TMA/EBERLINE
INDUSTRIAL HYGIENE
PROCEDURES MANUAL

CONFINED SPACE WORK

APPROVED:

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Vice President, Health Physics Services — 10/5/93 Date

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1.0 PURPOSE

The purpose of this procedure is to provide guidance on confined space work and to establish a confined space entry permit program.

2.0 SCOPE

This confined space procedure provides instructions on proper isolation methods, evaluation of physical hazards, and evaluation of chemical hazards. This procedure establishes two special classes of confined spaces and provides entry requirements for all confined spaces. Instructions for completion of Confined Space Permits are provided.

3.0 REFERENCES

3.1 TMA/Eberline Safety Manual, Volume 2: Field Operations, QA-06.

3.2 TMA/Eberline Respiratory Protection Program, QA-04.

3.3 A Guide to Safety in Confined Spaces. NIOSH Publication Number 87-113. U.S. Department of Health and Human Services, National Institute for Occupational Safety and Health.

3.4 OSHA, Code of Federal Regulations, 29 CFR part 146, Permit-required confined spaces, current edition.

3.5 Federal Register, Permit-required confined spaces for General Industry; Final Rule, pages 4462-4563, January 14, 1993.

4.0 DEFINITIONS

4.1 Confined Space - A space which has the following characteristics:

- limited openings for entry and exit.
- Has adequate size and configuration for employee entry.
- not designed for continuous work occupancy.

These spaces may include underground vaults, tanks, storage bins, pits and diked area, vessels and silos.

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

4.3 Attendant - an individual stationed outside one or more permit spaces who monitors the authorized entrants and who performs all attendant duties assigned in the employer's permit space program.

4.4 Authorized entrant - an employee who is authorized by the employer to enter a permit space.

4.5 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.

4.6 Emergency - any occurrence or event internal or external to the permit space that could endanger entrants. This includes any failure of hazard control or monitoring equipment.

4.7 Engulfment - the surrounding and effective capture of a person by a liquid or finely divided solid substance that can be aspirated to cause death by filling or plugging the respiratory system of that can exert enough force on the body t cause death by strangulation constriction or crushing.

4.8 Entry - the action by which a person passes through an opening into a permit-required 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.

4.9 Entry Permit- the written document that is provided by the employer to allow and control entry into a permit space and that contains the information

4.10 Entry Supervisor - the person 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.

4.11 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: 1) Flammable gas, vapor or mist in excess of 10% of its lower explosive limit (LEL); 2) Airborne combustible dust at a concentration that meets or exceeds its LEL; 3) Atmospheric Oxygen concentration below 19.5% or above 23.5%; 4) atmospheric concentration of any substance from which a dose, TLV or PEL could be exceeded; 5) any other condition that is immediately dangerous to life or health.

4.12 Inerting - The displacement of the atmosphere in a permit space by a noncombustible gas to such an extent that the resulting atmosphere is noncombustible.

4.13 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 lockout/tagout, blanking/blinding, or blocking or disconnection al mechanical linkages.

4.14 Non-permit confined space - a confined space that does not contain or have the potential to contain any hazard capable of causing death or serious physical harm.

4.15 Oxygen deficient - an atmosphere containing less than 19.5% oxygen.

4.16 Oxygen enriched - an atmosphere containing more than 23.5% oxygen.

4.17 Permit-required confined space - a confined space that has one or more of the following characteristics: 1) contains or has a potential to contain a hazardous atmosphere; 2) contains a material that has the potential for engulfing an entrant; 3) has an internal configurations 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.

4.18 Retrieval System - The equipment (including a retrieval line, chest or full body harness, wristlets and a lifting device) used for non-entry rescue of persons from permit spaces.

4.19 Testing - the process by which the hazards that may confront

entrants of a permit space are identified and evaluated. Testing includes specifying the tests that are to be performed in the permit space.

5.0 PROCEDURE

5.1 Testing the Atmosphere

5.1.1 The atmosphere of a confined space is considered tested once the following measurements have been performed:

a. If the entry is to be made in Level A or Level B personnel protective equipment (PPE), the following must be checked in the following sequence:

(1) % oxygen

(2) % LEL

(3) concentration of other vapors and gasses as appropriate for the facility.

b. If the entry is being considered in Level C or Level D PPE, the following must be checked in the following sequence:

(1) % oxygen

(2) % CO_2 (if oxygen is less than 20 %)

(3) % LEL

(4) ppm carbon monoxide

(5) ppm hydrogen sulfide

(6) concentrations of other gases as appropriate for the facility.

Based on readings, the confined space will be classified as either a permit- or non-permit confined space. If the confined space requires a permit, the rest of this procedure shall be followed.

5.2 Testing Frequency

Concentrations will be measured at least once per day. More frequent air sampling or continuous air sampling will be specified in a Confined Space when appropriate.

5.3 Continuous forced air ventilation shall be used as follows:

5.3.1 An employee may not enter the space until the forced air ventilation has eliminated any hazardous atmosphere.

5.3.2 The forced air shall be so directed as to ventilate the immediate areas where an employee is present within the space and shall continue until all employees have left the space.

5.3.3 The air supply for the forced air ventilation shall be from a clean source and may not increase the hazards in the space.

5.4 Pedestrian, vehicle or other barriers shall be provided as necessary

to protect entrants from external hazards.

5.2 Isolation - Isolate the confined space prior to entry. The confined space is considered isolated once the following has been performed.

5.2.1 Lockout and tagout electrical circuits supplying the confined space.

5.2.2 Blank and bleed or lockout and tag pneumatic lines, hydraulic lines and pipelines supplying the confined space.

5.2.3 Block, chock, latch, chain, or otherwise secure mechanical moving parts within the confined space.

5.2.4 Disconnect belt and chain drives, and mechanical linkages on shaft driven equipment where possible.

5.5 Personnel Protective Equipment (PPE)

5.5.1 The respiratory protection for confined space work will comply with the requirements given in the TMA/Eberline Respiratory Protection Program, Reference 3.2. The respiratory protection will be specified on the Confined Space Permit.

5.5.2 The selection of personnel protective equipment will comply with the general guidelines given in the TMA/Eberline Safety Manual, Volume 2: Field Operations (Reference 3.1). PPE requirements for a given job shall be specified on the Confined Space Permit.

5.5.3 Attendants shall be dressed in PPE that is sufficient for a safe entry into the confined space. Attendants will be provided with a pressure demand (PD) self contained breathing apparatus (SCBA).

5.5.4 Communications equipment shall be provided as necessary to complete the work.

5.6 Lighting equipment shall be provided to enable employees to see well enough to work safely and to exit the space quickly in an emergency.

5.7 Rescue and emergency equipment (retrieval system) for safe entry into and rescue from permit spaces shall be provided.

5.8 There will be one attendant outside the permit space into which entry is authorized for the duration of the entry operations.

5.9 If multiple spaces are to be monitored by a single attendant, include in the permit program the means and procedures to enable the attendant to respond to an emergency affecting one or more of the permit spaces being monitored without distraction from the attendants responsibilities.

5.10 The following individuals shall be designated and their roles defined: authorized entrants, attendants, entry supervisors, and safety technicians. These individuals shall receive training prior to work such that they understand and have the proper skills of the duties assigned.

5.6 Rescue and Emergency Planning

5.6.1 The Site Manager, Site Health and Safety Officer, or standby person should have current training in first aid and CPR.

5.6.2 In an emergency, the attendant should not enter the confined space unless other standby personnel are at the scene, and then only as a last resort.

5.6.3 The local fire department authorities should be advised and briefed on any confined space work.

5.6.4 Where possible, rescues should be completed without entry into the confined space. The lifeline system should be used to retrieve the victim where possible.

5.7 Physical hazards

5.7.1 Structures that a judicious person would suspect are unsound or unstable should not be entered or walked upon. The stability of questionable structures should be evaluated before the confined space work begins.

5.7.2 Do not enter a confined space that a judicious person would suspect that an engulfment hazard exists. Bins or hoppers filled with grain or pulverized coal are examples of confined spaces that present a severe engulfment hazard.

5.7.3 Monitor for heat stress if necessary according to the instructions provided in TMA/Eberline Industrial Hygiene Procedure IH 3.01.

5.7.4 If transient excursions above 25% oxygen are possible, tools used for confined space work shall be made of a non-sparking material. Fire retardant clothing shall be worn.

5.7.5 Where transient excursions above 10% of the LEL are possible, instruments and equipment used for confined space work shall be approved for Class I, Division I Hazardous Locations. Tools shall be made of a non-sparking material, and fire retardant clothing shall be worn.

6.0 ENTRY PERMITS

A Confined Space Permit is required for confined space work.

6.1 A confined Space pre-entry check list should be filled out prior to starting the work. This is a good aid to make sure that all equipment is in place.

6.2 Each Confined Space Permit will be reviewed and approved by the Site Health and Safety Officer.

6.3 The Confined Space Permit will identify:

- The space to be entered.
- Purpose of entry.
- Date and the authorized duration of the entry
- Authorized entrants by name, attendants by name, entry supervisor by name.
- Hazards of the space to be entered.
- Measures used to isolate the space or eliminate hazards
- Acceptable entry conditions
- Results of initial and periodic checks.
- Rescue and emergency services that can be summoned and the means for summoning those services.
- Communication procedures used but authorized entrants and attendants to maintain contact during the entry.
- Any other pertinent information related to the health and

safety of entrants concerning the confined space.
- Other permits such as hot permits issued.

6.3 A copy of the Confined Space Permit will be posted at the confined space location.

6.4 Workers will be briefed on the requirement given in the Confined Space Permit.

6.5 One copy of the Confined Space Permit will be retained in the site safety files. The original will be forwarded to the TMA/Eberline Safety Manager.

6.6 Figure 1 provides a good decision flow chart for confined space entries.

Confined Space Pre-Entry Check List

A confined space either is entered through an opening other than a door (such as manhole or side port) or requires the use of a ladder or rungs to reach the working level and test results are satisfactory. This check list must be filled out whenever the job site meets this criteria.

		Yes	No
1.	Did your survey of the surrounding area show it to be free of hazards such as drifting vapors from tanks, piping or sewers?	( )	( )
2.	Does your knowledge of industrial or other discharges indicate this area is likely to remain free of dangerous air contaminants while occupied?	( )	( )
3.	Are you certified in operation of the gas monitor to be used?	( )	( )
4.	Has a gas monitor functional test (Bump Test) been performed this shift on the gas monitor to be used?	( )	( )
5.	Did you test the atmosphere of the confined space prior to entry?	( )	( )
6.	Did the atmosphere check as acceptable (no alarms given)?	( )	( )
7.	Will the atmosphere be continuously monitored while the space is occupied?	( )	( )

Contact County Centrex for personnel rescue by local fire department in the event of an emergency.

Notice: If any of the above questions are answered "no" do not enter. Contact your immediate supervisor.

Job Location _____

LEAD MAN signature _____ Date _____

Date and Time Issued: _____

Job site: _____

Equipment to be worked on: _____

Pre-Entry (See Safety Procedure)

1. Atmospheric Checks: Time __ ____
   Oxygen _____%
   Explosive _____% L.F.L.
   Toxic _____PPM

2. Source isolation (No Entry):	N/A	Yes	No
Pumps or lines blinded,	( )	( )	( )
disconnected, or blocked	( )	( )	( )

3. Ventilation Modification:	N/A	Yes	No
Mechanical	( )	( )	( )
Natural Ventilation only	( )	( )	( )

4. Atmospheric check after isolation and Ventilation:

Oxygen _____%	>	19.5	%	
Explosive _____% L.F.L	<	10	%	
Toxic _____PPM	<	10	PPM	H_2S
Time _____				

If conditions are in compliance with the above requirements and there is no reason to believe conditions may change adversely, then proceed to the Permit Space Pre-Entry Check List. Complete and post with this permit. If conditions are not in compliance with the above requirements or there is reason to believe that conditions may change adversely, proceed to the Entry Check-List portion of this permit.

Date and Time Expires: _____

Job Supervisor _____

Work to be performed: _____

Entry (See Safety Procedure)

1. Entry, standby, and back up persons:	Yes	No
Successfully completed required training?		
Is it current?	( )	( )+

2. Equipment:	N/A	Yes	No
Direct reading gas monitor - tested	( )	( )	( )
Safety harnesses and lifelines for entry and standby persons	( )	( )	( )

2. Equipment (cont.):	N/A	Yes	No
Hoisting equipment	( )	( )	( )
Powered communications	( )	( )	( )
SCBA's for entry and standby persons	( )	( )	( )
Protective Clothing	( )	( )	( )
All electric equipment listed			

Class I, Division I, Group D
and Non-sparking tools ( ) ( ) ( )

3. Rescue Procedure:

_____
_____
_____
_____
_____
_____

We have reviewed the work authorized by this permit and the information contained here-in. Written instructions and safety procedures have been received and are understood. Entry cannot be approved if any squares are marked in the "No" column. This permit is not valid unless all appropriate items are completed.

Permit and Check List Prepared By: _____
Approved By: _____
Reviewed By
(TMA/Eberline Project Manager) : (printed name & signature)

_____ _____

This permit to be kept at job site. Return job site copy to Safety Office following job completion.
Copies: White Original (Safety Office)
Copy (Job Site)

ENTRY PERMIT

_____ CONFINED SPACE _____ HAZARDOUS AREA

PERMIT VALID FOR 8 HOURS ONLY. ALL COPIES OF PERMIT WILL REMAIN AT JOB SITE UNTIL JOB IS COMPLETED

SITE LOCATION and DESCRIPTION _____

PURPOSE OF ENTRY _____

SUPERVISOR(S) in charge of crews Type of Crew Phone #

_____ _____

_____

* BOLD DENOTES MINIMUM REQUIREMENTS TO BE COMPLETED AND REVIEWED PRIOR TO ENTRY*

REQUIREMENTS COMPLETED	DATE	TIME
Lock Out/De-energize/Try-out	_____	_____
Line(s) Broken-Capped-Blanked	_____	_____
Purge-Flush and Vent	_____	_____
Ventilation	_____	_____
Secure Area (Post and Flag)	_____	_____
Breathing Apparatus	_____	_____
Resuscitator - Inhalator	_____	_____
Standby Safety Personnel	_____	_____
Full Body Harness w/"D" ring	_____	_____
Emergency Escape Retrieval Equipment	_____	_____
Lifelines	_____	_____
Fire Extinguishers	_____	_____
Lighting (Explosive Proof)	_____	_____
Protective Clothing	_____	_____
Respirator(s) (Air Purifying)	_____	_____
Burning and Welding Permit	_____	_____

Note: Items that do not apply enter N/A in the blank.

**RECORD CONTINUOUS MONITORING RESULTS EVERY 2 HOURS

CONTINUOUS MONITORING** Permissible TEST(S) TO BE TAKEN	Entry Level	
PERCENT OF OXYGEN	19.5% to 23.5%	___ ___ ___ ___ ___ ___ ___ ___
LOWER FLAMMABLE LIMIT	Under 10%	___ ___ ___ ___ ___ ___ ___ ___
CARBON MONOXIDE	+35 PPM	___ ___ ___ ___ ___ ___ ___ ___
Aromatic Hydrocarbon	+ 1 PPM * 5PPM	___ ___ ___ ___ ___ ___ ___ ___
Hydrogen Cyanide	(Skin) * 4PPM	___ ___ ___ ___ ___ ___ ___ ___
Hydrogen Sulfide	+10 PPM *15PPM	___ ___ ___ ___ ___ ___ ___ ___
Sulfur Dioxide	+ 2 PPM * 5PPM	___ ___ ___ ___ ___ ___ ___ ___
Ammonia	*35PPM	___ ___ ___ ___ ___ ___ ___ ___

* Short-term exposure limit:Employee can work in the area up to 15 minutes.
+ 8 hr. Time Weighted Avg.:Employee can work in area 8 hrs (longer with appropriate respiratory protection).

REMARKS:_____

GAS TESTER NAME & CHECK #	INSTRUMENT(S) USED	MODEL &/OR TYPE
_____	_____	_____
_____	_____	_____

SERIAL NUMBER

_____

_____

SAFETY STANDBY PERSON IS REQUIRED FOR ALL CONFINED SPACE WORK

SAFETY STANDBY PERSON(S)	CHECK #	NAME OF SAFETY STANDBY PERSON(S)	CHECK #
_____	_____	_____	_____
_____	_____	_____	_____

SUPERVISOR AUTHORIZING ENTRY AMBULANCE _____ FIRE _____

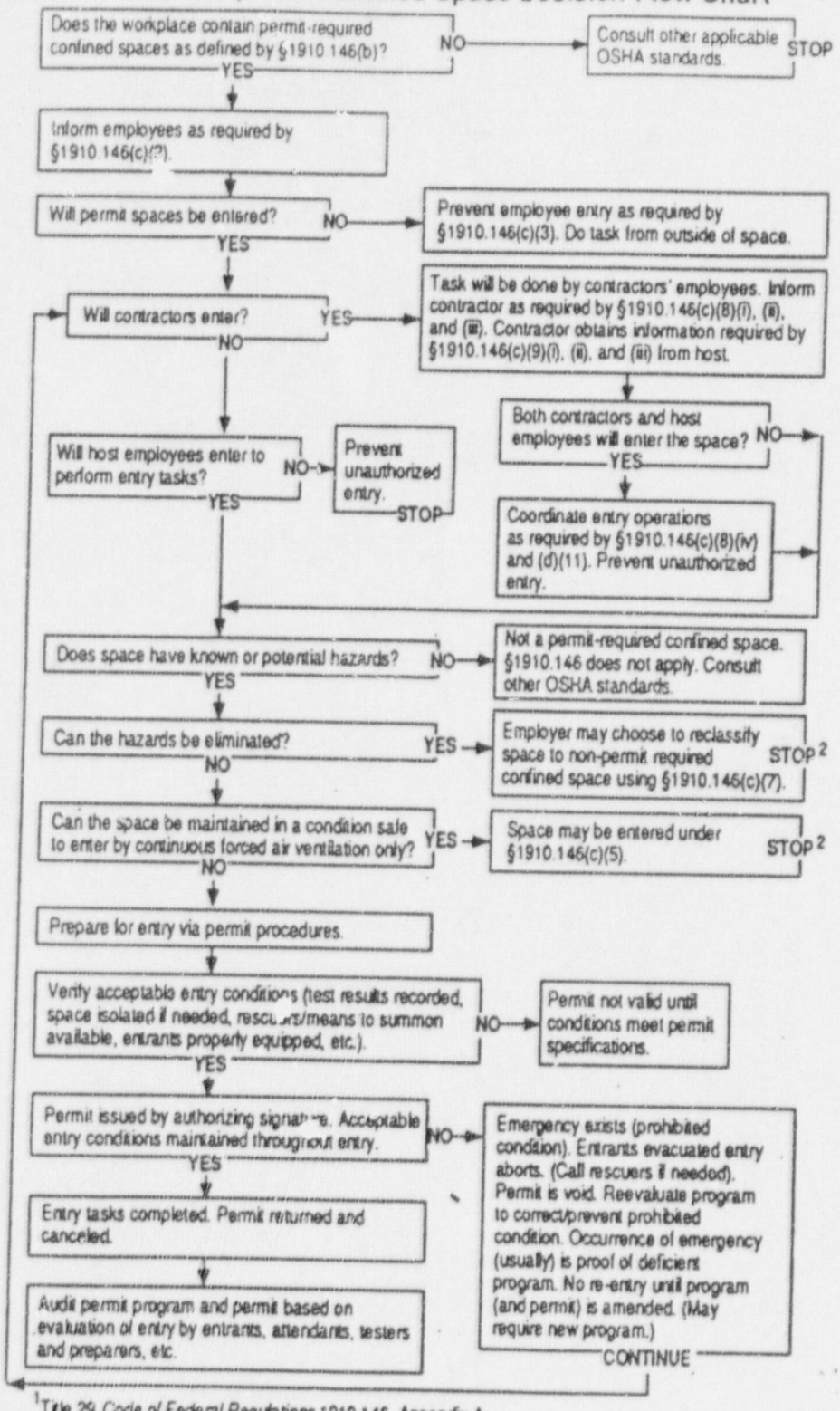
ALL ABOVE CONDITIONS SATISFIED _____

DEPARTMENT_____Phone_____

Original to Site Files

Copy to Safety Manager

Permit-Required Confined Space Decision Flow Chart



[1]Title 29 *Code of Federal Regulations* 1910.146, Appendix A.

[2]Spaces may have to be evacuated and re-evaluated if hazards arise during entry.

Figure 1.

APPENDIX D

RADIATION SAFETY OFFICER

EXPERIENCE AND QUALIFICATIONS

Training/Resume

Thomas J. Byrd

Mr. Byrd is a thirty-one year employee of Mallinckrodt. He is a Certified Hazardous Materials Manager at the master level. His education includes a B.S. in Chemistry from the University of Missouri at St. Louis (UMSL) along with numerous other courses in the Chemical, Environmental, and Radiation fields. Mr. Byrd is the RSO for C-T license STB-401 and has been RSO for 13 years. He developed the radiation safety program for C-T and has managed it ever since. Mr. Byrd was a supervisor in the C-T process area and has much knowledge of the process. He has managed the hazardous waste program and is currently managing all remedial work at the site. His title is Principal Environmental Engineer in the Health, Safety and Environment Department at the Mallinckrodt Specialty Chemicals Company - St.Louis Plant.