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5 Feb 2026

From: Chief Engineer, Naval Facilities Engineering Systems Command

Subj: ACCEPTABLE DESIGN CRITERIA FOR LOW LEVEL FIRE PROTECTION IN NAVY AND MARINE CORPS AIRCRAFT HANGAR FACILITIES

Ref: (a) National Defense Authorization Act for Fiscal Year 2020 (NDAA FY20)
(b) Assistant Secretary of the Navy (Energy, Installations and Environment) Sundown Policy for Foam-Based Fire Suppression Systems in Department of Navy Hangars, 7 AUG 2024
(c) Assistant Secretary of Defense Memorandum, Guidance for the Change Out from Aqueous Film Forming Foam to Fluorine-Free Firefighting Systems in Facilities, 30 Jul 24
(d) UFC 3-601-02, Fire Protection Systems Inspection, Testing, and Maintenance, 7 Oct 21
(e) UFC 4-211-01, Aircraft Maintenance Hangars, Change Three, 3 Apr 21
(f) UFC 3-460-01, Design: Petroleum Fuel Facilities, Change One, 12 Jan 22
(g) UFC 3-600-01, Fire Protection Engineering for Facilities, Change Six, 6 May 21
(h) NFPA 409, Standard on Aircraft Hangars, 2022 Edition

Encl: (1) ILDFA Introduction, Background, and Coverage Diagrams, Water Flushing Nozzle Layout Diagram
(2) UFGS 13 50 00, Ignitable Liquid Drainage Floor Assemblies

1. Purpose. This ITG provides requirements for acceptable low level fire protection for flammable liquid fires in Navy and Marine Corps aircraft hangars.

2. Cancellation. This ITG cancels and supersedes ITG FY23-02.1, Navy and Marine Corps Facilities with Aqueous Film Forming Foam (AFFF) Fire Suppression Systems, dated 26 July 2023.

3. Background.

a. Reference (a) prohibits the purchase of fluorinated AFFF concentrate that contains in excess of one part per billion of per- and polyfluoroalkyl (PFAS) after 1 OCT 2023. The two one-year extensions for the use of AFFF have been exercised by the Secretary of Defense, establishing a final removal date for all AFFF no later than 30 September 2026.

b. Reference (b) details the requirements to sundown foam-based Fire Suppression Systems (FSS) in Department of Navy (DoN) and United State Marine Corps (USMC) hangars. The memo requires immediate action to cease operations of installed foam FSS and permanent installation of a code compliant solution.

4. Discussion.

a. To provide acceptable fire protection for DoN aircraft hangars, one of the following

approved options must be implemented: 1) a combination of an automatic sprinkler system and an Ignitable Liquid Drainage Floor Assembly (ILDFA), 2) a combination of an automatic sprinkler system and a low-level water-based flushing nozzle system, or 3) an automatic overhead water sprinkler system for hangars housing only unfueled aircraft. A low-level Fluorine-Free Foam (F3) grate nozzle system is a fourth code compliant solution for DoN aircraft hangars. However, per reference (b), this system can only be used under certain conditions, and its use must be approved by the Assistant Secretary of the Navy for Energy, Installations, and Environment, ASN(EI&E). If conditions warrant, the NAVFAC HQ Chief Engineer (CHENG) will request the necessary approvals from ASN(EI&E).

b. As part of the initiative to phase out the use of AFFF, the Navy is developing a new low-level, water-based flushing nozzle system engineered to meet the design criteria outlined in NFPA 409. Ongoing testing, modeling, and analysis indicate that the system will perform at a level equivalent to the requirements in NFPA 409. The technical aspects of this system are contained in this Interim Technical Guidance (ITG) to provide design parameters for Architects and Engineers to use in designing FSS for DoN aircraft hangars.

c. Further development is underway for a flame arrester attachment for use with the currently specified cast iron trench grate covers. An amendment to this ITG or separate guidance will be provided when the trench grate cover flame arrester development is complete and ready for installation. Following the completion of this modification to include the flame arrester attachment on trench grate covers, the Navy will conduct a subsequent round of full-scale testing to validate the overall system performance. Final testing and analysis are scheduled for completion in the summer of 2026. Trench cover requirements are provided in the technical section of this document. The flame arrester installation will only require a minor modification to the specified trench grate covers which can be implemented in the field before or after grate installation.

d. The low-level, water-based flushing nozzle system utilizes much of the same infrastructure as the legacy low-level AFFF grate nozzle system. In the unlikely event that final testing does not validate performance equivalency with NFPA 409 requirements, the design will be converted to a low-level F3 grate nozzle system. Should this change become necessary, NAVFAC HQ will coordinate with the ASN(EI&E) to obtain the necessary approval for use of a foam FSS.

e. Until the final testing validates performance equivalency with NFPA 409, authorization to use the water-flushing system as specified herein must be granted by the NAVFAC HQ CHENG on a per-project basis. When installing the low-level, water-based flushing nozzle system prior to its final testing and NFPA 409 equivalency validation, the low-level F3 grate nozzle system is the associated code compliant solution that will be implemented in the unlikely event that the water based system equivalency is not validated. Therefore, the system should be designed to provide the ability to shift to a low-level F3 system. A waiver, approved by the NAVFAC HQ CHENG, to omit the foam components of a traditional system is required and should accompany the request

for approval to use the low-level water system in advance of final system equivalency validation. The NAVFAC project team must formally communicate the associated risks to the project, including potential cost and schedule impacts, should a conversion to a low-level F3 system be required. A design change to an F3 system would necessitate modifications to nozzle type and the addition and installation of foam storage tanks, foam inductors, and a containment system.

f. Two pilot projects using the prototype water flushing nozzle system are currently under construction in the Southwest region. These projects have already received HQ CHENG approval and the backup F3 system has been approved by ASN(EI&E). This ITG documents formal approval for those pilot projects.

5. Applicability. This ITG is effective until 1 FEB 2027 or superseded by additional guidance, and applies to new (i.e. in planning, design, or construction) Navy and Marine Corps facilities that house fueled aircraft.

6. Action. The strategies described below are presented as options for providing a protected facility housing aircraft.

a. New facilities must comply with one of the following code compliant solutions as described above and detailed by this ITG:

i. (a) ILDFA

ii. (b) Water Flushing Nozzle

iii. (c) Defueled Aircraft

7. Technical Criteria.

a. ILDFA:

i. ILDFA is a fire protection system and will be designed, installed, and tested under the oversight of a Fire Protection Engineer. Before selecting or designing an ILDFA system, consider all customer mission requirements which may prohibit or alter the design requirements of the ILDFA such as radar verification equipment, direct infrared countermeasure alignment, or other emerging technology. Design the ILDFA system in compliance with this ITG and applicable UFCs, FM Data Sheet 7-93, and NFPA 409. Design the system to control an ignitable liquid fire in an industrial hangar environment with aircraft maintenance, aircraft washing, corrosive materials, and electrical hazards. Design the ILDFA for environmental conditions such as humidity, solar (heat and glare), and consider the potential for exposure to freezing temperatures and impact to flushing water, residual trench water, waterflow detection, and other sensitive systems. ILDFA systems must be capable of activation with a fluid spill of 400 gpm (1,515 L/min) within 60 seconds, and 50 gpm (190 L/min) within 120

seconds. A supply pump is required if there is not sufficient pressure from the water supply to satisfy system demand. A flushing supply tank is required if there is insufficient water flow rate to meet system demand. ILDFA discharge must either flow by gravity or be pumped from the trench to the approved point of disposal or containment.

ii. Refer to Annex A, Section 1.0 for an introduction and background information, and Section 2.0 for relevant Unified Facilities Guide Specifications (UFGS). Due to the complexity involved in these delegated designs, it is recommended the designer of record contact an ILDFA manufacturer during design to fully coordinate and integrate the system.

iii. Location. When a hangar employs ILDFA, the space below the surface of the floor must be considered Class I, Division 1, in accordance with NFPA 70, and the electrical systems must be designated for the appropriate Class and Division. Recess the ILDFA system into hangar floors to provide level transition between adjacent floors in all new construction. For existing hangar floors recess in a new slab on grade, install directly on top of the hangar bay floor with level transitions or ramps on all sides, or as approved by the AHJ based upon project specific parameters. The ILDFA must be in continuous contact with the concrete slab and sloped to match the slope of the hangar bay floor slab. For existing hangar bay floor slabs that are not being demolished, modifications to slab slope and/or use of shims are permitted if proven acceptable through structural analysis of the existing slab and design by the Structural Engineer of Record. Coordinate with the ILDFA system manufacturer for compatibility with required floor design, slope, and flatness criteria.

iv. Obstructions. The ILDFA system must accommodate floor obstructions such as grounding locations, utility pits or pedestals, utility trenches and penetrations, tie down points, aircraft grounding points, and structure interferences. The ILDFA system must permit the opening of, and access to, all pits, trenches, utilities, aircraft grounding points, and tie down points without disabling or disassembling the ILDFA.

v. Ramps. Ramps are only permitted when installing ILDFA over an existing concrete slab and may only exist outside of the required full (or partial) ILDFA coverage area. Ramps may not interfere with perimeter egress paths, emergency equipment, or maintenance areas. Slope of ramps shall be compatible with aircraft, vehicle, and cart traffic. Where ramps or transition plates are utilized, provide the same finish as the ILDFA floor. Design all ramp and transition plates to meet the same structural strength requirements as the ILDFA. Include built-in thermal expansion in the design and installation.

vi. Finishes. Provide permanent striping and markings as described in this ITG and applicable UFCs. The ILDFA surface must be a non-reflective brushed metal finish. Consider solar glare at East, South, and West facing hangar bays or

hangars that have bays that open from both sides. Minimize solar glare interference with maintenance operations in accordance with solar glare analysis in 2-16. Provide slip resistant surface in accordance with third-party certified testing in accordance with ANSI B101.1 with wet and dry static coefficient of friction (SCOF) between 0.6 and 1.0 for traction. Provide options for knurling for increased slip resistance at User request.

vii. ILDFA Performance.

1. Provide an ILDFA floor surface including ramps that match the durability of the concrete slab under frequent large tool, part drops, and forklift traffic with pallet impacts.
2. Design the ILDFA system structurally such that fatigue life of the ILDFA is greater than the expected building life assuming design loading cycles and stresses.
3. Provide means to accommodate thermal variations for expansion and contraction of the ILDFA.
4. The ILDFA floor must not shift under vehicle loads and include features to prevent foreign object debris (FOD).
5. Do not reduce overall concrete slab thickness for ILDFA depressed slab. Define ILDFA tolerances for overall dimensions of the depressed area of slab.

viii. Additional ILDFA Requirements for Existing Construction. Install ILDFA on floors uniformly sloping towards the hangar door with continuous floor support where possible. Shims are only permitted for use with existing slabs when structural analysis and ILDFA manufacturer both permit. Material used for the purposes of shimming existing slabs to modify the slope of the ILDFA relative to the existing hangar slab, shall be fixed in place by chemical bonding agents or mechanical fixtures. Reslope floors where shims of 3 in. (76.2 mm) or greater are required. Do not exceed a shim spacing of 12 in. (0.3 m) on center and reduce spacing as required by ILDFA manufacturer's installation requirements. Where shims are used, structural calculations accounting for ILDFA material strength and concrete slab strength must be provided with requirements on maximum shim spacing (frequency) and material type.

ix. Strength and Durability. Specify that the manufacturer must provide an ILDFA system, including trench covers and grates, capable of supporting all hangar bay loads required by this UFC and the FRD, uniform loads, wheel loads, aircraft loads, jack loads, dynamic or impact loads without fatigue or loss of strength in accordance with established, recognized standards for the material utilized. Design to accommodate temperature changes and associated movement of the ILDFA system. Structural components of the ILDFA system, including floor panels, trench covers, and grating must be designed to support all specified loads. Cyclical loading and fatigue must be avoided by staying below the stress limits. Design will incorporate the effects of cyclic loading. The designated load

quantity of load cycles will be identified by the user and specified by the A/E.

x. ILDFA Zoning. Provide zoning and controls, such that no more than four zones of a maximum 1,320 sq. ft. (122.6- sq. m), can be triggered or activated. Each zone must have its own liquid detection sensor, flushing water distribution device, and control valve. When a spill occurs, only the flushing manifolds that detect a spill must activate. Design fuel spill is 18 ft. (4.9 m) lateral distance (horizontal radius) from the spill location unless FM 6090 requires larger area.

xi. ILDFA Water Supply. Water supply for the ILDFA varies based upon location and Installation; connect to a water supply source approved by the AHJ. Provide a dedicated backflow preventer for the ILDFA system ahead of all ILDFA components. Connect the ILDFA system to the domestic water supply upstream of the facility water meter, to the facility sprinkler water supply upstream of the sprinkler backflow preventer, or to a continuously maintained dedicated nonpotable water source, such as a flushing supply tank or water recycle system. If the ILDFA supply is connected to the domestic water or sprinkler lead-in, include 50 gpm flushing flow rate to flow calculations. ILDFA system requires a minimum of 100 psi (690 kPa) at the discharge of the water supply pump and 50 psi (15.2 kPa) at each nozzle at its design flow rate, in accordance with the manufacturer's calculations. Provide a minimum 3-inch (75 mm) water line. Where the water supply does not provide the required flow and pressure, provide a pump and/or tank in a dedicated room. Design in accordance with FM 6090, including minimum 50 gpm (190 L/min) flushing per zone and a minimum of four zones activated at a single time for a 200 gpm (760 L/min) flushing rate. Design flushing water supply for 60-minute duration.

xii. ILDFA Flushing Supply Pump. The pump must be an FM Approved booster pump installed with a listed pump controller. Pump must be in a dedicated room separated by 1-hour fire barriers. In areas with 99% winter, design temperatures below 32 °F (0.0 C), or where heating systems cannot be maintained above 40 °F (4.4 C), provide a heated room or enclosure for water supply, supply pump, and a dry pipe or preaction valve, in accordance with NFPA 13. The ILDFA control panel must monitor pump room or enclosure temperature.

xiii. Manifold Flow Monitoring. Monitor flushing manifold supply piping by a flow meter which is monitored by the ILDFA control panel.

xiv. ILDFA Control Panel. UL 698A, UL 508A, FM Approved, and appropriate for use in an ILDFA system. Provide controls listed by a Nationally Recognized Testing Laboratory (NRTL).

1. Control System Features. Control systems must provide the following features, at a minimum:

a. Fully Automatic Operation with alarms when the system detects a design spill.

b. Emergency Manual Operation with alarm (one for each zone if there are multiple zones) and an automatic return to Fully Automatic after an adjustable time delay.

c. Manual Cleaning Mode Operation without alarms with adjustable run time (one for each zone if there are multiple zones) and an automatic return to Fully Automatic after an adjustable time delay.

d. Temporary Off Mode for washing of aircraft or similar wet functions with an automatic return to Fully Automatic after an adjustable time delay.

e. Test Mode to test each zones' sensors and flow with an automatic return to Fully Automatic after an adjustable time delay following testing.

f. All operating features must be double action (for example, lift cover then push, or turn to pull, or two buttons/selections in an HMI).

g. The Control Panel must provide a real time display of current liquid detection and system status, at all liquid detection sensors.

h. Provide Manual Start and Stop stations. The signage wording must read "FLOOR SPILL SYSTEM".

i. Standby power supply must be capable of operating the system for 48 hours standby, and 30 minutes operation after failure of primary power supply.

2. Liquid Detection Sensors. Liquid detection sensors must be UL listed or FM approved for both hydrocarbon and water detection, and for Class I, Division 1, and wet locations, and must monitor continuously and automatically. Sensors must activate within 60 seconds at a minimum spill rate of 400 gpm (1,514 L/min) or within 120 seconds at a minimum spill rate of 50 gpm (189 L/min).

xv. ILDFA Discharge Trenches. Hydraulically design the discharge trench system to accommodate floor rinse water at 200 gpm (758 L/min) plus full flow from the fuel dump valve without overflowing the trench. To allow for sufficient space for maintenance in the trench, increase the volume of the trench by the volume of non-ILDFA piping. Trench must be wide enough to accommodate piping,

elbows, tees, and drain valves. Provide minimum 12 in. (0.3 m) wide by 16 in. (0.4 m) deep trenches parallel to the hangar door and perpendicular to the floor slope, with maximum spacing of 40 ft. (12.2 m) on center. An ILDFA trench may serve as the required interior hangar door trench if located along the entire interior of the hangar doors and if it collects drainage from the hangar door rails or pits. Increase trench free area (width or depth) if piping or duct systems other than those serving the ILDFA are installed in drainage trenches. Trench must be designed to accept full design flow without overflowing the trench. To allow for sufficient space for maintenance in the trench, consider the volume of piping within the trenches and the turning radii of the fittings in the design. Provide non-conductive isolation materials such as fluoroelastomer or bituminous coatings and dielectric unions for prevention of galvanic corrosion when aluminum ILDFA components contact dissimilar metals such as cast iron or carbon steel trench components.

1. ILDFA Trench Drain Collection System Flushing Water Volumetric Flow Rate. If the hangar floor slopes uniformly towards the hangar door, the trench drain collection system will collect volumetric flow rate of the design fuel spill, plus the flushing flow rate of four adjacent 1,320 sq. ft. (122.6 sq. m) maximum area zones. For existing hangars, if the hangar floor does not slope uniformly to the hangar door, the trench drain collection system will collect the volumetric flow rate of the fuel spill, the flushing flow rate of four adjacent zones, and the design overhead sprinkler discharge over the four adjacent ILDFA zoned, plus 500 gpm (1,893 L/min) outside hose stream. Classify volume inside trench and below grade as Class I, Division 1 in accordance with NFPA 70.

    a. Wash Bay. Design trench drain collection systems and discharge/containment for the wash bay floor rate and volume. If the wash apparatus is not designed to shut down on activation of the ILDFA, the trench drain collection system must be designed to remove both the wash system flow rate plus the ILDFA flushing flow rate.

2. ILDFA Trench Arrangement. Slope drainage trench inverts at a minimum of 1.0% plus or minus 0.5%, towards the out-fall points from the drainage trench. Capture oily wastewater contaminants from the hangar bay door trench system, as directed by the office overseeing environmental policy for the installation using an oil-water separator or other approved methods.

3. ILDFA Trench Discharge. Slope trenches to discharge by gravity and discharge from the trenches via gravity or effluent pump. Comply with the Installation’s environmental policy for trench discharge. Where drainage from flushing and fuel spill is to be pumped, size the trench and underground piping system to accommodate the anticipated flushing

volume of water plus the volume of the largest anticipated fuel bladder or tank that could spill into the ILDFA. This calculation assumes the effluent pumps do not operate, and spillage occurs in a single zone.

a. Effluent Discharge Options. Direct trench discharge to a location outside the building. Coordinate with the installation environmental office, the Publically Owned Treatment Works (POTW), and the POTW's National Pollutant Discharge Elimination System permit to determine an acceptable discharge solution, considering the following options or combination of options:

i. Discharge into an industrial wastewater collection system.

ii. Discharge to an oil-water separator that has the ability to separate and store the maximum fuel spill (rate and capacity) before releasing to an industrial wastewater collection system, domestic wastewater collection system, or water recycle system.

iii. Discharge to a containment tank for holding and testing. Containment tank to be manually pumped for removal and/or connect to a subsequent system for controlled release after testing or to a water recycle system.

b. Oil-Water Separator. Design the oil-water separator for the maximum potential design flow rate of the ILDFA system. This consists of 200 gallons (757 liters) per minute ILDFA flushing water plus the maximum fuel dump valve (200 gpm (757 liters per minute) for a small aircraft and 400 gallons (1514 liters) per minute for a large aircraft in accordance with NFPA 409) plus ILDFA cleaning mode wash rate if not automatically shut down when the ILDFA is activated, or as approved by the AHJ.

xvi. ILDFA Effluent Pump and Controller. Effluent pump (where required): Provide effluent pumps rated for Class I, Division 2 environments and for pumping hydrocarbon type liquids, supplied by the ILDFA manufacturer, capable of passing material not less than 0.375 in. (10 mm). Provide skid mounted centrifugal pumps resistant to chemicals used in the hangar and for pumping fuel, water, and fuel/water solution, sized for the design discharge rate, and with a welded aluminum bollard frame. Locate in an enclosure protected from freezing, near the containment tank. Locate skid and piping outside the hangar or inside the hangar bay but outside the aircraft clear zone, and without obstructing circulation at the perimeter of the hangar bay.

xvii. ILDFA Containment Tanks. When trench discharge does not leave through an

oil-water separator, sanitary sewer, industrial sewer, or requires containment, provide an ILDFA containment tank. Design containment tank for pumped or gravity flow trench discharge. Underground tanks must comply with UL 1316 and must be double walled. Aboveground tanks must comply with UL 142 or UL 2085. Comply with the installation's environmental policy for above or below grade discharge tanks. Provide a minimum 15,000 gallon (56,800 liters) capacity containment and remote containment monitoring with level sensors for low level alarm (minimum 20%) and high level (critical) alarm for use in a Class I, Division 1 location. Optical level sensors are not allowed.

xviii. ILDFA Water Recycle System. Where water is not readily available, when life-cycle-cost effective (LCCE), or when required by country, state, local, or environmental regulations, provide ILDFA water recycle system to recycle effluent discharge water to be reused for flushing water. An oil-water separator, UV filter, particulate filter, carbon filter, recycle pump, and control panel may be required for the recycle system. Provide a flushing tank with makeup water and level alarms with an ILDFA supply pump in a dedicated space to provide the required pressure and flow to the ILDFA system. Water recycle system panel troubles and battery calculations must be the same as, and report to, the ILDFA control panel.

xix. ILDFA Pipe Labeling. Mark all exposed interior piping with plastic wrap-type pipe labels, conforming to ASME and ANSI A13.1, Scheme for the Identification of Piping Systems. Indicate the type of fluid carried and direction of flow. Labels that stick-on (adhesive backed) or are held on with straps or adhesive tape, are not permitted. Labels are not required on piping routed below the floor line in trenches or pits. At a minimum, the following labels are required:

1. ILDFA SUPPLY – used on ILDFA supply piping downstream of backflow preventer or supply pump.

2. ILDFA EFFLUENT – used on ILDFA piping downstream of trench.

xx. Fire Alarm Interface.

1. ILDFA Monitoring

a. ILDFA activation alarms are local alarms, not connected to the building fire alarm control panel.

b. Provide a tamper switch on the main water supply to the ILDFA system that is monitored by the building FACP, programed as a supervisory signal.

2. Triple Infrared (IR) Optical Flame Detectors

a. Provide triple infrared (IR) optical flame detectors listed/approved for the expected fuel hazards in the hangar bay to be used for early warning of a fire. Tis detection is in no way tied into the ILDFA system. Provide detectors that are verified by an independent 3rd party testing service to be immune to radar and radio frequency emissions from handheld equipment or equipment on-board the aircraft as identified in NFPA 409 Annex C. Provide shielded circuiting for both the Signaling Line Circuit (SLC) and power circuit supplying the optical detectors.

b. Flame detectors in hangars protected by ILDFA are required to be tied to the building fire alarm control panel (FACP). Flame detectors must be individually addressed.

c. Provide single coverage flame detection across the hangar bay designed in accordance with NFPA 72.

xxi. ILDFA Acceptance Testing and Commissioning. The ILDFA design and installation must be under the supervision of the Fire Protection Quality Control Specialist, who is part of the Contractor's Quality Control Team, as specified in UFGS 01 45 00. Provide NFPA 409 recommended system documentation and acceptance testing of system controls. Provide integrated testing of interconnected systems, in accordance with NFPA 4. All system functions and controls must be tested. Test ILDFA supply piping, pumps, manifolds, solenoids, effluent components, and all other equipment to confirm they function as intended. Provide system documentation indicating test results and system set points in Operations and Maintenance (O&M) Manuals.

b. Water Flushing Nozzle.

i. Low-Level Water-Only Flushing Nozzle System: Design and construct a low-level water-only flushing nozzle system in accordance with the requirements herein.

1. Provide a low-level water-only flushing nozzle system at the peak of the hangar bay floor slope to move hazardous fuels from the hangar bay floor to the trench drainage and containment system.

2. Provide a "four-way-fall grading scheme" hangar bay floor in accordance with reference (e) and the below.

a. Provide a minimum 0.5% slope toward the hangar bay trench drains

3. Provide hangar bay trenches in accordance with UFC 4-211-01 (e).

4. Provide a single peak trench within each aircraft parking bay provided.

    a. The peak trench shall be located at the highest point of the hangar bay floor and contain the low-level water-only flushing nozzles and associated branch piping.
    b. Provide solid trench covers rated for heavy duty aircraft loading in accordance with reference (e) for all areas of the peak trench other than nozzle locations.
    c. Provide standard open ductile iron trench covers for low level (valley) trench drains rated for heavy duty aircraft loading in accordance with reference (e).

5. Provide low-level water-only flushing nozzles as outlined below, refer to enclosure (1):

    a. Provide nozzles such that spacing between each nozzle does not exceed 12 feet 6 inches from nozzle to nozzle.

    b. Provide branchline end nozzle at the end of the peak/ridge. This nozzle shall be within 25 feet of the aircraft parking area trench drain.

    c. Provide nozzles as follows starting furthest from the hangar bay wall/O1 and O2 shops space:

        i. Nozzle 1: Model # PK-180; The minimum flow rate required is 93 GPM at a minimum of 30 PSI.

        ii. Nozzle 2: Model # PK-250. The minimum flow rate required is 90 GPM at a minimum of 30 PSI.

        iii. Nozzle 3: Model # PK-360. The minimum flow rate required is 85 GPM at a minimum of 30 PSI.

        iv. Nozzle 4: Model # PK-70. The minimum flow rate required is 57 GPM at a minimum of 30 PSI.

        v. Nozzle 5: Model # PK-360. The minimum flow rate required is 85 GPM at a minimum of 30 PSI.

        vi. Nozzle 6: Model # PK-250. The minimum flow rate required is 90 GPM at a minimum of 30 PSI.

        vii. Nozzle 7: Model # PK-180. The minimum flow rate required is 93 GPM at a minimum of 30 PSI.

d. Provide zoning such that no more than two low-level water-only flushing nozzle branchlines are supplied by one single flow control valve.

    i. Where possible, collocate all low-level water-only flushing nozzle system control valves and equipment within the fire protection equipment room and not within the hangar bay.

e. Provide zoning controls such that the zone of fire incident activates and only the two immediately adjacent zones activate during a system discharge event, a total of 3 zones activated (area within +/- 100 feet radius of fire).

f. Provide system piping, location of equipment, and zoning such that water delivery time to the most remote low-level water-only flushing nozzle does not exceed 30 seconds.

    i. Provide water delivery time calculations.

g. Provide hydraulic calculations.

    i. Provide calculations based on the flow control valve regulating pressure at the trench so there is no balancing issue with the overhead sprinkler system.

    ii. Provide hydraulic calculations in conjunction with the overhead sprinkler system such that both systems are operating during a fire event. The overhead sprinkler system is required to be calculated in accordance with UFC 4-211-01 (e), paragraph 3-6.15.1.

h. Provide all piping downstream of low-level water-only flushing nozzle flow control valves as follows and in accordance with UFGS 21 13 19:

    i. Provide hot dipped galvanized cut groove schedule 40 piping.

    ii. Provide all low-level water-only flushing nozzle system branch piping pitched with greater than 0.5% slope towards the end of each branchline for drainage.

    iii. Provide each low-level water-only flushing nozzle system branch piping with a pressure test connection located at the most remote point of each branchline.

iv. Provide each low-level water-only flushing nozzle system branch piping with a minimum 1-inch orifice "normally open" flushing valve at the low-point of each branchline.

i. Provide surge suppression for low-level water-only flushing nozzle systems in accordance with UFC 4-211-01 (e), paragraph 3-6.5.

j. Additional system notes:

i. The low-level water-only flushing nozzle systems are not required to be supplied by a Fire Department Connection (FDC), however for ease of installation, the FDC can connect to the main fire water header which may supply the low-level water-only flushing nozzles.

ii. No low-level water-only flushing nozzle system test header is required. Adjustment of flow control valves/systems shall be via flowing of the trench piping.

iii. Flexhead Fire Pipe (FFP) is acceptable on low-level water-only flushing nozzle trench piping provided that it fits in the trench, the bend radius complies with the manufacturer's limitations, and the equivalent length of pipe is included in the calculations.

ii. Releasing System Requirements.

1. Triple Infrared (IR) Optical Flame Detectors.

a. Provide triple infrared (IR) optical flame detectors listed/approved for the expected fuel hazards in the hangar bay. Provide detectors that are verified by an independent 3rd party testing service to be immune to radar and radio frequency emissions from handheld equipment or equipment on-board the aircraft as identified in NFPA 409 Annex C. Provide shielded circuiting for both the Signaling Line Circuit (SLC) and power circuit supplying the optical detectors.

b. Flame detectors in hangars protected by low-level water-only flushing nozzle systems are required to be tied to a releasing service fire alarm control unit (RSFACU). Flame detectors must be individually addressed.

c. Provide flame detection such that each zone has coverage in all

areas from three separate flame detectors. Consult manufacturer recommendations on detector coverage via sight limiters.

d. Provide fire alarm system supervisory signal upon single detector in a single zone activation. Provide low-level water-only flushing nozzle system zone activation upon second detector activation.

e. Provide optical flame detectors around the perimeter of the hangar bay, such that all portions of the hangar bay are within the range and cone-of-vision of at least one detector. Exception: The area of the hangar bay within 5 ft. of the perimeter wall is not required to be within the cone-of-vision of an optical flame detector.

f. Angle detectors and provide manufacture approved blinds (field of view inhibitors) so the cone-of-vision does not extend beyond the hangar doors, or is within the view of hot sources such as radiant heaters. Locate optical flame detectors at a sufficient distance per the manufacturer's recommendations from sources that may cause false alarms such as welding, solar glare, radiant heaters, aircraft engine exhaust, strobes, hot surfaces and other relevant sources.

2. Defueled Aircraft.

a. Defuel all aircraft prior to bringing into the hangar for maintenance or storage. Per reference (f), defueled is defined as an aircraft that has never been fueled or whose fuel system has had flammable or combustible liquid removed to meet one of the following criteria:

i. Individual tanks/cells contain less than 1 percent of their volumetric capacity;

ii. Aircraft is drained to remove fuel to the greatest extent possible utilizing sump drains and other accessible non-maintenance means.

b. Signs are posted around the hangar bay stating “This Hangar Does Not Have a Fire Suppression System rated for fuel fires. All Aircraft Must be Defueled.” Signage and their locations need to be approved in advance by the base Safety Department and meet the requirements of reference (b), figure 1-1.

c. All building personnel must be instructed annually that fueled aircraft cannot be in the hangar because a FSS rated for fuel fires is not installed or active in the hangar. This can be accomplished

Subj: ACCEPTABLE DESIGN CRITERIA FOR LOW LEVEL FIRE PROTECTION IN NAVY AND MARINE CORPS AIRCRAFT HANGAR FACILITIES

as part of a safety brief.

8. Points of Contact: If you have questions or concerns with respect to this ITG, please contact NAVFACSYSCOM technical representatives listed below:

   a. For clarification or additional information related to fire protection systems, Mr. Darryl Nemeth, P.E., NAVFAC Fire Protection Engineering Technical Warrant Holder at telephone (757) 322-4408 or email at darryl.s.nemeth.civ@us.navy.mil.
   b. For clarification or additional information related to hangars, Mr. Scott Herold, P.E., at (757) 322-4294 or scott.t.herold2.civ@us.navy.mil.

S. Keith Hamilton

Digitally signed by S. Keith Hamilton
Date: 2026.02.05 09:27:28 -05'00'

S. KEITH HAMILTON, P.E.
Chief Engineer and Assistant Commander for Planning, Design and Construction

Copy to:
NAVFAC Atlantic
NAVFAC Pacific
NAVFAC Mid-Atlantic
NAVFAC Southeast
NAVFAC Washington
NAVFAC EURAFCENT
NAVFAC Northwest
NAVFAC Southwest
NAVFAC Far East
NAVFAC Hawaii
NAVFAC Marianas
OPNAV N4
CNIC N4
MCICOM GF
DASN (I&F)

Enclosure 1: ILDFA Introduction, Background, and Coverage Diagrams, Water Flushing Nozzle Layout Diagram

1.0 ILDFA Introduction, Background, and Coverage Diagrams

Factory Mutual 6090 describes ILDFA as an ignitable liquid drainage system (that) are a potential solution to eliminate or minimize the effects of ignitable liquid pool fires and/or hazardous liquid spills in commercial and industrial applications. The systems are intended to allow liquids to flow into a flooring section where the liquid is removed and transported to a remote location, ideally before ignition can occur. If the liquid has been ignited, the system will minimize the spill area and reduce the overall size of the fire until the flow of liquid is stopped or extinguished.

The ILDFA system specified in this UFC must cover all areas in which a fuel spill is anticipatable inside the hangar bay. Many hangar bays are designed to permit flexible arrangements of aircraft positions and/or aircraft types. For this reason, full hangar bay coverage of the ILDFA is most often required and is defined as the minimum of the entire hangar bay area no less than 1) from the hangar door trench to the permissible distances from the walls listed in Table 2-1: Minimum Aircraft Maintenance Bay Clearances or 2) the complete boundary of the aircraft clearance area. When permitted by the CFPE or CTR, partial hangar bay coverage of ILDFA may be provided. Partial coverage is defined as a fixed and clearly marked location for a specific aircraft (or series of aircraft parking positions) in which the ILDFA covers all anticipatable fuel spill areas of each aircraft plus an 18-foot radius (as determined from spill volume and height tests on current ILDFA floors).

Figure 1-1: Full Coverage ILDFA

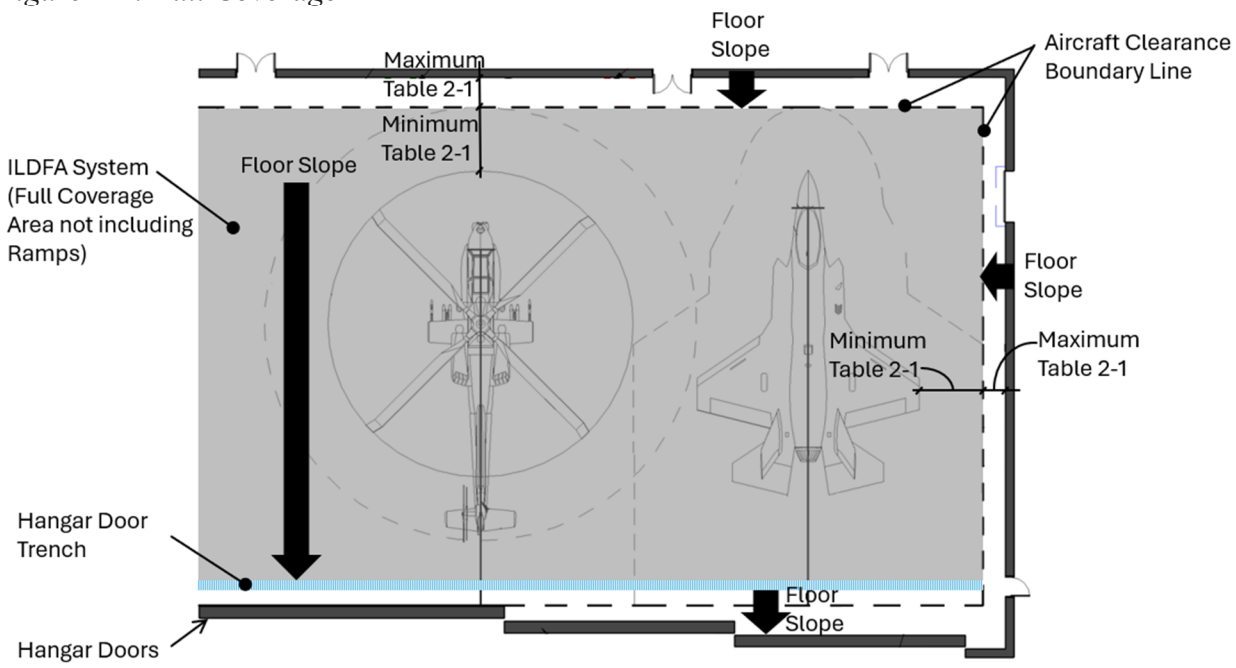
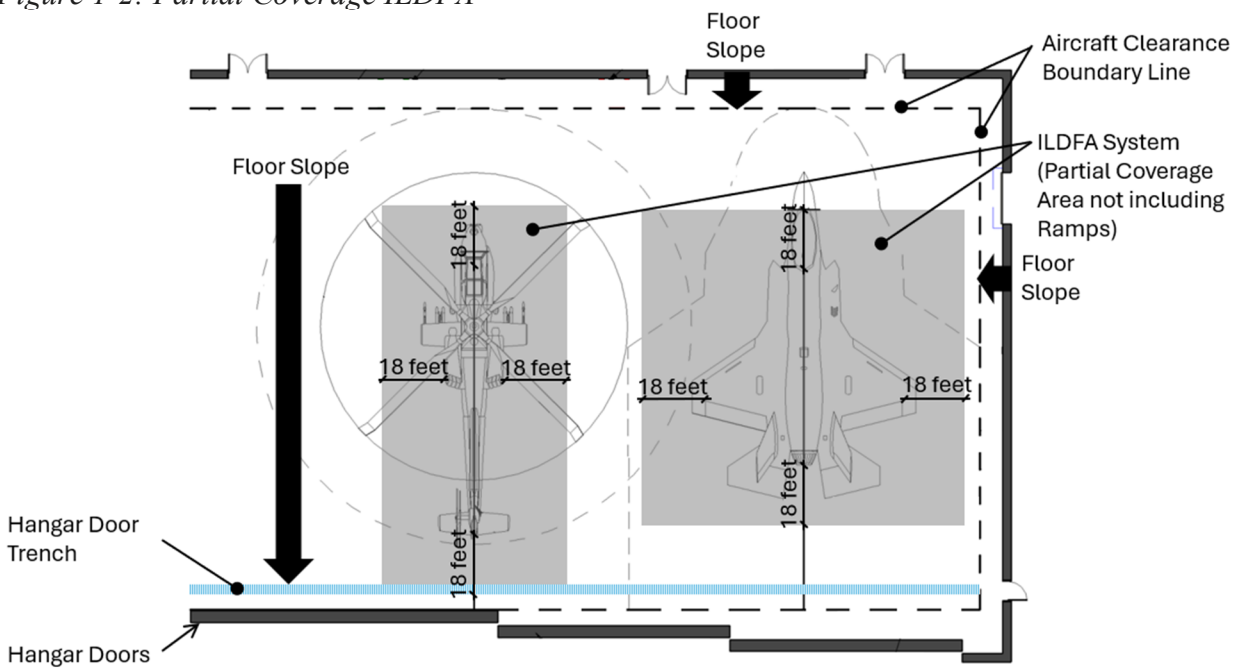


Figure 1-2: Partial Coverage ILDFA



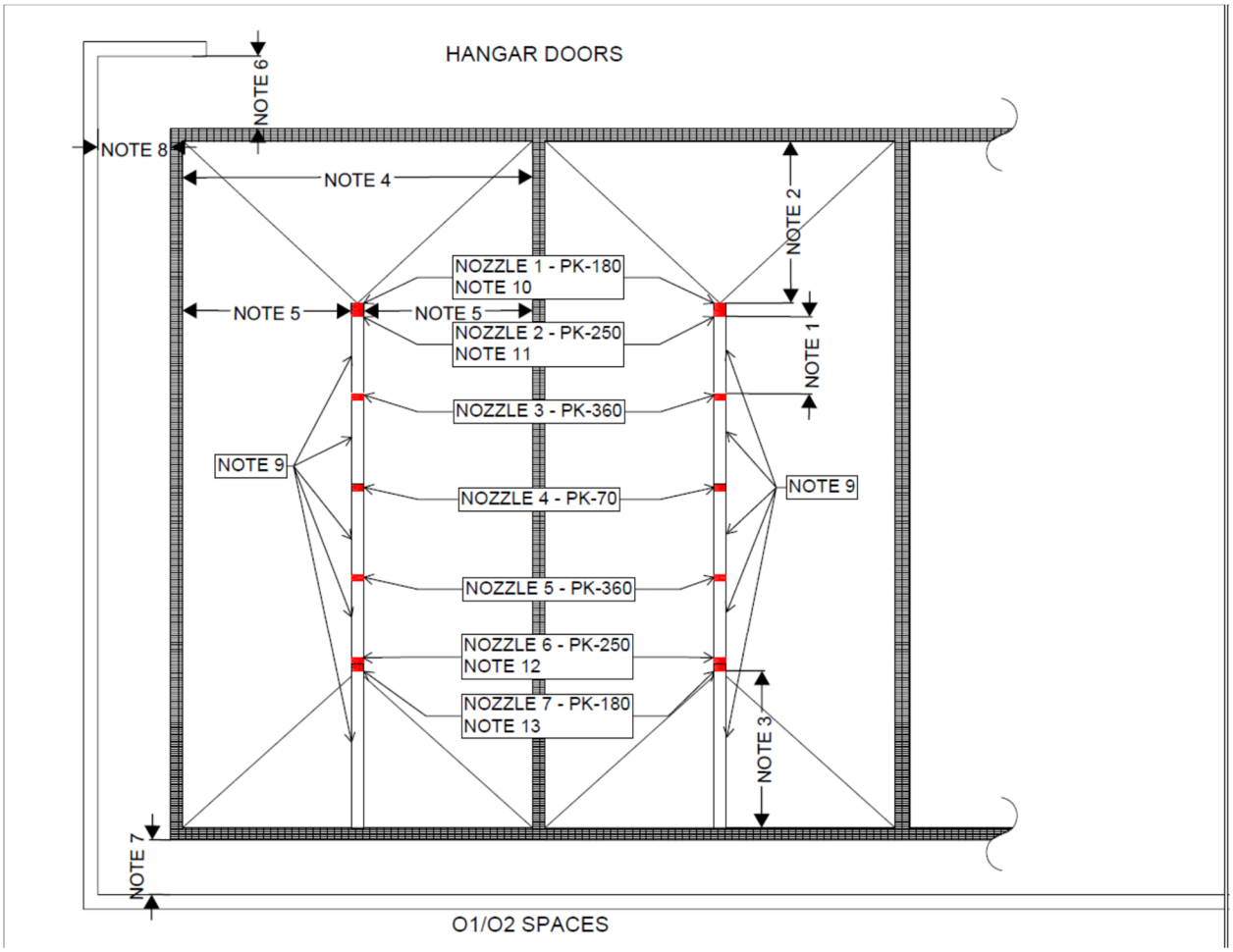
In either ILDFA approach, fuel spilled near the perimeter of the hangar bay and outside of the ILDFA coverage area, must flow into the nearest ILDFA system or out of the hangar door if the fuel spill is beyond the hangar door trench. The ILDFA system is comprised of separately marked zones, approximately 40 feet by 40 feet, such that no fuel spill plus its 18-foot radius can reach more than four zones. To flush up to four zones, the ILDFA requires 200 gallons of water per minute at 100 psi of pressure – which can be from any combination of domestic water, water storage, and/or pump. When the design liquid spill is detected in the hangar bay, the ILDFA uses water without any chemicals added to flush only those zones in which liquid spill was detected (up to four zones for a single spill). After flushing the ILDFA system, the effluent is captured by a trench system and conveyed by gravity or pump to containment, an oil-water separator, and/or as directed by the local authorities.

If installing ILDFA in a new hangar bay, design the ILDFA to be recessed in the slab for a flush mounted application with all non-ILDFA floor surfaces sloped to drain to the ILDFA system and away from doors to adjacent spaces. Design the new hangar bay floor to accommodate all loads as transmitted through the ILDFA floor profile and incorporate all required trenches.

If installing ILDFA in an existing hangar bay, design the ILDFA to be surface mounted application and determine required modifications to provide positive drainage away from doors to adjacent spaces. If required by the existing floor slope, alter the existing floor slope by designing shims, grout, or other means to provide the required bearing conditions and slope of the ILDFA system. If required by the existing floor trench layout, alter the existing trenches by designing infill or other structural means to provide the required bearing conditions and slope of

the ILDFA system. Verify through analysis that the existing hangar bay floor will accommodate all loads as transmitted through the ILDFA floor profile and verify/detail the additional required trenches. Consider the new floor elevation and its effect on the new electrical classification height and impact to adjacent spaces. Alternatively remove the existing slab (and trenches) and design new ILDFA to be recessed in a newly designed slab and trench system.

2.0 Water Flushing Nozzle Layout Diagram



NOZZLE PLACEMENT NOTES -

1. CENTER TO CENTER NOZZLE SPACING IS APPROVED FOR NO MORE THAN 12.5 ft. (3.8 m).
2. NOZZLE TO HANGAR DOOR TRENCH DRAIN IS APPROVED FOR NO MORE THAN 25 ft. (7.6 m).
3. NOZZLE TO O1/O2 TRENCH DRAIN IS APPROVED FOR NO MORE THAN 25 ft. (7.6 m).
4. THE MAXIMUM DISTANCE BETWEEN THE CENTERLINE OF HANGAR PARKING AREA TRENCHES IS 50 ft. (15.2 m).
5. THE MAXIMUM DISTANCE BETWEEN THE CENTERLINE OF THE NOZZLE AND THE HANGAR PARKING AREA TRENCHES IS 24.5 ft. (7.5 m).
6. DO NOT EXCEED THE TABULAR VALUE IN UFC 4-211-01 TABLE 2-1: MINIMUM AIRCRAFT MAINTENANCE BAY CLEARANCES FOR THE PERPENDICULAR DISTANCE FROM THE CENTERLINE OF THE TRENCH TO THE NEAREST OBSTRUCTION ON THE INSIDE FACE OF THE NEAREST HANGAR DOOR.
7. DO NOT EXCEED THE TABULAR VALUE IN UFC 4-211-01 TABLE 2-1: MINIMUM AIRCRAFT MAINTENANCE BAY CLEARANCES FOR THE PERPENDICULAR DISTANCE FROM THE CENTERLINE OF THE TRENCH TO THE NEAREST FIXED OBSTRUCTION ALONG THE O1/O2 AREA WALL.
8. DO NOT EXCEED THE TABULAR VALUE IN UFC 4-211-01 TABLE 2-1: MINIMUM AIRCRAFT MAINTENANCE BAY CLEARANCES FOR THE PERPENDICULAR DISTANCE FROM THE CENTERLINE OF THE TRENCH TO THE NEAREST FIXED OBSTRUCTION ALONG THE SIDE WALL.
9. PROVIDE REMOVABLE AIRCRAFT RATED SOLID GRATE COVERS FOR PEAK TRENCH, FLUSH WITH THE HANGAR FLOOR AND ALL ADJACENT NOZZLE ASSEMBILIES TO PREVENT ANY OBSTRUCTIONS.
10. ORIENT PK-180 FOR NOZZLE SPRAY TOWARDS HANGAR DOOR TRENCH.
11. ORIENT PK-250 FOR NOZZLE SPRAY TOWARDS HANGAR DOOR TRENCH.
12. ORIENT PK-250 FOR NOZZLE SPRAY TOWARDS O1/O2 SPACE TRENCH.
13. ORIENT PK-180 FOR NOZZLE SPRAY TOWARDS O1/O2 SPACE TRENCH.

****
USACE / NAVFAC / AFCESA **UFGS 13 50 00 ([August 2024])**

Preparing Activity: NAVFAC **[Superseding UFGS 13 50 00 ([August 2024])]**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated June 1, 2024
****

SECTION TABLE OF CONTENTS

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13 50 00

IGNITABLE LIQUID DRAINAGE FLOOR ASSEMBLIES
08/24

End of Section Table of Contents

****
USACE / NAVFAC / AFCESA **UFGS 13 50 00 ([August 2024])**

Preparing Activity: NAVFAC **[Superseding UFGS 13 50 00 (August 2024)]**

UFC 1-300-02 FORMAT STANDARD **for**
UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated June 1, 2024
****

SECTION 13 50 00

IGNITABLE LIQUID DRAINAGE FLOOR ASSEMBLIES
08/24

****
NOTE: This guide specification covers the requirements for ignitable liquid drainage floor assemblies including their peripheral equipment and controls.

Ignitable liquid drainage systems are a potential solution to eliminate or minimize the effects of ignitable liquid pool fires and/or hazardous liquid spills in industrial applications. The systems are intended to allow liquids to flow into a flooring section to be removed and transported to a remote location, ideally before ignition can occur. If the liquid has ignited, the system will minimize the spill area and reduce the overall size of the fire until the flow of liquid is stopped or extinguished. Refer to Factory Mutual Approval Standard Class Number 6090, 2.1.

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 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).
****

****
NOTE: In the design drawings accompanying this

specification as provided by the DOR for the complete implementation of an ILDFA system, include the following information, at a minimum, to fully coordinate the design drawings with this specification:

1. ILDFA Assumptions including system height and module width along with ILDFA trench height and width.

2. Extent of ILDFA coverage, application (recessed or surface mount), and details for application (such as trim details and ramps). Include all additional requirements such as a flushing water recycle system, if utilized.

3. Concept ILDFA trench drain locations (to show depth is compatible with foundations and system extents) and concept ILDFA trench drain details to be finalized by the selected ILDFA manufacturer.

4. Statement on plans and details that, based upon the ILDFA manufacturer selected, the contractor is required to confirm design assumptions and provide a fully functional system of a single ILDFA manufacturer. Require the contractor to be responsible for final coordination and integration with the building's design including all required adjustments based upon the ILDFA manufacturer's design which includes system dimensions, zoning, equipment locations, utility connections, operation, and construction tolerances.

5. All aircraft clearance lines, maximum extent calculation lines for aircraft parking, spill radius, to demonstrate compliance with required ILDFA extents. Include jack locations and configurations showing all jacks must either be fully on or fully off the ILDFA surface.

6. Provide a complete design and details for an aircraft-rated concrete slab in accordance with UFC criteria, contract requirements, and capability to support the ILDFA's imposed loads. Include floor flatness requirements compatible with the ILDFA without utilizing shims. For renovations utilizing existing slabs, demonstrate adequacy of slab capacity through analysis and include, as necessary for compatibility, details to accommodate the slope of ILDFA system with the slopes of the existing floor.

7. All floor loads to be included in the design of the ILDFA system, including but not limited to uniform loads, wheel loads, aircraft loads, jack loads, and dynamic or impact loads.

8. Floor slopes and details, grounding points and details, and tie-down locations and details.

9. ILDFA interferences to be resolved such as columns, utility pedestals, pits, conditioned or compressed air trenches.

10. Required floor markings.

11. Utility connections, size, and capacity for electrical and water. Include current flow test data (note this specification must require the contractor to perform their own flow test).

12. Concept ILDFA equipment locations such as tanks, pumps, and panel locations.

13. Trench drain evacuation method (gravity or pump) and all downstream systems including oil-water separator to sanitary or industrial sewer, containment, or recycle system.

14. Provide Electrical Hazard Plans indicating hazard classification above and below the top of the ILDFA surface.

****

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 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 will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish or 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 NATIONAL STANDARDS INSTITUTION (ANSI)

ANSI/NFSI B101.1 (2022) Measuring the Wet SCOF of Walkways

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A13.1	(2023) Scheme for the Identification of Piping Systems
ASME B16.3	(2021) Malleable Iron Threaded Fittings, Classes 150 and 300
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 B16.18	(2021) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B40.100	(2022) Pressure Gauges and Gauge Attachments
ASME B73.1	(2020) Specification for Horizontal End Suction Centrifugal Pumps for Chemical Process

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1010	(2021) Performance Requirements for Water Hammer Arresters

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A183	(2014; R 2020) Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A217/A217M	(2022) Standard Specification for Steel Castings, Martensitic Stainless and Alloy, for Pressure-Containing Parts, Suitable for High-Temperature Service
ASTM A351/A351M	(2018) Standard Specification for Castings, Austenitic, for Pressure-Containing Parts
ASTM A536	(1984; R 2019; E 2019) Standard Specification for Ductile Iron Castings
ASTM B26/B26M	(2018; E 2018) Standard Specification for Aluminum-Alloy Sand Castings
ASTM B85/B85M	(2018) Standard Specification for Aluminum-Alloy Die Castings
ASTM B88/B88M	(2020) Standard Specification for Seamless Copper Water Tube
ASTM B241/B241M	(2022) Standard Specification for Aluminum and Aluminum Alloy Seamless Pipe and Seamless Extruded Tube

ASTM B361	(2016) Standard Specification for Factory-Made Wrought Aluminum and Aluminum-Alloy Welding Fittings
ASTM F593	(2022) Standard Specification for Stainless-Steel Bolts, Hex Cap Screws, and Studs
ASTM F594	(2022) Standard Specification for Stainless-Steel Nuts

FACTORY MUTUAL GLOBAL (FM)

FM 6090	(2017) Approval Standard for Ignitable Liquid Drainage Floor Assemblies
FM Approval Guide	(updated on-line) Approval Guide http://www.approvalguide.com/

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41.1	(2002; R 2008) Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	(2002) Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

MASTER PAINTERS INSTITUTE (MPI)

MPI 83	(2018) Polyurethane Deck Coating (Slip-Resistant)
MPI 101	(2016) Primer, Epoxy, Anti-Corrosive, for Metal

MANUFACTURERS STANDARDIZATION SOCIETY (MSS)

MSS SP-71	(2018) Gray Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-80	(2019) Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2020) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 4	(2024) Standard for Integrated Fire Protection and Life Safety System Testing
NFPA 13	(2022; TIA 23-4) Standard for the Installation of Sprinkler Systems
NFPA 24	(2022) Standard for the Installation of

	Private Fire Service Mains and Their Appurtenances
NFPA 70	(2023; ERTA 7 2023; TIA 23-15) National Electrical Code
NFPA 72	(2022; ERTA 22-1) National Fire Alarm and Signaling Code
NFPA 409	(2022) Standard on Aircraft Hangars

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 11	(2020) Surface Preparation Standard No. 11 - Power Tool Cleaning to Bare Metal

UNDERWRITERS LABORATORIES (UL)

UL 142	(2006; Reprint Jan 2021) UL Standard for Safety Steel Aboveground Tanks for Flammable and Combustible Liquids
UL 312	(2022) UL Standard for Safety Check Valves for Fire-Protection Service
UL 508A	(2018; Reprint Jul 2022) UL Standard for Safety Industrial Control Panels
UL 698A	(2018; Rev 2019) UL Standard for Safety Industrial Control Panels Relating to Hazardous (Classified) Locations
UL 1316	(2018; Reprint Mar 2019) UL Standard for Safety Fiber Reinforced Underground Tanks for Flammable and Combustible Liquids
UL 2085	(1997; Reprint Sep 2010) Protected Aboveground Tanks for Flammable and Combustible Liquids
UL Fire Prot Dir	UL Product IQ (updated online) at https://productiq.ulpropsector.com/en

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 1-200-01	(2022; with Change 3, 2024) DoD Building Code
UFC 3-600-01	(2016; with Change 6, 2021) Fire Protection Engineering for Facilities
UFC 4-010-06	(2023) Cybersecurity of Facility-Related Control Systems
UFC 4-211-01	(2017; with Change 3, 2021) Aircraft Maintenance Hangars
MIL-STD-889	(2021; Rev D) Galvanic Compatibility of Electrically Conductive Materials

1.2 SUBMITTALS

****

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

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

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

The "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. Locate the "S" submittal under the SD number that best describes the submittal item.

Choose the first bracketed item for Navy and Air Force 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.] Submit SD-01 submittals prior to submitting all other submittals. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

SD-01 Preconstruction Submittals

Fire Protection QC Specialist; G[, [_____]]

Manufacturer's Qualifications; G[, [_____]]

Installer's Qualifications; G[, [_____]]

Test Personnel; G[, [_____]]

SD-02 Shop Drawings

System Layout; G[, [_____]]

Logic Tree; G[, [_____]]

SD-03 Product Data

Ignitable Liquid Drainage Floor Assembly; G[, [_____]]

Piping and Fittings; G[, [_____]]

Control Panel; G[, [_____]]

Supply Pump; G[, [_____]]

Flushing Manifolds; G[, [_____]]

Effluent Pumps and Controllers; G[, [_____]]

Flushing Water Solenoid Valves; G[, [_____]]

Supply Piping; G[, [_____]]

Pipe Hangers and Supports; G[, [_____]]

Seismic Bracing; G[, [_____]]

Liquid Detection Sensors; G[, [_____]]

Paint; G[, [_____]]

System Wiring; G[, [_____]]

Grounding; G[, [_____]]

Battery Charger; G[, [_____]]

Batteries; G[, [_____]]

Grounding Points; G[, [_____]]

Tie-down Points; G[, [_____]]

Trench Covers; G[, [_____]]

SD-05 Design Data

Flooring and Trench Cover (Grating) Strength Calculations; G[, [_____]]

Standby Battery Power Requirements Calculations; G[, [_____]]

Hydraulic Calculations; G[, [_____]]

Signage; G[, [_____]]

SD-06 Test Reports

Proof Load Test Data; G[, [_____]]

Test Procedures, Preliminary and Final; G[, [_____]]

Preliminary Test Report; G[, [_____]]

Final Acceptance Test Report; G[, [_____]]

Verification of Compliant Installation; G[, [_____]]

SD-07 Certificates

Materials and equipment; G[, [_____]]

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G[, [_____]]

Posted Instructions; G[, [_____]]

Warranty; G[, [_____]]

SD-11 Closeout Submittals

As-built Drawings; G[, [_____]]

Spare Parts; G[, [_____]]

On-site training; G[, [_____]]

1.2.1 SUBMITTAL REQUIREMENTS

1.2.1.1 Shop Drawings

Shop drawings shall be sealed and signed by the ILDFA manufacturer's registered professional engineer.

1.2.1.2 Product Data

Include annotated catalog data showing manufacturer's name, model, size, voltage, NRTL listing, options and catalog numbers for all equipment provided, combined into a single submittal and keyed to the System Layout. Product data must demonstrate compliance with all contract requirements.

1.3 SYSTEM DESCRIPTION

Design and provide a complete and fully functional new ignitable liquid drainage floor assembly (ILDFA) compliant with FM 6090 to control a 1520 liter 400 gallon per minute ignitable liquid fire within 60 seconds in accordance with UFC 4-211-01, the Contract Documents, and suitable for use in wet areas with all system components chemically compatible with all commonly used chemicals handled within the hangar bay. Provide all portions of a complete and fully functional ILDFA system including

components, piping, equipment, and accessories whether or not specifically referenced in the Contract Documents. All electrical work, equipment, and devices to comply with the electrical hazard classification indicated in Paragraph 3.5 ELECTRICAL WORK. [Design and install the ILDFA system to work in a cold environment with special attention paid to flushing water, residual trench water, and other sensitive systems.]

The design, equipment, materials, installation, and workmanship must comply with FM 6090, NFPA 70, and NFPA 409 except as modified herein. Submit a System Layout demonstrating each ILDFA system will include all materials, accessories, and equipment necessary so that it is complete and ready for use. Design and install each component to give full consideration to piping, electrical equipment, trenches, installation, and maintenance. Provide ILDFA controls for electronic detection, control, and activation including all wiring, raceways, accessories, and miscellaneous items required for a complete ILDFA system even though each component of the ILDFA system is not specifically mentioned or described.

1.3.1 Area of Coverage

****

NOTE: In the design drawings show potential conflicts with the ILDFA system, these shall include columns, bracing, foundations, grounding points, tie down points, below slab utilities, or trenches, pits, pedestals, or access points for utilities to the aircraft such as PCA, water, compressed air, power, or specialty power.

For new hangar bay slabs use the second paragraph and delete the third paragraph.

For existing hangar bay slabs delete the second paragraph and use the third paragraph.

****

Provide ILDFA coverage [as shown in the design drawings accompanying this specification][across the entire hangar bay floor to a maximum of[3.1 m 10 feet][4.6 m 15 feet] [_____] from the back and side walls, and up to the trench along the inside of the hangar bay doors][of the aircraft silhouette plus a minimum of an 5.5 m 18 feet radius drawn from the outer edge of the fuel tanks and engines]. Design and install the ILDFA to accommodate the floor obstructions shown in the Contract Documents and provide for daily, convenient, functional access to all [grounding points,][aircraft tie-down points,][utility service access points,][preconditioned air trench covers and access points,][_____,] shown in the design drawings and trench covers and grates.

[Recess the ILDFA system into the concrete slab to provide a flush and level transition between the surface of the coated concrete floor and the surface of the ILDFA as shown in the design drawings. Provide trim pieces to transition from the concrete slab to the ILDFA to cover gaps without restricting the positive slope from the concrete to the ILDFA system. Install the ILDFA to be in continuous contact with the concrete slab and sloped to match the slope of the hangar bay floor slab.]

[Install the ILDFA system directly on top of the concrete slab with[ramps on all sides][ramps as shown in the design drawings][cementitious infill as shown in the design drawings to provide a smooth walking transition from the concrete floor to the ILDFA][_____]. [Maximum slope for aircraft

ramps is 1:24 vertical: horizontal, and 1:12 vertical: horizontal for other ramps.] Install the ILDFA [to be in continuous contact with the concrete slab and sloped to match the slope of the hangar bay floor slab][over shims to provide the required slope as shown in the design drawings][_____].]

1.3.2 Structural Design Loads

****

NOTE: The required ILDFA design loads must be shown in the design drawings and match the concrete floor design loads required by the UFC (such as UFC 4-211-01) including uniform loads, wheel loads, aircraft loads, jack loads, dynamic or impact loads, and channelized patterns - these loads apply to both the field of the ILDFA, Trench Covers, and ramps if utilized.

Since ILDFA manufacturers develop limited, proprietary ILDFA sections it is recommended the specifier consult with manufacturers in advance.

Specifying structural engineer must provide a complete concrete floor design in accordance with UFC criteria, project requirements, and imposed load concentrations from the ILDFA system and a compatible floor flatness construction requirement so that shims are not required. If the slab is existing, the specifying engineer should verify, test, design check, and include requirements for modifying or replacing the slab as required to accommodate the ILDFA system.

Coordinate ILDFA slope requirements with as designed floor slope and tolerance to ensure system compatibility and operability.

****

Provide an ILDFA system, including trench covers and grates, to support [the slab loads as indicated in the design drawings][a minimum static load of 2410 kPa 350 psi over a 125 mm 5 inch wide by 250 mm 10 inch long contact area][_____]. Apply design loads to the ILDFA system for the required number of vehicle passes in channelized, cyclical patterns without fatigue or loss of strength and design in accordance with established, recognized standards for the material utilized in the ILDFA system. Design to accommodate temperature changes and associated movement of the ILDFA system.

With the exception of jack loads, design ramps for the same structural loads and durability as the rest of the ILDFA system. In addition to proof loading, demonstrate through analysis that components meet loading requirements. Apply proof load requirements to all ILDFA floor system components, including the trench covers and grates. Submit proof load test data for the flooring, trench covers, and grates, including the standards and procedures utilized.

Submit ILDFA Flooring and Trench Cover (Grating) Strength Calculations including ramps and utility covers along with strength test reports demonstrating compliance with indicated floor loads.

1.3.2.1 Additional Design Load Requirements

Design [grounding points and][utility service access points and] [preconditioned air trench covers and access points and] [and] ILDFA trench covers and grates to the same structural loads as the rest of the ILDFA system plus a proof load of[444 kN 100,000 pounds][223 kN 50,000 pounds][_____].

1.3.2.2 Additional Design Considerations

Design and install the ILDFA system to distribute loads to the concrete slab in a manner that does not result in overstress of the concrete slab. Confirm slope of concrete slab prior to installation of the ILDFA system, and remedy to the satisfaction of the Contracting Officer, prior to installation. As shown in the design drawings, [continuous bearing of the ILDFA is required with the concrete slab][shims are acceptable for use at the maximum spacing indicated][shims are acceptable for use with grouting in-between to provide continuous contact][_____].

1.3.3 Water Supply

****

NOTE: Domestic water supply may be used for ILDFA water supply when the ILDFA connection is downstream of a backflow preventer. A water supply pump and/or a flushing supply tank is required by the ILDFA if there is insufficient water supply based upon the contractor provided flow test.

Must provide backflow preventer rated for 1136 liters per minute 300 gallons per minute on a minimum 3 inch line (follow sprinkler specification for backflow preventer requirements).

ILDFA minimum system requirements: 75 mm 3 inch connection providing 760 liters 200 gallons per minute volume, at 690 kPa 100 psi. Flushing water run time for the ILDFA (supply and discharge) may be set to 30 minutes if approved by the AHJ, however the system will be designed to design the supply for 60 minutes.

Protect all exposed pipe from mechanical damage and prevent and protect from freezing with a dry pipe flushing supply system.

Supply all valves on the water supply with locking capability or electronic monitoring on each side of supply pump (include tamper switch with a supervisory alarm to the Fire Alarm Control Panel, Building Automation System, or other approved location.

****

Supply the ILDFA from the [potable] water supply system indicated in the design drawings which includes a[75 mm 3 inch] [_____] point of connection. The water supply is from the [domestic water supply][water storage][water recycle system][_____], as shown in the design drawings. Design the ILDFA system, including supply pump with control panel and

flushing supply tank if required, to work with the provided water supply to provide flushing water to [four][_____] zones for a minimum of [30 minutes][60 minutes][_____].

1.3.3.1 Hydraulic Design Basis for Calculations

Per the historic hydrant flow test on [_____], the water supply produces a static pressure of[_____] kPa psi with a residual pressure of[_____] kPa psi while flowing [_____].

The Contractor must perform their own flow test in accordance with UFC 3-600-01 for their use in the design of the ILDFA system.

1.3.3.2 Hydraulic Calculations

Include a water supply pump and flushing supply tank as required to provide[60 liters 200 gallons per minute at 690 kPa 100 psi][_____]. Provide Hydraulic calculations and substantiate a minimum water flow of 760 liters 200 gallons per minute at a pressure of 345 kPa 50 psi at the hydraulically most remote four flushing manifolds, as required by FM Approval.

Plot water supply curves and system requirements on semi-logarithmic graph paper to present a summary of the complete hydraulic calculation. Perform the calculations back to the [point of connection indicated in the design drawings][_____] and include the operation of the supply pump and piping to the discharge nozzles flowing a total of [four][_____] zones. Include a 70 kPa 10 psi margin of safety.

1.3.4 Cybersecurity

Design all control systems (including systems separate from a utility monitoring and control system) in accordance with UFC 4-010-06 and as required by Section 25 05 11[_____] CYBERSECURITY OF FACILITY RELATED CONTROL SYSTEMS WITH C-I-A DETERMINATION [_____]. Implement cybersecurity requirements to mitigate vulnerabilities to all facility-related control systems.

1.4 QUALITY ASSURANCE

1.4.1 Manufacturer's Qualifications

Use an ILDFA product from an ILDFA manufacturer who is regularly engaged in the design, fabrication, installation, and service of ILDFA systems of the type, complexity and size required for this project. The ILDFA manufacturer must have at least 3 years of similar ILDFA experience and have successfully installed and commissioned at least five similar ILDFA systems. ILDFA Manufacturer must submit written evidence on similar designs and installations listing the name, location, contact information of owners, installation dates, overall sizes, features, and other relevant information for experience and qualifications evaluation. Only ILDFA manufacturers who can submit this evidence of actual installations where the products have proven practical, durable, and require a minimum of maintenance, must be qualified under this specification.

1.4.2 Installer's Qualifications

An ILDFA manufacturer's representative, skilled and experienced in the installation of ILDFA of the type specified herein, is required to

supervise installation of the complete system in accordance with approved shop drawings. The Installer must have at least 3 years of similar ILDFA experience and have successfully installed and commissioned at least five similar ILDFA systems. For each Installer submit written evidence of similar past ILDFA installations listing the name, locations, contact information of owners, installation dates, overall sizes, features, and other relevant information for experience and qualifications evaluation.

1.4.3 Fire Protection QC Specialist (FPQC)

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NOTE: A Fire Protection QC Specialist is required to be involved in the installation and testing of the ILDFA system and associated equipment. A Fire Protection QC Specialist will be the contact person for integrating the ILDFA and associated components and their interface.

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Provide a Fire Protection QC Specialist in accordance with [Section 01 45 00 QUALITY CONTROL Paragraph 1.6.9.2][_____] to provide quality control related activities and testing specified within, including the review and approval of submittals under this section prior to the Contractor submitting the package for Government approval. Approval of the Fire Protection QC Specialist must be obtained prior to submittal of all ILDFA system layouts, product data, or hydraulic calculations.

1.4.4 Test Personnel

Test Personnel are trained by the ILDFA manufacturer in the installation, adjustment, testing, and operation of the equipment and are approved by the ILDFA manufacturer to carry out these duties on behalf of the ILDFA manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials and equipment in original rolls, packages, containers, boxes, or crates bearing the manufacturer's name, brand, and model number. Store materials and equipment in dry locations with adequate ventilation, free from dust and water, and permit access for inspection and handling. Handle materials and equipment carefully to prevent damage. Replace damaged items that cannot be restored to like-new condition and provide new items. All pipes must be capped or plugged until installed.

1.6 SPARE PARTS

Submit spare parts data for each different item of material and equipment specified below. Data must include a complete list of parts and supplies, with current unit prices, source of supply, lead time, and a list of parts recommended by the ILDFA manufacturer to be replaced after 1 year and 3 years of service. Include directions for replacement, a list of special tools required, and test equipment required for maintenance and testing of the items supplied.

a) Liquid Detection Sensors: Provide a quantity of spare parts equivalent to a minimum of 10% of the installed parts.

b) Liquid Sensor Barriers: Provide a quantity of spare parts equivalent to a minimum of 5% of the installed parts.

c) Solenoid Valves: Provide a quantity of spare parts equivalent to a minimum of 5% of the installed parts.

1.7 WARRANTY

Provide a ten-year warranty for the entire ILDFA system against defects in material and workmanship beginning on the date of Project Acceptance.

ILDFA Manufacturer's certified technician must conduct, in the first year after commissioning, a quarterly review of the ILDFA installation to assess system operation and maintenance, perform warranty work, and assess cleaning protocols. Based on the cleaning assessment, optimal cleaning and maintenance intervals will be established by the manufacturer and coordinated with the end user.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide materials and equipment that are standard products of ILDFA manufacturers regularly engaged in the design, manufacture, and installation of such products and which are of a compatible material, design, and workmanship. Provide products that are non-combustible, jet fuel resistant, suitable for use in a wet environment without corrosion, and compliant with electrical classification.

All equipment and material must have been tested by Underwriters Laboratories and listed in UL Fire Prot Dir or approved by Factory Mutual (FM) and listed in FM Approval Guide. Where the terms "listed" or approved appear in this specification, such must mean listed in UL Fire Prot Dir or FM Approval Guide. The omission of these terms under the description of all items of equipment described must not be construed as waiving this requirement.

2.2 ILDFA FLOOR SURFACE

The entire ILDFA floor surface including ramps, covers, and trim must be durable and secure such that it is not easily damaged and does not shift under moving loads. Floor surface profiles with ribs or other protrusions which create issues for rolling wheels, level alignment of aircraft maintenance devices, or stability of bottle jacks are prohibited. Demonstrate that frequent large tool drops, part drops, and forklift traffic with pallet impacts do not cause damage or deformation of the floor surface which affect system performance. Provide a replaceable aluminum Foreign Object Debris (FOD) screen of a material compatible with the ILDFA and which does not limit the ILDFA's drainage capacity but prevents items and debris as small as M4 or 2.38 mm 3/32 inch nuts, bolts, or washers from entering the ILDFA floor cavity.

Utilize an adhesive thread lock or self-locking nut on all fasteners and bolts and apply proper torque with quality assurance testing to prevent foreign object debris issues. Provide a finish which is non-reflective and utilizes a brushed metal surface to minimize reflectivity. Provide a slip resistance of less than 1.00 and greater than 0.60 as measured in accordance with ANSI/NFSI B101.1 utilizing a 3rd party certified test company.

[2.3 FLOOR EDGE SAFETY
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NOTE: Removable guard rails and markings are necessary if the floor is placed on top of the floor in an area without ramps. Guard rails and markings are not necessary for recessed floors or if ILDFA is installed with ramps on all perimeters.

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Provide removable guard rails and OSHA approved markings along all surface mounted edges of the ILDFA without ramps.

]2.4 WATER SUPPLY

2.4.1 Water Supply Components

Supply piping refers to the system of piping down stream of the ILDFA backflow preventer which provides water only supply to flushing manifolds used in the ILDFA. Valves, fittings, couplings, strainers, and similar devices must be rated for the maximum working pressures that can be experienced in the system, but in no case less than 1035 kPa 150 psi. All components of the aboveground piping must fully comply with the requirements of this specification section and manufacturer's requirements.

2.4.1.1 Water Supply System

Provide a [backflow preventer,][supply tank,][supply pump,] isolation valve, check valve, and strainer in the piping ahead of flushing manifolds.

2.4.2 Strainer

Provide chrome-moly simplex basket strainers conforming to ASTM A217/A217M (Grade WC6 or WC9). Strainer must have flanged connection. Provide stainless steel strainer baskets with stainless steel mesh size 40.

Design the strainer to permit removal of the strainer screen for replacement and repair without removing the body from the line. Provide a shutoff valve upstream of the strainer. Ensure that friction loss does not exceed expected pressure losses from hydraulic calculations at design flow with on-site testing.

2.4.3 Flushing Water Solenoid Valves

Water flow to the ILDFA's flushing manifolds must be controlled by electrically actuated solenoid control valves. Control valves must only provide opening and closing of the valve, with control via 24 volt DC (with battery backup) signal wire. Provide a solenoid valve with remote resetting and automatic reclosing capability for each flushing manifold. Control valves to be FM approved stainless steel, brass, bronze, or aluminum with construction rated for Class 1, Division 1 locations. For hydraulic calculations, include the ILDFA manufacturer's pressure drop across flow control valve and flushing manifold control valves for the features indicated. Provide access to flushing manifold spray holes, without requiring disassembly, for easy access to inspect and clean scale or other clogs.

House solenoid valves in a separate subgrade enclosure mounted adjacent to the trench. Gaskets to be compatible with all liquids handled within the hangar bay. Operate valves by a control system which is UL listed or FM approved for use with ILDFA system. Valves located in electrical classified locations to be UL listed or FM approved for the classification

of the area where located. Solenoids to be UL listed Class 1, Division 1 and FM approved.

[2.4.4 Backflow Preventers

Provide a [double check][double check detector assembly] on the water supply serving the ILDFA. Include backflow preventer (BFP) test connection, test connection, with sufficient outlets to forward flow test the BFP, measuring flow and pressure drop across the BFP for comparision to manufacturer's published data.

]2.4.5 Flow Meters

Provide venturi flow meter compatible with the piping system in which it is installed.

2.4.6 Check Valves

Provide check valves that comply with UL 312. Check valves 100 mm 4 inch and larger to be of the swing type, have a clear waterway and meet the requirements of MSS SP-71, for Type 3 or 4 or MSS SP-80. Inspection plate to be provided on valves larger than 150 mm 6 inch.

2.4.7 Water Control Valves

Provide water control valves that are indicating type and comply with NFPA 13 requirements. [Provide stainless steel valves.]

2.4.8 ILDFA Supply Piping and Fittings Downstream of Backflow Preventer

Piping must be Copper, Aluminum or Stainless Steel. Copper piping must be Type K with brazed joints, aluminum piping must be schedule 40 6063, and stainless steel must be 316L with welded, threaded, or grooved fittings. Incoming water service piping must be seamless copper water tube, ASTM B88/B88M. Fittings must be wrought copper and bronze solder pressure fitting, ASME B16.18, brazed joints. Alternately, piping may be ASTM B241/B241M Schedule 40 aluminum alloy with[grooved][threaded] [grooved or threaded] fittings. Grooved fittings must be suitable for dry service. Design joints and fittings for not less than 200 kPa 175 psi service. Rubber gasketed grooved end pipe and fittings with mechanical couplings are permitted.

2.4.9 Grooved Fittings and Couplings

Grooved fittings, couplings, and bolts must be provided by the same ILDFA manufacturer and listed for dry pipe application. Subgrade fittings and couplings must be aluminum ASTM B26/B26M, ASTM B85/B85M, ASTM B361 or stainless steel ASTM A351/A351M. Couplings must be of the rigid type. Coupling gaskets must be flush type, filling the entire cavity between the fitting and the pipe, Grade O (Fluoroelastomer), compatible with petroleum products.

When used in aboveground supply piping, couplings shall be malleable iron or ductile iron complying with ASTM A536 and coupling gaskets shall be Grade E (EPDM). Gaskets must be the flush type that fills the entire cavity between the coupling and the pipe. Nuts and bolts used for subgrade couplings must be stainless steel conforming to ASTM F593 and ASTM F594. When used in aboveground piping, nuts and bolts shall be heat treated steel conforming to ASTM A183 and must be cadmium plated or zinc

electroplated.

2.4.10 Non-Grooved Fittings and Couplings

Non-grooved fittings must be threaded or flanged. Subgrade fittings and couplings must be aluminum ASTM B26/B26M, ASTM B85/B85M, ASTM B361 or stainless steel ASTM A351/A351M. Aboveground threaded fittings are permitted to be cast iron ASME B16.4 or malleable iron ASME B16.3.

2.4.11 Flanges

Flanges must conform to ASME B16.5. Flanges must be of same material as the ILDFA pipe. For dissimilar metals (such as aluminum or copper to steel connections) provide isolating materials to eliminate galvanic potential.

2.4.12 Gaskets

Provide gaskets that are 1.6 mm 1/16 inch thick, one piece factory cut and resistant to the effects of aviation hydrocarbon fuels and associated oils, lubricants, and cleaners, and manufactured of fire resistant materials. Utilize full-face gaskets for flat-face flanged joints and utilize ring gaskets for raised-face flanged joints.

When below grade, all gaskets must be compatible with all liquids commonly handled in the work area.

2.4.13 Bolts

Provide bolts composed of the same material as the flanges to which they are connected. Extend bolts no less than three full threads beyond the nut when the bolt is tightened to the required torque.

2.4.14 Nuts

Provide nuts composed of the same material as the flanges to which they are connected.

2.4.15 Washers

Provide washers which conform to the associated bolt and nut. Provide flat circular washers under all bolt heads and nuts.

2.4.16 Pipe Hangers and Supports

Provide galvanized pipe hangers[, supports and seismic bracing][and supports] in accordance with NFPA 13 and as specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE. [Design and install seismic protection in accordance with the requirements of NFPA 13 section titled "Protection of Piping Against Damage Where Subject to Earthquakes for Seismic Design Category ["C"]["D"][_____]].

2.4.17 Water Hammer Arrestor

Provide water hammer arrestor selected per ASSE 1010 for the final ILDFA piping configuration to protect the ILDFA system. Size arrestor based on the water flow, pipe size, pipe length within the ILDFA system, and operating pressure. Provide arrestor comprised of a floating stainless-steel spherical piston, surge chamber, valve, gauge assembly, and 1380 kPa 200 psi pressure rating.

[2.4.18 Water Supply Pump

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NOTE: Remove Water Supply Pump if the following criteria is met with the building water supply: 75 mm 3 inch connection providing 760 liters 200 gallons per minute volume, at 690 kPa 100 psi.

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Provide a [FM approved]water supply booster pump, selected by the ILDFA manufacturer, for compatibility with the ILDFA system. Locate water supply pump with control panel in a separate, rated room as shown in the design drawings. Do not install the pump in a location which restricts the area of the hangar bay.

][2.4.19 Flushing Supply Tank

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NOTE: Remove Flushing Supply Tank if the hydraulic analysis indicates sufficient volume exists from the building water supply for the ILDFA operation and no water recycling system is provided.

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Provide a flushing supply tank, selected by the ILDFA manufacturer, for compatibility with the ILDFA system. Do not install the flushing supply tank in a location which restricts the area of the hangar bay.

]2.5 SYSTEM CONTROLS

Control ILDFA system activation with a control panel utilizing FM listed components and designed by the manufacturer for the purpose and function of the ILDFA, including full functional settings and controls. Locate the control panels as shown in the construction documents. [Provide relays for fire alarm monitoring of the ILDFA system and supply valve position.][Operation of the ILDFA must report as a supervisory and not cause evacuation of the building upon activation of the ILDFA.] Submit a Logic Tree illustrating all controls and function of the ILDFA system.

Control systems will control activation and provide the following features, at a minimum:

a. Fully automatic operation: Liquid detection sensors must activate flushing manifold for the associated zones upon detection of fluid spill of 1515 liters 400 gallons per minute within 60 seconds, and 190 liters 50 gallons per minute within 120 seconds.

b. Emergency operation: provide one for each zone if there are multiple zones and an automatic return to fully automatic mode after an adjustable time delay.

c. Manual operation: Provide with adjustable run time (one for each zone if there are multiple zones) and automatic return to fully automatic mode after an adjustable time delay.

d. Temporary off mode: Provide for washing of aircraft or similar wet functions, with an automatic return to fully automatic mode after an adjustable time delay.

e. Cleaning cycle: Provide an internal capability to establish and

enable automated and adjustable flushing cycles and flushing durations. Upon completion of flushing, the cleaning mode on the ILDFA will remain active for 15 minutes to permit water to drain, after which time the ILDFA control panel will automatically return to fully automatic mode after an adjustable time delay. During cleaning mode, automatic deactivation will occur if a design fluid spill is detected in another zone.

f. Test Mode: Provide to test each zone's sensors and flow, with an automatic return to fully automatic after an adjustable time delay following testing.

2.5.1 Liquid Detection Sensors for the ILDFA system

Provide ILDFA system liquid detection sensors in accordance with the manufacturer's system requirements and listed for use in a Class I, Division 1 location. Provide liquid detection sensors that are UL listed or FM approved for both hydrocarbon and water detection. Provide a sufficient number of liquid detection sensors in accordance with the ILDFA manufacturer's instructions and at least one sensor must be provided for each flushing zone manifold. Connect all wiring from liquid detection sensors to ILDFA Control Panel. Provide all cabling in conduit. The system must provide continuous and automated detection.

2.5.2 ILDFA Control Panel (ICP)

Provide control panels which are UL listed (UL 698A and UL 508A) or FM Approved for ILDFA control with surge suppression on the 120 volt AC power supply. Provide signage indicating "CONTROL PANEL FOR ILDFA". Provide zoning and controls, such that no more than four zones can be triggered or activated at one time due to a liquid spill. Panels to contain components and equipment required to provide the specified operational and supervisory functions of the system. House components in a surface mounted steel cabinet with hinged door and locking capabilities. On the face of the controls cabinet provide an emergency and manual start with a floor zone diagram. Provide Manual Start and Stop stations complying with UFC 4-211-01. Provide signage which reads "FLOOR SPILL SYSTEM". The manual stop returns to normal operations (stops either emergency or manual activation).

Include integral "power on," "alarm," and "trouble" lamps (LED type) with annunciation of each alarm, supervisory and trouble signal on the panel. Provide lamps which are plainly visible from a minimum distance of[91 m 300 ft][30.5 m 100 ft] [_____] when the cabinet door is closed. Upon restoration of power, provide automatic start-up (do not require manual operation). Design the ICPs to provide a real time display of current liquid detection status at any liquid detection sensor. [The effluent pump is controlled by the ICP.]

2.5.2.1 ICP Installation

Install the control panel and its components so that no part of the enclosing cabinet is less than 1219 mm 48 inches above the finished floor. Panels, devices, and appliances located in the hangar bay are subjected to water spray or runoff under normal operating conditions. Provide NEMA 250 Type 4 enclosures in the hangar bay and restrict conduit entry into the bottoms of enclosures (conduit is not permitted to enter tops or sides of enclosures).

2.5.2.2 Monitoring and Supervision

[The ICP must monitor pipe and containment tank leak detection, low and high-level containment tank alarms, and output contacts to send tank level status to [Base-wide Industrial Control System][Building Management System][_____]. Low-level tank alarms are silenceable, high-level tank alarm cannot be silenced.] The ICP will supervise valves to provide a trouble condition if a normally open valve is shut off and monitor the flow meter. Provide signage indicating each valve's normal operating position.

[The ICP must monitor the flushing supply tank with a "tank not full" alarm and output contacts to send tank not full level status to [Base-wide Industrial Control System][Building Management System][_____]. Tank not full alarm is not silenceable.]

2.5.2.3 Maximum Number of Zones

The ICP controller for the flushing water must not allow more than four zones to be activated at one time.

2.5.2.4 Primary Power Supply

Power the ICP with 120 volts AC transformed and rectified to 24 volts DC for operation of all system initiating, actuating, signal sounding, trouble signals. Loss of AC power, a break in the standby battery power circuits, or abnormal AC power or low battery voltage will result in the operation of the system trouble signals. Operate trouble signals continuously until the system has been restored to normal at the control panel.

2.5.2.5 Secondary Power Supply

Provide for system operation in the event of primary power source failure. Automatically transfer from normal to auxiliary (secondary) power and restoration from auxiliary to normal power without causing transmission of a false alarm.

2.5.2.6 Batteries

Provide maintenance free sealed lead acid batteries as the source for emergency power to the ICP. Batteries must contain suspended electrolyte. The battery system must be maintained in a fully charged condition by means of a solid state battery charger. Provide an automatic transfer switch to transfer the load to the batteries in the event of the failure of primary power.

2.5.2.6.1 Capacity - Standby Battery Power Requirements Calculations

Provide sufficient capacity to operate the ICP under supervisory and trouble conditions, including audible trouble signal devices for 48 hours and under alarm conditions for an additional 15 minutes. Include full current draw of solenoid valves in battery power requirements calculations.

2.5.2.6.2 Battery Charger

Provide a solid state, fully automatic, variable charging rate battery charger. The charger must be capable of providing 120 percent of the connected system load and must maintain the batteries at full charge. In

the event the batteries are fully discharged (20.4 Volts dc), the charger must recharge the batteries back to 95 percent of full charge within 48 hours after a single discharge cycle as described in paragraph CAPACITY above.

[2.6 EFFLUENT PUMPS AND CONTROLLERS

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NOTE: The following needs to be determined for the project and discussed with the Environmental and Civil Engineers. Effluent pumps and controllers are required when gravity outflow from the ILDFA trenches are not possible. Provide an effluent pump to remove liquid from trench if liquid is not able to adequately flow out of the trench under gravity flow.

These pumps and controllers may be part of the Civil Engineering design or can be part of the ILDFA, depending on the circumstances of the project and site.

Effluent pumps are not allowed for combat applications related to hardened and semi-hardened facilities and drainage must be dependent on gravity only. The loss of supporting utilities is anticipated.

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Provide effluent pumps rated as Class I, Division 2 with seals compatible with hydrocarbon type liquids and compatible with the ILDFA system. Provide [redundant] effluent pumps at each pump location, "trash" type capable of passing solid material not less than 10 mm 0.375 inch diameter, with FM Approved service controllers for the effluent pumps.

For effluent pumps, provide a horizontal, close coupled centrifugal pump or ASME B73.1 horizontal end suction centrifugal pump with TEFC motor that is not overloaded at pump runout. Provide a capacity of 4500 liters 1200 gallons per minute or greater. Test the pump at the ILDFA manufacturer's plant for operating characteristics at the rated capacity and under specified operating conditions. Furnish test curves showing capacity in liters gallons per minute, head in mm feet, efficiency, and brake horsepower. Size the electric motor for non-overload when operating at any point along the characteristic curve of the pump.

][2.7 CONTAINMENT TANKS

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NOTE: NOTE: The following needs to be determined for the project and discussed with the Environmental and Civil Engineers. These tanks may be provided with a gravity drain system or with the above effluent pumps and controllers.

A containment tank is typically a separate requirement (or a part of the water recycling system) and specified in a separate specification, but depending on location and circumstances, it may be beneficial to have the containment tank provided by the ILDFA manufacturer, if part of their package.

In general, it is best to utilize a gravity flow system into oil-water separator then into the sanitary or industrial sewer as permitted by environmental and Installation. If not permissible, then gravity flow into a containment tank; environmental will govern on disposal from there. When gravity flow is not feasible, a pump will be required.

For existing facilities retrofitted with ILDFA where the floor slope is not continuous to the door, add 1200 square feet of sprinkler system design discharge.

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Design containment tanks in accordance with UFC 4-211-01. Provide tanks which are double-walled and listed or approved for the storage of mixed petroleum waste products. [Underground tanks must comply with UL 1316.][Aboveground tanks must comply with [UL 142][UL 2085].]

Provide tank sized for the largest of 57,000 liters 15,000 gallons or 100 percent redundancy for 110 percent of the largest anticipatable fuel spill plus activation of [30 minutes][60 minutes][ ] of flushing water for [four][_____] zones [plus activation of 1200 square feet of sprinkler system design discharge].

][2.7.1 Liquid Detection Sensors for the Containment System

[Provide liquid detection sensors in the containment tank or structure to detect and alarm at [20 percent][percent] capacity of the tank and a critical alarm at [40 percent][percent] capacity of the tank and listed for use in a Class I, Division 1 location.]

][2.8 WATER RECYCLE SYSTEM

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NOTE: If required for the project, a water recycle system should be designed separately from the ILDFA system and then referenced in this specification and the design drawings.

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Coordinate the design of the ILDFA system with the water recycle system shown in the contract documents. The effluent from the ILDFA system will be recycled as shown to provide the water supply back to the ILDFA system.

]2.9 Pressure and Vacuum Gauges

Provide gauges conforming to ASME B40.100. Gauge to be a minimum of 90 mm 3.5 inches in diameter with a range from zero to approximately 1.5 times the maximum system working pressure. Select each gauge such that at normal operating pressure, the needle is within the middle third of the range. Provide liquid filled type gauges.

2.10 EFFLUENT (DRAIN) COMPONENTS

Provide all components in the trench discharge or drainage with materials of construction that are chemically resistant to the effects of aviation hydrocarbon fuels and associated oils, lubricants, and cleaners, and

manufactured of fire-resistant materials. If required for the manufacturer's design, request a complete list of chemicals and products potentially encountered in the effluent for reference with material specification. Provide all components in the trench discharge or drainage to also be chemically resistant to the effects of firefighting foams. Permissible piping materials include any material listed in Section 22 00 00 PLUMBING, GENERAL PURPOSE under Table I, "Service F" for corrosive waste and vent piping meeting the requirements listed above or one of the following alternate piping materials: ductile iron, stainless steel, or aluminum.

2.11 PAINT FOR FLOOR MARKINGS

Apply paint to top surface of ILDFA, which is anticipated to be an aluminum substrate. Ensure no overspray paint is applied to the ILDFA FOD screen nor enters the ILDFA. FOD screen which has been painted or otherwise damaged must be replaced. Utilize an MPI 101 epoxy primer on aluminum surfaces and an MPI 83 urethane topcoat on aluminum surfaces.

2.12 ACCESSORIES

2.12.1 Identification and Marking

Provide nameplates on major components with the ILDFA manufacturer's name, address, type or style, and model or serial number on a plate permanently affixed to the equipment.

Include pipe and fitting markings with name or identifying symbol of designations manufacturer and nominal size. Use standard pipes marked with ASTM. For valves and equipment include markings with name or identifying symbol of manufacturer, specific model number, nominal size, name of device, arrow indicating direction of flow, and position of installation (horizontal or vertical), except if valve can be installed in either position. Include markings on the body casting or on an etched or stamped metal nameplate permanently on the valve or cover plate.

2.12.2 Identification Signage

Signage must be affixed to each control valve, drain, and similar valves as appropriate. Provide labeling on the surfaces of all piping to show the pipe function (e.g., "Water Supply", "Drain") and normal valve position (e.g. "Normally Open", "Normally Closed"). Valve identification sign must be minimum 150 mm 6 inches wide by 50 mm 2 inches high with enamel baked finish on minimum 1.2 mm 18 gauge steel or 0.6 mm 0.024 inch aluminum with red letters on a white background or white letters on red background. Wording of the sign must include "water supply", "drain", and similar wording as required to identify operational components. Where there is more than one zone, signage must include specific details as to the respective zone the item serves, and each zone must be marked on the floor of each zone with flush aluminum signage.

For pipe sizes 50 mm 2 inches and larger provide white painted stenciled letters and arrows, a minimum of 50 mm 2 inches in height and visible from at least two sides when viewed from the floor. For pipe sizes less than 50 mm 2 inches, provide white painted stenciled letters and arrows, a minimum of 18 mm 0.75 inches in height and visible from the floor.

2.12.3 Other Signage

Manufacturer to provide additional signage as required for safe and proper operation of the ILDFA system.

2.12.4 Pipe Escutcheons

Provide escutcheons for all pipe penetration of ceilings, floors, and walls. Securely fasten escutcheons to the pipe at surfaces through which piping passes. Provide split hinge metal plates for piping entering walls, floors, and ceilings in exposed spaces. Provide polished stainless steel plates or chromium plated finish on copper alloy plates in finished spaces. Provide paint finish on metal plates in unfinished spaces.

PART 3 EXECUTION

3.1 VERIFICATION

Before commencing work, examine all adjoining work of which the ILDFA manufacturer's system is in any way dependent for consistency of system design, installation, and performance. Correct deficiencies before installation of ILDFA components.

3.2 INSTALLATION

The installation must be in accordance with the applicable provisions of FM 6090 and the ILDFA manufacturer's installation requirements. Provide all work associated with the ILDFA systems under the direct supervision and control of the ILDFA manufacturer for safety, control of product liability, and Engineer of Record responsibilities. Coordinate the installation of the ILDFA with the work of other trades. Coordinate electrical work, including locations of all panels, equipment, motors, and other components for required clearances, access, and routing of conduit with data or power.

Provide piping offsets, fittings, equipment and all system components or accessories required to provide a complete installation and to eliminate interference with other construction. Provide required supports and hangers so that loading will not exceed allowable loadings of any structural members. Piping must be installed straight and bear evenly on hangers and supports.

3.2.1 Metal Protection

Provide in accordance with Chapter 4 of UFC 1-200-01 when ILDFA system is in a corrosion prone location or where system components use dissimilar metals. If dissimilar metals are used, also provide in accordance with MIL-STD-889. Provide added corrosion protection to the design such as, but not limited to, the following.

Where aluminum materials contact masonry or concrete, cast iron trench grates, steel rebar, carbon steel, or other material with potential to cause galvanic action, provide a fluoroelastomer sheet material or bituminous coating to prevent galvanic corrosion.

3.2.2 Control Panel Installation

Locate all control panels indoors and where shown in the design drawings. Provide all conduit entries into the bottom of the control panel. Mount

control panels and provide three phase power to each control panel.

3.2.3 Signage

Submit a complete signage package detailing all signage, identifications, labels, and markings to be provided with the final ILDFA installation. Include text, material, and method of attachment.

3.2.4 Cleaning

Clean the ILDFA surface and all components after the completion of installation.

3.3 INSPECTIONS BY FIRE PROTECTION QC SPECIALIST

The fire protection QC specialist will: 1) inspect the system periodically during the installation to assure that the system is being provided and installed in accordance with the contract requirements, 2) witness the preliminary and final tests, and sign the test results, 3) after completion of the system inspections and a successful final test, certify in writing the system has been installed in accordance with the contract requirements. All discrepancies must be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered.

3.4 ABOVEGROUND PIPING INSTALLATION

The methods of fabrication and installation of the above ground piping must fully comply with the requirements of Section 22 00 00 PLUMBING and this specification section, including support, bracing, and seismic protection.

3.4.1 Piping in Exposed Areas

Install exposed piping without diminishing exit access widths, corridors, or equipment access. Exposed horizontal piping, including drain piping, must be installed to provide maximum headroom.

3.4.2 Piping in Finished Areas

In areas with suspended or dropped ceilings and in areas with concealed spaces above the ceiling, piping must be concealed above ceilings. Piping must be inspected, hydrostatically tested and approved before being concealed. Risers and similar vertical runs of piping in finished areas must be concealed.

3.4.3 Pipe Joints

Pipe joints must conform to Section 22 00 00 PLUMBING, except as modified herein. Not more than four threads must show after joint is made up. Welded joints will be permitted only if welding operations are performed as required by NFPA 13 at the Contractor's fabrication shop, not at the project construction site. Flanged joints must be provided where indicated or required by NFPA 13. Grooved pipe and fittings must be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size. Grooved couplings, fittings and grooving tools must be products of the same manufacturer. The diameter of grooves made in the field must be measured using a "go and no-go" gauge, vernier or dial caliper, narrow

land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe must be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances.

3.4.4 Reducers

Reductions in pipe sizes must be made with one piece tapered reducing fittings. When standard fittings of the required size are not manufactured, single bushings of the face or hex type will be permitted. Where used, bushings must be installed with the outer face flush with the face of the fitting opening being reduced. Bushings must not be used in elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 13 mm 1/2 inch.

3.4.5 Pipe Penetrations

Cutting structural members, including reinforcing steel, for passage of pipes or for pipe hanger fastenings will not be permitted. [Pipes penetrating concrete or masonry walls or concrete floors must be provided with pipe sleeves fitted into place at the time of construction,][Pipes penetrating concrete or masonry walls or concrete floors must be located to miss reinforcing steel before being core drilled and provided with pipe sleeves. Each sleeve must be Schedule 40 galvanized steel, ductile iron or cast iron pipe] and extend through its respective wall or floor and be cut flush with each wall surface. Sleeve sizes and clearance between pipe and sleeve must be in accordance with NFPA 13. Sleeves must provide clearance between the pipe and the sleeve such that the diameter of the hole is nominally 50 mm 2 inch larger than pipe nominally smaller than 100 mm 4 inch, and nominally 100 mm 4 inch larger than pipe 100 mm 4 inch nominal and larger. The space between the sleeve and the pipe must be firmly packed with mineral wool insulation.

Where pipes pass through fire walls, fire partitions, or floors, a fire seal must be placed between the pipe and sleeve in accordance with Section 07 84 00 FIRESTOPPING. For penetrations in non fire rated walls, the space around the pipe must be sealed at both ends with plastic waterproof cement that dries to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.

3.5 ELECTRICAL WORK

NFPA 70. Provide all conduit, wiring, grounding, and mounting of controls in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. [Alarm signal wiring connected to the building fire alarm control system must be in accordance with Section 28 31 76 INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM.] All electrical work to comply with the electrical hazard classification[as identified in the electrical hazard plans][as follows, provide Class I, Division 1 equipment and wiring for all areas below the top surface of the ILDFA and all areas within 1525 mm 5 feet of the silhouette shadow of any aircraft parking position and Class I, Division 2 for all other areas from the top surface of the ILDFA up to 460 mm 18 inches above that surface][_____].

ILDFA manufacturer to coordinate with the qualified, licensed electrical contractor who must provide and install all [208V 3-phase][480V 3-phase] supply power to all components (such as main, auxiliary, controllers, panels, and motors) which require this low voltage supply power. The

qualified, licensed electrical contractor must provide and install all conduit for the control level power under the review and approval of the ILDFA manufacturer. Either the qualified, licensed electrical contractor or a factory authorized technician shall provide and install all wiring for control level power under the review and approval of the ILDFA manufacturer in accordance with the approved construction submittals.

3.5.1 Overcurrent and Surge Protection

Protect equipment connected to alternating current circuits from surges in accordance with IEEE C62.41.1, IEEE C62.41.2, and NFPA 70. Provide all cables and conductors which serve as communication links, except fiber optics, with surge protection circuits installed at each end. Do not use fuses for surge protection.

3.5.2 Panels and Component Installation

Panels, devices, and appliances located in the hangar bay are subject to water spray or runoff under normal operating conditions. Provide NEMA 250 Type 4 enclosures in the hangar bay and restrict conduit entry into the bottoms of enclosures (do not enter tops or sides of enclosures).

3.5.3 System Wiring

Install all conductors, including fiber optic cabling, in electric metallic tubing or metallic conduit. Utilize screw terminal blocks for connections and splices. The use of wire nut type connectors is not permitted. Provide wiring within all control equipment that is readily accessible without removing any component parts. Color code all conductors and identify within each enclosure where a connection or termination is made. Color coding is required for circuits and must be maintained throughout the circuit. Conductor identification must utilize plastic coated, self-sticking, printed markers, or heat-shrink type sleeves. Pull a dedicated earth ground conductor on all runs and bond to enclosures, boxes, and field devices which have ground terminals. Provide solid copper or stranded wiring as permitted by NFPA 70. Provide all wiring within the ILDFA system as a part of an "electrical circuit integrity system" listed under UL category code FHIT.

3.5.4 Operating Power

Provide 24 volt DC for operation of all signal initiating, signal sounding, trouble signal, and actuating (releasing) circuits. Provide secondary DC power supply for operation of system in the event of failure of the AC supply. Transfer from normal to emergency power or restoration from emergency to normal power to be fully automatic and occur without transmission of a false alarm. Obtain AC operating power for control panel and battery charger as indicated in the design drawings.

[3.5.5 PUMP POWER

Provide electrical power supply connections for pump and control panel at the supply side of building service panel. Provide a separate fused safety type switch with locked lever for each connection. Provide pressure pump sensing piping in supply piping[upstream of fire pump].

]3.5.6 Grounding

Each ILDFA system must be connected underground to the building grounding

system in at least four diverse locations, as identified in the design drawings. Provide lugs or other appropriate means of attachment at the perimeter of ILDFA flooring system for attachment to grounding pigtails emerging from the hangar bay floor slab. Ground methods must provide a uniform positive ground across the ILDFA system. Floating grounding measurement is not allowed across the ILDFA system. Maximum variation between test measurements must not exceed 5 percent.

If copper ground cables are used between the ILDFA system and the building, appropriate dissimilar metal connection methods must be utilized.

3.6 PIPE PAINTING AND LABELING

3.6.1 Painting

Paint all exposed, interior, black steel piping the same color as the walls and or ceiling, or a complementing color approved by the Contracting Officer. Do not paint exposed interior piping red. Stainless steel and aluminum piping shall be cleaned and left unpainted.

3.6.2 Pipe Identification

Mark all exposed interior piping with plastic wrap around type pipe labels conforming to ASME A13.1. Indicate the type of fluid carried and direction of flow. Labels that stick-on (adhesive backed) or are held on with straps or adhesive tape are not permitted. Labels are not required on piping routed below the floor line in ILDFA trenches or pits. At a minimum, the following labels are required.

a. ILDFA FLUSHING MANIFOLD SUPPLY WATER - Used on dedicated potable and non-potable ILDFA flushing manifold water supply piping.

b. ILDFA FLUSHING MANIFOLD ZONE # - Used on branch lines from main flushing manifold supply piping to individual flushing manifold zones. Indicate zone number (#) on label.

c. ILDFA EFFLUENT - Used on discharge piping from the effluent pump.

3.7 PREPARATION AND PAINTING OF FLOOR MARKINGS

Clean, prime, and paint top surface of aluminum flooring as indicated. Place markings in accordance with the design drawings. This includes stenciling of each grounding point. Preparation and materials vary from typical hangar bay floor markings due to application on aluminum substrate rather than typical concrete substrate.

3.7.1 Preparation

Clean the surfaces in accordance with SSPC SP 11. Do not use abrasives containing iron such as steel wool, iron oxide, rouge, or steel wire.

3.7.2 Primer Application

Immediately after cleaning, prime the metal surfaces with MPI 101 epoxy primer applied at a spreading rate from 4.0 to 8.0 mils DFT.

3.7.3 Topcoat Application

Apply two coats of MPI 83 urethane topcoat. Apply a full coat of urethane topcoat at a spreading rate from 3.0 to 6.0 mils DFT. Apply a second coat of urethane topcoat at a spreading rate from 3.0 to 6.0 mils DFT.

3.7.4 Curing

Installed materials must cure and display performance equal to the ILDFA manufacturer's product literature. Remove and reapply improperly cured material

3.8 FIELD QUALITY CONTROL

3.8.1 Test Procedures Prepared or Approved by Fire Protection QC Specialist

In accordance with NFPA 4 include in the test plans complete procedures and methods, describe what tests are to be conducted, what data is to be collected, acceptable findings, corrective action for failure to meet acceptable findings, equipment required, personnel required, procedure for notifying Contracting Officer, list of ILDFA manufacturers employees to assist, and integration of test for water supply. Verify that the water supply is adequate to support the systems.

Reference NFPA 4 A.1.1 for the required testing methods for interconnected active and passive fire protection and life safety systems to verify end to end operational readiness and sequence of operation.

3.9 PRELIMINARY TESTING

Perform tests to make final adjustments to ILDFA operation, to verify the system functions as intended, and to confirm the system is ready for service. Include testing of all components and subsystems and conduct under the supervision of a technical representative of the ILDFA manufacturer.

Use a spill flow rate of 1500 liters 400 gallons per minute using a spill apparatus during testing to simulate a fuel spill flow rate of 750 liters 200 gallons per minute and a flushing rate of 760 liters 200 gallons per minute(170 liters 45 gallons per minute from each of four zones). Test results, including all operating conditions and instrumentation readings, must be recorded on an appropriate test form signed and dated by the ILDFA manufacturer's representative certifying that the system is in compliance with contract requirements and the ILDFA manufacturer's recommended practices.

3.9.1 Preliminary Test Requirements

Provide the following preliminary testing reports before performing Final Acceptance Testing. Testing reports must have been reviewed and approved by the Contracting Officer. Testing must include, but not be limited to, the following:

a. Functional testing of liquid detection sensors

b. Functional testing of each flushing manifold solenoid valve. For this test, the flushing manifold hatch covers or trench covers must be removed and flow of water to each channel observed. Pressure and flow rate for each manifold must be documented and

submitted with the preliminary test report.

c. Testing of all ICP functions to ensure compliance with submitted logic tree.

d. All the above tests must be performed with the system on battery power for 48 hours in advance of test. If the testing duration exceeds 15 minutes and the batteries get depleted, it is acceptable to restore primary power and continue testing.

e. Maximum flow test according to a worst case spill scenario detailed in the design plan.

f. Hydrostatic test of flushing water supply piping at not less than the greater of 1380 kPa 200 psi or 345 kPa 50 psi in excess of the maximum system operating pressure for 2 hours in accordance with NFPA 13 and NFPA 24. Testing scope includes all piping beginning at connection to water source within hangar bay and ending at flushing manifold inlet. There must be no visible leakage from the piping when the system is subjected to the hydrostatic test.

g. If present, prior to testing, fill the oil-water separator with water. Test the system at the maximum flow rate for 10 minutes to confirm capacity of the out-flow system is met.

h. Provide backflow preventer forward flow test and cross connection control test.

i. Visual inspection of wiring connections.

j. Verify whether power supplies to ICP panel are provided and identified in accordance with NFPA 72.

k. Verify that wire-nuts are not used in the ILDFA system wiring. Perform random checks by opening junction boxes to verify that screw type terminal blocks have been used throughout.

3.10 PRELIMINARY TEST REPORT

Submit the Preliminary Test report, before requesting a Final Acceptance Test. Provide a list of deficiencies prepared at the completion of preliminary test and a Final Acceptance Test plan.

3.11 FINAL ACCEPTANCE TESTING WITNESS AND APPROVAL

Upon receipt of the Preliminary Acceptance Test report, schedule a mutually agreed upon date to witness and approve the Final Acceptance Test (FAT). The FAT must consist of a maximum flow test according to a worst case spill scenario detailed in the design plan. The ILDFA system FAT must be conducted by the contractor and a representative from the ILDFA manufacturer and will be witnessed and approved in writing by the ILDFA manufacturer, Fire Protection QC Specialist and Contracting Officer. All instruments and equipment for testing must be furnished by the Contractor including liquid filled pressure gage and flow meter on the flushing water supply line in order to substantiate the hydraulic calculations and determine actual flow to each manifold.

Contractor must provide hose, personnel, and all other equipment necessary to fulfill testing requirements specified. Contractor must provide

calibration certificates for each instrument used for testing. Tests must be conducted by experienced personnel according to the equipment and ILDFA manufacturers' recommendations. Deficiencies must be corrected and successfully retested in the presence of the ILDFA Manufacturer, Fire Protection QC Specialist, and Contracting Officer.

3.12 FINAL ACCEPTANCE TEST REPORT AND RECORD DRAWINGS

Provide the Final Acceptance Test Report per NFPA 4 and As-built Drawings. Provide documentation of readings and test results. The Final Acceptance Test report must include the resolution of deficiencies identified during preliminary acceptance testing. The Final Acceptance Test Report must include a Verification of Compliant Installation letter signed by the ILDFA manufacturer and Fire Protection QC Specialist.

3.13 POSTED INSTRUCTIONS

Post a framed description of ILDFA system operation, instructions, and schematic diagrams of the overall ILDFA system and each subsystem where directed. Include condensed operating instructions to explain the system for normal operation and routine testing.

3.14 OPERATION AND MAINTENANCE MANUALS

Submit manuals at the time the test procedure is submitted and include the following identification on the covers: "OPERATING AND MAINTENANCE (O&M) INSTRUCTIONS," name and location of the building, name of the Contractor, and contract number. Place flysheets before instructions covering each subject. Use letter sized paper for instruction sheets, with larger sheets of drawings included as necessary. Include all operational, inspection, and maintenance data required for the ILDFA systems provided including:

a. System layout showing piping, valves, and controls.

b. Approved wiring and control diagrams.

c. A control sequence describing startup, operation, and shutdown.

d. Operating and maintenance instructions for each piece of equipment, including task list for routine maintenance, routine inspections, intermediate inspections, and annual inspections; lubrication instructions; and troubleshooting guide.

e. ILDFA Manufacturer's bulletins, cuts, descriptive data, parts list, and spare parts including replacement instructions.

3.15 ON-SITE TRAINING

Provide 8 hours of on-site training session for the responding fire department, base personnel, operating personnel, and maintenance personnel as designated by the Contracting Officer. Perform training on two separate days for a period of 4 hours of normal working time on dates and times approved by the Contracting Officer. Do not start training until after the system is functionally complete and after approval of the final acceptance test. The on-site training will cover all items contained in the approved Operating and Maintenance Instructions, including safety, normal operation, emergency operation, troubleshooting, maintenance, and repair guidelines. Each training session must include a walk through of the facility while describing the operation of the equipment and system.

Conduct a system actuation to demonstrate system operation and procedures for resetting the system. Demonstrate all routine maintenance (e.g. weekly, monthly, yearly,) in the equipment manuals and NFPA standards. Describe the warning signs of equipment failure and required responses to those warning signs.

[Record this on-site training and provide a video presented in an organized and coherent fashion such that the Government will use the video as the sole training program for future user operators. It is acceptable to utilize stock training video content in this video provided the door operation, safety and controls are identical to the door system provided.]

-- End of Section --