
CONFINED SPACE ENTRY

PERMIT-REQUIRED CONFINED SPACE ENTRY/RESCUE

For Compliance with OSHA Standard 29 CFR 1910.146

Prepared for:

CAMP LEJENUE MARINE BASE

ACCESS AMERICA
CONSULTING & TRAINING

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CHAPTER 1

INTRODUCTION

INTRODUCTION

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Fatalities

The lack of hazard awareness and unplanned rescue attempts led to the following deaths:

- On July 23, 1995, a city worker was removing an inspection plate from a sewer line in a 50-foot deep pump station, when the plate blew off allowing raw sewage to enter the room. Two fellow workers and a policeman attempted to rescue the worker from the sludge filled room and were unsuccessful. All four were dead when removed from the pumping station.

- On February 21, 1986, a self-employed truck driver died after entering the top of a 22-foot high x 15-foot square sawdust bin. He suffocated when the sawdust inside the bin collapsed and buried him.

- On July 5, 1986, a worker entered a chemical degreaser tank to clean out the bottom and collapsed. Two fellow workers noticed the man down and went in to rescue him. All three workers died.

- On July 16, 1986, a worker entered a septic tank to clean out the residue at the bottom and collapsed shortly afterward. Two workers on the outside went in to rescue the downed worker. All three were dead when removed from the tank.

- On October 10, 1986, a self-employed plumbing contractor entered an underground water line vault to inspect a backflow device. The contractor collapsed shortly after entering the vault. A supervisor noticed the man down and entered the vault in a rescue attempt. Both men had entered an untested oxygen-deficient atmosphere and died as a result.

- On February 6, 1987, two workers (father and son) at a wastewater plant were working on a digester that was being drained. They went on top of the digester and opened a hatch to check the sludge level. To provide light in the digester, they lowered an extension court with an exposed 200 watt light bulb into the digester. The light broke and caused the methane gas in the digester to explode, killing both men instantly.

If the guideline set forth in this course had been followed in each of the above scenarios, these fatalities would have been prevented.

Course Objectives

- Review the Permit-Required Confined Space Standard (29 CFR 1910.146)
- Determine proper use and selection of PPE
- Discuss the proper use and limitations of air monitoring equipment
- Discuss the options for confined space rescue

Course Outline

- See page i

Course Requirements

- Full attendance
- Class participation
- Passing score on the written exam and hands-on proficiency tests

Student/Instructor Introductions

- Name
- Company name and location
- Job title
- Job responsibilities

Miscellaneous Information

- Breaks
- Lunch
- Rest rooms
- Telephones
- Messages

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CHAPTER 2

REVIEW OF THE PERMIT-REQUIRED CONFINED SPACE STANDARD (29 CFR 1910.146)

ORIGINATED 1979

Permit-Required Confined Spaces 29 CFR 1910.146

A. ***Scope and Application:*** to protect employees in general industry from the hazards of entry into permit-required confined spaces

1. Since 1975, OSHA, NIOSH, ANSI Z117 Committee, have made efforts to address permit confined spaces

2. Other major contributors, Consad Research Corporation, 1988 (under contract), Dupont, and many other groups and organizations; manufacturers, industry representatives, unions, etc.

3. Covers general industry workers including **1.6 million** who enter confined spaces annually and an additional **10.6 million** employed at the 240,000 worksites covered by the standard. Expected to prevent about 85% of deaths and injuries = 54 deaths and 10,949 injuries each year.

4. Does **not** apply to agriculture, construction, or shipyard employment.

B. ***Definitions***

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

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

3. *Authorized Entrant* - means an employee who is authorized by the employer to enter a permit space

4. *Blanking or blinding* - means the absolute closure of a pipe, line, or duct by fastening 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.

5. *Confined Space* - means a space that:

   a. is large enough and so configured that an employee can bodily enter and perform assigned work; and

   b. has limited or restricted means for entry or exit; and one way in one way out

   c. is not designed for continuous employee occupancy

6. *Permit-Required Confined Space* - means a confined space that has one or more of the following characteristics:

- TOXIC GAS > PEL
- LACK OF O_2 MIN=19.5% MAX=23.5%
- HEAT ??
- DUST (FLAMMABLE) > FLAME LIMIT
- FLAMMABLE GAS - Lower Explosive Limit *10% of LEL

   a. Contains or has a potential to contain a hazardous atmosphere;

   b. Contains a material that has the potential for engulfing an entrant

   c. Has an internal configuration such that an entrant could be trapped or asphyxiated by inward converging walls or by a floor which slopes downward and tapers to a smaller cross section; or

   d. Contains any other recognized serious safety or health hazard.

7. *Double Block and Bleed* - means 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.

8. *Emergency* - means any occurrence (including any failure of hazard control or monitoring equipment) or event internal or external to the permit space that could endanger entrants.

9. *Engulfment* - means 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 filing or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction, or crushing.

10. *Entry* - means the action by which a person passes through an opening into a permit-required confined space. Entry includes ensuing work activities on 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.

11. *Entry Permit* - means the written or printed document that is provided by the employer to allow and control entry into a permit space and that contains the information specified in paragraph (f) of this section.

12. *Entry Supervisor* - means the person (such as the employer, foreman, or crew chief) responsible for:

    a. determining acceptable entry conditions;

    b. authorizing entry;

    c. overseeing entry operations; and

    d. terminating entry as required by this section.

NOTE: An entry supervisor also may serve as an attendant or as an authorized entrant, as long as that person is trained and equipped as required by this section for each role he or she fills. Also, the duties of entry supervisor may be passed from one individual to another during the course of an entry operation.

13. *Hazardous atmosphere* - means an atmosphere that may expose employees to the risk of:

    a. death;
    b. incapacitation;
    c. impairment of ability to self-rescue;
    d. injury; or
    e. acute illness;

from one or more of the following causes:

    1) Flammable gas, vapor, or mist in excess of 10 percent of its lower flammable limit (LFL, or LEL);

    2) Airborne combustible dust at a concentration that meets or exceeds its LFL; Vision obscured @ 5 ft or less

    3) Atmospheric oxygen concentration <19.5% or > 23.5%;

4) Atmospheric concentration of any substance for which a dose or PEL (permissible exposure limit) is published in OSHA Subpart G & Subpart Z of this part and which could result in employee exposure in excess of its dose or permissible exposure limit;

NOTE: An atmospheric concentration of any substance that is not capable of causing death, incapacitation, impairment of ability to self-rescue, injury, or acute illness due to its health effects is not covered by this provision

5) Any other atmospheric condition that is IDLH.

NOTE: For air contaminants for which OSHA has not determined a dose or PEL, other sources of information, such as MSDS's that comply with the Hazard Communication Standard 29 CFR 1910.1200 of this part, published information, and internal documents can provide guidance in establishing acceptable atmospheric conditions.

14. *Hot Work Permit* - means the employer's written authorization to perform operations (i.e. riviting, welding, cutting, burning, heating, etc.) capable of providing a source of ignition

15. *Inerting* - means the displacement of the atmosphere in a permit space by a noncombustible gas (i.e. nitrogen) to such an extent that the resulting atmosphere is noncombustible.

16. *Isolation* - means 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; or blocking or disconnecting all mechanical linkages.

17. *Line Breaking* - means the intentional opening of a pipe, line, or duct that is or has been carting flammable, corrosive, or toxic material, an inert gas, or any fluid at a volume, pressure, or temperature capable of causing injury.

18. *Non-Permit Confined Space* - means 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.

19. *Permit System* - means the employer's written procedures for preparing and issuing permits for entry and for returning the permit space to service following termination of entry.

20. *Prohibited Condition* - means any condition in a permit space that is not allowed by the permit during the period when entry is authorized.

21. *Rescue Service* - means personnel designated to rescue employees from permit spaces.

22. *Retrieval System* - means the 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 persons from permit spaces.

23. *Testing* - means 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.

NOTE: Testing enables employers both to devise and implement adequate control measures for the protection of authorized entrants and to determine if acceptable entry conditions are present immediately prior to, and during, entry.

C. ***General Requirements***

1. Evaluation by employer (refer to *Confined Space Evaluation Form)*

   a. Determine if there are any permit-required confined spaces.

   b. Inform exposed employees, by posting signs or by any other equally effective means, of the existence, location, and danger posed.

   c. Take effective measures to prevent employees from entering.

   d. Develop and implement a written permit space entry program.

   e. Where the employer can demonstration that forced air ventilation alone will control all hazards in the space, then the employer must comply with Paragraph (c)(5) in total. (Reclassification of a permit space.)

NOTE: "The forced air ventilation shall be so directed as to ventilated the immediate areas where an employee is or will be present within the space and shall continue until all employees have left the space."

D. ***Permit-Required Confined Space Program***

Under the permit-required confined space program required by paragraph (c)(4) of this section, the employer shall:

1. Implement the measures necessary to prevent unauthorized entry;

2. Identify and evaluate the hazards of permit spaces before employees enter them;

3. Develop and implement the means, procedures, and practices necessary for safe permit space entry operations, including, but not limited to, the following:

   a. Specifying acceptable entry conditions;

   b. Isolating the permit space;

   c. Purging, inerting, flushing, or ventilating the permit space as necessary to eliminate or control atmospheric hazards;

   d. Providing pedestrian, vehicle, or other barriers as necessary to protect entrants from external hazards; and

   e. Verifying that conditions in the permit space are acceptable for entry throughout the duration of an authorized entry.

4. Provide the following equipment at no cost to employees, maintain that equipment properly, and ensure that employees use that equipment properly:

   a. Monitoring equipment;

   b. Ventilating equipment;

   c. Communications equipment;

d. Personal protective equipment;

e. Lighting equipment;

f. Barriers and shields;

g. Ingress & egress equipment (i.e. ladders);

h. Rescue & emergency equipment; and

i. Any other equipment necessary for safe entry into and rescue from permit spaces.

5. Evaluate permit space conditions as follows when entry operations are conducted:

a. Pre-entry testing

b. Continuous monitoring

c. Test for atmospheric hazards in the following order;

1. Oxygen

2. Combustible gases and vapors

3. Toxic gases and vapors

6. Provide at least one attendant outside the permit space into which entry is authorized for the duration of entry operations.

7. 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 attendant's responsibilities under paragraph (i) of this section.

8. Designate active roles for persons involved, identify their duties, and provide each employee with the training required by paragraph (g) of this section.

9. Develop and implement procedures for summoning rescue and emergency services, for rescuing entrants from permit spaces, for providing necessary emergency services to rescued employees, and for preventing unauthorized personnel from attempting a rescue.

10. Develop and implement a system for the preparation, issuance, use, and cancellation of entry permits as required by this section.

11. Develop and implement procedures to coordinate entry operations when employees of more than one employer are working simultaneously as authorized entrants in a permit space, so that employees of one company do not endanger the employees of any other employer.

12. Develop procedures for concluding the entry after entry operations have been completed.

13. Review entry operations as often as needed to correct deficiencies.

14. Review the Permit-Required Confined Space program, using the canceled permits retained under paragraph (e)(6) of this section within one year after each entry and revise the program as necessary. (Single annual review covering all entries is acceptable. If no entry is performed during a 12-month period, then no review is necessary.)

E. ***Permit System***

1. Before entry is authorized, the employer shall document the completion measures required by paragraph (d)(3) of this section by preparing an entry permit.

2. Before entry begins, the entry/supervisor shall sign the entry permit.

3. Entry permit shall be posted at entry portal, so entrants can confirm that pre-entry preparations are complete.

4. The duration of the permit may not exceed the time required to complete the required job or task.

5. The entry supervisor shall terminate entry and cancel entry permit when:

   a. The entry operations covered by the permit have been completed; or

   b. A condition that is not allowed under the entry permit arises in or near the permit space.

6. The employer shall retain each canceled entry permit for at least one year to facilitate the review of the permit required confined space program. Any problems encountered during the entry operation shall be noted so appropriate revisions to the permit program can be made.

F. ***Entry Permit***

The entry permit that **documents** compliance with this section and authorizes entry to a permit space shall identify:

1. The permit space to be entered;

2. The purpose of entry;

3. The date and authorized duration of the entry permit;

4. The authorized entrants by name or other means to enable the attendant to determine which entrants are inside the permit space;

5. The personnel, by name, currently serving as attendants;

6 The individual currently serving as entry supervisor, and signature of the supervisor who originally authorized entry;

7. The hazards of the permit space to be entered;

8. Measures used to isolate, eliminate or control hazards before entry;

9. The acceptance entry conditions;

10. The results of initial and periodic atmospheric testing including the names of testers and time of testing;

11. The rescue and emergency services that can be summoned and means of summoning services;

12. The communication procedures used by the entrants and attendants;

13. Equipment such as the following:

    a. Personal Protective Equipment;

    b. Testing Equipment;

    c. Communication Equipment;

    d. Alarm Systems; and

    e. Rescue Equipment.

14. Any other information whose inclusion is necessary, given the circumstances of the particular confined space, in order to insure employee safety;

15. Any additional permits (such as hot work) that have been issued to authorize work in the permit space.

G. ***Training***

1. The employer shall provide that all employees involved in confined space work will acquire the understanding, knowledge and skills necessary for the safe performance of assigned duties.

2. Training shall be provided to each affected employee:

    a. Before employee is first assigned duties;

    b. Before there is first assigned duties;

    c. Whenever there is a change in permit space operations that presents

a hazard about which an employee has not previously been trained;

d. Whenever the employer has reason to believe that there are deviations from the original permit or there are inadequacies in the employer's knowledge or use of procedures.

3. The training shall establish employee proficiency in the duties required by this section and shall introduce new or revised procedures, as necessary, for compliance with this section.

4. The employer shall certify that the training required by paragraphs (g)(1) through (g)(3) of this section has been accomplished. The certification shall contain each employee's name, the signatures or initials of the trainers, and the dates of training. The certification shall be available for inspection by employees and their authorized representatives.

H. ***Duties of Authorized Entrants***

The employer shall ensure that all authorized entrants:

1. Know the hazards, signs or symptoms of exposure and consequences;

2. Properly use all equipment;

3. Communicate with attendant;

4. Alert the attendant whenever entrant recognizes a dangerous situation;

5. Exit as quickly as possible when required.

I. ***Duties of Attendants***

The employer shall ensure that each attendant:

1. Know the hazards, signs or symptoms of exposure and consequences;

2. Know the behavioral effects of exposure;

3. Maintain an accurate entrant count, continuously;

4. Remains outside until relieved by another qualified attendant;

5. Communicate with entrants;

6. Monitors activities inside and outside the space determining if it is safe for the entrants to remain in the permit space;

7. Summon rescue and emergency services as soon as it is determined entrants may need assistance to escape from permit space hazards;

8. Takes actions when unauthorized persons approach or attempt to enter the permit space;

9. Perform non-entry rescues as specified by the employers rescue procedure;

10. Performs no other duties that might interfere with the attendants duty to monitor and protect the authorized entrants.

J. ***Duties of Entry Supervisors***

The employer shall ensure that each entry supervisor:

1. Know the hazards, the sign or symptoms of exposure and consequences;

2. Verifies, by checking that the appropriate entries have been made on the permit as follows:

   a. All tests specified by permit have been conducted;

   b. All procedures specified by permit are in place; and

   c. All equipment specified by permit is in place.

3. Terminates the entry and cancels the permit when entry is completed or a prohibited condition arises;

4. Verifies that rescue services are available and means of summoning them are operatable;

5. Removes unauthorized individuals who enter or attempt to enter the permit space during entry operations;

6. Determines transfer of entry operation responsibility, and that acceptable entry conditions are maintained.

K. ***Rescue and Emergency Services***

The following requirements apply to employers who have employees enter permit spaces to perform rescue services:

1. The employer shall insure that each member of the rescue service is provided with and trained to use rescue equipment properly.

2. The host employer can arrange to have sub-contractors or off-site rescue services provide confined space rescue services.

3. To facilitate non-entry rescue, retrieval systems or methods shall be used whenever an entrant enters a permit space, unless the rescue equipment would increase the overall risk of entry or would not contribute to the rescue of the entrant. Retrieval systems shall meet the following requirements:

   a. Each authorized entrant shall use a chest or full body harness, with a retrieval line attached at the center of the entrant's back neat shoulder level, or above the entrant's head. Wristlets may be used in lieu of the chest or full body harness if the employer can demonstrate that the use of a chest or full body harness is infeasible or creates a greater hazard and that the use of wristlets is the safest and most effective alternative.

   b. The other 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 type permit spaces more than 5 feet deep.

4. If an injured entrant is exposed to a substance, a Material Safety Data Sheet (MSDS) or similar information identifying the substance shall be kept on-site and made available to the medical facility treating the exposed entrant.

* Proper Equipment Needed

- Lockouts / Tag Outs
- Harnesses

* Permit

Recnd all hazards in space

* Communication

- Voice
- Tag System
- Tap System

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CHAPTER 3

CONFINED SPACE HAZARDS

CONFINED SPACE HAZARDS

Accidents often occur in confined spaces because workers fail to recognize hazards (i.e. hazardous atmospheres, mechanical, electrical, noise, etc.). Even though confined space hazards may not appear to be present, always assume they are present when conducting an entry.

1. Atmospheric Hazards

    a. Oxygen deficient/enriched

    b. Flammable/explosive gases/vapors

    c. Toxic gases/vapors

    d. Airborne combustible dust

2. Physical Hazards

    a. Mechanical

    b. Electrical

    c. Heat Stress

    d. Cold Exposure

    e. Noise

    f. Slips, trips & falls

    g. Opening configuration/location

    h. PPE

i. Engulfment

j. Structural (Internal and External)

3. Biological Hazards

a. Bird/Bat droppings

b. Dead animals

c. Poisonous plants

d. Poisonous insects

e. Medical waste

f. Venomous snakes

g. Human waste

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CHAPTER 4

AIR MONITORING EQUIPMENT/PROGRAM

AIR MONITORING EQUIPMENT/PROGRAM

Air Monitoring Program

A written confined space air monitoring program shall be developed and implemented prior to conducting confined space entries. This program should include the following, as a minimum:

1. Air Monitoring Requirements

   a. Development of entry procedures and evaluation/interpretation of data should be done or reviewed by a technically qualified professional such as:

      - OSHA consultation service
      - Certified Industrial Hygienist (CIH)
      - Certified Safety Professional (CSP)
      - Registered Safety Engineer

   b. Testing must be done prior to entry to determine if atmospheric conditions are within limitations listed on the permit.

   c. Instrumentation must be of sufficient sensitivity and specifity to identify and evaluate any hazardous atmosphere. Separate instruments may be needed to detect:

      - Oxygen
      - Flammable gases/vapors
      - Toxic gases/vapors

   d. Entrants should monitor 4 feet in front of them as they enter a confined space or enter remote areas of the space during an initial entry.

   e. Remote sampling devices should be used to test deep spaces, spaces with odd shapes, or remote areas during an initial entry.

f. After the initial entry, further testing should be conducted during confined space work to verify that acceptable atmospheric conditions are being maintained.

g. If the confined space is part of a continuous system (i.e. sewer that can not be isolated), OSHA states that testing must be continuous during confined space work.

h. NIOSH recommends that testing during confined space work be continuous under the following conditions:

- Confined spaces that can generate toxic atmospheres (desorption)
- Confined spaces that can generate Oxygen deficient/enriched and/or flammable/explosive atmospheres

i. If the confined space is vacated for a period of time, the atmosphere should be tested before re-entry.

j. Direct reading instruments such as toxic gas and combustible gas meters should be calibrated before use as per the manufacturer's recommendations.

k. Documentation of calibration should be kept on file.

2. Acceptable Limits for Atmospheric Testing

a. Oxygen levels must be between:

b. Flammable gases/vapors must be less than:

c. Concentrations of toxic gases/vapors must be less than:

d. Airborne combustible dust must be less than:

Air Monitoring Equipment

Confined space workers must be trained in the use, limitations, and monitoring procedures for confined space air monitoring equipment, prior to entering confined spaces. All air monitoring equipment should be listed as being approved for use in hazardous atmospheres (UL or FM approved). The following pieces of air monitoring equipment can be separate, individual units, or all be contained in one single unit (i.e. tri- or quad-meters):

1. Oxygen Meter

   a. Use

      - This meter measures the percent concentration of oxygen in air by the amount of electrical current generated by the sensor.

   b. Limitations

      - Operates poorly below 32°F
      - Operates poorly in humid atmospheres
      - Chlorine, ozone and carbon monoxide will cause false high readings
      - Acid gases will decrease the service life of the sensor
      - Oxygen readings may be in error at high or low altitudes; the meter should be recalibrated there's been an increase or decrease of 500 feet or greater in altitude
      - Increase in sampling time when using sampling hoses; hoses >100 feet are not recommended

2. LEL Meter

   a. Use

      - This meter measures 0-100 percent of the Lower Explosive Limit through the resistance to the flow of electricity in the filament.

b. Limitations

- Low oxygen readings will cause false low explosive gas readings
- Has up to 20% error in unknown atmospheres
- Will not operate properly in high humidity atmospheres (above 90%)
- Will not detect explosive mists such as lubrication oils; or explosive dusts such as coal dust or grain dust
- Silicone, silicates and organic lead will poison the sensor
- Increase in sampling time when using sampling hoses; hoses >100 feet are not recommended

3. Toxic Gas Meters

a. Use

- These meters, which measure the concentration of toxic gases (in ppm) in the atmosphere, are as follows:

Photoionization Detectors

- HNU
- TIP
- Micro-Tip

Flame Ionization Detectors

- OVA
- TVA-1000

Toxic Gas Meters

- Hydrogen Sulfide
- Carbon Monoxide

- Hydrogen Cyanide
- Methane, etc.

b. Limitations

- Possible false or no reading in unknown atmospheres
- All operate poorly below 32°F
- Readings may also be affected by atmospheric pressure and/or humidity
- Can be expensive if a different meter/sensor is required for different confined space atmospheres

4. Monitoring Procedures

a. Always monitor prior to entry for:

-
-
-

b. Always monitor the top, middle, and bottom of a confined space due to stratification of gases and vapors due to their vapor densities

c. Continuous monitoring is highly recommended

d. In addition to remote air monitoring devices, utilize personal monitors whenever possible

e. Always record air monitoring reads on the entry permit or in the log book

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CHAPTER 5

OVERVIEW OF CONFINED SPACE EQUIPMENT AND ASSESSMENT

(k) Rescue and emergency services.

(1) The following requirements apply to employers who have employees enter permit spaces to perform rescue services.

(i) The employer shall ensure that each member of the rescue service is provided with, and is trained to use properly, the personal protective equipment and rescue equipment necessary for making rescues from permit spaces.

(ii) Each member of the rescue service shall be trained to perform the assigned rescue duties. Each member of the rescue service shall also receive the training required of authorized entrants under paragraph (g) of this section.

(iii) Each member of the rescue service shall practice making permit space rescues at least once every 12 months, but means of simulated rescue operations in which they remove dummies, manikins, or actual persons form the actual permit spaces or from representative permit spaces. Representative permit spaces shall, with respect to opening size, configuration, and accessibility, simulate the types of permit spaces from which rescue is to be performed.

(iv) Each member of the rescue service shall be trained in basic first-aid and in cardiopulmonary resuscitation (CPR). At least one member of the rescue service holding current certification in first aid and in CPR shall be available.

(2) When an employer (host employer) arranges to have persons other than the host employer's employees perform permit space rescue, the host employer shall:

(i) Inform the rescue service of the hazards that may confront when called on to perform rescue at the host employer's facility, and

(ii) Provide the rescue service with access to all permit spaces from which rescue may be necessary so that the rescue service can develop appropriate rescue plans and practice rescue operations.

(3) To facilitate non-entry rescue, retrieval systems or methods shall be sued whenever an authorized entrant enters a permit space, unless the retrieval equipment would increase the overall risk of entry or would not contribute to the rescue of the entrant. Retrieval systems shall meet the following requirements.

(i) Each authorized entrant shall use a chest or full body harness, with a retrieval line attached at the center of the entrant's back near shoulder level, or above the entrant's head. Wristlets may be used in lieu of the chest or full body harness f the employer can demonstrate that the use of a chest or full body harness is infeasible or creates a greater hazard and that the use of wristlets is the safest and most effective alternative.

(ii) The other 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 type permit spaces more than 5 feet deep.

(4) If an injured entrant is exposed to a substance for which a Material Safety Data Sheet (MSDS) or other similar written information is required to be kept at the worksite, that MSDS or written information shall be made available to the medical facility treating the exposed entrant.

Fall Protection and Confined Space Equipment Manufacturers

MAJOR:

- DBI/SALA
- Miller
- Rose
- RTC (Research Trading Corp)
- Protecta

MINOR:

- UniHoist
- Surety
- Elk River
- Arkon
- North

"Qualified Person"

- ANSI standard - An **"engineered" retrieval system** must be designed by a *qualified person* (i.e.,engineering background, person with a background in confined space retrieval systems, the individual can be justified as competent in this area.)

Confined Space Entry

PRIMARY means of entry is:

A. Ladder or B. Stairs

then the retrieval line may be used as *fall protection* and your secondary lifeline. Keep retrieval line taught!

PRIMARY means of entry is:

A. Lowering of the entrant!

then *two (2) lines* are required and one must have fall protection capability.

RETRIEVAL SELECTION
Primary Considerations of Design

- *Safety and Compliance*
- *Ease of Use*
  - Simplicity in set up
  - Easy to use
- *Versatility of equipment*
  - Make use of the investment
- *Price (Return on investment)*

EQUIPMENT VERSATILITY

- " **Equipment versatility** is also an important factor. A tool that can perform *multiple functions* or can be used in a *variety of situations* is often preferred to a single use device. "

(from US Fire Admin, Technical Rescue Technology Assessment, January 1995)

TO:
DATE:

Inc.

I. S. Resources,

4361 Route 8
Allison Park, PA 15101
(800) 327-5895
(412) 487-7817
(412) 487-1066 fax

QUESTIONNAIRE
FOR
CONFINED SPACE ENTRIES

1. Are you aware of the newly published OSHA standard 29 CFR Parts 1910, Final Rule for permit-required confined spaces for general industry? Yes_____ No_____

2. Is compliance to OSHA important to you? Yes_____ No_____

3. Is compliance to NFPA important to you? Yes_____ No_____

- - - - - - - - - - - - - - - - - - - -

ENTRY PROFILE:

PECS: What is your number of permit entry confined spaces per plant site? _____

WEEKLY ENTRIES: What is you number of permit confined space entries per week? _____

WORK TEAM: What is the average number of workers per entry team? _____

LKOUT TAG: Perform lockout tagout prior to entry? Yes_____ No_____

MECH VENT: Do you perform mechanical ventilation prior to and during entry? Yes_____ No_____

TSTATM SFLM: Test atmosphere for flammables? Yes_____ No_____

TSTATM SOXY: Test atmosphere for oxygen? Yes_____ No_____

TSTATM STOX: Test atmosphere for toxics? Yes_____ No_____

RETLINE: Do you use a retrieval line for entry? Yes_____ No_____

OUTATTEN: Use outside attendant during entry? Yes_____ No_____

ENTRY RQVENT: How many entries per month require ventilation? _____

ENTRY RQSAR: How many entries per month require use of an air line respirator? _____

ENTRY RQRESP: How many entries per month require respiratory protection? _____

INHRES: Do you have an in-house rescue team? Yes_____ No_____

INHRES: How many inside rescue team members do you have? _____

OUTRES: Do you use an outside rescue team for confined space situations? Yes_____ No_____

OUTRES NAME: What is the name of the outside organization which provides confined space rescue for you?
Name: _____

CHEM RES: Do you have a potential for a confined space rescue which would require a high degree of protection against chemicals (Level A Protection)? Yes_____ No_____

EQUIPMENT LIST:

Please list equipment currently used by your organization in confined space entry applications.

		Brand (if known)
Retrieval System (Tripod Type Device)	yes ___ no___	_____
Harnesses	yes ___ no ___	_____
Lanyards	yes ___ no ___	_____
Supplied Air Respirators	yes ___ no ___	_____
Self Contained Breathing Apparatus	yes ___ no ___	_____
Level A Chemical Suits	yes ___ no ___	_____
Level B Chemical Suits	yes ___ no ___	_____
Suit Cooling/Ventilation	yes ___ no ___	_____
Gas Detection	yes ___ no ___	_____

PROBLEM ENTRIES:

Please list the confined space applications where you have problems with entry or retrieval.

1. _____

_____

_____

2. _____

_____

_____

3. _____

_____

_____

4. _____

_____

_____

OPTIONAL:

1. Does your organization have a Hazardous Materials Response Team? yes____ no____

Who is responsible for the equipment selection?

_____

2. Do you have an interest in communication equipment for confined space and/or HAZMAT response? yes ____ no ____

RETRIEVAL

APPLICATIONS/ENGINEERING WORKSHEET

Date: _____

Contact Name: _____ Title: _____

Organization: _____ Sales Rep: _____

Address 1: _____ SIC: _____

Address 2: _____ PIN: _____

City,State: _____

Phone #: (____)_____

Equipment budgeted for? _____

Amount Estimate? _____

Time deadline? _____

Engineering contact: _____

Maintenance contact: _____

Safety Department contact: _____

Rescue Response contact: _____

Purchasing contact: _____

Other Needs: Harnesses: _____ Communications: _____

Rescue: _____ Ventilation: _____

Gas Det: _____ Respiratory: _____

PAGE ____

RETRIEVAL

PLANT SURVEY WORKSHEET

IS REF #	CS IDENTIFICATION	ANCHOR POINT/MEASUREMENTS	RETRIEVAL SOLUTION

RETRIEVAL

APPLICATIONS AND SOLUTIONS

I. Vertical Entry

A. Look for possible anchor points directly above the manhole

Possible anchor points:

1. Overhead I-Beams
2. Ceilings which will support eye hook
3. Use of straps or anchoring devices in conjunction with existing structures
4. Strength capacity of all anchoring points and the integrity of each engineered system to meet OSHA standards must be confirmed and approved by a "qualified" person as outlined in OSHA 1910.146 (trained engineer, certified welder, etc.). Provided by client

B. Look for I-Beams or steel structures

C. Can a sleeve be mounted to the side of the structure itself (confined space structure)?

D. Can Uni-Hoist sleeve and/or mast system be mounted in a way which would produce an anchor point above the manhole?

OTHER CONSIDERATIONS:

A. Is mast offset required for any of the above?

B. Is height adjustment required?

C. Is fall protection a factor in any application?

D. Is winch cable length sufficient?

E. Is communication equipment desired?

F. Is equipment cart needed?

G. Does customer desire to adapt existing winch to Uni-Hoist?

RETRIEVAL

APPLICATIONS AND SOLUTIONS

Vertical Solutions:

A. Tripod

B. UH-505

C. Extensions

D. Offset Masts

E. Wall Mount Sleeve

F. Floor Mount Sleeve

G. Flush Floor Mount Sleeve

H. Barrel Mount Sleeve

I. Hitch Mount

J. Platform

K. Counterweight

L. Forklift

M. Adjustable Tank Collar

N. Fixed Tank Collar

O. Extraction Device

P. Pole Hoist

Q. Chain Drive

R. GripTech

S. Rollgliss

T. Safe-Haul (Pre-rigged Rope & Pulleys)

U. Rope and Pulleys

V. Ladders lashed into "A" frame configuration

RETRIEVAL

APPLICATIONS AND SOLUTIONS

Horizontal Solutions:

A. Ropes/Pulleys

B. GripTech

C. Pole Hoist

D. UH-505

E. Tripod?

F. Uni-Hoist Horizontal System

UNI-HOIST®

Basic Systems

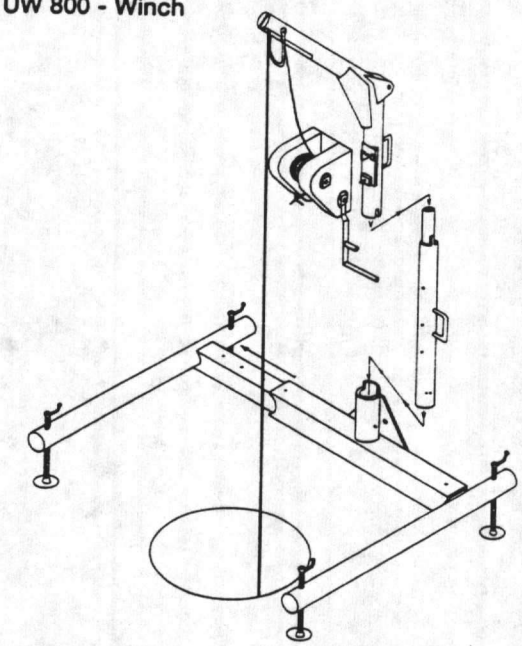
The basic Uni-Hoist consists of a base with levelling legs and a mast section with a positive braking winch holding up to 150 feet of 3/16" galvanized aircraft steel cable. It is available in a 3 piece or 5 piece system (or interchangeable bases and masts) and provides a starting point for a confined space entry/retrieval program.

The 3 piece system has a 36" fixed width base and a 2 piece mast with 78" height and 18" of reach. The 5 piece system has a 3 piece base adjustable from 36" to 56" in width and a 2 piece mast with 78" height and 18" reach. The 5 piece system fits in the trunk of a small vehicle.

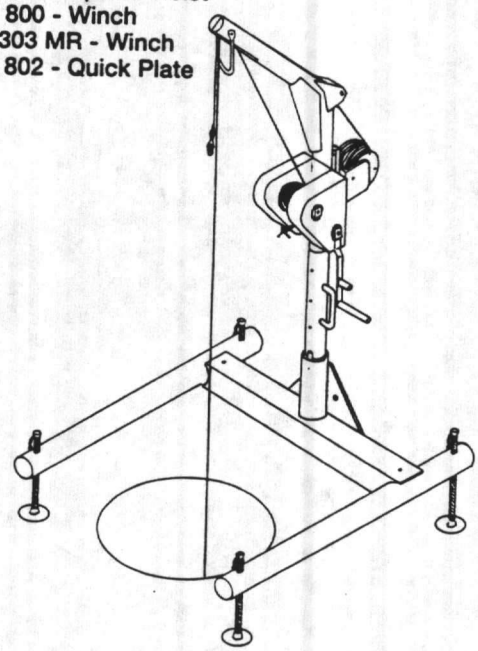
The mast sections can be utilized in all Uni-Hoist bases, sleeves, platforms or collars as well as forming the basic device for our custom design services. The winch can be mounted on the front, back, or both front and back of the mast and the height of the winch is also variable.

The basic Uni-Hoist system, packed with all features required by confined space users is ideally suited.

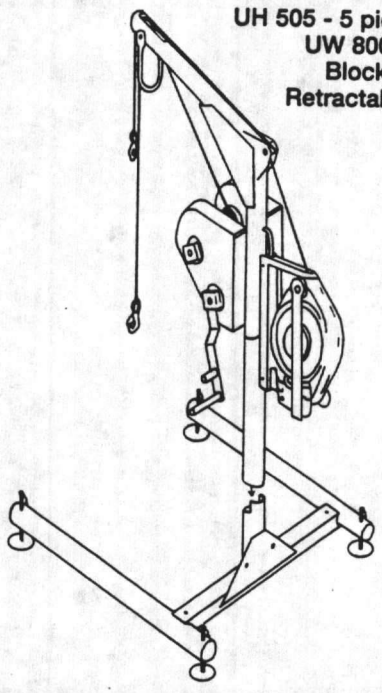
UH 505 - 5 piece Hoist
UW 800 - Winch



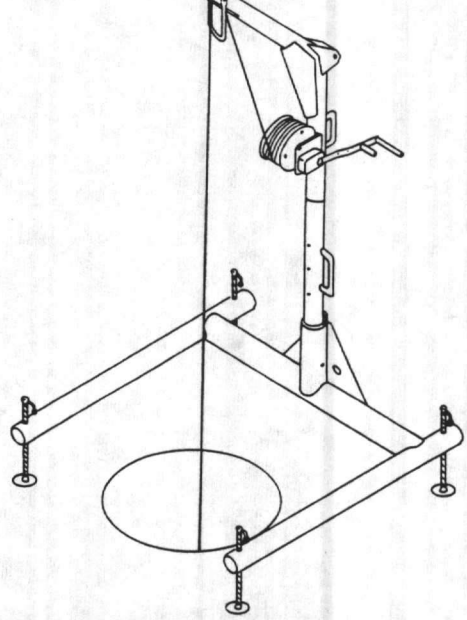
UH 505 - 5 piece Hoist
UW 800 - Winch
PR 303 MR - Winch
UW 802 - Quick Plate



UH 505 - 5 piece Hoist
UW 800 - Winch
Block Adaptor
Retractable Block



UH 305 - 3 piece Hoist
PR 303 MR - Winch



UNI-HOIST®

Ladder Systems

The self supporting Uni-Ladder System is used in conjunction with the basic Uni-Hoist System to provide confined space workers with another means of entering and exiting confined spaces.

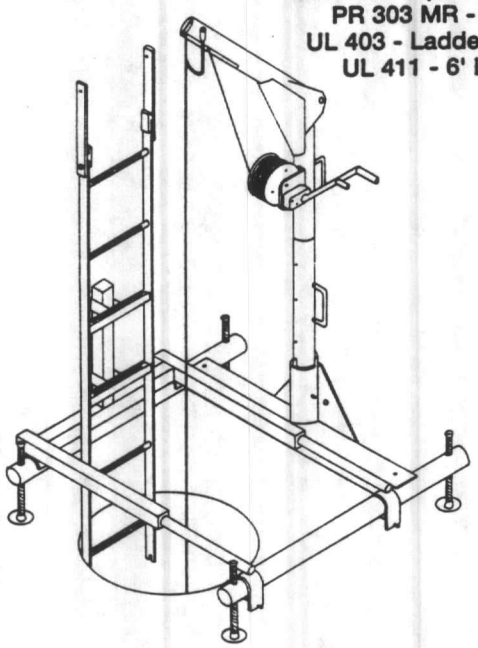
The system made from strong durable lightweight aluminum consists of a base mount or sleeve mount and double rail ladder sections that can be easily linked together to a maximum of 40' without auxiliary support.

The ladder base mount is used with the Uni-Hoist base while the ladder-sleeve mount can be used with all Uni-Hoist mounting devices.

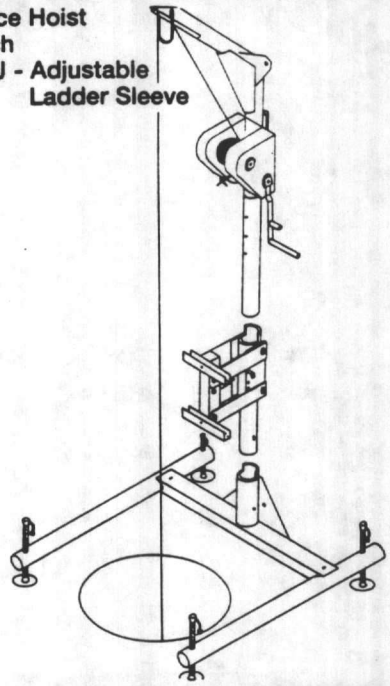
The ladder sections come in 4' and 6' lengths, are equipped with skid resistant paint on each rung, and sleeve together, securely fastened with steel bolts. The mount is equipped with locking pins to ensure the ladder remains secure in its support.

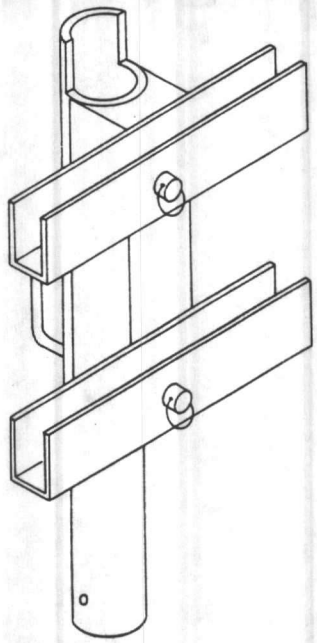
The Uni-Ladder is a worker friendly add-on to the basic Uni-Hoist system.

UH 505 - 5 piece Hoist
PR 303 MR - Winch
UL 403 - Ladder Base
UL 411 - 6' Ladder



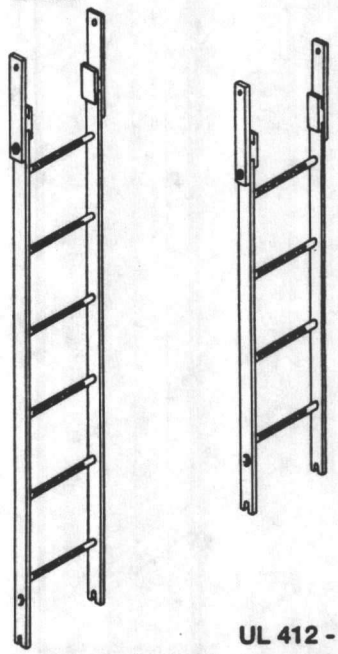
UH 505 - 5 piece Hoist
UW 800 - Winch
UL 403-SL-ADJ - Adjustable Ladder Sleeve





UL 403SL - Ladder Sleeve

UL 411 - 6' Ladder



UL 412 - 4' Ladder

UNI-HOIST®

Sleeve Systems

Uni-Sleeves were developed for applications where the base system for mounting a Uni-Hoist mast is not practical.

The sleeves are made of heavy gauge steel, zinc plated to abate corrosion, with a PVC liner to provide reduced friction from the inserted swivel mast. The wall mount and floor mount sleeves are bolted to rigid concrete structures or may be bolted or welded to steel tanks, catwalks, truck beds or bumpers. The barrel mount sleeve is portable and fits over the edges of steel casings. The hitch mount sleeve is mounted to a 2" square hitch receptacle and has an adjustable support leg to provide stability.

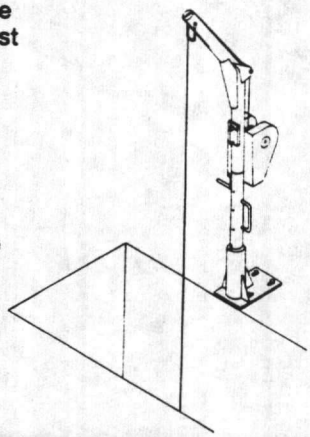
The Core Sleeve or Flush Mount Sleeve may be used in existing concrete.

For highly corrosive areas, Uni-Sleeves can be ordered in stainless steel.

The Uni-Sleeves provide the user with the versatility of being able to use the mast and winching systems in a wide variety of applications.

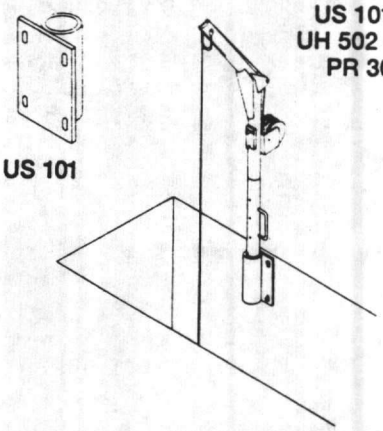
US 100 - Floor Sleeve
UH 502 - 2 piece Mast
UW 800 - Winch

US 100

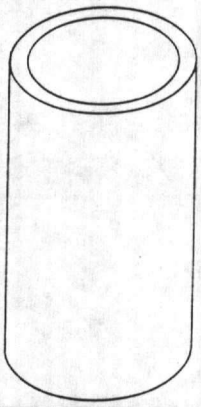


US 101 - Wall Sleeve
UH 502 - 2 piece Mast
PR 303 MR - Winch

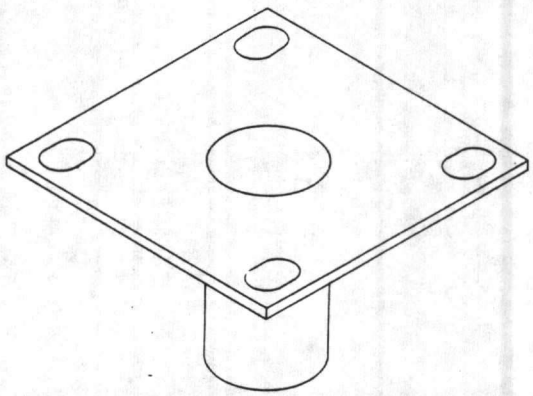
US 101



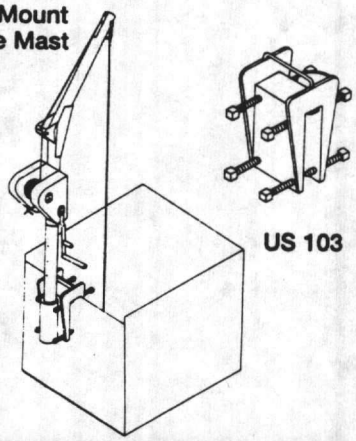
US 105 - Cylinder Core Sleeve



US 102B - Flush Floor Sleeve

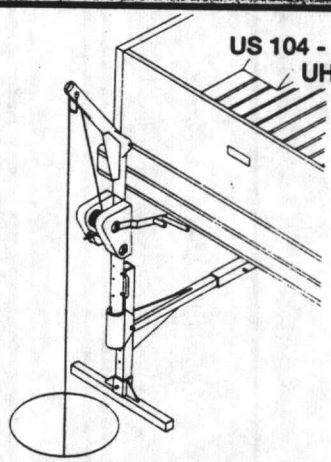


US 103 - Barrel Mount
UH 502 - 2 piece Mast
UW 800 - Winch



US 103

US 104 - Hitch Mount Sleeve
UH 502 - 2 piece Mast
UW 800 - Winch



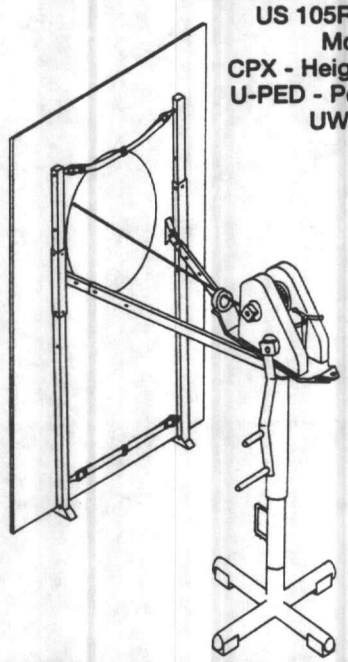
UNI-HOIST®

Horizontal Systems

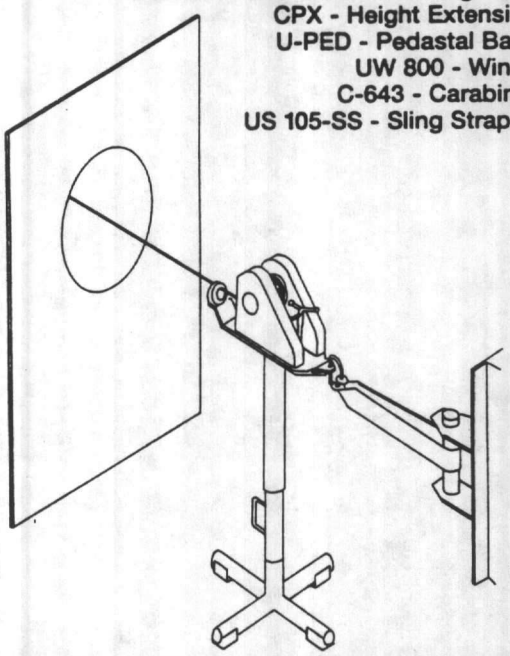
This unique Horizontal System sets up in minutes. Tie the Horizontal Mounting Plate back to an anchor point for stability or use the reverse extension arms directed back onto the tank and the system is ready to use. Made of lightweight aluminum this system solves many horizontal retrieval requirements. Extension posts for correct height are available in 1' to 4' lengths and may be piggy backed.

A retractable block may be used in place of a winch for ease of entry. The Horizontal Mounting Plate will accept most manufacturers retractable blocks.

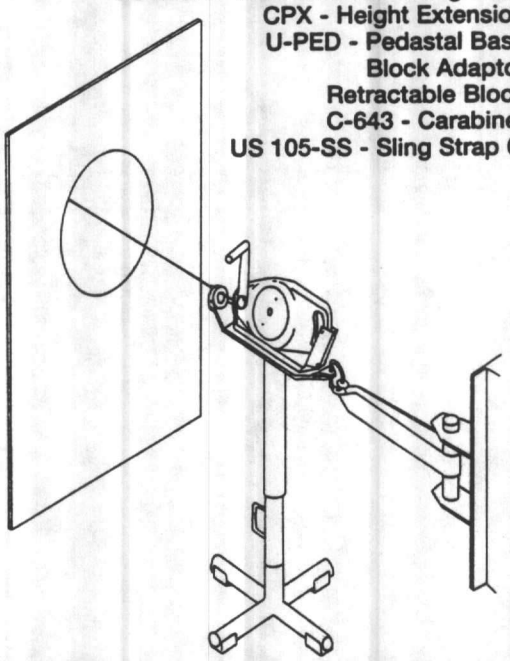
US 105X - Extension Arms
US 105R - Horizontal Mounting Plate
CPX - Height Extension
U-PED - Pedastal Base
UW 800 - Winch



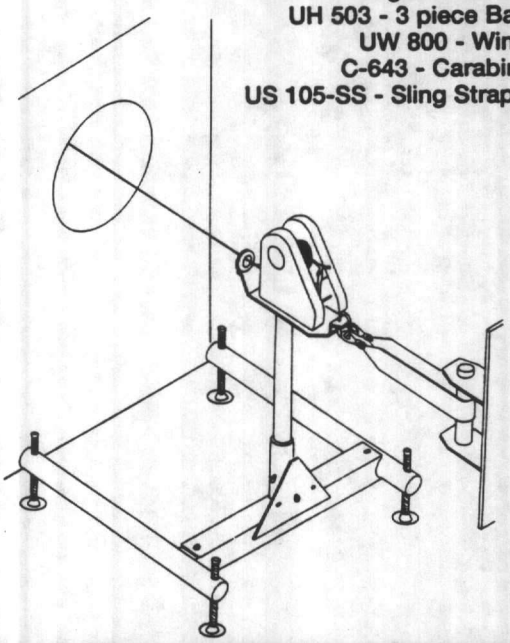
US 105R - Horizontal Mounting Plate
CPX - Height Extension
U-PED - Pedastal Base
UW 800 - Winch
C-643 - Carabiner
US 105-SS - Sling Strap 6'



US 105R - Horizontal Mounting Plate
CPX - Height Extension
U-PED - Pedastal Base
Block Adaptor
Retractable Block
C-643 - Carabiner
US 105-SS - Sling Strap 6'



US 105R - Horizontal Mounting Plate
CPX - Height Extension
UH 503 - 3 piece Base
UW 800 - Winch
C-643 - Carabiner
US 105-SS - Sling Strap 6'



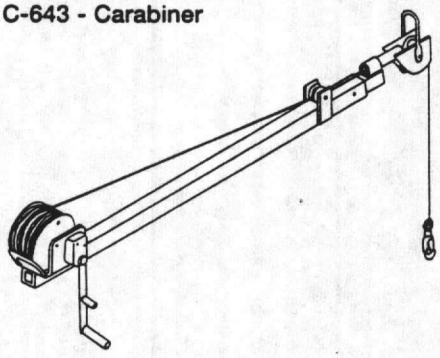
UNI-HOIST®

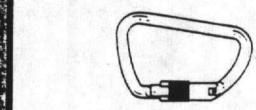
Pole Hoists

The Pole Hoist from Uni-Hoist is one of the most versatile retrieval devices available today. Capable of both vertical and horizontal retrieval in areas of limited space. Lightweight and very user friendly. Available in 4 different models: 3' long, 6' long, 4 1/2' that expands to 6 1/2' and the deluxe unit 6' expandable to 12'. Optional Bi-Pod legs available for all models.

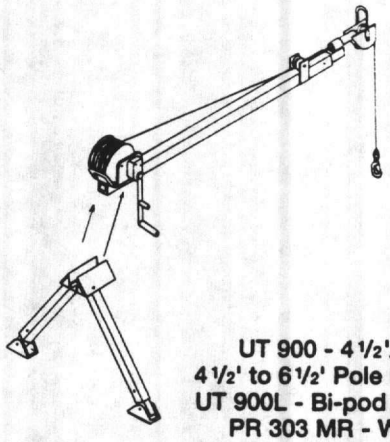
The head of the Pole Hoist swivels to the direction of the load.

UT 900-3 - 3' Pole Hoist
PR 303 MR - Winch
C-643 - Carabiner

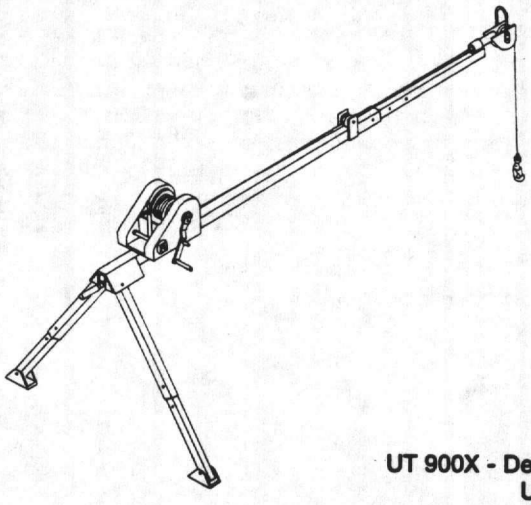




C-643 - Carabiner



UT 900 - 4 1/2'/6 1/2'
4 1/2' to 6 1/2' Pole Hoist
UT 900L - Bi-pod Legs
PR 303 MR - Winch
C-643 - Carabiner



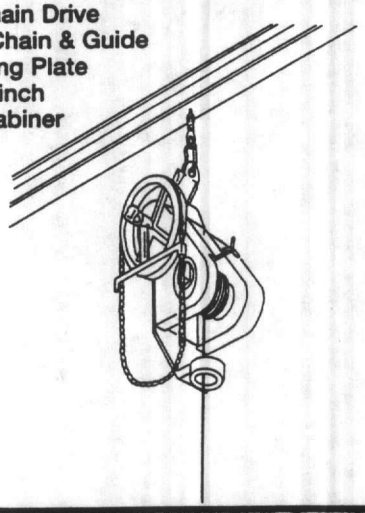
UT 900X - Deluxe Pole Hoist
UW 800 - Winch
C-643 - Carabiner

UNI-HOIST®

Chain Drive Systems

Chain Drive Retrieval System for those most difficult vertical tank entries. Using its double brake, two speed man rated winch, the Chain Drive takes the place of the crank handle and enables the entry to be performed in many varied ways. Excellent for the most difficult entries into kettles, vats, fibreglass and glass tanks.

UC 801 - Chain Drive
UC 801C - Chain & Guide
US 105 - Sling Plate
UW 800 - Winch
C-643 - Carabiner

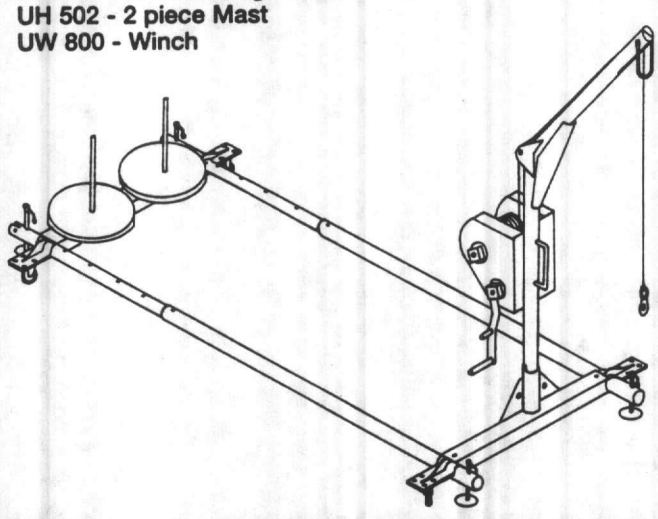


UNI-HOIST

Counter Weight Systems

A counter balance technique to provide the safe entry into the most difficult of confined space tank entries. The Counterweight System consists of legs that extend from 5' to 8' depending on what space is available, combined with a weight tray that houses the amount of counter weights necessary to provide a 10:1 safety factor on a 350 lb. maximum person load. The reach of the mast is available to a distance of 4'. Provides a means to also lower an entrant into open pits without having to construct a scaffold decking. Mounted on 5" locking wheels, the product may be moved from one area to another without having to breakdown.

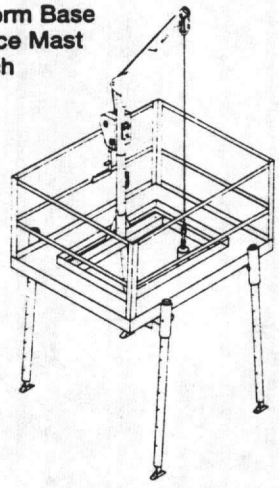
UH 506 - Counterweight Base
UH 502 - 2 piece Mast
UW 800 - Winch



UNI-HOIST® Platform Systems

The Uni-Platform is a specially designed base, with a receptacle for the Uni-Hoist mast. The platform has adjustable legs, with rubber foot pads and a catwalk grid for the attendant. It is utilized in applications where the entry point is raised above the ground (raised manholes) or where there is a curvature to a vessel (tanker trailers, rail cars, storage tanks).

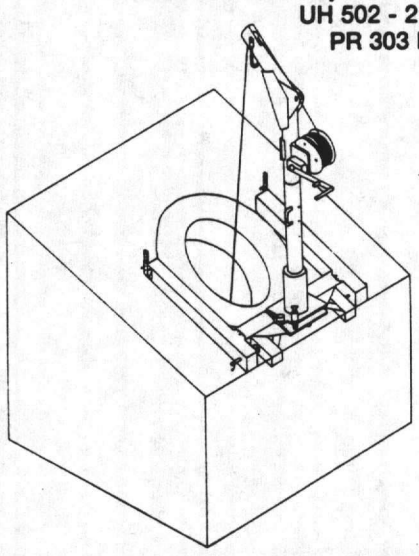
US 150 - Platform Base
UH 502 - 2 piece Mast
UW 800 - Winch



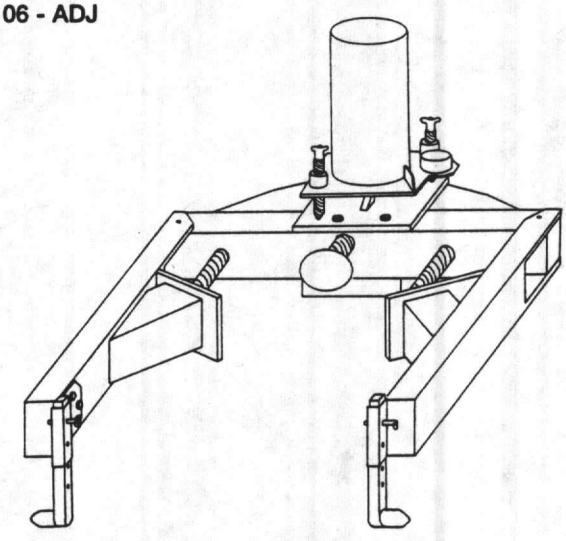
UNI-HOIST Adjustable Tank Collar

New from Uni-Hoist is the adjustable tank collar that is used on areas unable to accept the standard Uni-Hoist base. The adjustable collar is available for mounting to the inside of the tank opening or to the outside collar. Adjustable from 18" tank openings to 32" tank openings. Made from lightweight aluminum that is quick and easy to assemble. Breaks down into 3 pieces the Mast Collar is 360 degrees adjustable to accommodate the angle of the mount.

US 106-ADJ - Adjustable Tank Collar
UH 502 - 2 piece Mast
PR 303 MR - Winch



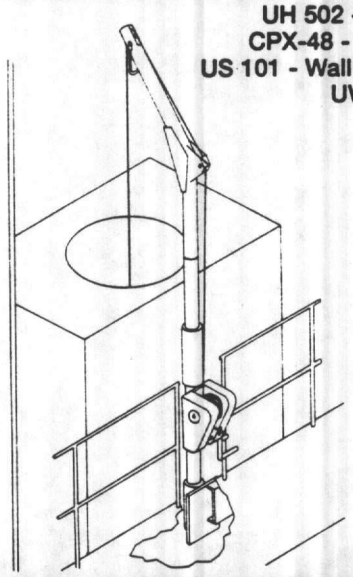
US 106 - ADJ



UNI-HOIST® Extensions

Mast extensions are available in lengths from 15" to 72". Made from carbon steel zinc plated these extensions provide additional heights to the Uni-Hoist mast.

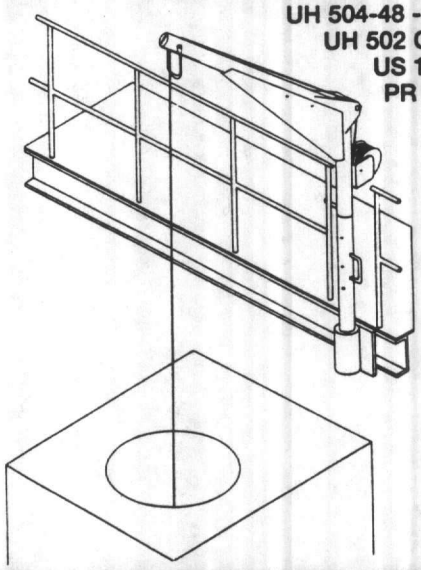
UH 502 - 2 piece Mast
CPX-48 - 48" Extension
US 101 - Wall Mount Sleeve
UW 800 - Winch



UNI-HOIST® Offsets

Mast offsets provide the reach required to enter a space. The standard mast offset used with the Uni-Hoist base is 18". Offsets are available to use in sleeves from 6" to 48" and are capable of accepting both winches and retractable blocks.

UH 504-48 - 48" Offset Mast
UH 502 CP - Centre Post
US 101 - Wall Mount
PR 303 MR - Winch



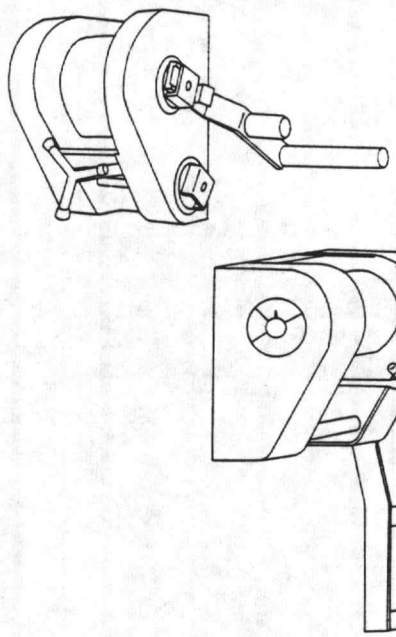
UNI-HOIST®

Winches

The UW-800 is a man rated, double brake, double speed winch capable of retrieval at 30' per minute on the 4:1 shaft and 60' per minute of the 2:1 shaft. The winch is capable of 250' of 3/16" S.S. cable.

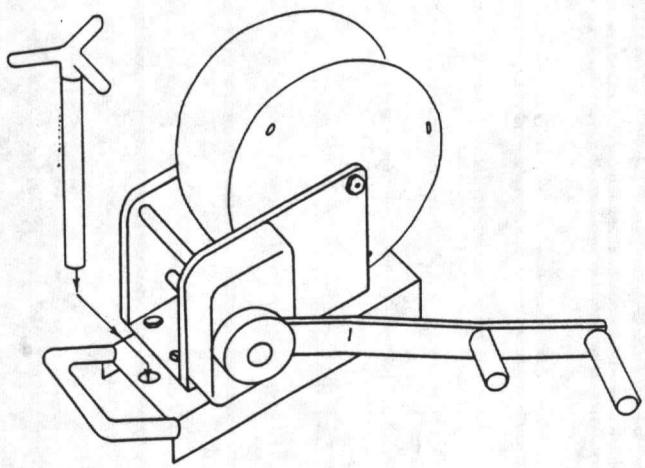
Double continuous braking prevents "free wheeling" of the crank handle. Winch is capable of operating with optional chain drive or electric/air drive power units. Weight is 39 lbs. with standard 70' cable length. Quick connects to all Uni-Hoist structures.

UW 800



The PR303MR is a man rated, single speed, single braking winch capable of retrieval at 20-23' per minute weighing only 23 lbs with 70' of 3/16" stainless steel cable. Continuous brake system prevents "free wheeling" of drum. Quick connects to all Uni-Hoist Structures.

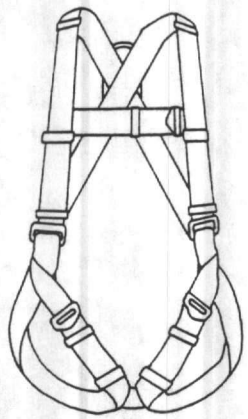
PR303 MR



UNI-HOIST®

Accessories

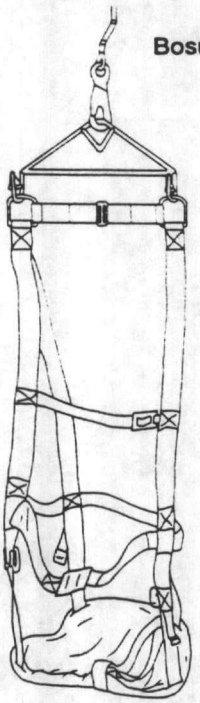
The Uni-Hoist Full Body Harness is an approved device which provides complete safety and comfort for the entrant. The nylon webbing is easy to put on with tongue and buckle or quick connects and the harness is adjustable to fit most sizes.



LIN 30630 -Quick Connect Harness

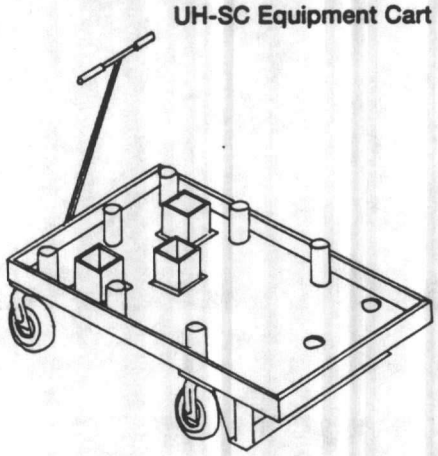
The Uni-Hoist Bosun's Chair features a moulded fibreglass seat with a built in nylon webbed safety harness and steel bar separator. Ideal for suspended work application.

BC 700 - Bosun's Chair



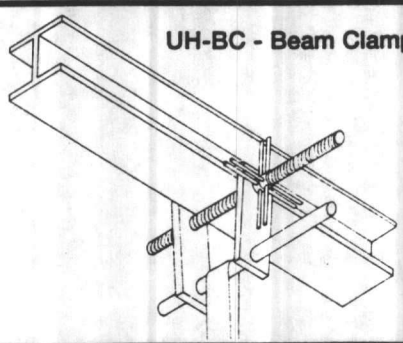
The Uni-Hoist Safety Equipment Cart is custom made to carry desired Uni-Hoist equipment. Front steering, vinyl cover, choice of colors, manual pull T-handle or ball hitch.

UH-SC Equipment Cart

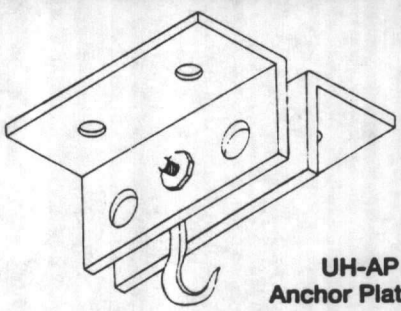


The new Beam Clamp from Uni-Hoist is a portable anchor point adjustable to I-Beams 3" wide to 12" wide. Made of carbon steel and zinc coated. Rated for 5400 lbs. static load.

UH-BC - Beam Clamp



An anchor point for Pole Hoists, Chain Drives, Retractable Blocks etc. 2 Holes for Carabiners and one open hook. Made of carbon steel and primer coated. Rated at 5400 lbs.



UH-AP - Anchor Plate

GRIPTECH SP HIGH ANGLE RESCUE SYSTEMS

The Ultimate in Versatility

If your potential for rescue spans the extremes - confined spaces, buildings, towers and cliffs (to name a few), here is your solution. Not only will you be able to accomplish virtually any rescue you encounter, but a GripTech SP System will allow you to do it faster and safer than any other method.

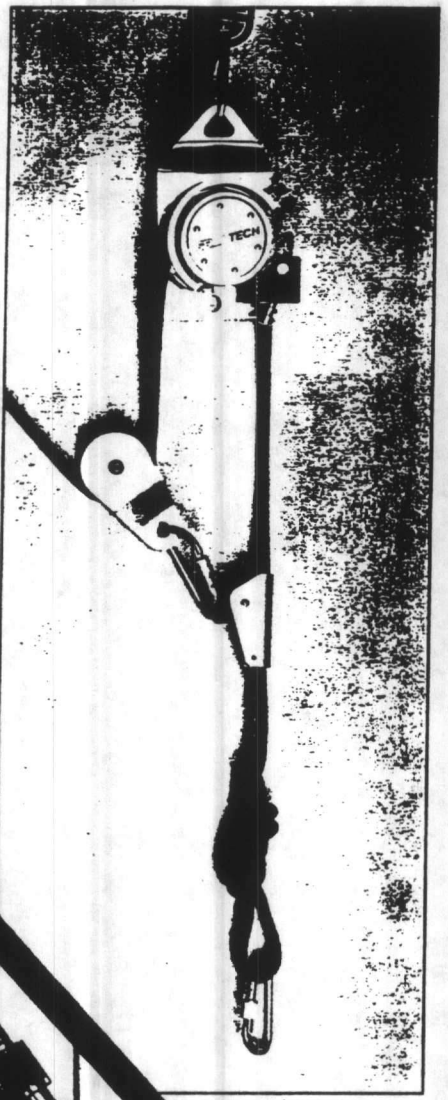
The GripTech SP2 System with optional Haul-Lock* and Lock-Off Bar* will provide you with the capability to perform confined space and high–angle rescues. The exclusive GripTech Haul-Lock provides many advantages for rescue operations. When not engaged, the system performs as normal and raising or lowering may be performed. For vertical hauling, when engaged, it prevents the load from descending between "hauls" providing extra protection in case the operator is incapacitated. When rigged horizontally, such as in rigging a Z-haul, the Haul–Lock holds the load between hauls and while resetting the Z-haul. The Haul-Lock also allows disengagement under full load for smooth conversion to lowering mode.

GripTech SP (Split Pulley) High Angle Rescue Systems come standard with a 3:1 lifting advantage and utilize removable, split pulleys to allow the user to rig different configurations as situations vary. The 3/8" rope version (SP1) is recommended for 1-person rescues performed by trained rescue personnel. The 1/2" rope version (SP2) is recommended for 2-person rescues performed by trained rescue personnel.

SP SYSTEMS

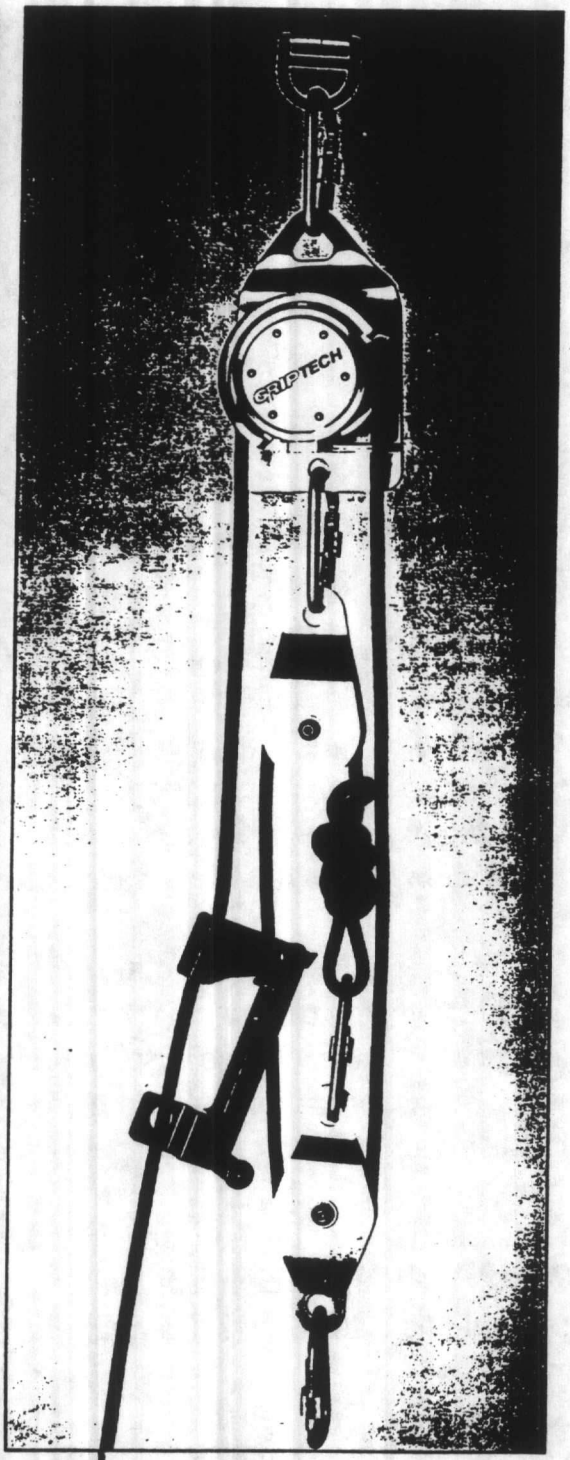
SP2 Z-RIG

The simplest and safest method of rigging a Z-haul - with lowering system built in!



SP1

GRIPTECH SP1 SYSTEM.



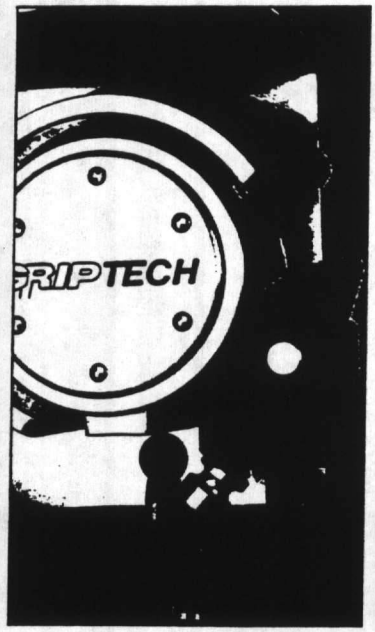
SP SYSTEM OPTIONS

HARSH ENVIRONMENT SERVICE OPTION

FOR SP1 AND SP2

If working in atmospherically or chemically-aggressive environments, your GripTech SP system may be upgraded as follows:

- ❑ Stainless Steel Pulley Sheaves
- ❑ Stainless Steel Carabiners



HAUL-LOCK OPTION

FOR SP2 ONLY

The GripTech Haul-Lock and Lock-Off Bar make previously complicated rescue operations, quick, simple and safe.

STORAGE CASE OPTION

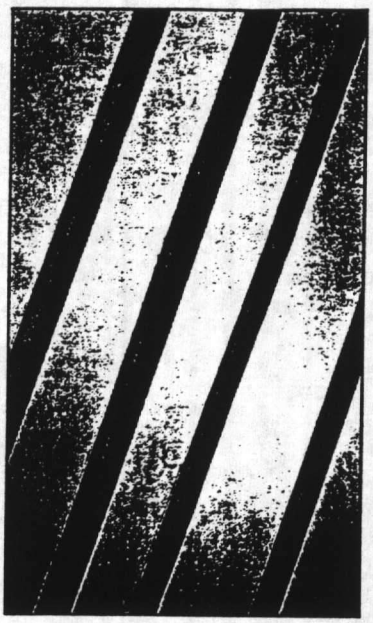
FOR SP1 AND SP2

These storage cases are tough! - and water-tight. Ideal for those who want the ultimate protection for their system.

4:1 LIFTING ADVANTAGE

FOR SP1 AND SP2

With the SP Systems, when the 4:1 option is chosen, an extra double-sheave pulley will be included to allow up-rigging to a 4:1 lifting advantage.



POLYESTER ROPE OPTION

FOR SP1 AND SP2

If working in environments where acids may be encountered, your GripTech System can be equipped with GripTech Polyester Kernmantle rope.

SYSTEM	HARDWARE		ROPE		STORAGE
SP1 -	R	S 3 -	N	100 -	B

R REGULAR SERVICE	**S** STANDARD	**3** 3:1 LIFTING ADVANTAGE	**N** NYLON ROPE	**XXX** TOTAL LENGTH OF ROPE IN FEET	**B** CORDURA STORAGE BAG
H HARSH ENVIRONMENT		**4** 4:1 LIFTING ADVANTAGE	**P** POLYESTER ROPE		**C** STORAGE CASE

SYSTEM	HARDWARE		ROPE		STORAGE
SP2 -	R	S 3 -	N	100 -	B

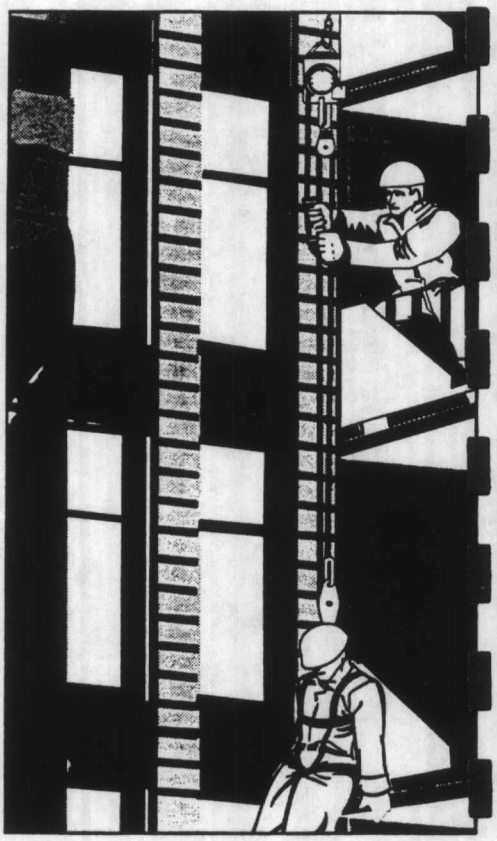
R REGULAR SERVICE	**S** STANDARD	**3** 3:1 LIFTING ADVANTAGE	**N** NYLON ROPE	**XXX** TOTAL LENGTH OF ROPE IN FEET	**B** CORDURA STORAGE BAG
H HARSH ENVIRONMENT	**L** HAUL-LOCK	**4** 4:1 LIFTING ADVANTAGE	**P** POLYESTER ROPE		**C** STORAGE CASE

SP SYSTEM APPLICATIONS**

CONFINED SPACE RESCUE

Allows quick, simple and safe raising and lowering of the victim and/or rescuer.

RECOMMENDED SYSTEM:
Two Person Load : SP2 with Haul-Lock
One Person Load : SP1



HIGH-ANGLE RESCUE

Allows vertical rigging in various lifting advantages for raising and lowering and allows horizontal rigging for the quickest, simplest and safest means of rigging a Z-haul and lowering system all in one.

RECOMMENDED SYSTEM:
One or Two Person Load : SP2 with Haul-Lock.

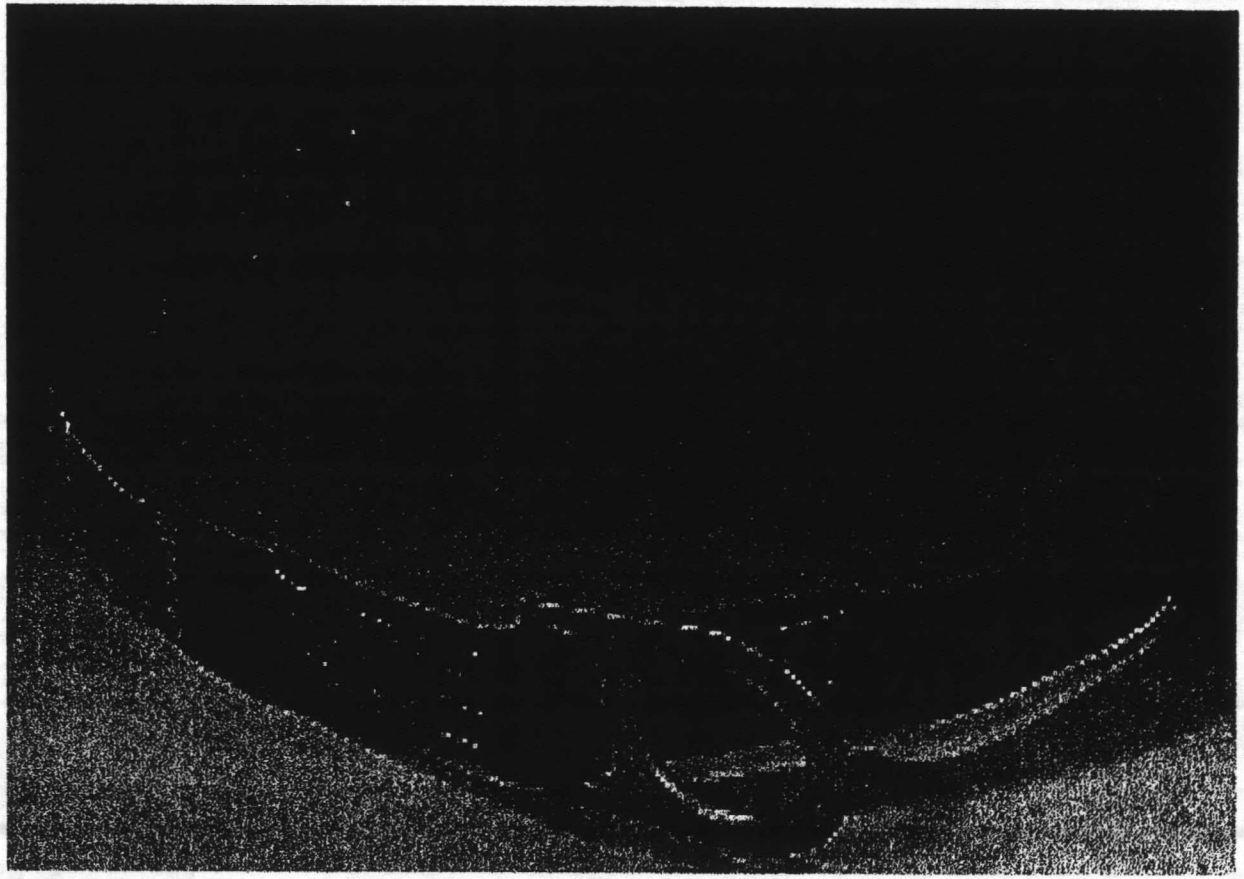
Horizontal Retrieval Solutions

- Ropes/Pulley Systems
- GripTech, Rollgliss, Miller Type System
- Pole Hoist
- UH-505
- Tripod - configured for horizontal
- UniHoist Horizontal Systems

Harnesses and Waist Belts

- Waist Belts - Causes injury with actual fall.
- Full Body Harness
  - Industrial Style
  - Rescue Style - Leading Manufacturers are:
    - Born Body Harness
    - Roco Harness
    - CMC Harness
  - Rescue Seats

Waist Belts - DON'T BOTHER!



General Types of Fall Protection

- Retractable Lifelines, Blocks
- Winches with built in fall protection
- Rope Grabs
- Ladder climbing systems
- Rope Techniques - Prusick hitch and belays
- Horizontal fall protection systems

ANCHORS and ANCHOR POINTS

- **INDUSTRIAL ANCHOR POINTS**

  (established in the design of the confined space retrieval system)

  - Must be certified to 5000 lb. strength requirement by an engineer.
  - Any welding must be performed by a registered welder.

Possible Anchor Point Types

- Steel I-Beams (not angle iron)
- Floors, Walls, Ceilings (not pipes, tubing)
- Tanks and major structures
- Cranes, forklifts (OSHA notification suggested)

RESCUE ANCHORS - TERMINOLOGY

Anchor is the general term for the combination of anchor points, rope, web and other equipment used to attach your rappel rope or rescue system to an immovable object such as a rock, tree, building or truck. An anchor can be simple, backed up or an anchor system.

Anchor Point is the object that you tie the web or rope to or around It could be a tree, bush, piton, fire truck, boulder, or whatever. The ultimate anchor point is a "bombproof BFR."

Anchor Systems are made by connecting a group of anchor points together to create an anchor that is self-equalizing and non-directional. If a single anchor point in an anchor system should fail, the anchor system will remain intact.

BFR is a slang term for a very large rock, but also includes a big tree, fire truck, water tank, stairway or other immovable object. Size is not always the controlling factor as several times a large "immovable" rock used for an anchor came down under rescue and even rappel size loads.

Bombproof describes an anchor or anchor point so strong that it obviously will support far more than the expected and unexpected lads of the rescue system. An anchor system can make questionable anchor points into a bombproof anchor. A BFR can be used to make a bombproof simple anchor.

Backed Up means that the anchor has a second, independent anchor. Since either anchor could support the load by itself, then the "back up" each other.

Compound Anchor or a **Complex Anchor** uses more than one anchor point. What we call an anchor system would be an example of a compound anchor.

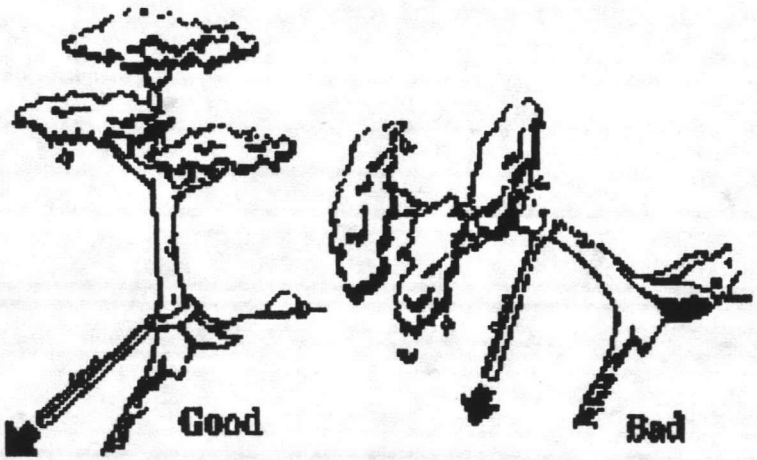
Load is the generic term for everything hanging on the rope at the end away from the anchor. This can include the rescuer, patient, stretcher, stretcher tenders and whatever gear they have with them. This differs slightly from the "load" the haul team must pull because they must life the load plus overcome all the friction in the system.

Non-Directional means that the load at each anchor point remains roughly equal to the others when the direction of pull shifts from one side to the other.

Simple Anchor describes an anchor with a single anchor point. You connect several simple anchors together to make an anchor system. A Tensionless Hitch around a strong tree is an example of a simple anchor that can be used for a rappel.

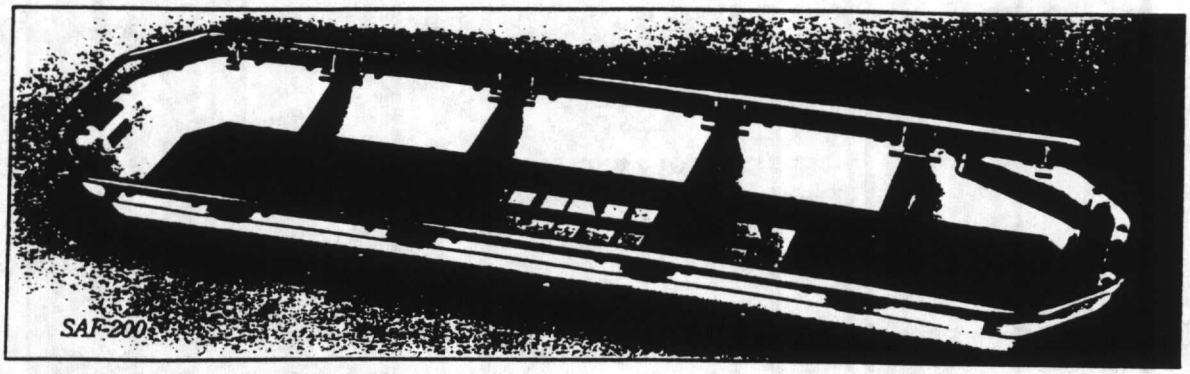
Self-Equalizing Anchor Systems spread the load among several anchor points in roughly equal amounts. Since friction hampers the system's ability to equal the loads, the user must be aware that some of the anchor points will have higher loads than the mathematical theory indicates.

Rescue Type Anchors



- **Natural:** Trees, Boulders, Etc.
- **Structures and Vehicles**
- **Pickets**
- **Chocks, Pitons, Bolts**
- **Snow (specialized area)**

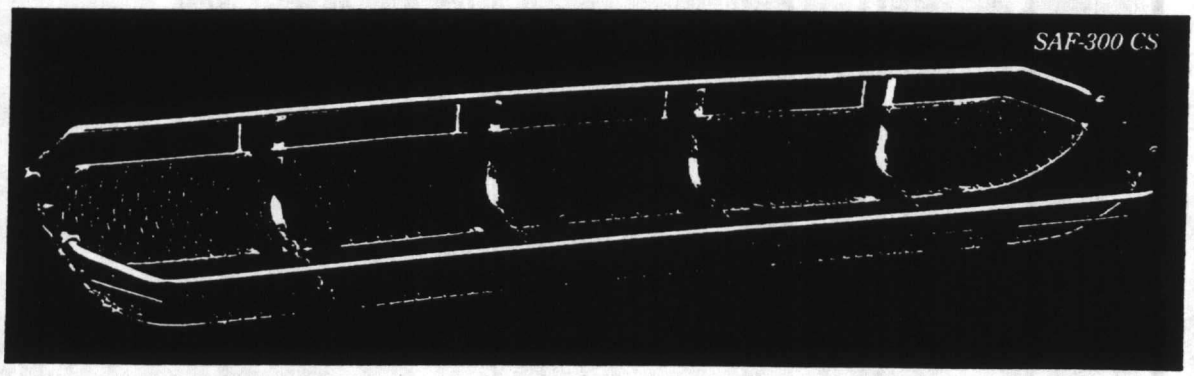
STRETCHERS



JUNKIN PLASTIC STRETCHER: SAF-200

Yellow high-density polyethylene shell, supported by a stainless steel outer rail, permanently attached with stainless steel semi-tubular rivets. Features molded runners, fully exposed outer rail, non-absorbent foam pad secured to stretcher and four patient restraint straps. Ideal for unusually rugged rescue situations such as industrial, mining or construction.
Patent Pending.

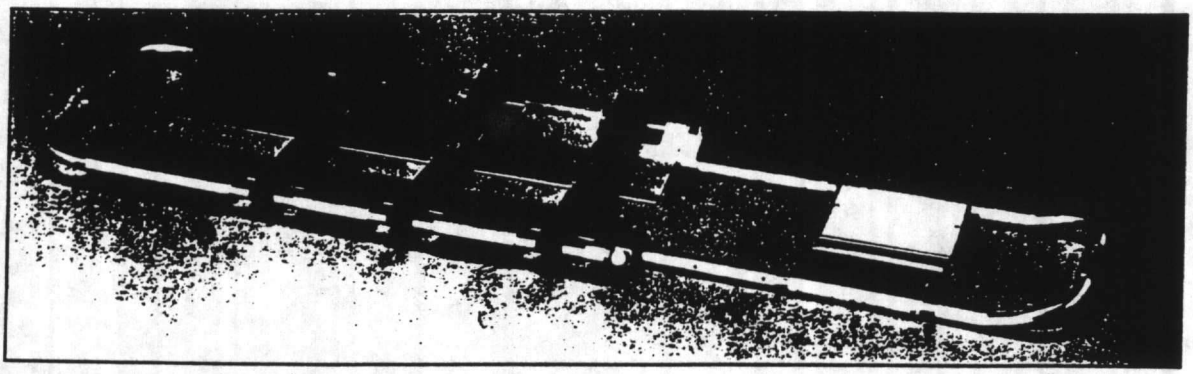
DIMENSIONS: 84 1/2" L; 24" W; 7 1/2" Depth.
LOAD CAPACITY: 1200 lbs.; SHIPPING WEIGHT: 31 lbs.



CONFINED SPACE STRETCHER: SAF-300CS

The new 19" width Confined Space Splint Rescue Stretcher has been designed for rescues where space is confined. With steel, all-welded rigid construction, which does not rely on the injured person to attain form or rigidity. Light in weight and ample in size. The basket is 18 gauge, 1" hexagon mesh netting. Nylon web straps for securing at chest, abdomen, thigh and calf. Supplemental accessories to facilitate special handling needs are available.

DIMENSIONS: 81 1/2" L; 18 3/8" W; 7 3/4" H.
WEIGHT: 23 lbs.

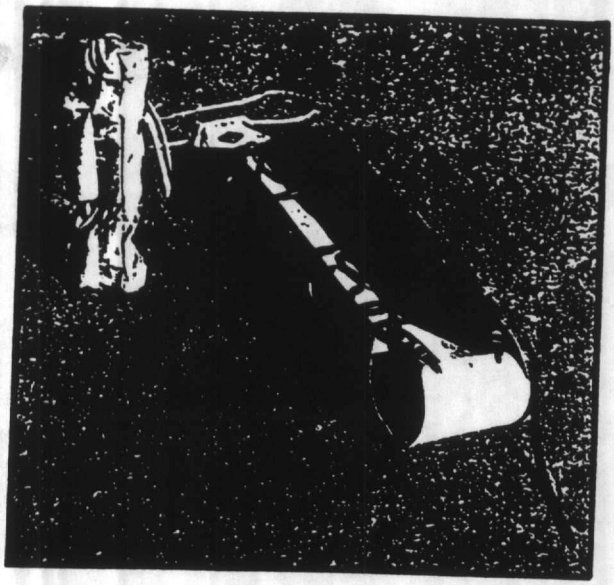


ALUMINUM BREAK-APART STRETCHER: SAF-400

Designed to gently maneuver stretcher under patient without rolling or lifting. The immobilization of the patient in the position found, minimizes the risk of complicating the existing injuries. The center of the stretcher can be opened to allow the patient to be X-rayed while secured on the stretcher. Features include sturdy, lightweight aluminum construction with an adjustable length and three patient restraint straps. Folds for easy storing and separates in half during application and removal.

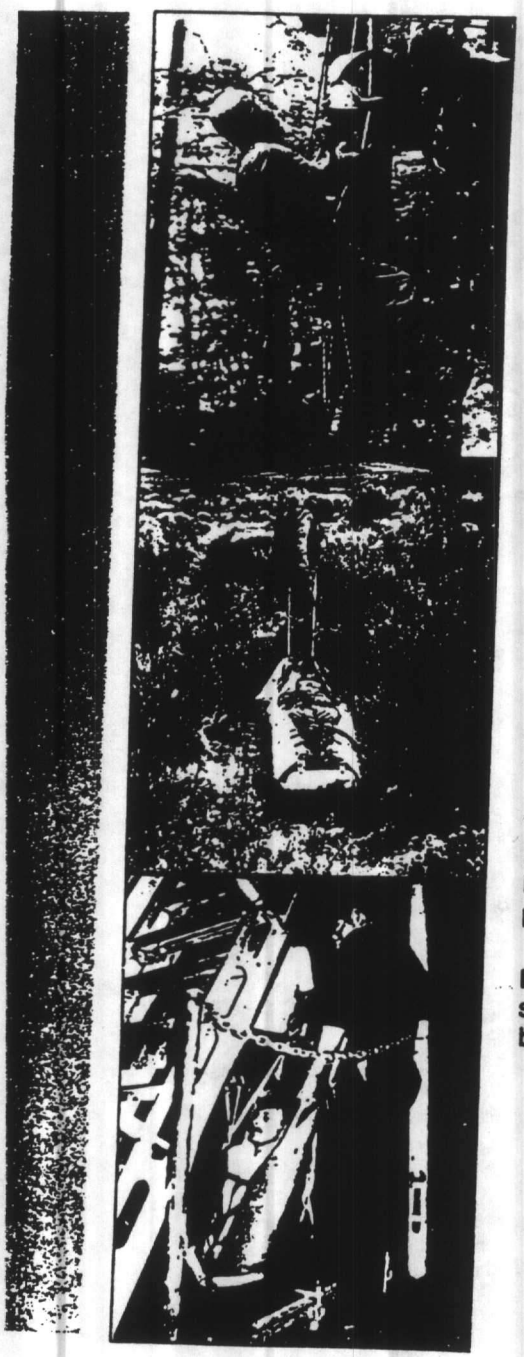
DIMENSIONS: Length 66 1/4" ; Width 17 1/2"; Depth 2 5/8"; Folded Length 49 1/2"; Folded Depth 3 1/2"; Adjustable to 80";
LOAD CAPACITY: 400 lbs.; SHIPPING WEIGHT: 21 1/2 lbs.

SKED® BASIC RESCUE SYSTEM



This is the most **versatile**, most **compact**, most **durable** emergency rescue stretcher on the market today. It provides outstanding patient protection and security and has revolutionized the technical rescue industry. It performs all the functions of traditional stokes and basket-type litters - and many more!

The **SKED® BASIC RESCUE SYSTEM** is completely equipped for land, high angle and confined space rescues.



It includes the following components:

The Sked® Stretcher - It starts with a sheet of specially formulated extremely durable but flexible plastic 3 feet by 8 feet cut to the special Sked® shape. Then through heavy brass grommets are attached: 4 cross straps, two foot end straps, four carrying handles and a towing handle.

Cordura Backpack/Towing Harness - This durable backpack bag holds the complete **Sked® Rescue System**. It has two pouches - one holds all of the accessory products listed below and the other can hold a first aid kit, other EMT supplies, or the inflatable flotation system.

Horizontal Lift Slings - A pair of 10,000 Lb. tensile strength slings are provided for lifting the Sked® with a helicopter or crane in a horizontal position.

Vertical Lift Sling - For vertical lifting of the Sked®, 30 feet of 3/8" PMI Kernmantle Nylon Rope is provided with a figure 8 knot in the middle.

Steel Locking D Carabiner - This is a standard large locking D- shaped carabiner made by the industry leader. It features a large gate for attaching the lift slings and has a 9,000 pound breaking strength.

Tow Strap - This 6 foot strap has bronze snap hooks on each end and two handles in the middle. It turns the backpack into a towing harness and can be used in several configurations for towing the Sked® by one or more people. It is designed for surface use only - not for hoisting.

Removable Webbing Handles - Although the Sked® has 4 carrying handles sewn onto it, we provide 4 additional handles for carrying a heavy patient by up to 8 rescuers.

SK-200-OR: SKED® BASIC RESCUE SYSTEM - International Orange

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CHAPTER 6

INCIDENT COMMAND SYSTEM

INTRODUCTION

National Inter-Agency Incident Management System (NIIMS)

The National Inter-Agency Incident Management System (NIIMS) has been developed to provide a common system that agencies can utilize at local, state, and federal levels.

NIIMS consists of five major sub-systems that collectively provide a total systems approach to all risk incident management (Table 1.1). The sub-systems are:

- *The Incident Command System (ICS)* that includes operating requirements, interactive components and procedures for organizing and operating an on-scene management structure.
- *Training* that is standardized and supports the effective operation of N I IMS.
- *A Qualifications and Certification System* that provides personnel across the nation meeting standard training, experience, and physical requirements to fill specific positions in the Incident Command System.
- *Publications Management* that includes development, publication, and distribution of NIIMS materials.
- *Supporting Technologies* such as orthophoto mapping, infrared photography, and a multi-agency coordination system that supports NIIMS operations.

TABLE 1.1

Major components of the National Interagency Incident Management System

Incident Command System	Training	Qualifications and Certifications	Publications Management	Supporting Technology

National Inter-Agency Fire Qualifications System (NIFQS)

Broadly speaking, NIFQS consists of the standards for qualification, certification, and standard training courses applicable to Incident Command System positions. At present, the NIFQS standards for qualification, certification, and training courses stress the application to the wildland urban interface fire protection problem.

Incident Command System (ICS)

The ICS was developed through a cooperative inter-agency (local, state and federal) effort. The basic organizational structure of the ICS is based upon a large fire organization that has been developed over time by federal fire protection agencies. The ICS is designed to be used for all kinds of emergencies and is applicable to both small day-to-day situations as well as very large and complex incidents.

ICS OPERATING REQUIREMENTS

The design requirements for the Incident Command System are the following:

- Must provide for the following kinds of operations: (a) single jurisdiction/single agency involvement, (b) single jurisdiction with multi-agency involvement, (c) multijurisdiction/multi-agency involvement.
- Organizational structure must be able to adapt to any emergency or incident to which agencies would be expected to respond*.
- Must be applicable and acceptable to users throughout the country.
- Should be readily adaptable to new technology.

**ICS is designed to be used in response to emergencies caused by fires, floods, earthquakes, hurricanes, tornados, tidal waves, riots, spills of hazardous materials, and other natural or man-caused incidents.*

- Must be able to expand in a logical manner from an initial attack situation into a major incident.
- Must have basic common elements in organization, terminology, and procedures. This allows for the maximum application and use of already developed qualifications and standards. Also, it insures continuation of a total mobility concept.
- Implementation should have the least possible disruption to existing systems.
- Must be effective in fulfilling all of the above requirements and yet be simple enough to insure low operational maintenance costs.

COMPONENTS OF THE ICS

The Incident Command System has a number of components. These components working together interactively provide the basis for an effective ICS concept of operation:

- Common terminology
- Modular organization
- Integrated communications
- Unified command structure
- Consolidated action plans
- Manageable span-of-control
- Predesignated incident facilities
- Comprehensive resource management

Common Terminology

It is essential for any management system, and especially one which will be used in joint operations by many diverse users, that common terminology be established for the following elements:

Organizational Functions - A standard set of major functions and functional units has been predesignated and named for the ICS. Terminology for the organizational elements is standard and consistent.

Resource Elements - Resources refer to the combination of personnel and equipment used in tactical incident operations. Common names have been established for all resources used within ICS. Any resource that varies in capability because of size or power, for example, helicopters, engines, or rescue units, is clearly typed as to capability.

Facilities - Common identifiers are used for those facilities in and around the incident area that will be used during the course of the incident. These facilities include such things as the command post, incident base, and staging areas.

Modular Organization

The ICS organizational structure develops in a modular fashion based upon the kind and size of an incident. The organization's staff builds from the top down with responsibility and performance placed initially with the incident commander. As the need exists, four separate sections can be developed, each with several units that may be established. The specific organizational structure established for any given incident will be based on the management needs of the incident. If one individual can simultaneously manage all major functional area, further organization is required. If one or more of the areas requires independent management, an individual is named to be responsible for that area.

In the ICS, the first management assignments by the initial attack incident commander will normally be one or more section chiefs to manage the major functional areas. Section chiefs will further delegate management authority for their areas only as required. If the section chief sees the need, functional units may be established within the section. Similarly, each functional unit leader will further assign individual tasks within the unit only as needed.

Unified Command Structure

The need for a unified command is brought about because:

- Incidents have no regard for jurisdictional boundaries. Wildland fires, transportation route incidents, floods, hurricanes, earthquakes, and hazardous material spills usually cause multi-jurisdictional major incident situations.
- Individual agency responsibility and authority is normally legally confined to a single jurisdiction.
- The concept of unified command simply means that all agencies who have a jurisdictional responsibility at a multi-jurisdictional incident contribute to the process of:
  - Determining overall incident objectives
  - Selection of strategies
  - Insuring that joint planning for tactical activities will be accomplished
  - Insuring that integrated tactical operations are conducted
  - Making maximum use of all assigned resources

The proper selection of participants to work within a unified command structure will depend upon:

- The location of the incident-which political jurisdictions are involved.
- The kind of incident - which functional agencies of the involved jurisdiction(s) are required.

A unified command structure could consist of a key responsible official from each jurisdiction in a multi-jurisdictional situation or it could consist of several functional departments within a single political jurisdiction*.

**As an option, the command structure could include landowners or their representatives. It could also invite the counsel of individuals or agencies having functional expertise or capability.*

Common objectives and strategy on major multi-jurisdictional incidents should be written. The objectives and strategies then guide development of the action plan. Under a unified command structure in the ICS, the implementation of the action plan will be done under the direction of a single individual - the operations chief.

The operations chief will normally be from the agency that has the greatest jurisdictional involvement. Designation of the operations chief must be agreed upon by all agencies having jurisdictional and functional responsibility at the incident.

Consolidated Action Plan

Every incident needs some form of an action plan. For small incidents of short duration, the plan need not be written. The following are examples of when written action plans should be used:

- When resources from multiple agencies are being used.
- When several jurisdictions are involved.
- When the incident will require changes in shifts of personnel and/or equipment.

The incident commander will establish objectives and make strategy determinations for the incident based upon the requirements of the jurisdiction. In the case of a unified command, the incident objectives must adequately reflect the policy and needs of all the jurisdictional agencies.

The action plan for the incident should cover all tactical and support activities required for the operational period.

Manageable Span-of-Control

Safety factors as well as sound management planning will both influence and dictate span-of-control considerations. In general, within the ICS, the span-of-control of any individual with emergency management responsibility should range from three to seven with a span-of-control of five being established as a general rule of thumb. Of course, there will always be exceptions (e.g., an individual wildland crew leader will normally have more than five personnel under supervision).

The kind of an incident, the nature of the task, hazard and safety factors, and distances between elements all will influence span-of-control considerations. An important consideration in span-of-control is to anticipate change and prepare for it. This is especially true during rapid build-up of the organization when good management is made difficult because of too many reporting elements.

Predesignated Incident Facilities

- Command Post
- Staging areas

Comprehensive Resource Management

- Single Resources

The incident command system can be used to manage any incident. Confined space rescue emergency must be executed in a systematic approach so that a successful rescue may take place.

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CHAPTER 7

ROPES AND BASIC KNOT TYING

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ROPES AND KNOTS

Rope is one of the oldest tools used by the rescue service. Rope is very valuable for applications such as hauling tools, accomplishing rescues from areas of different elevations, and cordoning off areas. Personnel must be knowledgeable of the different types of rope so that the correct one will be chosen to do the required job. The ability to tie proper knots is crucial to the safety of rope maneuvers. However, any knots that deviate from the standard should be thoroughly tested under controlled conditions before use in life safety applications.

ROPE MATERIALS

The materials used to construct rope can be divided into two basic categories: natural fibers and synthetic fibers. Each has its own advantages and disadvantages. This section describes the features of the major natural and synthetic fibers used for rope construction.

Natural Fibers

For many years natural fiber rope was the primary type of rope used for rescue. However, after much testing and evaluation, natural fiber rope is no longer accepted for use in life safety applications. It is acceptable to use natural fiber rope for utility purposes; however, it must not be used for specific rescue purposes. The following sections describe the most common fibers used for natural fiber rope.

Manila

The manila fiber, grown in Manila in the Philippines, is a strong, hard fiber that comes from the leaf stems of the abaca plant's trunk. The oily-waxy feeling of manila rope comes from special preserving and lubricating oils added during manufacturing.

There are several types of manila rope available; however, the best type to purchase is Type #1. Type #1 is made from the innermost part of the plant and is generally identified with a colored string twisted into the fibers. Type #1 manila rope is comparable in price to nylon, but its tensile strength is much less. This rope is biodegradable - it is subject to normal rot and decay from various environmental sources.

Manila rope is susceptible to the following types of damage:

- *Deterioration* - Manila is a natural fiber that deteriorates rapidly over the years. Its tensile strength is reduced proportionately. Manila rope should be considered "used" if it is six months old and has not been employed.
- *Water* - Once manila rope gets wet, it loses one-half of its tensile strength. Even though it has been a common practice, DO NOT soak manila before use. This practice dramatically decreases the strength of the line.
- *Humidity* - Rope stored in a humid atmosphere loses one-half its strength in one year.
- Abrasion and Chemicals - Manila rope is severely affected by chemicals and abrasion. Once it has been exposed to these hazards, it should be removed from service.
- *Charring* - Manila rope chars at 380°F (190°C) and loses strength at 180°F (82°C).

Sisal

Sisal fiber is the most common substitute for manila. Sisal is a hard fiber with about three-fourths the tensile strength of manila. Its most common use is in binder's twine, but it is sometimes used in larger ropes.

Cotton

Cotton fiber is used when a soft, pliable rope is needed. Cotton's tensile strength is slightly less than that of sisal and considerably less than that of manila. Cotton rope is the most susceptible to physical abrasion and damage. If still in regular use, it should be given careful examination for problems similar to those listed for manila.

Synthetic Fibers

The use of synthetic fiber rope is common in the rescue service. Advances in synthetic rope construction have made the use of synthetic rope preferable to natural fiber rope, especially in life safety applications. Synthetic fiber rope has excellent resistance to mildew and rotting, excellent strength, and easy maintenance. Unlike natural fiber rope, which is made of short overlapping strands of fiber, the synthetic rope may feature continuous fibers running the entire length of the rope.

Nylon

Nylon is one of the best materials used for ropes. Nylon has a high resistance to abrasion, high tensile strength, and basic properties resistant to moisture and most chemicals. However, acids and ultraviolet rays harm nylon after repeated or concentrated exposure.

Nylon is one of the strongest synthetic fiber ropes and has about three to three and one-half times tensile strength of manila rope. The high tensile strength of nylon permits the use of smaller rope to obtain equivalent strength of larger rope made from different materials. The advantage of using smaller ropes is that they are easy to handle and require less space storage. Nylon rope is also lightweight.

Nylon resists wear and abrasion and works comparatively well when wet. When wet, nylon rope maintains approximately 75 to 80 percent of its strength Nylon ropes have melting points around 400 to 500 degrees (204°C to 260°C) but will begin losing strength and integrity at around 300°F (149°C). Nylon rope cannot easily formed into solid knots and hitches, and because it stretches under load, is not suitable for vehicle stabilization or similar applications.

Polypropylene

Polypropylene rope is one of the most lightweight ropes available. This rope's resistance to water damage and its ability to float make it very popular in rescue incidents around water.

Polypropylene rope has excellent resistance to rotting, mildew, and abrasion. It has moderate elastic principles and about 60 percent of the energy absorption capacity of nylon but maintains a relatively low breaking strength.

Polypropylene is quickly affected by heat and should not be exposed to any source of heat. Prolonged exposure to direct sunlight will cause polypropylene to deteriorate. (This is particularly true at high altitudes.) Polypropylene begins to lose strength at around 200°F (93°C)and will begin to melt at around 285° to 300°F (140°C to 149°C). Polypropylene rope is difficult to secure into good knots and hitches.

Polyethylene

Polyethylene fiber is made from the same synthetic fiber family as polypropylene. Polyethylene is similar to polypropylene in weight, strength, elasticity, and chemical and abrasion resistance. At 230°F (110°C) it shows some degradation from the heat, with its melting point at 285°F (140°C). Polyethylene rope has no moisture absorption and floats indefinitely. The surface of polyethylene rope feels slick and oily and can be manufactured in bright colors for greater visibility . Polyethylene is not easily formed into knots and hitches because of its tendency to roll or to give under tension, and it has a relatively low breaking strength. Both polyethylene and polypropylene have relatively high rates of deterioration from sunlight.

Polyester

Polyester rope is used where a high strength, lowstretch rope is necessary. Polyester is NOT subject to damage from water, sunlight, most chemicals, or moderately high temperatures. Polyester can be damaged by 80+ percent acid solutions and 10+ percent basic solutions. Polyester is also fairly resistant to damage caused by flexing or abrasion. Polyester rope begins to lose strength at 300°F (149°C) but does not begin to melt until the temperature reaches 450° to 650°F (232°C to 343°C).

KEVLAR® ARAMID FIBER

Kevlar®, has high tensile strength and heat resistance; it will withstand 500°F (260°C) before losing strength. (Kevlar is used in the production of bulletproof vests.) Because Kevlar can be damaged by abrasion, it must be sheathed in another material, such as nylon or polyester, to protect it from abrasion during its use. Improvement is needed in Kevlar's shock-absorbing capabilities; therefore, the use of Kevlar rope

ROPE CONSTRUCTION

Ropes fall into one of two categories: static or dynamic. Static rope stretches very little - 11/2 to 2 percent - under normal loads. Dynamic lines stretch more than static lines both under weight and shock loads. Because static line has a low stretch factor, it is most often preferred for rescue work. Dynamic rope may be preferred under certain circumstances such as to arrest a fall or absorb the weight of a fall. Both static and dynamic ropes may

be constructed in a variety of ways. The most common types of rope construction are laid, braided, braid-on-braid, and kernmantle.

Laid (Twisted) Natural Or Synthetic Rope

All natural fiber ropes and some synthetic fiber ropes are of laid (also called twisted) construction. Hardlaid rope, constructed with only synthetic materials, is twisted tightly to form a rope that is stiff and resists abrasion. (Hard-laid rope was commonly used for mountaineering.) The disadvantage of this type of rope is that it is difficult to form into certain knots and hitches, and it must be tied off with a safety knot. Soft-laid rope is not twisted as tightly and is softer, easily tied, and somewhat stronger.

Laid ropes are constructed by twisting together yarns to form strands . Generally, three strands are twisted together to make the final rope. How tightly these ropes are twisted will determine the rope's properties. Twisted rope is susceptible to abrasion and other types of physical damage. Twisting a rope leaves all three load-bearing strands exposed at various points along the rope. Although this exposure allows for easy inspection, it also means that any damage will immediately affect the rope's strength.

Braided Rope

Although some braided ropes are made from natural fibers, most are of the synthetic variety. Braided rope is constructed by uniformly intertwining strands of rope together (similar to braiding a person's hair). This type of construction is without any type of outer sheath or core. Braided rope reduces or eliminates the twisting common to laid ropes. Because of its construction characteristics, the load-bearing fibers are subject to direct abrasion and damage.

Braid-On-Braid Rope

Because braid-on-braid is a jacketed rope, it is often confused with kernmantle rope. Braid-on-braid rope is just what the name implies: it is constructed with both a braided core and a braided sheath. However, this rope does remain a static-type rope. The appearance of the sheath is that of a herringbone pattern.

Braid-on-braid rope is very strong. Half of its strength is in the sheath and the other half of its strength is in the core. A disadvantage of braid-on-braid rope is that it does not resist abrasion as well as the kernmantle rope. It also has a problem with the outer sheath sliding along the inner core.

Kernmantle Rope

Kernmantle, a jacketed rope, is composed of a braided covering or sheath (mantle) over the main load-bearing strands (kern). The strands may be twisted or braided together. The rope core runs parallel with the rope covering. This increases the rope's stretch resistance and load characteristics. The core (kern) is made of high-strength fibers; these account for about three-fourths of the total strength of the rope with the sheath picking up the balance. With this type of construction, the sheath absorbs most of the abrasion and protects the load-bearing core. Kernmantle rope comes in both dynamic and static types. Dynamic lines stretch more than static lines do, both under weight and shock loads. Dynamic kernmantle is most commonly used as a sport rope for rock or ice climbing. Static kernmantle rope is most commonly used as rescue rope.

Kernmantle has low elastic properties under small loads such as body weight. These elongation figures average somewhere around 1 to 1.5 percent for static kernmantle and 8 to 12 percent for dynamic kernmantle. NFPA 1983, *Standard on Fire Service Life Safety Rope, Harness, and Hardware,* states that the rope breaking elongation should be not less than 15 percent and not more than 55 percent.

LIFE SAFETY AND UTILITY ROPE

Rope falls into two use classifications: life safety rope and utility rope. Life safety rope is used to support rescuers and/or victims. Because these situations demand a high degree of safety, the rope used must conform to the standards set forth by NFPA 1983. Life safety rope is defined by the NFPA as rope dedicated solely for the purpose of constructing lines for supporting people during rescue or other emergency operations, or during training evolutions." Only rope constructed of continuous filament fiber is suitable for life safety requirements. Rope made of any other materials should not be used in life safety applications. NFPA 1983 requires life safety rope to be used only once and then taken out of service. It may be reused for training purposes only.

Utility rope is used in any instance, excluding life safety applications, where the use of a rope is required. Utility rope can be used to hoist equipment, secure unstable objects, or cordon off an area. There are no standards set forth for utility rope; however, common sense should prevail in its use. Regularly inspect utility rope to see if it is damaged.

KNOTS

The ability to tie knots is a vital part of fire and rescue operations. Improperly tied knots can be extremely hazardous to both rescuers and victims. Good knots should be easy to tie, easy to identify, easy to untie, and strong enough to do the required job.

The methods of selecting and tying knots have changed with the advent of synthetic material rope. Knots considered safe and acceptable for many years may no longer be considered safe in some cases. Personnel who were educated in rope work with manila or other natural fiber ropes must reeducate themselves in the proper procedures and knots used with the newer ropes.

The newer synthetic rescue rope has a much smoother, slicker outside surface. The rope is much more likely to slide on itself than natural fibers will. Thus, many older, traditional knots can slip under load. In order to prevent slipping, a single-overhand, double overhand, half hitch, or double half hitch should be applied to the tail of the working end of the rope.

ELEMENTS OF A KNOT

Knots weaken a rope because the rope is bent in order to form a knot. The fibers on the outside of the bend are stretched, and the fibers on the inside of the bend are crushed. A knot with sharp bends weakens a rope more than a knot with easy bends. The bends that a rope undergoes in the formation of a knot or hitch are known as the bight, loop, and round turn. Each of these formations is shown in the following figures.

- The bight is formed by simply bending the rope back on itself while keeping the sides parallel.
- The loop is made by crossing the side of a bight over the standing part.
- The round turn consists of further bending one side of a loop.

Knots and hitches are formed by combining these elements in different ways so that the tight part of the rope bears on the free end to hold it in place. Knots and hitches should be those that may be rapidly tied, can be easily untied, are not subject to slippage, and have a minimum of abrupt bends.

Throughout the following descriptions of how to tie knots, the terms *running part, working* end, and *standing part* are used). The running part is the part of the rope that is to be used for work such as hoisting, pulling, or belaying. The working end is the part of the rope that is to be used in forming the knot (commonly referred to as the "loose end" or "bitter end"). The standing part is that part between the working end and the running part.

The Bowline Knot

The bowline maybe easily untied and is a good knot for forming a loop that will not constrict the object it is placed around. **(NOTE:** The bowline should be used only on natural fiber rope.) The bowline is not a secure knot on synthetic fiber rope; therefore, it cannot be used in life safety situations. The following method is one good way of tying the bowline, although other methods may be just as effective.

Step 1: Measure off sufficient rope to form the size of the knot desired, and form an overhand loop in the standing part.

Step 2: Pass the working end upward through the loop.

Step 3: Pass the working end over the top of the loop under the standing part, and bring the working end completely around the standing part and down through the loop.

Step 4: Pull the knot snugly into place, forming an inside bowline with the working end on the inside of the loop.

NOTE: The bowline may be tied with the working end outside the loop. This is known as an outside bowline. The outside bowline is as strong as the inside bowline; however, the preferred method is the inside bowline because of the safety feature of having the working end locked against the object to which it is tied.

The Clove Hitch

The clove hitch may be formed by several methods. It consists essentially of two half hitches. Its principal use is to attach a rope to an object such as a pole, post, or hose. The clove hitch may be formed anywhere in the rope from one end to the middle. When properly applied, it will stand a pull in either direction without slipping. One method for developing a clove hitch in the open is as follows:

Step 1: Form a loop in your left hand with the working end to the right crossing under the standing part.

Step 2: Form another loop in your right hand with the working end crossing under the standing part.

Step 3: Slide the right-hand loop on top of the left-hand loop). **(NOTE:** This is the important step in forming the clove hitch.)

Step 4: Hold the two loops together at the rope, and thus form the clove hitch. Pull the ends in opposite directions to tighten.

The clove hitch, when formed by the method just described, cannot be placed over an object that has no free end such as the center of a hose line. Therefore, it is necessary to know how to tie the clove hitch around an object. This method is as follows:

Step 1: Make one complete loop around the object, bringing the working end below the standing part .

Step 2: Cross the working end over the standing part, and complete the round turn about the object just above the first loop.

Step 3: Pass the working end under the upper wrap, just above the cross, and properly set the hitch by pulling).

To ensure that the clove hitch does not loosen during use, a safety hitch should be applied. To apply a safety hitch, tie a half hitch or overhand knot around the standing part of the rope with the working end.

The Half Hitch

The half hitch is particularly useful in stabilizing tall objects that are being hoisted. The half hitch is always used in conjunction with another knot. For example, when hoisting a pick-head axe, a half hitch is used around the handle; a clove hitch, timber hitch, or girth hitch is tied around the axe head. The half hitch is formed by making a round turn around the object. The standing part of the rope is passed under the round turn on the side opposite the intended direction of pull. Several half hitches can be applied in succession if required.

The Figure Of Eight Family Of Knots

Since the introduction of synthetic rope to the fire and rescue service, the figure of eight knot has basically replaced the bowline. Figure of eights are tighter and stronger knots than the bowline. They are also not as apt to damage the synthetic rope as the bowline will. There are several variations of the figure of eight that are commonly used in the rescue service.

DOUBLE FIGURE OF EIGHT KNOT (FIGURE OF EIGHT FOLLOW THROUGH)

This knot is used to tie ropes of equal diameters together. A safety knot, such as the double overhand, should be used in conjunction with this knot. The procedure for tying the double figure of eight knot is as follows:

Step 1: A figure of eight knot is tied on one end of the rope.

Step 2: The end of the other rope is fed through the figure of eight knot in reverse. It should follow (hence the name) the exact path of the original knot.

Step 3: A safety knot, such as the double overhand, should be used in conjunction with this knot.

FIGURE OF EIGHT ON A BIGHT (GUIDE KNOT)

This knot is preferred as the replacement for the bowline when using synthetic rope. It can be tied in the middle of the rope, or if a loop is needed in the end, it can be tied at the end

using a bight formed near the end of the rope. This variation is used as both an anchoring attachment and as a harness tie-in. The procedure for tying this knot is as follows:

Step 1: Form a bight in the working end and pass it over the standing part to form a loop.

Step 2: Pass the bight under the standing part, then over the loop and down through it .

Step 3: Having formed the figure of eight, extend the bight through the knot to whatever size working loop is needed and dress the knot).

The Becket Or Sheet Bend

The becket or sheet bend is used for joining two ropes and is particularly well suited for joining ropes of unequal diameters or joining a rope -and a chain. It is also unlikely to slip when the rope is wet. These advantages make it useful and dependable in fire service rope work. The becket bend is tied as follows:

Step 1: Form a bight in one of the ends to be tied (if two ropes of unequal diameter are being tied, the bight always goes in the larger of the two), and pass the end of the second rope through the bight.

Step 2: Bring the loose end around both parts of the bight.

Step 3: Tuck this end under its own standing part and over the bight.

Step 4: Draw the knot down snug.

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CHAPTER 8

SCENE SIZE-UP AND RESCUE TECHNIQUES

INTRODUCTION

Motivation

1. Approximately 60% of all confined space deaths are persons attempting to make a rescue.

2. This is a very specialized and technical operation that requires "expertise" in many disciplines.

3. OSHA CFR 1910.146, **Permit-Required Confined Spaces** requires a safety and standardized approach to confined space entry and rescue operations.

4. The hazard(s) are not easy to recognize - in many cases the area looks harmless.

Review of recent or significant incidents that the students can relate to -

- Houstentown, PA - three volunteer fire fighters die while performing a public service.
- Phoenix, AZ - fire fighter and worker die after an explosion in a toluene storage tank.

Objectives:

A. Determine space is a confined space.
B. Identify the hazards of the confined space.
C. Identify factors to consider during the size-up or risk assessment process.
D. Check for possibility of an oxygen deficient atmosphere.
E. Identify if material could cause engulfment.
F. Determine the ventilation procedure for the confined space.
G. Review the entry permit system (if used) as outlined in OSHA 20 CFR 1910.146 etc.
H. Conduct atmosphere monitoring procedure for a confined space.
I. Attain a "Zero Mechanical State." For the space.
J. Conduct entry/rescue procedures and victim removal from the confined space emergency.

Presentation:

A. Hazards of a confined space.

- Always assume a "worst case scenario"
- Do not be fooled by an innocuous appearing situation
- Conditions can change rapidly, i.e., liquid level
- Dangerous conditions can exist outside of the confined space
- Monitor **all conditions** before entry and at regular intervals

1. Atmospheric -

    a. oxygen deficient atmosphere (less than 19.5%)
    b. oxygen enriched atmosphere (greater than 23.5%)
    c. toxic/poisonous atmosphere
    d. flammable atmosphere

2. Physical -

    a. limited entry and egress
    b. excessive depths or heights
    c. poor visibility
    d. poor communication
    e. wet/slippery surfaces
    f. environmental - heat, vibration, steam
    g. biological and animal hazard
    h. accumulated or flowing liquids - check level
    i. structural stability - i.e., well walls

3. Mechanical -

    a. electrical
    b. hydraulic
    c. pneumatic
    d. moving parts

4. Engulfment -

a. unstable material i.e., grain, sand, gravel

B. Classes of Confined Spaces - 1910.146

1. *Confined Space*:

a. large enough and so configured that an employee can bodily enter and perform work.

b. has limited or restricted means of entry or exit.

c. is not designed for continuous human occupancy.

2. *Permit-Required Confined Space:* one or more of the following:

a. contains or has the potential to contain a hazardous atmosphere.

b. contain a material that has the potential to engulf the entrant.

c. has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or a floor which slopes downward and tapers to a smaller cross section.

d. contains any other recognized serious safety or health hazard.

3. *Non-Permit Confined Space:* does not contain, or with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm.

C. OSHA 1910.146 Permit-Required Confined Space -

1. *Hazardous Atmosphere:* An atmosphere that exposes employees to a risk of death, incapacitation, impairment of ability to self rescue, injury, or acute illness from one or more of the following causes.

a. a flammable gas vapor or mist in excess of 10% of its lower flammable limits (LEL).

b. an atmospheric oxygen concentration below 19.5% or above 23.5%

c. an airborne dust concentration that meets or exceeds its LFL (obscures vision at a distance of 5 feet).

d. an atmospheric concentration of any substance that could result in an employee exposure in excess of its dose or permissible exposure limit (PEL).

e. any atmospheric condition recognized as immediately dangerous to life and health.

2. *Immediately Dangerous to Life and Health:* A condition which pose an immediate or delayed threat of loss of life, or would cause irreversible adverse health effects, or would interfere with the individuals ability to escape unaided from the permit space.

a. route of entry for toxins into the body:

1. inhalation **most common**
2. skin absorption
3. injection
4. ingestion

b. test for the following atmosphere (at four foot vertical levels):

1. oxygen content
2. flammable vapors
3. toxic/poisonous gases

c. Oxygen Deficient Atmosphere: Less than 19.55 oxygen. Harm may occur from simple asphyxiation i.e., oxygen displacement due to:

1. inert atmosphere
2. natural oxidation or rusting
3. tank purging or cleaning
4. decomposition, heavy exhaust fumes

NOTE: *If oxygen content is:*

16% - shortness of breath, disorientation
12% - unconsciousness
6% - death

3. *Engulfment:* The surrounding and effective capture of a person by a liquid or finely divided solid substance 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.

4. *Mechanical Hazards:* Failed to isolate equipment from sources of mechanical and electrical energy.

D. Examples of Confined Space -

1. storage tanks
2. tank cars (rail and highway)
3. manholes
4. bins
5. silos and grain elevators
6. vats, tubs, pits and cisterns
7. utility vaults and pumping stations
8. floating roof storage tanks (open tops)

E. Permit-Required Confined Spaces Definitions:

1. *Entry Permit System:* An employers written procedures for preparing and issuing permits for entry, and returning the permit space to service following the termination of entry.

2. *Entry Permit:* The written or printed document established by the employer. It is the instrument by which the employer authorizes his/her employees to enter the permit-required confined space.

   a. defines the conditions under which the permit space may be entered.

b. reason for entering

c. anticipated hazards

d. lists eligible entrants/attendants

e. person in charge of the entry

f. length of time the permit is valid

3. *Authorized Entrant:* An employee who is authorized by the employer to enter a "permit-required confined space"

4. *Acceptable Entry Conditions:* Conditions that must exist in a permit space to allow entry and ensure that employees involved with a Permit-Required Confined Space entry can safely enter into and work within the space.

NOTE: *Each authorized entrant shall use a chest or full body harness with a retrieval line attached to the center of the entrants back. The other end of the retrieval line shall be attached to a mechanical device (required if the vertical depth is more than 5ft.) or a fixed point outside of the permit space. This will assist with "self rescue" or an attendant initiated rescue.*

5. *Attendant:* A person stationed outside the permit area required confined space who is trained to monitor the authorized entrants inside the permit-required confined space.

6. *Entry:* The act by which a person intentionally passes through an opening into a permit-required confined space or when any part of the body passes through the plane of the opening.

F. Safe Handling of Confined Space Incidents:

1. *Pre-Incident Planning:*

a. identify possible confined spaces
b. make contact with industry/utilities
c. identify resource capabilities and needs

2. *Training*

   a. basics - i.e., SCBA, ropes/knots
   b. technical skills - monitoring, lowering and hauling
   c. continuing education/simulations

3. *Standard Operating Procedures:* Systematic approach

   a. prevent blind, emotional, uncalculated entry
   b. safe operations
   c. use of incident management system
   d. proper entry procedures

4. *Size-up, Risk Analysis*

   a. identify all of the hazards
   b. identify the type of confined space
   c. time the victim has been trapped (rescue vs. recovery)
   d. number of victims available

5. *Common Sense:*

   a. control emotions
   b. do not be fooled
   c. be part of the solution, not the problem

G. Components of Rescue Operations at Confined Spaces:

1. *Incident Size-up:*

   a. dispatch and pre-plan information
   b. information from:
      1. co-workers
      2. witnesses
      3. entry permit
   c. what is the actual situation

d. what are the hazards they are exposed to
e. how many people and their conditions
f. how long have they been trapped
g. what are the atmospheric readings
h. what resources are on-scene and available

2. *Incident Management:* To provide safety, organization, effectiveness and efficiency to emergency operations.

a. need to delegate to divisions/groups or sectors
b. provides for technical assistance
c. permits integrated command with multiple agencies

3. *Isolation:* The separation of the permit space from unwanted forms of energy which could be a serious hazard to the entrants.

a. lockout/tagout - secure the machinery, equipment or hazards so that it will not be inadvertently activated while the employees are in the confined space.

b. blanking/blinding - the absolute closure of a pipe, line, or duct by fastening across its bore a solid plate or cap which completely covers the bore, and is capable of withstanding the maximum upstream pressure.

c. double lock and bleed - closure of a line, pipe or duct by locking or tagging a drain or vent which is open to the atmosphere in the line between two locked/closed valves.

d. removal of pipe section

e. creating a "Zero Mechanical State" - the mechanical potential energy of all portions of the machine or equipment, is so that the opening of pipes, tubes, hoses or the actuation of any valve lever or button will not produce a movement that will cause injury.

f. physically block any moving parts to prevent movement from residual energy.

4. *Ventilation:* Of the permit space using a mechanically powered ventilator:

a. prior to entry
b. continuously throughout the entry
c. use positive pressure to prevent migration of additional contaminants into the space.

5. *Atmospheric Testing:* In permit spaces with potential for atmospheric hazards, the atmosphere shall be tested prior to each entry, and as the entry proceeds, using an appropriate direct reading instrument and a remote sampling probe.

a. atmosphere must be tested for:

1. oxygen concentration
2. combustible gas/vapor
3. potential toxic contaminants

b. capabilities and limitations of the testing equipment:

1. what gases will it sample?
2. how are the results interpreted
   a. percentage of oxygen on the atmosphere
   b. percentage of LEL
   c. parts per million (PPM)

3. what gas(es) is it calibrated to?
4. when was it last calibrated?
5. what level does it alarm at?
6. how long does it take the sample to reach the matter?

c. remember stratification of gases due to different vapor densities

d. utilize a personal monitoring device with the entry team for oxygen, flammable atmosphere etc.

6. *Respiratory Protection:* Atmospheric hazards present the greatest/most common hazard to entrants and **rescue personnel!**

a. Self contained breathing apparatus (SCBA)

1. limited duration
2. bulky and cumbersome
3. recommended a minimum of a one hour rated unit
4. unit must be attached to the **same lowering line as the rescuer**
5. requires significant coordination at the opening
6. requires donning the harness in the confined space if the entrant is unable to fit in the opening

b. Supplied Air Respirator (SAR)

1. extended duration due to large supply, i.e., cascade, multiply cylinders, etc.
2. low profile for easy entrance
3. utilize five minute escape system - how far into the confined space has the rescuer entered and how long will it take to leave the space?
4. maximum of 300 feet of hose from the manifold
5. requires person or team to "manage" the air lines

7. *Entry and Removal of Personnel from a Confined Space:*

a. retrieval line required for our personnel to ensure rescuer safety

b. class 3 - full body harness

c. means of entry:

1. fixed ladders - safe secure?
2. fire department ladders - size
3. rope lowering system

d. means of removal

1. commercial retrieval systems
2. rope hauling system
3. do not use power winches, aerial devices, etc., to remove people through tight openings

e. fixed or portable anchor points:

1. tripod
2. A-frame
3. gin pole
4. aerial device

f. victim removal:

1. SKED stretcher
2. stokes basket - size?
3. wristlets/anklets
4. rescue hitch

Confined Space Rescue Operations:

A. Size-up and evaluate the incident

B. Determine incident objectives

C. Established an incident management system.

D. General Operating Procedures

E. Provide scene management

F. Monitor the atmosphere and other hazards

G. Isolate and create a "ZMS"

H. Ventilate the confined space

I. Prepare the entrants (entry team)

J. Prepare the back-up team

K. Respiratory protection and protective clothing

L. Prepare retrieval and fall arrest system

N. Lighting

Rescue Operations at Confined Space Incidents:

A. Complete entry permit for rescue team

B. Split into management, entry, and rigging teams

C. Brief the entry team

D. Entry Office operations

E. Rigging team operations

F. Personnel protection

G. Treatment of the victim

H. Victim removal

I. Termination

CONFINED SPACE RESCUE PRECHECKLIST		
OBJECTIVE	**YES**	**NO**
Size-up and evaluate incident		
Determine incident objectives		
Establish Incident Command System		
Establish General Operating Procedures		
Provide scene management and security		
Moniter the atmosphere and other hazards (document permits)		
Isolate and create a "ZMS" (zero mechanical state)		
Ventilate confined space (If needed)		
Prepare entrants		
Prepare back-up teams		
Prepare respiratory protection and protective clothing		
Prepare retrieval and fall arrest system		
Prepare lighting		
Ensure **safety** is followed throughout operation		
***If no is checked in the above checklist the RESCUE must not be conducted.**		

CONFINED SPACE RESCUE OPERATIONS CHECKLIST

OBJECTIVE	YES	NO
Ensure Incident Commander is in place and has checklist (The IC has the responsibility of ensuring a safe rescue or recovery)		
Complete entry permit for rescue team		
Split into management,entry, and rigging teams		
Brief the entry team		
Ensure entry officer is in place		
Ensure safety officer is in place		
Ensure rigging team is ready and safety has checked all rigging		
Ensure all personnel protection is used by rescuers		
Ensure treatment of patient is accomplished		
Remove victim		
Termination		
Debriefing		
Critique		

***IF NO IS CHECKED IN THE ABOVE CHECKLIST THE RESCUE WILL NOT BE CARRIED OUT OR THE RESCUE WAS NOT COMPLETED PROPERLY.**

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APPENDIX A

CONFINED SPACE ENTRY PERMIT

CONFINED SPACE ENTRY

Location of Work: _____

Description of Work (Trades): _____

Employees Assigned: _____

Entry Date: _____ Entry Time: _____

Outside Contractors: _____

Isolation Checklist:

- Blanking and/or Disconnecting
- Electrical
- Mechanical
- Other

Hazardous Work:

- Burning
- Welding
- Brazing
- Open Flame
- Other

Hazards Expected:

- Corrosive Materials
- Hot Equipment
- Flammable Materials
- Toxic Materials
- Drains Open
- Cleaning (Ex: chemical or water lance)
- Spark Producing Operations
- Spilled Liquids
- Pressure Systems
- Other

Vessel Cleaned:

- Deposits _____
- Method _____
- Inspection _____
- Neutralized with _____

Fire Safety Precautions: _____

_____

Personal Safety:

Ventilation Requirements
Respirators
Clothing
Head, Hand, and Foot Protection
Shields
Life Lines and Harness
Lighting
Communications
Employee Qualified
Buddy System
Standby Person
Emergency Egress Procedures
Training Sign Off (Supervisor or Qualified Person)_____
Remarks: _____

Atmospheric Gas Tests

	Tests Performed	- Location	- Reading
Example:	(Oxygen)	_____	(19.5%)
Example:	(Flammability)	_____	(Less than 10% LFL)
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____

Remarks: _____

Test Performed By: _____
Signature

Time: _____

Authorizations:

Supervisor: _____
Prod Supervisor: _____
Line Supervisor: _____
Safety Supervisor: _____
Etc.: _____

Entry and Emergency Procedures Understood:

Standby Person _____
Rescue _____
Telephone _____

Permit Expires: _____

This is an example of a CONFINED SPACE ENTRY PERMIT. The actual entry permit you will use depends on the atmospheric and physical hazards of that particular confined space. All regulations for that permit are addressed in 29 CFR Part 1910.146 Permit-Required Confined Spaces for General Industry; Final Rule.

CONFINED SPACE ENTRY PERMIT

1. Permit Space To Be Entered _____
2. Purpose of Entry _____
3. Date of Entry _____ Authorized Duration of Entry Permit _____
4. Authorized Entrants _____ _____

_____ _____

_____ _____

_____ _____

_____ _____

5. Attendants(s) _____ _____

_____ _____

6. Name of Current Entry Supervisor(s) 1. _____ Time _____

2. _____ Time _____

Entry Supervisor who Originally Authorized Entry _____

Signature or Initials

7. Record hazards of the permit space to be entered.				8. Check or list the measures used to isolate the permit space and to eliminate or control permit space hazards before entry.
Hazard	Yes	No	N/A	
A. Lack of Oxygen				☐ A. Purge-Flush and Vent
B. Combustible Gases				
C. Combustible Vapors				☐ B. Ventilation
D. Combustible Dusts				
E. Toxic Gases				☐ C. Lockout/Tag Out
F. Toxic Vapors				
G. Chemical Contact				☐ D. Inerting
H. Electrical Hazards				
I. Mechanical Exposure				☐ E. Blanking, Blocking, Bleeding
J. Temperature				
K. Engulfment				☐ F. External Barricades
L. Entrapment				
M. Others				☐ G. Confined Space Identification/Signs

DO NOT DESTROY THIS PERMIT
AFTER CANCELLATION THIS ENTRY PERMIT MUST BE RETAINED BY EMPLOYER FOR AT LEAST ONE YEAR.

184-F
(REV. 4/93)

CONFINED SPACE ENTRY PERMIT

9. Acceptable Entry Conditions

10. Test(s) To Be Taken	Permissible Entry Levels	Test 1	Test 2	Test 3	Test 4
A. Percent of Oxygen	19.5% to 23.5%				
B.					
C.					
D.					
E.					
F.					
G.					
H.					
I.					
Name or Initials of Tester					
Test Times					

11. Rescue and Emergency Services Available:

Name _____ Name _____

Telephone _____ Telephone _____

12. Communication procedures to be used by authorized entrants and attendants.

13. Equipment supplied to the employee.

Yes	No	N/A	Equipment	Description		
			(i) Gas Test and Monitoring	Name _____ Model/Type _____ Serial/Unit No.		
			(ii) Ventilating			
			(iii) Communications			
			(iv) Personal Protective Equipment	☐ Safety Harness With Life Lines ☐ Respiratory	☐ Hard Hats ☐ Eye ☐ Ear ☐ Face	☐ Hand ☐ Foot ☐ Clothing
			(v) Lighting			
			(vi) Barriers/ Shields	☐ Pedestrian	☐ Vehicle	☐ Other
			(vii) Safe Ingress/Egress	☐ Ladders		
			(viii) Rescue and Emergency	☐ Lifelines	☐ Hoists	☐ Resuscitators-Inhalator
			(ix) Other Safety Equipment			

14. Other information for this particular confined space to ensure employee safety.

15. Additional Permits Required. ☐ Hot Work ☐ Other

THIS CONFINED SPACE ENTRY PERMIT HAS BEEN CANCELLED:

BY _____ _____ : AM PM _____

Entry Permit Supervisor — Time — Date

CONFINED SPACE ENTRY PERMIT

COMPANY/LOCATION _____ DEPARTMENT: _____ DATE: _____

CONFINED SPACE TO BE ENTERED: _____ PERMIT EXPIRATION DATE/TIME: _____

DESCRIPTION OF WORK TO BE PERFORMED: _____

NATURE OF HAZARDS IN CONFINED SPACE: (check)

_____ Oxygen deficiency (Less than 19.5% at sea level)

_____ Flammable gases or vapors (greater than 10% of the lower flammable limit, or greater than 23.5% oxygen at sea level)

_____ Toxic gases or vapors (greater than the permissable exposure limit)

_____ Mechanical hazards

_____ Electrical shock

_____ Materials harmful to the skin

_____ Engulfment

_____ Configuration hazard

_____ Other _____

EQUIPMENT REQUIRED FOR ENTRY AND WORK: (check)

_____ Respirator

_____ Lifeline and safety harness

_____ Protective clothing

_____ Hearing protection

_____ Other _____

_____ Lighting (Explosive Proof)

_____ Fire Extinguishers

_____ Emergency Escape Retrieval Equipment

_____ Resuscitators — Inhalator

Electrical equipment/tools:

_____ Low voltage

_____ Ground-fault current interrupters

_____ Approved for hazardous locations

Respiratory protection (specify) _____

Communication aid (specify) _____

Rescue equipment (specify) _____

PREPARATION: (check)

_____ Notify affected departments of service interruption

_____ Isolate - blanked or double valve, with lock and tag.

_____ Zero energy state (Lock Out all energy sources)

_____ Cleaned, drained, washed and purged

_____ Ventilation to provide fresh air

_____ Emergency response team available

_____ Employees informed of specific confined space hazards

_____ Secure area (post, sign and flag)

_____ Procedures reviewed with each employee.

_____ Atmospheric test in compliance.

_____ Attach hot work permit

_____ Other _____

AUTHORIZED ENTRANTS:

_____

_____

_____

_____

_____

_____

AUTHORIZED ATTENDANTS:

_____

_____

_____

STAND BY SAFETY PERSONNEL:

_____

_____

TEST	Allowable Limits	Check (✓) if Required	Result : AM PM	Result : AM PM	Result : AM PM	Result : AM PM	Result : AM PM	Result : AM PM
Time								
Oxygen-min.	19.5%							
Oxygen-max.	23.5%							
Flammability	10% LEL							
H_2S	10 ppm							
Toxic (specify)								
Cl_2	.5 ppm							
ClO_2	.1 ppm							
SO_2	.2 ppm							
Heat	°F/°C							
Other								
Other								

Name of employee conducting atmospheric monitoring: _____ Instrument(s) used: _____

Statement of acceptable entry conditions _____

_____

_____

AUTHORIZATION:
I certify that all required precautions have been taken and necessary equipment is provided for safe entry and work in this confined space

Name (Print) _____

Time: _____ Date: _____

Signature _____

ENTRY PERMIT

CONFINED SPACE _____ **HAZARDOUS AREA** _____ **PERMIT NO.** _____

- **PERMIT VALID FOR EIGHT HOURS ONLY**
- **ALL COPIES OF PERMIT WILL REMAIN AT JOB SITE UNTIL JOB IS COMPLETED**

SITE LOCATION/DESCRIPTION _____

PURPOSE OF ENTRY _____

DATE _____ **PERMIT EXPIRATION DATE/TIME** _____

SUPERVISOR(S) IN CHARGE OF CREWS _____ **TYPE OF CREW** _____ **PHONE NO.** _____

REQUIREMENTS TO BE COMPLETED PRIOR TO ENTRY

(BOLD DENOTES MINIMUM REQUIREMENTS TO BE COMPLETED AND REVIEWED PRIOR TO ENTRY)

ENTER N/A FOR ITEMS THAT DO NOT APPLY	COMPLETED DATE	COMPLETED TIME		COMPLETED DATE	COMPLETED TIME
Lock Out / De-Energize / Try-Out			**Lifelines**		
Line(s) Broken – Capped – Blanked			**Resuscitator – Inhalator**		
Purge – Flush and Vent			**Standby Safety Personnel**		
Ventilation			**Full Body Harness (with "D" ring)**		
Breathing Apparatus			Fire Extinguishers		
Emergency Escape Retrieval Equipment			Lighting (explosive proof)		
Communication Device(s)			Protective Clothing		
Atmosphere Monitoring Device(s)			Respirator(s) (air purifying)		
Secure Area (post and flag)			Burning and Welding Permit		

CONTINUOUS MONITORING (record results every 2 hours)

TESTS TO BE TAKEN	PERMISSIBLE ENTRY LEVEL		MONITORING RESULTS AM/PM	AM/PM	AM/PM	AM/PM	AM/PM	AM/PM	AM/PM	AM/PM
Percent of Oxygen	19.5%-23.5%									
Lower Flammable Limit	Under 10%									
Carbon Monoxide	+35 PPM									
Aromatic Hydrocarbon	+1 PPM	*5 PPM								
Hydrogen Cyanide (Skin)		*4 PPM								
Hydrogen Sulfide	+10 PPM	*15 PPM								
Sulfur Dioxide	+2 PPM	*5 PPM								
Ammonia		*35 PPM								
Other										

* Short-term exposure limit: Employee can work in the area up to 15 minutes
\+ 8 hour time-weighted average: Employee can work in the area 8 hours (longer with appropriate respiratory protection)

REMARKS _____

GAS TESTER NAME & CHECK NO.	INSTRUMENT(S) USED	MODEL AND/OR TYPE	SERIAL AND/OR UNIT NO.

RESCUE PROCEDURE _____

ADDITIONAL INFORMATION _____

EMERGENCY PHONE NUMBERS

Ambulance _____ Safety _____
Fire _____ Rescue _____
Gas Coordinator _____

PERMIT AUTHORIZATION (pink copy to Safety)

I certify that all required precautions have been taken and necessary equipment is provided for safe entry and work in this space.

NAME (print) _____ **DATE** _____

SIGNATURE _____

DEPARTMENT _____ **PHONE NO.** _____

REQUIRED SAFETY STANDBY PERSON(S)	CHECK NO.	AUTHORIZED ENTRANTS	CHECK NO.

CONFINED SPACE ENTRY PERMIT

This permit must be properly completed prior to entering any confined space and is VALID ONLY FOR THE DATE AND TIME PERIOD STATED ON THIS FORM.

EMERGENCY CONTACT NO.: _____

LOCATION OF CONFINED SPACE AND PURPOSE OF ENTRY/DESCRIPTION OF WORK:

DATE/TIME:

DURATION:

EXPIRES ON:

ATMOSPHERIC HAZARDS: ☐ Oxygen Deficiency ☐ Flammable ☐ Toxic

PHYSICAL HAZARDS: ☐ Mechanical ☐ Electrical ☐ Chemical ☐ Engulfment ☐ Other

04856

PRE-ENTRY REQUIREMENTS

YES	N/A	
☐	☐	Entry area is free of debris and objects.
☐	☐	Warning barriers and signs are in place.
☐	☐	Atmospheric monitoring conducted.
☐	☐	All hazardous lines have been isolated.
☐	☐	Hot work permitted (welding, cutting, grinding, etc).
☐	☐	All energy sources have been neutralized/locked out.
☐	☐	The confined space has been drained and flushed.
☐	☐	Forced air or exhaust ventilation is provided.
☐	☐	Electrical equipment is properly grounded.
☐	☐	Ground fault circuit interrupters (GFCI) provided.

YES	N/A	
☐	☐	Non-sparking tools used.
☐	☐	Low voltage (less than 25 v) lighting used.
☐	☐	Electrical equipment rated for explosive atmospheres.
☐	☐	No compressed gas cylinders in the confined space.
☐	☐	Host employer and/or contractors notified.
☐	☐	Entry and Emergency procedures have been reviewed.
☐		All personnel have been trained (classroom/exercise).
☐		All personnel have been informed of potential hazards.
☐		Attendant stationed at entrance and properly instructed.
☐		Rescue equipment on location and readily accessible.

PROTECTIVE EQUIPMENT

YES	N/A		YES	N/A		YES	N/A	
☐	☐	Hard Hat	☐	☐	Protective Clothing	☐	☐	Communications Equipment
☐	☐	Eye/Face Protection	☐	☐	Hearing Protection	☐	☐	Respirator (type) _____
☐	☐	Boots	☐	☐	Retrieval Device	☐	☐	Fire Extinguisher (type) _____
☐	☐	Gloves	☐	☐	Harness and Lifeline	☐	☐	Other (type) _____

ATMOSPHERE MONITORING

TEST(S) TO BE TAKEN*	YES	NO	ACCEPTABLE ENTRY CONDITIONS			ENTER TIME AND MEASUREMENT							
			TLV-TWA**	STEL***	OTHER								
Oxygen			19.5 - 23.5%										
Combustible Gas			Below 10% LEL										
Carbon Monoxide			0-25 ppm	0-25 ppm									
Hydrogen Sulfide			0-10 ppm	0-15 ppm									
Ammonia			0-25 ppm	0-35 ppm									

APPROVALS

I CERTIFY THAT ALL ENTRY PERMIT REQUIREMENTS HAVE BEEN MET TO MAKE THIS CONFINED SPACE SAFE FOR ENTERING AND CONDUCTING THE PRESCRIBED WORK AND EMERGENCY RESPONSE PROCEDURES HAVE BEEN PROPERLY PLANNED.

Entry Supervisor's Signature: _____ Date: _____

	PRINT NAME	INITIAL	DATE
Permit Prepared By			
Atmosphere Tester			
Attendant			
Response Team Leader			

I HAVE BEEN PROPERLY INSTRUCTED FOR SAFE ENTRY INTO THIS CONFINED SPACE AND UNDERSTAND MY DUTIES AND EMERGENCY EVACUATION PROCEDURES. (List others on back of form.)

SIGNATURE OF ENTRANT(S)	I.D. NO.	DATE

* = An evaluation should be performed to consider all potential air contaminants which could be present and represent a hazard.

** = ACGIH (1992-93) Threshold Limit Value

*** = ACGIH (1992-93) Short Term Exposure Limit (15 minute)

WHITE COPY - SEND TO SAFETY DEPARTME:

GREEN COPY - POST AT ENTRANCE

DATE: _____ **NUMBER:** _____

TIME ISSUED: _____ **SHIFT ISSUED:** _____

LINE BREAKING PERMIT

This form shall be completed for each "line breaking" episode. The permit shall be invalid if the area is unattended for more than 15 minutes. This permit shall be valid for one work shift only.

ALL QUESTIONS MUST BE ANSWERED

1. Is the line under pressure? ___ Yes ___ No
2. What does the line contain? _____
3. What tests have been performed to determine the status of the line?

   _____
4. Describe the personal protective equipment required.

   _____
5. Describe the special hazards associated with this operation.

   _____
6. Are any other permits (Hot Work, Confined Space Entry, Lockout/Tagout) required for this job? ___ Yes ___ No

   If yes, explain: _____

_____ _____

AUTHORIZED PERSON (print) **AUTHORIZED PERSON (print)**

_____ _____

AUTHORIZED PERSON (signature) **AUTHORIZED PERSON (signature)**

CONFINED SPACE ENTRY

Location of Work: _____

Description of Work (Trades): _____

Employees Assigned: _____

Entry Date: _____ Entry Time: _____

Outside Contractors: _____

Isolation Checklist:

- Blanking and/or Disconnecting
- Electrical
- Mechanical
- Other

Hazardous Work:

- Burning
- Welding
- Brazing
- Open Flame
- Other

Hazards Expected:

- Corrosive Materials
- Hot Equipment
- Flammable Materials
- Toxic Materials
- Drains Open
- Cleaning (Ex: chemical or water lance)
- Spark Producing Operations
- Spilled Liquids
- Pressure Systems
- Other

Vessel Cleaned:

- Deposits _____
- Method _____
- Inspection _____
- Neutralized with _____

Fire Safety Precautions: _____

_____

Personal Safety:

Ventilation Requirements
Respirators
Clothing
Head, Hand, and Foot Protection
Shields
Life Lines and Harness
Lighting
Communications
Employee Qualified
Buddy System
Standby Person
Emergency Egress Procedures
Training Sign Off (Supervisor or Qualified Person)_____
Remarks: _____

Atmospheric Gas Tests

	Tests Performed	- Location	- Reading
Example:	(Oxygen)	_____	(19.5%)
Example:	(Flammability)	_____	(Less than 10% LFL)
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____

Remarks: _____

Test Performed By: _____
Signature

Time: _____

Authorizations:

Supervisor: _____
Prod Supervisor: _____
Line Supervisor: _____
Safety Supervisor: _____
Etc.: _____

Entry and Emergency Procedures Understood:

Standby Person _____
Rescue _____
Telephone _____

Permit Expires: _____

HOT WORK

PERMIT 16186

WORK TO BE DONE	TIME A.M. P.M.
SPECIAL HAZARDS	DATE
PERMIT ISSUED FOR	W. O. NO.

To be completed by supervisor of area where work is to be performed.

ITEM	YES	NO	COMMENTS	ITEM	YES	NO	COMMENTS
Lines washed				Neighboring area notified			
Lines Drained				Extinguisher			
Lines Pressure Vented				Manways, sewers, and floor drains			
Lines Disconnected				Oxygen Test			
Valves off and tagged				Exposimeter Test			
Power off and tagged				Fire watch (Name)			

I certify all the items above have been completed and hereby authorize this permit.

Supervisor's Initials _____

To be completed by Maintenance Personnel.

ITEM	YES	NO	COMMENTS	ITEM	YES	NO	COMMENTS
Lines Blinded				Glasses & gloves			
Power Locked				Protective Cloth			
Valves Locked				Area Roped off			
Air Mask				Barricade & signs			
Air Bottles checked				Screens & Curtains			

Supervisor's Signature _____ Maintenance Initials _____

I certify all the items above have been completed and hereby authorize this permit.

White Copy - SAFETY ENGINEER
Pink Copy - PLANT AREA AWARENESS BOARD
Tag Copy - DISPLAY AT WORK AREA

CWM-100

(FRONT)

BURNING & WELDING PERMIT

Both sides of permit must be completed

PERMIT NUMBER _____

A Burning and Welding Permit is required in any designated "Flammable" or "No Smoking" area and/or in any tank, vessel, sewer, or similar enclosed space; or on pipe lines anywhere in Division operations.

GOOD THIS DATE ONLY _____ m. TO _____ m.

BLDG. OR LOCATION _____ FLOOR _____

EQUIPMENT: _____

PURPOSE: _____

I certify that the location where the above work is to be done has been personally examined. The required precautions for safe burning or welding appearing on the reverse side of this card have been checked as indicated.

PRODUCTION SUPERVISOR _____

MAINTENANCE SUPERVISOR _____

I have been properly instructed for safe burning and welding and understand my duties.

WELDER _____ WELDER _____

FIRE WATCH _____ FIRE WATCH _____

CWM100

(BACK)

BEFORE THIS PERMIT CAN BE SIGNED THE FOLLOWING RULES MUST BE SATISFACTORILY COMPLIED WITH AND APPROPRIATE BOX CHECKED.

1. NO BURNING OR WELDING TO BE PERMITTED WHERE SPRINKLERS ARE OUT OF SERVICE.
   ☐ SPRINKLERS CHECKED.
2. NO BURNING OR WELDING TO BE PERMITTED IN PRESENCE OF FLAMMABLE DUST, VAPORS, AND LIQUIDS OR UNPURGED TANKS, LINES, ETC. AND EQUIPMENT PREVIOUSLY CONTAINING SUCH MATERIAL.
   A. TANKS, LINES, OTHER EQUIPMENT, CLEANED AND PURGED
      ☐ YES ☐ NOT NECESSARY.
   B. ATMOSPHERE TESTED FOR FLAMMABLE VAPORS?
      ☐ YES _____ ATMOSPHERE TEST
      (SIGNATURE)
      ☐ NOT NECESSARY _____ (SIGNATURE)
   C. TANK ENTRY PERMIT COMPLETED?
      ☐ YES ☐ NOT NECESSARY.
   D. LINE BREAKING PERMIT OR CHECK LIST COMPLETED
      ☐ YES ☐ NOT NECESSARY.
3. BEFORE BURNING OR WELDING OPERATIONS ARE STARTED, THE FOLLOWING APPLICABLE PRECAUTIONS MUST BE TAKEN AND APPROPRIATE BOX CHECKED.
   A. AREA SWEPT CLEAN AND WET DOWN, FLOORS AND SURROUNDINGS?
      ☐ YES ☐ NOT NECESSARY.
   B. ALL COMBUSTIBLES MOVED 30-40 FEET FROM OPERATION OR PROTECTED WITH ASBESTOS CURTAINS, METAL GUARDS OR FLAME-PROOFED TARPAULINS (NOT ORDINARY TARPAULINS)?
      ☐ YES ☐ NOT NECESSARY.
   C. ALL FLOOR OR WALL OPENINGS WITHIN 40 FEET OF OPERATION COVERED?
      ☐ YES ☐ NOT NECESSARY.
   D. MEN ASSIGNED TO WATCH FOR DANGEROUS SPARKS IN AREA AS WELL AS FLOORS ABOVE AND BELOW?
      ☐ YES ☐ NOT NECESSARY.
   E. PROPER FIRE PROTECTION PROVIDED — HOSES OR EXTINGUISHERS?
      ☐ YES ☐ NOT NECESSARY.
4. BURNING OR WELDING EQUIPMENT INSPECTED AND FOUND IN SAFE CONDITION?
   ☐ YES
5. THE AREA INCLUDING FLOORS ABOVE AND BELOW SHOULD BE CHECKED AT LEAST ½ HOUR AFTER WORK IS COMPLETED.
   ☐ AREA CHECKED.

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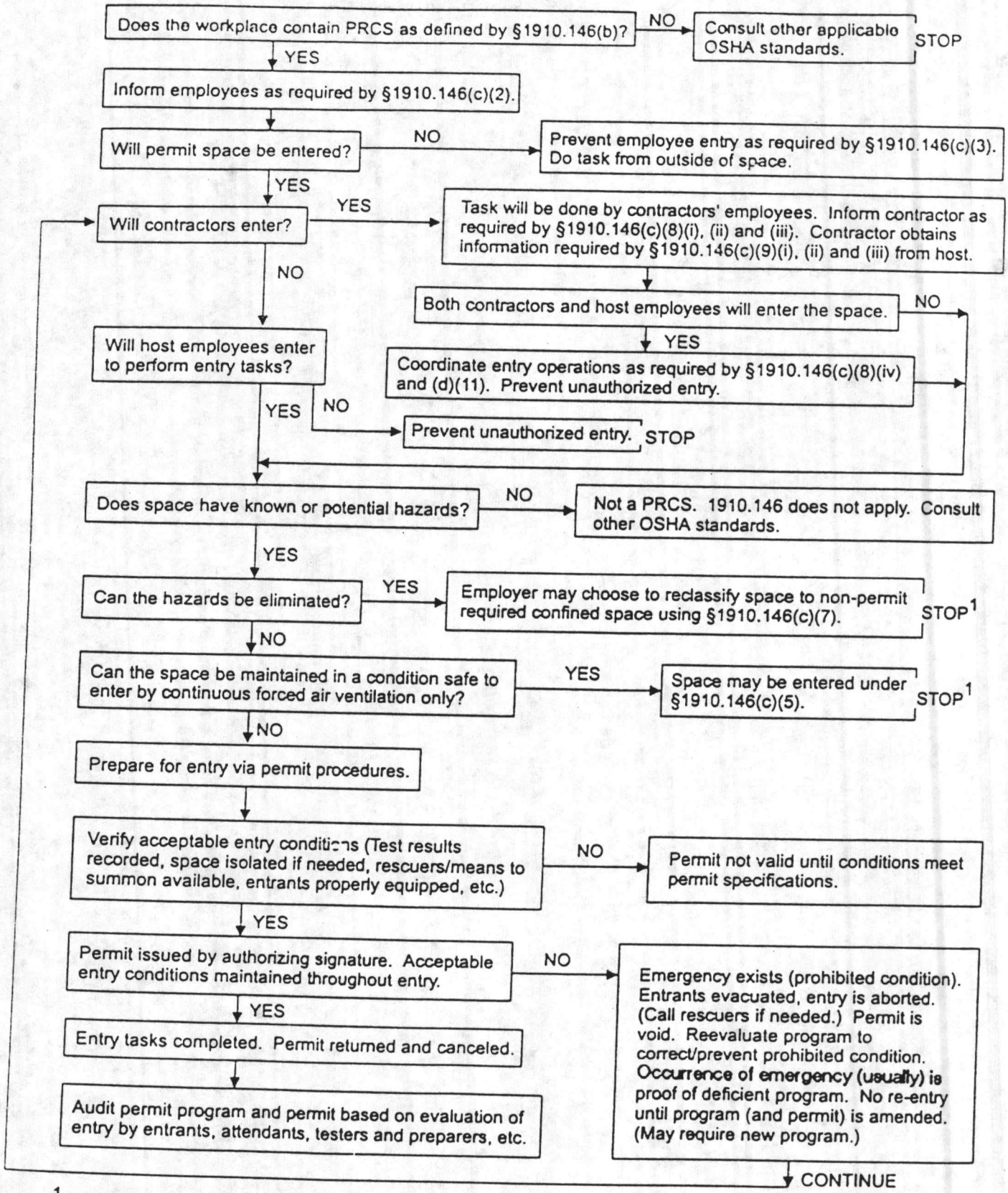
APPENDIX B

CONFINED SPACE FLOW CHART

Permit - Required Confined Space Decision Flow Chart



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

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APPENDIX C

ROPE ILLUSTRATIONS

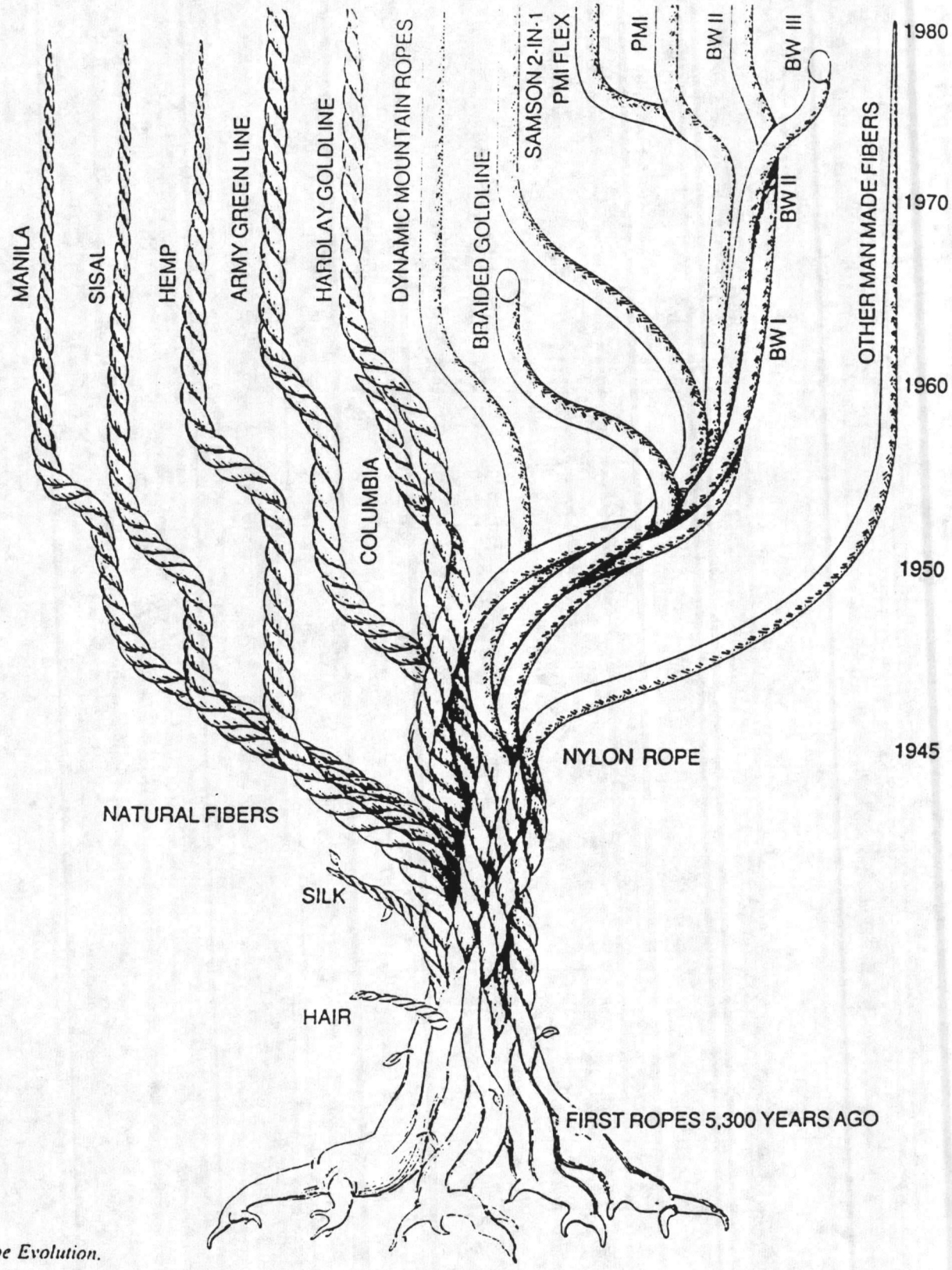


Fig. 2-2. Rope Evolution.

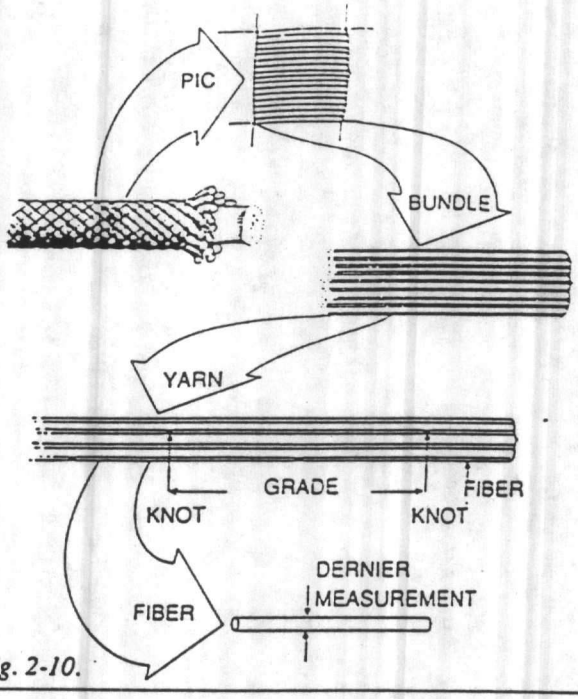


Fig. 2-10.

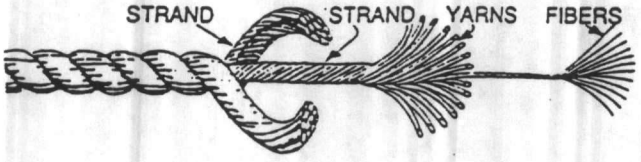


Fig. 2-11. Laid Ropes.

Fig. 2-12. Solid Braid.

Fig. 2-13. Dynamic kernmantle rope. Braided sheath woven over a twisted-strand shock-absorber core.

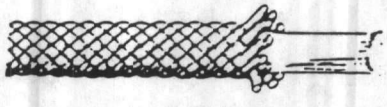


Fig. 2-14. Static kernmantle. A protective sheath woven tightly over a load-bearing parallel-fiber-bundle core.

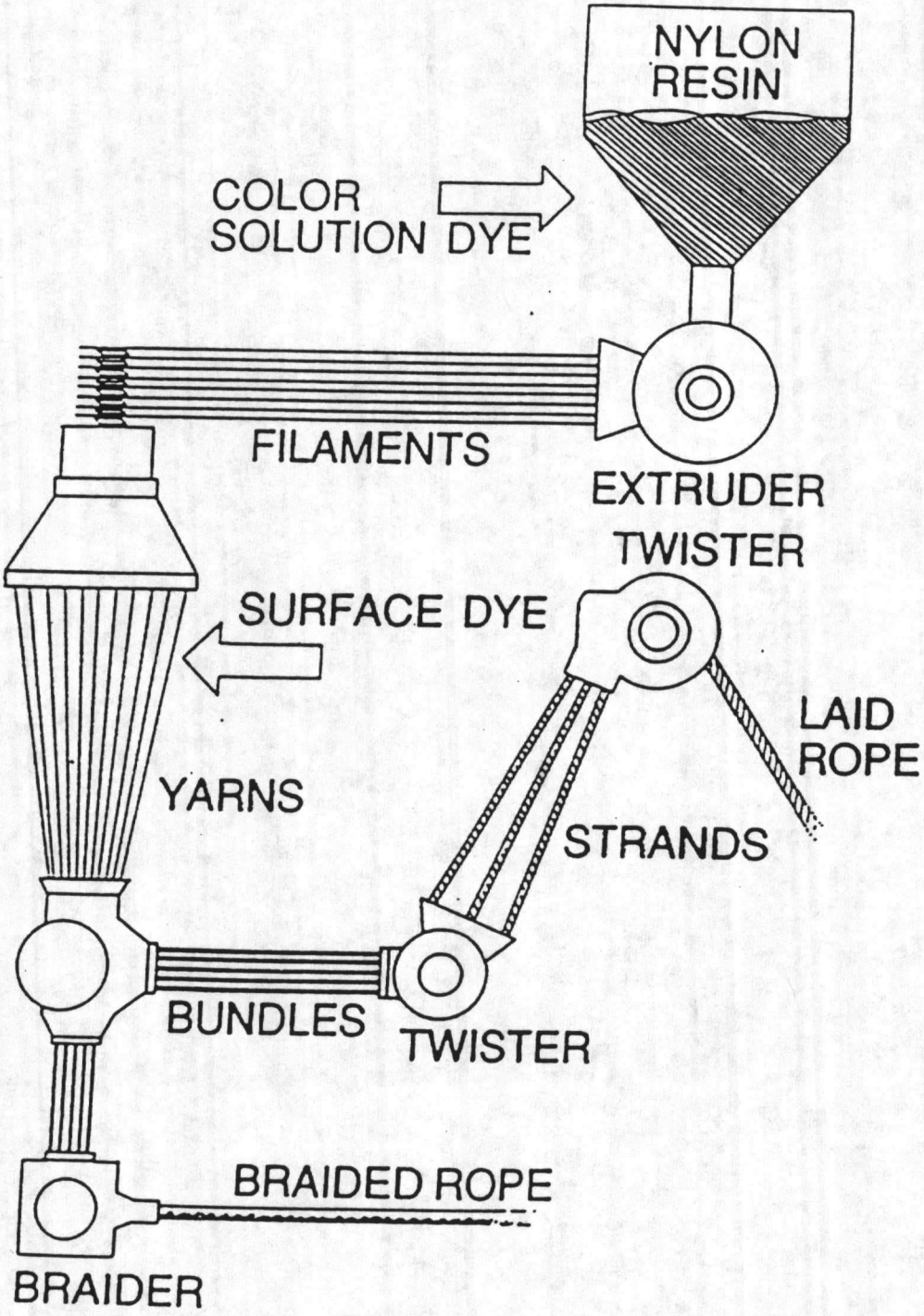


Fig. 2-1. The rope making process.

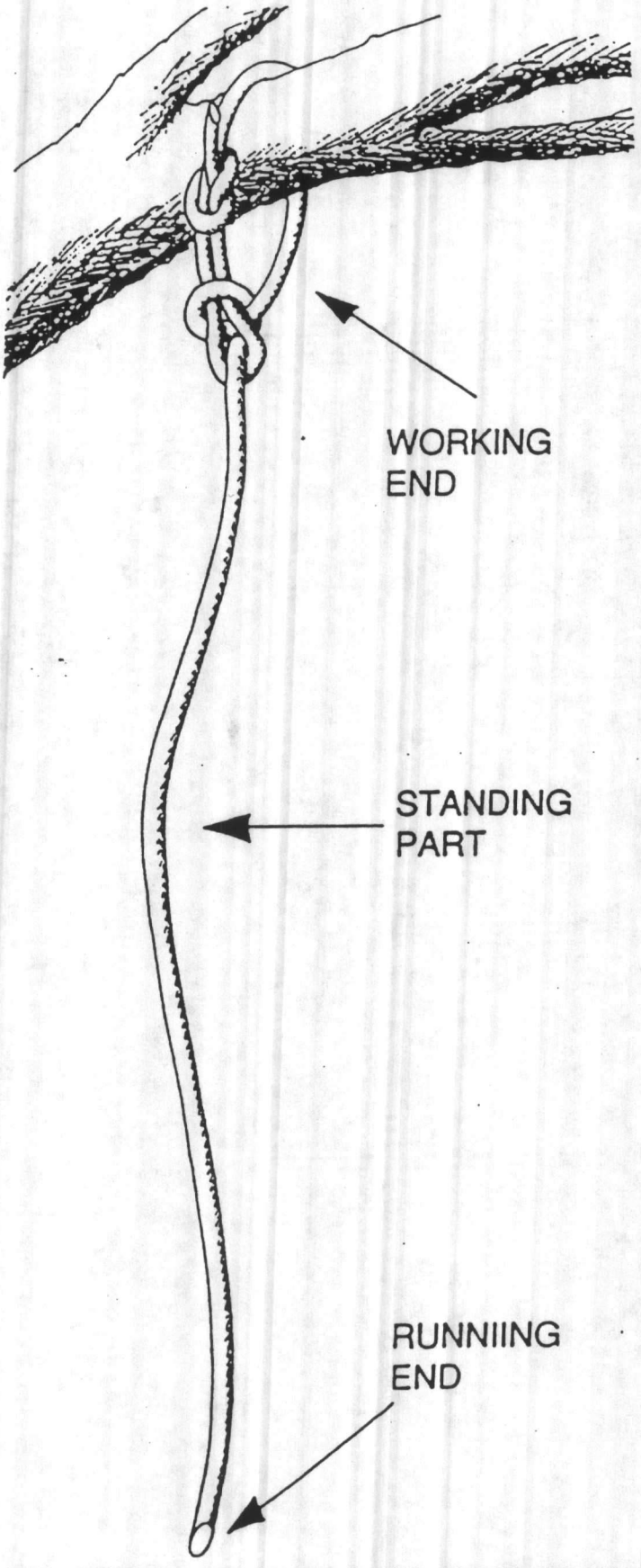

WORKING
END
STANDING
PART
RUNNIING
END

FIGURE EIGHT

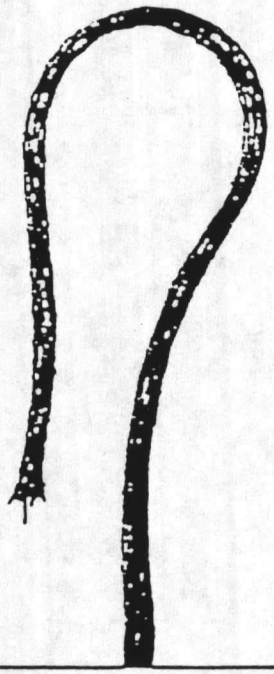


FIG. 1

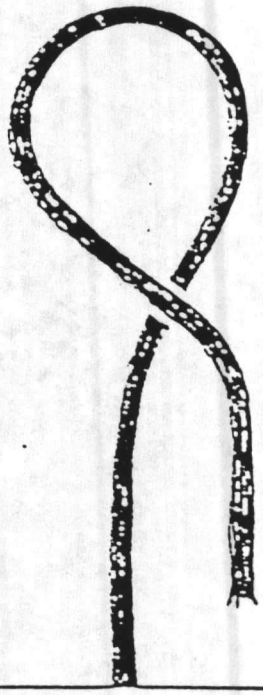


FIG. 2

FIG. 3

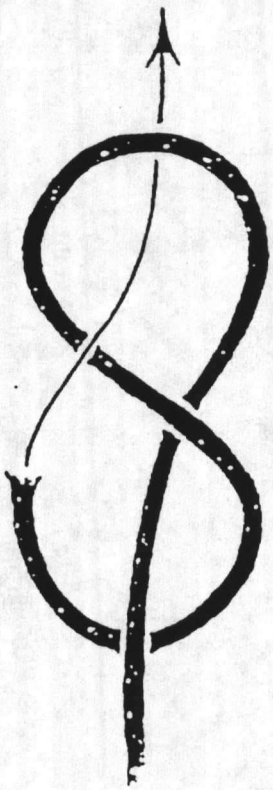
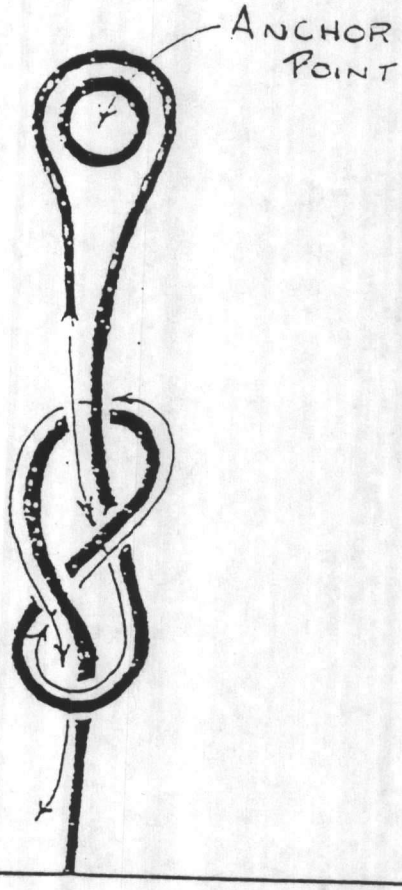


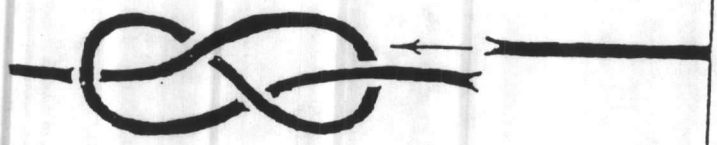
FIG. 4

FIGURE EIGHT ON A SIGHT

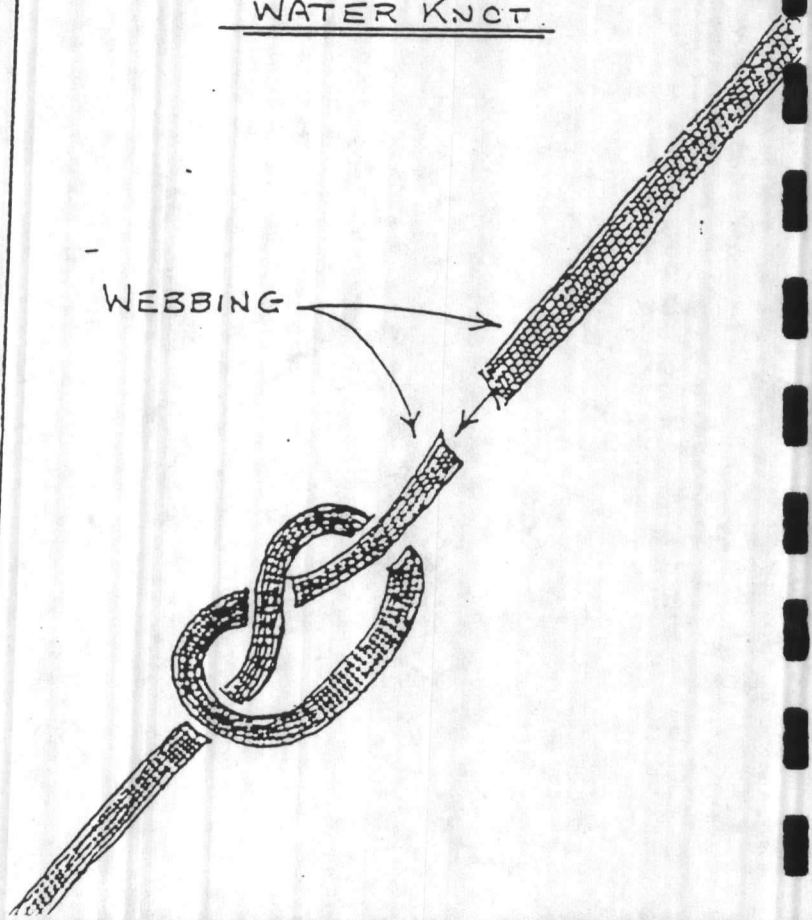
FIGURE EIGHT ON A BIG-



REWEAVE - ROPE SPLICE



WATER KNOT



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