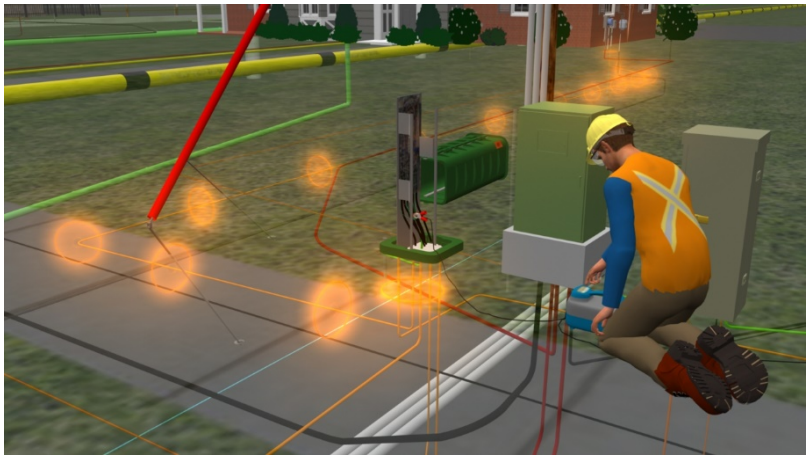
Underground Facility Locator's



Field Task Competency Manual

CANADIAN ASSOCIATION OF PIPELINE AND UTILITY LOCATING CONTRACTORS

Version 2.0

UNDERGROUND FACILITY LOCATOR'S FIELD TASK COMPETENCY MANUAL

A manual developed for Underground Facility Locators (UFL) and endorsed by the Canadian Association of Pipeline and Utility Locating Contractors (CAPULC)

Version 2.0 – 2015

DISCLAIMER

The information provided in this field task manual is intended for general application only and is not intended for use as a complete reference. Terms used in this manual vary between facility owner/operators and jurisdictions. It is not a definitive guide to government regulations nor is it a guide to the practices and procedures wholly applicable to every locate circumstance. The appropriate regulations, company-specific work practices and manufacturers' equipment instructions must be consulted and applied with due diligence. Canadian Association of Pipeline and Utility Locating Contractors (CAPULC) and Locate Management assumes no responsibility whatsoever, for any injury, loss or damage arising from its use.

ACKNOWLEDGEMENTS

This manual was developed for Underground Utility Locators (UFL) with the assistance from the Canadian Association of Pipeline and Utility Locating Contractors (CAPULC) members, industry, facility owner/operators, Canadian Common Ground Alliance (CCGA) members, and its provincial chapters. Their collective input and dedication to the development of the UFL Field Task Competency Manual are greatly appreciated by the Association.

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INTRODUCTION

This second edition of the Underground Facility Locator's Field Task Manual (Manual) specifies Locator training standards and competencies requirements in an effort to increase the accuracy and reliability of locates. The UFL is responsible for locating underground facility lines within urban and rural settings, and for creating and updating maps and records indicating the approximate alignment of underground facilities. The Manual contains task descriptions developed by experienced Locators with input from industry stakeholders.

Competencies are identified as every day work tasks that make up the knowledge, skills, attitudes, and technology used by Locators in accomplishing their day to day employment. The Manual developed for UFL's is endorsed by Canadian Association of Pipeline and Utility Locating Contractors – CAPULC (refer to Section 5.0) to provide a cross-section of Underground Facility Locators (UFL) tasks. The tasks in the Manual were derived from an extensive base of 3200+ competencies outlined in a line locator occupational profile assembled by Locate Management. A cross section of the competencies can be found in UFL Competency Assessment – Observations and Recommendation (refer to Section 5.1)

Field task competency training, work performance, experience, and successful completion of an industry-specific locating course(s) or program(s) are requirements for Underground Facility Locators.

The **UFL Competency Cycle** consists of three stages:

1. Knowledge development (preferably industry specific) course(s),
2. Industry specific field training (hands-on or OJT), and
3. Industry specific final assessment (verification of knowledge and skills).

The Manual represents the third and final stage in the UFL Competency Cycle. When this is completed, the UFL will have the necessary knowledge and skills to work within an industry specific sector(s).

Topics such as safety, personal protective equipment (PPE) and environmental considerations relating to underground facility locating have not been addressed in this manual. UFL's must be aware of applicable safety and environmental requirements within their industry specific sector and/or jurisdiction.

The content of the manual will be revised with advances in technology, education and training, industry feedback and regulatory changes.

TO EMPLOYERS OF UNDERGROUND FACILTY LOCATORS

An Employer is responsible to ensure that the UFL Competency Cycle is completed. From an Employer's point of view, the Manual verifies that the Employer has assessed the UFL in the applicable task descriptions relating to their industry sector. The Manual is the Employer's and UFL's record that the UFL has demonstrated competencies within industry specific sector(s).

TO UNDERGROUND FACILITY LOCATORS

The Manual is the property of the UFL to validate the UFL's competencies through consistent evaluation and assessment. The Manual contains task descriptions which were assembled by experienced Locators with input from industry stakeholders. We wish to reaffirm our commitment to the competencies of UFL's and the safe working environment in which they work.

The challenge will be to make sure that new procedures and changing technologies are incorporated into the Manual. In order for the Manual to continue to provide the necessary and relevant assessment now

and into the future, we need your input. As an experienced UFL your feedback is vital and we appreciate your help with the ongoing enhancement of the Manual.

TO ASSESSORS

Each applicable task description must be signed off by an Assessor after the UFL has demonstrated proficiency for that task. An Assessor is any person who has the knowledge, skills, ability, and experience to evaluate the performance of the UFL for industry specific task competency.

An Assessor must:

1. Possess current knowledge development (preferably industry specific) course certificate(s)
2. Have successfully completed industry specific field training and/or on-the-job training (OJT)
3. Have successfully completed a Train-the-Trainer course
4. Have a minimum of 5 years work experience as a UFL
5. Have completed the UFL Manual*

* The Employer must sign off on the Assessor's UFL Manual for the industry specific task competencies for which they are assessing.

TO FACILITY OWNERS/OPERATORS

Facility owner/operators must request to see that the UFL has completed (or is working toward completing) the Manual or possesses a Certificate of Achievement.

Facility owners/operators are encouraged to participate and support in the ongoing enhancement of the Manual.

HOW TO PURCHASE THE MANUAL

To order the Manual, please visit www.locatemanagement.com

HOW TO USE THE MANUAL

The Manual has been divided into five sections:

1. Locating Fundamentals and Utility
2. Locating Procedures
3. Obstacles and Tracing Problems
4. Industry Examples of Incidents and Preventative Procedures
5. Appendices and Forms

Section 1 – Locating Fundamentals and Facility Infrastructure provides a brief overview of electromagnetic locating fundamentals, and pipeline and utility infrastructure.

Section 2 - Locating Procedures details locating procedures from start to finish and methods used to locate underground facilities. The UFL must demonstrate competency in each of the required task as identified in Sections 5.1 and 5.2.

Section 3 – Obstacles and Tracing Problems details locating methods to locate underground facilities under abnormal operating conditions (AOC's). The UFL must demonstrate competency in each of the required task as identified in Sections 5.1 and 5.2.

Section 4 - Industry Examples of Incidents and Preventative Procedures illustrates industry examples of incidents caused by either improper line locating procedures and/or ground disturbance practices. Each example provides preventative procedures.

Section 5 – Appendices and Forms includes information and tables pertaining to CAPULC, UFL Competency Requirements Cross Reference, UFL Competency Assessment – Observations and Recommendations, UFL Competency Assessment – Summary, and UFL Certificate of Achievement Request. It also includes a glossary of terms and other tables helpful to a UFL.

The following table is found at the end of field tasks in Sections 2 and 3.

NOTES:		
Original Date	Review Date	Review Date
Assessor	Assessor	Assessor
UFL Signature	Employer Signature	

It comprises of:

- **NOTES** – to be used by the UFL, Assessor, and/or Employer
- Assessor sign off for Original Date of assessment and two subsequent Review Dates
- UFL and Employer signature after the final Review Date.

The **NOTES** table allows for specific procedural amendments and/or additions to be documented. The UFL must be assessed by performing the task written and/or described within each task description.

Field Task Competencies Assessments must take place at an Original Date plus two subsequent Review Dates (preferably within 6 months of the original date). An Assessor must sign each date the task was completed to indicate that the UFL has successfully performed the task.

All required tasks must be completed within 1 year from the date of issue (refer to Sections 5.1 and 5.2). Extensions may be granted on a case by case basis upon written request to Locate Management.
Any task(s) **not** completed will be deemed **not** applicable to the UFL.

The UFL and Employer must also sign-off to indicate the successful completion of each task.

CERTIFICATION PROCESS

Upon completion of all required task(s) the Employer must complete the UFL Certificate of Achievement Request form found at www.locatemanagement.com

Upon verification Locate Management will issue a Certificate of Achievement to the UFL for the industry sector(s). The Certificate is valid for a period of 3 years from the date of the Assessor's Final Assessment.

The UFL Competency Cycle must be completed every 3 years for re-certification. The **UFL Competency Cycle** consists of three stages:

1. Knowledge development (preferably industry specific) course(s),
2. Industry specific field training (hands-on or OJT), and
3. Industry specific final assessment (verification of knowledge and skills).

The UFL Certificate of Achievement must be presented along with photo identification to be considered authentic.

MODIFICATIONS

During 2015, sections were added and/or amended to version 2.0:

- Added Locating Fundamentals and Facility Infrastructure as new Section 1
- Moved Locating Procedures to Section 2
- Moved Obstacles and Tracing Problems to Section 3
- Moved Industry Examples of Incidents and Preventative Procedures to Section 4
- Moved Appendices and Forms to Section 5
- Updated references to specific sections
- Updated and added images

This Underground Facility Locator Field Task Competency Manual belongs to and is maintained by:

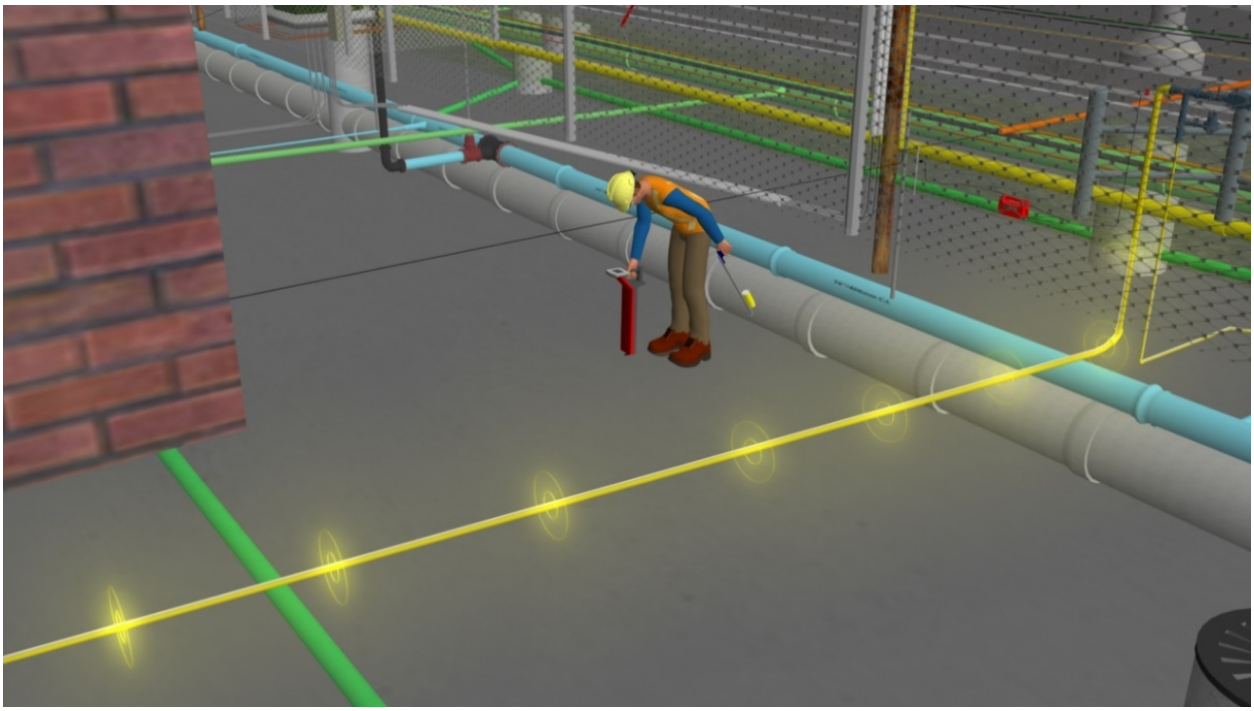
UFL Name
UFL ID Number

Table of Contents

1.0 Locating Fundamentals and Facility Infrastructure

1.1 Theory of Electromagnetic Locating

EM locators do **not** locate the buried pipes and cables — they detect the electromagnetic field or "*signal*" generated by an alternating current (AC) oscillating (moving back and forth) and flowing down or along the buried facilities.

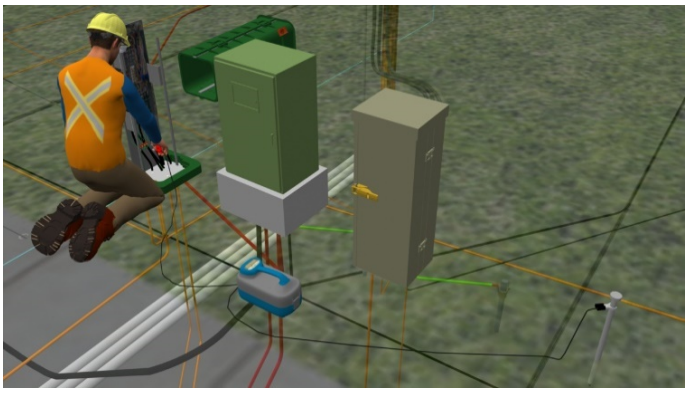


Radiating signals

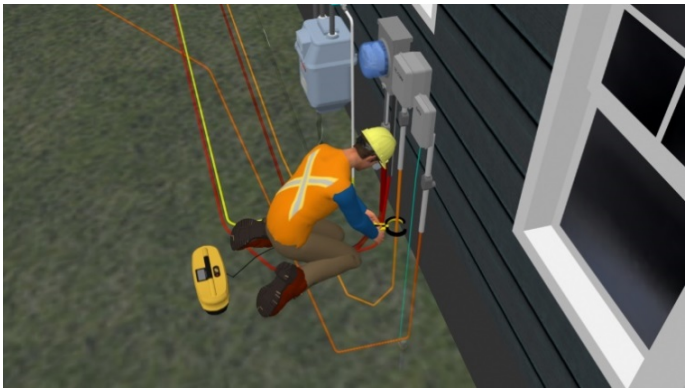
1.2 Active Signals

There are three ways (methods) to apply an active signal:

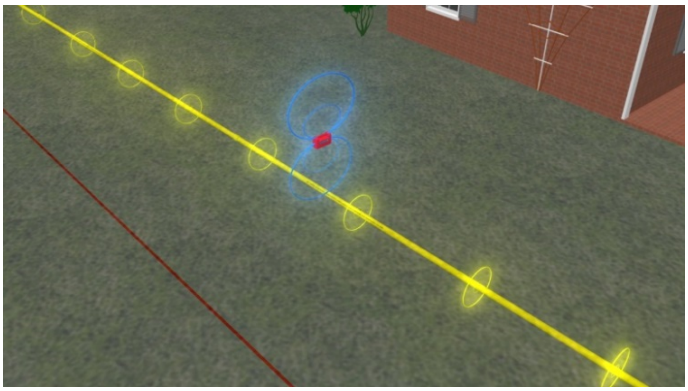
1. Direct Hook-Up



2. Inductive Clamp



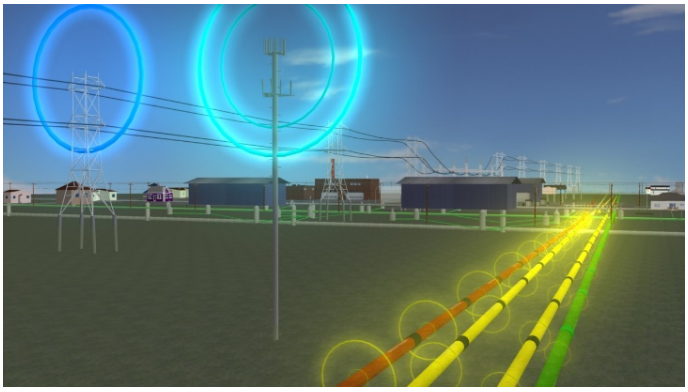
3. Inductive (Induction)



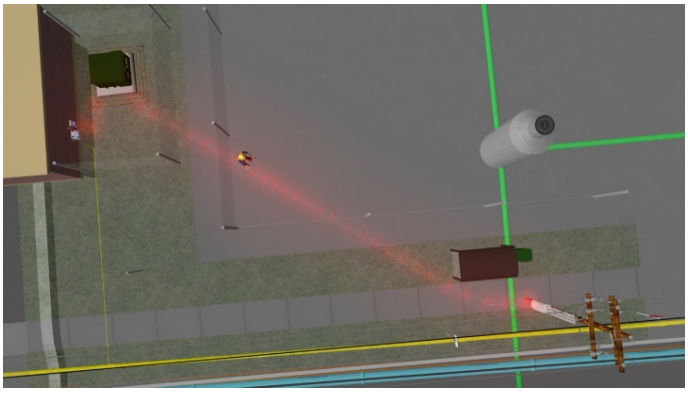
1.3 Passive Signals

The three common passive locating modes (methods) are:

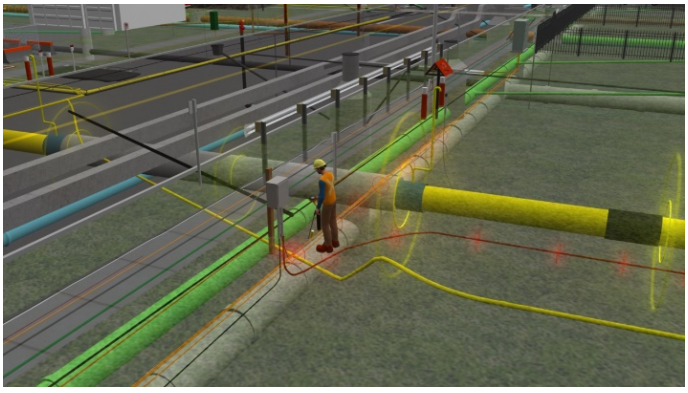
1. Radio



2. Power (Live AC Cable)



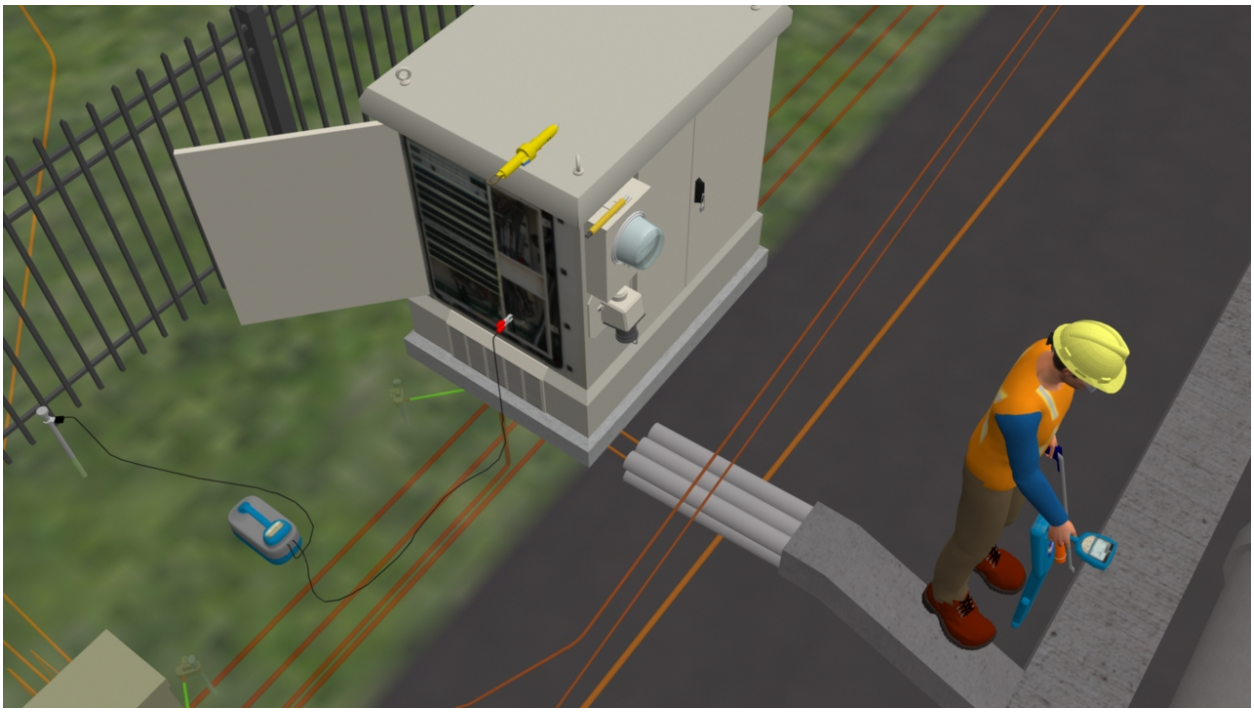
3. CPS (Cathodic Protection System)



2.0 Locating Procedures

This section details locating procedures from start to finish and methods used to locate underground facilities. The UFL must demonstrate competency in each of the required task as identified in Sections 5.1 and 5.2.

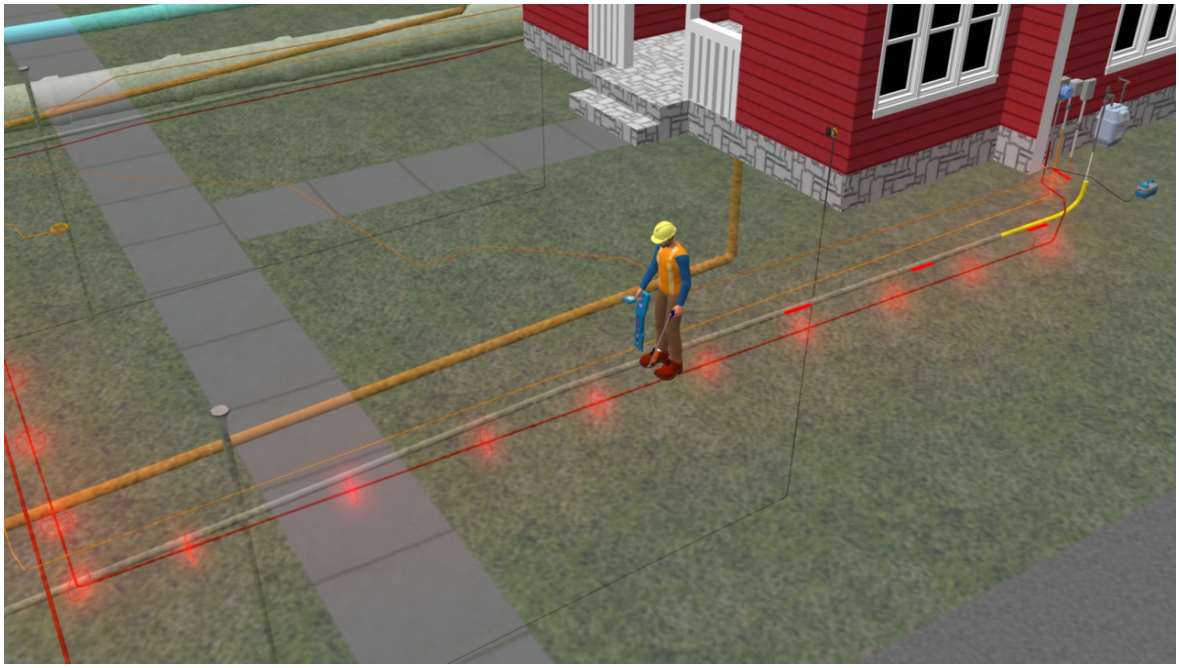
Voltage Detector



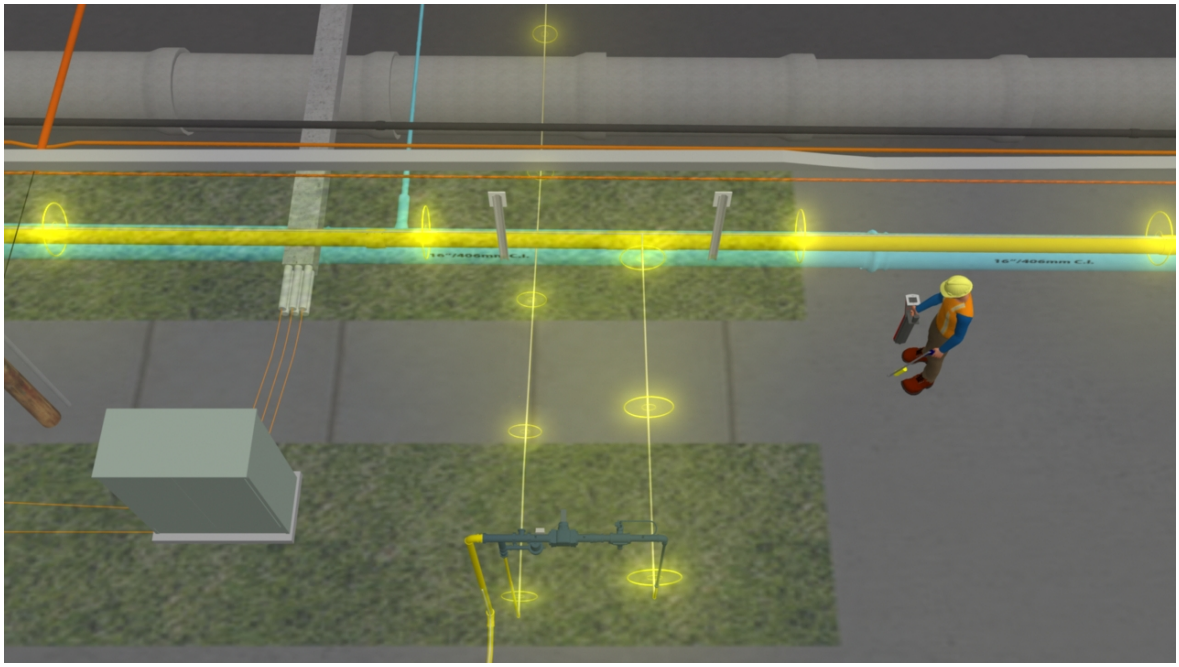
Direct Hook up to Digital Loop Carrier

2.1 Procedures for Locating - Start to Finish

Locators should perform locates after receipt of notification (one-call ticket or ticket number) from a One-Call Centre. There are times when Locators perform locates without receipt of notification from a One-Call Centre because not all buried facilities are registered with One-Call Centre (i.e., privately owned or One-Call Centre Non-Member facilities). There are other times when Locators are contracted to perform locates in addition to the One-Call Centre Process.



Locating from a customer power meter



Locating at Intermediate Regulating Station

2.1.1 Task Description: Review Locate Request - Office

1. Receive locate request (e.g., one-call ticket).
2. Record (i.e., archive, store, file) locate request.
3. Review locate request (i.e., contact information, location, date and time, reason for locate).
4. Check available records including, but not limited to the following, crossing agreements, as-built drawings, route sheets, mainline and station maps, survey plans, cathodic protection drawings, photographs, locate records. If necessary check with field employees familiar with the area.
5. If necessary, check third party databases, land titles, and any other pertinent information source.
6. Contact the ground disturber to verify the locate request. Determine if a pre- locate meeting on site is required.
7. If necessary, ensure that the land owner has been notified.
8. Prepare locate package including: locate request documentation, ground disturbance documentation, permits, facility owner/operator supplied records and/or any other information sources, and an access/direction map to work site.
9. Ensure pre-work safety considerations including: site background data, site familiarization and external resources are gathered.
10. Before performing any locate, ensure that all locating equipment is in proper working condition and calibrated according to the manufacturer's specifications. Ensure to perform a daily field calibration check on a known facility to ensure that the locating equipment is functioning as per the manufacturer's specifications. Always follow equipment manufacturer's operating instructions when conducting the field tasks described in this manual.

Underground Facility Locators should use the *APWA Uniform Colour Code* to mark buried facilities. To avoid confusion in congested areas, a Locator may need to use a site specific color code.

WHITE	Limits of proposed excavation
PINK	Temporary survey marks
RED	Electric power lines, cables, conduits and ducts or lighting wire and cables
YELLOW	Gas, oil, petroleum, steam or gaseous materials
ORANGE	Telephone, cable, TV, communications, alarm/signal lines, wires, cables, conduits or ducts
BLUE	Potable water lines or pipes
PURPLE	Irrigation, reclaimed water or slurry lines or pipes
GREEN	Sanitary sewer, storm water, culvert or drain lines

APWA Uniform Colour Code

NOTES:		
Original Date	Review Date	Review Date
Assessor	Assessor	Assessor
Signature UFL	Signature Employer	

2.1.2 Task Description: Pre-Locate Procedures - Field

1. Consult with ground disturber/excavator and/or field personnel to validate locate request and any safety or access (landowner) requirements, including receiving hot work permits and the use of gas detectors/monitors.
2. Create safe work plan.
3. Conduct a job briefing.
4. Implement safe work plan.
5. Utilize available facility owner/operator supplied records and any other available information sources.
6. Perform a visual inspection to ensure that facilities at the site match those shown on the records. Check facility/housing identification and safety labels/tags.
7. Acquire permission (written preferred) from facility owner/operator to take photographs of work area. Ensure the photos include work area and points of reference.

Performing pre-locate procedures

NOTES:		
Original Date	Review Date	Review Date
Assessor	Assessor	Assessor
Signature UFL	Signature Employer	

Appendices and Forms

5.0 Canadian Association of Pipeline and Utility Locating Contractors

MISSION STATEMENT

The Canadian Association of Pipeline and Utility Locating Contractors (CAPULC) provides leadership, promotes safety, and works to enhance the value and reputation of the underground facility locating industry in Canada.

- As contractors we have a vested interest in shaping our future, and we all have the desire to be proactive in the development of standards for the locating industry in Canada.
- As members of CAPULC we have a vested interest in directing the development of standards for the locating industry in Canada, through Education and making industry specific information available to our members.
- As a group we agree that the development of Canadian standards, the guidelines for evaluating competencies and qualifications required, should be determined by those of us with the knowledge and experience involved in the locating industry.

CAPULC ENDEAVOURS TO:

- Define, establish and preserve the identity and the common interests of the underground facility locating industry.
- Educate and promote better relations between members and governmental agencies, other Associations, contractors, professional engineers, manufacturers, suppliers, utility companies, one call centers, the public and the underground facility locating industry.
- Develop standards for the locating industry in Canada.
- Promote the practical application of knowledge related to the underground facility locating industry through education and ensure this education process is available to our members.
- Collect and disseminate information relative to the business in which Association members are engaged.
- Promote ethical practices among underground facility Locators and the general public.
- Encourage safety in the conduct of work.
- Represent the common interest of Association members.
- Encourage the education of Association members in the pursuit of underground facility locating in accordance with sound business principles.

OCCUPATIONAL DESIGNATION

A Task Force compiled from industry is applying for Designated Occupation status for the Underground Facility Locator (UFL) in the Province of Alberta.

The proposed designation will have a beneficial impact on:

- Workers; through increased worker safety, career viability, and job security
- Employers; through improved competency, reduced safety risk and standardized credentials
- Society; through increased public safety, and positive environmental impact.

5.1 UFL Competency Requirements Cross Reference

UFL Competency Requirements Cross Reference							
UFL Name					UFL ID		
TASK	Industry Sector						
	Gas Distribution	Tel/CATV	Petroleum	Electric Power	Transmission Pipelines	Potable Water	Sewer and Storm Water
2.1.1	Y	Y	Y	Y	Y	Y	Y
2.1.2	Y	Y	Y	Y	Y	Y	Y
2.1.3	Y	Y	Y	Y	Y	Y	Y
2.2	Y	Y	Y	Y	Y	Y	Y
2.3	Y	N	Y	N	Y	Y	Y
2.4	Y	Y	Y	Y	Y	N	N
2.5	Y	Y	Y	Y	Y	Y	Y
2.6	Y	N	Y	Y	Y	N	N
2.7	Y	Y	Y	Y	Y	Y	Y
2.8	Y	Y	Y	Y	Y	Y	Y
2.9	Y	Y	Y	Y	Y	Y	Y
2.10	Y	Y	Y	Y	Y	Y	Y
2.11	Y	Y	Y	Y	Y	Y	Y
2.12	Y	Y	Y	Y	Y	Y	Y
2.13	Y	Y	Y	Y	Y	Y	Y
2.14	Y	N	Y	N	Y	N	N
2.15	Y	Y	Y	Y	Y	Y	Y
2.16	Y	Y	Y	Y	Y	Y	Y
2.17	Y	Y	Y	Y	Y	Y	Y
2.18	Y	Y	Y	Y	Y	Y	Y
2.19	Y	Y	Y	Y	Y	Y	Y
2.20	Y	Y	Y	Y	Y	Y	Y
2.21	Y	Y	Y	Y	Y	Y	Y
2.22	Y	Y	Y	Y	Y	Y	Y
2.23	Y	Y	Y	Y	Y	Y	Y
3.7	Y	Y	Y	Y	Y	Y	Y
3.8	Y	Y	Y	Y	Y	Y	Y
3.9	Y	Y	Y	Y	Y	Y	Y
3.10	Y	Y	Y	N	Y	Y	Y
3.11	Y	Y	Y	Y	Y	Y	Y
3.12	Y	Y	Y	Y	Y	Y	Y
3.13	Y	Y	Y	Y	Y	Y	Y
3.14	Y	Y	Y	Y	Y	Y	Y
3.15	Y	Y	Y	Y	Y	Y	Y
3.16	Y	Y	Y	Y	Y	Y	Y
3.17	Y	Y	Y	Y	Y	Y	Y
3.18	Y	Y	Y	Y	Y	Y	Y
3.19	Y	Y	Y	Y	Y	Y	Y
3.20	Y	Y	Y	Y	Y	Y	Y
Note: Use this form to determine which tasks must be completed to receive a Certificate of Achievement for each industry sector.							

5.2 UFL Competency Assessment – Observations and Recommendations

This form and the *Underground Facility Locator Field Task Competency Manual* must be completed by the Assessor in order to attain a UFL Certificate of Achievement. The UFL must understand and demonstrate to the Assessor that he/she has the ability to perform the following generic and the applicable industry-specific set of tasks.

Print UFL name, UFL ID #, and the Assessor(s) name. The Assessor(s) must initial and record the date of each task assessment in the applicable field (**YES, NO, N/A**). The Assessor must provide reason(s) why any task(s) is marked as "**N/A**" in the "**Explanation**" section(s). Use the blank lines in each section to add industry or company specific tasks.

* The UFL must possess a valid knowledge development course(s) certificate prior to assessment.

UFL		**Assessor(s)**	
UFL ID #			

Generic					
Initials	**MM-DD-YY**	**Operational**	**YES**	**NO**	**N/A**
		Demonstrate safe vehicle operation.			
		Demonstrate ability to activate an emergency response plan.			
		Demonstrate ability to plan workloads effectively.			
		Demonstrate ability to accurately record scope of work.			
		Demonstrate computer operation.			
		Demonstrate ability to reference and access specific regulatory information.			
Initials	**MM-DD-YY**	**Records**	**YES**	**NO**	**N/A**
		Demonstrate ability to utilize symbology, legends, scales, profiles, alignments, schematics, etc.			
		Demonstrate ability to utilize available records (as-builts, route sheets, alignment sheets, station/facility drawings, plot plans, engineering plans, survey plans, construction plans, crossing agreements, regulatory permits, locator drawings, photographs, etc.)			
		Demonstrate ability to identify facilities in the work area.			
		Demonstrate ability to recognize facility identifiers (codes, status, substance, material, coating, sheath, etc.)			
		Demonstrate ability to recognize facility status (abandoned, discontinued, operating, permitted (to be constructed), removed, etc.)			
		Demonstrate ability to recognize right of ways and easements.			
		Demonstrate ability to utilize electronic database(s).			
Initials	**MM-DD-YY**	**Communication**	**YES**	**NO**	**N/A**
		Demonstrate proper use of work related communication system.			
		Demonstrate ability to obtain relevant information from client/contractor and/or ground disturber.			
		Demonstrate ability to effectively communicate with client / contractor.			
		Demonstrate ability to communicate locate and/or record discrepancies to the proper authorities or department.			
Initials	**MM-DD-YY**	**General Theory**	**YES**	**NO**	**N/A**
		Demonstrate ability to apply electromagnetic locating theory.			
		Demonstrate ability to select the appropriate frequency.			
		Demonstrate ability to correctly form a circuit.			
		Demonstrate ability to apply electromagnetic theory as it relates to the transmitter.			
		Demonstrate ability to apply electromagnetic theory as it relates to the receiver			
		Demonstrate the difference between active and passive signals.			

5.8 Conversions

The following Conversions are a Quick Reference Guide only.

Table 5 - Conversions

Length	
1 Metre (m) = 10 decimetres (dm) = 100 centimetres (cm) = 1000 millimetres (mm) = 1 x 10^6 micrometres (um)	
1 m = **39.37 inches (in) = 3.2808 feet (ft.) (U.S. survey ft.)*	
1 U.S. Survey ft = 1200/3937 = 0.30480061 m	
1 m = *3.280833333 survey ft.*	
1 ft = **0.3048 m International ft.*	
1 in = **2.54 cm = 25.4 mm*	
1 mile (mi) = **5280 ft. = 1609 m = 1.609 km*	
1 kilometre (km) = 1000 m = 0.6214 mi	
1 rod = 16.5 ft. = 1 perch = ¼ Gunter's chain	
1 chain (ch) = **66 ft. = 100 links = 4 rods (length of Gunter's ch)*	
Area	
1 acre (Ac) = **43560 ft^2 = 4047 m^2 = 10 $chains^2$*	
1 hectare (ha) = 1000m^2 = 2.471 Ac	
1 m^2 = 10.76 ft^2	
1 km^2 = 247.1 Ac	
1 ft^2 = 0.09290 m^2	
1 in^2 = 6.452 cm^2	
Angles	
1 revolution = **360° (degrees) = 400^g (gons or grads, European)*	
1 revolution = **6400 mills = 2(pie symbol) radians*	
1° = **60' (minutes of arc); 1' = *60'' (seconds of arc)*	
1^g = **(1/400) revolution = 0.9°*	
1 radian = 57.2957795° = 206264.8''	
Other Relationship Conversions	
0.000 004 848	= sin 1'' = tan 1''
0.000 290 888	= sin 1' = tan 1'
0.017 452 406	= sin 1°
0.017 455 065	= tan 1°
3.141 592 654	= (pie symbol)
0.574	= coefficient of combined curvature & refraction (c & r), ft/mi^2
0.0675	= coefficient of combined (c & r), m/km^2
1.15 mi	= 1' of latitude = 1 nautical mile
69.1 mi	= 1° latitude
6076.10 ft.	= 1 nautical mile
101 ft.	= 1 second (1'') of latitude
6 mi	= length and width of normal Township
*80 chains	= 1 Gunter's mile
640 acres	= 1 mi^2 = area of a normal section
480 chains	= length and width of a normal Township
*36	= number of sections in a normal Township
*15° longitude	= width of one time zone = 360° / 24 hr
*36	= number of sections in a normal Township
*15° longitude	= width of one time zone = 360° / 24 hr
*24 hr	= 360° of longitude
*15° C = 68° F	= standard temperatures (Celsius & Fahrenheit) in taping
299,792.5 km/sec	= speed of light and other magnetic waves in a vacuum
6,356,752.3 m	= earth's semi-minor axis (GRS80 ellipsoid)
6,378,137.0 m	= earth's semi-major axis (GRS80 ellipsoid)
6,378,206.4 m	= earth's semi-major axis (Clark ellipsoid, 1866)
6,371,000.0 m	= mean radius of earth = 20902000 ft.
2,000,000 kg/cm^2	= Young's modulus of elasticity of steel = 29,000,000 ld/in^2