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References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASME INTERNATIONAL (ASME)

ASME B16.12 (2009; R 2014) Cast Iron Threaded Drainage Fittings

ASTM INTERNATIONAL (ASTM)

ASTM A518/A518M (1999; R 2012) Standard Specification for Corrosion-Resistant High-Silicon Iron Castings

ASTM C1036 (2010; E 2012) Standard Specification for Flat Glass

ASTM D2447 (2003) Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter

ASTM D2665 (2014) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings

ASTM D4101 (2014) Standard Specification for Polypropylene Injection and Extrusion Materials

ASTM D6927 (2006) Standard Test Method for Marshall Stability and Flow of Bituminous Mixtures

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE (2004) NASA Reliability Centered Building and Equipment Acceptance Guide

1.2 SUBMITTALS

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NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project.

The Guide Specification technical editors have designated those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item, if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

An "S" following a submittal item indicates that the submittal is required for the Sustainability Notebook to fulfill federally mandated sustainable requirements in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

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Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submittals with an "S" are for inclusion in the Sustainability Notebook, in conformance to Section 01 33 29 SUSTAINABILITY REQUIREMENTS. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation Drawings[; G][; G, [\_\_\_\_]]

SD-03 Product Data

Borosilicate Glass Materials[; G][; G, [\_\_\_\_]]

High-Silicon Cast Iron Material[; G][; G, [\_\_\_\_]]

Polyethylene Material[; G][; G, [\_\_\_\_]]

Polypropylene Material[; G][; G, [\_\_\_\_]]

Polyvinylchloride Material[; G][; G, [\_\_\_\_]]

## SD-06 Test Reports

Test Reports[; G][; G, [\_\_\_\_]]

## SD-07 Certificates

Listing of Product Installations[; G][; G, [\_\_\_\_]]

Borosilicate Glass Materials[; G][; G, [\_\_\_\_]]

High-Silicon Cast Iron Material[; G][; G, [\_\_\_\_]]

Polyethylene Material[; G][; G, [\_\_\_\_]]

Polypropylene Material[; G][; G, [\_\_\_\_]]

Polyvinylchloride Material[; G][; G, [\_\_\_\_]]

### 1.3 GENERAL REQUIREMENTS

Submit installation drawings for chemical-waste drainage systems in accordance with the manufacturer's recommended instructions.

### 1.4 PREDICTIVE TESTING AND INSPECTION TECHNOLOGY REQUIREMENTS

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NOTE: The Predictive Testing and Inspection (PT&I) tests prescribed in Section 01 86 12.07 40 RELIABILITY CENTERED ACCEPTANCE FOR MECHANICAL SYSTEMS are MANDATORY for all [NASA] [\_\_\_\_] assets and systems identified as Critical, Configured, or Mission Essential. If the system is non-critical, non-configured, and not mission essential, use sound engineering discretion to assess the value of adding these additional test and acceptance requirements. See Section 01 86 12.07 40 RELIABILITY CENTERED ACCEPTANCE FOR MECHANICAL SYSTEMS for additional information regarding cost feasibility of PT&I.  
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This section contains systems and/or equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

Perform PT&I tests and provide submittals as specified in Section 01 86 12.07 40 RELIABILITY CENTERED ACCEPTANCE FOR MECHANICAL SYSTEMS.

## PART 2 PRODUCTS

### 2.1 BOROSILICATE GLASS, TYPE BSG

Provide borosilicate glass materials for drain, waste, and vent piping systems, tempered and annealed in conformance with ASTM C1036, coupling per

AISI Type 304 corrosion-resistant steel lined with Buna-N resilient member supporting a tetrafluoroethylene liner, ensuring that the liner is the only material wetted by waste stream. Verify piping class is BSG-1.

[ Provide vent-system materials 1800 millimeter 6 feet and higher above the floor of Type PP or PVC with extra-heavy Type HSCI extension through roof.

## ] 2.2 HIGH-SILICON CAST IRON, TYPE HSCI

For high-silicon cast iron material, conforming to ASTM A518/A518M, drain, waste, and vent piping systems provide bell-and-spigot or beaded-end straight barrel, extra heavy, acid-resistant soil pipe containing not less than 14-1/2 percent silicon. For joint seals provide lead and acid-resistant packing. Provide mechanical joint coupling constructed of AISI Type 304 corrosion-resistant steel with chloroprene resilient member supporting a tetrafluoroethylene liner, and ensure the liner is the only material wetted by waste stream. Tighten nut to a minimum of 12 newton-meter 9 foot-pounds.

[ Provide vent-system materials at 1800 millimeter 6 feet and higher above the floor of Type PP or Type PVC with extra-heavy Type HSCI extensions through roof.

## ] 2.3 POLYETHYLENE DRAIN, WASTE, AND VENT, TYPE PE-DWV

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**NOTE:** This guide specification for polyolefin thermoplastic drain, waste, and vent system materials provides for polyethylene use as a single material uniformly throughout the system or as a mixture of compatible materials. Materials include P-traps, drum traps, cup sinks, waste drains, downspouts, stand pipes, etc., as indicated.

PE materials are not recommended for service in subfreezing temperatures.

Type PE materials are prone to environmental-stress cracking. Ultraviolet light degrades PE materials.

Maximum continuous duty of type PE-DWV materials can not exceed 82 degrees C 180 degrees F. In multistory buildings, consider type HSCI or Type BSG mains or stacks.

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For polyethylene material drain, waste, and vent piping systems provide products manufactured from polyethylene (PE) olefin resins in conformance with ASTM D2447 and ASME B16.12 for applicable dimensions and configurations, Schedule 40, Type PE-2306, black, specifically suitable for joining by fusion of interfaces into a homogeneous mass at high temperatures. Ensure threaded assemblies are molded. No thread cutting is permitted.

Provide vent extensions through the roof of extra-heavy Type HSCI.

[ Selected drainage-system components may be manufactured from polypropylene (PP) materials, provided proposed means and methods of connection are recommended by the manufacturing source.

] 2.4 POLYPROPYLENE DRAIN, WASTE, AND VENT, TYPE PP-DWV

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NOTE: This guide specification for polyolefin thermoplastic drain, waste, and vent systems materials provides for pp use as a single material uniformly throughout the system or as a mixture of compatible materials. Materials include P-traps, drum traps, cup sinks, waste drains, downspouts, stand pipes, etc., as indicated.

Maximum continuous duty of type PP-DWV materials can not exceed 82 degrees C 180 degrees F. In multistory buildings, consider Type HSCI or Type BSG for mains or stacks.

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For Polypropylene material drain, waste, and vent piping systems provide products manufactured from Type I - 19509, black olefin resins conforming to ASTM D4101 and tested in accordance with applicable provisions of ASTM D2447. Comply with applicable provisions of ASME B16.12 for material dimensions and configurations.

Ensure pipe-wall thickness is Schedule 40 with minimum burst pressure when tested in accordance with ASTM D6927 for 60 to 90 seconds, as follows:

Size (millimeter) DN	40	50	80	100
Burst Pressure (kilopascal)	4585	380	3650	3100
Size (inches)	1-1/2	2	3	4
Burst Pressure (pounds per square inch)	665	550	530	450

Provide only PP materials specifically suitable for joining interfaces into a homogeneous mass by fusion at high temperatures, with molded threaded assemblies. No thread cutting is permitted.

Provide vent extensions through the roof of extra-heavy Type HSCI.

[ For selected drainage system components use products manufactured from PE materials when so specified, and provided proposed means and methods of connection as recommended by the manufacturing source.

] 2.5 POLYVINYLCHLORIDE DRAIN, WASTE, AND VENT, TYPE PVC-DWV

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NOTE: The following specification provides for polyvinylchloride thermoplastic drain, waste, and vent systems materials which include pipe and dwv fittings. P-traps, drum traps, cup sinks, waste drains, downspouts, standpipes, etc., are not covered.

Maximum continuous duty of PVC DWV materials can not exceed 66 degrees C 150 degrees F. In multistory

buildings, consider Type HSCI or Type BSG mains or stacks.

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For polyvinylchloride material drain, waste, and vent piping-system provide materials manufactured from Type I normal impact resins in conformance with ASTM D2665 and ASME B16.12 for applicable dimensions. Ensure materials are gray and specifically suited for joining socket interfaces into a homogeneous mass by solvent-cement welding.

Ensure all fittings are molded to produce, upon insertion of pipe, an interference fit at approximately 2/3 of the depth of the socket. No thread cutting is permitted.

Provide vent extensions through the roof of extra-heavy type HSCI.

### PART 3 EXECUTION

#### 3.1 INSTALLATION AND TESTING

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NOTE: If the specified system is identified as critical, configured, or mission essential, use Section 01 86 12.07 40 RELIABILITY CENTERED ACCEPTANCE FOR MECHANICAL SYSTEMS to establish predictive and acceptance testing criteria, above and beyond that listed below.

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Perform PT&I tests and provide submittals as specified in Section 01 86 12.07 40 RELIABILITY CENTERED ACCEPTANCE FOR MECHANICAL SYSTEMS.

Submit test reports consisting of system operation tests for chemical-waste drainage systems.

Within listing of product installations for chemical-waste drainage systems include identification of at least five units, similar to those proposed for use, that have been in successful service for a minimum of five years. Include purchaser, address of installation, service organization, and date of installation.

Install and test equipment in accordance with manufacturer's recommendations.

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