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# HANFORD ATOMIC PRODUCTS OPERATION

# ARCHITECTURAL AND CIVIL

# STANDARDS

HWS-10000

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Oak Ridge, Tenn.

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## HANFORD ENGINEERING STANDARDS

### INTRODUCTION

Hanford Engineering Standards are published in the following nine books:

- HWS-10000 - ARCHITECTURAL AND CIVIL STANDARDS
- HWS-10001 - MECHANICAL STANDARDS
- HWS-10002 - ELECTRICAL STANDARDS
- HWS-10003 - GUIDES, VOL. 1 & VOL. 2
- HWS-10004 - WELDING STANDARDS
- HWS-10005 - INSTRUMENT STANDARDS
- HWS-10006 - STANDARD DESIGN CRITERIA
- HWS-10007 - PROTECTIVE CLOTHING STANDARDS

These books are obtainable from Reproduction, 760 Building, upon presentation of an approved order.

In the development of Engineering Standards, due consideration is given to economies in materials and to methods which are consistent with sound engineering principles.

The Guides contain information which has been developed from good engineering and maintenance practices. These Guides are for use at Hanford in the selection of materials and methods.

HAPO OPG 4.1 assigns the responsibility for developing plant-wide Standards to Construction Engineering & Utilities Operation. The work of preparing and issuing Standards has been assigned to the Engineering Standards and Specifications Operation.

Suggestions concerning new and existing Standards are invited. The suggestions should be forwarded to the Secretary of the Engineering Standards Council.

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<u>SECTION E-5 (Cont'd)</u>	<u>STD. NO.</u>	<u>APPROV. DATE</u>	<u>REV. DATE</u>
Septic and Siphon Tanks	E-5-11	Superseded by AC-4-40	
Instructions for Use of Pipe Cradle and Encasement Standards	DI-E-5-12a, 13 & 14	Superseded by DI-AC-4-50, 51 & 52	
Pipe Protection-Concrete Cradle Bedding	E-5-12a	Superseded by AC-4-50	
Pipe Protection-Type A Encasement	E-5-13	Superseded by AC-4-51	
Pipe Protection-Type B Encasement	E-5-14	Superseded by AC-4-52	
Standard Clearances for Railroad Tracks	E-5-15	Superseded by AC-7-1	
Turnout 15' - 0" Switch and No. 8 Frog	E-5-15a	Superseded by AC-7-4	
Turnout 16' - 6" Switch and No. 10 Frog	E-5-15b	Superseded by AC-7-5	
Railroad Cross-Sections	E-5-15c	Superseded by AC-7-2	
Widening at Railroad Turnouts	E-5-15d	Superseded by AC-7-3	
Railroad Gage Rods	E-5-15e	Superseded by AC-7-6	
Rail Anchors	E-5-15f	Superseded by AC-7-7	
Standard Security Chain Link Fence	E-5-17	Superseded by HW-4680-S, Plate I	
Standard Security Chain Link Gate	E-5-19	Superseded by AC-5-20	
Bronze Survey Marker	E-5-20	Superseded by AC-5-30	
Instructions for Use of E-5-21	DI-E-5-21	Superseded by DI-AC-5-31	
Survey Monument	E-5-21	Superseded by AC-5-31	
Instructions for Use of E-5-26	DI-E-5-26	Superseded by DI-AC-5-1	
Barricade	E-5-26	Superseded by AC-5-1	
Instructions for Use of E-5-28a	DI-E-5-28a	Superseded by DI-AC-5-2	
Chain Barricade	E-5-28a	Superseded by AC-5-2	
Instructions for Use of E-5-29	DI-E-5-29	Superseded by DI-AC-5-3	
Single Post Marker or Guard Post	E-5-29	Superseded by AC-5-3	
Fire Prot. Services - Post Barricade	E-5-30	Superseded by AC-5-4	

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ARCHITECTURAL-CIVIL STANDARDS

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<u>SECTION E-5 (Cont'd)</u>	<u>STD. NO.</u>	<u>APPROV. DATE</u>	<u>REV. DATE</u>
Railroad Crossing	E-5-31	Superseded by AC-7-20	
Wood Plank Railroad Crossing	E-5-32	Superseded by AC-7-21	
Curb Details - 4" Comb. Curb & Gutter	E-5-33	Superseded by AC-6-10	
Curb Details - 6" Curb	E-5-34	Superseded by AC-6-10	
Curb Details - 6" Comb. Curb & Gutter	E-5-35	Superseded by AC-6-10	
Sidewalk Details	E-5-36	Superseded by AC-6-11 & DI-AC-6-11	
Railroad Mile Post	E-5-39	Superseded by AC-7-30	
Instructions for Use of E-5-40a	DI-E-5-40a	Superseded by DI-AC-6-1	
Inter-Area Highway Cross-Sections	E-5-40a	Superseded by AC-6-1	
Instructions for Use of E-5-40b	DI-E-5-40b	Superseded by DI-AC-6-2	
Intra-Area Roadway Cross-Sections	E-5-40b	Superseded by AC-6-2	



This Guide Consists of  
6 Numbered Pages.

GUIDE

for

SELECTING AND LOCATING

NATIONAL CODES AND SPECIFICATIONS

NO.	REVISION	APP'D	DATE	HANFORD GUIDE	SUBM. BY	DES. BY
3	General	hes	5-3-63		hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 2-10-58				SELECTING & LOCATING CODES	G-1-1	

## G-1-1

GUIDE FOR SELECTING AND LOCATING  
NATIONAL CODES AND SPECIFICATIONS1. PURPOSE

The purpose of this guide is to assist in selecting and locating appropriate national codes and specifications for HAPO's use.

2. HANFORD ENGINEERING STANDARDS AND NATIONAL CODES

Hanford Engineering Standards are based on and, in many cases, reference applicable national codes. When selecting the code or specification for a specific item, Hanford Engineering Standards (Drawings, Guides, Specifications and Design Criteria) should be considered first.

Examples of references to national codes in Hanford Engineering Standards are as follows:

- a. Standard Design Criteria SDC-1.2 for Codes, Standards and Specifications lists the approved codes for HAPO's use. Other Standard Design Criteria state specifically which codes to use for design of buildings, foundations, electrical systems, etc.
- b. Hanford Guides state ASTM specification numbers for roofing materials, valve component materials & stainless steels; ASA specification numbers for valve design; ASA Pressure Piping Code; ASME Boiler and Pressure Vessel Code; Federal Specification numbers for paints and roofing materials.
- c. The Standard Specification for Identification of Piping Systems references the American Standards Association (ASA) Standard for Identification of Piping Systems.
- d. The Standard Specification for Piping references ASTM and ASA specifications for pipe and pipe fittings, Federal Specifications for packing and calking, American Water Works Association (AWWA) Standard for protective coatings for steel water pipe, The American Standard National Plumbing Code and the ASA Code for Pressure Piping.

### 3. WHERE TO FIND INDEXES AND COPIES OF NATIONAL CODES AND SPECIFICATIONS

In selecting and locating a code or specification, much time can be saved by using an appropriate index. For Hanford Engineering Standards, a composite index of all Hanford Engineering Standards (Drawings, Guides, Specifications, and Design Criteria) has been issued to all Standards bookholders and to many others. There are also individual indexes at the front of each Standards book.

The Hanford Engineering Standards office has copies of certain national codes, specifications, and indexes. Often this office can assist in selecting and locating national and local codes and specifications. A telephone call to that office may be all that is required to answer a question on a code or specification. However, actual selection of a specific code or specification is the responsibility of the user.

Copies of Hanford Engineering Standards books, or single copies of individual standards, specifications, guides and design criteria may be ordered from Reproduction, 760 Building, by means of a reproduction order.

Single copies of Federal Specifications may be obtained directly, without charge from the General Services Administration, Regional Headquarters Building, Auburn, Washington.

Copies of many national codes and specifications and of the following indexes may be obtained on loan, or ordered for permanent assignment from the W-10 Library:

#### a. INDEXES OF NATIONAL CODES, STANDARDS AND SPECIFICATIONS

- (1) AAR - "Index to AAR Specifications", issued by the Association of American Railroads.
- (2) ACI - "Current ACI Standards", located on the inside front and back cover of American Concrete Institute Standard publications such as ACI-318.
- (3) AGA - "American Gas Association Publications", a list of standards and miscellaneous publications issued by the American Gas Association.
- (4) AGMA - "Standards Index" published by the American Gear Manufacturers Association.
- (5) AISE - "List of Publications", list of standards for slings, chains, machined surface finishes and miscellaneous publications issued by the Association of Iron and Steel Engineers.

- (6) AISI - "Steel Products Manual" a listing of standards and miscellaneous publications issued by the American Iron and Steel Institute.
- (7) AMCA - List of standards and other publications, Form: P 1 issued by the Air Moving & Conditioning Association Inc.
- (8) AMS - "Index to SAE Aeronautical Material Specifications, (SAE) - (AMS Index)" published by the Society of Automotive Engineers, Inc.
- (9) API - "Official List, Publications of the Division of Production, American Petroleum Institute".
- (10) ARI - "ARI Technical Publications", list of standards and publications issued by the Air-Conditioning and Refrigeration Institute.
- (11) ASHRAE - "Codes and Standards", list published in last chapter of Heating Ventilating Air Conditioning Guide, published by the American Society of Heating, Refrigerating and Air-Conditioning Engineers. (Includes ASRE Standards).
- (12) ASA - "Catalog of American Standards" issued by the American Standards Association, Inc.
- (13) ASTM - "Index to ASTM Standards", issued annually by the American Society for Testing Materials. Individual indexes to the various ASTM volumes are also located in the front of each volume.
- (14) ASME - Listing of ASME Publications such as ASME Boiler and Pressure Vessel Code, Standards and Power Test Codes, published by the American Society of Mechanical Engineers.
- (15) AWWA - "Table of Contents and Checklist" of AWWA Standards located in the front of the American Wood Preservers' Association Manual of Recommended Practice.
- (16) AWS - "AWS Publication Order Form", a list of codes, standards, specifications, and books on welding and allied processes issued by the American Welding Society, Inc.
- (17) AWWA - "AWWA Publications", a list of standards issued by the American Water Works Association, Inc.
- (18) CGA - "Compressed Gas Association Pamphlets - Order Form", a listing of standards and miscellaneous material issued by the Compressed Gas Association, Inc.

- (19) EEI - "Price list" Edison Electric Publications, a list of electrical standards and miscellaneous publications issued by the Edison Electric Institute.
- (20) EIA - "Recommended Standards and Engineering Publications of the Electronics Industries Association"; (formerly Radio-Electronic-Television Manufacturers Association, RETMA, RTMA & RMA).
- (21) HEI - "Standards of the Heat Exchange Institute" a Library listing of standards issued by the Heat Exchange Institute.
- (22) HI - "Hydraulic Institute Standards" located in the manual of Standards issued by the Hydraulic Institute.
- (23) IEEE - "Standards Publications Issued by the Institute of Electrical and Electronic Engineers", lists IEEE Standards, Test Codes, Recommended Practices, Guides, and Reports. (IEEE combined former American Institute of Electrical Engineers (AIEE) and the Institute of Radio Engineers (IRE).
- (24) IES - "Publications" of the Illuminating Engineering Society, a list of standards and standard practices issued by the Illuminating Engineering Society.
- (25) IPCEA - Listing and price list of standards and specifications, issued by the Insulated Power Cable Engineers Association.
- (26) ISA - "ISA Price List and Order Form", a list of recommended practices issued by the Instrument Society of America.
- (27) JIC - "Electrical Standards for Industrial Equipment" issued by the Joint Industry Conference now superseded by Industrial Electrical Equipment Council.
- (28) MSS - "Price List of MSS Standard Practices", issued by the Manufacturers Standardization Society of the Valve and Fittings Industry.
- (29) NBFU - "Publications of the National Board of Fire Underwriters" including Standards and Recommended Safeguards.
- (30) NEMA - "List of NEMA Standards Publications", issued by the National Electrical Manufacturers Association.  
and  
"Guide to NEMA Standards Publications", issued by the National Electrical Manufacturers Association. This guide describes briefly the function and use of each NEMA Standard.

- (31) NFPA - "A List of NFPA Publications", issued by the National Fire Protection Association. Includes a listing of the National Fire Codes by volumes and by individual bulletin numbers. Consult also the six volumes of the National Fire Codes.
- (32) SAE - The index to Society of Automotive Engineers Specifications is contained in the SAE Handbook. (For SAE-AMS see AMS (SAE) Item (8) in this listing).
- (33) SSPC - "Index of SSPC Specifications" located in Volume 2, "Systems and Specifications" of the Steel Structures Painting Manual, published by the Steel Structures Painting Council.
- (34) UL - A list of published Standards of Underwriters Laboratories, Inc., is located in the back of the Underwriters lists, such as "Fire Protection Equipment List" and in the bi-monthly supplements to those lists.
- (35) OTHER INDEXES - Indexes to other standards such as the American Railway Engineering Association (AREA), Alloy Casting Institute (ACI), American Association of State Highway Officials (AASHO), State of Washington - Department of Highways Standard Specifications, and others, can usually be found in published volumes of those standards or in the individual standards, many of which are available from the W-10 Library.

b. U. S. GOVERNMENT SPECIFICATIONS AND STANDARDS

- 1. FS - "Index of Federal Specifications, Standards and Handbooks" with cumulative monthly supplements, available on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.
- 2. NBS - "Publications of the National Bureau of Standards, are listed in Publication 240, C460 and supplements, Superintendent of Documents, U.S. Government Printing Office, Washington 25, D. C.
- 3. SPR - "Simplified Practice Recommendations", Catalog No. 979. An index of standards compiled and issued by the United States Department of Commerce, Commodity Standards Division. These and other commercial standards compiled by USDC are available from the Department of Commerce, Field Service, 809 Federal Office Building, Seattle 4, Washington.
- 4. CS - "Commercial Standards", Catalog No. 978, index issued by the United States Department of Commerce, Commodity Standards Division. These and other commercial standards compiled by USDC are available from the Department of Commerce, Field Service, 809 Federal Office Building, Seattle 4, Washington.

5. DOD - Department of Defense Index of Specifications and Standards is comprised of three separate parts, as follows:
  - Part I Alphabetical Listing
  - Part II Numerical Listing
  - Part III Federal Supply Classification ListingThe Index is published annually with monthly cumulative supplement. The 3 part index is available from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D. C. Each of these parts is voluminous because the listing includes the unclassified Federal, Military and Departmental specifications, standards and related standardization documents that are used by the DOD.

#### 4. WHERE TO FIND GENERAL ELECTRIC COMPANY STANDARDS

A complete set of General Electric Company (Schenectady) Standards and the following reference documents are on file at the W-10 Library.

To find a General Electric Company Standard, refer to General Electric Publication OSD-32.4, "General Electric Standards - How they are developed and used". Part II of this publication tells "how to find and use General Electric Company Standards". In the explanation, that document refers to OSD-25 "Numbering System for General Electric Standards", OSD-1.1 "Identifications of Standard Materials, Parts and Finishes", and the General Electric Standards Books themselves, each of which has its own index.

This Design Criteria Consists  
of 5 Numbered Pages.

SDC-1.2

STANDARD DESIGN CRITERIA

for

CODES, STANDARDS & SPECIFICATIONS

Supersedes S-1-2

NO.	REVISION	APP'D	DATE	DESIGN CRITERIA  CODES, STANDARDS AND SPECIFICATIONS	SUBM. BY	DES. BY
2	General	hes	5-3-63		hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL H.E. Struck SECRETARY. DATE 6-11-58					SDC-1.2	

SDC-1.2

STANDARD DESIGN CRITERIA FOR  
CODES, STANDARDS, AND SPECIFICATIONS

1. SCOPE

These Criteria list codes, standards and specifications (referred to herein as Codes), which are approved for design, construction, alterations and repairs of HAPO Plant facilities.

The Codes listed are grouped under the following headings:

General Codes,	Instrumentation Codes,
Building Codes,	Mechanical Codes,
Electrical Codes,	Railroads, Highways and Waterworks Codes,
	Safety and Fire Protection Codes.

Under most of these groups the Codes are classified under

- a. Basic Codes (these are Codes required to be used), and
- b. Guide Codes (these are Codes which are for information and guidance).

2. GENERAL INSTRUCTIONS

- a. The latest edition of the Codes shall be used, unless in a special case where another edition is justifiable.
- b. When Codes are referenced only the applicable Codes shall be listed.
- c. Where more than one Code covers the same subject, usually the more restrictive Code or portions of such Codes shall govern.
- d. Hanford Engineering Standards (standard drawings, specifications, design criteria and guides) often modify or include additional requirements to other Codes listed herein. Where this occurs these Hanford Engineering Standards shall govern.
- e. Where Codes are referenced in specifications, the reference shall state the title and complete identification number, including the date of the applicable edition, e. g. - ASTM A 312-61T Specification for Seamless and Welded Austenitic Stainless Steel Pipe (Tentative). Where Hanford Engineering Standards are referenced the title and identification number with the revision number shall be used, e. g. - AC-7-20 Rev. 0 Railroad Crossing. In the preparation of such specifications which are for use in contracts, the Code identification number followed by the statement "Latest Revision" shall not be used. Where it is intended, that only certain portions of the referenced Code is to be used, the reference shall state the specific section, chapter or paragraph which apply.

a. Basic Codes

- (1) Atomic Energy Commission, AEC Manual Chapters 0550, 6301;
- (2) Hanford Engineering Standards (standard drawings, specifications, design criteria, and guides);
- (3) HAPO Manual of Radiation Protection Standards HW-25457;
- (4) American Society for Testing and Materials, ASTM Standards including tentatives;
- (5) American Standards Association, ASA Standards;
- (6) Federal Specifications.

b. Guide Codes

- (1) American Petroleum Institute, API Standards;
- (2) National Bureau of Standards, NBS Handbooks and Standards;
- (3) Manufacturing Chemists Association, MCA Manual Sheets and Chemical Data Sheets.

4. BUILDING CODES

a. Basic Codes

- (1) Hanford Standard Design Criteria Architectural-General SDC-2.1;
- (2) Hanford Standard Design Criteria for Conventional Construction SDC-4.1;
- (3) Uniform Building Code, International Conference of Building Officials.

b. Guide Codes

- (1) Building Code Requirements for Reinforced Concrete, ASA A89.1;
- (2) Standard Specification for Design and Construction of Reinforced Concrete Chimneys, American Concrete Institute, ACI 505;
- (3) American Institute of Steel Construction, AISC Specification for Design, Fabrication and Erection of Structural Steel for Buildings;
- (4) American Iron and Steel Institute, AISI Light Gage Steel Design Manual;
- (5) Building Code Requirements for Masonry ASA A41.1;
- (6) Building Code Requirements for Reinforced Masonry ASA A41.2;
- (7) American Welding Society, AWS Code for Arc and Gas Welding in Building Construction D1.0;
- (8) American Wood Preservers' Association, AWPAA Manual of Recommended Practices;
- (9) National Lumber Manufacturers' Association, NLMA National Design Specifications for Stress Grade Lumber and Its Fastenings;
- (10) Steel Joist Institute, Standard Specification for Open Web Joist Construction, Short Span Series ASA A87.1.

## 5. ELECTRICAL CODES

CAPE-1072-95

### a. Basic Codes

- (1) Hanford Standard Electrical Design Criteria:
  - (a) SDC-7.1 General;
  - (b) SDC-7.2 Outside Lighting and Aerial Distribution Systems;
  - (c) SDC-7.4 Underground Power Distribution Systems;
  - (d) SDC-7.5 Interior Power and Lighting Systems;
  - (e) SDC-7.7 Plant Telephone System;
  - (f) SDC-7.8 Fire Alarm Systems;
  - (g) SDC-7.10 Corrosion Protective Systems.
- (2) National Electrical Code ASA C1 (National Fire Protection Association, NFPA 70);
- (3) Fire Alarm Systems, NFPA 71, 72, 72C, 73;
- (4) Static Electricity, NFPA 77M;
- (5) Protection Against Lightning, NFPA 78;
- (6) Safety Rules for Installation and Maintenance of Electrical Supply and Communications Lines-National Bureau of Standards Handbook H-81.

### b. Guide Codes

- (1) Certified Ballast Manufacturers, CBM Standards;
- (2) Edison Electric Institute, EEI Standards;
- (3) Institute of Electrical and Electronic Engineers, IEEE Standards and Recommended Practices;
- (4) Illuminating Engineering Society, IES Standards and Lighting Handbook;
- (5) Insulated Power Cable Engineers Association (IPCEA) Standards;
- (6) National Electrical Manufacturers Association (NEMA) Standards;
- (7) Registered Luminaire Manufacturers, RLM Standards.

## 6. INSTRUMENTATION CODES

### a. Basic Codes

- (1) Code for Pressure Piping, ASA B31.1;
- (2) Hanford Standard Design Criteria for Instrument Air Supply Systems, SDC-8.1.

b. Guide Codes

CAPE - 1072-96

- (1) Instrument Society of America, ISA Recommended Practices;
- (2) See applicable Codes listed under "5. ELECTRICAL CODES."

7. MECHANICAL CODES

a. Basic Codes

- (1) Hanford Standard Design Criteria for Heating, Ventilating and Air Conditioning - SDC-5.1;
- (2) Hanford Guide - DG-105-M Weather Data for Heating and Cooling Load Estimates;
- (3) American Society of Mechanical Engineers, ASME Boiler and Pressure Vessel Code;
- (4) Pressure Piping:
  - (a) Code for Pressure Piping, ASA B31.1 and B31.1a;
  - (b) Petroleum Refinery Piping, ASA B31.3 (Chemical Process Piping);
  - (c) Refrigeration Piping, ASA B31.5;
  - (d) Standard for Installation and Operation of Gas Systems for Welding and Cutting, NFPA No. 51;
  - (e) Standard for Storage and Handling Liquefied Petroleum Gases, NFPA No. 58;
- (5) National Plumbing Code, ASA A40.8.

b. Guide Codes

- (1) Air Conditioning and Refrigeration Institute, ARI Standards (Formerly Air Conditioning and Refrigerating Machinery Assoc.);
- (2) Air Moving and Conditioning Association, AMCA Standards and Test Codes, (Formerly National Association of Fan Manufacturers);
- (3) American Society of Heating, Refrigerating and Air Conditioning Engineers, ASHRAE Standard Codes;
- (4) Mechanical Contractors Association of America (MCAA) Standards, (Formerly Heating, Piping and Air-Conditioning Contractors National Assoc.);
- (5) National Warm Air Heating and Air-Conditioning Assoc. Codes and Manuals Steel Boiler Institute Codes.

8. SAFETY AND FIRE PROTECTION CODES

Safety is inherent to all Codes listed in these criteria. However, special attention is called to Safety and Fire Protection Codes by the following:

a. Basic Codes

- (1) American Standards Association, ASA American Safety Standards.

The following is a partial listing of ASA American Safety Standards, listing of these standards does not preclude the use of other ASA Safety Standards where applicable:

- ASA A10.2 Safety Code for Building Construction;
- ASA A12 Safety Code for Floor and Wall Openings, Railings and Toe Boards;
- ASA A17.1 Safety Code for Elevators, Dumb-waiters, and Escalators;
- ASA B9.1 Safety Code for Mechanical Refrigeration;
- ASA B15.1 Safety Code for Mechanical Power Transmission Apparatus;
- ASA B19 Safety Code for Compressed Air Machinery and Equipment;
- ASA B30.2 Safety Code for Cranes, Derricks and Hoists;
- ASA Z53.1 Safety Color Code for Marking Physical Hazards and the Identification of Certain Equipment;

- (2) National Fire Protection Association (NFPA) - National Fire Codes;
- (3) See applicable Codes listed under other CODES (items 3, 4, 5, 6, 7 and 9 contained within this Standard Design Criteria).

## 9. RAILROADS, HIGHWAYS AND WATERWORKS CODES

### a. Basic Codes

- (1) Hanford Standard Design Criteria for Railroads SDC-3.1;
- (2) American Railway Engineering Association, AREA, Standard Specifications;
- (3) Washington State Department of Highways Standard Specifications;
- (4) American Association of State Highway Officials, AASHO, Standard Specifications;
- (5) American Water Works Association, AWWA, Standards, and Specifications for Water Supply, Treatment, Distribution System, Storage Equipment, Materials and Procedures;
- (6) U. S. Public Health Service Standards, Bulletins and Recommendations for protection of water supplies:
  - (a) Drinking Water Standards, Report 61:371 Reprint No. 2697;
  - (b) Manual of Recommended Water Sanitation Practice, Bulletin No. 296;
  - (c) Sanitation Manual for Public Ground Water Supplies, Reports 59: 137-177, Reprint 2539.

### b. Guide Codes

- (1) Manual on uniform Traffic Control Devices for Streets and Highways ASA D6.1"
- (2) Institute of Traffic Engineer (ITE) Traffic Engineers Handbook;
- (3) Individual Water Supply Systems-Recommendations of Joint Committee on Rural Sanitation, PHS Pub. No. 24.



INSTRUCTIONS FOR USE OF ANCHOR  
BOLT STANDARDS AC-1-1, AC-1-2 and AC-1-3

When selecting and specifying anchor bolts, the following should be observed:

1. DRAWING INFORMATION

- a. Specify on the drawings the required bolt diameter and type (AC-1-1, Type I or I-S; AC-1-2, Type II or II-S; or AC-1-3).
- b. The required projection of the bolt from top of concrete should be shown on the drawings in all cases where the grout thickness (if any), anchored item thickness, and washer thickness (if any) are not shown. When calculating projection distance, consult the standards to find the proper "A" or "AA" distance to be added. Projection should be given to the nearest  $\frac{1}{4}$  inch.
- c. If two nuts will be required, this must be shown on the drawings.

2. TYPES OF LOADS

Types I, I-S, II and II-S (AC-1-1 and AC-1-2) are designed for tensile loads for anchoring machinery and equipment, column bases, etc., in interior applications. They should not be used where shear loads only, occur, such as at grating supports, ladder and stair connections. For such uses specify Type III bolts (AC-1-3). Although the standards state that the allowable loads are based on 15,000 psi, the design is based on 20,000 psi at the root of the thread, and the use of 3000 psi concrete. To allow latitude for forces other than straight tension on machinery and equipment, the allowable load was reduced to  $\frac{3}{4}$  of the calculated load. For structural uses where tension only, occurs, multiply the allowable load by 1.33 to obtain a new allowable load based on 20,000 psi. For exterior applications, consideration should be given to increasing bolt sizes to allow for corrosion.

3. EDGE DISTANCES

Anchor bolt clear distance from edge of concrete should be 4 inches, minimum. Sleeve clear distance from edge of concrete should be 2-1/2 inches, minimum. Clear distance from the bolt to the bottom of concrete should be 3 inches, minimum.

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL H.E. Struck SECRETARY, DATE 3-4-60				INSTRUCTIONS FOR USE OF AC-1-1, 2 & 3	DI-AC-1-1, 2&3	

4. BOLT ANCHORS

- a. Recent tests<sup>1</sup> show the following for multiple expansion unit bolt anchors:

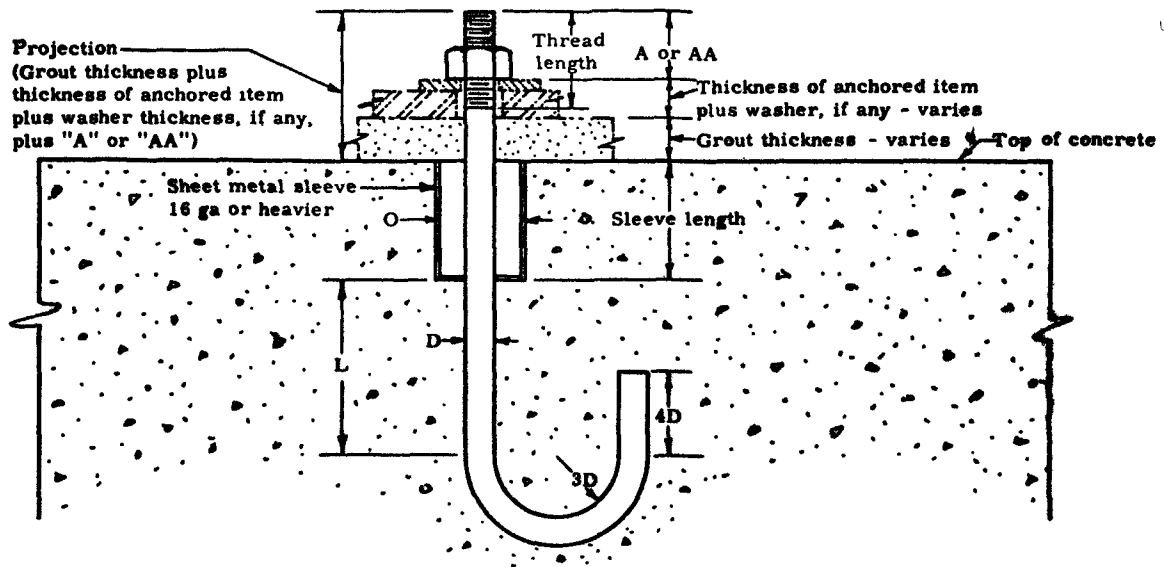
Best results are attained when the bolt anchors are set in a well-cleaned hole of the proper size and depth. The hole should be drilled with a drill which leaves a rough surface. The depth of the holes should be at least four times their diameter, and they should be placed at least two or three times their depth away from an edge or corner of the concrete, if possible. Two anchor units are sufficient for bolt anchors using bolts less than 3/4 inch in size, and three units should be used for those 3/4 inch or larger. If the anchorage is to take shearing loads, the annular space around the bolt above the anchor units should be filled with a rigid material to support the bolt when a shearing load is applied.

- b. For shear loads, self-drilling concrete anchors (Phillips "Red Head" self-drilling concrete anchors, for example) provide the rigid material referred to in a. above, as a part of the installed unit.

5. SPECIAL DESIGNS

Special anchor bolts such as those requiring leveling nuts or other special features should be detailed on the drawings.

1 Adams, R. F., "Some Factors Which Influence the Strength of Bolt Anchors in Concrete", Journal of the American Concrete Institute, Volume 52, (October 1955) pp 131-138



**ANCHOR BOLT TYPE I-S**  
(For Type I, without sleeve, see note 3)

**NOTES:**

1. Bolt material shall conform to ASTM A7-58T. Threads shall be American Standard Coarse-Thread Series, Class 2A.
2. Nuts shall conform to ASTM A307-58T, Heavy Hexagon Series with Coarse-Thread Series Class 2B threads.
3. When sleeve is not used, embedded length "L" is from top of concrete to tangent of hook bend.
4. Use one nut per bolt unless shown otherwise on installation drawings. Second nut, if used, shall be a heavy hexagon jam nut.
5. Sleeve shall be filled with cement grout or concrete after final adjustment.

Bolt Dia D Inches	Allowable* Tensile load per bolt, Pounds	Embedded Length L	Sheet Metal Pipe Sleeve		One Nut		Two Nuts	
			O Inches	Length	A Inches	Thread Length, Inches	AA Inches	Thread Length, Inches
1/2	1,900	4"	2	3"	1	1-1/2	1-1/4	1-3/4
5/8	3,000	4"	2	4"	1-1/4	1-3/4	1-1/2	2
3/4	4,500	6"	2	6"	1-1/4	2	1-3/4	2-1/4
7/8	6,300	7"	2	8"	1-1/2	2-1/4	2	2-1/2
1	8,300	8"	3	8"	1-3/4	2-1/2	2-1/4	2-3/4
1-1/8	10,400	9"	3	10"	2	2-3/4	2-1/2	3
1-1/4	13,400	11"	3	1'-0"	2	3	2-1/2	3
1-3/8	15,800	11"	3	1'-2"	2-1/4	3-1/4	2-3/4	3-1/4
1-1/2	19,400	1'-1"	4	1'-4"	2-1/2	3-1/2	3	3-1/2
1-3/4	26,200	1'-3"	4	1'-6"	3	4	3-1/2	4
2	34,500	1'-6"	4	1'-6"	3-1/4	4-1/2	4	4-1/2
2-1/4	45,300	1'-10"	4	1'-6"	3-1/2	5	4-1/4	5
2-1/2	55,700	2'-0"	4	1'-6"	4	5-1/2	4-3/4	5-1/2

\*Based on 15,000 psi on net section of bolt; 3000 psi concrete.

Supersedes Std B-1-14

Ref Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM. BY	DES. BY
						hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL				ANCHOR BOLTS - TYPE I & I-S		AC-1-1	
H. E. Struck SECRETARY, DATE 3-4-60							

**GENERAL ELECTRIC**  
HANFORD ATOMIC PRODUCTS OPERATION **GE-1072-102**



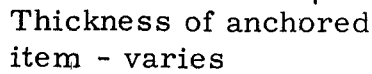
**NOTES:**

- | Bolt<br>Dia<br>D<br>Inches | Allowable*<br>Tensile load<br>per bolt,<br>Pounds | Embedded<br>Length<br>L<br>Inches | Square Washer       |                          | Fillet<br>Weld<br>F<br>Inches | Sheet Metal<br>Pipe Sleeve |        | One Nut     |                             | Two Nuts     |                             |
|----------------------------|---|-----------------------------------|---------------------|--------------------------|-------------------------------|----------------------------|--------|-------------|-----------------------------|--------------|-----------------------------|
|                            |   |                                   | Side<br>C<br>Inches | Thickness<br>T<br>Inches |                               | O<br>Inches                | Length | A<br>Inches | Thread<br>Length,<br>Inches | AA<br>Inches | Thread<br>Length,<br>Inches |
|                            |   |                                   |                     |                          |                               |                            |        |             |                             |              |                             |
| 1/2                        | 1,900   | 4                                 | 2                   | 3/8                      | 1/8                           | 2                          | 3"     | 1           | 1-1/2                       | 1-1/4        | 1-3/4                       |
| 5/8                        | 3,000   | 5                                 | 2                   | 1/2                      | 1/8                           | 2                          | 4"     | 1-1/4       | 1-3/4                       | 1-1/2        | 2                           |
| 3/4                        | 4,500   | 5                                 | 3                   | 1/2                      | 3/16                          | 2                          | 6"     | 1-1/4       | 2                           | 1-3/4        | 2-1/4                       |
| 7/8                        | 6,300   | 6                                 | 3                   | 5/8                      | 3/16                          | 2                          | 8"     | 1-1/2       | 2-1/4                       | 2            | 2-1/2                       |
| 1                          | 8,300   | 6                                 | 4                   | 3/4                      | 1/4                           | 3                          | 8"     | 1-3/4       | 2-1/2                       | 2-1/4        | 2-3/4                       |
| 1-1/8                      | 10,400  | 7                                 | 4                   | 3/4                      | 1/4                           | 3                          | 10"    | 2           | 2-3/4                       | 2-1/2        | 3                           |
| 1-1/4                      | 13,400  | 7                                 | 4-1/2               | 7/8                      | 1/4                           | 3                          | 1'-0"  | 2           | 3                           | 2-1/2        | 3                           |
| 1-3/8                      | 15,800  | 7                                 | 5                   | 1                        | 5/16                          | 3                          | 1'-2"  | 2-1/4       | 3-1/4                       | 2-3/4        | 3-1/4                       |
| 1-1/2                      | 19,400  | 8                                 | 5                   | 1                        | 5/16                          | 4                          | 1'-4"  | 2-1/2       | 3-1/2                       | 3            | 3-1/2                       |
| 1-3/4                      | 26,200  | 9                                 | 6                   | 1-1/4                    | 3/8                           | 4                          | 1'-6"  | 3           | 4                           | 3-1/2        | 4                           |
| 2                          | 34,500  | 10                                | 7                   | 1-3/8                    | 7/16                          | 4                          | 1'-6"  | 3-1/4       | 4-1/2                       | 4            | 4-1/2                       |
| 2-1/4                      | 45,300  | 11                                | 8                   | 1-1/2                    | 1/2                           | 4                          | 1'-6"  | 3-1/2       | 5                           | 4-1/4        | 5                           |
| 2-1/2                      | 55,700  | 12                                | 9                   | 1-3/4                    | 1/2                           | 4                          | 1'-6"  | 4           | 5-1/2                       | 4-3/4        | 5-1/2                       |

**Supersedes Std B-1-15**

**Ref Hanford Stds: None**

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL				ANCHOR BOLTS - TYPE II & II-S	AC-1-2	
H. E. Struck SECRETARY. DATE 3-4-60						



### ANCHOR BOLT TYPE III

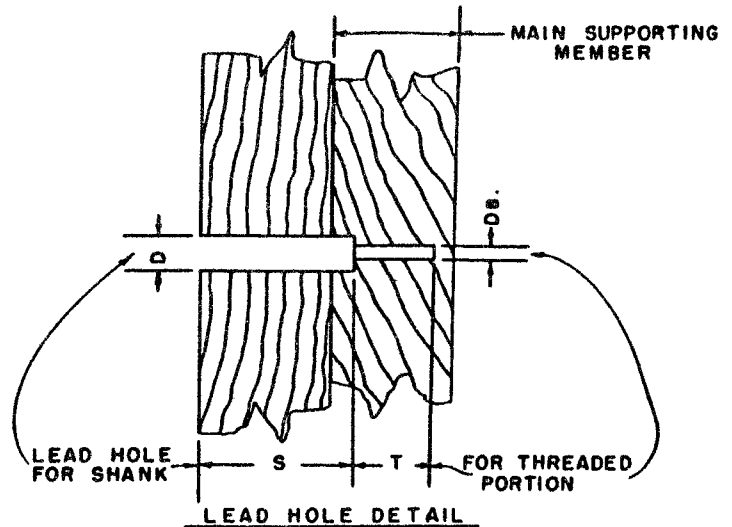
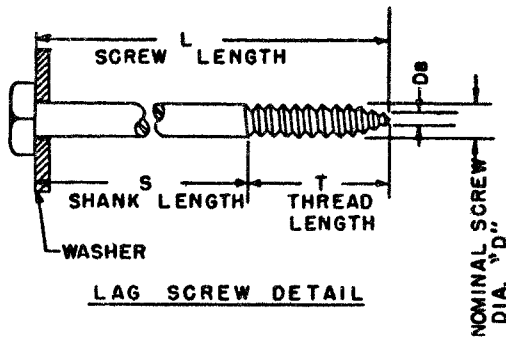
NOTES:

1. Bolts shall conform to ASTM A307-58T, grade A. Threads shall be American Standard Coarse-Thread Series, Class 2A
2. Nuts shall conform to ASTM A307-58T, Heavy Hexagon Series with Coarse-Thread Series Class 2B threads.

Bolt Dia Inches	Allowable* Shear per bolt, Pounds	Minimum Embedment L, Inches	A Inches	Thread Length, Inches
1/2	750	4	3/4	1-1/4
5/8	1000	4	1-1/4	1-1/2
3/4	1500	5	1-1/2	2
7/8	2000	6	1-3/4	2-1/4
1	2500	7	2	2-1/2
1-1/8	3000	8	2-1/4	2-3/4
1-1/4	3500	9	2-1/2	3

\*Pacific Coast Uniform Building Code

Supersedes Std B-1-16				Ref Hanford Stds: None	
NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	
APPROVED BY ENGINEERING STANDARDS COUNCIL				ANCHOR BOLTS - TYPE III	AC-1-3
H. E. Struck SECRETARY DATE 3-4-60					
				SUBM. BY	DES. BY
				hes	chh



**GENERAL NOTE:**

LEAD HOLE SHALL ALWAYS BE DRILLED WHEN INSTALLING LAG SCREWS. INSTALL A FLAT WASHER UNDER THE HEAD OF EACH LAG SCREW. TO OBTAIN THE FULL HOLDING POWER OF THE SCREW, THE FULL LENGTH OF THE THREADED PORTION OF THE SCREW SHALL BE IN THE MAIN SUPPORTING MEMBER. LEAD HOLES SHALL BE DRILLED IN ACCORDANCE TO THE FOLLOWING TABLES AND INSTRUCTIONS.

**TABLE I- LEAD HOLE DEPTHS**

LEAD HOLE DEPTH	NOMINAL SCREW LENGTHS											
	1"	1 1/2"	2"	*2 1/2"	3"	4"	5"	6"	7"	8"	9"	10"
SHANK DIMENSION "S"	1/4"	3/8"	1/2"	*3/4"	1"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	4 3/4"
THREADED PORTION DIMENSION "T"	3/4"	1 1/8"	1 1/2"	*1 3/4"	2"	2 1/2"	3"	3 1/2"	4"	4 1/2"	5"	5 1/4"

**TABLE II- LEAD HOLE DIAMETERS**

LEAD HOLE DIAMETER	NOMINAL SCREW DIAMETER																				
	WOOD GROUPS 1 & 2						WOOD GROUP 3						WOOD GROUP 4								
	1/4"	5/16"	3/8"	7/16"	1/2"	5/8"	3/4"	1/4"	5/16"	3/8"	7/16"	1/2"	5/8"	3/4"	1/4"	5/16"	3/8"	7/16"	1/2"	5/8"	3/4"
SHANK DIAMETER "D"	1/4"	5/16"	3/8"	7/16"	1/2"	5/8"	3/4"	1/4"	5/16"	3/8"	7/16"	*1/2"	5/8"	3/4"	1/4"	5/16"	3/8"	7/16"	1/2"	5/8"	3/4"
THREADED PORTION DIAMETER "DB"	1/8"	1/8"	5/32"	3/16"	1/4"	5/16"	7/16"	5/32"	3/16"	7/32"	1/4"	*5/16"	7/16"	1/2"	3/16"	7/32"	1/4"	5/16"	3/8"	1/2"	9/16"
WOOD GROUP IDENTIFICATION	INCLUDES CEDAR, WHITE PINE, REDWOOD, HEMLOCK AND SIMILAR WOODS.						INCLUDES DOUGLAS FIR SOUTHERN YELLOW PINE AND SIMILAR WOODS.						INCLUDES HARD MAPLE OAK AND SIMILAR WOODS.								
	NOTE: WOOD GROUPS SHALL BE AS DEFINED IN THE UNIFORM BUILDING CODE, LATEST EDITION. CONSULT THE UNIFORM BUILDING CODE FOR WOODS NOT LISTED ABOVE.																				

**INSTALLATION INSTRUCTIONS**

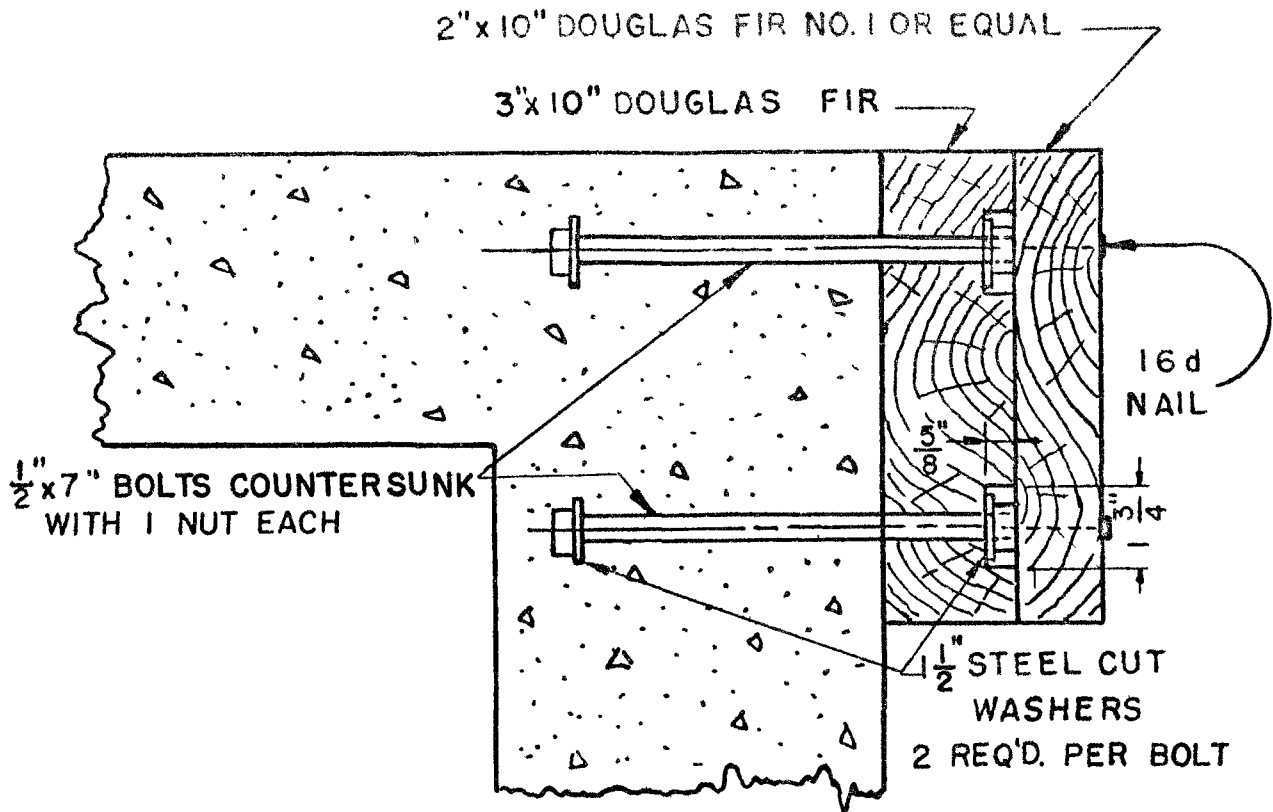
- LAG SCREWS ONLY PERMITTED WHERE THROUGH BOLTING IS NOT POSSIBLE OR IS IMPRACTICAL.
- LAG SCREWS TO BE INSTALLED WITH A WRENCH, USING SOAP OR EQUAL MATERIAL AS A LUBRICANT.
- WHEN INSTALLING A LAG SCREW IN A PREVIOUSLY USED HOLE, THE LEAD HOLE SHALL BE REBORED AND A LARGER DIAMETER LAG SCREW SHALL BE INSERTED USING THE ABOVE TABLES.
- THE MAXIMUM HOLDING POWER OF LAG SCREWS SHALL BE CALCULATED ACCORDING TO THE UNIFORM BUILDING CODE, LATEST EDITION.
- EXAMPLE: INSTALLATION OF A 1/2" X 2 1/2" LAG SCREW IN DOUGLAS FIR: DRILL A 1/2" HOLE 3/4" DEEP FOR THE SHANK FOLLOWED BY A 5/8" DIAMETER HOLE 1 1/2" DEEP FOR THE THREAD PORTION OF THE LAG SCREW.

NOTE: DIMENSIONS FOR EXAMPLE ARE DENOTED BY ASTERISKS IN TABLE I AND II

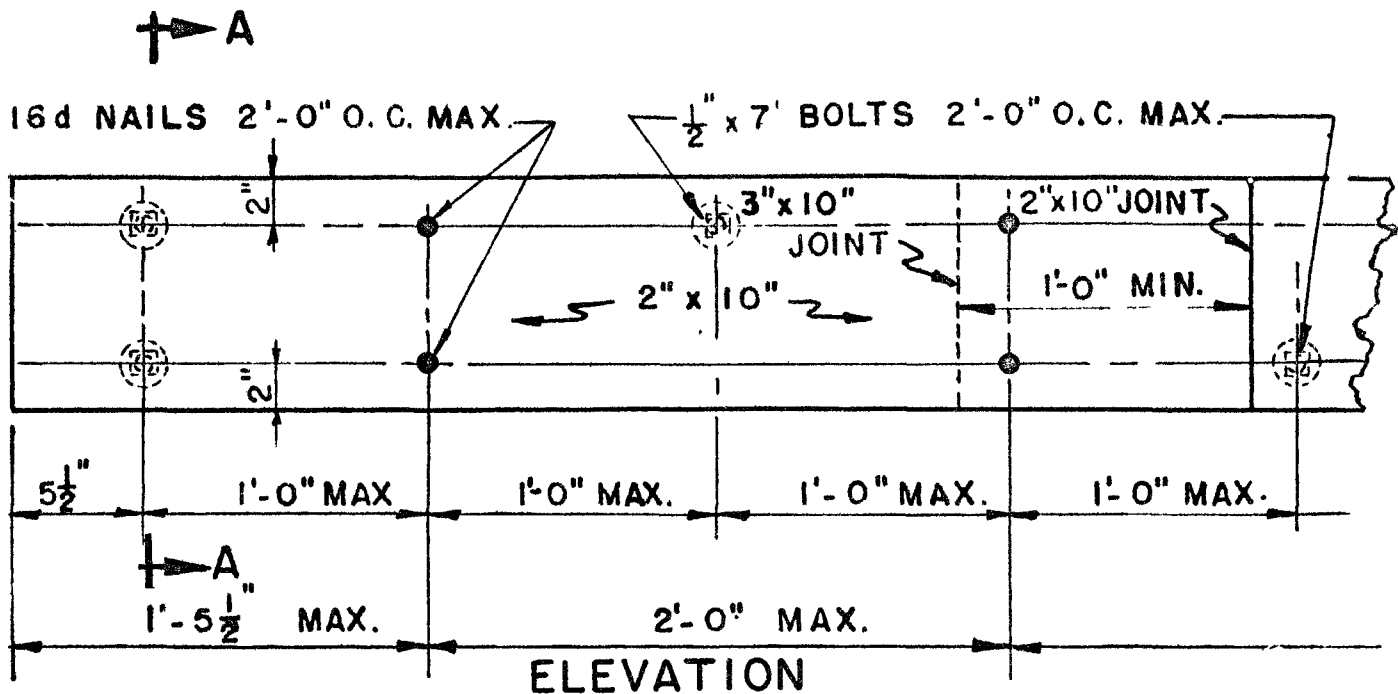
Supersedes Std C-2-10

Ref Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM. BY	DES. BY
						hes	
APPROVED BY ENGINEERING STANDARDS COUNCIL				INSTALLATION OF LAG SCREWS IN WOOD		AC-1-4	
H. E. Struck SECRETARY, DATE 5-15-61							



SECTION AA



Supersedes Std C-2-68

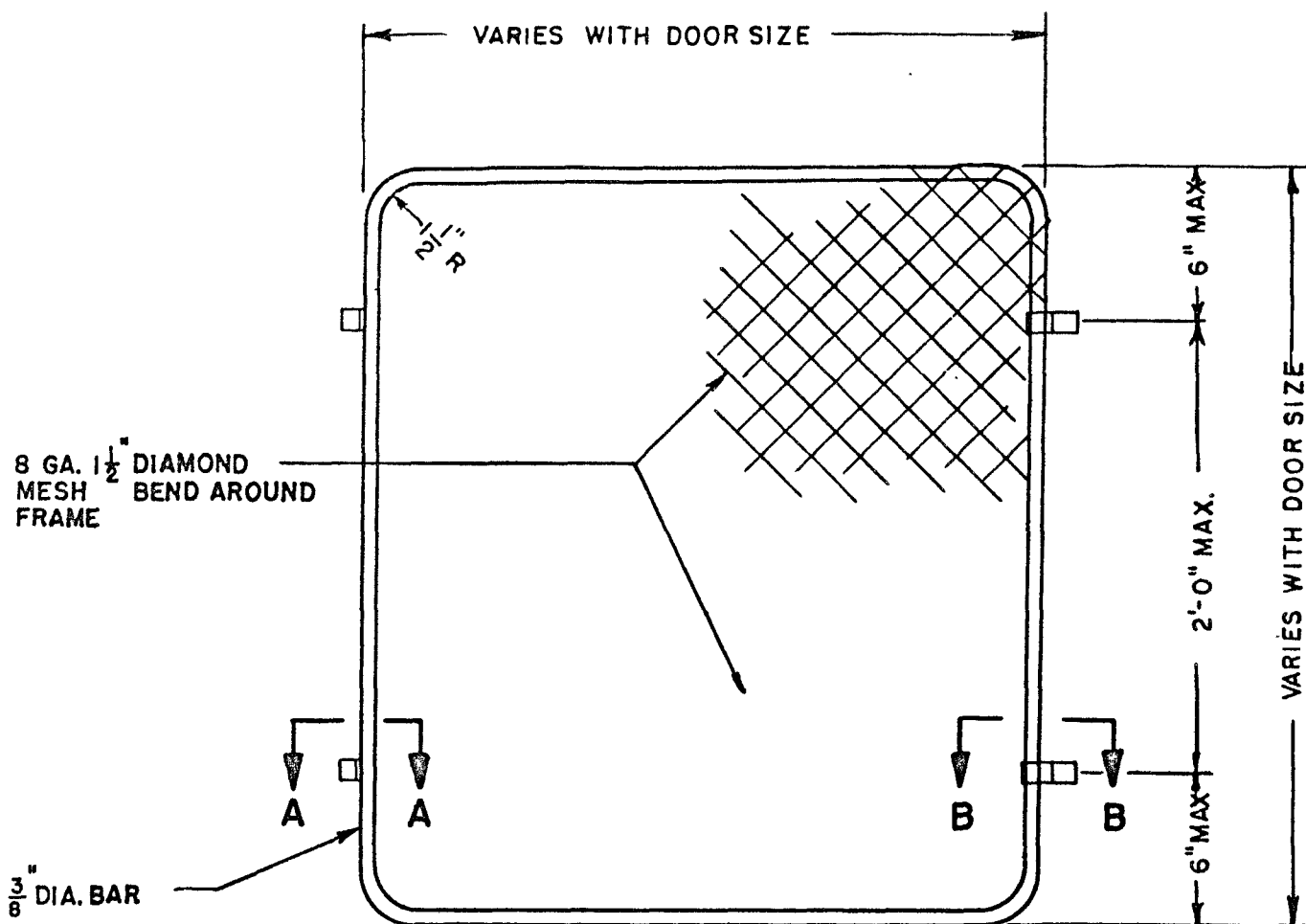
Ref Hanford Stds: None

NO	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM BY	DES. BY
						hes	
APPROVED BY ENGINEERING STANDARDS COUNCIL				LOADING PLATFORM BUMPER		AC-1-10	
H. E. Struck SECRETARY DATE 5-15-61							

CAPE-1072-106



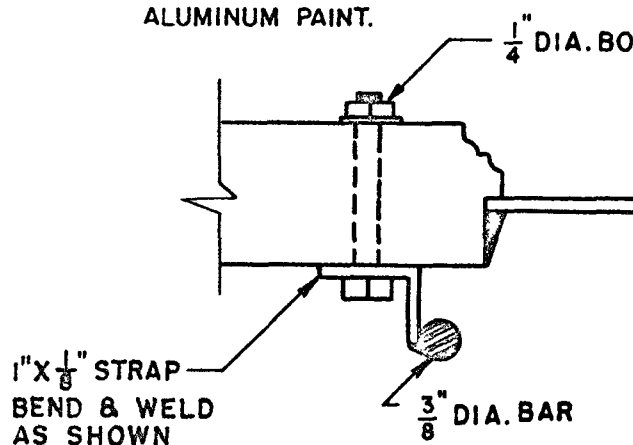
NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 5-1-60				WINDOW GUARD	AC-1-11	



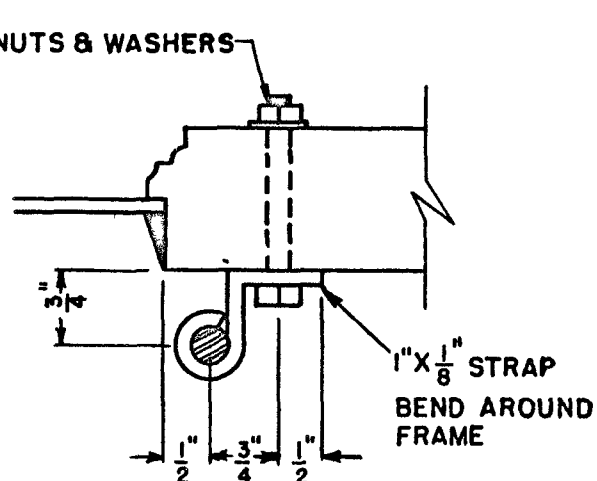
ELEVATION

NOTE:

1. PAINT TWO COATS ALUMINUM PAINT.



SECTION A-A

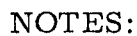


SECTION B-B

Supersedes Std C-4-13

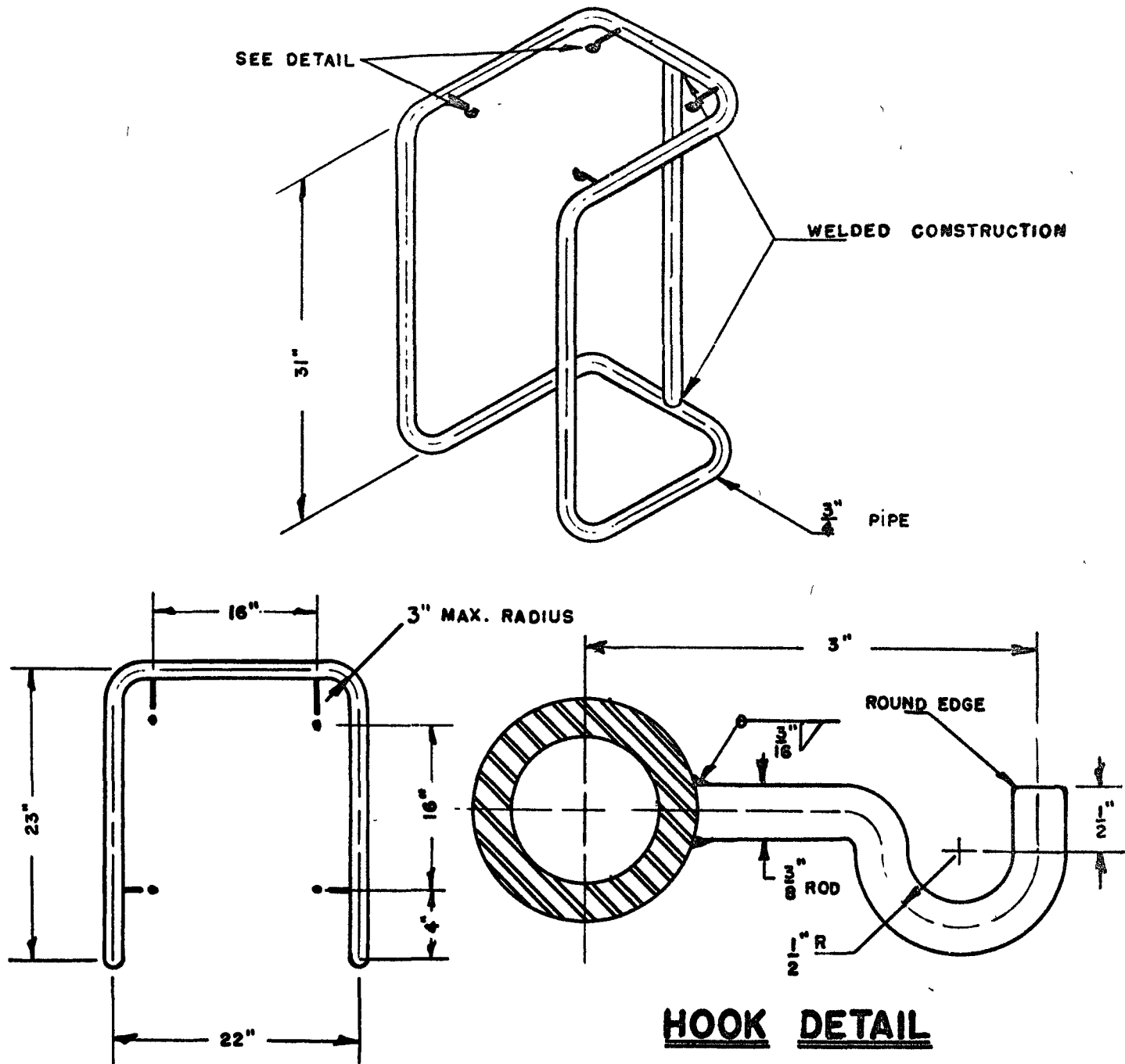
Ref Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM. BY	DES. BY
						hes	
APPROVED BY ENGINEERING STANDARDS COUNCIL				DOOR WINDOW GUARD		AC-1-12	
H. E. Struck SECRETARY. DATE 5-1-60							



- Ref Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	rea
APPROVED BY ENGINEERING STANDARDS COUNCIL				PORTABLE STANCHIONS	AC-1-20	
<u>H. E. Struck</u> SECRETARY, DATE <u>5-1-60</u>						



**NOTE:**

1. MATERIAL AND FINISH TO SATISFY CONDITIONS AT EACH LOCATION.
2. JOINTS AND WELDS TO BE DETERMINED WHEN FABRICATED.

Supersedes Std C-4-15

Ref Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 5-1-60				LAUNDRY BAG HOLDER	AC-1-21	

INSTRUCTIONS FOR THE USE OF STANDARD AC-1-30  
FIRE HOSE BOX

Standard AC-1-30 shows two types of fire hose boxes for use in heated buildings.

Type I is for a box to house only the fire hose rack and hose.

Type II is a box to house a fire hose rack, hose and also a water pump can or some other type of fire extinguishers.

When a fire hose box is to be used several items must be determined before a hose box is specified. The following are some of the important items to consider.

1. Location of the Box

The location of the box in a building will help determine whether or not the box should be recessed in the wall or surface mounted. This will probably determine whether or not the box will have a projection rim as shown on the drawing.

When a box is located in the corridor, proper clearances as specified in the Uniform Building Code will determine whether or not the box must be the recessed type. This must be checked for each installation.

2. Size of the Box

The dimensions of the box will vary depending on:

- a. Who the manufacturer is.
- b. Whether the box is Type I or II. The required dimensions of the box will depend on whether or not it is to house a water pump can or some other type of fire extinguishers.

Thus, the framing details around a recessed box will depend on the size of the box used and the thickness of the wall.

3. Box with or without Door

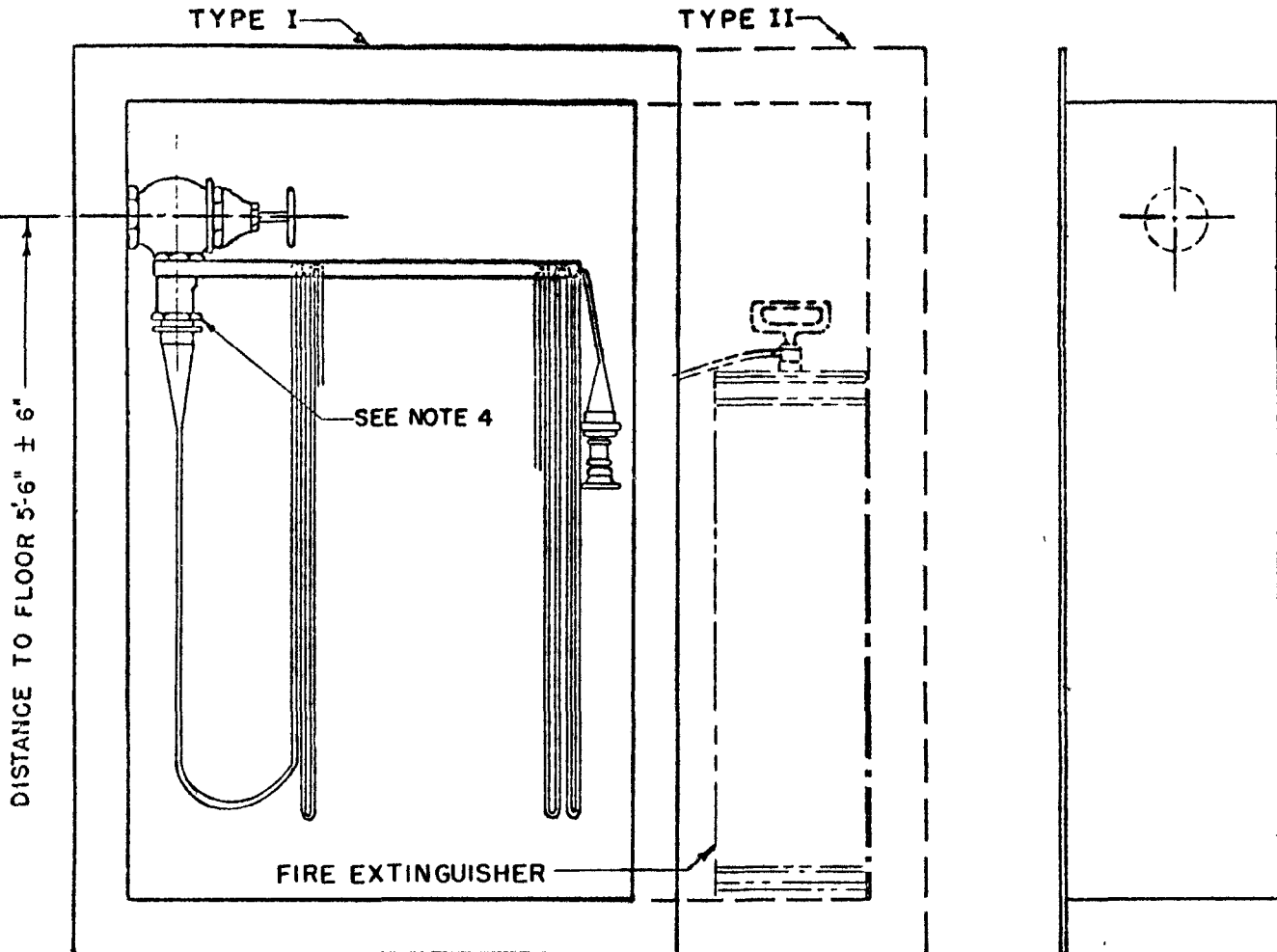
Specify whether or not a door is required for the box. Normally a door will not be needed in a manufacturing building.

4. Length of Hose

The hose length must be specified. Certain special locations, such as, some warehouses or long corridors, may require a hose 75' long. A 50' hose length is preferable, if it meets the requirements. However, if there is any question on the length, consult the area Fire Prevention Specialist.

Supersedes DI-C-2-1

NO	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM BY	DES BY
1	Rewritten	hes	8-15-62		hes	
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck, SECRETARY, DATE 5-15-61				INSTRUCTIONS FOR USE OF STANDARD AC-1-30	DI-AC-1-30	



NOTES:

1. TYPE I - Commercial, steel, fire hose cabinet with following UL approved items: Hose rack, 1-1/2" angle valve, 50 ft (unless otherwise specified) of 1-1/2" linen fire hose. Hose threads shall be National Standard. Nozzle shall be Elkhart Mystery Nozzle No. L-200, or approved equal. Cabinet shall be without door or with glazed door, as specified.
2. TYPE II - Same as Type I except larger cabinet equipped with UL approved 2-1/2 gallon water pump can, 4 or 5 lb. CO<sub>2</sub> extinguisher, or 4 or 5 lb. dry chemical extinguisher.
3. For normal installation, box shall be painted with 3" wide diagonal red and white stripes. In office buildings, a small sign, "Fire Hose", with arrow pointing to box may be used and box painted to match building trim.
4. Building fire system shall be supplied by a separate branch taken from the main ahead of the building shutoff.

Supersedes Stds A-2-4 & C-2-1

Ref Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	
APPROVED BY ENGINEERING STANDARDS COUNCIL				FIRE HOSE BOX	AC-1-30	
H. E. Struck SECRETARY. DATE 5-15-61						

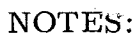
INSTRUCTIONS FOR USE OF STANDARD AC-1-31  
INTERIOR FIRE EXTINGUISHER INSTALLATION

When Standard AC-1-31 is used the following should be observed:

1. Specify whether or not the mounting board is required. The mounting board shown should be used where the stripes will properly function as an aid in locating the extinguisher. The board is not ordinarily required for extinguishers mounted in wall recesses or surface mounted in corridors or in small rooms. In such locations, the extinguisher itself is usually more prominent than the board.
2. The mounting heights shown apply to all extinguishers with or without mounting board. These heights should be used wherever practicable, but should be adjusted to fit actual conditions.
3. In mounting the board, the Molley Screw Anchors (or approved equal) should be placed so that the anchor heads are flush with concrete. After bolts are removed from anchors and board is placed, the bolts which comes with the anchors may be too short to engage the anchor threads. In this case, use 1/4-20 bolts of sufficient length to engage anchor threads. A washer shall be used against each bolt head and board. For 8XL Molley Screw Anchor use 15/32" drill to install anchor in wall and use 9/32" drill in mounting board.

Supersedes DI-C-2-2

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM BY	DES BY
1	Note 3 added & 2 rev.	hes	11-9-62		hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY DATE 5-15-61				INSTRUCTIONS FOR USE OF STANDARD AC-1-31	DI-AC-1-31	



1. Mount extinguisher with or without board, as specified on drawings.
2. Hanger furnished with extinguisher.
3. For installation to wood frame, use two 3/8" x 3" wood screws and washers; to concrete block, use two 8XL Molley Screw Anchors with 1/4-20 bolts of required length and washers, or an approved equal anchor.

Ref Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
1	Notes:3	hes	11-9-62		hes	
APPROVED BY ENGINEERING STANDARDS COUNCIL <u>H. E. Struck</u> SECRETARY, DATE <u>5-15-61</u>				INTERIOR FIRE EXTINGUISHER INSTALLATION	AC-1-31	

INSTRUCTIONS FOR USE OF STANDARDS AC-1-32, AC-1-33  
AND AC-1-34, AUTOMATIC CLOSING FIRE DOORS

Standards AC-1-32, AC-1-33 and AC-1-34 are "design standards" for automatic closing fire doors for use in fire walls. They are intended to show the preferred types and typical arrangements for such doors for HAPO. They are not intended for use by construction forces and shall not be referenced for such use.

When automatic closing fire doors are to be installed, the following shall be observed:

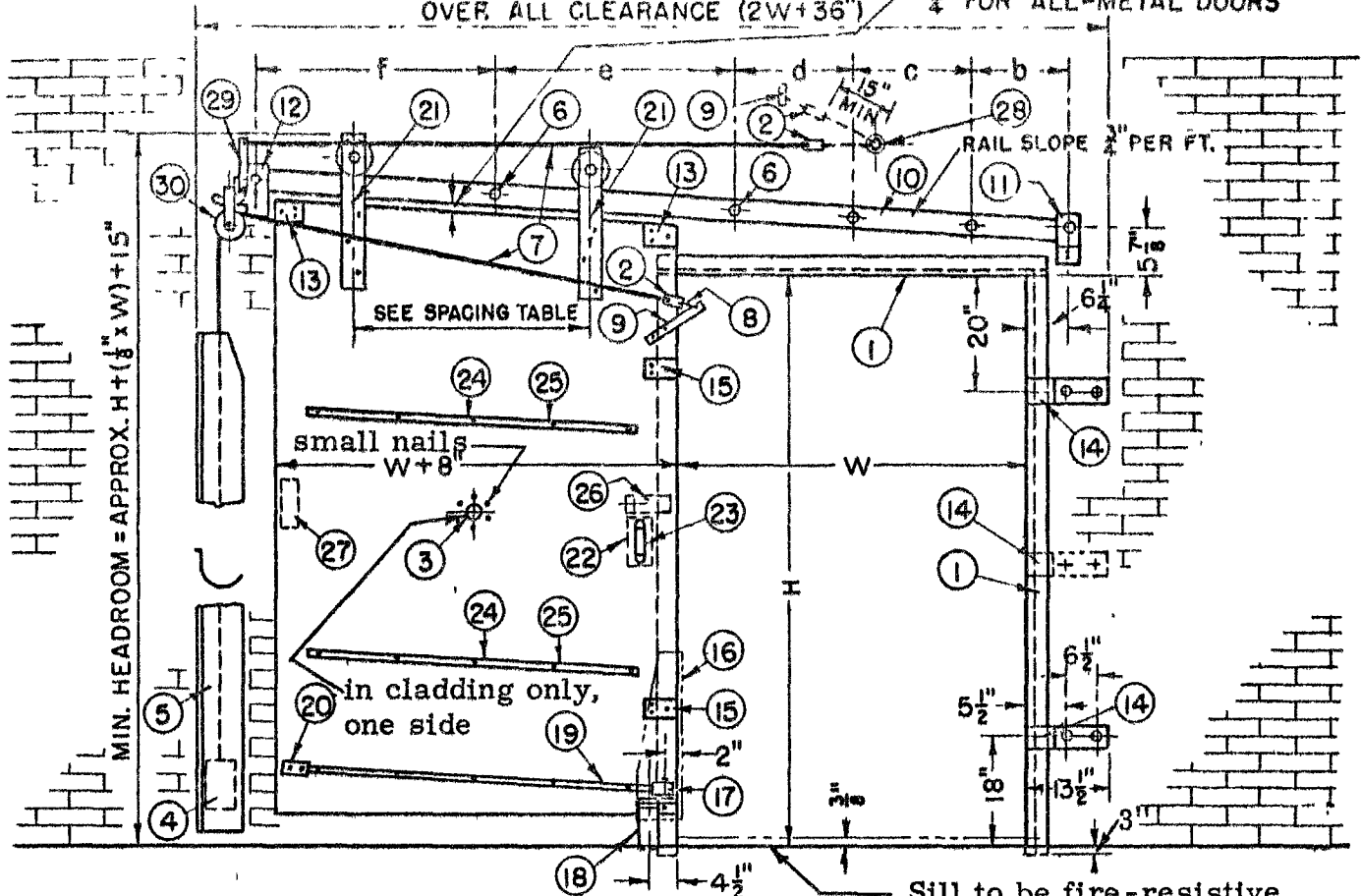
1. The fire door, frame, and hardware shall be specified to be Underwriters' Laboratories approved. This will insure proper materials, tolerances, etc., for the various parts. The door, frame, hardware and closing mechanism should be specified to be purchased as a unit from one manufacturer. Specify that installation shall be in accordance with Uniform Building Code Standard 43-4, and the manufacturer's installation instructions.
2. The sloping track fire door (AC-1-32) is the preferred type. The other types should be used only when specific conditions prevent the use of the sloping track type.
3. The following items must be specified for each door:
  - a. Width and height of door
  - b. Whether the door is tin-clad or all-metal.
  - c. Underwriters' Class (A,B,C,D or E), as required.
  - d. The thickness of the fire wall (For the frame)
  - e. Any special requirements
4. Specify on construction drawings the size and location of the vent hole as shown on the Standards. This vent hole is to be installed in the field.
5. The use of the particular design of fire doors shown is not required. Other designs of doors and hardware which are UL approved may be used. However, the types shown are preferred.
6. For further information on the use of fire doors and fire walls, refer to the latest edition of the Uniform Building Code.

113

Supersedes DI-C-2-6, 7 & 8

NO.	REVISION	APP'D	DATE	<b>ARCHITECTURAL-CIVIL STANDARD</b>	SUBM BY	DES. BY
					hes	chh
<small>APPROVED BY ENGINEERING STANDARDS COUNCIL</small> <b>H. E. Struck</b> SECRETARY. DATE <b>5-15-61</b>				<b>INSTRUCTIONS FOR USE OF STANDARDS AC-1-32 , 33 , &amp; 34</b>	<b>DI-AC-1-32 33 &amp; 34</b>	

FOR TIN-CLAD DOORS  
FOR ALL-METAL DOORS



- |    |                                  |    |                                    |    |                       |
|----|----------------------------------|----|------------------------------------|----|-----------------------|
| 1  | STEEL DOOR FRAME                 | 14 | BINDER (3RD BINDER,                | 25 | FLAT CHAFING STRIP    |
| 2  | FUSIBLE LINK<br>(160-165-20 LB.) |    | SHOWN DOTTED, FOR                  | 26 | REAR BINDER, CUT      |
| *3 | VENT HOLE                        | 15 | BINDER SHOE                        |    | CHANNEL JAMB IN FIELD |
| 4  | COUNTERWEIGHT                    | 16 | TRUCK GUARD                        |    | FOR REAR BINDER FOR   |
| 5  | WEIGHT GUARD                     | 17 | STAY ROLL                          | 27 | REAR BINDER POCKET    |
| 6  | DOOR RAIL BRACKET                | 18 | STAY ROLL BRACKET                  |    | FOR ALL-METAL         |
| 7  | FUSIBLE LINK CORD                | 19 | STAY ROLL STRIP                    |    | DOORS ONLY            |
| 8  | FUSIBLE LINK "S" HOOKS           | 20 | STAY ROLL WEDGE                    | 28 | WALL BUSHING          |
| 9  | FUSIBLE LINK BRACKET             | 21 | DOOR HANGER                        | 29 | TRIP RELEASE          |
| 10 | DOOR RAIL                        | 22 | FLUSH DOOR HANDLE,                 | 30 | PULLEY AND CLEVIS     |
| 11 | FRONT BUMPER                     |    | WALL SIDE                          |    |                       |
| 12 | BACK BUMPER                      | 23 | DOOR HANDLE (BOW)                  |    |                       |
| 13 | BUMPER SHOE                      | 24 | HALF-OVAL CHAFING STRIP, WALL SIDE |    |                       |

Notes: 1. Door, frame and hardware shall be Underwriters' Laboratories approved.  
2. Construct guard (5) so that it will not interfere with (7) when (29) operates.

TABLE FOR SPACING TRACK BOLTS AND DOOR HANGERS (IN INCHES)

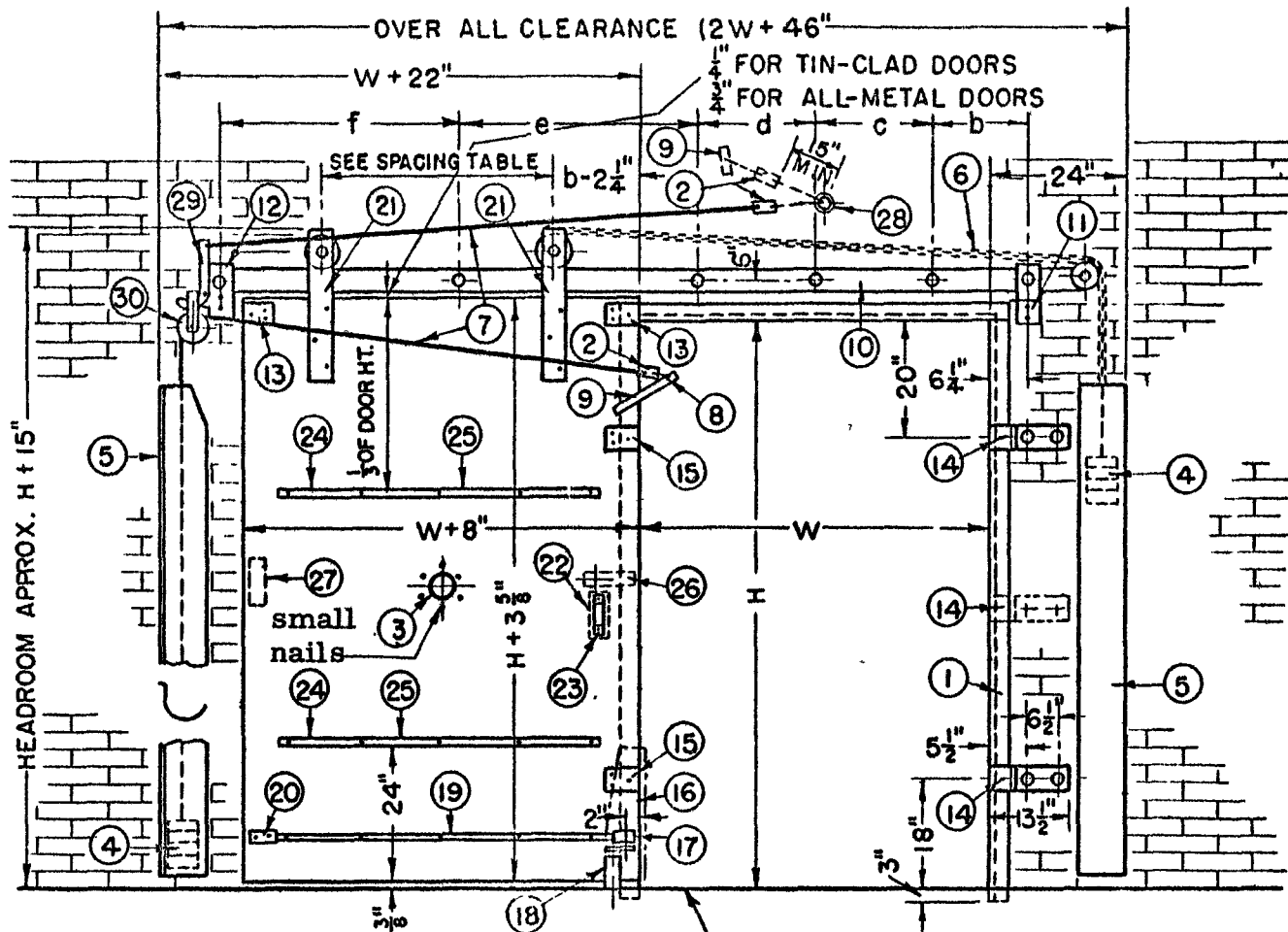
DOOR OPENING WIDTH "W"	Space b	Space c	Space d	Space e	Space f	Space g	Space h	Space i
5 FT.	16½	20	20	40½	40½	—	—	—
6 FT.	18½	24	24	32	32	31½	—	—
7 FT.	13½	35	35	34	34	34½	—	—
8 FT.	14½	20	20	20	20	39	38	38½

NOTE: UNDERLINED FIGURES INDICATE BOLTS TO BE OPPOSITE DOOR HANGERS WITH DOOR CLOSED.

Supersedes Stds A-1-2 & C-2-6 Not to be used in construction contracts

NO.	REVISION	APP D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	
APPROVED BY ENGINEERING STANDARDS COUNCIL <u>H. E. Struck</u> SECRETARY, DATE <u>5-15-61</u>				AUTOMATIC SLIDING FIRE DOOR SLOPING TRACK	AC-1-32	

\*NOTE: FOR TIN CLAD DOORS ONLY, 2" DIA. UNDER 30", 3" DIA. FOR 30 TO 50", AND 4" DIA. OVER 50"



- |   |   |   |
|---|---|---|
| 1 STEEL DOOR FRAME                        | 14 BINDER (3RD BINDER, SHOWN DOTTED, FOR DOORS OVER 8 FT. HIGH) | 25 FLAT CHAFING STRIP   |
| 2 FUSIBLE LINK (160°-165°-20 LB.)         | 15 BINDER SHOE  | 26 REAR BINDER, CUT CHANNEL JAMB IN FIELD FOR REAR BINDER FOR ALL-METAL DOORS |
| *3 VENT HOLE (IN CLADDING ONLY, ONE SIDE) | 16 TRUCK GUARD  | 27 REAR BINDER POCKET FOR ALL-METAL DOORS ONLY                                |
| 4 COUNTERWEIGHT                           | 17 STAY ROLL  | 28 WALL BUSHING   |
| 5 WEIGHT GUARD                            | 18 STAY ROLL BRACKET  | 29 TRIP RELEASE   |
| 6 WEIGHT CHAIN                            | 19 STAY ROLL STRIP  | 30 PULLEY AND CLEVIS  |
| 7 FUSIBLE LINK CORD                       | 20 STAY ROLL WEDGE  |   |
| 8 FUSIBLE LINK "S" HOOKS                  | 21 DOOR HANGER  |   |
| 9 FUSIBLE LINK BRACKET                    | 22 FLUSH DOOR HANDLE, WALL SIDE                                 |   |
| 10 DOOR RAIL                              | 23 DOOR HANDLE (BOW)  |   |
| 11 FRONT BUMPER                           | 24 HALF-OVAL CHAFING STRIP, WALL SIDE                           |   |
| 12 BACK BUMPER                            |   |   |
| 13 BUMPER SHOE                            |   |   |

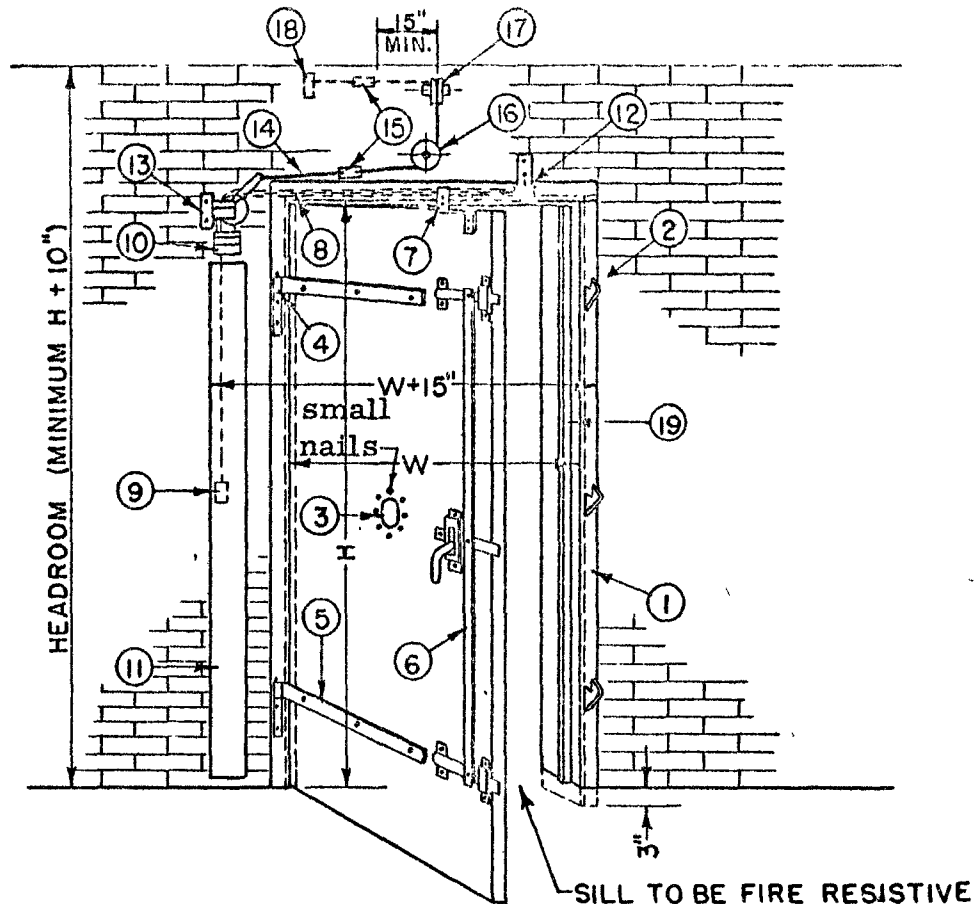
Notes: 1. Door, frame and hardware shall be Underwriters' Laboratories approved.  
2. Construct guard (5) so that it will not interfere with (7) when (29) operates.

TABLE FOR SPACING TRACK BOLTS AND DOOR HANGERS (IN INCHES)

DOOR OPENING WIDTH "W"	Space b	Space c	Space d	Space e	Space f	Space g	Space h	Space i
5 FT.	16½	20	20	40½	40½	—	—	—
6 FT.	18½	24	24	32	32	31½	—	—
7 FT.	13½	35	35	34	34	34½	—	—
8 FT.	14½	20	20	20	20	39	38	38½

NOTE: UNDERLINED FIGURES INDICATE BOLTS TO BE OPPOSITE DOOR HANGERS WITH DOOR CLOSED  
Supersedes Stds A-1-1 & C-2-7 Not for use in construction contracts

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	
APPROVED BY ENGINEERING STANDARDS COUNCIL				AUTOMATIC SLIDING FIRE DOOR		
H. E. Struck SECRETARY. DATE 5-15-61				LEVEL TRACK		
				AC-1-33		



NOTES:

1. Door, frame and hardware shall be Underwriters' Laboratories approved.

- |    |  |    |   |
|----|--|----|---|
| 1  | CHANNEL FRAME                          | 10 | CLOSING WEIGHT                              |
| 2  | LATCH KEEPER                           | 11 | WEIGHT GUARD                                |
| *3 | VENT HOLE (IN CLADDING ONLY, ONE SIDE) | 12 | CHAIN PULLEY                                |
| 4  | HINGE PINTLE                           | 13 | TRIP RELEASE                                |
| 5  | STRAP HINGE                            | 14 | LINK SASH CORD                              |
| 6  | TRIPLE LATCH RIG                       | 15 | FUSIBLE LINK (160°-165°-20 LB)              |
| 7  | CHAIN ANGLE                            | 16 | CORD PULLEY                                 |
| 8  | WEIGHT CHAIN                           | 17 | WALL BUSHING AND PULLEY                     |
| 9  | CHAIN WEIGHT                           | 18 | CORD ANCHOR                                 |
|    |  | 19 | STEEL DOOR STOP (MIN. $\frac{3}{4}$ " x 1") |

OPENING SIZE		HINGES EACH DOOR			LATCHES	
HEIGHT	WIDTH	NUMBER	LENGTH	BOLTS EACH HINGE	NUMBER	MIN. LENGTH
7'-0"	3'-6"	3	34"	4	3	14 $\frac{3}{4}$ "
7'-0"	4'-0"	3	37"	4	3	14 $\frac{3}{4}$ "
8'-0"	4'-0"	3	37"	4	3	14 $\frac{3}{4}$ "

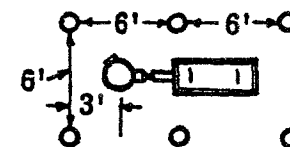
NOTE: HINGE STOCK TO BE 2  $\frac{1}{2}$ " x  $\frac{3}{8}$ " THICK — LATCH STOCK TO BE 1  $\frac{1}{2}$ " x  $\frac{3}{8}$ " THICK

Supersedes Stds A-1-4 & C-2-8

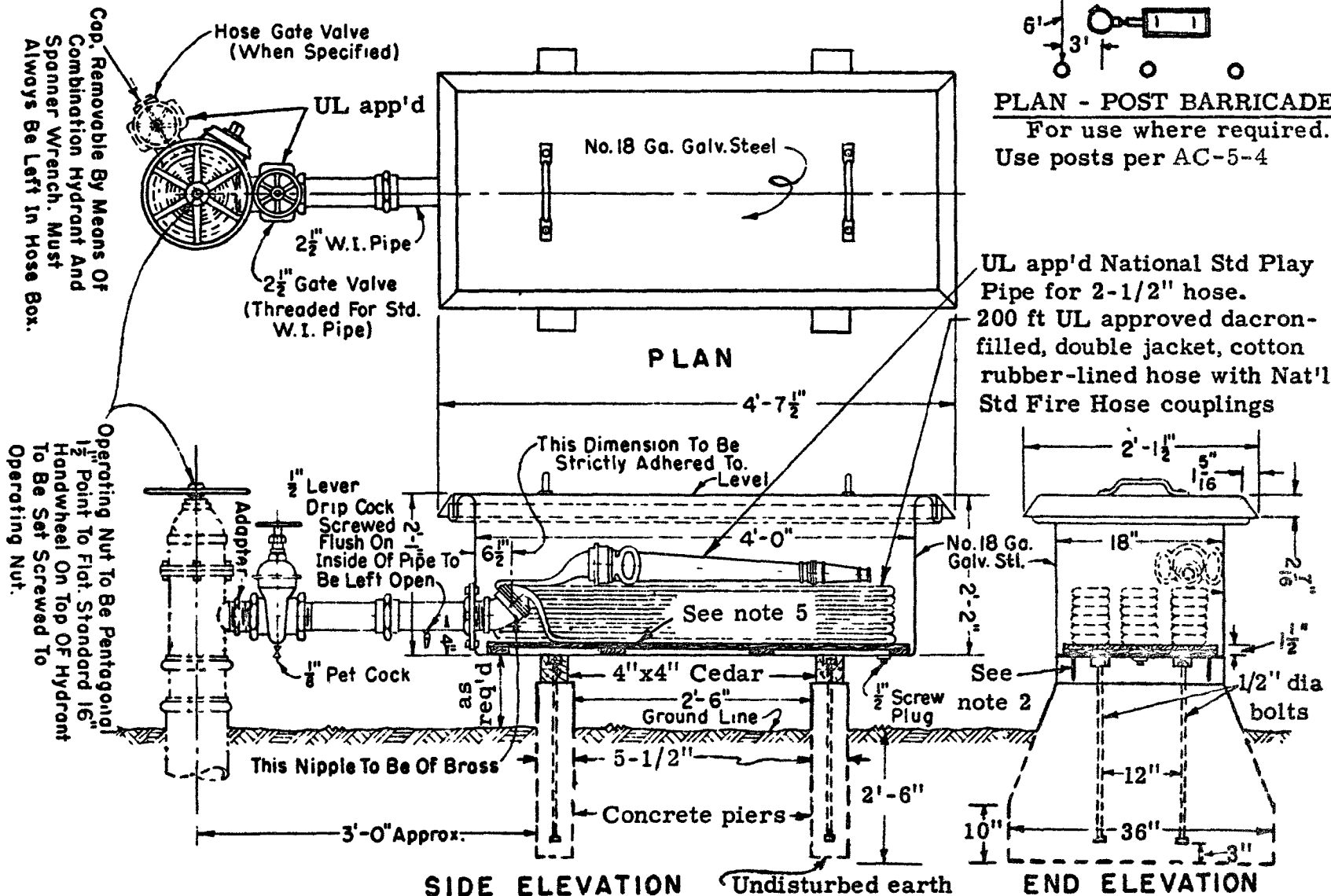
Not for use in construction contracts

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM. BY	DES. BY
				AUTOMATIC SWINGING FIRE DOOR IN STEEL CHANNEL FRAME		hes	
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY. DATE 5-15-61						AC-1-34	

\* NOTE: FOR TIN CLAD DOORS, 2" DIA. UNDER 300', 3" DIA. FOR 30 TO 500', AND 4" DIA. OVER 500'.



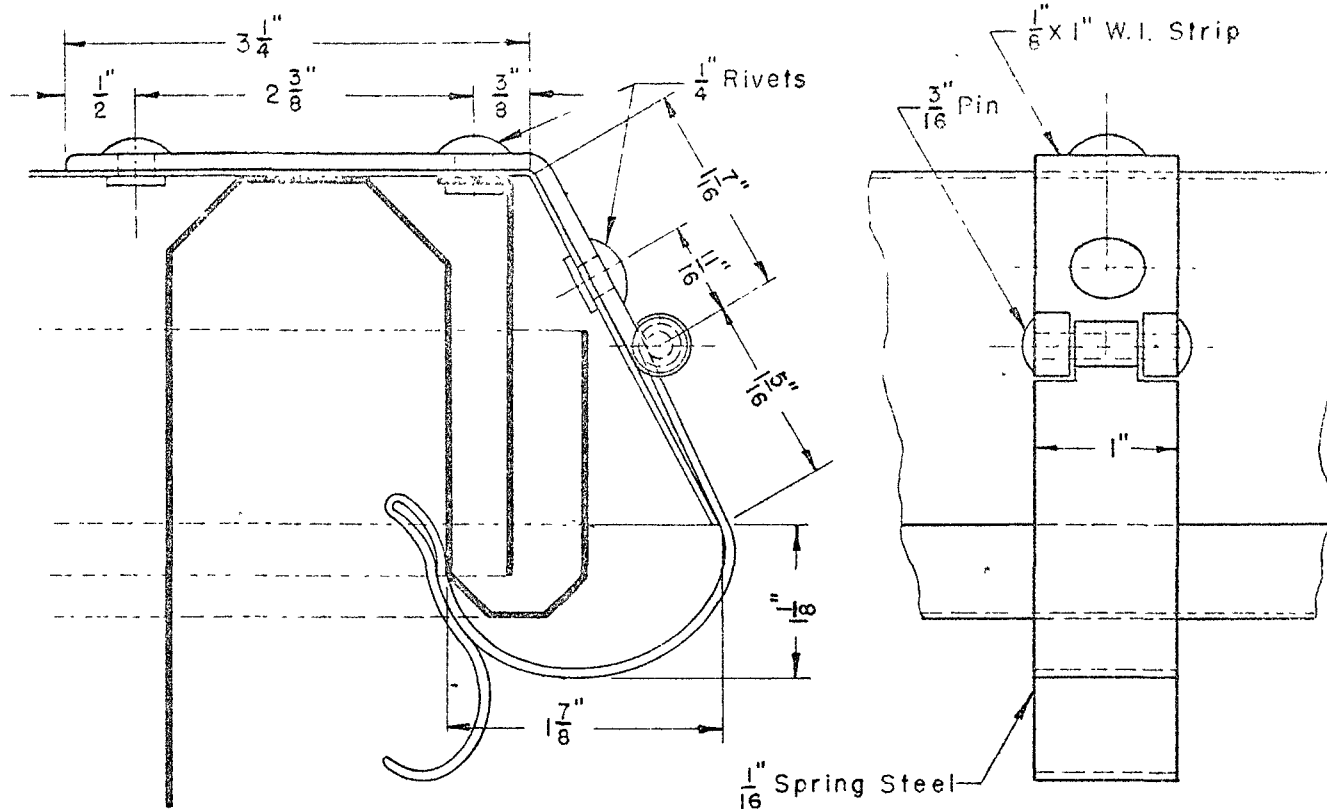
**PLAN - POST BARRICADE**  
For use where required.  
Use posts per AC-5-4



**NOTES:**

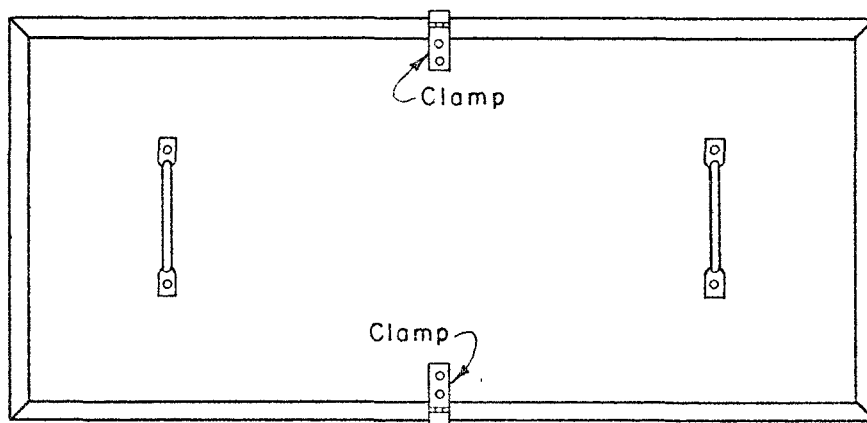
1. Paint box one coat zinc dust-zinc oxide primer and two finish coats fire equipment red enamel.
2. Use two 1/4"x 3" lag screws with 1-1/2" dia washers, each block. Install per Std AC-1-4
3. Where hose box is exposed to sweep of wind, install lid clamps per Std AC-1-35b.
4. Concrete shall have a minimum compressive strength of 2000 psi at 28 days.
5. Install hardwood rack as shown.

Supersedes Stds E-4-1a & A-2-1				Ref Hanford Stds: AC-1-35b, AC-5-4, AC-1-4			
NO.	REVISION	APP'D.	DATE	ARCHITECTURAL-CIVIL STANDARD			
2	Ref Std No.	hes	5-15-61				
APPROVED BY ENGINEERING STANDARDS COUNCIL				METAL HOSE BOX			
H. E. Struck, SECRETARY, DATE 2-1-60							
				SUBM. BY		DES. BY	
				hes			
				AC-1-35a			



SECTIONAL ELEVATION

SIDE ELEVATION



PLAN OF LID  
SHOWING POSITION OF CLAMPS

NOTES:

1. For use on Metal Hose Box, Standard AC-1-35a.

Supersedes Stds E-4-1b & A-2-2

Ref Hanford Stds : AC-1-35a

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	
APPROVED BY ENGINEERING STANDARDS COUNCIL				LID CLAMPS FOR METAL HOSE BOX	AC-1-35b	
H. E. Struck SECRETARY. DATE 2-1-60						

INSTRUCTIONS FOR USE OF  
STANDARDS AC-1-40a and AC-1-40b, GAS CYLINDER INSTALLATIONS

Standards AC-1-40a and AC-1-40b are "design standards" illustrating basic requirements for designing the arrangement and housing of manifolded flammable gas and oxygen cylinder installations. They are not intended for use by construction forces and shall not be referenced for such use. The following supplemental information should be reviewed by the design engineer when designing such installations:

1. For design of manifolds and piping, see Mechanical Standard M-2-21 and Mechanical Guide DG-100-M.
2. The cylinder sizes normally used in such an installation at Hanford are approximately:

Oxygen	-	} 9" to 9½" dia x 55" high
Hydrogen	-	
Methane	-	
Acetylene	-	12¼" to 12-3/4" dia x 40" to 44" high
Propane	-	15" dia x 49" high

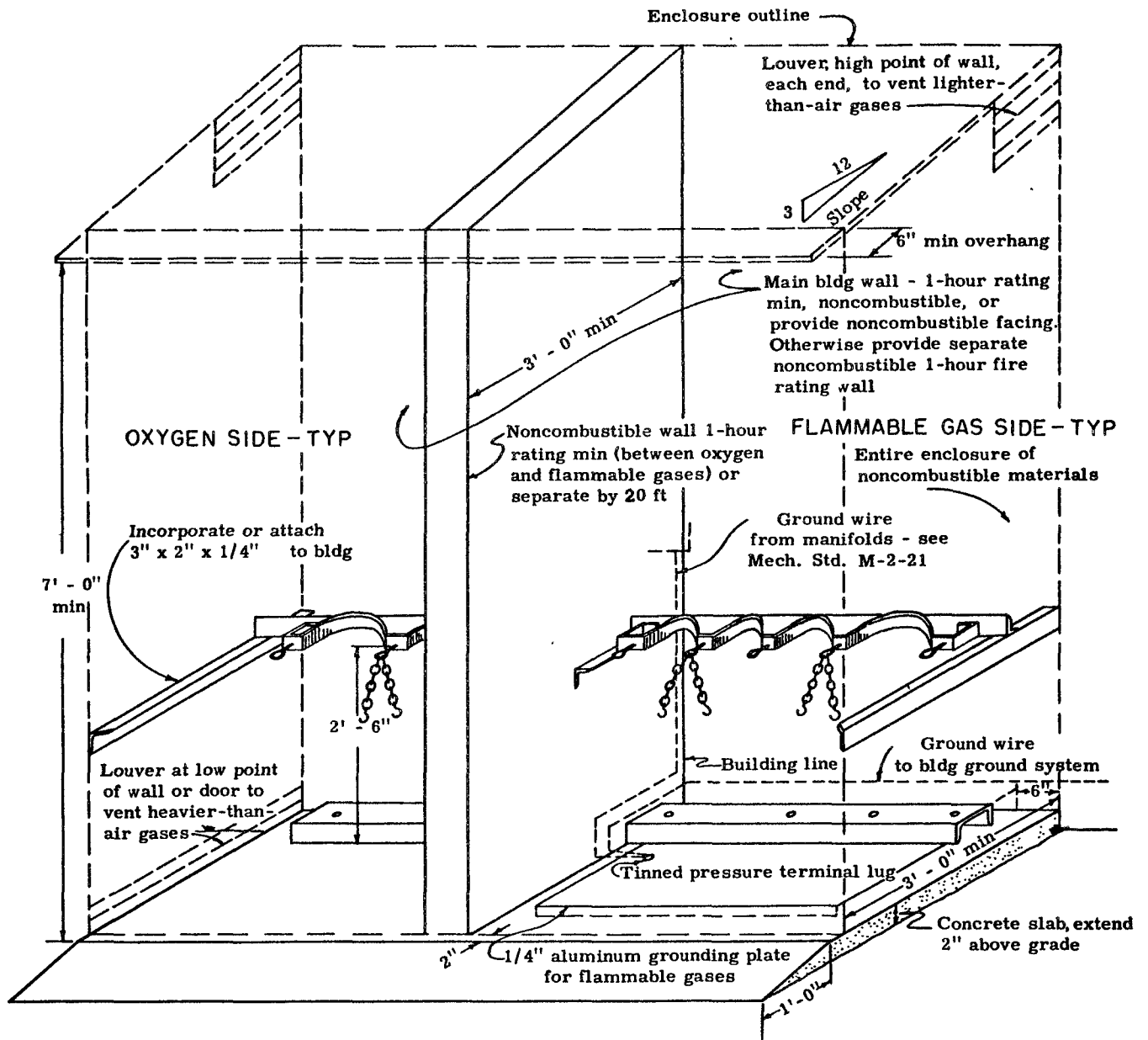
Height is to the top of the valves. These sizes are those actually stocked by G.E. Stores. The oxygen, hydrogen and methane are listed as size G.

It is recommended that the radius of the support cradle, shown on AC-1-40b, be 5" for oxygen, hydrogen and methane cylinders, 7" for acetylene and 8" for propane.

3. Fire rating of walls shall be as determined by the "Pacific Coast Uniform Building Code", latest edition.
4. If the installation is on the east, south or west side of a building, it should be enclosed. On a north side exposure, an enclosure is not required. In any case, if the cylinders are not enclosed, the roof must overhang on all sides far enough to shield the cylinders from the direct rays of the sun.
5. Consideration should be given to locating the floor elevations at the level of delivery truck bed, where this is desirable.

Supersedes DI-C-4-6a & DI-C-4-6b

NO	REVISION	APP D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM BY	DES BY
					hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL				INSTRUCTIONS FOR USE OF GAS CYLINDER INSTALLATION STDS	DI-AC-1-40a	
H. E. Struck SECRETARY DATE 5-1-60					& b	



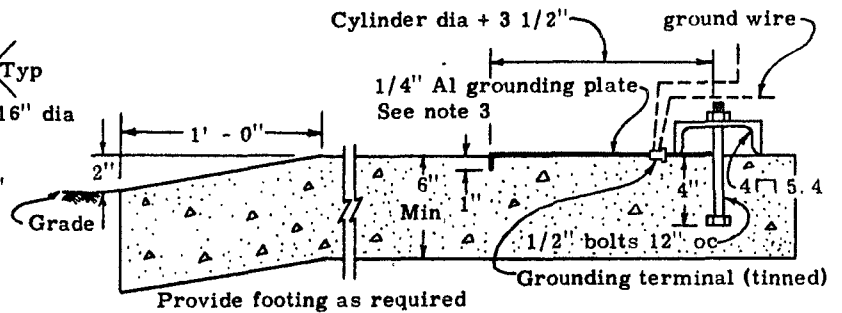
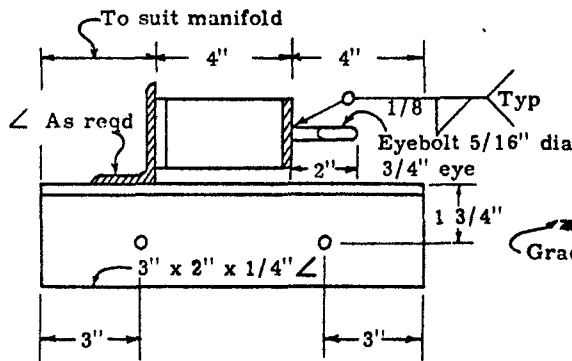
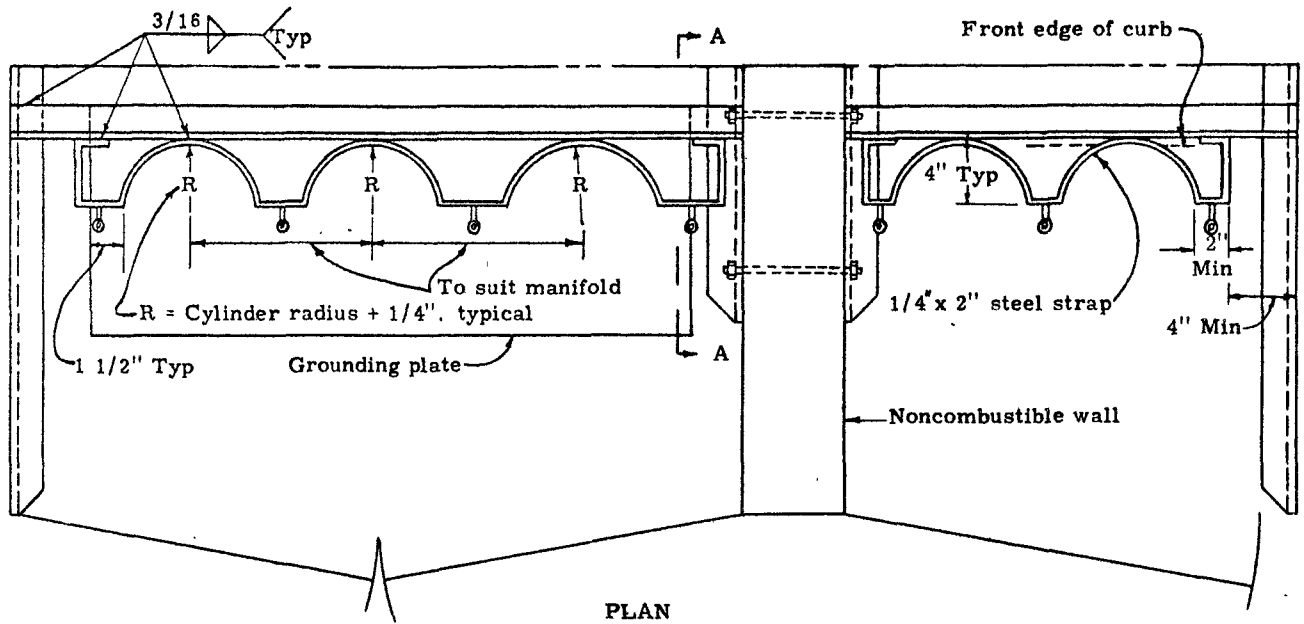
NOTES:

1. This drawing for design reference only, not for construction.
2. Wall or door ventilation area shall equal 15% of floor area. Design to eliminate dead pockets in roof and floor area.
3. Typical arrangement shown for installation of small number of flammable gas and oxygen cylinders with wall-mounted manifold. Other installations should suit conditions.
4. See Standard AC-1-40b for typical details.

Supersedes Std C-4-6a

Not for use in construction contracts

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
1	Separation dist	hes	9-18-61		hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 5-1-60				INSTALLATION REQUIREMENTS MANIFOLDED FLAMMABLE GASES AND OXYGEN CYLINDERS	AC-1-40a	



NOTES:

1. This drawing for design reference only, not for construction.
2. Use passing link chain No. 2/0 (3/16" dia mtl) and open hook to hold cylinder; two chains from each eyebolt to spread in opposite directions.
3. Aluminum grounding plate should be 2024-T4(24S-T4) or similar alloy with yield strength over 30,000 psi.

Supersedes Std C-4-6b

Not for use in construction contracts

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL <u>H. E. Struck</u> SECRETARY, DATE <u>5-1-60</u>				INSTALLATION REQUIREMENTS MANIFOLDED FLAMMABLE GASES AND OXYGEN CYLINDERS - DETAILS	AC-1-40b	

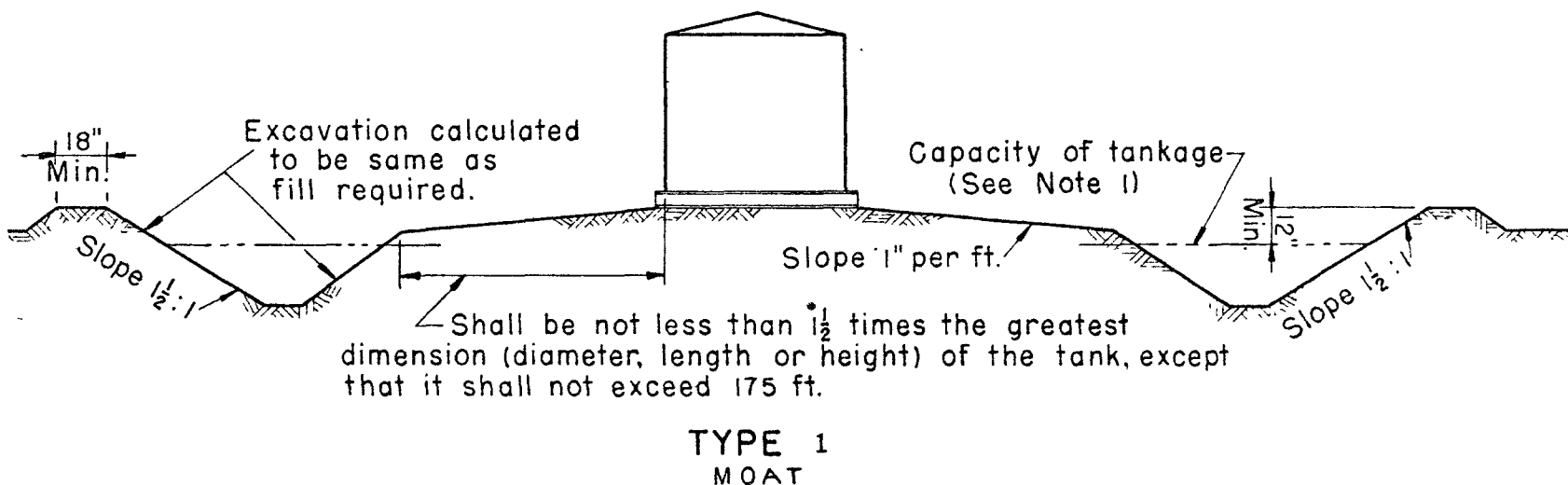
INSTRUCTIONS FOR USE OF DIKING STANDARDS  
AC-1-41 and AC-1-42

Standards AC-1-41 and 42 give general requirements for diking around flammable liquid storage tanks. They are not intended for use as construction drawings and shall not be referenced for such use. When these standards are used, the following should be observed:

1. When diking is required for individual projects, separate drawings shall be prepared for use in construction. Such drawings must necessarily include information such as specific dimensions, reinforcing steel and strength of concrete (for Type 2 and 3), etc.
2. Type 1 diking is the preferred type since it drains the flammable liquid away from the tank.
3. More specific information for individual cases can be found in Volume I of the National Fire Codes of the National Fire Protection Association, or by contacting the plant or area fire prevention specialist.

Supersedes DI-E-4-2a & 2b

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM BY	DES BY
					hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY DATE 5-1-60				INSTRUCTIONS FOR USE OF STANDARDS AC-1-41 & AC-1-42	DI-AC-1-41 & 42	



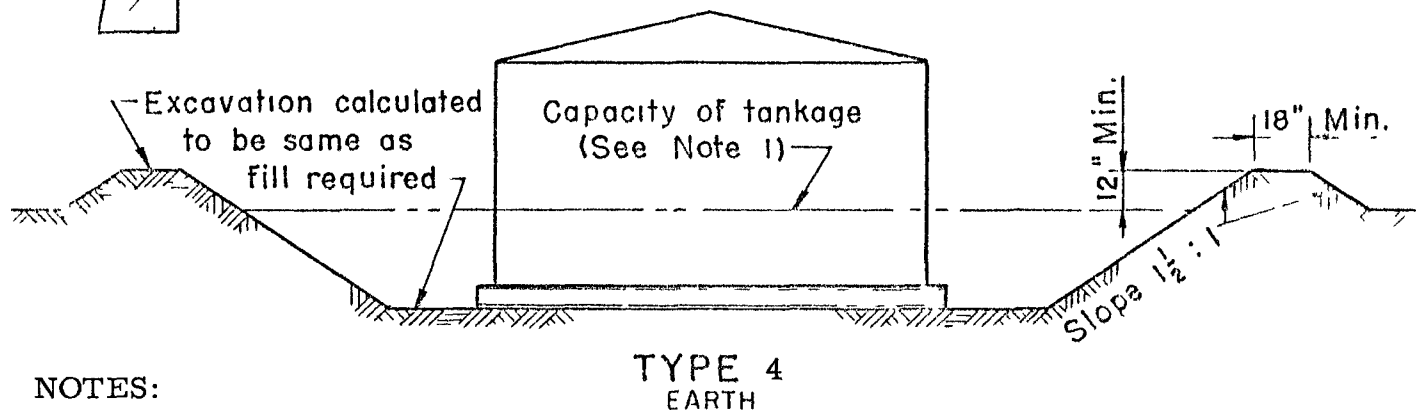
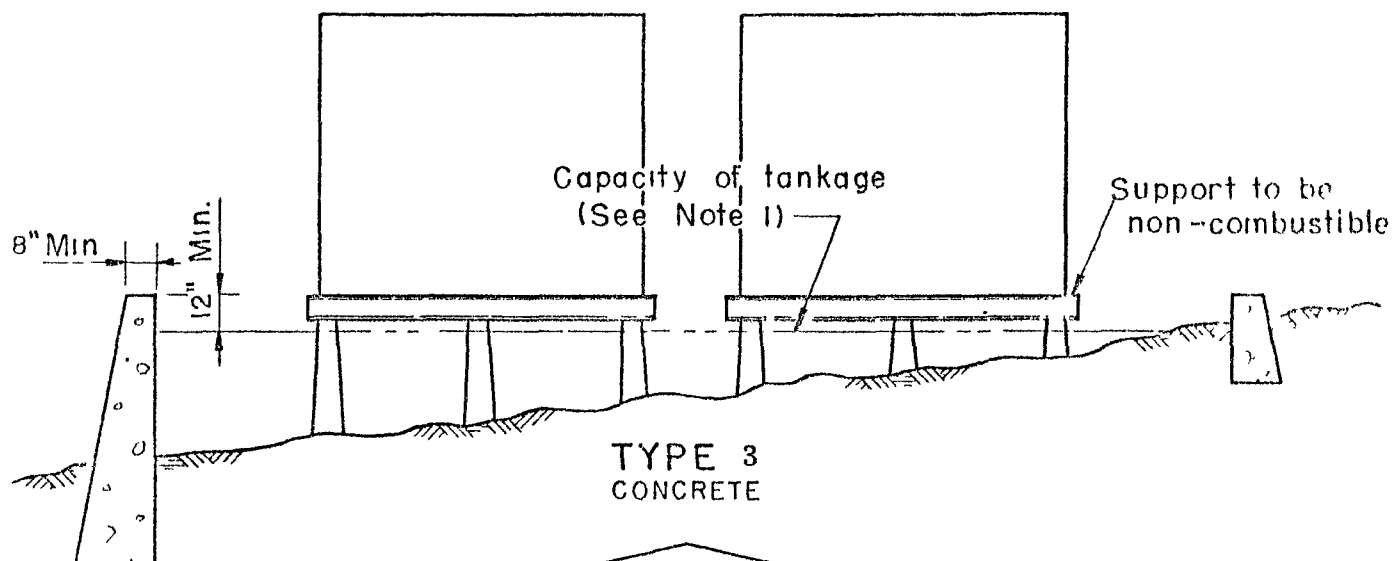
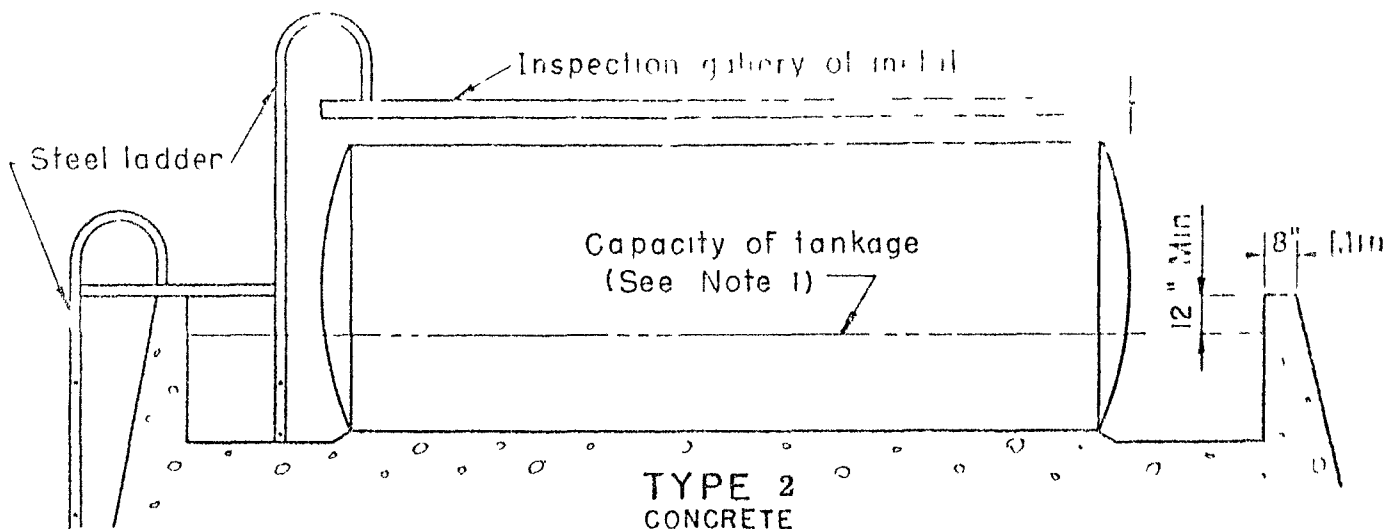
NOTES:

1. Capacity of retention moat shall be  $1\frac{1}{2}$  times capacity of tankage plus 12".
2. All tanks shall be electrically grounded.
3. No combustible material shall be used under tanks or within retention area.

Supersedes Stds A-4-3 & E-4-2a

Not for use in construction contracts

NO.	REVISION	APP'D	DATE	SUBM. BY	DES. BY
				hes	
APPROVED BY ENGINEERING STANDARDS COUNCIL					
H. E. Struck SECRETARY, DATE 5-1-60					
ARCHITECTURAL-CIVIL STANDARD				AC-1-41	
DIKING FOR FLAMMABLE LIQUID					
STORAGE TANKS					



NOTES:

1. Capacity of retention basin shall be 1-1/2 times capacity of tankage plus 12".
2. All tanks shall be electrically grounded.
3. No combustible material shall be used under tanks or within retention basin.
4. Dikes shall not be higher than 1/2 the tank height but capacity shall be maintained.

Supersedes Stds A-4-2 & E-4-2b

Not for use in construction contracts

NO	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM BY	DES BY
				DIKING FOR FLAMMABLE LIQUID STORAGE TANKS		hes	
APPROVED BY ENGINEERING STANDARDS COUNCIL						AC-1-42	
H. E. Struck SECRETARY DATE 5-1-60							

INSTRUCTIONS FOR THE USE OF STANDARDS  
AC-1-50 EMBEDDED ANGLES AND  
AC-1-51 EMBEDDED ANGLES FOR RADIATION ZONES

AC-1-50

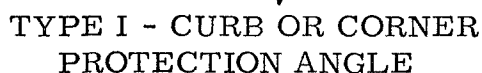
Where such details are required, Standard AC-1-50 should generally be used at all locations except in radiation zones where painted surfaces are specified for decontamination purposes.

AC-1-51

In the past, difficulty has been experienced in maintaining an unbroken paint film at the joints between steel and concrete surfaces. Broken paint films at these locations have caused trouble and expense in decontamination work. Good results have been experienced by using mastic joints before final painting at these locations. Since these mastic joints increase the cost, Standard AC-1-51 should only be used in radiation areas where painting is required for decontamination.

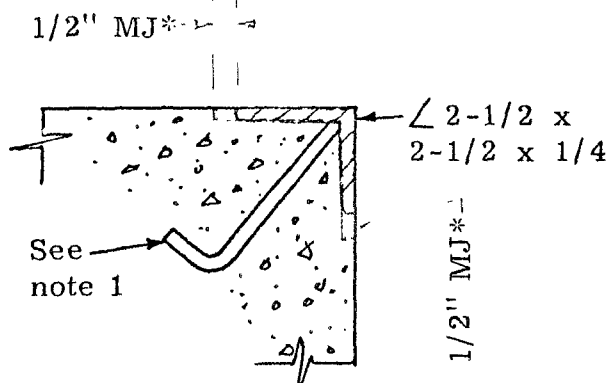
The manufacturer's direction for the mastic selected shall be followed. Some manufacturer's specify a prime coat before applying their mastic.

NO	REVISION	APP D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	hes
APPROVED BY ENGINEERING STANDARDS COUNCIL				INSTRUCTIONS FOR USE OF STANDARDS AC-1-50 & AC-1-51	DI-AC-1-50	
H. E. Struck SECRETARY DATE 11-9-62					DI-AC-1-51	

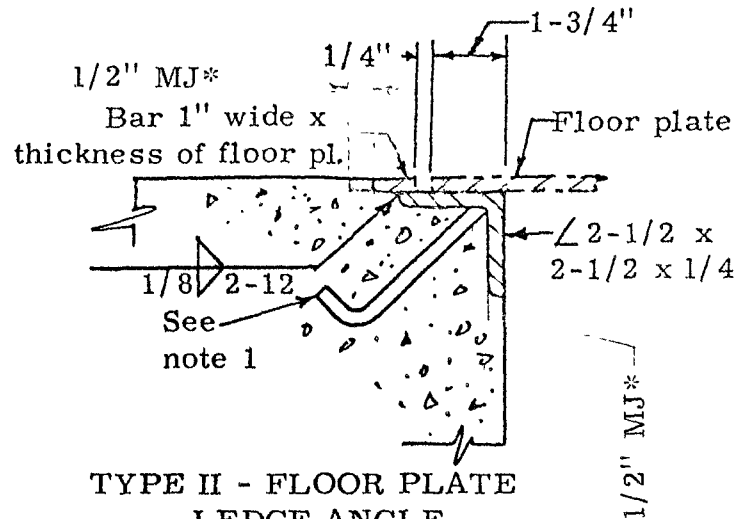


1. Nelson Nelweld Stud Anchors 1/4 x 4C4L or approved equal at 18" centers maximum.
2. After all welding is completed and prior to installation, all angle surfaces, which will not be in contact with concrete, shall be given one coat of paint meeting requirements of Fed. Spec. TT-P-86c Type II.
3. All joints, mitred corners and etc. shall be welded before installation.

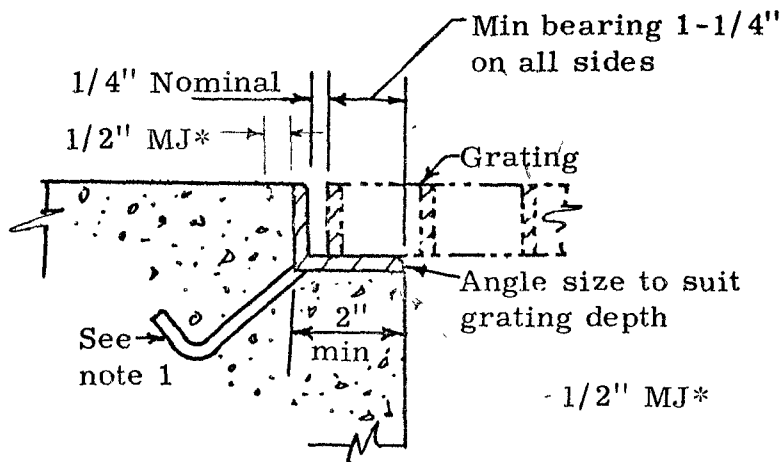
NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
2	Notes 1 & 2	hes	12-20-62		hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY. DATE 7-12-61				EMBEDDED ANGLES	AC-1-50	



TYPE I - CURB OR CORNER  
PROTECTION ANGLE



TYPE II - FLOOR PLATE  
LEDGE ANGLE



TYPE III - GRATING LEDGE ANGLE

NOTES:

1. Nelson Nelweld Stud Anchors 1/4 x 4C4L or approved equal at 18" centers maximum.
2. After all welding is completed and prior to installation, all angle surfaces, which will not be in contact with concrete, shall be given one coat of paint meeting requirements of Fed. Spec. TT-P-86c Type II.
3. All joints, mitred corners and etc. shall be welded before installation.
- \*4. All 1/2" MJ (Mastic Joint) shall be 1/4" deep. Prior to final painting of exposed surfaces, each MJ shall be filled with gray polysulfide-base sealing compound or an approved equal. The mastic used shall meet performance requirements for Class B (Non-sag) in American Std. Assoc. A-116.1-1960.

Ref Hanford Stds: None

NO.				REVISION				APP D				DATE				ARCHITECTURAL-CIVIL STANDARD												SUBM. BY				DES. BY			
																												hes							
APPROVED BY ENGINEERING STANDARDS COUNCIL																EMBEDDED ANGLES												AC-1-51							
H. E. Struck SECRETARY DATE 11-9-62																FOR RADIATION ZONES																			

CAPE - 1072 - 129

AC-2  
STAIRS, LADDERS, HANDRAILS

INSTRUCTIONS FOR USE OF STANDARD  
AC-2-1 "STAIRWAY CONSTRUCTION"

Standard AC-2-1 is a "design standard" prepared to require the use of abrasive nosing of proper type, show proper tread overhang and define rise and run, etc. It is not intended for use by construction forces and shall not be referenced for such use. The following additional design requirements also apply:

1. All stairways shall conform to all the requirements as set forth in the Uniform Building Code, Volume I, a portion of which is quoted below for basic information from Section 3305, 1958 edition. "Occupant load" shall be as defined in the Uniform Building Code. (Sec. 3301c)

"(a) **WIDTH.** Stairways serving an occupant load of more than 50 shall be not less in width than 44 inches. Stairways serving an occupant load of 50 or less may be 36 inches wide. Stairways serving an occupant load of 10 or less may be 30 inches wide. Trim and handrails may project 3½" into the required width of any stairway."

"(b) **RISE AND RUN.** The rise of every step in a stairway shall not exceed 7½ inches and the run shall be not less than 10 inches .... the maximum variations in the height of riser and the width of treads in any one flight shall be 3/16 inch.

Exception: In stairways serving an occupant load of 50 or less..... the rise may be 8 inches and the run may be 9 inches."

"(f) **DISTANCE BETWEEN LANDINGS.** There shall be not more than 12 feet vertically between landings."

"(j) **STAIRWAY CONSTRUCTION-EXTERIOR.** Exterior stairs shall be of incombustible material except that on buildings not exceeding two stories in height; they may be of wood not less than 2 inches in nominal thickness."

"(l) **HEADROOM.** Every required stairway shall have headroom clearance of not less than 6 feet 6 inches measured vertically from the nearest nosing to the nearest soffit."

Every stairway shall safely sustain a minimum live load of 100 lbs per square foot of horizontal projection."

2. The rise and run of stairs may be proportioned according to the following rule: Twice the rise added to the run should be not less than 24 inches nor more than 25 inches. Preferred rise and run: 7 inches by 11 inches where conditions will permit. All steps in any one stairway shall be the same type of tread.
3. In areas where decontamination is required, special designs will be required for treads and abrasive nosing. Suggested designs include removable treads, removable abrasive nosing or adhesive abrasive tape.

Supersedes DI-C-3-2

NO	REVISION	APP D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM BY	DES BY
					hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL				INSTRUCTIONS FOR USE OF AC-2-1 "STAIRWAY CONSTRUCTION"	DI-AC-2-1	
H. E. Struck SECRETARY DATE 2-1-60						



INSTRUCTIONS FOR USE OF HANDRAIL STANDARDS

AC-2-2, AC-2-2a, AC-2-3 & AC-2-3a

The welded type handrails shown on AC-2-2, AC-2-3 and AC-2-3a were adopted as standard because they best met the requirements for ease of decontamination, strength, rigidity and resistance to corrosion, by not having joint crevices. They are designed to withstand a load of at least 200 pounds applied in any direction at any point of the top rail. For special cases, where rails might be subjected to a greater loading, special designs shall be prepared. A location where conditions are extremely hazardous would be justification for a special design.

In some instances, where decontamination and corrosion are not factors, consideration may be given to other types of handrail connections, such as aluminum alloy slip fittings with set screws, provided such fittings can be justified as to strength, rigidity and cost for the specific application.

When these Standards are used, the following shall be observed:

1. For AC-2-2, when installation of the standard handrail post is in concrete, specify which type of base connection is to be used (Type A or Type B).
2. For AC-2-2a, specify which type base is to be used (Type E or Type F). Note that Type F provides for a fixed installation as well as a removable one. Supplemental drawings or specifications should clearly state whether the Type F base is to be fixed or removable.
3. For AC-2-3, specify, in supplemental specifications, the type base connection required for steel stairs (Type I, permanent or Type II, removable).
4. For AC-2-3, when types of base connections other than those shown on AC-2-3 are required, specify the type (Type B, C, D, E, or F, in accordance with Standards AC-2-2 and AC-2-2a).

When specifying stair handrails, the following shall be observed:

1. Location of platform railing, stair railings and toe boards shall conform to the requirements of the American Standard "Safety Code for Floor and Wall Openings, Railings and Toe Boards", ASA A12-1932, - and the "Pacific Coast Uniform Building Code", (UBC) Volume I, 1958, whichever is the more restrictive relative to the safety aspects of the installation.

Exception: Standard AC-2-2 requires a 6 inch high toe board which is a more restrictive requirement than those found in the above-mentioned standards.

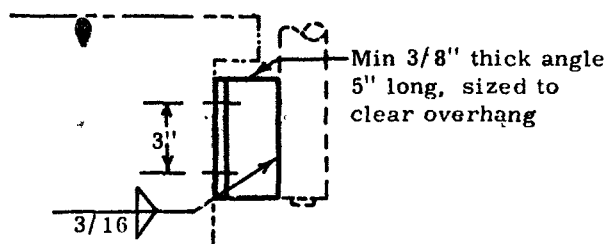
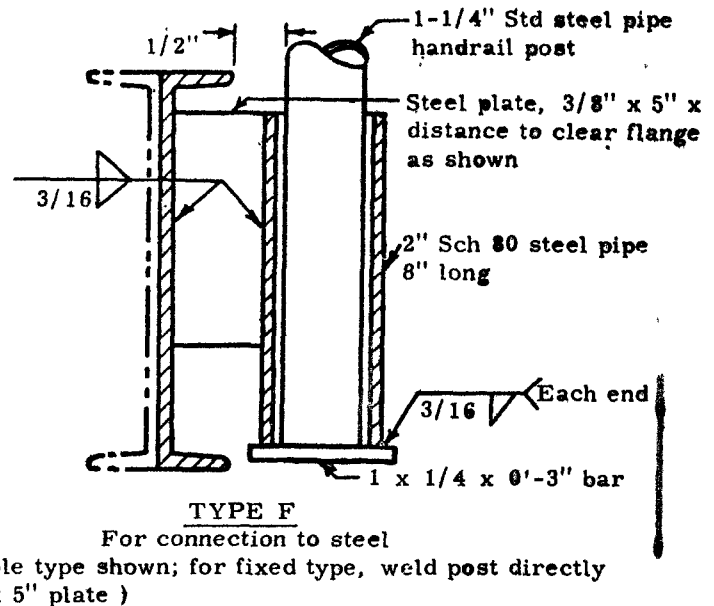
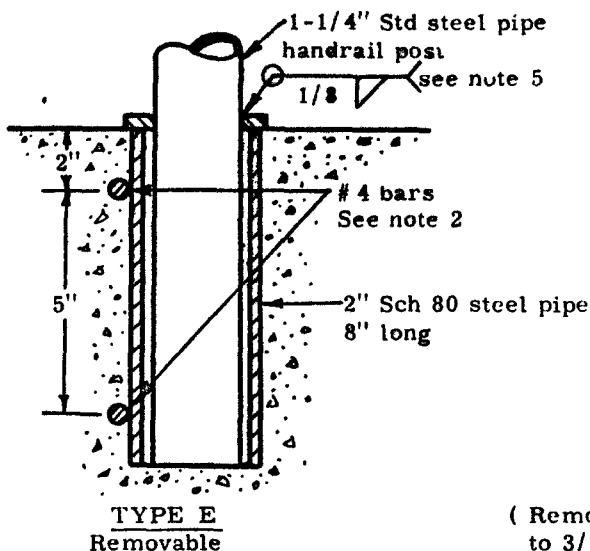
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NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
1	General	hes	11-9-61		hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL				INSTRUCTIONS FOR USE OF HANDRAIL STANDARDS AC-2-2, 2a, 3 & 3a	DI-AC-2-2, 2a, 3 & 3a	
H. E. Struck SECRETARY, DATE 2-1-60						

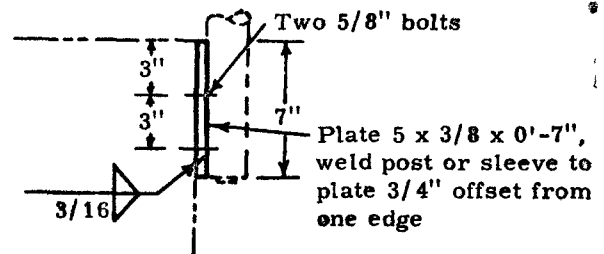


- Ref Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUDN BY	DES. BY
2	Rail height	hes	11-9-61		hes	bet
APPROVED BY ENGINEERING STANDARDS COUNCIL <u>H. E. Struck</u> SECRETARY DATE _____				PIPE HANDRAIL - PLATFORMS	AC-2-2	



**OPTIONAL BRACKET**  
( For bolting to concrete, wood, etc., with overhang. Use two 5/8" bolts. )



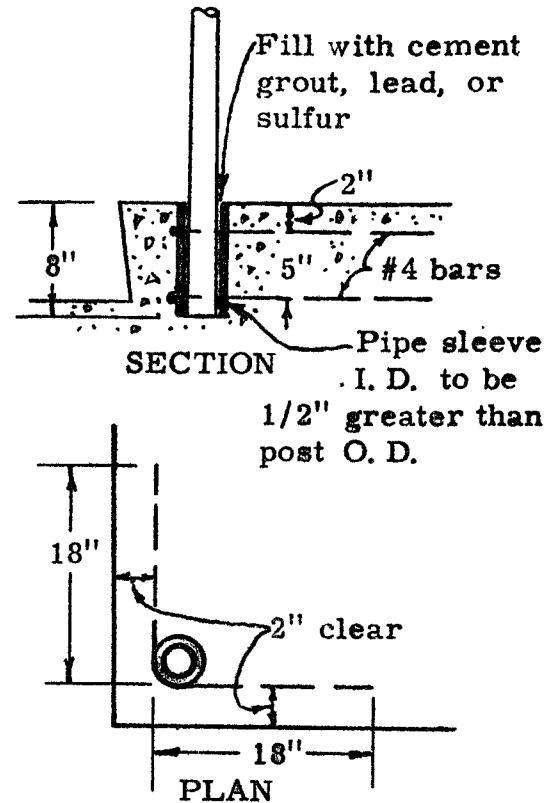
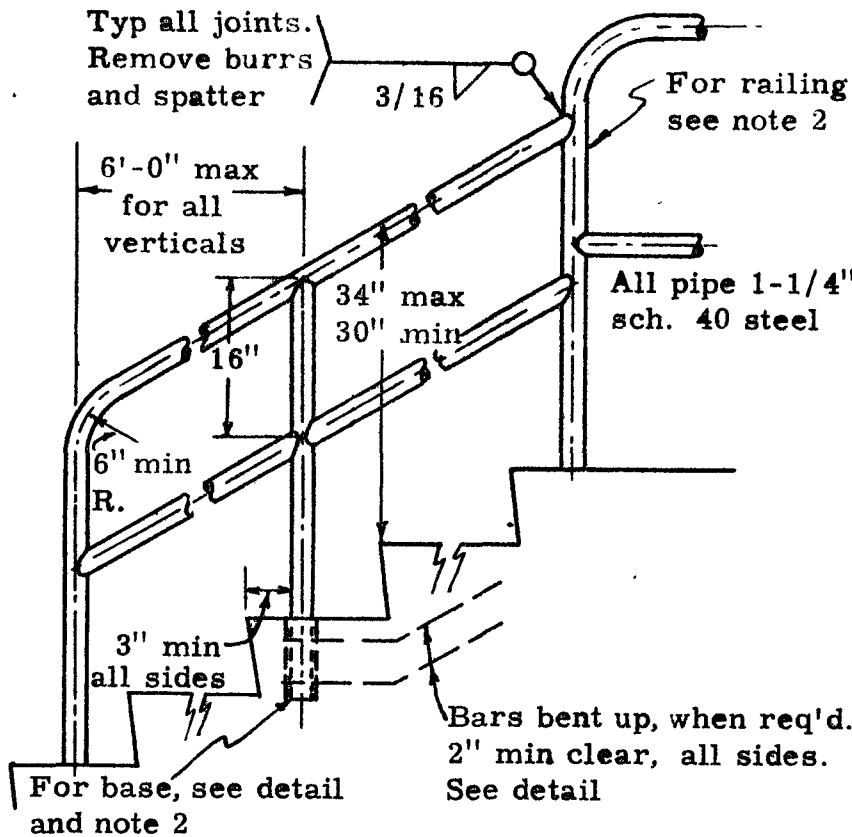
**OPTIONAL BRACKET**  
( For bolting to concrete, wood, etc., without overhang. For removable type, weld sleeve to plate; for fixed type, weld handrail post to plate. )

**NOTES:**

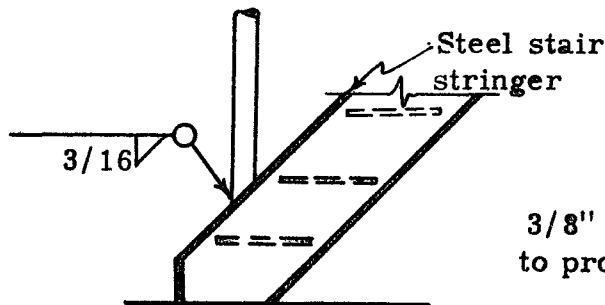
1. Removable handrail shall be constructed in 6-foot individual sections, two posts per section.
2. Reinforcement and edge distance to Type "E" base shall be same as for Type "A" base on Handrail Standard AC-2-2.
3. Paint inside and outside surfaces of steel sockets and exposed surfaces of steel plates with one coat red lead primer and two coats alkyd paint.
4. Remove burrs and spatter.
5. For outside locations weld 1/4" thick collar to post for seal.

Ref Hanford Stds: AC-2-2

1.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
1	Edge dist increased	hes	9-1-61		hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 7-12-61				BASES FOR REMOVABLE PLATFORM HANDRAIL	AC-2-2a	

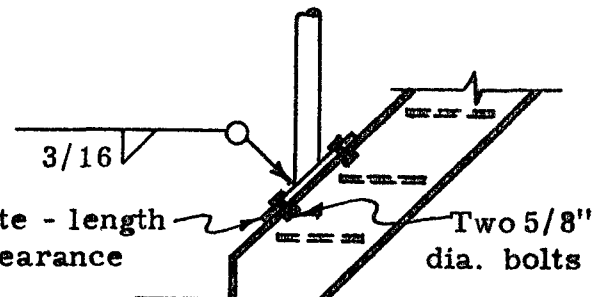


CONCRETE STAIR  
Typical Base Connection



TYPE I - PERMANENT

3/8" x 2-1/2" plate - length  
to provide bolt clearance



TYPE II - REMOVABLE

### STEEL STAIR BASE CONNECTIONS

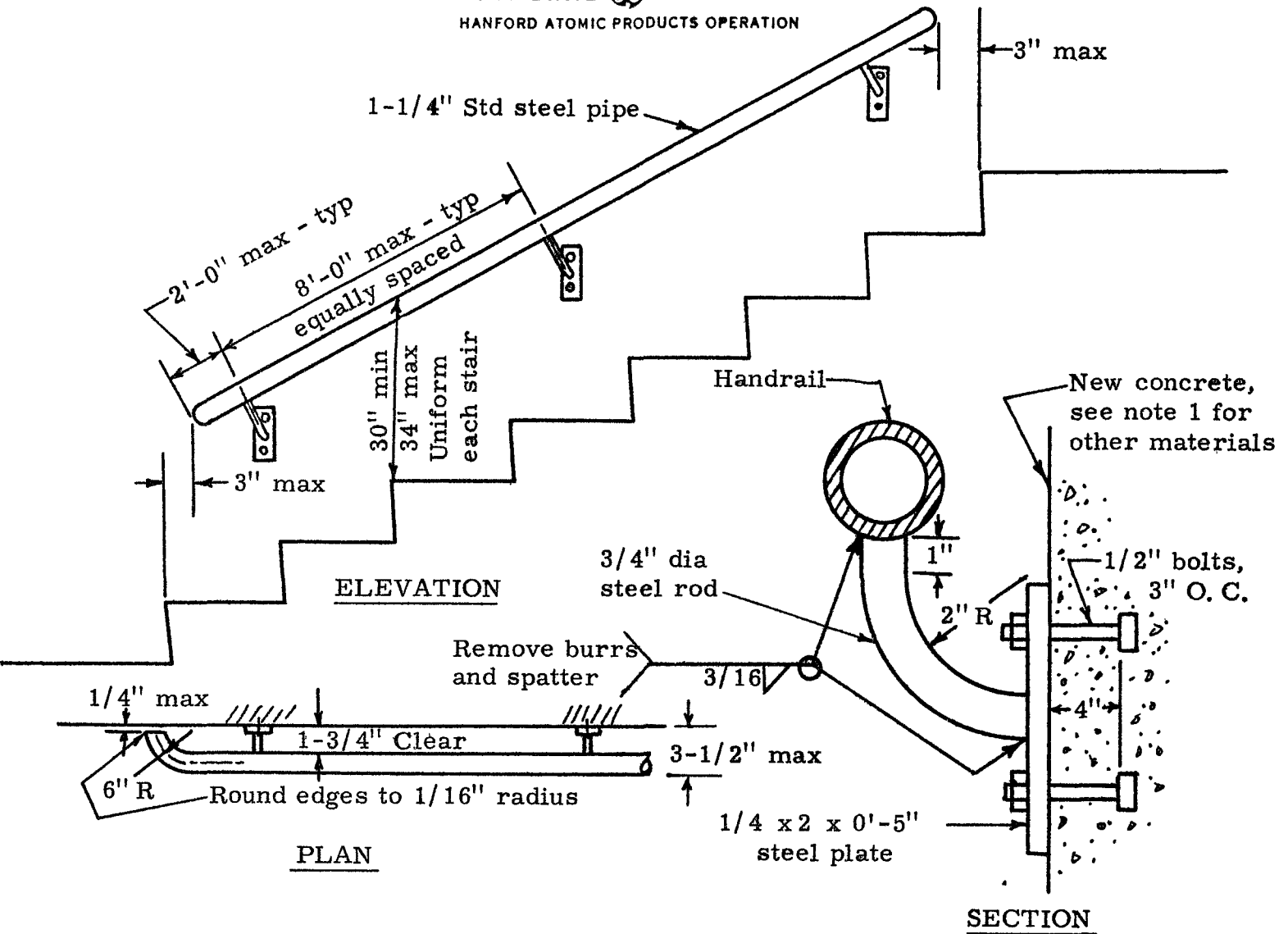
#### NOTES:

1. Before pouring molten lead or sulfur, be sure post and inside of pipe sleeve are clean and dry.
2. Railing and other type bases shall conform to Standard AC-2-2.
3. Paint one coat primer and two coats paint of approved quality.

Supersedes Std C-4-1a

Ref Hanford Stds: AC-2-2

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM. BY	DES. BY
1	Top rail height	hes	11-9-61			hes	bet
APPROVED BY ENGINEERING STANDARDS COUNCIL				PIPE HANDRAIL - STAIRS		AC-2-3	
H. E. Struck SECRETARY. DATE 2-1-60							



NOTES:

- Connection with other than cast-in-place bolts shall be:  
 EXISTING CONCRETE - Install with bolt anchors, self-drilling concrete anchors per Fed Spec FF-S-325, Group III, Type 1.  
 WOOD - Install with through bolts. Minimum thickness of supporting member shall be 1-1/2", peen threads; or use 1/2" dia lag screws installed per Std AC-1-4.  
 STEEL - Weld 3/4" dia rod directly to steel member. Minimum thickness of supporting member shall be 1/4". For thinner members use plate shown and use 1/4" x 8" dia plate on opposite side of member and bolt.
- Paint one coat red lead primer and two coats alkyd base paint.

Ref Hanford Stds:AC-1-4

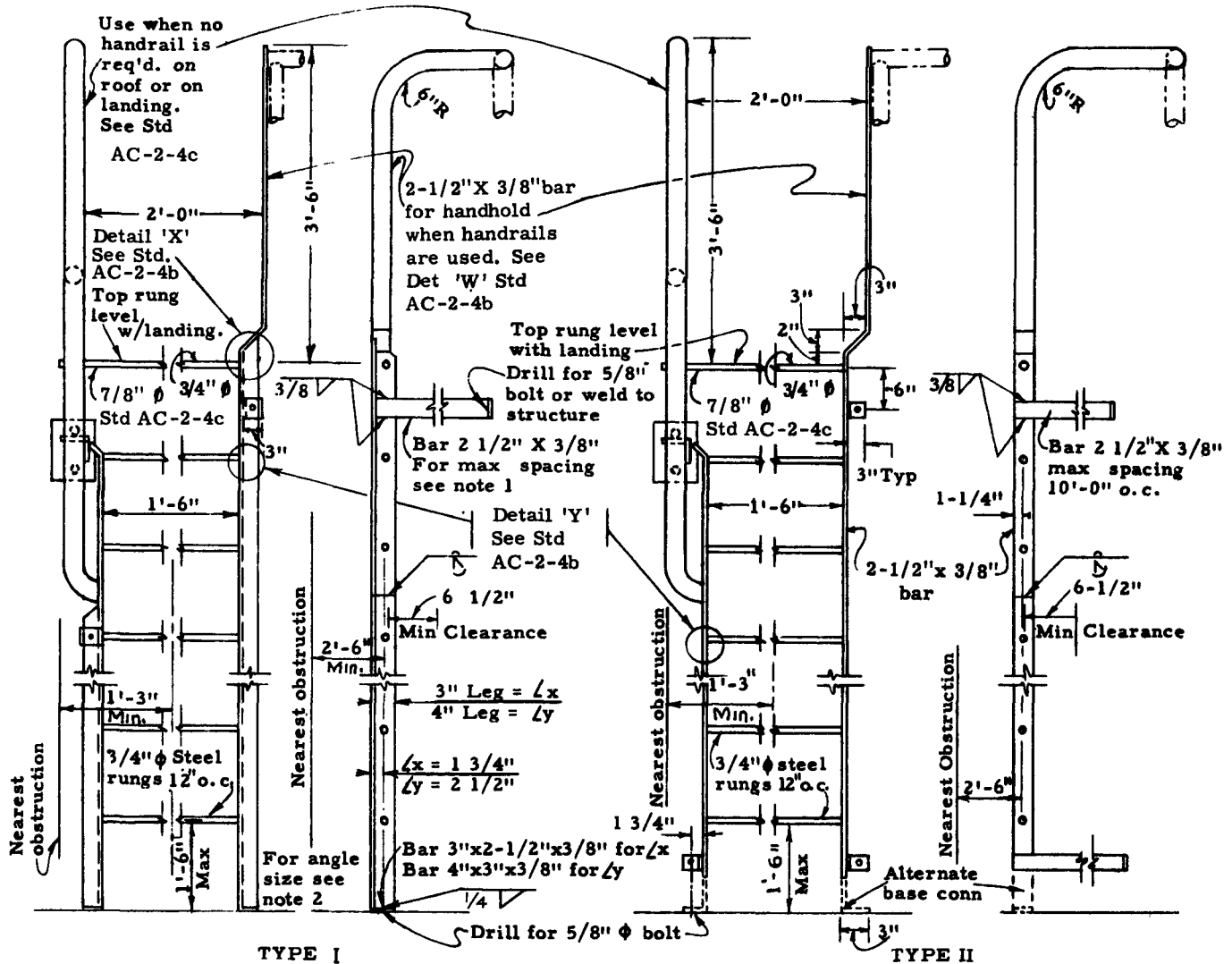
NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM. BY	DES. BY
1	Note 1 & Dimens.	hes	11-9-61			hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL				STAIR HANDRAIL - WALL MOUNTED		AC-2-3a	
H. E. Struck SECRETARY. DATE 7-12-61							

**RICHLAND, WASHINGTON**

Supersedes DI-C-4-2a, b & c					
NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	
1	Delete GE Monogram	hes	12-11-64		
APPROVED BY ENGINEERING STANDARDS COUNCIL				INSTRUCTIONS FOR USE OF	
H. E. Struck SECRETARY. DATE 2-1-60				LADDER STANDARDS AC-2-4a, b & c	
				SUBM. BY	DES. BY
				hes	chh
				DI-AC-2-4a, b & c	

# HANFORD STANDARD

RICHLAND, WASHINGTON



## NOTES:

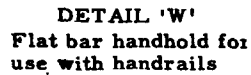
1. Use ladder with angle rails where points of support are greater than 10'-0" on centers. Distance between supports shall not exceed 20'-0".
2. Angle size:  $\angle x = 3" \times 2-1/2" \times 3/8"$  for 10'-1" to 15'-0" between horizontal ties.  
 $\angle y = 4" \times 3" \times 3/8"$  for 15'-1" to 20'-0" between horizontal ties.
3. Use ladder with flat rails where points of support do not exceed 10'-0" on centers.
4. Minimum thickness of wood supporting members shall be 1-1/2". Through bolting in wood is required.
5. Ladders over 20'-0" in height shall have safety cage. See Std AC-2-5. Clearances shown do not apply to ladders with safety cages. See Std AC-2-5 for those clearances.
6. All welded construction shown; bolted connections of equal strength may be used where required.
7. Paint one coat zinc chromate primer and two coats paint of approved quality.
8. Use 1-1/2" pipe handhold shown when landing does not have handrail.
9. Use 2-1/2" x 3/8" flat bar handhold per Std AC-2-4b when landing has handrail.

Supersedes Stds C-4-2 & C-4-2a

Ref Hanford Stds: AC-2-4b, AC-2-4c, AC-2-5

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM. BY	DES. BY
1	Delete GE Monogram	hes	12-11-64			hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL				STEEL LADDERS		AC-2-4a	
H. E. Struck SECRETARY, DATE 2-1-60							

**RICHLAND, WASHINGTON**

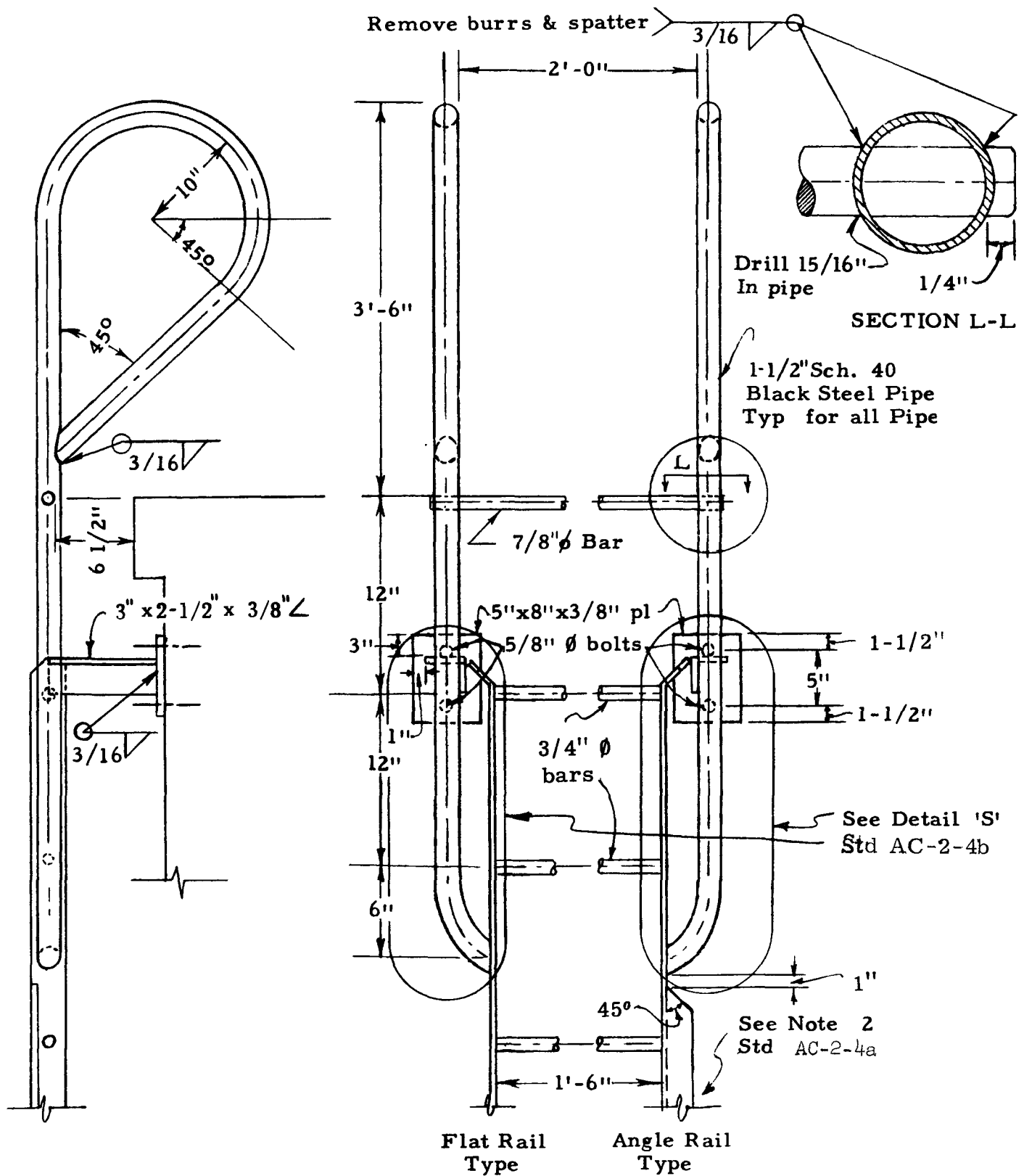


**Ref Hanford Stds: AC-2-2**

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
1	Delete GE Monogram	hes	12-11-54		hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL <b>H. E. Struck</b> SECRETARY, DATE <u>2-1-60</u>				STEEL LADDER DETAILS	AC-2-4b	

# HANFORD STANDARD

RICHLAND, WASHINGTON



Supersedes Std. C-4-2c

Ref. Hanford Stds.: AC-2-4a, AC-2-4b

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM. BY	DES. BY
1	Delete GE Monogram	hes	12-11-64			hes	jrs;chh
APPROVED BY ENGINEERING STANDARDS COUNCIL				PIPE HANDHOLD FOR STEEL LADDERS		AC-2-4c	
H. E. Struck SECRETARY, DATE 2-1-60							

# HANFORD STANDARD

RICHLAND, WASHINGTON

## INSTRUCTIONS FOR USE OF

### STANDARD AC-2-5 "STEEL LADDER CAGE"

When considering the use of steel ladder cages the following information should be kept in mind:

1. The design shown on Standard AC-2-5 is for an unobstructed fixed ladder.
2. Standard AC-2-5 specifies that the cage is for use on ladders over 20' - 0". The intent of the Standard is to provide a safety cage at locations where it is possible to fall 20 feet or more (such as on a ladder starting high up on a wall and having a small landing beneath). In such cases, even though the ladder may not be 20 feet long, a ladder cage should be used.
3. Restricted ladder clearances or some other condition may require special designs. Such designs may be
  - (a) Modification of this Standard, such as a side step ladder to provide means of leaving and mounting ladder at different elevations.
  - (b) A special climber's safety device, such as certain proprietary devices, where a climber by means of a belt attaches himself to a ladder rail or cable.
4. It is recommended that ASA 14.3 "American Standard Safety Code for Fixed Ladders" be reviewed during special designs and that the operating contractors Safety Engineer be consulted.

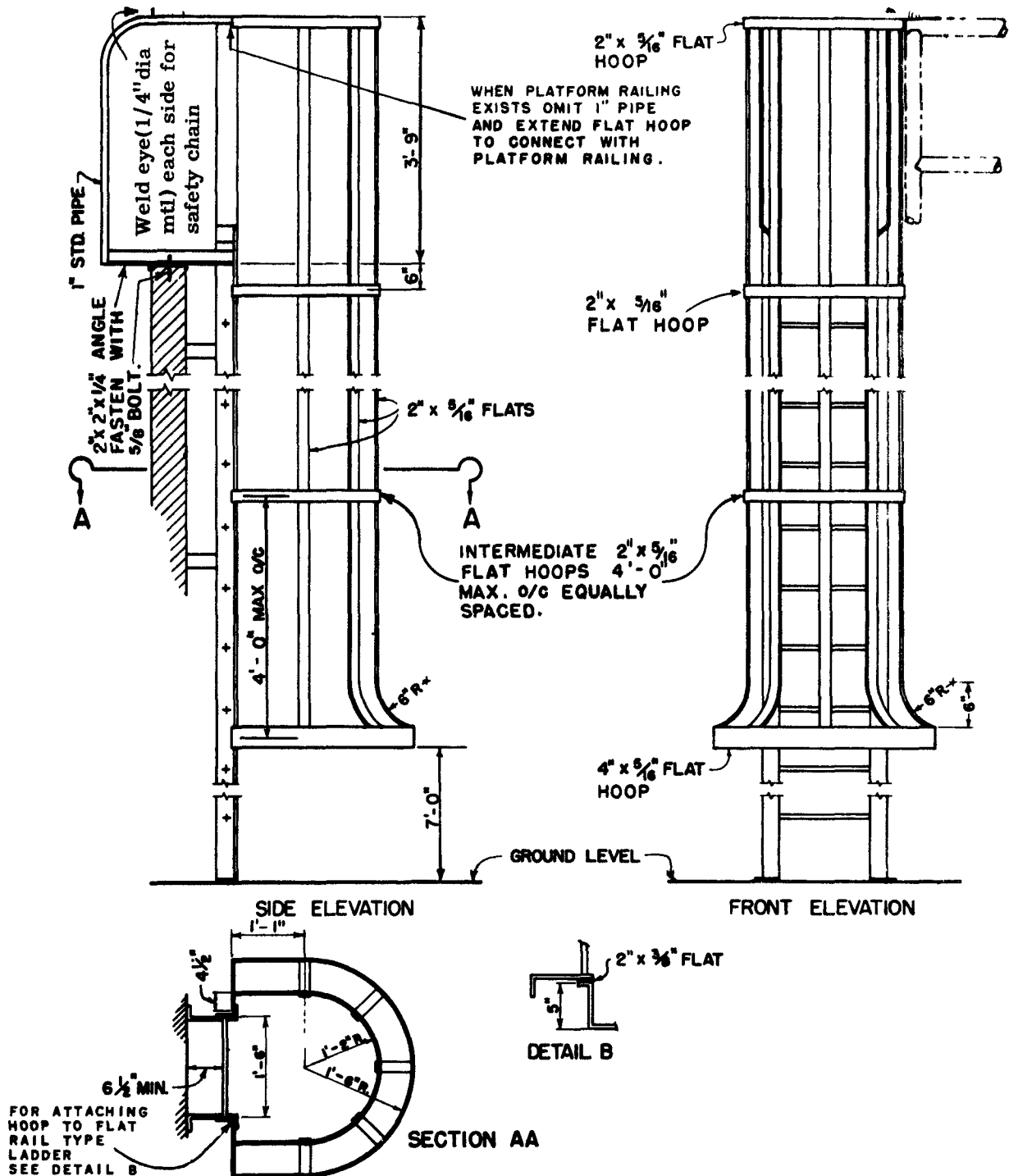
Supersedes DI-C-4-3

NO	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM BY	DES BY
1	General	hes	12-11-64		hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL				INSTRUCTIONS FOR USE OF STANDARD AC-2-5	DI-AC-2-5	
H.E. Struck SECRETARY. DATE 2-1-60						

# HANFORD STANDARD

RICHLAND, WASHINGTON

Weld eye (1/4" dia mtl)  
each side for safety  
chain. See note 5



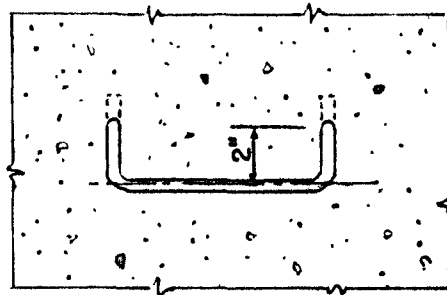
## NOTES

1. All welded construction.
2. This type cage to be used for ladders over 20'-0".
3. For ladder details see Stds AC-2-4a and AC-2-4b.
4. Paint one coat zinc chromate primer or equal and two coats paint.
5. See Std AC-2-4b for safety chain and snap.

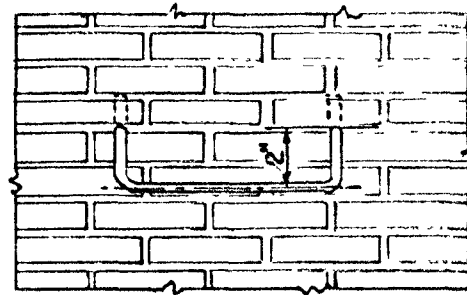
Supersedes Std C-4-3

Ref Hanford Stds: AC-2-4a, AC-2-4b,

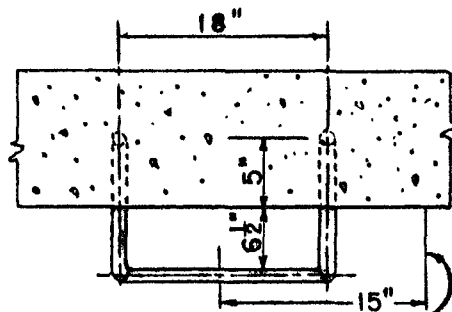
NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM BY	DES BY
2	Note 2 & delete GE Monogram	hes	12-11-64			hes	
APPROVED BY ENGINEERING STANDARDS COUNCIL				STEEL LADDER CAGE		AC-2-5	
H. E. Struck SECRETARY, DATE 2-1-60							



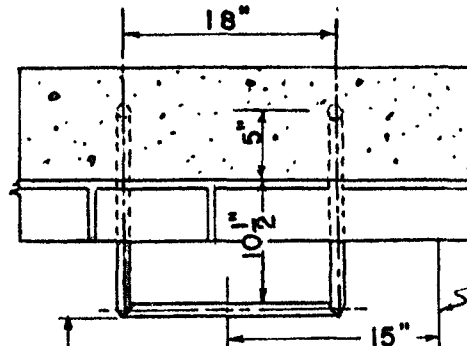
ELEVATION



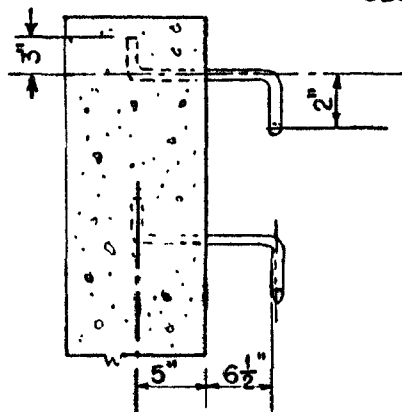
ELEVATION



PLAN

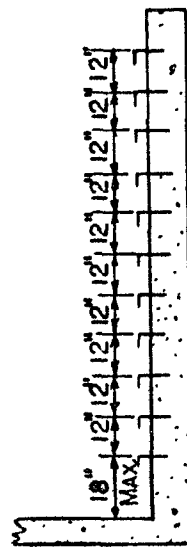


PLAN



SECTION

CONCRETE WALL  
3/4" x 12" C. TO C. 4'-3" LG.



SECTION

CONCRETE WALL W/  
BRICK VENEER  
3/4" x 12" C. TO C. 4'-11"

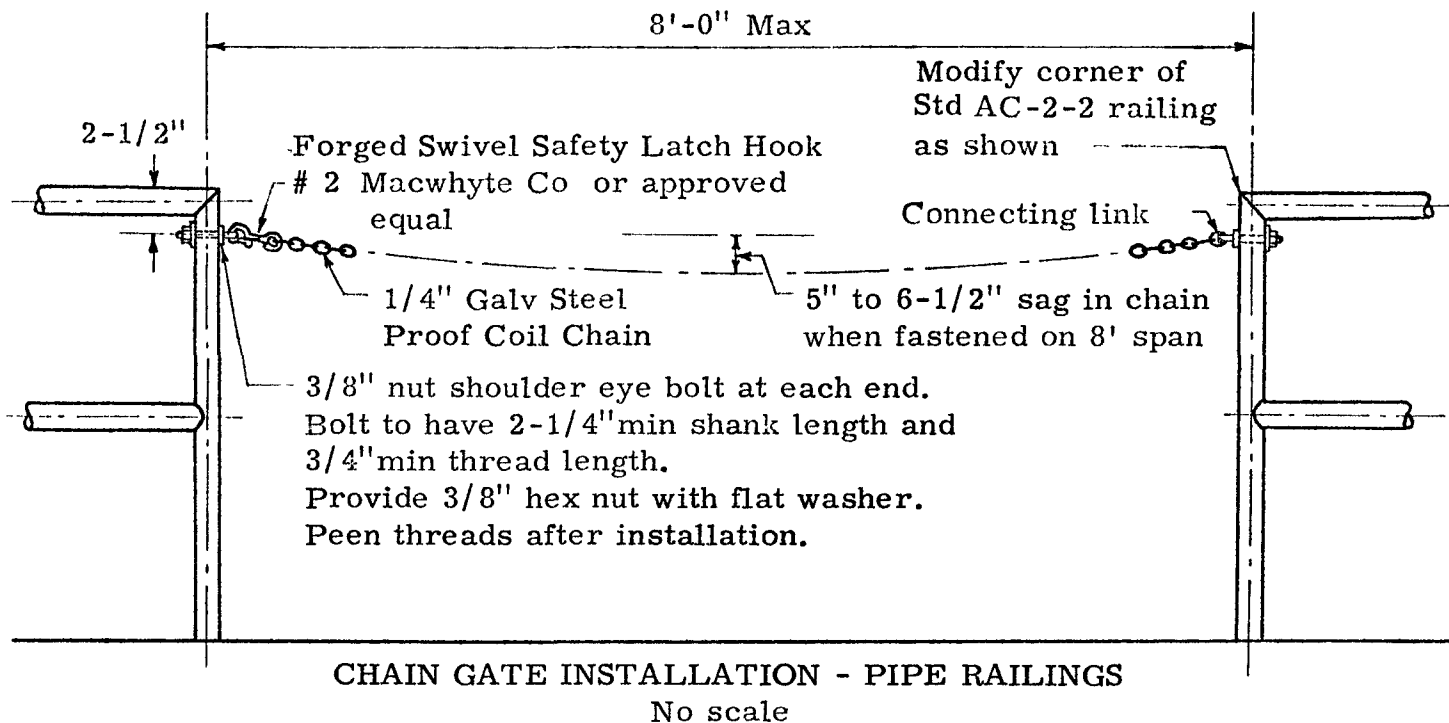
NOTES:

1. Bars shall be hot-rolled steel. All bars must be bent hot.
2. Hot dip galvanize bars per ASTM A123, after bending, or paint with chemical resistant coating systems specified on drawings.

Supersedes Std C-3-3

Ref Hanford Stds: None

NO	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM. BY	DL
1	Ref Std Nos.	hes	12-15-60	STEEL LADDER RUNG FOR CONCRETE WALLS		hes	
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 2-1-60						AC-2-6	



NOTES:

- Chain gates shall be installed in railings, doorways, docks, etc., where a safety barrier and access for loading and unloading is required.
- Chain and safety latch hook to be type shown or approved equal. Safety latch hook shall be fastened to chain with a 1/4" or 3/16" drop forged connecting link.
- 3/8" nut shoulder eye bolt connections to material other than pipe:  
STEEL- Through bolting preferred on 3/8" or greater thickness. Peen threads. May also be tapped or welded. Welding required on less than 3/8" thickness.  
OLD CONCRETE- Secure eye bolts with two-unit ring wedge cinch anchor for 3/8" bolt, Star No. 6825 or approved equal.  
NEW CONCRETE- Secure by embedding eye bolt shank 4" min. Anchor by using two nuts with a washer between at embedded end.  
WOOD- Through bolting preferred. 1-1/2" min supporting member. Peen threads. If bolting is not possible, use 3/8" screw eye bolt with 2" min penetration. 2-1/2" min supporting member.

Supersedes Std C-4-4

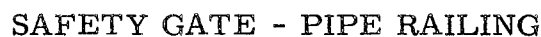
Ref Hanford Stds: AC-2-2

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	bet
APPROVED BY ENGINEERING STANDARDS COUNCIL				CHAIN GATE	AC-2-10	
H. E. Struck SECRETARY DATE 2-1-60						

INSTRUCTIONS FOR USE OF  
SAFETY GATE STANDARD AC-2-11

1. The intent of this standard is to provide a safety gate for ladder openings in hand railings, on catwalks, platforms and roofs. The gate should be used in such locations where space and traffic will allow. It may also be used for other openings in hand railings where a chain gate (Std AC-2-10) would not give sufficient protection.
2. Specify the width of the gate in places where the dimensions are not established by ladder or cage openings in hand railings. Normally the gate width should be about 3 feet and should not exceed 4 feet.
3. When a toe board is required, such as when the adjacent handrail has a toe board, specify that the gate leg and toe board be added.
4. When used for openings other than ladders, show the direction of gate swing on the drawings. The direction of gate swing should always be into the working or landing area.

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM. BY	DES. BY
						hes	gpt
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY: DATE 3-7-60				INSTRUCTIONS FOR USE OF SAFETY GATE STANDARD AC-2-11		DI-AC-2-11	



1. Remove burrs, weld spatter and sharp edges.
2. Spring shall be bolted as shown to gate and railing post with 1/4" steel bolts. Peen threads after installation.
3. Hinges shall be Post Pivot Gate Hinges No 163 7K, Yakima Hdw Co or approved equal. Hinge pivot post shall be drilled for cotter pin. Final assembly shall be made as shown with washer and cotter pin.
4. For railings other than pipe, modify gate construction to match railing construction.
5. Include gate leg and toe board when specified.
6. 1" typical; adjust to clear obstacles or uneven floors in field.

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
1	Add weld size	hes	9-18-61		hes	gpt
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 3-7-60				SAFETY GATE	AC-2-11	

CAPE-1072-147

INSTRUCTIONS FOR USE OF  
INDUSTRIAL SIGN STANDARD AC-3-1

When using Standard AC-3-1, Industrial Signs, for selecting signs the following should be observed:

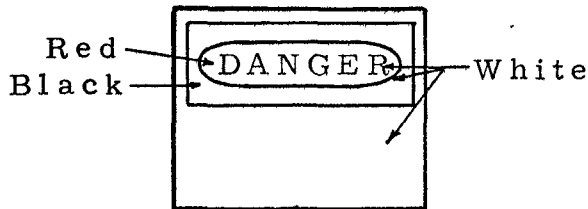
1. AC-3-1 is for information purposes to assist in the selection of standard signs for use at HAPO. It is not for use as a procurement specification or in construction contracts.
2. Commercially manufactured standard signs conforming to ASA Z35.1 are available from Purchasing and Stores either through stores stock (see catalog class 37) or by purchase requisition.
3. Industrial signs are grouped under the 5 classifications, DANGER, CAUTION, SAFETY INSTRUCTION, DIRECTIONAL AND INFORMATIONAL, as shown on Standard AC-3-1.

Typical examples of these various signs and examples of recommended wording can be found in ASA Z35.1 and in most commercial sign catalogs. When ordering signs it is recommended that a copy of ASA Z35.1 be obtained and used in conjunction with sign manufacturers' catalogs.

4. When specifying signs state the material to be used. Signs for outdoor service should be metal with baked enamel finish. Metal signs should not be specified where non-conducting electrical signs are required. Recommendations for other materials, such as wood, fiber, plastic, glass, reflective material, pasteboard and cloth for signs are covered in ASA Z35.1, Appendix A.
5. Recommendations for fasteners, supports, sign locations and maintenance are located in ASA Z35.1, Appendix A & B.
6. For radiation zone signs see Hanford Standards AC-3-20 and AC-3-21.
7. For personnel and office nameplates See Hanford Standard AC-3-10.
8. For standard exit signs see the American Standard Building Exits Code, ASA A9.1-1953.
9. Clearance signs, including overhead clearance, fall into one of two classifications: Danger - if the clearance is impaired, or Informational - to state the clearance for information purposes. AC-3-1 illustrates the Danger signs and Informational signs, while ASA Z35.1 covers sizes, lettering, colors, etc. to be used for them.
10. Outside building identification signs are informational signs. Recommended letter sizes for such signs are covered in ASA Z35.1, Section 7. Sign size will vary according to the letter size.

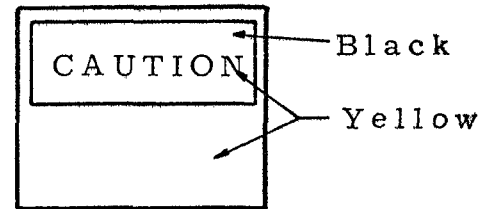
NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	gpt
APPROVED BY ENGINEERING STANDARDS COUNCIL				INSTRUCTIONS FOR THE USE OF AC-3-1. "INDUSTRIAL SIGNS"	DI-AC-3-1	
H. E. Struck SECRETARY. DATE 2-7-61						

### DANGER SIGNS



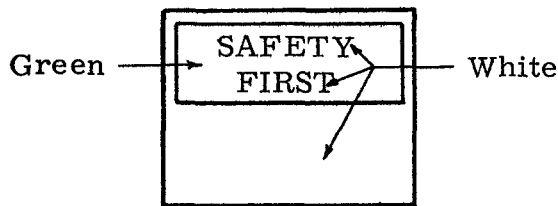
Message: Black on White

### CAUTION SIGNS



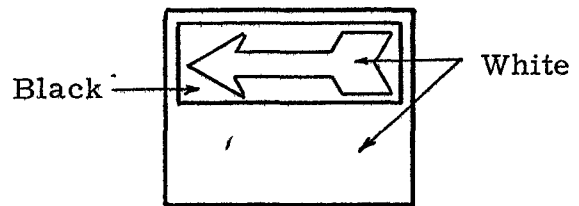
Message: Black on Yellow

### SAFETY INSTRUCTION SIGNS



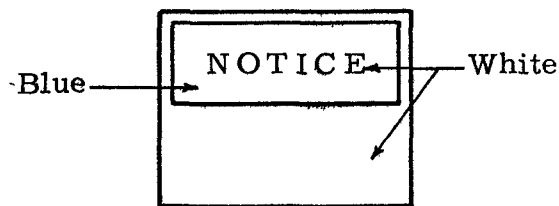
Message: Black on White

### DIRECTIONAL SIGNS



Message: Black on White

### INFORMATIONAL SIGNS



Message: Black on White



### NOTE:

All sign designs, sizes, material, colors, and lettering sizes shall be as specified in the American Standard Specifications for Industrial Accident Prevention Signs, ASA Z35.1 - 1959.

Supersedes Stds: C-5-18, 19, 20,  
23, 24, 25, 26 & 27

Not to be used in construction contracts

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM BY	DES. BY
						hes	gpt
APPROVED BY ENGINEERING STANDARDS COUNCIL				INDUSTRIAL SIGNS		AC-3-1	
H. E. Struck SECRETARY, DATE 2-7-61							

INSTRUCTIONS FOR USE OF

STANDARD AC-3-2

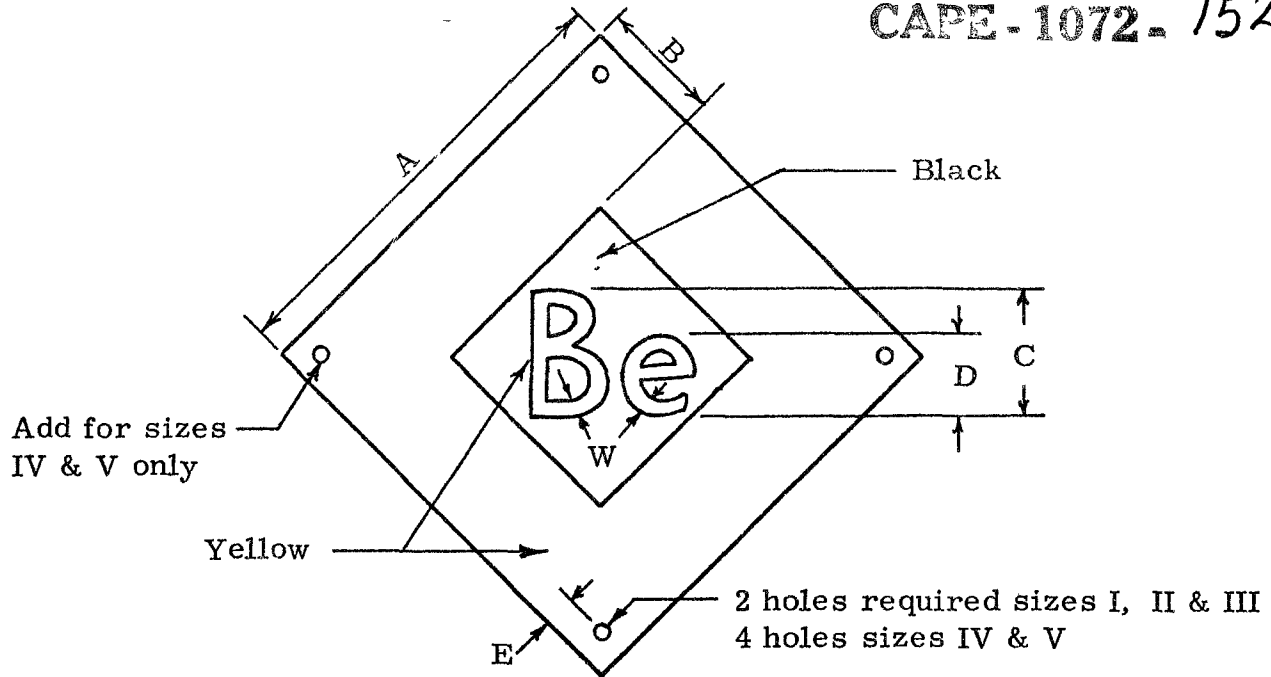
SECURITY SIGN - EMERGENCY EXIT

When using Standard AC-3-2 for specifying Emergency Exit signs the following should be observed:

1. Specify type of material and finish (I, II or III) best suited for service conditions. Wood or fiberboard signs (Type II or III) should be specified for inside service only. Metal signs with baked enamel finish (Type I) should be specified for outside service.
2. Metal signs shall not be used where non-conducting fiber electrical signs are required.

NO	REVISION	APP D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM BY	DES BY
APPROVED BY ENGINEERING STANDARDS COUNCIL				INSTRUCTIONS FOR USE OF STANDARD AC-3-2	DI-AC-3-2	
H. E. Struck SECRETARY, DATE 10-28-60						

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					lrr	
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY. DATE 10-28-60				SECURITY SIGN EMERGENCY EXIT	AC-3-2	



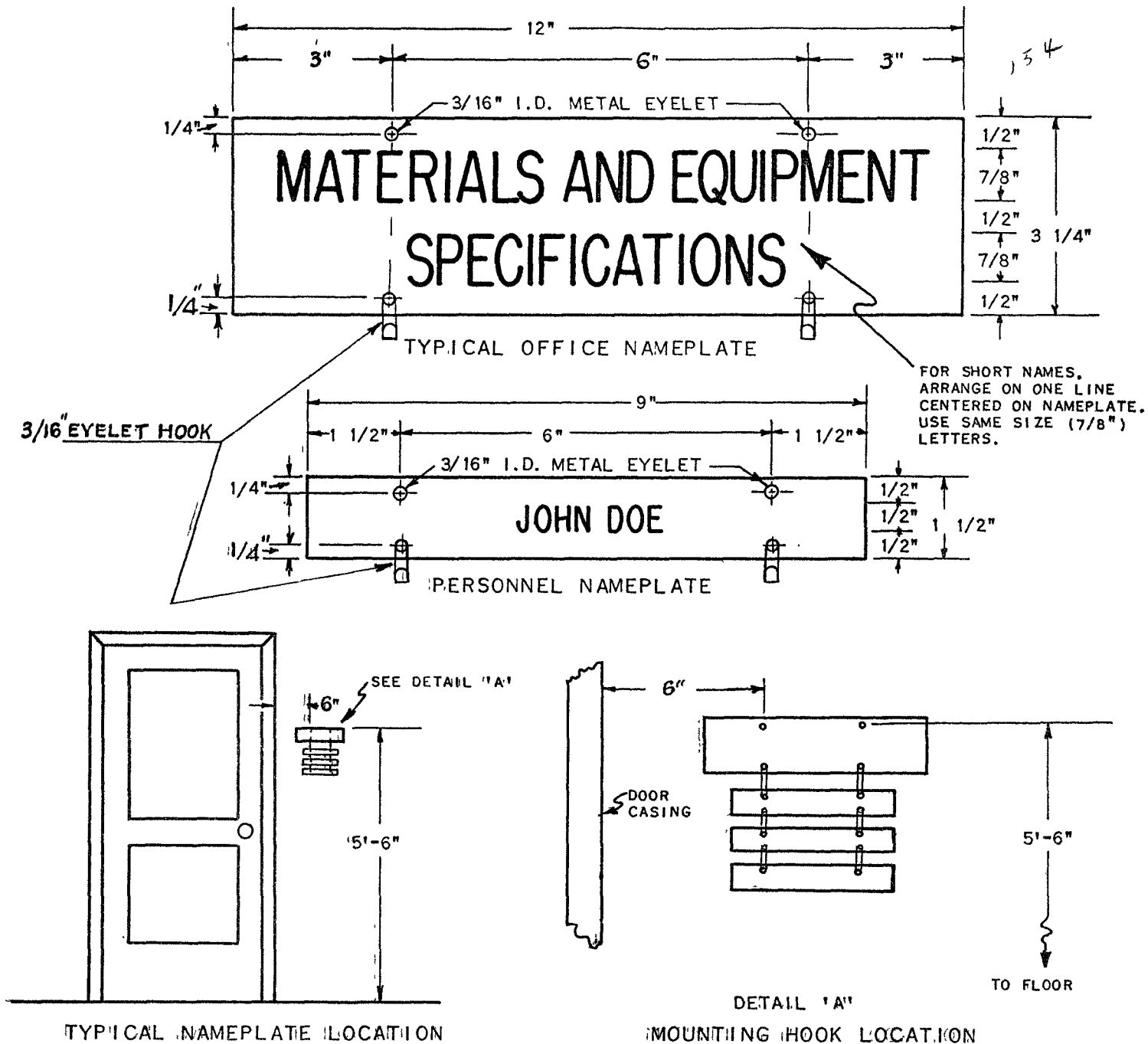
Size	A Inches	B Inches	C Inches	D Inches	Stroke Width Inches	Hole dia. Rigid signs Inches	E Inches
I	2.5	0.75	0.62	0.41	0.09	.1250	.25
II	5.0	1.5	1.25	0.83	0.18	.1250	.25
III	7.5	2.25	1.87	1.25	0.28	.1250	.25
IV	10.0	3.0	2.5	1.66	0.37	.1875	.375
V	12.5	3.75	3.12	2.08	0.46	.1875	.375

NOTES:

- For larger size signs A, B, C, D and Stroke Width shall be in the same proportions as shown above. Letters shall be Gothic Block.
- Yellow shall be a high visibility yellow approximately color No. 13655 in Federal Standard 595.
- Sign material for rigid signs shall meet standards as recommended in the American Standard Specifications for Industrial Accident Prevention Signs, ASA Z35.1-1959.
- Flexible adhesive backed signs shall be without holes. Material shall be Fasson Products 5 mil Vinyl plastic sheet with pressure sensitive backing, or approved equal.

Ref Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM. BY	DES. BY
						hes	gpt
APPROVED BY ENGINEERING STANDARDS COUNCIL				BERYLLIUM ZONE SIGN		AC-3-3	
H. E. Struck SECRETARY, DATE 5-24-61							



NOTES:

1. NAMEPLATES\* SHALL BE MADE BY "EMBOSOGRAF" MACHINE.
2. EDGE OF NAMEPLATE SHALL BE SMOOTH AND SQUARE.
3. LETTERS SHALL BE WHITE "CONDENSED GOTHIC" STYLE.
4. NAMEPLATE SHALL BE 1/16" BLACK FACED CARDBOARD, STANDARD "EMBOSOGRAF" STOCK.
5. USE OF OFFICE NAMEPLATE IS OPTIONAL.

\*NAMEPLATES MAY BE ORDERED FROM DUPLICATING

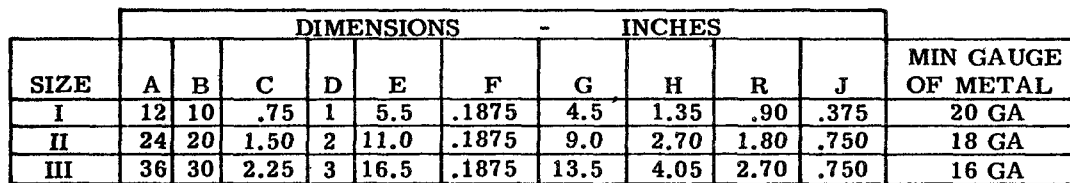
METHODS OF MOUNTING:

1. FOR MOUNTING ON WOOD OR PLASTER, USE 1" LONG, SQUARE BEND, SCREW HOOKS. HOOKS SHALL NOT EXTEND MORE THAN 1/4" OUT FROM WALL.
2. FOR MOUNTING ON TRANSITE, METAL, ETC., THE USE OF NO. 4 X 3/8" BINDING HEAD, SELF-TAPPING SHEET METAL SCREWS, OR CEMENTING, IS SUGGESTED.

Ref Hanford Stds: None  
Supersedes Stds C-5-32 & 32a

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
1	Add hooks & ch. dim's.	hes	2-28-63	PERSONNEL AND OFFICE NAMEPLATES	hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY DATE 10-28-60				AC-3-10		

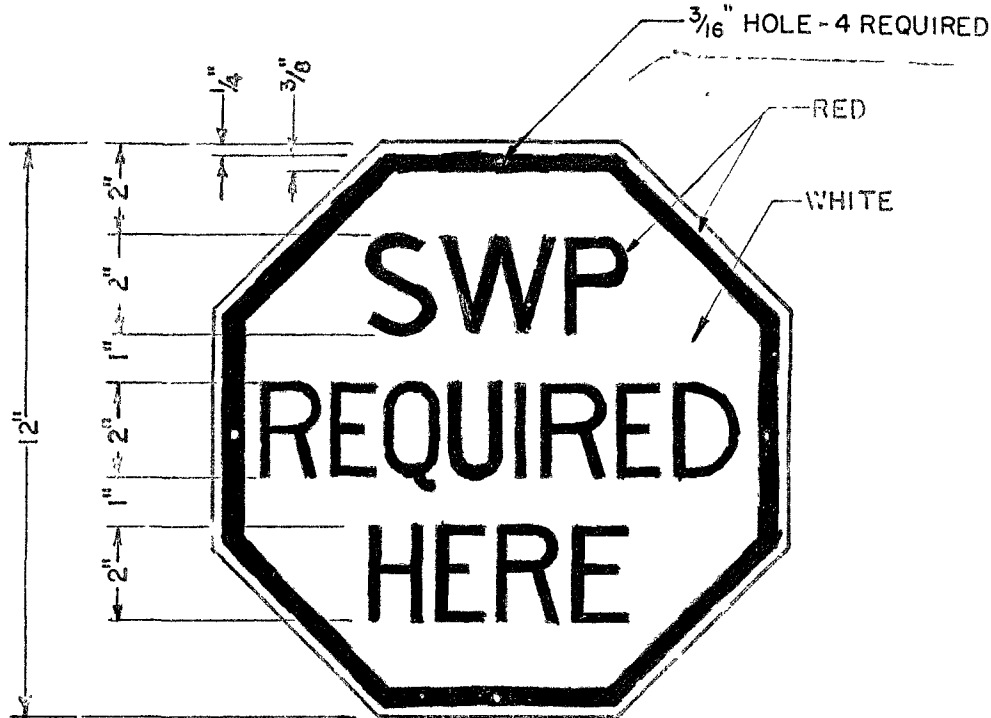
CAPE - 1072 - 154



1. Signs shall be of sheet metal, except where non-conducting fiber electrical signs are required. All signs shall have the edges dressed to eliminate all sharp edges, corners and projections. Corners shall be rounded on a radius of 1-1/2".
2. Finish to consist of at least one primer coat, two coats of the background color with lettering and symbol added, and properly baked to produce a tough flexible coating not visibly darkened and entirely free from blemishes. The back of each sign shall be given at least one heavy coat of background color or aluminum paint.
3. Background color to be Lemon Yellow; Munsell Color Code 5.0 Y-8/12 or equivalent. (Color No. 13655 in Federal Standard 595).
4. Letters and symbol to be Reddish Purple (Magenta), Munsell Color Code 2.5 RP-4/10 or equivalent. Letter style to be Franklin Gothic.
5. Symbol shall conform to American Standard N 2.1-1960, as shown.

**Ref Hanford Stds: None**

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	hvc
APPROVED BY ENGINEERING STANDARDS COUNCIL <u>H. E. Struck</u> SECRETARY, DATE <u>6-20-60</u>				RADIATION ZONE SIGN	AC-3-20	



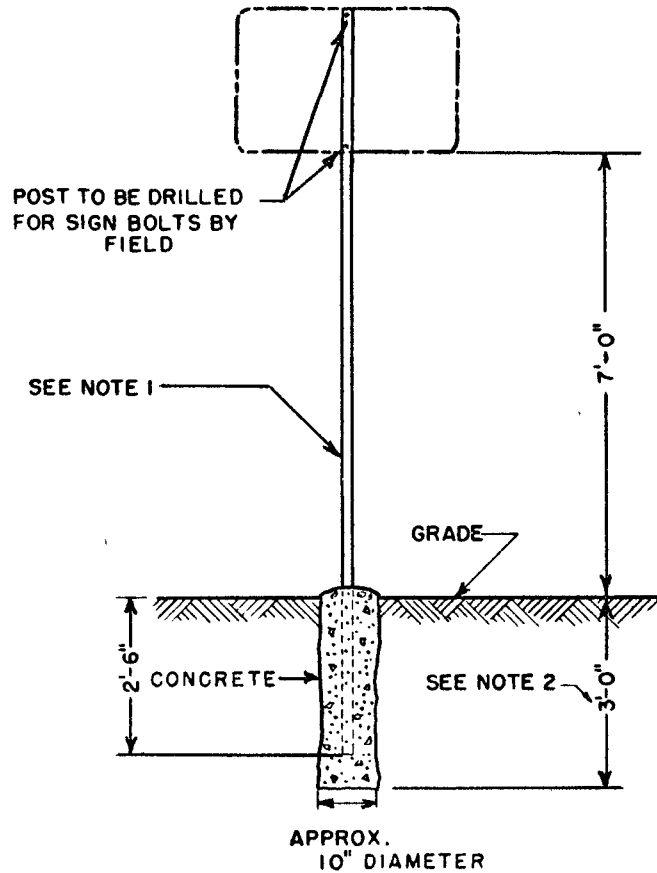
NOTES:

1. Signs shall be of sheet metal, minimum 18 gauge, except where non-conducting fiber electrical signs are required. All signs shall have edges dressed to eliminate all sharp edges, corners and projections.
2. Finish to consist of at least one primer coat, two coats of background color with lettering and border added, and properly baked to produce a tough, flexible coating not visibly darkened, and entirely free from blemishes. The back of each sign shall be given at least one heavy coat of background color or aluminum paint.
3. Background color to be White. Letters and border to be Red, Munsell Color Code 5.0 R-4/14 or equivalent. (Color No. 11105 in Federal Standard 595). Letter style to be Franklin Gothic.

Supersedes Std C-5-21a

Ref Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL - CIVIL STANDARD		SUBM. BY	DATE
						hes	hvc
APPROVED BY ENGINEERING STANDARDS COUNCIL				RADIATION SIGN		AC-3-21	
H. E. Struck SECRETARY, DATE 6-20-60				"SWP REQUIRED HERE"			



NOTES:

1. Post shall be 1-1/2" schedule 40 galvanized pipe.
2. For all signs greater than 4 sq ft area use 2" schedule 40 pipe with 4'-0" bury.

Supersedes Std C-5-28

Ref Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
1	Title block	hes	11-9-61		cel	
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 10-28-60				SIGN POST		AC-3-30

CAPE-1072-157

SEWERS, DRAINAGE, PILING



A diagram of a U-shaped channel cross-section. It shows a flat bottom and vertical side walls. The flow area is the interior of the U-shape, and the wetted perimeter is the boundary in contact with the fluid, including the bottom and the two side walls.

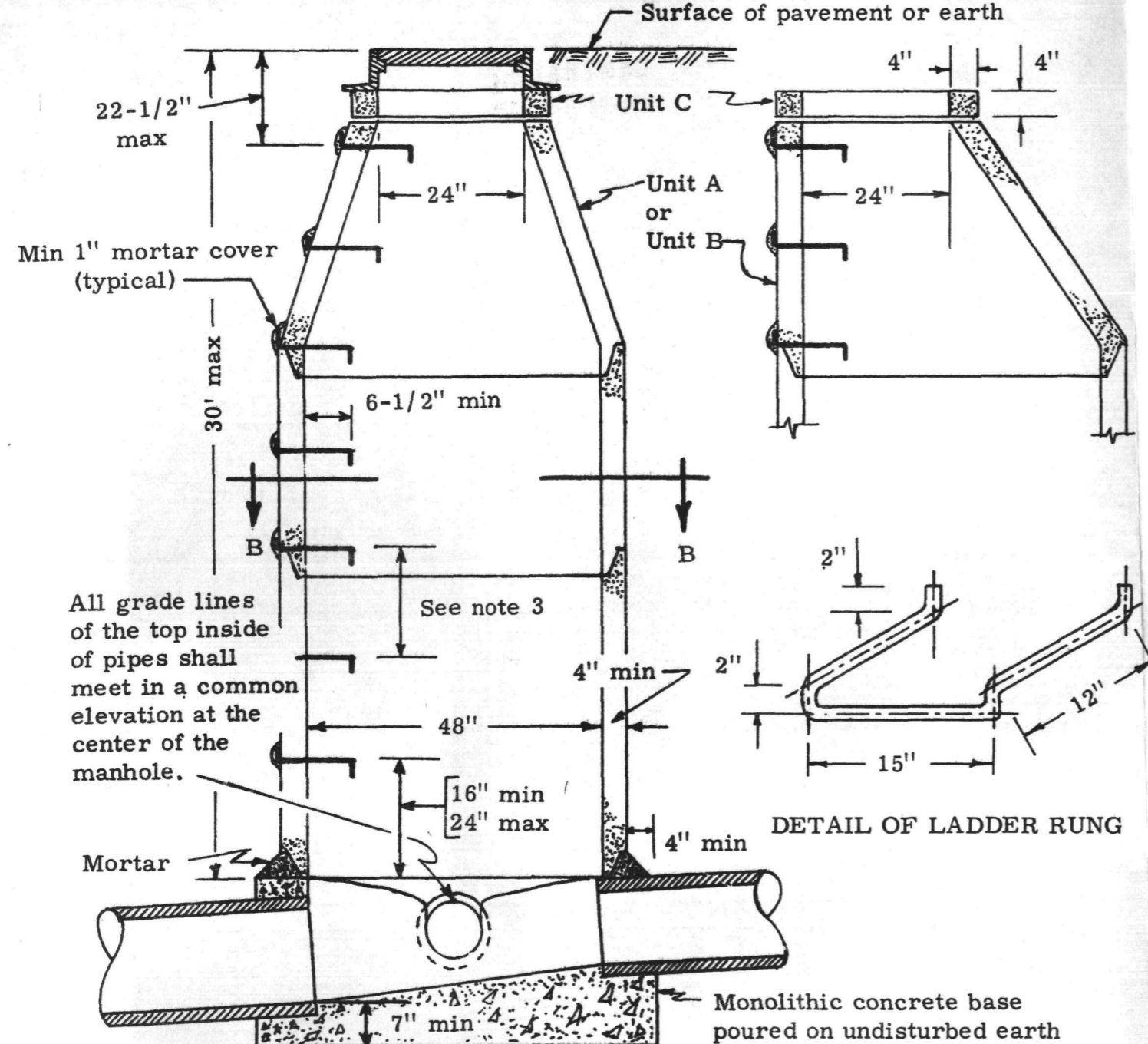
A technical drawing of a mechanical component, likely a bracket or support arm, shown in cross-section. The drawing includes several dimension lines indicating measurements:

- Overall Width:** 24"
- Internal Length:** 21½"
- Top Flange Thickness:** 1½"
- Top Flange Width (Left):** 1½"
- Top Flange Width (Right):** 1"
- Bottom Flange Thickness:** 1"
- Bottom Flange Width (Left):** 1¼"
- Bottom Flange Width (Right):** 1½"
- Central Hole Diameter:** 6"
- Vertical Spacing (Top):** 2½"
- Vertical Spacing (Bottom):** 3¾"
- Small Feature Height:** 1/2"

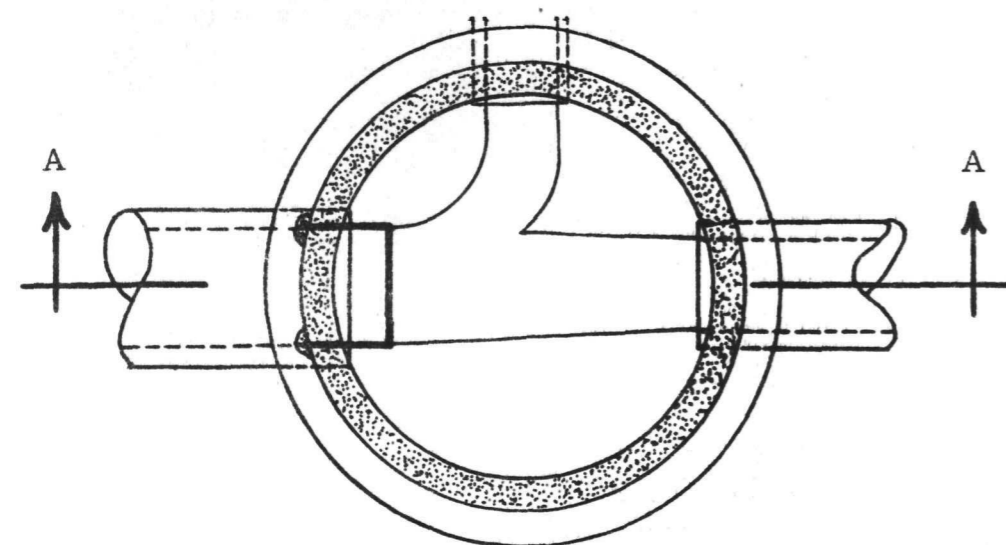
A diagram of a circular cross-section of a lens. It features a large outer circle and three smaller concentric circles inside it. A horizontal and a vertical line intersect at the center, forming a crosshair. The vertical line extends slightly beyond the top and bottom of the circles, while the horizontal line is contained within the width of the circles.

1. In acid bearing sewers no rungs shall be used in the manholes.
2. Frame & cover shall be cast iron ASTM A48, Class 30.
3. Cover shall weigh not less than 200 lbs. Frame shall weigh not less than 200 lbs.
4. Olympic Foundry Co No. 5920 or equal may be used.
5. Machine horizontal face of cover seat and corresponding face of cover.
6. Rungs shall be hot-rolled steel. All bars shall be bent hot.

NO.		REVISION		APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
1		Ref Stds Nos.		hes	12-15-60		hes	
APPROVED BY ENGINEERING STANDARDS COUNCIL <u>H. E. Struck</u> SECRETARY, DATE <u>10-19-59</u>						MANHOLE FRAME, COVER AND RUNG	AC-4-1	



ELEVATION (SECTION A-A)



PLAN (SECTION B-B)

NOTES:

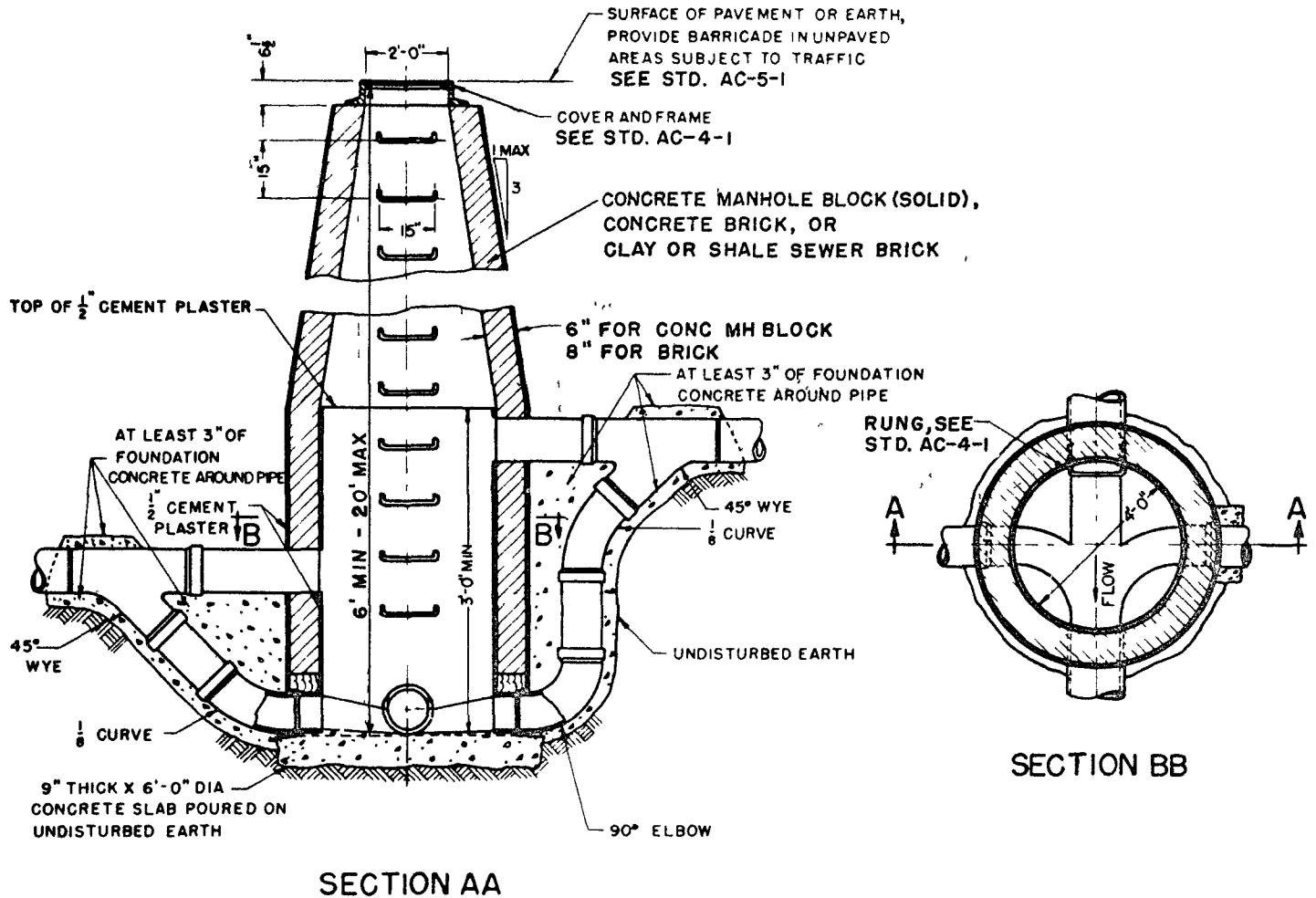
1. The concrete in precast units shall develop a minimum compressive strength of 4000 psi at 28 days.
2. The precast units shall contain not less than 0.13 square inches of steel reinforcement per linear foot of pipe.
3. Ladder rungs shall be 1" diameter, hot-rolled steel, shall be bent hot and shall be hot-dip galvanized after bending. Ladder rungs shall be grouted in molten sulphur or cement concrete mortar firmly packed in place in the concrete wall. Ladder rungs shall be uniformly spaced at 16" OC and vertically aligned.
4. All joints shall be completely filled with mortar.
5. Mortar shall consist of one part of portland cement and two parts of clean, washed sand.
6. Concrete for the base shall develop 2500 psi minimum compressive strength at 28 days.
7. Manhole frame and cover shall conform to Hanford Standard AC-4-1, Manhole Frame, Cover and Rung.
8. Up to 3 "C" units may be used to meet the required grade or the top course may be built up with concrete brick for a maximum of three 4-inch thick courses.
9. Provide barricade in unpaved areas subject to traffic. See Std AC-5-1.

Ref Hanford Stds: AC-4-1 AC-5-1

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM. BY	DES. BY
1	Drawing detail	hes	12-15-60			hes	chh cga
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY. DATE 9-2-60				PRECAST CONCRETE MANHOLE		AC-4-2	

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 10-19-59				BRICK OR CONCRETE BLOCK MANHOLE	AC-4-3	

FOR 8" TO 30" SANITARY & STORM SEWERS ONLY, DEPTH 6' TO 20'



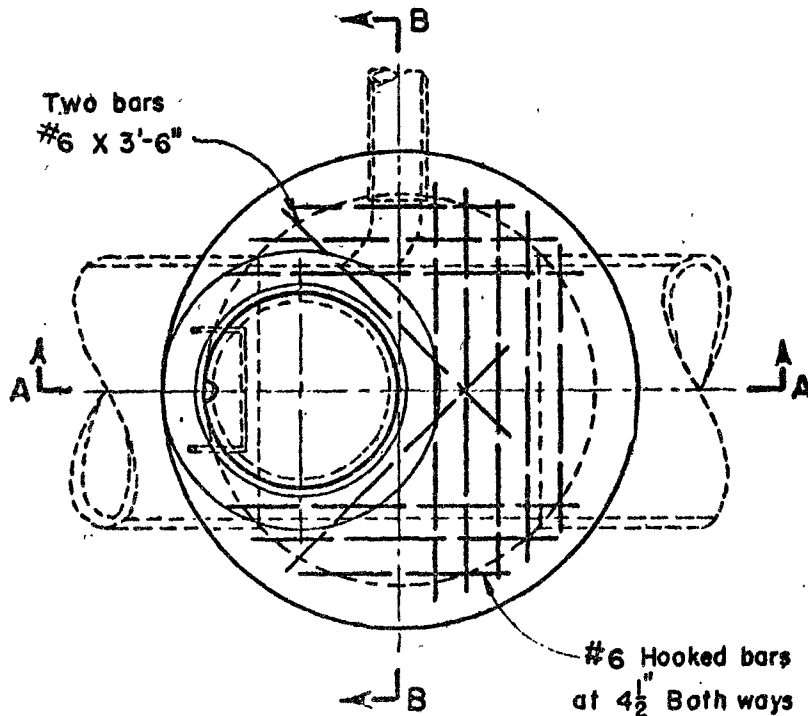
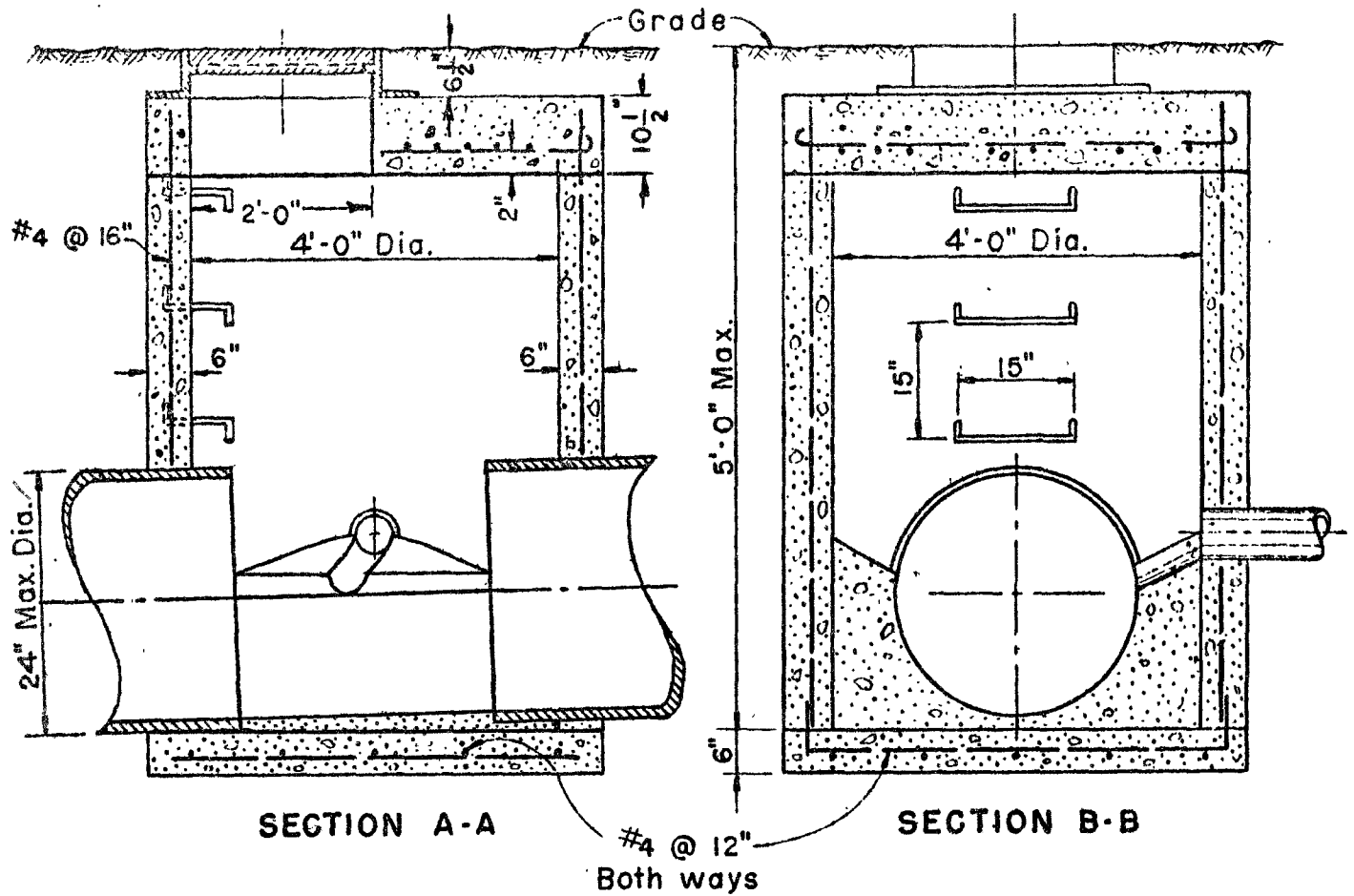
**NOTE:**

- 1 THE LOWEST RUNG TO BE GREATER THAN 15" AND LESS THAN 24" ABOVE THE FLOOR.
- 2 THE UPPER RUNG TO BE NOT MORE THAN 16" BELOW THE BOTTOM OF THE COVER FRAME
- 3 THE RUNGS SHALL PROJECT 6 1/2" INSIDE THE MANHOLE
- 4 THE DEPTH OF THE CHANNEL FORMED BY THE CONCRETE INVERT SHALL BE 1/2 THE DIAMETER OF THE SEWER
- 5 MORTAR JOINTS SHALL BE 3/8" THICK, THE MORTAR MIX SHALL BE 1 PART PORTLAND CEMENT AND 1/4 PART OF HYDRATED LIME TO 2 PARTS CLEAN SAND, THE PLASTER MIX SHALL BE 1 PART PORTLAND CEMENT TO 2 PARTS CLEAN SAND.
6. DROP IN FLOW LINE ACROSS MANHOLE SHALL BE 1 1/4", MINIMUM.
7. CONCRETE SHALL DEVELOP 2500 PSI MIN COMPRESSIVE STRENGTH AT 28 DAYS.

Supersedes Std. E-5-1a

Ref. Hanford Stds: AC-4-1, AC-5-1

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 10-19-59				BRICK OR CONCRETE BLOCK DROP MANHOLE	AC-4-4	



### NOTES

1. For design of manhole frame, cover and rungs, see Std. AC-4-1.
2. The depth of channel formed by the concrete invert shall be  $\frac{1}{2}$  the diameter of the sewer.
3. Manhole designed to support 16,000 lbs.
4. Drop in flow line across manhole shall be  $1\frac{1}{4}$ ", minimum.
5. Concrete shall develop 3000 psi compressive strength at 28 days.

Supersedes Std. E-5-1c

Ref. Hanford Stds: AC-4-1

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM. BY	DES. BY
						hes	
APPROVED BY ENGINEERING STANDARDS COUNCIL.				ROUND CONCRETE SHALLOW MANHOLE		AC-4-5	
E. Struck SECRETARY, DATE 10-19-59							

INSTRUCTIONS FOR USE OF AC-4-10 & AC-4-11

ACID-PROOF MANHOLES

The following items must be considered when standard AC-4-10 or AC-4-11 is referenced.

1. These manholes are designed for maximum sewer size of 30 inches I. D. Manholes for larger sewers will require special designs.
2. The chemical resistance of these manholes is limited. They should not be used indiscriminately "as is" for general chemical sewer manholes.

In general, the limiting materials are the joint cements for the vitrified clay liner. The vitrified clay liner will be affected only by hydrofluoric acid.

Where the specific chemicals to be resisted are known, and the "Vitrobond" or "Carbo-Korez" will not resist them, then other joint cements which will resist them should be specified on drawings or in supplemental specifications.

Note that both "Vitrobond" and "Carbo-Korez" are used in the manholes.

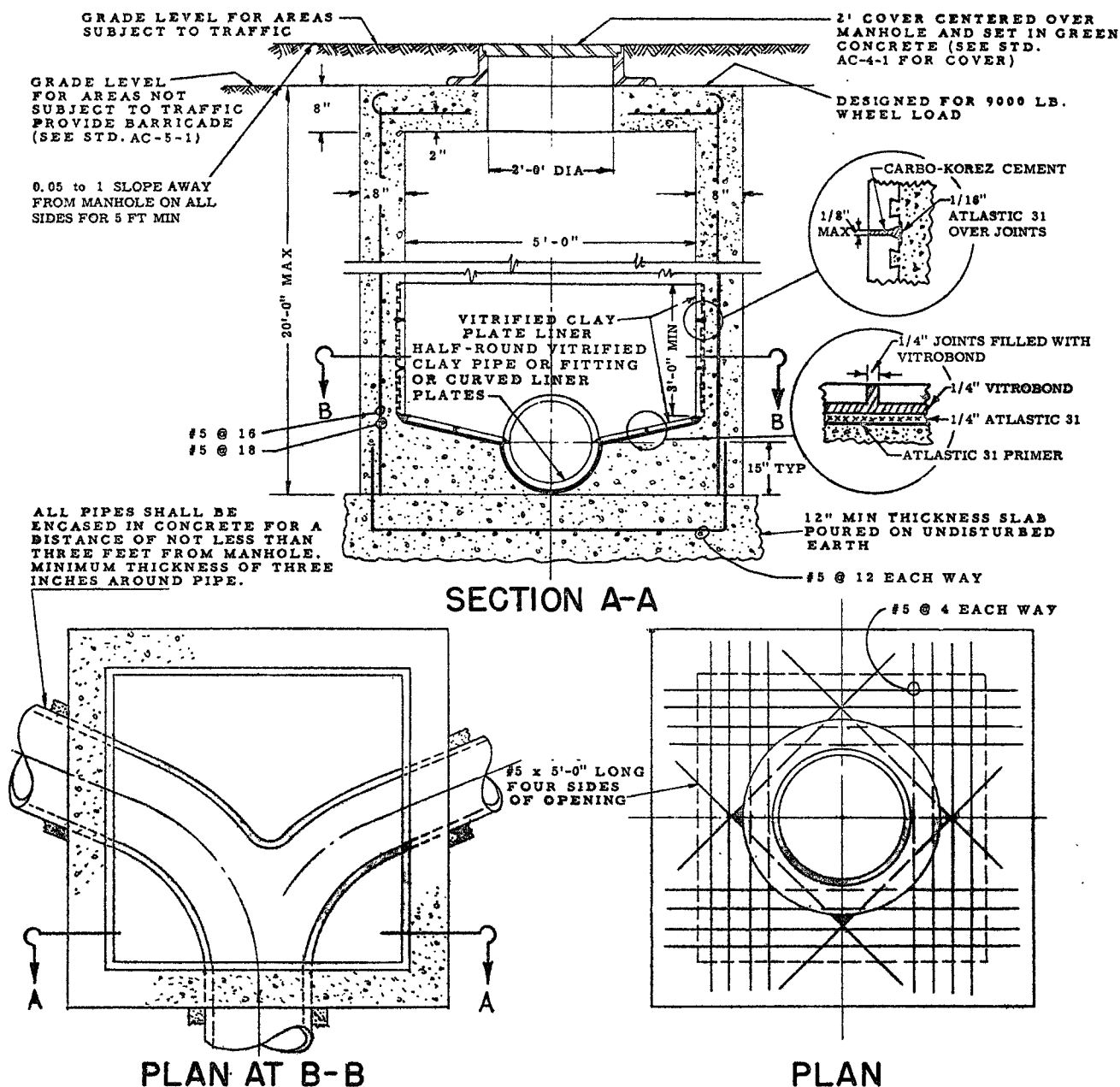
General chemical resistance of the joint cements specified on AC-4-10 and 11 are as follows: (For specific information on other chemicals, consult manufacturers' bulletins.)

<u>Chemical</u>	<u>Vitrobond*</u> <u>Resistance</u>	<u>Carbo-Korez**</u> <u>Resistance</u>
Hydrochloric Acid	Resists	Resists
Nitric Acid 5%	Resists	Resists @70 F
Nitric Acid 20%	Resists	Does not resist
Nitric Acid 40%	Resists @70 F	Does not resist
Sodium Hydroxide	Does not resist	Does not resist
Sulfuric Acid 50%	Resists	Resists
Methyl Ethyl Ketone	Does not resist	Resists
Trichloroethylene	Does not resist	Resists

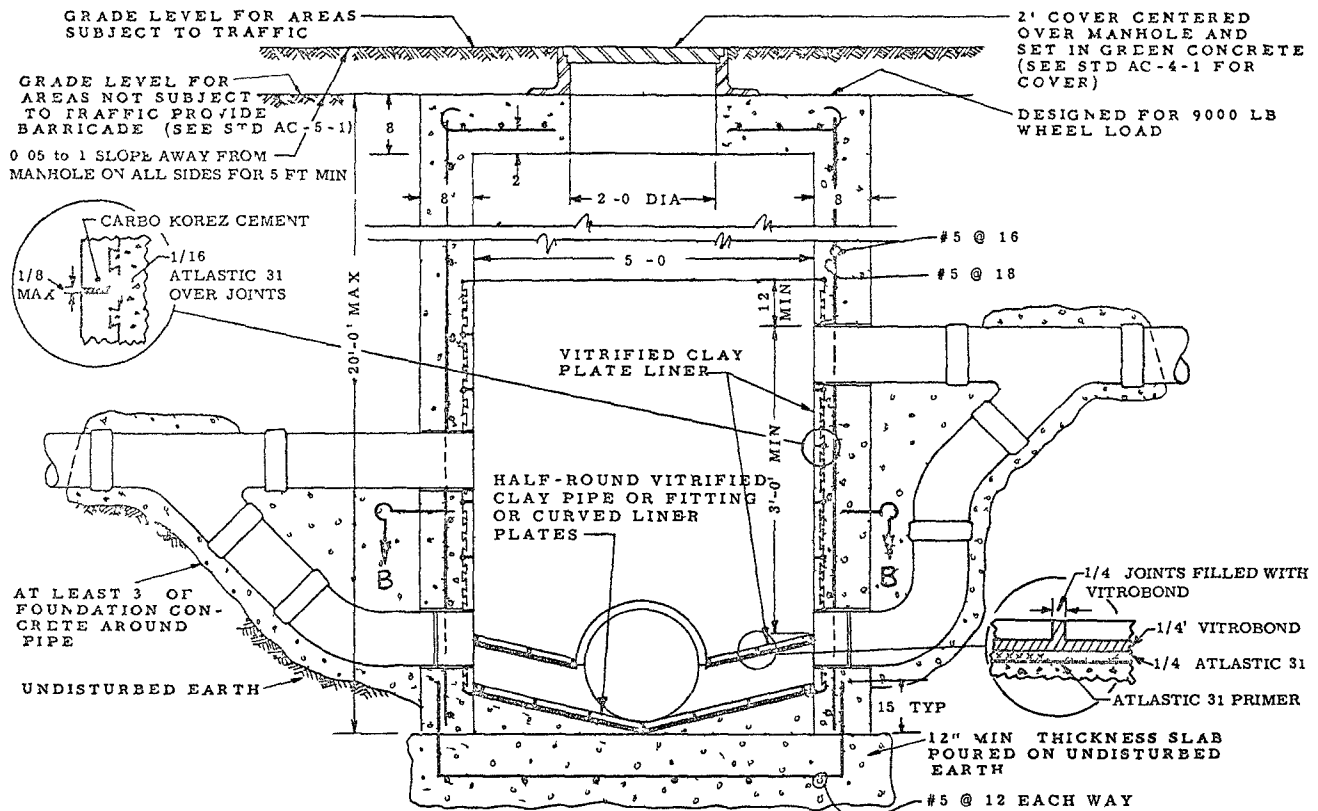
\* Temperature limit of Vitrobond is 200 F.

\*\*Temperature limit of Carbo-Korez is 370 F.

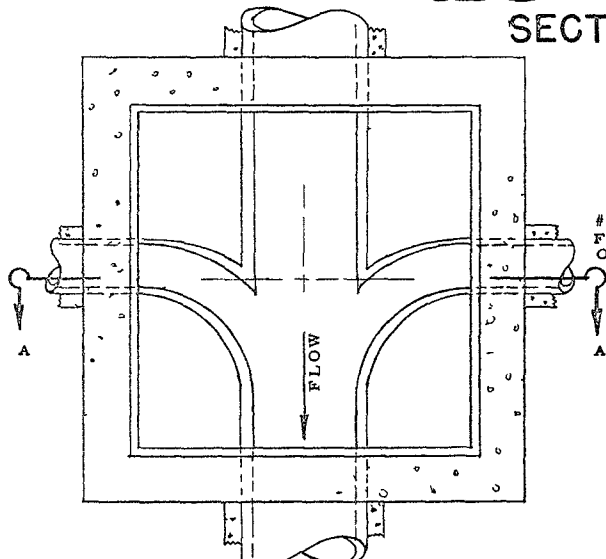
NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM BY	DES BY
					hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL				INSTRUCTIONS FOR USE OF AC-4-10 & AC-4-11	DI-AC-4-10 & 11	
H. E. Struck SECRETARY, DATE 1-25-60						



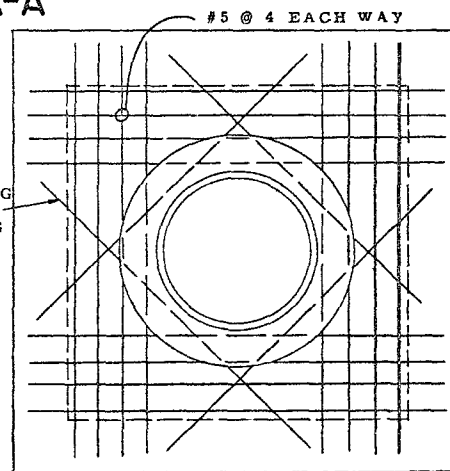
NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM. BY	DES. BY
						hes	gun chh
APPROVED BY ENGINEERING STANDARDS COUNCIL				ACID-PROOF MANHOLE		AC-4-10	
H. E. Struck SECRETARY. DATE 1-25-60							



SECTION A-A



PLAN AT B-B



PLAN

NOTES

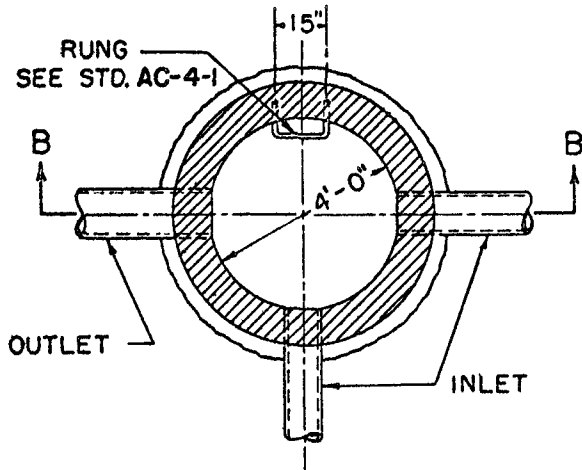
- 1 DROP IN FLOW LINE ACROSS MANHOLE SHALL BE 1-1/4' MINIMUM
- 2 NO MANHOLE RUNGS SHALL BE USED
- 3 MANHOLE MAY BE CIRCULAR IN CROSS SECTION 5'-0" MIN I D ALL OTHER DIMENSIONS AS SHOWN
- 4 CONCRETE SHALL DEVELOP 3000 PSI COMPRESSIVE STRENGTH AT 28 DAYS
- 5 CARBO-KOREZ CEMENT ATLASTIC 31 AND VITROBOND SHALL BE AS MANUFACTURED BY THE ATLAS MINERAL PRODUCTS CO, OR APPROVED EQUAL
- 6 LINER PLATES SHALL CONFORM TO THE SPECIFICATIONS FOR CLAY LINER PLATES OF THE CLAY PIPE INSTITUTE

NOTE TO DESIGNER SEE DI-AC-4-10 & 11 FOR INFORMATION ON CHEMICAL RESISTANCE OF THIS MANHOLE

SUPERSEDES STD B-4-7

Ref Hanford Stds AC-4-1 AC-5-1

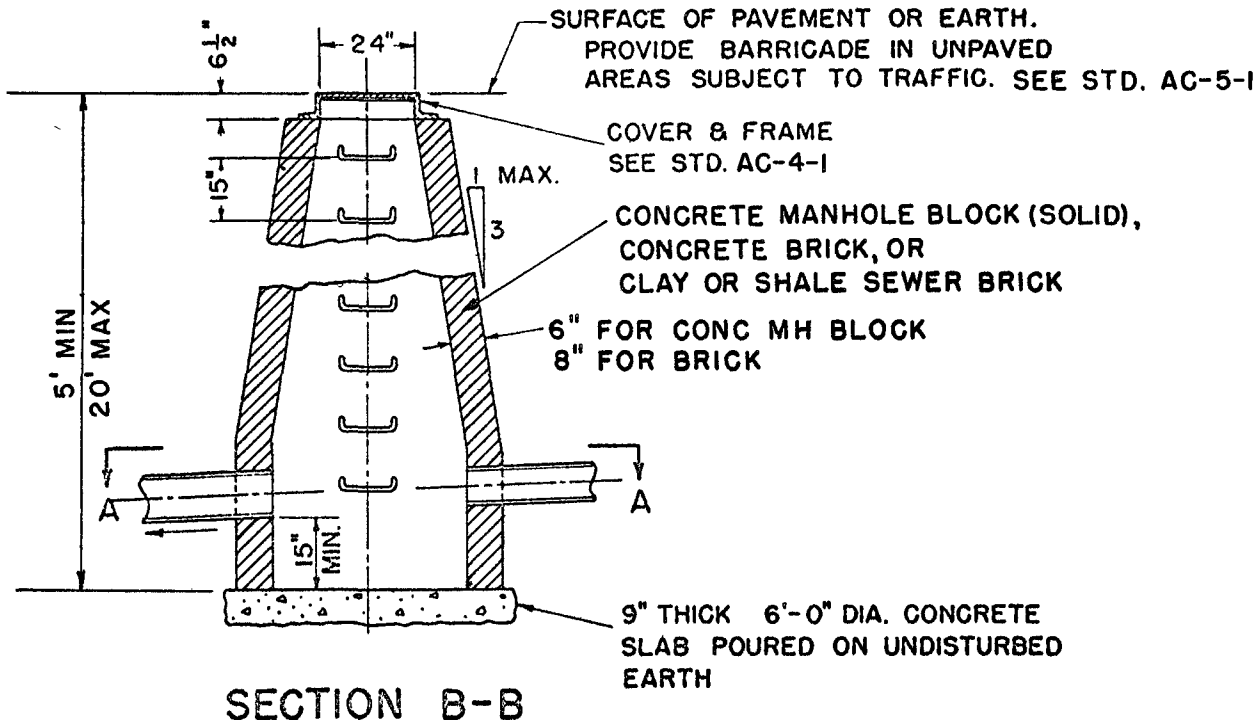
NO	REVISION	APP D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUB BY	DES BY
						hes	guu 8hh
APPROVED BY ENGINEERING STANDARDS COUNCIL				ACID-PROOF DROP MANHOLE		AC-4-11	
H.E. Struck SECRETARY DATE 1-25-60							



## NOTES

1. THE LOWEST RUNG TO BE GREATER THAN 15" AND LESS THAN 24" ABOVE THE SHELF.
2. THE UPPER RUNG TO BE NOT MORE THAN 16" BELOW THE BOTTOM OF THE COVER FRAME.
3. THE RUNGS SHALL PROJECT 6 1/2" INSIDE THE MANHOLE.
4. DROP IN FLOW LINE ACROSS BASIN SHALL BE 1 1/4", MINIMUM.
5. CONCRETE SHALL DEVELOP 2500 PSI MIN COMPRESSIVE STRENGTH AT 28 DAYS.

PLAN AT A-A

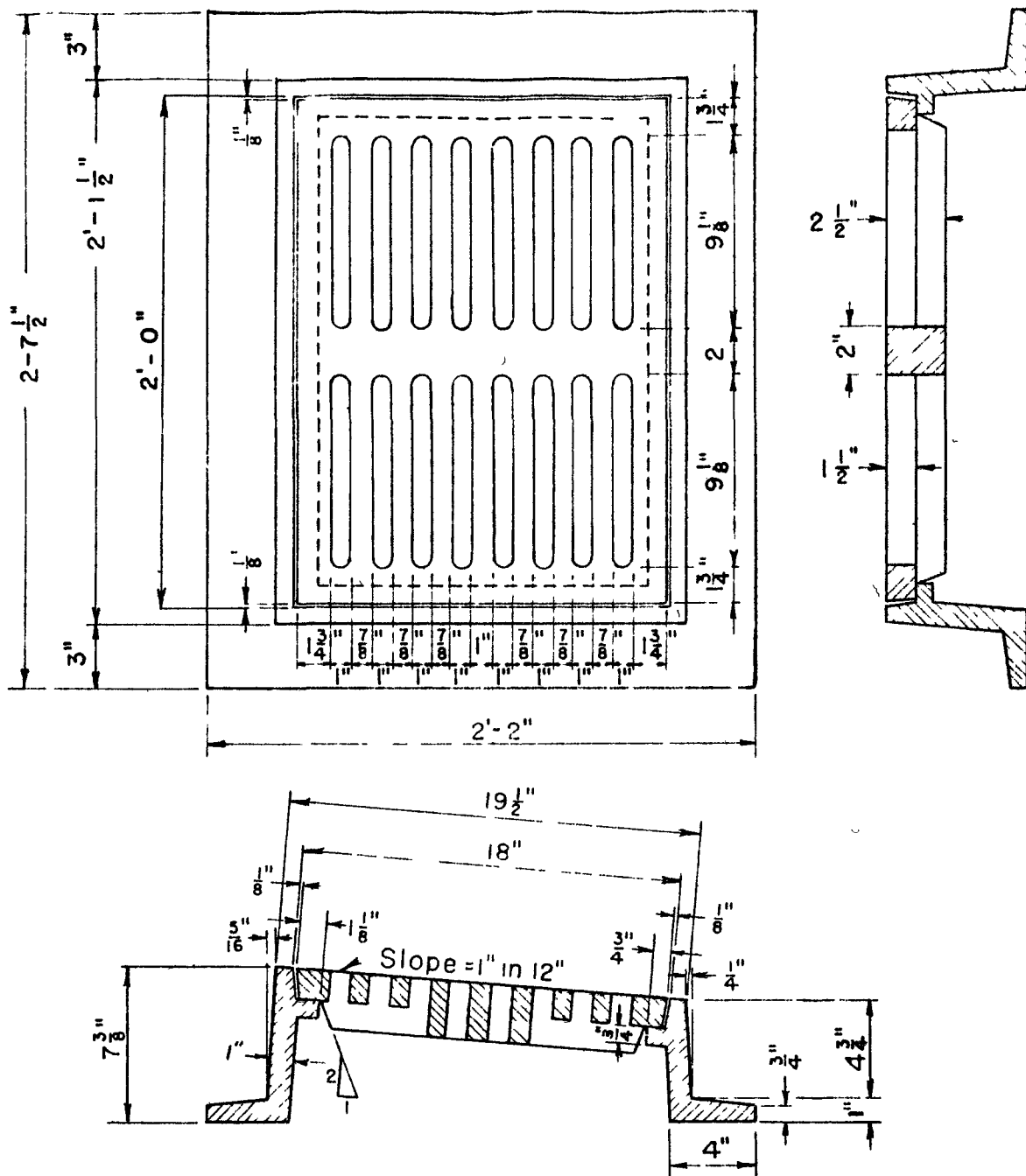


SECTION B-B

Supersedes Std. E-5-8

Ref. Hanford Stds: AC-4-1, AC-5-1

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 10-19-59				STORM SEWER CATCH BASIN	AC-4-20	



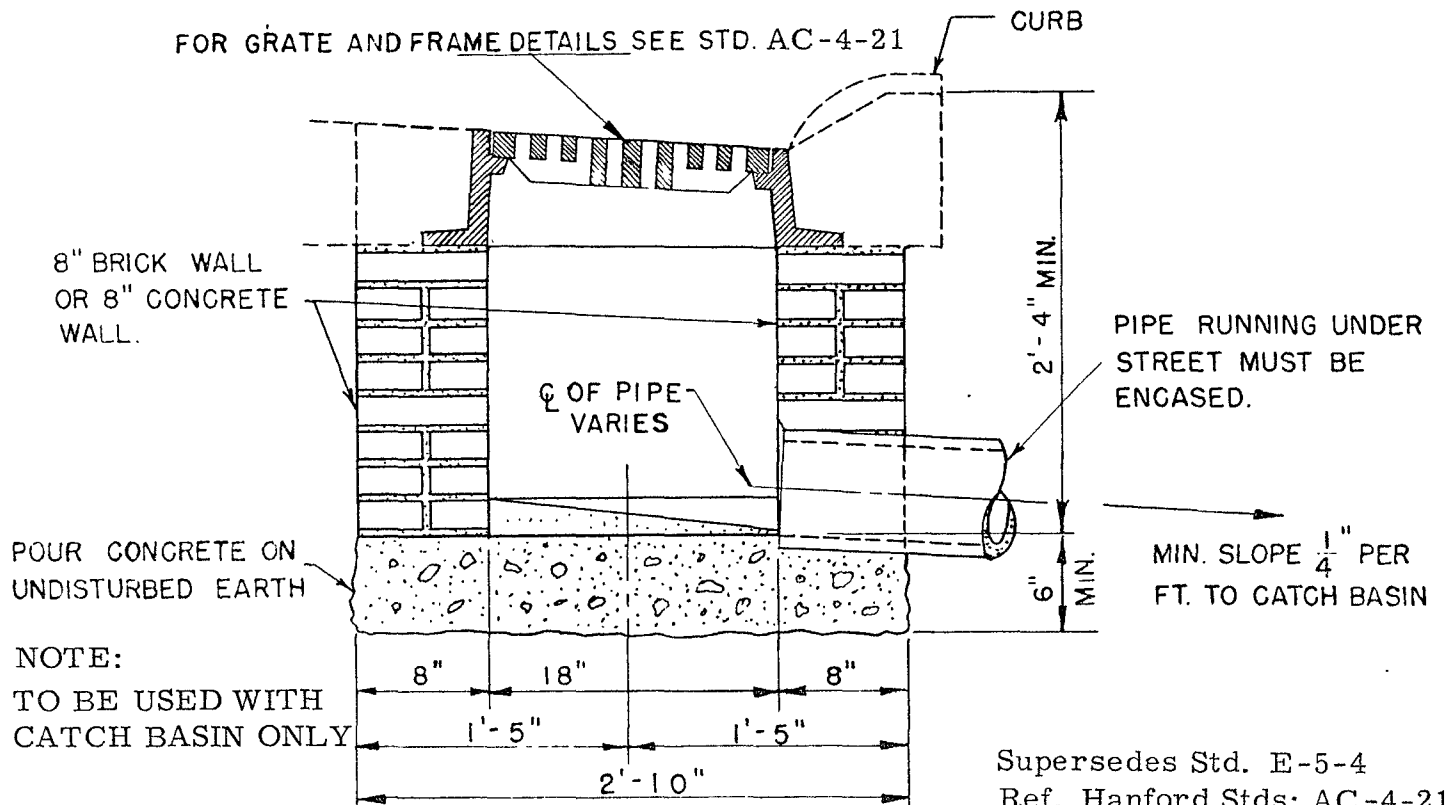
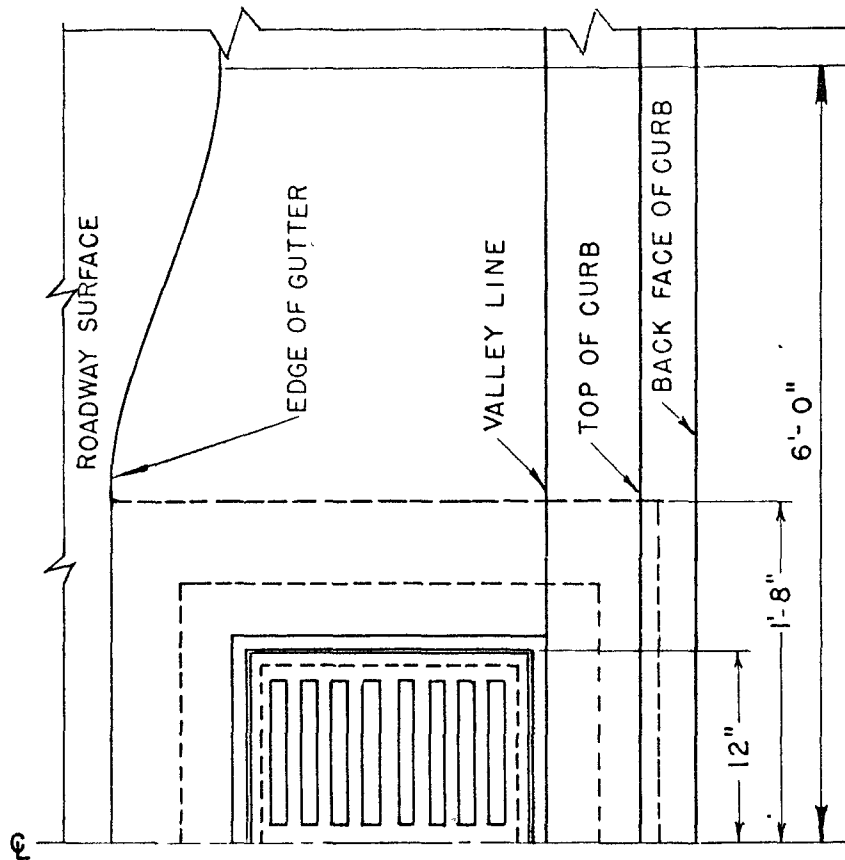
NOTES:

1. Workmanship shall conform to ASTM A48.
2. Cast iron shall conform to ASTM A48, Class 30.
3. Minimum weight of frame - 210 lbs.
4. Minimum weight of grate - 130 lbs.
5. Casting shall be boldly filleted at all angles.
6. Grating designed for Wash, State legal wheel load - 9000 lb.

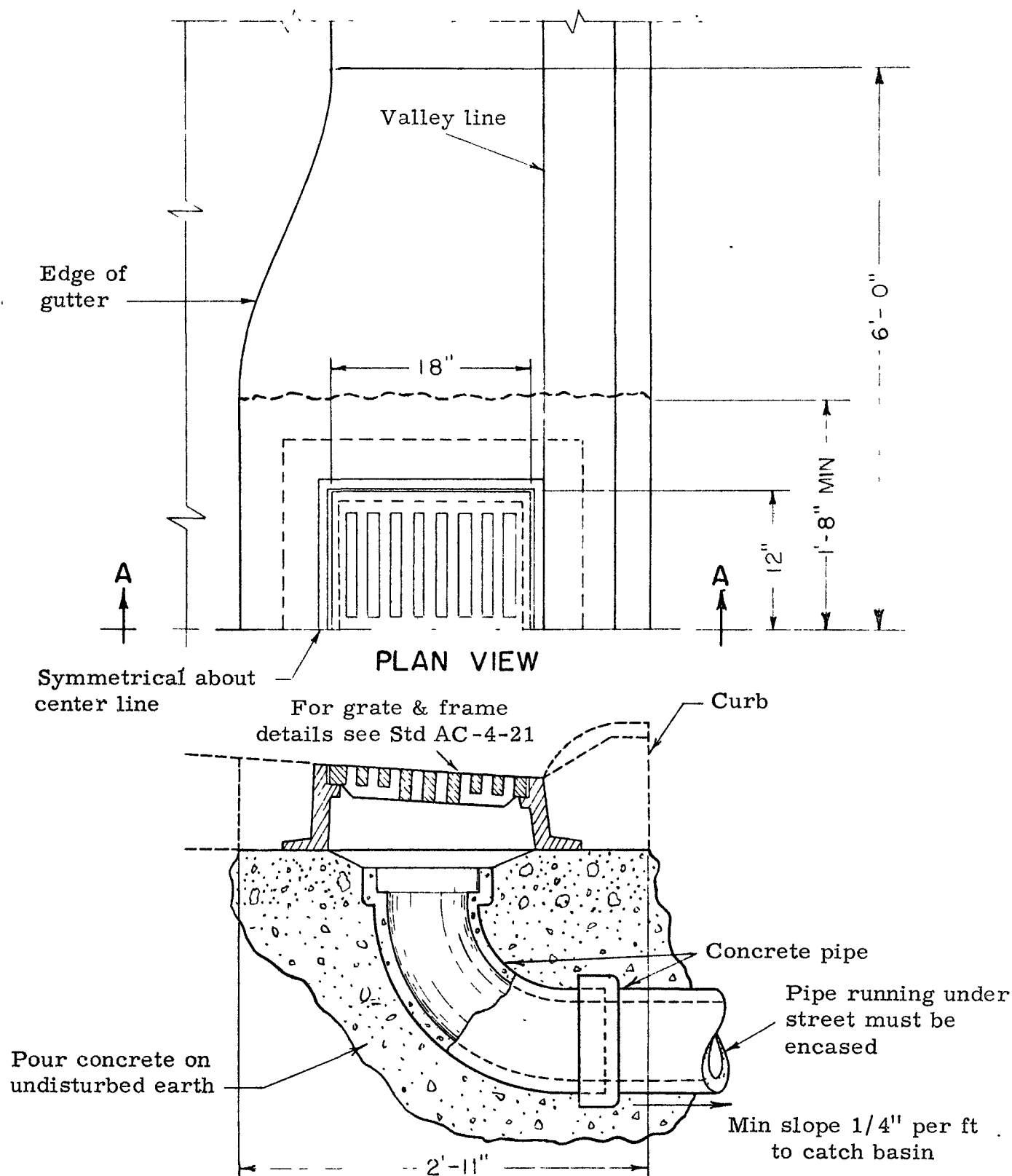
Supersedes Std E-5-4a

Ref Hanford Stds: None

NO	REVISION	APP D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM BY	DES. BY
1	Ref Std Nos.	hes	12-15-60	STORM DRAIN GRATE & FRAME		hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck, SECRETARY, DATE 2-1-60						AC-4-21	



NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM. BY	DES. BY
				STORM DRAIN INLET		hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL						AC-4-22	
H.E. Struck SECRETARY, DATE 2-1-60							



**NOTE:**

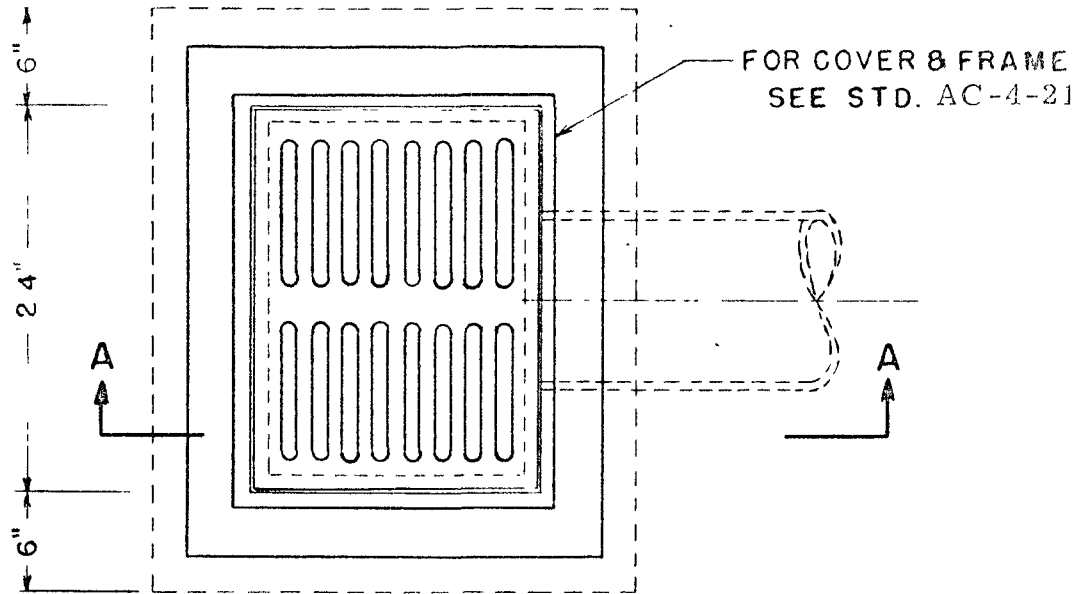
1. To be used with catch basin only

**SECTION A A**

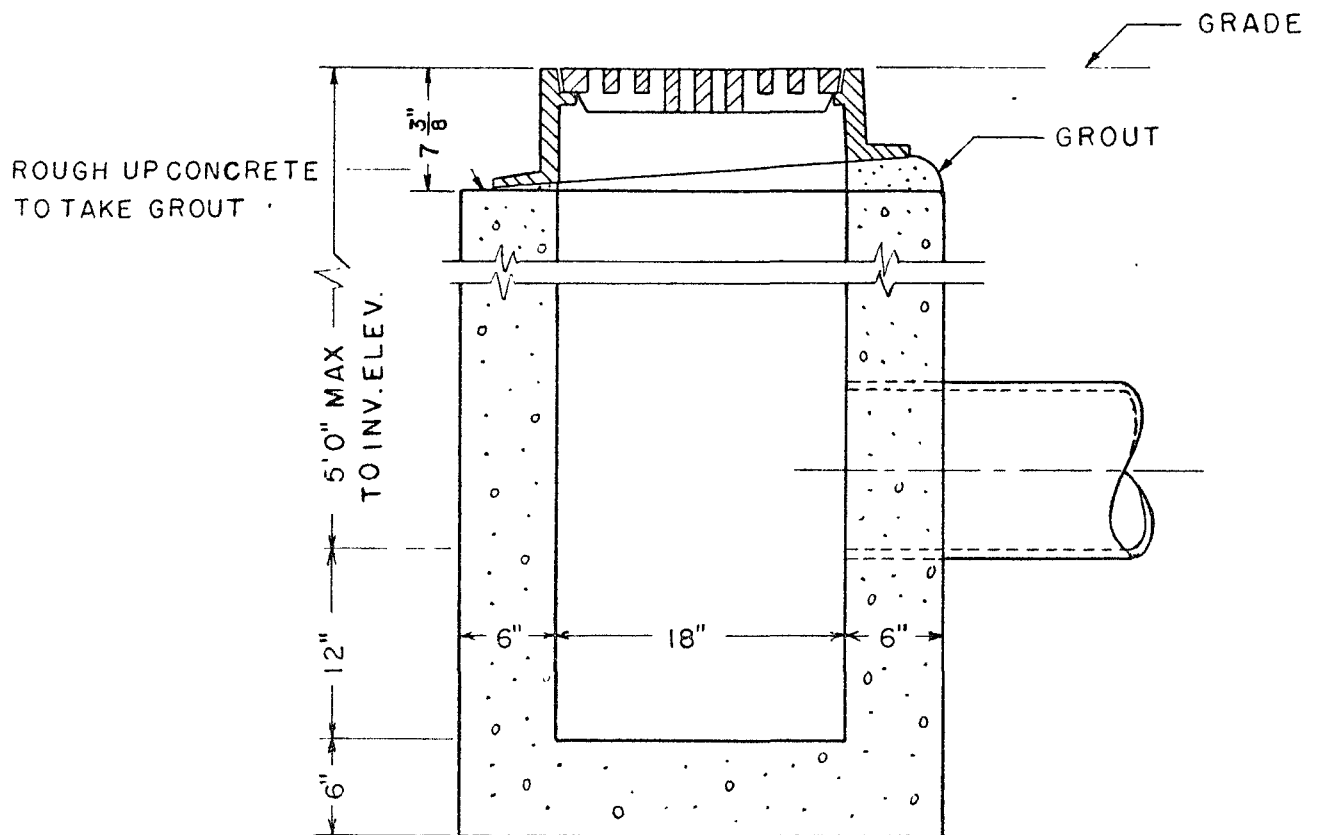
Supersedes Std E-5-5

Ref Hanford Stds: AC-4-21

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM. BY	DES. BY
						hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL				SHALLOW STORM DRAIN INLET		AC-4-23	
H. E. Struck SECRETARY, DATE 2-1-60							



## PLAN

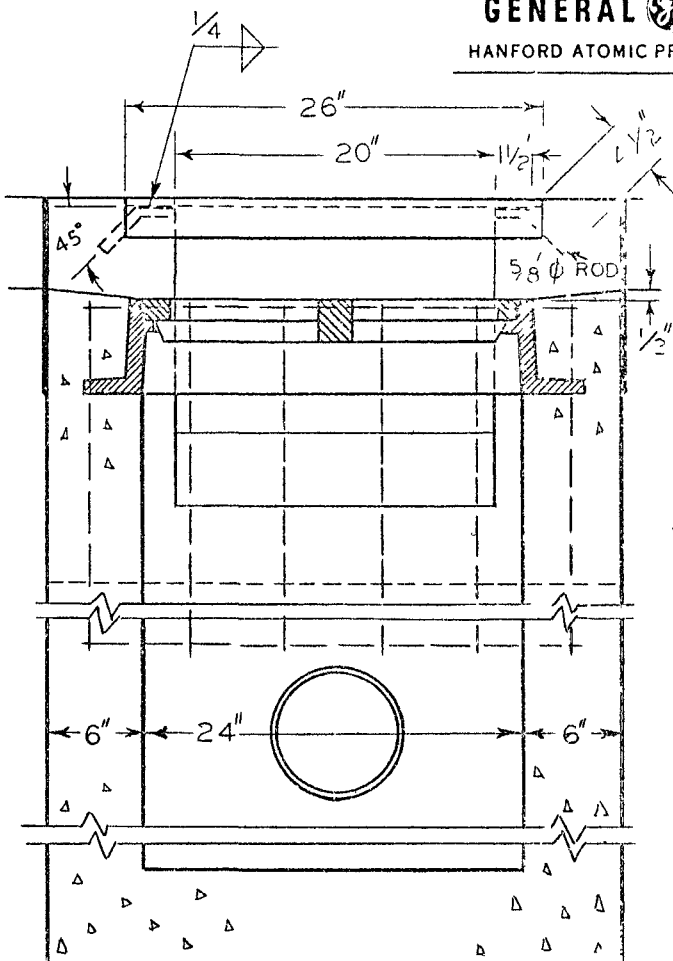


SECTION A-A

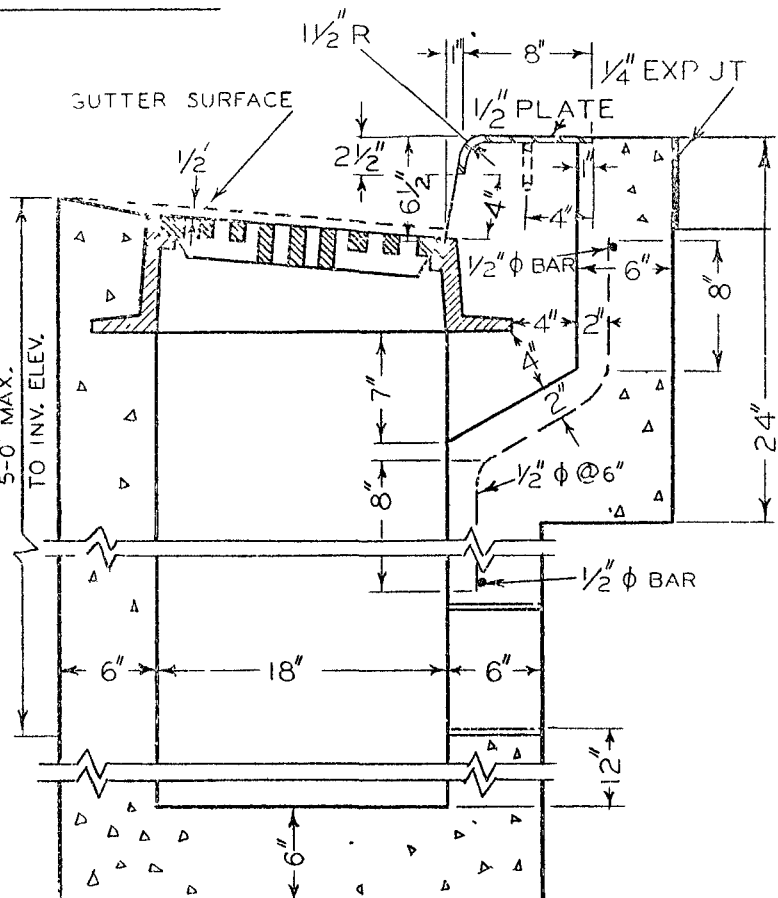
Supersedes Std. E-5-6

Ref. Hanford Stds. AC-4-21

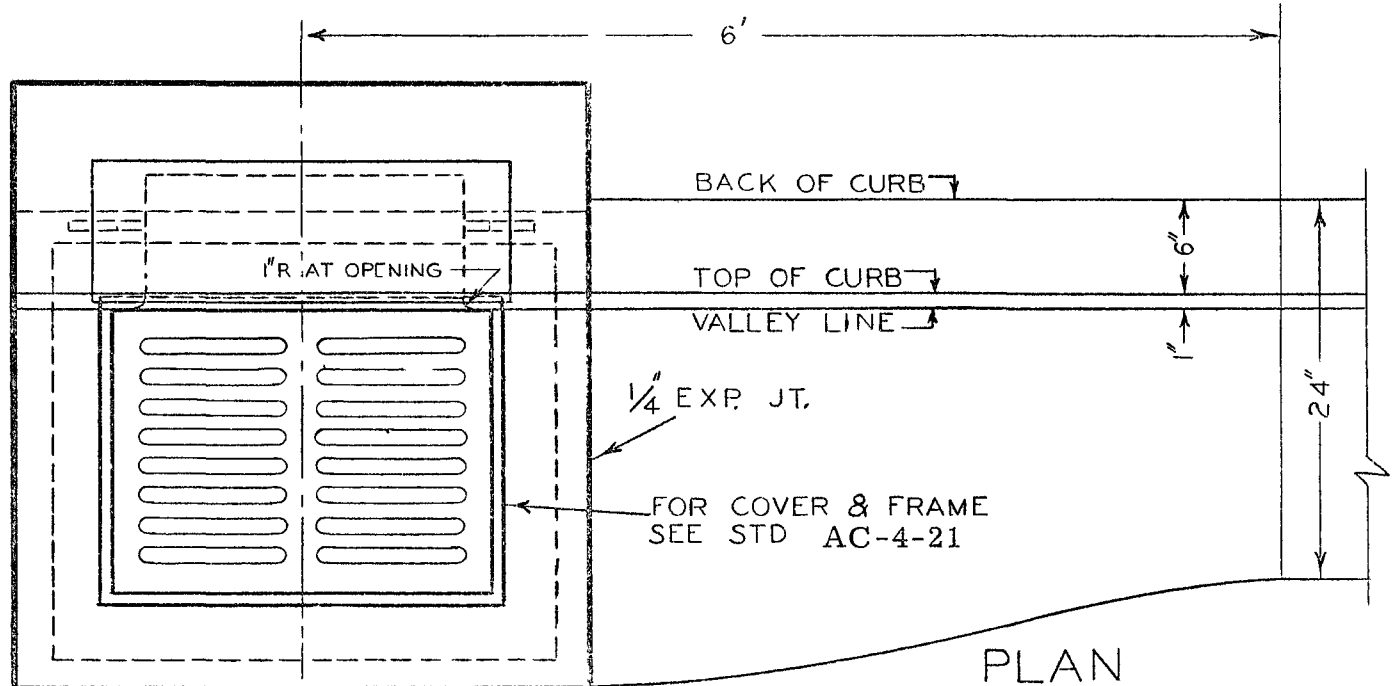
NO	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM BY	DES. BY
					hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 2-1-60				STORM DRAIN INLET CATCH TYPE	AC-4-24	



ELEVATION



SECTION

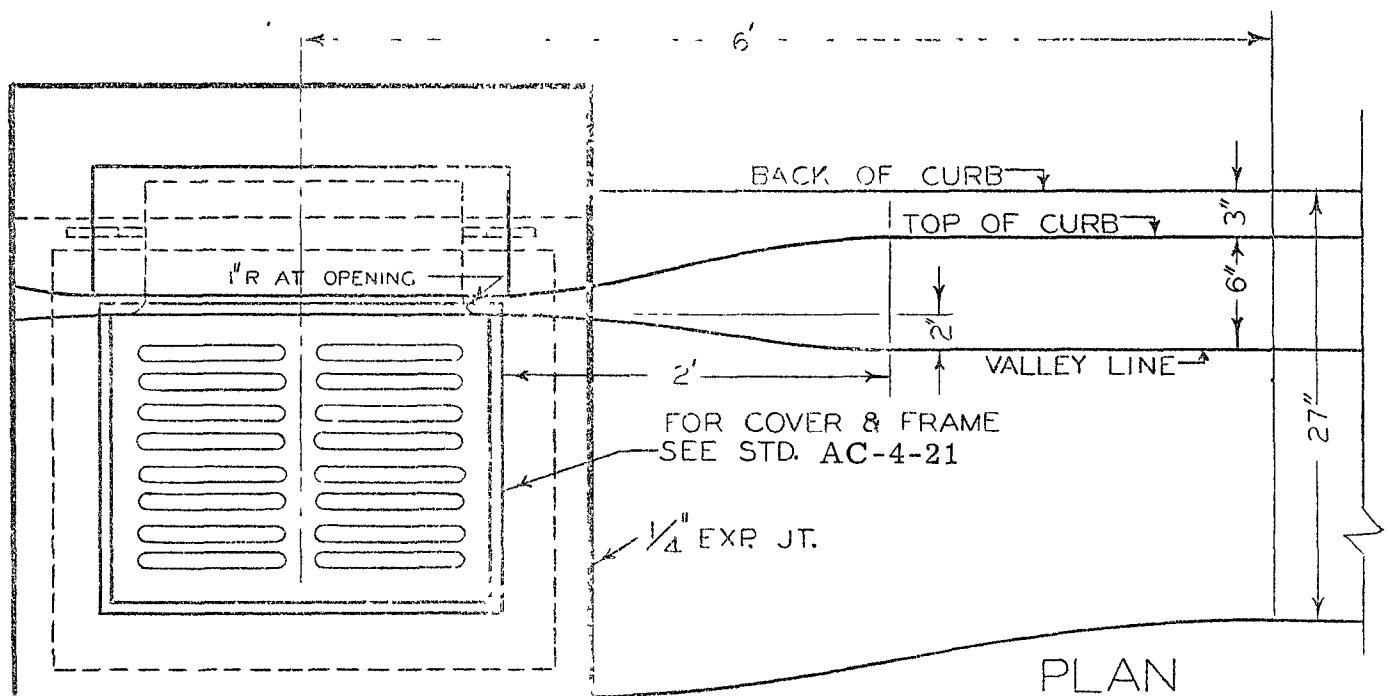


PLAN

Supersedes Std. E-5-6a

Ref. Hanford Stds: AC-4-21

NO	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM BY	DES BY
				STORM DRAIN, CATCH TYPE WITH CURB OPENING - 6" CURB		hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY DATE 2-1-60						AC-4-25	



Ref. Hanford Stds: AC-4-21

NO		REVISION		APP D		DATE		ARCHITECTURAL-CIVIL STANDARD				SUBM BY		DES BY	
												hes		chh	
APPROVED BY ENGINEERING STANDARDS COUNCIL								STORM DRAIN, CATCH TYPE WITH CURB OPENING - 4" CURB				AC-4-26			
<u>H. E. Struck</u> SECRETARY DATE <u>2-1-60</u>															

INSTRUCTIONS FOR USE OF  
STANDARD AC-4-30 'DRY WELL'

When the Design Engineer uses Standard AC-4-30 the following shall be observed:

1. A dry well shall be used only for disposal of minor amounts of waste liquids, e.g., steam condensate from small buildings. When the indicated capacity of the largest dry well is exceeded, a condensate return system, flash tank with sewer connection or other specially designed means of disposal must be provided.
2. The capacity of a dry well depends on several factors: infiltration rate at the dry well location, make up and temperature of waste liquids, ground water level, etc. Infiltration rates for Hanford soils vary widely over relatively short distances. For this reason it should not be assumed that a dry well will dispose of larger amounts of wastes than that indicated without actual test or specific knowledge of the infiltration rate at the location.

The approximate maximum capacity of the wells is as follows:

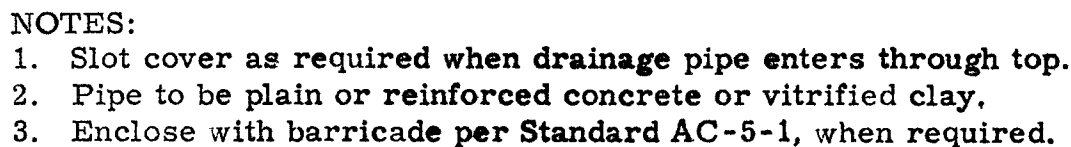
I.D. of pipe, inches	18	24	30	36	42	48
Capacity, gals./day	200	250	300	350	400	500

An infiltration rate of about 10 gallons per square foot per day was used to calculate these capacities. In areas of clay or other near-impervious soils where infiltration rates are known to be lower, the capacities of the dry wells should be reduced accordingly.

3. A dry well should not be located close to a foundation where excessive moisture might cause settlement, or at a low point or other locations where rain water, drainage, etc., could clog the well with excess water or fine soil.
4. The dry well shall not be used in areas of vehicular traffic. Where necessary to keep heavy traffic off, a barricade per Standard AC-5-1 should be specified in supplemental specifications, giving the required dimensions.
5. Proper use of this standard also requires the Design Engineer to specify in supplemental specifications, the size of the dry well pipe to be used, and the number of pipe sections required.

Supersedes DI-E-5-10

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL				INSTRUCTIONS FOR USE OF DRY WELL STANDARD, AC-4-30	DI-AC-4-30	
H. E. Struck SECRETARY, DATE 10-19-59						



Supersedes Stds B-4-45 & E-5-10				Ref. Hanford Stds: AC-5-1		
NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM BY	DES. BY
					hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL				DRY WELL	AC-4-30	
H. E. Struck SECRETARY, DATE 10-19-59						

INSTRUCTIONS FOR USE OF  
STANDARD AC-4-40 "SEPTIC TANKS"

When selecting septic tanks, the following should be kept in mind:

1. For ten people or less a manufactured steel or precast concrete tank, may be used.
2. Systems for more than 50 people are not covered in AC-4-40 and should be treated as individual design problems.
3. Provision must be made for proper disposal of the effluent by such means as seepage pits, leaching cesspools or tile field.
4. The septic tank capacities, based on 50 gallons per equivalent occupancy per 24 hours, are as follows:

<u>Tank No.</u>	<u>Equivalent Occupancy</u>	<u>Capacity in Gallons</u>	<u>Tank No.</u>	<u>Equivalent Occupancy</u>	<u>Capacity in Gallons</u>
1	10-14	720	5	31-35	1720
2	15-20	1000	6	36-40	1950
3	21-25	1250	7	41-45	2175
4	26-30	1480	8	46-50	2400

5. Code requirements and design information for individual sewage disposal systems can be found in the National Plumbing Code.

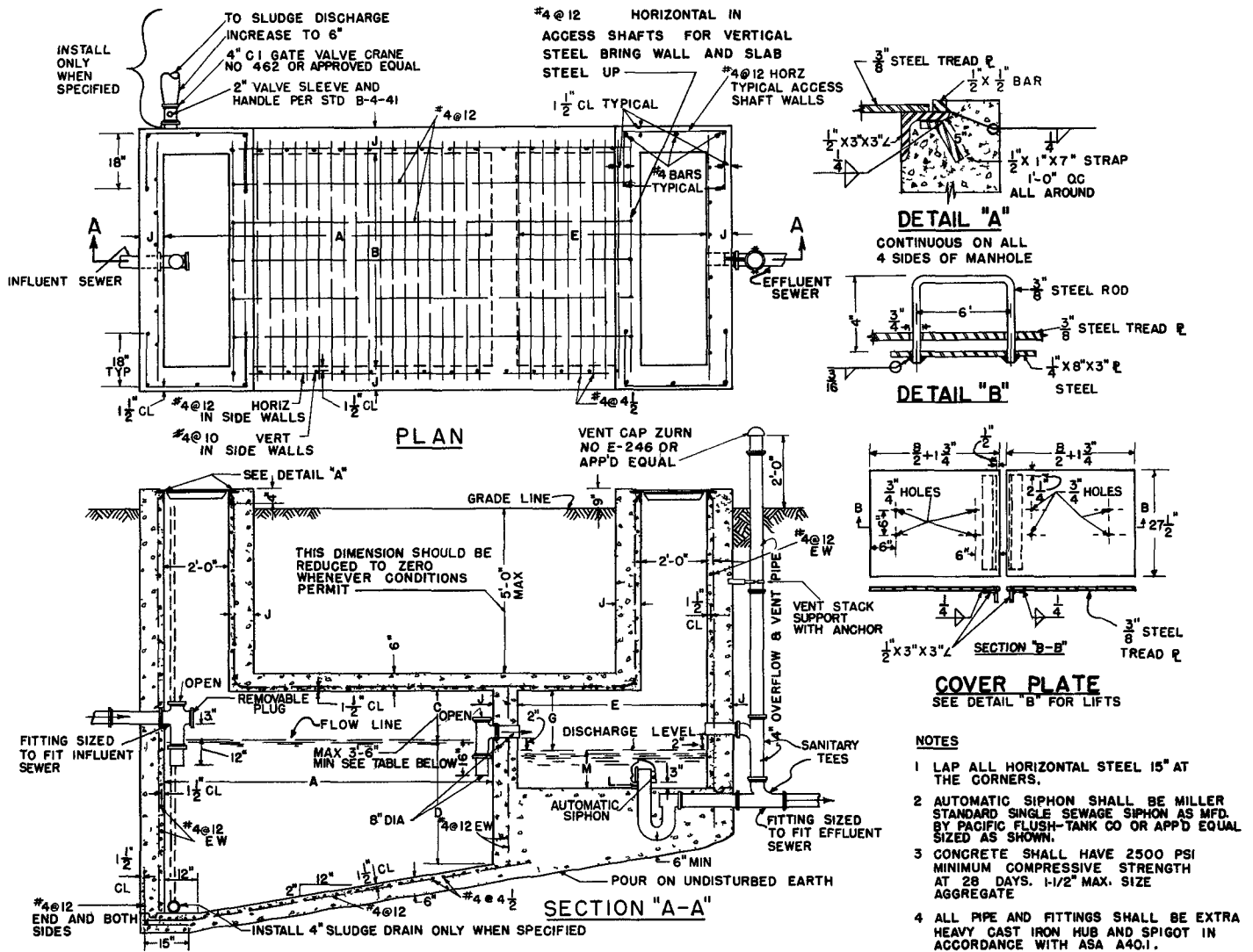
When Standard AC-4-40 is referenced, the user shall specify the additional requirements for the work involved. The following is a listing of some of the requirements which must be stated in accompanying specifications or plans.

1. Specify which size tank is to be built (by tank number).
2. When it is necessary to protect the septic tank from traffic, Standard AC-5-1 shall be used. Barricade shall be installed at least two feet outside of tank.
3. State that reinforcing bars shall conform to ASTM A-15\*, "Specifications for Billet-Steel Bars for Concrete Reinforcement" deformed bars, intermediate grade.
4. When special conditions require a sludge drain, specify that the sludge drain shown be installed.

\* Show date of latest revision.

Supersedes DI-E-5-11

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM. BY	DES. BY
2	Upper Note 1	hes	12-1-59			hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL				INSTRUCTIONS FOR USE OF		DI-AC-4-40	
H. E. Struck SECRETARY, DATE 10-19-59				AC-4-40, "SEPTIC TANKS"			



SEPTIC AND SIPHON TANKS									
TANK NO	SEPTIC TANK				SIPHON TANK			SIPHON	
	LENGTH A	WIDTH B	AIR SPACE C (MIN)	LIQ DEPTH D	LENGTH E	WIDTH F	DEPTH G	SIZE L	DWG DEPTH M
1	7'-0"	3'-6"	1'-3"	4'-0"	3'-6"	3'-6"	C+2"	3" ID	1'-4"
2	8'-0"	4'-0"	1'-3"	4'-0"	4'-0"	4'-0"	C+2"	4" ID	1'-8"
3	9'-0"	4'-6"	1'-3"	4'-3"	4'-6"	4'-6"	C+2"	4" ID	1'-8"
4	9'-6"	4'-8"	1'-3"	4'-6"	4'-8"	4'-8"	C+2"	4" ID	1'-8"
5	10'-0"	5'-0"	1'-3"	4'-8"	5'-0"	5'-0"	C+2"	4" ID	1'-8"
6	10'-6"	5'-3"	1'-3"	4'-9"	5'-3"	5'-3"	C+2"	4" ID	1'-8"
7	11'-0"	5'-6"	1'-3"	4'-10"	5'-6"	5'-6"	C+2"	5" ID	2'-2"
8	11'-6"	5'-9"	1'-3"	5'-0"	5'-9"	5'-9"	C+2"	5" ID	2'-2"

NOTE HEAVY EQUIPMENT SHALL NOT BE ALLOWED TO CROSS OVER THE TOP OF THIS STRUCTURE AT ANY TIME

Supersedes Std E-5-11

Ref. Hanford Stds: B-4-41

NO	REVISION	APP D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM BY	DES BY
						hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL				SEPTIC AND SIPHON TANKS		AC-4-40	
H. E. Struck SECRETARY DATE 10-19-59							

INSTRUCTIONS TO DESIGN ENGINEERS FOR USE OF  
PIPE CRADLE AND ENCASEMENT STANDARDS  
AC-4-50, AC-4-51 AND AC-4-52

The following instructions outline general requirements for the use of encasements and instructions to the design engineer for use of the cradle and encasement standards AC-4-50, AC-4-51 and AC-4-52.

1. TYPES OF LINES REQUIRING STANDARD ENCASEMENTS TYPE A OR B

- a. All export, primary raw, and process water lines passing under roads and railroads shall have standard encasement.

EXCEPTIONS: (1) when cast iron pipe is used, the line shall not be encased unless encasement is required under item 1b. (See items 2c and 2f for special encasement requirements.) (2) in cases of water lines passing under lightly-traveled roads the necessity for encasement shall be investigated and determined by the design engineer.

- b. Conduits under railroads which transport steam, water, or any non-flammable substance, which by its nature or pressure might cause damage if escaping under or in the vicinity of the track, shall have standard encasement.

2. TYPES OF LINES REQUIRING SPECIAL ENCASEMENT DESIGN CONSIDERATION

The following types of lines require special encasement design consideration in all locations, including those under roads and railroads.

- a. Electrical conduits. (See Electrical Design Criteria)
- b. Radioactive material conduits carrying process products. (This does not include regular process sewers.)
- c. Any line where the minimum coverage is less than 2' - 6".
- d. Conduits installed under railroads to carry oil, gas, gasoline, or other flammable or highly volatile substance under pressure.
- e. Conduits carrying hazardous chemicals.
- f. Cast iron filtered process water lines supplying all 190 Buildings.

3. TYPES OF LINES NOT REQUIRING ENCASEMENTS

Lines in the following types of service shall not be encased when passing under roads or railroads except when minimum coverage is less than 2' - 6" or as specifically noted below.

Supersedes Std E-5-12 & DI-E-5-12a, 13 & 14

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
1	Page 3	hes	5-1-60		hes	fhs chh
APPROVED BY ENGINEERING STANDARDS COUNCIL				INSTRUCTIONS FOR USE OF STANDARDS AC-4-50, 51 & 52	DI-AC-4-50, 51 & 52	
H. E. Struck SECRETARY. DATE 3-7-60						

- a. Sanitary and storm sewers. (No exceptions - see item 4a.)
- b. Process sewers, except when pressurized. (See item 4a.)
- c. Fire and sanitary water (except where required under item 1b.)
- d. Air lines. (No exceptions.)
- e. Chemical feed lines, unless classified hazardous. (See item 4b.)
- f. Cast iron pipe, except when required under item 1b. The proper wall thickness shall be determined by the use of ASA A-21.1 - 1957 "Manual for the Computation of Strength and Thickness of Cast Iron Pipe." Cast iron pipe of adequate strength shall be specified.

4. REQUIREMENTS FOR LINES NOT ENCASED

- a. All concrete and clay pipe process sewers over 8" shall be bedded in a concrete cradle where they pass under roads and railroads. The cradle shall conform to Standard AC-4-50.
- b. All direct buried steel lines under 8" nominal diameter, except drainage culverts, shall be not less than Schedule 40 pipe where they pass under roads and railroads.

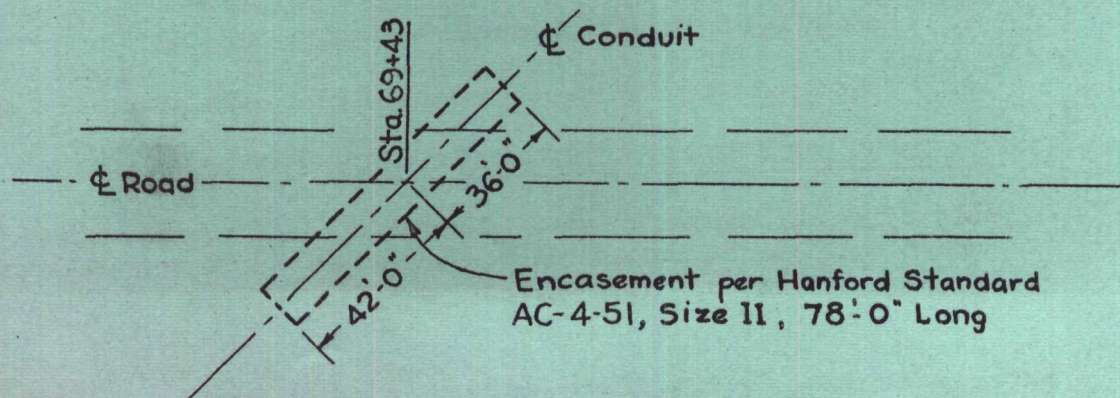
5. TYPES OF STANDARD ENCASEMENT TO USE

- a. Type A encasement, shown on Standard AC-4-51, shall be used to encase cast iron, concrete and clay pipes and steel pipe which uses flanged or Dresser type couplings where the couplings come within the length to be encased.
- b. Type B encasement shown on Standard AC-4-52, shall be used to encase steel pipe using (1) welded or screwed joints or (2) flanged or Dresser type couplings where the couplings do not come within the length to be encased.

6. TYPE A ENCASEMENT (STANDARD AC-4-51)

- a. The design engineer shall specify the size, (Size I, II or III) and length of the encasement to be used.

The following is an example of how this should be shown on a drawing:



- b. The size of encasement required may be selected from Table I following:

TABLE I

SIZE OF TYPE A ENCASEMENT FOR DIFFERENT PIPE SIZES

Steel	Concrete	Clay	C.I.	Size Required
8" - 24"	8" - 18"	8" - 18"	8" - 20"	I
25" - 36"	19" - 30"	19" - 30"	24" - 30"	II
36" - 56"	31" - 48"	31" - 48"	36" - 48"	III

- c. The design loads for Type A encasement are: Railroad, Cooper E-50; Highway, H-20; 3000 psi concrete; extreme fiber stress in steel, 20,000 psi.
- d. Where Type A encasement would normally be used but depth of burial is less than 2' - 6" or more than 20', a special design shall be prepared.
7. TYPE B ENCASEMENT (STANDARD AC-4-52)
- a. The design engineer shall specify size, gage and length of encasement pipe to be used. The gage for any certain size shall be selected from Table II following. The encasement pipe data should be shown on drawings similar to the example shown under Item 6 of these instructions for Type A encasement.
- b. The size of encasement pipe selected shall be sufficient to allow an installed minimum clearance of 2 inches at the top between the I.D. of the encasement pipe and O.D. of the protected pipe, joints or couplings. This clearance can be obtained with encasement pipes which are approximately 2 inches larger (I.D.) than the largest outside diameter of the protected pipe, joints or couplings and which are installed without distortion. The larger sizes (below the heavy line\* in Table II) must be strutted to prevent distortion. When conditions are such that strutting is impractical, the design engineer shall investigate each case to determine if an oversize encasement pipe should be specified.

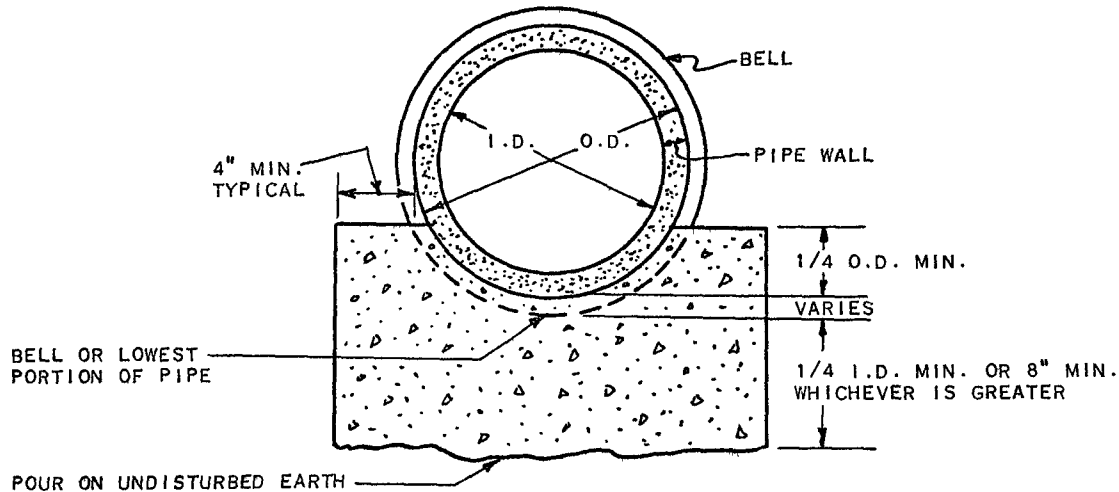
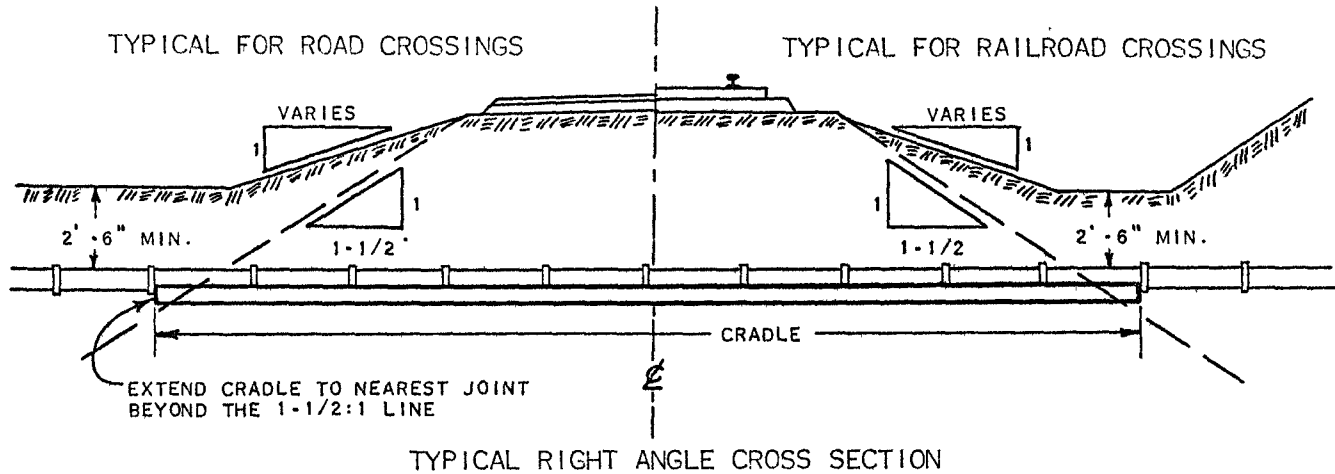
- c. Where Type B encasement would normally be used, but depth of burial is less than 3' - 11" or more than 30', a special design for encasement shall be prepared.

TABLE II

GAUGE OF CORRUGATED ENCASEMENT PIPE FOR DIFFERENT FILL DEPTHS

Nominal Encasement Pipe Size	FILL DEPTH		
	Up to 20'	21' - 25'	26' - 30'
Up to 21"	16 GA.	16 GA.	16 GA.
24" - 30"	14 GA.	14 GA.	14 GA.
32" - 36"	12 GA.	12 GA.	12 GA.
42"	12 GA.	12 GA.	10 GA.
48"	12 GA.	10 GA.	8 GA.
54"	10 GA.	8 GA.	8 GA.
60" - 72"	8 GA.	8 GA.	8 GA.

\* See  
note 7b



SECTION OF CONCRETE CRADLE

NOTES:

1. CONCRETE FOR CRADLE SHALL HAVE MINIMUM COMPRESSIVE STRENGTH OF 2000 POUNDS PER SQUARE INCH AT 28 DAYS. MAXIMUM SIZE AGGREGATE: 1-1/2 INCHES.
2. OVEREXCAVATED AREAS UNDER PIPES SHALL BE FILLED WITH CONCRETE IDENTICAL TO THAT USED IN CRADLE.
3. PRIOR TO AND DURING THE POURING OF THE CRADLE, SUPPORTS CONSISTING OF CONCRETE OR BRICK WEDGES OR BLOCKS SHALL BE USED TO SUPPORT THE PIPE IN PLACE. SUPPORTS SHALL BE AS SMALL AS POSSIBLE TO GIVE ADEQUATE SUPPORT AND SHALL BE PLACED UNDER THE BARREL OF THE PIPE, ONE NEAR EACH END OF EACH LENGTH. CRADLE SHALL BE MADE IN ONE CONTINUOUS POUR.

Supersedes Std E-5-12a

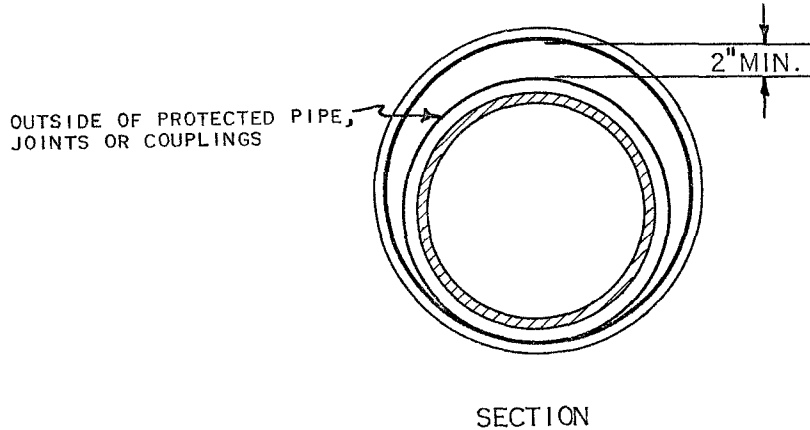
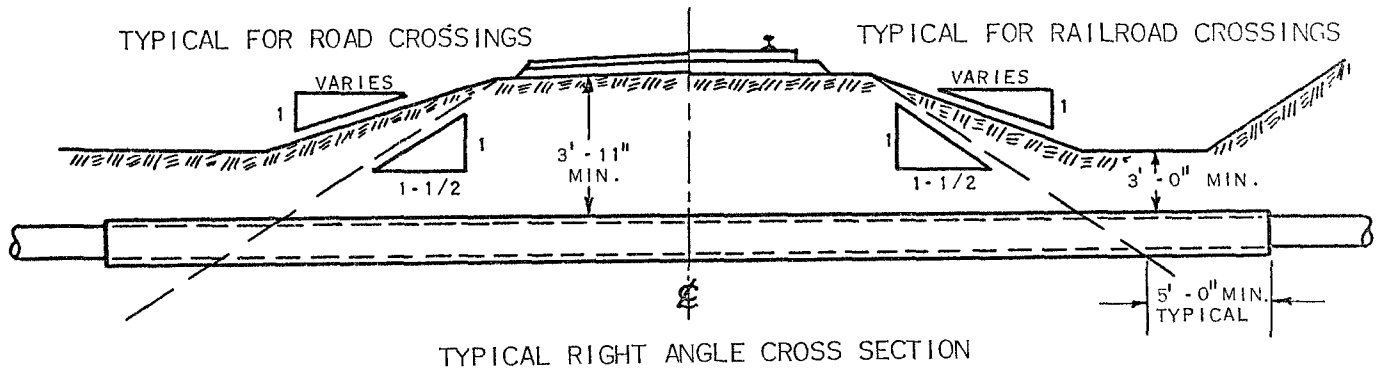
Ref Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL				PIPE PROTECTION CONCRETE CRADLE BEDDING	AC-4-50	
H. E. Struck SECRETARY, DATE 3-7-60						

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	
APPROVED BY ENGINEERING STANDARDS COUNCIL				PIPE PROTECTION TYPE A ENCASEMENT	AC-4-51	
<u>H. E. Struck</u> SECRETARY, DATE <u>3-7-60</u>						

ENCASEMENT FOR UNDERGROUND CONDUITS CROSSING  
ROADS AND RAILROADS

TYPE B ENCASEMENT



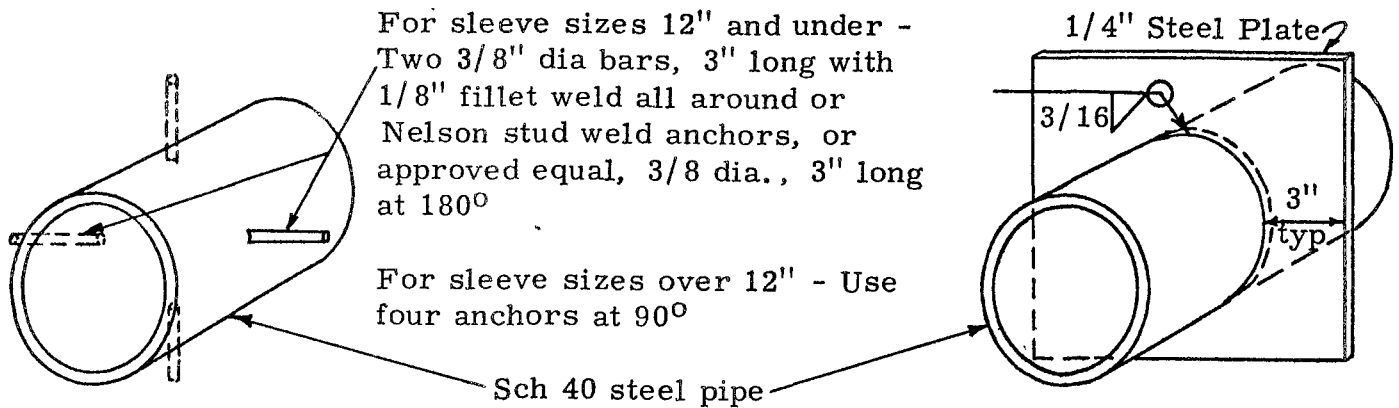
NOTES:

1. ENCASEMENT PIPE SHALL BE GALVANIZED, CORRUGATED METAL PIPE CONFORMING TO FEDERAL SPECIFICATION QQ-C-806a, TYPE I, CLASS 2 CORRUGATIONS. SIZE, GAGE AND LENGTH SHALL BE AS REQUIRED IN SPECIFICATIONS OR AS SHOWN ON DRAWINGS. CONNECTIONS SHALL BE BANDED AND NOT WELDED.

Supersedes Std E-5-14

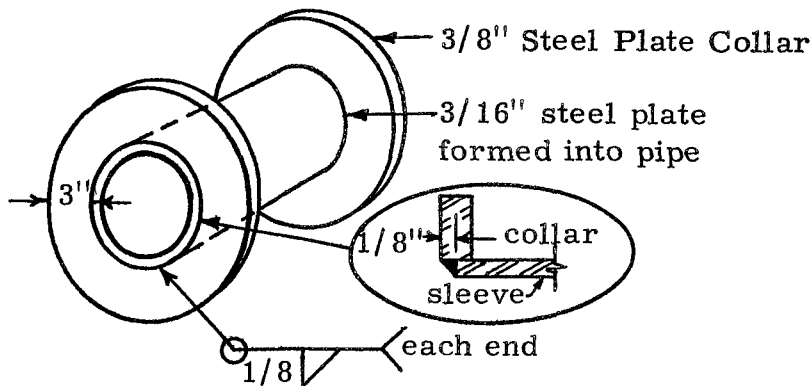
Ref Hanford Stds: None

NO.	REVISION	APP D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM BY	DES. BY
						hes	
APPROVED BY ENGINEERING STANDARDS COUNCIL				PIPE PROTECTION		AC-4-52	
H. E. Struck SECRETARY, DATE 3-7-60				TYPE B ENCASEMENT			

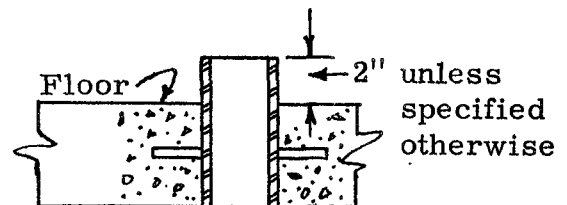


TYPE I - STANDARD PIPE SLEEVE

TYPE II - PIPE SLEEVE WITH SEAL RING



TYPE III - SPECIAL SIZE PIPE  
SLEEVE, FLANGED



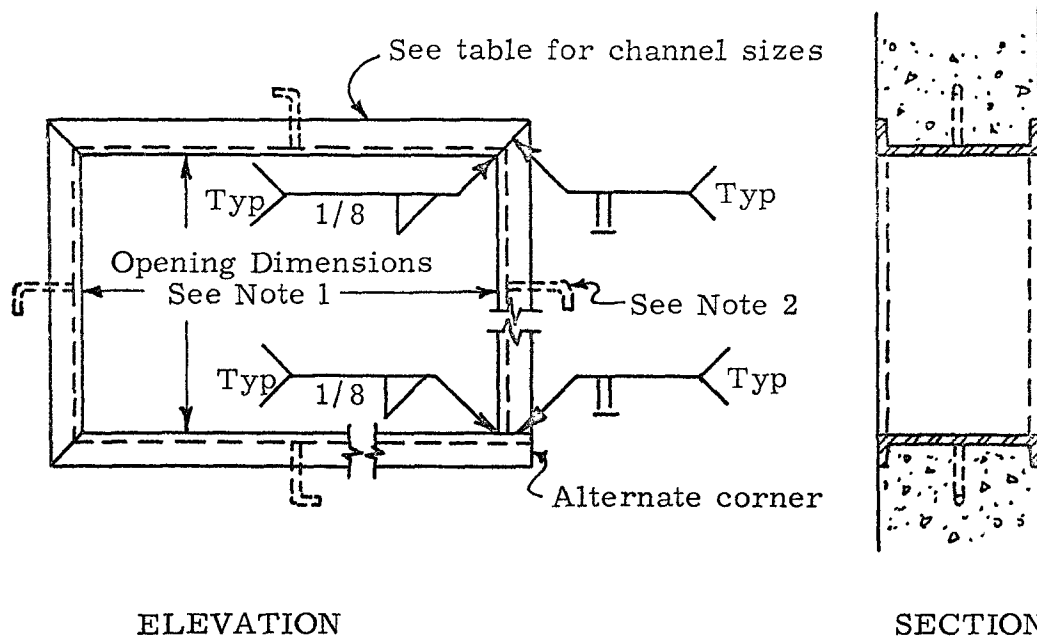
TYPICAL FLOOR PENETRATION

NOTES:

1. Diameter of sleeves shall be as specified in accompanying drawings or specifications.
2. Length of Type I and II sleeve shall be equal to wall thickness. Length of pipe for Type III sleeves shall be 1/4" less than wall thickness.
3. Standard pipe for sleeves shall conform to ASTM A120.
4. Ends of sleeves and outside of collars shall be cast flush with walls unless otherwise specified.

Ref Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM. BY	DES. BY
						hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL				PENETRATION SLEEVES, CONCRETE WALLS AND FLOORS		AC-4-60	
H. E. Struck SECRETARY, DATE 9-1-61							



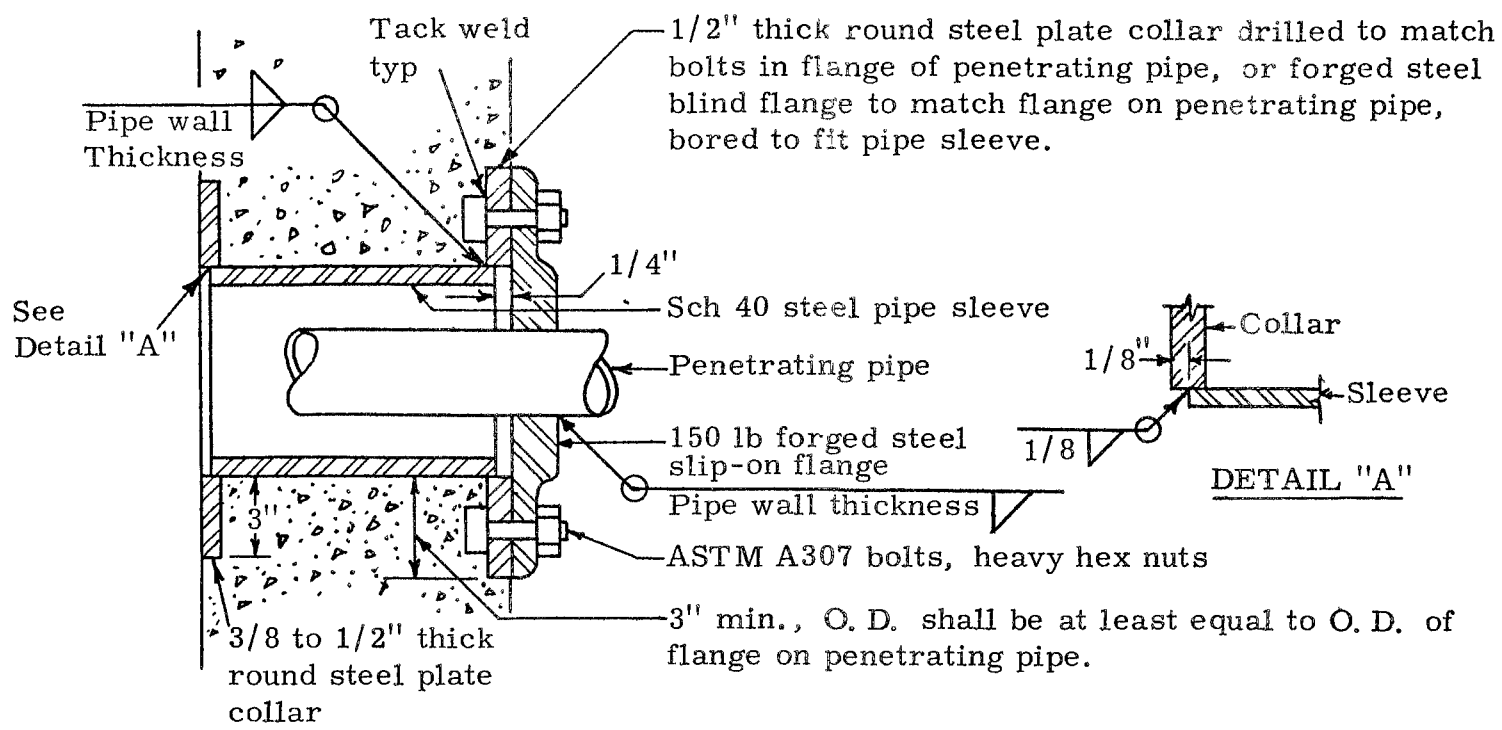
Concrete Thickness	Channel Size
4"	4 L 5.4
6"	6 L 8.2
8"	8 L 11.5
10"	10 Jr L 8.4
12"	12 Jr L 10.6
Over 12"	As Specified

NOTES:

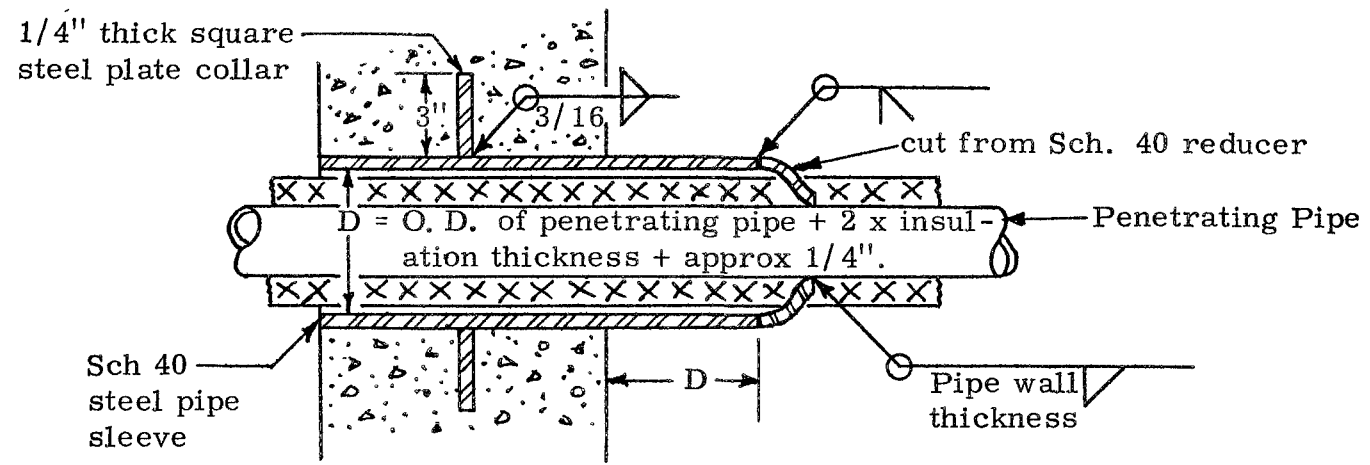
- Opening dimensions, width and height, shall be as specified on accompanying drawings. Dimension tolerance for width or height of opening is  $\pm 1/8"$  for each dimension; tolerance to maintain each corner angle is  $\pm 1/8"$  from plumb.
- Use four anchors as shown where width of opening is less than 36", height is less than 36". Where either dimension is 36" or more, place anchors on 18" centers max. Use Nelson Nelweld Stud Anchors 3/8 x 4C4L or approved equal.
- Unless specified otherwise, material shall be mild steel conforming to ASTM A7.
- Remove burrs and weld spatter.
- Prime paint all channel surfaces which will not be in contact with concrete. Primer and finish paint shall be as specified on accompanying drawings or specifications.

Ref Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD CHANNEL FRAME FOR CONCRETE WALL OR FLOOR PENETRATION	SUBM. BY	DES. BY
2	Note -1	hes	12-20-62		hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL H.E. Struck SECRETARY, DATE 9-1-61				AC-4-61		



TYPE I ANCHOR SLEEVE



TYPE II ANCHOR SLEEVE  
(For high temperature lines)

**NOTES:**

1. Diameter of Type I sleeves shall be as specified in accompanying drawings or specifications.
2. Ends of pipe sleeves and outside of collars shall be cast flush unless specified otherwise.
3. Pipe for sleeves shall conform to ASTM A120.
4. Remove burrs and weld spatter.

Ref Hanford Stds: None

NO.	REVISION	APP D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL				ANCHOR SLEEVES FOR PENETRATIONS, CONCRETE WALLS AND FLOORS	AC-4-62	
H.E. Struck SECRETARY, DATE 9-1-61						

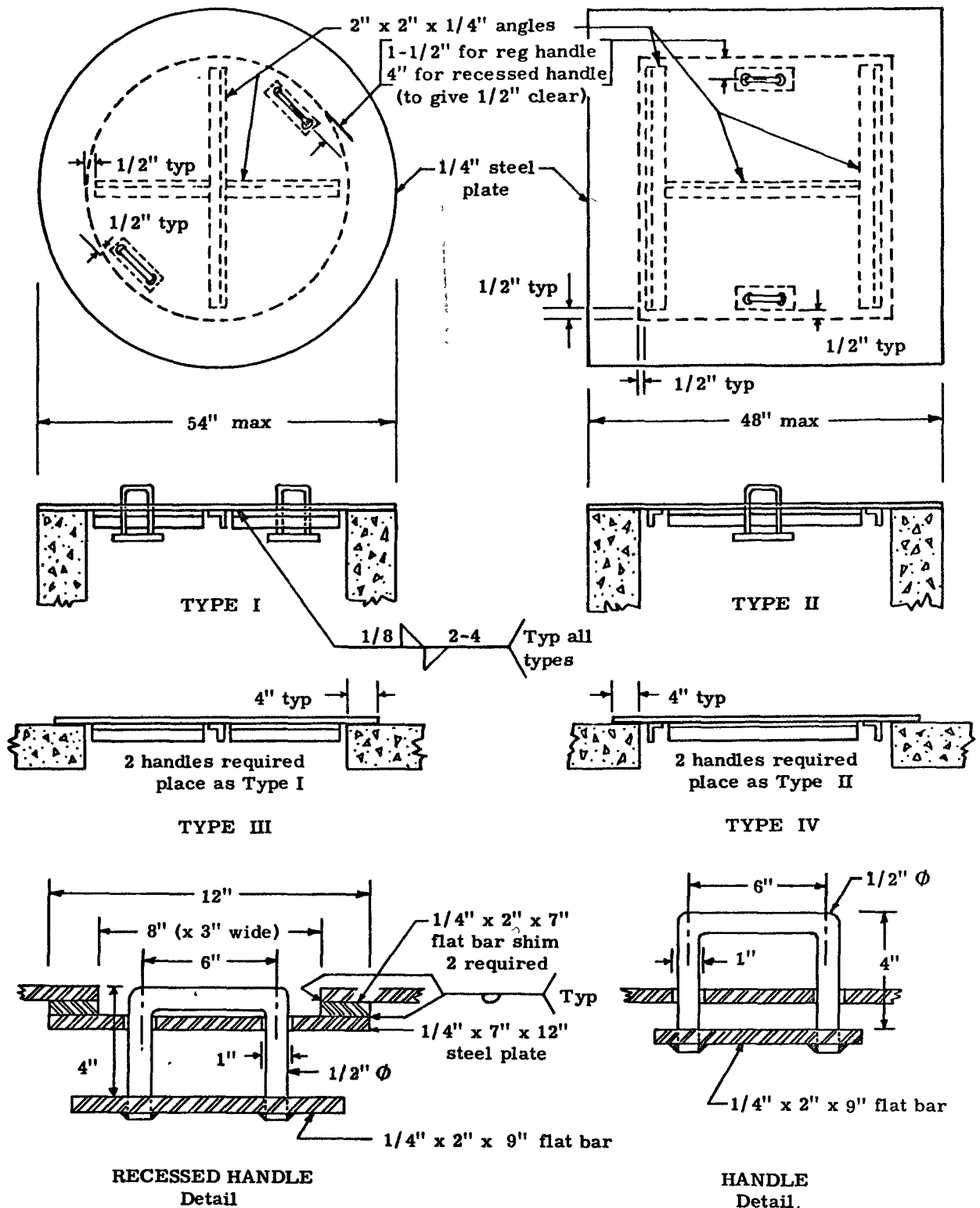
INSTRUCTIONS FOR USE OF PIT COVER STANDARD AC-4-70

This standard is intended for use both in maintenance work and in new construction. These pit covers may be used for valve pits, openings in slabs, cable pits or other uses.

When Standard AC-4-70 is used, the following shall be observed:

1. Type I, II, III or IV should be specified.  
Types I & II are intended for use on manhole or valve pit type structures and Types III and IV are intended for use in openings in slabs.
2. If the cover is located in an area subject to foot traffic, specify that the recessed handles be provided.
3. The maximum dimensions of the covers are 48" x 48" for Types I & III, 54" dia for Types II & IV. If larger sizes are required, a special design should be made, giving consideration to the use of a small opening within the larger cover for personnel access.
4. Since square covers can fall through the square openings they should not be used in places where they could injure personnel, or damage equipment if they should fall. From the safety standpoint the designer should either locate square openings where the cover would not do damage, or use a round hole and round cover.
5. This cover is designed for a maximum of 500 lb concentrated load or a 100 lb per sq ft uniform load. If the cover is located in an area subject to potential wheel loading (vehicular), the cover should be protected with a barricade per Standard AC-5-1.
6. If diamond or checkered plate is desired, it should be specified.
7. If corrosion protection is desired, hot-dipped galvanizing or painting should be specified.

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
1	Note 4 added	hes	12-15-60		hes	gpt
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 8-19-60				INSTRUCTIONS FOR USE OF AC-4-70	DI-AC-4-70	



NOTES:

1. Weld all joints 1/8" continuous fillet except as noted otherwise.
2. All edges free of burrs and sharp edges.
3. Provide recessed handle only when specified.

Ref Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM BY	DES. BY
						hes	gpt
APPROVED BY ENGINEERING STANDARDS COUNCIL				PIT COVER		AC-4-70	
H. E. Struck SECRETARY. DATE 8-19-60							

CAPE-1072-189

FENCES, BARRICADES, MARKERS

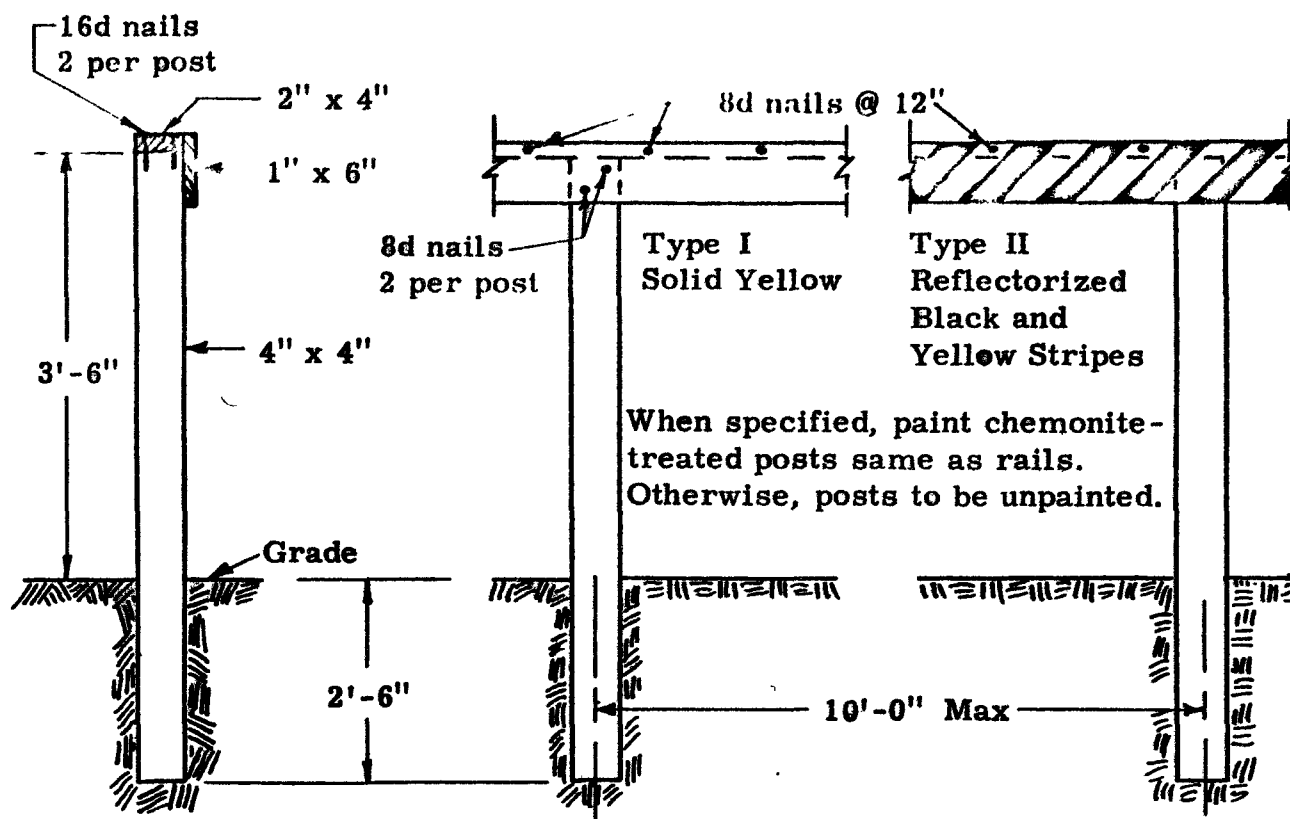
INSTRUCTIONS FOR USE OF  
STANDARD AC-5-1 - "BARRICADE"

When Standard AC-5-1, "Barricade", is used, the following shall be observed:

1. The location and limits of a barricade should be clearly defined on drawings.
2. The barricade on AC-5-1 is intended to be used on items such as septic tanks, underground storage tanks, and similar items. It is primarily a barricade for automotive traffic.
3. Specify on drawings, in supplementary specifications, or other instructions, the type of barricade to be used, Type I or Type II. Type I (solid yellow) is intended to be used in lightly traveled areas, such as small parking areas. Type II (reflectorized - black and yellow stripes) is intended for use in heavily traveled areas, such as large parking lots, or to reduce possibility of collision with a structure near a heavily traveled road. Type II may also be used for special purposes where a high visibility warning barricade is required, such as dead end barrier, or to mark open excavations, pits, basins, etc., near traveled areas.
4. When it is desired to paint the posts as well as the rail, specify the chemonite treatment and specify that posts be painted.
5. A simpler type of barricade, consisting of treated 4 x 4 posts painted yellow and spaced on not more than 6 foot centers, may be used for similar purposes, when desirable. For this type of barricade specify Type I posts per Standard AC-5-3 spaced on not more than 6 foot centers.

Supersedes DI-E-5-26

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 10-19-59				INSTRUCTIONS FOR USE OF STANDARD AC-5-1, "BARRICADE"	DI-AC-5-1	



**NOTES:**

1. Posts shall be full length pressure-treated with creosote or chemonite per Federal Specification TT-W-571c.
2. Type I Barricade - - - Paint cross members (and posts, when specified) one coat primer per Federal Specification TT-P-25a and two coats yellow enamel per Federal Specification TT-E-489b, Class A. Yellow shall be approximately color no. 13655 in Federal Standard 595. (formerly Federal Specification TT-C-595 color 1320).
3. Type II Barricade - - - Paint same as Type I. Apply self-sticking black and yellow "Scotchlite" warning stripes (3" wide stripes), W. H. Brady Co., or approved equal, on exposed side of cross members.
4. Backfill shall be firmly compacted.

Supersedes Std E-5-26.

Ref. Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM. BY	DES. BY
1	Ref Std No.	hes	11-18-60	BARRICADE		hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY. DATE 10-19-59						AC-5-1	

INSTRUCTIONS FOR USE OF  
STANDARD AC-5-2 - "CHAIN BARRICADE"

When Standard AC-5-2, "Chain Barricade", is used, the following shall be observed:

1. The location and limits of a barricade should be clearly defined on drawings.
2. The barricade on Standard AC-5-2 may be used:
  - a. As a new or replacement pipeline marker,
  - b. To outline limits of outside permanent radiation zones except where special conditions warrant other type barricade,
  - c. To barricade areas or items where a more positive type barricade is not required. It shall not be used as a barricade for automotive traffic or to barricade an extremely hazardous area where positive protection and high visibility are obviously required. For such areas use the barricade on Standard AC-5-1.
3. When used as a pipeline marker, the barricade shall be installed over underground piping.
4. When used as a radiation barricade, appropriate signs (Standard AC-3-20 and AC-3-21 as required) should be attached to posts so that at least one sign is easily visible from any ordinary angle of approach e.g., on long straight runs, level ground, attach sign(s) to every fifth post (every 100') and attach at least one sign on each side of enclosures. The drawings shall specify number, type and location of signs. Consult the responsible Radiological Unit for type of signs to be used and for placement of signs.
5. Show the location of required gates on the drawings.
6. When desirable, signs may be specified to indicate the type of pipeline or other structure being protected. Aluminum sheet, with steel stamped legend is suggested as a permanent, maintenance-free sign. Specify size, legend, and locations to be installed.

Supersedes DI-E-5-28a

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
1	Ref. Standards	hes	6-20-60		hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck, SECRETARY, DATE 10-19-59				INSTRUCTIONS FOR USE OF STANDARD AC-5-2	DI-AC-5-2	



- Supersedes Stds E-5-27, E-5-28 & E-5-28a      Ref. Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					H E S	CHH
APPROVED BY ENGINEERING STANDARDS COUNCIL				CHAIN BARRICADE	AC-5-2	
H. E. Struck SECRETARY, DATE 10-19-59						

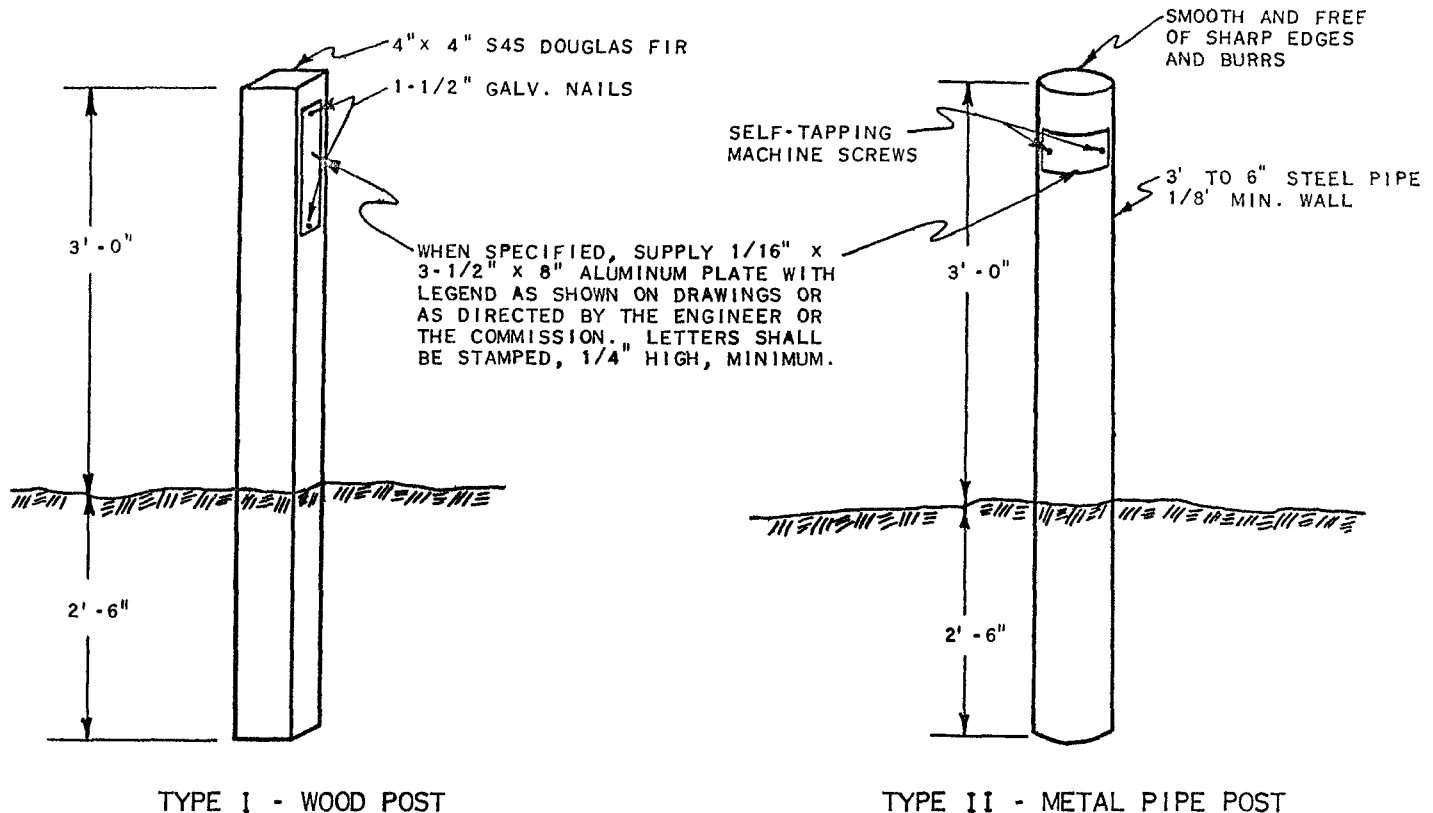
INSTRUCTIONS FOR USE OF AC-5-3  
SINGLE POST MARKER OR GUARD POST

When Standard AC-5-3 is used, specify the additional requirements for the work involved. The following is a listing of some of the requirements which must be stated in accompanying instructions, specifications or drawings.

1. These posts are intended for marking buried or partially buried items for identification and/or protection from traffic and for similar uses. When the identification feature is desired, specify that the aluminum name plate is to be supplied and show on the drawings the information to be stamped on the plate.
2. These posts may also be used for a barricade by specifying installation on not more than six foot centers. See DI-AC-5-1, Instructions for Use of Standard AC-5-1, Barricade.
3. Specify the type required, i.e., Type I - Wood Post or Type II - Metal Pipe Post.
4. Show the location on the drawings where the posts are to be installed.
5. For fire hydrant and valve post indicator identification and protection, use Standard AC-5-4 "Fire Protection Services - Post Barricade".

Supersedes DI-E-5-29

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
1	Ref Std No.	hes	11-18-60		hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 10-19-59				INSTRUCTIONS FOR USE OF STANDARD AC-5-3	DI-AC-5-3	



### NOTES

1. Wood posts shall be butt treated to 4 inches above ground line with creosote per Federal Specification TT-W-571c (as recommended for poles) or full length pressure-treated with chemonite per Federal Specification TT-W-571c.
2. Paint aboveground portion of each post one prime coat and two finish coats yellow enamel. Yellow shall be approximately color No. 13655 in Federal Standard 595 (a high visibility yellow, formerly Fed. Spec. TT-C-595 color 1320). Primer for metal posts shall meet Federal Specification TT-P-86a, Type II. Primer for wood posts shall meet Federal Specification TT-P-25a. Finish enamel shall meet Federal Specification TT-E-489b, Class A.
3. Prior to painting, metal posts shall be thoroughly wirebrushed to remove all dirt, rust, and other foreign material. Oil, grease, and similar substances shall be removed with solvents prior to wirebrushing.
4. Scrap or reject pipe is acceptable.
5. Backfill shall be firmly compacted.

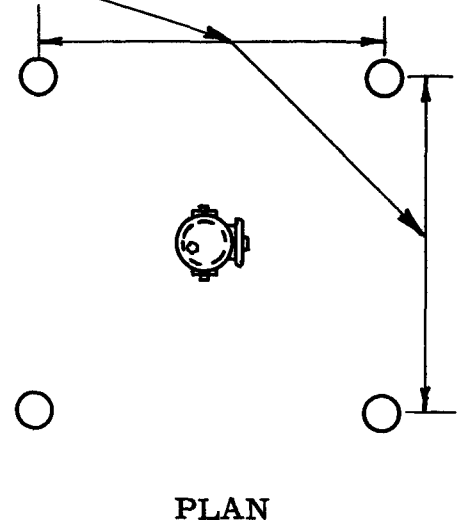
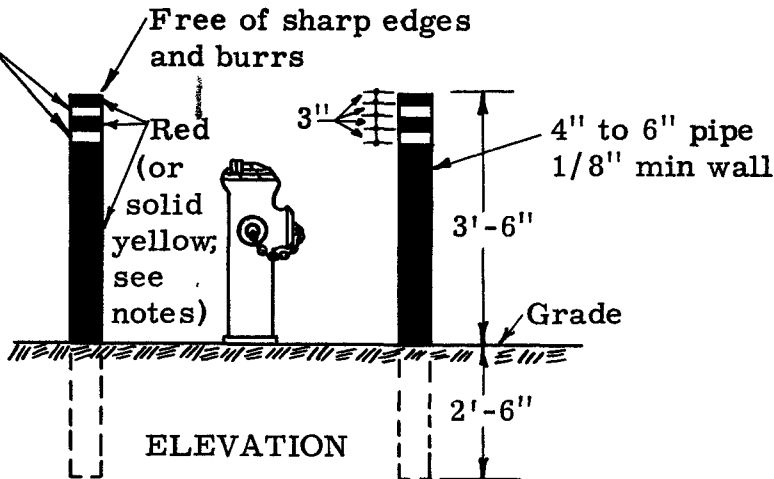
Supersedes Std E-5-29

Ref Hanford Stds: None

NO	REVISION	APP D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM BY	DES BY
1	Ref Stds No's.	hes	11-18-60		hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY DATE 10-19-59				SINGLE POST MARKER OR GUARD POST		AC-5-3

Two 3" bands of no. 3270 silver "wide angle flat-top" adhesive-coated Scotchlite reflective sheeting, or approved equal, each post. Red posts only; see notes.

Approx 6'-0" for fire hydrant,  
4'-0" for valve post indicator



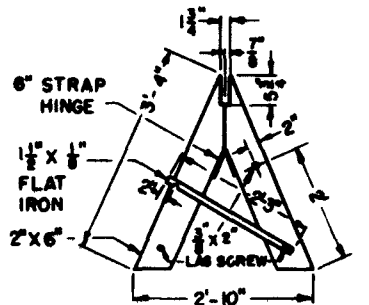
**NOTES:**

1. For use with fire hydrants and valve post indicators, where required.
2. For fire hydrants and valve post indicators controlling fire equipment (such as sprinkler systems, standpipes, etc.), paint aboveground portion of each post with one prime coat and two finish coats red enamel. Apply reflective bands as shown. For valve post indicators not controlling fire equipment, paint one prime coat and two finish coats yellow enamel.
3. Primer shall meet Federal Specification TT-P-86a, Type II. Finish enamel shall meet Federal Specification TT-E-489b, Class A. Red shall be approximately color no. 11105 in Federal Standard 595 (formerly Federal Specification TT-C-595 color 1110). Yellow shall be approximately color no. 13655 (formerly no. 1320, a high visibility yellow).
4. Prior to painting, posts shall be thoroughly wirebrushed to remove all dirt, rust, and other foreign material. Oil, grease, and similar substances shall be removed with solvents prior to wirebrushing.
5. Scrap or reject pipe is acceptable.
6. Backfill shall be firmly compacted.

Supersedes Std. E-5-30

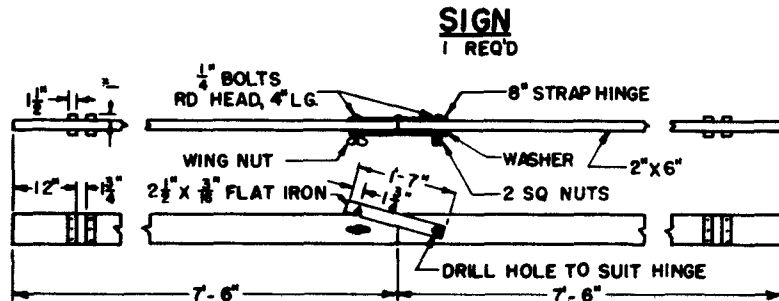
Ref Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL				FIRE PROTECTION SERVICES POST BARRICADE	AC-5-4	
H. E. Struck SECRETARY, DATE 11-18-60						



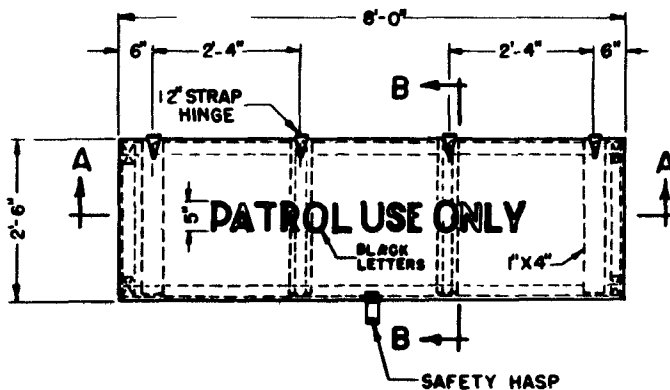
**HORSE ASSEMBLY**

4 REQ'D



**BARRIER STRINGER**

2 REQ'D

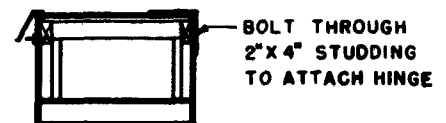


**NOTE:**

1. EQUIPMENT SHALL INCLUDE ONE FLARE KIT CONSISTING OF A STEEL BOX CONTAINING TWO RED FLAGS AND THREE FLARES.
2. BOX TO BE MADE OF 2" X 4" STUDDING AND 1" SHEATHING NAILED TOGETHER.
3. PAINT BOX WITH ONE COAT OF APPROVED PRIMER AND TWO COATS OF WHITE PAINT - OUTSIDE ONLY.
4. PAINT BARRIER STRINGER AND HORSE ASSEMBLY WITH ONE COAT OF APPROVED PRIMER AND TWO COATS OF WHITE PAINT. STRIPE HORSE AND STRINGER WITH RED PAINT AS INDICATED IN ISOMETRIC SKETCH.
5. PAINT SIGN WITH ONE COAT OF APPROVED PRIMER AND TWO COATS OF WHITE PAINT - PAINT LETTERING RED AND EDGING BLACK



**SECTION A-A**



**SECTION B-B**

Supersedes Std C-5-22

**EVACUATION BOX**

1 REQ'D

Ref Hanford Stds: None

NO	REVISION	APP D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM BY	DES. BY
				HAZARDOUS AREA BARRICADE EQUIPMENT			
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 10-28-60						AC-5-5	

# INSTRUCTIONS FOR USE OF STANDARD AC-5-6

## "GUY WARNING GUARD"

When Standard AC-5-6 is used, the following shall be observed:

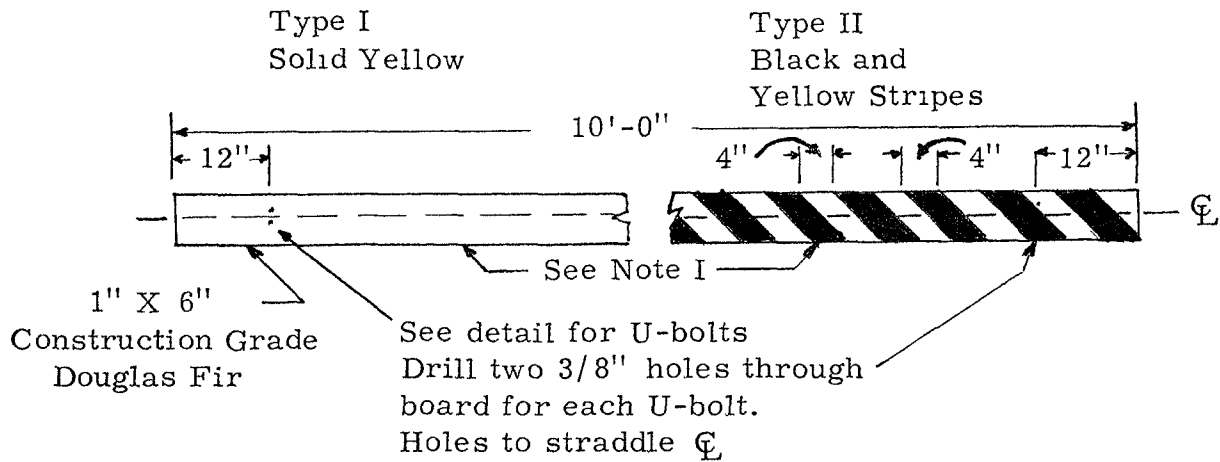
1. The guy protector shown is used primarily on guys for electrical poles (see Electrical Stds, D-4-1 series) but is not restricted to electrical guys.
2. The warning treatment (stripes or solid yellow areas) is required only in areas of pedestrian and vehicle traffic where the guy is within 10 feet of a sidewalk or roadway.
3. If Standard AC-5-6 is referenced for a construction contract, the user shall specify which type to use, i.e. zebra or plain board (type I or II) or guy protector type, plain or striped. Construction drawings shall indicate the number and location of such guy warning guards.
4. When the guy protector type is specified, the user shall also specify whether or not warning treatment is to be used. When warning treatment is to be used on only a portion of the guy protectors to be installed, it must be clearly indicated which protectors require the warning treatment.

Supersedes DI-A-5-15a

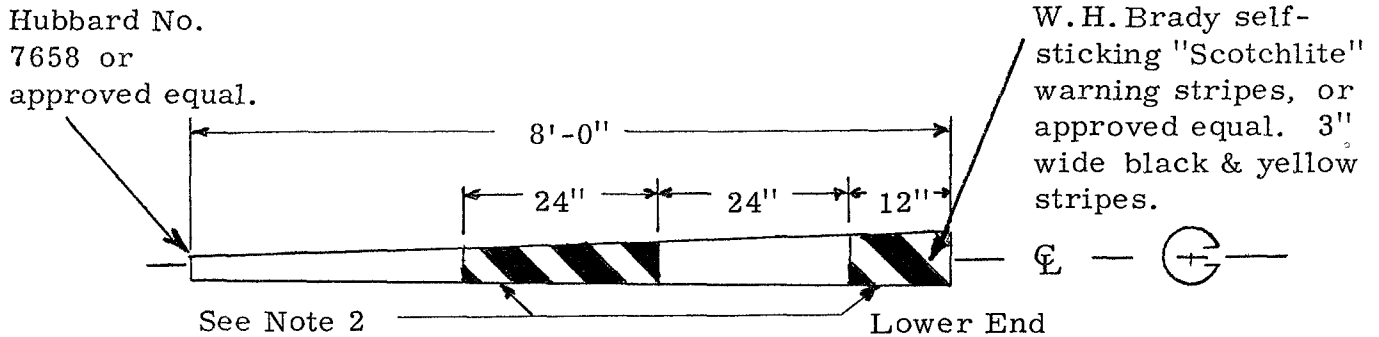
NO.	REVISION	APP'D	DATE	ARCHITECTURAL - CIVIL STANDARD	SUBM. BY	DES. BY
					hes	gpt
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY DATE 11-30-59				INSTRUCTIONS FOR USE OF AC-5-6	DI-AC-5-6	

GENERAL  ELECTRIC CAFE-1072-199

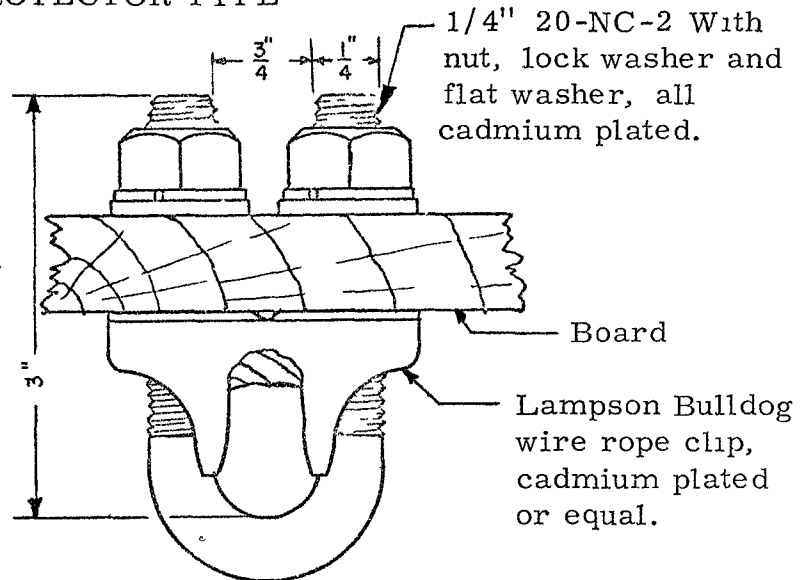
HANFORD ATOMIC PRODUCTS OPERATION



## PLAIN OR ZEBRA BOARD TYPE



# GUY PROTECTOR TYPE



NOTES:

1. Paint board all sides with one coat primer and one finish coat high visibility yellow. Where Type II board is required, finish with black stripes.
2. Where required, paint indicated areas of guy protectors solid yellow or apply stripes as shown, full circumference of guy protector.
3. To be used as called for on guy rods and wires for lines higher than 8'-0" overhead. See Hanford Stds. B-4-14 & 15.

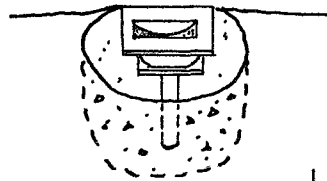
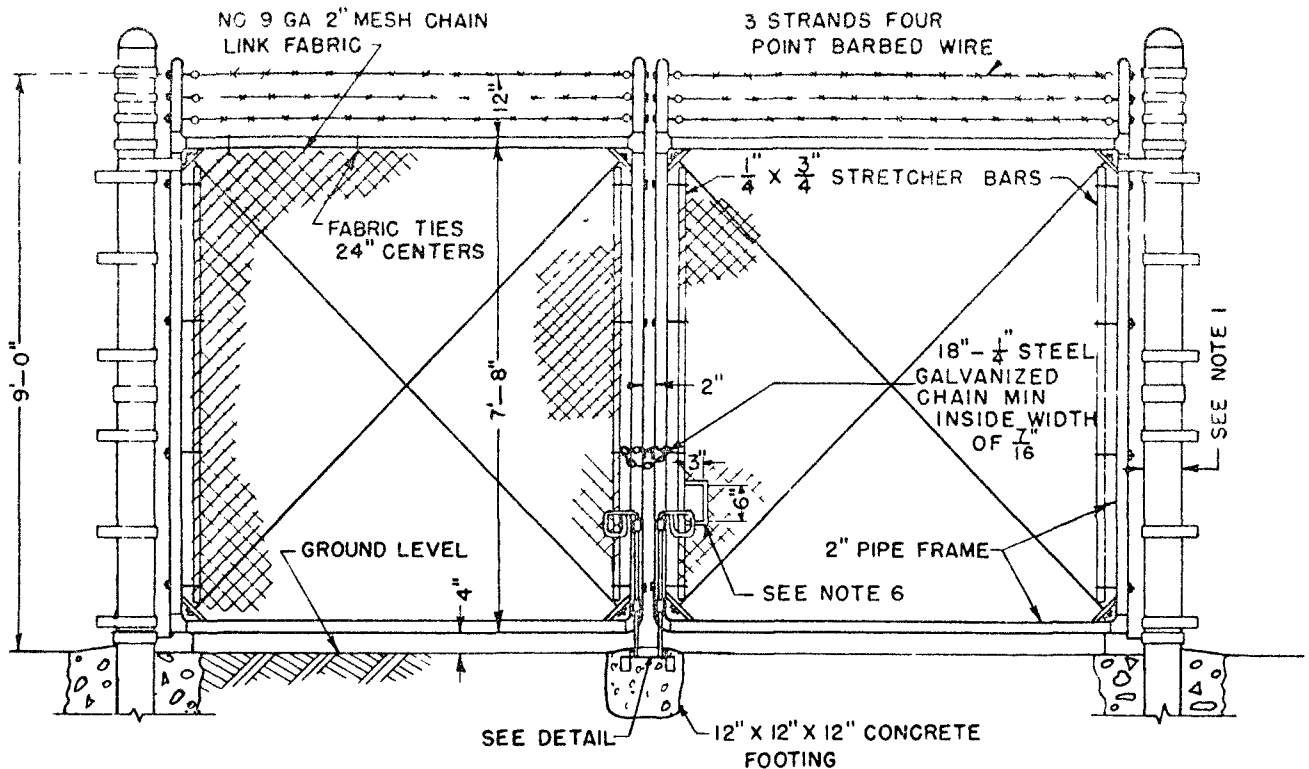
DETAIL

Two required for board

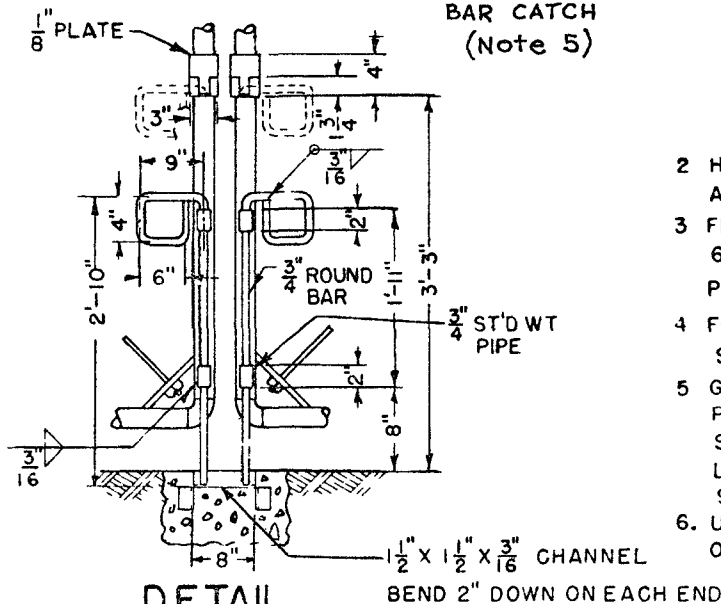
Supersedes Std A-5-15a

Ref. Hanford Stds: B-4-14, B-4-15

NO	REVISION	APP D	DATE	ARCHITECTURAL - CIVIL STANDARD	SUBM BY	DES BY
					hes	gpt
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY DATE 11-30-59				GUY WARNING GUARD	AC-5-6	



TYPICAL PLUNGER  
BAR CATCH  
(Note 5)



DETAIL

## NOTES

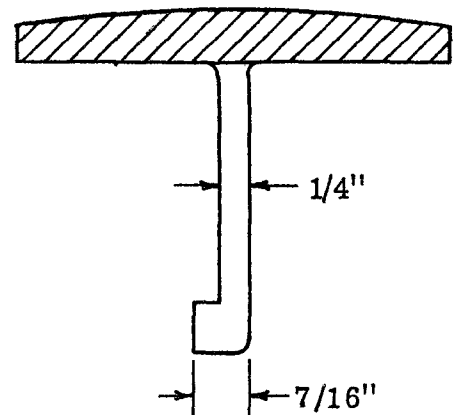
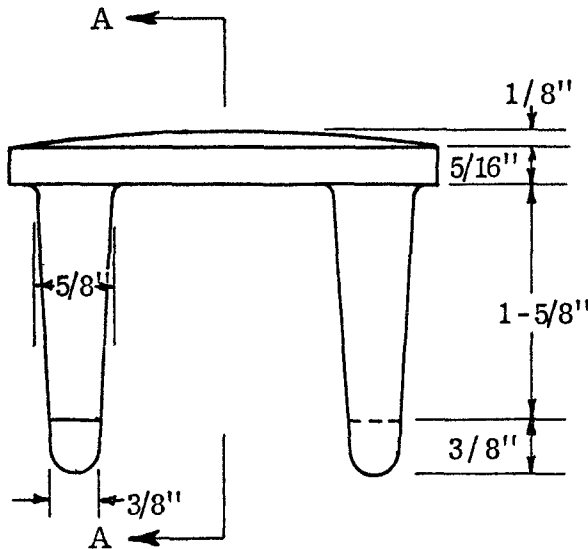
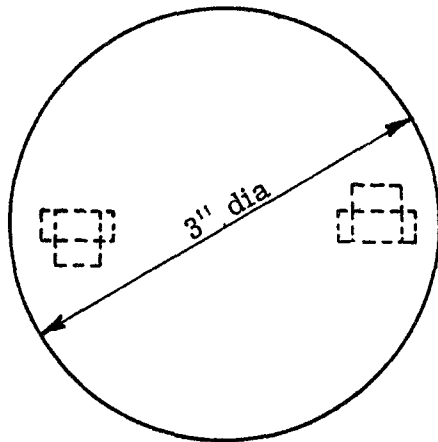
- 1 GATE POST SIZES  

SIZE	GATE WIDTH	
	SINGLE	DOUBLE
3" O D	6' & UNDER	12' & UNDER
4" O D	OVER 6' TO 13'	OVER 12' TO 26'
6 5/8" O D	OVER 13' TO 18'	OVER 26' TO 36'
8 5/8" O D	OVER 18'	OVER 36'
- 2 HINGES SHALL BE OF THE OFF-SET TYPE ALLOWING GATE TO SWING 180°
- 3 FENCE TO BE GALVANIZED TO WITHSTAND 6-1 MINUTE DIPS IN ACCORDANCE WITH PREECE TEST (ASTM A239)
- 4 FOR STANDARD SECURITY CHAIN LINK FENCE SEE HW-4680-S.
- 5 GATE STOPS TO BE U S STEEL CYCLONE FENCE PLUNGER BAR CATCH, OR APPROVED EQUI/ STOPS TO BE SET IN CONCRETE FOOTINGS, LOCATED BY FIELD, TO HOLD GATES OPEN 90° IN BOTH DIRECTIONS FROM CLOSED POSITION
6. USE "U" EDGING TO PROTECT ROUGH EDGES OF OPENING.

Supersedes E-5-19

Ref Hanford Stds: HW-4680-S

NO	REVISION	APP D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM BY	DES BY
						cel	
APPROVED BY ENGINEERING STANDARDS COUNCIL				STANDARD SECURITY		AC-5-20	
H. E. Struck SECRETARY DATE 5-1-61				CHAIN LINK GATE			



SECTION A - A

NOTES:

1. Marker shall be cast bronze.
2. For use as coordinate marker or bench mark.
3. See Standard AC-5-31 for installation in earth.
4. For installation in solid rock or existing concrete, chip hole approximately 6" diameter by 6" deep and set marker in 3000 psi concrete. Stamp desired information on marker after installation.

Supersedes Std E-5-20

Ref. Hanford Stds: AC-5-31

Super Seals Std. E-5-20				Rev. Markers Std. AC-5-30		
NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL				BRONZE SURVEY MARKER	AC-5-30	
H. E. Struck SECRETARY, DATE 10-19-59						

INSTRUCTIONS FOR USE OF  
AC-5-31 SURVEY MONUMENT

Standard AC-5-31 documents the established method of monumenting vertical and horizontal survey control points at Hanford. These monuments are normally placed by HAPO plant forces.

The Standard shows the minimum requirements for a monument which will serve satisfactorily in most locations. In locations where conditions require it, a special design may be prepared.

The bottom of the monument must be placed on undisturbed earth, as noted on the standard. If it is placed on backfill, even if the backfill is several years old, settlement will eventually render a bench mark ineffective and may cause slight shifting of a coordinate marker.

When monuments are to be placed by a contractor, the following should be observed:

1. Indicate the location of each monument on the drawing.
2. When the guard post per Standard AC-5-3 will be required, state this specifically in supplemental specifications.
3. Where the base of the monument must be several feet below grade in order to extend to undisturbed earth, specify the use of the footing noted on the standard. When the depth is excessive, or when soil conditions or other factors require a more massive monument, a special design should be prepared.

Supersedes DI-E-5-21

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM BY	DES BY
					hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL H.E. Struck SECRETARY, DATE 10-19-59				INSTRUCTIONS FOR USE OF AC-5-31	DI-AC-5-31	



1. For use as coordinate marker or bench mark.
2. Backfill shall be carefully placed and compacted by tamping.
3. When required, install a guard post per Standard AC-5-3, Type II, metal post, 3'-0" from the monument in areas of vehicular traffic.
4. Stamp desired information on marker after installation.
5. When specified, pour a 2' x 2', 3000 psi concrete footing, 12" minimum thickness, on undisturbed earth. Embed pipe in footing 3" minimum.

Ref. Hanford Stds: AC-5-30, AC-5-3

NO. REVISION APP'D DATE				ARCHITECTURAL-CIVIL STANDARD	SUBM. BY DES. BY	
					hes	rge chn
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 10-19-59				SURVEY MONUMENT	AC-5-31	

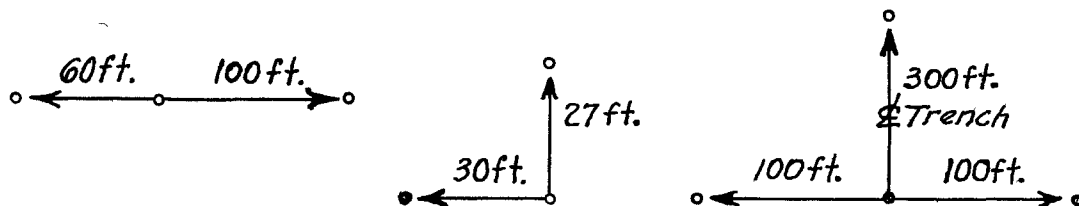
# HANFORD STANDARD

RICHLAND, WASHINGTON

## INSTRUCTIONS FOR USE OF AC-5-40 IDENTIFICATION MARKER FOR BURIED RADIOACTIVE MATERIAL

When Standard AC-5-40 is used, the following should be observed:

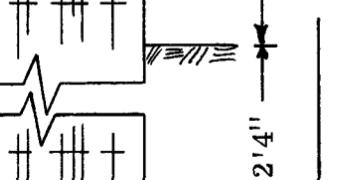
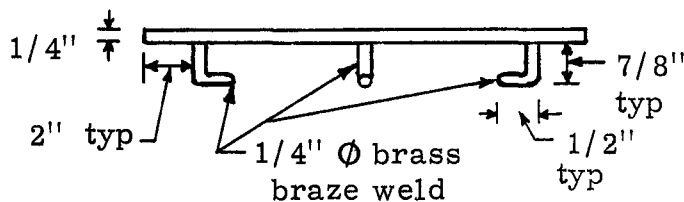
1. These marker posts are intended for permanent marking of burial plots containing solid radioactive material.
2. A marker post shall be erected at:
  - a. each end of each trench on the center line of the trench.
  - b. each boundary corner or other change of direction point.
  - c. a maximum of 100 feet spacing along boundaries. Trench end posts may also serve as boundary posts between corner markers.
3. All marker posts shall conform to Standard AC-5-40. These posts should be installed on an offset at least two feet from edge of the trench.
4. Specify in supplemental instructions, specifications, or drawings, the number of the post to be stamped on the medallion, the arrows and distances indicating the location of the two adjacent boundary posts or the opposite end trench post, and any additional legend that may be required on the medallion. Examples:-



The number of the post and any other specific requirements for each case must be obtained from the Health and Safety Division, Richland Operations Office of the Atomic Energy Commission.

5. Legal description of underground waste disposal sites will be recorded, by the Atomic Energy Commission, in the Benton County land records for the information of future owners of the land. The sites shall be surveyed to establish Lambert coordinates or section survey locations of the boundaries of each site. The description should include the maximum area that will be used in the predictable future for burial at the site. The legal description shall be submitted to the AEC, for recording, along with specifications and guidance to indicate probable radiation hazard at future times, so that future generations may judge the feasibility of using the site or excavating in **this area**. This information also will be made a part of Atomic Energy Commission records.

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
3	General	hes	12-11-64		hes	gpt
APPROVED BY ENGINEERING STANDARDS COUNCIL				INSTRUCTIONS FOR USE OF AC-5-40	DI-AC-5-40	
H.E. Struck SECRETARY, DATE 8-25-60						



1. Post is same as Highway Guard Post, Standard C-5, Wash. State Highway Comm.
2. Concrete for post shall conform to Section 72, Standard Specifications for Road and Bridge Construction, 1957, Washington State Highway Commission.
3. Backfill shall be firmly tamped.
4. Legend shown, plus specified post number and any additional legend specified, shall be stamped or engraved with 1/4" high, gothic letters. Radiation symbol shall be 1-1/2" dia, proportioned according to ASA N2.1-1960. ( See Std AC-3-20). Outline of radiation symbol shall be engraved or stamped.
5. Adhesive shall be Permagile Corp of America, Permagile "S", or approved equal.
6. Clean top of post and back of medallion of oil, dust or moisture. Roughen back of medallion with coarse emery cloth. Fill holes in top of post with adhesive and spread a 1/16" coat on top of post and back of medallion.
7. Form a 1/8" cant of adhesive between edge of medallion and post.

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM BY	DES. BY
2	* Revision made	hes	12-11-64		hes	gpt
APPROVED BY ENGINEERING STANDARDS COUNCIL <u>H. E. Struck</u> SECRETARY. DATE <u>8-25-60</u>				IDENTIFICATION MARKER FOR BURIED RADIOACTIVE MATERIAL	AC-5-40	

CAPE - 1072. 206

AC-6  
ROADS

INSTRUCTIONS FOR USE OF STANDARD AC-6-1  
"INTER-AREA HIGHWAY CROSS-SECTIONS"

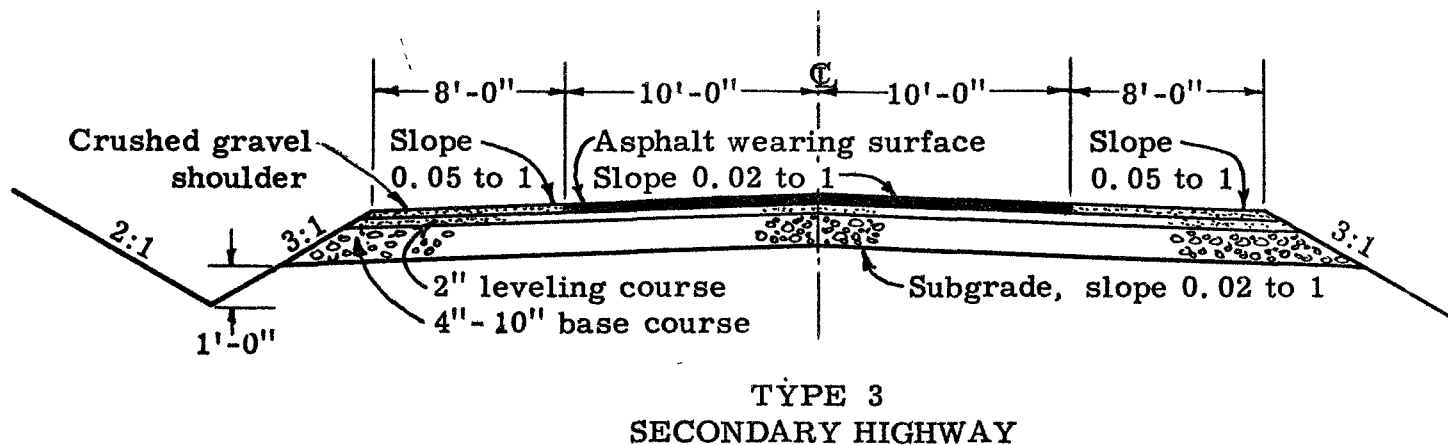
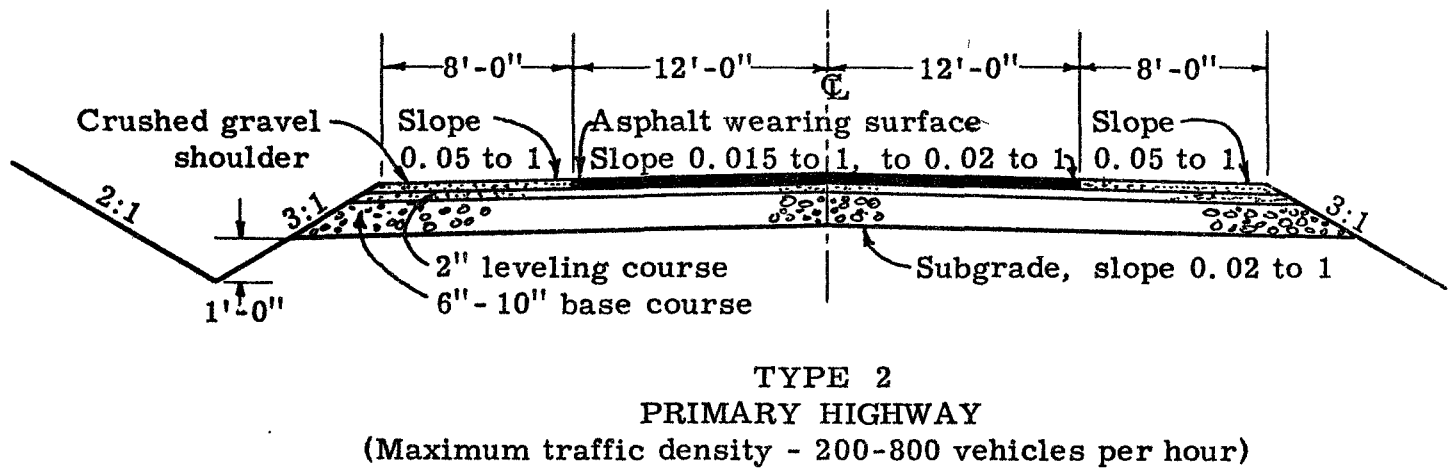
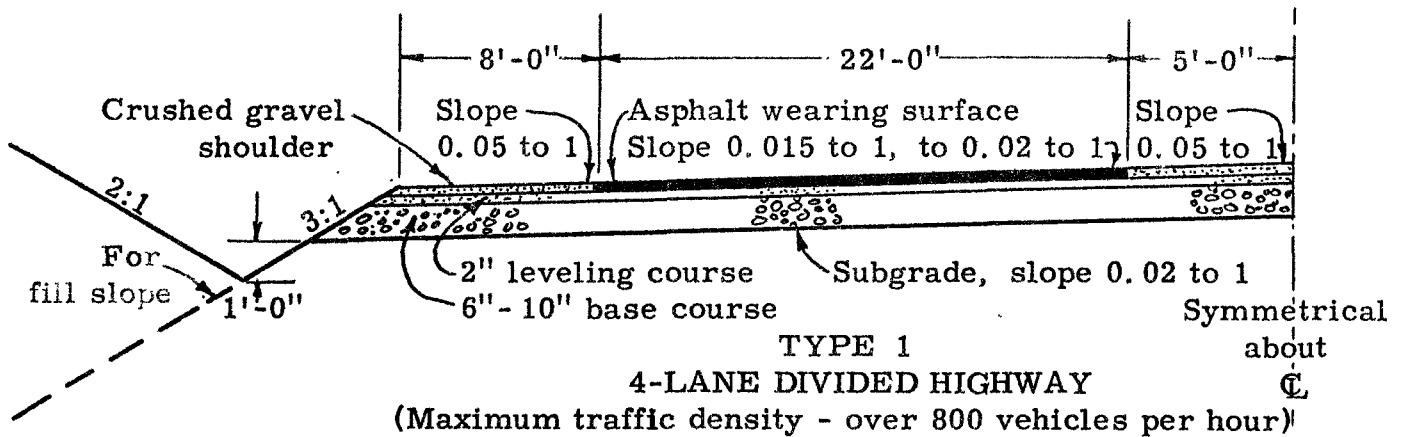
Standard AC-6-1 is a "design standard", illustrating basic requirements, such as lane widths, for plant highways between areas. It is not intended for use by construction forces and shall not be referenced for such use. It is intended that a specific cross-section be drawn for each job. The following factors should be considered when designing the individual cross-section:

1. The thickness of the base course and the thickness and type of asphalt wearing surface must be determined. Required thicknesses should be based on soil conditions and anticipated traffic, taking into consideration wheel loading.
2. The cut and fill slopes shown are typical. For high fills, rock cuts, or deep cuts, these slopes should be changed as required, depending on availability of borrow materials, haul, etc. Generally, for cuts and fills under 5' the slopes shown should be used.
3. The following pavement slopes should be used for various surfaces: Asphaltic concrete pavement 0.015 to 1; light bituminous surface treatment (Shot-and-cover type) and crushed stone surfacing, 0.02 to 1.
4. Shoulder slopes on the inside of curves shall be the pavement slope extended, unless the pavement slope is less than the standard shoulder slope, in which case the standard shoulder slope shall be used. Slopes on shoulders may be modified where standard slope decreases the depth on the shoulder below an adequate thickness.
5. Shoulder slope on the outside of curves shall be the pavement slope extended for 1 foot followed by a 4-foot-long transition to the standard shoulder slope for the remainder of the shoulder. The transition should be a smooth curve.
6. Where guard rail is to be used on embankments, the embankments shall be widened two feet on the side to receive guardrail.
7. Superelevation and widening on curves should be in accordance with Design Guide DG-80-AC, Superelevation and Widening for Highways.
8. Refer to the specifications section of the Architect-Civil Standards book for the following subgrade construction and surfacing specifications:

HWS-6131-S: Hot-Laid Asphaltic Concrete  
HWS-6133-S: Light Bituminous Surface Treatment  
HWS-6134-S: Grading and Drainage for Roads

Supersedes DI-E-5-40a

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 3-15-61				INSTRUCTIONS FOR USE OF STANDARD AC-6-1	DI-AC-6-1	



**Supersedes Std E-5-40a**

Not for use in construction contracts

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL <u>H. E. Struck</u> SECRETARY, DATE <u>3-15-61</u>				INTER-AREA HIGHWAY CROSS-SECTIONS	AC-6-1	

(These Instructions  
consist of 1 Page)

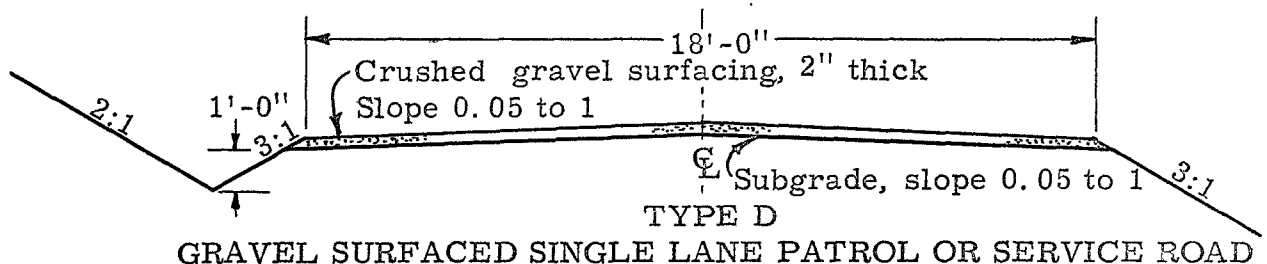
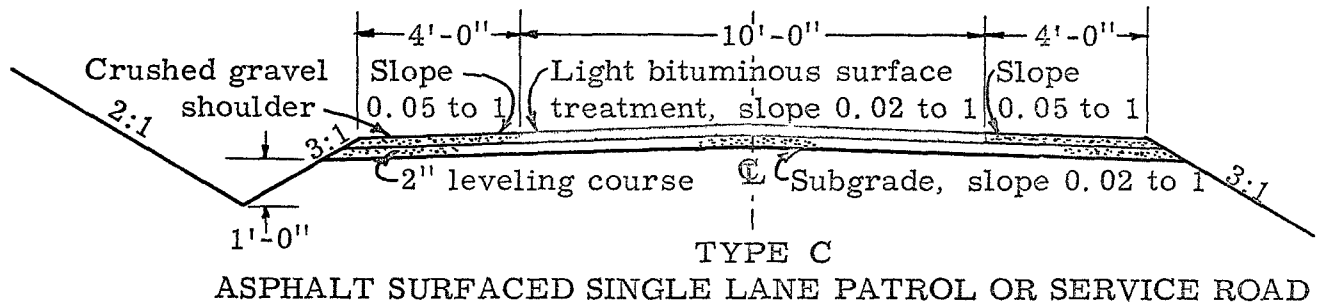
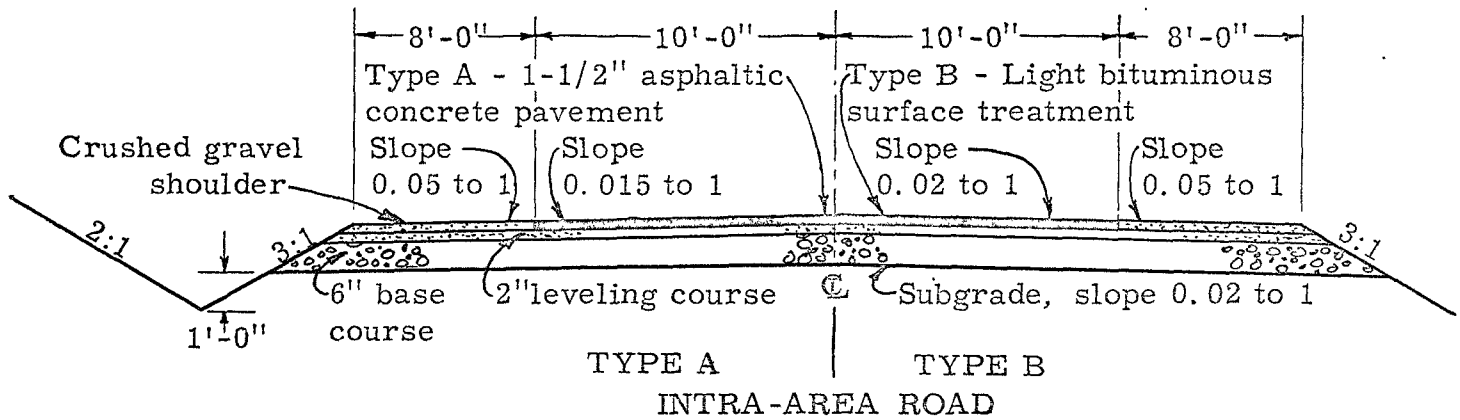
INSTRUCTIONS FOR USE OF STANDARD AC-6-2  
"INTRA-AREA ROADWAY CROSS-SECTIONS"

Standard AC-6-2 is for use in construction of new roads inside limited areas (100, 200 and 300 areas). When this standard is used the following should be observed:

1. Information which should accompany the standard drawing includes:
  - a. A plan and profile of proposed roads.
  - b. A notation as to type of roadway to be built (Type A, B, C or D).
2. Care should be used in selecting the type of roadway to insure adequacy for traffic conditions.
  - a. For two lane roads, durability and costs must be considered before selecting between Type A, hot-laid asphaltic concrete, and Type B, light bituminous surface treatment. For normal traffic conditions on these roads inside limited areas, the light bituminous surface treatment will usually be adequate. The initial cost of hot-laid asphaltic concrete is considerably more however, it is much more resistant to traffic and should be used where it can be justified.
  - b. Single lane roads are adequate for patrol roads and service drives. For such purposes, where subgrade materials and conditions are satisfactory, compacted gravel surfacing is usually adequate and should be used in most cases due to low costs of construction. However, where conditions warrents (such as erosion control or traffic) the light bituminous surface treatment may be justified.
3. Superelevation will not normally be used for roads inside limited areas.

Supersedes DI-E-5-40b

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM BY	DES BY
1	General	hes	12-20-62	INSTRUCTIONS FOR USE OF STANDARD AC-6-2		hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY DATE 3-15-61						DI-AC-6-2	



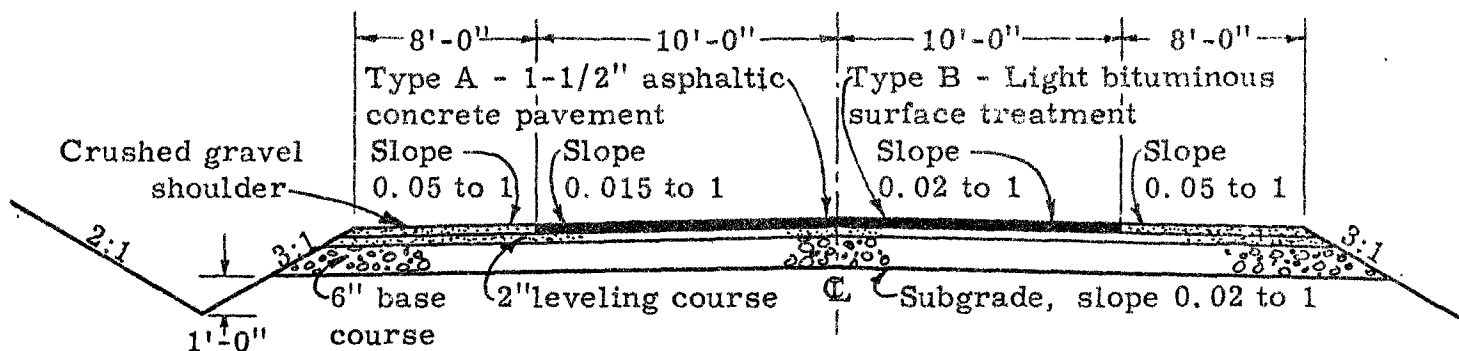
NOTE:

1. Roads shall be constructed in accordance with the following Hanford Standard Specifications: Base course, leveling course, and gravel shoulders per HWS-6131-S or HWS-6133-S; Asphaltic concrete pavement per HWS-6131-S; Light Bituminous Surface Treatment Paving per HWS-6133-S; Crushed gravel surfacing per HWS-6136-S; Subgrade per HWS-6134-S.

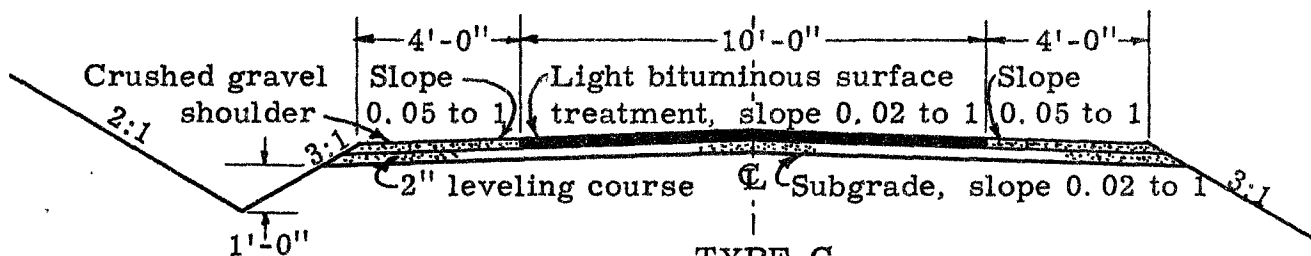
Supersedes Std E-5-40b

Ref Hanford Stds: See note

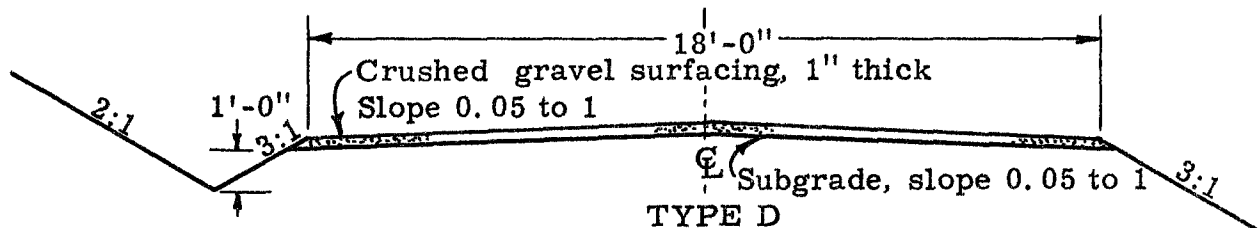
NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
1	Type D	hes	12-20-62		hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL <u>H. E. Struck</u> SECRETARY, DATE <u>3-15-61</u>				INTRA-AREA ROADWAY CROSS-SECTIONS	AC-6-2	



TYPE A & B  
INTRA-AREA ROAD



TYPE C  
ASPHALT SURFACED SINGLE LANE PATROL OR SERVICE ROAD



TYPE D  
GRAVEL SURFACED SINGLE LANE PATROL OR SERVICE ROAD

NOTE:

- Roads shall be constructed in accordance with the following Hanford Standard Specifications: Base course, leveling course, and gravel shoulders per HWS-6131-S or HWS-6133-S; Asphaltic concrete pavement per HWS-6131-S; Light Bituminous Surface Treatment Paving per HWS-6133-S; Crushed gravel surfacing per HWS-6136-S; Subgrade per HWS-6134-S.

Supersedes Std E-5-40b

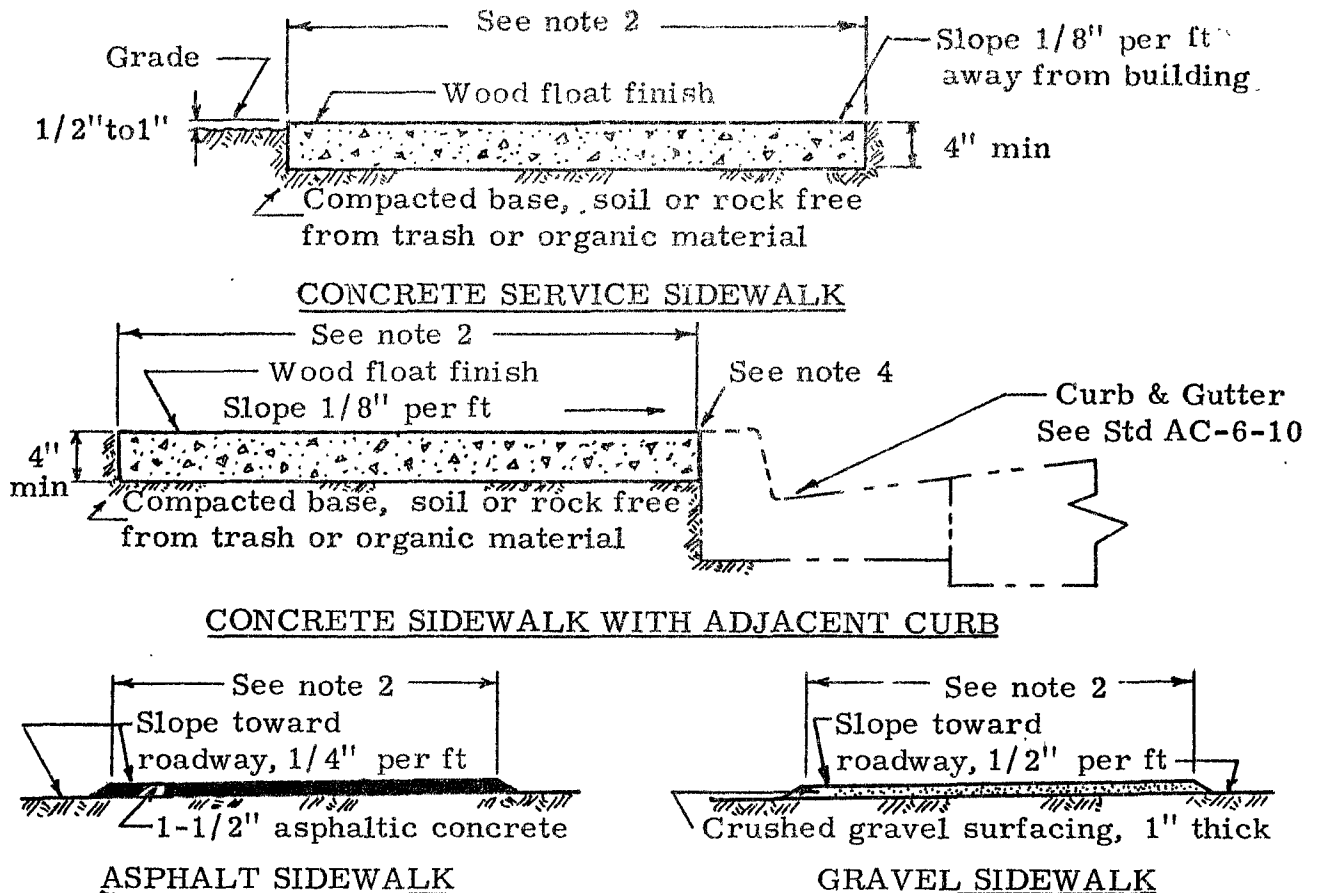
Ref Hanford Stds: See note

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM. BY	DES. BY
						hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL				INTRA-AREA		AC-6-2	
H. E. Struck SECRETARY, DATE 3-15-61				ROADWAY CROSS-SECTIONS			

INSTRUCTIONS FOR USE OF STANDARD AC-6-11  
"SIDEWALKS"

1. When sidewalks are required to be other than 4'-0" in width, this information should be specified on the drawings.
2. Asphalt and concrete sidewalk gradients should not exceed 3%. Where steeper gradients are encountered, provide steps in units of 2 or more steps. Flights of 5 or more risers shall have handrails; see Std AC-2-3.
3. Construction of sidewalks with hot-laid asphaltic concrete (Hanford Standard Specification HWS-6131-S) will only be economical in conjunction with other hot-laid asphaltic concrete work. When this type of work is not involved, sidewalks should be constructed of cold-laid asphaltic concrete (Hanford Standard Specification HWS-6135-S) such as normally stockpiled by Transportation Operation, or simpler construction such as gravel (HWS-6136-S), good sand-clay mixture, etc.
4. When asphaltic material is to be placed in areas of thick or hardy vegetation without extensive subgrade preparation, it may be desirable to specify soil sterilization to prevent the vegetation from growing up through the asphalt mat.

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL <b>H. E. Struck</b> SECRETARY, DATE <b>3-15-61</b>				INSTRUCTIONS FOR USE OF STANDARD AC-6-11	DI-AC-6-11	



NOTES:

1. Asphalt sidewalks shall be constructed per Hanford Standard Specification HWS-6131-S or HWS-6135-S. Gravel sidewalks shall be constructed per Hanford Standard Specification HWS-6136-S.
2. Unless specified otherwise, sidewalk width shall be 4'-0".
3. Concrete shall have 2500 psi min compressive strength at 28 days.
4. Paint curb side of concrete sidewalks with bituminous paint. Provide 3/4" thick premolded joint filler where service walks abut street walks or curb, and in expansion joints.
5. Concrete walks shall be scored 10' on center. Expansion joints shall be 40' on center, maximum. All edges of concrete sidewalks shall be rounded with 1/2" radius and neatly dressed.

Supersedes Std E-5-36

Ref Hanford Stds:  
AC-6-10, HWS-6131, 6135, & 6136-S

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL				SIDEWALKS	AC-6-11	
H. E. Struck SECRETARY, DATE 3-15-61						

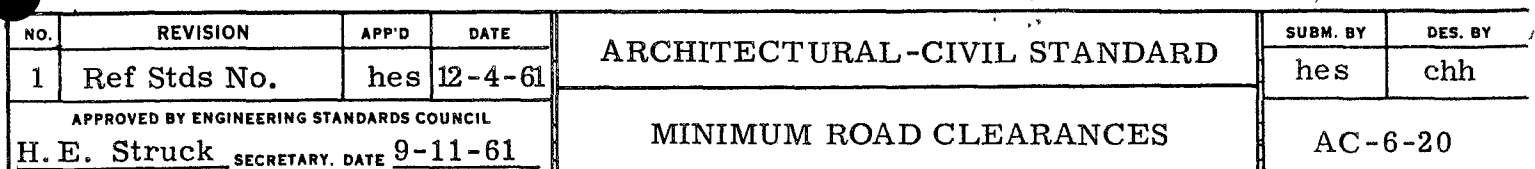
INSTRUCTIONS FOR USE OF AC-6-20

MINIMUM ROAD CLEARANCES

Standard AC-6-20 is a design standard which shows minimum clearances to various structures for Hanford roads and highways. When using this standard, the following should be kept in mind:

1. Standard AC-6-20 increases the minimum clearance to overhead signs, steam lines and other structures from the former 16'-0" to 20'-0". It should be noted that this will affect primarily new construction. It is not intended to require raising the many existing steam lines, etc. which have less than 20' of clearance.
2. The 20'-0" minimum clearance which applies to structures should not be automatically applied to highway overpass or underpass structures. For such structures, consideration should be given to a lower figure such as the 16'-0" normally used on state and U.S. highways.

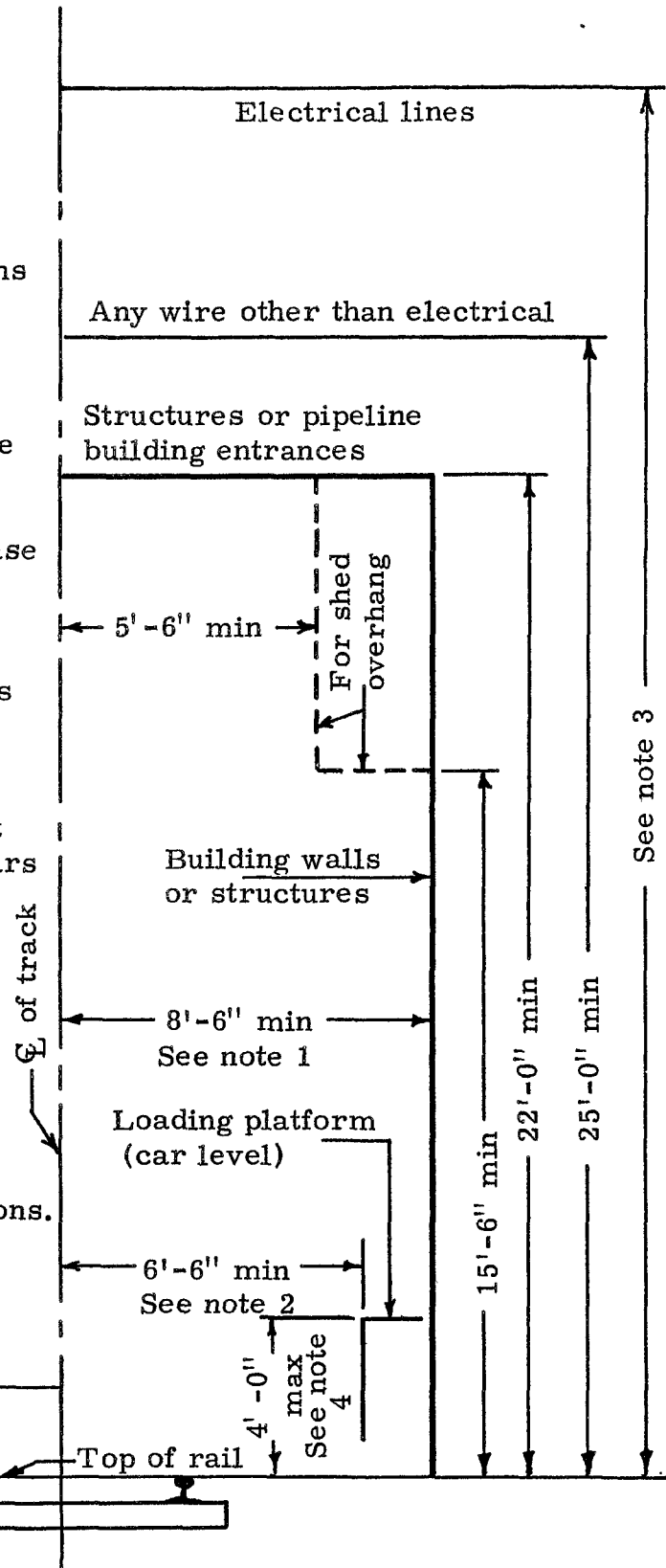
NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL H.E. Struck SECRETARY. DATE 9-11-61				INSTRUCTIONS FOR USE OF AC-6-20	DI-AC-6-20	



CAPE - 1072 - 216

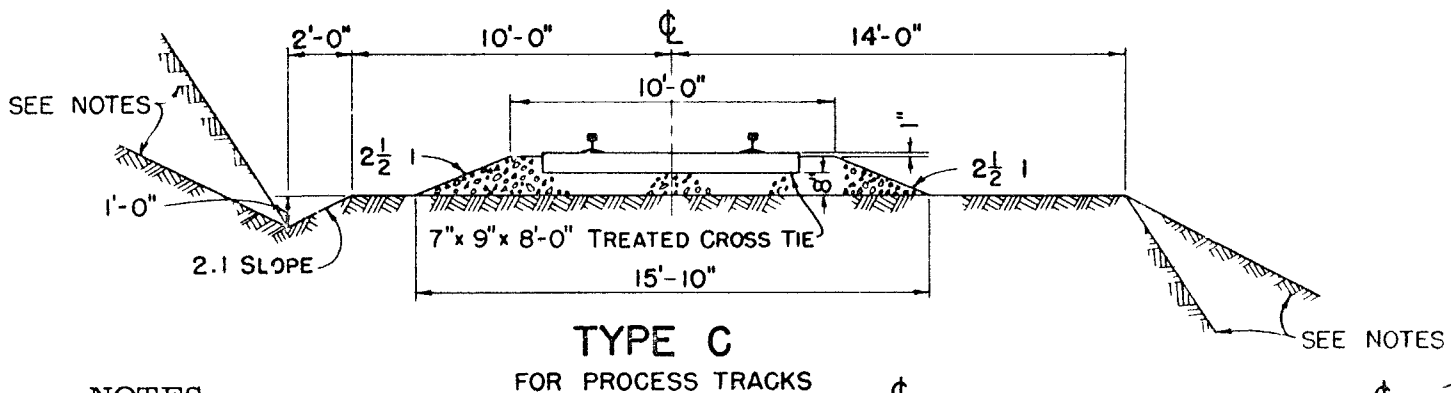
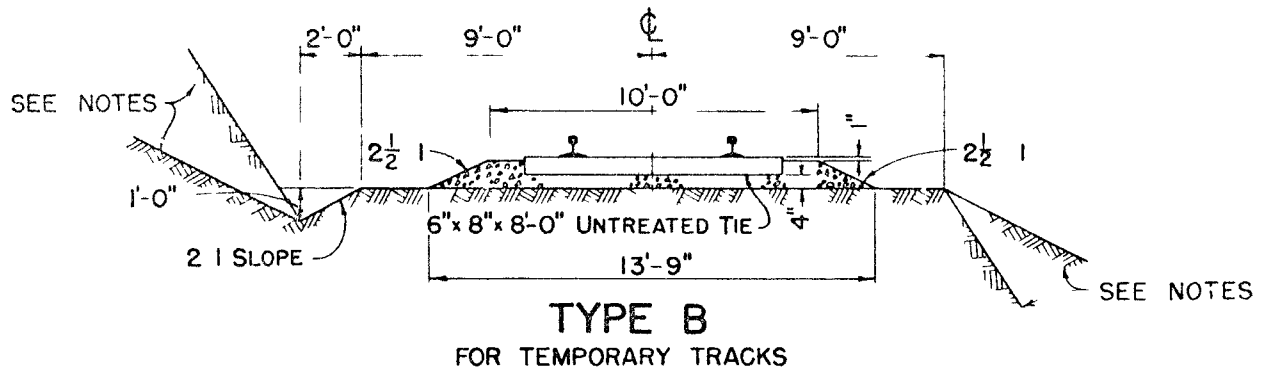
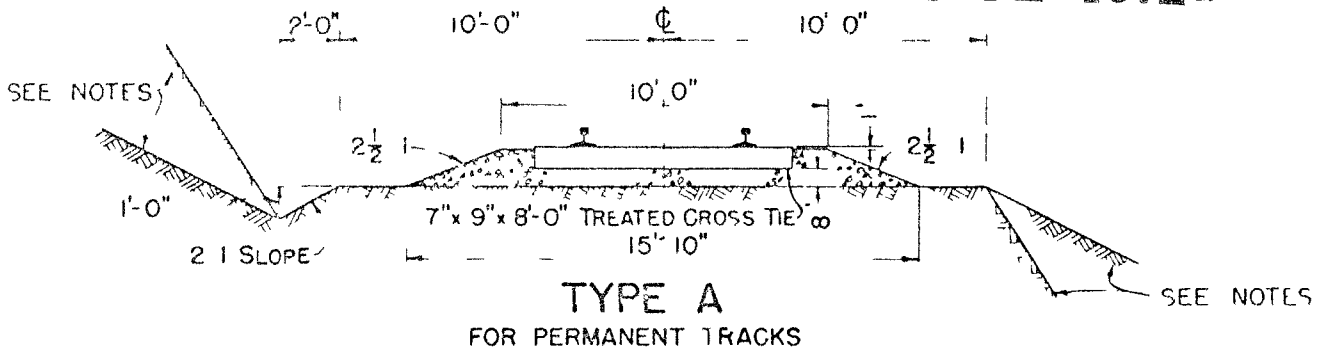
RAILROADS

Increase 2" per degree  
of curvature on curves



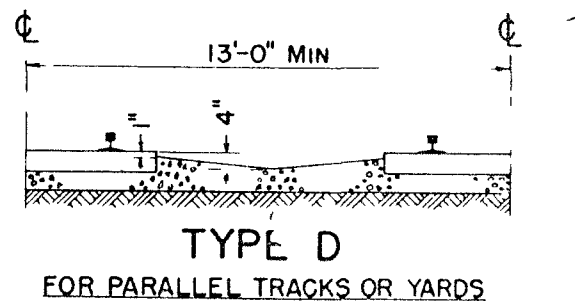
Not for use in construction contracts

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
1	Note 3	hes	12-4-61		hes	fhs
APPROVED BY ENGINEERING STANDARDS COUNCIL <u>H. E. Struck</u> SECRETARY, DATE <u>2-1-61</u>				STANDARD CLEARANCES FOR RAILROAD TRACKS	AC-7-1	



NOTES:

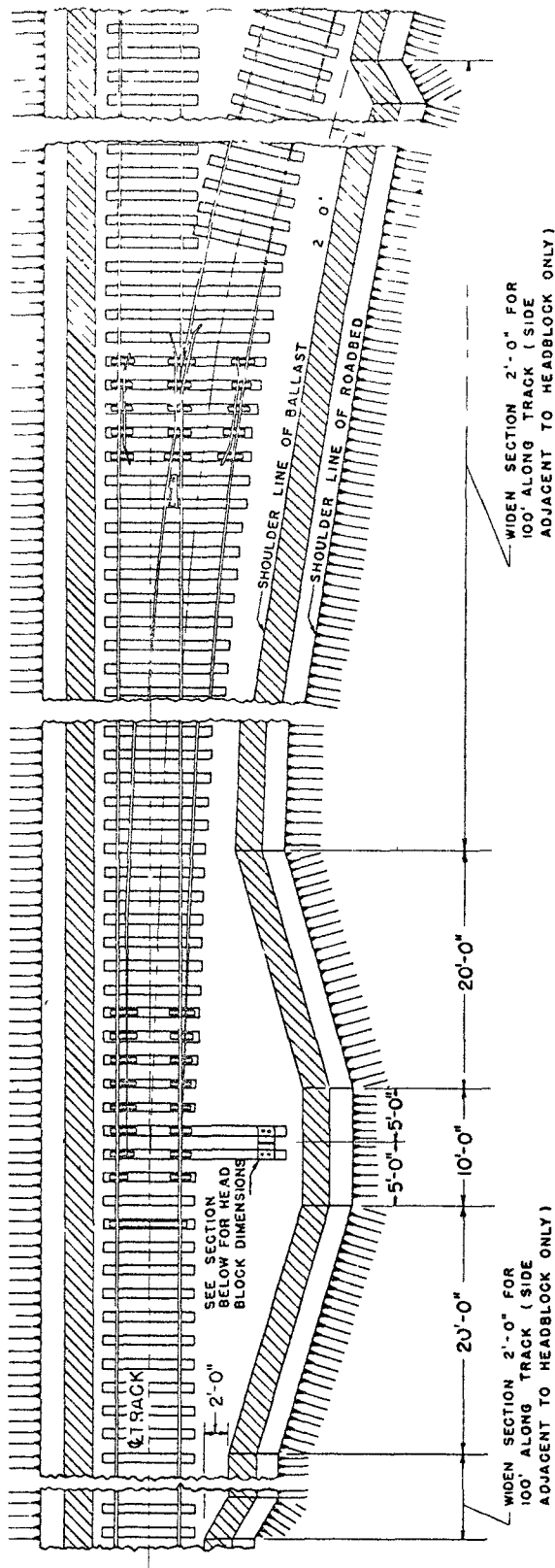
1. Widen subgrade and ballast sections around all switch stand locations per Standard AC-7-3.
2. Embankment slopes shall be 1-1/2: 1 in earth or stable materials and 2:1 in sand or light soil.
3. Excavation shall be sloped 2:1 in sand; 1-1/2: 1 in earth; 1/2: 1 in rock.
4. Slopes formed with sand or light soils shall be stabilized or otherwise protected from wind erosion.
5. Slopes in any one cut or fill are to be carried through without change.
6. Embankment or excavation slopes shall be designated on the construction drawings.



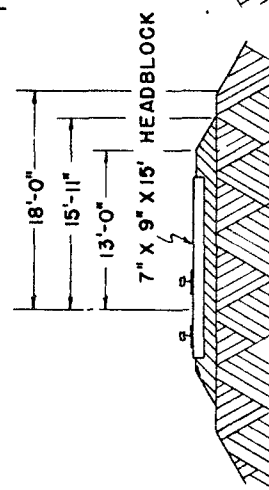
Supersedes Std E-5-15c

Ref Hanford Stds: AC-7-3

NO	REVISION	APP D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM BY	DES BY
				RAILROAD CROSS-SECTIONS		hes	
APPROVED BY ENGINEERING STANDARDS COUNCIL						AC-7-2	
H. E. Struck SECRETARY DATE 2-1-61							

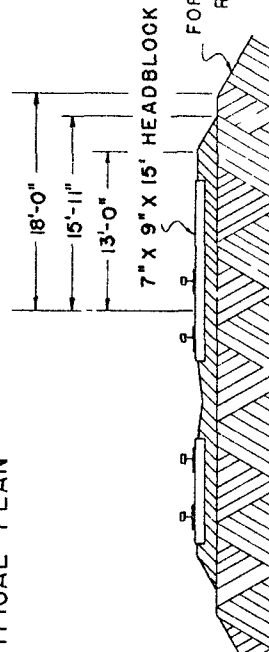


TYPICAL PLAN



SECTION THRU ROADBED AT HEADBLOCK

SINGLE TRACK



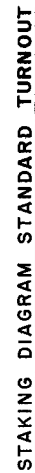
SECTION THRU ROADBED AT HEADBLOCK

DOUBLE TRACK

Supersedes Std E-5-15d

Ref Hanford Stds: AC-7-2

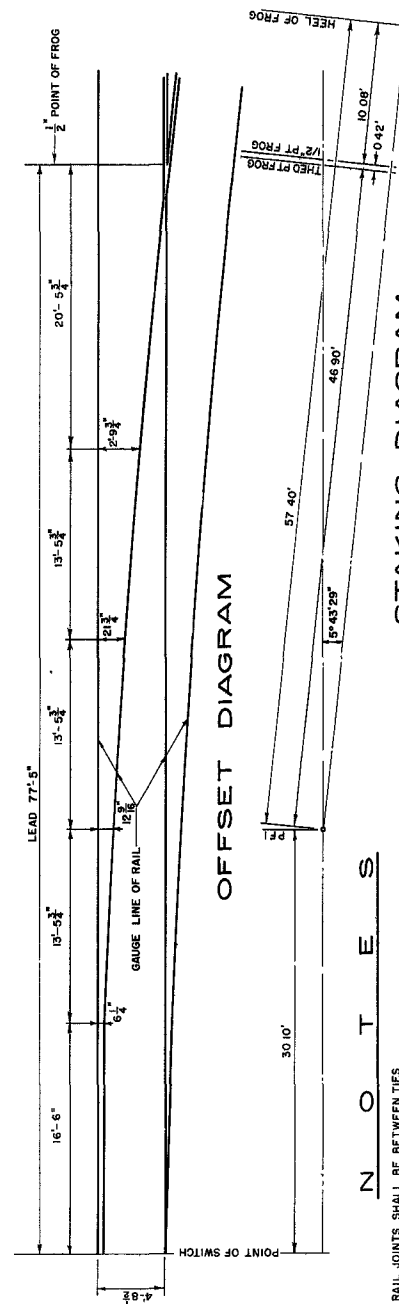
NO.	REVISION	APP D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM. BY	DES. BY
				WIDENING AT RAILROAD TURNOUTS		hes	
APPROVED BY ENGINEERING STANDARDS COUNCIL						AC-7-3	
H. E. Struck SECRETARY. DATE 2-1-61							

NOTES

1. ALL RAIL JOINTS SHALL BE BETWEEN TIES
2. JOINTS IN THE SAME TRACK WITHIN THE TURNOUT SHALL BE STAGGERED A MINIMUM OF TWO TIES.
3. NO COMPROMISE JOINTS SHALL BE INSTALLED WITHIN A FULL RAIL LENGTH OF THE TURNOUT.
4. COMPROMISE JOINTS ON BOTH RAILS SHALL BE MADE BETWEEN THE SAME TIES.
5. NO RAIL SHORTER THAN 15 FEET WILL BE PERMITTED.
6. IN THE ABSENCE OF SWITCH PLATES BEHIND THE HEEL BLOCK, TWIN TIE PLATES SHALL BE INSTALLED FOR 5 TIES BEHIND THE HEEL OF SWITCH.
7. PLATE IDENTIFICATION AS SHOWN TO BE USED ONLY AS A GUIDE. REFER TO VENDORS DRAWING FOR ACTUAL IDENTIFICATION NUMBERS.

Ref Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					lrr	clw
APPROVED BY ENGINEERING STANDARDS COUNCIL				TURNOUT 15'-0" SWITCH AND NO. 8 FROG	AC-7-4	
H. E. Struck SECRETARY, DATE 11-18-60						



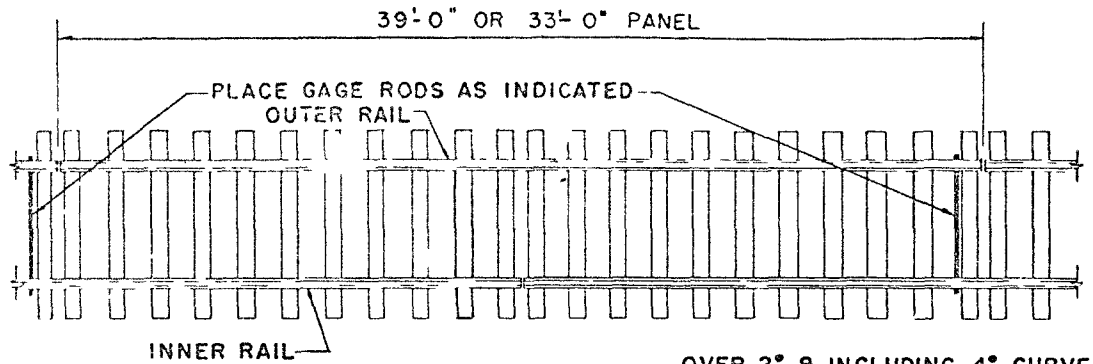
LENGTH	NO. REQD.	LENGTH	NO. REQD.
8'-6"	8	12'-6"	33
9'-0"	6	13'-0"	33
9'-6"	4	13'-6"	33
10'-0"	4	14'-0"	33
10'-6"	4	14'-6"	33
11'-0"	5	15'-0"	33
11'-6"	4	15'-6"	33
12'-0"	3	16'-0"	33

NOTE: 7"x9" SWITCH TIES TO BE USED

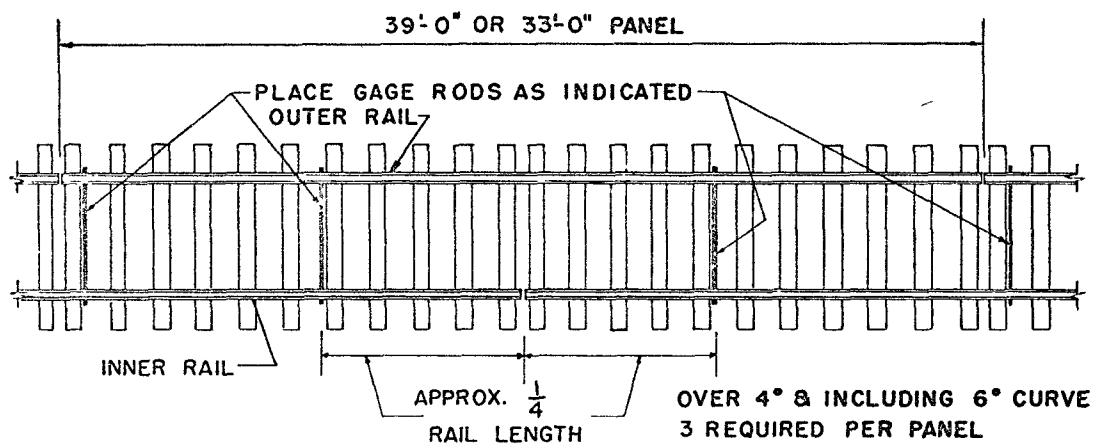
## STAKING DIAGRAM

S  
 W  
 T  
 O  
 Z

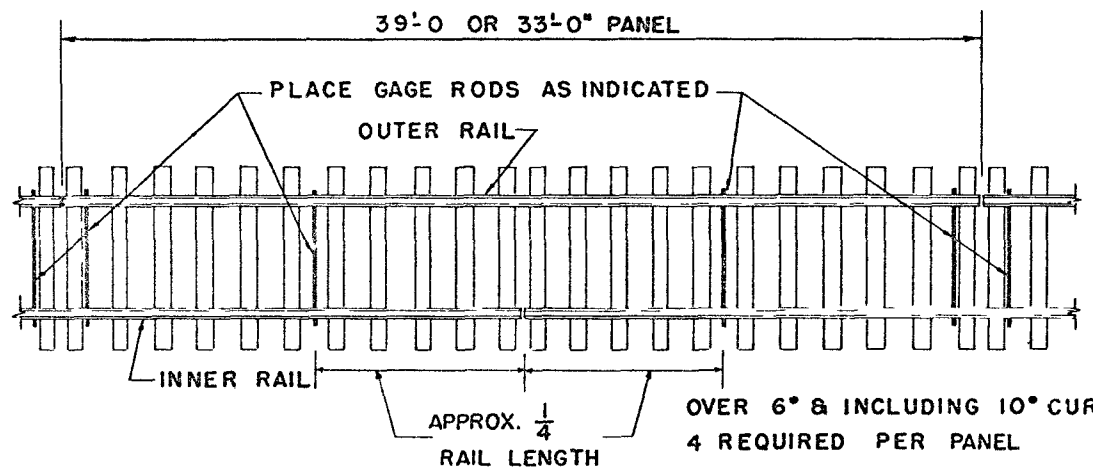
NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					1rr	clw
APPROVED BY ENGINEERING STANDARDS COUNCIL				TURNOUT 16'- 6" SWITCH AND NO. 10 FROG	AC-7-5	
<u>H. E. Struck</u> SECRETARY, DATE <u>11-18-60</u>						



OVER 2° & INCLUDING 4° CURVE  
1 REQUIRED PER PANEL



OVER 4° & INCLUDING 6° CURVE  
3 REQUIRED PER PANEL



OVER 6° & INCLUDING 10° CURVE  
4 REQUIRED PER PANEL

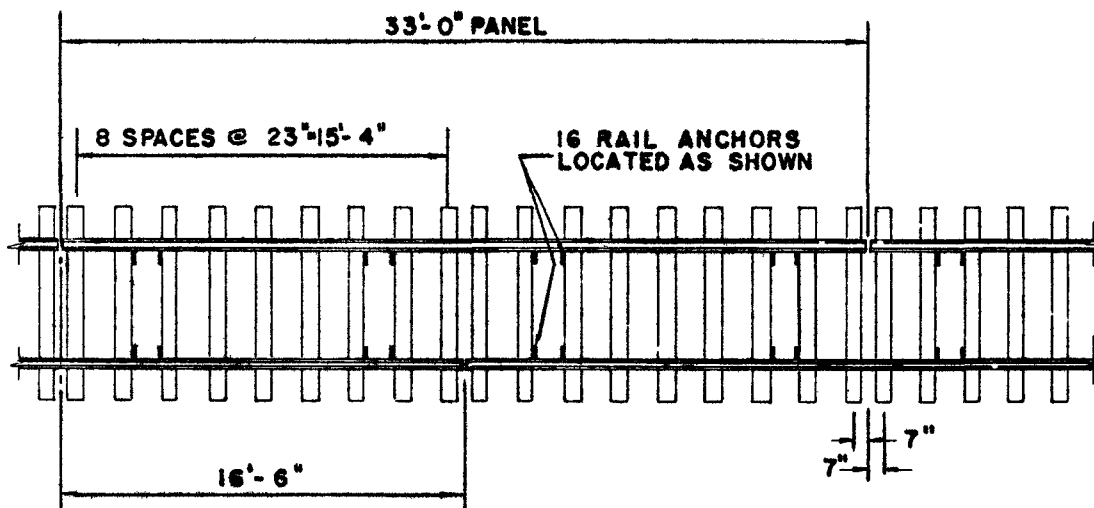
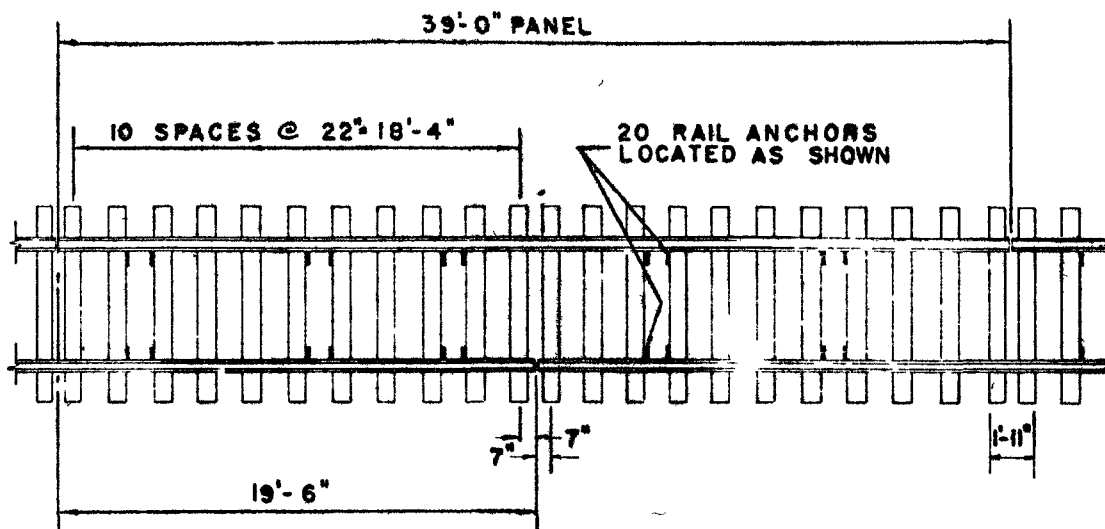
NOTE:

Gage rods shall be Bethlehem No. 855-F (non-insulated) or approved equal.

Supersedes Std E-5-15e

Ref Hanford Stds: None

NO	REVISION	APP D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM BY	DES BY
						hes	wlg
APPROVED BY ENGINEERING STANDARDS COUNCIL				RAILROAD GAGE RODS		AC-7-6	
H. E. Struck SECRETARY DATE 2-1-61							



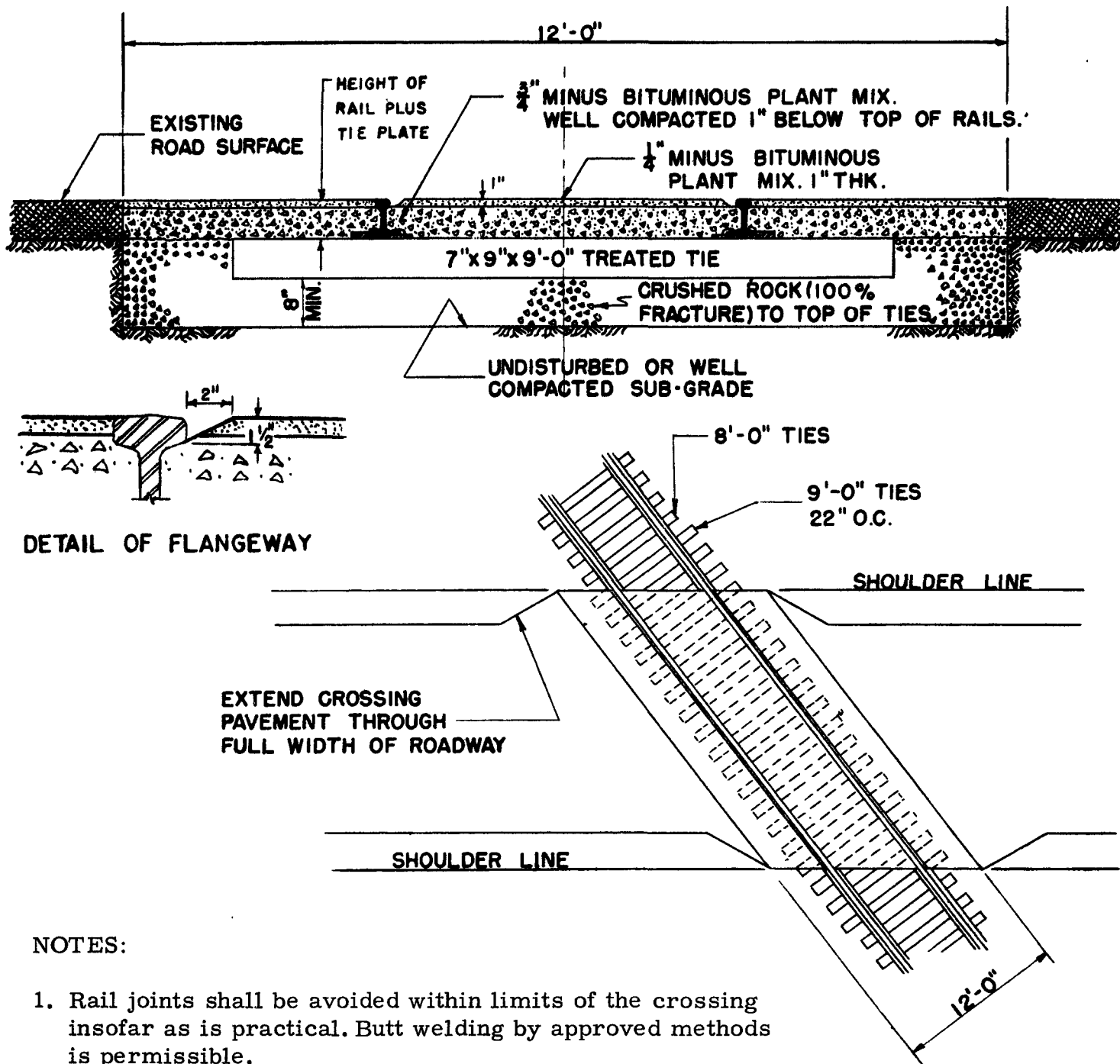
**NOTE:**

Rail anchors shall be P&M Company "Improved Fair Rail Anchor" or approved equal.

**Supersedes Std E-5-15f**

Ref Hanford Stds: None

NO	REVISION	APP D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	wlg
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY DATE 2-1-61				RAIL ANCHORS	AC-7-7	



NOTES:

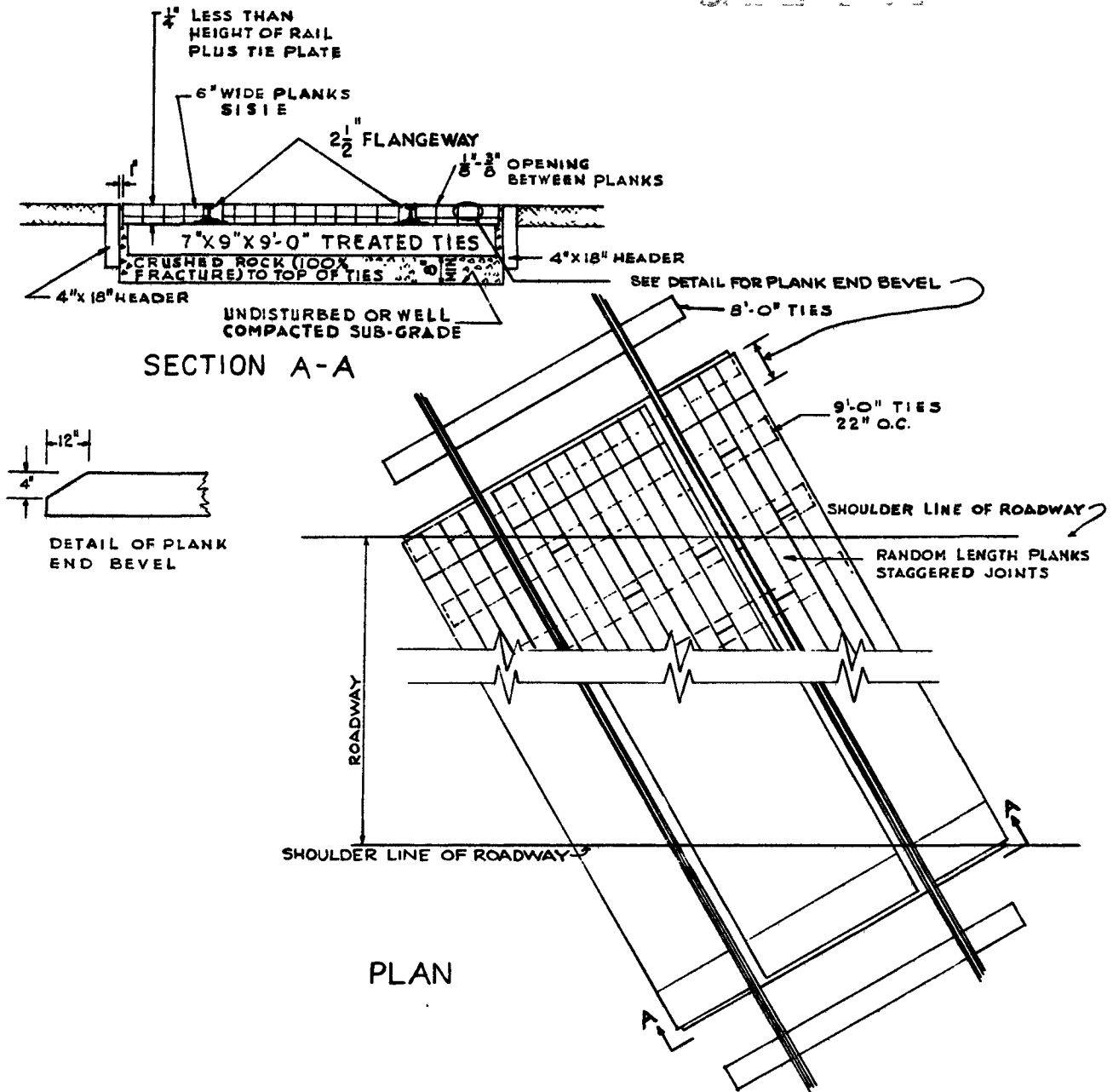
1. Rail joints shall be avoided within limits of the crossing insofar as is practical. Butt welding by approved methods is permissible.
2. Ample drainage for track and highway shall be provided.
3. Before blacktop is placed the track shall be in good surface (i. e. firmly bedded and tamped to maintain true grade and alignment) and have had a minimum of one train passed over it.
4. Flangeway shall be shaped as shown in detail to prevent heaving or ravelling. Rough cuts shall be hand tamped.

Supersedes Std. E-5-31

Ref Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM. BY	DES. BY
						hes	fhs
APPROVED BY ENGINEERING STANDARDS COUNCIL				RAILROAD CROSSING		AC-7-20	
H. E. Struck SECRETARY, DATE 11-18-60							

C-111. 225



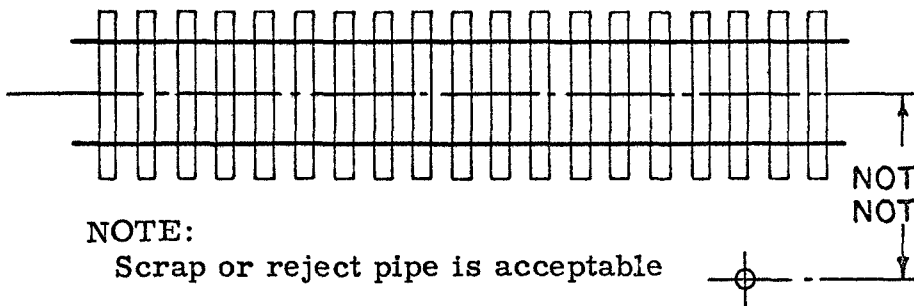
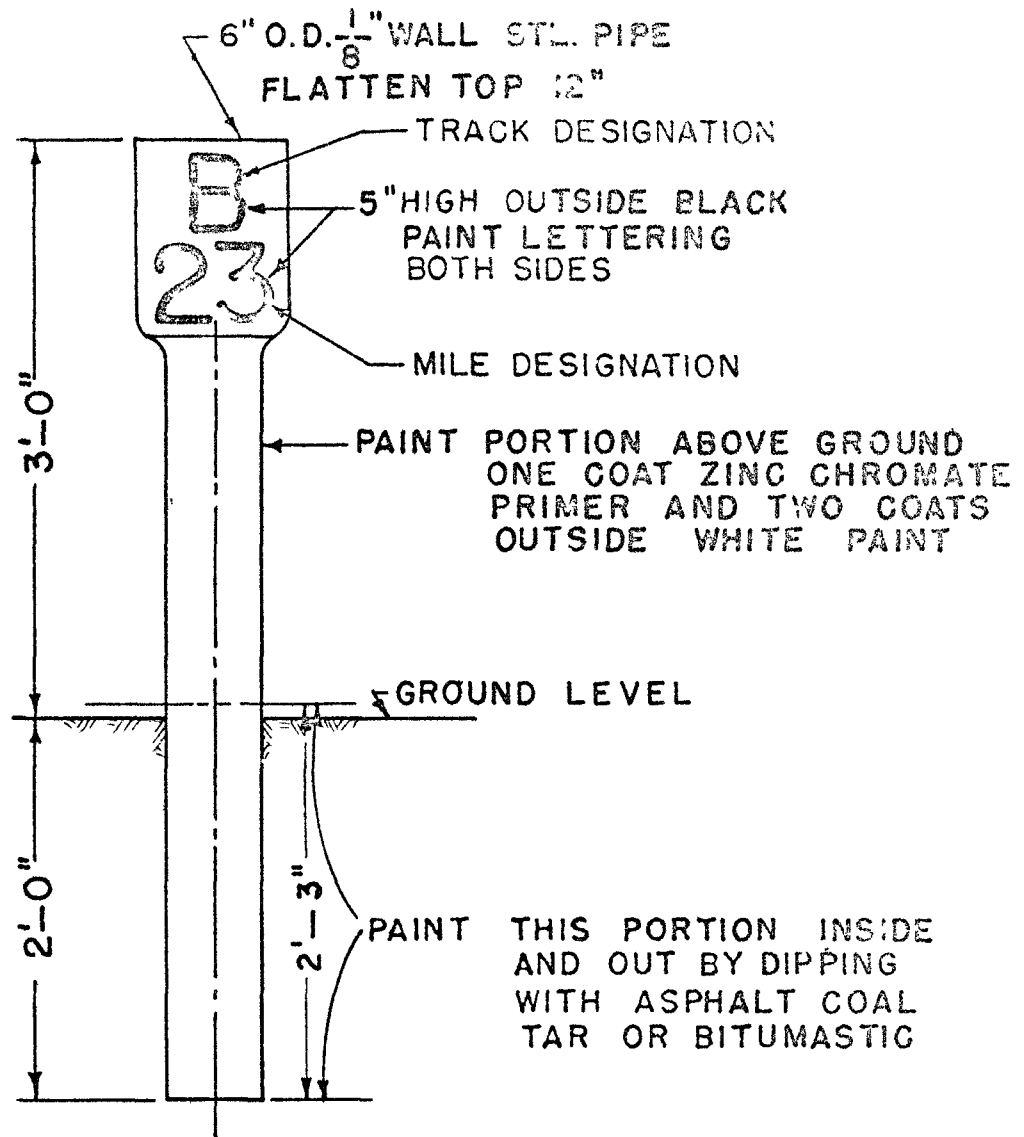
**NOTES:**

1. All beveling and sawing shall be done before treatment.
2. Planks and headers shall be Douglas Fir "Standard" grade (WCLIB Rules No. 15) pressure treated with creosote in accordance with American Wood-Preservers' Association Standard C2. Retention of creosote shall be 8 lbs. per cu. ft. min.
3. Each plank shall be spiked down at its ends and to alternate ties with two 3/8" sq. x 11" boat spikes per end and per tie, driven diagonally. Plank ends shall be bored for spikes.
4. Plank joints shall be centered on ties. Joints in adjacent planks shall not be on the same tie.

Supersedes Std. E-5-32

Ref Hanford Stds: None

NO	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM. BY	DES. BY
						hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL				WOOD PLANK RAILROAD CROSSING		AC-7-21	
H. E. Struck SECRETARY, DATE 11-18-60							

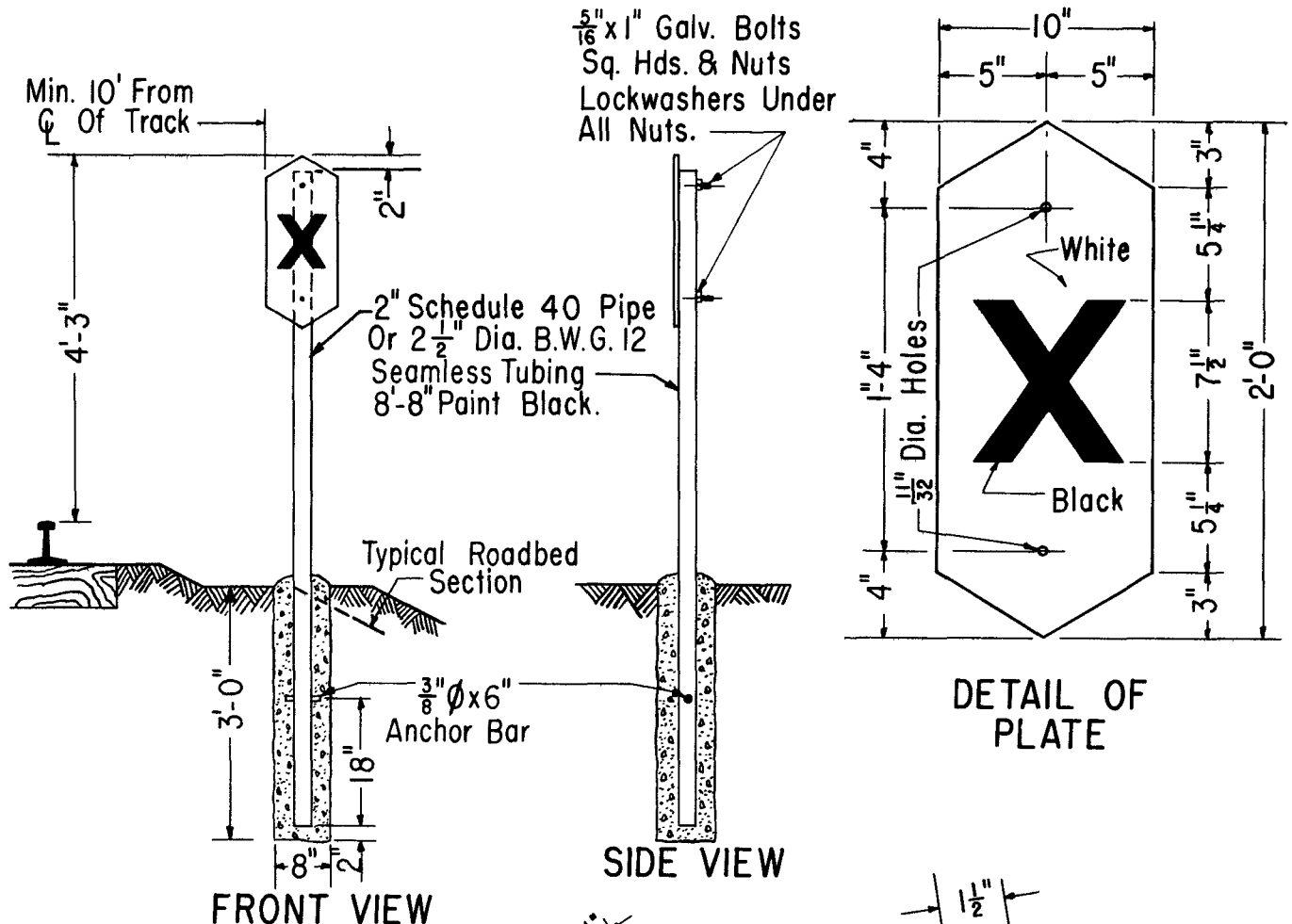


Supersedes Std E-5-39

Ref Hanford Stds: None

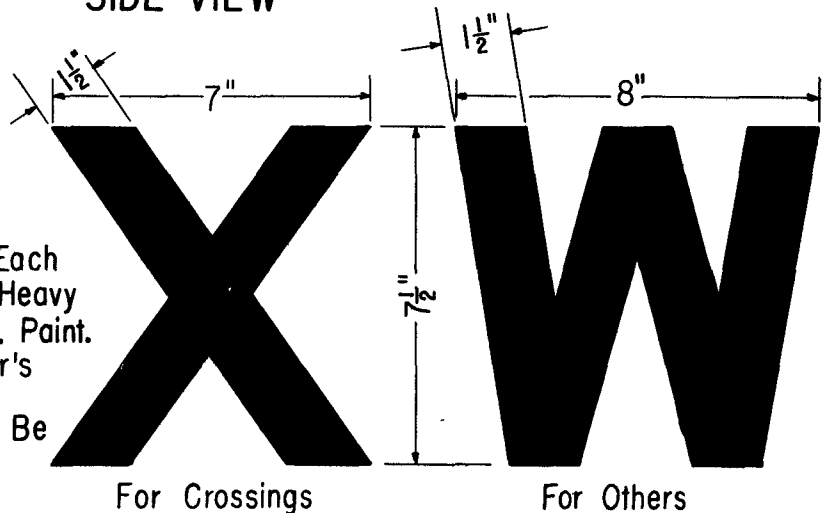
NO	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM BY	DES BY
						hes	fhs
APPROVED BY ENGINEERING STANDARDS COUNCIL				RAILROAD MILE POST		AC-7-30	
H. E. Struck SECRETARY. DATE 2-1-61							

WHISTLE POST 227



**NOTES:**

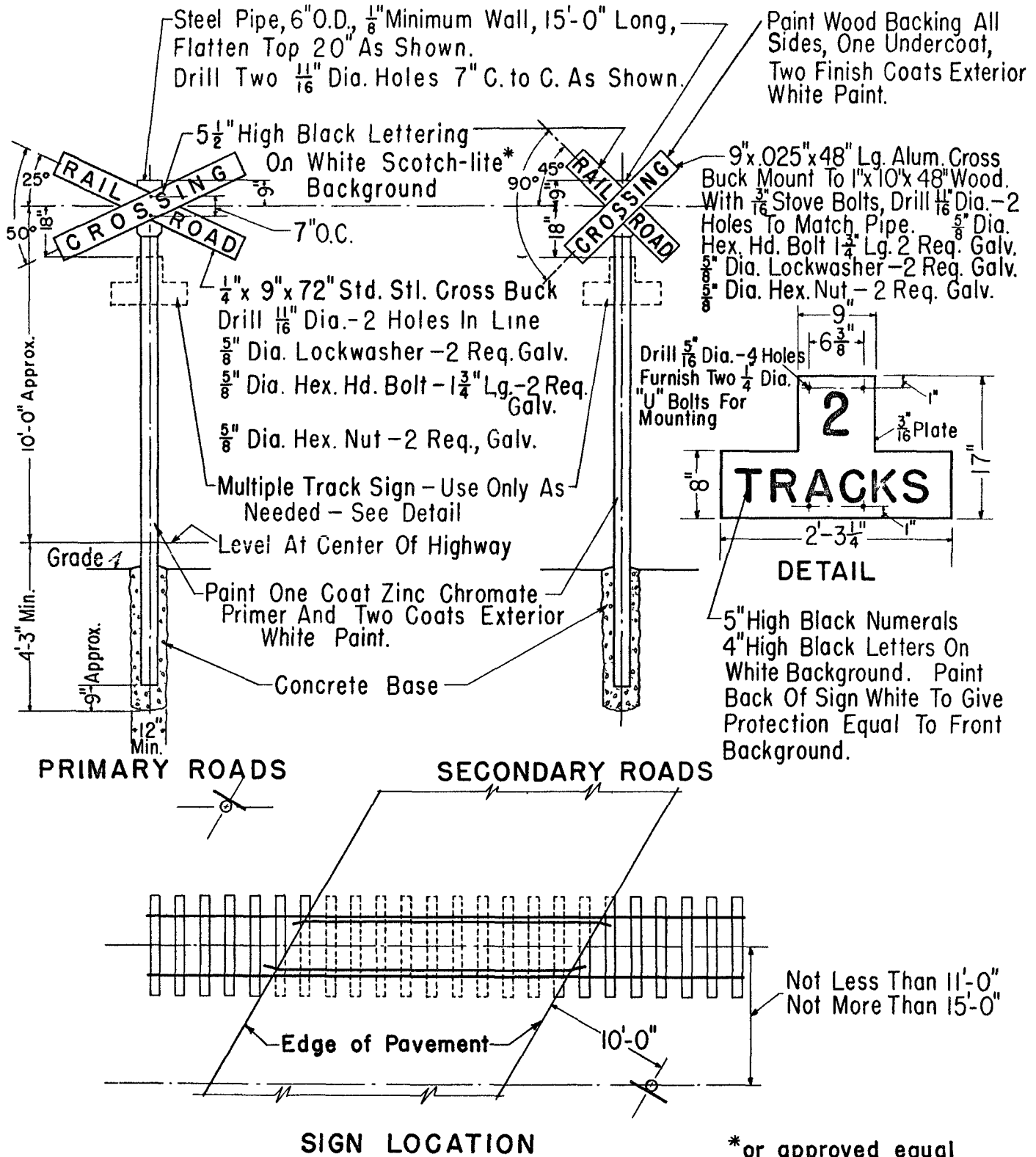
1. Sign To Be 16 Gauge Sheet Metal.
2. Finish To Consist Of At Least One Primer Coat And Two Coats Of Background Color. The Back Of Each Sign Shall Be Given At Least One Heavy Coat Of Background Color Or Alum. Paint.
3. All Signs To Be Located On Engineer's Side.
4. Signs For Crossings, Tunnels Etc. To Be 1/4 Mile In Each Direction From Warning Point.
5. Finish Background Of Face Of Sign With "SCOTCHLITE" or approved equal.



Supersedes Std C-5-29

Ref Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM. BY	DES. BY
						cel	
APPROVED BY ENGINEERING STANDARDS COUNCIL				WHISTLE POST		AC-7-31	
H. E. Struck SECRETARY. DATE 10-28-60							

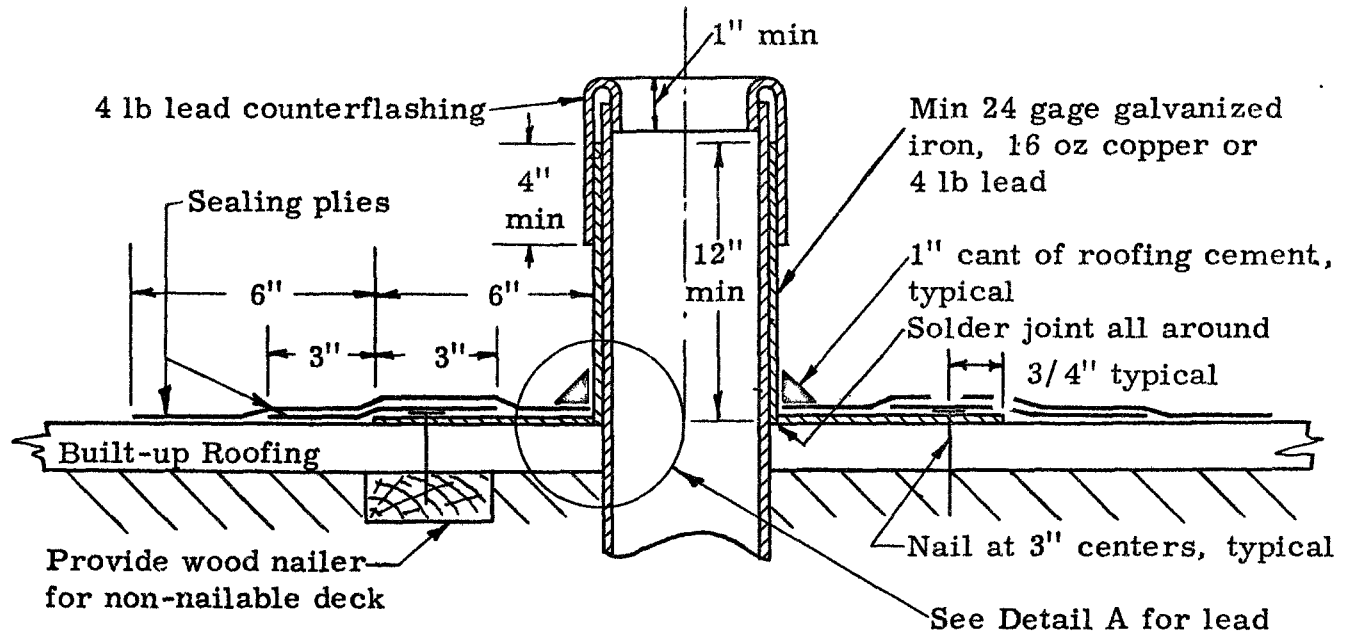


Supersedes Std C-5-17

Ref Hanford Stds: None

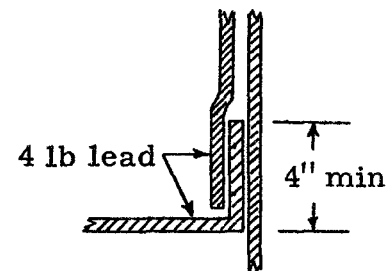
NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM BY	DES. BY
				RAILROAD - HIGHWAY CROSSING SIGN		cel	
APPROVED BY ENGINEERING STANDARDS COUNCIL						AC-7-32	
H. E. Struck SECRETARY. DATE 10-28-60							

CAPE - 1072 - 229



**NOTES:**

1. Installation shall conform to HWS-6144-S; 6145-S; 6146-S; 6147-S; 6148-S or 6149-S.
2. Nails shall be 1-1/2" long, 10 gage, hot-dipped galvanized.

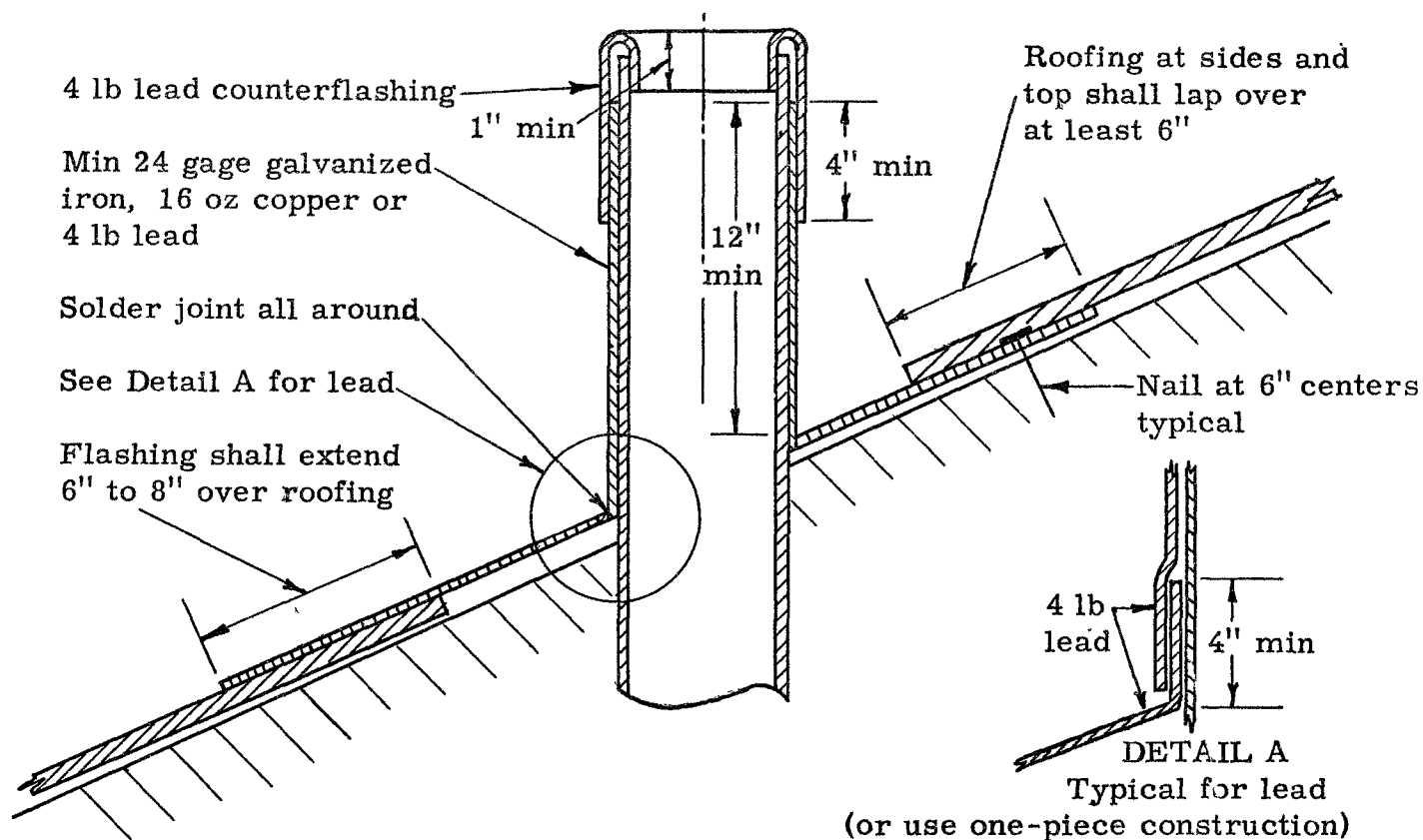


DETAIL A  
Typical for lead  
(or use one-piece construction)

Supersedes Std C-2-46

Ref Hanford Stds: See Note 1

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	ae
APPROVED BY ENGINEERING STANDARDS COUNCIL <u>H. E. Struck</u> SECRETARY. DATE <u>5-15-61</u>				FLASHING FOR VENT PIPES BUILT-UP ROOF	AC-8-1	



NOTE:

Nails shall be 1-1/2" long, 10 gage, hot-dipped galvanized.

Supersedes Std C-2-46

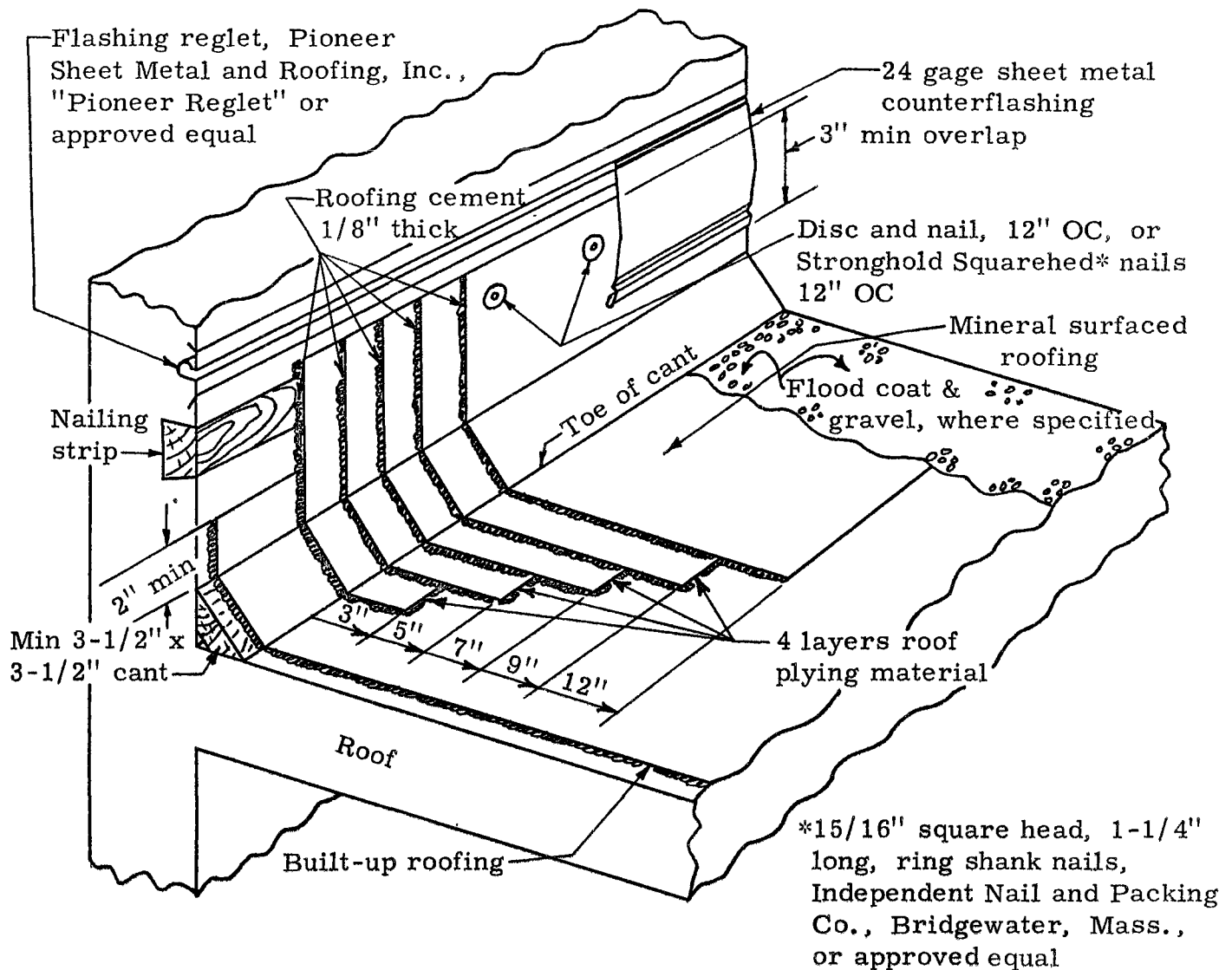
Ref Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
					hes	aee
APPROVED BY ENGINEERING STANDARDS COUNCIL				FLASHING FOR VENT PIPES SHINGLE ROOF	AC-8-2	
<u>H. E. Struck</u> SECRETARY, DATE <u>5-15-61</u>						



- Ref. Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
1	Flg dim., drip	hes	9-1-61		hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 8-4-61				ROOF EDGING FOR BUILT-UP ROOFS	AC-8-3	

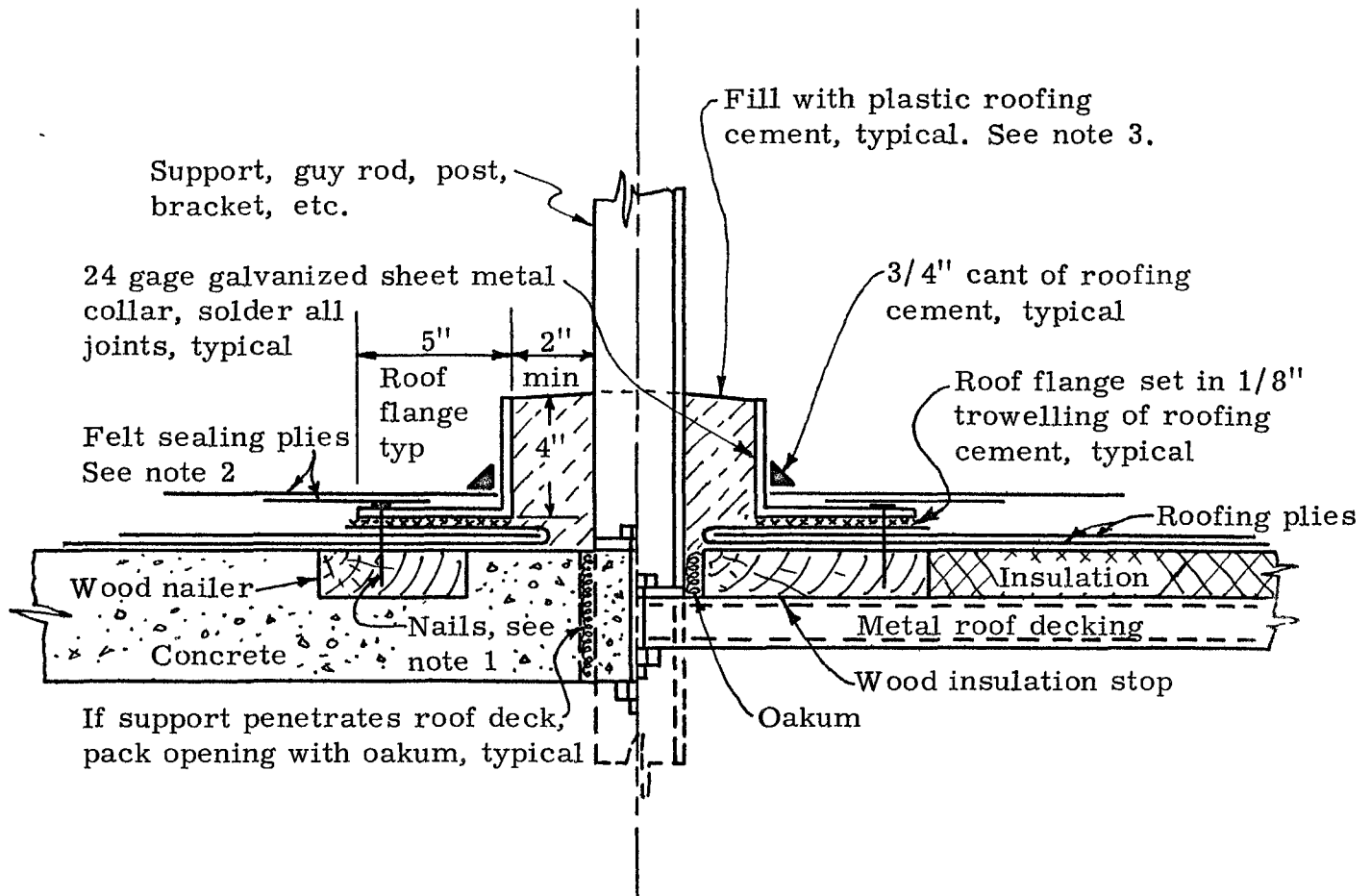


NOTES:

1. The 4 layers of roof plying material shall be applied in a 1/8" thick continuous trowelling of roofing cement full width of each ply. Each ply shall be carefully pressed into cement to eliminate buckles and blisters. Plies shall be applied in strips not over 10 feet long with staggered 3-inch end laps sealed with roofing cement. Mineral surfaced roofing shall be cut in strips across the roll. Selvage shall be trowelled with roofing cement and overlapped by the next piece. Water shall flow over, not against, lap edges.
2. Joints in counterflashing shall be lapped 4 inches.

Ref. Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM BY	DES. BY
				FLASHING FOR BUILT-UP ROOFS		hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL						AC-8-4	
H. E. Struck SECRETARY DATE 8-4-61							



NOTES:

1. Nail roof flange using 1-1/2" long, 10 gage, hot-dipped galvanized nails 3" on centers, 3/4" from edge of flange. For existing concrete roof decks where no nailer is provided, nails may be omitted.
2. Roof flange shall be sealed to roof with two plies of plying material used in the built-up roof, mopped solidly to roof and flanges with hot bitumen. The first ply shall cover approximately one-half the flange width and shall extend onto the roof 3 inches beyond edge of flange. Second ply shall cover full width of roof flange and shall extend onto roof 6 inches beyond edge of flange.
3. For wood decks, fill about one inch deep with plaster of paris or portland cement mortar before placing roofing cement.

Ref Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM BY	DES. BY
					hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL				PITCH POCKET FOR BUILT-UP ROOF	AC-8-5	
H. E. Struck SECRETARY, DATE 9-1-61						

CAPE-1072- 235

INSTRUCTIONS FOR USE OF  
STANDARD SPECIFICATION HW-4680-S, CHAIN LINK SECURITY FENCE

When Standard Specification HW-4680-S is used, the design engineer shall specify the additional requirements for the work involved. Listed below are some of the requirements which must be stated in accompanying specifications. (The items below should not be considered a complete list of all the requirements. Each job must be reviewed and considered separately.)

1. FENCE HEIGHTS AND ELECTRICAL SUBSTATION FENCING

Standard Specification HW-4680-S is primarily intended as a specification for security fencing. All chain link fencing for security purposes must be 8 foot high fabric plus 1 foot (3 strands) of barbed wire topping.

However, the specification can easily be adapted to electrical substation fencing. When used for this purpose the fence height, if different from the 9 foot total required by the specification, must be specified in the accompanying specifications. The following listing is a guide for fence heights around electrical substations.

- a. Electrical substations outside of perimeter fencing and all 230 KV substations: 8 foot fabric plus 1 foot (3 strands) barbed wire topping. (See instructions under 2. following.)
- b. Electrical substations inside perimeter fencing (except 230 KV substations) and fences within a 230 KV substation fence: 6 foot fabric without barbed wire topping. (See instructions under 3. following.)

2. SPECIFYING AN 8 FOOT FENCE FOR ELECTRICAL SUBSTATIONS

When specifying the 8 foot fabric plus 1 foot (3 strands) barbed wire topping for electrical substation fencing, the following statement should be inserted in the job specifications:

"Chain link fence around substation(s) shall be located as shown on the drawings. Material and installation shall be in accordance with Hanford Standard Specification HW-4680-S, Chain Link Security Fence, and Hanford Standards D-3-5 and D-3-5a, Substation Fence Grounding".

Supersedes DI-1-C

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM. BY	DES BY
3	Item 4	hes	5-1-61			hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL				INSTRUCTIONS FOR USE OF HW-4680-S		DI-4680-S	
H. E. Struck SECRETARY DATE 8-30-54							

HW-4680-S

STANDARD SPECIFICATION

for

CHAIN LINK SECURITY FENCE

Supersedes Std E-5-17

Ref Hanford Stds: AC-5-20, D-3-5, D-3-5a

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
3	General Revision	hes	5-1-61		hes	fhs
APPROVED BY H. W. STANDARDS COMMITTEE G. A. Fluke SECRETARY, DATE 5-31-51				CHAIN LINK SECURITY FENCE	HW-4680-S	

STANDARD SPECIFICATION FOR CHAIN LINK  
SECURITY FENCE

1. SCOPE

This specification covers materials for and installation of new or replacement chain link security fence.

2. MATERIAL

2.1 COATING

All fence parts shall have a firmly adhering zinc coating of uniform thickness. The coating shall weigh not less than 1.2 ounces per square foot of surface and shall withstand six one-minute dips by the PREECE copper sulphate method of testing, as outlined in ASTM Designation: A239-41. Coating shall be applied to all parts after fabrication.

2.2 FABRIC

- a. Fence fabric shall be two inch woven diamond mesh, chain link, of standard commercial grade steel wire. Wire shall be size No. 9 W & M gauge.
- b. The top and bottom selvages of the fabric shall have a twisted and barbed finish for greater security protection. The barbing shall be done by cutting the wire at an angle, producing sharp points. The total height of the fabric shall be eight feet, plus or minus 3/4 inch.

2.3 POSTS

a. Line Posts

Line posts shall be one of the three following types, but all posts used in any one job shall be of the same type:

Type 1 - "H" column section, 2" x 2-1/4", weighing 4.10 pounds per lineal foot.

Type 2 - Wing channel section, approximately 2-7/8" x 2-1/4", weighing 3.65 pounds per lineal foot.

Type 3 - Pipe section, 2-1/2" OD, weighing 3.65 pounds per lineal foot.

b. Terminal Posts

1. End posts, corner posts and posts set at a break in grade, shall

be standard commercial grade steel pipe, 3" OD, weighing 5.79 pounds per lineal foot.

2. Gate posts shall be standard commercial grade steel pipe, sized according to the following chart:

Gate Opening		Post	Weight Per
<u>Single Swing</u>	<u>Double Swing</u>	<u>Size</u>	<u>Lineal Foot</u>
Up to 6 ft	Up to 12 ft	3" OD	5.79 pounds
6 ft to 13 ft	12 ft to 26 ft	4" OD	9.11 pounds
13 ft to 18 ft	26 ft to 36 ft	6-5/8" OD	18.97 pounds
Over 18 ft	Over 36 ft	8-5/8" OD	28.50 pounds

Gate posts shall extend 12 inches above the top of the fabric for attachment of barbed wire, and shall be fitted with a ball top or similar fitting to shed water.

#### 2.4 EXTENSION ARMS

Arms on line posts for attachment of barbed wire above the fence fabric shall be made of pressed steel or other approved material with a base shaped to fit the top of the line posts being used. Arms for end, corner, and break-in-grade posts shall be made of malleable iron. Each arm shall carry three strands of barbed wire and shall be designed so that the top strand of barbed wire is twelve inches above the fabric. Arms shall extend at an angle of 45 degrees outward.

#### 2.5 TOP TENSION WIRE

The top tension wire shall be No. 7 W & M gauge, hot-dip galvanized, standard commercial grade steel.

#### 2.6 POST BRACES

Braces for terminal posts shall be hot-dip galvanized, standard commercial grade steel pipe, 1-5/8" OD, weighing 2.27 pounds per lineal foot.

#### 2.7 BARBED WIRE

Each strand of protection barbed wire shall consist of two No. 12-1/2 W & M gauge, hot-dip galvanized, standard commercial grade steel wires, with four point barbs spaced not less than three inches nor more than five inches apart.

#### 2.8 FABRIC TIES

Fence fabric shall be fastened to line posts with galvanized bands or galvanized steel wire ties of No. 9 W & M gauge or larger wire.

## 2.9 MISCELLANEOUS FITTINGS

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All other fittings used in the construction of the fence shall be malleable iron, cast iron, or pressed steel and shall be hot-dip galvanized.

## 2.10 GATES

- a. Swing gate frames shall be fabricated from 2" OD hot-dip galvanized, standard commercial grade steel pipe weighing 2.72 pounds per lineal foot. The end members of the frame shall extend 12" above the top horizontal member of the frame and shall be fitted to carry 3 strands of barbed wire. All open ends of pipe members in gate frames shall be fitted with a pipe plug. Gate frame corner fittings, if used, shall be of malleable iron. If gate frames are of welded construction they shall be hot-dip galvanized after fabrication. All gate frames shall be rigidly braced to prevent sagging, buckling and weaving.
- b. Fabric for gates shall be the same as specified for the fence.
- c. Swing gate hinges shall be of the offset type designed to allow the gate a minimum of 180 degrees swing. The lower hinge shall be either the ball and socket type or the offset peg type of heavy construction to relieve strain on the upper hinge.
- d. All single gates under 8 feet in width shall be provided with latches of the double locking type and shall have padlock attachment. All single gates over 8 feet shall be provided with a locking chain as shown on Hanford Standard AC-5-20, Standard Security Chain Link Gate. Each gate of double swing gates shall be provided with a center gate rest and plunger attachment, conforming to detail shown on Standard AC-5-20, allowing either gate to be securely closed while the other is opened. A plunger bar catch, designed to hold the gate firmly in the open position, shall be installed for each leaf of each gate.
- e. All miscellaneous fittings used in the construction of swing gates shall be malleable iron, cast iron, or pressed steel, and shall be hot-dip galvanized after fabrication.

## 2.11 CONCRETE

The concrete used for setting posts shall develop a minimum compressive strength of 2000 pounds per square inch at 28 days.

## 3. INSTALLATION

### 3.1 GENERAL

The fence shall be installed true to line and grade in the location shown on

the plans and in accordance with these specifications. The fence shall be erected in accordance with the manufacturer's recommended erection procedure.

### 3.2 SETTING POSTS

- a. All gate posts shall be set a minimum depth of 4 feet in concrete footings. All other posts shall be set a minimum depth of 3 feet in concrete footings. Concrete footings shall extend 6 inches below bottom of posts and shall be crowned to shed water. All line posts shall be set 7 feet, 9 inches above grade. Gate posts shall be set 9 feet above grade and other terminal posts shall be set 8 feet above grade.
- b. Holes for line posts shall be from 8 inches to 12 inches in diameter and holes for end, gate and corner posts, from 10 inches to 17 inches in diameter.
- c. The line posts adjacent to the terminal posts, which are the brace posts, shall be set exactly at the spacing required to make the horizontal braces fit properly. A terminal post shall be set at each break in the fence line grade.
- d. In setting gate posts, the posts must be set at the exact spacing shown on the plans. For example, posts for a six-foot gate must be set so as to leave a clear opening of six feet. The tops of gate posts at each gate must be at the same elevation regardless of the grade at the ground line.
- e. All posts shall be firmly supported to prevent movement or deflection until concrete has thoroughly set (24 hours, minimum).

### 3.3 ATTACHING AND STRETCHING FABRIC

- a. Stretcher bars shall be threaded through end loops of each section of fabric and tied to end, break-in-grade, corner and gate posts with stretcher bar bands spaced not more than 18" on centers.
- b. The fabric shall be fastened to the line posts with ties spaced not more than 14" on centers. The topmost tie shall be as near the top of the fabric as possible, the lowest tie as near the bottom of the fabric as possible.
- c. The fabric shall be tied to the top tension wire with ties spaced not more than 24" on centers.
- d. The fence fabric shall be stretched tight.

- e. The barbed ends of the barbed top fabric shall be dressed approximately two to three inches above the top tension wire. Each barb shall be straightened as needed so that they present an unbroken line above the top wire.
- f. The bottom of the fabric shall extend to within 2 inches of the firm finished grade.

#### 3.4 ATTACHING BARBED WIRE

On line posts the barbed wire shall be placed in the slots provided in the extension arms and either pinned in place or securely tied.

#### 3.5 INSTALLATION OF GATES

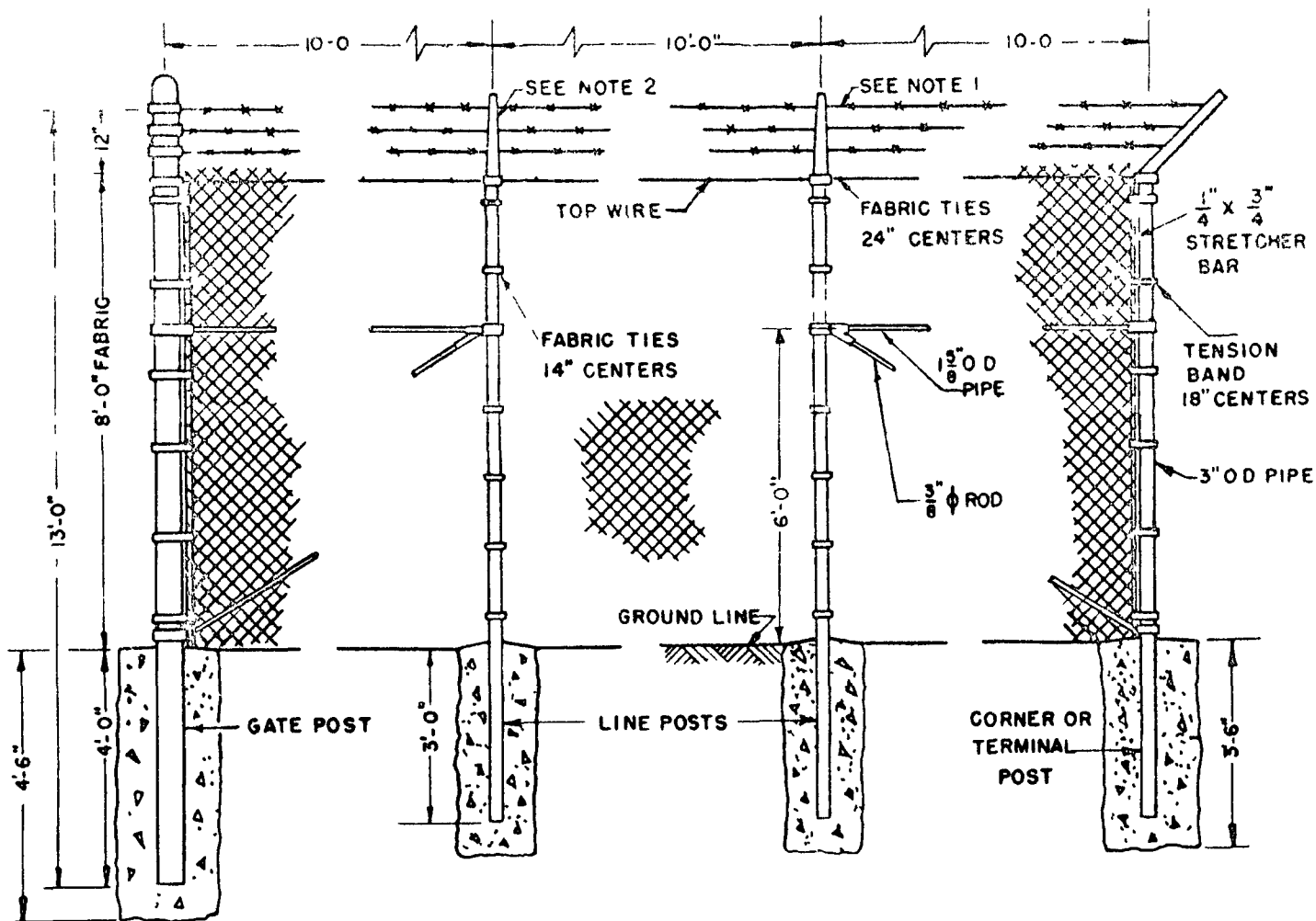
Gates shall be installed in accordance with this specification and Hanford Standard AC-5-20, Standard Security Chain Link Gate. Gates shall be installed so they are in good alignment and swing and latch properly. Gate hinges shall be adjusted so that gates swing inward and outward at an angle totaling 180 degrees or more.

#### 3.6 BOLT HEADS

All bolt heads shall be turned to the outside of the fence.

#### 3.7 GROUNDING

Fences shall be grounded at power line crossings in accordance with Electrical Standards D-3-5 and D-3-5a, Substation Fence Grounding. Grounding of fences parallel to power lines or at other required locations shall be as shown on the plans.



NOTES:

1. Three strands four-point barbed wire.
2. Barbed wire bracket slanted from interior 45° from vertical.

CHAIN LINK SECURITY FENCE DETAILS

PLATE I

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INSTRUCTIONS FOR USE OF HW-4798-S

STANDARD SPECIFICATION FOR PLACING REINFORCED CONCRETE

When Specification HW-4798-S is used, the user must specify the additional requirements for the work involved. Listed below are some of the requirements which must be stated in supplemental specifications or drawings.

(The items listed below are not to be considered a complete list of all the requirements. Each job must be reviewed and considered separately.)

1. MANUFACTURE OF CONCRETE

Specification HW-4798-S covers forming, reinforcing, placing, finishing and curing of portland cement concrete. It does not cover batching and delivery. See Hanford Standard Specification HW-4799-S, Batching and Delivery of Portland Cement Concrete, for this.

2. PLANS FOR FALSEWORK

\* Where forms or falsework are critical, special requirements should be  
\* specified, including submission of Contractor's form plans for review.

3. REINFORCING STEEL DRAWINGS

In order to assure the proper interpretation of his drawings, the designer should require the Contractor to submit reinforcing steel placing drawings for review before shop fabrication is begun.

4. REINFORCING STEEL

- a. HW-4798-S specifies intermediate grade bars per ASTM A15. When a different grade will be required, specify the grade.
- b. There are several items which are the responsibility of the engineer to put on the drawings. They should not be included in the supplemental specifications. These items are:
  - (1) Points of splice and length of lap for reinforcing bars and mesh.
  - (2) Hooks, bends and points of bend in reinforcing bars.
  - (3) Extension of reinforcing bars into support.

5. CONCRETE FINISHES

- a. HW-4798-S describes five finishes for formed surfaces (F1 thru F5) and five for unformed surfaces (U1 thru U5).

It does not state where they are to be used. This must be specified and should be shown on the drawings. State or show precisely which walls, which slabs, etc., are to receive which finishes (F1, U2, etc.).

\*Line changed

-1-

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3	Page 1 & 4	hes	12-20-62		hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY. DATE 8-30-54				INSTRUCTIONS FOR USE OF HW-4798-S	DI-4798-S	

Avoid placing the Contractor in the position where he must interpret which surfaces will be "exposed to view", "occupied portions of a building" or "permanently concealed", etc. He may have no way of determining this, particularly if the work is constructed in separate phases.

- b. The following may be used as a guide in selecting finishes for various locations. See HW-4798-S for complete descriptions.

#### FORMED SURFACES

FINISH F1 - Rough, formed surface with defective concrete repaired.

Where used: Surfaces where roughness is not objectionable, such as those upon or against which fill material will be placed, or which are permanently concealed from view.

FINISH F2 - Smooth, formed surface with defective concrete repaired and with fins, joint marks, bulges removed.

Where used: Surfaces which are to be permanently exposed to view but which are not prominently subjected to view such as pipe tunnels, and machinery and equipment spaces which are not to be painted.

FINISH F3 - Smooth, formed concrete surface with defective concrete repaired and with fins, etc., removed and small surface defects filled.

Where used: Surfaces prominently exposed to view where appearance is of special importance, and surfaces to be painted with conventional paints. Included in this classification are exposed exterior surfaces of buildings and structures and interior surfaces of the occupied parts of buildings and structures.

FINISH F4 - Exceptionally smooth, formed concrete surface with sack-rubbed finish.

Where used: Formed surfaces to which protective coatings for chemical or decontamination service are to be applied, and surfaces to be painted with conventional paints where a very smooth surface is desired prior to painting.

FINISH F5 - Rough, formed concrete surface (from rough-faced lumber) with defective concrete repaired.

Where used: Concrete surfaces which are to be covered with plaster, stucco, or wainscoting.

#### UNFORMED SURFACES

FINISH U1 - Leveled and screeded.

Where used: Surfaces which will be covered by fill material or surfaces which will be permanently hidden from view.

FINISH U2 - Wood float finish.

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Where used: Surfaces such as outside decks of buildings and structures; floors of service tunnels, sumps, and culverts; tops of parapet walls not prominently exposed to view; concrete road areas; slabs that will be covered with built-up roofing or membrane water-proofing; and surfaces of gutters and sidewalks.

FINISH U3 - Steel troweled without burnishing.

Where used: Surfaces such as those required on the inside floor slabs of buildings, except those subject to motorized traffic, but including those to which paint or protective coating is to be applied; tops of parapet walls prominently exposed to view; and interior stair treads and thresholds.

FINISH U4 - Hard, steel troweled finish - burnished.

Where used: Inside surfaces which will be subjected to hard wear such as motorized traffic areas in warehouses.

FINISH U5 - Broom finish over steel troweling.

Where used: Exterior concrete slabs such as ramps, loading platforms, entrance slabs and surfaces that require a finer finish than specified for U2.

## 6. JOINTS AND EDGES

If joints and edges of unformed surfaces are to be left unfinished or given a special radius or other shapes, specify the required treatment. Otherwise they will be "finished with edging tools" as specified in HW-4798-S.

## 7. CHAMFERS OF EXPOSED CORNERS

HW-4798-S calls for 3/4 inch chamfer on all exposed corners. If a larger chamfer is desired, specify the size.

## 8. CONCRETE TOPPING - FLOORS AND STAIRS

Where floors or stairs require concrete topping to resist especially hard wear, refer to Portland Cement Association booklet "Concrete Floor Finishes", which contains "Specifications for Heavy Duty Concrete Floor Finishes". The supplementary specifications should contain provisions similar to those in the above-named specifications to cover the concrete topping.

## 9. FLOOR HARDENERS

Ordinarily, floor hardeners should not be specified for new construction. A well-constructed concrete floor surface will give satisfactory service under any reasonable traffic without special treatment. Surfaces that dust and wear rapidly may be treated later with hardeners such as fluosilicates of magnesium and zinc, or sodium silicate.

10. WATERSTOPS

Waterstops are specified to be 6 inch size unless shown otherwise on the drawings. Where a different size or design will be used, show the required information on the drawings.

11. FORM TIES

HW-4798-S specifies that when forms and ties are removed, all metal shall be not less than  $3/4$  inches from any concrete surface. Under certain conditions, such as concrete to be in contact with water, it may be necessary for the drawings to require that this distance be increased to  $1\frac{1}{2}$  inches.

12. EPOXY BONDING COMPOUND

In special cases of bonding new concrete to old concrete where a particularly strong or watertight joint is required, specify the use of an epoxy bonding compound in accordance with HW-4798-S, Item 7b.

13. SEALING MEMBRANE

The use of a sealing membrane on dry, porous earth or sand is specified for slabs only. For other relatively thin sections to be placed against dry, porous earth or sand, such as small footings where it is desired to prevent rapid loss of water, the user should specify that the sealing membrane be used.

14. MONOLITHIC STRUCTURES

Where monolithic construction is used, and where large size or abnormal heights are factors, drawings should show the layout and sequence of placing concrete.

15. PREFORMED EXPANSION JOINT FILLER

HW-4798-S specifies a moderately resilient preformed expansion joint filler per Federal Specification HH-F-341. If a different type is needed, specify the required type.

16. CONSTRUCTION JOINTS

Where it is important that construction joints be located at certain points, show such locations on the drawings.

\* 17. CURING DURING COLD WEATHER

\* Change curing requirements as job requires. Examples: (a) where high early  
\* cement is used, concrete shall be kept at temperature not less than 70 F  
\* for 2 days or 50 F for 3 days; (b) heat of hydration in massive sections  
\* may eliminate heating specified in 15.5, but surface must be protected  
\* from freezing.

18. SLUMP

The required slump of the concrete must be specified. See paragraph 8.1a. It may be desirable to specify different slumps for different parts of the structure.

(This Specification  
consists of 19 pages,  
Arabic Numbered)

HW-4798-S

STANDARD SPECIFICATION

FOR

PLACING REINFORCED CONCRETE

Ref Hanford Stds: None

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6	Pg 1,10, 18	hes	12-20-62		hes	fhs chh
APPROVED BY H. W. STANDARDS COMMITTEE G. A. Fluke SECRETARY, DATE 5-31-51				PLACING REINFORCED CONCRETE	HW-4798-S	

STANDARD SPECIFICATION  
FOR  
PLACING REINFORCED CONCRETE

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HW-4798-S

## STANDARD SPECIFICATION

FOR

## PLACING REINFORCED CONCRETE

1. SCOPE

This specification applies to forming, reinforcing, placing, finishing and curing of portland cement concrete.

2. IDENTIFICATION OF ENGINEER

The term "Engineer" refers to the representative of the user of the facility to which this specification applies.

3. REFERENCED PUBLICATIONS

The following publications apply to this specification to the extent indicated by subsequent references. References are by basic designation only; however, the complete designation, including the suffix indicating the year of edition, shall apply.

## a. American Society for Testing Materials (ASTM) Standards:

(1) ASTM A15-58T, Specifications for Billet-Steel Bars for Concrete Reinforcement.

\* (2) ASTM A185-61T, Specifications for Welded Steel Wire Fabric for Concrete Reinforcement.

## b. American Concrete Institute (ACI) Standards:

ACI 318-56, Building Code Requirements for Reinforced Concrete.

## c. Federal Specifications:

(1) HH-F-341a, Filler, Expansion Joint, Preformed; Nonextruding and Resilient Types (for concrete).

(2) SS-C-192d, Cement, Portland.

#### 4. FORMS CAPE - 1072 - 2 54

##### 4.1 MATERIAL

Form faces in contact with concrete shall be wood, steel, plywood, or Masonite Corp. "Concrete Form Presdwood", or approved equal, as required in Section 14 for the various finishes.

##### 4.2 CONSTRUCTION

- a. Forms shall be set true to the lines designated, and the interior shape and dimensions and rigidity shall be such that the finished concrete will conform with the plans of the structure within the tolerances specified in Subsection 14.4. Forms shall be mortar-tight.
- b. For permanently exposed faces, the form surfaces shall be smooth and free from hardened or partially hardened concrete, irregularities, dents, sags, or holes.
- c. Unless specified otherwise, bolts and rods used for internal ties shall be so arranged that when the forms and ties are removed, all metal will not be less than 3/4 inches from any concrete surface. Wire ties or snap ties will not be permitted where the concrete surface will be exposed to weathering or where discoloration will be objectionable. Internal wood spreaders shall not be used.
- d. Forms shall be constructed so that they can be removed without damaging the concrete. Unless specified otherwise, all exposed corners of concrete shall be chamfered 3/4 inch.
- e. Inspection and cleanout openings shall be provided at the bottom of all forms for columns, pilasters, walls over 8 feet in height, and for forms for irregularly shaped pours where cleaning and inspection from the top would be impractical.

##### 4.3 TREATMENT

- a. Forms for surfaces exposed to view, except those to receive paint, protective coating, plaster, stucco or wainscoting, shall be coated with a non-staining form oil or emulsified stearate manufactured specifically for concrete form work.
- b. Forms for surfaces to receive paint, protective coating, plaster, stucco, or wainscoting shall be treated as follows:
  - (1) Wood forms shall be coated with a form lacquer.
  - (2) Form oil, stearate or water shall not be used on wood forms.
  - (3) Form oil or stearate shall not be used on steel forms.

- c. Care shall be taken to keep oil or stearate from getting on reinforcing steel, embedded items, or other surfaces requiring bond with the concrete; any oil or stearate on such surfaces shall be removed.
- d. Forms for surfaces which are to be covered with backfill or permanently concealed from view may be thoroughly wetted with water, in lieu of other treatment, immediately before placing the concrete, except that in freezing weather, oil or stearate shall be used.

#### 4.4 REMOVAL

Forms shall be removed only after permission is obtained from the Engineer. Form removal shall be accomplished in a manner which will prevent injury to the concrete. Forms shall remain in place for the following minimum periods.

Arches, beams and slabs - - - - -	240 hours
Columns - - - - -	120 hours
Walls and vertical faces - - - - -	48 hours

These minimum periods, based on standard curing conditions of 100% humidity at 70 F, may be extended by the Engineer, depending on actual curing and loading conditions.

#### 5. REINFORCING STEEL

##### 5.1 MATERIAL

- a. Unless specified otherwise, steel bar reinforcement shall be intermediate grade, deformed bars conforming to ASTM Designation: A15.
- b. Wire mesh reinforcement shall conform to ASTM Designation: A185.
- c. Reinforcing steel shall be free of bends not required by the drawings and shall be properly identified. Reinforcing steel shall be free of rust scale and loose mill scale, grease, paint, ice or any other substance that would reduce or destroy the bond.

##### 5.2 PLACING REINFORCING STEEL

- a. Reinforcing steel shall be fabricated and placed in conformance with the following sections of ACI 318, unless shown otherwise on the drawings.

Section 504 - Cleaning and Bending Reinforcement

Section 505 - Placing Reinforcement  
Section 506 - Splices in Reinforcement  
Section 507 - Concrete Protection for Reinforcement  
Section 906 - Hooks

- b. Reinforcing bars shall not be driven or forced into the concrete after initial set has occurred.
- c. Where reinforcing bars require bending after concrete has been placed, the bars shall not be bent until concrete curing as specified in Section 15, has been completed. Bars shall be bent in a manner to prevent undue stress in the concrete.

## 6. CONCRETE TEST SPECIMENS

Test specimens will be taken to determine the characteristics of the concrete. The number of specimens shall be determined by the Engineer according to the size and scope of the work.

## 7. PREPARATION OF OLD CONCRETE SURFACES

- a. Where new concrete is to be bonded to old concrete, the old concrete surface shall be chipped or sandblasted to remove all dirt or foreign material. All loose concrete, chipping dust and foreign material shall be removed from the surface, and the surface shall be kept continuously wet for a period of at least three hours before placing concrete on it. Immediately before placing the new concrete, a 1/8 inch thick layer of mortar of the same sand-cement ratio as the concrete shall be thoroughly scrubbed or broomed into the joint surfaces. The joint surfaces shall be damp but free of standing water when the mortar is applied.
- b. When specified, an epoxy bonding compound shall be used. The surface preparation shall be as specified in a. above except that wetting shall be omitted. The dry surface of the old concrete shall be coated with an epoxy bonding compound: Permagile Corporation of America, "UNIWELD"; Coast Pro-Seal and Mfg. Co., Pro-Seal #812; Furane Plastics Inc., Epocast 25A, or approved equal. Bonding compound shall be applied in accordance with the manufacturer's instructions. Concrete shall be placed at the proper time after application of the bonding compound to insure effective bond.

## 8. PLACING CONCRETE

### 8.1 GENERAL

- a. Concrete shall be placed as soon as possible after mixing. Concrete shall not be placed until released by the Engineer. The slump of the concrete, when placed, shall be within the specified slump limits.

- b. Retempering of concrete will not be permitted. 257
- c. Before placing concrete, the space between and at the bottom of forms shall be cleaned of all chips, shavings, wire, and other foreign material.
- d. Concrete shall be placed by methods and equipment which will minimize segregation.
- e. Concrete shall be deposited as close as possible to its final position in the forms. It shall not be flowed or otherwise moved laterally more than approximately 5 feet from the point at which it is first deposited. This limiting distance may be diminished by the Engineer when the lateral movement is causing segregation.
- f. Concrete shall not be dropped vertically more than 5 feet.
- g. Belt conveyors, chutes other than standard length mixer truck chutes, or other similar equipment, in which the concrete is conveyed to the structure in a continuously exposed flow, will not be permitted.

## 8.2 TEMPERATURE CONDITIONS

- a. Concrete shall not be placed without the written permission of the Engineer when the ambient temperature is at or below 40 F or whenever atmospheric temperature is expected to fall below 40 F within a period of 24 hours after placing concrete. When placing of concrete is permitted for these conditions, concrete when placed in the forms shall have a temperature of not less than 50 F, nor more than 80 F.
- b. When the ambient temperature is 85 F or higher:
- (1) Concrete shall be delivered to the forms at the coolest temperature which is practicable to produce under the prevailing conditions.
  - (2) Unless permitted otherwise in writing by the Engineer, the temperature of concrete placed in sections having a thickness of three feet or greater shall not be more than 80 F.
  - (3) The temperature of concrete placed in sections less than three feet shall not be more than 90 F.

## 8.3 EMBEDDED ITEMS

- a. Necessary precautions shall be taken to insure all items to be embedded have been placed in the work before placing concrete.
- b. Embedded items shall be firmly supported to prevent displacement during placing of concrete.

#### 8.4 PLACING CONCRETE AGAINST EARTH

- a. Concrete placed against earth shall be placed only upon or against firm, damp surfaces free from frost, ice and standing or running water. Concrete shall not be placed upon mud, or upon fills until the required compaction has been obtained.
- b. Under slabs, when dry porous earth is encountered, a sealing membrane of clear polyethylene sheeting 0.004 inch thick or polyethylene-coated waterproof paper shall be laid over the surfaces to receive concrete. The above materials shall be of the type specified for curing concrete in Subsection 15.4.

#### 8.5 LIFTS

- a. The permissible depth of concrete placed in one lift\* for each part of the structure shall be as authorized by the Engineer. Within a lift, concrete shall be deposited in horizontal layers not to exceed approximately 18 inches in depth unless directed otherwise by the Engineer. The placing shall be done at such a rate that: (1) no concrete surface shall have reached its initial set before additional concrete is placed on it and (2) deformations of the forms are not so great as to cause the concrete surfaces to exceed the tolerances specified in Subsection 14.4.
- b. In walls containing door and window openings, lifts shall stop at the top and bottom of the openings. Other lifts shall stop at such levels as will conform to architectural details.
- c. Unless specified otherwise, all slabs and finished floors shall be poured to the finish elevation in one continuous operation.

#### 8.6 PLACING IN MONOLITHIC STRUCTURES

The layout and sequence of placing of concrete in monolithic structures shall be as shown on the drawings or as directed by the Engineer.

#### 8.7 VIBRATION OF CONCRETE

- a. Concrete shall be compacted by mechanical vibrating equipment, supplemented by hand spading and tamping as required. The points of application of the vibrators shall be so patterned and spaced as to produce visual proof of effectiveness of the vibrators over the entire surface of the concrete being placed. Lateral movement of the concrete by vibration shall be held to a minimum. In no case shall such movement exceed the limiting distance set in paragraph 8.1e of this specification.

\* The term "lift" (sometimes referred to as a "pour") is used to describe that vertical depth or height of concrete placed in one continuous operation.

- b. The vibrating equipment shall be of the immersion type and shall at all times be adequate in number and power to properly consolidate all concrete. Vibrators shall maintain a speed of not less than 7000 rpm when in operation submerged in concrete. The amplitude of vibration shall be sufficient to produce satisfactory consolidation.
- c. The duration of vibration shall be limited to that necessary to produce satisfactory consolidation without causing objectionable segregation. Vibrators shall not be inserted into lower courses that have reached initial set. Care shall be taken to avoid disturbance of reinforcement embedded in concrete which is beginning to or has already set.

#### 8.8 PLACING CONCRETE THROUGH REINFORCEMENT

- a. In placing concrete through reinforcement, care shall be taken that no segregation of the coarse aggregate occurs. On the bottom of beams and slabs where the congestion of steel near the forms makes placing difficult, a layer of mortar, of the same sand-cement ratio as used in the concrete, shall first be deposited in the forms, followed immediately by the concrete. The thickness and use of this mortar layer shall be as directed by the Engineer.
- b. Special care shall be taken to prevent splashing forms or reinforcement with concrete. Any hardened concrete or partially hardened concrete on the forms or reinforcement above the level of the concrete already in place shall be removed before proceeding with the work.

#### 8.9 DEPOSITING CONCRETE IN WATER

- a. When specifically authorized, concrete may be deposited in water. The methods and equipment used shall be acceptable to the Engineer.
- b. When deposited by the tremie method, the tremie shall be watertight and sufficiently large to permit a free flow of concrete. The discharge end shall be kept submerged continuously in the concrete and the shaft kept full of concrete to a point well above the water surface.
- c. When the bottom-dump bucket method is used, the bucket shall not be dumped until after it has come to rest on the surface upon which the concrete is to be deposited. The bucket shall be provided with a suitable cover and the bottom doors when tripped, shall open freely. The bucket shall be completely filled and slowly lowered in order to avoid backwash. When tripped, it shall be withdrawn slowly until entirely free of the concrete.

- d. With either the tremie or bottom-dump bucket method, placing shall proceed without interruption until the top of the concrete has been brought to the required height.

## 9. EXPANSION AND CONTRACTION JOINTS

- a. Expansion and contraction joints shall be constructed and located as shown on the drawings.
- b. Unless specified otherwise, preformed expansion joint filler shall conform to Federal Specification HH-F-341, Type I, Class B (moderately resilient).

## 10. CONSTRUCTION JOINTS

### 10.1 GENERAL

- a. Construction joints shall be located as shown on the drawings or as directed by the Engineer.
- b. When completing a lift, working of the concrete beneath the surface shall be the minimum necessary to produce proper consolidation. Surface vibration or excessive surface working including screeding of any kind, will not be permitted.
- c. After the top surface of a lift is compacted, it shall be immediately and carefully protected.

### 10.2 CLEANING

- a. Before placing concrete on construction joints the surface shall be thoroughly roughened and cleaned of all laitance and unsatisfactory concrete. This shall be done by such methods as wet sandblasting or cutting with an air-water jet.
- b. If air-water cutting of a construction joint is used, it shall be performed at the proper time after the initial set has taken place. A high pressure air-water jet shall be used to remove all laitance and to expose clean, sound aggregate without undercutting around the edges of the larger particles of the aggregate. The air pressure used in the jet shall be 100 pounds plus or minus 5 pounds. The water pressure shall be just sufficient to bring the water into an effective influence of the air pressure.
- c. After cutting or sandblasting, the surface shall be rinsed until the wash water contains no trace of cloudiness.

- d. Wastes resulting from cutting, washing and rinsing of concrete surfaces shall be disposed of so that they do not stain or abrade exposed surfaces of the structures.
- e. Immediately before the concrete is placed, the construction joint surfaces shall be cleaned of all foreign materials and dampened. Excess water shall be removed and the surfaces shall be covered by a 1/8 inch thick layer of mortar of the same sand-cement ratio as the concrete.

## 11. WATERSTOPS

- a. Waterstops, where specified, shall be multiple ribbed, hollow center bulb type, manufactured from all new polyvinyl chloride resin. Waterstops shall be Tecon Products Co. "Multiseal", PVC waterstops, or approved equal, Design No. 6, 6-inch size, unless shown otherwise on the drawings.
- b. Intersections of waterstops shall be made with factory formed intersections.
- c. Splices shall be made in accordance with the manufacturer's instructions and the ribs in the area of the splice shall be re-formed to match the rib pattern.
- d. Waterstops shall be installed in the locations shown on the drawings in accordance with the manufacturer's installation instructions.
- e. Care shall be taken to prevent waterstops from being deformed or forced out of place when concrete is placed.

## 12. MORTAR FOR REPAIRING CONCRETE

- a. Except for white portland cement, cement for mortar and other miscellaneous uses shall conform to Federal Specification SS-C-192, Type II, low alkali cement, unless specified otherwise. White portland cement shall be used for color matching purposes.
- b. Sand for mortar shall be obtained either by processing of natural sand or by addition of a suitably graded blending sand, and shall have a fineness modulus of not less than 2.40 nor more than 3.00. It shall be washed clean by wet processing and shall consist of hard, tough, durable particles free from foreign materials. Sand shall conform to the following sieve analysis:

<u>Sieve Designation</u> <u>U. S. Standard Square Mesh</u>	<u>Culmulative Percentage by Weight</u> <u>Passing</u>	<u>Retained</u>
No. 4	95-100	0-5
No. 8	80-90	10-20
No. 16	55-75	25-45
No. 30	30-60	40-70
No. 50	12-30	70-88
No. 100	0-10	90-100

- c. Mortar for repair of concrete shall consist of one part portland cement and three parts sand (by volume) with sufficient water added for proper consistency. Sand and cement shall be thoroughly mixed while dry before adding water.
- d. Mortar shall be either of two consistencies, "wet" mortar or "dry-pack" mortar, as required herein. Mortar shall be of the driest consistency that can be worked into the area to be repaired. In batching dry-pack mortar, only enough water shall be used to produce a mortar which will stick together on being molded into a ball by a slight pressure of the hands, and which will leave the hands damp.
- e. Mortar not placed within one hour after adding water shall not be used. Retempering of mortar will not be permitted.

### 13. REPAIRING CONCRETE

- a. Immediately after removal of forms, all form ties shall be cut back and concrete surfaces shall be inspected for defects. Repair and patching shall be done only after inspection of the defective areas by the Engineer and then only if permission for patching is given. Repair of defects in formed concrete shall be completed within 48 hours after removal of forms.
- b. Defective concrete shall be made ready for repairs in conformance with the following:
  - (1) All defective and damaged concrete, including concrete that is honeycombed, sand streaked, or fractured, shall be removed from the area to be repaired. The minimum depth of chipped-out areas shall be one inch and the edges shall be squared with the surface to eliminate feather edges.
  - (2) Before placing the repair material, the area shall be free of chipping dust, dried mortar, and all other foreign material.

\*

- (3) Surfaces to be repaired shall be kept continuously wet for at least three hours prior to placing the new concrete or mortar but no free water shall remain on the surface when the repair material is placed.
  - (4) Immediately before placing dry-pack material, the moistened concrete surface shall be dusted lightly with cement until the area has been covered and darkened by absorption of the free water by the surrounding concrete surface.
- c. For surfaces permanently exposed to atmosphere, white cement shall be used for all repairs in proportions found by trial to be effective in producing a color which, in the hardened patch, will match the surrounding concrete surface.
- d. Repairs shall be made by: (1) dry-packing, (2) filling with concrete, or (3) filling with "wet" mortar in conformance with the following:
- (1) The dry-pack method shall be used for holes at least one inch deep where the depth is equal to, or greater than, the smallest surface dimension of the defect, such as cone-bolt or form tie holes, and for narrow slots cut for the repair of cracks. The dry-pack method shall not be used for shallow depressions where lateral restraint cannot be obtained. In dry-packing, the "dry-pack" mortar shall be placed and packed in layers having a compacted thickness of approximately 3/8 inch. Each layer shall be solidly compacted over its entire surface by use of a hardwood stick and hammer. Metal tools shall not be used for compacting. The surface shall be compacted just flush with the surface. Steel finishing tools shall not be used and water shall not be used to facilitate finishing.
  - (2) Concrete replacement shall be used for holes extending entirely through concrete sections; for holes larger than one square foot and deeper than four inches in which no reinforcement is encountered; and for holes larger than 1/2 of one square foot where reinforcement is exposed. Concrete used for replacement shall be of the same strength and mixture as used in the structure except for color matching as specified in Item c, above.
  - (3) Mortar replacement using "wet" mortar shall be used for holes too wide to dry-pack and too shallow for concrete replacement and for other conditions not covered by Items (1) and (2) above.
- e. All concrete repairs shall be cured the same as new concrete.

## 14. CONCRETE FINISHES AND TOLERANCES

### 14.1 GENERAL

- a. The required concrete finishes for various surfaces shall be as noted on the drawings or in accompanying specifications.
- b. Tolerances for all concrete surfaces and finishes shall be in accordance with Subsection 14.4.

### 14.2 FORMED SURFACES

Finishing for F3 and F4 finishes shall immediately follow concrete repairing and shall be completed within 96 hours after the forms are removed.\* Except where forms are left in place for the duration of the curing period, finishing shall be done during the curing period, keeping the interruptions to the curing process as short as possible. Where forms left on prevent finishing during the curing period, finishing shall be completed within the specified 48 or 96 hours after forms are removed. All finishes shall receive a minimum of 24 hours of curing after completion of the finish. Curing shall be carefully done so as not to disturb or remove any of the mortar.

Finishes for formed surfaces shall be as designated below:

#### Finish F1

Consists of: Rough, formed surface with defective concrete repaired, and form tie holes and other holes over 1/2 inch deep, filled as specified in Section 13.

Form Requirements: Forms may be built with a minimum of refinement and form sheathing may be any material that will not leak mortar when the concrete is vibrated.

#### Finish F2

Consists of: Smooth, formed concrete surface with all fins, joint marks bulges, projections and loose material removed and defective concrete and form tie holes and other holes over 1/2 inch deep, repaired and filled as specified in Section 13.

Form Requirements: Form faces in contact with concrete shall be plywood, "Presdwood" or steel.

\* Finishing for F1, F2 and F5 finishes consists of concrete repairing only, which is to be completed within 48 hours after forms are removed, in accordance with Section 13.

### Finish F3

**Consists of:** Smooth, formed concrete surface with all fins, joint marks, bulges, projections and loose material removed, and defective concrete, form tie holes, air bubble holes, surface pits, holes from defective forms, nailhead holes and similar surface defects repaired and filled as specified in Section 13.

**Form Requirements:** Form faces in contact with concrete shall be plywood, "Presdwood", or steel. At construction joints the forms shall be anchored by using an adequate number of form ties in the new pour a few inches from the construction joints. Ties adjacent to the joint and in the previous pours shall not be relied on to prevent spreading of the forms at the construction joint. Form construction shall be planned so that if any pattern from the forms is left on the concrete surfaces it will harmonize with the structure or building.

### Finish F4

**Consists of:** Exceptionally smooth, formed concrete surface with all fins, joint marks, bulges, projections and loose material removed; sandblasted to expose air bubble holes, surface pits and similar minor surface defects; defective concrete, form tie holes, holes from defective forms, and other holes too large to fill by "Sack rubbing", repaired and filled as specified in Section 13; and given a "sack-rubbed" finish, as follows:

The surface shall be thoroughly wetted and the treatment shall begin while the concrete is still damp. The mortar used shall be: 1 part cement, 2 parts (by volume) of sand which will pass a No. 16 screen, and enough water so that the consistency of the mortar will be that of thick cream. The mortar shall be rubbed thoroughly over the area with clean burlap, or a cork or sponge rubber float so as to fill all pits, surface holes, and air bubble holes. While the mortar in the pits is still plastic the surface shall be rubbed with a dry mix of the above proportions and materials. This shall remove all the excess mortar and place enough dry material in the pits to stiffen and solidify the mortar so that the filling will be flush with the surface. No material shall remain on the surface except that within the pits. When the ambient temperature is 85 F, or higher, the mortar shall be kept damp by means of a fog spray for 24 hours during the

setting period. Care shall be taken that the fog spray does not remove any of the mortar. The finish for any area shall be completed in the same day and the limits of a finished area shall be made at natural breaks in the finished surface.

Form Requirements- Same as for Finish F3 except that form oil or stearate shall not be used. Water shall not be used on wood or plywood forms.

#### Finish F5

Consists of: Rough, formed concrete surface with defective concrete repaired and filled as specified in Section 13.

Form Requirements- Forms shall be sheathed or lined with rough-faced "SIS2E" form boards with the rough face in contact with the concrete. Steel lining, steel sheathing, plywood or "Presdwood" will not be permitted and form oil, stearate, or water shall not be used on the forms.

### 14.3 UNFORMED SURFACES

Working of unformed surfaces in the various finishing operations shall be held to the minimum required to produce the desired finish. Use of any finishing tool in areas where water has accumulated will not be allowed. Work in these areas shall be delayed until the water has been absorbed, has evaporated, or has been removed by draining, mopping, dragging off with a loop of hose, or by other approved means. In no case shall cement or a mixture of cement and sand be spread on the surface to absorb excess moisture nor shall such materials or water be added to facilitate troweling. Joints and edges, unless specified otherwise, shall be carefully finished with edging tools. Finishes for unformed surfaces shall be as designated below:

#### Finish U1

Consists of: Even, uniform concrete surface produced by consolidating, leveling and screeding as follows:

The finishing operation shall consist of consolidating, leveling, and screeding the concrete to obtain an even, uniform surface. Surplus concrete shall be removed immediately after consolidation by striking it off with a sawing motion of the straightedge or template across wood or metal strips that have been set as guides. When the surface is curved a special screed shall be used.

For long, narrow stretches of curved surfaces such as on invert paving, a heavy slip form may be used. In the case of extensive flat paving, a paving and finishing machine is preferred.

### Finish U2

Consists of: A wood float finish, as follows:

This finish shall follow the treatment specified for finish U1 and shall be obtained by floating either by hand, or by power driven equipment. Floating shall not be started until some stiffening has taken place in the surface concrete and the moisture film or "shine" has disappeared. The floating shall work the concrete no more than necessary to produce a surface known as a "wood float finish" that is uniform in texture and free of screed marks. Any necessary cutting and filling shall be done during the floating operations.

### Finish U3

Consists of: A steel troweled finish, without burnishing, as follows:

This finish shall follow the treatment specified for finish U2, except that the floating shall leave a small amount of mortar without excess water at the surface to permit effective troweling. Steel troweling shall not be started until after the moisture film or "shine" has disappeared from the floated surface and after the concrete has hardened enough to prevent an excess of fine material and water from being worked to the surface. The troweling shall be performed with a firm pressure that will flatten the sandy surface left by the floating. Troweling shall produce a dense, uniform surface free of blemishes, ripples, and trowel marks.

### Finish U4

Consists of: A hard, steel troweled finish, burnished, as follows:

This finish shall follow the treatment specified for finish U3. The treatment shall consist of an additional steel troweling after the surface has nearly hardened, using a firm pressure and troweling until the surface has a burnished appearance.

Finish U5

Consists of: Broom finish over steel troweling, as follows:

This finish shall follow the treatment specified for Finish U3. The treatment shall consist of roughening the surface immediately after troweling by brushing with a fiber bristle broom in a direction perpendicular to the direction of traffic. The treatment shall not leave grooves more than 1/16 inch deep.

#### 14.4 TOLERANCES FOR CONCRETE SURFACES

The allowable tolerances for concrete surfaces shall be in accordance with those shown in the table below. Surface irregularities are classified as either "abrupt" or "gradual". Offsets and fins caused by displaced or misplaced form sheathing, lining, or form sections, or by defective form lumber will be considered as abrupt irregularities. All the others are classed as gradual irregularities. Gradual irregularities shall be measured with a template consisting of a straightedge for plane surfaces and its equivalent for curved surfaces.

The length of the template for testing formed surfaces shall be 5 feet. The length of the template for unformed surfaces shall be 10 feet.

MAXIMUM ALLOWABLE IRREGULARITIES IN CONCRETE  
SURFACES - INCHES

Type of Irregularities	Formed Surfaces					Unformed Surfaces				
	F1*	F2*	F3*	F4*	F5*	U1*	U2*	U3*	U4*	U5*
Gradual	1	1/2	1/4	1/4	1/4	3/8	1/8	1/8	1/8	1/8
Abrupt	1/2	1/4	1/8	1/8	1/4	1/8	-	-	-	-

\* "F" and "U" numbers refer to finish designations in subsections 14.2 and 14.3.

## 15. CURING AND PROTECTION

### 15.1 GENERAL

- a. The Contractor shall have on hand and ready to install, before actual concrete placing begins, all equipment needed for adequate curing and protection of the concrete.
- b. Every precaution shall be taken by the Contractor to protect finished surfaces from stains, abrasion, and mechanical injury. Surfaces or edges likely to be injured during the construction period shall be properly protected.
- c. All concrete shall be protected from accelerated drying. Excessive heat shall not be permitted near the concrete at any time. All galleries, conduits and other formed openings through the concrete shall be closed during the entire curing period and as long thereafter as practicable to prevent circulation of air and resultant drying out and cracking of the concrete.
- d. Curing shall be started as soon as free water has disappeared from the surface of the concrete after placing and finishing.

### 15.2 WATER CURING

- a. Water curing shall continue for a period of 7 days. The concrete shall be kept wet by covering with an approved, water-saturated material or by a system of perforated pipes or mechanical sprinklers or other approved method which will keep all surfaces continuously (not periodically) wet.
- b. Where forms of tongue-and-groove lumber are used and left in place for curing, they shall be kept wet at all times to prevent opening at the joints and drying out of the concrete.
- c. Water for curing shall be clean and free from any elements which might cause objectionable staining or discoloration of the concrete.

### 15.3 CURING WITH WATERPROOF SHEETING

- a. Sheeting for curing concrete shall be polyethylene sheeting 0.004 inch thick, Visking Company, "Visqueen", or approved equal, or a polyethylene-coated waterproof paper, American Sisalkraft Corporation, "Moistop", or approved equal. Sheeting shall be free of visible defects, holes or tears.

- b. Surfaces shall be completely covered with sheeting. Where a single sheet does not cover the entire surface, the ends and edges shall be lapped at least 4 inches and sealed with tape or other suitable means recommended by the manufacturer.
- c. Waterproof sheet curing shall continue for 7 days. Sheeting and edge and end seals shall be maintained intact. Any breaks in the envelope formed by the sheeting shall be repaired immediately.

#### 15.4 CURING COMPOUNDS

- a. If a curing medium other than water is used, it shall be authorized in writing by the Engineer, and it shall be applied in accordance with the manufacturer's recommendations.
- b. Curing compounds, where used, shall be of the surface membrane type. They shall be of such composition and characteristics as will spread readily on moist concrete and deposit a hard, tenacious film without permanently coloring the concrete surfaces which will be exposed. The resultant film shall adhere to the concrete surface without chemical reaction therewith, and shall not peel. The coverage of the curing compound shall be maintained for 28 days so as to prevent detrimental loss of water from the concrete.
- c. Prior to applying curing compounds to formed surfaces, the surfaces shall be moistened with a spray of water immediately after forms are removed. Moistening shall be continued until the surfaces will not readily absorb more water. The compound shall be applied as soon as the moisture film has disappeared and while the surface is still damp.
- d. On unformed surfaces the compounds shall be applied immediately after finishing and after bleeding water and "shine" has disappeared.
- e. Curing compounds shall not be used on surfaces where future bonding, painting or protective coating is required. In cold weather, curing compounds shall not be used on concrete surfaces which are kept at curing temperature by the use of steam.

#### 15.5 COLD WEATHER

Concrete placed when the ambient temperature is at or below 40 F or falls below 40 F within a period of 24 hours after placing concrete shall be kept at a temperature of not less than 70 F for 3 days or 50 F for 5 days for normal concrete.

#### 15.6 WIDE TEMPERATURE DIFFERENTIAL

- a. Under conditions of a temperature differential greater than 40 F between the concrete and the atmosphere, provision shall be made for gradually reducing or raising the temperature of the concrete.
- b. The freshly placed concrete shall be protected by adequate housing or covering. The methods of protection and covering shall prevent evaporation of moisture from the concrete and injury to the surface.
- c. Heating or cooling of the concrete to ambient temperature shall be at a rate not faster than 1 degree F. each hour for the first day and 2 degrees F. per hour thereafter until the ambient temperature is reached.

#### 15.7 SATURATED SAND CURING

Horizontal construction joints, and finished surfaces, cured with sand, shall be kept covered with a minimum thickness of one inch of sand. It shall be kept uniformly distributed and continuously wetted with clean water for a period of 7 days.

CAPE - 1072 - 272

BATCHING DIV. CONC.

(These Instructions  
consist of 1 page)

INSTRUCTIONS FOR USE OF  
HW-4799-S STANDARD SPECIFICATION FOR  
BATCHING AND DELIVERY OF CONCRETE

When Specification HW-4799-S is referenced, the user must specify the additional requirements for the work involved. Listed below are some of the requirements which must be stated in supplemental specifications or drawings.

(The items listed below are not to be considered a complete list of all the requirements. Each job must be reviewed and considered separately.)

1. AIR-ENTRAINMENT ADMIXTURES

HW-4799-S specifies the use of an air-entraining admixture unless specifically excluded from the particular mix. If concrete without entrained air is desired, specify that an air-entraining agent shall not be added to that particular mix.

2. CEMENT CONTENT

In some cases it may be desirable to specify the cement content (sacks/yd).

3. SLUMP

The allowable slump for the various parts of the structure or for various types and shapes of construction should be specified in supplemental specifications.

4. INFORMATION WHICH MUST BE PUT ON THE DRAWINGS

There are several items which are the responsibility of the design engineer to put on the drawings. They should not be included in the supplementary specifications. These items are:

- Compressive strength of concrete at 28 days for the various parts of the structure.
- Maximum size of coarse aggregate to be used in the various parts of the structure. The largest size permitted by code requirements should be specified.
- Points of splice and length of lap for reinforcing bars and mesh.
- Hooks, bends, and points of bend in reinforcing bars.
- Extension of reinforcing bars into support.

5. HIGH EARLY STRENGTH PORTLAND CEMENT

This material shall not be used unless properly authorized. When high early strength cement is allowed, it shall conform to Federal Specification SS-C-192, Type III, low alkali cement.

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM BY	DES BY
4	Add note 5	hes	12-20-62	INSTRUCTIONS FOR USE OF SPECIFICATION HW-4799-S		hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL H.E. Struck SECRETARY DATE 8-30-54						DI-4799-S	

(This Specification  
consists of 9 pages,  
Arabic Numbered)

HW-4799-S

STANDARD SPECIFICATION

FOR

BATCHING AND DELIVERY OF CONCRETE

Ref Hanford Stds: None

NO.	REVISION	APP D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM BY	DES. BY
4	Pages-i; 1 & 2	hes	12-20-62		hes	fhs
APPROVED BY ENGINEERING STANDARDS COUNCIL G.A. Fluke SECRETARY, DATE 5-3-51				BATCHING AND DELIVERY OF CONCRETE	HW-4799-S	

STANDARD SPECIFICATION  
FOR  
BATCHING AND DELIVERY OF CONCRETE

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STANDARD SPECIFICATION  
FOR  
BATCHING AND DELIVERY OF CONCRETE

1. SCOPE

This specification covers batching and delivery of portland cement concrete.

2. IDENTIFICATION OF ENGINEER

The term "Engineer" refers to the representative of the user of the facility to which this specification applies.

3. REFERENCED SPECIFICATIONS

The specifications listed in this section identify standard specifications which are referred to elsewhere in this specification by basic number only. These standard specifications form a part of this specification.

3.1 AMERICAN SOCIETY FOR TESTING MATERIALS (ASTM) SPECIFICATIONS

- \* C94-61, Standard Specifications for Ready-Mixed Concrete
- \* C136-61T, Tentative Method of Test for Sieve or Screen Analysis of Fine
- \* and Coarse Aggregates
- C143-58, Standard Method of Test for Slump of Portland Cement Concrete
- C172-54, Standard Method for Sampling Fresh Concrete
- \* C260-60T, Specifications for Air-Entraining Admixtures for Concrete(Tentative)

3.2 FEDERAL SPECIFICATIONS

- SS-C-192d, Cement, Portland
- \* AAA-S-121b(1), Scales, Weighing; General Specifications

4. COMPOSITION

Concrete shall be composed of portland cement, water, and fine and coarse aggregates. An air-entraining admixture shall be added at the mixer unless specifically excluded from a particular mix.

The design of concrete mixtures will be based on the water-cement ratio necessary to secure:

- a. A plastic, workable mixture suitable for the specific conditions of placement.
- b. A product that, when properly cured, will have durability, impermeability, and strength in accordance with all the requirements of the structures in which it is to be used.

## 5. CEMENT

### 5.1 GENERAL

Bulk cement shall be used for all major work. Cement for grouting, finishing, and repairing may be packaged. For small jobs the cement may be furnished in cloth or paper sacks.

### 5.2 PORTLAND CEMENT

- \* Only Portland cement conforming to Federal Specification SS-C-192,
- \* Type II, low alkali cement shall be used.

\*

\*

\*

### \* 5.3 SPECIAL TEST REQUIREMENTS

All cement will be sampled at the mill. In addition, it will be sampled at the batch plant site when required by the Engineer. All tests will be made through an arrangement with the U.S. Bureau of Standards at no cost to the Contractor.

No cement shall be used until notice is received from the Engineer that the test results are satisfactory.

### \* 5.4 TRANSPORTATION OF BULK CEMENT

Bulk cement shall be unloaded from railroad cars directly to weather-tight hoppers at the batch plant, or it shall be transported from the railhead to the batch plant in weather-tight trucks or by other approved methods. The method used must protect the cement from moisture.

### \* 5.5 STORAGE

Immediately upon receipt at the work site, cement shall be stored in a dry, weather-tight and properly ventilated structure. The cement shall be protected from moisture absorption during storage. Storage facilities shall be approved by the Engineer and shall be arranged to permit easy access for inspection.

The Contractor shall use cement which has been stored at the site for 60 days or more before using cement of lesser age. Cement stored at the project site for more than 4 months shall not be used unless retest proves it satisfactory.

## 6. ADDITIVES

### 6.1 AIR-ENTRAINMENT ADMIXTURES

Air-entrainment admixtures shall conform to ASTM Designation: C260, designed to produce air-entrainment of 3 per cent to 6 per cent by volume of the concrete.

The Contractor shall provide facilities satisfactory to the Engineer for the procurement of test samples at any time.

### 6.2 TESTS

Tests of all admixtures will be made in accordance with applicable ASTM Specifications. Certified copies of all test data shall be kept on file in the office of the Engineer.

### 6.3 OTHER ADDITIVES

Corrective additions to remedy deficiencies in aggregate grading, or additives desired for any other purpose may be used only with the written approval of the Engineer.

## 7. AGGREGATES

### 7.1 PRODUCTION FACILITY

The plant and equipment used in the production of fine and coarse aggregate shall be designed to produce aggregate conforming to these specifications. Plant and equipment shall meet with the approval of the Engineer.

### 7.2 QUALITY

All fine and coarse aggregate shall be washed clean by wet processing and shall consist of hard, tough, durable particles free from foreign materials. The particle shape of aggregate shall be generally rounded or cubical. Rock which breaks into thin, flat, elongated particles, will not be approved for use. A thin, flat, elongated particle is defined as a particle having a maximum dimension greater than five times the minimum dimension. The stated percentages of fines in the sand shall be obtained either by the processing of natural sand or by the addition of a suitably graded blending sand.

## 7.3 SOUNDNESS

Tests and the service record will be used to determine the acceptability of the aggregate. If such data are not available, (as in the case of newly-operated sources) aggregate shall be subjected to tests to determine its acceptability. Aggregate shall be approved by the Engineer for soundness before its use is begun.

## 7.4 SAMPLING AND TEST REPORTS

Sampling of aggregate shall be in accordance with ASTM Designation: C136. Unless specified otherwise, test samples shall be selected under the supervision of the Engineer and delivered to the location designated by him. All tests will be made as directed by and under the supervision of the Engineer. The Contractor shall provide facilities satisfactory to the Engineer for the procurement of test samples at any time.

Copies of all test data of aggregate shall be kept on file in the Engineer's office.

## 7.5 STORAGE

Aggregate shall be stored so that no foreign material is introduced. The material shall be stockpiled in a manner which will prevent segregation and excessive breakage. Rock ladders of satisfactory design shall be used with conveyor systems. All fine aggregate shall remain in free draining storage for at least one week prior to use. Sufficient live storage shall be maintained at all times to permit continuous placement of concrete at the rate required.

## 7.6 GRADING - FINE AGGREGATE

Fine aggregate shall consist of natural sand. The gradation shall conform to the following requirements:

<u>Sieve Designation</u> <u>U. S. Standard Square Mesh</u>	<u>Cumulative Percentage by Weight</u> <u>Passing</u>
No. 4	95-100
No. 8	81-89
No. 16	57-73
No. 30	32-58
No. 50	15-28
No. 100	2-8
No. 200	0-3

The fine aggregate shall have a fineness modulus of not less than 2.40 nor more than 3.00. During normal operations, the grading of the fine aggregate shall be controlled so that the fineness moduli of at least nine of

ten test samples, vary not more than 0.20 from the average fineness modulus. The fineness modulus shall be determined by dividing by 100 the sum of the cumulative percentages retained on U. S. Standard Sieves Nos. 4, 8, 16, 30, 50 and 100. After the sample passes one sieve, not more than 40 per cent of the total sample shall be retained on the next finer sieve in the series.

## 7.7 GRADING - COARSE AGGREGATE

Coarse aggregate shall consist of gravel, crushed gravel, stone or a combination. The crushed aggregate shall not exceed 25 per cent of any one size group of aggregate. The grading shall be as follows:

Sieve Size U. S. Standard Square Mesh	Size Groups Per cent by Weight Passing Individual Sieves		
	No. 4 to 3/4"	3/4" to 1-1/2"	1-1/2" to 2-1/2"
3"			100
2"			17-43
1-1/2"		92-100	0-8
1"		22-40	0-4
3/4"	92-100	0-6	
5/8"		0-4	
3/8"	27-53		
No. 4	0-4		
No. 8	0-2		

The maximum sizes of coarse aggregate to be used shall be as specified.

## 8. WATER

Water used in mixing concrete shall be fresh, clean and free from injurious amounts of sewage, oil, acid, alkali, salts or organic matter.

## 9. PROPORTIONING CONCRETE

### 9.1 CONTROL

The proportion of all material entering into the concrete shall be as approved by the Engineer. The Contractor shall provide equipment to measure and control the material entering each batch. The proportions shall be changed whenever necessary to maintain the quality required. The quality required shall mean the properties of mix as defined in ASTM Designation C94, paragraph 4, Alternate No. 2. (Using the terms in ASTM C94, the job contractor is the "purchaser").

### 9.2 MEASUREMENTS

Material entering into the concrete shall be batched and measured by weight. One sack of cement shall be considered as 94 pounds and one gallon of water as 8.33 pounds.

### 9.3 CEMENT CONTENT

The cement content in the concrete used in the various parts of the work shall be as approved by the Engineer, or as specified in accompanying specifications.

### 9.4 AGGREGATE CONTENT

Concrete mixes will be designed to use the largest size and the maximum content of coarse aggregate available and placeable in the various parts of the structures.

### 9.5 CONSISTENCY FOR PLACEMENT

The concrete mixtures which have been designed and tested in the laboratory will be adjusted at the batch plant to meet varying conditions. The concrete mix shall be so controlled that the slump, shall at all times be the minimum necessary to obtain the desired consistency for placement as approved by the Engineer, or as specified in accompanying specifications. Slump shall be taken in accordance with ASTM Designation: C143.

## 10. BATCHING AND MIXING

### 10.1 EQUIPMENT

- a. The equipment shall be capable of combining the ingredients of the concrete into a uniform mixture within the time limit specified, and of discharging this mixture without segregation. Adequate facilities shall be provided for accurate measurement and control of each of the materials in the mix. The plant shall include provisions for the inspection of all operations at all times. Records of the batching and mixing operations shall be prepared and delivered as required by the Engineer.
- b. The accuracy of the weighing equipment shall conform to Federal Specification AAA-S-121 for such equipment. The Engineer will provide standard test weights and other equipment required for checking the performance of each scale or other measuring device.

Periodic tests shall be made in the presence of the Engineer in such a manner and at such intervals as he may direct. Upon completion of each check test, and before further use of the devices, the Contractor shall make such adjustments, repairs, or replacements as may be required to secure satisfactory performance.

- c. Delivery of materials from the batching equipment shall be within the following limits of accuracy:

<u>MATERIAL</u>	<u>LIMITS OF ACCURACY-PERCENT BY WEIGHT</u>
Cement	1
Water	1
Aggregate smaller than 1-1/2"	2
Aggregate larger than 1-1/2"	3
Admixture (when batched separately)	3

Batching equipment shall be so constructed and arranged that the sequence and time of discharge can be controlled to produce a ribboning and mixing of the coarse with the fine aggregate and, wherever practicable, of the cement with the aggregate as the materials pass through the charging hopper into the mixer. This shall be controlled by the batcher discharge gates.

- d. Each weighing unit shall contain a device to indicate the accuracy of the weighing operation.
- e. The batching plant shall be adjustable to compensate for the varying moisture content of the aggregate and to change the weights of the materials being batched.
- f. The plant shall include a device for adding air-entraining admixtures. The device shall be adjustable to permit changing the amount of admixture.
- g. Facilities shall be provided by the Contractor for obtaining representative samples of aggregate and mixed concrete for testing. Platforms, tools and equipment for obtaining samples shall be furnished by the Contractor when requested by the Engineer. Concrete specimens will be prepared from the mixtures used in the work and tested to determine the adequacy of control of the materials entering into the concrete.
- h. Mixer drum fins shall be cleaned of dried, hard concrete at least once a month, or when, in the judgement of the Engineer, the accumulations are interfering with proper batching of concrete.
- i. At the beginning of each 8-hour shift, the mixer drum shall be wet down before aggregates and cement are placed in the drum.

## 10.2 MIXING TIME

Provided that all mixing water is introduced in the batch before 1/4 of the mixing time has elapsed, the mixing time for each batch after all solid materials are in the mixer drum, shall be as follows:

CAPACITY OF MIXERMIXING TIME

1/2 cubic yard or smaller	1-1/4 minutes
3/4 to 1-1/2 cubic yards incl.	1-1/2 minutes
2 and 3 cubic yards	2 minutes
4 cubic yards	2-1/2 minutes
6 cubic yards	3 minutes

The mixing times specified are based on proper control of the rotation speed of the mixer drum and introduction of the materials, including water, into the mixer. The mixing time may be increased when, in the opinion of the Engineer, the charging and mixing operation fails to produce the required uniformity and consistency of concrete.

It may also be increased when test samples of concrete taken from three locations in the mixer drum (such as front, center and back) show a difference of more than 10 per cent in the sand-cement or water-cement ratios.

The mixer drum shall revolve at a uniform speed for a minimum of 12 revolutions after all materials have been placed in it. Mixers shall not be charged in excess of the capacity recommended by the manufacturer, nor shall they be operated at a speed in excess of that recommended by the manufacturer. Excessive overmixing, requiring additions of water to preserve the required consistency, will not be permitted. Should any mixer at any time produce unsatisfactory results, as determined by the Engineer, it shall be stopped until repaired.

### 10.3 FIELD CONTROL

At the batch plant the Engineer may, at any time, reduce the size of the batches, adjust batching sequences, mixing time or speed, and make such changes as are deemed necessary to obtain concrete for the required quality. All equipment used for mixing and transporting concrete shall conform to ASTM Designation: C94.

### 11. CONCRETE SPECIMENS

Concrete specimens to determine the quality of the concrete shall be taken in accordance with ASTM Designation: C172.

### 12. DELIVERY

Concrete shall be delivered from the mixer to the forms as rapidly as practicable, by mixer-truck, agitators, or methods which will minimize segregation or loss of ingredients. If the slump is not within the specified limits, or if the concrete has not been placed within one hour from the time the cement is dampened, the batch shall be rejected. Retempering of concrete will not be permitted. Batches not placed immediately after mixing shall be

slowly and continuously agitated. All types of delivery equipment shall be subject to the approval of the Engineer.

When dry batches are delivered, the specified amount of water shall not be added until the batch reaches the job site. Mixing time shall be as approved by the Engineer. Water measuring equipment shall be in good condition and good working order. Measuring equipment shall be subject to the approval of the Engineer. Batches prepared with defective equipment shall be rejected.

### 13. COLD WEATHER

#### 13.1 HEATING OF MATERIALS

The mixing of concrete when the ambient temperature is at or below 40 F is subject to the approval of the Engineer. When such mixing is approved, aggregates, water, or both shall be heated at the batch plant. The average temperature of the concrete as it is produced at the plant shall be not less than 50 F nor more than 80 F. Aggregates containing frozen lumps shall be independently heated. No materials containing frozen lumps, ice, or snow shall be allowed to enter the mixer.

#### 13.2 ANTI-FREEZE COMPOUNDS

The use of salts, chemicals or other foreign materials in the mix to lower the freezing point of the concrete is prohibited.

#### 13.3 ACCELERATORS

Compounds intended to accelerate the hardening of the concrete or to produce abnormal strengths at early periods shall be permitted only upon the written approval of the Engineer. If approved, they shall be used only in amounts which will not have an injurious effect on the normal qualities of the concrete.

### 14. HOT WEATHER

When the ambient temperature is 85 F or higher:

- a. Concrete shall be delivered to the forms at the coolest temperature which is practicable to produce under the prevailing conditions.
- b. Unless permitted otherwise in writing by the Engineer, the temperature of the concrete delivered for placement in sections having a thickness of three feet or greater shall not be more than 80 F.
- c. The temperature of concrete delivered for placement in sections less than three feet shall not be more than 90 F.

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RAILROAD CONSTRUCTION

INSTRUCTIONS FOR USE OF

HWS-5722-S, STANDARD SPECIFICATION FOR RAILROAD CONSTRUCTION

When Standard Specification HWS-5722-S is referenced, the user should supply the additional details for the specific job. A number of the items to be considered for inclusion in supplemental specifications, or on the drawings, are listed below:

(The items below should not be considered as a complete list of all requirements. Each job must be carefully reviewed for special items.)

1. Connections

It must be clearly stated who is responsible to make connections to existing tracks.

2. Material Furnished

When ties, rails or other materials are to be furnished to the contractor, it is necessary to clearly state, elsewhere, what will be furnished.

3. Corrugated Metal Culverts

When specifying corrugated metal culvert pipe, obtain Federal Specification QQ-C-806a and determine which type is required. The accompanying specification must state type of pipe, class of corrugation and gage of metal.

When sections of corrugated metal culvert pipe are to be riveted together rather than banded, the accompanying specifications must state this fact and also state that "outside laps of circumferential joints shall point upstream."

4. Concrete Culvert Pipe

When specifying concrete culvert pipe, state whether the pipe is to be bell and spigot or tongue and groove design, standard strength or extra-strength. Tongue and groove design should be specified where earth cover is two (2) feet or less.

5. Stabilization

Where construction is known to be sand subject to erosion by the wind, stabilization of all disturbed surfaces with pit-run gravel in conformance with HWS-5722-S should be noted on the drawings.

-1-

Supersedes DI-4-C

NO.	REVISION	APP'D	DATE	CIVIL ENGINEERING STANDARDS	SUBM. BY	DES. BY
2	General Revision	hes	5-11-59		hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 8-30-54				INSTRUCTIONS FOR USE OF HWS-5722-S	DI-5722-S	

6.. Excess Excavation

If an excess of excavated material is available, it can be used to widen near-by embankments, and should be so indicated on the drawings.

7. Design Requirements, Turnouts, Temporary Track, etc.

See SDC-3.1, HAPO Standard Design Criteria for Railroads, for further information on design requirements, turnouts, temporary track, etc.

HWS-5722-S

STANDARD SPECIFICATION

for

RAILROAD CONSTRUCTION

Ref Hanford Stds:

AC-7-32    AC-7-5    AC-7-20

AC-7-31    AC-7-6    AC-7-21

AC-7-4    AC-7-7    AC-7-30

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM BY	DES BY
4	Ref Stds No's.	hes	2-1-61		hes	wlg chf
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck, SECRETARY, DATE 6-30-54				RAILROAD CONSTRUCTION	HWS-5722-S	

STANDARD SPECIFICATION  
FOR  
RAILROAD CONSTRUCTION

CAPE-1072-290

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HWS-5722-S  
STANDARD SPECIFICATION  
FOR  
RAILROAD CONSTRUCTION

1072-291

1. SCOPE

This specification applies to the construction of new railroads and rail renewal.

2. IDENTIFICATION OF ENGINEER

The term "Engineer" refers to the representative of the user of the facility to which this specification applies.

3. DEFINITIONS

Finish subgrade is defined as the roadbed surface on which ballast is placed.

4. REFERENCED PUBLICATIONS

The following publications apply to this specification to the extent indicated by subsequent references. References are by basic designation only; however, the complete designation, including the suffix indicating the year of the edition, shall apply:

a. American Association of State Highway Officials (AASHO) Specifications:

(1) Designation M41-55 "Standard Specification for Reinforced Concrete Culvert Pipe".

(2) Designation T99-57, "Moisture-Density Relations of Soils Using A 5.5-lb Rammer and A 12-in. Drop".

(3) Designation T147-54 "Field Determination of Density of Soil in Place".

b. Federal Specifications:

(1) QQ-C-806a, "Culverts and Underdrains, Iron or Steel, Zinc Coated".

(2) TT-W-571c, "Wood Preservative; Recommended Treating Practice."

c. West Coast Lumber Inspection Bureau, "Grading and Dressing Rules No. 15", March 15, 1956.

5. CLEARING AND GRUBBING

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The roadbed area to a distance of ten (10) feet outside limits of slope stakes shall be cleared and grubbed of all brush, trees, roots, and other foreign material. The materials so removed shall be disposed of as directed by the Engineer.

6. PIPE CULVERTS

6.1 MATERIALS FOR CULVERTS

- a. Culvert pipe shall be of the size and type shown on the construction drawings.
- b. Corrugated metal culvert pipe and coupling bands shall conform to Federal Specification QQ-C-806.
- c. Reinforced concrete culvert pipe shall conform to AASHTO Designation M41.
- d. Mortar for use with concrete culvert pipe shall be composed of one (1) part portland cement and three (3) parts sand. Only enough water shall be added to make a stiff, workable mix.

6.2 EXCAVATION FOR CULVERTS

Excavations for culverts shall be true to line and grade as shown on the construction drawings or as directed by the Engineer. Trenches shall be of adequate width to permit handling of pipe and making necessary connections. Trench bottoms shall be shaped to provide uniform bearing under barrel of pipe. If rock or boulder formations, hard pan or cemented gravel occurs in trench bottom, trenches shall be excavated to such additional depth as is required for placement of sand cushion at least six (6) inches in thickness. Sand cushion shall be shaped to receive barrel of pipe.

6.3 INSTALLATION OF CULVERTS

- a. Culvert pipe shall be carefully handled at all times and shall not be dropped or dumped. Suitable equipment shall be used in unloading and lowering pipe into position in trenches to prevent damage of any kind. Concrete pipe which is cracked, broken, or otherwise defective shall not be used. Corrugated metal pipe shall be free from sprung joints or other objectionable defects.
- b. Trench bottom shall be free from frost and frozen earth when culvert is placed.
- c. Adjoining sections of corrugated metal culvert pipe shall be firmly fastened together by means of galvanized steel coupling bands. Bands shall be drawn tight to insure tight joints.

Corrugations in coupling bands shall match perfectly the corrugations in the pipe and adjacent ends of pipe shall be placed in the same corrugation of the coupling. Longitudinal joints shall be at the side of the pipe.

- d. Reinforced concrete culvert pipe shall be placed with the bell end or groove end up, beginning at the lower end of the trench. After covering the ends with mortar, the spigot or tongue end shall be inserted into the bell or the groove as far as the construction of the pipe will permit. On the bell and spigot type the lower portion of the bell shall be filled with stiff mortar of sufficient thickness to make the inner surfaces of the abutting sections flush and even, when the pipe is placed. After pipe is in place, joint shall be filled with mortar and firmly caulked. On tongue and groove pipe the lower one-half of the groove and the upper one-half of the tongue shall be coated with a thin layer of mortar. Ends and joints of all concrete pipes shall be thoroughly wetted before applying mortar. The joints on the inside of the pipe shall be cleaned of all excess mortar.

#### 6.4 BACKFILL AND COMPACTION FOR CULVERTS

Backfill shall not be placed over concrete culverts until in the opinion of the Engineer, the joint material has set to the extent that the joints will not be damaged by the backfilling operations. Selected backfill material, free from large stones, trash, frozen earth or other foreign materials shall be deposited by hand in layers not to exceed six (6) inches in thickness. Backfill adjacent to pipe shall be carefully placed and compacted uniformly on each side to avoid displacement of pipe. Each layer shall be thoroughly compacted before the next layer is placed. This method of backfilling shall be followed on both sides of pipe and over the pipe to a depth of not less than one foot above the top of the pipe. Remainder of backfill shall be placed in the same manner as construction of embankments as specified in Section 12 of this specification.

#### 7. CLASSIFICATION OF EXCAVATED MATERIALS

##### 7.1 ROCK EXCAVATION

- a. Rock excavation shall include:
  - (1) All rock material in solid layers, embedded deposits, stratified masses, and conglomerate deposits which are so firmly cemented that they possess all the characteristics of solid rock and which cannot be removed by the use of a modern power shovel of three-fourths (3/4) cubic yard capacity, adequately powered and in good mechanical condition, without systematic drilling and blasting.

- (2) All boulders over one-half (1/2) cubic yard volume. Solid rock layers with overburden of shattered rock and solid rock layers interspersed with a layer of clay or other material will be classed as "rock excavation" for the total depth of excavation in which solid rock material constitutes eighty-five percent (85%) or more of the total depth.

## 7.2 COMMON EXCAVATION

Common excavation shall include all excavated material which is not classified as rock excavation, borrow, or excavation otherwise specified.

## 7.3 BORROW

All material excavated for borrow purposes shall be classified as "borrow".

## 8. BLASTING

When blasting is required on the job, the Engineer shall be advised in writing before any explosive is brought on the job site. Blasting, handling and storage of explosives at the job site shall be in strict accordance with all safety measures as may be prescribed by the Engineer. All explosives shall be transported in accordance with the regulations of the Interstate Commerce Commission. Detonators and explosives shall not be stored in the same building. All explosives shall be kept locked in isolated buildings until such time as they may be required for use. Storage buildings shall be marked on all sides with large signs legible from a distance of 500 feet, minimum. Explosives shall be handled only by persons experienced in their use.

Where blasting is required for rock excavation, care shall be exercised not to overshoot. Any rock or other material loosened or thrown outside the authorized cross-sections shall be removed.

## 9. EXCAVATION

Rock excavation shall be carried to a depth of one foot, no inches, (1' -0") below finish subgrade. Unstable material in bottom of cuts shall be removed and replaced as directed by the Engineer. The materials from excavations which are incidental to the construction of subgrade, ditches, etc. shall, if suitable, be used for construction of embankments. When material is encountered which may be classified as rock excavation, work shall stop until material is classified and notice to proceed is received. Slopes of excavations shall be graded to conform to slopes shown on the drawings. Surfaces of all slopes shall be reasonably smooth and compact. Excess excavated material shall be disposed of as directed by the Engineer.

• 10. BORROW PITS

Location of borrow pits shall be as indicated on the drawings or as directed by the Engineer.

Excavation for borrow shall not be started until notice to proceed is received from the Engineer. Borrow areas shall be stripped off, to remove all brush or other materials unacceptable for use in the construction of embankments. Excavation of borrow pits shall be to uniform lines to allow accurate measurement. Floor of borrow pits shall be left relatively level.

11. OVERHAUL

Overhaul shall consist of the transportation of acceptable excavation material beyond the free-haul limit. The free-haul limit shall be 2500 feet. Length of overhaul will be measured along the shortest possible routes.

12. EMBANKMENT

- a. Materials used for construction of embankments shall be subject to the approval of the Engineer. Material shall be free from brush, roots, rubbish, frozen materials or other objectionable matter. Rock may be incorporated into the embankment except that the top two (2) feet of the subgrade shall not contain rock larger than eight (8) inches, greatest dimension. Elsewhere, rock shall be not larger than two (2) feet, greatest dimension. Sand if used, shall be confined to the core of the embankment, with the more stable material placed to the outside.
- b. Embankment material shall not be placed on frozen ground. Snow and ice shall be removed before placing any embankment material. Embankments shall be constructed in successive horizontal layers not more than eight (8) inches in thickness, loose measurement. Each layer shall be placed to full width of embankment spread uniformly and thoroughly compacted. During construction of embankments the equipment shall be routed over layers as they are placed and the travel shall be distributed over entire width of embankment. Separate pieces of equipment shall not be permitted to track each other.

If equipment travel is not sufficient to obtain the required density, each layer shall be compacted by rolling with a (1) smooth-wheeled power roller, (2) a tamping (sheepsfoot) roller or (3) a pneumatic-tired roller of design approved by the Engineer. The type of roller used shall be suited to the character of the soil in the embankment.

If moisture content of embankment material is not sufficient to obtain required density, water shall be applied by means of approved distribution equipment and mixed with the soil.

- c. When tested in the field in accordance with AASHO (American Association of State Highway Officials) Designation T-147, "Field Determination of Density of Soil in Place," each layer of compacted embankment shall have a density not less than the following:

- (1) For Clayey and Silty Materials - 90% of the "maximum density" as determined in accordance with AASHO Designation T-99. The moisture content of the material shall be uniform throughout the layer and shall be such that the specified density can be obtained. In no case shall the moisture content vary more than 3 percentage points above or below the optimum moisture content as determined by AASHO Designation T-99.
- (2) For cohesionless free-draining material such as sands and gravels - 70% relative density as determined by the Standard U. S. Bureau of Reclamation relative density tests for cohesionless free-draining soils.

The relative density of a cohesionless free-draining soil, expressed as a percentage, is defined as its state of compactness with respect to the loosest and most compact states at which it can be placed by laboratory procedures. The relative density will be based on the following formula, wherein the maximum density is the highest unit weight of the soil, minimum density is the lowest unit weight of the soil and in-place density is the unit weight of the soil in place. Tests for moisture content are made on the materials and unit weights are expressed in terms of oven-dry weights.

$$\text{Relative density} = \frac{\text{max. den.} \times (\text{in-place den.} - \text{min. den.})}{\text{in-place den.} \times (\text{max. den.} - \text{min. den.})} \times 100$$

The particular test to be used, depending on the type of soil, shall be as determined by the engineer.

- d. At all locations that are inaccessible to a roller, the embankment shall be brought up in layers of the thickness specified above, and each layer shall be compacted to the density specified above, with mechanical tampers.
- e. Embankments shall not be widened by side casting or by adding loose materials from the top. As embankments are consolidated, sides shall be carefully trimmed to proper slopes. Embankments shall be maintained at proper height and shape until work is finally accepted by the Engineer.

- f. The roadbed shall be finished to a true, compacted surface, free from depressions which would prevent proper drainage, and free from soft spots. Where the roadbed is constructed of sand, the top layer shall be a minimum of four (4) inches of pit-run gravel containing no rocks larger than the compacted thickness of the layer. The top surface of this layer shall be at the elevation of finish subgrade as shown on the drawings.
- g. All slopes shall be graded to conform to the slopes shown on the drawings. Surfaces of all slopes shall be reasonably smooth and compact.

### 13. STABILIZATION

- a. Slopes of cuts, embankment slopes, and other areas disturbed by this work where the surface is composed of sand or is otherwise susceptible to wind erosion, shall be stabilized with a four (4) inch layer of pit-run gravel containing no rocks larger than 4 inches greatest dimension. The stabilization material shall be spread uniformly over areas to be covered and trimmed to the required lines.
- b. Where cut slopes or embankment slopes are to be protected from erosion, the gravel blanket shall be applied to the slope as completed to the section shown on the drawings. No additional cutting to care for the gravel blanket is intended.

### 14. TIES

#### 14.1 MATERIALS AND TREATMENT

- a. Unless otherwise specified, ties shall be new Douglas Fir, No. 1., or higher quality ties as produced and graded under the Grading and Dressing Rules of the West Coast Lumber Inspection Bureau. Ties shall be pressure treated with creosote-petroleum solution, creosote-coal tar solution or creosote, in accordance with Federal Specification TT-W-571, "Wood Preservative; Recommended Treating Practice".
- b. Tie dimensions shall be as follows:
  - (1) Cross ties shall be 7" x 9" x 8' 0".
  - (2) Switch ties shall be 7" x 9" and of lengths as shown on Hanford Standards AC-7-4, Turnout - 15' 0" Switch and No. 8 Frog , and AC-7-5, Turnout - 16' 6" Switch and No. 10 Frog .

- (3) Ties used in road crossings shall be 7"x 9"x 9' 0" placed as shown on Hanford Standard AC-7-20, "Railroad Crossing" or AC-7-21, "Wood Plank Railroad Crossing", whichever is applicable.

- c. All tie plugs shall be treated fir of the required size conforming to the requirements of the American Railway Engineering Association (A. R. E. A. ) "Specifications for Tie Plugs".

#### 14.2 INSTALLATION

Ties shall be carefully handled at all times to avoid damaging them. They shall be moved with tongs or other approved methods and shall not be thrown from cars onto rails or rock. Bars, chisels, forks, mauls, picks, shovels or sledges should not be used in moving ties or placing them beneath the rails. Damaged ties shall be replaced. Treated tie plugs shall be driven into all spike holes in ties which are to be reused. Plugs shall be driven to full depth with long dimension of the head parallel to the longitudinal axis of the tie.

Ties shall be placed with heart side down and shall be positioned at right angles to the rails. They shall be spaced approximately twenty-two (22) inches on centers. Ties shall be adjusted so that rail joints will be suspended between ties.

#### 15. BALLAST

Ballast material shall consist of crushed stone prepared from ledge rock formation or crushed from rock not smaller than 4" least dimension. Ballast shall conform to the American Railway Engineering Association (A. R. E. A. ) "Specifications for Prepared Stone, Slag and Gravel Ballast", size No. 4 as specified therein, tabulated as follows:

<u>SIEVE SIZE</u> <u>(SQUARE OPENING)</u>	<u>PERCENT</u> <u>PASSING</u>
2"	100
1-1/2"	90 - 100
1"	20 - 25
3/4"	0 - 15
1/2"	0

(See item 16.3 of this specification for placement, tamping, etc., of ballast).

## 16. RAILS AND ACCESSORIES

### 16.1 RAILS

Rails shall conform to the requirements of A. R. E. A. "Specifications for Open-Hearth Steel Rails". Rail section shall be ninety (90) pound RA-A Section as specified therein.

### 16.2 RAIL ACCESSORIES

- a. Joint bars shall be of the "toeless" type (without extended flange), approximately twenty-four (24) inches long. Material for joint bars shall be either high carbon steel or quenched carbon steel conforming to A. R. E. A. "Specifications for Joint Bars". Joint bars with extended flange may be used only with the written permission of the Engineer.
- b. Track bolts shall be carbon steel with elliptical shoulders and shall conform to A. R. E. A. "Specifications for Heat-Treated Carbon Steel Track Bolts". Bolts shall be of the proper length to fit the specific joint bar to be used. Washers for track bolts shall conform to A. R. E. A. "Specifications for Spring Washers".
- c. Tie plates shall be 8" x 10" x 1/2", single shoulder type, canted 1:40 without bottom ribs. Tie plates shall be of low carbon steel conforming to A. R. E. A. "Specifications for Low Carbon Steel Tie Plates". Plates shall be punched with eleven-sixteenths (11/16) inch square holes spaced so that the inside edges of holes fall one-sixteenth (1/16) inch inside the edge of the base of the rail. (e.g.: For rails having a base five and one-eighth (5-1/8) inches wide, the distance between inside edges of holes in the tie plates shall be five (5) inches). If joint bars with extended flange are used, tie plates with additional punchings shall be used at joints in order that spiking requirements (Par. 16.3 d.) will be met.
- d. Track spikes shall be nine-sixteenth inch by five and one-half inches (9/16" x 5-1/2") and shall conform to A. R. E. A. "Specifications for Track Spikes".
- e. Spikes for fastening planks in crossings shall be three-eighths (3/8) inch square by eleven (11) inches long.
- f. Rail anchors shall be "Improved Fair Rail Anchors" as manufactured by the P & M Company, or approved equal.
- g. Gage rods shall be Bethlehem No. 855-F (non-insulated) or approved equal.

- h. Compromise joints, when required, shall be cast steel designed for the specific joints as to size of rail sections, headwear and drilling of the sections.
- i. Turnouts and crossovers shall be the size and type shown on the drawings. High switch stands for the turnouts shall be Racor 112-D or approved equal, equipped with a single circular red day target (minimum fifteen (15) inches diameter) located as shown on the drawings. Low switch stands shall be Racor 36-D or approved equal, located as shown on the drawings. High and low switch stands shall be equipped with Adlake Reflex Switch Lamp #1379 or approved equal.

### 16.3 INSTALLATION OF NEW RAIL

- a. Rails shall be unloaded from cars with an approved derrick or crane and shall be carefully placed with head up and without dropping. The joints in each line of rail shall be suspended between ties and shall be not more than thirty (30) inches from the midpoints of the opposite rails. Rail joints shall not be located within the limits of road crossings insofar as practicable. Butt welding by approved methods is permissible. Rails shorter than fifteen (15) feet shall not be used.
- b. Tie plates shall be installed under rail on all ties. Ties shall be adzed as required to provide full bearing between tie plate and tie. Adzing or other cutting shall be held to the minimum and all cut surfaces of treated ties shall be treated with two (2) coats of hot coal-tar creosote. Tie plates shall be so placed that the shoulder is in contact with the base of rail or the joint bar for the entire length of the shoulder. Ties shall be placed so that one end of each tie falls on a common line. On curves this line shall be located on the inner side.
- c. Fishing surfaces of rail and joint bars shall be lubricated as joints are assembled using a rust-inhibiting lubricant, NO-OX-ID, as manufactured by Dearborn Chemical Company, or approved equal. All fishing surfaces shall be thoroughly cleaned with stiff wire brush before applying lubricant.

Rail joints shall be assembled and fully tightened before track is spiked. Joint bars shall be lined up with rail in vertical position and bolts tightened by starting in the middle of the joint and working toward the ends. Allowance for rail expansion shall be made according to the following table:

Rail Temperature  
Degrees F.

Opening Between Rail Ends  
33' 0"                      39' 0"

0 - 25	3/16 inch	1/4 inch
26 - 50	1/8 inch	3/16 inch
51 - 75	1/8 inch	1/8 inch
76 - 100	1/16 inch	1/16 inch
Over 100	None	None

Rail temperatures shall be taken at the time of laying by the use of an approved rail thermometer applied to the head of the rail. All shims used for spacing purposes shall be removed after track is spiked and ballasted.

All rail laid in any one day shall be fully spiked and bolted at the close of that day's work. Holes in rails shall be drilled in the field where required. Burning of bolt holes will not be permitted. Rails shall be cut only by sawing.

- d. Rails on tangent track shall be spiked to ties with two spikes per rail per tie. Spikes shall be uniformly located on all ties. The outside spikes shall be near one edge of the tie and the inside spikes near the other. On curves of less than 6°, rails shall be double spiked on the inside of each rail and single spiked on the outside of each rail from point of curve to point of tangent. Curves from 6° to 10° shall be double spiked inside and outside from point of curve to point of tangent. Spikes shall be driven vertically and square with the rail. They shall be so driven that the face of the spike has a full hold on the base of the rail. Joint bars shall not be slot-spiked.
- e. Gage rods shall be installed per each thirty-nine (39) foot or thirty-three (33) foot panel, on curves as follows:

<u>Degree of Curve</u>	<u>Number</u>
2° and less	None
Over 2° and incl. 4°	One
Over 4° and incl. 6°	Three
Over 6° and incl. 10°	Four

Placement of gage rods shall be as shown on Hanford Standard AC-7-6, Railroad Gage Rods.

- f. Ballast shall be uniformly distributed from ballast cars in the required amount and shall be leveled by means of a ballast plow or spreader. In tamping ballast both rails must be raised at one time and as uniformly as possible. Jacks shall be placed close enough together to prevent undue bending of the rails or strain on the joints.

Ballast shall be well packed or tamped. Tamping shall begin at the outside of each tie and shall proceed to a point fifteen (15) inches inside of each rail on both sides of the tie. The finishing lift shall be made by jacking the track to such a height that the final position of the track will be at the exact height indicated on the drawings, after ballast is properly tamped. The track shall be placed in good alignment before the finishing lift is made, and shall be brought to accurate alignment, both horizontally and vertically, when the finishing lift is completed. Curves shall be superelevated the amount shown on the drawings or as directed by the Engineer. After the finishing lift is completed and the track has been in service for thirty (30) days under normal traffic conditions, a final spotting and touch-up of grade and alignment shall be made.

Ballast shall be trimmed to conform to the sections shown on the drawings. Excess ballast shall be disposed of as directed by the Engineer.

- g. Rail anchors shall be installed, after the finishing lift, as shown on Hanford Standard AC-7-7, Rail Anchors. Care shall be taken to give anchors a firm bearing against the ties when installed.

#### 16.4 INSTALLATION OF TURNOUTS

Turnouts shall be installed in the locations shown on the drawings, in accordance with Hanford Standards AC-7-4, Turnout - 15'0" Switch and No. 8 Frog, and AC-7-5, Turnout - 16'6" Switch and No. 10 Frog. All requirements of 16.3 "INSTALLATION OF NEW RAIL" shall apply to installation of turnouts.

#### 16.5 RAIL RENEWAL

All requirements of 16.3 "INSTALLATION OF NEW RAIL" shall apply to renewal of rails. On completion of the replacement, the Engineer shall be notified. The track shall then be raised and lined to an approved grade and centerline.

#### 17. ROAD CROSSINGS

##### 17.1 PLANK CROSSINGS

Materials and installation of plank crossings shall be as shown on Hanford Standard AC-7-21, Wood Plank Railroad Crossing.

##### 17.2 BITUMINOUS CROSSINGS

Materials and installation for bituminous crossings shall be as shown on Hanford Standard AC-7-20, Railroad Crossing.

18. SIGNS

Crossing signs, whistle posts and mile posts, when required, shall be located and installed as shown on the plans and in accordance with Hanford Standards AC-7-32, Railroad-Highway Crossing Signs; AC-7-31, Whistle Post; and AC-7-30, Railroad Mile Post.

CAPE - 1072 - 304

WOOD POST FENCE

INSTRUCTIONS FOR USE OF  
STANDARD SPECIFICATION HWS-6105-S, WOOD POST FENCE

When selecting and specifying fences, the following should be kept in mind:

1. WOOD POST FENCE VS CHAIN LINK FENCE

Wood post fence using creosoted lumber is cheaper than chain link fence for about the first ten years. After that time, necessary repairs for the wood post fence run the cost over that of a chain link fence.

Accordingly, wood post fence can be used to advantage for facilities where a fence life of approximately ten years or less is desired. Where the desired fence life will exceed ten years or where permanent security fencing is involved, chain link fencing should be used. (Use Hanford Standard Specification HW-4680-S, Chain Link Security Fence).

2. TEMPORARY CONSTRUCTION FENCE

Specification HWS-6105-S can be readily adapted to temporary construction fence if there are either no gates or frequently-used gates in the fence. For this purpose, merely reference this specification and state that the preservative treatment is waived. (In compliance with a plant safety requirement, the specification uses metal gates for facilities where gates are used frequently.)

If there are to be infrequently-used gates in the temporary construction fence, the user may wish to specify such gates to be made of wood.

To use the specification for temporary construction fence with infrequently-used wood gates:

- a. Furnish a separate drawing or description of the wooden gate desired. Show gate post size (8" x 8", 48" bury).
- b. Waive the requirement for metal gates and metal gate and brace posts.
- c. Waive the requirement for preservative treatment.

3. GROUNDING OF FENCES

For all fences, the drawings should specify location and method of required grounding when a fence parallels power lines. Refer to DI-4680-S for additional references and information.

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1	General Revision	hes	12-1-59		hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL <b>H. E. Struck</b> SECRETARY. DATE <b>8-28-56</b>				INSTRUCTIONS FOR USE OF HWS-6105-S	<b>DI-6105-S</b>	

CAPE-1072-306

HWS-6105-S

STANDARD SPECIFICATION

for

WOOD POST FENCE

Ref Hanford Stds: HW-4680-S,  
AC-5-20, D-3-5, D-3-5a

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
1	General Revision	hes	5-1-61		hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 8-28-56				WOOD POST FENCE	HWS-6105-S	

## STANDARD SPECIFICATION FOR WOOD POST FENCE

1. SCOPE

This specification covers materials and installation for new or replacement wood post fence.

2. MATERIALS

## 2.1 LUMBER

- a. All lumber for wood post fence shall be Douglas fir as produced and graded under the West Coast Lumber Inspection Bureau, Grading and Dressing Rules No. 15, March 15, 1956. Refer to Plate 1 of this specification for dimensions and details.
- b. All lumber shall be full-length pressure-treated with creosote in accordance with Federal Specification TT-W-00571f (AGR-FSS) "Wood Preservative: Treating Practices". Retention of creosote shall be a minimum of six pounds per cubic foot. All lumber shall be cut to size and recessed for extension arms prior to treatment.
- c. Corner and pull posts shall be Standard Grade Posts, 8 inch x 8 inch nominal dimension, with a 15° roof as shown on Plate I.
- d. Line posts and bracing for corner and pull posts shall be Construction Grade Light Framing, 4 inch x 4 inch nominal dimension, with a 15° roof for line posts as shown on Plate I.
- e. Extension arms and cleats shall be Construction Grade Light Framing, 2 inch x 4 inch nominal dimension.

## 2.2 METAL POSTS

Gate posts shall be metal as shown on Hanford Standard AC-5-20, Standard Security Chain Link Gate. The line post adjacent to each gate post shall be metal as shown on Plate I of Hanford Standard Specification HW-4680-S, Chain Link Security Fence. Posts, extension arms, bracing, stretcher bars and fittings for metal posts shall conform to HW-4680-S.

## 2.3 FENCE FABRIC

Fence fabric shall be farm type, woven steel wire fabric, heavily galvanized. Top and bottom wires shall be not less than No. 10 Steel Wire Gage and all other wire in the fabric shall be not less than No. 12-1/2 Steel Wire Gage. Vertical wires of the fabric shall be uniformly spaced not more than 6 inches apart. Spacing of horizontal wires may vary but shall not exceed 9 inches. Fabric widths shall be chosen so as to provide finished fence height of 8 feet to top of fabric without cutting fabric.

1. BARBED WIRE

Each strand of barbed wire shall consist of two galvanized steel wires not less than No. 12-1/2 Steel Wire Gage with 4-point barbs spaced approximately 5 inches on centers.

2.5 GATES

Gates shall be chain link gates conforming to Hanford Standard AC-5-20 and Hanford Standard Specification HW-4680-S.

2.6 NAILS & STAPLES

Nails for fastening fence members, bracing and extension arms shall be 16d galvanized nails. Staples for fastening fabric to wood posts and barbed wire to extension arms shall be one inch x No. 9 gage, galvanized steel wire staples.

2.7 CONCRETE

Concrete for setting metal posts shall develop a minimum compressive strength of 2000 pounds per square inch at 28 days.

3. INSTALLATION

3.1 GENERAL

Fence shall be installed in the location shown on the plans in accordance with Plate I of this specification and the following.

3.2 SETTING POSTS

- a. The diameter of post holes shall be as small as is practicable but of sufficient size to admit a tamping bar all around the post. Posts shall be set plumb and true. Line posts shall be spaced not more than 10'-0" on centers and shall be set not less than 36 inches into the ground.
- b. Corner and pull posts shall be set not less than 48 inches into the ground. Pull posts shall be installed between corner posts or between gate and corner posts at intervals not to exceed 100 feet. When the run is between 100 and 200 feet, the pull post shall be located at the center of the run.
- c. Backfill for posts shall be free of trash, vegetable matter and stones larger than 1-1/2 inches, greatest dimension. Backfill around posts shall be placed in six-inch layers, loose measurement, wet down, and thoroughly tamped before placing the next layer.

- d. The metal gate posts and adjacent metal brace posts shall be set as specified in Hanford Standard Specification HW-4680-S.

### 3.3 INSTALLATION OF EXTENSION ARMS

Extension arms shall be recessed into the posts approximately 1-5/8 inches and shall be securely nailed to the posts with at least four 16d galvanized nails. Extension arms shall fit snugly into recess. Arms shall be installed so as to project outward from the enclosed area and upward from top of the fence fabric at an angle of approximately 45 degrees.

### 3.4 POST BRACING

- a. East corner or pull post shall be diagonally braced by means of a 4 inch x 4 inch timber as shown on Plate I of this specification. Braces shall be installed on both sides of corner and pull posts. Braces shall have cleats at top and bottom, as shown on Plate I.
- b. Gate post bracing shall conform to Plate I of Hanford Standard Specification HW-4680-S. One steel line post shall be used adjacent to each gate post to receive bracing members as shown on Plate I of HW-4680-S.

### 3.5 INSTALLATION OF FENCE FABRIC

- a. Fabric shall be stretched tightly between posts and shall be installed as close as possible to grade. Clearance between grade and the bottom wire of the fabric shall not exceed two inches. Low places in the ground surface shall be filled to a minimum distance of two feet on each side of the fence line to meet this requirement. Fabric shall be securely fastened to all wood posts with one inch x No. 9 gage, galvanized steel wire staples, spaced not more than 12 inches on centers.
- b. Fabric shall be securely fastened to metal posts adjacent to gate posts with metal clips or ties not smaller than No. 10 Steel Wire Gage spaced not more than 12 inches on centers. At gate posts, each horizontal wire of fabric shall be wrapped around the stretcher bar and wound around itself to form a secure connection. Stretcher bars shall be tied to gate posts with stretcher bar bands spaced not more than 18 inches on centers.
- c. If multiple widths of fabric are used to attain the required height of fence, the widths shall be securely clipped or wired together with metal ties which are not smaller than No. 10 Steel Wire Gage. Spacing of the ties shall not be greater than 12 inches on centers.

3.6 INSTALLATION OF BARBED WIRE

Three equally spaced strands of barbed wire shall be stretched between the extension arms as shown on Plate I and securely stapled at each arm. Wires shall be located as shown so that the topmost strand is approximately 12 inches upward and outward from the top of the fence fabric.

3.7 GATE CONSTRUCTION

Gates shall be constructed as shown on Hanford Standard AC-5-20 and in accordance with Hanford Standard Specification HW-4860-S.

3.8 GROUNDING

Fences shall be grounded at power line crossings in accordance with Hanford Standards D-3-5 and D-3-5a, Substation Fence Grounding. Grounding of fences which are parallel to power lines or at other locations where fences are required to be grounded to meet safety requirements shall be as shown on the plans.



CAPE-1072- 312

INSTRUCTIONS FOR USE OF HWS-6131-S  
STANDARD SPECIFICATION  
FOR HOT-LAID ASPHALTIC CONCRETE PAVEMENT.

Specification HWS-6131-S covers hot-laid asphaltic concrete pavement for roadways, driveways, parking lots and sidewalks and includes the gravel base course, leveling course and shoulders. It is intended primarily for use in new construction. Construction of the subgrade is covered by Hanford Standard Specification, HWS-6134-S, Grading and Drainage for Roads.

When Specification HWS-6131-S is used for roads inside limited areas (100, 200 and 300 areas) the following should be observed:

1. Roadway Sections

Unless unusual soil conditions exist or a special roadway section is required, specify that the roadway section shall be as shown on Standard AC-6-2, Type A. Separate drawings of cross-sections must be prepared for unusual soil conditions or special roadway sections.

2. Sidewalks, Parking Lots

Use the sidewalk section on Standard AC-6-2 for sidewalks constructed of hot-laid asphaltic concrete. Construction of sidewalks with this material will be economical only in conjunction with other hot-laid asphaltic concrete work. When other hot-laid asphaltic concrete work is not involved, sidewalks should be constructed of cold-laid asphaltic concrete (Hanford Standard Specification HWS-6135-S) such as normally stockpiled by Transportation Operation, or simpler construction such as gravel (HWS-6136-S), good sand-clay mixture, etc.

Hot-laid asphaltic concrete should be used for parking lots only when justified for the conditions of traffic, etc. Alternate and preferable construction includes light bituminous surface treatment (Hanford Standard Specification HWS-6133-S), gravel surface (HWS-6136-S), or light oiling for dust control.

3. Prime Coat

A prime coat is required for roadway construction.

For parking areas, driveways, and sidewalks, a prime coat is desirable but may be eliminated. If the prime coat is to be eliminated for these areas, specify that it be omitted and that the asphaltic concrete wearing course be constructed on the prepared leveling course.

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2	Ref Stds Nos.	hes	3-15-61		hes	chh
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When Specification HWS-6131-S is used for highways between areas, the following should be observed:

1. Roadway Sections

A roadway cross-section shall be drawn for each section of roadway to be constructed. Such sections shall conform to Standard AC-6-1, Roadway Sections, and shall show the required base course thickness and the wearing course thickness (1-1/2 inches or more).

2. Prime Coat

A prime coat is required for roadway construction.

For parking areas, driveways, and sidewalks, a prime coat is desirable but may be eliminated. If the prime coat is to be eliminated for these areas, specify that it be omitted and that the asphaltic concrete wearing course be constructed on the prepared leveling course.

HWS-6131-S

STANDARD SPECIFICATION

for

HOT-LAID ASPHALTIC CONCRETE PAVEMENT

HAPO Ref. Stds: None

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1	General Revision	hes	1-13-58		hes	chh
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HWS-6131-S

STANDARD SPECIFICATION

FOR HOT-LAID ASPHALTIC CONCRETE PAVEMENT

1. SCOPE

This specification covers the materials and construction requirements for hot-laid asphaltic concrete for paved roads, driveways, parking lots and sidewalks and includes the gravel base and leveling courses.

2. IDENTIFICATION OF ENGINEER

The term "Engineer" refers to the representative of the user of the facility to which this specification applies.

3. BASE COURSE

- a. After the roadway subgrade has been brought to the lines and grades shown on the construction drawings, the material for the base course shall be distributed full width between the shoulder lines of the subgrade to a depth sufficient to produce a compacted course of the thickness shown on the drawings. For driveways and parking lots the base course shall be distributed in a like manner over the area to be paved.
- b. Base course material shall consist of selected pit run stone conforming to the following gradation:

Passing 3-inch square opening	100%
Passing 2-inch square opening	
not more than	85%
not less than	55%
Passing 1-inch square opening	
not more than	55%
Passing 1/4-inch square opening	
not more than	45%
not less than	30%

All percentages are by weight.

- c. Base course material shall be processed by blading back and forth across the road bed with a motor patrol grader. During the processing, water shall be applied in sufficient quantities to thoroughly dampen, but not saturate, the base course material. Blading shall continue until the material shows a uniform grading from coarse to fine.

- d. While the material is still damp it shall be compacted by rolling with one of the following types of rollers:
  - (1) Ten ton, steel-wheel, power roller, 3-wheel model.
  - (2) Pneumatic-tired, multiple wheel, two axle roller, not less than five feet, nor more than 7.5 feet in width equipped with pneumatic tires of equal size and diameter, with smooth treads. The wheels on the front and rear axles shall be staggered and shall revolve in a plane perpendicular to the centerline of the axle. Air pressure in the tires shall be maintained within a range of 5 psi between high and low. Roller shall weigh not less than 4 tons nor more than 11 tons. Exact weight in this range shall be as determined by the Engineer. Roller may be self-propelled or may be towed with a rubber-tired tractor or light truck.
- e. Rolling shall be continued until the surface of the base course is firm and unyielding. If sandpockets or deposits of loose materials become evident during rolling, such deposits shall be removed and replaced with properly graded material.

#### 4. LEVELING COURSE

- a. The leveling course shall consist of crushed or partially crushed stone. The material shall be free from trash and vegetable matter. Leveling course aggregate, when separated on 1/4-inch and 3/4-inch square opening screens shall contain in each size, including material passing 1/4-inch, not less than 75 per cent by weight of particles with at least one fractured face produced by mechanical crushing.

- b. Leveling course material shall meet the following gradation:

Passing 3/4-inch square opening	100%
Passing 1/4-inch square opening	50 to 65%
Passing No. 200 mesh sieve	5 to 15%

All percentages are by weight.

- c. Leveling course material shall be placed on the base course full width of the roadway between shoulder lines to a depth necessary to produce a 2-inch thick course after compaction. The material shall be bladed, watered, and rolled in the same manner and with the same type equipment as specified for the base course until the surface of the leveling course is firm and unyielding.

- d. Leveling course used as "base course" for sidewalks which are inaccessible to a grader shall be dampened and raked into a uniform layer of depth sufficient to produce a 2-inch thick layer after compaction. Areas inaccessible to a roller of the size described in paragraph 3d of this specification, shall be rolled with a lawn roller or small power roller until the surface is firm and unyielding..

## 5. BINDER

When either the base course or the leveling course material does not afford sufficient stability and/or natural cementing properties to readily compact, binder shall be added in such amounts as the Engineer may direct. Binder shall be added to base and leveling course prior to placing on the roadway, whenever practicable. When binder is added to material on roadway, it shall be added to the material in the windrow and thoroughly mixed, while dry, by blading back and forth across the roadway.

Binder shall be natural clayey topsoil conforming to the following gradation:

Passing 3/8" square opening	100%
Passing 1/4" square opening	90 to 100%
Passing No. 200 mesh sieve	10 to 15 %

All percentages are by weight.

That portion passing a U.S. No. 40 sieve shall not have a liquid limit (ASTM Designation: D 423-54T) in excess of 30 nor a plasticity index (ASTM Designation: D 424-54T) in excess of 3.

## 6. ASPHALT

Asphalt products used in the work covered by this specification shall conform in all respects to the requirements of Section 25 of the Standard Specifications of the State of Washington Department of Highways, 1948, and Amendment No. 2, 1953. Paving asphalt shall be free from water and shall not foam when heated to 350 F. The grade of paving asphalt for use in the asphaltic concrete mixture shall be 86-100 penetration unless otherwise ordered by the Engineer. The grade of liquid asphalt for prime coat shall be MC-2 or MC-3. A certification that the asphalt conforms to Washington State Highway Specifications shall be furnished for each carload or other lot of asphalt.

## 7. PRIME COAT

On all roadways, the prepared leveling course shall be given a prime coat. Unless otherwise specified, the leveling course for sidewalks, driveways and parking areas shall also be given a prime coat.

After rolling and prior to application of prime coat, the roadway surface to receive the asphaltic concrete shall be stable and unyielding and reasonably smooth, in a dry to medium damp condition. MC-2 or MC-3 grade asphalt shall be spread at the rate of approximately 0.25 gallons per square yard by an approved pressure distributor, full width of the area to be paved. This asphalt shall be allowed to penetrate into the base for approximately 24 hours before placing the wearing course. Asphalt cement for prime coat shall be applied only during clearing or fair weather. The application temperature of cement shall meet the requirements set forth in Section 25 of the Standard Specifications of the State of Washington Department of Highways.

Application shall not be made when the temperature of the roadway is less than 50 F.

#### 8. AGGREGATES FOR ASPHALTIC CONCRETE

- a. Coarse aggregate shall consist of that portion of total aggregate retained on a U.S. No. 10 sieve. Fine aggregate shall consist of that portion of total aggregate passing a U.S. No. 10 sieve. Aggregates shall be furnished in gradings as specified in Item 10, "Proportions of Materials". Aggregate shall be uniform in quality and free from trash, extraneous material and adherent coatings. The presence of a thin, firmly adhering film of weathered rock will not be considered as coating unless it exists on more than 50 per cent of the surface area of any size between consecutive laboratory screens.
- b. Coarse aggregate when separated on consecutive laboratory screens shall contain in each size not less than seventy-five (75) per cent by weight of fragments with at least one fractured face produced by mechanical crushing.
- c. Fine aggregate may be either a natural sand, crushed screenings, or a uniform combination of the two. It shall be hard grained. When tested by wet sieving, the percentage passing the U.S. No. 200 sieve shall not exceed twice the percentage passing this sieve by dry sieving without water.

#### 9. MINERAL FILLER

Mineral filler used in the hot plant mix shall be either portland cement or commercially ground stone dust of a type approved by the Engineer. The filler shall be free from lumps, balls and extraneous material and shall conform to the following sieve analysis:

Passing U.S. No. 10 sieve	100%
Passing U.S. No. 200 sieve not less than	75%
Particles smaller than .025 mm, not less than	50%
Particles smaller than .005 mm, not more than	35%

All percentages are by weight.

Plasticity index of the material shall not exceed 2, as determined by the Standard Method of Test for Plastic Limit and Plasticity Index of Soils, ASTM Designation: D 424-54T.

#### 10. PROPORTIONS OF MATERIALS

- a. The materials of which the asphaltic concrete is composed shall be of such sizes and grading that when proportioned and mixed together, they will produce a uniformly graded mixture which, when tested by means of laboratory screens, will conform to the requirements given in the following tables. The percentages of aggregate include mineral filler and refer to the complete dry mix. The percentages of asphalt refer to the complete asphaltic concrete mixture. All percentages are by weight. Sieves and screens used for determining the percentages of the different sizes of aggregates shall have square openings.

##### Plant Mixed Asphaltic Concrete

Passing 5/8" screen retained on 1/2" screen	0-10%
Passing 1/2" screen retained on 1/4" screen	30-50%
Passing 1/4" screen retained on No. 10 sieve	20-40%
Passing U.S. No. 10 sieve	20-40%
Mineral Filler	1.0-2.0%
Asphalt	4.5-7.0%

- b. In the above gradation for asphaltic concrete, that portion of the aggregate passing No. 10 sieve when considered separately from the remainder of the aggregate shall meet the following screen test:

Passing U.S. No. 10 sieve retained on U.S. No. 40 sieve	30-55%
Passing U.S. No. 40 sieve retained on U.S. No. 80 sieve	20-50%
Passing U.S. No. 80 sieve retained on U.S. No. 200 sieve	10-30%
Passing U.S. No. 200 sieve	5-16%

The exact proportions of the constituents to be used in the production of the bituminous mixture shall be determined by the Contractor subject to the approval of the Engineer.

11. PREPARATION OF PLANT-MIX AGGREGATES

Preparatory to the proportioning of the materials, the aggregate, exclusive of mineral filler, shall be heated to a temperature of between 300 F and 385 F. The heating shall be done in a suitable rotary heater or drier equipped with fan and dust collector that will remove all excess dust contained in the aggregate.

12. HEATING ASPHALT

The asphalt shall be heated in insulated tanks, kettles or sumps so designed that the heating will be uniform throughout and the heat can be positively controlled at all times. No flame shall be permitted to come into direct contact with the heating kettles. The asphalt shall be heated to between 250 and 300 F.

13. MIXING

- a. The mixing of the asphaltic concrete shall be done in a mixer of the pug mill type approved by the Engineer.
- b. The properly proportioned hot aggregate shall be placed in the mixer first. The hot asphalt shall then be added and the mixing commenced, after which the cold stone dust or filler shall be added.
- c. The mixing period, after the hot aggregate is placed in the mixer, shall be at least 30 seconds and as much longer as may be necessary to produce a homogeneous mixture of unchanging appearance.
- d. The weight of the batch of mixed materials shall not be greater than the manufacturer's rated capacity of the mixer.

14. HAULING

- a. The asphaltic concrete mixture shall leave the mixing plant at a temperature between 260 F and 375 F, and when deposited on the road it shall have a temperature of not less than 250 F.
- b. When the asphaltic concrete mixture has been mixed as specified, it shall be transported to the place of deposit in suitable dump trucks. The sides and bottoms of the trucks shall be lubricated with a mixture of water and light oil or diesel oil before receiving a load mixture. Excess water and oil shall not be left in the bottom of the trucks.
- c. **Hauling shall not be done** over freshly placed pavement.

## 15. SPREADING AND FINISHING

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- a. The course shall be spread with a mechanical, self-propelled spreading and finishing machine equipped with a hopper or mixture compartment to receive the mixture from the hauling trucks and a screed or cut-off device that oscillates in a horizontal motion or vibrates vertically when striking off the course or lift under construction. The spreading machine shall be of a type and design approved by the Engineer.
- b. The thickness of the wearing course shall be as shown on the drawings, but in no case shall the compacted depth be less than 1-1/2 inches.
- c. Where the maximum thickness of a course is greater than three inches, the course shall be constructed in two or more layers.
- d. Where segregation of the larger pieces of aggregate occurs on the surface, such segregated areas shall be corrected after the first rolling of the pavement.
- e. When areas inaccessible to a spreading and finishing machine are encountered, hand methods of spreading and finishing shall be used. Immediately after each load is dumped, it shall be distributed into place by means of hot shovels or suitable forks and spread with hot rakes, of suitable design, in a loose layer of uniform density and correct depth.
- f. Asphaltic concrete shall be laid only during clearing or fair weather and shall not be distributed on a base that is frozen or wet, or that has not been properly prepared. The base shall be stable and unyielding. Asphaltic concrete shall not be deposited on the road when the ground temperature is below 35 F.

## 16. COMPACTING

- a. Immediately following the spreading of the course, the asphaltic concrete shall be compacted by rolling with a modern three-wheeled or tandem, power roller weighing not less than 10 tons. The compression wheels on all three-wheeled rollers shall each be at least 20 inches wide and shall be so shaped or set that their rolling surfaces conform with the crown specified for the finished pavement. All rolling shall start longitudinally at the sides and proceed toward the center of the pavement overlapping on successive trips by at least 1/2 but not more than 3/4 the width of the rear wheel of the three-wheel roller. Alternate trips of the roller shall be of slightly different lengths. The rolling shall be continued until all roller marks are eliminated and the pavement shall be rolled diagonally in at least one direction with a tandem roller of the size described above.

- b. Areas not accessible to a roller of the size described in a, above, shall be rolled with a smaller power roller having a weight on the rear wheel(s) of at least 175 lbs. per linear inch of roller width. Rolling shall be done as specified in a, above, except that diagonal rolling may be omitted where impracticable.
- c. The rollers shall be in good condition and capable of reversing without backlash. They shall be operated by competent and experienced roller operators and must be kept in continuous motion as nearly as practicable in such a manner that all parts of the pavement receive substantially equal compression. Rollers are not to be left standing on freshly rolled hot asphaltic concrete.
- d. The surface of the mixture after compression shall be smooth and true to established section and grade. Any mixture which shows an excess or deficiency of cement, or uneven distribution of cement due to insufficient mixing, or from the aggregate being excessively hot or cold, or becomes loose and broken, mixed with dirt or in any way defective, shall be removed and replaced with fresh hot mixture, which shall be immediately compacted to conform with the adjacent surfacing. Areas inaccessible to the rollers shall be compacted by tamping with iron tampers.
- e. Rolling of asphaltic concrete must be entirely completed before dark; therefore, no mixture of asphaltic concrete shall be deposited on the roadway that cannot be completely rolled before dark.

## 17. JOINTS

- a. The placing of wearing course shall be as nearly continuous as possible, and the roller shall pass over the unprotected end of the freshly laid mixture only when the laying of the course is discontinued for such length of time as to permit the mixture to become cold. When the work is resumed, the material laid shall be cut back so as to produce a slightly beveled edge for the full thickness of the course. The material which has been cut away shall be removed from the work.
- b. Where asphaltic concrete is to be placed against concrete curb or against a cold joint, a thin paint-coat of cut-back asphalt shall be applied in advance of the placing of asphaltic concrete.

## 18. SURFACE SMOOTHNESS

The surface of the wearing course, when finished, shall be of uniform texture, smooth, true to crown and grade and free from defects of all kinds. The maximum deviation of the surface when tested with a 10-foot straightedge parallel to the centerline of the roadway shall not exceed one-eighth of an inch. No portion of the finished pavement shall be more than one-quarter inch below a template cut to the crown shown on the cross-section drawings, placed on the course at right angles to the center line.

Any deviations in excess of these tolerances shall be corrected by addition or removal of the asphaltic material and rolling before the pavement mixture becomes cold.

19. SHOULDERS

Shoulders of the width shown on the drawings shall be constructed after placement of the wearing course. Compacted depth of shoulders shall be equal to depth of wearing course. Material for shoulders and method of placement shall be as specified for leveling course. Shoulders shall be compacted to a firm, unyielding surface, sloped as shown on the drawings.

20. SIDEWALK CONSTRUCTION

- a. Surfacing for sidewalks shall consist of an asphaltic concrete wearing course prepared and applied as specified herein.
- b. Where a base course is specified on the drawings for sidewalks, this "base course" shall consist of leveling course prepared and applied as specified in Item 4, "Leveling Course".

CAPE-1072-325

INSTRUCTIONS FOR USE OF HWS-6132-S

STANDARD SPECIFICATION FOR NON-SKID SINGLE SEAL  
TREATMENT FOR ROADS

When Standard Specification HWS-6132-S is used, the following should be considered:

1. HWS-6132-S, while describing construction requirements for non-skid single seal, is primarily a maintenance or repair-type specification. It is to be applied to existing bituminous pavements which require a new riding surface. It can be applied equally well to paved parking lots and highways.
2. Seal coating of this type should be arranged to be done only during clear, warm weather, such as late spring, summer and early fall.
3. Ordinarily, the specification may be referenced directly for individual jobs without supplemental information applying to the specification itself. If it is necessary to use a different asphalt than the RC-4 or RC-5 stated in this specification, state the grade to be used in supplementary specifications or drawings.

NO.	REVISION	APP'D	DATE	CIVIL ENGINEERING STANDARDS	SUBM. BY	DES. BY
					hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 6-19-57				INSTRUCTIONS FOR USE OF SPECIFICATION HWS-6132-S	DI-6132-S	

CAPE-1072-326

HWS-6132-S

STANDARD SPECIFICATION

for

NON-SKID SINGLE SEAL TREATMENT FOR ROADS

June 19, 1957

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APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 6-19-57				SPECIFICATION FOR NON-SKID SINGLE SEAL TREATMENT FOR ROADS	HWS-6132-S	

STANDARD SPECIFICATION FOR  
NON-SKID SINGLE SEAL TREATMENT FOR ROADS

1. SCOPE

This specification covers the materials and construction requirements for a new wearing surface to be placed over a previously constructed bituminous pavement. The single seal treatment shall consist of a thin course of mineral aggregate bound together and to the underlying bituminous pavement with asphalt cement. Wherever the term, "Engineer" is used in this specification, it shall be understood to mean the Engineer representing the user of the facility.

2. MATERIALS

2.1 ASPHALT CEMENT

Asphalt products used in the work covered by this specification shall conform in all respects to the requirements of Section 25 of the Standard Specifications of the State of Washington Department of Highways, 1948, and Amendment No. 2, 1953. Unless otherwise specified, asphalt shall be RC-4 or RC-5.

2.2 MINERAL AGGREGATE

- a. The mineral aggregate used in the work covered by these specifications shall consist of crushed stone or crushed gravel. The material from which the crushed screenings are manufactured shall not have a percentage of wear in the Los Angeles Machine in excess of 30 after 500 revolutions as determined in accordance with the American Society for Testing Materials (ASTM) Designation: C 131-55, Method of Test for Abrasion of Coarse Aggregate by the Los Angeles Machine.
- b. Crushed screenings shall be free from vegetable matter and adherent coatings. The presence of a thin, firmly adhering film of weathered rock shall not be considered as coating unless it exists on more than 50 per cent of the surface area on any size between consecutive laboratory screens.
- c. Coarse crushed screenings, when separated on consecutive test screens, shall contain in each size not less than 75 per cent by weight of fragments with at least one fractured face produced by mechanical crushing.

- d. The mineral aggregates shall conform to the following requirements for grading:

	<u>Coarse Screenings</u>	<u>Fine Screenings</u>
Passing 5/8" square opening	100%	
Passing 1/2" square opening	95 to 100%	100%
Passing U. S. No. 4 sieve	Not more than 10%	85 to 100%
Passing U. S. No. 10 sieve	Not more than 3%	Not more than 60%
Passing U. S. No. 100 sieve	Not more than 1%	Not more than 10%

Percentages are by weight

### CONSTRUCTION REQUIREMENTS

#### 3. SWEEPING

The existing bituminous pavement shall be swept by the use of a rotary power broom until the surface is free from dirt, loose stones and other extraneous materials. Hand push brooms shall be used to clean omissions of the power broom.

#### 4. PATCHING

- a. When sweeping has been completed the surface to be covered shall be inspected for breaks. All holes and edge breaks shall be repaired. Loose material shall be removed and holes and/or breaks swept clean.
- b. Holes and edge breaks one inch in depth or less shall be repaired by placing asphalt cement in the bottom and covering with coarse screenings. Material shall then be tamped or rolled until a surface has been established suitable for application of seal coat.
- c. Holes and edge breaks, greater than one inch in depth shall be filled with plant-mixed asphaltic concrete and tamped or rolled until thoroughly compacted.

#### 5. SEAL COAT APPLICATION

Seal coat asphalt cement, as specified in Item 2.1 of this specification shall be applied to the broom-cleaned, dry roadway by means of a pressure distributor, approved by the Engineer. The material shall be heated to a point within the range 210 F to 260 F, and shall be applied prior to cooling. The

material shall be applied to the surface of the roadway at a rate of 0.2 gallon per square yard (approximately). Actual application rate and temperature shall be adjusted to roadway and weather conditions as directed by the Engineer. Necessary measures shall be taken to avoid center laps and ridges at transverse joints in application of asphalt cement in order to produce a smooth surface with good riding qualities.

During the application of seal coat and screenings, traffic shall not be allowed directly on the seal coat. Asphalt cement shall not be applied to frozen or wet road surfaces or during sand, dust or rain storms. The surface of the road shall be dry during period of application of seal coat and screenings. Asphalt cement shall not be applied when the ground temperature is less than 50 F. If necessary, the Engineer may require a delay in application of asphalt until roadway and atmospheric conditions are satisfactory. No cement shall be placed which cannot be cured before the hours of darkness.

#### 6. SPREADING COARSE SCREENINGS

- a. Immediately following application of the asphalt cement and while it is still hot, clean coarse screenings shall be uniformly spread over the treated area at the rate of approximately .011 cubic yard per square yard (28 to 30 lb. per sq. yd.). Stone shall be distributed by the use of a spreader box of a type approved by the Engineer. Vehicle shall be operated so that it travels on the spread screenings and not on the freshly placed asphalt cement. A motor patrol grader with wire broom mold board attachment shall be provided to supplement the spreader box in the uniform distribution of screenings. Allowance for center lap in asphalt cement shall be made before screenings are spread.
- b. Rolling shall be started as soon as is practicable after screenings have been distributed over the fresh asphalt cement. Rolling shall be done with a modern, pneumatic-tired roller of a capacity of from 4 to 10 tons. Towing of roller shall be done only by a pneumatic-tired vehicle. Exact weight of the roller shall be adjusted as directed by the Engineer at the time of use. Rolling shall be continued until screenings are firmly embedded in the cement. The surface shall then be inspected and, where required by the Engineer, additional screenings added or excess screenings removed by hand work.

#### 7. SPREADING FINE SCREENINGS

- a. After the coarse screenings have been spread and rolled as described in Item 6, fine screenings shall be spread over the surface of the road at the rate of approximately .0026 cubic yard per square yard (7 to 10 lb. per sq. yd.). Addition of fine screenings may be delayed as much

as four days after spreading of coarse screenings, when, in the opinion of the Engineer, spreading of fine screenings is not required to prevent coarse screenings from being picked up by vehicle tires.

- b. Fine screenings shall be applied to the road surface by means of a spreader box. Distribution of fine screenings shall be supplemented by the use of hand street brooms to insure that no liquid asphalt is in evidence on the surface.
- c. Immediately after the fine screenings have been spread as described in a and b, above, the completed surface shall be thoroughly rolled with a pneumatic-tired roller as described in Item 6b.
- d. If required by the Engineer, additional fine screenings shall be added where surplus asphalt may appear, during a period of five days after application of the fine screenings specified in a, b, and c, above.

INSTRUCTIONS FOR USE OF HWS-6133-S  
STANDARD SPECIFICATION FOR LIGHT BITUMINOUS  
SURFACE TREATMENT PAVING

Specification HWS-6133-S covers light bituminous surface treatment paving, consisting of two "shot and cover" courses, for roadways, driveways and parking lots. It includes the bituminous surfacing, gravel base course, leveling course and shoulders for new construction and the preparation of subgrade, bituminous surfacing and shoulders for existing gravel surfaced areas. Hanford Standard Specification HWS-6134-S, Grading and Drainage for Roads, covers construction of new subgrade.

When used for roads inside limited areas (100, 200 and 300 areas), the following should be observed:

1. Roadway Sections

Unless unusual soil conditions exist or a special roadway section is required, specify that the roadway section shall be as shown on Standard AC-6-2, Type B or Type C, as required. Separate drawings of cross-sections must be prepared for unusual soil conditions or special roadway sections.

2. Parking Lots and Driveways

Normally, parking lots and driveways to be paved with light bituminous surface treatment do not require a base course. In such cases specify only the leveling course, or if the soil is of a stable gravel consistency or the area is already graveled, specify that the bituminous surfacing be applied directly on the existing gravel surface in accordance with the requirements of the specification.

3. Asphalt

The grade of asphalt specified in HWS-6133-S is MC-3. If a different grade is to be used, specify the required grade in supplemental drawings or specifications.

When used for highways between areas, the following should be observed:

1. Highway Cross-Sections

A cross-section shall be drawn for each type of highway to be constructed. Such cross-sections shall conform to Standard AC-6-1, Inter-Area Highway Cross-Sections, and shall show the required base course thickness.

2. Asphalt

The grade of asphalt specified in HWS-6133-S is MC-3. If a different grade is to be used, specify the required grade in supplemental drawings or specifications.

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2	Ref Stds Nos.	hes	3-15-61		hes	chh
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HWS-6133-S

STANDARD SPECIFICATION

for

LIGHT BITUMINOUS SURFACE TREATMENT PAVING

August 5, 1957

HAPO Ref. Stds: None

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STANDARD SPECIFICATION  
FOR  
LIGHT BITUMINOUS SURFACE TREATMENT PAVING  
(DOUBLE SHOT AND COVER)

CAPE-1072- 333

1. SCOPE

This specification covers the materials and construction requirements for light bituminous surface treatment for roadways subject to light or infrequent traffic, and for driveways and parking areas normally subject to light and comparatively slow traffic.

This specification covers base, leveling, and bituminous surface courses for new construction as well as bituminous surfacing for existing gravel surfaced roads and parking areas.

2. IDENTIFICATION OF ENGINEER

The term "Engineer" refers to the representative of the user of the facility to which this specification applies.

3. MATERIALS

3.1 BASE COURSE

Base course material to be placed on new subgrade shall consist of selected pit run stone conforming to the following gradation:

Passing 3-inch square opening	100%
Passing 2-inch square opening	
not more than	85%
not less than	55%
Passing 1-inch square opening	
not more than	55%
Passing 1/4-inch square opening	
not more than	45%
not less than	30%

(All percentages are by weight)

3.2 LEVELING COURSE

- a. The leveling course to be used with the base course specified above shall consist of crushed or partially crushed stone. The material shall be free from trash and vegetable matter. Leveling course aggregate when separated on 1/4-inch and 3/4-inch square opening

screens shall contain in each size, including material passing 1/4-inch, not less than 75 per cent by weight of particles with at least one fractured face produced by mechanical crushing.

- b. Leveling course material shall meet the following gradation:

Passing 3/4-inch square opening	100%
Passing 1/4-inch square opening	50 to 65%
Passing No. 200 mesh sieve	5 to 15%

(All percentages are by weight)

### 3.3 ASPHALT

- a. Asphalt cement used in the work covered by this specification shall conform in all respects to the requirements of Section 25 of the Standard Specifications of the State of Washington Department of Highways, 1948, and Amendment No. 2, 1953.
- b. Asphalt cement shall be MC-3, unless specified otherwise on construction drawings or in job specifications.

### 3.4 CRUSHED COVER STONE

- a. Crushed cover stone shall be manufactured from gravel. It shall be clean, uniform in quality, free from vegetable matter and other extraneous material.
- b. Crushed cover stone shall not have a percentage of wear in the Los Angeles machine in excess of 35 after 500 revolutions. The percentage of wear shall be determined in accordance with ASTM Designation: C 131-55.
- c. Crushed cover stone when separated on 1/4-inch, 3/8-inch and 5/8-inch sieves shall contain in each size, including material passing 1/4-inch sieve, not less than 75 per cent by weight of fragments with at least one fractured face produced by mechanical crushing.
- d. Crushed cover stone shall meet the following requirements for grading:

Passing 3/4-inch square opening	100%
Passing 5/8-inch square opening, not less than	95%
Passing 1/4-inch square opening, not more than	50%
not less than	30%

(All percentages are by weight)

### 3.5 BINDER

Binder for addition to base and leveling courses, when required, shall be natural clayey topsoil conforming to the following gradation:

Passing 3/8-inch square opening	100%
Passing 1/4-inch square opening	90 to 100%
Passing No. 200 mesh sieve	10 to 15%

(All percentages are by weight)

That portion passing a U. S. No. 40 sieve shall not have a liquid limit (ASTM Designation: D 423-54T) in excess of 30 nor a plasticity index (ASTM Designation: D 424-54T) in excess of 3.

### 4. FOUNDATION FOR NEW CONSTRUCTION

- a. After the new roadway subgrade has been brought to the lines and grades shown on the construction drawings, the material for the base course shall be distributed full width between the shoulder lines of the subgrade to a depth sufficient to produce a compacted course of the thickness shown on the drawings. For driveways and parking lots the base course shall be distributed in a like manner over the area to be paved.
- b. Base course material shall be processed by blading back and forth across the road bed with a motor patrol grader. During the processing, water shall be applied in sufficient quantities to thoroughly dampen, but not saturate, the base course material. Blading shall continue until the material shows a uniform grading from coarse to fine.
- c. While the material is still damp it shall be compacted by rolling with one of the following types of rollers:
  - (1) Ten ton, steel-wheel, power roller, 3-wheel model.
  - (2) Pneumatic-tired, multiple wheel, two axle roller, not less than five feet, not more than 7.5 feet in width, equipped with pneumatic tires of equal size and diameter, with smooth treads. The wheels on the front and rear axles shall be staggered and shall revolve in a plane perpendicular to the center line of the axle. Air pressure in the tires shall be maintained within a range of 5 psi between high and low. Roller shall weigh not less than 4 tons nor more than 11 tons. Exact weight in this range shall be as determined by the Engineer.

Roller may be self propelled or may be towed with a rubber-tired tractor or light truck.

- d. When either the base course or the leveling course material does not afford sufficient stability and/or natural cementing properties to readily compact, binder, as specified in Section 3.5 of this specification, shall be added in such amounts as the Engineer may direct. Binder shall be added to base and leveling courses prior to placing on the roadway, whenever practicable. When binder is added to material on roadway, it shall be added to the material in the windrow and thoroughly mixed, while dry, by blading back and forth across the roadway.
- e. Rolling shall be continued until the surface of the base course is firm and unyielding. If sandpockets or deposits of loose materials become evident during rolling, such deposits shall be removed and replaced with properly graded material.
- f. Leveling course material shall be placed on the base course full width of the roadway between shoulder lines to a depth necessary to produce a 2-inch thick course after compaction. The material shall be bladed, watered, and rolled in the same manner and with the same type equipment as specified for the base course, until it presents a firm and unyielding surface.

#### 5. PREPARATION OF EXISTING ROADWAY

- a. The surface of an existing gravel surfaced roadway to be given a bituminous surface treatment shall be shaped to a uniform grade and section as shown on the drawings. This shall be accomplished with a motor patrol grader equipped with scarifier and weighing not less than 6 tons. Reshaping shall be done by first blading the existing gravel surfacing into a windrow near the shoulder line at one edge of the roadway. The subgrade shall then be cut with blade and scarifier to a depth sufficient to remove all traces of traffic ruts and transverse corrugations but not less than one inch. During the blading operation, water shall be added to the subgrade material by the use of a tank truck equipped with a suitable sprinkling device to distribute the water uniformly. Water shall be added in quantities sufficient to thoroughly dampen, but not saturate, the material. The material shall be bladed back and forth across the roadway until it shows a uniform grading from coarse to dust.
- b. When the subgrade has been shaped to proper line, grade, and cross-section, the gravel surfacing previously left in the windrow shall be distributed evenly across the roadway. The surface shall then be rolled with a pneumatic-tired, two-axle roller as previously described herein.

- c. All holes or depressions which cannot be removed by blading shall be filled with pre-mixed asphaltic concrete material and thoroughly compacted. Patching material shall consist of crushed cover stone and asphalt cement mixed in small quantities by hand methods or in larger quantities by road-mix methods using a motor patrol blade and self-powered distributor truck.
- d. Reshaping the existing roadway shall include cleaning and realigning the roadside ditches. Stones larger than 3 inches in greatest dimension which appear during the reshaping operation shall be removed from the roadway and disposed of as directed by the Engineer.

#### 6. APPLICATION OF ASPHALT CEMENT-PRIME COAT

- a. When the roadway has been brought to the proper line, grade, and cross-section, asphalt cement shall be applied with a truck type distributor. Asphalt cement shall be applied at a rate between 0.25 gallons and 0.45 gallons per square yard. Actual application rate shall be adjusted to roadway and weather conditions as directed by the Engineer.
- b. Asphalt cement shall not be applied to wet or frozen material or during sand, dust or rainstorms. Asphalt cement shall not be applied when the ground temperature is below 50 F. If necessary, the Engineer may require a delay in application of asphalt until roadway and atmospheric conditions are satisfactory.
- c. Necessary measures shall be taken to avoid center laps and ridges at transverse joints in application of asphalt cement in order to produce a smooth surface with good riding qualities.
- d. After the asphalt cement has spread evenly over the roadway surface, or not less than 15 minutes after the application of asphalt cement, cover stone shall be applied uniformly over the fresh cement at a rate of from 27 pounds to 33 pounds per square yard by use of a trailer-type spreader box attached to the rear of the hauling truck or by a self-propelled spreader of design approved by the Engineer. The spreader box shall be supported by at least 4 wheels equipped with pneumatic tires with a satisfactory device for spreading the stone evenly. Stone shall be spread in one operation over 1/2 the width of the roadway. The operating speeds and loads of hauling trucks and spreaders shall be so regulated that damage to the completed work will not result from hauling operations.

- e. As soon as the cover stone has been spread on the fresh asphalt cement, rolling shall be begun using a pneumatic-tired roller as previously described. If uneven distribution of cover stone is evident, the Engineer may require the surface to be broomed with a motor patrol grader equipped with a wire moldboard broom to further equalize the distribution of the stone. Rolling shall continue until cover stone is thoroughly compacted.
- f. The surface of the freshly treated roadway shall then be inspected and where there is a lack of cover stone, additional cover stone shall be added from a "Spot Truck". Where there is an excess of cover stone such excess shall be removed by shoveling into the "Spot Truck".
- g. Not more than 24 hours after the application of the asphalt cement, the road surface shall be broomed full width between the shoulder lines and brooming shall continue until the roadway surface is evenly covered. There shall not be areas where there is a lack of cover stone or other areas where there is an excess of cover stone. The brooming shall be repeated from time to time to keep the cover stone uniformly distributed until the asphalt cement has hardened sufficiently so that it will not "pick-up" on vehicle tires.

## 7. SECOND APPLICATION OF ASPHALT CEMENT-TACK COAT

- a. Not less than 5 days after the prime coat has been applied, the roadway surface shall be swept free of all loose cover stone by the use of a motor patrol grader equipped with a moldboard broom. Where there is dirt, mud, dust, or other foreign matter remaining on the roadway surface, the brooming specified above shall be supplemented by the use of a suitable, rotary, power broom or by hand sweeping until the objectionable matter is removed.
- b. After the roadway surface has been properly cleaned and foreign matter removed, the second coat of asphalt cement shall be applied at a rate of from 0.20 gallons to 0.35 gallons per square yard.
- c. Immediately after application of tack coat of asphalt cement, cover stone shall be applied at a rate of from 27 pounds to 33 pounds per square yard. Cover stone shall be applied in the same manner as specified for covering prime coat. If uneven distribution of cover stone is evident, the Engineer may require the surface to be broomed with a motor patrol grader equipped with a wire moldboard broom to further equalize the distribution of the stone. As soon as the brooming is completed the surface shall be rolled with a pneumatic-tired roller, previously described.

- d. Brooming process shall be repeated at least once on each of the five days following application of the asphalt cement tack coat. It shall be repeated oftener as required by the Engineer to assure uniform redistribution of cover stone displaced by traffic.

#### 8. MAINTENANCE AND CONTROL OF TRAFFIC

- a. The bituminous surfacing shall be maintained for an additional five days following completion of the brooming process specified in 7d. This maintenance shall include addition of cover stone wherever excess asphalt may be in evidence, the patching of holes or flaws which may appear during this period, and the repair of any defects caused by faulty workmanship, and repair of damage caused by traffic.
- b. All traffic, including construction equipment, shall be controlled by means of signs, barricades, and/or flagmen for a period of ten days after addition of the second course of cover stone, as required to prevent damage to the newly constructed bituminous surfacing.

#### 9. SHOULDERS

- a. Shoulders of the width shown on the drawings shall be constructed after placement of the bituminous wearing course.
- b. Material for shoulders shall be the same as used for "leveling course" on new construction or that used for cover stone over asphalt cement.
- c. Shoulders shall be of a compacted depth equal to the depth of the bituminous wearing course. Shoulders shall be thoroughly compacted to a firm, unyielding surface, sloped as shown on the drawings.

**INSTRUCTIONS FOR USE OF HWS-6134-S  
 STANDARD SPECIFICATION  
 FOR GRADING AND DRAINAGE FOR ROADS**

Specification HWS-6134-S covers construction of new roads up to the subgrade upon which surfacing or paving is placed. Clearing and grubbing work and the construction of slopes, ditches, embankments, and culverts is included.

It is intended that one of the HAPD standard specifications for paving or surfacing be referenced for the subsequent surfacing when HWS-6134-S is used.

When Standard Specification HWS-6134-S is referenced, the user should supply the additional details for the specific job. A number of the items to be considered for inclusion in the supplementary specifications, or on the drawings, are listed below: (The items should not be considered as a complete list of requirements. Each job must be carefully reviewed for special items.)

1. The size, type, and joint design for culvert pipe must be given. There are a number of options for both corrugated steel and concrete culvert pipe. The specific requirements should be given.
2. Where construction is known to be sand subject to erosion by the wind, stabilization of all disturbed surfaces with pit run gravel in conformance with HWS-6134-S should be noted on the drawings.
3. If an excess of excavated material is available, it can be used to widen near-by embankments, and should be so indicated on the drawings.

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APPROVED BY ENGINEERING STANDARDS COUNCIL

H. E. Struck SECRETARY, DATE 2-3-58

**INSTRUCTIONS FOR USE OF  
 SPECIFICATION HWS-6134-S**

**DI-6134-S**

HWS-6134-S

STANDARD SPECIFICATION

for

GRADING AND DRAINAGE

FOR ROADS

HAPO Ref. Stds: None

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APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 2-3-58				SPECIFICATION FOR GRADING AND DRAINAGE FOR ROADS	HWS-6134-S	

HWS-6134-S

STANDARD SPECIFICATION

FOR

GRADING AND DRAINAGE FOR ROADS

1. SCOPE

This specification applies to the grading and drainage work required for road construction. The work includes clearing, grubbing, and the construction of cuts, embankments, slopes, ditches, culverts, and road and driveway intersections.

2. IDENTIFICATION OF ENGINEER

The term "Engineer" refers to the representative of the user of the facility to which this specification applies.

3. DEFINITIONS

"Subgrade" is defined as that portion of the roadway upon which or adjacent to which surfacing or paving is to be placed. "Surfacing" may consist of gravel only or may be gravel courses plus paving.

4. CLEARING AND GRUBBING

The roadbed area to a distance of ten (10) feet outside limits of slope stakes shall be cleared and grubbed of all brush, trees, roots, and other foreign material. The materials so removed shall be disposed of as directed by the Engineer.

5. PIPE CULVERTS

5.1 MATERIALS FOR CULVERTS

- a. Culvert pipe shall be of the size and type shown on the construction drawings.
- b. Corrugated metal culvert pipe and coupling bands shall conform to Federal Specification QQ-C-806a, "Culverts and Underdrains, Corrugated Iron or Steel, Zinc Coated."
- c. Reinforced concrete culvert pipe shall conform to American Association of State Highway Officials Designation M-41-53, "Standard Specifications for Reinforced Concrete Culvert Pipe".

- d. Mortar for use with concrete culvert pipe shall be composed of one (1) part Portland Cement and three (3) parts sand. Only enough water shall be added to make a stiff, workable mix.

## 5.2 EXCAVATION FOR CULVERTS

Excavations for culverts shall be true to line and grade as shown on the construction drawings or as directed by the Engineer. Trenches shall be of adequate width to permit handling of pipe and making necessary connections. Trench bottoms shall be shaped to provide uniform bearing under barrel of pipe. If rock or boulder formations, hard pan or cemented gravel occurs in trench bottom, trenches shall be excavated to such additional depth as is required for placement of sand cushion at least six (6) inches in thickness. Sand cushion shall be shaped to receive barrel of pipe.

## 5.3 INSTALLATION OF CULVERTS

- a. Culvert pipe shall be carefully handled at all times and shall not be dropped or dumped. Suitable equipment shall be used in unloading and lowering pipe into position in trenches to prevent damage of any kind. Concrete pipe which is cracked, broken, or otherwise defective will be subject to rejection. Corrugated metal pipe shall be free from sprung joints or other objectionable defect.
- b. Trench bottom shall be free from frost and frozen earth when culvert is placed.
- c. Adjoining sections of corrugated metal culvert pipe shall be firmly fastened together by means of galvanized steel coupling bands. Bands shall be drawn tight to insure tight joints.

Corrugations in coupling bands shall match perfectly the corrugations in the pipe and adjacent ends of pipe shall be placed in the same corrugation of the coupling. Longitudinal joints shall be at the side of the pipe.

- d. Reinforced concrete culvert pipe shall be placed with the bell end or groove end up grade, beginning at the lower end of the trench. After covering the ends with mortar, the spigot end or tongue end shall be inserted into the bell or the groove as far as the construction of the pipe will permit. On the bell and spigot type the lower portion of the bell shall be filled with stiff mortar of sufficient thickness to make the inner surfaces of the abutting sections flush and even, when the pipe is placed. After pipe is in place, joint shall be filled with mortar and firmly caulked. On tongue and groove pipe the lower one-half of the groove and the upper one-half of the tongue shall be coated with a thin layer of mortar. Ends and joints of all concrete pipes shall be thoroughly wetted before applying mortar. The joints on the inside of the pipe shall be cleaned of all excess mortar.

#### 5.4 BACKFILL AND COMPACTION FOR CULVERTS

CASE-1072-344

Backfill shall not be placed over concrete culverts until in the opinion of the Engineer, the joint material has set to the extent that the joints will not be damaged by the backfilling operations. Selected backfill material, free from large stones, trash, frozen earth or other foreign materials shall be deposited by hand in layers not to exceed six (6) inches in thickness. Backfill adjacent to pipe shall be carefully placed and compacted uniformly on each side to avoid displacement of pipe. Each layer shall be thoroughly compacted before the next layer is placed. This method of backfilling shall be followed on both sides of pipe and over the pipe to a depth of not less than one foot above the top of the pipe. Remainder of backfill shall be placed in the same manner as construction of embankments as specified in Section 11 of this specification.

#### 6. CLASSIFICATION OF EXCAVATED MATERIALS

##### 6.1 ROCK EXCAVATION

a. Rock excavation shall include:

- (1) All rock material in solid layers, embedded deposits, stratified masses, and conglomerate deposits which are so firmly cemented that they possess all the characteristics of solid rock and which cannot be removed by the use of a modern power shovel of three-fourths (3/4) cubic yard capacity, adequately powered and in good mechanical condition, without systematic drilling and blasting.
- (2) All boulders over one-half (1/2) cubic yard volume. Solid rock layers with overburden of shattered rock and solid rock layers interspersed with a layer of clay or other material will be classed as "rock excavation" for the total depth of excavation in which solid rock material constitutes eighty-five percent (85%) or more of the total depth.

##### 6.2 COMMON EXCAVATION

Common excavation shall include all excavated material which is not classified as rock excavation, borrow, or excavation otherwise specified.

##### 6.3 BORROW

All material excavated for borrow purposes shall be classified as "borrow".

#### 7. BLASTING

When blasting is required on the job, the Engineer shall be advised in writing before any explosive is brought on the job site. Blasting, and

handling and storage of explosives at the job site shall be in strict accordance with all safety measures as may be prescribed by the Engineer. All explosives shall be transported in accordance with the regulations of the Interstate Commerce Commission. Detonators and explosives shall not be stored in the same building. All explosives shall be kept locked in isolated buildings until such time as they may be required for use. Storage buildings shall be marked on all sides with large signs legible from a distance of 500 feet, minimum. Explosives shall be handled only by persons experienced in their use.

Where blasting is required for rock excavation, care shall be exercised not to overshoot. Any rock or other material loosened or thrown outside the authorized cross-sections shall be removed.

8. EXCAVATION

Rock excavation shall be carried to a depth of one foot, no inches, (1' - 0") below the subgrade. Unstable material in bottom of cuts shall be removed and replaced as directed by the Engineer. The materials from excavations which are incidental to the construction of subgrade, ditches, etc. shall, if suitable, be used for construction of embankments. When material is encountered which may be classified as rock excavation, work shall stop until material is classified and notice to proceed is received. Slopes of excavations shall be graded to conform to slopes shown on the drawings. Surfaces of all slopes shall be reasonably smooth and compact. Excess excavated material shall be disposed of as directed by the Engineer.

9. BORROW PITS

Location of borrow pits shall be as indicated on the drawings or as directed by the Engineer.

Excavation for borrow shall not be started until notice to proceed is received from the Engineer. Borrow areas shall be stripped off, to remove all brush or other materials unacceptable for use in the construction of embankments. Excavation of borrow pits shall be to uniform lines to allow accurate measurement. Floor of borrow pits shall be left relatively level.

10. OVERHAUL

Overhaul shall consist of the transportation of acceptable excavation material beyond the free-haul limit. The free-haul limit shall be 600 feet. Length of overhaul will be measured along the shortest possible routes.

11. EMBANKMENT

- a. Materials used for construction of embankments shall be subject to the approval of the Engineer. Material shall be free from brush, roots, rubbish, frozen materials or other objectionable matter.

Rock may be incorporated into the embankment except that the top two (2) feet of the subgrade shall not contain rock larger than eight (8) inches, greatest dimension. Elsewhere, rock shall be not larger than two (2) feet, greatest dimension. Sand if used, shall be confined to the core of the embankment, with the more stable material placed to the outside.

- b. Embankment material shall not be placed on frozen ground. Snow and ice shall be removed before placing any embankment material. Embankments shall be constructed in successive horizontal layers not more than eight (8) inches in thickness, loose measurement. Each layer shall be placed to full width of embankment spread uniformly and thoroughly compacted. During construction of embankments the equipment shall be routed over layers as they are placed and the travel shall be distributed over entire width of embankment. Separate pieces of equipment shall not be permitted to track each other.

If equipment travel is not sufficient to obtain the required density, each layer shall be compacted by rolling with a (1) smooth-wheeled power roller, (2) a tamping (sheepsfoot) roller or (3) a pneumatic-tired roller of design approved by the Engineer. The type of roller used shall be suited to the character of the soil in the embankment.

If moisture content of embankment material is not sufficient to obtain required density, water shall be applied by means of approved distribution equipment and mixed with the soil.

- c. When tested in the field in accordance with AASHO (American Association of State Highway Officials) Designation T-147-49 "Field Determination of Density of Soil in Place," each layer of compacted embankment shall have a density not less than the following:
  - (1) For Clayey and Silty Materials - 90% of the "maximum density" as determined in accordance with AASHO Designation: T-99-49 "Standard Method of Test for the Compaction and Density of Soils". The moisture content of the material shall be uniform throughout the layer and shall be such that the specified density can be obtained. In no case shall the moisture content vary more than 3 percentage points above or below the optimum moisture content as determined by AASHO Designation T-99-49.
  - (2) For cohesionless free-draining material such as sands and gravels - 70% relative density as determined by the Standard U. S. Bureau of Reclamation relative density tests for cohesionless free-draining soils.

The relative density of a cohesionless free-draining soil, expressed as a percentage, is defined as its state of compactness with respect to the loosest and most compact states at which it can be placed by laboratory procedures. The relative density will be based on the following formula, wherein the maximum density is the highest unit weight of the soil, minimum density is the lowest unit weight of the soil and in-place density is the unit weight of the soil in place. Tests for moisture content are made on the materials and unit weights are expressed in terms of oven-dry weights.

$$\text{Relative density} = \frac{\text{max. den.} \times (\text{in-place den.} - \text{min. den.})}{\text{in-place den.} \times (\text{max. den.} - \text{min. den.})} \times 100$$

The particular test to be used, depending on the type of soil, shall be as determined by the engineer.

- d. At all locations that are inaccessible to a roller, the embankment shall be brought up in layers of the thickness specified above, and each layer shall be compacted to the density specified above, with mechanical tampers.
- e. Embankments shall not be widened by side casting or by adding loose materials from the top. As embankments are consolidated, sides shall be carefully trimmed to proper slopes. Embankments shall be maintained at proper height and shape until work is finally accepted by the Engineer.
- f. The subgrade shall be finished to a true, compacted surface, free from depressions which would prevent proper drainage, and free from soft spots. Where the subgrade is constructed of sand, the top layer shall be a minimum of four (4) inches of pit-run gravel containing no rocks larger than the compacted thickness of that layer. The top surface of this layer shall be at the elevation of the subgrade as shown on the drawings.
- g. All slopes shall be graded to conform to the slopes shown on the drawings. Surfaces of all slopes shall be reasonably smooth and compact.

## 12. STABILIZATION

- a. Slopes of cuts, embankment slopes, and other areas disturbed by this work where the surface is composed of sand or is otherwise susceptible to wind erosion, shall be stabilized with a four (4) inch layer of pitrun gravel containing no rocks larger than 4 inches greatest dimension. The stabilization material shall be spread uniformly over areas to be covered and trimmed to the required lines.

- b. Where cut slopes or embankment slopes are to be protected from erosion, the gravel blanket shall be applied to the slope as completed to the section shown on the drawings. No additional cutting to care for the gravel blanket is intended.

13. FLAGMEN, BARRICADES, AND SIGNS

- a. Where equipment is working on, or crossing existing roads, flagmen to control traffic shall be provided as directed by the Engineer.
- b. All necessary signs and barricades to warn and protect pedestrian and vehicle traffic shall be provided as directed by the Engineer.
- c. Barricade construction shall meet the approval of the Engineer and shall be in keeping with the traffic hazard involved. Barricades shall be constructed to be conspicuous in daylight. Barricades shall be marked with at least three red lights or torches for each lane of traffic between sunset and sunrise and at any other times when visibility is reduced, such as during foggy weather or snowstorms. Lights or torches shall be plainly visible from the road for at least 500 feet from the barricade during clear weather.
- d. Warning signs shall be erected as directed by the Engineer to warn traffic of barricade or of other hazards resulting from the work covered by these specifications.

14. PROTECTION OF SUBGRADE

- a. All unnecessary traffic shall be prevented from using the completed subgrade.
- b. Any damage to the subgrade such as ruts, cuts, or breaks in the surface shall be repaired prior to placing surfacing materials. Repairs shall be made by blading, dragging, rolling, or otherwise working to the satisfaction of the Engineer.

15. CLEAN UP

- a. All loose rock over 4 inches in greatest dimension and all debris shall be removed from the surfaces constructed under these specifications.
- b. Culverts and ditches within the boundaries of the work shall be cleaned to permit free drainage.
- c. Waste material resulting from the above clean-up shall be disposed of as directed by the Engineer.

INSTRUCTIONS FOR USE OF HWS-6135-S  
STANDARD SPECIFICATION FOR COLD-LAID ASPHALTIC  
PLANT MIX FOR PAVING AND PATCHING

Specification HWS-6135-S covers the manufacture and placement of a cold-laid asphaltic plant mix for road repair. The mixture can also be used for paving parking areas and for sidewalks and driveways. Normally, this material is stockpiled through a summer, for patching purposes. It can be stockpiled up to six months.

It should be held in stockpile for about ten days before use. If applied too fresh, it will show traffic marks and will require extra work such as re-rolling.

When using this specification, the following should be observed:

1. Specify the areas to be repaired, the nature of the repairs, (build up raveled road edges, repair chuck holes, replace pavement over trench, etc.) and state the required thickness of the patch course for large patch areas.
2. For sidewalks, parking areas, and driveways, indicate the location of the construction, the dimensions of the paved area and the thickness of the course. The minimum thickness should be 1-1/2 inches.
3. If a base course is to be used for sidewalks, parking areas, or driveways, this must be specified. For areas of stable gravel consistency, a base course may not be required. For many other fairly stable areas, the base course described in HWS-6135-S will be sufficient. For parking areas and driveways to be built on unstable soil, and which may carry heavy loads, a separate specification on base course should be prepared. It should be based on the larger sized base course used in HWS-6131-S or HWS-6133-S. Consideration should be given to other types of surfacing for heavily used or heavily loaded areas.
4. When this material is to be placed in areas of thick or hardy vegetation without extensive subgrade preparation, it may be desirable to specify soil sterilization to prevent the vegetation from growing up through the asphalt mat.

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APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 9-3-57				INSTRUCTIONS FOR USE OF SPECIFICATION HWS-6135-S	DI-6135-S	

HWS-6135-S

STANDARD SPECIFICATION

FOR

COLD-LAID ASPHALTIC PLANT MIX

FOR PAVING AND PATCHING

September 3, 1957

HAPO Ref. Stds: None

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APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 9-3-57				SPEC. FOR COLD-LAID ASPHALTIC PLANT MIX FOR PAVING AND PATCHING	HWS-6135-S	

STANDARD SPECIFICATION FOR COLD-LAID ASPHALTIC  
PLANT MIX FOR PAVING AND PATCHING

1. SCOPE

This specification covers the manufacture and placing of cold-laid asphaltic plant mix for the repair of existing bituminous paving and for construction of new sidewalks, driveways, and parking areas. The material is suitable for stockpiling for future use. For best results, it should be held in stockpile for approximately ten days prior to use.

2. IDENTIFICATION OF ENGINEER

The term "Engineer", refers to the representative of the user of the facility to which this specification applies.

3. ASPHALT

Asphalt products used in the work covered by this specification shall conform in all respects to the requirements of Section 25 of the Standard Specifications of the State of Washington Department of Highways, 1948, and Amendment No. 2, 1953. The grade of asphalt for use in the asphaltic mixture shall be MC-3 unless otherwise ordered by the Engineer. A certification that the asphalt conforms to Washington State Highway Specifications shall be furnished for each car load or other lot of asphalt.

4. AGGREGATES FOR ASPHALTIC PLANT MIX

- a. Coarse aggregate shall consist of that portion of total aggregate retained on a 1/4" square screen. Fine aggregate shall consist of that portion of total aggregate passing a 1/4" square screen. Aggregates shall be furnished in gradings as specified in Item 5, "Proportions of Materials". Aggregate shall be uniform in quality and free from trash, extraneous material and adherent coatings. The presence of a thin, firmly adhering film of weathered rock will not be considered as coating unless it exists on more than 50 per cent of the surface area of any size between consecutive laboratory screens.
- b. Coarse aggregate when separated on consecutive laboratory screens shall contain in each size not less than fifty (50) per cent by weight of fragments with at least one fractured face produced by mechanical crushing.

- c. Fine aggregate may be either a natural sand, crushed screenings, or a uniform combination of the two. It shall be hard grained.

## 5. PROPORTIONS OF MATERIALS

The materials of which the asphaltic mixture is composed shall be of such sizes and grading that when proportioned and mixed together, they will produce a uniformly graded mixture. When tested by means of laboratory screens this mixture shall conform to the requirements given in the following table. The percentages of aggregate refer to the complete dry mix. The percentages of asphalt refer to the complete asphaltic mixture. All percentages are by weight. Sieves and screens used for determining the percentages of the different sizes of aggregates shall have square openings.

### Asphaltic Plant Mix

Passing 5/8" screen	100%
Passing 5/8" screen retained on 1/2" screen	10-40%
Passing 1/2" screen retained on 1/4" screen	10-40%
Passing 1/4" screen retained on U. S. No. 10 sieve	10-35%
Passing U. S. No. 10 sieve retained on U. S. No. 200	20-40%
Passing U. S. No. 200 sieve	4-8%
Asphalt	2.5-5.5%

The exact proportions of the constituents to be used in the production of the bituminous mixture shall be determined by the Contractor subject to the approval of the Engineer.

## 6. PREPARATION OF PLANT-MIX AGGREGATES

Preparatory to the proportioning of the materials, the aggregate shall be heated to a temperature of between 175 F and 275 F. The heating shall be done in a suitable rotary heater or drier equipped with fan and dust collector that will remove all excess dust contained in the aggregate.

## 7. HEATING ASPHALT

The asphalt shall be heated in insulated tanks, kettles or sumps so designed that the heating will be uniform throughout and the heat can be positively controlled at all times. No flame shall be permitted to come into direct contact with the heating kettles. The asphalt shall be heated to between 200 and 240 F.

## 8. MIXING

- a. The mixing shall be done in a mixer of the pug mill type approved by the Engineer.
- b. The properly proportioned hot aggregate shall be placed in the mixer first. The hot asphalt shall then be added and the mixing commenced.

- c. The mixing period, after the hot aggregate is placed in the mixer, shall be at least 30 seconds and as much longer as may be necessary to produce a homogeneous mixture of unchanging appearance.
- d. The weight of the batch of mixed materials shall not be greater than the manufacturer's rated capacity of the mixer.

#### 9. HAULING AND STOCKPILING

- a. When the asphaltic mixture has been mixed as specified, it shall be transported to the place of deposit in suitable dump trucks. The sides and bottoms of the trucks shall be lubricated with a mixture of water and light oil or diesel oil before receiving a load mixture. Excess water and oil shall not be left in the bottom of the trucks.
- b. Stockpile sites shall be cleared of all vegetation, trees, brush, rocks, or other debris and a uniform ground surface made before the material is deposited.

#### 10. PREPARATION OF SURFACE

- a. Areas of existing bituminous surfaces to receive the mixture shall be thoroughly cleaned by sweeping. All loose materials shall be removed from holes, raveled areas, etc., to be patched. Overhanging and irregular edges of existing bituminous surfacing shall be cut back to stable material to form straight lines.
- b. Trenches or large holes extending through the pavement to underlying gravel base or leveling courses or below shall be backfilled with material equal to that used in the existing construction. Backfill materials shall be compacted to a density approximately equal to that of adjacent undisturbed material as determined by the Engineer, and shall present a firm and unyielding surface. Water shall be added as required to secure this compaction. Allowance shall be left for placement of asphaltic mixture equal to the depth of existing surfacing, or two inches, whichever is greater.

#### 11. SPREADING AND FINISHING

- a. The mixture shall be spread by means of a motor patrol grader or a spreader box of suitable design.
- b. The mixture shall be in a plastic, workable condition when applied to the area to be repaired. Hardened material shall not be used. The mixture shall not be applied hot directly from the mixer. It shall have preferably lain in stockpile for approximately ten days. It shall have preferably cooled to ambient temperature.

- c. The thickness of the patch course shall be as shown on the drawings or specified in accompanying specifications.
- d. Where segregation of the larger pieces of aggregate occurs on the surface, such segregated areas shall be corrected after the first rolling of the pavement.
- e. For areas inaccessible to a grader or spreader box, hand methods of spreading and finishing shall be used. The mixture shall be distributed into place by means of shovels or suitable forks and spread with rakes, of suitable design, in a loose layer of uniform density and correct depth.
- f. The asphaltic mixture shall be laid only during clearing or fair weather and shall not be distributed on a base that is frozen or wet, or that has not been properly prepared. The base shall be stable and unyielding. Asphaltic mixture shall not be deposited on any surface when the ground temperature is below 35 F.

## 12. COMPACTING

- a. Immediately following the spreading of the course, accessible areas of the asphaltic mixture shall be compacted by rolling with a modern three-wheeled or tandem power roller weighing not less than eight tons. The compression wheels on all three-wheeled rollers shall each be at least 20 inches wide and shall be so shaped or set that their rolling surfaces conform with the crown specified for the finished pavement. All rolling shall start longitudinally at the sides and proceed toward the center of the pavement overlapping on successive trips by at least 1/2 but not more than 3/4 the width of the rear wheel of the three-wheel roller. Alternate trips of the roller shall be of slightly different lengths. The rolling shall be continued until all roller marks are eliminated. The pavement shall be rolled diagonally in at least one direction with a tandem roller of the size described above.
- b. Areas not accessible to a roller of the size described in a, above, shall be rolled with a smaller power roller having a weight on the rear wheel(s) of at least 175 lbs. per linear inch of roller width. Rolling shall be done as specified in a, above, except that diagonal rolling may be omitted where impracticable.
- c. The rollers shall be in good condition and capable of reversing without backlash. They shall be operated by competent and experienced roller operators and must be kept in continuous motion as nearly as practicable in such a manner that all parts of the pavement receive substantially equal compression. Rollers are not to be left standing on freshly rolled asphaltic mixture.

- d. The surface of the mixture after compression shall be smooth and true to established section and grade. Any mixture which shows an excess or deficiency of cement, or uneven distribution of cement due to insufficient mixing, or becomes mixed with dirt or in any way defective, shall be removed and replaced with fresh mixture, which shall be immediately compacted to conform with the adjacent surfacing. Areas inaccessible to the rollers shall be compacted by tamping with iron tampers.
- e. Rolling of the mixture must be entirely completed before dark; therefore, no mixture shall be deposited on the roadway that cannot be rolled before dark.
- f. When required by the Engineer, the previous day's work shall be back-rolled.

### 13. SURFACE SMOOTHNESS

The surface of the wearing course, when finished, shall be of uniform texture, smooth, true to crown and grade and free from defects of all kinds and shall blend smoothly into the existing surface. The maximum deviation of the surface when tested with a 10-foot straight edge parallel to the centerline of the roadway shall not exceed one-quarter of an inch. No portion of the finished pavement shall be more than one-quarter inch below a template cut to the crown of the existing surfacing, or cross-section drawings showing required corrections, placed on the course at right angles to the centerline.

Any deviations in excess of these tolerances shall be corrected by addition or removal of the asphaltic material and rolling or tamping.

### 14. SIDEWALK, PARKING AREA, AND DRIVEWAY CONSTRUCTION

#### 14.1 GENERAL

- a. Where sidewalks, parking areas, or driveways are specified to be constructed of cold-laid asphaltic plant mix, the material shall be prepared, applied and compacted as specified herein. Rolling shall be as specified in Section 12, "Compacting".
- b. Sidewalks, parking areas, and driveways shall be constructed in the locations specified or shown on drawings and shall be of the width and thickness specified or shown on drawings, except that the compacted thickness of the asphaltic mixture shall be not less than 1-1/2".
- c. Base course, if specified for parking areas, driveways, or sidewalks, shall be prepared and applied as specified in Sections 14.2, 14.3, and 14.4.

## 14.2 BASE COURSE MATERIAL

- a. Gravel for base course shall consist of crushed or partially crushed stone. The material shall be free from trash and vegetable matter. Base course material, when separated on 1/4-inch and 3/4-inch square opening screens shall contain in each size, including material passing 1/4-inch, not less than 75 per cent by weight of fragments with at least one fractured face produced by mechanical crushing.
- b. Base course material shall meet the following requirements for grading:

Passing 3/4-inch square opening	100%
Passing 1/4-inch square opening	50 to 65%
Passing No. 200 mesh sieve	5 to 15%

(All percentages are by weight)

## 14.3 BINDER

Binder for addition to base course when required, shall be natural clayey topsoil conforming to the following gradation:

Passing 3/8-inch square opening	100%
Passing 1/4-inch square opening	90 to 100%
Passing No. 200 mesh sieve	10 to 15%

(All percentages are by weight)

That portion passing a U. S. No. 40 sieve shall not have a liquid limit (ASTM Designation: D 423-54T) in excess of 30 nor a plasticity index (ASTM Designation: D 424-54T) in excess of 3.

## 14.4 SPREADING AND COMPACTING

- a. After the new driveway or parking area subgrade has been brought to the lines and grades shown on the construction drawings, the material for the base course shall be distributed full width between the shoulder lines of the subgrade to a depth sufficient to produce a 2-inch thick course after compaction.
- b. Base course material shall be processed by blading back and forth across the subgrade with a motor patrol grader. During the processing, water shall be applied in sufficient quantities to thoroughly dampen, but not saturate, the base course material. Blading shall continue until the material shows a uniform grading from coarse to fine.

- c. While the material is still damp it shall be compacted by rolling with one of the following types of rollers:

- (1) Ten ton, steel-wheel, power roller, 3-wheel model.
- (2) Pneumatic-tired, multiple wheel, two axle roller, not less than five feet, nor more than 7.5 feet in width, equipped with pneumatic tires of equal size and diameter, with smooth treads. The wheels on the front and rear axles shall be staggered and shall revolve in a plane perpendicular to the center line of the axle. Air pressure in the tires shall be maintained within a range of 5 psi between high and low. Roller shall weigh not less than 4 tons nor more than 11 tons. Exact weight in this range shall be as determined by the Engineer.

Roller may be self propelled or may be towed with a rubber-tired tractor or light truck.

- d. For sidewalks and areas inaccessible to a grader, the base course material shall be dampened and raked into a uniform layer of depth sufficient to produce a 2-inch thick layer after compaction. Base course for sidewalks and areas inaccessible to rollers of the size described in c, above, shall be rolled with a lawn roller or small power roller until the surface is firm and unyielding.
- e. When the base course material does not afford sufficient stability and/or natural cementing properties to readily compact, binder, as specified in Section 14.3 of this specification, shall be added in such amounts as the Engineer may direct. Binder shall be added to base course prior to placing on the subgrade, whenever practicable. When binder is added to material on subgrade, it shall be added to the material in the windrow and thoroughly mixed, while dry, by blading back and forth across the subgrade.
- f. Rolling shall be continued until the surface of the base course is firm and unyielding. If sandpockets or deposits of loose materials become evident during rolling, such deposits shall be removed and replaced with properly graded material.

#### 15. PROTECTION OF NEW WORK

When ordered by the Engineer, suitable signs and/or barricades shall be erected to protect the area from heavy wheel loads, or from all traffic if the material is fresh and soft. Such signs and barricades shall be maintained in place until, in the opinion of the Engineer, the material has set sufficiently to allow traffic.

16. SHOULDERS

Where repair of a roadway raises the pavement edge, shoulder material shall be added to restore the shoulders flush with pavement edge. Shoulder material and placement shall be as specified for base course in Sections 14.2, 14.3, and 14.4. Shoulders shall be compacted to a firm, unyielding surface sloped to match existing shoulder slope.

INSTRUCTIONS FOR USE OF HWS-6136-S

STANDARD SPECIFICATION FOR ONE COURSE CRUSHED GRAVEL SURFACING

Specification HWS-6136-S covers a crushed gravel surfacing suitable for lightly traveled roads, sidewalks, driveways, and parking areas. Hanford Standard Specification HWS-6134-S, Grading and Drainage for Roads, covers construction of the subgrade.

When Specification HWS-6136-S is used, the following should be observed:

1. Roadway Sections

Where a gravel surface is suitable for a patrol or service road, specify that the roadway section shall be as shown on Standard AC-6-2, Type D.

2. Sidewalks, Parking Lots, or Driveways

Specify the limits of the area to be surfaced and thickness of the surfacing. The thickness should be not less than one inch. For sidewalks, refer to Standard AC-6-11 for gravel sidewalk section. If the sidewalk is to be wider than 4' - 0", designate the required width.

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
2	Ref Stds Nos.	hes	3-15-61		hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 9-3-57				INSTRUCTIONS FOR USE OF SPECIFICATION HWS-6136-S	DI-6136-S 7	

HWS-6136-S

STANDARD SPECIFICATION

FOR

ONE COURSE CRUSHED GRAVEL SURFACING

September 3, 1957

HAPO Ref. Stds: None

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APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 9-3-57				SPECIFICATION FOR ONE COURSE CRUSHED GRAVEL SURFACING	HWS-6136-S	

STANDARD SPECIFICATION FOR ONE COURSE  
CRUSHED GRAVEL SURFACING

1. SCOPE

This specification covers the materials and construction requirements for one course crushed gravel surfacing for roads, sidewalks, parking areas and driveways.

2. IDENTIFICATION OF ENGINEER

The term "Engineer" refers to the representative of the user of the facility to which this specification applies.

3. MATERIALS

3.1 GRAVEL

- a. Gravel for crushed gravel surfacing shall consist of crushed or partially crushed stone. The material shall be free from trash and vegetable matter. When separated on 1/4-inch and 3/4-inch square opening screens, the crushed gravel shall contain in each size, including material passing 1/4-inch, not less than 75 per cent by weight of particles with at least one fractured face produced by mechanical crushing.
- b. Crushed gravel surfacing material shall meet the following gradation:

Passing 3/4-inch square opening	100%
Passing 1/4-inch square opening	50 to 65%
Passing No. 200 mesh sieve	5 to 15%

(All percentages are by weight)

3.2 BINDER

Binder for addition to crushed gravel surfacing, when required, shall be natural clayey topsoil conforming to the following gradation:

Passing 3/8-inch square opening	100%
Passing 1/4-inch square opening	90 to 100%
Passing No. 200 mesh sieve	10 to 15%

(All percentages are by weight)

That portion passing a U. S. No. 40 sieve shall not have a liquid limit (ASTM Designation: D 423-54T) in excess of 30 nor a plasticity index (ASTM Designation: D 424-54T) in excess of 3.

#### 4. SPREADING AND COMPACTING

- a. After the roadway subgrade has been brought to the lines and grades shown on the construction drawings, the gravel surfacing material shall be distributed full width between the shoulder lines of the subgrade to a depth sufficient to produce a compacted course of the thickness shown on the drawings. For sidewalks, driveways, and parking lots the material shall be distributed in a like manner over the area to be paved.
- b. For roads, parking areas and driveways the surfacing material shall be processed by blading back and forth across the road bed with a motor patrol grader. During the processing, water shall be applied in sufficient quantities to saturate the material. Blading shall continue until the material shows a uniform grading from coarse to fine.
- c. While the material is still damp it shall be compacted by rolling with one of the following types of rollers:
  - (1) Ten ton, steel-wheel, power roller, 3-wheel model.
  - (2) Pneumatic-tired, multiple wheel, two axle roller, not less than five feet, nor more than 7.5 feet in width, equipped with pneumatic tires of equal size and diameter, with smooth treads. The wheels on the front and rear axles shall be staggered and shall revolve in a plane perpendicular to the center line of the axle. Air pressure in the tires shall be maintained within a range of 5 psi between high and low. Roller shall weigh not less than 4 tons nor more than 11 tons. Exact weight in this range shall be as determined by the Engineer.

Roller may be self propelled or may be towed with a rubber-tired tractor or light truck.
- d. For sidewalks, the surfacing material shall be raked into a uniform layer, dampened, and rolled with a lawn roller or small power roller until the surface is reasonably firm and uniform.
- e. When the gravel surfacing material does not afford sufficient stability and/or natural cementing properties to readily compact, binder, as specified in Section 3.2 of this specification, shall be added in such amounts as the Engineer may direct. Binder shall be added to the gravel surfacing material prior to placing on the roadway, whenever

practicable. When binder is added to material on roadway, it shall be added to the material in a windrow and thoroughly mixed, while dry, by blading back and forth across the roadway.

- f. Rolling shall be continued until the surface of the course is firm and unyielding. If sandpockets or deposits of loose materials become evident during rolling, such deposits shall be removed and replaced with properly graded material.

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INSTRUCTIONS FOR USE OF HWS-6137-S  
STANDARD SPECIFICATION FOR EXCAVATION, BACKFILL AND FINISH GRADING

Specification HWS-6137-S covers excavation and backfill for building construction, including finish grading and surface stabilization.

When Specification HWS-6137-S is referenced, the user should supply additional details for the specific job. A number of items to be considered for inclusion in supplemental specifications, or on the drawings are listed below:

(These items should not be considered as a complete list of requirements. Each job must be carefully reviewed for special items.)

1. Excavation and backfill for roads, railroads, and piping is covered in Hanford Standard Specifications HWS-6134-S, HWS-5722-S, and HWS-6138-S respectively. HWS-6137-S should not be referenced for the excavation and backfill for these types of construction.
2. Section 4.1, item c 1 in HWS-6137-S states that "Excavations over four feet in depth, unless in solid rock, hard shale or hardpan shall either be shored, sheeted and braced, or the sides of the excavation shall be sloped to the angle of repose for the soil involved". When excavations will be involved in the work, the angle of repose for the soil involved, if known, should be stated in the special conditions for the job. If the angle of repose is not known, then the best available knowledge of the soil conditions should be stated and an estimate of the angle of repose should be determined by test and stated. The angle of repose, except for solid rock, etc., should not be assumed to be steeper than 1:1.

The purpose for stating the angle of repose is to help insure safer working conditions and also to provide contractors a firmer basis for bidding.

3. When there is a possibility of wheeled traffic passing over newly laid or existing buried pipe during the course of the work, the required depth of backfill, or the need for special protection, for each individual case should be included in supplemental documents such as the special conditions. See Hanford Guide DG-502-AC, Determining Allowable Live Loads Over Buried Piping, for information on required depth of backfill.
4. If there are any locations not covered by item 5.2 of HWS-6137-S where load-bearing backfill is required, show those locations on the drawings.

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NO.	REVISION	APP D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM BY	DES BY
1	General	hes	4-3-61		hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL				INSTRUCTIONS FOR USE OF HWS-6137-S	DI-6137-S	
H. E. Struck SECRETARY, DATE 2-29-60						

HWS-6137-S

STANDARD SPECIFICATION

FOR

EXCAVATION, BACKFILL AND FINISH GRADING

Ref. Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM BY	DES. BY
1	General Revision	hes	4-3-61		hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY. DATE 2-29-60				SPECIFICATION FOR EXCAVATION, BACKFILL AND FINISH GRADING	HWS-6137-S	

HWS-6137-SSTANDARD SPECIFICATIONFOR EXCAVATION, BACKFILL AND FINISH GRADING1. SCOPE

This specification applies to earth excavation, backfill, finish grading and surface stabilization.

2. IDENTIFICATION OF ENGINEER

The term "Engineer" refers to the representative of the user of the facility to which this specification applies.

3. REFERENCED STANDARDS

The following issues of the standards listed below, but referred to hereafter by basic designation only, form a part of this specification to the extent indicated by subsequent references.

## 3.1 AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS (AASHO) STANDARDS

T 99-57      The Moisture-Density Relations of Soils Using A 5.5-lb. Rammer and A 12-in. Drop.

T 147-54      Field Determination of Density of Soil in Place.

## 3.2 STATE OF WASHINGTON STANDARD

Safety Standards for Construction Work, State of Washington Department of Labor and Industries, January 1, 1957.

4. EXCAVATING

## 4.1 GENERAL

a. Where drawings require concrete or other materials to be placed against undisturbed earth surfaces, any loosened or disturbed material shall be removed from such surfaces.

b. Excavated material shall be kept off roadways, sidewalks and paved areas.

- c. Safety requirements for the protection of all personnel working in, around, or near any site where work covered by this specification is being performed shall be determined in accordance with the State of Washington Safety Standards for Construction Work, except that:
  - (1) Excavations over four feet in depth unless in solid rock, hard shale or hardpan shall either be shored, sheeted and braced, or the sides of the excavation shall be sloped to the angle of repose for the soil involved.
  - (2) All shoring and bracing shall be designed so that it is effective to the bottom of the excavation. Sheeting, sheet piling, bracing, shoring, trench boxes and other methods of protection, including sloping, shall be based upon calculation of pressure exerted by and the condition and nature of the materials to be retained, including surcharge imparted to the sides of the excavation by equipment and stored materials.
  - (3) Excavated or other material shall not be stored nearer than 2 feet from the edge of any excavation and shall be so stored and retained as to prevent its falling or sliding into the excavation and to prevent excessive pressure upon the sides of the excavation.
  - (4) Sides and slopes of excavations shall be maintained in a safe condition by scaling, benching or barricading.
  - (5) Additional precautions by way of shoring and bracing shall be taken to prevent slides, or cave-ins, when excavations are made in locations adjacent to backfilled excavations or subjected to vibrations from railroad or highway traffic, the operation of machinery, or any other source.
- d. Excavation within 4 feet of underground telephone and power lines, instrument tubing, and cathodic protection systems shall be done by hand digging only.
- e. Travel of construction equipment, including track-laying vehicles, pickup trucks and other wheeled vehicles, over new or existing buried piping, shall be over routes approved or designated by the Engineer or designated in accompanying documents.

#### 4.2 BUILDINGS AND OTHER STRUCTURES

Where concrete for walls and footings is specified to be deposited directly

against excavated surfaces, excavation shall conform to the structure dimensions and elevations indicated on the drawings. Elsewhere, excavation shall be of size to allow for placing and removal of forms and bracing, installation of services, and for inspection.

#### 4.3 DRAINAGE

During construction, the excavated area shall be drained and kept free of water at all times.

#### 4.4 EXCESS OR UNSUITABLE MATERIAL

Material from excavation which is not required for or is not suitable for fill or backfill shall be wasted where indicated on the drawings or designated in other contract documents.

### 5. FILLING & BACKFILLING

#### 5.1 GENERAL

- a. Locations to be filled or backfilled shall be cleaned of organic material, roots, trash, lumber, other debris, and frozen material.
- b. Material for any fill or backfill shall contain no organic material, roots, trash, lumber, other debris, or frozen material.
- c. Rock and fines shall be uniformly distributed during placement of backfill material.
- d. Except where specifically authorized otherwise by the Engineer, fill or backfill shall not be placed against foundation walls prior to 14 days after completion of walls and then only after permission by the Engineer.
- e. Fill or backfill shall be brought up evenly on each side of walls, structures and pipelines to avoid damage or displacement from unbalanced loading.
- f. If at any time during excavation or backfill, mud pockets or other unsuitable materials are encountered that may impair the stability of the structure, this material shall be removed.
- g. Fill or backfill shall not be placed on frozen ground.
- h. Backfilling by means of sluicing or flooding with water will not be permitted.

## 5.2 LOAD BEARING FILL OR BACKFILL

- a. Material for load-bearing fill or backfill shall consist of select material containing no rocks larger than 4 inches in any dimension.
- b. Load-bearing fill or backfill shall be placed:
  - (1) Where asphaltic or portland cement concrete slabs, sidewalks or pavement are to be placed on disturbed earth, and
  - (2) in other locations shown on the drawings.
- c. Load-bearing fill or backfill shall be placed as follows:
  - (1) Materials shall be placed in layers not more than 8 inches thick, loose measurement. Each layer shall be uniformly spread, and compacted to the required density shown below.
  - (2) If moisture content of material is not sufficient to obtain required density, water shall be applied and mixed with the soil.
  - (3) When tested in the field in accordance with AASHO Standard T 147, the compacted material shall have a density not less than 95% of the "maximum density" as determined in accordance with AASHO Standard T99. The moisture content shall be uniform throughout each layer and shall not vary more than 3 percentage points above or below the optimum moisture content as determined by AASHO Standard T 99.
- d. A procedure for compacting load-bearing backfill shall be submitted in writing to the Engineer prior to placement of any load-bearing backfill, except as required for initial determination and demonstration of the compaction procedure. Actual tests shall be made at the work site by the Contractor, witnessed by the Engineer, on material placed in conformance with the procedure to show that the degree of compaction specified in "c" above, is attained.

## 5.3 NON-LOAD-BEARING FILL OR BACKFILL

- a. Material for non-load-bearing fill or backfill shall contain no rocks larger than 8 inches in any dimension.
- b. Non-load-bearing fill or backfill shall be placed in layers not more than 12 inches thick, loose measurement. Each layer shall be compacted, full width, by at least two passes of a vibratory or

rammer type compactor, pneumatic-tired roller, loaded scraper wheel, grader wheel, or power roller.

## 6. FINISH GRADING & SURFACE STABILIZATION

### 6.1 FINISH GRADING

- a. Areas shown on the drawings to be graded or reshaped shall be graded to present reasonably smooth, uniform surfaces conforming to the elevations shown on the drawings.
- b. Where grading limits and elevations are not shown on the drawings, areas disturbed by work done under this contract shall be blended smoothly into existing contours and sloped to drain away from buildings and structures.
- c. The surface of graded areas shall be left free of rocks larger than one inch, least dimension.

### 6.2 SURFACE STABILIZATION

The areas designated on the drawings to be stabilized shall be surfaced with gravel. Unless other thickness and gradation are shown on the drawings, gravel shall be a 3-inch thick course of pit-run gravel containing no rocks larger than 2 inches in any dimension. The gravel shall be uniformly spread and brought to the elevation shown on the drawings. Where stabilization is required, the finish elevation is to the top of the stabilizing layer.

### 6.3 EXISTING SURFACES

Material and placement of backfill material for restoration of existing parking areas, roads, shoulders, ditches, sidewalks and paved areas disturbed by the work under this contract, or as shown on the drawings, shall be in accordance with 5.1 "GENERAL" and 5.2 "LOAD-BEARING FILL OR BACKFILL".

7-1072-272

HMS-6138-S  
UNDERGROUND PIPING

INSTRUCTIONS FOR USE OF  
STANDARD SPECIFICATION HWS-6138-S, INSTALLATION OF UNDERGROUND PIPING

Specification HWS-6138-S covers installation of all types of directly buried piping. When it is referenced, the user should supply additional details for the specific job. A number of items to be considered for inclusion in supplemental specifications, or on the drawings, are listed below:

(The items should not be considered as a complete list of requirements. Each job must be carefully reviewed for special items.)

1. USE OF HWS-6138-S

Specification HWS-6138-S covers requirements common to installation of underground piping. It does not cover the materials such as pipe, fittings, valves, etc., or certain workmanship requirements such as jointing of steel pipe and cast iron soil pipe. Those requirements, which will vary for each job, are covered in Hanford Guide Specification DG-100-M, Process and Service Piping.\*

When HWS-6138-S is referenced, the user must supply supplemental drawings and specifications for such items and any additional requirements for the particular job. Those items should be extracted from the above-mentioned guide. Hanford Guides may not be referenced for construction work. Typical items which would appear in the supplemental drawings and specifications include:

- a. Material specifications for pipe, fittings, gaskets, jointing materials, safety and relief valves, traps, strainers, manholes, insulation.
- b. Installation requirements for jointing of cast iron soil pipe and steel and wrought iron pipe, and requirements for cleaning and testing.
- c. Any special requirements.

2. EXCAVATION APPROVALS

Generally, approval to excavate is required for any excavation work done at Hanford. Specific requirements for excavation permits and approvals should be included in supplemental documents. For work done by contract with the AEC this is already covered in the AEC "General Conditions".

3. SLOPE OF TRENCH SIDES

HWS-6138-S requires trenches to be either shored or sheeted, or the sides sloped to an angle of 1:1. Where the angle of repose of the soil is known to be flatter than 1:1 and trenching in it with 1:1 side slopes would create hazardous working conditions, specify that the flatter slope be used for the trench sides.

\*Currently under revision to cover those requirements

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APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY. DATE 4-3-61				INSTRUCTIONS FOR USE OF HWS-6138-S	DI-6138-S	

FIRE HYDRANTS

Where new fire hydrants are to be installed, their location should be shown on the drawings; see Section 9.2 of HWS-6138-S. Guard posts for fire hydrants should be specified where required, in accordance with Standard AC-4-4.

5. LOAD-BEARING BACKFILL - SPECIAL LOCATIONS

If there are any locations not covered by Section 12.6 of HWS-6138-S where load-bearing backfill is required, show those locations on the drawings.

6. PLACING OF EXCAVATED MATERIAL

Section 6.1, b of HWS-6138-S states that excavated material shall be kept off roadways, sidewalks and paved areas. The required distance to keep excavated material away from buildings, fences, power lines, etc., will vary for specific conditions. These distances should be stated in the specifications, on the drawings, or in supplemental documents such as the special conditions.

7. TRAFFIC OVER BURIED PIPE

When there is a possibility of wheeled traffic passing over newly-laid or existing buried pipe during the course of the work, the required depth of backfill for each individual case should be included in supplemental documents, such as the special conditions.

8. ENCASEMENT

Piping located under roads and railroads may require special encasement. Consult DI-AC-4-50, 51 & 52, Instructions for Use of the Pipe Cradle and Encasement Standards, AC-4-50, 51 & 52.

9. BACKFILL NEAR BUILDINGS

Section 12.5, item b (1) of HWS-6138-S states that backfill in all trenches within 25 feet of any building shall be compacted in 12-inch lifts with at least one pass with a vibratory type rammer. This 25-foot distance should be varied if necessary, in supplemental documents, to fit local conditions and requirements.

10. CATHODIC PROTECTION FOR STAINLESS STEEL PIPE

Cathodic protection is always required for buried stainless steel pipe. Details for the various protective systems are found in SDC-7.10, Standard Design Criteria for Corrosion Protective Systems.

HWS-6138-S

STANDARD SPECIFICATION

FOR

INSTALLATION OF UNDERGROUND PIPING

Supersedes HWS-6130-S

Ref. Hanford Stds: See Section 3.4

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM BY	DES
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APPROVED BY ENGINEERING STANDARDS COUNCIL				INSTALLATION OF UNDERGROUND PIPING	HWS-6138-S	
H. E. Struck SECRETARY, DATE 4-3-61						

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FOR  
INSTALLATION OF UNDERGROUND PIPINGTABLE OF CONTENTS

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STANDARD SPECIFICATION FOR  
INSTALLATION OF UNDERGROUND PIPING

1. SCOPE

This specification covers the installation of directly buried underground piping, and includes trenching and backfilling.

2. IDENTIFICATION OF ENGINEER

The term "Engineer" refers to the representative of the user of the facility to which this specification applies.

3. REFERENCED STANDARDS

The following issues of the standards listed below, but referred to hereafter by basic designation only, form a part of this specification to the extent indicated by subsequent references.

3.1 AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS (AASHO) STANDARDS

T 147-54      Field Determination of Density of Soil in Place

T 99-57      The Moisture-Density Relations of Soils Using a 5.5-lb Rammer and a 12-in. Drop.

3.2 STATE OF WASHINGTON STANDARD

Safety Standards for Construction Work, State of Washington Department of Labor and Industries, January 1, 1957.

3.3 AMERICAN WATER WORKS ASSOCIATION (AWWA) STANDARD

C 600-54T      AWWA Standard for Installation of Cast-Iron Water Mains

3.4 HANFORD STANDARDS

HW-4926-S      Rev. 4      Specification for Welding Carbon Steels

HW-4966-S      Rev. 1      Specification for Disinfecting Sanitary Water Supply Systems

HWS-8067-S Rev. 4 Specification for Austenitic Stainless Steel Welding Electrodes and Filler Materials

M-2-22 Rev. 0 Fire Hydrants

M-2-23 Rev. 0 Thrust Blocks for Underground Piping

#### 4 MATERIALS

##### 4.1 PIPE, FITTINGS, VALVES, GASKETS AND JOINTING MATERIALS

Pipe, fittings, valves, gaskets and jointing materials shall be as specified on accompanying drawings or specifications.

##### 4.2 SAFETY AND RELIEF VALVES, STEAM TRAPS AND STRAINERS

Safety and relief valves, steam traps and strainers shall be as specified on accompanying drawings or specifications.

##### 4.3 WELDING ELECTRODES AND FILLER METAL

a. Stainless steel welding electrodes and filler metal shall conform to Hanford Standard Specification HWS-8067-S, Austenitic Stainless Steel Welding Electrodes and Filler Materials.

b. The following filler metal shall be used:

<u>Alloy to be Joined</u>	<u>Filler Materials</u>
304	308
304L	308L
316	316
316L	316L

c. Carbon steel welding electrodes and filler metal shall conform to Hanford Standard Specification HW-4926-S, Welding Carbon Steels.

##### 4.4 INSULATION

Insulation materials for underground piping shall be as specified on accompanying drawings and specifications.

#### 5. PRECAUTIONS

Travel of construction equipment, including track-laying vehicles, pickup trucks and other wheeled vehicles, over new or existing buried piping, shall be over routes approved or designated by the Engineer or designated in accompanying documents.

6. EXCAVATING

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6.1 GENERAL

- a. Where drawings require concrete or other materials to be placed against undisturbed earth surfaces, any loosened or disturbed materials shall be removed from such surfaces.
- b. Excavated material shall be kept off roadways, sidewalks and paved areas.
- c. Safety requirements for the protection of all personnel working in, around, or near any site where work covered by this specification is being performed shall be determined in accordance with the State of Washington Safety Standards for Construction Work, except that:
  - (1) Trenches over 4 feet in depth, unless in solid rock, hard shale or hardpan, shall be either shored, sheeted and braced, or the sides of the trenches shall be sloped to an angle not steeper than 1:1.
  - (2) All shoring and bracing shall be designed so that it is effective to the bottom of the excavation. Sheet piling, sheet piling, bracing, shoring, trench boxes, and other methods of protection, including sloping, shall be based upon calculation of pressure exerted by and the condition and nature of the materials to be retained, including surcharge imparted to the sides of the excavation by equipment and stored materials.
  - (3) Excavated or other materials shall not be stored nearer than 2 feet from the edge of any excavation and shall be so stored and retained as to prevent its falling or sliding into the excavation, and to prevent excessive pressure upon the sides of the excavation.
  - (4) Sides and slopes of excavations shall be maintained in a safe condition by scaling, benching or barricading.
  - (5) Additional precautions by way of shoring and bracing shall be taken to prevent slides or cave-ins, when trenches are made in locations adjacent to backfilled excavations or subjected to vibrations from railroads or highway traffic, the operation of machines, or any other source.
- d. Excavation within four feet of underground telephone and power lines, instrument tubing and cathodic protection systems shall be done by hand digging only.

## 6.2 TRENCHING

- a. Trenches shall be of size to permit handling of pipe and accessories and making connections. For cast-iron, clay, and concrete bell-and-spigot pipe, cast-iron mechanical-joint pipe and asbestos-cement pipe, sheeted or unsheeted trench width shall exceed bell or coupling diameter by at least 12 inches.
- b. For clay, concrete, and asbestos-cement pipe, the trench width at the top of the pipe shall not be more than the outside diameter of the barrel of the pipe plus two feet. The trench above the top of the pipe may be any width permitted by the Engineer.
- c. Excavation of trenches in rock, soil containing rocks larger than 2 inches in any dimension, and other nonuniform materials, shall be carried to a depth of at least 4 inches and not more than 12 inches below the bottom of the pipe, to provide for a bedding course.
- d. Excavation of trenches in quicksand, mud, silt, or other unstable material shall be carried to a depth below pipe bottom as determined by the Engineer.

## 6.3 PREPARATION OF TRENCH BOTTOM

- a. Trenches shall be dry when the trench bottom is prepared. A continuous trough shall be pared, excavated or compacted to receive the bottom quadrant of the pipe barrel. Bedding course is not required in soil containing rocks not larger than two inches in any dimension. Where bedding course is not required, the trench bottom shall be undisturbed earth; loose or disturbed material shall be removed and the trench bottom shall be brought up to grade with sand or 5/8" minus select material compacted in accordance with Section 12.6. In addition, for cast-iron, clay, and concrete bell-and-spigot pipe, cast-iron mechanical-joint pipe and asbestos-cement pipe, bell or coupling holes shall be excavated so that the pipe will bear on the trench bottom along the entire length of the barrel.
- b. Preparation of the trench bottom shall be carefully made so that when placed in its final position, the pipe will be true to line and grade and uniformly supported.
- c. If the excavation is carried below the finished grade of the pipe to remove unsuitable material, the trench shall be backfilled to within 4 inches of the finished grade of the pipe bottom with load-bearing backfill as specified in Section 12.6 of this specification. A bedding course shall be placed over the load-bearing backfill. It shall consist of coarse sand or 5/8" minus select material placed and compacted as specified in Section 12.6 and shaped to receive the pipe as specified in Paragraph "a" above.

7. LAYING PIPE

## 7.1 GENERAL

- a. All pipe shall be clean at the time it is placed in the line. During the times when pipe laying is not in progress, the open ends of sections of line already in place shall be tightly plugged to prevent the entrance of trench water, mud, dirt or other foreign substances.
- b. Trench bottom shall be kept free of frost, frozen earth or standing water at the time of laying and jointing pipe.

## 7.2 CAST-IRON WATER PIPING

Laying of cast-iron water piping shall be in accordance with AWWA Standard C600, Section 7, LAYING.

## 7.3 CLAY, CONCRETE, ASBESTOS-CEMENT AND CAST-IRON SOIL PIPE

Laying of vitrified clay, concrete, and asbestos-cement pipe and cast-iron soil pipe shall conform to the following:

- a. Pipe shall be protected during handling against impact shocks and dropping. Immediately prior to laying, the pipe shall be inspected and any damaged sections shall be discarded.
- b. The laying of pipe in finished trenches shall be started at the lowest point of the run and progress upgrade with spigot ends pointed in the direction of flow.
- c. All pipe joints shall be carefully centered, so that when the pipe is laid, a pipeline with a uniform invert will be formed.
- d. Pipe shall be firmly set so as to resist deformation, according to line and grade, preparatory to making pipe joints.

8. JOINTING PIPE

## 8.1 CAST-IRON MECHANICAL-JOINT PIPE

Jointing of cast-iron mechanical-joint pipe shall be in accordance with AWWA Standard C600, Section 9b, JOINTING MECHANICAL-JOINT PIPE.

## 8.2 CAST-IRON SOIL PIPE

Joints in cast-iron soil piping shall be made as specified in accompanying specifications.

8.3 VITRIFIED CLAY AND CONCRETE PIPE

Vitrified clay and concrete pipe shall have resilient jointing ends as specified in accompanying specifications. Jointing shall be done in accordance with the manufacturer's instructions.

8.4 ASBESTOS-CEMENT PIPE

- a. Joints in asbestos-cement piping shall be made with sleeve type couplings and rubber sealing rings.
- b. Joints between asbestos-cement piping and metal piping shall be made with adapter couplings using rubber sealing rings.
- c. Jointing shall be done in accordance with the manufacturer's instructions.
- d. After assembly of each joint, the rubber ring location shall be checked with a suitable gage. If the location of rings is not as recommended by the manufacturer for the full circumference of the pipe, the joint shall be reassembled properly.

8.5 STEEL AND WROUGHT IRON PIPE

Joints in steel and wrought iron piping shall be made in accordance with accompanying drawings and specifications.

9. INSTALLATION OF ACCESSORIES

9.1 THRUST BLOCKS

All tees and bends in cast-iron and asbestos-cement water piping shall be provided with concrete thrust blocks in accordance with Hanford Standard M-2-23 Thrust Blocks for Underground Piping.

9.2 FIRE HYDRANTS

Fire hydrants shall be installed at the locations shown on the drawings in accordance with Hanford Standard M-2-22 Fire Hydrants.

9.3 INSULATION

Insulation for underground piping shall be installed as specified on accompanying drawings or specifications.

10. CLEANING AND TESTING

- a. Piping shall be cleaned and tested in accordance with accompanying drawings and specifications.

- b. Where concrete thrust blocks are used, seven days shall elapse, or the concrete shall have developed 1000 psi compressive strength after placement, before hydrostatic testing.

## 11. DISINFECTING SANITARY WATER PIPING

All sanitary water piping shall be disinfected in conformance with Hanford Standard Specification HW-4966-S, Disinfecting Sanitary Water Supply Systems.

## 12. BACKFILLING

### 12.1 GENERAL

- a. Trenches shall be partially backfilled immediately after the pipe is laid therein, with joints left exposed for hydrostatic testing, unless other methods for anchoring pipe are provided. Water shall not be permitted to rise in unbackfilled trenches after pipe has been placed.
- b. Trenches shall be cleaned of organic material, roots, trash, lumber, other debris, and frozen material prior to backfilling.
- c. Material for backfill shall contain no organic material, roots, trash, lumber, other debris, or frozen material.
- d. Backfill shall not be placed on frozen ground.
- e. Backfilling by means of sluicing or flooding with water will not be permitted.
- f. Whenever timber or other sheeting is driven to a depth below the elevation of the top of the pipe, that portion of the sheeting below a point 4 feet above the elevation of the top of the pipe shall not be disturbed or removed.
- g. Backfilling around manholes and other structures in the line shall be performed in essentially the same manner as specified for backfilling trenches.

### 12.2 BACKFILLING UNDER PIPE

- a. Material and placement of backfill below the elevation four inches below the bottom of the pipe shall be the same as specified for load-bearing backfill in Section 12.6 of this specification. (See Section 6.3 of this specification.)
- b. Material and placement of bedding course shall be as specified in Section 6.3 of this specification.

### 12.3 BACKFILLING AROUND PIPE

- a. Backfill material under the haunches of the pipe, around the sides, and up to a point one foot above the top of the pipe shall be:
  - (1) For cast iron, wrought iron, and steel pipe - sand or select material containing no rocks larger than 2 inches in greatest dimension.
  - (2) For concrete, vitrified clay and asbestos-cement pipe - sand or select material containing no rocks larger than 1 inch in greatest dimension.
- b. Sand or select backfill material under the haunches, around the sides, and up to a point one foot above the top of the pipe shall be placed and compacted as specified for load-bearing backfill in Section 12.6 of this specification.
- c. Backfill shall be brought up evenly on each side of the pipe to avoid damage or displacement from unbalanced loading.
- d. Joints in pipe lines shall not be covered with backfill until pressure and leak testing is completed.

### 12.4 BACKFILLING OVER PIPE

Backfilling above the elevation one foot above the top of the pipe shall be as follows:

- a. Load-bearing backfill, in accordance with Section 12.6, shall be placed:
  - (1) In trenches which occur under asphaltic or portland cement concrete slabs, sidewalks or pavement, and
  - (2) in other locations shown on the drawings.
- b. Non-load-bearing backfill, in accordance with Section 12.5 shall be used in all other trenches.

### 12.5 NON-LOAD-BEARING BACKFILL

- a. Non-load-bearing backfill material shall contain no rocks larger than 8 inches in any dimension.
- b. Placement of non-load-bearing backfill in trenches shall be as follows:
  - (1) In trenches within 25 feet of buildings and in trenches which traverse areas designated on the drawings to be reshaped or graded,

material shall be placed in layers not more than 12 inches thick, loose measurement. Each layer shall be compacted, full width, by at least one pass of a vibratory or rammer type compactor. The material shall be left mounded above the surrounding terrain approximately one inch for each foot of backfill depth, to a maximum of 3 inches.

- (2) In trenches not covered by (1) above, material shall be placed in 12-inch thick layers. Each layer shall be inspected for materials specified in Section 12.1 "GENERAL" as not to be included in the backfill, and any such material shall be removed. The material shall be left mounded above the surrounding terrain approximately 1-1/2 inches for each foot of backfill depth to a maximum of 6 inches.

## 12.6 LOAD-BEARING BACKFILL

- a. Materials for load-bearing backfill shall consist of select material containing no rocks larger than 4 inches in any dimension.
- b. Load-bearing backfill shall be placed as follows:
  - (1) Materials shall be placed in layers not more than 8 inches thick, loose measurement. Each layer shall be uniformly spread, and compacted to the required density shown below.
  - (2) If moisture content of material is not sufficient to obtain required density, water shall be applied and mixed with the soil.
  - (3) When tested in the field in accordance with AASHTO Standard T 147, the compacted material shall have a density not less than 95% of the "maximum density" as determined in accordance with AASHTO Standard T 99. The moisture content shall be uniform throughout each layer and shall not vary more than 3 percentage points above or below the optimum moisture content as determined by AASHTO Standard T 99.
  - (4) A procedure for compacting load-bearing backfill shall be submitted in writing to the Engineer prior to placement of any load-bearing backfill, except as required for initial determination and demonstration of the compaction procedure. Actual tests shall be made at the work site by the Contractor, and witnessed by the Engineer, on material placed in conformance with the procedure to show that the degree of compaction specified in (3) above is attained.

CAFÉ-1072-386

MS-6139-S  
LOW SHRINKAGE GROUT

**INSTRUCTIONS FOR USE OF HWS-6139-S  
STANDARD SPECIFICATION FOR MIXING, PLACING, AND CURING  
OF LOW SHRINKAGE (LONG-MIX) GROUT**

Standard Specification HWS-6139-S covers a special sand-cement grout for seating equipment, structural steel members, etc. on concrete foundations.

The following items concerning grout and the use of the specification should be observed:

1. Low shrinkage (long-mix) grout should be used whenever possible to seat all major items of equipment and structural shapes.
2. Non-shrink grout involving the use of graded metallic aggregate such as Master Builders Embeco, or a similar commercial product can be used in some instances. The fact that hardened grout made of this material will "rust" often makes its use objectionable where, for example, it must be painted.
3. Where fractional tolerances in the  $\pm .001$  inches per inch range are not of major importance, the mixing time can be reduced from 105 minutes to as low as 15 minutes. Tests have indicated that the unit 24-hour settlement for a mixing time of 15 minutes is 0.0011 inches per inch compared to a settlement of 0.0005 inches per inch for a total mixing time of 105 minutes.<sup>#</sup> If a reduction in the mixing time is desired, the required mixing time must be stated in the accompanying specifications.
4. The use of unpolished aluminum powder to produce non-shrink grout is not recommended. If the recommended percent of aluminum powder by weight is exceeded by even a fractional amount, the hydrogen gas generated by the chemical reaction will cause an unpredictable expansion of the grout. The rigid control of such small amount of this material makes its use impractical for average job conditions.

<sup>#</sup> Concrete Manual, Bureau of Reclamation,  
Sixth Edition, page 387.

NO.	REVISION	APP'D	DATE	CIVIL ENGINEERING STANDARDS	SUBM. BY	DES. BY
1	Note 4	hes	12-20-62		hes	gkm
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 6-24-57				INSTRUCTIONS FOR USE OF SPECIFICATION HWS-6139-S	DI-6139-S	

(This Specification  
consists of 4 pages)

HWS-6139-S

STANDARD SPECIFICATION

for

MIXING, PLACING, AND CURING OF

LOW SHRINKAGE (LONG-MIX) GROUT

HAPO Ref. Stds: None

NO.	REVISION	APP'D	DATE	CIVIL ENGINEERING STANDARDS	SUBM. BY	DES. BY
1	Page 1 & 2	hes	12-20-62		hes	gkm
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 6-24-57				SPECIFICATION FOR LOW SHRINKAGE (LONG-MIX) GROUT	HWS-6139-S	

HWS-6139-S

STANDARD SPECIFICATION FOR MIXING,  
PLACING AND CURING OF LOW SHRINKAGE  
(LONG-MIX) GROUT

1. SCOPE

This specification applies to the batching, mixing, and placement of low shrinkage grout produced by extended mixing. It is used for seating equipment and structural steel members on foundation. Where the term, "Engineer" is used in this specification, it shall mean the engineer representing the user of the facility.

2. COMPOSITION

The low shrinkage grout shall be composed of portland cement, water, and fine aggregate as specified herein.

3. CEMENT

\* The cement shall be Type II, low alkali, in accordance with Federal Specification SS-C-192d, and may be furnished in cloth or paper sacks. The cement shall be free from lumps and shall be otherwise undamaged.

4. AGGREGATE

4.1 COMPOSITION AND QUALITY

Aggregate shall consist of sand obtained either by processing of natural sand or by the addition of a suitably graded blending sand. All sand shall be washed clean by wet processing and shall consist of hard, tough, durable particles free from foreign materials. The shape of the particles shall be generally rounded or cubical and reasonably free from thin, flat, elongated particles. Such a particle is defined as having a maximum dimension in excess of five times its minimum dimension.

#### 4.2 GRADING

The sand shall be well graded from fine to coarse. The gradation shall conform to the following requirements as delivered to the mixer:

	Sieve Designation	Cumulative Percentage by Weight	
	<u>U. S. Standard Square Mesh</u>	<u>Passing</u>	<u>Retained</u>
*	No. 4	100	0
	No. 8	81-89	11-19
	No. 16	57-73	27-43
	No. 30	32-58	42-68
	No. 50	15-28	72-85
	No. 100	0-10	90-100

In addition to the grading limits shown above, the sand as delivered to the mixer, shall have a fineness modulus of not less than 2.40 nor more than 3.00.

#### 4.3 SAMPLING

- \* | All sampling and testing of sand shall be in accordance with ASTM Designation: C136-61T, "Tentative Method of Test for Sieve or Screen Analysis of Fine and Coarse Aggregates". Unless otherwise specified, facilities for procurement of test samples, frequency of sand tests, selection of samples, and location to which samples are to be delivered shall be as approved or directed by the Engineer. All tests will be under the supervision of the Engineer and shall be performed by the Contractor.

#### 4.4 STORAGE

Sand for grout shall be stored in a manner which will prevent segregation and introduction of foreign material.

#### 5. WATER

Water used in mixing grout shall be clean and free from injurious amounts of sewage, oil, acid, alkali, salts or organic matter and shall be handled in clean containers.

#### 6. BATCH PROPORTIONS

All necessary equipment shall be provided for accurate measurement and control of the amount of material entering each batch. Unless otherwise specified by the Engineer, the grout shall consist of approximately equal parts of cement and sand with a water-cement ratio of 0.40 by weight and

a slump of between 9 inches and 11 inches at the time of placement. All materials entering into the grout shall be batched and measured by weight.

## 7. MIXING

### 7.1 MIXER

The mixer shall be capable of combining the ingredients of the grout into a uniform mixture within 5 minutes.

### 7.2 MIXING TIME

After charging the mixer, the sand, cement, and water mixture shall be mixed for approximately 15 minutes. Slump tests will then be taken and the water content shall be adjusted at this time to obtain a slump of between 9 and 11 inches at the time of placement. Grout shall then be mixed for one hour and thirty minutes before placement, for a total mixing time of one hour and forty-five minutes. Water shall not be added after the initial adjustment.

## 8. PLACING

### 8.1 CONSISTENCY

Grout having a slump of less than 9 inches or more than 11 ~~inches~~ at the time of placing shall not be used. In hot, dry weather it may be necessary to perform the grouting operations at night or provide a means of cooling the mixing water in order that the material may arrive at the work site with the necessary slump. Adjusting the consistency of the grout by adding water after the mixing is completed (retempering) will not be permitted.

### 8.2 SURFACE PREPARATION

Before placing grout the surface of the concrete pier or foundation shall be cleaned of all laitance, dirt, oil, or other foreign matter. This shall be done by chipping, wet or dry sandblasting, cutting with air-water jet, or other method approved by the Engineer. The surface shall be well saturated with water, but shall not have free water or puddles on the surface.

### 8.3 PLACEMENT

A form shall be built around the base plate to confine the grout. The top of the form shall be above bottom of the base plate. The grout shall be placed in such a manner as to insure uniform distribution throughout the grout space and to insure that the grout space is completely filled and no air pockets remain. The method of placing the grout shall be subject to the approval of the Engineer.

9. FINISHING & CURING

Excess grout shall be cut away before it is thoroughly hardened, and exposed surfaces shall be troweled smooth to the required lines. Exposed surfaces of grout shall be water cured for seven days. This may be accomplished by covering the surface with a water-saturated burlap pad or by other methods satisfactory to the Engineer which will keep all exposed surfaces continuously wet. Where designated by the Engineer, certain areas of grout shall be surface coated with an approved white-pigmented sealing compound, in lieu of water curing, or in addition to a reduced water curing period. Equipment grouted in place shall not be operated for a minimum of four days after placement of grout. This period may be increased to seven days, if, in the opinion of the Engineer, the nature of the installation requires the additional time.

CAPE-1072-393

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INSTRUCTIONS FOR USE OF HANFORD STANDARD  
SPECIFICATIONS FOR BUILT-UP ROOFING  
HWS-6141-S THROUGH HWS-6149-S

When the Hanford Standard roofing specifications are used, the user must choose the applicable specification and indicate his choice of optional items, if any. These instructions are intended to aid in making effective use of the standards. Some general information on built-up roofing and a partial check list of good roofing practices are included with the instructions. The check list is not intended to be all-inclusive; however, it indicates many of the items which should be considered.

The Hanford Standards for built-up roofing are based upon standard specifications of roofing materials manufacturers for average conditions. Special conditions such as steep slopes, multiple purpose use of roof decks, unusual deck construction, or severe fire hazards will require special treatment. Bonds for roofing are of questionable value at Hanford and, in accordance with Commission design criteria, are not to be provided. Construction of roofs in accordance with the standard specifications will meet or exceed normal bond requirements.

Details for metal flashing, wood insulation stops and nailing strips, cant strips, and walkways should be shown on the drawings.

1. Use of the Hanford Standard Roofing Specifications

The proper Hanford roofing specification to fit a given job may be selected as outlined below:

- a. The type of bitumen and its softening point is determined by the slope of the deck. For slopes 1/2 inch per foot and less, coal-tar pitch (softening point 140 F to 150 F) per HWS-6144-S, 6145-S or 6146-S or low melt asphalt (softening point 135 F to 148 F) per HWS-6147-S, 6148-S or 6149-S should be used. For slopes over 1/2 inch up to 3 inches per foot on wood decks, and over 1/2 inch up to 2 inches per foot on concrete and insulated decks, high melt asphalt (softening point 165 F to 190 F) per HWS-6147-S, 6148-S or 6149-S should be used. For slopes steeper than the limits specified for each roof type, the specifications should be altered in accordance with material manufacturer's recommendations. Engineering Standards and Specifications Operation has some information on this subject and on other aspects of roofing which may be helpful to the designer.
- b. The type of roof deck determines which coal-tar pitch or asphalt roof specification should be used. Specifications are provided for wood, concrete, and steel decks. If an asphalt roof is to be applied, there are optional items to select as noted in the specification list in these instructions.

-1-

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
1	General Revision	hes	6-6-60		hes	ae
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 7-11-57				INSTRUCTIONS FOR USE OF BUILT-UP ROOFING SPECIFICATIONS	DI-6141-6149-S	

- c. If roof insulation is required, the type of roof deck (wood, concrete, or steel) determines the insulation application specification to use. Insulation is always used on steel decks. For wood and concrete decks the type of bitumen used to adhere the insulation is the same as that used on the roofing which follows. For steel decks plastic sheet is required for the vapor barrier, and insulation is adhered with a special adhesive.
- d. The roof insulation specified in HWS-6141-S thru 6143-S is rigid fiberboard insulation. When these specifications are referenced for the insulation portion of the roof, the desired insulation thickness must be stated in accompanying specifications or shown on the drawings. The fact that fiberboard insulation is specified does not preclude the use of glass fiber or other type of insulation if there is good reason for it. Glass fiber insulation is covered by Federal Specification HH-I-526b. When specifying, or allowing substitution of glass fiber insulation, special attention must be given to certain details such as the thickness of wood insulation stops, nailing strips and any recesses in the concrete for insulation, and the structural capacity to span voids in fluted decks.
- e. Fire retardant values for all the roof types covered by Hanford Standards meet the requirements of the Uniform Building Code for fire-retardant roofs.
- f. Requirements for proper deck surfaces, smooth and free from depressions, must be specified in other specifications or on drawings. The roofing contractor should not be expected to smooth and level up a concrete roof deck built by another contractor, for example. For concrete decks, specify the U2 finish (a wood float finish) and tolerances in accordance with Hanford Standard Specification HW-4798-S.
- g. Any special requirements needed to assist in administration of project inspection work should be written into the special conditions for the project. This includes items such as requiring advance notice from the contractor of when roofing operations are to start, or when he plans to change to non-standard shift hours, and requiring the contractor to keep all materials on the jobsite until the job is completed so that they may be inventoried to see if the proper amounts were used per 100 square feet of roof area.
- h. An example of the use of the Hanford Standards is given below:  

"Material and workmanship for applying roof insulation shall conform to Hanford Standard Specification HWS-6142-S, Applying Insulation to Concrete Roof Decks. Material and workmanship for applying built-up roofing shall conform to Hanford Standard Specification HWS-6146-S, Built-Up Gravel Surfaced Coal-Tar Roofs on Insulated Decks".

Listed following are the Hanford standards for applying roof insulation and built-up roofing. The users of the standards must select the desired optional items from among those listed.

Spec. No.	Title	Optional Items
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INSULATION

HWS-6141-S	Applying Insulation to Wood Roof Decks	None
HWS-6142-S	Applying Insulation to Concrete Roof Decks	None
HWS-6143-S	Applying Insulation to Steel Roof Decks	None

COAL-TAR PITCH ROOFS

HWS-6144-S	Built-Up Gravel Surfaced Coal-Tar Roofs on Wood Decks	None
HWS-6145-S	Built-Up Gravel Surfaced Coal-Tar Roofs on Concrete Decks	None
HWS-6146-S	Built-Up Gravel Surfaced Coal-Tar Roofs on Insulated Decks	None

ASPHALT ROOFS

HWS-6147-S	Built-Up Smooth and Gravel Surfaced Asphalt Roofs on Wood Decks	Select: (1) For roof slopes over $\frac{1}{2}$ inch per foot, select smooth or graveled surface (roofs on slopes $\frac{1}{2}$ inch per foot and under are to be graveled) (2) If smooth surfaced, choose between special roofing sheets and glass fiber sheets for plying material. (3) If gravel surfaced, choose between roofing felt and glass fiber sheets for plying material. (4) For smooth surfaced roofs, specify reflective coating, if desired.
HWS-6148-S	Built-Up Smooth and Gravel Surfaced Asphalt Roofs on Concrete Decks	Options same as HWS-6147-S, above.
HWS-6149-S	Built-Up Smooth and Gravel Surfaced Asphalt Roofs on Insulated Decks	Options same as HWS-6147-S, above.

2. General Information on Built-Up Roofing

Built-up roofs are normally constructed either with asphalt products or with coal-tar pitch. Asphalt is produced with softening points in three main ranges between 140 F and 200 F. Coal-tar pitch for ordinary roofs has a softening point between 140 F and 150 F. Medium and high melt point asphalt roofs may be gravel surfaced or smooth surfaced. Coal-tar pitch and low melt point asphalt roofs are always graveled.

There are many conflicting claims for the relative water resistance, weathering properties, and maintenance requirements for asphalt and for coal-tar pitch roofs. The Hanford Standards are based upon the use of coal-tar pitch or low melt point asphalt on roof decks with slopes of 1/2 inch per foot and less and the use of high melt point asphalt on slopes over 1/2 inch per foot.

When properly constructed and when protected from abuse and foot traffic, graveled roofs can be expected to give 20 years service with very little maintenance. Smooth surfaced roofs require recoating at intervals of about 4 to 7 years. The main advantage of smooth surfaced roofs is ease in maintenance since leaks are easier to find and repair than leaks in graveled roofs.

3. Roof Design Considerations

The following factors have a direct effect on roof life and serviceability:

- a. Sloped roof decks eliminate standing water, prolong roof life and prevent leaks. Dead level decks invariably have pools of standing water which often lead to roof leaks.
- b. Precast slabs and plank must be securely anchored to building structure.
- c. Vapor barriers are recommended for insulated decks to prevent insulation from becoming moisture laden.
- d. Steel roof decks require a minimum of 1/2 inch of insulation to isolate roofing from decks.
- e. Wide voids in fluted steel decking increase difficulty of installing tight vapor barrier and may require thick insulation to bridge the voids for proper support of roofing.
- f. Lightweight aggregate concrete decks poured over steel decks or other vaportight membrane must be vented from below by the use of ventilating clips between laps, or other suitable means. Otherwise, drying of the concrete will be retarded and the roofing will blister.
- g. Wood insulation stops of the same thickness as the insulation are required at the edges of all insulated areas, including penetrations and wherever flashing is to be nailed to the deck. Additional stops are required on steel decks with slopes over one inch per foot. Where flashing, roof edging, or gravel stops are to be installed the insulation stops should be at least one inch wider than the flange which is to be nailed to it.

Where new roofing joins existing roofing, existing insulation stops may remain in place provided they are in good condition, secure and of the correct size and thickness.

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- h. For concrete decks, wood nailers for securing flashing, gravel stops or roof edging are required around roof penetrations and at edges of roof decks. Nailers for securing felt base flashing are also required in concrete or masonry walls which intersect the roof deck. Nailers should be 2" x 2" or 2" x 4" preservative-treated wood strips cast flush in the concrete.
- i. Wood roof sheathing should be center matched (tongue and groove) to provide a smooth, tight deck to give good support and to reduce hazard of blow off when doors and windows are opened in windy weather.
- j. Cant strips of wood, fiber, concrete, or sheet steel are required at all intersections of vertical surfaces with the roof. Minimum height of cants should be 3-1/2 inches.
- k. Flashing details are extremely important in maintaining weather-tight roofs. Curbs or flanged collars should be installed at all roof penetrations. Galvanized metal flashing should be 22 or 24 gage. Copper flashing should be 16 oz. Roof flanges of flashing and edging should be at least 5 inches wide and should be placed on top of all built-up roofing plies. The recommended height for the gravel stop bead is one inch. Flanges should be securely nailed to the deck and sealed to the roofing with two mopped strips. Pitch-pockets at least 4 inches deep should be provided wherever objects such as handrail posts and structural supports must be attached to the roof deck. Felt base flashing should be constructed of at least 4 plies of felt and 1 ply of mineral surfaced roofing, all applied with roofing cement.
- l. Counterflashing reglets should be located from 8 to 14 inches above the roofing deck. For poured concrete walls the "Pioneer Flashing Reglet", or equal, is recommended.
- m. Counterflashing must be securely attached to prevent displacement due to wind and temperature changes. Bottom edge of counterflashing should be close to top of cant. See item k above, for minimum recommended thicknesses of sheet metal.
- n. Roof drains should be provided with roof flanges extending at least five inches all around drain fittings.
- o. Ventilation ducts and other facilities on roof should be located high enough above roof (approximately 30 inches minimum) to permit roof maintenance and re-roofing. Wherever possible, ducts and other facilities should be supported from adjacent walls to maintain clear roof surfaces.
- p. Access to equipment and facilities should be planned to eliminate foot traffic and equipment maintenance on unprotected roofs.
- q. Protection for roofs should be provided in the form of asphalt plank walkways and/or special paving to permit heavy traffic without damaging roofs. Asphalt plank pads should be provided at top and bottom of stairs and ladders landing on roofs, and at doorways opening onto roofs.

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- r. Reflective coatings can be used on smooth asphalt roofs to reduce solar heat gain.
- s. On roofing work of unusual importance or of large extent, inspection by the materials manufacturer during application can be requested. This service is normally furnished without charge.
- t. Internal building pressure can dislodge a built-up roof and cause rapid failure of the roofing. Extreme care should be exercised when pressurizing a building, particularly if it is by a pressure test. It should preferably be completed prior to application of built-up roofing.

HWS-6141-S

STANDARD SPECIFICATION

for

APPLYING INSULATION TO WOOD ROOF DECKS

Ref Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
1	General Revision	hes	4-22-60		hes	aee
APPROVED BY ENGINEERING STANDARDS COUNCIL <u>H. E. Struck</u> SECRETARY. DATE <u>7-11-57</u>				APPLYING INSULATION TO WOOD ROOF DECKS	HWS-6141-S	

STANDARD SPECIFICATION  
FOR  
APPLYING INSULATION TO WOOD ROOF DECKS

1. SCOPE

This specification covers the application of the insulation portion of a built-up roof to wood roof decks with slopes up to 2 inches per foot.

2. IDENTIFICATION OF ENGINEER

The term "Engineer" refers to the representative of the user of the facility to which this specification applies.

3. REFERENCED PUBLICATIONS

The following publications apply to this specification to the extent indicated by subsequent references. References are by basic designation only; however, the complete designation, including the suffix indicating the year of edition, shall apply.

a. American Society for Testing Materials (ASTM) Specification:

ASTM Designation: C208-57T, Structural Insulating Board Made from Vegetable Fibers

b. Federal Specifications:

R-P-381	Pitch; Coal-Tar (for) Mineral Surfaced Built-up Roofing, Waterproofing and Dampproofing
HH-F-191a	Felt; Asphalt-Saturated (for) Flashing, Roofing and Waterproofing
HH-F-201	Felt; Coal-Tar Saturated (for) Roofing and Waterproofing
SS-A-666	Asphalt (for) Built-Up Roofing, Waterproofing and Dampproofing
SS-C-153	Cement, Bituminous, Plastic

Grading and Dressing Rules No. 15, March 15, 1956

MATERIALS4. ROOF INSULATION

Roof insulation shall be integrally treated and asphalt coated, rigid type insulation intended for use with built-up bitumen-bonded roofs. The composition and surface of the material shall be such that a thorough bond is effected to asphalt or pitch over 100% of the area to which it is applied, without permitting bitumen penetration that would reduce the bond to the material or insulating efficiency of the material.

Material shall be of the thickness shown on the drawings and shall conform to ASTM Designation: C208, Class C.

5. COAL-TAR PITCH

Coal-tar pitch shall conform to Federal Specification R-P-381, Type I, with a softening point within the range of 140 F to 150 F.

6. ASPHALT

Asphalt shall conform to Federal Specification SS-A-666, Type II, Grade 2, with a softening point within the range of 165 F to 190 F.

7. COAL-TAR-SATURATED ROOFING FELT

Felt for use where the built-up roofing to follow will be of coal-tar pitch shall be coal-tar-saturated roofing felt weighing at least 13 pounds per 100 square feet (commonly referred to as "15-pound felt") and conforming to Federal Specification HH-F-201.

8. ASPHALT-SATURATED ROOFING FELT

Felt for use where the built-up roofing to follow will be of asphalt shall be asphalt-saturated roofing felt weighing at least 13 pounds per 100 square feet (commonly referred to as "15-pound felt") and conforming to Federal Specification HH-F-191.

9. ROSIN-SIZED PAPER

Rosin-sized paper shall be rosin-sized building paper weighing not less than 5 pounds per 100 square feet.

10. LUMBER FOR INSULATION STOPS

Lumber for insulation stops shall be Douglas fir, "Standard" Grade as produced and graded under the Grading and Dressing Rules of the West Coast Lumber Inspection Bureau.

11. NAILS AND BOLTS

- a. Nails for securing insulation, rosin-sized paper, and roofing felts to deck shall be 10 gage, flat-headed, hot-dipped galvanized nails of proper length to insure minimum 3/4-inch penetration into roof decking. Minimum diameter of nail head shall be 3/8 inch.
- b. Nails for securing insulation stops to deck shall be same as specified in a, above except that nail heads may be smaller than 3/8 inch.
- c. Bolts for securing insulation stops to metal parts of the structure shall be 1/4 inch diameter oval head bolts.

12. ROOFING CEMENT

Roofing cement shall conform to Federal Specification SS-C-153, Type I.

WORKMANSHIP13. STORAGE, HANDLING, AND PREPARATION OF MATERIALS

- a. All materials shall be kept clean and dry and shall be protected from the weather during storage and application. Insulation which has become damp or wet shall not be used.
- b. Rolls of felt shall be stored in upright position and shall be protected from damage during storage and application.
- c. Extreme care shall be used to control the temperature of pitch and asphalt during heating. Any evidence that a batch has been overheated shall be cause for rejection of the entire batch. A spear type thermometer shall be provided and it shall be used by the kettleman to maintain pitch and asphalt temperatures within the specified limits.
- d. Pitch shall not be heated above 375 F. Temperature of pitch when applied shall be not less than 300 F.
- e. Asphalt shall not be heated above 425 F. Temperature of asphalt when applied shall be not less than 350 F.

- f. Pitch and asphalt shall not be adulterated in any way.
- g. Leaky containers shall not be used for handling pitch, asphalt or roofing cement. If such materials are spilled or spattered on permanently exposed surfaces of structures, the material shall be completely removed.
- h. Material handling dollies and other wheeled equipment used on new or existing roofs shall be equipped with low-pressure pneumatic tires.
- i. Materials and/or equipment shall not be used on, stored on, or transported over existing or new roofs unless protection is provided to prevent damaging or overloading the roof deck, built-up roofing components and the structural system.
- j. All roofing materials shall be delivered to the jobsite in their original sealed packages or containers with the manufacturer's label intact showing name and grade of material.

#### 14. SURFACE PREPARATION

- a. All surfaces to receive roofing materials shall be completely dry and free from dirt, dust, loose material, and frost, or effects of freezing. Surfaces shall be swept clean prior to applying materials.
- b. All open joints, knot holes, and voids in the roof deck over 1/2 inch in least dimension shall be covered with minimum 26-gage galvanized sheet metal securely nailed to the deck.
- c. Wood insulation stops of the same thickness as the insulation shall be installed where sheet metal roof flanges are to be installed and at other locations as shown on the drawings. Stops shall be attached to the roof deck with nails and to metal parts of the structure with bolts. Nails shall penetrate roof deck a minimum of 3/4 inch and shall be spaced not more than 12 inches on centers. Bolts shall be spaced not more than 24 inches on centers.
- d. Roofing materials shall not be applied to the deck until the deck surfaces have been prepared in accordance with a, b and c, above, and approved by the Engineer.

#### 15. MINIMUM TEMPERATURES FOR APPLYING ROOFING MATERIALS

Roofing materials shall not be applied when the ambient temperature or the temperature of the roof deck is 40 F or lower.

## 16. APPLICATION OF VAPOR BARRIER

CAPE-1072-405

### 16.1 GENERAL

A vapor barrier shall be applied to the roof deck prior to placing roof insulation.

### 16.2 APPLICATION OF VAPOR BARRIER FOR COAL-TAR PITCH ROOFING

Vapor barriers for roof decks where the built-up roofing to follow will be of coal-tar materials shall be constructed as specified below:

- a. One layer of rosin-sized paper shall be laid over the roof deck and nailed sufficiently to hold in place. Ends and sides of sheets shall be lapped a minimum of 3 inches. Any holes or tears in the rosin-sized paper shall be patched with an additional layer of paper nailed in place.
- b. Two plies of 15-pound coal-tar-saturated felt shall be laid over the rosin-sized paper, lapping each ply 19 inches over the preceding ply and nailing sufficiently to hold in place. Ends of sheets shall be lapped a minimum of 6 inches. End laps shall be staggered at least 3 feet apart. Felt shall extend at least 8 inches beyond insulation stops to provide a flap for eventual mopping to the top surface of the insulation.
- c. Areas in vapor barrier felts damaged after installation shall be repaired with 2 plies of felt laid in a troweling of roofing cement and nailed in place before placing insulation. First ply of felt shall extend 3 inches beyond edges of damaged area. Second ply of felt shall extend 6 inches beyond edges of damaged area.
- d. Felt damaged in handling shall not be patched. The damaged area shall be cut out and laying of felt shall continue as though it were a new roll.
- e. Only that amount of vapor barrier shall be applied which can be covered with insulation and roofing on the same day the vapor barrier is applied.
- f. Where new vapor barrier joins an existing barrier, the joint shall be troweled with roofing cement.

### 16.3 APPLICATION OF VAPOR BARRIER FOR ASPHALT ROOFING

Vapor barriers for roof decks where the built-up roofing to follow will be of asphalt shall consist of one layer of rosin-sized paper and

2 plies of 15-pound asphalt-saturated felt. Application shall be as specified in Section 16.2, above, except for the change to asphalt-saturated felt from coal-tar-saturated felt.

17. LAYING INSULATION

- a. On roof decks to be covered with coal-tar pitch roofing, insulation shall be embedded in coal-tar pitch.
- b. On roof decks to be covered with asphalt roofing, insulation shall be embedded in asphalt.
- c. Insulation shall be embedded in a continuous mopping of hot bitumen, as specified in a. or b. above, applied to the vapor barrier felt at a minimum rate of 30 pounds per 100 square feet. Insulation shall be laid with long dimension joints continuous and short dimension joints broken.
- d. Each sheet of insulation shall be nailed to the deck with nails driven on 12-inch centers along the edges and through the middle of the sheet. Nails shall be proper length to penetrate into wood decking at least 3/4 inches, but shall not pierce the underside of the decking.
- e. End flaps of vapor barrier felts around the edges of the insulated area shall be turned back over the insulation and mopped solidly to the insulation.
- f. Joint between existing roofing and new insulation shall be troweled with roofing cement to form a sloping transition at least four inches wide.
- g. Water cut-off strips shall be provided at the first full insulation joint back from cants and roof penetrations and as required to provide unit-leak areas approximately 20 feet square or 400 square feet in area over the entire roof. Water cut-offs shall be 12-inch wide strips of 15-pound felt mopped solidly along a straight insulation joint. The strips shall have one edge mopped to the vapor barrier and the other edge mopped to the top of the insulation. Strips shall be installed to effectively isolate each unit-leak area.
- h. All insulation applied to the deck shall be completely covered and securely sealed with built-up roofing on the same day the insulation is applied. Where additional insulation is to be laid on succeeding shifts, the exposed edges of the insulation shall be sealed to the vapor barrier with 15-pound felt applied same as specified for water cut-off strips, to prevent the entry of water into or under the insulation.

- i. Insulation shall be adhered to the vapor barrier over 100% of the roof area, and all end flaps, water cut-off strips and strips for sealing edges of insulation between shifts shall be adhered over 100% of their area.

N O T I C E

Before using this specification see  
DI-6141-6149-S, "Instructions for Use  
of Hanford Standard Specifications for  
Built-Up Roofing, HWS-6141-S through  
HWS-6149-S", which is located in front  
of HWS-6141-S.

CAPE - 1072 - 409

409

HWS-6142-S

STANDARD SPECIFICATION

for

APPLYING INSULATION TO CONCRETE ROOF DECKS

Ref Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
1	General Revision	hes	4-22-60		hes	aee
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY. DATE 7-11-57				APPLYING INSULATION TO CONCRETE ROOF DECKS	HWS-6142-S	

## STANDARD SPECIFICATION

FOR

## APPLYING INSULATION TO CONCRETE ROOF DECKS

1. SCOPE

This specification covers the application of the insulation portion of a built-up roof to poured concrete and precast concrete roof decks with slopes up to 2 inches per foot.

2. IDENTIFICATION OF ENGINEER

The term "Engineer" refers to the representative of the user of the facility to which this specification applies.

3. REFERENCED PUBLICATIONS

The following publications apply to this specification to the extent indicated by subsequent references. References are by basic designation only; however, the complete designation, including the suffix indicating the year of edition, shall apply.

## a. American Society for Testing Materials (ASTM) Specification:

ASTM Designation: C208-57T, Structural Insulating Board Made from Vegetable Fibers.

## b. Federal Specifications:

R-P-381	Pitch; Coal-Tar (for) Mineral Surfaced Built-up Roofing, Waterproofing and Dampproofing
HH-F-191a	Felt; Asphalt-Saturated (for) Flashing, Roofing and Waterproofing
HH-F-201	Felt; Coal-Tar Saturated (for) Roofing and Waterproofing
SS-A-666	Asphalt (for) Built-Up Roofing, Waterproofing and Dampproofing
SS-A-701	Asphalt-Primer (for) Roofing and Waterproofing
SS-C-153	Cement, Bituminous, Plastic

## c. West Coast Lumber Inspection Bureau

Grading and Dressing Rules No. 15, March 15, 1956

MATERIALS4. ROOF INSULATION

Roof insulation shall be integrally treated and asphalt coated rigid type insulation intended for use with built-up bitumen-bonded roofs. The composition and surface of the material shall be such that a thorough bond is effected to asphalt or pitch over 100% of the area to which it is applied, without permitting bitumen penetration that would reduce the bond to the material or insulating efficiency of the material.

Material shall be of the thickness shown on the drawings and shall conform to ASTM Designation: C208, Class C.

5. COAL-TAR PITCH

Coal-tar pitch shall conform to Federal Specification R-P-381, Type I, with a softening point within the range of 140 F to 150 F.

6. ASPHALT

Asphalt shall conform to Federal Specification SS-A-666, Type II, Grade 2, with a softening point within the range of 165 F to 190 F.

7. COAL-TAR-SATURATED ROOFING FELT

Felt for use where built-up roofing to follow will be of coal-tar pitch shall be coal-tar-saturated roofing felt weighing at least 13 pounds per 100 square feet (commonly referred to as "15-pound felt") and conforming to Federal Specification HH-F-201.

8. ASPHALT-SATURATED ROOFING FELT

Felt for use where the built-up roofing to follow will be of asphalt shall be asphalt-saturated roofing felt weighing at least 13 pounds per 100 square feet (commonly referred to as "15-pound felt") and conforming to Federal Specification HH-F-191.

9. ASPHALT PRIMER

Asphalt primer shall conform to Federal Specification SS-A-701.

10. LUMBER FOR INSULATION STOPS

CAPE - 1072 - # 12

Lumber for insulation stops shall be Douglas fir, "Standard" Grade as produced and graded under the Grading and Dressing Rules of the West Coast Lumber Inspection Bureau.

11. FASTENERS FOR INSULATION STOPS

Fasteners for insulation stops shall be anchor bolts embedded in the concrete or other fasteners as shown on the drawings.

12. ROOFING CEMENT

Roofing cement shall conform to Federal Specification SS-C-153, Type I.

WORKMANSHIP

13. STORAGE, HANDLING AND PREPARATION OF MATERIALS

- a. All materials shall be kept clean and dry and shall be protected from the weather during storage and application. Insulation which has become damp or wet shall not be used.
- b. Rolls of felt shall be stored in upright position and shall be protected from damage during storage and application.
- c. Extreme care shall be used to control the temperature of pitch and asphalt during heating. Any evidence that a batch has been overheated shall be cause for rejection of the entire batch. A spear type thermometer shall be provided and it shall be used by the kettleman to maintain pitch and asphalt temperatures within the specified limits.
- d. Pitch shall not be heated above 375 F. Temperature of pitch when applied shall be not less than 300 F.
- e. Asphalt shall not be heated above 425 F. Temperature of asphalt when applied shall be not less than 350 F.
- f. Pitch and asphalt shall not be adulterated in any way.
- g. Leaky containers shall not be used for handling pitch, asphalt, roofing cement, or primer. If such materials are spilled or spattered on permanently exposed surfaces of structures, the material shall be completely removed.

- h. Material handling dollies and other wheeled equipment used on new and existing roofs shall be equipped with low-pressure pneumatic tires.
- i. Materials and/or equipment shall not be used on, stored on, or transported over existing or new roofs unless protection is provided to prevent damaging or overloading the roof deck, built-up roofing components and the structural system.
- j. All roofing materials shall be delivered to the jobsite in their original sealed packages or containers with the manufacturer's label intact showing name and grade of material.

#### 14. SURFACE PREPARATION

- a. All surfaces to receive roofing materials shall be completely dry and free from dirt, dust, loose material, and frost, or effects of freezing. Surfaces shall be swept clean prior to applying materials.
- b. Roofing materials shall not be applied to new poured concrete decks until 21 days after curing is completed.
- c. New concrete decks shall have had a minimum of 3 consecutive days of good drying weather immediately before roofing materials are applied.
- d. Wood insulation stops of the same thickness as the insulation shall be installed where sheet metal roof flanges are to be installed, and in other locations as shown on the drawings. Stops shall be attached to the roof deck or structure with anchor bolts or other devices as shown on the drawings, spaced not more than 4 feet on centers.
- e. On precast concrete slab decks, all joints between slabs shall be sealed and smoothed with a troweling of roofing cement.
- f. Roofing materials shall not be applied to the deck until the deck surfaces have been prepared in accordance with a. through e., above, and approved by the Engineer.

#### 15. MINIMUM TEMPERATURES FOR APPLYING ROOFING MATERIALS

Roofing materials shall not be applied when the ambient temperature or the temperature of the roof deck is 40 F or lower.

16. APPLICATION OF VAPOR BARRIER

CASE-1072-474

16.1 GENERAL

A vapor barrier shall be applied to the roof deck prior to placing roof insulation.

16.2 APPLICATION OF VAPOR BARRIER FOR COAL-TAR PITCH ROOFING

Vapor barriers for roof decks where the built-up roofing to follow will be of coal-tar pitch shall be constructed as specified below:

- a. Two plies of 15-pound coal-tar-saturated felt shall be applied to the deck with coal-tar pitch. On poured concrete decks, felt shall be embedded in a uniform solid mopping of coal-tar pitch. On precast concrete slab decks, felt shall be embedded in a uniform mopping of coal-tar pitch which shall be held back 4 inches from all joints between slabs.
- b. Each ply of felt shall be lapped 19 inches over the preceding ply and shall be mopped solidly to the preceding ply. At no place shall felt touch felt. Ends of sheets shall be lapped a minimum of six inches. End laps shall be staggered at least 3 feet apart. Felt shall extend at least 8 inches beyond insulation stops to provide a flap for eventual mopping to the top surface of the insulation. Vapor barrier shall be free from buckles, blisters, curled edges, and air pockets.
- c. Moppings of pitch shall be applied at the following minimum rates per 100 square feet of mopped area:

Between concrete and felt	30 pounds
Between felt plies	25 pounds
- d. Areas in vapor barrier felts damaged after installation shall be repaired with 2 plies of felt mopped in place. First ply of felt shall extend 3 inches beyond edges of damaged area. Second ply of felt shall extend 6 inches beyond edges of damaged area.
- e. Felt damaged in handling shall not be patched. The damaged area shall be cut out and laying of felt shall continue as though it were a new roll.
- f. Only that amount of vapor barrier shall be applied which can be covered with insulation and roofing on the same day the vapor barrier is applied.
- g. Where new vapor barrier joins an existing barrier, the joint shall be troweled with roofing cement.

- h. Vapor barrier shall be adhered to the deck over 100% of the mopped area and second ply shall be adhered to the first ply over 100% of the roof area. Patches shall be adhered over 100% of their area.

### 16.3 APPLICATION OF VAPOR BARRIER FOR ASPHALT ROOFING

Vapor barriers for roof decks where the built-up roofing to follow will be of asphalt shall be constructed as specified below:

- a. Poured concrete decks shall be coated uniformly with primer applied at a minimum rate of one gallon per 100 square feet.
- b. Precast concrete slab decks shall be coated with primer which shall be held back 4 inches from all joints between slabs. Primer shall be applied at a minimum rate of 1 gallon per 100 square feet of coated area.
- c. Primer shall be allowed to thoroughly dry before applying asphalt to the deck.
- d. Two plies of 15-pound asphalt-saturated felt shall be applied to the deck with asphalt. Application shall be as specified in Section 16.2 above, except for the change to asphalt products in place of coal-tar products.

### 17. LAYING INSULATION

- a. On roof decks to be covered with coal-tar pitch roofing, insulation shall be embedded in coal-tar pitch.
- b. On roof decks to be covered with asphalt roofing, insulation shall be embedded in asphalt.
- c. Insulation shall be embedded in a continuous mopping of hot bitumen, as specified in a. or b. above, applied to the vapor barrier felt, at a minimum rate of 30 pounds per 100 square feet. Insulation shall be laid with long dimension joints continuous and short dimension joints broken.
- d. End flaps of vapor barrier felts around the edges of the insulated area shall be turned back over the insulation and mopped solidly to the insulation.
- e. Joint between existing roofing and new insulation shall be troweled with roofing cement to form a sloping transition at least four inches wide.

- f. Water cut-off strips shall be provided at the first full insulation joint back from cants and roof penetrations, and as required to provide unit-leak areas approximately 20 feet square or 400 square feet in area over the entire roof. Water cut-offs shall be 12-inch wide strips of 15-pound felt mopped solidly along a straight insulation joint. The strips shall have one edge mopped to the vapor barrier and the other edge mopped to the top of the insulation. Strips shall be installed to effectively isolate each unit-leak area.
- g. All insulation applied to the deck shall be completely covered and securely sealed with built-up roofing on the same day the insulation is applied. Where additional insulation is to be laid on succeeding shifts, the exposed edges of the insulation shall be sealed to the vapor barrier with 15-pound felt applied same as specified for water cut-off strips, to prevent the entry of water into or under the insulation.
- h. Insulation shall be adhered to the vapor barrier over 100% of the roof area and all end flaps, water cut-off strips and strips for sealing edges of insulation between shifts shall be adhered over 100% of their area.

CAPE-1072-477

4.7

N O T I C E

Before using this specification see  
DI-6141-6149-S, "Instructions for Use  
of Hanford Standard Specifications for  
Built-Up Roofing, HWS-6141-S through  
HWS-6149-S", which is located in front  
of HWS-6141-S.

CAPE-1072-418

HWS-6143-S

STANDARD SPECIFICATION

FOR

APPLYING INSULATION TO STEEL ROOF DECKS

Ref Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM BY	DES. BY
1	General Revision	hes	4-22-60		hes	aee
APPROVED BY ENGINEERING STANDARDS COUNCIL H.E. Struck <small>SECRETARY</small> DATE 7-11-57				APPLYING INSULATION TO STEEL ROOF DECKS	HWS-6143-S	

STANDARD SPECIFICATION  
FOR  
APPLYING INSULATION TO STEEL ROOF DECKS

1. SCOPE

This specification covers the application of the insulation portion of a built-up roof to steel roof decks with slopes up to 1-1/2 inches per foot.

2. IDENTIFICATION OF ENGINEER

The term "Engineer" refers to the representative of the user of the facility to which this specification applies.

3. REFERENCED PUBLICATIONS

The following publications apply to this specification to the extent indicated by subsequent references. References are by basic designation only; however, the complete designation, including the suffix indicating the year of edition, shall apply.

a. American Society for Testing Materials (ASTM) Specification:

ASTM Designation: C208-57T, Structural Insulating Board Made  
from Vegetable Fibers

b. Federal Specifications:

HH-F-191a	Felt; Asphalt-Saturated (for) Flashing, Roofing and Waterproofing
HH-F-201	Felt; Coal-Tar Saturated (for) Roofing and Waterproofing

c. West Coast Lumber Inspection Bureau:

Grading and Dressing Rules No. 15, March 15, 1956

4. ROOF INSULATION

Roof insulation shall be integrally treated and asphalt coated rigid type insulation intended for use with built-up bitumen-bonded roofs. The composition and surface of the material shall be such that a thorough bond is effected to asphalt or pitch over 100 % of the area to which it is applied, without permitting bitumen penetration that would reduce the bond to the material or insulating efficiency of the material.

Material shall be of the thickness shown on the drawings and shall conform to ASTM Designation: C208, Class C.

5. ASPHALT-SATURATED ROOFING FELT

Felt for use where the built-up roofing to follow will be of asphalt shall be asphalt-saturated roofing felt weighing at least 13 pounds per 100 square feet (commonly referred to as "15-pound felt") and conforming to Federal Specification HH-F-191.

6. COAL-TAR-SATURATED ROOFING FELT

Felt for use where the built-up roofing to follow will be of coal-tar pitch shall be coal-tar-saturated roofing felt weighing at least 13 pounds per 100 square feet (commonly referred to as "15-pound felt") and conforming to Federal Specification HH-F-201.

7. PLASTIC SHEET VAPOR BARRIER

Vapor barrier shall consist of a vinyl plastic sheet of 0.004 inches minimum thickness cemented to roof deck. Plastic sheet and adhesive for applying the sheet to the deck, and for applying the insulation to the sheet shall be products specifically manufactured for use as vapor barrier material in built-up roofing. They shall be listed as having been tested and approved for use in built-up roofing by Factory Mutual Laboratories or Underwriter's Laboratories, Inc.

8. LUMBER FOR INSULATION STOPS

Lumber for insulation stops shall be Douglas fir, "Standard" Grade as produced and graded under the Grading and Dressing Rules of the West Coast Lumber Inspection Bureau.

9. FASTENERS FOR INSULATION STOPS

Fasteners for securing insulation stops to roof deck shall be No. 14 stove head sheet metal screws or 1/4 inch diameter oval head bolts of length to insure minimum penetration of 1/4 inch through the roof deck.

10. STORAGE, HANDLING AND PREPARATION OF MATERIALS

- a. All materials shall be kept clean and dry and shall be protected from weather during storage and application. Insulation which has become damp or wet shall not be used.
- b. Rolls of felt shall be stored in upright position and shall be protected from damage during storage and application.
- c. Leaky containers shall not be used for handling vapor barrier adhesive. If such material is spilled or spattered on permanently exposed surfaces of structures, the material shall be completely removed.
- d. Material handling dollies and other wheeled equipment used on new or existing roofs shall be equipped with low-pressure pneumatic tires.
- e. Materials and/or equipment shall not be used on, stored on, or transported over existing or new roofs unless protection required to prevent damaging or overloading the roof deck, built-up roofing components and the structural system, is provided.
- f. All roofing materials shall be delivered to the jobsite in their original sealed packages or containers with the manufacturer's label intact showing name and grade of material.

11. SURFACE PREPARATION

- a. All surfaces to receive roofing materials shall be completely dry, and free from dirt, dust, loose materials, and frost, or effects of freezing. Surfaces shall be swept clean prior to applying materials.
- b. Wood insulation stops of the same thickness as the insulation shall be installed where sheet metal roof flanges are to be installed, and at other locations as shown on the drawings. For deck slopes from 1 to 1-1/2 inches per foot, additional 3 inch minimum width insulation stops shall be installed across the slope of the deck with approximately 4 feet clear between stops. Stops shall be attached to the steel roof deck with stove head sheet metal screws or oval head bolts spaced not more than 24 inches on centers.

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- c. Roofing materials shall not be applied to the deck until the deck surfaces have been prepared in accordance with a, and b, above and approved by the Engineer.

## 12. MINIMUM TEMPERATURES FOR APPLYING ROOFING MATERIALS

Roofing materials shall not be applied when the ambient temperature or the temperature of the roof deck is 40 F or lower.

## 13. APPLICATION OF PLASTIC SHEET VAPOR BARRIER

A plastic sheet vapor barrier shall be applied to the roof deck prior to placing insulation, as specified below:

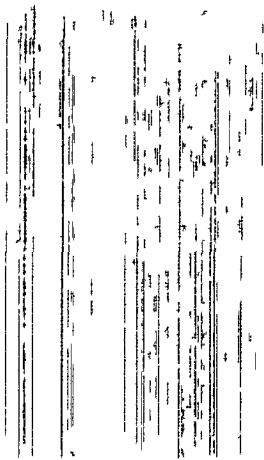
- a. Plastic sheet vapor barrier shall be applied in conformance with the application specifications of the manufacturer, for adhesive application.
- b. Vapor barrier shall be cemented to the roof deck in a continuous coating of vapor barrier adhesive using not less than 5 pounds per 100 square feet.
- c. Barrier shall extend at least 8 inches beyond insulation stops to provide a flap for eventual cementing to the top surface of the insulation. Plastic sheet shall be applied parallel to the flutes in the steel decking. Sides shall be lapped a minimum of 2". Side laps shall be made on top of flutes and not over voids. Ends shall be lapped a minimum of 6". End laps shall receive special attention to insure that laps are sealed over voids in decking.
- d. All holes and damaged areas in vapor barrier shall be patched with a layer of vapor barrier material set in a continuous coating of vapor barrier adhesive. Patch shall extend a minimum of 2 inches beyond edges of damaged area.
- e. Only that amount of vapor barrier shall be applied which can be covered with insulation and roofing on the same day the vapor barrier is applied.
- f. Where new vapor barrier joins an existing barrier, the joint shall be troweled with roofing cement.
- g. Vapor barrier shall be adhered to the deck over 100% of the roof area, and all laps and patches shall be adhered over 100% of their area.

14. LAYING INSULATION 463

Insulation shall be laid over plastic sheet vapor barrier as specified below:

- a. Roof insulation shall be cemented to the vapor barrier with 1/4 inch diameter ribbons of vapor barrier adhesive spaced not more than 6 inches apart and using not less than 5 pounds of adhesive per 100 square feet. Insulation shall be immediately embedded in the adhesive and firmly pressed down.
- b. Insulation shall be laid with long dimension joints continuous and with short dimension joints broken. Edges of insulation shall bear on or across flutes in steel decking. Edges parallel to flutes shall not extend over the voids in decking.
- c. End flaps of vapor barrier at insulation stops shall be turned back over and cemented continuously to insulation with vapor barrier adhesive.
- d. To protect the plastic vapor barrier material from hot moppings of pitch or asphalt, the exposed surface of end flaps at insulation stops shall be covered with 15-pound felt continuously cemented to the flaps with vapor barrier adhesive. For asphalt roofs, asphalt-saturated felt shall be used. For coal-tar roofs, coal-tar-saturated felt shall be used.
- e. Joint between existing roofing and new insulation shall be troweled with roofing cement to form a sloping transition at least four inches wide.
- f. Water cut-off strips shall be provided at the first full insulation joint back from eaves and roof penetrations and as required to provide unit-leak areas approximately 20 feet square or 400 square feet in area over the entire roof. Water cut-offs shall be 12-inch wide strips of 15-pound felt cemented continuously along a straight insulation joint. For asphalt roofs, asphalt-saturated felt shall be used. For coal-tar roofs, coal-tar-saturated felt shall be used. The strips shall be cemented to the vapor barrier and to the top of the insulation. Strips shall be installed to effectively isolate each unit-leak area.

- g. All insulation applied to the deck shall be completely covered with built-up roofing on the same day the insulation is applied. Where additional insulation is to be laid on succeeding shifts, the exposed edges of the insulation shall be sealed to the vapor barrier with 12-inch wide strips of vapor barrier material and vapor barrier cement applied same as specified for water cut-off strips, to prevent the entry of water into or under the insulation.
- h. Insulation shall be adhered to the vapor barrier over 100% of the cemented area, and all end flaps, water cut-off strips, protective felt strips and strips for sealing edges of insulation between shifts shall be adhered over 100% of their area.



N O T I C E

Before using this specification see  
DI-6141-6149-S, "Instructions for Use  
of Hanford Standard Specifications for  
Built-Up Roofing, HWS-6141-S through  
HWS-6149-S", which is located in front  
of HWS-6141-S.

HWS-6143-S

STANDARD SPECIFICATION

FOR

APPLYING INSULATION TO STEEL ROOF DECKS

Ref Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
1	General Revision	hes	4-22-60		hes	aee
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY DATE 7-11-57				APPLYING INSULATION TO STEEL ROOF DECKS	HWS-6143-S	

## STANDARD SPECIFICATION

## FOR

## APPLYING INSULATION TO STEEL ROOF DECKS

1. SCOPE

This specification covers the application of the insulation portion of a built-up roof to steel roof decks with slopes up to 1-1/2 inches per foot.

2. IDENTIFICATION OF ENGINEER

The term "Engineer" refers to the representative of the user of the facility to which this specification applies.

3. REFERENCED PUBLICATIONS

The following publications apply to this specification to the extent indicated by subsequent references. References are by basic designation only; however, the complete designation, including the suffix indicating the year of edition, shall apply.

## a. American Society for Testing Materials (ASTM) Specification:

ASTM Designation: C208-57T, Structural Insulating Board Made from Vegetable Fibers

## b. Federal Specifications:

HH-F-191a	Felt; Asphalt-Saturated (for) Flashing, Roofing and Waterproofing
HH-F-201	Felt; Coal-Tar Saturated (for) Roofing and Waterproofing

## c. West Coast Lumber Inspection Bureau:

Grading and Dressing Rules No. 15, March 15, 1956

4. ROOF INSULATION

Roof insulation shall be integrally treated and asphalt coated rigid type insulation intended for use with built-up bitumen-bonded roofs. The composition and surface of the material shall be such that a thorough bond is effected to asphalt or pitch over 100 % of the area to which it is applied, without permitting bitumen penetration that would reduce the bond to the material or insulating efficiency of the material.

Material shall be of the thickness shown on the drawings and shall conform to ASTM Designation: C208, Class C.

5. ASPHALT-SATURATED ROOFING FELT

Felt for use where the built-up roofing to follow will be of asphalt shall be asphalt-saturated roofing felt weighing at least 13 pounds per 100 square feet (commonly referred to as "15-pound felt") and conforming to Federal Specification HH-F-191.

6. COAL-TAR-SATURATED ROOFING FELT

Felt for use where the built-up roofing to follow will be of coal-tar pitch shall be coal-tar-saturated roofing felt weighing at least 13 pounds per 100 square feet (commonly referred to as "15-pound felt") and conforming to Federal Specification HH-F-201.

7. PLASTIC SHEET VAPOR BARRIER

Vapor barrier shall consist of a vinyl plastic sheet of 0.004 inches minimum thickness cemented to roof deck. Plastic sheet and adhesive for applying the sheet to the deck, and for applying the insulation to the sheet shall be products specifically manufactured for use as vapor barrier material in built-up roofing. They shall be listed as having been tested and approved for use in built-up roofing by Factory Mutual Laboratories or Underwriter's Laboratories, Inc.

8. LUMBER FOR INSULATION STOPS

Lumber for insulation stops shall be Douglas fir, "Standard" Grade as produced and graded under the Grading and Dressing Rules of the West Coast Lumber Inspection Bureau.

9. FASTENERS FOR INSULATION STOPS

Fasteners for securing insulation stops to roof deck shall be No. 14 stove head sheet metal screws or 1/4 inch diameter oval head bolts of length to insure minimum penetration of 1/4 inch through the roof deck.

10. STORAGE, HANDLING AND PREPARATION OF MATERIALS

- a. All materials shall be kept clean and dry and shall be protected from weather during storage and application. Insulation which has become damp or wet shall not be used.
- b. Rolls of felt shall be stored in upright position and shall be protected from damage during storage and application.
- c. Leaky containers shall not be used for handling vapor barrier adhesive. If such material is spilled or spattered on permanently exposed surfaces of structures, the material shall be completely removed.
- d. Material handling dollies and other wheeled equipment used on new or existing roofs shall be equipped with low-pressure pneumatic tires.
- e. Materials and/or equipment shall not be used on, stored on, or transported over existing or new roofs unless protection required to prevent damaging or overloading the roof deck, built-up roofing components and the structural system, is provided.
- f. All roofing materials shall be delivered to the jobsite in their original sealed packages or containers with the manufacturer's label intact showing name and grade of material.

11. SURFACE PREPARATION

- a. All surfaces to receive roofing materials shall be completely dry, and free from dirt, dust, loose materials, and frost, or effects of freezing. Surfaces shall be swept clean prior to applying materials.
- b. Wood insulation stops of the same thickness as the insulation shall be installed where sheet metal roof flanges are to be installed, and at other locations as shown on the drawings. For deck slopes from 1 to 1-1/2 inches per foot, additional 3 inch minimum width insulation stops shall be installed across the slope of the deck with approximately 4 feet clear between stops. Stops shall be attached to the steel roof deck with stove head sheet metal screws or oval head bolts spaced not more than 24 inches on centers.

- c. Roofing materials shall not be applied to the deck until the deck surfaces have been prepared in accordance with a, and b, above and approved by the Engineer.

## 12. MINIMUM TEMPERATURES FOR APPLYING ROOFING MATERIALS

Roofing materials shall not be applied when the ambient temperature or the temperature of the roof deck is 40 F or lower.

## 13. APPLICATION OF PLASTIC SHEET VAPOR BARRIER

A plastic sheet vapor barrier shall be applied to the roof deck prior to placing insulation, as specified below:

- a. Plastic sheet vapor barrier shall be applied in conformance with the application specifications of the manufacturer, for adhesive application.
- b. Vapor barrier shall be cemented to the roof deck in a continuous coating of vapor barrier adhesive using not less than 5 pounds per 100 square feet.
- c. Barrier shall extend at least 8 inches beyond insulation stops to provide a flap for eventual cementing to the top surface of the insulation. Plastic sheet shall be applied parallel to the flutes in the steel decking. Sides shall be lapped a minimum of 2". Side laps shall be made on top of flutes and not over voids. Ends shall be lapped a minimum of 6". End laps shall receive special attention to insure that laps are sealed over voids in decking.
- d. All holes and damaged areas in vapor barrier shall be patched with a layer of vapor barrier material set in a continuous coating of vapor barrier adhesive. Patch shall extend a minimum of 2 inches beyond edges of damaged area.
- e. Only that amount of vapor barrier shall be applied which can be covered with insulation and roofing on the same day the vapor barrier is applied.
- f. Where new vapor barrier joins an existing barrier, the joint shall be troweled with roofing cement.
- g. Vapor barrier shall be adhered to the deck over 100% of the roof area, and all laps and patches shall be adhered over 100% of their area.

14. LAYING INSULATION

Insulation shall be laid over plastic sheet vapor barrier as specified below:

- a. Roof insulation shall be cemented to the vapor barrier with 1/4 inch diameter ribbons of vapor barrier adhesive spaced not more than 6 inches apart and using not less than 5 pounds of adhesive per 100 square feet. Insulation shall be immediately embedded in the adhesive and firmly pressed down.
- b. Insulation shall be laid with long dimension joints continuous and with short dimension joints broken. Edges of insulation shall bear on or across flutes in steel decking. Edges parallel to flutes shall not extend over the voids in decking.
- c. End flaps of vapor barrier at insulation stops shall be turned back over and cemented continuously to insulation with vapor barrier adhesive.
- d. To protect the plastic vapor barrier material from hot moppings of pitch or asphalt, the exposed surface of end flaps at insulation stops shall be covered with 15-pound felt continuously cemented to the flaps with vapor barrier adhesive. For asphalt roofs, asphalt-saturated felt shall be used. For coal-tar roofs, coal-tar-saturated felt shall be used.
- e. Joint between existing roofing and new insulation shall be troweled with roofing cement to form a sloping transition at least four inches wide.
- f. Water cut-off strips shall be provided at the first full insulation joint back from cants and roof penetrations and as required to provide unit-leak areas approximately 20 feet square or 400 square feet in area over the entire roof. Water cut-offs shall be 12-inch wide strips of 15-pound felt cemented continuously along a straight insulation joint. For asphalt roofs, asphalt-saturated felt shall be used. For coal-tar roofs, coal-tar-saturated felt shall be used. The strips shall be cemented to the vapor barrier and to the top of the insulation. Strips shall be installed to effectively isolate each unit-leak area.

- g. All insulation applied to the deck shall be completely covered with built-up roofing on the same day the insulation is applied. Where additional insulation is to be laid on succeeding shifts, the exposed edges of the insulation shall be sealed to the vapor barrier with 12-inch wide strips of vapor barrier material and vapor barrier cement applied same as specified for water cut-off strips, to prevent the entry of water into or under the insulation.
- h. Insulation shall be adhered to the vapor barrier over 100% of the cemented area, and all end flaps, water cut-off strips, protective felt strips and strips for sealing edges of insulation between shifts shall be adhered over 100% of their area.

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N O T I C E

Before using this specification see  
DI-6141-6149-S, "Instructions for Use  
of Hanford Standard Specifications for  
Built-Up Roofing, HWS-6141-S through  
HWS-6149-S", which is located in front  
of HWS-6141-S.

CAPE-1072- 434

HWS-6144-S

STANDARD SPECIFICATION

for

BUILT-UP GRAVEL SURFACED COAL-TAR ROOFS

on

WOOD DECKS

Ref Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD		SUBM. BY	DES. BY
3	Page 3	hes	12-4-61	BUILT-UP GRAVEL SURFACED COAL-TAR ROOFS ON WOOD DECKS		hes	aee
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 7-11-57						HWS-6144-S	

STANDARD SPECIFICATION  
FOR  
BUILT-UP GRAVEL SURFACED COAL-TAR ROOFS  
ON  
WOOD DECKS

1. SCOPE

This specification covers the construction of built-up gravel surfaced coal-tar pitch roofs on uninsulated wood roof decks with slopes of 1/2 inch per foot and less.

2. IDENTIFICATION OF ENGINEER

The term "Engineer" refers to the representative of the user of the facility to which this specification applies.

3. REFERENCED PUBLICATIONS

The following publications apply to this specification to the extent indicated by subsequent references. References are by basic designation only; however, the complete designation, including the suffix indicating the year of edition, shall apply.

a. American Society for Testing Materials (ASTM) Specification:

ASTM Designation: D517-50, Asphalt Plank

b. Federal Specifications:

R-P-381	Pitch; Coal-Tar (for) Mineral Surfaced Built-up Roofing, Waterproofing and Dampproofing
HH-F-201	Felt; Coal-Tar Saturated (for) Roofing and Waterproofing
QQ-C-576a	Copper Plates, Rolled Bars, Sheet, and Strips
QQ-S-775a	Steel, Sheets, Carbon, Zinc Coated
SS-C-153	Cement, Bituminous, Plastic
SS-R-521	Roofing and Shingles; Asphalt-Prepared, Mineral-Surfaced

4. COAL-TAR PITCH

Coal-tar pitch shall conform to Federal Specification R-P-381, Type I, with a softening point within the range of 140 F to 150 F.

5. COAL-TAR-SATURATED ROOFING FELT

Felt shall be coal-tar-saturated roofing felt weighing at least 13 pounds per 100 square feet (commonly referred to as "15-pound felt") and conforming to Federal Specification HH-F-201.

6. MINERAL SURFACED ROOFING

Mineral surfaced roofing for base flashing shall be asphalt-saturated felt surfaced with mineral granules and weighing at least 83 pounds per 100 square feet (referred to as "90-pound roofing") with 2 or 4-inch base edge lap. Material shall conform to Federal Specification SS-R-521, Type I.

7. ROOFING CEMENT

Roofing cement shall conform to Federal Specification SS-C-153, Type I or II.

8. ROOFING GRAVEL

- a. Roofing gravel shall consist of hard, rounded stones free from sand, clay, dust or any other foreign matter. Crushed stone or crushed gravel shall not be used.
- b. Gravel shall have a size range of 5/8 inch minus to 1/4 inch plus. All gravel shall be within these limits with the largest proportion in the 3/8 inch to 1/2 inch sizes.
- c. Gravel removed from existing roofs shall not be reused.

9. ROSIN-SIZED PAPER

Rosin-sized paper shall be rosin-sized building paper weighing not less than 5 pounds per 100 square feet.

10. ASPHALT PLANK

Asphalt plank for walkways shall be one inch thick by 8 inches wide plain asphalt plank conforming to ASTM Designation: D517.

11. METAL FLASHING AND GRAVEL STOPS

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- a. Metal flashing and gravel stops shall be fabricated as shown on the drawings.
- b. Galvanized sheet metal shall conform to Federal Specification QQ-S-775, Type I, Class d.
- c. Copper shall conform to Federal Specification QQ-C-576, light cold-rolled temper.

12. NAILS, SCREWS AND DISCS

- a. Roofing nails shall be one inch long, 10 gage, hot-dipped galvanized roofing nails with heads not less than 3/8 inch in diameter.
- b. Tin discs for use with roofing nails shall have a minimum diameter of one inch. Where nailing through tin discs is specified herein, the following are acceptable alternates: one-inch long, ring shank nails with one inch minimum diameter round head, or 15/16 inch minimum square head.
- c. Nails for attaching metal flashing shall be 1-1/2 inch long, 10 gage, hot-dipped galvanized nails.
- d. Screws for attaching metal flashing shall be No. 8, one inch long, zinc or cadmium plated, stove head sheet metal screws.

WORKMANSHIP

13. STORAGE, HANDLING, AND PREPARATION OF MATERIALS

- a. All materials, including gravel, shall be kept clean and dry and shall be protected from the weather during storage and application.
- b. Rolls of felt shall be stored in upright position and shall be protected from damage during storage and application.
- c. Gravel shall not be stockpiled on unprotected felt surfaces. Roofing shall be graveled or glazed prior to stockpiling gravel.
- d. Extreme care shall be used to control the temperature of the pitch during heating. Any evidence that a batch has been overheated shall be cause for rejection of that batch. A spear type thermometer shall be provided and it shall be used by the kettleman to maintain pitch temperatures within the specified limits.

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- e. Pitch shall not be heated above 375 F. Temperature of pitch when applied shall be not less than 300 F.
- f. Pitch shall not be adulterated in any way.
- g. Leaky containers shall not be used for handling pitch or roofing cement. If such materials are spilled or spattered on permanently exposed surfaces of structures, the material shall be completely removed.
- h. Material handling dollies and other wheeled equipment used on new or existing roofs shall be equipped with low-pressure pneumatic tires.
- i. Materials and/or equipment shall not be used on, stored on, or transported over existing or new roofs unless protection required to prevent damaging or overloading the roof deck, built-up roofing components and the structural system, is provided.
- j. All roofing materials shall be delivered to the jobsite in their original sealed packages or containers with the manufacturer's label intact showing name and grade of material.

#### 14. SURFACE PREPARATION

- a. All surfaces to receive roofing materials shall be completely dry and free from dirt, dust, loose material, and frost, or effects of freezing. Surfaces shall be swept clean prior to applying roofing materials.
- b. All open joints, knot holes, and voids in the roof deck over 1/2 inch in least dimension shall be covered with minimum 26 gage galvanized sheet metal securely nailed to the deck.
- c. If new roofing is to be joined to an existing graveled roof, all gravel shall be removed from the existing roof for a minimum of 42 inches back from the joint. The joint between new deck and existing roofing shall be troweled with roofing cement to form a sloping transition at least 4 inches wide.
- d. Existing metal flashing and gravel stops in the area to receive roofing shall be removed and preserved for reinstallation after roofing materials are in place, unless shown otherwise on the drawings.
- e. Cant strips at least 3-1/2 inches high shall be installed in the intersection of all vertical surfaces with the roof deck. If larger cant strips are shown on the drawings, the larger cant strips shall be installed.

- f. A one-inch cant of roofing cement shall be applied around all roof penetrations prior to mopping the first ply of felt.
- g. Roofing materials shall not be applied to the deck until the deck surfaces have been prepared in accordance with a. through f., above, and approved by the Engineer.

15. MINIMUM TEMPERATURES FOR APPLYING ROOFING MATERIALS

Roofing materials shall not be applied when the ambient temperature or the temperature of the roof deck is 40 F or lower.

16. APPLICATION OF BUILT-UP ROOFING

- a. Roof shall be 20-year rating, 5-ply, built-up, graveled coal-tar pitch roof containing not less than the following quantities of roofing materials per 100 square feet:

Rosin-sized paper	5 pounds
Coal-tar-saturated felt	75 pounds
Coal-tar pitch	150 pounds
Gravel	400 pounds

- b. Roof shall be applied as follows:

- (1) One layer of rosin-sized paper shall be laid over the roof deck and nailed sufficiently to hold in place. Ends and sides of sheets shall be lapped a minimum of 3 inches. Any holes or tears in the rosin-sized paper shall be patched with an additional layer of paper nailed in place.

If new roofing joins existing roofing, the rosin-sized paper shall be inserted a minimum of three inches under the existing roof.

- (2) Two dry plies of 15-pound coal-tar-saturated felt shall be laid over the rosin-sized paper, lapping each ply 19 inches over the preceding ply. Each ply shall be nailed through tin discs on 9-inch centers not more than one inch from bottom (front) edge of the sheet. Ends of sheets shall be lapped a minimum of 6 inches. End laps shall be staggered at least 3 feet apart.

Dry plies shall extend 6 inches beyond edges of roof decks and 6 inches over roof penetrations to provide flaps for sealing ends and edges of plies. After all plies are in place, roofing shall be trimmed flush with the roof edges and penetrations and the flaps shall be turned back over and mopped to the top of the roofing.

All plies shall be laid parallel to the low edge of the deck starting at the low edge. Water shall flow over, not against, lap edges.

If new roofing joins existing roofing, the dry plies shall be inserted a minimum of 3 inches under the existing roofing. After dry plies have been inserted, edges of existing roofing shall be nailed through tin discs on 6-inch centers not more than 2 inches from the edge. The cut edge of roofing shall then be troweled with roofing cement to form a sloping transition at least four inches wide.

- (3) Three plies of 15-pound coal-tar-saturated felt shall be laid over the dry sheets lapping plies 24-2/3 inches and mopping full width underneath each sheet at a minimum rate of 25 pounds of pitch per ply per 100 square feet. At no place shall felt touch felt. The upper (back) edge of each sheet shall be nailed through tin discs on 9-inch centers approximately 2 inches from upper (back) edge. Ends of sheets shall be lapped a minimum of 6 inches. End laps shall be staggered at least 3 feet apart.

Felt damaged in handling shall not be patched. The damaged area shall be cut out and laying of felt shall continue as though it were a new roll.

At cants, all plies shall extend up wall or curb at least 2 inches above top of cant, and shall be trimmed evenly at this point.

All plies shall be free from buckles, blisters, curled edges, and air pockets.

- (4) Where new roofing joins existing roofing, 4 mopped plies shall extend over both sides of joint as follows:

1st ply - approximately 9 inches  
 2nd ply - approximately 18 inches  
 3rd ply - approximately 27 inches  
 4th ply - approximately 35 inches

- (5) All exposed felt shall be graveled as specified in (9) below or felt shall be glazed with a continuous mopping of pitch on the same day the felt is laid except that pitch shall not be applied where flashing and gravel stop roof flanges are to be installed. Precautions shall be taken at all times to prevent entry of water into or under the roof, such as at eaves, roof penetrations, and where flashing is to be installed.

- (6) Base flashing consisting of 4 plies of felt and 1 ply of mineral surfaced roofing shall be applied over all cants. All base flashing plies shall be trimmed evenly at a height such that metal counter-flashing overlaps the base flashing the full height of the counter-flashing.

First ply of flashing felt shall extend onto roof 3 inches beyond toe of cant; second ply shall extend 5 inches beyond toe of cant; third ply shall extend 7 inches beyond toe of cant; fourth ply shall extend 9 inches beyond toe of cant. Mineral surfaced roofing shall extend 12 inches beyond toe of cant. Each ply and the mineral surfaced roofing shall be set in a 1/8-inch thick continuous coating of roofing cement. Felt shall be applied in strips not over 10 feet long with staggered 3-inch end laps sealed with roofing cement. All plies shall be carefully pressed into cement to eliminate buckles and blisters. Mineral surfaced roofing shall be cut in strips across the roll. Salvage shall be troweled with roofing cement and overlapped by the next piece. Water shall flow over, not against, lap edges. Flashing shall be nailed to wood nailers, curbs, or walls through all plies along top edge using roofing nails and tin discs on 12-inch centers.

- (7) Metal cap flashing and gravel stops shall be installed in conformance with Section 17, Installation of Metal Flashing and Gravel Stops.
- (8) Asphalt plank walkways shall be installed where shown on the drawings. Each piece of plank shall be laid across the walkway and shall be set in a solid mopping of pitch leaving approximately 2 inches clear between adjacent pieces of plank. Gravel shall be applied to spaces between plank same as rest of roof. Top surfaces of plank shall not receive pitch or gravel.
- (9) One flood coat of not less than 75 pounds of pitch per 100 square feet shall be poured, not mopped, over the broom-clean, completely dry felt surface and not less than 400 pounds of completely dry gravel per 100 square feet shall be embedded in the hot pitch. Pitch and gravel shall extend over mineral surfaced base flashing to the toes of the cants.
- (10) The completed roof shall have the first mopped ply firmly adhered to the top dry ply and all mopped plies firmly adhered to each other over 100% of the roof area. All end flaps, flashing felts, asphalt plank and mineral surfaced roofing shall be adhered over 100% of their area.

17. INSTALLATION OF METAL FLASHING AND GRAVEL STOPS

- a. Metal roof flashing and gravel stops as shown on the drawings shall be applied after all built-up roofing plies are in place.
- b. All roof flanges shall be set in a coating of roofing cement. Roof flanges shall be nailed to the wood deck on 3-inch centers 3/4 inch from back edge of roof flange. In addition, gravel stop roof flanges shall be secured to deck with stove head sheet metal screws on maximum 24-inch centers. Gravel stop fascia shall be secured to building siding or structure with stove head sheet metal screws on maximum 36-inch centers or as shown on the drawings.
- c. Nail and screw heads in roof flanges shall be troweled with roofing cement.
- d. Joints in counterflashing over base flashing and in gravel stops shall be lapped 4 inches. Laps in gravel stops shall be sealed over the entire roof flange and gravel stop bead area with roofing cement. All excess roofing cement shall be carefully and completely removed from permanently exposed metal surfaces.
- e. Roof flanges shall be sealed to roof with two plies of coal-tar-saturated felt mopped solidly to roof and flanges with hot pitch. The first ply shall cover approximately half of the flange width and shall extend onto roof 3 inches beyond edge of flange. The second ply shall cover the full width of roof flange and shall extend onto roof 6 inches beyond edge of flange. At roof penetrations, a 1-inch cant of roofing cement shall be applied at the intersection of the penetration flashing and the sealing plies.
- f. Pitch pockets shall be completely filled with roofing cement.

CAPE-1072-443

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N O T I C E

Before using this specification see  
DI-6141-6149-S, "Instructions for Use  
of NAPO Standard Specifications for  
Built-Up Roofing, HWS-6141-S through  
HWS-6149-S", which is located in  
front of HWS-6141-S.

CAPE-1072-444

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HWS-6145-S

STANDARD SPECIFICATION

for

BUILT-UP GRAVEL SURFACED COAL-TAR ROOFS

on

CONCRETE DECKS

Ref Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
3	Page 3	hes	12-4-61		hes	aee
APPROVED BY ENGINEERING STANDARDS COUNCIL				BUILT-UP GRAVEL SURFACED	HWS-6145-S	
H. E. Struck SECRETARY, DATE 7-11-57				COAL-TAR ROOFS ON CONCRETE DECKS		

HWS-6145-S  
STANDARD SPECIFICATION  
FOR  
BUILT-UP GRAVEL SURFACED COAL-TAR ROOFS  
ON  
CONCRETE DECKS

CAPE-1072-445  
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1. SCOPE

This specification covers the construction of built-up gravel surfaced coal-tar pitch roofs on uninsulated poured concrete, pre-cast concrete slab and poured lightweight aggregate concrete decks with slopes of 1/2 inch per foot and less.

2. IDENTIFICATION OF ENGINEER

The term "Engineer" refers to the representative of the user of the facility to which this specification applies.

3. REFERENCED PUBLICATIONS

The following publications apply to this specification to the extent indicated by subsequent references. References are by basic designation only, however, the complete designation, including the suffix indicating the year of edition, shall apply.

a. American Society for Testing Materials (ASTM) Specification:

ASTM Designation: D517-50, Asphalt Plank

b. Federal Specifications:

R-P-381	Pitch; Coal-Tar (for) Mineral Surfaced Built-Up Roofing, Waterproofing and Dampproofing
HH-F-201	Felt; Coal-Tar Saturated (for) Roofing and Waterproofing
QQ-C-576a	Copper Plates, Rolled Bars, Sheet, and Strips
QQ-S-775a	Steel, Sheets, Carbon, Zinc Coated
SS-C-153	Cement, Bituminous, Plastic
SS-R-521	Roofing and Shingles; Asphalt-Prepared, Mineral-Surfaced

4. COAL-TAR PITCH

Coal-tar pitch shall conform to Federal Specification R-P-381, Type I, with a softening point within the range of 140 F to 150 F.

5. COAL-TAR-SATURATED ROOFING FELT

Felt shall be coal-tar-saturated roofing felt weighing at least 13 pounds per 100 square feet (commonly referred to as "15-pound felt") and shall conform to Federal Specification HH-F-201.

6. MINERAL SURFACED ROOFING

Mineral surfaced roofing for base flashing shall be asphalt-saturated felt surfaced with mineral granules and weighing at least 83 pounds per 100 square feet (referred to as "90-pound roofing") with a 2 or 4-inch base edge lap. Material shall conform to Federal Specification SS-R-521, Type I.

7. ROOFING CEMENT

Roofing cement shall conform to Federal Specification SS-C-153, Type I or II.

8. ROOFING GRAVEL

- a. Roofing gravel shall consist of hard, rounded stones free from sand, clay, dust or any other foreign matter. Crushed stone or crushed gravel shall not be used.
- b. Gravel shall have a size range of 5/8 inch minus to 1/4 inch plus. All gravel shall be within these limits with the largest proportion in the 3/8 inch to 1/2 inch sizes.
- c. Gravel removed from existing roofs shall not be reused.

9. ASPHALT PLANK

Asphalt plank for walkways shall be one inch thick by eight inches wide plain asphalt plank conforming to ASTM Designation: D517.

10. METAL FLASHING AND GRAVEL STOPS

- a. Metal flashing and gravel stops shall be fabricated as shown on the drawings.

- b. Galvanized sheet metal shall conform to Federal Specification QQ-S-775, Type I, Class d.
- c. Copper shall conform to Federal Specification QQ-C-576, light cold-rolled temper.

11. NAILS, SCREWS AND DISCS

- a. Nails for securing felt base flashing shall be one inch long, 10 gage, hot-dipped galvanized roofing nails with heads not less than 3/8 inch in diameter.
- b. Tin discs for use with roofing nails shall have a minimum diameter of one inch. Where nailing through tin discs is specified herein, the following are acceptable alternates: one-inch long, ring shank nails with one inch minimum diameter round head, or 15/16 inch minimum square head.
- c. Nails for attaching metal flashing shall be 1-1/2 inch long, 10 gage, hot-dipped galvanized nails.
- d. Screws for attaching metal flashing shall be No. 8, one inch long, zinc or cadmium plated, stove head sheet metal screws.

WORKMANSHIP

12. STORAGE, HANDLING AND PREPARATION OF MATERIALS

- a. All materials, including gravel, shall be kept clean and dry and shall be protected from the weather during storage and application.
- b. Rolls of felt shall be stored in upright position and shall be protected from damage during storage and application.
- c. Gravel shall not be stockpiled on unprotected felt surfaces. Roofing shall be graveled or glazed prior to stockpiling gravel.
- d. Extreme care shall be used to control the temperature of the pitch during heating. Any evidence that a batch has been overheated shall be cause for rejection of that batch. A spear type thermometer shall be provided and it shall be used by the kettleman to maintain pitch temperatures within the specified limits.
- e. Pitch shall not be heated above 375 F. Temperature of pitch when applied shall be not less than 300 F.
- f. Pitch shall not be adulterated in any way.

- g. Leaky containers shall not be used for handling pitch or roofing cement. If such materials are spilled or spattered on permanently exposed surfaces of structures, the material shall be completely removed.
- h. Material handling dollies and other wheeled equipment used on new or existing roofs shall be equipped with low-pressure pneumatic tires.
- i. Materials and/or equipment shall not be used on, stored on, or transported over new or existing roofs unless protection required to prevent damaging or overloading the roof deck, built-up roofing components and the structural system, is provided.
- j. All roofing materials shall be delivered to the jobsite in their original sealed packages or containers with the manufacturer's label intact showing name and grade of material.

### 13. SURFACE PREPARATION

- a. All surfaces to receive roofing materials shall be completely dry and free from dirt, loose material, dust, and frost, or effects of freezing. Surfaces shall be swept clean prior to applying roofing materials.
- b. Roofing materials shall not be applied to new concrete or new lightweight aggregate concrete decks until 21 days after curing is completed.
- c. New lightweight aggregate concrete decks shall have had a minimum of 10 consecutive days of good drying weather immediately before roofing materials are applied. New concrete decks shall have had a minimum of 3 consecutive days of good drying weather immediately before roofing materials are applied.
- d. If new roofing is to be joined to an existing graveled roof, all gravel shall be removed from the existing roof for a minimum of 42 inches back from the joint. The joint between new deck and existing roofing shall be troweled with roofing cement to form a sloping transition at least 4 inches wide.
- e. Existing metal flashing and gravel stops in the area to receive roofing shall be removed and preserved for reinstallation after roofing materials are in place, unless shown otherwise on the drawings.
- f. On pre-cast concrete slab decks all joints between slabs shall be troweled with roofing cement to seal joints and to eliminate unevenness. Where unevenness of deck is more than 1/8" at joints, roofing cement shall be applied to form a sloping transition 4" wide.

- g. Cant strips at least 3-1/2 inches high shall be installed in the intersection of all vertical surfaces with the roof deck. If larger cant strips are shown on the drawings, the larger cant strips shall be installed.
- h. A one-inch cant of roofing cement shall be applied around all roof penetrations prior to mopping the first ply of felt.
- i. Unless shown otherwise on the drawings, expansion joints in the deck shall be covered full length with a 6" wide strip of galvanized sheet metal, 26 gage minimum, centered over the joint. Splices in the metal strip shall be 3-inch overlaps sealed with roofing cement. On one side of the expansion joint this strip shall be bedded in a 1/8" thick coating of roofing cement; the other side shall be free.
- j. Roofing materials shall not be applied to the deck until the deck surfaces have been prepared in accordance with a, through i, above, and approved by the Engineer.

#### 14. MINIMUM TEMPERATURE FOR APPLYING ROOFING MATERIALS

Roofing materials shall not be applied when the ambient temperature or the temperature of the roof deck is 40 F or lower.

#### 15. APPLICATION OF BUILT-UP ROOFING

- a. Roof shall be 20 year rating, 4-ply, built-up, graveled coal-tar pitch roof containing not less than the following quantities of roofing materials per 100 square feet:

Coal-tar-saturated felt	60 pounds
Coal-tar pitch	180 pounds on poured concrete decks 170 pounds on precast slab decks 162 pounds on poured lightweight aggregate concrete decks
Gravel	400 pounds

- b. Roof shall be applied as follows: —

- (1) Two plies of minimum 12-inch wide 15-pound felt strips shall be laid in a coating of roofing cement four inches wide and nailed through tin discs on 12-inch centers to the nailing strip along edges of roof decks and roof penetrations before laying built-up plies, to provide 6-inch flap for sealing ends and edges of plies. After all plies are in place, roofing shall be trimmed flush with the roof edges and penetrations and the flaps shall be turned back over and mopped to the top of the roofing.

- (2) Four plies of coal-tar-saturated felt shall be laid shingle fashion lapping plies 27-1/2 inches. On poured concrete decks felt shall be embedded in a uniform solid mopping of coal-tar pitch applied at a minimum rate of 30 pounds per 100 square feet.

On poured lightweight aggregate concrete decks felt shall be spot-mopped to the deck with pitch applied at a minimum rate of 12 pounds per 100 square feet of roof area. Spots of pitch shall be applied in the pattern shown in Figure 1, below:

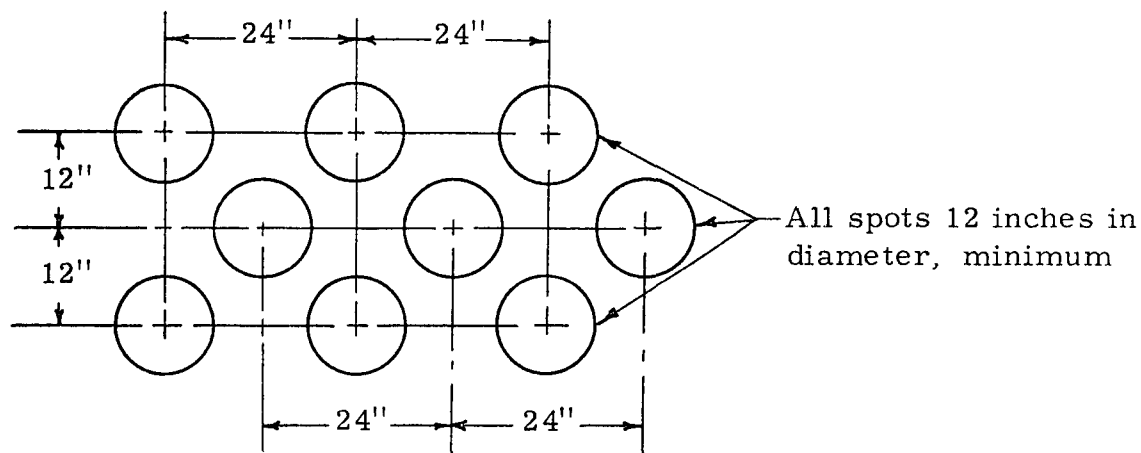


Figure 1 Spot Mopping

On precast slab decks, felt shall be embedded in a uniform solid mopping of pitch, approximately 20 pounds per 100 square feet of roof area (30 pounds per 100 square feet of mopped area, minimum), which shall be held back 4 inches from all joints between slabs.

At edges of roof deck and roof penetrations, pitch shall not be mopped to the bare deck closer than four inches to the edge. Each ply shall be solidly mopped to the preceding ply with pitch applied at a minimum rate of 25 pounds per 100 square feet. At no place shall felt touch felt. Ends of sheets shall be lapped a minimum of 6 inches. End laps shall be staggered at least 3 feet apart.

All plies shall be laid parallel to the low edge of the deck starting at the low edge. Water shall flow over, not against, lap edges.

Felt damaged in handling shall not be patched. The damaged area shall be cut out and laying of felt shall continue as though it were a new roll.

At cants, all plies shall extend up wall or curb at least 2 inches above top of cant and shall be trimmed evenly at this point.

All plies shall be free from buckles, blisters, curled edges, and air pockets.

- (3) Where new roofing joins existing roofing, 4 mopped plies shall extend over both sides of joint as follows:

1st ply - approximately 9 inches  
2nd ply - approximately 18 inches  
3rd ply - approximately 27 inches  
4th ply - approximately 35 inches

- (4) All exposed felt shall be graveled as specified in (8) below or felt shall be glazed with a continuous mopping of pitch on the same day the felt is laid except that pitch shall not be applied where flashing and gravel stop roof flanges are to be installed. Precautions shall be taken at all times to prevent entry of water into or under the roof, such as at eaves, roof penetrations, and where flashing is to be installed.

- (5) Base flashing consisting of 4 plies of felt and one ply of mineral surfaced roofing shall be applied over all cants. All base flashing plies shall be trimmed evenly at a height such that metal counterflashing overlaps the base flashing the full height of the counterflashing.

First ply of flashing felt shall extend onto roof 3 inches beyond toe of cant; second ply shall extend 5 inches beyond toe of cant; third ply shall extend 7 inches beyond toe of cant; fourth ply shall extend 9 inches beyond toe of cant. Mineral surfaced roofing shall extend 12 inches beyond toe of cant. Each ply and the mineral surfaced roofing shall be set in a 1/8-inch thick continuous coating of roofing cement. Felt shall be applied in strips not over 10 feet long with staggered 3-inch end laps sealed with roofing cement. All plies shall be carefully pressed into cement to eliminate buckles and blisters. Mineral surfaced roofing shall be cut in strips across the roll. Selvage shall be troweled with roofing cement and overlapped by the next piece. Water shall flow over, not against, lap edges. Flashing shall be nailed to the wood nailers, curbs, or walls through all plies along top edge using roofing nails and tin discs on 12-inch centers.

- (6) Metal cap flashing and gravel stops shall be installed in conformance with Section 16, Installation of Metal Flashing and Gravel Stops.

- (7) Asphalt plank walkways shall be installed where shown on the drawings. Each piece of plank shall be laid across the walkway and shall be set in a solid mopping of pitch leaving approximately 2 inches clear between adjacent pieces of plank. Gravel shall be applied to spaces between plank same as rest of roof. Top surfaces of plank shall not receive pitch or gravel.
- (8) One flood coat of not less than 75 pounds of pitch per 100 square feet shall be poured, not mopped, over the broom-clean, completely dry felt surface and not less than 400 pounds of completely dry gravel per 100 square feet shall be embedded in the hot pitch. Pitch and gravel shall extend over mineral surfaced base flashing to the toes of the cants.
- (9) The completed roof shall have all plies firmly adhered to the deck over 100% of the mopped areas and all plies firmly adhered to each other over 100% of the roof area. All end flaps, flashing felts, asphalt planks, and mineral surfaced roofing shall be adhered over 100% of their area.

#### 16. INSTALLATION OF METAL FLASHING AND GRAVEL STOPS

- a. Metal roof flashing and gravel stops as shown on the drawings shall be applied after all built-up roofing plies are in place.
- b. All roof flanges shall be set in a coating of roofing cement. Roof flanges shall be nailed to the wood nailers on 3-inch centers, 3/4 inch from back edge of roof flange. In addition, gravel stop roof flanges shall be secured to nailers with stove head sheet metal screws on maximum 24-inch centers. Gravel stop fascia shall be secured to building siding or structure with stove head sheet metal screws on maximum 36-inch centers, or as shown on the drawings.
- c. Nail and screw heads in roof flanges shall be troweled with roofing cement.
- d. Joints in counterflashing over base flashing and in gravel stops shall be lapped 4 inches. Laps in gravel stops shall be sealed over the entire roof flange and gravel stop bead area with roofing cement. All excess roofing cement shall be carefully and completely removed from permanently exposed metal surfaces.
- e. Roof flanges shall be sealed to roof with two plies of coal-tar-saturated felt mopped solidly to roof and flanges with hot pitch. The first ply shall cover approximately half the flange width and shall extend onto roof 3 inches beyond edge of flange. The

second ply shall cover the full width of roof flange and shall extend onto roof 6 inches beyond edge of flange. At roof penetrations, a 1-inch cant of roofing cement shall be applied at the intersection of the penetration flashing and the sealing plies.

- f. Pitch pockets shall be completely filled with roofing cement.

N O T I C E

Before using this specification see  
DI-6141-6149-S, "Instructions for Use  
of Hanford Standard Specifications for  
Built-Up Roofing, HWS-6141-S through  
HWS-6149-S", which is located in front  
of HWS-6141-S.

HWS-6146-S

STANDARD SPECIFICATION

for

BUILT-UP GRAVEL SURFACED COAL-TAR ROOFS

on

INSULATED DECKS

Ref Hanford Stds: None

NO	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
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APPROVED BY ENGINEERING STANDARDS COUNCIL				BUILT-UP GRAVEL SURFACED	HWS-6146-S	
H. E. Struck SECRETARY, DATE 7-11-57				COAL-TAR ROOFS ON INSULATED DECKS		

STANDARD SPECIFICATION  
FOR  
BUILT-UP GRAVEL SURFACED COAL-TAR ROOFS  
ON  
INSULATED DECKS

1. SCOPE

This specification covers the construction of built-up gravel surfaced coal-tar pitch roofs on insulated decks with slopes of 1/2 inch per foot and less.

2. IDENTIFICATION OF ENGINEER

The term "Engineer" refers to the representative of the user of the facility to which this specification applies.

3. REFERENCED PUBLICATIONS

The following publications apply to this specification to the extent indicated by subsequent references. References are by basic designation only; however, the complete designation, including the suffix indicating the year of edition, shall apply.

a. American Society for Testing Materials (ASTM) Specification:

ASTM Designation: D517-50, Asphalt Plank

b. Federal Specifications:

R-P-381 Pitch; Coal-Tar (for) Mineral Surfaced Built-Up Roofing, Waterproofing and Dampproofing

HH-F-201 Felt; Coal-Tar Saturated (for) Roofing and Waterproofing

QQ-C-576a Copper Plates, Rolled Bars, Sheet, and Strips

QQ-S-775a Steel, Sheets, Carbon, Zinc Coated

SS-C-153 Cement, Bituminous, Plastic

SS-R-521 Roofing and Shingles; Asphalt-Prepared, Mineral-Surfaced

Coal-tar pitch shall conform to Federal Specification R-P-381, Type I, with a softening point within the range of 140 F to 150 F.

5. COAL-TAR-SATURATED ROOFING FELT

Felt shall be coal-tar-saturated roofing felt weighing at least 13 pounds per 100 square feet (commonly referred to as "15-pound felt") and conforming to Federal Specification HH-F-201.

6. MINERAL SURFACED ROOFING

Mineral surfaced roofing for base flashing shall be asphalt-saturated felt surfaced with mineral granules and weighing at least 83 pounds per 100 square feet (referred to as "90-pound roofing") with 2 or 4-inch base edge lap. Material shall conform to Federal Specification SS-R-521, Type I.

7. ROOFING CEMENT

Roofing cement shall conform to Federal Specification SS-C-153, Type I or II.

8. ROOFING GRAVEL

- a. Roofing gravel shall consist of hard, rounded stones free from sand, clay, dust or any other foreign matter. Crushed stone or crushed gravel shall not be used.
- b. Gravel shall have a size range of 5/8 inch minus to 1/4 inch plus. All gravel shall be within these limits with the largest proportion in the 3/8 inch to 1/2 inch sizes.
- c. Gravel removed from existing roofs shall not be reused.

9. ASPHALT PLANK

Asphalt plank for walkways shall be one inch thick by eight inches wide plain asphalt plank conforming to ASTM Designation: D517.

10. METAL FLASHING AND GRAVEL STOPS

- a. Metal flashing and gravel stops shall be fabricated as shown on the drawings.

- b. Galvanized sheet metal shall conform to Federal Specification QQ-S-775, Type I, Class d.
- c. Copper shall conform to Federal Specification QQ-C-576, light cold-rolled temper.

11. NAILS, SCREWS AND DISCS

- a. Nails for securing felt base flashing shall be one inch long, 10 gage, hot-dipped galvanized roofing nails with heads not less than 3/8 inch in diameter.
- b. Tin discs for use with roofing nails shall have a minimum diameter of one inch. Where nailing through tin discs is specified herein, the following are acceptable alternates: one-inch long, ring shank nails with one inch minimum diameter round head, or 15/16 inch minimum square head.
- c. Nails for attaching metal flashing shall be 1-1/2 inch long, 10 gage, hot-dipped galvanized nails.
- d. Screws for attaching metal flashing shall be No. 8, one inch long, zinc or cadmium plated, stove head sheet metal screws.

WORKMANSHIP

12. STORAGE, HANDLING AND PREPARATION OF MATERIALS

- a. All materials, including gravel, shall be kept clean and dry and shall be protected from the weather during storage and application.
- b. Rolls of felt shall be stored in upright position and shall be protected from damage during storage and application.
- c. Gravel shall not be stockpiled on unprotected felt surfaces. Roofing shall be graveled or glazed prior to stockpiling gravel.
- d. Extreme care shall be used to control the temperature of the pitch during heating. Any evidence that a batch has been overheated shall be cause for rejection of that batch. A spear type thermometer shall be provided and it shall be used by the kettleman to maintain pitch temperatures within the specified limits.
- e. Pitch shall not be heated above 375 F. Temperature of pitch when applied shall be not less than 300 F.
- f. Pitch shall not be adulterated in any way.

- g. Leaky containers shall not be used for handling pitch or roofing cement. If such materials are spilled or spattered on permanently exposed surfaces of structures, the material shall be completely removed.
- h. Material handling dollies and other wheeled equipment used on new or existing roofs shall be equipped with low-pressure pneumatic tires.
- i. Materials and/or equipment shall not be used on, stored on, or transported over existing or new roofs unless protection required to prevent damaging or overloading the roof deck, built-up roofing components and the structural system, is provided.
- j. All roofing materials shall be delivered to the jobsite in their original sealed packages or containers with the manufacturer's label intact showing name and grade of material.

### 13. SURFACE PREPARATION

- a. All surfaces to receive roofing materials shall be completely dry and free from dirt, dust, loose material, and frost or effects of freezing. Surfaces shall be swept clean prior to applying roofing materials.
- b. If new roofing is to be joined to an existing graveled roof, all gravel shall be removed from the existing roof for a minimum of 42 inches back from the joint. The joint between new insulation and existing roofing shall be troweled with roofing cement to form a sloping transition at least 4 inches wide.
- c. Existing metal flashing and gravel stops in the area to receive roofing shall be removed and preserved for reinstallation after roofing materials are in place, unless shown otherwise on the drawings.
- d. Cant strips at least 3-1/2 inches high shall be installed in the intersection of all vertical surfaces with the roof deck. If larger cant strips are shown on the drawings, the larger cant strips shall be installed.
- e. A one-inch cant of roofing cement shall be applied around all roof penetrations prior to mopping the first ply of felt.
- f. Roofing materials shall not be applied to the deck until the deck surfaces have been prepared in accordance with a. through e., above, and approved by the Engineer.

14. MINIMUM TEMPERATURE FOR APPLYING ROOFING MATERIALS

Roofing materials shall not be applied when the ambient temperature or the temperature of the roof deck is 40 F or lower.

15. APPLICATION OF BUILT-UP ROOFING

- a. Roof shall be 20-year rating, 4-ply, built-up, graveled coal-tar pitch roof containing not less than the following quantities of roofing materials per 100 square feet:

Coal-tar-saturated felt	60 pounds
Coal-tar pitch	175 pounds
Gravel	400 pounds

- b. Roof shall be applied as follows:

- (1) Two plies of minimum 12-inch wide 15-pound felt strips shall be laid in a coating of roofing cement four inches wide and nailed through tin discs on 12-inch centers to the insulation stop along edges of roof decks and roof penetrations before laying built-up plies to provide 6-inch flap for sealing ends and edges of plies. After all plies are in place, roofing shall be trimmed flush with the roof edges and penetrations and the flaps shall be turned back over and mopped to the top of the roofing.
- (2) Four plies of coal-tar-saturated felt shall be laid shingle fashion lapping plies 27-1/2 inches. Felt shall be embedded in a uniform solid mopping of coal-tar pitch applied to the insulation. At edges of roof deck and roof penetrations, pitch shall not be mopped to the insulation closer than 4 inches to the edge. Each ply shall be solidly mopped to the preceding ply and to the insulation with pitch applied at a minimum rate of 25 pounds per 100 square feet. At no place shall felt touch felt. Ends of sheets shall be lapped a minimum of 6 inches. End laps shall be staggered at least 3 feet apart.

All plies shall be laid parallel to the low edge of the deck starting at the low edge. Water shall flow over, not against, lap edges.

Felt damaged in handling shall not be patched. The damaged area shall be cut out and laying of felt shall continue as though it were a new roll.

At cants, all plies shall extend up wall or curb at least 2 inches above top of cant and shall be trimmed evenly at this point.

All plies shall be free from buckles, blisters, curled edges and air pockets.

- (3) Where new roofing joins existing roofing, 4 mopped plies shall extend over both sides of joint as follows:

1st ply - approximately 9 inches  
 2nd ply - approximately 18 inches  
 3rd ply - approximately 27 inches  
 4th ply - approximately 35 inches

- (4) All exposed felt shall be graveled as specified in (8) below or felt shall be glazed with a continuous mopping of pitch on the same day the felt is laid except that pitch shall not be applied where flashing and gravel stop roof flanges are to be installed. Precautions shall be taken at all times to prevent entry of water into or under the roof, such as at eaves, roof penetrations, and where flashing is to be installed.

- (5) Base flashing consisting of 4 plies of felt and one ply of mineral surfaced roofing shall be applied over all cants. All base flashing plies shall be trimmed evenly at a height such that metal counterflashing overlaps the base flashing the full height of the counterflashing.

First ply of flashing felt shall extend onto roof 3 inches beyond toe of cant; second ply shall extend 5 inches beyond toe of cant; third ply shall extend 7 inches beyond toe of cant; fourth ply shall extend 9 inches beyond toe of cant. Mineral surfaced roofing shall extend 12 inches beyond toe of cant. Each ply and the mineral surfaced roofing shall be set in a 1/8-inch thick continuous coating of roofing cement. Felt shall be applied in strips not over 10 feet long with staggered 3-inch end laps sealed with roofing cement. All plies shall be carefully pressed into cement to eliminate buckles and blisters. Mineral surfaced roofing shall be cut in strips across the roll. Selvage shall be troweled with roofing cement and overlapped by the next piece. Water shall flow over, not against, lap edges. Flashing shall be nailed to wood nailers, curbs, or walls through all plies along top edge using roofing nails and tin discs on 12-inch centers.

- (6) Metal cap flashing and gravel stops shall be installed in conformance with Section 16, Installation of Metal Flashing and Gravel Stops.

- (7) Asphalt plank walkways shall be installed where shown on the drawings. Each piece of plank shall be laid across the walkway and shall be set in a solid mopping of pitch leaving

approximately 2 inches clear between adjacent pieces of plank. Gravel shall be applied to spaces between plank same as rest of roof. Top surfaces of plank shall not receive pitch or gravel.

(8). One flood coat of not less than 75 pounds of pitch per 100 square feet shall be poured, not mopped, over the broom-clean, completely dry felt surface and not less than 400 pounds of completely dry gravel per 100 square feet shall be embedded in the hot pitch. Pitch and gravel shall extend over mineral surfaced base flashing to the toes of the cants. 462

(9) The completed roof shall have all plies firmly adhered to the roof insulation and to each other over 100% of the roof area. All end flaps, flashing felts, asphalt plank, and mineral surfaced roofing shall be adhered over 100% of their area.

#### 16. INSTALLATION OF METAL FLASHING AND GRAVEL STOPS

- a. Metal roof flashing and gravel stops as shown on the drawings shall be applied after all built-up roofing plies are in place.
- b. All roof flanges shall be set in a coating of roofing cement. Roof flanges shall be nailed to the wood nailers on 3-inch centers, 3/4 inch from back edge of roof flange. In addition, gravel stop roof flanges shall be secured to insulation stops with stove head sheet metal screws on maximum 24-inch centers. Gravel stop fascia shall be secured to building siding or structure on maximum 36-inch centers, or as shown on the drawings.
- c. Nail and screw heads in roof flanges shall be troweled with roofing cement.
- d. Joints in counterflashing over base flashing and in gravel stops shall be lapped 4 inches. Laps in gravel stops shall be sealed over the entire roof flange and gravel stop head area with roofing cement. All excess roofing cement shall be carefully and completely removed from permanently exposed metal surfaces.
- e. Roof flanges shall be sealed to roof with two plies of coal-tar-saturated felt mopped solidly to roof and flanges with hot pitch. The first ply shall cover approximately half the flange width and shall extend onto roof 3 inches beyond edge of flange. The second ply shall cover the full width of roof flange and shall extend 6 inches beyond edge of flange. At roof penetrations, a 1-inch cant of roofing cement shall be applied at the intersection of the penetration flashing and the sealing plies.
- f. Pitch pockets shall be completely filled with roofing cement.

CAPE-1072-463

463

N O T I C E

Before using this specification see  
DI-6141-6149-S, "Instructions for Use  
of Hanford Standard Specifications for  
Built-Up Roofing, HWS-6141-S through  
HWS-6149-S", which is located in front  
of HWS-6141-S.

CAPE-1072-464

464

HWS-6147-S

STANDARD SPECIFICATION

for

BUILT-UP, SMOOTH AND GRAVEL SURFACED ASPHALT ROOFS

on

WOOD DECKS

Ref Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
3	Page 5	hes	12-4-61		hes	aee
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 7-11-57				BUILT-UP, SMOOTH AND GRAVELED ASPHALT ROOFS ON WOOD DECKS	HWS-6147-S	

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HWS-6147-S  
STANDARD SPECIFICATION **CAPE-1072**  
FOR  
BUILT-UP, SMOOTH AND GRAVEL SURFACED ASPHALT ROOFS  
ON WOOD DECKS

1. SCOPE

465

This specification covers the construction of built-up, smooth and gravel surfaced asphalt roofs on uninsulated wood roof decks with slopes up to 3 inches per foot. Roofs on deck slopes over 1/2 inch per foot may be smooth or gravel surfaced. Roofs on deck slopes 1/2 inch per foot and under are to be gravel surfaced.

2. IDENTIFICATION OF ENGINEER

The term "Engineer" refers to the representative of the user of the facility to which this specification applies.

3. REFERENCED PUBLICATIONS

The following publications apply to this specification to the extent indicated by subsequent references. References are by basic designation only; however, the complete designation, including the suffix indicating the year of edition, shall apply.

a. American Society for Testing Materials (ASTM) Specification:

ASTM Designation: D517-50, Asphalt Plank

b. Federal Specifications:

SS-R-00620 (GSA-FSS)	Roofing Felt, Glass Fiber, Asphalt-Saturated, Uncoated (For Flashing and Roofing)
HH-F-191a	Felt; Asphalt-Saturated (for) Flashing, Roofing and Waterproofing
QQ-C-576a	Copper Plates, Rolled Bars, Sheet, and Strips
QQ-S-775a	Steel, Sheets, Carbon, Zinc Coated
SS-A-666	Asphalt (for) Built-Up Roofing, Waterproofing and Dampproofing
SS-C-153	Cement, Bituminous, Plastic
SS-R-501a	Roofing, Prepared; Asphalt, Smooth-Surfaced
SS-R-521	Roofing and Shingles; Asphalt-Prepared, Mineral- Surfaced

c. Military Specification

MIL-R-3472      23 April    1951, Roof-Coating; Asphalt-Base Emulsion

d. Corps of Engineers Specification:

CE-220.01, 3 October 1956, Guide Specification for Military Construction Roofing; Built-Up, Asphalt and Tar; and Interim Information dated 17 January 1958.

MATERIALS

4. LOW MELT ASPHALT

Asphalt for roof slopes 1/2 inch per foot and under shall be Type A or B conforming to the Corps of Engineers Guide Specification CE 220.01 as extracted below. Prior to application of built-up roofing the Contractor shall furnish a certificate from the asphalt manufacturer stating that the asphalt conforms to the extracted portion of Specification CE 220.01.

Type	Test Method	A		B	
		Min	Max	Min	Max
Softening point (R&B) °F	ASTM D36	135	148	135	148
Ductility at 77F 5 cm/min, cm	ASTM D113	12		100	
Ductility at 40F, 0.25 cm/min, cm		3		---	
Penetration at 32F, 200g 60 sec	ASTM D5	10		5	
77F, 100g 5 sec		25	60	15	25
115F, 50g 5 sec		100		90	
Weight loss, 5 hrs, at 325F, %	ASTM D6		0.5		0.5
Penetration of residue at 77F, percent of original		85		75	
Bitumen soluble in CCl <sub>4</sub> , %	ASTM D165	99		99	
Bitumen insoluble in n-pentane, %	NBS RP-2577		30		30
Flow test at 120F, 5 hrs, cm	ASTM D1191	1	9	2	9
Modified					
1. Aluminum panel (6" x 2-3/4" x 0.064")					
2. 45° ± 1° inclination					
3. 120F ± 2°					
Spot test	AASHTO T102	Negative		Negative	
Susceptibility factor	Pen. at 115F - Pen. at 32F	2		5	
	Pen. at 77F				
Flash point, COC, °F	ASTM D92	425		425	

5. HIGH MELT ASPHALT

Asphalt for roof slopes over 1/2 inch per foot shall conform to Federal Specification SS-A-666, Type II, Grade 2, with a softening point within the range of 165 F to 190 F.

6. ASPHALT-SATURATED ROOFING FELT

Felt shall be asphalt-saturated roofing felt weighing not less than 13 pounds per 100 square feet (commonly referred to as "15-pound felt") and conforming to Federal Specification HH-F-191.

7. SPECIAL ROOFING SHEETS

Special roofing sheets shall be asphalt saturated and coated sheets conforming to Federal Specification SS-R-501, Class B, modified as follows:

Top surfacing shall be composed of an opaque, granular material equal to ilmenite in chemical inertness and opacity, said surfacing to be 15 lbs. minimum weight per 108 square feet. The total minimum weight requirements of the finished roofing shall be 50 lbs with weight of moisture-free desaturated felt and coating not less than 7.5 lbs (0.04 inch minimum thickness) and 11 lbs per 108 square feet, respectively, and a maximum of 25 lbs per 108 square feet of mineral retained on 100 mesh.

8. GLASS FIBER ROOFING SHEETS

Glass fiber roofing sheets shall be designed and manufactured for use in constructing built-up roofs and shall conform to Federal Specification SS-R-00620.

8.1 GLASS FIBER BASE SHEETS

Glass fiber base sheets shall be made of glass fibers reinforced with continuous glass yarns and shall be loaded with approximately 12 pounds of asphalt per 100 square feet. For use on wood decks, the base sheet shall be backed on one side with kraft paper.

8.2 GLASS FIBER PLY SHEETS

Glass fiber ply sheets shall be made of glass fibers reinforced with continuous glass yarns and shall be loaded with approximately 6 pounds of asphalt per 100 square feet.

9. ROSIN-SIZED PAPER

Rosin-sized paper shall be rosin-sized building paper weighing not less than 5 pounds per 100 square feet.

10. MINERAL SURFACED ROOFING

Mineral surfaced roofing for base flashing shall be asphalt-saturated felt, surfaced with mineral granules and weighing at least 83 pounds per 100 square feet (referred to as "90-pound roofing") with a 2 or 4-inch base edge lap. Material shall conform to Federal Specification SS-R-521, Type I.

11. ROOFING CEMENT

Roofing cement shall conform to Federal Specification SS-C-153, Type I.

12. ROOFING GRAVEL

- a. Roofing gravel shall consist of hard, rounded stones free from sand, clay, dust, or any other foreign matter. Crushed stone or crushed gravel shall not be used.
- b. Gravel shall have a size range of 5/8 inch minus to 1/4 inch plus. All gravel shall be within these limits with the largest proportion in the 3/8 inch to 1/2 inch sizes.
- c. Gravel removed from existing roofs shall not be reused.

13. ASPHALT PLANK

Asphalt plank for walkways shall be one inch thick by eight inches wide plain asphalt plank conforming to ASTM Designation: D517.

14. ASPHALT EMULSION

Asphalt emulsion shall be a stable, clay-type emulsion designed and manufactured for protective coating of built-up roofing. Emulsion shall conform to Military Specification MIL-R-3472, except that resistance to re-emulsification shall be determined as follows:

A 1/8 inch thick film of emulsion shall be applied to a minimum 2-inch by 2-inch area of a clean glass panel. The panel shall be dried in an oven at 110 F for 24 hours. To meet these specifications the emulsion film shall not disintegrate or re-emulsify when the test panel is submerged in a vertical position in distilled water at room temperature for 24 hours. The emulsion shall be considered not re-emulsifiable if the film maintains the adhesion to the glass panel without dropping of its own weight after 24 hours immersion and, if by slight rubbing with the fingers, the emulsion film does not disintegrate and become suspended in the distilled water. Slight surface stain or rusting of the emulsion film will not be considered re-emulsification.

15. REFLECTIVE ROOF COATINGS

- a. Reflective coating for application over hot-mopped asphalt coating shall be Flintkote Company No. 54 "Sta-Kool Aluminum", or approved equal.
- b. Reflective coating for application over asphalt emulsion coating shall be Flintkote Company "Rexkote"; or approved equal, white in color.

16. METAL FLASHING AND GRAVEL STOPS

CAF-1072-469

- a. Metal flashing and gravel stops shall be fabricated as shown on the drawings. 469
- b. Galvanized sheet metal shall conform to Federal Specification QQ-S-775, Type I, Class d.
- c. Copper shall conform to Federal Specification QQ-C-576, light cold-rolled temper.

17. NAILS, SCREWS AND DISCS

- a. Roofing nails shall be one inch long, 10 gage, hot-dipped galvanized roofing nails with heads not less than 3/8 inch in diameter.
- b. Tin discs for use with roofing nails shall have a minimum diameter of one inch. Where nailing through tin discs is specified herein, the following are acceptable alternates: one-inch long, ring shank nails with one inch minimum diameter round head, or 15/16 inch minimum square head.
- c. Nails for attaching metal flashing shall be 1-1/2 inch long, 10 gage, hot-dipped galvanized nails.
- d. Screws for attaching metal flashing shall be No. 8, one inch long, zinc or cadmium plated, stove head sheet metal screws.

WORKMANSHIP

18. STORAGE, HANDLING, AND PREPARATION OF MATERIALS

- a. All materials, including gravel, shall be kept clean and dry and shall be protected from the weather during storage and application.
- b. Rolls of felt shall be stored in upright position and shall be protected from damage during storage and application.
- c. Gravel shall not be stockpiled on unprotected felt surfaces. Roofing shall be graveled or glazed prior to stockpiling gravel.
- d. Special roofing sheets shall be cut into 12 to 18-foot lengths and shall be allowed to flatten in piles before using.
- e. Extreme care shall be used to control the temperature of the asphalt during heating. Any evidence that a batch has been overheated shall be cause for rejection of that batch. A spear type thermometer shall be provided and it shall be used by the kettleman to maintain asphalt temperatures within the specified limits.

- 470
- f. Asphalt shall not be heated above 425 F for high melt asphalt or 400 F for low melt asphalt. Temperature of asphalt when applied shall be not less than 350 F for high melt asphalt or 325 F for low melt asphalt.
  - g. Asphalt and asphalt emulsion shall not be adulterated in any way. Asphalt emulsion shall not be allowed to freeze.
  - h. Leaky containers shall not be used for handling asphalt, asphalt emulsion or roofing cement. If such materials are spilled or spattered on permanently exposed surfaces of structures, the material shall be completely removed.
  - i. Material handling dollies and other wheeled equipment used on new or existing roofs shall be equipped with low-pressure pneumatic tires.
  - j. Materials and/or equipment shall not be used on, stored on, or transported over existing or new roofs unless protection required to prevent damaging or overloading the roof deck, built-up roofing components and the structural system is provided.
  - k. All roofing materials shall be delivered to the jobsite in their original sealed packages or containers with the manufacturer's label intact showing name and grade of material.

#### 19. SURFACE PREPARATION

- a. All surfaces to receive roofing materials shall be completely dry and free from dirt, dust, loose materials, and frost, or effects of freezing. Surfaces shall be swept clean prior to applying roofing materials.
- b. All open joints, knot holes, **and** voids in the roof deck over 1/2 inch in least dimension shall be covered with minimum 26 gage galvanized sheet metal securely nailed to the deck.
- c. If new roofing is to be joined to an existing graveled roof, all gravel shall be removed from the existing roof for a minimum of 42 inches back from the joint.
- d. Existing metal flashing and gravel stops in the area to receive roofing shall be removed and preserved for reinstallation after roofing materials are in place, unless shown otherwise on the drawings.
- e. Cant strips at least 3-1/2 inches high shall be installed in the intersection of all vertical surfaces with the roof deck. If larger cant strips are shown on the drawings, the larger cant strips shall be installed.

- f. A one-inch cant of roofing cement shall be applied around all roof penetrations prior to mopping the first ply of felt.
- g. Roofing materials shall not be applied to the deck until the deck surfaces have been prepared in accordance with a. through f., above, and approved by the Engineer.

## 20. MINIMUM TEMPERATURES FOR APPLYING ROOFING MATERIALS

Roofing materials shall not be applied when the ambient temperature or the temperature of the roof deck is 40 F or lower.

## 21. APPLICATION OF SMOOTH SURFACED BUILT-UP ROOFING

Smooth surfaced roofs shall be constructed with high melt asphalt and special roofing sheets or glass fiber sheets as specified in Subsections 21.1 and 21.2 respectively.

### 21.1 SMOOTH SURFACED SPECIAL ROOFING SHEET ROOF

- a. Roof shall be a 3-layer, built-up, special roofing sheet roof with an asphalt emulsion coating. Roof shall contain not less than the following quantities of materials per 100 square feet:

Rosin-sized paper	5 pounds
Special roofing sheets, 3 @ 50 pounds	150 pounds
Asphalt	60 pounds
Asphalt emulsion	6 gallons

- b. Roof shall be applied as follows:

- (1) One layer of rosin-sized paper shall be laid over the roof deck and nailed sufficiently to hold in place. Ends and sides shall be lapped a minimum of 3 inches. Any holes or tears in the rosin-sized paper shall be patched with an additional layer of paper nailed in place.

If new roofing joins existing roofing, the rosin-sized paper shall be inserted a minimum of 3 inches under the existing roofing. Edges of existing roofing shall be nailed through tin discs on 6-inch centers not more than 2 inches from the edge. The edge shall then be troweled with roofing cement to form a sloping transition at least four inches wide.

- (2) Three layers of special roofing sheets shall be laid shingle fashion lapping layers 24-3/4 inches and mopping full width between layers with hot asphalt applied at a rate of 30 pounds per 100 square feet, minimum. At no place shall bare sheets touch each other. Sheets shall not be mopped to the rosin-sized paper. Ends of sheets shall be lapped at least 4 inches.

End laps shall be staggered at least 3 feet apart and shall be blind nailed through tin discs on 6-inch centers. Layers shall be nailed through tin discs on 6-inch centers and one inch from back (upper) edge.

Sheets shall be laid parallel to the low edge of the deck starting at the low edge. Water shall flow over, not against lap edges.

Sheets damaged in handling shall not be patched. The damaged sheet shall be discarded or the damaged area shall be cut out and laying of sheets shall continue as for a new sheet.

At cants, all layers shall extend up wall or curb to at least two inches above top of cant and shall be trimmed evenly at this point.

All layers shall be free from buckles, blisters, curled edges and air pockets.

- (3) Where new roofing joins existing roofing, 3 mopped layers of special roofing sheets shall extend over both sides of joint as follows:

1st layer - approximately 12 inches  
2nd layer - approximately 24 inches  
3rd layer - approximately 35 inches

- (4) Base flashing consisting of 4 plies of 15-pound asphalt-saturated roofing felt and one ply of mineral surfaced roofing shall be applied over all cants. All base flashing plies shall be trimmed evenly at a height such that metal counterflashing overlaps the base flashing the full height of the counterflashing.

First ply of flashing felt shall extend onto roof 3 inches beyond toe of cant; second ply shall extend 5 inches beyond toe of cant; third ply shall extend 7 inches beyond toe of cant; fourth ply shall extend 9 inches beyond toe of cant. Mineral surfaced roofing shall extend 12 inches beyond toe of cant. Each ply and the mineral surfaced roofing shall be set in a 1/8 inch thick continuous coating of roofing cement. Felt shall be applied in strips not over 10 feet long with staggered 3-inch laps sealed with roofing cement. All plies shall be carefully pressed into cement to eliminate buckles and blisters. Mineral surfaced roofing shall be cut in strips across the roll. Selvage shall be troweled with roofing cement and overlapped by the next piece. Water shall flow over, not against, lap edges. Flashing shall be nailed to tops of wood nailers, curbs, or walls through all plies along top edge using roofing nails and tin discs on 12-inch centers.

- (5) Metal cap flashing and roof edging shall be installed in conformance with Section 23, Installation of Metal Flashing, Gravel Stops, and Edging.
- (6) Asphalt plank walkways shall be installed where shown on the drawings. Each piece of plank shall be laid across the walkway and shall be set in a solid mopping of asphalt leaving approximately 2 inches clear between adjacent planks. Spaces

between planks shall be coated with asphalt emulsion same as rest of roof. Top surface of planks shall not receive emulsion coating.

- (7) All surfaces of the roof to the toes of cants shall be uniformly coated with two coats of asphalt emulsion applied at the rate of at least 3 gallons per 100 square feet per coat. Emulsion shall be applied in conformance with the emulsion manufacturer's recommendations. The first coat shall be allowed to dry for a minimum of 48 hours before the second coat is applied. If emulsion is sprayed, the final finish and spreading of each coat shall be accomplished by light brushing with a soft fiber brush.
- (8) The completed roof shall have all plies securely nailed to the deck as specified and all plies firmly adhered to each other over 100% of the roof area. All flashing felts, asphalt plank and mineral surfaced roofing shall be adhered over 100% of their area.

## 21.2 SMOOTH SURFACED GLASS FIBER SHEET ROOF

- a. Roof shall be a 4-ply, built-up, glass fiber sheet roof with asphalt coating. Roof shall contain not less than the following quantities of roofing materials per 100 square feet:

Rosin-sized paper	5 pounds
Base sheet, 1 ply	15 pounds
Ply sheets, 3 @ 8 pounds	24 pounds
Asphalt	115 pounds

- b. Roof shall be applied as follows:

- (1) One layer of rosin-sized paper shall be laid over the roof deck and nailed sufficiently to hold in place. Ends and sides shall be lapped a minimum of 3 inches. Any holes or tears in the rosin-sized paper shall be patched with an additional layer of paper nailed in place.
- (2) One ply of base sheet shall be laid over the rosin-sized paper and lapped a minimum of 2 inches at sides and 6 inches on ends. Base sheets shall be nailed through tin discs on 6-inch centers through the laps and on 12-inch centers along lines 12 inches from each edge.

If new roofing joins existing roofing, the rosin-sized paper and base sheet shall be inserted a minimum of 3 inches under the existing roofing. Edges of existing roofing shall be nailed through tin discs on 6-inch centers not more than 2 inches from the edge. The cut edge shall then be troweled with roofing cement

to form a sloping transition at least 4 inches wide. <sup>474</sup>

- (3) Three layers of ply sheets shall be laid shingle fashion lapping each ply 24-3/4 inches. End laps shall be 4 inches minimum and adjacent end laps shall be staggered at least 12 inches apart. Each ply shall be mopped full width underneath with a minimum of 30 pounds of asphalt per 100 square feet. Plies shall be laid parallel to the low edge of the deck starting at the low edge. Water shall flow over, not against, lap edges.

Sheets damaged in handling shall not be patched. The damaged area shall be cut out and the laying of the sheets shall continue as through it were a new roll.

At cants, all plies shall extend up walls or curbs at least 2 inches above top of cant and shall be trimmed evenly at this point.

All plies shall be free from buckles, blisters, curled edges and air pockets.

- (4) Where new roofing joins existing roofing, 4 mopped plies shall extend over both sides of joint as follows:

1st ply - approximately 9 inches  
2nd ply - approximately 18 inches  
3rd ply - approximately 27 inches  
4th ply - approximately 35 inches

- (5) All exposed ply sheets shall be glazed with a continuous mopping of asphalt on the same day the sheets are laid except that asphalt shall not be applied where flashing or edging roof flanges are to be installed. Precautions shall be taken at all times to prevent entry of water into or under the roof, such as at eaves, roof penetrations, and where flashing is to be installed.
- (6) Base flashing shall be installed as specified under Subsection 21.1 Item b. (4) except glass fiber ply sheets shall be substituted for asphalt-saturated roofing felt.
- (7) Metal flashing and roof edging shall be installed in conformance with Section 23, Installation of Metal Flashing, Gravel Stops, and Edging.
- (8) Asphalt plank walkways shall be installed where shown on the drawings. Each piece of plank shall be laid across the walkway and shall be set in a solid mopping of asphalt leaving approximately two inches clear between adjacent pieces of plank. Spaces between planks shall be coated with hot asphalt same as rest of roof. Top surface of planks shall not receive asphalt coating.

- (9) All surfaces of the roof to the toes of cants shall be coated with not less than 25 pounds of asphalt per 100 square feet.
- (10) The completed roof shall have the base sheet securely nailed to the deck as specified, all plies firmly adhered to the base sheet over 100% of the roof area and all plies firmly adhered to each other over 100% of the roof area. All flashing plies, asphalt plank and mineral surfaced roofing shall be adhered over 100% of their area.

## **22. APPLICATION OF GRAVEL SURFACED BUILT-UP ROOFING**

Gravel surfaced asphalt roofing shall be constructed with asphalt and roofing felt or glass fiber sheets as specified in Subsection 22.1 and 22.2 respectively.

High melt asphalt shall be used on roofs with slopes over 1/2 inch per foot. Low melt asphalt shall be used on roofs with slopes 1/2 inch per foot and under.

### **22.1 GRAVEL SURFACED, ASPHALT FELT ROOF**

- a. Roof shall be a 20-year rating, 5-ply, built-up, graveled asphalt roof containing not less than the following quantities of roofing materials per 100 square feet:

Rosin-sized paper	5 pounds
Asphalt-saturated felt	75 pounds
Asphalt	135 pounds
Gravel	400 pounds

- b. Roof shall be applied as follows:

- (1) One layer of rosin-sized paper shall be laid over the roof deck and nailed sufficiently to hold in place. Ends and sides of sheets shall be lapped a minimum of 3 inches. Any holes or tears in the rosin-sized paper shall be patched with an additional layer of paper nailed in place.

Where new roofing joins existing roofing, the rosin-sized paper shall be inserted a minimum of 3 inches under the existing roofing.

- (2) Two dry plies of 15-pound asphalt-saturated felt shall be laid over the rosin-sized paper, lapping each ply 19 inches over the preceding ply. Each ply shall be nailed through tin discs on 9-inch centers not more than one inch from bottom (front) edge of the sheet. Ends of sheets shall be lapped a minimum of 6 inches. End laps shall be staggered at least 3 feet apart.

On roofs constructed with low melt asphalt, dry plies shall extend 6 inches beyond edges of roof decks and 6 inches over roof penetrations to provide flaps for sealing ends and edges of plies. After all plies are in place, roofing shall be trimmed flush with the roof edges and penetrations and the flaps shall be turned back over and mopped to the top of the roofing.

All plies shall be laid parallel to the low edge of the deck starting at the low edge. Water shall flow over, not against, lap edges.

If new roofing joins existing roofing, the dry plies shall be inserted a minimum of 3 inches under the existing roofing. After dry plies have been inserted, edges of existing roofing shall be nailed through tin discs on 6-inch centers not more than 2 inches from the edge. The cut edge of roofing shall then be troweled with roofing cement to form a sloping transition at least four inches wide.

- (3) Three plies of 15-pound asphalt-saturated felt shall be laid over the dry sheets lapping plies 24-2/3 inches and mopping full width underneath each sheet at a minimum rate of 25 pounds of asphalt per ply per 100 square feet. At no place shall felt touch felt. The upper (back) edge of each sheet shall be nailed through tin discs on 9-inch centers approximately 2 inches from upper (back) edge. Ends of sheets shall be lapped a minimum of 6 inches. End laps shall be staggered at least 3 feet apart.

Felt damaged in handling shall not be patched. The damaged area shall be cut out and laying of felt shall continue as though it were a new roll.

At cants, all plies shall extend up wall or curb at least 2 inches above top of cant, and shall be trimmed evenly at this point.

All plies shall be free from buckles, blisters, curled edges and air pockets.

- (4) Where new roofing joins existing roofing, 4 mopped plies shall extend over both sides of joint as follows:

- 1st ply - approximately 9 inches
- 2nd ply - approximately 18 inches
- 3rd ply - approximately 27 inches
- 4th ply - approximately 35 inches

- (5) All exposed felt shall be graveled as specified in (9) below, or felt shall be glazed with a continuous mopping of asphalt on the same day the felt is laid except that asphalt shall not

be applied where flashing or gravel stop roof flanges are to be installed. Precautions shall be taken at all times to prevent entry of water into or under the roof, such as at eaves, roof penetrations, and where flashing is to be installed.

- (6) Base flashing shall be installed as specified in Subsection 21.1 Item b. (4) of this specification.
- (7) Metal cap flashing and gravel stops shall be installed in conformance with Section 23, Installation of Metal Flashing, Gravel Stops and Edging.
- (8) Asphalt plank walkways shall be installed where shown on the drawings. Each piece of plank shall be laid across the walkway and shall be set in a solid mopping of asphalt leaving approximately two inches clear between adjacent pieces of plank. Spaces between planks shall be graveled same as rest of roof. Top surface of planks shall not receive asphalt or gravel.
- (9) One flood coat of not less than 60 pounds of asphalt per 100 square feet shall be poured, not mopped, over the broom-clean, completely dry felt surface and not less than 400 pounds of completely dry gravel per 100 square feet shall be embedded in the hot asphalt. Asphalt and gravel shall extend over mineral surfaced base flashing to the toes of cants.
- (10) The completed roof shall have all plies securely nailed to the deck as specified and all mopped plies firmly adhered to each other over 100% of the roof area.

All end flaps, flashing felts, asphalt plank and mineral surfaced roofing shall be adhered over 100% of their area.

## 22.2 GRAVEL SURFACED GLASS FIBER SHEET ROOF

- a. Roof shall be a 20-year rating, 3-ply, built-up, glass fiber sheet roof with graveled surface. Roof shall contain not less than the following quantities of material per 100 square feet:

Rosin-sized paper	5 pounds
Base Sheet, 1 ply	15 pounds
Ply Sheets, 2 @8 pounds	16 pounds
Asphalt	120 pounds
Gravel	400 pounds

- b. Roof shall be applied as specified in Subsection 21.2 Item b. of this specification with the following changes:

- (1) Two ply sheets shall be laid instead of three. Lap shall be 19 inches.
- (2) On roofs constructed with low melt asphalt, two plies of minimum 12-inch wide 15-pound asphalt-saturated felt strips shall be installed along edges of roof decks and roof penetrations before laying built-up plies, to provide 6-inch flaps for sealing ends and edges of plies. Strips shall be laid in a 4-inch wide coating of roofing cement applied to the top of the base sheet, and nailed to the wood deck through tin discs on 12-inch centers. After all plies are in place, roofing shall be trimmed flush with the roof edges and penetrations and the flaps shall be turned back over and mopped to the top of the roofing.
- (3) The final surfacing, in place of a mopping of asphalt, shall consist of a flood coat of not less than 60 pounds of asphalt per 100 square feet, poured, not mopped, over the broom-clean, completely dry surface and not less than 400 pounds of completely dry gravel per 100 square feet embedded in the hot asphalt. Top surface of asphalt plank shall not receive asphalt coating or gravel.

### 23. INSTALLATION OF METAL FLASHING, GRAVEL STOPS, AND EDGING

- a. Metal roof flashing, gravel stops, and edging as shown on the drawings shall be applied after all built-up roofing plies are in place.
- b. All roof flanges shall be set in a coating of roofing cement. Roof flanges shall be nailed to the wood deck on 3-inch centers, 3/4 inches from back edge of roof flange. In addition, gravel stop roof flanges shall be secured to deck with stove head sheet metal screws on maximum 24-inch centers. Gravel stop or edging fascia shall be secured to building siding or structure with stove head sheet metal screws on maximum 36-inch centers, or as shown on the drawings.
- c. Nail and screw heads in roof flanges shall be troweled with roofing cement.
- d. Joints in counterflashing over base flashing and in gravel stops and edging shall be lapped 4 inches. Laps in gravel stops and roof edging shall be sealed over the entire roof flange and bead area with roofing cement. All excess roofing cement shall be carefully and completely removed from permanently exposed metal surfaces.
- e. Roof flanges shall be sealed to roof with two plies of the plying material used in the built-up roof, mopped solidly to roof and flanges with hot asphalt. The first ply shall cover approximately

half of the flange width and shall extend onto roof 3 inches beyond edge of flange. The second ply shall cover the full width of roof flange and shall extend onto roof 6 inches beyond edge of flange. At roof penetrations, a 1-inch cant of roofing cement shall be applied at the intersection of the penetration flashing and the sealing plies.

- f. Pitch pockets shall be completely filled with roofing cement.

## 24. APPLICATION OF REFLECTIVE ROOF COATINGS

When reflective coating is specified, the coating shall be applied in conformance with Subsection 24.1 or 24.2, as applicable.

### 24.1 COATING OVER HOT-MOPPED ASPHALT

- a. The hot-mopped asphalt coating shall be allowed to weather to a dull, oxidized finish, as determined by the Engineer, before any reflective coating is applied. In no case shall reflective coating be applied sooner than 90 days after mopped asphalt is applied.
- b. The aluminum reflective coating shall be applied uniformly over the roof surfaces at a rate of not less than 1 gallon of aluminum coating per 200 square feet.

### 24.2 COATING OVER ASPHALT EMULSION

- a. The asphalt emulsion roof coating shall be allowed to set until no pickup of material results from normal foot traffic. Reflective coating material shall not be applied until the emulsion surface has been approved for coating by the Engineer.
- b. The reflective coating shall be applied uniformly over the roof surface at a rate of not less than 2/3 gallons per 100 square feet.

N O T I C E

Before using this specification see  
DI-6141-6149-S, "Instructions for Use  
of Hanford Standard Specifications for  
Built-Up Roofing, HWS-6141-S through  
HWS-6149-S", which is located in front  
of HWS-6141-S.

HWS-6148-S

STANDARD SPECIFICATION

for

BUILT-UP, SMOOTH AND GRAVEL SURFACED ASPHALT ROOFS

on

CONCRETE DECKS

Ref Hanford Stds: None

REV	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM BY	DES. BY
3	Page 5	hes	12-4-61	BUILT-UP, SMOOTH AND GRAVELED ASPHALT ROOFS ON CONCRETE DECKS	hes	aee
APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY, DATE 7-11-57				HWS-6148-S		

CAPE-1072-482

HWS-6148-S  
STANDARD SPECIFICATION  
FOR  
BUILT-UP, SMOOTH AND GRAVEL SURFACED ASPHALT ROOFS  
ON CONCRETE DECKS

1. SCOPE

This specification covers the construction of built-up, smooth and gravel surfaced asphalt roofs over uninsulated poured concrete, pre-cast concrete slab and poured lightweight aggregate concrete decks with slopes up to 2 inches per foot. Roofs on deck slopes over 1/2 inch per foot may be smooth or gravel surfaced. Roofs on deck slopes 1/2 inch per foot and under are to be gravel surfaced.

2. IDENTIFICATION OF ENGINEER

The term "Engineer" refers to the representative of the user of the facility to which this specification applies.

3. REFERENCED PUBLICATIONS

The following publications apply to this specification to the extent indicated by subsequent references. References are by basic designation only; however, the complete designation, including the suffix indicating the year of edition, shall apply.

a. American Society for Testing Materials (ASTM) Specification:

ASTM Designation: D517-50, Asphalt Plank

b. Federal Specifications:

SS-R-00620 (GSA-FSS)	Roofing Felt, Glass Fiber, Asphalt-Saturated, Uncoated (for Flashing and Roofing)
HH-F-191a	Felt; Asphalt-Saturated (for) Flashing, Roofing and Waterproofing
QQ-C-576a	Copper Plates, Rolled Bars, Sheet, and Strips
QQ-S-775a	Steel, Sheets, Carbon, Zinc Coated
SS-A-666	Asphalt (for) Built-Up Roofing, Waterproofing and Dampproofing
SS-A-701	Asphalt-Primer (for) Roofing and Waterproofing
SS-C-153	Cement, Bituminous, Plastic
SS-R-501a	Roofing, Prepared; Asphalt, Smooth-Surfaced
SS-R-521	Roofing and Shingles; Asphalt-Prepared, Mineral-Surfaced

## c. Military Specification:

MIL-R-3472

23 April 1951, Roof-Coating; Asphalt-Base Emulsion

## d. Corps of Engineers Specification.

CE-220.01, 3 October 1956, Guide Specification for Military Construction Roofing, Built-Up, Asphalt and Tar, and Interim Information dated 17 January 1958.

MATERIALS4. LOW MELT ASPHALT

Asphalt for roof slopes 1/2 inch per foot and under shall be Type A or B conforming to the Corps of Engineers Guide Specification CE 220.01 as extracted below. Prior to application of built-up roofing the Contractor shall furnish a certificate from the asphalt manufacturer stating that the asphalt conforms to the extracted portion of Specification CE 220.01.

Type	Test Method	A		B	
		Min	Max	Min	Max
Softening point (R&B) °F	ASTM D36	135	148	135	148
Ductility at 77F 5 cm/min, cm	ASTM D113	12		100	
Ductility at 40F, 0.25 cm/min, cm		3		---	
Penetration at 32F, 200g 60 sec	ASTM D5	10		5	
77F, 100g 5 sec		25	60	15	25
115F, 50g 5 sec		100		90	
Weight loss, 5 hrs, at 325F, %	ASTM D6		0.5		0.5
Penetration of residue at 77F, percent of original		85		75	
Bitumen soluble in CCl <sub>4</sub> , %	ASTM D165	99		99	
Bitumen insoluble in n-pentane, %	NBS RP-2577		30		30
Flow test at 120F, 5 hrs, cm	ASTM D1191	1	9	2	9
	Modified				
	1. Aluminum panel (6" x 2-3/4" x 0.064")				
	2. 45° ± 1° inclination				
	3. 120F ± 2°				
Spot test	AASHTO T102	Negative		Negative	
Susceptibility factor	Pen. at 115F - Pen. at 32F	2		5	
	Pen. at 77F				
Flash point, COC, °F	ASTM D92	425		425	

5. HIGH MELT ASPHALT

Asphalt for roof slopes over 1/2 inch per foot shall conform to Federal Specification SS-A-666, Type II, Grade 2, with a softening point within the range of 165 F to 190 F.

6. ASPHALT-SATURATED ROOFING FELT

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Felt shall be asphalt-saturated roofing felt weighing not less than 13 pounds per 100 square feet (commonly referred to as "15-pound felt") and conforming to Federal Specification HH-F-191.

7. SPECIAL ROOFING SHEETS

Special roofing sheets shall be asphalt-saturated and coated sheets conforming to Federal Specification SS-R-501, Class B, modified as follows:

Top surfacing shall be composed of an opaque, granular material equal to ilmenite in chemical inertness and opacity, said surfacing to be 15 lbs. minimum weight per 108 square feet. The total minimum weight requirements of the finished roofing shall be 50 lbs with weight of moisture-free desaturated felt and coating not less than 7.5 lbs (0.04 inch minimum thickness) and 11 lbs per 108 square feet, respectively, and a maximum of 25 lbs per 108 square feet of mineral retained on 100 mesh.

8. GLASS FIBER ROOFING SHEETS

Glass fiber roofing sheets shall be designed and manufactured for use in constructing built-up roofs and shall conform to Federal Specification SS-R-00620.

8.1 GLASS FIBER BASE SHEETS

Glass fiber base sheets shall be made of glass fibers reinforced with continuous glass yarns and shall be loaded with approximately 12 pounds of asphalt per 100 square feet.

8.2 GLASS FIBER PLY SHEETS

Glass fiber ply sheets shall be made of glass fibers reinforced with continuous glass yarns and shall be loaded with approximately 6 pounds of asphalt per 100 square feet.

9. MINERAL SURFACED ROOFING

Mineral surfaced roofing for base flashing shall be asphalt-saturated felt, surfaced with mineral granules and weighing at least 83 pounds per 100 square feet (referred to as "90-pound roofing") with 2 or 4-inch base edge lap. Material shall conform to Federal Specification SS-R-521, Type I.

10. ASPHALT PRIMER

Primer for concrete shall conform to Federal Specification SS-A-701.

11. ROOFING CEMENT

Roofing cement shall conform to Federal Specification SS-C-153, Type I.

12. ROOFING GRAVEL

- a. Roofing gravel shall consist of hard, rounded stones free from sand, clay, dust, or any other foreign matter. Crushed stone or crushed gravel shall not be used.
- b. Gravel shall have a size range of 5/8 inch minus to 1/4 inch plus. All gravel shall be within these limits with the largest proportion in the 3/8 inch to 1/2 inch sizes.
- c. Gravel removed from existing roofs shall not be reused.

13. ASPHALT PLANK

Asphalt plank for walkways shall be one inch thick by eight inches wide plain asphalt plank conforming to ASTM Designation: D517.

14. ASPHALT EMULSION

Asphalt emulsion shall be a stable, clay-type emulsion designed and manufactured for protective coating of built-up roofing. Emulsion shall conform to Military Specification MIL-R-3472, except that resistance to re-emulsification shall be determined as follows:

A 1/8 inch thick film of emulsion shall be applied to a minimum 2-inch by 2-inch area of a clean glass panel. The panel shall be dried in an oven at 110 F for 24 hours. To meet these specifications the emulsion film shall not disintegrate or re-emulsify when the test panel is submerged in a vertical position in distilled water at room temperature for 24 hours. The emulsion shall be considered not re-emulsifiable if the film maintains its adhesion to the glass panel without dropping of its own weight after 24 hours immersion and, if by slight rubbing with the fingers, the emulsion film does not disintegrate and become suspended in the distilled water. Slight surface stain or rusting of the emulsion film will not be considered re-emulsification.

15. REFLECTIVE ROOF COATINGS

- a. Reflective coating for application over hot-mopped asphalt coating shall be Flintkote Company No. 54 "Sta-Kool Aluminum", or approved equal.
- b. Reflective coating for application over asphalt emulsion coating shall be Flintkote Company "Rexkote", or approved equal, white in color.

16. METAL FLASHING AND GRAVEL STOPS

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- a. Metal flashing and gravel stops shall be fabricated as shown on the drawings.
- b. Galvanized sheet metal shall conform to Federal Specification QQ-S-775, Type I, Class d.
- c. Copper shall conform to Federal Specification QQ-C-576, light cold-rolled temper.

17. NAILS, SCREWS AND DISCS

- a. Nails for securing felt base flashing and other uses specified herein, shall be one inch long, 10 gage, hot-dipped galvanized roofing nails with heads not less than 3/8 inch in diameter.
- b. Tin discs for use with roofing nails shall have a minimum diameter of one inch. Where nailing through tin discs is specified herein, the following are acceptable alternates: one-inch long, ring shank nails with one inch minimum diameter round head, or 15/16 inch minimum square head.
- c. Nails for attaching metal flashing shall be 1-1/2 inch long, 10 gage, hot-dipped galvanized nails.
- d. Screws for attaching metal flashing shall be No. 8, one inch long, zinc or cadmium plated, stove head sheet metal screws.

WORKMANSHIP

18. STORAGE, HANDLING, AND PREPARATION OF MATERIALS

- a. All materials, including gravel, shall be kept clean and dry and shall be protected from the weather during storage and application.
- b. Rolls of felt shall be stored in upright position and shall be protected from damage during storage and application.
- c. Gravel shall not be stockpiled on unprotected felt surfaces. Roofing shall be graveled or glazed prior to stockpiling gravel.
- d. Special roofing sheets shall be cut into 12 to 18-foot lengths and shall be allowed to flatten in piles before using.
- e. Extreme care shall be used to control the temperature of the asphalt during heating. Any evidence that a batch has been overheated shall be cause for rejection of that batch. A spear type thermometer shall be provided and it shall be used by the kettleman to maintain asphalt temperatures within the specified limits.

- f. Asphalt shall not be heated above 425 F for high melt asphalt or 400 F for low melt asphalt. Temperature of asphalt when applied shall be not less than 350 F for high melt asphalt or 325 F for low melt asphalt.
- g. Asphalt, asphalt primer and asphalt emulsion shall not be adulterated in any way. Asphalt emulsion shall not be allowed to freeze.
- h. Leaky containers shall not be used for handling asphalt, asphalt emulsion, asphalt primer or roofing cement. If such materials are spilled or spattered on permanently exposed surfaces of structures, the material shall be completely removed.
- i. Material handling dollies and other wheeled equipment used on new or existing roofs shall be equipped with low-pressure pneumatic tires.
- j. Materials and/or equipment shall not be used on, stored on, or transported over existing or new roofs unless protection required to prevent damaging or overloading the roof deck, built-up roofing components and the structural system is provided.
- k. All roofing materials shall be delivered to the jobsite in their original sealed packages or containers with the manufacturer's label intact showing name and grade of material.

19. SURFACE PREPARATION

- a. All surfaces to receive roofing materials shall be completely dry and free from dirt, dust, loose materials, and frost, or effects of freezing. Surfaces shall be swept clean prior to applying roofing materials.
- b. Roofing materials shall not be applied to new concrete or new lightweight aggregate concrete decks until 21 days after curing is completed.
- c. New lightweight aggregate concrete decks shall have had a minimum of 10 consecutive days of good drying weather immediately before roofing materials are applied. New concrete decks shall have had a minimum of 3 consecutive days of good drying weather immediately before roofing materials are applied.
- d. On precast concrete slab decks all joints between slabs shall be troweled with roofing cement to seal joints and to eliminate unevenness. Where unevenness of deck is more than 1/8 inch at joints, roofing cement shall be applied to form a sloping transition 4 inches wide.

- e. If new roofing is to be joined to an existing graveled roof, all gravel shall be removed from the existing roof for a minimum of 42 inches back from the joint. The joint between new deck and existing roofing shall be troweled with roofing cement to form a sloping transition at least 4 inches wide. y 6 6
- f. Existing metal flashing and gravel stops in the area to receive roofing shall be removed and preserved for reinstallation after roofing materials are in place, unless shown otherwise on the drawings.
- g. Cant strips at least 3-1/2 inches high shall be installed in the intersection of all vertical surfaces with the roof deck. If larger cant strips are shown on the drawings, the larger cant strips shall be installed.
- h. A one-inch cant of roofing cement shall be applied around all roof penetrations prior to mopping the first ply of felt.
- i. Unless shown otherwise on the drawings, expansion joints in the deck shall be covered full length with a 6 inch wide strip of galvanized sheet metal, 26 gage minimum, centered over the joint. Splices in the metal strip shall be 3-inch overlaps sealed with roofing cement. On one side of the expansion joint this strip shall be bedded in a 1/8 inch thick coating of roofing cement; the other side shall be free.
- j. Roofing materials shall not be applied to the deck until the deck surfaces have been prepared in accordance with a. through i., above and approved by the Engineer.

## 20. MINIMUM TEMPERATURES FOR APPLYING ROOFING MATERIALS

Roofing materials shall not be applied when the ambient temperature or the temperature of the roof deck is 40 F or lower.

## 21. APPLICATION OF SMOOTH SURFACED BUILT-UP ROOFING

Smooth surfaced roofs shall be constructed with high melt asphalt and special roofing sheets or glass fiber sheets as specified in Subsections 21.1 and 21.2, respectively.

### 21.1 SMOOTH SURFACED SPECIAL ROOFING SHEET ROOF

- a. Roof shall be a 3-layer, built-up, special roofing sheet roof with an asphalt emulsion coating. Roof shall contain not less than the following quantities of materials per 100 square feet:

Concrete Primer	1 gallon
Special Roofing Sheets, 3 layers @ 50 pounds	150 pounds
Asphalt	75 pounds on poured decks 85 pounds on precast slab decks
Asphalt Emulsion	6 gallons

b. Roof shall be applied as follows:

- (1) Primer shall be applied to the deck and allowed to dry.  
On precast slab decks, primer shall be held back 4 inches from all joints between slabs.
- (2) Three layers of special roofing sheets shall be laid shingle fashion lapping layers 24-3/4 inches and spot mopping to deck with a minimum of 15 pounds of asphalt per 100 square feet of roof area.

Spots of asphalt shall be applied in the pattern show in Figure 1, below.

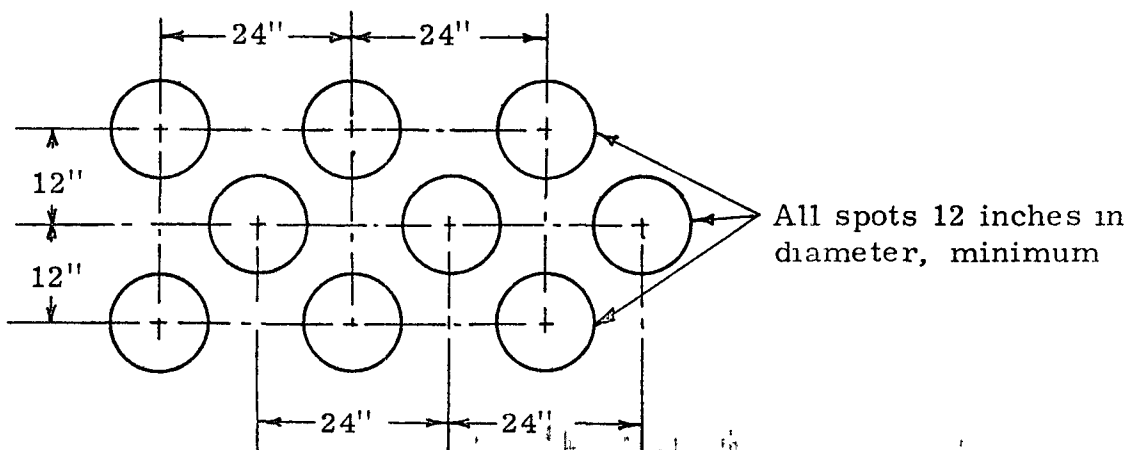


Figure 1 Spot Mopping

On precast slab decks, sheets shall be embedded in a uniform solid mopping of asphalt, approximately 25 pounds per 100 square feet of roof area, (35 pounds per 100 square feet of mopped area, minimum) which shall be held back 4 inches from all joints between slabs.

Sheets shall be laid parallel to the low edge of the deck starting at the low edge. Water shall flow over, not against, lap edges.

Sheets shall be mopped full width between layers with asphalt applied at the rate of 30 pounds per 100 square feet, minimum. At no place shall bare sheets touch each other. Ends of sheets shall be lapped at least 4 inches. End laps shall be staggered at least 3 feet apart.

Sheets damaged in handling shall not be patched. The damaged sheet shall be discarded or the damaged area shall be cut out and laying of sheets shall continue as for a new sheet.

All cants, all layers shall extend up wall or curb to at least two inches above top of cant and shall be trimmed evenly at this point.

All layers shall be free from buckles, blisters, curled edges and air pockets.

- (3) Where new roofing joins existing roofing, 3 mopped layers of special roofing sheets shall extend over both sides of joint as follows:

1st layer - approximately 12 inches  
2nd layer - approximately 24 inches  
3rd layer - approximately 35 inches

- (4) Base flashing consisting of 4 plies of 15-pound asphalt-saturated roofing felt and one ply of mineral surfaced roofing shall be applied over all cants. All base flashing plies shall be trimmed evenly at a height such that metal counterflashing overlaps the base flashing the full height of the counterflashing.

First ply of flashing felt shall extend onto roof 3 inches beyond toe of cant; second ply shall extend 5 inches beyond toe of cant; third ply shall extend 7 inches beyond toe of cant; fourth ply shall extend 9 inches beyond toe of cant. Mineral surfaced roofing shall extend 12 inches beyond toe of cant. Each ply and the mineral surfaced roofing shall be set in a 1/8 inch thick continuous coating of roofing cement. Felt shall be applied in strips not over 10 feet long with staggered 3-inch end laps sealed with roofing cement. All plies shall be carefully pressed into cement to eliminate buckles and blisters. Mineral surfaced roofing shall be cut in strips across the roll. Selvage shall be troweled with roofing cement and overlapped by the next piece. Water shall flow over, not against, lap edges. Flashing shall be nailed to tops of wood nailers, curbs, or walls through all plies along top edge using roofing nails and tin discs on 12-inch centers.

- (5) Metal cap flashing and roof edging shall be installed in conformance with Section 23, Installation of Metal Flashing, Gravel Stops, and Edging.
- (6) Asphalt plank walkways shall be installed where shown on the drawings. Each piece of plank shall be laid across the walkway

and shall be set in a solid mopping of asphalt leaving approximately 2 inches clear between adjacent planks. Spaces between planks shall be coated with asphalt emulsion same as rest of roof. Top surface of planks shall not receive emulsion coating.

- (7) All surfaces of the roof to the toes of cants shall be uniformly coated with two coats of asphalt emulsion applied at the rate of at least 3 gallons per 100 square feet per coat. Emulsion shall be applied in conformance with the emulsion manufacturer's recommendations. The first coat shall be allowed to dry for a minimum of 48 hours before the second coat is applied. If emulsion is sprayed, the final finish and spreading of each coat shall be accomplished by light brushing with a soft fiber brush.
- (8) The completed roof shall have all plies firmly adhered to the deck over 100% of the mopped areas and all plies firmly adhered to each other over 100% of the roof area. All flashing felts, asphalt plank and mineral surfaced roofing shall be adhered over 100% of their area.

## 21.2 SMOOTH SURFACED GLASS FIBER SHEET ROOF

- a. Roof shall be a 4-ply, built-up, glass fiber roof with asphalt coating. Roof shall contain not less than the following quantities of materials per 100 square feet:

Primer	1 gallon
Base Sheet, 1 ply	15 pounds
Ply Sheets, 3 @ 8 pounds	24 pounds
Asphalt	130 pounds on poured decks 140 pounds on precast slab decks

- b. Roof shall be applied as follows:

- (1) Primer shall be applied to the deck and allowed to dry. On precast slab decks, primer shall be held back 4 inches from all joints between slabs.
- (2) One ply of base sheet shall be spot-mopped to the deck with a minimum of 15 pounds of asphalt per 100 square feet of roof area. Spots of asphalt shall be applied in the pattern shown in Figure 1 under Subsection 21.1. Item b. (2).

On precast slab decks, base sheet shall be embedded in a uniform solid mopping of asphalt, approximately 25 pounds per 100 square feet of roof area, (35 pounds per 100 square feet of mopped area, minimum) which shall be held back 4 inches from all joints between slabs. Base sheets shall be lapped 2 inches on sides and 6 inches at ends.

- (3) Three layers of ply sheets shall be laid shingle fashion lapping each ply 24-3/4 inches. End laps shall be 4 inches minimum and adjacent end laps shall be staggered at least 12 inches apart. Each ply shall be mopped full width underneath with a minimum of 30 pounds of asphalt per 100 square feet. At no place shall bare ply sheets touch each other. Plies shall be laid parallel to the low edge of the deck starting at the low edge. Water shall flow over, not against, lap edges. 492

Sheets damaged in handling shall not be patched. The damaged area shall be cut out and the laying of the sheets shall continue as though it were a new roll.

At cants, all plies shall extend up walls or curbs at least 2 inches above top of cant and shall be trimmed evenly at this point.

All plies shall be free from buckles, blisters, curled edges and air pockets.

- (4) Where new roofing joins existing roofing, 4 mopped plies shall extend over both sides of joint as follows:

1st ply - approximately 9 inches  
2nd ply - approximately 18 inches  
3rd ply - approximately 27 inches  
4th ply - approximately 35 inches

- (5) All exposed ply sheets shall be glazed with a continuous mopping of asphalt on the same day the sheets are laid except that asphalt shall not be applied where flashing or edging roof flanges are to be installed. Precautions shall be taken at all times to prevent entry of water into or under the roof, such as at eaves, roof penetrations, and where flashing is to be installed.
- (6) Base flashing shall be installed as specified under Subsection 21.1 Item b. (4) except glass fiber ply sheets shall be substituted for asphalt-saturated roofing felt.
- (7) Metal flashing and roof edging shall be installed in conformance with Section 23, Installation of Metal Flashing, Gravel Stops, and Edging.
- (8) Asphalt plank walkways shall be installed where shown on the drawings. Each piece of plank shall be laid across the walkway and shall be set in a solid mopping of asphalt leaving approximately two inches clear between adjacent pieces of plank. Spaces between planks shall be coated with hot asphalt same as rest of roof. Top surface of planks shall not receive asphalt coating.

- (9) All surfaces of the roof to the toes of cants shall be coated with not less than 25 pounds of asphalt per 100 square feet.
- (10) The completed roof shall have all plies firmly adhered to the deck over 100% of the mopped areas and all plies firmly adhered to each other over 100% of the roof area. All flashing felts, asphalt plank and mineral surfaced roofing shall be adhered over 100% of their area.

## 22. APPLICATION OF GRAVEL SURFACED BUILT-UP ROOFING

Gravel surfaced asphalt roofing shall be constructed with asphalt and roofing felt or glass fiber sheets as specified in Subsection 22.1 and 22.2 respectively.

High melt asphalt shall be used on roofs with slopes over 1/2 inch per foot. Low melt asphalt shall be used on roofs with slopes 1/2 inch per foot and under.

### 22.1 GRAVEL SURFACED, ASPHALT FELT ROOF

- a. Roof shall be a 20 year rating, 4-ply, built-up, graveled asphalt roof containing not less than the following quantities of materials per 100 square feet:

Primer	1 gallon
Asphalt-Saturated Felt	60 pounds
Asphalt	150 pounds on poured decks 160 pounds on precast slab decks
Gravel	400 pounds

- b. Roof shall be applied as follows:

- (1) Primer shall be applied to the deck and allowed to dry. On precast concrete slab decks, primer shall be held back 4 inches from all joints between slabs.
- (2) On roofs constructed with low melt asphalt, two plies of minimum 12-inch wide, 15-pound felt strips shall be laid in a coating of roofing cement 4 inches wide and nailed through tin discs on 12-inch centers to the nailing strips along edges of roof decks and roof penetrations before laying built-up plies, to provide 6-inch flaps for sealing ends and edges of plies. After all plies are in place, roofing shall be trimmed flush with the roof edges and penetrations, and the flaps shall be turned back over and mopped to the top of the roofing.

- (3) Four plies of 15-pound asphalt-saturated felt shall be laid shingle fashion lapping plies 27-1/2 inches and spot mopping to deck with a minimum of 15 pounds of asphalt per 100 square feet of roof area. Spots of asphalt shall be applied in the pattern shown in Figure 1, under Subsection 21.1 Item b. (2).

On precast slab decks, sheets shall be embedded in a uniform solid mopping of asphalt, approximately 25 pounds per 100 square feet of roof area (35 pounds per 100 square feet of mopped area, minimum) which shall be held back 4 inches from all joints between slabs. At edges of roof deck and roof penetrations, low melt asphalt shall not be mopped to the bare deck closer than 4 inches to the edge.

Each ply shall be solidly mopped to the preceding ply with a minimum of 25 pounds of asphalt per ply per 100 square feet. At no place shall felt touch felt. Ends of plies shall be lapped a minimum of 6 inches. End laps shall be staggered at least 3 feet apart.

All plies shall be laid parallel to the low edge of the deck starting at the low edge. Water shall flow over, not against, lap edges.

Felt damaged in handling shall not be patched. The damaged area shall be cut out and laying of felt shall continue as though it were a new roll.

At cants, all plies shall extend up walls or curbs at least 2 inches above top of cants and shall be trimmed evenly at this point.

All plies shall be free from buckles, blisters, curled edges and air pockets.

- (4) Where new roofing joins existing roofing, 4 mopped plies shall extend over both sides of joint as follows:

1st ply - approximately 9 inches  
2nd ply - approximately 18 inches  
3rd ply - approximately 27 inches  
4th ply - approximately 35 inches

- (5) All exposed felt shall be graveled as specified in (9) below, or felt shall be glazed with a continuous mopping of asphalt on the same day the felt is laid except that asphalt shall not be applied where flashing or gravel stop roof flanges are

to be installed. Precautions shall be taken at all times to prevent entry of water into or under the roof, such as at eaves, roof penetrations, and where flashing is to be installed.

- (6) Base flashing shall be installed as specified in Subsection 21.1 Item b. (4) of this specification.
- (7) Metal cap flashing and gravel stops shall be installed in conformance with Section 23, Installation of Metal Flashing, Gravel Stops and Edging.
- (8) Asphalt plank walkways shall be installed where shown on the drawings. Each piece of plank shall be laid across the walkway and shall be set in a solid mopping of asphalt leaving approximately two inches clear between adjacent pieces of plank. Spaces between planks shall be graveled same as rest of roof. Top surface of planks shall not receive asphalt or gravel.
- (9) One flood coat of not less than 60 pounds of asphalt per 100 square feet shall be poured, not mopped, over the broom-clean, completely dry felt surface and not less than 400 pounds of completely dry gravel per 100 square feet shall be embedded in the hot asphalt. Asphalt and gravel shall extend over mineral surfaced base flashing to the toes of cants.
- (10) The completed roof shall have all plies firmly adhered to the deck over 100% of the mopped areas and all plies firmly adhered to each other over 100% of the roof area. All end flaps, flashing felts, asphalt plank and mineral surfaced roofing shall be adhered over 100% of their area.

## 22.2 GRAVEL SURFACED GLASS FIBER SHEET ROOF

- a. Roof shall be a 20-year rating, 3-ply, built-up, glass fiber sheet roof with graveled surface. Roof shall contain not less than the following quantities of material per 100 square feet:

Primer	1 gallon
Base Sheet, 1 ply	15 pounds
Ply Sheets, 2 @ 8 pounds	16 pounds
Asphalt	135 pounds on poured decks 145 pounds on precast slab decks
Gravel	400 pounds

- b. Roof shall be applied as specified in Subsection 21.2 Item b. of this specification with the following changes:

- (1) Two ply sheets shall be laid instead of three. Lap shall be 19 inches.

- (2) On roofs constructed with low melt asphalt, two plies of minimum 12-inch wide 15-pound asphalt-saturated roofing felt strips shall be laid in a coating of roofing cement 4 inches wide and nailed through tin discs on 12-inch centers to the nailing strip along edges of roof decks and roof penetrations before laying built-up plies, to provide 6-inch flaps for sealing ends and edges of plies. After all plies are in place, roofing shall be trimmed flush with the roof edges and penetrations and the flaps shall be turned back over and mopped to the top of the roofing. 46 ✓
- (3) The final surfacing, in place of a mopping of asphalt, shall consist of a flood coat of not less than 60 pounds of asphalt per 100 square feet, poured, not mopped, over the broom-clean, completely dry surface and not less than 400 pounds of completely dry gravel per 100 square feet embedded in the hot asphalt. Top surface of asphalt plank shall not receive asphalt or gravel.

## 23. INSTALLATION OF METAL FLASHING, GRAVEL STOPS, AND EDGING

- a. Metal roof flashing, gravel stops, and edging as shown on the drawings shall be applied after all built-up roofing plies are in place.
- b. All roof flanges shall be set in a coating of roofing cement. Roof flanges shall be nailed to the wood nailers on 3-inch centers. 3/4 inches from back edge of roof flange. In addition, gravel stop roof flanges shall be secured to nailers with stove head sheet metal screws on maximum 24-inch centers. Gravel stop or edging fascia shall be secured to building siding or structure with stove head sheet metal screws on maximum 36-inch centers, or as shown on the drawings.
- c. Nail and screw heads in roof flanges shall be troweled with roofing cement.
- d. Joints in counterflashing over base flashing and in gravel stops and edging shall be lapped 4 inches. Laps in gravel stops and roof edging shall be sealed over the entire roof flange and bead area with roofing cement. All excess roofing cement shall be carefully and completely removed from permanently exposed metal surfaces.
- e. Roof flanges shall be sealed to roof with two plies of the plying material used in the built-up roof, mopped solidly to roof and flanges with hot asphalt. The first ply shall cover approximately half of the flange width and shall extend onto roof 3 inches beyond edge of flange. The second ply shall cover the full width of roof flange and shall extend onto roof 6 inches beyond edge of flange.

At roof penetrations, a 1-inch cant of roofing cement shall be applied at the intersection of the penetration flashing and the sealing plies.

- f. Pitch pockets shall be completely filled with roofing cement.

## 24. APPLICATION OF REFLECTIVE ROOF COATINGS

When reflective coating is specified, the coating shall be applied in conformance with Subsection 24.1 or 24.2, as applicable.

### 24.1 COATING OVER HOT-MOPPED ASPHALT

- a. The hot-mopped asphalt coating shall be allowed to weather to a dull, oxidized finish, as determined by the Engineer, before any reflective coating is applied. In no case shall reflective coating be applied sooner than 90 days after mopped asphalt is applied.
- b. The aluminum reflective coating shall be applied uniformly over the roof surfaces at a rate of not less than 1 gallon of aluminum coating per 200 square feet.

### 24.2 COATING OVER ASPHALT EMULSION

- a. The asphalt emulsion roof coating shall be allowed to set until no pickup of material results from normal foot traffic. Reflective coating material shall not be applied until the emulsion surface has been approved for coating by the Engineer.
- b. The reflective coating shall be applied uniformly over the roof surface at a rate of not less than 2/3 gallons per 100 square feet.

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NOTICE

Before using this specification see  
DI-6141-6149-S, "Instructions for use  
of HAPO Standard Specifications for  
Built-Up Roofing, HWS-6141-S through  
HWS-6149-S" Which is located in  
front of HWS-6141-S

CAPE-1072-499

HWS-6149-S

STANDARD SPECIFICATION

for

BUILT-UP, SMOOTH AND GRAVEL SURFACED ASPHALT ROOFS

on

INSULATED DECKS

Ref Hanford Stds: None

NO.	REVISION	APP'D	DATE	ARCHITECTURAL-CIVIL STANDARD	SUBM. BY	DES. BY
3	Page 5	hes	12-4-61		hes	aee
APPROVED BY ENGINEERING STANDARDS COUNCIL				BUILT-UP, SMOOTH AND GRAVELED	HWS-6149-S	
H. E. Struck SECRETARY, DATE 7-11-57				ASPHALT ROOFS ON INSULATED DECKS		

HWS-6149-S  
STANDARD SPECIFICATION  
FOR

CAFE-1072-500

BUILT-UP, SMOOTH AND GRAVEL SURFACED ASPHALT ROOFS  
ON INSULATED DECKS

1. SCOPE

This specification covers the construction of built-up, smooth and gravel surfaced asphalt roofs over insulated decks with slopes up to 2 inches per foot. Roofs on deck slopes over 1/2 inch per foot may be smooth or gravel surfaced. Roofs on deck slopes 1/2 inch per foot and under are to be gravel surfaced.

2. IDENTIFICATION OF ENGINEER

The term "Engineer" refers to the representative of the user of the facility to which this specification applies.

3. REFERENCED PUBLICATIONS

The following publications apply to this specification to the extent indicated by subsequent references. References are by basic designation only; however, the complete designation, including the suffix indicating the year of edition, shall apply.

a. American Society for Testing Materials (ASTM) Specification:

ASTM Designation: D517-50, Asphalt Plank

b. Federal Specifications:

SS-R-00620 (GSA-FSS)	Roofing Felt, Glass Fiber, Asphalt-Saturated, Uncoated (For Flashing and Roofing)
HH-F-191a	Felt; Asphalt-Saturated (for) Flashing, Roofing and Waterproofing
QQ-C-576a	Copper Plates, Rolled Bars, Sheet, and Strips
QQ-S-775a	Steel, Sheets, Carbon, Zinc Coated
SS-A-666	Asphalt (for) Built-Up Roofing, Waterproofing and Dampproofing
SS-C-153	Cement, Bituminous, Plastic
SS-R-501a	Roofing, Prepared; Asphalt, Smooth-Surfaced
SS-R-521	Roofing and Shingles; Asphalt-Prepared, Mineral- Surfaced

## c. Military Specification:

MIL-R-3472      23 April 1951, Roof-Coating; Asphalt-Base Emulsion

## d. Corps of Engineers Specification:

CE-220.01, 3 October 1956, Guide Specification for Military Construction Roofing; Built-Up, Asphalt and Tar, and Interim Information dated 17 January 1958.

MATERIALS4. LOW MELT ASPHALT

Asphalt for roof slopes 1/2 inch per foot and under shall be Type A or B conforming to the Corps of Engineers Guide Specification CE 220.01 as extracted below. Prior to application of built-up roofing the Contractor shall furnish a certificate from the asphalt manufacturer stating that the asphalt conforms to the extracted portion of Specification CE 220.01.

Type	Test Method	A		B	
		Min	Max	Min	Max
Softening point (R&B) °F	ASTM D36	135	148	135	148
Ductility at 77F 5 cm/min, cm	ASTM D113	12		100	
Ductility at 40F, 0.25 cm/min, cm		3		---	
Penetration at 32F, 200g 60 sec	ASTM D5	10		5	
77F, 100g 5 sec		25	60	15	25
115F, 50g 5 sec		100		90	
Weight loss, 5 hrs, at 325F, %	ASTM D6		0.5		0.5
Penetration of residue at 77F, percent of original		85		75	
Bitumen soluble in CCl <sub>4</sub> , %	ASTM D165	99		99	
Bitumen insoluble in n-pentane, %	NBS RP-2577		30		30
Flow test at 120F, 5 hrs, cm	ASTM D1191	1	9	2	9
Modified					
1. Aluminum panel (6" x 2-3/4" x 0.064")					
2. 45° ± 1° inclination					
3. 120F ± 20°					
Spot test	AASHTO T102	Negative		Negative	
Susceptibility factor	Pen. at 115F - Pen. at 32F	2		5	
	Pen. at 77F				
Flash point, COC, °F	ASTM D92	425		425	

5. HIGH MELT ASPHALT

Asphalt for roof slopes over 1/2 inch per foot shall conform to Federal

Specification SS-A-666, Type II, Grade 2, with a softening point within the range of 165 F to 190 F.

6. ASPHALT-SATURATED ROOFING FELT

Felt shall be asphalt-saturated roofing felt weighing not less than 13 pounds per 100 square feet (commonly referred to as "15-pound felt") and conforming to Federal Specification HH-F-191.

7. SPECIAL ROOFING SHEETS

Special roofing sheets shall be asphalt saturated and coated sheets conforming to Federal Specification SS-R-501, Class B, modified as follows:

Top surfacing shall be composed of an opaque, granular material equal to ilmenite in chemical inertness and opacity, said surfacing to be 15 lbs. minimum weight per 108 square feet. The total minimum weight requirements of the finished roofing shall be 50 lbs with weight of moisture-free desaturated felt and coating not less than 7.5 lbs (0.04 inch minimum thickness) and 11 lbs per 108 square feet, respectively, and a maximum of 25 lbs per 108 square feet of mineral retained on 100 mesh.

8. GLASS FIBER PLY SHEETS

Glass fiber ply sheets shall be designed and manufactured for use in constructing built-up roofs and shall conform to Federal Specification SS-R-00620.

Glass fiber ply sheets shall be made of glass fibers reinforced with continuous glass yarns and shall be loaded with approximately 6 pounds of asphalt per 100 square feet.

9. MINERAL SURFACED ROOFING

Mineral surfaced roofing for base flashing shall be asphalt-saturated felt, surfaced with mineral granules and weighing at least 83 pounds per 100 square feet (referred to as "90-pound roofing") with 2 or 4-inch base edge lap. Material shall conform to Federal Specification SS-R-521, Type I.

10. ROOFING CEMENT

Roofing cement shall conform to Federal Specification SS-C-153, Type I.

# 11. ROOFING GRAVEL

- a. Roofing gravel shall consist of hard, rounded stones free from sand, clay, dust, or any other foreign matter. Crushed stone or crushed gravel shall not be used.
- b. Gravel shall have a size range of 5/8 inch minus to 1/4 inch plus. All gravel shall be within these limits with the largest proportion in the 3/8 inch to 1/2 inch sizes.
- c. Gravel removed from existing roofs shall not be reused.

# 12. ASPHALT PLANK

Asphalt plank for walkways shall be one inch thick by eight inches wide plain asphalt plank conforming to ASTM Designation: D517.

# 13. ASPHALT EMULSION

Asphalt emulsion shall be a stable, clay-type emulsion designed and manufactured for protective coating of built-up roofing. Emulsion shall conform to Military Specification MIL-R-3472, except that resistance to re-emulsification shall be determined as follows:

A 1/8 inch thick film of emulsion shall be applied to a minimum 2-inch by 2-inch area of a clean glass panel. The panel shall be dried in an oven at 110 F for 24 hours. To meet these specifications the emulsion film shall not disintegrate or re-emulsify when the test panel is submerged in a vertical position in distilled water at room temperature for 24 hours. The emulsion shall be considered not re-emulsifiable if the film maintains its adhesion to the glass panel without dropping of its own weight after 24 hours immersion and, if by slight rubbing with the fingers, the emulsion film does not disintegrate and become suspended in the distilled water. Slight surface stain or rusting of the emulsion film will not be considered re-emulsification.

# 14. REFLECTIVE ROOF COATINGS

- a. Reflective coating for application over hot-mopped asphalt coating shall be Flintkote Company No. 54 "Sta-Kool Aluminum", or approved equal.
- b. Reflective coating for application over asphalt emulsion coating shall be Flintkote Company "Rexkote", or approved equal, white in color.

15. METAL FLASHING AND GRAVEL STOPS

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- a. Metal flashing and gravel stops shall be fabricated as shown on the drawings.
- b. Galvanized sheet metal shall conform to Federal Specification QQ-S-775, Type I, Class d.
- c. Copper shall conform to Federal Specification QQ-C-576, light cold-rolled temper.

16. NAILS, SCREWS AND DISCS

- a. Nails for securing felt base flashing and other uses specified herein, shall be one inch long, 10 gage, hot-dipped galvanized roofing nails with heads not less than 3/8 inch in diameter.
- b. Tin discs for use with roofing nails shall have a minimum diameter of one inch. Where nailing through tin discs is specified herein, the following are acceptable alternates: one-inch long, ring shank nails with one inch minimum diameter round head, or 15/16 inch minimum square head.
- c. Nails for attaching metal flashing shall be 1-1/2 inch long, 10 gage, hot-dipped galvanized nails.
- d. Screws for attaching metal flashing shall be No. 8, one inch long, zinc or cadmium plated, stove head sheet metal screws.

WORKMANSHIP

17. STORAGE, HANDLING, AND PREPARATION OF MATERIALS

- a. All materials, including gravel, shall be kept clean and dry and shall be protected from the weather during storage and application.
- b. Rolls of felt shall be stored in upright position and shall be protected from damage during storage and application.
- c. Gravel shall not be stockpiled on unprotected felt surfaces. Roofing shall be graveled or glazed prior to stockpiling gravel.
- d. Special roofing sheets shall be cut into 12 to 18-foot lengths and shall be allowed to flatten in piles before using.
- e. Extreme care shall be used to control the temperature of the asphalt during heating. Any evidence that a batch has been over-heated shall be cause for rejection of that batch. A spear type thermometer shall be provided and it shall be used by the kettle-man to maintain asphalt temperatures within the specified limits.

- f. Asphalt shall not be heated above 425 F for high melt asphalt or 400 F for low melt asphalt. Temperature of asphalt when applied shall be not less than 350 F for high melt asphalt or 325 F for low melt asphalt.
- g. Asphalt and asphalt emulsion shall not be adulterated in any way. Asphalt emulsion shall not be allowed to freeze.
- h. Leaky containers shall not be used for handling asphalt, asphalt emulsion or roofing cement. If such materials are spilled or splattered on permanently exposed surfaces of structures, the material shall be completely removed.
- i. Material handling dollies and other wheeled equipment used on new or existing roofs shall be equipped with low-pressure pneumatic tires.
- j. Materials and/or equipment shall not be used on, stored on, or transported over existing or new roofs unless protection required to prevent damaging or overloading the roof deck, built-up roofing components and the structural system is provided.
- k. All roofing materials shall be delivered to the jobsite in their original sealed packages or containers with the manufacturer's label intact showing name and grade of material.

#### 18. SURFACE PREPARATION

- a. All surfaces to receive roofing materials shall be completely dry and free from dirt, dust, loose materials, and frost, or effects of freezing. Surfaces shall be swept clean prior to applying roofing materials.
- b. If new roofing is to be joined to an existing graveled roof, all gravel shall be removed from the existing roof for a minimum of 42 inches back from the joint. The joint between new insulation and existing roofing shall be troweled with roofing cement to form a sloping transition at least 4 inches wide.
- c. Existing metal flashing and gravel stops in the area to receive roofing shall be removed and preserved for reinstallation after roofing materials are in place, unless shown otherwise on the drawings.
- d. Cant strips at least 3-1/2 inches high shall be installed in the intersection of all vertical surfaces with the roof deck. If larger cant strips are shown on the drawings, the larger cant strips shall be installed.

- e. A one-inch cant of roofing cement shall be applied around all roof penetrations prior to mopping the first ply of felt.
- f. Roofing materials shall not be applied to the deck until the deck surfaces have been prepared in accordance with a. through e., above, and approved by the Engineer.

#### 19. MINIMUM TEMPERATURES FOR APPLYING ROOFING MATERIALS

Roofing materials shall not be applied when the ambient temperature or the temperature of the roof deck is 40 F or lower.

#### 20. APPLICATION OF SMOOTH SURFACED BUILT-UP ROOFING

Smooth surfaced roofs shall be constructed with high melt asphalt and special roofing sheets or glass fiber sheets as specified in Subsections 20.1 and 20.2 respectively.

##### 20.1 SMOOTH SURFACED SPECIAL ROOFING SHEET ROOF

- a. Roof shall be a 3-layer, built-up special roofing sheet roof with an asphalt emulsion coating. Roof shall contain not less than the following quantities of materials per 100 square feet:

Special Roofing Sheets,	
3 layers @ 50 pounds	150 pounds
Asphalt	90 pounds
Asphalt Emulsion	6 gallons

- b. Roof shall be applied as follows:

- (1) Three layers of special roofing sheets shall be laid shingle fashion, lapping layers 24-3/4 inches. Sheets shall be applied to the insulation in a uniform solid mopping and mopped full width between layers with asphalt applied at the rate of 30 pounds per ply per 100 square feet, minimum. At no place shall bare sheets touch each other. Ends of sheets shall be lapped at least 4 inches. End laps shall be staggered at least 3 feet apart.

Sheets shall be laid parallel to the low edge of the deck starting at the low edge. Water shall flow over, not against, lap edges.

Sheets damaged in handling shall not be patched. The damaged sheet shall be discarded or the damaged area shall be cut out and laying of sheets shall continue as for a new sheet.

At cants, all layers shall extend up wall or curb to at least two inches above top of cant and shall be trimmed evenly at this point.

All layers shall be free from buckles, blisters, curled edges and air pockets.

- (2) Where new roofing joins existing roofing, 3 mopped layers of special roofing sheets shall extend over both sides of joint as follows:

1st layer - approximately 12 inches  
2nd layer - approximately 24 inches  
3rd layer - approximately 35 inches

- (3) Base flashing consisting of 4 plies of 15 pound asphalt-saturated roofing felt and one ply of mineral surfaced roofing shall be applied over all cants. All base flashing plies shall be trimmed evenly at a height such that metal counterflashing overlaps the base flashing the full height of the counterflashing.

First ply of flashing felt shall extend onto roof 3 inches beyond toe of cant; second ply shall extend 5 inches beyond toe of cant; third ply shall extend 7 inches beyond toe of cant; fourth ply shall extend 9 inches beyond toe of cant. Mineral surfaced roofing shall extend 12 inches beyond toe of cant. Each ply and the mineral surfaced roofing shall be set in a 1/8 inch thick continuous coating of roofing cement. Felt shall be applied in strips not over 10 feet long with staggered 3-inch end laps sealed with roofing cement. All plies shall be carefully pressed into cement to eliminate buckles and blisters. Mineral surfaced roofing shall be cut in strips across the roll. Selvage shall be troweled with roofing cement and overlapped by the next piece. Water shall flow over, not against, lap edges. Flashing shall be nailed to tops of wood nailers, curbs, or walls through all plies along top edge using roofing nails and tin discs on 12-inch centers.

- (4) Metal cap flashing and roof edging shall be installed in conformance with Section 22, Installation of Metal Flashing, Gravel Stops, and Edging.
- (5) Asphalt plank walkways shall be installed where shown on the drawings. Each piece of plank shall be laid across the walkway and shall be set in a solid mopping of asphalt leaving approximately 2 inches clear between adjacent planks. Spaces between planks shall be coated with asphalt emulsion same as rest of roof. Top surface of planks shall not receive emulsion coating.

- (6) All surfaces of the roof to the toes of cants shall be uniformly coated with two coats of asphalt emulsion applied at the rate of at least 3 gallons per 100 square feet per coat. Emulsion shall be applied in conformance with the emulsion manufacturer's recommendations. The first coat shall be allowed to dry for a minimum of 48 hours before the second coat is applied. If emulsion is sprayed, the final finish and spreading of each coat shall be accomplished by light brushing with a soft fiber brush.
- (7) The completed roof shall have all plies firmly adhered to the insulation and to each other over 100% of the roof area. All flashing felts, asphalt plank and mineral surfaced roofing shall be adhered over 100% of their area.

## 20.2 SMOOTH SURFACED GLASS FIBER SHEET ROOF

- a. Roof shall be a 4-ply, built-up, glass fiber roof with asphalt coating. Roof shall contain not less than the following quantities of materials per 100 square feet:

Ply Sheets, 4 @ 8 pounds	32 pounds
Asphalt	145 pounds

- b. Roof shall be applied as follows:

- (1) Four layers of ply sheets shall be laid shingle fashion lapping each ply 27-1/2 inches. End laps shall be 4 inches minimum and adjacent end laps shall be staggered at least 12 inches apart. Each ply shall be mopped full width underneath with a minimum of 30 pounds of asphalt per 100 square feet. At no place shall bare ply sheets touch each other. Plies shall be laid parallel to the low edge of the deck starting at the low edge. Water shall flow over, not against, lap edges.

Sheets damaged in handling shall not be patched. The damaged area shall be cut out and the laying of the sheets shall continue as though it were a new roll.

At cants, all plies shall extend up walls or curbs at least 2 inches above top of cant and shall be trimmed evenly at this point.

All plies shall be free from buckles, blisters, curled edges and air pockets.

- (2) Where new roofing joins existing roofing, 4 mopped plies shall extend over both sides of joint as follows:

1st ply - approximately 9 inches  
2nd ply - approximately 18 inches  
3rd ply - approximately 27 inches  
4th ply - approximately 35 inches

- (3) All exposed ply sheets shall be glazed with a continuous mopping of asphalt on the same day the sheets are laid except that asphalt shall not be applied where flashing or edging roof flanges are to be installed. Precautions shall be taken at all times to prevent entry of water into or under the roof, such as at eaves, roof penetrations, and where flashing is to be installed.
- (4) Base flashing shall be installed as specified under Subsection 20.1 Item b. (3) except glass fiber ply sheets shall be substituted for asphalt-saturated roofing felt.
- (5) Metal flashing and roof edging shall be installed in conformance with Section 22, Installation of Metal Flashing, Gravel Stops, and Edging.
- (6) Asphalt plank walkways shall be installed where shown on the drawings. Each piece of plank shall be laid across the walkway and shall be set in a solid mopping of asphalt leaving approximately two inches clear between adjacent pieces of plank. Spaces between planks shall be coated with hot asphalt same as rest of roof. Top surface of planks shall not receive asphalt coating.
- (7) All surfaces of the roof to the toes of cants shall be coated with not less than 25 pounds of asphalt per 100 square feet.
- (8) The completed roof shall have all plies firmly adhered to the insulation and to each other over 100% of the roof area. All flashing felts, asphalt plank and mineral surfaced roofing shall be adhered over 100% of their area.

## 21. APPLICATION OF GRAVEL SURFACED BUILT-UP ROOFING

Gravel surfaced asphalt roofing shall be constructed with asphalt and roofing felt or glass fiber sheets as specified in Subsection 21.1 and 21.2 respectively.

High melt asphalt shall be used on roofs with slopes over 1/2 inch per foot. Low melt asphalt shall be used on roofs with slopes 1/2 inch per foot and under.

21.1 GRAVEL SURFACED, ASPHALT FELT ROOF

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- a. Roof shall be a 20 year rating, 4-ply, built-up, graveled asphalt roof containing not less than the following quantities of materials per 100 square feet:

Asphalt-Saturated Felt	60 pounds
Asphalt	160 pounds
Gravel	400 pounds

- b. Roof shall be applied as follows:

- (1) On roofs constructed with low melt asphalt, two plies of minimum 12-inch wide 15-pound felt strips shall be laid in a coating of roofing cement 4 inches wide and nailed through tin discs on 12-inch centers to the insulation stop along edges of roof decks and roof penetrations before laying built-up plies, to provide 6-inch flaps for sealing ends and edges of plies. After all plies are in place, roofing shall be trimmed flush with the roof edges and penetrations, and the flaps shall be turned back over and mopped to the top of the roofing.
- (2) Four plies of 15-pound asphalt-saturated felt shall be laid shingle fashion lapping plies 27-1/2 inches. Plies shall be applied to the insulation in a uniform solid mopping and mopped full width between plies with asphalt applied at the rate of 25 pounds per ply per 100 square feet. At no place shall felt touch felt. Ends of plies shall be lapped a minimum of 6 inches. End laps shall be staggered at least 3 feet apart.

All plies shall be laid parallel to the low edge of the deck starting at the low edge. Water shall flow over, not against, lap edges.

Felt damaged in handling shall not be patched. The damaged area shall be cut out and laying of felt shall continue as though it were a new roll.

At cants, all plies shall extend up walls or curbs at least 2 inches above top of cants and shall be trimmed evenly at this point.

All plies shall be free from buckles, blisters, curled edges, and air pockets.

- (3) Where new roofing joins existing roofing, 4 mopped plies shall extend over both sides of joint as follows:

1st ply - approximately 9 inches  
2nd ply - approximately 18 inches  
3rd ply - approximately 27 inches  
4th ply - approximately 35 inches

- (4) All exposed felt shall be graveled as specified in (8) below, or felt shall be glazed with a continuous mopping of asphalt on the same day the felt is laid except that asphalt shall not be applied where flashing or gravel stop roof flanges are to be installed. Precautions shall be taken at all times to prevent entry of water into or under the roof, such as at eaves, roof penetrations, and where flashing is to be installed.
- (5) Base flashing shall be installed as specified in Subsection 20.1 Item b. (3) of this specification.
- (6) Metal cap flashing and gravel stops shall be installed in conformance with Section 22, Installation of Metal Flashing, Gravel Stops and Edging.
- (7) Asphalt plank walkways shall be installed where shown on the drawings. Each piece of plank shall be laid across the walkway and shall be set in a solid mopping of asphalt leaving approximately two inches clear between adjacent pieces of plank. Spaces between planks shall be graveled same as rest of roof. Top surface of planks shall not receive asphalt or gravel.
- (8) One flood coat of not less than 60 pounds of asphalt per 100 square feet shall be poured, not mopped, over the broom-clean, completely dry felt surface and not less than 400 pounds of completely dry gravel per 100 square feet shall be embedded in the hot asphalt. Asphalt and gravel shall extend over mineral surfaced base flashing to the toes of cants.
- (9) The completed roof shall have all plies firmly adhered to the insulation and to each other over 100% of the roof area. All end flaps, flashing felts, asphalt plank and mineral surfaced roofing shall be adhered over 100% of their area.

## 21.2 GRAVEL SURFACED GLASS FIBER SHEET ROOF

- a. Roof shall be a 20-year rating, 3-ply, built-up, glass fiber sheet roof with graveled surface. Roof shall contain not less than the

following quantities of material per 100 square feet:

Ply Sheets, 3 @ 8 pounds	24 pounds
Asphalt	150 pounds
Gravel	400 pounds

- b. Roof shall be applied as specified in Subsection 20.2 Item b. of this specification with the following changes:
- (1) Three ply sheets shall be laid instead of four. Lap shall be 24-3/4 inches.
  - (2) On roofs constructed with low melt asphalt, two plies of minimum 12-inch wide 15-pound asphalt-saturated roofing felt strips shall be laid in a coating of roofing cement 4 inches wide and nailed through tin discs on 12-inch centers to the insulation stop along edges of roof decks and roof penetrations before laying built-up plies, to provide 6-inch flaps for sealing ends and edges of plies. After all plies are in place, roofing shall be trimmed flush with the roof edges and penetrations and the flaps shall be turned back over and mopped to the top of the roofing.
  - (3) The final surfacing, in place of a mopping of asphalt, shall consist of a flood coat of not less than 60 pounds of asphalt per 100 square feet, poured, not mopped, over the broom-clean, completely dry surface and not less than 400 pounds of completely dry gravel per 100 square feet embedded in the hot asphalt. Top surface of asphalt plank shall not receive asphalt or gravel.

## 22. INSTALLATION OF METAL FLASHING, GRAVEL STOPS, AND EDGING

- a. Metal roof flashing, gravel stops, and edging as shown on the drawings shall be applied after all built-up roofing plies are in place.
- b. All roof flanges shall be set in a coating of roofing cement. Roof flanges shall be nailed to the wood nailers on 3-inch centers, 3/4 inches from back edge of roof flange. In addition, gravel stop roof flanges shall be secured to nailers with stove head sheet metal screws on maximum 24-inch centers.

Gravel stop or edging fascia shall be secured to building siding or structure with stove head sheet metal screws on maximum 36-inch centers, or as shown on the drawings.

- c. Nail and screw heads in roof flanges shall be troweled with roofing cement.
- d. Joints in counterflashing over base flashing and in gravel stops and edging shall be lapped 4 inches. Laps in gravel stops and roof edging shall be sealed over the entire roof flange and bead area with roofing cement. All excess roofing cement shall be carefully and completely removed from permanently exposed metal surfaces.
- e. Roof flanges shall be sealed to roof with two plies of the plying material used in the built-up roof, mopped solidly to roof and flanges with hot asphalt. The first ply shall cover approximately half of the flange width and shall extend onto roof 3 inches beyond edge of flange. The second ply shall cover the full width of roof flange and shall extend onto roof 6 inches beyond edge of flange. At roof penetrations, a 1-inch cant of roofing cement shall be applied at the intersection of the penetration flashing and the sealing plies.
- f. Pitch pockets shall be completely filled with roofing cement.

## 23. APPLICATION OF REFLECTIVE ROOF COATINGS

When reflective coating is specified, the coating shall be applied in conformance with Subsection 23.1 or 23.2, as applicable.

### 23.1 COATING OVER HOT-MOPPED ASPHALT

- a. The hot-mopped asphalt coating shall be allowed to weather to a dull, oxidized finish, as determined by the Engineer, before any reflective coating is applied. In no case shall reflective coating be applied sooner than 90 days after mopped asphalt is applied.
- b. The aluminum reflective coating shall be applied uniformly over the roof surfaces at a rate of not less than 1 gallon of aluminum coating per 200 square feet.

### 23.2 COATING OVER ASPHALT EMULSION

- a. The asphalt emulsion roof coating shall be allowed to set until no pickup of material results from normal foot traffic. Reflective coating material shall not be applied until the emulsion surface has been approved for coating by the Engineer.
- b. The reflective coating shall be applied uniformly over the roof surface at a rate of not less than 2/3 gallons per 100 square feet.

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INSTRUCTIONS FOR USE OF HWS-6200-S,  
STANDARD SPECIFICATION FOR REPAINTING OF STEEL STRUCTURES,  
AND GUIDE FOR PREPARATION OF PAINTING SPECIFICATIONS

When HWS-6200-S is used or referenced, the following shall be observed:

1. Specification HWS-6200-S is designed for use in repainting work by plant maintenance forces or by contract, and should not be used for new construction painting (see item 8 of these Instructions). One of the five paint systems outlined in the specification should be specified in the work order or accompanying specifications.
2. When special or unusual conditions exist, other paint systems using different paints, different surface preparation or number of coats may be specified. Consult DG-82-AC or the Steel Structures Painting Manual\* for further information in selection of paints.
3. Section 2 of HWS-6200-S requires spot cleaning surface preparation unless otherwise specified. The following may be used as a guide for determining when to specify over-all cleaning and priming:
  - a. If no rusting is present, solvent clean if necessary. Apply one or two coats of finish paint depending on conditions.
  - b. If less than 50% of the surface is rusted, use the spot cleaning, spot priming procedure covered by the specification.
  - c. If over 50% of the surface is rusted, remove rust and as much old paint as is practical. Apply a full prime coat and one or two finish coats as necessary.
4. For System No. 2 (frequently wet or high humidity conditions), it may be desirable to specify blast cleaning for badly rusted surfaces or severe service conditions.
5. When large areas of tight, well-adhered paint are to be removed this must be specified (See item 3.1c of HWS-6200-S). If the paint is not too thick, it may be advisable to use the spot cleaning as specified in HWS-6200-S and specify application of enough coats of primer to the bad areas to build them up to a satisfactory thickness. Then an over-all finish coat, or 2 coats, as required, may be specified.

\* Published by Steel Structures Painting Council, 4400 Fifth Avenue, Pittsburgh 13, Pa. Volumes I and II; available at W-10 Library.

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NO.	REVISION	APP'D	DATE	CIVIL ENGINEERING STANDARDS	SUBM. BY	DES. BY
					hes	chh
APPROVED BY ENGINEERING STANDARDS COUNCIL				INSTRUCTIONS FOR USE OF HWS-6200-S	DI-6200-S	
H.E. Struck SECRETARY, DATE 1-19-59						

6. Specify the colors required. Manufacturers' color numbers or Federal Standard 595 may be referenced for colors. This standard is nationally recognized by paint manufacturers.
7. If the finished film thicknesses are to be different from that specified in HWS-6200-S, specify the film thickness. (See items 2d and 6.8 of HWS-6200-S)
8. This specification is designed for maintenance painting and should not be used for new construction painting. For such work, it is recommended that the specifications of the Steel Structures Painting Council (SSPC) be referenced. For paint application, reference specification SSPC-PA 1-53T, Shop, Field, and Maintenance Painting. When SSPC-PA 1-53T is referenced, the following items must also be specified:
  - a. The type of surface preparation required. The SSPC specifications for surface preparation may be referenced for this. See DG-81-AC, Guide for Painting Specifications, for a list of these.
  - b. The type of pretreatment, if any. SSPC specifications for pretreatment may be referenced for this. See DG-81-AC for a list of these.
  - c. The type, color, and number of coats of paint to be used. Consult HWS-6200-S; DG-82-AC, Guide for Selection of Paints for Ordinary Service; the Steel Structures Painting Manual; or other authority for paint selection. The use of proprietary products of proven performance is recommended.

For painting the interior of potable water tanks, it is recommended that consideration be given to the vinyl paints. When properly applied, their performance is much superior to the commonly-used red lead and litharge. For such service, "double coating" of joints, welds, rivets and corners, as outlined in HWS-6200-S for System No. 4, is recommended. Before specifying any paint for a potable water tank be sure that the cured coating will be non-toxic, odorless, and will not impart tastes to the water. Of the three paints listed in System No. 4 (water immersion), only the Amercoat No. 86-33 or 86-33 HB system is recommended by the manufacturer for use in potable water tanks.

## APPENDIX I

SAFETY AND HEALTH CONSIDERATIONS

## A. GENERAL

General considerations for health and safety measures for painting operations are included in this appendix. They are presented as recommendations only and are not intended to relieve plant forces of the responsibility of contacting safety and health organizations in the department where the work is being done. Additional specific recommendations and requirements for health and safety should be obtained from Department health and safety organizations or the Industrial Hygiene Operation, Relations and Utilities Operation, which provides a plant-wide service in toxicology, ventilation design and testing, material analyses, respiratory requirements, etc.

## B. VENTILATION

The term "adequate ventilation" as used in this appendix and in the specification means positive ventilation of the type required to maintain safe working conditions for the particular operation being performed. "Adequate ventilation" may require exhaust equipment, forced ventilation to all portions of a room plus exhaust facilities, air fed respirators, or other equipment arrangements. In many indoor locations, adequately-sized mechanical air moving equipment is required. Specific recommendations for ventilation may be obtained from Industrial Hygiene Operation, R&UO.

## C. SOLVENT CLEANING, STEAM CLEANING, DETERGENTS, ETC.

Concentrations of solvents should be kept below the maximum allowable concentrations\* for breathing unless respiratory equipment is used.

Chemical cartridge respirators are usually satisfactory unless concentrations are above 1000 ppm or can be smelled through such a respirator, in which case a more protective canister type or an air supply mask is necessary. Concentrations of solvents must always be kept below the lower explosive limit\*. Contact with solvents or other cleaning compounds should be avoided. Gloves may be required.

Use of detergents or other cleaning compounds should be reviewed beforehand by Department health and safety organizations or Industrial Hygiene Operation.

## D. REMOVING OLD COATINGS

A Lead Dust Respirator approved by the Bureau of Mines should be used during brushing, scaling, sanding, chipping, etc. of old coatings. Face shields or goggles should also be used.

\* See Appendix II for values.

## E. BLAST CLEANING

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1. Nozzle blast operators exposed to blast dust from old coatings should wear a Lead Dust Respirator approved by the U.S. Bureau of Mines. Other approved respiratory equipment should be provided when blast cleaning other surfaces.
2. Respiratory equipment should be worn by all others who are exposed to blast dust. Adequate protection from flying particles should be provided.
3. Safety goggles should be worn by all persons near any blasting operation.
4. The blast hose should be grounded to dissipate static charges.

## F. MIXING AND THINNING

1. Respiratory equipment should be worn when mixing or thinning paints in poorly ventilated areas and at all times when mixing or handling dry, powdered, toxic pigments such as litharge (lead oxide).
2. Other precautions associated with solvents and pigments are noted under Sections C and G of this appendix.

## G. PAINT APPLICATION

## 1. General

- a. All necessary precautions should be taken to protect personnel and property from hazards due to falls, injuries, toxic fumes, fire, explosion or other harm.
- b. Particular care should be used when working in closed spaces. Adequate ventilation should be provided. If the structure previously contained flammable materials, it should be purged of dangerous concentrations.

Ventilation of closed spaces, tanks, etc. should be maintained until the coating is dry, to prevent buildup of vapors released from the coating during drying. See Sections A, B and C of this appendix for further information on solvents, ventilation and respiratory equipment.

- c. Extraordinary care should be taken to prevent fire. Cans of paint should be opened only as needed. Wiping cloths and oily rags should be kept in tightly closed metal containers and removed from buildings at the close of each day's work. Smoking, sparks, welding and open flames should not be allowed around painting operations. Areas where painting is being done should be barricaded and "No Smoking" signs posted.
- d. All personnel engaged in painting, paint mixing, etc. should clean themselves thoroughly before smoking or eating and before leaving the job.

## 2. Spray Painting

Respiratory equipment should be worn at all times when spraying paints except where the pigments and rapidly volatilized solvents are definitely controlled by ventilation. When respiratory equipment is not used, the concentration of solvents should be kept below the maximum allowable concentration\* for breathing. Approved respiratory equipment should always be used when spraying paints containing red lead, white lead, blue lead, litharge (lead oxide) or other lead compounds. This applies to other persons besides the spray equipment operator who are exposed to the fumes. The concentration in air of flammable solvents must always be kept below the lower explosive limit.\*\*

\* See Appendix II for values.

\*\* The maximum allowable concentration of solvent vapors for breathing is well below the lower explosive limit in all cases. See Appendix II.

APPENDIX II

CAPE-1072-520

The following threshold limit values for solvents (Column A) were adopted at the annual meeting of the American Conference of Governmental Industrial Hygienists in April, 1958, and are taken from the A.M.A. Archives of Industrial Health, August, 1958.

The lower explosive limits (Column B) are taken from Factory Mutual Bulletin of Loss Prevention No. 36.10, January 1945.

Solvent	Column A	Column B
	Maximum allowable concentration in parts per million, by volume for breathing during continuing 8 hour working days	Lower explosive limit, per cent by volume in air
Acetone (dimethyl ketone)	1000	2.15
Amyl acetate*	200	1.1
Benzene (benzol)*	25	1.4
Butyl alcohol (n-butanol)	100	1.7
Carbon tetrachloride*	25	non-flammable
Cellosolve (2-ethoxyethanol)	200	2.6
Cellosolve acetate	100	1.71
Ethyl alcohol (ethanol)	1000	3.28
Methyl alcohol (methanol)	200	6.0
Methyl ethyl ketone (butanone)	250	1.81
Stoddard solvent (mineral spirits)	500	1.1
Toluene (toluol)	200	1.27
Trichloroethylene	200	non-flammable
Turpentine	100	0.8
Xylene (xylol)	200	1.0

Dusts, Fumes, Mists

Milligrams per Cubic Meter of Air

Lead	0.2	---
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\* The use of amyl acetate, benzene and carbon tetrachloride should be avoided if at all possible, due to the health hazard. Special written permission from proper HAPO Safety & Health authorities must be secured for the use of carbon tetrachloride when a satisfactory substitute cannot be found.

HWS-6200-S

STANDARD SPECIFICATION  
FOR  
REPAINTING  
OF  
STEEL STRUCTURES

HAPO Ref. Stds: None

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APPROVED BY ENGINEERING STANDARDS COUNCIL H. E. Struck SECRETARY. DATE 1-19-59				REPAINTING OF STEEL STRUCTURES	HWS-6200-S	

CAPE - 1072 - 522  
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HWS-6200-S  
STANDARD SPECIFICATION FOR REPAINTING  
OF STEEL STRUCTURES

1. SCOPE

This specification covers repainting of interior and exterior steel surfaces such as structural steel, tanks, handrails, piping, etc., subjected to normal exposures and weathering. It is not intended to cover machinery and equipment, severe chemical service, or new construction painting.

2. PAINT SYSTEMS AND MATERIALS

Unless otherwise specified, use the following paint systems and materials:

a. System No. 1 (for normally dry conditions, interior or exterior)

<u>Minimum</u> <u>Surface</u> <u>Prepara-</u> <u>tion:</u>	Unless otherwise specified, spot clean by "hand cleaning" (sections 3.1 & 3.2) or "power tool cleaning" (sections 3.1 & 3.3).
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Primer: (1) 1 coat spot prime of a single or mixed pigment, maintenance type primer:

- (a) Rust Oleum - No. 769 Dampproof Red Primer
- (b) Sherwin-Williams Co. - Metal Primer Red
- (c) DuPont - ENG-1008 No. 785 DuPont Metal Primer or approved equal.

(2) or 1 coat spot prime of a zinc dust, zinc oxide alkyd base primer:

- (a) DuPont - ENG-1007 No. 765 Dulux Galvanized Metal Primer
- (b) Sherwin-Williams Co. - Galvanized Iron Primer or approved equal.

(3) or, where steel is exceptionally hard to clean:

1 coat spot prime of a slow drying, linseed oil, red lead primer, National Lead Co. Dutch Boy 055 Liquid Red Lead, or approved equal. Where quicker drying is required, add 2 lbs of litharge per gallon.

Finish  
Paint:

1 spot coat plus 1 complete coat of an alkyd base, metal protective paint:

- (a) Sherwin-Williams - Metalastic  
 (b) DuPont - ENG-5100-5199 Dulux Metal Protective Paint  
 (c) Rodda Paint Co. - Exterior Metal Paint (SSPC-Paint 104-55T)  
 or approved equal.

or a Ready-to-Mix aluminum alkyd paint:

- (d) Sherwin-Williams Co. - Silverbrite Aluminum #95  
 (e) Socony Paint Co. - 11-A-1 Exterior Aluminum Paint  
 (f) DuPont - ENG-8400 No. 976 Dulux Ready-to-Mix Aluminum Paint  
 or approved equal.

- b. System No. 2 (for frequently wet or high humidity conditions, interior or exterior)

Minimum  
Surface  
Prepara-  
tion:

Unless otherwise specified, spot clean by "power tool cleaning" (sections 3.1 & 3.3).

Primer &  
Finish  
Paint:

Same as system No. 1.

- c. System No. 3 (for potable or non-potable cold water tank interiors)

Minimum  
Surface  
Prepara-  
tion:

Unless otherwise specified, spot clean by "hand cleaning" (sections 3.1 & 3.3) or "power tool cleaning" (sections 3.1 & 3.3).

Primer &  
Finish  
Paint:

1 coat spot prime, brushed, plus 2nd spot prime coat on joints, welds, rivets, corners, etc., plus 2 complete coats National Lead Co. Dutch Boy No. 055 Liquid Red Lead, or approved equal, red lead oil base primer with 2 lbs litharge added per gallon.

- d. System No. 4 (for steel surfaces continuously wet by immersion or condensation or in very highly humid atmospheres, where paint deterioration and metal rusting is such that a complete repaint job is required. Not for potable water tanks unless so specified).

Minimum Surface Preparation: "Blast cleaning" (sections 3.1 & 3.4) over entire surface to be painted.

Primer: 1 brush spot coat over joints, welds, rivets and corners, plus 1 complete brush coat water resistant primer:

- (a) Amercoat - No. 86 Primer (vinyl-epoxy primer)
- (b) DuPont - ENG-1011 No. 570 Chemical Resistant Gray Primer (vinyl)
- (c) Sherwin-Williams - Chemical and Moisture Resisting Red Lead Primer No. B69E11 (chlorinated rubber) or approved equal.

Finish Paint: 2 or more complete coats water resistant finish paint sufficient to make total dry film thickness of 5 mils. Use double spray passes or heavy brush coats at joints, welds, rivets and corners, to give double thickness (8-10 mils) at these points.

- (a) Amercoat - No. 33 aluminum (vinyl) or 33 HB aluminum
- (b) DuPont - ENG-6200-6299 Chemical Resistant Paint(vinyl)
- (c) Sherwin-Williams - Chemical and Moisture Resisting Enamel (chlorinated rubber) or approved equal.

NOTE: For these paints use only the products of one manufacturer in any one system (primer, finish, thinners). Different brands of these synthetics may not be compatible.

- e. System No. 5 (for surfaces with temperatures up to 500-600 F, interior or exterior)

Minimum Surface Preparation: "Blast cleaning" (sections 3.1 & 3.4) over entire surface to be painted.

Primer: 1 complete coat heat resistant paint:

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- (a) Pittsburgh - Ironhide Heat Resistant Gray No. 8-10  
(zinc dust, zinc oxide)
- (b) Preservative Paint Co. - Red Hot Aluminum No. 2058
- (c) Amercoat - No. 61 Stack Coating (silicone) aluminum
- (d) Midland Industrial Finishes Co. - Sicon Aluminum  
No. 3X258 (silicone)
- (e) Amercoat Corp. - Dimetecote No. 3 (zinc silicate)  
1 coat only, (500 F, temperature limitation)  
or approved equal.

Finish 1 complete coat of same paint used for first coat, except  
Paint: item (e) which requires only the first coat.

### **3. SURFACE PREPARATION**

Refer to Section 2 for the type of surface preparation to be used with each paint system. Prepare surfaces as follows:

#### **3.1 GENERAL**

The following requirements apply equally to hand cleaning, power tool cleaning and blast cleaning:

- a. Oil or grease shall be removed by solvent cleaning. The surfaces shall be wiped or scrubbed with rags or brushes wetted with "Stoddard Solvent" or approved high flash solvent (flash point 100 F or above). The final wiping shall be done with clean solvent and clean rags.

Because of fire and explosion hazards, no work shall proceed until safe conditions have been established. Adequate ventilation shall be provided. Areas where solvent cleaning is being done shall be barricaded and "No Smoking" signs posted.

Emulsion cleaners or steam cleaning with detergents or cleaners may be used in place of solvent cleaning. However, the surfaces must be steamed or washed with clean, hot water to remove residues. Note: Some detergents and cleaning compounds are toxic.

- b. Rust scale shall be removed by hand hammering, chipping, scraping, power impact tools, or a combination of these methods. Hand scrapers shall be used for light gage metal. When specified, light gage metal weakened by excessive rusting shall be replaced.

- c. Large areas of tight, well-adhered paint shall be removed only if specified. Thick edges of remaining old paint shall be feathered so that the repainted surface will have a smooth appearance. The remaining old paint shall have sufficient adhesion so that it cannot be lifted as a layer by inserting the blade of a dull putty knife under it.
- d. All rivets, crevices, welds, joints, and openings shall be cleaned by hand scraping, sanding, chipping, brushing or with power wire brushes, rotary grinders or sanders, or by a combination of such methods.
- e. There shall be no burrs, sharp ridges or sharp cuts in the steel when surface preparation is complete.
- f. After cleaning is complete, dust and other loose matter shall be removed from the surface. If grease or oil is still present, these areas shall be spot cleaned with solvent.
- g. The prime coat shall be applied as soon as possible after cleaning and before further rusting occurs.

### 3.2 HAND CLEANING

- a. Deposits of oil or grease shall be removed as outlined under 3.1, GENERAL.
- b. All loose mill scale, loose rust, and loose paint shall be removed by hand wirebrushing, hand sanding, hand scraping or a combination of these methods.
- c. The surface of the metal shall be cleaned to at least the standard of surface preparation established by the following test. This test also establishes the definition of loose mill scale, loose rust, and loose paint.

Rust, mill scale and paint are classified as loose mill scale, loose rust, and loose paint if they can be removed from a steel surface by vigorous hand brushing with a new, commercially acceptable wire brush, at a rate of two square feet per minute. This test shall be conducted on an area not previously brushed, scraped or sanded, but from which all detrimental rust-scale, oil, and grease have been removed. This test establishes a standard for surface preparation and shall not be considered as establishing the production rate of cleaning.

### 3.3 POWER TOOL CLEANING

- a. Deposits of oil or grease shall be removed as outlined under 3.1, GENERAL.
- b. All loose mill scale, loose rust and loose paint shall be removed by one or more of the following methods:
  - (1) Power wirebrushing using rotary radial or cup brushes of suitable size and stiffness. The surface shall not be polished or burnished.
  - (2) Power impact tool cleaning using power driven chipping or scaling hammers, or other similar impact cleaning tools.
  - (3) Power grinding using abrasive wheels or power sanding using abrasive materials.
- c. The metal surface shall be cleaned to at least the standard of surface preparation established by the following test. This test also establishes the definition of loose mill scale, loose rust, and loose paint.

Mill scale, rust, and paint are classified as loose mill scale, loose rust, and loose paint if they can be removed from a steel surface by power wirebrushing using a commercial air or electric wire brushing machine operated at a speed under load of 3450 RPM and equipped with a 6-inch diameter cup brush, of double row knotted construction, made of No. 20 gauge music wire (Osborn Manufacturing Company, Cleveland, Ohio, Brush No. 4503 or equal.) The brush shall be held against the steel surface with a force of sixteen pounds, and the rate of cleaning shall be two square feet of surface per minute. This test must be conducted on an area not previously brushed, scraped, or sanded, but from which all detrimental rust-scale, oil, and grease have been removed. This test establishes a standard for surface preparation and shall not be considered as establishing the production rate of cleaning.

- d. If an area is inaccessible to power tools, it shall be cleaned by hand cleaning methods.

### 3.4 BLAST CLEANING

- a. Heavy deposits of oil or grease shall be removed by solvent cleaning as outlined under 3.1, GENERAL. Small quantities of oil or grease may be removed by the blast cleaning operation. Abrasive used to remove oil or grease shall not be re-used.
- b. The surface of the metal shall be cleaned to at least the standard of surface preparation established by the following test:

An acceptable blast cleaned surface is defined as one which is cleaned at least as well as one which has been air pressure blasted with dry Ottawa silica sand, American Foundryman's Association standard grade No. 27, through a new nozzle, with a one-quarter inch diameter bore, using an air pressure of 90 pounds per square inch gauge at the entrance to the nozzle. During this test the nozzle shall be held at the optimum angle and distance for the particular surface being cleaned. In this test a plane or slightly curved surface shall be cleaned at a rate of three square feet per minute of blasting time. This test establishes a standard for surface preparation and shall not be considered as establishing the production rate of cleaning.

- c. Blast cleaning shall be done by dry, wet, or water vapor sandblasting using compressed air blast nozzles. A graded flint or silica sand of 16-30 mesh, that is, 0% retained on a 16 mesh screen, 100% retained on a 30 mesh screen, shall be used. Other permissible grits are cast iron, malleable iron, steel or synthetic grits other than sand.
- d. For nozzle blasting, only compressed air which is free of condensed water or oil shall be used. Separators and traps shall be provided.
- e. When blasting is complete, all dust, blast products, abrasive, etc. shall be removed by brushing or by vacuum.
- f. Wet sandblasted surfaces shall be rinsed with fresh water which has corrosion inhibitor added to prevent rusting, or with fresh water followed immediately by an inhibitive treatment. When the surface has dried, it shall be brushed to remove any residue.
- g. Since blasted surfaces rust rapidly, the surface shall be primed within 8 hours after blasting. The bare metal surface shall not be left overnight before priming. If any visible rusting occurs, it shall be re-blasted and primed immediately.

h. The blast hose shall be grounded to dissipate static charges.

#### 4. STORAGE OF PAINT AND THINNER

- a. All paints and thinner shall be stored in a well ventilated area, free from excessive heat, sparks, flame or direct rays of the sun. Paints subject to freeze damage shall be prevented from freezing.
- b. Containers shall not be opened until required for use. Those which have been opened shall be used first. The oldest paint of each kind shall be used first.
- c. Paint which has livered, gelled, or otherwise deteriorated during storage shall not be used.

#### 5. MIXING AND THINNING

- a. All ingredients of paint shall be mixed thoroughly before use. For containers over 5 gallons in size, a mechanical mixer shall be used. All lumps, settled pigments, etc. shall be broken up so that the paint has a uniform composition with no streaks of color.
- b. Any skin which may have formed shall be removed and discarded.
- c. All pigmented paint shall be strained after mixing. A strainer which removes only undesirable matter and not the dispersed pigment shall be used.
- d. Dry pigments which are separately packaged, shall be uniformly blended and all particles thoroughly wetted by the vehicle. For such paints, only that amount required in a day's use shall be mixed.
- e. Thinner shall not be added to paint unless it is necessary for proper application. Not more than one pint of thinner shall be added per gallon unless the paint is made for greater thinning. Only the type of thinner recommended by the paint manufacturer shall be used.

#### 6. APPLICATION

##### 6.1 CLEANING

Prior to painting, any oil, grease, dust or foreign matter deposited on the surface after surface preparation is completed shall be removed. If rusting has occurred, the surfaces shall be cleaned again in accordance with the specified method. Special care shall be taken to prevent contamination of cleaned surfaces with salts, acids, alkali or other corrosive chemicals before priming and between coats. Any such contamination shall be removed from the surface.

## 6.2 WEATHER AND TEMPERATURE LIMITATIONS

### a. Paint shall not be applied:

- (1) when the surrounding air temperature is below 40 F,
  - (2) when the temperature is expected to drop to 32 F or below before the paint has dried,
  - (3) to steel which is more than 5 degrees Fahrenheit below the air temperature,
  - (4) to steel which is at a temperature less than 35 F,
  - (5) to steel which is at a temperature over 125 F except where a manufacturer's instructions permit it, such as for a special heat resistant paint,
  - (6) in rain, snow, fog, mist or sandstorms,
  - (7) when the relative humidity exceeds 85 per cent,
  - (8) to wet, damp, frosted or ice coated surfaces.
- b. If any freshly applied paint is exposed to freezing, excess humidity, rain, snow, dust, or condensation, it shall be allowed to dry. Then damaged areas of paint shall be removed, the surface prepared again, and the damaged areas repainted same as the undamaged areas.

## 6.3 TINTING OF COATS

When successive finish paint or primer coats of the same color are used, alternate coats shall be tinted to produce enough contrast to indicate complete coverage.

## 6.4 METHODS OF APPLICATION

Paint shall be applied by brushing or spraying, or a combination of these methods, unless otherwise specified.

## 6.5 APPLICATION - GENERAL

- a. Paint shall be worked into all crevices and corners where possible.
- b. Runs and sags shall be brushed out immediately, whether spray painting or brushing.

- c. Surfaces not accessible to brushes shall be painted by spray, and vice-versa. When not accessible to either, painting shall be by daubers or sheepskins.
- d. Paint ingredients shall be kept properly mixed in the spray pots or containers during application, either by continuous mechanical or intermittent hand agitation.
- e. If any paint curls or lifts after being painted over, it shall be removed by scraping and the area shall be repainted.

#### 6.6 SPRAY EQUIPMENT & APPLICATION

- a. Only equipment which is capable of properly applying the paint shall be used. It shall be operated as recommended by the manufacturer for the material being sprayed.
- b. The equipment shall have traps or separators to remove oil and condensed water from the air. These traps or separators shall be drained periodically during operations. The air from the spray gun impinging against the surface shall show no condensed water or oil.

#### 6.7 DRYING

- a. Sufficient time for each coat to be in the proper state of cure or dryness shall be allowed before applying the next coat. Paint shall be considered dry for recoating when an additional coat can be applied without wrinkling, lifting or loss of adhesion of the undercoat.
- b. When an undercoat is too hard or glossy for proper adhesion of the next coat, it shall be sanded lightly or a solvent applied which will increase adhesion but not cut through or decrease the performance of the undercoat.

#### 6.8 FINISHED FILM THICKNESSES AND APPEARANCE

- a. Unless otherwise specified, prime coats of paint shall be at least 1.5 to 2.0 mils thick when dry, and each intermediate and finish coat of paint shall be at least 1.0 to 1.5 mils thick when dry. The film thickness shall not be so great that either the appearance or the service life of the paint will be adversely affected.

- b. The finished paint films shall show uniform coverage throughout and shall be reasonably free from brush marks, paint runs, sags, thin covering, overspray, noticeable color variation or foreign substances. Edges of paint adjoining other colors or material shall be clean and sharp without overlapping.

7. INSPECTION

All work and materials supplied under this specification shall be subject to inspection by the owner's representative. All parts of the work shall be accessible to the inspector. Materials which are found to be defective shall be replaced. Workmanship found to be defective shall be corrected.

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INSTRUCTIONS FOR USE OF HWS-6201-S

STANDARD SPECIFICATION FOR MAINTENANCE PAINTING OF CONCRETE,  
WOOD AND PLASTERBOARD

When HWS-6201-S is used or referenced, the following shall be observed:

1. Specification HWS-6201-S is designed for use in painting and repainting work by plant maintenance forces. One of the six paint systems outlined in the specification should be specified in the work order. This specification is not intended to be used for contract work.
2. When special or unusual conditions exist, other paint systems using different paints, different surface preparation or number of coats may be specified. Consult DG-82-AC for further information in selection of paints.
3. When large areas of tight, well-adhered paint are to be removed, the removal must be specified, (see item 3.1d).
4. Specify the colors required. Manufacturers' color numbers or Federal Standard 595 may be referenced for colors. Federal Standard 595 is nationally recognized by paint manufacturers. (See also Hanford Guide DG-84-AC, Paint Colors).
5. It may be desirable to specify more than one finish for an area, e.g. semi-gloss of one color for the walls below the wainscote, usually 4' high, and flat paint of another color for the upper walls and ceiling.
6. Specify method of application if a specific method is desired, e.g. brushing, spraying, rolling or other.
7. Consideration should be given to Appendix I and II, Safety and Health Considerations, of DI-6200-S, Instructions for Use of HWS-6200-S, Standard Specification for Repainting Steel Structures.

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APPROVED BY ENGINEERING STANDARDS COUNCIL				INSTRUCTIONS FOR USE OF HWS-6201-S	DI-6201-S	
H.E. Struck SECRETARY, DATE 6-28-60						

CAPE-1072-535

HWS-6201-S

STANDARD SPECIFICATION

FOR

MAINTENANCE PAINTING OF

CONCRETE, WOOD AND PLASTERBOARD

Not for use in construction contracts

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HWS-6201-S  
STANDARD SPECIFICATION FOR  
MAINTENANCE PAINTING OF  
CONCRETE, WOOD AND PLASTERBOARD

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HWS-6201-S  
STANDARD SPECIFICATION FOR  
MAINTENANCE PAINTING OF  
CONCRETE, WOOD AND PLASTERBOARD

1. SCOPE

This specification covers painting and repainting of concrete, wood, plasterboard and plaster surfaces subjected to normal exposures and weathering. It is not intended to cover structural steel, miscellaneous steel and metals, machinery and equipment or severe chemical service.

2. PAINT SYSTEMS AND MATERIALS

The following paint systems and materials or approved equals shall be used unless specified otherwise. Only compatible products shall be used in any one system (primer, finish, thinners).

- a. System No. 1 (for exterior poured concrete walls, concrete block & asbestos - cement board) (flat)

Minimum  
Surface  
Preparation:

In accordance with section 3.1 and 3.2 b, & c of this specification unless specified otherwise.

United Paint

Prime & Finish Coat: Two coats "Vinyl Coat"

Fuller

Prime & Finish Coat: Two coats "No. 820 Exterior Latex Masonry Paint."

Pittsburgh

Prime & Finish Coat: Two coats "Cementhide" Rubberized Masonry Paint

Benjamin Moore

Prime & Finish Coat: Two coats "Stucco Gard"

- b. System No. 2 (for interior concrete block walls, poured concrete, plaster, plasterboard and asbestos-cement board walls and ceilings) (semi-gloss)

Minimum  
Surface  
Preparation:

In accordance with section 3.1 and 3.2 b, c & d of this specification unless specified otherwise.

DuPont

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Prime Coat: One coat 860 DuPont "Primer-Sealer"(odorless)  
Eng. 1202

Finish Coat: One coat Color Conditioning "Dulux" Semi-  
gloss Enamel (odorless) Eng. 3200-3249

Pittsburgh

Prime Coat: One coat "Wallhide" Primer-Sealer 24-10

Finish Coat: One coat "Wallhide" Semi-Gloss Enamel, 27 Serie

United Paint

Prime Coat: One coat "Nu-Wall" Primer-Sealer

Finish Coat: One coat "Pearlite"

c. System No. 3 (for interior concrete floors) (gloss)

Minimum In accordance with section 3.1 and 3.2 b of this specification  
Surface unless specified otherwise.  
Preparation:

DuPont

Prime & Finish Coat: Two coats "DuPont Porch and Floor  
Enamel" Eng. 8350-8399

Pittsburgh

Prime & Finish Coat: Two coats "Florhide" enamel, 3 Series.

General Paint

Prime & Finish Coat: Two coats "Quick-Step" 3700

North Coast Chemical

Prime & Finish Coat: Two coats "Durokote Gray Floor Seal".

United Paint

Prime & Finish Coat: Two coats "Quickstone Floor Enamel".

d. System No. 4 (for exterior wood) (flat)

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Minimum  
Surface  
Preparation:

In accordance with section 3.1 and 3.2 a of this specification unless specified otherwise.

DuPont

Prime Coat: DuPont "39 Wood Primer" Eng 1100

Finish Coats: Two coats DuPont "40 Outside White House Paint" Eng. 4000, or DuPont "Trutint House Paint Colors (Alkyd for Siding and Trim)" Eng. 4057, 4075, 4076, 4077, 4080, 4081

Pittsburgh

Prime Coat: One coat "Sun-Proof" White Primer 1-201

Finish Coats: Two coats "Sun-Proof" House Paint, 1 Series

Sherwin-Williams

Prime Coat: One coat "450 Undercoater"

Finish Coats: Two coats "SWP House Paint".

Benjamin Moore

Prime Coat: One coat "Morwhite" Primer

Finish Coats: Two coats "Moore's House Paint" or "Moore's Decorative Trim Color" (best grade)

e. System No. 5 (for interior wood walls, ceiling and trim) (semi-gloss)

Minimum  
Surface  
Preparation:

In accordance with section 3.1 and 3.2 a of this specification unless specified otherwise.

DuPont

Prime Coat: One coat 63 "Duco" Undercoat White (odorless) Eng. 2100

Finish Coat: One coat Color Conditioning "Dulux" Semi-Gloss enamel (odorless) Eng. 3200-3249

Pittsburgh

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Prime Coat: One coat "Architectural Enamel Undercoater"  
48-30

Finish Coat: One coat "Architectural Enamel, Rubbed Effect"  
48-31

Sherwin-Williams

Prime Coat: One coat "Flat-rite" Undercoater

Finish Coat: One coat "Semi-Lustre"

Benjamin Moore

Prime Coat: One coat "Moore's Alkyd Enamel Underbody"

Finish Coat: One coat "Moore's Alkyd Dulamel" or one coat  
"Moore's Regal Wall Satin."

General Paint

Prime Coat: One coat "5 Star" Paste Undercoater 2213

Finish Coat: One coat "Semi-gloss enamel 70467"

- f. System No. 6 (for interior wood, concrete, concrete block, plaster,  
plasterboard, and asbestos-cement walls and ceilings) (flat)

Minimum Surface Preparation: In accordance with section 3.1 and 3.2 of this specification unless specified otherwise.

DuPont

Prime Coat: One coat 860 DuPont "Primer-Sealer"(odorless)  
Eng. 1202

Finish Coat: One coat "Flow-kote" Wall Paint (odorless)  
Eng. 3400-3449.

Pittsburgh

Prime Coat: One coat "Wallhide" Primer-Sealer 24-10

Finish Coat: One coat "Wallhide" Rubberized Wall Paint,  
64 Series.

Prime Coat: One coat "Flat-Rite" Undercoater

Finish Coat: One coat "Super Kem-Tone".

### 3. SURFACE PREPARATION, CLEANING

#### 3.1 GENERAL

All dirt, dust, oil, grease, exuded sap, pitch, old loose coatings, calcimine, or any interfering substances shall be removed. Surfaces shall be primed or painted not more than 24 hours after the surfaces have been prepared.

In using power-driven wire brushes, burnishing shall be avoided.

- (a) DIRT AND DUST shall be removed by hand or power-driven wire brushes, hand or power-driven scrapers, by vacuum or bristle brush, or by washing with detergent and water.
- (b) CHEMICAL DEPOSITS shall be removed by washing with water.
- (c) OIL, GREASE AND WAX shall be removed by a solvent wash or by steam using cleaning compounds. The solvent shall be oil-free.
- (d) LOOSE, SCALING PAINT shall be removed. Large areas of tight, well-adhered paint shall be removed only if specified. Thick edges of remaining old paint shall be feathered so that the repainted surface will have a smooth appearance. The remaining old paint shall have sufficient adhesion so that it cannot be lifted as a layer by inserting the blade of a dull putty knife under it.
- (e) MILDEW shall be removed by scraping and then by washing thoroughly with a solution of tri-sodium phosphate (1-1/2 oz to a gallon of water) followed by a water rinse.
- (f) HARDWARE, hardware accessories, plates, lighting fixtures, and similar items in place prior to painting, shall be removed during painting operations and repositioned upon completion of each space, or shall be otherwise protected.
- (g) RADIATORS and other equipment adjacent to walls shall be disconnected by workmen skilled in these trades and moved to permit the wall surfaces to be painted, and, following completion of painting, shall be replaced and reconnected.

### 3.2 SURFACES

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#### a. WOOD SURFACES

Knots, sap streaks and pitch areas shall be sealed with DuPont "Ready-Mixed Aluminum Paint" or a shellac type sealer or an approved equal. New or unfinished wood shall be sanded as necessary. Countersunk nail holes and cracks shall be puttied after first coat is dry.

#### b. MASONRY, CONCRETE AND PLASTER SURFACES

These surfaces shall be allowed to dry completely (usually 30 days) before painting. Cracks and crevices of interior plaster and masonry shall be filled with a patching plaster; for exterior masonry surfaces a portland cement-lime mortar shall be used. Glaze from a hard smooth troweled surface shall be removed by etching with muriatic acid (5 percent solution with water). After etching, the surface shall be flushed with water and allowed to dry.

#### c. ASBESTOS-CEMENT SURFACES

No surface preparation required except that it shall be dry and free of dust and dirt or other foreign substances.

#### d. PLASTERBOARD SURFACES

Cracks, gouges, nail holes and other imperfections shall be filled with a gypsum cement patching compound. Patched areas and joints shall be sanded.

### 3.3 PROTECTING SURFACES NOT TO BE PAINTED

- a. Precautions shall be taken to protect surfaces not to be painted from paint splash or drip.
- b. Clean drop cloths shall be used to protect all surfaces not to be painted. All spatter or smears shall be removed from finished surfaces, hardware and glass.

### 4. STORAGE OF PAINT AND THINNER

- a. All paints and thinners shall be stored in a well ventilated area, free from excessive heat, sparks, flame or direct rays of the sun. Paints subject to freeze damage shall be prevented from freezing.
- b. When not in use, paints and thinners shall be kept in metal containers, tightly covered.

## 5. MIXING AND THINNING

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- a. All ingredients of paint shall be mixed thoroughly before use. For containers over 5 gallons in size, a mechanical mixer shall be used. All lumps, settled pigments, etc. shall be broken up so that the paint has a uniform composition with no streaks of color.
- b. Paint which has "livered", gelled, or otherwise deteriorated during storage shall not be used.
- c. Any skin which may have formed shall be removed and discarded.
- d. All pigmented paint shall be strained after mixing. A strainer which removes only undesirable matter and not the dispersed pigment shall be used.
- e. Dry pigments which are separately packaged, shall be uniformly blended and all particles thoroughly wetted by the vehicle. For such paints, only that amount required in a day's use shall be mixed.
- f. Thinner shall not be added to paint unless it is necessary for proper application. Only the type and amounts of thinner recommended by the paint manufacturer shall be used.

## 6. APPLICATION

### 6.1 CLEANING

Prior to painting, all oil, grease, dust or foreign matter deposited on the surface after surface preparation is completed shall be removed. Special care shall be taken to prevent contamination of cleaned surfaces with salts, acids, alkali or other chemicals before priming and between coats. Any such contamination shall be removed from the surface.

### 6.2 WEATHER AND TEMPERATURE LIMITATIONS

- a. Paint shall not be applied:
  - (1) when the surrounding air temperature is below 40 F.
  - (2) when the temperature is expected to drop to 32 F or below before the paint has dried,
  - (3) in rain, snow, fog, mist or sandstorms,
  - (4) when the relative humidity exceeds 85 percent,
  - (5) to wet, damp, frosted or ice coated surfaces.

- b. If any freshly applied paint is exposed to freezing, excess humidity, rain, snow, dust, or condensation, it shall be allowed to dry. The damaged areas of paint shall be removed, the surface prepared again, and the damaged areas repainted same as the undamaged areas.

### 6.3 TINTING OF COATS

When successive finish paint or primer coats of the same color are used, alternate coats shall be tinted to produce enough contrast to indicate complete coverage.

### 6.4 APPLICATION - GENERAL

- a. Paint shall be worked into all crevices and corners.
- b. Runs and sags shall be brushed out immediately, whether spray painting, brushing, or roller painting.
- c. Paint ingredients shall be kept properly mixed in the spray pots or containers during application, either by continuous mechanical or intermittent hand agitation.
- d. If any paint wrinkles, blisters, curls or lifts after being painted over, it shall be removed by scraping and the area shall be repainted.

### 6.6 SPRAY EQUIPMENT AND APPLICATION

- a. Only equipment which is capable of properly applying the paint shall be used. It shall be operated as recommended by the manufacturer for the material being sprayed.
- b. The equipment shall have traps or separators to remove oil and condensed water from the air. These traps or separators shall be drained periodically during operations. The air from the spray gun impinging against the surface shall show no condensed water or oil.

### 6.7 DRYING

- a. Sufficient time for each coat to be in the proper state of cure or dryness shall be allowed before applying the next coat. Paint shall be considered dry for recoating when an additional coat can be applied without wrinkling, lifting or loss of adhesion of the undercoat.
- b. When an undercoat is too hard or glossy for proper adhesion of the next coat, it shall be sanded lightly or a solvent applied which will increase adhesion but not cut through or decrease the performance of the undercoat.

The finished paint films shall show uniform coverage throughout and shall be reasonably free from brush marks, paint runs, sags, thin covering, overspray, noticeable color variation or foreign substances. Edges of paint adjoining other colors or material shall be clean and sharp without overlapping.

7. FIRE PRECAUTIONS

(See also Section 4, Storage of Paint and Thinner)

Wiping cloths and oily rags shall be kept in tightly closed metal containers and shall be removed from the buildings at the close of each day's work. Smoking, sparks, welding and open flames shall not be allowed around painting operations. Areas where painting or solvent cleaning is being done shall be barricaded and "No Smoking" signs posted.

Because of fire and explosion hazards no work shall proceed until safe conditions have been established\*. Adequate ventilation shall be provided\*.

8. INSPECTION

All work and materials supplied under this specification shall be subject to inspection by a representative of the component having the work accomplished. All parts of the work shall be accessible to the inspector. Materials which are found to be defective shall be replaced. Workmanship found to be defective shall be corrected.

\* See Appendix I and II, Safety and Health Considerations, of DI-6200-S, for additional items to be given consideration. The Area Safety, Health and Fire Prevention Specialists should be consulted for additional items and any special problems.

SPECIFICATIONS FOR PAINT MATERIALS

The following listing gives Federal Specification numbers which are approximately equivalent to the paints listed by brand name in HWS-6201-S. The specifications should be used for purchase of paints where, because of quantities involved, government regulations require the use of Federal or other specifications.

It should be noted that it is not possible to relate every brand or type of paint to a particular specification. Purchasing by specification will not necessarily obtain the brands listed and in some cases may not even obtain paint with the same type of vehicle or resin as the brands listed.

<u>System No. &amp; Surface</u>	<u>Type of Paint</u>	<u>Typical Brand Name</u>	<u>Approx. Equivalent Federal Spec.</u>
1. Exterior concrete, conc. block & asbestos-cement (flat)	Exterior latex masonry paint	Benjamin Moore "Stucco Gard"	TT-P-0055a
2. Interior concrete, conc. block, plaster, plasterboard & asbestos-cement (semi-gloss)	Primer-sealer	Pittsburgh "Wallhide" Primer-sealer 24-10	TT-P-56b
	Semi-gloss interior alkyd enamel	Pittsburgh "Wallhide" Semi-gloss enamel	TT-E-508
	Semi-gloss interior alkyd enamel (odorless)	DuPont Color Conditioning "Dulux" Semi-gloss enamel (odorless)	TT-E-00509
3. Interior concrete floors (gloss)	Floor enamel	General Paint "Quick-Step" 3700	TT-E-487
	Floor sealer	North Coast Chemical "Durokote Gray Floor Seal"	None

<u>System No. &amp; Surface</u>	<u>Type of Paint</u>	<u>Typical Brand Name</u>	<u>Approx. Equivalent Federal Spec.</u>
4. Exterior wood (flat)	Wood primer	DuPont " 39 Wood Primer"	TT-P-25a
	Linseed oil white house paint (chalking type)	DuPont " 40 Outside White Paint"	TT-P-102 Class A
	Alkyd fortified house paint in colors	DuPont "Trutint" House Paint Colors (alkyd for siding & trim)	TT-P-81c
5. Interior wood (semi-gloss)	Enamel under- coater	Benjamin Moore "Moore's Alkyd Enamel Underbody"	TT-P-56b
	Alkyd semi-gloss interior enamel	Benjamin Moore "Dulamel"	TT-E-508
6. Interior wood, concrete, conc. block, plaster, plasterboard & asbestos- cement (flat)	Primer-sealer	Pittsburgh "Wallhide" Primer-Sealer 24-10	TT-P-56b
	Latex base interior flat wall paint	Sherwin-Williams "Super Kem-Tone"	TT-P-29