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Glenn Safety Manual – Chapter 35

Digging, Trenching, & Excavating

Approved by: QS/Safety and Health Division

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Cleveland, OH 44135**

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Change Record

Rev.	Effective Date	Expiration Date	C-25, Change Request #	Description
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Change 1	4/15/2014	7/17/2017	N/A	Administrative change to add front cover and change history log to comply with NPR 1400.1. Deleted “All digging, trenching, or excavation activities shall be in compliance with” and inserted “The GRC shall follow” in Section 4.0 Policy.
C	1/15/2016	1/15/2021	15-020	Modified to reflect process and coordination improvements.

***Include all information for each revision. Do not remove old revision data. Add new rows to table when space runs out by pressing the tab key in the last row, far right column.*

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Chapter 35—Digging, Trenching, and Excavating

NOTE: The current version of this chapter is maintained and approved by the Safety and Health Division (SHeD). The last revision date of this chapter was January 2016. The current version is located at <http://smad-ext.grc.nasa.gov/shed/pub/gsm/gsm-manual.pdf>. Approved by: Chief of Safety and Health Division.

1.0 PURPOSE

This chapter provides requirements to ensure the safety of workers or visitors in and around excavation activities performed at the Glenn Research Center (GRC).

2.0 APPLICABILITY

This chapter is applicable to all civil servant and contractor employees working at GRC and to all NASA-controlled, Government-owned facilities associated with GRC.

3.0 BACKGROUND

Excavation and trenching are among the most hazardous construction operations. Cave-ins and utility encounters pose the greatest risks and are much more likely than other excavation-related accidents to result in worker fatalities. Other potential hazards include falls, falling loads, hazardous atmospheres, and incidents involving mobile equipment. An excavation program was jointly created by Codes Q and F to mitigate these risks and protect personnel working at the GRC. This included the development of a GRC Excavation Manual by the Code FDS Civil Systems Manager and the addition of an electronic tracking base by the Operational Safety Branch.

4.0 POLICY

It is GRCs policy to evaluate all excavation and ground penetration activities to minimize the potential of cave-ins, environmental contamination, underground utility damage, or contact with subsurface encumbrances. To aid in this goal, GRC excavation activities follow the requirements of 29 Code of Federal Regulations (CFR) 1926, Subpart P, Excavations; the Glenn Safety Manual (GSM); the GRC Excavation Manual; the Ohio Manual of Uniform Traffic Control Devices (OMUTCD); and the Ohio Revised Code, Duties of Excavator (ORC 3781.30).

5.0 RESPONSIBILITIES

5.1 Initiator shall:

NOTE: The Initiator is a member of a GRC organization (e.g. Civil Servant or support service contractor) who is required to be onsite to monitor the digging, trenching, excavating and ground penetration activities.

- (1) Initiate an Excavation Permit by completing Part A, Step 1 of the Excavation Permit and submitting it electronically using the SUBMIT button at the end of Step 1 on the electronic form.
- (2) Ensure the Excavation Competent Person has signed off receiving and understanding the use of the GRC Excavation Manual.
- (3) Ensure the Contractor Excavator operator has signed off receiving and understanding the use of the GRC Excavation Quick Reference Card.
- (4) Ensure that all personnel working at the jobsite are designated as being trained and aware of the hazards of excavation activities.
- (5) Ensure that all items outlined on the Excavation Permit are properly defined and concerns resolved prior to excavation activities.

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- (6) Ensure the Contractor performs excavation activities in a safe manner per the requirements of the Excavation Manual.
- (7) Attend daily tag up meetings held by the Excavation Competent Person, and contractor's excavation personnel to ensure all aspects of excavation work are discussed and coordinated per the GRC Excavation Manual. Coordinate excavation activities with the System Managers and Facility Managers to ensure that related activities such as utility service interruptions and area access are addressed
- (8) Cease operations in the event of the discovery of an unknown utility and begin discovery using the NASA Surveyors and Underground Records Drawings. Work may be continued after resolving concerns resulting from the discovery.
- (9) In the event of utility or structure damage, ensure all work ceases until the hazardous conditions are cleared and NASA designates the excavation area to be safe to re-enter and resume work.

5.2 GRC Soil Coordinator shall:

- (1) Using the Soil Determination Checklist obtained from Code FE, assess soil conditions and associated working requirements with respect to the contaminants in the designated excavation area/segment.
- (2) Review Step 2 of the Excavation Permit and provide the Soil Determination Checklist as an attachment to the Excavation Permit.
- (3) Notify the Operational Safety Branch and the NASA Surveyor that pre-excavation identification/markings activities can proceed.

5.3 Operational Safety Branch Reviewer shall:

- Ensure the Excavation Permit, associated documentation, and subsequent excavations are evaluated with respect to the requirements from Occupational Safety and Health Administration (OSHA) and other national consensus standards, and the GRC Safety Manual. This is done in conjunction with the Initiator of the Excavation Permit.
- Evaluate the excavation operations and work to be performed in the excavation with respect to the confined space requirements of the NASA-GRC Safety Manual Chapter 16, Confined Space Entry. These shall be evaluated by the Operational Safety Branch with regard to known and potential hazards to determine if the excavation is to be considered a Permit-Required Confined Space (PRCS). If deemed a permit required confined space, the requirements of the GSM, Chapter 16, Confined Space Entry, shall be in effect.
- Verify compliance with this Chapter's requirements by inspections. Discrepancies will be noted in the documented construction inspections.
- Ensure this chapter meets current regulations and standards provided by the OSHA, NASA Headquarters, and other organizations providing nationally accepted consensus standards.
- Ensure this program is evaluated annually to assess compliance with this chapter.

5.4 NASA Surveyors shall:

- Review Step 4 of the Excavation Permit and associated drawings to identify the excavation area and identify any additional requirements.
- Identify and mark known underground utilities and structures within the limits of excavation as identified by the excavation contractor.
- Identify in the manner designated by the GRC Excavation Manual.

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- Locate existing utilities and provide to the contractor an underground record drawing of the permit area.
- Verify utilities type and location after contractor potholes utility, when applicable.
- Ensure required changes to the Underground Records Drawings are made in a timely manner.

5.5 Civil Systems Manager shall:

- Maintain and publish the GRC Excavation Manual
- Review the training and experience of the submitted Excavation Competent Persons to determine acceptability. Notification shall be made in writing if the submitted person(s) is not acceptable.
- Ensure underground utilities are located prior to excavation activities to the extent possible.
- Provide oversight for all excavation activities, including final review of the GRC Excavation Permit.
- Designate when the GRC Excavation Permit Parts B1, B2, and C are not required.

5.6 Utility System Manager (USM) shall:

- Review all GRC Excavation Permits affecting the systems assigned to that USM.

5.7 Energy and Environmental Management Office Reviewer shall:

- Ensure requirements of the Environmental Programs Manual, Chapter 23, Handling, Reuse, and Disposal of Soil, are identified in the work documents.
- Ensure adequate environmental control measures have been identified
- Ensure the Soil Determination Checklist (NASA GRC-133) is completed and the appropriate soil disposal method is identified.

5.8 Contracting Officer's Representative shall:

- Ensure contractor employees comply with the GRC excavation requirements as given in this chapter and the Glenn Excavation Manual.
- Ensure all work requirements are properly defined and required information is provided to the contractor.
- Ensure known underground utilities and structures have been identified and marked on the construction/excavation drawing(s).
- Ensure excavation activities are conducted in a safe manner and avoid or protect the underground utilities and structures identified on the Excavation Permit
- Ensure competent utility and excavation personnel are assigned to oversee excavation and utility work.
- Ensure the issuance of an approved Excavation Permit prior to excavation activities.
- Notify SHED of an excavation incident and enter the incident in the NASA Mishap Information System (NMIS) within 24 hours.

5.9 Excavation Contractor shall:

- Submit a Health and Safety Plan to the COR for review and receive concurrence prior to starting a task.
- Appoint an appropriate –level Excavation Competent Person and submit that person's experience and training information to the Civil Systems Manager for concurrence.
- Have a Professional Ohio Surveyor stake out and mark all proposed infrastructure work in accordance with the GRC Excavation Manual.
- Receive an approved Excavation Permit (GRC927) prior to beginning excavation activities.

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- Verify (pothole) all utilities as identified on the Underground Record Drawing (URD) prior to completing infrastructure excavation.
- Submit “As-Built” drawings and the completed GRC927 permit within 10 business days of the Excavation Permit closure.

5.10 Excavation Competent Person shall:

- Physically be at and oversee all excavation activities. Those activities shall cease if the Excavation Competent Person is not present.
- Hold daily coordination meetings with excavation personnel to coordinate work activities for the day witnessed by NASA Construction Manager and/or Inspector.

Note: During these meetings the area of work shall be addressed. That day’s excavation activities shall be limited to the designated area.

- Cease operations immediately if an unknown utility is discovered and contact the Initiator.
- Maintain safe operations, including OSHA-compliant conditions with each excavation activity.

5.11 Excavation Workers shall:

- Notify the Excavation Competent Person and/or the COR (if a contractor) if an unexpected underground utility or structure is found during the excavation activities. or
- Immediately notify their supervisor if a utility or structure is hit or broken during excavation activities so the supervisor can notify the Emergency Dispatch.
 - This notification shall be made to 911 if using a NASA internal telephone or if using a cell phone 216-433-8888 at Lewis Field or 419-621-3222 at Plum Brook Station.

Note: It is the supervisor’s (if a civil servant) or COR’s responsibility to notify SHeD of the incident and enter the incident in the NMIS within 24 hours.

- Follow established procedures as outlined in the approved Health and Safety Plan (HASP) or JHA, enter an excavation only after receiving training, and have a complete understanding of the safe work practices to be followed while working in an excavation area or surroundings.

6.0 REQUIREMENTS

6.1 Training Requirements (GLM-QS-1700.1)

- All individuals involved in digging, trenching, excavating and ground penetration activities shall be trained in the hazards associated with these activities and in the emergency action to take if an underground utility or structure is hit or broken during these activities.
- All NASA/Support-Service Contractors performing the duties as either a Point-of-Contact or inspector for excavation activities shall participate in Excavation 101 provided by the Civil Systems Manager or SATERN Course GRC-012-15 every three years.
- Confined Space Entry Training (SATERN Course GRC-4R0241 or Operational Safety Branch-approved equivalent) will be required if an excavation has been determined to be a Permit-Required Confined Space.
- All personnel involved in a “Solid or Hazardous Waste” excavation shall have OSHA 40-hr Hazardous Waste Operations Emergency Response (HAZWOPER) training. Solid or Hazardous Waste excavation areas are determined by Code FE and documented on the Soil Determination Checklist.

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6.2 General Program Requirements (29 CFR 1926, Subpart P, Ohio Manual of Uniform Traffic Control Devices (OMUTCD))

6.2.1 Competent Person

- The contractor performing the excavation and/or utility work shall ensure a competent person to oversee each permitted excavation (GRC927) depending on type of work performed. This person shall be at the physical excavation site 100 percent of the time comparing construction documents to the Underground Record Drawings (URD), auditing the excavation process, evaluating utility markings, evaluating symbols versus details and ensuring the permit process is followed. The following are minimum competency requirements:
 - The excavation competent person must take GRC Excavation 101 and pass the exam minimum every three years. SATERN Course GRC-012-15
 - Excavation Competent Person
 - Has a working knowledge of trenching, excavation, horizontal directional drilling, underground construction, shoring, and soil types as appropriate to the assigned task.
 - Has the ability to assure that all underground utilities are located, field verified, and clearly marked prior to excavation.
 - Is knowledgeable in applicable excavation regulations to include OSHA 29CFR1926. Have knowledge of trench collapse prevention, ventilation and air monitoring requirements (where applicable), ground water control, personal protective equipment, and emergency procedures as they pertain to underground construction and utility work. A minimum 5 years excavating experience is required.
 - Has the ability to notify the prime contractor or Government (as applicable) of any nonconformance issues and document them; and to provide any corrective actions to mitigate hazards or nonconformance issues.
 - Excavation and Utility Competent Person
 - Required when breaking the ground and impervious surfaces and when working within 10 feet of a utility or installing a new utility.
 - Has a working knowledge of trenching, excavation, horizontal directional drilling, underground construction, shoring, and soil types as appropriate to the assigned task.
 - Has the ability to assure that all underground utilities are located, field verified, and clearly marked prior to excavation for proposed infrastructure or infrastructure repair.
 - Is knowledgeable in applicable excavation regulations to include OSHA 29CFR1926. Have knowledge of trench collapse prevention, ventilation and air monitoring requirements (where applicable), ground water control, personal protective equipment, and emergency procedures as they pertain to underground construction and utility work. A minimum 5 years excavating experience is required.
 - Has the ability to notify the prime contractor or Government (as applicable) of any nonconformance issues and document them; and to provide any corrective actions to mitigate hazards or nonconformance issues.
 - Has the ability to review, understand, and interpret URDs, contract drawings, and specifications.
 - Has the ability to oversee and witness underground construction and utility work to ensure that established processes are followed. A minimum of 5 years utility installation experience is required.
 - Has working knowledge of hydro-testing and pigging, as well as welding and fusion procedures, as appropriate to the assigned task.

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- Is knowledgeable in applicable rules and regulations to include 29CFR1926 and installation of utilities such as domestic water (i.e. fire hydrants, thrust blocks, testing, cleaning and chlorination), sewers, duct banks, natural gas, and other pressure pipes, as appropriate to the assigned task.
- Is capable of identifying existing and predictable hazards in the surroundings of underground utility construction and understanding the corrective measures to eliminate them.

6.2.2 Confined Space Evaluation

- Excavations between 4 and 20 feet in depth may be considered confined spaces. As such, these shall be evaluated by The Operational Safety Branch with regard to known and potential hazards to determine if the excavation is be considered a Permit-Required Confined Space (PRCS). If deemed a permit required confined space, the requirements of the GSM, Chapter 16, Confined Space Entry, shall be in effect.
- All excavations greater than 20 feet in depth shall be considered a PRCS and the requirements of the GSM, Chapter 16, Confined Space Entry, shall be in effect.
- High noise levels caused by the excavation activities shall be addressed by the project. This may require excavating activities to be performed during off-hours for local site personnel.

6.2.3 Contractor's Health and Safety Plan (HASP) or Job Hazards Analysis (JHA) Requirements (*GLM-QS-1700.1*)

- The following information shall be included in the HASP. Please refer to the GSM, Chapter 17, Construction Safety, for a description of the HASP process.
 - Requirement for an Excavation Permit.
 - Location(s) where the excavation activities will take place
 - Identify the method(s) of excavating soil or surfacing material
 - Identification of underground utilities known to be impacted by construction activities.
 - Identify the type(s) of equipment to be used at the site.
 - Identify chemicals to be used and provide (MSDS for those as attachments to the HASP.
 - Define how PRCS requirements will be met, if required.
 - Define how the requirements of the OMUTCD will be met.
 - Define emergency procedures in the event of struck or damaged utilities and structures or cave-ins.

6.2.4 Excavation Near Utilities (*PS-01278*][JDR(1))

- GRC has established tolerance zones surrounding all underground utilities because adherence to ORC 3781.30 is critical.
 - The lateral tolerance zone is the total width of the underground utility plus 18 inches on each side.
 - The vertical tolerance zone extends from the elevation shown on the utility profile and/or underground record drawing to 24 inches above the top edge and 24 inches below the bottom edge of the utility.
- Approved methods of excavation within the tolerances zones are hand digging, vacuum excavation, and hydro excavation.
- Potholing of all utilities for verification is required prior to infrastructure excavation.
 - The FD Civil Systems Manager may grant a waiver for potholing however the contractor is still required to excavate in accordance with the tolerance zone requirements. See NASA GRC Excavation Manual for further information.

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6.3 Excavation Permit Requirements (*GLM-QS-1700.1*)

- An Excavation Permit (GRC 927) is required for any penetration into outdoor soil surfaces at GRC. Each permit is limited to a 400 linear foot section or approximately 1 acre as determined by FD.
- The permit shall only be valid for 3 months or until work is complete within the permit defined area, whatever comes first.
- The Initiator of the Excavation Permit shall be either the NASA employee or the Support-Service Contractor that will be the primary point-of-contact (POC) for the excavation activities.
- The Civil Systems Manager or designee shall designate when Parts B1, B2, and C are required.
- Discovery of unidentified or improperly located utilities or underground structures requires work to cease and the NASA POC to be notified. If the utility or structure is damaged, work shall cease and NASA Emergency Dispatch shall be notified.
 - The NASA Surveyor shall be notified and the utility/structure surveyed and identified on the URD.
- Discovery of unidentified hazards such as chemicals and fuels requires work to cease and the Initiator to be notified. The new hazards shall be incorporated into the HASP with appropriate work controls.
- Other Excavation Permit requirements specific to the project shall be identified on either the Excavation Permit or supporting documents.
- The completed Excavation Permit is considered part of the project documentation and maintained by the organization requiring the excavation.

6.4 Rescue Procedures (*GLM-QS-1700.1*)

- Only trained and designated personnel may perform entry rescues. These personnel are provided by offsite municipal fire departments for both Lewis Field and Plum Brook.
- Any rescue requires the immediate notification of the GRC Emergency Dispatch. The internal telephone number is 911 for both Lewis Field and Plum Brook Station. Offsite telephone numbers, such as when using a cellular telephone, are 216-433-8888 at Lewis Field and 419-621-3222 at Plum Brook Station.

Note: Only the GRC Emergency Dispatch shall summon offsite emergency response personnel. This is to prevent confusion and delay of response teams as well as maintain the security of both sites.

6.5 Audits and Inspections (*29 CFR 1910.146 and GLM-QS1700.1*)

- The Operational Safety Branch shall periodically monitor excavation activities to ensure compliance with this chapter. Violations of the work controls identified in this chapter shall be documented with the construction site safety inspections.
- Operational Safety Branch shall evaluate the overall Excavation Safety Program for effectiveness and need for modifications annually.

7.0 RECORDS

Records generated by this Chapter:

- Excavation Permits, GRC 927, and supporting documentation – Terminated permits with supporting documentation are maintained by the organization or project requiring the excavation for a minimum of one (1) year. Active permits are maintained by the same.

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- Training records - maintained by the Human Capital Development Branch and/or Contractor Organizations in accordance with their retention schedules.

Records generated for other safety and health processes/procedures in support of this chapter will be maintained in accordance with the requirements of those programs. These include, but are not limited to, the Confined Space Entry; construction site safety inspections; and HASPs required by the Construction Safety and Health program.

8.0 REFERENCES

Document number	Document name
10 CFR 1926, Subpart P	Excavations
OMUTCD	Ohio Manual of Uniform Traffic Control Devices
ORC-3781.30	Ohio Revised Code, Duties of Excavator
NASA NPR 8715.3	NASA Procedural Requirements, NASA General Safety Program Requirements (current revision)
GLM-QS-1700.1	NASA GSM, Chapter 8, Electrical Systems Safety
GLM-QS-1700.1	NASA GSM, Chapter 9, Lockout/Tagout
GLM-QS-1700.1	NASA GSM, Chapter 16, Confined Space Entry
GLM-QS-1700.1	NASA GSM, Chapter 17, Construction Safety
GLM-FE-8500.1	GRC Environmental Programs Manual, Chapter 20, Handling, Reuse, and Disposal of Soil

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APPENDIX A.—DEFINITIONS AND ACRONYMS

CFR - Code of Federal Regulations

COR - Contracting Officer's Representative

Competent person.— Individual who is capable of identifying existing and predictable hazards or working conditions that are hazardous, unsanitary, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate or control these hazards and conditions.

Confined space.—A space that is large enough and so configured that an employee can bodily enter and perform work and has limited or restricted means of entry or exit and is not designed for continuous employee occupancy.

Excavation.— Per OSHA, any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal.

HASP - Health and Safety Plan – The document submitted to NASA for review and concurrence prior to beginning a project which identifies the known and potential credible hazards that could harm workers, procedures to prevent accidents, and steps to take should an accident occur.

Hazardous atmosphere.—An atmosphere that is verified to be explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen-deficient, toxic, or otherwise harmful and may cause death, illness, or injury to persons exposed to it.

Ingress and egress.—An entry and exit, respectively. In trenching and excavation operations, they refer to the provision of safe means for employees to enter or exit an excavation or trench safely.

OSHA - Occupational Safety and Health Administration

OMUTCD - Ohio Manual of Uniform Traffic Control Devices

PRCS - Permit-Required Confined Space - A confined space which has one or more of the following characteristics:

- Contains or has the potential to contain a hazardous atmosphere (e.g., oxygen-deficient, oxygen-enriched, flammable, explosive, toxic, or otherwise harmful)
- Contains a material that has the potential for engulfing an entrant
- Has an internal configuration such that an entrant could be trapped or asphyxiated because of inwardly converging walls or a floor that slopes downward and tapers to a smaller cross section
- Contains any other recognized serious safety or health hazard (e.g., need for LOTO provisions, need for personal protective equipment)

PPE - Personal protective equipment

Potholing- Potholing is the process of safely excavating a hole in order to locate a utility that is known to be within the tolerance zone as designated in the GRC Excavation Manual.

Protective system.—Refers to a method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, and from the collapse of adjacent structures. Protective systems include support systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection.

SMAD - Safety and Mission Assurance Directorate

SHed – Safety and Health Division

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Shield.—A structure that is able to withstand the forces imposed on it by a cave-in and thereby protects employees within the structures. Shields can be permanent structures or can be designed to be portable and moved along as work progresses. Additionally, shields can be either manufactured or job built in accordance with CFR 1926, Subpart P. Shields used in trenches are usually referred to as trench boxes or trench shields.

Shoring - Structures such as underpinning, bracing, and shoring that provide support to an adjacent structure or underground installation or to the sides of an excavation or trench.

Sloping.—A method of protecting employees from cave-ins by excavating to form sides of an excavation that are inclined away from the excavations so as to prevent cave-ins. The angle of incline required to prevent a cave-in varies with differences in such factors as the soil type, environment conditions of exposure, and application of exposure and application of surcharge loads.

Stepping - A method of protecting employees from cave-ins by excavating the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.

Subsurface encumbrances.—Underground utilities, foundations, streams, water tables, transformer vaults, and geological anomalies.

Tolerance Zone - Zone surrounding an utility or underground structure as defined within Excavation near utilities section within this chapter and GRC Excavation Manual