

OJT Training Module Cover Sheet

Title: 822 Understand determining depth of exploration and dielectric permittivity for GPR.

Type: Skill Knowledge

Performance Objective: Trainee will be able to:

- Define relative dielectric permittivity (E_r).
- List E_r ranges for common materials.
- Understand velocity of propagation in regards to converting from time scale to depth scale.
- Outline methods for depth scale determinations.
- Identify factors affecting depth of exploration.

Target Proficiency:

- Awareness Understanding Perform w/ Supervision
 Apply Independently Proficiency, can teach others

Trainer Preparation:

- Trainer should be familiar with the assigned reading/review material in the lesson plan that follows.
- If possible, have several radar records and the associated soil descriptions on hand for interpretation.
- Have calculator available.

Special Requirements:

Initiate an external learning request with a SF-182 in Aglearn for this activity. Instructions and a template are located on the training webpages for OJT modules.

Prerequisite Modules:

- 802 Understanding GPR and how GPR works.
- 803 Using GPR for soil investigations.

Notes:

None

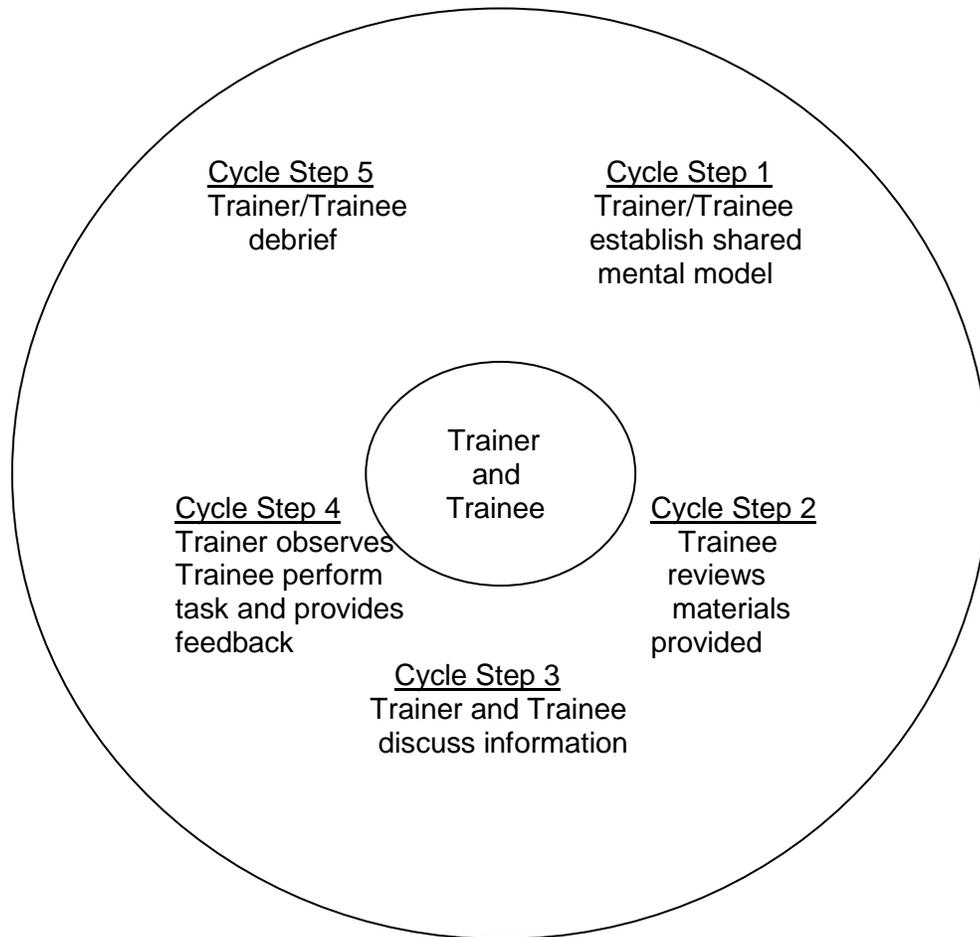
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The Five-Step OJT Cycle for Declarative Training (Knowledge)



OJT Module Lesson

Title: 822 Understand determining depth of exploration and dielectric permittivity for GPR.

WHAT	WHY, WHEN, WHERE, HOW, SAFETY, QUALITY
Cycle step 1	Trainer and trainee review objectives of module.
Cycle step 2	Trainee should review the attached Dielectric Permittivity.pdf
Cycle step 3	Trainer and trainee discuss:
1. Relative dielectric permittivity.	<ul style="list-style-type: none"> • Definition of E_r • List common E_r for air, water, and soil types in the local work area. • The effect soil water has on E_r.
2. Propagation of electromagnetic energy into the ground.	<ul style="list-style-type: none"> • Unit of measure associated with velocity in GPR applications. • Equations used to calculate velocity of propagation and relative dielectric permittivity.
3. Depth-scale determinations.	<ul style="list-style-type: none"> • 3 ways to determine subsurface velocity of propagation and method most commonly used in soil survey.
4. Depth of exploration.	<ul style="list-style-type: none"> • Which frequency antenna allows greatest depth of exploration? • Effects of clay on exploration depth.
Cycle step 4	Have the trainee describe the concepts discussed.
Cycle step 5	Trainer can debrief trainee and address any concerns.

OJT Module Lesson Measurement of Learning

Title: **822 Understand determining depth of exploration and dielectric permittivity for GPR.**

WHAT	WHY, WHEN, WHERE, HOW, SAFETY, QUALITY
Trainee's learning is measured.	Have the trainee complete the attached quiz to reinforce the concepts in this module.
Apply knowledge gained to work.	The trainee can define relative dielectric permittivity and list the ranges for typical soil conditions; calculate velocity of propagation, outline methods for depth scale determinations and identify factors affecting depth of exploration.

SF-182

Trainee and/or supervisor access Aglearn to verify completion of the module via its SF-182.

Quiz

1. The relative dielectric permittivity of soils will increase with increases in:
 - A) Rock fragments
 - B) Soil conductivity
 - C) Moisture content
 - D) Soil depth

2. _____ is inversely related to relative dielectric permittivity (ϵ_r).
 - A) Velocity of pulse propagation
 - B) Soil porosity
 - C) Depth of exploration
 - D) Clay content

3. What is the velocity of propagation, if the two-way travel time of a radar pulse is 10 ns to an interface that is at a depth of 0.5 m?
 - A) 10 m/ns
 - B) 1.0 m/ns
 - C) 0.1 m/ns
 - D) 0.01 m/ns

4. What is the relative dielectric permittivity of the material profiled in question 3?
 - A) 0.09
 - B) 0.9
 - C) 9
 - D) 3

5. The most accurate method to determine the velocity of propagation in the field is:
 - A) Common mid-point survey
 - B) Wide angle reflection and refraction
 - C) Ground truth coring and measurement to a known reflector
 - D) Hyperbola velocity analysis

6. True or False. Soil electrical conductivity increases as the contents of water, clay and soluble salt increase and soils with high electrical conductivity severely limit the effectiveness of GPR.

7. In which of the following soil materials would you expect the greatest depth of exploration?
 - A) Sodium-affected soils.
 - B) Clayey soils.
 - C) Saturated soils.
 - D) Sandy soils.