Trench Rescue - Operations Level

Student Manual

Technical Rescue
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State of New York

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THE NYS OFFICE OF FIRE PREVENTION AND CONTROL AND THE NYS OFFICE OF HOMELAND SECURITY

Welcome to the New York State Fire Training Program

Trench Rescue - Operations Level

The Division of Homeland Security and Emergency Services recognizes that providing training for paid and volunteer firefighters and related officials is an important part of the services it makes available. Our Office of Fire Prevention and Control (OFPC) places a very high priority on training because we believe it is essential for the men and women of the fire and emergency services in New York State.

The Office of Fire Prevention and Control's programs include the most complete progression of training available today -- beginning with probationary firefighters and extending the full length of a firefighter's career with the fire service. While our training programs address specific fire and arson prevention and control issues, we also encourage expansion and improvement of local training facilities and programs in cooperation with fire companies, municipal corporations and districts.

Trench Rescue - Operations Level consists of intense hands-on training in the field of trench rescue. The students will be taught several ways to shore trenches, the different types of extrication techniques, proper rescue site management, as well as the proper safety concepts needed to complete a safe and successful rescue. There will be live exercises in which the students will actually extricate a trapped victim from an open trench scenario.

Your comments and suggestions about this student manual, our training classes or any OFPC program are always welcome. Your input will help us build on our successes and make needed changes, when appropriate.

On behalf of the citizens you serve, we want you to know that your participation and commitment are greatly appreciated.

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BASIC TRENCH COLLAPSE OPERATIONS

ACKNOWLEDGMENTS

The preparation of this course was made possible through the assistance, cooperation and dedication of many people. The Department of State's Office of Fire Prevention and Control wishes to thank the following persons for their roles in the development of this course:

Principle Development Group

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Jack Moser, Capital District Urban/Technical Search & Rescue Team

This program is dedicated to the memory of principal development group members Raymond Meisenheimer and Dennis Mojica who perished in the line of duty September 11, 2001. Their contributions to the development of this program and to the rescue community will not be forgotten.

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Unit 1: Introduction to Trench Rescue

Introduction

Course Overview

Trench Rescue - Operations Level consists of two units - sixteen hours total.
This course provides information to adequately prepare you to identify a trench incident and provide assistance to those trained and qualified to enter the trench to perform rescue services. The overall objective of the Trench Rescue - Operations Level course is to prepare the rescuer to perform at the operations level in accordance with NFPA 1670 and to continue with the acquisition of the knowledge and skills required for certification in accordance with NFPA 1006. The Trench Rescue - Operations Level course encompasses trenches up to eight feet in depth. Topics include: regulations and standards, worker protection systems, safety, equipment, incident management and skills performance testing.

Trench Rescue - Operations Level is part of a series of courses designed to develop and enhance your skills as a rescuer. These courses are delivered in the field in addition to being taught as part of the residential offerings at the New York State Academy of Fire Science to allow you the opportunity to continue your education and training as a rescuer.

Trench Rescue - Awareness Level, Medium Structural Collapse Operations: Tools, Rescue Technician Basic and Trench Rescue - Operations Level courses are the prerequisites for taking the 16 hour Trench Rescue-Technician Level rescue course.

Course breakdown is as follows:

Unit 1 – Introduction to Trench Rescue
1.1 Introduction
1.2 Regulations and Standards
1.3 Introduction to Trench Operations

Unit 2 – Operations at Trench Rescue Incidents
2.1 Trench Rescue Operations
2.2 Student Practical Skills Exercises
2.3 Scenarios and Practical Skills Evaluations

Course Objectives

While the lessons each have specific enabling objectives, the overall course objectives that each student is expected to perform at the completion of this course are:

1. Demonstrate an understanding of his/her role as part of the rescue team called to the scene of a trench-related accident.
2. Demonstrate the skills used to carry out the functions of a rescue action plan at the company/team level.
3. Demonstrate an understanding of the common causes for trench collapse.
4. Demonstrate an understanding of the personal safety equipment used for trench rescue.
5. Demonstrate the use of scene safety equipment and techniques.
6. Demonstrate the placement of ground pads to make the lip of the trench safe.
7. Demonstrate sheeting and shoring procedures using wood timbers.
8. Demonstrate sheeting and shoring procedures using pneumatic shores.
9. Demonstrate supplemental sheeting and shoring procedures using walers and planks.
10. Demonstrate safe retrieval of all equipment, and a return to the "ready to respond" mode.

Regulations and Standards

Introduction to Regulations and Standards

This unit covers the work of three organizations:
NIOSH (National Institute for Occupational Safety & Health).
OSHA (Occupational Safety & Health Administration)
NFPA (National Fire Protection Association)

NIOSH

National Institute for Occupational Safety and Health (NIOSH) studies incidents and compiles statistics and makes recommendations to OSHA.

NIOSH facts:

- Deaths and injuries
  Average of 73 persons killed per year in cave-ins
  Average of 97 persons killed per year in excavation related accidents
  Average of 140 permanent disabilities
  1000 – 4000 injuries per year.

- Most trench accidents happen in trenches 5ft to 15ft in depth. This is the depth that utility companies work in or the homeowner attempts to dig to save a few dollars.

- Causes of Death:
  Suffocation – unable to breathe
  Crushing Injury – Damage to internal organs, acidosis
  Loss of Circulation – Depriving vital organs of needed oxygen
  Being struck by fallen objects – Becoming unconscious, blocked airway

OSHA

OSHA is a division of the U.S. Department of Labor and is charged with making the standards that apply to worker safety. While the following excavation standards do not technically apply to rescue services, we follow them just the same.

1926.650 – Scope, Application & Definitions
Includes definitions used throughout subpart P (excavations) and important Terms contained in 1926.650 such as:

- Excavation – any man-made cut, cavity, trench or depression in the earth's surface formed by the removal of that earth.

- Trench – a narrow excavation (in relation to its length) made below the surface of the ground. In general, the depth is greater than the width but the width of a trench (measured at the bottom) is not greater than 15 feet.

- Competent Person – one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous or dangerous and who has authorization to take prompt, corrective measures to eliminate them.

- Every excavation site (including rescue operations) must have a competent person.

You should be familiar with these terms and any other terms contained within the standard. Refer to the glossary in the appendix for other definitions.

1926.651 – Specific Excavation Requirements

1926.652 – Requirements for Protective Systems

Trench requirements include:

- Trenches greater than 4 feet must be laddered.
- Trenches greater than 5 feet must be safed.
- Trenches 4 feet in depth or greater must have a stairway, ladder, or ramp every 25 feet of lateral travel.
- Ladder must extend 3 feet above the lip of the trench and be secured.

NFPA Standards

NFPA 1670 "Operations and Training for Technical Search and Rescue Incidents" is designed to assist organizations in developing a technical rescue capability in their community. Commonly referred to as "organizational standard", the organization as a whole (as compared to individual members) must comply with the requirements of this standard. It is designed as a core + (plus) standard meaning that all specialties share a common set of needs and there is no point in repeating these for each individual specialty.

Standard Components

Core requirement for all specialties including:

- Establish operational procedures consistent with organizational response level
- Medical care.
- Hazard analysis & risk assessment
- Training
    - Continuing education
    - Evaluation of training programs
    - Documentation of required training
    - Initial training to the level of response
- Incident response planning
    - Mutual aid agreements are implemented
- Equipment
    - Shall be commensurate with response level
    - Training provided on all equipment
    - Inventory and accountability procedure established
- Safety
    - AHJ ensures rescuers are trained to the appropriate response level
    - AHJ ensures all rescuers comply with NFPA 1500

- Safety Officer
- Incident management system
- Nuclear, Biological and Chemical response
- Fitness

Specific requirements for the following specialties:

- Structural Collapse
- Rope Rescue
- Confined Space
- Vehicle
- Machinery
- Water
    - Dive
    - Ice
    - Surf
    - Surface/Swift Water
- Wilderness Search & Rescue
- Trench and Excavation
- Cave
- Mine & Tunnel
- Helicopter

This standard is also based on a 3 operational level system. These include: Awareness, Operations and Technician. All members of any type of emergency response should have at least the Awareness level of training (EMS, Police, Fire) and fire departments that respond to emergencies to perform rescues involving entry need to be trained and equipped as a minimum to the Operational level. The Operation level response allows the organization to work in non-intersecting trenches up to 8 feet deep. The Technician level response allows the organization to work in trenches greater than 8 feet deep and intersecting trenches. Trench rescue requirement areas include:

Awareness Level

- Recognize the need for trench rescue
- Resource identification
- Response system & scene mgt. procedures
- Hazard recognition and mitigation
- Recognition of collapse patterns, reasons for collapse & potential for secondary collapse
- Procedures for making a rapid, non-entry rescue.
- Hazards recognition of soil weight & associated entrapping characteristics.
- Must be trained to the Awareness level for Confined Space Rescue
- Must meet the requirements of NFPA 472, Standard for Professional Competence of Responders to Hazardous Materials Incidents, and a competent person identified as defined in section 3.3.18

Organizations at this level shall meet the definition of an OSHA "competent person". The NYS Trench Rescue – Awareness Level course is designed to bring an individual to the Awareness level.

Operations Level – Awareness plus:

- Must be at the Operations level for Rope Rescue
- Must be at the Operations level for Confined Space Rescue
- Must be at the Operations level for Vehicle and Machinery Rescue
- Must be capable of identifying hazards at trench incidents involving a single trench less than 8 feet deep that does not have severe environmental concerns or require the use of supplemental sheeting and shoring
- Size-up
- Procedures to make entry into the trench
- Recognition of unstable areas
- Identify probable victim location and survivability
- Making the rescue area safe
- Initiating a one-call utility location service
- Identification of soil types
- Ventilation of the trench
- Identification of bell-bottom excavation & its associated hazards
- Procedures for placing ground pads
- Provide entry & egress paths for entry personnel
- Pre-entry briefing
- Record keeping and documentation during entry
- Selecting, utilizing and applying shield systems
- Selecting, utilizing and applying sloping and benching systems
- Identifying the duties of panel teams, entry teams, and shoring teams
- Assessing the needs for victim removal
- Extrication

The NYS Trench Rescue – Operations Level course is designed to bring an individual to the operations level.

Technical Level – Operations plus:

- Technician level for Confined Space Rescue
- Technician level for Vehicle and Machinery Rescue
- Involves trenches deeper than 8 feet where severe environment conditions exist, supplemental sheeting and shoring may be needed or manufactured trench boxes or isolation devices will be used.
- Involves intersecting trenches
- Supplemental sheeting and shoring
- Atmospheric monitoring
- Manufactured protection
- Isolation systems
- Ability to adjust the protective system based on digging operations and environmental conditions
- Rigging and placement of isolation systems

The NYS Trench Rescue – Technician Level course is designed to bring an individual to the technician level.

NFPA 1006 "Technical Rescuer Professional Qualifications" is designed to specify minimum job performance requirements for service as a rescuer in an emergency response agency. It is commonly referred to as an "individual standard" and requires both knowledge and skills be demonstrated in various subject areas to provide for the certification of the individual as a "Technical Rescuer" in a given specialty. There are 2 levels of certification:

- Level 1 – corresponds with "Operations" level in NFPA 1670
- Level 2 – corresponds with "Technician" level in NFPA 1670

Certification involves both written testing (knowledge) and skills testing performed by someone other than the instructor. As with NFPA 1670 it is also designed as a core + (plus) standard meaning that all specialties share a common set of needs and there was no point in repeating these for each individual specialty.

Standard Components

Core requirements for all specialties including:

- Site Operations
  - Includes areas such as resource management, action planning, incident management system, search, helicopter ops and recordkeeping.
- Victim Management
  - Includes areas such as victim access, stabilization, triage, packaging, moving and transfer.
- Ropes & Rigging
  - Includes ability in low-angle rope rescue.

Specific requirements for the following specialties:

- Rope Rescue
- Surface Water
- Vehicle & Machinery
- Confined Space
- Structural Collapse
- Trench & Excavation
- Swift Water
- Dive Rescue
- Ice
- Surf
- Wilderness
- Mine & Tunnel
- Cave

Trench rescue requirement areas include:

- Size-up
- Incident management
- Non-entry rescue
- Emergency action planning
- Scene safety
- Equipment & resources
- Environmental concerns
- Load stabilization systems & lifting heavy loads
- Coordination of heavy equipment
- Construction & placement of shoring & shielding systems
- Victim release & extrication

Introduction to Trench Operations

Introduction

An understanding of the basic factors involved in excavation collapse is critical to a safe and effective operation. These factors all impact the ability of rescue services to perform safe, effective and timely rescues in this dangerous environment.

Anatomy of a trench (Figure 1-1):

- Lip – 2 feet down from the ground surface
- Toe – 2 feet up from the floor of the trench
- Belly – Area between the lip and toe
- Spoil Pile – Soil that is removed from the trench
  - Should be located at least 2 feet back from the lip of the trench

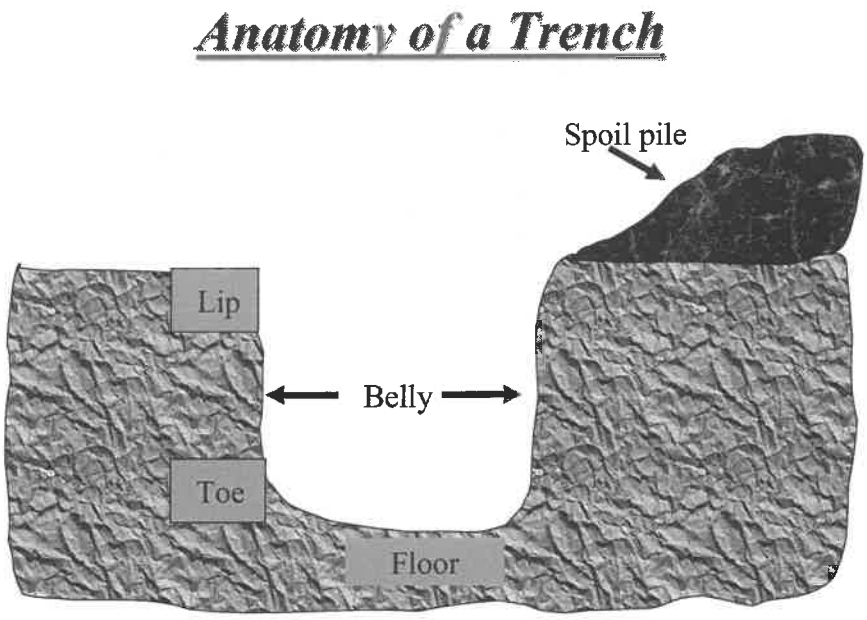

Figure 1-1

Soil Physics

It is because of these forces that specialized training is necessary:

- Shear wall collapse speed = 45 MPH
- 1 cubic foot of soil = 100-120 lbs
- Clay can weigh 140lbs, sand as little as 65 lbs
- 24 in. of soil on chest = 750-1000 lbs
- 18 in. of soil covering body = 1000 - 3000 lbs
- The speed of soil collapsing + weight of the soil can cause various injuries.
- Shows why weight and volume are important considerations in trench collapse.

Victim considerations

- Speed of soil collapsing + weight of the soil causes various injuries including:
  - Crush injuries
  - Suffocation and/or toxic atmospheres
  - Mouth fills with soil
  - Chest unable to expand
  - Chest unable to continue expanding
  - Uncover victim's head and chest first.
    - This is because of the weight of the soil
  - Take care pulling on the victim
  - Weight can hold the victim
  - Dislocation injuries

Most accidents happen in trenches 6-8 feet deep. Many trenches this depth are dug to place or repair water, sewer lines etc. At this depth you are below the frost line allowing the soil to be looser. Many people don't think they need to use a protective shield for a small size trench. This can be because of a lack of contractor training and enforcement and some will cut corners to save time and money.

The potential for trench incidents increases when the following conditions exist:

- Underground utilities
- Thousands of open trenches throughout the state
- Lack of contractor training
- Lack of enforcement
- More complex underground engineering
- Amount of construction going on
- Home improvement projects
- Toxic atmospheres in trench

Soil Types

Clay/mud is the most common type of soil encountered. We tend to be careful in sand but let our guard down in clay, which we think is safe when it is not safe at all. Soils are classified by OSHA as one of three types:

- Type "A"
  - Most stable (other than stable rock)
  - Includes strong clay soils, cemented soils and hard pan.
- Type "B"
  - Next most stable
  - Includes granular soils, weaker clay soil and disturbed soils.
- Type "C"
  - Least stable
  - Includes gravel, sand and weakest clays

Other terms that are frequently used to classify soil include:

- Compact (Visual)
  - Appears compact or hard
- Saturated (Visual)
  - Soil with water seeping from it.

- Running (Visual)
  - Loose, free-flowing soil, i.e., sand etc.

All trench rescues should be considered type "C" soil. This will eliminate the problem of trying to classify the soil as Type "A", "B" or "C" soil.

Different types of cave-ins:

- Lip Slide (Figure 1-2) occurs when the weight of the spoil pile is located too close to the lip of the trench causing it to fail. A lip slide could occur on one or both sides of the trench.

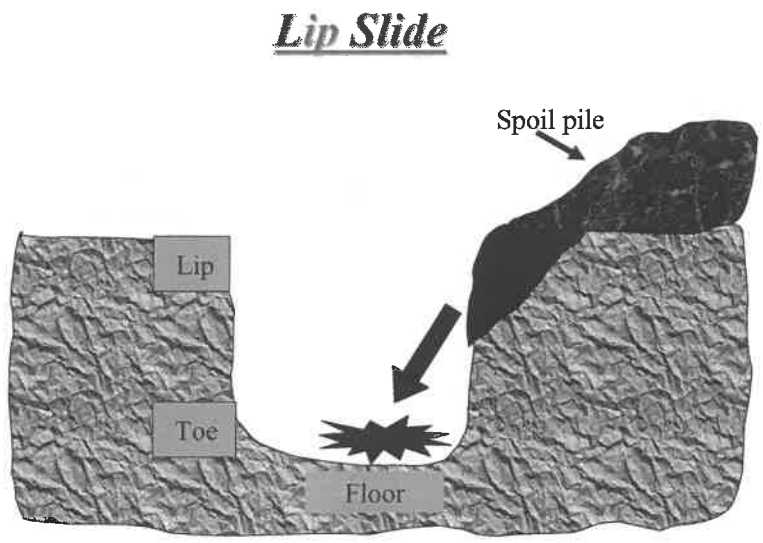

Figure 1-2

- Belly/Slough-in (Figure 1-3) occurs when weight is exerted onto the trench wall causing it to fail.

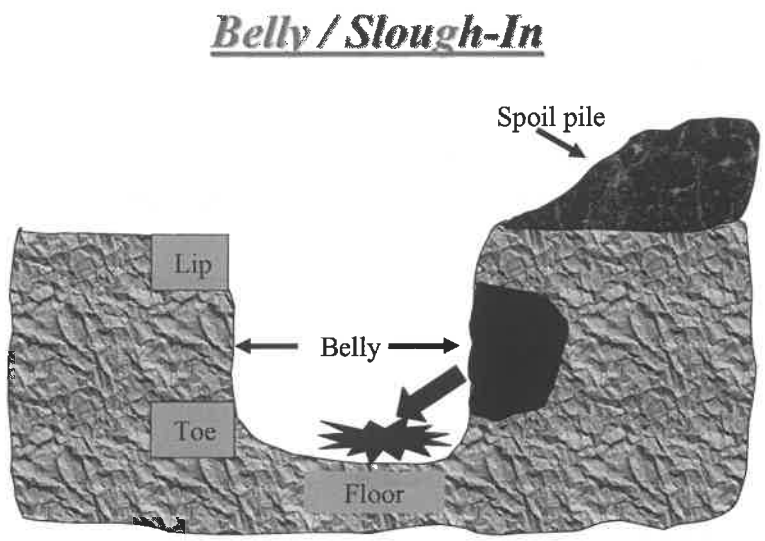

Figure 1-3

- Wall Shear (Figure 1-4) is when a section of the trench wall breaks away and collapses into the trench.

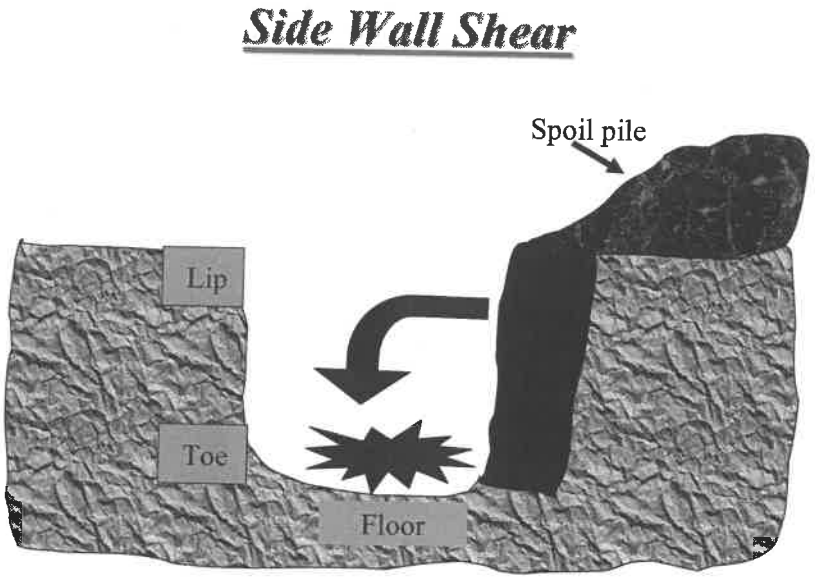

Figure 1-4

- A spoil pile cave-in (Figure 1-5) occurs when the spoil pile is place to close to the lip of the trench and the loose dirt slides into the trench.

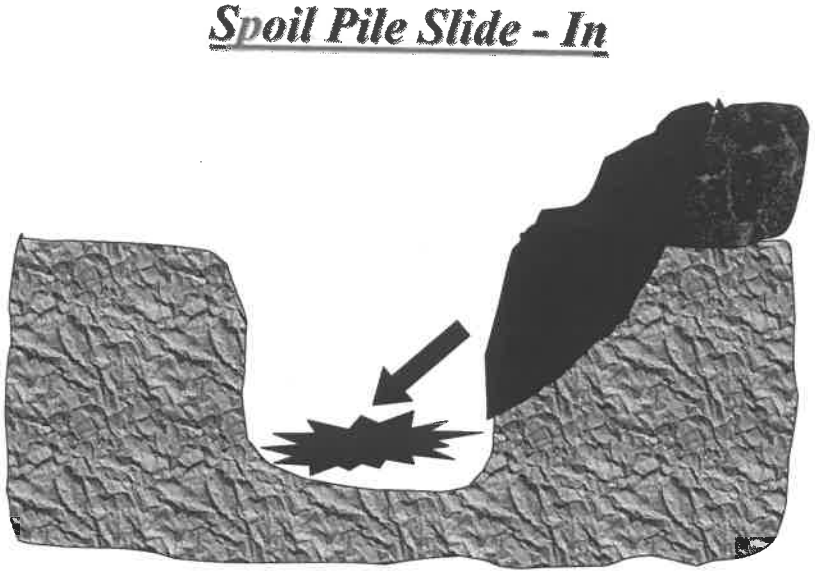

Figure 1-5

NOTES:

Unit 2: Operations at Trench Rescue Incidents

Trench Rescue Operations

Introduction

The primary function of rescue is to locate and extricate trapped victims, transferring the victims to a stable and safe area while providing basic life support. A secondary function is to restore the area to a safe condition, thus precluding additional rescue at the incident site. The purpose of this lesson is to assist in: establishment of a functional ICS, the proper assessment of an incident, development of an appropriate action plan, and development of an understanding of the components of a successful trench rescue operation.

The Incident Management System

A rescue scene can be one of confusion if a command system is not established early in the incident. The command system must be versatile and must be adaptable to any type or size of emergency or incident. The system must be relatively familiar if it is going to be useable throughout the State. The system must be able to expand in a logical manner if changing conditions dictate.

The majority of technical rescue operations will be most efficiently managed with a pared down version of the full blown IMS model. It will be the rare technical rescue incident that will require filling positions such as Planning, Logistics, Finance, etc. as functional areas assigned to different individuals.

The IMS allows for a manageable span of control of people and resources. Utilizing an IMS takes much of the pressure off the Incident Commander. The maximum span of control is 7 (seven) persons. The recommended effective span of control of 5 to 1 allows for most effective management. The system is set up so that the IC is only communicating to and receiving information from a maximum of five people, rather than the whole assignment of personnel at the scene. Individual managers of personnel and resources within ICS are also working within a manageable span of control

IMS Positions for the typical trench rescue scenario are as follows (Figure 2-1):

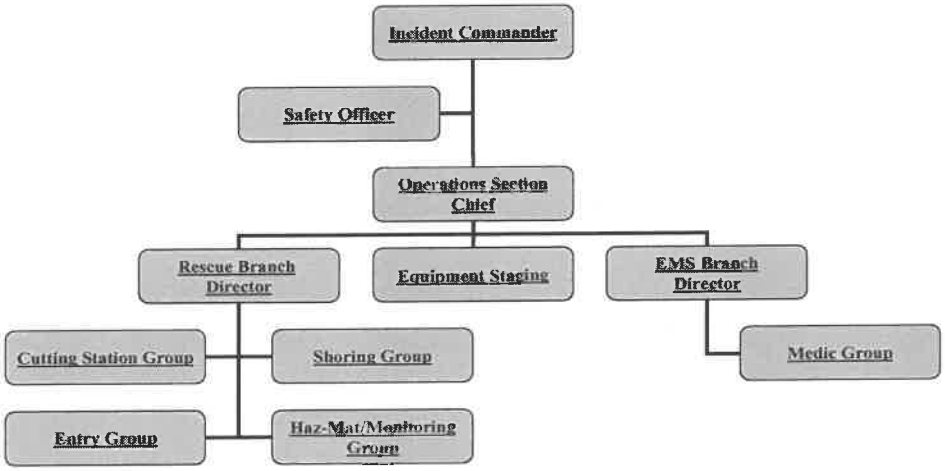

Figure 2-1

The Incident Commander (I.C.) or "command" is the individual responsible for the management of all incident operations. The I.C. does not need to be well versed in trench rescue, however, should be well versed in the IMS. The I.C. should be stationed at a command post remote from the incident and on large, complex, and or protracted incidents, the I.C. may delegate functional responsibilities by appointing an:

- Operations Section Chief (Operations)
- Planning Section Chief (Planning)
- Logistics Section Chief (Logistics)
- Finance Section Chief (Finance)

The I.C. also communicates directly with Command Staff including:

- Public Information Officer (PIO)
- Safety Officer (Safety)
- Liaison Officer (Liaison)

The **Operations Section Chief** is responsible for direction and coordination of all tactical operations. On modest sized rescue incidents, Operations may fulfill the functions of the Rescue Branch. At large scale rescues, Operations may designate a Rescue Branch Director. The Operations Section Chief also interfaces with other appropriate agencies.

The **Safety Officer (SO)** is responsible for enforcing general safety rules, ensuring that the personnel working in and around the trench are using appropriate techniques and procedures. When manpower is limited, the SO position may be combined with the TRO and or Operations positions. The SO develops measures for ensuring personnel safety and can bypass chain of command when necessary to correct an unsafe act immediately.

The **Rescue Branch Director** is responsible for the rescue operation. This person should be the most experienced rescue technician on the team. Responsibilities include:

- Assuming the lead role in implementing incident tactics.
- Overseeing the set-up of the rescue system. When the set-up is complete the TRO will check the entire system.
- Acts as the liaison between the rescue site and the Operations Section Chief.
- Designates "tactical" level positions in the IMS as needed.

The **Cutting Group** is responsible for the supply of dimensional lumber that is cut to fit the trench shoring or associated operations.

The **Shoring Group** is responsible for the proper placement and securing of shoring systems used in the rescue operation.

The **Entry Group** is responsible for entry into the trench to extricate the victim. The entry crew is also responsible for the placement and securing of additional sheeting or shoring as required.

The **Medical Group** provides initial medical assessment and stabilization. Medics should be trained to at least the CFR level, as well as training appropriate for entry into the trench.

The **EMS Branch Director** oversees the medical care of the victim/victims, and makes triage, treatment and transport decisions on multiple victim rescues. They also advise the Medic on medical issues and provide advanced life support care for patients who have been removed to grade.

The **Equipment Staging Officer**, this position is especially useful if personnel resources allow. The EO assembles all available rescue equipment on a tarp in a neat organized manner. While not recommended, once the equipment is organized the EO could be available for reassignment.

The **Hazardous Materials/ Monitoring Group,** is responsible for the monitoring of the incident for hazardous materials. This will primarily involve the monitoring of the atmosphere in the trench and providing ventilation if necessary.

Hazard and Risk Assessment Components

Assessment Components include:

- Preplan Information
- Site Survey- This includes an evaluation of soil type, soil conditions and accessibility.
- Analysis of past incidents-this includes a review of
  - Where
  - How
  - Probability of survivability
- Assessment of available resources including:
  - In house resources
  - Mutual aid- Capabilities and response time

Determination of Rescue versus Recovery

Rescue involves the moving of victims to a safer environment. When it is unknown if a victim is alive, the operation should proceed as a rescue. Recovery is the removal of a body from a trapped location to a location where it can be examined and identified.

It is unfortunate that there are times when we can tell with assurance that there is no possibility of rescue. The following list may help in understanding the decision process to be followed.

- Know victim is alive.
  - Can see or hear victim.
  - Report from a reliable source.
- High probability victim is alive.
  - No known toxic conditions.
  - Air space available.
- Low probability victim is alive.
  - Exposed to toxic or hazardous gases or highly probable exposures.
  - Minimal chance of air space remaining.
- Certain victim is dead.
  - Exposed to high concentration of toxic gases.
  - Trapped with no air voids (example: sand bank or farm grain silo).
  - Body decapitated or dismembered

Determination of Hazards

Hazards present at a scene may prohibit rescue of live victims. Hazard assessment of the scene may dictate whether the incident is a patient rescue or a victim recovery. The size-up or scene survey can assist decision-making process and should include the entire area for potential hazards. General hazards present or potentially present include:

- Unsafe ground or unsafe footing
- Improper equipment
- Potential for secondary collapse.

Determination of Risk versus Benefit

Another way of analyzing the "patient rescue" versus "victim recovery" issue is to weigh the risks versus the benefit. All rescue work involves some risk, but some operations are riskier than others. The following should be considered when calculating risk vs. benefit:

- Danger to rescuers
- Number of victims
- Are the victims salvageable?
- Capabilities of the department
- Anything overlooked?

Development of the Incident Action Plan (IAP)

An IAP should deal with the following as a minimum.

- Establishment of "safety" zones.
- Complete risk/benefit analysis.
- Safety of the trench and general area.
- Establishment and confirmation of the incident strategy and tactics.
- Establishment and assignment of operational and support tasks.
- Establishment of a Rapid Intervention Team.
- Hazard mitigation.
- Resource staging.
- Selection and use of protective systems.

Operations at Trench Rescue Incidents

Operations at technical rescue incidents are no different than other emergency situations in that a consistent approach in dealing with an incident will provide a more favorable outcome. The following is intended to provide you with a step by step approach in preparing for, assessing and responding to technical rescue incidents.

Preparation

- Includes
  - Training
  - Equipment
  - Personnel

Initial Response

- Pre-arrival Size-up
  - Dispatcher can add valuable information while enroute.
  - Number of patients
    - Are they fully or partially buried
  - Any known hazards
  - Name of contractor in charge
  - Weather conditions
  - Location
- First Arriving unit
  - Establish command; begin physical size-up of the situation.
  - Keep apparatus at least 50' away.
    - Allow space for additional resources if needed.
  - Determine utility involvement
  - Establish victim contact.
  - Set up initial safety zones.

Assessment and Planning

- Scene size-up
  - Verify who is in charge.
  - What happened?
  - How many victims.
  - Potential for non-entry or victim self rescue.
  - Victim location.
  - Type of soil
  - Hazards
  - Type of injuries
  - Initial assessment of rescue vs. recovery.
  - Cave-in or entrapment.

Gaining access

- This begins the tactical phase of the rescue.
  - Inner circle, (inside the safety zone)
  - Outer circle,(equipment and manpower staging)
  - Divide manpower into groups.
    - Shoring Group
    - Cutting Group
    - Medical Group
    - Safety Group
    - Support Group
- Shoring Group
  - Makes trench lip safe
  - Measures for shoring
  - Places shoring in accordance with tabulated data.
  - Makes trench safe for entry.

- Cutting Group
  - Prepares the lumber as needed
  - Cuts the shoring to the proper lengths as determined by the shoring team.

- Medical Group
  - Works the bottom of the trench
  - Disentangles packages and removes the patient or victim.
  - This could be EMS personnel as needed.

- Safety Group
  - Monitors air quality
  - Inner circle accountability
  - Keeps rotation times of the crews in the trench.

- Support Group
  - Used as manpower pool, for rotation of personnel.
  - Equipment organization and tracking.
  - Provides equipment as needed to the cutting and shoring teams.
  - Prepares other systems as needed.

Incident Termination

Once the victims are removed the incident is not over. The trench must be inspected by an investigative authority. Once a decision is made to release, the trench shoring materials may be removed. This is very labor intensive, additional manpower may be required to assist. The following is a list of activities that should be performed at the end of each trench incident:

- Cleanup and replacement of equipment on the vehicles.
- Completion of documentation and reports.
- Incident debriefing.
- Stress debriefing (as appropriate).

Shoring Construction

Safe the Trench Lip

The use of ground pads will be needed at all trench incidents to distribute the load created by rescuers working around the trench. Safe the trench lip by sliding 4' x 8' sheets of ¾" plywood from several feet away towards trench. The first pad should be placed at the end of the trench. Once the first plywood sheet is in place, a ladder should be placed into the trench as a self rescue option should a rescuer fall in. This ladder should remain in place until the last ground pad is ready to be removed. Repeat the process of placing ground pads by working off of the plywood or from a safe distance away. Overlap the plywood and nail in place using 8d nails driven all the way in, use at least 2 nails per intersection. This will allow for the creation of a system to distribute weight.

If a spoil pile is present and is too close to the trench lip, rescuers should work off of 2" x 10" planks and shovel the pile back until they are able to slide the planks around the trench to create a 20" wide work platform. The rescuers should also overlap and nail these with 16d nails.

Sheeting

The most common type of protective system used by rescuers is sheeting and shoring (Figure 2-2). The panels that are used are made of 4'x8' sheets of ¾" Finform plywood with a 10' long 2"x12" strongback placed down the center with an optional strongback midway along one edge. The panels are placed in sets, a minimum of 3 sets of panels are needed for a nonintersecting trench.

The first set of panels is placed on either side of the victim's head and upper torso to protect the victim from further collapse. The second and third sets are placed at each end of the first set of panels to form a protected area for the rescuers to work. Panels are placed by lowering the bottom of the panel into the trench along the trench wall. While the panel is being lowered push out on the top of the panel, this will keep the bottom of the panel against the wall, reducing the amount of space behind the panel. Any spaces behind the panels must be filled by shoveling dirt into them or by placing padding into the voids.

Figure 2-2

Shoring

Shoring is the process of tying the panels together to form a protective system. The shores are the part of the system that transfers the load from one trench wall to the other.

- Pneumatic Shoring

  Pneumatic (air) shores are placed by attaching the air line to the strut at one end and a rope at the other end. The struts are lowered into the proper place (usually determined by someone standing at the end of the trench) and then pressurized (commonly referred to as shooting the strut) (Figure 2-3). Once the strut is in place and shot, be sure to lock the locking collar. Ensure that 2 -16d nails are placed in each base plate at least halfway in then bent over this will prevent the strut from dropping should it become loose. The air hose and rope may be removed and used to place the next strut if needed. The pressure exerted by the strut stabilizes the soil preventing further collapse.

Figure 2-3

Struts are placed into the trench in a predetermined order. When using pneumatic shoring place the first strut in the middle of the panel to hold it in place and not kick the panel out. The second strut is placed 2' down from the lip of the trench. Remember that the rescuer should not enter the trench further than waist level to an installed strut. The third strut is placed 2' up from the trench bottom.

The first set of panels should have 3 struts in place (Figure 2-4) until a second set of panels have been secured, creating a protective system. Once the second set of panels is secured, the middle strut on the first panel may be removed provided that the remaining struts are not more than 4' apart. Once a rescuer is in the trench they may shore from top down or bottom up as long as they work from a safe area. This process should be repeated until there are at least 3 panel sets, creating a safe area of at least 12' in width.

Figure 2-4

This allows for the head and chest of a victim to be protected by the initial 4' protection of the sheeting, as well as an additional 4' on either side of the victim, protecting both the rescuer and victim from secondary collapses. Ensure all 3 sets of panels are tight and well pressurized. Ensure that all struts are tight. Re-pressurize or tighten the locking collars by hand if needed. Rescuers should check the shoring when they leave or enter the trench.

- *Timber shoring*

With timber shoring the first strut should be placed 2' down from lip of trench (Figure 2-5). This is because timber shores must be measured, cut and then capped after installation. Rescuers should only work to their waist level at the lip of the trench. Once a strut is in place the rescuer can then move down so their waist is level with the first strut.

Figure 2-5

When placing the timber strut, the rescuer should get a measurement in inches from strongback to strongback (Figure 2-6). If any movement of the panels is expected they should add length to their measurement to ensure they pressurize the strut. A 1' scab should be placed on one strongback for the timber strut to rest on (Figure 2-7). Place one end of the timber strut on the top of the 1' scab and then use a dead blow hammer to pressurize the strut until it is level. Add scabs and/or Johnny caps to keep the strut from moving.

Figure 2-6

Figure 2-7

Use 2x4 or 4x4 wedges as necessary behind the timber strut to pressurize as needed. Repeat the above steps so that the second strut is placed in the middle and the third strut is placed 2' up from toe. The maximum vertical distance between struts is 4 feet. Once a second set of panels has been placed and secured the middle strut in the first panel set may be removed. Once a rescuer is in the trench they may shore from the top down or the bottom up as long as they work from a safe area. This process should be repeated until there are at least 3 panel sets, creating a safe area of at least 12' in width.

Ensure all 3 sets of panels are tight and well pressurized. Ensure that all struts are tight. Pressurize the struts with wedges as needed. Rescuers should check the shoring after additional shoring has been added to ensure that all struts are tight. Rescuers should check the shoring when they leave or enter the trench.

Wales

With the trench safed, a waler system could be constructed and installed. Wales are used to create an open area for the rescuers to work because they allow for the removal of the center struts. Waler systems could be constructed using timber or pneumatic shoring.

Timber shore waler system

The top waler is placed 2 feet below the lip of the trench. Measure down 2' from the lip of the trench and place an inverted 4"x4" wedge onto each strongback. Place a 6"x6" wale along each side of the trench covering each panel (Figure 2-8), this wale will sit on the 4"x4' wedges. Toe nail the wales into place. Measure between the 6"x6" at each strongback at the ends of the protective system and cut a strut to length, place a 2"x6" cathead on the top of the strut so that it extends 5" longer than the strut on each end.

Figure 2-8

Position the strut properly (Figure 2-9) and drive into place using a deadblow hammer. Repeat this process installing the lower wales 2' up from the bottom of the trench. Once the waler system is in place the 4"x4" struts may be removed creating an open area for the rescuers to work.

Figure 2-9

Pneumatic shore waler system

A pneumatic shore waler system is built in the same manner as the timber shore system, the difference being that the timber shores are replaced with the pneumatic shores. Measure between the 6"x6" wales and place pneumatic shores with 6"x6" channel bases into place, and then pressurize them. When the top and bottom waler systems are in place the remaining struts may be removed.

Victim Packaging and Removal

Victim packaging at trench incidents utilizes the same techniques you have been previously taught. There are only a couple of considerations that you should be aware of.

While working to remove a victim from the trench care should be taken to not dislodge any of the shoring materials. This happens often, someone at the scene should be assigned to continuously monitor the shoring.

The placement of your shoring is critical to the effective removal of your victim. Often rescuers place shoring materials too close to the victim making it impossible to remove them. Time should be taken to develop a plan for the removal of the victim taking into consideration: direction of travel, method of removal, and the type of packaging device to be used. The placement of shoring should be done according to this plan. If shoring needs to be moved, it should be done prior to patient packaging.

Figure 2-10

Figure 2-11

Another concern is how the victim is going to be removed from the trench. If the victim is large or the trench is deep a mechanical advantage system may be needed (Figures 2-10 and 2-11). To effectively achieve this, a high point will need to be established such as a ladder gin or a ladder a-frame (Figures 2-12 and 2-13). These skills are taught during the Rescue Technician Basic course and should be reviewed.

Figure 2-12

Figure 2-13

Incident Termination

Termination will begin after all investigative authorities (IE. OSHA, local police, PESH, etc.) have completed their investigations and released the trench. This is generally the most dangerous portion of the incident. It is at this point that the rescuers are tired and the attention to detail is gone. Relief crews may need to be utilized to break down equipment and remove the protective system. Remember the emergency is over so work safely.

The removal of the protective system is done in the reverse order that it was installed. This begins with the removal of the shoring material and ends with the removal of the ladder at the end of the trench. At this point all rescuers should remain clear of the trench.

After all of the equipment has been removed from the trench it will need to be cleaned and placed back into service on the apparatus. This should be done prior to anyone being released. Remember trench incidents can occur at any time so your equipment needs to be ready to respond.

An incident critique and possibly a critical incident stress debriefing should be conducted as soon after the incident as possible. The critique will allow you to evaluate your performance and make changes to your procedures if needed. This will allow for a continuously improving system.

Critical Incident Stress Debriefing (CISD) is the outlet for individuals to defuse after an incident. Not all people react to stress in the same way, everyone's tolerance for critical events is different. If you have a significant event, offer CISD to all personnel who participated in the incident.

Trench Rescue Level Certification
Skill Sheets

Trench Rescue Level 1 Certification

Minimum Requirements. Qualification is specific to a specialty area. For qualification, a rescuer shall perform all of the job performance requirements in NFPA 1006, 2008 edition, Chapter 5 and all job performance requirements listed in at least one level of a specialty area (Chapters 6 through 14). Technical rescuers will be identified by their specialty area and level of certification (i.e. Rope Rescuer- Level I, Confined Space Rescuer- Level II, etc.).

Level I General Requirements. The job performance requirements defined in NFPA 1006, 2008 edition, Chapter 8 section 8.1.1 thru 8.1.7 shall be met prior to Level I certification in trench rescue.

Each job performance requirement shall be performed safely, competently, and in its entirety.

Performance of each requirement shall be in accordance with applicable NFPA standards and OSHA regulations

Job performance requirements do not need to be mastered in the order in which they appear

Trench Rescue Operations
Level I Certification

Size Up

Skill Competency

Name _____ Date _____

Evaluator _____

NFPA 1006, Chapter 8, Section 8.1.1(B) – Conduct a size-up of a collapsed trench

3	2	1	X	Skill
☐	☐	☐	☐	Measure dimensions of trench
☐	☐	☐	☐	Categorize soil
☐	☐	☐	☐	Identify type and degree of collapse
☐	☐	☐	☐	Determine severe environmental conditions with implications for secondary collapse and survivability
☐	☐	☐	☐	Demonstrate interview techniques
☐	☐	☐	☐	Implement protocols and resource acquisition agreements
☐	☐	☐	☐	Implement public works utility notification, response, and location procedures
☐	☐	☐	☐	Perform Risk/Benefit analysis for self rescue, rescue, or recovery mode
☐	☐	☐	☐	Implement an Incident Management System for span of control.
☐	☐	☐	☐	Apply governing regulations, laws, and standards

Competency Rating Scale

3 – Skilled
2 – Moderately Skilled
1 – Unskilled
X – Unassigned (Not Required or Not Performed)

Trench Rescue Operations
Level I Certification

Emergency Action Plan

Skill Competency

Name _____ Date _____

Evaluator _____

NFPA 1006, Chapter 8, Section 8.1.2(B) – Implement a trench emergency action plan

3	2	1	X	Skill
☐	☐	☐	☐	Utilize tactical worksheets
☐	☐	☐	☐	Disseminates information
☐	☐	☐	☐	Understands mechanics and extent of collapse effects
☐	☐	☐	☐	Perform Risk/Benefit analysis
☐	☐	☐	☐	Execute rapid non-entry rescue
☐	☐	☐	☐	Mitigate hazards by isolation, removal, or control
☐	☐	☐	☐	Choose strategy and tactics that enhance successful outcome
☐	☐	☐	☐	Uses IMS and resource staging
☐	☐	☐	☐	Apply choice of isolation and/or protective system promptly to surround victim

Competency Rating Scale

3 – Skilled
2 – Moderately Skilled
1 – Unskilled
X – Unassigned (Not Required or Not Performed)

Trench Rescue Operations
Level I Certification

Support Operations

Skill Competency

Name _____ Date _____

Evaluator _____

NFPA 1006, Chapter 8, Section 8.1.3(B) – Implement support operations at trench emergencies

3	2	1	X	Skill
☐	☐	☐	☐	Track equipment inventory
☐	☐	☐	☐	Provide power
☐	☐	☐	☐	Use lighting
☐	☐	☐	☐	Choose and deploy dewatering techniques
☐	☐	☐	☐	Acquire or construct structures for shelter and thermal protection
☐	☐	☐	☐	Select rehab areas and perform personnel rotations
☐	☐	☐	☐	Operate atmospheric monitoring and ventilation equipment
☐	☐	☐	☐	Perform patient packaging and removal

Competency Rating Scale

3 – Skilled
2 – Moderately Skilled
1 – Unskilled
X – Unassigned (Not Required or Not Performed)

Trench Rescue Operations
Level I Certification
Non-Intersecting Trench

Skill Competency

Name _____ Date _____

Evaluator _____

NFPA 1006, Chapter 8, Section 8.1.4(B) – Support a nonintersecting straight wall trench less than 8' deep

3	2	1	X	Skill
☐	☐	☐	☐	Interpret tabulated data information and tables
☐	☐	☐	☐	Place shoring and shielding systems
☐	☐	☐	☐	Install supplemental shoring
☐	☐	☐	☐	Use protocols
☐	☐	☐	☐	Choose methods to stabilize
☐	☐	☐	☐	Use PPE
☐	☐	☐	☐	Anticipate extrication logistics
☐	☐	☐	☐	Create systems in trenches 8 ft deep

Competency Rating Scale

3 – Skilled
2 – Moderately Skilled
1 – Unskilled
X – Unassigned (Not Required or Not Performed)

Trench Rescue Operations

Level I Certification

Release Victim

Skill Competency

Name _____ Date _____

Evaluator _____

NFPA 1006, Chapter 8, Section 8.1.5(B) – Release a victim from soil entrapment by components of a nonintersecting collapsed trench of 8' or less in depth.

3	2	1	X	Skill
☐	☐	☐	☐	Ability to select, use, and care for PPE
☐	☐	☐	☐	Operate rescue tools and stabilization systems
☐	☐	☐	☐	Identify crush syndrome clinical settings
☐	☐	☐	☐	Complete Risk/Benefit assessments for selected methods of rescue and time restraints

Competency Rating Scale

3 – Skilled
2 – Moderately Skilled
1 – Unskilled
X – Unassigned (Not Required or Not Performed)

Trench Rescue Operations
Level I Certification

Victim Removal

Skill Competency

Name _____ Date _____

Evaluator _____

NFPA 1006, Chapter 8, Section 8.1.6(B) – Remove a Victim from a trench

3	2	1	X	Skill
☐	☐	☐	☐	Ability to select and use PPE
☐	☐	☐	☐	Provide basic medical care and immobilization techniques
☐	☐	☐	☐	Identify need for ALS care and crush syndrome management
☐	☐	☐	☐	Use a removal system that matches logistical and medical management time frame concerns

Competency Rating Scale

3 – Skilled
2 – Moderately Skilled
1 – Unskilled
X – Unassigned (Not Required or Not Performed)

Trench Rescue Operations

Level I Certification

Incident Termination

Skill Competency

Name _____ Date _____

Evaluator _____

NFPA 1006, Chapter 8, Section 8.1.7(B) – Disassemble support systems at a trench emergency incident

3	2	1	X	Skill
☐	☐	☐	☐	Ability to use PPE
☐	☐	☐	☐	Remove equipment and protective systems
☐	☐	☐	☐	Use trench safety protocols
☐	☐	☐	☐	Clean and service equipment
☐	☐	☐	☐	Perform an incident debriefing

Competency Rating Scale

3 – Skilled
2 – Moderately Skilled
1 – Unskilled
X – Unassigned (Not Required or Not Performed)

NYS Division of Homeland Security and Emergency Services

OFFICE OF FIRE PREVENTION & CONTROL

Name: ____________________

Organization: ____________________

FOLD

Please remember to:

Enter into the discussion enthusiastically.
Give freely of your experience.
Keep confidences and assume others will, too.
Confine your discussion to the topic.
Listen alertly and take accurate notes.
Provide constructive feedback.
Appreciate the other person's point of view.
Practice learned skills on the job.
Be prompt and regular in attendance.