DOCUMENT RESUME

ED 409 482 CE 074 477

TITLE	Skill Standards for Open Cut Pipe Laying.
INSTITUTION	Laborers-AGC Education and Training Fund, Pomfret Center, CT.
SPONS AGENCY	Department of Education, Washington, DC.
PUB DATE	Jun 97
NOTE	53p.
CONTRACT	V244B30011
PUB TYPE	Guides - Non-Classroom (055) -- Legal/Legislative/Regulatory Materials (090)
EDRS PRICE	MF01/PC03 Plus Postage.
DESCRIPTORS	Building Trades; Competency Based Education; *Construction (Process); *Evaluation Criteria; Job Analysis; *Job Skills; Occupational Information; *Performance Based Assessment; Performance Factors; *Plumbing; Postsecondary Education; Secondary Education; *Standards; Student Evaluation; Task Analysis; Vocational Education

ABSTRACT

This document identifies skill standards for utility construction in a format that uses scenarios to provide a picture of the construction process under consideration. The scenarios provide a general description of the pipe laying and utility construction process. An introduction describes use and benefits of skill standards. Section 2 presents the skill standards for open cut pipe laying. Each standard has four informational components: (1) scenario describing the construction process, context of applications of workplace skills, and industry standards that can serve as performance criteria; (2) conventional industry standards containing proficiency, health and safety, and production requirements that serve as performance criteria; (3) key tasks; and (4) workplace skills, knowledge, and aptitudes. These skill standards are included: site preparation, excavation operation, elevation and alignment control; pressure pipe installation, pressure pipe repair, gravity flow pipe installation, gravity flow pipe repair, and backfill, compaction, and site restoration. Section 3 provides workplace skills, knowledge, and aptitudes (WSKAs) arranged into these categories: aptitudes and abilities, workplace basic skills, cross-functional skills, and occupation-specific knowledge. Each WSKA page contains the following elements: context, mastery performance level, content, reference to applicable job functions, and sample tasks and activities in which the WSKAs are applied. (YLB)

Laborers-AGC Education and Training Fund

Skill Standards for Open Cut Pipe Laying

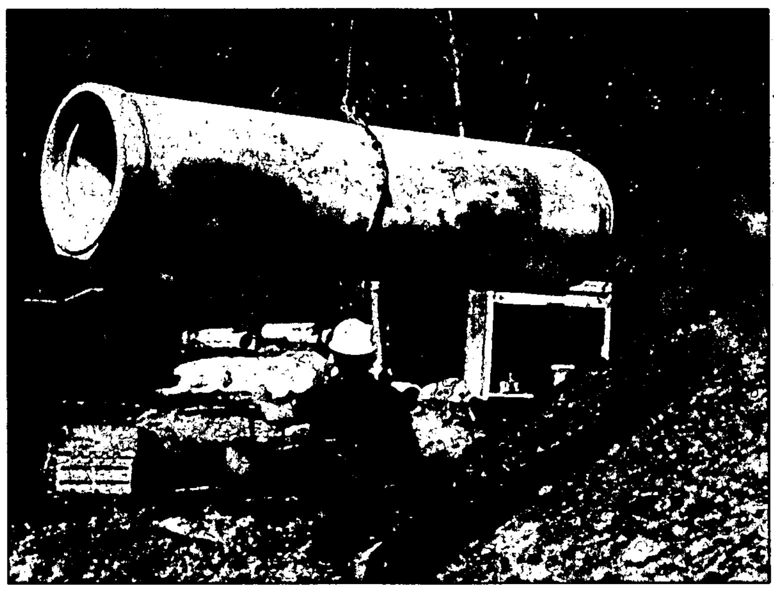


Table of Contents

Introduction 1
Origin and Purpose of Skill Standards 1
Development of Skill Standards 2
Use of Skill Standards 4
Organization of Skill Standards 6
Summary 10

Skill Standards for Open Cut Pipe Laying 11
Site Preparation 12
Excavation Operation 14
Elevation and Alignment Control 16
Pressure Pipe Installation 18
Pressure Pipe Repair 20
Gravity Flow Pipe Installation 22
Gravity Flow Pipe Repair 24
Backfill, Compaction, and Site Restoration 26

Workplace Skills, Knowledge, and Aptitudes 29
Organization of the WSKAs 29
Elements of a WSKA 30

Aptitudes and Abilities 31
Lift and Move Heavy Objects 31
Demonstrate Manual Dexterity and Eye-Hand Coordination 32
Work in Areas of Constricted Movement 33

Workplace Basic Skills 34
Calculate Volumes of Various Shapes 34
Read/Interpret Blueprints, Plans, or Prints 35
Use and Convert Between Common Measurement Systems 36
Find and Use Percentage Measures 37

Cross-Functional Skills 38
Choose and Use Appropriate Personal Protective Equipment 38
Learn and Use Sequences 39
Use Proper Signaling Techniques 40
Perform CPR 41
Identify Hazards 42
Perform Traffic Control Duties 43

Occupation-Specific Knowledge 44
Read Gauges and Instruments 44
Read Soils 45
Rig and Move Loads 46
Deal with Temperature Extremes 47

Acknowledgements 49

This material was produced in part under grant number V244B30011 from the U.S. Department of Education. It does not necessarily reflect the views or policies of the U.S. Department of Education, nor does the mention of trade names, commercial products, or organizations imply endorsement by the U.S. Government.

4

Introduction

"The changing workplace and marketplace demand that LIUNA take the lead in setting training and skill assessment standards in order to offer our members and signatory contractors the best service in the industry. As always, we are ready to meet the challenge."

Arthur A. Coia, General President
Laborers' International
Union of North America

Origin and Purpose of Skill Standards

The Laborers-AGC Education and Training Fund (Laborers-AGC) Business and Education Skill Standards Project (BESP) is one of 22 pilot projects designed to develop and use workplace skill standards to help the North American work force compete in an increasingly global marketplace. Funded in part by a grant from the U. S. Department of Education, the project's main goal is to generate world-class skill standards based on an analysis of the tasks a worker performs on the job, as well as the skills, knowledge, and aptitudes necessary to perform the work successfully.

Laborers-AGC elected to undertake this project to improve the skills of construction craft laborers and increase the market share of their employers in the heavy construction and environmental remediation industries.

Laborers-AGC believes that these skill standards will:

- Promote recognition of the construction craft laborer's numerous and varied skills.
- Enable trainers and educators to develop curricula that are relevant to the industries.
- Assist labor unions and employers in gaining market share by ensuring the skills of their workers.

For skill standards to be effective, workers, educators and trainers, labor union officials, and contractors and suppliers must use the standards.

- *Workers* must review the standards and seek training in areas in which they are not skilled.
- *Educators and trainers* must adopt the standards and pattern their curricula and assessments around them.
- *Labor union officials* must acknowledge the value of workers who possess these skills and encourage their members to obtain them.

- *Contractors and suppliers* must demand workers who possess these skills and continually provide feedback to educators and trainers about the quality of training.

Development of Skill Standards

In an effort to make these skill standards useful for all stakeholders, Laborers-AGC invited experts from labor, management, and education to join two coalitions to guide the process. One coalition directs the development of skill standards for the heavy construction industry and the other directs the work for the environmental remediation industry.

During development, staff used two task identification techniques—Modified DACUM (Develop A Curriculum) sessions and the Extended Search of published references—to generate a list of tasks, skills, knowledge, and aptitudes for each job.

"The most important part of the pilot project was the front-line worker interviews. These interviews allowed working construction craft laborers to describe in detail the skills they need and equally important, what skills they expect their coworkers to possess."

John Tippie, Project Director
Laborers-AGC Business and Education Standards

To ensure that the tasks included were valid and important to each of the jobs, three validation techniques (i.e., structured interviews, critical incident discussions, and surveys) were used with front-line workers, trainers, and supervisors. More than 200 construction craft laborers from different areas of North America were interviewed and asked to rate the importance and frequency of the tasks, skills, knowledge, and aptitudes.

The project aimed to compile a complete industry viewpoint on the tasks performed by workers in each of the job categories investigated. Validation sessions were conducted throughout North America to ensure geographic representation of the construction processes and tasks. Similarly, both union and nonunion workers were invited to participate in the interviews and surveys to ensure that a full array of practices were considered.

Figure 1 depicts how these skill standards fit into the construction industry.

SKILL STANDARDS FOR OPEN CUT PIPE LAYING

OCCUPATION:

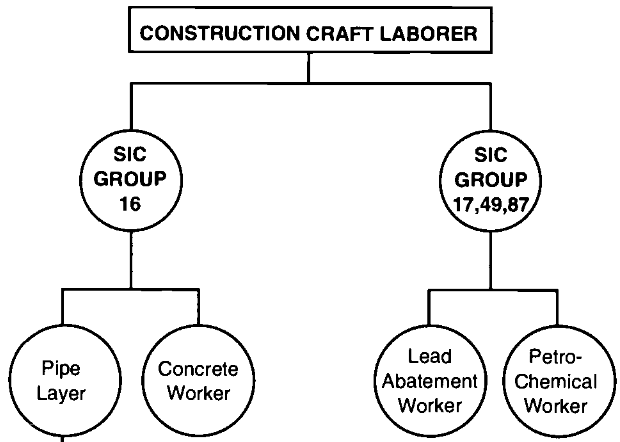
A set of jobs that provide lifelong employment. A single occupation may encompass several industries (as defined below).

INDUSTRY:

A major grouping within the Standard Industrial Classification system (SIC). This term describes a broad collection of occupations that function together or separately to produce products. The industries addressed in this project include those involved in heavy/highway construction and those in environmental remediation activities (SIC Groups 16, 17, 49 & 87.)

JOB TYPE:

The job types addressed in this project include Pipe Layer, Concrete Worker, Lead Abatement Worker, and Petro-Chemical Remediation Worker. This document only addresses the skill standards associated with Pipe Layer.



TYPE OF WORK:

Pipe Laying involves several steps that are similar for every type of utility installation. More specifically, site preparation, excavation, elevation/aligment control techniques, and backfill processes are almost identical regardless of the type of pipe or its purpose. For that reason, these work types are presented in a generic manner that applies to all pipe types. However, the joining techniques and accuracy requirements differ between pressure and gravity flow pipe system. Those work types have been addressed separately.

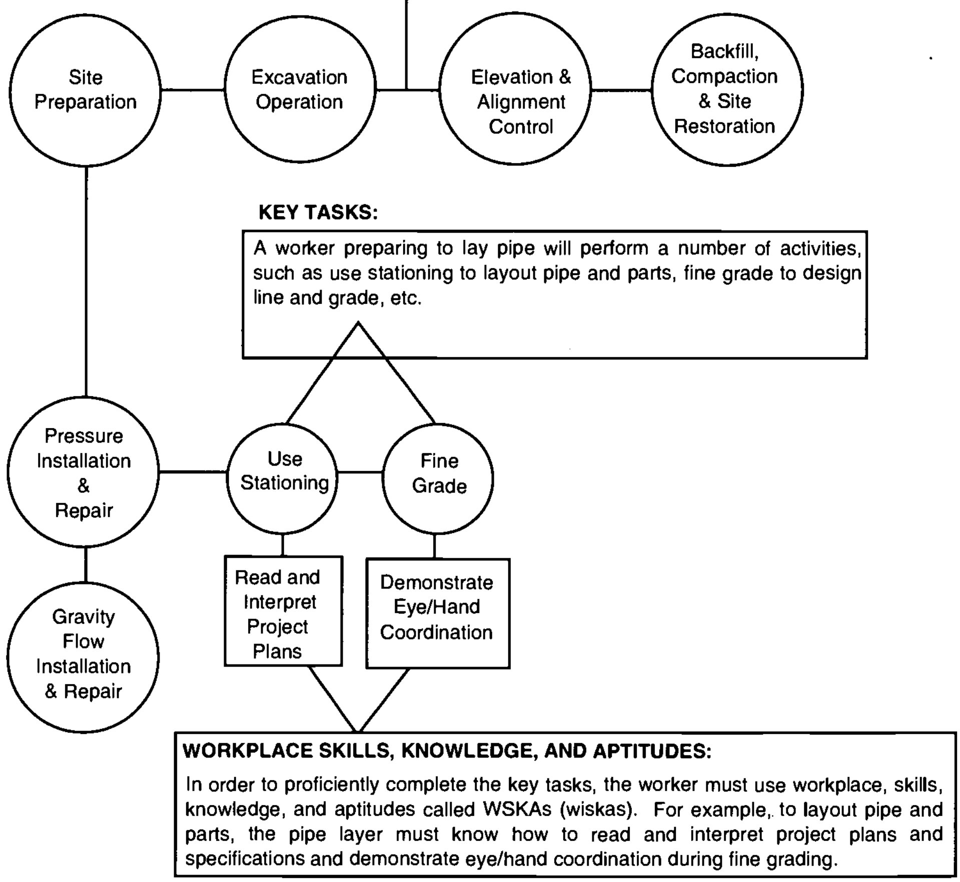


Figure 1
BESP Structure

Use of Skill Standards

The purpose of this document is to identify skill standards for utility construction in a manner that is easy to understand, useful, and meaningful to workers, educators, trainers, labor leaders, contractors, and project owners. To best achieve this goal, the coalition selected a format that uses scenarios to provide the reader with a picture of the construction process under consideration. The scenarios are designed specifically to provide a general description of the pipe laying and utility construction process. They are not intended to describe or prescribe craft worker jurisdictions or specialty construction methods and should not be interpreted as such.

Since there are many different types of underground utilities and each must be installed under different conditions, these skill standards cannot completely describe the construction process. Instead, Laborers-AGC elects to identify and describe the work practices and skills common to all job sites and regions.

The coalition envisions the standards will be used by many entities. However, we anticipate the primary users will be prospective and existing construction workers, the educational community, construction contractors and their associations, construction training organizations, and labor organizations.

Each of these entities will have a different application of the standards and each will seek different information. For that reason, we have designed the standards with four informational components:

1. **Scenario** – The scenario describes the construction process and conveys the context of the various applications of workplace skills, knowledge, and aptitudes. In addition, the scenario includes or implies conventional industry standards that can serve as performance criteria.

2. **Conventional Industry Standards** – Conventional industry standards contain proficiency, health and safety, and production requirements that serve as performance criteria. This information provides valid criteria for the design and implementation of assessment routines and informs the reader of the quality required during various steps of the construction procedure.

3. **Key Tasks** – Key tasks are selected from a master task list as identified and rated by incumbent workers. Since it would be too time-consuming to present the complete task list for every operation, only the tasks rated by workers as the most important and most frequently performed are included.

4. **Workplace Skills, Knowledge, and Aptitudes** – Relevant Workplace Skills, Knowledge, and Aptitudes (WSKAs) are listed with the standard's other components. In addition, directly following the standards is a section containing detailed description of key WSKAs as identified and verified by workers. Each WSKA includes the context, the mastery performance level, the content for training, and scenario(s) and relevant tasks to which it applies. The information enables curriculum development and performance assessment.

Organization of Skill Standards

As shown in Figure 2, each standard is presented on facing pages with the scenarios located adjacent to the key tasks, conventional industry standards, and WSKAs. The design and format enable every potential user of these standards to find the information they require quickly and efficiently.

SITE PREPARATION

Scenario

Specific steps to prepare a job site for underground utility construction depend mainly on project location. For example, utility construction in the center of a major urban area presents a different set of problems than construction in a rural area. However, regardless of the project location, there are five elements of the site that must be considered: 1) existing soil type at the design location; 2) proximity of the excavation to existing foundations and buildings and the risk of damage; 3) existing underground or overhead utilities that must be crossed, or are near the design location; 4) potential hazards to the workers; and 5) potential hazards for the human, animal, and plant life in the area . . .

12 © Laborers-AGC, June 1997

Conventional Industry Standards

1) No mechanical excavation within 2' (0.61 m) of a marked utility location.
2) Clearing to the "clearing limits" only.
3) No spoil piles or equipment outside the . . .

Key Tasks

1) Identify "right-of-way" limits.
2) Offset and reference survey and utility control staking.
3) Identify the location for spoil, pipe parts, . . .

Workplace Skills, Knowledge, and Aptitudes

1) Use and convert between common measurement systems.
2) Calculate volumes of various shapes.
3) Find and use percentage measures . . .

© Laborers-AGC, June 1997 13

Figure 2
Sample Skill Standard Layout

The anticipated users, as well as the information and benefits they will derive from the standards, follow.

Workers

Workers in the construction industry should use these standards as a benchmark for the skills they must possess to be successful in the described workplace. These standards reflect what employers expect of workers; therefore, without the skills, knowledge, and aptitudes, job prospects and consistent earnings will be more difficult to attain.

A worker should read the scenarios to recognize which aspect of a job is being described. Next, the worker should read the key tasks associated with that scenario, making sure he or she knows how to perform each task. This document can be used as a checklist. When the worker encounters a skill he or she does not possess, he or she should seek outside or on-the-job training, or begin self-study of the skills he or she does not yet have. To be considered proficient in these tasks, the worker must be able to perform the tasks according to conventional industry standards and recognize that different jobs may require different skills.

Workers also can compare their current skill levels in math, communication, safety, and other topics with the information found in the WSKA portion of these skill standards. The WSKAs are considered prerequisites for performance of the relevant tasks. Again, a worker can determine what prerequisite skills he or she needs by comparing his/her knowledge with the WSKA list.

Once the credentialing part of this project is created, workers will have a way to document what they know and use it as a selling point when seeking employment. To increase marketability, a worker should take an inventory of his or her skills using these standards, master the skills he or she doesn't yet have, and document the skills for current or future employment.

"Our coalition designed the WSKAs to contain a context, a content, and performance levels. These skill indicators enable educators to easily adapt their curriculum to include examples and assessments."

Carl Horstrup, Department Chair, Industrial Technology Program
Lane Community College

Educators and Trainers

The scenario component is designed to convey contextual information to educators. It describes the construction process and how a worker must use the workplace basic skills and knowledge that schools teach. Furthermore, information contained in the specific WSKAs enables educators to evaluate their curriculum, design instructional material, and build tests around measurable performance criteria and necessary work-based content.

Information contained in the conventional industry standards component will assist industry trainers in designing valid performance assessment tools. The key task component informs trainers of the most important tasks their trainees are expected to perform. This information enables trainers to design applicable, hands-on manipulative training exercises. When lessons and training strategies are designed around these standards, the schools and training facilities have a valid set of goals and objectives, measurable performance indicators, task lists, and necessary WSKAs to develop classroom and hands-on exercises. The resulting training process enables facility administrators to promote the credibility of their programs within the community and the industry, and with accreditation agencies.

The skill standards will help educators devise appropriate programs by providing educators, employers, and employees a common language for talking about skill needs and training goals. The result is strengthened relationships between workers, educators, and employers, as well as schools that will be capable of providing better preparation and career advice to prospective construction workers.

Employers

An unskilled worker on the job can cost a contractor in many ways, such as delaying the progress of the job, creating penalties for the contractor, causing accidents that lead to increased worker compensation costs and public safety hazards, and making errors that may result in loss of profit.

"A contractor's survival and profitability is determined in large part by the efficiency and effectiveness of the work force. Ensuring that workers' skills fit the needs of the job site is a bottom-line economic necessity."

John Heffner, Executive Director
Training and Educational Services
Associated General Contractors of America

A skilled work force is one of the most important ingredients to a contractor's success, which is why skill standards are so beneficial.

A contractor with a team of highly skilled workers can develop a strong reputation and an important element with which to market the company. Additionally, when a contractor needs additional workers, he or she can request a worker with specific identified skills and be guaranteed the worker knows the job.

Employers also will benefit by ensuring that revenue contributed to joint labor/management training funds will be used for training occupational skills versus academic skills which will be addressed by schools that adopt the standards.

All employers involved in training can, through this document, have access to the industry's best skills data and training strategies. Contractors will be able to use the standards information to restructure work assignments so as to enable a high-performance workplace.

In order for any employer (contractor or otherwise) to experience these benefits however, everyone must do their part. An employer's most vital role is to encourage the use of these skill standards by supporting their implementation in local schools and training funds, and by requesting workers that have demonstrated they possess these skills through training or job experience.

Summary

Skill standards provide benefits to all stakeholders by emphasizing quality of production, safe work environments, and ensuring lifelong learning and earning for workers. They also improve the industry image which attracts workers, increases confidence in products in the broader community, and improves profit margins by ensuring quality, improving skills, and boosting efficiency of workers at all levels.

"We can achieve success only if employers, employees, educators, and communities across North America want this to succeed."

James R. Houghton,
National Skill Standards Board
Chairman and Retired Chairman
and Chief Executive Officer
Corning Corporation

The standards are designed to be used by all stakeholders in the utility construction industry. Stakeholders include:

- *Workers* who seek lifelong employment in the construction industry.
- *Labor leaders* who work together with their signatory contractors to staff the most intricate construction projects in history.
- *Employers* who strive to remain competitive in an increasingly global marketplace.
- *Educators and trainers* who need accurate descriptions of the work to teach the basic skills to perform it.
- *Project owners* who must choose among competing contractors.
- *Members of the general public* who purchase, use, and benefit from the utility systems.

Pipe Laying Worker Skill Standards

The Skill Standards for Open Cut Pipe Laying follow.

15

SITE PREPARATION

Scenario

Specific steps to prepare a job site for underground utility construction depend mainly on project location. For example, utility construction in the center of a major urban area presents a different set of problems than construction in a rural area. However, regardless of the project location, there are five elements of the site that must be considered: 1) existing soil type at the design location; 2) proximity of the excavation to existing foundations and buildings and the risk of damage; 3) existing underground or overhead utilities that must be crossed, or are near the design location; 4) potential hazards to the workers; and 5) potential hazards for the human, animal, and plant life in the area. Other hazards that need to be identified and planned for during site preparation include: 1) surface water control during rainstorms or in case of an accident such as a water main break; 2) sub-surface water; 3) chemically contaminated soil from the excavation; and 4) biological hazards such as snakes, alligators, scorpions, and poisonous plants.

The potential for these hazards as well as possible disruptions created by underground construction require that a pipe layer know not only how to install and maintain a utility system, but also know the safety precautions involved. A pipe layer must know the: 1) soil types and the appropriate angle of repose for each; 2) environmental factors that can affect soil stability; 3) capacities and installation techniques of ground support systems to prevent an excavation from caving or undermining a nearby building or structure; 4) current methods and requirements to locate and safely excavate around existing utilities; and 5) methods and means to protect workers and the public from the hazards created by, or inherent to, underground construction. In addition, the pipe layer should be empathetic and diplomatic when dealing with the public because underground utility construction creates disruption.

The first step for site preparation is to implement the traffic control plan. This includes installing signs and barricades, detouring construction, and posting traffic control personnel.

The second step is to perform a site inspection and construction survey. If the area must be cleared of trees and brush, clearing limits must be marked before the area is cleared. In order for the pipe layer to become familiar with the staking system, he or she is often involved in the initial survey and staking operation. During this process, reference points are established outside the work area before excavation begins. Knowledge of construction survey procedures, squaring principles, and elevation and alignment control techniques is critical. The pipe layer must know how to apply ratio, volume, and percentage formulas to calculate approximate spoil quantities, excavation depth, and excavation width. These calculations are critical in determining spoil pile location and how and where pipe materials must be stock piled and laid out.

Existing utilities are then located and marked by the utility owners or operators. The marked locations are carefully excavated in strategic locations to verify that the utility is at the marked location and to establish its depth (called "pot-holing"). After pot-holing, the actual depth and location of the utilities are referenced and recorded on the project drawings.

Conventional Industry Standards

1) No mechanical excavation within 2' (0.61 m) of a marked utility location.
2) Clearing to the "clearing limits" only.
3) No spoil piles or equipment outside the right-of-way or within 2' (0.61 m) of the excavation.
4) Traffic control in accordance with project, state, and municipal codes/specifications.
5) Normal angle of repose = 1 1/2:1.
6) Staking accuracy is dependent on the type of installation (e.g. gravity flow is tighter tolerance than water).
7) Soil types and protection systems are described and classified in OSHA 29 CFR 1926 Subpart P 1926.650.

Key Tasks

1) Identify "right-of-way" limits.
2) Offset and reference survey and utility control staking.
3) Identify the location for spoil, pipe parts, ground support structures, and groundwater control including pump discharge.
4) Locate and verify existing utilities.
5) Identify (and locate) potential hazards of all types.

Workplace Skills, Knowledge, and Aptitudes

1) Use and convert between common measurement systems.
2) Calculate volumes of various shapes.
3) Find and use percentage measures.
4) Read soils.
5) Know OSHA regulations for excavations.
6) Practice public relations skills to deal with the public.
7) Work as part of a team.
8) Know about groundwater (its movement and affects on an excavation).
9) Identify hazards.
10) Read/interpret blueprints, plans, or prints.

EXCAVATION OPERATION

Scenario

Cave-in danger makes working in an excavation one of the most dangerous jobs in the construction industry. However, the dangers can be minimized by knowing the soil types and factors that affect soil stability.

Before the excavation project begins, soils are identified through test holes. Test holes are either drilled or dug by an excavator. They are strategically located to provide the best possible information regarding the soils. OSHA regulations classify soil types as Type A, B, C, or solid rock. However, test holes may not accurately identify all the soil types found during the excavation process. Therefore, pipe layers must watch for changes that affect the stability of the excavation walls. For example, test holes and soil samples will not always reveal the existence of previous excavations.

The identification of previous excavations is important for two reasons: 1) soil previously excavated will not stand or support the same load as undisturbed soil of the same type; and 2) a previous excavation could indicate an existing utility close by. Common signs of a previous excavation include a marked change in the soil stratification or type, litter or debris in the excavation, and utility company marker tape.

Other factors affecting the stability and safe working conditions in an excavation are falling material from spoil piles, groundwater, and hazardous chemical contamination.

- *Spoil piles* must be placed far enough away from the edge of the excavation (at least 2' or 0.61 m) to prevent the excavated material from falling into the excavation. In addition, spoil piles must be placed far enough away that excavation walls will not be required to bear the piles' weight.

- *Groundwater* may undermine and weaken the excavation walls as well as create muddy conditions that make it difficult for the pipe layers to move around quickly. Therefore, pipe layers need to watch for undermining (caused by water movement) and make sure their boots don't get stuck in the mud.

- *Hazardous chemical contamination* may be encountered whenever a pipe layer is excavating near a waste site, chemical plant, or other form of pollution. Because not all chemicals have detectable odors, odor is not a reliable indicator of contamination. Employers increasingly are seeking pipe layers trained in hazardous waste identification and remediation.

Pipe layers should know the safety procedures for getting in and out of an excavation. Ladders and/or ramps must be kept within 25' (7.6 m) of workers at all times. Protective systems are based on OSHA's soil type classifications. Protective systems include sloping, shoring, and trench shields. If sloping is selected as the protective measure, worker safety regulations describe specific slope ratios based on the type of soil. For example, an excavation in Type C soils (sandy, gravel) must be sloped at least 1 1/2:1 (horizontal:vertical).

During the excavation process, pipe layers and excavator operators work as a team. Since the noise of the equipment usually will not allow verbal communication, hand signals are the primary means of communication. The pipe layer will use hand signals to: 1) guide the excavator around existing utilities or obstructions; 2) indicate how close the excavation is to design elevation and alignment, and 3) help guide loads, such as pipe, shoring materials, and trench shields.

Conventional Industry Standards

1) International hand signals.
2) Spoil placement at the OSHA prescribed distances.
3) Sloping and shoring, trench shield regulations as identified in OSHA 29 CFR 1926 Subpart P.
4) Operations matched to soil types.
5) Observe and excavate appropriately around utility company markers and locates.
6) Notification time to utility locators.
7) Access and egress regulations followed to the letter of the regulations.

Key Tasks

1) Identify and monitor soil.
2) Select and install protective systems.
3) Excavate around utilities.
4) Control groundwater.
5) Work with the excavator operator to establish and maintain line and grade.

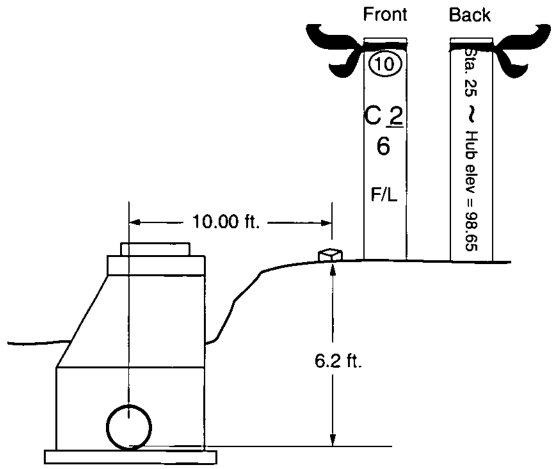
Workplace Skills, Knowledge, and Aptitudes

1) Determine slope ratios.
2) Read soils.
3) Use proper signaling techniques.
4) Choose and use appropriate PPE.
5) Identify hazards.
6) Use and convert between common measurement systems.
7) Match and install appropriate protective systems to soils, conditions, and regulations.
8) Work as member of a team.

ELEVATION AND ALIGNMENT CONTROL

Scenario

Piping systems must be installed at specific horizontal and vertical locations. The horizontal and vertical requirements are referred to as "line" and "grade," respectively. The design line and grade of a piping system is identified in project drawings (blueprints) and accuracy requirements (tolerances) are further identified in the project specifications. The tolerances for deviation from design line and grade vary with the type of piping installation. For example, potable water distribution systems require less accuracy than do gravity flow sanitary sewer installations. Normal industry tolerances for water pipe is ± 0.10' (30 mm) per joint of pipe. Normal tolerances for sanitary sewer is ± 0.03' (9 mm) per joint of pipe. Sanitary sewer systems require greater accuracy because they operate on principles of gravity flow to move material. Deviations from design line and grade larger than the specified tolerances can create blockages.



Each of several methods to control line and grade during installation use standard surveying equipment and procedures. Line is established using a transit. Elevation is established using a level. In most gravity flow pipe installations, a laser is used to establish both line and grade; however, the laser should always be set up and checked periodically with the transit and level. Pipe layers must follow standard construction survey steps and sequences to set up and operate transits, levels, and lasers. Additionally, they must maintain daily "as-built" records that follow standard construction survey protocols.

On the project site, line and grade is transferred from survey stakes set by project engineers. Since the construction process will destroy staking, reference stakes that identify the horizontal and vertical distance from the pipe are offset outside of the work area. Pipe layers may use a "cut sheet" (horizontal and vertical dimensions from the survey stakes to pipe center) to identify line and grade. Piping systems are designed and staked longitudinally using a system called "stationing." Stationing provides an imaginary design grid system that enables pipe features such as bends, tees, valves, and hydrants to be measured from reference stakes and installed at the designed location.

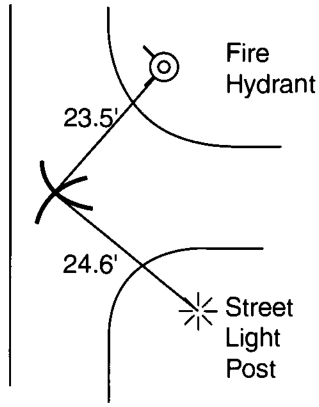
Pipe layers also use stationing to determine horizontal distances and start and stop locations; to calculate elevation differences and to locate existing utilities.

Project drawings express the rise or fall of a pipe section either as a percentage of slope or as a rate per foot. Pipe layers must apply basic slope formulas to calculate elevation differences. In addition, project drawings may use bearings or coordinates to describe the line of pipe; therefore, basic geometric and trigonometric principles assist during layout and installation.

Often, distance and noise from construction equipment prevents the pipe crew from talking with each other. Therefore, the ability to use and understand hand signals is critical, especially while checking the line and grade of a newly installed pipe section.

Conventional Industry Standards

1) Standards of accuracy for reference staking follows second order survey protocol.
2) Standard survey closure procedure for all level loops and as-built notes.
3) Potable water installation accuracy is ±0.10' (30 mm) in 18' (5.5 mm).
4) Sanitary sewer installation accuracy is ±0.02' (6 mm) in 19' (5.8 m).
5) Storm drain installation accuracy is ±0.10' (30 mm) in 20' (6 m).
6) Laser setups must be checked with conventional line and grade methods.
7) Minimum "bury" requirements in areas with freezing potential must be followed (as prescribed in local codes).



Key Tasks

1) Follow sequential set up steps for transit, level, and lasers.
2) Calculate offset distances and use squaring principles to locate design pipe from offset reference staking.
3) Locate and establish reference elevations from bench-mark locations.
4) Use differential leveling principles to establish ditch grade, bedding grade, and pipe grade from offset reference stakes.
5) Read and understand cut sheet explanations.
6) Know and apply the stationing system to locate pipe features, start, and end locations.
7) Calculate elevation changes using percentage of slope, rate per foot, and slope ratios.

Workplace Skills, Knowledge, and Aptitudes

1) Perform traffic control duties.
2) Find and use percentage measures.
3) Use basic survey principles and applications.
4) Use and convert between common measurement systems.
5) Use differential leveling principles and application.
6) Read/interpret blueprints, plans, and prints.
7 Work as a member of a team.
8) Use proper signaling techniques.
9) Demonstrate manual dexterity and eye-hand coordination.
10) Follow sequential steps.

PRESSURE PIPE INSTALLATION

Scenario

Pressure pipe installations commonly use reinforced concrete, ductile iron (DI) or polyvinyl chloride (PVC) pipe. Most pipe types use DI fittings (such as valves, tees, hydrants, and bends). Pressure pipe sections may be joined with slip-on joints, welding, or mechanical joints. Slip-on joints incorporate a bell and spigot-type assembly. Mechanical joints utilize tee-bolts, pipe flanges, and nuts tightened to manufacturers' specifications. Both joint types require a gasket and careful attention during the joining process. Pipe layers must know how to install the different types of pipe and fittings and know common building codes.

The installation process is accomplished through team work. A normal pipe crew consists of six or seven persons. There are two equipment operators (one responsible for excavating, and the other responsible for backfilling), two pipe layers (a lead and tail pipe layer), a top man, an engineer, and a foreman.

Each crew member works on specific duties during the installation process. The excavator operator excavates the ditch close to design line and grade. The lead pipe layer uses a shovel to level the sub-grade and bedding to final grade. The top man rigs the pipe sections and hooks them to the excavator, who then lowers the pipe sections into the ditch. The lead pipe layer steadies the pipe section, while the tail pipe layer guides the end into the preceding section. The tail pipe layer also watches the pipe insertion carefully to ensure the gasket seats correctly. Once the section is joined, the lead pipe layer sets the pipe to design line and grade. This is accomplished either by aligning the pipe section with a laser beam and target or with the assistance of an engineer using a grade rod, level, and transit to check line and grade at top of pipe. Initial back filling of the pipe section begins as soon as the joint is set to design line and grade. The tail pipe layer must pay careful attention to eliminating air voids, ensuring that bedding material is compacted tightly around the haunches of the pipe. In addition, the tail pipe layer must ensure that the pipe is secure and will not move during subsequent back filling.

As installation progresses, lead and tail pipe layers install valves, bends, and tees at the designed locations. The engineer and top man assist the pipe layers by laying out pipe and parts at the proper location and by assembling pipe parts before they are rigged and lowered into the trench. The foreman is responsible for maintaining production, ensuring a safe excavation, getting required materials to the job site, and producing daily reports, such as progress reports, employee time records, and equipment records.

After a large section of main line pipe is assembled and back filled, it must be hydrostatically tested for leaks and sterilized to kill bacteria. The normal procedure involves: 1) flushing the section by leaving a pipe section open and pointed out of the trench, and slowly turning on the water to full force; 2) plugging the open section and back filling; and 3) pressure testing the section. Project specifications use a formula that calculates the allowable leakage based on the length and diameter of the pipe section. Sterilization follows a successful pressure test and involves adding the appropriate ratio of chlorine to water while filling the pipe section. Once a section is tested and approved for service, the pipe laying crew installs service connections. They excavate the appropriate service connection location and hot-tap (while under pressure) the main line, install fittings, and install flexible copper tubing to the property line.

Conventional Industry Standards

1) Pressure test formulas and testing matched to specifications.
2) Installation tolerances and proper closure and recording of as-builts.
3) Mechanical joint torque sequence and torque pressure.
4) Ratio/percentage of chlorine to water for chlorination.
5) Soil density as indicated in project specifications.
6) Normal backfill lift heights to achieve design soil density.

Key Tasks

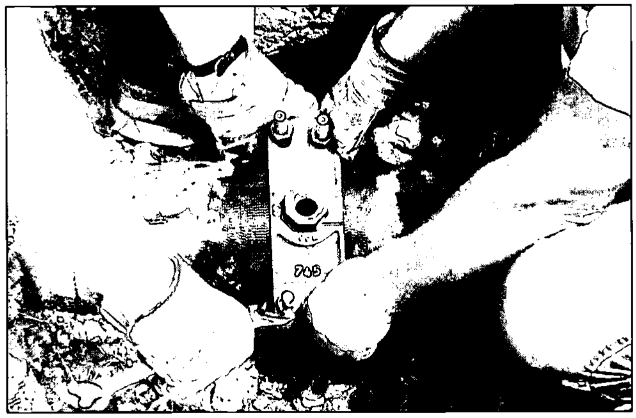
1) Use stationing to layout pipe and parts.
2) Fine grade to the design line and grade.
3) Install and join to ensure no leaks.
4) Tighten nuts to design torque using proper sequence.
5) Recheck tightness of nuts or parts assembled out of the ditch.
6) Rig pipe and parts at appropriate balance point.
7) Watch the joining for "spring back" that indicates a rolled gasket.
8) Back fill around pipe haunches completely.
9) Compact bedding material to specified density.

Workplace Skills, Knowledge, and Aptitudes

1) Calculate volumes of various shapes.
2) Find and use percentage measures.
3) Read/interpret blueprints, plans, or prints.
4) Use leakage formulas to calculate allowable pressure drops.
5) Use proper signaling techniques.
6) Know and follow common building codes.
7) Read soils.
8) Demonstrate manual dexterity and eye-hand coordination.
9) Rig and move loads.
10) Read gauges and instruments.

PRESSURE PIPE REPAIR

Scenario



Repairs to pressure pipe may be necessary as a result of many factors, including improper installation, earthquakes, damage by excavating equipment, freezing, and corrosion. Pipe layers must be familiar with the type of pipe to be repaired and have the necessary tools, fittings, and lengths of pipe readily available at the job site.

If a repair is necessary because of a water main break, careful inspection of the site and proper planning is essential. In most water main breaks, it is necessary to isolate the section from the rest of the distribution system by turning off the closest main line valves. Knowledge of the distribution system and exact valve location allows isolation of the section. To properly identify the correct valves and accurately locate the break, most repair projects require the review of "as-built" drawings and records.

High pressure water usually washes material away from the pipe creating holes and undercut areas. The possibility of cave-ins makes the excavation and repair operation extremely hazardous. Special shoring may be needed to protect the pipe layers. If the repair is isolated to a small area and the pipe is deep, confined space regulations must be followed.

Broken pipes caused by an earthquake, improper bedding, or poor installation usually break the pipe crosswise. This type of breakage can be repaired using a wraparound repair clamp. The clamp is completely unbolted, unwrapped, and placed around the broken area. Once the clamp is rewrapped around the broken area, the bolts are assembled and torqued to manufacturers' specifications.

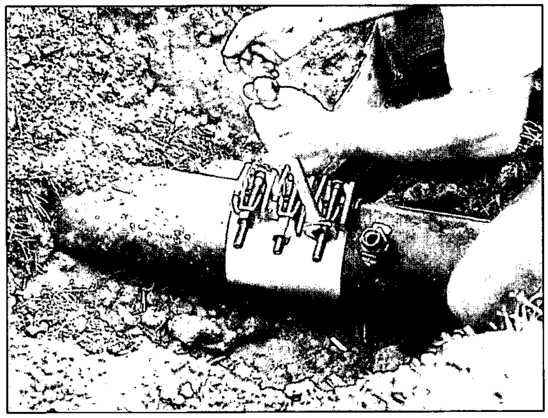
When the pipe is broken lengthwise, the broken section of pipe is usually removed and replaced. Once the water is turned off and the broken section excavated, the pipe layer repairs the damage as follows: 1) uses a cut-off saw to make a cut on each side of the break; 2) removes the broken section; 3) slides the mechanical joint repair couplings on each side of the existing pipe; 4) lowers the new section into position; 5) slides the couplings back until the cut is centered in the coupling; and 6) tightens the coupling bolts to manufacturers' specifications.

Service connection repairs may include replacing broken fittings and/or copper service lines. Copper service lines can be repaired by turning off the water flow at the main line and using a tubing cutter to cut out the damaged section. Unions can then be used to install a replacement tubing section.

After the pipe repair is complete, proper bedding and backfilling of the pipe is crucial to maintain pipe alignment and strength. To prevent settling of the area around the break, the back fill material must be compacted to at least 95% density.

Conventional Industry Standards

1) Proper ground support procedures must be applied.
2) Confined space regulations may apply.
3) Torque specifications and sequence for clamps and couplings.
4) Soil density requirements must be followed as in new construction.
5) Slip-on joint replacement requires 45° bevel on the spigot end.
6) Couplings and repair clamps must be centered over the break and/joint.



Key Tasks

1) Install and maintain ground support mechanisms.
2) Control water flow using pumps.
3) Stop leakage by isolating the break.
4) Install repair devices following manufacturers' instructions and/or project specifications.
5) Backfill and compact soil around the repaired pipe to eliminate voids and reduce the possibility of settlement.
6) Ensure repaired section is installed at the same line and grade as originally designed.
7) Prevent soils, rocks, and other debris from entering the pipe.

Workplace Skills, Knowledge, and Aptitudes

1) Read soils.
2) Read/interpret blueprints, plans, or prints.
3) Read and identify line and grade measurements from as-built drawings and notes.
4) Know confined space regulations and the hazards of confined space.
5) Use and convert between common measurement systems.
6) Read instruments.
7) Demonstrate manual dexterity and eye-hand coordination.
8) Rig and move loads.
9) Use proper signaling techniques.
10) Read gauges and instruments.

GRAVITY FLOW PIPE INSTALLATION

Scenario

Gravity flow pipe systems include sanitary sewers, storm drains, and sub-drains. Installation tolerances vary between the types. The most rigid system is the sanitary sewer system. It is routinely required to be within 0.02' (6 mm) to 0.03' (9 mm) of designed line and grade. This degree of accuracy is needed to ensure that the pipe has a smooth bore and will not inhibit the movement of fluids and solid matter. Sanitary sewers must be installed within a specific gradient range. If the gradient is too steep, fluids run away from the solid material, creating blockages. If the gradient is too flat, the fluids will not carry the solid material, also creating blockages. Large elevation differences required by land contours (or long gradient runs) will use pumping equipment installed at lift or drop stations. Storm and sub-drain systems require less accuracy, but still operate using the principles of gravity flow. Tolerances are normally within 0.10' (30 mm) in 20' (6 m), but the pipe must always fall in the direction in which the fluid is designed to travel. When flat gradients are specified, greater accuracy is required to avoid installing pipe that falls against the design flow direction.

Most gravity flow pipe systems utilize manholes for direction change or maintenance. However, sanitary sewers are unique; they are not designed for any type of direction or gradient change except where it occurs in a manhole. Since gravity flow systems must be installed with a downhill slope, a long run of pipe can become very deep, particularly where the natural terrain slopes the opposite direction. The greater excavation depth requires all workers to pay close attention to the installation and maintenance of ground support devices that protect the pipe layers from cave-ins.

Usually, gravity flow pipe installations utilize a similar crew composition as pressure pipe installations. However, there are different concerns. The most notable concern is where to place the larger amount of excavated material and the techniques to ensure the required installation accuracy is achieved. In addition, gravity flow pipe elevations are normally described in project plans as "flow line" or "invert" grade (the inside, bottom of the pipe). Pipe layers must account for inside and outside pipe diameter when calculating elevation and rod readings. During manhole installation, the depth and thickness of manhole bases must be included in depth calculations.

Joining methods vary with the type of pipe and design. Usually, DI, PVC, and vitrified clay pipe are joined by bell and spigot. Corrugated metal (used in sub-drains and storm drains) uses a bolted band that is shaped in the same configuration as the pipe ends. Regardless of the joint type, the pipe ends must be free of dirt, rocks, and debris. Also, the tail pipe layer must closely watch the joining process to ensure the spigot and gasket seat properly.

Similar to pressure pipe systems, sanitary sewer is pressure tested to ensure it was installed without defects. However, instead of a hydrostatic test, sanitary sewers are pneumatically tested in a low pressure air test. The pipe section is blocked between manholes and pumped up to 4-5 lbs. psi. The length of time for the pressure to drop 1 psi is recorded and compared with the specified allowable leakage. The leakage formula is identified in the project specifications or in the local building codes.

Service connections for sanitary sewers are installed after the section is tested and approved for use. The pipe crew excavates the main line at the design location of the service and uses a drill or saw to cut a circular hole at the design clock position on the main pipe. A saddle fitting is installed and bolted to the main line and the service line is installed to the property line. Service connections for private residences are normally made with 4" (100 mm) pipe set to a gradient of 2%. In most instances, the standard for a service pipe is a "quarter bubble" of slope on a torpedo level.

Another test procedure used for all types of gravity flow systems is called "lamping." In a lamp test, the inspectors use a light to sight down the bore, top, bottom, and sides of the pipe section looking for defects in line and grade. A successful lamp test shows a full moon or circle of light.

Conventional Industry Standards

1) Allowable pressure drop in low pressure air test specified in project documents or local building codes.
2) Sanitary sewer installation accuracy is 0.02' (6 mm) to 0.03'(9 mm) per 18' (5.5 m) of pipe.
3) Installation accuracy for storm drain pipe is 0.10'(30 mm) per 20' (6 m) of pipe.
4) The flatter the gradient, the greater the accuracy required.
5) Standard low pressure air test begins at 4 psi.
6) Torque amounts and installation procedures for different types of joints are manufacturers' recommendations.
7) Lamp tests must show a full moon or circle of light.
8) Service pipe falls at 2% or 1/4 bubble on a torpedo level.
9) Cut spigot sections must be beveled to 45° on DI pipe.
10) Service connections must be installed at a 45° angle (10:30-1:30 clock position) unless the main is deeper than 10' (3 m).
11) Main line clean outs are installed at the end of a pipe section and normally at 45°.

Key Tasks

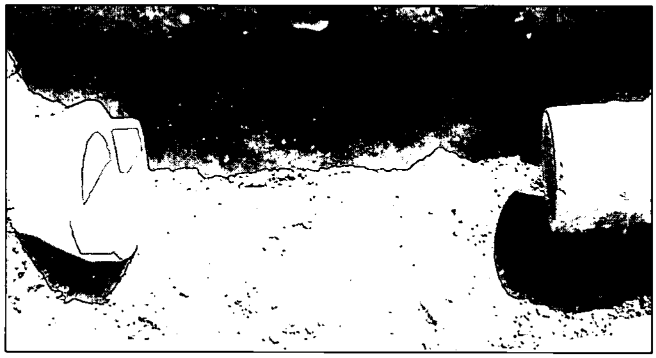
1) Install and maintain ground support procedures.
2) Ensure no dirt or debris are present in pipe ends.
3) Lubricate gaskets for bell and spigot installations.
4) Monitor insertion, watching for signs of a "rolled" or improperly seated gasket.
5) Control traffic in areas with vehicles and equipment.
6) Grade pipe bed to design line and grade.
7) Account for pipe diameter and thickness in elevation calculations.
8) Account for manhole base thickness in excavation and bedding elevation calculations.
9) Check and recheck laser setups with conventional surveying equipment, such as level and transit.
10) Ensure pipe and pipe parts are not placed in the way of the excavation or intended spoil location, but are close enough to be conveniently accessible.

Workplace Skills, Knowledge, and Aptitudes

1) Perform traffic control duties.
2) Use principles of elevation transfer.
3) Use and convert between common measurement systems.
4) Read/interpret blueprints, plans, or prints.
5) Read soils.
6) Know confined space hazards and regulations.
7) Demonstrate manual dexterity and eye/hand coordination.

GRAVITY FLOW PIPE REPAIR

Scenario



Repairs to gravity flow pipes may be necessary as a result of a number of factors such as improper installation, earthquakes, damage by excavating equipment, tree roots, and corrosion.

Gravity flow installations can be very deep. To safely and efficiently repair these pipes requires careful planning of the excavation and for employee protection procedures. In the case of repairs to a live sanitary sewer system, factors such as hazardous atmospheres and biological hazards must be planned for and proper personal protective equipment be available and ready for use. In addition, if the damaged pipe is live, provisions must be made to stop the flow through the repair area either by diversion or plugging. For diversions, a pipe layer must be familiar with fluid pump operation and maintenance. If the damaged area is large and requires more than a single replacement joint, line and grade equipment will be necessary to ensure the replacement section is installed at the correct elevation and alignment.

A pipe layer's responsibility during a repair operation are similar to those during the installation operation. The pipe layer must know the type of installation, manufacturers' recommended installation procedures for clamps, couplings, and bands, and the tools and equipment needed to make the repairs. Since time may be a critical factor during the repair, the foreman must plan ahead and ensure that all of the needed tools, parts, and equipment are on hand and ready before the excavation begins.

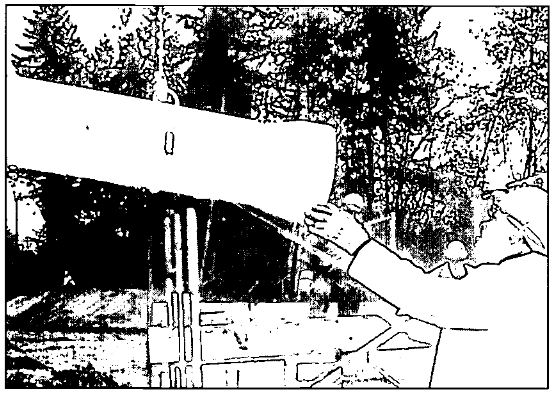
The most common repair part for a sanitary sewer is a flexible rubber coupling. The coupling is fastened over the joint or break using steel bands over a rubber gasket and tightened with threaded screws. When repairing a pipe section less than one joint in length, two couplings and the necessary length of pipe are used. Similar to repairing pressure pipe, the broken section is cut and removed. The couplings are slipped over both ends, then slid over the center of the joint and tightened.

Repairs requiring more than one joint are performed with one coupling and normal joining procedures. Flexible rubber couplings are manufactured for pipes up to 18" in diameter. Larger pipe must be repaired using mechanical couplings or by replacing the damaged joint.

To replace a damaged section of concrete pipe, one-half of the bell section of a replacement joint and the top half of the existing bell are cut away. The replacement joint is then lowered into position and rotated 180°. This rotates the factory-made bell section under the pipe. The pipe section is shifted to the proper line and grade (if needed) and the cut away bell sections are replaced with mortar.

To repair corrugated metal pipe used in storm drains, sub-drains or culverts, the damaged section is cut out and replaced using the appropriate band. CMP bands are manufactured in spiral, annular, and universal configurations. The band either must match the corrugations on the pipe sections or be a universal band.

Conventional Industry Standards



1) Accuracy requirements are same for repaired section as the original installation.
2) Repaired section must be properly backfilled and compacted to original density requirements.
3) Confined space regulations may apply.
4) Proper ground support procedures must be applied.
5) Manufacturer recommended torque specifications and sequences for bolts on repair parts.
6) Cuts must be made square and spigot cuts must be beveled to 45°.
7) Couplings/clamps must be centered over joint or break.

Key Tasks

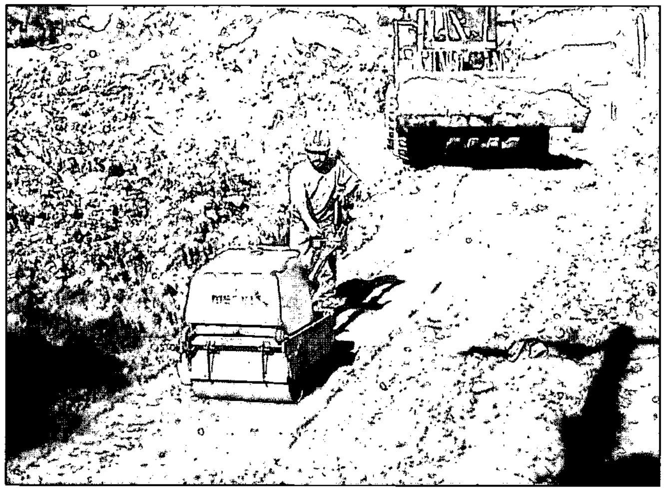
1) Start up, operate, and maintain fluid pumps.
2) Install and maintain ground support systems.
3) Have pipe, parts, tools, and equipment ready before starting the excavation.
4) Prevent soil, rocks, and debris from entering the pipe.
5) Measure and mark the location of the repair couplings to ensure the joint or break is centered under the coupling/clamp.
6) Ensure all gaskets are in place and seated correctly.
7) Set up and maintain diversion and/or plugs for live-line repairs.
8) Select personal protection equipment and have it ready for use.
9) Install repair devices following manufacturers' and/or project specifications.
10) Start up and operate cut-off saw for concrete, vitrified clay, and steel pipe.

Workplace Skills, Knowledge, and Aptitudes

1) Choose and use appropriate personal protective equipment.
2) Read soils.
3) Use and convert between common measuring systems.
4) Perform traffic control duties.
5) Use principles of elevation transfer.
6) Knowledge of repair techniques, parts, and equipment.
7) Read/interpret blueprints, plans, and prints.
8) Demonstrate manual dexterity and eye/hand coordination.

BACKFILL, COMPACTION, AND SITE RESTORATION

Scenario



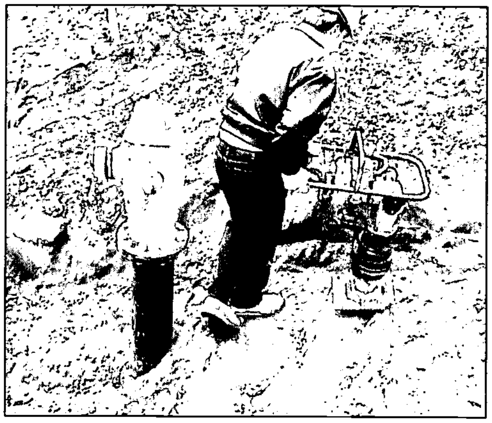
Back-fill and compaction procedures usually begin as each section of pipe is installed. Once the section is placed at design line and grade, the excavator carefully places bedding material on the center of the pipe. The pipe layers use a shovel to level the bedding to spring-line of pipe (half way up the pipe) and to fill in all voids around the pipe haunches. Then the tail pipe layer uses a teebar tamper or shovel handle to pack the bedding material completely under and around the pipe. This process is called "haunching." Haunching is very important because the tamped bedding material provides support, preventing the pipe section from moving during the subsequent back filling operation.

Once the bedding is placed around the pipe, hand-operated pneumatic- or gasoline-powered compacting equipment is operated on both sides of the pipe to compact the bedding to the specified density. Compacting on both sides of the pipe is a crucial step because the support provided by the compacted bedding gives the pipe strength to resist crushing. With large pipe, the bedding and compaction process may involve several steps or "lifts" until the pipe is completely buried and securely bedded. The depth the compacting equipment is able to penetrate determines how deep each lift can be. The pipe layers must know the soil characteristics and recognize when the material has reached its maximum density.

After the pipe is buried and compacted to at least the top of the pipe, large equipment is used to begin back filling. Most often, loaders or dozers are used to begin filling the excavation and leveling the fill in lifts of 1' (300 mm) to 3' (900 mm). In addition, self-powered compactors are used on each lift to maintain the specified density of backfill. In areas where freezing temperatures are likely, project specifications may require a layer of insulation be installed at a specified distance above the pipe. If the pipe crosses a street or another utility, it may be required to be encased in concrete.

The type of site restoration required depends on the location of the project. For example, if an excavation is located in a business or residential area, the material is compacted to subgrade and graded to design elevation. When a project involves manholes, fire hydrants, and valves, the utilities must be adjusted to finish grade to match the street, sidewalk, elevation, and slope. If the site restoration project is being done in an uninhabited area (where no further building activity will occur) the area needs to be returned to its original state. The excavation is backfilled with existing material and graded to match the natural contours of the land. Site restoration also involves replacing existing signs, fences, and utility poles or adding new ones. The final step is replacing topsoil, sod, seeding, shrubs, and trees and making other repairs to the area around the excavation.

Conventional Industry Standards



1) Density requirements are at least 95% of maximum material density.
2) Normal lift height for hand-operated pneumatic- and/or gasoline-powered compactors is 6" (150 mm).
3) Usually two passes are required to adequately compact bedding on both sides of the pipe.
4) Lifts of one to three test feet are normal to make density specifications when compacting with larger diesel-powered compactors.
5) No organic material can be backfilled around the pipe.
6) No rocks larger than 2" (50 mm) in diameter can be backfilled against the pipe.
7) Pipe features, such as manholes, drop inlets, valves, and hydrants must be adjusted to within 6" (150 mm) of finish grade.
8) Seeding, resodding, and other erosion control operations must be accomplished within the specified growing season.

Key Tasks

1) Haunch the pipe.
2) Ensure no organic material contaminates the bedding.
3) Ensure no rocks are backfilled against the pipe.
4) Place and level each lift only as deep as the compaction equipment can compact to the specified density.
5) Compact each side equally and avoid moving the pipe during compaction.
6) Ensure enough cover to avoid pipe damage is placed prior to operating compaction equipment on top of the pipe.
7) Place the initial backfill on the center of the pipe so the weight of the material doesn't shift the pipe.
8) Assemble and back fill valve stand pipes, hydrants, manholes, and other pipe features, ensuring they are plumb.
9) Maintain accurate reference records if pipe features (e.g., manholes, valves) are to be left buried for subsequent grading operations to be conducted unobstructed.

Workplace Skills, Knowledge, and Aptitudes

1) Use and convert between common measurement systems.
2) Read soils.
3) Perform traffic control duties.
4) Use percentage measures.
5) Read/interpret blueprints, plans, or prints.
6) Perform differential leveling procedures.

Workplace Skills, Knowledge, and Aptitudes

Organization of the Workplace Skills, Knowledge, and Aptitudes

The following Workplace Skills, Knowledge, and Aptitudes (WSKAs) are comprehensive descriptions of the skills, knowledge, and aptitudes required to perform the job duties of a pipe layer. They are arranged in the following categories:

Aptitudes and Abilities
Workplace Basic Skills
Cross-Functional Skills
Occupation-Specific Knowledge

The arrangement allows readers to identify quickly the group of WSKAs most applicable to their individual needs. For example, if the reader is a secondary or post-secondary teacher, he or she might be most interested in comparing the content of his or her curriculum with the minimum job skills required of a prospective pipe layer. Therefore, he or she might focus on the use of the academic disciplines as described in the section containing workplace basic skills. If the reader is a trainer, the sections containing cross-functional skills and occupation-specific knowledge might be most helpful.

Regardless of the specific use, the reader should review all of the WSKAs to obtain a complete picture of the skills, knowledge, and aptitudes required for a pipe layer's success in the industry.

Elements of a WSKA

Each WSKA contains the following elements:

- context
- mastery performance level
- content
- reference to job functions to which the WSKA applies
- sample tasks and activities in which the WSKA is applied

The context element describes when and under what circumstances a pipe layer applies the WSKA and provides examples of work processes using that skill, knowledge, and/or aptitude.

The mastery performance element identifies how well the WSKA must be performed. The information is useful both to judge priority and as performance criteria for assessment.

The content element describes teaching exercises and identifies performance demonstrations that will ensure competency.

The reference elements identify the job functions and key tasks and activities to which a WSKA pertains.

APTITUDES AND ABILITIES

LIFT AND MOVE HEAVY OBJECTS

Context

Construction is physical, heavy work. It involves lifting, moving, and placing very heavy objects and materials. Weight usually exceeds 50 lbs. (23 kg) and often exceeds 90 lbs. (41 kg). Among the pipe work that involves lifting and moving heavy objects are the following tasks: (a) rigging materials; (b) moving pipe into exact position; (c) using heavy tools such as soil compactors; (d) moving base and subgrade materials; and (e) moving, storing, and installing valves and fittings.

Mastery Performance

1. Workers will explain the correct steps for lifting and moving heavy objects.
2. Given a load, a worker will lift and move the load correctly using each step.
3. Given an example of someone else lifting and moving a heavy load, the worker will point out errors/problems in the technique and suggest how to correct it.
4. Workers will smoothly lift, balance, and carry three 2" (50 mm) by 4" (100 mm) by 16' (4.8 m) pieces of lumber a distance of 50' (or 15 m) and set them down on dunnage.
5. Workers will move couplings, fittings, and tools without incurring damage to the materials.

Content

1. Size up a load (weight, size, and shape) to ensure you can handle it.
2. Place feet close to object and shoulder-width apart.
3. Bend at the knees and find handholds.
4. Keep your back straight (in line with hips) and tuck your chin so your head is in line with your back.
5. Lift by standing, putting the load's weight on your knees and thighs. Lift the load straight up. Keep load close to your body.
6. Turn by changing foot position and carry the load close to your body.
7. Set load down using legs to support weight.

Reference

Job Functions	**Sample Tasks and Activities**
All	Operate soil compaction equipment Place, rig, and move materials Move lengths of pipe, equipment, and materials Move fittings and tools

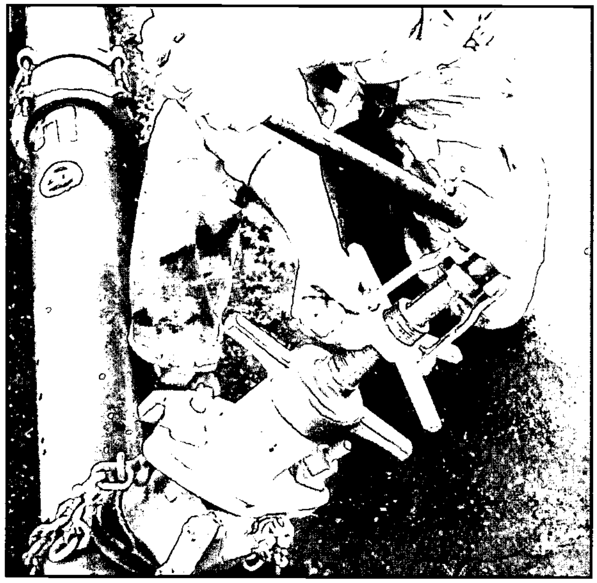
DEMONSTRATE MANUAL DEXTERITY AND EYE-HAND COORDINATION

Context

Pipe layers must use strength combined with manual dexterity and eye-hand coordination to perform much of the work they do. In pipe work, dexterity, coordination, and strength are required to: (a) hold and use hand and power tools to achieve the required grade tolerance of the bedding; (b) adjust and use the transit, laser, and level; (c) manipulate the rigging and lifting equipment; and (d) align and install fittings and repair materials.

Mastery Performance

1. Given any of a number of tools used in pipe work, the worker will demonstrate sufficient hand strength, manual dexterity, and eye-hand coordination to operate correctly the machine or use the tool.
2. Given the tasks of a pipe layer, the worker will receive an acceptable score on a standardized test of manual dexterity, such as the Minnesota Rate of Manipulation tests or the revised Touchek/Brown eye-hand-foot coordination samples.



Content

1. Demonstrate, explain, and practice tool and equipment use to work on coordination and dexterity in mock-up situations.
2. Work with strength, flexibility, dexterity, and eye-hand exercises, including both gross and fine motor movement.

Reference:

Job Functions	**Sample Tasks and Activities**
All	Use lasers/levels/transits to mark/check installation location Grade compact and fill materials Install barricades Rig materials Use signals to move loads/control materials Align and install all types of fittings and material

WORK IN AREAS OF CONSTRICTED MOVEMENT

Context

Most work associated with pipe laying involves moving, installing materials, carrying loads, and other efforts in cramped, small areas that dramatically restrict range of motion. Much of the work of pipe layers is inside an excavation. Examples of constricted movement include: (a) difficult footing in narrow space; (b) limited space for arm movement and tool use; (c) limited space to move materials in excavation; (d) limited space for access and egress; and (e) no room to move from falling materials.

Mastery Performance

1. Exhibit no signs of claustrophobia or exhibit excellent control in mock-up work situations that include restricted movement.
2. Demonstrate sufficient strength and dexterity to use tools to complete work to quality and on schedule in constricted space.

Content

1. Discuss situations and types of constricted movement in pipe work.
2. Discuss problems, dangers, and strategies for dealing with work situations.
3. Demonstrate technique for some types of identified situations.
4. Practice on mock-ups that illustrate job settings. Use a variety of working surfaces and situations including at least working in narrow space; moving materials into and around in restricted area; working in areas of restricted vertical vision; and using tools where "swing" and arm movement are restricted.
5. Install and work in areas with different types of trench protection systems.

Reference

Job Functions	Sample Tasks and Activities
All	Install trench protection of correct type in appropriate place Install pipe, fittings, and couplings Move pipe, fittings, and tools into and out of excavation Excavate materials

CALCULATE VOLUMES OF VARIOUS SHAPES

Context

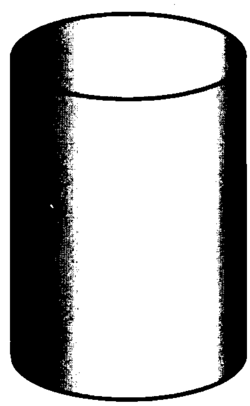
Pipe workers must determine the volume of objects and spaces of different sizes and shapes. For example, work involving volume calculations includes at least the following: (a) calculation of the number of cubic yards or cubic meters of earth that must be moved to excavate or fill a site; (b) determination of the progress on excavation and fill sites; (c) determination of air space and ventilation requirements and d) calculation of pipe volumes to determine leakage, pressure, and sanitation needs.

Mastery Performance

1. Given specific objects, the pipe layer will find volumes from linear measurements. Volumes must be correct within 1/2 cu yd ($0.4m^3$).
2. Given an object, the pipe layer will demonstrate how to "break" the object into manageable shapes to apply formulas and find capacity.
3. Given several volume formulas, the pipe layer will match the appropriate formula with the specific shape.

Content

1. Demonstrate, explain, practice, and find volumes of squares and rectangles.
2. Demonstrate, explain, practice, and find volumes of spheres and hemispheres.
3. Demonstrate, explain, practice, and find volumes of cylinders.
4. Demonstrate, explain, practice, and find volumes of pyramids.
5. Match formulas for volume calculation of objects to various shapes.
6. Work with and convert cubic units of measure, both in metric and U.S. Standard measure.
7. Illustrate how to break objects into shapes from which one can find volume measures.
8. Discuss work tasks where volume calculation is used.



Reference

Job Functions	**Sample Tasks and Activities**
All	Excavate materials Estimate fill needs Prepare/compact base and sub-base Track job progress

37

READ/INTERPRET BLUEPRINTS, PLANS, OR PRINTS

Context

Pipe workers often perform much of the preparation work for all phases or tasks of pipe installation and repair. Among the tasks pipe layers perform from plans are: (a) locating, placing, and checking grade stakes; (b) locating existing utilities; (c) ordering, storing, and stocking materials; (d) installing pipe fittings; (e) estimating materials; and (f) back filling and restoring the site.

Mastery Performance

1. Given a set of prints and information request, a pipe layer will locate any given structure, object, material, or specification with a view and/or text that provides the required data.
2. Given a set of prints and an object location need, the worker will locate the correct information from the appropriate print and transfer it to the site with an accuracy of ± 1/4" (6 mm).
3. Given a symbol or abbreviation, the worker will correctly interpret the information.
4. Given a set of prints, the worker will calculate a dimension and/or use scale to find a dimension, correct to ± 1/4" (6 mm or .02").

Content

1. Read index of plans and specifications to locate information.
2. Interpret symbols and abbreviations.
3. Understand and follow rules of prints, specifications, and addendum.
4. Find information in plans and specifications.
5. Read and calculate dimensions accurately.
6. Use scale to find dimension and location.
7. Transfer information from plans to site.
8. Use plans to estimate and/or order correct type and amount of materials.
9. Read and interpret views and types of drawings.
10. Use notes and specifications to determine materials requirements.
11. Use references to locate information and/or correct view.
12. Discuss and read legend symbols.

Reference

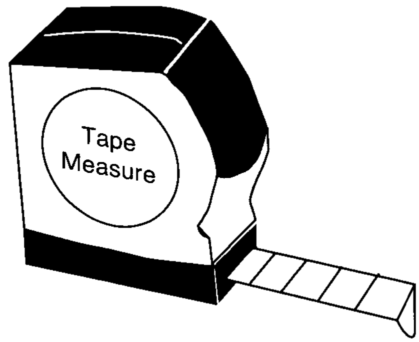
Job Functions	Sample Tasks and Activities
All	Check materials specifications Install and check line and grade stakes Determine exact location and type of fitting Determine depth of pipe

USE AND CONVERT BETWEEN COMMON MEASUREMENT SYSTEMS

Context

Pipe layers routinely mark, measure, and check distances in their work. Measurements are used to: (a) check the location of excavation; (b) mark, establish, and check grade stakes; (c) monitor and/or excavate materials; (d) estimate pipe volume and fill needs; (e) determine allowable tolerances and quality standards for work; (f) size fittings; and (g) establish exact location of tees, bends, fittings, and pipe.

Mastery Performance



1. Given a measurement value, the worker will read the unit of measure correctly 90% of the time.
2. Given space to measure, the worker will measure linear distance (horizontal and vertical) correctly within ± 1/8" (3 mm or .01").
3. Given a unit of measure, the worker will convert the unit to fractions, decimals, or metric measures, correct within ± 1/8" (3mm or .01").
4. Given a measurement to transfer from one object to another, the worker will mark the distance on the object, correct within ± 1/8" (3 mm or .01").
5. Given blueprint or verbal measurements, the worker will correctly convert measures (fractions, decimals, and metric)100% of the time.
6. Given decimal versus standard measuring instruments, the worker will determine correctly, 100% of the time, whether markings are presented in feet, inches, millimeters, meters, and tenths or hundredths.

Content

1. Read dimensions of units of measure on measuring rods, rules, and/or tapes.
2. Convert fractions to other equivalent fractions, convert millimeters to equivalent meters and convert standard measures to decimal measure.
3. Change fractions from mixed to whole numbers and change whole and mixed numbers to fractions.
4. Transfer measurements from one object to another with a tape or rule.
5. Discuss conventions for location of mark when measuring.

Reference

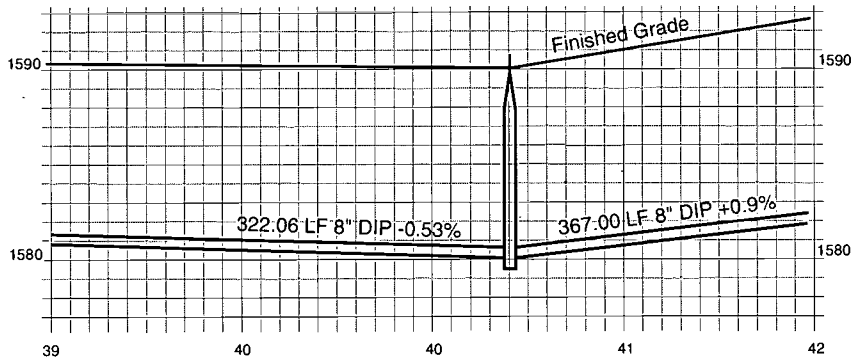
Job Functions	**Sample Tasks and Activities**
All	Install grade stakes and check grade Clear and excavate site Back fill and compact Install pipe and fittings at locations Estimate/order materials Layout and square area Find appropriate size materials for installation Excavate in exact location and to proper depth

FIND AND USE PERCENTAGE MEASURES

Context

Pipe layers use percentage measures in much of their work. For example, they calculate horizontal and vertical distances using percentages. Percentages also are used in estimating and monitoring work; calculating volume discounts of purchased materials; and buying tools and equipment on sale.

Mastery Performance



1. Given a problem involving percentages, the worker will work the problem and find the answer correct to within 1%, 80% of the time.
2. Given a percentage measure, the worker will explain how it applies to the work situation.
3. Given two of three measures (rate per foot, vertical distance, or horizontal distance) the pipe layer will find the third measure, correct to within 1%, 90% of the time.
4. Given two of three measures (rate per foot, vertical distance, or horizontal distance) the pipe layer will find the percentage of slope, correct to within 1%, 90% of the time.

Content

1. Describe and explain the principles of percentages.
2. Review units of measure and how they pertain to percentages.
3. Illustrate how to find percentages as: (a) part of the whole; (b) as a part; or (c) as a percentage and work a number of practical problems for each type.
4. Describe work-related situations where percentages are used, including as a minimum material/tool pricing and tracking the percentage of a task that is completed.
5. Explain and illustrate slope ratios and calculations of rate per foot.
6. Explain and illustrate percentage of slope.
7. Explain and illustrate systems to deal with angles of elevation.
8. Demonstrate, explain, and practice using percentage of slope to calculate vertical rise or fall.
9. Create problems from the workplace to practice.

Reference

Job Functions	**Sample Tasks and Activities**
All	Check or establish grade Align and check pipe

CROSS-FUNCTIONAL SKILLS

CHOOSE AND USE APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT

Context

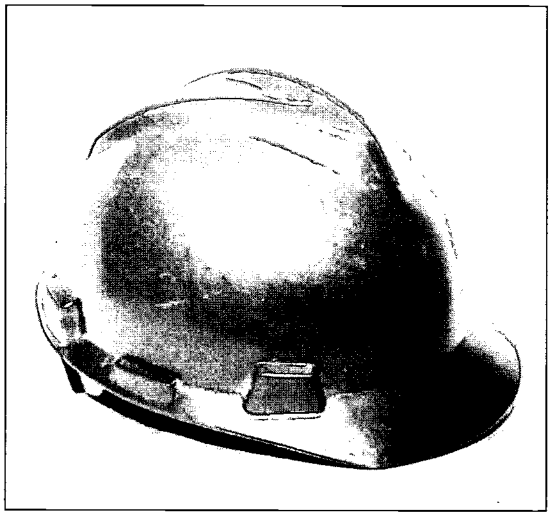
Pipe workers need and use personal protective equipment (PPE) to help prevent chronic and/or serious injury to various body parts like skin, feet, eyes, ears, hands, and head. The specific type of equipment a worker chooses and uses depends on the particular task being performed and the type of hazard that might be encountered. For example, working in muddy conditions may require wearing a different boot than working in dry conditions. Typically pipe layers wear hard hats, gloves, and safety glasses on the job. In addition, some pipe jobs require special PPE to protect workers from environmental hazards such as contaminated soil, bio-hazards, or contaminated air.

Mastery Performance

1. Given a pipe work task, the worker will identify the appropriate PPE to wear.
2. Given any PPE for pipe work, the worker will explain the selection of correct type, class, and size of PPE and demonstrate how to fit, adjust, and use the PPE appropriately.
3. The worker will identify situations where special PPE is or may be required.

Content

1. Review types of eye protection and match each to the tasks and safety hazards for which it is used.
2. Demonstrate correct fit, use of each type, and care of PPE.
3. Review types of ear protection and match each to the tasks and safety hazards for which it is used.
4. Review types of boots and match each to tasks and safety hazards for which it is used.
5. Review types of hard hats and match each to tasks and safety hazards for which it is used.
6. Review types of gloves and match each to the tasks and safety hazards for which it is used.
7. Discuss conditions pipe layers may encounter and match appropriate PPE to each situation.
8. Choose appropriate protective clothing for the various hazards that may be encountered by pipe workers.



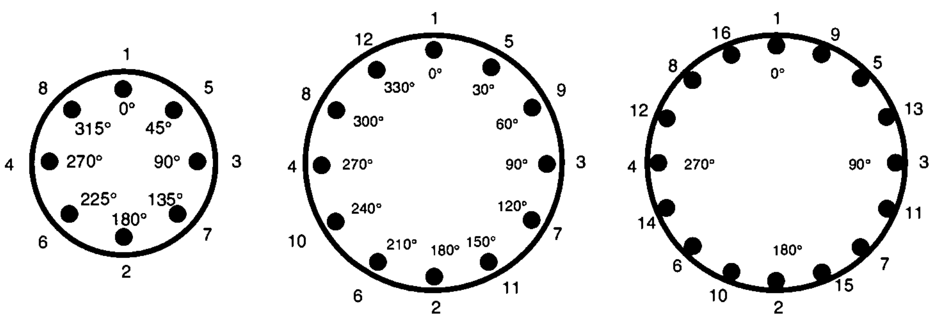
Reference

Job Functions	**Sample Tasks and Activities**
All	All

LEARN AND USE SEQUENCES

Context

Pipe layers must learn and use specific sequences for many aspects of their jobs. For example, they must follow specific sequences to pressure test repairs, to chlorinate water, to fuse polypipe, and to install fittings. In addition, they must learn and follow the most often used sequence—the torque sequence for mechanical joint assembly. The torque sequence refers to the order in which the nuts are tightened to produce an equal pressure on all parts of the gland, or flange, as part of the joint assembly. By using a torque assembly sequence, one ensures uniform pressure both on the gland and on the rubber gasket beneath it. Further, the uniform pressure allows consistent seating and closing of the opening such that leaks do not occur. The general order for applying bolt torque on mechanical joints is as follows: (1) install all nuts and bolts finger-tight; (2) apply torque in 20% increments until the required final torque is reached; (3) tighten the bolts in sequential order, moving at 180° across the face of the joint. For example, work from 0° position to 180° position, then 90° position to 270° position, and so forth at each step until the final torque is reached; and (4) use a rotational order until all bolts are stable at the final torque level.



Mastery Performance

1. Identify the types of joint assemblies and repair mechanisms where torque sequences are important 100% of the time.
2. Identify the general principle of working at 180° differences exactly, regardless of the particular joint assembly.
3. Identify the steps for any particular joint assembly and demonstrate appropriate bolt tightening technique.

Content

1. Explain and illustrate the purpose of mechanical joint assembly, using the torquing sequence.
2. Illustrate the torquing sequence for a number of joints, including at least 8, 12, and 16 bolt mechanical joints.
3. Explain the steps and the process.
4. Require trainees to practice the process while explaining the order they actually use in the sequence.

Reference

Job Functions	**Sample Tasks and Activities**
Pipe installation and pipe repair	Install mechanical joint assemblies.

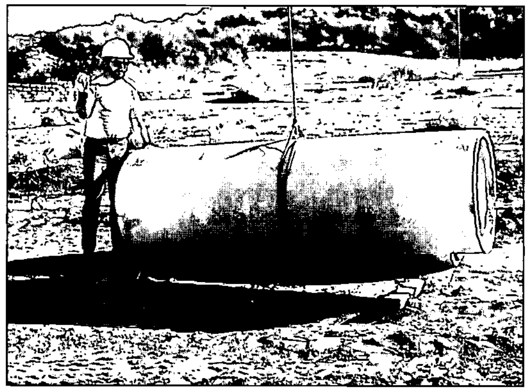
USE PROPER SIGNALING TECHNIQUES

Context

Pipe layers direct heavy equipment to lift and hoist materials to placement locations. Equipment operators are located out of direct sight from the placement location and often cannot see the work area. Therefore, operators must rely on a signaler to safely direct the movement of equipment, pipe, and other materials. Signalers must understand how the speed, direction, and movement of the hoisting equipment will affect the load and its position. Signals are given nonverbally with hand signals. Signals must be standardized, timely, and accurate, or workers can be killed or injured and materials can be damaged. Additionally, it is critical that only one signaler give signals to the operator and that the signaler is positioned to see the work and can be seen by the operator.

Mastery Performance

1. Given a test of common hand signals, the worker will identify and use the correct signal to direct the load every time.
2. Given a construction work site and equipment location, the worker will identify the correct location to see and be seen as the signaler.



Content

1. Illustrate, describe, and use appropriate signaling techniques to direct equipment and move loads.
2. Demonstrate how to work out signal use with the equipment operator.
3. Discuss vantage points (locations), why they are important, and how to select them.
4. Locate/choose vantage points for a variety of loads.
5. Discuss rules for designating signalers and how to deal with infractions.

Reference

Job Functions	**Sample Tasks and Activities**
All	Rig and move all pipe materials Designate signaler and check signals with operator Move/transport pipe to placement locations Select appropriate lifting equipment

PERFORM CPR

Context

Because pipe laying is one of the more dangerous jobs in construction, at least one person on every crew needs to be trained and certified in CPR (cardiopulmonary resuscitation). Certification must be renewed every year. If a member of the work crew is first-aid certified, he or she can administer immediate life-saving measures if a fellow worker has fallen, suffered from heat stress, or suffered the effects of another work-site hazard.

Mastery Performance

1. Successfully pass the test to achieve certification.
2. Correctly identify (100% of the time) situations in which CPR is necessary.
3. List the cautions associated with administering CPR to a victim.

Content

1. Become qualified to provide CPR training.

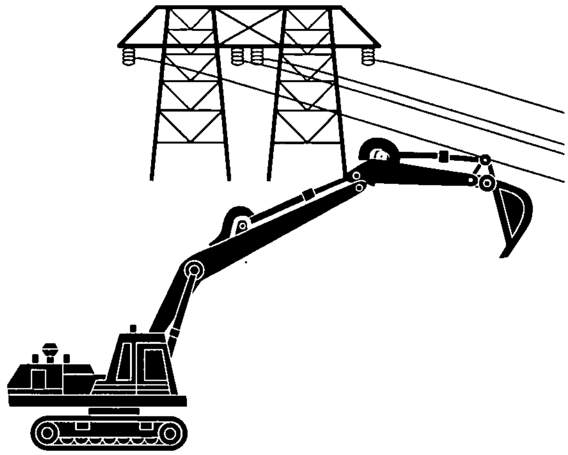
Reference

Job Functions	**Sample Tasks and Activities**
All	Anywhere needed

IDENTIFY HAZARDS

Context

Pipe laying is one of the most dangerous occupations in the construction industry. Not only must the pipe layer protect against potential cave-ins of the excavation, but also must be aware of potential hazards arising from contamination in soil, hazardous atmospheres within the excavation, and bio-hazards such as snakes and scorpions. Additionally, previous excavations pose potential hazards such as high voltage utility wires, pressurized gas pipes, and debris. In addition, pipe layers also must be vigilant about electrical hazards, particularly overhead wires. It is critical that pipe layers learn to recognize the hazards incumbent to this work.



Mastery Performance

1. Given any pipe work site, the worker will perform an immediate and accurate inspection to identify readily apparent hazards and point those out.
2. Given a scenario, picture, work site, or mock-up area, the worker will correctly identify each existing or staged hazard correctly 100% of the time.
3. Given an identified hazard, the worker will match the strategies available to the worker to mitigate that hazard. In some instances, this includes the OSHA requirements for safe distance, PPE, or other protections.

Content

1. Illustrate and discuss the range of hazards associated with pipe work. Include at a minimum, above and below ground electrical hazards, contamination of soil and air hazards, confined space issues, bio-hazards, and the hazards associated with previous excavations.
2. For each hazard, match and discuss the range of mitigating and safety procedures that can be implemented by the worker.
3. Discuss symptoms or early warning signs associated with each of the categories of hazards.
4. Provide trainees with an opportunity to identify each of the classifications of hazard and to indicate the appropriate remediation or mitigation procedures for that hazard.

Reference

Job Functions	**Sample Tasks and Activities**
All	Excavate materials Install pipes, fittings, and couplings Move pipes and fittings Install trench protection of the correct type in the appropriate place Backfill and compact the area Clear and excavate the site Layout and set or offset reference staking

PERFORM TRAFFIC CONTROL DUTIES

Context

Pipe installation and repair projects often occur on or adjacent to high traffic volume streets and highways. Pipe layers often are required to set up traffic control devices before a project begins. In addition, pipe layers may be required to assist with traffic control by flagging and signaling to ensure workers are protected from vehicle traffic.

Mastery Performance

1. Given a traffic control situation, a pipe layer will identify the correct flag or paddle signal to oncoming traffic every time.
2. Given a mock site and proposed traffic circulation pattern, a pipe layer will identify the best possible circulation pattern to provide public and worker safety and maintain production every time.
3. Given a mock site and proposed traffic circulation pattern, a pipe layer will identify the correct location for signs and barricades every time.
4. Pipe layers performing traffic control will place barriers, barricades, signs, signals, and other traffic control devices safely and at the correct distance and orientation every time.

Content

1. Discuss and practice signaling with flags and paddles.
2. Demonstrate traffic control strategies that provide for public safety, worker safety, and production.
3. Discuss, review, and demonstrate knowledge of the Uniform Traffic Control Code or state equivalent for flagging and signage requirements.
4. Understand/adopt traffic control planning and set-up, given real-life scenarios.

Reference

Job Functions	**Sample Tasks and Activities**
All	Identify right-of-way limits Offset and reference survey and utility control staking Identify (and locate) potential hazards

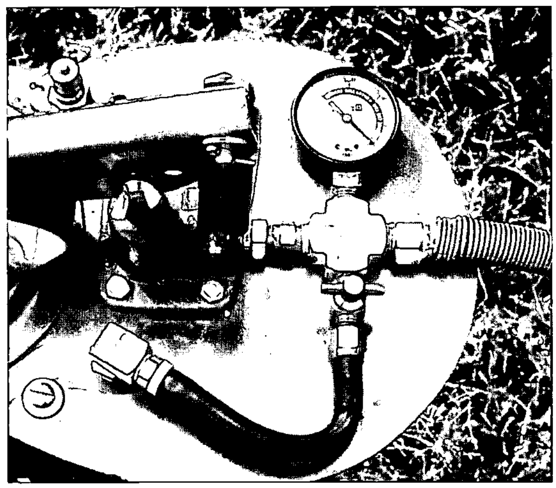
READ GAUGES AND INSTRUMENTS

Context

One of the primary responsibilities of pipe layers is to operate various types of equipment. Each piece of equipment has one or more gauges or instruments that enable the operator to use the equipment efficiently. In fact, gauges and equipment are critical for accuracy and efficiency. Gauges can be found on equipment ranging from tampers (where the gauge may be a gas gauge or a fuel gauge, to transits, levels, and lasers where the gauge or instrument is a very fine gradient of accuracy) to compaction equipment and pressure testing equipment (where the gauge indicates some level of density or some pounds per square inch within the pipe). It is important that pipe layers be able to read gauges accurately in order for their work to be done efficiently and effectively.

Mastery Performance

1. Correctly identify the type of gauge and unit of measure for each piece of equipment used in pipe laying 80% of the time.
2. Read the gauge correctly within 5%, 90% of the time.
3. Identify the unit of measure on the gauge correctly 80% of the time.
4. Convert the unit of measure to another useful unit of measure correctly 7 out 10 times.



Content

1. Describe and list four situations where instrumentation and gauges are used in pipe laying work.
2. Show three types of gauges and demonstrate how to read them.
3. Practice with reading the gauges on instruments or on pictures or simulations of instruments.
4. Discuss the units of measure.
5. Convert and demonstrate conversion of units of measure to other units commonly used in construction.
6. List the acceptable ranges for the units of measure on the primary equipment used in pipe laying.

Reference

Job Functions	**Sample Tasks and Activities**
All	Clear the excavation site Backfill and restore the site Install the pipe Pressure test the pipe Install backfill in lifts

READ SOILS

Context

The effectiveness and efficiency of pipe layers is dependent on their ability to work effectively with soils. Soils differ in a number of ways, the most important of which is composition. It is critical for pipe layers to identify, recognize, or read the composition of soils in order to adjust their work practices for effectiveness, safety, and efficiency. Soil that is loose, sandy, and gravelly offers little structure to support weight or provide protection when working in an excavation whereas soil with good texture and tight composition maintains its structure and may better support an excavation. The specific soil type that the pipe layer reads helps determine the slope of the excavation, the type of protection or shoring that is installed in the excavation, and suggests the type of hazards that may be encountered in that particular location.

Mastery Performance

1. Given a picture or a sample of soil, the worker will identify the soil classification correctly 100 % of the time.
2. Given a soil classification, the pipe layer will correctly match the range of protection likely to be used with that soil with the soil 100% of the time.
3. Given a soil sample, the pipe layer will classify the soil accurately as well as indicate the type of hazard associated with that soil type.
4. Given a soil classification, the pipe layer will correctly match the type of compaction, equipment, lift height, and optimum moisture content to ensure maximum density.

Content

1. Discuss, illustrate, and show samples of each soil type according to the formal classification system.
2. Inspect sites where each of the soils is excavated so that workers can see the composition and look at each soil type on a larger scale.
3. Discuss, illustrate, and practice soil identification using soil test equipment such as penetrometer.
4. Match and discuss types of excavation support systems used in different types of soil.
5. Provide samples and pictures and require trainees to identify the soils.
6. Discuss the hazards associated with each particular type of soil.
7. Illustrate those hazards through pictures and on-site demonstrations so that pipe layers begin to see the warning signs of the different hazards.
8. Discuss, illustrate, and practice soil compaction and the reaction of different soil types to various moisture levels.

Reference

Job Functions	Sample Tasks and Activities
All	Prepare and excavate the site Assemble pipe and fittings in any excavation Install protection systems Back fill and restore the site

RIG AND MOVE LOADS

Context

A fundamental task on pipe jobs is rigging and moving heavy equipment and materials. It is dangerous because it involves: (1) moving extremely heavy materials; (2) moving heavy materials in the air, above the work and workers on the ground; (3) an operator who often cannot see where the load is being placed; (4) rigging a load in ways that provide balance and effective grasp so that the load does not slip, shift, or fall.

The pipe layer's responsibility for rigging includes inspecting all the rigging hardware for damage, and ensuring that it is in sufficient shape to be able to move the load safely. Inspection requires a number of tasks, ranging from counting the wires on a wire rope to ensure that the rope is still safe, to reading charts and tables that match the type of rigging equipment to the types of materials that must be moved, and the weight capacity of the equipment to the types of materials that must be used. In addition, the pipe layer must match the weight and shape of potential loads to the type of rigging equipment—slings, ropes, chokers, and so forth. In addition, the pipe layer must attach the rigging at an appropriate place to provide for balance when the load is not supported by anything other than the rigging.

Mastery Performance

1. Point out hazards associated with rigging in any site. The hazards of note must include the swing radius of the equipment; "over flight" patterns to the installation site; the shape and weight of materials; the quality of the rigging materials; and the signals to be used by the pipe layer and the operator. In addition, it should include any structures or other obstacles that must be negotiated in the lift.
2. Examine and identify correctly (100% of the time) first quality and damaged rigging equipment, using a variety of ropes, chains, chokers, and slings.
3. Match the rigging equipment to the load 100% of the time by size, and 90% of the time by type.
4. Hook up the load at the appropriate balance point 80% percent of the time.

Content

1. Demonstrate how to read tables and charts.
2. Show the various types of rigging equipment, like slings, ropes, and chokers that are used to rig and move equipment and materials on the pipe work site.
3. Illustrate the swing radius of various types of equipment and show how to calculate that radius.
4. Illustrate damage to various types of rigging equipment and lecture on how to spot that damage.
5. Practice each of these situations, coach the trainee, and test their capacity to do it.
6. Demonstrate rigging locations for various types of pipe equipment and rigging equipment.
7. Have trainees practice rigging the material, both in pointing out the hook-up location, and the way that hook-up should occur.

Reference

Job Functions	**Sample Tasks and Activities**
All	Unload and store pipe and materials Move pipe and materials into the excavation Install trench protection materials

DEAL WITH TEMPERATURE EXTREMES

Context

Pipe laying occurs in relatively small, excavated areas, which often means the work environment will differ from the environment at ground level. The work environment often has little air movement, and can intensify temperatures, whether hot or cold. An excavated environment also may be damp or wet from ground water. Adding to the existing environmental conditions, pipe layers must wear different levels of personal protective equipment, including tyvek suits and respirators. Therefore, pipe layers must be aware of the potential effects of both the cold and the heat, as well as nonenvironmental factors that compound the affects of temperature extremes, and they must be able to adjust their work accordingly.

Mastery Performance

1. Correctly match (90% of the time) the physical symptoms of exposure to the appropriate temperature extreme.
2. Correctly identify (80% of the time) the action that a pipe layer should take to remediate the temperature-induced physical symptom.
3. Monitor one's own pulse and weight accurately within 10% of exact on the job site.

Content

1. Identify the symptoms of different types of temperature exposure and match each to the remediation steps available to the pipe layer.
2. Demonstrate and coach how to monitor one's weight.
3. Demonstrate and coach how to monitor one's pulse.
4. Discuss appropriate ranges of weight loss and pulse rate on the work site.
5. Discuss situations where temperature issues become critical for the pipe layer. Include at least cold, hot, wet, and windy situations.
6. Set up scenarios and have trainees identify the probable type of temperature condition, as well as the symptoms of exposure to that condition.

Reference

Job Functions	**Sample Tasks and Activities**
All	Anywhere needed.

Acknowledgements

We recognize the following coalition members for the time and effort they put forth on this project.

Labor and Management Coalition Members

Nick Badami
President
Ritangela Construction, NY

Nicholas Fiore
Vice President, Labor Relations and Safety
National Constructors Association, DC

George Fischer
Senior Vice President
Human Resources
AMERON, CA

John Heffner
Executive Director, Training and Educational Services
Associated General Contractors of America, DC

Richard Gabrielse
National Director
Associated General Contractors of America, DC

Craig Grimm
Associate Director of Training
Associated General Contractors of America, DC

Mike Sharp
Director
Northwest LECET

Bill Walker
Owner
Walker Construction Specialties

Eric Waterman
Director of Membership Services
National Erectors Association, VA

Education and Training Coalition Members

Harold Avery
Director of Training
Northwest Laborers-Employers Training Trust Fund, WA

Larry Casey
Director of Building Trades Programs
University of Minnesota, MN

Carl Horstrup
Department Chair, Industrial Technology Program
Lane Community College, OR

Jim Horton
Chancellor
San Jacinto College, TX

Dr. Mikala Rahn
Evaluation and Training Institute, CA

Jerald Pelker
Director of Training
AGC Eastern Missouri Laborers' Joint Training Fund, MO

Doug Whitney
Dean of Assessment
Regents College, NY

Joe Zipfel
Director of Training
Safety, Education, and Training Trust Fund
Heavy and General Laborers' Local 172, NJ

Project Staff and Consultants

John Tippie – Associate Director, Laborers-AGC
Terry Johnson – Program Specialist, Laborers-AGC
Dr. Eric Rice – Assessment Specialist
Dr. Robert Glover – Independent Evaluator
Arnold Stoeberl – Technical Writer
Laborers-AGC Publications Department – Editing/Layout Services

And, most importantly, the 200 other technical experts who participated in the validation interviews.

52

Laborers-AGC Education and Training Fund
37 Deerfield Road, P.O. Box 37, Pomfret Center, CT 06259
Phone: (860) 974-0800 Fax: (860) 974-1459

NOTICE

REPRODUCTION BASIS

☐ This document is covered by a signed "Reproduction Release (Blanket)" form (on file within the ERIC system), encompassing all or classes of documents from its source organization and, therefore, does not require a "Specific Document" Release form.

☑ This document is Federally-funded, or carries its own permission to reproduce, or is otherwise in the public domain and, therefore, may be reproduced by ERIC without a signed Reproduction Release form (either "Specific Document" or "Blanket").