

California Institute of Technology

CONFINED SPACE PROGRAM



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SCOPE

The purpose of the Caltech Confined Space Program is to protect workers entering confined spaces to perform maintenance, cleaning, or other types of work and comply with applicable Title 8 of the California Code of Regulations (8 CCR Section 5157). The Program provides information and guidelines for working with all classifications of confined spaces including the below-listed program elements.

PROGRAM ELEMENTS

1. Identifies and classifies the known confined spaces at Caltech and discusses the reclassification of areas.
2. Identifies the necessary components for entry into confined spaces including monitoring and equipment, which may be required.
3. Identifies rescue and emergency procedures of confined spaces and the responsibilities of authorized employees in such instances.
4. Describes the Caltech Permit System including preparation, use, and cancellation of permits.
5. Provides training requirements for employees involved with confined space work and identifies their duties.
6. Provides a review of common operations involving confined spaces and an annual program review.

SPACE EVALUATION

IDENTIFICATION AND CLASSIFICATION

The Confined Space evaluation identifies and classifies all known and recognized spaces assessed at Caltech for confined space hazards. All confined spaces are evaluated using the "Confined Space Survey" form (See Appendix F: Confined Space Survey).

The classifications of confined spaces ([See Appendix A: Definitions](#)) are:

- NON-PERMIT REQUIRED
- HAZARDOUS ATMOSPHERE ONLY
- PERMIT REQUIRED

POSTING

Permit-required spaces, which could be inadvertently entered, will be labeled as a permit-required confined space. Obvious confined spaces, such as manholes, or confined spaces that are not permit-required, will not be labeled. A sign reading: **“DANGER- PERMIT-REQUIRED CONFINED SPACE, DO NOT ENTER”** or using other similar language would satisfy the requirement for a sign.

VERIFICATION TESTING

Before entering a permit space that may have a hazardous atmosphere, the atmosphere must be tested using the steps identified on the permit. Verification testing makes sure that the chemical hazards that may be present are below the levels necessary for safe entry, and that they meet the conditions identified on the permit. Test the atmosphere in the following order:

- 1) Oxygen content
- 2) Flammable gases and vapors
- 3) Potential toxic air contaminants

The testing results (the actual test concentrations) must be recorded on the permit.

DURATION AND APPROACH TO TESTING

For each test required on the permit, you must allow enough time for the air from the space to be drawn into the equipment and for the sensor (or other detection devices) to detect the chemical if it is present. This is considered the “minimum response time” and it will be noted by the manufacturer in the operator’s manual. Be aware that you will need to add time to this minimum response time if you have attached a hose or a probe extension to the inlet. Additional time is needed to allow the air from the different depths of the space to be pulled into the equipment inlet. For spaces that are deep or have areas leading away from the entry point, the atmosphere may be layered or different in remote areas of the space. For these spaces, testing must be done in the area surrounding the worker, which is considered four (4) feet in the direction of travel and to each side.

If a hazardous atmosphere is detected during entry:

- a. Each employee shall leave the space immediately.
- b. The space shall be evaluated to determine how the hazardous atmosphere developed, and
- c. Measures shall be implemented to protect employees from the hazardous atmosphere before any subsequent entry takes place.

RECLASSIFICATION OF PERMIT SPACE

Permit Required and Alternate Entry Confined Spaces – Permit Required Confined Spaces may be reclassified as Non-Permit spaces ([See Appendix B: Non-Permit Confined Space Reclassification Safety Certification](#)). Reclassification occurs when all hazards and potential hazards are removed. Neutralization of dangerous moving parts, by lockout for example, may allow reclassification to Non-Permit status. However, if the hazard(s) return, have the potential to return, or new hazards arise, the space shall be evacuated and reclassified as a Permit Required Confined Space or Alternative Confined Space Entry. Additional guidance is included in the above section [PROCEDURES FOR ATMOSPHERIC TESTING IN CONFINED SPACE](#).

ENTRY WITHOUT PERMIT

Confined spaces that do not contain known hazards have reduced requirements for entry. Spaces classified as Non-Permit do not involve hazards considered serious ([See Appendix A: Definitions](#)). Non-Permit spaces do not require a written permit or attendant for entry. Non-Permit spaces do not require any special testing or training, but they do require awareness to distinguish Non-Permit Required Confined Spaces from Permit Required Confined Spaces, and that additional requirements established in this Program must be met to enter permit required confined spaces. To determine whether a permit is required for entry into a confined space, use [Appendix D](#), the Caltech Confined Space Program Decision Flowchart.

PERMIT REQUIRED ENTRY

Confined Spaces that contain known or potential safety and health hazards to entrants require a permit and an entry procedure or space review prior to entry. These areas are PERMIT REQUIRED CONFINED SPACES ([See Appendix A: Definitions](#)). Entry is allowed to trained and authorized individuals only. If the space contains only atmospheric hazards correctable through ventilation, the

permit area is an ALTERNATE ENTRY CONFINED SPACE and will require certification. To determine if a permit is required to enter a space, use the Caltech Confined Space Program Decision Flowchart in [Appendix C](#).

ACCEPTABLE ENTRY CONDITIONS

Because of the dangers that exist within Permit Required Confined Spaces, there are conditions that must be eliminated before entry (See Appendices [D](#) and [E](#): Permit Systems). Precautionary steps such as source isolation, ventilation, and atmospheric level testing are required prior to entry. Acceptable entry conditions for specific areas are contained in Entry Permits.

Test the permit space prior to entry and routinely to make sure that the atmospheric conditions continue to be safe for entry.

ISOLATION

Lockout/Tagout of all sources of hazardous energy (mechanical, chemical, etc.) must follow the requirements described in the Caltech [Lockout/Tagout Program](#).

PURGING AND FLUSHING

If a confined space contains an atmosphere that is flammable, explosive, toxic or oxygen deficient, the area will require purging before employees can enter ([See Appendix A: Definitions](#)). Continual forced air ventilation and atmospheric monitoring are necessary to keep some areas safe during and throughout entry.

VERIFICATION MONITORING

Requirements of entry are listed on Entry Permits. Monitoring of hazardous conditions is required prior to receiving entry authorization. Conditions to monitor include atmospheric, mechanical, and physical hazards. Ongoing monitoring may be periodic or continuous as required by the permit. Only personnel trained in the proper use of the equipment and interpretation of the results are authorized to perform required air monitoring.

BARRIERS

Barriers must be placed around Permit Required Confined Spaces when conditions may cause injury. Conditions requiring the use of barriers include:

- Unauthorized entry.
- Objects or pedestrians falling into the space.
- Vehicular hazards around the space, or

CONFINED SPACE ENTRY EQUIPMENT

Equipment that may be required during entry operations must be listed on the permit and may include:

- Testing and Monitoring Equipment
- Ventilation Equipment
- Communications Equipment
- Personal Protective Equipment
- Lighting Equipment
- Barriers and Shields
- Ingress and Egress Equipment

- Rescue and Emergency Equipment
- Any other equipment necessary for safe entry and rescue

Entry equipment will be maintained by their respective owners. Only trained and authorized employees are to use the equipment.

ATTENDANTS

There must be at least one attendant present outside the space for the duration of the work being performed in Permit Required Confined Spaces ([See Duties](#)). Attendants must not monitor more than one confined space at any given time.

CONCLUDING OPERATIONS

When the scheduled work operations in a Permit Required Confined Space have concluded:

- 1) Entrants will exit the space
- 2) The area will be closed off
- 3) The Permit will be cancelled

HAZARDOUS ATMOSPHERE ONLY SPACE

Spaces are classified as Hazardous Atmosphere Only if the space contains an actual or potential hazard but still can be controlled by ventilation ([See Definitions](#)).

Hazardous Atmosphere Only spaces require completion of a pre-entry certification prior to entry but do not require an attendant or permit ([See Appendix D](#)).

Atmospheric testing is required prior to entry and periodically as necessary to confirm the elimination of hazardous atmospheres. Continual forced ventilation is required to eliminate hazardous atmospheres.

If circumstances other than a scheduled break require an interruption of work, evacuate the space. A new pre-entry certification, including a re-evaluation, must be completed before resuming work.

Employees working with Hazardous Atmosphere Only spaces must receive training.

RESCUE AND EMERGENCY SERVICES PROCEDURES

1. An emergency is an event in or near the Permit Space that could endanger entrants. Emergency rescue services during entry by Caltech employees will be provided by the Pasadena Fire Department.
2. Notify Campus Security of the location of the planned confined space entry prior to entry to facilitate rescue service response in the event of an emergency.

EVACUATION AND RESCUE PROCEDURES

1. Attendant will notify all Entrants to evacuate.
2. Attendant will notify 626-395-5000 / x 5000 if the emergency involves serious injury or fire.
3. Attendant will request emergency rescue services from Pasadena Fire Department, if needed.
4. Attendant will execute any "non-entry" rescue procedures appropriate to the situation.
5. Rescue involving space entry will not be performed by Caltech employees.
6. The Entry Supervisor will immediately cancel the Entry Permit.

SUPERVISOR AND ATTENDANT RESPONSIBILITIES

- Provide the Rescue Services group with information on the work being done.
- Provide the Entry Permit to Rescue Services personnel.
- Provide Rescue Services with any observations or information about the emergency.
- Keep unauthorized personnel out of the area.
- Forward information on any chemicals involved in exposures to the medical facility treating exposed victims (if applicable).

PERMIT SYSTEM

A sample of the Caltech Confined Space Entry Permit is located in [Appendix E](#). Cancelled Entry Permits are kept on file by Supervisors authorized to assign entry for a minimum of one year.

PREPARATION

Prior to "Permit-Required" confined space entry, an applicable permit form must be completed in full. Additional requirements may apply to Permit-Required areas based upon entry testing results ([See Space Evaluation and Monitoring](#)). A final authorization signature is required by the Unit Supervisor for "Permit-Required" spaces. If the area is a "Non-Permit" space, work may proceed without a permit or notification. To determine if a space requires a permit for entry, use the Caltech Confined Spaces Program Decision Flowchart in [Appendix C](#).

ISSUE/USE

Space entry work must not deviate from the requirements of the permit, including the time required to complete the assignment. Permits must be posted during entry. It is the responsibility of the Entry Supervisor to see that permits are posted. In addition, if there will be any hot work conducted inside of the confined space, a hot work permit is also required and must also be posted. For more information and requirements see the [Caltech Hot Work Permit Program](#).

CONCLUSION OF OPERATIONS/CANCELLATION OF PERMIT

Upon conclusion of the entry operations, the authorized Entry Supervisor is responsible for terminating the entry and canceling the Permit ([See Duties](#)). The Entry Supervisor is also required to terminate entry and cancel the Permit when a condition exists that is not acceptable by the Permit. Entry must not exceed the expiration date and time posted on Entry Permits. Upon conclusion of entry operations, the Entry Supervisor shall cancel the Permit and keep the record on file for at least one year.

OUTSIDE CONTRACTORS

Outside contractors must be informed of the fact that a space requires a permit, the hazards of the space, Caltech's experience with the space, and precautions and procedures that have been implemented for protecting employees in or around the space. If a Caltech employee works in or near the space, coordinated entry operations are necessary. A copy of the contractor's permit or a Caltech permit must be obtained before entry.

TRAINING

Employees working with "Permit-Required" or "Hazardous Atmosphere Only" Spaces must receive training. Employees working as Attendants, Authorized Entrants, or Entry Supervisors receive OSHA compliant training for safe performance of assigned duties in confined space areas.

Contractors are expected to provide their employees with similar training that is compliant with OSHA requirements for entry of confined spaces. Caltech may request documentation of this training from its contractors.

FREQUENCY

Affected employees must receive training before their first assignment of work in confined spaces. Employees receive additional training when there is a change in assignment, operation, or procedure(s).

DUTIES

There are three (3) different active roles in the performance of Permitted Confined Space entry operations: Entrants, Attendants, and Entry Supervisors.

ENTRANTS

Entrants are employees authorized to enter a permit space. Entrants shall:

- Read and fully understand the entry permit.
- Know the hazards that they may be faced during entry.
- Conduct entry in accordance with the entry permit.
- Alert the Attendant whenever the entrant recognizes any warning signs or symptoms of exposure to a dangerous situation, or when any prohibited condition is detected.
- Properly use equipment mentioned under the "Equipment" section and/or the entry permit.
- Communicate with the Attendant as necessary alerting him/her of hazards.
- Exit from permit space whenever there is an order to evacuate, a hazard is recognized, or an evacuation alarm is activated.

ATTENDANTS

Attendants are employees stationed outside of a permit space to monitor Entrant activity and perform duties listed on the permit. Attendants are responsible to:

- Read and fully understand the Entry Permit.
- Know the hazards that they may be faced during entry.
- Know the behavioral effects of hazard exposure in Authorized Entrants.
- Keep an accurate count of the number of Entrants in the permit space.
- Remain outside the space during operations until relieved.
- Monitor the work area inside and outside the space for hazardous conditions.
- Summon rescue and emergency services.
- Communicate with Entrants to relay information and monitor the status of the Entrants.
- Order the evacuation of the Entrants from space if a hazardous condition is encountered.
- Keep unauthorized employees away from the space.
- Perform no duties that might interfere with the Attendant's primary duty to monitor and protect the Authorized Entrants.
- Perform non-entry rescues.

ENTRY SUPERVISORS

Entry Supervisors authorize and supervise entry operations. An Entry Supervisor that authorizes entry may delegate supervisory responsibilities during entry to another employee authorized as a Supervisor. Entry Supervisors are responsible to:

- Read and fully understand the Entry Permit.
- Ensure that at least one on-site employee is trained in Cardio-Pulmonary Resuscitation (CPR)/First Aid, and readily available to provide assistance to the confined space entry operation, if needed.
- Recognize the potential hazards during entry, including signs and symptoms of exposure.
- Determine, before entry, that area conditions meet the requirements of the permit.
- Provide necessary equipment, hazardous material information, and assure rescue services are in place.
- Assure that Entrants and Attendants are trained prior to entry.
- Determine that entry operations and conditions remain consistent with the terms of the permit.
- Remove unauthorized individuals from the area during entry operations.
- Cancel the permit at the conclusion of entry or if other conditions warrant it, such as uncontrolled hazards.

REVIEWS

POST-ENTRY REVIEW

The Environmental Health and Safety Office will immediately review specific entry operations under the following circumstances:

- Unauthorized entry
- Detection of hazards not addressed on a permit
- Complaints of the effectiveness of entry procedures
- Entries resulting in emergency exit or rescue

Subsequent entries will not be authorized until the review is completed with all necessary revisions made.

APPENDICES

APPENDIX A: DEFINITIONS

ACCEPTABLE ENTRY CONDITIONS

The conditions that must exist in a permit space to allow entry so that employees involved with a permit-required confined space entry can safely enter into and work within the space.

ATTENDANT

An individual stationed outside the permit space monitoring the authorized entrants and who performs all attendants' duties assigned in the Confined Space Program.

BLANKING OR BLINDING

The absolute closure of a pipe, line, or duct by the fastening of a solid plate 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.

CONFINED SPACE

A space that meets the following criteria:

- Is large enough and so configured that an employee can bodily enter and perform assigned work; and
- Has limited or restricted means for entry or exit (for example, tanks, vessels, storage bins, vaults, pits, and excavations are spaces that may have limited means of entry); and
- Is not designed for continuous employee occupancy.

EMERGENCY

Any occurrence (including any failure of hazard control or monitoring equipment) or event, internal or external, to the permit space 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

Employee who is authorized to enter a permit space.

ENTRY

Action by which a person passes through an opening into a permit-required confined space. Entry includes ensuing work activities in that space and occurs as soon as any part of the entrant's body breaks the plane of the opening of the space.

ENTRY PERMIT

The written or printed document provided by Caltech allowing and controlling entry into a permit space. If Hot Work will be done inside of the permit space a [Hot Work Permit](#) is also required.

ENTRY SUPERVISOR

The person (such as the supervisor, foreman, or crew chief) responsible for determining if acceptable entry conditions are present at a permit space where entry is planned, for authorizing entry and overseeing entry operations, and for terminating entry as required by this section.

HAZARDOUS ATMOSPHERE

An atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue, injury, or acute illness from one or more of the following causes:

- Flammable gas, vapor, or mist in excess of 10 percent of its lower explosive limit (LEL);
- Airborne combustible dust at a concentration that meets or exceeds its LEL;
- Atmospheric oxygen concentration below 19.5 percent or above 23.5 percent; or
- Atmospheric concentration of any substance for which a dose or a published exposure guideline is available, and which could result in employee exposure in excess of its dose or permissible exposure limit. These may include ACGIH TLV, OSHA PEL, and IDLH

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH (IDLH)

Any condition that poses an immediate or delayed threat to life or what would cause irreversible adverse health effects or that would interfere with an individual's ability to escape unaided from a permit space.

ISOLATION

The process by which a permit space is removed from service and completely 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, including hydraulic or electric; blocking or disconnecting all mechanical linkages; or physically restraining moving parts.

NON-PERMIT CONFINED SPACE

A confined space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm.

HAZARDOUS ATMOSPHERE ONLY SPACE

A confined space in which the only hazard posed is an actual or potential hazardous atmosphere which can be controlled by continuous forced ventilation.

PERMIT REQUIRED CONFINED SPACE (PRCS)

A confined space that has one or more of the following characteristics:

- Contains or has the potential to contain a hazardous atmosphere
- Contains a material that has the potential for engulfing an entrant
- 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
- Contains any other recognized serious safety or health hazard

RETRIEVAL SYSTEM

Equipment (including a retrieval line, chest or full-body harness, wristlets, if appropriate, and a lifting device or anchor) used for non-entry rescue of a person from a permit space.

APPENDIX B: NON-PERMIT CONFINED SPACE RECLASSIFICATION SAFETY CERTIFICATION

LOCATION: _____

DESCRIPTION: _____

HAZARDS ORIGINALLY EXISTING IN THE SPACE	HOW ELIMINATED	INITIAL
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

TESTS PERFORMED FOR ACCEPTABLE ATMOSPHERIC HAZARDS

	RESULTS	INITIAL
Oxygen content (greater than 19.5% and less than 23.5%)	_____	_____
Flammable gas/vapor levels (not exceeding permissible levels)	_____	_____
Toxic air contaminant levels (not exceeding permissible levels)	_____	_____

Reclassification occurs when all hazards and potential hazards are removed. Neutralization of dangerous moving parts, by lockout for example, may allow reclassification to Non-Permit status. However, if the hazard(s) return, has the potential to return, or new hazards arise, the space shall be evacuated and reclassified as a Permit Required Confined Space.

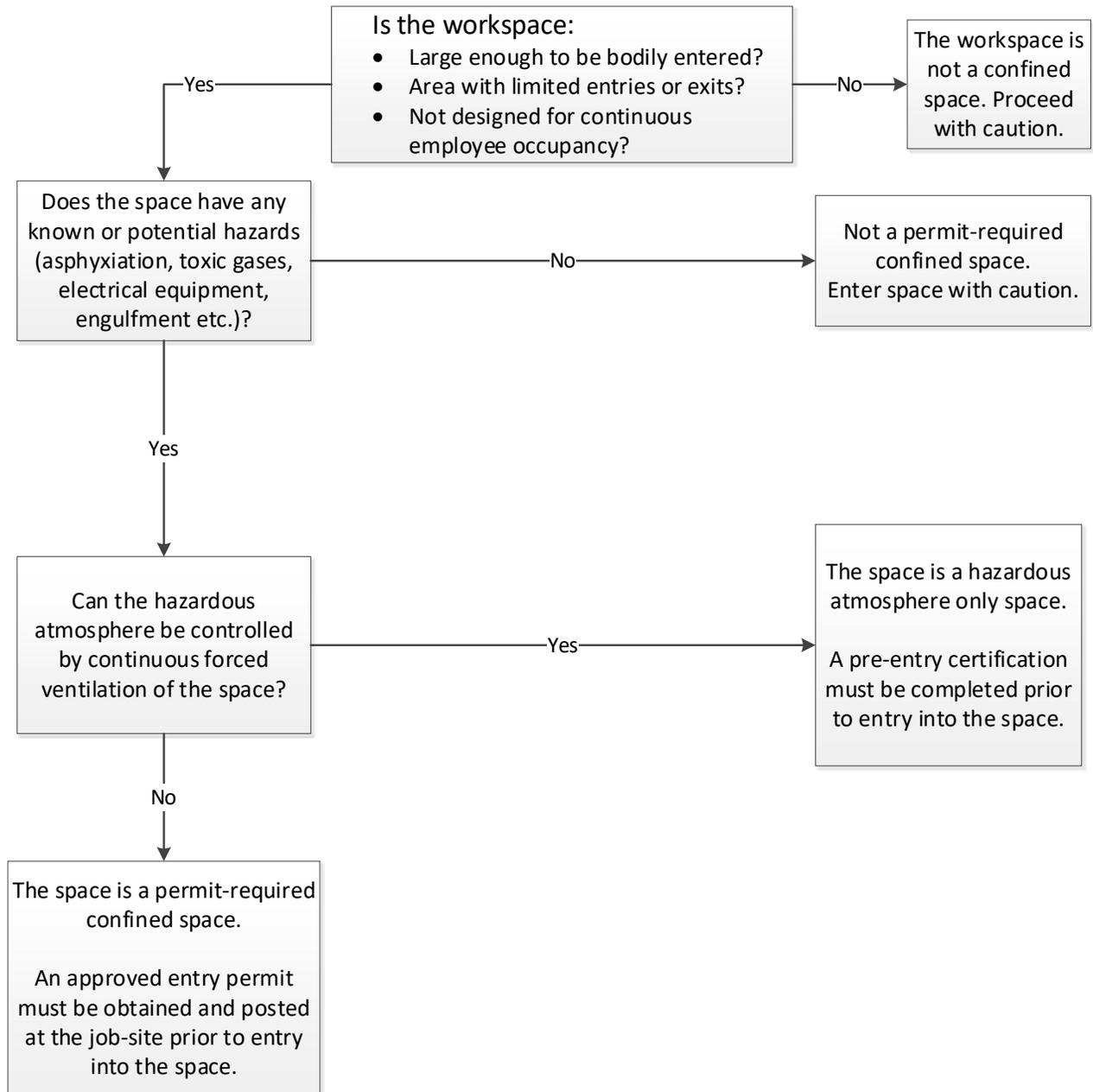
CERTIFICATION

The following Confined Space is reclassified as a "Non-Permit Confined Space." All hazards within the space are eliminated.

Certifying Employee: _____

Signature: _____ Date: _____

APPENDIX C: CALTECH CONFINED SPACE PROGRAM DECISION FLOWCHART



APPENDIX D: "HAZARDOUS MATERIAL ONLY" CONFINED SPACE ENTRY PERMIT PRE-ENTRY CERTIFICATION

LOCATION: _____

DESCRIPTION: _____

	YES	NO
_____ Have any entrance cover hazards been eliminated before removal of the cover?	_____	_____
_____ Have guard rails or barriers been installed?	_____	_____
_____ Does your knowledge of industrial or other discharges indicate this area is likely to remain free of dangerous air contaminants while occupied?	_____	_____
_____ Were all atmospheric levels of the confined space tested?	_____	_____
_____ Has a Confined Space Survey been completed?	_____	_____
_____ Enter Results (if multiple levels present, enter highest readings): Time _____		

Date of Last Calibration

Oxygen _____ %

Explosive _____ % LEL

H2S _____ PPM

Name of tester: _____

Signature of tester _____

Has a continuous forced air ventilation system been installed? _____

Has the area been purged or flushed? _____

Will there be periodic monitoring of the atmosphere while the space is occupied? Give interval _____

If the answers to any of the above questions are negative, the space cannot be entered. If a hazardous atmosphere is detected during entry, the area must be evacuated. Promptly notify the Environmental Health and Safety Office of an evacuation.

CERTIFICATION

_____ This space has no hazards other than the existing atmospheric hazards.

_____ A continuous forced air ventilation system is in place to eliminate or control the existing atmospheric hazards.

Supervisor / Supervisor Designee signature _____

APPENDIX E: CONFINED SPACE ENTRY PERMT

LOCATION / MANHOLE #.:	DATE AND TIME PERMIT AUTHORIZED:	ENTRY PERMIT DURATION:	NAME OF CONTRACTOR (IF APPLICABLE):	ENTRY SUPERVISOR:	CLASSIFICATION OF SPACE: PERMIT- REQUIRED CONFINED SPACE NON-PERMIT REQUIRED		
PURPOSE OF ENTRY			ANTICIPATED HAZARDS				
MATERIAL PREVIOUSLY IN CONFINED SPACE		MONITORING INSTRUMENT USED		SERIAL NO.	LAST DATE OF CALIBRATION		
ATMOSPHERIC CONDITIONS							
(Initial testing of the atmosphere in the space must be taken before entry. Take a minimum of two samples and at different levels to ensure the space readings are consistent and record them below. Ensure that all entrants are wearing personal four (4) gas monitors before entry.)							
TIME	OXYGEN % (>19.5%, <23.5%)	% OF LEL (<10%)	CO (<25ppm)	H ₂ S (<10ppm)	Other Toxics (PEL)	Initials	
CHECKLIST							
		YES	N/A			YES	N/A
Ignition sources removed/isolated				Tripod, winch, safety harnesses, lifelines, and hoists operational			
Monitoring equipment calibrated				Special warning/caution signs posted			
Lockout/Tagout permit procedures completed				Communications available, tested and operational (i.e. Radios and Cell Phone).			
Ground Fault Circuit Interrupters (GFI) operational							
Ventilation equipment in use							
Hot Work Permit (if: riveting, welding, cutting, burning, heating).							
Protective equipment appropriate, inspected & operational							
RESCUE SYSTEMS/EQUIPMENT		COMMUNICATION DEVICES/PROCEDURES RADIOS/WALKIE-		REQUIRED PERSONAL PROTECTIVE EQUIPMENT			
TRIPOD		TALKIES		PENDANT ALARM			
HARNESS W/RETRIEVAL LINES		CELLULAR PHONE		HAND SIGNALS			
WINCH N/A		HARDWIRED TELEPHONE		VISUAL CONTACT			
SIGNATURES							
AUTHORIZED ENTRANT #1			ATTENDANT #2				
Name	Signature	Date	Name	Signature	Date		
AUTHORIZED ENTRANT #2							
Name	Signature	Date	Name	Signature	Date		
ATTENDANT #1			OFFICE OF ENVIRONMENTAL HEALTH AND SAFETY – REVIEWED BY				
Name	Signature	Date	Name	Signature	Date		

IMPORTANT PHONE NUMBERS

Campus Security: EMERGENCY Ext. 5000 When dialing from a cell phone 626-395-5000

This permit must be complete and readily available upon request before entry.

APPENDIX F: CONFINED SPACE SURVEY

LOCATION: _____ DATE OF SURVEY: _____

General Description: _____

CLASSIFICATION

_____ Permit-Required Space _____ Hazardous Atmosphere Only Space

_____ Non-Permitted Space _____ Not a Confined Space

Can be bodily entered? Yes No Hazardous atmosphere? Yes No

Limited or restricted entry? Yes No Potential for engulfment? Yes No

Not designed for continuous human occupancy? Yes No Internal configuration hazard? Yes No

Other serious safety hazard? Yes No

HAZARDS

Who usually enters the space? _____

Frequency of entry _____

Number of entry points _____

Reasons for entering space and typical activities _____

Have warning signs posted been posted? Yes No

Has the space been sealed or locked? Sealed Locked No Action Taken

Has atmospheric testing been performed on or in the space? Yes No

- If Yes, attach copy.

OTHER PERTINENT INFORMATION

