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USACE / NAVFAC / AFCEC / NASA **UFGS-01 33 00 (August 2018)**
Change 4 - 02/21

Preparing Activity: USACE **Superseding**
UFGS-01 33 00 (May 2011)

UNIFIED FACILITIES GUIDE SPECIFICATIONS
****

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 33 00

SUBMITTAL PROCEDURES

08/18, CHG 4: 02/21

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USACE / NAVFAC / AFCEC / NASA | **UFGS-01 33 00 (August 2018)**
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UNIFIED FACILITIES GUIDE SPECIFICATIONS
****

SECTION 01 33 00

SUBMITTAL PROCEDURES
08/18, CHG 4: 02/21

****
NOTE: This guide specification covers the requirements for general procedures regarding submittals, data normally submitted for review to establish conformance with the design concept and contract documents, called for in other sections of the specifications.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

This guide specification includes tailoring options for Army, Navy, NASA, and NAVFAC component requirements. Army tailoring options also include DESIGN-BUILD (DB) and DESIGN-BID-BUILD, and at least one of these options must be deselected. Do not use this section for Navy DESIGN-BUILD (DB)D projects. Use the DB specs in the NAVFAC DB Master posted within the Whole Building Design Guide. Selection or deselection of a tailoring option will include or exclude that option in the section, but the resulting section must still be edited to fit the project required.
****

PART 1 GENERAL

1.1 SUMMARY

****
NOTE: This paragraph contains tailoring for Army, Design-Bid-Build, and Design-Build. Use for Army projects only.
****

1.1.1 Submittal Information

The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections. Each submittal is to be complete and in sufficient detail to allow ready determination of compliance with contract requirements.

Units of weights and measures used on all submittals are to be the same as those used in the contract drawings.

1.1.2 Project Type

The Contractor's Quality Control (CQC) System Manager are to check and approve all items before submittal and stamp, sign, and date indicating action taken. Proposed deviations from the contract requirements are to be clearly identified. Include within submittals items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals.

The Contractor and the Designer of Record (DOR), if applicable, are to check and approve all items before submittal and stamp, sign, and date indicating action taken. Proposed deviations from the contract requirements are to be clearly identified. Include within submittals items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals.

1.1.3 Submission of Submittals

Schedule and provide submittals requiring Government approval before acquiring the material or equipment covered thereby. Pick up and dispose of samples not incorporated into the work in accordance with manufacturer's Safety Data Sheets (SDS) and in compliance with existing laws and regulations.

1.2 DEFINITIONS

1.2.1 Submittal Descriptions (SD)

****
NOTE: The SD numbers and titles, assigned by the SPECSINTACT Configuration, Control, and Coordinating Board, relate to the terminology of the technical

sections and should not be changed. Refer to UFC 1-300-02 UNIFIED FACILITIES GUIDE SPECIFICATIONS (UFGS) FORMAT STANDARD for additional information.
****

****
NOTE: This paragraph contains tailoring tags for Army, Navy, NASA, Design-Bid-Build and Design-Build.
****

Submittal requirements are specified in the technical sections. Examples and descriptions of submittals identified by the Submittal Description (SD) numbers and titles follow:

SD-01 Preconstruction Submittals

****
NOTE: For projects in the NAVFAC PAC Area of Operation, the submittal(s) identified as SD-01 Preconstruction Submittal for this spec section, select the "G" designation requiring Government approval.
****

Submittals that are required prior to or commencing with the start of work on site. Submittals that are required prior to or at the start of construction (work) or the next major phase of the construction on a multiphase contract.

****
NOTE: For projects in the NAVFAC PAC Area of Operation, add the bracket paragraph below.
****

[For Government approved division 01 preconstruction submittals that are required prior to or commencing with the start of work must be submitted within 30 calendar days of contract award unless specified elsewhere in the specifications. For contractor approved division 01 submittals that are required prior to or commencing with the start of work must be submitted within 45 calendar days of contract award unless specified elsewhere in the specifications.]

Preconstruction Submittals include schedules and a tabular list of locations, features, and other pertinent information regarding products, materials, equipment, or components to be used in the work.

****
NOTE: For projects in the NAVFAC PAC Area of Operation, remove the "List of Proposed Subcontractors", "List of Proposed Products", "Submittal Register" and "Work Plan". For Guam projects add the bracketed Explosive Safety Submission ESS Work Plan.
****

Certificates Of Insurance

Surety Bonds

List Of Proposed Subcontractors

List Of Proposed Products

Baseline Network Analysis Schedule (NAS)

Submittal Register

Schedule Of Prices Or Earned Value Report

Accident Prevention Plan Health And Safety Plan

Work Plan

Quality Control (QC) plan

Environmental Protection Plan [Explosive Safety Submission ESS Work Plan]

SD-02 Shop Drawings

Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.

Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project.

Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated.

SD-03 Product Data

Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work.

Samples of warranty language when the contract requires extended product warranties.

SD-04 Samples

Fabricated or unfabricated physical examples of materials, equipment or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged.

Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project.

Field samples and mock-ups constructed on the project site establish standards ensuring work can be judged. Includes assemblies or portions of assemblies that are to be incorporated into the project and those that will be removed at conclusion of the work.

****

NOTE: This paragraph contains tailoring tags for

Army, and Design-Build.

****

SD-05 Design Data

Design calculations, mix designs, analyses or other data pertaining to a part of work.

Design submittals, design substantiation submittals and extensions of design submittals.

SD-06 Test Reports

Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with specified requirements. Unless specified in another section, testing must have been within three years of date of contract award for the project.

Report that includes findings of a test required to be performed on an actual portion of the work or prototype prepared for the project before shipment to job site.

Report that includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.

Investigation reports

Daily logs and checklists

Final acceptance test and operational test procedure

SD-07 Certificates

Statements printed on the manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that the product, system, or material meets specification requirements. Must be dated after award of project contract and clearly name the project.

Document required of Contractor, or of a manufacturer, supplier, installer or Subcontractor through Contractor. The document purpose is to further promote the orderly progression of a portion of the work by documenting procedures, acceptability of methods, or personnel qualifications.

Confined space entry permits

Text of posted operating instructions

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material, including special notices and (SDS)concerning impedances, hazards and safety precautions.

SD-09 Manufacturer's Field Reports

Documentation of the testing and verification actions taken by

manufacturer's representative at the job site, in the vicinity of the job site, or on a sample taken from the job site, on a portion of the work, during or after installation, to confirm compliance with manufacturer's standards or instructions. The documentation must be signed by an authorized official of a testing laboratory or agency and state the test results; and indicate whether the material, product, or system has passed or failed the test.

Factory test reports.

SD-10 Operation and Maintenance Data

Data provided by the manufacturer, or the system provider, including manufacturer's help and product line documentation, necessary to maintain and install equipment, for operating and maintenance use by facility personnel.

Data required by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item.

Data incorporated in an operations and maintenance manual or control system.

SD-11 Closeout Submittals

Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

Submittals required for Guiding Principle Validation (GPV) or Third Party Certification (TPC).

Special requirements necessary to properly close out a construction contract. For example, Record Drawings and as-built drawings. Also, submittal requirements necessary to properly close out a major phase of construction on a multi-phase contract.

1.2.2 Approving Authority

Office or designated person authorized to approve the submittal.

1.2.3 Work

As used in this section, on-site and off-site construction required by contract documents, including labor necessary to produce submittals, construction, materials, products, equipment, and systems incorporated or to be incorporated in such construction. In exception, excludes work to produce SD-01 submittals.

1.3 SUBMITTALS

****

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified 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 Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters 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.

Submittal documents must not contain any Employee Personnel Information (EPI) or Protected Personal Information (PPI), including but not limited to Social Security Number, date of birth, home address, and home telephone number. If EPI/PPI is understood to be required as part of a submittal, contact the Contractor Officer for guidance on how to properly furnish the information in accordance with 32 CFR 701.115.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

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

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submittal Register; G

1.4 SUBMITTAL CLASSIFICATION

1.4.1 Government Approved (G)

****

NOTE: This paragraph contains tailoring tags for Army, Design-Bid-Build and Design-Build.

****

Government approval is required for extensions of design, critical

materials, variations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Government.

Government approval is required for any variations from the Solicitation or the Accepted Proposal and for other items as designated by the Government.

Within the terms of the Contract Clause SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION, submittals are considered to be "shop drawings."

1.4.2 Design-Build Submittal Classifications

****
NOTE: Use tis Subpart for Army Design-Build projects only.
****

1.4.2.1 Designer of Record Approved (DA)

Designer of Record (DOR) approval is required for extensions of design; critical materials; any variations from the Solicitation, the Accepted Proposal, or the completed design; equipment whose compatibility with the entire system must be checked; and other items as designated by the Contracting Officer. Provide the Government with the number of copies designated hereinafter of all DOR approved submittals. The Government may review any or all Designer of Record approved submittals for conformance with the Solicitation, the Accepted Proposal, and the completed design. The Government will review all submittals designated as varying from the Solicitation or Accepted Proposal, as described below. Provide design submittals in accordance with Section 01 33 16.00 10 DESIGN DATA (DESIGN AFTER AWARD). Generally, list design submittals under SD-05 Design Data.

1.4.2.2 Government Conformance Review of Design (CR)

The Government will review all intermediate and final design submittals for conformance with the technical requirements of the Solicitation. Section 01 33 16.00 10 DESIGN DATA (DESIGN AFTER AWARD) covers the design submittal and review process in detail. Review will be only for conformance with the applicable codes, standards, and contract requirements. Design data includes the design documents described in Section 01 33 16.00 10 DESIGN DATA (DESIGN AFTER AWARD).

1.4.2.3 Designer of Record Approved/Government Conformance Review (DA/CR)

1.4.2.3.1 Variations from the Accepted Design

DOR approval and the Government's concurrence are required for any proposed variation from the accepted design that still complies with the contract before the Contractor is authorized to proceed with material acquisition or installation. If necessary to facilitate the project schedule, before official submission to the Government, the Contractor and the DOR may discuss with the Contracting Officer's Representative a submittal proposing a variation. However, the Government reserves the right to review the submittal before providing an opinion. In any case, the Government will not formally agree to or provide a preliminary opinion on any variation without the DOR's approval or recommended approval. The Government reserves the right to reject any design, variation that may affect furniture, furnishings, equipment selections, or operational decisions that were made, based on the reviewed and concurred design.

1.4.2.3.2 Substitutions

Unless prohibited or otherwise provided for elsewhere in the contract, where the Accepted Proposal named products, systems, materials or equipment by manufacturer, brand name, model number, or other specific identification, and the Contractor desires to substitute a manufacturer or model after award, submit a requested substitution for Government concurrence. Include substantiation, through identifying information and the DOR's approval, that the substitute meets the contract requirements and that it is equal in function, performance, quality, and salient features to that in the accepted contract proposal. If the contract otherwise prohibits substitutions of equal named products, systems, materials or equipment by manufacturer, brand name, model number or other specific identification, the request is considered a "variation" to the contract. Variations are discussed below in paragraphs: "DESIGNER OF RECORD APPROVED/GOVERNMENT APPROVED" and VARIATIONS.

1.4.2.4 Designer of Record Approved/Government Approved (DA/GA)

In addition to the above-stated requirements for proposed variations to the accepted design, both DOR and Government Approval and, where applicable, a contract modification are required before the Contractor is authorized to proceed with material acquisition or installation for any proposed variation to the contract (the Solicitation or the Accepted Proposal), that constitutes a change to the contract terms. The Government reserves the right to accept or reject any such proposed variation.

1.4.3 For Information Only

****
NOTE: This paragraph contains tailoring for Army.
****

Submittals not requiring Government approval will be for information only. For Design-build construction all submittals not requiring DOR or Government approval will be for information only. Within the terms of the Contract Clause SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION, they are not considered to be "shop drawings."

1.4.4 Sustainability Reporting Submittals (S)

Submittals for Guiding Principle Validation (GPV) or Third Party Certification (TPC) are indicated with an "S" designation. These submittals are for information only and for use as specified in Section 01 33 29 SUSTAINABILITY REPORTING.

Schedule submittals for these items throughout the course of construction as provided; do not wait until closeout.

1.5 FORWARDING SUBMITTALS REQUIRING GOVERNMENT APPROVAL

****
NOTE: Use for Navy projects only.
****

****
NOTE: For bracketed items, choose NAVFAC for projects designed In-House, or choose AE for

projects designed by AE, unless the AE is not contracted for post-award support.

****

As soon as practicable after award of contract, and before procurement or fabrication, forward to the [Commander, NAVFAC [_____], Code CI4[_____], [_____]] [Architect-Engineer: [_____],] submittals required in the technical sections of this specification, including shop drawings, product data and samples. In addition, forward a copy of the submittals to the Contracting Officer.

1.5.1 O&M Data

Submit data specified for a given item within 30 calendar days after the item is delivered to the contract site.

In the event the Contractor fails to deliver O&M data within the time limits specified, the Contracting Officer may withhold from progress payments 50 percent of the price of the items to which such O&M data apply.

[1.5.2 Submittals Reserved for NAVFAC [_____] Approval

****

NOTE: Use this bracketed para for projects designed by AE firms only; do not use for projects designed in-house. Coordinate with the Government project manager to validate who will review these submittals. Fill in the Command name and address in the bracketed items

****

As an exception to the standard submittal procedure for Government Approval, submit the following to the Commander, NAVFAC [_____], Code CI4[_____], [_____]:

****

NOTE: Add Section Reference tags where appropriate below when blanks are filled.

****

[a. Section [_____] [_____]: Pile driving records

][b. Section [_____] [_____]: All fire protection system submittals

][c. Section [_____] [_____]: All fire alarm system submittals

][d. Section [_____] [_____]: All elevator submittals

][e. Section 01 91 00.15 20 TOTAL BUILDING COMMISSIONING: SD-06 Commissioning Plan, Certificate of Readiness, and Commissioning Report submittals

][f. Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC: SD-06 field test report submittals

][g Section 23 09 53.00 20 SPACE TEMPERATURE CONTROL SYSTEMS: SD-06 field test report submittals

][h. Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC: All

submittals

][i. Section 23 08 01.00 20 TESTING INDUSTRIAL VENTILATION SYSTEMS: All submittals

][j. Section 26 12 19.10 THREE-PHASE PAD-MOUNTED TRANSFORMERS: All submittals

][k. Section 26 12 21 SINGLE-PHASE PAD-MOUNTED TRANSFORMERS: All submittals

][l. Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION: Transformer submittals

][m. Section 26 11 16 SECONDARY UNIT SUBSTATIONS: Transformer submittals

][n. Section 26 11 13.00 20 PRIMARY UNIT SUBSTATION: Transformer submittals

]][1.5.3 Overseas Shop Drawing Submittals

****
NOTE: Use this paragraph on overseas projects only.
****

Send submittals via overnight express mail service. All costs associated with the overnight express mail service are borne by the Contractor. Costs associated with the overnight express mail of submittals related to proposed submittal variances of resubmittals necessary as a result of noncompliant or incomplete Contractor submittals are the responsibility of the Contractor.

]1.6 PREPARATION

1.6.1 Transmittal Form

****
NOTE: This paragraph includes tailoring for Navy and NASA.
****

Transmit each submittal, except sample installations and sample panels to the office of the approving authority using the transmittal form prescribed by the Contracting Officer. Include all information prescribed by the transmittal form and required in paragraph IDENTIFYING SUBMITTALS. Use the submittal transmittal forms to record actions regarding samples.

****
NOTE: This paragraph includes tailoring for Army. ENG Form 4025 is not a part of this guide specification; a sample ENG Form 4025 may be added to this section locally. If a sample is inserted, fill in blocks as appropriate for the project. If the Contractor is required to use the RMS CM software for the contract, that system includes an electronic version of ENG Form 4025.
****

Use the ENG Form 4025-R transmittal form for submitting both Government-approved and information-only submittals. Submit in accordance with the instructions on the reverse side of the form. These forms or similar forms [will be furnished to the Contractor][are included in the RMS

CM software that the Contractor is required to use for this contract][are included in the eCMS software that the Contractor is required to use for this contract]. Properly complete this form by filling out all the heading blank spaces and identifying each item submitted. Exercise special care to ensure proper listing of the specification paragraph and sheet number of the contract drawings pertinent to the data submitted for each item.

1.6.2 Identifying Submittals

****
NOTE: This paragraph includes tailoring for Navy and NASA. Select Quality Control Manager for Navy projects, or approving authority for NASA projects.
****

The Contractor's [Quality Control Manager] [approving authority] must prepare, review and stamp submittals, including those provided by a subcontractor, before submittal to the Government.

Identify submittals, except sample installations and sample panels, with the following information permanently adhered to or noted on each separate component of each submittal and noted on transmittal form. Mark each copy of each submittal identically, with the following:

a. Project title and location

b. Construction contract number

c. Dates of the drawings and revisions

d. Name, address, and telephone number of Subcontractor, supplier, manufacturer, and any other Subcontractor associated with the submittal.

e. Section number of the specification by which submittal is required

f. Submittal description (SD) number of each component of submittal

g. For a resubmission, add alphabetic suffix on submittal description, for example, submittal 18 would become 18A, to indicate resubmission

h. Product identification and location in project.

1.6.3 Submittal Format

1.6.3.1 Format of SD-01 Preconstruction Submittals

When the submittal includes a document that is to be used in the project, or is to become part of the project record, other than as a submittal, do not apply the Contractor's approval stamp to the document itself, but to a separate sheet accompanying the document.

Provide data in the unit of measure used in the contract documents.

1.6.3.2 Format for SD-02 Shop Drawings

Provide shop drawings not less than 210 by 297 mm 8 1/2 by 11 inches nor more than 1189 by 841 mm 30 by 42 inches, except for full-size patterns or templates. Prepare drawings to accurate size, with scale indicated, unless another form is required. Ensure drawings are suitable for reproduction

and of a quality to produce clear, distinct lines and letters, with dark lines on a white background.

a. Include the nameplate data, size, and capacity on drawings. Also include applicable federal, military, industry, and technical society publication references.

b. Dimension drawings, except diagrams and schematic drawings. Prepare drawings demonstrating interface with other trades to scale. Use the same unit of measure for shop drawings as indicated on the contract drawings. Identify materials and products for work shown.

****
NOTE: Select either the hard copy submittal or electronic submittal paragraph for the project.
****

Present 210 by 297 mm shop drawings sized 8 1/2 by 11 inches as part of the bound volume for submittals. Present larger drawings in sets. Submit an electronic copy of drawings in PDF format.

1.6.3.2.1 Drawing Identification

Include on each drawing the drawing title, number, date, and revision numbers and dates, in addition to information required in paragraph IDENTIFYING SUBMITTALS.

Number drawings in a logical sequence. Each drawing is to bear the number of the submittal in a uniform location next to the title block. Place the Government contract number in the margin, immediately below the title block, for each drawing.

****
NOTE: Do not use the following paragraph for NAVFAC PAC AOR.
****

Reserve a blank space, no smaller than [_____] millimeter inches on the right-hand side of each sheet for the Government disposition stamp.

1.6.3.3 Format of SD-03 Product Data

Present product data submittals for each section as a complete, bound volume. Include a table of contents, listing the page and catalog item numbers for product data.

Indicate, by prominent notation, each product that is being submitted; indicate the specification section number and paragraph number to which it pertains.

1.6.3.3.1 Product Information

Supplement product data with material prepared for the project to satisfy the submittal requirements where product data does not exist. Identify this material as developed specifically for the project, with information and format as required for submission of SD-07 Certificates.

Provide product data in metric dimensions. Where product data are included in preprinted catalogs with English units only, submit metric dimensions on

separate sheet.

Provide product data in units used in the Contract documents. Where product data are included in preprinted catalogs with another unit, submit the dimensions in contract document units, on a separate sheet.

1.6.3.3.2 Standards

Where equipment or materials are specified to conform to industry or technical-society reference standards of such organizations as the American National Standards Institute (ANSI), ASTM International (ASTM), National Electrical Manufacturer's Association (NEMA), Underwriters Laboratories (UL), or Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. State on the certificate that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.6.3.3.3 Data Submission

Collect required data submittals for each specific material, product, unit of work, or system into a single submittal that is marked for choices, options, and portions applicable to the submittal. Mark each copy of the product data identically. Partial submittals will [not] be accepted for expedition of the construction effort.

Submit the manufacturer's instructions before installation.

1.6.3.4 Format of SD-04 Samples

1.6.3.4.1 Sample Characteristics

Furnish samples in the following sizes, unless otherwise specified or unless the manufacturer has prepackaged samples of approximately the same size as specified:

a. Sample of Equipment or Device: Full size.

b. Sample of Materials Less Than 50 by 75 mm 2 by 3 inches: Built up to 210 by 297 mm 8 1/2 by 11 inches.

c. Sample of Materials Exceeding 210 by 297 mm 8 1/2 by 11 inches: Cut down to 210 by 297 mm 8 1/2 by 11 inches and adequate to indicate color, texture, and material variations.

d. Sample of Linear Devices or Materials: 250 mm 10 inch length or length to be supplied, if less than 250 mm 10 inches. Examples of linear devices or materials are conduit and handrails.

e. Sample Volume of Nonsolid Materials: 750 ml Pint. Examples of nonsolid materials are sand and paint.

f. Color Selection Samples: 50 by 100 mm 2 by 4 inches. Where samples are specified for selection of color, finish, pattern, or texture, submit the full set of available choices for the material or product specified. Sizes and quantities of samples are to represent their

respective standard unit.

g. Sample Panel: 1200 by 1200 mm 4 by 4 feet.

h. Sample Installation: 10 square meters 100 square feet.

1.6.3.4.2 Sample Incorporation

Reusable Samples: Incorporate returned samples into work only if so specified or indicated. Incorporated samples are to be in undamaged condition at the time of use.

Recording of Sample Installation: Note and preserve the notation of any area constituting a sample installation, but remove the notation at the final clean-up of the project.

1.6.3.4.3 Comparison Sample

Samples Showing Range of Variation: Where variations in color, finish, pattern, or texture are unavoidable due to nature of the materials, submit sets of samples of not less than three units showing extremes and middle of range. Mark each unit to describe its relation to the range of the variation.

****
NOTE: To avoid unnecessary effort by the Contractor, use the following paragraph only when no color board is prepared during design.
****

When color, texture, or pattern is specified by naming a particular manufacturer and style, include one sample of that manufacturer and style, for comparison.

1.6.3.5 Format of SD-05 Design Data

Provide design data and certificates on 210 by 297 mm 8 1/2 by 11 inch paper. Provide a bound volume for submittals containing numerous pages.

1.6.3.6 Format of SD-06 Test Reports

Provide reports on 210 by 297 mm 8 1/2 by 11 inch paper in a complete bound volume.

By prominent notation, indicate each report in the submittal. Indicate the specification number and paragraph number to which each report pertains.

1.6.3.7 Format of SD-07 Certificates

Provide design data and certificates on 210 by 297 mm 8 1/2 by 11 inch paper. Provide a bound volume for submittals containing numerous pages.

1.6.3.8 Format of SD-08 Manufacturer's Instructions

Present manufacturer's instructions submittals for each section as a complete, bound volume. Include the manufacturer's name, trade name, place of manufacture, and catalog model or number on product data. Also include applicable federal, military, industry, and technical-society publication references. If supplemental information is needed to clarify the

manufacturer's data, submit it as specified for SD-07 Certificates.

Submit the manufacturer's instructions before installation.

1.6.3.8.1 Standards

Where equipment or materials are specified to conform to industry or technical-society reference standards of such organizations as the American National Standards Institute (ANSI), ASTM International (ASTM), National Electrical Manufacturer's Association (NEMA), Underwriters Laboratories (UL), or Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. State on the certificate that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.6.3.9 Format of SD-09 Manufacturer's Field Reports

Provide reports on 210 by 297 mm 8 1/2 by 11 inch paper in a complete bound volume.

By prominent notation, indicate each report in the submittal. Indicate the specification number and paragraph number to which each report pertains.

1.6.3.10 Format of SD-10 Operation and Maintenance Data (O&M)

Comply with the requirements specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA for O&M Data format.

1.6.3.11 Format of SD-11 Closeout Submittals

When the submittal includes a document that is to be used in the project or is to become part of the project record, other than as a submittal, do not apply the Contractor's approval stamp to the document itself, but to a separate sheet accompanying the document.

Provide data in the unit of measure used in the contract documents.

Provide all dimensions in administrative submittals in metric. Where data are included in preprinted material with English units only, submit metric dimensions on separate sheet.

1.6.4 Source Drawings for Shop Drawings

1.6.4.1 Source Drawings

The entire set of source drawing files (DWG) will not be provided to the Contractor. Request the specific Drawing Number for the preparation of shop drawings. Only those drawings requested to prepare shop drawings will be provided. These drawings are provided only after award.

1.6.4.2 Terms and Conditions

Data contained on these electronic files must not be used for any purpose other than as a convenience in the preparation of construction data for the referenced project. Any other use or reuse is at the sole risk of the

Contractor and without liability or legal exposure to the Government. The Contractor must make no claim, and waives to the fullest extent permitted by law any claim or cause of action of any nature against the Government, its agents, or its subconsultants that may arise out of or in connection with the use of these electronic files. The Contractor must, to the fullest extent permitted by law, indemnify and hold the Government harmless against all damages, liabilities, or costs, including reasonable attorney's fees and defense costs, arising out of or resulting from the use of these electronic files.

These electronic source drawing files are not construction documents. Differences may exist between the source drawing files and the corresponding construction documents. The Government makes no representation regarding the accuracy or completeness of the electronic source drawing files, nor does it make representation to the compatibility of these files with the Contractor hardware or software. The Contractor is responsible for determining if any conflict exists. In the event that a conflict arises between the signed and sealed construction documents prepared by the Government and the furnished source drawing files, the signed and sealed construction documents govern. Use of these source drawing files does not relieve the Contractor of the duty to fully comply with the contract documents, including and without limitation the need to check, confirm and coordinate the work of all contractors for the project. If the Contractor uses, duplicates or modifies these electronic source drawing files for use in producing construction data related to this contract, remove all previous indication of ownership (seals, logos, signatures, initials and dates).

1.6.5 Electronic File Format

****
NOTE: Use the following two paragraphs when electronic files are submitted.
****

Provide submittals in electronic format, with the exception of material samples required for SD-04 Samples items. [In addition to the electronic submittal, provide [three] [_____] hard copies of the submittals.] Compile the submittal file as a single, complete document, to include the Transmittal Form described within. Name the electronic submittal file specifically according to its contents, and coordinate the file naming convention with the Contracting Officer. Electronic files must be of sufficient quality that all information is legible. Use PDF as the electronic format, unless otherwise specified or directed by the Contracting Officer. Generate PDF files from original documents with bookmarks so that the text included in the PDF file is searchable and can be copied. If documents are scanned, optical character resolution (OCR) routines are required. Index and bookmark files exceeding 30 pages to allow efficient navigation of the file. When required, the electronic file must include a valid electronic signature or a scan of a signature.

****
NOTE: The DOD SAFE Web Application described in the following paragraph may be used for Army and Navy projects.
****

E-mail electronic submittal documents smaller than 10MB to an e-mail address as directed by the Contracting Officer. Provide electronic

documents over 10 MB on an optical disc or through an electronic file sharing system such as the DOD SAFE Web Application located at the following website: https://safe.apps.mil/.

1.7 QUANTITY OF SUBMITTALS

****
NOTE: The quantities suggested below are consistent with the quantities to be retained by the Government, in paragraph QC ORGANIZATION RESPONSIBILITIES. Maintain the coordination.
****

1.7.1 Number of SD-01 Preconstruction Submittal Copies

Unless otherwise specified, submit [two][three] sets of administrative submittals.

1.7.2 Number of SD-02 Shop Drawing Copies

****
NOTE: Use when asking for hard copies of Shop Drawings and Product Data.
****

Submit [six][_____] copies of submittals of shop drawings requiring review and approval by a QC organization. Submit [seven][_____] copies of shop drawings requiring review and approval by the Contracting Officer.

1.7.3 Number of SD-03 Product Data Copies

Submit in compliance with quantity requirements specified for shop drawings.

1.7.4 Number of SD-04 Samples

****
NOTE: For NAVFAC, require one sample in paragraph "a," and delete the second sentence of paragraph "a."
****

a. Submit [two] [_____] samples, or [two] [_____] sets of samples showing the range of variation, of each required item. One approved sample or set of samples will be retained by the approving authority and one will be returned to the Contractor.

b. Submit one sample panel or provide one sample installation where directed. Include components listed in the technical section or as directed.

c. Submit one sample installation, where directed.

d. Submit one sample of nonsolid materials.

1.7.5 Number of SD-05 Design Data Copies

Submit in compliance with quantity requirements specified for shop drawings.

1.7.6 Number of SD-06 Test Report Copies

Submit in compliance with quantity and quality requirements specified for shop drawings, other than field test results that will be submitted with QC reports.

1.7.7 Number of SD-07 Certificate Copies

Submit in compliance with quantity requirements specified for shop drawings.

1.7.8 Number of SD-08 Manufacturer's Instructions Copies

Submit in compliance with quantity requirements specified for shop drawings.

1.7.9 Number of SD-09 Manufacturer's Field Report Copies

Submit in compliance with quantity and quality requirements specified for shop drawings other than field test results that will be submitted with QC reports.

1.7.10 Number of SD-10 Operation and Maintenance Data Copies

****
NOTE: In bracketed item, choose "three" copies for NAVFAC.
****

Submit [five][three][_____] copies of O&M data to the Contracting Officer for review and approval.

1.7.11 Number of SD-11 Closeout Submittals Copies

Unless otherwise specified, submit [two][three] sets of administrative submittals.

1.8 INFORMATION ONLY SUBMITTALS

****
NOTE: This paragraph contains tailoring tags for Army and Design-Build.
****

Submittals without a "G" designation must be certified by the QC manager and submitted to the Contracting Officer for information-only. Provide information-only submittals to the Contracting Officer a minimum of 14 calendar days prior to the Preparatory Meeting for the associated Definable Feature of Work (DFOW). Approval of the Contracting Officer is not required on information only submittals. The Contracting Officer will mark "receipt acknowledged" on submittals for information and will return only the transmittal cover sheet to the Contractor. Normally, submittals for information only will not be returned. However, the Government reserves the right to return unsatisfactory submittals and require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the Contracting Officer from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or for check testing by the Government in those instances where the technical

specifications so prescribe. For Design-Build construction, the Government will retain [_____] copies of information-only submittals.

1.9 PROJECT SUBMITTAL REGISTER AND DATABASE

****
NOTE: Create the submittal register from the project specification files, at the conclusion of the design. In SPECSINTACT, choose "Export Submittal Register" from the "Process" pull-down menu. Local procedures should be responsive to the requirement that the submittal register, required with the QC plan, is usually due from the Contractor within 20 days after the Notice of Award.
****

****
NOTE: Use bracketed items for Army projects only.
****

A sample Project Submittal Register showing items of equipment and materials for when submittals are required by the specifications is provided as "Appendix A - Submittal Register."

****
NOTE: This paragraph contains ARMY, and DESIGN-BUILD tailoring

NOTE: Use the first bracketed sentence of the paragraph if the Contractor is required by the contract to use the RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE (RMS CM). Use the second bracketed sentence of the paragraph if RMS CM is not required. It may not be necessary or beneficial to use the RMS CM in small, simple, short-duration contracts/delivery orders for construction, or for other contracts where its use would not be in the best interest of the Government.
****

1.9.1 Submittal Management

Prepare and maintain a submittal register, as the work progresses. Use an electronic submittal register program furnished by the Government. Do not change data that is output in columns (c), (d), (e), and (f) as delivered by Government; retain data that is output in columns (a), (g), (h), and (i) as approved. As an attachment, provide a submittal register showing items of equipment and materials for which submittals are required by the specifications. This list may not be all-inclusive and additional submittals may be required. Maintain a submittal register for the project in accordance with Section 01 45 00.15 10 RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE(RMS CM).[The Government will provide the initial submittal register][in electronic format][with the following fields completed, to the extent that will be required by the Government during subsequent usage.]

Column (c): Lists specification section in which submittal is required.

Column (d): Lists each submittal description (SD Number. and type, e.g., SD-02 Shop Drawings) required in each specification section.

Column (e): Lists one principal paragraph in each specification section where a material or product is specified. This listing is only to facilitate locating submitted requirements. Do not consider entries in column (e) as limiting the project requirements.

Column (f): Lists the approving authority for each submittal.

****
NOTE: Use the following paragraph for NASA projects only.
****

The database and submittal management program will be furnished to the Contractor on a writable compact disk (CD-R), for operation on a Windows-based personal computer.

****
NOTE: Use the following paragraph for Army projects only.
****

Thereafter, the Contractor is to track all submittals by maintaining a complete list, including completion of all data columns and all dates on which submittals are received by and returned by the Government.

1.9.2 Design-Build Submittal Register

****
NOTE: Use the following paragraph for Army Design-Build projects only.
****

The Designer of Record develops a complete list of submittals during design and identify required submittals in the specifications, and use the list to prepare the Submittal Register. The list may not be all inclusive and additional submittals may be required by other parts of the contract. Complete the submittal register and submit it to the Contracting Officer for approval within 30 calendar days after Notice to Proceed. The approved submittal register will serve as a scheduling document for submittals and will be used to control submittal actions throughout the contract period. Coordinate the submit dates and need dates with dates in the Contractor prepared progress schedule. Submit monthly or until all submittals have been satisfactorily completed, updates to the submittal register showing the Contractor action codes and actual dates with Government action codes. Revise the submittal register when the progress schedule is revised and submit both for approval.

1.9.3 Preconstruction Use of Submittal Register

****
NOTE: Include the bracketed text, invoking the use of the electronic database for submittals, in most projects. The alternative is a manually processed submittal register initially created from the

Submittal Register program, that may be appropriate for small projects.
****

Submit the submittal register as an electronic database, using the submittal management program furnished to Contractor. Include the QC plan and the project schedule. Verify that all submittals required for the project are listed and add missing submittals. Coordinate and complete the following fields on the register database submitted with the QC plan and the project schedule:

Column (a) Activity Number: Activity number from the project schedule.

Column (g) Contractor Submit Date: Scheduled date for the approving authority to receive submittals.

Column (h) Contractor Approval Date: Date that Contractor needs approval of submittal.

Column (i) Contractor Material: Date that Contractor needs material delivered to Contractor control.

1.9.4 Contractor Use of Submittal Register

Update the following fields in the Government-furnished submittal register program or equivalent fields in the program used by the Contractor with each submittal throughout the contract.

Column (b) Transmittal Number: List of consecutive, Contractor-assigned numbers.

Column (j) Action Code (k): Date of action used to record Contractor's review when forwarding submittals to QC.

Column (l) Date submittal transmitted.

Column (q) Date approval was received.

1.9.5 Approving Authority Use of Submittal Register

Update the following fields:

Column (b) Transmittal Number: List of consecutive, Contractor-assigned numbers.

Column (l) Date submittal was received.

Column (m) through (p) Dates of review actions.

Column (q) Date of return to Contractor.

1.9.6 Action Codes

****
NOTE: Select the tailoring option for either Army, Design-Build; Army, Design-Bid-Build; Navy; or NASA.
****

Entries for columns (j) and (o) are to be used as follows (others may be prescribed by the Transmittal Form):

1.9.6.1 Government Review Action Codes

"A" - "Approved as submitted"; "Completed"

"B" - "Approved, except as noted on drawings"; "Completed"

"C" - "Approved, except as noted on drawings; resubmission required"; "Resubmit"

"D" - "Returned by separate correspondence"; "Completed"

"E" - "Disapproved (See attached)"; "Resubmit"

"F" - "Receipt acknowledged"; "Completed"

"G" - "Other (Specify)"; "Resubmit"

"X" - "Receipt acknowledged, does not comply with contract requirements"; "Resubmit"

1.9.6.2 Government Review Action Codes

"A" - "Approved as submitted"

"AN" - "Approved as noted"

"RR" - "Disapproved as submitted"; "Completed"

"NR" - "Not Reviewed"

"RA" - "Receipt Acknowledged"

1.9.6.3 Contractor Action Codes

****

NOTE: Use the following codes for Army, Design-Bid-Build projects only.

****

DESIGN BID BUILD SUBMITTALS			
Submittal Classifications shown in UFGS Sections	Submittal Classification	Corresponding SpecsIntact Submittal Register Code which is populated in the SI Submittal Register. Software Limitations: (The software shows one character delineation in the SpecsIntact Submittal Register)	RMS - The following Submittal Classifications are populated in RMS when the SpecsIntact Submittal Data File is pulled into RMS)
G	Submittal requires Government	G	GA
BLANK	Submittal is For Information Only (FIO)	BLANK	FIO
S	Submittal is for documentation of Sustainable requirements	S	S/FIO

1.9.6.4 Contractor Action Codes

****
NOTE: Use the following codes for Army, Design-Build projects only.
****

DESIGN BUILD SUBMITTALS			
Submittal Classifications shown in UFGS Sections	Submittal Classification	Corresponding SpecsIntact Submittal Register Code which is populated in the SI Submittal Register. Software Limitations: (The software shows one character delineation in the SpecsIntact Submittal Register)	RMS - The following Submittal Classifications are populated in RMS when the SpecsIntact Submittal Data File is pulled into RMS)
G	Submittal requires Government	G	GA

DESIGN BUILD SUBMITTALS			
BLANK	Submittal is For Information Only(FIO)	BLANK	FIO
DA	Submittal requires Designer of Record Approval	D	DA
CR	Submittal requires Government Conformance Review	C	CR
DA/CR	Submittal requires Designer of Record Approval and Government Conformance	R	DA/CR
DA/GA	Submittal requires Designer of Record Approval and Government Approval	A	DA/GA

1.9.7 Delivery of Copies

****
NOTE: For NASA projects only. Include the use of the electronic database for submittals, in most projects. The alternative is a manually processed submittal register initially created from the Submittal Register program, that may be appropriate for small projects.
****

Submit an updated electronic copy of the submittal register to the Contracting Officer with each invoice request , unless a paper copy is requested by the Contracting Officer. Provide an updated Submittal Register monthly regardless of whether an invoice is submitted.

1.10 VARIATIONS

Variations from contract requirements require Contracting Officer approval pursuant to contract Clause FAR 52.236-21 Specifications and Drawings for Construction, and will be considered where advantageous to the Government.

1.10.1 Considering Variations

****
NOTE: For projects in the NAVFAC PAC Area of Operation, include bracketed item.
****

Discussion of variations with the Contracting Officer before submission [of a variation submittal] will help ensure that functional and quality requirements are met and minimize rejections and resubmittals. For

variations that include design changes or some material or product substitutions, the Government may require an evaluation and analysis by a licensed professional engineer hired by the contractor.

****
NOTE: For projects in the NAVFAC PAC Area of Operation, include the second bracket option.
****

Specifically point out variations from contract requirements in a [transmittal letter][variation submittal]. Failure to point out variations may cause the Government to require rejection and removal of such work at no additional cost to the Government.

1.10.2 Proposing Variations

****
NOTE: Use the following paragraphs For projects in the NAVFAC PAC Area of Operation only.
****

[When proposing variation, deliver a submittal, clearly marked as a "VARIATION" to the Contracting Officer, with documentation illustrating the nature and features of the variation including any necessary technical submittals and why the variation is desirable and beneficial to Government. If lower cost is a benefit, also include an estimate of the cost savings. In addition to documentation required for variation, include the submittals required for the item. Clearly mark the proposed variation in all documentation.]

[The Contracting Officer will indicate an approval or disapproval of the variation request; and if not approved as submitted, will indicate the Government's reasons therefore. Any work done before such approval is received is performed at the Contractor's risk.]"

Specifically point out variations from contract requirements in a [transmittal letter][variation submittal]. Failure to point out variations may cause the Government to require rejection and removal of such work at no additional cost to the Government.

****
NOTE: Use the following paragraph for Army projects only.
****

Check the column "variation" of ENG Form 4025 for submittals that include variations proposed by the Contractor. Set forth in writing the reason for any variations and note such variations on the submittal. The Government reserves the right to rescind inadvertent approval of submittals containing unnoted variations.

1.10.3 Warranting that Variations are Compatible

When delivering a variation for approval, the Contractor warrants that this contract has been reviewed to establish that the variation, if incorporated, will be compatible with other elements of work.

1.10.4 Review Schedule Extension

****
NOTE: Allow a longer additional review period if the construction phase will have geographically scattered reviewers.
****

In addition to the normal submittal review period, a period of [14] [_____] calendar working days will be allowed for the Government to consider submittals with variations.

1.11 SCHEDULING

****
NOTE: Use the term "Database" in the following paragraphs on NASA projects only.
****

Schedule and submit concurrently product data and shop drawings covering component items forming a system or items that are interrelated. Submit pertinent certifications at the same time. No delay damages or time extensions will be allowed for time lost in late submittals. [Allow an additional [_____] calendar working days for review and approval of submittals for [food service equipment] [and] [refrigeration and HVAC control systems]].

a. Coordinate scheduling, sequencing, preparing, and processing of submittals with performance of work so that work will not be delayed by submittal processing. The Contractor is responsible for additional time required for Government reviews resulting from required resubmittals. The review period for each resubmittal is the same as for the initial submittal.

b. Submittals required by the contract documents are listed on the submittal register. If a submittal is listed in the submittal register but does not pertain to the contract work, the Contractor is to include the submittal in the register and annotate it "N/A" with a brief explanation. Approval by the Contracting Officer does not relieve the Contractor of supplying submittals required by the contract documents but that have been omitted from the register or marked "N/A."

c. Resubmit the submittal register and annotate it monthly with actual submission and approval dates. When all items on the register have been fully approved, no further resubmittal is required.

****
NOTE: Use the first sentence with the number of days for review.
****

Contracting Officer review will be completed within [_____] calendar working days after the date of submission.

****
NOTE: Use the following items d and e for Navy projects only. The items are tailored for Navy.
****

d. Except as specified otherwise, allow a review period, beginning with receipt by the approving authority, that includes at least [15] [_____] working days for submittals for QC manager approval and [20] [_____] working days for submittals where the Contracting Officer is the approving authority. The period of review for submittals with Contracting Officer approval begins when the Government receives the submittal from the QC organization.

****
NOTE: At bracket, use 30 working days for projects estimated to require 180 or more calendar days to construct. For projects requiring less than 180 calendar days to complete, use at least 20 working days.
****

e. For submittals requiring review by a Government fire protection engineer, allow a review period, beginning when the Government receives the submittal from the QC organization, of [30][_____] working days for return of the submittal to the Contractor.

****
NOTE: Delete this part if the submittal schedule is specified elsewhere or is not required because of the size or nature of the project.
****

****
NOTE: Use this paragraph for NASA projects only. This Article is tailored for NASA.
****

[Within [30][15] calendar days of Notice To Proceed][At the Preconstruction conference], provide the following schedule of submittals for approval by the Contracting Officer:

d. A schedule of shop drawings and technical submittals required by the specifications and drawings. Indicate the specification or drawing reference requiring the submittal; the material, item, or process for which the submittal is required; the "SD" number and identifying title of the submittal; the anticipated submission date, and the approval need date.

e. A separate schedule of other submittals required under the contract but not listed in the specifications or drawings. Indicate the contract requirement reference, the type or title of the submittal, the anticipated submission date, and the approval need date (if approval is required).

1.11.1 Reviewing, Certifying, and Approving Authority

****
NOTE: Use this subpart for NAVFAC projects only.
****

The QC Manager is responsible for reviewing all submittals and certifying that they are in compliance with contract requirements. The approving authority on submittals is the QC Manager unless otherwise specified. At each "Submittal" paragraph in individual specification sections, a notation

"G" following a submittal item indicates that the Contracting Officer is the approving authority for that submittal item. Provide an additional copy of the submittal to the Government Approving authority

1.11.2 Constraints

****
NOTE: Use this subpart for NAVFAC projects only.
****

Conform to provisions of this section, unless explicitly stated otherwise for submittals listed or specified in this contract.

Submit complete submittals for each definable feature of the work. At the same time, submit components of definable features that are interrelated as a system.

When acceptability of a submittal is dependent on conditions, items, or materials included in separate subsequent submittals, the submittal will be returned without review.

Approval of a separate material, product, or component does not imply approval of the assembly in which the item functions.

1.11.3 QC Organization Responsibilities

****
NOTE: Use this subpart for NAVFAC projects only.
****

a. Review submittals for conformance with project design concepts and compliance with contract documents.

b. Process submittals based on the approving authority indicated in the submittal register.

(1) When the QC manager is the approving authority, take appropriate action on the submittal from the possible actions defined in paragraph APPROVED SUBMITTALS.

(2) When the Contracting Officer is the approving authority or when variation has been proposed, forward the submittal to the Government, along with a certifying statement, or return the submittal marked "not reviewed" or "revise and resubmit" as appropriate. The QC organization's review of the submittal determines the appropriate action.

c. Ensure that material is clearly legible.

d. Stamp each sheet of each submittal with a QC certifying statement or an approving statement, except that data submitted in a bound volume or on one sheet printed on two sides may be stamped on the front of the first sheet only.

(1) When the approving authority is the Contracting Officer, the QC organization will certify submittals forwarded to the Contracting Officer with the following certifying statement:

"I hereby certify that the (equipment) (material) (article) shown and

marked in this submittal is that proposed to be incorporated with Contract Number [_____] is in compliance with the contract drawings and specification, can be installed in the allocated spaces, and is submitted for Government approval.

Certified by Submittal Reviewer _____, Date _____
(Signature when applicable)

Certified by QC Manager _____, Date _____"
(Signature)

(2) When approving authority is the QC manager, the QC manager will use the following approval statement when returning submittals to the Contractor as "Approved" or "Approved as Noted."

"I hereby certify that the (material) (equipment) (article) shown and marked in this submittal and proposed to be incorporated with Contract Number [_____] is in compliance with the contract drawings and specification, can be installed in the allocated spaces, and is approved for use.

Certified by Submittal Reviewer _____, Date _____
(Signature when applicable)

Approved by QC Manager _____, Date _____"
(Signature)

e. Sign the certifying statement or approval statement. The QC organization member designated in the approved QC plan is the person signing certifying statements. The use of original ink for signatures is required. Stamped signatures are not acceptable.

f. Update the submittal register as submittal actions occur, and maintain the submittal register at the project site until final acceptance of all work by the Contracting Officer.

g. Retain a copy of approved submittals and approved samples at the project site.

h. For "S" submittals, provide a copy of the approved submittal to the Government Approving authority.

1.11.4 Government Reviewed Design

****
NOTE: Use this subpart for Army Design-Build projects only.
****

The Government will review design submittals for conformance with the technical requirements of the Solicitation. Section 01 33 16.00 10 DESIGN DATA (DESIGN AFTER AWARD) covers the design submittal and review process in detail. Government review is required for variations from the completed design. Review will be only for conformance with the contract requirements. Included are only those construction submittals for which the DOR's design documents do not include enough detail to ascertain contract compliance. The Government may, but is not required to, review extensions of design such as structural steel or reinforcement shop drawings.

1.12 GOVERNMENT APPROVING AUTHORITY

When the approving authority is the Contracting Officer, the Government will:

a. Note the date on which the submittal was received from the QC manager.

b. Review submittals for approval within the scheduling period specified and only for conformance with project design concepts and compliance with contract documents.

c. Identify returned submittals with one of the actions defined in paragraph REVIEW NOTATIONS and with comments and markings appropriate for the action indicated.

Upon completion of review of submittals requiring Government approval, stamp and date submittals. [_____] copies of the submittal will be retained by the Contracting Officer and [_____] copies of the submittal will be returned to the Contractor.If the Government performs a conformance review of other Designer of Record approved submittals, the submittals will be identified and returned, as described above.

1.12.1 Review Notations

Submittals will be returned to the Contractor with the following notations:

a. Submittals marked "approved" or "accepted" authorize proceeding with the work covered.

b. Submittals marked "approved as noted" or "approved, except as noted, resubmittal not required," authorize proceeding with the work covered provided that the Contractor takes no exception to the corrections.

c. Submittals marked "not approved," "disapproved," or "revise and resubmit" indicate incomplete submittal or noncompliance with the contract requirements or design concept. Resubmit with appropriate changes. Do not proceed with work for this item until the resubmittal is approved.

d. Submittals marked "not reviewed" indicate that the submittal has been previously reviewed and approved, is not required, does not have evidence of being reviewed and approved by Contractor, or is not complete. A submittal marked "not reviewed" will be returned with an explanation of the reason it is not reviewed. Resubmit submittals returned for lack of review by Contractor or for being incomplete, with appropriate action, coordination, or change.

e. Submittals marked "receipt acknowledged" indicate that submittals have been received by the Government. This applies only to "information-only submittals" as previously defined.

1.13 DISAPPROVED SUBMITTALS

Make corrections required by the Contracting Officer. If the Contractor considers any correction or notation on the returned submittals to constitute a change to the contract drawings or specifications, give notice to the Contracting Officer as required under the FAR clause titled CHANGES. The Contractor is responsible for the dimensions and design of

connection details and the construction of work. Failure to point out variations may cause the Government to require rejection and removal of such work at the Contractor's expense.

If changes are necessary to submittals, make such revisions and resubmit in accordance with the procedures above. No item of work requiring a submittal change is to be accomplished until the changed submittals are approved.

1.14 APPROVED SUBMITTALS

****
NOTE: For Navy or NASA projects, choose Design-Bid-Build text. For Army projects, choose either Design-Bid-Build or Design-Build text.
****

The Contracting Officer's approval of submittals is not to be construed as a complete check, and indicates only thatthe general method of construction, materials, detailing, and other information are satisfactory. the design, general method of construction, materials, detailing, and other information appear to meet the Solicitation and Accepted Proposal.

Approval or acceptance by the Government for a submittal does not relieve the Contractor of the responsibility for meeting the contract requirements or for any error that may exist, because under the Quality Control (QC) requirements of this contract, the Contractor is responsible for ensuring information contained with in each submittal accurately conforms with the requirements of the contract documents.

After submittals have been approved or accepted by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.15 APPROVED SAMPLES

Approval of a sample is only for the characteristics or use named in such approval and is not be construed to change or modify any contract requirements. Before submitting samples, provide assurance that the materials or equipment will be available in quantities required in the project. No change or substitution will be permitted after a sample has been approved.

Match the approved samples for materials and equipment incorporated in the work. If requested, approved samples, including those that may be damaged in testing, will be returned to the Contractor, at its expense, upon completion of the contract. Unapproved samples will also be returned to the Contractor at its expense, if so requested.

Failure of any materials to pass the specified tests will be sufficient cause for refusal to consider, under this contract, any further samples of the same brand or make as that material. The Government reserves the right to disapprove any material or equipment that has previously proved unsatisfactory in service.

Samples of various materials or equipment delivered on the site or in place may be taken by the Contracting Officer for testing. Samples failing to meet contract requirements will automatically void previous approvals.

Replace such materials or equipment to meet contract requirements.

1.16 WITHHOLDING OF PAYMENT

****
NOTE: Choose either Design-Bid Build construction or Design-Build construction text.
****

Payment for materials incorporated in the work will not be made if required approvals have not been obtained. No payment for materials incorporated in the work will be made unless all required DOR approvals or required Government approvals have been obtained. No payment will be made for any materials incorporated into the work for any conformance review submittals or information-only submittals found to contain errors or deviations from the Solicitation or Accepted Proposal.

1.17 CERTIFICATION OF SUBMITTAL DATA

Certify the submittal data as follows on Form ENG 4025: "I certify that the above submitted items had been reviewed in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise stated.

_____NAME OF CONTRACTOR _____ SIGNATURE OF CONTRACTOR

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

****
USACE / NAVFAC / AFCESA / NASA | **NASA/KSC-01 42 00 (November 2014)**

Preparing Activity: NASA | **Superseding**
NASA/KSC-01 42 00 (August 2012)
UFGS-01420 (February 2009)

NASA/KSC GUIDE SPECIFICATIONS
****

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 42 00

SOURCES FOR REFERENCE PUBLICATIONS

11/14

****
USACE / NAVFAC / AFCESA / NASA

Preparing Activity: NASA

NASA/KSC-01 42 00 (November 2014)

Superseding
NASA/KSC-01 42 00 (August 2012)
UFGS-01420 (February 2009)

NASA/KSC GUIDE SPECIFICATIONS
****

SECTION 01 42 00

SOURCES FOR REFERENCE PUBLICATIONS
11/14

****
NOTE: This guide specification provides a listing of organizations whose publications are referenced in other sections of the specifications.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Recommended changes to a NASAKSC Master Specification Section should be submitted as a Criteria Change Request (CCR) to the appropriate Technical Proponent (TP) through the SpecsIntact Help Desk.

In accordance with FAR 11.201, identification of sources for obtaining documents referenced in the specificatioins must be provided in contract documents.
****

PART 1 GENERAL

1.1 REFERENCES

Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the standards producing organization, (e.g. ASTM B564 Nickel Alloy Forgings). However, when the standards producing organization has not assigned a number to a document, an identifying number has been assigned for reference purposes.

1.2 ORDERING INFORMATION

****
NOTE: Information regarding standards producing organizations was in agreement with information

contained in the Unified Master Reference List (UMRL) as of date of this guide specification.

This paragraph is automatically edited by removal of those organizations not included in other sections of the project specifications when SpecsIntact (Reconcile Addresses item from the Print menu) is use for job processing. However, if publications of organizations in addition to those listed below are used in the project, such additional organizations must be added to this paragraph.

****

The addresses of the standards publishing organizations whose documents are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided. Documents listed in the specifications with numbers which were not assigned by the standards producing organization must be ordered from the source by title rather than by number.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)
One East Wacker Drive, Suite 3100
Chicago, IL 60601-2001
Ph: 312-670-2400
Fax: 312-670-5403
Publications: 800-644-2400
E-mail: pubs@aisc.org
Internet: http://www.aisc.org

AMERICAN IRON AND STEEL INSTITUTE (AISI)
1140 Connecticut Avenue, NW, Suite 705
Washington, DC 20036
Ph: 202-452-7100
Fax: 202-463-6573
Internet: http://www.steel.org

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
1819 L Street, NW, 6th Floor
Washington, DC 20036
Ph: 202-293-8020
Fax: 202-293-9287
E-mail: info@ansi.org
Internet: http://www.ansi.org/

--- ANSI documents beginning with the letter "S" can be ordered from:

Acoustical Society Of America
2 Huntington Quadrangle, Suite 1NO1
Melville, NY 11747-4502
Ph: 516-576-2360
Fax: 516-576-2377
E-mail: asa@aip.org
Internet: http://asa.aip.org

AMERICAN WATER WORKS ASSOCIATION (AWWA)
6666 West Quincy

Denver, CO 80235
Ph: 800-926-7337
Fax: 303-795-2114
Internet: www.awwa.org

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
Three Park Avenue
New York, NY 10016-5990
Ph: 212-591-7722
Fax: 212-591-7674
Internet: www.asme.org

AMERICAN WELDING SOCIETY (AWS)
550 N.W. LeJeune Road
Miami, FL 33126
Ph: 800-443-9353 - 305-443-9353
Fax: 305-443-7559
E-mail: info@aws.org
Internet: http://www.aws.org

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)
600 North 18th Street
P.O. Box 2641
Birmingham, AL 35291
Ph: 205-257-2530
Fax: 205-257-2540
Internet: http://www.aeic.org

ASTM INTERNATIONAL (ASTM)
100 Barr Harbor Drive, P.O. Box C700
West Conshohocken, PA 19428-2959
Ph: 610-832-9500
Fax: 610-832-9555
E-mail: service@astm.org
Internet: http://www.astm.org

BUILDING INDUSTRY CONSULTING SERVICE INTERNATIONAL (BICSI)
8610 Hidden River Parkway
Tampa, Florida 33637-1000
Ph: 1-800-242-7405 or 813-979-1991
Fax: 813-971-4311
Internet: www.bicsi.org
e-mail: bicsi@bicsi.org

COMPRESSED GAS ASSOCIATION (CGA)
4221 Walney Road, 5th Floor
Chantilly, VA 20151-2923
Ph: 703-788-2700
Fax: 703-961-1831
E-mail: cga@cganet.com
Internet: http://www.cganet.com

ELECTRONIC INDUSTRIES ALLIANCE (EIA)
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Ph: 904-488-2323

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Fax: 401-275-3029
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Internet: http://www.fmglobal.com

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)
USC
KAP-200 University Park MC-2531
Los Angeles, CA 90089-2531
Ph: 213-740-2032
Fax: 213-740-8399

GEOLOGICAL SOCIETY OF AMERICA (GSA)
P.O. Box 9140
Boulder, CO 80301
Ph: 800-472-1988
Fax: 303-447-1133

GREEN BUILDING INITIATIVE (GBI)
2104 SE Morrison
Portland, Oregon 97214
Ph: 877-424-4241
Fax: 503.961.8991
Email: info@thegbi.org
Internet: http://www.thegbi.org/gbi/

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
445 Hoes Lane
Piscataway, NJ 08855-1331
Ph: 732-981-0060
Fax: 732-981-1712
E-mail: customer-services@ieee.org
Internet: http://www.ieee.org

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)
P.O. Box 1568
Carrollton, GA 30112
Ph: 770-830-0369
Fax: 770-830-8501
Internet: http://www.icea.net

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)
P.O. Box 687
106 Stone Street
Morrison, CO 80465
Ph: 303-697-8441
Fax: 303-697-8431
E-mail: neta@netaworld.org
Internet: http://www.netaworld.org

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)
3, rue de Varembe, P.O. Box 131
CH-1211 Geneva 20, Switzerland
Ph: 41-22-919-0211
Fax: 41-22-919-0300
E-mail: custserv@iec.ch
Internet: http://www.iec.ch

JOHN F. KENNEDY SPACE CENTER (KSC)
National Aeronautics and Space Administration
KSC Doc Library - D
Kennedy Space Center, FL 32899
Ph: 321-867-3613

KITCHEN CABINET MANUFACTURERS ASSOCIATION (KCMA)
1899 Preston White Drive
Reston, VA 20191-5435
Ph: 703-264-1690
Fax: 703-620-6530
Internet: http://www.kcma.org

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)
127 Park Street, NE
Vienna, VA 22180-4602
Ph: 703-281-6613
Fax: 703-281-6671
E-mail: info@mss-hq.com
Internet: http://www.mss-hq.com

MASTER PAINTERS INSTITUTE (MPI)
2800 Engleton Avenue
Burnaby, BC CANADA V5C 6G7
Ph: 1-888-674-8937
Fax: 1-888-211-8708
E-mail: info@paintinfo.com,jody@mpi.net,bgl@mpi.net
Internet: http://www.paintinfo.com/mpi

NACE INTERNATIONAL (NACE)
1440 South Creek Drive
Houston, TX 77084-4906
Ph: 281-228-6200
Fax: 281-228-6300
E-mail: firstservice@nace.org
Internet: http://www.nace.org

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

Superintendent of Documents at
U.S. Government Printing Office

732 North Capitol Street, NW
Washington, DC 20401-0001
Ph: 202-783-3238
Fax: 202-512-1800
E-mail: ContactCenter@gpo.gov
Internet: http://www.gpoaccess.gov/help

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
1300 North 17th Street, Suite 1847
Rosslyn, VA 22209
Ph: 703-841-3200
Fax: 703-841-5900
E-mail: webmaster@nema.org
Internet: http://www.nema.org/

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
1 Batterymarch Park
Quincy, MA 02169-7471
Ph: 617-770-3000
Fax: 617-770-0700
E-mail: webmaster@nfpa.org
Internet: http://www.nfpa.org

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)
1420 King Street
Alexandria, VA 22314-2794
Ph: 888-476-4238
E-mail: tech@nicet.org
Internet: http://www.nicet.org

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)
Mail Stop C-13
4676 Columbia Parkway
Cincinnati, OH 45226-1998
Ph: 800-356-4674
Fax: 513-533-8573
E-mail: pubstaff@cdc.gov
Internet: http://www.cdc.gov/niosh/homepage.html

NSF INTERNATIONAL (NSF)
789 North Dixboro Road
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Ann Arbor, MI 48113-0140
Ph: 734-769-8010 or 800-NSF-MARK
Fax: 734-769-0109
E-mail: info@nsf.org
Internet: http://www.nsf.org

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)
2500 Wilson Blvd., Suite 300
Arlington, VA 22201 USA
ph: (703) 907-7700
fax: (703) 907-7727
tty: (703) 907-7776

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)
Warrendale, PA, USA - Headquarters
400 Commonwealth Drive

Warrendale, PA 15096
Phone: +1-724-776-4841
Fax: +1-724-776-0790

SOCIETY FOR PROTECTIVE COATINGS (SSPC)
40 24th Street, 6th Floor
Pittsburgh, PA 15222-4656
Ph: 412-281-2331
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Internet: http://www.sspc.org

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Internet: http://www.dodssp.daps.mil

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Internet: http://www.gpoaccess.gov

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General Services Administration
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Washington, DC 20405
Ph: 202-501-1021

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Federal Supply Service Bureau
1941 Jefferson Davis Highway
Arlington, VA 22202
Ph: 703-605-5400
Internet: http://apps.fss.gsa.gov/pub/fedspecs/indexcfm

- - - - - Commercial Item Description Documents - - - - -

U S. GREEN BUILDING COUNCIL (USGBC)
2101 L St NW, Suite 500
Washington, D.C. 20037

Fax: 202-828-5110
E-mail: info@usgbc.org
Internet: http://www.usgbc.org

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Fax: 202-512-1262
E-mail: gpoaccess.gov
Internet: http://www.gpoaccess.gov

-- End of Section --

****
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA/KSC-01 91 00.00 98 (August 2012)

Preparing Activity: NASA

New

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
****

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COMMISSIONING

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****
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA/KSC-01 91 00.00 98 (August 2012)

Preparing Activity: NASA

New

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
****

SECTION 01 91 00.00 98

COMMISSIONING
08/12

****
NOTE: This specification covers the requirements for Sustainability and U.S. Green Building Council (USGBC) requirements for Commissioning.

Adhere to http://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Recommended changes to a NASAKSC Master Specification Section should be submitted to the appropriate Technical Proponent (TP) through the SpecsIntact Help Desk.
****

PART 1 GENERAL

The requirements of this Section apply to, and are a component part of, each section of the specifications.

This Section includes:

a. Building commissioning of the following systems:

(1) HVAC components and equipment

(2) HVAC system: interaction of cooling, heating, and comfort delivery systems

(3) Building Automation System (BAS): control hardware and software, sequence of operations, and integration of factory controls with BAS

(4) Lighting Control System and interface with daylighting

(5) Domestic hot water systems

(6) Renewable energy generation systems

b. Building commissioning activities and documentation in support of the U.S. Green Building Council (USGBC) LEED BD+C™ rating program. Commissioning activities and documentation include the section on "Energy and Atmosphere" prerequisite of "Fundamental Building Systems Commissioning" and the section on "Additional Commissioning."

c. Building commissioning activities and documentation in support of the Building Research Establishment (BRE) GBI Green Globes for NC - US rating system.

The Government, Green Consultant, Architect/Engineer, or Commissioning Agent are not responsible for construction means, methods, job safety, or management function related to commissioning on the job site.

The commissioning process does not take away from or reduce the responsibility of the system designers or installing Contractors to provide a finished and fully functioning product.

The following Sections are an integral part of this project Commissioning:

a. Section 01 30 00 ADMINISTRATIVE REQUIREMENTS

b. Section 01 57 19.00 20 TEMPORARY ENVIRONMENTAL CONTROLS

c. Section 01 45 00.00 40 QUALITY CONTROL

[d. Section 01 45 35 SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS]

g. Section 01 78 23 OPERATION AND MAINTENANCE DATA

[h. Section 02 62 16.16 10 COMMISSIONING AND DEMONSTRATION FOR SOIL VAPOR EXTRACTION (SVE) SYSTEMS

] i. Section 22 00 00 PLUMBING, GENERAL PURPOSE

j. Section 23 30 00 HVAC AIR DISTRIBUTION SYSTEMS

k. Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS

j. Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL

1.1 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in

this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

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.

****

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.

ASTM INTERNATIONAL (ASTM)

ASTM D6245	(2012) Using Indoor Carbon Dioxide Concentrations to Evaluate Indoor Air Quality and Ventilation
ASTM D6345	(2010) Standard Guide for Selection of Methods for Active, Integrative Sampling of Volatile Organic Compounds in Air

GREEN BUILDING INITIATIVE (GBI)

GBI Green Globes for NC	(2017) Green Globes(tm) for New Construction Technical Reference Manual

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED BD+C	(2009; R 2010) Leadership in Energy and Environmental Design(tm) Building Design and Construction (LEED-NC)
LEED GBDC Ref Guide	(2009; R 2010) LEED Reference Guide for Green Building Design, Construction and Major Renovations of Commercial and Institutional Buildings including Core & Shell and K-12 Projects

1.2 DEFINITIONS

a. Basis of Design - The basis of design is the documentation of the primary thought processes and assumptions behind design decisions that were made to meet the Project Requirements. The basis of design describes the systems, components, conditions and methods chosen to meet the intent. Some reiterating of the Project Requirements may be included.

b. Commissioning - Commissioning is a comprehensive and systematic process to verify that the building systems perform as designed to meet the requirements. Commissioning during the construction, acceptance, and

warranty phases intends to achieve the following specific objectives:

(1) Verify and document that equipment is installed and started per manufacturer's recommendations, industry accepted minimum standards, and the Contract Documents.

(2) Verify and document that equipment and systems receive complete operational checkout by the installing Contractors.

(3) Verify and document equipment and system performance.

(4) Verify the completeness of Operations and Maintenance materials.

(5) Ensure that the operating personnel are adequately trained on the operation and maintenance of the building equipment.

c. Commissioning Agent - develops the functional test procedures in a sequential written form, coordinates, oversees and documents the actual testing, which is usually performed by the installing Contractor or vendor. Functional Performance Tests are performed after pre-functional checklists and startup are complete.

d. Commissioning Plan - an overall plan that provides the structure, schedule and coordination planning for the commissioning process.

e. Deficiency - a condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents, does not perform properly, or is not complying with the Project Requirements.

f. Project Requirements - a dynamic document that provides the explanation of the ideas, concepts and criteria that are considered to be very important to the Government. It is initially the outcome of the programming and conceptual design phases.

g. Functional Performance Test - test of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems (rather than just components) under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint). Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's sequences of operation and components are verified to be responding as the sequences state. Traditional air or water test and balancing (TAB) is not functional testing, in the commissioning sense of the word.

h. Manual Test - using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").

i. Monitoring - the recording of parameters (flow, current, status, pressure, etc.) of equipment operation using data loggers or the trending capabilities of control systems.

j. Pre-functional Checklist - a list of items to inspect and elementary component tests to conduct to verify proper installation of equipment,

provided by the Commissioning Agent to the Contractor. Pre-functional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels OK, labels affixed, gages in place, sensors calibrated, etc.). However, some pre-functional checklist items entail simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage imbalance on a three-phase pump motor of a chiller system). The word "pre-functional" refers to before functional testing. Pre-functional checklists augment and are combined with the manufacturer's start-up checklist.

k. Seasonal Performance Tests - Functional Performance Test that are deferred until the system(s) will experience conditions closer to their design conditions.

l. Warranty Period - warranty period for entire project, including equipment components. Warranty begins at Substantial Completion and extends for at least one year, unless specifically noted otherwise in the Contract Documents and accepted submittals.

1.3 ADMINISTRATIVE REQUIREMENTS

Perform commissioning services for the system. Expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. The commissioning requires cooperation of the Contractor, Subcontractors, vendors, Architect/Engineer, Commissioning Agent, Green Consultant, and Contracting Officer.

1.3.1 Co-ordination

Provide a Commissioning Agent for overall co-ordination and management of the commissioning program. The commissioning team comprises the following groups:

a. Contractors Project Manger and Test Engineer

b. Sub-Contractor for the System being Commissioned

c. Commissioning Agents Project Manager and Project Engineers

d. Contracting Officers Representative

e. Green Consultant

f. Architect/Engineer and Specialty Consultant

Coordinate with IAQ baseline evaluation in conformance with ASTM D6245, and ASTM D6345.

1.3.2 Progress Meetings

Plan and co-ordinate meetings as required to monitor construction and commissioning progress the work. Notify the Contracting Officer of construction job-site meetings to address co-ordination, deficiency resolution and planning issues.

1.3.3 Functional Testing Co-ordination

Do **not** "temporarily" start equipment for commissioning. Do not conduct

functional performance testing until a pre-functional, start-up and TAB is completed for a given system. Do not functionally test the controls system and equipment it controls until all points have been calibrated and the pre-functional checklists are completed.

1.4 SUBMITTALS

****
NOTE: EO 13423 directs Federal agencies to "provide reports on agency implementation of this order to the Chairman of the Council [on Environmental Quality] on such schedule and in such format as the Chairman of the Council may require; and … provide information and assistance to the Director of the Office of Management and Budget, the Chairman of the Council, and the Federal Environmental Executive. Refer to http://www.wbdg.org/sustainableEO

Additionally, under the Sustainable Building requirements per Guiding Principle No. 2 Optimize Energy Performance, EO 13423 directs Federal agencies to "Enter data and lessons learned from sustainable buildings into the High Performance Buildings Database." http://femp.buildinggreen.com/

EO 13514; Federal Leadership in Environmental, Energy, and Economic Performance; was signed on October 5, 2009.
http://www.epa.gov/oaintrnt/documents/fleetguidance_13514.pdf
It expands upon the environmental performance requirements of EO 13423.
http://www1.eere.energy.gov/femp/regulations/printable_versions/eo13423.html
****

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

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

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 REPORTING.
****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for

Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Commissioning Plan[; G]

Commissioning Schedule[; G]

SD-05 Design Data

Basis Of Design[; G]

SD-06 Test Reports

Functional Performance Testing Results[; G]

Seasonal Testing[; G]

Short-Term Diagnostic Testing[; G]

Deficiency Report and Resolution Record[; G]

SD-07 Certificates

Commissioning Agents Qualifications[; G]

SD-10 Operation and Maintenance Data

Operations and Maintenance manuals[; G]

Training plan[; G]

Operations and Maintenance Database[; G]

SD-11 Closeout Submittals

Final Commissioning Report[; G]

[LEED™ Documentation[; G]

][Green Globes - US Documentation[; G]

] Warranty[; G]

1.5 QUALITY CONTROL

Commissioning Agents Qualifications: Engage commissioning service personnel, that specialize in the types of inspections and tests to be performed.

[Inspection and testing service agencies are members of the Building Commissioning Association (BCA)[_____].

]1.6 DESIGN REVIEW AND DOCUMENTATION

Document basis of design and Project Requirements as they relate to

environmentally responsive characteristics, including:

a. Functionality

b. Energy performance

c. Water efficiency

d. Maintainability

e. System cost

f. Indoor environmental quality

g. Local environmental impacts

Review design documents to verify that each commissioned system meets the Project Requirements, including conformance with ASTM D6245, ASTM D6345 [.][, and LEED GBDC Ref Guide for new construction.]

Review construction documents to verify that commissioning is adequately specified, that each commissioned system can be commissioned and is likely to meet the Project Requirements.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

[_____]

2.2 TEST EQUIPMENT

Ensure instrumentation used for testing meets the following standards:

a. Sufficient quality and accuracy to test and measure system performance within the tolerances required to determine adequate performance.

b. Calibrated on the manufacturer's recommended intervals with calibration tags permanently affixed to the instrument being used.

c. Maintained in good repair and operating condition throughout the duration of use on this project.

Provide all standard testing equipment required for performing startup and initial checkout and required functional performance testing for the system. Datalogging equipment or software required to test equipment will be provided by the Commissioning Agent, and not become the property of the Government.

2.2.1 Commissioning Plan

Develop a Commissioning Plan to identify how commissioning activities will be integrated into general construction and trade activities. The commissioning plan identifies how commissioning responsibilities are distributed. The intent of this plan is to evoke questions, expose issues, and resolve them with input from the entire commissioning team early in construction.

The Plan identifies who is responsible for producing the various

procedures, reports, forms, and notifications. It will include the Commissioning Schedule and describe the test/acceptance procedure.

2.3 START-UP/PRE-FUNCTIONAL CHECKLISTS

Coordinate start-up plans and documentation formats, including pre-functional checklists to be completed during the startup process. Manufacturer's start-up checklists and other technical documentation guidelines can be used as the basis for pre-functional checklists.

PART 3 EXECUTION

3.1 COMMISSIONING PROCESS

****
NOTE: Executive Order 13514; Federal Leadership in Environmental, Energy, and Economic Performance; was signed by President Obama on October 5, 2009. It expands upon the environmental performance requirements of EO 13423.
http://www.epa.gov/oaintrnt/documents/fleetguidance_13514.pdf
Additionally, Federal Agencies are required, per "DOE guidelines issued under section 103 of the Energy Policy Act of 2005 (EPAct), to install building level utility meters in new major construction and renovation projects to track and continuously optimize performance."

The Federal Real Property Council was established under EO 13327, Federal Real Property Asset Managed, issued February 4, 2004. The FRPC annual guidance and FRPP reporting instructions can be found at:
http://www.whitehouse.gov/omb/financial/fia_asset.html
The reporting of data for the "sustainability" data element is required for FY 2009 and beyond.

Commissioning, including the Commissioning Report, can assist agencies in meeting the commitments outlined in the MOU.
****

The Commissioning Agent coordinates all activities. The following activities outline the commissioning tasks and the general order in which they occur.

a. Design Review and documentation consisting of:

(1) Documentation of Basis of Design and Project Requirements

(2) Design Development Review

(3) Construction Document Review

b. Commissioning Scoping Meeting

c. Commissioning Plan

d. Submittals Review

e. Start-Up/Pre-Functional Checklists

f. Functional Performance Testing

g. Short-Term Diagnostic Testing

h. Deficiency Report and Resolution Record

i. Operations and Maintenance Training

j. Record Documents Review

k. Final Commissioning Report and [LEED™] [Green Globes - US] [_____] Documentation

l. Deferred testing due to unforeseen deferred tests, seasonal testing or end of Warranty review.

3.2 FUNCTIONAL PERFORMANCE TESTING

Fully describe system test procedures identifying configuration and steps required for each test. Provide appropriate documents so that another party can repeat the tests with virtually identical results.

Submit documentation to the Contracting Officer verifying conformance with the following standards:

3.2.1 Functional Performance Test Procedures

Develop functional performance test procedures for equipment and systems. Identify specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Coordinate test procedures with the Contractor for feasibility, safety, equipment and warranty protection.

Include the following information on the functional performance test forms:

a. System and equipment or component name(s)

b. Equipment location and ID number

c. Date

d. Project name

e. Participating parties

f. Instructions for setting up the test, including special cautions, alarm limits, etc

g. Specific step-by-step procedures to execute the test

h. Acceptance criteria of proper performance with a Yes / No check box

i. Comment section

3.2.2 Test Methods

Methods for functional performance testing and verification include direct

manipulation of system inputs (i.e. heating or cooling sensors), manipulation of system inputs with the building automation system (i.e. software override of sensor inputs), trend logs of system inputs and outputs using the building automation system, or short-term monitoring of system inputs and outputs using stand alone data loggers. The Commissioning Agent determines which method, or combination of methods, is most appropriate.

3.2.3 Setup

Perform each test procedure under conditions that simulate normal operating conditions as closely as possible. Where equipment requires integral safety devices to stop/prevent equipment operation unless minimum safety standards or conditions are met, have functional performance test procedures demonstrate the actual performance of safety shutoffs in a real or closely-simulated conditions of failure.

3.2.4 Sampling

The Commissioning Agent develops a sampling strategy when multiple identical pieces of non-life-safety or non-critical equipment may be functionally tested. If, after three test attempts at testing the specified sample percentage, failures are still present, then test all remaining units at the Contractors' expense.

3.2.5 Functional Performance Testing Results

Coordinate, observe and record the results of the functional performance testing. Coordinate retesting as necessary until satisfactory performance is verified. Verify the intended operation of individual components and system interactions under various conditions and modes of operation.

3.3 SHORT-TERM DIAGNOSTIC TESTING

After initial occupancy, perform short-term diagnostic testing, using [data acquisition equipment] [the building automation system] to record system operation over a [two] [three] [_____] week period.

[Investigate the dynamic interactions between components in the building system. Evaluate the scheduling, the interaction between heating and cooling, and the effectiveness of the HVAC system in meeting the comfort requirements.

]3.4 DEFICIENCY REPORT AND RESOLUTION RECORD

Document items of non-compliance in materials, installation or operation.

3.4.1 Non-Conformance

Immediately address observed non-conformance and deficiencies in terms of notification to responsible parties, and provide recommended actions to correct deficiencies.

Corrections of minor deficiencies identified may be made during the tests at the discretion of the Commissioning Agent. In such cases document the deficiency and resolution on the procedure form.

3.4.1.1 Identified Deficiencies Correction Procedure

If there is no dispute on the deficiency and the responsibility to correct it:

a. The Commissioning Agent documents the deficiency and the adjustments or alterations required to correct it. The Contractor corrects the deficiency and notifies the Commissioning Agent that the equipment is ready to be retested.

b. The Commissioning Agent reschedules the test and the test is repeated.

If there is a dispute about a deficiency or who is responsible:

a. The deficiency is documented on the non-compliance form and a copy given to the Green Consultant.

b. Resolutions are made at the lowest management level possible. Additional parties are brought into the discussions as needed. Contractor has responsibility for resolving construction deficiencies. If a design revision is deemed necessary and approved by the Contracting Officer, the Architect/Engineer has responsibility for providing a design revision.

c. The Commissioning Agent documents the resolution process.

d. Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency and notifies the Commissioning Agent that the equipment is ready to be retested. The Commissioning Agent reschedules the test and the test is repeated until satisfactory performance is achieved.

The Contractor is responsible for retesting costs.

3.5 OPERATIONS AND MAINTENANCE TRAINING

Provide complete Operations and Maintenance manuals, a Training Plan and an Operations and Maintenance Database.

Coordinate and review with the Contracting Officers' representative the training program[s] for O&M personnel.

Develop the database from the O&M manual containing the information required to start a preventative maintenance program.

Provide additional materials as necessary to stress and enhance the importance of system interactions, troubleshooting, and long-term preventative maintenance and operation.

3.6 FINAL COMMISSIONING REPORT AND LEED™ DOCUMENTATION

Compile and submit a Final Commissioning Report. Summarize all of the tasks, findings, conclusions, and recommendations of the commissioning process.

Compile and submit [LEED™ Documentation] [Green Globes - US Documentation] [_____]. Format as required by [USGBC] [GBI] [_____] for submittal under the referenced green building rating system.

3.7 DEFERRED TESTING

3.7.1 Unforeseen Deferred Tests

If a test cannot be completed due to the building structure, required occupancy condition, or other deficiency, the functional testing may be delayed upon recommendation of the Commissioning Agent and the approval of the Contracting Officer. Conduct these tests in the same manner as the seasonal tests as soon as possible.

3.7.2 Deferred Tests

Schedule, coordinate, observe, and document additional testing for seasonal variation in operations and control strategies during the opposite season to verify performance of the [HVAC][_____] system and controls. Complete testing during the warranty period to fully test all sequences of operation.

3.7.3 End-of-Warranty Review

Conduct end of warranty review prior to the end of the warranty period. Review the current building operation with the facility maintenance staff. Include in the review all outstanding issues from original or seasonal testing. Interview facility staff to identify concerns with building operation. Provide suggestions for improvements and assist Contracting Officer in developing reports or documentation to remedy problems.

Update O&M manuals and Record Documents as necessary due to the testing.

3.8 EQUIPMENT AND SYSTEM SCHEDULE

Commission the following equipment in this project.

****
NOTE: Edit below to suit project.
****

System	Equipment	Check
HVAC System	Chillers	
	Pumps	
	Cooling Tower	
	Variable frequency drives	
	Air Handlers	
	Packaged AC units	
	Terminal units	
	Unit heaters	
	Heat exchangers	

System	Equipment	Check
	Fume hoods	
	Lab room pressures	
	Exhaust fans	
	Supply fans	
Lighting Controls	Sweep or scheduled lighting controls	
	Day light dimming controls	
	Lighting occupancy sensors	
BAS System		
Domestic Hot Water		
Renewable Energy	Solar energy electrical power generation	
	Wind energy electrical power generation	
	Biomass energy electrical power generation	

-- End of Section --

****
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA/KSC-02 82 13.00 98 (July 2020)

Preparing Activity: NASA

Superseding
NASA/KSC-02 82 13.00 98 (February 2012)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
****

SECTION TABLE OF CONTENTS

DIVISION 02 - EXISTING CONDITIONS

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ASBESTOS ABATEMENT

07/20

-- End of Section Table of Contents --

****
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****

SECTION 02 82 13.00 98

ASBESTOS ABATEMENT
07/20

****
NOTE: This specification covers the requirements for asbestos demolition, construction and abatement requirements at Kennedy Space Center (including NASA/KSC facilities at Cape Canaveral Air Station). This section is to be edited only by personnel certified by the State of Florida as a Florida Licensed Abatement Consultant (FLAC). This is a local master specification for NASA at Kennedy Space Center.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Recommended changes to a NASAKSC Master Specification Section should be submitted as a Criteria Change Request (CCR) to the appropriate Technical Proponent (TP) through the SpecsIntact Help Desk.
****

PART 1 GENERAL

1.1 SUMMARY

This section specifies the asbestos abatement requirements and the applicable asbestos procedures. These include:

a. Demolition or salvage of structures where asbestos is present

b. Removal or encapsulation of materials containing asbestos

c. Construction, alteration, repair, maintenance, or renovation of structures, substrates, or portions thereof, that contain asbestos

d. Installation of products containing asbestos

e. Asbestos spill/emergency cleanup

f. Transportation

g. Disposal

h. Storage

i. Containment of and housekeeping activities involving asbestos or products containing asbestos, on the site or location at which construction activities are performed

Under OSHA, Asbestos Abatement work is categorized into four classes:

Class I Work: Activities involving the removal of Thermal System Insulation (TSI) and surfacing Asbestos Containing Materials (ACM) and Presumed Asbestos Containing Material (PACM).

Class II Work: Activities involving the removal of ACM is not TSI or surfacing material. This includes wallboard, floor tile and sheeting, roofing, siding, shingles, and construction mastics.

Class III Work: Repair and Maintenance operations, where ACM, including TSI and surfacing ACM and PCM, is likely to be disturbed.

Class IV Work: Maintenance and custodial activities during which employees contact but do not disturb ACM or PACM and activities to clean up dust, waste, and debris from Class I,II, and III activities.

Conduct abatement work in accordance with the Class I, II, III, or IV Methods of Compliance as required by 29 CFR 1910, 29 CFR 1926, 40 CFR 61-SUBPART M, 49 CFR 171, 49 CFR 172, FAC CHAPTER 62-257, and FL-STAT 469. Submit all required training certifications prior to commencement of work, and experience of Contractor's "Competent Person," Supervisor, and workers.

1.2 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update

the issue dates.

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.

****

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.

COMPRESSED GAS ASSOCIATION (CGA)

CGA G-7.1	(2011) Commodity Specification for Air; 5th Edition

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1926	Safety and Health Regulations for Construction
40 CFR 61-SUBPART M	National Emission Standard for Asbestos
40 CFR 763	Asbestos
49 CFR 171	General Information, Regulations, and Definitions
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements
AFSPCMAN 91-710	(2004) Range Safety User Requirements Manual
FAC CHAPTER 62-257	(2008) Florida Administrative Code, Asbestos Program
FL-STAT 469	(2010) Asbestos Abatement
KNPR 1840.19	KSC Industrial Hygiene Programs
KNPR 8500.1	KSC Environmental Requirements
KNPR 8715.3	KSC Safety Practices Procedural Requirements
NIOSH 7400	(1994) Standard Test Method for Asbestos and Other Fibers by PCM

1.3 DEFINITIONS

Competent Person - Per OSHA, one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization

to take prompt corrective measures to eliminate them.

FLAC - Florida Licensed Asbestos Consultant as defined within the FL-STAT 469 ASBESTOS ABATEMENT.

IH - Contractor's independent Industrial Hygienist. This person is responsible for the oversight and approval of the abatement procedures and the health, safety, and welfare of those who it effects.

CIH - A Certified Industrial Hygienist is an individual who has met the minimum requirements for education and experience, and through examination, has demonstrated a minimum level of knowledge and skills in 16 rubric (subject matter) areas.

1.4 ADMINISTRATIVE REQUIREMENTS

1.4.1 Licenses And Permits

Submit a copy of asbestos consultant's license to the Contracts Administrator. Ensure that the FLAC possesses a current license and complies with all Federal, State of Florida and local regulations. Only those consultants who are licensed by the Department of Business and Professional Regulation(DBPR) are permitted to perform Asbestos Surveys or abatement specifications and plans as per Florida Statute 469.

Also submit a copy of Asbestos Contractor's License. Possession of a current asbestos contractor's license is mandatory, as well as securing all necessary licenses and permits associated with asbestos removal, transportation, and disposal as may be required by Federal, State, and local regulations. Only those Contractors who are certified and licensed by the State of Florida DBPR will be permitted to perform asbestos abatement activities at Kennedy Space Center.

Submit a copy of waste disposal permit and all disposal shipping manifests and tickets as they are obtained.

1.4.2 Certificates

Submit the following certificates:

a. Certification of participation (documentation showing current and 2 previous consecutive PAT test round results) in a proficiency analytical test (PAT) program such as or equivalent to the American Industrial Hygiene Association PAT or Asbestos Analytical Registry (AAR) accreditation certificate and Interlab QA/QC Program participation for the independent air monitoring agency selected by the Contractor before starting work.

b. Training Certifications and accreditation certificates for the independent air monitoring agency's on-site personnel and a copy of independent air monitoring agency's Quality Control Program.

c. Certification documents by the Contractor verifying that employees have been provided current respirator fit test, training, and medical examinations in compliance with 29 CFR 1926.

1.4.3 Safety Data Sheets (SDS)

Submit Safety Data Sheets (SDS) as required for materials to be used on the

specified project.

1.4.4 Notification

When applicable, submit a Florida Department of Environmental Protection (DEP) "Notice of Demolition or Asbestos Renovation" (DEP Form 62-257.900(1)) to the DEP District Office. Provide copy of the notification to the Government as part of the Implementation Plan.

1.5 SUBMITTALS

****

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

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

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Asbestos Consultant's License[; G]

Asbestos Contractor's License[; G]

Training Certifications[; G]

Implementation Plan[; G]

Air Monitoring Plan[; G]

Contingency Plan for Emergencies[; G]

Respiratory Protection Plan[; G]

Work Schedule[; G]

Initial Inspection[; G]

SD-06 Test Reports

Initial Exposure Assessments[; G]

Air Monitoring Reports[; G]

Work Site Entry Logs[; G]

Daily Site Inspection Logs[; G]

Waste Inventory[; G]

Waste Shipment Record (WSR)[; G]

SD-07 Certificates

Training Certifications[; G]

Safety Data Sheets[; G]

Proficiency Analytical Test[; G]

SD-08 Manufacturer's Instructions

Implementation Plan[; G]

SD-11 Closeout Submittals

Waste Disposal Permit[; G]

Disposal Shipping Manifests and Tickets[; G]

Daily Site Inspection Logs[; G]

Negative Pressure Logs[; G]

OSHA Compliance Inspection Records[; G]

Air Monitoring Reports[; G]

Independent Monitoring Data[; G]

Calibration Records[; G]

Waste Stream Inventory[; G]

1.6 IMPLEMENTATION PLAN

Prepare and submit a detailed, written Implementation Plan created, signed and sealed by a FLAC to the Government for approval, prior to the start of work, that includes the following:

a. Coordination drawings, in .DWG or .DGN electronic format, including site specific drawings of proposed work areas, clean room/change areas, mini-enclosures, shower, equipment room, waste loading/staging areas, locations of High Efficiency Particulate Air (HEPA) filtered negative pressure devices and exhaust points, work areas, emergency egress, and

areas to be modified.

b. Detailed drawings for asbestos abatement systems consisting of fabrication and assembly drawings for all parts of the work in sufficient detail to enable the Government to check conformity with the requirements of the contract documents.

c. A copy of the applicable DEP Notification of Demolition/Renovation (DEP Form 62-257.900(1)).

d. Plan of action, including proposed procedures to be used in complying with the requirements of this specification, 29 CFR 1926, and other applicable regulatory requirements, sequence of asbestos abatement work, the interfaces of trades involved in the performance of work, posting of licenses, permits, etc., methods to be used to assure the safety of building occupants and visitors to the site, fiber migration procedure for ensuring other ACM and/or heavy metal hazards not in scope are not disturbed, disposal plan including location of approved disposal site, a detailed description of the methods employed to control pollution, and a detailed work schedule. Expand upon the method for removal of ACM, the use of portable HEPA ventilation systems, closing out of the buildings HVAC system, method of removal to prohibit visible emissions in the work area, and packaging of removed debris.

e. Details of the decontamination areas and procedures, locations of staging areas, posting of warning signs, and details of negative air system to be used in the work area.

f. Sketch(s) or drawing(s) of complete contract area(s) showing the shower room, clean room, drum staging area, decontamination and containment areas, the negative air system, and exits. Indicate designation of the "Competent Person" (CP), and Site Supervisor.

1.6.1 Air Monitoring Plan

Provide a written Air Monitoring Plan to be prepared under the direction of and signed/stamped by a FLAC specifying the air monitoring criteria and an action plan for implementation by the Competent Person.

Provide certification that the Contractor, his staff, and abatement workers (including Supervisors) have attended and successfully completed (an) asbestos abatement course(s) including refresher courses as set forth in FL-STAT 469 and in accordance with 29 CFR 1926 and 40 CFR 763.

Provide a written (OSHA compliant) Respiratory Protection Plan in accordance with 29 CFR 1910 including training in the care, use, and maintenance of respirators and fit test certification.

Provide a written description of respiratory equipment (name, type, model number) and protective clothing provided to the abatement workers.

1.6.2 Medical Examination

Provide medical documentation that all personnel assigned to the abatement project have been examined annually by a physician. Submit the physician's written opinion containing the results of the employee's medical examination in compliance with 29 CFR 1926.

1.6.3 Procedures for enforcement of Personal Hygiene Practices

Describe personnel work practices and personnel hygiene procedures in the work plan submittals.

1.6.4 Contingency Plans

Prepare and submit a contingency plan for emergencies including fire, accident, power failure, heating or cooling, negative air system failure, respirator supplied air system failure, or any other event that may require modification of the work area isolation procedures. Include in the plan specific procedures for decontamination or work area isolation, safe exiting, and the need for medical attention in the event of an emergency.

1.6.5 Additional Procedures

Submit any additional procedures (fall protection, confined space, etc.) and policies that are in effect to ensure worker safety and environmental, KNPR 8500.1, KNPR 8715.3,[and AFSPCMAN 91-710] requirements are met.

Establish, maintain, and make readily available for review all work site entry logs of all personnel entering and leaving the regulated work area by the on-site competent person indicating the date and time of entry and egress.

1.7 AIR MONITORING REPORTS

Obtain the services of an independent Air Monitoring agency/FLAC. Air samples will be analyzed by an independent Air Monitoring Agency accredited by the American Industrial Hygiene Association (AIHA) or personnel participating in the AIHA Asbestos Analyst Registry (AAR), for analysis of airborne asbestos concentration levels[, and submittal of Independent Monitoring Data taken during the abatement]. Provide a copy of the monitoring agency's Quality Control Program to Contracts Administrator prior to commencement of the abatement activities. Ensure that the individual performing the on-site air monitoring meets the requirements as set forth in FL-STAT 469 and 40 CFR 763, and performs sample collections in accordance with the approved Air Monitoring Plan under the direction of FLAC.

Perform all Air Monitoring under the direction of the FLAC using an independent Air Monitoring Contractor, in compliance with Florida Statute 469 requirements.

Calibrate pumps before and after each air sample and submit calibration records to the Government.

Submit daily Air Monitoring Reports. Include in the Air Monitoring Report the following information for each sample:

a. Sample identification, Sample location

b. Employee Name, Unique Identifying Number

c. Description of task being monitored

d. Exposure level results in (f/cc), sample period/8 hr. TWA

e. Monitoring instrument identification number

f. Pre-calibration, post calibration, and average flow rate of each sample

g. Sample date, start and stop times

h. Type of protective devices worn (if any)

i. Project identification number, Facility number and name

j. Sampling and Analytical Methods used

k. Contact name and company, and name of individual performing the sampling

l. Name of FLAC and license number reviewing air monitoring

1.7.1 Air Sample Analytical Method

Airborne fiber sampling and analytical procedures are to be analyzed by Phase Contrast Microscopy (PCM) in accordance with 29 CFR 1926 and NIOSH 7400 method.

1.7.2 Air Sampling Rate, Volumes and Frequency

Conduct daily monitoring utilizing sample rates, volumes and frequency in accordance with 29 CFR 1926 and retain for final submittal at closeout. The minimum number of samples or sample volumes may not be less than those specified below:

Sample Type	Volume	Minimum No. Samples	Location
Prior to set-up (within 24 hours)	1200 L	2	Regulated Area
Personal, During work	400 L	2	Personal B.Z.
Area samples, Adjacent to work area	1200 L	2	Regulated Area
Area samples at Negative Air Unit Exhaust	1200 L	1	In area of outlets

NOTE: The KSC IH may perform air sampling outside the regulated work area.

1.8 WORKER PROTECTION

Perform Initial Exposure Assessments and Employee Exposure Monitoring in accordance with 29 CFR 1926, part 1926.1101, under direction of the FLAC.

Select and provide respiratory protection to employees and ensure they are utilized in accordance with 29 CFR 1926.

Submit the Work schedule indicating the work days, hours, and the number of workers per shift. Include a bar chart to identify the individual milestones through to the completion of the project (i.e., number of days to complete work site preparation, number of days to complete ACM removal, number of days to complete final cleaning and lockdown, etc.).

Submit the OSHA compliance inspection records as part of the closeout documents.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 TEMPORARY UTILITIES AND SERVICES

The Government will make available at the work site, water at hose bibs and 120 Volt AC at receptacles for use. Provide water proof safety lighting where necessary for safe, adequate illumination.

Ensure that all electrical equipment used inside the work areas is powered from an Underwriters Laboratory (UL) approved Ground Fault Circuit Interrupter (GFCI). Do not exceed the manufacturer's limits per GFCI. Make all necessary connections and restore the site connections to the original condition or better, before project completion.

Ensure that all energized or pressurized systems inside the work area have been locked out, tagged out or otherwise rendered safe.

Provide temporary water from the existing building water source to control the generation of airborne dust, to allow for area, personnel, and equipment decontamination, and to supply decontamination unit needs. Also provide a backflow preventer at the source.

Provide temporary sanitary drainage piping to the decontamination unit sump and to the shower unit at a minimum slope of 2.0 percent, and temporary drainage piping to waste water pump and existing drain in accordance with local standards and as approved by the Contracts Administrator.

3.2 WORK AREA PREPARATION

The Government will re-arrange equipment and storage areas to the extent of providing a direct and unobstructed path to the work area(s). During ACM removal, confine equipment and employees to the designated work area(s).

Unless otherwise directed by the Contracts Administrator, establish and maintain a [8 meters] [25-foot] [_____] access control barrier zone(s) around the designated work area(s). Interference with the functional operation of the building occupants outside these areas is not permitted.

Ensure that all building supply and return air ducts from the mechanical system are isolated to eliminate air flow into or out of containment area(s).

3.2.1 Pre-Cleaning

Shut down HVAC systems and seal all critical barriers before initiating pre-cleaning actions. Seal, with 0.15 mm 6 mil minimum thickness plastic sheeting, all openings, windows, corridors, doorways, elevator openings, skylights, ducts, grilles, diffusers, and any other penetrations between the contaminated work areas and uncontaminated areas.

Pre-clean all movable objects identified as contaminated by the Contracts

Administrator or designated representative within the work area using a HEPA filtered vacuum and wet cleaning methods as appropriate. Remove these objects after cleaning and store in a protected area.

Pre-clean all surfaces in the work area using HEPA filtered vacuums and/or wet cleaning methods as appropriate. Methods that would raise dust, such as dry sweeping or vacuuming with equipment not equipped with HEPA filters, are PROHIBITED. Pay detailed attention to machinery or areas behind grilles and gratings.

Do not remove or otherwise disturb asbestos containing building materials during the pre-cleaning phase.

3.2.2 Work Area(s) Notification

Inform all other Contractors and personnel on the site of the abatement work, of the nature of the work with ACM and/or PACM, of the existence of and requirements pertaining to regulated areas, and the measures taken to ensure that employees of such other Contractor employers are not exposed to asbestos in accordance with 29 CFR 1926.

Use industry controls and work practice methods in accordance with 29 CFR 1926. Ensure that the daily site inspection logs are posted at the jobsite by the on-site competent person.

Use flame resistant, 0.15 mm 6 mil polyethylene sheeting when constructing Negative Pressure Enclosures (NPE) or decontamination areas.

3.3 WASTE LOAD-OUT UNIT

Establish a waste load-out unit to provide for interim secure storage. Include an equipment room for storage of asbestos-contaminated items (drums, tools, equipment). Decontaminate all equipment and waste containers prior to being taken out of the work area(s).

All asbestos-containing waste material is to be sealed in leak-tight disposal containers. Thoroughly wet all waste within the disposal containers. Maintain proper labeling protocols for all running and final inventory of filled disposable containers.

3.4 SIGNS AND MARKINGS

Post signs before commencing asbestos work as required in 29 CFR 1926. Post signs at the perimeter of the asbestos work areas, along the route of the temporary waste material holding (Drum Staging) area, and at all entrances to asbestos work areas. Ensure that the signs are conspicuous and legible.

Post telephone numbers and locations of emergency services including, but not limited to, fire, ambulance, doctor, and hospital, at the regulated area.

Post one copy of all permits at the work site perimeter in an accessible location outside the regulated area.

Post one copy of the Abatement Contractors current license at the work site perimeter in an accessible location outside the regulated area.

Post hazard communication notification signs in accordance with KNPR 1840.19

requirements.

3.5 NEGATIVE AIR SYSTEM

Construct Negative Pressure Enclosures (NPE's) as required by 29 CFR 1926.

Duct each of the negative air units through the containment barrier walls to the outside of the work area(s). When the building is occupied, ensure that the ducts exhaust into the outside air; otherwise, ducts may exhaust into an area of the building beyond the critical barriers. Never exhaust the units into the work area(s).

Provide each unit with temporary back-up electrical power (120 Volt AC) in the event of power failures or outages.

3.5.1 Testing

Design the negative air system to provide a minimum of four (4) air changes per hour and test before any work is begun. After the work area has been prepared, the decontamination unit set up, and the negative air units(s) installed, test the system. Before beginning abatement activities, an Asbestos Abatement Pre-Work Inspection checklist (KSC Form 28-1230A) will be completed by the qualified IH working under the direction of an FLAC to verify the adequacy of the containment and work area. Once activated, ensure the negative air exhaust unit(s) remain in operation until final clearance air monitoring has been performed. Maintain daily negative pressure logs for review by the FLAC and submit as part of the closeout documents.

Install a differential pressure meter or manometer to continuously measure pressure differential between inside and outside the work area for all Class I activities which utilize a NPE. Maintain a minimum pressure differential of 0.5 mm 0.02 inch of water column.

3.6 RESPIRATORY PROTECTION

Instruct and train each worker involved in asbestos abatement in proper respirator use and care. Fit all respirators by approved qualitative or quantitative test. Use respiratory protection appropriate for the fiber level encountered in accordance with initial assessment and if conditions change in the Work Area and as specified herein, or as required for other situations encountered.

3.6.1 Air Quality for Supplied Air Respiratory Systems

Provide breathing air used in Type "C" supplied air respiratory systems that meets or exceeds CGA G-7.1, standards for Grade D air.

3.7 REMOVAL OF ASBESTOS

Use industry controls and work practices for all operations in accordance with 29 CFR 1926 Methods of Compliance for Class I, II, III, or IV asbestos work. The abatement contractor is responsible for these practices.

Ensure that all Class I, II, III and IV work is supervised by an on-site Competent Person or designated representative at all times that work is in progress.

Following removal of contaminated items and asbestos material, seal the

edges of the adjacent surfaces that were exposed when the asbestos was removed, with an asbestos bridging sealant/encapsulant.

3.8 DAILY HOUSEKEEPING

Maintain a clean work area in accordance with 29 CFR 1926. Perform the following housekeeping functions at the end of each shift or prior to leaving the work site unattended:

a. Prepare contaminated waste for disposal by packaging the waste and removing it from the work area.

b. HEPA vacuum the work area.

c. Visually inspect the polyethylene in the work area and other high traffic areas.

3.9 CLEANING PROCEDURES

Clean the work area at the end of each day's abatement activities. Designate a separate, secured area within the work area for storage of debris until it can be properly disposed. Secure the work area after termination of the work day to prevent entry. Regularly dispose and replace disposable supplies, such as mop heads, sponges, and rags. Clean all equipment by HEPA vacuuming and wet wiping.

Clean all work areas in which abatement operations have been completed, starting at the ceiling and working down to the floors, by HEPA vacuuming and wet wiping. Before removal of worksite access controls and re-occupancy inspection by the Government, and upon satisfactory final clearance air sampling, and removal of polyethylene sheeting, perform a final cleaning (wet wipe) of all surfaces within the work area.

3.10 INSPECTION

Do not commence removal of asbestos materials before the qualified IH under the direction of a FLAC gives concurrence to proceed on the Asbestos Abatement Pre-Work Inspection (checklist KSC Form 28-1230A).

3.10.1 Initial Inspection

The Contractor and the FLAC or personnel working under direction of the FLAC will conduct a walk-through of the work area before beginning the abatement work to review existing conditions and ensure safe and practical conditions for the work to be implemented. Document any damage to structures, surfaces, and equipment that could be misconstrued as damage resulting from work, and immediately submit to the Contracts Administrator.

Perform background sampling for work areas in accordance with 29 CFR 1926 before beginning the abatement work. Any debris, cleanliness conditions, or damaged ACM must be brought to the attention of the Contract Administrator at this time.

3.10.2 Daily Inspection

Maintain a work site entry log of all personnel who enter the regulated work area. Through continuous surveillance and inspections of the worksite, ensure the integrity of containment, proper function of the negative pressure system, and posting of signs and labels. Also ensure,

through frequent inspections during each work shift, that negative pressure is maintained, appropriate work practices are followed, appropriate protective clothing and equipment are used, and worker decontamination procedures are being followed.

Ensure that critical barriers and negative pressure enclosures remain effectively sealed and taped. Take immediate action to remedy defects immediately upon discovery. Details of the inspections are to be included in the daily inspection log and posted in an accessible location outside the regulated area.

Provide updated copies of the Air Monitoring Reports, daily site inspection logs and waste stream inventory to the Contracts Administrator at the end of each week of the abatement work.

NASA/Kennedy Space Center reserves the right to conduct periodic inspections and air monitoring in the work area(s). If the work area is unsafe as determined by the Contracts Administrator, the Contracts Administrator, will require a work stoppage until the unsafe conditions are corrected.

3.10.3 Final Inspection

The thoroughness of asbestos removal is to be evaluated by visually inspecting the affected surfaces for residual asbestos material and accumulated dust followed by air sampling. Evidence of residual asbestos or asbestos debris on any adjacent surfaces upon completion of the work is not acceptable.

Upon completion of the work, conduct a thorough visual inspection of the work area by the Abatement Contractor and the qualified IH working under the direction of a FLAC to ensure that no residual asbestos material, dust or debris remains. Document final inspections on the Asbestos Abatement Clearance Inspection Checklist (KSC Form 28-1231A), to be completed by a qualified IH under the direction of a FLAC.

If applicable, final aggressive air sampling is to be performed by the KSC IH for each NPE work area after completion of a satisfactory visual inspection. The clearance criteria is 0.01 fibers per cubic centimeter (f/cc) of air as determined by PCM. Satisfactory fiber counts from all final samples are to be less than 0.01 f/cc. If any of the final air samples contain greater than 0.01 f/cc, repeat the final cleaning operation and re-test the area until satisfactory clearance levels are obtained.

Collect five PCM final air samples for the first 5000 square feet of containment plus one additional PCM final air sample for each additional 5000 square feet or one air sample per room, whichever is greater. The number of final air samples may be reduced for small enclosures of less than approximately 2500 square feet. In no case may fewer than two final samples be collected for any enclosure. The qualified IH working under the direction of a FLAC will make this determination.

Ensure that the clearance air sample volumes meet the minimum volumes as indicated for analysis by the NIOSH 7400 method.

3.11 ASBESTOS WASTE AND CONTAMINATED MATERIALS

3.11.1 Removal of Asbestos Waste Materials

For purposes of this paragraph, asbestos waste materials are defined as those materials which contain or have been contaminated by asbestos and are not planned to be encapsulated and remain at the job site. They are primarily removed asbestos, disposable clothing and safety equipment, polyethylene sheeting, contaminated amended water, vacuum cleaner contents, and filtration media.

Contain all asbestos waste material in two 0.15 mm 6 mil polyethylene disposal bags, or two 0.15 mm 6 mil disposal bags and a sealed leak-tight container such as, but not limited to, a steel or fiberboard drum. Pack the asbestos waste material while still wet. Clean the external surface of the waste containers by HEPA vacuuming and wet wiping before moving from the work area. Protect the interior of truck or dumpster with two layers of polyethylene sheeting.

3.11.1.1 Waste Inventory

Maintain Waste Inventory records of all generated waste drums or containers. Indicate the location and approximate quantity of material in each container. Clearly label and mark all disposal containers, dumpsters, and trucks, in accordance with 40 CFR 61-SUBPART M, 29 CFR 1910 of OSHA's Hazard Communications Standard, and 49 CFR 171 and 49 CFR 172, Hazardous Substances.

Provide conspicuous, legible labels, affixed to plastic bags and drums indicating the name of the waste generator and the location (facility name and number) where the waste was generated.

3.11.1.2 Waste Shipment Record

Provide a Waste Shipment Record (WSR) to the waste site owner in accordance with the instructions in 40 CFR 61-SUBPART M.

For non-friable asbestos that will be disposed at the KSC/Schwartz Road Landfill, provide a completed landfill disposal verification form (KSC Form 28-1064NS) send to the Contracts Administration. NOTE: Regulated ACM is not permitted for disposal at KSC/Schwartz Road Landfill.

3.11.2 Work Area Disposal

After final inspection has been completed and the work area is released for occupancy, shut off and remove the Negative Air System units. Unseal all entrances and exits. Dispose of all plastic sheeting, tape, and any other trash and debris, except for critical barriers, in sealable plastic bags, or in drums and moved to the staging area. After final wet wipe of the work area and satisfactory clearance air sampling, dismantle critical barriers and the decontamination unit.

3.11.3 Decontamination Area And Support Area Disposal

Dismantle the decontamination area after the work area is released by the KSC IH for re-occupancy. Vacuum all surfaces of the decontamination unit before it is disassembled.

3.12 WASTE TRANSPORTATION AND DISPOSAL

Transport and dispose of asbestos waste in full compliance with 40 CFR 61-SUBPART M, SUBPART A, 49 CFR 171 and 49 CFR 172.

3.13 ASBESTOS ABATEMENT NOTICE AND CHECKLIST

An Asbestos Abatement Pre-Work Inspection form (KSC Form 28-1230A) and an Asbestos Abatement Clearance Checklist (KSC Form 28-1231A) will be provided by the Contracts Administrator. Send copies to the Contracts Administrator upon satisfactory completion of the work. Notify KSC IH and the Contracts Administrator at least three days prior to the planned commencement of work. Coordinate and schedule all Pre-Work and Clearance Site inspections with KSC IH. The completed forms are to be used to establish approval of the containment, work practices and final acceptance/re-occupancy of the work area(s).

3.14 FINAL ACCEPTANCE

3.14.1 Closeout Submittals

****
NOTE: Section 01 78 00 CLOSEOUT SUBMITTALS should be reviewed and revised to meet any required performance by the Contractor before the project is considered complete.
****

Within 10 days after the completion of work, submit to the Contracts Administrator a written summary and copies of the following items:

a. Notification of Demolition/Renovation

b. Waste Disposal Permit

c. Disposal Shipping Manifests and Tickets

d. Daily Site Inspection Logs

e. Negative Pressure Logs

f. OSHA Compliance Inspection Records

g. Air Monitoring Reports

h. Independent Monitoring Data

i. Calibration Records

j. Waste Stream Inventory

The work will not be considered complete until the asbestos materials identified herein have been abated, the areas cleaned, satisfactory clearance air monitoring completed, all asbestos contaminated waste has been properly disposed of, and all project close out documents have been received and approved by the Contracts Administrator.

-- End of Section --

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA/KSC-09 90 00.00 98 (July 2020)

Preparing Activity: NASA

Superseding
NASA/KSC-09 90 00.00 98 (November 2014)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
****

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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SECTION 09 90 00.00 98

PAINTING AND COATING
07/20

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NOTE: This specification covers the requirements for the general requirements, materials, surface preparation, material preparation, and coating systems for exterior and interior on-site painting.

Factory-finished and semifinished surfaces are specified in their respective sections. Apply field finish to factory-semifinished surfaces and check for compatibility.

The following areas and surfaces are not generally painted except as noted or specified:

Elevator and duct shafts, concealed spaces, concealed pipes and ducts

Exterior brick, stone, and concrete surfaces are not generally painted, unless considered aesthetically desirable.

Nonferrous metal and stainless steel surfaces, unless required for aesthetic reasons

Acoustic tile and acoustic plaster surfaces

Materials with acceptable factory-finished surfaces

Concrete floors

Structural steel encased in concrete and structural steel concealed by interior building finish, except where subject to high humidity or corrosive conditions

Indicate on drawings and paint schedules exterior and interior surfaces to be painted and the finish coating color and gloss.

Adhere to UFC 1-300-02 Unified Facilities Guide

Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Recommended changes to a NASAKSC Master Specification Section should be submitted as a Criteria Change Request (CCR) to the appropriate Technical Proponent (TP) through the SpecsIntact Help Desk.

****

PART 1 GENERAL

1.1 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

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.

****

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.

ASTM INTERNATIONAL (ASTM)

ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants

MASTER PAINTERS INSTITUTE (MPI)

MPI 47	(2016) Alkyd, Interior, Semi-Gloss (MPI Gloss Level 5)
MPI 50	(2015) Primer Sealer, Latex, Interior

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 25	(1997; E 2004) Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II
SSPC SP 2	(2018) Hand Tool Cleaning
SSPC SP 3	(2018) Power Tool Cleaning

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-595	(Rev C; Notice 1) Colors Used in Government Procurement

1.2 SUBMITTALS

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

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

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 REPORTING.
****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Exterior Painting Materials[; G]

Interior Painting Materials[; G]

Manufacturer's Standard Color Charts[; G]

SD-07 Certificates

Safety Data Sheets[; G]

Exterior Painting Materials[; G]

Interior Painting Materials[; G]

SD-08 Manufacturer's Instructions

Manufacturer's Instructions[; G]

1.3 QUALITY CONTROL

Submit manufacture's catalog data for each coating material, including designated name, formula or specification number, manufacturer's instructions and name of manufacturer. Detail data analysis of each coating material required, with constituents measured as percentages of the total weight of coating; and details of application, thinning, and average coverage per liter gallon.

1.3.1 Contractor Personnel Qualification

Ensure personnel assigned to the work have had adequate previous experience in the successful application of paints and coatings similar to those specified.

1.3.2 Color Charts

Submit manufacturer's standard color charts for architectural painting materials showing manufacturer's recommended finish colors. Submit three color chips of each color and gloss schedule.

1.3.3 Manufacturer's Instructions

Submit manufacturer's instructions for architectural coatings showing printed instructions covering thinning, mixing, handling, and applying.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials in their original, unbroken containers bearing the manufacturer's name and product identification.

Store all paint materials, thinners, and cleaners in tightly closed containers in a covered, well-ventilated area where they are not exposed to excessive heat, sparks, flame, or direct sunlight. Protect water-based materials against freezing.

Submit safety data sheets to Contracting officer.

1.5 WARRANTY

Guarantee all work against defects in labor and material for a period of [_____] year.

PART 2 PRODUCTS

The following are suggested paint manufacturers and their products. When approved, other paint manufacturers' products of equal quality will be considered. Ensure all thinners and cleaners are products of the coating manufacturer. Ensure primer and finish coats of the paint system are products of the same manufacturer.

2.1 MATERIALS

2.1.1 Exterior Products

Submit the following Exterior painting materials information: Caulk/Sealer, Latex Block Filler, Masonry Primer/Sealer, Enamel, Wood Primer, Inhibitive Metal Primer, Acrylic Latex, and Wash Primer.

	FEDERAL SPECIFICATION	PITTSBURGH	SHERWIN WILLIAMS	GLIDDEN
Caulk/Sealer	ASTM C920	Chem Caulk	Elastomeric	--
Latex Block Filler	[_____]	6-7	B25W46	5317
Masonry Primer/Sealer	[_____]	6-3	A 5V2	5212
Enamel	[_____]	1-934	A 2	1400
Wood Primer	[_____]	1-870	Y24W20	3651
Inhibitive Metal Primer	SSPC Paint 25	--	B50N2	310
Acrylic Latex flat emulsion	[_____]	6-650	A80	3525
Wash Primer	[_____]	97-687/8	P-60G2	--

2.1.2 Interior Products

Submit the following Interior painting materials information: Latex Block Filler, Masonry Primer/Sealer, Wood Primer, Inhibitive Metal Primer, Pigmented Primer/Sealer, Enamel, Acrylic Latex, and water-base Acrylic Epoxy.

	FEDERAL SPECIFICATION	PITTSBURGH	SHERWIN WILLIAMS	GLIDDEN
Latex Block Filler	[_____]	6-7	B25W46	5317
Masonry Primer/Sealer	[_____]	6-3	A 5V2	5212
Wood Primer	[_____]	1-870	Y24W20	3651
Inhibitive Metal Primer	SSPC Paint 25	--	B50N2	310
Pigmented Primer/Sealer	MPI 47	6-2	B28W1	3416
Enamel	MPI 50	6-90	A 40	4600
Acrylic Latex	[_____]	6-510	B42	3700
Water-base Acrylic Epoxy	--	16 line	B70/B60V15	--

PART 3 EXECUTION

Manufacturer's recommendations for surface preparation, thinning, mixing, handling, and applying his product are considered a part of this specification. In the event of conflict between the requirements of this specification and the manufacturer's recommendations this specification takes precedence.

3.1 SURFACE PREPARATION

3.1.1 Protection

Remove, reinstall or provide acceptable protection for, all hardware, accessories, lighting and electrical components, factory-finished materials, plumbing fixtures and fittings, and any other materials that become splattered or damaged by the painting work. Post "WET PAINT" signs to indicate newly painted surfaces.

Take every precaution to prevent damage to adjacent buildings, shrubs and motor vehicles. Cut back shrubs to 300 mm 12-inches from structures to be painted. Provide roping, barricading or covering to preclude damage to personal and real property during surface preparation and painting. Ensure 24-hour advance warning when spray painting,and coordinate with the Contracting Officer or his representative. Post signs to ensure parking arrangements are made. Repair affected damaged surfaces at no additional cost to the Government.

3.1.2 General Surface Preparation

Ensure all surfaces are clean, dry, and free from contaminants and foreign matter. Remove mildew and chalking and thoroughly sterilize the surface. Remove all chipped, peeling, or blistered paint and spot-prime the surface. Dull and roughen hard, glossy surfaces to ensure proper adhesion.

3.1.3 Earth and Masonry Interface

Hand remove where applicable, soil to expose 100 mm 4 inches of cement block wall below grade level. Ensure exposed cement block receives the same treatment under this specification as the cement block above grade level. Replace soil to restore the original grade no sooner than 48 hours after the block painting is complete.

3.1.4 Metal Surfaces

Remove all heavy rust and loose mill scale from steel in accordance with [SSPC SP 2, Hand Tool Cleaning] [SSPC SP 3, Power Tool Cleaning].

Remove by hand or power tool cleaning, minor aluminum oxide film and corrosion.

Treat previously unpainted galvanized and aluminum surfaces with wash primer in accordance with manufacturer's instructions.

3.1.5 Wood Surfaces

Seal knots with a mixture of equal parts of shellac and alcohol (or product approved equal). Fill nail holes, cracks, and other defects with plastic wood or putty. Back-prime concealed surfaces before installation.

3.1.6 Masonry Surfaces

Ensure all surfaces are free from form-release compounds, laitance, and other contaminants.

Repair large cracks, voids and other major surface imperfections before painting. Prepare all repairs to cracks and openings in cement block or masonry surfaces that require a "V" type opening and ensure the top of the "V" is one-half the depth of the crack or opening. Remove all non-tenacious material, then fill the "V" using [Portland cement grout as described and formulated in [_____]. Moisten substrates to receive mortar.] [Epoxy gel grout in accordance with manufacturer's instructions.]

3.1.7 Plaster and Drywall

Ensure all surfaces are clean and dry. Fill cracks and other surface imperfections with spackling compound and sanded smooth.

3.1.8 Sealing

Seal all cracks, crevices, and joints such as those along the perimeter of windows and doors with a paintable [polysulfide] [latex] type caulking conforming to ASTM C920.

3.2 APPLICATION

3.2.1 General

Accomplish all painting in accordance with the painting schedule.

Do not perform exterior painting in rainy weather or when rain is imminent. Do not apply paints or coatings when the temperature or humidity is outside the limits recommended by the manufacturer.

Apply paints and coatings by brush, roller, or airless spray.

Ensure each coat of material applied is free from runs, sags, bubbles, and foreign contaminants; variations in color, gloss and texture; dry overspray, brush, and roller marks; holidays (missed areas); or other evidence of poor application.

Thoroughly work all paints and coatings into corners and crevices.

Neatly "cut-in" paints and coatings around doors, windows, ceilings, etc.

Protect all newly painted surfaces from damage.

3.2.2 Procedures

Apply coatings as follows:

a. Thoroughly stir material to produce a uniform mixture.

b. Thin material for workability and improved spray characteristics, but only according to the manufacturer's instructions.

c. Apply each coat uniformly at the minimum wet-film thickness specified by the manufacturer.

d. Give special attention when coating sharp edges, corners, and crevices to ensure complete coverage.

e. Ensure finish coats show good hiding characteristics and uniform appearance.

3.2.3 Exterior Surfaces

Prime metal surfaces with alkyd primer in accordance with [[_____]] [manufacturer's instructions], and topcoated with two coats enamel in accordance with [[_____]] [manufacturer's instructions].

Allow paint to dry overnight before re-coating.

Prime wood surfaces with alkyd primer in accordance with [[_____]] [manufacturer's instructions], and topcoated with two coats [acrylic emulsion] [enamel] in accordance with [[_____]] [[_____]] [manufacturer's instructions]. Allow primer and enamel to dry overnight before top-coating. Allow a four hour drying time between coats of acrylic emulsion paint.

Ensure masonry surfaces have two topcoats of acrylic emulsion paint applied and both coatings are in accordance with [[_____]] [manufacturer's instructions]. Tint first coat with a universal color (number) to allow quick identification between the first and second coats. Allow for a four hour drying time between coats. Apply coating with a fibered roller or airless sprayer. Using appropriate brushes, cut-in at junction of the wall and roof, window framing, door framing and piping.

3.2.4 Interior Surfaces

Ensure wood and metal surfaces have two coats of enamel paint applied in accordance with [[_____]] [manufacturer's instructions]. Allow for a [four] [twelve] [_____] hour drying time between coats. Surfaces to be painted with enamel paint include any metal or wood paintable surface. Items to be painted include (but are not limited to) doors, jambs, handrails, and grilles.

Apply 2 coats of [latex] [epoxy] paint to masonry surfaces in accordance with [[_____]] [manufacturer's instructions] on wall surfaces, ceilings and appurtenances (excluding vinyl cove base) with colors other than that specified. Allow for a [four] [twelve] [____] hour drying time between coats. Apply one coat of [latex] [epoxy] on areas where existing color is the same as that specified. Patch and spot prime or touch up before painting areas requiring only one coat of [latex] [epoxy] coverage. Allow for a four hour minimum drying time between the spot primed coat and the finish coat. Surfaces painted with [latex] [epoxy] paint include concrete, concrete masonry, gypsum drywall systems and plaster. Items to be painted include (but are not limited to) walls, ceilings, pipes and columns.

3.2.5 Spot-Painting

Allow spot-painting to correct damaged surfaces only when touchup area blends into the surrounding finish. Otherwise, re-coat the entire area. Accomplish touchup using the same method of application as was used to apply the original material.

3.3 FIELD QUALITY CONTROL

3.3.1 Inspection

Provide for inspection of work to ensure that the requirements of this section have been fulfilled.

3.3.2 Cleanup

Remove all paint or coating splatter and spills from floors, adjacent walls, hardware, and all other finished surfaces.

Leave the work area clean and free from all rubbish and accumulated material.

3.4 SCHEDULES

3.4.1 Exterior Paint Schedule

Ensure colors are in accordance with [FED-STD-595] [manufacturer's product name/number].

SURFACE	PRIMER	FINISH COAT	FINISH COLOR AND SHEEN
Exterior masonry (rough/ porous)	Latex block filler	Acrylic emulsion latex	[_____]
Exterior masonry (smooth)	Alkali-resistant primer	Acrylic emulsion latex	[_____]
Exterior wood	Exterior wood primer	Enamel/acrylic emulsion latex	[_____]
Exterior metal	Exterior metal primer	Enamel	[_____]

3.4.2 Interior Paint Schedule

Ensure colors are in accordance with [FED-STD-595] [manufacturer's product name/number].

SURFACE	PRIMER	FINISH COAT	FINISH COLOR AND SHEEN
Interior masonry (rough/porous)	Latex block filler	Latex/water-base acrylic epoxy	[_____]
Interior masonry (smooth)	Pigmented sealer	Latex/water-base acrylic epoxy	[_____]
Interior	Pigmented	Latex/water-base	[_____]

SURFACE	PRIMER	FINISH COAT	FINISH COLOR AND SHEEN
plaster	sealer	acrylic epoxy	
Interior drywall	Pigmented sealer	Latex/water-base acrylic epoxy	[_____]
Interior wood	Interior wood primer	Enamel	[_____]
Interior metal	Interior metal primer	Enamel	[_____]

-- End of Section --

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA/KSC-01 91 00.00 98 (August 2012)

Preparing Activity: NASA

New

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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PROTECTIVE COATING OF [CARBON][STAINLESS][STEEL][ALUMINUM] ON [STRUCTURES][FACILITIES][GROUND SUPPORT EQUIPMENT]

11/12

-- End of Section Table of Contents --

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA/KSC-01 91 00.00 98 (August 2012)

Preparing Activity: NASA

New

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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SECTION 09 97 30.30 98

PROTECTIVE COATING OF [CARBON][STAINLESS][STEEL][ALUMINUM] ON [STRUCTURES][FACILITIES][GROUND SUPPORT EQUIPMENT]
11/12

****

NOTE: This specification covers the requirements for the application of protective coatings to mitigate corrosion of exterior exposed carbon steel, stainless steel, and aluminum.

This specification includes requirements for materials, equipment, safety,procedures, and quality assurance inspections.

Refer to Appendices A, B, and C for listings of approved coating materials.

This specification is applicable to facilities, launch structures, ground support equipment (GSE), test facilities, and structures that are intended for use at all NASA locations world-wide.

Due to the changing environmental considerations and different site conditions, new advances in corrosion technology, and a wide array of possible applications, do not use this specification as a stand-alone specification that meets every contingency.

Use this specification in the preparation of specific projects for the prevention of corrosion through the use of protective coatings on space vehicle launch structures, facilities, Ground Service Equipment, and test facilities and structures in the specific environments identified as Zones of Exposure.

The appendices are considered to be an integral part of this Specification. Review Appendices A, B, C, and D for the preparation of coating specifications.

Adhere to
http://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc

UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Recommended changes to a NASAKSC Master Specification Section should be submitted to the appropriate Technical Proponent (TP) through the SpecsIntact Help Desk.

****

PART 1 GENERAL

1.1 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

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.

****

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.

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2023) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A653/A653M	(2023) Standard Specification for Steel

	Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A780/A780M	(2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM D520	(2000; R 2011) Zinc Dust Pigment
ASTM D610	(2008; R 2019) Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces
ASTM D714	(2002; R 2017) Standard Test Method for Evaluating Degree of Blistering of Paints
ASTM D1654	(2008; R 2016; E 2017) Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D4285	(1983; R 2018) Indicating Oil or Water in Compressed Air
ASTM D4417	(2021) Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
ASTM D4752	(2010) Standard Practice for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub

COMPRESSED GAS ASSOCIATION (CGA)

CGA G-7.1	(2011) Commodity Specification for Air; 5th Edition
KSC-STD-F-0004	(2016, Rev G) Standard for Fire Protection Design

NACE INTERNATIONAL (NACE)

NACE RP0198	(2004) The Control of Corrosion Under Thermal Insulation and Fireproofing Materials - A Systems Approach
NACE RP0288	(1994; R 2004) Inspection of Linings on Steel and Concrete
NACE SP0188	(1999; R 2006) Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

KSC-SPEC-F-0006B	(2009) Heat And Blast Protection Coating Materials And Application Methods, Specification For
NASA-STD-5008	(2011b; R 2016; E 2016; Change 1) Protective Coating of Carbon Steel, Stainless Steel, and Aluminum on Launch Structures, Facilities, and Ground Support Equipment
NASA-STD-6001	(1998; Rev B 2011) Flammability, Offgassing, and Compatibility Requirements and Test Procedures

NSF INTERNATIONAL (NSF)

NSF/ANSI 61	(2022) Drinking Water System Components - Health Effects

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC AB 1	(2015; E 2017) Mineral and Slag Abrasives
SSPC AB 2	(2015; E 2016) Cleanliness of Recycled Ferrous Metallic Abrasive
SSPC AB 3	(2003; E 2004) Ferrous Metallic Abrasive
SSPC Guide 15	(2013) Field Methods for Extraction and Analysis of Soluble Salts on Steel and Other Nonporous Substrates
SSPC PA 2	(2015; E 2018) Procedure for Determining Conformance to Dry Coating Thickness Requirements
SSPC SP 1	(2015) Solvent Cleaning
SSPC SP 3	(2018) Power Tool Cleaning
SSPC SP 5/NACE No. 1	(2007) White Metal Blast Cleaning
SSPC SP 10/NACE No. 2	(2015) Near-White Blast Cleaning
SSPC SP 11	(2020) Surface Preparation Standard No. 11 - Power Tool Cleaning to Bare Metal
SSPC TU 2/NACE 6G197	(1997) Design, Installation, and Maintenance of Coating Systems for Concrete Used in Secondary Containment

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-A-22262	(1993; Rev B; Am 1 1994; Am 2 1996; Notice 1 2021) Abrasive Blasting Media Ship Hull Blast Cleaning

MIL-PRF-24667	(2008) Coating System, Non-Skid, For Roll, Spray, Or Self-Adhering Application
QPL 22262	(2011) Abrasive Blasting Media Ship Hull Blast Cleaning

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-595	(Rev C; Notice 1) Colors Used in Government Procurement

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.134	Respiratory Protection

1.2 DEFINITIONS

a. DFT - Dry Film Thickness

b. GSE - Ground Support Equipment

c. IOT - Inorganic Topcoat

d. WFT - Wet Film Thickness

e. High-gloss finish - a minimum of 85 gloss units (GUs) at a 60-degree angle

f. Semi-gloss finish - 60 GU to 85 GU at a 60-degree angle

****
NOTE: The Zone of Exposure is determined by the Design Engineer responsible for preparing the coating specification.
****

g. Zones of Exposure - The following zones of exposure are established to define coating system requirements for surfaces located in specific environments:

(1) Zone 1

Zone 1a - Surfaces that are directly impinged on by solid rocket booster (SRB) engine exhaust.

Zone 1b - Surfaces that are indirectly impinged on by SRB exhaust.

Zone 1c - Walking surfaces in Zones 1a and 1b.

(2) Zone 2 - Surfaces that are exposed to elevated temperatures above 65 degrees C above 150 degrees F and/or acid deposition from SRB exhaust with no exhaust impingement.

(3) Zone 3

Zone 3a - Surfaces, other than those located in Zones 1 or 2, exposed to acid deposition from SRB exhaust products.

Zone 3b - Surfaces exposed to other types of chemical

contamination (e.g., cooling towers, diesel exhaust stacks, acidic industrial environments, and water treatment facilities).

(4) Zone 4

Zone 4a - Surfaces not located in the launch environment but located in a neutral pH corrosive marine industrial environment or other chloride-containing environments.

Zone 4b - Surfaces located in neutral pH exterior environments in any geographical area.

Zone 4c - Surfaces located in indoor environments that are not air-conditioned.

(5) Zone 5

Zone 5a - Surfaces located in a continuous indoor air-conditioned environment, such as an office or clean room, where both temperature and humidity are controlled more than 90 percent of the time.

Zone 5b - Surfaces located in a low humidity, high ultraviolet environment, such as a high altitude, arid location.

****

NOTE: In Zone 6b, based on the complexity of the liquid stored, this has to be engineered separately in compliance with all Federal, State, and local environmental statutory requirements.

****

(6) Zone 6

Zone 6a - Surfaces located underground or subject to intermittent or continuous immersion in aqueous environments.

Zone 6b - Surfaces subject to exposure in a chemical/fuel storage environment.

(7) Zone 7 - Surfaces under thermal insulation, such as chilled water, steam, and heated gas lines.

1.3 SUBMITTALS

****

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in

context of the project.

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

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Plan for Storage of Coating Materials[; G]

Safety and Health Plan[; G]

Hazard Communication Program[; G]

Respiratory Protection Program[; G]

Hearing Conservation Program[; G]

Material Safety Data Sheets[; G]

Quality Control Coating Inspection Plan[; G]

Blasting System Design[; G]

SD-03 Product Data

List of Blasting Aggregates[; G]

Coatings[; G]

Thinners[; G]

SD-04 Samples

Representative Sample Areas[; G]

SD-06 Test Reports

Test Results for Off-Gassing, Flammability, and Hypergolic Compatibility[; G]

Coating System Daily Inspection Report[; G]

SD-07 Certificates

Training Program[; G]

SD-08 Manufacturer's Instructions

Manufacturer's Recommendations[; G]

1.4 QUALITY ASSURANCE

1.4.1 Applicator Qualifications

****
NOTE: The applicator's proficiency and ability to attain the required quality of workmanship for the specified coating system can be verified by testing and qualification in accordance with ASTM D 4228, Standard Practice for Qualification of Coating Applicators for Application of Coatings to Steel Surfaces.
****

Provide written evidence indicating the coating applicators have successfully completed a comprehensive training program, such as Painting and Decorating Contractors of America (PDCA)/NACE/SSPC Industrial Painters Training, or equivalent[and qualified in accordance with ASTM D 4228].

Provide all painting personnel an orientation including the following topics: proper mixing and application of the specified coatings(particularly for inorganic zinc coatings), specification requirements, material application characteristics, and inspection criteria. Only personnel that have received training are permitted to perform mixing or application of coatings.

Prepare representative sample areas that meet specification requirements, and NASA-STD-5008.

1.4.1.1 Coating Work Plan

Provide procedures for reviewing contract documents immediately after award to identify errors, omissions, and discrepancies so that any such issues can be resolved prior to project planning and development of detailed procedures. For each proposed deviated change, provide procedures that include appropriate work instructions, material and equipment requirements, personnel qualifications, controls, and process verification procedures. Provide procedures for inspecting work to verify and document compliance with contract requirements, including inspection forms and checklists, and acceptance and rejection criteria.

1.4.2 Responsibility for Inspection

The coating contractor/applicator responsibilities include:

a. Provide continuous quality control of all work to ensure conformance to the project specifications as defined in the paragraph entitled, "Requirements for Inspection," of this section.

b. Submit a project-specific quality control coating inspection plan to the Contracting Officer for approval.

c. Provide the[NASA assigned] coatings inspector with safe access to the work.

The[NASA assigned] coatings inspector is a NACE Certified[Level III][_____] inspector under the NACE International Coating Inspector

Program (CIP). Inspection of the surface preparation and coating application processes is performed by the[NASA assigned] coatings inspector as follows:

a. Perform all of the in-process required inspections.

b. Witness, inspect, and test all protective coating work to verify compliance with the specified requirements

c. Document the work on the inspection forms described in the paragraph entitled, "Inspection Forms," of this section.

d. Prepare and sign the daily inspection reports on a daily basis and submit them to the Contracting Officer on a weekly basis as a minimum.

e. When a nonconformance report is required, sign and submit the report to the Contracting Officer within one workday from the time written.

f. After determining that all nonconformances have been corrected and/or the coating work is in compliance with the project specifications, complete a conformance verification report for the specific item, area, or project.

****

NOTE: The application of the certified inspector's seal to the verification conformance report indicates that the inspector personally inspected the indicated work and has found it to be in compliance with the specified requirements.

****

g. Sign and seal the conformance verification report.

h. Do not affix the seal to the daily inspection report or to the nonconformance report.

1.4.3 Requirements for Inspection

Zones 1, 2, and 3 - Since these zones are located in the highly corrosive launch environment or other chemical exposures, a NACE inspection is required for all surface preparation and coating applications, including all new work, touch-up of new work, major refurbishment of existing coatings, and modifications.

Zone 4 - For systems requiring abrasive blasting and coating of metallic substrates, all surfaces require a full NACE inspection with the following exception; for touch-up of existing coatings, NACE inspection is not mandatory but recommended in cases of critical systems or equipment.

****

NOTE: All other aluminum or carbon steel structures in Zone 5a environments are exempt from NACE inspection. NACE inspections are required for Zone 5b locations.

****

Zone 5a and 5b - All clean-room structures fabricated of aluminum or carbon steel that will be abrasive-blast-cleaned and/or coated outside Zone 5 environments require NACE inspection.

Zone 6 - Since this zone is located in a highly corrosive underground environment or other submerged exposures, a NACE inspection is required for all surface preparation and coating applications, including all new work, touch-up of new work, major refurbishment of existing coatings, and modifications.

Zone 7 - Since this zone is located in a highly corrosive environment, a NACE inspection is required for all surface preparation and coating applications, including all new work, touch-up of new work, major refurbishment of existing coatings, and modifications.

1.4.4 Inspection Hold Points

Mandatory inspection hold points include, but are not limited to, the following:

a. Verification of ambient weather conditions in accordance with paragraph entitled, "Weather Conditions," of this section.

b. Prior to the beginning of surface preparation work; operation of equipment prior to beginning of surface preparation work.

c. After surface preparation work and before the beginning of the coating application work, the mixing of products.

d. Before and after the application of each coat of material.

e. After completion and prior to final acceptance.

1.4.5 Inspection Forms

****
NOTE: See KSC Forms 28-589A and 28-588 for examples of these forms.
****

Record and document all inspections on forms acceptable to the Contracting Officer (Appendix F).

1.5 Storage of Coating Materials

Store coating materials and thinners in their original containers with the manufacturer's name, product identification, shelf life, and batch number. Follow the manufacturer's written instructions for storage limitations. Do not use tarpaulins as the sole means of covering coating materials for storage.

Inspect coating material storage conditions every [week][_____].

Provide on-site Material Safety Data Sheets (MSDS) for coating materials and thinners or made accessible to users in the area. Submit a written plan for storage of coating materials to the Contracting Officer for approval.

1.6 PROJECT/SITE CONDITIONS

1.6.1 Safety and Health Requirements

****
NOTE: Some of the materials handled in accordance with this document are combustible, or toxic, or both.
****

Take necessary precautions, in accordance with OSHA regulations, manufacturers' recommendations, and industry standards, to ensure the safety and health of personnel performing the work and personnel who may be affected by such work.

Provide the required equipment for safe and healthful application along with instruction to the users regarding the hazards, proper handling, and disposal procedures to prevent injury or illness.

Submit a written safety and health plan that includes a Hazard Communication Program, a Respiratory Protection Program, and a Hearing Conservation Program that conforms to OSHA requirements and industry standards.

When required to remove surface coatings that contain PCB, lead, chromium, mercury, cadmium, or other regulated materials, include specific provisions in the safety and health plan for complying with all Federal, State, local, and NASA Center specific requirements.

Ensure respiratory protection is in accordance with 29 CFR 1910.134, and Center respiratory protection requirements.

Submit complete design drawings and calculations for the scaffolding and containment system, including an analysis of the loads which will be added to the structure by the containment system and waste materials. A registered engineer shall approve calculations and scaffold system design.

1.6.2 Personal Protective Equipment (PPE)

Use PPE and/or administrative controls when engineering controls cannot be implemented to protect workers. Where required, use PPE in accordance with all Federal, State, NASA, and Center requirements. Ensure both supervisors and workers are properly instructed, trained, and certified in the selection, use, and maintenance of PPE.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Design Requirements for Carbon Steel

Protect carbon steel surfaces from atmospheric corrosion through the application of zinc coatings (inorganic zinc coating and/or hot-dip galvanizing and/or metallizing) as defined herein. Hot-dip galvanize new steel components, such as stair treads, grating, handrails, pipes, and hardware (nuts, bolts, and fasteners), in accordance with the paragraph entitled, "Protection by Galvanizing," of this section.

****

NOTE: The zinc coatings may require topcoating with additional protective coatings as specified; but in neutral pH atmospheres, testing has proven zinc without topcoating to have superior performance.

****

Coat all other carbon steel surfaces that are exposed to the atmosphere with inorganic zinc or metallized. For a friction-type joint, use an inorganic zinc coating approved by the American Institute of Steel Construction (AISC).

For carbon steel faying surfaces that are a part of all friction-type and electrical grounding joints, prior to installation, abrasive-blast the surface and coat with 100 um to 150 um 4 mil to 6 mil of inorganic zinc only, in accordance with paragraph entitled, "Stripe Coat Application for Carbon Steel," of this section.

The recommended coating application sequence for carbon steel is to first abrasive blast the steel and then prime it with inorganic zinc before installation or erection. Further topcoating, if required, is applied after all welding, grinding, or drilling has been completed, and after areas damaged by these procedures have been properly repaired with inorganic zinc.

2.1.2 Protection of Stainless Steel

****

NOTE: Certain highly alloyed stainless steels, such as AL6XN or 254 SMO, do not require protective coatings for corrosion protection.

****

Protect Type 300 series stainless steels from corrosion by the use of protective coatings as defined in the paragraph entitled, "Surface Preparation of Stainless Steel," of this section.

2.2 EQUIPMENT

2.2.1 Compressed Air

****

NOTE: The required air capacity depends upon the configuration of the abrasive system used. Have the air system comply with the instructions and recommendations of the abrasive-blasting system manufacturer.

****

Provide a compressed air system capable of delivering a continuous nozzle pressure of 620 [_____] kPa 90 [_____] psi minimum to each blast nozzle in operation to achieve the required surface cleanliness and profile. Equip the compressed air system with oil and moisture separators to ensure only clean, dry air is provided to the service outlet.

Ensure the compressed air system complies with Occupational Safety and Health Administration (OSHA), American National Standards Institute (ANSI), CGA G-7.1, and National Institute of Occupational Safety and Health (NIOSH) configurations. Ensure air distribution manifolds conform to American Society of Mechanical Engineers (ASME) standards.

2.2.2 Abrasive-Blasting System

Ensure the abrasive-blasting system complies with OSHA, ANSI, and NIOSH configurations consisting of, but not limited to, the following:

a. A remote-controlled welded pressure pot conforming to ASME standards

b. The required length of blast hose

c. A venturi nozzle

d. A respiratory air-line filter

e. A blast hood approved by the Mine Safety and Health Administration/NIOSH with the required length of air hose.

Ensure the blasting system design produces the specified cleanliness level and profile when coupled with the available compressed air supply.

2.2.3 Coating Application System

Provide an airless spray system, conventional spray system, or other approved coating application system in accordance with the coating manufacturer's recommendations and.

Brush application is permitted for minor touch-up of spray applications and stripe coats of inorganic zinc.

2.3 MATERIALS

2.3.1 Abrasive-Blasting Aggregates

Provide blasting aggregates materials approved in accordance with MIL-A-22262, or SSPC AB 1, or steel grit in accordance with SSPC AB 3. Use only materials approved in QPL 22262, Qualified Products List: List of Products Qualified Under Military Specification MIL-A-22262. Submit the list of blasting aggregates to the Contracting Officer for approval. Ensure the abrasive grade selected produces the required surface profile and possesses physical properties that are compatible with the requirements of this specification. Use new, commercial-grade blasting steel grit with a neutral pH (6.0 to 8.0), rust-free, oil-free, and dry, with a hardness of 40 to 50 Rockwell C. Recycle steel grit in accordance with SSPC AB 2. Select the aggregate size to produce the required anchor profile.

Select aggregates that are free of crystalline silica unless exemptions to this policy are coordinated with the Contracting Officer. Use materials that do not change the surface profile when using blasting aggregate for abrasion-sensitive hardware(such as bellows, gimbal joints, and other thin-walled components). Ensure blasting operations do not produce holes, cause distortion, remove metal, or cause thinning of the substrate.

2.3.2 Protective Coatings, Thinners, and Cleaners

****

NOTE: The following paragraphs establish minimum requirements for each generic type of protective coating specified in this specification. See paragraph entitled, "Coating Systems," of this

section, for coating intercoat compatibility requirements.
****

Ensure coatings possess physical properties and handling characteristics that are compatible with the application requirements of this specification. Use self-curing coatings. Procure thinners and cleaners for each coating from the manufacturer of the coating. Submit the list of coatings and thinners for approval by the Contracting Officer.

****
NOTE: Interested parties should be aware of the following requirement and are urged to arrange for testing of their product so that they may be eligible for award of contracts or orders for coatings to be supplied in accordance with this Specification. To arrange for product testing and the testing criteria, manufacturers must contact the Engineering Directorate, NASA, John F. Kennedy Space (KSC) Center, FL 32899 or contact the Corrosion Technology Laboratory at http://corrosion.ksc.nasa.gov.
****

Provide protective coatings compatible with fluids expected in the areas to the extent required to prevent fire, explosion, or damage to facility, hardware, and GSE. Ensure all coating materials, when used in areas where exposure to hypergolic propellants could occur, are compatible with the propellants in accordance with NASA-STD-6001.

2.3.2.1 Inorganic Zinc Coatings

****
NOTE: Inorganic zinc coatings that have been approved are listed in Appendix A, Approved Products List for Inorganic Zinc Coatings.
****

To be listed, a coating meets the following minimum requirements:

a. Self-curing, multiple-component

b. Dry-temperature resistance to 400 °C 750 °F for 24 hours.

c. Minimum shelf life of 6-months when stored in accordance with manufacturer's instructions.

d. Minimum of 83-percent zinc by weight in the applied dry film

e. Contain Type III zinc dust pigment in accordance with ASTM D520, and be asbestos-free, polychlorinated biphenyl (PCB)-free, lead-free, cadmium-free, and chromate-free (less than 0.002 percent by weight of mixed coating).

****
NOTE: Application characteristics are judged acceptable prior to beach testing.
****

f. Attain a rating of not less than 9 in accordance with ASTM D610, and ASTM D1654 when applied to composite carbon steel test panels and exposed at the KSC Beach Corrosion Test Site for the following periods:

(1) 18 months for initial acceptance

(2) 5 years for final acceptance

2.3.2.2 Primer and/or Intermediate Coatings

****
NOTE: These coatings are listed in Appendix B, Approved Products List for Topcoat Systems.
****

a. Inhibitive Polyamide Epoxy Coatings

Provide a polyamide epoxy coating conforming to the following minimum requirements:

(1) Polyamide-cured

(2) Rust-inhibitive

(3) PCB-free, lead-free, cadmium-free, and chromate-free (less than 0.002 percent by weight of mixed coating)

(4) Suitable as a primer for carbon steel, galvanized steel, and aluminum.

(5) Suitable as an intermediate coat between an inorganic zinc primer and an aliphatic polyurethane finish coat.

(6) Contains a minimum of 40-percent solids by volume.

b. Noninhibitive Polyamide Epoxy Coatings

Provide a polyamide epoxy coating conforming to the following minimum requirements:

(1) Polyamide-cured

(2) PCB-free, lead-free, cadmium-free, and chromate-free (less than 0.002 percent by weight of mixed coating)

(3) Suitable as an intermediate coat between inorganic zinc primer and an aliphatic polyurethane finish coat.

(4) Contains a minimum of 40-percent solids by volume

(5) Do not use as a primer on carbon steel

c. Water-Reducible Intermediate Coatings

Provide a water-reducible intermediate coating conforming to the following minimum requirements:

(1) Self-curing, one or two packages, water reducible

(2) PCB-free, lead-free, cadmium-free, and chromate-free (less than 0.002 percent by weight of mixed coating).

(3) Suitable as an intermediate coat between inorganic zinc primer and water-reducible topcoats

(4) Contain a minimum of 30 percent solids by volume

(5) Do not use used as a primer on carbon steel.

2.3.2.3 Finish Coatings

a. Aliphatic Polyurethane Coatings

Provide an aliphatic polyurethane coating conforming to the following minimum requirements:

(1) Catalyst isocyanate cured.

(2) High-gloss finish (minimum 85 gloss units (GUs) at a 60-degree angle).

(3) Retain gloss and color upon prolonged exterior exposure

(4) Suitable as an exterior finish coat over an inorganic zinc primer with a polyamide epoxy intermediate coat

(5) Contain a minimum of 44-percent solids by volume

(6) PCB-free, lead-free, cadmium-free, and chromate-free (less than 0.002 percent by weight of mixed coating)

(7) Attain a numerical rating of not less than 8 in accordance with ASTM D610 and ASTM D1654 and a numerical rating of not less than 9F in accordance with ASTM D714, when applied as a system to composite carbon steel test panels and exposed at the KSC Beach Corrosion Test Site for the following periods:

(a) 18 months for initial acceptance

(b) 5 years for final acceptance

b. Water-Reducible Topcoats

Provide a water-reducible topcoat conforming to the following minimum requirements:

(1) Self-curing, one or two packages, water-reducible.

(2) PCB-free, lead-free, cadmium-free, and chromate-free (less than 0.002 percent by weight of mixed coating).

(3) Retain gloss and color upon prolonged exterior exposure

(4) [Semi-gloss][High-gloss] finish

(5) Attain a numerical rating of not less than 8 in accordance with ASTM D610 and ASTM D1654 and a numerical rating of not less than 9F in accordance with ASTM D714, when applied as a system to

composite carbon steel test panels and exposed at the KSC Beach Corrosion Test Site for the following periods:

(a) 18 months for initial acceptance

(b) 5 years for final acceptance

c. Inorganic Topcoats (IOTs)

Provide an inorganic topcoat conforming to the following minimum requirements:

(1) Dry-temperature resistance to 400 degrees C 750 degrees F for 24 hours

(2) Suitable as a topcoat for inorganic zinc and galvanized steel in high-temperature environments.

(3) Listed as an approved coating system (see Appendix B).

(4) PCB-free, lead-free, cadmium-free, and chromate-free (less than 0.002 percent by weight of mixed coating).

(5) Attain a rating of not less than 9 in accordance with ASTM D610 and ASTM D1654 when applied to composite carbon steel test panels and exposed at the KSC Beach Corrosion Test Site for the following periods:

(a) 18 months for initial acceptance

(b) 5 years for final acceptance

d. Polysiloxane Topcoats

Provide a polysiloxane topcoat conforming to the following minimum requirements:

(1) Suitable as a finish coat for exterior exposure

(2) Contain a minimum of 44 percent solids by volume

(3) High-gloss finish (minimum 85 GU at a 60-degree angle)

(4) Retain gloss and color on prolonged outdoor exposure

(5) PCB-free, lead-free, cadmium-free, and chromate-free (less than 0.002 percent by weight of mixed coating)

(6) Listed as an approved coating system (see Appendix B).

(7) Attain a numerical rating of not less than 8 in accordance with ASTM D610 and ASTM D1654 and a numerical rating of not less than 9F in accordance with ASTM D714 when applied to composite carbon steel test panels and exposed at the KSC Beach Corrosion Test Site for the following periods:

(a) 18 months for initial acceptance

(b) 5 years for final acceptance

2.3.2.4 Epoxy Mastic Coatings

****
NOTE: Examples of epoxy mastic coating that currently meet these requirements include:

(1) Ameron Amerlock 400 AL.

(2) Devoe Bar Rust 239.

(3) PPG Pittguard DTR.

(4) Sherwin-Williams Epolon Mastic
****

Provide a epoxy mastic coating conforming to the following minimum requirements:

a. Specifically intended for use over mechanically cleaned steel

b. Contain a minimum of 80-percent solids by volume

c. Two-component, catalyst-cured, aluminum-pigmented

d. PCB-free, lead-free, cadmium-free, and chromate-free (less than 0.002 percent by weight of mixed coating)

2.3.2.5 Coal Tar Epoxy

****
NOTE: Examples of coal tar epoxies that currently meet these requirements include the following:

a. Sherwin-Williams Hi-Mil Sher-Tar

b. Made Well 1103

c. Devoe Devtar 247
****

Provide a two-component, high-build coal tar epoxy with low volatile organic content (VOC). Ensure the coal tar epoxy contains, at a minimum, 65-percent solids by volume and produces a one-coat thickness of 405 ìm to 510 ìm 16 mil to 20 mil per coat dry film thickness (DFT).

2.3.2.6 Potable Water Epoxy

****
NOTE: Some NSF-approved products include:

a. Ameron Amercoat 395

b. Devoe Bar Rust 233

c. Sherwin-Williams Potable Water Epoxy
****

Ensure all coatings used in potable water immersion service are three-coat

epoxy systems certified by NSF/ANSI 61.

2.3.2.7 Non-Skid Coatings

****
NOTE: Non-Skid coatings supplied by American Safety Technologies, Inc., 565 Eagle Rock Avenue, Roseland, NJ 07068, telephone (800) 631-7841 www.astantislip.com, or an approved equivalent (Primer MS 7C, Topcoat MS 400G, Color Topping MS-200).
****

Ensure approved nonskid coatings conform to MIL-PRF-24667.

2.3.3 Sealants/Caulking

Provide sealants that are self-curing, single-component, polysulfide rubber or polyurethane material only. Provide sealants conforming to ASTM C920, Type S, Grade NS, Class 25, use NT, A, and O. If not topcoated, match the caulking color of the joint to the surface being caulked.

For caulking used in a clean-room environment, select an approved material with low off-gassing characteristics, in accordance with NASA-STD-6001.

2.3.4 Chip-free Clean-room Paint

****
NOTE: Paint systems for metal substrates in clean-rooms may be required to pass tests for adhesion, off-gassing, flammability, vacuum out-gassing, and hypergolic compatibility.
****

Provide paint test results for off-gassing, flammability, and hypergolic compatibility in accordance with NASA-STD-6001.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Surfaces

Prepare surfaces to be coated by cleaning and drying. Free surfaces of oil, grease, dirt, dust, corrosion, peeling paint, caulking, weld spatter, and any other surface contaminants. Degrease surfaces, as required, before subsequent surface preparation procedures or the application of protective coatings, or both.

While surfaces are accessible, prepare and coat surfaces that cannot be accessed after fabrication, erection, or installation. Sequence surface preparation and coating operations, so that freshly applied coatings are not contaminated by dust or foreign matter.

Protect all equipment and adjacent surfaces not to be coated from surface preparation operations. Protect working mechanisms against intrusion of the abrasive.

3.1.2 Cleaning and Degreasing

Perform degreasing by solvent cleaning, detergent washing, or steam cleaning in accordance with SSPC SP 1. Follow this degreasing procedure when cleaning carbon steel, galvanized steel, stainless steel, or aluminum. Select solvents in accordance with use requirements and applicable Federal, State, and NASA environmental policies.

Use of chlorofluorocarbon solvents is not allowed.

Use clean potable water to wash surfaces when high levels of chloride (>5 ug/cm2) or other undesirable contaminants are found on the surfaces. Perform water washing using standard industrial pressure cleaners with a pressure-versus-volume output balance to ensure thorough and productive cleaning. Ensure all water washing or pressure cleaning operations comply with all Federal, State, local and NASA Center environmental requirements.

3.1.3 Abrasive Blasting

Provide clean and dry abrasive-blasting aggregate.

Remove abrasive residues from the surface, leaving it clean and dry before the coatings are applied.

Contain particulate emissions generated during abrasive-blasting operations. Design the containment system to comply with all applicable Federal, State, and local regulations as well as all NASA policies. Exemptions concerning the containment system must be approved by the Contracting Officer.

Ensure the aggregate used is identified and selected when abrasive-sensitive hardware such as bellows, gimbal joints, and other thin-walled components are abrasive cleaned.

3.1.4 Sealing/Caulking

Completely seal the perimeter of all faying surfaces, joints open less than 13 mm 0.5 in, and skipwelded joints. Use a self-curing, single-component, polysulfide rubber or polyurethane type sealant. Apply the sealant to the joint with a caulking gun after application of the inorganic zinc primer on carbon steel. Ensure the bead has a smooth and uniform finish and cured (tacky to the touch) before the topcoat is applied.

For topcoated zinc primers, apply caulking after the intermediate coat of epoxy.

For coatings on stainless steel, galvanized steel, and aluminum, apply caulking before application of the topcoat.

3.1.5 Inorganic Zinc Protection

3.1.5.1 Carbon Steel Pre-Cleaning

Clean and degrease carbon steel surfaces in accordance with SSPC SP 1 followed by power tool cleaning in accordance with SSPC SP 3, to remove weld spatter, weld slag, laminations, sharp edges, and other surface defects prior to abrasive blasting or power tool cleaning to bare metal.

3.1.5.2 Power Tool Cleaning of Carbon Steel

Use power tools to clean carbon steel to bare metal, in accordance with SSPC SP 11, when a roughened, clean, bare metal surface is required but abrasive blasting is not feasible or permissible. Generate a surface anchor profile between 40 um to 75 um 1.5 mil to 3.0 mil. Ensure all rust is completely removed from pits and depressions.

3.1.5.3 Abrasive Blasting of Carbon Steel

Abrasive-blast carbon steel to a minimum cleanliness of near-white metal, in accordance with SSPC SP 10/NACE No. 2. Ensure the anchor profile of the blasted surface is 40 um to 75 um 1.5 mil to 3.0 mil, measured in accordance with ASTM D4417. Remove all rust from pits and depressions.

3.1.6 Protection by Galvanizing

****

NOTE: Do not galvanize steel components with an ultimate tensile strength above 900 MPa 130 ksi or hardness above Rockwell C Hardness 28 due to potential hydrogen embrittlement.

Except for Zone 5a & 5b exposures, protect sheet steel with a galvanizing weight lower than G165 with coatings.

****

Apply galvanizing (zinc coating) after fabrication by the hot-dip process conforming to ASTM A123/A123M, ASTM A153/A153M, and ASTM A653/A653M. Ensure galvanizing weight for steel sheet without further coating protection meets the standards of ASTM A653/A653M, with a galvanizing weight of G165.

Do not use the Galvannealed process for the coating of steel sheet.

3.1.6.1 Surface Preparation for Galvanizing

****

NOTE: CAUTION: Some galvanized configurations are susceptible to distortion when they are abrasive-blasted.

****

Take special care to prevent any metal distortion by reducing blast nozzle pressure and increasing the working distance from the nozzle to the surface. In some cases, such as in the surface preparation of light-gage sheet steel, these precautions may not be sufficient to prevent distortion; employ alternate procedures, such as abrading or mechanical cleaning to remove corrosion or roughen the surface. Prepare galvanized surfaces to be further topcoated by degreasing before any additional surface preparation. After degreasing, perform abrasive blasting or mechanical cleaning as required by the Zone of Exposure, as defined in the paragraph entitled, "Galvanizing Coating Systems for Carbon Steel," of this section.

Abrasive blast galvanized surfaces with fine-grade abrasives. Ensure abrasives conform to the requirements in the paragraph entitled, "Abrasive-Blasting Aggregates," of this section. Remove corrosion, old coatings or roughen new surfaces. Ensure the blasted surface is free of

all corrosion and foreign matter and have a uniform, slightly roughened appearance. If galvanized steel is prepared for the application of coatings by abrasive blasting, lightly brush-blasted the steel with fine-grade abrasive at a lower pressure to provide a corrosion free and uniform, slightly roughened surface. Do not completely remove the galvanized finish.

Maintain the zinc coatings clean, dry, and free from contaminants before topcoat systems are applied. Perform field repair of damaged galvanized surfaces in accordance with ASTM A780/A780M, using inorganic zinc coatings.

Mechanically clean galvanized steel in accordance with SSPC SP 3 using abrasive discs/sheets, or other approved methods. Remove all corrosion and foreign matter and slightly roughen the entire surface.

3.1.7 Metallizing Protection of Carbon Steel

Clean and degrease carbon steel surfaces in accordance with SSPC SP 1 followed by power tool cleaning in accordance with SSPC SP 3 to remove weld spatter, weld slag, laminations, sharp edges, and other surface defects prior to abrasive blasting or power-tool cleaning to bare metal.

3.1.7.1 Abrasive Blasting of Carbon Steel

At a minimum, abrasive-blast carbon steel to near-white metal SSPC SP 10/NACE No. 2. Provide an anchor profile of 62.5 um to 75 um 2.5 mil to 3 mil for the blasted surface. Remove all rust from pits and depressions.

3.1.8 Protection of Aluminum

****
NOTE: Protect aluminum from corrosion by the use of protective coatings as defined herein. Certain alloys may require coatings in specific environments as specified in the paragraph entitled, "Aluminum Protective Coatings," of this section.
****

3.1.8.1 Surface Preparation of Aluminum

****
NOTE: CAUTION: Some aluminum configurations are susceptible to distortion and/or destruction when they are abrasive-blasted.
****

Ensure against any metal damage by the choice of abrasive aggregate and by reducing blast nozzle pressure and increasing the working distance from the nozzle to the surface as necessary. In some cases, such as in the surface preparation of light-gage sheet, these precautions may not be sufficient to prevent distortion; use an alternate procedure, such as abrading or mechanical cleaning, to remove corrosion or roughen the surface. Prepare aluminum by degreasing and abrasive blasting or mechanical cleaning, as required by the condition and configuration of the surface.

Use abrasive blasting whenever possible using nonmetallic abrasives. Abrasive-blast aluminum surfaces with fine-grade non-metallic abrasive materials to remove corrosion and old coatings or roughen new surfaces.

Ensure the blasted surface is free of corrosion and foreign matter and has a uniform, slightly roughened appearance. Use plastic media or an approved equivalent for abrasive blasting of bellows, gimbal joints, and other thin-walled, abrasion-sensitive components.

Use mechanical cleaning only when abrasive blasting is impractical, would damage the structure or component, or is prohibited in the area where the work is being performed. Mechanically clean aluminum in accordance with SSPC SP 3 using abrasive discs/sheets, or other approved methods. Remove corrosion and foreign matter and slightly roughen the entire surface.

Do not mechanically clean anodized or chemical-conversion-coated aluminum surfaces.

3.1.9 Surface Preparation of Stainless Steel

****
NOTE: Thin-walled 300-series stainless-steel tubing is subject to pitting corrosion failure in outdoor marine environments. For exterior installations, degrease this tubing, prepared with a stainless-steel wire wheel or equivalent, and coated.
****

Prepare stainless steel by degreasing in accordance with SSPC SP 1 and abrasive blasting or mechanical cleaning. As an alternative, mechanically clean stainless steel in accordance with SSPC SP 3 using abrasive discs/sanding sheets or other approved methods.

****
NOTE: CAUTION: Some stainless steel configurations are susceptible to distortion and/or destruction, when they are abrasive-blasted. Identify susceptible pieces for the Contractor.
****

Ensure against any metal damage by choice of abrasive aggregate and by reducing the blast nozzle pressure and increasing the working distance from the nozzle to the surface as necessary. In some cases, such as in the surface preparation of light-gage sheet, these precautions may not be sufficient to prevent distortion; use an alternate procedure, such as abrading or mechanical cleaning, to remove corrosion or roughen the surface. Use abrasive blasting whenever possible, using nonmetallic abrasives. Abrasive-blast stainless steel surfaces with fine-grade abrasive to remove corrosion and old coatings or roughen new surfaces. Ensure the blasted surface is free of all corrosion and foreign matter and have a uniform, slightly roughened appearance.

3.1.10 Underground, Submerged, or Continuously Wetted Surfaces

****
NOTE: Co-ordinate cathodic protection requirements with the application of this coating.
****

Coal tar epoxy coatings are not allowed for surfaces that are in contact with potable water.

Prepare underground, submerged, or continuously wetted surfaces in

accordance with SSPC SP 5/NACE No. 1, with a profile of 75 um to 100 um 3 mil to 4 mil and coated with coal tar epoxy.

3.2 APPLICATION OF COATINGS

Coat all prepared surfaces within 6-hours after surface preparation and before corrosion or recontamination occurs. As an exception, surfaces prepared under temperature and humidity control may be coated after 6-hours but only after inspection of the surface confirms that the cleanliness level has met the specified standards. Prepare again any surface that shows corrosion or contamination, regardless of the length of time after preparation.

The application and handling characteristics of all coatings will vary. Follow written instructions from the manufacturer in conjunction with the requirements defined herein. Follow the manufacturer's written recommendations for thinning, mixing, handling, and applying the product.

Work coatings into all joints, crevices, and open spaces. Protect newly coated surfaces from damage. Protect equipment and adjacent surfaces not to be coated from overspray and splattered coatings.

Contain particulate emissions during all spray-painting operations. Design the containment system to comply with all Federal, State, and local regulations as well as NASA policies. Requested exemptions to this requirement must be approved by the Contracting Officer.

3.2.1 Coating Systems

Ensure thinners and cleaners are products of the coating manufacturer, except as defined in the paragraph entitled, "Non-Skid Coatings," of this section. For intercoat compatibility, ensure coating systems consisting of more than one coat are products of the same manufacturer.

Maintain continuity of the coating manufacturer's system for the duration of an individual project.

3.2.2 Colors

Add pigment to inorganic zinc coatings so that there is a definite contrast between the coating and the dull gray appearance of the blasted steel surface during the coating application.

Ensure color coding for fluid system piping is in accordance with KSC-STD-F-0004. Ensure finish coat colors are in accordance with FED-STD-595.

a. White, No. 17925

b. Blue, No. 15102 (safety)

c. Yellow, No. 13538 (standard)

d. Yellow, No. 13655 (safety)

e. Red, No. 11136

f. Red, No. 11105 (safety)

g. Black, No. 17038

h. Green, No. 14110 (safety)

i. Gray, No. 16187 (safety)

j. Brown, No. 10080 (safety)

k. Gray, No. 16473 (standard)

Use pigments free of PCB, lead, chromium, and cadmium.

3.2.3 Mixing and Application Instructions

Thoroughly mix coating materials prior to application with a mechanical mixing instrument that does not induce air into the coating.[Power the mixer by an air motor or an explosion-proof electric motor.]

Perform all mixing operations over an impervious surface with provisions to prevent runoff to grade of any spilled material.[Strain the mixed coating material through a 30 to 60-mesh screen prior to application.]

Thinning is for viscosity control only. If thinner is required, use the amount recommended by the manufacturer of the thinner.

Agitate the material as required during application to maintain a uniform suspension of solids. Avoid continuous rapid agitation.

Adjust spray equipment to produce an even, wet coat with minimum overspray.[Apply coatings in even, parallel passes, overlapping 50 percent.]

3.2.4 Weather Conditions

Do not apply coating when contamination from any source (i.e., rainfall) is imminent or when the temperature or humidity is outside limits recommended by the coating manufacturer.

Spray application methods are not allowed when wind speed exceeds 25-km/hr 15-mph in the area where the coating is being applied.

To prevent condensation during application, ensure the surface temperature is at least 3 degrees C 5 degrees F) above the dew point and rising.

Limitations against using certain coatings under specific relative humidity (RH) are as follows:

a. Do not apply solvent-based inorganic zinc coatings , polysiloxane topcoats, and IOTs in conditions with <40 percent RH.

b. Do not apply water-based inorganic zinc coatings in conditions with <40 percent or >80 percent RH.

3.2.5 Methods of Application

****
NOTE: Organic midcoats and topcoats may be applied using a brush, roller, or spray device as applicable.
****

Apply coatings with an airless or conventional spray equipment, or both. For minor touch-up of spray applications and stripe coats of inorganic zinc, brush application can be used.

3.2.6 Coating Finish

Ensure each coat of material applied is free of runs, sags, blisters, bubbles, and mudcracking; variations in color, gloss, and texture; holidays (missed areas); excessive film buildup; foreign contaminants; or dry overspray.

Ensure complete coverage and proper thickness on welds, corners, crevices, sharp edges, bolts, nuts, and rivets.

Ensure each coat of applied material is rendered clean, dry, and free from surface contaminants before another coating is applied.

3.2.7 Touchup of Welds and Damaged Coatings

Touch-up field welds and damaged coatings. Accomplish touch-up and repair promptly after the damage or welding has occurred.

3.2.8 Coating, Drying, and Curing

****
NOTE: The curing time of solvent-based inorganic zinc coatings can be accelerated by rinsing or spraying the coating with potable fresh water after an initial overnight drying. The number and frequency of rinse cycles can vary with environmental conditions. Check with the material manufacturer for recommended procedures.
****

Follow the coating manufacturer's recommended drying and curing times for handling, recoating, and topcoating. Follow the coating manufacturer's recommendations to test the coating for proper curing.

Verify proper curing of solvent-based inorganic zinc-rich coatings by ASTM D4752, prior to further coating. Verify water-based inorganic zinc-rich coatings for curing in accordance with the same procedure, but water is to be substituted as the solvent.

3.2.9 Stripe Coat Application for Carbon Steel

Apply stripe coating with inorganic zinc to welds, cutouts, sharp edges, rivets, crevices, and bolts to ensure complete coverage prior to subsequent applications of inorganic zinc.

3.2.10 Application of Inorganic Zinc Coatings for Carbon Steel

Apply inorganic zinc coatings to a DFT of 100 um 4.0 mil minimum to 150 um 6.0 mil maximum when they are left without a topcoat or when IOT or ablative coating is applied. When the zinc coatings are to be topcoated with organic topcoats, reduce the DFT to 65 um 2.5 mil minimum to 100 um 4.0 mil maximum. Obtain the proper DFT for the inorganic zinc coating in a single application, which may consist of multiple passes, while the coating is still wet (including the application of a stripe coat).

3.2.11 Inorganic Zinc Coating Topcoat Systems for Carbon Steel

Apply the following topcoat systems over the inorganic zinc coatings as required for each Zone of Exposure. Apply topcoats at the DFT recommended by the manufacturer or as specified as follows. Ensure the film thickness of the topcoats is sufficient to achieve uniform coverage and color.

a. Zones 1a and 1b - [Leave inorganic zinc coatings without a topcoat][For maximum protection, topcoat the inorganic zinc coating with a heat-resistant silicone ablative coating material in accordance with KSC-SPEC-F-0006B.]

b. Zone 1c - Leave inorganic zinc coatings without a topcoat.

****
NOTE: As an alternate, surfaces may be topcoated with a heat-resistant silicone ablative coating material in accordance with KSC-SPEC-F-0006B.
****

c. Zone 2 - Apply an IOT conforming to the paragraph entitled, "Coating Finish," of this section, at a DFT of 75 um to 125 um 3 mil to 5 mil.

d. Zones 3a and 3b

(1) Apply an intermediate/tie coat and a finish coat conforming to the paragraph entitled, "Protective Coatings, Thinners, and Cleaners," of this section.

(2) As an alternate, apply [an IOT][a polysiloxane finish coat] at the manufacturer's recommended DFT.

(3) Ensure the DFT is sufficient to completely hide the inorganic zinc primer.

e. Zones 4a, 4b, and 4c - [No topcoats are required.][Apply topcoats as needed for color coding, safety purposes, identification, or special conditions.][When required for color coding, safety purposes, identification, or special conditions, provide topcoats in accordance with the paragraph entitled, "Colors," of this section.]

f. Zone 5a and 5b - [Apply inorganic zinc coating.][Apply an inhibitive epoxy primer and a polyurethane finish coat at the manufacturer's recommended thickness.]

g. Zone 6 - Provide a coating system as specified in the paragraphs entitled, "Underground, Submerged, or Continuously Wetted Surfaces," and "Coating Systems for Potable Water Immersion Service," of this section.

h. Zone 7 - Provide the coating system as specified in NACE RP0198.

3.2.12 Galvanizing Coating Systems for Carbon Steel

a. Zones 1a and 1b - [No Topcoat][For maximum protection, topcoat the galvanized coating with a heat-resistant silicone ablative coating material in accordance with KSC-SPEC-F-0006B.]

b. Zone 1c - Leave galvanized surfaces without a topcoat.

****
NOTE: As an alternate, surfaces may be topcoated with a heat-resistant coating material, such as a silicone ablative coating material in accordance with KSC-SPEC-F-0006B.
****

c. Zone 2 - After brush-blasting, apply an IOT conforming to the paragraph entitled, "Inorganic Zinc Coatings," of this section, at a DFT of 75 um to 125 um 3 mil to 5 mil.

d. Zones 3a and 3b - After brush-blasting, apply primer/tiecoat and finish coat in accordance with manufacturer's recommended thicknesses.

(1) [Apply an IOT conforming to the paragraph entitled, "Finish Coatings," under "Inorganic Topcoats (IOTs)," of this section.] [Apply a polysiloxane finish coat conforming to the paragraph entitled, "Finish Coatings," under "Polysiloxane Topcoats," of this section, at the manufacturer's recommended DFT.]

(2) Ensure the DFT is sufficient to completely hide the galvanized coating.

e. Zones 4a, 4b, and 4c - No topcoats are required for galvanizing weights meeting or exceeding ASTM A123/A123M, ASTM A153/A153M, and ASTM A653/A653M, with a galvanizing weight of G165.

****
NOTE: When steel sheet is galvanized to less than ASTM A653/A653M, with a galvanizing weight of G165, further coating in accordance with Zone 3 is required.
****

(1) [As an alternate to topcoats,]degrease and brush-blast steel sheet, and apply an inorganic zinc primer conforming to the paragraph entitled, "Inorganic Zinc Coatings," of this section, with a DFT of 50 um to 75 um 2 mil to 3 mil.

f. Zone 5a and 5b - [No topcoats are required.][Apply topcoat when needed for color coding, safety purposes, identification, or special conditions.]

(1) When topcoats are required for color coding, safety purposes, identification, or special conditions, degrease the surface and apply an epoxy primer at the manufacturer's recommended DFT.

(2) Within 24 hours, apply a polyurethane finish coat at the manufacturer's recommended DFT.

(3) [As an alternate,]Apply a polysiloxane topcoat at the manufacturer's recommended DFT.

(4) Ensure the DFT is sufficient to completely hide the galvanized coating.

g. Zone 6 - The coating system is as specified in the paragraphs entitled,

"Underground, Submerged, or Continuously Wetted Surfaces," and "Coating Systems for Potable Water Immersion Service," of this section

h. Zone 7 - The coating system as specified in NACE RP0198.

3.2.13 Application of Metallized Coatings

Ensure metal wire used with the arc spray metallizing equipment is [pure zinc] [90-10 zinc-aluminum] [85-15 zinc-aluminum alloys] [53-56 aluminum-magnesium] [pure magnesium]. Apply metallized zinc coatings to a DFT of 200 um 8 mil minimum to 375 um 15 mil maximum, depending on the intended service environment.

3.2.13.1 Topcoat Systems for Metallized Zinc Coatings

Apply topcoat systems over the metallized zinc coatings as required for each Zone of Exposure. Select the coating materials from Appendix C, Approved Products List for Metallized (TSC) Systems. Apply topcoats at the DFT recommended by the manufacturer or as specified as follows:

Apply sufficient topcoat film thickness to ensure uniform coverage and color.

a. Zones 1a and 1b - Metallized coatings may be left without a topcoat; however, for maximum protection, topcoat the metallized coating with a heat resistant silicone ablative coating material in accordance with KSC-SPEC-F-0006B.

b. Zone 1c - Leave metallized coatings without a topcoat.

****
NOTE: As an alternate, surfaces may be topcoated with a heat-resistant silicone ablative coating material in accordance with KSC-SPEC-F-0006B.
****

c. Zone 2 - Apply an IOT at a DFT of 75 um to 125 um 3 mil to 5 mil.

d. Zone 3 - Apply an intermediate/tie coat and a finish coat.

(1) As an alternate, apply an IOT at a DFT of 75 um to 125 um 3 mil to 5 mil, or apply a polysiloxane finish coat at the manufacturer's recommended DFT.

(2) Ensure the DFT is sufficient to completely hide the metallized coating.

****
NOTE: No topcoats are required for Zones 4a, 4b, and 4c, except as needed for color coding, safety purposes, identification, or special conditions.
****

e. Zones 4a, 4b, and 4c - When topcoats are required for color coding, safety purposes, identification, or special conditions, provide topcoats in accordance with the paragraph entitled, "Colors," of this section.

f. Zones 5a and 5b - [Not required] [Apply an inhibitive epoxy primer and a

polyurethane finish coat at the manufacturer's recommended thickness.]

g. Zones 6a and 6b - [Apply a metallized coating.][Apply an inhibitive epoxy primer and a polyurethane finish coat. Apply at the manufacturer's recommended thickness.]

h. Zone 7 - Provide a coating system as specified in NACE RP0198

3.2.14 Aluminum Protective Coatings

****
NOTE: Aluminum surfaces require special coatings if used underwater.

Zones 1, 2, and 3 Use the following coatings to protect aluminum in the launch environment and to facilitate washdown of SRB residue on critical hardware.

Zones 4 and 5 No protective coatings are required except as needed for color coding, safety purposes, identification, or special conditions for normal atmospheric service of 1000-, 5000-, and 6000-series alloys.
****

Apply the following protective coatings to aluminum surfaces as required for each Zone of Exposure:

a. Zones 1, 2, and 3 - [Use an inhibited polyamide epoxy coating and aliphatic polyurethane topcoat.] Use a[polysiloxane][IOTs][silicone] ablative coating.

b. Zones 4 and 5 - Fully coat aluminum that is located within 3.5 km 2 mi of the coastline or subject to chemical exposure with an[inhibited polyamide epoxy coating and aliphatic polyurethane topcoat][polysilorane][IOT][and silicone ablative].

c. Zone 6 - Provide the coating system specified in the paragraph entitled, "Underground, Submerged or Continuously Wetted Surfaces," and the paragraph entitled, "Coating Systems for Potable Water Immersion Service," of this section.

d. Zone 7 - Provide the coating system specified in NACE RP0198.

3.2.15 Stainless Steel Protective Coating

a. Zones 1, 2, and 3 - For 300 series stainless steels, use an inhibited polyamide epoxy primer and[aliphatic polyurethane][polysiloxane][silicone ablative] topcoat.

b. Zones 4 and 5 - For special conditions, brush-blast and coat stainless steel with inhibitive epoxy primer to a DFT of 50 um to 75 um 2 mil to 3 mil followed by a finish coat that provides a DFT of 50 um to 75 um 2 mil to 3 mil.

c. Zone 6 - Provide a coating system as specified in the paragraph entitled, "Underground, Submerged or Continuously Wetted Surfaces and the paragraph entitled, "Coating Systems for Potable Water Immersion

Service," of this section.

d. Zone 7 - Provide a coating system as specified in NACE RP0198.

3.2.16 Underground, Submerged, or Continuously Wetted Surfaces

Apply the coating to a minimum DFT of 410 um 16.0 mil and checked for missed areas or pinholes with a properly calibrated holiday detector in accordance with NACE SP0188.

3.2.17 Coating Systems for Potable Water Immersion Service

Ensure all surface preparation for carbon steel is in accordance with SSPC SP 5/NACE No. 1, with a surface profile of 75 m to 100 um 3 mil to 4 mil.

3.2.18 Provision for Nonskid Surfaces

Where a nonskid surface is required for walkways, decks, or other such surfaces, apply a nonskid coating as follows:

a. Carbon steel - Apply coatings directly over the zinc coating (inorganic zinc, galvanizing, or metallizing) and follow surface preparation instructions.

b. Aluminum and stainless steel - Apply coatings directly over these surfaces after surface preparation.

3.2.19 Coating Systems for Metallic Surfaces Under Thermal Insulation

Coating systems for carbon steel and stainless steel surfaces under thermal insulation and cementitious fireproofing are as specified in NACE RP0198.

3.3 FIELD TESTS

3.3.1 Coating Systems for Potable Water Immersion Service

Inspect potable water coating systems in accordance with standard recommended practices in NACE RP0288, and with NACE SP0188.

3.3.2 Inspection Prior to Surface Preparation and Coating Application

Inspect conditions before beginning surface preparation and coating application operations.

3.3.2.1 Surface Condition

Visually inspect the surface condition. Give attention to weld spatter, sharp edges, flame or saw cuts, delaminations, burrs, slag, or other surface irregularities that affect performance of protective coatings prior to surface preparation.

3.3.2.2 Protection of Adjacent Surfaces

Visually inspect adjacent surfaces for adequate protection.[Conduct this inspection with a Government Quality Engineering representative.]

3.3.2.3 Ambient Weather Conditions

Determine the ambient weather conditions at the actual work location before and during the surface preparation and coating application operations to ensure they meet the requirements for the work. Record all of these ambient weather conditions on the Coating System Daily Inspection Report as shown in[Appendix F][KSC Form 28-589].

Use proper instrumentation to measure air temperature, relative humidity, dewpoint, surface temperature, and wind speed and direction. Calibrate all measurement instrumentation per the manufacturer's instructions prior to use.

Do not spray paint when the measured wind speed in the immediate area of the coating work is above 25 km/hr 15 mph.

3.3.2.4 Compressed Air Cleanliness

Inspect the compressed air supply for the use of inline moisture and oil traps. Evaluate proper functioning of the traps daily by allowing the air supply (down line from the traps) to blow against a clean, white cloth for several minutes, in accordance with ASTM D4285.

3.3.2.5 Surface Salt Concentration

Determine the surface chloride concentration on structures prior to surface preparation operations using an industry-recognized method, such as described in SSPC Guide 15. Record the information in the inspection records weekly.

Surfaces that measure 5 ug/cm2 0.00016 oz/ft2 or above require washing with water in accordance with the paragraph entitled, "Cleaning And Degreasing," of this section, prior to surface preparation.

3.3.3 Surface Preparation Inspection

3.3.3.1 Abrasive-Blasting Material

Verify the abrasive-blasting material complies with the paragraph entitled, "Abrasive-Blasting Aggregates," of this section.

3.3.3.2 Blast Nozzle Air Pressure and Size

Determine the air pressure at the blast nozzle through the use of a hypodermic needle air pressure gage. Insert the needle of the gage as close to the nozzle as practically possible and in the direction of the air flow.

Take pressure readings with the blasting system in full operation. Record the nozzle pressure. To ensure the compressor output correlates with the nozzle size, check the nozzle with a blast nozzle orifice gage initially and then at a frequency determined by the[NACE inspector][Contracting Officer's representative].

3.3.3.3 Degree of Surface Cleanliness

****

NOTE: Use of SSPC-VIS 1-89, Visual Standard for Abrasive Blast Cleaned Steel, and SSPC-VIS 3, Visual

Standard for Power - and Hand-Tool Cleaned Steel, is recommended for judging surface cleanliness.

****

Inspect the surface cleanliness after the surface preparation and before primer application. The surface preparation cleanliness requirements apply to 100 percent of the subject area, including places that are difficult to reach.

Verify the degree of cleanliness of abrasive-blasted carbon steel with a visual inspection. Inspect galvanized steel, aluminum, and stainless steel for removal of all corrosion and foreign matter with the surface slightly roughened.

3.3.3.4 Surface Profile or Roughness

Visually inspect galvanized steel, stainless steel, and aluminum surfaces as required for slight roughening.

3.3.4 Coating Finish and DFT

Inspect the finish and DFT of each applied coating prior to the application of successive coats. Take the DFT measurement on carbon steel using a magnetic gage calibrated in accordance with SSPC PA 2. Take DFT measurements on aluminum and stainless steel using an eddy current instrument that has been properly calibrated on surfaces similar to the coated surface.

3.3.5 Caulking Inspection

Visually inspect all surfaces to determine whether they comply with the requirements for sealing and caulking in accordance with the paragraph entitled, "Sealing/Caulking," of this section.

3.3.6 Galvanizing Inspection

Inspect galvanized carbon steel in accordance with the applicable ASTM standard in the paragraph entitled. "Galvanizing Coating Systems for Carbon Steel," of this section.

3.4 ADJUSTING AND CLEANING

3.4.1 Repair of Applied Coatings

Repair newly applied coatings in accordance with Table 1, Repair of Applied Coatings.

Table 1—Repair of Applied Coatings

Existing Coating	Repair Coating
Inorganic zinc	
Zones 1* and 4	Inorganic zinc/epoxy mastic for small area touch-up
Zone 2	Inorganic zinc/inorganic topcoat

Existing Coating	Repair Coating
Zones 3 and 5	Epoxy mastic/polyurethane/polysiloxane system for small area touch-up
Galvanized steel	
Zones 1 and 4	Inorganic zinc/epoxy mastic for small area touch-up
Zone 2	
Zones 3 and 5	
Inorganic topcoat	
	Inorganic zinc/inorganic topcoat
Epoxy/Polyurethane**	
Zones 3, 4, and 5	Epoxy/polyurethane system/polysiloxane
Water-reducible	
Zones 3, 4, and 5	Water-reducible intermediate/finish
Coal tar epoxy	
Zone 6	Coal tar epoxy
* Zones are defined in section 1.4.	
** When this coating is replaced with inorganic zinc, complete removal of the existing coating is required.	

Prepare surfaces by washing with water and using mechanical methods in accordance with SSPC SP 11, to remove corrosion, weld slag, and to "feather back" coating edges.

Perform touch-up and repair promptly after the damage has occurred. Provide touch-up and repair of shop-applied coatings using coatings from the same manufacturer as those applied in the shop.

APPENDIX A

APPROVED PRODUCTS LIST FOR INORGANIC ZINC COATINGS

This list shall be used by or for the Government in the procurement of products covered by this specification. All products listed herein have been tested and meet the requirements for the product as specified. This list is subject to change without notice; revisions or amendments of this list will be issued as necessary. The listing of a product does not release the supplier from compliance with the specification requirements. This list is arranged in two sections based on the coating material's VOC.

Procure thinners and cleaners for each of these coatings from the manufacturer of the coating.

The Materials Test and Corrosion Control Branch in the Engineering Directorate at KSC is responsible for conducting the testing and evaluation of candidate coatings for inclusion in the APL and for submitting updates to the KSC Engineering Directorate, which is responsible for this list.

Section I

Materials With Greater Than 400 Grams/Liter 3.3 Pounds/Gallon VOC:

Coating Designation	Type	Manufacturer
Dimetcote 9	SB	PPG Industries, Inc. One PPG Place Pittsburgh, PA 15272 (800) 722-4509 http://ppgamercoatus.ppgp
Carbo-Zinc 11	SB	Carboline Company 2150 Schuetz Road St. Louis, MO 63146 314-644-1000 www.carboline.com
Cathacoat 304K Cathacoat 304L	SB	International Paint LLC/ Devoe Coatings 6001 Antoine Drive Houston, TX 77091(713) 682-1711 (800) 654-2616
Metalhide 1001	SB	PPG Industries, Inc. One PPG Place Pittsburgh, PA 15272 (800) 722-4509 www.ppg.com
ZincClad II	SB	Sherwin-Williams Company 101 Prospect Avenue N.W. Cleveland, OH 44115 (800) 336-1110 www.sherwin-williams.com

* SB is solvent based

Section II

Materials With Less Than 400 Grams/Liter 3.3 Pounds/Gallon VOC:

Coating Designation	Type	Manufacturer
Dimetcote D-9HS Dimetcote D-9H	SB SB	PPG Industries, Inc. One PPG Place Pittsburgh, PA 15272 (800) 722-4509 http://ppgamercoatus.ppgpmc.com/
Carbo-Zinc 11HS Carbo-Zinc 11WB Carbo-Zinc 11 VOC	SB WB SB	Carboline Company 2150 Schuetz Road St. Louis, MO 63146 314-644-1000 www.carboline.com
Cathacoat 305 Cathacoat 304V	WB SB	International Paint LLC/ Devoe Coatings 6001 Antoine Drive Houston, TX 77091(713) 682-1711 (800) 654-2616
InterZinc 22HS	SB	International Paint LLC 6001 Antoine Drive Houston, TX 77091 (713) 682-1711 www.international-pc.com
Zinc Clad XI Zinc Clad II Plus	WB SB	Sherwin-Williams Company 101 Prospect Avenue N.W. Cleveland, OH 44115 (800) 336-1110 www.sherwin-williams.com
Kolor-Zinc 2.8 VOC	SB	Keeler & Long/PPG 856 Echo Lake Road Watertown, CT 06795 1-800-238-8596 http://www.ppg.com/coatings/pmc/brands/Pages/defa

* SB is solvent based, WB is water based

APPENDIX B

APPROVED PRODUCTS LIST FOR TOPCOAT SYSTEMS

This list shall be used by or for the Government in the procurement of products. All products listed herein have been tested and meet the requirements for the product as specified. This list is subject to change without notice; revisions or amendments of this list will be issued as necessary. The listing of a product does not release the supplier from compliance with the specification requirements. This list is arranged in two sections based on the coating material's VOC.

procure thinners and cleaners for each of these coatings from the manufacturer of the coating.

The Materials Test and Corrosion Control Branch in the Engineering Directorate at KSC is responsible for conducting the testing and evaluation of candidate coatings for inclusion in the APL and for submitting updates to the KSC Engineering Directorate, which is responsible for this list.

Section I

Materials With Greater Than 400 Grams/Liter 3.3 Pounds/Gallon VOC:

Primer (Type)	**Midcoat (Type)**	**Topcoat (Type)**	**Manufacturer**
Cathacoat 304L (SB) Cathacoat 304L (SB) Cathacoat 304L (SB) Cathacoat 304K (SB)	Devran 201 (SB)* Devran 230 (SB) Devran 201 (SB)* Devran 201 (SB)*	Devthane 359 (SB) Devthane 369 (SB) Devthane 369 (SB) Devthane 379 UVA (SB)	International Paint LLC/Devoe Coatings 6001 Antoine Drive Houston, TX 77091 (713) 682-1711 (800) 654-2616 www.international-pc.com
MetalHide 1001 (SB)	PittGuard 95-245 (SB)*	PittThane 95-812 (SB)	PPG Industries, Inc. One PPG Place Pittsburgh, PA 15272 (800) 722-4509 www.ppg.com
Kolor-Zinc 2.8 VOC (SB)	N/A	Coraflon ADS (SB)	Keeler & Long/PPG 856 Echo Lake Road Watertown, CT 06795 1-800-238-8596 http://www.ppg.com/coati
Carbozinc 11 (SB)	N/A	Carbothane 133 LH (SB)	Carboline Co. 2150 Schuetz Road St. Louis, MO 63146 314-644-1000 www.carboline.com
* Can be used as a direct-to-metal primer for stainless steel, aluminum, and other materials in Zone 5a and 5b environments.			

* SB is solvent based, WB is water based

Section II

Materials With Less Than 400 Grams/Liter 3.3 Pounds/Gallon VOC:

Primer (Type)	Midcoat (Type)	Topcoat (Type)	Manufacturer
D-9HS (SB) D-9HS (SB) D-9H (SB) D-9H (SB) D-9H (SB)	Amerlock 400 (SB)* N/A Amercoat 383 (SB) Amerlock 2/400 (SB)* Amerlock 2/400 (SB)*	Amercoat 450HS (SB) PSX700 (SB) PSX1001 (SB) Amercoat 450H (SB) Amercoat 335 (SB)	PPG Industries, Inc. One PPG Place Pittsburgh, PA 15272 (800) 722-4509 http://ppgamercoatu/
CZ-11HS (SB) CZ-11HS (SB) CZ-11HS (SB) CZ-11WB (WB) CZ-11WB (WB) CZ-11WB (WB)	Carboguard 893(SB)* Carbomastic 15(SB)* Carboguard 893 (SB)* N/A Carboguard 893 (SB)* Carboacrylic 3358 (WB)	Carbothane 134HS (SB) Carboacrylic 3359(WB) Carboxane 2000 (SB) Carboxane 2000 (SB) Carboacrylic 3359(WB) Carboacrylic 3359(WB)	Carboline Co. 2150 Schuetz Road St. Louis, MO 63146 314-644-1000 www.carboline.com
Cathacoat 304V (SB)	Devran 201 H (SB)*	Devthane 379 (SB)	International Paint LLC/Devoe Coatings 6001 Antoine Drive Houston, TX 77091 (713) 682-1711 (800) 654-2616
Zinc Clad XI (WB) Zinc Clad II Plus (SB) Zinc Clad II Plus (SB)	N/A Macropoxy 646-100 (SB)* Macropoxy 646-100 (SB)*	Polysiloxane XLE Hydrogloss WB (WB) Hi-Solids Poly-CA (SB)	Sherwin-Williams 101 Prospect Ave Cleveland, OH 44115 (800) 336-1110 www.sherwin-william
InterZinc 22HS (SB) InterZinc 22HS (SB)	Interseal 670HS (SB)* Interseal 670HS (SB)*	Interfine 979 (SB) Interfine 878 (SB)	International Paint LLC 6001 Antoine Dr. Houston, TX 77091 (713) 682-1711 www.international-p

Primer (Type)	**Midcoat (Type)**	**Topcoat (Type)**	**Manufacturer**
* Can be used as a direct-to-metal primer for stainless steel, aluminum, and other materials in Zone 5a and 5b environments. ** SB is solvent based, WB is water based			

Section III

Inorganic Topcoat Systems:

Primer (Type)	**Midcoat (Type)**	**Topcoat (Type)**	**Manufacturer**
D-9 HS (SB)	N/A	741 (SB) (IOT)	PPG Industries, Inc. One PPG Place Pittsburgh, PA 15272 (800) 722-4509 http://ppgamercoatu
CZ-11 VOC (SB) CZ-11(SB)	N/A N/A	Carbozinc Finish (SB) (IOT) Carbozinc Finish (SB) (IOT)	Carboline Co. 2150 Schuetz Road St. Louis, MO 63146 314-644-1000 www.carboline.com
Cathacoat 304V (SB)	N/A	Devram 701 (SB) (IOT)	International Paint LLC/ Devoe Coatings 6001 Antoine Drive Houston, TX 77091 (713) 682-1711 (800) 654-2616
InterZinc 22HS (SB)	N/A	Intertherm 181 (SB) (IOT)	International Paint LLC 6001 Antoine Dr Houston, TX 77091 (713) 682-1711 www.international-p
Zinc Clad II (SB)	N/A	L03 (SB) (IOT)	Sherwin-Williams 101 Prospect Ave. Cleveland, OH 44115 (800) 336-1110 www.sherwin-willian

* SB is solvent based, WB is water based

APPENDIX C

APPROVED PRODUCTS LIST FOR METALLIZED (TSC) SYSTEMS

This list shall be used by or for the Government in the procurement of products covered. All products listed herein have been tested and meet the requirements for the product as specified. This list is subject to change without notice; revisions or amendments of this list will be issued as necessary. The listing of a product does not release the supplier from compliance with the specification requirements.

Procure thinners and cleaners for each of these coatings from the manufacturer of the coating.

The Materials Test and Corrosion Control Branch in the Engineering Directorate at KSC is responsible for conducting the testing and evaluation of candidate coatings for inclusion in the APL and for submitting updates to the KSC Engineering Directorate, which is responsible for this list.

Section I

Materials With Greater Than 400 Grams/Liter (3.3 Pounds/Gallon) VOC:

N/A

Section II

Materials With Less Than 400 Grams/Liter (3.3 Pounds/Gallon) VOC:

TSC Primer	Intermediate	Topcoat	Manufacturer
Pure Zinc Pure Zinc Pure Zinc	Interseal 1100 (WB) N/A N/A	Interthane 2100 (SB) Intercryl 520 (WB) Intertherm 181 (SB) (IOT)	International Paint LLC 6001 Antoine Dr Houston, TX 77091 (713) 682-1711 www.international-p
Pure Zinc Pure Zinc Pure Zinc	Macropoxy 646-100 (SB)* Macropoxy 646-100 (SB)*	0 VOC Acrylic (WB) Hi-solids Poly 100 (SB) L03 (SB) (IOT)	Sherwin-Williams 101 Prospect Ave. Cleveland, OH 44115 (800) 336-1110 www.sherwin-willia
Pure Zinc Pure Zinc Pure Zinc	N/A N/A N/A	Carbothane 134MC (SB) Carbothane 133MC (SB) Carbozinc Finish (SB) (IOT)	Carboline Co. 2150 Schuetz Road St. Louis, MO 63146 314-644-1000 www.carboline.com
Pure Zinc	N/A	Noxyde (WB)	Rustoleum 11 Hawthorn Parkway Vernon Hills, IL 60061 (800) 323-3584 http://www.rustoleu
Pure Zinc	N/A	Sky White Powder	Dupont Powder Coatings 9800 Genard Rd Houston, TX 77041 (800) 247-3886 http://www2.dupont.
Pure Zinc Pure Zinc	BarRust 231V (SB)*	Devthane 379H(SB) Devram 701 (SB) (IOT)	International Paint LLC/Devoe Coatings 6001 Antoine Drive Houston, TX 77091 (713) 682-1711 (800) 654-2616

TSC Primer	**Intermediate**	**Topcoat**	**Manufacturer**
Pure Zinc Pure Zinc Pure Zinc Pure Zinc	Amerlock Sealer (SB) Amercoat 351 (WB) Amerlock 2 VOC (SB)* N/A	PSX700 (SB) PSX700 (SB) Amershield VOC (WB) 741 (SB) (IOT)	PPG Industries, Inc. One PPG Place Pittsburgh, PA 15272 (800) 722-4509 http://ppgamercoatu
*Can be used as a direct-to-metal primer for stainless steel, aluminum, and other materials in Zone 5a and 5b environments.			

** SB is solvent based, WB is water based

APPENDIX D

COATING SPECIFICATION KEY ELEMENTS

1. SCOPE.
2. APPLICABLE DOCUMENTS.
3. SUBMITTALS.
4. ENVIRONMENTAL PROTECTION.
5. WASTE MANAGEMENT.
6. SAFETY/PERSONNEL PROTECTION.
7. MATERIALS.
8. TOOLS AND EQUIPMENT.
9. ENVIRONMENTAL CONDITIONS.
10. WORK SCHEDULE.
11. SURFACE PREPARATION.
12. COATING SCHEDULE (see next page).
13. COATING MIXING AND APPLICATION.
14. QUALITY CONTROL INSPECTION.
15. REPORTING.
16. FINAL ACCEPTANCE.

APPENDIX E

COATING SCHEDULE

SURFACE DESCRIP (STEEL, CONCRETE, SURFACE A, B, ETC.) SSPC TU 2/NACE 6G197	APPROX. SURFACE AREA SQ FT	SURFACE PREP TYPE	PROFILE RANGE	FIRST COAT			SECOND COAT			THIRD COAT		
				TYPE	WFT/DFT	COLOR	TYPE	WFT/DFT	COLOR	TYPE	WFT/DFT	COLOR

APPENDIX F

COATING SYSTEM DAILY INSPECTION REPORT

See KSC Forms 28-589 and 28-589A.
http://corrosion.ksc.nasa.gov/pubs/kscstd01.txt

Forms can be obtained from the Contracting Officer.

-- End of Section --

****
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA/KSC-21 13 00.00 98 (July 2020)

Preparing Activity: NASA

Superseding
NASA/KSC-21 13 00.00 98 (November 2013)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
****

SECTION TABLE OF CONTENTS

DIVISION 21 - FIRE SUPPRESSION

SECTION 21 13 00.00 98

FIRE SUPPRESSION SPRINKLER SYSTEMS

07/20

-- End of Section Table of Contents --

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA/KSC-21 13 00.00 98 (July 2020)

Preparing Activity: NASA

Superseding
NASA/KSC-21 13 00.00 98 (November 2013)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
****

SECTION 21 13 00.00 98

FIRE SUPPRESSION SPRINKLER SYSTEMS
07/20

****
NOTE: This specification covers the requirements for wet and dry fire protection sprinkler systems, hydrants, standpipe equipment, and firehose stations.

This is a performance based type of specification, with the Contractor responsible for providing professional engineering services associated with hydraulic calculations, head layout and detailed design. Estimate the system water flow demand requirements to determine the adequacy of the water supply and as certain the need for a fire pump or water storage.

Include the following in the drawings:

Current up-to-date water supply flow test data

Location and invert elevations of existing obstructions and utilities that are to be avoided during construction or are required to be plugged and abandoned or demolished and removed

Location of soil storage areas and spoil areas on government property where disposal of excess and waste material is permitted

Typical riser details

Areas to be sprinkled, hazard by class, water application density, hose requirements, temperature setting of heads, ceiling type, height, and any other special design criteria

Existing alarm-system connections

Location of fire pumps and controllers

Proper utilization and coordination of symbols, legends, or codes for various materials and classed

conditions as provided in the specifications

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Recommended changes to a NASAKSC Master Specification Section should be submitted as a Criteria Change Request (CCR) to the appropriate Technical Proponent (TP) through the SpecsIntact Help Desk.

****

PART 1 GENERAL

1.1 REQUIREMENTS

****

NOTE: If Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS is not included in the project specification, insert applicable requirements therefrom and delete the following paragraph.

****

[Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS applies to work specified in this section.]Provide design and installation in accordance with NFPA Standards. The interpretation of NFPA Standards rests with the [Kennedy Space Center] Fire Protection Engineer who is the Authority Having Jurisdiction (AHJ), and whose opinion is final.

This is a performance-based specification with the Contractor responsible for providing engineering design, installation and testing associated with the work to be performed. As defined under Florida Administrative Code, Chapter 61G15-32, all design work will be performed by a "delegated engineer", who is a Professional Engineer, licensed to practice in Florida and competent in fire protection engineering.

1.2 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's

Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

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

****

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.

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISC/AISI 121	(2007) Standard Definitions for Use in the Design of Steel Structures

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.18.1/CSA B125.1	(2018) Plumbing Supply Fittings
ASME B16.4	(2021) Gray Iron Threaded Fittings; Classes 125 and 250
ASME B16.5	(2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	(2018) Factory-Made Wrought Buttwelding Fittings
ASME B16.34	(2021) Valves - Flanged, Threaded and Welding End
ASME B16.39	(2020) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B31.1	(2022) Power Piping

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C606	(2022) Grooved and Shouldered Joints

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2022) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A126	(2004; R 2019) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A135/A135M	(2021) Standard Specification for Electric-Resistance-Welded Steel Pipe

ASTM A183	(2014; R 2020) Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A234/A234M	(2023a) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A307	(2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A563	(2021; E 2022a) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A563M	(2007; R 2013) Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A795/A795M	(2021) Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
ASTM C592	(2022a) Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type)
ASTM D2000	(2018) Standard Classification System for Rubber Products in Automotive Applications
ASTM F568M	(2007) Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

FM GLOBAL (FM)

FM 4991	(2013) Approval of Firestop Contractors
FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(2018) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

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

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13	(2022; ERTA 3 2022) Standard for the Installation of Sprinkler Systems

NFPA 13E	(2020) Recommended Practice for Fire Department Operations in Properties Protected by Sprinkler and Standpipe Systems
NFPA 14	(2019; TIA 19-1) Standard for the Installation of Standpipes and Hose Systems
NFPA 24	(2022) Standard for the Installation of Private Fire Service Mains and Their Appurtenances
NFPA 70	(2023) National Electrical Code
NFPA 72	(2022; ERTA 22-1) National Fire Alarm and Signaling Code
NFPA 75	(2020) Standard for the Protection of Information Technology Equipment
NFPA 251	(2006) Standard Methods of Tests of Fire Resistance of Building Construction and Materials
NFPA 1963	(2019) Standard for Fire Hose Connections

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-101	(2014; Rev C) Color Code for Pipelines and for Compressed Gas Cylinders

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-1922	(Rev A; Notice 1; Notice 2; Notice 3; Notice 4) Shield, Expansion (Caulking Anchors, Single Lead)
CID A-A-1923	(Rev A; Notice 1; Notice 2; Notice 3; Notice 4) Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)
CID A-A-1924	(Rev A; Notice 3) Shield, Expansion (Self Drilling Tubular Expansion Shell Bolt Anchors
CID A-A-1925	(Rev A; Notice 3) Shield Expansion (Nail Anchors)
CID A-A-55614	(Basic; Notice 2) Shield, Expansion (Non-Drilling Expansion Anchors)
CID A-A-55615	(Basic; Notice 1; Notice 2; Notice 3; Notice 4) Shield, Expansion (Wood Screw and Lag Bolt Self-Threading Anchors
FED-STD-595	(Rev C; Notice 1) Colors Used in Government Procurement

UNDERWRITERS LABORATORIES (UL)

UL 6	(2022) UL Standard for Safety Electrical Rigid Metal Conduit-Steel
UL 193	(2016) UL Standard for Safety Alarm Valves for Fire-Protection Service
UL Fire Prot Dir	(2012) Fire Protection Equipment Directory

1.3 ADMINISTRATIVE REQUIREMENTS

1.3.1 Pre-Installation Meeting

No later than [15] [30] [_____] calendar days of Contract Award, mandatory attendance is required at a pre-installation meeting. Submit the following to the Contracting Officer for review:

a. Contractor's State Certification

b. Factory test data, including fully verified and dated copies of all results with a copy of the approved test procedure and any other related information.

c. Quality Assurance Plan

d. Test procedures and recording forms for the preliminary tests

Provide one copy of the test procedures and recording forms for the preliminary tests. For the final acceptance tests, provide 10 copies of the test procedures and recording forms. In each test procedure, identify each sprinkler and standpipe component to be tested, describe the initial condition, each step or function in the test, required test results, and equipment to be employed. Provide test forms with suitable spaces for recording test results on all equipment, devices, and wiring to be tested. Provide test record forms that also have identified spaces for verification signatures of official witnesses and dates of the test.

1.3.1.1 Shop Drawings

Submit shop drawings for the following items in sufficient detail and scope to verify compliance with the requirements of the contract documents:

a. Records of Existing Conditions

Submit records of existing conditions showing the results of Contractor's survey of work area conditions and features of existing structures and facilities within and adjacent to the job site. Commencement of work constitutes acceptance of existing conditions.

b. Schematics and Fabrication Drawings

Submit schematics and fabrication drawings for automatic sprinkler and standpipe systems, consisting of fabrication and assembly drawings to be performed in the shop, prior to installation and at the actual job site. Meet all requirements in NFPA 13 for fabrication drawings, stipulated for "working plans", to include a building cross-section. Provide working plans signed and sealed by a Professional Engineer, licensed to practice in the State of Florida.

Indicate on working plans all sprinkler and standpipe piping (size and length), pipe hangers, sprinkler head type and locations, valves, riser trim and associated components, etc. to comply with NFPA 13, "Working Plans."

c. Fire Service Floor Plans

Provide .DWG format computer generated floor plan layouts indicating all automatic sprinkler and standpipe systems components.

[Locate sprinkler heads in a consistent pattern with ceiling grid, lights, and supply and return air diffusers. For spaces with lay-in type ceilings, locate heads in center of tile, unless otherwise approved by the Contracting Officer. In the design, give full consideration to blind spaces, other system piping, electrical equipment, HVAC ductwork, and all other types of obstructions which could prevent the proper installation and operation of the sprinkler and standpipe systems.

] Indicate in the Fire Service Floor Plans, the location of the wet-pipe and dry-pipe automatic sprinkler system, risers, standpipes, isolation valves, initiating devices, and the dry-pipe compressed air panel. Coordinate with the requirements of the Fire Alarm System Fire Service Floor Plan such that all fire alarm and suppression system devices are combined on a single fire service floor plan. Provide a symbol legend, which clearly identifies each device shown on the fire service floor plan. Install a copy of the fire service floor plan minimum size 457 by 610 mm 18 by 24 inches in a painted metal frame with a Plexiglas cover. Submit the floor plan and its location for approval to the Contracting Officer prior to installation.

d. Connection Diagrams

Submit connection diagrams indicating the relations and connections of the following items. Indicate on the drawings the general physical layout of all controls, and internal tubing and wiring details.

1.3.1.2 Manufacturer's Product Data

Submit manufacturer's catalog data in sufficient detail and scope to verify compliance with the requirements of the contract documents.

1.3.1.3 Fire-Protection System Performance Data

Submit fire-protection system performance data consisting of information on useful life, system functional flows, safety features, and mechanical automated details. As a minimum, include the following:

a. Design Analysis and Hydraulic Calculations

Provide hydraulic calculations for the hydraulic remote area of each riser and each occupancy classification. Provide hydraulic calculations signed and sealed by a Professional Engineer, licensed to practice in Florida.

Include in the design data design density, hydraulically most remote area, occupancy classification, sprinkler head orifice size, and pipe velocities. Specify the design density in gpm per sq ft or L/m per sq m of floor area. Provide discharge from individual heads in the hydraulically most remote area to be between 100 percent and 120 percent of the specified density. Design systems such that pipe velocities do not exceed 6.1

m/second 20 feet per second.

1.4 SUBMITTALS

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

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

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 REPORTING.
****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Records of Existing Conditions[; G]

Contractor's State Certification[; G]

Factory Test Data[; G]

Quality Assurance Plan[; G]

Test Procedures and Recording Forms for the Preliminary Tests[; G]

SD-02 Shop Drawings

Connection Diagrams[; G]

Schematics and Fabrication Drawings[; G]

As-Built Drawings[; G]

Fire Service Floor Plans[; G]

Records of Existing Conditions[; G]

Preaction Sprinkler Systems; G

SD-03 Product Data

Piping Materials[; G]

Supporting Elements[; G]

Sprinkler Riser Equipment[; G]

Riser Alarm Equipment[; G]

Compressed Air Supply Equipment[; G]

Fire Department Connections[; G]

Standpipe Equipment[; G]

Fire Hose Cabinet Stations[; G]

Sprinkler Heads[; G]

Valves[; G]

Miscellaneous Materials[; G]

Identification Tags[; G]

Sound Stopping[; G]

Fire Stopping[; G]

Fire-Protection System Performance Data[; G]

Manufacturer's Catalog Data; G

SD-05 Design Data

Design Analysis and Hydraulic Calculations[; G]

SD-06 Test Reports

Pressure Tests[; G]

[Air Tests[; G]

] Valve-Operating Tests[; G]

Drainage Tests[; G]

Inspector's Test[; G]

System Operating Tests[; G]

Two Hour Leak Test with Air[; G]

Pneumatic Tests; G

SD-07 Certificates

Test Gauge Accuracy[; G]

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals[; G]

1.5 QUALITY ASSURANCE PLAN

Ensure all equipment provided under this sprinkler system specification is manufactured to meet the requirements of this paragraph. Provide system(s) that is (are) the latest standard design, that is listed by Underwriters' Laboratories or approved by Factory Mutual FM APP GUIDE, and is suitable for the intended use.

Components installed under this contract cannot be more than one year older than the date of installation. Submit proof that all components are Underwriter Laboratory UL Fire Prot Dir listed or Factory Mutual FM APP GUIDE and FM 4991 approved for their intended use and function, and are installed per manufacturer instructions.[Provide materials and equipment furnished that are compatible with the existing system.]

[Prepare a test procedure and test record forms for conducting and recording complete tests on preaction sprinkler systems installed in accordance with the hydraulic calculations, the installation drawings and these specifications. Submit for approval, the test procedure to the Contracting Officer at least 30 days prior to the preliminary system test described in the paragraph SYSTEM TESTING. Provide test procedure to identify each sprinkler component to be tested. Describe the initial condition, each step or function in the test, required test results, and equipment to be employed. Provide test forms with suitable spaces for recording test results on all equipment, devices, and wiring to be tested. Provide identified spaces on test record forms for verification signatures of official witnesses and dates of the test.]

Number all fittings and coupling that require a specific torque range and ensure the corresponding torque value is documented. Submit verification that all grooved clamp type couplings and fittings were installed in accordance with the manufacturer installation manual.

1.5.1 Services of a Certified Automatic Sprinkler Specialist

Provide services of a Certified Specialist thoroughly experienced in automatic sprinkler system installations on site to perform or directly supervise the installation, make all necessary adjustments and perform all tests on the automatic sprinkler system at the site.

Sprinkler System Specialist is certified when the specialist holds a valid Sprinkler System Layout, Level III Certification from the National Institute for Certification in Engineering Technologies or is licensed by the State of Florida as a Contractor Class I in accordance with Florida State Statute, Chapter 633, Section 633.521 and holds a current Certificate of Competency.

Also consider certification of other recognized agencies with equivalent requirements. Provide evidence of the Contractors State Certification and the basis of certification to the Contracting Officer and approve by the Contracting Officer prior to any work being performed at Kennedy Space Center.

1.6 PREDICTIVE TESTING AND INSPECTION TECHNOLOGY REQUIREMENTS

****

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.

****

This section contains systems and 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 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 SYSTEM DESCRIPTION

Provide fire-protection system materials and equipment conforming to the requirements of Underwriters Laboratories UL Fire Prot Dir or the Factory Mutual FM APP GUIDE.[Provide materials and equipment compatible with the existing system.]

2.1.1 Design Requirements

[The work includes designing and providing new automatic wet pipe sprinkler systems consisting of but not limited to an easy riser type swing check valve, with all associated trim, including gauges, DN 50 2-inch main drain connection, floor drains, flow switches, and sprinkler heads for the wet-pipe sprinkler system.] [The work includes designing and providing new automatic dry-pipe sprinkler system(s) consisting of, but not limited to, OS&Y isolation valve(s), dry-pipe valves, floor drains, inspector's test drain, flow switches and sprinkler heads.] [The work includes designing and providing new automatic preaction sprinkler system(s) consisting of, but not limited to a [single or double interlock pneumatic/electric][single interlock electric] releasing preaction valve with all associated trim, air compressor with air maintenance device, OS&Y isolation valves, floor drains, pressure switches, and dry pendant sprinkler heads.] Hydraulically design the automatic sprinkler system(s) to meet density and area of coverage requirements using a UL listed or FM approved hydraulic design program. Provide the design, equipment, materials, installation, workmanship, examination, inspection, and testing in strict accordance with the required and advisory provisions of NFPA 13, NFPA 72, [NFPA 14,] [

NFPA 24,] [and NFPA 75] except as modified herein. Include in each system all materials, accessories, and equipment inside and outside the building to provide an operationally compliant system. In the system design give full consideration to blind spaces, piping, electrical equipment, ductwork, and other construction and equipment in accordance with working plans to be submitted for approval prior to installation. Locate sprinkler heads in a consistent pattern with ceiling grids, lights, speakers, supply diffusers and return diffusers.

Provide all additional equipment, junction boxes, conduit, and labor to meet the requirements and intent of this specification.

2.2 PIPING MATERIALS

2.2.1 Type BCS - Black Carbon Steel

Pipe DN 6 through DN 50 1/8 through 2 inches: Schedule 40 furnace butt welded or electric-resistance welded black-carbon steel conforming to ASTM A53/A53M, ASTM A135/A135M, ASTM A795/A795M, Type F (furnace butt welded) or Type E (electric-resistance welded), Grade B.

Pipe DN 65 through DN 20 2-1/2 through 8 inches: Schedule 40 seamless or electric-resistance welded black carbon steel, conforming to ASTM A53/A53M, ASTM A135/A135M, ASTM A795/A795M, Type E (electric-resistance welded), Grade B, or Type S (seamless), Grade B.

Unions DN 50 2 inches and under: 2068 kilopascal 300-pounds per square inch gauge (psig) working steam pressure (wsp) female, screwed, black malleable iron, with ground joint and brass-to-iron seat conforming to ASME B16.39

Standard Pipe Couplings: Extra-heavy screwed black steel.

Fittings DN 50 2 inches and under: 1207 kilopascal 175 psi working pressure, cast iron, screwed conforming to ASTM A126, Class A, and ASME B16.4.

Fittings DN 65 2-1/2 inches and larger: 1207 kilopascal 175 psi working pressure, wrought steel, buttweld fittings, wall thickness to match piping system, complying with ASME B16.9 and 68 kilogram 150-pound steel flanges complying with ASME B16.5.

Provide elbows that are of the long radius type.

Provide grooved pipe couplings 6.35 cm 2-1/2 inch and larger: 1207 kilopascal 175 psig minimum working pressure with a housing fabricated in two or more parts of black malleable-iron castings. Ensure grooved couplings do not require a specific torque setting for housing bolt installation. Provide piping that is grooved in accordance with AWWA C606, or the manufacturer's specifications, for proper installation of the grooved couplings used. Provide couplings of the same part number for use on a single system.

Provide coupling gaskets of molded synthetic rubber conforming to requirements of ASTM D2000. Provide coupling bolts that are oval-neck, track-head type with heavy hexagonal nuts, conforming to ASTM A183.

Grooved fittings 6.35 cm 2-1/2 inch and larger: 1207 kilopascal 175 psig working pressure fittings used with grooved couplings that are fabricated

of black malleable-iron castings, and are of the same manufacture as the pipe couplings. If a manufacturer's standard-size malleable-iron fitting pattern is not available, use fabricated fittings; fabricate fittings from Grade B seamless-steel pipe and long-radius seamless welding fittings, with wall thickness to match pipe, conforming to ASTM A234/A234M and ASME B16.9.

Do not use bushings; only pre-manufactured concentric or eccentric reducing fittings or reducing tees/elbows can be used to reduce pipe size.

Pre-manufactured shaped welded outlets (weld-o-lets) can be used in lieu of "tee" fittings where the branch pipe outlet is at least one pipe diameter smaller than the main.

Do not use non-grooved products which rely in any way upon gasketing, clamps, straps, or setscrews for maintaining system integrity.

Do not use adjustable "drop nipples" which utilize an O-ring type seal arrangement.

Only use threaded welded outlets Class 6000, schedule 160 type for all welded outlets installed in accordance with manufacturer's most current published installation instructions. Holes for welded outlets must be machine cut on centerline of pipe.

****
NOTE: Select the following where dry-pipe systems are used, or corrosive conditions are anticipated, to specify hot dipped galvanized steel. For projects where both piping materials are required, identify where each type of piping material is to be used in PART 3 EXECUTION.
****

2.3 SUPPORTING ELEMENTS

Provide piping system components and miscellaneous supporting elements, including, but not limited to, building-structure attachments; standpipe equipment and fire hose cabinet stations; supplementary steel; hanger rods, stanchions, and fixtures; vertical-pipe attachments; horizontal-pipe attachments; restraining anchors; and guides. Provide supporting elements suitable for stresses imposed by systems pressures and temperatures, natural, and other external forces. Include an additional 113 kilogram 250-pound load at each anchor per NFPA 13.

****
NOTE: Refer to Section 23 05 48.00 40 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT if design requires vibration isolation.
****

Provide FM approved or UL listed supporting elements conforming to ASME B31.1, MSS SP-58, and ASME B16.34.

2.3.1 Building-Structure Attachments

2.3.1.1 Anchor Devices, Concrete and Masonry

Conform anchor devices to CID A-A-1922, CID A-A-1923, CID A-A-1924A, CID A-A-1925, CID A-A-55614 and CID A-A-55615:

Group I: Shield, expansion (lead, bolt, and stud anchors)

Group II: Shield, expansion (bolt anchors), Type 2, Class 2, Style 1 or 2

Group III: Shield, expansion (self-drilling tubular expansion shell bolt anchors

Provide adjustable positions for cast-in floor-mounted equipment-anchor devices.

Do not use powder-actuated anchoring devices to support mechanical-systems components.

2.3.1.2 Beam Clamps

Provide beam clamps that are center-loading Types 21, 28, 29, and 30, UL listed, cataloged, and load-rated commercially manufactured products.

Type 20 beam clamps can be used for pipe DN 50 2 inches and under.

Where Type 25 beam clamps are used, use two per point of pipe support.

2.3.1.3 C-Clamps

****
NOTE: Avoid C-clamps, as a means of attaching hangers to structural steel. For metal building systems roofs, Z-Purlin beam clamps can be used if approved by the Contracting Officer and KSC AHJ. Where used, consider vibration forces and single or accumulated load and resultant moment on structural steel.
****

Do not use C-clamps.

2.3.1.4 Inserts, Concrete

Provide concrete inserts in accordance with the requirements of MSS SP-58 for Type 18. When applied to piping in sizes DN 50 2-inch iron pipe size (ips) and larger, and where otherwise required by imposed loads, insert and wire a 304.8 mm length of 12.7 mm 1-foot length of 1/2-inch reinforcing rod through wing slots.

2.3.2 Horizontal-Pipe Attachments

2.3.2.1 Single Pipes

Support piping in sizes up to and including DN 50 2-inch ips by Type 1, 5, 6, 7, 9, 10, 11, or 12 solid, split-ring, or band type attachments.

Support piping in sizes DN 65 2-1/2 inches and larger by Type 1, 2, 3, or 4 attachments or with Type 41 or Type 49 pipe rolls.

2.3.2.2 Parallel Fire-Protection Pipes

Use trapeze hangers fabricated from approved structural steel shapes, with U-bolts, when so specified. Provide structural-steel shapes that conform to supplementary steel requirements or provide supports that are commercially available, approved proprietary-design rolled steel.

2.3.3 Vertical-Pipe Attachments

Provide single Type 8 vertical-pipe attachments.

2.3.4 Hanger Rods and Fixtures

Use only circular solid cross section rod hangers to connect building structure attachments to pipe-support devices. Use pipe, straps, or bars of equivalent strength for hangers.

Provide turnbuckles, swing eyes, and clevises as required by support system to accommodate temperature changes, pipe accessibility, and adjustment for load and pitch.

Where required, pipe hangers used in exterior applications must be made of zinc coated or hot dip galvanized steel or other suitable corrosion-resistant materials.

For dry pipe and preaction systems, pitch branch lines at least 12 in. per 10 ft (4 mm/m), and pitch mains at least 14 in. per 10 ft (2 mm/m) toward main and auxiliary drains.

2.3.5 Supplementary Steel

Where it is necessary to frame structural members between existing members or where structural members are used in lieu of commercially rated supports, design and fabricate such supplementary steel in accordance with AISC/AISI 121.

Provide supplementary steel that is hot dipped galvanized or otherwise protected from corrosion as acceptable to the Contracting Officer.

2.4 SPRINKLER RISER EQUIPMENT

Provide UL listed or FM approved Riser alarm equipment for fire-protection use.

2.4.1 Standard Check Valve

****
NOTE: This subpart is required for all new systems. Remove this subpart if no check valves are required for system modifications.
****

Provide check valve that is UL listed or FM approved standard swing-check type with elastomer-disc seat. Provide check valve that has a ductile iron body with flanged or grooved ends and is of the clear opening type with flanged inspection and access cover plate for sizes DN 100 4 inches and larger. Provide check valve that is able to be installed vertically or horizontally, and that is rated for 2068 kilopascal 300 psi working pressure. Provide clapper that is type 304 stainless steel, Teflon-coated

hot-rolled steel, ductile iron, coated ductile iron, or bronze with field replaceable EDPM or Nitrite seal, with nickel or bronze seat. Provide a valve with springs, hinge shafts and retaining rings that are stainless steel. Provide a valve that has a valve body manufacturer painted with a corrosion resistant non-lead coating.

2.4.2 Preaction Valve

Provide a preaction valve that is a Viking [single or double interlock pneumatic/electric] [single interlock electric] interlocking deluge type. Provide standard accessories and trim necessary to give a water flow alarm, supervisory alarm for low air pressure, and includes pressure gauges, accelerator, priming provisions, testing provisions, deluge valve, supervisor air compressor, release system and all required compressed-air and water piping, fittings, and valves. Install accelerator(s) as needed to meet the 60 second discharge time required by the paragraph SYSTEM TESTING.

Provide deluge valve that is of the diaphragm type with field replaceable diaphragm and seat EDPM materials, without removal from the system. Construct valves of ductile iron, rated for a minimum 1207 kilopascal's 175 psi working pressure. Provide valve that is [single or double interlock electric/pneumatic] [single interlock electric] releasing type and designed to allow for resetting without having to open the valve. Provide the manufacturers standard trim package consisting of all gauges, manual release station, unions, fittings, drains and valves as required for a completely functional installation. Provide galvanized trip piping and fittings.

Provide pressure switches to indicate alarm and supervisory trouble corresponding to an increase in water pressure or a loss of air pressure respectively.

Provide releasing means through a solenoid valve.

Provide solenoid valve that is an electrically operated control valve UL listed or FM approved for releasing of [deluge][preaction] sprinkler valves. Provide solenoid that is the normally closed type and is electrically energized to open.

Provide a suppression system safing/disconnect switch for maintenance purposes and disconnect both conductors upon switching. Provide circuits that are Class B, with yellow positive/violet negative conductors. Provide item that is Best Lock Switch No. 1W702-S4D, and install in a separate enclosure, with an engraved phenolic sign stating, "Preaction System Safing Switch."

2.4.3 Wet Pipe Valve

Provide wet pipe valve that is of the combination check valve/main drain type complete with standard accessories and trim, including pressure gauges, DN 502-inch main drain connection, flow switch tapping, and all necessary intercomponent water piping, fittings, and valves. Component requirements for Standard Check Valves also apply to Wet Pipe Valves.

[Wet-pipe sprinkler systems require a UL listed or FM approved OS&Y isolation valve with tamper switch and flow switch for each floor, as indicated on the contract drawings, complete with standard accessories and trim necessary to give alarm, supervisory, and trouble signals. Provide

provisions for testing and draining the systems, including all necessary piping, fittings, and valves for proper operation of the systems.

][Provide wet-pipe sprinkler systems with a UL listed or FM approved alarm valve with DN 50 2-inch main drain. Provide alarm valve that complies with UL 193.

]2.4.4 Dry Pipe Valve

****
NOTE: This subpart is required if a dry pipe system is to be installed. If only a dry pipe system is to be installed, remove requirements for wet pipe valves in the preceding subpart.
****

Provide a dry-pipe sprinkler system that has a UL listed or FM approved dry-pipe valve, complete with standard accessories and trim necessary to provide alarm, trouble and supervisory signals. Provide DN 50 a dry-pipe valve with a 2-inch main drain connection and pressure gauges on the water side of the valve, air side of the valve, and the compressor. Also provide provisions for testing and draining the system and all necessary water piping, fittings, quick opening devices and valves for proper operation of the system.

Provide an air pressure switch capable of giving supervisory indication of a loss of air pressure.

2.5 COMPRESSED AIR SUPPLY EQUIPMENT

****
NOTE: Select the type of air compressor to be used based upon the system size. Generally, riser mounted compressors have limited capacity and are only suited for use on small systems. Use floor mounted compressors for large systems. Where in doubt, seek direction from the AHJ.
****

2.5.1 Floor/Wall Mounted Compressed Air Supply

Provide a [floor] [wall]-mounted compressed air system, complete with air compressor, pressure gauges, pressure switches, air maintenance devices, desiccant air dryer and appurtenances. Provide compressed air system that maintains 275 kilopascal's 40 pounds per square inch air pressure on the dry-pipe system piping, and transmits a supervisory trouble alarm to the fire alarm control panel when pressure drops below 207 kilopascal's 30 pounds per square inch. Include a pressure switch for controlling the compressor that is field adjustable for both the "on" and "off" pressure settings. In an air maintenance device with a by-pass line for fast filling the system, include an air strainer, air pressure regulator, air restrictor, air check valve, and all other associated piping, valves and fittings. Provide compressor that is spring and elastomer vibration isolated. Provide pressure gauges that are air or oil type, and calibrated in pounds per square inch. Supply power for the compressed air system as indicated on the drawings. Provide an independent, properly fused safety disconnect switch with provisions for locking the covers and operating handles in both the "Power ON" and "Power OFF" positions. Locate the disconnect switch within .91 m 3 feet of the compressor. Paint the

disconnect switch with two coats of enamel, Color No. 11105 (red) and permanently affix a label which reads, "[Dry-Pipe][Preaction] Compressor Disconnect Switch - Fed from Panel [_____] CKT No. [_____]."

2.6 COMPRESSED AIR BY-PASS LINE

Provide air supply line for each [dry-pipe valve] [preaction valve] with an orifice union with a 6 mm 1/8 inch orifice corrosion-resistant steel plate, externally identified, and a[13 mm 1/2 inch][19 mm 3/4 inch] three-valve by-pass around the orifice union.

2.7 LOW AIR PRESSURE SUPERVISORY SWITCH

Provide low air pressure supervisory switch for the dry-pipe sprinkler system and connect to the building fire alarm control panel to activate the system supervisory alarm when air pressure in the sprinkler system drops below 20% of normal. Provide a bleeder valve in the airline ahead of the switch for testing operation of the low air pressure switch.

2.8 WATER FLOW ALARM DEVICE

Provide water flow alarm devices that are UL listed for the particular type of system. Wire water flow switch to make or break a circuit on rise of water pressure. Provide water flow switch that has an integral field adjustable 0-90 second retard feature, and activates within 60 seconds, plus or minus 10 seconds upon opening of the inspector's test station.

Provide water flow alarm device that has a design working pressure of 2068 kilopascal 300 psi, include two sets of single pole, double throw contacts rated for not less than 2.0 amps at 30 VC. Provide housing that is die cast, suitable for both indoor and outdoor use and includes knockouts for conduit connections.

2.9 PRESSURE GAUGE

Provide pressure gauge with a [_____] minimum 89 mm 3.5 inch diameter, brass or stainless steel case with chrome finish, glass or polycarbonate window, brass dial with white background, black markings, dual units (English and Metric), phosphor bronze bourdon tube, brass precision geared movement, plus or minus 3 percent accuracy, 2068 kilopascal 300 psi working pressure, and three-way globe style gauge isolation valve with plugged end.

2.10 INSPECTOR'S TEST

Provide an inspector's test valve that is a three-position (OFF-TEST-DRAIN) combination test, drain, and pressure relief device with bronze body, bronze ball valve, one quarter turn handle, integral sight glass (on discharge side), and internal corrosion resistant orifice, sized to match the sprinkler head orifice size. Ensure pressure relief device is factory set to relieve pressure at 1206 kilopascal 175 psi.

2.11 CLASS 1 STANDPIPE

Provide an automatic Class 1 standpipe system as established by NFPA 14, with DN 65 2-1/2 inch, 1206 kilopascal's 175-psi hose connections in the stairwells, at the locations indicated on the contract drawings. Hydraulically design the standpipe systems to provide a minimum water flow rate of 1892 liters/min 500 gpm, with a minimum residual pressure of 689 kilopascal's 100 psig at the outlet of the two hydraulically most remote DN

65 2-1/2 inch hose connections. Base hydraulic calculations and pipe sizes for the standpipe system on providing 1892 liters/min 500 gpm for the first standpipe and 946 liters/min 250 gpm from the most remote valve on each additional standpipe, with the total not to exceed 4731 liters/min 1250 gpm.

****
NOTE: Rewrite the following for dry systems.
****

2.12 FIRE DEPARTMENT CONNECTIONS

Provide hose connections that have National Fire hose standard-thread form and rocker lugs in accordance with NFPA 1963. Provide hose connection sizes and threads that are compatible with the equipment used by the fire department serving the facility. Do not install FDC on Backflow Preventers per

2.12.1 Wall Siamese

Provide unit that has a cast brass or bronze flush-mounted escutcheon-plate with two DN 65 2-1/2inch, fire-department, swivel, female inlets; double-clapper valves; rocker-lug caps and chains; and cast-in function-identifying lettering. Provide model that has chrome-plated or polished surface finish in accordance with ASME A112.18.1/CSA B125.1.

2.12.2 Sidewalk Siamese

Provide unit that is cast brass or bronze with two DN 65 2-1/2-inch, fire-department, swivel, female inlets; double-clapper valves; rocker-lug caps and chains; and cast-in function-identifying lettering. Provide model with Chrome-plated or polished surface finish in accordance with ASME A112.18.1/CSA B125.1. Mount unit on a Schedule 40 ASTM A53/A53M galvanized carbon-steel pipe with red-enameled finish on prime-coated surface. Protect all surfaces embedded in concrete or below grade with a 0.508 mm 20-mil thick bituminous coating.

2.12.3 Wall Hydrant

Provide unit that has a cast brass or bronze flush-mounted escutcheon-plate with two DN 65 2-1/2-inch, fire-department, male outlets; rocker-lug caps and chains; and cast-in function-identifying lettering. Provide model with chrome-plated or polished surface finish in accordance with ASME A112.18.1/CSA B125.1.

2.12.4 Roof Manifold

Provide unit that is cast brass or bronze, horizontal type, with two DN 65, 1206 kilopascal 2 1/2-inch 175 psi, rated hose valves fitted with rocker-lug caps and chains. Provide model with rough body finish and polished trim.

2.13 SPRINKLER HEADS

2.13.1 Head Types

Use standard 12.7 mm 1/2-inch orifice [dry pendant] sprinkler heads, except that 13.5 mm 17/32-inch heads can be used where required by hydraulic calculation.

For heads required to be concealed where the appearance of a smooth ceiling is required use concealed pendent type heads with a low profile, small diameter cover plate with a factory applied finish to match suspended ceiling tiles.

For heads required to be located in the center of the suspended ceiling tiles, use return bends or an FM approved VicFlex commercial ceiling sprinkler assembly with a maximum overall length of 1.8 m 6 feet.

Provide [upright] [pendant] [sidewall] type heads in unfinished areas or above suspended ceilings. Provide sidewall type heads in elevator pits. Provide [upright] [pendant] type heads at the top of elevator shafts.

Provide semi-recessed or flush pendent type heads in finished areas with suspended ceilings. Provide heads and escutcheon plates that are chrome-plated brass. Sidewall type heads can be used where indicated on the drawings, or in locations as defined by NFPA 13.

Do not use pendant sprinkler heads in dry-pipe sprinkler systems, except where dry pendant type heads are acceptable.

Where needed, provide corrosion-resistant heads that are wax-coated, Nickel-Teflon coated, or manufacturer coated with an equivalent UL listed or FM approved corrosion-resistant coating.

2.13.2 Temperature Rating

Provide fusible links that have ordinary temperature classification, except where otherwise indicated or in locations defined in NFPA 13 as requiring intermediate or high temperature heads.

2.13.3 Spares

Furnish spares for each type of sprinkler head, complete with appropriate storage cabinet and wrench. Provide quantity of spare heads in accordance with NFPA 13. Mount cabinet next to riser or other location as directed by the Contracting Officer.

2.13.4 Head Protection

Protect heads with paper or plastic bags during painting operations. Immediately remove protection upon finishing painting operations.

Provide steel wire head guards wherever mechanical damage could occur. Provide head guards UL listed or FM approved for use with the sprinkler heads installed. Provide head guards with a manufacturer applied red finish, except where head guards UL listed or FM approved for use with the sprinkler heads installed do not come in a manufacturer applied red finish.

Provide water shields of cold rolled galvanized steel, and install on all heads located beneath other heads within their spray areas. Provide shields with red finish.

2.14 VALVES

2.14.1 Aboveground

Provide FM approved or UL listed gate, globe, and check valves (all sizes).

Provide FM approved ball valves, DN 50 2 inches and under, rate 2070 kilopascald to 300 psi, with provisions to wire or lock handle in place where a critical alarm function is isolated.

Provide gate valves that are of the outside screw and yoke configuration with cast iron body and wedge and bronze yoke bushing, seat ring and face ring. Provide gate valves with a solid wedge, constructed of cast iron or bronze. Provide valves that have flanged or grooved ends and are rated for 1206 kilopascal 175 psi non-shock cold water.

Provide angle valves (for main drain) of the screwed or union bonnet type that have bodies constructed of bronze with a bronze disk. Provide angle valves having rubber disk seats and screwed ends rated for 1206 kilopascal 175 psi non-shock cold water.

Supervise all control and isolation valves using a tamper switch, except for post indicator valves and OS&Y valves on double check valve assemblies backflow prevention, unless otherwise directed by the AHJ.

2.15 MISCELLANEOUS MATERIALS

2.15.1 Bolting

Provide flange and general-purpose bolting that is hex-head and conforms to ASTM F568M, Class 4.8 or higher ASTM A307, Grade B. Provide heavy hex-nuts that conform to ASTM A563M ASTM A563. Square-head bolts and nuts are not acceptable.

2.15.2 Escutcheons

Provide escutcheons manufactured from ferrous metals. Provide only chrome-plated escutcheons, except when AISI 300 series corrosion-resistant steel is provided. Provide metals and finishes conforming to ASME A112.18.1/CSA B125.1.

Provide escutcheons that are one-piece type where mounted on chrome-plated pipe or tubing and one-piece or split-pattern type elsewhere. Provide escutcheons that have internal spring tension devices or setscrews to maintain a fixed position against a surface.

2.15.3 Flange Gaskets

Provide gaskets that are suitable for the intended use and contain no asbestos.

2.15.4 Pipe-Thread Compounds

Use tetrafluoroethylene tape or other suitable compounds.

2.16 FIRE-PROTECTION SYSTEM IDENTIFICATION

Provide a coordinated system of piping and equipment identification which includes the following:

Framed and plastic-protected diagrammatic layout of all piping systems, identifying and locating piping, equipment, and valves. Where existing systems are being modified, bring existing layouts up to date.

Metal-tag-identified major valves, piping-system components, and

equipment

Metal identification plate at controlling alarm valve identifying system and area protected

Service-labeled piping

Factory rating of 175 PSI for systems fed from potable water. Factory rating of 195 PSI for any system fed from a fire pump.

2.16.1 Diagrams

Provide chart listing of equipment by designation number and show pertinent data. Provide diagrams that are neat, mechanical drawings mounted in extruded aluminum frames, with 3 mm 1/8-inch thick acrylic plastic protection. Provide at a location directed by the Contracting Officer. Provide minimum of one mounted chart and diagram, plus one extra copy of each, for each fire-protection system. This requirement does not apply to single story facilities.

2.16.2 Metal Tags

Install identification tags made of brass or aluminum and indicating function of valve or similar component on each system device. Provide tags that are not less than 50 mm 2 inches in diameter and that have stamped markings.

Provide equipment with metal identification tags bearing an equipment designation number matching the drawing or diagram designations.

Secure tags to valve or equipment items with 2.7 mm 12-gauge galvanized wire.

Provide risers with a stamped metal tag containing the hydraulic design data. Also identify main drain and inspectors test stations using metal nameplates with minimum 50 mm 2-inch high lettering chained to the valve.

2.16.3 Service Labeling

Label piping, including that concealed in accessible spaces, to designate service. Provide labels with an arrow or arrows to indicate flow direction. Provide labels or tag designations as follows:

SERVICE	LABEL OR TAG DESIGNATION
Main sprinkler supply	MAIN SPRINKLER SUPPLY
Sprinkler riser number	SPRINKLER RISER NO.
Sprinkler branch	SPRINKLER BRANCH
Standpipe equipment	STANDPIPE

Provide labels and arrows in accordance with the following:

Each point of entry and exit through walls

Each change in direction

In congested or hidden areas, at each point required to clarify service or indicate hazard

In long straight runs, locate labels at a distance visible to each other, but in no case can the distance between labels exceed 12.2 m 40 feet.

Provide label lettering to be 50 mm 2 inches high. Where the size of pipes is 65 mm 2-1/2-inch outside diameter and smaller, attach labels to 1.6 mm 16-gauge aluminum sheet that is attached to the pipe with 2.7 mm 12-gauge galvanized wire. Provide labels that are legible from the primary service and operating area.

Provide labels that are made of self-sticking plastic film designed for permanent installation. Provide labels that have red letters on white background.

Do not construe label and valve tag schedule above as defining or limiting the work. Label all piping systems.

2.17 PAINTING

Furnish equipment of the manufacturer's standard product with the manufacturer's standard finish coat.

Furnish other mechanical equipment with a shop-applied prime paint.

2.18 MAIN DRAINS

Provide dedicated drain piping at riser [to discharge to the building exterior] [or] [to discharge to sight cones attached to drains of adequate size to readily accept the full flow from each drain under maximum pressure]. Select discharge location to avoid creating a nuisance or hazardous condition and that is acceptable to the Contracting Officer. For multi-story buildings using a common drain system, increase drain size by one pipe size as required by NFPA. Discharge to mop sinks or floor drains is prohibited. Use schedule 80 PVC pipe for horizontal portions of 50.8 mm2 inch main drains.

Sleeve and caulk penetrations of exterior walls. Provide penetrations of exterior walls no greater than 610 mm 24 inches and no less than 152 mm 6 inches above grade. Provide drain lines that terminate in a 45 or 90 degree elbow turned down discharging to an 450 mm 18 inch concrete splash block.

PART 3 EXECUTION

****
NOTE: Rewrite following paragraph if no NFPA 13, NFPA 13E, NFPA 14, or NFPA 24 work is included in project.
****

3.1 GENERAL

Install system materials and equipment in accordance with the recommendations and provisions of NFPA 13, NFPA 13E, NFPA 14, and NFPA 24, and related Codes and Standards contained herein. Perform work in the presence of the Contracting Officer who will be notified by the Contractor

48 hours in advance of the start of work.

Provide licensed fire protection sprinkler contractors, licensed for such work in the state where the work is to be performed, to perform all installation work.

Riser locations, pipe sizes, and the number of risers shown on the drawings is approximate in nature. Coordinate final riser quantity and location with the building construction, system design, Code requirements, and water supply limitations and maintenance requirements. The number of risers shown on the documents are the minimum to be provided. Indicate on Contractor's shop drawing submittal the exact location and number of risers approved by the Contracting Officer.

For heads which could be damaged, provide wire head guards. For heads located beneath other heads where the spray from the upper head could cool the lower head, provide water shields. For locations where existing building elements could disrupt sprinkler or nozzle spray patterns, provide multiple levels of protection.

Provide return bends for systems with non-potable water sources.

3.2 ABOVEGROUND PIPING-SYSTEMS INSTALLATION

Run piping parallel with the lines of the building. Space and install piping and components so that a threaded pipe fitting can be removed between adjacent pipes and so that there is not less than 12.7 mm 1/2 inch of clear space between the finished surface and other work and between the finished surface of parallel adjacent piping. Arrange hangers on different adjacent service lines running parallel to be in line with each other and parallel to the lines of the building.

Base load rating for pipe-hanger supports on all lines filled with water. Do not exceed slope gradient of pipe for deflection per span. Install schedule 40 and heavier ferrous pipe supports in accordance with the following minimum rod size and maximum allowable hanger spacing. For concentrated loads such as valves, reduce allowable span proportionately.

PIPE SIZE (DN) (MILLIMETER)	ROD SIZE (MILLIMETER)	HANGER SPACING FOR STEEL PIPE (MILLIMETER)
25	10	2400
32	10	3600
40	10	4500
65 to 90	10	4500
125	15	4500
150	15	4500
200	15	4500

PIPE SIZE (INCHES)	ROD SIZE (INCHES)	HANGER SPACING FOR STEEL PIPE (FEET)
1	3/8	8
1-1/4	3/8	12
1-1/2	3/8	15
2-1/2 to 3-1/2	3/8	15
5	1/2	15
6	1/2	15
8	1/2	15

Support vertical risers at the base where possible and at intervals specified. Guide piping for lateral stability as necessary. Place clamps under fittings wherever possible. Support carbon-steel at each floor at not more than 4.5 m 15 feet intervals for pipe DN 50 2 inches and smaller, and at not more than 6.1 m 20 feet intervals for pipe DN 65 2-1/2 inches and larger.

Securely support piping with allowance for thrust forces and thermal expansion and contraction and do not subject to mechanical, chemical, irrational, or other damage, in conformance with ASME B31.1.

Extend riser main drain piping full size to discharge outdoors in a location approved by the Contracting Officer.

Install DN 65 2-1/2-inch fire hose connection valves for the Class I standpipe at 1.21 m 4'-0" above the finished floor, measured from the top of the valve discharge outlet.

Install piping sloped back towards the riser or the auxiliary drains to allow for drainage. Where trapped piping is unavoidable, provide auxiliary drains.

Install grooved couplings in accordance with manufacturer's instructions and provide means for the government inspector to access and verify proper installation. Provide access to piping materials prior to installation for the government inspector to verify proper grooves exist on all piping with grooved ends.

Locate inspector's test valve approximately 1.5 m 5 feet above finished floor. Provide inspector's test valve for each sprinkler system, or portion thereof equipped with an alarm device, for testing purposes. Locate inspector's test valve at the hydraulically most remote portion of the sprinkler system. Provide inspector's test piping that [discharges to the building exterior] [or] [discharges to a drain location sized to accommodate the full flow] without resulting in property damage. Do not permit discharge to janitors sinks and similar locations.

Provide penetrations of exterior walls that are no greater than 610 mm 24 inches and no less than 152 mm 6 inches above grade, and are sleeved and caulked. Terminate inspector's test discharge in a 45 or 90 degree elbow

turned down, discharging to an 450 mm 18 inch concrete splash block. Size inspector's test lines to be capable of development of the design flow from one sprinkler without creating excessive back pressure.

3.3 SOUND STOPPING

Provide effective sound stopping and adequate operating clearance to prevent structure contact where piping penetrates walls, floors, or ceilings; into occupied spaces adjacent to equipment rooms; where similar penetrations occur between occupied spaces; and where penetrations occur from pipe chases into occupied spaces. Occupied spaces include space above ceiling where no special acoustic treatment of ceiling is provided. Finish penetrations to be compatible with surface being penetrated.

Sound stopping and vapor-barrier sealing of pipe shafts and large floor and wall openings can be accomplished by packing with properly supported mineral fiber insulation or by foaming-in-place with self-extinguishing, 0.9 kilogram 2-pound density polyurethane foam to a depth not less than 152 mm 6 inches. Finish foam with a rasp. Provide vapor barrier that is not less than 3 mm 1/8-inch thickness of vinyl mastic applied to visible and accessible surfaces.

3.4 FIRE STOPPING

Seal through-penetrations in fire walls, partitions, or any floors to allow passage of cables, ducts, pipes and conduits with a "fire stopping assembly" that is UL listed or FM approved, with a fire-resistance rating equal to the fire resistance rating of the walls, partitions, or floors, in accordance with NFPA 251. For sealing purposes, consider all floors to have a fire-resistance rating of 2 hours. Seal openings no longer required with a material of equal or greater fire resistance to that of the walls, partitions, or floors.

3.5 SLEEVES

Provide sleeves where piping passes through roofs, masonry or concrete walls, or floors.

Continuously weld or braze sleeves passing through steel decks to the deck.

Provide sleeves extending through floors, roofs, or load-bearing walls, and sleeves through fire barriers that are continuous and fabricated from Schedule 40 steel pipe with welded anchor lugs. Form other sleeves by molded linear polyethylene liners or similar materials that are removable. Provide sleeves with diameters that are large enough to accommodate pipe, insulation, and jacketing without touching the sleeve, and additionally provide a minimum 10 mm 3/8-inch clearance. Provide sleeve that accommodates mechanical and thermal motion of pipe to preclude transmission of vibration to walls and generation of noise.

Pack solid the space between a pipe and the inside of a pipe sleeve or a construction surface penetration with mineral fiber conforming to ASTM C592 wherever the piping passes through firewalls, equipment-room walls, floors, and ceilings connected to occupied spaces, and other locations where sleeves or construction-surface penetrations occur between occupied spaces. Where sleeves or construction-surface penetrations occur between conditioned and unconditioned spaces, fill the space between a pipe, bare or insulated, and the inside of a pipe sleeve or construction-surface penetration with an elastomer caulk to a depth of 12.7 mm 1/2 inch.

Provide oil and grease free surfaces to be caulked.

Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.

3.6 ESCUTCHEONS

Provide escutcheons at penetrations of piping into finished areas. Where finished areas are separated by partitions through which piping passes, provide escutcheons on both sides of the partition. Where suspended ceilings are installed, provide plates at the underside only of such ceilings. Provide escutcheons that are chrome plated in occupied spaces and that conceal openings in building construction. Firmly attach escutcheons.

3.7 PAINTING

Bring manufacturer's standard-finish equipment surfaces damaged during construction to as-new condition by touchup or repainting to the satisfaction of the Contracting Officer, or replace with new undamaged equipment at no additional cost to the Government.

Thoroughly clean and paint with one coat of primer paint pipe hangers, supports, and other iron work in concealed spaces.

Give all automatic sprinkler and standpipe system piping, valves, and appurtenances, two coats of enamel, color No. 11105 (red) in accordance with MIL-STD-101 and FED-STD-595.

3.8 ELECTRICAL WORK

Provide electrical work that is specified in DIVISION 26 ELECTRICAL for control system wiring under Section 28 31 00.00 98 FIRE DETECTION AND ALARM and this section in accordance with UL 6 and NFPA 70. Use rigid metal conduit or intermediate metal conduit, except that electrical metallic tubing can be used in dry locations not enclosed in concrete or where not subject to mechanical damage.

3.9 SYSTEM TESTING

Prior to acceptance of the work, test completed systems in the presence of the Contracting Officer. Upon approval, provide certificates of testing.

Conduct hydrostatic Pressure tests, unless otherwise specified. Use only potable water for testing.

[Perform System operating tests, Air tests, Valve-Operating Tests, and Drainage Tests for dry-pipe systems.

Perform system operating tests, air tests, pneumatic tests, valve-operating tests, inspector's test, and drainage tests for the preaction systems.

] Prior to filling any system with water for a hydrostatic test or after minor repairs or modifications, perform a two hour leak test with air at 275 kilopascal 40 psi demonstrating 0 psi leakage over two hours.

Full opening of the inspector's test connection [after the solenoid valve has been released (manually or automatically) to cause the preaction valve to trip] has to activate the riser water flow alarm device indicator and

deliver a steady stream of water at the test outlet through a calibrated orifice equivalent in diameter to a single system sprinkler head. [[On dry-pipe] [preaction] systems, if a steady stream at the outlet cannot be delivered within the 60 seconds, install air accelerator(s) per the manufacturer's requirements to meet the 60 second discharge time in accordance with NS'S 8719.11, NASA Safety Standard for Fire Protection.]

Government will supply testing water at a location determined by the Contracting Officer, but the Contractor is responsible for approved disposal of test water.

Prepare and maintain test records of piping-system tests. Ensure records show personnel responsibilities, dates, test-gauge identification numbers, ambient and test-water temperatures, pressure ranges, rates of pressure drops, and leakage rates. Each test acceptance requires the signature of the Contracting Officer.

3.9.1 Test Gauges

Provide test gauges that have 115 mm 4-1/2-inch dials or larger with accuracy of plus or minus 1/2 of 1 percent of full-scale range and dial graduations and pointer width compatible with readability to within one-half of the accuracy extremes. Include maximum permissible scale range for a given test to be such that the pointer during a test can only have a starting position at midpoint of the dial or within the middle third of the scale range. For each test gauge, include a table indicating test gauge accuracy certification and corrections made within 90 days prior to the test, the test gauge number, and the project number.

3.9.2 Test and Acceptable Criteria

Hydrostatically test above ground systems at 1378 kilopascal 200 psi or where the maximum normal working pressure exceeds 1034 kilopascal 150 psi, test the system at the maximum normal working pressure plus 344 kilopascal's 50 psi. Maintain the applied pressure without further addition of test media for not less than 2 hours. Maximum allowable pressure drop is 0 kilopascal 0 psi.

[Dry pipe systems also require an air pressure leakage test at 275 kilopascal's 40 psi. Maintain the applied pressure without further addition of test media for not less than 24 hours. Maximum allowable pressure drop is 10.3 kilopascal's 1-1/2 psi.

] Test underground systems, rubber jointed ferrous-pipe water systems at 1378 kilopascal's 200 psi, or where the maximum normal working pressure exceeds 1034 kilopascal's 150 psi, test the system at the maximum normal working pressure plus 344 kilopascal's 50 psi. Maintain the applied test pressure for not less than 2 hours. Maximum allowable pressure drop is 14 kilopascal's 2 psi.

Test backflow prevention connected to potable-water systems and system devices for proper functioning under conditions normal to their application, in accordance with 98K01375. Precede backflow tests with full flow testing.

Repair dripping or weeping joints.

3.10 CLEANING AND ADJUSTING

At the completion of the work, thoroughly clean all parts of the installation. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that accumulated from the installation and testing of the system. Adjust automatic control devices for proper operation.

3.11 AS-BUILT DRAWINGS

Submit as-built drawings for approval 21 days prior to the acceptance testing phase of the project as described in the paragraph entitled, "System Testing," of this section. Provide two (2) sets of magnetic media as-built drawings in .DWG or .DGN electronic format, and hard copies of all new and revised software and drawings with the submittal. Document on as-Built drawings the final system configuration including deviations from and amendments to the drawings, and field installation changes, concealed and visible.

Provide as-built drawings signed and sealed by a Professional Engineer, licensed to practice in the State of Florida

3.12 OPERATION AND MAINTENANCE

Submit operation and maintenance manuals, grouped by technical sections consisting of manufacturer's standard brochures, schematics, procedures, recommended spare parts, recommended test equipment, and safety precautions. Submit this information prior to performing acceptance tests.

-- End of Section --

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA/KSC-21 22 00.00 98 (July 2020)

Preparing Activity: NASA

New

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
****

SECTION TABLE OF CONTENTS

DIVISION 21 - FIRE SUPPRESSION

SECTION 21 22 00.00 98

CLEAN AGENT FIRE EXTINGUISHING SYSTEMS

07/20

-- End of Section Table of Contents --

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****

SECTION 21 22 00.00 98

CLEAN AGENT FIRE EXTINGUISHING SYSTEMS
07/20

****
NOTE: This guide specification covers the requirements for clean agent fire extinguishing systems.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Recommended changes to a NASAKSC Master Specification Section should be submitted as a Criteria Change Request (CCR) to the appropriate Technical Proponent (TP) through the SpecsIntact Help Desk.
****

PART 1 GENERAL

****
NOTE: Edit this specification section as either a performance-designed system or a fully designed system as applicable.

Highlight all concealed spaces on the drawings that require protection, such as spaces above suspended ceilings.

A fully designed system includes all additional information that is required by NFPA 2001 for a fully operational system.

Select the appropriate Division 28 Fire Detection and Alarm section to address the project requirements.

****

1.1 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

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

****

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.

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2022) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM B88	(2022) Standard Specification for Seamless Copper Water Tube

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(2018) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

NASA-STD-5008	(2011b; R 2016; E 2016; Change 1) Protective Coating of Carbon Steel, Stainless Steel, and Aluminum on Launch Structures, Facilities, and Ground Support Equipment

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023) National Electrical Code

NFPA 72	(2022; ERTA 22-1) National Fire Alarm and Signaling Code
NFPA 101	(2021; TIA 21-1) Life Safety Code
NFPA 2001	(2022) Standard on Clean Agent Fire Extinguishing Systems

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS-STD-595A	(2017) Colors used in Government Procurement

UNDERWRITERS LABORATORIES (UL)

UL 536	(2021) UL Standard for Safety Flexible Metallic Hose
UL 2127	(2017, Reprint Nov 2021) UL Standard for Safety Inert Gas Clean Agent Extinguishing System Units
UL 2166	(2017; Reprint Dec 2021) UL Standard for Safety Halocarbon Clean Agent Extinguishing System Units

1.2 SUBMITTALS

****

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified 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 Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters 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.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00

SUBMITTAL PROCEDURES.

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

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Previous Product Installation; G

SD-02 Shop Drawings

High-Pressure Cylinders; G

Piping Materials; G

Pipe Hangers and Supports; G

Pressure Alarm Switch; G

Nozzle; G

Manual Actuation Station[s]; G

Installation Drawings; G

SD-03 Product Data

Escutcheons; G

Storage Batteries; G

Battery Charger; G

Air Sampling Detection System (ASDS); G

Audible Alarms; G

Visual Alarms; G

Annunciator Panels; G

Electromagnetic Door Holder Release; G

Pressure-Relief Device; G

SD-05 Design Data

Design Analysis; G

Discharge Calculations; G

SD-06 Test Reports

Test Procedure; G

Preliminary Tests; G

Final Acceptance Tests; G

SD-07 Certificates

Certificates of Compliance

SD-10 Operation and Maintenance Data

Operating Instructions; G

Operation and Maintenance Manuals

SD-11 Closeout Submittals

Record Drawings

1.3 QUALITY CONTROL

Use State certified contractors to supervise installation and perform acceptance testing of the system in accordance with NFPA 2001.

****
NOTE: Subject to project type and scope, keep the section reference below, or delete, and insert the applicable section for the type of alarm and detection system desired.
****

Perform all work by, or under the direct supervision of the certified contractor[.][, the same certified contractor providing work under Section 28 31 00.00.98 FIRE DETECTION AND ALARM SYSTEM].

1.3.1 Special Hazards Suppression Systems

Provide the services of an on-site Certified Special Hazards Design Specialist (CSHDS) thoroughly experienced in Clean Agent Suppression System installations, to perform or directly supervise the installation, make all necessary adjustments, and perform all tests.

A CSHDS is considered certified when the specialist holds a valid System Layout Certification, Level IV Certification from the National Institute for Certification in Engineering Technologies (NICET) or is licensed by the State of Florida as a Contractor in accordance with Florida State Statutes, and holds a current Certificate of Competency.

Certification of other recognized agencies with equivalent requirements may be considered. Provide evidence of the Contractor's State Certification and the basis of certification to the Contracting Officer for approval prior to any work being performed.

1.3.2 Previous Product Installation

Submit the names, locations, and client contact information of three successful projects, completed in the previous three years, of similar size and scope that the installer has constructed using the manufacturer's submitted products for this project.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Design clean agent extinguishing system as per NFPA 2001. Submit plans and calculations for approval before installation. Submit certificates of compliance for the following items showing conformance with the referenced standards contained in this section:

a. Piping Materials and Supports

b. High-Pressure Cylinders

c. Escutcheons

d. Pipe Hangers and Supports

e. Pressure Alarm Switch

f. Internal Cleaning and Swabbing of Pipe

2.1.1 Installation Drawings

Submit installation drawings for Clean Agent Fire Protection Systems. Annotate clean agent extinguishing system piping layout with reference points for design. In field wiring diagrams, show locations of devices and points of the system. Prepare working drawings in accordance with the requirements for "Specifications, Plans and Approvals" as specified in NFPA 2001. Include data essential to the proper installation of each system. Coordinate with the alarm and detection system.

Include details of equipment layout and design. Indicate the general physical layout of all controls, manual actuation station[s], and internal tubing and wiring details.

Give full consideration to built-in spaces, piping, electrical equipment, ductwork, and all other construction and equipment for the layout of the system.

[Provide electronic drawings in Microstation.dgn format or AutoCAD.dwg format. If the electronic files are AutoCAD format, only use standard AutoCAD fonts and line styles and furnish the pcp file.

]2.1.2 Design Requirements

Submit design analysis and calculations for Fire-Protection Systems including spray areas, hazard by class, and pressure calculations.

Submit clean agent discharge calculations verifying total storage requirements, flooding concentrations, discharge times, piping flow rates, pipe sizes, and nozzle orifice sizes, in accordance with the manufacturer's listed design manual and NFPA 2001.

Design the total flooding system to a concentration of [_____] percent for [_____] minutes.

2.1.3 Equipment Approval

Provide devices and equipment of make and type listed by the Underwriters Laboratories, Inc. (UL),[UL 2127,][UL 2166,] or Factory Mutual (FM) approved. In the UL and FM publications, consider the advisory provisions as mandatory. Reference to the "authority having jurisdiction", AHJ is interpreted as the [_____].

Provide an approved high-pressure total flooding type Fire-Extinguishing system conforming to NFPA 2001. Acceptable product trade names are FM-200, Novec-1230 (Sapphire), Intergen, HCFC, [_____], or approved equal.

2.1.4 Performance Requirements

Provide construction type, test, and mark of high-pressure cylinders in accordance with U.S. Department of Transportation specifications for seamless steel cylinders.

Provide each cylinder with a safety device to relieve excess pressure safely, in advance of the rated cylinder test pressure. Devices are to be Interstate Commerce Commission approved frangible safety disks.

Provide cylinder support racks and straps that anchor to walls and floors.

Provide [gauges] [magnetic volume tape] or approved equal to allow semi-annual visual verification of cylinder's agent volume/weight.

Main System: Arrange system for fully automatic and manually operated electric control operation, using two action or enclosed release to prevent accidental operation. Provide for [a] manual actuation station[s] and keyed override operations.

2.2 EQUIPMENT

Design and construct the system as a total-flood system to include a fixed supply of extinguishing agent connected to properly sized, fixed piping with fittings and nozzles to direct this agent into the protected area.

2.3 COMPONENTS

2.3.1 Piping

Provide only galvanized, ferrous piping, Schedule 40 manifolds and distribution piping materials conforming to ASTM A53/A53M, nonferrous drawn seamless copper tubing conforming to ASTM B88, and flexible metallic hose conforming to UL 536.

Provide fittings for changes in direction of piping and for all connections. Reduce pipe sizes in the fitting. Do not use flush bushings. Fuse brazed joints, when used, with an alloy with a melting point above 537 degrees C 1,000 degrees F.

Provide pipe and fittings having a minimum bursting pressure of 34.47 megaPascal 5,000 psi. For 12.7 mm 1/2 inch and 19.05 mm 3/4 inch iron pipe size (ips), provide Schedule 40. For 25.4 mm 1 inch or greater, use only

Schedule 80 pipe. Standard malleable iron banded fittings or ductile iron fittings are to be used up through 19.05 mm 3/4 inch ips. Use extra heavy malleable iron or ductile iron fittings through 50.8 mm 2 inch ips. Use forged steel fittings in all sizes over 50.8 mm 2 inches.

Permanently mark discharge nozzles to identify the nozzle and to show the equivalent single orifice diameter regardless of shape and number of orifices. Design discharge nozzles to uniformly distribute the clean agent throughout the hazard area.

2.3.1.1 Pipe Hangers And Supports

Provide pipe hangers and supports conforming to MSS SP-58, adjustable type, zinc-coated. No C-type beam clamps allowed. Provide center-loaded beam clamps listed for the use.

2.3.1.2 Pipe Sleeves

Provide sleeves where piping passes through masonry or concrete walls, floors, roofs and partitions. Use standard weight zinc coating for steel pipe sleeves in outside walls, below and above grade, in floor, and roof slabs. Zinc coat steel sleeves in partitions having a nominal weight of not less than 4.40 kg per sq meters 0.90 pounds per square foot. Ensure space between piping and the sleeve, is not less than 13 mm 0.5-inch. Use sleeves of sufficient length to pass through the entire thickness of walls, partitions and slabs. Extend sleeves in floor slabs 50 mm 2-inches above the finished floor. Pack space between the pipe and sleeve with asbestos free insulation and caulk at both ends of the sleeve with plastic waterproof cement.

2.3.2 Escutcheons

Provide approved-type escutcheons for piping passing through floors, walls, and ceilings, consisting of one-piece or split-type. Provide chrome plated escutcheons where pipe passes through finished ceilings. Other escutcheons may be steel or cast iron, with paint finish. Securely fasten escutcheons in place with setscrews or other positive means.

2.3.3 Supervisory Switch

2.3.3.1 Low Pressure Alarm Switch

Provide the clean agent tanks with a low-pressure alarm switch to warn of clean agent tank depressurization when more than 20% drop in normal tank ready pressure.

2.3.4 Releasing Control Panel

Provide a separate releasing control panel for the clean agent system. Route all supervision and control through the facility fire alarm panel per Section 28 31 00 .00 98 Fire Detection and Alarm.

Provide the suppression system releasing control panel with power-on, alarm, supervisory, and trouble indicating lights plainly visible when the cabinet is closed. Ensure the following functions are accessible only by unlocking and opening the unit:

a. Alarm Silence

b. Trouble Silence

c. Supervisory Silence

d. Power On-Off (If standard by the manufacturer)

e. Alarm/Trouble Acknowledge

f. Auxiliary Devices (AHU shutdown relay) Maintenance By-pass Switches

g. System Reset

h. Manual Actuation Station

Provide the suppression system control panel with all components necessary to monitor and supervise all initiating device circuits. When any detector, connected to the releasing control panel is activated, activate the releasing control panels visual alarm indication and audible signal. (This causes all notification appliances to be activated, including all associated auxiliary control functions.) The releasing control panel is to visually indicate the addressable device or zone in alarm and transmit an alarm condition to the remote Central Fire Monitoring System. Separate audible and visual notification appliance circuits. Provide audible and visual notification appliance circuits having sufficient capacity to operate all devices connected, plus 25 percent minimum spare capacity. Visual notification appliances are to remain operational until the panel has been reset.

Provide a releasing control panel containing all components necessary to monitor and supervise all supervisory device circuits. When any valve tamper switch, pressure switch, or other supervisory device connected to the control panel is activated, they are to activate the control panel supervisory visual indication and supervisory audible device. The control panel is to visually indicate the addressable device or zone in supervisory alarm and transmit a supervisory condition to the remote Central Fire Monitoring System.

Provide a releasing control panel containing all components necessary to operate and supervise the circuits for annunciator panels indicated and auxiliary devices controlling equipment. Provide circuits for auxiliary control relays which are supervised to within 914 millimeter 3-feet of the device controlled in accordance with NFPA 101. Include a maintenance by-pass switch for all auxiliary control devices. Supervise the by-pass to report trouble when in the maintenance by-pass position.

Design the releasing control panel to monitor and report as trouble, open supervised circuits, ground faulted supervised circuits, removal of detector or device, removal or failure of control panel module, maintenance by-pass switch activated, loss of primary power, power supply trouble, low battery voltage, loss of battery voltage, and activation of the alarm silence switch. Identify all trouble signals by initiating notification appliance, auxiliary control, or signaling line device. Trouble signals are to activate the control panel trouble visual indication and trouble audible devices, and send a trouble signal to the remote Central Fire Monitoring System.

Provide alarm/trouble reset switches to reset a cleared device in alarm or trouble. Alarm or trouble signals are not to be self-restoring without activating the switch.

Alarm, supervisory, and trouble silence switches are to silence the alarm and trouble audible's. Either switch placed in other than the normal position is to provide the following:

a. Report as an alarm, supervisory, or a trouble to the Central Fire Monitoring System.

b. Transfer audible signal to a panel lamp visual indication.

c. Re-ring the trouble audible if the problem has been cleared, but the switch has been left in the silence position.

When the alarm silencing switches are in the silence position, subsequent alarms are to reactivate the notification appliances, with the strobes remaining operational until the reaction control panel is reset.

Ensure the releasing control panel is suitable for use with the detectors and manual alarm stations, and other devices specified in this section.

Provide a releasing control panel having a normally closed set of dry contacts, single pole, double throw (SPDT), which opens for trouble conditions and a normally open set of dry contacts (SPDT), which closes under alarm conditions for connection to the Central Fire Monitoring System.

Provide continuous duty relays with self-cleaning contacts of silver or an alloy of equivalent performance. Suitably protect supervisory relays against dust by individual covers. For all relays that provide external functions, such as remote reporting, control device activation, and notification appliance activation, ensure at least one (1) set of space contacts are provided. Permanently mark relays with the coil resistance, operating-current range, and internal pin connections using standard pin numbers.

Provide steel construction releasing control panel, terminal cabinets and battery cabinets (when used). Provide panel and cabinets with a hinged cover and an integral pin-tumbler cylinder lock with removable core that accepts the key presently in use with other control units existing in the area; lock core is provided by the government. Paint cabinets with a prime coat and one or more finish coats of scratch-resistant baked enamel. Provide a red finish coat unless otherwise indicated. Permanently affix an etched metal or engraved laminated plastic identification plate labeled, "Suppression Control Cabinet", to the cabinet door of the preaction control unit to identity the cabinet as a preaction control system cabinet. For cabinets painted red, provide an identification plate with white letters on a black background. For cabinets not painted red, the identification plate is to have white letters on a red background.

Provide a system which operates from a power supply with 120 grounded Vac int and 24 Vdc output, satisfactorily with power input voltage varying from 85 to 110 percent of nominal value. Ensure that the power supply output is capable of powering all initiation, signaling, annunciation, and control devices during alarm condition with 25 percent minimum spare capacity.[If supplied within the cabinet, ensure the power on-off switch will disconnect all power sources to the control panel, and that the on-off switch has DC rated contacts.]

2.3.4.1 Secondary Power Supply

Provide batteries, charger, and power transfer equipment which supplies the means of automatically supplying the entire preaction system with battery backup power in event of a primary power system failure, and switches to battery power in the event of AC power failure, and switches back to AC power upon return of primary power. Provide a control panel which operates when the backup batteries are disconnected for any reason, and controls charging currents and floating voltage levels to maintain batteries in optimum condition. Provide capability to recharge batteries in event of discharge. Fuse wiring to protect against battery over-current and polarity reversal. Primary power, battery, or charging equipment failure is to activate a preaction control panel trouble signal and visual indication.

2.3.4.1.1 Storage Batteries

Provide sealed and spill-proof battery modules (no corrosive fumes). Utilize only batteries which are listed for preaction service and suitable for high discharge currents required under alarm conditions, sized to operate the suppression and detection system (including voice evacuation systems and UV/IR flame detectors) in normal supervisory condition for 24 hours minimum, then operate the system in the alarm mode for 15 minutes, minimum.

Provide calculations substantiating the battery capacity. Provide reliable separation between cells to prevent contact between terminals of adjacent cells and between battery terminals and other metal parts.

2.3.4.1.2 Battery Charger

Provide completely automatic high/low charging rate type charger capable of battery recovery from full discharge to full charge in 24 hours or less. Provide an ammeter for recording rate of charge and a voltmeter to indicate the state of battery charge. Provide a red pilot light to indicate when batteries are manually placed on a high rate of charge as part of the unit assembly if a high-rate switch is provided.

2.3.5 Manual Actuation Stations

****
NOTE: Where there is no room flooding or no raised floor space, omit requirement for separate actuation stations.
****

Provide actuation stations for systems at the exits from the protected areas. Ensure manual station operation causes the control panel to go into full alarm condition and discharge Clean Agent into the protected area following the adjustable time delay. [Provide separate, clearly labeled, manual stations for control of underfloor discharge and room flooding.] Install stations of a type not subject to operation by jarring or vibration. Ensure stations have a dual action release configuration to prevent accidental system discharge. Break-glass-front stations are not permitted; however, a pull lever break-glass-rod type is acceptable. Station color is yellow. Place warning signs, ["Agent Trade Name"] manual release, at each station indicating that operation of the station initiates immediate Fire Suppression Agent discharge. Where building fire alarm pull stations are also mounted at the exits from the protected areas, separate

them from Fire Suppression Agent actuation stations by at least one meter 3-feet horizontally. Provide labels to clearly distinguish building fire alarm stations from Fire Suppression Agent stations.

2.3.6 Air Sampling Detection System (ASDS)

Design for detection of smoke densities by installation of Air Sampling Detection System (ASDS)in all areas protected by clean agent extinguishing system(s) per Section 28 31 33.00 98 Air Sampling Detection System.

[2.3.7 Inhibit Switch

****
NOTE: Inhibit switches are optional devices which decrease system reliability and are not used without approval of the Division Fire Protection Engineer.
****

Provide one switch where activation of switch is to delay only equipment shutdown and agent discharge. Switch is guarded, spring-loaded type which operates only when pressure is manually applied to the switch. Upon release of manual pressure, switch de-activates allowing delayed functions to resume. After start of agent discharge, switch has no effect. Activation of switch during normal (non-alarm) conditions causes activation of system trouble signals.

]2.3.8 Alarm Signaling Devices

Provide each protected area with audible and visual alarms located where shown. Electrically supervise all alarm circuits. Provide separate and distinct audible and visual pre-discharge and discharge signals. Where the building is equipped with a separate fire evacuation alarm system, ensure the discharge signals is distinct from those used by the building fire evacuation system. Provide each signal device with a rigid plastic or metal identification sign with lettering a minimum of 40 mm 1.5-inches high. Label the pre-discharge alarm "FIRE" and the discharge alarm "Fire Suppression Agent DISCHARGE." [Locate post-discharge visual alarms outside all entrances to the protected areas, and provided with signs reading "Fire Suppression Agent DISCHARGED WHEN FLASHING - DO NOT ENTER].

2.3.8.1 Audible Alarms

a. Alarm bells

Provide 250 mm 10 inch [surface mounted] [recessed] alarm bells with matching mounting back box. Install bells of the vibrating type suitable for use in an electrically supervised circuit. Install bells of the underdome type that have a sound output rating of at least 90 decibels at 3 meters 10 feet.

b. Alarm horns

Provide [recessed,] [surface mounted,] vibrating type alarm horns suitable for use in an electrically supervised circuit that have a sound output rating of at least 90 decibels at 3 meters 10 feet.

2.3.8.2 Visual Alarms

[Flush] [Surface mounted] lamp assembly suitable for use in an electrically

supervised circuit. Provide flashing [stroboscopic] [incandescent] [rotary beacon] type lamps, powered from the control panel alarm circuit. Provide lamps with a minimum of 50 candle power with a flash rate is between 60 and 120 flashes per minute. Protect lamps by a thermo-plastic lens, red for pre-discharge alarms and blue for discharge [and post-discharge] alarms. [Visual alarms may be part of an audio-visual alarm assembly.]

2.3.9 Main Annunciator

When an annunciator is used, it is integral with the main control panel. Provide separate alarm and trouble lamps for each zone alarm initiating circuit located on the exterior of the cabinet door or visible through the cabinet door. Supervision is not required provided that a fault in the annunciator circuits results only in loss of annunciation and does not affect the normal functional operation of the remainder of the system. Ensure each lamp provides specific identification of the [zone] [area] [device] by means of a permanent label. Do not use generic nondescript wording such as "Zone 1," or "Zone 2," for the label identifications. A releasing control panel may be addressable with fire floor plan features meeting annunciator interface requirements to the primary FACP.

2.3.9.1 Annunciation Zones

Arrange annunciation zones as follows: [_____]

2.3.9.2 Annunciator Panels

a. Remote Annunciator Panels

Locate as shown. Ensure panel duplicates all requirements specified for the main control panel annunciator, except that in lieu of individual zone trouble lamps a single common system trouble lamp may be provided. Provide a panel lamp test switch. Provide zone identification by means of [permanently attached rigid plastic or metal plate(s).] [Silk-screened labels attached to the reverse face of backlighted viewing windows(s).] Provide [interior] [weatherproof] type, [flush] [surface] [pedestal-mounted] panel.

b. Graphic Annunciator Panel

Locate as shown. Provide [interior] [weatherproof] type, [flush] [surface] [pedestal]-mounted panel. Provide panel with the [building] [room] floor plan, drawn to scale, with remote alarm lamps mounted to represent the location of [each concealed detector] [each alarm in initiating device]. [Label principal rooms and areas shown with their room numbers or titles.] Show the panel location on the floor plan. Ensure detectors mounted above ceilings, [on ceilings,] and beneath raised floors [and different types of initiating devices] have different symbols or lamps of different colors for identification. Ensure that lamps illuminate upon actuation of their corresponding device and remain illuminated until the system is reset. Provide a lamp test switch for the panel.

[2.3.10 Automatic Fire Dampers

****
NOTE: Automatic dampers are required in all ducts passing through walls, floors, and ceilings, to prevent the leakage of Clean Agent from the protected space, and to prevent the communication of

fire and smoke. Locations of dampers should be shown on HVAC plans. Additional smoke dampers may be required in systems over 424,740 L/m 15,000 cfm by NFPA 90A, Air Conditioning and Ventilating Systems. Coordinate with Section 23 09 53.00 20 SPACE TEMPERATURE CONTROL SYSTEMS. Provide access door in duct at each damper location. Connect duct detectors to Clean Agent system control panel only if no building fire alarm system is provided.

****

Provide automatic control of fire dampers in air conditioning supply duct work as specified in Section 23 09 53.00 20 SPACE TEMPERATURE CONTROL SYSTEMS. Ensure activation of fire dampers occurs upon second zone detection, or upon activation of Clean Agent discharge by manual pull station. Fire dampers are specified in Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS. Provide heaters for fusible links.

][2.3.11 Electromagnetic Door Holder Release

Provide where shown. Mount the armature portion on the door and have an adjusting screw for setting the angle of the contact plate. Wall mount the electro-magnetic release, with a total horizontal projection not exceeding 100 mm 4-inches. Ensure all doors release to close upon first stage (pre-discharge) alarm. Electrical supervision of wiring external of control panel for magnetic door holding circuits is not required.

]2.4 ACCESSORIES

2.4.1 Electrical Work

[Electrical work is specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, except for control and fire alarm wiring.

]2.4.1.1 Wiring

Provide control and fire alarm wiring, including connections to fire alarm systems, under this section and conform to NFPA 70. Use No. 12 AWG minimum wiring for 120 volt circuits. Use No. [14] [16] AWG minimum wiring for low voltage DC circuits. Color code all wiring. Use rigid metal conduit or intermediate metal conduit, except electrical metallic tubing may be used in dry locations not enclosed in concrete and where not subject to mechanical damage.

2.4.1.2 Operating Power

Use 120 Vac power, transformed through a two winding isolation type transformer and rectified to 24 volts DC for operation of all signal initiating, signal sounding, trouble signal and [master box] [transmitter] tripping circuits. Provide secondary DC power supply for operation of system in the event of failure of the AC supply. Ensure transfer from normal to emergency power or restoration from emergency to normal power is fully automatic and does not cause transmission of a false alarm. Obtain AC operating power to control panel and battery charger from the line side of the incoming building power source ahead of all building services. Provide independent properly fused safety switch, with provisions for locking the cover and operating handle in the "POWER ON" position for these connections and locate adjacent to the main distribution panel. Paint

switch box red and suitably identify by a lettered designation.

2.4.1.3 Conductor Identification

Identify all circuit conductors within each enclosure where a tap, splice or termination is made. Use plastic coated self-sticking printed markers or by heat-shrink type sleeves for conductor identification. Attach the markers in a manner that does not permit accidental detachment. Properly identify control circuit terminations.

PART 3 EXECUTION

3.1 INSTALLATION

Install materials and equipment in accordance with NFPA 2001. Ensure each system is complete and ready for operation.

Conceal piping to the maximum extent possible. Inspect and test pipe; receive Contracting Officer approval before pipe is concealed.

Provide each system with an approved pressure-relief device designed to operate between 13.79 and 22.75 megapascal 2,000 and 3,300 psi and located between the storage cylinder manifolds and any normally closed valve.

3.1.1 Warning Signs

Provide signs manufactured of 3-layer red-white-red micarta, engraved to show white uppercase letters on a red background, warning signs. Warning sign thickness is 0.3175 cm 1/8-inch thick with beveled edges.

3.1.1.1 Inside Control Room

Permanently affix a sign adjacent to every audible/visual system alarm reading:

WARNING

WHEN THIS STROBE IS ILLUMINATED,
RELEASE OF FIRE SUPPRESSION AGENT WILL OCCUR WITHIN 60 SECONDS

Make letters for "WARNING" 3.81 cm 1-1/2-inch tall, and all other lettering 1-inch tall.

3.1.1.2 Protected Space

Permanently affix a sign adjacent to every audible/visual system alarm reading:

WARNING

THIS SPACE IS PROTECTED BY A CLEAN AGENT
EXTINGUISHING SYSTEM. DO NOT ENTER
WITHOUT AUTHORIZATION DURING OR
AFTER DISCHARGE. THIS STROBE
INDICATES DISCHARGE.

Make letters for "WARNING" 3.81 cm 1-1/2-inch tall, and all other lettering 1-inch tall.

3.1.1.3 Manual Activation or Release Station

Place a sign at every location where manual operation of the system may occur, reading:

WARNING

ACTUATION OF THIS DEVICE WILL CAUSE FIRE SUPPRESSION GAS TO DISCHARGE. BEFORE ACTUATING, ENSURE THAT PERSONNEL ARE CLEAR OF THE AREA.

Make letters for "WARNING" 1.905 cm 3/4-inch tall, and all other lettering 0.9525 cm 3/8-inch tall.

3.1.2 System Control

3.1.2.1 Controls

****
NOTE: Select the appropriate Division 28 Fire Protection and Alarm section to address the project requirements.
****

Provide an electrical and mechanical actuating control system contained in a fire alarm panel specified in Section 28 31 00.00 10 FIRE DETECTION AND ALARM SYSTEM, DIRECT CURRENT LOOP as modified below.

3.1.2.2 Extinguishing System Safing/Disconnect Switch

Connect the positive and negative conductors of the Class B solenoid/actuator/electric release head circuitry in series to a lock switch. Provide and install the switch in an enclosure inside the facility. A clearly visible sign on the enclosure, or immediately adjacent, is to explicitly indicate its purpose as "FIRE EXTINGUISHING SYSTEM SAFING SWITCH".

3.1.3 Electrical Work

****
NOTE: Select the appropriate Division 28 Fire Protection and Alarm section to address the project requirements
****

Electrical work is specified in Section 28 31 00.00 10 FIRE DETECTION AND ALARM SYSTEM.

3.1.4 Operating Instructions

Submit operating instructions for Clean Agent Fire Protection Systems consisting of raised or embossed white letter on red rigid plastic or enameled steel background and of a size to permit them to be easily read.

Provide operating instructions at each remote control station. Instructions are to clearly indicate necessary steps for the operation of the system.

Submit [four][_____] copies of the operation and maintenance manuals 30 days prior to testing the Clean Agent Fire Protection Systems. Include a specific system parts list and the recommended spare parts list with anticipated frequency of replacement/use. Update and resubmit data for final approval no later than 30 days prior to contract completion.

3.1.5 Field Painting

Touch-up painting is to match equipment manufacturer's original paint.

Paint all equipment, piping, and other components of the system red per NASA-STD-5008, Zone 5, conforming to SAE AMS-STD-595A, Color 11105.

3.2 FIELD QUALITY CONTROL

Conduct final acceptance testing to determine conformance with the requirements in the presence of the Contracting Officer.

3.2.1 Manufacturer's Field Service

Provide an experienced manufacturer's field engineer to supervise installation and testing of the system.

3.2.2 Test Procedure

Prepare and submit the clean agent system test procedure to the Contracting Officer for approval 30 days prior to the planned tests. Provide testing of releasing control panel and alarm devices associated with the clean agent system according to Section 28 31 00 .00 98 Fire Detection and Alarm and NFPA 72.

3.2.3 Preliminary Tests

Pneumatically test each piping system at 1.034 megapascal 150 psi gage to ensure no leakage or reduction in gage pressure after 2 hours. Use the discharge of breathing air from each system discharge nozzle to test discharge nozzles. Test remote control stations, and all other components and accessories individually to demonstrate proper functioning. At the completion of tests and corrections, submit a signed and dated certificate to the Contracting Officer attesting to the satisfactory completion of all testing and that the system is in operating condition.

3.2.4 Final Acceptance Tests

Provide the suppression agent, instruments, personnel, appliances, and equipment necessary for testing are furnished by the Contractor at their expense.

At a time agreed upon by the Government, the Government Fire Protection Engineer or AHJ's representative will witness final acceptance tests and approve systems before they are accepted. Ensure the presence of an experienced technician regularly employed by the system installer during the testing. During the testing, repeat any of the required tests, as directed by the Contracting Officer. Perform a fan test witnessed by the Government wherein the enclosure integrity is required to perform in accordance with NFPA 2001.

Provide the final acceptance test results to the Contracting Officer.

3.3 CLOSEOUT ACTIVITIES

3.3.1 Record Drawings

Upon completion, and before final acceptance of the work, submit a complete set of as-built (record) working drawings, including complete as-built circuit diagrams, of each clean agent system for record purposes. Provide two record working drawings [no smaller than A0 1189 by 841 mm 30 by 42 inches, reproducible with title block 200 by 100 mm 8 by 4 inches similar to full size contract drawings][in [dgn.][dwg.]electronic format]. Redlines of the installation drawings must be on-site at the time of preliminary & final acceptance testing.

-- End of Section --

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA/KSC-21 23 00.00 98 (July 2020)

Preparing Activity: NASA

Superseding
NASA/KSC-21 23 00.00 98 (December 2009)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
****

SECTION TABLE OF CONTENTS

DIVISION 21 - FIRE SUPPRESSION

SECTION 21 23 00.00 98

WET-CHEMICAL FIRE-EXTINGUISHING SYSTEMS

07/20

-- End of Section Table of Contents --

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA/KSC-21 23 00.00 98 (July 2020)

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****

SECTION 21 23 00.00 98

WET-CHEMICAL FIRE-EXTINGUISHING SYSTEMS
07/20

****
NOTE: This specification covers the requirements for pre-engineered wet chemical fire extinguishing systems for protection of cooking equipment, including exhaust hoods, ducts, and related work. Conform system requirements to NFPA 17A, "Wet Chemical Extinguishing Systems."

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Recommended changes to a NASAKSC Master Specification Section should be submitted as a Criteria Change Request (CCR) to the appropriate Technical Proponent (TP) through the SpecsIntact Help Desk.
****

****
NOTE: Do not indicate on project drawings locations of piping, fusible links, or discharge nozzles, but do indicate on the drawings the following information:

a. Location and detail of each hood, plenum, and duct to be protected.

b. Location, type, height, and size of each cooking appliance to be protected.

c. Location of fire alarm panel.

d. Method of electrical or fuel shut-off, such as shunt trip breakers or extinguishing system operated solenoid valves. NFPA 96 requires that the electrical power and fuel to all protected appliances be shut off upon actuation of the extinguishing system. Additionally, shut off any gas appliance under the same hood as protected appliances. NFPA 96 requires the shut off equipment be of the type that requires manual resetting prior to the fuel or power being restored. This includes power outages.

e. Location of remote manual actuation stations.

****

PART 1 GENERAL

1.1 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

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

****

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.

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2022) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A106/A106M	(2019a) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide

http://www.approvalguide.com/

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 17A	(2024) Standard for Wet Chemical Extinguishing Systems
NFPA 70	(2023) National Electrical Code
NFPA 72	(2022; ERTA 22-1) National Fire Alarm and Signaling Code
NFPA 96	(2024) Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

UNDERWRITERS LABORATORIES (UL)

UL 300	(2005) Fire Testing of Fire Extinguishing Systems for Protection of Restaurant Cooking Areas
UL Fire Prot Dir	(2012) Fire Protection Equipment Directory

1.2 SYSTEM REQUIREMENTS

****
NOTE: If Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS is not included in the project specification, insert applicable requirements therefrom and delete the following paragraph.
****

[Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS applies to work specified in this section.]

1.2.1 Design Requirements

Provide new [and] [modify existing] pre-engineered wet chemical fire extinguishing system for protection of [new] [and] [existing] cooking equipment including exhaust hoods, ducts, and related work. Provide equipment, materials, installation, workmanship, inspection, and testing in strict accordance with the required and advisory provisions of the manufacturer's installation manual, NFPA 17A and NFPA 96, except as modified herein. In each system include materials, accessories, and equipment necessary to provide each system complete and ready for use. Provide each system with full consideration to blind spaces, piping, electrical equipment, ducts, and other construction and equipment in accordance with detailed working drawings submitted for approval. Provide devices and equipment for fire protection service that are UL Fire Prot Dir listed or FM APP GUIDE approved for use with wet chemical fire extinguishing systems and meet the requirements of UL 300. In the NFPA publications referred to herein, consider the advisory provisions to be mandatory, and interpret reference to the "authority having jurisdiction" to mean the Kennedy Space Center, Fire Protection Engineer.

1.2.2 Detail Drawings

Submit electrical wiring diagrams and dimensioned or scaled piping layout showing components, pipe sizes, manual activation stations, pipe lengths, nozzles, electrical power and gas isolation devices, and valve locations in relation to cooking appliances and fusible link locations.

1.3 SUBMITTALS

****

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

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

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 REPORTING.

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Submit detailed computer-generated drawings in DWG or DGN format of the pre-engineered wet chemical fire extinguishing system. In details include electrical wiring diagrams, and dimensioned or scaled isometric piping layout showing components, pipe size, pipe lengths, nozzles and valve locations in relation to cooking appliances and fusible link locations and submit for approval.

Submit Factory Installation Drawings for approval ten days prior to start of installation.

Submit Record (As-Built Conditions) computer generated drawings for approval ten (10) days prior to the acceptance testing phase of the project, as described in the paragraph entitled, "Formal Tests and Inspection," of this section.

Submit .DXF or .DWG format computer generated shop drawings, schematics and Record Drawings[; G].

SD-03 Product Data

Submit Manufacturers Catalog Data for the following items:

Agent[; G]

Storage Cylinder[; G]

Fusible Links[; G]

Regulator[; G]

Electrical Equipment and Gas Line Shut-Off Devices[; G]

Release Mechanisms[; G]

Metal Blow-Off Caps[; G]

Discharge Nozzle[; G]

Piping and Fittings[; G]

Manual Actuators[; G]

Remote Manual Pull Stations[; G]

Manufacturer's Installation Manuals[; G]

Pulley Elbows[; G]

SD-06 Test Reports

Provide testing of the system in accordance with paragraph entitled, "Field Quality Control," of this section.

Prepare a Test Procedure and Test Record Forms[; G] for conducting and recording complete test on the suppression system in accordance with manufacturer's requirements and these specifications. Submit the test procedure for approval to the Contracting Officer at least 30 days prior to the preliminary system test described in the paragraph entitled, "Preliminary Tests," of this section. In the test procedure identify the initial condition, each step or function in the test, required test results, and provide for recording test results on all equipment devices, and wiring to be tested. On test record forms also identify spaces for verification signature of official witnesses and dates of the test.

SD-07 Certificates

Qualifications of Factory Trained Installer[; G]

SD-08 Manufacturer's Instructions[; G]

Fire Extinguishing System[; G]

Submit the extinguishing system manufacturer's installation manual.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals[; G]

1.4 ELECTRICAL WORK

Conform associations to Section [26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL][_____], except for control [and fire alarm] wiring. [Fire alarm system is specified in Section 28 31 00.00 98FIRE DETECTION AND ALARM.] Provide control [and fire alarm wiring,] [including connections to fire alarm systems,] under this section in accordance with NFPA 70 and NFPA 72. Provide wiring in rigid metal conduit or intermediate metal conduit, except electrical metallic tubing conduit can be provided in dry locations not enclosed in concrete or where not subject to mechanical damage.

1.5 QUALITY ASSURANCE

1.5.1 Qualifications of Factory Trained Installer

Qualifications of System Technician: Prepares installation shop drawings, and Record Drawings of as-built conditions, by or under the supervision of an individual who is experienced with the types of works specified herein, and is currently certified by the National Institute for Certification in Engineering Technologies [_____] as an engineering technician with minimum Level-III certification in Special Hazard Systems and Factory Training for the hardware to be installed. Submit data for approval showing the name and certification of all involved individuals with such qualifications at or prior to submittal of drawings.

Submit Record Drawings of as-built conditions for approval 21 days prior to the acceptance testing phase of the project as described in the paragraph entitled, "Formal Tests and Inspections," of this section. Provide (2) sets electronically and hard copies of all new and revised software and drawings with the submittal. On Record Drawings document final system configuration including deviations from and amendments to the drawings, and field installation changes, concealed and visible.

1.5.2 Components

Provide components in the installation that are not more than one year old.

Provide devices and equipment for fire protection service that are UL Fire Prot Dir or FM APP GUIDE approved for their intended use and function.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver, store, protect, and handle products to site in such a manner as to prevent damage caused by dirt, debris, and weather. During storage of materials do not impact safety or work operations in areas adjacent to the storage site.

Deliver materials to the job site in sealed, original containers, each bearing the manufacturer's labels.

Do not accept materials that arrive at the site without labels, opened, damaged, or containing less material than specified for use.

Store materials in a well-ventilated area at temperatures not exceeding

54.4 degrees C 130 degrees F or less than 0 degrees C 32 degrees F.

PART 2 PRODUCTS

2.1 PRE-ENGINEERED WET CHEMICAL FIRE EXTINGUISHING SYSTEMS

****

NOTE: If the piping between hood and storage canisters is mounted

against	**specify**
A porous surface (gypsum wallboard, etc.) that has a painted enamel	**Galvanized malleable iron, or galvanized steel**
A stainless steel wall plate or other nonporous, prefinished surface	**Chrome plated or stainless steel**

Galvanized pipe and fittings are not permitted for use with wet chemical extinguishing systems.

****

Provide systems conforming to NFPA 17A and NFPA 96, except as modified herein. Provide piping and accessories within the hood that are Schedule 40 stainless-steel or chrome plated. Provide all other piping to be [Schedule 40 malleable iron or steel, painted to match the adjacent surface][chrome plated or stainless-steel]. Exhaust hoods with grease extractors UL Fire Prot Dir listed or FM APP GUIDE approved are not required to have protection downstream of the grease extractors. Provide a wet chemical agent that is listed for the particular system and recommended by the manufacturer of the system. Provide systems for protection of new [and] [existing] cooking equipment, including exhaust hoods and ducts for cooking equipment requiring protection by NFPA 96.

Use UL 300 as a guide to list all system components as part of the manufacturer's UL approved, integrated fire suppression system. Install systems within their maximum and minimum piping and temperature limitations as established by testing laboratories, and as published in the manufacturers installation manual, to comply with their UL 300 listing.

2.2 SYSTEM CONTROLS

****

NOTE: If there is no building fire alarm system, include provision for connection to the base fire alarm system in a separate specification section. Refer to Section 28 31 00 .00 98 Fire Detection and Alarm .

****

Mechanically actuate each system by fusible links and by remote manual actuation stations connected to the extinguishing system release mechanisms by stainless-steel cables. Arrange each system to automatically shut off the flow of fuel and electrical power to cooking appliances as indicated automatically, shutdown makeup air units is provided, and to automatically actuate the building fire alarm system as indicated. Provide gas valves that are UL listed and are of the manual mechanical reset type. Do not

shut off electrical power to hood exhaust fans unless specifically required by the UL Fire Prot Dir listing or FM APP GUIDE approval. Provide operating instructions at all system remote manual actuation stations.

2.3 [EXISTING]BUILDING FIRE ALARM CONTROL PANEL

Discharge of the extinguishing system is to actuate the fire alarm control panel in the same manner as other actuating devices in accordance with NFPA 72. Supervise extinguishing system wiring in the same manner as other devices connected to the fire alarm system. [Refer to Section 28 31 00.00 98 FIRE DETECTION AND ALARM for related requirements.]

2.4 COMPONENTS

Provide a basic wet chemical suppression system that consists of a regulated release assembly, which includes a regulated release mechanism and a wet chemical storage cylinder housed within a single enclosure. Piping, fittings, discharge nozzles, metal blow off caps, nitrogen or CO2 cartridges, agent, fusible links, and pulley elbows. Provide additional equipment to include remote manual pull stations, mechanical gas valves, , and electrical switches for automatic electrical equipment and gas line shut-off devices.

2.4.1 Manual Actuators

Provide manual actuators that do not require a force of more than 18.1 kilograms 40 lbs or a movement of more than 355 mm 14 inches to secure operation. Provide all manual actuators with operating instructions. Permit these instructions to include the use of pictographs and have lettering at least 6.35 mm 1/4 inch in height. Identify all remote manual operating devices as to the hazard they protect.

2.4.2 Electric Dual Snap-Action Switch

Provide UL listed electric dual snap-action switch(s). Make all electrical connections to the snap action switch wiring harness in junction boxes mounted adjacent to the stainless-steel enclosure for the wet chemical suppression system.

2.4.3 Distribution Piping

Provide distribution piping that is Schedule 40 black iron, chrome-plated or stainless-steel pipe conforming to ASTM A53/A53M, or ASTM A106/A106M.

2.4.4 Wet Chemical Agent

Provide extinguishing agent that is a potassium carbonate, potassium acetate-base formulation designed for flame knockdown and securement of grease-related fires. Make the agent available in plastic container, labeled with handling and usage instructions.

2.4.5 Agent Tank

Install the agent tank in a stainless-steel enclosure. Construct the tank of deep drawn carbon steel, finished in red enamel, 5.7 liter or 11.4 liter 1.5 gallon or 3.0 gallon in size, as required by manufacturer's design. Provide tanks that have 689 kilopascal 100 psi working pressure, 2068 kilopascal 300 psi minimum burst pressure.

2.4.5.1 Tank Adaptor

Provide tank adaptor assembly that is chrome-plated steel with a 6.35 mm 1/4 inch NPT female inlet and a 19 mm 3/4 inch, NPT male outlet.

2.4.5.2 Regulated Release Mechanism

Spring-loaded mechanical/fusible link pneumatic type regulator capable of providing expellant gas supply to agent tank(s), that contains a factory installed regulator deadset at 689 kilopascal 100 psi and is compatible with mechanical and electrical gas shut-off devices.

2.4.5.3 Regulated Actuator Assembly

Provide expellant gas for additional tanks in systems requiring (three) or more tanks, complete with a factory installed regulator deadset at 689 kilopascal 100 psi.

2.4.5.4 Discharge Nozzles

Provide tested discharge nozzles which are listed for a specific application, and stamp each with flow designation and tip part number. Equip each nozzle with a metal protective cap to keep the nozzle tip orifice free of cooking grease build-up. Note: Rubber protective caps are prohibited.

2.5 IDENTIFICATION SIGNS

****
NOTE: Locate remote manual actuation stations in the normal path of egress and at least 1.50 meters 5 feet from the protected cooking appliances. Avoid grouping stations for different systems together; however, when this is not possible, include identification signs.
****

Provide red rigid plastic signs with engraved 6.35 mm 0.25 inch high white lettering at each remote manual actuation station. Provide sign legends to read "Fire Extinguishing System" followed by a brief description of the equipment protected.

PART 3 EXECUTION

3.1 INSTALLATION

Provide equipment, materials, installation, workmanship, inspection, and testing in accordance with the manufacturer's installation manuals and maintenance manuals NFPA 17A, except as modified herein.

3.1.1 Piping

Install piping in accordance with the manufacturers UL listing. Where possible, run piping concealed or otherwise located to minimize the potential of inadvertent damage. Install piping parallel or perpendicular to the line of buildings and within hoods.

Seal all piping, fittings, and connections with pipe tape. When applying pipe tape, start on second male thread and wrap the tape (two turns

maximum) clockwise around the threads, away from the pipe opening. Do not allow tape to overlap the pipe opening as this could cause possible blockage of the gas pressure.

Properly support piping to withstand static and dynamic loading. Install piping to prevent contact of dissimilar metals.

3.2 FIELD QUALITY CONTROL

Perform tests to determine compliance with the specified requirements in the presence of the Contracting Officer. Test, inspect, and approve piping before covering or concealing. Provide Test Procedure and Test Record Forms for approval 21 days prior to formal testing and inspection.

3.2.1 Preliminary Tests

Upon completion and before final acceptance of the work, test each piping and fittings system by discharging a minimum of one storage cylinder of same size as system cylinder of compressed air or nitrogen (do not use wet chemical) to demonstrate the reliability and proper functioning of all pressure switches, electrical and gas shutoff features, and the discharge of gas from each system discharge nozzle. Individually test remote control stations and other components and accessories to demonstrate proper functioning. In testing also include automatic and manual actuation, fuel or electrical power shutoff, and automatic actuation of the building fire alarm system. When tests have been completed and corrections made, submit a signed and dated certificate, with a request for formal inspection and tests.

3.2.2 Final Acceptance Tests and Inspection

Ensure that the Contracting Officer witnesses final acceptance tests and approves systems before acceptance. Submit Record Drawings of As-Built conditions and a written request for final acceptance inspection at least [21] [_____] working days prior to inspection date. Provide an experienced technician regularly employed by the system installer to be present during the inspection. At the inspection, repeat all of the required tests as directed. Provide nitrogen or CO2 and discharge each system to demonstrate uniform distribution of the wet chemical among the nozzles. Furnish nitrogen, or CO2, and personnel for the tests. Refill and reset systems after tests have been completed.

3.3 OPERATION AND MAINTENANCE

Operation and Maintenance Manuals, grouped by technical sections consisting of manufacturer's standard catalog data, as-built schematics, testing and maintenance procedures, recommended spare parts, recommended test equipment, and safety precautions. Submit this information prior to acceptance test being performed.

-- End of Section --

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA/KSC-21 30 00.00 98 (July 2020)

Preparing Activity: NASA

Superseding
NASA/KSC-21 30 00.00 98 (November 2011)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
****

SECTION TABLE OF CONTENTS

DIVISION 21 - FIRE SUPPRESSION

SECTION 21 30 00.00 98

FIRE PUMPS

07/20

-- End of Section Table of Contents --

****
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
****

SECTION 21 30 00.00 98

FIRE PUMPS
07/20

****
NOTE: This specification covers the requirements for internal combustion engine and electric motor driven fire pumps and associated equipment.

Provide combustion engine drive, unless electric power is provided from two separate sources or the KSC AHJ deems the power source to be reliable. Dual drive pumps are not permitted. Conform system requirements to KSC-STD-F-0004 (latest revision), "Standard for Fire Protection Design" and NFPA 20, "Installation of Centrifugal Fire Pumps."

Adhere to http://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc **UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.**

Remove information and requirements not required in respective project, whether or not brackets are present.

Recommended changes to a NASAKSC Master Specification Section should be submitted to the appropriate Technical Proponent (TP) through the SpecsIntact Help Desk**.**
****

****
NOTE: Show the following information on the project drawings:

a. Configuration, and minimum sizes for each piping system (see Table 2-20 in NFPA 20);

b. Location and type of each pump, controller, test header including associated equipment housekeeping pads and appurtenances;

c. Capacity of each item of equipment, including showing the size of all floor drains and their locations. Ensure the minimum size floor drain is 152 mm 6 inches. Show the pitch of the floor also.

d. Locations and details for special supports for piping; and

e. For pipe larger than 300 mm 12 inches, details of anchoring piping including pipe clamps and tie rods.

f. Provide redundant pumping for all installations.

g. This specification is intended for use as part of a performance based criteria, with the detailed engineering calculations and design to be provided by the Contractor. Evaluate the existing water supply and estimated system requirements to provide an approximation of the actual pump capacity and pressure needed.

****

PART 1 GENERAL

This is a performance based specification with the Contractor responsible for providing engineering design, installation and testing associated with the work to be performed.

1.1 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

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

****

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.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325	(2017) Steel Construction Manual

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.3	(2021) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.5	(2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	(2018) Factory-Made Wrought Buttwelding Fittings
ASME B16.11	(2022) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(2021) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.26	(2018) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.34	(2021) Valves - Flanged, Threaded and Welding End
ASME B16.39	(2020) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B31.1	(2022) Power Piping

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	(2022) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	(2021) Ductile-Iron and Gray-Iron Fittings
AWWA C111/A21.11	(2017) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C151/A21.51	(2017) Ductile-Iron Pipe, Centrifugally Cast
AWWA C500	(2019) Metal-Seated Gate Valves for Water Supply Service

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2022) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A135/A135M	(2021) Standard Specification for Electric-Resistance-Welded Steel Pipe

ASTM A193/A193M	(2023) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A194/A194M	(2023) Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM B42	(2020) Standard Specification for Seamless Copper Pipe, Standard Sizes
ASTM B88	(2022) Standard Specification for Seamless Copper Water Tube
ASTM B135	(2010) Standard Specification for Seamless Brass Tube
ASTM B88M	(2020) Standard Specification for Seamless Copper Water Tube (Metric)
ASTM C533	(2017; R 2023) Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(2018) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-69	(2003; Notice 2012) Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)
MSS SP-80	(2019) Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13	(2022; ERTA 3 2022) Standard for the Installation of Sprinkler Systems
NFPA 20	(2022;TIA 21-1; TIA 21-2) Standard for the Installation of Stationary Pumps for Fire Protection
NFPA 24	(2022) Standard for the Installation of Private Fire Service Mains and Their Appurtenances

NFPA 37 (2021) Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines

NFPA 70 (2023) National Electrical Code

NFPA 72 (2022; ERTA 22-1) National Fire Alarm and Signaling Code

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)

NICET 1014-7 (2012) Program Detail Manual for Certification in the Field of Fire Protection Engineering Technology (Field Code 003) Subfield of Automatic Sprinkler System Layout

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-101 (2014; Rev C) Color Code for Pipelines and for Compressed Gas Cylinders

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-1922 (Rev A; Notice 1; Notice 2; Notice 3; Notice 4) Shield, Expansion (Caulking Anchors, Single Lead)

CID A-A-1923 (Rev A; Notice 1; Notice 2; Notice 3; Notice 4) Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)

CID A-A-1924 (Rev A; Notice 3) Shield, Expansion (Self Drilling Tubular Expansion Shell Bolt Anchors

CID A-A-1925 (Rev A; Notice 3) Shield Expansion (Nail Anchors)

CID A-A-55614 (Basic; Notice 2) Shield, Expansion (Non-Drilling Expansion Anchors)

CID A-A-55615 (Basic; Notice 1; Notice 2; Notice 3; Notice 4) Shield, Expansion (Wood Screw and Lag Bolt Self-Threading Anchors

FED-STD-595 (Rev C; Notice 1) Colors Used in Government Procurement

UNDERWRITERS LABORATORIES (UL)

UL 80 (2007; Reprint Jan 2014) Standard for Steel Tanks for Oil-Burner Fuels and Other Combustible Liquids

UL 142 (2006; Reprint Jan 2021) UL Standard for Safety Steel Aboveground Tanks for Flammable and Combustible Liquids

UL 262	(2004; Reprint Oct 2011) Gate Valves for Fire-Protection Service
UL 789	(2004; Reprint May 2017) UL Standard for Safety Indicator Posts for Fire-Protection Service
UL 1247	(2007; Reprint Jun 2020) Diesel Engines for Driving Stationary Fire Pumps
UL Fire Prot Dir	(2012) Fire Protection Equipment Directory

1.2 DEFINITIONS

a. Authority Having Jurisdiction(AHJ) - The [Kennedy Space Center][Cape Canaveral Air Force Station] Fire Protection Engineer, whose opinion is final regarding interpretation of the National Fire Protection Association(NFPA) codes.

b. Delegated engineer - A Professional Engineer, as defined under Florida Statutes, Chapter 471, licensed to practice in the State of Florida.

1.3 SUBMITTALS

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

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

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

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Piping Layout and Sensing Piping Arrangement[; G]

Pump Room[; G]

SD-03 Product Data

Fire Pumps[; G]

Jockey Pump[; G]

Driver[; G]

Fire Pump Controller[; G]

Jockey Pump Controller[; G]

Pipe[; G]

Fittings[; G]

Valves[; G]

Hose Valve Manifold Test Header[; G]

Pipe Hangers and Supports[; G]

[Flow Meter[; G]

] SD-07 Certificates

Qualifications of Welders[; G]

Qualifications of Installer[; G]

Contractor's State Certification[; G]

Signed and Dated Flushing Certificate[; G]

Preliminary Test Certificate[; G]

Final Test Certificate[; G]

Manufacturer's Certified Test Characteristic Curves for Each Pump [; G]

SD-10 Operation and Maintenance Data

Fire Pumps[; G]

Driver[; G]

Fire Pump Controller[; G]

[Flow Meter][; G]

Valves[; G]

Operation and Maintenance Manuals[; G]

SD-11 Closeout Submittals

Posted Operating Instructions[; G]

1.4 QUALITY ASSURANCE

1.4.1 Qualifications of Welders

Submit certificates of each welder's qualifications prior to site welding; do not provide certifications that are more than one year old.

1.4.2 Qualifications of Installer

Qualifications of System Technician: Prepare installation drawings, shop drawings and as-built drawings, by or under the supervision of, an individual who is experienced with the types of work specified herein, and is currently certified by the National Institute for Certification in Engineering Technologies (NICET 1014-7) as an engineering technician with minimum Level-III certification in Automatic Sprinkler System layout program. Submit data for approval showing the name and certification of all involved individuals with such qualifications prior to submittal of drawings. Provide a Florida Contractor's State Certification as a Class I, Fire Pump Installation Services by the installing fire pump contractor.

1.4.3 Preliminary Test Certificate

When preliminary tests have been completed and corrections made, submit a signed and dated certificate with a request for a formal inspection and tests.

1.4.4 Components

Do not include components installed under this contract that are more than one (1) year older than the date of installation.

Provide UL Fire Prot Dir listed or FM APP GUIDE approved devices and equipment for fire protection services.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide fire pumps and associated equipment complete and ready for operation. Provide equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing in accordance with NFPA 20, NFPA 70, and NFPA 72, except as modified herein.

2.1.1 Design Requirements

Prepare working drawings on sheets not smaller than 610 by 914 mm 24 by 36 inches. Sign and seal drawings by a registered engineer, licensed to practice in Florida. In addition to hard copies, provide an electronic .DWG, .DXF or .DGN computer format on a CD ROM.

2.1.1.1 Pump Room

Show detail plan view of the pump room including elevations and sections showing the fire pumps, associated equipment, and piping. Show piping schematic of pumps, devices, valves, pipe, and fittings.[Provide an isometric drawing of the fire pump and all associated piping.] Show point to point electrical wiring diagrams. Show piping layout and sensing piping

arrangement. Show engine fuel and cooling system. Include:

a. Pumps, drivers, and controllers

b. Hose valve manifold test header

c. Circuit diagrams for pumps

d. Wiring diagrams of each controller

2.1.1.2 Fire Pumps

****
NOTE: In selecting rated head pressures of fire pumps, consider the fact that horizontal split case fire pumps and vertical turbine fire pumps develop 140 percent of rated head pressure when operating under shutoff or "churn" conditions. Maximum desired fire pump rated head pressure is 862 kPa (gage) 125 psig.
****

Provide [[_____] electric motor driven] [and] [[_____] diesel engine driven] [horizontal split-case] [vertical turbine][vertical in-line][end suction][factory skid mounted] fire pump(s). Provide fire pump(s) that are [automatic start and manual stop] [manual pushbutton start and stop] [and] [_____] pump[s] and are [automatic start and automatic stop]. Provide each pump with capacity at rated head to be [not less than that indicated] [_____] liter per minute (L/m) gpm at a discharge pressure of [_____][kPa (gage) psig]. Furnish with each pump not less than 150 percent of rated capacity at not less than 65 percent of total rated head. Provide pumps that are of the centrifugal [horizontal split case with automatic air release] [water lubricated, vertical turbine type]. [Provide maximum pump, motor, and engine speed to be 188 rad/sec 1800 rpm.]

Provide fire pump bearings that have an L-10 rating of not less than 5,000 hours, based on load ratings and fatigue life.

Submit manufacturer's certified test characteristic curves for each pump.

2.1.1.3 Electrical Motors, Controllers, Contactors, And Disconnects

Furnish motors, controllers, contactors, and disconnects with their respective pieces of equipment. Provide motors, controllers, contactors, and disconnects as specified herein and that have electrical connections provided under Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL. Provide controllers and contactors that have a maximum of 120-volt control circuits, and auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, provide additional electrical service and related work required for an operational system.

2.1.1.4 Electrical Work

****
NOTE: Include Section 28 31 00.00 98 FIRE DETECTION AND ALARM when a fire alarm panel or transmitter is required to transmit pump supervisory signals to a constantly attended location as required by NFPA 20.

Provide four (4) signals for each pump, pump controller in manual/off mode, pump running, loss of AC power, phase reversal.

****

Provide electrical power work associated with this section under Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL except for control and fire alarm wiring. Provide fire alarm system under Section 28 31 00.00 98 FIRE DETECTION AND ALARM. Provide control wiring under this section in accordance with NFPA 20 and NFPA 70. Provide wiring in metal conduit of a type as specified in DIVISION 26 ELECTRICAL.

2.2 SYSTEM COMPONENTS

2.2.1 Fire Pumps

****

NOTE: Use the following requirements for horizontal split case pumps.

****

[Provide a double suction type impeller, made of cast bronze, balanced hydraulically and dynamically, keyed to the shaft and securely retained in an axial position by positive mechanical means.

] Locate suction and discharge connections on opposite sides of the lower half casing, allowing removal of the rotating element without disturbing the system piping connections.

Rate fire pump discharge flange for 79.4 kilograms 175 pounds.

Provide a fire pump casting that is smooth, free of scale, lumps, cracks, sand holes, and defects of any nature, which make the casting unfit for it's intended use.

Provide the bolting of pressure-holding castings to be such that the maximum stress on any bolt does not exceed 1/4 the elastic limit of the material as computed by using the stress area and on the basis of the water pressure equivalent to the shut-off pressure effective over the area out of the centerline of the bolts.

Seal the shaft with a stuffing box and packing with external water-seal piping. Provide stuffing box glands that exert uniform pressure on the packing.

Furnish replaceable shaft sleeves constructed of a corrosion-resistant material.

Provide the following accessories:

a. Suction eccentric reducer, with the flat side on top, at the pump inlet. Provide a reducer of cast iron or wrought steel material with flanged connections.

b. Automatic air release valve with threaded inlet and discharge connections, to vent air from the pump casing.

c. Casing relief valve, non-adjustable bronze-type, set above the design pressure anticipated but below the combined suction pressure and

shut-off head pressure, to discharge water from the system to avoid pump overheating. Ensure valve conforms to NFPA 20.

[d. Main relief valve and open waste cone discharge where required by NFPA 20.

]2.2.2 Fire Pump Alarms

****
NOTE: Provide power for alarms to be from a source other than the engine starting batteries and that does not exceed 125 volts. Do not supply power from the same circuit supplying power to the fire pump controllers or from an emergency circuit. The preferred method of remote pump supervision is via the KSC/CCAFS supervised alarm system reporting to KSC FMS, not via a remote pump trouble panel. Use a remote pump panel only as a last resort, and only if the wiring between the pump and the panel is supervised in accordance with NFPA 72.
****

Provide audible and visual alarms as required by NFPA 20 on the controller. Provide remote supervision as required by NFPA 20, in accordance with NFPA 72 under [Section 28 31 00.00 98 FIRE DETECTION AND ALARM][_____]. [Provide remote pump trouble panel located [at [_____]] [where shown].] Provide weatherproof exterior alarm devices where shown. Provide alarm silencing switch and red signal lamp, with signal lamp arranged to come on when switch is placed in OFF position.

Activate alarm signal upon the following conditions:

[a. Electric motor controller has operated into a pump running condition

b. Pump controller has been turned to manual or to off position

c. Loss of electrical power to electric motor starter

d. Phase reversal on line side of motor starter

][e. Engine drive controller has operated into an engine running condition, engine drive controller main switch has been turned to OFF or to MANUAL position

f. Trouble on engine driven controller or engine

]2.2.3 Pressure Maintenance (Jockey) Pump

****
NOTE: Include this item to prevent fire pumps from cycling due to system pressure drops. Pump capacity is to be less than the flow from a sprinkler head.
****

Provide a jockey pump with an UL listed full voltage combination motor controller to maintain a pressure of [_____] kPa (gage) psig on the system. Provide a pump that is [horizontal shaft][or][in-line vertical shaft] centrifugal type with rated discharge pressure of [_____] L/m gpm at [_____] kPa (gage) psig. Ensure the pump shut off pressure does not exceed [the

design working pressure of the system] [_____] kPa (gage) [_____] psig. Start pump when the fire system pressure drops to [_____] kPa (gage)[_____] psig and stops when the pressure reaches [_____] kPa (gage) [_____] psig.

Rate the jockey pump to 2068 kilopascal 300 psi [_____]. Provide drain and gauge tappings on the pump. Provide pump impeller that is hydraulically balanced, non-vapor-binding type, mechanically keyed to the shaft. Provide pump that has replaceable bronze impeller (casing) wear rings, threaded connections, mechanical seal, non-regreasable cast iron cartridge roller ball bearings, close-coupled to an open-drip proof motor.

Arrange pump to draw water [from the suction supply side of the gate valve of the fire pump(s)][as indicated] and discharge into the system on the downstream side of the pump discharge gate valve. Provide an approved indicating gate valve of the outside stem and yoke (O.S.&Y.) type in the jockey pump discharge and suction piping. Provide an approved [oil-filled with a pulsation snubber][glycerin filled] pressure gauge and approved check valve in the jockey pump discharge piping. Provide a check valve that is a swing type with removable inspection plate.

2.2.3.1 Jockey Pump Controller

Provide a Jockey pump controller that is UL listed, completely assembled, wired, and tested at the factory. Provide a lockable disconnect switch adjacent to, or as an integral part of the jockey pump controller.

Provide a unit that is complete with:

a. Across-the-line magnetic starter equipped with overload protection

b. 3-pole fusible disconnect switch, H-O-A selector switch

c. 2068 kilopascal 300 psi bourdon tube type pressure regulator, with independent high and low setpoints

[d. Solid-state pressure switch with independent high and low adjustment for automatic starting and stopping

] e. Pump run light

f. [NEMA 2][NEMA 4][NEMA 12] enclosure with lockable handle

g. Automatic stop function

h. Minimum run time clock

i. Contacts for remote start.

Provide and connect a sensing line to the pressure maintenance pump discharge piping between the control valve and the check valve. Conform the sensing line in accordance with the paragraph entitled, "Pressure Sensing Line," of this section. Completely separate the jockey pump sensing line from the fire pump sensing line(s). Provide an adjustable relay (0-60 minute) with a Form "C" NO/NC alarm contact such that if the jockey pump cycles off and then is restarted before the expiration of the relay timer, the alarm contact is energized and an excessive cycling alarm is sent to the FEMS and KCCS. Exceed start/stop pressure settings by those of the main fire pump(s). Also include a run timer to ensure the jockey pump runs for the minimum time, as recommended by the manufacturer of the

jockey pump motor.

2.2.3.2 Pressure Sensing Line

Provide a completely separate pressure sensing line for each fire pump and jockey pump. Arrange the sensing line in accordance with Figure A-7-5.2.1 of NFPA 20. Provide a sensing line that has 12.7 mm 1/2 inch H58 brass tubing complying with ASTM B135. Equip the sensing line with two (2) restrictive orifice unions each. Provide restricted orifice unions that are ground-face unions with brass restricted diaphragms drilled for a 2.4 mm 3/32 inch. Mount restricted orifice unions in the horizontal position, not less than 1.5 m 5 feet apart on the sensing line. Provide two (2) test connections that consist of two (2) brass 12.7 mm 1/2 inch globe valves and 6.3 mm 1/4 inch gauge connection tee arranged per NFPA 20. Equip one of the test connections with a 0 to 2068 kPa 0 to 300 psi water oil-filled gauge. Connect sensing line to the pump discharge piping between the discharge piping control valve and the check valve.

2.2.4 Electric Motor Driver

Provide an electric motor drive by the fire pump manufacturer, with the electrical characteristics indicated. Provide a motor that is open drip-proof (ODP), with a 1.15 service factor. Provide an electric motor that has an energy efficiency of 93[_____] percent or greater.

Provide fire pump and jockey pump electrical motors, controllers, contactors, and disconnects as specified herein. Conform power supply to each motor and controller as indicated.

2.2.4.1 Motors

Provide motor power that is not less than the pump power requirements at all points on the pump operating curve.

2.2.4.2 Fire Pump Controller [Electric Driven]

****

NOTE: Do not specify an automatic power shutdown for pumps which provide the sole source of water supply to a sprinkler system or standpipe. Verify whether the AHJ requires a second source of power or deems the existing power source reliable as defined in NFPA 20.

****

Conform the fire pump controller to meet NFPA 20 requirements for fire pump service.

[Provide controllers for electric motor driven fire pump service and arrange for manual pushbutton [and automatic] starting and manual pushbutton shutdown [and automatic shutdown following expiration of a minimum running period of 10 minutes, then begin the timing after all starting causes have returned to normal.] [Provide a controller that is completely terminally wired, ready for field connections, and mounted in a moisture resistant [NEMA 2] [NEMA 3] [NEMA 4] [_____] enclosure arranged so that controller current carrying parts is not less than 300 mm 12 inches above the floor. Provide controllers with [[_____] and]]: sequential start timers as required by NFPA 20.] Provide a NEMA rated starting contactor sized for the motor load.

[Provide the controller with:

[a. Digital pressure readout which displays water system pressure

][b. Paperless recorder which records water pressure, time, and date for at least the previous 7 days into a non-volatile memory

][c. Low voltage monitor which alarms when the starting and running voltage drops below the level required by NFPA 20

][d. Motor overload monitor which alarms when the motor exceeds 125 percent of the full load motor current

][e. Low pump room temperature monitor which alarms when the pump room temperature drops below 40 degrees F][4.4 degrees C

][f Low reservoir monitor which alarms when the suction supply water reservoir level drops below 85 percent of capacity

] Furnish controllers to include:

] a. A built-in 2068 kilopascal 0 to 300 psi bourdon tube type pressure switch with independent high and low setpoints

b. Automatic and manual start and manual stop pushbuttons

c. An adjustable minimum run timer

d. Power available light

e. Power monitoring sensing all phases for loss of any phase

f. Under voltage or phase reversal

Provide controller with Form "C" dry contacts for remote monitoring of each condition required to be monitored by NFPA 20 and by this specification. [Provide controller enclosures with legs that are a minimum of [304] [_____] mm [12] [_____] inches long.] Provide controller that is of the [solid-state reduced voltage] [across the line] [part winding] [primary resistor], [primary reactor], [autotransformer] [wye delta] [open or closed transition] starting type with a fault current interrupting capacity of [_____] amperes RMS. Design controller for [_____] kilowatt (kW) horsepower (HP) at [_____] volts and include service entrance label. [Provide an approved power transfer switch to transfer emergency power to the fire pump; Provide a transfer switch that transfers power from [an emergency generator.]]

2.2.5 Diesel Engine Driver

****

NOTE: Select bracketed choice of method of specifying power requirements. Exercise special caution in using the second expression because once a proper pump is selected only that diesel engine driver in the UL Fire Protection Equipment Directory corresponding to pump requirements is acceptable. Selection of a specific power can then further limit the suppliers of the equipment. Where

diesel-engine-driven pumps are provided because reliable electrical power is not available to the pump, design the pump room so that electrical power is not required to supply ventilation for engine operation or engine cooling, or provide two totally independent sources of ventilation.

****

Conform to UL 1247 and list or approve for fire pump service and [of the make and kW hp rating recommended by the pump manufacturer for the pump being provided. Provide adequate engine power to drive the pump at all conditions of speed and load over the full range of the pump performance curve] [of [_____] kW hp rating]. Provide a compression ignition diesel type engine with an electric starting device taking current from two battery units mounted not less than 304 mm 12 inches above the floor. Provide lead-acid or lead-calcium type batteries.

2.2.5.1 Fire Pump Controller (Diesel Engine)

Provide approved controllers for diesel-engine-driven fire pump service and arrange for manual pushbutton [and automatic] starting and manual pushbutton shutdown [and automatic shutdown following expiration of a minimum running period of 30 minutes, begin timing after all starting causes have returned to normal.] Provide a weekly program timer to automatically start and run the engine for a test period of at least 30 minutes once per week. [If during this test period the engine develops critically low lubricating oil pressure or high engine jacket coolant temperature, initiate on the controller a "trouble on engine or controller" alarm as required by NFPA 20 and stop the engine. While in this stopped condition, if any other starting input is received by the controller, restart the controller and run the engine as required by NFPA 20.] [Provide the controller with:

[a. Digital pressure readout which displays water system pressure

][b. Paperless recorder which records water pressure, time, and date for at least the previous 7 days into a non-volatile memory

][c. Low voltage monitor which alarms when the starting and running voltage drops below the level required by NFPA 20

][d. Motor overload monitor which alarms when the motor exceeds 125 percent of the full load motor current

][e. Low pump room temperature monitor which alarms when the pump room temperature drops below 4.4 degrees C40 degrees F

][f. Low reservoir monitor which alarms when the suction supply water reservoir level drops below 85 percent of capacity.

]]Provide the controller with Form "C" dry contacts for remote monitoring of each condition required to be monitored by NFPA 20 and by this specification.

2.2.5.2 Battery Charger

Provide charger that is an integral part of the controller or a separate wall-mounted unit. For each battery unit, provide voltmeter to indicate the state of the battery charge and provide ammeter to indicate rate of

charge.

2.2.5.3 Fuel System External to Engine

Ensure external fuel system is in accordance with NFPA 20 and NFPA 37. Provide vent piping with weatherproof vent cap. Provide flexible bronze or stainless steel piping connectors with single braid at each piping connection to diesel engine. Provide steel piping for supply, return, vent, and fill piping. Supply and return piping can be made of copper tubing.

a. Steel Pipe: ASTM A53/A53M, Weight Class XS (Extra Strong), black steel, threaded end connections. Provide ASME B16.3 threaded fittings and ASME B16.39 threaded unions.

b. Copper Tubing: ASTM B88M ASTM B88, Type K, soft annealed, with ASME B16.26 flared fittings or compression type fittings.

c. Tanks: UL 80 or UL 142 for aboveground steel tanks.

d. Valves: Ensure valves are suitable for fuel oil service. Provide valves with union end connections or threaded end connections.

(1) Gate, Globe, and Angle Valves: MSS SP-80, Class 125.

(2) Check Valves: MSS SP-80, Class 125, swing check.

(3) Ball Valves: Full port design, copper alloy body, two-position lever handles.

Extend engine vents to outside the building. Equip each tank with a fuel level gauge. Protect fuel lines against mechanical damage. Equip fill lines with 16 mesh removable wire screen. Extend fill lines to the exterior. Mount a weatherproof tank gauge on the exterior wall near each fill line for each tank. Provide a fill cap that is able to be locked by padlock. Locate the engine supply (suction) connection on the side of the fuel tank so that 5 percent of the tank volume provides a sump volume not useable by the engine. Place fuel tank at an elevation where the inlet of the fuel supply line is located so that its opening is no lower than the level of the engine fuel transfer pump. Pitch the bottom of the tank 21 mm per meter 1/4 inch per foot to the side opposite the suction inlet connection, and to an accessible 25.4 mm 1 inch plugged globe drain valve.

Provide an indicating and lockable ball valve in the supply line adjacent to the tank suction inlet connection. Provide a check valve in the fuel return line.

2.2.5.4 Exhaust System External to Engine

Ensure exhaust system is in accordance with NFPA 20 and NFPA 37. Provide exhaust mufflers to reduce noise levels less than 85 [_____] dBA.

Meet the following:

a. Steel Pipe: ASTM A53/A53M, Weight Class XS (Extra Strong), black steel, welding end connections. Provide ASME B16.9 or ASME B16.11 welding fittings of the same material and weight as the piping.

b. Flanges: ASME B16.5, Class 150. Provide flanges at connections to

diesel engines, exhaust mufflers, and flexible connections. Ensure gaskets conform to ASME B16.21, are composition ring, and are 1.60 mm 0.0625 inch thick. Provide ASTM A193/A193M, Grade B7 bolts and ASTM A194/A194M, Grade 7 nuts.

c. Piping Insulation: Products containing asbestos are not permitted. Provide exhaust piping system inside the building with ASTM C533 calcium silicate insulation minimum of 76 mm 3 inches thick; secure with not less than 9.65 mm 0.38 inch width fibrous glass reinforced waterproof tape or stainless steel bands spaced not more than 203 mm 8 inches on centers. Provide one layer of asphalt-saturated felt over the insulation prior to installing aluminum jacket. Provide insulation with aluminum jacket, minimum thickness of 0.40 mm 0.016 inch, with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Secure jacket with stainless steel bands spaced not more than 203 mm 8 inches on centers.

2.2.6 Flow Meter

****
NOTE: Where a flow meter is desired, show a straight line run of pipe without valves or fittings equal to at least 10 times the pipe diameter on the intake side and at least 5 times the pipe diameter on the discharge side of the flow meter. Where possible, arrange the piping so that the metered flow can be discharged through the pump test header and/or back into the pump suction supply by the proper configuration of valves. Only use flow meters where testing can not be performed on an open stream and with the concurrence of the NASA AHJ.
****

Provide an UL listed or FM approved flow meter for the fire pump installation with a direct flow readout device. Select a flow meter with a flow range between [_____] gpm and [_____] gpm. [Provide a [venturi] [annular probe] [orifice plate] [_____] meter.]

2.2.7 Pressure Gauges

Provide pressure gauges that are a minimum of 89 mm 3.5 inch in diameter, brass cased with chrome finish, glass or polycarbonate window, brass dial with white background, black markings, dual units (English and metric), phosphor bronze bourdon tube, brass precision geared movement, plus or minus 3 percent accuracy, 2068 kilopascal 300 psi working pressure, and three-way globe style gauge isolation valve with a plugged end. Provide liquid filled gauges or pulsation dampers for gauges located at pumps.

****
NOTE: Carefully coordinate piping requirements including supports and valves in related fire protection system specifications, to avoid conflicting requirements.
****

2.3 ABOVEGROUND WATER PIPING SYSTEMS

The following requirements apply to miscellaneous fire pump trim piping located in the fire pump room, except where other related specification

sections have more stringent requirements, the more stringent requirements prevail.

2.3.1 Sizes 63.5 Millimeter 2.5 Inches and Larger

2.3.1.1 Steel Pipe

Use ASTM A53/A53M, or ASTM A135/A135M Weight Class Schedule 40; black steel pipe.

2.3.1.2 Buttwelding

ASME B16.9. Provide the same material and weight as the piping in which fittings are installed. Use black steel pipe with buttwelding end connections.

2.3.1.3 Steel Pipe Flanges and Fittings

Provide ASME B16.5, Class 150 flanges at valves, connections to equipment, and where indicated. Provide elbows of the long radius type. Do not use reducing bushings. Extend bolts no less than two full threads beyond the nut with the bolts tightened to the required torque.

a. Gaskets: AWWA C111/A21.11, provide one piece factory cut cloth inserted red rubber gaskets.

b. Bolts: ASTM A193/A193M, Grade B7 bolts.

c. Nuts: ASTM A193/A193M, Grade 7.

d. Washers: Use steel flat circular washers under bolt heads and nuts.

2.3.2 Piping Sizes 50 mm 2 Inches and Smaller

2.3.2.1 Steel Pipe

ASTM A53/A53M, Weight Class Schedule 80; zinc-coated steel pipe with threaded end connections.

a. Threaded Fittings: ASME B16.3, Class 300, zinc-coated.

b. Unions: ASME B16.39, Class 300, zinc-coated.

c. Copper Tubing: ASTM B88M ASTM B88, Type L, soft annealed.

d. Fittings: ASME B16.26 flared joint fittings.

e. Pipe Nipples: ASTM B42 copper pipe with threaded end connections.

2.3.3 Valves

Provide valves of types listed or approved for fire protection service with flanged grooved or threaded end connections.

2.3.3.1 Gate Valves

Provide outside screw and yoke type which open by counterclockwise rotation.

Do not use butterfly type control valves.

2.3.3.2 Check Valves

Provide a check valve that is a UL listed or FM approved, standard swing check type with elastomer disc seat. Provide check valve with a ductile iron body with flanged or grooved ends of a clear opening type with a flanged inspection and access coverplate for sizes 152 mm 6 inches or larger.

Install check valve vertically or horizontally, and rate for 2068 kilopascal's 300 psi working pressure. Provide a clapper that is type 304 stainless steel or bronze, with a field replaceable EDPM or Nitrite seal and a nickel or bronze seat. Ensure spring, hinge shaft, and retaining ring are stainless steel. Paint the valve body with a corrosion resistant non-lead coating.

2.3.3.3 Relief Valve

Provide each [engine driven] pump with an approved [pilot operated] [or] [spring operated] circulation relief valve conforming to NFPA 20. Provide a discharge relief valve where the combination of the static pressure and pump churn pressure produce pressures downstream of the pump that exceeds the rating of the components.

2.3.3.4 Circulating Relief Valve

Provide an adjustable circulating relief valve for each fire pump in accordance with NFPA 20.

2.3.4 Hose Valve Manifold Test Header

****

NOTE: Indicate a detail of the hose valve manifold test header on the contract drawings showing supply arrangement, size of header supply piping, number of hose valves, valve arrangement, and test header location. Provide a "straight line manifold" test header which allows the pump to be tested without the use of fire hoses. The "rosebud" test header is not permitted. Where the straight line manifold test header is not a stock item and is shop fabricated, provide a fabrication detail on the contract drawings. In lieu of the hose valve manifold test header, this paragraph can be changed to specify an inline water metering device in accordance with NFPA 20, subject to the approval of the NASA AHJ.

****

Construct manifold test header of steel pipe as specified in paragraph entitled "Aboveground Water Piping Systems," of this section. Provide ASME B16.5, Class 150 flanged inlet connection to hose valve manifold assembly. Provide an approved bronze hose gate valve with 63.5 mm 2.5 inch National Standard male hose threads with cap and chain; locate .91 m 3 feet above grade in the horizontal position for each test header outlet. Ensure metallic arc process welding is in accordance with ASME B31.1. Base the number of DN 65 2.5 inch valves upon the capacity of the fire pump with not less than one (1) valve for every 946 liters per minute 250 gallons per minute of pump capacity.

2.3.5 Pipe Sleeves

Install pipe sleeves where piping passes entirely through walls, ceilings, roofs, and floors. Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, and floors. Provide 25 mm one inch minimum clearance between exterior of piping or pipe insulation, and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal space at both ends of the sleeve or core-drilled hole with plastic waterproof cement which dries to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal. In fire walls and fire floors, seal both ends of pipe sleeves or core-drilled hole with UL listed fill, void, or cavity material.

Install the following:

a. Sleeves in Masonry and Concrete Walls, Ceilings, Roofs, and Floors: Provide hot-dip galvanized steel, ductile-iron, or cast-iron pipe sleeves. Core drilling of masonry and concrete is allowed in lieu of pipe sleeves provided that cavities in the core-drilled hole be completely grouted smooth.

b. Sleeves in Other Than Masonry and Concrete Walls, Ceilings, Roofs, and Floors: Provide 26 gage galvanized steel sheet.

2.3.6 Escutcheon Plates

Provide split-hinge metal plates for piping entering floors, walls, and ceilings in exposed areas. Provide polished stainless steel or chromium-plated finish on copper alloy plates in finished spaces. Provide paint finish on plates in unfinished spaces.

2.4 BURIED WATER PIPING SYSTEMS

2.4.1 Pipe and Fittings

****
NOTE: In last sentence, use first phrase in brackets for connection to existing water distribution system where no other Civil work is being performed; delete first phrase in brackets only for connection to new water distribution system where underground piping materials are specified in DIVISION 02 EXISTING CONDITIONS, Section 33 11 00 WATER DISTRIBUTION. For pipe larger than 300 mm 12 inches, detail methods for anchoring piping including pipe clamps and tie rods. Consult NFPA 24 for required depth of coverage of buried fire mains.
****

Provide outside-coated, cement mortar-lined, ductile-iron pipe and fittings conforming to NFPA 24 for piping under the building and less than 1.50 m 5 feet outside of the building walls. Anchor the joints in accordance with NFPA 24; provide concrete thrust block at the elbow where the pipe turns up toward the floor, and restrain the pipe riser with steel rods from the elbow to the flange above the floor. Minimum pipe size is 152 mm 6 inches. Provide minimum depth of cover as required by NFPA 24, but no less than .91 m 3 feet. Provide piping more than 1.50 m 5 feet outside of the building

walls to be [outside-coated, AWWA C104/A21.4 cement mortar-lined, AWWA C151/A21.51 ductile-iron pipe, and AWWA C110/A21.10 fittings conforming to NFPA 24][provided under [Section 33 11 00 WATER DISTRIBUTION.]].

2.4.2 Valves

Provide as required by NFPA 24. Ensure gate valves conform to AWWA C500 or UL 262 with cast-iron body and bronze trim and that open by counterclockwise rotation.

2.4.3 Post Indicator Valves

Provide gate valves conforming to UL 262 and indicator posts conforming to UL 789. Locate operating nut .91 m 3 feet above grade. Provide post indicator valves with one coat of primer and two coats of red enamel paint.

2.4.4 Valve Boxes

Except where indicator posts are provided, provide each gate valve in buried piping with an adjustable cast-iron or ductile-iron valve box of a size suitable for the valve on which the box is to be used. Provide cast-iron or ductile-iron cover for the box with the word "WATER" cast on the cover. Boxes outside of paved areas are allowed to be constructed of ABS plastic or inorganic fiber reinforced black polyolefin plastic. Provide the shaft of the box with a minimum diameter of 133 mm 5.25 inches. Coat cast-iron and ductile-iron boxes with bituminous paint.

2.4.5 Buried Utility Warning and Identification Tape

Provide detectable aluminum foil plastic-backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping. Provide tape that is detectable by an electronic detection instrument. Provide tape in rolls, 76.2 mm 3 inches minimum width, color coded for the utility involved, with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Provide warning and identification that states CAUTION BURIED WATER PIPING BELOW or similar statement. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material. Bury tape with the printed side up at a depth of 304 mm 12 inches below the top surface of earth or the top surface of the subgrade under pavements.

2.5 PAINTING

Furnish equipment of the manufacturer's standard product with the manufacturer's standard finish coat.

Furnish other mechanical equipment with a shop-applied prime paint.

Paint piping in accordance with paragraph entitled, "Painting," of this section.

2.6 SUPPORTING ELEMENTS

Provide piping system components and miscellaneous supporting elements, including, but not limited to, building-structure attachments; standpipe equipment and fire hose cabinet stations; supplementary steel; hanger rods, stanchions, and fixtures; vertical-pipe attachments; horizontal-pipe

attachments; restraining anchors; and guides. Provide supporting elements that are suitable for stresses imposed by systems pressures and temperatures, natural, and other external forces. Include an additional 113 kilogram 250 pound load at each anchor per NFPA 13.

****
NOTE: Refer to Section 23 05 48.00 40 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT if design requires vibration isolation.
****

Provide supporting elements to be FM approved or UL listed and conforms to ASME B31.1, MSS SP-69, and ASME B16.34.

2.6.1 Building-Structure Attachments

2.6.1.1 Anchor Devices, Concrete and Masonry

Conform anchor devices to CID A-A-1922, CID A-A-1923, CID A-A-1924, CID A-A-1925, CID A-A-55614 and CID A-A-55615 with:

a. Group I: Shield, expansion (lead, bolt, and stud anchors)

b. Group II: Shield, expansion (bolt anchors), Type 2, Class 2, Style 1 or 2

c. Group III: Shield, expansion (self-drilling tubular expansion shell bolt anchors)

Provide adjustable positions for cast-in floor mounted equipment anchor devices.

Do not use powder-actuated anchoring devices to support mechanical systems components.

2.6.1.2 Beam Clamps

Provide beam clamps that are center-loading types 21, 28, 29, and 30, UL listed catalogued, and load-rated commercially manufactured products.

Type 20 beam clamps are allowed for pipe DN 50 2 inches and under.

Where Type 25 beam clamps are used, use two (2) per point of pipe support.

2.6.1.3 C-Clamps

****
NOTE: Avoid C-clamps as a means of attaching hangers to structural steel. For metal building system roofs, Z-purlin beam clamps can be used if approved by the Contracting Officer and KSC AHJ. Where used, consider vibration forces and single or accumulated load and resultant moment on structural steel.
****

Do not use C-clamps.

2.6.1.4 Inserts, Concrete

Construct concrete inserts in accordance with the requirements of MSS SP-58 for Type 18 or 19, and ASME B16.34. When applied to piping in sizes DN 50 2 inch iron pipe sizes (ips) and larger, and where otherwise required by imposed loads, insert a 300 mm length of 15 mm 1 foot length of 1/2 inch reinforcing rod and wire through wing slots.

2.6.2 Horizontal-Pipe Attachments

2.6.2.1 Single Pipes

Support piping in sizes up to and including DN 50 2 inch ips by Type 1, 5, 6, 7, 9, 10, 11, or 12 solid, split-ring, or band type attachments.

Support piping in sizes DN 65 2-1/2 inches and larger by Type 1, 2, 3, or 4 attachments or with Type 41 or Type 49 pipe rolls.

2.6.2.2 Parallel Fire Protection Pipes

Use trapeze hangers fabricated from approved structural steel shapes, with U-bolts, when so specified. Conform structural steel shapes to supplementary steel requirements or provide supports of commercially available, approved proprietary design rolled steel.

2.6.3 Vertical Pipe Attachments

Provide single vertical pipe attachments that are Type 8.

2.6.4 Hanger Rods and Fixtures

Use only circular solid cross-section rod hangers to connect building structure attachments to pipe support devices. Use pipe, straps, or bars of equivalent strength for hangers.

Provide turnbuckles, swing eyes, and clevises as required by support system to accommodate temperature changes, pipe accessibility, and adjustment for load and pitch.

2.6.5 Supplementary Steel

Where it is necessary to frame structural members between existing members, or where structural members are used in lieu of commercially rated supports, design and fabricate such supplementary steel in accordance with AISC 325.

Provide supplementary steel that is hot dipped galvanized or otherwise protected from corrosion, as acceptable to the Contracting Officer.

PART 3 EXECUTION

3.1 INSTALLATION

Conform equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing in accordance with NFPA 20, except as modified herein. Provide all materials required for a completely functional and operational system. Install piping straight and true to bear evenly on supports.

Install fire pumps, jockey pumps and controllers on minimum 152.4 mm 6 inch thick concrete housekeeping pads. Anchor pumps to the housekeeping pads using leveling bolts and grouted with non-shrink grout. Anchor controllers to the pad, jockey pump controller can be of the wall mount type.

3.1.1 Pumps

Factory test the pump and motor combination prior to shipment. Cover the suction and discharge flanges with wood or metal blanks. Thoroughly clean and paint the pump with one coat of machinery enamel, and assemble and seal the entire pump unit in plastic for shipment.

Prior to fire pump testing, verify proper rotation and check for excessive noise or vibration.[Install vibration isolation for the fire and jockey pump according to the manufacturers recommendations.]

Install pumps with recommended clearances provided for service and maintenance. Completely service the pump without breaking piping or motor connections.

Align the pump and motor with a dial indicator to within 0.05 mm 1.97 mil misalignment tolerance.

3.1.2 Accessories

Unless otherwise indicated, include in pump assemblies suction and discharge isolation valves with tamper switches and discharge check valve. Rigidly connect suction and discharge piping. Provide strain relief coupling where pump and suction piping are installed on separate foundations.

Provide pressure gauges with gauge valves and equip with a pulsation snubber or fill with glycerin. Locate the gauges as close to the pump impeller as possible on each suction and discharge. Provide suction side gauge of the compound type.

Extend all drain and outlets from relief valves, drip rims, and similar items full size to discharge directly above floor drains. Provide drain piping that is Type "L" copper with soldered joints or galvanized Schedule 80 steel with threaded or welded joints.

[Provide conduit, wiring, relays, contacts, and related devices for control signals between the fire pump controller, jockey pump controller and the remote alarm panel. Test each alarm point and control point.

]3.1.3 Cleaning of Piping

Keep the interior and ends of new piping and existing piping affected by construction thoroughly cleaned of water and foreign matter. Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping and fittings so that water and foreign matter does not enter the pipes or fittings. Inspect piping before placing into position.

[3.1.4 Demolition

Carefully remove materials so as not to damage material which is to remain. Replace existing work damaged by operations with new work of the same construction.

]3.2 PIPE AND FITTINGS

Test, inspect, and approve piping before burying, covering, or concealing. Provide fittings for changes in direction of piping and for all connections. Make changes in piping sizes through tapered reducing pipe fittings; do not use bushings. Perform welding in the shop, field welding is not permitted.[Photograph all piping prior to burying, covering, or concealing.]

3.2.1 Threaded Connections

Provide jointing compound for pipe threads that is Teflon pipe thread paste; apply only on male threads. Provide exposed ferrous pipe threads with one coat of zinc molybdate primer applied to a minimum dry film thickness of 0.025 mm one mil.

3.2.2 Pipe Hangers and Supports

Provide additional hangers and supports for concentrated loads in piping between hangers and supports, such as for valves.

3.2.2.1 Vertical Piping

Support metal piping at each floor, but at not more than 3 m 10 feet intervals.

3.2.2.2 Horizontal Piping

****
NOTE: Add to table for pipe sizes greater than DN 150 six inch.
****

Support piping as follows:

MAXIMUM SPACING (METERS)										
Nominal Pipe Size (mm)	25 and under	32	40	50	65	80	90	100	125	150
Copper Tube	1.80	2.10	2.40	2.40						
Steel Pipe	2.10	2.40	2.70	3.00	3.40	3.70	4.00	4.30	4.57	4.57

MAXIMUM SPACING (FEET)										
Nominal Pipe Size (inches)	One and under	1.25	1.5	2	2.5	3	3.5	4	5	6
Copper Tube	6	7	8	8						
Steel Pipe	7	8	9	10	11	12	13	14	15	15

3.3 NAMEPLATES

Provide laminated plastic nameplates for equipment, gages, thermometers,

and valves. Provide nameplates that are melamine plastic, 3 mm 0.125 inch thick, black with white center core. Matte finish the surface and square the corners. Accurately align lettering and engrave into the white core. Provide nameplates with minimum size of 63.5 mm 1 by 2.5 inches. Provide lettering with minimum of 6.3 mm 0.25 inch high normal block style. Key the nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed by the Contracting Officer near each system. Furnish two copies of each chart and schedule. Identify each inscription's function. On equipment nameplates show the following information:

a. Manufacturer, type, and model number;

b. Contract number and accepted date;

c. Capacity or size;

d. System in which installed; and

e. System which it controls.

3.4 FLUSHING

Flush all new pump suction and discharge piping at 150 percent of rated pump capacity. Where the pump installation involves more than one pump, provide the flushing volume to be the total quantity of water flowing when all pumps are discharging at 150 percent of their rated capacities. The new pumps can be used to attain the required flushing volume. Do not flush any underground piping by using the fire pumps. Continue flushing operations until water is clear, but for not less than 10 minutes. Submit a signed and dated flushing certificate with a request for field testing.

3.5 FIELD INSPECTIONS AND TESTS

3.5.1 Inspections

Prior to initial operation, inspect equipment and piping systems for compliance with drawings, specifications, and manufacturer's submittals.

3.5.2 Preliminary Tests

Use only potable water for testing. Perform tests on pumps, drivers, and equipment, including visual equipment checks to ensure compliance with approved detail drawings; pump start-run to ensure proper operation and to detect leakage of piping, valves, and fittings; sequence of operation check; verification that required pump accessories have been provided; test of pump alarm devices; and additional inspections and tests necessary to ensure that the entire pump installation is correct, complete, and ready for operation.

Hydrostatically pressure test each above ground piping system at [_____] 345 kPa (gage) 50 psig above normal system working pressure or 1379 kpa (gage) 200 psig, whichever is greater, for a period of 2 hours in accordance with NFPA 20. No drop in pressure or observed leakage is allowed.

Hydrostatically test below ground piping at not less than 1379 kilopascal 200 psi pressure for not less than two hours, or at 345 kilopascal 50 psi in excess of the maximum static pressure when the maximum static pressure

is in excess of 1034 kilopascal 150 psi. Measure leakage in underground systems by pumping from a calibrated container at the required test pressure. For new piping, do not exceed a leakage rate of 1.89 liters two quarts per hour per 100 gaskets or joints irrespective of pipe diameter. This rate can be adjusted upwards where the test section contains metal seated valves or dry barrel hydrants under pressure by the amounts specified in NFPA 24.

Upon completion of the preliminary test, submit a preliminary test certificate to the Contracting Officer.

3.5.3 Final Formal Inspection and Tests

****
NOTE: Where a specific list of test equipment is warranted by design or site conditions, list equipment such as hoses, pipe, pipe nozzles, tachometers, and current measuring devices.
****

The Contracting Officer and NASA AHJ will witness the final formal tests and approve all systems before they are accepted. Conduct tests in accordance with NFPA 20. Submit the request for formal inspection at least [15] [_____] days prior to the date the inspection is to take place. Ensure an experienced technician regularly employed by the pump installer is present during the inspection. Where pumps are engine driven, ensure an experienced technician regularly employed by the engine manufacturer capable of demonstrating that all engine trouble alarms and operating features perform as required is present. Provide portable radios, hoses, nozzles, calibrated pitot gauges, calibrated pressure gauges, digital tachometer, and volt/ammeter to conduct a complete fire pump acceptance test. Include in acceptance test a full water flow test. Secure all hoses and nozzles during the tests. Conduct water flow testing in a safe manner with no destruction to the existing facility or new construction. Include tests for 100 and 150 percent capacity flows and pressures, along with no-flow pressures for compliance with manufacturer's characteristic curves. At this inspection repeat the required tests as directed. Correct defects in the work, and make additional tests to demonstrate that the system complies with the contract requirements. Furnish appliances, equipment, [water,] electricity, instruments, connecting devices, and personnel for the tests.

[The Government will furnish water for the tests.] Upon completion of the final test, submit a final test certificate to the Contracting Officer.

3.5.4 Operational Testing

Perform system operating tests, valve operating test, fire pump/controller test, and jockey pump/controller test in accordance with NFPA 20. Ensure the controller manufacturer's representative[and transfer switch manufacturer's representative is present].

3.5.4.1 Sequence

Set the jockey pump pressure switch to energize the jockey pump when the system pressure falls through the pressure deadband, and open upon re-pressurizing the system to the set point pressure. Upon further loss of pressure, the pressure switch for the lead fire pump is to close and start the main pump.

Provide the [_____] pump to [be the lead pump which]starts [automatically whenever the pressure in the main system is reduced to [_____] kPa (gage) [_____] psig] [automatically upon activation of the [_____] sprinkler system,] [and][or] manually when the starter is operated. [Continue to run pump(s) until they shut down manually.] [Automatically shut down pump(s) after a running time of [_____] minutes, unless manually shut down.] [If after [_____] seconds, the lead pump can not maintain a pressure of at least [_____] kPa (gage) [_____] psig on the system, then start Pump No. 2.] [If after an additional [_____] seconds, Pump No. 1 and Pump No. 2 can not maintain a pressure of at least [_____] kPa (gage) [_____] psig on the system, then start Pump No. 3.] [Do not let failure of the lead pump starting prevent subsequent pumps from starting.]

Base final pressure settings upon actual performance during acceptance testing with approval of the Contracting Officer.

3.5.4.2 Testing

Perform testing of the automatic operation of the jockey and fire pump(s). Slowly partially open the inspectors test station until the jockey pump starts. Then fully close the inspectors test and restore the system to "normal" status. Then fully open the inspectors test station, which first starts the jockey pump then the lead fire pump. If the inspectors test station does not generate sufficient pressure loss when opened, use the main drain or other approved method to activate the lead pump.

3.5.4.3 Adjusting

Adjust and record the pressure switch setpoints and deadbands upon successful completion of the above test. Correct deficiencies such as rapid cycling of the jockey pump, activation of both fire pumps (non-sequential starting) and similar anomalies for final acceptance. Verify all trouble, supervisory and alarm conditions.

3.6 CLEANING AND ADJUSTING

At the completion of the work, thoroughly clean all parts of the system. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that accumulated from the installation and testing of the system. Adjust automatic control devices for proper operation.

3.6.1 Painting

Touch up or repaint to bring to as-new condition all manufacturer's standard finish equipment surfaces damaged during construction to the satisfaction of the Contracting Officer, or replace with new undamaged equipment at no additional cost to the Government.

Thoroughly clean and paint pipe hangers, supports, and other iron work in concealed spaces.

Paint all fire sprinkler system piping, valves, and appurtenances with two coats of enamel, color No. 11105 (red) in accordance with MIL-STD-101 and FED-STD-595.

3.7 DEMONSTRATION

3.7.1 Operating Personnel Instruction

Upon completion of the work and at a time designated by the Contracting Officer, provide the services of experienced technicians regularly employed by the manufacturer of the pumps and the drivers to instruct Government operating personnel in the proper operation and maintenance of the equipment for a period of not less than two separate four hour sessions on two separate days.

At the option of the Contracting Officer, all training sessions are documented by the Government using audio, visual, or a combination of methods. Contain all training information presented in the Operations and Maintenance Manuals.

3.8 OPERATION AND MAINTENANCE MANUALS

Submit operation and maintenance manuals, grouped by technical sections consisting of manufacturer's standard brochures, schematics, procedures, recommended spare parts, recommended test equipment, and safety precautions. Submit this information prior to acceptance tests being performed.

Include manufacturers catalog data, installation instructions, maintenance manuals, wiring diagrams, and test results. Organize data in a three ring loose-leaf notebook binder, into sections with identifying tabbed dividers, a table of contents and identifying front and spline covers.

3.8.1 Posted Operating Instructions

Post operating instructions for all devices to include pumps, drivers, controllers, valves, and flow meters. Include warning statements as to actions that can take the system out of service, or that can cause accidental discharge and/or activation in the instructions.

-- End of Section --

****
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASAKSC-26 05 13.00 98 (August 2012)

Preparing Activity: NASA

Superseding
NASAKSC-26 05 13.00 98 (November 2011)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
****

SECTION TABLE OF CONTENTS

DIVISION 26 - ELECTRICAL

SECTION 26 05 13.00 98

MEDIUM VOLTAGE CABLES

08/12

-- End of Section Table of Contents --

****
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****

SECTION 26 05 13.00 98

MEDIUM VOLTAGE CABLES
08/12

****
NOTE: This specification covers the requirements for medium voltage cables, including 5 kV and 15 kV shielded single-conductor power cables, cable splices and terminations, potheads, and fireproofing cables in manholes.

Show plan layout on drawings of power cable and power-cable terminations. Indicate on electrical riser diagrams size, type, electrical characteristics, and raceway system of power cables and type of cable termination.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Recommended changes to a NASAKSC Master Specification Section should be submitted as a Criteria Change Request (CCR) to the appropriate Technical Proponent (TP) through the SpecsIntact Help Desk.
****

PART 1 GENERAL

****
NOTE: If Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL and Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS are not included in the project specification, insert applicable

requirements there from and delete the following paragraph.
****

Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL and Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

1.1 REFERENCES

****
NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

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

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.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS8 (2013) Specification for Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV

ASTM INTERNATIONAL (ASTM)

ASTM B8 (2011; R 2017) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

ASTM D746 (2014) Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 48 (2020) Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV

IEEE 386	(2016) Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV
IEEE 400.2	(2013) Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF)
IEEE 404	(2012) Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500,000 V

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-94-649	(2021) Concentric Neutral Cables Rated 5 Through 46 KV

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2021) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems
NETA MAINT	(2011) Standard for Maintenance Testing Specifications for Electric Power Distribution Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C119.1	(2016) Electric Connectors - Sealed Insulated Underground Connector Systems Rated 600 Volts

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023) National Electrical Code
NFPA 70E	(2024) Standard for Electrical Safety in the Workplace

1.2 DEFINITIONS

Medium voltage power cables means all cables rated above 601 to 35,000 volts.

1.3 ADMINISTRATIVE REQUIREMENTS

1.3.1 Pre-Installation Meetings

No later than [30] [_____] days of Contract Award, the Contracting Officer will schedule a pre-installation meeting. Submit the following for review and approval prior to the meeting:

a. Pulling Plan including calculations of pulling tension and side wall pressure anticipated, and the maximum allowable pulling tension for each pull. Do not perform any pull until Government reviews and approves the pulling plan.

b. Splicer/Terminator Certifications

c. List of Splices and Terminations to be Installed by Splicer/Terminator

d. Manufacturer's catalog data for the following items:

(1) Single Conductor 5 kV Shielded Cable

(2) Single Conductor 15 kV Shielded Cable

(3) Cable Supports and Fittings

(4) Cable Tags

(5) Fireproof Tape

(6) Splice Kits (including splice grounding and manufacturer's recommended installation tools)

(7) Terminations

e. Certificates for the following showing that the cable manufacturer has made factory-conducted tests on each shipping length (reel) of cable. Include certified copies of test data showing conformance with the referenced standards and approval prior to delivery of cable.

(1) Conductor Resistance

(2) Accelerated Water Absorption Test

(3) Water Immersion Test

(4) Ionization

(5) High-Voltage

(6) Partial Discharge Test

(7) Qualification Test Reports

1.4 SUBMITTALS

****

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

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

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 REPORTING.

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

List of Splices and Terminations to be Installed by Splicer/Terminator[; G]

SD-02 Shop Drawings

Pulling Plan[; G]

SD-03 Product Data

Single Conductor 5 kV Shielded Cable[; G]

Single Conductor 15 kV Shielded Cable[; G]

Cable Supports and Fittings[; G]

Cable Tags[; G]

Fireproof Tape[; G]

Splice Kits[; G]

Terminations[; G]

SD-06 Test Reports

Field Testing[; G]

KSC Medium Voltage Cable Test Form[; G]

Qualification Test Reports[; G]

Radiographic Tests[; G]

SD-07 Certificates

Factory-Conducted Tests on Each Shipping Length (Reel) of Cable[; G]

Splicer/Terminator Certifications[; G]

Conductor Resistance[; G]

Accelerated Water Absorption Test[; G]

Water Immersion Test[; G]

Ionization[; G]

High-Voltage[; G]

Partial Discharge Test[; G]

Qualification Test Reports[; G]

SD-08 Manufacturer's Instructions

Single Conductor 5 kV Shielded Cable[; G]

Single Conductor 15 kV Shielded Cable[; G]

Terminations[; G]

Splice Kits[; G]

SD-11 Closeout Submittals

List of Splices and Terminations to be Installed by Splicer/Terminator[; G]

1.5 QUALITY ASSURANCE

1.5.1 Qualifications`

Verify personnel performing Medium Voltage (MV) splicing or terminations have 5 years minimum experience in cable splicing and terminations of the type used in this project. In addition, submit splicer/terminator certifications issued by the cable splice and termination manufacturer who has examined and tested a test splice or termination of each type required by this contract for each cable splicer. Ensure the certification identifies which splices and terminations it applies to. Require each individual, certified or not, with the required 5 years medium voltage splicing and terminating experience, who is to perform cable splicing or terminating, to perform a minimum of one splice or termination of each type in the presence of the manufacturer's[and Government's representative at Kennedy Space Center]. Supply all materials and tools required for the demonstration splices and terminations. Submit each splice or termination performed by individuals without manufacturer's certification to the manufacturer for testing and subsequent certification. Proof of certification will be verified by the [NASA] [_____] Contracting Officer's Technical Representative prior to installation of any splices or terminations. Certification is not required for load break elbows and dead break connectors.

Once a splice or termination has been started by a splicer, ensure the same splicer completes that particular splice, and that each termination and splice is started and completed in one continuous work period.

Maintain and submit a list of splices and terminations to be installed by splicer/terminator. Ensure the list includes the following for each splice or termination completed, and if a splice or termination fails after energizing, then the splicer/terminator making the splice is required to be recertified on the type that failed by the manufacturer prior to making any such future splices or terminations at KSC.

a. Name of splicer/terminator.

b. Date splice or termination was performed.

c. Location of splice or termination. For terminations at equipment indicate equipment number as required to completely define the location.

d. Feeder number.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Shipping

Ship the cable on reels in such a manner that the cable is protected from mechanical injury. Hermetically seal every cable end of each length using heat-shrinkable molded cable end caps to exclude moisture and securely attached to the reel.

Ensure the minimum diameter of the reel drum is 14 times the overall diameter of the cable. For reels less than 1524 millimeters 60 inches in diameter, provide arbor holes sized for 65 millimeters 2-1/2 inches spindles; for those greater than 1524 millimeters 60 inches in diameter, provide arbor holes sized for 76 millimeters 3 inch spindles. Ensure reel sizes accommodate reel lengths specified in the purchase order, and that each reel contains only one length of cable cut to order.

Provide each reel with an arrow and appropriate wording, stenciled in plain view on each side, indicating proper rotation of reels. Plainly mark each reel on each side, and attach a tag to the cable end inside the lagging, stating the following information:

a. Purchaser's order number

b. Complete description of cable including manufacturer, cable size, voltage rating, percent insulation rating, insulating material, conductor size(s), year of manufacture

c. Actual shipping cable (reel) length

d. Reel number (e.g. 2 of 10)

e. Gross weight (i.e. with reel) and net weight (i.e. cable only)

Ship reels in a vertical position, sufficiently blocked in the bed of shipping vehicle to preclude movement.

PART 2 PRODUCTS

2.1 CONDUCTORS

2.1.1 Material

Provide annealed copper core (phase) conductor material in accordance with ASTM B8.

2.1.2 Stranding

Provide Class B stranded conductors.

2.2 CABLE IDENTIFICATION

Provide cables with printing on the outer jacket showing the cable type, name of the manufacturer, the year in which the cable was manufactured, sequential cable reel length markings and a unique number for identification purposes. Closely group the information on the tape at 1.8 meters 6 foot maximum intervals to permit complete identification.

2.3 15 KV CABLES

****
NOTE: Due to the high available fault currents on Kennedy Space Center's 5 kV and 15 kV systems, minimum conductor and concentric neutral sizes are required. For most areas of KSC, use at least No. 4/0 AWG with full neutral or 350 kcmil with 1/3-neutral. Areas far from supply substations can use smaller cable sizes. Specify 12.7 cm 5-inch minimum conduit size.
****

2.3.1 General; 15 kV Cable

Provide single conductor 15 kv shielded cable assemblies consisting of:

a. Conductor core described above, an extruded semiconductor shield over the conductors

b. 5.59 millimeter 220 mils of ethylene-propylene-rubber (EPR) insulation

c. An extruded semiconductor insulation shield, a concentric neutral

d. A polyethylene (PE) jacket.

Ensure cable is rated for minimum 90 degrees C 194 degrees F continuous conductor temperature and 130 degrees C 266 degrees F emergency overload.

Provide single-conductor, ethylene-propylene-insulated, polyethylene-jacketed, shielded cable conforming to ICEA S-94-649 and AEIC CS8.

2.3.2 15 kV Cable Conductor Shielding

Provide conductors with a stress control layer consisting of extruded material applied between the conductor and the insulation to form a conductor shield (strand screen). Ensure material has proven long-term chemical compatibility with both the conductor and overlying insulation materials, and that the stress control layer meets the electrical and physical requirements of ICEA S-94-649.

2.3.3 Insulation; 15 kV Cable

Provide ozone resistant insulation material, of extruded thermosetting ethylene-propylene based polymer, capable of withstanding the continuous and emergency overload temperature ratings of the conductor.

2.3.4 Non-metallic Insulation Shield; 15 kV Cable

Provide extruded insulation shield made of an extruded thermoset material compatible with the insulation and jacket. Ensure insulation shield is applied directly over and bonded to the insulation, and complies with AEIC CS8.

2.3.5 Concentric Neutral Shield; 15 kV Cable

Provide copper wires helically applied over the insulation shield, where the minimum total cross sectional area (of the shield wires) is 1/3 of the core conductor for 350 kcmil cable, and full core conductor for 4/0 cable. Minimum size of an individual shield wire is 1.6 millimeter No. 14 AWG.

2.3.6 Jacket; 15 kV Cable

Provide polyethylene jacketed cable (PE) extruded over the concentric neutral to a minimum thickness of 2 millimeter 80 mils.

2.4 5 KV CABLES

****
NOTE: Due to the high available fault currents on Kennedy Space Center's 5 kV and 15 kV systems, minimum conductor and concentric neutral sizes are required. For most areas of KSC, use at least No. 4/0 AWG with full neutral or 350 kcmil with 1/3-neutral. Areas far from supply substations can use smaller cable sizes. Specify 12.7 cm 5-inch minimum conduit size.
****

2.4.1 General; 5 kV Cables

Provide single conductor 5 kv shielded cable assemblies consisting of:

a. Conductor core described above, an extruded semiconductor shield over the conductors

b. 2.92 millimeter 115 mils of ethylene-propylene-rubber (EPR) insulation

c. An extruded semiconductor insulation shield, a concentric neutral

d. A polyethylene (PE) jacket.

Ensure the cable is rated for minimum 90 degrees C 194 degrees F continuous conductor temperature and 130 degrees C 266 degrees F emergency overload.

Provide single-conductor, ethylene-propylene-insulated, polyethylene-jacketed, shielded cable conforming to ICEA S-94-649 and AEIC CS8.

2.4.2 5 kV Cable Conductor Shielding

Provide conductors having a stress control layer consisting of extruded material applied between the conductor and the insulation to form a conductor shield (strand screen). Ensure material has proven long-term chemical compatibility with both the conductor and overlying insulation materials, and meets all electrical and physical requirements of

ICEA S-94-649.

2.4.3 Insulation; 5 kV Cable

Provide insulation material which is ozone resistant, extruded thermosetting ethylene-propylene based polymer, and capable of withstanding continuous and emergency overload temperature ratings of the conductor.

2.4.4 Non-metallic Insulation Shield; 5 kV Cable

Provide extruded insulation shield made of an extruded thermoset material compatible with the insulation and jacket. Ensure insulation shield is applied directly over and bonded to the insulation, and complies with AEIC CS8.

2.4.5 Concentric Neutral Shield; 5 kV Cable

Provide copper wires helically applied over the insulation shield. Minimum total cross sectional area of the shield wires is 1/3 of the core conductor for 350 kcmil cable, and full core conductor for 4/0 cable. Minimum size of an individual shield wire is 1.6 millimeter No. 14 AWG.

2.4.6 Jacket; 5 kV Cable

Provide polyethylene jacket (PE) extruded over the concentric neutral to a minimum thickness of 2 millimeter 80 mils.

2.5 INSULATED MEDIUM VOLTAGE CONNECTORS

Provide connector with a steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material per IEEE 386. Ensure connections are compatible with equipment bushings. Provide connectors as follows:

a. 200 Ampere loadbreak connector ratings: Voltage: 15kV, 95kV BIL. Short time rating: 10,000 amperes rms, symmetrical for a time duration of 0.17 seconds.

b. 600 Ampere deadbreak connector ratings: Voltage: 15kV, 95kV BIL. Short time rating: 27,000 ampere rms, symmetrical for a time duration of 4.0 seconds.

c. Provide connectors with a steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material per IEEE 386. [Provide hot line voltage indicators on all connectors.]

Ensure connections are compatible with equipment bushings.

2.6 SPLICES

Provide splice kits which are the product of a single manufacturer, meeting the requirements in the paragraph entitled, "Splices and Terminations," of this section.

Provide splices for 15 kV EPR cable specifically designed for NASA cable and grounding provisions which include but are not limited to the following:

a. Inner heat shrink stress control tube with external end sealant, additional heat shrink tube over inner tube and inner tube end sealant.

b. Heat shrink outer wraparound sleeve with heat sensitive indications on both the tube and rail/channel area to indicate proper torch heating, stress relief material, mastic, sealant, shielding mesh, and silicone grease.

2.7 TERMINATIONS

Provide Class 1 terminations per IEEE 48.

****
NOTE: Coordinate the following paragraph with Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION if Section 33 71 02 is used in this project.
****

2.8 CABLE SUPPORTS AND FITTINGS

[Provide cable supports, related fittings, and accessories for use in corrosive underground locations, such as manholes, with a factory applied coating of polyvinylchloride of at least [0.51] [_____] millimeter [20] [_____] mils thick. Ensure polyvinylchloride (PVC) coated items have a uniform thickness and are free of blisters, breaks, and holidays. Use PVC compound conforming to ASTM D746.

][Ensure cable racks, rack arms, cable tray supports and related fittings are UL listed [standard] [heavy]-duty nonmetallic [glass-reinforced nylon] [polycarbonate].

]2.9 CABLE TAGS IN MANHOLES AND AT TERMINATIONS

Provide tags for each cable or wire located in manholes and at each termination. Place tags on all cables indicated to have tags.

2.9.1 Polyethylene Cable Tags

Provide tags of polyethylene that have an average tensile strength of 31 MPa 4500 pounds per square inch, and are 0.9 millimeter 0.035-inch thick, non-corrosive non-conductive. Ensure tags are resistive to acids, alkalis, organic solvents, salt water, and are distortion resistant to 150 degrees C 300 degrees F. Provide a one-piece nylon, self-locking tie at each end of the cable tag. Ensure ties have a minimum loop tensile strength of 780 newtons 175 pounds. Provide cable tags with block letters, numbers, and symbols 25 millimeter 1 inch high on a yellow background. Ensure letters, numbers, and symbols do not fall off or change positions regardless of the cable tags orientation.

2.10 FIREPROOF TAPE

Provide fireproof tape approximately 0.8 millimeter 30 mils thick by 76 millimeters 3 inches wide, consisting of a flexible, unsupported elastomer that expands in fire to provide a thick char buildup between the flame and the cable. Ensure the tape does not give off a smoke when subjected to flames or support combustion. Also, ensure tape does not deteriorate when subjected to oil, water, gases, salt water, sewage and fungus.

2.11 FACTORY TESTING

Submit certified evidence that the cable manufacturer has made factory-conducted tests on each shipping length (reel) of cable. Submit certified copies of test data in accordance with applicable provisions of the referenced standard. Include in tests on each length of cable, conductor resistance; ionization; high voltage; partial discharge test.[Contracting Officer or designee has the option of witnessing required factory testing at no additional cost. Provide a schedule of manufacturing and testing in advance to permit such witnessing, if requested.]

Submit certified qualification test reports in accordance with AEIC CS8 made in accordance with the applicable referenced standards. Ensure certified copies of test data show conformance to the requirements of referenced standards and submit for approval prior to shipment of the cable.

Prior to manufacturing, provide data regarding degradation of proposed insulating material and cable performance due to water immersion test as specified in this specification to the Contracting Officer or designee. Indicate in information AC breakdown stress in kV/mm or V/mil versus immersion time. Ensure a complete description and condition under which cable was tested accompanies the test information. Submit an accelerated water absorption test.

PART 3 EXECUTION

3.1 DEMOLITION OR CABLE CUTTING

Notify the Contracting Officer 14 working days prior to an outage for demolition or cable cutting of medium voltage electrical system.

The Government has established a mandatory inspection point prior to Contractor performing any medium voltage cable cuts or demolition. Notify the Contracting Officer 48 hours in advance of this mandatory inspection point.

As part of the mandatory inspection point, positively identify and label the medium voltage cable to be worked utilizing an electronic cable identifier. Ensure the process of identifying and labeling the cable to be worked is witnessed by the Government. Cable cutting and demolition of any medium voltage cable can occur only after approval by the Contracting Officer.

3.2 INSTALLATION

Install medium-voltage cables in accordance with NFPA 70, and NFPA 70E.

[Refer to contract provisions for safety submittals and requirements associated with working in the vicinity of energized cables and equipment. The use of arc-flash and shock prevention equipment and personal protective equipment is mandatory.

] Notify the Contracting Officer 14 working days prior to an outage that requires testing for phasing and phase rotation of 15 KV medium voltage electrical systems. The [Institutional Services Contractor(ISC)][_____] will identify and tag the phasing of equipment and provide to the Contractor, in writing, the results of phasing and phase rotation tests. The Contractor is responsible for maintaining the phasing and phase rotation tests, and is responsible for maintaining the phasing, and

matching the existing phase rotation and phasing when installing conductors in existing electrical systems.

Install the cables in the following locations:

Exterior:

a. In underground duct banks

b. In conduit above and below grade

c. In manholes

d. And by direct burial

Inside Buildings:

a. By open wire method

b. On insulator hooks

c. On racks

d. In wall and ceiling mounted cable trays

Installed cable or conductors of a primary distribution system will be rejected by the Government when placed:

a. Openly in cable trays or openly racked along interior walls

b. In the same raceway or conduit with AC/DC control circuits or AC power circuits operating at less than 600 volts

c. In a manner allowing the cable to support its own weight

3.2.1 Protection During Splicing Operations

Provide blowers to force fresh air into manholes or confined areas where free movement or circulation of air is obstructed. Ensure waterproof protective coverings are available on the work site to provide protection against moisture while a splice is being made. Use pumps to keep manholes dry during splicing operations. Under no conditions, make a splice or termination with the interior of a cable exposed to moisture. Moisture-test conductor insulation paper before the splice is made. Use a manhole ring at least [150] [_____] millimeter [6] [_____]-inches above ground around the manhole entrance to keep surface water from entering the manhole. Plug unused ducts and stop water seepage through ducts in use before the splice is started.

3.2.2 Duct Cleaning

****
NOTE: Delete the title and the following paragraph if the installation of power cables is in ducts and manholes provided under this project. Provisions for cleaning new duct are adequately covered in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.
****

Thoroughly clean ducts before installation of power cables. Pull a standard flexible mandrel through each duct to loosen particles of earth, sand, or foreign material in the line.

3.2.2.1 PVC Duct

Ensure mandrel length is not less than 300 millimeters 12 inches long and has a diameter 13 millimeters 1/2 in less than the inside diameter of the duct. Pull a stiff bristled brush through each duct to remove the loosened particles. Ensure brush diameter is the same or slightly larger than the diameter of the duct.

3.2.2.2 Existing Fiber (Orangeburg) Duct

Push rod through duct. Pull a series of four 50 millimeters 2 inch wire brushes back and forth through the duct. Progressively increase the size of the four wire brushes until four 100 millimeters 4 inch wire brushes can be pulled back and forth, and all of the debris has been removed. Next pull a flexible mandrel with two 100 millimeters 4 inch heavy duty wire brushes on each side through the duct. Ensure mandrel is not less than 300 millimeters 12 inches long, and has a diameter that is 13 millimeters 1/2 inchto 25 millimeters 1 inch less than the inside diameter of the duct. Next, pull a 1.5 meters 5 foot section of sample cable, equivalent to what is being used. Make the final cable pull on the same day the sample cable was pulled.

3.2.3 Pulling Cables in Ducts and Manholes

3.2.3.1 Pulling Procedures

Pull medium-voltage cables into ducts with equipment designed for this purpose, including power-driven winch, jamb skid, cable-feeding flexible tube guide, long radius quadrant block cable pulling sheaves, pulling eyes, and lubricants. Employ a sufficient number of trained personnel and equipment with two-way radio communication capability to ensure the careful and proper installation of the cable.

Set up cable reel at the side of the manhole or tunnel hatch opening and above the duct or hatch level, allowing the cable to enter through the opening without reverse bending. Install a flexible tube guide through the opening in a manner that prevents the cable from rubbing on the edges of any structural member (manhole frame, chimney, duct, etc.).

Use two long-radius 760 millimeter 30 inches minimum quadrant block cable pulling sheaves and necessary jamb skid support at the pulling end to ensure that sidewall pressures during pulling is not excessive. Use a dynamometer in the pulling line to ensure that the pulling force is not exceeded. Ensure the pulling force does not exceed the smaller of: allowable tension on pulling device, allowable tension on cable, or the tension which produces the allowable sidewall pressure. The allowable tension on the pulling device is 28,900 newtons 6500 pounds for pulling eyes [and 4400 newtons 1000 pounds for pulling grip (where allowed)]. Do not exceed the allowable tension on cable, using the allowable tension value computed from the following equation:

TM =0.036 X N X CM

Where: TM = maximum allowable pulling tension in newtons pounds

N = number of conductors in the cable

CM = cross-sectional area of each conductor in square millimeter circular mils

3.2.3.2 Allowable Sidewall Pressure

The allowable sidewall pressure is the smaller of 7300 newtons per meter 500 pounds per foot of bend radius or the cable manufacturer's recommended maximum value. Show in the pulling plan submittal the calculations for allowable tension and sidewall pressure as well as the anticipated tension and sidewall pressure for each pull in the project.

Unreel cable from the top of the reel, carefully controlling payout. Attach cable to be pulled through a swivel to the main pulling wire by means of a [pulling eye installed by the factory or approved cable splicer] [suitable cable grip permitted only on cables less than 60 meter 200 feet long and less than 50 millimeter 2 inches in diameter].

Attach pulling eyes to the cable conductors of the 3-1/C circuit to prevent damage to the cable structure. Pull the entire 3-1/C circuit simultaneously.

3.2.3.3 Minimum Bending Radius

Minimum bending radius during cable pulling operations is 760 millimeter 30 inches. For permanent cable bending/racking the minimum bending radius is 12 times cable diameter.

3.2.3.4 Coating of Cables

Liberally coat cables with a suitable cable-pulling lubricant as it enters the tube guide or duct. Do not use greaser and oil lubricants. Cover nonmetallic sheathed cables with wire-pulling compounds, when required, which have no deleterious effects on the cable. Use rollers, sheaves or tube guides, around which the cable is pulled, conforming to the 760 millimeter 30 inches minimum bending radius of the cable during the pulling operations.

3.2.3.5 Pulling Speed

Pull cables into ducts at a speed not to exceed [15] [_____] meters per minute 50 feet per minute and not in excess of maximum permissible pulling tension specified by the cable manufacturer. Cable pulling using a vehicle is not be permitted. Stop pulling operations immediately with any indication of binding or obstruction and do not resume until such difficulty is corrected. Provide sufficient slack for free movement of cable due to expansion or contraction.

3.2.3.6 Cable Splice Support And Sealing

Firmly support cable splices made up in manholes on cable racks as indicated. Do not pull cable splices in ducts. Overlap cable ends at the ends of a section to provide sufficient undamaged cable for splicing. Overlap cables to be spliced in manholes to the centerline of the proposed joint by not less than [600] [_____] millimeters 2 feet.

Immediately seal cut ends of cables cut in the field to prevent entrance of moisture with heat-shrinkable molded cable end caps.

3.2.4 Splices and Terminations

Field fabricate terminations from termination kits supplied by, and in accordance with, the termination manufacturer's recommendations for the type, size, and electrical characteristics of the cable specified.

Make splices in manholes or direct buried cable as shown on the drawings. Make cable terminations at equipment specifically indicated. Expedite splicing and terminating of cables to minimize exposure and cable deterioration.

Field fabricate cable splices from pre-molded or heat-shrinkable splicing kits supplied by, and in accordance with, the cable manufacturer's recommendations for the type, size, and electrical characteristics of the cable specified. Locate cable splices in manholes midway between cable racks on walls of manholes and supported with cable arms at approximately the same elevation as the enclosing duct.

Use only equipment and materials recommended by the splice manufacturer including calibrated cutting equipment to ensure consistent cut depths when preparing cable ends for the application of the splice kit. Connect the cable concentric neutral/shield wires across one side of the splice by split bundling the splice neutral wiring and connecting each bundle set to a continuous No. 4 AWG solid bare copper conductor via two compression conductors. Ensure the No. 4 AWG conductor extrudes from the cable splice jacket and connects to the manholes grounding system. Make all connections within the splice utilizing long barrel-type compression connectors and appropriate compression tools with proper size dies to ensure a satisfactory mechanical and electrical joint. Ensure bare connections of concentric neutral/shield wires are either contained within the splice kit or sealed via an additional outer covering,consisting of a heavy wall, heat-shrinkable tubing containing adhesive material (mastic) that melts as heat is applied and the outer tubing shrinks to form a moisture proof environmental seal. Provide outer tubing conforming to ANSI C119.1. Ensure splice meets the requirements of IEEE 404 for a 15 kV rating and is rated by the manufacturer for use on 15 kV class feeder cable systems. Take extra precautions to seal around the exit area of the bare copper jumpers with an additional mastic per the splice manufacturer's recommendations.

Terminate cables in approved cable terminations, rated Class 1 per IEEE 48. Dry terminations with medium voltage pennants, preformed, and hand wrapped stress cones can be used for terminating cables. Provide terminations with adequate means for making external connections to the cable conductors of single-conductor cables (phase and concentric neutral), protecting the cable insulation against moisture, oil, or other contaminants. Take extra precautions in physically protecting and supporting cables, and maintaining the insulation level of the cable.

Include in installation built-up or prefabricated heat or cold shrink stress-relief cones at the terminals of all shielded cables and at the terminals of single-conductor lead-covered cables rated 15 kV and above.

Install cable splices on cable racks or by other approved methods which minimizes physical stress on the splice connections. Support splices at approximately the same elevation as the installed cable, except where space limitations or existing cable length limitations make this method impractical or impossible.

Support all universal demountable splices in such manner so as to minimize physical stress on the splice connections. Support each cable end termination using a pair of saddle type supports under the cable end termination and/or cable with a minimum [300] [_____] millimeter 12 inches and a maximum [750] [_____] millimeter 30 inches separation between the supports. Secure cable end termination and cable to the supports in such a manner as to prevent movement of termination or cable at the support. Install saddle type supports on galvanized steel framing channel anchored to the wall or securely fastened to the cable tray or installed by other approved methods.

3.2.5 Fireproofing

Provide fireproofing (Arc Proofing) for individual cable conductor in manholes, handholes and vaults which carry current at 2200 volts or more.

Tightly wrap strips of fireproofing tape around each cable spirally in half-lapped wrapping. Extend the tape 25 millimeter 1 inch into the ducts. To prevent unraveling, random wrap the fireproofing tape the entire length of the fireproofing with pressure-sensitive glass cloth tape.

3.2.6 Cable Tag Installation

Install cable tags in each manhole and at each termination as specified. Install cable tags over the fireproofing and position the tags so that they are clearly visible without disturbing any cabling or wiring in the manholes and equipment.

****

NOTE: Although NETA ATS, NETA MAINT and referenced standards indicate higher DC High Potential test voltages, KSC has elected to use the values shown below.

****

3.3 FIELD TESTING

After the installation of power cables has been completed, including splices, joints, and terminations, and before the cable is energized, subject each medium voltage cable to field testing in accordance with the following requirements:

a. Provide test equipment, labor, and trained technical personnel as necessary to perform the electrical acceptance tests.

b. Obtain a KSC medium voltage cable test form from the Contracting Officer prior to commencing Field Testing. Record all tests on forms provided, and submit completed forms to the Contracting Officer.

c. Make arrangements to have tests witnessed and approved by the Contracting Officer.

d. Isolate each power-cable installation completely from extraneous electrical connections at cable splices/terminations and joints. Observe all safety precautions.

e. Ensure each power cable is first given an insulation resistance test using a meg-ohmmeter with a voltage output of at least 2,500-volts.

Apply test for a long enough time to fully charge the cable (no less than one minute). Record readings as indicated on forms provided. The minimum reading is 5000 megohms at an ambient temperature of 20 degrees C 68 degrees F. Correct readings taken at other than 20 degrees C 68 degrees F ambient temperatures accordingly.

f. Conform testing to NETA ATS, and NETA MAINT.

Upon successful completion of the insulation resistance test, subject the cable to a Very Low Frequency (VLF) AC high potential test. Adhere general VLF testing measures, parameters, considerations, and results to the following:

a. Ensure test voltage duration is continuous duty for 30 minutes (non-interrupted)

b. Provide the test equipment to test the cable capacity in microfarads and record on the KSC Medium Voltage AC Hi-pot test form (VLF).

c. Provide the test equipment to generate the test voltages required for the 30 minute test duration and adhere to the following table:

VLF Test Voltage for Sinusoidal Waveform

Cable Rating phase to phase	Acceptance (phase to ground test values)	Acceptance (phase to ground test values)
	(New cable)	(Existing cable spliced to new cable)
(rms voltage, KV)	(peak voltage, KV)	(peak voltage, KV)
[5]	[14]	[10]
[15]	[28]	[22; (EPR TO EPR)]
[15]	[15]	[15; (EPR TO NON-EPR)]

d. Ensure the sinusoidal test frequency is 0.1 Hertz.

e. Do not perform test on cable attached to equipment.

****

NOTE: Include, but do not limit Acceptance test values to peak voltage, frequency, and duration, with respect to the cable rating, and clearly identify each on the test submittal, with pass/fail results identified per cable installation (refer to IEEE 400.2). Notify Contracting Officer or Contracting Officer's Technical Representative 48 hours prior to test start. All testing will be witnessed by the Government.

****

Ensure Splices/terminations are clean, dry, and tested per IEEE 48 and IEEE 400.2.

Perform and submit radiographic tests on all splices/terminations at the discretion of the Contracting Officer to determine if voids exist. Rework unacceptable cable, splices or terminations at no additional expense to the Government.

-- End of Section --

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA/KSC-26 05 19.33 98 (July 2020)

Preparing Activity: NASA

Superseding
NASA/KSC-26 05 19.33 98 (February 2014)
NASA/KSC-26 05 19.00 98 (October 2007)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
****

SECTION TABLE OF CONTENTS

DIVISION 26 - ELECTRICAL

SECTION 26 05 19.33 98

MINERAL-INSULATED (MI) CABLE

07/20

-- End of Section Table of Contents --

****
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA/KSC-26 05 19.33 98 (July 2020)

Preparing Activity: NASA

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NASA/KSC-26 05 19.33 98 (February 2014)
NASA/KSC-26 05 19.00 98 (October 2007)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
****

SECTION 26 05 19.33 98

MINERAL-INSULATED (MI) CABLE
07/20

****
NOTE: This specification covers the requirements for this KSC local specification covers mineral insulated (MI) electrical cables.

This section is not to be changed but used in its entirety whenever (MI) cable is required on the project. Notes are for designer information and do not appear in the final project specification.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Recommended changes to a NASAKSC Master Specification Section should be submitted as a Criteria Change Request (CCR) to the appropriate Technical Proponent (TP) through the SpecsIntact Help Desk.
****

PART 1 GENERAL

****
NOTE: If Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL and Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS are not included in the project specification, insert applicable requirements therefrom and delete the following paragraph.

****

Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL and Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS apply to work specified in this section.

All work in this section that is covered by procedure 79K06110 is to be in accordance with Specification 79K06110.

1.1 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

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.

****

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

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (2023) National Electrical Safety Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2023) National Electrical Code

1.2 RELATED REQUIREMENTS

This section references Kennedy Space Center document 79K06110, Procedure for MI Cable Termination. Coordinate with Contracting Officer (CO) to obtain a copy of this procedure document.

1.3 SUBMITTALS

****

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

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

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 REPORTING.

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Mineral-Insulated (MI) Cable[; G]

Sealing Compound[; G]

SD-06 Test Reports

Test Report[; G]

SD-07 Certificates

Mineral-Insulated (MI) Cable[; G]

Sealing Compound[; G]

1.4 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Ensure equipment, materials, installation, and workmanship are in accordance with the mandatory and advisory provisions of NFPA 70, IEEE C2 unless more stringent requirements are specified or indicated.

1.5 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Provide products which have been in satisfactory commercial or industrial use for 2 years prior to bid opening. Ensure the 2-year period includes applications of equipment and materials under similar circumstances and of similar size. Ensure the product has been on sale on the commercial market through advertisements,

manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items must be products of a single manufacturer.

PART 2 PRODUCTS

2.1 MINERAL-INSULATED (MI) CABLE

Provide MI cable consisting of soft annealed, uncoated, copper conductors insulated with a highly compressed refractory mineral insulation and complying with NFPA 70.

2.2 SEALING COMPOUND

Ensure sealing compound is in accordance with Kennedy Space Center procedure 79K06110.

PART 3 EXECUTION

3.1 GENERAL

Measure the length of cable needed for a particular run. Make allowance for the length of conductor needed at each end to properly make the desired terminations and add minimum of 48 inches 1220 millimeter of cable to be wrapped into a service loop at each end to the required length.. Cut cable to the necessary length with a hacksaw. Do not use cable cutters and other cutting tools that exert excessive pressure on the metallic sheath. Immediately following cutting, seal both ends of the cable in accordance with Kennedy Space Center procedure 79K06110 to prevent moisture penetration of the insulation. Cut cable immediately preceding installation.

Train cable into place by hand wherever possible. On straight runs, place into its final position by tapping cable with a wooden mallet, block, or plank.

Avoid sharp bends and kinks during preliminary handling and training.

Support cable at least every 1800 millimeter 6 feet during handling and training.

Make bends by approved template or hand hickey. Minimum bending radius of the inside edge of any bend is five times the diameter of the cable.

Make cable termination in accordance with Kennedy Space Center procedure 79K06110.

Support MI cables as shown in the contract drawings. Intervals between supports are not to be more than 1800 millimeter 6-feet on both horizontal and vertical runs. MI cable installed in ducts, raceways, conduits, and cable trays is deemed adequately supported along horizontal runs. Wrap cable with an adhesive heat-resistant glass tape at each support point to minimize electrolysis between the cable sheath and the supports. Minimum thickness of wrap is 0.36 millimeter 14-mils (two complete wraps of 0.18 millimeter 7-mil tape). Extend wrap past the support device a minimum of 6.4 millimeter 1/4-inch on each side. As an alternative to the tape wrapping, MI cable with a plastic jacket may be used.

Ensure no splices are made in runs of MI cable unless specifically shown in

the contract drawings. If splices are shown, make splices only in junction boxes.

3.2 TESTS

Test MI cables in accordance with Kennedy Space Center procedure 79K06110. Furnish a copy of the completed test report to the Contracting Officer

-- End of Section --

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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NASA/KSC-26 05 19.33 98 (February 2011)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
****

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DIVISION 26 - ELECTRICAL

SECTION 26 05 63.00 98

COORDINATED POWER SYSTEM PROTECTION AND ARC FLASH ANALYSIS

07/20

-- End of Section Table of Contents --

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA/KSC-26 05 63.00 98 (July 2020)

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NASA/KSC-26 05 19.33 98 (February 2011)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
****

SECTION 26 05 63.00 98

COORDINATED POWER SYSTEM PROTECTION AND ARC FLASH ANALYSIS
07/20

****
NOTE: This specification covers the requirements for the coordinated protection and arc flash analysis and labeling of electrical power systems.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Recommended changes to a NASAKSC Master Specification Section should be submitted as a Criteria Change Request (CCR) to the appropriate Technical Proponent (TP) through the SpecsIntact Help Desk.
****

PART 1 GENERAL

1.1 REFERENCES

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NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

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reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

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

****

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.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 242	(2001; Errata 2003) Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems - Buff Book
IEEE 399	(1997) Brown Book IEEE Recommended Practice for Power Systems Analysis
IEEE 1584	(2018; E 2019) Guide for Performing Arc-Flash Hazard Calculations
IEEE C2	(2023) National Electrical Safety Code

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2021) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA Z535.4	(2011; R 2017) Product Safety Signs and Labels

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023) National Electrical Code
NFPA 70E	(2024) Standard for Electrical Safety in the Workplace
UFC 3-310-04	(2013) Seismic Design for Buildings

1.2 PRE-INSTALLATION SUBMITTALS

No later than [90] [_____] days after Contract Award and prior to submission of electrical equipment and protective device product data, submit the following to the Contracting Officer for review and approval:

a. Fault Current Analysis

b. System Coordinator qualifications

c. Testing Agency qualifications[

d. Proposed Test Plan]

1.3 SUBMITTALS

****

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

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

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 REPORTING.

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Fault Current Analysis[; G][

] Proposed Test Plan[; G]

SD-03 Product Data

Software[; G]

Arc Flash Hazard Analysis[; G]

Protective Device Coordination Study[; G]

Equipment Evaluation Report[; G]

SD-04 Samples

Arc Flash Label Samples[; G]

SD-06 Test Reports

Field Testing[; G]

SD-07 Certificates

System Coordinator[; G]

Qualifications Of Testing Agency[; G]

Certificate of Conformance[; G]

1.4 ADMINISTRATIVE REQUIREMENTS

1.4.1 Review Submittals and Meetings

Submit the following to the Contracting Officer for review and approval:

a. Arc Flash Hazard Analysis Review Submittal

b. Protective Device Coordination Study Review Submittal

The Contractor and System Coordinator [agree to attend a review meeting at a location designated by the Contracting Officer and] provide review submittals as follows:

a. 90 percent submittal[and review meeting]: Study is complete except for disposition of Government comments.

b. 100 percent submittal: Incorporates approved Government comments. Setting sheets and test procedures from these documents are to be used to implement protective device settings.

[1.4.1.1 Proposed Test Plan

Submit a proposed test plan, consisting of complete field test procedure including tests to be performed, test equipment required, and tolerance limits, including complete testing and verification of the ground fault protection equipment, where used.

]1.4.2 Field Changes

If field changes are required due to discrepancies between the setting sheet documents and the available setting selections on the protective device, submit within [10] days after installation the following to the Contracting Officer for review and approval:

a. Fault Current and Arc Flash Analysis

b. Protective Device Coordination Study

1.5 QUALITY ASSURANCE

Ensure all work performed is in conformance with the following standards:

IEEE C2

IEEE 1584

NEMA Z535.4

NETA ATS

NFPA 70

NFPA 70E

1.5.1 System Coordinator

Provide documentation verifying that system coordination, recommended ratings and settings of protective devices, and design analysis are prepared (performed/reviewed/approved) by a registered professional electrical power engineer with a minimum of [three][_____] years of current experience in the coordination of electrical power systems.

Provide a list of references complete with points of contact, addresses and telephone numbers. The selection of the engineer is subject to the approval of the Contracting Officer.

1.5.2 Testing Agency

Ensure all final calibration, testing, adjustment, and placing into service of the protective devices must accomplished by an independent testing company with a minimum of [two] [_____] years of current product experience in protective devices. Submit name and qualifications of testing agency. Ensure the organization has a calibration program, and test instruments used must be calibrated in accordance with NETA ATS.

1.6 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this Section.

Coordinate requirements of this Section with all other Sections that specify electrical equipment and overcurrent protective devices.

1.7 PROJECT/SITE CONDITIONS

****
NOTE: Unusual service conditions for altitude start above 1005 m (3300 feet) for most apparatus. Unusual ambient temperature ranges are minus 30 to 40 degrees C, but other ambients may apply. Frequency is generally 60 Hz, although 50 Hz may also be standard. Fungus control for electrical devices is required only in tropical areas.

Provide seismic requirements, if a Government designer is the Engineer of Record, and show on the drawings. Delete the inappropriate bracketed phrase. Pertinent portions of UFC 3-310-04 and Sections 13 48 00 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT, 13 48 00.00 10 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT, and 26 05 48.00 10 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT, properly edited, must be included in the contract documents.
****

Provide devices and equipment suitable for the following seismic site conditions:

Provide Seismic details [conforming to UFC 3-310-04 and Sections 13 48 00

SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT, 23 05 48.19 [SEISMIC]BRACING FOR HVAC, and 26 05 48.00 10 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT] [as indicated].

a. Altitude: [_____]

b. Ambient Temperature: [_____]

c. Frequency: [_____]

d. Fungus Control: [_____]

e. Hazardous Classification: [_____]

f. Humidity Control: [_____]

g. Ventilation: [_____]

h. Seismic Parameters: [_____]

i. Other: [_____]

PART 2 PRODUCTS

****
NOTE: Select types to suit project conditions and delete all others. Delete all paragraphs not applicable.
****

2.1 SYSTEM DESCRIPTION

The power system covered by this specification consists of: [_____].

Drawing: [_____]

Sheets: [_____]

The Government will provide the short circuit values for the following connection points on the electrical system:

[_____]

[_____]

[The Government will provide the existing protective device settings for the following devices on the electrical system:

[_____]

[_____]]

[The Government will provide the existing protective device time-current curves for the following devices on the electrical system:

Curve Set 1:

[_____]

[_____]

[_____]

Curve Set 2:

[_____]

[_____]

[_____]

]2.2 SOFTWARE

Provide software complying with IEEE 399. Ensure software program is capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program must report device settings and ratings of all overcurrent protective devices and demonstrate selective coordination by computer-generated, time-current coordination plots.

2.3 ARC FLASH LABELS

Provide weatherproof detailed arc flash warning labels for all electrical equipment as required by NFPA 70 and NFPA 70E, including, medium voltage switches, transformers, switchgear main breakers, switchgear bus-tie breaker, switchgear feeder breakers, switchgear cable compartments, switchboards, panel boards, motor control centers, enclosed breakers, safety switches automatic transfer switches, motor starters, control panels, and other equipment modified or installed by the project that is likely to require examination, adjustment, servicing, or maintenance while energized.

2.3.1 Label Format

Label format is to be in compliance with NFPA 70E and KSC label format. Coordinate with Contracting Officer to obtain copies of software data file label format from previously completed projects. If data file is not available for approved software, contractor will be responsible for creating label format based on example labels provided. Format includes different colors for different incident energy levels per NEMA Z535.4. Ensure labels contain the following information:

a. Arc Flash hazard boundary

b. Incident energy

c. Working Distance

d. Nominal System Voltage

e. Limited approach boundary distance

f. Restricted approach boundary distance

Submit arc flash label samples provided at the time of award.

2.3.2 Label Content

Ensure arc flash label content is based on the operational scenario, fault

location, and fault type (arcing or bolted) that results in the highest incident energy (worst-case).

Ensure labels for panelboards reflect incident energy calculated on the line side of the main circuit breaker. Switchboards, switchgear, and motor-control centers with full height barriers separating sections of the equipment will have two labels. One label on the incoming section reflecting the incident energy on the lines side of the main protective device and one label for the distribution sections reflecting incident energy on the load side of the main protective device. Ensure bus names shown on labels clearly indicate which is calculated on the line side of the main protective device.

2.4 COORDINATED POWER SYSTEM PROTECTION

****

NOTE: The requirements for the studies in these paragraphs depend on the complexity and extent of the power system. Delete these requirements for: projects of limited scope; projects having protective devices which are not adjustable or for which coordination is not possible (standard molded case circuit breakers); projects involving simple extension of 600 volt level service to a building or facility from an existing transformer (750 kVA or less); or projects involving simple extension of 600 volt level service to a building or facility from a new transformer (750 kVA or less).

The designer is responsible for showing and specifying the requirements for fuses, circuit breakers, protective relays, or other protective devices associated with the project. The protective devices should be selected and specified to protect electrical power system conductors or equipment against sustained overloads, in-rush conditions, electrical faults, or other abnormal power system or equipment operating conditions, in accordance with UFC 3-520-01, IEEE 242, and IEEE Std 141.

The complexity and extent of coordinated power system protection depends on the type of buildings or facilities required, on the load demand of facilities, and on the quantity and types of facilities to be constructed. Facilities having a relatively-low power demand (e.g., 2500 kVA or less) generally require protection of: an incoming aerial distribution line or underground, medium-voltage feeder; low-voltage feeders to individual items of equipment, or to power distribution equipment, and branch circuits. More complex projects such as facilities with generating capacity, large motors, or larger load demands, will require more detailed and extensive coordinated power system protection.

Independent of the type or types of facilities or load demands, the coordinated power system protection will be based on: life safety, economics, simplicity, and the electrical power

availability dictated by the Using Agency or Service, or by the functional use of the facilities or utilities; requirement to provide maximum power service with a minimum of power interruptions; and the operating speed of protective devices required to minimize damage to electrical components or items of equipment and to prevent injury to personnel and nuisance tripping.

Unless otherwise approved, a dc power source will be shown and specified to ensure proper closing and tripping of protective devices which require a reliable power source during outage of the normal alternating-current power source.

****

Prepare and submit analyses to demonstrate that the equipment selected and system constructed meet the contract requirements for ratings, coordination, and protection. Include a fault current analysis and arc flash hazard analysis with equipment evaluation report, and a protective device coordination study. Final analysis reports must be signed and sealed by the System Coordinator.

Prepare and submit short circuit studies, [load flow studies,] [motor starting analysis,] [coordination studies,] and arc-flash hazard analysis in accordance with IEEE 1584, NETA ATS, and as specified herein.

2.4.1 Scope of Analyses

Ensure all equipment that requires testing, adjustment, or servicing while energized is included in the analysis. Provide labels for all panelboards, switchboards, switchgear, motor-control centers, variable frequency drives, and disconnect switches rated 100A and greater. Single phase equipment, disconnect switches rated less than 100A, junction boxes, pull boxes, and control panels may be excluded from the analysis.

Ensure the fault current and arc flash analysis, and protective device coordination study begin at:

[The source bus and extend down to system buses where fault availability is 10,000 amperes (symmetrical) for building/facility 600 volt level distribution buses.

][The source bus and extended through the secondary side of transformers for medium voltage distribution feeders.

][The source bus and extend through [outgoing breakers] [outgoing medium voltage feeders, down to the individual protective devices for medium voltage radial taps]

][Outgoing medium voltage feeders, through the secondary side of transformers

][[As indicated] for main electric supply substations.

][The nearest upstream device in the existing source system and extend through the downstream devices at the load end.

]2.4.2 Determination of Facts

****
NOTE: Require the Contractor to obtain an available fault capacity at the power source or provide a fault capacity on which to base the analysis. Delete the unused option.
****

Perform field inspections to determine and document the time-current characteristics, features, and nameplate data for each existing protective device. [Coordinate with the [commercial power company] [_____] for fault current availability at the site.] [Utilize the fault current availability indicated as a basis for fault current studies.]

2.4.3 Single Line Diagram

Prepare a single line diagram to show the electrical system buses, devices, transformation points, and all sources of fault current (including generator and motor contributions). A fault-impedance diagram or a computer analysis diagram may be provided. Ensure each bus, device or transformation point has a unique identifier. If a fault-impedance diagram is provided, show impedance data. Show the location of switches, breakers, and circuit interrupting devices on the diagram together with available fault data, and the device interrupting rating.

2.4.4 Fault Current Analysis

2.4.4.1 Method

Perform the fault current analysis in accordance with methods described in IEEE 242, and IEEE 399. Single line drawings based on existing hardware will be provided to the Contractor for reference. Utilize specialized computer aided engineering software designed for fault current analysis, including the following capabilities:

a. Single-ended substation source operation

b. Double-ended substation source operation

c. Generator source operation

Perform analysis and provide separate study report generated for each operational scenario.

2.4.4.2 Data

Utilize actual hardware data in fault calculations. Ensure bus characteristics and transformer impedance are those proposed. Document all data in the report.

2.4.4.3 Fault Current Availability

Provide balanced three-phase fault, bolted line-to-line fault, and line-to-ground fault current values at each voltage transformation point and at each power distribution bus. Show the maximum and minimum values of fault available at each location in tabular form on the diagram or in the report.

2.4.5 Coordination Study

Ensure the study demonstrates that the maximum possible degree of selectivity has been obtained between devices specified, consistent with protection of equipment and conductors from damage from overloads and fault conditions. Include a description of the coordination of the protective devices in this project. Provide a written narrative describing:

a. Which devices may operate in the event of a fault at each bus; the logic used to arrive at device ratings and settings;

b. Situations where system coordination is not achievable due to device limitations (an analysis of any device curves which overlap);

c. Coordination between upstream and downstream devices; and relay settings.

d. Provide recommendations to improve or enhance system reliability by reducing the incident energy level, and detail where such changes would involve additions or modifications to the contract and cost damages (addition or reduction).

Provide composite coordination plots on log-log graph paper.

a. Provide separate plots for phase and ground faults.

b. Include applicable cable and transformer damage curves on phase fault plots.

c. Limit the number of protective device curves on any plot to [5] [_____].

2.4.6 Study report

Include the following in the report:

a. A cover sheet and table of contents. Provide separate sections with all applicable content, for all operating scenarios.

b. A narrative describing:

(1) The analyses performed;

(2) The basis and methods used;

(3) The desired method of coordinated protection of the power system.

c. Descriptive and technical data for existing devices and new protective devices proposed, including manufacturers published data, nameplate data, time-current curves, and definition of the fixed or adjustable features of the existing or new protective devices.

d. Document [utility company data including system voltages, fault MVA, system X/R ratio, time-current characteristic curves, current transformer ratios, and relay device numbers and settings;] [and] [existing power system data including time-current characteristic curves and protective device ratings and settings].

e. Provide time-current characteristics curves for each bus in the system, as required to ensure coordinated power system protection between

protective devices or equipment, including recommended ratings and settings of all protective devices in tabulated form.

****

NOTE: Requirement to use SKM, ETAP, or other specific software packages will generally require approval of a sole-source justification. If no such justification has not been approved then do not select a particular software requirement.

****

f. Provide all calculations performed for the analyses. Include all information input to (define) nodes such as cable data, conduit type, circuit length, transformer impedance, bus impedance, generator impedances, etc. For all nodes include phase fault short circuit levels and X/R ratios, ground fault short circuit levels and X/R ratios, load flow levels, arc flash energy (for both bolted and arcing short circuit levels), and motor starting studying results. Indicate which study options have been chosen which the software utilizes to generate the Short Circuit Analysis and Arc Flash Hazard Analysis results; use preferred method below when available. Options included are, but not limited to the following:

(1) Standard used for arc-flash calculations: (IEEE 1584 - preferred method).

(2) 240 Volt Exceptions (report Cat 0 if XFMR less than 125kVA - preferred method).

(3) Maximum arcing time: (2 sec - preferred - fully dependent on task performed). For certain tasks, such as working in manholes, elevated work areas, or underneath equipment, it may not be possible for trained personnel to distance themselves from the Arc Flash within 2 seconds.

(4) Motor fault contributions: (5 cycles preferred - motors or motor groups totaling 50 hp or greater are to be evaluated).

(5) Levels Mis-coordination checked (5 levels-preferred).

(6) Mis-coordination Ratio: (80 percent - preferred - ensure Cleared Fault Threshold matches Mis-coordination Ratio).

(7) Flash Boundary Calculation Adjustments above 1kV, Trip Time less than =0.1s: (1.5 cal/square meter - preferred).

(8) Properly categorize all equipment types in Arc Flash Evaluation: (Ensure switchgear, panel boards have proper gap distance).

(9) Utility information from latest [_____] Area Load Flow and Fault Study ([_____] [local utility company only] -preferred).

(10) Short Circuit Study Utilized: (Comprehensive-preferred).

(11) Fault types analyzed: (Three Phase, Single Line to Ground, Line to Line, Line to Line to Ground, All -preferred).

g. Single line diagram(s)

h. Protective device setting sheets, as separate pages, suitable for use by installing technicians, separate from other report analysis and data. Include recommended changes to existing protective device settings and settings for all new protective devices. Provide all information to field install the settings, including settings or features not used or turned off.

i. Tabulated Arc Flash data for all equipment requiring an arc flash warning label and all modified equipment also requiring an arc flash label.

j. Equipment Evaluation Report (EER) showing the AIC/SCCR ratings for all equipment evaluated and the required rating for the application where the equipment is installed. Ensure the EER identifies underrated and marginally rated equipment. Underrated equipment is defined as equipment with actual AIC/SCCR ratings that do not meet the required AIC/SCCR rating for the application/installation. Marginally rated equipment is defined as equipment within 90 percent to 100 percent of the required rated AIC/SCCR for the application/installation.

PART 3 EXECUTION

3.1 INSTALLATION

Install and test protective devices settings in accordance with the manufacturer's published instructions and in accordance with the protective device coordination study protective device setting sheets and test plan.

Affix detailed arc flash warning labels to all electrical equipment as required by NFPA 70 and NFPA 70E.

3.2 FIELD TESTING

****
NOTE: Select types to suit project conditions and delete all others. Delete all paragraphs not applicable.
****

3.2.1 General

Section 26 08 00 APPARATUS INSPECTION AND TESTING, applies to this section, with the additions and modifications specified herein. Submit Performance Test Reports ishowing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Indicate in each test report the final position of settings and controls. Submit Certificate of Conformance to the Contracting Officer, certifying that all devices or equipment meet the requirements of the contract documents.

3.2.2 Safety

Provide and use safety devices such as arc flash personal protective equipment, electrically insulating rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. Replace any devices or equipment which are damaged due to improper test procedures or handling.

3.2.3 Molded-Case Circuit Breakers

Visually inspect circuit breakers. Verify current ratings and adjustable settings incorporated in accordance with the coordination study.

3.2.4 Power Circuit Breakers

3.2.4.1 General

Visually inspect the circuit breaker and implement settings in accordance with the coordination study.

3.2.4.2 Current Injection Tests

****
NOTE: These tests below are typical for NETA acceptance testing as specified in Section 26 08 00 APPARATUS INSPECTION AND TESTING or other protective device sections and should be coordinated between sections accordingly.
****

Test with approved settings installed in accordance with NETA ATS and the Test Plan; document results in the field test reports.

a. Determine long time pick-up value and delay by primary current injection.

b. Determine short time pick-up value and delay by primary current injection.

c. Determine instantaneous pick-up value by primary current injection.

d. Determine ground-fault pick-up value and delay by primary current injection.

e. Test trip unit functions by secondary current injection or in accordance with the manufacturer's requirements.

3.2.5 Protective Relays

3.2.5.1 General

Visually inspect protective relays. Implement relay settings in accordance with the coordination study.

3.2.5.2 Current Injection Tests

Test with approved settings installed in accordance with NETA ATS and the Test Plan; document results in the field test reports.

a. Determine long time pick-up value and delay by secondary current injection.

b. Determine short time pick-up value and delay by secondary current injection.

c. Determine instantaneous pick-up value by secondary current injection.

d. Determine ground fault pick-up value and delay by secondary current injection.

-- End of Section --

****
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA/KSC-26 23 00.00 98 (July 2020)

Preparing Activity: NASA

Superseding
NASA/KSC-26 23 00.00 98 (October 2007)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
****

SECTION TABLE OF CONTENTS

DIVISION 26 - ELECTRICAL

SECTION 26 23 00.00 98

LOW-VOLTAGE SWITCHGEAR

07/20

-- End of Section Table of Contents --

****
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
****

SECTION 26 23 00.00 98

LOW-VOLTAGE SWITCHGEAR
07/20

****
NOTE: This specification covers the requirements for switchgear and switchboards of special design or configuration.

For primary-unit substations, use Section 26 11 13.00 20 PRIMARY UNIT SUBSTATION; for secondary-unit substations, use NASA Section 26 11 16 SECONDARY UNIT SUBSTATIONS; for motor-control centers, use Section 26 24 19.00 40 MOTOR-CONTROL CENTERS; for power panelboards, use Section 26 24 16.00 40 PANELBOARDS.

Drawings must show switchgear/switchboard elevation, dimensions, devices, instruments, and installation.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Recommended changes to a NASAKSC Master Specification Section should be submitted as a Criteria Change Request (CCR) to the appropriate Technical Proponent (TP) through the SpecsIntact Help Desk.
****

PART 1 GENERAL

1.1 REFERENCES

****
NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

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

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.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2020; Errata 1 2021) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A240/A240M	(2023) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A307	(2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A572/A572M	(2021; E 2021) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A1008/A1008M	(2021a) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
ASTM E84	(2023) Standard Test Method for Surface

	Burning Characteristics of Building Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 802.3	(2022) Ethernet
IEEE C2	(2023) National Electrical Safety Code
IEEE C37.13	(2015) Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C37.16	(2009) Standard for Preferred Ratings, Related Requirements, and Application Recommendations for Low-Voltage AC (635 V and below) and DC 3200 V and below) Power Circuit Breakers
IEEE C37.20.1	(2015) Standard for Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear
IEEE C37.17	(2022) Standard for Trip Devices for AC and General-Purpose DC Low-Voltage Power Circuit Breakers
IEEE C37.20.2	(2022) Metal-Clad Switchgear
IEEE C37.20.7	(2017; Corr 2021) Guide for Testing Switchgear Rated Up to 52 kV for Internal Arcing Faults
IEEE C37.90	(2005; R 2011) Standard for Relays and Relay Systems Associated With Electric Power Apparatus
IEEE C57.12.28	(2014) Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.12.29	(2014) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments
IEEE C57.13	(2016) Standard Requirements for Instrument Transformers
IEEE C63.2	(2009) Standard for Electromagnetic Noise and Field Strength Instrumentation, 10 Hz to 40 GHz - Specifications
IEEE C63.4	(2014) American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2021) Standard for Acceptance Testing

	Specifications for Electrical Power Equipment and Systems
NETA MTS	(2015) Standard for Maintenance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 3	(2013) Molded Case Circuit Breakers and Their Application
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
NEMA LI 1	(1998; R 2011) Industrial Laminating Thermosetting Products

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023) National Electrical Code
NFPA 70E	(2024) Standard for Electrical Safety in the Workplace

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS-STD-595A	(2017) Colors used in Government Procurement

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-568-C.3	(2008; Add 1 2011) Optical Fiber Cabling Components Standard

UNDERWRITERS LABORATORIES (UL)

UL 489	(2016; Rev 2019) UL Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 1558	(2016; Reprint Nov 2019) UL Standard for Safety Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear
UL 1666	(2007; Reprint Sep 2021) UL Standard for Safety Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts

1.2 SYSTEM DESCRIPTION AND GENERAL REQUIREMENTS

****

NOTE: Provide NASA Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL and Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS along with this specification.

****

NASA Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL and Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS apply to work specified in this section.

This specification details the requirements for electrical switchgear rated 600 volts and less.

1.3 SUBMITTALS

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

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

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 REPORTING.
****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Provide all submittals in electronic format. Where multiple submittals are provided under single cover provide bookmarked PDF file. Bookmarks must be titled and configured to link to individual submittals, materials, or products as identified in this specification section. Multiple submittals provided under single cover that are not organized in such a fashion to be easily navigated and reviewed will be rejected for resubmittal.

SD-02 Shop Drawings

Submit connection diagrams and shop drawings for approval prior to switchgear fabrication indicating the relations and connections of the following items by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Sequence of Operation[; G] for all switchgear operational modes

Schematics and Wiring Diagrams[; G]

Switchgear Monitoring and Control System[; G] hardware, software,

and interconnection drawings which include details of the power sources and communications pathways for devices accessed by KCCS

Switchgear Foundation Design Data[; G]

Fabrication Drawings[; G]

Weatherproof Pre-Fabricated Structure[; G]

KCCS Integration Design[; G]

Switchgear Drawings[; G]

As-Built Drawings[; G]

SD-03 Product Data

Submit manufacturer's catalog data for the following items:

Switchgear Components[; G] including all control switches and auxiliary relays

[Local/Remote Switches][; G]

[Control-Power Circuit Transfer Contactor][; G]

Space Heaters and Humidistat[; G]

Switchgear Monitoring and Control System[; G] including hardware as identified in this specification, software, and interconnection drawings which include details of the power sources and communications pathways for devices accessed by KCCS

[Uninterruptible Power Supply][; G]

Surge Protective Device[; G]

Switchgear Assembly[; G]

Electronic Trip Units[; G]

Unmanaged Ethernet Switch[; G]

Control Devices[; G]

Remote Racking System[; G]

SD-06 Test Reports

Submit Factory Test reports on switchgear assemblies in accordance with paragraphs, entitled "Factory Testing" of this section.

Submit Production test reports on switchgear assemblies for the following tests:

Switchgear Design Tests[; G]

Equipment Test Schedule[; G]

Switchgear Production Tests[; G]

Switchgear Paint Qualification Test[; G]

Integral Assembly Test[; G]

Auto-Transfer Sequence Factory Test Results[; G]

Monitoring And Control System Certification Test[; G]

SD-07 Certificates

Citect Scada Systems Integrator Qualifications[; G]

Testing Certificate Of Compliance[; G]

SD-08 Manufacturer's Instructions

Submit Manufacturer's Instructions for the Switchgear Assembly[; G] including special provisions required to install equipment components and system packages. Include special notices detailing impedances, hazards, safety precautions, and installation instructions.

SD-10 Operation and Maintenance Data

Switchgear Assembly[; G]Include manuals and materialson the following at a minimum:

Multi-function Relays

Circuit Breakers

Trip Units

Contactors

Metering

Programmable Logic Controller

HMI Touch Screen[

Uninterruptible Power Supply]

Switchgear Operation Procedures

All instruction leaflets and technical data

All software programs

Device address listing

Software data files

Function block program

All application software and screens

Detailed start-up report, including a list of customer trained individuals

List of programming and monitoring software and hardware

1.4 OPERATION AND MAINTENANCE DATA REQUIREMENTS

Include Operation and Maintenance Manuals for each Switchgear Assembly containing the following:

a. Instruction manuals for each device, including but not limited to multi-function relays, circuit breakers, trip units, contactors, metering, touch screens, [uninterruptible power supplies (UPS),]spare parts lists, and Programmable Logic Controllers(PLC), furnished in the switchgear.

b. Maintenance Manuals for each device, including but not limited to multi-function relays, circuit breakers, trip units, contactors, [control switches], metering, touch screens, [UPS units], recommended spare parts list, and PLCs, furnished in the switchgear.

c. Final as-built schematics, as-built one-lines, and as-built wiring diagrams (full point-to-point wiring tags) for the switchgear.

d. Integral switchgear operation procedures detailing all switching modes including, but not limited to loss of one source, loss of both sources, closed transition loss of PLC, loss of touch screen.

e. Sequence of Operation for all switchgear operational modes.

Provide Operation and Maintenance Manuals for the Switchgear Monitoring and Control System (SMCS) to include the following:

a. Instruction manuals for each device

b. Complete system description

c. All instruction leaflets and technical data

d. All software programs on CD ROM

e. Function block program and device address listing

f. Software data files and screens

g. Detailed start-up report including a list of customer trained individuals

h. List of programming and monitoring software and hardware

i. All application software and screens

Provide two (2) original licensed copies of all software with the final package.

1.5 QUALITY CONTROL

1.5.1 Manufacturer's Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship, and:

a. Have been in satisfactory commercial or industrial use for 2 years prior to bid opening including applications of equipment and materials under similar circumstances and of similar size.

b. Have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.

c. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

d. Products manufactured more than 1 year prior to date of delivery to site are not acceptable.

1.5.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" or "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Provide equipment, materials, installation, and workmanship in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.6 ENVIRONMENTAL REQUIREMENTS

1.6.1 General Requirements

Ensure items provided under this section are specifically suitable for the following service conditions:

a. Ambient Temperature: 50 degrees C120 degrees F

b. Frequency: 60 Hz

c. Humidity Control[

d. Hurricane Force Winds

e. Salt Fog Corrosive Atmosphere]

1.6.2 Humidity Control

Provide thermostatically and humidistatically controlled space heaters inside each section/cubicle of the substation as required to preclude the buildup of condensation within the substation.

[1.6.3 Hurricane Force Winds

Provide substation structure and associated substructure of sufficient construction to withstand a Basic Wind Speed of 150 mph (3 sec. gust) without physical damage due to wind loading or wind driven rain water infiltration.

]1.7 Citect SCADA SYSTEMS INTEGRATOR QUALIFICATIONS

The Kennedy Complex Control Systems (KCCS) is a combination of hardware and software components that are used to monitor and control power and other utilities across the Kennedy Space Center. Citect SCADA is an industrial control Supervisory Control and Data Acquisition (SCADA) software application that is used to monitor and control the I/O devices connected to the KCCS network. Information is transferred to and from the Citect SCADA server over a dedicated Ethernet controls network using Modbus TCP/IP as the preferred transportation protocol.

Submit documentation of Citect SCADA integrator systems qualifications demonstrating experience with Citect SCADA use in power systems. Provide information on a minimum of three projects completed within the last 5 years where the proposed Citect SCADA systems integrator has successfully completed. Ensure submittal includes sample Citect SCADA graphical process visualization and user interface screens with power systems related elements prepared by the proposed integrator.

PART 2 PRODUCTS

2.1 SWITCHGEAR ASSEMBLY

Provide switchgear assemblies conforming to IEEE C37.20.1 and UL 1558.

Provide switchgear conforming to IEEE C37.20.1 and UL 1558. Provide a new [double-ended][single-ended], [Main-Tie-Main (M-T-M)] switchgear consisting of main, distribution, [bus-tie,]and auxiliary sections listed and labeled by the manufacturer as suitable for use as service equipment. Switchgear must be of [NEMA 3R][NEMA 1] construction.[

Switchgear will be installed outdoors in a new weatherproof pre-fabricated structure. Refer to "WEATHERPROOF PRE-FABRICATED STRUCTURE" article of this section for structure requirements.]

2.1.1 Drawings

2.1.1.1 Switchgear Drawings

Include wiring diagrams and installation details of equipment indicating layout and arrangement, control panels, accessories, and other items that must be shown to ensure a coordinated installation. Identify circuit terminals on wiring diagrams and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Indicate on the drawings adequate clearance for operation, maintenance, and replacement of operating equipment devices. Include the nameplate data, size, and capacity on submittal. Also include applicable federal, military, industry, and technical society publication references on submittals. Include the following:

a. One-line diagram including breakers, fuses, instrument transformers, and meters.

b. Dimensioned plan drawings including front elevation, section views, footprint, and overall dimensions.

c. Bus configuration including dimensions and ampere ratings of bus bars.

d. Markings and NEMA nameplate data, including fuse information (manufacturer's name, catalog number, and ratings).

e. Circuit breaker type, interrupting rating, and trip devices, including available settings.

f. Wiring diagrams and elementary diagrams with terminals identified, and indicating prewired interconnections between items of equipment and the interconnection between the items.

g. Switchgear monitoring and control system hardware with touch screen monitor, software, and interconnection drawings which include details of the power sources and communications pathways for devices accessed by KCCS.

****
NOTE: If selecting provisions for future expansion, ensure the facility and room size is adequate for the additional equipment.
****

2.1.1.2 Fabrication Drawings

Upon approval of initial switchgear drawings, provide manufacturer fabrication and assembly drawings detailing the work to be performed in the factory. Fabrication drawings must cover the following:

a. Switchgear Assemblies

b. Enclosures

c. Buses

d. Switchgear components including all control switches and auxiliary relays

e. Control-power system

f. Switchgear electrical interlocks

g. Space heaters

2.1.1.3 As-Built Drawings

Submit "As-Built" Configuration Drawings after installation, inspection, and testing is complete documenting the configuration of the final switchgear and its components. Ensure drawings show in sufficient detail all wiring, settings, adjustments, and field changes made during construction and installation of the switchgear.

2.1.2 Construction

Provide equipment with the following ratings:

****
NOTE: Select "as indicated" if there are multiple switchgear with details of each shown on drawings. Most switchgear will be 4-wire, but might be a 3-wire design for delta-connected or ungrounded systems.
****

a. Voltage rating: [480Y/277][480][208/120] volts AC, three-phase, [4][3]-wire.

b. Continuous current rating of the main bus: [ ] amperes.

c. Short-circuit current rating: [42,000][65,000][100,000][ ] rms symmetrical amperes.

d. UL listed and labeled[as service entrance equipment].

****
NOTE: Edit the selection options below as needed for the intended project configuration.

Determine if an arc-resistant design will be specified for the installation. A selection of arc-resistant switchgear can affect the installation design. Arc-resistant switchgear is tested and certified to IEEE C37.20.7, and is intended to provide added protection for internal arcing faults. Select Type 1 if arc protection is only required for the freely accessible front of the enclosure. Select Type 2 if arc protection is required for freely accessible front, sides and rear of the enclosure. Select the 'B' suffix for additional protection applied to compartments designated as low voltage control or instrumentation compartments. Select the 'C' suffix where isolation from the effects of an internal arcing fault is desired between all adjacent compartments within a switchgear assembly. Most manufacturers produce Type 2B as a standard product, which could increase the switchgear cost by about 20 percent. Review IEEE C37.20.7 for additional information.
****

Provide the following:

a. Switchgear: consisting of vertical sections bolted together to form a rigid assembly, [front][rear][front and rear] aligned[as indicated].

b. All circuit breakers: front accessible with rear load connections.

c. Compartmentalized switchgear: vertical insulating barriers between the front device section, the main bus section, and the cable compartment[with full front to rear vertical insulating barriers between adjacent sections].

d. Where indicated, "space for future" or "space" means to include all necessary components and hardware to be fully equipped for racking in a

circuit breaker element.

e. Insulating barriers: provided in accordance with NEMA LI 1, Type GPO-3, 6.35 mm 0.25 inch minimum thickness.

[f. Moisture resistant coating: applied to all rough-cut edges of barriers.

][g. Switchgear: Arc-resistant[Type 1[B][C]][Type 2[B][C]], tested in accordance with IEEE C37.20.7.

]2.1.2.1 Compartment Details

Switchgear assemblies and auxiliary equipment must be stationary, mounted in self-supporting, self-contained, sheet metal enclosures with front and rear hinged full size doors. Secure switchgear front compartment doors and covers with knurled knob bolts or latches. Provide the capability to lock doors. Join sheet metal compartments together to form a continuous structure. Construct sheet metal barriers, enclosures, external covers and doors from cold-rolled carbon-steel sheets of commercial quality not less than 1.9 [_____] millimeter [12] [_____]-gage, with stretcher-level flatness in accordance with ASTM A1008/A1008M.

Unit sheet metal must enclose one or more vertically mounted power circuit breakers or auxiliary equipment in individual sheet metal compartments and a full height rear compartment. Provide housing of approximately 2300 millimeter 90 inches high with individual ventilated front and rear-hinged panels and bolted top covers. Rear compartment must contain the main bus, main bus-tap connections, cable connections, and instrument transformers. Completely wire compartments with cable terminals, cable clamps, control bus, control power switch, and terminal blocks. Generate Schematics and Wiring Diagrams for each compartment. Make terminal blocks readily accessible for the external connections of metal-enclosed switchgear.

Run low-voltage wiring for controls and accessories to terminal blocks having numbered points, as indicated, to identify circuits. Run low-voltage wiring in conduit or wiring raceways to isolate the wiring from high-voltage circuits. Clearly identify all wiring connections.

Clearly identify and designate, by cubicle, all switchgear components, including but not limited to fuse blocks, push buttons, selector switches, indicating lights, and terminal blocks (i.e.: 1A, 1B, 2A, 2B, this being cubicle 1 device A, cubicle 1 device B, etc.) Identify device designation with a label, with a minimum 1/4 inch high lettering. Wiring between sections/cubicles must identify the end devices by section/cubicle number and device designation. All controls equipment must be accessible from the front of the switchgear and face the front.

Provide terminal blocks with engraved plastic terminal strips with screw type terminals having letter designations and numbered terminal points. Terminal blocks in each section/cubicle used for the same wiring as the adjacent sections/cubicles must have the same letter designation preceded by the section/cubicle number. Terminal blocks associated with current transformers must be short circuiting type. Terminal blocks with sliding links are not allowed. Terminal blocks for multi-ratio current transformers must be wired with all taps and ground, one terminal block per current transformer. Wiring must be SIS Class insulation, sized No. 12 AWG at 120/240 panel with 20 amp breakers, No. 14 AWG for control, No. 12 AWG for potential leads, and No. 10 AWG for current leads. Terminate all

current conductors with compression ring terminal lugs and control and potential conductors with compression forked (with tabs) terminal lugs. Do not use male/female spade connectors. Final conductor leads for terminations on the switchgear heaters must be a minimum of 150 degrees high temperature wiring.

Locate at each end, wire marking for controls, metering, relaying, and accessory conductors. Wire markers must be white plastic tubing heat stamped with black block type letters. On all wire markers, indicate the device or equipment, including specific terminal numbers to which the other end of the wire is attached, and the terminal number to which the wire is directly attached (near end/far end marking).

Identify each compartment of the switchgear assembly by an identification plate engraved with circuit and function designations. Plate must be a minimum of 24 mm 1 inch high and 48 mm 2 inches long.

Removable elements of the same type and rating in the switchgear assembly must be physically and electrically interchangeable in corresponding compartments. Provide front-hinged panel suitable for mounting instruments, relays, control switches, and indicating lamps.

Barriers between a sectionalized bus with bus sectionalizing breakers in a compartment must be sheet steel not less than[3.1] [_____] millimeter [11] [_____] gage. Other covers, barriers, panels, and doors must be not less than [1.9] [_____] millimeter [14] [_____] gage.

Reinforce each compartment with structural members and weld together. Grind welds to a smooth flat surface before painting.

2.1.2.2 Mimic Bus

Provide mimic bus using 2.4 mm 3/32 inch red plastic laminate. Mimic bus must show breakers and bus. Fasten to switchgear using stainless steel screws or rivets.

2.1.2.3 Buses

Switchgear assemblies must be completely bused utilizing electrical grade, high conductivity, solid copper bus bar having a rectangular cross section. Uniformly position and phase sequence main, riser and bus tap connections in accordance with IEEE C37.20.1. Support and brace buses to withstand both electrically and mechanically the short circuit current ratings, rated not less than [42,000][65,000][100,000][ ] amperes symmetrical. Support and brace bus bar to withstand short-circuit stresses with momentary current ratings, in accordance with IEEE C37.20.1. Voltage and current ratings must conform to IEEE C37.20.1.

Ensure all buses are insulated.

Provide silver-plated termination and connection points on all bus bar used in the switchgear. Silver coating methods that do not use the flow of electrical current as part of the process are not acceptable. After plating the contact surface do not sand or abrade, clean only with a soft cloth immediately prior to final assembly.

All bus bar connections must be made using silicon bronze or Grade 5 steel bolts with wide flat silicon bronze or Grade 5 steel washers under the bolt head and nut. Tighten and check connections by use of a calibrated torque

wrench. Other connection designs can be used with the written agreement of the Contracting Officer.

[Make main bus readily accessible for connection of future switchgear assemblies at either end. Main and auxiliary control drawout type connections must be silver-to-silver contact, positive pressure, self-aligning, with enclosure-to-enclosure stationary mechanism when breaker is in drawout position.
]

Voltage rating and insulation level of switchgear assemblies must be as specified and conform to IEEE C37.20.1.

Temperature limits for buses and bus-tap connections in switchgear assemblies must be in accordance with IEEE C37.20.1.

Extend a continuous rigid copper ground bus throughout the entire assembly and ground the stationary structure and equipment. Ground bus must be capable of carrying the rated short circuit current of the protective devices in the switchgear assembly for a minimum period of 30 cycles.

Metal-enclosed bus must be of non-segregated group phase construction. Include rigid insulated conductors and supports in a grounded metal enclosure with associated ventilation and space-heater enclosures, condensation barriers, expansion and connection joints, and fittings in accordance with IEEE C37.20.1.

Completely bus enclosures and transition cabinets with an insulated solid rigid copper bus bar of rectangular cross section. Uniformly position and phase sequence bus bar and connections within the enclosure for adaptation to metal-clad switchgear assemblies and power transformers, in accordance with IEEE C37.20.1.

Insulating supports must consist of track-resistant, flame-retardant IEEE Class 130 electrical insulating materials. Voltage rating and insulation level must conform to IEEE C37.20.1.

2.1.2.4 Switchgear Foundations

Submit Switchgear Foundation Design Data for switchgear assemblies. Include plan dimensions of foundations and relative elevations, equipment weight and operating loads, horizontal and vertical loads, horizontal and vertical clearances for installation, and size and location of anchor bolts.

2.1.3 Switchgear Components

2.1.3.1 Power Circuit Breakers

[All switchgear, main, tie, and feeder breakers must be drawout type power circuit breakers and conform to Section 26 05 71.00 40 LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES.

] Provide air-break type power circuit breakers enclosed in ventilated housings for those rated below 600 volts with current (frame and trip), voltage, and interrupting ratings as indicated. Provide 100 percent rated drawout type circuit breakers. Comply with IEEE C37.16 and IEEE C37.13.

Provide drawout power circuit breakers with three-position operation:

a. Connected Position - Contacts are fully engaged. Breaker must be

tripped before it can be racked into or out of this position.

b. Test/Disconnect Position - Position must allow for complete testing and operation of the breaker without energizing the primary circuit.

c. Withdrawn (Removed) Position - Places the breaker completely out of the compartment, ready for removal.

d. Breaker truck switches must be wired in series or parallel with each mechanism operated contact used in control sequences such that control sequences consider breaker position.

Drawout compartments must contain the mechanisms for racking the breaker on and off the bus. Provide a barrier that covers energized bus when the breaker is in the withdrawn position.

Mount draw-out breakers on a mobile frame with primary and secondary disconnecting devices to allow complete removal of the unit for inspection and maintenance. Provide a mechanism with an electrically and remotely operated racking mechanism that moves the breaker between the connected, test, and disconnect positions by means of a remote operator. Provide interlocks to prevent the complete withdrawal of the circuit breaker from its compartment when the stored-energy mechanism is in the fully charged position. Design circuit breakers to prevent the release of stored energy unless the mechanism is fully charged. Provide provisions to manually charge, open and trip electrically operated breakers.

Upon a circuit breaker trip operation, it must not be possible to close the circuit breaker until a manual reset operation occurs locally at the breaker trip unit or a lockout relay activated by the circuit breaker trip unit.

Supply alarms, auxiliary switches, truck auxiliary switches, interlocks, and similar devices as required and indicated.

Provide breakers with a removable operating handle, provision for locking, and position indicator.

[2.1.3.2 Molded-Case Circuit Breakers

Provide circuit breakers that conform to UL 489 and NEMA AB 3 [and as specified in Section 26 05 71.00 40 LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES]with frame a trip ratings as indicated.

Provide bolt-on type, molded-case, manually operated, trip-free circuit breakers, with inverse-time thermal-overload protection and instantaneous magnetic short-circuit protection. Completely enclose circuit breakers in a molded case, with a factory-sealed, calibrated sensing element to prevent tampering. Plug-in type, tandem, and half-size circuit breakers are not permitted.

Provide common trip-type with single operating handle. Design breaker such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.

Provide inverse-time-delay thermal-overload protection and instantaneous magnetic short-circuit protection. Provide an instantaneous [thermal-magnetic][electronic][solid-state] tripping element that is

adjustable and accessible from the front of the breaker on frame sizes larger than [100][250][ ] ampere.[Provide circuit breakers with frame sizes [100][250][ ] ampere and larger with [electronic][solid-state] trip units equipped with adjustable [long-time][,][short-time][and][ground-fault] settings in addition to instantaneous.]

Provide sufficient interrupting capacity of the panel and lighting branch circuit breakers to successfully interrupt the maximum short-circuit current imposed on the circuit at the breaker terminals. Provide circuit breaker interrupting capacities with a minimum of 10,000 A and that conform to NEMA AB 3. Series rating of circuit breakers or overcurrent protective devices to achieve indicated interrupt rating is [not]permitted.

Provide the common-trip-type multipole circuit breakers having a single operating handle and a two-position on/off indication. Provide circuit breakers with temperature compensation for operation in an ambient temperature of 40 degrees C 104 degrees F. Provide circuit breakers that have root mean square (rms) symmetrical interrupting ratings sufficient to protect the circuit being supplied. Interrupting ratings may have selective-type tripping (time delay, magnetic, thermal, or ground fault).

Provide a phenolic-composition breaker body capable of having such accessories as handle-extension, handle-locking, and padlocking devices attached where required to meet lock-out/tag-out requirements of NFPA 70E.

Provide shunt trips where indicated.

Ensure branch circuit breakers supplying convenience receptacle circuits have sensitive instantaneous trip settings of not more than [10] [_____] times the trip rating of the breaker to prevent repeated arcing shorts resulting from frayed appliance cords. Provide UL listed single-pole 15- and 20-ampere circuit breakers as "Switching Breakers" at [120 volts ac] [277 volts ac].

When multiple wires per phase are specified, furnish the circuit breakers with connectors made to accommodate multiple wires.

Ensure circuit breaker spaces called out on the drawings are complete with mounting hardware to permit ready installation of the circuit breakers.

]2.1.3.3 Electronic Trip Units

****

NOTE: Switchgear circuit breakers will be supplied with electronic trip units. Select from the bracketed options below. In the items below, choose the bracketed item "main" when the item only applies to the main breaker.

A digital display for the main breaker will typically not be selected if digital metering is provided per the paragraph DIGITAL METERS is selected.

Provide ground fault protection of equipment for solidly grounded wye electrical services of more than 150 volts to ground for each service disconnect rated 1000 amperes or more in accordance with NFPA

70.

NFPA 70 requires arc energy reduction where the highest continuous current trip setting for which the actual overcurrent device installed in a circuit breaker is rated or can be adjusted to 1200 amperes or higher. The option identified below is based on an energy-reducing maintenance switch. Add the additional appropriate information if other methods such as differential relaying or an active arc flash mitigation system are included. Identify locations of alternate arc energy reduction methods in the design.

****

Equip main and distribution power circuit breakers and molded-case breakers with trip settings [100][250] amps or greater with a solid-state tripping system consisting of three current sensors and a microprocessor-based trip unit that provides true rms sensing adjustable time-current circuit protection. Include the following:

a. Current sensors ampere rating: the same as the breaker frame rating.

b. Trip unit ampere rating: as indicated.

c. Ground fault protection: as indicated.

d. Electronic trip units: provide additional features:

(1) Breakers: include long delay pick-up and time settings, and indication of cause of circuit breaker trip.

(2) Main breakers: include short delay pick-up and time settings and, instantaneous settings and ground fault settings.

(3) Distribution breakers: include short delay pick-up and time settings, instantaneous settings, and ground fault settings.

(4) Breakers: include a digital display for phase and ground current.

(5) Breakers: include a digital display for phase voltage and current.

(6) Breakers: include provisions for communication via a network twisted pair cable for remote monitoring and control. Provide the following communications protocol:Modbus.

Equip drawout power circuit breakers with static trip (solid-state) units with long-time, short-time,[and] instantaneous elements[, and ground fault protection]. Provide breakers that are electrically and mechanically trip-free in any position of the closing stroke. Provide silver-plated main contacts and sintered tungsten alloy arcing contacts. Accomplish tripping by a shunt-trip device. Provide electrical closing operation.

Ensure trip units are digital solid-state type for low voltage power circuit breakers in accordance with IEEE C37.17. Provide trip unit electronics modules that are interchangeable between breaker frame sizes without replacing current sensors or flux trip devices already installed. Power units from current sensors and [a separate battery back-up source][switchgear UPS]. Batteries must only be used to power indicator

lights and display after the unit trips. Ensure trip units are adjustable. Trip settings must not rely on rheostats, dip switches, jumpers or pins to maintain their present adjustments. Ensure instantaneous trip settings are defeatable or capable of being turned off. Provide a sealable cover over the adjustments to prevent tampering. Ensure units do not rely solely on any volatile or nonvolatile electronic memory to maintain their settings. Provide units complete with the capability, options, accessories, devices, cabling, wiring, and appurtenances, setup, programming, testing, and certification necessary for the implementation of the zone-selective interlocking systems described in paragraph entitled "Zone-Selective Interlocking Systems."

Provide communication interface to allow the trip units to communicate using the communication system described in paragraph entitled "Switchgear Monitoring and Control System." The digital solid state trip units will be capable of clearly communicating all data to KCCS via Modbus TCP/IP communication protocol using a maximum of one hardware conversion and no software conversions. Breaker status data includes, but is not limited to, the following: breaker status, current, time of trip, operational history, cause of trip, current date and time, power (KW), energy (KWH), peak demand, self-diagnostic information and set points. Breaker remote control functions include, but are not limited to, the following: breaker open, close, and trip operations for electrically operated breakers, date/time energy clear, energy (KWH) clear and remote set date/time and trip reset.

Provide trip units equipped with test jacks on circuit breaker face for service functional testing of each trip unit function using a full function test kit for secondary injection. Provide one full function test kit to the Contracting Officer as part of this project. Test kit must be a product of the trip unit manufacturer.

2.1.3.4 Control Devices

2.1.3.4.1 Test Switches

Provide test switches between all instrument transformer circuits and protective relays/meters, and in all trip and hardwired interlock circuits, to allow full protective and metering device testing or replacement without physically disconnecting instrument transformer and control circuits. Provide ABB Type FT-1 or approved equal test switches with clear covers mounted on the door of the instrument compartment.

2.1.3.4.2 Control, Transfer and Selector Switches

Provide rotary cam operated for remote operation devices with individual stages, a dust-tight cover and contacts with a positive wiping action. Ensure contacts are silver-to-silver or an approved substitute which provides equal or superior performance. Provide contacts that have a rating adequate for the duty performed, but not less than 600 volts, 20 amperes continuous. Circuit breaker control switches will have a red and green target. Provide and wire red, amber, and green indicator lamps. Ensure circuit breaker control switches have a combination of maintained action and spring return type of operation and pistol grip handles. Equip all switches with engraved plastic escutcheons identifying its function and position.

2.1.3.4.3 Instrument Transformers

Provide instrument transformers conforming to IEEE C57.13and comply with

the interference requirements measured in accordance with IEEE C63.2 and IEEE C63.4 as applicable.

a. Current transformers: Provide multi-ratio relay accuracy transformers as indicated, 60 Hz, and coordinated to the rating of the associated switchgear, trip-units, relays, meters, and instruments. Use CTs with standard multi-ration 5A secondary and a thermal rating factor of 2.0. Provide transformers that are complete with secondary short-circuiting device.

b. Potential transformers: Provide fixed mount transformers, 60 Hz, with voltage ratings and ratios coordinated to the ratings of the associated switchgear, trip-units, relays, meters, and instruments. Ensure potential transformers are provided with two current limiting fuses in the primary sized as recommended by the potential transformer manufacturer. Transformers must meet ANSI metering accuracy classifications of 0.3 W, X, Y.

2.1.3.4.4 Pilot and Indicating Lights

Provide transformer, push-to-test LED type, rated for 120 volts ac. Lights must be capable of being relamped from the front.

1. Breaker Open - Green

2. Breaker Closed - Red

3. Control Power On - Red

4. Automatic Mode - Blue

5. Manual Mode - White

6. Auto Lockout - Amber

2.1.3.4.5 Multi-Function Voltage Relays

For undervoltage relays conform to IEEE C37.90.

Provide three-phase solid-state multi-function type voltage relays, Basler or equal, with definite time characteristics and adjustable and calibrated pick-up settings for protection against negative sequence voltage, undervoltage, and overvoltage. Provide thumb wheel setting switches for pick-up and timing adjustments and equip relays with electrically separate contact circuits for all protective functions that are suitable for operation on DC or AC control circuits.

Provide relays that are of draw-out construction with built-in testing facilities and that are suitable for operation on 120VAC instrument circuits.

Provide a semi-flush mount case with matching cover to the hinged instrument panel.

2.1.3.4.6 Synchronization Check Relays

For synchronization check relays conform to IEEE C37.90.

Provide solid-state electronic relay, Basler Electric or equal, with the

ability to user select synchronization check function for the following conditions:

Live Line - Dead Bus

Live Line - Live Bus

Dead Line - Dead Bus

Dead Line - Live Bus

Provide three-phase solid state relay designed to accept 120VAC inputs. Ensure dead line and live line settings are adjustable. Synchronization angle must be adjustable from 1 to 99 degrees with an adjustable time delay of 1 to 99 seconds. Provide thumb wheel setting switches for pick-up and timing adjustments and equip relays with electrically separate contact circuits for all protective functions that are suitable for operation on DC or AC control circuits.

Provide relays that are of draw-out construction with built-in testing facilities, and that are suitable for operation on 120VAC instrument circuits.

Provide semi-flush mount case with matching cover to the hinged instrument panel.

2.1.3.4.7 Timing Relays

Provide timing relays with calibrated timing head, precision-wound potted coil, and a snap-action switch assembly. The calibrated timing head will re-circulate air under controlled pressure through a variable orifice to provide a linearly adjustable timing. The precision-wound potted coil must be totally sealed without any external leads. Provide double-pole, double-throw snap-action switch assembly with copper blades and silver-cadmium oxide contacts to insure positive wiping action.

2.1.3.4.8 Lockout Relays

Provide high speed lockout relays with manual rotary cam reset and latching relay clearing contact. Provide contact deck with contacts having a rating adequate for the duty performed, but not be less than 600 volts, 20 amperes continuous. Provide door mounted control switch with mechanical targets with spring return type of operation and pistol grip handle. Ensure all switches are equipped with engraved plastic escutcheons identifying its function.

2.1.3.5 Control-Power Circuit Overcurrent Protection

Provide Branch-circuit breakers with circuit overload protection to compartment heater, lights, convenience outlets, transformer fans, and other devices.

2.1.3.6 Control-Power Circuit Transfer Contactor

****
NOTE: Delete this paragraph when the switchgear is single-ended.
****

[Design contactor for automatic transfer of control-power for 120/240-volt, single-phase, 60-Hz service with current rating. Make contactor the open type, two-pole, double-throw with solid neutral connections and must automatically transfer its load circuits to the alternate power supply upon loss of power in the normal supply. Device must be electrically operated and [electrically] [mechanically] held and obtain its operating current from the source to which the load is transferred. Provide contactors for automatic transfer of control power suitable for installation in metal-enclosed switchgear. [Provide two extra normally open and two extra normally closed contacts. One set of contacts must be wired to the PLC for status indication.]]

2.1.3.7 Service and Maintenance Devices

Include the following service and maintenance devices as a part of the switchgear:

A manual handle for operating the air and power circuit breaker isolating mechanism

Removable manual maintenance closing devices for air and power circuit breakers

Facilities for operating air and power circuit breakers in the test or removed position

Facilities for withdrawing air and power circuit breakers for inspection or maintenance

Test plugs and cable for meters and relays

A NEMA 5-20R receptacle at each switchgear end for service tools

2.1.4 Remote Racking System

****

NOTE: UFC 3-520-01 requires consideration of remote racking methods for switchgear circuit breakers. Determine if this feature is desired by electrical personnel that will operate and maintain this equipment. The remote racking mechanism design varies among manufacturers; however the method of connection to the racking mechanism tends to be similar. Determine if the project budget can fund this device (might cost as much as $40,000 with all options including camera and wireless system). Do not select this option if other remote racking mechanisms are available within the activity and can be used for this location.

****

Provide a remote racking mechanism to allow an operator to rack a circuit breaker in or out from at least 20 feet away from the front of the equipment.

2.1.5 Local/Remote Switches

****

NOTE: Eliminate the Local/Remote switches for

shuttle projects (i.e. when circuit breakers can be controlled through a second device such as the power meters and not just the PLC).

****

[Install a manually operated, two position rotary snap-action switch with silver-plated contacts to disengage all automatic and remote controls from the switchgear when in local mode. Locate this switch in the bus tie section of the switchgear.

Label the states of the switch "Local" and "Remote". Refer to paragraph, entitled "Local/Remote Operation." Provide at least two extra normally open and two extra normally closed sets of switch contacts. One set of contacts must be wired to the PLC for status indication.]

2.1.6 Surge Protective Device

Provide parallel type surge protective devices which comply with UL 1449 in the locations indicated on the drawings. Provide surge protectors in a NEMA Type enclosure per NEMA ICS 6. Provide the following modes of protection:

FOR THREE PHASE WYE CONNECTED SYSTEMS -

Each phase to neutral {L-N)

Neutral to ground (N-G)

Phase to ground (L-G)

Ensure surge protective devices have a minimum surge current rating of 80,000 amperes per mode minimum. The maximum line to neutral (L-N) Suppressed Voltage Rating {SVR) is 900V for 480Y/277V, three phase systems.

The minimum MCOV (Maximum Continuous Operating Voltage) rating is 600/320V for 480Y/277V, three phase systems.

Provide EMI/RFI filtering for each mode with the capability to attenuate high frequency noise. Minimum attenuation is 20db.

2.2 WEATHERPROOF PRE-FABRICATED STRUCTURE

2.2.1 Construction

Install switchgear in a pre-fabricated custom walk-in style weather-tight corrosion-resistant structure. The structure must be designed for outdoor service with ventilation openings, and gasketing provided to ensure a weather-tight assembly under rain, corrosive atmospheres, and hurricane conditions. The structure must include hinged external rear doors to provide unfettered access to the cable terminations in the rear of each section (main, distribution, [bus-tie,]and auxiliary) without requiring the removal of any bolts. No other barriers will be located between the cable terminations and the external rear doors. Provide external doors with handles/latching mechanisms with provisions for locking.

Provide minimum 1-1/2 inch square tube welded to the interior floor as mounting base for switchgear. Coordinate new square tube with mounting dimensions of switchgear to ensure proper mounting of equipment.

Structure must be weatherproof, prefabricated, with exterior walls and roof constructed from self-framing interlocking panels to house and protect the internal equipment installed in configuration shown on the drawings. Structural grid base and floor must be designed for applicable floor loading allowing the structure to be lifted and transported with (as applicable) the interior equipment installed.

Basic design loads, as well as auxiliary and collateral loads include live load and wind load, in addition to the dead load.

Structure must provide for an aisle along the front of the switchgear of adequate width and height to allow the removal and insertion of circuit breakers.

2.2.2 Materials

Structural steel frame fabricated from steel channel, wide flange and angle sections forming a self-supporting grid to support floor.

a. Steel Grade: ASTM A572/A572M (Cl0 and larger) or ASTM A36/A36M (CB and smaller).

b. One (1) set of removable lift lugs.

c. All welding to be in accordance with AWS D1.1/D1.1M Structural Welding Code.

d. All bolts for field assembly of primary structural members (where required) must be high strength bolts conforming to ASTM A307 and be a minimum of 1/2-inch diameter.

Floor Plate - 5/16-inch, ASTM A240/A240M type 304 or 304L stainless steel.

Base Structure - galvanized steel with epoxy paint finish.

Exterior Walls - 12 gauge interlocking ASTM A240/A240M type 304 or 304L stainless steel panels with stainless steel fasteners.

Insulated Roof Panels - 12 gauge interlocking ASTM A240/A240M type 304 or 304L stainless steel insulated panels (2 inch thick rigid insulation between stainless steel sheets) with stainless steel fasteners. Provide polyurethane, polyisocyanurate, or manufacturer's standard insulation with a maximum flame spread of 25 and a smoke developed rating of 450 per ASTM E84. Penetrations of, or through insulated roof panels are not permitted.

2.2.3 Doors and Hardware

2.2.3.1 Personnel Doors

Provide two exterior personnel doors on either side of switchgear front access aisle, minimum 3ft x 7ft x 1-3/4in, 18 Gauge ASTM A240/A240M type 304 or 304L stainless steel, out swing, with 3-inch Factory Stainless Steel Frame. Each door must be equipped with the following:

a. Stainless Steel Hinges

b. Stainless Steel Panic Hardware - Lockwood/Magnokrom (or approved equal)

c. N1500-5XOT53 x 32D w/Cylinder Lock Exterior Trim (or approved equal)

d. Closer w/Stopping Arm

e. Crash Chain

f. Aluminum Threshold

g. Weatherstripping

h. Stainless Steel Drip Edge

i. Removable Transom above Door (MRT)

j. Sign "Danger Electrical Equipment/ Authorized Personnel Only"

2.2.4 Equipment Doors

Equipment Doors, Louvered (stamped louvers in doors), 12 Gauge ASTM A240/A240M type 304 or 304L stainless steel, size and swing as required for equipment access. Each must include the following:

a. Stainless Steel Hinges

b. Hold Open Device

c. Padlocking Handle

d. Adjustable Cam w/2 Notches Hub for Unthreaded Shank Pawl

e. Equipment Door Locking

f. Equipment Door Access Brackets

g. Adjustable Rod Guide

h. 60-inch Closer Rods

i. Full Gasketing

j. Drip Shield

k. Sign "Danger High Voltage/ Keep Out"

2.2.5 Finishes

Prepare surface per coating manufacturer's instructions/recommendations. Shop Applied High Performance Primer and Finish coats per requirements of IEEE C57.12.29. Provide one (1) quart touch-up paint for each type and color used. Paint colors will be as follows:

a. Exterior - ANSI 61 "Gray"

b. Interior - "White"

c. Floor and Base - ANSI 61 "Gray"

Floor underside must have undercoating of Transcoat 101 (or approved equal), minimum 10 mils dry-film thickness. Clean and prepare surfaces in

accordance with manufacturer recommendations. Final coating must be zero volatile organic compound (VOC), asbestos free with a flame spread rating of zero.

2.2.6 Lighting

2.2.6.1 Interior Lighting

Provide a minimum average maintained illumination on the floor of 30 footcandles. Lighting must be accomplished using vapor-tight LED luminaires. Provide lighting control using a timer switch located adjacent to the main access door.

2.2.6.2 Emergency/Exit Lighting

Provide 120VAC, LED type, combination emergency light/exit sign (green). Light may be wall or ceiling mounted.

2.2.6.3 Exterior Lighting

Exterior fixtures must be located over personnel access doors. All exterior luminaires are required to be Certified and Approved by Florida Fish and Wildlife Conservation Commission (FWC) as Sea Turtle/Wildlife Friendly. LED Lighting must be true red, orange, or amber diodes. Filters are not permitted. Provide lighting control through photo cell integrated with each luminaire fixture, one per light fixture.

2.2.7 Receptacles

Provide one exterior and two interior 20A, 120VAC, NEMA 5-20R, industrial grade ground fault circuit interrupter (GFCI) type duplex receptacles. The interior receptacles must be located at each end of the structure for servicing the switchgear.

2.2.8 Grounding and Bonding

a. Ground Pads - 4 Hole Stainless Steel Welded

b. Ground Lug - #4/0 AWG

c. Copper Ground Bar 2-inch x 1/4-inch, installed on Mounting Anchors 3 inches below ceiling mounted on wall

d. Ground Drops from Ground Bar to Ground Lugs at Base or Equipment Ground Bus - #4/0 AWG bare copper cable

2.2.9 Ventilation

a. Exhaust Fan Assembly 16-inch diameter - 117 CFM w/Aluminum Damper and Thermostat

b. Power Circuit - 120 VAC, 1-Phase, 20A powered from switchgear panelboard

c. Intake Louver Assembly - 24-inch x 24-inch w/Damper and Aluminum Mesh Filter

2.3 SWITCHGEAR MONITORING AND CONTROL SYSTEM (SMCS)

Provide complete switchgear monitoring and control system that includes,

but is not limited to, a programmable logic controller (PLC) that monitors and controls remote devices, touch screen display human machine interface (HMI), electrical power monitoring system, device communications interface hardware, intercommunication wiring, software, startup and training services, and ongoing technical support. This system must comply with the applicable portions of IEEE 802.3. The Contractor's specialist and the CITECT integrator will demonstrate that the communication systems provided under this project will communicate efficiently with the KCCS Citect software. Efficiently implies that the data will be transmitted and received such that the response time to the KCCS workstation will be less than 4 seconds. This demonstration must include multiple trip units, meters, a PLC and a laptop loaded with the KCCS Citect project software. Provide two licensed copies of all software and all hardware necessary to modify and download the program to the touch screen.

Main and tie-bus circuit breakers must be electrically operated with capability to be both operated locally via touch screen and remotely via KCCS. Main-Tie-Main (M-T-M) circuit breakers must be electrically interlocked so that only two of the three breakers may be closed for any extended length of time by operation of the respective breaker closing. Provide a separate hardware timer that will trip the tie-bus circuit breaker if all three circuit breakers are closed for a period adjustable from 0-900 seconds.

Main circuit breakers must include multi-function voltage relays with adjustable pick-ups and time delay.

A control-power circuit transfer contactor must be provided for the automatic transfer of control power.

Ensure the UPS unit supplies power to the power meters, trip units, I/O circuit power, indicating and status lights, PLC touch screen, PLC, the communication equipment such as the unmanaged Ethernet switch and media converters, and a double duplex receptacle in the controls compartment. Ensure the receptacle on UPS power is clearly marked "UPS POWER" using a laminated plastic nameplate having 3/16-inch high white letters on black background.

Provide main and tie-bus circuit breakers equipped with three-phase sync-check relays, hardwired to main and tie-bus circuit breaker control schemes for fail safe operation. These functions will be available even when the PLC is not functioning.

Ensure any main or tie circuit breaker trip activates a separate lockout relay that electrically blocks any subsequent close operation, automatic or manual, for that breaker. If a main or tie breaker trips, block close circuits will ensure that the faulted section cannot be re-energized from another source until the lockout relay is reset.

Ensure all transfer control functions are accomplished via the PLC and that circuit breakers remain in the last state if PLC is taken off-line.

Ensure all timing and control for automatic transfer are performed via the PLC. Auxiliary relays will only be used where circuit breaker control circuit exceeds the rating of the PLC output contacts. Auxiliary relays will only be used to directly connect one circuit breaker control circuit. Use of auxiliary relays to provide relay logic or timing functions is not permitted. Provide industrial grade, octal based, single tier relays with screw terminals, pilot light, retainer clip, vibration resistant 10 amp

rated output contacts.

Design switchgear transfer control to auto transfer load on loss of power on either of the two sources and provide automatic re-transfer on source return after an adjustable time period. Ensure the re-transfer operation is selectable either open or closed transition from touch screen display or KCCS remote operator. Provide touch screen display controls that allow the user to enable/disable the automatic transfer function and initiate the appropriate changes to the PLC logic to allow the selection of the desired switchgear modes of operation. Modes of operation are 'Automatic' or 'Manual' with re-transfer options for either 'Open' or 'Closed' transition.

The touch screen display controls must also allow the user to change the time delays for the transfer scheme. Ensure these changes do not require the use of additional equipment such as a laptop computer or additional PLC programming software. Provide touch screen display controls for operating circuit breakers that requires two step commands, the first to initiate the command and the second to confirm the command.

Selection of 'Closed' transition, selectable from the touch screen display, also disables electrical interlocks functions, specifically, circuit breakers can be configured such that all three breakers (M-T-M) can be closed simultaneously for a limited duration. This protective function is intended to ensure the three circuit breakers are not closed for an extended duration.

2.3.1 KCCS Integration

Integration of the Monitoring and Control System with the existing KCCS (CITECT) system will be performed by the Contractor in coordination with the Contractor's specialist and the CITECT integrator.

Provide Engineering and Technical Support for on-site modifications to the existing user interface screens used by the Government power coordinators as part of the Kennedy Complex Control System (KCCS). The Contractor must provide technical support to develop additional screens and/or modifications to existing screens required to incorporate the new Monitoring and Control System into the KCCS system. The additional screens will allow the Government power coordinator to monitor and control each circuit breaker via Citect "Genies" and "Super-Genies." The Government will perform the final integration of the new screens, Genies, and Super-Genies into the existing KCCS file server. The existing KCCS system will be modified to incorporate all the changes associated with the installation of the new relays. The modifications to the project includes but is not limited to, adding/deleting variable tags, alarm tags and trend tags, modifying/building "genies and super genies," and modifying/creating user interface screens. All modifications to the Citect project must comply with the KCCS Software Architecture Standard. The following minimum information and control will be available to the user through the developed genies:

a. Individual phase and ground currents

b. Phase-to-phase and phase-to-neutral voltage

c. Alarm on circuit breaker trip, cause of trip and magnitude of the fault current (trip records)

d. Circuit breaker status including open, close, tripped, truck position

and connected, test, or disconnected if available

e. Time-stamped trip data including magnitude and cause of trip

f. Remote circuit breaker open and close commands

g. Control power indication

h. Auto/Manual and Open/Close Transition statuses

i. UPS/Control Power Status

j. Synchronization status

k. Power Meter data

A Government sample KCCS Citect project containing a library of Citect symbols, Genies and Super Genies will be provided to the Contractor to use for development of the new operator screens. If the SMCS communication architecture described in the design documents are followed, new development for existing components will not be required. New operator screens depicting the new switchgear are still required but they can be developed using the existing KCCS Citect library. Additional and/or new programming and Citect integration resulting from the use of an approved equal will be the responsibility of the contractor.

Three KCCS integration design reviews will be scheduled by the Contractor to ensure that all of the parties involved in developing any new Citect interfaces (screens, Genies, Super Genies, alarms data exchange methods) are properly coordinated. The first meeting will be a kickoff meeting where the Government will provide a sample KCCS Citect project to assist in the development of new interfaces. Provide KCCS Integration Project Data for the second and third review meetings. At the second meeting, the Contractor will provide a sample of all the new types of Citect interfaces that are being developed. At the third meeting, the Contractor will provide a fully working sample of the entire project. Schedule the first meeting within 75 days of the contract award.

2.3.2 Programmable Logic Controller (PLC)

For compatibility, PLC will be NASA KSC Standard, Schneider Electric M-580 or approved equal. Citect example projects using the M580 PLC are available to the contractor. Additional and/or new programming and Citect integration resulting from the use of an approved equal will be the responsibility of the contractor. Provide two (2) original licensed copies of all software.

Provide the following discrete input points to the PLC:

a. Secondary voltage monitors

b. Main circuit breaker status open/close

c. Tie-bus circuit breaker status open/close

d. Automatic/Manual transfer mode status

e. Feeder/branch circuit breaker status open/close

f. Open/Closed Transition mode

g. Circuit breaker truck position

h. Trip lockout indications on all electrically operated circuit breakers

i. Normal configuration

j. UPS control contactor position indication

k. Internal status registers of the PLC {communication via Ethernet connection TCP/IP or connection with M580 PLC}

Provide the following discrete output points to the PLC:

a. Main circuit breaker open/close

b. Tie-bus circuit breaker open/close

c. Automatic/Manual transfer control function

d. Open/Close retransfer control function

2.3.3 Human Machine Interface (HMI) Touch Screen Display

Provide touch screen display with the following characteristics and features:

a. Industrial grade

b. Impact and scratch resistant

c. Color screen with greater than or equal to (228 mm) 9 inch screen size

d. Screen lockout for cleaning

e. Field replaceable display that is capable of being replaced while in service

f. Provide one spare display for each display installed

g. Integrated drivers for direct serial connection to PLC

h. Simultaneous communications with multiple PLCs

i. Two licensed copies of software

j. Windows based configuration software

k. Support for third party graphics

1. Dynamic object based graphics

m. Bitmap graphics

n. Software manuals

o. Users manuals

p. Interface cables

2.3.4 Electrical Power Monitoring System

Where indicated, provide metering equipment to monitor energy usage on the circuit indicated. Provide metering appurtenances, including cables, as required for complete and proper operation. Power device from switchgear control power supply, confirm with device characteristics. Install metering equipment in accordance with the metering equipment manufacturer's published installation instructions. Mount metering equipment in strict accordance with the orientation recommendations of the metering equipment manufacturer.

For compatibility, provide NASA KSC Standard metering equipment, Schweitzer Engineering Laboratories SEL-735 Power Quality and Revenue meter or approved equal. Ensure metering equipment is UL recognized, CSA certified and also complies with IEEE C37.90.

a. Meter Monitoring Functions: Provide meter designed for use on a 3-phase, 3- or 4-wire, system with 3 current transformers and 2 or 3 voltage transformers as indicated. Ensure the meter provides direct reading metered or calculated values and auto ranges between units, kilo-units, and mega-units for all metered values.

b. Case: Display case mounted semi-flush to a hinged panel door. Power supply and other metering components may be fixed mounted within an auxiliary compartment.

c. Meter Enclosure: Provide a separate NEMA 3R enclosure or specific compartment within the switchgear. Include a back-panel for mounting power supply, terminal strip, and similar components and a hinged interior panel for mounting the display case. Provide a warning label on the hinged panel indicating energized line voltage components are behind the hinged panel.

d. Test Blocks: Provide six pole current and four pole potential test blocks, General Electric Type PK, Eaton Type FT or approved equal in line after the power monitor for additional metering or testing.

e. Meter Fusing: Provide a fusible disconnecting switch upstream of a fully enclosed pullout, dead-front type fuse block containing one fuse per phase to protect the voltage input to the watt-hour meter. Size fuses as recommended by the meter manufacturer.

f. Provide short-circuiting type terminal strips for connecting meter to current transformer circuits.

2.3.5 Communication

Ensure the control system provides for the exchange of data via Ethernet communications with the following:

a. KCCS.

b. Circuit breaker trip unit interface.

c. Electrical Power Monitoring System (Modbus TCP/IP).

Provide industrial unmanaged Ethernet switch, N-TRON 309FXE-ST or approved

equal. Provide industrial media adapters as required. Unless otherwise noted, ensure ethernet communications employs 4-pair #23 AWG CAT6 UTP Type CM indoor/outdoor rated fully water blocked and sunlight resistant cable. Provide ethernet communications extending outside of switchgear using 62.5/125 .um multimode (OM1) indoor/outdoor all dielectric riser (OFNR) rated backbone fiber optic cable (FOC) conforming to ICEA S-104-696, TIA-568-C.3, UL 1666, and NFPA 70.

2.3.6 Sequence of Operation

M-T-M transfer scheme must have two operating modes: Automatic and Manual each with selectable open transition and closed transition switching. Ensure modes of operation are selectable via the touch screen display or remotely via KCCS. Circuit breakers must remain in the last state when mode is changed except when going to the automatic mode. Only controls under the current mode will have any control capability over the circuit breakers. Over current, under voltage, and synchronization check trip or block close features must not be defeated in any mode. Use synchronization relay and lockout relay contacts to provide trip and block close functions independent of the PLC.

The normal configuration for switchgear is with the main circuit breakers in the closed position, the tie-bus circuit breaker in the open position, and the PLC program in 'Automatic' transfer and 'Closed' transition modes.

Design the switchgear transfer control to auto transfer load on loss of power on either of the two sources and provide automatic re-transfer on source return after an adjustable time period. Ensure the re-transfer operation is selectable either Open or Closed transition from touch screen or KCCS remote operator.

2.3.6.1 Automatic Operation

"Automatic" transfer mode is designed as the normal configuration for the M-T-M transfer scheme and gives the PLC at the substation complete and autonomous control of the switchgear. Ensure the PLC program allows KCCS to take control of the switchgear remotely through an Ethernet connection to the PLC by enabling or disabling the 'Automatic' transfer mode. An indicator light seen on the front of the switchgear will illuminate while in the 'Automatic' transfer mode.

Automatic Transfer operation is predicated the switchgear being in normal substation configuration.

Automatic Transfer operation must be disabled if:

a. The M-T-M circuit breakers' protective/control relays' Automatic Transfer statuses are inconsistent (such as in a 'non-normal' state, locked-out, etc.), or

b. A manually asserted trip or an overcurrent trip is detected or

c. Either main breakers' bus lockout signal is asserted

Automatic Transfer sequence is as follows:

If KCCS has enabled the 'Automatic' transfer mode, the circuit breakers will remain in their current positions unless one of the following situations occur:

a. Loss source feeder (A-Side operation described, B-Side is the same):

1. If the multi-function voltage relay for A-Main detects phase voltage imbalance, loss of voltage, under voltage, or over voltage, for a period adjustable from 1 to 600 seconds initially set at 10 seconds,

   A-Main: If B-Main is closed with acceptable supply voltage then the A-Main breaker opens. After the A-Main breaker has opened and if acceptable voltage is present on the alternate source (B-Side) the Tie circuit breaker closes.

   The switchgear will then act as a single-ended switchgear.

2. When voltage returns to the A-Main circuit breaker, all circuit breakers will remain in the transferred state until a retransfer is initiated by the transfer scheme calling for an automatic retransfer as follows:

   A-Side with live bus condition and both automatic retransfer mode and closed transition mode enabled: After utility voltage synchronized across A-Main breaker returns for a period adjustable from 1 to 600 seconds initially set at 60 seconds, the A-Main closes and, when verified closed, the Tie opens.

   A-Side with automatic retransfer enabled and either dead bus condition or open transition mode enabled: After utility voltage returns to the A-Main breaker with a de-energized load bus for a period adjustable from 1 to 600 seconds initially set at 15 seconds, the Tie opens (if closed) and, when Tie is verified open, A-Main closes.

b. Loss of both main source feeders:

1. If the multi-function voltage relays detect phase voltage imbalance, loss of voltage, under voltage, or over voltage on both of the main source feeders simultaneously (plus or minus 3 seconds adjustable), then both main circuit breakers will open and the tie-bus circuit breaker will remain open.

2. If the voltage returns to one of the main source feeders for a period adjustable from 1 to 600 seconds (initially set at 60 seconds), the main circuit breaker on that side must close, the main breaker the other side remains open, and the tie-bus circuit breaker will close.

2.3.6.2 Manual Mode

The "Manual" transfer mode is designed to give either a local operator or the KCCS operator (at a remote location) complete control of the switchgear. The operator takes control of the switchgear by enabling or disabling the 'Automatic' transfer mode. An indicator light visually seen on the front of the switchgear will illuminate while in the 'Manual' transfer mode. When the operator engages the 'Manual' transfer mode, the circuit breakers will remain in their current positions and the following apply:

a. Mains and Tie 'Open' functions operate directly from KCCS commands and touch screen display.

b. Mains and Tie 'Close' functions operate by KCCS and touch screen after

verification of the sync-check relay and respective breaker trip lockout device.

c. Open Transition mode prevents the paralleling of the main and tie breakers.

d. Closed Transition mode (selectable from the touch screen) enables closed transition switching if the sources are synchronized per the settings on the synchronization relay.

e. Breaker controls must be electrically interlocked so that at the most two of the three breakers (M-T-M) can be closed for an extended amount of time. If two out of the three breakers are closed and if the third breaker is called to close, the source feeders will be verified through the sync-check relays that each source feeder is synchronized before the third breaker is closed.

2.4 EQUIPMENT FINISH

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NOTE: For all outdoor applications and all indoor applications in a harsh environment refer to Section 09 96 00 HIGH-PERFORMANCE COATINGS. High performance coatings are specified for all outdoor applications because ultraviolet radiation breaks down most standard coatings, causing a phenomena known as chalking, which is the first stage of the corrosion process. For additional information contact The Coatings Industry Alliance, specific suppliers such as Keeler and Long and PPG, and NACE International (NACE).

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2.4.1 Protective Coatings

Verify the intended location of equipment, materials, and degree of continuous exposure to the KSC corrosive environment. The equipment finish must meet the requirements of IEEE C57.12.28 and IEEE C57.12.29. Holidays, sags, pinholes, blistering, solvent popping or rust as part of the finish are not acceptable. Provide smooth and even finish resistant to corrosion, sunlight and abrasion with high impact strength.

2.4.2 Surface Preparation

Steel parts must be free of weld slag and mill scale. Chemically clean, rinse, phosphate coat, rinse, and de-ionize switchgear enclosure in preparation for the powder coat.

2.4.3 Powder Coat

Coat the switchgear enclosure with a corrosion resistant thermosetting polyester coating applied by electrostatic powder spray. Apply a minimum coating of 2.5 mils uniformly and pinhole free.

2.7.4 Final Coating

Following the application and cure of the powder coat and the manufacturing assembly of the switchgear enclosure, apply a final finish coat to the switchgear enclosure with silicone enamel, free from surface defects with a

minimum 1.5 mil dry film thickness. The color of the final coating must be light gray in accordance with SAE AMS-STD-595A and must be approved by the Contracting Officer prior to shipping the switchgear from the factory.

2.5 SPACE HEATERS AND HUMIDISTAT

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NOTE: Space heaters prevent moisture build-up in ventilated compartments.

Wattage supplied by heaters is one-fourth of heater nameplate rating when 240-volt heaters are operated at 120 volts.
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Equip each section of the switchgear assembly with externally energized space heaters to provide approximately 40 watts per square meter 4 watts per square foot of outer surface area. Heater power density must not exceed 4 watts per 650 square millimeter per square inch of heater element surface. Heaters must be rated at 240 volts for connection to 120 volts. Install heaters at the lowest portion of each space to be heated. Cover all terminals. Provide thermostats to regulate the temperature.

Install operable heaters at the time of shipment for use immediately upon arrival at the site, during storage, or before installation. Prominently mark connection locations on drawings and shipping covers. Provide temporary leads capable of plugging into a standard 120 volt, 20 amp receptacle for storage operation. Make connections easily accessible without having to remove shipping protection.

Provide humidistat to control space heating equipment. Ensure humidity controller is equipped with positive on-off settings and is capable of being manually or automatically operated. Provide controller with impact-resistant, molded plastic cover with fully enclosed, single pole single throw, snap-acting switch. Provide sensing element of moisture sensitive nylon ribbon to ensure reliable operation in temperature ranges from 50 degrees Fahrenheit 10 degrees celsius to 125 degrees Fahrenheit 52 degrees celsius. Ensure humidistat operates from 4% to 6% relative humidity differential. Provide controller with contacts rated to the full load of all connected heaters.

2.6 EXTERNAL VOLTAGE SOURCE

Group all externally powered wiring together as much as possible and connect to a terminal block marked with a laminated plastic nameplate having 5 millimeter 3/16 inch high white letters on a red background as follows:

DANGER - EXTERNAL VOLTAGE SOURCE

Externally powered wiring must include 120-volt unit space heaters.

[2.7 UNINTERRUPTIBLE POWER SUPPLY

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NOTE: When a Facility UPS is available delete this paragraph and use the Facility UPS.
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Provide an Uninterruptible Power Supply (UPS) system sized for a minimum of

15 minutes of battery backup for the control power loads. The UPS must be capable of operating in an ambient temperature of 0 to [40][60] degrees C (32 to [104][140] degrees F) and a relative humidity of 5 to 95 percent. Mount the UPS in a spare compartment or cubicle.

]2.8 SOURCE QUALITY CONTROL

2.8.1 Equipment Test Schedule

The Government reserves the right to witness tests. Provide equipment test schedules for tests to be performed at the manufacturer's test facility. Submit required test schedule and location, and notify the Contracting Officer 30 calendar days before scheduled test date. Notify Contracting Officer 15 calendar days in advance of changes to scheduled date. Provide documentation on successful completion of factory tests for the equipment prior to final activation at KSC.

Provide the following as part of test equipment calibration:

a. Provide a calibration program which assures that all applicable test instruments are maintained within rated accuracy.

b. Accuracy: Traceable to the National Institute of Standards and Technology.

c. Instrument calibration frequency schedule: less than or equal to 12 months for both test floor instruments and leased specialty equipment.

d. Dated calibration labels: visible on all test equipment.

e. Calibrating standard: higher accuracy than that of the instrument tested.

f. Keep up-to-date records that indicate dates and test results of instruments calibrated or tested. For instruments calibrated by the manufacturer on a routine basis, in lieu of third party calibration, include the following:

(1) Maintain up-to-date instrument calibration instructions and procedures for each test instrument.

(2) Identify the third party/laboratory calibrated instrument to verify that calibrating standard is met.

2.8.2 Switchgear Design Tests

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NOTE: Use the first bracketed option for standard switchgear. Use the second bracketed option for arc-resistant switchgear.
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IEEE C37.20.1 and UL 1558.

2.8.2.1 Design Tests

Furnish documentation showing the results of design tests on a product of the same series and rating as that provided by this specification.

a. Short-circuit current withstand test.

b. Short-time current withstand test.

c. Dielectric test.

d. Rated continuous current test.

e. Mechanical endurance test.

f. Flame-resistance tests.

2.8.3 Switchgear Production Tests

IEEE C37.20.1 and UL 1558. Furnish reports which include results of production tests performed on the actual equipment for this project. These tests include:

a. 60-hertz dielectric tests.

b. Mechanical operation tests.

c. Electrical operation and control wiring tests.

d. Ground fault sensing equipment test.

e. Impulse withstand test.

f. Grounding of instrument transformer case test

2.8.4 Switchgear Paint Qualification Test

Submit reports showing that the paint qualification test has been performed according to IEEE C37.20.2 or IEEE C57.12.28 as applicable, to ensure the adequacy of finishes to inhibit the buildup of rust on ferrous metal materials used for enclosures.

2.8.5 Integral Assembly Test

Test switchgear as an integral assembly at the switchgear manufacturer's test facility. Test must include verification of connections between switchgear sections/cubicles, including but not limited to, main bus, ground bus, control power, and control wiring. Ensure this test conforms to IEEE C37.20.2. Once acceptance of test results is received, ship switchgear.

2.8.6 Auto-Transfer Sequence Factory Test Results

Submit report certifying successful execution of the switchgear auto-transfer sequence at the factory. The Government reserves the right to witness testing.

2.8.7 Monitoring and Control System Certification Test

Perform Certification Testing showing Switchgear Monitoring and Control System successfully communicates with existing Citect Software prior to the approval of the switchgear. Compliance Certification Testing must include a Government witness qualification demonstration of at least, but not limited to the following equipment if the proposed hardware has not been

previously approved:

a. Circuit breakers

b. Trip units

c. PLC

d. Meters

Include in testing verification of the Citect Screens using a PC and the current Citect software.

Submit certificate of compliance showing completion of certification testing.

PART 3 EXECUTION

3.1 CERTIFICATION TESTING

Perform Certification Testing showing Switchgear Monitoring and Communication System successfully communicates with existing Citect Software prior to the approval of the switchgear. Compliance Certification Testing must include a government witness qualification demonstration of at least, but not limited to the following equipment if the proposed hardware has not been previously approved (current approved hardware is from Square D):

Circuit breakers

Trip units

PLC

Meters

Include in testing verification of the Citect Screens using a PC and the current Citect software.

3.2 INSTALLATION

Installation must conform to IEEE C2 and NFPA 70.

Electrically and mechanically connect the complete assembly at the site from coordinated subassemblies shipped in complete sections from the manufacturer. Carefully align, level, and secure complete installation in conformance with the manufacturer's recommendations.

Carefully join separated switchgear assemblies to present a neat appearance, with main and ground bus joints tightened to manufacturer's recommended torque values. Handle assemblies with appropriate lifting devices.

Submit Installation Drawings for the switchgear assemblies. Include in drawings complete details of equipment layout and design.

3.3 FIELD TESTING

The switchgear manufacturer must provide the test equipment, labor and technical expertise for testing and checkout of the switchgear assembly as

a connected system after it is installed. Provide manufacturer's written test results for all tests performed. Submit test reports including Testing Certificate of Compliance to the Contracting Officer prior to energizing equipment. Replace any material, equipment or devices found to be defective at no cost to the Government.

Comply with NETA ATS and NETA MTS for electrical acceptance tests of transformers, switchgear, breakers, relaying, metering and all related material, including secondary current injection tests and manufacturers recommendations. Submit a testing procedure 30 calendar days prior to field testing. Include in testing procedure complete functional testing of the entire system which evaluates the functionality and performance of all control and automatic sequencing and operation of the switchgear.

Additional testing to those described in NETA ATS and NETA MTS are as follows:

[a. Demonstrate switchgear automatic transfer scheme, timing functions and interlocks for mains and tie breaker operate as specified.]

b. Remove all controls [and UPS power] from PLC/PC and verify when power is restored, programming automatically recovers with no anomalies. This test must ensure fully functional programming is restored and ready to operate on restoration of power to PLC/PC. Perform this test three separate times.

[c. Demonstrate control voltage automatic transfer relay and components until on properly.]

d. Functionally verify SMCS system through the Ethernet connection fully operational and all I/O functions are as specified.

[e. Demonstrate switchgear local/remote switch, if installed, operates as specified.]

Final acceptance is dependent upon the satisfactory performance of the equipment under test. Provide final test data to the Contracting Officer.

3.4 RELAY SETTINGS AND TESTS

Properly coordinate all circuit-interrupting devices before the switchgear assemblies are energized. Thoroughly inspect and adjust protective relays at the site in the presence of and at the discretion of the Contracting Officer.

3.5 FIELD TESTING FOR COMMUNICATIONS

3.5.1 Field Quality Control

Furnish the services of a manufacturer's representative to assist in starting-up and programming the system. The manufacturer's representative must be factory-trained and have a thorough knowledge of the software, hardware, and system programming. The manufacturer's representative must provide the following services:

a. Perform full functionality tests on the communications network from all IEDs to the Ethernet gateway.

b. Setting all the addresses of all devices in the equipment.

c. Verifying and troubleshooting the integrity of the data line.

d. Assisting the government in correcting any data line problems.

e. Configure the SMCS software to match the field devices.

3.5.2 Field Testing

Verify complete system operation including all hardware, software and communication devices. Verify networking performance with all interfacing systems by other manufacturers.

3.5.3 Manufacturers Certification

A qualified factory-trained manufacturer's representative must certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.

3.5.4 Training

Furnish the services of manufacturer representatives to train the owner's personnel in operation and programming of the system. The manufacturer representatives must be factory-trained and must have a thorough knowledge of the switchgear, PLC and touch-screen software, hardware and system programming. Include in the training session on the PLC and all controls:

a. Switchgear on-site training

(1) Full operation demonstrations of all functions.

(2) Breaker electrical and mechanical operations.

(3) Explanations and instructions for all protective devices.

b. Classroom on-site training for programming the touch screen.

3.5.5 After Start-up Support

The manufacturer must provide a 24-hour 800 telephone number manned with Engineers/Technicians expert in SMCS devices, software and communication system troubleshooting or capable of providing technical information. Provide this support at no cost to the Government for a period of five years.

3.6 ENERGIZING SWITCHGEAR ASSEMBLIES

Do not energize switchgear assembly until it is completely installed, tested, approved by the Contracting Officer, and ready for operation. Site testing must be conducted and approved by the Contracting Officer.

Using ammeter, voltmeter, and wattmeter or phase-angle meter, the values and polarities of voltage and current, measure and compare with those expected in the various relay circuits. Inspect and note all contact positions of directional elements and the voltage relays.

After inspection and satisfactory tests have been completed on all active relay circuits under a no-load condition, perform an operational test with diverted load currents or simulated ground faults on each relay.

Prepare a comprehensive report with records of connections, electrical constants, settings, test values, operating performance, and failures or weaknesses found on test.

Tests and procedures for testing must be in accordance with paragraph, entitled "Field Testing," in this section and the manufacturer's recommendations. Upon completion of all testing and approval of the Contracting Officer, the switchgear must be energized, as approved by the Contracting Officer.

-- End of Section --

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NASA/KSC-27 05 26.00 98 (September

Preparing Activity: NASA

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NASA/KSC-27 05 26.00 98 (October 2007)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
****

SECTION TABLE OF CONTENTS

DIVISION 27 - COMMUNICATIONS

SECTION 27 05 26.00 98

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

09/09

-- End of Section Table of Contents --

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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****

SECTION 27 05 26.00 98

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS
09/09

****

NOTE: This specification covers the requirements for electrical system and equipment grounding including ground rods, grounding conductors, connectors, and other accessories for small jobs. The section excludes instrumentation and static grounding systems.

Provide drawings showing plan layout of each grounding electrode, ground mat, ground grid, substation ground bus, interconnecting grounding conductor, and tap connections to steel building columns and outdoor electrical equipment. Provide detail drawings of ground mats and ground grids showing configuration, ground rod spacing, interconnecting cable and tap connections to substation yard fence, substation ground bus, and interior equipment.

If grounding systems as shown fail to achieve the desired measured resistance to ground, additional ground rods could be required.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Recommended changes to a NASAKSC Master Specification Section should be submitted as a Criteria Change Request (CCR) to the appropriate Technical Proponent (TP) through the SpecsIntact

Help Desk.

****

PART 1 GENERAL

1.1 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

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

****

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.

AMERICAN WELDING SOCIETY (AWS)

AWS A3.0M/A3.0	(2020) Standard Welding Terms and Definitions
AWS B2.1/B2.1M	(2021) Specification for Welding Procedure and Performance Qualification

ASTM INTERNATIONAL (ASTM)

ASTM B8	(2011; R 2017) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
KSC-SPEC-Z-0005A	(Rev A; 1995) Specification for Brazing, Steel, Copper, Aluminum, Nickel, and Magnesium Alloys
KSC-STD-E-0012	(Rev F; 2013) Standard for Facility Grounding and Lightning Protection

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023) National Electrical Code
NFPA 780	(2023) Standard for the Installation of Lightning Protection Systems

UNDERWRITERS LABORATORIES (UL)

TO 31W3-10-15	(2010) Outside Plant Cable Testing - (under U.S. Air Force)
UL 467	(2022) UL Standard for Safety Grounding and Bonding Equipment

1.2 SUBMITTALS

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

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

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

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Submit manufacturer's catalog data for the following items:

Ground Rods[; G]

Ground and Bond Wires[; G]

Grounding and Bonding Connectors[; G]

Grounding and Bonding Fasteners[; G]

Corrosion Inhibitors[; G]

PART 2 PRODUCTS

2.1 GROUND AND BOND WIRES

Provide annealed bare copper, Class "B" stranded ground and bond wires in accordance with ASTM B8; size wires in accordance with the requirements of NFPA 70 and NFPA 780.

2.2 GROUNDING AND BONDING CONNECTORS

Provide grounding and bonding connectors conforming to the requirements of UL 467.

2.3 GROUNDING AND BONDING FASTENERS

Provide [copper] [bronze] [tin plated tempered brass] bolts, nuts, washers, lock washers, and associated fasteners for grounding and bonding connection.

2.3.1 CORROSION INHIBITORS

Provide corrosion inhibitors manufactured for use with electrical connections. Provide corrosion inhibitor appropriate for protecting a connection between the installed metals.

2.4 GROUND RODS

Provide 20 mm diameter by 6100 mm 3/4 inch by 20 feet solid copper ground rods in accordance with KSC-STD-E-0012.

PART 3 EXECUTION

3.1 GENERAL

Specify NFPA 70 and NFPA 780 bonding and grounding requirements as a minimum.

3.2 BONDING

3.2.1 Types of Bonds

****

NOTE: Choose from one of the bond types or a combination of bond types listed below.

****

Unless otherwise specified herein, accomplish bonding of metal surfaces by [brazing] [welding] [clamping] [structural joining methods] [a combination thereof].

3.2.1.1 Brazing

Brazing solder is to conform to KSC-SPEC-Z-0005A.

3.2.1.2 Welding

Use the exothermic welding process with procedures conforming to AWS A3.0M/A3.0, AWS B2.1/B2.1M, and manufacturer's written instructions.

3.2.1.3 Clamping

In outdoor locations, install connecting clamps only where a disconnect type of connection is required. Use either spring-loaded jaw or threaded fastener connection devices. Install clamps so that positive contact pressure is maintained at all times. Install clamps using machine bolts with tooth type or spring type lock washers. Apply corrosion inhibitor to grounding and bonding connections in outdoor locations and in unconditioned spaces, unless otherwise indicated in the drawings.

3.2.2 Cleaning of Bonding Surfaces

Thoroughly clean all surfaces which comprise the bond, removing all paint, oxides, and other resistance films from the mating area before joining. Use gentle and uniform pressure, along with an appropriate abrasive, to ensure a smooth uniform surface without "point contacts". Do not remove excessive metal from the surface. Clean clad metals with a fine steel wool or emery paper in such a manner that the cladding material is not penetrated by the cleaning process. Then clean bare metal with a solvent-moistened cheesecloth. Remove all grease, oil, dirt, corrosive preventatives, and other contaminants using this same method. Allow this cleaned area to air dry before making bond. Attach bond within 1 hour after cleaning. For surfaces that will receive additional finishes such as paint or other coating, seal the joint and refinish the exposed surfaces within 2 hours to prevent oxidation. If additional time is required, apply a corrosion-inhibiting compound until the area can be refinished.

3.2.3 Bond Resistance

Test resistance of any bond in accordance with TO 31W3-10-15. Rework bonds that fail to successfully comply to test parameters at no additional cost to the Government.

3.2.4 Enclosure Bonding

Bond all new communication enclosures and fiber optic terminal (FOT)cabinets to ground. Make at least one copper connection from the system ground point to one or more enclosures in the area, such that all enclosures and equipment, when properly bonded together, provide a low impedance path to ground. Install one ground wire for each enclosure to a single-point ground; daisy-chaining of enclosure grounds is not allowed.

3.2.5 Cable Tray Bonding

Bond cable tray sections together. Consider cable tray sections in tandem assembly as having electrical continuity when these sections are bonded with appropriate high strength bolts. Whenever expansion joints are required, install a jumper consisting of a bond strap. Ground trays to the building's ground system.

3.2.6 Bonding of Conduit and Raceway Systems

Bond metal conduit, fittings, junction boxes, outlet boxes, armored and metal sheathed cable, and other raceways as listed herein. Ensure adequate electrical contact at the joints and terminations.

3.2.7 Rigid Metal Conduit and Terminations

[Clean and coat with conductive epoxy] [Weld as specified herein] all

threaded connections and wrench tight. Paint all exposed threads. [Weld] [Coat with conductive epoxy and bond] all conduits entering boxes and enclosures to the box with bonding type locknuts [(one outside and one inside)] [locknut and grounding type bushing]. Locknuts that gouge into the metal box when tightened are acceptable.

3.2.8 Protection of Finished Bonds

For bonds in interior conditioned spaces, protect finished bonds by painting to match the original finish after bond is made, or as otherwise directed in the drawings. For bonds in outdoor or unconditioned spaces apply corrosion inhibitor.

3.2.9 Splice Bonds

Maintain shield continuity through each splice for cable with full shielding. Provide bond clamp with perforating teeth to penetrate the cable's metallic shield and connect across the splice with the equivalent of a 13 mm2 No. 6 AWG diameter copper conductor.

3.3 GROUNDING CONNECTIONS

Provide bonded ground connections in accordance with paragraph entitled, "Bonding" of this section.

Weld all ground connections that are buried or in inaccessible locations. Join all strands without causing any weakening or damage.

3.4 PLACING GROUND RODS

Install and test ground rods in accordance with KSC-STD-E-0012.

-- End of Section --

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DIVISION 27 - COMMUNICATIONS

SECTION 27 11 00.00 98

COMMUNICATIONS EQUIPMENT ROOM FITTINGS

07/20

-- End of Section Table of Contents --

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****

SECTION 27 11 00.00 98

COMMUNICATIONS EQUIPMENT ROOM FITTINGS
07/20

****
NOTE: This specification covers the requirements for Communication/Equipment Room and Entrance Facilities.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

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****

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INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 802.3	(2022) Ethernet

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

IEC 60603-7	(2011) Connectors for Frequencies Below 3 MHz For Use With Printed Boards - Part 7: Detail Specification for Connectors, 8-Way, Including Fixed and Free Connectors With Common Mating Features, With Assessed Quality
KSC-SPEC-E-0012	(1968) Specification for Heat and Blast Protection coating Materials for Electrical Cables
NFPA 70	(2023) National Electrical Code
NFPA 780	(2023) Standard for the Installation of Lightning Protection Systems

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-568-C.1	(2009; Add 2 2011; Add 1 2012) Commercial Building Telecommunications Cabling Standard
TIA-606	(2021d) Administration Standard for Telecommunications Infrastructure

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC Part 68	Connection of Terminal Equipment to the Telephone Network (47 CFR 68)

UNDERWRITERS LABORATORIES (UL)

UL 497	(2001; Reprint Jul 2022) UL Standard for Safety Protectors for Paired Conductor Communication Circuits

1.2 SUBMITTALS

****

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Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Floor Plans[; G]

Front Elevations[; G]

SD-03 Product Data

Entrance Facility Terminals[; G]

Surge Protection Modules[; G]

Distribution Frames[; G]

Floor Mounted Equipment Racks[; G]

Floor Mounted Equipment Racks and Cabinets[; G]

Wall Mounted Equipment Cabinets[; G]

Wall Mounted Equipment Racks[; G]

Cable Management[; G]

Patch Panels[; G]

Fiber Optic Panels[; G]

Grounding Bars[; G]

110 System Blocks[; G]

Patch Cords[; G]

UTP Cross Connects[; G]

Backboards[; G]

Cable Tray[; G]

SD-07 Certificates

Test Meter

SD-11 Closeout Submittals

Record Drawings[; G]

1.3 QUALITY CONTROL

Provide equipment and materials per [construction drawings] [Bill of Materials] or approved equal. Meet specified separation from sources of Electromagnetic Interference (EMI).

Provide the communication grounding and bonding in accordance with applicable Codes and regulations, conforming to KSC-SPEC-E-0012 and NFPA 780. Meet the requirements of NFPA 70 for grounding throughout the entire cabling system.

1.4 GENERAL NOTES1.4.1 Specification Override

This section overrides any conflicting SpecsIntact specifications.

1.4.2 UTP/STP Testing

Test all comm UTP/STP (unshielded twisted pair/shielded twisted pair) cables using a Fluke Model DSX-5000 or NASA approved equal. Test the horizontal UTP/STP cables terminating in patch panels to the IEEE 802.3 10GBASE-T Permanent Link Specification. Test UTP/STP cable terminations on insulation displacement connection (IDC) disconnect blocks to the TIA-568-C.1 Category 6 permanent link specification.

1.4.3 UTP/STP Test Results

Deliver Comm UTP/STP cable test results electronically to NASA KSC in Linkware machine readable format.

1.4.4 Test Meter

Submit the test meter serial numbers (main and remote units), software version and calibration date to the Contracting Officer for approval before testing any horizontal wiring.

1.4.5 NASA KSC Provisions

Comm cabling, faceplate, patch panel, IDC block and cabinet labeling is provided by NASA KSC Comm personnel.

1.4.6 Component Approval

Obtain NASA KSC Comm Personnel pre-approval on all horizontal wiring components (cable, patch panels, jacks and intermediate distribution frame (IDF) blocks). NASA KSC comm personnel will provide a list of qualified components upon request.

1.4.7 Customer Face Plate (CFP)

Ensure the standard customer facing faceplate (CFP - customer face plate) contains 2 each 10GBASE-T horizontal links terminating in separate patch panels.

1.4.8 Chatsworth Products Inc (CPI)

The NASA KSC standard telecommunications cabinet is the CPI (Chatsworth Products Inc) M series cabinet.

1.4.9 Color Coded Wiring

Use the following color codes for wiring:

DESCRIPTION	COLOR
Date Premise Wiring	Blue
Wireless Access Points	Orange
Paging	Yellow
Security Cameras	Green
Horizontal Wiring	Blue
Auxiliary Circuits - Alarm, Security	Yellow
Future use and Key Systems	Red
Inter-building Campus Backbone	Brown

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Minimum requirements for entrance equipment, termination hardware, and cable installations in main communication equipment rooms and communication rooms/closets contain the following:

a. Entrance Facility (EF) Terminals

b. Surge Protection Modules

c. Wall Mounted Distribution Frames

d. Ladder Racking/Cable Tray

e. Grounding and Bonding Provisions

f. Backboards

g. Frame Mounted Termination Blocks and Rings

h. Cross Connects

2.1.1 Design Requirements

2.1.1.1 Preliminary Drawings

Submit preliminary drawings prior to the start of work for the following: (Obtain electronic files of the building floor plans from the Contracting Officer.)

a. Scaled 1:50 1/4-inch by 1-foot Communication Room floor plans showing the planned location of all installed components.

b. Front elevations of a typical patch panel for each system.

2.1.1.2 Environmental System

Provide connecting hardware rated for operation under ambient conditions of 0 to 60 degrees C 32 to 140 degrees F and in the range of 0 to 95 percent relative humidity, non-condensing.

2.2 EQUIPMENT

2.2.1 Entrance Facilities

2.2.1.1 Entrance Facility Terminals

Protect all lines (pairs) through entrance facility terminal. Input stub (tip) cable required is [26][Sized by NASA] AWG shielded cable. Verify actual stub length in field. Equip input stub with a heavy-duty strain relief and encapsulated cable connector. Serve input stub as internal fuse link. The output stub cable required is 24 AWG shielded cable. Field verify actual stub length. Provide 5 pin protection modules, wall or frame mountable, for entrance facility terminals. Meet or exceed requirements of UL 497 for plastic components.

2.2.1.2 Surge Protection Modules

Provide true balance operation, 5 pin, 3 element gas type surge protection modules. Provide surge modules that ionize the entire tube through over-voltage on either side to provide a simultaneous path to ground for both sides of the circuit. Provide surge protection modules that have UL 497 certification. Provide a tin-plated ground pin, gold alloy ring pins, and color black module. Provide a color green surge protection module for spare pair modules. Use 350V at 100V/microsecond for the nominal DC breakdown. Use 700A at 100V/microsecond and 150A at 1KV/microsecond for the impulse breakdown voltage.

For the surge protection modules DC holding current, use 135V for less than 150millisecond (ms). The surge protection modules surge life (min. operations) required is as follows:

At 10A, 10 by 1000 microseconds

Use less than 1pf capacitance, for 1 Vrms at 1Khz, 50 DCV. Use greater than 100M ohms at 50 VDC for the insulation resistance. The fail safe operation required is as follows:

At 1.0A	less than 50 sec
At 5.0A	less than 15 sec

At 20A less than 10 sec

At 60A less than 3 sec

The current limiters required are as follows:

hold current (ma) at 20 C equals 145

R min / max ohms equals 3/6

2.2.1.3 Floor Mounted Frames for Protection Terminals

Provide 2.1 m 84-inch high frames suitable for single side mounting of protection terminals. Ensure the overall width of the frame 0.9 m is [35.5] [_____] inches and the depth 381 mm [15] [_____] inches. Supply the frame with 305 mm 12-inch cable runway support, junctioning bolts, aluminum bond bars, grounding screws and screws for installing the blocks. Provide 153 mm 6-inch vertical channel to feed cables to blocks for floor mounted frames for protection terminals. Provide the lowest installed block at 153 mm 6-inch above finished floor (AFF).

2.2.1.4 Floor Mounted Distribution Frames

Provide 2.1 m 84-inch high frames suitable for single side mounting of 110 termination blocks. Configure the frame to support the number of pairs indicated on the drawings. Ensure the overall width of frame 953 m is [37.5][_____] inches and the depth 409 mm [16.13] [_____] inches. Supply the frame with 305 mm: 12-inch cable runway support, junctioning bolts, bond bars, grounding screws and screws for installing the blocks. Divide frame into two modules. Construct top module to support six (6) 110 blocks and bottom module to support nine (9) 110 blocks, with the lowest installed block at 18-inches AFF. Provide racks with 153 mm a 6-inch vertical channel to feed cables to blocks.

2.2.1.5 Steel Ladder Racking/Cable Tray

Provide ladder rack/cable tray in equipment room, as shown on drawings for backbone cable support. Provide connecting and support hardware to suit installation, including but not limited to, racks, runway mount plates, wall angle support brackets, butt splice swivels, connect junctions and grounding kit.

2.2.1.6 Grounding and Bonding

Provide grounding bar assembly and a minimum No. 2 grounding electrode conductor from the ground bar to a suitable electrical building ground. Label grounding and bonding hardware and connections per TIA-606. Appropriately bond the grounding wire to the grounding bar and electrical building ground. Construct ground bar assembly with the following materials (see drawing details for additional information):

a. Copper ground bar 6 mm by 102 mm by 305 mm 1/4-inch by 4-inch by 12-inch with 7 mm 9/32-inch holes spaced 32 mm 1-1/8-inch apart.

b. Stand-off insulators.

c. Lockwashers.

d. Wall mounting brackets.

2.2.1.7 Backboards

Provide 1.2 m by 2.4 m by 19 mm 4-foot by 8-foot by 3/4-inch ACX or CDX, fire rated plywood backboards or as indicated on the drawings. Paint backboards with gray, acrylic, interior grade, fire-retardant paint.

Install open end distribution rings above all wall mounted blocks for wall mounted cross-connect fields, two rings per vertical row.

2.2.1.8 Termination Blocks on Frame

Provide blocks that are 110 style 300 pair blocks. Provide connecting clip, designation strip, plastic covers and retaining clip necessary to terminate cables.

2.2.1.9 UTP Cross Connects

Provide same gauge (22 AWG and 24 AWG) of cross connect wire as the feed cable to which it is being connected. For circuit connections use 24 AWG single twisted pair and dual twisted pair wire as required. Rate conductors a minimum of TIA-568-C.1 Category 6 or better. Provide cross connect wires of the following colors:

DESCRIPTION	COLOR
Voice Circuits	White-Blue
Fire Alarm	White-Red
Temporary Circuits	White-Black
4 Wire Services	Solid Colored White-Blue-Red-Green

2.2.2 Communications/Equipment Rooms

2.2.2.1 Floor Mounted Equipment Racks

Required physical specifications of racks are as follows:

a. 483 mm 19-inch rack mounting space.

b. 2.1 m 7-foot - 0-inch tall.

c. Lightweight, high strength aluminum construction.

d. Black powder coat finish.

e. 381 mm 15-inch deep base with four (4) 19 mm 3/4-inch bolt down holes.

f. EIA Channel width of 76 mm 3.0-inch, with No. 12-24 screw holes.

Provide racks with double sided 12/24 tapped holes and EIA universal rack 16 mm to 13 mm 5/8-inch to 1/2-inch standard hole pattern (compatible with 32 mm to 13 mm 1-1/4-inch to 1/2-inch hole patterns).

2.2.2.2 Wall Mounted Equipment Racks

Required physical specifications of wall mounted equipment racks are as follows:

a. 483 mm 19-inch rack mounting space.

b. 1.2 m 48-inch high with 24 mounting spaces.

c. Lightweight, high strength steel construction.

d. Black powder coat finish.

e. Stationary mounting with 533 mm 21-inch deep, 14 gauge mounting brackets and 45 kg 100 lb. capacity.

f. Provide racks with double sides EIA universal rack 16 mm to 13 mm 5/8-inch to 1/2-inchstandard hole pattern, (compatible with 32 mm to 13 mm 1-1/4-inch to 1/2-inch hole patterns).

2.2.2.3 Wall Mounted Equipment Cabinets

Provide wall mounted equipment cabinets that meet the following specifications:

a. 483 mm 19-inch equipment mounting space.

b. 1.2 m 48-inch high with 26 rack mount spaces.

c. Universal mounting rails with 10/32 and 12/24 tapped holes.

d. 16 mm to 13 mm 5/8-inch to 1/2-inch EIA standard hole pattern.

e. Black powder coat finish.

Provide cabinets with a two-hinge lockable front and rear access, with louvered sides for ventilation, and knockouts in top and bottom for cable access.

2.2.2.4 Floor Mounted Cabinet

Provide floor mounted cabinets that meet the following specifications:

a. 16-gauge steel construction.

b. Nominal 1956 mm by 483 mm by 762 mm 77-inch by 19-inch by 30-inch.

c. Lockable Plexiglas hinged door on front and steel hinged door in rear.

d. Vented roof.

e. Removable side panels.

f. Leveling feet.

2.2.2.5 Cable Management for Equipment Racks

Provide black metal cable management with integral wire retaining fingers. Provide vertical cable management panels that have front and rear channels. Provide vertical cable management panels that have removable front and back covers, made of black metal. Provide a horizontal crossover cable manager at the top of each relay rack, with a minimum height of 2 rack units each. Provide a horizontal crossover cable manager near the

center and at the bottom of each relay rack, with a minimum height of 4 rack units.

2.2.2.6 Patch Panels - Category 6 or better

Provide termination panels that support the appropriate TIA-568-C.1 Category 6 or better (tested to 10 G) applications and facilitate cross-connection and inter-connection using modular patch cords. Size patch panels to fit an EIA standard 483 mm 19-inch rack, or are capable of being mounted to a wall.

Provide patch panels that accommodate at least 48 ports for each rack mount space, and have circuit boards tested in both directions as required by TIA-568-C.1. Provide patch panels that have left angle and right-angle modules to provide optimum cable management, and that have removable six port modules to allow replacement in the field. Provide patch panels that have TIA-568-C.1 Category 6 or better (tested to 10 G) jacks available in both T568A and T568B wiring schemes, with 110-style termination.

Provide patch panels that allow for a minimum of 200 re-terminations without signal degradation below standard compliance limit, and modular ports compliant with FCC Part 68, subpart F and IEC 60603-7 with gold plating over nickel contacts or approved equivalent. Provide patch panels that allow the use of a 4-pair 110-style impact termination tool. Ensure patch panels have a plastic strip for physical protection of the printed circuit board, with port identification numbers on both the front and rear of the panel. Provide clear label holders and white designation labels, with optional color labels available. Provide patch panels that are TIA-568-C.1 Category 6 or better (tested to 10 G) compliant.

Meet the following performance requirements (NEXT Loss and FEXT tested in both Differential and Common Mode):

PARAMETERS	PERFORMANCE AT 100 MHz
NEXT Loss	43.0 dB
FEXT	35.1 dB
Insertion Loss (Attenuation)	0.4 dB
Return Loss	20 dB

Provide patch panels that are UL verified for TIA/EIA TIA-568-C.1 Category 6 or better (tested to 10 G) electrical performance, constructed of a steel frame with black powder coat finish, with 48 and 96 port configurations. Provide patch panels that allow the modular insert to accept 110-style patch plugs as a means of termination, and are T-568-B wired. Provide 48 port panels, unless otherwise noted.

Provide paired punch down sequence to allow pair twist within 13 mm 1/2-inch of the termination. Provide port configurations and densities as designated on drawings. Provide rear cable management bar(s) as recommended by the manufacturer, and insulation displacement connector 110-style terminations. Provide TIA-606 compliant color-coded icons or color-coded designation label strips for all patch panels. Identify voice or data functionality as required.

2.2.2.7 Fiber Optic Panels - Wall Mount Box

Provide all panels and trays (units) that cross-connect, and inter-connect,

with splicing capabilities containing cable management for supporting and routing the fiber cables/jumpers. Provide wall mount boxes that are [available in 12, 24 port termination densities for a single door applications,] [available in 12, 24 and 48 port termination densities for dual door applications,] [accommodate various Simplex connectors including ST, SC, FC, dual LC, LX.5, and MT-RJ,] and have single or dual hinged doors. Provide wall mount boxes allowing the mounting of the cable clamp on the interior of the panel, feature adapters which are angled, and have raised outer edges and be putty white in color. Provide wall mount boxes with factory termination of the optical cable as an option. Provide port configurations and densities as called for on drawings.

2.2.2.8 Fiber Optic Panels - Rack Mount (Low Fiber Count)

Provide all panels and trays (units) that cross-connect, and inter-connect, with splicing capabilities containing cable management for supporting and routing the fiber cables/jumpers. Provide rack mount panels with 12 and 24 ports with no splicing, accommodating 24 port configuration for splicing, and allowing for mounting in either 483 mm 19-inch or 584 mm 23-inch equipment bays. Provide rack mount panels that allow [flush] 127 mm 5-inch recess mounting. Use adapter plates that house a minimum of six (6) adapters each, and have adapters angled to the left and right of the panel. Provide only rack mount panels in black or putty, meeting or exceeding all TSB-72 requirements, with port configurations and densities as called for on drawings, wall or rack mountable. Provide rack mount panels with a hinged removable front cover, featuring a front access design with a hinged bulkhead plate.

2.2.2.9 Fiber Optic Panels/Frames - Rack Mount (Moderate Fiber Count)

Provide all panels and trays (units) that cross-connect, and inter-connect, with splicing capabilities containing cable management for supporting and routing the fiber cables/jumpers. Provide rack mount panels in 12, 24, 48, 72, and 96 port configurations, featuring a front access design with hinged bulkhead plate, using adapter plates that house six (6) adapters each. Provide panels with a hinged removable front cover with adapters that are angled to the left of the panel. Provide an integrated vertical cableway on one side of the panel, mountable in flush, 25 mm, 50 mm, and 127 mm 1-inch, 2-inch, and 5-inch recess options, wall mountable. Provide rack mount panels that are 483 mm 19-inch and 584 mm 23-inch rack mountable, with storage and splicing options as part of the product offering, available in black or putty.

2.2.2.10 Fiber Optic Frames - Rack Mount (High Fiber Count)

Provide all panels and trays (units) that cross-connect, and inter-connect, with splicing capabilities containing cable management for supporting and routing the fiber cables/jumpers. Provide rack mount panels in putty or black, made of 12-gauge aluminum alloy. Provide rack mount panels as 24, 32, 48, and 72 port versions with ST or MT-RJ fiber adapters pre-loaded into adapter plates, or 48, 64, 96, and 144 port versions using quad SC fiber adapters pre-loaded into adapter plates. Provide rack mount panels with pre-loaded adapter plates with SC, ST, dual LC, or MT-RJ fiber adapters in 6 and 8 port versions, as well as a 12 port version for the SC adapter. Ensure panels have blank adapter plates for future growth of the fiber infrastructure.

Provide frames with fiber managers to store fiber cable slack and comply with fiber bend radius requirements, with six and eight port fiber adapter

plates, allowing for color coding connectors, and accommodating stackable splice trays. Each tray to have a minimum total of 24 splices. Provide frames with an adapter plate-mounting bracket, which slides out to the front and rear of the unit for increased access. Provide access points for fiber jumpers entering and exiting the unit, and rotating grommets to facilitate cable loading, minimizing micro bending stress, with anchor points for fiber cable(s) entering the unit. Provide labeled frames which meet or exceed TIA-606 requirements and are laser printable.

Provide only frames that are mountable to both 483 mm 19-inch and 584 mm 23-inch rack/cabinets. Provide port configurations and densities as called for on the drawings.

2.2.2.11 Fiber Optic Trays - Rack Mount

Provide all panels and trays (units) that cross-connect, and inter-connect, with splicing capabilities, containing cable management for supporting and routing the fiber cables/jumpers. Provide 18-gauge steel rack mount trays, with a black finish, in 16-, 24-, 28-, 32-, and 48-port configurations, and capable of doubling the port count using 6-port adapters. Provide trays that accommodate SC, ST, dual LC and MT-RJ adapters, hybrid adapter bezels for ST-to-SC or SC-to-ST, or MT-RJ to MT-RJ connections, with changeable ports, which are removable from the front of the unit to allow custom configuration or modification.

Provide rack mount trays with silk screened port identification numbers on both the front and rear of the panel; include slack storage fiber managers to comply with fiber bend radius requirements and slack storage length recommendations. Provide stackable splice trays, managing up to 24 splices per tray, smoked polycarbonate cover and quarter turn screws for easy access. Provide rack mounted trays that do not exceed a 254 mm 10-inch depth for mounting in standard cabinets and enclosures, with strain relief lugs for the fiber cable entering the unit from the side or back, and port configurations and densities as called for on drawings.

2.2.2.12 Backboards

Provide backboards that are 1.2 m by 2.4 m by 19 mm 4 by 8 by 3/4-inch ACX, exterior grade, fire rated plywood, painted with gray, acrylic, interior grade fire-retardant paint. Ensure backboards provide adequate support and dress horizontal cabling between ladder rack and 110 wiring blocks as necessary or as shown on the drawings. Review cable routing plan for the Telecommunications Rooms, in the field, before installation of cabling commences.

2.2.2.13 110 System Blocks

Provide connecting hardware block that supports the appropriate TIA-568-C.1 Category 6 or better applications and facilitate cross-connection and/or inter-connection using either approved cross-connect wire or patch cords. Provide system blocks that are 110 System IDC style blocks, UL verified or equivalent for TIA/EIA Category electrical performance, and TIA-568-C.1 Category 6 or better (tested to 10 G).

Meet the following criteria (NEXT Loss and FEXT tested in both Differential and Common Mode):

PARAMETERS	PERFORMANCE AT 100 MHz
NEXT Loss	43.0 dB
FEXT	35.1 dB
Insertion Loss (Attenuation)	0.4 dB
Return Loss	20 dB

Provide system blocks made of flame-retardant thermoplastic, in 50-, 100-, and 300-pair sizes, with 50-, 100-, and 300-pair blocks available without legs, while the 100, and 300 pair blocks are available with legs. Ensure blocks include means to identify cables/services per TIA-606. Provide clear label holders with the appropriate colored inserts available for the wiring blocks. Provide insert labels with the product that contain vertical lines spaces on the basis of circuit size (3-, 4-, or 5-pair) and that do not interfere with running, tracing or removing jumper wire/patch cords. Provide label holders capable of mounting in the under portion of the wiring block. Provide system blocks with connecting blocks used for either the termination of cross-connect (jumper) wire or patch cords. Provide connecting blocks that are available in 3-, 4-, and 5-pair sizes.

Provide all connecting blocks with color-coded tip and ring designation markers, and of single piece construction. Provide system blocks with connecting blocks with a minimum of 200 re-termination without signal degradation below standard compliance limit. Provide blocks that support wire sizes: Solid 0.64 mm to 0.40 mm 22 to 26 AWG, and 7-strand wires. Provide 300 pair blocks made by an ISO 9001 Certified Manufacturer, typical for feed and station cable, unless otherwise noted. Provide keep-off indicator buttons on all active cross-connected pairs used for alarm and security purposes. Coordinate the color and use with the Contracting Officer. Provide connecting block designation label strips of the colors conforming to TIA-606.

2.2.2.14 Cross Connect

Provide modular 110 cross connect blocks for all backbone terminations. Provide cross connects with wire of equal gauge and performance category to that of the feed cable, which it is being connected to. Provide UL listed cross connect, and with one (1) roll of 1-pair and one (1) roll of 2-pair per Telecommunications Room (TR). Coordinate color code of one and two pair with Contracting Officer.

2.2.2.15 Grounding Bars

Provide grounding bar assembly as shown on drawings and a minimum No. 4 grounding electrode conductor from ground bar to suitable electrical building ground. Label grounding and bonding hardware and connections per TIA-606. Provide grounding wire that is appropriately bonded to the grounding bar and electrical building ground rod. Provide ground bar assembly that is constructed with the following materials (see drawing details for additional information):

a. Copper ground bar 16.35 mm by 10.2 cm by 25.4 cm 1/4-inch by 4-inch by 10-inch with 7.15 mm 9/32-inch holes spaced 2.86 cm 1-1/8-inch apart.

b. Stand-off insulators.

c. Lockwashers.

d. Wall mounting brackets.

2.2.2.16 Optical Fiber Patch Cords - Multimode

Provide optical fiber patch cords that are available in standard lengths of 1, 3, and 5 meters, and custom lengths, and meet or exceed standards as defined in TIA-568-C.1. Provide patch cords that use duplex optical fiber cable that is 62.5/125 or 50/125 micron multimode, OFNR riser grade, that uses optical fiber cable where the attenuation does not exceed 3.5 dB/km at 850 nm wave length or 1.0 dB/km at 1300 nm. Equip with SC, ST, dual LC, or MT-RJ connectors. Provide patch cords with terminated connectors exhibiting a maximum insertion loss of 0.75 dB with an average of 0.40 dB when tested at either 850 nm or 1300 nm wave lengths for 62.5/125 um, with terminated connectors exhibiting a maximum insertion loss of 0.75 dB with an average of 0.50 dB when tested at either 850 nm or 1300 nm wave lengths for 50/125 um. Provide optical fiber patch cords that have a minimum return loss of 20 dB (25 dB typical) at both 850 nm and 1300 nm. Provide duplex fiber cable patch cords meeting or exceeding the transmission characteristics of the optical fiber horizontal cable. Provide configuration of patch cords as required to accommodate the application.

2.2.2.17 Category 6 or better (tested to 10 G) Patch Cords

Provide TIA-568-C.1 Category 6 or better (tested to 10 G) patch cords that are round, and consist of eight insulated 24 AWG, stranded copper conductors, arranged in four color-coded twisted-pairs within a flame-retardant jacket, and are equipped with modular 8-position plugs on both ends, wired straight through with standards compliant wiring. Use modular plugs and have gold plating over nickel contacts. Use TIA-568-C.1 Category 6 or better (tested to 10 G) patch cords that are resistant to corrosion from humidity, extreme temperatures, and airborne contaminants, use cable that exhibits power sum NEXT performance, and is available in several colors with or without color strain relief boots providing snagless design.

Provide TIA-568-C.1 Category 6 or better (tested to 10 G) patch cords that meet the flex test requirements of 1000 cycles with boots and 100 cycles without boots, is available in any custom length and standard lengths (3, 5, 7, 10, 15, 20, and 25 feet), and input impedance without averaging 100 ohms plus or minus 15 percent from 1 to 100 MHz. Provide TIA-568-C.1 Category 6 or better (tested to 10 G) patch cords that use cable that is UL verified (or equivalent) for TIA-568-C.1 Category 6 or better (tested to 10 G) electrical performance.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Entrance Facility Terminals

Install frame mounted terminals and field verify actual length required for the input and output stubs. Install clear labeling information at the splice end of the tip cable referencing rack, row, and block. Terminate output stub to appropriate block on distribution frame. Install No. 4 grounding conductor as straight as possible from terminal to ground bar.

3.1.2 Surge Protection Modules

Ensure all pairs entering a building are fully protected with active pair surge protection modules or surge protection modules specific to inactive pairs.

3.1.3 Floor Mounted Distribution Frames

Install frames as designated on drawings, in accordance with manufacturer instructions. Ensure frames are securely fastened to the floor using expansion anchors, and are plumb and square with the room.

3.1.4 Steel Ladder Racking/Cable Tray

Install all ladder rack/cable tray and associated mounting hardware in a manner that allows it to support its maximum rated load. Install ladder rack/cable tray a minimum of 45.7 cm 18-inch above top of floor mounted rack or wall mounted cross-connect fields. Ensure installation complies with manufacturer's instructions.

3.1.5 Termination Blocks on Frame

Install color designation strips as follows:

DESCRIPTION	COLOR
C.O. Circuits	Orange
Common Equipment - PBX, Lan's, Muxes	Purple
First Level Backbone Cable	White
Second Level Backbone Cable	Gray
Horizontal Wiring	Blue
Auxiliary Circuits - Alarm, Security	Yellow
Future use and Key Systems	Red
Inter-building Campus Backbone	Brown

Install red insulator clips on all special circuits in the Main Equipment Room termination hardware and cross-connect facilities (ER). Confirm with the Contracting Officer which circuits to designate as special.

3.1.6 Floor Mounted Equipment Racks and Cabinets

Ensure all floor mounted equipment racks that anchor to the floor and are plumb. Provide vertical and horizontal cable and terminations as shown on the drawing. Mount with a minimum of 1 m 36-inches clear access behind and in front of rack from the wall to the rack. Install floor mounted equipment racks that ground the rack to the equipment ground bar. Adjacent racks maybe bonded together. Install communication grounding and bonding in accordance with applicable Codes and regulations. Install floor mounted equipment cabinets in a location that allows both the front and rear doors to open a full 90 degrees. Install cabinets employing cooling fans with at least 152 mm 6-inch of clear space above the top of the fan casing.

3.1.7 Wall Mounted Equipment Racks and Cabinets

Install wall mounted equipment racks to building structure with approved anchoring means. Verify all existing wall construction and submit proposed

anchoring methods for approval. Install both front and rear vertical and horizontal cable management as required. Install wall mounted equipment cabinets so to not interfere with the use of the front door or hinged body section.

3.1.8 Cable Management

Install a horizontal crossover cable manager at the top and bottom of each rack, with a minimum height of 2 rack units each. Install a horizontal crossover cable manager near the center of each relay rack, with a minimum height of 4 rack units. Install two rear cable management bars and reusable Velcro-type hook and loop straps in each rear vertical channel. Provide reusable straps of varying sizes (each allowing 50 percent spare future expansion) and of adequate quantity to secure cable bundles at least every 4 rack units. Secure cable managers, slack managers, support bars, hook and loop straps per manufacturer recommendations.

3.1.8.1 Cable Supports

Install "D" rings 0.6 m 24-inches on center for all exposed, wall mounted vertical Category 6 or better (tested to 10 G) cable runs. Make all horizontal cable runs within room on cable tray.

3.1.9 Category 6 or better (tested to 10 G) Patch Panels

Install and label TIA-568-C.1 Category 6 or better (tested to 10 G) patch panels as recommended by manufacturer per TIA-606. Install rear cable management bar(s) as recommended by manufacturer. Attach compliant color-coded icons or color-coded designation label strips for all patch panels per TIA-606. Identify voice or data functionality.

Install panels to provide minimal signal impairment by preserving wire pair twists as closely as possible to the point of mechanical termination. Ensure the amount of untwisting in a pair as a result of termination to the patch panel is not greater than 13 mm 0.5-inches.

Install panels according to manufacturer's instructions and properly mounted to a rack, cabinet, bracket, or other appropriate mounting device.

Install panels such that cables terminated to the panel maintain a minimum bend radius of at least 4 times the cable diameter into the IDC contacts. Terminate cables on the panels to ensure there is no tension on the conductors in the termination contacts.

Properly label panels on front and back with the cable number and port connections for each port.

3.1.10 Optical Fiber Patch Panels

Install panels according to manufacturer's instructions. Furnish and install labels for each strand, and install blank adapter panels in all positions not used at time of installation for fiber terminations.

Install adhesive or snap-in routing clips that are secured to the inside of the adapter tray that allow and maintain the minimum bend radius of the cable and the proper storage of at least 2 m 6-1/2-foot of fiber cable inside the tray.

Properly anchor incoming cable as it enters the rear or bottom of the

tray. Install the anchor to the cable jacket without the use of excessive force and without crushing the cable jacket.

3.1.11 Backboards

Per the drawings, line the linear wall space used for anchoring equipment for the full room width with plywood. Install plywood for mounting termination equipment vertically, side by side and a minimum of 152 mm 6-inches above finished floor. Install plywood for supporting backbone riser cables vertically and resting directly on the finished floor.

Ensure anchoring and mounting techniques of plywood used to support backbone riser cables are sufficient to support a minimum of 453 kg 1000 pounds of weight. Ensure heads of mounting screws do not protrude past the face of any plywood. Install distribution rings, two rings per vertical row of blocks, for the cross-connect fields above all wall mounted blocks. Mount rings with two hex head screws per ring.

3.1.12 110 System Blocks

Install 110 system blocks on plywood backboard so that top of 300 pair block is 1.7 m 66-inches above finished floor, or as noted on the drawing. Install blocks using steel, zinc plated 8 mm 5/16-inch slotted hex head No. 10 by 19 mm3/4-inch drill screws, minimum four screws per block. Install designation strips color-coded in conformance with TIA-606 standard, as follows:

DESCRIPTION	COLOR
C.O. Circuits	Orange
Common Equipment - PBX, LAN, Mux	Purple
First Level Backbone Cable	White
Second Level Backbone Cable	Gray
Horizontal Wiring	Blue
Auxiliary Circuits - Alarms, Security	Yellow
Future Use and Key Systems	Red
Inter-building Campus Backbone	Brown

3.1.13 Grounding and Bonding

Install a copper ground bar in each communication equipment room, as per the plans, and bond all metallic equipment racks, conduits, cable trays, ladder racks, etc. to the ground bar, using 13.0 mm2 No. 6 AWG (minimum) equipment grounding conductor. Ensure all connectors and clamps are mechanical type made of silicon bronze, and terminals are solderless compression type, copper long-barrel NEMA two bolt. Bond the shield of shielded cable to the ground bar in communications rooms and spaces, per applicable code and manufacturer's recommended practices. Install communication grounding and bonding that is in accordance with applicable codes and regulations.

3.1.14 Miscellaneous Requirements

Neatly dress, rack, label, and terminate all cables in communication rooms. Ensure a minimum of 609 mm 24-inch service loop on each terminated conductor, unless otherwise specified.

Ensure room support services include HVAC, lighting, power, and fire

protection as designated on the drawings.

Firestop all sleeves and conduit openings after the cable installation is complete.

3.2 CLOSEOUT ACTIVITIES

3.2.1 Record Drawings

Submit final record "As-built" drawings at the completion of the project of the following:

a. Scaled 1:50 1/4-inch by 1-foot Communication Room floor plans showing all installed components.

b. Front elevations of all systems patch panels.

-- End of Section --

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA/KSC-28 31 00.00 98 (August 2023)

Preparing Activity: NASA

Superseding
NASA/KSC-28 31 00.01 98 (September 2009)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
****

SECTION TABLE OF CONTENTS

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

SECTION 28 31 00.00 98

FIRE DETECTION AND ALARM

08/23

-- End of Section Table of Contents --

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA/KSC-28 31 00.00 98 (August 2023)

Preparing Activity: NASA

Superseding
NASA/KSC-28 31 00.01 98 (September 2009)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
****

SECTION 28 31 00.00 98

FIRE DETECTION AND ALARM
08/23

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NOTE: This specification covers the requirements for fire-alarm and detection equipment.

Indicate on drawings:

a. Location and mounting height of manual alarm stations, control unit, remote annunciator, transmitter, detectors, notification appliances, and other interfacing controllers.

b.Automatic fire detectors coverage (heat detector, flame detectors, etc.).

c. Fire alarm Notification Appliances coverage, candela, and wattage ratings.

d. Boundaries and classifications of hazardous locations.

e. Fire alarm input/output matrix. Show sequence of operations of input devices on one axis and output functions on the other.

f. Show single riser diagram of the fire-alarm system including interlocking circuits to air-handling-unit and ventilating-fans and other auxiliary equipment. Each device on the riser should be identified by type. Indicate connection of equipment.

g. Interfaces with fire-protection systems

Utilize KSC STD-F-0004 as a design standard for the fire detection and alarm system, including any additional direction and guidance provided by the KSC AHJ, as applicable.

Point-to-point wiring is defined as wiring from field device with integral terminal strip to next

device with integral terminal strip, wiring between modules internal to fire alarm control panels (FACP), circuit terminations on terminal strips in fire alarm control panels and terminal boxes are equipment specific and will be provided by the fire alarm contractor as a Shop Drawing submittal.

Add to Section 01 11 00 SUMMARY OF WORK a description of the scope of the fire alarm work particular to this project.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Recommended changes to a NASAKSC Master Specification Section should be submitted as a Criteria Change Request (CCR) to the appropriate Technical Proponent (TP) through the SpecsIntact Help Desk.

****

PART 1 GENERAL

1.1 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

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

****

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.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A17.1/CSA B44	(2019) Safety Code for Elevators and Escalators

COMPRESSED GAS ASSOCIATION (CGA)

KSC-STD-F-0004	(2016, Rev G) Standard for Fire Protection Design

FM GLOBAL (FM)

FM 3260	(2021) Radiant Energy-Sensing Fire Detectors For Automatic Fire Alarm Signaling
FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991; R 1995) Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

NASA-STD 8719.11	(2020; Rev B) Safety Standard for Fire Protection

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2020) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023) National Electrical Code
NFPA 72	(2022; ERTA 22-1) National Fire Alarm and Signaling Code
NFPA 75	(2020) Standard for the Protection of Information Technology Equipment
NFPA 90A	(2024) Standard for the Installation of Air Conditioning and Ventilating Systems
NFPA 101	(2021; TIA 21-1) Life Safety Code
NFPA 780	(2023) Standard for the Installation of Lightning Protection Systems

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS-STD-595A	(2017) Colors used in Government Procurement

UNDERWRITERS LABORATORIES (UL)

UL 13	(2015) Power-Limited Circuit Cables
UL 38	(2008; Reprint Nov 2013) Manual Signaling Boxes for Fire Alarm Systems
UL 268	(2023) UL Standard for Safety Smoke Detectors for Fire Alarm Systems
UL 268A	(2008; Reprint Oct 2014) Smoke Detectors for Duct Application
UL 346	(2005; Reprint Sep 2019) UL Standard for Waterflow Indicators for Fire Protective Signaling Systems
UL 444	(2017; Reprint Jun 2021) UL Standard for Safety Communications Cables
UL 464	(2023) UL Standard for Safety Audible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories
UL 497B	(2004; Reprint Feb 2022) UL Standard for Safety Protectors for Data Communications and Fire Alarm Circuits
UL 521	(1999; Reprint Feb 2023) UL Standard for Safety Heat Detectors for Fire Protective Signaling Systems
UL 864	(2014; Reprint May 2020) UL Standard for Safety Control Units and Accessories for Fire Alarm Systems
UL 1424	(2015) Cables for Power-Limited Fire-Alarm Circuits
UL 1449	(2021; Reprint Dec 2022) UL Standard for Safety Surge Protective Devices
UL 1480	(2023) UL Standard for Safety Speakers for Fire Alarm and Signaling Systems, Including Accessories
UL 1711	(2006) UL Standard for Amplifiers for Fire Protective Signaling Systems, 4th Edition
UL 1638	(2023) UL Standard for Safety Visible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories
UL 2196	(2008) UL Standard for Tests for Fire Resistive Cables, 1st Edition
UL 1971	(2002; Reprint Oct 2008) Signaling Devices for the Hearing Impaired

UL Fire Prot Dir (2012) Fire Protection Equipment Directory

UL Fire Resistance (2014) Fire Resistance Directory

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, and corresponding submittal items in the text, to reflect only the submittals required for the project.

A "G" following a submittal item indicates that the submittal requires Government approval. Specification Editor is responsible for selecting items that require Government approval due to their complexity or criticality. Delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

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 REPORTING.

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

****

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 with Section 01 33 29 SUSTAINABILITY REPORTING.

SD-02 Shop Drawings, SD-03 Product Data and Design Data (SD-05)are to be combined and submitted as one complete package. A Qualified Engineer provided by the Fire Alarm Contractor and independent of the design Architect & Engineer, reviews the SD-02/SD-03/SD-05 submittal package for completeness and compliance with the Contract provisions prior to submission to the Government. Partial submittals and submittals not reviewed by the Qualified Engineer will be returned by the Government disapproved without review.

Submit the following in accordance with 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Contractor's Certifications[; G] Submit to the Contracting Officer

for approval, prior to any work being started on the Fire Alarm System, in accordance with paragraph entitled "Qualifications".

SD-02 Shop Drawings

Connection Drawings[; G]

Site-Specific Software Programs[; G]

Fire Service Floor Plans[; G]

Floor Plan Drawings[; G]

Module Schematics[; G]

SD-03 Product Data

Where multiple types of the same item are required (Example: indoor, weatherproof, and explosion-proof types) provide separate Catalog Data for each type of device. Submit Manufacturer's Catalog Data for the following items:

Fire Alarm Control Panel[; G]

CRMS Reporting Equipment[; G]

Addressable Modules/Devices[; G]

Annunciator Panels[; G]

Heat-Actuated Detectors[; G]

[Flame Detectors][; G]

Smoke Detectors[; G]

Duct Smoke Detectors[; G]

Manual Alarm Stations[; G]

Horn/Strobe Combination Units[; G]

Strobe Units[; G]

Speakers[; G]

Fire Resistive Cables[; G]

Water Flow Alarm Devices[; G]

Valve Tamper Switches[; G]

Remote Auxiliary Control Relays[; G]

Power Source[; G]

Batteries[; G]

Line Voltage Surge Suppressors[; G]

Low Voltage Surge Suppressors[; G]

Wiring (Wire and Multi-Conductor Cable)[; G]

SD-05 Design Data

Voice Evacuation System[; G]

[Flame Detectors FOV][; G]

SD-06 Test Reports

Fire Alarm System Acceptance Test Procedures[; G]

CRMS Antenna Performance Test[; G]

Continuity Test Report[; G]

Insulation Resistance Test Report[; G]

SD-07 Certificates

NFPA 72 Record Of Completion[; G]

Verification of Compliant Installation[; G]

[Certificate of Training][; G]

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals[; G]

Recommended Critical Spares List[; G]

[Special Tools][; G]

[Instruction of Government Employees][; G]

SD-11 Closeout Submittals

Record Drawings[; G] (As-builts after completion of the final acceptance test)

Fire Alarm System Acceptance Test Procedures[; G](with signatures)

Site-Specific Software Programs[; G](Record copy)

NFPA 72 Record of Completion Form[; G](with signatures)

1.3 GENERAL REQUIREMENTS

Related Specification Sections that apply to work specified in this section:

Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL
[Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS]
[Section 28 31 33.00 98 AIR SAMPLING DETECTION SYSTEMS (ASDS)]
[Section 21 13 00.00 98 FIRE SUPPRESSION SPRINKLER SYSTEMS]
[Section 21 13 26.00 98 DELUGE FIRE-SUPPRESSION SPRINKLER SYSTEMS]

[Section 21 23 00.00 98 WET-CHEMICAL FIRE-EXTINGUISHING SYSTEMS]

1.3.1 Submittals Sequence

Submit submittals for approval in the following sequence with each approved prior to the next submittal.

1.3.1.1 Preconstruction Submittals

Submit the following submittals no later than [30] [_____] days after notice to proceed:

a. Contractor's Certifications

b. Product Data (Catalog Data)

c. Shop Drawings

d. Design Data

Combine and submit (b.), (c.) and (d.) above as one complete package.

1.3.1.2 Acceptance Test Procedures

Submit the following no later than [60] [_____] days prior to performing system tests:

a. Fire Alarm System Acceptance Test Procedures

1.3.1.3 Site-Specific Software Programs

Provide Fire Alarm Control Panel (FACP) [and network] Site-specific Software Programs and provide a copy to the Contracting Officer in accordance with owner's Representative (i.e., O&M System Engineer) instruction document titled Software Modifications Process for review, approval, and upload to the panel no later than [30] [ ] days prior to the scheduled preliminary test.

1.3.1.4 Preliminary Test Submittals

Submit the following submittals no later than 14 [_____] days prior to the scheduled preliminary acceptance test:

a. Fire Alarm System Preliminary Acceptance Test Procedures (Approved copy. Re-submit if approved test procedure was revised)

b. Site-Specific Software Programs (Approved copy. Re-submit if approved site-specific software was revised)

c. NFPA 72 Record of Completion (Draft form)

d. Verification of Compliant Installation

e. CRMS Antenna Performance Test(results)

Provide two completed sets minimum of the shop drawings and documentation above and make available for reference at the preliminary test.

1.3.1.5 Final Test Submittals

Submit the following submittals no later than [14] [_____] days prior to the scheduled final test:

a. Fire Alarm System Final Acceptance Test Procedures

b. NFPA 72 Record of Completion Form

Provide two completed sets minimum of the Shop Drawings and documentation above, completed Preliminary Test Documentation results and make available for reference at the final test.

1.3.1.6 Closeout Submittals

Submit the following submittals no later than [21] [_____] days after approved completion of Final Acceptance Test:

a. Operation and Maintenance Manuals

b. Recommended Critical Spares List

c. Record Drawings

d. Site-Specific Software Programs (Record copy)

e. Fire Service Floor Plans

f. Completed Fire Alarm System Acceptance Test Procedures (with signatures)

g. Completed NFPA 72 Record of Completion (with signatures)

h. [Special Tools]

i. [Instruction for Government Employees]

Include in this submittal .DWG or .DGN electronic computer format file of all the Record Drawings (As-builts)and Fire Service Floor Plans. Prepare and submit all drawings generated by computer aided design (CAD). Provide a complete copy of the Record Drawings (As-builts) and Fire Service Floor Plans in PDF format. Submit these items electronically or using a government approved method.

1.3.2 Documentation Requirements

Provide Installation shop drawings, record drawings, connection drawings, signed and sealed by a Qualified Engineer as defined in section 1.6 titled "QUALIFICATIONS".

Prepare all drawings generated by computer aided design (CAD) .DWG or .DGN electronic computer format file.

1.3.2.1 Shop Drawings

Include in Shop Drawings: Connection Drawings, Floor Plan Drawings, Module Schematics, Fire Alarm Control Panel (FACP), Sequence of Operations, Battery Calculations, Voltage Drop Calculations, and all other wiring details required to fully document the completed system. After final

testing is complete, submit Record Drawings including digital media and hard copies of all new and revised software, drawings, and analysis/calculations incorporating approved comments and any changes.

1.3.2.2 Connection and Floor Plan Drawings

Provide Connection Drawings consisting of point-to-point wiring diagrams and color-coding of internal and external wiring including, but not limited to, all fire alarm field devices, panel wiring, and interconnection between other building systems and components and the fire alarm system. Indicate wire label designations matching the field installation on these drawings.

Include in Floor Plan Drawings, device legend, equipment locations, device locations with address designation, heat detector spacing, notification appliances with signal circuit, with speaker wattage tap and candela rating, and conduit/wiring routing from the FACP(s) to all field devices. Also include typical mounting requirements for each type of initiation, signaling, notification appliance, and control device,[spaces/areas requiring voice intelligibility], floor plans drawn to scale, and ceiling heights. [Show validation and replication of actual Flame Detectors FOV (field of views), consisting of left and right horizontal axis and vertical axis on drawing for each detector. Map and use FOV drawn to scale. Indicate detector's sensitivity setting, fuel type selection, size of flame, and distance range on drawing. Show detector's location, angle alignment, mounting height, and aiming point/mark with clear dimensions from fixed and readily identifiable structural references on drawing.] Include riser diagram and sequence of operations in an input/output matrix format that clearly shows interaction of system components.

1.3.2.3 Record Drawings

The record drawings are the final compilation of actual conditions reflected in the as-built drawings. Include in Record Drawings all data required to fully document the completed system. Prepare and submit all drawings generated by computer aided design (CAD) .dwg or .dgn. Provide a complete copy of the Record Drawings in PDF format. Submit the record drawing in accordance with Section 01 78 00 CLOSEOUT SUBMITTALS.

Document final system configuration in Record Drawings including, but not limited to, geographic monitor zone boundaries, location of the FACP, all initiating and auxiliary control devices, signaling line devices, notification appliances, additional cabinets, water-based system riser, releasing control panel, smoke and fire dampers, magnetic door holders, and all other equipment associated with the fire alarm system(s). Also, annotate the location and address setting for each multiplexed addressable device (when used), deviations from and amendments to the record drawings, and field installation changes, concealed and visible.

1.3.2.4 Software Programs

Provide Site-Specific Software Programs, both hard copy in PDF format and compact disc media, for all new and/or existing programmable FACP(s) affected by the project. Provide system software executable file and source file, including all files and data to restore the system on the compact disc media. FACP program documentation to include system point summary, addressable device switch settings, and descriptive check boxes for program functions listed on paragraphs titled "FACP Functions". FACP site-specific software program documentation to clearly show interaction of system components in accordance with the Fire Alarm Input/Output Matrix and

Sequence of Operations included in design. Programming documentation specifically programming check boxes to be reviewed and approved by government prior to Final Acceptance Testing.

1.3.2.5 Fire Alarm System Acceptance Test Procedures

Conduct tests in accordance with approved Fire Alarm System Acceptance Test Procedures, and in accordance with the paragraph entitled "Field Testing" in this specification. Prepare a test procedure and test record form for conducting complete tests on control panels, reporting systems, wiring systems, and field devices installed in accordance with the manufacturer's requirements and these specifications. Identify each device and circuit to be tested in the test procedure, describe the initial condition, each step or function in the test, required test result, and equipment to be employed.

Test procedures are to be written to minimally disrupt facility operations and reduce the time required to receive signals at the Ground Support Fire Alarm (GSFA) console for KSC testing by not routinely transmitting repetitive signals, for example on site inspectors may observe relay operations that cause radio zones to transmit. Test procedure to detail how to minimize activation of evacuation notification appliances, AHU shutdown, etc. in support of testing requirements. Ensure test forms have suitable space for recording test results on all equipment, devices, and wiring to be tested. Provide test record forms with identified spaces for verification signatures of AHJ or designee, Owner's Representative (i.e., O & M System Engineer), and Contracting Officer or Designee.

1.3.2.6 Fire Service Floor Plans

Clearly indicate on Fire Service Floor Plans the location of the FACP, all initiating and auxiliary control devices, signaling line devices, notification appliances, additional cabinets, detection systems, releasing control panels, smoke and fire dampers, magnetic door holders and all other equipment associated with the fire alarm system(s). Show floor plan(s) drawn to scale. Also, annotate the location and address setting for each multiplexed addressable device (when used). Do not place borders or title blocks on the Fire Service Floor Plan. Where applicable, maximize viewing area by showing only a close-up view of all fire alarm devices and eliminating empty floor plan space. Provide uniform font size and line type styles throughout entire space. For multistory building, show all floor levels in single Fire Service Floor Plan to be located in the main floor level. Maximize the floor plan scale, device size, font size, close-up views, as required to obtain best result and generate a clear view of entire Fire Service Floor Plan. Provide a symbol legend, which clearly identifies each device shown on the Fire Service Floor Plan. Install a copy of the Fire Service Floor Plan, minimum size 457 mm by 610 mm 18 by 24 inch in a painted metal frame with a Plexiglas cover. Submit the floor plan and its location for approval, to the Contracting Officer, prior to installation.

1.3.2.7 Battery Calculations and Voltage Drop Calculations

Include Battery Calculations for the Fire Alarm and Detection Systems consisting of the battery capacity and loading calculations, including 20 percent safety margin on the shop drawing.

Include Voltage drop calculations for each notification circuit indicating that sufficient voltage is available for proper operation of the system and

all components, at a minimum rated voltage of the system operating on batteries on the shop drawings.

1.3.2.8 Operation And Maintenance Manuals

Submit Operation and Maintenance Manuals. Bind information in manual format and group by technical sections consisting of manufacturer's standard brochures, schematics, procedures, recommended test equipment, and safety precautions.

1.3.2.9 Recommended Critical Spares List

Submit Recommended Critical Spares List specific to the project. List to include critical spare parts and components recommended by the manufacturer to restore the system to operation in with minimal downtime and to be replaced after 1 year of service. Spare parts furnished must be directly interchangeable with the corresponding components of the installed system[s]. Spare parts must be suitably packaged and identified by nameplate, tagging, or stamping. Spare parts must be delivered to the Contracting Officer at the time of the Government testing and must be accompanied by an inventory list.

****
NOTE: Coordinate inclusion of the following bracketed paragraph with the Flame Detector requirements paragraph in this specification.
****

****
NOTE: Select the bracketed submittal paragraph if the design prepared under this project will be for installation of a new flame detector (make/manufacturer) other than Det-tronics, which is currently installed at KSC premises.
****

[1.3.2.10 Special Tools

Furnish special tools necessary for the maintenance and testing of the equipment to the Contracting Officer after completion of Government Testing. Provide test lamp, approved by manufacturer, for testing of new flame detectors.

]1.4 SYSTEM REQUIREMENTS

[Provide a new, complete fully addressable, modular type, microprocessor based, supervised, non-coded electrical][Modify existing]fire alarm system, as described herein and on the contract drawings, and in accordance with applicable requirements of NFPA 72, NFPA 70, NFPA 75, NFPA 90A, NFPA 101, KSC standards KSC-STD-F-0004 and NASA Standard NASA-STD 8719.11. Provide NFPA 72 Class A initiating device circuits, signaling line circuits, notification appliance circuits, and auxiliary control circuits, NFPA 72 Class B Central Radio Monitoring System (CRMS) circuits, and NFPA 72 Class X network reporting circuits. Ensure all Class A and Class X circuits use diverse routing in accordance with NFPA 72. Do not run the outgoing and return redundant circuit conductors in the same cable assembly, enclosure, or raceway, except where permitted by NFPA 72.

Provide system complete and ready for operation. Electrically connect the fire alarm system to report alarm, trouble, and supervisory signals to the CRMS; to sound the general alarm continuously (where applicable); and to control auxiliary equipment such as dampers, air handling units, magnetic door latches, elevator recall, etc., upon operation of one or more initiating devices. For initiating, notification, signal, and auxiliary control circuits, use 24 V(DC).

Provide all equipment, cabinets, modules, devices, programming, circuits, conduits, testing and labor to meet the requirements of this specification.

1.5 QUALIFICATIONS

1.5.1 Qualified Engineer

Installations requiring completion of installation shop drawings and record drawings for fire alarm systems require signing and sealing by a qualified engineer. For the purpose of meeting this requirement, a qualified engineer is defined as an individual meeting one of the following conditions:

a. A Registered Professional Engineer (P.E.) in fire protection engineering.

b. Registered Professional Engineer with verification of experience and minimum of five years of current experience in the design of fire alarm systems of similar complexity.

1.5.2 Installer

Installation of wire, cable, conduit, control cabinets, fire alarm terminal cabinets, and backbones for fire alarm components must be performed by Fire Alarm Installers. Licensed Electricians are allowed to be Fire Alarm Installers. [Fire Alarm Installer to be assisted by a Fire Alarm Technician.]

1.5.3 Technician

Installation and termination of fire alarm control panels, releasing panels, notification appliances, initiating devices, cabinets and modules must be performed by [NICET Level II certified] Fire Alarm Systems Technicians with a minimum of four years of experience. Fire Alarm SystemsTechnicians must be trained by the manufacturer in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.5.4 Supervisor

****
NOTE: Select the Supervisor bracketed item based on complexity level of system installation.
****

Installation of the fire alarm control panels and releasing panels must be supervised by a [NICET Level III certified] Fire Alarm Systems Technician with a minimum of 8 years of experience [who will be on-site to supervise all activities, from pre-construction to install.]. The Fire Alarm SystemsTechnicians must be trained by the manufacturer in the installation, adjustment, testing, and operation of the equipment specified herein and on

the drawings.

1.5.5 Test Personnel

Testing and certification of fire alarm systems must be performed by a [NICET Level III certified] Fire Alarm Systems Technician with a minimum of 8 years of experience. The Fire Alarm Systems Technicians must be trained by the manufacturer in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.5.6 Manufacturer's Representative

The fire alarm control panel and releasing panel equipment Manufacturer's Representative must be present for the connection of wiring to the panel. The Manufacturer's Representative must be an employee of the manufacturer with necessary technical training [NICET Level III] on the system being installed or certified by the manufacturer with necessary technical training on the system being installed.

1.5.7 Manufacturer

Components must be of current design and be in regular and recurrent production at the time of installation. Provide design, materials, and devices for a protected premises fire alarm system, complete, conforming to the most current version of NFPA 72, except as otherwise or additionally specified herein.

[1.5.8 Certified Flame Detector Specialist

Provide on-site services of a manufacturer's certified representative, to supervise installation, adjustments, and tests of the flame detection system. Manufacturer's certified representative involved with designing and installation of flame detection system shall have a minimum of three (3) years experience in the installation of flame detection system, holding a valid Laser Aimer Certificate of Training, by manufacturer as being trained and certified to model, design, install, program, and test the multi-spectrum IR flame detector field of view coverage. Provide evidence of experience and of the equivalent certification and the basis of certification to the Contracting Officer for approval.

]PART 2 PRODUCTS

2.1 FIRE ALARM CONTROL PANEL

Provide fully addressable Fire Alarm Control Panel (FACP), of modular construction with solid state, microprocessor-based electronics. Provide a control panel that complies with the applicable requirements of UL 864 and suitable for use with fire alarm devices specified in this specification. Include non-volatile programmable operating system memory for all operating requirements in the panel. Ensure control unit provides power, supervision, control, and logic for the entire system. Program FACP in accordance with fire alarm input/output matrix and sequence of operations in contract drawings or specified herein. Provide visual annunciation for a LED or LCD visual display as an integral part of the control panel and identify with a word description and ID number each device. Addressable components are to include, but not be limited to, addressable monitor modules, control modules, signal modules, and addressable input/output relays. Equip modules with transient surge suppression. Provide visual indication of alarm, supervisory, or trouble initiation on the FACP is by LED or LCD. Provide

panel with supervisory functions for power failure, internal component placement, and operation. Ensure control unit is suitable for operation on a 60 hz, 120 V (AC) building power supply.

Wiring for fire alarm control panel must meet resistance, capacitance, and length in accordance with the manufacturers circuit type wiring requirements.

[Provide FACP UL listed or FM approved and rated for service as a releasing panel. Ensure FACP includes all components and modules required to electronically activate fire [suppression] [extinguishing] systems.]

[2.1.1 New and Retrofit Facilities FACP

****
NOTE: Select the following paragraph for new FACP installation where a new fire system is being installed to replace the existing Simplex or Siemens fire system (obsolescence, beyond its life expectancy, fails to meet current needs, upgrade that would require the entire existing system to be brought up to current code, etc.)
****

Provide an addressable NOTIFIER FACP, or approved equivalent.

][2.1.2 Existing Facilities FACP

****
NOTE: Select the following paragraph for existing Simplex or Siemens FACP modification where the existing Simplex or Siemens fire system is being reconfigured or expanded (within its life expectancy, no obsolescence).
****

For upgrades or expansion of existing Fire System, equipment and devices must be compatible and operable with the existing building fire alarm system. Equipment must not impair reliability or operational functions of the existing system. The existing FACP is a [make, model number].

Ensure new components are compatible with, and UL listed for use with remaining FACP.

]2.1.3 FACP Functions

2.1.3.1 Indicator Lights and Switches

Ensure (FACP) contains power-on, alarm, supervisory, and trouble indicating lights plainly visible when the cabinet is closed; and also contains the following functions accessible only by unlocking and opening the unit:

a. Alarm Silence - Audible and visual notification appliances will deactivate upon a silence signal from the FACP. When the notification appliances have been silenced, ensure subsequent alarms reactivate them.

b. Power On-Off (If standard by the manufacturer)

c. Supervisory/Trouble Acknowledge - Ensure that supervisory and trouble

acknowledge switches silence the supervisory and trouble audibles in the panel, but not extinguish the visual indicator. This switch must be overridden upon activation of a subsequent supervisory or trouble condition. Audible trouble indication must resound automatically every 24 hours after the silencing feature has been operated if the supervisory or trouble condition still exists.

d. Auxiliary Devices Maintenance Disable - Include maintenance disable switches for all auxiliary control devices in the FACP. Ensure disable switches are supervised to report supervisory signal when in the maintenance (disable) position. Provide switches used for disable functions which are either toggle or soft key type, and listed for use with the control panel. In addition, provide each switch with a positive visual indication to show the function is ON.

e. System Reset - Provide alarm, supervisory, and trouble reset switches which reset a cleared device in alarm, supervisory, or trouble condition. Ensure alarm signal does not self-restore without activating the switch. Ensure programmable capability to automatically clear a trouble or supervisory condition when the problem causing the trouble or supervisory is corrected.

2.1.3.2 Software Requirements

Unless otherwise specified, the following operating parameters will be incorporated in the system configuration software:

a. Time will be displayed in 24-hour format.

b. Time and date must be automatically set.

c. Temperature will be displayed as degrees Fahrenheit.

d. Local mode will not be used.

e. Service reset and combined alarm/hardware reset will be employed.

f. Audible notification will be temporal mode.

g. Ensure there is no alarm cutout or silence/reset inhibit used.

h. Ensure no active signal reminders are used.

i. All operator actions except "silence", "system reset", "acknowledge", and "display time" must require passcode for access.

j. Default passcodes can be used and are acceptable

k. Ensure all ceiling smoke detectors to operate as "verified" smoke detectors.

l. After all active troubles are acknowledged, additional troubles must retransmit a trouble signal to CRMS where software permits.

m. AC power failure and card failure troubles must transmit a separate trouble signal when possible.

n. Remote annunciators panels will only display alarm, priority 2, and supervisory signals. Trouble signals will be displayed only at the main

control unit.

o. Visual notification appliance must be silenced at the same time as the audible notification devices.

p. Automatic self-test routines must be performed on heat detector that will functionally check detector sensitivity electronics and ensure the accuracy of the value being transmitted. Any detector that fails this test must indicate a trouble condition with the detector location at the control unit.

q. Automatically adjust/set analog type smoke detector's sensitivity to compensate environmental changes meeting UL listed calibrated sensitivity requirements per NFPA 72. When the limits of this compensation are reached, a "trouble" signal must be initiated.

2.1.3.3 Alarm

Ensure FACP contains all components necessary to monitor and supervise all initiating device circuits, and when any detector, manual alarm station (pull box), water flow switch, pressure switch, etc., connected to the fire alarm control panel is activated, the control panel's visual alarm, alarm indicator and audible signal are activated. This causes all notification appliances to be activated, where applicable, including all associated auxiliary control functions. Verify that the control panel visually indicates the addressable device or zone in alarm and transmits an alarm condition to the remote Central Radio Monitoring System.

2.1.3.4 Supervisory

Ensure that the FACP contains all components necessary to monitor and supervise all supervisory device circuits. Verify that when any valve tamper switch, low air pressure switch, water level indicator, panel maintenance disable functions, or other supervisory device connected to the control panel is activated, the control panel supervisory visual indication and supervisory audible device is activated; and that control panel visually indicates the addressable device or zone in supervisory alarm and transmit a supervisory condition to the remote Central Radio Monitoring System.

2.1.3.5 Auxiliary Devices

Provide FACP with all components necessary to operate and supervise the circuits for annunciator panels indicated, auxiliary power supplies indicated, and auxiliary devices controlling equipment such as ventilating fans, air handling units, fan coil units, damper motors, solenoids, magnetic door holders, and elevator recall. Ensure circuits for auxiliary control relays are supervised to within 0.91 m 3 feet of the device to be controlled in accordance with NFPA 72.

2.1.3.6 Trouble

Provide panel which monitors and reports any trouble open supervised circuits, ground faulted supervised circuits, removal of detector or device, removal or failure of control panel module, maintenance disable switch activated, loss of primary power, power supply trouble, low battery voltage, loss of battery voltage, and activation of the alarm silence switch. Ensure all trouble signals are identified by initiating, notification appliance, auxiliary control, or signaling line circuit; and

that trouble signals activate the control panel trouble visual indication and trouble audible devices, and send a trouble signal to the remote Central Radio Monitoring System.

[2.1.3.7 Voice Evacuation

Include in FACP a voice evacuation system with all components and modules required for a [single] [multiple] channel audio signaling system distributed over [8] [_____] audio signaling device circuits, capable of accurately reproducing horn, bell, chimes, or slow whoop tones and pre-programmed voice messages for [staged] building evacuation. Include audio amplifier input with a dedicated power supply, with a primary power input of 120 V(AC) and a battery backup input of 24 V(DC). Ensure audio amplifier output is a minimum 100 watts at [25][75] VRMS. Locate a microphone and 102 mm 4 inch speaker at the control panel for fire fighter paging and monitoring. Include in audio system controls switching with visual indication for localized facility-wide paging announcements. [Provide voice messages in English language, followed by temporal threetones in accordance with NFPA 72. Intelligibility testing of the System must be accomplished in accordance with NFPA 72 and KSC-STD-F-0004 for Voice Evacuation Systems. Use commercially available test instrumentation to measure intelligibility as specified by NFPA 72 as applicable. Use the mean value of at least three readings to compute the intelligibility score at each test location.]

]2.1.4 FACP Contacts

Provide FACP with an individual set of Form C dry contacts which activate for alarm, trouble and supervisory conditions for connection to the Central Radio Monitoring System (CRMS). Provide additional other fire monitoring or special function relay contacts as indicated.

Ensure all relays are continuous duty and have self-cleaning contacts of silver or an alloy of equivalent performance and are suitably protected against dust by individual covers. Provide all relays with external functions, control device activation, and notification appliance activation, with at least one set of spare contacts. Permanently mark relays with the coil resistance, operating-current range, and internal pin connections using standard pin numbers.

2.1.5 FACP Cabinets

Install a separate terminal cabinet adjacent to the FACP for interfacing device field wiring to the control panel. Install addressable module cabinets to house multiple modules. Install terminal strips for all field wiring circuits plus 25 percent spare. Where a terminal cabinet is installed, install terminal strips to accommodate remote reporting circuits and associated surge suppressors. Provide copper ground bus within this terminal cabinet for termination of equipment ground conductors. Ground/bond enclosures and surge suppressors in accordance with NFPA 70 and manufacturer's instructions.

Provide steel FACP, terminal cabinets, addressable module cabinets, surge suppression cabinets and battery cabinets (when used), with a hinged cover and an integral pin-tumbler cylinder lock (mortise or standard rim cylinder from Best Access Systems) with removable core that accepts the key presently in use with other control units existing in the area. Lock core will be provided by the government. Cabinet must be large enough to accommodate all components and also to allow ample gutter space for

interconnection of control units as well as field wiring, factory painted with a prime coat and one or more finish coats of scratch-resistant baked enamel red finish coat unless otherwise indicated.

2.1.6 FACP Power and Batteries

Ensure primary power to the local fire alarm systems for all purposes, including separately powered notification appliances and initiating devices, is 120 V (AC), 60 hertz. Ensure fire alarm system operates satisfactorily between 85 and 110 percent of normal voltage. Provide fire-alarm-system disconnect/protective device as a fused switch with factory painted red finish coat. Mount this disconnect fused switch adjacent to the main FACP and, where applicable, to auxiliary/supplemental fire alarm system panel(s). Mark as FIRE-ALARM DISCONNECT FED FROM (indicate supply circuit) with 1/2-inch high letters in white paint or engraved phenolic identification plates fastened with sheet metal screws. Ensure switch is capable of being locked in the "on" or "off" position, a feature which can not interfere with the circuit protection capability of the device. Equip switch with surge suppression for all phase and neutral conductors. Install current limiting Class RK1 fuses properly sized to protect the fire alarm equipment.

Provide all FACPs and auxiliary power supplies units with a DC power input and with a DC disconnect switch integral with the equipment provided (1P switch), or provide a separate safety switch. If supplied within the cabinet, ensure the power on-off switch disconnects all power sources to the control panel. Provide the on-off switch with DC rated contacts.

Provide the means of automatically supplying the entire fire alarm system with backup power with batteries, charger, and power transfer equipment alarm system with battery backup power in event of a primary power system failure. Ensure system switches to battery power in event of AC power failure, and switches back to AC power upon return of primary power. Transmission of loss of AC power trouble signal to be delayed by a minimum of [60] minutes. Ensure control panel(s) and auxiliary power supplies are able to operate when the backup batteries are disconnected for any reason. Also ensure system controls charging currents and floating voltage levels to maintain batteries in optimum condition. Provide capability to recharge batteries in event of discharge. Fuse wiring to protect against battery over-current and polarity reversal. Confirm primary power, battery, or charging equipment failure results in a FACP trouble signal and visual indication.

Provide lead-acid, sealed batteries to prevent any corrosive fumes. Provide batteries listed for fire alarm service and suitable for high discharge currents required under alarm conditions. Size batteries to operate the fire alarm and detection system (including voice evacuation system and flame detectors, where installed), in normal supervisory condition for [24] [48] [72] hours, minimum, then operate the system in the alarm mode for [5] 10 [15] [_____] minutes, minimum in accordance with NFPA 72.

2.2 CRMS REPORTING EQUIPMENT

[2.2.1 Radio Based FACP Reporting

[Provide a new, complete][Modify existing] Keltron Corporation UL 864 Listed Radio Fire transceiver [Model 778F] with minimum eight 8 supervised zones and a Keltron Corporation UL Listed DataTap FACP Interface [Model 95K3222], with removable BEST core that accepts the key presently in use

with other control units existing in the area. Lock core will be provided by the government.

Point-specific event information captured by FACP is required for reporting, install a Keltron Corporation UL Listed DataTap FACP Interface [Model 95K3222] and coordinate programming with Owner's Representative (i.e., O & M System Engineer). Provide a panel RS-232 Interface Module and configure serial data port connections as indicated per manufacturer's instructions and recommendations. Provide UL listed, copper, twisted pair RS-232 wiring size of not less than 0.8mm2 No. 18 AWG diameter with an insulation rating of not less than 300 volts. Use shielded, twisted pair cable where recommended by the manufacturer. Ensure cable is listed as Type [CMP][FPLP][for fire alarm applications]

Power transmitters by a combination of locally available 60 hz 120 V AC, and sealed lead-acid type batteries. Provide dedicated electrical circuit for CRMS with surge protection, circuit may be shared with the FACP. The battery package shall be capable of supplying all the power requirements for a given transmitter. Radio fire alarm transmitter standby battery capacity shall provide sufficient power to operate the transmitter in a normal standby status for a minimum of [24][60] hours and shall be capable of transmitting alarms during that period. Submit substantiating battery calculations for supervisory and alarm power requirements.

Provide separate enclosure(s) as required for 60 hz 120 V(AC) power supply components (receptacle and plug-in step-down power transformer). Provide AES Corporation [Model 1640-ENCL] radio transformer enclosure and secure [Model 1640] transformer to receptacle with the screw provided. Provide factory painted with a prime coat and one or more finish coats of scratch-resistant baked enamel red finish coat on all enclosures unless otherwise indicated.

The radio frequency (RF) power output of each transmitter shall be sufficient for reliable alarm reporting. The antenna system and cabling shall be furnished to provide adequate system gain. Each transmitter shall transmit a distinct identity code number as part of all signals emanating from the transmitter.

Provide a Metz antenna [Model 217] omnidirectional with a driving point impedance to match transceiver output (SWR 1.5:1 or less). Provide at least two RF pathways across the mesh radio network to the Central monitoring station to comply with NFPA 72. Antenna lightning protection, surge protection, and grounding requirements shall comply with NFPA 70, NFPA 780, and as described on the contract drawings.

]2.3 ADDRESSABLE MODULES/DEVICES

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NOTE: Select and edit paragraphs as necessary for the multiplex system designs only.
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Provide solid-state addressable modules compatible with the FACP. Provide modules which are suitable for individual outlet box mounting or group mounting within a control enclosure.

Provide field addressable modules to individually communicate with the FACP using multiplexed communication techniques. Provide communication circuit wiring connections suitable for supervised Class A operation. Derive

module power from the communication circuit or 24 V(DC) power supply supervised by the FACP. Ensure invalid address setting, component failure, or power failure initiates a trouble signal at the FACP.

Provide supervised addressable modules for initiation circuits, Class A type, unless otherwise indicated. Two-wire Class B modules are acceptable when installed in the same box or enclosure as the connected initiating device.

Provide supervised addressable modules for notification appliance circuits with parallel wired Class A type unless otherwise indicated. Ensure module is suitable for use with all notification devices types and relays.

Provide addressable relay modules for control and/or remote reporting circuits (addressable relays), including 2 separate fused Form-C contacts rated at 2 Amperes for 28 V(DC) or 120 V(AC).

[Provide addressable modules for [suppression] [extinguishing] system releasing service which are UL listed for use with the fire alarm control panel and the releasing device [valve] [_____]. Include in module all necessary circuitry to supervise the system release device coil.]

2.3.1 Addressable Module Boxes and Enclosures

Install outdoor modules in NEMA 250 [Type 4X] [Type 3R] [stainless steel] rated enclosures.

Provide manufacturer's standard outlet box for enclosure housing a single isolated module (not grouped with other modules or no other modules nearby).

Provide enclosures housing more than one addressable module with hinged door type with back panel for module mounting. Provide hinged cover(s) with an integral pin-tumbler cylinder lock (Mortise or Standard Rim Cylinder from Best Access Systems) with removable core that accepts the key presently in use with other fire alarm control units at KSC; lock core will be provided by the government. Provide adequately sized enclosure to allow a minimum of50.8mm 2-inch wiring space for all module termination points. Provide additional spare space for [2] [_____] future modules. Provide terminal strips for interfacing all module connections to field wiring. Provide factory painted enclosures with a prime coat and one or more finish coats of scratch-resistant baked enamel red finish coat unless otherwise indicated. Provide enclosures with an engraved phenolic nameplate which reflects the cabinet designation as shown on the contract drawings.

2.4 ANNUNCIATOR PANELS

Provide LCD alphanumeric type annunciator compatible with and supervised from the FACP, with an operating power supply of 24 V(DC). Provide yellow lamp color for trouble/supervisory and red for alarm; also provide a test switch for testing all lamps. Provide each lamp with a nameplate, with zone and function identified for all lamps.

The display must indicate the device in alarm or supervisory and show the device name, address, and building location. Program annunciator to annunciate only alarm and supervisory signals; annunciate trouble signals only at the main FACP.

Provide LED type graphic annunciator panels where indicated. Include laminated area display to indicate location and condition (trouble and

alarm) of devices connected with annunciator panels.

Provide terminal strips suitable for 0.8 mm through 2.0 mm2 No. 18 through No. 14 AWG diameter solid copper conductors for all annunciator panel wiring connections.

Mount annunciator panels in manufacturer required enclosures. Provide hinged cover with an integral pin-tumbler cylinder lock (Mortise or Standard Rim Cylinder from Best Access Systems) with removable core that accepts the key presently in use with other fire alarm control units at KSC; lock core will be provided by the government.

2.5 HEAT-ACTUATED DETECTORS

Provide alarm-initiating heat-actuated detectors, listed for use with the FACP in accordance with UL 521.

[Provide heat detectors which are individually addressable by connection to addressable modules. Provide addressable modules in accordance with the paragraph entitled, "Addressable Modules/Devices," of this section.]

[Provide analog addressable heat detector with base including circuitry and user selectable switching required for assigning each detector a unique address on the FACP communication bus. Verify invalid address switch settings or component failure initiates a trouble signal at the FACP. Provide detector head which plugs into a separate receptacle type base wired to the FACP signaling line circuit which powers and monitors the detector. Provide supervised base which initiates a trouble signal at the FACP if the detector is removed.]

Provide detectors with a set of normally open contacts that close to initiate an alarm, with wiring connections which are for supervised Class A operation, and made with terminal blocks capable of accepting 0.8 mm through 2.0 mm2 No. 18 through No. 14 AWG diameter solid copper conductors. Provide detectors with a LED indicator light which gives a visual indication when the detector initiates an alarm. Ensure all components of the detectors are rust and corrosion resistant.

Ensure activation of detector causes annunciation at the FACP, transmits an alarm to the Central Radio Monitoring Station, and activate the building evacuation notification appliances.

In areas subject to moisture or exterior atmospheric conditions, provide only detectors that are UL listed or FM approved for use in those locations.

Ensure enclosures and detectors mounted in hazardous locations conform to the requirements of Underwriter's Laboratory (UL) or Factory Mutual (FM) for the hazardous location classification indicated. Provide conduit seal-off fittings suitable for the hazardous location classification at each conduit connection to the explosion-proof enclosure in accordance with NFPA 70.

2.5.1 Combination Fixed-Temperature and Rate-of-Rise Detector

Detectors must be self-resetting. Detector must operate at [57.2][68][88] degrees C [135][155][190] degrees F. Detector must feature rate of rise operation between 8.33 and 13.88 degrees C 15 and 25 degrees F.

2.5.2 Fixed Temperature Detector

Detectors must be self-resetting. Detector must have a specific temperature setting of [57.2][68][88] degrees C [135][155][190] degrees F.

Provide heat-actuated detectors in elevator shafts and machine rooms in accordance with ASME A17.1/CSA B44 and NFPA 72.

2.5.3 Line-Type Fixed Temperature Heat Detector

Provide [thermostatic] or [thermistor] line-type heat detection cable where indicated, with cable nominally rated for a temperature of 138 degrees C 280 degrees F and operational on a fixed temperature principle only.

Ensure Linear Heat Detector can distinguish when a physical damage condition and an alarm condition are present.

2.5.4 Rate Compensating Heat Detector

Provide hermetically sealed, automatically resetting type detectors which operate when ambient air temperature reaches detector setting, regardless of rate of temperature rise or subject to thermal lag.

2.6 FLAME DETECTORS FOV

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NOTE: Edit paragraphs as necessary for flame detection characteristics.
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2.6.1 Multi-spectrum Infrared (IR) Flame Detectors

Provide FM approved multi-spectrum IR flame detectors, incorporating all sensory, signal processing, and alarm system interfacing components, sensitive to the IR radiation range best suited for their intended use. Ensure detector logic requires IR signal from three (3) sensors present in the proper spectral signature, as emitted by a [hydrogen] [hydrocarbon] flame and retains alarm-initiating capability in the presence of modulated false alarm sources. Ensure detector is not activated by single sources of UV and IR radiation including sunlight (direct, intermittent, or reflected), quartz halogen lighting, electric discharge lighting, arc welding, lightning, radiant heat, hot engine exhaust, heating coils, etc., as well as being immune from radio frequency interference and electromagnetic frequency interference. Detectors using guard band technology are not acceptable.

Ensure detector has a minimum field of view of 90 degrees along the horizontal axis and 75 degrees along the vertical axis, and is capable of detecting a [_____] fuel type and minimum [____] size at a specific [_____] distance from its axis in accordance with its design FM 3260 approval performance criteria. Ensure detector response time is selectable to 500 msec with typical response under 5 seconds for initiating fire signal, and includes self-diagnostic features to monitor its sensors, power source, and internal circuitry.

Detectors must operate over electrically supervised wiring circuits and the loss of power to the detector must result in a trouble signal. Provide a detector which incorporates separate single pole, double throw (SPDT) alarm and trouble contacts rated 5 amperes minimum at 30 V(DC), with alarm

contacts which activate upon fire detection and are programmable for latching or non-latching operation; program for non-latching operation unless otherwise indicated. Ensure cycling detector power or momentarily (10ms) activating the manual test line resets latching alarm contacts. Provide non-latching trouble contacts which activate upon loss of unit power or internal diagnostic failure. Provide wiring connections for all contacts suitable for Class A wiring and made on screw terminals capable of accepting 0.8 mm through 3.0 mm2 No. 18 through No. 12 AWG solid copper conductors. Ensure detectors are individually addressable for alarm and trouble conditions by connection to addressable modules. Provide addressable modules in accordance with the paragraph entitled, "Addressable Modules/Devices," of this section.

Ensure activation of detector causes annunciation at the FACP, transmits an alarm to the Central Radio Monitoring Station, and activate the building evacuation notification appliances.

Power detector from a 24 V(DC) source. Where a power source other than the FACP is used, ensure the power source is UL 864 listed, and incorporates power supply, battery backup, and power transfer equipment in accordance with the paragraph entitled, "Fire Alarm Control Panel," of this section. Ensure detector power wiring connections are made on screw terminals suitable for No. 16 through 5.0 mm2 No. 10 AWG diameter solid copper conductors.

Ensure enclosures and detectors mounted in hazardous locations conform to the requirements of Underwriter's Laboratory or Factory Mutual for the hazardous location classification indicated. Install conduit seal-off fittings suitable for the hazardous location classification at each conduit connection to the explosion-proof enclosure in accordance with NFPA 70. Provide stainless steel, rated NEMA 4X enclosures, and include threaded conduit connection. Mount enclosure on a stainless steel swivel base, which allows 180 degree horizontal and vertical rotation from the pivot point.

[A self-test feature must be provided for each detector to be individually tested. Provide detector with an automatic calibrated integral optical integrity test feature, automatically performs a test, at minimum once per minute, and generate a fault condition when 50 percent of the detection range is lost (optical contamination, etc.) and do not generate an alarm when more than 50 percent of the detection range is retained.]

Provide a manual remote test capability for each flame detector from the addressable FACP. Ensure the test is activated, manually or when the addressable control module is activated from the FACP. Ensure activation of the control circuit via the addressable control module causes all the associated flame detectors to go into an alarm condition. Also ensure that when the test switch is restored to its normal position all the affected flame detectors self-restore. Ensure flame detector can be tested by use of an external IR test lamp and by use of placing a magnet at the detector.

2.7 SMOKE DETECTORS

Provide analog addressable photoelectric alarm initiating smoke detectors designed for use with automatic/manual fire alarm systems in accordance with UL 268.

Provide [2.5] [_____] percent per foot nominal obscuration (photo-electric) type smoke detectors, listed for use with FACP installed, including all

required accessories, rust and corrosion resistant. Ensure detector head is a plug-in unit, that detector contains no moving parts, nor requires readjustment or removal to resume normal operation after an alarm. Provide all detector openings with screen to prevent the entry of insects and debris.

Provide detector head that plugs into a separate receptacle type base wired to the FACP signaling line circuit which powers and monitors the detector. Provide detectors with a set of normally open contacts that close to initiate an alarm, wiring connections which are for supervised Class A operation, and base screw terminals suitable for 0.8 mm through 2.0 mm2 No. 18 through No. 14 AWG diameter solid copper conductors for all wiring connections required. Ensure base is supervised to initiate a trouble signal at the fire alarm control panel if the detector is removed, and a light emitting diode indicator to provide a visual indication when the detector initiates an alarm.

Ensure activation of detector causes annunciation at the FACP, transmits an alarm to the Central Radio Monitoring Station, and activate the building evacuation notification appliances.

Provide detectors in areas subject to moisture or exterior atmospheric conditions that are UL listed or FM approved for such locations.

2.7.1 Duct Smoke Detectors

Provide analog addressable alarm-initiating duct-mounted smoke detector designed for use with automatic/manual fire alarm systems in accordance with UL 268A.

Provide addressable type duct smoke detectors connected to an addressable FACP, unless otherwise indicated, with the ability to perform sensitivity testing from the FACP in accordance with NFPA 72.

Detectors must be listed for operation over the complete range of air velocities, temperature and humidity expected at the detector when the air-handling system is operating. Provide photoelectric type duct smoke detectors listed by UL Fire Prot Dir or FM APP GUIDEFM Approval Guide, including duct housings, mounted exterior to the duct, and perforated sampling tubes extending across the width of the duct. Ensure activation of duct smoke detectors causes shutdown of the associated air-handling unit in accordance with NFPA 90A, annunciation at the FACP, and transmits a silent alarm to the Central Radio Monitoring Station but does not activate the building evacuation notification appliances. Provide a single maintenance by-pass switch to isolate each air handling unit's duct smoke detectors.

Ensure activation of any maintenance by-pass switch inhibits reporting and causes a supervisory condition at the FACP, and when the maintenance by-pass switch is restored to its normal configuration, the supervisory signal at the FACP self-restores. Where duct smoke detectors are installed outdoors, in unconditioned mechanical or electrical rooms, or in areas with high ambient temperatures and humidity, or in high ambient temperature areas, install the detector housing in an additional PVC enclosure with an additional set of supply and exhaust sampling tubes to prevent condensation from forming within the detector housing.

Provide duct smoke detectors with terminals suitable for Class A wiring powered from the panel alarm initiation or communication bus circuit; separate power sources are not acceptable.

Install a separate remote indicator for each duct smoke detector. Indicator must consist of LED lamp with a key test switch type. Where multiple duct smoke detectors are installed, group the remote indicators together at a common location.

2.8 MANUAL ALARM STATIONS

Provide non-coded, single action, addressable manual alarm stations designed for use with automatic/manual fire alarm systems in accordance with UL 38.

Ensure wiring terminals are suitable for Class A wiring and capable of accepting 0.8 mm through 2.0 mm2 No. 18 through No. 14 AWG diameter solid copper conductors. Make manual alarm stations individually addressable by connection to addressable modules, provided in accordance with the paragraph entitled, "Addressable Modules/Devices," of this section.

Ensure activation of manual pull station causes annunciation at the FACP, transmits an alarm to the Central Radio Monitoring Station, and activate the building evacuation notification appliances.

Ensure manual alarm station door has a protected, pull-down operating lever with recessed finger grip. When operated, ensure the station mechanically latches, closes single pole contacts, and locks the contacts in the operated position until reset. Provide manual pull stations that are toggle switch type with terminal board. Stations with a pushbutton which depends upon a spring-loaded device to close the contacts when the handle is pulled are not acceptable, nor are stations which are resettable without the use of a key or tool.

Provide factory painted red finish coat pull station made of impact resistant, durable polycarbonate or cast metal construction. Provide identification and directions for operating fire-alarm stations on the cover in raised or depressed white-enameled letters.

Furnish surface-mounted stations with matching factory painted red finish coat durable polycarbonate or cast-iron back boxes with top and bottom threaded-conduit connections. For stations mounted outdoors, provide weatherproof type, with a neoprene gasket, and protect against corrosion.

For hazardous locations, provide manual pull stations that are UL listed, FM approved, or approved by a recognized testing laboratory for the hazardous location classification indicated. Ensure unit consists of a complete manufactured explosion-proof manual pull station assembly. Provide conduit seal-off fittings suitable for the hazard classification at each conduit connection to the explosion-proof enclosure in accordance with NFPA 70.

2.9 HORN/STROBE COMBINATION UNITS

Audible appliances must conform to the applicable requirements of UL 464. Appliances must be connected into notification appliance circuits. Horns must be [semi-flush mounted][surface-mounted, with the matching mounting backbox surface mounted vibrating type suitable for use in an electrically supervised circuit]. [Multitone]horns must produce a sound rating of at least 85 dBA at3.1 meters 10 feet.[Horns used in exterior locations must be specifically listed [weatherproof] or approved for outdoor use and be provided with metal housing and protective grilles.][Horns must be

explosion proof].

Where horns and strobes are provided in the same location, they may be combined into a single unit.

2.10 STROBE UNITS

Provide strobe units designed for use with automatic/manual fire alarm systems, in accordance with UL 1971, UL 1638, Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA).

Provide UL listed or FM approved strobe units including factory painted red finish coat housing made of impact resistant polycarbonate or cast metal, clear high intensity optic lens with white "FIRE" lettering on two sides, and a xenon flash tube or light emitting diode (LED) with solid state circuitry. Ensure unit brightness candela rating is set in accordance with NFPA 72, producing a minimum flashing frequency of 1 Hz and a maximum of 2 Hz. Provide a [multiple-candela][fixed candela (as described on the contract drawing)] type strobe. Synchronize strobes in accordance with NFPA 72.

Addressable strobes are not acceptable.

Ensure visual notification appliance circuits have sufficient capacity to operate all devices connected.

Provide units which operate from polarized 24 V(DC), Class A, parallel wired supervised notification appliance circuits, and capability of operating over a 20 percent variation in nominal input voltage. Ensure wiring connection screw terminal blocks are suitable for 1.0 through 3.0 mm2 No. 16 through No. 12 AWG diameter solid copper conductors.

Provide [semi-flush mounted][surface-mounted, with the matching mounting backbox surface mounted type] units. Provide weatherproof units with a neoprene gasket, protected from corrosion, in exterior or wet locations.

If mounted in hazardous locations, provide strobes UL listed or FM approved for the hazardous location classification indicated. When the unit is not factory sealed, provide conduit seal-off fittings suitable for the hazardous location classification indicated at each conduit connection to the explosion-proof enclosure in accordance with NFPA 70.

2.11 SPEAKERS

Provide speakers UL listed or FM approved for audible signal use, designed for use with automatic/manual fire alarm systems in accordance with UL 1480 and UL 1711, capable of clearly reproducing voice messages and horn, bell, chime, or slow whoop tone sin a three-pulse temporal pattern over a 400 to 4000 Hz range. Ensure speaker output at 1000 Hz for 1-watt input power is no less than 87 dB at 3.04 m 10 feet.

Provide Notification Appliance mechanism consisting of sealed speaker and multiple-tap impedance matching transformer suitable for 24 V(DC), Class A parallel-wired, supervised audio signaling systems. Include with transformer settings 0.25, 0.5, 1.0, and 2.0 watt taps unless otherwise indicated. Ensure Wiring connections for 4 wire operation are screw terminals suitable for 1.0 through 3.0 mm2 No. 16 through No. 12 AWG diameter conductors.

Provide factory painted red finish coat speaker housings made of impact resistant polycarbonate or cast metal construction. Mount flush mounted interior speakers using standard electrical back boxes. Mount surface mounted speakers using factory painted red finish coat cast iron or cast aluminum boxes with threaded conduit hubs. If mounted in exterior or wet locations, provide weather-proof type with a neoprene gasket, protected from corrosion.

Ensure strobe portion of a combination audible/visual notification appliance is in accordance with the applicable provisions of the paragraph entitled, "Strobe Units," of this section.

If mounted in hazardous locations, provide speakers UL listed or FM approved for the hazardous location classification indicated. When the unit is not factory sealed, provide conduit seal-off fittings suitable for the hazardous location classification indicated at each conduit connection to the explosion-proof enclosure in accordance with NFPA 70.

2.12 WATER FLOW ALARM DEVICES

Provide alarm-initiating water flow devices designed for use with automatic/manual fire alarm systems, in accordance with UL 346, conforming to UL or FM requirements for the particular type of sprinkler system being specified.

Ensure contact have a minimum of 2 single pole, double throw contacts rated 5 amps at 28 V(DC) or 250 V(AC). Make water flow devices individually addressable by connection to addressable modules, and provide in accordance with the paragraph entitled, "Addressable Modules/Devices," of this section.

Ensure activation of device causes annunciation at the FACP, transmits an alarm to the Central Radio Monitoring Station, and activate the building evacuation notification appliances.

Operation of a sprinkler waterflow switch serving an elevator machinery room or elevator shaft must operate shunt trip circuit breaker(s) to shut down power to the elevator(s) in accordance with ASME A17.1/CSA B44/CSA B44.

Provide weatherproof and corrosion protected flow devices for outdoor installations. If installed in hazardous locations, provide water flow devices UL listed or FM approved for the hazardous location classification indicated. When the switch is not factory sealed, provide conduit seal-off fittings suitable for the hazardous location classification indicated at each conduit connection to the explosion-proof enclosure in accordance with NFPA 70.

2.12.1 Pressure Switch

Wire alarm pressure switch to make or break an alarm circuit depending on rise or fall of water pressure.

2.12.2 Vane-Type Flow Switch

Provide vane-type alarm flow switch which makes or breaks an alarm circuit upon deflection by a volume of flowing water that equals or exceeds the capacity of a single sprinkler. Ensure alarm flow switch has an instant-recycle pneumatic-retard, or electronic adjustable setting time delay, settable from 45 to 90 seconds. During Preliminary Testing, verify

switch is set to 50 to 70 seconds.

2.13 VALVE TAMPER SWITCHES

Provide supervisory initiating valve tamper switches designed for use with automatic/manual fire alarm systems, in accordance with UL 346, conforming to UL or FM requirements of use on the specified valve.

Provide contacts with a minimum of 2 single pole, double throw contacts rated 5 amps at 28 V(DC) or 250 V(AC). Ensure valve tamper switches are individually addressable by connection to addressable modules, in accordance with the paragraph entitled, "Addressable Modules/Devices," of this section.

Provide weatherproof, corrosion-protected switches for outdoor installations. In hazardous locations, provide valve tamper switches UL listed or FM approved for the hazardous location classification indicated. If the tamper switch is not factory sealed, provide conduit seal-off fittings suitable for the hazardous location classification indicated, at each conduit connection to the explosion-proof enclosure in accordance with NFPA 70.

Where close-valve supervision is required for system configuration/programming capabilities, do not use devices designed to monitor open valves. Use device Designed for this special type application, such as potter plug type supervisory switch or equal. Otherwise use nonelectrical methods, such as chains.

2.14 REMOTE AUXILIARY CONTROL RELAYS

Provide remote control relays with continuous duty coils rated 24 V(DC). Where relays are used on Class A parallel wired supervised circuits, ensure coils incorporate supervisory current blocking diode. Provide relays with a minimum of 2 single pole, double throw contacts rated 5 amps at 28 V(DC) or 250 V(AC). Where auxiliary control circuits connected to the relay are protected at a higher ampacity than the relay contacts are rated, provide fusing rated to protect the relay contacts in the relay enclosure.

Provide addressable type relays, where indicated, in accordance with the paragraph entitled, "Addressable Modules/Devices," of this section.

Mount remote auxiliary control relays in enclosures indicated, or if not indicated, in manufacturer's finished red painted required enclosure. Install outdoor relays in a weatherproof enclosure with a neoprene gasket and protection against corrosion.

In hazardous locations, install relays with enclosures UL listed or FM approved for the hazardous location classification indicated. Provide seal-off conduit fittings at each conduit connection to the explosion-proof enclosure in accordance with NFPA 70.

Label enclosure with an engraved phenolic nameplate stating, "F/A RELAY."

The auxiliary contacts must be supplied by the fire alarm system manufacturer to ensure complete system compatibility. Mount remote auxiliary control relays and supervise within 0.91 m 3 feet of the controlled device in accordance with NFPA 72.

2.15 POWER SOURCE

Ensure primary power to the local systems for all purposes, including separately powered notification appliances and initiating devices, is 60 hertz 120 V. Ensure system operates satisfactorily between 85 and 110 percent of normal voltage. Provide fire-alarm-system disconnect/protective device as a fused switch with factory painted red finish coat. Mount this disconnect fused switch adjacent to the main FACP and, where applicable, to auxiliary/supplemental fire alarm system panel(s). Mark as FIRE-ALARM DISCONNECT FED FROM (indicate supply circuit) with 0.5 13mm 1/2-inch high letters in white paint or engraved phenolic identification plates fastened with sheetmetal screws. Ensure switch is capable of being locked in the "on" or "off" position, a feature which can not interfere with the circuit protection capability of the device. Equip switch with surge suppression for all phase and neutral conductors. Install current limiting Class RK1 fuses properly sized to protect the fire alarm equipment.

When power is supplied from a single 20-amp circuit breaker, provide a factory finished red adjustable set screw type clamping device over the circuit breaker handle to prevent handle operation.

2.16 WIRING

Provide copper conductor wiring in accordance with NFPA 70 and NFPA 72. Connect all devices per NFPA 72, with the wire types specified in this section, unless specifically noted otherwise in the paragraph entitled, "Wiring (Wire and Multi Conductor Cable). For 120 V(AC) circuits, use 3.0 mm2 No. 12 AWG minimum stranded copper with an insulation rating of not less than 600 V(AC).

Ensure all conductors installed on fire alarm systems are solid copper with an insulation rating of not less than 300 volts, permanently marked with the size, voltage rating and manufacturer's name on the conductor jacket at no less than 610 mm 2 feet intervals. Conductor sizes are listed below.

Where modifications are made to existing systems, match the new or added conductors to the size and color-coding of the existing system. Conductor AWG diameter and Insulation Type are listed below. Required wire colors are listed in the paragraph entitled, "Wiring (Wire and Multi-Conductor Cable)," of this section.

Provide solid copper meeting UL 497B requirements, for conductors in Signaling Line Circuits (SLC). Use shielded, twisted pair cable where recommended by the manufacturer. For shielded wiring, ground the shield at only one point, which is in or adjacent to the FACP. Unshielded, twisted pair cable is permitted to be used if the manufacturer's installation manual requires, or states preference for, unshielded cable. Ensure cable is listed as Type FPL, Power-Limited Fire Protective Signaling Cable, as appropriate with red colored covering. Select a wire size sufficient to prevent voltage drop problems, otherwise provide copper conductor size of not less than1.0 mm2 No. 16 AWG.

Provide solid copper, shielded, twisted pair, meeting UL 497B requirements, for conductors in Speaker audio circuits and remote reporting circuits. Ensure cable is listed as Type FPL, Power-Limited Fire Protective Signaling Cable, as appropriate with red colored covering. Select a wire size sufficient to prevent voltage drop problems, otherwise provide copper conductor size of not less than 1.0 mm2 No. 18 AWG diameter for remote reporting circuits and 2.0 mm2 No. 14 AWG diameter for Speaker audio

circuits.

Air sampling detection units are permitted to use 0.8 mm2 No. 18 AWG for connection to addressable modules with maximum conductor length not to exceed 7.62m 25 ft.

Provide direct current initiating device circuit copper conductor size sufficient to prevent voltage drop problems, otherwise provide copper conductor size of not less than 1.0 mm2 No. 16 AWG diameter, with insulation Type TFN or not less than 2.0 mm2 No. 14 AWG diameter, with insulation Type THHN/THWN.

Size power leads from the control panel for product-of-combustion detectors accordingly, but not less than 2.0 mm2 No. 14 AWG diameter, with insulation Type THHN/THWN for 2.0 mm2 No. 14 AWG diameter and larger.

Provide direct current notification appliance circuit (strobes, horns) copper conductor size sufficient to prevent voltage drop problems, otherwise provide copper conductor size of not less than 2.0 mm2 No. 14 AWG diameter, with insulation Type THHN/THWN.

Provide direct current auxiliary control device (AHU shut down relay) circuit copper conductor size sufficient to prevent voltage drop problems, otherwise provide copper conductor size of not less than 2.0 mm2No. 14 AWG diameter, with insulation Type THHN/THWN.

Provide solenoid valve control circuit copper conductor size sufficient to prevent voltage drop problems, otherwise provide copper conductor size of not less than 2.0 mm2 No. 14 AWG diameter, with insulation type THHN/THWN.

[Ensure all underground circuit wiring meets UL 444, UL 13, UL 1424 and TIA 455-82B water infiltration tests.]

[2.16.1 Fire Resistive Cables

Provide fire resistive cables for notification appliance circuits designed for use with automatic/manual fire alarm systems in accordance with UL 2196.

Provide UL Fire Prot Dir listed Type FPL-CI fire alarm cable for use with power limited fire alarm notification appliance circuits. Ensure the CI cable has a minimum 2-hour fire resistance rating by having passed the applicable testing requirements of UL 2196. Install this cable in locations required to meet NFPA 72 survivability requirements.

]2.17 SURGE SUPPRESSORS

Provide line voltage and low voltage surge suppression devices to suppress all voltage transients which might damage the control panel components.

Install surge suppression in accordance with UL 497B on each conductor of fire alarm circuits which extend beyond a building. Locate protection as close as practical to the point where the circuits leave the building. Install protectors in factory painted with a prime coat and one or more finish coats of scratch-resistant baked enamel red finish coat surge suppression cabinets of adequate size with terminal strips for all wiring connections. Where installed outdoors, provide stainless steel NEMA 4X rated cabinets. Provide a copper ground bus inside the cabinet and connect protectors to an earth ground electrode system in accordance with the manufacturer's requirements and NFPA 70. Ensure an etched metal or

engraved laminated plastic identification plate labeled, "TSTC," is affixed to the cabinet door of the alarm control unit to identify the cabinet as a fire alarm transient surge terminal cabinet. For cabinets not painted red, the identification plate has white letters on a red background.

2.17.1 Line Voltage Surge Suppressors

Provide suppressor UL 1449 listed with a maximum 330-volt clamping level and a maximum response time of 5 nanoseconds, and also meets IEEE C62.41, category B tests for surge capacity. Ensure suppressor is a multi-stage construction type which includes inductors and silicon avalanche zener diodes. Provide suppressor which has a long-life indicating lamp (light emitting diode or neon lamp) which extinguishes upon failure of protection components, with externally accessible fuses. Wire in series with the incoming power source to the protected equipment using screw terminations.

2.17.2 Low Voltage Surge Suppressors

Provide for all circuits which leave the building shell and as shown on the contract drawings. When circuits interconnect two or more buildings, provide suppressors at the circuit entrance to each building. Ensure suppressor is UL 497B listed, with a maximum 30-volt clamping level and a maximum response time of five nanoseconds, with multi-stage construction and both differential/common mode protection.

[2.18 SOLENOID VALVES AND SAFING KEY SWITCH

Provide solenoid valves at [suppression] [extinguishing] system valves indicated, UL listed or FM approved for operation with the respective releasing control panel. Provide solenoid valves with all fittings, hardware meeting the specified in Division 21 DELUGE FIRE-SUPPRESSION SPRINKLER SYSTEMS, and solenoid fire alarm interface modules as required specified herein.

Incorporate a safing key switch in solenoid valve, with safing key switches which accepts a Best Access Systems 7-Pin core (Mortise or Standard Rim Cylinder). Design switch and operator for mounting on the front of a sheet metal electrical enclosure cabinet. Ensure that each key switch disconnects all conductors connected to the releasing solenoid valve, and that switch contacts are rated 5 amps minimum at 28V DC. Ensure activation of safing key switch causes annunciation at the FACP, transmits a trouble to the Central Radio Monitoring Station.

When installed in hazardous locations, provide solenoid valves UL listed or FM approved for the hazardous location classification indicated. When the solenoid valve is not factory sealed, provide conduit seal-off fittings suitable for the hazardous location classification indicated at each conduit connection to the explosion-proof enclosure in accordance with NFPA 70.

]2.19 MANUAL ACTIVATION STATIONS

Provide manual activation stations that meet the requirements specified in Division 21 DELUGE FIRE-SUPPRESSION SPRINKLER SYSTEMS.

PART 3 EXECUTION

3.1 SYSTEM SEQUENCE OF OPERATION

3.1.1 Normal Operation

Ensure all switches are in the normal position; available power indicator light is on, the trouble and detector indication lights are off, and all circuits are electrically supervised.

3.1.2 Supervisory Condition

Per system conditions identified in the paragraph entitled, "Fire Alarm Control Panel," of this section, ensure that a supervisory signal is transmitted to the Central Radio Monitoring System, device indication is provided, a supervisory signal is activated in the FACP, and input is provided to remote annunciators (when used). Ensure supervisory signal in the alarm control unit is comprised of visual and audible indications and is self-restoring.

3.1.3 Trouble Condition

Per system conditions identified in the paragraph entitled, "Fire Alarm Control Panel," of this section, ensure that a trouble signal is transmitted to the remote reporting device of the Central Radio Monitoring System, providing zone indication, activating a trouble signal in the FACP, and providing input to remote annunciators (when used). Ensure trouble signal in the alarm-control unit provides visual and audible indications.

3.1.4 Alarm Condition

Ensure activation of any detectors, manual alarm stations, water flow switches, or other initiating devices closes a contact that activates the appropriate FACP. FACP transmits a signal to the remote reporting device of the Central Radio Monitor System, activates the facility indicating appliances (where applicable), provides zone identification, controls air handling and ventilating units, provides an input to remote annunciators (when used), and provides indication or control to devices or other systems.

3.2 INSTALLATION

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NOTE: If the installation of the specified fire alarm system is on a new facility, then delete the first paragraph under the paragraph entitled, "Installation," of this section.

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Prior to performing any installation or modification work to existing Fire Alarm system(s), secure a Transfer of Responsibility Form completed by the COR and signed by the Contractor and Owner's Representative (i.e., O & M System Engineer). The completed form will be turned over to the Contracting Officer by the COR. Permanently affix a copy of the completed "Transfer of Responsibility" Form to the affected FACP throughout the construction period.

For modifications, additions, or expansion to an existing fire alarm system, the Contractor is not responsible for existing troubles and ground faults that are not in contract scope. Before commencing work, clearly convey the existing troubles, ground faults, or other present faults that

are not in contract to the Contracting Officer. Contracting Officer shall be notified to request and schedule support from Owner's Representative (i.e., O & M System Engineer) to resolve the identified FACP fault indications.

Install all equipment in accordance with manufacturer's installation instructions and requirements of this Section. Use new components in the installation that are not more than one (1) year old.

3.2.1 Fire Alarm Control Panel(s)[and Battery Cabinets] and Reporting Equipment

Install equipment in each protected building, located where indicated on contract drawing, and complete with all indicated accessories and devices. Install equipment in accessible locations. Surface mount the enclosure with the top of the cabinet 2 m 6 feet above the finished floor or center the cabinet at 1.5 m5 feet, whichever is lower, unless otherwise indicated. Equipment requires a minimum of 0.91 m 3 feet clearance directly in front of the panel for maintenance per NFPA 70. With multiple equipment, the 0.91 m3 feet clearance is required directly in front of the complete configuration. In addition, provide a 711 mm 28-inch clear aisle way for access to the equipment.

Ensure wiring within FACP(s) is in accordance with the paragraph entitled, "Installation in Cabinets and Boxes," of this section.

When FACP(s) are installed flush or semi-flush, provide three spare 25 mm 1-inch conduits in accordance with the paragraph entitled, "Conduit and Raceways," of this section, from the FACP wiring termination cabinet to an accessible location.

3.2.1.1 Battery Cabinets

When batteries will not fit in the FACP, locate battery cabinets below or adjacent to the FACP. Battery cabinets must be installed at an accessible location when standing at floor level. Battery cabinets must not be installed lower than 300 mm 12 inches above finished floor, measured to the bottom of the cabinet, nor higher than 900 mm 36 inches above the floor, measured to the top of the cabinet. Battery cabinets must be large enough to accommodate batteries. The cabinet must be provided in a sturdy steel housing, hinged steel door with cylinder lock, and surface mounting provisions. The cabinet must be identified by an engraved phenolic resin nameplate. Lettering on the nameplate must indicate the control unit(s)the batteries power and must not be less than 25 mm 1-inch high.

3.2.2 CRMS Reporting Equipment

Install equipment in each protected building, located where indicated on contract drawing, and complete with all indicated accessories and devices. Install equipment in accessible locations. Surface mount the enclosure with the top of the cabinet 1.5m 5 feet above the finished floor, unless otherwise indicated.

Perform test in accordance with approved Fire Alarm System Acceptance Test Procedures and the paragraph entitled "Field Testing" in this specification to confirm expected CRMS Transceiver signals and messages (alarms and fault conditions) are properly transmitted and received at the CRMS Station.

3.2.2.1 CRMS Antenna

CRMS antenna mounting location must be validated and coordinated with the Owner's Representative (i.e., O & M System Engineer) prior to installation. Contractor must Validate Antenna placement produces a minimum of 2 mesh network radio frequency (RF) signal paths in accordance with NFPA 72 and entire RF transmission line must be tuned to achieve a 1.5:1 Standing Wave Ration (SWR) reading or lower.

The radiating element of the antenna must be at least .457m 18 inches above the highest point on the facility roofline providing 360 degree "visibility", in a straight up and level position. Place the antenna where it is not subject to damage and obstructions to connectivity or service. Use mounting offset bracket to space the antenna body a minimum of 18-inches from any metal (metal building, conduit, piping, gutter, etc.). Where structures exist above the facility roofline (e.g. fixed ladders, rooftop HVAC systems, building wall, etc.) the antenna must be mounted a minimum of .254 10 inches away from such obstructions.

Trim the antenna to a length of .7874m 31-inches measured from the top of the coil body. Use LMR-400 coaxial cable and approved Type-N and UHF PL-259 male connectors to connect the antenna to the suppression module, and from the suppression module to the radio Type-N bulkhead and BNC coaxial AES cable assembly Model 13-0346. Route the coaxial cable in as direct a route as possible, avoiding tight radius bends and the coiling of excess cable. PL-259 connectors must be designed to accept the soldering of the center conductor, and all PL-259 connectors must have the center pin soldered. Outdoor antenna coaxial connections must be weatherproofed. RF Surge suppression module must be the approved [Polyphaser model][Keltron Lightning Suppressor [Model 10R7230]] as indicated on contract drawings. For UL listed compliance, all antenna system wiring must be installed in minimum 25.4mm 1-inch rigid galvanized conduit. Use only long radius sweep elbows.

Bond the antenna surge suppression module and the antenna mast/bracket to the facility ground in accordance with NFPA 70. Use an approved grounding mechanical connector or exothermic weld to achieve a proper earth ground connection. Mount the suppressor/enclosure in a location where the path (#8 ground wire) to facility/earth ground is shorter than the path (LMR-400) to the CRMS radio. The surge suppression enclosure must be large enough to eliminate tight radius bending of the LMR-400 cable

3.2.2.2 CRMS Antenna Performance Test

a. Verify and Validate the Network Connectivity (NetCon) value of NetCon 5 using the hand-held AES Network Connectivity Tool. A NetCon 5 reading indicates 2 good paths to the network.

b. Verify and Validate the Standing Wave Ratio (SWR) reading of 1.5:1 or lower using a SWR meter. The SWR reading indicates the efficiency of transceiver power level, cable integrity, and antenna placement for optimum RF (mesh network) performance.

c. Identify final antenna location/details.

Notify the Contracting Officer [30] [___] days before the antenna performance test is to be conducted and submit the test procedure, in booklet form showing field tests above are being performed to prove compliance with the specified system performance criteria, upon completion

of the installed system. Perform the test in the presence of the Contracting Officer and the Owner's Representative (i.e., O&M System Engineer). Secure the signatures and date on the summarized set of test procedure from the required witnesses. Test report shall document all readings, test results, and indicate the final position of the antenna. Furnish all instruments and personnel required for the tests.

3.2.3 Addressable Modules/Devices

Install addressable modules at accessible locations indicated. Configure module address switches to settings indicated on approved shop submittals. Individually identify modules adjacent to their mounting.

Mount control zone addressable modules used for smoke control, AHU shutdown, etc. in accessible locations or within 0.91 m 3 feet of the device to be controlled. Do not install control modules connected to separately energized control wiring from auxiliary systems in the same enclosure with initiation and signal zone addressable modules.

Where addressable modules are grouped within an enclosure, wire in accordance with the paragraph entitled, "Installation in Cabinets and Boxes," of this section.

3.2.4 Annunciator Panels

Install [surface mount] [semi-recessed][flush] annunciator in accessible locations make for first responders, such as near main entrance door in accordance with NFPA 72.

Locate the LCD annunciator as shown on the drawings. Mount the annunciator, with the top 1.5m 5 feet above the finished floor.

Provide wiring within annunciator panels in accordance with the paragraph entitled, "Installation in Cabinets and Boxes," of this section.

3.2.5 Heat-Actuated Detectors

Ceiling mount detectors unless otherwise indicated. Location, number, and general arrangement to be as indicated. Provide field installation locations complying with NFPA 72.

Configure addressable electronic heat detector address switch settings as approved on shop drawings and submittals. Do not install detectors until work by other trades is completed. Individually identify detectors adjacent to their mounting.

Locate detectors, where in the vicinity of ceiling light fixture/diffuser, as permitted per manufacturer's installation instructions and recommendations.

Make provisions for devices mounted in acoustical, lay-in type ceilings to utilize 'T' bar or corner plate/bracket. Cut ceiling tile as required to accommodate mounting corner plate/bracket and prime and paint to match ceiling grid color.

[3.2.6 [Flame Detectors]

Provide flame detector location and general arrangement for general coverage protection. Ensure field of view (FOV) from detector is free of

obstructions. Adjust location as required to prevent obstruction of the detector field of view (FOV) and provide coverage in all protected areas by at least one detector. Aim detectors to accurately cover the areas or target using a laser tool recommended by the detector manufacturer, avoid aiming detector field of view outside the building (open doors) or outside specified protection area perimeter. Mount detector to a solid mounting structure using approved manufacturer's mounting brackets. Provide partial flexible conduit from detector to wall or ceiling for ease of alignment. Determine and identify actual detector mounting height at field to meet all coverage requirements. Ensure field installation are in accordance with manufacturer's installation instructions and NFPA 72. [Provide cross-zoned detection for automatic release of fire suppression systems/extinguishing agents.]

Where detectors are installed outdoors, arrange conduit systems to drain away from the detector.

Aim detectors to accurately cover the field specified using a laser tool recommended by the detector manufacturer. Point the aiming spot on the floor for each detector and include the measurements of this spot from fixed structural elements on the shop drawings and record (as-built) drawings.

]3.2.7 Smoke Detectors

Provide smoke detector location, number, and general arrangement as indicated on the contract drawing. Ensure field installation are in accordance with NFPA 72. Do not install detectors until the work of other trades is complete.

Make provisions for devices mounted in acoustical, lay-in type ceilings to utilize 'T' bar and corner plate/bracket. Cut ceiling tile as required to accommodate mounting corner plate/bracket and prime and paint to match ceiling grid color.

Install duct smoke detectors in accordance with the manufacturer's installation requirements and NFPA 90A. Install remote indicator in the vicinity, corridor/public area, of the detector and identify it with corresponding equipment label. Install a ductwork hinged access panel to each duct smoke detector, for inspection and cleaning in accordance with NFPA 72. Seal all duct penetrations air and watertight. Individually identify detectors adjacent to their mounting.

Configure addressable smoke detector address switch settings as approved on shop drawings and submittals. Individually identify detectors adjacent to their mounting.

Locate detectors where in the vicinity of ceiling light fixture/diffuser, as permitted per manufacturer's installation instructions and recommendation. Ensure detectors installed in areas subject to moisture or exterior atmospheric conditions are UL listed or FM approved for such locations.

3.2.8 Manual Pull Stations

Mount manual pull stations at locations indicated on the contract drawing within 5-feet of each exit doorway in accordance with NFPA 72. Ensure mounting height is 1219 mm 48-inch above the finished floor measured from the top of the device. Individually identify detectors adjacent to their

mounting.

Where manual pull stations are installed outdoors, arrange conduit systems to drain away from the manual pull stations.

3.2.9 Alarm Horns/Speakers

Mount horns and/or audio speaker notification appliances at the approximate locations indicated. Ensure mounting height is 2286 mm 90-inches above the finished floor measured from the top of the horn/speaker, but no less than 152 mm 6 inches below the ceiling. Individually identify speakers along with their respective wattage setting adjacent to their mounting.

Where horns or speakers are installed outdoors, arrange conduit systems to drain away from the bells or speakers.

3.2.10 Strobe Units/Combination Audio Visual

Mount strobe notification appliances at the approximate locations indicated on the contract drawing. Ensure locations are unobstructed and allow viewing by area Occupants, and meet room spacing in accordance with NFPA 72. Ensure mounting height is no less than 2032 mm 80 inches above the finished floor measured from the bottom of the strobe, but no greater than 2440 mm 96 inches above finished floor.

Where strobes are installed outdoors, arrange conduit systems to drain away from strobes.

Ensure visual and audible appliances are capable of operating independently via separate and independent circuits for both the audible and visual portions.

Addressable strobes are not acceptable.

3.2.11 Auxiliary Control Relays

Install and supervise remote control relays in accessible locations within 0.91 m 3 feet of the device to be controlled or power disconnection point as applicable in accordance with NFPA 72. Individually identify relays adjacent to their mounting.

3.2.12 Wiring (Wire and Multi-Conductor Cable)

Provide wiring conforming to the requirements of NFPA 70 and the following special requirements:

Install fire alarm system circuits in a separate raceway system. Route circuits (Initiating, Notification, Signaling, and Control) through a dedicated separate conduit or raceway system configured to comply with NFPA 72 Class "A" conduit system requirements. Do not allow 60-Hertz power circuits to enter enclosures containing fire alarm circuits except where required to connect to the fire alarm system.

Provide continuous conductors from a terminal point at one device to a terminal point at the next device and from a device to the FACP. Break wires at each terminal; do not loop wires over a terminal. Terminate approved explosion proof devices, provided with pigtail wiring connection leads, on a field installed terminal strip installed in the box on which the device is mounted. Install solderless ring tongue

terminal lugs with manufacturer's required tooling on the device wiring connection leads. Use this ring type lug on stranded wire only. Terminate solid wire on compression or screw type terminals. When screw type terminals are used, capture the conductor under 80 percent of the screw head surface. Identify all circuit conductors within each enclosure where a tap, splice, or termination is made. Provide conductor identification by heat-shrink-type sleeves or other approved method. Use point destination type conductor labels to indicate cabinet, circuit board, terminal block and screw terminal location for each individual conductor.

Provide conductor colors as listed below and in accordance with SAE AMS-STD-595A. Where modifications are made to existing systems, match the new or added conductors to the size and color-coding of the existing system.

Mark conductors for Signaling Line Circuits, Speaker audio circuits, and remote reporting circuits with circuit designation, and maintain consistent (twisted pair) color-coding for the positive and negative loops throughout the cable system.

Install direct current initiating device circuits (heat detectors, manual pull station) as Class A, parallel-wired circuits per NFPA 72. Ensure the positive loop conductor is colored blue, Color No. 15102, and the negative loop conductor is colored black, Color No. 17038.

Install power leads from the control panel for product-of-combustion detectors as Class A, parallel-wired circuits per NFPA 72. Ensure the positive conductor is colored White, Color No. 17875, and the negative conductor is colored black, Color No. 17038.

Install direct current notification appliance (horns, strobes) circuits as Class A, parallel-wired circuits per NFPA 72. Ensure the positive conductor is colored red, Color No. 11105, and the negative conductor is colored orange, Color No. 12473.

Install direct current auxiliary device control device circuits (AHU shutdown relay) as Class A, parallel-wired circuits per NFPA 72. Ensure the positive conductor is colored yellow, Color No. 13591, and the negative conductor is colored brown, Color No. 10055.

Install solenoid valve control circuits as Class B circuits per NFPA 72. Ensure the positive conductor is colored yellow, Color No. 13591, and the negative conductor is colored violet, Color No. 37100.

3.2.13 60-Hertz Power

Provide 60-hertz power to FACP(s) and, where applicable, to auxiliary/supplemental fire alarm system panel(s) or separately powered devices of 120 V(AC). Provide one black phase conductor, one white or gray solidly grounded neutral conductor, and one green equipment grounding conductor. Size conductor as shown on the drawing with the minimum size No. 12 AWG copper. Install surge arrestors in accordance with NFPA 72 and NFPA 70.

Clearly identify Circuit Breakers used to supply AC power to the FACP and, where applicable, auxiliary/supplemental fire alarm system panel(s). Provide a permanent label with white background and red lettering adjacent to the circuit breaker.

3.2.14 Installation in Cabinets and Boxes

Install wiring in control cabinets and boxes in a neat and orderly manner with wire properly grouped, tie-wrapped, or laced parallel and perpendicular to the major axis, supported and identified. Provide continuous control wiring from device to device with no splices unless otherwise indicated. Permanently mark all wires entering or leaving control cabinets, boxes, and devices and terminate on screw terminals. Ensure marking is consistent throughout the fire alarm system and is the same as the identification shown on the connection drawings.

Ensure wire labels correspond to the approved connection drawings and use a method indicating the destination of the other end of the wire. Provide labels in control panel equipment or between fire alarm terminal cabinets which indicate the destination of the other end by cabinet designation-terminal strip designation-terminal number. Provide labels in fire alarm terminal cabinets indicating connection in control panel equipment by fire alarm cabinet designation-module identifier-module terminal strip identifier-terminal number. Provide conductor labels with legible machine-printed black lettering on white background using indelible ink. Ensure labels are heat shrink or wrap around type.

3.2.15 Conduit and Raceways

Minimum size for fire alarm system initiating, notification, signaling line and control circuit conduits and raceways is 12 mm 3/4-inch. Install in accordance with NFPA 70. Ensure all Class A initiating device, signaling line, notification appliance and control circuits use diverse routing in accordance with NFPA 72. Do not run outgoing and return redundant circuit conductors in the same cable assembly, enclosure or raceway except where permitted by NFPA 72.

Install rigid galvanized steel conduit in all hazardous (classified) locations, exterior locations where the conduit is exposed above grade, where subject to physical damage, interior exposed locations from finished floor to 304 mm 1 foot above finished ceiling unless otherwise shown on the drawings. EMT with hexnut expansion gland-type fittings can be installed in all other locations, including above suspended ceiling. Use flexible metal conduit, maximum length 1828 mm 6 feet, as the final connecting raceway to a fire alarm device mounted on vibrating equipment or on a suspended ceiling.

Where devices, junction boxes, and cabinets are installed outdoors, arrange conduit systems to drain away from the box; ensure conduit enters the box side or bottom only and drain type fittings are installed.

Use schedule 80 PVC for conduit direct buried in earth. Ensure that portions of underground raceway systems that penetrate above finished grade are rigid, galvanized, heavy-wall steel conduit with a 40-mil PVC coating or painted with a bitumastic compound.

Conceal all conduit in interior finished areas. In finished areas, paint exposed electrical conduit (serving fire alarm equipment), fire alarm conduit, surface metal raceways, junction boxes, and electrical boxes to match adjacent finishes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project. For bends of over 25 mm 1-inch in diameter, provide factory made elbows.

3.2.16 Firestopping

Install tested and listed UL Fire Resistance firestopping systems to maintain the integrity of fire-resistant rated walls, floors or ceilings, including through-penetrations and construction joints and gaps.

3.2.17 Water Flow Alarm and Valve Tamper Switches

Install switches in accordance with the manufacturer's requirements and make final connections using liquid-tight flexible metallic conduit. Adjust time delays on water flow/pressure switches to between 50 and 70 seconds to prevent false alarms due to momentary water movement. Individually identify devices adjacent to their mounting.

3.2.18 Elevators

Ensure activation of fire alarm initiating devices interfaced to elevator control execute the Elevator emergency functions for Elevator Recall [and Elevator Power Shutdown] and initiate the following actions in the elevator controls in accordance with ASME A17.1/CSA B44 and NFPA 72:

a. Primary Fire Fighter Recall.

b. Secondary Fire Fighter Recall.

c. Power Feed Shunt-Trip.

d. Fire-Hat Warning.

e. Shunt-Trip Power Monitoring

3.3 FIELD TESTING

After complete installation of the equipment, conduct tests to demonstrate that the installation requirements of this specification have been met and that the sequential functions of the system comply with the requirements specified herein. Perform the Tests covered in the following paragraphs in three parts:

3.3.1 Contractor Checkout Test

Test includes the testing of fire system conductors, in accordance with subparagraph to remove all troubles, ground faults, and shorts and to determine the wiring acceptability. Ensure all devices are fully functional and operational. Test the programming to ensure the installation meets the contract drawings and specifications. If equipment was found to be defective or non-compliant with contract requirements, perform corrective actions and repeat the test.

****
NOTE: Delete the following requirement if the installation is for a new fire alarm system
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[Refer back to Transfer of Responsibility form, in paragraph entitled, "Installation," of this section, for existing fire system troubles, ground faults, and other present faults that are not in the contract scope.]

3.3.1.1 Existing Fire System Wiring

Perform the following tests on the fire system wiring before connection to the control panel:

a. Continuity Tests: Measure and record the resistance of each circuit with each pair of conductors in the circuit short-circuited at the farthest point from the circuit origin. Insert temporary jumpers in appropriate sockets of missing detectors and install the end-of line resistor when this test is performed. Verify resistance reading for each circuit is the value of the end-of-line resistor, plus or minus 10 percent. Check continuity of circuits with an ohmmeter. Ensure that the tests are witnessed by the Contracting Officer and that test results are recorded for use at the Final Acceptance Test.

b. Insulation Resistance Tests: Megger test wiring for insulation resistance, grounds, and/or shorts. Test conductors with 300 volt rated insulation at a minimum of 250 V dc. Ensure resistance to ground is not less than 20 megohms. Isolate each wire tested from ground, with all other wires within the same conduit grounded. Verify that the conduit system is grounded prior to insulation resistance testing by verifying a short circuit between the conduit and earth ground. Ensure that the tests are witnessed by the Contracting Officer and that the test results are recorded for use at the Final Acceptance Test.

Submit Continuity Test Report and Insulation Resistance Test Report.

3.3.2 Preliminary Test

After successful completion of Contractor Checkout Test, conduct a Preliminary Test in the presence of the Contracting Officer and Owner's Representative (i.e., O&M System Engineer). Notify the Contracting Officer in writing when the system is ready for a formal Preliminary test. Submit a request for formal Preliminary Test at least [14] [_____] calendar days before the test date.

Submit all completion documentation to the Contracting Officer as required by NFPA 72 including all test reports noted below:

a. Completed and signed Contractor Readiness Affirmation - For Preliminary Fire Alarm Testing

b. Copy of Preliminary Acceptance Test Procedures

c. Draft copy of NFPA 72 Record of Completion Form

d. A signed Verification of Compliant Installation letter by the Qualified Engineer that the installation is complete, compliant with the specification and fully operable. The letter must include the names and titles of the witnesses to the Contractor Checkout test.

[e. Completion of CRMS Antenna Performance Test results in accordance with Part 3 section entitled "CRMS Reporting Equipment."]

Perform this test using the approved Acceptance Test Procedure. Ensure that tests meet the requirements of paragraph entitled "Fire Alarm System Acceptance Test Procedure" and all test requirements in accordance with NFPA 72. Verify fire alarm system drawings against the system installed, annotate all red-lines, and summarize on a single set of drawings. Follow

the test procedures as written and annotate all red-lines on a single Test Procedure. Secure the signatures and date on the summarized set of test procedures from the required witnesses. The Preliminary test is not considered complete until all steps in the test procedure have been satisfactorily completed. This includes any additional steps required to complete 100 percent testing of the fire alarm system and its associated functionality. Test must be conducted and repeated if necessary, until the system has been demonstrated to comply with all contract requirements. In the event of malfunctions or excessive nuisance alarms, the Contractor must re-schedule the Preliminary Test, take prompt corrective action, and repeat the 100 percent Preliminary test.

The following must be provided at the job site for formal Preliminary testing:

a. Copy of Acceptance Test Procedures for all witnesses.

b. Marked-up redlines as-built drawings of the system.

c. Copy of site-specific software.

3.3.3 Final Acceptance Test

After the successful completion of the preliminary test, conduct a Final Acceptance test. Ensure the Contracting Officer, Owner's Representative (i.e., O&M System Engineer), and the Authority Having Jurisdiction (AHJ) or their designee(s) witness the final acceptance test for the fire alarm system. The final test must be performed in accordance with the approved acceptance test procedure. Notify the Contracting Officer in writing when the system is ready for Final Acceptance Test. Submit a request for formal Final Acceptance Test at least [14] [_____] calendar days before the test date.

Submit all completion documentation to the Contracting Officer as required by NFPA 72 including all test reports noted below:

a. Completed and signed Contractor Readiness Affirmation - For Final Fire Alarm Testing

b. Copy of Final Acceptance Test Procedures with all marked-up redlines from Preliminary Test incorporated

c. Copy of Marked-up redlines Acceptance Test Procedure from formal Preliminary Test (signed and with all steps annotated as complete)

d. Final copy of NFPA 72 Record of Completion form

Prior to test start, on-site, conduct a line-by-line review that proves all issues found during the preliminary test have been incorporated. At this time, any and all required tests noted in the paragraph entitled "Fire Alarm System Acceptance Test Procedure" or Acceptance Test Procedure must be repeated at the discretion of the AHJ.

The following must be provided at the job site for Final Acceptance Testing:

a. Copy of Final Acceptance Test Procedures for all witnesses.

b. Copy of Final draft/Marked-up redlines as-built drawings of the system.

c. Copy of Final draft site-specific software.

Upon successful completion of the Final Acceptance Test, submit all completion documentation to the Contracting Officer as required by NFPA 72 including all test reports noted below:

a. A signed and completed Final Acceptance Test procedure (with all steps annotated as complete)

b. Complete Record drawings of the system as actually installed.

c. Complete site-specific software.

d. A signed and complete NFPA 72 Record of Completion form.

3.3.4 Fire Alarm System Acceptance Test Procedures

Test the system in accordance with the procedures outlined in NFPA 72. The required tests are as follows:

With the control panel energized, demonstrate the proper operation of all indicating lights and alarms.

Demonstrate remote annunciator indicator lights to operate when a system alarm / supervisory / trouble condition is present and the correct information is displayed. Verify acknowledge button silences audible sound at both the FACP and annunciator, alarm silence button silences both audible and visual appliances, system reset button restores FACP back to normal, and programmable buttons perform their assigned operations.

Activate each manual pull station to demonstrate proper operation.

Activate each smoke detector, test with smoke in accordance with the manufacturer's instructions, to demonstrate proper operation of both alarm and trouble.

Perform a static pressure differential test on each duct smoke detector to verify the pressure differential between the inlet and outlet tubes is within the manufacturer's specifications for acceptable operation. For air handling units with variable speed drives, test at both the minimum and maximum operating speeds.

Activate each duct smoke detector, test with smoke in accordance with the manufacturer's instructions, to demonstrate proper operation.

Activate each flame detector in accordance with the manufacturer's recommendation; verify both alarm and trouble indications at the FACP.

Activate each flame detector test switch and verify that each flame detector on this circuit went into alarm and that all the addressable interface modules latched in the alarm condition. Restore the test switch and visually verify the flame detectors returned to normal operation.

Each time an initiating or supervisory circuit is activated, verify that the associated device address, notification appliances circuits, auxiliary control circuits, and alarm reporting to the Central Radio Monitoring System is activated, and the correct information is displayed.

Open circuit test: Introduce an open circuit at each circuit (alarm initiating device circuit, notification appliance circuit, control device circuit and signaling line circuit). Verify indication of trouble signal at FACP.

[Open circuit test: Introduce an open circuit at each fire suppression interface circuit. Verify indication of a supervisory signal at FACP.]

Ground fault test: Introduce a ground fault at each circuit (alarm initiating device circuit, notification appliance circuit, control device circuit and signaling line circuit). Verify indication of ground fault at FACP.

Short circuit test: Introduce a short circuit at each circuit (alarm initiating device circuit, notification appliance circuit, control device circuit and signaling line circuit). Verify indication of short circuit at FACP.

Circuit integrity test: Remove one lead at not less than 10% of the initiating device, notification appliance, and control device on every initiating device circuit, notification appliance circuit, control device circuit, and signaling line circuit. Verify indication of trouble signal at the FACP. For Class A circuits, test the device to verify an alarm/supervisory operation over the trouble condition.

Loop Resistance Tests: Measure and record the resistance of each circuit with each pair of conductors in the circuit short-circuited at the farthest point from the circuit origin. The tests must be witnessed by the Contracting Officer and test results recorded for use at the Preliminary and Final tests.

Turn off power to each separately powered panel or device to simulate loss of power and to demonstrate operation of the trouble alarm.

Test the rate-of-rise function on each heat-actuated detector in each zone by application of heat source from a heat lamp or handheld hot air blower to demonstrate proper operation. Ensure detectors initiate an alarm to the system, sustain repeated tests of the rate-of-rise function without damage to the fixed temperature function. Replace heat-actuated detectors (HADS) subject to operation from body temperature.

Open and close water suppression system valves to activate tamper switches, to demonstrate proper operation. Ensure that testing of tamper switches complies with the requirements of NFPA 72.

Activate water flow/pressure switches by opening of the inspector's test valve to demonstrate proper operation. Set water flow time delay between 50 and 70 seconds.

Verify discharge within 60 +/-10 seconds of electrically activated suppression systems. Verify each initiation device that activates the suppression system to activate the solenoid valve. Fully discharge the overall system at least once, via separate test procedure, that may include alternatives such as cylinders filled with breathing air.

Demonstrate each alarm initiating circuit to operate its associated alarm-control and auxiliary control units and remote reporting.

Initiate an alarm to verify all audible and visual notification appliances

are functional. Verify audible information to be distinguishable and understandable.[In locations where voice intelligibility is required, verify by one of the NFPA 72 approved methods. Ensure Acceptable Sound pressure level comply with NFPA 72.]

Demonstrate capacity and the operation of the battery backup system to operate as required by these specifications by disconnecting the 120 V(AC), 60 Hz power from the fire alarm (control) panel and operating the system as specified for backup operation.

Test fire alarm circuit to ensure no stray voltages exist between fire alarm circuit conductors and ground, and, where shield cables are installed, between fire alarm circuit conductors, cable shields, and drain wires. The tests will be conducted during the Preliminary Test with results available at the final acceptance test

Measure voltage readings for all circuits to validate voltage drop calculations provided with shop drawings and ensure voltage drop values do not exceed device voltage tolerance. Measure the voltage drop at the most remote appliance (based on wire length) on each notification appliance circuit.

Demonstrate all circuits interconnecting with other systems fire protection, smoke control, HVAC, security and safety, elevators, etc., to operate as specified on alarm from the associated zone or zones.

Verify all maintenance disable functions operate as specified. Independently verify each device or circuit controlled by the disable function.

[Test Class X network wiring configuration and fault tolerance to verify proper operation.]

Demonstrate each alarm control unit to operate in all modes.

3.3.5 Reacceptance System Tests

Perform reacceptance testing after system components are added or deleted; after any modification, repair, or adjustment to system hardware or wiring; or after any change to software. Test all components, circuits, systems operations, or site specific software functions known to be affected by the change or identified by a means that indicates the system operational changes are 100 percent tested. In addition, also test 10 percent of the initiating devices (maximum of 50 devices) that are not directly affected by the change and verify proper system operation.

Changes to all control units connected or controlled by the system executive software require a 10 percent functional test of the system, including a test of at least one device on each input and output circuit to verify proper system operation.

Upon completion of the modification, functionally test the existing devices that were reinstalled and test the devices that are on both sides of the point of connection of the new devices. Test all newly installed devices in accordance with the paragraph entitled, "Fire Alarm System Acceptance Test Procedures (For Both Preliminary and Final Tests)," of this section.

After final acceptance testing has been successfully completed, submit test data under the terms of the "GENERAL REQUIREMENTS" clause of this contract.

****
NOTE: NOTE: Add the following bracketed option if the design prepared under this project will be for installation of a new fire alarm system (make/manufacturer) other than Simplex or Siemens, which is currently installed on KSC premises.
****

3.4 INSTRUCTION OF GOVERNMENT EMPLOYEES

3.4.1 Instructor

Provide the services of an instructor, who has received specific training from the manufacturer for the training of other persons regarding the operation, inspection, testing, and maintenance of the system provided. The instructor must train the Government employees designated by the Contracting Officer, in the care, adjustment, maintenance, and operation of the fire alarm system. The instructor must be thoroughly familiar with all parts of this installation. The instructor must be trained in operating theory as well as in practical O&M work. Submit the instructor's information and qualifications including the training history.

3.4.2 Required Instruction Time

Provide [8][16][_____] hours of instruction after final acceptance of the system. The instruction must be given during regular working hours on such dates and times selected by the Contracting Officer. The instruction may be divided into two or more periods at the discretion of the Contracting Officer. The training must allow for rescheduling for unforeseen maintenance and/or fire department responses.

3.4.3 Technical Training

Equipment manufacturer or a factory representative must provide [1][3][_____] days of on site[and 5 days of technical training to the Government at the manufacturing facility]. Training must allow for classroom instruction as well as individual hands on programming, troubleshooting and diagnostics exercises.[Factory training must occur within [6][12][_____] months of system acceptance.]

3.4.4 Technical Training Manual

Provide, in manual format, lesson plans, operating instructions, maintenance procedures, and training data for the training courses. The operations training must familiarize designated government personnel with proper operation of the installed system. The maintenance training course must provide the designated government personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system.

3.5 PAINTING

Bring all manufacturer's standard finish equipment surfaces, damaged during construction, to as-new condition by touchup or repainting to the satisfaction of the Contracting Officer, or replace with new undamaged equipment at no additional cost to the Government.

Paint all fire alarm conduit fittings, junction boxes, and junction box

covers red, Color No. 11105 in accordance with SAE AMS-STD-595A. Mark conduit with a minimum 2.54 cm1-inch wide band every 6.1 m20 feet.

-- End of Section --

****
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA/KSC-28 31 33.00 98 (July 2020)

Preparing Activity: NASA

Superseding
NASA/KSC-28 31 33.00 98 (November 2011)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
****

SECTION TABLE OF CONTENTS

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

SECTION 28 31 33.00 98

AIR SAMPLING DETECTION SYSTEMS (ASDS)

07/20

-- End of Section Table of Contents --

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SECTION 28 31 33.00 98

AIR SAMPLING DETECTION SYSTEMS (ASDS)
07/20

****
NOTE: This specification covers the requirements for air sampling detection systems.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Recommended changes to a NASAKSC Master Specification Section should be submitted as a Criteria Change Request (CCR) to the appropriate Technical Proponent (TP) through the SpecsIntact Help Desk.
****

PART 1 GENERAL

Section 28 31 00.00 98 FIRE DETECTION AND ALARM applys to work specified in this section.

Provide all additional equipment, cabinets, conduit, and labor to meet the requirements and intent of this specification.

1.1 REFERENCES

****
NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date,

and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

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

****

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.

ASTM INTERNATIONAL (ASTM)

ASTM D1784	(2020) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D2564	(2020) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM F438	(2017) Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
ASTM F442/F442M	(2023) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)
ASTM F493	(2022) Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings

COMPRESSED GAS ASSOCIATION (CGA)

KSC-STD-F-0004	(2016, Rev G) Standard for Fire Protection Design

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991; R 1995) Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

NASA-STD 8719.11	(2020; Rev B) Safety Standard for Fire Protection

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA TC 3	(2021) Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023) National Electrical Code
NFPA 72	(2022; ERTA 22-1) National Fire Alarm and Signaling Code
NFPA 75	(2020) Standard for the Protection of Information Technology Equipment

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-595	(Rev C; Notice 1) Colors Used in Government Procurement

UNDERWRITERS LABORATORIES (UL)

UL 497	(2001; Reprint Jul 2022) UL Standard for Safety Protectors for Paired Conductor Communication Circuits
UL 497B	(2004; Reprint Feb 2022) UL Standard for Safety Protectors for Data Communications and Fire Alarm Circuits
UL 1481	(2006) Standard for Power Supplies for Fire-Protective Signaling Systems
UL 2196	(2008) UL Standard for Tests for Fire Resistive Cables, 1st Edition
UL 1449	(2021; Reprint Dec 2022) UL Standard for Safety Surge Protective Devices
UL Fire Prot Dir	(2012) Fire Protection Equipment Directory
UL Fire Resistance	(2014) Fire Resistance Directory

1.2 SUBMITTALS

****

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

A "G" following a submittal item indicates that the submittal requires Government approval. Some

submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

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 REPORTING.

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit Contractor's Certifications[; G] to the Contracting Officer for approval, prior to any work being started on the ASDS, in accordance with paragraph titled "Qualifications".

KSC Transfer Of Responsibility[; G]

Quality Assurance Plan[; G]

SD-02 Shop Drawings

Connection Drawings[; G]

Record Drawings[; G]

Fire Service Floor Plans[; G]

Software Programs[; G]

Floor Plan Drawings[; G]

Module Schematics; {;G}

SD-03 Product Data

Submit Manufacturer's Product Data[; G] (Catalog Data) for the following items:

Pipe Hangers and Supports[; G]

Remote Display Module[; G]

Annunciator Cabinet And Interface Equipment[; G]

ASDS Detector Assembly[; G]

Pipe Network[; G]

Power Supply-Battery Charger[; G]

Filter[; G]

Fire Resistive Cables[; G]

Line Voltage Surge Suppressors[; G]

Low Voltage Surge Suppressors[; G]

Wiring (Wire And Multi-Conductor Cable)[; G]

SD-05 Design Data

ASDS Pipe Network Design Analysis[; G]

SD-06 Test Reports

ASDS Acceptance Test Procedures[; G] (For preliminary and final tests)

Continuity Test Report[; G]

Insulation Resistance Test Report[; G]

SD-07 Certificates

NFPA 72 Fire Alarm System Record Of Completion Form[; G]

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals[; G]

Recommended Critical Spares List[; G]

1.3 GENERAL REQUIREMENTS

Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL[and Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS] apply to work specified in this section.

1.3.1 Submittals Sequence

Submit submittals for approval in the following sequence with each approved prior to the next submittal.

1.3.1.1 Preconstruction Submittals

Submit the following submittals no later than [14] [_____] days after notice to proceed:

a. KSC Transfer of Responsibility form

b. Product Data (Catalog Data)

c. Contractor's Certifications

d. Quality Assurance Plan

1.3.1.2 Preliminary Test Submittals

Submit the following submittals no later than [14] [_____] days prior to the scheduled preliminary acceptance test:

a. ASDS Acceptance Test Procedures

b. Shop Drawings

Provide two completed sets minimum of the drawings and documentation and make available for reference at the preliminary test.

1.3.1.3 Final Test Submittals

Submit the following submittals no later than [14] [21] [_____] days prior to the scheduled final test:

a. Electronic Shop Drawings

b. NFPA 72 Fire Alarm System Record of Completion Form

Provide two completed sets minimum of the Shop Drawings and documentation and make available for reference at the final test.

1.3.1.4 Closeout Submittals

Submit the following submittals no later than 14 [21] [_____] days after the final acceptance test has been completed and approved:

a. Operation and Maintenance Manuals

b. Record Drawings

c. Completed final ASDS Acceptance Test Procedures

d. Recommended Critical Spares List

Include in this submittal two (2) sets of CD ROM digital media .DWG or .DGN format files of all the Record Drawings. Prepare and submit all drawings generated by computer aided design (CAD). Provide a complete copy of the Record Drawings in PDF format. Submit Recommended Critical Spares List in accordance with the paragraph entitled "Documentation Requirements" of this section. Submit these items electronically or using a government approved method.

1.3.2 Documentation Requirements

Installation shop drawings, record drawings, connection drawings, and design analysis must be signed and sealed by a Professional Engineer with qualifications as defined in paragraph titled "QUALIFICATIONS".

1.3.2.1 Shop Drawings

Include in Shop Drawings: Connection Drawings, Floor Plan Drawings, Air-sampling Smoke Detection System (ASDS), Sequence of Operations, ASDS Pipe Network Design Analysis, Module Schematics, and all other data required to fully document the completed system. After final testing is complete, provide Record Drawings including digital media and hard copies

of all new and revised softwares, drawings, and analysis/calculations incorporating approved comments and any changes.

1.3.2.1.1 Connection Drawings

Provide ASDS and Fire Alarm Control Panel (FACP) Connection Drawings consisting of point-to-point wiring diagrams of internal and external wiring including, but not limited to, detectors, modules, wiring type and AWG, and communication networking connections, where present, and battery connections. Point-to-point wiring is defined as wiring from device with integral terminal strip to next device with integral terminal strip, wiring between internal modules/devices in cabinet, circuit termination's on terminal strips in terminal boxes with integral terminal strips.

1.3.2.2 Record Drawings

Document final system configuration in Record Drawings (As-Built) including, but not limited to, all new and revised softwares, drawings, and analysis/calculations incorporating approved comments and any changes, including deviations from the amendments to the connections drawings, and field installation changes, concealed and visible.

1.3.2.3 Software Programs

Provide software programs, both hard copy and compact disc, for all new and/or existing programmable FACP(s) affected by the project. Provide system executable file and report file on the compact disc. FACP program documentation to include system point summary, addressable device switch settings, and descriptive check boxes for program functions listed on paragraphs titled "FACP Functions". FACP program documentation to clearly show interaction of system components in accordance with the Fire Alarm Input/Output Matrix and Sequence of Operations included in design. Programming documentation specifically programming check boxes to be reviewed and approved by government prior to Final Acceptance Testing.

1.3.2.4 ASDS Acceptance Test Procedures

Conduct tests in accordance with approved ASDS Acceptance Test Procedures, and in accordance with the paragraph entitled "Field Testing" in this specification. Prepare a test procedure and test record form for conducting complete tests on control panels, reporting systems, wiring systems, and field devices installed in accordance with the manufacturer's requirements and these specifications. Identify each device and circuit to be tested in the test procedure, describe the initial condition, each step or function in the test, required test result, and equipment to be employed.

Test procedures are to be written to minimally disrupt facility operations and reduce the time required to receive signals at the Ground Support Fire Alarm (GSFA) console for KSC testing by not routinely transmitting repetitive signals, for example on site inspectors may observe relay operations that cause radio zones to transmit. Test procedure to detail how to minimize activation of evacuation notification appliances, AHU shutdown, etc. in support of testing requirements. Ensure test forms have suitable space for recording test results on all equipment, devices, and wiring to be tested. Provide test record forms with identified spaces for verification signatures of [KSC][CCAFS Fire & Emergency Services] Authority Having Jurisdiction and [_____] System Engineer witnesses and dates of the test.

1.3.2.5 Fire Service Floor Plans

Clearly indicate on Floor Plans geographic monitor zone boundaries, location of remote displays (ASDS Annunciator Cabinet), FACP, communication networking interface equipment, terminal cabinets, batteries, power source, pipe network (pipe segment dimensions), piping isometric views, operational calculations, detector performance criteria and sampling points (size and locations) and all other associated equipment that is required to provide a complete ASDS. Include program logic and/or ladder logic diagrams that show interaction of system components.

1.3.2.6 Design Analysis

Submit ASDS Pipe Network Design Analysis for approval for the Fire Alarm and Detection System modeled with manufacturer Windows-based software (ASPIRE), latest revision, consisting of fan speed, air flow pressures, transport times, sampling points diameter, and pipe segment dimensions.

1.3.2.7 Operation And Maintenance Manuals

Submit Operation and Maintenance Manuals. Bind information in manual format and group by technical sections consisting of manufacturer's standard brochures, schematics, procedures, recommended test equipment, and safety precautions.

1.3.2.8 Recommended Critical Spares List

Submit Recommended Critical Spares List specific to the project. List to include critical spare parts and components recommended by the manufacturer to restore the system to operation in with minimal downtime.

1.4 SYSTEM REQUIREMENTS

Provide ASDS for smoke detection[of IT/Communication room(s)] conforming to the applicable requirements of NFPA 75, NFPA 72, KSC standards KSC-STD-F-0004, NASA requirements NASA-STD 8719.11 and manufacturer's application design guidelines, and requirements specified herein.

Provide all equipment, cabinets, modules, devices, programming, circuits, conduits, testing and labor to meet the requirements of this specification. Ensure all equipment and components provided are Underwriter Laboratory (UL) UL Fire Prot Dir listed or Factory Mutual (FM) FM APP GUIDE approved for their intended use and function.

Ensure manufacturer's Product Data identifies detector manufacturer's name and model number including any special tools for the maintenance and testing of the detector to operate and meet its UL or FM approval standards. Verify actual installed pipe network integrity meets or exceeds manufacturer pipe network modeling software (ASPIRE) and specifications herein.

1.4.1 ASDS Requirements

a. Consist of a highly sensitive, short wavelength LASER-based[, in conjunction with photodiodes and advanced imaging Flair detection technology].

b. Have a reset/disable/acknowledge button, LED indicator, and a [3.5" color touch screen] user interface Display to provide detector status

information, including smoke level, smoke level bar graph, % airflow level, and fault categories.

c. Consist of a [four] [_____] pipe model to transport air to the detection system, supported by calculations from a computer-based design modeling tool.

d. Be tested and approved for an area coverage of [21,520] [_____] sq. ft with a [919] [_____] ft pipe length (linear) and [1,837] [_____] ft pipe length (branched).

e. Provide [four] [_____] alarm levels (thresholds) corresponding to [Alert, Action, Fire 1 and Fire 2] [_____] with a wide sensitivity range and two fault warning levels (maintenance and major fault).

f. Consist of alarm threshold sensitivity range of [0.0016%-6.25%] [_____] obs/ft with a minimum Fire 1 threshold of [0.0031%] [_____] obs/ft.

g. Incorporate an ultrasonic flow sensor in each pipe inlet and provide staged airflow faults against flow fault thresholds that may be determined and set for each pipe individually.

h. Consist of [seven] [_____] configurable relay outputs, rated minimum 2A at 30 VDC, and [two] [_____] programmable GPIs to report any alarm level, fault and disable indication on the detector.

i. Be a [two] [_____]-stage filtration type and self-monitoring for filter dust count contamination and remaining filter life.

j. Have an AutoLearn Smoke/Flow internal button for rapid normalization function of detector.

k. Be modular type with field replaceable sub-assemblies.

l. Be configured, monitored, and maintained using a Windows application (Xtralis VSC/VSM) software running on a PC (or table/smart phone) via USB port, Ethernet, or WiFi. Software (VSC/VSM) to be provided for download.

m. Be provisioned for field upgrading the firmware in the system using a USB memory key connected directly to the detector, avoiding the need for a separate PC for this function.

n. Be capable of being protected (access) using a detector password specific to the detector with authentication protocol software security measures.

o. Support network connectivity which includes intelligent remote display module(s) and/or a high-level interface (HLI) with the building fire alarm system, or a dedicated graphics package (such as VSM4), for primary reporting, centralized configuration, control, maintenance and monitoring.

p. Be capable of storing up to [20,000] [_____] events in on-board memory and report events via peer-to-peer communications networking.

1.5 QUALITY ASSURANCE PLAN

Provide manufactured UL listed or FM approved ASDS fire-alarm equipment

which meets the requirements according to the paragraph titled "System Requirements" of this section. Use the latest standard design, and as listed by Underwriters' Laboratories (UL Fire Prot Dir) or approved by Factory Mutual FM APP GUIDE for its intended use. Ensure all installed devices are comparable, and function with the operation of the control panel and do not interfere.

Supplier and Installer should be factory-trained by the manufacturer to model, design, install, program, test, and commission the ASDS based on code requirements herein.

Installer should provide fully verified and dated electronic copies of all test data and results with a copy of the approved test procedure and any factory commissioning form.

1.6 QUALIFICATIONS

1.6.1 Professional Engineer

Installations requiring completion of installation shop drawings and record drawings for ASDS and fire alarm systems require signing and sealing by a qualified engineer. For the purpose of meeting this requirement, a qualified engineer is defined as an individual meeting one of the following conditions:

a. A Registered Professional Engineer having a Bachelor of Science or Master of Science Degree in Fire Protection Engineering from an accredited university engineering program, plus a minimum of four years work experience in fire protection engineering.

b. A Registered Professional Engineer (P.E.) in fire protection engineering.

c. Registered Professional Engineer with verification of experience and minimum of five years of current experience in the design of fire alarm systems of similar complexity.

1.6.2 Installer

Installation of wire, cable, conduit, control cabinets, fire alarm terminal cabinets, and backboxes for fire alarm components must be performed by Fire Alarm Installers. Electricians are allowed to be Fire Alarm Installers. [Fire Alarm Installer to be assisted by a Fire Alarm Technician.]

1.6.3 Technician

Installation and termination of fire alarm control panels, releasing panels, notification appliances, initiating devices, cabinets and modules must be performed by [NICET Level II certified] Fire Alarm Technicians with a minimum of four years of experience. Fire Alarm Technicians must be trained by the manufacturer in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.6.4 Supervisor

Installation of the fire alarm control panels and releasing panels must be supervised by a [NICET Level III certified] Fire Alarm Technician with a minimum of 8 years of experience. The Fire Alarm Technicians must be trained by the manufacturer in the installation, adjustment, testing, and

operation of the equipment specified herein and on the drawings.

1.6.5 Test Personnel

Testing and certification of fire alarm systems must be performed by a [NICET Level III certified] Fire Alarm Technician with a minimum of 8 years of experience. The Fire Alarm Technicians must be trained by the manufacturer in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.6.6 Manufacturer's Representative

The fire alarm control panel and releasing panel equipment Manufacturer's Representative must be present for the connection of wiring to the panel. The Manufacturer's Representative must be an employee of the manufacturer with necessary technical training [NICET Level III] on the system being installed.

1.6.7 Manufacturer

Components must be of current design and be in regular and recurrent production at the time of installation. Provide design, materials, and devices for a protected premises fire alarm system, complete, conforming to the most current version of NFPA 72, except as otherwise or additionally specified herein.

PART 2 PRODUCTS

Provide an ASDS with performance conforming to the requirements of UL or FM approval standards. Ensure manufacturer's Product Data identifies detector manufacturer's name and model number including any special tools for the maintenance and testing of the detector to operate and meet its UL or FM approval standards. Verify actual installed pipe network integrity meets or exceeds manufacturer pipe network modeling software (ASPIRE) and specifications herein. Use components in the installation that are currently being produced and manufactured (not at 'End of Life') and are no more than two years old.

2.1 FRONT PANEL AND INTERNAL BUTTONS

Provide front panel and internal buttons in accordance of the paragraph titled "System Requirements" of this section.

Ensure the detector provides a LED button interface to control all operations of the ASDS to suit particular applications. Confirm that any alarm/fault condition causes the indicator lamps to flash and remain in this state until reset or acknowledged. Provide an isolate (disable) button or a separate maintenance by-pass switch to isolate each detector for testing purposes.

2.2 DETECTOR DISPLAY AND STATUS INDICATORS

Provide a [3.5" color] LCD touch-screen interface to allow scrolling through status screens to show/look-up a range of status information, such as overall status, smoke level, flow levels, individual faults, trouble status, AutoLearn smoke/flow functions, alarm thresholds indicators, etc. Ensure that the color LCD touch-screen displays the detector's continuous output of smoke levels per active zone. Ensure that each detector contains a bar graph display feature with bar graph indicators being

light-emitting-diodes (LED) or liquid crystal display (LCD).

Ensure the detector provides LED indicators to monitor all operations of the ASDS to suit particular applications. Detector provides an LED user interface with four LEDs to indicate Alert, Action, Fire 1, and Fire 2 alarm events, one fault LED, one disable/standby LED, and power On/Off indication. Ensure all alarm lamps, fault lamp, disable, and power On/Off indicators are visible on the detector front panel. Ensure LED indicators illuminate when their respective activation conditions are met.

Provide a separate detector LED indicator to show normal operating status when the ASDS is functioning as designed. Ensure detector status indicates a fault upon the loss of power, an open circuit or an electrical/electronic problem within the detector's circuitry or external wiring.

Ensure the detector [Alert, Action, Fire 1 and Fire 2][_____] indicators stay illuminated or flashes and a detector configurable relay or separate detector relay operates when the detected smoke is higher than the set alarm thresholds.

Ensure the detector fault indicator flashes and a trouble relay or separate detector failure relay operates when there is a failure/problem (fault categories: detector, chamber, filter, flow, aspirator, network, power, etc.) within the detector's circuitry and/or external wiring.

The detector should support generation and transmission of urgent and minor faults.

Adjust the time delay from zero (0) to sixty (60) seconds for each detector failure indicator lamp/relay. Set detector fault time delay to not more than ten (10) seconds.

[2.2.1 Remote Display Module

Provide a remote ASDS Annunciator Cabinet with LCD remote display module(s) to control, monitor, and report the status of the ASDS. Channel and distribute power and communication for the ASDS from the display module including referencing and chart recording. Ensure smoke level bar graph, alarm level threshold indicators for Alert, Action, and Fire 1, fault icons indicating specific individual faults such as detector, chamber, filter, air flow, aspirator, network, power, flow percentages levels per pipe sections, filter life, etc. are visible on each display module face. Protect all time delays, alarm level adjustments, and testing facilities for detector sensitivity within a secured enclosure to prevent tampering. Provide an override circuit per manufacturer's requirements for fail-safe operation in the event that the programmed alarm threshold is not set or is disabled, or that the fourth alarm threshold automatically defaults to the full-scale smoke level. Provide display module that contain all components necessary to maintain a smoke level history log and a historical event log. Ensure storage capacity for the smoke level history log is a minimum of [40,000] samples. Ensure historical event log is capable of a minimum storage capacity of [100] events. Ensure display module is capable of retaining this information upon loss of both primary and secondary power sources.

Ensure display module is compatible with ASDS detector.

For single zone or multiple zone applications a unitized, self-contained, single enclosure detector/display can be utilized.

In multiple zone installations, where it is desirable to have a central control point monitoring and controlling the remote detector assembly panels, use a multi-zone display module(s). Provide a remote ASDS Annunciator Cabinet and Interface Equipment appropriately sized based on the number of remote display modules used, with a capacity of up to 200 devices, to report ASDS status to FACP. Obtain authorized network access by utilizing a minimum of two levels of password protection.

Communication Networking wiring should comply with manufacturer recommended wire type and size specifications to meet required communication baud rate. ASDS should detect communications networking interference, open, short circuit, and ground fault.

]2.3 ASDS CONFIGURATION AND PROGRAMMING

Provide latest software (VSC/VSM) revision to configure and program the ASDS.

2.3.1 Alarm Threshold Levels

Provide an ASDS with a minimum of four (4) alarm threshold levels for each zone:

Alarm Level 1 - ALERT

Alarm Level 2 - ACTION

Alarm Level 3 - FIRE 1

Alarm Level 4 - FIRE 2

Ensure programmed alarm thresholds are clearly visible on the face of the display and are adjustable through the full bar graph scale of the display. Provide a visual alarm level indicator that illuminates and/or flashes when the detector output signal reaches the programmed threshold level for the programmed time. Ensure that the visual alarm indicators on the display have circuitry arranged so that they can be manually reset through the reset feature. Ensure that alarm thresholds for each alarm level indicator are independently programmable across its sensitivity range and are set to meet the requirements herein. Setting of alarm threshold level Fire 1 should always appear as 100% on the bar graph scale. Program alarm thresholds to the following values unless the results of the System Acceptance Test procedures, indicate a clear need to change them. In the event that such a need is indicated, notify the Contracting Officer and provide complete documentation concerning the need to deviate from these values. Ensure initial threshold levels are approved prior to the final acceptance test.

Alarm Level 1: set ALERT at 0.0250 percent obs/ft

Alarm Level 2: set ACTION at 0.0500 percent obs/ft

Alarm Level 3: set FIRE 1 at 0.1000 percent obs/ft

Alarm Level 4: set FIRE 2 at 0.2000 percent obs/ft

Ensure the ASDS contains individual adjustable alarm time delays for each alarm threshold levels between 0 to 60 seconds. Program the alarm

threshold time delays to 30 seconds for alarm levels 1 and 2, and 15 seconds for alarm level 3 and 4.

2.3.2 Air Flow Levels

Ensure the ASDS continuously monitors the air flow in each pipe. Ensure the color LCD touch-screen displays the flow level percentage for each of the flow sensors in each pipe inlet in use and shows an Air Flow malfunction as a separate fault indication from a trouble indication. Ensure display indicates a trouble condition when the air flow through the detector is insufficient to permit proper operation of the detection system. Use the detector air flow (% of normalized) factory default settings (Major and Minor Highs/Lows) and confirm the final settings based on design considerations and aspirator speed setting using manufacturer pipe network calculation software (ASPIRE).

Ensure the air flow fault threshold setting(s) are adjusted by the factory-trained representative on site and meet site specific conditions. Have a programmable time delay for the air flow fault alarm signal with a range of 0 to 60 seconds for each zone. Program the air flow fault time delay to 10 [_____] seconds unless the results of the system acceptance and commissioning tests, required in this specification, indicate a clear need to change them. In the event that such a need is indicated, provide the Contracting Officer with complete documentation concerning the need to deviate from these values.

2.4 ASDS AND FACP INTERFACE

Provide all contacts, addressable modules, cabinet, hardware, conduit, wire, and power circuits required for proper operation and interface between the ASDS and FACP per 28 31 00.00 98 section.

2.4.1 Alarm Level 1 (Alert)

Configure and program the ASDS so that when ALERT alarm threshold setting is reached for any detector, the alarm level indicator for that detector illuminates and an audible and a visual alarm sound at the display and remote display module, where present. Ensure a supervisory alarm activates at the [FACP][Releasing Control panel (RCP)] and is transmitted to the KSC Central Radio Monitoring Station (CRMS).

2.4.2 Alarm Level 2 (ACTION)

Configure and program the ASDS so that when ACTION alarm threshold setting is reached for any detector, the alarm level indicator for that detector illuminates and an audible and a visual alarm sound at the display and remote display module, where present. Ensure a supervisory alarm activates at the [FACP][RCP] and is transmitted to the KSC Central Radio Monitoring Station (CRMS).

2.4.3 Alarm Level 3 (Fire 1)

Configure and program the ASDS so that when FIRE 1 alarm threshold setting is reached for any detector, the alarm level indicator for that detector illuminates and an audible and a visual alarm sound at the display and remote display module, where present. Ensure a silent alarm activates at the [FACP][RCP], a visual notification appliance(s) and is transmitted to the KSC Central Radio Monitoring Station (CRMS). Activate visual notification appliance(s) in affected areas only

2.4.4 Alarm Level 4 (Fire 2)

Configure and program the ASDS so that when FIRE 2 alarm threshold setting is reached for any detector, the alarm level indicator for that detector illuminates and an audible and a visual alarm sound at the display and remote display module, where present. Ensure an alarm activates at the [FACP][RCP] and is transmitted to the KSC Central Radio Monitoring Station (CRMS). Activate general facility audio and visual notification appliances.

2.4.5 Isolate (disable) Indication

Confirm the ASDS is set-up so that in the event the isolate (disable) button is activated, the appropriate indicator illuminates. Ensure the ASDS activates an isolate alarm at the [FACP][RCP] and is transmitted to the KSC Central Radio Monitoring Station (CRMS).

2.4.6 Trouble Indications

Confirm the ASDS is set-up so that in the event of an air flow fault, or a detector fault; the appropriate air flow fault indicator or detector fault indicator illuminates. Ensure that the ASDS activates two separate trouble alarms at the [FACP][RCP] and transmits separate trouble alarms to the KSC Central Radio Monitoring Station (CRMS).

Coordinate audible trouble signal silencing with AHJ when FACP is located in occupied areas to minimize disturbance to occupants.

2.5 WIRING

Provide copper conductor wiring in accordance with NFPA 70 and NFPA 72. Connect all devices per NFPA 72, with the wire types specified in this section, unless specifically noted otherwise in the paragraph titled "Wiring (Wire and MultiConductor Cable)" of this section. For 120 VAC circuits, use 3.0 mm2 No. 12 AWG minimum.

Ensure all conductors installed on fire alarm systems are solid copper with an insulation rating of not less than 300 volts, permanently marked with the size, voltage rating and manufacturer's name on the conductor jacket at no less than 610 mm 2 feet intervals. Conductor sizes are listed below.

Where modifications are made to existing systems, match the new or added conductors to the size and color-coding of the existing system. Conductor AWG diameter and Insulation Type are listed below. Required wire colors are listed in the paragraph titled "Wiring (Wire and Multi-Conductor Cable)" of this section.

Provide solid copper, shielded, twisted pairs, meeting UL 2196 requirements, for conductors in multiplexed communication circuits, signaling line circuits, speaker audio circuits, and remote reporting circuits. Ensure cable is listed as Type FPL, Power-Limited Fire Protective Signaling Cable, with conductor size less than 1.0 mm2 No. 16 AWG diameter for data circuits and 2.0 mm2 No. 14 AWG diameter for audio circuits.

Air sampling detection units are permitted to use 0.8 mm2 No. 18 AWG for connection to addressable modules with maximum conductor length not to exceed 25 feet.

Size power leads from the control panel for product-of-combustion detectors accordingly, but not less than 2.0 mm2 No. 14 AWG diameter, with insulation Type THHN/THWN for 2.0 mm2 No. 14 AWG diameter and larger.

[Ensure all underground circuit wiring meet UL Standards 444 and 13, and TIA 455-82B water infiltration tests.]

2.5.1 Fire Resistive Cables

Provide fire resistive cables for notification appliance circuits designed for use with automatic/manual systems in accordance with UL 2196.

Provide UL Fire Prot Dir listed Type FPL-CI fire alarm cable for use with power limited fire alarm notification appliance circuits. Ensure the CI cable has a minimum 2-hour fire resistance rating by having passed the applicable testing requirements of UL 2196. Install this cable in locations required to meet NFPA 72 survivability requirements.

2.6 ASDS DETECTOR ASSEMBLY

Air is drawn into the ASDS detector via the sampling pipe network by an aspirator, then passes through the filter and it is exposed to the short wavelength LASER light source [and Flair detection technology]within the detection chamber. Imaging and Light scattered smoke particles is measured by photodiodes and analyzed and converted to an electronic signal directly proportional to the obscuration level within the chamber. A signal corresponding to the obscuration level within the chamber is then transmitted to the ASDS display.

Provide a detector consisting of: cabling and pipe inlet and outlet ports, quick connector socket (screw terminals) interfacing, chamber assembly, filter, aspirator, flow sensing module, sensing module, and display. Detector should be modular type to allow field replacement of the filter, changer, and aspirator.

Provide a[VEP-A10-P model or approve equal] ASDS detector to contain all of the equipment, devices, and pipe network required for protection of [IT Communication room(s)],

When the floor area to be protected exceeds the maximum allowable coverage of that specific detector, use multiple detectors.

Submit manufacturer data indicating sensitivity range. The manufacturer recommends the detector sensitivity for the area to be protected by zone/application.

Provide a high-efficiency aspirator, electric centrifugal-flow impeller air pump designed for long life. Ensure the aspirator flow and pressure ratings meet the maximum transport time for an air sample removed from the furthest sampling point (open or capillary tube holes) of each branch within the pipe network. Provide a detector equipped with a sensing device(s) which detects any change in the air flow through the detector which could impair the proper operation of the detector. Include four sample pipe inlets containing a flow sensor for each pipe inlet.

Ensure the detector is usable in environments with relatively high levels of airborne dust and other contaminants through the use of a filter or other approved method. Treatment of contaminants is by either an air filtration mechanism or by electronic discrimination of particle size. If

a mechanical filtering system is used, provide a disposable filter cartridge to permit visual inspection of the filter without having to dismantle the detector. Ensure an indication is shown on display for replacement. Confirm the first stage filter has a maximum nominal pore size of 20 microns[with a second stage filter for ultra-fine 0.3 microns] or larger.

2.7 PIPE NETWORK

Design and install the sampling pipe network to monitor total room/zone concentration of smoke. Accomplish the design using a computer program based on sound fluid dynamic principles and is approved by Factory Mutual Engineering (FM) FM APP GUIDE or listed by Underwriters Laboratories (UL) UL Fire Prot Dir for its intended use. Pipe Network design, including sampling point size and quantity, should be developed and accepted by manufacturer Windows-based Pipe Network Design software (ASPIRE).

2.7.1 Sampling Pipe

Provide sampling pipe consisting of 19 millimeter smooth bore, 3/4-inch inside diameter, orange color, Chlorinated Poly(Vinyl Chloride) (CPVC) schedule 40. Pipe and fittings as defined in this section, are limited to thermoplastic materials meeting or exceeding the requirements of ASTM F442/F442M, ASTM F438, and ASTM D1784 or an approved equal. Ensure the CPVC pipe is the slip-joint solvent-weld type and fittings unthreaded solid CPVC. Joints should be bonded using appropriate solvent cement, ASTM F493, ASTM D2564. Use recommended manufacturer solvent cement. Accomplish directional changes in the pipe network by using bends and elbows. All sampling pipes should be fitted with end caps. Use socket fittings for final connection to the detector, and where pipe network removal is required for maintenance of equipment, glue is not permitted. Ensure pipe and fittings are air tight and installation conforms to NEMA TC 3.

[In areas subject to condensation build up within the sampling pipe, employ a water trap to prevent moisture from entering the detector.]

2.7.2 Sampling Points

The sampling pipe network is engineered for a maximum transport time of [60] [120] seconds, and has equal sensitivity throughout the entire system. Balance the air sampling pipe network so that the volume of air drawn from the last sampling point is not less than 70 percent of the volume from the first sampling point.

Ensure each sampling point has a maximum coverage of 23.2 square meter 250 sq ft of floor area for above ceiling, ceiling, and underfloor protection. Sampling points should not be separated by more than the NFPA 72 maximum allowable distance of 30 feet. Comply with NFPA 75 sampling point maximum coverage for return grille applications.

2.7.2.1 Capillary Sampling Points

Capillary sampling points should terminate at an approved ceiling sampling point, approved by the manufacturer, connected by means of a capillary tube with 3/8" internal diameter and maximum length of 26 feet.

2.7.3 Labeling

Label all sampling pipe and sampling points as follows: "CAUTION SMOKE DETECTION SAMPLING PIPE DO NOT DISTURB" and "FIRE DETECTION SYSTEM" respectively.

2.8 PRIMARY POWER SUPPLY

The normal power for the ASDS detector is 120 V AC, 60 hertz. Ensure ASDS operates satisfactorily between 85 and 110 percent of normal voltage. Provide an ASDS disconnect/protective device as a fused switch with a red factory finish. Mount this disconnect switch adjacent to the ASDS. Mark as "AIR SAMPLING DETECTION SYSTEM # (indicate detector number) FED FROM (indicate supply circuit)" with a permanently affixed label that is plastic or phenolic type with a red background and white lettering using a minimum of 6 millimeter 0.25-inch block. Provide an installed switch capable of being locked in the "ON" or "OFF" position. This feature is not to interfere with the circuit protection capability of the device. Equip switch with surge suppression for all phase and neutral conductors. Install current limiting Class RK1 fuses properly sized to protect the ASDS equipment.

When power is supplied from a single 20-amp circuit breaker, provide an adjustable set screw type clamping device, red factory finish, over the circuit breaker handle to prevent handle operation.

2.9 SURGE SUPPRESSORS

Provide line voltage and low voltage surge suppression devices to suppress all voltage transients which might damage the control panel components.

Install surge suppression in accordance with UL 497B on each conductor of fire alarm circuits which extend beyond a building. Locate protection as close as practical to the point where the circuits leave the building. Install protectors in surge suppression cabinets of adequate size with terminal strips for all wiring connections plus 25 percent spare. Paint enclosures with a prime coat and one or more coats of red baked enamel finish to provide a smooth, hard, and durable finish. Where installed outdoors, provide stainless steel NEMA 4X rated cabinets. Provide a copper ground bus inside the cabinet and connect protectors to an earth ground electrode system in accordance with the manufacturer's requirements and NFPA 70. Ensure an etched metal or engraved laminated plastic identification plate labeled, "Fire Alarm Cabinet", is affixed to the cabinet door of the alarm control unit to identify the cabinet as a fire alarm cabinet. For cabinets painted black, ensure the identification plate has white letters on a black background, and for cabinets not painted red, the identification plate has white letters on a red background.

2.9.1 Line Voltage Surge Suppressors

Provide suppressor UL 1449 listed with a maximum 330-volt clamping level and a maximum response time of 5 nanoseconds, and also meets IEEE C62.41, category B tests for surge capacity. Ensure suppressor is a multi-stage construction type which includes inductors and silicon avalanche zener diodes. Provide suppressor which has a long-life indicating lamp (light emitting diode or neon lamp) which extinguishes upon failure of protection components, with externally accessible fuses. Wire in series with the incoming power source to the protected equipment using screw terminations.

2.9.2 Low Voltage Surge Suppressors

Provide for all circuits which leave the building shell and as shown on the contract drawings. When circuits interconnect two or more buildings, provide suppressors at the circuit entrance to each building. Ensure suppressor is UL 497B listed, with a maximum 30-volt clamping level and a maximum response time of five nanoseconds, with multi-stage construction and both differential/common mode protection.

2.10 SECONDARY POWER SUPPLY

Provide a power supply-battery charger, UL 1481, as a means of automatically supplying the entire ASDS with backup power in the event the primary power system fails. In the event of AC power failure, the system switches to battery backup power and switches back to AC power upon return of primary power. If the backup batteries are removed for any reason, the ASDS detector continues operation. The system controls charging and floating level to maintain batteries in optimum condition. Provide capability to recharge batteries in event of discharge. Use fused wiring to protect against battery over-current and polarity reversal. Primary power, battery, or charging equipment failure results in a trouble signal and visual indication at the ASDS display, transmitted to the FACP and the KSC Central Radio Monitoring System (CRMS).

Provide spill proof sealed battery modules, (no corrosive fumes). Use batteries that are listed for fire alarm service and suitable for high discharge currents required under alarm conditions. Size batteries to operate the ASDS in normal supervisory condition for 24 hours, minimum, then operate the system in the alarm mode for 10 minutes, minimum.

Provide a battery disconnect switch with DC rated contacts to allow testing for loss of secondary power supply.

2.10.1 Grounding

Design equipment allowing for low-impedance bond to the protective grounding system. Ensure equipment functions in an environment which supplies only a safety ground per NFPA 70. Isolate cabinet and equipment ground from battery return at the equipment and within the frame or cabinet.

PART 3 EXECUTION

3.1 INSTALLATION

Prior to performing any installation or modification work to existing ASDS, secure a Transfer of Responsibility Form completed by the COTR and signed by the Contractor and Institutional Services Contractor (ISC) Fire Protective Systems designee. The completed form will be turned over to the Contracting Officer by the COTR. Permanently affix a copy of the completed "Transfer of Responsibility" Form to the affected FACP throughout the construction period.

Install all equipment in accordance with manufacturer's recommendations, and this document.

3.1.1 ASDS Detector

Securely mount the smoke detector to the building structure (i.e. column, permanent wall) using approved type anchors. Determine the mounted

detector's orientation by the application (normal/inverted mounting). Maintain total access for servicing of the detector. Install equipment in accessible locations in such a manner as to prevent damage from vibration or jarring. Equipment requires a minimum of 914 millimeter 3 feet clearance directly in front of the detector for maintenance per NFPA 70. With multiple equipment, the three-foot clearance is required directly in front of the complete configuration. In addition, provide a 711 millimeter minimum 28-inch clear aisle way for access to the equipment. Provide cabinets with a hinged cover and an integral pin-tumbler cylinder lock (mortise or standard rim cylinder from Best Access Systems) with removable core that accepts the key presently in use with other control units existing in the area. Lock core will be provided by the government. Prior to installation, obtain approval from the Contracting Officer for mounting of the detector to other equipment/structure other than the building structure.

3.1.2 Sampling Pipe Network

Optional open or closed end system, per manufacturer's approved computer modeling design program can be used. Do not exceed 91.5 millimeter maximum single detector pipe length or maximum branch detector pipe total length for piping runs. Support all pipe network from the building structure only. Support all piping at approximately 5 feet maximum intervals on center with bracing for end of pipe run not to exceed 1 feet. Provide fasteners, pipe hangers and supports of appropriate dimensional size for supporting piping without distortion. Obtain Contracting Office approval for alternate means of support such as from cable trays, raceways, duct work, etc. prior to installation. Mount all piping which is adjacent to the detector tight against the wall or other structural elements which the detector is mounted on, and terminate within 457 millimeter 20 inches of the detector inlet ports. Connect piping to the detector by a socket union with a 457 millimeter 20-inch CPVC nipple of the same ID as the pipe network, to facilitate maintenance. Clean sampling pipe network inside and out. Join using manufacturer's approved solvent cement for air tight connections except at the detector enclosure connections for servicing. For safe handling of solvent cements used for joining thermoplastic pipe and fittings refer to ASTM F493, ASTM D2564. Ensure installation of pipe network is airtight.

3.1.2.1 Sampling Points

All sampling points should be identified. Ensure the size and spacing between sampling points is as per design calculations. Where sampling pipe is installed above suspended ceiling, center the sampling point fitting in the ceiling tiles and connect to the main sampling pipe using approved capillary tube. Locate sampling points so that they are clear of all supply air registers and/or air flows.

3.1.3 Spare Parts

Provide spare parts directly interchangeable with the corresponding components of the installed system. Ensure spare parts are suitably packaged and identified by nameplate, stamping, or tagging. Furnish the following:

a. Two filter assemblies

b. [_____]

3.1.4 Wiring (Wire and Multi-Conductor Cable)

Provide wiring conforming to the requirements of NFPA 70 and NFPA 72 and the following special requirements:

a. Install ASDS circuits in a separate raceway system. Route each circuit type (Initiating, Notification, Signaling, and Control) through a dedicated separate conduit or raceway system configured to comply with NFPA 72 Class A conduit system requirements. Do not allow 60-Hertz power circuits to enter enclosures containing fire alarm circuits except where required to connect to the ASDS.

b. Provide continuous conductors from a terminal point at one device to a terminal point at the next device and from a device to the FACP. Break wires at each terminal; do not loop wires over a terminal. Terminate approved explosion proof devices, provided with pigtail wiring connection leads, on a field installed terminal strip installed in the box on which the device is mounted. Install solderless ring tongue terminal lugs with manufacturer's required tooling on the device wiring connection leads. Use this ring type lug on stranded wire only. Terminate solid wire on compression or screw type terminals. When screw type terminals are used, capture the conductor under 80 percent of the screw head surface. Identify all circuit conductors within each enclosure where a tap, splice, or termination is made. Provide conductor identification by heat-shrink-type sleeves or other approved method. Use point destination type conductor labels to indicate cabinet, circuit board, terminal block and screw terminal location for each individual conductor.

c. Provide conductor colors as listed below and in accordance with FED-STD-595. Where modifications are made to existing systems, match the new or added conductors to the size and color-coding of the existing system.

d. Mark conductors for multiplexed communication circuits, speaker audio circuits, and remote station signaling circuits with circuit designation, and maintain consistent color-coding for the positive and negative loops throughout the cable system.

e. Install direct current initiating device circuits (heat detectors, manual pull station) as Class A, parallel-wired circuits per NFPA 72. Ensure the positive loop conductor is colored blue, Color No. 15102, and the negative loop conductor is colored black, Color No. 17038.

f. Install power leads from the control panel for product-of-combustion detectors as Class A, parallel-wired circuits per NFPA 72. Ensure the positive conductor is be colored Red, Color No. 11105, and the negative conductor is colored black, Color No. 17038.

g. Use approved manufacturer communications networking wiring, UL 497, UL 497B.

3.1.4.1 60-Hertz Power

Provide 120 volt, 60-hertz power to the ASDS. Provide one black phase conductor, one white solidly grounded neutral conductor and one green equipment grounding conductor. Provide conductor size as shown on the drawing with the minimum size No. 12 AWG copper. Install surge arresters in accordance with NFPA 70, UL 497B and UL 1449.

3.1.4.2 Installation In Cabinets and Boxes

Install wiring in control cabinets and boxes in a neat and orderly manner with wire properly grouped, tie-wrapped, or laced parallel and perpendicular to the major axis, supported and identified. Provide continuous control wiring from device to device with no splices unless otherwise indicated. Permanently mark all wires entering or leaving control cabinets, boxes, and devices and terminate on screw terminals. Ensure marking is consistent throughout the fire alarm system and is the same as the identification shown on the connection drawings.

Ensure wire labels correspond to the approved connection drawings and use a method indicating the destination of the other end of the wire. Provide labels in control panel equipment or between fire alarm terminal cabinets which indicate the destination of the other end by cabinet designation-terminal strip designation-terminal number. Provide labels in fire alarm terminal cabinets indicating connection in control panel equipment by fire alarm cabinet designation-module identifier-module terminal strip identifier-terminal number. Provide conductor labels with legible machine-printed black lettering on white background using indelible ink. Ensure labels are heat shrink or wrap around type.

3.1.5 Conduit and Raceways

Minimum size for fire alarm system initiating, notification, signaling line and control circuit conduits and raceways is 12 mm 3/4-inch. Install in accordance with NFPA 70. Ensure all Class A initiating device, signaling line, notification appliance and control circuits use diverse routing in accordance with NFPA 72. Do not run outgoing and return redundant circuit conductors in the same cable assembly, enclosure or raceway except where permitted by NFPA 72.

Install rigid galvanized steel conduit in all hazardous (classified) locations, exterior locations where the conduit is exposed above grade, interior exposed locations from finished floor to 304 mm 1 foot above finished ceiling unless otherwise shown on the drawings. EMT with hexnut expansion gland-type fittings can be installed in all other locations. Use flexible metal conduit, maximum length 1828 mm 6 feet, as the final connecting raceway to a fire alarm device mounted on vibrating equipment or on a suspended ceiling.

Where devices, junction boxes, and cabinets are installed outdoors, arrange conduit systems to drain away from the box; ensure conduit enters the box side or bottom only and drain type fittings are installed.

Use schedule 80 PVC for conduit direct buried in earth. Ensure that portions of underground raceway systems that penetrate above finished grade are rigid, galvanized, heavy-wall steel conduit with a 40-mil PVC coating or painted with a bitumastic compound.

Conceal all conduit in interior finished areas. Ensure conduit installed in a vertical position is parallel with walls and perpendicular with the floor and ceiling, and that conduit installed in a horizontal position is parallel with the floor and ceiling and perpendicular to the walls. Make changes in direction of runs with symmetrical bends. For bends of over 25 mm 1-inch in diameter, provide factory made elbows.

3.1.6 Firestopping

Seal all fire rated pipe network penetrations of floors, ceilings and walls. Fire-stop UL Fire Resistance all sampling pipe passing through fire-resistant rated walls, floors, ceilings, in a manner that maintains the integrity of the fire-resistant rating of the wall, floor or ceiling. Weather seal all pipe penetrations passing through non-fire rated wall/equipment enclosure.

3.1.7 Labeling

Provide red background with white lettering smoke detector labels that are plastic or phenolic type with a minimum of 6 millimeter 0.25-inch block lettering to indicate zone detector. For example: "ASDS No. 1".

Clearly label pipe network every 1.5 meter 5 feet to distinguish the pipe from other facility pipe work or protective cabling enclosures. For example: "CAUTION SMOKE DETECTION SAMPLING TUBE DO NOT REMOVE, PAINT, OR DISTURB."

Label all air sampling points with a round red label, each with a center hole to match the diameter of the drilled sampling point. For example: "FIRE DETECTION SYSTEM DO NOT PAINT". Indicate fractional dimensions in decimal format with a minimum of 3[_____] decimal places.

3.2 FIELD TESTING

After complete installation of the equipment and at such time as directed by the Contracting Officer, conduct tests to demonstrate that the installation requirements of this specification have been met and that the sequential functions of the system comply with the requirements specified herein. Perform the Tests covered in the following paragraphs in three parts:

a. Contractor Checkout - Perform this test to remove all troubles, ground faults, ensure all devices are fully functional and operational, and test the programming to ensure the installation meets the contract drawings and specifications, including reporting.

****
NOTE: Delete the following requirement if the installation is for a new fire alarm system
****

For modification and rehabilitation work, the Contractor is not responsible for existing troubles and ground faults that are not in contract scope. Clearly convey the existing troubles and ground faults that are not in contract scope in the Transfer of Responsibility form. Submit a draft of NFPA 72 Fire Alarm System Record of Completion.

b. Preliminary - Perform this test using the approved test procedure and witnessed by the Government construction inspectors. Verify ASDS drawings against the system installed, annotate all red-lines, and summarize on a single set of drawings. Follow the test procedures as written and annotate all red-lines on a single Test Procedure. Secure the initials and date on the summarized set of drawings and test procedures from the construction inspector and the fire alarm vendor. The Preliminary test is not considered complete until all steps in the test procedure have been satisfactorily completed. This includes any

additional steps required to complete 100 percent testing of the fire alarm system and its associated functionality.

c. Final Acceptance - After the successful completion of the preliminary test, schedule a Final Acceptance test. Incorporate the final acceptance test procedure and record drawings including all red lines from the preliminary test. Provide a copy of the consolidated redlines for the record drawings and preliminary test procedures from the preliminary test. Ensure the Contracting Officer, System Engineer, and the Authority Having Jurisdiction or their designee(s) witness the final acceptance test for the ASDS. Prior to test start, on-site, conduct a line by line review that proves all issues found during the preliminary test have been incorporated. During the Final Acceptance Test, provide five corrected as-built drawings and Final Acceptance Test Procedures for use in conducting the final acceptance test. Upon completion of the Final Acceptance Test, provide the following documentation to the Contracting Officer; a copy of the Final Acceptance Test procedure (with all steps annotated as complete), a corrected set of as-built drawings and a signed and completed NFPA 72 Fire Alarm System Record of Completion form.

3.2.1 External System Wiring

Perform the following tests on the external system wiring before connection to the control panel:

Loop Resistance Tests: Measure and record the resistance of each circuit with each pair of conductors in the circuit short-circuited at the farthest point from the circuit origin. Ensure that the tests are witnessed by the Contracting Officer and that test results are recorded for use at the Final Acceptance Test.

Megger Tests: After wiring has been installed, and connections to panels or devices, megger test wiring for insulation resistance, grounds, and/or shorts. Test conductors with 300 volt rated insulation at a minimum of 250 V dc. Ensure that the tests are witnessed by the Contracting Officer and that the test results are recorded for use at the Final Acceptance Test.

Check continuity of circuits with an ohmmeter. Insert temporary jumpers in appropriate sockets of missing detectors and install the end-of line resistor when this test is performed. Verify resistance reading for each circuit is the value of the end-of-line resistor, plus or minus 10 percent.

Check each wire for grounds with 300-volt and 500-volt insulation resistance test set. Ensure resistance to ground is not less than 20 megohms. Isolate each wire tested from ground, with all other wires within the same conduit grounded. Verify that the conduit system is grounded prior to insulation resistance testing by verifying a short circuit between the conduit and earth ground.

Submit Continuity Test Report and Insulation Resistance Test Report.

3.2.2 ASDS Acceptance Test Procedures

Subject each zone of every ASDS to a full operational test in the presence of the Contracting Officer to demonstrate proper operation before any system is considered acceptable. Acceptance criteria for ASDS include the

measurements and tests for each detector and its entire sampling pipe network. The approved operational test procedure submitted by the subcontractor for the ASDS includes the following tests:

3.2.2.1 Suction Pressure Test

Measure, record, and compare pressure at all sampling points, except the end cap port to APPROVED Design Calculations. Verify the suction pressure is within the manufacturer's specified range. Measure the pressure in inches of water or pascals.

3.2.2.2 Smoke Transport Time Test

Measure and record the time required for smoke to travel from the most remote sampling point in each air sampling piping network to the detector, and compared to APPROVED Design Calculations. Determine this TIME on each branch line individually by introducing a "gross" smoke source into the sampling point which is hydraulically most remote from the detector. The TIME from the beginning of smoke introduction until the bar-graph on the display reflects the presence of smoke in the detector is the Transport Time. The MAXIMUM ALLOWABLE Transport Time is [60] [120] seconds.

3.2.2.3 Deviations

If the measured and recorded results significantly differ from the measurement predicted by the APPROVED Design Calculations, determine and correct the cause of deviation. If the cause is a difference between the system as built and the system as designed, resubmit revised shop drawings and calculations for approval to the Contracting Officer. If the revised drawings and calculations agree with measured results, the system is considered acceptable provided that all other provisions of this specification have been met.

[3.2.2.4 Sensitivity Verification Test

This test is a month long (30 day minimum) test for all detection system installations. Each air sampling piping network by zone is subjected to this test before the system is considered acceptable. The purpose of this test is to ensure that the earliest possible alarm for smoke is rendered with the fewest number of false alarms. This is considered mandatory due to the fact that the ambient levels of dust or other air borne particulate which the detector senses as smoke varies from building to building or room to room within a given building or area.

a. Implement proper test procedures and data analysis to eliminate all false alarms from transient dust or smoke which can become airborne due to installation activity, cleaning and/or normal operations.

b. During the period while the sensitivity verification test is being conducted, ensure normal operations continue unaltered within the area being protected. Verify that the FACP monitors the ASDS. The FACP is to only transmit supervisory and trouble conditions to the KSC Central Radio Monitoring Station (CRMS). During this trial period, a successful test has the ASDS not activate any automatic suppression systems or cause a facility evacuation.

c. After the ASDS has been installed and all acceptance tests successfully conducted, maintain the event log and the smoke level history log for a period of not less than (30) calendar days.

d. Conduct data review and analysis after (7) calendar days of operation to identify any gross trends, and again at the end of (30) calendar days of operation. Additional interim analysis can be required depending on the results of the first week review.

e. During data review and analysis consider the normal base line, or ambient, pollutant level recorded, and all deviations from the established base line as recorded by the data logger from the detector.

(1) Compare the level of the ambient base line with the alarm threshold levels selected. Twenty percent is the minimum acceptable range between the ambient base line and the first alarm threshold of the detector's full-scale sensitivity calibration setting.

(2) Investigate each peak recorded to determine its cause. Analyze and consider whether the peak recurrence is at regular intervals, or whether it is a single event. Recurring peaks are usually related to activities within the protected area. Non-recurring peaks are generally the results of other types of activities, including fires. Consideration of normal activity within the fire zone, the time of day, and day of the week can be of assistance in determining the cause of a peak.

(3) Compare the magnitude and duration of the recorded peaks to the alarm threshold levels selected and initial time delay settings to determine the possible occurrence of a false alarm.

(4) Based on the data review, make adjustments to alarm levels and time delay settings, as required to eliminate false alarms.

(5) Peaks or alarms that are attributed to smoking in the protected area ARE NOT considered to be false alarms. Specifically configure the ASDS to alarm when smoking takes place within the protected area.

(6) Change detector sensitivity if data indicates that the adjustments to the alarm threshold levels and the time delay settings do not eliminate false alarms. If the false alarms cannot be eliminated, provide alternative solutions to the Contracting Officer for approval and implementation.

Fully document any change to the initial settings as prescribed by this specification with supportive analysis and review data and submitted by the manufacturers to the Contracting Officer for approval.

][3.2.2.5 Smoke Test

Provide all required testing tools, equipment, materials to complete all tests of the ASDS.

Introduce smoke at the furthest sampling point and demonstrate transport time meets requirements herein, and as specified by manufacturer pipe network design software (ASPIRE).

Perform smoke test in the vicinity of possible fires. For example: at equipment heights 1 to 1.5 meter 3 to 5 feet above the finished floor. Repeat the test in different locations within each protected zone under

normal and abnormal operating conditions of the HVAC system. This ensures that the smoke source in both a high and still air flow environment have been addressed.

]3.3 Reacceptance System Tests

Perform reacceptance testing after system components are added or deleted; after any modification, repair, or adjustment to system hardware or wiring; or after any change to software. Test all components, circuits, systems operations, or site specific software functions known to be affected by the change or identified by a means that indicates the system operational changes are 100 percent tested. In addition, also test 10 percent of the initiating devices (maximum of 50 devices) that are not directly affected by the change and verify proper system operation.

Changes to all control units connected or controlled by the system executive software require a 10 percent functional test of the system, including a test of at least one device on each input and output circuit to verify proper system operation.

Upon completion of the modification, functionally test the existing devices that were reinstalled and test the devices that are on both sides of the point of connection of the new devices. Test all newly installed devices in accordance with the paragraph titled, "ASDS Acceptance Test Procedures" of this section.

After final acceptance testing has been successfully completed, submit test data under the terms of the "GENERAL REQUIREMENTS" clause of this contract.

3.4 PAINTING

Paint all ASDS conduit fittings, junction boxes, and junction box covers red, Color No. 11105 in accordance with FED-STD-595. Mark conduit with a minimum 2.54 cm 1-inch wide band every 6.1 m 20 feet. Alternative compliant method is to use red-colored EMT conduit that is hot-galvanized for durability with a red top coat. If the alternative method is selected, none of the conduit fittings, junction boxes, or junction box covers are required to be painted.

-- End of Section --