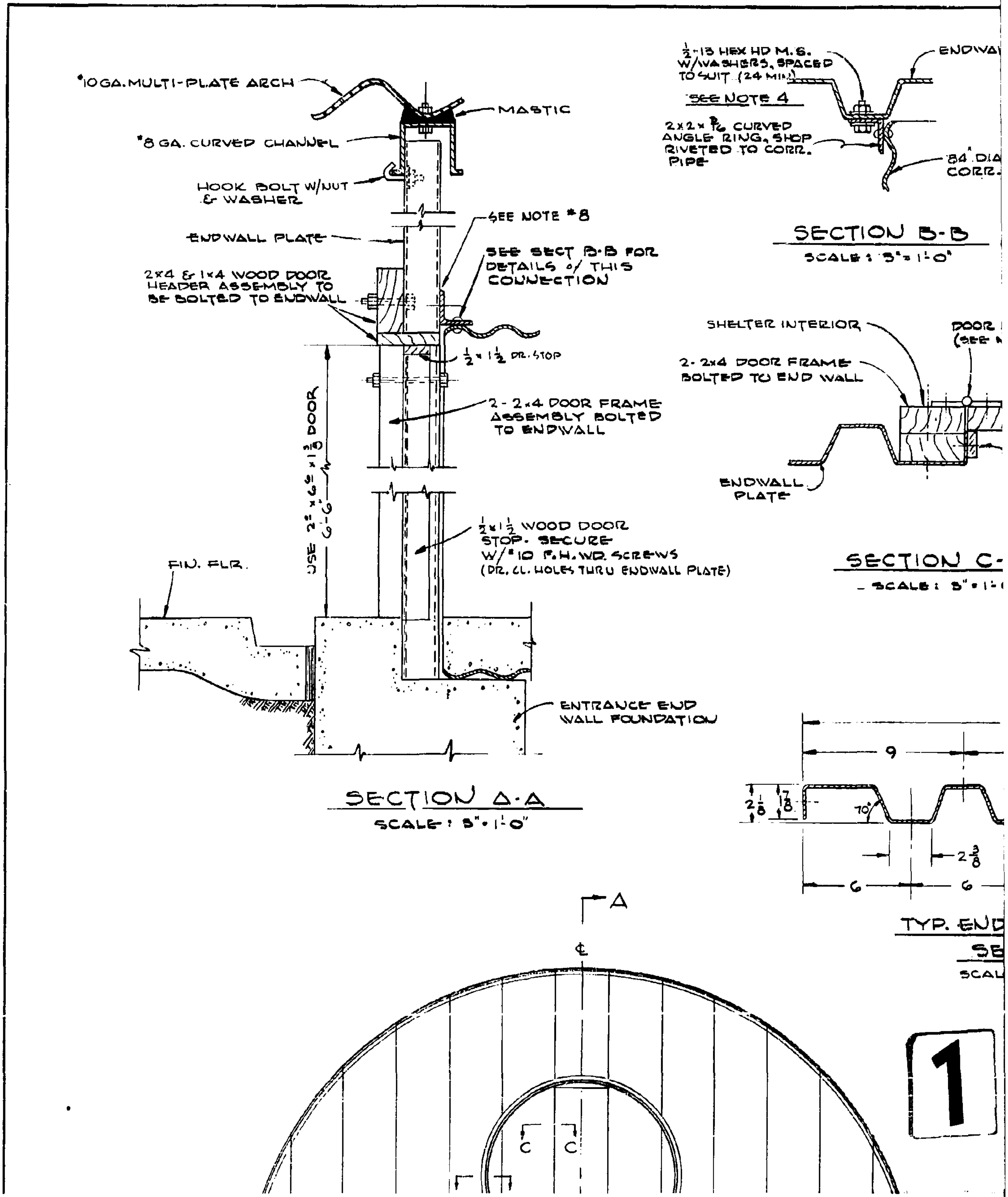
1. FOR TREATMENT REQUIREMENTS - STEEL & WOOD - SEE NOTES ON FIGS. A-5M & A-15M.

5

ENGINEERING & DESIGN IS APPROVED BY: Lewis G. Porter DATE: 22 MAY 62

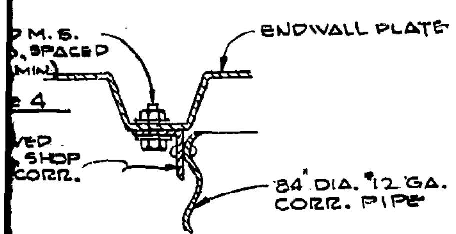
| REVISION | DAT |
|---|---|
| DRAWN | |
| CHECKED | |
| SECTION HEAD | |
| BRANCH HEAD | |
| DIVISION HEAD | |
| DATE | |
| 26 FEB 62 | |
| SATISFACTORY | |
| DATE | 5 - |


U-SHAPED ASBESTOS GASKET
3/4 DIA.
1" I.D. SET SCR. COLLARS
2" CLEARANCE
1 × 1/2
WELD
9"
DOOR LOCKING DEVICE
NO SCALE
2-6"
HANDLE
W/ BOLTS
P.S.I. HATCH
R OPENING
1/4 THK. 90" DISH RAD. 1" K.R. 3" S.F.
5/16 THK. 90" DISH RAD. 1" K.R. 3" S.F.
DED)
TREAD - 24 LG.
GRADE
2 × 1 × 3/16 ⊔ 2' LG.
RAISED POSITION
U-SHAPED ASBESTOS GASKET
20" O.D. SEMI-ELLIPTICAL TYPE HEAD
20" DISH RADIUS, 3/16 THK STL. 4" S.F.
3/4 SET SCREW COLLARS
3/4-10 NUT : WELD TO STL. ANGLE
6"
12"
21"
3/4-10 THD 5" LG
2×2×1/4 STL. ANGLE
14" O.D. STD. PIPE 3/8" WALL
3/4 DIA.
CLEARANCE HOLE
CHANNEL
DISHED BULKHEAD
1/2-13 BOLTS - 22 REQ'D EVENLY SPACED
2×1×3/16 ⊔ 14 LG.
8 1/2"
12 1/2"
8'
"LG., 8 REQ'D.
SECTION THRU INTAKE VENT
NO SCALE
WITH 3-20d NAILS.
1 2/3 PITCH
0" 12" 24"
GRAPHIC SCALE
TREATMENT REQUIREMENTS - STEEL
OOD - SEE NOTES ON FIGS. A-5M & A-15M.
6
REVISION
DATE
DESCRIPTION
BY
APP.
UNITED STATES
NAVAL RADIOLOGICAL DEFENSE LABORATORY
SAN FRANCISCO 24, CALIFORNIA
DRAWN POND
CHECKED
SECTION HEAD
BRANCH HEAD
DIVISION HEAD
DEVELOPMENTAL DWG
FIG. A-4M
ENTRANCE DETAILS I
DATE 26 FEB 62
SCALE 3/4" = 1'-0"
PROJECT
FINISH
HEAT TREAT
SATISFACTORY TO:
DATE 5-22-62
DRAWING NUMBER S-62-970
SHEET 6 OF 19
ALT.
ENGINEERING & DESIGN IS APPROVED BY
DATE: 22 MAY 62


*10 GA. MULTI-PLATE ARCH
MASTIC
*8 GA. CURVED CHANNEL
HOOK BOLT W/NUT & WASHER
SEE NOTE *8
ENDWALL PLATE
SEE SECT B-B FOR DETAILS of THIS CONNECTION
2x4 & 1x4 WOOD DOOR HEADER ASSEMBLY TO BE BOLTED TO ENDWALL
1/2 x 1 1/2 DR. STOP
USE 2'-6" x 6'-6" x 1 3/8 DOOR
2 - 2x4 DOOR FRAME ASSEMBLY BOLTED TO ENDWALL
1/2 x 1 1/2 WOOD DOOR STOP. SECURE W/#10 F.H. WD. SCREWS
(DR. CL. HOLES THRU ENDWALL PLATE)
FIN. FLR.
ENTRANCE END WALL FOUNDATION
SECTION A-A
SCALE: 3" = 1'-0"
1/2-13 HEX HD M.S. W/WASHERS, SPACED TO SUIT (24 MIN)
SEE NOTE 4
2x2x 3/16 CURVED ANGLE RING, SHOP RIVETED TO CORR. PIPE
ENDWA
84" DIA CORR.
SECTION B-B
SCALE: 3" = 1'-0"
SHELTER INTERIOR
DOOR (SEE
2 - 2x4 DOOR FRAME BOLTED TO END WALL
ENDWALL PLATE
SECTION C-
SCALE: 3" = 1'-
9
2 1/8
1 7/8
70°
2 3/8
6
6
TYP. END
SE
SCAL
A
℄
C
C
1

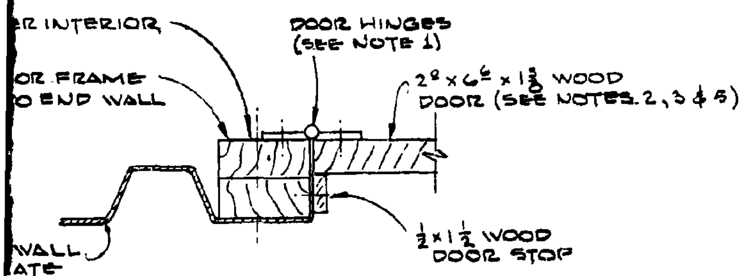
QUANTITIES SHO

PC. NO.



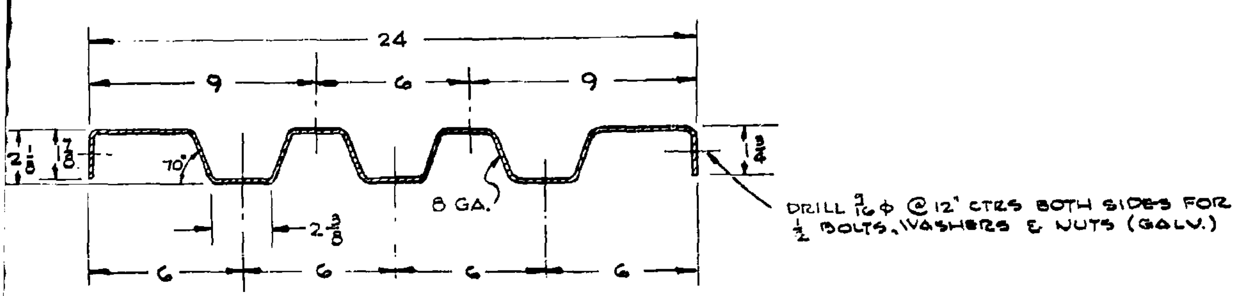

SECTION B-B

SCALE: 3"=1'-0"



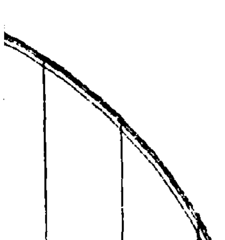

SECTION C-C

SCALE: 3"=1'-0"




TYP. ENDWALL PLATE SECTION

SCALE: 3"=1'-0"



1. ONE P
PAINT
2. DOOR
HAMIL
3. SCREE
FINISH
12 FRO
4. CONTR
JUNCT
5. THE W
DOOR.
6. ALL L
DOOR
ZINC C
TO ST
ASSOC
7. ALL E
LUMB
DOUGL
OTHER
8. THE
PIPE
AIR L
WHEN
TWO
EQUIV
WEAT
A PR

2

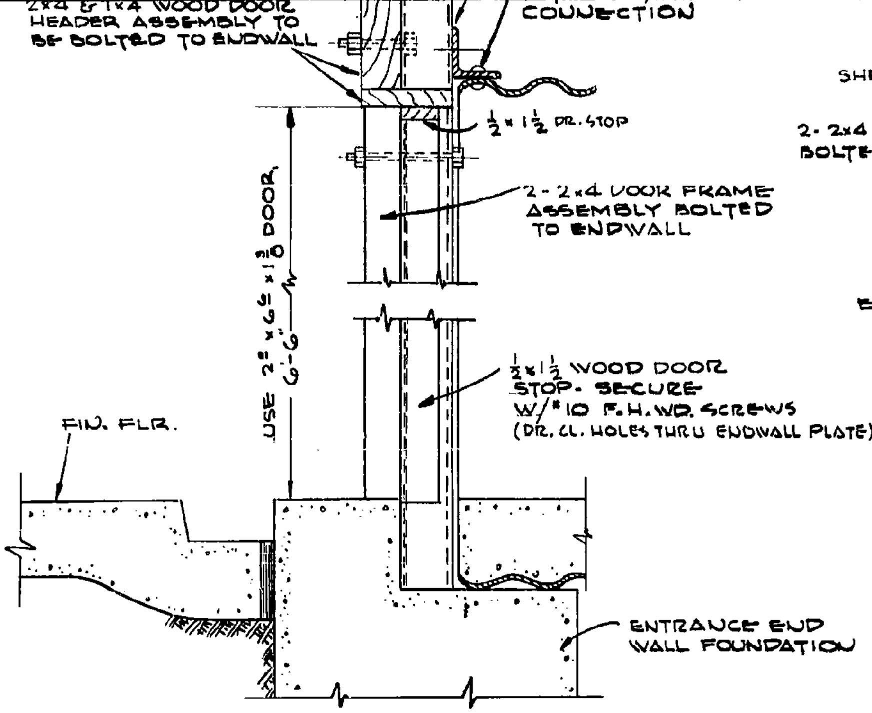
| LIST OF MATERIAL | | | | | | |
|---|---|---|---|---|---|---|
| QUANTITIES SHOWN ARE FOR | | | | | | |
| PC. NO. | NAME | NO. REQ. | MAT'L. | MAT'L. SPECS. | STOCK SIZE | REMARKS |
| | | | | | | |

## GENERAL NOTES

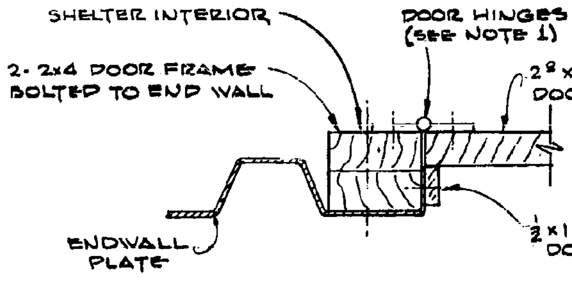
1. ONE PAIR 4×4 BUTT HINGES, WROUGHT STL., PRIMED for PAINTING, LOOSE PIN - STANLEY N242P OR EQUAL.
2. DOOR PULL, STL., JAPANNED FIN., STANLEY $1\frac{1}{16}\times5\frac{3}{4}$, BAKER-HAMILTON-PAC. CO. C7782 OR EQUAL. (2 REQ'D.)
3. SCREEN DOOR CATCHES, "SNAPPY", WRT. STL. JAPANNED FINISH, BAKER-HAMILTON-PAC. CO., 2 REQ'D., ONE MOUNTED 12 FROM TOP & ONE MTD. 12" FROM BOTTOM.
4. CONTRACTOR TO PROVIDE SUITABLE FLASHING AT JUNCTION of CORR. PIPE & ENDWALL.
5. THE WOOD DOOR SHALL BE A PLAIN CORE, 1 3/8 INCH FLUSH DOOR.
6. ALL LUMBER & TIMBERS USED IN STAIRWAY, ENDWALL SUPPORTS, DOOR ETC. SHALL BE GIVEN 2 BRUSH COATS OF CHROMATED ZINC CHLORIDE OR TANALITH. THE PRESERVATIVE SHALL CONFORM TO STANDARD P5-57 OF THE AMERICAN WOOD PRESERVER'S ASSOCIATION MANUAL.
7. ALL BOLTS, SCREWS & NAILS SHALL BE GALVANIZED. ALL LUMBER & TIMBERS SHALL BE EQUIVALENT TO PACIFIC COAST DOUGLAS FIR, S4S, & OF GRADES INDICATED. WOOD NOT OTHERWISE INDICATED SHALL BE CONSTRUCTION GRADE.
8. THE JOINT BETWEEN THE ENDWALL PLATE & 84" DIA. ENTRY PIPE SHALL BE SUITABLY FLASHED IN ORDER TO PREVENT AIR LEAKAGE FROM THE SHELTER TO THE ENTRY TUBE WHEN A DIFFERENCE IN AIR PRESSURE EXISTS BETWEEN THE TWO SPACES EQUAL TO 0.3 INCH STATIC HEAD (WATER EQUIVALENT). THE WOOD DOOR SHALL BE ADEQUATLY WEATHER STRIPPED TO PREVENT AN AIR EXCHANGE WITH A PRESSURE DIFFERENTIAL AS SPECIFIED ABOVE.

DRILL $\frac{9}{16}$ ϕ @ 12" CTRS BOTH SIDES FOR $\frac{1}{2}$ BOLTS, WASHERS & NUTS (GALV.)

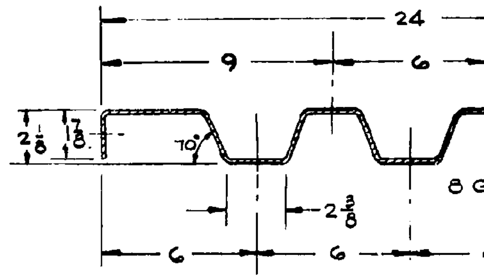
3



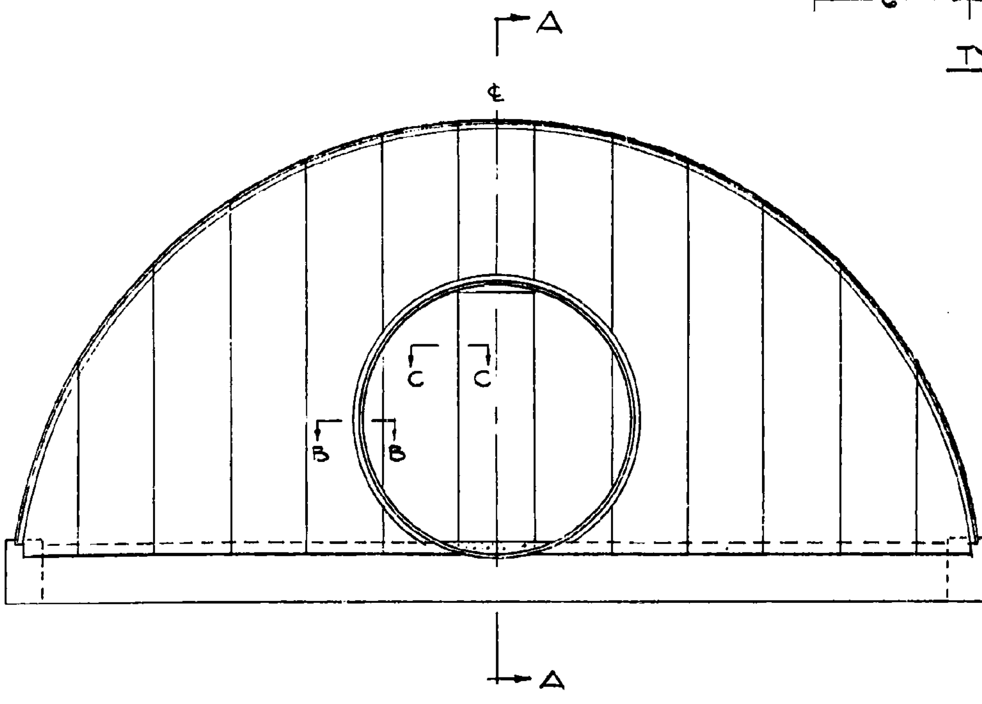

SECTION A-A
SCALE: 3" = 1'-0"




SECTION C-C
SCALE: 3" = 1'-0"

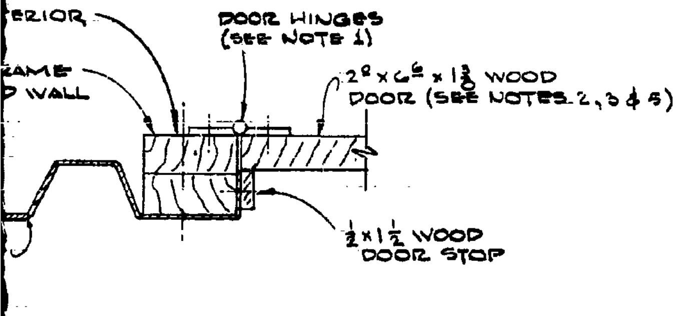



TYP. ENDWALL
SECTION
SCALE: 3" = 1



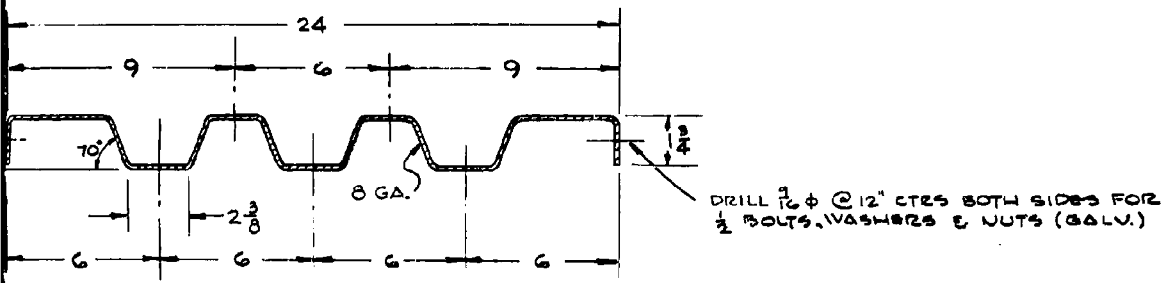

ENTRANCE END WALL
ELEVATION
SCALE: 3/8" = 1'-0"

4



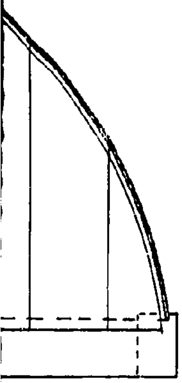

SECTION C-C

SCALE: 3" = 1'-0"




TYP. ENDWALL PLATE SECTION

SCALE: 3" = 1'-0"



1. ONE PAIR 4
PAINTING,
2. DOOR PULL
HAMILTON-
3. SCREEN DOO
FINISH, BAK
12 FROM TO
4. CONTRACTO
JUNCTION
5. THE WOOD D
DOOR.
6. ALL LUMBE
DOOR ETC. S
ZINC CHLOR
TO STANDAR
ASSOCIATION
7. ALL BOLTS
LUMBER & T
DOUGLAS F
OTHERWISE
8. THE JOINT
PIPE SHAL
AIR LEAKAG
WHEN A DIF
TWO SPACE
EQUIVALENT
WEATHER S
A PRESSUR

5

ENGINEERING & DESIGN IS APPROVED BY: Lewis A. Portens DATE: 12 May 62

GENERAL NOTES

1. ONE PAIR 4×4 BUTT HINGES, WROUGHT STL., PRIMED for PAINTING, LOOSE PIN - STANLEY N242P OR EQUAL.
2. DOOR PULL, STL., JAPANNED FIN., STANLEY 1 1/16 × 5 3/4, BAKER-HAMILTON-PAC. CO. C7782 OR EQUAL. (2 REQ'D.)
3. SCREEN DOOR CATCHES, "SNAPPY", WRT. STL. JAPANNED FINISH, BAKER-HAMILTON-PAC. CO., 2 REQ'D., ONE MOUNTED 12 FROM TOP & ONE MTD. 12" FROM BOTTOM.
4. CONTRACTOR TO PROVIDE SUITABLE FLASHING AT JUNCTION of CORR. PIPE & ENDWALL.
5. THE WOOD DOOR SHALL BE A PLAIN CORE, 1 3/8 INCH FLUSH DOOR.
6. ALL LUMBER & TIMBERS USED IN STAIRWAY, ENDWALL SUPPORTS, DOOR ETC. SHALL BE GIVEN 2 BRUSH COATS OF CHROMATED ZINC CHLORIDE OR TANALITH. THE PRESERVATIVE SHALL CONFORM TO STANDARD P5-57 OF THE AMERICAN WOOD PRESERVER'S ASSOCIATION MANUAL.
7. ALL BOLTS, SCREWS & NAILS SHALL BE GALVANIZED. ALL LUMBER & TIMBERS SHALL BE EQUIVALENT TO PACIFIC COAST DOUGLAS FIR, S4S, & OF GRADES INDICATED. WOOD NOT OTHERWISE INDICATED SHALL BE CONSTRUCTION GRADE.
8. THE JOINT BETWEEN THE ENDWALL PLATE & 84" DIA. ENTRY PIPE SHALL BE SUITABLY FLASHED IN ORDER TO PREVENT AIR LEAKAGE FROM THE SHELTER TO THE ENTRY TUBE WHEN A DIFFERENCE IN AIR PRESSURE EXISTS BETWEEN THE TWO SPACES EQUAL TO 0.3 INCH STATIC HEAD (WATER EQUIVALENT). THE WOOD DOOR SHALL BE ADEQUATLY WEATHER STRIPPED TO PREVENT AN AIR EXCHANGE WITH A PRESSURE DIFFERENTIAL AS SPECIFIED ABOVE.

DRILL 7/16 φ @ 12" CTRS BOTH SIDES FOR 1/2 BOLTS, WASHERS & NUTS (GALV.)

6

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| | | DATE |
|---|---|---|
| DRAWN | POND | |
| CHKD | [illegible] | |
| SCOPE APPROVED | [illegible] | 5/[illegible] |
| ENG. DESIGN APPROVAL — PROJ. ENGR. | | |
| SUPVR. | | |
| BRANCH HEAD | | |
| DIVISION HEAD | | |

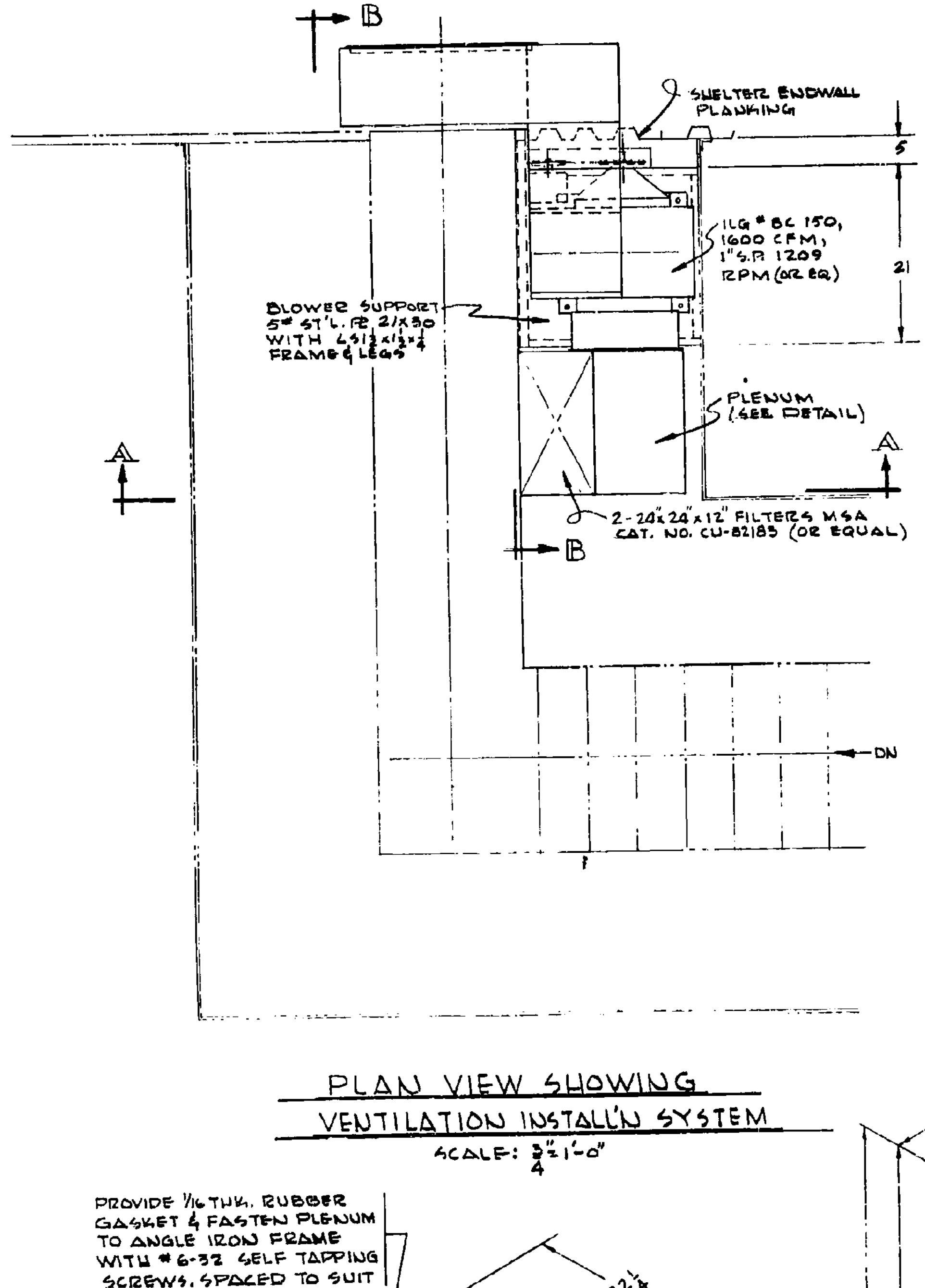
DEVELOPMENTAL DWG

FIG. A-5M
ENTRANCE DETAILS II

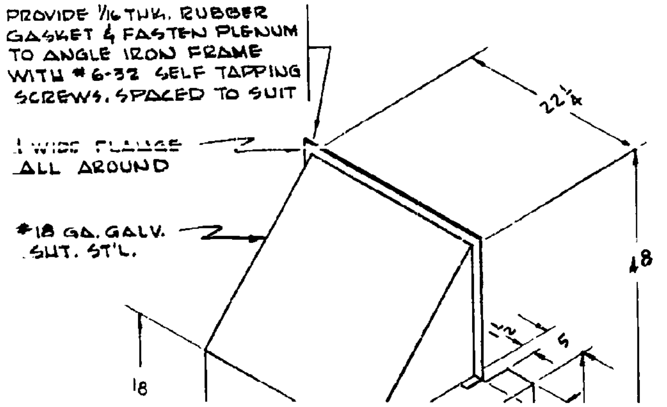
| SCALE | PROJECT | TECH MEMO. |
|---|---|---|
| AS NOTED | | |

DRAWING NUMBER S - 62 - 970 ALT.
SHEET 7 OF 19

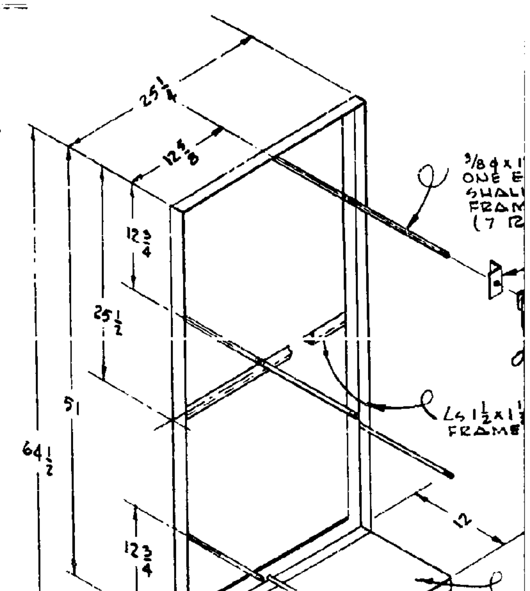
ENGINEERING & DESIGN IS APPROVED BY: Louis A. Poterue DATE: 22 May 62

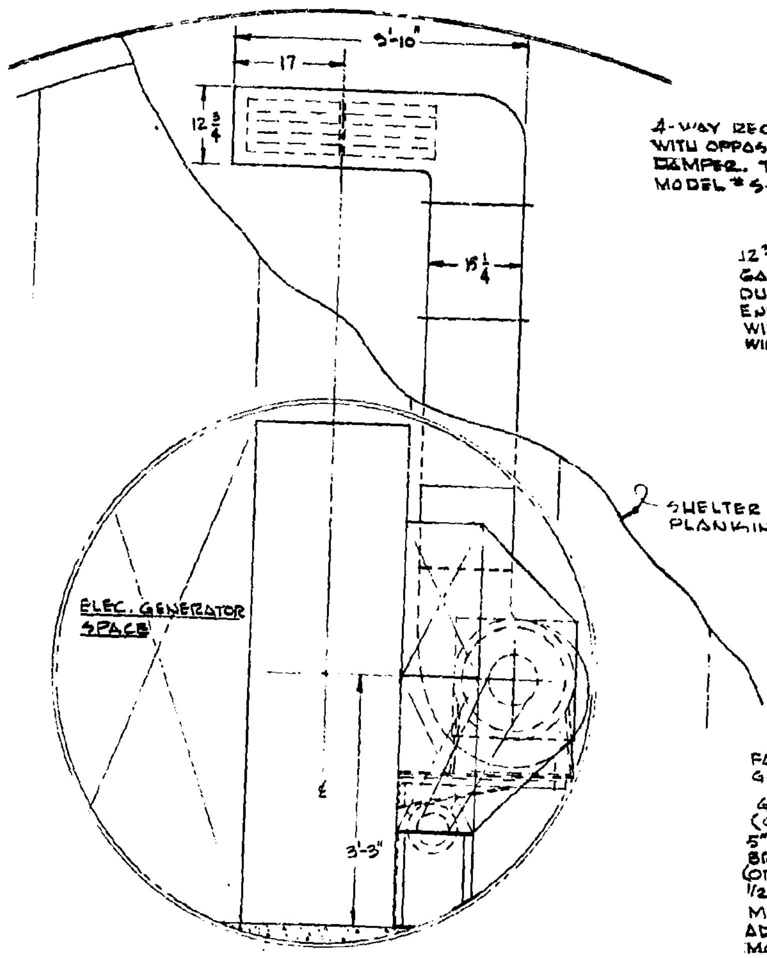



PLAN VIEW SHOWING
VENTILATION INSTALL'N SYSTEM
SCALE: ¾"=1'-0"

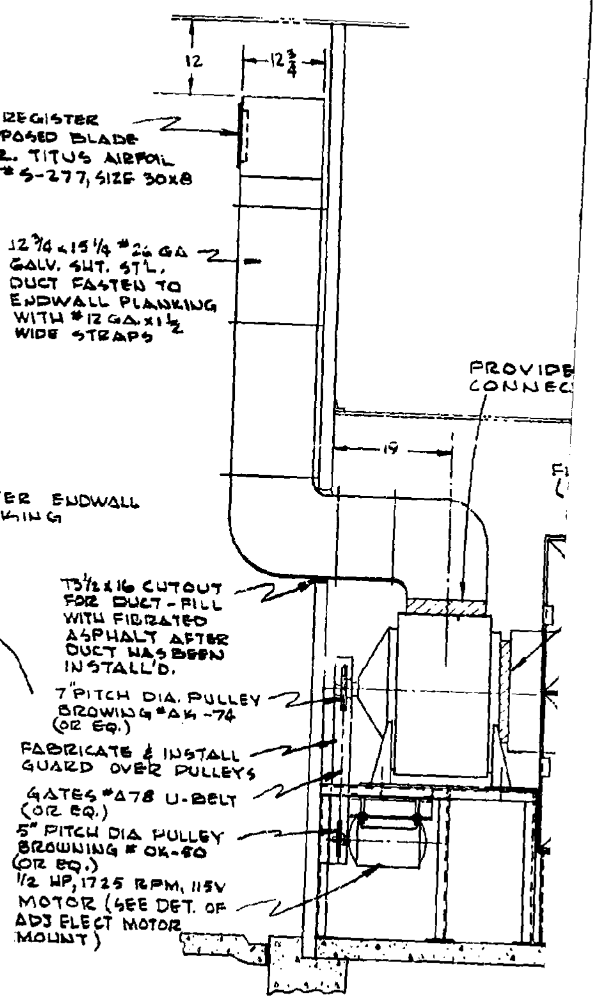




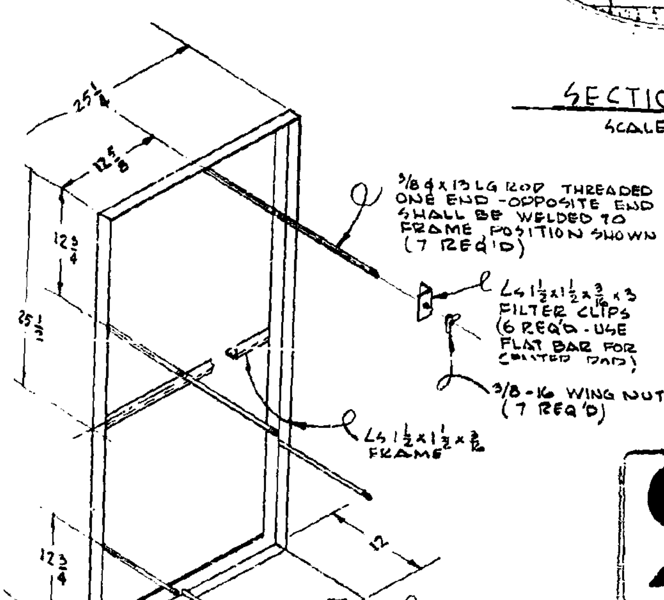




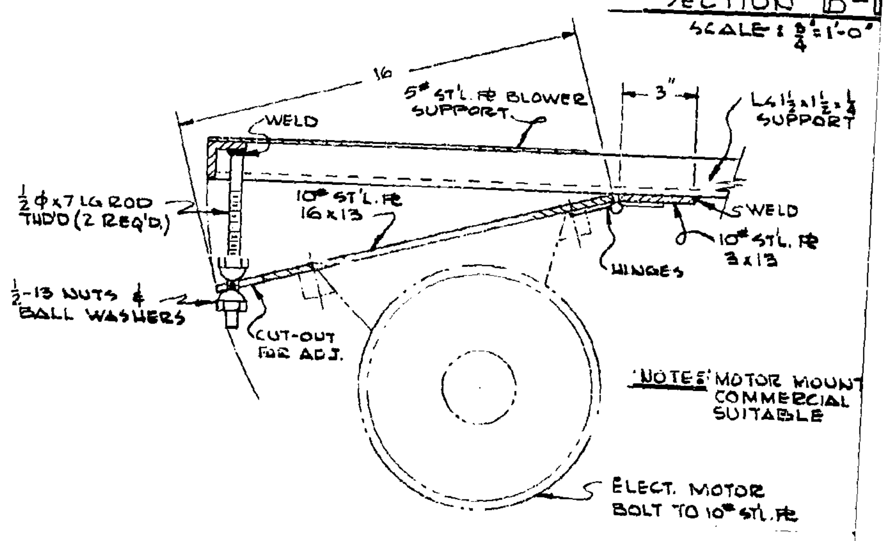

SECTION A-A
SCALE: 3/4"=1'-0"




SECTION B-B
SCALE: 3/4"=1'-0"




2



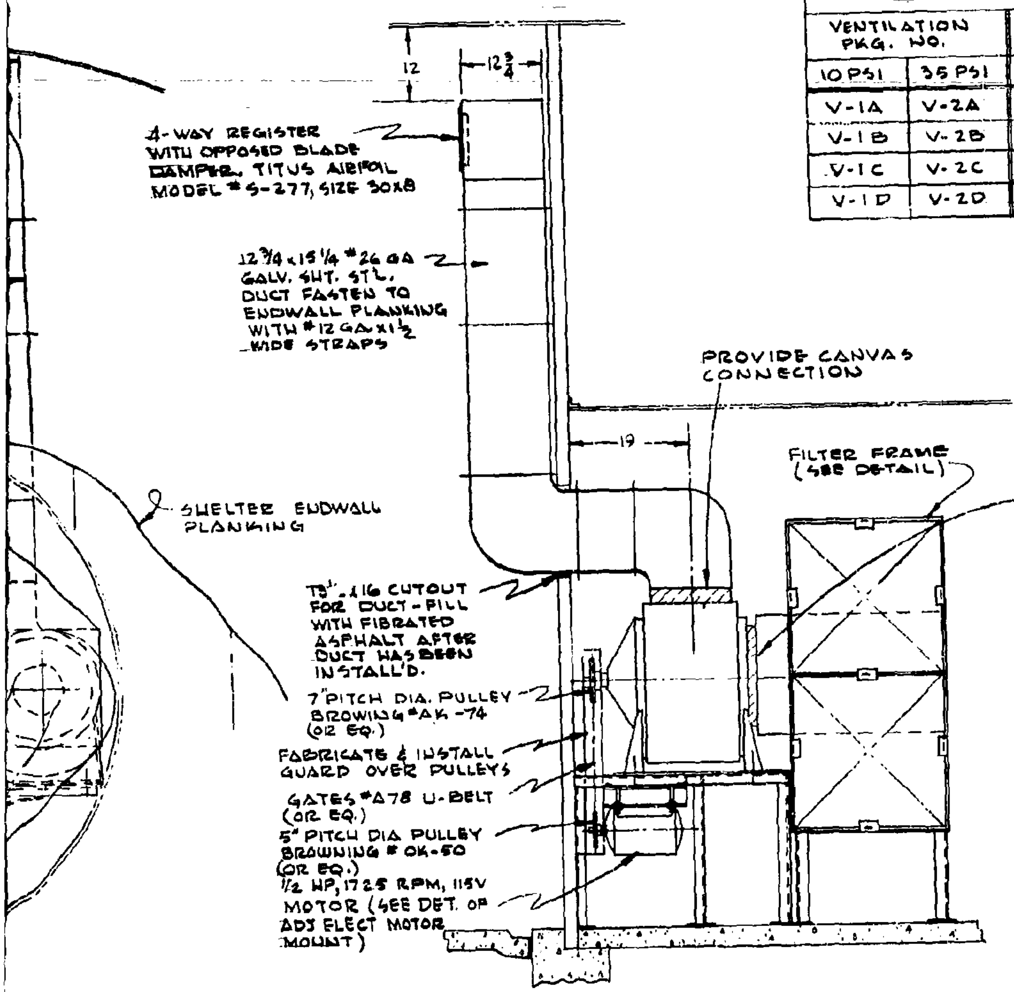
## LIST OF MATERIAL

QUANTITIES SHOWN ARE FOR

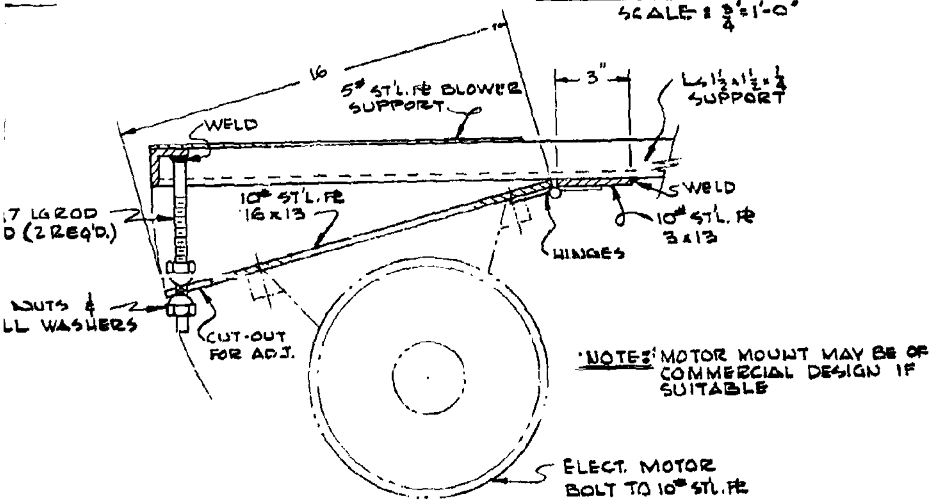
| PC NO. | NAME | NO. REQ. | MAT'L. | MAT'L. SPEC. | STOCK SIZE | REMARKS |
|---|---|---|---|---|---|---|
| | | | | | | |

## VENTILATION SCHEDULE

| VENTILATION PKG. NO. | | BLOWER TYPE (ILG ELEC. VENT. CO. OR EQ.) | |
|---|---|---|---|
| 10 PSI | 35 PSI | RATING | CAPACITY |
| V-1A | V-2A | 1/7 HP | 675 CFM @ 0.2 S.P. |
| V-1B | V-2B | 1/3 H.P. | 675 CFM @ 0.7 S.P. |
| V-1C | V-2C | 1/3 H.P. | 1600 CFM @ 0.2 S.P. |
| V-1D | V-2D | 1/2 H.P. | 1600 CFM @ 1.0 S.P. |

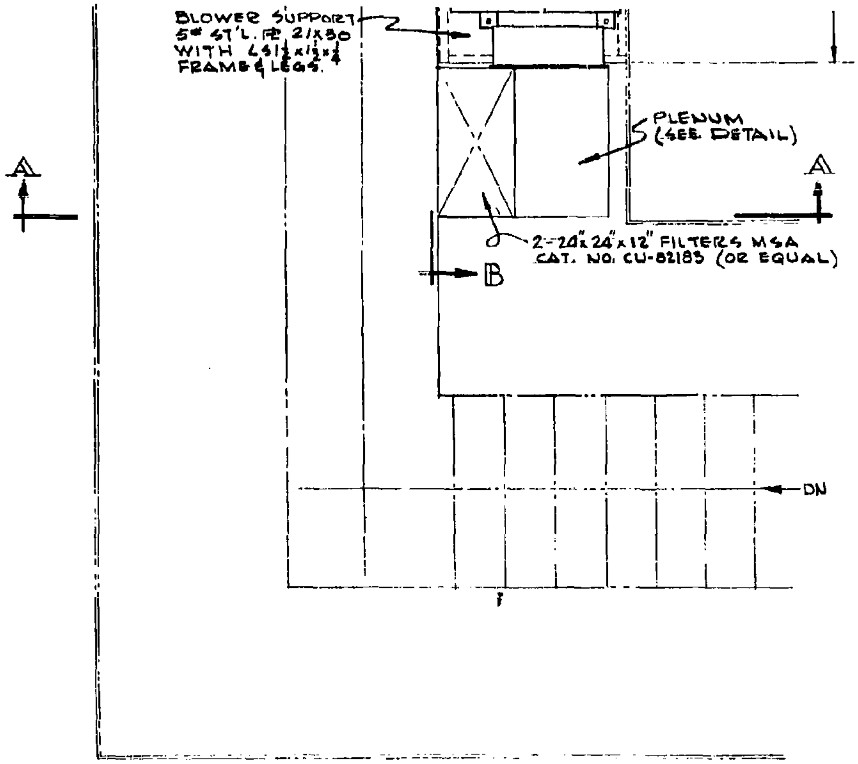



SECTION B-B
SCALE: 3/4" = 1'-0"

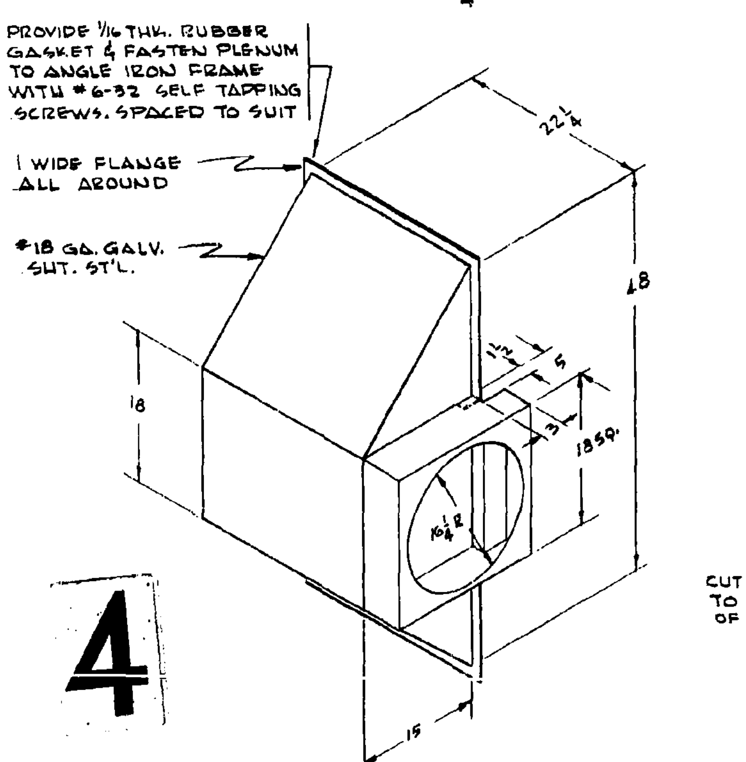



**NOTE:** MOTOR MOUNT MAY BE OF COMMERCIAL DESIGN IF SUITABLE

3

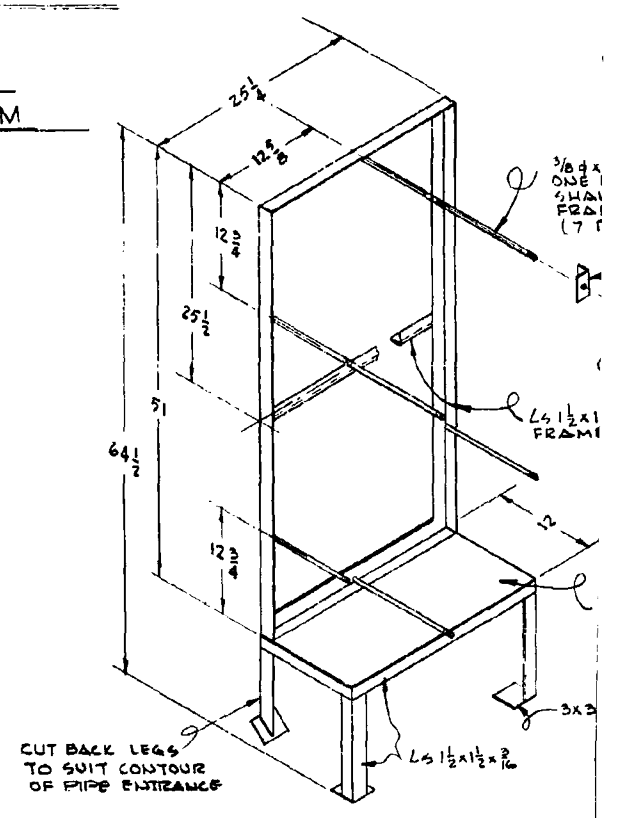



PLAN VIEW SHOWING
VENTILATION INSTALL'N SYSTEM
SCALE: ¾" = 1'-0"

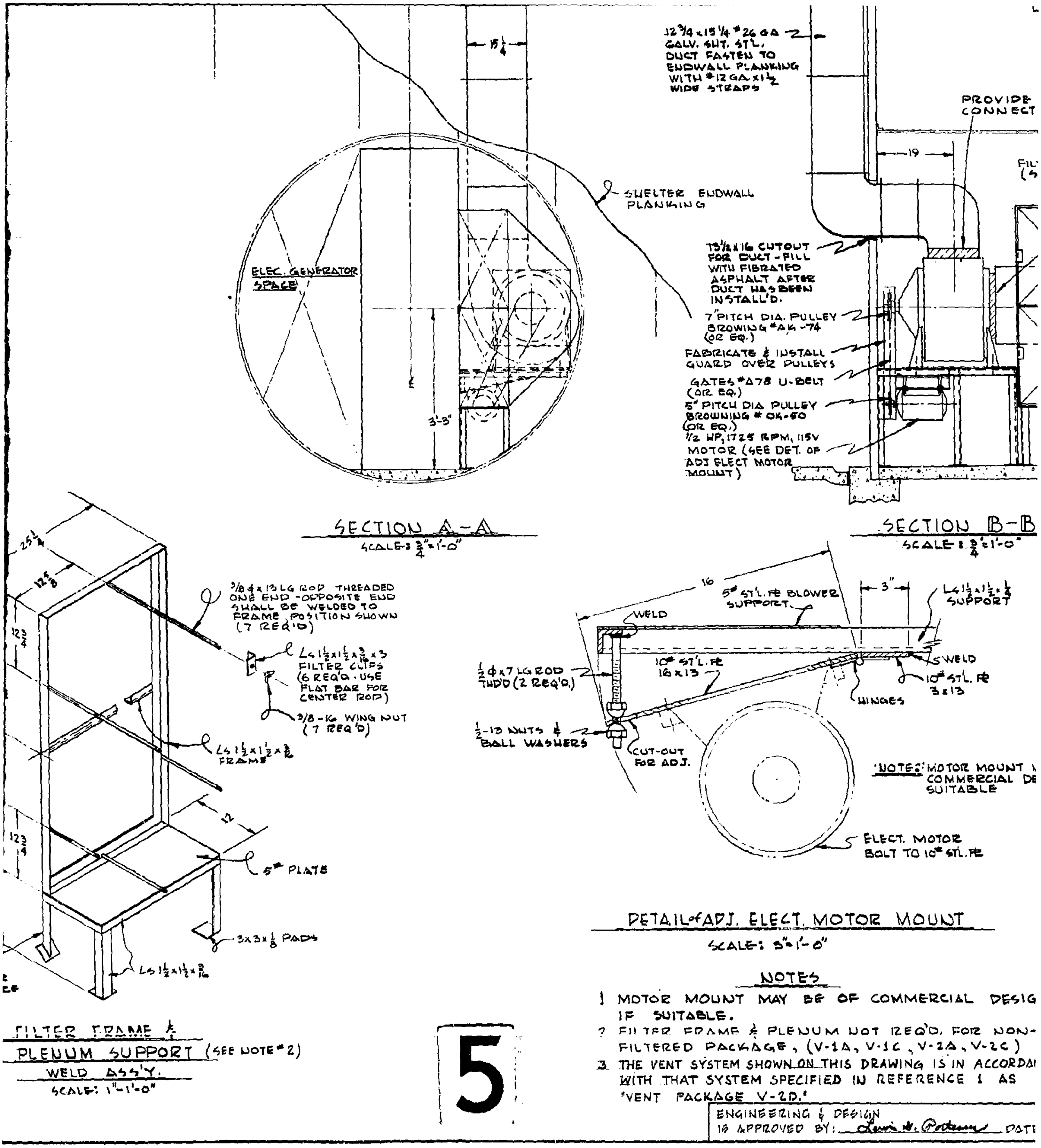



4

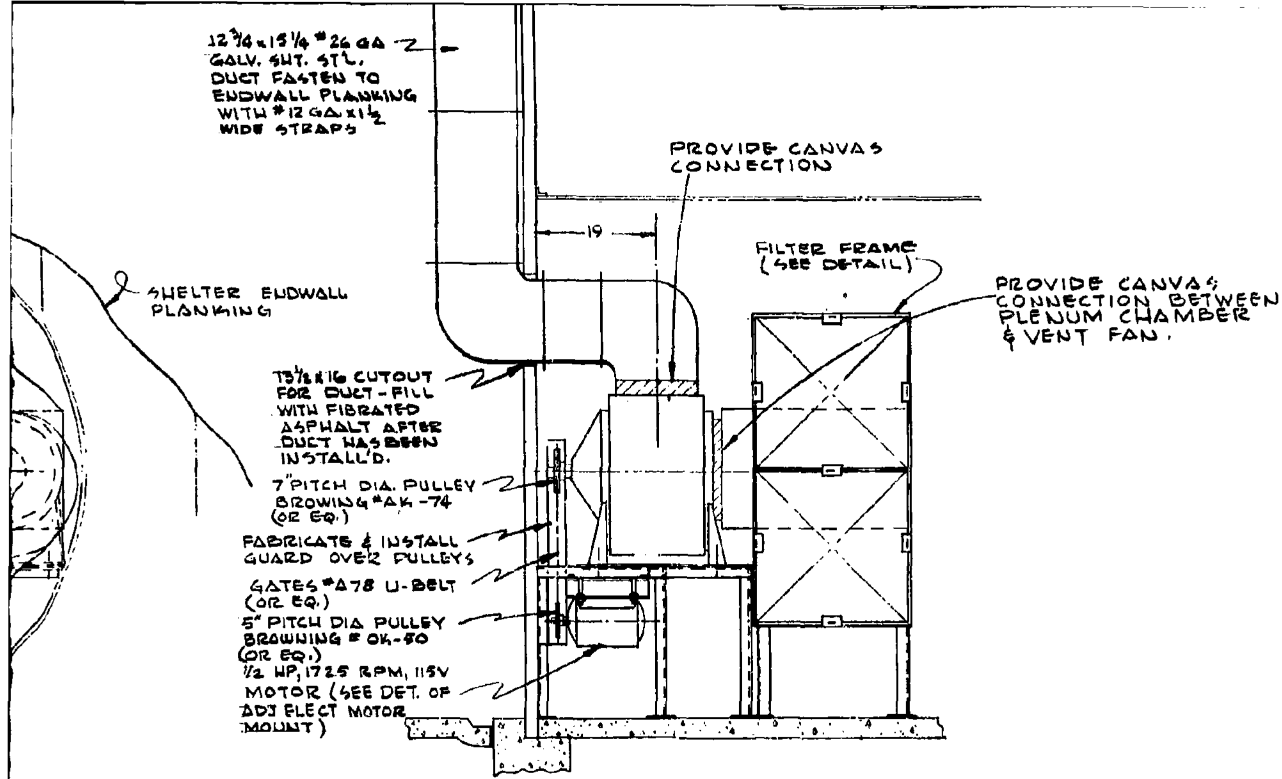
DETAIL of PLENUM (SEE NOTE # 2)
SCALE: 1" = 1'-0"




FILTER FRAME &
PLENUM SUPPORT (SEE NO
WELD ASS'Y.
SCALE: 1" = 1'-0"

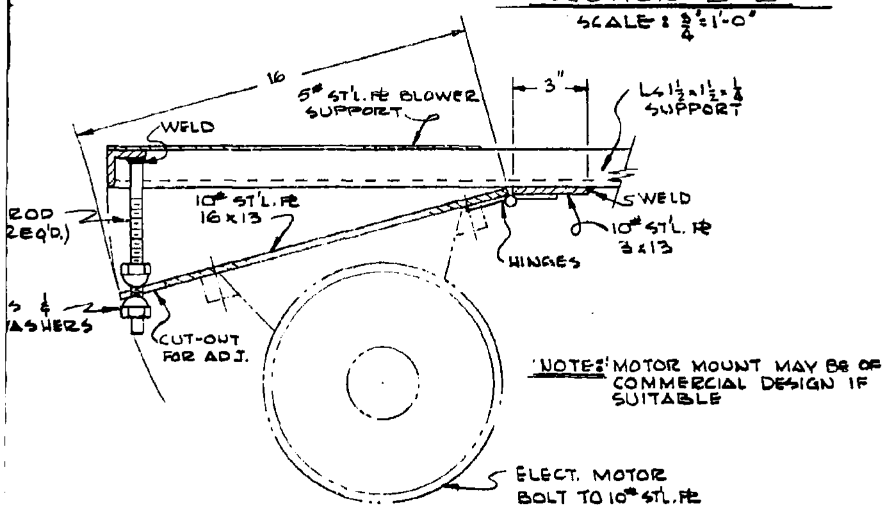


12 3/4 x 15 1/4 #26 GA GALV. SHT. ST'L. DUCT FASTEN TO ENDWALL PLANKING WITH #12 GA x 1 1/2 WIDE STRAPS
15 1/4
PROVIDE CONNECT
19
SHELTER ENDWALL PLANKING
ELEC. GENERATOR SPACE
3'-3"
13 1/2 x 16 CUTOUT FOR DUCT - FILL WITH FIBRATED ASPHALT AFTER DUCT HAS BEEN INSTALL'D.
7" PITCH DIA. PULLEY BROWNING #AK-74 (OR EQ.)
FABRICATE & INSTALL GUARD OVER PULLEYS
GATES #A78 V-BELT (OR EQ.)
5" PITCH DIA PULLEY BROWNING # OK-50 (OR EQ.)
1/2 HP, 1725 RPM, 115V MOTOR (SEE DET. OF ADJ ELECT MOTOR MOUNT)
SECTION A-A
SCALE: 3/4"=1'-0"
SECTION B-B
SCALE: 3/4"=1'-0"
25 1/4
12 5/8
12 3/4
12 3/4
3/8 φ x 13 LG ROD THREADED ONE END - OPPOSITE END SHALL BE WELDED TO FRAME POSITION SHOWN (7 REQ'D)
L's 1 1/2 x 1 1/2 x 3/16 x 3 FILTER CLIPS (6 REQ'D - USE FLAT BAR FOR CENTER ROD)
3/8-16 WING NUT (7 REQ'D)
L's 1 1/2 x 1 1/2 x 3/16 FRAME
12
5# PLATE
3x3x1/8 PADS
L's 1 1/2 x 1 1/2 x 3/16
16
WELD
5# ST'L. PL BLOWER SUPPORT
3"
L's 1 1/2 x 1 1/2 x 1/8 SUPPORT
1/2 φ x 7 LG ROD THD'D (2 REQ'D.)
10# ST'L. PL 16 x 13
WELD
10# ST'L. PL 3 x 13
HINGES
1/2-13 NUTS & BALL WASHERS
CUT-OUT FOR ADJ.
NOTES: MOTOR MOUNT COMMERCIAL DE SUITABLE
ELECT. MOTOR BOLT TO 10# ST'L. PL
DETAIL of ADJ. ELECT. MOTOR MOUNT
SCALE: 3"=1'-0"
FILTER FRAME & PLENUM SUPPORT (SEE NOTE #2) WELD ASS'Y.
SCALE: 1"=1'-0"
NOTES
1 MOTOR MOUNT MAY BE OF COMMERCIAL DESIG IF SUITABLE.
2 FILTER FRAME & PLENUM NOT REQ'D. FOR NON-FILTERED PACKAGE, (V-1A, V-1C, V-2A, V-2C)
3 THE VENT SYSTEM SHOWN ON THIS DRAWING IS IN ACCORDA WITH THAT SYSTEM SPECIFIED IN REFERENCE 1 AS "VENT PACKAGE V-2D."
ENGINEERING & DESIGN IS APPROVED BY: Lewis H. Pottenger DATE
5




SECTION B-B

SCALE: 3/4" = 1'-0"




6

DETAIL of ADJ. ELECT. MOTOR MOUNT

SCALE: 5" = 1'-0"

NOTES

1. MOTOR MOUNT MAY BE OF COMMERCIAL DESIGN IF SUITABLE.
2. FILTER FRAME & PLENUM NOT REQ'D. FOR NON-FILTERED PACKAGE, (V-1A, V-1C, V-2A, V-2C)
3. THE VENT SYSTEM SHOWN ON THIS DRAWING IS IN ACCORDANCE WITH THAT SYSTEM SPECIFIED IN REFERENCE 1 AS "VENT PACKAGE V-2D."

ENGINEERING & DESIGN
IS APPROVED BY: Louis H. Pottery DATE: 22 MAY 62

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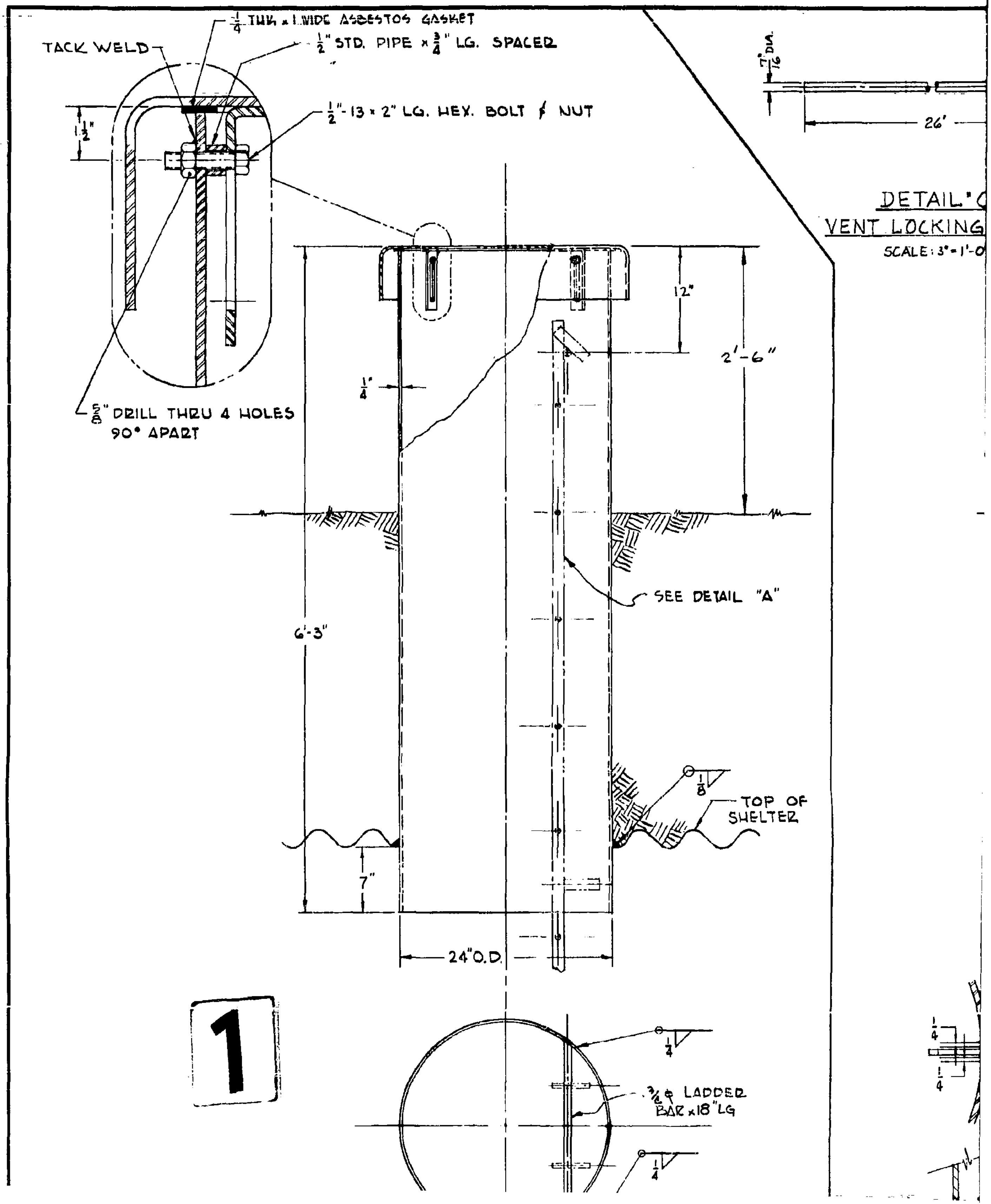
| | | |
|---|---|---|
| DRAWN | FJA | |
| CHKD | HA | |
| SCOPE APPROVED | LBP | 5/2/62 |
| PROJ. ENGR. | | |
| SUPVR. | | |
| BRANCH HEAD | | |
| DIVISION HEAD | | |

DEVELOPMENTAL DWG

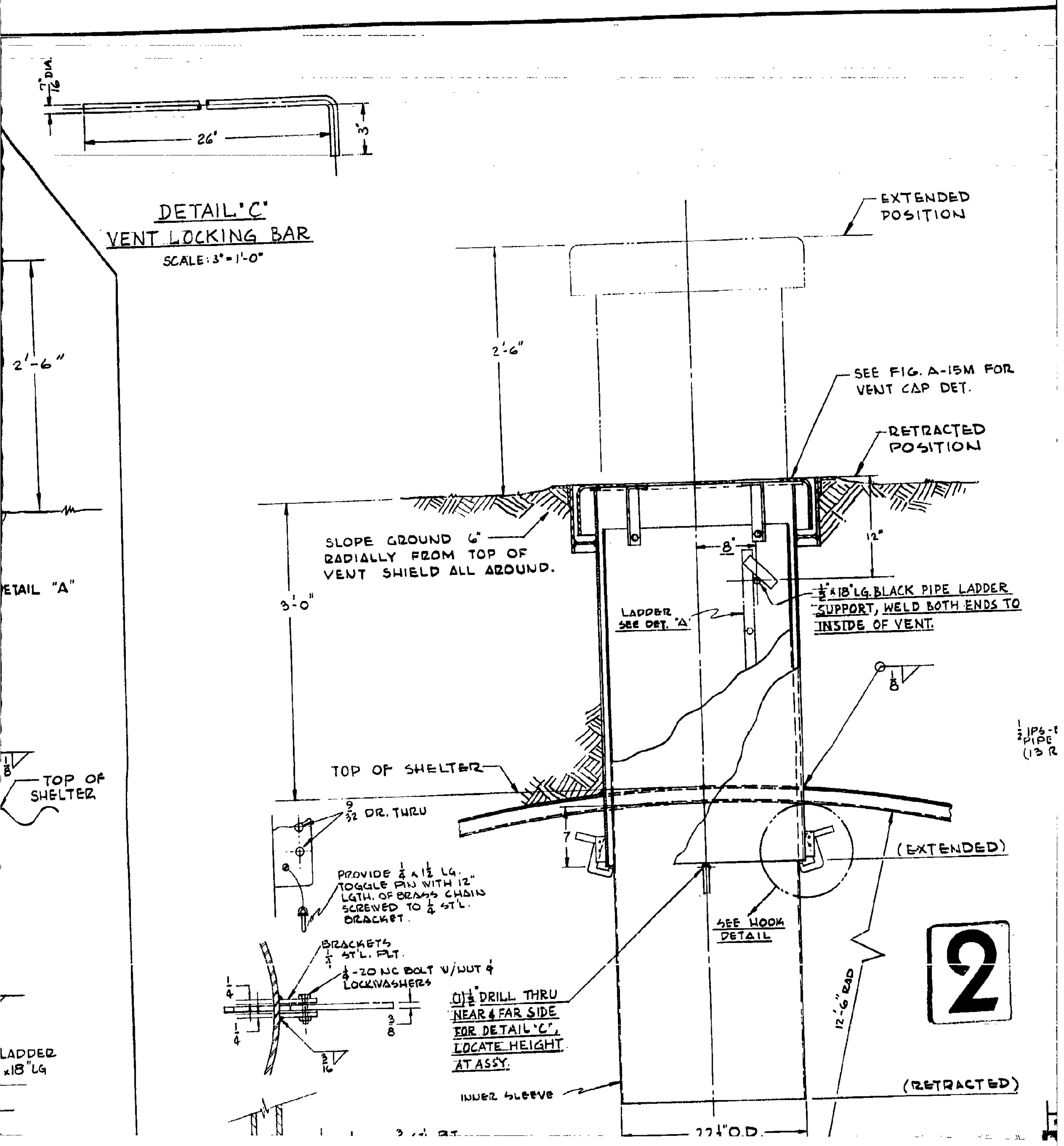
FIG. A-6M
VENTILATION SYSTEM

| SCALE | PROJECT | TECH MEMO. |
|---|---|---|
| AS SHOWN | | |

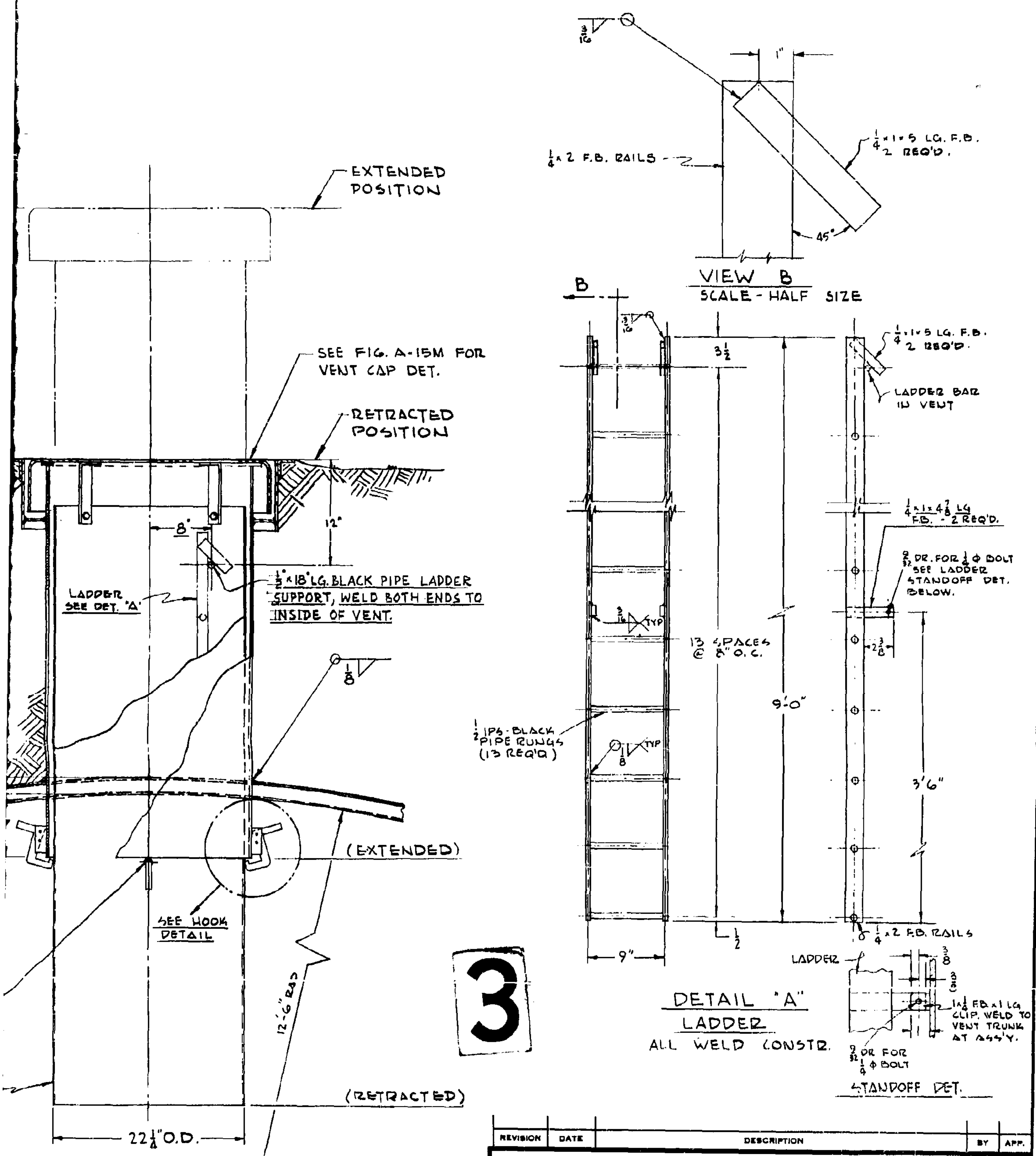
DRAWING NUMBER: S-62-970, SHEET 8 OF 19



¼ THK x 1 WIDE ASBESTOS GASKET
TACK WELD
½" STD. PIPE x ¾" LG. SPACER
½"-13 x 2" LG. HEX. BOLT & NUT
1½"
⅝" DRILL THRU 4 HOLES 90° APART
12"
2'-6"
¼"
SEE DETAIL "A"
6'-3"
⅛
TOP OF SHELTER
7"
24" O.D.
1
¼
⅜ ɸ LADDER BAR x 18" LG
¼
7/16" DIA.
26'
DETAIL "C
VENT LOCKING
SCALE: 3" = 1'-0
¼
¼



DETAIL 'C'
VENT LOCKING BAR
SCALE: 3" = 1'-0"
7/16" DIA.
26'
3"
2'-6"
DETAIL "A"
TOP OF SHELTER
LADDER
x18" LG
EXTENDED POSITION
SEE FIG. A-15M FOR VENT CAP DET.
RETRACTED POSITION
12"
8"
1/2" x 18" LG. BLACK PIPE LADDER SUPPORT, WELD BOTH ENDS TO INSIDE OF VENT.
LADDER SEE DET. 'A'
SLOPE GROUND 6" RADIALLY FROM TOP OF VENT SHIELD ALL AROUND.
3'-0"
TOP OF SHELTER
9/32 DR. THRU
PROVIDE 1/4 x 1 1/2 LG. TOGGLE PIN WITH 12" LGTH. OF BRASS CHAIN SCREWED TO 1/4 ST'L. BRACKET.
BRACKETS 1/4 ST'L. PLT.
1/4-20 NC BOLT W/NUT & LOCKWASHERS
1/4
3/8
3/16
7
(EXTENDED)
SEE HOOK DETAIL
(1) 1/2" DRILL THRU NEAR & FAR SIDE FOR DETAIL 'C', LOCATE HEIGHT AT ASSY.
12'-6" RAD
INNER SLEEVE
(RETRACTED)
22 1/4" O.D.
2




| REVISION | DATE | DESCRIPTION | BY | APP. |
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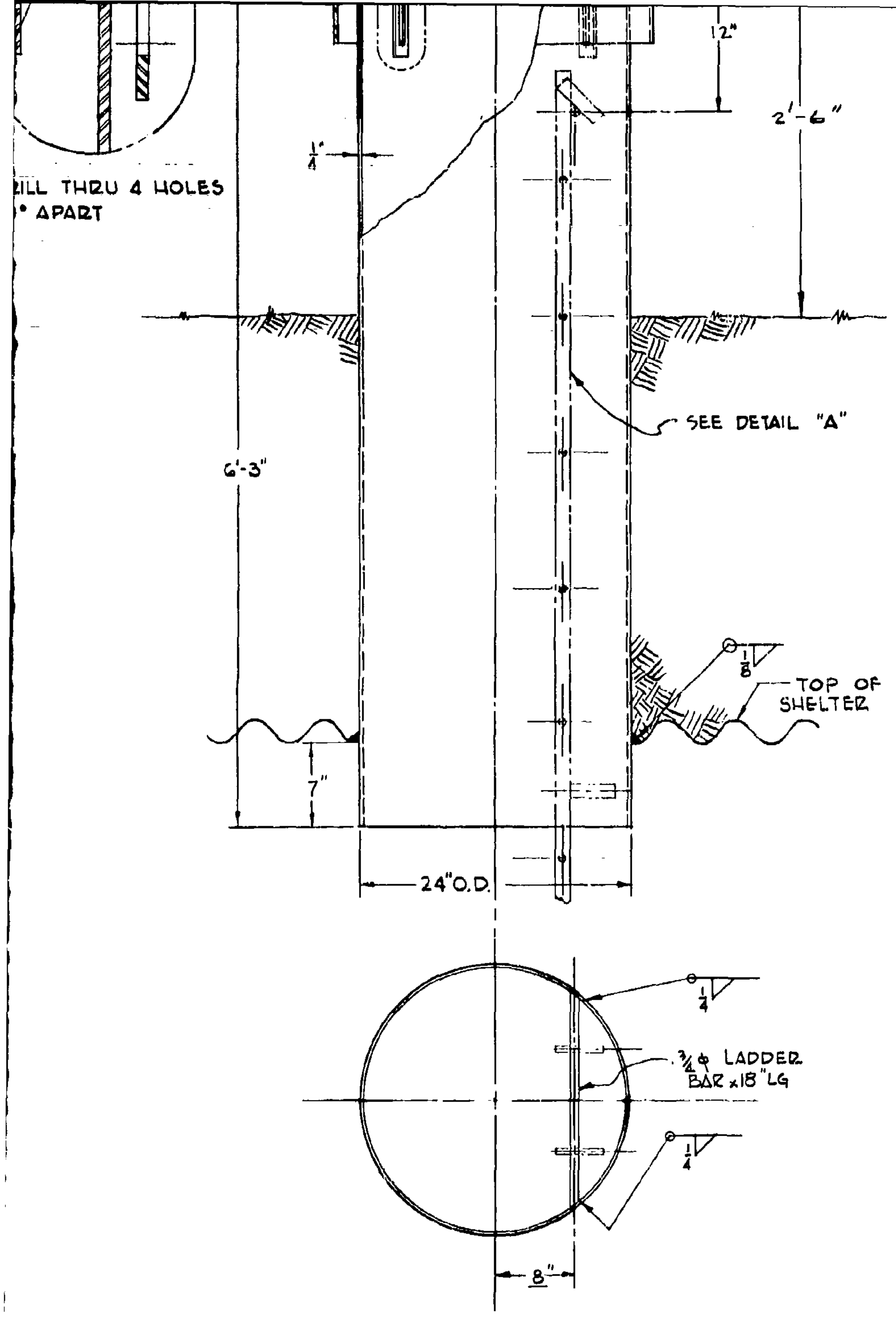
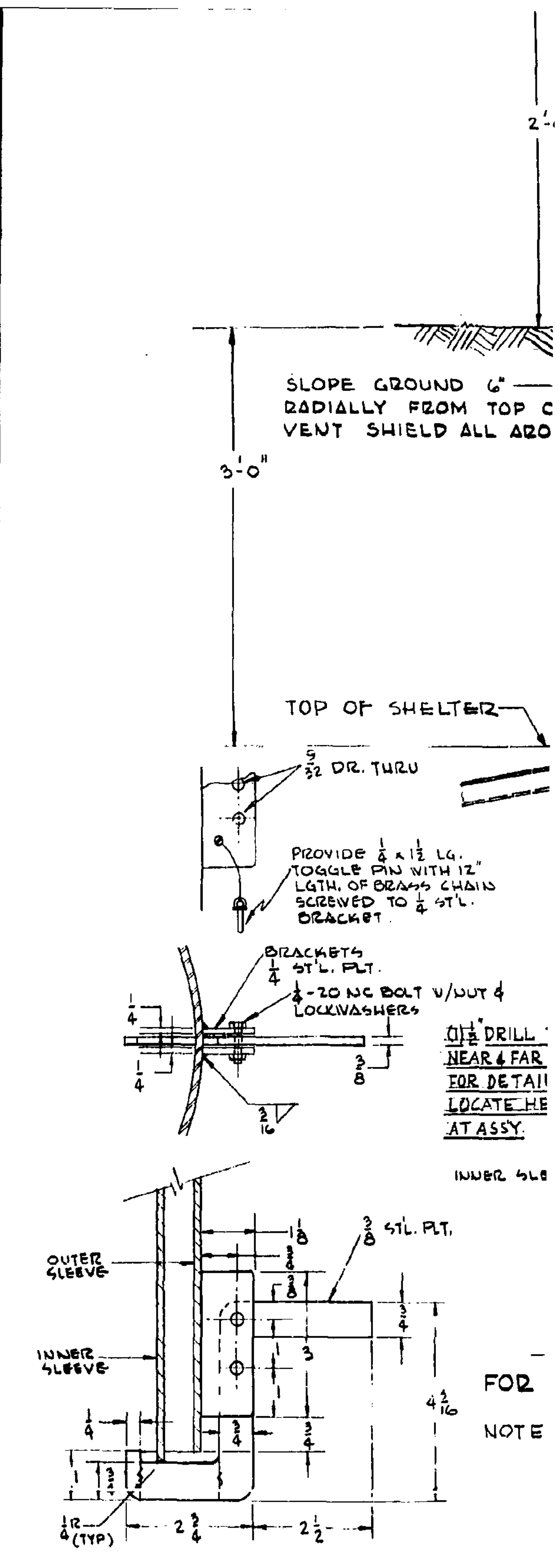
UNITED STATES




FIXED VENT

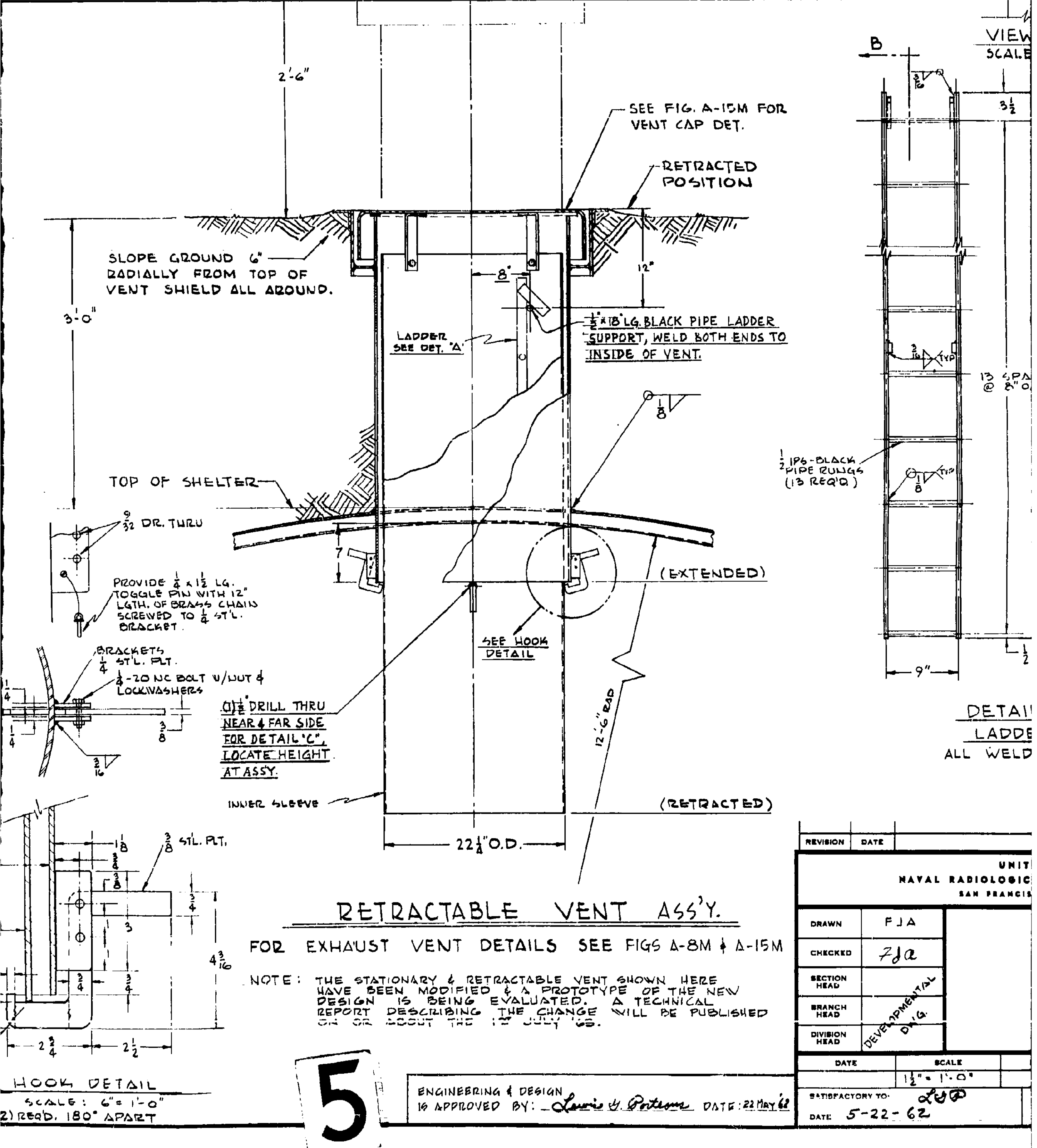
4



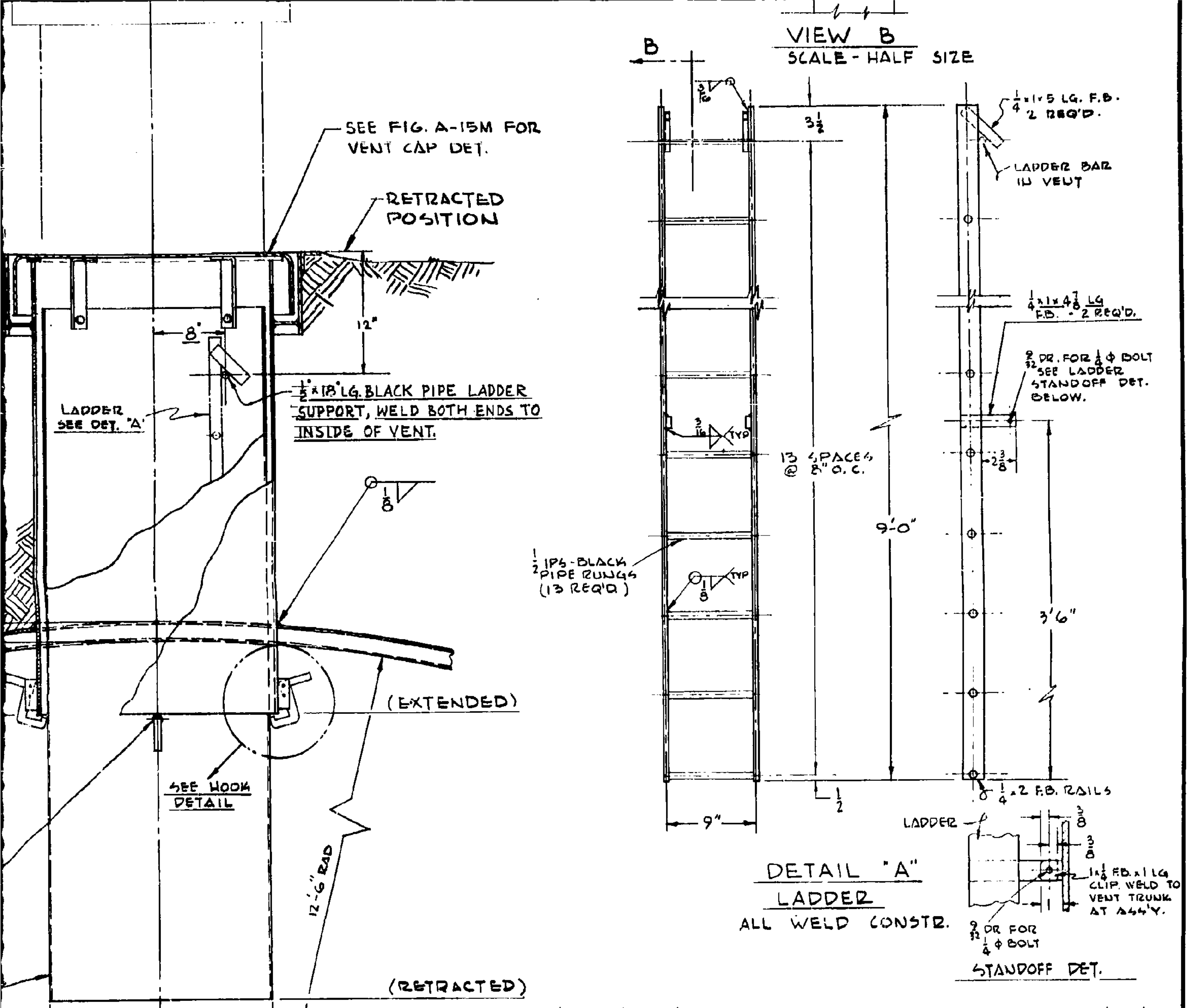

HOOK DETAIL

SCALE: 6"= 1'-0"

(2) REQ'D. 180° APART



2'-6"
SEE FIG. A-15M FOR VENT CAP DET.
RETRACTED POSITION
SLOPE GROUND 6" RADIALLY FROM TOP OF VENT SHIELD ALL AROUND.
3'-0"
12"
8"
½"x18" LG. BLACK PIPE LADDER SUPPORT, WELD BOTH ENDS TO INSIDE OF VENT.
LADDER SEE DET. 'A'
TOP OF SHELTER
9/32 DR. THRU
PROVIDE ¼ x 1½ LG. TOGGLE PIN WITH 12" LGTH. OF BRASS CHAIN SCREWED TO ¼ ST'L. BRACKET.
(EXTENDED)
SEE HOOK DETAIL
BRACKETS ¼ ST'L. PLT.
⅜-20 NC BOLT W/NUT & LOCKWASHERS
(1)½" DRILL THRU NEAR & FAR SIDE FOR DETAIL 'C', LOCATE HEIGHT AT ASSY.
12'-6" RAD
INNER SLEEVE
(RETRACTED)
22¼" O.D.
⅜ ST'L. PLT.
HOOK DETAIL
SCALE: 6" = 1'-0"
(2) REQ'D. 180° APART
VIEW
SCALE
3½
13 SPA @ 8" O.C.
½ IPS-BLACK PIPE RUNGS (13 REQ'D)
9"
DETAIL LADDER
ALL WELD
RETRACTABLE VENT ASS'Y.
FOR EXHAUST VENT DETAILS SEE FIGS A-8M & A-15M
NOTE: THE STATIONARY & RETRACTABLE VENT SHOWN HERE HAVE BEEN MODIFIED & A PROTOTYPE OF THE NEW DESIGN IS BEING EVALUATED. A TECHNICAL REPORT DESCRIBING THE CHANGE WILL BE PUBLISHED ON OR ABOUT THE 1ST JULY '62.
ENGINEERING & DESIGN IS APPROVED BY: Lewis G. Porteous DATE: 22 May '62
REVISION DATE
UNIT
NAVAL RADIOLOGIC
SAN FRANCIS
DRAWN FJA
CHECKED FJA
SECTION HEAD
BRANCH HEAD
DIVISION HEAD
DEVELOPMENTAL DWG.
DATE
SCALE 1½" = 1'-0"
SATISFACTORY TO: LGP
DATE 5-22-62
5




RETRACTABLE VENT ASS'Y.

...AUST VENT DETAILS SEE FIGS A-8M & A-15M

...STATIONARY & RETRACTABLE VENT SHOWN HERE ...E BEEN MODIFIED & A PROTOTYPE OF THE NEW ...IGN IS BEING EVALUATED. A TECHNICAL ...ORT DESCRIBING THE CHANGE WILL BE PUBLISHED ...OR ABOUT THE 1ST JULY '62.

ENGINEERING & DESIGN IS APPROVED BY: Lewis G. Porteous DATE: 22 MAY 62

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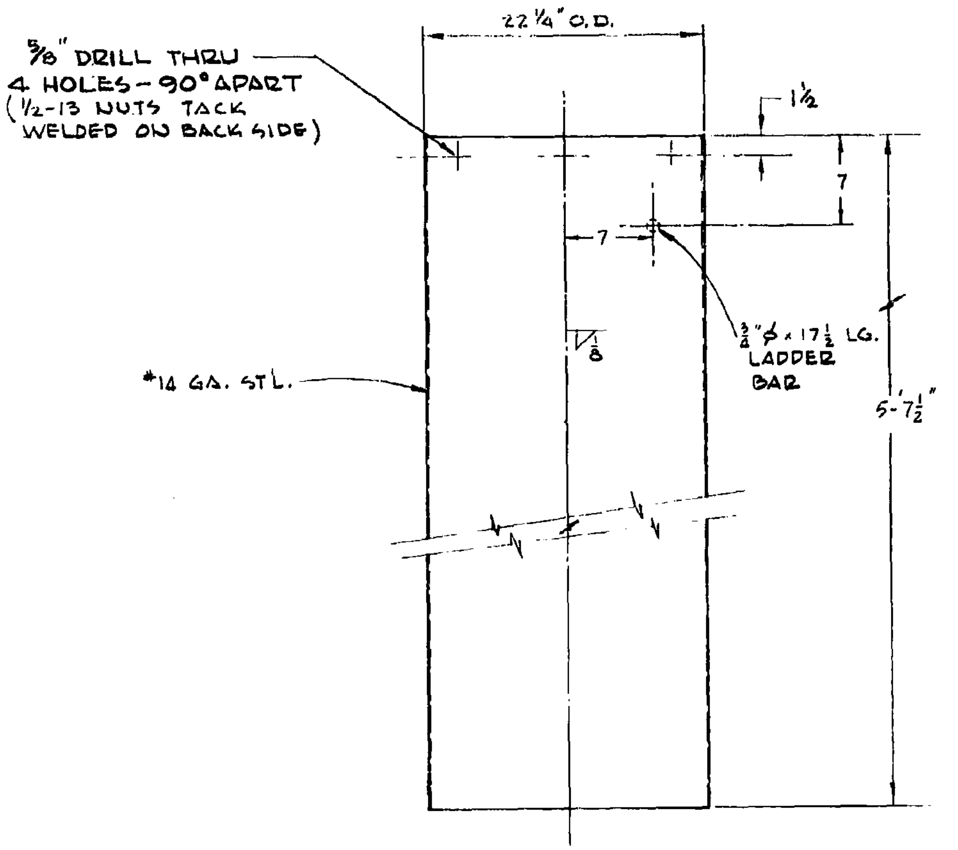
| | | |
|---|---|---|
| DRAWN | FJA | FIG. A-7M |
| CHECKED | FJA | EXHAUST VENT ARRANGEMENTS |
| SECTION HEAD | DEVELOPMENTAL DWG. | |
| BRANCH HEAD | | |
| DIVISION HEAD | | |

| DATE | SCALE | PROJECT | FINISH | HEAT TREAT |
|---|---|---|---|---|
| | 1 1/2" = 1'-0" | | | |

SATISFACTORY TO: LGP
DATE 5-22-62
DRAWING NUMBER S-62-970
SHEET 9 OF 19
ALT.

6



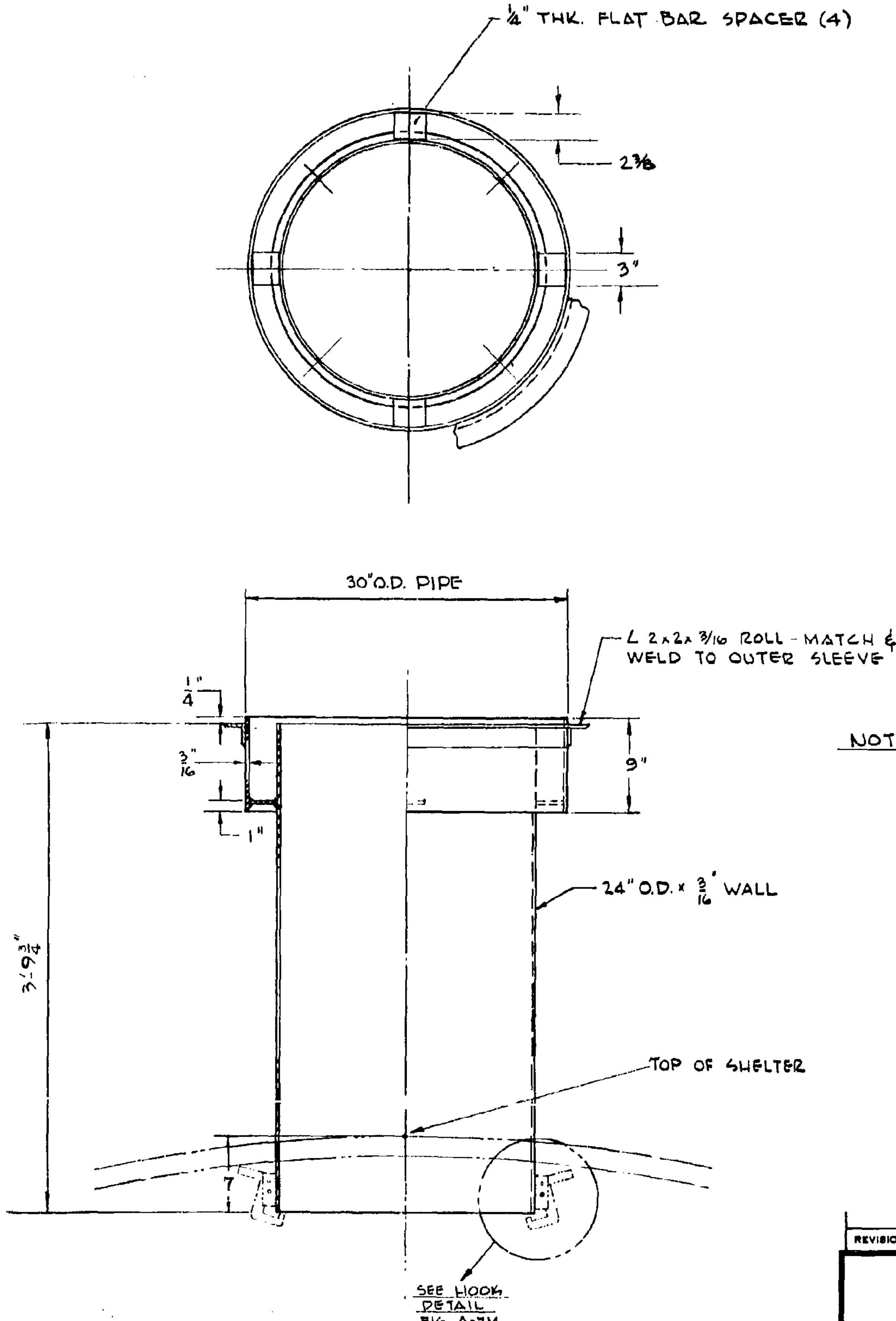

INNER SLEEVE

RETRACTABLE VENT

SCALE: 1 1/2" = 1'-0"

3'-9 3/4"

1



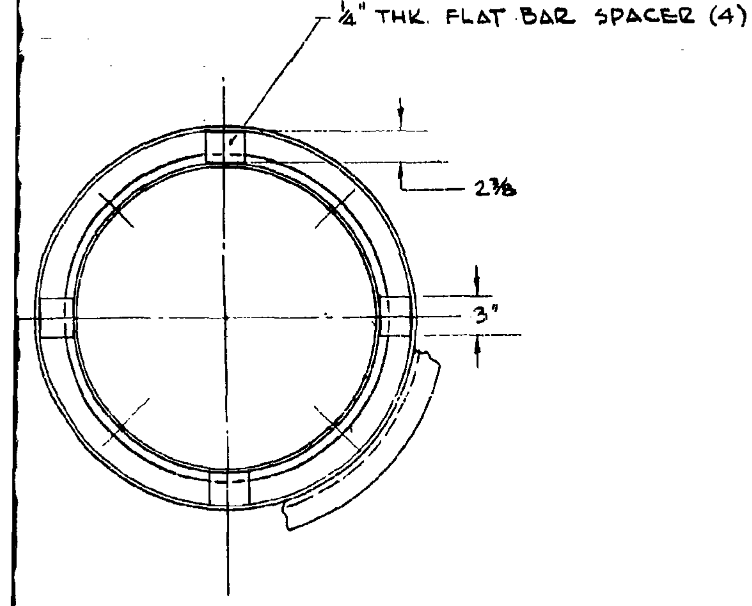

NOTE:
SEE FIG. A-7M FOR

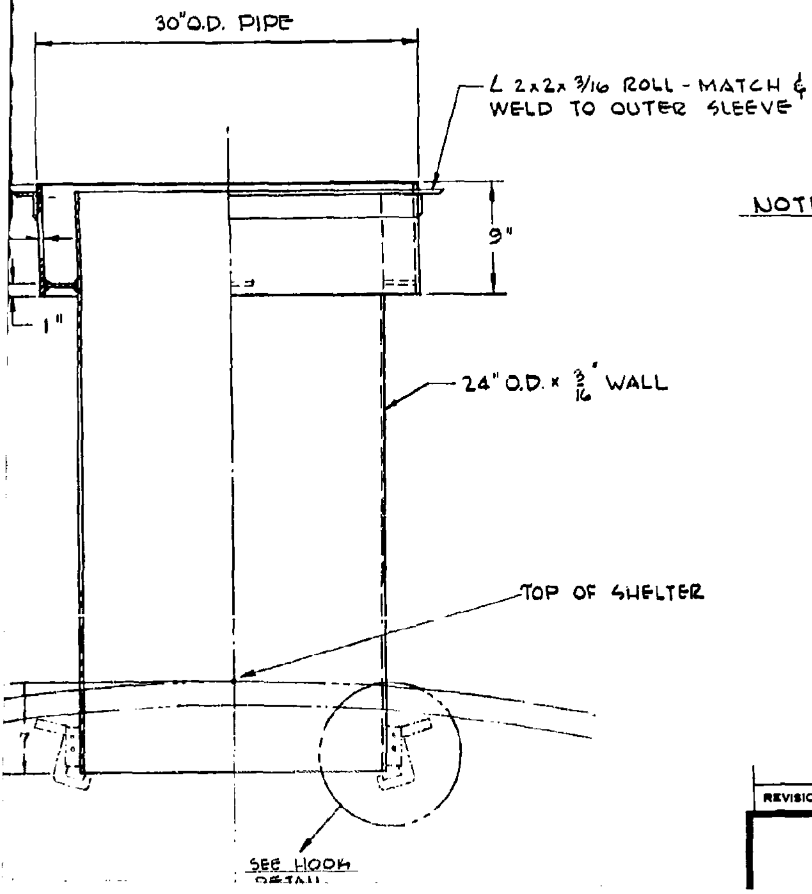
2

| REVISION | DATE | |
|---|---|---|

NAVAL RADI

SAN




NOTE:
SEE FIG. A-7M FOR VENT ASSEMBLY

3

| REVISION | DATE | DESCRIPTION | BY | APP. |
| --- | --- | --- | --- | --- |

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NAVAL RADIOLOGICAL DEFENSE LABORATORY
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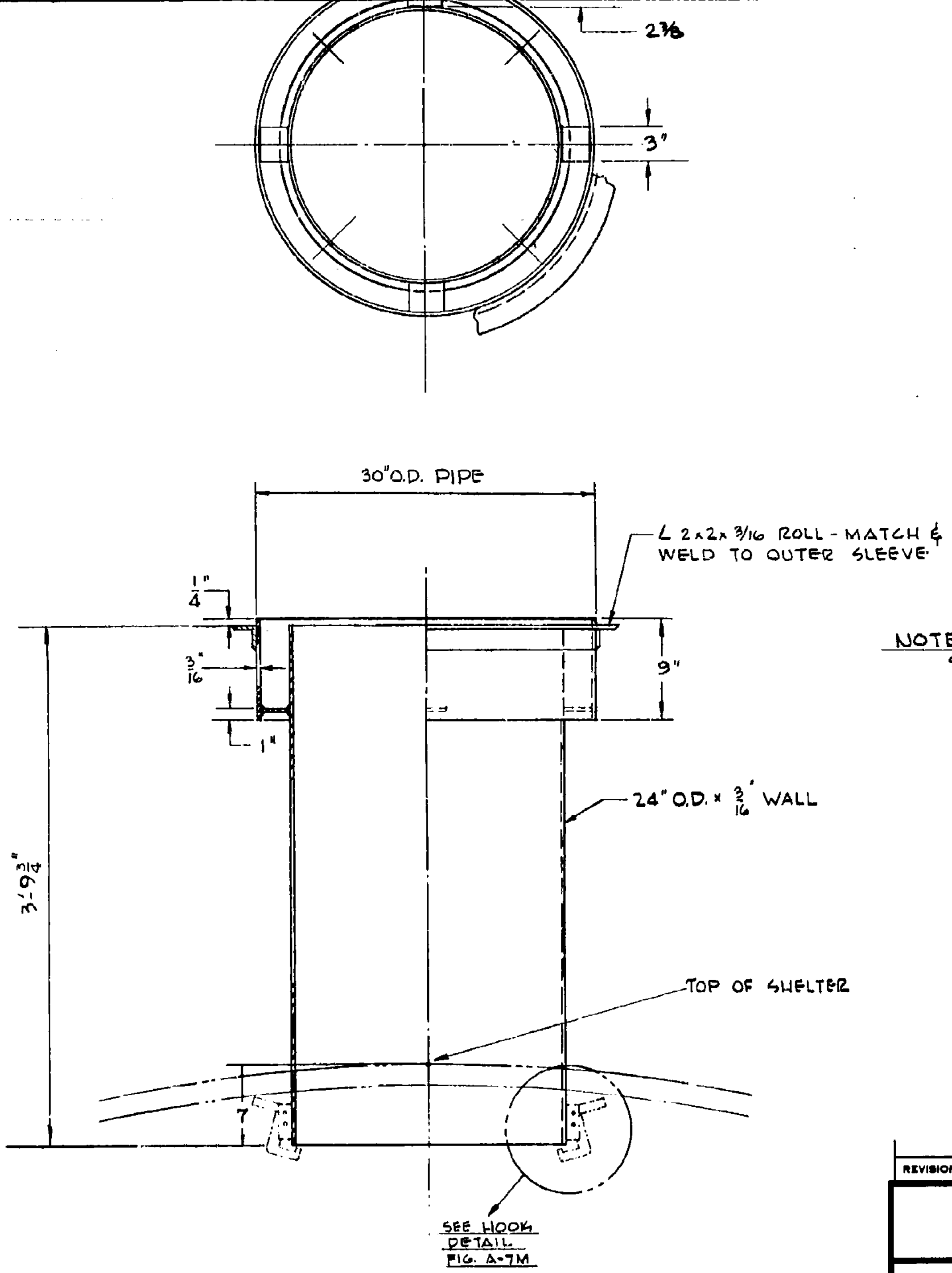



NOTE:
SEE FIG. A-7M FOR VE

OUTER SLEEVE
RETRACTABLE VENT
SCALE : 1/8" = 1"

4

ENGINEERING & DESIGN
IS APPROVED BY: Lewis G. Porteus DATE: 22 MAY 62

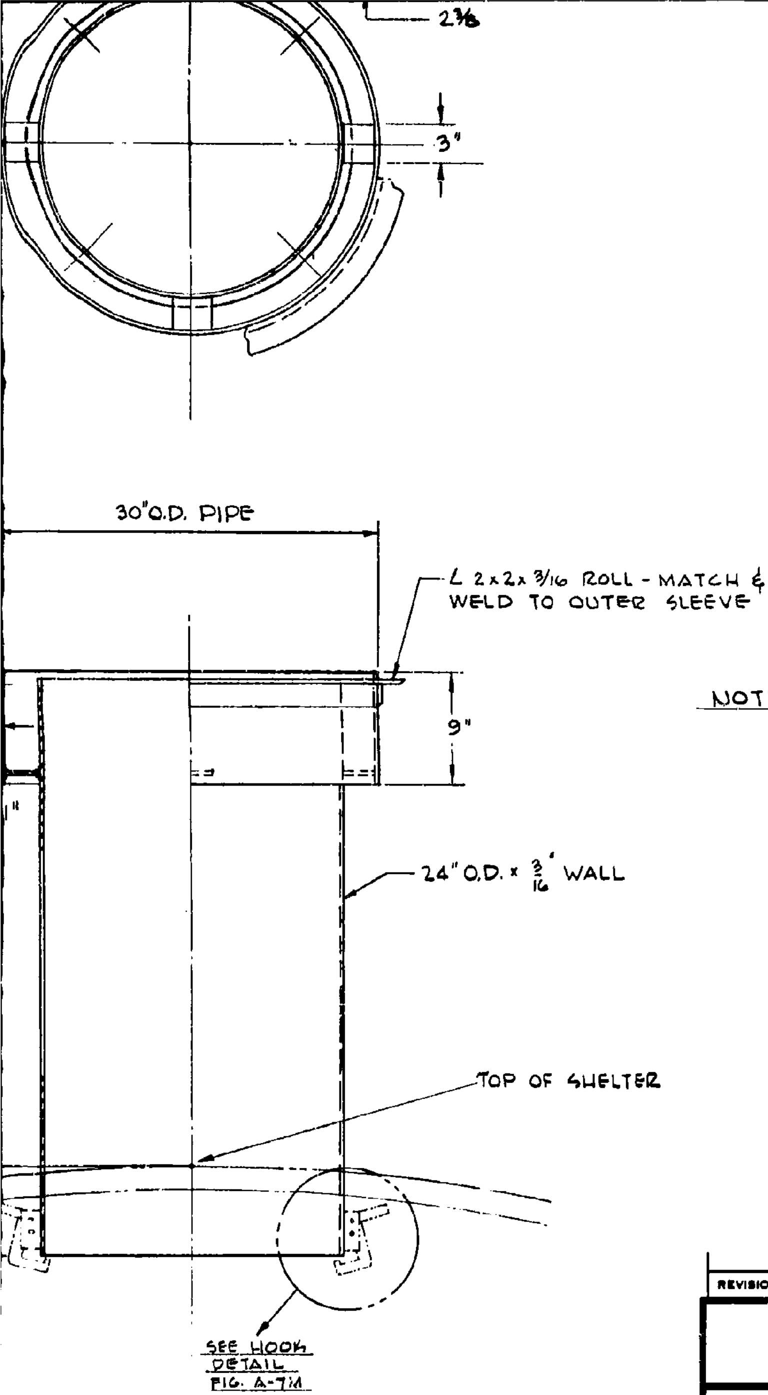
| REVISION | DATE | |
|---|---|---|

NAVAL RADIOLO
SAN FRA

| | | |
|---|---|---|
| DRAWN | FJA | |
| CHECKED | FJa | |
| SECTION HEAD | DEVELOPMENTAL DWG | |
| BRANCH HEAD | | |
| DIVISION HEAD | | |

| DATE | SCALE |
|---|---|
| 26 FEB 62 | NOTED |

SATISFACTORY TO: LGP
DATE 5-22-62




NOTE:
SEE FIG. A-7M FOR VENT ASSEMBLY

5

OUTER SLEEVE
RETRACTABLE VENT
SCALE: $\frac{1}{8}$" = 1"

ENGINEERING & DESIGN IS APPROVED BY: Lewis G. Potteiger DATE: 22 MAY 62

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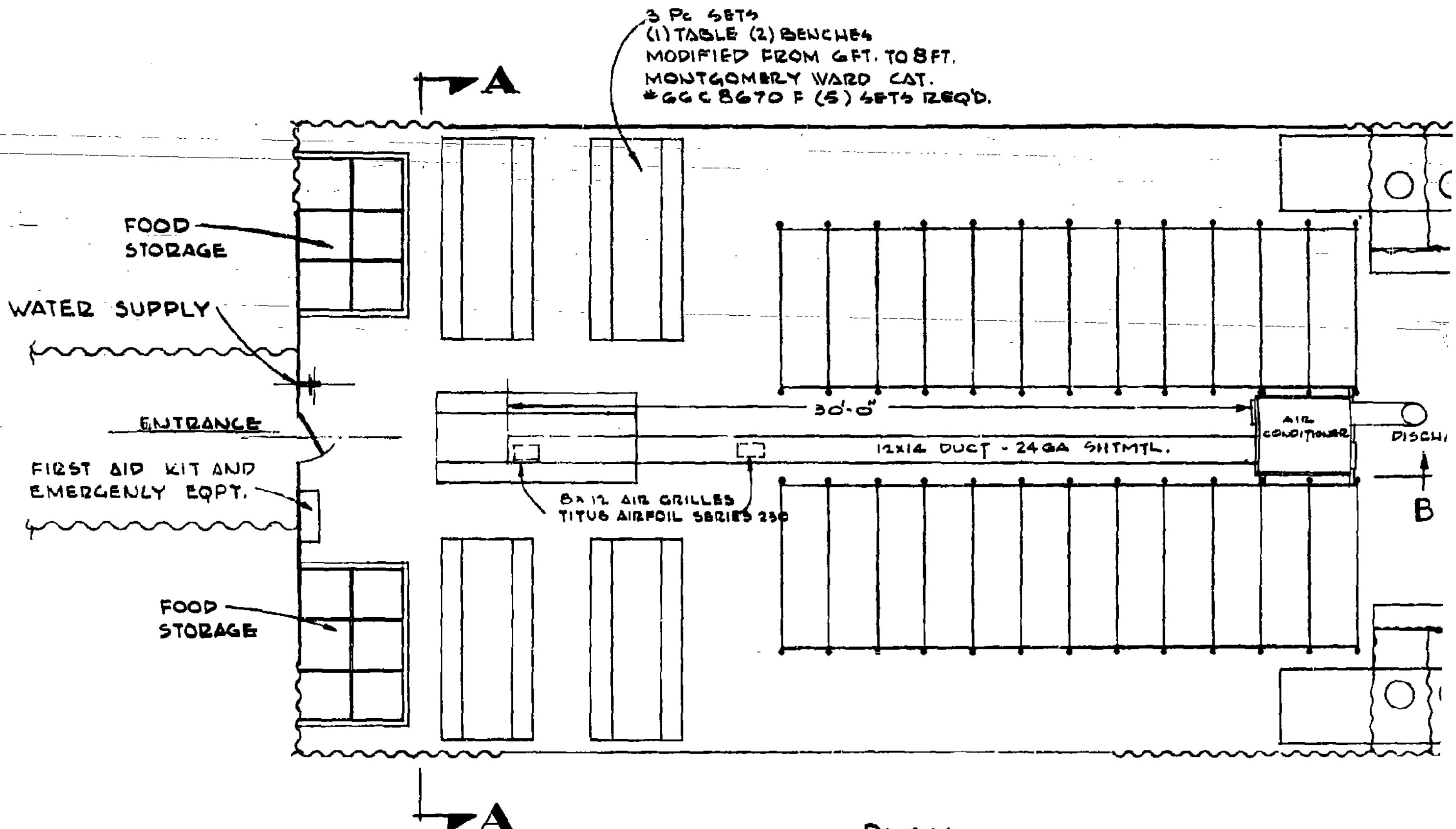
| | |
|---|---|
| DRAWN | FJA |
| CHECKED | Fja |
| SECTION HEAD | DEVELOPMENTAL DWG |
| BRANCH HEAD | |
| DIVISION HEAD | |

FIG. A-8M
EXHAUST VENT
DETAILS

| DATE | SCALE | PROJECT | FINISH | HEAT TREAT |
|---|---|---|---|---|
| 26 FEB 62 | NOTED | | | |

SATISFACTORY TO: LGP
DATE 5-22-62

DRAWING NUMBER S-62-970
SHEET 10 OF 19
ALT.

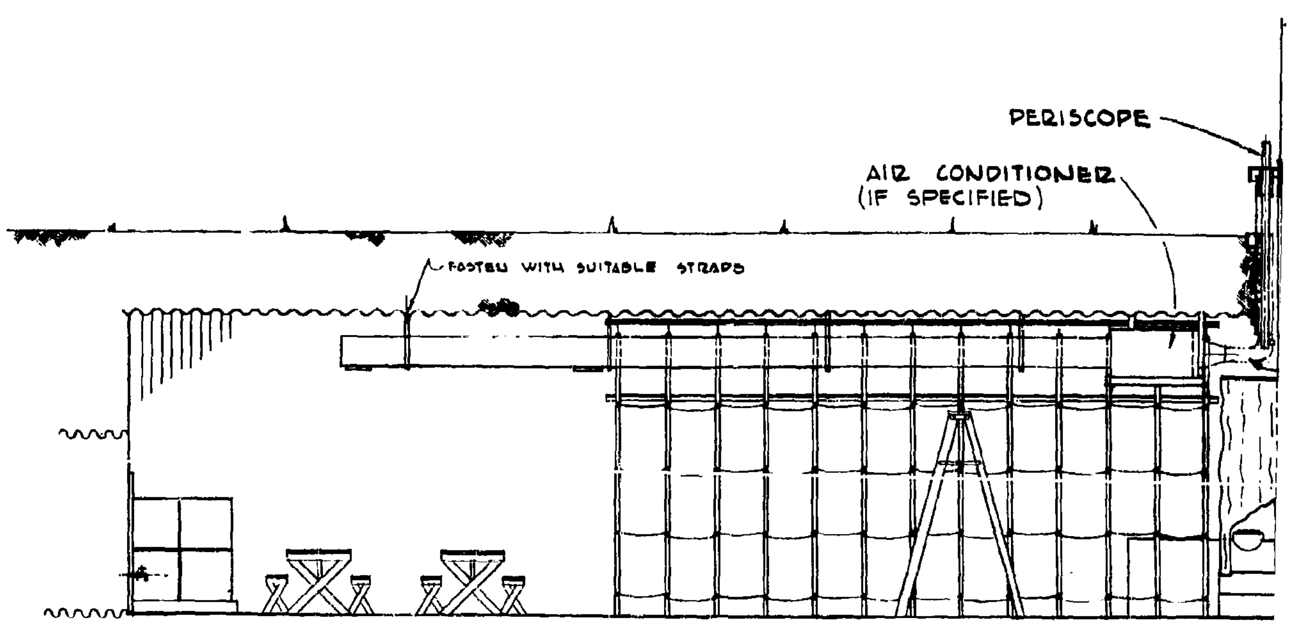



## PLAN

HOTEL PKG. H-1C SHOWN ONLY

SEE FIGS. A-10N & A-11M FOR OTHER ARRANGEMENTS

1

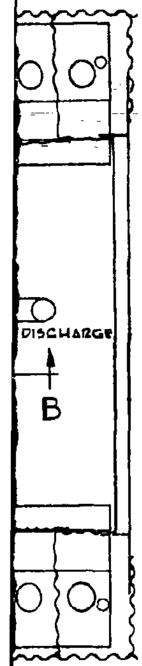


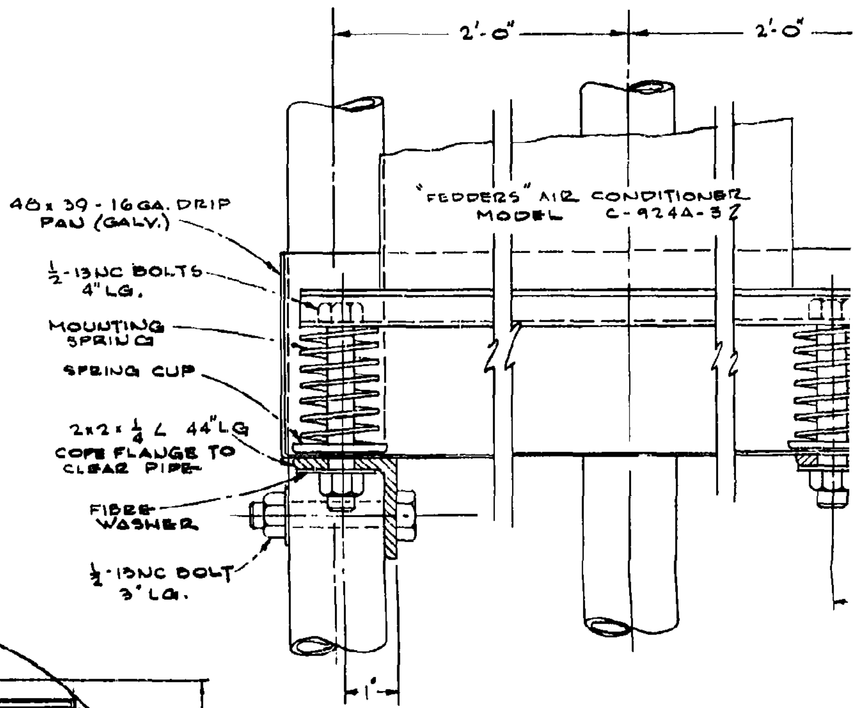

## LONGITUDINAL SECTION

**LIST OF MATERIAL**

QUANTITIES SHOWN ARE FOR

| PC. NO. | NAME | NO. REQ. | MAT'L. | MAT'L. SPECS. | STOCK SIZE |
|---|---|---|---|---|---|
| | | | | | |



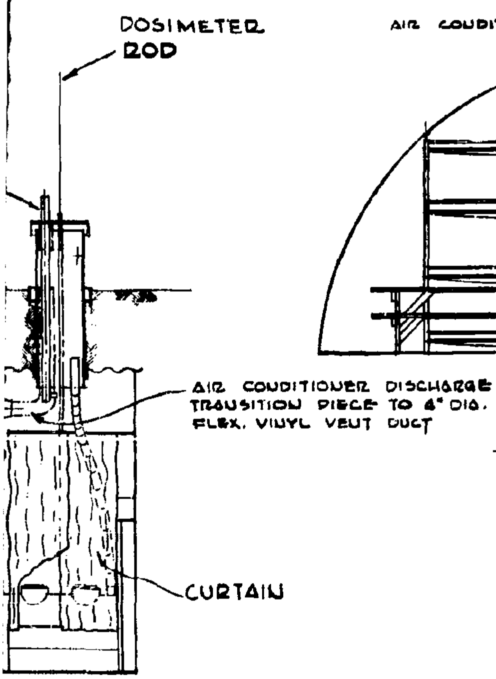



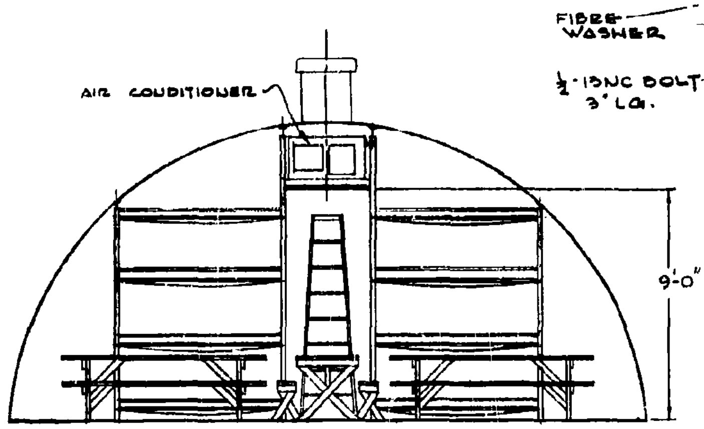

INSTALLATION DETAIL of AIR CO

SECTION B

SCALE: HALF SIZE

FOR VENTILATION PKGS:



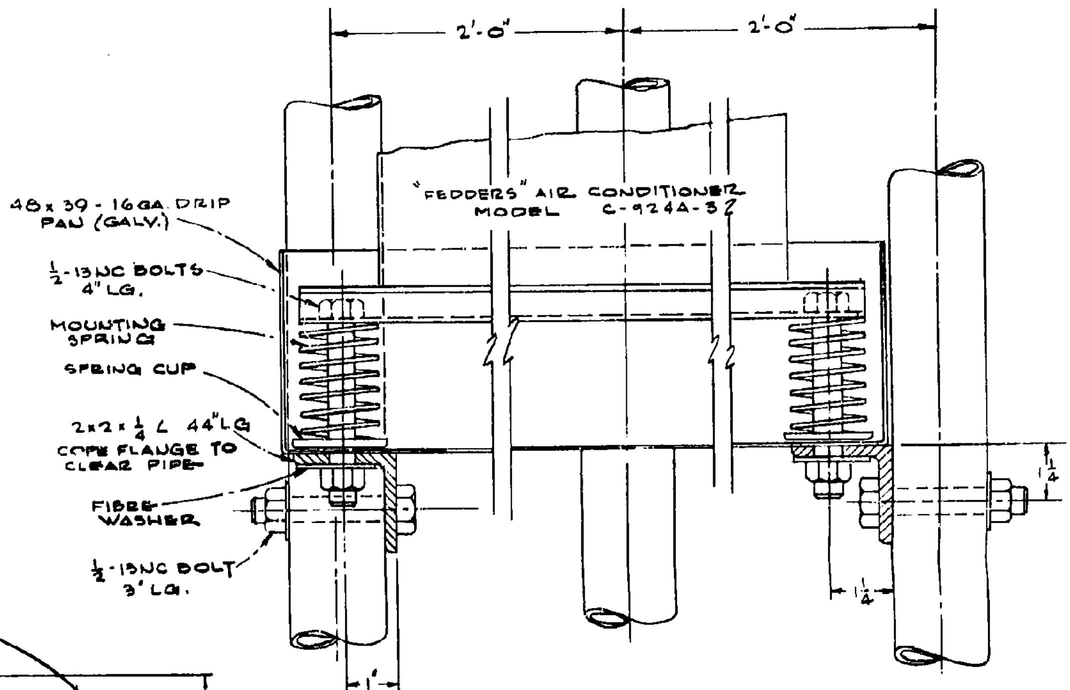

SECTION A-A

2

| REVISION | DATE | DESCRIPTION |
|---|---|---|
| | | |

UNITED STATES
NAVAL RADIOLOGICAL DEFENSE LA
SAN FRANCISCO 24, CALIFORNIA

| LIST OF MATERIAL | | | | | | |
|---|---|---|---|---|---|---|
| QUANTITIES SHOWN ARE FOR | | | | | | |
| PC. NO. | NAME | NO. REQ. | MAT'L. | MAT'L. SPECS. | STOCK SIZE | REMARKS |
| | | | | | | |

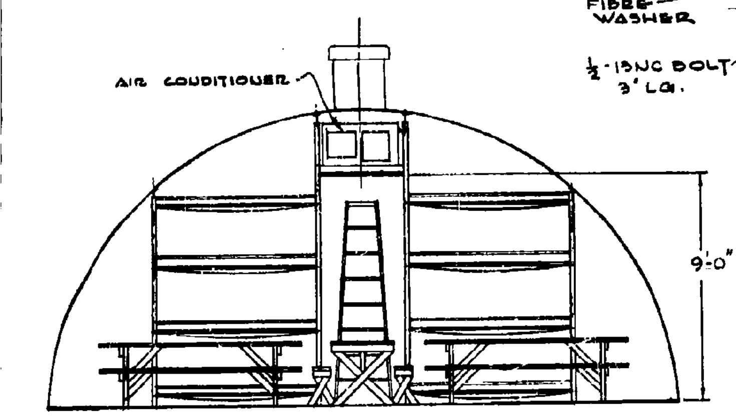



INSTALLATION DETAIL of AIR CONDITIONER

SECTION B

SCALE : HALF SIZE

FOR VENTILATION PKGS: V-1C, V-1D, V-2C, V-2D } SEE REF. 1




...DITIONER DISCHARGE
...ON PIECE TO 4" DIA.
...NYL VENT DUCT

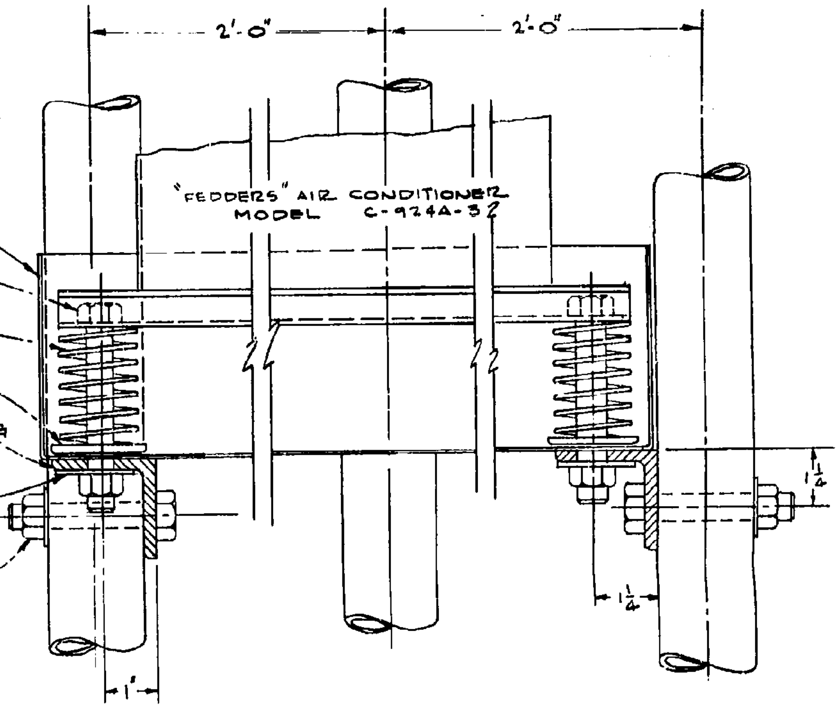
SECTION A-A

3

| REVISION | DATE | DESCRIPTION | BY | APP. |
|---|---|---|---|---|

UNITED STATES
NAVAL RADIOLOGICAL DEFENSE LABORATORY
SAN FRANCISCO 24, CALIFORNIA

| DRAWN | FJA |
|---|---|

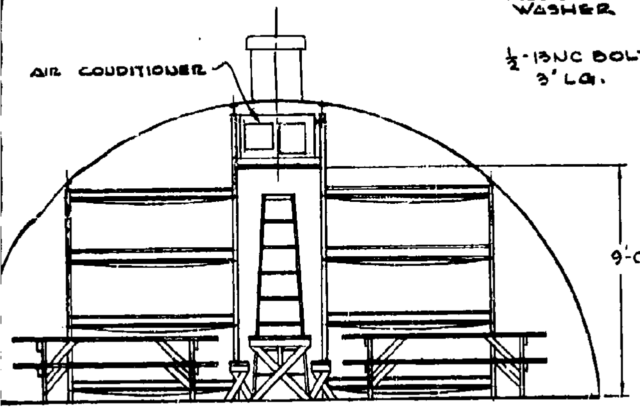



INSTALLATION DETAIL of AIR CONDITIONER

SECTION B

SCALE: HALF SIZE

FOR VENTILATION PKGS: V-1C, V-1D, V-2C, V-2D } SEE REF. 1




SECTION A-A

4

ENGINEERING & DESIGN IS APPROVED BY: Lewis G. Porterm DATE: 22 May 62

| REVISION | DATE | DESCRIPTION | BY | APP. |
|---|---|---|---|---|
| | | | | |

UNITED STATES
NAVAL RADIOLOGICAL DEFENSE LABORATORY
SAN FRANCISCO 24, CALIFORNIA

| | |
|---|---|
| DRAWN | FJA |
| CHECKED | EJA |
| SECTION HEAD | |
| BRANCH HEAD | DEVELOPMENTAL DWG |
| DIVISION HEAD | |

FIG. A-9M

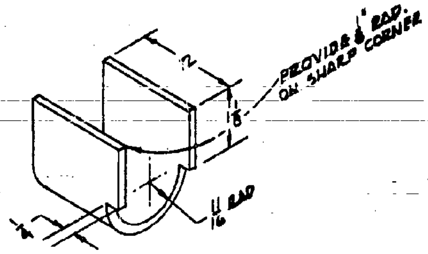
HOTEL ARRANGEMENTS AND AIR CONDITIONING DETAILS

| DATE | SCALE | PROJECT | FINISH | HEAT TREAT |
|---|---|---|---|---|
| 26 FEB 62 | ¼" = 1'-0" | | | |

SATISFACTORY TO: LGP
DATE 5-22-62

DRAWING NUMBER S-62-970
SHEET 11 OF 19

ALT.

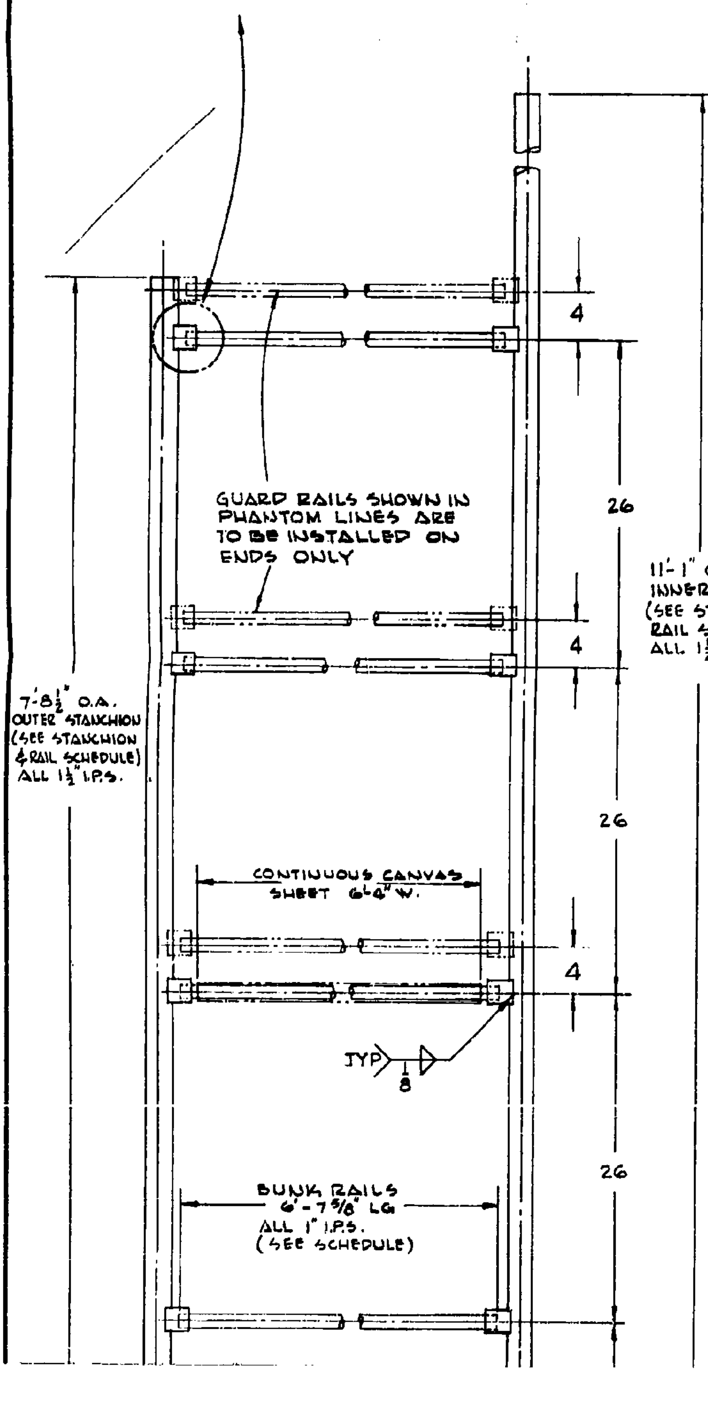


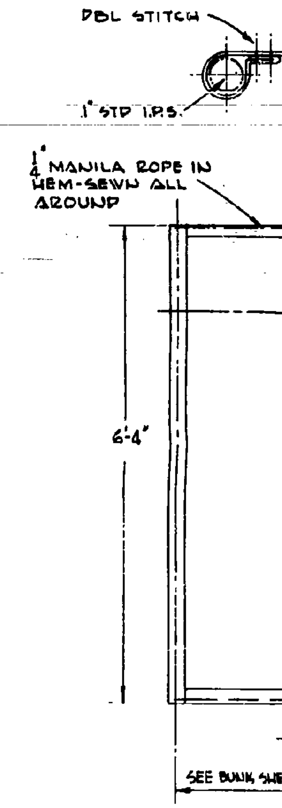

BUNK RAIL CLIP DETAIL
SCALE: HALF
MAT'L: 5# ST'L PL
(SEE SCHEDULE)

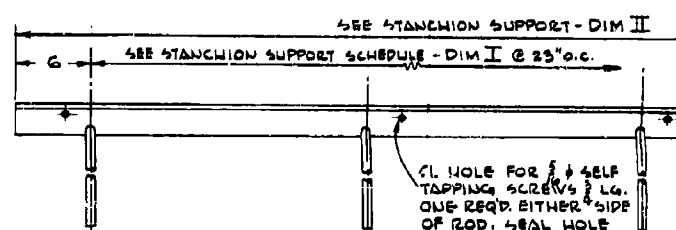
| CONTINUOUS BUNK SHEET SCHEDULE | | | |
|---|---|---|---|
| HOTEL PKG. | Nº OF BUNKS PER SHT. | Nº OF SHEETS | DIM A |
| H-1 | 12 | 8 | 23'-0" |
| H-2 | 6 | 8 | 11'-0" |
| H-3 | 4 | 8 | 7'-8" |

| STANCHION & RAIL SCHEDULE | | | | | | |
|---|---|---|---|---|---|---|
| HOTEL PKG. | INNER STANCHION | INNER STANCHION END | OUTER STANCHION | OUTER STANCHION END | BUNK RAIL | BUNK RAIL CLIPS |
| H-1 | 22 | 4 | 22 | 4 | 116 | 232 |
| H-2 | 10 | 4 | 10 | 4 | 68 | 136 |
| H-3 | 6 | 4 | 6 | 4 | 52 | 104 |

| OUTER & INNER STANCHION SUPPORT SCHEDULE | | | |
|---|---|---|---|
| HOTEL PKG. | Nº OF SPACES | DIM I | DIM II |
| H-1 | 12 | 23'-0" | 24'-0" |
| H-2 | 6 | 11'-6" | 12'-6" |
| H-3 | 4 | 6'-0" | 7'-0" |

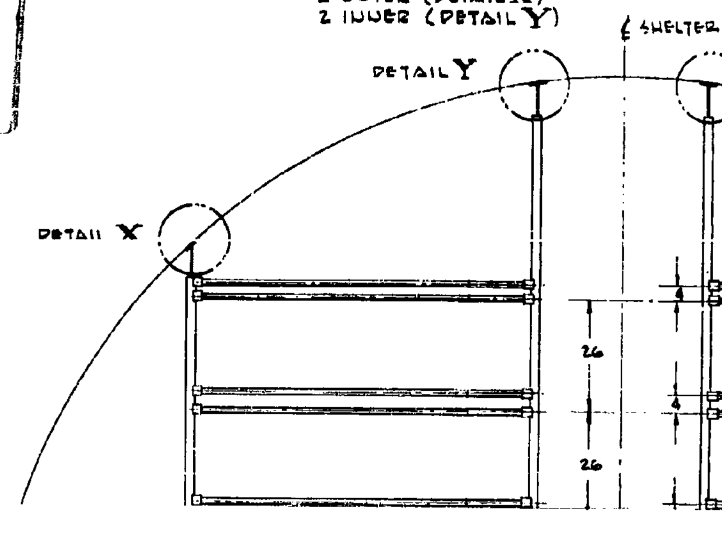


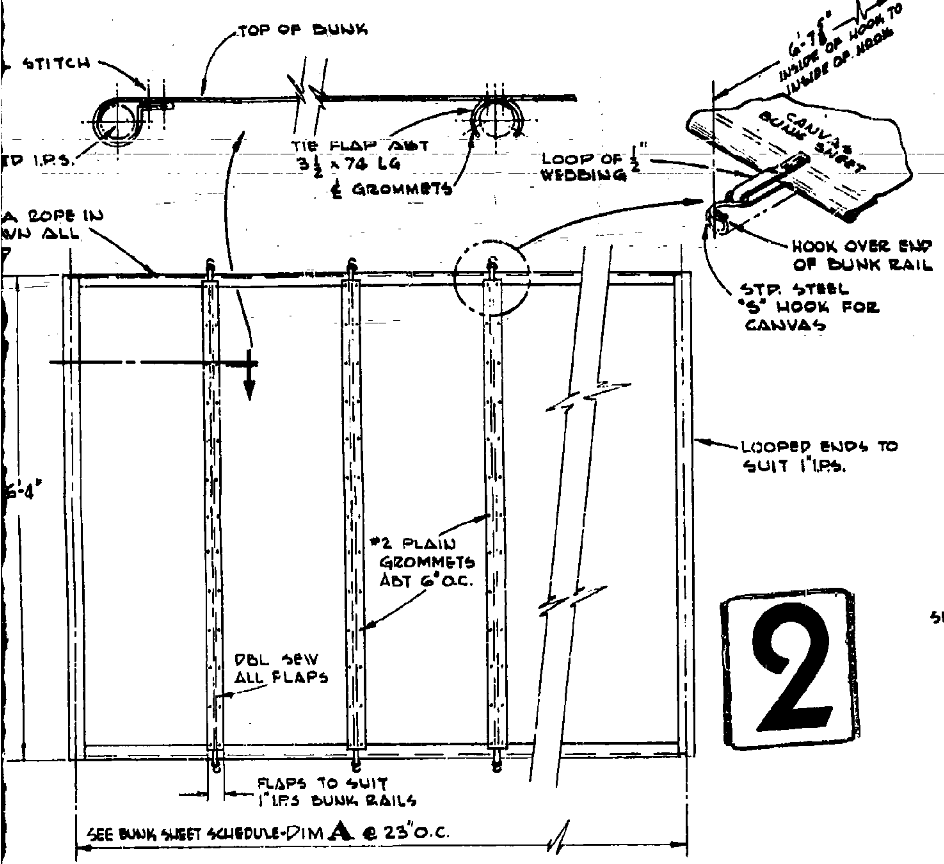




OUTER & INNER STANCHION SUPPORT
SCALE: 1½"=1'-0"
2 EA. TYPE REQ'D.
2 OUTER (DETAIL X)
2 INNER (DETAIL Y)

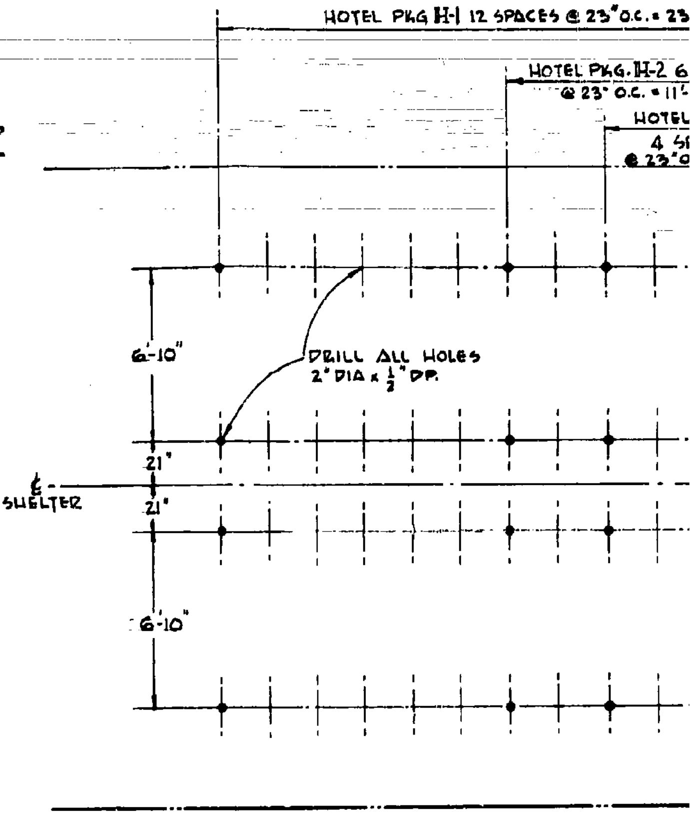
1



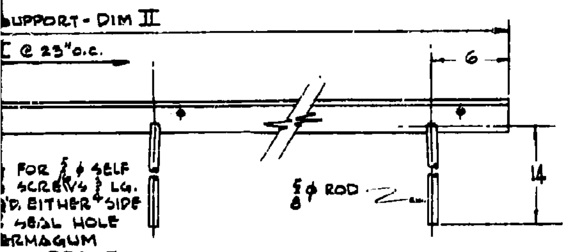
| LIST OF MA | | | |
|---|---|---|---|
| QUANTITIES SHOWN ARE FOR | | | |
| PC. NO. | NAME | NO. REQ. | MAT'L. |



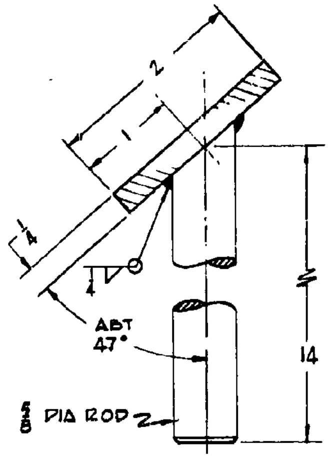

CONTINUOUS BUNK SHEET
BOTTOM VIEW SHOWN
SCALE: 3/4=1'-0"
MAT'L. #12 NUMBER DUCT



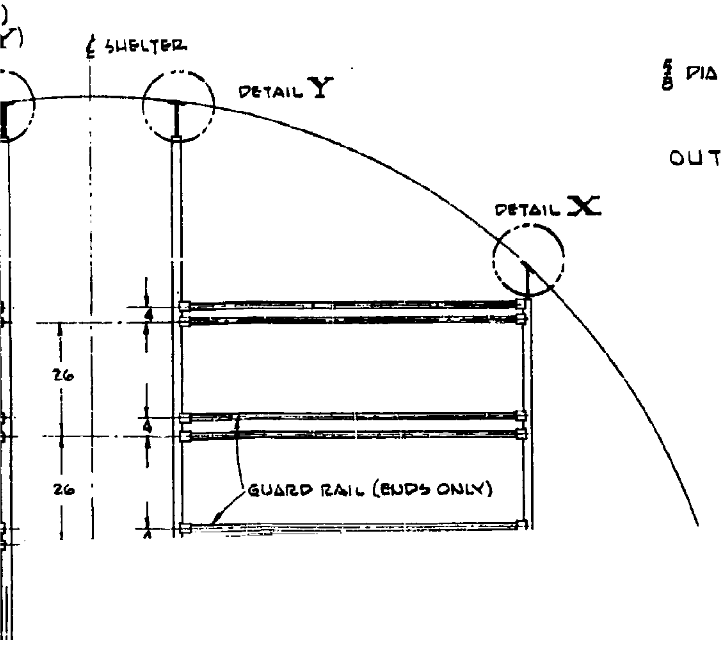

FLOOR PLAN SHOWING LAYOUT
OF HOLES FOR BUNK STANCHIONS
SCALE: ¼"=1'-0"

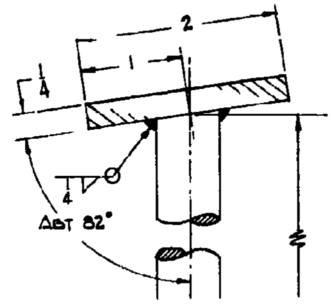



...SUPPORT




DETAIL X
OUTER STANCHION SUPPORT
SCALE: FULL



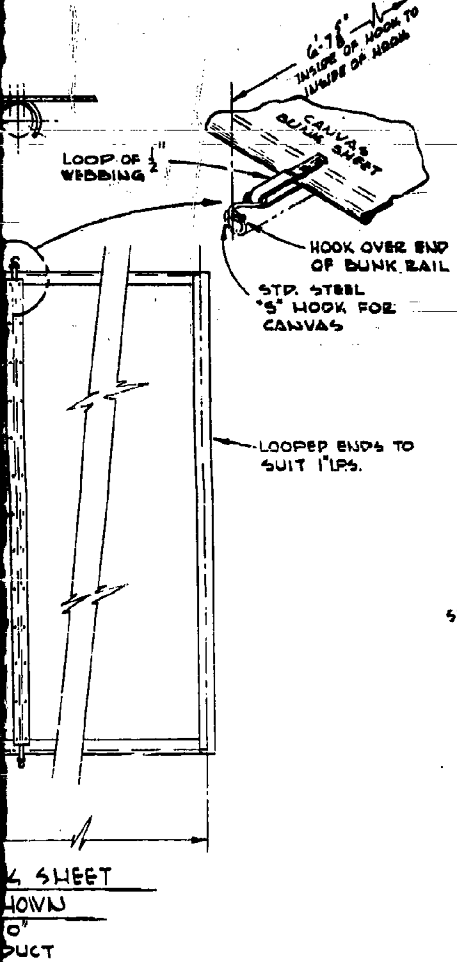



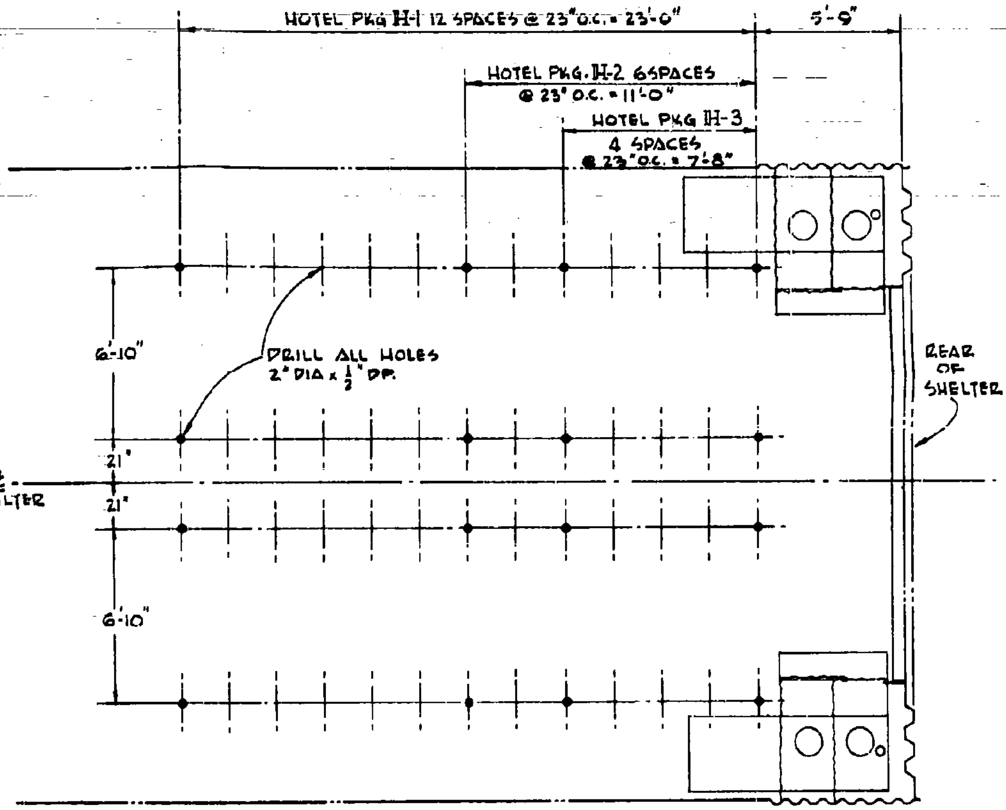

| REVISION | DATE | |
|---|---|---|

## LIST OF MATERIAL

QUANTITIES SHOWN ARE FOR

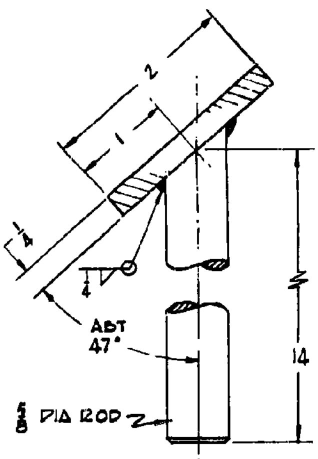
| PC. NO. | NAME | NO. REQ. | MAT'L. | MAT'L. SPEC. | STOCK SIZE | REMARKS |
|---|---|---|---|---|---|---|
| | | | | | | |




FLOOR PLAN SHOWING LAYOUT OF HOLES FOR BUNK STANCHIONS

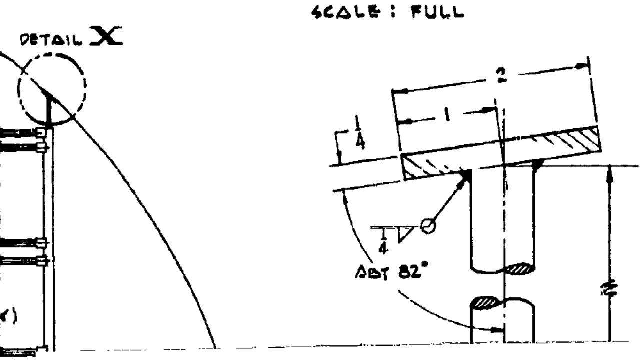
SCALE: 1/4" = 1'-0"




DETAIL X

OUTER STANCHION SUPPORT

SCALE: FULL

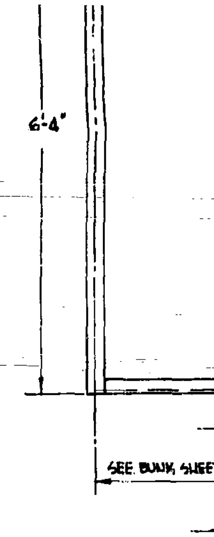



3

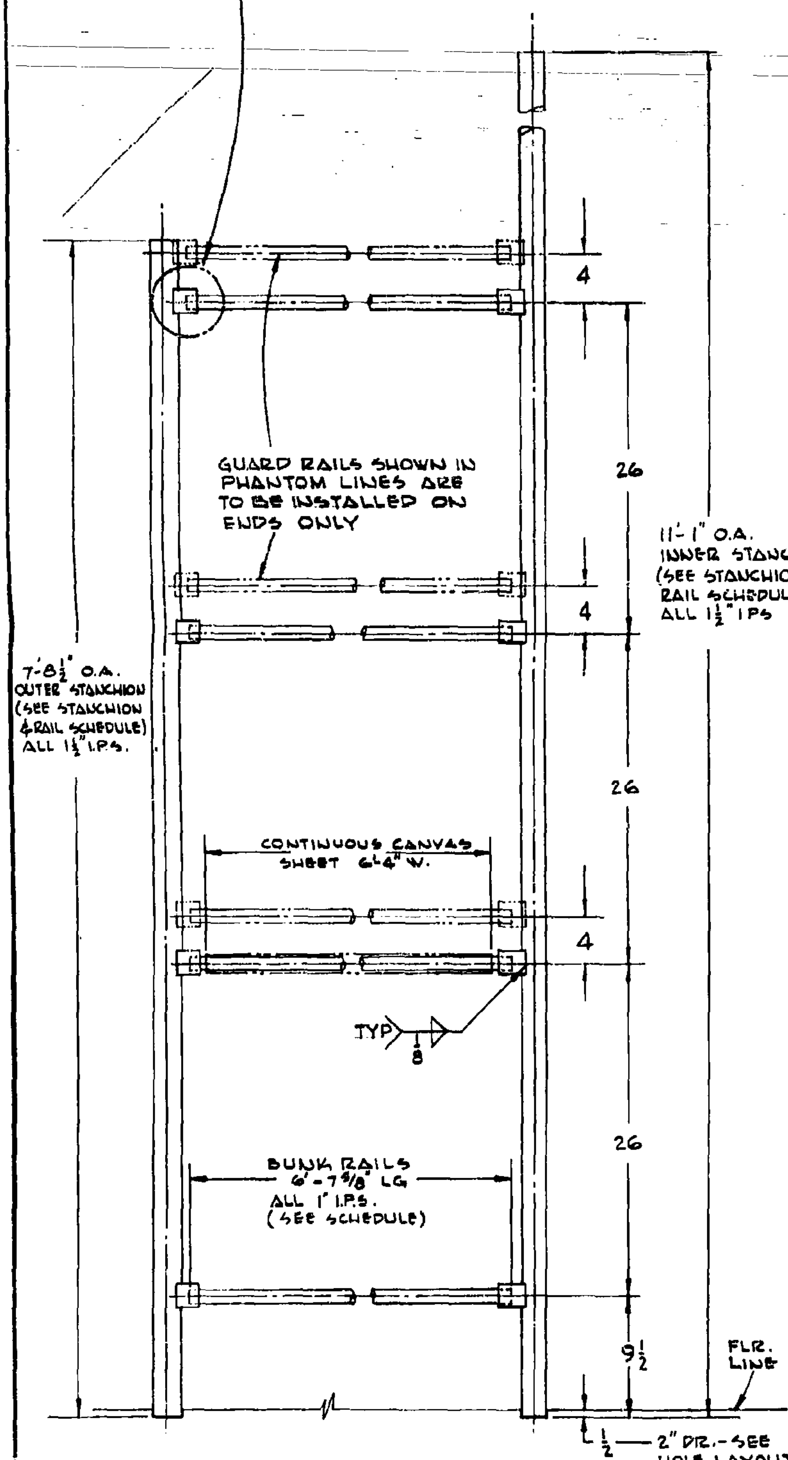
| REVISION | DATE | DESCRIPTION | BY | APP. |
|---|---|---|---|---|
| | | | | |

BUNK RAIL
CLIP DETAIL
SCALE: HALF
MAT'L: 5" ST'L PL
(SEE SCHEDULE)

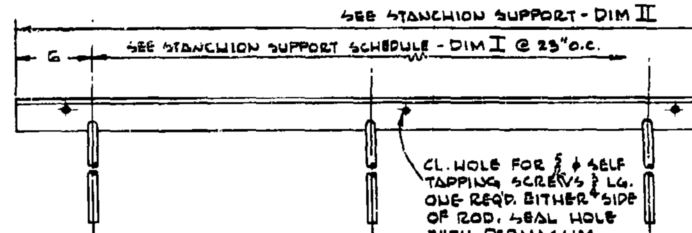
| STANCHION & RAIL SCHEDULE | | | | | | |
|---|---|---|---|---|---|---|
| HOTEL PKG. | INNER STANCHION | INNER STANCHION END | OUTER STANCHION | OUTER STANCHION END | BUNK RAIL | BUNK RAIL CLIPS |
| H-1 | 22 | 4 | 22 | 4 | 116 | 232 |
| H-2 | 10 | 4 | 10 | 4 | 68 | 136 |
| H-3 | 6 | 4 | 6 | 4 | 52 | 104 |



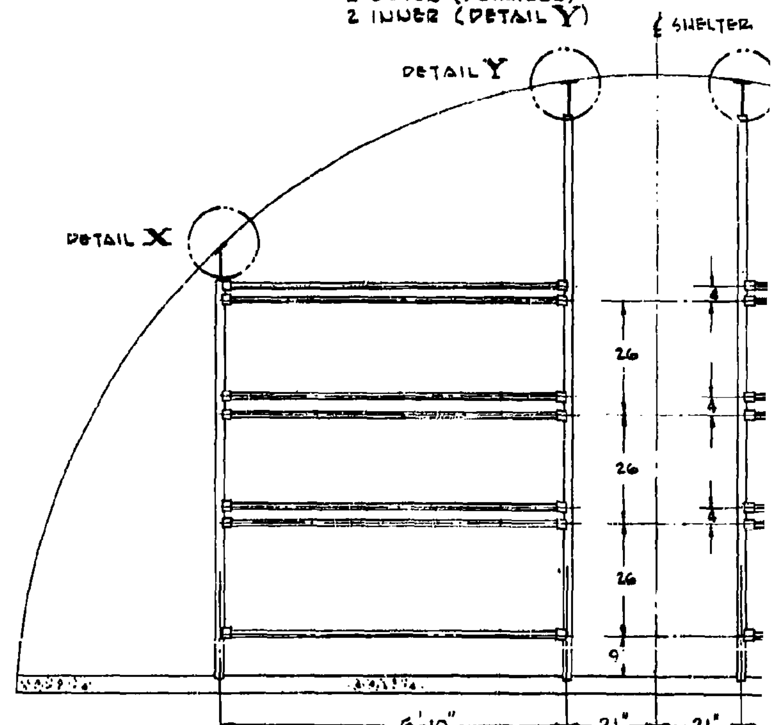

| OUTER & INNER STANCHION SUPPORT SCHEDULE | | | |
|---|---|---|---|
| HOTEL PKG. | Nº OF SPACES | DIM I | DIM II |
| H-1 | 12 | 23'-0" | 24'-0" |
| H-2 | 6 | 11'-6" | 12'-6" |
| H-3 | 4 | 6'-0" | 7'-0" |



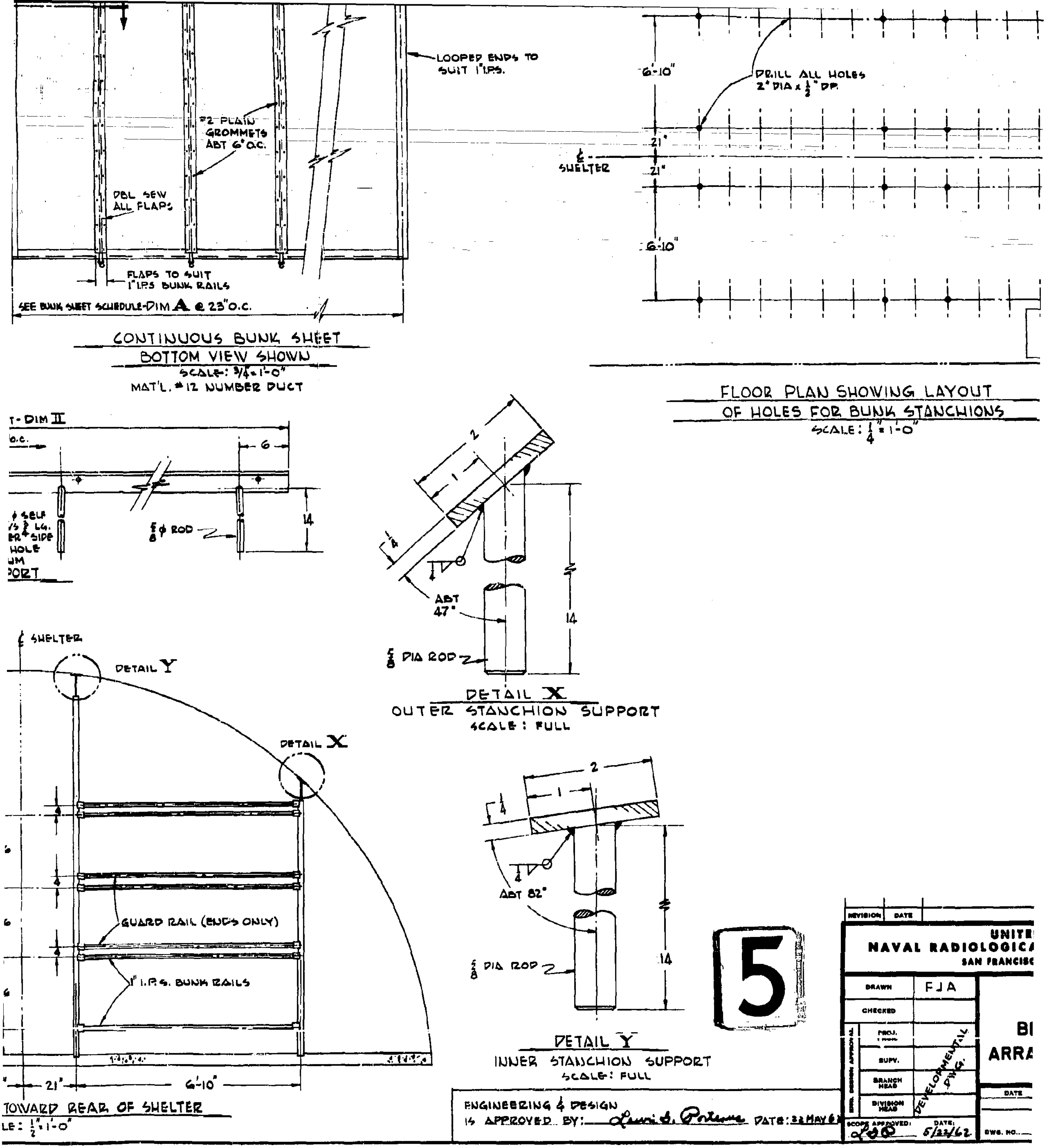

STANCHION & RAIL DETAILS
SCALE: 1½" = 1'-0"
ALL MATERIAL TO BE GALVANIZED

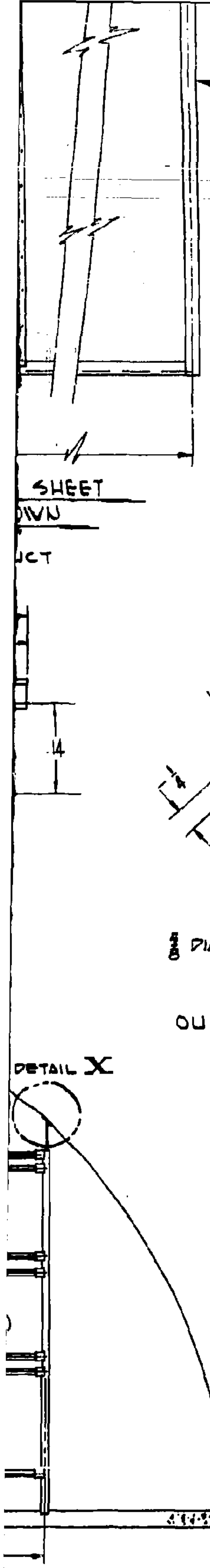


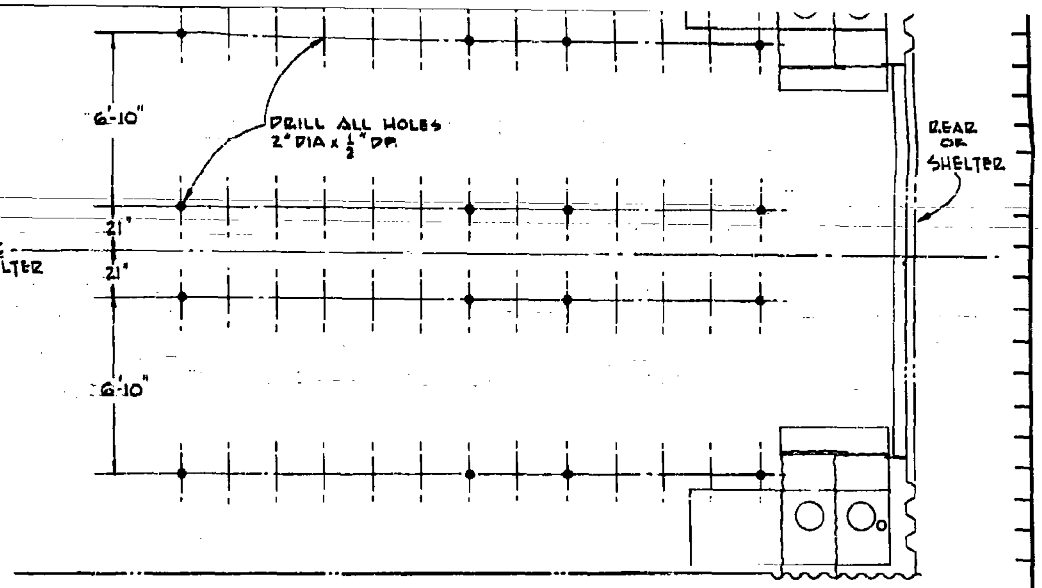

OUTER & INNER STANCHION SUPPORT
SCALE: 1½" = 1'-0"
2 EA. TYPE REQ'D.
2 OUTER (DETAIL X)
2 INNER (DETAIL Y)




ELEVATION - LOOKING TOWARD REI
SCALE: ½" = 1'-0"

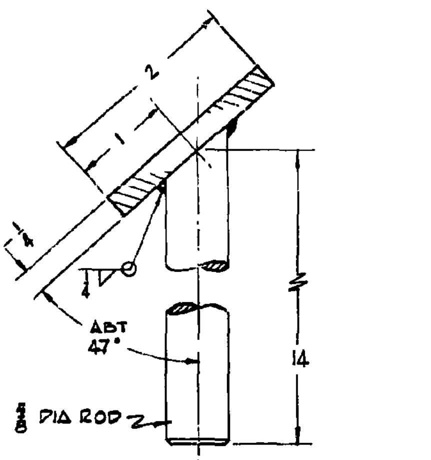

LOOPED ENDS TO SUIT 1" I.P.S.
#2 PLAIN GROMMETS ABT 6" O.C.
DBL SEW ALL FLAPS
FLAPS TO SUIT 1" I.P.S BUNK RAILS
SEE BUNK SHEET SCHEDULE-DIM A @ 23" O.C.
CONTINUOUS BUNK SHEET
BOTTOM VIEW SHOWN
SCALE: 3/4=1'-0"
MAT'L. #12 NUMBER DUCT
6'-10"
DRILL ALL HOLES 2" DIA x 1/2" DP.
21"
℄ SHELTER
21"
6'-10"
FLOOR PLAN SHOWING LAYOUT
OF HOLES FOR BUNK STANCHIONS
SCALE: 1/4"=1'-0"
6
14
5/8 ϕ ROD
2
1
1/4
ABT 47°
14
5/8 DIA ROD
DETAIL X
OUTER STANCHION SUPPORT
SCALE: FULL
℄ SHELTER
DETAIL Y
DETAIL X
4
4
4
GUARD RAIL (ENDS ONLY)
1" I.P.S. BUNK RAILS
21"
6'-10"
TOWARD REAR OF SHELTER
2
1
1/4
ABT 82°
14
5/8 DIA ROD
DETAIL Y
INNER STANCHION SUPPORT
SCALE: FULL
5
ENGINEERING & DESIGN
IS APPROVED BY:
DATE:
REVISION
DATE
NAVAL RADIOLOGICA
SAN FRANCISC
DRAWN
FJA
CHECKED
PROJ.
SUPV.
BRANCH HEAD
DIVISION HEAD
DEVELOPMENTAL DWG.
SCOPE APPROVED:
DATE:
5/22/62
DATE
DWG. NO.




FLOOR PLAN SHOWING LAYOUT OF HOLES FOR BUNK STANCHIONS

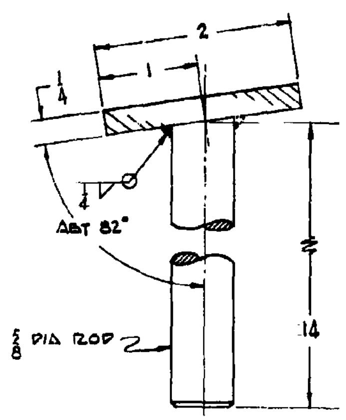
SCALE: ¼" = 1'-0"




DETAIL X

OUTER STANCHION SUPPORT

SCALE: FULL




DETAIL Y

INNER STANCHION SUPPORT

SCALE: FULL

6

ENGINEERING & DESIGN IS APPROVED BY: Louis S. Porter DATE: 22 MAY 62

| REVISION | DATE | DESCRIPTION | BY | APP. |
|---|---|---|---|---|

UNITED STATES
NAVAL RADIOLOGICAL DEFENSE LABORATORY
SAN FRANCISCO 24, CALIFORNIA

| | |
|---|---|
| DRAWN | FJA |
| CHECKED | |
| PROJ. ENGR. | DEVELOPMENTAL DWG. |
| SUPV. | |
| BRANCH HEAD | |
| DIVISION HEAD | |
| SCOPE APPROVED: LSP | DATE: 5/22/62 |

FIG. A-10N

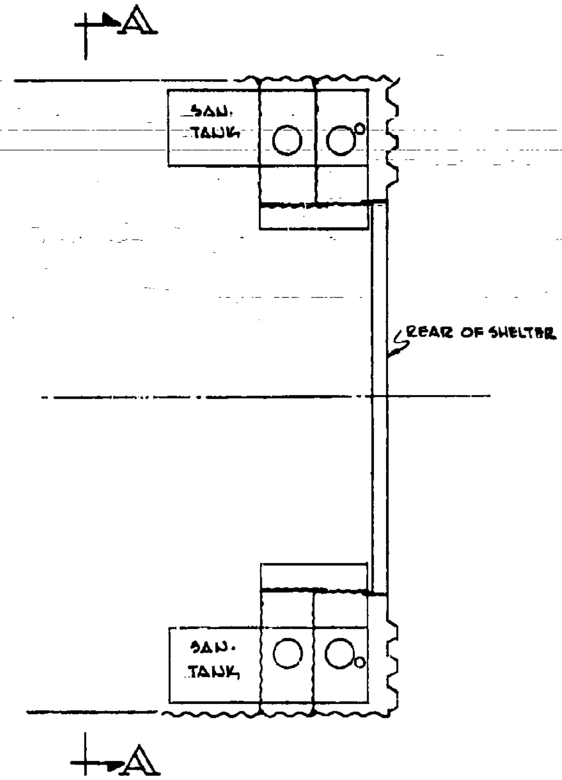
BERTHING FACILITY

ARRANGEMENT & DETAILS

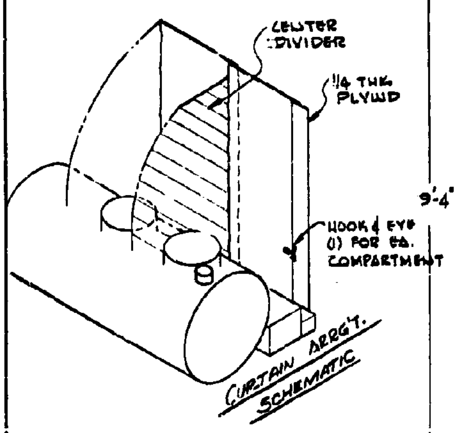
| DATE | SCALE | PROJECT | TECH MEMO |
|---|---|---|---|
| | | | |

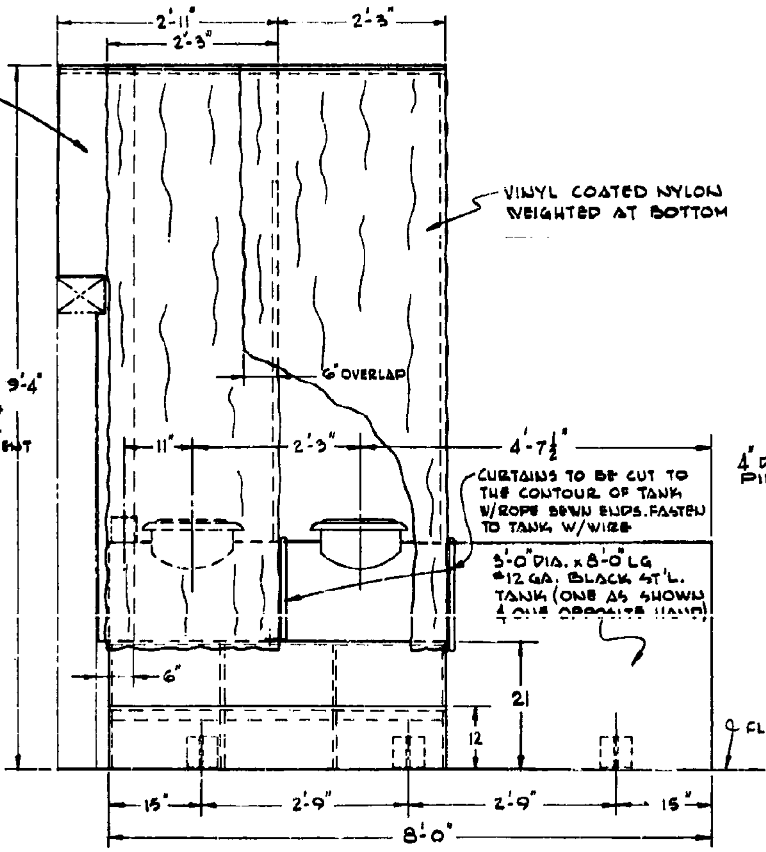
DWG. NO. S-62-970 SHT. 12 OF 19 ALT.

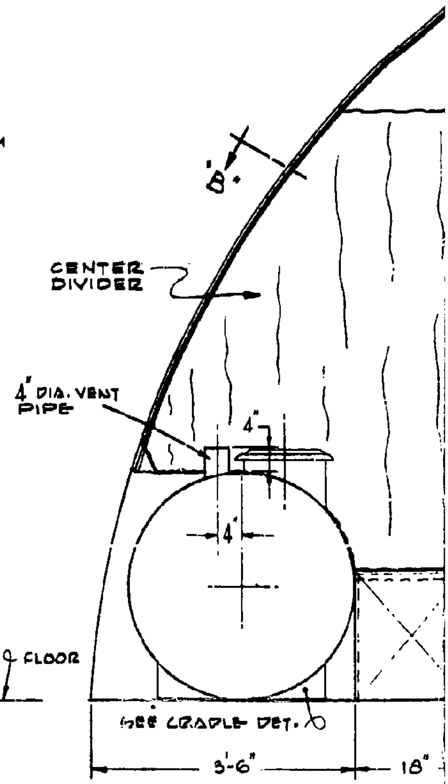
SHELTER
IRON LIN




PLAN-SANITATION
FACILITIES
SCALE: 1/4"=1'-0"

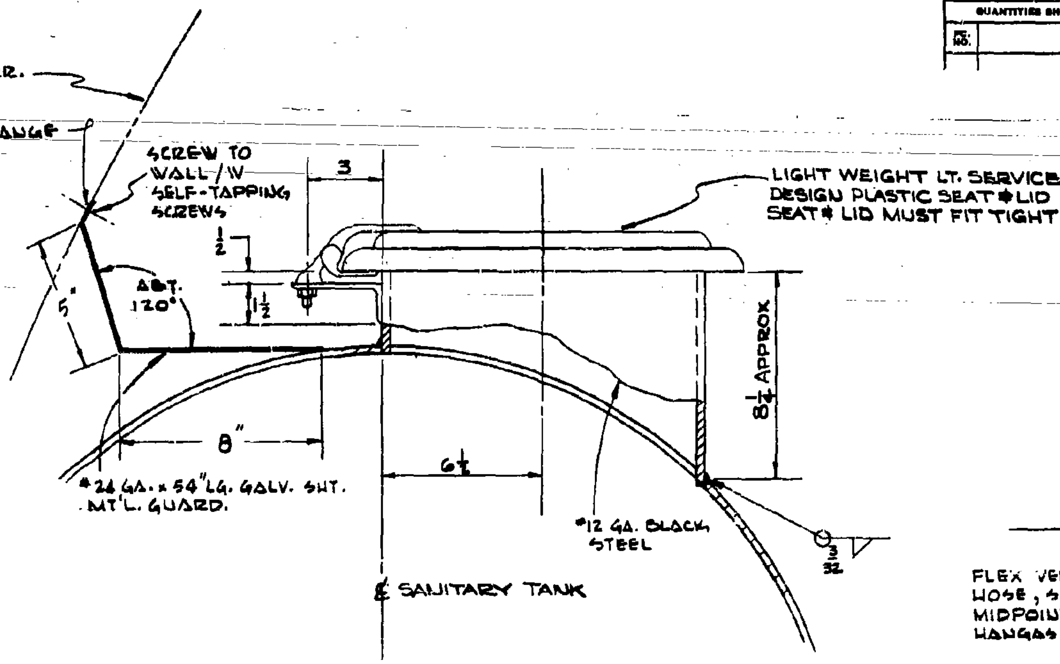


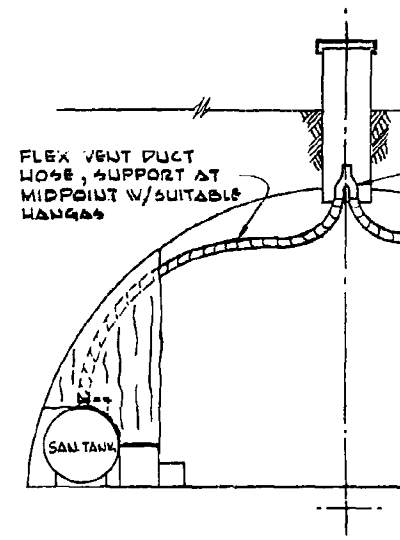

1

| LIST OF MAT | | | |
|---|---|---|---|
| QUANTITIES SHOWN ARE FOR | | | |
| PC. NO. | NAME | NO. REQ. | MAT'L. |



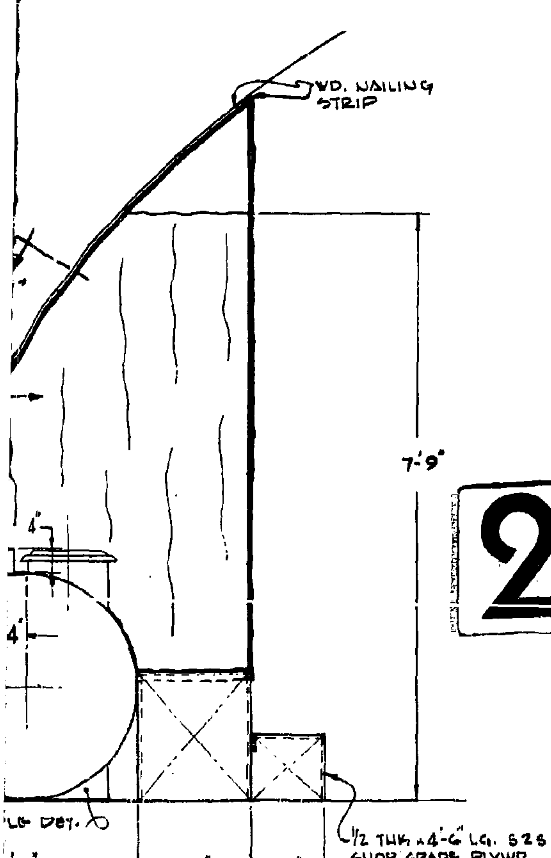

## WATER CLOSET DETAIL

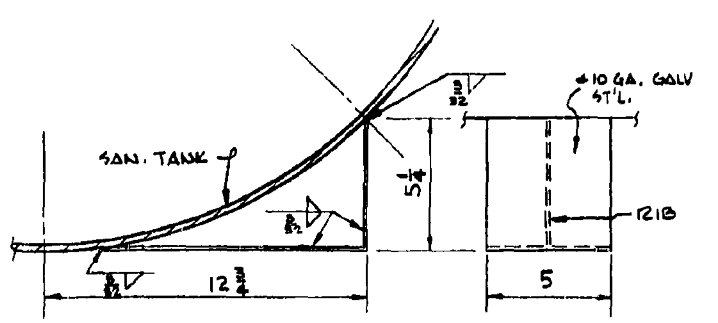
SCALE: 3" = 1'-0




SECTION

SCALE: 1/4

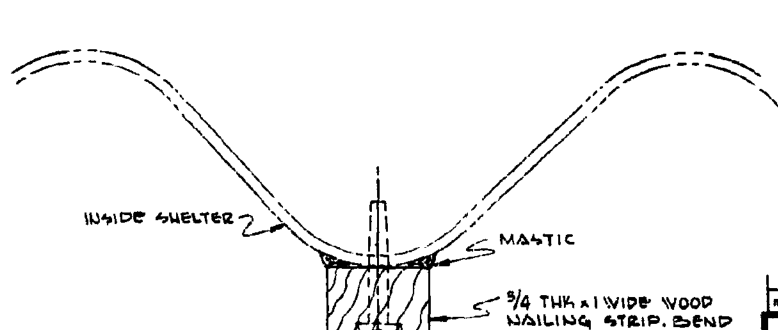



## CRADLE DETAIL (SIX REQ'D)

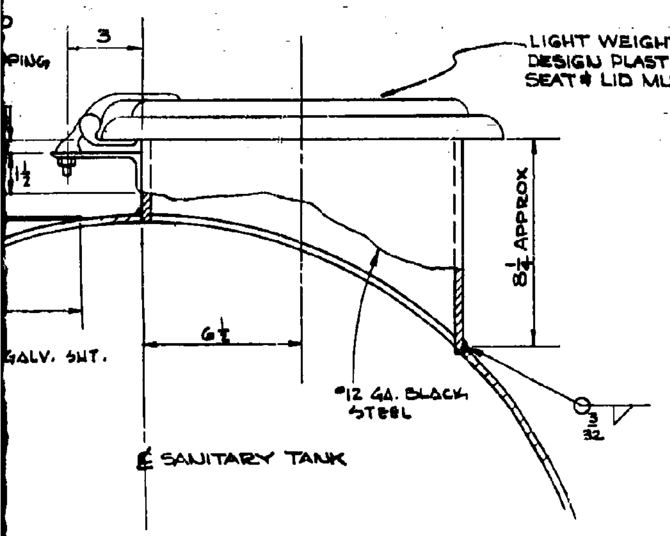
SCALE: 3" = 1'-0"

2



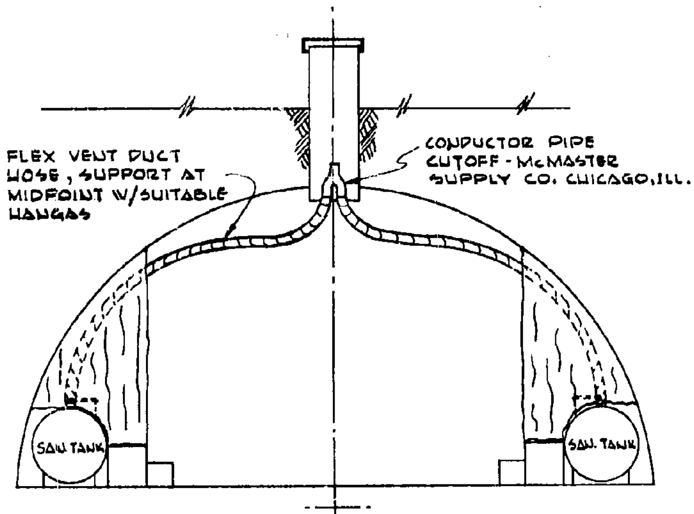

| REVISION | DATE |
|---|---|

| LIST OF MATERIAL | | | | | | |
|---|---|---|---|---|---|---|
| QUANTITIES SHOWN ARE FOR | | | | | | |
| PC. NO. | NAME | NO. REQ. | MAT'L. | MAT'L. SPECS. | STOCK SIZE | REMARKS |
| | | | | | | |



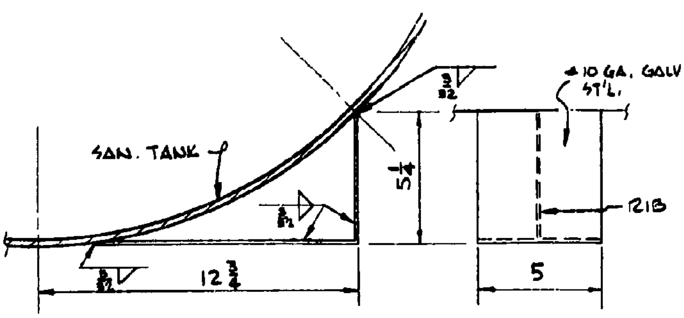

WATER CLOSET DETAIL

SCALE: 3" = 1'-0




SECTION A-A

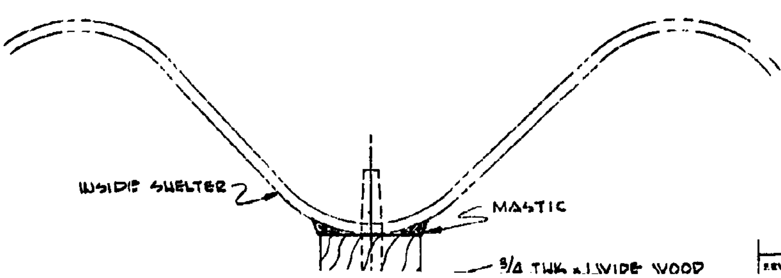
SCALE: ¼" = 1'-0"



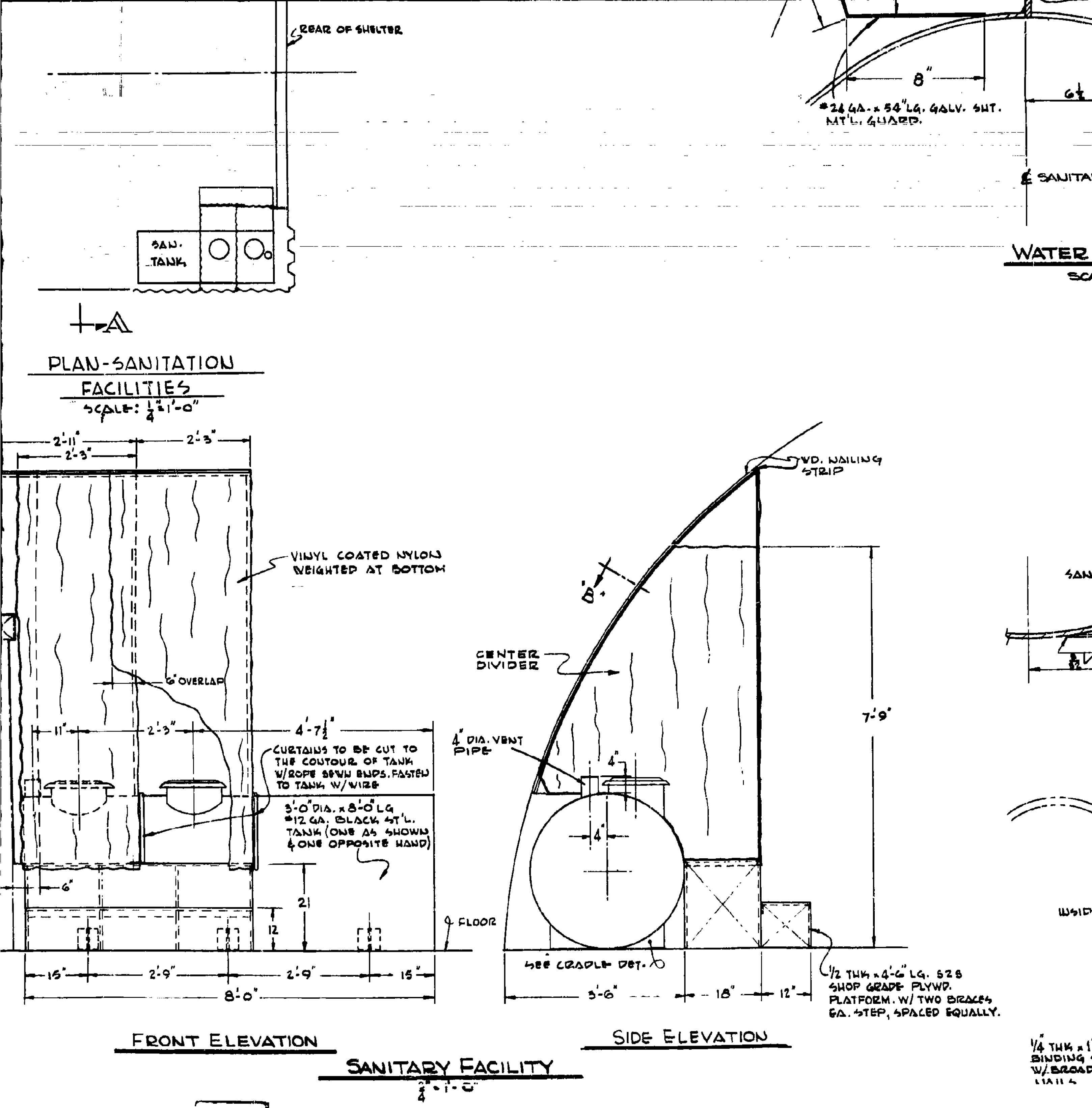

CRADLE DETAIL (SIX REQ'D)

SCALE: 3" = 1'-0"

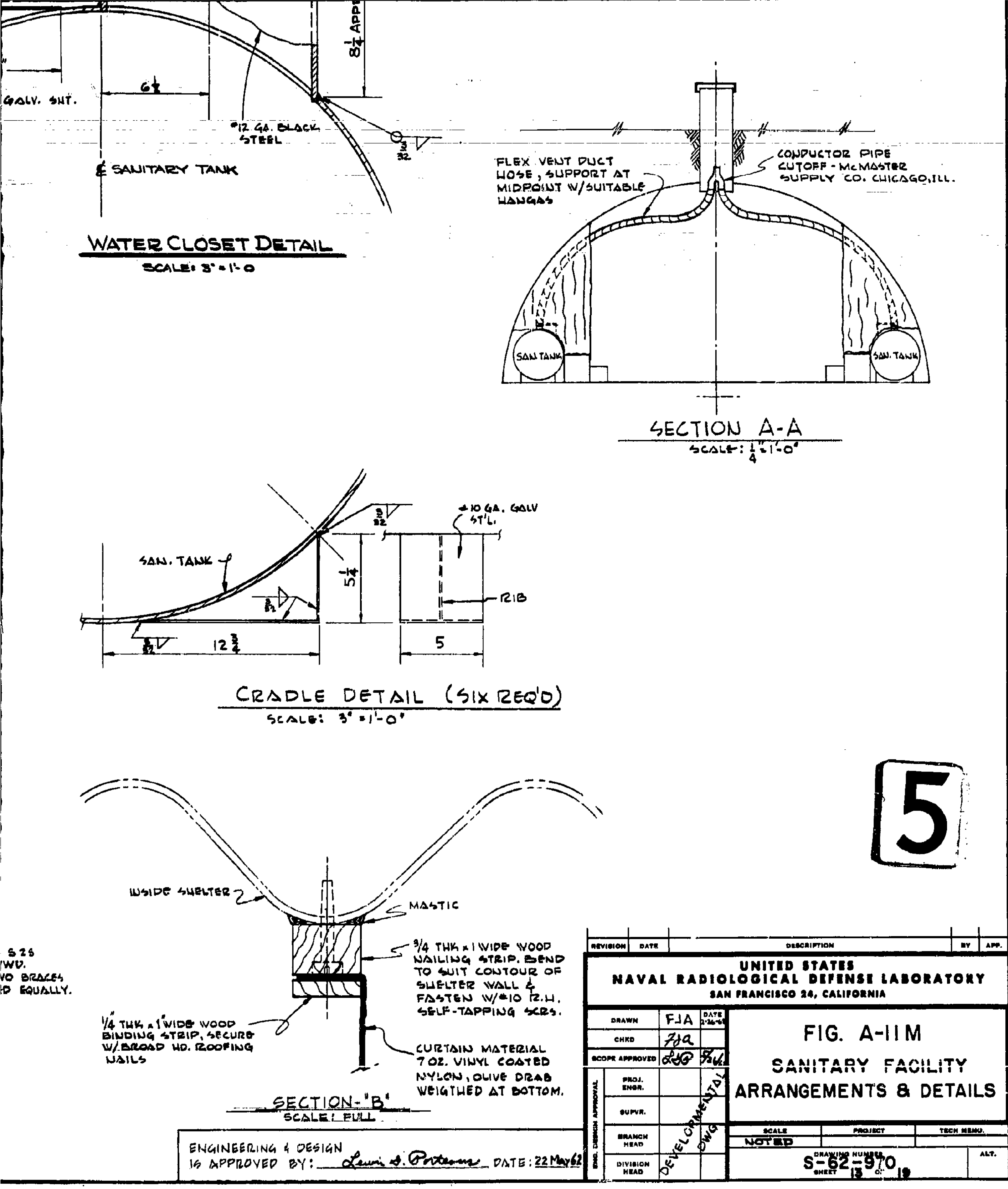
3

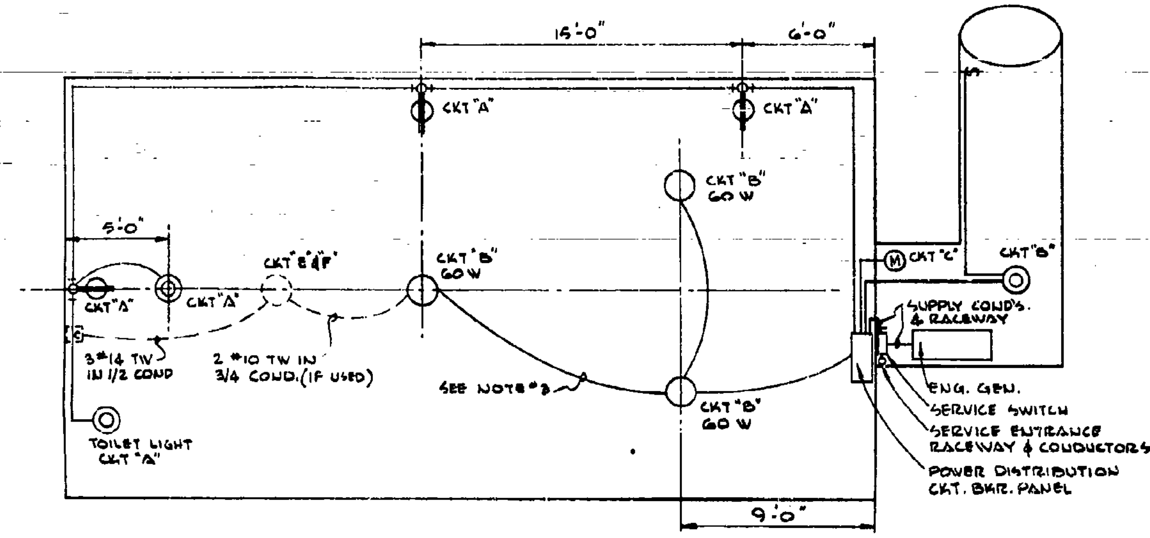



| REVISION | DATE | DESCRIPTION | BY | APP. |
|---|---|---|---|---|
| | | | | |


REAR OF SHELTER
SAN. TANK
PLAN-SANITATION FACILITIES
SCALE: 1/4"=1'-0"
#24 GA. x 54" LG. GALV. SHT. MT'L. GUARD.
8"
SANITA
WATER
VINYL COATED NYLON WEIGHTED AT BOTTOM
6" OVERLAP
CURTAINS TO BE CUT TO THE CONTOUR OF TANK W/ROPE SEWN ENDS. FASTEN TO TANK W/WIRE
3'-0" DIA. x 8'-0" LG #12 GA. BLACK ST'L. TANK (ONE AS SHOWN & ONE OPPOSITE HAND)
2'-11"
2'-3"
11"
4'-7 1/2"
6"
21
12
FLOOR
15"
2'-9"
8'-0"
FRONT ELEVATION
WD. NAILING STRIP
CENTER DIVIDER
4" DIA. VENT PIPE
4"
7'-9"
SEE CRADLE DET.
3'-6"
18"
12"
1/2 THK x 4'-6" LG. S2S SHOP GRADE PLYWD. PLATFORM. W/ TWO BRACES EA. STEP, SPACED EQUALLY.
SIDE ELEVATION
SANITARY FACILITY
3/4"=1'-0"

4

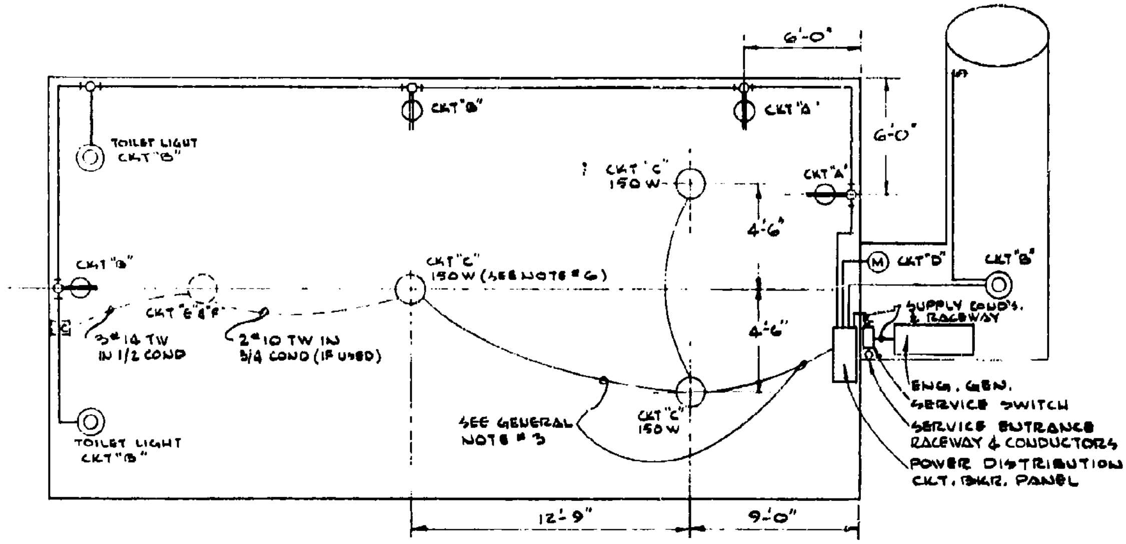

GALV. SHT.
#12 GA. BLACK STEEL
℄ SANITARY TANK
WATER CLOSET DETAIL
SCALE: 3" = 1'-0
FLEX VENT DUCT HOSE, SUPPORT AT MIDPOINT W/SUITABLE HANGAS
CONDUCTOR PIPE CUTOFF - McMASTER SUPPLY CO. CHICAGO, ILL.
SAN. TANK
SECTION A-A
SCALE: 1/4" = 1'-0"
#10 GA. GALV ST'L.
SAN. TANK
RIB
12 3/4
5
CRADLE DETAIL (SIX REQ'D)
SCALE: 3" = 1'-0"
INSIDE SHELTER
MASTIC
3/4 THK x 1 WIDE WOOD NAILING STRIP. BEND TO SUIT CONTOUR OF SHELTER WALL & FASTEN W/#10 R.H. SELF-TAPPING SCRS.
1/4" THK x 1" WIDE WOOD BINDING STRIP, SECURE W/BROAD HD. ROOFING NAILS
CURTAIN MATERIAL 7 OZ. VINYL COATED NYLON, OLIVE DRAB WEIGHTED AT BOTTOM.
SECTION-"B"
SCALE: FULL
5
ENGINEERING & DESIGN IS APPROVED BY: DATE: 22 May 62
UNITED STATES
NAVAL RADIOLOGICAL DEFENSE LABORATORY
SAN FRANCISCO 24, CALIFORNIA
DRAWN FJA
FIG. A-11M
SANITARY FACILITY
ARRANGEMENTS & DETAILS
DEVELOPMENTAL DWG
SCALE NOTED
S-62-970
SHEET 13 OF 19




ARRANGEMENT "A" ELECT. PACKAGE

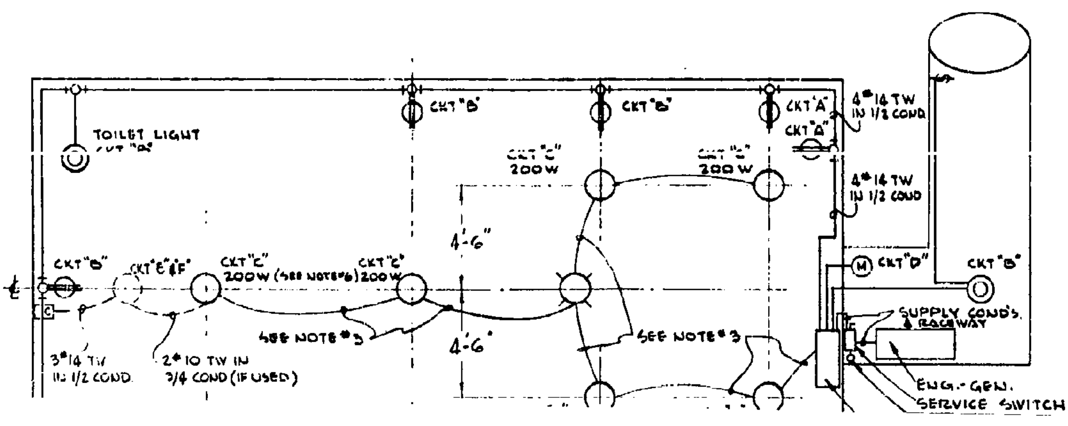
| ARRANGEMENT "A" ELECT. … CKT BREAKER PAN… 120V, 2WIRE, 1φ-70AMP BUS, UNLESS OTHEWISE … | | | | |
|---|---|---|---|---|
| CKT No | CIRCUIT BREAKER No POLES | CIRCUIT BREAKER RATING | PURPOSE | |
| A | 1 | 15 | OUTLET RECPT. & LIGHTS | |
| B | 1 | 15 | LIGHTS | |
| C | 1 | 15 | VENT MOTOR | |
| E | 2 | 30 | AIR CONDITIONER | IF A… POW… USE… 120… PAN… |
| F | | | | |

1




ARRANGEMENT "B" ELECT. PACKAGE

| ARRANGEMENT "B" ELECT. … CKT BREAKER PANE… 120V, 2WIRE, 1φ-70AMP BUS, UNLESS OTHERWISE … | | | | |
|---|---|---|---|---|
| CKT No | CIRCUIT BREAKER No POLES | CIRCUIT BREAKER RATING | PURPOSE | |
| A | 1 | 15 | HOT PLATE SUPPLY TOILET & ENTRANCE-WAY LIGHT PLUS RECEPT. | |
| B | 1 | 15 | | |
| C | 1 | 15 | LIGHTS | |
| D | 1 | 15 | VENT MOTOR | |
| E | 2 | 30 | AIR CONDITIONER | IF A… POW… USE… 120/… PAN… |
| F | | | | |




| ARRANGEMENT "C" ELECT. P… CKT BREAKER PANE… 120, 2WIRE, 1φ-70AMP BUS, UNLESS OTHERWISE … | | | | |
|---|---|---|---|---|
| CKT No | CIRCUIT BREAKER No POLES | CIRCUIT BREAKER RATING | PURPOSE | |
| A | 1 | 15 | HOT PLATE SUPPLY TOILET ENTRANCE-WAY LIGHTS PLUS OUTLET RECEPTACLES | |
| B | 1 | 15 | | |
| C | 1 | 15 | LIGHTS | |
| D | 1 | 15 | VENT MOTOR | |
| E | 2 | 30 | AIR CONDITIONER | IF A… POW… USE… 120… |
| F | | | | |

| LIST OF MAT | | | |
|---|---|---|---|
| QUANTITIES SHOWN ARE FOR | | | |
| PC. NO. | NAME | NO REQ. | MAT'L. |

GEMENT "A" ELECT. PACKAGE
CKT BREAKER PANEL
AMP BUS, UNLESS OTHEWISE NOTED IN REMARK COLUMN

| AKER TING | PURPOSE | REMARKS |
|---|---|---|
| 5 | OUTLET RECPT. & LIGHTS | |
| 5 | LIGHTS | |
| 5 | VENT MOTOR | |
| 30 | AIR CONDITIONER | IF AIR COND. IS SPECIFIED POWER PKG. P-4 WILL BE USED, THIS WILL REQUIRE 120/240 V, 3W, 1φ PANEL HAVING 100 AMP BUS |

UGEMENT "B" ELECT. PACKAGE
CKT BREAKER PANEL
MP BUS, UNLESS OTHERWISE NOTED IN REMARK COLUMN

| KER TING | PURPOSE | REMARKS |
|---|---|---|
| 15 | HOT PLATE SUPPLY TOILET & ENTRANCE- | |
| 15 | WAY LIGHT PLUS RECEPT. | |
| 15 | LIGHTS | |
| 15 | VENT MOTOR | |
| 30 | AIR CONDITIONER | IF AIR COND. IS SPECIFIED POWER PKG. P-4 WILL BE USED. THIS WILL REQUIRE 120/240 V, 3W, 1φ PANEL HAVING 100 AMP BUS |

GEMENT "C" ELECT. PACKAGE
CKT BREAKER PANEL
AMP BUS, UNLESS OTHERWISE NOTED IN REMARK COLUMN

| EAKER ATING | PURPOSE | REMARKS |
|---|---|---|
| 15 | HOT PLATE SUPPLY TOILET ENTRANCE- | |
| 15 | WAY LIGHTS PLUS OUTLET RECEPTACLES | |
| 15 | LIGHTS | |
| 15 | VENT MOTOR | |
| 30 | AIR CONDITIONER | IF AIR COND. IS SPECIFIED POWER PKG. P-4 WILL BE |

## MATERIAL LIST

| DESCRIPTION | SIZE | ITEM Nº & QUANTITY REQ'D PER HOTEL ARRANGEMENT PKG. A | | B | | C | | MANUFACTURER | CATALOG NUMBER | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| | | ITEM | Nº OR FT. REQ'D | ITEM | Nº OR FT. REQ'D | ITEM | Nº OR FT. REQ'D | | | |
| CONDUCTOR TYPE TW | #14 AWG | | 440 | | 440 | | 500 | | | |
| OUTLET BOXES | | | 4 | | 5 | | 6 | STEEL CITY ELECT CO. PITTSBURG, PENN | 58561 | |
| DUPLEX RECEPT U'GRD 15 AMP | | | 3 | | 4 | | 5 | BRYANT ELECT CO. BRIDGEPORT CONN. | 808 | |
| DUPLEX RECEPT. BOX COVER | | | 3 | | 4 | | 5 | STEEL CITY ELECT CO. PITTSBURG, PENN | 58C7 | |
| PENDANT TYPE RLM FIXT. 200W | | | 0 | | 0 | | 6 | SPERO ELECT CORP. CLEVELAND, OHIO | D-516 | ALL W/ 200 WATT BULBS |
| PENDANT TYPE RLM FIXT. 150 W | | | 0 | | 3 | | 0 | SPERO ELECT CORP | D-514 | ALL W/ 140 WATT BULBS |
| PENDANT TYPE RLM FIXT. 60 W | | 1 | 6* | 2 | 3 | 3 | 3 | SPERO ELECT CORP | D-512 | * 5 W/60 WATT BULBS, ALL OTHERS 25 WATT |
| LAMP BALL ALIGNER | | | 6 | | 6 | | 9 | SPERO ELECT CORP | Nº 15 | |
| SWITCH S.P | 15 AMP | | 1 | | 1 | | 1 | BRYANT ELECT CO. | Nº 51 | |
| OUTLET BOX 4" | | | 6 | | 6 | | 10 | STEEL CITY ELECT. | 54151 | |
| OUTLET BOX COVER | | | 0 | | 0 | | 1 | STEEL CITY ELECT. | 54-C-1 | |
| SWITCH SP COVER | | | 1 | | 1 | | 1 | STEEL CITY ELECT. | 58C30 | |
| SINGLE POLE CIRCUIT BKRS. | 15 AMP | | 3 | | 4 | | 4 | SQ. "D" ELECT CO. | Q0115 | |
| MISC. FITTINGS AS REQ'D. | LOT | | 1 | | 1 | | 1 | STEEL CITY ELECT. | | |
| 4 CKT. BKR PANEL 120 V, 2 WIRE, 1φ, 70 AMP BUS | 2 WIRE 70 AMP BUS | 4 | 1 | 4 | 1 | 4 | 1 | SQ. "D" ELECT. CO. | Q04S | POWER PANEL FOR SHELTER WITHOUT A/C |
| 6 CKT. BKR. PANEL 120/240 V, 3 WIRE, 1φ, 100 AMP BUS | 3 WIRE 100 AMP BUS | 5 | 1 | 5 | 1 | 5 | 1 | SQ "D" ELECT. CO. | Q06S | POWER PANEL FOR SHELTER WITH A/C |
| CONDUIT | ½ | 11 | 220 | 11 | 220 | 12 | 250 | STEEL CITY ELECT | | AMT REQ'D. IF A/C NOT USED |
| CONDUIT | ½ | 13 | 140 | 13 | 140 | 14 | 170 | STEEL CITY ELECT | | AMT REQ'D. IF A/C IS USED |
| | | ITEM Nº & QUANTITY REQ'D. PER HOTEL ARRG'MT. OR AIR CONDITIONER REQ'MT. | | | | | | | | |
| 2 POLE BREAKER | 30 AMP | | 1 | | 1 | | 1 | SQ "D" ELECT CO. | Q0230 | |
| CONDUIT | ¾ | | 80 | | 80 | | 80 | STEEL CITY ELECT. | | |
| CONDUCTOR TYPE TW | #10 AWG | | 160 | | 160 | | 160 | | | THESE ITEMS REQ'D. FOR |
| OUTLET BOX | | 6 | 1 | 6 | 1 | 6 | 1 | STEEL CITY ELECT | 54141 | AIR COND. ONLY |
| FLEX CONDUIT | ½ | | 2 | | 2 | | 2 | | | |
| CONDUCTOR TYPE TW | #14 AWG | | 20 | | 20 | | 20 | | | |
| MISC. FITTINGS AS REQ'D. | LOT | | 1 | | 1 | | 1 | | | |
| CONTROL BOX | | | 1 | | 1 | | 1 | | | FURNISHED W/ AC |

## MISC. ELECT. SERVICE EQUIP. REQ'D. FOR A SPECIFIC POWER PACKAGE

| ITEM | ELECT EQUIP REQ'D. FOR POWER PKG | DESCRIPTION | CIRCUIT EQUIP. SEE NOTE #9 | SIZE OR RATING | Nº OR FT. REQ'D | MANUFACTURER | CATALOG Nº | REMARKS |
|---|---|---|---|---|---|---|---|---|
| 7 | P-1 OR P-2 | DT SINGLE BLADE FUSED SAFETY SW. | SERVICE SWITCH | 30 AMP | 1 | MEYERS SAFETY SW. CO. INC | 322 SCF | |
| | | SER. ENTRANCE COND SEE NOTE #7 | SER. ENT. RACEWAY & COND. | —— | —— | —— | —— | |
| | | CONDUIT | SUPPLY COND RACEWAY | ½" | 3 | STEEL CITY ELECT. | | |
| | | CONDUCTOR TYPE TW | SUPPLY COND 2-REQ'D. | Nº 12 AWG | 8 | GRAYBAR ELECT. CO. | | |
| 8 | P-3 | DT SINGLE BLADE FUSED SAFETY SW | SERVICE SWITCH | 60 AMP | 1 | MEYERS SAFETY SW. CO. INC. | 622 SCF | |
| | | SER. ENTRANCE COND SEE NOTE #7 | SER. ENT RACEWAY & COND. | —— | —— | —— | —— | |
| | | CONDUIT | SUPPLY COND RACEWAY | ¾ | 3 | STEEL CITY ELECT. | | |
| | | CONDUCTOR TYPE TW | SUPPLY COND 2-REQ'D. | Nº 10 AWG | 8 | GRAYBAR ELECT. CO. | | |

## LEGEND

- DUPLEX RECEPTACLE - 15 AMP
- OUTLET BOX - LIGHTS
- RLM FIXTURE WITH OUTLE
- RLM FIXTURE - 25 WATTS WIT
- OUTLET BOX - RECEPTACLE
- AIR CONDITIONER OUTLET
- SINGLE POLE TOGGLE SWITC
- M VENT MOTOR
- [C] CONTROL BOX - FOR AIR

## GENE
APPLICABLE T

1. ALL WIRING TO BE INSTALLED
2. ALL WIRING SHOWN IS TWO CO
UNLESS OTHERWISE INDICATE
3. THIS WIRING TO CONSIST OF
CONDUCTORS Nº 10 TW INST
ANYONE OF THE FOLLOWIN
V-1C, V-2C, V-1D, V-2D I
4. ALL DUPLEX RECEPTACLES
ABOVE THE FLOOR.
5. THE TOILET LIGHTS ARE TO B
THE TWO STALLS.
6. WHEN AREA IS USED FOR S
SPECIFIED WITH ONE RATED
7. THE MINIMUM SIZE OF SER
TWO CONDUCTORS ARE REQ
WHEN POWER PACKAGE P-4
ENTRANCE CONDUCTORS
DESIGNED TO SUIT THE
8. ALL WORK TO BE PERFORMED
SECTIONS OF THE NATIONAL
EDITION)
9. REFER TO ELECTRICAL ARRAN
DESCRIPTION OF ELECTRIC

2

| REVISION | DATE |
|---|---|

## MATERIAL LIST

| CRIPTION | SIZE | A ITEM | A Nº OR FT. REQ'D | B ITEM | B Nº OR FT. REQ'D | C ITEM | C Nº OR FT. REQ'D | MANUFACTURER | CATALOG NUMBER | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| DUCTOR PE TW | #14 AWG | | 440 | | 440 | | 500 | | | |
| TLET OXES | | | 4 | | 5 | | 6 | STEEL CITY ELECT CO. PITTSBURG, PEN | 58561 | |
| LEX RECEPT D 15 AMP | | | 3 | | 4 | | 5 | BRYANT ELECT CO. BRIDGEPORT CONN. | 808 | |
| LEX RECEPT. COVER | | | 3 | | 4 | | 5 | STEEL CITY ELECT CO. PITTSBURG, PENN | 58C7 | |
| DANT TYPE FIXT. 200W | | | 0 | | 0 | | 6 | SPERO ELECT CORP. CLEVELAND, OHIO | D-516 | ALL W/ 200 WATT BULBS |
| DANT TYPE FIXT. 150W | | | 0 | | 3 | | 0 | SPERO ELECT CORP | D-514 | ALL W/ 150 WATT BULBS |
| DANT TYPE FIXT. 60W | | — | 6* | 2 | 3 | 3 | 3 | SPERO ELECT CORP | D-512 | * 5 W/60 WATT BULBS, ALL OTHERS 25 WATT |
| AP BALL GUER | | | 6 | | 6 | | 9 | SPERO ELECT CORP | Nº 15 | |
| WITCH SP | 15 AMP | | 1 | | 1 | | 1 | BRYANT ELECT CO. | Nº 51 | |
| LET BOX 4" | | | 6 | | 6 | | 10 | STEEL CITY ELECT | 54151 | |
| LET BOX COVER | | | 0 | | 0 | | 1 | STEEL CITY ELECT. | 54-C-1 | |
| WITCH SP COVER | | | 1 | | 1 | | 1 | STEEL CITY ELECT. | 58C30 | |
| NGLE POLE RCUIT BKRS. | 15 AMP | | 3 | | 4 | | 4 | SQ. "D" ELECT CO. | Q0115 | |
| C. FITTINGS REQ'D. | LOT | | 1 | | 1 | | 1 | STEEL CITY ELECT. | | |
| T. BKR PANEL V, 2 WIRE, , 70 AMP BUS | 2 WIRE 70 AMP BUS | 4 | 1 | 4 | 1 | 4 | 1 | SQ. "D" ELECT. CO. | Q045 | POWER PANEL FOR SHELTER WITHOUT A/C |
| T. BKR. PANEL /240 V, 2 WIRE, , 100 AMP BUS | 3 WIRE 100 AMP BUS | 5 | 1 | 5 | 1 | 5 | 1 | SQ "D" ELECT. CO. | Q065 | POWER PANEL FOR SHELTER WITH A/C |
| ONDUIT | 1/2 | 11 | 220 | 11 | 220 | 12 | 250 | STEEL CITY ELECT | | AMT REQ'D. IF A/C NOT USED |
| ONDUIT | 1/2 | 13 | 140 | 13 | 140 | 14 | 170 | STEEL CITY ELECT | | AMT REQ'D. IF A/C IS USED |
| | | ITEM Nº & QUANTITY REQ'D. PER HOTEL ARRG'MT. OR AIR CONDITIONER REQ'MT. | | | | | | | | |
| 2 POLE BREAKER | 30 AMP | | 1 | | 1 | | 1 | SQ "D" ELECT CO. | Q0230 | |
| CONDUIT | 3/4 | | 80 | | 80 | | 80 | STEEL CITY ELECT. | | |
| CONDUCTOR TYPE TW | #10 AWG | | 160 | | 160 | | 160 | | | THESE ITEMS REQ'D. FOR |
| OUTLET BOX | | 9 | 1 | 9 | 1 | 9 | 1 | STEEL CITY ELECT. | 54141 | AIR COND. ONLY |
| FLEX CONDUIT | 1/2 | | 2 | | 2 | | 2 | | | |
| CONDUCTOR TYPE TW | #14 AWG | | 20 | | 20 | | 20 | | | |
| MISC. FITTINGS AS REQ'D. | LOT | | 1 | | 1 | | 1 | | | |
| CONTROL BOX | | | 1 | | 1 | | 1 | | | FURNISHED W/ AC |

## MISC. ELECT. SERVICE EQUIP. REQ'D. FOR A SPECIFIC POWER PACKAGE

| TEM | ELECT EQUIP REQ'D. FOR POWER PKG | DESCRIPTION | CIRCUIT EQUIP. SEE NOTE #9 | SIZE OR RATING | Nº OR FT. REQ'D | MANUFACTURER | CATALOG Nº | REMARKS |
|---|---|---|---|---|---|---|---|---|
| 7 | P-1 OR P-2 | DT SINGLE BLADE FUSED SAFETY SW. | SERVICE SWITCH | 30 AMP | 1 | MEYERS SAFETY SW. CO. INC | 322 SCF | |
| | | SER. ENTRANCE COND SEE NOTE #7 | SER. ENT. RACEWAY & COND. | ——— | ——— | ——— | ——— | |
| | | CONDUIT | SUPPLY COND RACEWAY | 1/2" | 3 | STEEL CITY ELECT. | | |
| | | CONDUCTOR TYPE TW | SUPPLY COND 2-REQ'D. | Nº 12 AWG | 8 | GRAYBAR ELECT. CO. | | |
| 8 | P-3 | DT SINGLE BLADE FUSED SAFETY SW | SERVICE SWITCH | 60 AMP | 1 | MEYERS SAFETY SW. CO. INC. | 622 SCF | |
| | | SER. ENTRANCE COND SEE NOTE #7 | SER. ENT. RACEWAY & COND. | ——— | ——— | ——— | ——— | |
| | | CONDUIT | SUPPLY COND RACEWAY | 3/4 | 3 | STEEL CITY ELECT. | | |
| | | CONDUCTOR TYPE TW | SUPPLY COND 2-REQ'D. | Nº 10 AWG | 8 | GRAYBAR ELECT. CO. | | |

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## LIST OF MATERIAL

QUANTITIES SHOWN ARE FOR

| PC. NO. | NAME | NO. REQ. | MAT'L. | MAT'L. SPECS. | STOCK SIZE | REMARKS |
|---|---|---|---|---|---|---|
| | | | | | | |

## LEGEND

- DUPLEX RECEPTACLE - 15 AMP
- OUTLET BOX - LIGHTS
- RLM FIXTURE WITH OUTLET BOX
- RLM FIXTURE - 25 WATTS WITH OUTLET BOX
- OUTLET BOX - RECEPTACLE
- AIR CONDITIONER OUTLET (IF USED)
- SINGLE POLE TOGGLE SWITCH
- (M) VENT MOTOR
- [C] CONTROL BOX - FOR AIR CONDITIONER

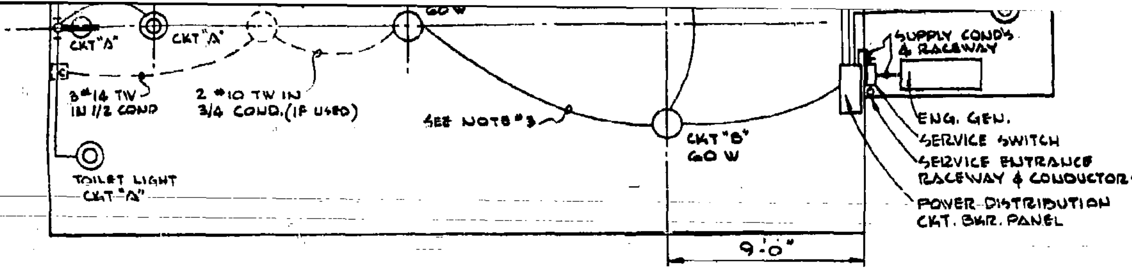
## GENERAL NOTES

APPLICABLE TO ALL ARRANGEMENTS

1. ALL WIRING TO BE INSTALLED IN RIGID METALLIC CONDUIT.
2. ALL WIRING SHOWN IS TWO COND. Nº 14 TW IN 1/2" CONDUIT UNLESS OTHERWISE INDICATED.
3. THIS WIRING TO CONSIST OF TWO CONDUCTORS Nº 14 TW & TWO CONDUCTORS Nº 10 TW INSTALLED IN 3/4" CONDUIT IF ANYONE OF THE FOLLOWING VENT PACKAGES ARE SPECIFIED V-1C, V-2C, V-1D, V-2D IN REF. 1.
4. ALL DUPLEX RECEPTACLES SHALL BE LOCATED FOUR FEET ABOVE THE FLOOR.
5. THE TOILET LIGHTS ARE TO BE LOCATED MIDWAY BETWEEN THE TWO STALLS.
6. WHEN AREA IS USED FOR SLEEPING, REPLACE THE LAMP SPECIFIED WITH ONE RATED AT 10 WATTS.
7. THE MINIMUM SIZE OF SERVICE CONDUCTOR IS Nº 8 AWG. TWO CONDUCTORS ARE REQUIRED (EXCEPT 3 COND. REQUIREMENT WHEN POWER PACKAGE P-4 & P-5 IS USED) THE SERVICE ENTRANCE CONDUCTORS & RACEWAY SHOULD BE DESIGNED TO SUIT THE SPECIFIC SITE.
8. ALL WORK TO BE PERFORMED IN ACCORDANCE WITH APPLICABLE SECTIONS OF THE NATIONAL ELECTRIC CODE (LATEST EDITION)
9. REFER TO ELECTRICAL ARRANGEMENT, THIS DWG., FOR DESCRIPTION OF ELECTRICAL EQUIPMENT.

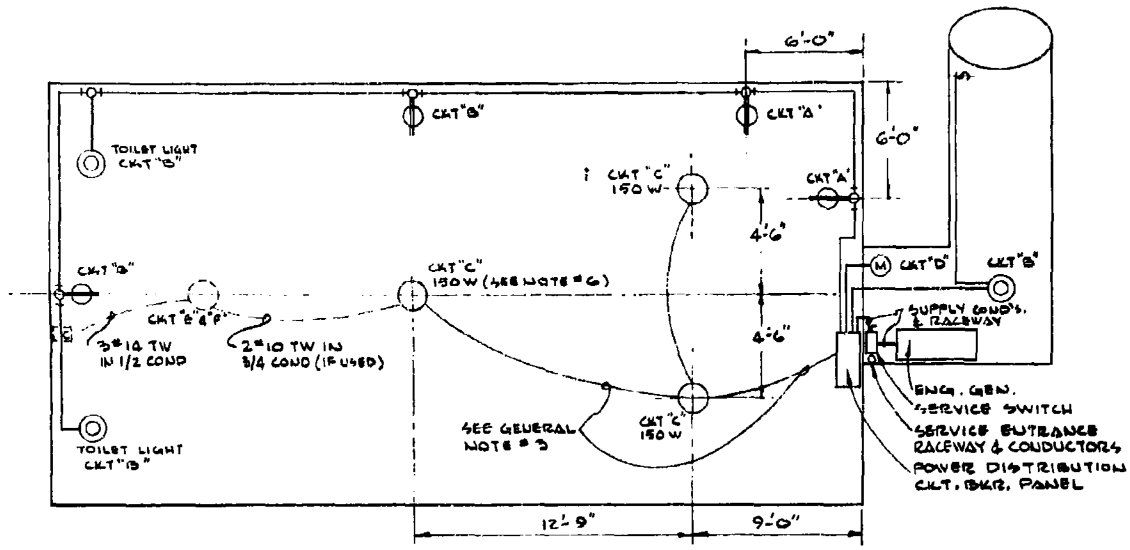
3

| REVISION | DATE | DESCRIPTION | BY | APP. |
|---|---|---|---|---|
| | | | | |




| | | | | |
|---|---|---|---|---|
| E | 2 | 30 | AIR CONDITIONER | IF PO… US… 12… PA… |
| F | | | | |

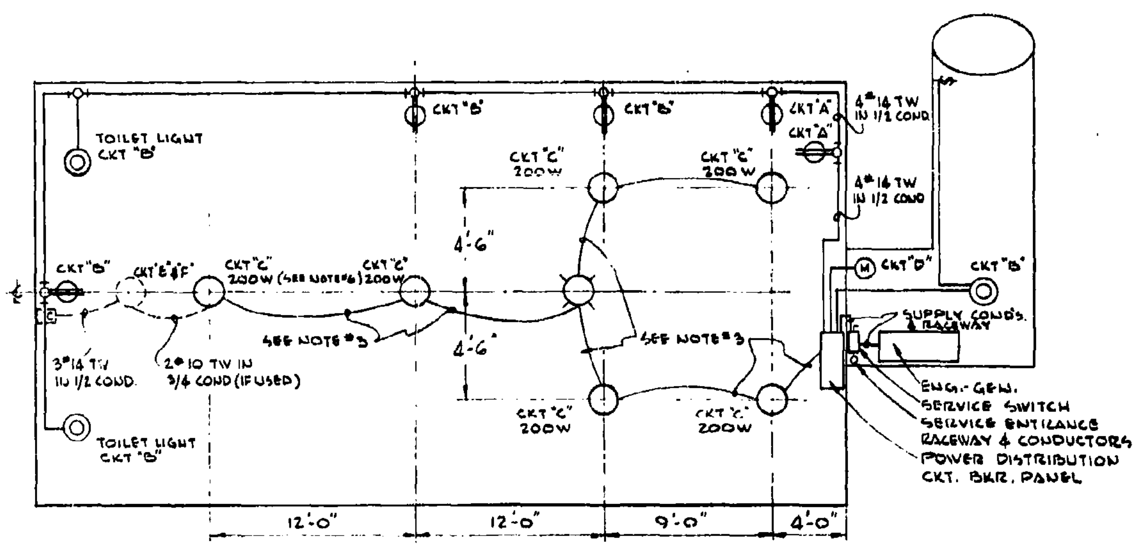
## ARRANGEMENT "A" ELECT. PACKAGE




ARRANGEMENT "B" ELECT…
CKT BREAKER PAN…
120V, 2WIRE, 1φ-70AMP BUS, UNLESS OTHERWISE …

| CKT No | CIRCUIT BREAKER No POLES | CIRCUIT BREAKER RATING | PURPOSE | |
|---|---|---|---|---|
| A | 1 | 15 | HOT PLATE SUPPLY TOILET & ENTRANCE-WAY LIGHT PLUS RECEPT. | |
| B | 1 | 15 | | |
| C | 1 | 15 | LIGHTS | |
| D | 1 | 15 | VENT MOTOR | |
| E | 2 | 30 | AIR CONDITIONER | IF PO… U… 12… PA… |
| F | | | | |

## ARRANGEMENT "B" ELECT. PACKAGE




ARRANGEMENT "C" ELECT. …
CKT BREAKER PA…
120, 2WIRE, 1φ-70AMP BUS, UNLESS OTHERWISE…

| CKT No | CIRCUIT BREAKER No POLES | CIRCUIT BREAKER RATING | PURPOSE | |
|---|---|---|---|---|
| A | 1 | 15 | HOT PLATE SUPPLY TOILET ENTRANCE-WAY LIGHTS PLUS OUTLET RECEPTACLES | |
| B | 1 | 15 | | |
| C | 1 | 15 | LIGHTS | |
| D | 1 | 15 | VENT MOTOR | |
| E | 2 | 30 | AIR CONDITIONER | IF… P… U… 12… P… |
| F | | | | |

## ARRANGEMENT "C" ELECT. PACKAGE

4

ENGINEERING & DESIGN IS APPROVED BY: [illegible]

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| DUPLEX RECEPT. BOX COVER | | | 3 | | 4 | | 5 | STEEL CITY ELECT CO. PITTSBURG, PENN | 58C7 | |
| PENDANT TYPE RLM FIXT. 200W | | | 0 | | 0 | | 6 | SPERO ELECT CORP. CLEVELAND, OHIO | D-516 | ALL W/ 200 WATT BULBS |
| PENDANT TYPE RLM FIXT. 150 W | | | 0 | | 3 | | 0 | SPERO ELECT CORP | D-514 | ALL W/ 150 WATT BULBS |
| PENDANT TYPE RLM FIXT. 60 W | | — | 6* | 2 | 5 | 3 | 3 | SPERO ELECT CORP | D-512 | *5 W/60 WATT BULBS, ALL OTHERS 25 WATT |
| LAMP BALL ALIGNER | | | 6 | | 6 | | 9 | SPERO ELECT CORP | Nº 15 | |
| SWITCH S.P. | 15 AMP | | 1 | | 1 | | 1 | BRYANT ELECT CO. | Nº 41 | |
| OUTLET BOX 4" | | | 6 | | 6 | | 10 | STEEL CITY ELECT | 54151 | |
| OUTLET BOX COVER | | | 0 | | 0 | | 1 | STEEL CITY ELECT. | 54-C-1 | |
| SWITCH SP COVER | | | 1 | | 1 | | 1 | STEEL CITY ELECT | 58C30 | |
| SINGLE POLE CIRCUIT BKRS. | 15 AMP | | 3 | | 4 | | 4 | SQ. "D" ELECT CO. | Q0115 | |
| MISC. FITTINGS AS REQ'D. | LOT | | 1 | | 1 | | 1 | STEEL CITY ELECT. | | |
| 4 CKT. BKR. PANEL 120 V, 2 WIRE, 1φ, 70 AMP BUS | 2 WIRE 70 AMP BUS | 4 | 1 | 4 | 1 | 4 | 1 | SQ. "D" ELECT. CO. | Q04S | POWER PANEL FOR SHELTER WITHOUT A/C |
| 6 CKT. BKR. PANEL 120/240 V, 3 WIRE, 1φ, 100 AMP BUS | 3 WIRE 100 AMP BUS | 5 | 1 | 5 | 1 | 5 | 1 | SQ "D" ELECT. CO. | Q06S | POWER PANEL FOR SHELTER WITH A/C |
| CONDUIT | 1/2 | 11 | 220 | 11 | 220 | 12 | 250 | STEEL CITY ELECT | | AMT REQ'D. IF A/C NOT USED |
| CONDUIT | 1/2 | 13 | 140 | 13 | 140 | 14 | 170 | STEEL CITY ELECT | | AMT REQ'D. IF A/C IS USED |
| | | ITEM Nº & QUANTITY REQ'D. PER HOTEL ARRG'MT. OR AIR CONDITIONER REQ'MT. | | | | | | | | |
| 2 POLE BREAKER | 30 AMP | | 1 | | 1 | | 1 | SQ "D" ELECT CO. | Q0230 | |
| CONDUIT | 3/4 | | 80 | | 80 | | 80 | STEEL CITY ELECT. | | |
| CONDUCTOR TYPE TW | #10 AWG | | 160 | | 160 | | 160 | | | THESE ITEMS REQ'D. FOR |
| OUTLET BOX | | 9 | 1 | 9 | 1 | 9 | 1 | STEEL CITY ELECT. | 54141 | AIR COND. ONLY |
| FLEX CONDUIT | 1/2 | | 2 | | 2 | | 2 | | | |
| CONDUCTOR TYPE TW | #14 AWG | | 20 | | 20 | | 20 | | | |
| MISC. FITTINGS AS REQ'D. | LOT | | 1 | | 1 | | 1 | | | |
| CONTROL BOX | | | 1 | | 1 | | 1 | | | FURNISHED W/ AC |

## MISC. ELECT. SERVICE EQUIP. REQ'D. FOR A SPECIFIC POWER PACKAGE

| ITEM | ELECT. EQUIP. REQ'D. FOR POWER PKG. | DESCRIPTION | CIRCUIT EQUIP. SEE NOTE #9 | SIZE OR RATING | Nº OR FT. REQ'D | MANUFACTURER | CATALOG Nº | REMARKS |
|---|---|---|---|---|---|---|---|---|
| 7 | P-1 OR P-2 | DT SINGLE BLADE FUSED SAFETY SW. | SERVICE SWITCH | 30 AMP | 1 | MEYERS SAFETY SW. CO. INC | 322 SCF | |
| | | SER. ENTRANCE COND. SEE NOTE #7 | SER. ENT. RACEWAY & COND. | — | — | — | — | |
| | | CONDUIT | SUPPLY COND RACEWAY | 1/2" | 3 | STEEL CITY ELECT. | | |
| | | CONDUCTOR TYPE TW | SUPPLY COND 2-REQ'D. | Nº 12 AWG | 8 | GRAYBAR ELECT. CO. | | |
| 8 | P-3 | DT SINGLE BLADE FUSED SAFETY SW | SERVICE SWITCH | 60 AMP | 1 | MEYERS SAFETY SW. CO. INC. | 622 SCF | |
| | | SER. ENTRANCE COND. SEE NOTE #7 | SER. ENT. RACEWAY & COND. | — | — | — | — | |
| | | CONDUIT | SUPPLY COND RACEWAY | 3/4 | 3 | STEEL CITY ELECT. | | |
| | | CONDUCTOR TYPE TW | SUPPLY COND 2-REQ'D. | Nº 10 AWG | 8 | GRAYBAR ELECT. CO. | | |
| 9 | P-4 | DT TWO BLADE FUSED SAFETY SW | SERVICE SWITCH | 60 AMP | 1 | MEYERS SAFETY SW. CO. INC. | 632 SCF | |
| | | SERVICE ENT. COND. SEE NOTE #7 | SER. ENT. RACEWAY & COND. | — | — | — | — | |
| | | CONDUIT | SUPPLY COND RACEWAY | 3/4 | 3 | STEEL CITY ELECT. | | |
| | | CONDUCTOR TYPE TW | SUPPLY COND 3-REQ'D. | Nº 12 AWG | 12 | GRAYBAR ELECT. CO. | | |
| 10 | P-5 | DT TWO BLADE FUSED SAFETY SW | SERVICE SWITCH | 60 AMP | 1 | MEYERS SAFETY SW. CO. INC. | 632 SCF | |
| | | SERVICE ENT. COND. SEE NOTE #7 | SER. ENT. RACEWAY & COND. | — | — | — | — | |
| | | CONDUIT | SUPPLY COND RACEWAY | 3/4 | 3 | STEEL CITY ELECT. | | |
| | | CONDUCTOR TYPE TW | SUPPLY COND 3-REQ'D. | Nº 10 AWG | 12 | GRAYBAR ELECT. CO. | | |

MOTOR

DITIONER — IF AIR COND. IS SPECIFIED POWER PKG. P-4 WILL BE USED, THIS WILL REQUIRE 120/240 V, 3W, 1φ PANEL HAVING 100 AMP BUS

B" ELECT. PACKAGE
KER PANEL
S OTHERWISE NOTED IN REMARK COLUMN

| RPOSE | REMARKS |
|---|---|
| ATE SUPPLY ENTRANCE GHT PLUS PT. | |
| TS | |
| MOTOR | |
| DITIONER | IF AIR COND. IS SPECIFIED POWER PKG. P-4 WILL BE USED. THIS WILL REQUIRE 120/240 V, 3W, 1φ PANEL HAVING 100 AMP BUS |

" ELECT. PACKAGE
AKER PANEL
SS OTHERWISE NOTED IN REMARK COLUMN

| RPOSE | REMARKS |
|---|---|
| RATE SUPPLY Y ENTRANCE LIGHTS PLUS R RECEPTACLES | |
| GHTS | |
| T MOTOR | |
| ONDITIONER | IF AIR COND. IS SPECIFIED POWER PKG. P-4 WILL BE USED. THIS WILL REQUIRE 120/240 V, 3W, 1φ PANEL HAVING 100 AMP BUS |

. S. Potague DATE: 22 May 62

○ RLM FIXTURE WITH OUTLET BOX
◎ RLM FIXTURE - 25 WATTS WITH OUTLET
OUTLET BOX - RECEPTACLE
AIR CONDITIONER OUTLET (IF USED)
SINGLE POLE TOGGLE SWITCH
(M) VENT MOTOR
[C] CONTROL BOX - FOR AIR CONDITIO

## GENERAL NO
APPLICABLE TO ALL ARR

1. ALL WIRING TO BE INSTALLED IN RIGID
2. ALL WIRING SHOWN IS TWO COND. Nº 14 UNLESS OTHERWISE INDICATED.
3. THIS WIRING TO CONSIST OF TWO COND CONDUCTORS Nº 10 TW INSTALLED IN ANYONE OF THE FOLLOWING VENT F V-1C, V-2C, V-1D, V-2D IN REF.
4. ALL DUPLEX RECEPTACLES SHALL BE ABOVE THE FLOOR.
5. THE TOILET LIGHTS ARE TO BE LOCATE THE TWO STALLS.
6. WHEN AREA IS USED FOR SLEEPING, R SPECIFIED WITH ONE RATED AT 10 W
7. THE MINIMUM SIZE OF SERVICE CO TWO CONDUCTORS ARE REQUIRED (EX WHEN POWER PACKAGE P-4 & P-5 IS U ENTRANCE CONDUCTORS & RACEW DESIGNED TO SUIT THE SPECIFIC
8. ALL WORK TO BE PERFORMED IN ACCOR SECTIONS OF THE NATIONAL ELECTRI EDITION)
9. REFER TO ELECTRICAL ARRANGEMENT, T DESCRIPTION OF ELECTRICAL EQUIP

| REVISION | DATE | DESCRIPTI |
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UNITED ST
NAVAL RADIOLOGICAL DI
SAN FRANCISCO 24,

| | | |
|---|---|---|
| DRAWN | FJA | FI |
| CHECKED | | ELECTRI |
| PROJ. ENGR. | DEVELOPMENTAL DWG | |
| SUPV. | | |
| BRANCH HEAD | | DATE |
| DIVISION HEAD | | |
| SCOPE APPROVED: | DATE: 5/23/62 | DWG. NO. S-( |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| ...RECEPT. COVER | | | 3 | | 4 | | 5 | STEEL CITY ELEC., CO. PITTSBURG, PENN. | 58C7 | |
| ...ANT TYPE FIXT. 200W | | | O | | O | | 6 | SPERO ELECT CORP. CLEVELAND, OHIO | D-516 | ALL W/ 200 WATT BULBS |
| ...ANT TYPE FIXT. 150 W | | | O | | 3 | | O | SPERO ELECT CORP | D-514 | ALL W/ 150 WATT BULBS |
| ...ANT TYPE FIXT. 60W | | — | 6* | 2 | 3 | 3 | 3 | SPERO ELECT CORP | D-512 | * 5 W/ 60 WATT BULBS, ALL OTHERS 25 WATT |
| ...P BALL ...NER | | | 6 | | 6 | | 9 | SPERO ELECT CORP | Nº 15 | |
| ...TCH ...P. | 15 AMP | | 1 | | 1 | | 1 | BRYANT ELECT CO. | Nº 51 | |
| ...ET BOX | | | 6 | | 6 | | 10 | STEEL CITY ELECT. | 54151 | |
| ...ET BOX ...VER | | | O | | O | | 1 | STEEL CITY ELECT. | 54-C-1 | |
| ...CH SP ...VER | | | 1 | | 1 | | 1 | STEEL CITY ELECT. | 58C30 | |
| ...LE POLE ...UIT BKER | 15 AMP | | 3 | | 4 | | 4 | SQ. "D" ELECT CO. | Q0115 | |
| ...FITTINGS REQ'D. | LOT | | 1 | | 1 | | 1 | STEEL CITY ELECT. | | |
| ...KR. PANEL ...2 WIRE, ...AMP BUS | 2 WIRE 70 AMP BUS | 4 | 1 | 4 | 1 | 4 | 1 | SQ. "D" ELECT. CO. | Q045 | POWER PANEL FOR SHELTER WITHOUT A/C |
| ...KR. PANEL ...V, 2 WIRE, ...AMP BUS | 3 WIRE 100 AMP BUS | 5 | 1 | 5 | 1 | 5 | 1 | SQ "D" ELECT. CO. | Q065 | POWER PANEL FOR SHELTER WITH A/C |
| ...DUIT | ½ | 11 | 220 | 11 | 220 | 12 | 250 | STEEL CITY ELECT | | AMT REQ'D. IF A/C NOT USED |
| ...DUIT | ½ | 13 | 140 | 13 | 140 | 14 | 170 | STEEL CITY ELECT | | AMT REQ'D. IF A/C IS USED |
| | | ITEM Nº & QUANTITY REQ'D. PER HOTEL ARRGMT. OR AIR CONDITIONER REQ'MT. | | | | | | | | |
| ...POLE ...REAKER | 30 AMP | | 1 | | 1 | | 1 | SQ "D" ELECT CO. | Q0230 | |
| ...NDUIT | ¾ | | 80 | | 80 | | 80 | STEEL CITY ELECT. | | |
| ...NDUCTOR ...PE TW | #10 AWG | | 160 | | 160 | | 160 | | | THESE ITEMS REQ'D. FOR |
| ...TLET ...OX | | 9 | 1 | 9 | 1 | 9 | 1 | STEEL CITY ELECT. | 54141 | AIR COND. ONLY |
| ...EX ...NDUIT | ½ | | 2 | | 2 | | 2 | | | |
| ...NDUCTOR ...YPE TW | #14 AWG | | 20 | | 20 | | 20 | | | |
| ...C. FITTINGS REQ'D. | LOT | | 1 | | 1 | | 1 | | | |
| ...NTROL ...OX | | | 1 | | 1 | | 1 | | | FURNISHED W/ AC |

## MISC. ELECT. SERVICE EQUIP. REQ'D. FOR A SPECIFIC POWER PACKAGE

| ELECT. EQUIP. REQ'D. FOR POWER PKG. | DESCRIPTION | CIRCUIT EQUIP. SEE NOTE #9 | SIZE OR RATING | Nº OR FT. REQ'D | MANUFACTURER | CATALOG Nº | REMARKS |
|---|---|---|---|---|---|---|---|
| P-1 OR P-2 | DT SINGLE BLADE FUSED SAFETY SW. | SERVICE SWITCH | 30 AMP | 1 | MEYERS SAFETY SW. CO. INC | 322 SCF | |
| | SER. ENTRANCE COND. SEE NOTE #7 | SER. ENT. RACEWAY & COND. | — | — | — | — | |
| | CONDUIT | SUPPLY COND RACEWAY | ½" | 3 | STEEL CITY ELECT. | | |
| | CONDUCTOR TYPE TW | SUPPLY COND 2-REQ'D. | Nº 12 AWG | 8 | GRAYBAR ELECT. CO. | | |
| P-3 | DT SINGLE BLADE FUSED SAFETY SW | SERVICE SWITCH | 60 AMP | 1 | MEYERS SAFETY SW. CO. INC. | 622 SCF | |
| | SER. ENTRANCE COND. SEE NOTE #7 | SER. ENT. RACEWAY & COND. | — | — | — | — | |
| | CONDUIT | SUPPLY COND RACEWAY | ¾ | 3 | STEEL CITY ELECT. | | |
| | CONDUCTOR TYPE TW | SUPPLY COND 2-REQ'D. | Nº 10 AWG | 8 | GRAYBAR ELECT. CO. | | |
| P-4 | DT TWO BLADE FUSED SAFETY SW | SERVICE SWITCH | 60 AMP | 1 | MEYERS SAFETY SW. CO. INC. | 632 SCF | |
| | SERVICE ENT. COND. SEE NOTE #7 | SER. ENT. RACEWAY & COND. | — | — | — | — | |
| | CONDUIT | SUPPLY COND RACEWAY | ¾ | 3 | STEEL CITY ELECT. | | |
| | CONDUCTOR TYPE TW | SUPPLY COND 3-REQ'D. | Nº 12 AWG | 12 | GRAYBAR ELECT. CO. | | |
| P-5 | DT TWO BLADE FUSED SAFETY SW | SERVICE SWITCH | 60 AMP | 1 | MEYERS SAFETY SW. CO. INC. | 632 SCF | |
| | SERVICE ENT. COND. SEE NOTE #7 | SER. ENT. RACEWAY & COND. | — | — | — | — | |
| | CONDUIT | SUPPLY COND RACEWAY | ¾ | 3 | STEEL CITY ELECT. | | |
| | CONDUCTOR TYPE TW | SUPPLY COND 3-REQ'D. | Nº 10 AWG | 12 | GRAYBAR ELECT. CO. | | |

RLM FIXTURE WITH OUTLET BOX

RLM FIXTURE - 25 WATTS WITH OUTLET BOX

OUTLET BOX - RECEPTACLE

AIR CONDITIONER OUTLET (IF USED)

SINGLE POLE TOGGLE SWITCH

(M) VENT MOTOR

[C] CONTROL BOX - FOR AIR CONDITIONER

## GENERAL NOTES

APPLICABLE TO ALL ARRANGEMENTS

1. ALL WIRING TO BE INSTALLED IN RIGID METALLIC CONDUIT.
2. ALL WIRING SHOWN IS TWO COND. Nº 14 TW IN 1/2" CONDUIT UNLESS OTHERWISE INDICATED.
3. THIS WIRING TO CONSIST OF TWO CONDUCTORS Nº 14 TW & TWO CONDUCTORS Nº 10 TW INSTALLED IN 3/4" CONDUIT IF ANYONE OF THE FOLLOWING VENT PACKAGES ARE SPECIFIED: V-1C, V-2C, V-1D, V-2D IN REF. 1.
4. ALL DUPLEX RECEPTACLES SHALL BE LOCATED FOUR FEET ABOVE THE FLOOR.
5. THE TOILET LIGHTS ARE TO BE LOCATED MIDWAY BETWEEN THE TWO STALLS.
6. WHEN AREA IS USED FOR SLEEPING, REPLACE THE LAMP SPECIFIED WITH ONE RATED AT 10 WATTS.
7. THE MINIMUM SIZE OF SERVICE CONDUCTOR IS Nº 8 AWG. TWO CONDUCTORS ARE REQUIRED (EXCEPT 3 COND. REQUIREMENT WHEN POWER PACKAGE P-4 & P-5 IS USED) THE SERVICE ENTRANCE CONDUCTORS & RACEWAY SHOULD BE DESIGNED TO SUIT THE SPECIFIC SITE.
8. ALL WORK TO BE PERFORMED IN ACCORDANCE WITH APPLICABLE SECTIONS OF THE NATIONAL ELECTRIC CODE (LATEST EDITION)
9. REFER TO ELECTRICAL ARRANGEMENT, THIS DWG., FOR DESCRIPTION OF ELECTRICAL EQUIPMENT.

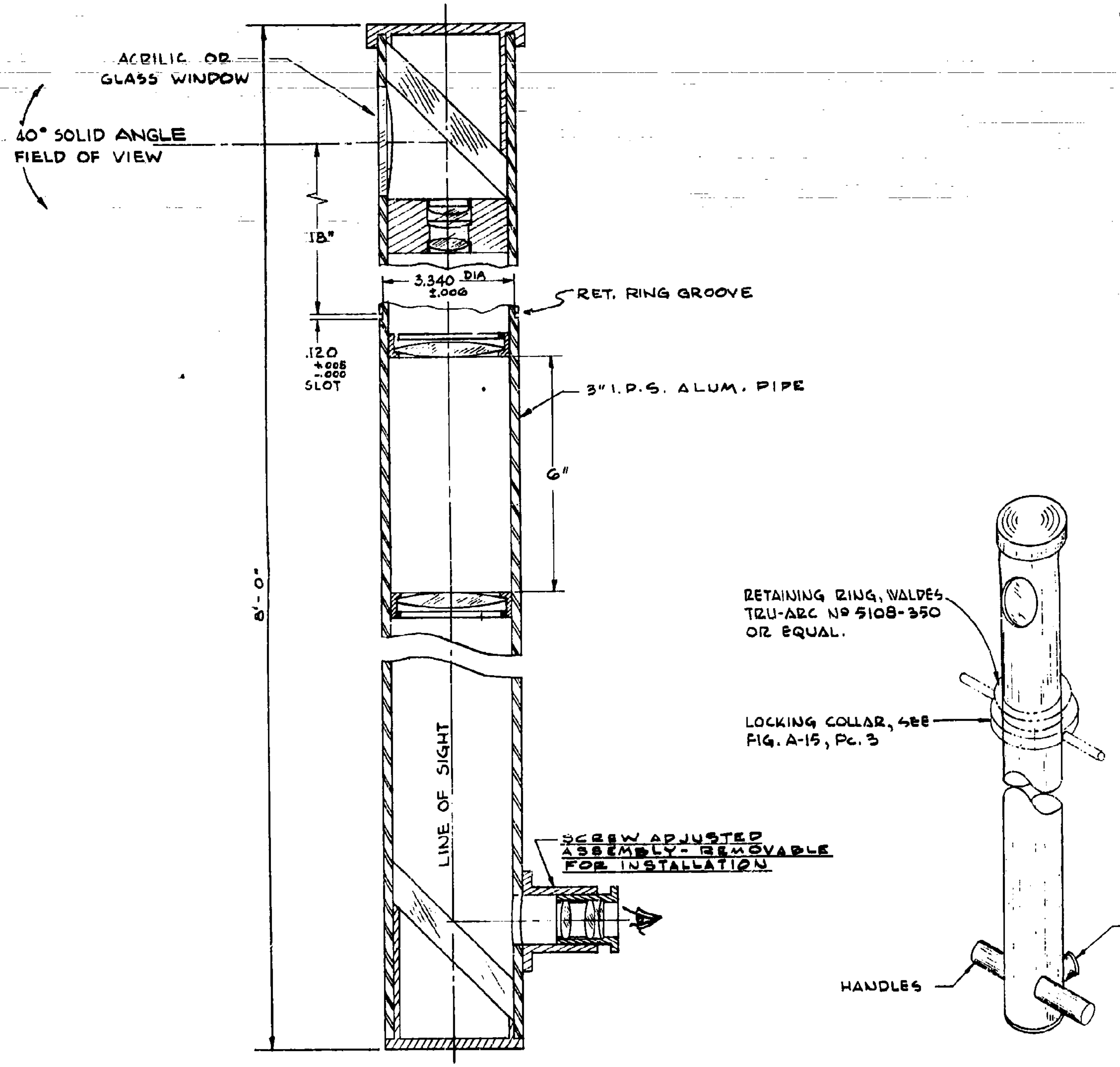
6

| REVISION | DATE | DESCRIPTION | BY | APP |
|---|---|---|---|---|

**UNITED STATES NAVAL RADIOLOGICAL DEFENSE LABORATORY**
**SAN FRANCISCO 24, CALIFORNIA**

| | | |
|---|---|---|
| DRAWN | FJA | FIG. A-12N ELECTRICAL ARRANGEMENT |
| CHECKED | | |
| PROJ. ENGR. | DEVELOPMENTAL DWG. | |
| SUPV. | | |
| BRANCH HEAD | | |
| DIVISION HEAD | | |
| SCOPE APPROVED: | DATE: 5/22/62 | DWG. NO. S-62-970 SHT. 14 OF 19 |

| DATE | SCALE | PROJECT | TECH MEMO |
|---|---|---|---|




MODEL "A"
PERISCOPE
SECTION VIEW
SCALE: 1/2 SIZE

NOTES:

1. SEE FIGS. A-14M & A-15M FOR MOUNTING DET... (FOR MODEL "A" ONLY)
2. PERISCOPE MOUNTING DETAILS FOR ~~MODEL "B" HAVE NOT BEEN DESIGNED.~~ SEE NOTE #3 OF FIG. A-15M.

1

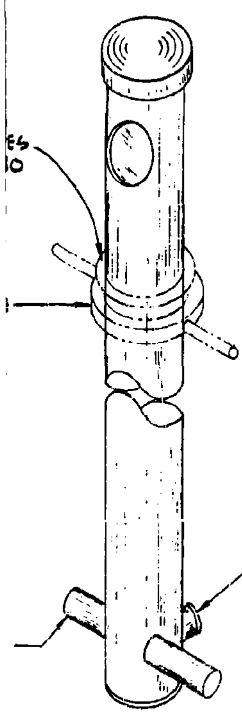
## PERISCOPE MODEL "A"

MFG. BY LENOX INSTR. CO.
PHILA. 3, PA.
MODEL № LICO (OR EQUAL)

LIST OF MATERIA

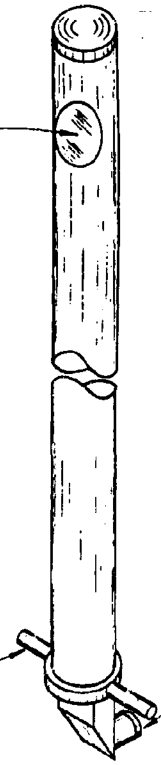
QUANTITIES SHOWN ARE FOR

| PC. No. | NAME | No. REQ. | MAT'L. | MAT'L SPECS |
|---|---|---|---|---|
| | | | | |




PE

1. TUBE MATERI
OD - 2¼"
2. LENGTH - 44 1
3. EQUIPPED WIT
4. OPTIC SYSTE
EYEPIECE.
5. ALL METAL TO
FLAT BLACK
CHROME PLA
6. GLASS MIRRO
HARD SURFA
7. GLASS LENSE
MAGNESIUM
8. 17° SOLID A
9. DRIP PROOF C
10. WEIGHT - 6½
11. ADJUSTABLE
TINSLEY DWG
12. THE LENS SY
SEALED & T
AT APPROX.




PERISCOPE MODEL "B"

MFG. BY TINSLEY LAB. INC. (OR EQUAL)
BERKELEY 10, CALIF.

2

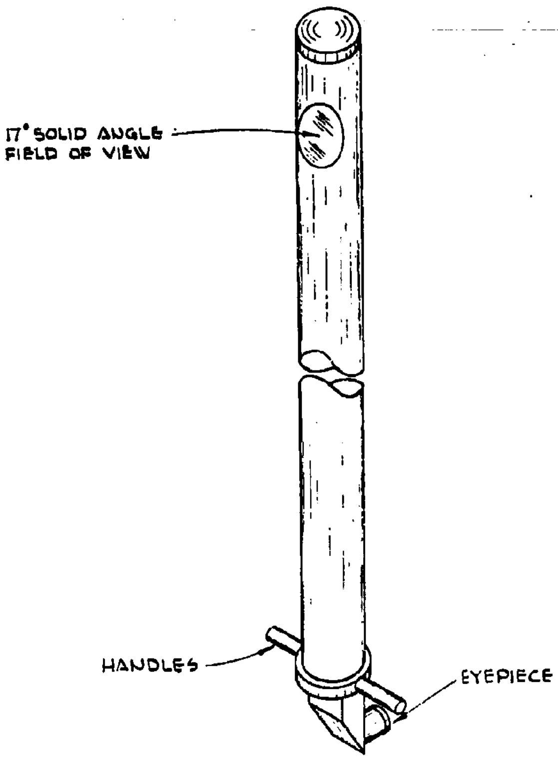
| REVISION | DATE | |
|---|---|---|
| | | |

UNIT
NAVAL RADIOLOGIC
SAN FRANCIS

| LIST OF MATERIAL | | | | | | |
|---|---|---|---|---|---|---|
| QUANTITIES SHOWN ARE FOR | | | | | | |
| PC. NO. | NAME | NO. REQ. | MAT'L. | MAT'L. SPECS. | STOCK SIZE | REMARKS |
| | | | | | | |

## MODEL "B" PERISCOPE SPECS.

1. TUBE MATERIAL ALUM. OD - $2\frac{1}{4}$"
2. LENGTH - AS PER SKETCH.
3. EQUIPPED WITH HANDLES.
4. OPTIC SYSTEM - THREE OPTICAL ELEMENTS & ONE EYEPIECE.
5. ALL METAL TO BE BLACK ANODIZED & PAINTED FLAT BLACK EXCEPT BRASS EYEPIECE WHICH IS CHROME PLATED.
6. GLASS MIRROR - FRONT SURFACED (ALUMINIZED) & HARD SURFACED.
7. GLASS LENSES - LOW REFLECTION COATING USING MAGNESIUM FLORIDE.
8. 17° SOLID ANGLE.
9. DRIP PROOF CONSTRUCTION
10. WEIGHT - $6\frac{1}{2}$ LBS. (APPROX.)
11. ADJUSTABLE EYEPIECE. TINSLEY DWG Nº D-0624
12. THE LENS SYSTEM IS TO BE HERMETICALLY SEALED & TO BE FILLED WITH DRY. NITROGEN AT APPROX. ATMOSPHERIC PRESSURE.




PERISCOPE MODEL "B"

MFG. BY TINSLEY LAB. INC. (OR EQUAL)
BERKELEY 10, CALIF.

3

| REVISION | DATE | DESCRIPTION | BY | APP. |
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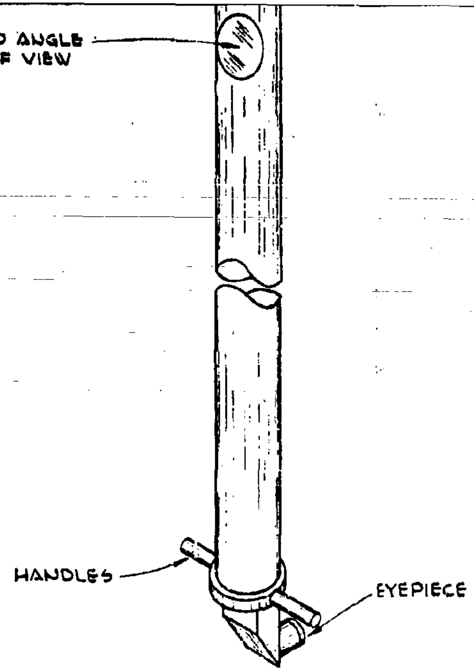
UNITED STATES
NAVAL RADIOLOGICAL DEFENSE LABORATORY
SAN FRANCISCO 24, CALIFORNIA




4. OPTIC SYSTEM - THREE OPTICAL ELEMENTS & ONE EYEPIECE.
5. ALL METAL TO BE BLACK ANODIZED & PAINTED FLAT BLACK EXCEPT BRASS EYEPIECE WHICH IS CHROME PLATED.
6. GLASS MIRROR - FRONT SURFACED (ALUMINIZED) & HARD SURFACED.
7. GLASS LENSES - LOW REFLECTION COATING USING MAGNESIUM FLORIDE.
8. 17° SOLID ANGLE.
9. DRIP PROOF CONSTRUCTION
10. WEIGHT - 6½ LBS. (APPROX.)
11. ADJUSTABLE EYEPIECE.
TINSLEY DWG Nº D-0624
12. THE LENS SYSTEM IS TO BE HERMETICALLY SEALED & TO BE FILLED WITH DRY NITROGEN AT APPROX. ATMOSPHERIC PRESSURE.

PERISCOPE MODEL "B"

MFG. BY TINSLEY LAB. INC. (OR EQUAL)
BERKELEY 10, CALIF.

4

| REVISION | DATE | DESCRIPTION | BY | APP. |
|---|---|---|---|---|

UNITED STATES
NAVAL RADIOLOGICAL DEFENSE LABORATORY
SAN FRANCISCO 24, CALIFORNIA

| | |
|---|---|
| DRAWN | FJA |
| CHECKED | FJA |
| SECTION HEAD | DEVELOPMENTAL DWG |
| BRANCH HEAD | |
| DIVISION HEAD | |

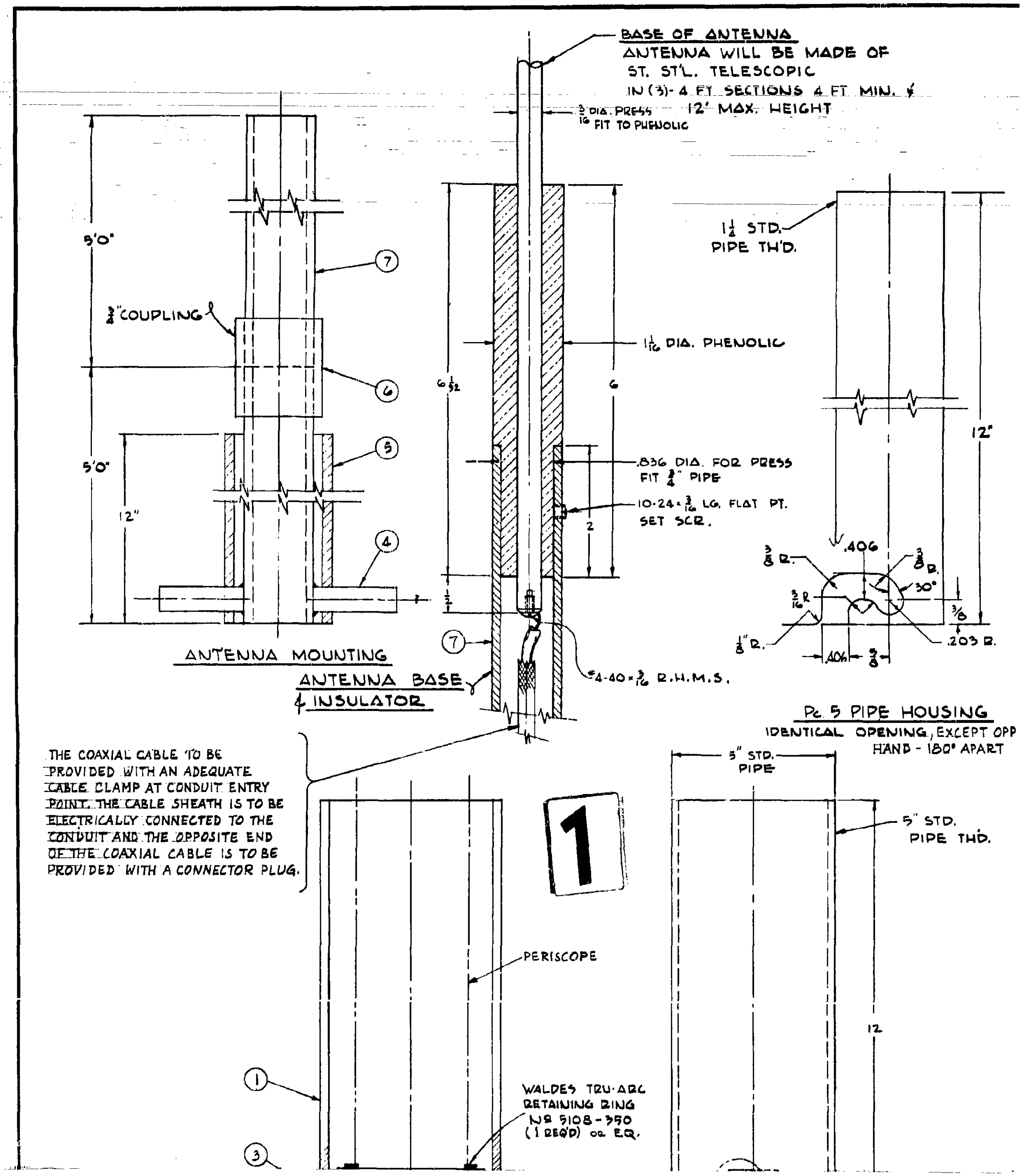
FIG. A-13M
SHELTER PERISCOPE
SCHEMATIC

| DATE | SCALE | PROJECT | FINISH | HEAT TREAT |
|---|---|---|---|---|
| 26 FEB 62 | NOTED | | | |

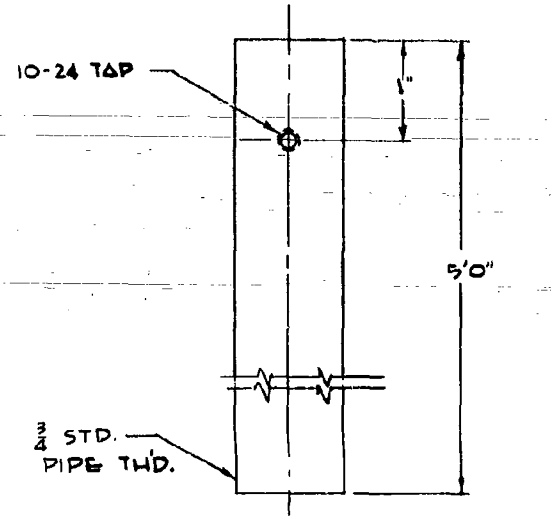
SATISFACTORY TO: LGP
DATE 5-22-62

DRAWING NUMBER S-62-970 SHEET 15 OF 19 ALT.

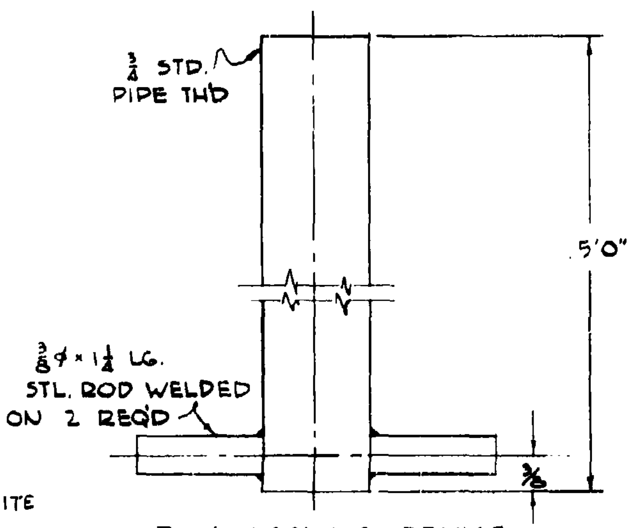
ENGINEERING & DESIGN IS APPROVED BY: Laura G. Portesus DATE: 22 May 62


BASE OF ANTENNA
ANTENNA WILL BE MADE OF
ST. ST'L. TELESCOPIC
IN (3)- 4 FT SECTIONS 4 FT MIN. & 12' MAX. HEIGHT
3/16 DIA. PRESS FIT TO PHENOLIC
5'0"
3/4" COUPLING
7
6
5
4
5'0"
12"
ANTENNA MOUNTING
6 5/32
6
1 1/16 DIA. PHENOLIC
.836 DIA. FOR PRESS FIT 3/4" PIPE
10-24 × 3/16 LG. FLAT PT. SET SCR.
2
1/2
7
#4-40 × 3/16 R.H.M.S.
ANTENNA BASE & INSULATOR
1 1/4 STD. PIPE TH'D.
12"
.406
3/8 R.
3/8 R.
30°
3/16 R
3/8
1/8" R.
.406
3/8
.203 R.
Pc. 5 PIPE HOUSING
IDENTICAL OPENING, EXCEPT OPP HAND - 180° APART
THE COAXIAL CABLE TO BE PROVIDED WITH AN ADEQUATE CABLE CLAMP AT CONDUIT ENTRY POINT. THE CABLE SHEATH IS TO BE ELECTRICALLY CONNECTED TO THE CONDUIT AND THE OPPOSITE END OF THE COAXIAL CABLE IS TO BE PROVIDED WITH A CONNECTOR PLUG.
5" STD. PIPE
5" STD. PIPE THD.
1
PERISCOPE
12
1
WALDES TRU-ARC RETAINING RING No 5108-350 (1 REQ'D) or EQ.
3

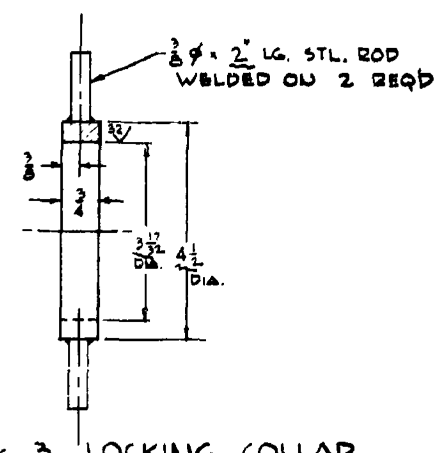
| LIST OF MATERIAL | | | | | |
| --- | --- | --- | --- | --- | --- |
| QUANTITIES SHOWN ARE FOR | | | | | |
| PC. NO. | NAME | NO. REQ. | MAT'L. | MAT'L. SPECS. | STOCK SIZE |




Pc. 7 EXTENSION PIPE

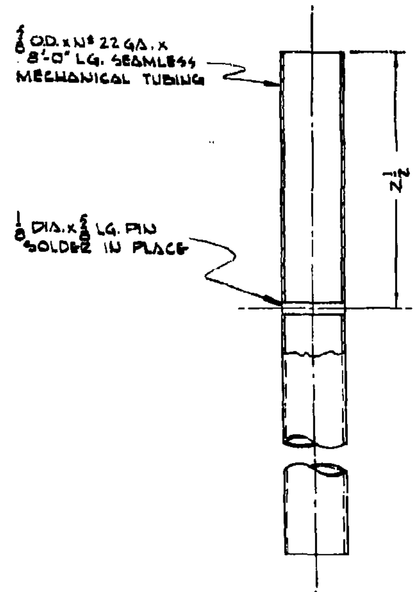



Pc. 4 LOCKING DEVICE




Pc. 3 LOCKING COLLAR

SCALE - HALF SIZE




DOSIMETER ROD

SCALE: FULL SIZE

2" B.

G

PT OPPOSITE

ART

HD.

NOTES:

1. ANTENNA & MOUNTING REQUIRED FOR PKG. ONLY.
2. ALL DETAILS RELATING TO PERISCOPE MODEL "A" DESIGN. IT WILL BE NECES ALL PERISCOPE MOUNTING DETAILS IS USED. SEE NOTE #3 OF FIG. A-15

2

| REVISION | DATE | DESCRIPTION |
| --- | --- | --- |

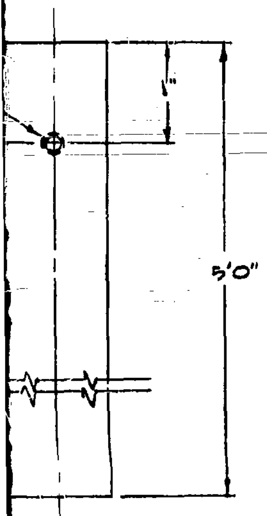
UNITED STATES

NAVAL RADIOLOGICAL DEFENSE LA

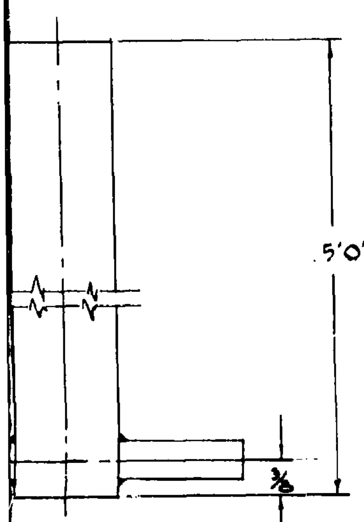
SAN FRANCISCO 24, CALIFORNI

DRAWN | E. J. A.

| LIST OF MATERIAL | | | | | | |
|---|---|---|---|---|---|---|
| QUANTITIES SHOWN ARE FOR | | | | | | |
| PC. NO. | NAME | NO. REQ. | MAT'L. | MAT'L. SPECS. | STOCK SIZE | REMARKS |
| | | | | | | |

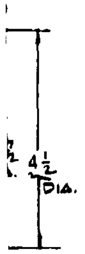



EXTENSION PIPE

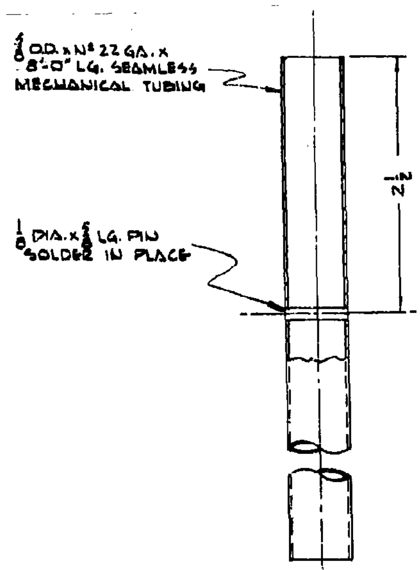



LOCKING DEVICE

$\frac{3}{8}\phi$ x 2" LG. STL. ROD WELDED ON 2 REQD




ING COLLAR
F SIZE




DOSIMETER ROD

SCALE: FULL SIZE

3

NOTES:

1. ANTENNA & MOUNTING REQUIRED FOR C-3 CONTROL PKG. ONLY.
2. ALL DETAILS RELATING TO PERISCOPE ARE BASED ON MODEL "A" DESIGN. IT WILL BE NECESSARY TO MODIFY ALL PERISCOPE MOUNTING DETAILS IF PERISCOPE "B" IS USED. SEE NOTE #3 OF FIG. A-15M.

| REVISION | DATE | DESCRIPTION | BY | APP. |
|---|---|---|---|---|
| | | | | |

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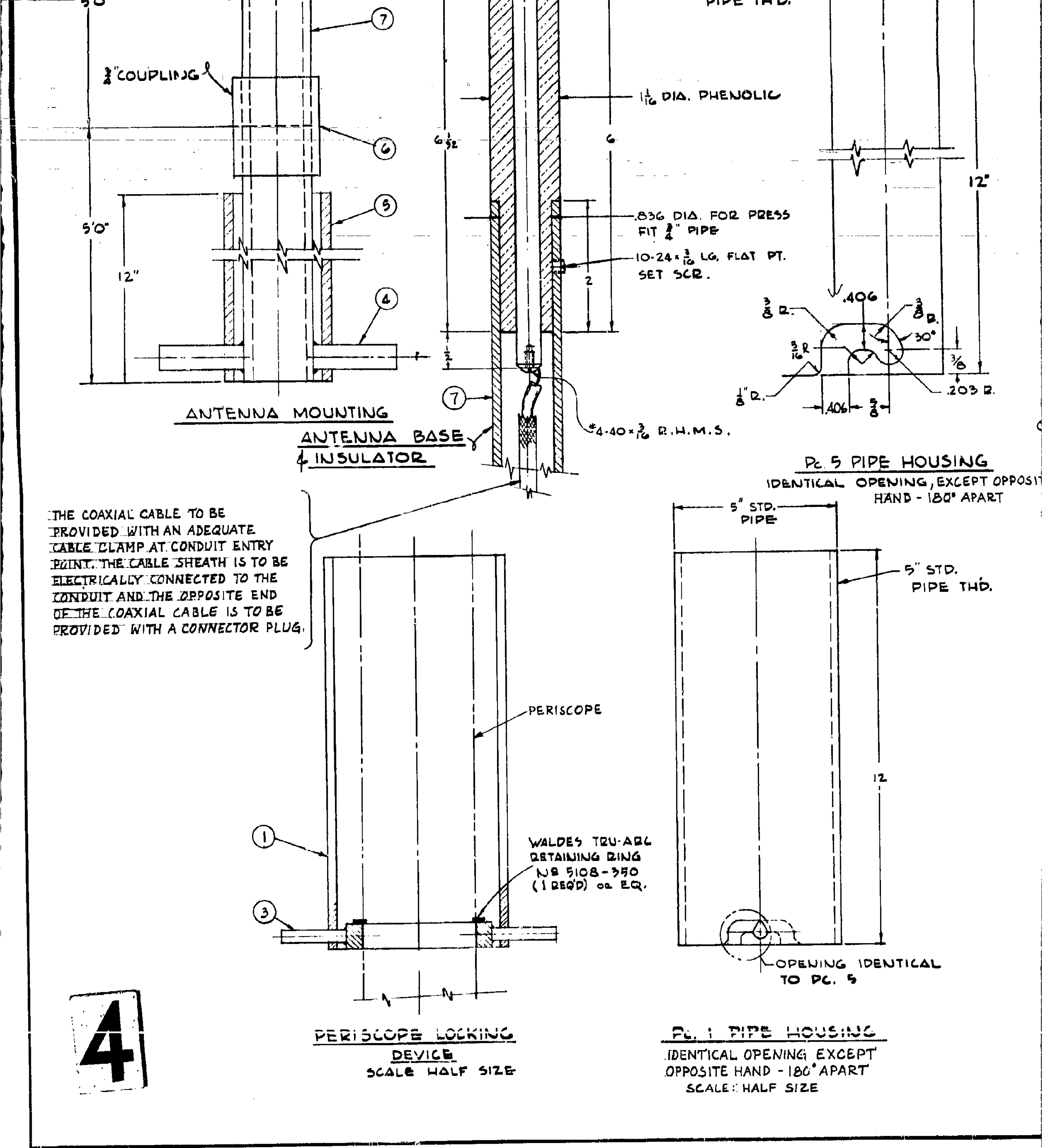
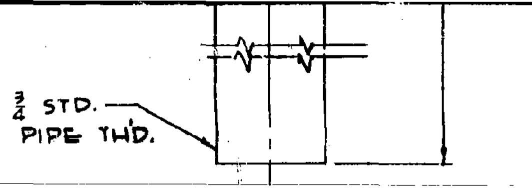
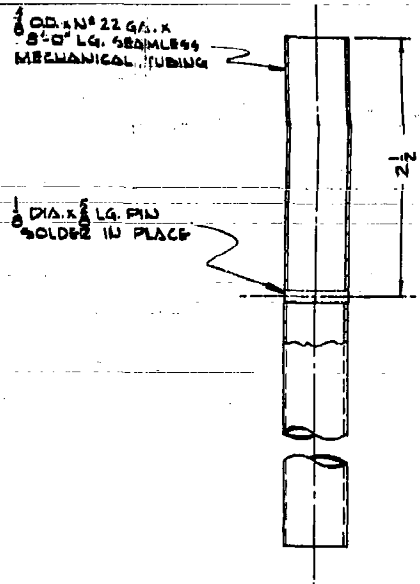
| DRAWN | FJA |
|---|---|



¾" COUPLING
5'0"
12"
ANTENNA MOUNTING
1⁵⁄₁₆ DIA. PHENOLIC
6
.836 DIA. FOR PRESS FIT ¾" PIPE
10-24 × ³⁄₁₆ LG. FLAT PT. SET SCR.
2
½
#4-40 × ³⁄₁₆ R.H.M.S.
ANTENNA BASE & INSULATOR
12"
.406
⅜ R.
⅜ R.
30°
³⁄₁₆ R
⅜
⅛" R.
.406
⅝
.203 R.
Pc. 5 PIPE HOUSING
IDENTICAL OPENING, EXCEPT OPPOSITE HAND - 180° APART
THE COAXIAL CABLE TO BE PROVIDED WITH AN ADEQUATE CABLE CLAMP AT CONDUIT ENTRY POINT. THE CABLE SHEATH IS TO BE ELECTRICALLY CONNECTED TO THE CONDUIT AND THE OPPOSITE END OF THE COAXIAL CABLE IS TO BE PROVIDED WITH A CONNECTOR PLUG.
PERISCOPE
WALDES TRU-ARC RETAINING RING NS 5108-350 (1 REQ'D) OR EQ.
PERISCOPE LOCKING DEVICE
SCALE HALF SIZE
5" STD. PIPE
5" STD. PIPE THD.
12
OPENING IDENTICAL TO PC. 5
Pc. 1 PIPE HOUSING
IDENTICAL OPENING EXCEPT OPPOSITE HAND - 180° APART
SCALE: HALF SIZE
4

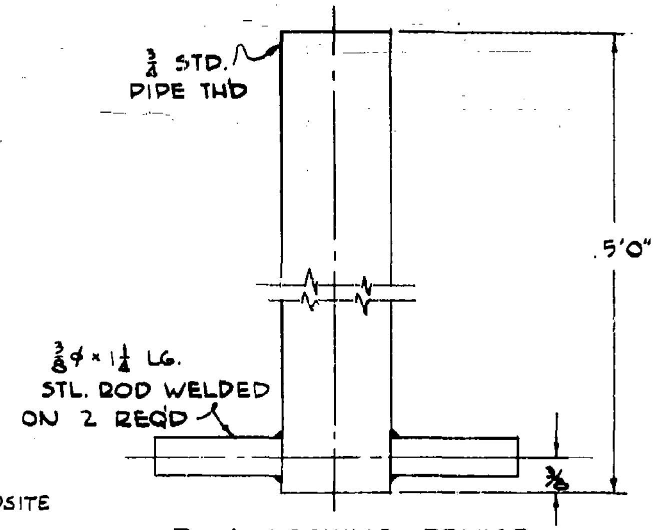



Pc. 7 EXTENSION PIPE

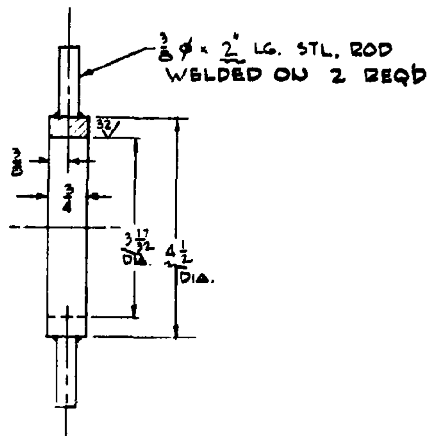



DOSIMETER ROD

SCALE: FULL SIZE




Pc. 4 LOCKING DEVICE




Pc. 3 LOCKING COLLAR

SCALE - HALF SIZE

NOTES:

1. ANTENNA & MOUNTING REQUIRED FOR
PKG. ONLY.
2. ALL DETAILS RELATING TO PERISCOP
MODEL "A" DESIGN. IT WILL BE NECE
ALL PERISCOPE MOUNTING DETAILS
IS USED. SEE NOTE #3 OF FIG. A-15

| REVISION | DATE | DESCRIPTION |
|---|---|---|

UNITED STATES
NAVAL RADIOLOGICAL DEFENSE LA
SAN FRANCISCO 24, CALIFORNI

| | |
|---|---|
| DRAWN | FJA |
| CHECKED | Fda |
| SECTION HEAD | DEVELOPMENTAL DWG |
| BRANCH HEAD | |
| DIVISION HEAD | |

FIG. A
PERISCOPE &
MOUN

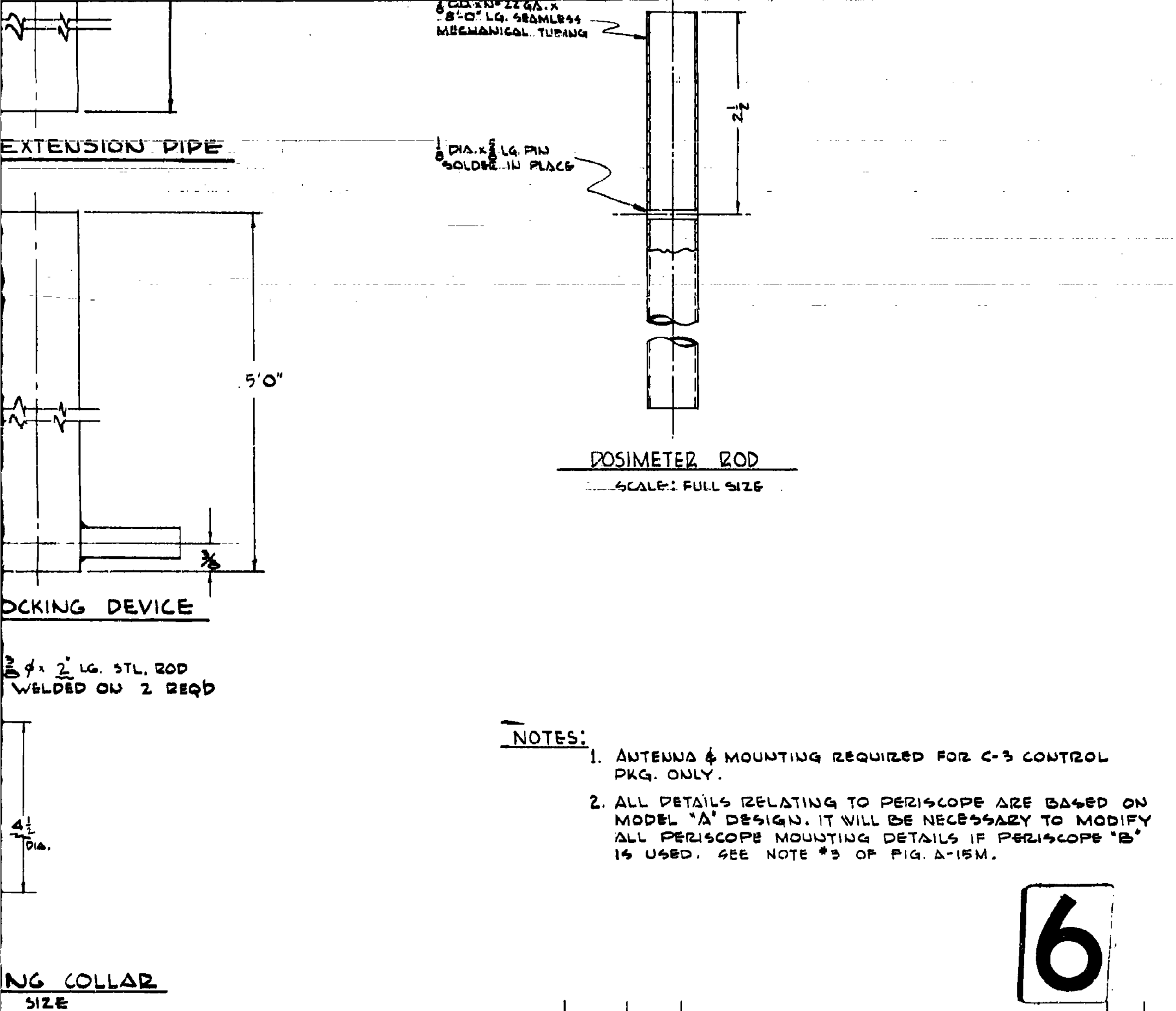
| DATE | SCALE | PROJECT |
|---|---|---|
| 26 FEB 62 | FULL & NOTED | |

SATISFACTORY TO: LGP
DATE 5-22-62

DRAWING S-62
SHEET

TOLERANCES UNLESS OTHERWISE NOTED
DECIMALS:
4 PLACES ± .001
3 PLACES ± .005
2 PLACES ± .01
FRACTIONAL ± 1/64
ANGULAR ± ½°
GEN. ROUGHNESS SURFACE UNLESS SPECIFIED.

ENGINEERING & DESIGN IS APPROVED BY: Lewis G. Petersen DATE: 22 May 62




NOTES:

1. ANTENNA & MOUNTING REQUIRED FOR C-3 CONTROL PKG. ONLY.
2. ALL DETAILS RELATING TO PERISCOPE ARE BASED ON MODEL "A" DESIGN. IT WILL BE NECESSARY TO MODIFY ALL PERISCOPE MOUNTING DETAILS IF PERISCOPE "B" IS USED. SEE NOTE #3 OF FIG. A-15M.

| REVISION | DATE | DESCRIPTION | BY | APP. |
|---|---|---|---|---|

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SAN FRANCISCO 24, CALIFORNIA

| | |
|---|---|
| DRAWN | FJA |
| CHECKED | FJA |
| SECTION HEAD | |
| BRANCH HEAD | DEVELOPMENTAL DWG |
| DIVISION HEAD | |

FIG. A-14M
PERISCOPE & ANTENNA MOUNTING

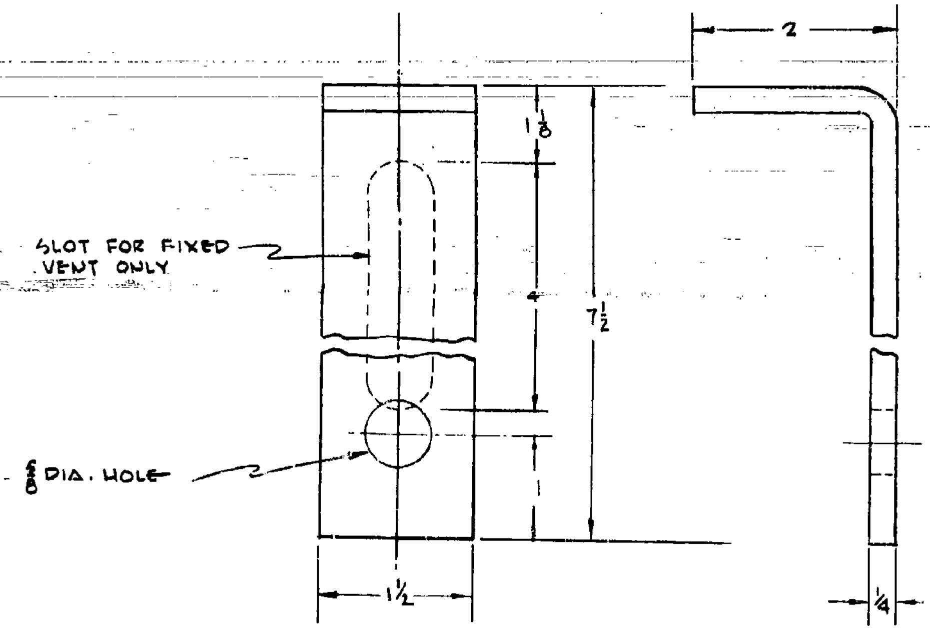
TOLERANCES UNLESS OTHERWISE NOTED
DECIMALS:
4 PLACES ± .001
3 PLACES ± .005
2 PLACES ± .01
FRACTIONAL ± 1/64
ANGULAR ± ½°
GEN. ROUGHNESS SURFACE UNLESS SPECIFIED.

| DATE | SCALE | PROJECT | FINISH | HEAT TREAT |
|---|---|---|---|---|
| 26 FEB 62 | FULL & NOTED | | | |

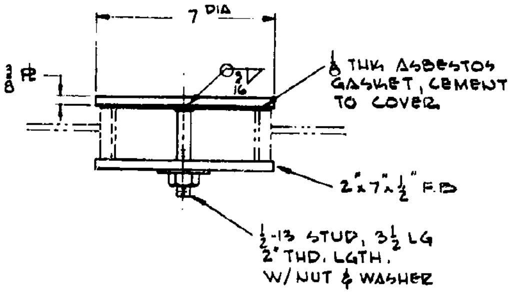
SATISFACTORY TO: LGO
DATE 5-22-62

DRAWING NUMBER S-62-970 SHEET 16 OF 19 ALT.

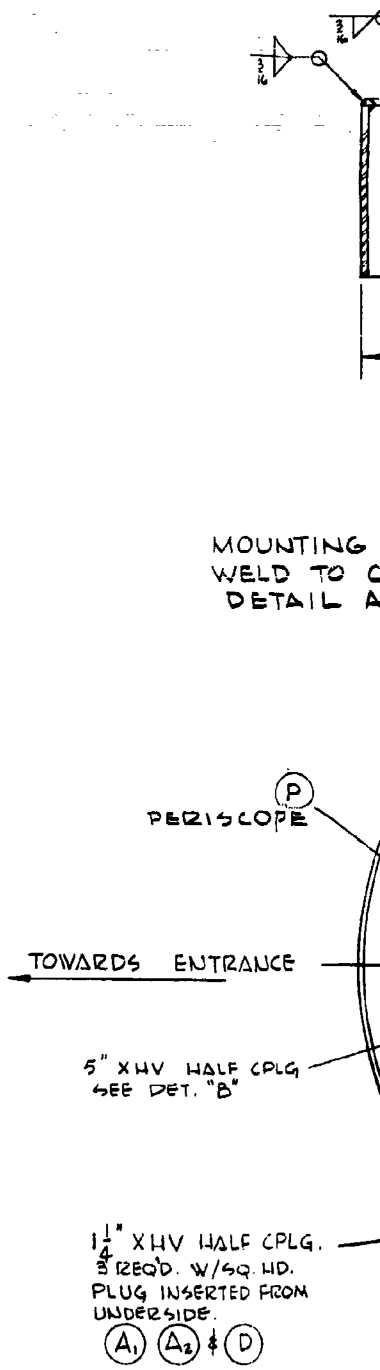
DESIGN BY: Lewis H. Peterson DATE: 22 May 62



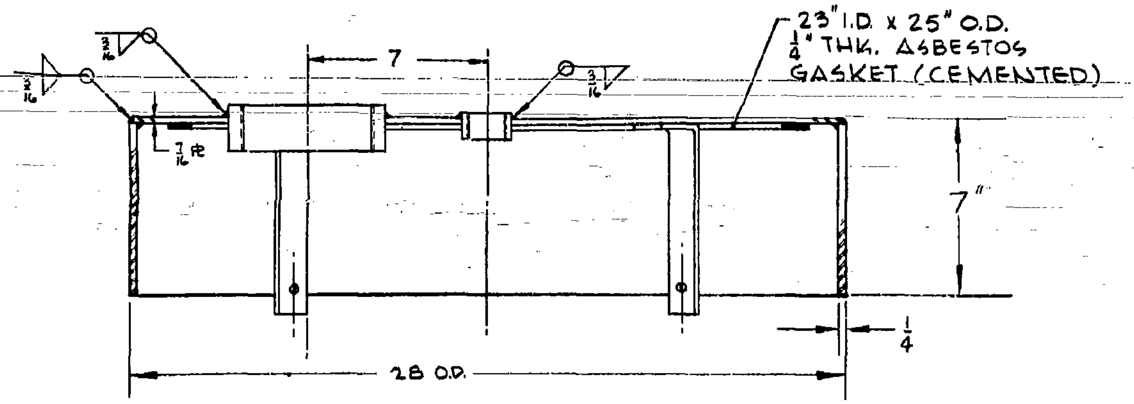

DETAIL A
MOUNTING BRACKET
(4 REQ'D.)

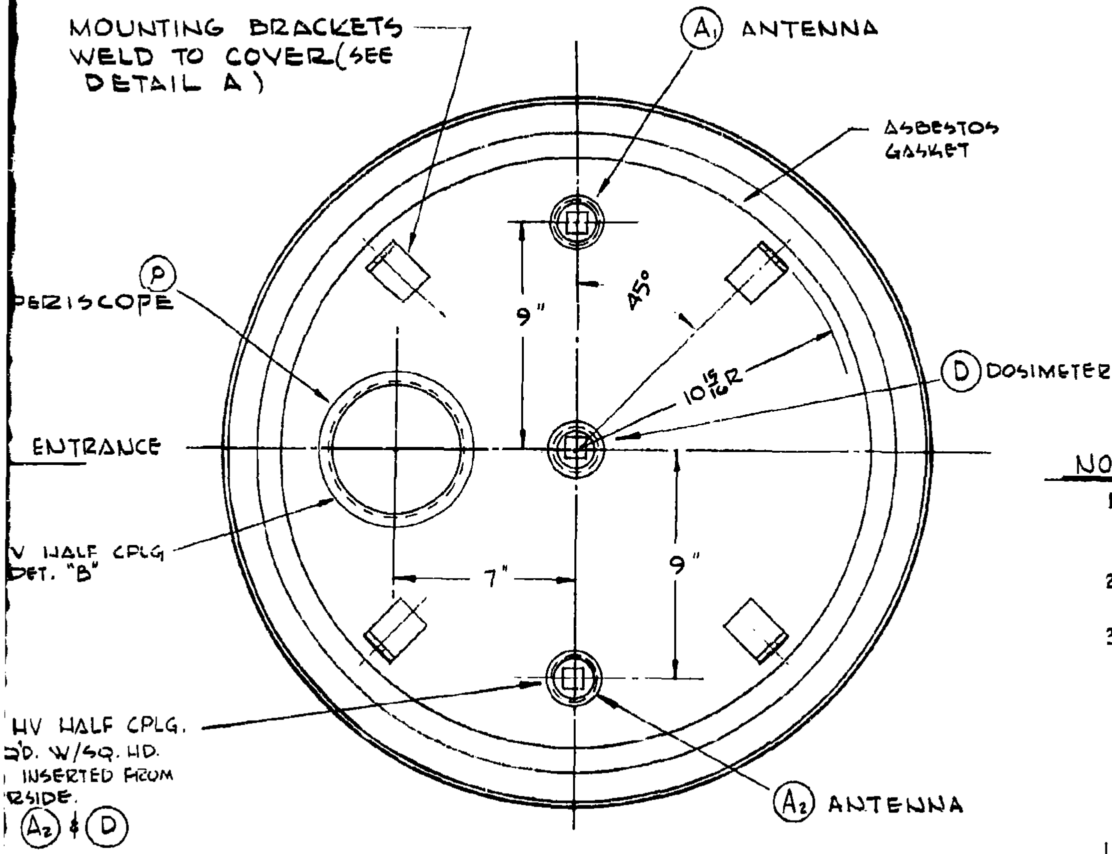



DETAIL "B"
PERISCOPE OPENING
COVER PLATE




1




BOTTOM VIEW

2

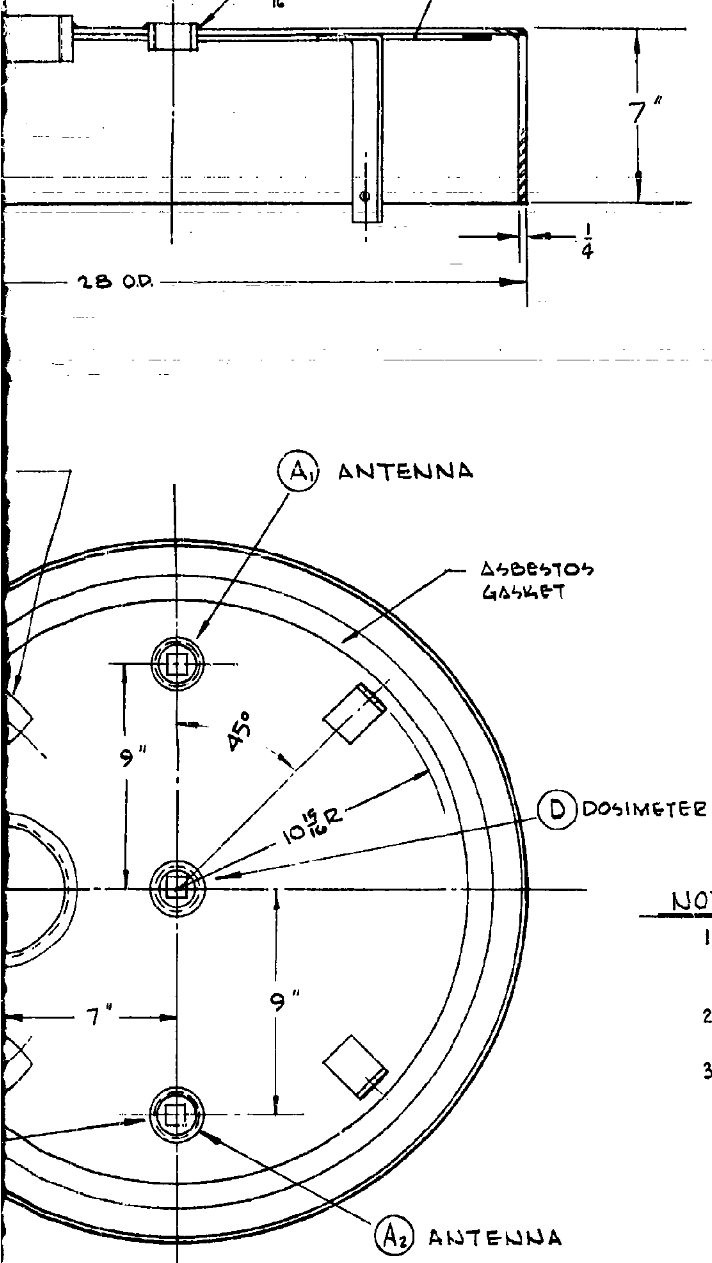
NOTES:

1. ALL UNGALVANIZED STEEL WORK SHALL BE
   COAT OF RED LEAD PAINT CONFORMING
   SPECIFICATION TT-P-86 a, TYPE I OR
2. TOTAL FITTINGS ARE SHOWN ON THIS DWG.
   PKG. DESIRED FOR ACTUAL Nº OF FITTI
3. ALL DETAILS RELATING TO PERISCOPE A
   MODEL "A" PERISCOPE DESIGN. IT WILL
   MODIFY ALL PERISCOPE MOUNTING DE
   "B" IS USED.

| REVISION | DATE | DESCRIPTION |
|---|---|---|

UNITED STATES
NAVAL RADIOLOGICAL DEFENSE L
SAN FRANCISCO 24, CALIFOR

| | | |
|---|---|---|
| DRAWN | FJA | FIG. |
| CHECKED | FJa | VENTILATOR |
| SECTION HEAD | DEVELOPMENTAL DWG | CONTRO |
| BRANCH HEAD | | |
| DIVISION HEAD | | |




BOTTOM VIEW

NOTES:

1. ALL UNGALVANIZED STEEL WORK SHALL BE GIVEN ONE SHOP COAT OF RED LEAD PAINT CONFORMING WITH FEDERAL SPECIFICATION TT-P-86 a, TYPE I OR II.
2. TOTAL FITTINGS ARE SHOWN ON THIS DWG. REFER TO CONTROL PKG. DESIRED FOR ACTUAL Nº OF FITTINGS TO BE INSTALLED.
3. ALL DETAILS RELATING TO PERISCOPE ARE BASED ON MODEL "A" PERISCOPE DESIGN. IT WILL BE NECESSARY TO MODIFY ALL PERISCOPE MOUNTING DETAILS IF PERISCOPE "B" IS USED.

| REVISION | DATE | DESCRIPTION | BY | APP. |
|---|---|---|---|---|

UNITED STATES
NAVAL RADIOLOGICAL DEFENSE LABORATORY
SAN FRANCISCO 24, CALIFORNIA

| | |
|---|---|
| DRAWN | FJA |
| CHECKED | FJa |
| SECTION HEAD | |
| BRANCH HEAD | DEVELOPMENTAL DWG |
| DIVISION HEAD | |

FIG. A-15M
VENTILATOR CAP FOR CONTROL PKG.

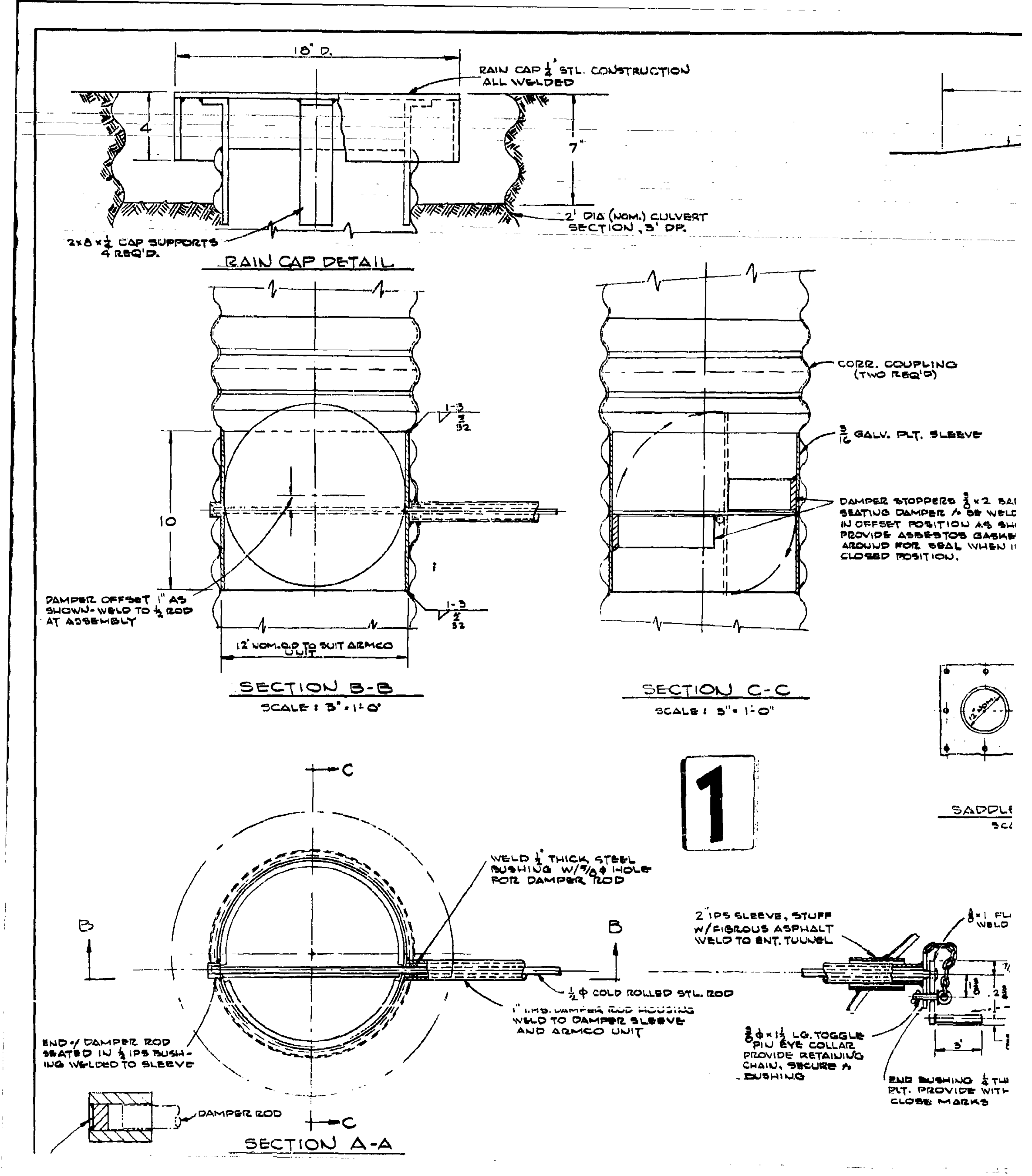
3

| DATE | SCALE | PROJECT | FINISH | HEAT TREAT |
|---|---|---|---|---|
| 26 FEB 62 | NONE | | | |

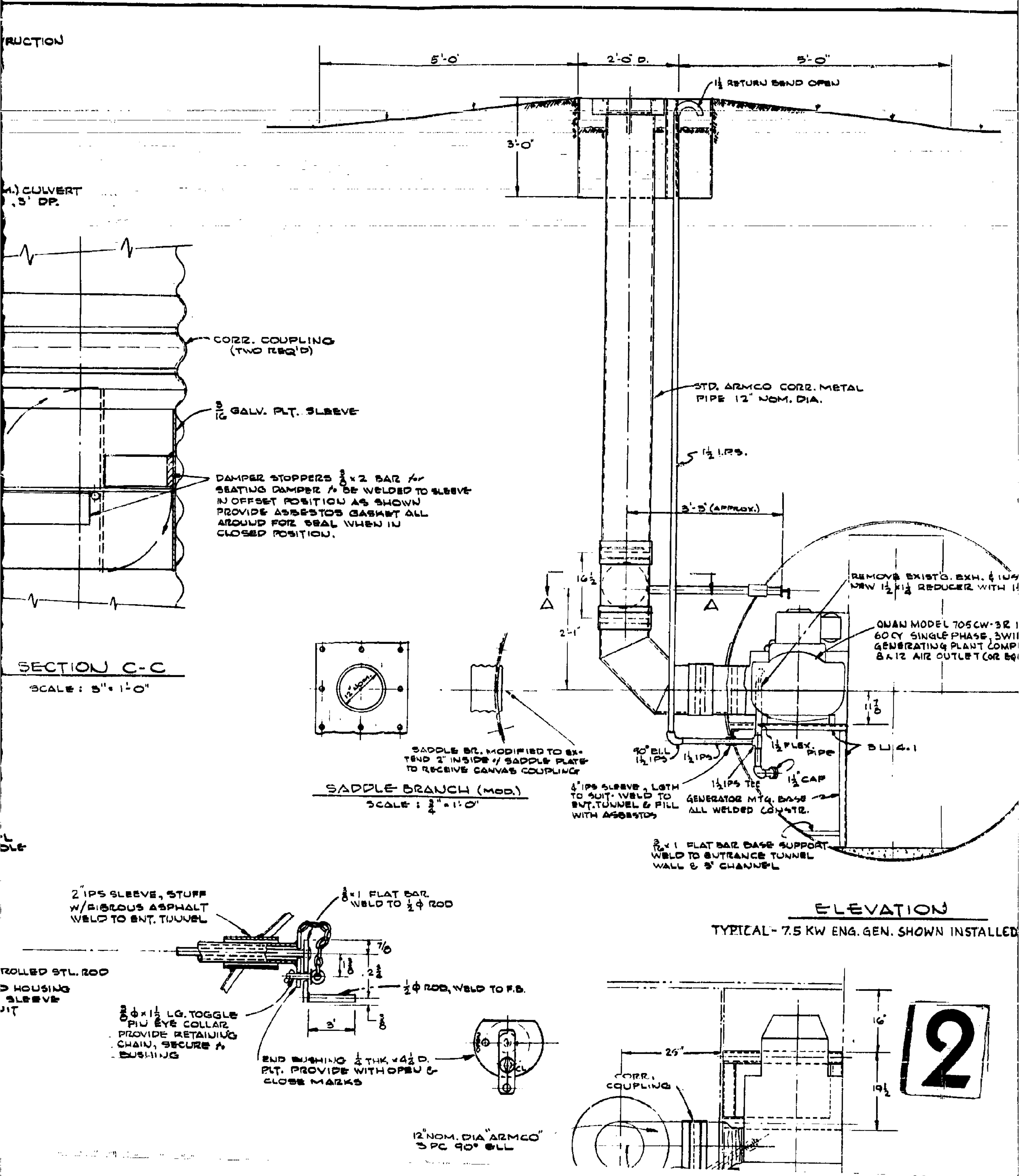
SATISFACTORY TO: L&D
DATE 5-22-62

DRAWING NUMBER S-62-970 SHEET 17 OF 19 ALT.

ENGINEERING & DESIGN IS APPROVED BY: Lewis G. Porteous DATE: 22 MAY 62



18" D.
RAIN CAP 1/4" STL. CONSTRUCTION ALL WELDED
4
7"
2' DIA (NOM.) CULVERT SECTION, 3' DP.
2×8×1/2 CAP SUPPORTS 4 REQ'D.
RAIN CAP DETAIL
CORR. COUPLING (TWO REQ'D)
3/16 GALV. PLT. SLEEVE
DAMPER OFFSET 1" AS SHOWN - WELD TO 1/2 ROD AT ASSEMBLY
10
12" NOM. O.D. TO SUIT ARMCO UNIT
SECTION B-B
SCALE: 3" = 1'-0"
SECTION C-C
SCALE: 3" = 1'-0"
1
WELD 1/2" THICK STEEL BUSHING W/ 9/16 Φ HOLE FOR DAMPER ROD
1/2 Φ COLD ROLLED STL. ROD
1" I.P.S. DAMPER ROD HOUSING WELD TO DAMPER SLEEVE AND ARMCO UNIT
END OF DAMPER ROD SEATED IN 1/2 IPS BUSHING WELDED TO SLEEVE
DAMPER ROD
SECTION A-A
2" IPS SLEEVE, STUFF W/ FIBROUS ASPHALT WELD TO ENT. TUNNEL
3/8 Φ × 1 1/2 LG. TOGGLE PIN EYE COLLAR PROVIDE RETAINING CHAIN, SECURE TO BUSHING
3'

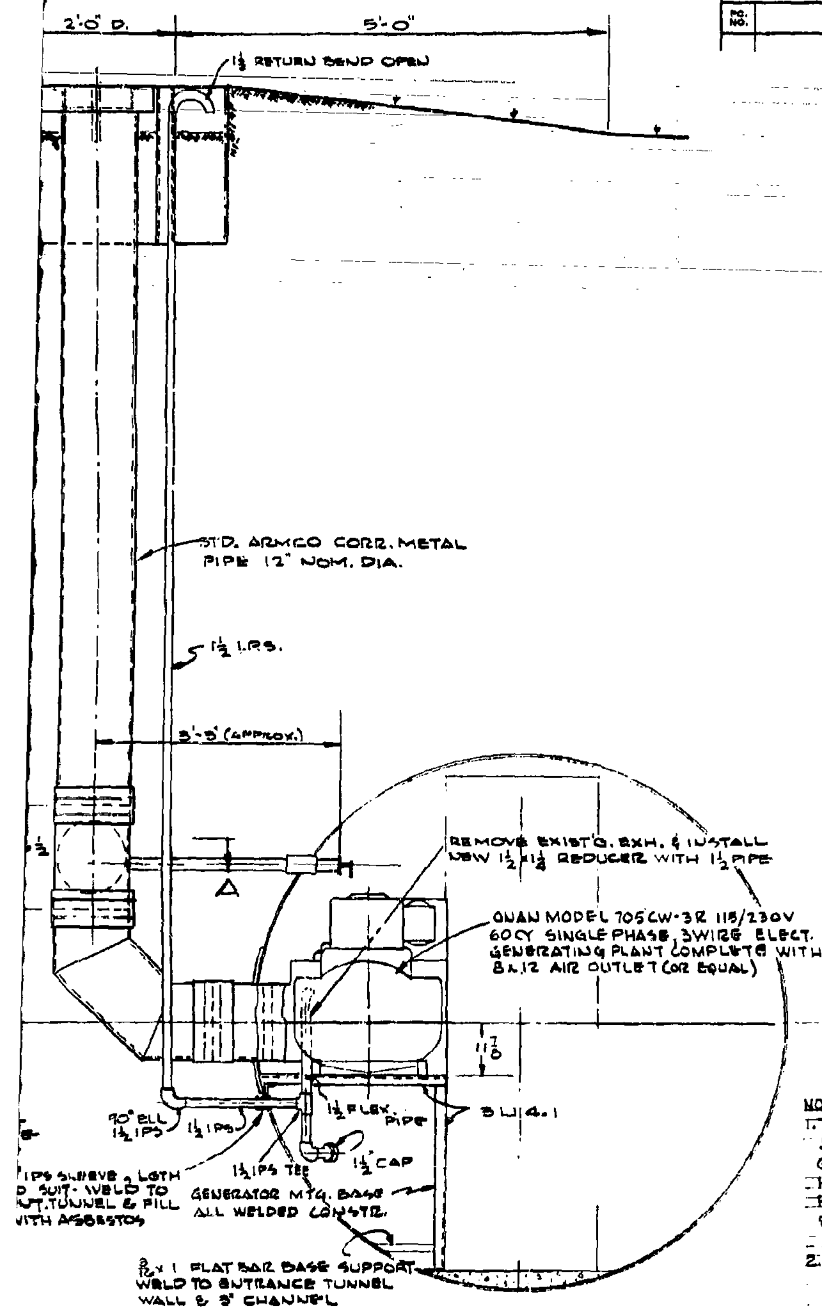


RUCTION
5'-0"
2'-0" D.
5'-0"
1½ RETURN BEND OPEN
3'-0"
M.) CULVERT
, 3' DP.
CORR. COUPLING
(TWO REQ'D)
STD. ARMCO CORR. METAL
PIPE 12" NOM. DIA.
3/16 GALV. PLT. SLEEVE
1½ I.P.S.
DAMPER STOPPERS 3/8 x 2 BAR for
SEATING DAMPER to BE WELDED TO SLEEVE
IN OFFSET POSITION AS SHOWN
PROVIDE ASBESTOS GASKET ALL
AROUND FOR SEAL WHEN IN
CLOSED POSITION.
3'-5" (APPROX.)
16½
2'-1"
REMOVE EXIST'G. EXH. & INS
NEW 1½ x 1¼ REDUCER WITH 1
ONAN MODEL 705CW-3R
60 CY SINGLE PHASE, 3WI
GENERATING PLANT COMP
8 x 12 AIR OUTLET (OR EQ
SECTION C-C
SCALE: 3" = 1'-0"
12" NOM.
11⅞
SADDLE BR. MODIFIED TO EX-
TEND 2" INSIDE of SADDLE PLATE
TO RECEIVE CANVAS COUPLING
90° ELL
1½ IPS
1½ IPS
1½ FLEX. PIPE
3 U 4.1
1½ CAP
SADDLE BRANCH (MOD.)
SCALE: 3/4" = 1'-0"
4" IPS SLEEVE, LGTH
TO SUIT. WELD TO
ENT. TUNNEL & FILL
WITH ASBESTOS
1½ IPS TEE
GENERATOR MTG. BASE
ALL WELDED CONSTR.
3/16 x 1 FLAT BAR BASE SUPPORT
WELD TO ENTRANCE TUNNEL
WALL & 3" CHANNEL
2" IPS SLEEVE, STUFF
w/FIBROUS ASPHALT
WELD TO ENT. TUNNEL
3/8 x 1 FLAT BAR
WELD TO ½ φ ROD
ELEVATION
TYPICAL - 7.5 KW ENG. GEN. SHOWN INSTALLED
7/8
1⅜
2¾
ROLLED STL. ROD
D HOUSING
SLEEVE
UIT
½ φ ROD, WELD TO F.B.
3/8 φ x 1½ LG. TOGGLE
PIN EYE COLLAR
PROVIDE RETAINING
CHAIN, SECURE to
BUSHING
3"
3/8
16"
19½
26"
CORR.
COUPLING
END BUSHING ¼ THK. x 4½ D.
PLT. PROVIDE WITH OPEN &
CLOSE MARKS
12" NOM. DIA "ARMCO"
3 PC 90° ELL
2

## LIST OF MATERIAL

QUANTITIES SHOWN ARE FOR

| PC. NO. | NAME | NO. REQ. | MAT'L. | MAT'L. SPECS. | STOCK SIZE | REMARKS |
|---|---|---|---|---|---|---|
| | | | | | | |




## ELEVATION

TYPICAL - 7.5 KW ENG. GEN. SHOWN INSTALLED

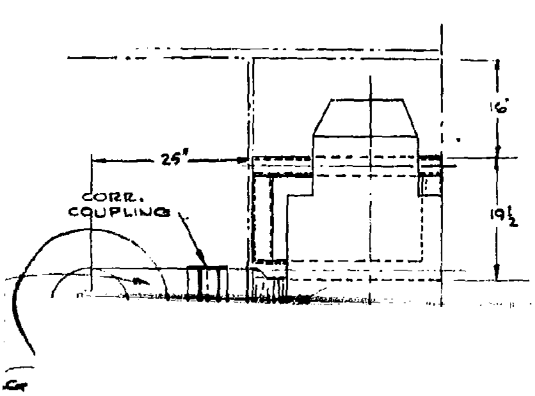
| MOTOR-GENERATOR SCHEDULE | | | |
|---|---|---|---|
| PKG NO. | POWER | 'ONAN' GAS TYPE | 'KOHLER' GAS TYPE |
| P-1 | 1.2 KW | | LM21 |
| P-2 | 2.5 KW | 2LK 1M | 2.5 M25 |
| P-3 | 3.5 KW | 305 CCK 1M | 3.5 MM21 |
| P-4 | 5.0 KW | 5 CCK 8M | 5 MM21 |
| P-5 | 7.5 KW | 705 CW 3R | 7.5 RM21 |
| | | | |

**NOTES:**

1. THE ENGINE GENERATOR SHALL BE PROVIDED WITH A SUCTION-TYPE AIR-COOLING SYSTEM WITH A DIRECT-CONNECTED CENTRIFUGAL BLOWER. THE ENGINE AND THE GENERATOR SHALL BE PROVIDED WITH AN AIR-COOLING SYSTEM SO AS TO ALLOW HEATED AIR AND EXHAUST GASES TO BE DUCTED OUT OF THE ENTRANCE COMPARTMENT. THE ENGINE GENERATOR, FOR THE CAMP PARKS INSTALLATION, SHALL BE EQUAL TO ONAN ELECTRIC PLANT SERIES NO. 705 CW.

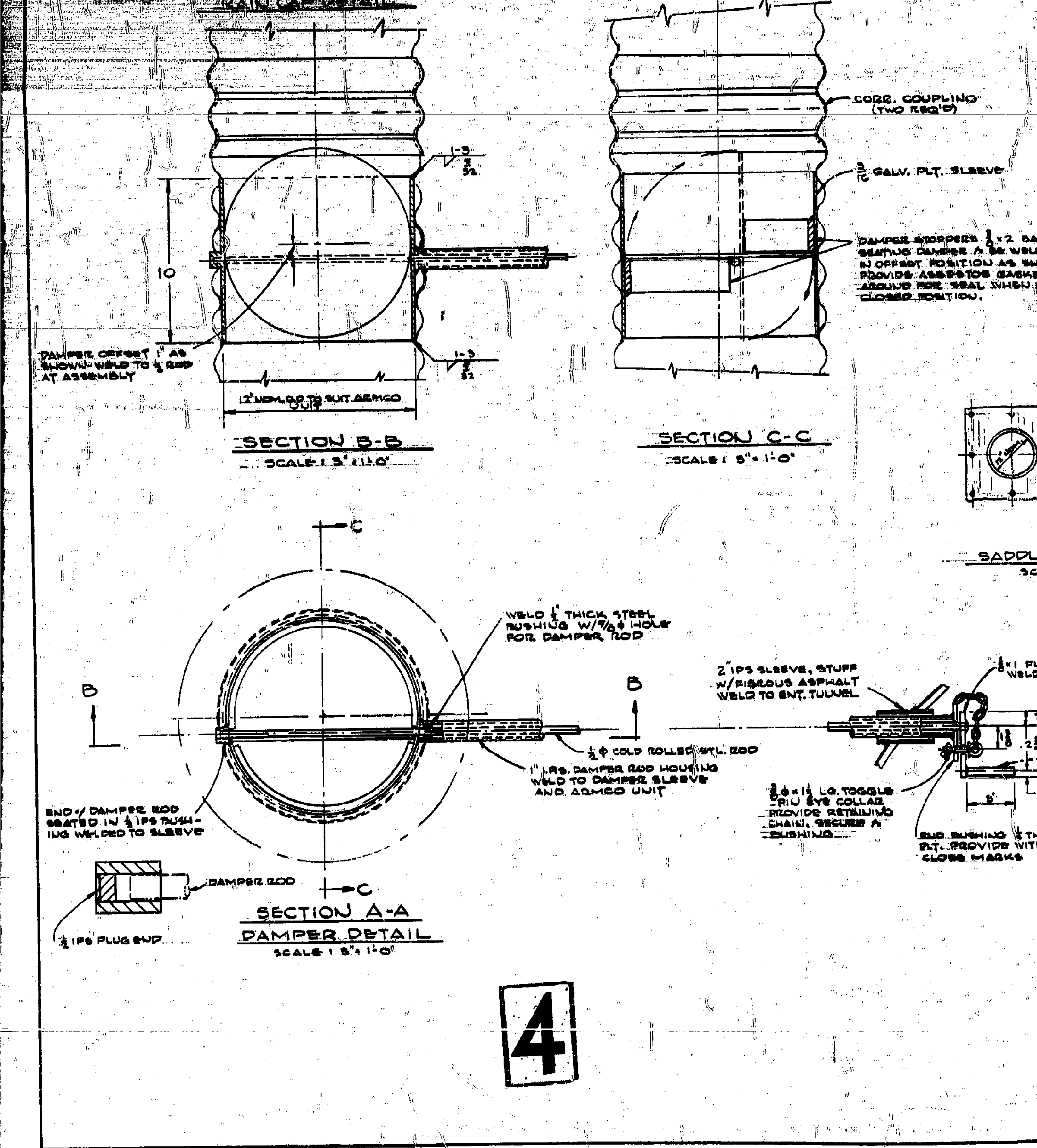
2. THE TOTAL ENGINE GENERATOR ELECTRICAL INSTALLATION COMPLETE WITH FUEL TANKS, GAS DISTRIBUTION SYSTEM, VENT SYSTEM, ETC., SHALL BE TESTED IN THE PRESENCE OF THE OFFICER IN CHARGE OF CONSTRUCTION OR HIS AUTHORIZED REPRESENTATIVE. THE TEST SHALL CONSIST OF REPEATED START AND STOPS AND A FULL-LOAD HEAT RUN FOR A PERIOD OF AT LEAST 2 HOURS. THIS TEST SHALL BE CONDUCTED BY THE CONTRACTOR AT HIS EXPENSE. THE FREQUENCY AND VOLTAGE REGULATION SHALL BE CHECKED TO DETERMINE THAT THE FREQUENCY REGULATION IS WITHIN 3 CYCLES AND THE VOLTAGE REGULATION WITHIN ± 3% NO LOAD TO FULL LOAD.

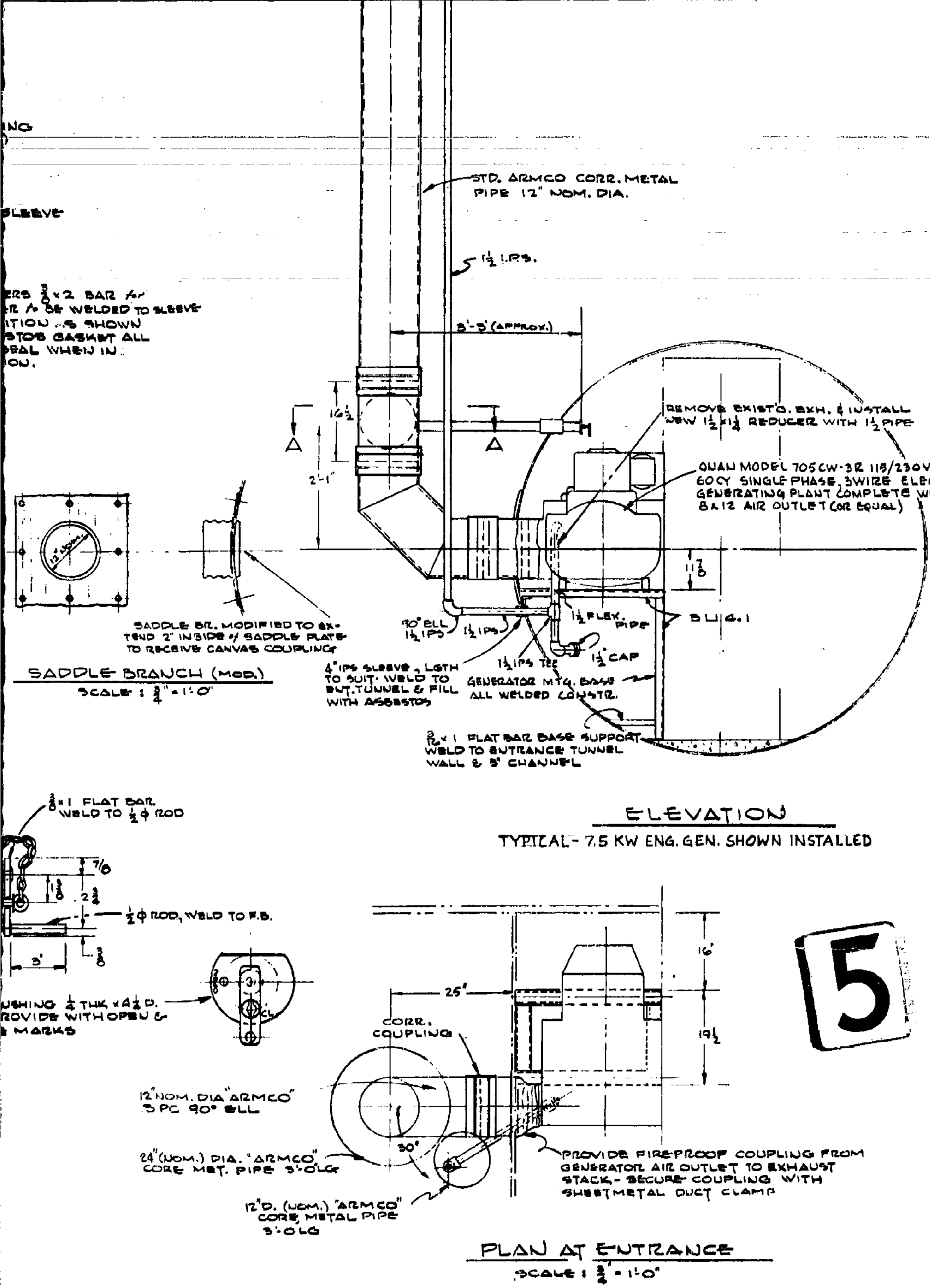
3. ALL EXPOSED EXHAUST PIPING INSIDE SHELTER SHALL BE COVERED WITH GRADE 1, CLASS A INSULATION IN ACCORDANCE WITH SPEC. MIL-P-2781.




3

| REVISION | DATE | DESCRIPTION | BY | APP. |
|---|---|---|---|---|
| | | | | |


CORR. COUPLING (TWO REQ'D)
3/16 GALV. PLT. SLEEVE
DAMPER OFFSET 1" AS SHOWN-WELD TO 1/2 ROD AT ASSEMBLY
12" NOM. O.D. TO SUIT ARMCO UNIT
SECTION B-B
SCALE: 3"=1'-0"
SECTION C-C
SCALE: 3"=1'-0"
WELD 1/4" THICK STEEL BUSHING W/9/16 ϕ HOLE FOR DAMPER ROD
B
B
1/2 ϕ COLD ROLLED STL. ROD
1" I.P.S. DAMPER ROD HOUSING WELD TO DAMPER SLEEVE AND ARMCO UNIT
END of DAMPER ROD SEATED IN 1/2 IPS BUSHING WELDED TO SLEEVE
DAMPER ROD
1/2 IPS PLUG END
SECTION A-A
DAMPER DETAIL
SCALE: 3"=1'-0"
2" IPS SLEEVE, STUFF W/FIBROUS ASPHALT WELD TO ENT. TUNNEL
3/8 ϕ x 1 1/2 LG. TOGGLE PIN EYE COLLAR PROVIDE RETAINING CHAIN, SECURE to BUSHING
4




SADDLE BRANCH (MOD.)
SCALE: ¾" = 1'-0"

ELEVATION
TYPICAL - 7.5 KW ENG. GEN. SHOWN INSTALLED

PLAN AT ENTRANCE
SCALE: ¾" = 1'-0"

| MOTOR - GENERATOR | |
|---|---|
| PKG NO | POWER |
| P-1 | 1.2 KW |
| P-2 | 2.5 KW |
| P-3 | 3.5 KW |
| P-4 | 5.0 KW |
| P-5 | 7.5 KW |

NOTES:

1. THE ENGINE GENERATOR SHALL BE PROVIDED W SYSTEM WITH A DIRECT-CONNECTED CENTRIF GENERATOR SHALL BE PROVIDED WITH AN AIR- HEATED AIR AND EXHAUST GASES TO BE DUC PARTMENT. THE ENGINE GENERATOR, FOR T SHALL BE EQUAL TO ONAN ELECTRI

2. THE TOTAL ENGINE GENERATOR ELECTRIC FUEL TANKS, GAS DISTRIBUTION SYSTEM, TESTED IN THE PRESENCE OF THE OFFICE OR HIS AUTHORIZED REPRESENTATIVE. THE START AND STOPS AND A FULL-LOAD HEAT 2 HOURS. THIS TEST SHALL BE CONDUC EXPENSE. THE FREQUENCY AND VOLTAGE TO DETERMINE THAT THE FREQUENCY AND THE VOLTAGE REGULATION WITHIN

3. ALL EXPOSED EXHAUST PIPING INSIDE S WITH GRADE 1, CLASS A INSULATION MIL-P-2781.

ENGINEERING & DESIGN IS APPROVED BY: Lewis S. Putnam DATE: 28MAY62

| REVISION | DATE | DES |
|---|---|---|

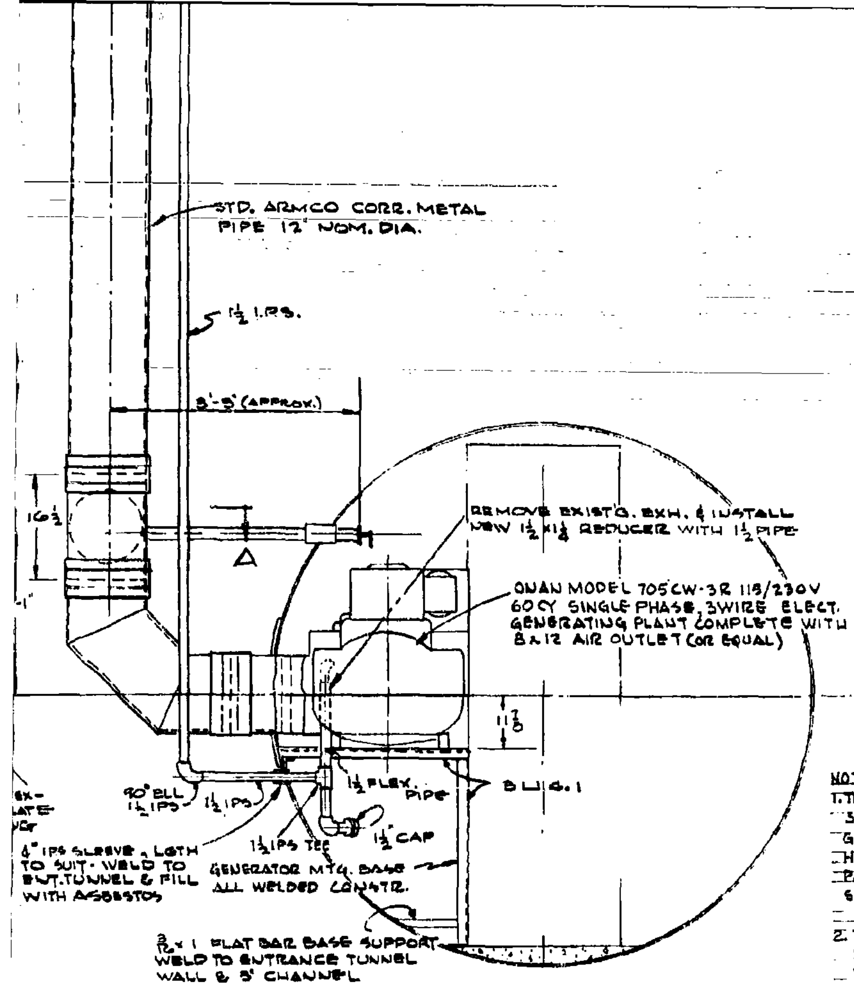
UNITED
NAVAL RADIOLOGICAL
SAN FRANCISCO

| | | |
|---|---|---|
| DRAWN | POND | |
| CHKD | JJA | |
| | | |
| PROJ. ENGR. | | |
| SUPVR. | | |
| BRANCH HEAD | | |
| DIVISION HEAD | | |

DEVELOPMENTAL DWG

ELECT

SCALE
NOTED



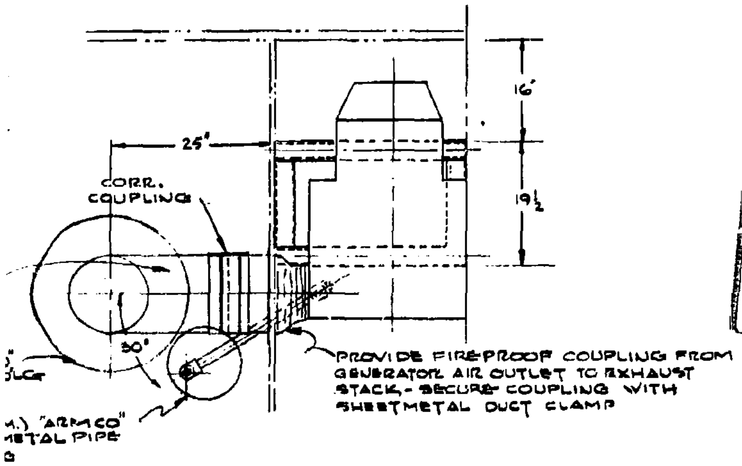

## ELEVATION

TYPICAL - 7.5 KW ENG. GEN. SHOWN INSTALLED

| MOTOR-GENERATOR SCHEDULE | | | |
|---|---|---|---|
| PKG NO. | POWER | 'ONAN' GAS TYPE | 'KOHLER' GAS TYPE |
| P-1 | 1.2 KW | | LM21 |
| P-2 | 2.5 KW | 2LK 1M | 2.5 M25 |
| P-3 | 3.5 KW | 305 CCK 1M | 3.5 MM21 |
| P-4 | 5.0 KW | 5 CCK 3M | 5 MM21 |
| P-5 | 7.5 KW | 705 CW 3R | 7.5 RM21 |
| | | | |

NOTES:

1. ~~THE~~ ENGINE GENERATOR SHALL BE PROVIDED WITH A SUCTION-TYPE AIR-COOLING SYSTEM WITH A DIRECT-CONNECTED CENTRIFUGAL BLOWER. THE ENGINE AND THE GENERATOR SHALL BE PROVIDED WITH AN AIR-COOLING SYSTEM SO AS TO ALLOW HEATED AIR AND EXHAUST GASES TO BE DUCTED OUT OF THE ENTRANCE COMPARTMENT. THE ENGINE GENERATOR, FOR THE CAMP PARKS INSTALLATION, SHALL BE EQUAL TO ONAN ELECTRIC PLANT SERIES NO. 705 CW.
2. THE TOTAL ENGINE GENERATOR ELECTRICAL INSTALLATION COMPLETE WITH FUEL TANKS, GAS DISTRIBUTION SYSTEM, VENT SYSTEM, ETC., SHALL BE TESTED IN THE PRESENCE OF THE OFFICER IN CHARGE OF CONSTRUCTION OR HIS AUTHORIZED REPRESENTATIVE. THE TEST SHALL CONSIST OF REPEATED START AND STOPS AND A FULL-LOAD HEAT RUN FOR A PERIOD OF AT LEAST 2 HOURS. THIS TEST SHALL BE CONDUCTED BY THE CONTRACTOR AT HIS EXPENSE. THE FREQUENCY AND VOLTAGE REGULATION SHALL BE CHECKED TO DETERMINE THAT THE FREQUENCY REGULATION IS WITHIN 3 CYCLES AND THE VOLTAGE REGULATION WITHIN ± 3% NO LOAD TO FULL LOAD.
3. ALL EXPOSED EXHAUST PIPING INSIDE SHELTER SHALL BE COVERED WITH GRADE 1, CLASS A INSULATION IN ACCORDANCE WITH SPEC. MIL-P-2781.




## PLAN AT ENTRANCE

SCALE: ¾" = 1'-0"

6

| REVISION | DATE | DESCRIPTION | BY | APP. |
|---|---|---|---|---|

**UNITED STATES**
**NAVAL RADIOLOGICAL DEFENSE LABORATORY**
SAN FRANCISCO 24, CALIFORNIA

| | | |
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| DRAWN | POND | DATE |
| CHKD | FJA | |
| SCOPE APPROVED | LGP | |
| PROJ. ENGR. | | |
| SUPVR. | | |
| BRANCH HEAD | | |
| DIVISION HEAD | | |

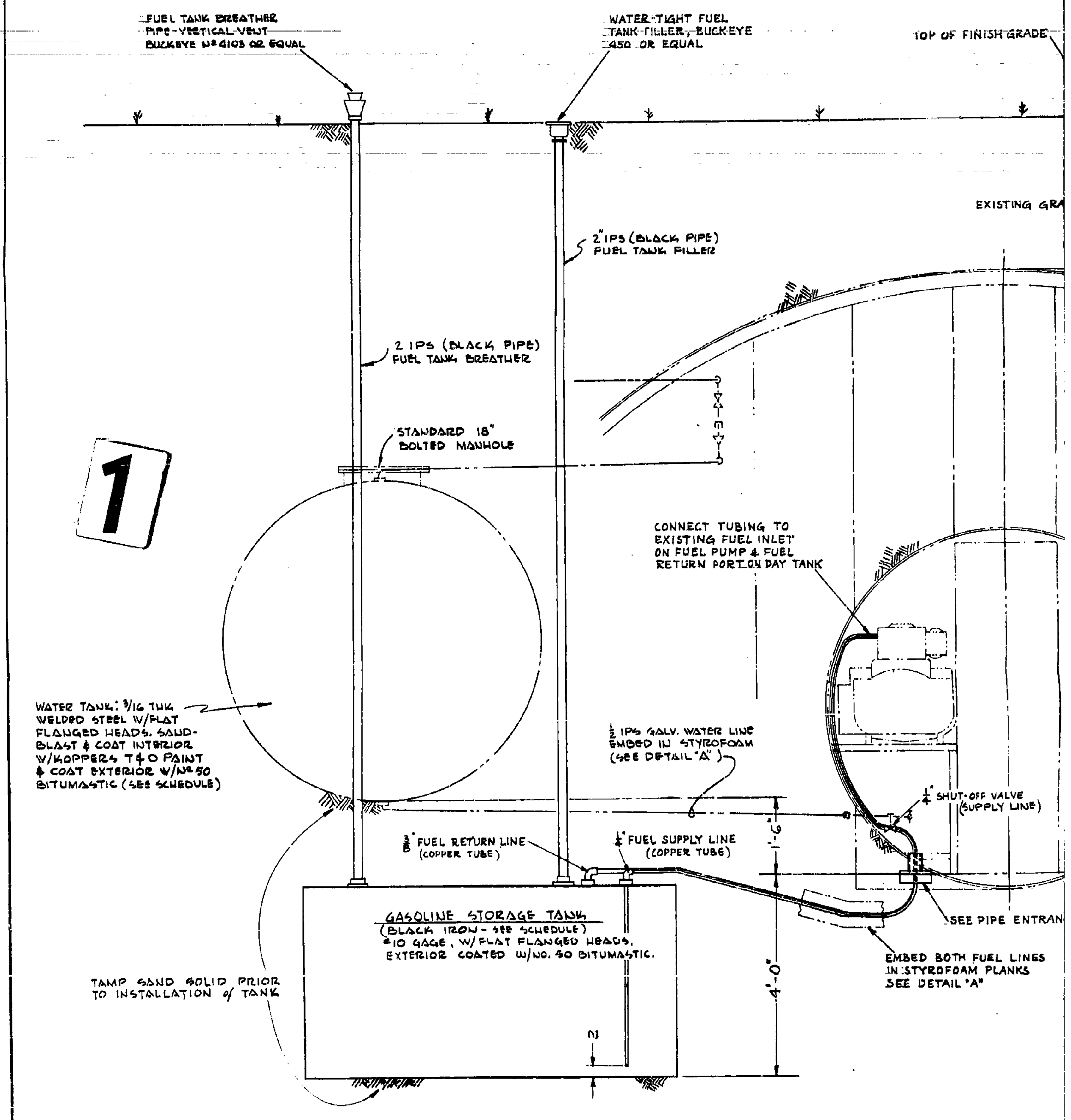
DEVELOPMENTAL DWG.

# FIG. A-16M
# ELECTRICAL GENERATING PLANT

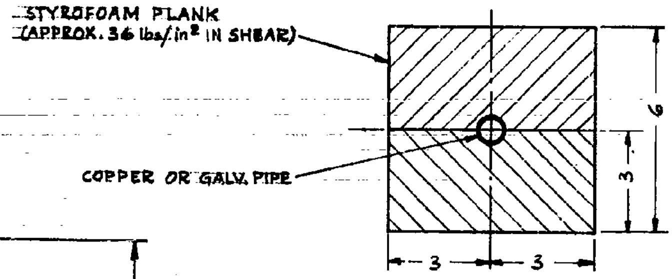
| SCALE | PROJECT | TECH MEMO. |
|---|---|---|
| NOTED | | |

DRAWING NUMBER S-62-970 SHEET 18 OF 19 ALT.

ENGINEERING & DESIGN IS APPROVED BY: Lewis B. Porter DATE: 23 May 63

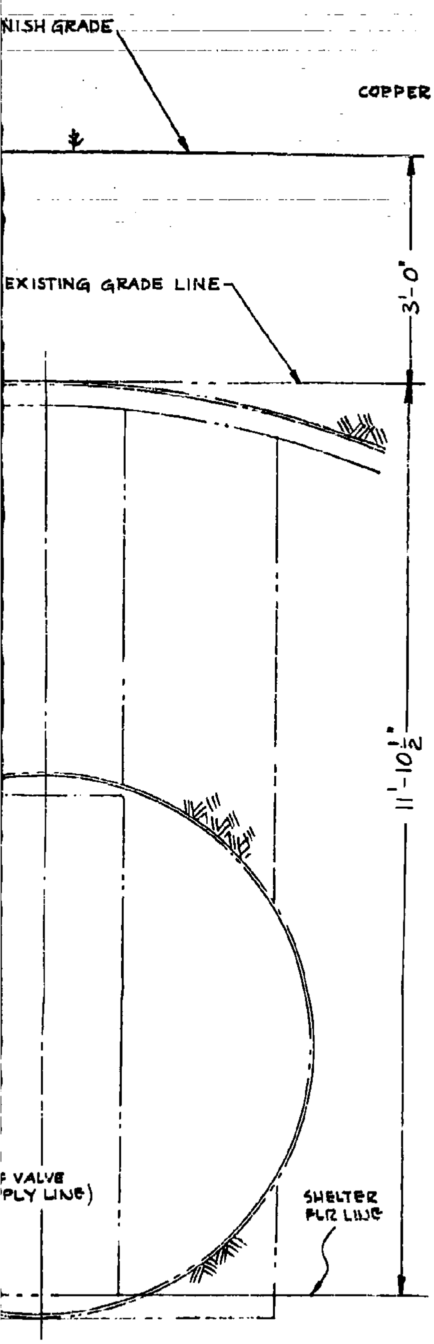

FUEL TANK BREATHER
PIPE-VERTICAL VENT
BUCKEYE Nº 4103 OR EQUAL
WATER-TIGHT FUEL
TANK FILLER, BUCKEYE
450 OR EQUAL
TOP OF FINISH GRADE
EXISTING GRA
2" IPS (BLACK PIPE)
FUEL TANK FILLER
2 IPS (BLACK PIPE)
FUEL TANK BREATHER
STANDARD 18"
BOLTED MANHOLE
1
CONNECT TUBING TO
EXISTING FUEL INLET
ON FUEL PUMP & FUEL
RETURN PORT ON DAY TANK
WATER TANK: 3/16 THK
WELDED STEEL W/FLAT
FLANGED HEADS. SAND-
BLAST & COAT INTERIOR
W/KOPPERS T&O PAINT
& COAT EXTERIOR W/Nº 50
BITUMASTIC (SEE SCHEDULE)
½ IPS GALV. WATER LINE
EMBED IN STYROFOAM
(SEE DETAIL "A")
¼" SHUT-OFF VALVE
(SUPPLY LINE)
⅜" FUEL RETURN LINE
(COPPER TUBE)
¼" FUEL SUPPLY LINE
(COPPER TUBE)
1'-6"
GASOLINE STORAGE TANK
(BLACK IRON - SEE SCHEDULE)
#10 GAGE, W/ FLAT FLANGED HEADS.
EXTERIOR COATED W/NO. 50 BITUMASTIC.
SEE PIPE ENTRAN
EMBED BOTH FUEL LINES
IN STYROFOAM PLANKS
SEE DETAIL "A"
TAMP SAND SOLID PRIOR
TO INSTALLATION of TANK
4'-0"
2"

| LIST OF MATERIA | | | | | |
|---|---|---|---|---|---|
| QUANTITIES SHOWN ARE FOR | | | | | |
| PC. NO. | NAME | NO. REQ. | MAT'L. | MAT'L. SPECS. | |



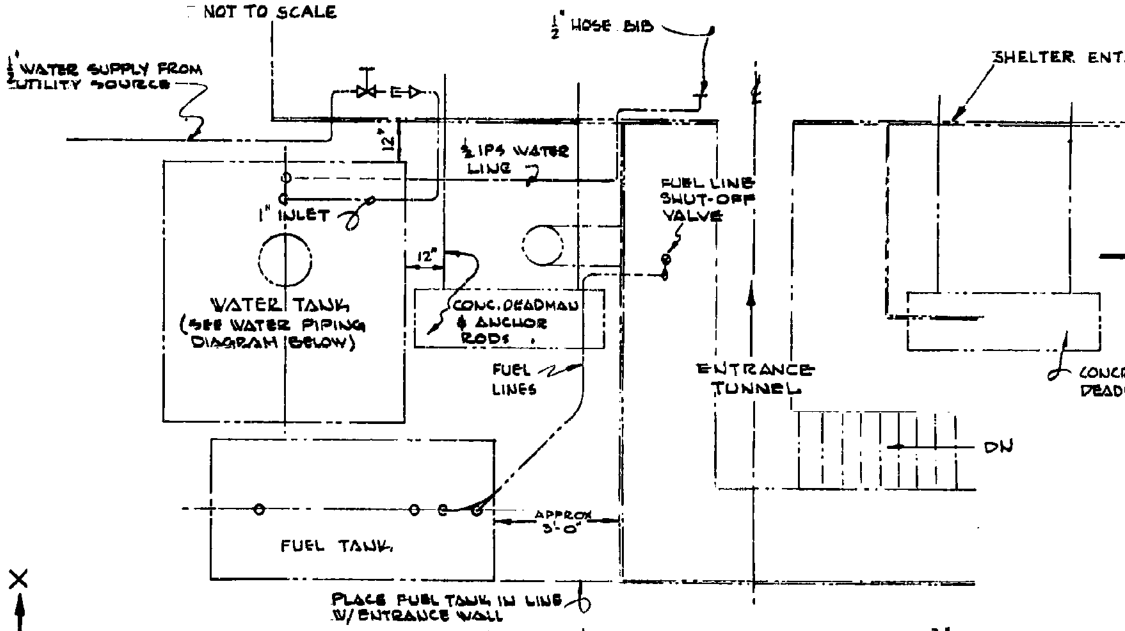

DETAIL "A"

TYPICAL UNDERGROUND PIPE INSTALLATION NOT TO SCALE

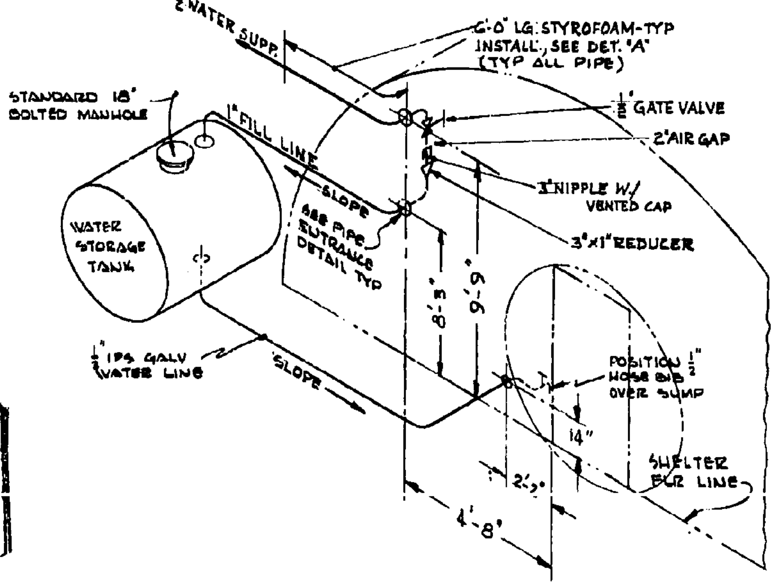



PIPE ENTRANCE DETAIL

EL LINES




PARTIAL PLAN AT PASSAGEWAY, SCALE: ⅜"-1'-0"




2

WATER TANK PIPING DIAGRAM

(SCHEMATIC ONLY)

WELD OR SOLDER ALL AROUND

## NOTES:

1. ENTRY OF ALL PIPES INTO SHELTER WITH DETAILS SHOWN IN PIPE ENT
2. PRIOR TO BACKFILLING AROUND TA TEST THE TOTAL GAS & WATER TA PRESSURIZING TO 5 lb/SQ.IN. NEITH AT THIS PRESSURE, AND LEAKS D BE REPAIRED AND THE SYSTEM R
3. THE WATER TANK COMPLETE WITH DISINFECTED WITH CHLORINE BE OPERATION. THE AMOUNT OF CHL SUCH AS TO PROVIDE A DOSAGE PER MILLION. FOLLOWING A CON THAN 8 HOURS, THE HEAVILY C BE FLUSHED OUT WITH CLEAN PLACED IN SERVICE.

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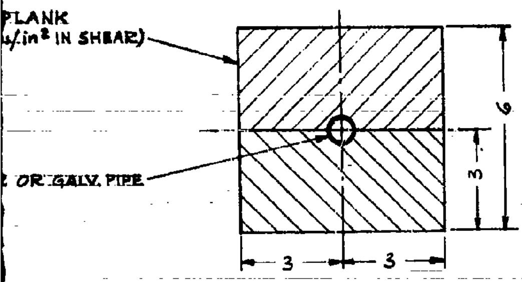
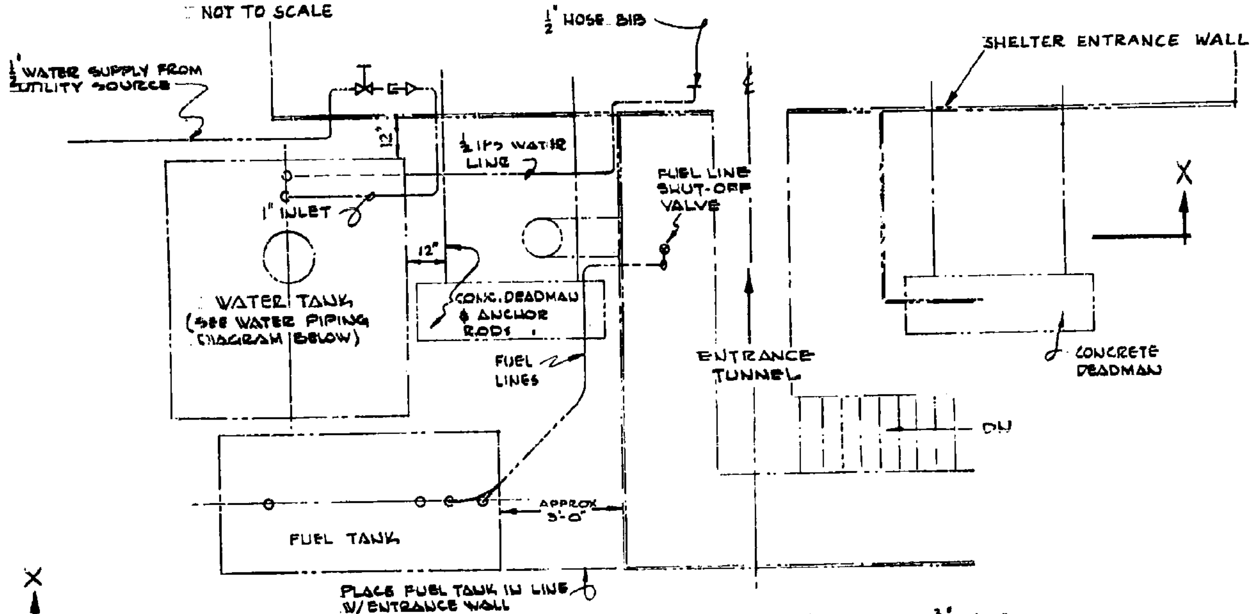


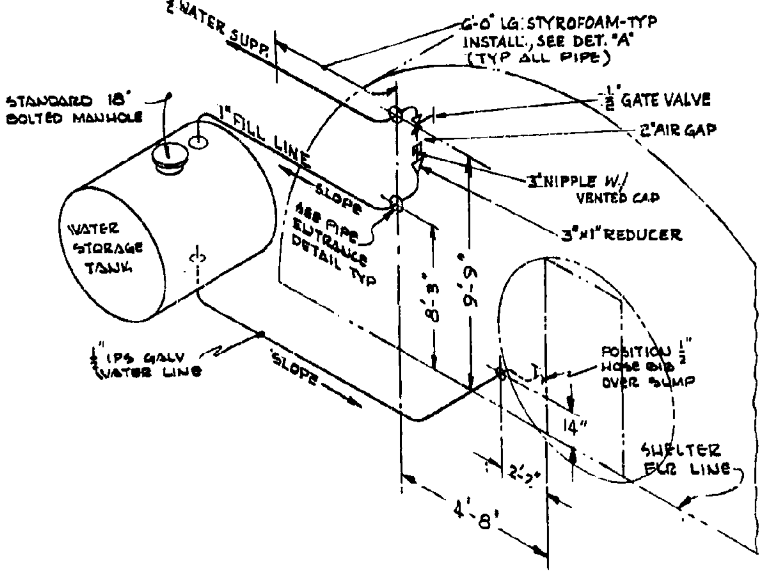

DETAIL "A"

TYPICAL UNDERGROUND PIPE INSTALLATION NOT TO SCALE

| LIST OF MATERIAL | | | | | | |
|---|---|---|---|---|---|---|
| QUANTITIES SHOWN ARE FOR | | | | | | |
| PC. NO. | NAME | NO. REQ. | MAT'L. | MAT'L. SPECS. | STOCK SIZE | REMARKS |




PARTIAL PLAN AT PASSAGEWAY, SCALE: 3/8" = 1'-0"

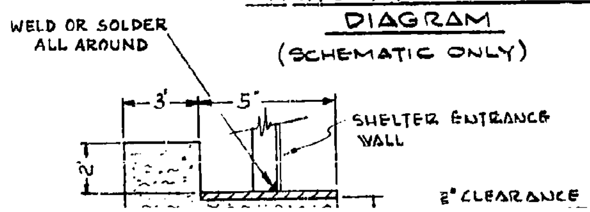



WATER TANK PIPING DIAGRAM

(SCHEMATIC ONLY)

## NOTES:

1. ENTRY OF ALL PIPES INTO SHELTER IS TO BE IN ACCORDANCE WITH DETAILS SHOWN IN PIPE ENTRANCE DETAIL ON THIS DRAWING.
2. PRIOR TO BACKFILLING AROUND TANKS, THE CONTRACTOR IS TO TEST THE TOTAL GAS & WATER TANK-PIPE SYSTEM BY AIR PRESSURIZING TO 5 lb/SQ.IN. NEITHER SYSTEM SHALL LEAK AIR AT THIS PRESSURE, AND LEAKS DISCLOSED BY THIS TEST SHALL BE REPAIRED AND THE SYSTEM RETESTED.
3. THE WATER TANK COMPLETE WITH PIPING SHALL BE THOROUGHLY DISINFECTED WITH CHLORINE BEFORE BEING PLACED IN OPERATION. THE AMOUNT OF CHLORINE APPLIED SHALL BE SUCH AS TO PROVIDE A DOSAGE OF NOT LESS THAN 50 PARTS PER MILLION. FOLLOWING A CONTACT PERIOD OF NOT LESS THAN 8 HOURS, THE HEAVILY CHLORINATED WATER SHALL BE FLUSHED OUT WITH CLEAN WATER AND THE SYSTEM PLACED IN SERVICE.

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| REVISION | DATE | DESCRIPTION | BY | APP. |
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NAVAL RADIOLOGICAL DEFENSE LABORATORY
SAN FRANCISCO 24, CALIFORNIA

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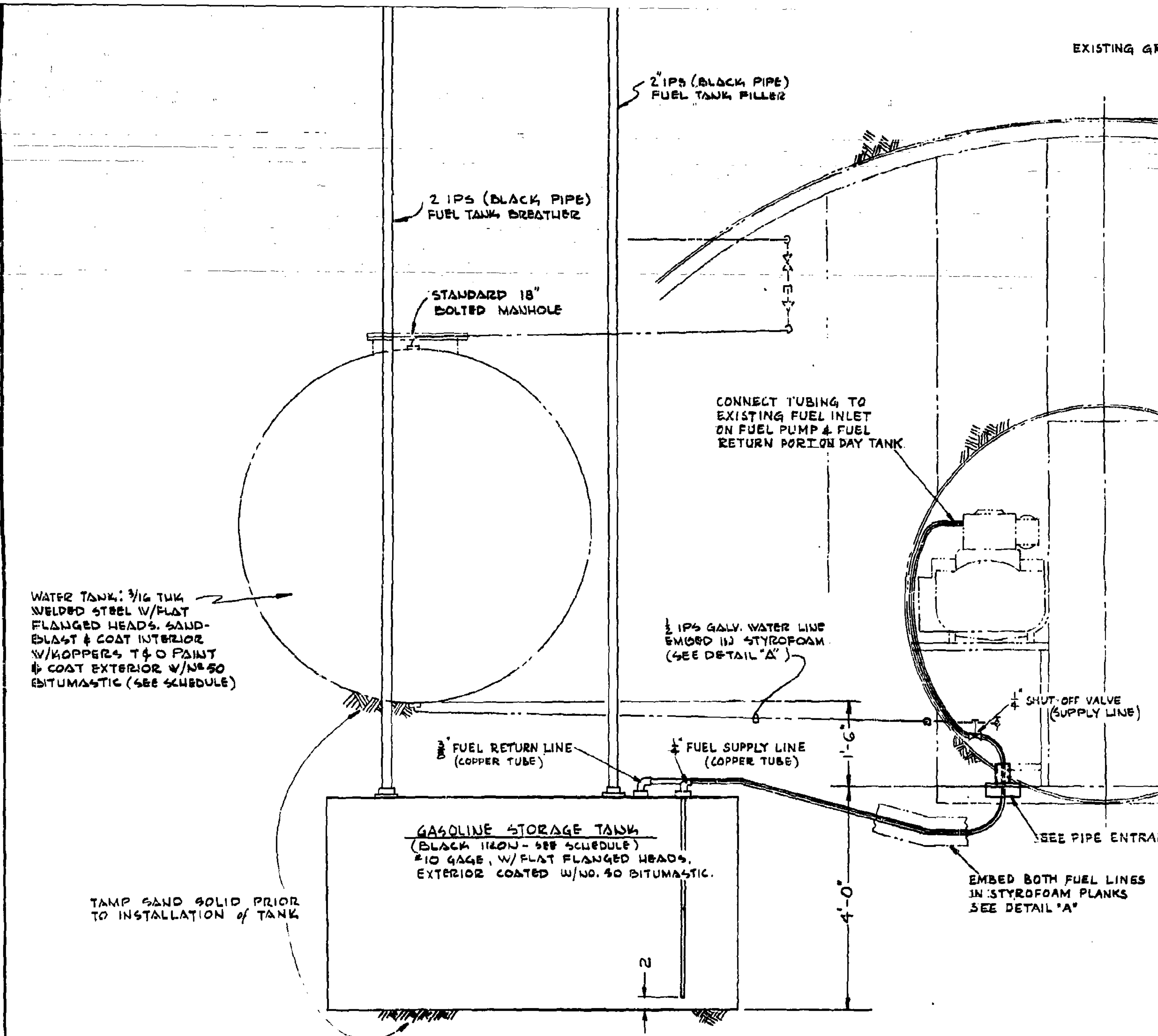
| DRAWN | FJA | DATE | FIG. A-17M |
| CHKD | JJR | | |




| GASOLINE TANK SCHEDULE | | | |
|---|---|---|---|
| PKG No | POWER | CAPACITY | APPROX. DIM. |
| P-1 | 1.5 KW | 95 GAL | 28" DIA. x 42" |
| P-2 | 2 KW | 160 GAL | 28" DIA. x 60" |
| P-3 | 3.5 KW | 280 GAL | 45 1/2" DIA. x 40" |
| P-4 | 5 KW | 390 GAL | 45 1/2 DIA. x 54" |
| P-5 | 7.5 KW | 620 GAL | 45 1/2 DIA. x 88" |
| | | | |

## SECTION X-X

SCALE: 3/4" = 1'-0"

4

| WATER TANK S | | |
|---|---|---|
| PKG No | CAPACITY (GAL) | |
| A | 1000 | |
| B | 1500 | |
| C | 1500 | |
| | | |

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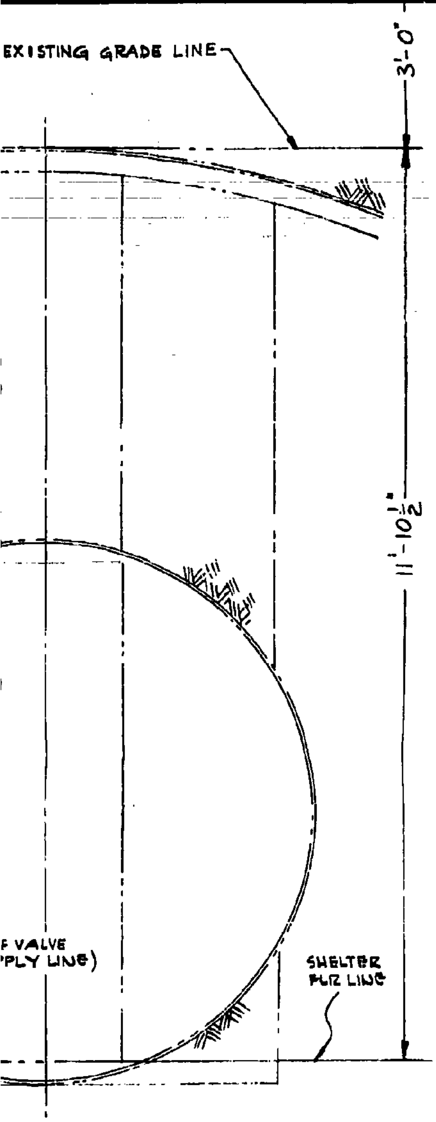
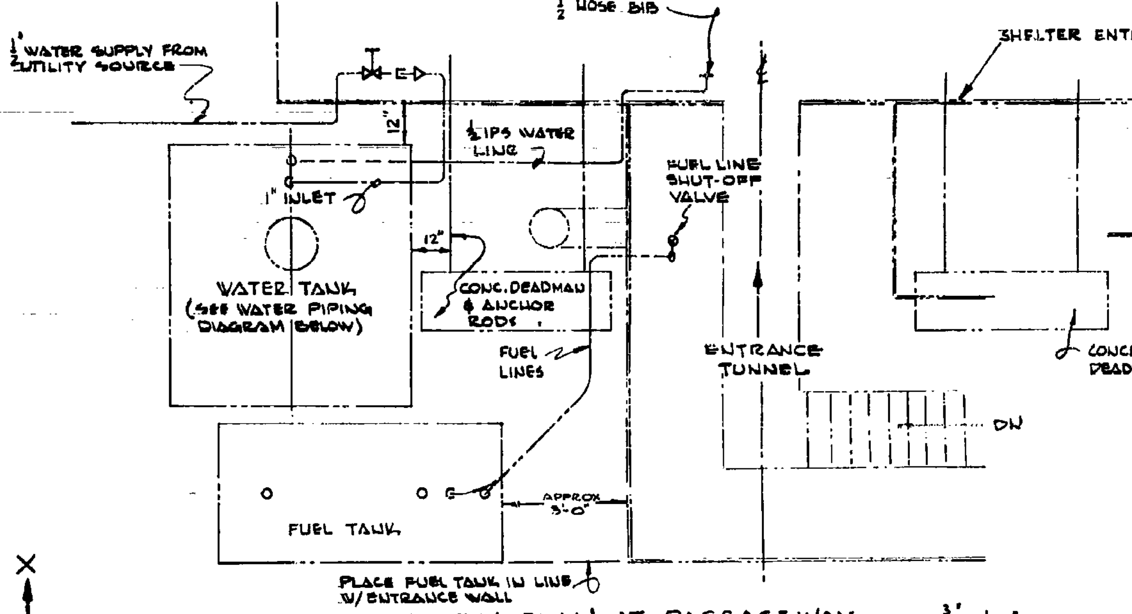


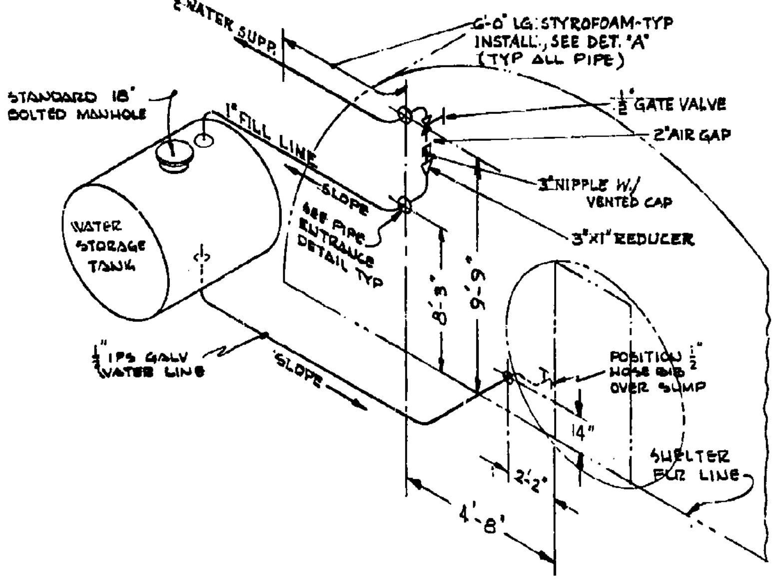

PIPE ENTRANCE DETAIL

UEL LINES
PLANKS

TYPICAL UNDERGROUND PIPE INSTALLATION NOT TO SCALE




PARTIAL PLAN AT PASSAGEWAY, SCALE: ⅜"=1'-0"




WATER TANK PIPING DIAGRAM

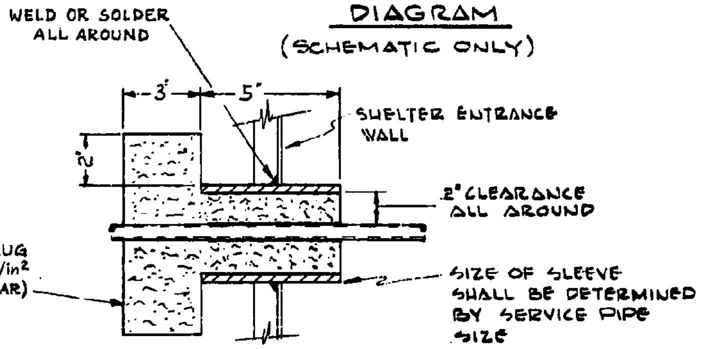
(SCHEMATIC ONLY)

5

## NOTES:

1. ENTRY OF ALL PIPES INTO SHELTE
   WITH DETAILS SHOWN IN PIPE EN
2. PRIOR TO BACKFILLING AROUND T
   TEST THE TOTAL GAS & WATER T
   PRESSURIZING TO 5 lb/SQ.IN. NEIT
   AT THIS PRESSURE, AND LEAKS
   BE REPAIRED AND THE SYSTEM
3. THE WATER TANK COMPLETE WIT
   DISINFECTED WITH CHLORINE B
   OPERATION. THE AMOUNT OF CH
   SUCH AS TO PROVIDE A DOSAGE
   PER MILLION. FOLLOWING A CO
   THAN 8 HOURS, THE HEAVILY
   BE FLUSHED OUT WITH CLEAN
   PLACED IN SERVICE.

| TANK SCHEDULE | |
|---|---|
| PACITY (GAL) | APPROX. DIM. |
| 1000 | 4'-6 DIA x 8'-6 |
| 1500 | 75½" DIA x 82" |
| 1500 | 75½" DIA x 82" |
| | |




PIPE ENTRANCE DETAIL

NOT TO SCALE

NG & DESIGN
ED BY: Lewis S. Patterson DATE: 22 May 62

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SAN FRANCISCO 24

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| SCOPE APPROVED | FJA | |
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| BRANCH HEAD | | |
| DIVISION HEAD | | |

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WATER

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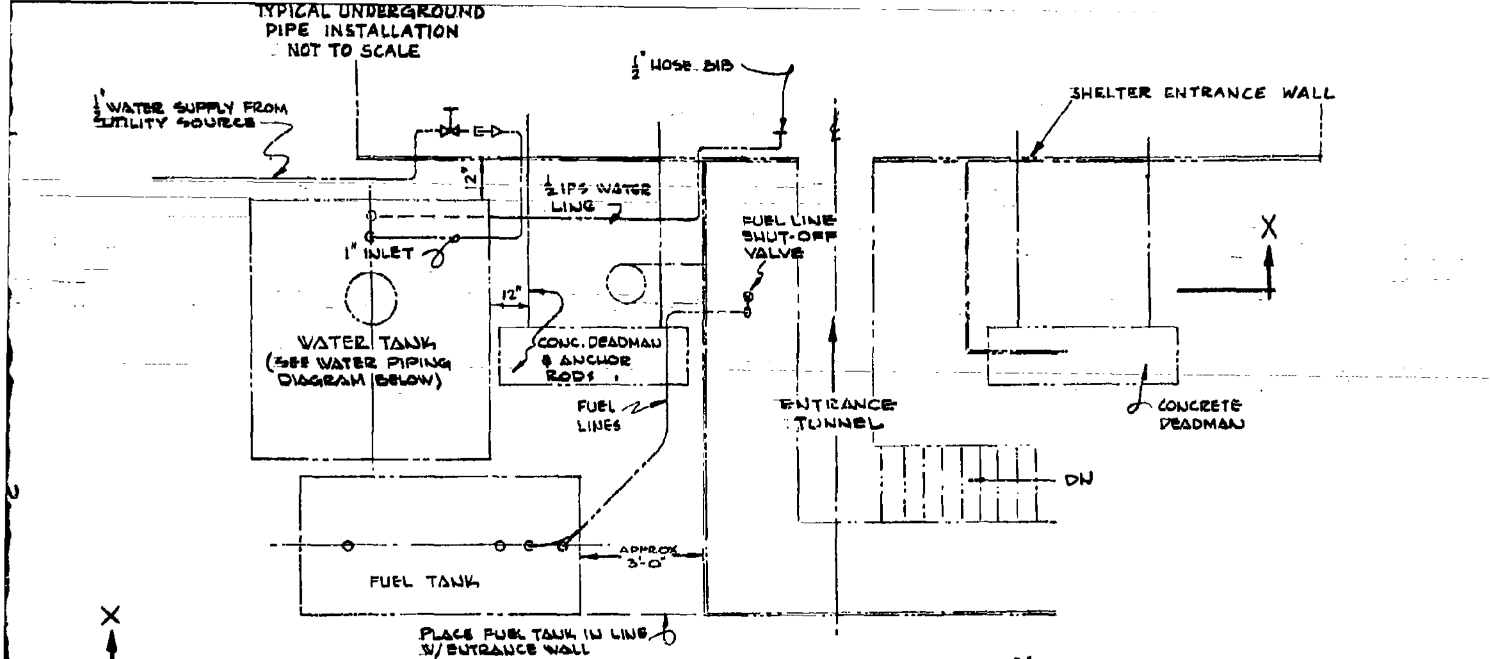
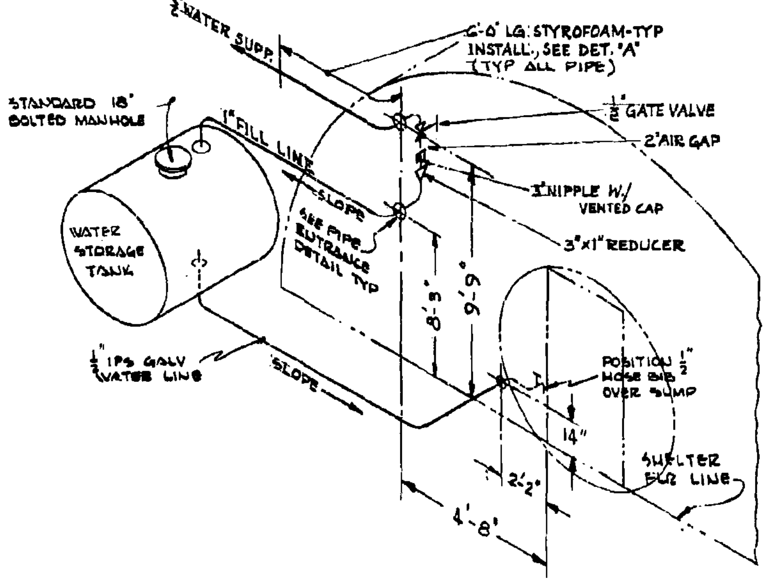



PARTIAL PLAN AT PASSAGEWAY, SCALE: ⅜" = 1'-0"

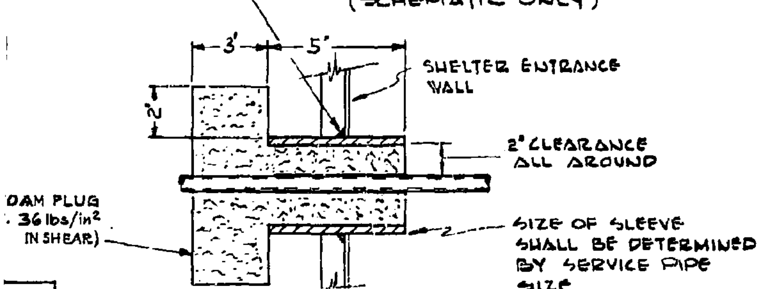



## NOTES:

1. ENTRY OF ALL PIPES INTO SHELTER IS TO BE IN ACCORDANCE WITH DETAILS SHOWN IN PIPE ENTRANCE DETAIL ON THIS DRAWING.
2. PRIOR TO BACKFILLING AROUND TANKS, THE CONTRACTOR IS TO TEST THE TOTAL GAS & WATER TANK-PIPE SYSTEM BY AIR PRESSURIZING TO 5 lb/SQ.IN. NEITHER SYSTEM SHALL LEAK AIR AT THIS PRESSURE, AND LEAKS DISCLOSED BY THIS TEST SHALL BE REPAIRED AND THE SYSTEM RETESTED.
3. THE WATER TANK COMPLETE WITH PIPING SHALL BE THOROUGHLY DISINFECTED WITH CHLORINE BEFORE BEING PLACED IN OPERATION. THE AMOUNT OF CHLORINE APPLIED SHALL BE SUCH AS TO PROVIDE A DOSAGE OF NOT LESS THAN 50 PARTS PER MILLION. FOLLOWING A CONTACT PERIOD OF NOT LESS THAN 8 HOURS, THE HEAVILY CHLORINATED WATER SHALL BE FLUSHED OUT WITH CLEAN WATER AND THE SYSTEM PLACED IN SERVICE.

6

WATER TANK PIPING DIAGRAM
(SCHEMATIC ONLY)




PIPE ENTRANCE DETAIL
NOT TO SCALE

| REVISION | DATE | DESCRIPTION | BY | APP. |
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UNITED STATES
NAVAL RADIOLOGICAL DEFENSE LABORATORY
SAN FRANCISCO 24, CALIFORNIA

| | | |
|---|---|---|
| DRAWN | FJA | DATE |
| CHKD | FJA | |
| SCOPE APPROVED | | |
| PROJ. ENGR. | | |
| SUPVR. | | |
| BRANCH HEAD | | |
| DIVISION HEAD | | |

DEVELOPMENTAL DWG.

FIG. A-17M
WATER & FUEL TANKS

| SCALE | PROJECT | TECH MEMO. |
|---|---|---|

DRAWING NUMBER S-62-970 SHEET 19 OF 19 ALT.

# APPENDIX B

## COST TABLES

Table 1

MATERIAL AND LABOR COSTS BY ITEM FOR BASIC-SHELTER PACKAGES

| Item No. | DESCRIPTION | MANUFACTURER | FIGURE NO. | ACTUAL MATERIAL AND LABOR-1959[a] | | | MATERIAL AND LABOR COSTS-1962[a] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Unit Labor Req. | | Material and Labor Unit Cost ($: Mat./Lab.) | Labor Hourly Rate | Cost Per Unit in Quantities Indicated ($: Mat./Lab.) | | | |
| | | | | Man-hours | Hourly Rate | | | 1 | 10 | 100 | 1,000 |
| 1 | Multi plate steel arch 12 gage -10 psi | Armco Drainage and Metal Products Inc., Youngstown, Ohio or U.S. Steel Corp. Amer.Bridge Div. Pittsburgh, Pa. | (25' -0" Span by 11'-8-1/2" Rise and 48' long) | | | | | 2662/ | 2662/ | 2662/ | 2662/ |
| 2 | Multi plate steel arch 10 gage - 35 psi | " | " " | | | 2550/ | | 3127/ | 3127/ | 3127/ | 3127/ |
| 3 | Front endwall, steel 8 gage | " | Fig. A-3M and A-5M | | | 672/ | | 1379/ | 1259/ | 955/ | 820/ |
| 4 | Rear endwall, steel 8 gage | " | " | | | 608/ | | 1253/ | 1144/ | 870/ | 748/ |
| 5 | Rear and front endwall bracing (includes steel rods) | General Contractor | Fig. A-3M | 41 | 3.375 | 114/138 | 3.98 | 114/64 | 114/62 | 100/57 | 100/38 |
| 6 | Foundation and dead men | " | Sidewall detail type 1, Fig. A-2N-1. Endwall type 4, Fig.A-2N-2. | 44 | 3.41 | 245/150 | 4.07 | 245/179 | 203/175 | 200/155 | 196/112 |
| 7 | Floor slab complete with drain trough and sump | " | | 26.6 | 3.38 | 175/90 | 3.98 | 175/106 | 170/104 | 164/104 | 163/95 |
| 8 | Expansion joint filler | " | | 5.1 | 3.34 | 16/17 | 3.92 | 8/15 | 7/14 | 6/10 | 5/6 |

[a] Material costs are F.O.B. San Francisco. The material cost for a mass-produced item includes all manufacturing costs--material, labor, overhead, profit, etc. Labor costs have not been entered for items that do not require installation labor or whose installation labor has been included as a part of another package. Material and labor costs for 1959 are for those items installed in the Camp Parks prototype shelter, and are based on actual costs reported by the General Contractor. The 1962 hourly rates are based on the U.S. Department of Labor 1962 schedule for building trades in San Francisco. For detailed discussion of 1959 and 1962 material and labor costs listed see 4.1 of this report.

Table 2

UNIT COST DIFFERENTIALS FOR BASIC-SHELTER-PACKAGE ITEMS

(See Table 1)

| Item No. | One-Off Item Cost (Material/Labor) | | | Net Unit Cost Differential* (Mat./Labor) | Remarks relating to one-off item cost differentials when original unit cost quoted in Ref. 1 and/or actual contractor cost (modified as required) is used as a basis for comparison with 1962 prices. |
|---|---|---|---|---|---|
| | Available From General Contractor | Estimate in Ref. 1 | 1962 From Table 1 | | |
| 1 | | 2225/ | 2662 | + 437/ | Cost rise is due to increase in cost of labor for fabrication of the item and its transportation. |
| 2 | 2550/ | | 3127/ | + 577/ | " |
| 3 | 672/ | | 1379/ | + 707/ | Cost rise is due to experience gained by the fabricator in producing the endwall for the Camp Parks prototype shelter. |
| 4 | 608/ | | 1253/ | + 645/ | " |
| 5 | 114/138 | | 114/64 | / - 74 | Labor cost reduction is due to (a) a redesign of the support brackets that tie the vertical struts to the horizontal strongback; (b) the shaping of the horizontal strongback. |
| 6 | 245/150 | | 245/179 | / + 29 | Labor cost increase is due to wage increase. |
| 7 | 175/90 | | 175/106 | / + 16 | " |
| 8 | 16/17 | | 8/15 | - 8/ - 2 | Material cost reduction is due to redesign of expansion filler. Labor cost reduction is due to reduced labor cost resulting from design modifications. |

*A plus mark indicates an increase in 1962 item cost over its cost in 1959.
A minus mark indicates a decrease in 1962 item cost based on its cost in 1959.

TABLE 3

1962 SUMMARY COSTS FOR BASIC-SHELTER PACKAGES

NO. S-1 (10 psi)

| Item | No. Req'd | Average Labor and Material Cost Per Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 1 | 1 | 2662 | 2662 | 2662 | 2662 |
| 3 | 1 | 1379 | 1259 | 955 | 820 |
| 4 | 1 | 1253 | 1144 | 870 | 748 |
| 5 | 1 | 178 | 176 | 157 | 138 |
| 6 | 1 | 424 | 378 | 355 | 307 |
| 7 | 1 | 282 | 274 | 268 | 258 |
| 8 | 1 | 23 | 21 | 16 | 11 |
| TOTAL Average Cost Per Package ($) | | 6201 | 5914 | 5283 | 4944 |

NO. S-2 (35 psi)

| Item | No. Req'd | Average Labor and Material Cost Per Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 2 | 1 | 3127 | 3127 | 3127 | 3127 |
| 3 | 1 | 1379 | 1259 | 955 | 820 |
| 4 | 1 | 1253 | 1144 | 870 | 748 |
| 5 | 1 | 178 | 176 | 157 | 138 |
| 6 | 1 | 424 | 378 | 355 | 307 |
| 7 | 1 | 282 | 274 | 268 | 258 |
| 8 | 1 | 23 | 21 | 16 | 11 |
| TOTAL Average Cost Per Package ($) | | 6666 | 6379 | 5748 | 5409 |

Table 4

MATERIAL AND LABOR COSTS BY ITEM FOR ENTRANCE PACKAGES

| Item No. | DESCRIPTION | MANUFACTURER | FIGURE NO. | ACTUAL MATERIAL AND LABOR-1959[a] | | | MATERIAL AND LABOR COSTS - 1962[a] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Unit Labor Reqt. | | Material and Labor Unit Cost ($:Mat./Labor) | Labor Hourly Rate | Cost Per Unit in Quantities Indicated ($) Material/Labor | | | |
| | | | | Man-hours | Hourly Rate | | | 1 | 10 | 100 | 1,000 |
| 1 | Corrugated steel 84" diameter conduit - 12 gage (10 psi) complete with elbow endwall ring, connecting band and inner liner (semi-buried and buried configuration) | Armco Drainage and Metal Products, Inc. | Fig. A-4 and A-5 | | | | | 890/ | 890/ | 890/ | 890/ |
| 2 | Same as Item 1 except for above ground configuration. | | | | | | | 1040/ | 1040/ | 1040/ | 1040/ |
| 3 | Corrugated steel 84" diameter conduit - 10 gage (35 psi) complete with elbow endwall ring, connecting band and inner liner. | | | | | 700/ | | 1050/ | 1050/ | 1050/ | 1050/ |
| 4 | Endwall entrance door with frame in place. Complete with weather strip | Emsco Plywood Co. 922 19th Ave. Oakland, Calif. | Fig. A-5M | 5 | 3.37 | 29/17 | 3.98 | 14/20 | 13/20 | 12/19 | 11/16 |
| 5 | Dished head, bulkhead with door locking device (35 psi) material 5/16" thick steel | Lukens Steel Co. Coatsville, Penn. | Fig. A-4M | | 3.85 | 307/100 | 4.60 | 206/120 | 165/119 | 144/113 | 130/84 |

[a]Material costs are F.O.B. San Francisco. The material cost for a mass-produced item includes all manufacturing costs--material, labor, overhead, profit, etc. Labor costs have not been entered for items that do not require installation labor or whose installation labor has been included as part of another package. Material and labor costs for 1959 are for those items installed in the Camp Parks prototype shelter, and are based on actual costs reported by the General Contractor. The 1962 hourly rates are based on the U.S. Department of Labor 1962 schedule for building trades in San Francisco. For detailed discussion of 1959 and 1962 material and labor costs listed see 4.1 of this report.

(Table Continues)

Table 4 (Continued)

MATERIAL AND LABOR COSTS BY ITEM FOR ENTRANCE PACKAGES

| Item No. | DESCRIPTION | MANUFACTURER | FIGURE NO. | ACTUAL MATERIAL AND LABOR-1959[a] | | | MATERIAL AND LABOR COSTS-1962[a] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Unit Labor Req. | | Material and Labor Unit Cost ($: Mat./Lab.) | Labor Hourly Rate | Cost per Unit in Quantities Indicated ($: Mat./Lab.) | | | |
| | | | | Man-hours | Hourly Rate | | | 1 | 10 | 100 | 1,000 |
| 6 | Dished head, bulkhead with door-locking device (10 psi), material--1/4" thick steel | W.R. Cole Co. Oakland, Calif. Lukens Steel Co. Coatsville, Penn. | Fig. A-4M | | 3.85 | | 4.60 | 177/120 | 140/119 | 122/113 | 116/84 |
| 7 | Blast door complete with handle and hinges installed (10 psi) | Gen. Veneer Mfg. Co. 8652 Otis St. So. Gate, Calif. | Fig. A-4M | | | | | 142/30 | 91/30 | 67/30 | 56/28 |
| 8 | Blast door complete with handle and hinges installed (35 psi) | " | Fig. A-4M | 7 | 3.85 | 150/30 | 4.60 | 150/36 | 101/36 | 75/36 | 63/31 |
| 9 | Steps and hand rail completely installed in entrance tube | General Contractor | Fig. A-4M | 13 | 3.37 | 29/44 | 3.98 | 32/44 | 32/39 | 28/37 | 28/28 |
| 10 | Concrete walkway in entry tube (buried and semi-buried configuration) | " | Fig. A-4M | 1.8 | 3.37 | 11/6 | 3.97 | 6/6 | 6/6 | 4/5 | 4/5 |
| 11 | Same as Item 10 except for above ground configuration | " | " | | | | | 18/12 | 18/12 | 12/8 | 12/8 |

Table 5

UNIT COST DIFFERENTIALS FOR ENTRANCE-PACKAGE ITEMS
(See Table 4)

| Item No. | One-Off Item Cost (Material/Labor) | | | Net Unit Cost Differential* (Mat./Labor) | Remarks relating to one-off item cost differentials when original unit cost quoted in Ref. 1 and/or actual contractor cost (modified as required) is used as a basis for comparison with 1962 prices. |
|---|---|---|---|---|---|
| | Available From General Contractor | Estimate in Ref. 1 | 1962 From Table 4 | | |
| 1 | | 510/ | 890/ | + 320/ | Increase in cost is due to: (a) rise in cost for labor to fabricate the pipe; (b) transportation cost, and (c) omission in Ref. 1 for requirement of connecting bands and inner entrance liner. |
| 2 | | 650/ | 1040/ | + 390/ | " |
| 3 | 700/ | | 1050/ | + 350/ | " |
| 4 | 29/17 | | 14/20 | - 15/ + 3 | Decrease in material cost is the direct result of changing the design of the entrance door (which obviates door fabrication per federal specification) and locating a supplier who has long door-production experience. Weather stripping of the door is included in costs indicated. |
| 5 | 307/100 | | 206/120 | - 101/ + 20 | The decrease in material cost is the direct result of locating a supplier who is presently tooled to mass produce the dished head. Increase in labor cost is due to wage increase. |
| 6 | | 180/100 | 177/120 | - 3/ + 20 | " |
| 7 | | 142/25 | 142/30 | / + 5 | Increase in labor cost is due to wage increase. |
| 8 | 150/30 | | 150/36 | / + 6 | " |

(Table continues)

*A plus mark indicates an increase in 1962 item cost over its cost in 1959.
A minus mark indicates a decrease in 1962 item cost based on its cost in 1959.

Table 5 (Continued)

UNIT COST DIFFERENTIALS FOR ENTRANCE-PACKAGE ITEMS
(See Table 4)

| Item No. | One-Off Item Cost (Material/Labor) | | | Net Unit Cost Differential* (Mat./Labor) | Remarks relating to one-off item cost differentials when original unit cost quoted in Ref. 1 and/or actual contractor cost (modified as required) is used as a basis for comparison with 1962 prices. |
|---|---|---|---|---|---|
| | Available From General Contractor | Estimate in Ref. 1 | 1962 From Table 4 | | |
| 9 | 29/44 | | 32/44 | + 3/ | Increase in material cost is due to increased cost of fabrication labor. |
| 10 | 11/6 | | 6/6 | - 5/ | Decrease in material cost is due to error in contracting cost. |
| 11 | | 7/5 | 18/12 | + 11/ + 6 | Increase in material and labor cost is due to error in Ref. 1 costing. |

*A plus mark indicates an increase in 1962 item cost over its cost in 1959.
A minus mark indicates a decrease in 1962 item cost based on its cost in 1959.

Table 6 (Continued)

1962 SUMMARY COSTS FOR ENTRANCE PACKAGES

NO. E-1B

| Item | No. Req'd. | Average Labor and Material Cost Per Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 2 | 1 | 1040 | 1040 | 1040 | 1040 |
| 4 | 1 | 34 | 33 | 31 | 27 |
| 6 | 1 | 297 | 259 | 235 | 200 |
| 7 | 1 | 147 | 96 | 72 | 60 |
| 11 | 1 | 30 | 30 | 20 | 20 |
| TOTAL Average Cost Per Package ($) | | 1548 | 1458 | 1398 | 1347 |

NO. E-2

| Item | No. Req'd. | Average Labor and Material Cost Per Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 3 | 1 | 1050 | 1050 | 1050 | 1050 |
| 4 | 1 | 34 | 33 | 31 | 27 |
| 5 | 1 | 326 | 284 | 257 | 214 |
| 8 | 1 | 155 | 106 | 80 | 67 |
| 9 | 1 | 76 | 71 | 65 | 56 |
| 10 | 1 | 12 | 12 | 9 | 9 |
| TOTAL Average Cost Per Package ($) | | 1653 | 1556 | 1492 | 1423 |

(Table Continues)

TABLE 6 (Continued)

1962 SUMMARY COSTS FOR ENTRANCE PACKAGES

NO. E-1A

| Item | No. Req'd. | Average Labor and Material Cost Per Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 1 | 1 | 890 | 890 | 890 | 890 |
| 4 | 1 | 34 | 33 | 31 | 27 |
| 6 | 1 | 297 | 259 | 235 | 200 |
| 7 | 1 | 147 | 96 | 72 | 60 |
| 9 | 1 | 76 | 71 | 65 | 56 |
| 10 | 1 | 12 | 12 | 9 | 9 |
| TOTAL Average Cost Per Package ($) | | 1456 | 1361 | 1302 | 1242 |

Table 7

MATERIAL AND LABOR COSTS BY ITEM FOR VENT PACKAGES

| Item No. | DESCRIPTION | MANUFACTURER | FIGURE NO. | ACTUAL MATERIAL AND LABOR - 1959[a] | | | MATERIAL AND LABOR COSTS - 1962[a] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Unit Labor Reqt. | | Material and Labor Unit Cost ($: Mat./Labor) | Labor Hourly Rate | Cost Per Unit in Quantities Indicated ($:Material/Labor) | | | | |
| | | | | Man-Hours | Hourly Rate | | | 1 | 10 | 100 | 1,000 | |
| 1 | 675 cfm at 0.2 in. W.G. blower with 1/7 HP Motor Single phase, 110 volt Model B-15 | ILG Electric Ventilating Co. Chicago, Illinois | Fig. A-6M | | | | | 71/ | 71/ | 71/ | 58/ | |
| 2 | 675 cfm at 0.7 in. W.G. blower with 1/3 HP Motor Single phase, 110 volt Model B-18 | " | " | | | | | 119/ | 119/ | 119/ | 96/ | |
| 3 | 1600 cfm at 0.2 in. W.G. blower with 1/3 HP Motor Single phase, 110 volt Model BC-122 | " | " | | | | | 185/ | 185/ | 185/ | 154/ | |
| 4 | 1600 cfm at 1.0 in. W.G. blower with 1/2 HP Motor Single phase, 110 volt Model BC-122 | | " | | | 230/ | | 302/ | 302/ | 202/ | 172 | |
| 5 | Absolute filter Ultra aire space filter rated at 99.97% efficiency on the 0.3 micron dia. DOP test at 1000 SCFM at 0.9 in. W.G. | Mine Safety Appliances Co. 201 Braddock Ave., Pittsburgh 8, Pa. | " | | | 55/ | | 67/ | 61/ | 58/ | 41/ | |
| 6 | Combination filter support, transition duct and blower base (675 cfm system) | General contractor | " | | | | 4.30 | 49/97 | 49/91 | 48/68 | 47/36 | |
| 7 | Combination filter support, transition duct and blower base (1600 cfm system) | " | " | 23 | 3.85 | 52/89 | " | [illegible]/106 | 54/105 | 53/77 | 52/41 | |
| 8 | Duct work from vent fan outlet to center line of shelter complete ready to accept diffuser (675 cfm) | " | " | | | | 4.315 | 8/69 | 8/69 | 8/67 | 8/55 | |

[a] Material costs are F.O.B. San Francisco. The material cost for a mass-produced item includes all manufacturing costs--material, labor, overhead, profit, etc. Labor costs have not been entered for items that do not require installation labor or whose installation labor has been included as a part of another package. Material and labor costs for 1959 are for those items installed in the Camp Parks prototype shelter, and are based on actual costs reported by the General Contractor. The 1962 hourly rates are based on the U.S. Department of Labor 1962 schedule for building trades in San Francisco. For detailed discussion of 1959 and 1962 material and labor costs listed see 4.1 of this report.

(Table Continues)

Table 7 (Continued)

MATERIAL AND LABOR COSTS BY ITEM FOR VENT PACKAGES

| Item No. | DESCRIPTION | MANUFACTURER | FIGURE NO. | ACTUAL MATERIAL AND LABOR-1959[a] | | | MATERIAL AND LABOR COSTS - 1962[a] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Unit Labor Reqt. | | Material and Labor Unit Cost ($)Mat'l./Labor | Labor Hourly Rate | Cost Per Unit in Quantities Indicated ($) Material/Labor | | | |
| | | | | Man-hours | Hourly Rate | | | 1 | 10 | 100 | 1,000 |
| 9 | Same as for item No. 8 above except duct system is for 1600 cfm | General Contractor | Fig. A-6M | 18 | 3.60 | 12/65 | 4.315 | 12/78 | 12/78 | 12/76 | 12/62 |
| 10 | Diffuser (675 cfm) equivalent to Titus Model S-277-6" x 12" | The Titus Mfg.Co. Waterloo, Iowa | " | | | | " | 9/2 | 9/2 | 5/2 | 5/1 |
| 11 | Diffuser (1600 cfm) equivalent to Titus Model S-277 8" x 30" | " | | | | 17/1 | " | 17/2 | 17/2 | 11/2 | 11/1 |
| 12 | 2 Ton Air conditioning unit equivalent to Fedders Model C-924A-3 complete with mounting springs, control act. | Fedders Corporation Maspeth 78, New York | Fig. A-9M | | | | " | 453/ | 453/ | 372/ | 321/ |
| 13 | Exhaust ventilator fixed -10 psi | General Contractor | Fig. A-7M | | | | 4.60 | 110/53 | 102/53 | 96/52 | 96/43 |
| 14 | Retractable ventilator 35 psi | Tanner Welding Co. 888 Folsom St. San Francisco,Calif. | " | 26 | 3.60 | 92/100 | " | 105/73 | 99/73 | 92/70 | 92/58 |
| 15 | Installation of air conditioner complete with ducting | General Contractor | Fig. A-9M | | | | 4.315 | 40/74 | 40/74 | 40/70 | 40/51 |
| 16 | Intake ventilator 10 psi or 35 psi | General Contractor | Fig. A-4M | | 3.85 | 17/42 | 4.60 | 17/51 | 15/50 | 14/50 | 14/41 |
| 17 | Base for 675 cfm blower | | Fig. A-6M | | | | | 9/16 | 9/16 | 9/12 | 9/7 |
| 18 | Base for 1600 cfm blower | | " | | | | | 10/19 | 10/19 | 10/14 | 10/8 |

Table 8

UNIT COST DIFFERENTIALS FOR VENT PACKAGE ITEMS

(See Table 7)

| Item No. | One-Off Item Cost (Material/Labor) | | | Net Unit Cost Differential* (Mat./Labor) | Remarks relating to one-off item cost differentials when original unit cost quoted in Ref. 1 and/or actual contractor cost (modified as required) is used as a basis for comparison with 1962 prices. |
|---|---|---|---|---|---|
| | Available From General Contractor | Estimate in Ref. 1 | 1962 From Table 7 | | |
| 1 | | 178/ | 71/ | - 107/ | The cost differential is attributed to an error in costing as listed in Ref. 1. |
| 2 | | 182/ | 119/ | - 63/ | |
| 3 | | 224/ | 185/ | - 39/ | |
| 4 | 238/ | | 202/ | - 36/ | Cost reduction is due to reduction in sales price by the manufacturer. |
| 5 | 55/ | | 67/ | + 12/ | Cost increase is due to an increase is sales price by the manufacturer. |
| 6 | | 52/103 | 49/97 | - 3/- 6 | Cost decrease in labor and material reflects results of current cost study findings. |
| 7 | 52/89 | | 56/106 | + 4/+ 17 | Cost increase in labor and material is the result of a rise in cost of fabrication labor and material. |
| 8 | | 5/50 | 8/69 | + 3/+ 19 | Cost increase in labor and material is the result of a rise in cost of fabrication labor and material. |
| 9 | 12/65 | | 12/78 | 0/ + 13 | Cost increase in labor is due to a rise in the fabrication wages. |
| 10 | | 9/2 | 9/2 | | |
| 11 | 17/1 | | 17/2 | 0/ + 1 | Cost increase in labor is due to a rise in wages. |

*A plus mark indicates an increase in 1962 item cost over its cost in 1959.
A minus mark indicates a decrease in 1962 item cost based on its cost in 1959.

(Table continues)

Table 8 (Continued)

UNIT COST DIFFERENTIALS FOR VENT PACKAGE ITEMS

(See Table 7)

| Item No. | One-Off Item Cost (Material/Labor) | | | Net Unit Cost Differential* (Mat./Labor) | Remarks relating to one-off item cost differentials when original unit cost quoted in Ref. 1 and/or actual contractor cost (modified as required) is used as a basis for comparison with 1962 prices. |
|---|---|---|---|---|---|
| | Available From General Contractor | Estimate in Ref. 1 | 1962 From Table 7 | | |
| 12 | | 400/ | 453/ | + 53 | Cost increase in material is due to an increase in sales price by the manufacturer. |
| 13 | | 110/0 | 110/53 | 110/53 | Increase in cost of labor is attributed to an error in costing as listed in Ref. 1. |
| 14 | 92/100 | | 105/73 | + 13/ - 27 | The increase in cost for material and the decrease in cost for labor is the result of current cost study findings. |
| 15 | | 0/0 | 40/74 | + 40/ + 74 | The increase in cost for the installation of this equipment is due to this item being inadvertently omitted from the estimate in Ref. 1. |
| 16 | 17/42 | | 17/51 | / + 9 | The increase in cost for labor is the result of a rise in the fabrication wages. |
| 17 | | 0/0 | 9/16 | + 9/ + 16 | The increase in cost for the installation of this equipment is due to this item being inadvertently omitted from the estimate in Ref. 1. |
| 18 | | 0/0 | 10/19 | + 10/ + 19 | " |

*A plus mark indicates an increase in 1962 item cost over its cost in 1959.
A minus mark indicates a decrease in 1962 item cost based on its cost in 1959.

Table 9

1962 SUMMARY COST FOR VENT PACKAGES

NO. V-1A

| Item | No. Req'd | Average Labor and Material Cost Per Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 1 | 1 | 71 | 71 | 71 | 58 |
| 3 | 1 | 77 | 77 | 75 | 63 |
| 10 | 1 | 11 | 11 | 7 | 6 |
| 13 | 1 | 163 | 155 | 148 | 139 |
| 16 | 1 | 68 | 65 | 64 | 55 |
| 17 | 1 | 25 | 25 | 21 | 16 |
| TOTAL Average Cost Per Package ($) | | 415 | 404 | 386 | 337 |

NO. V-1B

| Item | No. Req'd | Average Labor and Material Cost Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 2 | 1 | 119 | 119 | 119 | 96 |
| 5 | 1 | 67 | 61 | 58 | 41 |
| 6 | 1 | 146 | 140 | 116 | 83 |
| 8 | 1 | 77 | 77 | 75 | 63 |
| 10 | 1 | 11 | 11 | 7 | 6 |
| 13 | 1 | 163 | 155 | 148 | 139 |
| 16 | 1 | 68 | 65 | 64 | 65 |
| TOTAL Average Cost Per Package ($) | | 651 | 628 | 587 | 493 |

(Table Continues)

Table 9 (Continued)

1962 SUMMARY COST FOR VENT PACKAGES

NO. V-1C

| Item | No. Req'd | Average Labor and Material Cost Per Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 3 | 1 | 185 | 185 | 185 | 154 |
| 9 | 1 | 90 | 90 | 88 | 74 |
| 11 | 1 | 19 | 19 | 13 | 12 |
| 12 | 1 | 453 | 453 | 372 | 321 |
| 13 | 1 | 163 | 155 | 148 | 139 |
| 15 | 1 | 114 | 114 | 110 | 91 |
| 16 | 2 | 136 | 130 | 128 | 110 |
| 18 | 1 | 29 | 29 | 24 | 18 |
| TOTAL Average Cost Per Package ($) | | 1189 | 1175 | 1068 | 919 |

NO. V-1D

| Item | No. Req'd | Average Labor and Material Cost Per Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 4 | 1 | 202 | 202 | 202 | 172 |
| 5 | 2 | 134 | 122 | 116 | 82 |
| 7 | 1 | 162 | 159 | 130 | 93 |
| 9 | 1 | 90 | 90 | 88 | 74 |
| 11 | 1 | 19 | 19 | 13 | 12 |
| 12 | 1 | 453 | 453 | 372 | 321 |
| 13 | 1 | 163 | 155 | 148 | 139 |
| 15 | 1 | 114 | 114 | 110 | 91 |
| 16 | 2 | 136 | 130 | 128 | 110 |
| TOTAL Average Cost Per Package ($) | | 1473 | 1444 | 1307 | 1094 |

(Table Continues)

Table 9 (Continued)

1962 SUMMARY COST FOR VENT PACKAGES

NO. V-2A

| Item | No. Req'd | Average Labor and Material Cost Per Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 1 | 1 | 71 | 71 | 71 | 58 |
| 8 | 1 | 77 | 77 | 75 | 63 |
| 10 | 1 | 11 | 11 | 7 | 6 |
| 14 | 1 | 189 | 172 | 162 | 150 |
| 16 | 1 | 68 | 65 | 64 | 55 |
| 17 | 1 | 25 | 25 | 21 | 16 |
| TOTAL Average Cost Per Package ($) | | 430 | 421 | 400 | 348 |

NO. V-2B

| Item | No. Req'd | Average Labor and Material Cost Per Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 2 | 1 | 119 | 119 | 119 | 96 |
| 5 | 1 | 67 | 61 | 58 | 41 |
| 6 | 1 | 146 | 140 | 116 | 83 |
| 8 | 1 | 77 | 77 | 75 | 63 |
| 10 | 1 | 11 | 11 | 7 | 6 |
| 14 | 1 | 178 | 172 | 162 | 150 |
| 16 | 1 | 58 | 65 | 64 | 55 |
| TOTAL Average Cost Per Package ($) | | 666 | 645 | 601 | 494 |

(Table Continues)

Table 9 (Continued)

1962 SUMMARY COST FOR VENT PACKAGES

NO. V-2C

| Item | No. Req'd | Average Labor and Material Cost Per Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 3 | 1 | 185 | 185 | 185 | 154 |
| 9 | 1 | 90 | 90 | 88 | 74 |
| 11 | 1 | 19 | 19 | 13 | 12 |
| 12 | 1 | 453 | 453 | 372 | 321 |
| 14 | 1 | 178 | 170 | 162 | 150 |
| 15 | 1 | 114 | 114 | 110 | 91 |
| 16 | 2 | 136 | 130 | 123 | 110 |
| 18 | 1 | 29 | 29 | 24 | 18 |
| TOTAL Average Cost Per Package ($) | | 1204 | 1192 | 1082 | 930 |

NO. V-2D

| Item | No. Req'd | Average Labor and Material Cost Per Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 4 | 1 | 202 | 202 | 202 | 172 |
| 5 | 2 | 134 | 122 | 116 | 82 |
| 7 | 1 | 172 | 159 | 130 | 93 |
| 9 | 1 | 90 | 90 | 88 | 74 |
| 11 | 1 | 19 | 19 | 13 | 12 |
| 12 | 1 | 453 | 453 | 372 | 321 |
| 14 | 1 | 178 | 172 | 162 | 150 |
| 15 | 1 | 114 | 114 | 110 | 91 |
| 16 | 2 | 136 | 130 | 128 | 110 |
| TOTAL Average Cost Per Package ($) | | 1488 | 1461 | 1321 | 1105 |

Table 10

MATERIAL AND LABOR COSTS BY ITEM FOR HOTEL PACKAGES

| Item No. | DESCRIPTION | MANUFACTURER | FIGURE NO. | ACTUAL MATERIAL AND LABOR - 1959[a] | | | MATERIAL AND LABOR COSTS - 1962[a] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Unit Labor Reqd.: Man-hours | Unit Labor Reqd.: Hourly Rate | Material and Labor Unit Cost ($:Mat./Labor) | Labor Hourly Rate | Cost Per Unit In Quantities Indicated ($) Material/Labor: 1 | 10 | 100 | 1,000 |
| 1 | Upper bunk rail support and upright floor holes complete for Hotel Package "H-1." 96 bunks | General contractor | Fig. A-10H | | 3.85 | *158/134 | 4.60 | 42/50 | 40/46 | 40/46 | 36/32 |
| 2 | Upper bunk rail support and upright floor holes complete for Hotel Package "H-2." 48 bunks | " | " | | | | | 21/25 | 20/23 | 20/23 | 12/16 |
| 3 | Upper bunk rail support and upright floor holes complete for Hotel Package "H-3." 32 bunks | " | " | | | | | 15/17 | 14/16 | 14/16 | 12/11 |
| 4 | Bunk sheets complete for Hotel Package "H-1." 96 bunks | " | " | | 3.75 | *397/206 | 4.00 | 167/202 | 166/197 | 159/170 | 121/102 |
| 5 | Bunk sheets complete for Hotel Package "H-2." 48 bunks | " | " | | | | | 84/101 | 83/99 | 80/85 | 61/51 |
| 6 | Bunk sheets complete for Hotel Package "H-3." 32 bunks | " | " | | | | | 56/68 | 56/66 | 53/57 | 41/34 |
| 7 | Upright support for bunks complete - Hotel Package "H-1." 96 bunks | " | " | 26 | 3.85 | *378/131 | 4.60 | 196/159 | 185/148 | 185/148 | 166/103 |
| 8 | Upright support for bunks complete - Hotel Package "H-2." 48 bunks | " | " | | | | | 98/79 | 93/74 | 93/74 | 83/52 |
| 9 | Upright support for bunks complete - Hotel Package "H-3." 32 bunks | " | " | | | | | 65/53 | 62/50 | 62/49 | 56/34 |
| 10 | Bunk poles (horizontal) complete - Hotel Package "H-1." 96 bunks | " | " | | | *154/162 | | 183/20 | 173/18 | 173/18 | 156/13 |

* This price represents cost (per item listed) for 96 bunks, the design of which is shown in H-366.

[a] Material costs are F.O.B. San Francisco. The material cost for a mass-produced item includes all manufacturing costs--material, labor, overhead, profit, etc. Labor costs have not been entered for items that do not require installation labor or whose installation labor has been included as a part of another package. Material and labor costs for 1959 are for those items installed in the Camp Parks prototype shelter, and are based on actual costs reported by the General Contractor. The 1962 hourly rates are based on the U.S. Department of Labor 1962 schedule for building trades in San Francisco. For detailed discussion of 1959 and 1962 material and labor costs listed see 4.1 of this report. (Table Continues)

Table 10 (Continued)

MATERIAL AND LABOR COSTS BY ITEM FOR HOTEL PACKAGES

| Item No. | DESCRIPTION | MANUFACTURER | FIGURE NO. | ACTUAL MATERIAL AND LABOR - 1959[a] | | | MATERIAL AND LABOR COSTS - 1962[a] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Unit Labor Reqt. | | Material and Labor Unit Cost ($:Mat./Labor) | Labor Hourly Rate | Cost Per Unit In Quantities Indicated ($) Material/Labor | | | |
| | | | | Man-hours | Hourly Rate | | | 1 | 10 | 100 | 1,000 |
| 11 | Bunk poles (horizontal) complete - Hotel Package "H-2" 48 bunks | General Contractor | Fig. A-10N | | | | | 91/10 | 87/9 | 87/9 | 78/7 |
| 12 | Bunk poles(horizontal) complete - Hotel Package "H-3" 32 bunks | " | " | | | | | 61/7 | 58/6 | 58/6 | 52/5 |
| 13 | Table with two benches complete | Montgomery Ward & Co. | Fig. A-9M | | | 57/ | | 35/ | 35/ | 34/ | 28/ |
| 14 | Step ladder - 8 foot | " | " | | | 12/ | | 12/ | 12/ | 12/ | 10/ |
| 15 | Toilet tank - 415 gallon (one unit) | Rheem Mfg. Co. Richmond, Calif. or Butler Mfg. Co. Richmond, Calif. | Fig. A-11M | | | 256/ | | 183/ | 158/ | 141/ | 140/ |
| 16 | Toilet tank platform with steps (one unit) | General contractor | " | 3 | 3.32 | 24/10 | 3.95 | 12/8 | 12/8 | 12/8 | 12/6 |
| 17 | Toilet curtains complete (one unit) | Stuart-Sauter Co. 100 Utah Ave. South San Francisco or Sullivan Co. 245 South Van Ness Ave. San Francisco. | " | 6 | " | 40/20 | " | 10/16 | 10/16 | 10/15 | 10/11 |
| 18 | Toilet Seat-installed (one unit) | Montgomery Ward & Co. | " | | 3.62 | 4/1 | 4.315 | 3/1 | 3/1 | 3/1 | 3/1 |
| 19 | Toilet 4" Vent hose completely installed (for one tank) | Flexhaust Co. 100 Park Ave. New York | " | | " | 35/5 | " | 18/3 | 18/3 | 16/2 | 15/2 |
| 20 | Toilet vent 4" "Y" connection | McMaster Car Supply Co. Chicago | " | | | 10/1 | | 3/1 | 3/1 | 3/1 | 3/1 |

(Table Continues)

Table 10 (Continued)

MATERIAL AND LABOR COSTS BY ITEM FOR HOTEL PACKAGES

| Item No. | DESCRIPTION | MANUFACTURER | FIGURE NO. | ACTUAL MATERIAL AND LABOR - 1959[a] | | | MATERIAL AND LABOR COSTS - 1962[a] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Unit Labor Reqt. | | Material and Labor Unit Cost ($:Mat./Labor) | Labor Hourly Rate | Cost Per Unit In Quantities Indicated ($) Material/Labor | | | |
| | | | | Man-hours | Hourly Rate | | | 1 | 10 | 100 | 1,000 |
| 21 | Toilet chemical. Linacreol or equal per gallon | West Chemical Product Co. 1490 - 66th St. Emeryville, Calif. | | | | 3/ | | 3/ | 3/ | 3/ | 2/ |
| 22 | 1000 gallon water tank | Rheem Mfg. Co. Richmond, Calif. or Butler Mfg. Co. Richmond, Calif. | Fig. A-17M | | | | | 250/ | 232/ | 215/ | 144/ |
| 23 | 1500 gallon water tank | " | " | | | 489/ | | 400/ | 395/ | 345/ | 222/ |
| 24 | Water piping complete less the utility connection | General contractor | " | | 4.05 | 18/24 | 4.93 | 18/30 | 18/30 | 18/29 | 18/24 |
| 25 | First aid kit complete. | " | | | | 17/ | | 19/ | 19/ | 19/ | 19/ |
| 26 | Electric lantern with two batteries. | Montgomery Ward & Co. | | | | 3/ | | 6/ | 6/ | 5/ | 4/ |
| 27 | Flashlight complete with two batteries. | " | | | | 1/ | | 1/ | 1/ | 1/ | 1/ |
| 28 | Blanket-wool 3/4 bed size | " | | | | 5/ | | 9/ | 9/ | 9/ | 7/ |
| 29 | 14" adjustable pipe wrench | " | | | | 4/ | | 4/ | 4/ | 4/ | 3/ |
| 30 | Steel sledge 8 pound | " | | | | | | 5/ | 5/ | 5/ | 4/ |

(Table Continues)

Table 10 (Continued)

MATERIAL AND LABOR COSTS BY ITEM FOR HOTEL PACKAGES

| Item No. | DESCRIPTION | MANUFACTURER | FIGURE NO. | ACTUAL MATERIAL AND LABOR - 1959[a] | | | MATERIAL AND LABOR COSTS - 1962[a] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Unit Labor Reqt. | | Material and Labor Unit Cost ($:Mat./Labor) | Labor Hourly Rate | Cost Per Unit In Quantities Indicated ($) Material/Labor | | | |
| | | | | Man-hours | Hourly Rate | | | 1 | 10 | 100 | 1,000 |
| 31 | Round point shovel. | Montgomery Ward & Co. | | | | | | | | | |
| 32 | Wrecking bar four feet long | McMaster Co. Chicago, Ill. | | | | | | 3/ | 3/ | 3/ | 2/ |
| 33 | Roll-Toilet paper-One roll | Baker/Hamilton San Francisco, Calif. | | | | | | 7/ | 7/ | 7/ | 6/ |
| | | | | | | | | 0.14/ | 0.14/ | .13/ | 0.11/ |
| 34 | Toilet seat covers (1 pack) | " | (200 covers per pack) | | | | | 0.64/ | 0.64/ | 0.63/ | 0.56/ |
| 35 | Insecticide - DDT | " | Baker Hamilton Cat. No.2E2751 | | | | | 1/ | 1/ | 0.91/ | 0.61/ |
| 36 | Paper towels (1 carton) | " | (1875 per carton) | | | | | | | | |
| 37 | Disposable wash-cloths (1 cloth) | R.R. Williams Inc. Cabman, Conn. | | | | | | 4/ | 4/ | 4/ | 3/ |
| | | | | | | | | 0.023/ | 0.023/ | 0.023/ | 0.018/ |
| 38 | Broom | Montgomery Ward & Co. | | | | | | | | | |
| 39 | Misc. recreational equipment - includes playing cards, games and paperback books (Lot.) | | | | | | | 1.3/ | 1.3/ | 1.2/ | 0.90/ |
| | | | | | | | | 7/ | 7/ | 7/ | 6/ |

(Table Continues)

Table 10 (Continued)

MATERIAL AND LABOR COSTS BY ITEM FOR HOTEL PACKAGES

| Item No. | DESCRIPTION | MANUFACTURER | FIGURE NO. | ACTUAL MATERIAL AND LABOR REQUIREMENTS -1959[a] | | | MATERIAL AND LABOR COSTS- 1962 [b] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Unit Labor Reqt. | | Material and Labor Unit Cost ($:Mat./Labor) | Labor Hourly Rate | Total Price Per Unit in Quantities as Indicated ($) Material/Labor | | | |
| | | | | Man-hours | Hourly Rate | | | 1 | 10 | 100 | 1,000 |
| 40 | Food allowance--same as listed in Appendix C of Ref. 1 | | | | | | | 700 | 700 | 700 | 700 |
| 41 | Refuse bags, Polyethylene Bag, 24 x 72 x .0025 thick-Two bags per unit | | | | | | | 0.28 | 0.28 | 0.28 | 0.22 |
| 42 | Detergent pow. Gen.use one per unit | | | | | | | 1/ | 1/ | 1/ | 1/ |
| 43 | Sauce pan. Aluminum, one per unit | Dunham Carrig., and Hayden | (Mirror No. 423M-3 qt., capacity-18 gage) | | | | | 2/ | 2/ | 1/ | 1/ |
| 44 | Hot plate, elect., one per unit | Bersteed Mfg., Div. of McGraw Edison Co. | (Two-burner-total wattage-1600.) | | | | | 7/ | 5/ | 5/ | 4/ |
| 45 | Immersion Heater, one per unit | Arthur H.Thomas Co. | (250 watt, 115 volts.) | | | | | 5/ | 5/ | 3/ | 3/ |
| 46 | Pail, one per unit | Montgomery Ward and Co. | (10 qt.metal-rust-resistant) | | | | | 1/ | 1/ | 1/ | 1/ |
| 47 | Plastic cups,disposable, 200 cups per unit | Zellerbach Paper Co., Special Div. | (Commercial grade) | | | | | 3/ | 3/ | 2/ | 1/ |

(Table Continues)

Table 10 (Continued)

MATERIAL AND LABOR COSTS BY ITEM FOR HOTEL PACKAGES

| Item No. | DESCRIPTION | MANUFACTURER | FIGURE NO. | ACTUAL MATERIAL AND LABOR REQUIREMENTS - 1959[a] | | | MATERIAL AND LABOR COSTS - 1962[b] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Unit Labor Reqt. | | Material and Labor Unit Cost ($:Mat./Labor) | Labor Hourly Rate | Total Price Per Unit in Quantities as Indicated ($) Material/Labor | | | |
| | | | | Man-hours | Hourly Rate | | | 1 | 10 | 100 | 1,000 |
| 48 | Waterless hand cleaner, 1 gal. | Hanlon Chem.Co., Oakland, California | | | | | | 3/ | 3/ | 3/ | 2/ |
| 49 | Plastic soup spoons, 1000 each | Crest Sales Co., San Francisco, Calif | | | | | | 7/ | 7/ | 6/ | 6/ |
| 50 | Paper food plates, 8", 1000 each | " | | | | | | 9/ | 8/ | 8/ | 7/ |
| 51 | Disposable diapers, 6 doz. | Montgomery Ward and Co. | | | | | | 3/ | 3/ | 3/ | 2/ |
| 52 | Sanitary Napkins, 8 doz. | " | | | | | | 3/ | 3/ | 3/ | 2/ |

[a] Material costs listed are F.O.B. San Francisco. The material cost includes labor and material in the event the specific item is presently mass-produced by a manufacturer. The labor prices for 1959 are actual costs reported by the general contractor who was responsible for the construction of the Camp Parks Shelter located at Pleasanton, California. Item costs marked with an * were modified because contractor data was found to be incorrect.

[b] Labor and material prices have been adjusted to 1962 costs where necessary.

Table 11

UNIT COST DIFFERENTIALS FOR HOTEL PACKAGE ITEMS
(See Table 10)

| Item No. | One-Off Item Cost (Material/Labor) | | | Net Unit Cost Differentials* (Mat./Labor) | Remarks relating to one-off item cost differentials when original unit cost quoted in Ref. 1 and/or actual contractor cost (modified as required) is used as a basis for comparison with 1962 prices. |
|---|---|---|---|---|---|
| | Available From General Contractor | Estimate in Ref. 1 | 1962 From Table 10 | | |
| 1 | 158/134 | | 42/50 | - 116/- 84 | The decrease in material cost is the result of:(1) design change;(2) correcting error made by the contractor in costing material. The decrease in labor cost is the result of design changes. |
| 2 | 79/67 | | 21/25 | - 58/- 42 | " |
| 3 | 53/45 | | 15/17 | - 39/- 28 | " |
| 4 | 397/206 | | 167/202 | - 230/- 4 | The decrease in material cost is the result of deleting the requirement for the bunks to be fabricated from plastic sheeting. The decrease in labor cost is the result of less labor requirement to fabricate the bunks from canvas instead of plastic material. |
| 5 | 199/103 | | 84/101 | - 115/- 2 | " |
| 6 | 133/70 | | 56/68 | - 77/- 2 | " |
| 7 | 378/131 | | 196/159 | - 182/+ 28 | The decrease in material cost is the result of: (1) design changes;(2) correcting error made by the contractor in costing material. The increase in labor is the result of wage increases to labor. |
| 8 | 189/65 | | 98/79 | - 91/+ 14 | |

*A plus mark indicates an increase in 1962 item cost over its cost in 1959.
A minus mark indicates a decrease in 1962 item cost based on its cost in 1959.

(Table continues)

Table 11 (Continued)

UNIT COST DIFFERENTIALS FOR HOTEL PACKAGE ITEMS
(See Table 10)

| Item No. | One-Off Item Cost (Material/Labor) | | | Net Unit Cost Differential* (Mat./Labor) | Remarks relating to one-off item cost differentials when original unit cost quoted in Ref. 1 and/or actual contractor cost (modified as required) is used as a basis for comparison with 1962 prices. |
|---|---|---|---|---|---|
| | Available From General Contractor | Estimate in Ref. 1 | 1962 From Table 10 | | |
| 9 | 126/46 | | 65/53 | - 51/+ 7 | The decrease in material cost is the result of: (1) design changes;(2) correcting error made by the contractor in costing material. The increase in labor is the result of wage increases to labor |
| 10 | 154/162 | | 183/20 | + 29/- 142 | The increase in material cost is the result of a design change. The decrease in labor cost is the result of design changes. |
| 11 | 76/81 | | 91/10 | + 15/- 71 | |
| 12 | 52/55 | | 61/7 | + 9/- 48 | |
| 13 | 57/ | | 35/ | - 22/ | The decrease in cost is the result of table and bench design changes. |
| 14 | 12/ | | 12/ | | |
| 15 | 256/ | | 183/ | - 73/ | The decrease in cost is the result of tank design changes. |
| 16 | 24/10 | | 12/8 | - 12/- 2 | The decrease in cost is the result of design changes |
| 17 | 40/20 | | 10/16 | - 30/- 4 | The decrease in material cost is the result of deleting the requirement for plastic curtains and miscellaneous other changes. The decrease in labor cost is the result of less labor required to fabricate canvas curtains in place of plastic. |

(Table continues)

*A plus mark indicates an increase in 1962 item cost over its cost in 1959.
A minus mark indicates a decrease in 1962 item cost based on its cost in 1959.

Table 11 (Continued)

UNIT COST DIFFERENTIALS FOR HOTEL PACKAGE ITEMS
(See Table 10)

| Item No. | One-Off Item Cost (Material/Labor): Available From General Contractor | Estimate in Ref. 1 | 1962 From Table 10 | Net Unit Cost Differential* (Mat./Labor) | Remarks relating to one-off item cost differentials when original unit cost quoted in Ref. 1 and/or actual contractor cost (modified as required) is used as a basis for comparison with 1962 prices. |
|---|---|---|---|---|---|
| 18 | 4/1 | | 3/1 | - 1/ | The decrease in material cost is the result of locating a supplier having greater learning experience in the fabrication of the items. |
| 19 | 35/5 | | 18/3 | - 17/- 2 | The decrease in material cost is the result of locating a supplier having greater learning experience in the fabrication of the item. The decrease in labor cost is the result of installation requirements for the purchased item being minimized. |
| 20 | 10/1 | | 3/1 | | |
| 21 | 3/ | | 3/ | | |
| 22 | | 265/ | 250/ | - 15/ | The decrease in cost is the result of design modifications to the task. |
| 23 | 489/ | | 400/ | - 89/ | The cost reduction is the result of design changes that provide for the installation of tanks that are standard with the supplier. |
| 24 | 18/24 | | 18/30 | / + 6 | The increase in the cost of labor is the result of labor wage increases. |
| 25 | 17/ | | 19/ | + 2/ | The increase in cost of the kit is the result of general increases in basic labor and material req'd. |
| 26 | 3/ | | 6/ | + 3/ | The increase in the cost reflects additional funds that are required to purchase the item from retail outlets rather than from federal stock. |

*A plus mark indicates an increase in 1962 item cost over its cost in 1959.
A minus mark indicates a decrease in 1962 item cost based on its cost in 1959.

(Table continues)

Table 11 (Continued)

UNIT COST DIFFERENTIALS FOR HOTEL PACKAGE ITEMS
(See Table 10)

| Item No. | One-Off Item Cost (Material/Labor) | | | Net Unit Cost Differential* (Mat./Labor) | Remarks relating to one-off item cost differentials when original unit cost quoted in Ref. 1 and/or actual contractor cost (modified as required) is used as a basis for comparison with 1962 prices. |
|---|---|---|---|---|---|
| | Available From General Contractor | Estimate in Ref. 1 | 1962 From Table 10 | | |
| 27 | 1/ | | 1/ | | |
| 28 | 5/ | | 9/ | + 4/ | The increase in cost reflects additional funds that are required to purchase the item from retail outlets rather than from federal stock. |
| 29 | 4/ | | 4/ | | |
| 30 | | 0/ | 5/ | + 5/ | This item has been added as it was inadvertently left off Ref. 1 material list. |
| 31 | | 2/ | 3/ | + 1/ | As a result of this investigation the square pointed shovel (Ref. 1) has been replaced with a round pointed shovel. |
| 32 | | 1/ | 7/ | + 6/ | This item has been changed from a small 18" wrecking bar to that of a four foot bar. |
| 33 | | 0.085/ | 0.14/ | +0.055/ | The increase in cost reflects additional funds required to purchase the item from retail outlets rather than from federal stock. |
| 34 | | 0.64/ | 0.64/ | | |
| 35 | | 1/ | 1/ | | |
| 36 | | 1.60/ | 4/ | + 2.40/ | The increase in cost reflects additional funds required to purchase the item from retail outlets rather than from federal stock. |

*A plus mark indicates an increase in 1962 item cost over its cost in 1959.
A minus mark indicates a decrease in 1962 item cost based on its cost in 1959.

(Table continues)

Table 11 (Continued)

UNIT COST DIFFERENTIALS FOR HOTEL PACKAGE ITEMS
(See Table 10)

| Item No. | One-Off Item Cost (Material/Labor) | | | Net Unit Cost Differential* (Mat./Labor) | Remarks relating to one-off item cost differentials when original unit cost quoted in Ref. 1 and/or actual contractor cost (modified as required) is used as a basis for comparison with 1962 prices. |
|---|---|---|---|---|---|
| | Available From General Contractor | Estimate in Ref. 1 | 1962 From Table 10 | | |
| 37 | | 0.23/ | 0.23/ | | |
| 38 | | 0.89/ | 1.3/ | + 0.41/ | The increase in cost reflects additional funds required to purchase the item from retail outlets rather than from federal stock. |
| 39 | | 0/ | 7/ | + 7/ | This item has been added as a result of NRDL habitable test findings. |
| 40 | | 700/ | 700/ | | Detailed information regarding the status of current shelter food research is not available. Costing listed in Ref. 1 has been specified without change. |
| 41 | | 0.20 | 0.28/ | +0.08 | The increase in cost reflects additional funds req'd to purchase the item from retail outlets rather than from federal stock. |
| 42 | | 0.18/ | 1/ | + 0.82 | " |
| 43 | | 1.60/ | 2/ | + 0.40/ | " |
| 44 | | 7/ | 7/ | | |
| 45 | | 4.80/ | 5/ | + 0.20/ | The increase in material cost is the result of rise in cost for item |
| 46 | | 1.13/ | 1/ | - 0.13/ | The decrease in cost for the item is the result of locating a minimum cost supplier. |

*A plus mark indicates an increase in 1962 item cost over its cost in 1959.
A minus mark indicates a decrease in 1962 item cost based on its cost in 1959.

(Table continues)

Table 11 (Continued)

**UNIT COST DIFFERENTIALS FOR HOTEL PACKAGE ITEMS**
(See Table 10)

| Item No. | One-Off Item Cost (Material/Labor) | | | Net Unit Cost Differential* (Mat./Labor) | Remarks relating to one-off item cost differentials when original unit cost quoted in Ref. 1 and/or actual contractor cost (modified as required) is used as a basis for comparison with 1962 prices. |
|---|---|---|---|---|---|
| | Available From General Contractor | Estimate in Ref. 1 | 1962 From Table 10 | | |
| 47 | | 3/ | 3/ | | |
| 48 | | 0/ | 3/ | + 3/ | This item was not included in Ref. 1. |
| 49 | | 0/ | 7/ | + 7/ | |
| 50 | | 0/ | 9/ | + 9/ | |
| 51 | | 0/ | 3/ | + 3/ | |
| 52 | | 0/ | 3/ | + 3/ | |

*A plus mark indicates an increase in 1962 item cost over its cost in 1959.
A minus mark indicates a decrease in 1962 item cost based on its cost in 1959.

Table 12

1962 SUMMARY COSTS FOR HOTEL PACKAGES

NO. H-1A

| Item | No. Req'd. | Average Labor and Material Cost Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 1 | 1 | 92 | 86 | 86 | 68 |
| 4 | 1 | 369 | 363 | 329 | 223 |
| 7 | 1 | 355 | 333 | 333 | 269 |
| 10 | 1 | 203 | 191 | 191 | 169 |
| 13 | 1 | 35 | 35 | 34 | 28 |
| 14 | 1 | 12 | 12 | 12 | 10 |
| 15 | 1 | 183 | 158 | 141 | 140 |
| 16 | 1 | 20 | 20 | 20 | 18 |
| 17 | 1 | 26 | 26 | 26 | 22 |
| 18 | 2 | 8 | 8 | 8 | 8 |
| 19 | 1 | 21 | 21 | 18 | 17 |
| 21 | 2 | 6 | 6 | 6 | 6 |
| 22 | 1 | 250 | 232 | 215 | 144 |
| 24 | 1 | 48 | 48 | 47 | 42 |
| 25 | 1 | 19 | 19 | 19 | 19 |
| 27 | 1 | 1 | 1 | 1 | 1 |
| 29 | 1 | 4 | 4 | 4 | 4 |
| 30 | 1 | 5 | 5 | 5 | 5 |
| 31 | 1 | 3 | 3 | 3 | 3 |
| 32 | 1 | 7 | 7 | 7 | 7 |
| 33 | 100 | 13 | 11 | 11 | 11 |
| 34 | 15 | 10 | 10 | 9 | 9 |
| 35 | 1 | 1 | 1 | 1 | 1 |
| 36 | 2 1/2 | 10 | 10 | 10 | 8 |
| 38 | 1 | 2 | 2 | 2 | 1 |
| 40 | 1 | 700 | 700 | 700 | 700 |
| 41 | 7 1/2 | 2 | 2 | 2 | 2 |
| 42 | 5 | 5 | 5 | 5 | 5 |
| 46 | 1 | 1 | 1 | 1 | 1 |
| 47 | 12 1/2 | 38 | 38 | 25 | 13 |
| 48 | 2 | 6 | 6 | 5 | 5 |
| 49 | 2 | 14 | 14 | 12 | 12 |
| 50 | 2 | 18 | 18 | 16 | 14 |
| 51 | 8 | 24 | 24 | 24 | 16 |
| 52 | 7 | 21 | 21 | 21 | 14 |
| TOTAL Average Cost Per Package ($) | | 2532 | 2441 | 2348 | 2015 |

NO. H-1B

| Item | No. Req'd. | Average Labor and Material Cost Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 1 | 1 | 92 | 86 | 86 | 68 |
| 4 | 1 | 369 | 363 | 329 | 223 |
| 7 | 1 | 355 | 333 | 333 | 269 |
| 10 | 1 | 203 | 191 | 191 | 169 |
| 13 | 5 | 175 | 175 | 170 | 140 |
| 14 | 1 | 12 | 12 | 12 | 10 |
| 15 | 2 | 366 | 316 | 282 | 280 |
| 16 | 2 | 40 | 40 | 40 | 36 |
| 17 | 2 | 52 | 52 | 52 | 44 |
| 18 | 4 | 16 | 16 | 16 | 16 |
| 19 | 2 | 42 | 42 | 36 | 34 |
| 20 | 1 | 4 | 4 | 4 | 4 |
| 21 | 4 | 12 | 12 | 12 | 8 |
| 23 | 1 | 400 | 355 | 345 | 222 |
| 24 | 1 | 48 | 48 | 47 | 42 |
| 25 | 1 | 19 | 19 | 19 | 19 |
| 26 | 1 | 6 | 6 | 5 | 4 |
| 29 | 1 | 4 | 4 | 4 | 3 |
| 30 | 1 | 5 | 5 | 5 | 4 |
| 31 | 1 | 3 | 3 | 3 | 3 |
| 32 | 1 | 7 | 7 | 7 | 6 |
| 33 | 100 | 13 | 11 | 11 | 11 |
| 34 | 15 | 10 | 10 | 9 | 9 |
| 35 | 1 | 1 | 1 | 1 | 1 |
| 36 | 2 1/2 | 10 | 10 | 10 | 8 |
| 38 | 1 | 2 | 2 | 1 | 1 |
| 40 | 1 | 700 | 700 | 700 | 700 |
| 41 | 7 1/2 | 2 | 2 | 2 | 2 |
| 42 | 5 | 5 | 5 | 5 | 5 |
| 43 | 1 | 2 | 2 | 1 | 1 |
| 45 | 1 | 5 | 5 | 3 | 3 |
| 46 | 1 | 1 | 1 | 1 | 1 |
| 47 | 12 1/2 | 38 | 38 | 25 | 13 |
| 48 | 2 | 6 | 6 | 5 | 5 |
| 49 | 2 | 14 | 14 | 12 | 12 |
| 50 | 2 | 18 | 18 | 16 | 14 |
| 51 | 8 | 24 | 24 | 24 | 16 |
| 52 | 7 | 21 | 21 | 21 | 14 |
| TOTAL Average Cost Per Package ($) | | 3102 | 2999 | 2845 | 2420 |

(Table Continues)

Table 12 (Continued)

1962 SUMMARY COSTS FOR HOTEL PACKAGES

NO. H-1C

| Item | No. Req'd. | Average Labor and Material Cost Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 1 | 1 | 92 | 86 | 86 | 86 |
| 4 | 1 | 369 | 363 | 329 | 223 |
| 7 | 1 | 355 | 333 | 333 | 269 |
| 10 | 1 | 203 | 191 | 191 | 169 |
| 13 | 5 | 175 | 175 | 170 | 140 |
| 14 | 1 | 12 | 12 | 12 | 10 |
| 15 | 2 | 366 | 316 | 282 | 280 |
| 16 | 2 | 40 | 40 | 40 | 36 |
| 17 | 2 | 52 | 52 | 52 | 44 |
| 18 | 4 | 16 | 16 | 16 | 16 |
| 19 | 2 | 42 | 42 | 36 | 34 |
| 20 | 1 | 4 | 4 | 4 | 4 |
| 21 | 4 | 12 | 12 | 12 | 8 |
| 23 | 1 | 400 | 395 | 345 | 222 |
| 24 | 1 | 48 | 48 | 47 | 42 |
| 25 | 1 | 19 | 19 | 19 | 19 |
| 26 | 1 | 6 | 6 | 5 | 4 |
| 28 | 1 | 9 | 9 | 9 | 7 |
| 29 | 1 | 4 | 4 | 4 | 3 |
| 30 | 1 | 5 | 5 | 5 | 4 |
| 31 | 1 | 3 | 3 | 3 | 2 |
| 32 | 1 | 7 | 7 | 7 | 6 |
| 33 | 100 | 13 | 11 | 11 | 11 |
| 34 | 15 | 10 | 10 | 9 | 9 |
| 35 | 1 | 1 | 1 | 1 | 1 |
| 36 | 5 | 20 | 20 | 20 | 16 |
| 37 | 1400 | 32 | 32 | 32 | 25 |
| 38 | 1 | 2 | 2 | 1 | 1 |
| 39 | 1 | 7 | 7 | 7 | 6 |
| 40 | 1 | 700 | 700 | 700 | 700 |
| 41 | 15 | 4 | 4 | 4 | 4 |
| 42 | 5 | 5 | 5 | 5 | 5 |
| 43 | 4 | 8 | 8 | 4 | 4 |
| 44 | 1 | 7 | 5 | 5 | 4 |
| 46 | 1 | 1 | 1 | 1 | 1 |
| 47 | 25 | 76 | 76 | 50 | 26 |
| 48 | 4 | 12 | 12 | 10 | 10 |
| 49 | 4 | 28 | 28 | 24 | 24 |
| 50 | 4 | 36 | 36 | 32 | 28 |
| 51 | 8 | 24 | 24 | 24 | 16 |
| 52 | 7 | 21 | 21 | 21 | 14 |
| TOTAL Average Cost Per Package ($) | | 3246 | 3191 | 2968 | 2533 |

NO. H-2A

| Item | No. Req'd. | Average Labor and Material Cost Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 2 | 1 | 46 | 43 | 43 | 34 |
| 5 | 1 | 185 | 182 | 165 | 112 |
| 8 | 1 | 177 | 167 | 167 | 135 |
| 11 | 1 | 101 | 96 | 96 | 85 |
| 13 | 1 | 35 | 35 | 34 | 28 |
| 14 | 1 | 12 | 12 | 12 | 10 |
| 15 | 1 | 183 | 158 | 141 | 141 |
| 16 | 1 | 20 | 20 | 20 | 18 |
| 17 | 1 | 26 | 26 | 26 | 21 |
| 18 | 2 | 8 | 8 | 8 | 8 |
| 19 | 1 | 21 | 21 | 18 | 17 |
| 21 | 2 | 6 | 6 | 6 | 4 |
| 22 | 1 | 250 | 232 | 215 | 144 |
| 24 | 1 | 48 | 48 | 47 | 42 |
| 25 | 1 | 19 | 19 | 19 | 19 |
| 27 | 1 | 1 | 1 | 1 | 1 |
| 29 | 1 | 4 | 4 | 4 | 3 |
| 30 | 1 | 5 | 5 | 5 | 4 |
| 31 | 1 | 3 | 3 | 3 | 2 |
| 32 | 1 | 7 | 7 | 7 | 6 |
| 33 | 100 | 13 | 11 | 11 | 11 |
| 34 | 15 | 10 | 10 | 9 | 9 |
| 35 | 1 | 1 | 1 | 1 | 1 |
| 36 | 2 1/2 | 10 | 10 | 10 | 8 |
| 38 | 1 | 2 | 2 | 1 | 1 |
| 40 | 1 | 700 | 700 | 700 | 700 |
| 41 | 7 1/2 | 2 | 2 | 2 | 2 |
| 42 | 5 | 5 | 5 | 5 | 5 |
| 46 | 1 | 1 | 1 | 1 | 1 |
| 47 | 12 1/2 | 38 | 38 | 25 | 13 |
| 48 | 2 | 6 | 6 | 5 | 5 |
| 49 | 2 | 14 | 14 | 12 | 12 |
| 50 | 2 | 18 | 18 | 16 | 14 |
| 51 | 8 | 24 | 24 | 24 | 16 |
| 52 | 7 | 21 | 21 | 21 | 14 |
| TOTAL Average Cost Per Package ($) | | 2022 | 1956 | 1880 | 1646 |

(Table Continues)

Table 12 (Continued)

1962 SUMMARY COSTS FOR HOTEL PACKAGES

NO. H-2B

| Item | No. Req'd. | Average Labor and Material Cost Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 2 | 1 | 46 | 43 | 43 | 34 |
| 5 | 1 | 185 | 182 | 165 | 112 |
| 8 | 1 | 177 | 167 | 167 | 135 |
| 11 | 1 | 101 | 96 | 96 | 85 |
| 13 | 5 | 175 | 175 | 170 | 140 |
| 14 | 1 | 12 | 12 | 12 | 10 |
| 15 | 2 | 366 | 316 | 282 | 280 |
| 16 | 2 | 40 | 40 | 40 | 36 |
| 17 | 2 | 52 | 52 | 52 | 42 |
| 18 | 4 | 16 | 16 | 16 | 16 |
| 19 | 2 | 42 | 42 | 39 | 34 |
| 20 | 1 | 4 | 4 | 4 | 4 |
| 21 | 4 | 12 | 12 | 12 | 8 |
| 23 | 1 | 400 | 395 | 345 | 222 |
| 24 | 1 | 48 | 48 | 47 | 42 |
| 25 | 1 | 19 | 19 | 19 | 19 |
| 26 | 1 | 6 | 6 | 5 | 4 |
| 29 | 1 | 4 | 4 | 4 | 3 |
| 30 | 1 | 5 | 5 | 5 | 4 |
| 31 | 1 | 3 | 3 | 3 | 2 |
| 32 | 1 | 7 | 7 | 7 | 6 |
| 33 | 100 | 13 | 11 | 11 | 11 |
| 34 | 15 | 10 | 10 | 9 | 9 |
| 35 | 1 | 1 | 1 | 1 | 1 |
| 36 | 2 1/2 | 10 | 10 | 10 | 8 |
| 38 | 1 | 2 | 2 | 1 | 1 |
| 40 | 1 | 700 | 700 | 700 | 700 |
| 41 | 7 1/2 | 2 | 2 | 2 | 2 |
| 42 | 5 | 5 | 5 | 5 | 5 |
| 43 | 1 | 2 | 2 | 1 | 1 |
| 45 | 1 | 5 | 5 | 3 | 3 |
| 46 | 1 | 1 | 1 | 1 | 1 |
| 47 | 12 1/2 | 38 | 38 | 25 | 13 |
| 48 | 2 | 6 | 6 | 5 | 5 |
| 49 | 2 | 14 | 14 | 12 | 12 |
| 50 | 2 | 18 | 18 | 16 | 14 |
| 51 | 8 | 24 | 24 | 24 | 16 |
| 52 | 7 | 21 | 21 | 21 | 14 |
| TOTAL Average Cost Per Package ($) | | 2594 | 2458 | 2380 | 2054 |

NO. H-2C

| Item | No. Req'd. | Average Labor and Material Cost Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 2 | 1 | 46 | 43 | 43 | 34 |
| 5 | 1 | 185 | 182 | 165 | 112 |
| 8 | 1 | 177 | 167 | 167 | 135 |
| 11 | 1 | 101 | 96 | 96 | 85 |
| 13 | 5 | 175 | 175 | 170 | 140 |
| 14 | 1 | 12 | 12 | 12 | 10 |
| 15 | 2 | 366 | 316 | 282 | 280 |
| 16 | 2 | 40 | 40 | 40 | 36 |
| 17 | 2 | 52 | 52 | 52 | 42 |
| 18 | 4 | 16 | 16 | 16 | 16 |
| 19 | 2 | 42 | 42 | 39 | 34 |
| 20 | 1 | 4 | 4 | 4 | 4 |
| 21 | 4 | 12 | 12 | 12 | 8 |
| 23 | 1 | 400 | 395 | 345 | 222 |
| 24 | 1 | 48 | 48 | 47 | 42 |
| 25 | 1 | 19 | 19 | 19 | 19 |
| 26 | 1 | 6 | 6 | 5 | 4 |
| 28 | 1 | 9 | 9 | 9 | 7 |
| 29 | 1 | 4 | 4 | 4 | 3 |
| 30 | 1 | 5 | 5 | 5 | 4 |
| 31 | 1 | 3 | 3 | 3 | 2 |
| 32 | 1 | 7 | 7 | 7 | 6 |
| 33 | 100 | 13 | 11 | 11 | 11 |
| 34 | 15 | 10 | 10 | 9 | 9 |
| 35 | 1 | 1 | 1 | 1 | 1 |
| 36 | 5 | 20 | 20 | 20 | 16 |
| 37 | 1400 | 33 | 33 | 33 | 26 |
| 38 | 1 | 2 | 2 | 1 | 1 |
| 39 | 1 | 7 | 7 | 7 | 6 |
| 40 | 1 | 700 | 700 | 700 | 700 |
| 41 | 15 | 4 | 4 | 4 | 4 |
| 42 | 5 | 5 | 5 | 5 | 5 |
| 43 | 4 | 8 | 8 | 4 | 4 |
| 44 | 1 | 7 | 5 | 5 | 4 |
| 46 | 1 | 1 | 1 | 1 | 1 |
| 47 | 25 | 76 | 76 | 50 | 26 |
| 48 | 4 | 12 | 12 | 10 | 10 |
| 49 | 4 | 28 | 28 | 24 | 24 |
| 50 | 4 | 36 | 36 | 32 | 28 |
| 51 | 8 | 24 | 24 | 24 | 16 |
| 52 | 7 | 21 | 21 | 21 | 14 |
| TOTAL Average Cost Per Package ($) | | 2737 | 2652 | 2504 | 2151 |

(Table Continues)

Table 12 (Continued)

1962 SUMMARY COSTS FOR HOTEL PACKAGES

NO. H-3A

| Item | No. Req'd. | Average Labor and Material Cost Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 3 | 1 | 32 | 30 | 30 | 23 |
| 6 | 1 | 124 | 122 | 110 | 75 |
| 9 | 1 | 118 | 112 | 111 | 90 |
| 12 | 1 | 68 | 64 | 64 | 57 |
| 13 | 1 | 35 | 35 | 34 | 28 |
| 14 | 1 | 12 | 12 | 12 | 10 |
| 15 | 1 | 183 | 158 | 141 | 140 |
| 16 | 1 | 20 | 20 | 20 | 18 |
| 17 | 1 | 26 | 26 | 26 | 22 |
| 18 | 2 | 8 | 8 | 8 | 8 |
| 19 | 1 | 21 | 21 | 18 | 17 |
| 21 | 2 | 6 | 6 | 6 | 6 |
| 22 | 1 | 250 | 232 | 215 | 144 |
| 24 | 1 | 48 | 48 | 47 | 42 |
| 25 | 1 | 19 | 19 | 19 | 19 |
| 27 | 1 | 1 | 1 | 1 | 1 |
| 29 | 1 | 4 | 4 | 4 | 4 |
| 30 | 1 | 5 | 5 | 5 | 5 |
| 31 | 1 | 3 | 3 | 3 | 3 |
| 32 | 1 | 7 | 7 | 7 | 7 |
| 33 | 100 | 13 | 11 | 11 | 11 |
| 34 | 15 | 10 | 10 | 9 | 9 |
| 35 | 1 | 1 | 1 | 1 | 1 |
| 36 | 2 1/2 | 10 | 10 | 10 | 8 |
| 38 | 1 | 2 | 2 | 1 | 1 |
| 40 | 1 | 700 | 700 | 700 | 700 |
| 41 | 7 1/2 | 2 | 2 | 2 | 2 |
| 42 | 5 | 5 | 5 | 5 | 5 |
| 46 | 1 | 1 | 1 | 1 | 1 |
| 47 | 12 1/2 | 38 | 38 | 25 | 13 |
| 48 | 2 | 6 | 6 | 5 | 5 |
| 49 | 2 | 14 | 14 | 12 | 12 |
| 50 | 2 | 18 | 18 | 16 | 14 |
| 51 | 8 | 24 | 24 | 24 | 16 |
| 52 | 7 | 21 | 21 | 21 | 14 |
| TOTAL Average Cost Per Package ($) | | 1855 | 1796 | 1724 | 1531 |

NO. H-3B

| Item | No. Req'd. | Average Labor and Material Cost Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 3 | 1 | 32 | 30 | 30 | 23 |
| 6 | 1 | 124 | 122 | 110 | 75 |
| 9 | 1 | 118 | 112 | 111 | 90 |
| 12 | 1 | 58 | 64 | 64 | 57 |
| 13 | 5 | 35 | 35 | 34 | 28 |
| 14 | 1 | 12 | 12 | 12 | 10 |
| 15 | 2 | 366 | 316 | 282 | 280 |
| 16 | 2 | 40 | 40 | 40 | 36 |
| 17 | 2 | 52 | 52 | 52 | 42 |
| 18 | 4 | 16 | 16 | 16 | 16 |
| 19 | 2 | 42 | 42 | 39 | 34 |
| 20 | 1 | 4 | 4 | 4 | 4 |
| 21 | 4 | 12 | 12 | 12 | 8 |
| 23 | 1 | 400 | 395 | 345 | 222 |
| 24 | 1 | 48 | 48 | 47 | 42 |
| 25 | 1 | 19 | 19 | 19 | 19 |
| 26 | 1 | 6 | 6 | 5 | 4 |
| 29 | 1 | 4 | 4 | 4 | 3 |
| 30 | 1 | 5 | 5 | 5 | 4 |
| 31 | 1 | 3 | 3 | 3 | 2 |
| 32 | 1 | 7 | 7 | 7 | 6 |
| 33 | 100 | 13 | 11 | 11 | 11 |
| 34 | 15 | 10 | 10 | 9 | 9 |
| 35 | 1 | 1 | 1 | 1 | 1 |
| 36 | 2 1/2 | 10 | 10 | 10 | 8 |
| 38 | 1 | 2 | 2 | 1 | 1 |
| 40 | 1 | 700 | 700 | 700 | 700 |
| 41 | 7 1/2 | 2 | 2 | 2 | 2 |
| 42 | 5 | 5 | 5 | 5 | 5 |
| 43 | 1 | 2 | 2 | 1 | 1 |
| 45 | 1 | 5 | 5 | 3 | 3 |
| 46 | 1 | 1 | 1 | 1 | 1 |
| 47 | 12 1/2 | 38 | 38 | 25 | 13 |
| 48 | 2 | 6 | 6 | 5 | 5 |
| 49 | 2 | 14 | 14 | 12 | 12 |
| 50 | 2 | 18 | 18 | 16 | 14 |
| 51 | 8 | 24 | 24 | 24 | 16 |
| 52 | 7 | 21 | 21 | 21 | 14 |
| TOTAL Average Cost Per Package ($) | | 2285 | 2214 | 2088 | 1821 |

(Table Continues)

Table 12 (Continued)

1962 SUMMARY COSTS FOR HOTEL PACKAGES

NO. H-3C

| Item | No. Req'd. | Average Labor and Material Cost Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 3 | 1 | 32 | 30 | 30 | 23 |
| 6 | 1 | 124 | 122 | 110 | 75 |
| 9 | 1 | 118 | 112 | 111 | 90 |
| 12 | 1 | 68 | 64 | 64 | 57 |
| 13 | 5 | 35 | 35 | 34 | 28 |
| 14 | 1 | 12 | 12 | 12 | 10 |
| 15 | 2 | 366 | 316 | 282 | 260 |
| 16 | 2 | 40 | 40 | 40 | 36 |
| 17 | 2 | 52 | 52 | 52 | 42 |
| 18 | 4 | 16 | 16 | 16 | 16 |
| 19 | 2 | 42 | 42 | 39 | 34 |
| 20 | 1 | 4 | 4 | 4 | 4 |
| 21 | 4 | 12 | 12 | 12 | 18 |
| 23 | 1 | 400 | 395 | 345 | 222 |
| 24 | 1 | 48 | 48 | 47 | 42 |
| 25 | 1 | 19 | 19 | 19 | 19 |
| 26 | 1 | 6 | 6 | 5 | 4 |
| 28 | 1 | 9 | 9 | 9 | 7 |
| 29 | 1 | 4 | 4 | 4 | 3 |
| 30 | 1 | 5 | 5 | 5 | 4 |
| 31 | 1 | 3 | 3 | 3 | 2 |
| 32 | 1 | 7 | 7 | 7 | 6 |
| 33 | 100 | 13 | 11 | 11 | 11 |
| 34 | 15 | 10 | 10 | 9 | 9 |
| 35 | 1 | 1 | 1 | 1 | 1 |
| 36 | 5 | 20 | 20 | 20 | 16 |
| 37 | 1400 | 32 | 32 | 32 | 25 |
| 38 | 1 | 2 | 2 | 1 | 1 |
| 39 | 1 | 7 | 7 | 7 | 6 |
| 40 | 1 | 700 | 700 | 700 | 700 |
| 41 | 15 | 4 | 4 | 4 | 4 |
| 42 | 5 | 5 | 5 | 5 | 5 |
| 43 | 4 | 2 | 2 | 1 | 1 |
| 44 | 1 | 7 | 5 | 5 | 4 |
| 46 | 1 | 1 | 1 | 1 | 1 |
| 47 | 25 | 76 | 76 | 50 | 26 |
| 48 | 4 | 12 | 12 | 10 | 10 |
| 49 | 4 | 28 | 28 | 24 | 24 |
| 50 | 4 | 36 | 36 | 32 | 28 |
| 51 | 8 | 24 | 24 | 24 | 16 |
| 52 | 7 | 21 | 21 | 21 | 14 |
| TOTAL Average Cost Per Package ($) | | 2423 | 2350 | 2208 | 1924 |

Table 13

MATERIAL AND LABOR COSTS BY ITEM FOR CONTROL PACKAGES

| Item No. | DESCRIPTION | MANUFACTURER | FIGURE NO. | ACTUAL MATERIAL AND LABOR - 1959[a] Unit Labor Reqt. Man-hours | Unit Labor Reqt. Hourly Rate | Material and Labor Unit Cost ($:Mat./Labor) | MATERIAL AND LABOR COSTS - 1962[a] Labor Hourly Rate | Cost Per Unit In Quantities Indicated ($) Material/Labor 1 | 10 | 100 | 1,000 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | AM Broadcast Receiver | Allied Radio 100 N. Western Ave. Chicago 80, Ill. | (4 Tube-AC/DC 110-120V 50-60 cycle-plastic case) | | | | | 8/ | 8/ | 8/ | 8/ |
| 2 | Citizens band 5 watt transceiver, 120 VAC, 50 to 60 cycles equivalent to vocaline commaire model ED-27M complete with one crystal, microphone and microphone mounting clip less mobile mounting bracket-one channel. | Vocaline Corp. Old Saybrook, Conn. | (Vocaline Model ED-27M one channel - or equivalent) | | | | | 123/ | 114/ | 106/ | 101/ |
| 3 | Same as unit No. 2 above except transceiver is furnished with 4 crystals | " | " | | | | | 129/ | 120/ | 112/ | 107/ |
| 4 | Radiation measurement set. Consists of one dosimeter - range 0-120 r/hr 0-600 R and one dosimeter charger. | Heath Company Benton Harbor, Mich. | Refer to Heath Catalog Supplement 80/02 Cat. No. GDP-341 (Not a kit) | | | | | 26/ | 26/ | 26/ | 26/ |

[a]Material costs are F.O.B. San Francisco. The material cost for a mass-produced item includes all manufacturing costs—material, labor, overhead, profit, etc. Labor costs have not been entered for items that do not require installation labor or whose installation labor has been included as a part of another package. Material and labor costs for 1959 are for those items installed in the Camp Parks prototype shelter, and are based on actual costs reported by the General Contractor. The 1962 hourly rates are based on the U.S. Department of Labor 1962 schedule for building trades in San Francisco. For detailed discussion of 1959 and 1962 material and labor costs listed see 4.1 of this report.

(Table Continues)

Table 13 (Continued)

MATERIAL AND LABOR COSTS BY ITEM FOR CONTROL PACKAGES

| Item No. | DESCRIPTION | MANUFACTURER | FIGURE NO. | ACTUAL MATERIAL AND LABOR - 1959[a] | | | MATERIAL AND LABOR COSTS - 1962[a] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Unit Labor Reqt. | | Material and Labor Unit Cost ($:Mat./Labor) | Labor Hourly Rate | Cost Per Unit In Quantities Indicated ($) Material/Labor | | | |
| | | | | Man-hours | Hourly Rate | | | 1 | 10 | 100 | 1,000 |
| 5 | Antenna for 27M trans-ceiver complete with rigid transmission line; coax cable and opening with support fitting. | General contractor | Fig. A-14M | 2 | 3.85 | 8/8 | 4.60 | 8/9 | 8/9 | 8/8 | 7/7 |
| 6 | Periscope | Tinsley Lab Inc. Berkeley, Calif. | Fig. A-13M | | -- | 450/ | | 152/ | 145/ | 137/ | 60/ |
| 7 | Periscope support fitting opening | General contractor | Fig. A-14M | 6 | 3.85 | 8/24 | 4.60 | 8/28 | 8/28 | 8/27 | 7/22 |
| 8 | Dosimeter rod complete with opening and support fitting. | " | " | 1 | 3.85 | 7/4 | | 7/5 | 7/5 | 7/5 | 5/4 |
| 9 | Antenna - AM Receiver complete with opening and support fitting. | " | " | 2 | 3.85 | 8/8 | | 8/9 | 8/9 | 8/8 | 7/7 |

Table 14

UNIT COST DIFFERENTIALS FOR CONTROL PACKAGE ITEMS
(See Table 13)

| Item No. | One-Off Item Cost (Material/Labor) | | | Net Unit Cost Differential* (Mat./Labor) | Remarks relating to one-off item cost differentials when original unit cost quoted in Ref. 1 and/or actual contractor cost (modified as required) is used as a basis for comparison with 1962 prices. |
|---|---|---|---|---|---|
| | Available From General Contractor | Estimate in Ref. 1 | 1962 From Table 13 | | |
| 1 | 12 | | 8/ | - 4/ | Cost decrease is the result of locating a least cost supplier. |
| 2 | 105/ | | 123/ | + 18/ | The unit specified in Ref. 1 is no longer manufactured by the Vocaline Co. This unit was found to have an unstable transmitting frequency oscillator, therefore the Federal Communication Commission restricted its use. In addition this unit did not have sufficient range. The unit specified as a result of this study has a reliable transmitting range of at least 2 miles where the terrain is hilly. |
| 3 | 120/ | | 129/ | + 9/ | The increase in price is due to an error in Ref. 1. |
| 4 | | 18/ | 26/ | + 8/ | Cost quoted in Ref. 1 were based on SCDR estimates. Current 1962 Bendix sales price is $45.00. The cost listed is the cost of set being sold by Allied Radio and Heath Kit Co. |
| 5 | 8/8 | | 8/9 | /+1 | Cost rise due to wage increase. |
| 6 | 450/ | | 152/ | - 298/ | Cost decrease is due to a redesign of the periscope. |
| 7 | 8/24 | | 8/28 | /+4 | Cost rise due to wage increase. |
| 8 | 7/4 | | 7/5 | /+1 | " |
| 9 | 8/8 | | 8/9 | /+1 | " |

*A plus mark indicates an increase in 1962 item cost over its cost in 1959.
A minus mark indicates a decrease in 1962 item cost based on its cost in 1959.

Table 15

1962 SUMMARY COSTS FOR CONTROL PACKAGES

No. C-1

| Item | No. Req'd. | Average Labor and Material Cost Per Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 1 | 1 | 8 | 8 | 8 | 8 |
| 9 | 1 | 17 | 17 | 16 | 14 |
| TOTAL Average Cost Per Package ($) | | 25 | 25 | 24 | 22 |

No. C-2

| Item | No. Req'd. | Average Labor and Material Cost Per Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 1 | 1 | 8 | 8 | 8 | 8 |
| 2 | 1 | 123 | 114 | 106 | 101 |
| 4 | 1 | 26 | 26 | 26 | 26 |
| 5 | 1 | 17 | 17 | 16 | 14 |
| 6 | 1 | 152 | 145 | 137 | 60 |
| 7 | 1 | 36 | 36 | 35 | 29 |
| 8 | 1 | 12 | 12 | 12 | 9 |
| 9 | 1 | 17 | 17 | 15 | 14 |
| TOTAL Average Cost Per Package ($) | | 391 | 375 | 356 | 261 |

Table 15

1962 SUMMARY COSTS FOR CONTROL PACKAGES

NO. C-3

| Item | No. Req'd. | Average Labor and Material Cost Per Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 1 | 1 | 8 | 8 | 8 | 8 |
| 3 | 1 | 129 | 120 | 112 | 107 |
| 4 | 1 | 26 | 26 | 26 | 26 |
| 5 | 1 | 17 | 17 | 16 | 14 |
| 6 | 1 | 152 | 145 | 137 | 60 |
| 7 | 1 | 36 | 36 | 35 | 29 |
| 8 | 1 | 12 | 12 | 12 | 9 |
| 9 | 1 | 17 | 17 | 16 | 14 |
| TOTAL Average Cost Per Package ($) | | 397 | 381 | 362 | 267 |

Table 16

MATERIAL AND LABOR COSTS BY ITEM FOR AUXILIARY-POWER PACKAGES

| Item No. | DESCRIPTION | MANUFACTURER | FIGURE NO. | ACTUAL MATERIAL AND LABOR - 1959[a] | | | MATERIAL AND LABOR COSTS - 1962[a] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Unit Labor Reqt. | | Material and Labor Unit Cost ($:Mat./Labor) | Labor Hourly Rate | Cost Per Unit In Quantities Indicated ($) Material/Labor | | | |
| | | | | Man-hours | Hourly Rate | | | 1 | 10 | 100 | 1,000 |
| 1 | 1.2 KW Engine generator | Kohler Co. Kohler, Wisconsin<br>D.W. Onan & Sons. Inc. Minneapolis, Minn. | Fig. A-16M | | | | | 305/ | 305/ | 305/ | 282/ |
| 2 | 3 quarts of oil per unit, one spark plug wrench, one 8" screw driver, one 8" crescent wrench (2 week supply for 1.2 kw engine generator) | General contractor | " | | | | | 4/ | 3/ | 3/ | 3/ |
| 3 | 2 KW Engine generator | Kohler Co. Kohler, Wisconsin<br>D.W. Onan & Sons. Inc. Minneapolis, Minn. | " | | | | | 295/ | 295/ | 273/ | 243/ |
| 4 | 8 quarts of oil per unit, one spark plug wrench, one 8" screw driver, one 8" crescent wrench (2 week supply for 2 kw engine generator) | General contractor | " | | | | | 4/ | 4/ | 4/ | 3/ |

[a]Material costs are F.O.B. San Francisco. The material cost for a mass-produced item includes all manufacturing costs--material, labor, overhead, profit, etc. Labor costs have not been entered for items that do not require installation labor or whose installation labor has been included as a part of another package. Material and labor costs for 1959 are for those items installed in the Camp Parks prototype shelter, and are based on actual costs reported by the General Contractor. The 1962 hourly rates are based on the U.S. Department of Labor 1962 schedule for building trades in San Francisco. For detailed discussion of 1959 and 1962 material and labor costs listed see 4.1 of this report.

(Table Continues)

Table 16 (Continued)

MATERIAL AND LABOR COSTS BY ITEM FOR AUXILIARY-POWER PACKAGES

| Item No. | DESCRIPTION | MANUFACTURER | FIGURE NO. | ACTUAL MATERIAL AND LABOR - 1959[e] | | | MATERIAL AND LABOR COSTS - 1962[a] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Unit Labor Reqt. | | Material and Labor Unit Cost ($:Mat./Labor) | Labor Hourly Rate | Cost Per Unit In Quantities Indicated ($) Material/Labor | | | |
| | | | | Man-hours | Hourly Rate | | | 1 | 10 | 100 | 1,000 |
| 5 | 3.5 KW Engine generator | Kohler Co. Kohler, Wisconsin<br>D.W. Onan & Sons. Inc. Minneapolis, Minn. | Fig. A-16H | | | | | 475/ | 475/ | 441/ | 412/ |
| 6 | 6 quarts of oil per unit, one spark plug wrench, one 8" screw driver, one 8" crescent wrench (2 week supply for 3.5 kw engine generator) | General contractor | " | | | | | 4/ | 4/ | 4/ | 3/ |
| 7 | 5 KW Engine generator | Kohler Co. Kohler, Wisconsin<br>D.W. Onan & Sons. Inc. Minneapolis, Minn. | " | | | | | 589/ | 569/ | 572/ | 530/ |
| 8 | 11 quarts of oil per unit, one spark plug wrench, one 8" screw driver, one 8" crescent, one pair pliers, one feeler gage set | General contractor | " | | | | | 5/ | 5/ | 4/ | 4/ |
| 9 | 7.5 KW Engine generator complete with battery, cable, and battery box-Elect. stand | Kohler Co. Kohler, Wisconsin | " | | | 1,103 | | 893/ | 893/ | 893/ | 731/ |
| 10 | 11 quarts of oil per unit, one spark plug wrench, one 8" screw driver, one 8" crescent, one pair pliers, one feeler gage set | General contractor | " | | | | | 5/ | 5/ | 4/ | 4/ |

(Table Continues)

Table 16 (Continued)

MATERIAL AND LABOR COSTS BY ITEM FOR AUXILIARY-POWER PACKAGES

| Item No. | DESCRIPTION | MANUFACTURER | FIGURE NO. | ACTUAL MATERIAL AND LABOR - 1959[a] | | | MATERIAL AND LABOR COSTS - 1962[a] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Unit Labor Reqt. | | Material and Labor Unit Cost ($:Mat./Labor) | Labor Hourly Rate | Cost Per Unit In Quantities Indicated ($) Material/Labor | | | |
| | | | | Man-hours | Hourly Rate | | | 1 | 10 | 100 | 1,000 |
| 11 | 95-gal gas storage tk. | Rheem Mfg. Co. Richmond, Calif.<br>Butler Mfg. Co. Richmond, Calif. | Fig. A-17M | | | | | 58/ | 53/ | 53/ | 53/ |
| 12 | 160 gal gas storage tk. | " | " | | | | | | | | |
| 13 | 270 gal-gas storage | " | " | | | | | 67/ | 67/ | 62/ | 62/ |
| 14 | 390 gal-gas storage | " | | | | | | 71/ | 71/ | 65/ | 65/ |
| 15 | 620 gal-gas storage | " | | | | | | 78/ | 78/ | 73/ | 73/ |
| 16 | Exhaust duct with butterfly closure, complete with raincaps and 2' dia. exit pipe | Armco Drainage and Metal Products American Bridge | Fig. A-16M | | | 308/ | | 124/ | 124/ | 117/ | 117/ |
| | | | | 5 | 3.85 | 168/17 | 4.60 | 159/30 | 147/30 | 145/30 | 136/29 |
| 17 | Fuel piping complete with shut off valve, tank vent & filter | General contractor | Fig. A-17M | 5 | 4.05 | 36/19 | 4.93 | 36/23 | 36/23 | 36/23 | 34/22 |
| 18 | Motor generator foundation | " | Fig. A-16M | 4 | 3.85 | 9/16 | 4.60 | 9/19 | 9/19 | 9/19 | 8/18 |
| 19 | Engine exhaust | " | " | 6 | 4.05 | 6/25 | 4.93 | 6/30 | 6/30 | 6/30 | 5/29 |

Table 17

UNIT COST DIFFERENTIALS FOR AUXILIARY-POWER-PACKAGE ITEMS
(See Table 16)

| Item No. | One-Off Item Cost (Material/Labor) | | | Net Unit Cost Differential* (Mat./Labor) | Remarks relating to one-off item cost differentials when original unit cost quoted in Ref. 1 and/or actual contractor cost (modified as required) is used as a basis for comparison with 1962 prices. |
|---|---|---|---|---|---|
| | Available From General Contractor | Estimate in Ref. 1 | 1962 From Table 16 | | |
| 1 | | 355/ | 305/ | - 50/ | Engine generators listed to be furnished in Ref. 1 are electric starting and require an electric storage battery. The battery, with its associated cable and battery box, was inadvertently omitted from Ref. 1. The cost decrease listed reflects the cost differential between that specified in Ref. 1 and the cost for manually started units which have been specified to be used as a result of this study. |
| 2 | | 0/ | 4/ | + 4/ | This item was inadvertently omitted from Ref. 1. |
| 3 | | 422/ | 295/ | - 127/ | Same remarks as presented for item 1. |
| 4 | | 0/ | 4/ | + 4/ | Same remarks as presented for item 2. |
| 5 | | 494/ | 475/ | - 19/ | Same remarks as presented for item 1. |
| 6 | | 0/ | 4/ | + 4/ | Same remarks as presented for item 2. |
| 7 | | 782/ | 589/ | - 193/ | Same remarks as presented for item 1. |
| 8 | | 0/ | 5/ | + 5/ | Same remarks as presented for item 2. |
| 9 | 1,103/ | | 893/ | - 110/ | This cost reduction is based on cost data furnished by a different engine generator manufacturer. |
| 10 | | 0/ | 5/ | + 5/ | Same remarks as presented for item 2. |

*A plus mark indicates an increase in 1962 item cost over its cost in 1959.
A minus mark indicates a decrease in 1962 item cost based on its cost in 1959.

(Table continues)

Table 17 (Continued)

UNIT COST DIFFERENTIALS FOR AUXILIARY-POWER-PACKAGE ITEMS
(See Table 16)

| Item No. | One-Off Item Cost (Material/labor) | | | Net Unit Cost Differential* (Mat./Labor) | Remarks relating to one-off item cost differentials when original unit cost quoted in Ref. 1 and/or actual contractor cost (modified as required) is used as a basis for comparison with 1962 prices. |
|---|---|---|---|---|---|
| | Available From General Contractor | Estimate in Ref. 1 | 1962 From Table 16 | | |
| 11 | | 35/ | 58/ | + 23/ | The original cost estimate for this tank as it is presented in Ref. 1 is not sufficient to provide for material purchase and fabrication per Ref. 1 design. Evidence of this low estimate is apparent when one considers the actual contractor cost of the 620-gallon tank vs the Ref. 1 cost. The tank has been redesigned so that more efficient use of material results, and the tank can be purchased for the costs indicated. |
| 12 | | 54/ | 67/ | + 13/ | " |
| 13 | | 100/ | 71/ | - 29/ | " |
| 14 | | 140/ | 78/ | - 63/ | " |
| 15 | 308/ | | 124/ | - 184/ | " |
| 16 | 168/17 | | 159/30 | - 9/ + 13 | Cost changes are due to fabricator gaining experience and raise in wages. |
| 17 | 36/19 | | 36/23 | / + 4 | The increase in labor cost is due to wage increases. |
| 18 | 9/16 | | 9/19 | / + 3 | " |
| 19 | 6/25 | | 6/30 | / + 5 | " |

*A plus mark indicates an increase in 1962 item cost over its cost in 1959.
A minus mark indicates a decrease in 1962 item cost based on its cost in 1959.

Table 18

1962 SUMMARY COSTS FOR AUXILIARY POWER PACKAGES

NO. P-1

| Item | No. req'd. | Average Labor and Material Cost Per Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 1 | 1 | 305 | 305 | 282 | 255 |
| 2 | 1 | 4 | 3 | 3 | 3 |
| 11 | 1 | 58 | 53 | 53 | 53 |
| 16 | 1 | 189 | 177 | 175 | 165 |
| 17 | 1 | 59 | 59 | 59 | 56 |
| 18 | 1 | 28 | 28 | 28 | 26 |
| 19 | 1 | 36 | 36 | 36 | 34 |
| TOTAL Average Cost Per Package ($) | | 679 | 661 | 636 | 592 |

NO. P-2

| Item | No. req'd. | Average Labor and Material Cost Per Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 3 | 1 | 295 | 295 | 273 | 243 |
| 4 | 1 | 4 | 4 | 4 | 3 |
| 12 | 1 | 67 | 67 | 62 | 62 |
| 16 | 1 | 189 | 177 | 175 | 165 |
| 17 | 1 | 59 | 59 | 59 | 56 |
| 18 | 1 | 28 | 28 | 28 | 26 |
| 19 | 1 | 36 | 36 | 36 | 34 |
| TOTAL Average Cost Per Package ($) | | 678 | 666 | 637 | 589 |

(Table Continues)

Table 18 (Continued)

1962 SUMMARY COSTS FOR AUXILIARY-POWER PACKAGES

NO. P-3

| Item | No. req'd. | Average Labor and Material Cost Per Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 5 | 1 | 475 | 475 | 441 | 412 |
| 6 | 1 | 4 | 4 | 4 | 3 |
| 13 | 1 | 71 | 71 | 65 | 65 |
| 16 | 1 | 189 | 177 | 175 | 165 |
| 17 | 1 | 59 | 59 | 59 | 56 |
| 18 | 1 | 28 | 28 | 28 | 28 |
| 19 | 1 | 36 | 36 | 36 | 34 |
| TOTAL Average Cost Per Package ($) | | 862 | 850 | 808 | 761 |

NO. P-4

| Item | No. req'd. | Average Labor and Material Cost Per Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 7 | 1 | 589 | 589 | 572 | 530 |
| 8 | 1 | 5 | 5 | 4 | 4 |
| 14 | 1 | 78 | 78 | 73 | 73 |
| 16 | 1 | 189 | 177 | 175 | 165 |
| 17 | 1 | 59 | 59 | 59 | 56 |
| 18 | 1 | 28 | 28 | 28 | 26 |
| 19 | 1 | 36 | 36 | 36 | 34 |
| TOTAL Average Cost Per Package ($) | | 984 | 972 | 947 | 888 |

(Table Continues)

Table 18 (Continued)

1962 SUMMARY COSTS FOR AUXILIARY-POWER PACKAGES

NO. P-5

| Item | No. req'd. | Average Labor and Material Cost Per Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 9 | 1 | 878 | 878 | 878 | 716 |
| 10 | 1 | 5 | 5 | 4 | 4 |
| 15 | 1 | 124 | 124 | 117 | 117 |
| 16 | 1 | 189 | 177 | 175 | 165 |
| 17 | 1 | 59 | 59 | 59 | 56 |
| 18 | 1 | 28 | 28 | 28 | 26 |
| 19 | 1 | 36 | 36 | 36 | 34 |
| TOTAL Average Cost Per Package ($) | | 1319 | 1307 | 1297 | 1118 |

Table 19

MATERIAL AND LABOR COSTS BY ITEM FOR FIRE-PROTECTION PACKAGE

| Item No. | DESCRIPTION | MANUFACTURER | SPECIFICATIONS | ACTUAL MATERIAL AND LABOR - 1959[a] | | | MATERIAL AND LABOR COSTS - 1962[a] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Unit Labor Reqt. | | Material and Labor Unit Cost ($:Mat./Labor) | Labor Hourly Rate | Cost Per Unit In Quantities Indicated ($) Material/Labor | | | |
| | | | | Man-hours | Hourly Rate | | | 1 | 10 | 100 | 1,000 |
| 1 | 405 pounds of baralyme | Mc-Graw Edison Stuyvesant Falls, New York | Consists of 20% barium hydroxide & 80% calcium hydroxide without any inert material or free water. It is to be provided in the four to eight mesh granular size. This material is to be packaged in 40 lb. airtight containers, with each container provided with an indicator that registers the materials exhaustion of $CO_2$ absorbent capacity. | | | 204/ | | 102/ | 102/ | 102/ | 102/ |
| 2 | Oxygen bottles completely filled with breathing grade oxygen | | 7 200-cu ft bottles | | | | | 301/ | 298/ | 281/ | 209/ |
| 3 | Oxygen regulator - single stage. Cylinder content gage only. One regulator. | Victor Equipment Co. 844 Folsom San Francisco | Approx. 500 cubic feet per hour at 40 pounds per sq. in. Victor cat. No. 5R-200 MS-967 | | | | | 28/ | 28/ | 26/ | 19/ |

[a]Material costs are F.O.B. San Francisco. The material cost for a mass-produced item includes all manufacturing costs--material, labor, overhead, profit, etc. Labor costs have not been entered for items that do not require installation labor or whose installation labor has been included as a part of another package. Material and labor costs for 1959 are for those items installed in the Camp Parks prototype shelter, and are based on actual costs reported by the General Contractor. The 1962 hourly rates are based on the U.S. Department of Labor 1962 schedule for building trades in San Francisco. For detailed discussion of 1959 and 1962 material and labor costs listed see 4.1 of this report.

Table 20

UNIT COST DIFFERENTIALS FOR FIRE-PROTECTION-PACKAGE ITEMS
(See Table 19)

| Item No. | One-Off Item Cost (Material/Labor) | | | Net Unit Cost Differential* (Mat./Labor) | Remarks relating to one-off item cost differentials when original unit cost quoted in Ref. 1 and/or actual contractor cost (modified as required) is used as a basis for comparison with 1962 prices. |
|---|---|---|---|---|---|
| | Available From General Contractor | Estimate in Ref. 1 | 1962 From Table 19 | | |
| 1 | 204/ | | 102/ | - 102/ | A more efficient carbon dioxide absorber has been developed by the supplier. |
| 2 | | 200 | 301/ | + 101/ | The increase in cost reflects additional funds required to purchase the item from retail outlets rather than from federal stock. |
| 3 | | 23 | 28/ | + 5/ | |

*A plus mark indicates an increase in 1962 item cost over its cost in 1959.
A minus mark indicates a decrease in 1962 item cost based on its cost in 1959.

Table 21

1962 SUMMARY COSTS FOR FIRE-PROTECTION PACKAGE

NO. F-1

| Item | No. Req'd | Average Labor and Material Cost Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 1 | 1 | 102 | 102 | 102 | 102 |
| 2 | 1 | 301 | 298 | 281 | 209 |
| 3 | 1 | 28 | 28 | 26 | 19 |
| TOTAL Average Cost Per Package ($) | | 431 | 428 | 409 | 330 |

Table 22

MATERIAL AND LABOR COSTS BY ITEM FOR INSTALLATION PACKAGES

| Item No. | DESCRIPTION | MANUFACTURER | FIGURE NO. | ACTUAL MATERIAL AND LABOR - 1959[a*] | | | MATERIAL AND LABOR COSTS - 1962[a] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Unit Labor Reqt. | | Material and Labor Unit Cost ($:Mat./Labor) | Labor Hourly Rate | Cost Per Unit In Quantities Indicated ($) Material/Labor | | | |
| | | | | Man-hours | Hourly Rate | | | 1 | 10 | 100 | 1,000 |
| 1 | Steel erection which includes basic arch, endwalls (without bracing) entrance tube complete (without entrance bulkhead) | Armco Steel Youngstown, Ohio<br>Commercial Shearing and Stamping Youngstown, Ohio<br>Republic Steel Corp. Cleveland, Ohio | Figs. A-1M and A-3M | 266 | 3.85 | 0/1025 | 4.60 | 0/1200 | 0/1000 | 0/950 | 0/950 |
| 2 | Shelter, entrance way and tank excavation <u>Semi-Buried</u> configuration | General Contractor | Fig. A-1M<br>Section B-B<br>Excavation equal to 583 cubic yards | | | | 4.54 | 654/159 | 571/139 | 303/220 | 244/94 |
| 3 | Shelter, entrance way and tank excavation <u>Buried</u> configuration | " | Fig. A-1M<br>Section C-C<br>Excavation equal to 860 cubic yards | 54 | 3.75 | 830/203 | 4.54 | 958/234 | 837/204 | 418/310 | 342/131 |
| 4 | Compacted backfill (Volume up-to 8 feet above foundations-basic shelter and entrance way <u>Above-Ground</u> configuration | " | Fig. A-1M<br>Sections A-A<br>Assume hand or equivalent machine type compaction of 274 cubic yards. 490 cubic yards to be compacted with "sheep foot" technique. | | | | 4.54 | 514/713 | 480/681 | 384/512 | 238/286 |
| 5 | Compacted backfill (Volume up to 8 feet above foundations-basic shelter and entrance way Semi-Buried | | Fig. A-1M<br>Section B-B<br>Compacted backfill equal to 208 cubic yards | | | | 4.54 | 325/540 | 309/504 | 227/372 | 121/197 |

* **Material costs shown reflect machine amortization or rental cost.**

** **Assume material is available without cost within 1 mile of site. Excavation and hauling of this material to site are included in charge.**

[a] Material costs are F.O.B. San Francisco. The material cost for a mass-produced item includes all manufacturing costs--material, labor, overhead, profit, etc. Labor costs have not been entered for items that do not require installation labor or whose installation labor has been included as a part of another package. Material and labor costs for 1959 are for those items installed in the Camp Parks prototype shelter, and are based on actual costs reported by the General Contractor. The 1962 hourly rates are based on the U.S. Department of Labor 1962 schedule for building trades in San Francisco. For detailed discussion of 1959 and 1962 material and labor costs listed see 4.1 of this report.

(Table Continues)

Table 22 (Continued)

MATERIAL AND LABOR COSTS BY ITEM FOR INSTALLATION PACKAGES

| Item No. | DESCRIPTION | MANUFACTURER | FIGURE NO. | ACTUAL MATERIAL AND LABOR-1959* | | | MATERIAL AND LABOR COSTS - 1962a* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Unit Labor Reqt. | | Material and Labor Unit Cost ($:Mat./Labor) | Labor Hourly Rate | Cost Per Unit in Quantities Indicated ($) Material/Labor | | | |
| | | | | Man-hours | Hourly Rate | | | 1 | 10 | 100 | 1,000 |
| 6 | Compacted backfill (Volume up to 8 feet above foundations-basic shelter and entrance way. Buried configuration | General Contractor | Fig. A-1M Section C-C Compacted backfill equal to 206 cu.yards | 145 | 3.75 | 329/544 | 4.54 | 325/540 | 309/504 | 227/372 | 121/197 |
| 7 | Non-compacted backfill Above-ground configurations | " | Fig. A-1M Section A-A 131 cubic yards** | | | | 4.54 | 91/47 | 86/44 | 63/33 | 33/17 |
| 8 | Non-compacted backfill Semi-Buried configurations | | Fig. A-1M Section B-B 380 cubic yards | | | | 4.54 | 262/135 | 247/127 | 182/94 | 95/49 |
| 9 | Non-compacted backfill Buried configuration | | Fig. A-1M Section C-C 652 cubic yards | 59 | 3.75 | 429/221 | 4.54 | 450/232 | 424/219 | 312/161 | 163/84 |
| 10 | Select backfill under fuel and water tanks | | Fig. A-17M 4 cubic yards of sand | 8 | 3.75 | 18/30 | 4.54 | 18/36 | 18/31 | 16/20 | 15/10 |
| 11 | Arch and endwall mastic joint seal complete- one lot | General Contractor | Fig. A-3M | 16 | 3.75 | 30/60 | 4.54 | 30/72 | 30/72 | 30/57 | 29/42 |

Table 23

UNIT COST DIFFERENTIALS FOR INSTALLATION-PACKAGE ITEMS
(See Table 22)

| Item No. | One-Off Item Cost (Material/Labor) | | | Net Unit Cost Differential* (Mat./Labor) | Remarks relating to one-off item cost differentials when original unit cost quoted in Ref. 1 and/or actual contractor cost (modified as required) is used as a basis for comparison with 1962 prices. |
|---|---|---|---|---|---|
| | Available From General Contractor | Estimate in Ref. 1 | 1962 From Table 22 | | |
| 1 | 0/1025 | | 0/1200 | / + 175 | Increase in labor is due to wage increases. |
| 2 | | 600/145 | 654/159 | + 54/ + 14 | Increase in material cost is due to increase in cost of excavating equipment. Increase in labor cost is due to wage increases. The 1962 cost for excavation per yard is $1.386. |
| 3 | 830/203 | | 958/234 | + 138/ + 31 | " |
| 4 | | 310/434 | 514/713 | + 204/ + 279 | Increase in cost of material is due to increase in cost of earth-handling equipment. Increase in labor cost is due to wage increases. The 1962 cost for compacted backfill is $4.158 per cubic yard in place. |
| 5 | | 144/199 | 325/540 | + 181/ + 341 | " |
| 6 | | 180/249 | 325/540 | + 145/ + 291 | " |
| 7 | | 115/60 | 91/47 | - 24/ - 13 | Same remarks as listed for item 4 except that the 1962 cost for backfill is $1.046 per cubic yard in place. |
| | | | | | |

*A plus mark indicates an increase in 1962 item cost over its cost in 1959.
A minus mark indicates a decrease in 1962 item cost based on its cost in 1959.

(Table Continues)

Table 23 (Continued)

UNIT COST DIFFERENTIALS FOR INSTALLATION-PACKAGE ITEMS
(See Table 22)

| Item No. | One-Off Item Cost (Material/Labor) | | | Net Unit Cost Differential* (Mat./Labor) | Remarks relating to one-off item cost differentials when original unit cost quoted in Ref. 1 and/or actual contractor cost (modified as required) is used as a basis for comparison with 1962 prices. |
|---|---|---|---|---|---|
| | Available From General Contractor | Estimate in Ref. 1 | 1962 From Table 22 | | |
| 8 | | 54/28 | 262/135 | + 208/+ 107 | Cost differential with respect to that listed in Ref. 1 is partially due to an error in volume as listed in Ref. 1. Labor cost increase is due to wage increases. |
| 9 | 429/221 | | 450/232 | + 21/+11 | " |
| 10 | | 18/30 | 18/36 | 0/+6 | Labor cost increase is due to wage increases. |
| 11 | | 30/60 | 30/72 | 0/+12 | " |

*A plus mark indicates an increase in 1962 item cost over its cost in 1959.
A minus mark indicates a decrease in 1962 item cost based on its cost in 1959.

Table 24

1962 SUMMARY COSTS FOR INSTALLATION PACKAGES

NO. I-1

| Item | No. Req'd | Average Labor and Material Cost Per Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 1 | 1 | 1200 | 1000 | 950 | 950 |
| 4 | 1 | 1227 | 1161 | 896 | 524 |
| 7 | 1 | 138 | 130 | 96 | 50 |
| 10 | 1 | 54 | 49 | 36 | 25 |
| 11 | 1 | 102 | 102 | 87 | 71 |
| TOTAL Average Cost Per Package ($) | | 2721 | 2442 | 2065 | 1620 |

NO. I-2

| Item | No. Req'd | Average Labor and Material Cost Per Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 1 | 1 | 1200 | 1000 | 950 | 950 |
| 2 | 1 | 813 | 710 | 528 | 338 |
| 5 | 1 | 865 | 813 | 599 | 318 |
| 8 | 1 | 397 | 374 | 276 | 144 |
| 10 | 1 | 54 | 49 | 36 | 25 |
| 11 | 1 | 102 | 102 | 87 | 71 |
| TOTAL Average Cost Per Package ($) | | 3431 | 3048 | 2476 | 1846 |

NO. I-3

| Item | No. Req'd | Average Labor and Material Cost Per Item | | | |
|---|---|---|---|---|---|
| | | 1 | 10 | 100 | 1000 |
| 1 | 1 | 1200 | 1000 | 950 | 950 |
| 3 | 1 | 1192 | 1042 | 728 | 473 |
| 6 | 1 | 865 | 813 | 599 | 318 |
| 9 | 1 | 682 | 643 | 473 | 247 |
| 10 | 1 | 54 | 49 | 36 | 25 |
| 11 | 1 | 102 | 102 | 87 | 71 |
| TOTAL Average Cost Per Package ($) | | 4095 | 3649 | 2873 | 2084 |

Table 25

MATERIAL AND LABOR COSTS BY ITEM FOR ELECTRICAL PACKAGES

| Item No. | DESCRIPTION | MANUFACTURER | FIGURE NO. | ACTUAL MATERIAL AND LABOR - 1959[a] Unit Labor Reqt. Man-hours | ACTUAL MATERIAL AND LABOR - 1959[a] Unit Labor Reqt. Hourly Rate | ACTUAL MATERIAL AND LABOR - 1959[a] Material and Labor Unit Cost ($:Mat./Labor) | MATERIAL AND LABOR COSTS - 1962[a] Labor Hourly Rate | MATERIAL AND LABOR COSTS - 1962[a] Cost Per Unit In Quantities Indicated ($) Material/Labor. 1 | 10 | 100 | 1,000 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Electrical system for arrangement "A" hotel package One Lot | Graybar Electric San Francisco, Calif. | Fig. A-16M | | | | 4.47 | 63/99 | 59/95 | 55/95 | 54/80 |
| 2 | Electrical system for arrangement "B" hotel package One Lot | " | " | | | | " | 67/126 | 63/125 | 58/123 | 57/100 |
| 3 | Electrical system for arrangement "C" hotel package One Lot | " | " | | 4.066 | 209/510* | " | 92/130 | 86/130 | 79/126 | 78/103 |
| 4 | 4 ckt breaker panel completely installed | " | " | | | | " | 3/23 | 3/23 | 3/22 | 3/19 |
| 5 | 6 ckt breaker panel completely installed | " | " | | | | " | 5/34 | 5/34 | 4/33 | 4/27 |
| 6 | Electrical items required for the air conditioner One Lot | " | " | | | | " | 30/70 | 30/70 | 28/66 | 26/56 |
| 7 | Service equipment required for power package p-1 or p-2 One Lot | Graybar Electric S.F.Calif.(for conduit and wire) Meyers Safety Sw.Co. S.F.Calif.(for safety switch | " | | | | " | 17/14 | 16/14 | 14/14 | 13/21 |

* This contractor cost includes the cost for electrical package items 3, 5, 6, 10, and 14 as listed in this schedule.

[a] Material costs are F.O.B. San Francisco. The material cost for a mass-produced item includes all manufacturing costs--material, labor, overhead, profit, etc. Labor costs have not been entered for items that do not require installation labor or whose installation labor has been included as a part of another package. Material and labor costs for 1959 are for those items installed in the Camp Parks prototype shelter, and are based on actual costs reported by the General Contractor. The 1962 hourly rates are based on the U.S. Department of Labor 1962 schedule for building trades in San Francisco. For detailed discussion of 1959 and 1962 material and labor costs listed see 4.1 of this report.

(Table Continues)

Table 25 (Continued)

MATERIAL AND LABOR COSTS BY ITEM FOR ELECTRICAL PACKAGES

| Item No. | DESCRIPTION | MANUFACTURES | FIGURE NO. | ACTUAL MATERIAL AND LABOR - 1959[a] | | | MATERIAL AND LABOR COSTS - 1962[a] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Unit Labor Reqt. | | Material and Labor Unit Cost ($:Mat./Labor) | Labor Hourly Rate | Cost Per Unit In Quantities Indicated ($) Material/Labor | | | |
| | | | | Man-hours | Hourly Rate | | | 1 | 10 | 100 | 1,000 |
| 8 | Service equipment required for power package P-3 <u>One Lot</u> | Graybar Electric S.F.Calif. (for conduit and wire) Meyers Safety Sw. Co. S.F.Calif. (for safety switch | Fig. A-1674 | | | | 4.47 | 25/17 | 24/17 | 22/17 | 19/14 |
| 9 | Service equipment required for power package P-4 <u>One Lot</u> | " | " | | | | " | 36/17 | 35/17 | 31/17 | 28/14 |
| 10 | Service equipment required for power package P-5 <u>One Lot</u> | " | " | | | | " | 36/17 | 35/17 | 31/17 | 28/14 |
| 11 | 1/2" conduit required if the air conditioner is not used. (Arrangement "A" & "B" Hotel Package) <u>One Lot</u> | " | " | | | | " | 38/116 | 36/116 | 36/113 | 33/92 |
| 12 | 1/2" conduit required if the air conditioner is not used. (Arrangement "C" Hotel Package) <u>One Lot</u> | " | " | | | | " | 43/134 | 38/134 | 38/130 | 37/10[illegible] |
| 13 | 1/2" conduit required if the air conditioner is used. (Arrangement "A" & "B" Hotel Package) <u>One Lot</u> | " | " | | | | " | 25/76 | 23/76 | 23/74 | 21/61 |
| 14 | 1/2" conduit required if the air conditioner is used. (Arrangement "C" Hotel Package) <u>One Lot</u> | " | " | | | | " | 30/63 | 28/63 | 28/62 | 25/50 |

## UNIT COST DIFFERENTIALS FOR ELECTRICAL-PACKAGE ITEMS

Since the construction and cost information in Ref. 1 and that provided by the general contractor on electrical items are insufficient, no attempt has been made to obtain cost differentials between those electrical items and the items in the new electrical packages (itemized in Table 25).

Table 26

1962 SUMMARY COSTS FOR ELECTRICAL PACKAGES

| Item or Lot | No. or Ft Reqd. | Package W-1 | | | | Package W-2 | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Total Price Per Unit in Quantities as Indicated | | | | Total Price Per Unit in Quantities as Indicated | | | |
| | | 1 | 10 | 100 | 1000 | 1 | 10 | 100 | 1000 |
| 1 | 1 | 162 | 158 | 151 | 124 | 162 | 158 | 151 | 124 |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | 1 | 26 | 26 | 25 | 22 | | | | |
| 5 | 1 | | | | | 39 | 39 | 37 | 31 |
| 6 | 1 | | | | | 100 | 100 | 94 | 82 |
| 7 | 1 | 31 | 30 | 28 | 24 | | | | |
| 8 | | | | | | | | | |
| 9 | 1 | | | | | 53 | 52 | 48 | 42 |
| 10 | | | | | | | | | |
| 11 | 220 | 154 | 152 | 149 | 125 | | | | |
| 12 | | | | | | | | | |
| 13 | 140 | | | | | 101 | 99 | 97 | 82 |
| 14 | | | | | | | | | |
| TOTAL | | 373 | 366 | 353 | 295 | 455 | 448 | 427 | 361 |

| Item or Lot | No. or Ft Reqd. | Package W-3 | | | | Package W-4 | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Total Price Per Unit in Quantities as Indicated | | | | Total Price Per Unit in Quantities as Indicated | | | |
| | | 1 | 10 | 100 | 1000 | 1 | 10 | 100 | 1000 |
| 2 | 1 | 193 | 189 | 181 | 157 | 193 | 189 | 181 | 157 |
| 4 | 1 | 26 | 26 | 25 | 22 | | | | |
| 11 | 220 | 154 | 152 | 149 | 125 | | | | |
| 7 | 1 | 31 | 30 | 28 | 24 | | | | |
| 5 | 1 | | | | | 39 | 39 | 37 | 31 |
| 6 | 1 | | | | | 100 | 100 | 94 | 82 |
| 9 | 1 | | | | | 53 | 52 | 48 | 42 |
| 13 | 140 | | | | | 101 | 99 | 97 | 82 |
| TOTAL | | 404 | 397 | 383 | 328 | 486 | 479 | 457 | 394 |

(Table Continues)

Table 26 (Continued)

1962 SUMMARY COSTS FOR ELECTRICAL PACKAGES

| Item or Lot | No. or Ft Reqd. | Package W-5 | | | | Package W-6 | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Total Price Per Unit in Quantities as Indicated | | | | Total Price Per Unit in Quantities as Indicated | | | |
| | | 1 | 10 | 100 | 1000 | 1 | 10 | 100 | 1000 |
| 3 | 1 | 222 | 216 | 205 | 181 | 222 | 216 | 205 | 181 |
| 4 | 1 | 26 | 26 | 25 | 22 | | | | |
| 12 | 250 | 177 | 172 | 168 | 144 | | | | |
| 8 | 1 | 42 | 41 | 39 | 33 | | | | |
| 5 | 1 | | | | | 39 | 39 | 37 | 31 |
| 14 | 170 | | | | | 93 | 91 | 90 | 75 |
| 6 | 1 | | | | | 100 | 100 | 94 | 82 |
| 10 | 1 | | | | | 53 | 52 | 48 | 42 |
| TOTAL | | 467 | 455 | 437 | 380 | 507 | 498 | 474 | 411 |

Table 27

ELECTRICAL PACKAGE FOR A GIVEN COMBINATION OF HOTEL AND VENTILATION PACKAGES

| Elect. Pkg. | Elect. Sys. Arrgt. | Power Pkg./kw | Packages Serviced | Load Range (kw) |
|---|---|---|---|---|
| W-1 | A | P-1/ 1.2 | V-1A, V-2A, V-1B, V-2B H-1A, H-2A, H-3A, any control package | 0.65 to 1.1 |
| W-2 | A | P-4/ 5 | V-1C, V-2C, V-1D, V-2D, H-1A, H-2A, H-3A, H-1B, H-2B H-3B, any control package | 3.7 to 4.7 |
| W-3 | B | P-2/ 2 | V-1A, V-2A, V-1B, V-2B H-1B, H-2B, H-3B, any control package | 1.25 to 1.75 |
| W-4 | B | P-4/ 5 | V-1C, V-2C, V-1D, V-2D, H-1A, H-2A, H-3A, H-1B, H-2B, H-3B, any control package | 3.7 to 4.7 |
| W-5 | C | P-3/ 3.5 | V-1A, V-2A, V-1B, V-2B, H-1C, H-2C, H-3C, any control package | 3.1 to 3.6 |
| W-6 | C | P-5/ 7.5 | V-1C, V-2C, V-1D, V-2D, H-1C, H-2C, H-3C, any control package | 6.25 to 6.6 |

Table 28

**PERCENTAGE CONTRIBUTIONS OF PACKAGES TO AVERAGE ONE-OFF SHELTER COST FOR FOUR PACKAGE COMBINATIONS**

Minimum (Least Austere) 10-psi Shelter
Average One-Off Cost = $14248

| Package No. | Package $ Cost | Percent of Avg. One-Off Cost |
|---|---|---|
| S-1 | 6201 | 43.52 |
| E-1B | 1548 | 10.86 |
| V-1A | 415 | 2.91 |
| H-3A | 1855 | 13.02 |
| C-1 | 25 | 0.18 |
| P-1 | 679 | 4.77 |
| F-1 | 431 | 3.02 |
| I-1 | 2721 | 19.10 |
| W-1 | 373 | 2.62 |
| Total | $14248 | 100% |

Minimum (Least Austere) 35-psi Shelter
Average One-Off Cost = $16207

| Package No. | Package $ Cost | Percent of Avg. One-Off Cost |
|---|---|---|
| S-2 | 6666 | 41.13 |
| E-2 | 1653 | 10.20 |
| V-2A | 430 | 2.65 |
| H-3A | 1855 | 11.45 |
| C-1 | 25 | 0.15 |
| P-1 | 679 | 4.19 |
| F-1 | 431 | 2.66 |
| I-3 | 4095 | 25.27 |
| W-1 | 373 | 2.30 |
| Total | $16207 | 100% |

Minimum (Most Austere) 10-psi Shelter
Average One-Off Cost = $18461

| Package No. | Package $ Cost | Percent of Avg. One-Off Cost |
|---|---|---|
| S-1 | 6201 | 33.59 |
| E-1A | 1456 | 7.89 |
| V-1D | 1473 | 7.98 |
| E-1C | 3246 | 17.58 |
| C-3 | 397 | 2.15 |
| P-5 | 1319 | 7.14 |
| F-1 | 431 | 2.33 |
| I-2 | 3431 | 18.59 |
| W-6 | 507 | 2.75 |
| Total | $18461 | 100% |

Minimum (Most Austere) 35-psi Shelter
Average One-Off Cost = $19802

| Package No. | Package $ Cost | Percent of Avg. One-Off Cost |
|---|---|---|
| S-2 | 6666 | 33.66 |
| E-2 | 1653 | 8.35 |
| V-2D | 1488 | 7.52 |
| E-1C | 3246 | 16.39 |
| C-3 | 397 | 2.00 |
| P-5 | 1319 | 6.66 |
| F-1 | 431 | 2.18 |
| I-3 | 4095 | 20.68 |
| W-6 | 507 | 2.56 |
| Total | $19602 | 100% |

Table 29

**COMPARISON OF 1959 AND 1962 AVERAGE ONE-OFF SHELTER COSTS FOR FOUR PACKAGE COMBINATIONS**

Most Austere 10-psi Shelter

| Package No. | 1959 Pkg. Cost Per Ref. 1 | 1962 Pkg. Cost Per This Study | Cost Difference | Percent Increase or Decrease |
|---|---|---|---|---|
| S-1 | $ 4430 | $ 6201 | $+1771 | + 40 |
| E-1B | 1229 | 1548 | + 319 | + 26 |
| V-1A | 371 | 415 | + 44 | + 12 |
| H-3A | 2585 | 1855 | - 730 | - 28 |
| C-1 | 24 | 25 | + 1 | + 4 |
| P-1 | 724 | 679 | - 45 | - 6 |
| F-1 | 433 | 431 | - 2 | - 0.5 |
| I-1 | 2419 | 2721 | + 302 | + 13 |
| W-1 | -- | 373 | + 373 | +100 |
| Total | $12215 | $14248 | $+2033 or 17% | |

Most Austere 35-psi Shelter

| Package No. | 1959 Pkg. Cost Per Ref. 1 | 1962 Pkg. Cost Per This Study | Cost Difference | Percent Increase or Decrease |
|---|---|---|---|---|
| S-2 | $ 4845 | $ 6666 | $+1821 | + 38 |
| E-2 | 1408 | 1653 | + 245 | + 17 |
| V-2A | 526 | 430 | - 96 | - 18 |
| H-3A | 2585 | 1855 | - 730 | - 28 |
| C-1 | 24 | 25 | + 1 | + 4 |
| P-1 | 724 | 679 | - 45 | - 6 |
| F-1 | 433 | 431 | - 2 | - 0.5 |
| I-3 | 3517 | 4095 | + 578 | + 16 |
| W-1 | -- | 373 | + 373 | +100 |
| Total | $14062 | $16207 | $+2145 or 15% | |

Least Austere 10-psi Shelter

| Package No. | 1959 Pkg. Cost Per Ref. 1 | 1962 Pkg. Cost Per This Study | Cost Difference | Percent Increase or Decrease |
|---|---|---|---|---|
| S-1 | $ 4430 | $ 6201 | $+1771 | + 40 |
| E-1A | 1193 | 1456 | + 263 | + 22 |
| V-1D | 1144 | 1473 | + 329 | + 29 |
| H-1C | 4847 | 3246 | -1601 | - 33 |
| C-3 | 728 | 397 | - 331 | - 45 |
| P-5 | 1483 | 1319 | - 164 | - 11 |
| F-1 | 433 | 431 | - 2 | - 0.5 |
| I-2 | 2679 | 3431 | + 752 | + 28 |
| W-6 | -- | 507 | + 507 | +100 |
| Total | $16937 | $18461 | $+1524 or 9% | |

Least Austere 35-psi Shelter

| Package No. | 1959 Pkg. Cost Per Ref. 1 | 1962 Pkg. Cost Per This Study | Cost Difference | Percent Increase or Decrease |
|---|---|---|---|---|
| S-2 | $ 4845 | $ 6666 | $ +1821 | + 38 |
| E-2 | 1408 | 1553 | + 245 | + 17 |
| V-2D | 1299 | 1488 | + 189 | + 14 |
| H-1C | 4847 | 3246 | -1601 | - 33 |
| C-3 | 728 | 397 | - 331 | - 45 |
| P-5 | 1483 | 1319 | - 164 | - 11 |
| F-1 | 433 | 431 | - 2 | - 0.5 |
| I-3 | 3517 | 4095 | + 578 | + 16 |
| W-6 | — | 507 | + 507 | +100 |
| Total | $18560 | $19802 | $ +1242 or 7% | |

# APPENDIX C

## HISTORY OF BUNK-SYSTEM TESTING AND DEVELOPMENT

### C.1 GENERAL

After the Camp Parks shelter had been constructed and outfitted in August 1959, the shelter underwent the following human occupancy tests: (1) a preliminary test in November 1959 in which 17 NRDL volunteers lived 2 days in the shelter; (2) the first full-capacity test[8] in December 1959 in which 100 male volunteers lived 14 days in the shelter; (3) a second full-capacity test[9] in July 1960 in which 100 male volunteers lived for 5 days in the shelter in hot weather; and (4) a third full-capacity test in November 1960 in which a mixed population of 100 men, women, and children lived 2 days in the shelter. The bunk system was part of the least austere, 1-shift sleeper, H-1C hotel package, which is described in detail in Ref. 1. The design drawings of Appendix A of the present report contain modifications of the bunk system based on the findings of these tests.

### C.2 PRELIMINARY TEST

This test revealed several defects in the bunk system. A number of bunk poles bent under the weight of the bunk occupants. The continuous-sheet arrangement of the bunks caused some discomfort, since the movements of one person were felt by all others in the same tier. Some bending and breaking of the pins connecting the bunk poles to the uprights also occurred. However, no major action was taken to correct these defects because of the short time between the preliminary test and the first full-capacity test and because it was believed that the defects would remain minor. The lashings connecting the bunk sheeting to the poles were tightened in the hope of reducing the tendency to transmit movements along the tier. Spare bunk pins were also procured.

### C.3 FIRST FULL-CAPACITY TEST

#### C.3.1 Findings of Test

The first full-capacity human occupancy test was conducted 3-17 December 1959 when 100 male volunteers lived for 14 days in the shelter. A number of defects developed in the bunk system (cf Ref. 1) during this rigorous test. In many cases, the horizontal bunk poles of 3/4-inch pipe were too light—the weight of the heavier men bent these poles. The lower tiers of bunks were too close to the floor, so that sagging of the occupied bunk sheet allowed the occupant's body to bear on the floor. Bunk sheets tore because occupants stepped on the ends of the sheets instead of using the ladder. The bolt (anchor type) fasteners in the floor holding the lower bunk channels started to pull out of the concrete.

#### C.3.2 Corrective Actions Taken During Test

Early in this test, it became obvious that the bunk system would not hold up for the remainder of the test. Therefore, the following changes were made: the 3/4-inch-pipe bunk poles were replaced by 1-inch-pipe bunk poles; the lowest tiers of bunks were raised by relocating the support brackets on the vertical uprights; the torn bunk sheets were sewn up by the shelterees; and the bolt fasteners in the floor were only hand tightened.

### C.4 MODIFICATIONS MADE AFTER FIRST FULL-CAPACITY TEST

#### C.4.1 Modifications in Bunk Sheets

To prepare the bunk system for the second full-capacity test, the bunk sheets and bunk structure were modified. New canvas bunk sheets were procured that were 3 inches longer than the plastic bunk sheets (6 feet) used in the test. Several innovations were attempted in the shape of the bunk sheets to provide more comfort, such as providing simulated pillows.

Two basic layouts were developed: Type I, individual bunk sheets, and Type II, continuous bunk sheets. The individual bunk sheets were designed so that adjacent sheets were supported by a common bunk pole inserted through a tube of canvas, part of which was formed from one sheet and part from the other. In addition, these sheets were cut so that the width at the head end was 1 inch less than that at the foot end. In place, the head end would be more taut than the foot end, thus raising the head in lieu of a pillow. Pilot models of the Type I bunk sheets failed to fulfill expectations. Because of the shape of the bunk sheets, they provided uneven support to the body. Therefore, the individual bunk sheets were not used in the second full-capacity test, and instead two new types of the continuous canvas bunk sheets were tried: a rectangular shape, and a tapered shape to provide a taut head end to simulate a pillow. To prevent tearing along the edges, a 1/4-inch manila rope was sewn directly into the hem. The tie flaps that connect the continuous sheet to the bunk poles were provided with a double stitch to prevent separation of the flap from the main sheet. Two weights of canvas (No. 10 duck and No. 12 duck) were tried with each shape of continuous canvas sheet to obtain adequate comfort at minimum cost.

For the second full-capacity test, only four bunk sheets could be procured: one of each weight in each of the two types of continuous canvas sheets. Therefore, four plastic sheets were selected from those used in the first full-capacity test. This arrangement of different type bunk sheets enabled a comparison between the new canvas designs and the old plastic sheets.

#### C.4.2 Modifications in Bunk Structure

The horizontal bunk poles were made longer than the previous poles to accommodate the increased length of the new bunk sheets. To permit the use of these longer poles, the rows of short uprights near the shelter sidewalls were moved closer to the sidewalls. This necessitated lowering the total height of the bunk system to maintain clearance, and since the lowest tiers of bunks had been raised an additional 3 inches above the floor (to about 8 inches) during the test, the distance between tiers of bunks was reduced from 30 inches to 26 inches.

Guard rails were provided at each end of each tier to replace the unsatisfactory fabric straps used in the test. Since the pinned connections for supporting the bunk poles at the uprights had proved unsatisfactory during the test, 12 prototype connectors were constructed at NRDL and a mockup was made. Experience with the mockup resulted in the selection of 4 different connectors for the second full-capacity test. These connectors were as follows: (1) a simple U-shaped cup of 1/8-inch sheet steel welded to the upright; (2) a stirrup-type support made of 1/4-inch steel round stock bent into a long U and welded to the upright at the ends so as to project downward at an angle of about 45°; (3) a hook-type support of bent 1/4-inch steel round stock, designed to hook into two drilled holes in the upright and two drilled holes in the end of the bunk pole; and (4) a slot-type connector consisting of a notched piece of flat bar pressed in the end of the bunk pole which engaged a slot cut in the upright. Each type of connector was provided on two tiers of bunks.

The bottom channels (of Ref. 1) that held the lower ends of the uprights were deleted from the design, and 2-inch diameter holes were drilled 1 inch deep in the concrete floor. A considerable saving in material, labor, and bunk-assembly effort was effected by the elimination of the bottom channels.

## C.5 SECOND FULL-CAPACITY TEST

All the foregoing changes in the bunk system were highly satisfactory except for the defects discussed below.

Each shelteree slept 2 nights on canvas and 2 nights on plastic sheets. The canvas sheets were preferred over the plastic sheets by 82 shelterees. The plastic sheets were preferred by 13 shelterees. The principal objection to the plastic sheets was that they were uncomfortable in the warm environment, sticking to the perspiring skin of the shelterees because of the lack of air circulation through the nonporous plastic.

Only 14 of the shelterees remarked that the canvas bunks were longer than the plastic bunks. One reason for this observation was that the canvas bunk sheets, not being restrained at their extremities, tended to creep along the bunk poles when occupied. This action put more sag in the bunks than had been anticipated and negated the attempt to provide a taut head end in lieu of a pillow.

The continuous canvas bunk sheets wore very well, but some tearing of stitches connecting the tieflaps to the sheets was observed near the ends of the flaps. These failures were the result of stresses caused by the shelterees sitting upright on the ends of the bunks. Some tearing of the grommets in the tieflaps was also observed.

The U-shaped cup connectors were quite satisfactory as receptacles for supporting the horizontal bunk poles and enabled easy and quick connections. None of the other three connectors were considered satisfactory. Many of the stirrup connectors would flatten next to the pole during handling and stowage of the uprights, thus allowing the horizontal bunk poles to slip from the stirrup loop and become a safety problem. The hook connectors would bend or drop loose during the stowage of uprights. If the holes in the poles (vertical and horizontal) did not exactly match the curve of the hooks, the assembly of the bunks became a difficult and tiring task. The slot connectors had the advantage of holding the entire bunk framework rigidly, but were very difficult to assemble. All slots and notched bars had to be within a close tolerance to be effective and would require better quality control in manufacture with consequent increased cost.

## C.6 MODIFICATIONS MADE AFTER SECOND FULL-CAPACITY TEST

The defects described in C.5 have been satisfactorily overcome by improved design, shown in detail in Fig. A-10N.

## C.7 THIRD FULL-CAPACITY TEST

The bunk system functioned adequately during this mixed population test. It is therefore concluded the bunk system has now been developed and tested to the point where it represents a reasonable compromise between cost and comfort.

# APPENDIX D

## DISCUSSION OF AIR-HANDLING ASPECTS TO ILLUSTRATE NEED FOR FUNDAMENTAL PERFORMANCE SPECIFICATIONS

### D.1 GENERAL

The most important shelter auxiliary system is the air-handling system. This system should be designed to protect the occupants from the radiological,- chemical,- and biological-warfare threat resulting from ingress via the air supply. Prior to World War II, the wartime danger from breathing air was mainly derived from chemical agents. Precautions and protective-equipment design were based on the assumption that the chemical agents would be employed as gases, vapors, and/or particulate matter. Weapons developed for and used in World War II resulted in destruction by explosion and fire. These effects made necessary air-handling equipment that would prevent chemical agents, dust, and hot air from being drawn into the shelter. The nuclear weapon and the recent development in biological warfare have placed further requirements on the air-handling system in that radioactive particulate plus biological warfare agents may have to be kept from the shelter atmosphere.

Briefly then, the importance of the air-handling system cannot be over emphasized because it must provide an adequate human environment during shelter close up as well as during other shelter conditions. By normal United States standards, a system for accomplishing this will be costly and complicated unless the design requirements are very closely controlled.

The author is of the opinion that the ventilation and air-conditioning systems specified in Ref. 1 are adequate to meet the requirements there stated, and, if properly applied, will ensure a suitable environment when the exterior air conditions are within the normal range of wet and dry bulb values found in the continental United States. The system as originally specified in Ref. 1 also provides for a shelter close-up period. The use of chemicals was resorted to for removal of $CO_2$, bottled oxygen was recommended as a means for oxygen replenishment, and the system has a marginal filter arrangement. When the firestorm package is added, the total system will enable operating the shelter completely sealed off for 24 hours. We have assumed that the air outside the shelter during all other periods of the 14-day stay will be suitable for human use if it is passed through the marginal filter. But the system is not designed to remove modern chemical - and biological-warfare agents.

The author is of the opinion that design criteria for an effective air filtration system do not now exist; research and experimentation is needed to provide data for the design engineer to satisfactorily develop an adequate and austere shelter air-handling system. Specific information required is discussed below.

### D.2 SPECIFIC INFORMATION REQUIRED

1. A specific particulate size (and density) below which penetrating particulate will not add materially to the radiological hazard. The filter can then be designed to have a particulate "cut off" at this point. This criterion is important, since many shelter designers at present are specifying filters that have an "American Filter Institute efficiency value of 90% with particulate size of 0.3 micron." This type of filter is of necessity a high-resistance filter having about 0.9 inch of water drop at normal air flow. Such a filter in itself is costly and also will completely govern the design characteristics of the air-handling blower and motor-duct system. Prefiltering for this filter will no doubt be required.

2. The total time during the 14-day stay in the shelter that airborne radioactive material must be filtered from the incoming air, and the approximate amount of such material that will accumulate in the filter during this time. With this information in hand, the designer can then determine the type of filter he must furnish and whether the filter must be installed inside a radiation shield. If a shield is necessary, this information will be adequate to provide for its design. (The present trend in West Germany is to provide a radiological filtration capacity of approximately 49 hours.[10])

3. The time that each specific class of shelter will be closed off from the outside in the event of a firestorm. For example, compared to the 24-hour period specified in Ref. 1, Sweden has specified that their class 1 shelter shall have an air-handling system capable of complete shut off from the outside for a period of 10 hours.[11]

4. The number of people that will be assigned to the shelter and the maximum effective temperature that will be allowable. High-performance, class-1 shelters in Sweden are provided with temperature control and ventilation devices, as well as gas and aerosol filters, for a population density of 5.4 sq ft per person.[11] The current OCD recommendation is 12.5 sq ft per person. The former density is reasonable when one considers the high cost for the basic class-1-type shelter vs the additional cost of air-handling plus miscellaneous other hotel-type requirements necessary to accommodate the former density.

5. The heat-absorbing capability of the air-handling equipment. This design requirement will necessitate research that is directed at determining the conditions that will exist as the result of a fire caused by a nuclear weapon detonation at a specified location. Basically, this research should provide shelter air-inlet temperatures vs time data with the air inlet installed in a specific environment. The temperature vs time environment of the air inlet will be dependent on:

Weapon yield range being considered.
Distance from ground zero of the specified class of shelter.
Percent buildup of combustibles in the vicinity.
General features of terrain surrounding the inlet location relative to hills and amount of combustibles.

6. The optimum internal pressuring of the shelter to ensure minimum ingress of contaminants when the shelter is exposed to outside winds of varying velocities.

7. The duration that chemical and biological agents will persist, the types of such agents, and the amount of such agents a filter must remove from inlet air. This feature is an extremely important feature of a shelter's air-handling system. Research should establish the type and possible concentration of chemical and biological agents that must be removed. Then, research regarding the filter's required capacity for this air-cleaning problem is necessary. Currently German research is based on the assumption that these war gases will persist for approximately 96 hours.[12]

8. The design of the shelter air inlet. Results of the Camp Parks firestorm test indicate that the air inlet must protrude above the rubble after the detonation in order to minimize the entry of hot air, oxygen-depleted air, carbon monoxide, carbon dioxide, into the shelter. Research must determine for the designer the correlation between buildings in the proposed shelter location and the possible rubble height.

## D.3 PROPOSED SHELTER AIR-HANDLING SYSTEM

The most satisfactory air-handling system for minimum cost will no doubt result when the designer has been furnished the information discussed above. This system will then operate as follows:

At the time of detonation, the shelter will have been manually or automatically closed off from the exterior by means of blast shields.

The system will not be used when the outside air is above 1000°F, depleted of oxygen, or has lethal concentrations of carbon monoxide or carbon dioxide.

The system will be used when the outside air presents a radiological, chemical, or biological hazard to the shelterees; it will have an air valve for bypassing the filter when these threats disappear.

When an airborne-activity hazard exists, the shelter air supply will be reduced to a minimum and passed through the filter. Under this operating condition, the air supply can be reduced to approximately 2.5 cfm per person. This reduction during thermal, chemical, radiological, or biological conditions will aid in designing an adequate filter at minimum cost.

It is of interest to note that West Germany and Sweden have developed over the past 15 years a simplified sand filter that will function as a filter for chemical, biological, and radiological-warfare agents and also as an air cooler.[12]

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2. Shelters - Design.
3. Underground structures - Construction.
I. Porteous, L.
II. Title.

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believed that the shelter will provide the specified fallout and blast protection, the required interior environment, and the essential "hotel-type" equipment at minimum cost. The shelter items are specified by several packages, each having one or more different arrangements of items, depending on the degrees of protection and comfort desired. The proper selection of packages will result either in a 35-psi or 10-psi blast and fallout shelter sited above or below grade. The radiation protection factor is at least 1000. "Most austere" to "least austere" living accommodations can be selected. Average cost data for the packages by item are tabulated for quantities up to 1000. Respective costs (less overhead, profit, etc.) for four complete shelters (combinations of most austere and least austere with 35-psi and 10-psi) have been estimated and are presented graphically. Costs for shelter quantities were estimated by means of learning curves. The costs range (one-off) from $19,800 for the least-austere 35-psi shelter to $14,200 for the most-austere 10-psi shelter. The design modifications are based on findings of the USNRDL Shelter Research Program for the period, 1959 to June 1962.

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