10. Confined Space Safety

(With changes 11-14-06)

This Chapter Describes Hazardous Operations.

Contents

1.0 PURPOSE OF CHAPTER

This Chapter establishes the DFRC Confined Space Safety Program.

2.0 SCOPE & APPLICABILITY

2.1 Scope

This chapter provides the minimum procedures required to conduct confined space operations at DFRC.

2.2 Applicability

This chapter applies to all persons under DFRC supervision, including civil service, contractors, experimenters, and visitors, but in particular to persons whose work causes them to work in or near confined spaces.

3.0 CHAPTER OBJECTIVES

The objective of this safety instruction is to identify, eliminate, or control potential confined space mishaps with the desired result of sustained zero mishaps during confined space operations.

4.0 RELEVANT DOCUMENTS

4.1 Authority Documents

NPD 8710.2	NASA Safety and Health Program Policy
NPR 8715.3	NASA Safety Manual
29 CFR 1910.146	Permit-Required Confined Spaces
29 CFR 1910.268	Telecommunications
PI-20	NASA-DFRC Process Instruction
Applicable Aircraft Maintenance Manuals or Technical Orders	
T.O. 1-1-3	Inspection And Repair Of Aircraft Integral Tanks And Fuel Cells, (latest issue)
T.O. 00-25-172	Ground Servicing Of Aircraft And Static Grounding / Bonding, (latest issue)

4.2 Reference Documents

ANSI Z117.1 Safety Requirements for Confined Spaces

4.3 Informational Documents

Title 8, California Code of Regulations; Article 108, Sections 5156-5157	This Code follows 29 CFR 1910.146 closely.
National Institute for Occupational Safety and Health, 80-106	Criteria for a Recommended Standard - Working in Confined Spaces
National Institute for Occupational Safety and Health, 87-113	A Guide to Safety in Confined Spaces

5.0 WAIVER AUTHORITY

Requests for waivers and variances to DFRC specific safety documents shall be made to the Office of Safety and Mission Assurance, (Code S). Requests for waivers and variances to NASA safety instructions shall be made to NASA HQ in accordance with instructions provided by NPR 8715.3, “NASA Safety Manual,” Par. 1-19, “Safety Variance Process,” and Table 1-1: “NASA Safety Risk and Approval Process Matrix.” All requests for waivers and variances to safety instructions including those to other regulatory agencies shall be coordinated through Code S.

6.0 ACRONYMS & DEFINITIONS

6.1 Acronyms

ACGIH	American Conference of Governmental Industrial Hygienist
CO	Contracting Officer
COTR	Contracting Officer Technical Representative
IDLH	Immediately Dangerous to Life or Health
IH	Industrial Hygienist
MSDS	Material Safety Data Sheet
PPE	Personal Protective Equipment
TLV	Threshold Limit Values
T.O.	Technical Orders

6.2 Definitions

Acceptable Entry Conditions	Conditions that must exist in a confined space to allow entry and to ensure that employees involved can safely enter into and work within the space.
Attendant	An individual stationed outside one or more permit spaces who monitors the entrants and who performs attendant's duties.
Blanking or Blinding	The absolute closure of pipe, line, or duct by the fastening of a solid plate (such as a spectacle blind or a skillet blind) that completely covers the bore and that is capable of withstanding the maximum pressure of the pipe, line, or duct with no leakage beyond the plate.
Checklist	A document that is provided to allow entry into a nonpermit confined space. Dryden Non-Permit Confined Space Checklist is WK 8-224.
Confined Space	A space that 1) Is large enough and so configured that an employee can bodily enter and perform assigned work and; 2) Has limited or restricted means for entry or exit (for example, tanks, vessels, fuel cells, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry) and; 3) Is not designed for continuous employee occupancy.
Double Block and Bleed	The closure of a line, duct, or pipe by closing and locking or tagging two in-line valves and by opening and locking or tagging a drain or vent valve in the line between the two closed valves.
Emergency	Any occurrence (including any failure of hazard control, or monitoring equipment) or event internal or external to the confined space that could endanger Entrants.
Engulfment	The surrounding and effective capture of a person by a liquid or finely divided (flowable) solid substance that can be aspirated to cause death by filling or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction, or crushing.
Entrant	An employee who has the required training and is authorized by the employer to enter a confined space.
Entry	The action by which a person passes through an opening into a confined space. Entry includes ensuing work activities in that space and is considered to have occurred as soon as

	any part of the entrant's body breaks the plane of an opening into the space.
Entry Permit	A document that is provided by the employer to allow and control entry into a permit required space. Dryden Confined Space Entry Permit is DFRC 8-223.
Entry Supervisor	1) Individual (such as the employer, foreman, or crew chief) responsible for determining if acceptable entry conditions are present at a confined space where entry is planned. 2) Has the authority to authorize entry and to oversee entry operations. 3) Has the authority to order evacuation, terminate entry and must sign the entry checklist or permit. 4) May serve as an attendant or entrant as long as he/she is trained and equipped for that position as required by this document.
Hazardous Atmosphere	An atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue (that is, escape unaided from a confined space), injury, or acute illness. A hazardous atmosphere may contain toxic gasses or vapors, inert gasses, reduced or increased oxygen, explosive or flammable substances
Exposure Limits	NASA uses 29 CFR Part 1910.1000 Subpart Z, Toxic and Hazardous Substances, which sets Permissible Exposure Limits (PEL) and American Conference of Governmental Industrial Hygienist (ACGIH), which establishes Threshold Limit Values (TLV®). Exposure limits for some substances have not been made by OSHA or ACGIH. There are sources of information, such as Material Safety Data Sheets, that comply with the Hazard Communication Standard, 29 CFR 1910.1200, published information, and internal documents that may provide guidance in determining acceptable conditions. The Safety, Health, and Environmental Office shall be contacted anytime information is not available or there is a question regarding a substance.
Hot Work Permit	The employer's written authorization to perform operations (for example, riveting, welding, cutting, burning, and heating) capable of providing a source of ignition. For DFRC this permit is AF Form 592, which must be filled out by the employee and approved by the Safety, Health, and Environmental Office before hot work is started.
Immediately Dangerous to Life or Health (IDLH)	A condition that poses a threat of exposure to airborne contaminants when that exposure is likely to cause death, immediate or delayed permanent adverse health effects, or

	prevent escape from such an environment in the event of the failure of respirator protection equipment.
Inerting	The displacement of the atmosphere in a permit space by an inert gas (such as nitrogen) to such an extent that the resulting atmosphere is noncombustible. This may produce an IDLH condition.
Isolation	The process by which a confined space is removed from service and protected against the release of energy and material into the space by such means as blanking or blinding; misaligning or removing sections of lines, pipes, or ducts; a double block and bleed system; lockout or tagout of all sources of energy; or blocking or disconnecting all mechanical linkages.
Line breaking	Intentional opening of a pipe, line, or duct that is or has been carrying flammable, corrosive, or toxic material, inert gas, or any fluid at a volume, pressure, or temperature capable of causing injury.
Non-Permit Confined Space	Confined space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazards capable of causing death or serious physical harm.
Oxygen Deficient Atmosphere	An atmosphere containing less than 19.5 percent oxygen by volume.
Oxygen Enriched Atmosphere	An atmosphere containing more than 23.5 percent oxygen by volume.
Permit-Required Confined Space (permit space)	A confined space that has one or more of the following characteristics: 1) Contains or has potential to contain a hazardous atmosphere or; 2) Contains a material that has the potential for engulfing an entrant or; 3) Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section or; 4) Contains any other serious safety or health hazard.
Permit-Required Confined Space Program	The employer's overall program for controlling and protecting employees from permit space hazards and for regulating employee entry into permit-required spaces.
Prohibited Condition	Any condition in a confined space that is not allowed by the permit or checklist during the period when entry is authorized.
Rescue Service	The personnel designated to rescue employees from

confined spaces.

Retrieval System	Safety equipment including a retrieval line, full body harness, wristlets and a lifting device or anchor used for non-entry rescue of persons from confined spaces.
Testing	The process by which the hazards that may confront Entrants of a confined space are identified and evaluated. Testing includes specifying the tests that are to be performed in the confined space. Testing enables employers both to devise and implement adequate control measures for the protection of Entrants and to determine if acceptable entry conditions are present immediately prior to and during entry.

7.0 PROCEDURES & GUIDANCE

7.1 Responsibilities

7.1.1 Directorates and Single Letter Offices

Directorates and Single Letter Offices are responsible for ensuring that risk assessments of potential confined spaces within their area of responsibility are made and, when confined spaces are determined to exist, to control entry in accordance with this and other applicable documents. This includes identifying to the Safety, Health, and Environmental Office new confined spaces that have been created in order for a classification of the space to be made. The owner will be notified as to how the space was classified (Non-Permit Confined Space or Permit Required Confined Space). Upon classification, the Directorate or Single Letter Office must post an appropriate sign that alerts potential entrants.

7.1.2 Chief, Safety, Health, and Environmental Office

The Chief, Safety, Health, and Environmental Office has oversight for confined space entry and as such incurs the following responsibilities:

A. Develop and maintain a confined space safety program for DFRC

B. Include organizational confined space activity as part of safety inspections

C. Investigate confined space accidents and incidents and report them to management and required agencies

D. Issue confined space checklists and permits

7.1.3 Entry Supervisor

The Entry Supervisor is the "foreman" for confined space entry and has the following responsibilities:

A. With the assistance of the Safety, Health, and Environmental Office Industrial Hygienist (IH), complete DFRC 8-223, Confined Space Entry Permit

B. Review the confined space and project hazards with the IH

C. Make form DFRC 8-223 available to employees and post the form near the confined space entry

D. Verify that entry personnel and attendants are qualified, required forms are complete, necessary pre-entry tests have been completed, required PPE is worn by Entrants, and necessary equipment is in place including non-entry rescue, and communications equipment when required

E. Ensure that conditions are monitored, do not degrade from initial evaluation, and remain consistent with the entry permit

F. Ensure hazards listed on DFRC 8-223 are controlled or eliminated

G. Provide appropriate barriers to isolate the area and protect entrants from external hazards. Remove unauthorized individuals who enter or who attempt to enter the secured area

H. Order evacuation of the confined space and cancel the permit when unsafe conditions exist or the task is completed. Return permit, and test equipment to the Safety, Health, and Environmental Office when the task is terminated

7.1.4 Attendant

The attendant is stationed outside a permit required confined space to monitor the conditions of the entrants. The attendant will be in communication with the Entrants and have the following responsibilities:

A. Be aware of the hazards that may be faced during entry, monitor physical and behavioral changes in entrants, and know the consequences of exposure

B. Maintain entrant identification and effective communication with all Entrants

C. Monitor entry activities and watch for prohibited conditions both inside and outside the confined space. Entrants may not be assigned another duty that could possibly be a distraction.

Attendants shall not leave their location unless relieved by another qualified attendant.

D. The attendant will order the Entrants to cease operation and exit the confined space when:
   1) A prohibited condition exists.
   2) A behavior or other unusual condition in the Entrants is detected.
   3) An unsafe condition occurs inside or outside of the permit space.
   4) Unable to perform all necessary duties

E. Initiate on-site rescue procedures and notify emergency rescue service if necessary.

7.1.5 Entrants

All Entrants who enter a confined space shall know the potential hazards that may be encountered during entry and the proper use and limitations of equipment to control those hazards. Other responsibilities include:

A. Communicate with the attendant to enable the attendant to maintain current status of entry operations. The Entrants will notify the attendant whenever
   1) The entrant recognizes any warning sign or symptom of exposure to a dangerous substance or;
   2) The entrant detects a prohibited or dangerous condition
   3) Entrants will exit from the confined space quickly when:
      - An order to evacuate is given.
      - The entrant recognizes any warning sign or symptom of exposure or a dangerous situation.
      - The entrant detects a prohibited condition.
      - An evacuation alarm is activated.
      - An air monitor indicates an unsafe atmosphere, (when an air-breathing source is not used).

7.1.6 Contracting Officer (CO)

A. Off-site Contractors – Off-site contractors involved in confined space entry shall be informed of the following by the Contracting Officer:

1) That confined space entry is allowed only through compliance with the contractor's approved confined space entry program or this document. If the contractor's program is used it must be approved by the Safety, Health, and Environmental Office
2) Of the elements that make the space a confined space, including hazards identified and DFRC's experience with the space
3) Coordinating entry operations with both the on-site and off-site contractors when both will be working in or near confined spaces

B. Multiple Contractors – If more than one contractor will be entering the confined space the DFRC line supervisor or Contracting Officer Technical Representative (COTR) responsible for the project shall coordinate entry operations and ensure that each contractor is aware of the operations of the other(s) and that each contractor has been issued and signed their own NASA entry permit or checklist. A qualified Entry Supervisor shall be selected to oversee entry operations.

C. Documentation – The CO shall request necessary documentation from the contractor, such as training records, PPE training, etc., prior to start of work. Off-site contractor personnel are not required to have a medical clearance for confined space entry.

7.2 Confined Space Entry Procedures

7.2.1 Nonpermit Confined Space Entry Control

If the only hazard in the confined space is the atmosphere and it can be eliminated or controlled by ventilation, the confined space may be classified as nonpermit. There are, however, entry control procedures to ensure the safety of Entrants.

A. Signage – A Caution sign shall be posted at all nonpermit confined spaces by the facilities organization under the direction of the Safety, Health, and Environmental Office. The purpose of the sign is to inform employees of the classification of the confined space.

B. Pre-entry – Before entry into a nonpermit space is authorized, the Designated Entrant shall, with the assistance of an IH, complete WK 8-224, Non-Permit Confined Space Checklist.

C. Checklist – Checklist WK 8-224 will be made available at the time of entry to all Entrants by posting it at the portal or by any other equally effective means in order that the Entrants can confirm entry preparations have been completed.

D. Form Duration – The effective time of form WK 8-224 shall not exceed the time required to complete the task identified. The

duration must not extend beyond one shift with the same crew. If a new crew arrives, new forms must be completed.

7.2.2 Permit Space Entry Control

Entry control may be enhanced by the use of area or job specific procedures. Work often involves trade-skilled individuals that must routinely work in areas that are permit required confined spaces. In some cases, the work is preventative maintenance, which has specific written work procedures. In this case, the confined space safety requirements may be added to the written work procedures as long as they meet the requirements of this document and are approved by the Safety, Health, and Environmental Office.

A. Signage – A Danger sign shall be posted at all permit-required confined spaces by Research Facilities Directorate (Code F) under the direction of the Safety, Health, and Environmental Office. The purpose of the sign is to inform employees of the danger posed by the permit-required confined space.

B. Pre-Entry – Before entry into a permit space is authorized the Entry Supervisor shall, with the assistance of an IH, complete DFRC 8-223, Confined Space Entry Permit.

C. Permit – DFRC 8-223 will be made available, at the time of entry, to all Entrants and attendant(s) by posting it at the portal or by any other equally effective means in order that the Entrants and attendant can confirm entry preparations have been completed.

D. Form Duration – The effective time of form DFRC 8-223 shall not exceed the time required to complete the task identified. The duration must not extend beyond one shift with the same crew. If a new crew is scheduled to enter, the new supervisor must complete form DFRC 8-223.

E. Permit Termination – A permit shall be terminated under the following conditions:

   1) The task covered by the permit has been completed

   2) A condition not allowed under the permit or this document arises in or near the confined space

F. Entry Review – The entry supervisor shall note any problems encountered during the entry on form DFRC 8-223 so that appropriate revisions to the confined space program may be made. Form DFRC 8-223 will be returned to the Safety Office within three (3) days of entry completion.

7.2.3 Reclassification of Confined Spaces

A. Permit Space to Non-Permit Space – If it is necessary to enter a permit required confined space to eliminate hazards such entry shall be performed under permit space entry procedures. If testing and inspection demonstrates that the hazards within the permit space have been eliminated, the permit required confined space may be reclassified as a nonpermit space for as long as conditions remain safe.

B. Non-Permit Space to Permit Space – When there is a change in the use or configuration of a nonpermit space that increases the hazard to Entrants the Safety, Health, and Environmental Office shall be notified. The nonpermit space shall be reevaluated and, if necessary reclassify it as a permit required confined space.

C. Documentation – The permanent reclassification of a confined space shall be documented on form WK 8-225, Confined Space Evaluation and placed on file in the Safety, Health, and Environmental Office. For temporary reclassification, the notation shall be made on the appropriate form (DFRC 8-223 or WK 8-224) and placed on file in the Safety, Health, and Environmental Office.

7.3 Safety Precautions

7.3.1 Confined Space Hazards

Confined space hazards fall into two (2) general categories, hazardous atmospheres, and physical hazards.

Table 1
Atmospheric Hazards

Hazard	Description	Comments
O_2 Deficiency	Less than 19.5 % by volume	May cause light-headedness dizziness or unconsciousness
O_2 Increase	Greater than 23.5 % by volume	Increases flammability and explosion possibilities.
Hydrogen Cyanide	Poisonous gas	Has a bitter almond odor
Hydrogen Sulfide	Toxic gas	Has a rotten egg odor
Methane	Toxic, flammable and explosive	Has no odor
Freon	May be toxic depending on type	Displaces breathing air
Vapors from jet fuels, gasoline, solvents, and other carbon-based liquids	Usually toxic, flammable and explosive	Get upwind from vapors
Dusts & flyings	May be explosive	May damage respiratory system
Carbon Dioxide (CO2) & Nitrogen (N2)	Can concentrate in low places	Displaces breathing air
Carbon Monoxide (CO)	Toxic gas	Replaces O_2 in the blood. Can be fatal.
Fumes, vapors, gases, and mists.	Welding, cutting, flames, sparks, etc.	Work being done may change the classification of the space

See 29 CFR 1910.1000 Subpart Z Toxic and Hazardous substances, or current ACGIH TLV® for other toxic and hazardous substances and exposure limits.

7.3.2 Test of Conditions

A. Conditions must be tested in a confined space to determine if acceptable entry conditions exist before entry is authorized.

B. If isolation of the space is not feasible because the space is large or is part of a continuous system, such as a sewer, pre-entry testing shall be performed to the extent feasible before entry is authorized. If entry is authorized, entry conditions shall be continuously monitored in the area where Entrants are working.

C. If a hazardous atmosphere could be created by the work being done such as welding, cutting, brazing, open flames, etc., atmospheric monitoring will be continuous.

7.3.3 Test Sequence

When testing for atmosphere hazards it is **CRITICAL** that the testing order below be followed.

1. Oxygen
2. Combustible gases and vapors
3. Toxic gases and vapors

7.3.4 Ventilation

Entrants shall not enter a confined space that contains a hazardous atmosphere without appropriate respirators. The hazardous atmosphere must be eliminated by forced ventilation in order for the space to be classified as a nonpermit confined space. The airflow shall be directed to ventilate the immediate area where the Entrants are to be in the space and shall start 30 minutes prior to entry and continue until all Entrants have left the space. The air supply shall be from a clean source and may not increase the hazards of the space. The atmosphere shall be tested periodically or as directed by the permit or checklist to ensure the ventilation is adequate. Should a hazardous atmosphere be detected Entrants will evacuate the space. The reason for the atmosphere change will be determined and corrected before Entrants may re-enter the space.

Table 2
Physical Hazards

Hazard	Description	Comments
Electrical	Electrical transmission line, equipment or machines	Lockout or tagout (LOTO) procedures may be required
Thermal energy	Heat, steam, or hot atmosphere	May require ventilation, LOTO, etc.
Becoming lodged	Space becomes narrower, slopes downward	Area requires a survey before entering and the use of an extraction harness
Falling objects	Debris, or tools that can fall into a space	Isolate openings. Hard hats required and other precautions need to be taken
Falls	Falls from ladders or other support equipment	Use proper support equipment
Noise	Noise may be excessive where equipment or machinery is located in a confined space	Wear hearing protection where required, however, Entrants must have a means of hearing the attendant
Engulfment	See Section 6.0 definition	
Ionizing and non-ionizing radiation	May be from microwave equipment, etc.	See Chapters 10 &11, ionizing and non-ionizing radiation
Hot Tap, welding, brazing, etc.	Open flames, sparks	May require additional permits. Fuel tanks may not be left in confined space when not in use

Note: Some physical hazards may not be apparent on entry unless a thorough evaluation of the site has been made.

7.4 Rescue

7.4.1 First Aid & CPR

For entry involving DFRC personnel, it is recommended that either the entry supervisor or the attendant hold a current certification in First Aid and CPR.

7.4.2 Retrieval System

To facilitate non-entry rescue, a suitable retrieval system shall be used whenever an entrant enters a permit required confined space unless the retrieval equipment would increase the overall risk of entry or would not contribute to the rescue of the entrant.

7.4.3 Retrieval Harness

Entrants shall use full body harness, with a retrieval line attached behind the center of the entrant's back or above the head. Wristlets may be used in lieu of the full body harness if the employer can demonstrate that the use of a full body harness is not feasible or creates a greater hazard and that the use of wristlets is the safest and most effective alternative. Wristlets should not be used to lift a person’s full weight.

7.4.4 Retrieval Line

The end of the retrieval line shall be attached to a mechanical device or fixed point outside the permit space in such a manner that rescue can begin as soon as the rescuer becomes aware that rescue is necessary. A mechanical device shall be available to retrieve personnel from vertical permit spaces more than 5 feet deep.

7.4.5 Rescue Notification

If in the course of a permit required space entry, an attendant becomes aware that an entrant needs assistance in evacuating, the attendant shall summon rescue and other emergency services and begin non-entry rescue procedures.

7.4.6 Attendants

Attendants may enter a permit-required space to attempt a rescue only if they have been certified, trained and properly equipped for rescue operations, and have been relieved by another attendant.

7.4.7 Toxic Materials

If an injured entrant is exposed to a substance for which a material safety data sheet (MSDS) or similar written information is required to be kept at the work site, that MSDS or written information shall be made available to the medical facility treating the exposed entrant.

7.5 Medical Clearances

7.5.1 Medical Clearances

DFRC and on-site contractor Entrants who enter confined spaces and attendants shall receive medical clearances annually. Medical clearances shall be completed prior to training unless otherwise approved. On-site contractor Entrants are authorized to receive medical clearance from the DFRC Health Unit.

7.5.2 Medical Clearance for Respirators

Persons requiring the use of respirators shall receive medical clearance and training as directed by Chapter 15 Respiratory Protection.

7.6 Tools, Equipment, and Materials

Each confined space entry will offer different conditions that must be controlled. When a proper hazard analysis is made of the confined space these conditions should become evident allowing actions to be taken to control them. Following is a list of items that may be required depending on the conditions of the entry.

A. Atmosphere testing and monitoring equipment

B. Air exchangers and ventilation equipment

C. Personal Protective Equipment such as:

- Respiratory equipment
- Gloves
- Hard hats
- Face shields or safety glasses
- Special footwear
- Coveralls

D. Communication equipment

E. Lighting (explosion proof if necessary)

F. Barriers

G. Ladders or other types of entry and exit devices

H. Non-entry rescue equipment such as:

- Harness
- Retrieval line

- Wristlets

7.7 Telecommunications Field Work

This section applies to the guarding of utility vaults and street openings, and to atmospheric testing and ventilation in utility vaults and nonvented vaults where telecommunications fieldwork is performed on or with underground lines. See 29 CFR 1910.268, Telecommunications.

7.7.1 Guarding Utility Vaults and Street Openings

When covers of utility vaults or street openings are removed, the opening shall be promptly guarded by a railing, temporary cover, or other suitable barriers appropriate to prevent an accidental fall through the opening, and to protect employees working in the utility vault from foreign objects entering the opening.

7.7.2 Requirements Prior to Entering Utility Vaults & Nonvented Vaults

Before an employee enters a utility vault, the following steps shall be taken:

A. The internal atmosphere shall be tested for oxygen deficiency, combustible gases, and toxic gases.

B. When unsafe conditions are detected by atmospheric testing or other means the work area shall be ventilated or otherwise be made safe before entry.

7.7.3 Air Supply

An adequate continuous supply of air shall be provided while work is performed in utility vaults under any of the following conditions:

A. Combustible or explosive gas vapors have been initially detected and subsequently reduced to a safe level by ventilation

B. Solvents or other hazardous materials are used in the work procedure

C. Open flame torches are used in the work procedure

D. The utility vault is located in that portion of a public right of way open to vehicular traffic and/or exposed to a seepage of gas or gases

E. A toxic gas or oxygen deficiency is found

7.7.4 Joint Power and Telecommunication Utility Vault

A. First Aid and CPR – An employee with basic first aid and CPR training shall be available in the immediate vicinity to render emergency assistance when work is being performed in a utility vault occupied jointly by an electric and telecommunication utility. This employee is not precluded from occasionally entering a utility vault to provide assistance other than in an emergency. The requirement of this section does not preclude a qualified employee working alone from entering, for brief periods of time, a utility vault where energized cables or equipment are in service for the purpose of inspection, housekeeping, taking readings, or similar work when such work can be performed safely.

B. Ladders – Ladders shall be used to enter and exit utility vaults exceeding 4 feet in depth.

C. Open Flames – When open flames are used in utility vaults, the following precautions shall be taken to protect against the accumulation of combustible gas:

   1) A confined space permit is required.

   2) A test for combustible gas shall be made immediately before using the open flame device and continuously while using the device.

   3) A fuel tank (e.g., acetylene, etc.) may not be in the utility vault except during actual use.

   4) A welding, cutting, and brazing permit (AF Form 592) shall be filled out and approved by the Safety, Health, and Environmental Office prior to performing any work that creates a flame or spark. Precautions shall be taken to guard against a build up of combustible, toxic gases, fumes, mists, etc., when open flames or welding operations are being done in vaults.

7.7.5 Microwave Equipment

Microwave equipment in underground vaults and tunnel shall be properly posted with warning signs. Radiation exposure limits shall not be exceeded. See Chapter 11, Non-Ionizing Radiation, and ANSI/IEEE C95.3, Measurement of Potential Hazardous Electrical-Magnetic Fields – RF and Microwave, for additional information.

7.7.6 Sewers

A. Sewer Entry – Working in sewers differs in three vital respects from other permit required confined space entries. They are:

1) There is rarely a means to isolate the space

2) The atmosphere cannot be controlled and, therefore, may suddenly and unpredictably become lethal beyond control of the entrant

7.7.7 Atmosphere Monitoring

To ensure safety while in sewer systems, the atmosphere shall be monitored continuously with equipment that sounds an audible alarm when the atmosphere becomes out of limit for one of the following:

1) Oxygen below 19.5 or above 23.5 percent

2) Flammable gas or vapor at 10% or more of the lower flammable limit

3) Hydrogen sulfide at 10 PPM and carbon monoxide at 25 PPM

7.8 Aircraft Fuel Cells/Tanks

7.8.1 Aircraft Fuel Cell/Tank Entry

Entry into aircraft fuel cells and tanks require precautions not normally associated with other confined space entry at DFRC. Entrant's movement may be restricted, and solvents and adhesives may be used in enclosed areas during repairs.

In addition to the appropriate requirements of this chapter, aircraft fuel cells and tanks must be purged of all fuel prior to entry. Appropriate ventilation/respiratory systems, atmospheric testing, and entrant recovery procedures shall be established prior to entry.

7.8.2 Aircraft Fuel Cell/Tank Documentation

The following documentation provides procedures required to safely enter aircraft fuel cells/tanks.

A. NASA DFRC Process Instruction, PI-20

B. Applicable Aircraft Maintenance Manuals or Technical Orders. Where a manual or T.O is written for a specific aircraft they shall take precedence over other documentation where there is a conflict.

C. T.O. 1-1-3, Inspection and Repair of Aircraft Integral Tanks and Fuel Cells, (latest issue)

D. T.O. 00-25-172, Ground Servicing of Aircraft and Static Grounding / Bonding, (latest issue)

8.0 TRAINING & CERTIFICATION

8.1 Training Requirements

Entrants, Attendants, Entry Supervisors, and rescue service members shall be qualified for the position they fill. Training records shall include each employee's name, the signatures, or initials of the trainers, and the dates of training. Training records and medical approvals shall be maintained by the organization/s conducting the confined space entry or in a central DFRC location and shall be available for inspection by Safety personnel, supervisors, authorized confined space team members, and their authorized representatives. Training shall, at a minimum, include the following:

A. Awareness of the DFRC confined space entry program

B. The specific duties of each person involved in confined space operations

C. The hazards of confined spaces including information on the mode, signs or symptoms, and consequences of exposure

D. The proper use of equipment required during confined space operations including testing and monitoring equipment, ventilating equipment, communication equipment, personal protective equipment, lighting equipment, barriers and shields, ingress/egress equipment, rescue and emergency equipment used for non-entry rescue

E. The importance of maintaining communications between entrants and attendants

F. The conditions that require the space to be evacuated

G. The procedures for summoning rescuers

H. The procedures to be used for a non-entry rescue

I. Each member of the confined space entry team at DFRC will receive biannual training

8.2 Safety, Health, and Environmental Office

Will provide confined space training to DFRC personnel and on-site contractors. Off-site contractors will make appropriate arrangements for training and documentation in accordance with 29 CFR 1910.146.

8.2.1 Additional Training

Additional training will be required when

A. There is a change in confined space operations, which presents a hazard, about which an employee has not previously been trained.

B. Deviations from the confined space entry procedures occur or when there are inadequacies in the employee's knowledge of confined space entry procedures.

9.0 METRICS & TREND ANALYSIS

See Chapter 1, "Program", Section 8.0, Metrics & Trend Analysis

10.0 MANAGEMENT RECORDS & RECORDS RETENTION

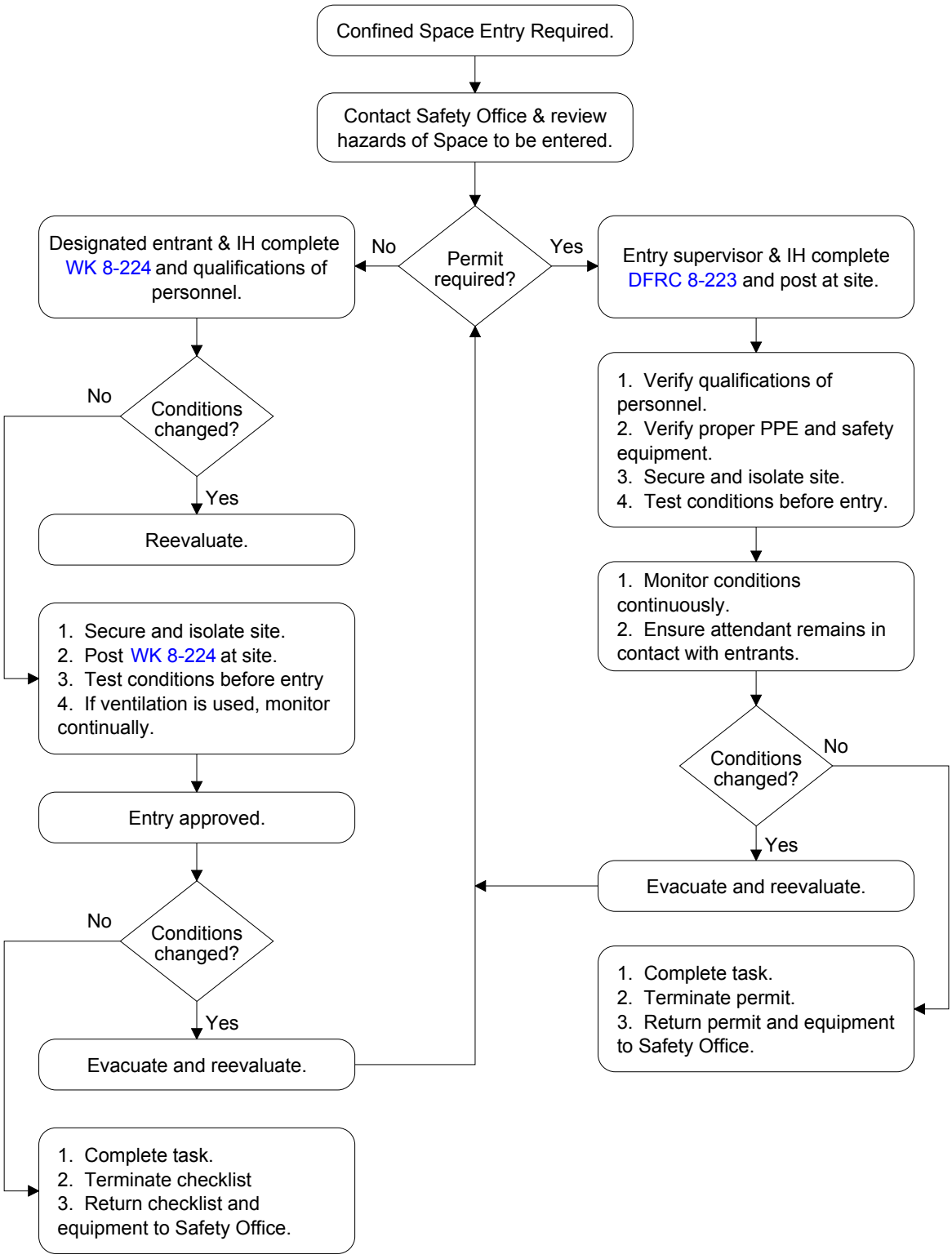
Table 3
Records

Record or Form #	Title	Responsibility for Completion	File Location
DFRC 8-223	Confined Space Entry Permit	Customer & Safety Office	Safety Office
WK 8-224	Non-Permit Confined Space Checklist	Customer & Safety Office	Safety Office
WK 8-225	Confined Space Evaluation	Customer & Safety Office	Safety Office
N/A	Medical Approval	Customer & Health Unit	Training Files & Health Unit
	Training Records	Customer & Instructor	Safety, Health, and Environmental Office

10.1 Retention and Archive

Records will be maintained and archived in accordance with NPR 1441.1D, Records Retention Schedules.

APPENDIX A – CONFINED SPACE ENTRY FLOWCHART



APPENDIX B – SAMPLE FORMS

Confined Space Entry Permit, DFRC 8-223

Permit must be **POSTED** at job-site until work is completed. _____
Control Number

I. Confined space location: _____ _____
DATE

Permit valid this date only: From: _____ To: _____

Entrants:	Attendants:	Fire Watch (Open Flame)
1. _____	1. _____	1. _____
2. _____	2. _____	
3. _____		
4. _____		

Description of Job or Special procedures: _____
_____
_____

Hazards Expected: (Describe or Indicate N/A)

_____Atmosphere _____
_____Hazardous Energy _____
_____Hot/Cold work _____
_____Radiation_____
_____Engulfment, Entrapment _____
_____Corrosives _____
_____Flammables _____
_____Inert _____
_____Toxics _____
_____Spark Producing _____
_____Activities increase hazard _____
_____Other hazards _____

Special Requirements: (Describe or Indicate N/A)

_____Personal Protective Equipment: _____
_____Communication (required)_____
_____Lighting _____
_____Safety Instructions _____
_____Monitoring _____

_____Ventilation _____
_____Fire Extinguisher _____
_____Barricades, Etc. _____
_____Retrieval/Fall/Arresting Equip. _____
_____Safety Harness/Wristlets _____
_____First Aid/CPR _____
_____GFCI Device_____
_____Contact EAFB Fire Dept._____

Atmospheric Tests

Acceptable Range	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8
Oxygen % 23.5 to 19.5								
Flammability <10 % LEL								
CO<12 ppm								
H2S 5ppm								
Other <1/2 PEL								
Tester Initials								
Time								

Instrument Make, Model No.	Serial No.	Calibration Date	Conditions Measured

Comments: _____

Permit Approval

Entry Supervisor is responsible for ensuring that all necessary procedures, practices, and equipment for safe entry are in place before and during entry.

Permit Requested by _____ Org. _____ Date: _____

Permit Completed by _____ Org. _____ _____

Entry Supervisor _____ _____ Date: _____

DFRC Industrial Hygienist _____ Date: _____ I H Review Date: _____

Permit terminated: Time: _____ Date: _____ Initials: _____

Reviewed by _____ Date: _____
(Following completion)

Return permit to Safety Office When work is completed.

DFRC 8-223

Non-Permit Confined Space Checklist, WK 8-224

Control Number: _____

Industrial Hygienist: _____Location: _____Date: _____

Entrants Name/Organization

1. _____ | _____ 3. _____ | _____

2. _____ | _____ 4. _____ | _____

- Will operations introduce contaminants into the space which change the atmospheric quality and characterization of the space? Yes ☐ No ☐
- Do conditions exist outside the space that could adversely affect the entry? Yes ☐ No ☐

If Yes on either item, the conditions must be eliminated prior to entry or re-evaluate for Permit Required Confined Space Entry.

Secure the work site: Initials: _____
Post the area with appropriate signs: Initials: _____

Acceptable Range	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8
Oxygen % 23.5 to 19.5								
Flammability <10 % LEL								
CO<12 ppm								
H S 5ppm								
Other <1/2 PEL								
Tester Initials								
Time								

Instrument Make, Model #	Serial No.	Calibration Date	Conditions Measured

Purge/Ventilate Yes ☐ No ☐ Initials: _____

Retest after ventilation Yes ☐ No ☐ N/A ☐ Initials: _____

Is continuous monitoring recommended inside the space? Yes ☐ No ☐ Initials: _____

Is continuous ventilation recommended for duration of operation? Yes ☐ No ☐ Initials: _____

_____ | _____ _____
Entry Supervisor Org. Date

_____ _____
DFRC Industrial Hygienist Date

_____ _____
Reviewed by (following completion) Date
WK 8-224

Confined Space Evaluation, WK 8-225

Identification #:_____ Date: _____
Space Owner:_____ Location: _____
Dimensions: _____
Description: _____
Type of Evaluation (Check One): Initial ☐ Re-evaluation ☐

Does the space meet the definition of a confined space? Yes ☐ No ☐
If no, evaluation is complete and space is not a confined space (indicate below). Sign, date, and file the evaluation form.
If yes, determine if the space is a Non-Permit Confined Space or Permit Required Confined Space.

Hazard Identification

The hazard identification process shall be performed by Industrial Hygienist and shall include:

- Oxygen deficiency? Yes ☐ No ☐
- Oxygen enrichment? Yes ☐ No ☐
- Flammable gases or vapors present? Yes ☐ No ☐
- Toxic gases or vapors present? Yes ☐ No ☐
- Possibility of engulfment? Yes ☐ No ☐
- Biological hazards present? Yes ☐ No ☐
- Mechanical hazards present? Yes ☐ No ☐
- Electrical (high voltage) hazards? Yes ☐ No ☐
- Gas lines present? Yes ☐ No ☐
- Past history of hazardous atmosphere? Yes ☐ No ☐
- Potential for nearby activities to make entry hazardous? Yes ☐ No ☐

- Oxygen content (percent); _____% • H_2S _____ppm
- Flammability determination; _____%LEL • CO _____ppm

Hazard Evaluation

The hazard evaluation shall be performed initially without regard to the work performed in the space, for determination of permitting status as follows:

- Is the hazard exposure likely to be high? Yes ☐ No ☐
- Is there potential for uncontrollable changing condition? Yes ☐ No ☐
- Is an occurrence likely to occur? Yes ☐ No ☐
- Are the consequences of an occurrence high? Yes ☐ No ☐

This space has been determined to be: (check one):

Not a confined space ☐ Non-Permit confined space ☐ Permit Required confined space ☐

If a confined space, is the appropriate sign posted? Yes ☐ No ☐
If No, provide the appropriate sign to owner for posting. Sign provided? Yes ☐ No ☐

This space has been inspected and evaluated for the purpose of determining the permitting status as a confined space. Work in this space must be further evaluated prior to entry, as the status may change based on the work performed.

_____ Date: _____
DFRC Industrial Hygienist

Reviewed By: _____ Date: _____

WK 8-225

Chapter 10 History Log

This page is for informational purposes and does not have to be retained with the document.

Status Change	Document Revision	Effective Date	Page	Description of Change
Baseline		7-9-04		Replaces DCP-S-022.
Admin. Change	Baseline	11-14-06	All	• Updated form numbers: D(FRC) 223 to DFRC 8-223 D(FRC) 224 to WK 8-224 D(FRC) 225 to WK 8-225 • Rebuilt flowchart • Minor formatting and grammar corrections