



AIR QUALITY PROGRAM SAFETY PLAN

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Air Quality Program

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TO: Air Quality Program Staff
SUBJECT: Safety Plan Endorsement

This Safety Plan is a handbook which describes the type of work Air Quality Program staff conduct, the potential health and safety hazards to which staff may be exposed and the training, personal protective equipment and medical monitoring, and appropriate procedures that staff must have/follow in order to work around those hazards safely.

Management of the Air Quality Program support and direct all program staff to follow the requirements outlines in the Safety Plan and will support decisions made by staff regarding their comfort level should they encounter hazardous situations they feel unsafe handling.

The Safety Plan will be updated annually or more frequently, if necessary, to ensure that it reflects changes that affect the employees.

Mary E. Burg

8/7/03

Mary E. Burg
Program Manager
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Date

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Chapter I.
INTRODUCTION

Purpose of the Safety Plan

This Air Quality Program (AQP) Safety Plan is a supplement to, and should be used in concert with, the Ecology Safety Program Manual. The AQP Safety Plan is intended to:

- Increase safety and hazard awareness on the job.
- Describe the various field and technical work conducted by AQP staff.
- Be a guide to the necessary training or training references for AQP field/technical staff.
- Describe the health and safety hazards to which AQP field/technical staff may be exposed and provide appropriate prevention guidelines.
- Provide a list of the appropriate personal protective equipment for field/technical staff.
- Be an integral part of Ecology accident prevention.

Responsibilities

All AQP staff share a responsibility in helping to maintain a safe and healthy working environment. Effective communication between managers, supervisors and employees is essential to ensure that safety and health information is provided and available to all staff.

Specific safety and health responsibilities follow.

AQP Management Team

The AQP Management Team (Program Manager and Section Managers) will support and encourage participation in all AQP-specific and agency safety and health programs.

Immediate Supervisors

Safety and health of the employees is a primary responsibility of the employee's immediate supervisor. In addition to the supervisor's safety responsibilities outlined in the Ecology Safety Program Manual, the AQP supervisor will:

- Ensure that all field staff is first aid/CPR certified.
- Ensure that staff are properly equipped with appropriate personal protective equipment.
- Require the proper care and use of all needed personal protective equipment.
- Identify and minimize job hazards by implementing the requirements of this safety plan.
- Take immediate and appropriate action when it is known or suspected that proper safety policies and/or procedures are not being followed.
- Ensure that a safety briefing or a review of safety issues is conducted prior to any field project or special field activity.

- Coordinate with the Safety Office to review accident trends and to establish accident prevention measures.
- Ensure that the appropriate AQP staff are familiar with and follow the requirements of the AQP Confined Space Entry Policy.

AQP Staff

In addition to the Ecology staff safety responsibilities outlined in the Ecology Safety Program Manual, AQP staff are responsible for:

- Applying the principles of accident prevention in their day-to-day duties.
- Ensuring that issued personal protective equipment is properly used and maintained.
- Not entering confined spaces as stipulated in the Confined Space Entry Policy of this safety plan.
- Not performing an activity which is known to be or may be unsafe. When in doubt--- Stay out!!!
- Not smoking in state vehicles.
- Being properly attired for the respective task being performed.
- Observing all hazard warnings and no smoking signs.
- Refraining from fighting and horseplay with fellow workers.
- Reviewing the appropriate facility safety procedures with plant personnel before proceeding with inspections or site visits. Plant personnel must be present and take the lead during site visits.
- Reporting any job-related injury, occupational illness or property damage to the supervisor and seeking treatment promptly regardless of the severity. Responsibilities also include completing the appropriate forms and submitting them to the Program Safety Coordinator and the Regional Safety Office.
- Coordinating and cooperating with all other employees in an attempt to eliminate accidents.

Safety Committees

Purpose

To assist the AQP in the detection, prevention, and elimination of unsafe conditions, workplace accidents and hazards.

Procedure

Refer to the Ecology Safety Program Manual (on Ecology's intranet), under Ecology Safety Committees, for how a safety committee is organized and managed.

AQP Program Safety Coordinator

The designated Air Quality Program Safety Coordinator in HQ and in each regional office will represent the AQP on their respective HQ or Regional Safety Committees. In addition, the following documents and forms are available through the AQP Program Safety Coordinator:

- Safety Committee Meeting Minutes
- Report of Employee Personal Injury/Accident (forms)
- Names of the respective Emergency Action Team (consisting of the Program Safety Coordinator, floor monitors, and certified first aid personnel)
- Building Safety Plan

Accident Investigation and Reporting

Refer to the Ecology Safety Program Manual (on Ecology's intranet), under Accident Investigation and Reporting.

Occupational Injury and Illness Recordkeeping

Refer to the Ecology Safety Program Manual (on Ecology's intranet), under Industrial Insurance Claims, Occupational Injury/Illness Recordkeeping.

Safety Bulletin Board

The safety bulletin board is another method to increase employee's awareness of safety and health and to communicate safety information. Refer to the Ecology Safety Program Manual (on Ecology's intranet), for posting requirements, contents and use. Also refer to the Ecology Building Safety Plan (on Ecology's intranet) and Regional Office building safety plans for the exact location of the safety bulletin boards.

First Aid/CPR

- First Aid/CPR Certification
 - 1) All field staff, lab staff and their immediate supervisors will be first aid/CPR certified. Refer to Chapter VII, of this plan; First Aid/CPR: Field Considerations.
 - 2) Employees are responsible for keeping their first aid/CPR certification cards current.
- Refer to the Ecology Safety Program Manual (on Ecology's intranet), First Aid. Also refer to the individual HQ and Regional Office building safety plans for additional first aid information.

Chapter II.

SAFETY TRAINING

- Section 1: Training Objectives
- Section 2: Safety Orientation
- Section 3: Core Safety Training Requirements
- Section 4: Safety Training Summary
- Section 5: Training Records and Tracking System

Section 1: Training Objectives

Proper training is the key to working safely. This chapter was designed:

- To provide an outline of all the appropriate and required training to AQP staff who work in the office and in the field.
- To provide all AQP staff, through training, the skills necessary to understand the hazards, health and safety risks associated with their respective office and field duties.

Section 2: Safety Orientation

Purpose

The purpose of safety orientations is to familiarize new AQP employees with Ecology and AQP safety programs, policies and procedures, as well as general safety rules and guidelines. The orientation includes all Ecology and program-specific safety information appropriate to the new employee's job duties and a safety review or briefing from a manager or supervisor in the respective AQP section or unit. (See the Ecology Safety Program Manual, under Safety Orientation on Ecology's intranet.)

AQP/Agency Requirements

The safety orientation for each new employee will begin on the first day of employment or as soon as possible after the new employee begins work in the program. The employee's immediate supervisor or designee is responsible for conducting a review of the all job safety requirements and the appropriate key elements of the AQP safety plan. Where appropriate, a tour of the typical facilities associated with the employee's job will also be conducted. The immediate supervisor is also responsible to ensure that any new AQP employee either receives or is scheduled to attend a New Employee Safety Orientation in accordance with the Ecology Safety Program Manual. At the HQ building, Employee Safety Orientations are conducted by the Ecology Safety Office. Supervisors at the HQ building should contact Employee Services to schedule employees to attend the next available presentation. In the regions, supervisors should contact the regional safety office to coordinate for an employee safety orientation.

Section 3: Core Safety Training Requirements

- **Job-Specific**: Every new employee must receive an initial job-specific safety orientation from his or her immediate supervisor (or designee) before the employee conducts job activities. This includes any specific hazard communication training associated with the respective job duties.
- **First Aid/CPR**: All field staff, lab staff, and their immediate supervisors must take First Aid and CPR training.
- **Defensive Driving**: Every employee who drives a state vehicle is required to take a Defensive Driving Course. All field staff are required to renew their Defensive Driving every four years. Defensive driving is offered through Ecology CORE Training.
- **Conflict Resolution Training**: Employees who interact with the public and/or who are likely to find themselves in emotionally charged situations, where there is a potential to be physically or verbally accosted, must take Serving Difficult Clients or equivalent training. Serving Difficult Clients is offered through Ecology CORE Training.

NOTE: There are no routine AQP activities that require the use of respirators and, therefore, respirator training for Program staff is not normally required. However, circumstances may arise where facilities being inspected or monitored may require the issuance of "emergency escape devices" to Program staff to be used for evacuation purposed in the event of some type of catastrophic failure of plant equipment or machinery. Under these circumstances, affected staff MUST notify the Agency Respiratory Protection Administrator, Ecology Safety Program (Roger Sesna @ [360] 407-6252) prior to visiting such sites for appropriate guidance.

Section 4: Safety Training Summary

The required health and safety training for AQP staff is summarized in Table 1, below.

Table 1. Required Safety Training		
TRAINING REQUIRED	PROVIDER	ACTIVITIES/STAFF WHICH REQUIRE TRAINING
Job Specific Safety Orientation (See Note 3)	Supervisor or Designee	All staff
First Aid/CPR (See Notes 1 & 3)	CORE Training	All staff & their immediate supervisors involved in the following activities: <ul style="list-style-type: none"> • Inspections • CEMs • Ambient Air Quality Monitoring • Meteorological Monitoring • I/M • Calibration & Repair • Telemetry System Activities • Quality Assurance
Defensive Driving (See Note 1)	CORE Training	All staff who drive state vehicles. Field staff must repeat every 4 years.
General Hazard Communication (HAZCOM) (See Note 1, 2 & 3)	CORE Training (Employee Safety Orientation)	All staff
Specific or expanded on-the-job HAZCOM for field staff who are exposed to, or who work with hazardous substances. Training includes: MSDS information, hazard recognition, permissible exposure limits and respirator considerations applicable to the job. (See Notes 2 & 3)	Supervisor or Designee	Designated staff: This may include supervisors & staff involved in the following activities: <ul style="list-style-type: none"> • Inspections • CEMs • Ambient Air Quality Monitoring • Meteorological Monitoring • I/M • Calibration & Repair • Quality Assurance
Respirator Training and Fit Testing (annual requirement for designated field staff).	Ecology Safety Office	Designated staff and immediate supervisors
Serving Difficult People (2 days) (See Note 1)	CORE Training	All staff
Compressed Gas/Chemical Safety (See Notes 2 & 3)	Supervisor, designated AQP staff or contractor	Designated staff and immediate supervisors engaged in: <ul style="list-style-type: none"> • I/M • Calibration & Repair • Quality Assurance

Table 1. (con't)		
Required Safety Training		
TRAINING REQUIRED	PROVIDER	ACTIVITIES/STAFF WHICH REQUIRE TRAINING
Fall Protection (See Notes 2 & 3)	Supervisor, designated AQP staff or contractor	Designated staff and immediate supervisors engaged in: <ul style="list-style-type: none"> • CEMs • Ambient Air Quality Monitoring • Meteorological Monitoring • Calibration & Repair • Quality Assurance
Electrical Safety Training (See Notes 2 & 3)	Supervisor, designated AQP staff or outside contractor	Designated staff and immediate supervisors engaged in: <p>Inspections</p> <ul style="list-style-type: none"> • CEMs • Ambient Air Quality Monitoring • Meteorological Monitoring • I/M • Calibration & Repair • Quality Assurance
Dealing with Animals and Poisonous Vegetation (See Notes 2 & 3)	Supervisor, designated AQP staff or outside contractor	Field staff and immediate supervisors engaged in: <ul style="list-style-type: none"> • Ambient Air Quality Monitoring • Meteorological Monitoring • Quality Assurance`
Traffic Safety (See Notes 2 & 3)	Supervisor, designated AQP staff or outside contractor	All staff driving state vehicles

NOTES:

1. CORE Training through Employee Services. Check CORE training schedule on the Ecology intranet or call Employee Services Training Office.
2. Consult Chapter IV, Hazard Recognition, of this Safety Plan for the appropriate topic and its application to your section staff.
3. Check on line schedule of L&I free (safety) workshops at the L&I Home Page.

**Staff must receive the required training
before they may conduct the particular activity.**

Section 5: Training Records and Tracking System

Employees are required to submit a training plan including safety training at the time of their annual evaluation.

The Training Section of the Ecology Employee Services Office tracks all safety training. A printout of all training for each employee can be obtained from the Employee Services Office. This information may also be available on the Ecology intranet.

Chapter III.

STAFF ACTIVITIES

- Section 1: Facility Inspections
- Section 2: Ambient Air Monitoring
- Section 3: Meteorological Monitoring
- Section 4: Vehicle Inspection/Maintenance (I/M) Activities
- Section 5: Calibration and Repair
- Section 6: Telemetry System Activities
- Section 7: Work Space Ergonomics
- Section 8: Quality Assurance
- Section 9: Vehicle Operations
- Section 10: Laboratory Activities

Section 1: Facility Inspections

Description of Type of Work

Inspections are used to assess compliance with air regulations or to provide on-site technical assistance. They can serve many goals: to gather data about compliance, to identify violations, to establish the basis for an enforcement action, to be a visible manifestation of regulatory process, or to provide business and/or technical assistance and/or informal consulting.

Field inspections are of four general types:

1) Compliance Inspections

Compliance inspections are a scheduled, but usually unannounced, visit to a wide variety of industrial and commercial sites. An inspection's complexity might vary from a simple visual check of emissions to gathering extensive process data.

2) Complaint Investigations

Complaint investigations are conducted as needed when a complaint is received. Complaints are commonly about offensive odors, visible emissions such as smoke, particle fallout, or releases of substances that harm property or health. Complaints might concern industrial facilities, but inspectors may also visit private residences to gather information or investigate the source of a nuisance.

3) Investigation or reconnaissance Inspections

There are site visits at an industrial or commercial facility for the purpose of educating the agency staff on the operation and emissions coming from a particular emissions source or to determine the nature and type of pollutants being emitted. This is not a compliance or registration inspection.

4) Business Technical Assistance Site Visits

These are done at the request of a business or source. Their purpose is to provide the business or source with technical assistance, advice, and information on how to comply with federal and/or state air quality laws and regulations.

Continuous Emission Monitoring Field Accuracy Testing

The continuous emission monitor system (CEMS) field accuracy test is used to evaluate the quality of data produced by any CEMS that is used to determine compliance with emission standards on a continuous basis. The CEMS may include pollutants (e.g., SO₂ and NO_x), diluent (e.g., O₂) or opacity monitors.

Continuous emission monitoring systems may be categorized into one of three general types:

1) Extractive

Extractive CEMSs typically withdraw a continuous effluent sample stream, condition it to remove particulate matter and some or all of the moisture and deliver this cleaned sample stream to individual gas analyzers for analysis of the various components of interest. The sampling system is in a harsh stack environment. The analyzers for these systems are typically installed in a controlled environment at locations remote from the sampling location where the physical environment is controlled.

2) Point In-Situ

Point in-situ type CEMs are mounted on the stack or duct with a probe projecting into the effluent stream. By eliminating active sampling components, these systems avoid most of the sampling maintenance problems of the extractive CEMS's but still require periodic servicing of in-stack filters. These analyzers may be subject to problems caused by exposure to temperature extremes, vibration, and corrosive atmospheres.

3) Cross-Stack In-Situ

Cross-stack in-situ type CEMSs are stack or duct mounted. They project a measurement beam across the entire effluent stream, thus completely eliminating the sampling system. They employ internal gas cells for daily calibration drift checks.

The monitor is checked (both pollutant and diluent portions) with an audit gas or neutral density filter at two or more points within the span of the instrument. The difference between the actual concentration of the audit gas and the concentration indicated by the monitor is used to assess the accuracy of the CEMS.

Specific Actions and Associated Hazards

The actions, situations, and hazards outlined in Table 2 are typically performed/encountered as part of any inspection. Table 2 also contains references to specific sections of Chapter IV, describing in detail the respective hazards and associated safety requirements.

Table 2 Inspections - Specific Actions and Associated Hazards		
ACTIVITY/SITUATION	POTENTIAL HAZARD(S)	CHAPTER & SECTION REFERENCED FOR DETAILED INFORMATION
A. Prepping for the Job		
Loading Vehicle	<ul style="list-style-type: none"> ▪ Back injury from improper lifting. ▪ Muscle strain from lifting items that are too heavy. ▪ Bodily injury due to dropped equipment/falls. 	Chapter IV, Section 2, Lifting. Chapter IV, Section 3, Working with Gases and Compressed Gas Cylinders.
Preparing/Loading Toxic/Flammable/High Pressure gases/Chemicals	<ul style="list-style-type: none"> ▪ Irritation/damage to eyes, skin or lungs ▪ Trauma from high pressure releases of compressed gas. • Fire and explosion 	Chapter IV, Section 11, Chemical Safety.
B. Getting There		
Driving	<ul style="list-style-type: none"> ▪ Accidents caused by reckless, unsafe driving. ▪ Accidents caused by insufficient experience operating a vehicle. ▪ Driver and/or passengers not properly restrained. 	Chapter IV, Section 3, Working with Gases, Compressed Gas Cylinders and Chemicals. Chapter IV, Section 6, AQP Vehicle Safety & Required Training.
Vehicle Maintenance	<ul style="list-style-type: none"> ▪ Accidents resulting from improper maintenance of vehicle. ▪ Inadequate safety equipment. 	Chapter IV, Section 11, Chemical Safety.
Equipment Restraints	<ul style="list-style-type: none"> ▪ Improperly restrained cargo hitting the driver, passengers or others outside the vehicle. 	
Toxic/Flammable/High Pressure Gases/Chemicals Transport	<ul style="list-style-type: none"> ▪ Trauma caused by high pressure releases from compressed gas cylinders ▪ Improperly restrained gas cylinders hitting the driver, passengers or others outside the vehicle. ▪ Exposure to toxic gases through the skin, eyes or inhalation. ▪ Explosion/fire. ▪ Oxygen deficient atmospheres. 	

Table 2 (con't) Inspections - Specific Actions and Associated Hazards		
ACTIVITY/SITUATION	POTENTIAL HAZARD(S)	CHAPTER & SECTION REFERENCED FOR DETAILED INFORMATION
C. Setting Up at the Job Site		
General Hazards	<ul style="list-style-type: none"> ▪ Injury due to inattention to, or lack of safety instructions from facility staff. 	See Pre-Requisites, at end of this Section.
Moving Around the Site	<ul style="list-style-type: none"> ▪ Improper lifting/carrying techniques. ▪ Improper ladder-climbing techniques. ▪ Slippery rungs caused by mud/rain/ice. ▪ Unrestrained or improperly constructed ladders. ▪ Loss of equilibrium from fear of heights/vertigo. ▪ Debris on stairs. ▪ Poor lighting/visibility. ▪ Non-uniform/excessively high/low/narrow/wide risers on stairs. ▪ Inadequate railings on stairs. ▪ Wet, slippery stairs and ladders. ▪ Insufficient capacity or improper application of hoisting equipment. ▪ Falling or swinging equipment. ▪ Inadequate size safe work area on platforms. ▪ Platform/work area with insufficient weight capacity. ▪ Inadequate rails/enclosure on platforms. ▪ Material falling, dropping, or dripping from overhead ducts or machinery. ▪ Overhead obstructions. ▪ Vehicular traffic. 	<p>Chapter IV, Section 1, Fall Protection.</p> <p>Chapter IV, Section 2, Lifting.</p> <p>Chapter IV, Section 5, Working Around Vehicular Traffic.</p> <p>Chapter IV, Section 8, Working Around Machinery.</p>

Table 2 (con't) Inspections - Specific Actions and Associated Hazards		
ACTIVITY/SITUATION	POTENTIAL HAZARD(S)	CHAPTER & SECTION REFERENCED FOR DETAILED INFORMATION
D. Performing the Task		
Working in Variable or Unpredictable Weather Conditions	<ul style="list-style-type: none"> ▪ Electrocutation from lightning ▪ Falls caused by wind ▪ Heat/cold stress ▪ Frostbite; hypothermia 	Chapter IV, Section 5, Working Around Vehicular Traffic. Chapter IV, Section 7, Exposure to Noise.
Working Around Excessive Noise	<ul style="list-style-type: none"> ▪ Disorientation ▪ Hearing damage 	Chapter IV, Section 8, Working Around Machinery.
Working Around Airborne Contaminants/Objects	<ul style="list-style-type: none"> ▪ Irritation/damage to eyes, skin or lungs ▪ Impact from flying particles from machinery ▪ Bulk piles and hoppers ▪ Positive pressure from sampling ports ▪ Fugitive emissions ▪ Inadequate respiratory protection 	Chapter IV, Section 10, Working with Electricity. Chapter IV, Section 11, Chemical Safety. Chapter V: Medical Monitoring.
Working Around Potential Asphyxiants	<ul style="list-style-type: none"> ▪ Bulk piles or discharging hoppers ▪ Positive pressure behind sampling ports ▪ Fugitive emissions ▪ Invisible plumes ▪ Inadequate respiratory protection 	Chapter VI: Personal Protective Equipment.
Working with Toxic, Flammable and/or High Pressure Gases/Chemicals	<ul style="list-style-type: none"> ▪ Irritation/damage to eyes, skin or lungs ▪ Impact caused by high pressure releases from compressed gas cylinders. ▪ Fire and explosion ▪ Oxygen deficient atmospheres 	Chapter IV, Section 3, Working with Gases and Compressed Gas Cylinders. Chapter IV, Section 4, Working in Confined Spaces.
Working Around Vision Hazards	<ul style="list-style-type: none"> ▪ UV burns caused by watching welding ▪ Impact from flying particles from machinery 	
Working Around High Temperature Equipment and Surfaces	<ul style="list-style-type: none"> ▪ Hot plant equipment and control devices ▪ Hot sampling equipment ▪ Hot surfaces ▪ Hot exhaust gases 	
Working Around Potentially Explosive Areas/substances	<ul style="list-style-type: none"> ▪ Explosions caused by sparks from non-intrinsically safe equipment ▪ Explosions caused by static discharge during sampling ▪ Explosions caused by smoking 	

Table 2 (con't) Inspections - Specific Actions and Associated Hazards		
ACTIVITY/SITUATION	POTENTIAL HAZARD(S)	CHAPTER & SECTION REFERENCED FOR DETAILED INFORMATION
Working Around Electricity	<ul style="list-style-type: none"> ▪ Improperly grounded equipment ▪ High voltage overhead wires 	
Working Around Moving Machinery Parts	<ul style="list-style-type: none"> ▪ Clothing, hair, body parts getting caught in machinery ▪ Flying debris from machinery 	
Working In and Around Confined Areas	<ul style="list-style-type: none"> ▪ Toxic gases or vapors. ▪ Oxygen deficiency. ▪ Combustible/flammable/explosive atmospheres. ▪ Physical Hazards: <ul style="list-style-type: none"> ○ Moving Machinery ○ Insecure footing, tripping, slipping and falling ○ Electrical hazards ○ Corrosive chemicals ○ Rodents/snakes/spiders ○ Poor visibility ○ Standing water ○ Ionizing radiation ○ Temperature extremes ○ Excessive noise ○ Hot surfaces 	
Working Around Asbestos	<ul style="list-style-type: none"> ▪ Emphysema, bronchitis, or cancer due to inhalations of asbestos 	
E. Prepping to Leave the Site	(See Activity A, above)	
F. Getting Back to the Office/Check In	(See Activity B, above)	
G. Cleanup and Lab Work	(See Activity A, above)	

Required Training before Performing Inspections

- Job-Specific Safety Orientation
 - 1) Hazard Communication Right-to-Know/MSDS
 - 2) Hazard recognition/permmissible exposure limits
 - 3) Compressed gas/chemical safety
 - 4) Fall protection
 - 5) Electrical safety
- First Aid/CPR Training (certified & current)
- Defensive Driving
- Respirator Training/Fit testing (where required)
- Serving Difficult Clients - Training

Personal Protective Equipment (PPE)

The PPE which may be required to perform inspections (Compliance/Complaint/Technical Assistance) is listed below. All staff performing inspections are required to have the listed PPE with them. On the job use of each item will be dictated by the job circumstance, facility requirements and the requirements of Chapter 4, Hazard Recognition, of this safety plan. PPE may include:

- Hard Hat
- Hearing Protection (ear muffs or plugs)
- Safety Glasses or Goggles
- Steel-toed Footwear (leather or chemical resistant material)

Medical Monitoring Requirements

This activity may expose staff to vapors and plumes. Medical monitoring (MedMon) is a requirement for all staff that is or may be exposed to hazardous substances at or above regulated exposure limits. MedMon is also recommended for environmental staff that is exposed to concentrations less than the regulated exposure limits. (See Chapter V)

Pre-Requisites

Prior to performing this activity, staff must:

- Review the applicable sections of the AQP Safety Plan.
- Review facility safety requirements.
- Have completed the appropriate safety training (see above).

Section 2: Ambient Air Monitoring (Opacity Certification, Special Project Monitoring, Emergency Event Monitoring)

Description of the Type of Work

Ambient monitoring includes all work done by station operators on a routine basis at air monitoring sites, including special purpose monitoring sites. This work may also include: site installation, quality assurance, and visits from local air pollution agency staff and students from educational institutions. In some cases these sites are located in remote areas.

Ambient air monitoring sites house instrumentation used for measuring meteorological parameters and pollutants including gases and particulate matter. Working at monitoring sites requires special care since a number of these sites are remote and the station operator may be alone.

Quality Assurance requirements mandate that some air pollution monitors be operated in a temperature controlled environment. This requirement has been met by using portable radiant heaters at a number of air monitoring sites. These "hot element" heaters could be a fire hazard and cause injury, loss of life, or damage to the facilities leased from the private sector. All portable heaters should be the electric hot water or oil filled types, which have no exposed high temperature elements.

Staff conducting portable PM-10 and carbon monoxide studies are also exposed to the hazards described in this section. In addition, they are exposed to vehicular traffic. Most carbon monoxide sites are located in high traffic and congestion areas. Parking the vehicle in these congested areas presents a hazard. Sampling from lamps or power poles creates hazards for staff and pedestrians below. Portable PM-10 monitoring staff are also exposed to various types of weather conditions that may be hazardous.

Specific Actions and Associated Hazards

The actions, situations, and hazards outlined in Table 3 are typically performed/encountered as part of Ambient Air Monitoring activities. Table 3 also contains references to specific sections of Chapter IV describing in detail the respective hazards and associated safety requirements.

Table 3 Ambient Air Monitoring - Specific Actions and Associated Hazards		
ACTIVITY/SITUATION	POTENTIAL HAZARD(S)	CHAPTER & SECTION REFERENCED FOR DETAILED INFORMATION
A. Prepping for the Job		
Loading Vehicle	<ul style="list-style-type: none"> ▪ Back injury from improper lifting. ▪ Muscle strain from lifting items that are too heavy. ▪ Bodily injury due to dropped equipment/falls. 	Chapter IV, Section 2, Lifting. Chapter IV, Section 3, Working with Gases, and Compressed Gas Cylinders.
Preparing, Loading Toxic, Flammable, High Pressure Gases/Chemicals	<ul style="list-style-type: none"> ▪ Irritation/damage to eyes, skin or lungs ▪ Trauma from high pressure releases of compressed gas. ▪ Fire and explosion 	Chapter IV, Section 11, Chemical Safety.
B. Getting There		
Driving	<ul style="list-style-type: none"> ▪ Accidents caused by reckless, unsafe driving. ▪ Accidents caused by insufficient experience operating a vehicle. ▪ Driver and/or passengers not properly restrained. 	Chapter IV, Section 3, Working with Gases and Compressed Gas Cylinders. Chapter IV, Section 6, AQP Vehicle Safety & Required Training.
Vehicle Maintenance	<ul style="list-style-type: none"> ▪ Accidents resulting from improper maintenance of vehicle. ▪ Inadequate safety equipment. 	Chapter IV, Section 11, Chemical Safety.
Equipment Restraints	<ul style="list-style-type: none"> ▪ Improperly restrained cargo hitting the driver, passengers or others outside the vehicle. 	
Toxic/Flammable/High Pressure Gases/Chemicals Transport	<ul style="list-style-type: none"> ▪ Trauma caused by high pressure releases from compressed gas cylinders ▪ Improperly restrained gas cylinders hitting the driver, passengers or others outside the vehicle. ▪ Exposure to toxic gases through the skin, eyes or inhalation. ▪ Explosion/fire. ▪ Oxygen deficient atmospheres. 	

Table 3 (con't) Ambient Air Monitoring - Specific Actions and Associated Hazards		
ACTIVITY/SITUATION	POTENTIAL HAZARD(S)	CHAPTER & SECTION REFERENCED FOR DETAILED INFORMATION
C. Setting Up at the Job Site		
General Hazards	<ul style="list-style-type: none"> ▪ Injury due to inattention to, or lack of safety instructions from facility staff. 	Chapter III, Section 1, Pre-Requisites.
Moving Around the Site	<ul style="list-style-type: none"> ▪ Improper lifting/carrying techniques. ▪ Improper ladder-climbing techniques. ▪ Slippery rungs caused by mud/rain/ice. ▪ Unrestrained or improperly constructed ladders. ▪ Loss of equilibrium from fear of heights/vertigo. ▪ Debris on stairs. ▪ Poor lighting/visibility. ▪ Non-uniform/excessively high/low/narrow/wide risers on stairs. ▪ Inadequate railings on stairs. ▪ Wet, slippery stairs and ladders. ▪ Insufficient capacity or improper application of hoisting equipment. ▪ Falling or swinging equipment. ▪ Inadequate size safe work area on platforms. ▪ Platform/work area with insufficient weight capacity. ▪ Inadequate rails/enclosure on platforms. ▪ Material falling, dropping, or dripping from overhead ducts or machinery. ▪ Overhead obstructions. ▪ Vehicular traffic. 	<p>Chapter IV, Section 1, Fall Protection.</p> <p>Chapter IV, Section 2, Lifting.</p> <p>Chapter IV, Section 5, Working Around Vehicular Traffic.</p> <p>Chapter IV, Section 8, Working Around Machinery.</p>

Table 3 (con't) Ambient Air Monitoring - Specific Actions and Associated Hazards		
ACTIVITY/SITUATION	POTENTIAL HAZARD(S)	CHAPTER & SECTION REFERENCED FOR DETAILED INFORMATION
D. Performing the Task		
Working in Variable/Unpredictable Weather Conditions	<ul style="list-style-type: none"> ▪ Electrocutation from lightning ▪ Falls caused by wind ▪ Heat/cold stress ▪ Frostbite; hypothermia 	Chapter IV, Section 5, Working Around Vehicular Traffic. Chapter IV, Section 7, Exposure to Noise.
Working Around Excessive Noise	<ul style="list-style-type: none"> ▪ Disorientation ▪ Hearing damage 	Chapter IV, Section 8, Working Around Machinery.
Working Around Potential Asphyxiants	<ul style="list-style-type: none"> ▪ Bulk piles or discharging hoppers ▪ Positive pressure behind sampling pt ▪ Fugitive emissions ▪ Invisible plumes ▪ Inadequate respiratory protection 	Chapter IV, Section 10, Working With Electricity. Chapter IV, Section 11, Chemical Safety.
Working with Toxic/Flammable/High Pressure Gases/Chemicals	<ul style="list-style-type: none"> ▪ Irritation/damage to eyes, skin/lungs ▪ Impact caused by high pressure releases from compressed gas cylinders. ▪ Fire and explosion ▪ Oxygen deficient atmospheres 	Chapter V: Medical Monitoring Chapter VI: Personal Protective Equipment.
Working Around Vision Hazards	<ul style="list-style-type: none"> ▪ UV burns caused by watching welding ▪ Impact from flying particles from machinery 	Chapter IV, Section 3, Working with Gases and Compressed Gas Cylinders. Chapter IV, Section 4, Working in Confined Spaces.
Working Around High Temperature Equipment and Surfaces	<ul style="list-style-type: none"> ▪ Hot plant equipment and control devices ▪ Hot sampling equipment ▪ Hot surfaces ▪ Hot exhaust gases 	
Working Around Potentially Explosive Areas/substances	<ul style="list-style-type: none"> ▪ Explosions caused by sparks from non-intrinsically safe equipment ▪ Explosions caused by static discharge during sampling ▪ Explosions caused by smoking 	
Working Around Electricity	<ul style="list-style-type: none"> ▪ Improperly grounded equipment ▪ High voltage overhead wires 	
Working Around Heavy Equipment and Machinery	<ul style="list-style-type: none"> ▪ Clothing, hair, body parts getting caught in machinery ▪ Injury from falling or flying objects 	

Table 3 (con't) Ambient Air Monitoring - Specific Actions and Associated Hazards		
ACTIVITY/SITUATION	POTENTIAL HAZARD(S)	CHAPTER & SECTION REFERENCED FOR DETAILED INFORMATION
Working In and Around Confined Areas	<ul style="list-style-type: none"> ▪ Toxic gases or vapors. ▪ Oxygen deficiency. ▪ Combustible/flammable/explosive atmospheres. ▪ Physical Hazards: <ul style="list-style-type: none"> ○ Moving Machinery ○ Insecure footing, tripping, slipping and falling ○ Electrical hazards ○ Corrosive chemicals ○ Rodents/snakes/spiders ○ Poor visibility ○ Standing water ○ Ionizing radiation ○ Temperature extremes ○ Excessive noise ○ Hot surfaces 	
Working Around Animals and Poisonous Vegetation	<ul style="list-style-type: none"> ▪ Injury from another person ▪ Bites and stings from insects and animals ▪ Allergic reactions from insect bites/contact with vegetation 	
E. Prepping to Leave the Site	(See Activity A, above)	
F. Getting Back to the Office/Check In	(See Activity B, above)	
G. Cleanup and Lab Work	(See Activity A, above)	

Required Training before Performing Ambient Station and Special Purpose Monitoring Station Operation

- First Aid/CPR Training (current and certified)
- Defensive Driving (within last 4 years)
- Job Specific Safety Orientation Training:
 - 1) HAZCOM (as necessary and appropriate to the task/job to be performed)
 - 2) Permissible exposure limits (as necessary if exposure is an issue)
 - 3) Hazard recognition
 - 4) Compressed gas/chemical safety
 - 5) Fall Protection
 - 6) Electrical safety
 - 7) Dealing with animals and poisonous vegetation
 - 8) Traffic control
- Respirator Training/Fit testing (as required)
- Serving Difficult Clients Training

Personal Protective Equipment (PPE)

The PPE which may be required to perform ambient air monitoring inspections is listed below. All staff performing monitoring inspections are required to have the listed PPE with them. Use of each item is dependent on the current circumstance, facility requirements and the requirements of Chapter 4, Hazard Recognition, of this safety plan.

- Hard Hat
- Hearing Protection (ear muffs or plugs)
- Safety Glasses or Goggles

Medical Monitoring Requirements

This activity may expose staff to vapors and plumes. Medical monitoring (MedMon) is a requirement for all staff that is or may be exposed to hazardous substances at or above regulated exposure limits (See Chapter V). MedMon is recommended for environmental staff that is exposed to concentrations less than the regulated exposure limits.

Pre-Requisites

Prior to performing this activity, staff must:

- Review the applicable sections of the AQP Safety Plan.
- Review facility safety requirements.
- Have completed the appropriate safety training (see above).

Section 3: Meteorological Monitoring

Description of the Type of Work

Meteorological monitoring sites are operated throughout the state. These sites are used in conjunction with ambient air quality monitoring to evaluate the effects of air pollution on a region, as well as assist in pinpointing sources of pollution. Equipment calibrations and/or audits are performed quarterly to evaluate the performance of the meteorological sensors and make any necessary repairs to ensure compliance with EPA Prevention of Significant Deterioration (PSD) specifications.

Meteorological monitoring instrumentation is typically installed at the top of 10 meter (approx. 30 ft.) towers. However, tower heights can range anywhere from 3 meters to 15 meters. In addition to height variation, towers also differ in instrument accessibility. Currently, all AQP meteorological towers are tilt-over towers that permit instruments to be brought to ground level for removal or servicing. Other types of towers which occasionally may be used accomplish accessibility through a crank mechanism that raises or lowers the individual section vertically similar to an auto jack. Either of these types of towers are relatively safe because they don't require climbing in order to service or install/remove the instruments.

Historically, AQP also utilized towers that were fixed in place and once in place the only way the instrumentation could be accessed was by climbing to the top. This is particularly hazardous because a fall from a 30 foot height can easily be fatal. Under these circumstances, staff needed to take special precautions, use good judgment, and utilize the appropriate fall protection. Fixed-in-place towers will not be used by the AQP.

Specific Actions and Associated Hazards

The actions, situations, and hazards outlined in Table 4 are typically performed or encountered as part of Meteorological Monitoring activities. Table 4 also contains references to specific sections of Chapter IV describing the respective hazards and associated safety requirements.

Table 4 Meteorological Monitoring - Specific Actions and Associated Hazards		
ACTIVITY/SITUATION	POTENTIAL HAZARD(S)	CHAPTER & SECTION REFERENCED FOR DETAILED INFORMATION
A. Prepping for the Job		
Loading Vehicle	<ul style="list-style-type: none"> ▪ Back injury from improper lifting. ▪ Muscle strain from lifting items that are too heavy. ▪ Injury or damage due to dropped equipment or falls. 	Chapter IV, Section 2, Lifting. Chapter IV, Section 3, Working with Gases and Compressed Gas Cylinders.
Preparing/Loading High Pressure Gases	<ul style="list-style-type: none"> ▪ Trauma from high pressure releases of compressed gas. 	
B. Getting There		
Driving	<ul style="list-style-type: none"> ▪ Accidents caused by reckless, unsafe driving. ▪ Accidents caused by insufficient experience operating a vehicle. ▪ Driver and/or passengers not properly restrained. 	Chapter IV, Section 3, Working with Gases and Compressed Gas Cylinders. Chapter IV, Section 6, AQP Vehicle Safety & Required Training.
Vehicle Maintenance	<ul style="list-style-type: none"> ▪ Accidents resulting from improper maintenance of vehicle. ▪ Inadequate safety equipment. 	
Equipment Restraints	<ul style="list-style-type: none"> ▪ Improperly restrained cargo hitting the driver or passengers or causing damage. 	
C. Setting Up at the Job Site		
General Hazards	<ul style="list-style-type: none"> ▪ Injury due to inattention, or unfamiliar with site safety requirements. 	Chapter III, Section 1, Pre-Requisites.
D. Performing the Task		
Working in Variable or Unpredictable Weather Conditions	<ul style="list-style-type: none"> ▪ Electrocutation from lightning ▪ Falls caused by wind ▪ Heat/cold stress ▪ Frostbite; hypothermia ▪ Slips, trips & falls 	Chapter IV, Section 5, Working Around Vehicular Traffic. Chapter IV, Section 7, Exposure to Noise. Chapter IV, Section 8, Working Around Machinery. Chapter IV, Section 10, Working With Electricity. Chapter VI: Personal Protective Equipment.

Table 4 (con't) Meteorological Monitoring - Specific Actions and Associated Hazards		
ACTIVITY/SITUATION	POTENTIAL HAZARD(S)	CHAPTER & SECTION REFERENCED FOR DETAILED INFORMATION
Working with Gases and Chemicals	<ul style="list-style-type: none"> ▪ Irritation/damage to eyes, skin or lungs ▪ Impact caused by high pressure releases from compressed gas cylinders. ▪ Fire and explosion ▪ Oxygen deficient atmospheres 	Chapter IV, Section 3, Working with Gases and Compressed Gas Cylinders. Chapter IV, Section 1, Fall Protection.
Working Around Electricity	<ul style="list-style-type: none"> ▪ Improperly grounded equipment ▪ High voltage overhead wires 	
Working Around Heavy Equipment and Moving Machinery	<ul style="list-style-type: none"> ▪ Propeller or wind speed sensor may cause lacerations or eye damage <ul style="list-style-type: none"> ○ Wind vane impact may cause disorientation and or vertigo ▪ Injury from falling or flying objects ▪ Injury from clothing, hair and body parts getting caught in machinery 	
Working on Ladders, Roofs, Platforms and Climbing Antennas	<ul style="list-style-type: none"> ▪ Electrocution from lightning ▪ Falls 	
Working Around Animals and Poisonous Vegetation	<ul style="list-style-type: none"> ▪ Bites and stings from insects and animals ▪ Allergic reactions from insect bites or contact with vegetation 	
E. Prepping to Leave the Site	(See Activity A, above)	
F. Getting Back to the Office/Check In	(See Activity B, above)	
G. Cleanup and Lab Work	(See Activity A, above)	

Required Training before Performing Meteorological Audits and Calibrations

- First Aid/CPR Training (current and certified)
- Defensive Driving (within last 4 years)
- Job Specific Safety Orientation Training
 - 1) HAZCOM (as necessary and appropriate to the task/job to be performed)
 - 2) Permissible exposure limits (as necessary if exposure is an issue)
 - 3) Hazard recognition
 - 4) Compressed gas
 - 5) Fall Protection
 - 6) Electrical safety
 - 7) Dealing with animals and poisonous vegetation

Required Personal Protective Equipment (PPE)

The PPE which may be required to perform meteorological monitoring are listed below. All staff performing meteorological monitoring inspections are required to have the listed PPE with them. Required use of each item is dependent on the circumstance of the monitoring activity and the requirements of Chapter 4, Hazard Recognition, of this safety plan.

- Hard Hat
- Safety Glasses or Goggles

Medical Monitoring Requirements:

None

Pre-Requisites

Prior to performing this activity, staff must:

- Review the applicable sections of this AQP Safety Plan.
- Be familiar with the site safety requirements.
- Have completed the appropriate safety training (see above).
- Be familiar with the area hospital locations/telephone numbers. (See of the Ecology Safety Program Manual, on line at the Ecology intranet of the Ecology Safety Program Manual, on line at the Ecology intranet.)
- Comply with the appropriate building safety guidelines for use and storage of compressed gas cylinders. (For the Lacey Ecology Building, refer to the Hazardous Materials Management Plan and Chemical Hygiene Plan.)

Section 4: Vehicle Inspection/Maintenance (I/M) Activities

Description of Type of Work

The AQP administers the vehicle exhaust emissions inspection and maintenance program. The main tasks are establishing and monitoring emissions test stations, authorizing and monitoring vehicle emissions systems repair facilities, training and monitoring authorized emission specialists, and refereeing conflicts between vehicle owners, repair shops, test stations, and interpreting the appropriate Washington Administrative Code.

Test Stations

I/M staff maintain a quality assurance inspection schedule of the test stations to ensure that accurate and complete testing is being done. Test stations are typically four-lane or larger, drive-through structures. Each lane is equipped with emissions test equipment, including a dynamometer, and is staffed by an inspector. Unscheduled and informal visits by I/M staff augment the scheduled inspections. I/M staff check and verify the accuracy of each test stations' equipment. Inspectors also observe the lane inspectors while they conduct actual emissions tests.

Repair Shops

I/M staff maintain a schedule of visits to authorized repair shops to ensure compliance with emissions control policies and to check the calibration of the shops' emission analyzers. Repair shops are configured and maintained differently: Staff must be observant and aware of the varying hazards in each shop.

Training Emission Specialists

I/M staff conduct classes throughout the area to train and test vehicle technicians to become authorized emission specialists.

Refereeing Conflicts

I/M staff respond to and try to resolve vehicle owner complaints about their vehicle's failure to meet emissions standards. Vehicle owners may be difficult to deal with. These responses may involve visits to repair shops and test stations.

Office Duties

I/M staff maintain extensive records of their activities, and an extensive library of manuals and diverse literature for distributing to test stations, repair shop managers, and emission specialists.

Compressed Gases Used

I/M staff may use and work around the following compressed gases: See Table 17 for the hazards associated with these compressed gasses.

- Carbon Monoxide (CO) in N₂
- Carbon Dioxide (CO₂)
- Propane (C₃H₈) in N₂

Specific Actions and Associated Hazards

The actions, situations, and hazards outlined in Table 5 are typically performed or encountered as part of I/M activities.

Table 5 Vehicle Inspection/Maintenance (I/M) Activities - Specific Actions and Associated Hazards		
ACTIVITY/SITUATION	POTENTIAL HAZARD(S)	CHAPTER & SECTION REFERENCED FOR DETAILED INFORMATION
A. Prepping for the Job		
Loading Vehicle	<ul style="list-style-type: none"> ▪ Back injury from improper lifting. ▪ Muscle strain from lifting items that are too heavy. ▪ Bodily injury or damage from dropped equipment and falls. 	Chapter IV, Section 2, Lifting.
B. Getting There		
Driving	<ul style="list-style-type: none"> ▪ Accidents caused by reckless, unsafe driving. ▪ Accidents caused by insufficient experience operating a vehicle. ▪ Driver and/or passengers not properly restrained. 	Chapter IV, Section 6, AQP Vehicle Safety & Required Training.
Vehicle Maintenance	<ul style="list-style-type: none"> ▪ Accidents resulting from improper maintenance of vehicle. ▪ Inadequate safety equipment. 	
Equipment Restraints	<ul style="list-style-type: none"> ▪ Improperly restrained cargo hitting the driver or passengers, or causing damage. 	

Table 5 (con't) Vehicle Inspection/Maintenance (I/M) Activities - Specific Actions and Associated Hazards		
ACTIVITY/SITUATION	POTENTIAL HAZARD(S)	CHAPTER & SECTION REFERENCED FOR DETAILED INFORMATION
C. Setting Up at the Job Site		
General Hazards	<ul style="list-style-type: none"> ▪ Injury due to inattention, or being unfamiliar with site safety requirements. 	Chapter III, Section 1, Pre-Requisites.
Moving Around the Site	<ul style="list-style-type: none"> ▪ Improper lifting/carrying techniques. ▪ Vehicular traffic. 	Chapter IV, Section 2, Lifting. Chapter IV, Section 5, Working Around Vehicular Traffic. Chapter IV, Section 8, Working Around Machinery.
D. Performing the Task		
Working in and around the Facility	<ul style="list-style-type: none"> ▪ Physical Hazards: <ul style="list-style-type: none"> ○ Machinery & Dynamic Rotating Components ○ Insecure footing – slips, trips and falls ○ Electrical hazards ○ Standing water ○ Excessive noise 	Chapter IV, Section 5, Working Around Vehicular Traffic. Chapter IV, Section 7, Exposure to Noise. Chapter IV, Section 8, Working Around Machinery.
Working Around Excessive Noise	<ul style="list-style-type: none"> ▪ Disorientation ▪ Hearing loss 	Chapter IV, Section 10, Working With Electricity.
Working Around Eye Hazards	<ul style="list-style-type: none"> ▪ Impact from flying particles from machinery 	Chapter IV, Section 10, Working With Electricity.
Working Around Electricity	<ul style="list-style-type: none"> ▪ Improperly grounded equipment 	Chapter VI: Personal Protective Equipment.
Working Around Dynamic Rotating Components	<ul style="list-style-type: none"> ▪ Clothing, hair, body parts getting caught in machinery ▪ Flying debris from machinery 	
Working with Toxic, or High Pressure Gases	<ul style="list-style-type: none"> ▪ Irritation/damage to eyes, skin or lungs ▪ Impact caused by high pressure releases from compressed gas cylinders. 	Chapter IV, Section 3, Working with Gases and Compressed Gas Cylinders.
E. Prepping to Leave the Site	(See Item A)	
F. Getting Back to the Office/Check In	(See Item B)	
G. Cleanup and Lab Work	(See Item A)	

Required Training before Performing Inspection/Maintenance Activities

- First Aid/CPR Training (current and certified)
- Defensive Driving (within last 4 years)
- Job Specific Safety Orientation Training
 - 1) HAZCOM (as necessary and appropriate to the task/job to be performed)
 - 2) Permissible exposure limits (as necessary if exposure is an issue)
 - 3) Hazard recognition
 - 4) Compressed gas/chemical safety
- Serving Difficult Clients Training

Personal Protective Equipment (PPE)

The PPE which may be required to perform inspection maintenance is listed below. All staff performing I/M are required to have the listed PPE with them. Use of each item is dependent on the current circumstance, facility requirements, and the requirements of Chapter 4, Hazard Recognition, of this safety plan.

- Hearing Protection (ear muffs and plugs)
- Safety Glasses with side-shields or Safety Goggles

Medical Monitoring Requirements

This activity may expose staff to a limited number of hazardous materials and at levels below medical monitoring requirements. (See Chapter V)

Pre-Requisites

Prior to performing this activity, staff must:

- Review the applicable sections of this AQP Safety Plan.
- Be familiar with the facility safety requirements.
- Have completed the appropriate safety training.

Section 5: Calibration and Repair

Description of Type of Work

In order to maintain the required accuracy and precision of ambient air monitoring instrumentation, each device must be periodically inspected, tested, calibrated, and repaired. This work is usually performed under laboratory conditions by trained technicians. Unless absolutely necessary, it should not be attempted by field operators and anyone who is not trained.

Hazards associated with calibration and repair work include, but are not limited to, electrical shock, cuts and abrasions from moving parts, compressed gas cylinders containing toxic/flammable.

Specific Actions and Associated Hazards

The actions, situations, and hazards outlined in Table 6 are typically performed and encountered as part of the calibration and repair activities. Table 6 also contains references to specific sections of Chapter IV describing in detail the respective hazards and associated safety requirements.

Table 6 Calibration and Repair - Specific Actions and Associated Hazards		
ACTIVITY/SITUATION	POTENTIAL HAZARD(S)	CHAPTER & SECTION REFERENCED FOR DETAILED INFORMATION
A. Prepping for the Job		
Loading Vehicle	<ul style="list-style-type: none"> ▪ Back injury from improper lifting. ▪ Muscle strain from lifting items that are too heavy. ▪ Bodily injury or damage from dropped equipment and falls. 	Chapter IV, Section 2, Lifting. Chapter IV, Section 3, Working with Gases and Compressed Gas Cylinders.
Preparing/Loading Toxic, Flammable, High Pressure Gases and Chemicals	<ul style="list-style-type: none"> ▪ Irritation/damage to eyes, skin or lungs ▪ Trauma from high pressure releases of compressed gas. ▪ Fire and explosion 	Chapter IV, Section 11, Chemical Safety.

Table 6 (con't) Calibration and Repair - Specific Actions and Associated Hazards		
ACTIVITY/SITUATION	POTENTIAL HAZARD(S)	CHAPTER & SECTION REFERENCED FOR DETAILED INFORMATION
B. Getting There		
Driving	<ul style="list-style-type: none"> ▪ Accidents caused by reckless, unsafe driving. ▪ Accidents caused by insufficient experience operating a vehicle. ▪ Driver/passengers not properly restrained. 	Chapter IV, Section 3, Working with Gases and Compressed Gas Cylinders. Chapter IV, Section 6, AQP Vehicle Safety & Required Training.
Vehicle Maintenance	<ul style="list-style-type: none"> ▪ Accidents resulting from improper maintenance of vehicle. ▪ Inadequate safety equipment. 	Chapter IV, Section 11, Chemical Safety.
Equipment Restraints	<ul style="list-style-type: none"> ▪ Improperly restrained cargo hitting the driver or passengers, or causing damage. 	
Toxic/Flammable/High Pressure Gases/Chemicals Transport	<ul style="list-style-type: none"> ▪ Trauma caused by high pressure releases from compressed gas cylinders ▪ Injury or damage from improperly restrained gas cylinders. ▪ Exposure to toxic gases. ▪ Explosion/fire. 	
C. Setting Up at the Job Site		
General Hazards	<ul style="list-style-type: none"> ▪ Injury due to inattention to, or not following safety protocols and work practices. 	Chapter III, Section 1, Pre-Requisites.

Table 6 (con't) Calibration and Repair - Specific Actions and Associated Hazards		
ACTIVITY/SITUATION	POTENTIAL HAZARD(S)	CHAPTER & SECTION REFERENCED FOR DETAILED INFORMATION
D. Performing the Task		
Working in Variable, Unpredictable Weather Conditions	<ul style="list-style-type: none"> ▪ Electrocutation from lightning ▪ Falls caused by wind ▪ Heat/cold stress ▪ Frostbite; hypothermia 	Chapter IV, Section 5, Working Around Vehicular Traffic. Chapter IV, Section 7, Exposure to Noise.
Working Around Excessive Noise	<ul style="list-style-type: none"> ▪ Disorientation ▪ Hearing loss 	Chapter IV, Section 10, Working With Electricity. Chapter IV, Section 11, Chemical Safety. Chapter V: Medical Monitoring. Chapter VI: Personal Protective Equipment.
Working with Toxic, Flammable or High Pressure Gases and Chemicals	<ul style="list-style-type: none"> ▪ Irritation/damage to eyes, skin or lungs from toxic gases, vapors or chemicals ▪ Impact caused by high pressure releases from compressed gas cylinders ▪ Fire and explosion ▪ Oxygen deficiency ▪ Combustible/flammable/explosive atmospheres 	Chapter IV, Section 3, Working with Gases and Compressed Gas Cylinders.
Working Around Electricity	<ul style="list-style-type: none"> ▪ Improperly grounded equipment 	

Table 6 (con't) Calibration and Repair - Specific Actions and Associated Hazards		
ACTIVITY/SITUATION	POTENTIAL HAZARD(S)	CHAPTER & SECTION REFERENCED FOR DETAILED INFORMATION
D. Performing the Task (con't)		
Moving Around and working on Site	<ul style="list-style-type: none"> ▪ Improper lifting/carrying techniques. ▪ Improper ladder-climbing techniques. ▪ Slippery rungs caused by mud/rain/ice. ▪ Unrestrained or improperly constructed ladders. ▪ Loss of equilibrium from fear of heights. ▪ Poor lighting/visibility. ▪ Wet, slippery stairs and ladders. ▪ Insufficient load capacity or improper application of hoisting equipment. ▪ Falling or swinging equipment. ▪ Platform/work area with insufficient weight capacity. ▪ Other Physical Hazards: <ul style="list-style-type: none"> ○ Insecure footing, tripping, slipping and falling ○ Electrical hazards ○ Rodents/snakes/spiders ○ Standing water ○ Temperature extremes ○ Excessive noise 	Chapter IV, Section 1, Fall Protection. Chapter IV, Section 2, Lifting.
Working Around Animals and Insects	<ul style="list-style-type: none"> ▪ Bites and stings from insects and animals ▪ Allergic reactions 	
E. Prepping to Leave the Site	(See Item A)	
F. Getting Back to the Office/Check In	(See Item B)	
G. Cleanup and Lab Work	(See Item A)	

Required Training before Performing Calibration and Repair Procedures

- First Aid/CPR Training (current and certified)
- Defensive Driving (within last 4 years)
- Job Specific Safety Orientation Training
 - 1) HAZCOM (as necessary and appropriate to the task/job to be performed)
 - 2) Permissible exposure limits (as necessary if exposure is an issue)
 - 3) Hazard recognition
 - 4) Compressed gas/chemical safety
 - 5) Fall Protection
 - 6) Electrical safety

Personal Protective Equipment (PPE)

The PPE required to perform calibration and repair is listed below. All staff performing calibration and repair is required to have the listed PPE with them. Use of each item is dependent on the activity being conducted, task needs, and the requirements of Chapter 4, Hazard Recognition, of this safety plan.

- Hearing Protection (ear muffs and plugs)
- Safety Glasses or Goggles
- Steel-toed Footwear with chemical resistant material, where appropriate when performing lab work
- Chemically-resistant gloves

Medical Monitoring Requirements

Some calibration and repair activities may expose staff to hazardous materials. However, our HAZCOM training, work practices and safety protocols are designed to reduce these exposures below any regulated limits that require medical monitoring. Medical monitoring is a requirement for Ecology staff that is or may be exposed to hazardous substances at or above the permissible exposure limits on the job. It is recommended for Ecology environmental staff that is exposed to hazardous substances below the permissible exposure limits on the job. (See Chapter V)

Pre-Requisites

Prior to performing this activity, staff must:

- Review the applicable sections of this AQP Safety Plan.
- Be familiar with site safety requirements.
- Comply with the appropriate building safety guidelines for use and storage of hazardous materials. (For the Lacey Ecology Building, refer to the Hazardous Materials Management Plan and Chemical Hygiene Plan.)
- Have completed the appropriate safety training

Section 6: Telemetry System Activities

Telemetry System

The telemetry system consists of computers and data collection nodes. The computers and collection nodes are networked together via leased phone lines which gather ambient air monitoring data from monitors statewide. Telemetry activities are categorized as follows:

Operation

- Data entry and editing — An employee spending long periods of uninterrupted time using a keyboard is at risk of Repetitive Stress Injury.
- Data requests and review — Time spent at computer is usually insufficient to cause Repetitive Stress Injury.
- Programming additions, deletions and changes to network — Time spent at computer is usually insufficient to cause Repetitive Stress Injury.
- System maintenance and backup tapes — Time spent at computer is usually insufficient to cause Repetitive Stress Injury.

Repair or Evaluation of Equipment Failures

Employees are required to resolve data logger, computer peripheral, test equipment and miscellaneous electronic equipment failures. The repair process requires trouble-shooting the defective device with the cover removed and the power applied. This exposes the employee to a potential 120 VAC electric shock.

The use of a soldering iron in repairing electronic equipment presents a hazard for minor burns.

Resolving telemetry software or phone network problems poses no safety hazard.

Installation and Calibration Visits to Monitoring Sites throughout the State

All telemetry monitoring sites are visited several times annually to assure that the data collected is accurate. Data loggers are tested with a voltage standard and are checked for correct programming and operation.

Work will occasionally include the installation of monitoring sites, assisting site operators or assisting Q/A staff with site audits.

Specific Actions and Associated Hazards

The actions, situations, and hazards outlined in Table 7 are typically performed or encountered as part of the telemetry system activities. Table 7 also contains references to specific sections of Chapter IV describing in detail the respective hazards and associated safety requirements.

Table 7 Telemetry System Activities - Specific Actions and Associated Hazards		
ACTIVITY/SITUATION	POTENTIAL HAZARD(S)	CHAPTER & SECTION REFERENCED FOR DETAILED INFORMATION
A. Prepping for the Job		
Loading Vehicle	<ul style="list-style-type: none"> ▪ Back injury from improper lifting. ▪ Muscle strain from lifting items that are too heavy. ▪ Bodily injury due to dropped equipment/falls. 	Chapter IV, Section 2, Lifting.
B. Getting There		
Driving	<ul style="list-style-type: none"> ▪ Accidents caused by reckless, unsafe driving. ▪ Accidents caused by insufficient experience operating a vehicle. ▪ Driver/passengers not properly restrained. 	Chapter IV, Section 6, AQP Vehicle Safety & Required Training.
Vehicle Maintenance	<ul style="list-style-type: none"> ▪ Accidents resulting from improper maintenance of vehicle. ▪ Inadequate safety equipment. 	
Equipment Restraints	<ul style="list-style-type: none"> ▪ Improperly restrained cargo hitting the driver or passengers, or causing damage. 	
C. Setting Up at the Job Site		
General Hazards	<ul style="list-style-type: none"> ▪ Injury due to inattention, or unfamiliar with site safety requirements. 	Chapter III, Section 1, Pre-Requisites.
Moving Around the Site	<ul style="list-style-type: none"> ▪ Improper lifting/carrying techniques. ▪ Improper ladder-climbing techniques. ▪ Slippery rungs caused by mud/rain/ice. ▪ Unrestrained or improperly constructed ladders. ▪ Debris on stairs. ▪ Poor lighting/visibility. ▪ Material falling, dropping, or dripping from overhead ducts or machinery. ▪ Overhead obstructions. ▪ Vehicular traffic. 	Chapter IV, Section 1, Fall Protection. Chapter IV, Section 2, Lifting.

Table 7 Telemetry System Activities - Specific Actions and Associated Hazards		
ACTIVITY/SITUATION	POTENTIAL HAZARD(S)	CHAPTER & SECTION REFERENCED FOR DETAILED INFORMATION
D. Performing the Task		
Working in Variable, Unpredictable Weather Conditions	<ul style="list-style-type: none"> ▪ Electrocution from lightning ▪ Falls caused by wind ▪ Heat/cold stress ▪ Frostbite; hypothermia 	Chapter VI: Personal Protective Equipment.
E. Prepping to Leave the Site	(See Item A)	
F. Getting Back to the Office/Check In	(See Item B)	
G. Cleanup and Lab Work	(See Item A)	

Required Training before Performing Telemetry System Activities

- First Aid/CPR Training (current and certified)
- Defensive Driving (within last 4 years)
- Job Specific Safety Orientation Training
 - 1) HAZCOM (as necessary and appropriate to the task/job to be performed)
 - 2) Permissible exposure limits (as necessary if exposure is an issue)
 - 3) Hazard recognition
 - 4) Electrical safety

Required Personal Protective Equipment (PPE)

The PPE which may be required to perform telemetry system activities are listed below. All staff performing telemetry system activities are required to have the listed PPE with them. Use of each item is dependent on the circumstance surrounding the activity, task needs, and the requirements of Chapter 4, Hazard Recognition, of this safety plan.

- Hearing Protection (ear muffs and plugs)
- Safety Glasses or Goggles
- Appropriate, non-conductive footwear when working with electrical components

Medical Monitoring Requirements

None

Pre-Requisites

Prior to performing this activity, staff must:

- Review the applicable sections of this AQP Safety Plan.
- Be familiar with the site safety requirements.
- Have completed the appropriate safety training.
- Be familiar with the area hospital locations/telephone numbers. (See Appendix C of the Ecology Safety Program Manual, on line at the Ecology intranet.)

Section 7: Work Space Ergonomics

Refer to the Ecology Safety Program Manual (on Ecology's intranet), under Ergonomics.

Section 8: Quality Assurance

Description of Type of Work

The purpose of quality assurance is to ensure that the data being recorded at Ecology's air monitoring sites meets appropriate accuracy and precision standards. Quality Assurance (QA) personnel evaluate quality controls used by the station operators and the data generated by the air monitoring equipment. To perform this job, QA personnel are required to travel by vehicle to air monitoring stations located throughout the state and transport audit equipment, which may include compressed gas cylinders.

For a complete description of the AQP Quality Assurance program, please refer to the latest draft of the Air Monitoring Quality Assurance Plan & Procedures, Publication No. 95-201.

Specific Actions and Associated Hazards

The actions, situations, and hazards outlined in Table 8 are typically performed or encountered as part of the quality assurance activities. Table 8 also contains references to specific sections of Chapter IV describing in detail the respective hazards and associated safety requirements.

Table 8 Quality Assurance - Specific Actions and Associated Hazards		
ACTIVITY/SITUATION	POTENTIAL HAZARD(S)	CHAPTER & SECTION REFERENCED FOR DETAILED INFORMATION
A. Prepping for the Job		
Loading Vehicle	<ul style="list-style-type: none"> ▪ Back injury from improper lifting. ▪ Muscle strain from lifting items that are too heavy. ▪ Bodily injury due to dropped equipment/falls. 	Chapter IV, Section 2, Lifting. Chapter IV, Section 3, Working with Gases and Compressed Gas Cylinders.
Preparing/Loading Toxic, High Pressure Gases	<ul style="list-style-type: none"> ▪ Irritation/damage to eyes, skin or lungs ▪ Trauma from high pressure releases of compressed gas. 	
B. Getting There		
Driving	<ul style="list-style-type: none"> ▪ Accidents caused by reckless, unsafe driving. ▪ Accidents caused by insufficient experience operating a vehicle. ▪ Driver/passengers not properly restrained. 	Chapter IV, Section 3, Working with Gases and Compressed Gas Cylinders. Chapter IV, Section 6, AQP Vehicle Safety & Required Training.

Table 8 (con't) Quality Assurance - Specific Actions and Associated Hazards		
ACTIVITY/SITUATION	POTENTIAL HAZARD(S)	CHAPTER & SECTION REFERENCED FOR DETAILED INFORMATION
B. Getting There (con't)		
Vehicle Maintenance	<ul style="list-style-type: none"> ▪ Accidents resulting from improper maintenance of vehicle. ▪ Inadequate safety equipment. 	
Equipment Restraints	<ul style="list-style-type: none"> ▪ Improperly restrained cargo hitting the driver or passengers, or causing damage. 	
Toxic, High Pressure Gases during Transport	<ul style="list-style-type: none"> ▪ Trauma caused by high pressure releases from compressed gas cylinders ▪ Injury or damage from improperly restrained gas cylinders. ▪ Exposure to toxic gases. 	
C. Setting Up at the Job Site:		
General Hazards	<ul style="list-style-type: none"> ▪ Injury due to inattention, or unfamiliar with site safety requirements. 	Chapter III, Section 1, Pre-Requisites.
Moving Around the Site	<ul style="list-style-type: none"> ▪ Improper lifting/carrying techniques. ▪ Improper ladder-climbing techniques. ▪ Slippery rungs caused by mud/rain/ice. ▪ Unrestrained or improperly constructed ladders. ▪ Loss of equilibrium from fear of heights/vertigo. ▪ Debris on stairs. ▪ Poor lighting/visibility. ▪ Non-uniform/excessively high/low/narrow/wide risers on stairs. ▪ Inadequate railings on stairs. ▪ Wet, slippery stairs and ladders. ▪ Insufficient capacity or improper application of hoisting equipment. ▪ Falling or swinging equipment. ▪ Inadequate size safe work area on platforms. ▪ Platform/work area with insufficient weight capacity. ▪ Inadequate rails/enclosure on platforms. 	Chapter IV, Section 1, Fall Protection. Chapter IV, Section 2, Lifting.

Table 8 (con't) Quality Assurance - Specific Actions and Associated Hazards		
ACTIVITY/SITUATION	POTENTIAL HAZARD(S)	CHAPTER & SECTION REFERENCED FOR DETAILED INFORMATION
D. Performing the Task		
Working in Variable, Unpredictable Weather Conditions	<ul style="list-style-type: none"> ▪ Electrocution from lightning ▪ Falls caused by wind ▪ Heat/cold stress ▪ Frostbite; hypothermia 	Chapter IV, Section 10, Working With Electricity. Chapter VI: Personal Protective Equipment.
Working Around Electricity	<ul style="list-style-type: none"> ▪ Improperly grounded equipment 	
Working with Toxic, High Pressure Gases	<ul style="list-style-type: none"> ▪ Irritation/damage to eyes, skin or lungs ▪ Impact caused by high pressure releases from compressed gas cylinders. 	Chapter IV, Section 3, Working with Gases and Compressed Gas Cylinders.
Working Around Animals and Insects	<ul style="list-style-type: none"> ▪ Bites and stings from insects and animals ▪ Allergic reactions 	
E. Prepping to Leave the Site	(See Item A)	
F. Getting Back to the Office/Check In	(See Item B)	
G. Cleanup and Lab Work	(See Item A)	

Required Training before Performing Quality Assurance Procedures

- First Aid/CPR Training (current and certified)
- Defensive Driving (within last 4 years)
- Job Specific Safety Orientation Training
 - 1) HAZCOM (as necessary and appropriate to the task/job to be performed)
 - 2) Permissible exposure limits (as necessary if exposure is an issue)
 - 3) Hazard recognition
 - 4) Compressed gas/chemical safety
 - 5) Fall Protection
 - 6) Electrical safety
 - 7) Dealing with animals and poisonous vegetation
- Serving Difficult Clients Training

Personal Protective Equipment (PPE)

The PPE which may be required to perform quality assurance activities is listed below. All staff performing quality assurance activities are required to have the listed PPE with them. Use of each item is dependent on the circumstances surrounding the activity, task needs, and the requirements of Chapter 4, Hazard Recognition, of this safety plan.

- Hard Hat
- Hearing Protection (ear muffs and plugs)
- Safety Glasses or Goggles
- Steel-toed footwear

Medical Monitoring Requirements

Some quality assurance activities may expose staff to hazardous materials. However, HAZCOM training, work practices and safety protocols are designed to reduce these exposures below any regulated limits that require medical monitoring. Medical monitoring is a requirement for Ecology staff that is or may be exposed to hazardous substances at or above the permissible exposure limits on the job. It is recommended for Ecology environmental staff that are exposed to hazardous substances below the permissible exposure limits on the job. (See Chapter V)

Pre-Requisites

Prior to performing this activity, staff must:

- Review the applicable sections of this AQP Safety Plan.
- Be familiar with site safety requirements.
- Comply with the appropriate building safety guidelines for use and storage of hazardous materials. (For the Lacey Ecology Building, refer to the Hazardous Materials Management Plan and Chemical Hygiene Plan.)
- Have completed the appropriate safety training

Section 9: Vehicle Operations

Description of Type of Work

Most staff take driving for granted and are comfortable behind the wheel. However, most on-the-job serious injuries and fatalities are caused by vehicle accidents. The greatest risk to Ecology employees is not from exposure to hazardous materials, it is from driving.

Specific Actions and Associated Hazards

The actions, situations, and hazards outlined in Table 9 are typically performed/encountered as part of the vehicle operations. Table 9 also contains references to specific sections of Chapter IV describing in detail the respective hazards and associated safety requirements.

Table 9 Vehicle Operations - Specific Actions and Associated Hazards		
ACTIVITY/SITUATION	POTENTIAL HAZARD(S)	CHAPTER & SECTION REFERENCED FOR DETAILED INFORMATION
A. Getting There		
Driving	<ul style="list-style-type: none"> ▪ Accidents caused by reckless, unsafe driving. ▪ Accidents caused by insufficient experience operating a vehicle. ▪ Driver and passengers not properly restrained. 	Chapter IV, Section 3, Working with Gases and Compressed Gas Cylinders. Chapter IV, Section 6, AQP Vehicle Safety & Required Training.
Vehicle Maintenance	<ul style="list-style-type: none"> ▪ Accidents resulting from improper maintenance of vehicle. ▪ Inadequate safety equipment. 	
Equipment Restraints	<ul style="list-style-type: none"> ▪ Improperly restrained cargo hitting the driver or passengers, or causing damage. 	
B. Getting Back to the Office/Check In	(See Item A)	

Required Training before Driving a Vehicle

- Defensive Driving

Required Safety Equipment in Vehicles

The safety equipment required in the vehicles is listed below. All AQP vehicles are required to have this safety equipment with them. Use of each item is dependent on the circumstance, task needs, and the requirements of Chapter 4, Hazard Recognition, of this safety plan.

- First Aid Kit
- Chains
- Emergency triangle (flares should be removed and disposed)
- Jack
- Spare Tire

In addition, the following are also required in each vehicle:

- Washington State Map
- Report of Personal Injury/Accident (ECY 010-151)
- Vehicle Accident Report (S.F. 137)
- Washington Motor Vehicle Collision Report
- DOT Claims Information brochure

The following is optional but recommended:

- Vehicle Accident Checklist (S.F. 136)

Winter driving may require additional equipment to ensure staff safety. Where appropriate, other items should be considered for addition to the above list of recommended items including, but not limited to: blankets, gloves, food items, and cell phones.

Pre-Requisites

Prior to performing this activity, staff must thoroughly review the applicable sections of this AQP Safety Plan and facility safety requirements, take the appropriate safety training, and appropriate precautions, including knowing area hospital locations/telephone numbers as per Appendix C of the Ecology Safety Program Manual, on line at the Ecology intranet.

Section 10. Laboratory Activities

AQP staff must comply with the appropriate regional or satellite building safety guidelines for use and storage of hazardous materials and for approved lab activities. (For the Lacey Ecology Building, please refer to the Hazardous Materials Management Plan and the Chemical Hygiene Plan.)

Chapter IV.

HAZARDS RECOGNITION FOR STAFF ACTIVITIES

- Section 1: Fall Protection
- Section 2: Lifting
- Section 3: Working with Compressed Gases/Compressed Gas Cylinders and Chemicals
- Section 4: Working in Confined Spaces
- Section 5: Working Around Vehicular Traffic
- Section 6: Vehicle Safety and Required Training
- Section 7: Exposure to Noise
- Section 8: Working Around Machinery
- Section 9: Working Around Fugitive Emissions
- Section 10: Working with Electricity
- Section 11: Chemical Safety
- Section 12: Working Around Animals and Poisonous Vegetation

Section 1: Fall Protection

Description

Working at heights can be very hazardous because of the danger of falling as well as dropping tools and/or equipment that can injure others below. Knowing how to identify at-risk areas and to recognize when fall protection is needed can mean the difference between life and death or injury.

THE ONLY ON-THE-JOB FATALITY ECOLOGY HAS EXPERIENCED WAS FROM A FALL IN AN INDUSTRIAL FACILITY.

To protect staff and promote safe working conditions, the Air Quality Program hereby promulgates the following policy:

THE DEPARTMENT OF ECOLOGY
AIR QUALITY PROGRAM

FALL PROTECTION POLICY

GENERAL: It is the policy of the Air Quality Program that AQP staff will not work at unprotected heights of 10 feet or above without adequate fall protection. Adequate fall protection will consist of a written fall protection work plan (see Appendix C, this safety plan), the appropriate fall arrest or fall restraint measures and safe work practices for the existing hazard(s).

ROOFS: It is the policy of the Air Quality Program that AQP staff will not work on steep roofs (see Selected Definitions) where a fall hazard of 10 feet or more exists.

Regulatory Information

WAC 296-155 - Part C1, FALL ARREST AND FALL RESTRAINT is the state regulation that governs fall protection requirements:

WAC 296-155-24505, Fall Protection Work Plan. The requirements for a work plan and a work plan fill-in form can be found in Appendix C of this plan and in the Ecology Safety Program Manual.

Selected Definitions:

“**Safe surface**” means a horizontal surface intended to be occupied by personnel, which is so protected by a fall protection system that it can be reasonably assured that said occupants will be protected against falls.

“**Fall arrest system**” means the use of multiple, approved safety equipment components such as; body harnesses, lanyards, deceleration devices, drop lines, horizontal and/or vertical lifelines and anchorages, interconnected and rigged as to arrest a free fall. Compliance with anchorage strength requirements specified in the applicable sections of chapter 296-155 WAC, Part C-1 shall constitute approval of the anchorage.

“**Fall protection work plan**” means a written planning document in which the employer identifies all areas on the job site where a fall hazard of 10 feet or greater exists. The plan describes the method or methods of fall protection to be utilized to protect employees, and includes the procedures governing the installation use, inspection, and removal of the fall protection method or methods which are selected by the employer. (See WAC 296-155-24505.)

“**Fall-restraint system**” means an approved device and any necessary components that function together to restrain an employee in such a manner as to prevent that employee from falling to a lower level. When standard guardrails are selected, compliance with applicable sections governing their construction and use shall constitute approval.

“**Positioning device system**” means a body belt or body harness system rigged to allow an employee to be supported on an elevated vertical surface, such as a wall, and work with both hands free while leaning. (This is provided for reference purposes only. It is not intended to be used by the AQP staff as a part of fall protection requirements.)

“**Standard guardrail**” means a horizontal barrier at the perimeter of any surface edge presenting a potential fall hazard constructed to provide a smooth surfaced top rail a distance of not more than 42 inches or less than 36 inches above the walking surface. An intermediate rail shall be installed halfway between the walking surface and the top of the top rail.

“**Restraint line**” means a line from a fixed anchorage or between two anchorages to which an employee is secured in such a way as to prevent the worker from falling to a lower level.

“**Roll out**” means unintentional disengagement of a snap hook caused by the gate being depressed under torque or contact while twisting or turning; a particular concern with single action snap hooks that do not have a locking gatekeeper.

“**Roof**” means the exterior surface on the top of a building. This does not include floors or form work which, because a building has not been completed, temporarily become the top surface of a building.

“Safety monitor system” means a system of fall restraint used in conjunction with a warning line system only, where a competent person as defined by this part, having no additional duties, monitors the proximity of workers to the fall hazard when working between the warning line and the unprotected sides and edges including, the leading edge of a low pitched roof or walking/working surface.

“Steep roof” means a roof having a slope greater than four in 12.

“Unprotected sides and edges” means any side or edge (except at entrances to points of access) of a floor, roof, ramp or runway where there is no wall or guardrail system.

“Lifeline” means a vertical line from a fixed anchorage or between two horizontal anchorages, independent of walking or working surfaces, to which a lanyard or device is secured. Lifeline as referred to in this text is one which is part of a fall protection system used as back-up safety for an elevated worker.

The above apply in any situation where AQP employees are working on platforms, roofs, runways or meteorological towers where the actual work area is 10 feet or more in height. These requirements do not apply to ladders, stairways or ramps, which have specific safety requirements.

General Air Quality Program Fall Protection Safety Requirements

When working on flat or nearly flat elevated surfaces with fall potentials equal to or greater than 10 feet, traditional fall protection measures may not be necessary when:

- The slope of the work surface is such that under no circumstances can staff or tools/equipment slide over an unprotected edge of the work surface.
- The work area is no closer than six feet to the nearest unprotected edge of the working surface.
- Accessing or departing the work area, the AQP staff will not come any closer than six feet to an unprotected edge of the elevated surface.

Under these circumstances, no additional fall protection measures need to be implemented. However, should staff encounter slippery conditions on the roof and/or high wind conditions, the six foot “buffer zone” may not be sufficient to guarantee a safe working environment. Under these conditions, staff should cease or avoid work in the particular location until conditions improve.

At all sites involving work activities on roofs, platforms, runways, meteorological towers or other structures/locations, where an unprotected fall hazard of 10 feet or higher exists, the following shall apply prior to commencing such work:

- Section/Unit supervisors will ensure a written Fall Protection Work Plan is developed for each specific work location where their respective section staff is exposed to this hazard.

For a description of how to develop a fall protection work plan, refer to Appendix C.

- Section/Unit supervisors will ensure that a copy of each specific Fall Protection Work Plan, written for their respective employees, is kept on file as an attachment to Appendix C.
- Section/Unit supervisors will ensure that a copy of the specific Fall Protections Work Plan is a required item for AQP field staff to take to the respective job site.
- Each work plan should be reviewed by the appropriate Regional Safety Office.
- Alternative methods that minimize or eliminate fall hazards shall be utilized to the greatest extent possible. For instance: Remote sample collection by pole or rope; having a facility representative or contractor perform the required task; etc.
- Section/Unit supervisors will ensure that their respective AQP field staff receive the appropriate fall arrest/restraint and equipment training and have the appropriate safety equipment available for use.

Fall Potential Less Than 10 Feet

Staff working on low-pitch surfaces with a fall potential of LESS than 10 feet may do so without a Fall Protection Work Plan or the use of fall restraint or arresting systems. However, AQP staff should observe the following:

- Avoid being on exposed roofs, platforms or runways during storms or high winds.
- Don't work within six feet of the edge of a roof or platform.
- Don't store material or equipment within six feet of the edge of a roof, platform, or runway.
- Don't work on roofs or platforms or use runways covered with snow and/or ice.

LADDERS

Description

Some Air Quality Program field activities require climbing ladders. This sub-section addresses the safety requirements for the proper use of ladders.

Regulatory Requirements

WAC 296-800-290, Portable Ladders: Metal and Wood

Safety Requirements for Staff Use of Portable Ladders

AQP staff are required to comply with the following ladder safety guidelines:

- If a ladder is damaged and suspected to be unsafe don't use it. For wood ladders, make sure there are no weak spots such as knots, pitch or bark pockets or cracks. Pay special attention to rotted or warped areas. For metal ladders, make sure they are not rusted or corroded or have sharp edges or burrs which can hurt hands.

- If there is danger of the ladder moving, station someone to hold it or fasten it in place – use warning signs or barricades where there is danger of the ladder being struck by vehicles or other equipment.
- Set the ladder at a safe working angle - recommended angle is 1 ft. out for every 4 feet up.
- Face the ladder when going up or down and keep both hands free to hold onto the ladder.
- **Always follow the three-point rule:** Always maintain contact the ladder with either two feet and one hand or two hands and one foot when climbing or descending and grasp rungs, not the side rails, with your hands.
- When using a step ladder, make sure the ladder is fully opened and locked.
- Be sure to leave three to three and one half feet of ladder extending above the landing onto which you intend to step.
- Carry tools in suitable pockets, not in your hands as you climb or descend; or have tools and all other articles hoisted with line and bucket.
- Dry off hands and feet before climbing.
- Get down to move the ladder.
- Step ladders should only be used on firm and level surfaces to reduce the danger of tipping.
- Extension ladder sections should overlap enough to prevent buckling.
- Keep rungs free of slippery materials such as oil, grease and/or water.
- All bearings, locks, wheels and pulleys on the ladder should be lubricated frequently.
- All hardware and fittings should be securely attached. Moveable parts should operate without catching or wobbling. The joints between steps and the side rail should be tight.
- Never use the tray on a step ladder as a step.
- Never slide down a ladder.

Fixed Ladders fall under WAC 296-155-280 and are the responsibility of the building owner or facility operator. The following information is provided for your information only.

- Fixed ladders shall be provided with cages, wells, ladder safety devices, or self-retracting lifelines where the length of climb is less than 24 feet, but the top of the ladder is at a distance greater than 24 feet above lower levels.
- The step-across distance from the ladder to the structure must not be more than twelve inches unless a platform is provided.
- Where the total length of a climb equals or exceeds 24 feet (7.3 m), fixed ladders shall be equipped with one of the following:
 - 1) Ladder safety devices; or
 - 2) Self-retracting lifelines, & rest platforms at intervals not to exceed 150 ft. (45.7 m); or
 - 3) A cage or well, and multiple ladder sections, each ladder section not to exceed 50 feet in length. Ladder sections shall be offset from adjacent sections, and landing platforms shall be provided at maximum intervals of 50 feet.

* A ladder safety device is any device, other than a cage or well, designed to eliminate or reduce the possibility of accidental falls and which may incorporate such features as life belts, friction brakes, and sliding attachments.

Section 2: Lifting

Description of Activity

Proper lifting techniques are key factors in avoiding one of the most common work-related injuries - back injuries. In the workplace, back injury prevention is enhanced by not exceeding your physical limitations, by following appropriate lifting techniques and by using available mechanical aids for moving, carrying, pushing or pulling loads

Essential Job Functions

When an AQP employee is required to lift, carry, push or pull a load as a normal part of his/her work duties, then it must be so stated in the employee's essential job functions. *Example: Required to lift, carry and/or manipulate weights up to 50 pounds.*

- Jobs that require lifting, carrying, pushing or pulling duties/tasks must be made known to the employee at the time of recruitment, initial employment or reassignment to a new job.
- Where there are available mechanical aids/devices for lifting, carrying, pushing or pulling, the employee must be given the appropriate training on how to properly use these devices.

Ergonomic Guidelines for Lifting (WISHA)

Where heavy, frequent or awkward lifting tasks are part of the employee's job duties, the Ecology Safety Office should be notified as soon as possible to help evaluate the lifting task(s). Lifting guidelines are provided in the Appendices of the WISHA Ergonomic Rule (WAC 266-62-051, Ergonomics), and there is also an on-line lifting calculator for analyzing lifting operations. The Safety Office can assist in evaluating whether the required lifting tasks fall outside of the requirements of the Ergonomic Rule or will require further analysis in accordance with the rule. (See the Lifting Safety section of the Ecology Safety Program Manual general information about lifting safely.)

Section 3: Working With Compressed Gases/Compressed Gas Cylinders and Chemicals

Description

Air Quality Program field activities use a variety of compressed gases. These compressed gases are managed by the AQP staff at Headquarters and in each of the regional or satellite offices around the state. Information regarding these materials is provided in the respective Headquarters, Region and Satellite office building safety guidelines.

NOTE:

1. For the Lacey Ecology Headquarters Building, refer to the Hazardous Materials Management Plan and Chemical Hygiene Plan.
2. General information regarding use of hazardous materials and information on how to use and understand a Material Safety Data Sheet (MSDS) can be found in the Ecology Safety Program Manual under Right-To-Know/Hazard Communication, and is presented during the initial New Employee Safety Orientation. (See Chapter II)

Information related to a hypothetical release of Carbon Monoxide during transport and compressed gas hazards is provided in Appendix B of this safety plan in the form of:

- Formulas for determining potential, worse case scenarios and exposure levels in vehicles in the event of a release (real-life examples of the calculations) and the Chlorine/Ammonia Work Practices. This information was provided by an Industrial Hygienist with the Department of Labor and Industries.
- Tables summarizing the hazards related to the specific compressed gases used by/for each of the activities conducted by AQP staff (Facility Inspections, CEMs, Ambient Air Monitoring, Meteorological Monitoring, I/M, Calibration and Repair, Telemetry System Activities, and Quality Assurance, respectively).

Management of Compressed Gases

The Compressed Gas Association, Inc. classifies compressed gases into six categories: inert, non-flammable, flammable, poisonous/toxic, corrosive and oxidizing gases (see glossary for definitions/examples). AQP personnel manage compressed gases that fall into four of those categories: inert, non-flammable, flammable and poisonous/toxic gases.

AQP staff may work with carbon monoxide and sulfur dioxide at high concentrations that could cause serious acute health effects and possibly be lethal. In addition, staff may work with potentially explosive gases (oxygen and hydrogen). Staff working with these gases and any other compressed gases must comply with the safety procedures outlined in the policy below.

Regulatory Requirements

The State of Washington Department of Labor & Industries (L&I), Department of Transportation (DOT), State Building Codes Advisory Council and Local Fire Departments have hazardous materials management requirements with which AQP staff must comply.

The following policy provides a management strategy that is in compliance with the requirements of these regulatory authorities.

THE DEPARTMENT OF ECOLOGY
AIR QUALITY PROGRAM

**Policy for Management of
Compressed Gases and Compressed Gas Cylinders**

Air Quality Program (AQP) staff manage gas cylinders containing four categories of pressurized gases: compressed air; non-flammable toxic gases; flammable toxic gases; and combustible gases.

Appendix B (this safety plan) includes a table for each of the AQP activities that use compressed gases (Facility Compliance Inspections, CEMs, Ambient Air Quality Compliance Monitoring, Meteorological Monitoring, I/M, Calibration and Repair, Telemetry, and Quality Assurance). Each table summarizes the pressure, weight, concentration, explosive limits and hazards for each of the gases used respectively.

Air Quality Program staff are not allowed to work in environments that exceed the exposure limits outlined in WAC 296-62-075, "Part H, Air Contaminants" without the appropriate personal protective equipment.

The requirements for safe management of the compressed gases during transport, use and storage are outlined below:

General

- Avoid dragging, rolling or sliding compressed gas cylinders. Use a suitable hand cart (equipped with a restraint).
- A Material Safety Data Sheet (MSDS) for each compressed gas must be accessible at all times.
- Keep compressed gas cylinders away from sources of heat, flames or sparks.

Transport of Cylinders

Staff will limit the quantity of gas being transported to no more than 1,000 pounds of any one gas at a time (quantities over 1,000 pounds gross weight are subject to DOT placard requirements).

The following applies to the transport of all cylinders:

- Cylinders may be transported up to the maximum capacity of the vehicle's compressed gas cylinder restraint configuration.
- Each cylinder must be independently restrained during transport.
- Cylinders must be restrained either vertically or horizontally during transport. The restraints must be bolted or welded to the vehicle to prevent the cylinder from moving in the event of a sudden stop or a collision. Only an approved restraint system such as that illustrated in Appendix B (this safety plan) for vertical and for horizontal transport or some other restraint system approved in writing is to be used. ***Seat belts may not be used to restrain cylinders.***
- Cylinders must be transported with caps in place. Under no circumstances are cylinders to be transported with regulators attached.
- A Material Safety Data Sheet (MSDS) must be carried in the vehicle for each of the gases being transported.

In addition to the above general requirements the following procedures are to be followed during the transport of poisonous/toxic and or flammable gasses:

- Except when the vehicle or driver is equipped with an appropriate real-time exposure monitor with alarm specific to the gas being transported, toxic gases must be transported in a compartment separate from the passenger/driver compartment (bed vs. cab of a truck). This is to prevent the potential of the driver or occupants being exposed during transport because of a leak or release of the gas into the passenger compartment. Refer to the hazards related to the respective compressed gases used during each AQP activity in Appendix B (this safety plan).
- Flammable/combustible gases may not be transported in the vehicle's passenger/driver compartment. These gases must be transported in a separate compartment from the passenger compartment.

Use of Cylinders

The following applies to the use of all cylinders:

- Cylinders must be restrained during use (either vertically or horizontally). The restraint must prevent the cylinder(s) from falling or rolling.
- Cylinders must be equipped with a pressure reducing regulator when connecting to a low pressure piping systems.

In addition to the above general requirements the following procedures are to be followed during the use of toxic, flammable, or combustible gases:

- When staff are working with a compressed gas that may potentially release into the work environment and exceed the PEL or generate an oxygen deficient environment there must be an appropriate real-time exposure monitor with an alarm in use.
- Adequate ventilation must be provided to prevent users and others in the work area from unhealthy exposure during use and in the event of a leak.

Storage of Cylinders

The following applies to the storage of all cylinders:

- Cylinders must be restrained during storage (either vertically or horizontally). The restraint must prevent the cylinder(s) from falling.
- Restraints must be configured so that no more than one cylinder must be moved to remove a second cylinder.
- Cylinders must be stored with caps in place. Under no circumstances are cylinders to be stored with regulators attached.

In addition to the above general requirements the following procedures are to be followed during the storage of toxic, flammable/combustible gases.

- Adequate ventilation must be provided in the storage area to prevent accidental accumulation of unhealthy concentrations.
- Combustible gas cylinders must be stored in a dry, cool and well ventilated area.

**Never assume that someone else is taking care of you!
Be aware and lookout for real or potential hazards.**

Section 4: Working in Confined Spaces

Description

Working in confined spaces can be very dangerous. Knowing how to identify confined spaces and the hazards they present can sometimes mean the difference between life and death. Because of the inherent risks/dangers of confined space entry and, in an effort to protect its staff, the Air Quality Program hereby promulgates the following policy:

THE DEPARTMENT OF ECOLOGY
AIR QUALITY PROGRAM

Confined Space Policy

Air Quality Program staff may not, under any circumstances, enter a known Permit-Required Confined Space, or any other location that meets the definition of a Permit-Required Confined Space. Staff will make maximum use of alternative methods for completing work tasks in these areas, such as remote sample collection by pole or rope or having a facility representative or a contractor perform the required task.

AQP staff may not enter a confined space unless the facility, owner or operator has documentation that designates the confined space to be a non-permitted confined space.

AQP staff that must enter a non-permitted restricted or confining space may do so only after evaluation of the situation and the known hazards. In some cases, it may be prudent to request or conduct air monitoring or other preventive actions prior to entry.

Definition of a Confined Space

WAC 296-62-14501 defines a confined space as any space that:

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

Five Types of Confined Spaces

The confined space definition is quite broad and covers some very obvious situations and some not so obvious ones. Generally, there are three types of locations that need to be considered in any discussion of confined spaces:

- (a) Permit-Required Confined Space (permit space): **Because of the inherent dangers, AQP staff are forbidden to work in or access Permit-Required Confined Spaces.**

The WAC defines a Permit-Required Confined Space as confined space that has one or more of the following characteristics:

- (1) Contains or has a potential to contain a hazardous atmosphere;
- (2) Contains a material that has the potential for engulfing an entrant;
- (3) Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or
- (4) Contains any other recognized serious safety or health hazard.

The most dangerous aspects of Permit-Required Confined Spaces are the potentials to maintain a low oxygen atmosphere and/or to accumulate toxic, hazardous or explosive gasses. These situations could prove injurious or fatal to anyone entering the confined space. Consequently, Permit-Required Confined Space entry/work is governed by strict training and entry requirements designed to reduce these dangers.

Examples of Permit-Required Confined Spaces include:

- Boilers
- Digesters
- Ditches
- Holds of ships
- Machinery housing
- Manholes
- Pipelines
- Pits
- Sewers and Sewer Accesses
- Silos
- Storage tanks
- Trenches more than four feet deep
- Truck and railroad tank cars
- Underground
- Wells

Some examples of specific Permit-Required Confined Spaces that AQP employees may encounter include:

- Interior of any control device such as a bag house, electrostatic precipitator or scrubber dewatering tank
- Interior of Boilers
- Petroleum storage tanks
- Process vessels
- Reaction vessels
- Rotary kilns
- Underground utility vaults
- Vapor degreasers
- Ventilation and exhaust ducts

- b) Non-permit Confined Space: The WAC defines a Non-permit Confined Space as confined space that does not contain any physical hazards or any actual or potential atmospheric hazards capable of causing death or serious physical harm.

However, in these cases, the confined space is assumed to be a permit-required space unless it has been documented by the employer, facility, owner or operator to be a non-permit confined space under the following conditions and procedures.

- 1) If the confined space poses no actual or potential atmospheric hazards.
- 2) If the confined space has no other recognized health or safety hazards including engulfment in solid or liquid material, electrical shock, or moving parts.
- 3) If all hazards within the confined space are eliminated without entry into the space, the confined space may be classified as a non-permit confined space for as long as the hazards remain eliminated.
- 4) If it is necessary to enter the confined space to eliminate hazards, it must be assumed to be a permit space and such entry must be performed under a permit-required confined space program.

- c) Restricted or Confining Spaces are not regulated or defined by the WAC.

AQP staff may also encounter spaces that may not strictly fit the definition of a confined space, yet present similar characteristics. For example, recovery furnace buildings often contain rooms clearly designed for human occupancy. However, these same rooms may also contain physical obstructions to air flow, i.e., walls, tanks, etc. as well as exposed pipes carrying various gasses. Should a pipe leak occur, this could result in gas accumulations exacerbated by poor air circulation and/or oxygen deprivation similar to what can occur in a Permit-Required Confined Space.

Because of this danger, AQP staff must take appropriate precautions including appropriate hazard recognition training and following appropriate entry procedures including atmospheric testing.

Restricted/Confining Space Entry Procedures

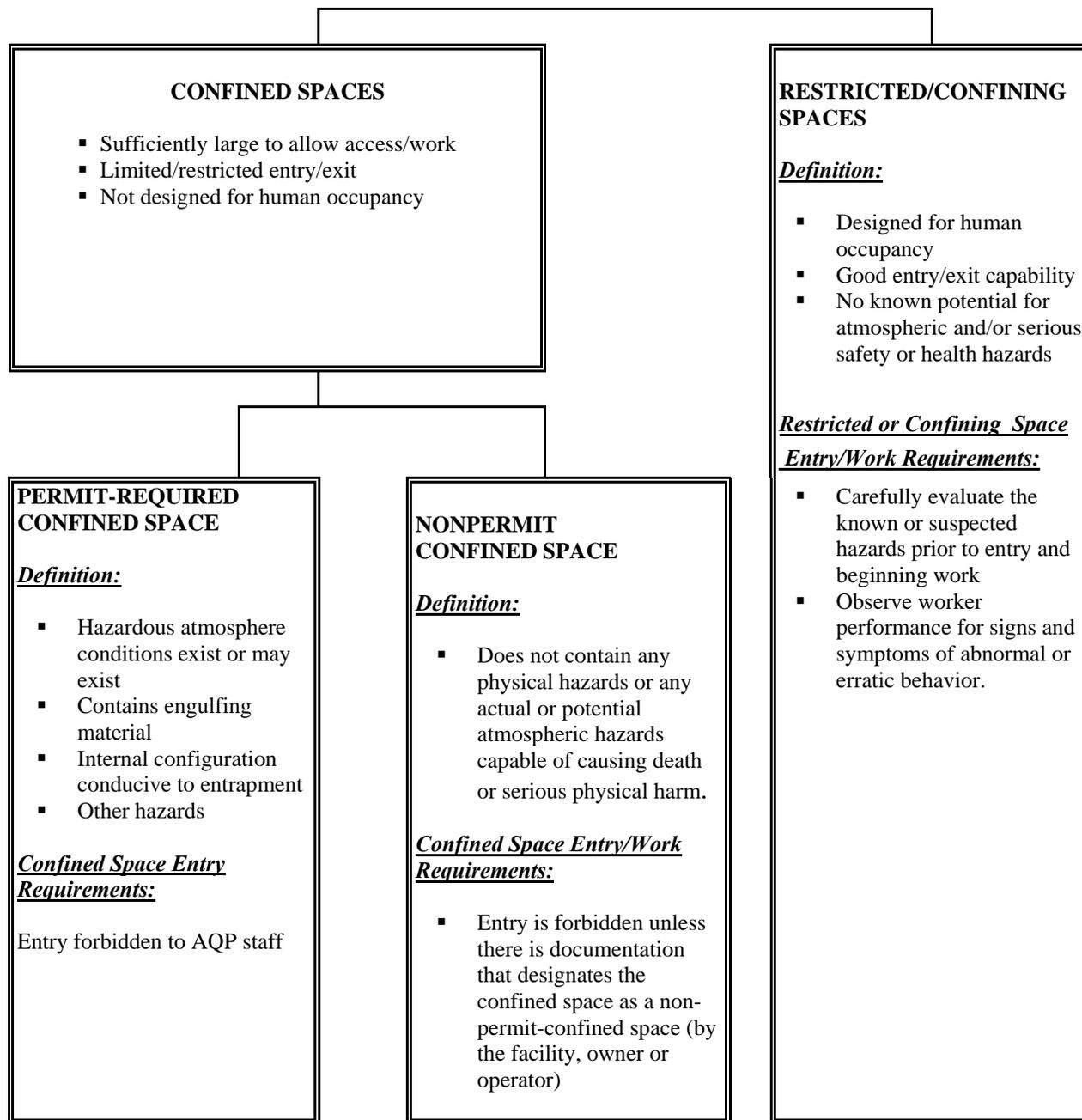
In restricted or confining spaces, AQP staff must take prudent precautions to safeguard against exposure to unnecessary health and safety hazards:

- Carefully evaluate the known or suspected hazards prior to entry and beginning work in the space.
- If you have doubts about the space, request that the facility owner or operator test the atmosphere or ventilate the space prior to beginning work.
- Where there are no obvious odors or other atmospheric hazards within the space, and where there are indications that the percent of oxygen in air is greater than 19.5%, but less than 20.8%, then question the facility, owner or operator about what might be displacing or depleting the oxygen.

NOTE: If, at any time, during the performance of work in restricted, confining or non-permit confined spaces, staff begin to feel faint, dizzy, different or strange, then evacuate the location immediately and move to an area with fresh air.

An outline of Confined/Restricted Space delineation and entry/work requirements is summarized on the following page.

CONFINED/RESTRICTED SPACE DELINEATION AND ENTRY/WORK REQUIREMENTS



Section 5: Working Around Vehicular Traffic

Description

Air Quality Program activities are sometimes carried on close to vehicular traffic. For example, CO saturation studies often require the placement of portable CO sampling equipment on telephone poles along streets and roads.

In addition to road traffic hazards, staff may also be exposed to dangers from vehicles that are encountered on-site at facilities while performing site visits or inspections. Such vehicles could include fork lifts, front end loaders, and various types of maintenance vehicles.

On-Site Traffic

Exposure to on-site traffic can occur when AQP staff are engaged in on-site activities such as CEM audits, technical assistance site visits, etc. Vehicles encountered may range from cars in parking lots, to hauling equipment, to various types of maintenance vehicles.

Many types of mobile heavy equipment that operate within the confines of a plant or facility are required to display external, rotating amber light(s) during operation and to have an audio alarm which sounds when the vehicle is backing up. It is important to remember that it is often difficult for the operators of heavy equipment to see or hear others. Therefore, AQP staff must stay alert when moving around any facility. The best prevention is to anticipate and/or avoid situations where contact with moving vehicles is possible.

Street Traffic

Exposure to street traffic is extremely dangerous, as evidenced by the numbers of fatalities sustained by flaggers and construction workers each year, and is to be avoided wherever possible. If exposure to traffic cannot be avoided, state and federal regulations require certain precautions and procedures be followed regarding time on scene, traffic safety devices (signs, barriers, barricades, etc.), position of vehicles/equipment, and safety clothing. These traffic safety requirements vary, depending on whether the work is being done in the roadway, on the shoulder of the roadway, or beyond the shoulder of the roadway.

IMPORTANT NOTE: AQP vehicles are not generally equipped with the appropriate traffic safety devices (cones and signs) to adequately set up a work area along side a roadway. Therefore, roadside work situations that might require the use of traffic safety devices must have the approval of the respective AQP supervisor prior to conducting the activity.

Roadside Safety

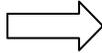
The following procedures are to be followed when roadside activity is necessary:

- Safety Briefing: Identify/discuss the hazards before conducting roadside activities
- Park vehicles as far off the roadway as possible (i.e., Clear Zone, see schematic) or in a safe place (parking lot, turnout, etc.).
- When moving about or standing outside the vehicle, wear a hardhat and high visibility clothing to give increase visibility.
- If the traffic side of the vehicle is within five feet of the fog line, access the vehicle on the side away from traffic.
- Turn on the vehicle emergency flashers.
- If equipped, turn on any overhead fixed amber caution lights or place the portable amber caution light on the top of the AQP vehicle.
- When at a facility, stay alert for moving traffic. Staff should always make sure that vehicle operators can see them - avoid blind spots in front of or behind moving vehicles.

AIR QUALITY TRAFFIC SAFETY MATRIX

*****IMPORTANT - READ FIRST*****

1. **CLEAR ZONE: A vehicle parked 8' or more outside of the fog line is in a CLEAR ZONE and no traffic control devices are required. Turn on flasher and beacon/amber light (see fig 1).**
2. An AQ vehicle that is parked on the shoulder (without encroachment) for the sole purpose of loading/off loading does not require a shoulder closure. However, do not to stage the vehicle to perform continuous work to/from the vehicle and the work area, otherwise more stringent controls apply.
3. Reflective Traffic Vest are required by DOT for roadside activities. However, AQ situations may warrant not wearing a vest; use good judgment.
4. **ENCROACHMENT:** It is considered encroachment
 - a. When any part of the AQ vehicle or the work activity extends into the lane of travel (inside the fog line).
 - b. When traffic cones are placed within 10 feet of the center line on a low speed road (greater than 35mph).
 - c. When any part of the vehicle, cones or work activities are set up inside the fog line on a high speed road (greater than 40mph).
5. **If the AQ vehicle is parked with encroachment, then you may not proceed with work activities until the AQ vehicle is moved.**
6. **If the AQ work area or equipment encroaches into the traffic lane, then you may not proceed with work activities.**

<p><i><u>If this applies</u></i></p>  <p><i><u>These may be</u></i></p> <p>↓ <i><u>Required</u></i> ↓</p>	<p>If AQ vehicle is</p> <p>parked in the</p> <p>CLEAR ZONE</p> <p>no time</p> <p>limits apply</p>	<p>If AQ vehicle is</p> <p>parked on</p> <p>shoulder</p> <p>of road for less</p> <p>than 15 minutes</p>	<p>If AQ vehicle</p> <p>is parked</p> <p>On shoulder of</p> <p>road for</p> <p>greater than 15</p> <p>minutes</p> <p>but less than</p> <p>an 1 hour</p>	<p>AQ vehicle</p> <p>may not</p> <p>park along side</p> <p>of road</p> <p>for greater</p> <p>than 1 hour</p> <p>unless in Clear</p> <p>Zone</p>	<p>If vehicle</p> <p>encroaches</p> <p>or a lane</p> <p>closure is</p> <p>required, park</p> <p>AQ vehicle</p> <p>in a safe location</p>
<p>AQ Vehicle, with</p> <p>Emergency Flashers</p> <p>amber beacon on:</p> <p>Road Work</p> <p>Ahead Sign</p> <p>Cones</p>	<p>Required</p> <p>Not Required</p> <p>Not Required</p>	<p>Required</p> <p>No required</p> <p>Not required</p>	<p>Required</p> <p>Required</p> <p>Required</p>	<p>Required</p> <p>Additional signs</p> <p>are required</p> <p>Additional</p> <p>cones are</p> <p>Required</p>	<p>Required</p> <p>Additional signs</p> <p>are required</p> <p>Additional</p> <p>cones are</p> <p>Required</p>

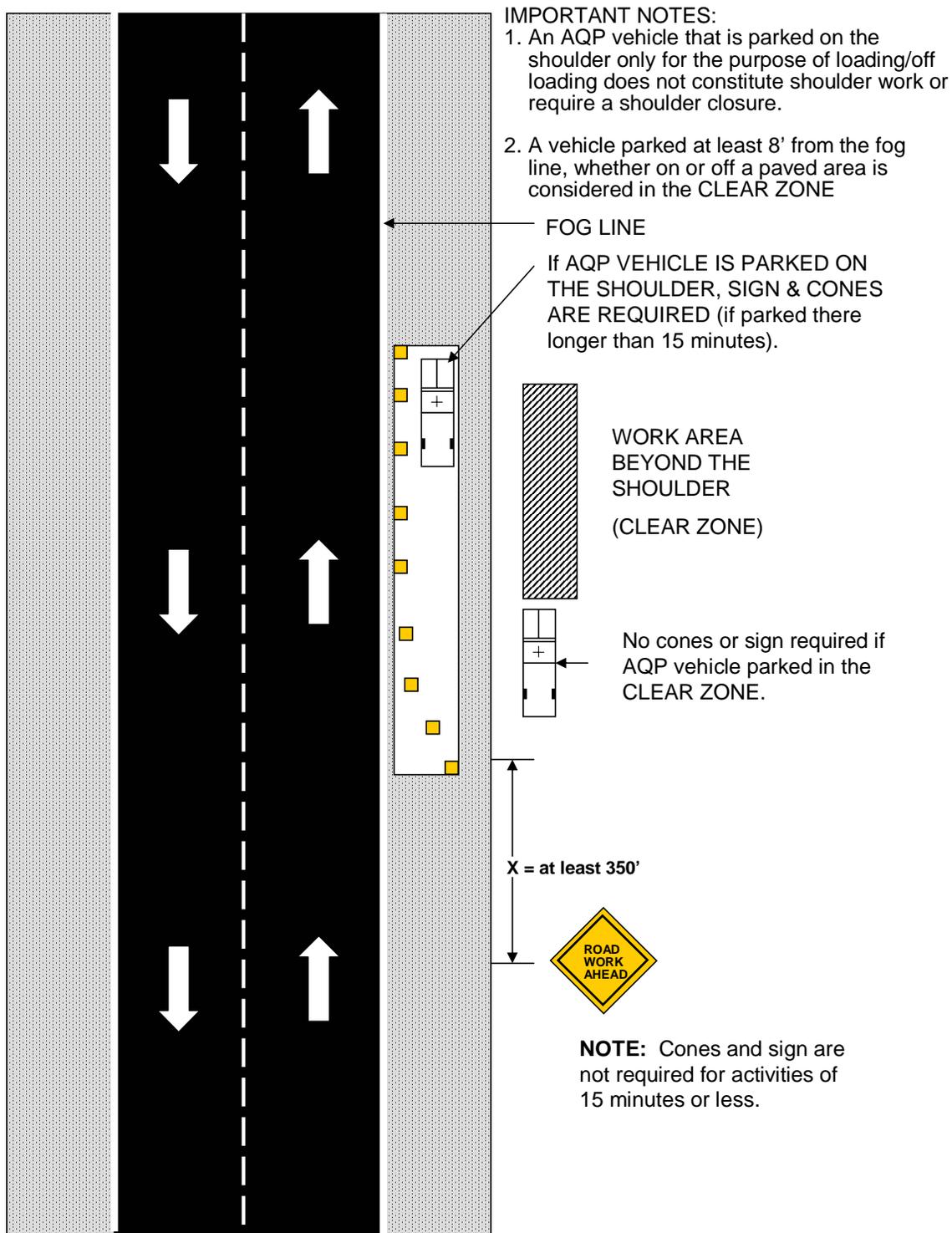


FIGURE 1
AQP WORK ON AND BEYOND THE SHOULDER OF A ROADWAY

Section 6: Vehicle Safety and Required Training

Description

Operating a motor vehicle is likely the most dangerous activity Ecology Employees perform on a routine basis. Vehicle drivers are responsible for operating the vehicle in a safe, professional manner on the road to ensure a safe environment within the vehicle for both driver and passengers. In addition, specific training is required for any Ecology employee operating an AQP vehicle equipped with fixed compressed gas cylinders. For more information about vehicle safety, refer to the Ecology Safety Program Manual (on Ecology's intranet), under Vehicle Safety.

Safety Requirements

- Make sure, at a minimum, the following forms are in all AQP Special Use Vehicles: Check with the Ecology Transportation Office for a current list of required forms and/or a vehicle accident packet. For information about how/when to use these accident forms, call the Ecology Safety Office or refer to the Ecology Safety Program Manual (on Ecology's intranet), under Accident Investigation and Reporting.
 - 1) The *Ecology Report of Personal Injury/Accident* form
 - 2) *State form 137 - Report of a Motor Vehicle Accident*
 - 3) The *Washington State Patrol Collision Report*
- Guard against theft and break-in: This especially applies to AQP Special Use vehicles.
 - 1) Always lock the vehicle.
 - 2) Close all the windows.
 - 3) Put all valuables in the trunk or hide them from plain site.
 - 4) Always park in a well lit or busy parking area (when available).
 - 5) Park with wheels turned sharply to the right or left to thwart towing by thieves.
 - 6) Use the anti-theft device if the vehicle is equipped with one.

Defensive Driver Training

All AQP field staff, are required to take an approved Defensive Driver course every four years. This training is required for all Ecology field staff and may be required for other employees who drive a state vehicle on state business. If in doubt, look for a current policy in the Ecology Policies and Procedures manual (on line) or call the Ecology Safety Office about Defensive Driving requirements. Employees who are not required to take Defensive Driver training are encouraged to do so.

Driver Training for AQP Vehicles Carrying Carbon Monoxide Cylinders

This training is a statewide requirement for any Ecology employee who drives an AQP vehicle equipped with Carbon Monoxide compressed gas cylinder(s).

Checking out this special use vehicle to other Ecology employees

The AQP section supervisor directly responsible for this vehicle must ensure that these guidelines are in place and implemented. A running list of all drivers trained in the hazards of operating this vehicle must be kept on file.

- The best practice is to remove the CO cylinders prior to use by someone other than the primary operator(s) of this vehicle.
- If the CO cylinders are removed prior to use, then the driver need only be made aware of the CO alarm should it alarm while driving the vehicle (see below).
- If the CO cylinders are not removed prior to use, then the driver must be made aware of all the following hazards and training elements listed below.

Why are we training people to drive this vehicle?

- This vehicle transports gas cylinders containing a calibrated mixture of Carbon Monoxide, Propane (hydrocarbons) and Carbon Dioxide. If a cylinder were to leak for any reason, high levels of gas, particularly carbon monoxide, could enter the passenger compartment and affect the driver and any passengers.
- This training is designed to make drivers aware of this potential hazard and how to prepare for an emergency caused by a gas leak.

What do I need to know?

- The cylinders transported in the vehicle contain levels of CO from one percent to six percent, Propane from 400ppm to 1200ppm and Carbon Dioxide from six percent to one percent.
- The Material Safety Data Sheets (MSDS) are located in the vehicle logbook and are also available from the Air Quality Program section that owns the vehicle.
- A Carbon Monoxide monitor is in the vehicle and will sound an alarm at 35ppm.

What specifically is the hazard?

- Carbon Monoxide (CO) is a colorless, odorless, toxic gas that can cause drowsiness, headaches and even death.
- A CO leak in the passenger compartment of the vehicle could cause a driver to become impaired or rendered unconscious and lose control of the vehicle.
- Review the MSDS; explain cylinder contents and hazards as necessary.

What do I do in case of a alarm?

If the Carbon Monoxide alarm sounds or if staff start to feel drowsy, immediately roll down the window(s) to ventilate the vehicle and pull off the road as soon as it is safe to do so. Get out of the vehicle and into fresh air.

- If the Carbon Monoxide alarm went off, wait for it to cease before re-entering the vehicle. Continue to ventilate the vehicle if necessary. Open doors and windows as needed.
- If the Carbon Monoxide alarm did not sound off, check the display to see if there are any readings. Readings of 34ppm or less will not sound the alarm but may cause drowsiness over a period of time.
- If the battery in the alarm is weak, a different alarm will sound and the display should indicate that the battery needs to be changed.

Reporting after a real or potential exposure

If staff feel that they have been exposed to Carbon Monoxide, they should seek medical attention as soon as possible.

- Report the incident to the regional Safety Office as soon as possible.
- Report the incident to the AQP Section supervisor.

Inspection of the Vehicle

- A visual tour of the vehicle.
- Cylinder location.
- Cylinder restraints and proper securing.
- Location of the Carbon Monoxide monitor.

Operation of the Carbon Monoxide Monitor

- How to understand and interpret the Carbon Monoxide monitor.
- Different kinds of readings that the monitor is likely to display.
- Alarms – what they mean and what they sound like.
- Low battery warnings.

Section 7: Exposure to Noise

Description

Noise is often defined as unwanted sound. It is a hazard because it can damage hearing, cause stress, and often interferes with verbal communication.

Noise can inflict damage on one's hearing either temporarily or permanently. The extent of damage is a function of several factors:

- The level of the sound at the ear, as measured in decibels (dBs).
- The exposure time at a particular sound level.
- The number and length of recovery periods (quiet periods) between the sound periods.
- Personal sensitivity or intolerance to sound.

As a matter of perspective, the following are some examples of sources and the noise they make:

0 to 10 dB	lowest humans can hear
10 to 40 dB	a ticking clock
40 to 70 dB	conversational speech
70 to 90 dB	a table saw
90 to 100 dB	a gas powered brush cutter
110 to 130 dB	a jet plane takeoff

Standards have been established for occupational noise exposure. They define the maximum permissible length of time that a worker can be exposed to a particular noise level in an 8-hour day:

Hours	Levels (dB)
8	90
6	92
4	95
3	97
2	100
1	105
.5	110

Sound level is often designated as A-weighted, decibels (dBs). A-weighting is a sound measuring technique that discriminates against low frequency sounds that the human ear does not hear very well.

It is important to remember that sound tolerance is different from one individual to another. In addition, hearing loss may be very gradual and not noticeable at first. By the time the loss becomes obvious it is too late because the loss is permanent.

Noise Control

Excessive noise can be controlled in three ways:

- At the source
- Along its path
- At the point of hearing

Controlling noise at the source is the preferred option and includes such things as installing mufflers or insulation to dampen the sound. Path control involves limiting access by individuals to the source of the noise and is often less effective.

The use of ear protection, the third way to control noise, is the least desirable because it does nothing to eliminate the hazard but it is often the only option available during site visits or inspections.

There are three basic types of ear protection;

- Disposable pliable materials such as foam or wax-impregnated cotton which are inserted into the ear. These are one-time, disposable units.
- Molded ear plugs which are inserted into the ear, are reusable, but must be cleaned daily.
- Ear muffs which are worn over the head or around the neck or are attached to a hard hat.

The above three types of ear protection devices are not equally effective. The alternative ranges for each is shown below:

Ear Protector	Range of Attenuation
Cotton	5 to 20dB
Ear Plug	15 to 35dB
Ear Muff	15 to 45dB
Muff & Plug	28 to 48dB

Cotton is not recommended for protection and is shown only for comparison purposes. The attenuation of properly fitted ear plugs and ear muffs is nearly equivalent. A combination of the two can provide additional protection. Probably the most important factors for staff to consider when selecting a type of ear protection are (1) noise levels, (2) proper fit, (3) reasonable comfort, and (4) convenience. If ear protection is comfortable and convenient, it will usually be used.

Recommended Safety Procedures

- Always carry hearing protectors when in the field.
- Make sure your hearing protectors fit properly and will provide the appropriate level of protection
- Hearing protectors should be worn when sound levels reach moderate levels and must be worn in designated areas, when required by the particular facility on-site Safety Plan and/or when the following sound levels are exceeded.
 - When exposed to an 8-hour time-weighted average of 85 dBs or greater.
 - When exposed to any noise above 115 dBs.
 - Any impact noise at or above 140 dBs.

Section 8: Working Around Machinery

Description

There are numerous physical hazards which can be encountered while working around air pollution process and/or air pollution control machinery. These hazards include exposure to elevated temperatures, exposure to moving machine parts, exposure to ionizing radiation, exposure to fugitive emissions (see Section 9), and exposure to high voltage/current (see Section 10).

This section will cover hazards associated with high temperatures caused by air pollution process and/or control systems, moving machine parts, and ionizing radiation.

Exposure to High Temperatures

Exposure to high temperatures can result in a heat-related injury, especially for workers wearing protective clothing. The protective materials that shield the body from chemical exposure also limit the dissipation of body heat and moisture. The heat buildup this creates can constitute a hazardous condition. Depending on the ambient conditions and the work being performed, heat stress can occur very rapidly, within as little as 15 minutes. It can pose as great a danger to the worker's health as chemical exposure. In its early stages, heat stress can cause rashes, cramps, discomfort and drowsiness, resulting in impaired functional ability that threatens the safety of both the individual and co-workers. Continued heat stress can lead to heat stroke and death.

Safety Considerations

- Avoid using more personal protective equipment than you need, particularly in warm environments.
- Be alert to the signs and symptoms of heat stress in you and in co-workers, especially when the temperature rises above 85°F and during periods of intense activity.
- Take periodic or scheduled rest periods. Rest cycles provide the body an opportunity to get rid of excess heat, slow down the buildup of internal body heat, and provide greater blood flow to the skin.
- Where possible, select a cool or covered rest area.
- Avoid dehydration; provide water or other liquids designed to replace body fluids. Drink 5 to 7 ounces of fluids every 15 to 20 minutes (recommended).
- If possible, leave the most stressful tasks for the cooler parts of the day (early morning or evening)

Moving Equipment Parts

Moving equipment parts (belts, flywheels, pulleys, motors, etc.) are extremely dangerous and should be avoided at all cost. They have pinch points that can cause death or serious injury by catching loose clothing, jewelry, or long hair and pulling the unfortunate individual into the moving machinery.

Safety Considerations

- Be aware of your surroundings.
- Avoid working too close to moving parts or leaning against machine guards.
- **Avoid wearing loose clothing or jewelry when working around moving parts. If you have long hair, tuck it under your hard hat or otherwise prevent it hanging free.**

Section 9: Working Around Fugitive Emissions

Description

Some AQP field activities are conducted around fugitive dust or gases. This section of the safety plan addresses the hazards of working around fugitive emissions. Staff may be exposed to unexpected/uncontrolled releases of both criteria and toxic pollutants as well as high temperature steam while working around pollution control equipment, continuous emission monitors and/or emission testing locations. An added complication is that many of these sites are located on above-ground platforms making it difficult to escape quickly.

Chapter 173-400-030 WAC defines "fugitive emissions" as:

"...emissions which do not pass and which could not reasonably pass through a stack, chimney, vent, or other functionally equivalent opening."

and "fugitive dust" as:

"....a particulate emission made airborne by forces of wind, man's activity, or both. Unpaved roads, construction sites, and tilled land are examples of areas that originate fugitive dust. Fugitive dust is a type of fugitive emission."

A wide variety of potential hazards may be encountered while inspecting air pollution process and control systems. Unlike industrial workers, AQP inspectors are not subject to chronic (long-term) exposure to the same chemicals. Rather, they are potentially at risk for acute (short-term) exposures to a variety of airborne contaminants at industrial sites. It is important for each inspector to know the hazards and to choose the appropriate personal protective equipment for protection from the various contaminants encountered during inspections of industrial sites.

As an AQP inspector and from a safety and health perspective, does the following information pertain to AQP staff when performing an inspection at a facility? Or is this information merely about emissions or situations that might occur somewhere other than where the inspection is conducted?

One of the fundamental principles of industrial hygiene is that possible exposures should be minimized or eliminated through the application of engineering controls. In the case of the field inspector for a regulatory agency exposed to fugitive emissions, this is not a realistic possibility. Most exposures occur because of fugitive leaks of the pollutant-laden gases which stream out into the area immediately surrounding the air pollution control system. These conditions occur by accident and often are not identified by plant personnel. Other sources of exposure are contact with the downdraft from nearby stacks or rising clouds of toxic pollutants released from intermittent process operations. Both types of exposures can happen when inspectors are present on elevated platforms surrounding air pollution systems or stack sampling locations. In a sense, the inspector is at risk of exposure from the discharge points

of the very engineering control systems which are intended to protect plant personnel and the public.

Since these exposures may not be prevented by engineering controls, the inspector must be aware of the hazards and the potential problem areas encountered during the inspection. The inspector must know what and when areas should be avoided and what protective equipment is appropriate for the hazards present.

NOTE: There are 300 to 600 known contaminants in fugitive emissions that an inspector may be exposed to during a year. Rarely is real-time monitoring data available in locations where the inspector may experience the most significant exposure. Ambient conditions are highly variable and this makes real-time monitoring subject to error. AQP inspectors who do not use appropriate personal protective equipment may place themselves at a substantial health risk.

There are three basic rules that field personnel should follow while inspecting air pollution control systems:

1) Every fugitive emission exposure situation should be approached carefully:

This means that the inspector should bring the proper personal protective equipment (PPE) necessary for the areas to be inspected. Where an Ecology or AQP file exists for the facility, it should be reviewed before the inspection. These files may contain a list of the chemicals and hazards that may be encountered during the inspection. This information, in addition to the recommendations of facility personnel and/or the facility safety plan, will provide the information necessary to select the appropriate PPE and respirator protection to be used.

Prior to entering each specific area of the plant, the inspector should inquire what potential problems can exist. Partially confined areas are to be avoided to the extent possible (see Section 4, Working in Confined Spaces).

2) Halt the inspection immediately if you have any of these symptoms:

- Headache
- Nausea
- Drowsiness
- Chest Pains
- Shortness of Breath
- Lightheadedness
- Eye or Nose Irritation

It is important that the inspector be aware of how she/he is feeling during the inspection. Initial mild feelings of discomfort may develop into serious situations. While feeling ill may not be from exposure to airborne contaminants, the inspector should not risk their personal health and safety. At the first feeling of discomfort from any of the symptoms listed above or

other signs/symptoms of exposure, IMMEDIATELY move to a safe, well-ventilated area and re-evaluate the situation. Also, consult with facility staff and keep in mind that, as the inspector, you may be more sensitive to lower concentrations of odors and/or to airborne contaminants than facility personnel.

NOTE: Seek medical attention, if warranted, and contact the Ecology Safety Office as soon as practical for reporting purposes and medical monitoring follow up (if necessary).

3) Utilize the appropriate personal protective equipment (PPE)

If the AQP inspector does not have the required PPE for the inspection or if the appropriate PPE is not provided to the inspector by the facility, then all inspection areas requiring PPE must be avoided and the inspection postponed.

As an AQP inspector, facility personnel may assume that you are trained and qualified to use the PPE provided by the facility, especially when respirators are required in certain areas. Facilities may offer a respirator to AQP staff without realizing that the individual has had no previous training in the use of the respirators and has not had a medical examination to determine an adverse health affects from the stress of wearing a respirator. Therefore, it is the responsibility of AQP staff to notify the appropriate facility personnel:

- When they are unfamiliar with the PPE provided.
- That they are not certified to wear the respiratory equipment offered by the facility.
Exception – When respiratory protection is provided for emergency escape purposes only.

NOTE: You must be trained, certified, and have a current fit test card issued by Ecology to use a respirator on the job. Except for respirators issued for escape only, when offered a respirator, it must be the same make, model and size as the respirator described on the fit test card. See the Respirator Protection Program in the Ecology Safety Program Manual.

Remember, if your activity requires the use of a respirator, bring the one issued and fit-tested by Ecology. It is okay for the facility to provide you with an escape respirator to be used in an evacuation during an emergency. However, AQP staff are not permitted to enter areas or perform inspection activities that require the use of a self-contained breathing apparatus (SCBA).

4) Some Typical Areas With Inhalation Hazards Include:

- Elevated Sampling Platforms
- Areas Adjacent to Process Vents and Discharge Points
- Partially Confined Areas
- Fugitive Emissions

Inspection activities involving stack sampling should be done from the safest locations. If possible, avoid performing work directly at the sampling platform or other exposed locations; find a protected location.

When working in close proximity to vents and discharge points, a substantial quantity of the gas can escape from the port into the breathing zone of the people.

Large diameter ports should be avoided, especially when the static pressure of the gas is positive. The port should be one half to one inch in diameter to minimize the flow rate of gas through the port. Only ports with good ventilation should be used in any case. Before opening the port, the inspector should put on the appropriate respirator.

It is very common for the bag house discharge to be very low to the ground with either a horizontal or downward orientation. In other words, some stacks do not point up! Sudden malfunctions of air pollution control devices occasionally happen.

The inspector must be aware of all the pollution control system discharge points and all process vents. It is necessary to be constantly aware of the best way to leave the area rapidly and it is advisable to have a respirator available at all times.

In addition, a bag house does not remove any gases and vapors. Many asphalt plants, for example, (and other facilities) have moderate concentrations of sulfur dioxide and other contaminants which easily pass through the bag house.

Areas fumigated by the plume from upset process equipment must be avoided. Sudden changes in the wind direction can result in exposure to the highly contaminated plume.

Inspectors should always be aware of the location of the plume during such periods and should avoid areas where they might be trapped as the plume passes.

Inspectors should always be aware of the best means to escape an area which is suddenly in the path of the plume. It may be impossible to see due to the irritating properties of many pollutants. The inspector may experience difficulty in breathing. The potential problems related to falls from elevated surfaces become even more serious under such conditions.

There can also be moderately heavy deposits of contaminated soil or dirt on the floor in

portions of any plant. Walking through this area to reach the air pollution control device will stir up this material. The inspector should usually wear a respirator and cartridge that provides the same or better protection as the personnel working in this area (the respirator used must be issued and fit-tested by Ecology). This area should be avoided if there is an alternate route to the inspection area.

4) Safety Requirements

- Receive a safety briefing from the appropriate facility personnel.
 - Review of the appropriate facility hazards.
 - Review pertinent safety information.
 - Avoiding areas or operations not directly related to the inspection.
 - Understanding the emergency signals, alarms and hand signals used at the facility; to include escape routes and assembly areas.
- Familiarize yourself with the facility that you will be visiting and the emissions that you likely will be exposed to. This includes talking to facility personnel and reading the facility's safety plan.
- Always request an escort by facility personnel during the site visit.
- Bring the proper PPE. If you don't have or are not provided the proper PPE, you may not perform the activity.
- If, during the site visit, you feel uncomfortable, believe you are in an unsafe situation, or develop exposure symptoms, leave the area immediately.
- If you must use a respirator, use the one that you have been fitted for by Ecology.

Section 10: Working With Electricity

Description of Activity

General

AQP staff can encounter electrical hazards while performing a variety of work-related activities. Such activities may include: Electronic instrumentation installation and servicing, calibration and repair, CEM field accuracy testing, routine inspections and other types of site visits.

Electronic Instrumentation, Installation, Servicing, Calibration and Repair

Air quality monitoring involves the use of electronic instrumentation for the detection of pollutants such as particulates, ozone, sulfur dioxide, carbon monoxide, etc. To maintain their designated level of accuracy, all instruments require scheduled cleaning, maintenance, calibration and repair. Calibration and repair of electronic equipment may only be performed by qualified persons.

Safety hazards for the calibration and repair of electronic instrumentation include shock hazards:

- Many types of monitoring, Q/A or Calibration and Repair instrumentation are operated with normal household voltages. Should staff inadvertently come into contact with this "live" voltage while performing Q/A, calibration, repair, or routine maintenance checks, the results could prove to be fatal.
- There are also power sources located within the instruments that generate voltages many times higher than line voltage. The hazards associated with contacting these power sources are proportionately greater.
- A good rule of thumb is never work on the "innards" of 110V instrumentation unless the power is turned off and the instrument is unplugged. Unfortunately, instruments can contain capacitors which store electrical energy even with the main power turned off. Should staff inadvertently come in contact with a charged capacitor, the capacitor could discharge its energy through them to ground causing serious injury or even death.
- Some instruments must be powered while being worked on. In this case, staff should not perform the work unless they are experienced, thoroughly familiar with the instrumentation and take the appropriate precautions.

Safety Requirements

- Disconnect the power when working on electrical equipment, unless power is needed for testing purposes.

- Make sure all electrical equipment and tools are properly grounded.
- Contact qualified personnel for advice and assistance if you lack experience.
- Make sure instrument power supply is the correct voltage and frequency.
- Consult the manufacturer's instruction manual when working on equipment.
- Make only manufacturer authorized modifications to instrument and its' safety features.
- Insulate your body as much as possible with the proper clothing or other insulation materials. Remember that concrete is a good conductor of electricity, especially if it is wet.
- **Do not wear metal watches, bracelets, necklaces, and/or rings, where there is danger of being shocked.**

Section 11: Chemical Safety

Description

This section deals with AQP activities that may involve use of hazardous chemicals; excluding compressed gases. A variety of hazardous chemicals may be managed by the AQP staff in each of the regional or satellite offices around the state. Information regarding these materials is provided in the respective building safety guidelines for that region or satellite office.

- For the Lacey Ecology Building, refer to the Hazardous Materials Management Plan and Chemical Hygiene Plan.
- General information regarding use of hazardous materials and information on how to use and understand a Material Safety Data Sheet (MSDS) can be found in the Ecology Safety Program Manual under Right-To-Know/Hazard Communication, and is presented during the initial New Employee Safety Orientation. (See Chapter II)

Respiratory Protection

Whenever the job duties of AQP staff require the use of respirators on the job, the certification, respirator training and fit testing must be in accordance with the Respiratory Protection Program section of the Ecology Safety Program Manual (on line; see the Ecology intranet). Call the Ecology Safety Office for more information.

Standard Operating Procedures

A Standard Operating Procedure (SOP) should be available for any task or method that requires the use of hazardous materials. If you're performing a task or method using chemical reagents, refer to the local Chemical Hygiene Plan or ask your supervisor for a copy of the method, which must include the procedures and the associated hazards with the materials used.

Material Safety Data Sheet (MSDS)

An MSDS file must be maintained at each Ecology location for all hazardous materials used or stored on site. The MSDS file must be available to all employees for review during scheduled working hours. (See Appendix A of this safety plan for a [sample MSDS](#) for Sulfur Dioxide.)

It's important to read, understand, and consult the MSDS for any chemical with which you work. The MSDS contains technical information that outlines the physical properties, hazards, and protective measures appropriate for using the material. It also offers information about what to do in case the chemical should spill.

Obtaining a copy of the MSDS

If a current MSDS is not on file or available, or if one is not received with a chemical shipment, then write to the manufacturer to request an MSDS. The manufacturer is required to provide the MSDS for every hazardous product they manufacture or distribute.

Chemical Safety and Training Requirements

Supervisors of AQP staff who use specific hazardous chemicals on the job are responsible to ensure all training requirements are met in accordance with the Right-To-Know/Hazard Communication section of the Ecology Safety Program Manual (on line at the Ecology intranet). The extent of training for working with any hazardous chemical depends on the associated hazards, proper handling, PPE, and regulatory requirements of the specific hazardous chemical.

- Get adequate training for your work responsibilities and activities.
- Use proper grounding procedures when transferring flammable fluids between containers.
- Read the safety information on the labels of chemical containers.
- Read the safety information on the Material Safety Data Sheets (MSDS) of chemicals you are going to use. An MSDS must be on file and readily accessible for each hazardous chemical used in the workplace.
- Use all of the appropriate personal protective equipment (PPE) when handling hazardous chemicals (consult the MSDS).
- Store and maintain your PPE in working condition.
- Consider all unlabeled containers as hazardous until the contents can be properly identified. Notify the appropriate Safety Office or Room Champion.
- Inspect all chemical containers before attempting to open. If the container is bulging, be very careful about opening it. Be sure you know exactly what it contains, what are the hazards, and open it VERY slowly.
- When you expect to be working with hazardous chemicals, make sure someone knows where you and what you will be doing. Use the buddy system where possible.
- Pay attention to odors and physical sensations in your work area. Consider anything unusual to be an indicator of a potentially hazardous situation.
- Labels containing CAUTION, WARNING, or DANGER means that the chemical is hazardous.

- When in doubt, get out, notify, and control the area. Stay out and keep other away.
- Check the containers in your work area for appropriate labeling. Reject deliveries of chemicals that are not properly labeled. Question the information on handwritten labels.
- Do not smoke or allow a potential ignition source in the area when working with flammable liquids or vapors.
- Don't assume someone else will save you in the event of an accident.
- Don't assume that all chemicals have the same hazards.
- Don't attempt to identify chemicals by smell or taste.
- Don't eat or drink while working with hazardous chemicals.
- Store all hazardous chemicals with labels and in clearly marked and approved storage containers. (Consult local Safety Plan, Chemical Hygiene Plan or ask your supervisor.)

Section 12: Working Around Animals and Poisonous Vegetation

Description

There are many occasions when an employee may be exposed to animals or vegetation that could be a health and or safety risk. The following discussion identifies the types of animals and vegetation Air Quality Program staff may encounter in Washington and how to handle those situations.

Staff that may potentially encounter dangerous animals and/or poisonous vegetation in their work should have first aid and CPR training.

Regulatory Requirements

There are no regulatory requirements relating to working around dangerous and/or poisonous vegetation.

Safety Considerations

- Safety Briefing:
 - Conduct a safety briefing before conducting the activities:
 - Review the hazards
 - Review pertinent safety plans (including facility plan)
- Identify locations of telephones in the vicinity
- Identify the locations of hospitals in the vicinity
 - Bees: If you encounter a hive of bees and you must work close to the hive, wait until dusk. Bees retreat to their nest in the evening. Option: Once the bees are inside the hive, you can spray inside the hive entrance with a consumer bee spray product. Continue your work only when you are sure you are safe.
 - If you are allergic to bees, keep the medications with you and inform your co-workers how to administer the antidote for you, should you become incapacitated.
 - Rattle Snakes: Rattle snakes are the only poisonous snakes indigenous to Washington (Eastern WA). If you see a rattlesnake, stay away from it.
 - Do not touch a dead rattlesnake. A dead rattlesnake has the potential to have a "reflective strike." If you must kill a rattlesnake to protect yourself, cut off the head safely, as with a shovel from a safe distance, and bury the head to prevent a possible reflective strike to another person.
 - Carry a snake bite kit and use it if you are bitten. Stay calm and get medical help immediately.

- Vicious Dogs: If you see a vicious dog outside your vehicle, stay in your vehicle until the animal leaves or simply leave the area. If possible, contact the dog's owner and request that the owner restrain the dog while you conduct your work. If bitten, seek medical assistance immediately.
- Poisonous Spiders: If you are bitten by a spider, seek medical attention promptly. The Black Widow and the Brown Recluse are two of the most likely poisonous spiders you may encounter during AQP activities.
- Mosquitoes, Ticks, and other Insects: Carry and apply insect repellent. In situations where you may encounter ticks wear a long sleeved shirt and wear your socks over your pant legs. Wear netting over your face if warranted. Repellents with 50% or less of DEET are recommended against mosquitoes. The most significant threat posed by mosquitoes is the West Nile Virus.
- Cows and Bulls: Contact the owner and have the animals restrained while you conduct your work.
- Rodents: Avoid them. Use rodent poison if the site is infested. If bitten seek medical attention immediately.
- **Poisonous Vegetation: Learn to recognize poisonous vegetation. Avoid coming in contact with it. If you must come in contact with suspect vegetation, wear the appropriate field gear for skin and/or eye protection.**

Chapter V.
MEDICAL MONITORING

Medical Monitoring

The MedMon program is designed to provide quality medical surveillance appropriate to the nature of exposures encountered by Ecology employees. The program establishes baseline health data and follow-up exams to facilitate the early detection of physical problems related to on-the-job exposure to hazardous materials. The frequency of follow-up exams depends upon your potential for on-the-job exposures. These exams look for evidence of exposures, evidence of organ damage which might have resulted from various exposures, and evidence of adverse affects from toxic exposures. Expert consultation and assistance after exposure is also available, especially in situations involving on-the-job exposures above permissible or published limits or where signs/symptoms of exposure are evident.

The medical monitoring program is available to employees whose jobs involve respirator use or potential or actual exposures to toxic chemicals or hazardous substances above regulated exposure limits. The program is administered by the Ecology Safety Office and is conducted by a contracted Medical Monitoring provider. Ask your supervisor about participating in the MedMon Program or call the Ecology Safety Office if you fall into one of the above categories. (For a complete description of the MedMon Program, see the Medical Monitoring section of the Ecology Safety Program Manual on the Ecology intranet.)

Who should participate in medical monitoring?

The Air Quality Program field and lab staff have a relatively minimal exposure to job-related hazardous materials and, therefore, AQP staff participation in the Ecology Medical Monitoring (MedMon) program is not necessary. From time to time, however, exceptions may arise and these need to be handled on a case-by-case basis following consultation among affected employees, their supervisors and the Ecology Safety Office.

Chapter VI.
PERSONAL PROTECTIVE EQUIPMENT

Personal Protective Equipment

AQP staff must evaluate and pre-plan for potential safety and health hazards in the field. Selecting and using the appropriate personal protective equipment (PPE) greatly reduces the risk of exposure to both known and unknown on-site hazards. There are four levels of protection (A, B, C and D), each requiring specific PPE use:

Levels of Protection

Levels A & B: These levels of protection require some form of supplied air system, i.e., Self Contained Breathing Apparatus (SCBA), that is combined with a chemical protective suit and other chemically resistant PPE.

Air Quality Program Policy
Level A or B is not approved for AQP work.

Level C: This level of protection requires use of an air purifying respirator (APR); usually in combination with other chemically resistant PPE. The use of an APR on the job requires annual respiratory certification and fit testing from the Ecology Respirator Administrator. Inhalation is one of the primary ways staff can be exposed to hazardous substances. The need for Level C respiratory protection is rare in AQP field/lab work. Exceptions may occur typically at a facility when the concentration of an airborne contaminant exceeds or may exceed regulatory levels; or levels set by that facility.

NOTE: You must be trained and certified annually, and have a current fit test card issued by Ecology to use a respirator on the job. Contact the Ecology Safety Office or see the Respiratory Protection Program in the Ecology Safety Program Manual, which is available on the Ecology intranet (go to Employee Services, then click on Safety).

Procedure for Obtaining Respiratory Fit Test Certification

- Inform your immediate supervisor of your wish or requirement to use of a respirator on the job.
- The immediate supervisor should contact Ecology Safety Office staff to discuss your respiratory protection needs. Provide specific information about the activities you will conduct and the types of sites that you will visit, the contaminants you will be exposed to, and maximum concentrations you may encounter.
- Annual respiratory training and fit testing are required to maintain current certification to use a respirator on the job.

Level D: Level D is the common protection level required during the vast majority of AQP field/lab activities. Level D provides minimal skin protection and little respiratory protection. Level D may include any combination of the following equipment (Refer to Chapter III and your respective AQP staff activities for the appropriate PPE requirements):

- Hard hat
- Ear Muffs and/or Ear Plugs
- Safety Glasses
- Safety Sun Glasses
- Safety Goggles
- Particle Mask
- Steel-toed Boots (Leather or Rubber)
- Chemically Resistant Gloves (Disposable/Non-disposable)
- Leather Gloves
- Rain jacket and Rain Bib
- Gear Bag
- Flashlight (explosion-proof)
- Disposable Coverall (chemically resistant or other)
- Laerdal Pocket Mask
- Repellent (Dogs, Bees, and/or Insects)

PPE and Facilities

As an AQP inspector, facility personnel may assume that you are trained and qualified to use the PPE provided by the facility, especially when respirators are required in certain areas. Facilities may offer a respirator to AQP staff without realizing that the individual has had no previous training in the use of respirators and has not had a medical examination to determine an adverse health affects from the stress of wearing a respirator. Therefore, it is the responsibility of AQP staff to notify the appropriate facility personnel:

- When they are unfamiliar with the PPE provided.
- When they are not certified to wear the respiratory equipment offered by the facility.
Exception – When respiratory protection is provided for emergency escape purposes only.

NOTE: *If your activity requires the use of a respirator, then bring the one that was issued and fit-tested by Ecology. If the facility provides you with an escape respirator to be used in an evacuation during an emergency, ensure you have been provided the training to inspect the escape device for safe operation and to properly don the escape device in the event of an emergency. Remember, AQP staff are not permitted to enter areas or perform inspection activities that require the use of supplied air, i.e., a self-contained breathing apparatus (SCBA).*

Chapter VII.
FIRST AID AND CPR

Introduction

This chapter explains guidelines on when to call 911, agency requirements for first aid and CPR training and first aid kit contents.

Before You Administer First Aid

The prerequisite for administering first aid and CPR is a current first aid/CPR certification. The Department of Ecology encourages everyone to take first aid and CPR training on a regular basis and cautions you to stay within your training when administering it. Washington State's Good Samaritan law protects you against liability when administering first aid, but only when you operate within your level of training. (Refer to the First Aid section of the Ecology Safety Program Manual.)

Should you choose to administer first aid, be aware of the potential for infectious diseases. Contact with bodily fluids (saliva, vomit, blood, urine, fecal matter) could expose you to diseases such as AIDS and hepatitis B.

First Aid/CPR Training Requirements

All AQP field/lab staff and their immediate supervisors are required to take First aid and CPR training (refer to the training requirements described for each job description in Chapter III). All other Ecology employees are encouraged to take First aid and CPR training. Classes are offered regularly throughout the year by Employee Services as Core Training. Contact your training coordinator for information.

- First Aid and CPR certifications are generally good for two years, depending on the course.
- All field staff including immediate supervisors **must** be first aid certified.

Medical Emergencies in the Field - When to Call 911

Be sure to plan ahead before going to the field, especially when traveling to remote locations. AQP staff working in the field must be current in first aid/CPR and prepared for the possibility of a medical emergency involving themselves, a co-worker or other individuals. This includes having a communications device (if available) and knowing the location of the nearest hospital. Emergency 911 calling is available throughout Washington State although not all areas provide cell phone access.

First aid kits are required in all Ecology vehicles. (For a list of the first aid kit locations in Ecology buildings, refer to Ecology's Headquarters and Regional Office Building Safety Plans.)

Inventory Your First Aid Kit

- The only requirement for the contents of first aid kits, is that they must be appropriate to the work place, occupational setting and response time of local emergency medical services.
- Is the kit large enough for the number of passenger in your vehicle?
- Are items missing from the kit?
- Replace any materials or medical items that have passed their printed expiration dates.

Replacing Items in First Aid Kits

First Aid kit replacement items can be ordered through Central Stores or purchased from a local retail vendor or safety supply.

Appendix

- Appendix A: Material Safety Data Sheets
- Appendix B: Health and Safety Hazards Related to
Working with and around Compressed
Gases and Compressed Gas Cylinders
- Appendix C: Fall Protection
- Appendix D: Glossary

Appendix A
Material Safety Data Sheet

FIGURE 2: Material Safety Data Sheets

Scott Specialty Gases, Inc.

7446095

MATERIAL SAFETY DATA SHEET

1 PLUMSTEADVILLE, PA 215-766-8861 (CORPORATE & REGIONAL OFFICE)
 2 FREMONT, CA 510-659-0162
 4 LONGMONT, CO 303-442-4700
 6 TROY, MI 313-589-2950
 8 SOUTH PLAINFIELD, NH 908-754-7700

3 SAN BERNARDINO, CA 714-887-2571
 5 WAKEFIELD, MA 617-245-8707
 7 DURHAM, NC 919-220-0803
 9 HOUSTON, TX 713-644-4820

SECTION I - MATERIAL IDENTIFICATION

CHEMICAL NAME: Sulfur Dioxide SUPPLIER: Scott Specialty Gases, Inc.
 CHEMICAL FORMULA: SO₂ ADDRESS: 6141 Easton Road, Plumsteadville, PA 18949
 CHEMICAL FAMILY: Acid Gas **In Case of Emergency, Contact your Regional Plant Manager**
 DATE PREPARED: 5/8/92 OTHER DESIGNATIONS: Sulfurous Acid Anhydrous,
 CAS # 7446-09-5

SECTION II - HAZARDOUS INGREDIENTS

COMPONENT	CAS #	CONCENTRATION	EXPOSURE LIMITS (PPM)		
			ACGIH TLV	OSHA PEL	OTHER
Sulfur Dioxide	7446-09-5	100%	2 ppm	5 ppm	None

SECTION III - PHYSICAL DATA

BOILING POINT (°F): 14 SPECIFIC GRAVITY (H₂O=1) @ -10°C: 1.5
 VAPOR PRESSURE @ 21.1°C: 34.4 psig PERCENT, VOLATILE BY VOLUME (%): 100
 VAPOR DENSITY (AIR=1) @ 25°C: 2.26 EVAPORATION RATE (____=1): N/A
 SOLUBILITY IN WATER 20°C: 10.2% by weight APPEARANCE AND ODOR: Colorless gas with an irritating pungent odor

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT AND METHOD	FLAMMABLE LIMITS	LEL	UEL
N/A	Non-flammable	N/A	N/A

EXTINGUISHING MEDIA: Use that which is appropriate for surrounding fire.

SPECIAL FIRE FIGHTING PROCEDURES: Wear self-contained breathing apparatus and full protective clothing. Water spray can be used to cool fire exposed cylinders.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Anhydrous SO₂ reacts with chlorates to produce chlorine peroxide which presents an explosive hazard. Cylinders exposed to fire may rupture with violent force.

SECTION V - REACTIVITY DATA

STABILITY: Will react with water or steam to produce toxic and corrosive fumes.

INCOMPATIBILITY (MATERIALS TO AVOID): Aluminum, cesium oxide, chlorates, chromium, iron oxide, fluorine, magnese, potassium chlorate, sodium, tin oxide, bases, oxidizing materials, unsaturated organics.

HAZARDOUS DECOMPOSITION PRODUCTS: Sulfur trioxide and sulfuric acid.

HAZARDOUS POLYMERIZATION: Will not occur.

SECTION VI - HEALTH HAZARD DATA

ROUTES OF ENTRY: Inhalation, skin, eyes

EFFECTS OF OVEREXPOSURE: (**ACUTE**): Corrosive and irritating to the upper respiratory tract, skin, and eyes. Contact with liquid SO₂ may cause skin burns. Excessive inhalation may cause burning sensations, coughing, shortness of breath, headache, nausea, and vomiting. May produce bronchitis, chemical pneumonitis, and pulmonary edema. Eye contact may result in destruction of eye tissue. Excessive exposures can be fatal. (**CHRONIC**): Pulmonary disease or loss of pulmonary function. (**MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE**): Pulmonary diseases.

CARCINOGENICITY - NTP? NO IARC MONOGRAPHS? NO OSHA REGULATED? NO

EMERGENCY AND FIRST AID: **Inhalation** - Immediately remove victim to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. **Skin/Eye contact** - Immediately flush with copious amounts of water for at least 15 minutes while removing contaminated clothing. See medical attention immediately.

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN: Evacuate and ventilate area. Wear protective equipment. Attempt to stop leak if this can be done safely. Remove leaking cylinder to exhaust hood or safe outdoors area if this can be done safely.

WASTE DISPOSAL METHOD: Try to prevent direct release to atmosphere. Discharge SO₂ at a controlled rate into a large amount of water solution of 15% of NaOH or other suitable alkali. The alkaline sulfite solution can be oxidized to inert sulfate salts or shipped for disposal. Return cylinders to supplier for proper disposal with any valve outlet plugs or caps secured and valve protection cap in place.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (SPECIFY TYPE): Use a self-contained breathing apparatus in case of emergency or non-routine use.

VENTILATION: Sulfur dioxide should be handled in a fume hood. Provide adequate general and local exhaust ventilation to maintain concentration below exposure limits.

OTHER PROTECTIVE EQUIPMENT: Safety shoes when handling gas cylinders. Safety shower and eyewash station should be available.

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: Store in well ventilated areas only. Keep valve protection cap on cylinders when not in use and secure cylinder when using to protect from falling. Use suitable hand truck to move cylinders.

OTHER PRECAUTIONS: Protect containers from physical damage. Do not deface cylinders or labels. Move cylinder with adequate hand truck. Cylinder should be refilled by qualified producers of compressed gases. Shipment of a compressed gas cylinder which has not been filled by the owner or with his written consent is a violation of federal law (49 CFR).

Disclaimer: The information in this Material Safety Data Sheet is offered without charge for use by technically qualified personnel at their discretion and risk. Scott Specialty Gases, Inc., has made this sheet available with data which we believe is reliable, but the accuracy and completeness of the data is not guaranteed and no warranty is either expressed or implied. Since Scott Specialty Gases, Inc. has no control over the use of the product described herein, we assume no liability for loss or damage incurred from the proper or improper use of such product. This form is essentially similar to U.S. Department of Labor form OSHA-174.

0025-042992

Appendix B

**Health and Safety Hazards Related to
Working with and around
Compressed Gases and Compressed Gas Cylinders**

Air Contaminant Concentrations in IM Vehicles:

Example Calculations of Worse Case Scenarios

Example: AQP staff conducting audits, transport one cylinder containing a mixture of the following gases in an AQP vehicle. **NOTE: This may not be current AQP policy.**

Cylinder Content:

1 mole-% carbon monoxide (CO)

6 mole-% carbon dioxide (CO₂)

400 ppm propane

Balance is nitrogen

Table 10 summarizes the potential exposures inside the respective example vehicle and compares them to the Permissible Exposure Limit (PEL) of each gas.

Vehicle	Concentration In Tank ^{1/} (ppm)	Standard Tank # ^{2/} (#/ft ³)	Volume of Vehicle Air Space ^{3/} (ft ³ /m ³)	Concentration in Vehicle if Tank Empties (ppm) ^{4/}	TWA/STEL/ceiling/ IDLH ^{5/ & 6/} (ppm)
Ford Escort Station Wagon		50/52	190/5.38		
CO	10,000			2,779	35/52.5/200/1500
CO ₂	60,000			16,740	5,000/30,000/NA/50,000
propane	400			111	1,000/1250/NA/20,000
nitrogen	929,600			balance	Simple asphyxiant
O ₂	0.0%			15.25% [21% x (190-52)/190]	19.5%
GMC Safari		50/52	163/4.62 ⁽²⁾		
CO	10,000			3,200	35/52.5/200/1500
CO ₂	60,000			19,500	5,000/30,000/NA/50,000
propane	400			130	1,000/1250/NA/20,000
nitrogen	929,600			balance	Simple asphyxiant
O ₂	0.0%			14.3% [21x(163-52)/163]	19.5% minimum
Dodge Caravan/van (QA at Test Stations)		50/52	262/7.42 (cargo area volume)		
CO	10,000+30,000+60,000 (total of 3 tanks)			20,200	35/52.5/200/1500
CO ₂	0+60,000+140,000 (total of 3 tanks) or 60,000+100,000+140,000 (total of 3 tanks)			40,500 60,800	5,000/30,000/NA/50,000
propane	400+1200+2200 (total of 3 tanks)			770	1,000/1250/NA/20,000

Table 10
Potential Air Contaminant Concentrations In I/M Vehicles

Vehicle	Concentration In Tank ^{1/} (ppm)	Standard Tank # ^{2/} (#/ft ³)	Volume of Vehicle Air Space ^{3/} (ft ³ /m ³)	Concentration in Vehicle if Tank Empties (ppm) ^{4/}	TWA/STEL/ceiling/IDLH ^{5/ & 6/} (ppm)
nitrogen	balance				Simple asphyxiant
O ₂	0.0%			8.5% [21x(262-156)/262]	19.5% minimum
Chevrolet/full size van (QA Test Stations)		50/52	786/22.3 (assumed 3 x 262 -vol of Caravan)		
CO	10,000+30,000+60,000 (total of 3 tanks)			6,700	35/52.5/200/1500
CO ₂	0+60,000+140,000 (total of 3 tanks) or 60,000+100,000+140,000 (total of 3 tanks)			13,500 20,200	5,000/30,000/NA/50,000
propane	400+1200+2200 (total of 3 tanks)			255	1,000/1250/NA/20,000
nitrogen	balance				Simple asphyxiant
O ₂	0.0%			16.8% [21%(786-156)/786]	19.5% minimum

See notes 1/, 2/, 3/, 4/, & 5/ beginning on page following Table 11.

Table 11
Potential SO₂ Concentrations in Engineering Lab And Transport Vehicles

Laboratory/ Vehicle	Concentration in Tank (ppm)	Standard Tank # ^{2/} #/ volume in ft ³)	Volume of Vehicle/Lab Air Space (ft ³ /m ³) ^{7/}	Concentration in Confined Space if Tank Empties (ppm) ^{7/}	TWA/STEL/Ceiling/IDLH ^{5/ & 6/} (ppm)
Engineering Laboratory/CEMS (HQ building)	1,000	30/28	8580/743	3.3	2/5/NA/100
Compressed Gas Storage Room (HQ building)	1,000		6564/186	4.3	2/5/NA/100
Vehicle (Chevy Van)	1,000	30/28	84/2.4	336	2/5/NA/100

See notes 2/, 5/, 6/, and 7/ on the following pages.

NOTE 1/: Calibration Gas Mixtures:

1 bottle of each of the three following blends may be held in reserve for test station referee situations only. Stored in tank room. Transported together in QA vehicle. **NOTE: This may not be current AQP policy.**

1. 1 Mole-% Carbon Monoxide, ± EPA Protocol-1, 400 ppm Propane, ±1% EPA Protocol-1 Balanced in Nitrogen (\$252.00)
2. 3 Mole-% Carbon Monoxide, ±1% EPA Protocol-1, 1200 ppm Propane, ±1% EPA Protocol-1, 6 Mole-% Carbon Dioxide, ±1% EPA Protocol-1, Balanced in Nitrogen (\$457.00)
3. 6 Mole-% Carbon Monoxide, ±1% EPA Protocol-1, 2200 ppm Propane, ±1% EPA Protocol-1, 14 Mole-% Carbon Monoxide, ±1% EPA Protocol-1, Balanced in Nitrogen (\$457.00)

The following three blends are used for test station quality assurance. One bottle of each blend is transported in QA vehicle. They are stored in tank room when not being used. **NOTE: This may not be current AQP policy.**

1. 1 Mole-% Carbon Monoxide, ±1% NIST analysis, 400 ppm Propane, ±1% NIST analysis, 6 Mole-% Carbon Dioxide, ±1% NIST analysis, Balanced in Nitrogen (\$276.00)
2. 3 Mole-% Carbon Monoxide, ±1% NIST analysis, 1200 ppm Propane, ±1% NIST analysis, 10 Mole-% Carbon Dioxide, ±1% NIST analysis, Balanced in Nitrogen (\$276.00)
3. 6 Mole-% Carbon Monoxide, ±1% NIST analysis, 2200 ppm Propane, ±1% NIST analysis, 14 Mole-% Carbon Dioxide, ±1% NIST analysis, Balanced in Nitrogen (\$276.00)

The blend below is used for repair shop audits. Only one bottle is transported in a vehicle at any one time. (Ford Escort SWs, Ford Taurus SWs & Chevrolet S-10 Pickup w/canopy).

1 Mole-% Carbon Monoxide, ±2% Secondary analysis, 400 ppm Propane, ±2% Secondary analysis, 6 Mole-% Carbon Dioxide, ±2% Secondary analysis, Balanced in Nitrogen (\$166.00)

Notes: 1 mole % = 10,000 ppm

NOTE 2/: The standard tank numbers and volumes are as follows: **NOTE: This may not be current information.**

Table 12 Standard Tank Specification	
Standard Tank Number	Standard Tank Volume (ft ³)
30	28
50	52
100	105
150	143

NOTE 3/: The volumes were measured and calculated by Terry Whittmeier (NWRO vehicles) with the exception of the Safari. The respective dealerships were contacted to confirm the volumes of the interior air spaces. Chrysler and Ford had no specifications available, GMC's spec sheet for the Safari reported a volume of 163 ft³.

NOTE 4/: Calculations:

These calculations are based on the Chlorine/Ammonia Work Practice Guidelines provided by Rick Paulette (206-956-5473), Industrial Hygienist with the Department of Labor and Industry's Region IV Consultation Section (attachment 1, page D.2-10).

Interior volume of the Ford Escort Station Wagon = 190 ft³ (measured and calculated by Terry Whittmeier)

$$190 \text{ ft}^3 \times 1/35.3 \text{ m}^3/\text{ft}^3 = 5.38 \text{ m}^3$$

$$1 \text{ mole-\% of CO} = 10,000 \text{ ppm}$$

$$6 \text{ mole-\% of CO}_2 = 60,000 \text{ ppm}$$

$$\text{propane} = 400 \text{ ppm}$$

Nitrogen has no PELs. Nitrogen is a simple asphyxiant (WAC 296-62-0711, p.1499 and Table 1, p. 1510) which means that the limiting factor is available oxygen. The minimal oxygen content shall be 19.5% by volume under normal atmospheric pressure (partial pressure of pO₂ mm Hg).

$$\text{Molecular weight of CO} = 28$$

$$\text{Molecular weight of CO}_2 = 44$$

$$\text{Molecular weight of propane} = 44.1$$

$$\text{Volume of a \#50 tank} = 52 \text{ ft}^3$$

$$\text{There are 24.5 liters of gas per mole @ 760mm Hg \& 25}^\circ\text{C}$$

Basis of calculations: The cylinder(s) are completely emptied and their contents displace an equal volume of air in the vehicle. None of the cylinder gases escape the vehicle. This is a worst case scenario.

For the worst case scenario, vehicles transporting the cylinder(s) were assumed to be the smallest by volume available to AQP.

Quantity of gases in the #50 cylinder:

$$\text{CO: } 10,000 \text{ ppm} \times 1.16^* \text{ mg/m}^3 \times 52 \text{ ft}^3 \times 1 \text{ m}^3/35.3 \text{ ft}^3 = 17,088 \text{ mg/1.00 ppm}$$

$$\text{CO}_2: 60,000 \text{ pip} \times 1.83^* \text{ mg/m}^3 \times 52 \text{ ft}^3 \times 1 \text{ m}^3/35.3 \text{ ft}^3 = 161,745 \text{ mg/1.00 pip}$$

$$\text{Propane: } 400 \text{ pip} \times 1.83^* \text{ mg/m}^3 \times 52 \text{ ft}^3 \times 1 \text{ m}^3/35.3 \text{ ft}^3 = 1,078 \text{ mg/1.00 pip}$$

Nitrogen: balance

* Conversion Factor taken from "Pocket Guide to Chemical Hazards" published by the National Institute for Safety and Health (NIOSH).

Concentration of gases in the breathing space of the vehicle in the event the tank empties:

$$\text{CO: } \frac{17,088 \text{ mg}}{5.38 \text{ m}^3} = 3,176 \text{ mg/m}^3 \quad 3,176 \text{ mg/m}^3 \times \frac{24.5}{28} = 2,779 \text{ pip CO}$$

$$\text{CO}_2: \frac{161,745 \text{ mg}}{5.38 \text{ m}^3} = 30,064 \text{ mg/m}^3 \quad 30,064 \text{ mg/m}^3 \times \frac{24.5}{44} = 16,740 \text{ ppm CO}_2$$

$$\text{Propane: } \frac{1,078 \text{ mg}}{5.38 \text{ m}^3} = 200 \text{ mg/m}^3 \quad 200 \text{ mg/m}^3 \times \frac{24.5}{44.1} = 111 \text{ ppm propane}$$

$$\text{Oxygen: } 21\% \times \frac{(190 - 52) \text{ ft}^3}{190 \text{ ft}^3} = 15.25\%$$

NOTE 5/: WAC 296-62-075, PART H, Air Contaminants, defines the PELs (TWA, STEL, and Ceiling) and provides a listing of PELs for many air contaminants.

NOTE 6/: The National Institute for Occupational Safety and Health (NIOSH) publishes the "*Pocket Guide to Chemical Hazards*." This publication contains Immediately Dangerous to Life or Health Concentrations (IDLH) for certain chemicals/gases. The purpose of establishing an IDLH exposure concentration is to "ensure that the worker can escape from a given contaminated environment in the even of failure of the respiratory protection equipment."

NOTE 7/:

SO ₂ 1 ppm = 2.66 mg/m ³	
Quantity of Gas in #30 cyl.	
SO ₂ : (1,000 PPM) (2.66 mg) (28 ft ³) (1)	= 2110 mg
1 ppm	35 m ³ /ft ³
Conc of gas in breathing space should cylinder empty:	
1 tank SO ₂ : (2110 mg) = 8.68 mg/m ³	8.68 $\frac{\text{mg}}{\text{m}^3} \times \frac{24.5}{64.1} = 3.3 \text{ ppm} > 2 \text{ (TWA)}$
in lab	243 m ³
1 tank SO ₂ : (2110 mg) = 879 mg/m ³	879 $\frac{\text{mg}}{\text{m}^3} \times \frac{24.5}{64.1} = 336 \text{ ppm} > 2 \text{ (TWA)} > 5 \text{ (STEL)} > 100 \text{ IDLH}$
in van	2.4 m ³
1 tank SO ₂ : $\frac{2110 \text{ mg}}{186 \text{ m}^3} = 11.3 \text{ mg/m}^3$	$11.3 \frac{\text{mg}}{\text{m}^3} \times \frac{24.5}{64.1} = 4.3 \text{ ppm} > 2 \text{ (TWA)}$
in gas store room	186 m ³

Chlorine/Ammonia Work Practices

(Excerpted from a December 5, 1991, memo from the Department of Labor and Industries to the Regional Administrators.)

Chlorine and ammonia systems are used in a variety of industrial settings for both processing and manufacturing purposes. Due to the inherent hazards associated with these chemicals, employers are required to develop specific guidelines and practices for their safe use. The following information has been developed for field staff members when encountering work sites which utilize one of these systems and should be used to evaluate the appropriateness of the employers existing program.

Work Practices

Several field staff members have raised questions regarding the interpretation of safe work practices and respiratory protection requirements for employees engaged in chlorine and ammonia system work. Specifically, these questions deal with the issues of policy and procedures for both routine maintenance and emergency response activities. In order to clarify these issues and maintain consistent enforcement policy, the following discussion will examine these questions.

Routine Maintenance

During routine maintenance operations such as chlorine/ammonia system repair or cylinder replacement, the use of respiratory protection (pressure demand self contained breathing apparatus or full facepiece canister gas mask) would not normally be required. However, since preventing releases of chlorine or ammonia is not always possible, respiratory equipment should be selected based on careful evaluation of hazards and air contaminant calculations. To illustrate this, the chlorine manual states that when containers or cylinders are connected to or disconnected from plant piping, small releases of chlorine may occur. For precautionary measures, the manual advises that appropriate respiratory and eye protection be worn during such operations. Chemical cartridge respirators, provide some protection; a half face APR with gas-tight goggles up to 5 ppm and a full face APR up to 10 ppm (current as of July 2003). Although these respirators may be used for escape purposes, keep in mind that if it is anticipated that chlorine levels may exceed the IDLH (10 ppm; current as of July 2003), or if chlorine monitoring equipment is not used to sample the air in the vicinity of the workers, the use of a pressure demand self-contained breathing apparatus would be required.

Evacuation

Employers who will evacuate their employees from the danger zone when an emergency occurs and do not permit any of their employees to assist in handling the emergency must develop and implement an egress plan for proper actions to take in the event of an emergency. It is required that this plan be developed in written format and prohibit employees from re-entering the worksite following an evacuation order. Compliance officers should verify this policy through employee interviews.

In enclosed work locations or areas with limited means of egress it may be determined that an uncontrolled release of chlorine or ammonia would expose workers to hazardous exposure concentrations during an emergency evacuation. In this situation the facility is required to provide respiratory protection for emergency egress purposes.

Ammonia Concentration Calculation Examples

A cold storage room uses an ammonia gas refrigerant system. The compressor and ammonia storage tanks are located in a room separate from the main storage facility.

Calculations

Room Size: $150' \times 120' \times 20' = 360,000 \text{ Ft}^3$

One Pound of Ammonia Gas = 454 grams (454,000 mg)

Mol. Wt. Ammonia = $17 \frac{360,000 \text{ Ft}^3}{35.3} = 10,198 \text{ M}^3$

$\frac{454,000 \text{ mg}}{10,198 \text{ M}^3} = 45 \text{ mg/M}^3$ $24.5 \text{ l/gas mole @ } 760 \text{ mm Hg \& } 25^\circ\text{C}$

$45 \text{ mg/M}^3 \times \frac{24.5}{17.0} = 65 \text{ PPM Ammonia}$

If five pounds of ammonia were released, the calculated airborne concentration would be 325 PPM. The IDLH for ammonia is 300 PPM (current as of July 2003).

Note: Calculation based on complete release and mixing. Greater concentrations may exist near the escape source during release.

Chlorine Concentration Calculation Examples

A small water purification plant has a 10 pound chlorine cylinder located in the basement of the treatment building. The only means of escape is by the stairwell which is located on the far side of the room. There is a concern as to the potential airborne concentration that could be generated if the total contents of the cylinder were released into room.

Calculations

Room Size: $100' \times 120' \times 10' = 120,000 \text{ Ft}^3$

One Pound of Chlorine Gas = 454 grams (454,000 mg)

$\frac{120,000 \text{ Ft}^3}{35.3} = 3399 \text{ M}^3$ Mol. Wt. Chlorine = 35.5

$\frac{454,000 \text{ mg}}{3399 \text{ M}^3} = 134 \text{ mg/M}^3$ $24.5 \text{ l/gas mole @ } 760\text{mm Hg \& } 25^\circ\text{C}$

$134 \text{ mg/M}^3 \times \frac{24.5}{35.5} = 92 \text{ PPM Chlorine}$

If ten pounds of chlorine were released, the calculated airborne concentration would be 920 PPM. The IDLH for chlorine is 10 PPM (current as of July 2003).

Note: Calculation based on complete release and mixing. Greater concentration may exist near the escape source during release.

Compressed Gas Hazards

<u>Table #</u>	<u>Activity</u>
13	Facility Inspections (Compliance)
14	CEMs
15	Ambient Air Quality Compliance Monitoring
16	Meteorological Monitoring
17	I/M
18	Calibration & Repair
19	Quality Assurance

Table 13 Compressed Gas Hazards Facility Inspections (Compliance)	
Content of Cylinder:	Isobutylene (in Air)
Application:	Calibration of Microtip for PM ₁₀
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	<20
Concentration (PPM):	100
LEL,UEL:	NA
<ul style="list-style-type: none"> • Color/Odor: • Isobutylene • Air 	<ul style="list-style-type: none"> Colorless/slightly olefinic Colorless/odorless
H A Z A R D S	
<p>1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.</p> <p>2. Inhalation:</p> <p style="padding-left: 40px;">a) Exposure Limits: There are no published PELs for Isobutylene</p> <p style="padding-left: 40px;">b) Toxicological properties: There are no toxicological properties reported on the MSDS for Isobutylene.</p>	
S Y M P T O M S O F O V E R E X P O S U R E	
<ul style="list-style-type: none"> • There are no symptoms reported on the MSDS. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • Isobutylene in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of Isobutylene. 	

Table 14 Compressed Gas Hazards Continuous Emission Monitoring (CEM)	
Content of Cylinder:	Compressed Air
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	???
LEL,UEL:	NA
<ul style="list-style-type: none"> • Color/Odor: • Air 	Colorless/odorless
H A Z A R D S	
<p>1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.</p> <p>2. Inhalation</p> <p>a) Exposure Limits: There are no published PELs for compressed air.</p> <p>b) Toxicological properties: There are no toxicological properties reported on the MSDS for compressed air.</p>	
S Y M P T O M S O F O V E R E X P O S U R E	
<ul style="list-style-type: none"> • There are no symptoms reported on the MSDS. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • Compressed air in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems. • Store cylinders in a dry, cool, well ventilated area. Avoid heat, flame or sparks. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of compressed air. 	

Table 14 (con't) Compressed Gas Hazards Continuous Emission Monitoring (CEM)	
Content of Cylinder:	Benzene
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	1.03-1.15
LEL,UEL:	1.3/7.1
<ul style="list-style-type: none"> • Color/Odor: • Benzene 	Colorless/aromatic
H A Z A R D S	
<p>1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.</p> <p>2. Inhalation</p> <p>a) Exposure Limits:</p> <ol style="list-style-type: none"> 1) 1 ppm is the legal Time Weighted Average (TWA). Employees may not be exposed to concentrations above 1 ppm over the course of an 8-hour work day. 2) 5 ppm is the legal Short Term Exposure Limit (STEL). The STEL is the 15-minute time weighted average that may not be exceeded during any 15 minute time period during a work day unless another time limit is specified. 3) No legal Ceiling reported. 4) No IDLH reported. <p>b) Toxicological properties:</p> <ol style="list-style-type: none"> 1) Benzene is a carcinogen. 2) Benzene can penetrate the skin and cause poisoning. 3) Benzene causes erythema and burning of the skin. 4) Vapor or mist is irritating to the eyes, mucous membranes and upper respiratory tract. 	
S Y M P T O M S O F O V E R E X P O S U R E	
<p>Acute:</p> <ul style="list-style-type: none"> • May cause headache, nausea, dizziness, weakness, loss of appetite, and lassitude. • May cause tightness of chest, breathlessness, collapse, pneumonia, and bronchitis. <p>Chronic:</p> <ul style="list-style-type: none"> • May cause cancer (leukemia), injury to blood forming tissue and bone marrow. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • Benzene in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems. • Store cylinders in well ventilated area. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of benzene. 	

Table 14 (con't) Compressed Gas Hazards Continuous Emission Monitoring (CEM)	
Content of Cylinder:	Carbon Monoxide (in Air)
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	2,000
LEL,UEL:	12.5/74
• Color/Odor:	
• CO	Colorless/odorless
• Air	Colorless/odorless
H A Z A R D S	
<p>1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.</p> <p>2. Inhalation</p> <p>a) Exposure Limits:</p> <p>CO: NOTE: CO is dangerously toxic at the concentrations used by staff (10,000 - 100,000 ppm)</p> <ol style="list-style-type: none"> 1) 35 ppm is the legal Time Weighted Average (TWA). Employees may not be exposed to concentrations above 35 ppm over the course of an 8-hour work day. 2) 52.5 ppm (35ppm * 1.5) is the legal Short Term Exposure Limit (STEL). The STEL is the 15-minute time weighted average that may not be exceeded during any 15 minute time period during a work day unless another time limit is specified. 3) 200 ppm is the legal Ceiling. This concentration may not be exceeded for any period of time during a work day. 4) 1500 ppm is the Immediately Dangerous to Life or Health (IDLH). NIOSH <p>Air:</p> <ol style="list-style-type: none"> 1) There are no published PELs for compressed air. 2) Toxicological properties: <p>CO:</p> <ol style="list-style-type: none"> 1) Chemical asphxiant which reacts with the blood hemoglobin preventing hemoglobin from taking up oxygen. <p>Air:</p> <ol style="list-style-type: none"> 1) There are no toxicological properties reported on the MSDS for compressed air. 	
S Y M P T O M S O F O V E R E X P O S U R E	
<p>CO:</p> <ul style="list-style-type: none"> • 400-1,000 ppm Continuous exposure can produce headache, confusion, and nausea in a few hours. • 2,000- 3,000 ppm continuous exposure can cause unconscious in 30 minutes. • >3,000 ppm can cause unconsciousness and death. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • CO in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems. • Store cylinders in a dry, cool, well ventilated area. Ventilate enclosed areas to prevent O₂ deficient atmospheres or buildup of high CO concentrations. Avoid heat, flame or sparks. • If O₂ deficient atmospheres or high CO atmospheres are suspected or occur, use monitoring equipment. • Self-contained breathing apparatus is required in O₂ deficient atmospheres. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of CO. 	

Table 14 (con't) Compressed Gas Hazards Continuous Emission Monitoring (CEM)	
Content of Cylinder:	Sulfur dioxide (in N ₂)
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	2,000
LEL,UEL:	NA/NA
<ul style="list-style-type: none"> • Color/Odor: • SO₂ • N₂ 	Colorless/irritating & pungent Colorless/odorless
H A Z A R D S	
1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.	
2. Inhalation <ul style="list-style-type: none"> a) Exposure Limits: SO₂: NOTE: SO₂ is dangerously toxic at the concentrations used by staff (2,000 ppm) <ul style="list-style-type: none"> 1) 2 ppm is the legal Time Weighted Average (TWA). Employees may not be exposed to concentrations above 35 ppm over the course of an 8-hour work day. 2) 5 ppm is the legal Short Term Exposure Limit (STEL). The STEL is the 15-minute time weighted average that may not be exceeded during any 15 minute time period during a work day unless another time limit is specified. 3) No legal Ceiling reported. 4) No IDLH reported. N₂: <ul style="list-style-type: none"> 1) Simple asphyxiant (it will displace O₂ in air). Breathing space of worker must be > or = 19.5% O₂. 2) Excessive exposures may be fatal. 3) Toxicological properties SO₂: <ul style="list-style-type: none"> 1) Corrosive and irritating to the upper respiratory tract, skin and eyes. 2) Contact with liquid SO₂ may cause skin burns. 3) Eye contact may result in destruction of eye tissue. N₂: <ul style="list-style-type: none"> 1) Simple asphyxiant (it will displace O₂ in air). 	
S Y M P T O M S O F O V E R E X P O S U R E	
SO ₂ : <ul style="list-style-type: none"> Acute: Excessive inhalation may cause burning sensations, coughing, shortness of breath, headache, nausea and vomiting and may produce bronchitis, chemical pneumonia, and pulmonary edema. Chronic: Pulmonary disease or loss of pulmonary function. 	
N ₂ : <ul style="list-style-type: none"> 1) O₂ deficient atmospheres may produce rapid respiration, dizziness, nausea, vomiting, loss of consciousness and death. 2) Death may result from errors in judgment, confusion, or loss of consciousness which prevents self-rescue. 3) At low concentrations, unconsciousness and death may occur in seconds without warning. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • SO₂ should be handled in a fume hood. Provide adequate general and local exhaust ventilation to maintain concentration below exposure limits. • Store cylinders in well ventilated areas only. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of SO₂. 	

Table 14 (con't) Compressed Gas Hazards Continuous Emission Monitoring (CEM)	
Content of Cylinder:	Hydrogen (in Air)
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	??????
LEL,UEL:	4/75
<ul style="list-style-type: none"> • Color/Odor: • H₂ • Air 	<ul style="list-style-type: none"> Colorless/odorless Colorless/odorless
H A Z A R D S	
<p>1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.</p> <p>2. Inhalation</p> <p style="padding-left: 40px;">a) Exposure Limits:</p> <p style="padding-left: 80px;">H₂</p> <p style="padding-left: 120px;">1) Simple asphxiant (it will displace O₂ in air). Breathing space of worker must be > or = 19.5% O₂.</p> <p style="padding-left: 80px;">Air:</p> <p style="padding-left: 120px;">1) There are no published PELs for Air</p> <p style="padding-left: 80px;">H₂:</p> <p style="padding-left: 120px;">1) Simple asphxiant (it will displace O₂ in air).</p> <p style="padding-left: 80px;">Air:</p> <p style="padding-left: 120px;">1) There are no toxicological properties reported on the MSDS for Air.</p>	
S Y M P T O M S O F O V E R E X P O S U R E	
<p>H₂:</p> <ul style="list-style-type: none"> • Hydrogen acts as a simple asphyxiant by displacing oxygen. Oxygen deficient atmospheres may produce rapid respiration, muscular in coordination, fatigue, nausea, vomiting, and loss of consciousness. <p>N₂:</p> <ul style="list-style-type: none"> • O₂ deficient atmospheres may produce rapid respiration, dizziness, nausea, vomiting, loss of consciousness and death. • Death may result from errors in judgment, confusion, or loss of consciousness which prevents self-rescue. • At low concentrations, unconsciousness and death may occur in seconds without warning. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • H₂ in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems. • Quantities > 400 scf should be stored in specially ventilated rooms or outside. • Store away from oxidizers, combustible materials, sources of heat (should never be exposed to > 125 °F) or ignition sources. Ventilation equipment should be explosion proof. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of hydrogen. 	

Table 15 Compressed Gas Hazards Ambient Air Quality Compliance Monitoring	
Content of Cylinder:	Compressed Air
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	NA
LEL,UEL:	NA
<ul style="list-style-type: none"> • Color/Odor: • Air 	Colorless/odorless
H A Z A R D S	
<p>1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.</p> <p>2. Inhalation:</p> <p>a) Exposure Limits:</p> <p>1) There are no published PELs for compressed air.</p> <p>b) Toxicological properties:</p> <p>1) There are no toxicological properties reported on the MSDS for compressed air.</p>	
S Y M P T O M S O F O V E R E X P O S U R E	
<ul style="list-style-type: none"> • There are no symptoms reported on the MSDS. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • Compressed air in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems. • Store cylinders in a dry, cool, well ventilated area. Avoid heat, flame or sparks. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of compressed air. 	

Table 15 (con't) Compressed Gas Hazards Ambient Air Quality Compliance Monitoring	
Content of Cylinder:	Carbon Monoxide (in Air)
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	????
LEL,UEL:	12.5/74
<ul style="list-style-type: none"> • Color/Odor: • CO • Air 	<ul style="list-style-type: none"> Colorless/odorless Colorless/odorless
H A Z A R D S	
<p>1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.</p> <p>2. Inhalation</p> <p>a) Exposure Limits:</p> <p>CO: NOTE: CO is dangerously toxic at the concentrations used by staff (10,000 - 100,000 ppm)</p> <ol style="list-style-type: none"> 1) 35 ppm is the legal Time Weighted Average (TWA). Employees may not be exposed to concentrations above 35 ppm over the course of an 8-hour work day. 2) 52.5 ppm (35ppm * 1.5) is the legal Short Term Exposure Limit (STEL). The STEL is the 15-minute time weighted average that may not be exceeded during any 15 minute time period during a work day unless another time limit is specified. 3) 200 ppm is the legal Ceiling. This concentration may not be exceeded for any period of time during a work day. 4) 1500 ppm is the Immediately Dangerous to Life or Health (IDLH). NIOSH <p>Air: There are no published PELs for compressed air.</p> <ol style="list-style-type: none"> 1) Toxicological properties: <p>CO:</p> <ol style="list-style-type: none"> 1) Chemical asphxiant which reacts with the blood hemoglobin preventing hemoglobin from taking up oxygen. <p>Air:</p> <ul style="list-style-type: none"> • There are no toxicological properties reported on the MSDS for compressed air. 	
S Y M P T O M S O F O V E R E X P O S U R E	
<p>CO:</p> <ul style="list-style-type: none"> • 400-1,000 ppm Continuous exposure can produce headache, confusion, and nausea in a few hours. • 2,000- 3,000 ppm continuous exposure can cause unconscious in 30 minutes. • >3,000 ppm can cause unconsciousness and death. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • CO in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems. • Store cylinders in a dry, cool, well ventilated area. Ventilate enclosed areas to prevent O₂ deficient atmospheres or buildup of high CO concentrations. Avoid heat, flame or sparks. • If O₂ deficient atmospheres or high CO atmospheres are suspected or occur, use monitoring equipment. • Self-contained breathing apparatus is required in O₂ deficient atmospheres. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of CO. 	

Table 15 (con't) Compressed Gas Hazards Ambient Air Quality Compliance Monitoring	
Content of Cylinder:	Freon-12 (Dichlorodiflouromethane)
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	???????
LEL,UEL:	NA
<ul style="list-style-type: none"> • Color/Odor: • Freon 	blue/very slight ethereal to odorless
H A Z A R D S	
<p>1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.</p> <p>2. Inhalation</p> <p>a) Exposure Limits:</p> <p>Freon NOTE: Freon is toxic at concentrations above 1,000 ppm</p> <ol style="list-style-type: none"> 1) 1,000 ppm is the Threshold Limit Value reported by ACGIH. 2) There is no published Short Term Exposure Limit (STEL) for Freon. 3) There is no published Ceiling for Freon. 4) There is no Immediately Dangerous to Life or Health (IDLH) published by NIOSH for Freon. <p>b) Toxicological properties:</p> <ol style="list-style-type: none"> 1) See MSDS for description of animal studies. 	
S Y M P T O M S O F O V E R E X P O S U R E	
<p>Acute:</p> <ul style="list-style-type: none"> • Humans exposed to 1,000 ppm (for 2-1/2 - 8 hours) showed no adverse effects. • Humans exposed to 40,000 ppm (for 14 min) experienced a tingling, humming in the ears, apprehension and slurred speech. • At 110,000 ppm (for 11 min) the subject showed a decrease in consciousness with amnesia occurring in 10 min. • Over 100 daths have been reported related to sniffing fluorocarbon propellents. They exhibit very toxic properties when sniffed (asphyxiation and cardiac arhythmias). <p>Chronic:</p> <ul style="list-style-type: none"> • Eight human volunteers were exposed to i,000 ppm for 8hrs/day for 2-1/2 weeks w/no recorded abnormalities. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • Freon in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems. • If concentrations exceed 1000 ppm use an approved respirator for organic vapors. • Store cylinders in a dry, cool, well ventilated area. Avoid heat, flame or sparks. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of freon-12. 	

Table 15 (con't) Compressed Gas Hazards Ambient Air Quality Compliance Monitoring	
Content of Cylinder:	Helium
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	???????
LEL,UEL:	NA/NA
<ul style="list-style-type: none"> • Color/Odor: • Helium 	Colorless/odorless
H A Z A R D S	
<p>1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.</p> <p>2. Inhalation</p> <p>a) Exposure Limits:</p> <p>1) Simple asphxiant (it will displace O₂ in air). Breathing space of worker must be > or = 19.5% O₂.</p> <p>b) Toxicological properties:</p> <p>1) Contact with liquid may cause extensive tissue damage or burns.</p>	
S Y M P T O M S O F O V E R E X P O S U R E	
<p>Acute:</p> <ul style="list-style-type: none"> • My cause dizziness, nausea, vomiting, loss of consciousness, confusion, collapse and death. • Death may result from errors in judgment, confusion, or loss of consciousness which prevents self-rescue. • At low concentrations, unconsciousness and death may occur in seconds without warning. <p>Chronic:</p> <ul style="list-style-type: none"> • None reported on the MSDS. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • Helium in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems. • Store in well ventilated areas only. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of helium. 	

Table 15 (con't) Compressed Gas Hazards Ambient Air Quality Compliance Monitoring	
Content of Cylinder:	Hydrogen (in Air)
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	?????
LEL,UEL:	4/75
<ul style="list-style-type: none"> • Color/Odor: • H₂ • Air 	Colorless/odorless Colorless/odorless Colorless/odorless
H A Z A R D S	
<p>1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.</p> <p>2. Inhalation</p> <p style="padding-left: 40px;">a) Exposure Limits:</p> <p style="padding-left: 80px;">H₂</p> <p style="padding-left: 120px;">1) Simple asphxiant (it will displace O₂ in air). Breathing space of worker must be > or = 19.5% O₂.</p> <p style="padding-left: 80px;">Air:</p> <p style="padding-left: 120px;">1) There are no published PELs for Air</p> <p style="padding-left: 80px;">H₂:</p> <p style="padding-left: 120px;">1) Simple asphxiant (it will displace O₂ in air).</p> <p style="padding-left: 80px;">Air:</p> <p style="padding-left: 120px;">1) There are no toxicological properties reported on the MSDS for Air.</p>	
S Y M P T O M S O F O V E R E X P O S U R E	
<p>H₂:</p> <ul style="list-style-type: none"> • Hydrogen acts as a simple asphyxiant by displacing oxygen. Oxygen deficient atmospheres may produce rapid respiration, muscular in coordination, fatigue, nausea, vomiting, and loss of consciousness. <p>N₂:</p> <ul style="list-style-type: none"> • O₂ deficient atmospheres may produce rapid respiration, dizziness, nausea, vomiting, loss of consciousness and death. • Death may result from errors in judgment, confusion, or loss of consciousness which prevents self-rescue. • At low concentrations, unconsciousness and death may occur in seconds without warning. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • H₂ in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems. • Quantities > 400 scf should be stored in specially ventilated rooms or outside. • Store away from oxidizers, combustible materials, sources of heat (should never be exposed to > 125 °F) or ignition sources. Ventilation equipment should be explosion proof. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of hydrogen. 	

Table 15 (con't) Compressed Gas Hazards Ambient Air Quality Compliance Monitoring	
Content of Cylinder:	Hydrogen sulfide (in N ₂)
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	???????
LEL,UEL:	4/44
<ul style="list-style-type: none"> • Color/Odor: • H₂S • N₂ 	<p>Colorless/odorless</p> <p>Colorless/odorless</p>
H A Z A R D S	
<p>1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.</p> <p>2. Inhalation</p> <p style="padding-left: 40px;">a) Exposure Limits:</p> <p style="padding-left: 80px;">H₂S:</p> <ol style="list-style-type: none"> 1) 10 ppm is the legal Time Weighted Average (TWA). Employees may not be exposed to concentrations above 35 ppm over the course of an 8-hour work day. 2) 15 ppm is the legal Short Term Exposure Limit (STEL). The STEL is the 15-minute time weighted average that may not be exceeded during any 15 minute time period during a work day unless another time limit is specified. 3) There is no Ceiling published. 4) 300 ppm is the Immediately Dangerous to Life or Health (IDLH) published by NIOSH. <p style="padding-left: 80px;">N₂: Simple asphxiant (it will displace O₂ in air). Breathing space of worker must be > or = 19.5% O₂.</p> <p style="padding-left: 40px;">b) Toxicological properties:</p> <p style="padding-left: 80px;">N₂: Simple asphxiant (it will displace O₂ in air).</p>	
S Y M P T O M S O F O V E R E X P O S U R E	
<p>N₂:</p> <ul style="list-style-type: none"> • O₂ deficient atmospheres may produce rapid respiration, dizziness, nausea, vomiting, loss of consciousness and death. • Death may result from errors in judgment, confusion, or loss of consciousness which prevents self-rescue. • At low concentrations, unconsciousness and death may occur in seconds without warning. <p>H₂S:</p> <ul style="list-style-type: none"> • 20-150 ppm produces mild to severe eye irritation. • 500 ppm for 30 minutes may produce headache, dizziness, gastroenteric disorders and pneumonia. • >600 ppm can be fatal within 30 minutes through respiratory paralysis. • Sense of smell is lost at high concentrations. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • H₂S in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems. • Store cylinders in a dry, cool, well ventilated area. Ventilate enclosed areas to prevent O₂ deficient atmospheres or buildup of high CO concentrations. Avoid heat, flame or sparks. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of H₂S. 	

Table 15 (con't) Compressed Gas Hazards Ambient Air Quality Compliance Monitoring	
Content of Cylinder:	Isobutylene (in Air)
Application:	Calibration of Microtip for PM ₁₀
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	<20
Concentration (PPM):	????
LEL,UEL:	NA
<ul style="list-style-type: none"> • Color/Odor: • Isobutylene • Air 	<ul style="list-style-type: none"> Colorless/slightly olefinic Colorless/odorless
H A Z A R D S	
<p>1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.</p> <p>2. Inhalation</p> <p style="padding-left: 40px;">a) Exposure Limits:</p> <p style="padding-left: 80px;">1) There are no published PELs for Isobutylene.</p> <p style="padding-left: 40px;">b) Toxicological properties:</p> <p style="padding-left: 80px;">1) There are no toxicological properties reported on the MSDS for Isobutylene.</p>	
S Y M P T O M S O F O V E R E X P O S U R E	
<ul style="list-style-type: none"> • There are no symptoms reported on the MSDS. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • Isobutylene in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of Isobutylene. 	

Table 15 (con't) Compressed Gas Hazards Ambient Air Quality Compliance Monitoring	
Content of Cylinder:	Methane
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	??????
LEL,UEL:	5/15
<ul style="list-style-type: none"> • Color/Odor: • Methane 	Colorless/odorless
H A Z A R D S	
<p>1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.</p> <p>2. Inhalation</p> <p style="padding-left: 40px;">a) Exposure Limits:</p> <p style="padding-left: 80px;">1) Simple asphyxiant (it will displace O₂ in air). Breathing space of worker must be > or = 19.5% O₂.</p> <p style="padding-left: 40px;">b) Toxicological properties:</p> <p style="padding-left: 80px;">1) Contact with liquid methane can cause freeze burns.</p>	
S Y M P T O M S O F O V E R E X P O S U R E	
Methane:	
<ul style="list-style-type: none"> • O₂ deficient atmospheres may produce dizziness, nausea, loss of consciousness and death. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • Methane in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems. • Store in a well ventilated area away from oxidizers, sources of heat (never > 125°F) and ignition. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of methane. 	

Table 15 (con't) Compressed Gas Hazards Ambient Air Quality Compliance Monitoring	
Content of Cylinder:	Nitrogen
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	???????
LEL,UEL:	NA/NA
<ul style="list-style-type: none"> • Color/Odor: • Nitrogen 	Colorless/odorless
H A Z A R D S	
<p>1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.</p> <p>2. Inhalation</p> <p style="padding-left: 40px;">a) Exposure Limits:</p> <p style="padding-left: 80px;">1) Simple asphxiant (it will displace O₂ in air). Breathing space of worker must be > or = 19.5% O₂.</p> <p style="padding-left: 40px;">b) Toxicological properties:</p> <p style="padding-left: 80px;">1) May cause cryogenic burns on liquid contact.</p>	
S Y M P T O M S O F O V E R E X P O S U R E	
Nitrogen:	
<ul style="list-style-type: none"> • O₂ deficient atmospheres may produce dizziness, nausea, loss of consciousness and death. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • Nitrogen in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems. • Store in a well ventilated area away from oxidizers, sources of heat (never > 125°F) and ignition. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of nitrogen. 	

Table 15 (con't) Compressed Gas Hazards	
Ambient Air Quality Compliance Monitoring	
Content of Cylinder:	Nitrogen oxide (Nitric oxide) (in N ₂)
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	???????
LEL,UEL:	NA/NA
<ul style="list-style-type: none"> • Color/Odor: • NO • N₂ 	Colorless/pungent & sweet Colorless/odorless
H A Z A R D S	
1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.	
2. Inhalation	
a) Exposure Limits:	
<ol style="list-style-type: none"> 1) 25 ppm is the legal Time Weighted Average (TWA). Employees may not be exposed to concentrations above 35 ppm over the course of an 8-hour work day. 2) 37.5 ppm (25ppm * 1.5) is the legal Short Term Exposure Limit (STEL). The STEL is the 15-minute time weighted average that may not be exceeded during any 15 minute time period during a work day unless another time limit is specified. 3) There is no Ceiling published. 4) 100 ppm is the Immediately Dangerous to Life or Health (IDLH). NIOSH 	
N ₂ :	
<ol style="list-style-type: none"> 1) Simple asphxiant (it will displace O₂ in air). Breathing space of worker must be > or = 19.5% O₂. 	
b) Toxicological properties:	
NO:	
<ol style="list-style-type: none"> 1) Extremely toxic gas forming irritating nitric and nitrous acids in the respiratory tract. 	
N ₂ :	
<ol style="list-style-type: none"> 1) Simple asphxiant (it will displace O₂ in air). 	
S Y M P T O M S O F O V E R E X P O S U R E	
NO:	
<ul style="list-style-type: none"> • 60-150 ppm exposure causes immediate irritation of the nose and throat, cough, burning in the chest and dizziness. 5-24 hours later delayed pulmonary edema can occur. • 200-700 ppm may be fatal after a very short exposure. 	
Mixture:	
<ul style="list-style-type: none"> • O₂ deficient atmospheres may produce rapid respiration, dizziness, nausea, vomiting, and loss of consciousness and may be fatal result from errors in judgment, confusion, or loss of consciousness which prevents self-rescue. • At low concentrations, unconsciousness and death may occur in seconds without warning. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • Use self contained breathing apparatus in emergency or rescue situations. • Enclosed areas must be provided with general or local exhaust ventilation to avoid hazardous conditions. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of NO. 	

Table 15 (con't) Compressed Gas Hazards Ambient Air Quality Compliance Monitoring	
Content of Cylinder:	Oxygen (in Air)
Application:	QA at test stations and repair shop audits
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	???????
LEL,UEL:	NA/NA
<ul style="list-style-type: none"> • Color/Odor: • Oxygen • Air 	<ul style="list-style-type: none"> Colorless/natural gas Colorless/odorless
H A Z A R D S	
<p>1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.</p> <p>2. Inhalation</p> <p style="padding-left: 40px;">a) Exposure Limits:</p> <p style="padding-left: 80px;">Oxygen:</p> <p style="padding-left: 120px;">1) No PELs published.</p> <p style="padding-left: 80px;">Air:</p> <p style="padding-left: 120px;">1) No PELs published.</p> <p style="padding-left: 40px;">b) Toxicological properties:</p> <p style="padding-left: 80px;">Oxygen:</p> <p style="padding-left: 120px;">1) A number of central nervous system effects may result form breathing oxygen greater than 2 atmospheres.</p> <p style="padding-left: 120px;">2) Contact with liquid oxygen can cause severe frostbite/freeze burns.</p>	
S Y M P T O M S O F O V E R E X P O S U R E	
<p>Oxygen:</p> <ul style="list-style-type: none"> • Symptoms of exposures of oxygen over 2 atmospheres include dizziness, impaired coordination, visual and breathing disturbances, and seizures. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • Use only oxygen cleaned equipment. Avoid oils and grease. Oxygen will react violently with hydrocarbons especially at high pressures. • Store away from combustibles and heat (never > 1225 °F). • Store in well ventilated areas. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of oxygen. 	

Table 15 (con't) Compressed Gas Hazards Ambient Air Quality Compliance Monitoring	
Content of Cylinder:	Pentane (in Air)
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	???????
LEL,UEL:	1.4/7.8
<ul style="list-style-type: none"> • Color/Odor: • Pentane • Air 	<ul style="list-style-type: none"> Colorless/mild gas Colorless/odorless
H A Z A R D S	
<p>1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.</p> <p>2. Inhalation</p> <p style="padding-left: 40px;">a) Exposure Limits:</p> <p style="padding-left: 80px;">Pentane:</p> <ol style="list-style-type: none"> 1) 600 ppm is the legal Time Weighted Average (TWA). Employees may not be exposed to concentrations above 35 ppm over the course of an 8-hour work day. 2) 750 ppm is the legal Short Term Exposure Limit (STEL). The STEL is the 15-minute time weighted average that may not be exceeded during any 15 minute time period during a work day unless another time limit is specified. 3) There is no Ceiling published. 4) 15,000 ppm is the Immediately Dangerous to Life or Health (IDLH). NIOSH <p style="padding-left: 80px;">Air:</p> <ol style="list-style-type: none"> 1) No PELs published. <p style="padding-left: 40px;">b) Toxicological properties:</p> <p style="padding-left: 80px;">Pentane:</p> <ol style="list-style-type: none"> 1) Vapors are mildly narcotic and may cause irritation to the respiratory passages. 2) Sustained exposure to high concentrations may cause central nervous system depression and narcosis. 3) Skin contact may lead to defatting of skin and dermatitis. 4) Eye contact may be irritating. 	
S Y M P T O M S O F O V E R E X P O S U R E	
<p>Pentane:</p> <ul style="list-style-type: none"> • Vapors are mildly narcotic and may cause irritation to the respiratory passages. • Sustained exposure to high concentrations may cause central nervous system depression and narcosis. • Skin contact may lead to defatting of skin and dermatitis. • Eye contact may be irritating. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • Store in well ventilated areas only. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of pentane. 	

Table 15 (con't) Compressed Gas Hazards	
Ambient Air Quality Compliance Monitoring	
Content of Cylinder:	Propane (in N ₂)
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	????????
LEL,UEL:	NA/NA
<ul style="list-style-type: none"> • Color/Odor: • Propane • N₂ 	<ul style="list-style-type: none"> Colorless/natural gas Colorless/odorless
H A Z A R D S	
<p>1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.</p> <p>2. Inhalation</p> <p style="padding-left: 40px;">a) Exposure Limits:</p> <ol style="list-style-type: none"> 1) 1,000 ppm is the legal Time Weighted Average (TWA). Employees may not be exposed to concentrations above 35 ppm over the course of an 8-hour work day. 2) 1250 ppm (1000ppm * 1.25) is the legal Short Term Exposure Limit (STEL). The STEL is the 15-minute time weighted average that may not be exceeded during any 15 minute time period during a work day unless another time limit is specified. 3) There is no Ceiling published. 4) 20,000 ppm is the Immediately Dangerous to Life or Health (IDLH). NIOSH <p style="padding-left: 40px;">Propane:</p> <ol style="list-style-type: none"> 1) Simple asphxiant (it will displace O₂ in air). Breathing space of worker must be > or = 19.5% O₂. <p style="padding-left: 40px;">b) Toxicological properties:</p> <p style="padding-left: 80px;">Propane:</p> <ol style="list-style-type: none"> 1) Simple asphxiant (it will displace O₂ in air). 2) Mild mucous membrane irritant. 3) Has some degree of anesthetic action. <p style="padding-left: 40px;">N₂:</p> <ol style="list-style-type: none"> 1) Simple asphxiant (it will displace O₂ in air). 	
S Y M P T O M S O F O V E R E X P O S U R E	
<p>Propane:</p> <ul style="list-style-type: none"> • O₂ deficient atmospheres may produce rapid respiration, dizziness, nausea, vomiting, loss of consciousness and death. • Brief exposures to 10,000 ppm cause no symptoms. • 10% concentration causes dizziness within minutes. <p>N₂:</p> <ul style="list-style-type: none"> • O₂ deficient atmospheres may produce rapid respiration, dizziness, nausea, vomiting, loss of consciousness and death. • Death may result from errors in judgment, confusion, or loss of consciousness which prevents self-rescue. <p>At low concentrations, unconsciousness and death may occur in seconds without warning.</p>	

SPECIAL PRECAUTIONS

- Propane in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems.
- Store cylinders in a dry, cool, well ventilated area. Ventilate enclosed areas to prevent O₂ deficient atmospheres or buildup of high CO concentrations. Avoid heat, flame or sparks.
- Self-contained breathing apparatus is required in O₂ deficient atmospheres.
- Read and become familiar with the MSDS. The MSDS provides more information about the safe use of propane.

Table 15 (con't) Compressed Gas Hazards

Ambient Air Quality Compliance Monitoring

Content of Cylinder:	Sulfur dioxide (in N ₂)
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	???
LEL,UEL:	NA/NA
• Color/Odor:	
• SO ₂	Colorless/irritating & pungent
• N ₂	Colorless/odorless

H A Z A R D S

1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.

2. Inhalation

a) Exposure Limits:

SO₂: NOTE: SO₂ is dangerously toxic at the concentrations used by staff (2,000 ppm)

- 1) 2 ppm is the legal Time Weighted Average (TWA). Employees may not be exposed to concentrations above 35 ppm over the course of an 8-hour work day.
- 2) 5 ppm is the legal Short Term Exposure Limit (STEL). The STEL is the 15-minute time weighted average that may not be exceeded during any 15 minute time period during a work day unless another time limit is specified.
- 3) No legal Ceiling reported.
- 4) No IDLH reported.

N₂:

- 1) Simple asphxiant (it will displace O₂ in air). Breathing space of worker must be > or = 19.5% O₂.
- 2) Excessive exposures may be fatal.

b) Toxicological properties:

SO₂:

- 1) Corrosive and irritating to the upper respiratory tract, skin and eyes.
- 2) Contact with liquid SO₂ may cause skin burns.
- 3) Eye contact may result in destruction of eye tissue.

N₂:

Simple asphxiant (it will displace O₂ in air).

SYMPTOMS OF OVEREXPOSURE**SO₂:**

Acute:

- 1) Excessive inhalation may cause burning sensations, coughing, shortness of breath, headache, nausea and vomiting.
- 2) May produce bronchitis, chemical pneumonia, and pulmonary edema.

Chronic:

- 1) Pulmonary disease or loss of pulmonary function.

N₂:

- 1) O₂ deficient atmospheres may produce rapid respiration, dizziness, nausea, vomiting, loss of consciousness and death.
- 2) Death may result from errors in judgment, confusion, or loss of consciousness which prevents self-rescue.
- 3) At low concentrations, unconsciousness and death may occur in seconds without warning.

SPECIAL PRECAUTIONS

- SO₂ should be handled in a fume hood. Provide adequate general and local exhaust ventilation to maintain concentration below exposure limits.
- Store cylinders in well ventilated areas only.
- Read and become familiar with the MSDS. The MSDS provides more information about the safe use of SO₂.

Table 16 Compressed Gas Hazards	
Meteorological Monitoring	
Content of Cylinder:	Helium
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	??????
LEL,UEL:	NA/NA
<ul style="list-style-type: none"> • Color/Odor: • Helium 	Colorless/odorless
H A Z A R D S	
<p>1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.</p> <p>2. Inhalation</p> <p>a) Exposure Limits:</p> <p>1) Simple asphxiant (it will displace O₂ in air). Breathing space of worker must be > or = 19.5% O₂.</p> <p>b) Toxicological properties:</p> <p>1) Contact with liquid may cause extensive tissue damage or burns.</p>	
S Y M P T O M S O F O V E R E X P O S U R E	
<p>Acute:</p> <ul style="list-style-type: none"> • My cause dizziness, nausea, vomiting, loss of consciousness, confusion, collapse and death. • Death may result from errors in judgment, confusion, or loss of consciousness which prevents self-rescue. • At low concentrations, unconsciousness and death may occur in seconds without warning. <p>Chronic:</p> <ul style="list-style-type: none"> • None reported on the MSDS. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • Helium in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems. • Store in well ventilated areas only. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of helium. 	

Table 17 Compressed Gas Hazards Vehicle Inspection Maintenance (I/M)	
Content of Cylinder:	Carbon Monoxide (in N ₂)
Application:	QA at test stations and repair shop audits
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	10,000-100,000
LEL,UEL:	12.5/74
<ul style="list-style-type: none"> • Color/Odor: • CO • N₂ 	Colorless/odorless Colorless/odorless Colorless/odorless
H A Z A R D S	
1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.	
2. Inhalation	
a) Exposure Limits:	
CO: NOTE: CO is dangerously toxic at the concentrations used by staff (10,000 - 100,000 ppm)	
1) 35 ppm is the legal Time Weighted Average (TWA). Employees may not be exposed to concentrations above 35 ppm over the course of an 8-hour work day.	
2) 52.5 ppm (35ppm * 1.5) is the legal Short Term Exposure Limit (STEL). The STEL is the 15-minute time weighted average that may not be exceeded during any 15 minute time period during a work day unless another time limit is specified.	
3) 200 ppm is the legal Ceiling. This concentration may not be exceeded for any period of time during a work day.	
4) 1500 ppm is the Immediately Dangerous to Life or Health (IDLH). NIOSH	
N ₂ : Simple asphxiant (it will displace O ₂ in air). Breathing space of worker must be > or = 19.5% O ₂ .	
b) Toxicological properties:	
CO: Chemical asphxiant which reacts with the blood hemoglobin preventing hemoglobin from taking up oxygen.	
N ₂ : Simple asphxiant (it will displace O ₂ in air).	
S Y M P T O M S O F O V E R E X P O S U R E	
N ₂ :	
<ul style="list-style-type: none"> • O₂ deficient atmospheres may produce rapid respiration, dizziness, nausea, vomiting, loss of consciousness and death. • Death may result from errors in judgment, confusion, or loss of consciousness which prevents self-rescue. • At low concentrations, unconsciousness and death may occur in seconds without warning. 	
CO:	
<ul style="list-style-type: none"> • 400-1,000 ppm Continuous exposure can produce headache, confusion, and nausea in a few hours. • 2,000- 3,000 ppm continuous exposure can cause unconscious in 30 minutes. • >3,000 ppm can cause unconsciousness and death. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • CO in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems. • Store cylinders in a dry, cool, well ventilated area. Ventilate enclosed areas to prevent O₂ deficient atmospheres or buildup of high CO concentrations. Avoid heat, flame or sparks. • If O₂ deficient atmospheres or high CO atmospheres are suspected or occur, use monitoring equipment. • Self-contained breathing apparatus is required in O₂ deficient atmospheres. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of CO. 	

Table 17 (con't) Compressed Gas Hazards Vehicle Inspection Maintenance (I/M)	
Content of Cylinder:	Carbon Dioxide (in N ₂)
Application:	QA at test stations and repair shop audits
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	50,000
LEL,UEL:	NA/NA
<ul style="list-style-type: none"> • Color/Odor: • CO₂ • N₂ 	<ul style="list-style-type: none"> Colorless/odorless Colorless/odorless
H A Z A R D S	
<p>1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.</p> <p>2. Inhalation</p> <p>a) Exposure Limits:</p> <p>CO₂:</p> <ol style="list-style-type: none"> 1) Simple asphxiant (it will displace O₂ in air). Breathing space of worker must be > or = 19.5% O₂. 2) 5,000 ppm is the legal Time Weighted Average (TWA). Employees may not be exposed to concentrations above 35 ppm over the course of an 8-hour work day. 3) 30,000 is the legal Short Term Exposure Limit (STEL). The STEL is the 15-minute time weighted average that may not be exceeded during any 15 minute time period during a work day unless another time limit is specified. 4) There is no published Ceiling. 5) 50,000 ppm is the Immediately Dangerous to Life or Health (IDLH) published by NIOSH <p>N₂: Simple asphxiant (it will displace O₂ in air). Breathing space of worker must be > or = 19.5% O₂.</p> <p>b) Toxicological properties:</p> <p>N₂: Simple asphxiant (it will displace O₂ in air).</p>	
S Y M P T O M S O F O V E R E X P O S U R E	
<p>CO₂:</p> <ul style="list-style-type: none"> • 100,000 ppm (10%) can be endured for only minutes. • 120,000-150,000 ppm will cause unconsciousness. • 25% may cause death after several hours of exposure. <p>N₂:</p> <ul style="list-style-type: none"> • O₂ deficient atmospheres may produce rapid respiration, dizziness, nausea, vomiting, loss of consciousness and death. • Death may result from errors in judgment, confusion, or loss of consciousness which prevents self-rescue. • At low concentrations, unconsciousness and death may occur in seconds without warning. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • CO₂ in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems. • Store cylinders in a dry, cool, well ventilated area. Ventilate enclosed areas to prevent O₂ deficient atmospheres or buildup of high CO concentrations. Avoid heat, flame or sparks. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of CO₂. 	

**Table 17 (con't) Compressed Gas Hazards
Vehicle Inspection Maintenance (I/M)**

Content of Cylinder:	Propane (in N ₂)
Application:	QA at test stations and repair shop audits
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	300-2500
LEL,UEL:	NA/NA
• Color/Odor:	
• Propane	Colorless/natural gas
• N ₂	Colorless/odorless

H A Z A R D S

1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.

2. Inhalation

a) Exposure Limits:

- 1) 1,000 ppm is the legal Time Weighted Average (TWA). Employees may not be exposed to concentrations above 35 ppm over the course of an 8-hour work day.
- 2) 1250 ppm (1000ppm * 1.25) is the legal Short Term Exposure Limit (STEL). The STEL is the 15-minute time weighted average that may not be exceeded during any 15 minute time period during a work day unless another time limit is specified.
- 3) There is no Ceiling published.
- 4) 20,000 ppm is the Immediately Dangerous to Life or Health (IDLH). NIOSH

Propane:

- 1) Simple asphxiant (it will displace O₂ in air). Breathing space of worker must be > or = 19.5% O₂.

b) Toxicological properties:

Propane

- 1) Simple asphxiant (it will displace O₂ in air).
- 2) Mild mucous membrane irritant.
- 3) Has some degree of anesthetic action.

N₂:

- 1) Simple asphxiant (it will displace O₂ in air).

S Y M P T O M S O F O V E R E X P O S U R E

Propane:

- O₂ deficient atmospheres may produce rapid respiration, dizziness, nausea, vomiting, loss of consciousness and death.
- Brief exposures to 10,000 ppm cause no symptoms.
- 10% concentration causes dizziness within minutes.

N₂:

- O₂ deficient atmospheres may produce rapid respiration, dizziness, nausea, vomiting, loss of consciousness and death.
- Death may result from errors in judgment, confusion, or loss of consciousness which prevents self-rescue.
- At low concentrations, unconsciousness and death may occur in seconds without warning.

SPECIAL PRECAUTIONS

- Propane in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems.
- Store cylinders in a dry, cool, well ventilated area. Ventilate enclosed areas to prevent O₂ deficient atmospheres or buildup of high CO concentrations. Avoid heat, flame or sparks.
- Self-contained breathing apparatus is required in O₂ deficient atmospheres.
- Read and become familiar with the MSDS. The MSDS provides more information about the safe use of propane.

Table 18 Compressed Gas Hazards Calibration and Repair	
Content of Cylinder:	Compressed Air
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	NA
LEL,UEL:	NA
<ul style="list-style-type: none"> • Color/Odor: • Air 	Colorless/odorless
H A Z A R D S	
<p>1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.</p> <p>2. Inhalation</p> <p style="padding-left: 20px;">a) Exposure Limits:</p> <p style="padding-left: 40px;">1) There are no published PELs for compressed air.</p> <p style="padding-left: 20px;">b) Toxicological properties:</p> <p style="padding-left: 40px;">1) There are no toxicological properties reported on the MSDS for compressed air.</p>	
S Y M P T O M S O F O V E R E X P O S U R E	
<ul style="list-style-type: none"> • There are no symptoms reported on the MSDS. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • Compressed air in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems. • Store cylinders in a dry, cool, well ventilated area. Avoid heat, flame or sparks. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of compressed air. 	

Table 18 (con't) Compressed Gas Hazards Calibration and Repair	
Content of Cylinder:	Carbon Monoxide (in Air)
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	????
LEL,UEL:	12.5/74
<ul style="list-style-type: none"> • Color/Odor: • CO • Air 	<p>Colorless/odorless</p> <p>Colorless/odorless</p>
H A Z A R D S	
<p>1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.</p> <p>2. Inhalation</p> <p style="margin-left: 40px;">a) Exposure Limits:</p> <p style="margin-left: 80px;">CO: NOTE: CO is dangerously toxic at the concentrations used by staff (10,000 - 100,000 ppm)</p> <p style="margin-left: 80px;">1) 35 ppm is the legal Time Weighted Average (TWA). Employees may not be exposed to concentrations above 35 ppm over the course of an 8-hour work day.</p> <p style="margin-left: 80px;">2) 52.5 ppm (35ppm * 1.5) is the legal Short Term Exposure Limit (STEL). The STEL is the 15-minute time weighted average, that may not be exceeded during any 15 minute time period during a work day unless another time limit is specified.</p> <p style="margin-left: 80px;">3) 200 ppm is the legal Ceiling. This concentration may not be exceeded for any period of time during a work day.</p> <p style="margin-left: 80px;">4) 1500 ppm is the Immediately Dangerous to Life or Health (IDLH). NIOSH</p> <p style="margin-left: 40px;">Air: There are no published PELs for compressed air.</p> <p style="margin-left: 40px;">b) Toxicological properties:</p> <p style="margin-left: 80px;">CO: Chemical asphxiant which reacts with the blood hemoglobin preventing hemoglobin from taking up oxygen.</p> <p style="margin-left: 40px;">Air: There are no toxicological properties reported on the MSDS for compressed air.</p>	
S Y M P T O M S O F O V E R E X P O S U R E	
<p>CO:</p> <ul style="list-style-type: none"> • 400-1,000 ppm Continuous exposure can produce headache, confusion, and nausea in a few hours. • 2,000- 3,000 ppm continuous exposure can cause unconscious in 30 minutes. • >3,000 ppm can cause unconsciousness and death. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • CO in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems. • Store cylinders in a dry, cool, well ventilated area. Ventilate enclosed areas to prevent O₂ deficient atmospheres or buildup of high CO concentrations. Avoid heat, flame or sparks. • If O₂ deficient atmospheres or high CO atmospheres are suspected or occur, use monitoring equipment. • Self-contained breathing apparatus is required in O₂ deficient atmospheres. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of CO. 	

Table 18 (con't) Compressed Gas Hazards	
Calibration and Repair	
Content of Cylinder:	Freon-12 (Dichlorodifluoromethane)
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	??????
LEL,UEL:	NA
<ul style="list-style-type: none"> • Color/Odor: • Freon 	blue/very slight ethereal to odorless
H A Z A R D S	
<p>1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.</p> <p>2. Inhalation</p> <p>a) Exposure Limits:</p> <p>Freon NOTE: Freon is toxic at concentrations above 1,000 ppm</p> <ol style="list-style-type: none"> 1) 1,000 ppm is the Threshold Limit Value reported by ACGIH. 2) There is no published Short Term Exposure Limit (STEL) for Freon. 3) There is no published Ceiling for Freon. 4) There is no Immediately Dangerous to Life or Health (IDLH) published by NIOSH for Freon. <p>b) Toxicological properties:</p> <ol style="list-style-type: none"> 1) See MSDS for description of animal studies. 	
S Y M P T O M S O F O V E R E X P O S U R E	
<p>Acute:</p> <ul style="list-style-type: none"> • Humans exposed to 1,000 ppm (for 2-1/2 - 8 hours) showed no adverse effects. • Humans exposed to 40,000 ppm (for 14 min) experienced a tingling, humming in the ears, apprehension and slurred speech. • At 110,000 ppm (for 11 min) the subject showed a decrease in consciousness with amnesia occurring in 10 min. • Over 100 deaths have been reported related to sniffing fluorocarbon propellants. They exhibit very toxic properties when sniffed (asphyxiation and cardiac arhythmias). <p>Chronic:</p> <ul style="list-style-type: none"> • Eight human volunteers were exposed to i,000 ppm for 8hrs/day for 2-1/2 weeks w/no recorded abnormalities. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • Freon in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems. • If concentrations exceed 1000 ppm use an approved respirator for organic vapors. • Store cylinders in a dry, cool, well ventilated area. Avoid heat, flame or sparks. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of freon-12. 	

Table 18 (con't) Compressed Gas Hazards Calibration and Repair	
Content of Cylinder:	Helium
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	??????
LEL,UEL:	NA/NA
<ul style="list-style-type: none"> • Color/Odor: • Helium 	Colorless/odorless
H A Z A R D S	
<p>1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.</p> <p>2. Inhalation</p> <p style="padding-left: 40px;">a) Exposure Limits:</p> <p style="padding-left: 80px;">1) Simple asphxiant (it will displace O₂ in air). Breathing space of worker must be > or = 19.5% O₂.</p> <p style="padding-left: 40px;">b) Toxicological properties:</p> <p style="padding-left: 80px;">1) Contact with liquid may cause extensive tissue damage or burns.</p>	
S Y M P T O M S O F O V E R E X P O S U R E	
<p>Acute:</p> <ul style="list-style-type: none"> • My cause dizziness, nausea, vomiting, loss of consciousness, confusion, collapse and death. • Death may result from errors in judgment, confusion, or loss of consciousness which prevents self-rescue. • At low concentrations, unconsciousness and death may occur in seconds without warning. <p>Chronic:</p> <ul style="list-style-type: none"> • None reported on the MSDS. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • Helium in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems. • Store in well ventilated areas only. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of helium. 	

Table 18 (con't) Compressed Gas Hazards Calibration and Repair	
Content of Cylinder:	Hydrogen (in Air)
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	??????
LEL,UEL:	4/75
<ul style="list-style-type: none"> • Color/Odor: • H₂ • Air 	Colorless/odorless Colorless/odorless
H A Z A R D S	
1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.	
2. Inhalation	
a) Exposure Limits:	
H ₂	
1) Simple asphxiant (it will displace O ₂ in air). Breathing space of worker must be > or = 19.5% O ₂ .	
Air:	
1) There are no published PELs for Air	
H ₂ :	
1) Simple asphxiant (it will displace O ₂ in air).	
Air:	
1) There are no toxicological properties reported on the MSDS for Air.	
S Y M P T O M S O F O V E R E X P O S U R E	
H ₂ :	
<ul style="list-style-type: none"> • Hydrogen acts as a simple asphyxiant by displacing oxygen. Oxygen deficient atmospheres may produce rapid respiration, muscular in coordination, fatigue, nausea, vomiting, and loss of consciousness. 	
N ₂ :	
<ul style="list-style-type: none"> • O₂ deficient atmospheres may produce rapid respiration, dizziness, nausea, vomiting, loss of consciousness and death. • Death may result from errors in judgment, confusion, or loss of consciousness which prevents self-rescue. • At low concentrations, unconsciousness and death may occur in seconds without warning. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • H₂ in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems. • Quantities > 400 scf should be stored in specially ventilated rooms or outside. • Store away from oxidizers, combustible materials, sources of heat (should never be exposed to > 125 °F) or ignition sources. Ventilation equipment should be explosion proof. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of hydrogen. 	

Table 18 (con't) Compressed Gas Hazards Calibration and Repair	
Content of Cylinder:	Hydrogen sulfide (in N ₂)
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	???????
LEL,UEL:	4/44
<ul style="list-style-type: none"> • Color/Odor: • H₂S • N₂ 	<p>Colorless/odorless</p> <p>Colorless/odorless</p>
H A Z A R D S	
<p>1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.</p> <p>2. Inhalation</p> <p style="padding-left: 20px;">a) Exposure Limits:</p> <p style="padding-left: 40px;">H₂S</p> <p style="padding-left: 60px;">1) 10 ppm is the legal Time Weighted Average (TWA). Employees may not be exposed to concentrations above 35 ppm over the course of an 8-hour work day.</p> <p style="padding-left: 60px;">2) 15 ppm is the legal Short Term Exposure Limit (STEL). The STEL is the 15-minute time weighted average that may not be exceeded during any 15 minute time period during a work day unless another time limit is specified.</p> <p style="padding-left: 60px;">3) There is no Ceiling published.</p> <p style="padding-left: 60px;">4) 300 ppm is the Immediately Dangerous to Life or Health (IDLH) published by NIOSH.</p> <p style="padding-left: 40px;">N₂: Simple asphxiant (it will displace O₂ in air). Breathing space of worker must be > or = 19.5% O₂.</p> <p style="padding-left: 20px;">b) Toxicological properties:</p> <p style="padding-left: 40px;">N₂: Simple asphxiant (it will displace O₂ in air).</p>	
S Y M P T O M S O F O V E R E X P O S U R E	
<p>N₂:</p> <ul style="list-style-type: none"> • O₂ deficient atmospheres may produce rapid respiration, dizziness, nausea, vomiting, loss of consciousness and death. • Death may result from errors in judgment, confusion, or loss of consciousness which prevents self-rescue. • At low concentrations, unconsciousness and death may occur in seconds without warning. <p>H₂S:</p> <ul style="list-style-type: none"> • 20-150 ppm produces mild to severe eye irritation. • 500 ppm for 30 minutes may produce headache, dizziness, gastroenteric disorders and pneumonia. • >600 ppm can be fatal within 30 minutes through respiratory paralysis. • Sense of smell is lost at high concentrations. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • H₂S in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems. • Store cylinders in a dry, cool, well ventilated area. Ventilate enclosed areas to prevent O₂ deficient atmospheres or buildup of high CO concentrations. Avoid heat, flame or sparks. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of H₂S. 	

Table 18 (con't) Compressed Gas Hazards Calibration and Repair	
Content of Cylinder:	Isobutylene (in Air)
Application:	Calibration of Microtip for PM ₁₀
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	<20
Concentration (PPM):	????
LEL,UEL:	NA
<ul style="list-style-type: none"> • Color/Odor: • Isobutylene • Air 	Colorless/slightly olefinic Colorless/odorless
H A Z A R D S	
<ol style="list-style-type: none"> 1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path. 2. Inhalation <ol style="list-style-type: none"> a) Exposure Limits: <ol style="list-style-type: none"> 1) There are no published PELs for Isobutylene. b) Toxicological properties: <ol style="list-style-type: none"> 1) There are no toxicological properties reported on the MSDS for Isobutylene. 	
S Y M P T O M S O F O V E R E X P O S U R E	
<ul style="list-style-type: none"> • There are no symptoms reported on the MSDS. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • Isobutylene in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of Isobutylene. 	

Table 18 (con't) Compressed Gas Hazards Calibration and Repair	
Content of Cylinder:	Methane
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	??????
LEL,UEL:	5/15
<ul style="list-style-type: none"> • Color/Odor: • Methane 	Colorless/odorless
H A Z A R D S	
<ol style="list-style-type: none"> 1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path. 2. Inhalation <ol style="list-style-type: none"> a) Exposure Limits: <ol style="list-style-type: none"> 1) Simple asphxiant (it will displace O₂ in air). Breathing space of worker must be > or = 19.5% O₂. b) Toxicological properties: <ol style="list-style-type: none"> 1) Contact with liquid methane can cause freeze burns. 	
S Y M P T O M S O F O V E R E X P O S U R E	
Methane:	
<ul style="list-style-type: none"> • O₂ deficient atmospheres may produce dizziness, nausea, loss of consciousness and death. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • Methane in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems. • Store in a well ventilated area away form oxidizers, sources of heat (never > 125°F) and ignition. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of methane. 	

Table 18 (con't) Compressed Gas Hazards Calibration and Repair	
Content of Cylinder:	Nitrogen
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	??????
LEL,UEL:	NA/NA
<ul style="list-style-type: none"> • Color/Odor: • Nitrogen 	Colorless/odorless
H A Z A R D S	
<p>1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.</p> <p>2. Inhalation</p> <p style="padding-left: 40px;">a) Exposure Limits:</p> <p style="padding-left: 80px;">1) Simple asphxiant (it will displace O₂ in air). Breathing space of worker must be > or = 19.5% O₂.</p> <p style="padding-left: 40px;">b) Toxicological properties:</p> <p style="padding-left: 80px;">1) May cause cryogenic burns on liquid contact.</p>	
S Y M P T O M S O F O V E R E X P O S U R E	
Nitrogen:	
<ul style="list-style-type: none"> • O₂ deficient atmospheres may produce dizziness, nausea, loss of consciousness and death. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • Nitrogen in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems. • Store in a well ventilated area away from oxidizers, sources of heat (never > 125°F) and ignition. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of nitrogen. 	

Table 18 (con't) Compressed Gas Hazards Calibration and Repair	
Content of Cylinder:	Nitrogen oxide (Nitric oxide) (in N ₂)
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	???????
LEL,UEL:	NA/NA
<ul style="list-style-type: none"> • Color/Odor: • NO • N₂ 	<ul style="list-style-type: none"> Colorless/pungent & sweet Colorless/odorless
H A Z A R D S	
<p>1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.</p> <p>2. Inhalation</p> <p style="padding-left: 20px;">a) Exposure Limits:</p> <ol style="list-style-type: none"> 1) 25 ppm is the legal Time Weighted Average (TWA). Employees may not be exposed to concentrations above 35 ppm over the course of an 8-hour work day. 2) 37.5 ppm (25ppm * 1.5) is the legal Short Term Exposure Limit (STEL). The STEL is the 15-minute time weighted average that may not be exceeded during any 15 minute time period during a work day unless another time limit is specified. 3) There is no Ceiling published. 4) 100 ppm is the Immediately Dangerous to Life or Health (IDLH). NIOSH <p style="padding-left: 20px;">N₂:</p> <ol style="list-style-type: none"> 1) Simple asphxiant (it will displace O₂ in air). Breathing space of worker must be > or = 19.5% O₂. <p style="padding-left: 20px;">b) Toxicological properties:</p> <p style="padding-left: 20px;">NO:</p> <ol style="list-style-type: none"> 1) Extremely toxic gas forming irritating nitric and nitrous acids in the respiratory tract. <p style="padding-left: 20px;">N₂:</p> <ol style="list-style-type: none"> 1) Simple asphxiant (it will displace O₂ in air). 	
S Y M P T O M S O F O V E R E X P O S U R E	
<p>NO:</p> <ul style="list-style-type: none"> • 60-150 ppm exposure causes immediate irritation of the nose and throat, cough, burning in the chest and dizziness. 5-24 hours later delayed pulmonary edema can occur. • 200-700 ppm may be fatal after a very short exposure. <p>Mixture:</p> <ul style="list-style-type: none"> • O₂ deficient atmospheres may produce rapid respiration, dizziness, nausea, vomiting, and loss of consciousness and may be fatal result from errors in judgment, confusion, or loss of consciousness which prevents self-rescue. • At low concentrations, unconsciousness and death may occur in seconds without warning. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • Use self contained breathing apparatus in emergency or rescue situations. • Enclosed areas must be provided with general or local exhaust ventilation to avoid hazardous conditions. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of NO. 	

Table 18 (con't) Compressed Gas Hazards Calibration and Repair	
Content of Cylinder:	Oxygen (in Air)
Application:	QA at test stations and repair shop audits
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	????????
LEL,UEL:	NA/NA
<ul style="list-style-type: none"> • Color/Odor: • Oxygen • Air 	Colorless/natural gas Colorless/odorless
H A Z A R D S	
1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.	
2. Inhalation <ul style="list-style-type: none"> a) Exposure Limits: <ul style="list-style-type: none"> Oxygen: <ul style="list-style-type: none"> 1) No PELs published. Air: <ul style="list-style-type: none"> 1) No PELs published. b) Toxicological properties: <ul style="list-style-type: none"> Oxygen: <ul style="list-style-type: none"> 1) A number of central nervous system effects may result form breathing oxygen greater than 2 atmospheres. 2) Contact with liquid oxygen can cause severe frostbite/freeze burns. 	
S Y M P T O M S O F O V E R E X P O S U R E	
Oxygen: <ul style="list-style-type: none"> • Symptoms of exposures of oxygen over 2 atmospheres include dizziness, impaired coordination, visual and breathing disturbances, and seizures. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • Use only oxygen cleaned equipment. Avoid oils and grease. Oxygen will react violently with hydrocarbons especially at high pressures. • Store away from combustibles and heat (never > 1225 °F). • Store in well ventilated areas. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of oxygen. 	

Table 18 (con't) Compressed Gas Hazards Calibration and Repair	
Content of Cylinder:	Pentane (in Air)
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	???????
LEL,UEL:	1.4/7.8
<ul style="list-style-type: none"> • Color/Odor: • Pentane • Air 	<ul style="list-style-type: none"> Colorless/mild gas Colorless/odorless
H A Z A R D S	
<p>1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.</p> <p>2. Inhalation</p> <p style="margin-left: 40px;">a) Exposure Limits:</p> <p style="margin-left: 80px;">Pentane:</p> <ol style="list-style-type: none"> 1) 600 ppm is the legal Time Weighted Average (TWA). Employees may not be exposed to concentrations above 35 ppm over the course of an 8-hour work day. 2) 750 ppm is the legal Short Term Exposure Limit (STEL). The STEL is the 15-minute time weighted average that may not be exceeded during any 15 minute time period during a work day unless another time limit is specified. 3) There is no Ceiling published. 4) 15,000 ppm is the Immediately Dangerous to Life or Health (IDLH). NIOSH <p style="margin-left: 40px;">b) Toxicological properties:</p> <p style="margin-left: 80px;">Pentane:</p> <ol style="list-style-type: none"> 1) Vapors are mildly narcotic and may cause irritation to the respiratory passages. 2) Sustained exposure to high concentrations may cause central nervous system depression and narcosis. 3) Skin contact may lead to defatting of skin and dermatitis. 4) Eye contact may be irritating. 	
S Y M P T O M S O F O V E R E X P O S U R E	
<p>Pentane:</p> <ul style="list-style-type: none"> • Vapors are mildly narcotic and may cause irritation to the respiratory passages. • Sustained exposure to high concentrations may cause central nervous system depression and narcosis. • Skin contact may lead to defatting of skin and dermatitis. • Eye contact may be irritating. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • Store in well ventilated areas only. • Read and become familiar with the MSDS. The MSDS provides information about the safe use of pentane. 	

Table 18 (con't) Compressed Gas Hazards Calibration and Repair	
Content of Cylinder:	Propane (in N ₂)
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	???????
LEL,UEL:	NA/NA
<ul style="list-style-type: none"> • Color/Odor: • Propane • N₂ 	<ul style="list-style-type: none"> Colorless/natural gas Colorless/odorless
H A Z A R D S	
<p>1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.</p> <p>2. Inhalation</p> <p style="padding-left: 20px;">a) Exposure Limits:</p> <ol style="list-style-type: none"> 1) 1,000 ppm is the legal Time Weighted Average (TWA). Employees may not be exposed to concentrations above 35 ppm over the course of an 8-hour work day. 2) 1250 ppm (1000ppm * 1.25) is the legal Short Term Exposure Limit (STEL). The STEL is the 15-minute time weighted average that may not be exceeded during any 15 minute time period during a work day unless another time limit is specified. 3) There is no Ceiling published. 4) 20,000 ppm is the Immediately Dangerous to Life or Health (IDLH). NIOSH <p style="padding-left: 20px;">Propane:</p> <ol style="list-style-type: none"> 1) Simple asphxiant (it will displace O₂ in air). Breathing space of worker must be > or = 19.5% O₂. <p style="padding-left: 20px;">b) Toxicological properties:</p> <p style="padding-left: 40px;">Propane</p> <ol style="list-style-type: none"> 1) Simple asphxiant (it will displace O₂ in air). 2) Mild mucous membrane irritant. 3) Has some degree of anesthetic action. <p style="padding-left: 20px;">N₂:</p> <ol style="list-style-type: none"> 1) Simple asphxiant (it will displace O₂ in air). 	
S Y M P T O M S O F O V E R E X P O S U R E	
<p>Propane:</p> <ul style="list-style-type: none"> • O₂ deficient atmospheres may produce rapid respiration, dizziness, nausea, vomiting, loss of consciousness and death. • Brief exposures to 10,000 ppm cause no symptoms. • 10% concentration may cause dizziness within minutes. <p>N₂:</p> <ul style="list-style-type: none"> • O₂ deficient atmospheres may produce rapid respiration, dizziness, nausea, vomiting, loss of consciousness and death. • Death may result from errors in judgment, confusion, or loss of consciousness which prevents self-rescue. • At low concentrations, unconsciousness and death may occur in seconds without warning. 	

SPECIAL PRECAUTIONS

- Propane in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems.
- Store cylinders in a dry, cool, well ventilated area. Ventilate enclosed areas to prevent O₂ deficient atmospheres or buildup of high CO concentrations. Avoid heat, flame or sparks.
- Self-contained breathing apparatus is required in O₂ deficient atmospheres.
- Read and become familiar with the MSDS. The MSDS provides more information about the safe use of propane.

Table 18 (con't) Compressed Gas Hazards

Calibration and Repair

Content of Cylinder:	Sulfur dioxide (in N ₂)
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	????
LEL,UEL:	NA/NA
• Color/Odor:	
• SO ₂	Colorless/irritating & pungent
• N ₂	Colorless/odorless

H A Z A R D S

1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.
2. Inhalation
 - a) Exposure Limits:

SO₂: NOTE: SO₂ is dangerously toxic at the concentrations used by staff (2,000 ppm)

 - 1) 2 ppm is the legal Time Weighted Average (TWA). Employees may not be exposed to concentrations above 35 ppm over the course of an 8-hour work day.
 - 2) 5 ppm is the legal Short Term Exposure Limit (STEL). The STEL is the 15-minute time weighted average that may not be exceeded during any 15 minute time period during a work day unless another time limit is specified.
 - 3) No legal Ceiling reported.
 - 4) No IDLH reported.

N₂:

 - 1) Simple asphxiant (it will displace O₂ in air). Breathing space of worker must be > or = 19.5% O₂.
 - 2) Excessive exposures may be fatal.
 - b) Toxicological properties:

SO₂:

 - 1) Corrosive and irritating to the upper respiratory tract, skin and eyes.
 - 2) Contact with liquid SO₂ may cause skin burns.
 - 3) Eye contact may result in destruction of eye tissue.

N₂:

 - 1) Simple asphxiant (it will displace O₂ in air).

SYMPTOMS OF OVEREXPOSURESO₂:

Acute:

- Excessive inhalation may cause burning sensations, coughing, shortness of breath, headache, nausea and vomiting.
- May produce bronchitis, chemical pneumonia, and pulmonary edema.

Chronic:

- Pulmonary disease or loss of pulmonary function.

N₂:

- O₂ deficient atmospheres may produce rapid respiration, dizziness, nausea, vomiting, loss of consciousness and death.
- Death may result from errors in judgment, confusion, or loss of consciousness which prevents self-rescue.
- At low concentrations, unconsciousness and death may occur in seconds without warning.

SPECIAL PRECAUTIONS

- SO₂ should be handled in a fume hood. Provide adequate general and local exhaust ventilation to maintain concentration below exposure limits.
- Store cylinders in well ventilated areas only.
- Read and become familiar with the MSDS. The MSDS provides more information about the safe use of SO₂.

Table 19 Compressed Gas Hazards Quality Assurance	
Content of Cylinder:	Compressed Air
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	?????
LEL,UEL:	NA
<ul style="list-style-type: none"> • Color/Odor: • Air 	Colorless/odorless
H A Z A R D S	
<p>1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.</p> <p>2. Inhalation</p> <p style="padding-left: 40px;">a) Exposure Limits:</p> <p style="padding-left: 80px;">1) There are no published PELs for compressed air.</p> <p style="padding-left: 40px;">b) Toxicological properties:</p> <p style="padding-left: 80px;">1) There are no toxicological properties reported on the MSDS for compressed air.</p>	
S Y M P T O M S O F O V E R E X P O S U R E	
<ul style="list-style-type: none"> • There are no symptoms reported on the MSDS. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • Compressed air in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems. • Store cylinders in a dry, cool, well ventilated area. Avoid heat, flame or sparks. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of compressed air. 	

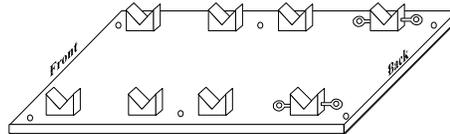
Table 19 (con't) Compressed Gas Hazards	
Quality Assurance	
Content of Cylinder:	Carbon Monoxide (in Air)
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	10 - 50
LEL,UEL:	12.5/74
<ul style="list-style-type: none"> • Color/Odor: • CO • Air 	<ul style="list-style-type: none"> Colorless/odorless Colorless/odorless
H A Z A R D S	
<p>1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.</p> <p>2. Inhalation</p> <p style="margin-left: 40px;">a) Exposure Limits:</p> <p style="margin-left: 80px;">CO: NOTE: CO is dangerously toxic at the concentrations used by staff (10,000 - 100,000 ppm)</p> <p style="margin-left: 120px;">1) 35 ppm is the legal Time Weighted Average (TWA). Employees may not be exposed to concentrations above 35 ppm over the course of an 8-hour work day.</p> <p style="margin-left: 120px;">2) 52.5 ppm (35ppm * 1.5) is the legal Short Term Exposure Limit (STEL). The STEL is the 15-minute time weighted average that may not be exceeded during any 15 minute time period during a work day unless another time limit is specified.</p> <p style="margin-left: 120px;">3) 200 ppm is the legal Ceiling. This concentration may not be exceeded for any period of time during a work day.</p> <p style="margin-left: 120px;">4) 1500 ppm is the Immediately Dangerous to Life or Health (IDLH). NIOSH</p> <p style="margin-left: 40px;">Air: There are no published PELs for compressed air.</p> <p style="margin-left: 40px;">b) Toxicological properties:</p> <p style="margin-left: 80px;">CO:</p> <p style="margin-left: 120px;">1) Chemical asphxiant which reacts with the blood hemoglobin preventing hemoglobin from taking up oxygen.</p> <p style="margin-left: 40px;">Air: There are no toxicological properties reported on the MSDS for compressed air.</p>	
S Y M P T O M S O F O V E R E X P O S U R E	
<p>CO:</p> <ul style="list-style-type: none"> • 400-1,000 ppm Continuous exposure can produce headache, confusion, and nausea in a few hours. • 2,000- 3,000 ppm continuous exposure can cause unconscious in 30 minutes. • >3,000 ppm can cause unconsciousness and death. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • CO in the cylinder is at high pressure. Use only with high pressure equipment. Use a pressure reducing regulator when connecting to low pressure piping systems. • Store cylinders in a dry, cool, well ventilated area. Ventilate enclosed areas to prevent O₂ deficient atmospheres or buildup of high CO concentrations. Avoid heat, flame or sparks. • If O₂ deficient atmospheres or high CO atmospheres are suspected or occur, use monitoring equipment. • Self-contained breathing apparatus is required in O₂ deficient atmospheres. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of CO. 	

Table 19 (con't) Compressed Gas Hazards	
Quality Assurance	
Content of Cylinder:	Nitrogen oxide (Nitric oxide) (in N ₂)
Application:	Calibration gas
Maximum Pressure (PSI):	2000
Weight When Full (Pounds):	25-50
Concentration (PPM):	50
LEL,UEL:	NA/NA
<ul style="list-style-type: none"> • Color/Odor: • NO • N₂ 	Colorless/pungent & sweet Colorless/odorless
H A Z A R D S	
1. High pressure - if the valve is broken or the cylinder is punctured the cylinder may become a missile causing serious injury or damage to people, vehicles, concrete walls, objects in its path.	
2. Inhalation	
a) Exposure Limits:	
1) 25 ppm is the legal Time Weighted Average (TWA). Employees may not be exposed to concentrations above 35 ppm over the course of an 8-hour work day.	
2) 37.5 ppm (25ppm * 1.5) is the legal Short Term Exposure Limit (STEL). The STEL is the 15-minute time weighted average that may not be exceeded during any 15 minute time period during a work day unless another time limit is specified.	
3) There is no Ceiling published.	
4) 100 ppm is the Immediately Dangerous to Life or Health (IDLH). NIOSH	
N ₂ : Simple asphxiant (it will displace O ₂ in air). Breathing space of worker must be > or = 19.5% O ₂ .	
b) Toxicological properties:	
NO: Extremely toxic gas forming irritating nitric and nitrous acids in the respiratory tract.	
N ₂ : Simple asphxiant (it will displace O ₂ in air).	
S Y M P T O M S O F O V E R E X P O S U R E	
NO:	
<ul style="list-style-type: none"> • 60-150 ppm exposure causes immediate irritation of the nose and throat, cough, burning in the chest and dizziness. 5-24 hours later delayed pulmonary edema can occur. • 200-700 ppm may be fatal after a very short exposure. 	
Mixture:	
<ul style="list-style-type: none"> • O₂ deficient atmospheres may produce rapid respiration, dizziness, nausea, vomiting, and loss of consciousness and may be fatal result from errors in judgment, confusion, or loss of consciousness which prevents self-rescue. • At low concentrations, unconsciousness and death may occur in seconds without warning. 	
S P E C I A L P R E C A U T I O N S	
<ul style="list-style-type: none"> • Use self contained breathing apparatus in emergency or rescue situations. • Enclosed areas must be provided with general or local exhaust ventilation to avoid hazardous conditions. • Read and become familiar with the MSDS. The MSDS provides more information about the safe use of NO. 	

Designs for Compressed Gas Cylinder Restraints in AQP Vehicles:

Figure 3
Horizontal Cylinder Restraint

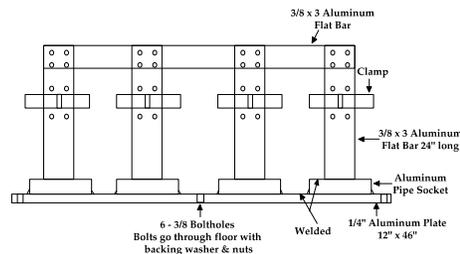
Four sets V-Blocks - 3/4" X 4" X 8" Aluminum



Aluminum Base Plate - 1/4" X 16" X 46",
bolted through floor, 6 places

V-Blocks will be bolted from bottom, and coated with a non-slip rubber. All eight V-Blocks will have eyebolts to accept Groboski Quick-Release tie down straps, two straps per tank. The cost for the first unit will be \$625.00, after that \$575.00 each.

Figure 4
Vertical Cylinder Restraint

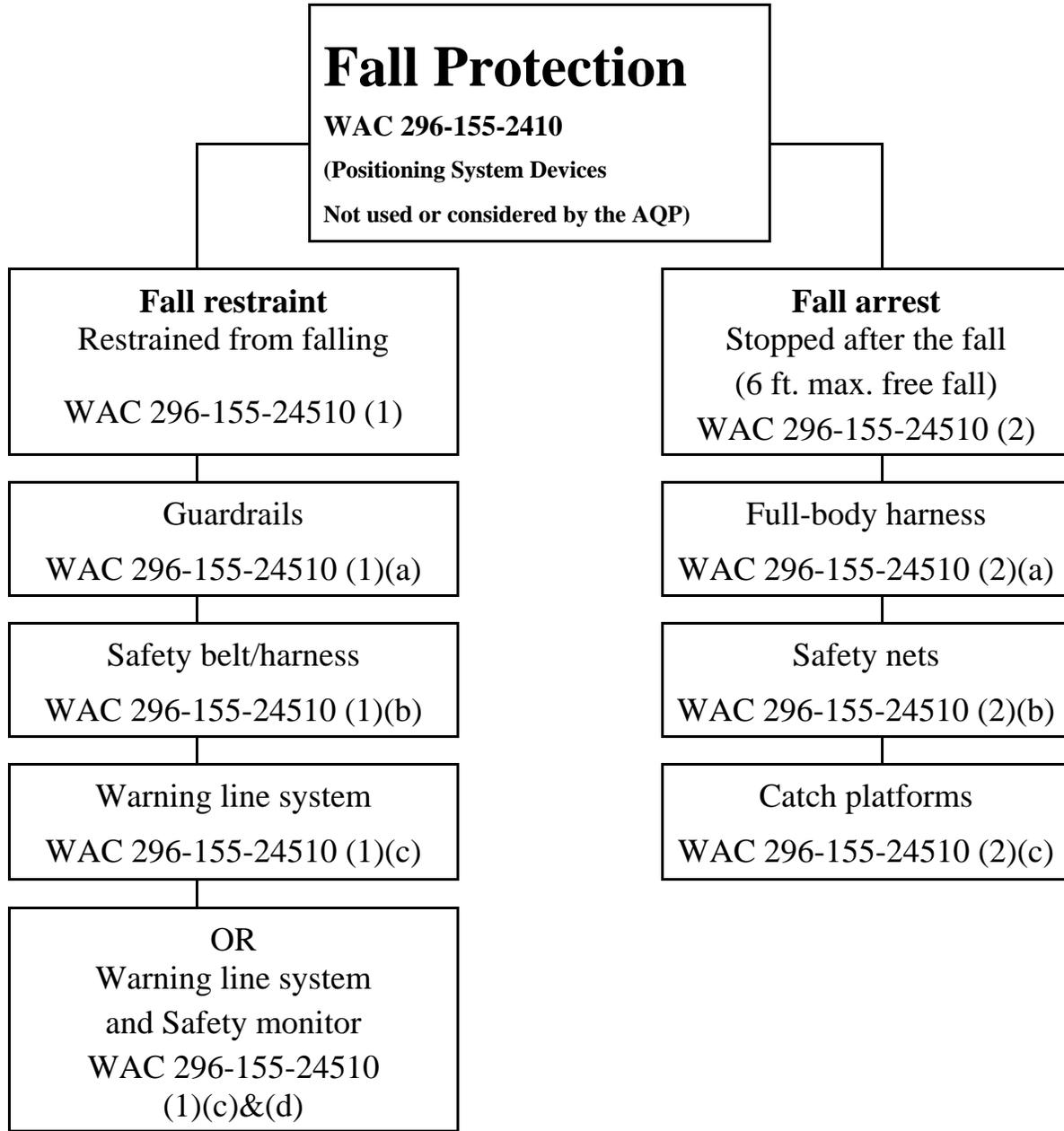


The cost of each installed is \$725.00

Designs and estimates were submitted by Bruce Bender, Valley Machine and Manufacturing, 9011 Valley Avenue East, Puyallup, WA 98371.

Appendix C

Fall Protection



The fall protection work plan shall:

- Identify all fall hazards in the work area.
- Describe the method of fall arrest or fall restraint to be provided.
- Describe the correct procedures for the assembly, maintenance, inspection, and disassembly of the fall protection system to be used.
- Describe the correct procedures for the handling, storage, and securing of tools and materials.
- Describe the method of providing overhead protection for workers who may be in, or pass through the area below the work site.
- Describe the method for prompt, safe removal of injured workers.
- Be available on the job site for inspection by the department.

<u>FALL PROTECTION WORK PLAN</u>	
Name and address of site: _____	
Physical location work area (pictures are good): _____	
Identify all fall hazards in the work area.	
Fall Protection method: <input type="checkbox"/> fall arrest <i>or</i> <input type="checkbox"/> fall restraint	Describe method:
Describe the correct procedures for the assembly, maintenance, inspection, and disassembly of the fall protection system to be used.	Assembly: Maintenance: Inspection: Disassembly:
Describe the correct procedures for the handling, storage, and securing of tools and materials.	Handling: Storage: _____ Securing:
Describe the method of providing overhead protection for workers who may be in, or pass through the area below the work site.	_____
Describe method for prompt, safe removal of injured workers.	

Requirements of a fall protection work plan

Falls from elevated work surfaces continue to produce injuries and death to workers at a high rate. In one year alone, five deaths within the construction industry were caused by falls. Through the Washington Industrial Safety and Health Act (WISHA), the Department of Labor and Industries developed a comprehensive safety standard that became effective February 12, 1991, to address fall hazards (WAC 296-155-245). This standard requires a written fall protection plan to be developed and maintained on the job site. The plan must describe how the employer will protect employees on a given work site when they are working 10 feet or more above the ground, other work surfaces, or water.

The six primary elements to be included in the plan are as follows:

- Identify all fall hazards in the work area.
- Describe the method of fall arrest or fall restraint to be provided.
- Describe the correct procedures for the assembly, maintenance, inspection and disassembly of the fall protection system to be used.
- Describe the correct procedures for handling, storage and securing of tools and materials.
- Describe the method of providing overhead protection for workers who may be in, or pass through, the area below the work site.
- Describe the method for prompt, safe removal of injured workers.

Definitions

Definitions are included on the first page of the standard (WAC 196-155-24503), a copy of which is included as Appendix 1 to this document. Two of the most important definitions you will need to understand before an effective plan can be developed are summarized below.

- 1) Fall arrest system — Equipment used to protect a person from falling more than six feet or from striking a lower object in the event of a fall, whichever distance is less. This equipment includes Class III approved full-body harnesses and lanyards properly secured to anchorage points or to lifelines; or safety nets, or catch platforms.
- 2) Fall restraint system — Equipment used to keep a person from reaching a fall point (i.e., edge of a roof). This equipment includes scaffolding or other work platforms with standard guardrails; or approved safety belts (or harnesses) and lanyards attached to secure anchorage points; or nets.

Developing a Fall Protection Work Plan

1) Identify your company and the work site to which the plan applies.

This information should be listed as the first item in your plan.

2) Identify all fall hazards in the work area.

All jobs and tasks to be done must be reviewed to make this determination. Replacing siding on a building, building forms for a highway overpass, replacing skylights, or building the top deck of a building are some examples of fall hazards. After all fall hazards have been identified, list those requiring employees to work 10 feet or more above the ground, other work surface, or water. See the appendix to Part C-1 (WAC 296-155-24525) for some specific safety codes requiring the use of fall protection equipment. These are in addition to the general requirements contained in Part C-1, WAC 296-155-245.

3) Determine the method of fall arrest or fall restraint to be provided for each job and task to be done that is 10 feet or more above the ground, other work surface, or water.

You might decide to use scaffolding with standard guardrails for replacing siding on a building, and full-body harness with lanyard secured to an anchorage point for building forms for a highway overpass or replacing skylights. Building the top deck of a building might best be done by using different kinds of fall protection, such as fall restraint for those working away from the leading edge and fall arrest for those working near the edge of the unprotected deck. If a safety monitor system is used, you must use special care to ensure full compliance with WAC 296-155-24521.

4) Describe the procedures for assembly, maintenance, inspection, and disassembly of the fall protection system to be used.

Examples of how this requirement might appear on the document are as follows:

Tube and coupler scaffolding with standard railguards will be used to replace siding on building number 2140. The scaffolding will be erected and disassembled by "Z" Scaffolding Company. The job supervisor will inspect the scaffolding before allowing employees to work on it at the start of each work day and after major changes in the weather conditions. The scaffolding must meet the requirements of WAC 296-155-485.

Some critical items are:

- It must be on a firm base.
- The planks must be in good condition and secured from shifting. They must also be fitted to fill the scaffolding frame.
- All open sides and ends must be enclosed with standard guardrails and toe boards.

Fall arrest equipment, including approved full-body type III harness, lanyards and horizontal lifelines attached to _____ will be used for replacing skylights. Employees will put the equipment on before climbing to the roof. They will snap into the horizontal lifeline immediately after mounting the roof. All equipment will be inspected by the employee using it each day before putting it on. The inspection will include checking for damage, wear and mildew. Any defective equipment will be taken to the job shack for evaluation by the job supervisor and turned in for repair or destroyed, as appropriate. The lifeline will be secured to the roof by employees wearing fall blocks anchored to _____ before the decking crew is allowed on the roof and will be removed after the deck crew is off the roof. (List procedures and equipment to be used for other jobs or tasks.)

5) Describe the correct procedures for handling, storage and security of tools and materials.

Some examples follow:

All fall protection equipment will be kept in a designated place or in the job equipment shack. It will be picked up from the shack at the start of each work day by each using employee and returned after the shift is over. Employees will advise the job supervisor of any damage to the equipment. Webbing will be washed, if dirty.

Tools will be secured as follows:

- Tool belts will be used to carry hand tools to the elevated work surface.
- Tools too large for the tool belt will be raised by rope and pulley.
- When hand tools are used, they will be returned to the tool belt immediately after use.
- Large tools, such as skill saws, will be secured to the scaffold guard rails with the cable provided.
- Siding material will be raised to the work platform by crane and sling. No more than _____ of material will be kept on the platform at any one time. It will be secured inside the guardrails not more than one stack high.

6) Describe the method of providing overhead protection for workers who may be in, or pass through, the area below the worksite.

An example follows:

- The area under the scaffolding will have a warning line installed to protect against other employees accidentally walking under it.
- The scaffolding will have #18 screen installed between the toe board and the guardrail at all locations where employees must work below.
- The area above the scaffolding will be decked over at all points where the siding crew must work immediately under the roofing crew or other employees.

7) Describe the method for prompt, safe removal of injured workers.

An example of this requirement might be as follows:

If a siding crew member is injured, the supervisor will evaluate the employee's condition and administer first aid. If the employee's condition appears serious, the supervisor or other designated person will call "911" or other local emergency rescue unit to require assistance. The lift platform will be used to lower the injured person to ground level if appropriate.

8) Include where (on the job site) a copy of this plan will be posted (i.e., the job shack).

9) Train and instruct all personnel in all of the above items (equipment to use, how to use it, etc.).

10) Keep a record of employee training and maintain it on the job.

Appendix D

Glossary

CO	Carbon Monoxide - Odorless, colorless, toxic and flammable gas. The Compressed Gas Association, Inc. (CGA) recommends that all leaks be eliminated before a system is put into operation by testing with nitrogen. At least two persons should be assigned to any operation involving high concentrations of CO and a suitable supply of oxygen should be available to administer to personnel who may be exposed to excessive CO concentrations. Exposure to concentrations of about 4,000 ppm may be fatal in less than one hour. Exposure to very high levels may result in immediate death. The CGA in their "Handbook of Compressed Gases" states that all personnel handling or transferring high concentrations of CO should be protected by self-contained breathing apparatus.
Compressed Gas	Any material or mixture having in the container an absolute pressure exceeding 40 psi at 70°F or regardless of pressure at 70°F having an absolute pressure exceeding 104 psi at 130°F, or any liquid material having a vapor pressure exceeding 40 psi absolute at 100°F (according to the Compressed Gas Association, Inc. there are nearly 200 different substances shipped as compressed gases.
IDLH	Immediately Dangerous to Life and Health: The purpose of establishing an IDLH exposure concentration is to <i>“ensure that the worker can escape from a given contaminated environment in the even of failure of the respiratory protection equipment.”</i>
L&I	Labor and Industries
LEL	Lower Explosive Limit: The lowest concentration in air of the respective contaminant that is explosive or flammable. Ecology has determined that 10% of the LEL is and IDLH situation. DO NOT GO THERE.
NIOSH	National Institute for Occupational Safety and Health, NIOSH publishes the "Pocket Guide to Chemical Hazards"
MSDS	Material Safety Data Sheet
NIOSH	National Institute for Occupational Safety and Health
NTP	National Toxicology Program
PEL	Permissible Exposure Limit: A regulatory limit established by WISHA (OSHA). It is the highest airborne concentration of a contaminant that a worker can be exposed to during a 40 hour work week without the required use of respiratory protection. Any exposure above the PEL requires respiratory protection.

PPE	Personal Protective Equipment
PSD	Prevention of Significant Deterioration
RCW	Revised Code of Washington
	<p>Simple Asphyxiant refers to "Inert" gases or vapors. There are a number of gases and vapors that, when present in high concentrations, replace oxygen in air and act as asphyxiants without other significant physiological effects. Some are heavier than air and can exist in an outdoor environment. The minimum oxygen content must be 19.5 % by volume under normal atmospheric conditions (partial pressure of 148 mm Hg). Atmospheres deficient in oxygen do not provide adequate warning and many simple asphyxiants are odorless and may present an explosion hazard (i.e., <i>propane</i>).</p>
STEL	Short-Term Exposure Limit: A 15-minute time weighted average exposure which may not be exceeded at any time during a work day.
TLV	Threshold Limit Value
TWA	Time Weighted Average: WISHA considers the TWA synonymous with the PEL - It is the highest airborne concentration of a contaminant that a worker can be exposed to during a 40 hour work week without the required use of respiratory protection. Any exposure above the PEL requires respiratory protection
UEL	Upper Explosive Limit: Upper end of the flammability or explosive range.
WAC	Washington Administrative Code
WISHA	Washington Industrial Safety and Health Act: It also identifies the safety and health regulatory and compliance branches of L&I.